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## **THE FRESHWATER MOLLUSCA FROM CRIȘANA (CRIȘ RIVERS BASIN, ROMANIA)**

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**Abstract.** The freshwater mollusc fauna from Crișana comprises 60 species (among them 41 gastropods and 19 bivalves). 19 species were newly identified in this area by the author. At least one species has disappeared and another is at the edge of its extinction, because of human impact. This paper's aim is to establish the systematical and chorological catalogue of this fauna, to highlight the most characteristic and significant elements, the threats represented by human impact on the area's waters and their communities.

**Résumé.** La faune des mollusques de Crișana contient 60 espèces (41 escargots et 19 coquillages). 19 espèces ont été identifiées pour la première fois dans cette région par l'auteur. Au moins une espèce a disparu et une autre est menacée par extinction à cause de l'impact humain. L'objectif de ce travail est d'établir un catalogue systématique et chorologique de cette faune, de souligner les plus significatives de ses éléments et les menaces représentées par l'impact humain pour les habitats et les communautés aquatiques de la région.

**Key words:** freshwater snails and bivalves, systematical and chorological catalogue, human impact.

### *INTRODUCTION*

Some material and information regarding the freshwater Mollusca from Crișana date back to the 19<sup>th</sup> century, and were provided by the naturalists from the Transylvanian Society for Natural Sciences in Sibiu, their collections being kept mainly in the museum from the same town. Data on several species and sampling sites were published by Bielz (1867), Kimakowicz (1883 - 1884). The relict species from 1 Mai resort thermal lake were subject to lots of research and papers, such as those accomplished by Hauer (1852 ap. Paucă, 1936), Wolf (1863, ap. Paucă, 1936), Clessin (1887), followed in the 20<sup>th</sup> century by Brusina (1902, ap. Paucă, 1936), Kormos (1903, 1905, 1912, ap. Paucă, 1936), Paucă (1936), Grossu (1941 - 1993), Soós (1943), Sîrbu (2001), and others. Some authors brought more faunistic information regarding the molluscs from Răbăgani, among them Clessin (1887), Soós (1943), Jurcsák (1969), and Sîrbu (2001). The underground freshwater cave-snails were subjected to investigations published by Boettger (1940), Rotarides (1943), Negrea (1966), Grossu & Negrea (1963, 1984), Grossu (1981, 1986).

The first thorough extended basin-level research was organized and accomplished by A. Sárkány-Kiss, in the frame of some multidisciplinary screening-type sampling trips, which investigated the three Criș rivers and Barcău River from the sources down to their flow into the Tisa River. The field researches were carried out during 1993, 1994 and 1995, the results being published in 1997.

Thus, the main information published by Sárkány-Kiss, Boloș & Nagy (1997) are the faunistic lists from several sampling sites selected along the main riverbeds. In 1994, the freshwater molluscs from 8 sampling stations along the Crișul Alb were

investigated (16 species being found on Romanian territory) and in 7 stations, along the Crișul Negru River (highlighting 17 species in this area). In 1995, the same team checked out the Crișul Repede River and its tributaries, Drăgan and Iad, (in 10 sampling sites, finding 17 species in the Romanian stretches), and the Barcău River (5 stations, identifying 4 species). Their main conclusions were focused on: a low specific diversity, the threats represented by pollution and hydrotechnical plants, the better ecological state of Crișul Alb River, followed by the Crișul Negru, while Crișul Repede is the most debased because of embankments and dams, and Barcău is highly degraded by pollution. The team identified 31 species of freshwater molluscs in Crișana. At the same time, Sárkány-Kiss accomplished an ecological study regarding the Unionidae community from Crișul Alb at Ineu, and, together with A. Fodor and M. Ponta, an investigation of some heavy metals' accumulation by the naiads (Unionidae) from the Criș rivers, both being published in 1997.

The Unionidae from Crișana were also characterized in some synthetic papers, like those published by Sárkány-Kiss (1997) and Sîrbu et al. (2005). Some information were recently published by Sîrbu & Benedek (2004 a, b, 2005 a, b), mainly concerning the present day state of the species belonging to *Theodoxus* and *Pisidium* genera in the Romanian Inner Carpathian Basin, than the distribution of *Bythinella austriaca* at national level, as well as a paper concerning the aquatic molluscs, hydro- and hygrocormoflora from the Cefa area (Bihar County).

The present paper's aim is to establish the freshwater mollusc systematic and chorologic catalogue, based on all mentioned references and the author's extensive information gained in this area between 1998 and 2006, to highlight the present state and dangers faced by several relict or ecologically significant species, and to characterize the ecological state of the rivers.

#### MATERIALS AND METHODS

The freshwater mollusc systematical and chorological catalogue from Crișana (Romanian territory) is based on all available references and collections, also on the author's research accomplished during the last 8 years. In order to expand the knowledge regarding this group, several areas, that were not researched before the past decade, were included, such as sectors of the Ier, Crișul Pietros, Crișul Băița, Holod, Sighiștel, Crăiasa, waters from the Pădurea Craiului and Bihar Vlădeasa Mountains, etc. Because the former investigations were focused especially on main riverbeds and thermal waters, several other specific habitats were researched, such as: springs, brooks and rivulets, flood areas, pools, ponds, active caves, dam lakes, channels and ditches, marshes. Some stations, already researched by Sárkány-Kiss, have been checked out again, in order to trace the possible changes.

The sampling sites were selected from the mountain areas down to lowland, according to the geomorphologic and hydrologic features, and to the presence of human impact sources.

The molluscs were sampled directly, by hand, by sieves, using bottom Surber or dredges. The systematics is given in accordance to the latest catalogue concerning the freshwater molluscs from the Romanian Inner Carpathians Basin (Glöer & Sîrbu, 2005).

