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A scoring method for the assessment of rarity and conservation value of the Hungarian freshwater molluscs

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With 2 figures and 1 Table.

Abstract.

A list of the freshwater molluscs, occurring in Hungary, is given with additional notes or occurrence data to those species which are not mentioned, or mentioned in a different way from Hungary by the CLECOM (FALKNER & al. 2001). A rarity based score (Mollusc Rarity Index, MRI) was calculated for each species, taking their local frequency and the size of their global range into consideration (SÓLYMOS 2004). Frequency rates, calculated on the basis of the material in some significant private and state-owned collections, were sometimes in contradiction with our subjective field experience, regarding the rarity and the conservation status of the species. In order to find the explanation of these contradictions, we examined how the possible error factors affect the calculated frequency rates. We found that the obsolescence of the basic data-set due to recent changes in the fauna is the most significant error factor. This gave us the grounds for placing greater emphasis on the correction factors of our MRI formula, than it has been done by SÓLYMOS (2004), who has introduced first this method for terrestrial molluscs in Hungary. Numerous taxa, which have not been protected yet in Hungary - for example *Bythiospeum oshanovae, Bythinella austriaca, Valvata macrostoma, Planorbis carinatus, Anisus leucostoma, Gyraulus riparius, Gyraulus rossmaessleri, Sphaerium solidum, Sphaerium rivicola,* and *Pisidium pseudosphaerium* - were ranked among the rarest ones. These species were recommended to be taken into consideration in the course of setting further conservation priorities and designating further species for protection in Hungary.

Introduction

There have already been attempts in Hungary to determine conservation priorities for certain animal taxa based on the rarity of the species (e. g. Odonata: DÉVAI & MISKOLCZI 1987, Vertebrata: BÁLDI & al. 2001). For terrestrial molluscs, a rarity based scoring method has been introduced recently: the Mollusc Rarity Index (MRI), defined by SÓLYMOS (2004), is composed of the global size of the geographical range (on a 1-4 scale from wide to narrow range), the frequency of occurrence in Hungary (on a 1-5 scale from frequent to rare species) and a correction factor (on a 0-1 scale) due the biased frequency estimate or special importance of some species. This index ranges from two to ten, where higher scores indicate rarer species and it is suggested to be used in species-based conservation, habitat assessment and long-term faunistical monitoring.

For the sake of practical usability, it seemed reasonable to calculate rarity scores for freshwater mollusc species as well, which are compatible with those of the terrestrial ones. In addition, we aimed to examine how the calculated species' frequency values are affected by certain error factors, namely (i) unequal representation of certain geographical areas in the basic data-set, (ii) incompleteness of the distribution data due to improper exploration of the Hungarian fauna (iii) and obsolescent data caused by the changes in the fauna. We also aimed to examine how the calculated species' frequency values are in accordance with our field experience. At the same time, the changes of the list and the nomenclature of the Hungarian aquatic molluscs in relation to the works of PINTÉR (1984) and FALKNER & al. (2001) were also reviewed.

Materials and Methods.

Mollusc Rarity Index (MRI) was calculated as the sum of the following components: RS score (range size), LF score (local frequency) and three special correction factors (SF_1, SF_2, SF_3). Compared to the MRI formula of SÓLYMOS (2004), correction factors used herein are slightly different, but the RS and LF values are calculated in the same way.

The RS score was calculated as a function of the global range of the species as follows: 1=the area was equal to or larger than the size of Europe (e. g. Euro-Siberian, Palearctic, Holarctic species), 2=the species had a large range within Europe, covering more biogeographical regions (e. g. Central European or Alpine-Carpathian species), 3=the species was distributed within a well-defined biogeographical region (e. g. Pannonian species) or belonged to one river-system (e. g. Danubial species), 4=the species had a narrower range within one biogeographical region (e. g. Northern Carpathian species). The geographic ranges were determined according to BÁBA (1999), EHRMANN (1956), GLÖER (2002a), JAEKKEL & al. (1957), RICHNOVSZKY & PINTÉR (1979) and SOÓS (1943, 1955, 1957).

Data on the Hungarian distribution of the species were taken from the publications of PINTÉR & al. (1979) and PINTÉR & SZIGETHY (1979, 1980), which contained the data of the larger Hungarian private and state-owned collections up to 1980, and from the collections of the Hungarian Natural History Museum, Budapest (HNHM), the Mátra Museum, Gyöngyös (MMGY) and G. MAJOROS (Budapest). The basic data-set consisted of the following fields: species, locality, date of sampling and the UTM based position (a cell in the 10 x 10 km resolution UTM grid system) of the locality. These data were then converted into species-in-grid-cell records, a species was considered to occur in a given cell if there was any occurrence of the species, independently from the number of records and the number of the specimens found. The frequency of a species was calculated by proportioning the number of the grid cells occupied by the given species to the number of the grid cells occupied by any of the terrestrial or aquatic mollusc species. LF scores were calculated as a function of the species' frequency, as follows: 1=the frequency was higher than 25%, 2=the frequency was between 15 and 24.9%, 3=the frequency was between 5% and 14.9%, 4=the frequency was between 1% and 4.9%, 5=the frequency was below 1%.

Correction factor SF_1 was used when Hungarian population(s) represented a considerable part or the whole of the global stand of a species, and therefore they had a special importance concerning the global conservation status of the species. SF_2 was used when the global population density of a species – due to its sporadic distribution – was overestimated by its global range. SF_3 was used when the present frequency of a species was estimated incorrectly by the available distribution data. Since LF was calculated disregarding the temporal heterogeneity of the available distribution data, this correction was used in the cases of spreading and disappearing species. SF_1 and SF_2 scores ranged between 0 and +2, and SF_3 score could theoretically be any value between -4 and +4, on the condition that $RS + SF_2 \leq 5$, and $1 \leq LF + SF_3 \leq 5$.

On the basis of our field experience, observations and subjective impressions freshwater molluscs were grouped into conservation status categories (table 1). Actual rarities, as well as dispersal and colonising abilities, vulnerability of the biotopes and trends of frequency changes were taken into consideration. In the cases of non-indigenous species, their effect on the indigenous fauna was also considered. The following categories were set: CE: critically endangered taxa that occur only in a few, endangered biotopes, without dispersal ability; E: taxa that are endangered, very rare or getting rarer rapidly, without dispersal ability; R: taxa that are rare or getting rarer, occurring in vulnerable biotopes, with limited dispersal ability; F: not rare, frequent or common taxa, with good dispersal ability; I/0: introduced taxa, not able to disperse spontaneously; I/+: non-indigenous taxa that are able to disperse, but do not cause apparent damage to the indigenous mollusc fauna; I/-: invasive non-indigenous taxa, competitor of some indigenous mollusc species; I/--: taxa like in the former category which deteriorate the habitat as well.

In order to test how the basic data-set affect the MRI values, species' frequencies and LF scores were derived not only from the whole database (WHOLE), but from the data of the HNHM alone and from the data of the MMGY alone, too. PEARSON's correlation coefficients (r) were calculated and the significance of the r-values were tested by t-test. Species' frequencies were plotted against each other (fig. 1).

Species' frequencies and LF scores were tested pair-wise by sign test (HNHM vs. MMGY and HNHM vs. WHOLE).

In general, the nomenclature used by FALKNER & al. (2001) was followed, otherwise, the use of different names was explained in a separate note. Any deviation from the customary nomenclature, used by Hungarian authors (e. g. PINTÉR 1984 or RICHNOVSZKY & PINTÉR 1979) was also indicated. In the cases of the species, that were not mentioned from Hungary by FALKNER & al. (2001) the data of occurrences or some literature references were given.

Results.

The list of Hungarian freshwater molluscs contained 64 gastropod taxa, belonging to 61 species and 28 bivalve species (Table 1). Compared to the CLECOM (FALKNER & al. 2001), this list included ten additional species (*Bythinella austriaca, Planorbella nigricans, Hebetancylus excentricus, Gyraulus parvus, Gyraulus riparius, Gyraulus rossmaessleri, Sphaerium solidum, Pisidium pulchellum, Corbicula fluminea* and *Corbicula fluminalis*). One (*Bythinella hungarica*) was indicated in subspecific status, and one (*Bythiospeum gebhardti*) was cancelled.

Two of the indigenous taxa (*T. prevostianus, B. austriaca hungarica*) were considered critically endangered, 14 endangered and 21 rare. Five non-indigenous taxa were categorised as invasive and harmful, another four of them were considered invasive without causing apparent damage to the indigenous mollusc fauna. Six non-indigenous species were categorised as introduced exotic species, which are unable to disperse spontaneously, and therefore they were not considered as the part of the fauna in the strict sense (table 1: Conservation Notes).

Table 1 contains the calculated RS, LF and MRI scores, as well as the SF values for each freshwater mollusc taxon. Explanations for the SF values are given below in the Discussion. MRI scores ranged between 2 and 11. The mean of the MRI scores was 4.98 (S.D.=2.20), and 6 was the lower bound of their upper quartile value. Excluding non-indigenous species that are unable to spread spontaneously, the mean of the MRI scores changed to 4.86 (S.D.=2.20), but the upper quartile range did not change.