Following abbreviations were used in order to present the chorologic catalogue in a brief and synthetic way: col. = collection; leg. = sampled by; ! - original data; Km. = data from the „Mauritius and Richard Winnicki von

Kimakowicz collection“ kept in the Natural History Museum from Sibiu; SVNH = collections of the „Siebenbürgischer Verein für Naturwissenschaften in Hermannstadt“ (Transylvanian Society for Nature Sciences in Sibiu, its collections being kept mainly in the Museum from Sibiu), NNHA = collections from the „Grigore Antipa“ National Museum of Natural History in Bucharest. The other authors are given by surname and year of quotation or sampling.

#### RESULTS AND DISCUSSION

In the Crișana region 60 freshwater mollusc species (41 of snails and 19 of bivalves) were identified up to the present, as it is detailed below.

#### *The systematical and chorological catalogue of the freshwater molluscs from Crișana (Criș rivers basin, Romania)*

##### 1. *Theodoxus danubialis* (C. Pfeiffer, 1828)

(col. SVNH and col. Km.) – as “var. *serratilinea*” from Pețea, Episcopiei (1 Mai) resort near Oradea; (Soós, 1943) - „(...) the species lived in the thermal waters from Episcopiei Resort close to Oradea. In the 1870’s Mocsary Sándor has sampled living individuals. Since then, nobody has found the species alive in that site“. (Paucă, 1936; Grossu, 1986, 1993; Sîrbu, 2001) - other quotations as empty shells only, from the same spot: the thermal lake „Ochiul Mare“ on the Pețea rivulet. Present day status in Crișana: extinct.

##### 2. *Theodoxus prevostianus* (C. Pfeiffer, 1828)

(col. Km.) - Răbăgani in Bihor (sampled in the 19<sup>th</sup> century); (Soós, 1943; Jurcsák, 1969; Sîrbu, 2001) - other reports from the same site. It lived in two short mesothermal rivulets, tributaries of the Holod River (Crișul Negru River Basin). Because of human impact it disappeared from one rivulet (Gagiu, 2004), the population from the other one decreasing dangerously (Sîrbu & Benedek, 2005 a). It is worth mentioning that Răbăgani is the single site where the species surely lives in Romania, having a highly patchy distribution in Europe (some small populations are still found in thermal waters from Austria and Hungary, possible also in Bulgaria). It was erroneously reported from other Romanian spots by Grossu (1986), Soós (1943) and Sárkány-Kiss et al. (1997 a).

##### 3. *Viviparus contectus* (Millet, 1813)

(col. Km.) - from Bihor;

! - Ier River from Rădulești downstream Diosig. Road draining ditch at Berechiu.

##### 4. *Viviparus acerosus* (Bourguignat, 1862)

(col. SVNH and Bielz, 1867) - Pețea rivulet at Oradea; (Sárkány-Kiss, 1997 a) - Crișul Negru River at Zerind;

! - canals and fishponds in the Cefa - Ateaș area, channels near Berechiu.

##### 5. *Melanopsis parreyssii* (Philippi, 1847)

(col. SVNH; col. Km.; Soós, 1943; Grossu, 1981, 1986, 1993; Sîrbu, 2001) - 1 Mai (Episcopiei) Resort near Oradea, in the Ochiul Mare thermal lake. It is a local endemic and relict species that has to be carefully monitorized in the future, being endangered by alien species introduction in the lake.

6. *Esperia daudebartii acicularis* (Férussac, 1823)

(col. SVNH, col. Bielz, col. Km.) - Registered as „*Hemisinus acicularis* var. *biharensis* Hazay“, leg. Kerzen from Răbăgani in Bihor since the second half of the 19th Century; the same spot and origin in the col. NNHA. Other reports from the same spot: Clessin, 1887, Soós, 1943, Jursák, 1969 (Băii and Ciorgău rivulets at Răbăgani), Sîrbu, 2001. It still lives as a relict, in high abundance but only in short sectors from both mentioned rivulets from Răbăgani, tributaries of the Holod River (Crișul Negru River Basin). It is endangered because of household wastewater discharges, siltation and debasement of specific habitat.

7. *Bithynia tentaculata* (Linnaeus, 1758)

(Sárkány-Kiss, 1997 a) - Crișul Repede River at Cheresig; Crișul Negru River at Zerind; ! - Peșea River near Oradea; Ier River at Căuaș, from Andrid downstream Diosig.

8. *Bithynia leachii* (Sheppard, 1823)

! - canals in the Cefa - Ateaș area.

9. *Paladilhiopsis transsylvanica* Rotarides, 1943 (?)

(Soós, 1943) - Unguru Mare Cave close to Vadu Crișului; (Negrea, 1966; Grossu & Negrea, 1984; Grossu, 1986 - Vadu Crișului Cave, Floarea de Lotus spring, Peștera de Sus Cave from Vizii Valley, Sighiștel Valley - entrance in Coliboaia cave, Șuncuiuș Cave - Izbândiș – Șuncuiuș spring (Pădurea Craiului Mountains); ! - Vadu Crișului Cave, Unguru Mic Cave (leg. Denes, 2004); shells from Pișolca Cave in the Sighiștel Valley. Its systematical status is doubtful.

10. *Paladilhiopsis leruthi* C. R. Boettger, 1940 (?)

(Boettger, 1940, quoted by Soós, 1943; Negrea, 1966) - species described from Varnița, Cugliș and Coiba Mare caves; (Grossu, 1981, 1986) - Moanei Cave, spring in the Valea lui Precup, tributary of Mișid River in Pădurea Craiului Mountains; (Grossu & Negrea, 1963) - Pișolca Cave in the Sighiștel Valley. Its systematical status is doubtful.