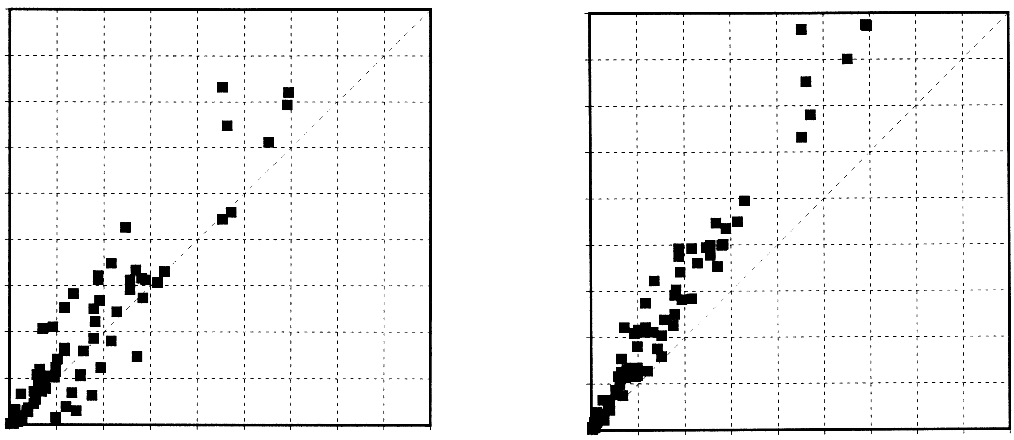

Fig. 1. Frequency rates of the Hungarian freshwater mollusc species.
Each dot represents one taxa, frequency of which was calculated (a): from the databases of the Hungarian Natural History Museum and the Mátra Museum in Gyöngyös, (b): from the whole database, containing the data of several significant Hungarian private and state-owned collections and from the database of the Hungarian Natural History Museum alone.

When species were grouped by conservation status categories, and LF scores were averaged by these groups, these values were 2.29 for the frequent (F), 3.33 for the invasive (I/+, I/-, I/--), 3.40 for the rare (R, R-F), 4.14 for the endangered (E, E-R), and 5.0 for the critically endangered (CE) species. Due partly to the correction factors, MRI score averages by the same groups gave a different order, these averages were 3.49 for the frequent, 3.22 for the invasive, 6.0 for the rare, 6.86 for the endangered and 10.5 for the critically endangered species (table 1).

Significant positive correlation was found between species' frequencies, derived from the data of two different collections (HNHM and MMGY), (r=0.944, p<0.000001, fig. 1a). The correlation was even stronger when the compared freqency values were derived from the HNHM data and from the whole database (r=0.984, p<0.000001, fig 1b). Comparing HNHM and MMGY, more species (46 out of 84) had lower frequency values on the basis of the HNHM database, however this difference did not prove to be significant by sign test (n=84, V>v=54.8%, Z=0.76, p=0.445). Different frequency values resulted different LF scores in the cases of 24 taxa (7 taxa got lower LF score on the basis of the HNHM database and 17 taxa got lower LF score on the basis of the MMGY database). Neither this difference proved to be significant by sign test (n=24, V>v=70.8%, Z=1.83, p=0.067). Comparing HNHM data to the whole database, an overwhelming majority of the species (74 out of 84) had higher frequency values on the basis of the larger database (n=84, V>v=88.1%, Z=6.87, p<0.000001) and this resulted lower LF scores for 34 of them (n=34, V>v=100 %, Z=5.66, p<0.000001).

Table 1a. MRI scores, global distribution ranges and conservation status of the prosobranchia occurring in Hungary. Taxa of unclear taxonomic position were indicated by a question mark in front of their name. In the cases of invasive species, the non-indigenous distribution was indicated in brackets. For more explanations see below Table 1c.

Taxon	**Distribution**	**Conserva-tion Notes**	**RS**	**LF**	**SF_1**	**SF_2**	**SF_3**	**MRI**
Theodoxus (*Theodoxus*) *fluviatilis fluviatilis* (LINNAEUS 1758) [1]	European	I/+	1	4	-	-	-1	4
Theodoxus (*Theodoxus*) *transversalis* (C. PFEIFFER 1828) [2]	Danubial	E, P, A II.	3	3	-	-	+2	8
Theodoxus (*Theodoxus*) *danubialis* (C. PFEIFFER 1828) [3]	SE European	R, P	2	3	-	-	+2	7
Theodoxus (*Theodoxus*) *danubialis stragulatus* (C. PFEIFFER 1828) [4]	Northern Illyric	E-R, P	4	5	-	-	-	9
Theodoxus (*Theodoxus*) *prevostianus* (C. PFEIFFER 1828) [5]	Pannonian	CE, P	3	5	+1	+1	-	10
Viviparus contectus (MILLET 1813)	European	F	1	2	-	-	-	3
Viviparus acerosus acerosus (BOURGUIGNAT 1862)	Danubial	F	3	2	-	-	-	5
Melanoides tuberculatus (O. F. MÜLLER 1774)	Pantropical	I/0	1	4	-	-	-	5
Melanopsis parreyssii (PHILIPPI 1847) [6]	Pannonian	I/0 (CE)	4	5	+1	-	-	10
Esperiana (*Fagotia*) *esperi* (A. FÉRUSSAC 1823)	Pontic	F, P	2	4	-	-	-	6
Esperiana (*Microcolpia*) *daudebartii daudebartii* (PREVOST 1821) [7]	Pannonian	R, P	3	5	-	+1	-	9
? Esperiana (*Microcolpia*) *daudebartii acicularis* (A. FÉRUSSAC 1823) [8]	Pontic	R-F, P	2	3	-	-	+1	6
Amphimelania holandrii (C. PFEIFFER 1828) [9]	Illyric	R, P	3	4	-	-	+1	8
Bithynia (*Bithynia*) *tentaculata* (LINNAEUS 1758)	Palearctic	F	1	1	-	-	-	2
Bithynia (*Codiella*) *leachii* (SHEPPARD 1823)	Palearctic	F	1	3	-	-	-	4
Bithynia (*Codiella*) *troschelii* (PAASCH 1842) [10]	E Central Europe to E Europe	F	2	3	-	-	-	5
Potamopyrgus antipodarum (J. E. GRAY 1843) [11]	New Zealander (Cosmopolitan)	I/+	1	3	-	-	-1	3
Bythiospeum oshanovae (L. PINTÉR 1968) [12]	Pannonian	E-R	4	5	+2	-	-	11
Bythiospeum hungaricum (SOÓS 1927) [13]	Pannonian	R, P, A II.	4	5	+2	-	-	11
Sadleriana pannonica (FRAUENFELD 1865) [14]	N Carpathian	R, P, A II.	4	4	+1	-	-	9
Lithoglyphus naticoides (C. PFEIFFER 1828)	Pontic - Danubial	F	2	2	-	-	-	4
Bythinella austriaca austriaca (FRAUENFELD 1857) [15]	East Alpine - Carpathian	R	2	4	-	-	-	6
? Bythinella austriaca hungarica HAZAY 1881 [16]	Pannonian	CE	4	5	+2	-	-	11
Valvata (*Valvata*) *cristata* O. F. MÜLLER 1774	Palearctic	F	1	2	-	-	-	3
Valvata (*Tropidina*) *macrostoma* MÖRCH 1864 [17]	Euro-Siberian	E (?)	1	4	-	-	+1	6
Valvata (*Cincinna*) *piscinalis piscinalis* (O. F. MÜLLER 1774)	Palearctic	F	1	2	-	-	-	3
Borysthenia naticina (MENKE 1845) [18]	Pontic - Balthic	R, P	2	3	-	-	+1	6

Table 1b. MRI scores, global distribution ranges and conservation status of the freshwater pulmonates occurring in Hungary.