11. *Paladilhiopsis carpathica* Soós, 1940 (?)

(Grossu & Negrea, 1963) - Pișolca Cave in Sighiștel Valley; the 38 sampled shells were ascribed to this species, and others to *P. leruthi*. (Grossu & Negrea, 1984; Grossu, 1986) - spring in the Blaj Valley, close to Cugliș Cave in Pădurea Craiului Mountains. In 2003, Denes sampled some empty shells from Pișolca Cave. Its systematical status is doubtful.

12. *Lithoglyphus naticoides* (C. Pfeiffer, 1828)

(Sárkány-Kiss, 1997 a) - Crișul Alb River at Almaș, Ineu and Chișineu-Criș; Crișul Repede River at Cheresig; Crișul Negru River at Borz, Tinca and Zerind; ! - (Crișul Alb River) in the riverbed between Ineu and Chișineu-Criș; (Crișul Negru River Basin) in the Holod River downstream of Răbăgani, in the Crișul Negru riverbed at Tinca and Zerind; Crișul Repede River at Cheresig.

13. *Bythinella austriaca* (Frauenfeld, 1859)

! - small rivulets in the Mișid Valley, downstream of Moanei Cave, spring close to Precup Valley (Crișul Repede Basin); small brook in Vârtop Pass, in the Crișul Băița basin (tributary of Crișul Negru).

14. *Valvata cristata* O. F. Müller, 1774

(Soós, 1943) - 1 Mai Resort;

! - empty shells from the Ier River at Ciocaia; draining ditches covered with vegetation near Berechiu village.

15. *Valvata piscinalis* (O. F. Müller, 1774)

(Soós, 1943) - Oradea;

! - (Crișul Repede) Tileagd dam lake, lateral channel and the riverbed at Ineu; ditch and canals at Berechiu and Cefa villages; (Ier River) on most of its length (from Ghilești, Căuaș, Rădulești, Andrid, Otomani, Ciocaia, downstream Diosig).

16. *Acroloxus lacustris* (Linnaeus, 1758)

(Jurcsák, 1969) - Răbăgani village, Baia and Ciorgău rivulets;

! - Ier River at Căuaș, Andrid and Ciocaia; canal near the country border at Ateaș.

17. *Galba truncatula* (O. F. Müller, 1774)

(col. Km.) - spring at Beiuș (leg. Riess, 1879); 1 Mai (Episcopiei) Resort (leg. Riess, 1879); (Km., 1883) - Oradea and Beiuș; (Sárkány-Kiss, 1997 a) - Crișul Alb at Mihăileni, Acința, Almaș; Crișul Negru at Ștei;

! - Crișul Alb at Chișineu-Criș; (Crișul Negru Basin) brooks tributaries of Crișul Pietros River in Padiș Plateau; brooks and springs in Grajduri Clearing (Bihar Mountains); brooks in Sighiștel Valley; canals at Sudrigiu; Crișul Repede riverbed at Șuncuiuș and Aleșd; brooks in Mișid Valley, Vadu Crișului Gorges; Ier River at Ghilești; Barcău River at Suplacu; canal near Berechiu village.

18. *Stagnicola palustris* (O. F. Müller, 1774)

(col. Km.) - Episcopiei (1 Mai) Resort and other sites near Oradea, leg. 1879; (Soós, 1943) - Crișul Repede in Oradea, 1 Mai Resort; (Sárkány-Kiss, 1997 a) - Crișul Alb flood area at Almaș; Crișul Repede downstream the lake from Aleșd;

! - Crișul Alb at Chișineu-Criș; Crișul Negru Basin - canals and ditches in Sudrigiu; Ier River at Otomani; canals near Suplacu de Barcău; canals at Berechiu and Ateaș.

19. *Stagnicola turricula* (Held, 1836)

(Km., 1883) - Oradea and Episcopiei (1 Mai) Resort. Its presence is still doubtful, because there is no anatomical evidence regarding the former reports, and the taxonomic criteria are no more the same.

20. *Stagnicola corvus* (Gmelin, 1791)

! - Ier River at Andrid; ditch at Berechiu.

21. *Radix auricularia* (Linnaeus, 1758)

(col. SVNH) - Oradea; (Soós, 1943) fossil at Episcopiei (1 Mai) Resort; (Sárkány-Kiss, 1997 a) - Crișul Alb at Ineu and Chișineu-Criș; Crișul Repede at Aleșd upstream the lake, both in the riverbed and the flood area, Aleșd downstream the lake and at Fughiu;

! - Băii brook at Răbăgani; Crișul Repede in Tileagd Lake, canal at Ineu; Ochiul Mare thermal lake from 1 Mai Resort; Pețea rivulet downstream the thermal lake; Ier River at Căuaș, Andrid, Otomani and Ciocaia; canals at Ateaș, Cefa and Berechiu.

22. *Radix labiata* (Rossmässler, 1835) syn. *Radix peregra* (O. F. Müller, 1774) (col. Km.) - spring and pools at Beiuș (leg. Riess, 1879); Episcopiei (1 Mai) Resort, Felix Resort; (Bielz, 1867) - Basarabasa, puddles at Vața de Sus, springs near Baia de Criș, (Sárkány-Kiss, 1997 a) Crișul Alb River at Criș, Mihăileni, Acința; Crișul Repede Basin in Drăgan and Iad tributaries, Remetei; Crișul Negru at Borz; Barcău downstream of Boghiș;

! - Crișul Alb at Mihăileni; Sighiștel Valley in the gorges; brooks towards Vârtop Pass in the Crișul Băița basin; Craiașa River (Crișul Negru Basin); Săcuieu and Drăganu valleys (Crișul Repede basin).