Taxon	**Distribution**	**Conservation Notes**	**RS**	**LF**	**SF$_1$**	**SF$_2$**	**SF$_3$**	**MRI**
Acroloxus lacustris (LINNAEUS 1758)	Euro-Siberian	R-F	1	2	-	-	-	3
Galba truncatula (O. F. MÜLLER 1774)	Holarctic	F	1	1	-	-	-	2
Stagnicola palustris complex: *S. turricula* (HELD 1836), *S. fuscus* (C. PFEIFFER 1821), *S. corvus* (GMELIN 1791) [19]	Palearctic	F	1	1	-	-	-	2
Radix auricularia auricularia (LINNAEUS, 1758)	Palearctic	F	1	2	-	-	-	3
Radix labiata complex: *R. labiata* (ROSSMÄSSLER 1835), *R. balthica* (LINNAEUS 1758), *R. ampla* (W. HARTMANN 1821) [20]	Palearctic	F	1	1	-	-	-	2
Lymnaea stagnalis (LINNAEUS 1758)	Holarctic	F	1	1	-	-	-	2
Pseudosuccinea columella (SAY 1817)	North American	I/0	1	5	-	-	-	6
Physa fontinalis (LINNAEUS 1758) [21]	Holarctic	R	1	3	-	-	+1	5
Physella (*Costatella*) *acuta* (DRAPARNAUD 1805) [22]	S+W European (European)	I/+	1	2	-	-	-	3
Aplexa hypnorum (LINNAEUS 1758) [23]	Holarctic	R	1	3	-	-	+1	5
Planorbarius corneus corneus (LINNAEUS, 1758)	Euro-Siberian	F	1	1	-	-	-	2
Planorbella duryi (WETHERBY 1879) [24]	North American	I/0	1	5	-	-	-	6
Planorbella nigricans (SPIX 1827) [25]	South American	I/0	1	5	-	-	-	6
Ferrissia (*Pettancylus*) *clessiniana* (JICKELI 1882) [26]	European	I/+	1	3	-	-	-	4
Planorbis (*Planorbis*) *planorbis* (LINNAEUS 1758)	Holarctic	F	1	1	-	-	-	2
Planorbis (*Planorbis*) *carinatus* O. F. MÜLLER 1774 [27]	European	E	1	4	-	-	+1	6
Anisus (*Anisus*) *spirorbis* (LINNAEUS 1758) [28]	Palearctic	R-F	1	1	-	-	-	2
Anisus (*Anisus*) *leucostoma* (MILLET 1813) [29]	Palearctic	E	1	4	-	-	+1	6
Anisus (*Anisus*) *calculiformis* (SANDBERGER 1874) [30]	East European	E	2	3	-	-	-	5
Anisus (*Disculifer*) *vortex* (LINNAEUS 1758)	Euro-Siberian	F	1	3	-	-	-	4
Anisus (*Disculifer*) *vorticulus* (TROSCHEL 1834)	Central and East European	R, A II.	2	3	-	-	-	5
Bathyomphalus contortus (LINNAEUS 1758) [31]	Palearctic	R	1	3	-	-	+1	5
Gyraulus (*Gyraulus*) *albus* (O. F. MÜLLER 1774)	Holarctic	F	1	2	-	-	-	3
Gyraulus (*Torquis*) *laevis* (ALDER 1838) [32]	Holarctic	E (?)	1	3	-	-	+2	6
Gyraulus (*Torquis*) *parvus* (SAY 1817) [33]	North American (European)	I/-	1	3	-	-	-	4
Gyraulus (*Armiger*) *crista* (LINNAEUS 1758)	European	F	1	2	-	-	-	3
Gyraulus (*Lamorbis*) *riparius* (WESTERLUND 1865) [34]	N-E European	E	2	5	-	-	-	7
Gyraulus (*Lamorbis*) *rossmaessleri* (AUERSWALD 1852) [35]	Central and East European	E-R	2	5	-	-	-	7
Hippeutis complanatus (LINNAEUS 1758)	European - West Asian	F	1	3	-	-	-	4
Segmentina nitida (O. F. MÜLLER 1774)	Palearctic	F	1	2	-	-	-	3
Ancylus fluviatilis O. F. MÜLLER 1774	European	F	1	3	-	-	-	4
Hebetancylus excentricus (MORELET 1851) [36]	Middle American	I/0	1	5	-	-	-	6

CE: critically endangered taxa that occur only in a few, endangered biotopes, without dispersal ability; **E**: taxa that are endangered, very rare or getting rarer rapidly, without dispersal ability; **R**: taxa that are rare or getting rarer, occurring in vulnerable biotopes, with limited dispersal ability; **F**: not rare, frequent or common taxa, with good dispersal ability; **I/0**: introduced taxa, not able to disperse spontaneously; **I/+**: non-indigenous taxa that are able to disperse, but do not cause apparent damage to the indigenous mollusc fauna; **I/-**: invasive non-indigenous taxa, competitor of some indigenous mollusc species; **I/--**: taxa like in the former category which deteriorate the habitat as well. **P**: protected in Hungary, **A II.**: Listed by the Annex II of the European Habitats and Species Directive (Council of Europe 1992). **MRI**: Mollusc Rarity Index, **RS**: range size, **LF**: local frequency, **SF**: special factors. **MRI**=RS+LF+SF$_1$+SF$_2$+SF$_3$.

Table 1c. MRI scores, global distribution ranges and conservation status of the freshwater bivalves occurring in Hungary.