23. *Radix balthica* (Linnaeus, 1758) syn. *Radix ovata* (Draparnaud, 1805) (col. SASN and col. Blz) - Oradea; (col. Km.) - Răbăgani (thermal brook, leg. Riess, 1879); (Sárkány-Kiss, 1997 a) - Crișul Negru at Borz and Tinca. All these quotations are doubtful because there is no anatomical evidence of these samplings and taxonomical criteria are strictly focused on such clues, at present.

24. *Lymnaea stagnalis* (Linnaeus, 1758) (col. SVNH and col. Km.) - Oradea, water mill and pool, leg. 1879; (Sárkány-Kiss, 1997 a, b) - Crișul Alb in the flood area at Almaș; ! - Ier River between Căuș and Otomani; main canal at Cefa.

25. *Pseudosuccinea columella* (Say, 1817) ! - an adventive species first found on *Nymphaea lotus* var. *thermalis* leaves from the Ochiul Mare thermal lake at 1 Mai Resort, in 1999 and afterwards in 2003. Not found again during the trips from 2004 - 2005 - most likely it was not able to survive here.

26. *Physa fontinalis* (Linnaeus, 1758) (Sárkány-Kiss, 1997 a) - Crișul Negru River at Zerind; ! - lateral canal of Crișul Repede River at Ineu; in the author's personal collection some individuals sampled by P. M. Bănărescu from the Ochiul Mare thermal lake, 1 Mai Resort (not found again during the last years in this habitat); Ier River at Rădulești, Andrid and Ciocaia.

27. *Physella acuta* (Draparnaud, 1805) (Sárkány-Kiss, 1997 a) - Crișul Alb River at Ineu; Crișul Repede at Aleșd, downstream the dam lake; ! - Crișul Alb at Ineu; Crișul Repede at Șaula; Ochiul Mare thermal lake, 1 Mai Resort; canal between Ateaș and Cefa.

28. *Aplexa hypnorum* (Linnaeus, 1758) (col. SVNH and col. Km.; leg. Riess, 1899) - Oradea.

29. *Planorbarius corneus* (Linnaeus, 1758) (col. SVNH, col. Km. - leg. Riess, 1865) - Oradea; Pețea rivulet and ponds (leg. Riess, 1866); (Sárkány-Kiss, 1997 a) - Crișul Alb at Almaș in the flood area; ! - Ochiul Mare thermal lake at 1 Mai Resort; Ier River between Căuș and Ciocaia; canals at Ateaș and Cefa, fishponds from the Cefa fishery.

30. *Planorbella anceps* (Menke, 1830) ! - Nearctic species, adventive in Europe, first sampled by M. Petrescu in 1999 and identified by P. Glöer, from thermal artificial ponds in Felix Resort, not found again since 2003; it seems unable to survive in this area.

31. *Planorbis planorbis* (Linnaeus, 1758)

(col. Km.) - Oradea; (Sárkány-Kiss, 1997 a) - Crișul Alb flood area at Acința and Almaș; Crișul Repede downstream the dam lake from Aleșd;

! - Ier River at Căuaș and Rădulești.

32. *Anisus spirorbis* (Linnaeus, 1758)

! - draining ditches near Sudrigiu, Băii brook at Răbăgani (Crișul Negru Basin); Drăgan Valley upstream the village; puddles in the Rădvani (Cefa) forest; draining ditches close to Șuplacu de Barcău.

33. *Anisus calculiformis* (Sandberger, 1874) syn. *Anisus septemgyratus* (Rossmäessler, 1835)

! - Ier River at Rădulești; road draining ditches between Cefa and Berechiu.

34. *Anisus vortex* (Linnaeus, 1758)

! - ditches at Berechiu.

35. *Anisus vorticulus* (Troschel, 1834)

! - Ier River at Rădulești.

36. *Gyraulus albus* (O. F. Müller, 1774)

(Soós, 1943) - Oradea;

! - Băii brook at Răbăgani; Crișul Repede - dam lake from Tileagd, lateral channel at Ineu; Ier River at Andrid; canals at Ateaș and main canal close to Cefa.

37. *Gyraulus (Armiger) crista* (Linnaeus, 1758)

(Soós, 1943) - Episcopiei (1 Mai) Resort.

38. *Hippeutis complanatus* (Linnaeus, 1758)

(Km., 1883) - puddles of the Criș River at Oradea; (Soós, 1943) - Oradea;

! - Băii rivulet at Răbăgani; draining ditch at Berechiu.

39. *Segmentina nitida* (O. F. Müller, 1774)

! - Ier River at Căuaș and Rădulești.

40. *Ferrissia wautieri* (Mirolli, 1960)

! - empty shells at Răbăgani; Ochiul Mare thermal lake, 1 Mai Resort; Ier River at Rădulești.

41. *Ancylus fluviatilis* O. F. Müller, 1774

(Km., 1883) - rivulet at Beiuș; (Soós, 1943) - Moneasa; Sighiștel Valley; (Sárkány-Kiss, 1997 a) - Crișul Alb at Chișineu-Criș, Almaș; Drăgan Valley, Iad Valley, Remeți, Crișul Repede at Bologa, Ciucea, Stâna de Vale, Aleșd upstream the lake; Crișul Negru at Poiana and Borz; Barcău River in the spring area and at Boghiș; ! - (Crișul Negru Basin) Sighiștel and Chișcău rivers valleys; (Crișul Repede Basin) Săcuieu River upstream Bologa, Drăgan Valley, outflow of the "Peștera cu Apă de la Bulz" (the "Cave with Water" from Bulz), Crișul Repede at the outflow of Iad Valley and at Șuncuiuș, brooks in the Mișid Valley, Izbândiș karstic spring, Crișul Repede River at Aleșd, empty shells at Cheresig.