Taxon	**Distribution**	**Conservation Notes**	**RS**	**LF**	**SF$_1$**	**SF$_2$**	**SF$_3$**	**MRI**
Unio (*Unio*) *pictorum* (LINNAEUS 1758) [37]	European	F	1	2	-	+1	-	4
Unio (*Unio*) *tumidus* PHILIPSSON 1788	European	F	1	2	-	+1	-	4
Unio (*Crassunio*) *crassus* PHILIPSSON 1788	European	R-F, P, A II.	1	3	-	+1	-	5
Anodonta (Anodonta) cygnea (LINNAEUS 1758) [38]	Euro-Siberian	F	1	3	-	-	-	4
? Anodonta (Anodonta) anatina (LINNAEUS 1758)	Euro-Siberian	F	1	3	-	-	-	4
Sinanodonta woodiana (LEA 1834) [39]	E Asian (Europe, Middle America)	I/-	1	3	-	-	-2	2
Pseudanodonta complanata (ROSSMÄSSLER 1835) [40]	Central and North European	E-R, P	2	3	-	-	+1	6
Corbicula fluminea (O. F. MÜLLER 1774) [41]	South-East Asian (Cosmopolitan)	I/-	1	4	-	-	-2	3
Corbicula fluminalis (O. F. MÜLLER 1774) [42]	S-W Asian (Europe, North America)	I/-	1	5	-	-	-2	4
Sphaerium (*Sphaerium*) *corneum* (LINNAEUS 1758)	Holarctic	F	1	2	-	-	-	3
Sphaerium (*Nucleocyclas*) *nucleus* (S. STUDER 1820) [43]	North and Central European	R (?)	2	4 (?)	-	-	-	6
Sphaerium (*Amesoda*) *rivicola* (LAMERCK 1818) [44]	Central and East European	R	2	3	-	-	+1	6
Sphaerium (Cyrenastrum) solidum (NORMAND 1844)[45]	Central and East European	R	2	5	-	-	-	7
Musculium (*Musculium*) *lacustre* (O. F. MÜLLER 1774)	Palearctic	F	1	3	-	-	-	4
Pisidium (*Pisidium*) *amnicum* (O. F. MÜLLER 1774) [46]	Palearctic	R	1	3	-	-	+1	5
Pisidium (*Euglesa*) *casertanum* (POLI 1791)	Cosmopolitan	F	1	2	-	-	-	3
Pisidium (*Euglesa*) *personatum* MALM 1855	Euro-Siberian, North African	F	1	3	-	-	-	4
Pisidium (*Cyclocalyx*) *obtusale* (LAMARCK 1818)	Holarctic	R	1	4	-	-	-	5
Pisidium (*Tropidocyclas*) *henslowanum* (SHEPPARD 1823)	Palearctic	F	1	3	-	-	-	4
Pisidium (*Tropidocyclas*) *supinum* A. SCHMIDT 1851	Euro-Siberian	F	1	3	-	-	-	4
Pisidium (*Cingulipisidium*) *nitidum* JENYNS 1832	Holarctic	F	1	3	-	-	-	4
Pisidium (*Cingulipisidium*) *pseudosphaerium* J. FAVRE 1927	Central and West European	E	2	4	-	-	-	6
Pisidium (*Cingulipisidium*) *milium* HELD 1836	Holarctic	R	1	4	-	-	-	5
Pisidium (*Pseudeupera*) *subtruncatum* MALM 1855	Holarctic	F	1	3	-	-	-	4
Pisidium (*Pseudeupera*) *pulchellum* JENYNS 1832 [47]	Palearctic	E (?)	1	5	-	-	-	6
Pisidium (*Odhneripisidium*) *tenuilineatum* STELFOX 1918 [48]	Central and East European	E (?)	2	5	-	-	-	7
Pisidium (*Odhneripisidium*) *moitessierianum* PALADILHE 1866	European	F	1	4	-	-	-	5
Dreissena (*Dreissena*) *polymorpha polymorpha* (PALLAS 1771) [49]	Pontic (Europe, North America)	I/--	1	3	-	-	-2	2

Notes to Table 1.

(1) A non-indigenous species. First Hungarian records are from the River Tisza (HORVÁTH 1955). Later, it has appeared in the River Danube (first record in the HNHM CT57 Budapest: Római-part, leg. ERŐSS 1981.) and in the River Körös (LENNERT 1997) too. SF$_3$ is added because it is still spreading and it will probably be dispersed along the whole Hungarian section of the Danube soon, thus present collection data underestimate its frequency.

(2) A disappearing species, only a few existing populations have recently been observed in the River Tisza, River Bódva, River Rába and River Hernád (VARGA & CSÁNYI 1998). Disappeared from the Danube almost entirely, thus collection data, dating from the past decades, overestimate its present frequency.

(3) A disappearing species, collection data most probably overestimate its present frequency.

(4) In Hungary this form lives in the River Zala, River Kerka and River Mura (SOÓS 1943).