42. *Unio pictorum* (Linnaeus, 1758)

(col. Km.) - Crișul Alb; (Sárkány-Kiss, 1997 a, b) - Crișul Alb at Ineu; Crișul Repede at Cheresig; Crișul Negru at Zerind;

! - Crișul Alb at Ineu and Chișineu-Criș; Crișul Negru at Zerind; Crișul Repede at Cheresig; Ier River at Andrid, Otomani and Ciocaia.

43. *Unio tumidus* Philipsson, 1788

(Sárkány-Kiss, 1997 a, b) - Crișul Alb at Ineu; Crișul Repede at Cheresig; Crișul Negru at Tinca and Zerind;

! - Crișul Negru at Zerind; Crișul Alb at Chișineu-Criș; Crișul Repede at Cheresig; Ier River at Andrid and Otomani, only empty shells at Ciocaia.

44. *Unio crassus* Lamarck, 1819

(col. Km.) - Pețea rivulet at Oradea (leg. Riess, 1879); Crișul Repede at Sîntion; (Km., 1884) - Crișul Repede at Oradea; (Sárkány-Kiss, 1997 a, b) - Crișul Alb at Almaș, Ineu, Chișineu-Criș; Crișul Repede at Fughiu, Cheresig; Crișul Negru at Borz, Tinca, Zerind; Barcău River at Boghiș;

! - Crișul Alb between Ineu and Chișineu-Criș; Crișul Negru between Tinca and Zerind; Crișul Repede at Ineu, Fughiu and Cheresig; Pețea rivulet upstream Oradea; empty shells in the Ier River at Otomani; Barcău River upstream Suplacu.

45. *Anodonta cygnaea* (Linnaeus, 1758)

(col. SVNH) - Pețea River near Oradea; (col. Km.) - Crișul Repede at Oradea (leg. Riess, 1879); (Sárkány-Kiss, 1997 a, b) Crișul Repede in the Aleșd dam lake; ! - Crișul Alb at Bocsig, Ineu and Chișineu-Criș; Crișul Negru at Tinca and Zerind; Crișul Repede in the Tileagd dam lake and at Cheresig; Ier River at Ghilești, Andrid, Otomani and Ciocaia; canals at Ateaș, Berechiu and Cefa.

46. *Anodonta anatina* (Linnaeus, 1758)

(col. SASN) - Oradea; (Sárkány-Kiss, 1997 a, b) - Crișul Alb at Ineu; Crișul Repede at Fughiu; Crișul Negru at Borz, Tinca and Zerind;

! - Crișul Alb between Ineu and Chișineu-Criș; Crișul Negru at Tinca; Ier between Andrid and Otomani; canal at Berechiu.

47. *Sinanodonta woodiana* (Lea, 1834)

Adventive species, first sampled in Europe by Béla Kiss in 1979 from the Cefa fishponds; published by Sárkány-Kiss (1986); found by the same author (1997 a, b) in canals linking the three Criș rivers; in the Crișul Alb at Ineu, Crișul Repede at Fughiu and Cheresig; Crișul Negru at Tinca.

! - Crișul Alb River at Ineu and Chișineu-Criș; Crișul Negru at Tinca and Zerind; Crișul Repede at Cheresig; the Ochiul Mare thermal lake from 1 Mai Resort (one sampled in 2003, lots of individuals found in February 2006); Ier between Andrid and Diosig; Barcău River near Mihai Bravu; canals at Berechiu and Cefa, fishponds in the Cefa fishery.

48. *Pseudanodonta complanata* (Rossmässler, 1835)

(Sárkány-Kiss, 1997 a, b) - Crișul Alb at Ineu; Crișul Negru at Tinca;

! - Crișul Alb at Ineu and Chișineu-Criș; Ier River at Ciocaia and empty shells at Andrid.

49. *Sphaerium corneum* (Linnaeus, 1758)

(col. SASN) - Oradea; (Sárkány-Kiss, 1997 a) - Crișul Negru at Tinca and Zerind;

! - Ier between Andrid and Ciocaia, at Rădulești and Otomani.

50. *Sphaerium ovale* (A. Férussac, 1807)

! - Crișul Repede one dead individual at Cheresig; Ier at Andrid (det. P. Glöer in 2003); channel near Ateaș.

51. *Sphaerium riviculum* (Lamarck, 1818)

(Sárkány-Kiss, 1997 a) - Crișul Repede at Cheresig; Crișul Negru at Zerind; Barcău River at Sântimreu;

! - Barcău downstream Mihai Bravu; channel between Ateaș and Cefa.

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

(Sárkány-Kiss, 1997 a) - Crișul Repede at Cheresig;

! - pool of concrete on the Băii brook at Răbăgani; Ier River at Rădulești and Ciocaia; canals near Ateaș and Cefa.

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

(Sárkány-Kiss, 1997 a) - Crișul Repede at Zerna and Drăgan; Crișul Negru at Tinca;

! - Holod River downstream Răbăgani; empty shells in the Băii brook at Răbăgani and from Crișul Negru at Zerind; shells in Ier at Andrid; alive in a canal near Berechiu.

54. *Pisidium casertanum* (Poli, 1791)

(Bielz, 1867) - „Baia de Criș, from a spring near a road“;

! - brooks and puddles from the Padiș Plateau, tributaries to the Crișul Pietros River; springs, marshes and brooks in the Grajduri Clearing, rivulets entering the Cetățile Ponorului Cave, „Tăul Suspendat“ pond from Groapa de la Barsa; brooks near Vârtop Pass, tributaries of Crișul Băița; Băii rivulet at Răbăgani; (Crișul Repede Basin) Drăgan River Valley, spring near the Mișid River, close to the entrance in Unguru Mic Cave.

55. *Pisidium personatum* Malm, 1855

! - (Crișul Negru Basin) upstream Chișcău in the Crăiasa river, both riverbed and some puddles supplied by springs; (Crișul Repede) in the carstic brook outflow of „Peștera cu Apă de la Bulz“ (cave from Bulz); brooks and springs close to the Mișid flow in the Crișul Repede River.

56. *Pisidium henslowanum* (Sheppard, 1823)

! - lateral channel of the Crișul Repede at Ineu.

57. *Pisidium nitidum* Jenyns, 1832

! - Munteni dam lake in Iad Valley (det. P. Glöer, 2003).

58. *Pisidium milium* Held, 1836

! - ditches at Berechiu.

59. *Pisidium subtruncatum* Malm, 1855

! - Crișul Alb at Bocsig; Băii brook at Răbăgani; Crișul Repede downstream Șaula; Munteni lake in the Iad Valley (det. P. Glöer); spring near the Mișid flow in the Crișul Repede; puddles in the Vadu Crișului Defile; Tileagd dam lake; lateral channel at Ineu (upstream Fughiu); Ier River at Căuaș, Rădulești and Ciocaia; canal at Berechiu.

60. *Pisidium moitessierianum* (Paladilhe, 1866)

! - Tileagd dam lake and lateral channel of the Crișul Repede River at Ineu.

The former and present-day occurrence of the freshwater mollusc species in the Crișul Alb, Crișul Negru, Crișul Repede, Ier and Barcău rivers basins is showed in table 1. Among the 60 species of freshwater molluscs known from Crișana, 41 were cited by others or were found in several collections, 53 were identified by the author after 1998, among the latter 19 taxa being newly found in this area. The

Table 1

The freshwater mollusc species identified in the five researched river basins from Crișana (past and present-day information).

Hydrographic Basin Species	Crișul Alb		Crișul Negru		Crișul Repede		Ier		Barcău	
1. <i>Theodoxus danubialis</i>					⊕	●				
2. <i>Theodoxus prevostianus</i>			▲	●						
3. <i>Viviparus contectus</i>					▲		▲			
4. <i>Viviparus acerosus</i>				●	▲	●				
5. <i>Melanopsis parreyssii</i>					▲	●				
6. <i>Esperiana d. acicularis</i>			▲	●						
7. <i>Bithynia tentaculata</i>				●	▲	●	▲			
8. <i>Bithynia leachii</i>					▲					
9. <i>Paladilhiopsis transsylvanica</i> (?)				●	▲	●				
10. <i>Paladilhiopsis leruthi</i> (?)				●		●				
11. <i>Paladilhiopsis carpathica</i> (?)				●						
12. <i>Lithoglyphus naticoides</i>	▲	●	▲	●	▲	●				
13. <i>Bythinella austriaca</i>			▲		▲					
14. <i>Valvata cristata</i>					▲	●	⊕			
15. <i>Valvata piscinalis</i>					▲	●	▲			
16. <i>Acroloxus lacustris</i>				●	▲	▲	▲			
17. <i>Galba truncatula</i>	▲	●	▲	●	▲	●	▲		▲	
18. <i>Stagnicola palustris</i>	▲	●	▲		▲	●	▲		▲	
19. <i>Stagnicola turricola</i>						●?				
20. <i>Stagnicola corvus</i>					▲		▲			
21. <i>Radix auricularia</i>		●	▲		▲	●	▲			
22. <i>Radix labiata</i>	▲	●	▲	●	▲	●				●
23. <i>Radix balthica</i>				●?		●?				
24. <i>Lymnaea stagnalis</i>		●			▲	●	▲			
25. <i>Pseudosuccinea collumella</i>					E					
26. <i>Physa fontinalis</i>				●	▲	●	▲			
27. <i>Physella acuta</i>	▲	●			▲	●				
28. <i>Aplexa hypnorum</i>						●				
29. <i>Planorbarius corneus</i>		●			▲	●	▲			
30. <i>Planorbella anceps</i>					E					
31. <i>Planorbis planorbis</i>		●				●	▲			
32. <i>Anisus spirorbis</i>			▲		▲				▲	
33. <i>Anisus calculiformis</i>					▲		▲			
34. <i>Anisus vortex</i>					▲					

35. <i>Anisus vorticulus</i>							▲			
36. <i>Gyraulus albus</i>			▲		▲	●	▲			
37. <i>Gyraulus crista</i>						●				
38. <i>Hippeutis complanatus</i>			▲		▲	●				
39. <i>Segmentina nitida</i>							▲			
40. <i>Ferrissia wautieri</i>			⊕		▲		▲			
41. <i>Ancylus fluviatilis</i>		●	▲	●	▲	●				●
42. <i>Unio pictorum</i>	▲	●	▲	●	▲	●	▲			
43. <i>Unio tumidus</i>	▲	●	▲	●	▲	●	▲			
44. <i>Unio crassus</i>	▲	●	▲	●	▲	●	⊕		▲	
45. <i>Anodonta cygnaea</i>	▲		▲		▲	●	▲			
46. <i>Anodonta anatina</i>	▲	●	▲	●	▲	●	▲			
47. <i>Sinanodonta woodiana</i>	▲	●	▲	●	▲	●	▲		▲	
48. <i>Pseudanodonta complanata</i>	▲	●		●			▲			
49. <i>Sphaerium corneum</i>				●		●	▲			
50. <i>Sphaerium ovale</i>					▲		▲			
51. <i>Sphaerium riviculum</i>				●	▲	●			▲	●
52. <i>Musculium lacustre</i>			▲		▲	●	▲			
53. <i>Pisidium amnicum</i>			▲	●	▲	●	⊕			
54. <i>Pisidium casertanum</i>		●	▲		▲					
55. <i>Pisidium personatum</i>			▲		▲					
56. <i>Pisidium henslowanum</i>					▲					
57. <i>Pisidium nitidum</i>					▲					
58. <i>Pisidium milium</i>					▲					
59. <i>Pisidium subtruncatum</i>	▲		▲		▲		▲			
60. <i>Pisidium moitessierianum</i>					▲					
Total by column	13	17	23	23	44	34	27	0	6	3
TOTAL BY BASIN		19		34		54		27		8
Newly identified species **		2		11		19		27		5
		Crișul Alb		Crișul Negru		Crișul Repede		Ier		Barcău