(5) This is a relict species, inhabiting thermal springs and lakes. The majority of the former Hungarian populations (SOÓS 1943) have already become extinct, and there are only a few certainly known populations in the World (Hungary: Kács and (possibly) Miskolctapolca; Austria: Bad Vöslau and Bad Fischau; Romania: Rabagani (=Robogány)). Due to its sporadic distribution, the range size overestimates its global frequency. Hungarian population(s) has a significant role in the global conservation of the species.

(6) A relict species, indigenous only to the thermal lake of Baile 1 Mai (= Püspökfürdőó, Bischofsbad) near Oradea, Romania. The species is critically endangered, since the lake is threatened by water pollution and habitat destruction. Although its locus typicus is given as "Hungaria", this refers to the above mentioned locality, which belonged to Hungary at the time of description. Other Hungarian data refer to its introduction to Budapest: Malom-tó, and its occurrence in the fluvial drift of the River Körös (e. g. PINTÉR & al. 1979). Despite it is an introduced species, SF_1 score was added, because it is possible that some people are going to make an attempt to introduce this species to Hungary again. If some of these colonies were established, they could play a significant role in the conservation of the species.

(7) This species is generally known as *Fagotia acicularis* in the Hungarian literature (SOÓS 1943, RICHNOVSZKY & PINTÉR 1979), and the same genus name is used by the CLECOM too. GLAUBRECHT (1996), however believes, that *Esperiana* is the valid genus name, and the *Fagotia* is the junior synonym of that. According to the CLECOM, both the nominate form and the subspecies *thermalis* (BROT, 1868) occur only in thermal waters; the former one in Austria, the latter one in Hungary. However SOÓS (1943) does not see the sense of such separation and treats them together as *F. acicularis audebardii*. The subspecific distinction is questionable even between the fluviatile and the thermal forms. However, if they are separated, *daudebartii* needs correction (SF_2), due to its sporadic occurrence.

(8) The fluviatile form of the species is considered as a separate subspecies by the CLECOM. This form is known in the Hungarian literature (SOÓS 1943, RICHNOVSZKY & PINTÉR 1979) as *Fagotia acicularis.* It can generally be found together with the other *Esperiana* species in the River Danube, but its frequency decreased recently in a large extent compared to *E. esperi*.

(9) A rare and vulnerable species. In Hungary it still lives in the River Kerka and River Dráva, however it seems to be disappeared from the River Zala. Collection data, dating from the past decades, overestimates its present frequency.

(10) There is no general agreement regarding the valid name of this taxon. Although it is mentioned by the CLECOM as *B. transsilvanica* (E. A. BIELZ, 1853), GLÖER's (2002b, 2004) arguments seem to be convincing to use the name *troschelii*. Since this taxon was treated by RICHNOVSZKY & PINTÉR (1979) as a simple size variation of *B. leachii,* the two species had generally not been distinguished in the Hungarian literature up to the present.

(11) An introduced species. In the Hungarian literature its synonym, *P. jenkinsi* (E. A. SMITH, 1889) is generally used (e. g. PINTÉR 1984). It is probably more wide-spread, than it is estimated by the collection data.

(12) This species inhabits the subterranean part of underwater springs. To our present knowledge, its whole global stand lives in the Szigetköz area within a restricted range. It was found in the drift of the River Danube in several localities (CT39 Esztergom: Duna, leg. L. PINTÉR 1965.; Esztergom: Prímás-sz., Duna, leg. MAJOROS 1986.; XN99: Vámosszabadi: Duna, 1805. str. km, leg. MAJOROS 1994.; XP61 Rajka: Duna, 1850. str. km, leg. MAJOROS 1994.; Rajka: Ördög-sz., Duna, leg. MAJOROS 1993.; Rajka: Jónás-sz., Duna, leg. MAJOROS 1993.; XP71 Dunakiliti: Helénai-sz., Duna, leg. MAJOROS 1993.), but due to its inaccessible habitats, live specimens were found only in a single site till now (XP81 Kisbodak, leg. MAJOROS & FEHÉR 1999.). Empty but fresh shells, found in other sites, indicate, that this species most probably inhabits other springs too. Its relationship with other *Bythiospeum* forms – e. g. with *B. geyeri* (FUCHS, 1925) occurring in the Vienna Basin – is unclear and deserves further studies.

(13) This species is endemic to the karst area of the Mecsek Mountains, thus the whole global stand lives within a restricted range. Although the CLECOM mentions *Bythiospeum gebhardti* (H. WAGNER, 1931) as a separate species, it is only a synonym for *B. hungaricum*. L. PINTÉR (1968) has shown, that there is no significant morphological difference between the specimens found in the Mánfa-cave (locus typicus of *gebhardti*) and in the Abaliget-cave (locus typicus of the *hungaricum*). Moreover, these sites are not even isolated, since their connection through the subterranean water system was proved.