Observations: in the cells the symbol ▲ means a species identified by the author between 1998 and 2006; ● - reported before 1998 by other authors or present in some older collections; ? - doubtful status or report; ⊕ - only empty shells were found, thus they are not counted in the totals; E - ephemeral presence of adventive species in some thermal water habitats; \*\* - row containing the number of species found in the specified basin for the first time by the author.

distribution of these categories across the five rivers' basins of reference is represented in fig. 1.

The author has not found 7 species previously reported, but there is sure evidence that only one is extinct (namely *Theodoxus danubialis* from the 1 Mai Resort thermal lake).

The systematical status of three species is still doubtful, namely the cave snails (*Paladilhiopsis* sp.), because neither anatomical nor genetical evidence is still available. The used generic name *Paladilhia* was changed to *Paladilhiopsis* according to a personal communication made by A. Falniowski to the author.

The presence of two former reported species (*Stagnicola turricula* and *Radix balthica* syn. *Radix ovata*) is also put under question, because there is no anatomical evidence of the past sampled material.

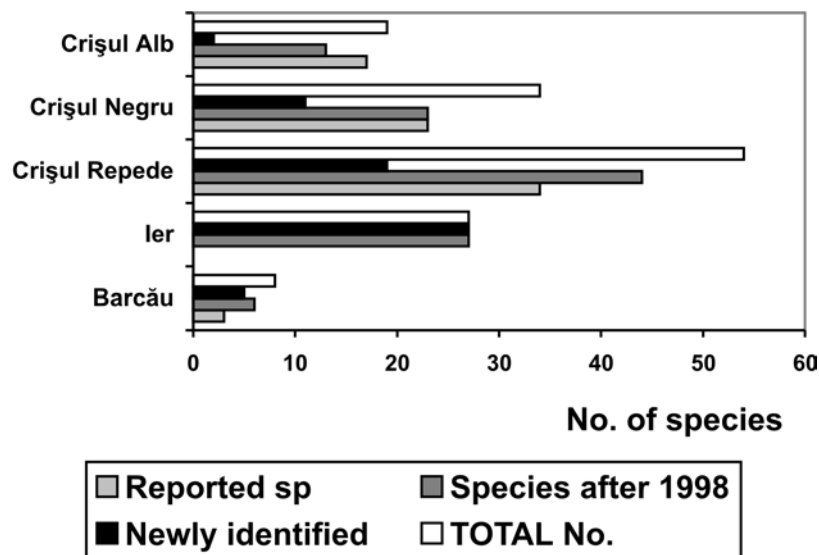


Fig. 1 – The total number of freshwater mollusc species in the five researched river basins from Crișana, those reported by others, than found by the author after 1998, and the newly identified taxa.

Four species are adventive elements, among them only one bivalve (*Sinanodonta woodiana*) and one Pulmonate (*Physella acuta*) surely established stable populations, the others being Nearctic species, presumably not being able to survive in the thermal waters of this area.

The thermal relict and local endemic species, *Melanopsis parreyssii*, is still represented by an abundant population, having certain chances for survival. In the “Ochiul Mare” thermal lake (1 Mai Resort), where it lives, in February 2006 it was proved to be the single active snail, although there are some other species found during the warmer seasons, sharing its habitat. In the same place and time lots of individuals of *Sinanodonta woodiana* were spotted at the surface of sediments, by open syphons, although normally during the winter they usually are deeply buried in the sediments of other waters. The first individual was sampled by the author in 2003 and it is obvious that this invasive species has adapted well, as the single naiad, also to this thermal habitat. Some changes in the molluscs fauna are obvious: for instance the adventive *Pseudosuccinea columella* was first found in the “Ochiul Mare” lake in 1999, later in 2003, but not again in 2004 - 2005, meaning that it was unable to survive for a longer period. Other reported species in the past, like *Physa fontinalis* or *Gyraulus (Armiger) crista* were not found again during the last 8 years.

In Răbăgani the last investigations indicate that *Theodoxus prevostianus*, is either extinct (Gagiu, 2004) or is in the very border of its extinction, due to human activities. Although in 1981 the thermal springs were declared protected areas, nothing was really done to prevent the decline of its population. Scientific interest is also a threat of these two sites and their fauna. For instance, Gagiu (2004) mentioned that in Oradea Museum there are 526 individuals of *Theodoxus prevostianus* sampled by T. Jurcsák and K. Csák between 1957 - 1964, too many in any purposive respect. This fact raises the question if sampling and research should not be put under a certain legal control, like in other states.

The main threat for the aquatic fauna of Crișana is represented by the hydrotechnical works and plants, especially by straightening of the rivers, channel-like shaped, with no flood-area and too close dams. The main part of the middle and lowland sectors of the three Criș rivers, Ier and Barcău are in a such extended modification that they can be better characterized as canals than rivers. Pollution is an impact factor of lower pressure than in other parts of Romania. As Sárkány-Kiss (1997 a) stated the pollution effects are more intense in the Barcău River, and some stretches from the upper Crișul Alb and Crișul Negru rivers. Hydroenergetical plants and works were mentioned to have the main impact on the Crișul Repede River.

These statements are valid up to the present, with some remarks. For instance, during the former mentioned research, no Unionidae were found in Barcău upstream Suplacu de Barcău. In 2002 I found an abundant but highly patchy distributed *Unio crassus* population upstream this locality, the individuals being placed singularly in rows, parallel to the banks, according to the poor offer of specific habitat. Downstream the locality the first naiad that was able to colonize the former polluted stretch was *Sinanodonta woodiana*, proving once again its abilities and wider tolerance. As an effect of industrial collapse in the past decade, centralized pollution has decreased in most of the country, and the effects registered all over, were the recolonization (usually with some different species) and establishment of new communities, even in once highly polluted rivers stretches. The increase and diffuse placement of household wastes and wastewater discharges are in opposition.

Despite all these negative facts, another feature of Crișana is the diverse and abundant Unionidae communities, in some of the middle and lower courses of the main rivers and channels. All the seven species encountered in Romania are present in this area, highlighting especially some significant abundant population of *Unio crassus*, especially in the lower sectors of Crișul Alb and Crișul Negru rivers, and also the presence of the most endangered and exacting naiad, namely *Pseudanodonta complanata*, in the same stretches (Sîrbu et al., 2005). The Unionidae cover sometimes the whole riverbed as it happens in some sectors of the three Criș rivers, but exceptionally characteristic in the Ier River (Sîrbu, 2001). The high diversity of the molluscs fauna and the former mentioned feature, suggests that against all odds, Crișana is still an area of high ecological state and value, compared to other regions of Romania.

As it is shown in fig. 1, due to pollution, the Barcău River shelters the poorest mollusc fauna. Opposite, the Crișul Repede is characterized by the richest fauna, both present and reported. This is due to several causes: the long time-span samplings and reports, the presence of the fauna related to the thermal lake from 1 Mai Resort, the high diversity of natural habitats (ranging from mountain springs, underground waters in caves until lowland flowing or stagnant waters), but also to the established dam lakes, which are in present densely inhabited by some lentiphyllous intruders that were able to invade and colonize the newly formed habitats. Ranked on the second place, the Ier River is a remarkable surprise. Despite that it was transformed almost entirely in a canal, it shelters a rich and a representative lowland fauna, stagnant confined, with many phytophyllous species, together with highly abundant Unionidae communities, inhabiting the whole cross-section of the riverbed. The Crișul Negru and Crișul Alb rivers present intermediate values between these edges, being insignificant in more natural conditions than the others.

In the Cefa area 27 species of aquatic Mollusca were found in a very narrow geographical range (Sîrbu & Benedek, 2005 b). Among them, some very rare and threatened species have been encountered, such as *Valvata cristata*, *Bithynia leachii*, *Viviparus contectus*. In this region, the mosaic display of diverse aquatic and paludal microhabitats are the main characteristic, mostly linked by canals, reflected in the diverse structure of communities. This is the main cause for the occurrence of usually niche-segregated species inhabiting sometimes microhabitats found closely each other, like the pairs: *Viviparus acerosus* and *Viviparus contectus*, *Valvata cristata* and *Valvata piscinalis*, or *Anodonta cygnaea* and *Anodonta anatina*. It is highly important to preserve these remnant communities and their habitats, especially considering that they resemble the past array of life and environment, representative for the Crișana region, before the raising of human impact effects.

### Conclusions

In Crișana, the five investigated river basins, namely the Crișul Alb, Crișul Negru, Crișul Repede, Barcău and Ier, 60 species of freshwater molluscs were found (about three quarters of the species from Romania), a remarkable abundant and diverse fauna. The thermal relicts are the most characteristic, but also some species that are known only from this area, or others which became very rare or endangered, in Romania. At least one species, *Theodoxus danubialis*, has disappeared, and another one, *Theodoxus prevostianus*, is at the border of extinction. Although highly transformed and altered by hydrotechnical and hydroenergetical works and plants, to which some effects of pollution have to be added, abundant Unionidae communities can still be found in some of these river stretches and wetlands. The draining of most marshes and wetlands have drastically reduced the specific habitats, and imposed a highly patchy distribution of most populations and communities confined to such conditions. Many areas, from mountains to lowlands, especially the Ier River, the Apuseni Mountains Natural Park, the thermal lake from Peștea River (1 Mai Resort), areas of Răbăgani and Cefa, the Ecedea Marshes, the middle and lower sectors of Crișul Alb and Crișul Negru rivers and the karst from Pădurea Craiului Mountains are of great importance, because they shelter some outstanding habitats and remnant communities, of high scientific interest.

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## MOLUȘTELE ACVATICE DIN CRIȘANA (BAZINUL CRIȘURILOR, ROMÂNIA)

## REZUMAT

Fauna moluștelor acvatice din Crișana cuprinde 60 de specii (dintre care 41 de gastropode și 19 bivalve). 19 specii sunt nou identificate în această arie de către autor. Această lucrare prezintă catalogul sistematic și chorologic al malacofaunei dulcicole, evidențierea elementelor cele mai caracteristice și semnificative, a amenințărilor reprezentate de impactul antropic asupra apelor din zonă și a comunităților adăpostite de acestea.

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