(14) This species can be found in North-East Hungary, in two patches; in the Bükk Mountains and in the Gömör-Torna Karst. The latter distribution area extends to Slovakia, in our estimation (cf. DOMOKOS 1992, SZABÓ 1984, PINTÉR & al. 1979, LISICKY 1991, FEHÉR & GUBÁNYI 2001) 70-80% of the global stand lives in Hungary and the rest in Slovakia.

(15) Despite it is a well-known species which occurs in several localities of the Zemplén, Bükk, Mátra, Cserhát, Börzsöny, and Pilis Mountains (SOÓS 1943, RICHNOVSZKY & PINTÉR 1979, PINTÉR & al. 1979, DOMOKOS 1996), it is not mentioned from Hungary by the CLECOM.

(16) This taxon has been described from "a spring in the plain, somewhere in the outparts of Budapest" (HAZAY, 1881). This locality has recently been rediscovered by PETRÓ (1984a). The whole stand, living in some little springs within a restricted range, is threatened by habitat destruction. Although this form is mentioned by the CLECOM as *B. hungarica*, this is not a distinct species. SOÓS (1943) believes that this is a subspecies of *B. austriaca*, however regarding the large morphological variability of other Hungarian *B. austriaca* populations, even the subspecific distinction is questionable.

(17) In the Hungarian literature its synonym, *V. pulchella* STUDER, 1820 is generally used (e. g. RICHNOVSZKY & PINTÉR 1979, PINTÉR 1984). If occurs, it is very rare in Hungary, since collection and literature data refer mostly to subfossil occurrences, and to empty shells, which were drifted by the River Danube, possibly from long distances.

(18) Occurrence data are based partly on empty shells. Although one would think that it is a relatively wide-spread species, live specimens can rarely be found.

(19) According to PINTÉR (1984), Hungarian malacologists have not distinguished *Stagnicola* forms from each other, thus there are no information about their individual distribution and frequency at the moment. Until a revision is done, the name *palustris*-complex is used for this group. CLECOM mentions only *S. turricula, S. fuscus* and *S. corvus*, it is possible that *S. palustris* also occurs in Hungary.

(20) In the Hungarian literature *Lymnaea peregra* (O. F. MÜLLER, 1774) is generally used for *R. labiata*, and the other two taxa is considered as variations of that (*Lymnaea peregra* var. *ovata* (DRAPARNAUD, 1805)=*R. balthica* and *Lymnaea peregra* var. *ampla* (HARTMANN, 1821)=*R. ampla*) (e. g. RICHNOVSZKY & PINTÉR 1979). The three forms have rarely been distinguished by Hungarian authors, and therefore collection materials and faunistical papers give poor data on their distribution. Until a general revision is done, the three forms are treated as *R. labiata*-complex.

(21) A disappearing species. Its present frequency is most probably lower than as it is suggested by the collection data.

(22) This species first appeared in Hungary in 1926 (see: SOÓS 1943), and became wide-spread by now. It seems to have a significant invasive potential, in polysaprobic habitats (e.g. DT19 Gyöngyös: sewage works) dramatic fluctuations of the population size can be observed occassionally. Although the CLECOM as well as the Hungarian literature (e.g. RICHNOVSZKY & PINTÉR 1979) mentions *P. heterostropha* as a separate species, according to DILLON & al. (2002) and TAYLOR (2003), they are treated here as synonyms. The species is listed under its widely used genus name, in spite of that TAYLOR (2003) suggests to use a new genus name, *Haitia.*

(23) Although distribution data may suggest that it is relatively wide-spread, it can be found in small quantities in most of the sites. This seemed to justify the correction of the frequency score.

(24) An introduced species. Most probably each record of an another species, *P. trivolvis* (SAY, 1817) in the Hungarian literature (e. g. KOVÁCS 1979), refer to this species too (see: DOMOKOS 1992, PINTÉR 1984).

(25) An introduced species, not mentioned by the CLECOM from Europe. DOMOKOS (1992) indicated that this species has probably settled in Hungary under natural conditions. Known localities: CT56 Budapest: Zoo; Budapest: Margitsziget, Japánkert. leg. MAJOROS 1981.; DU50 Eger: Public Bath, leg. DOMOKOS 1990.; ES06 Békéscsaba: Jókai út, leg. DOMOKOS 1977.; leg. KOVÁCS 1979.

(26) This species is most probably not indigenous in Hungary. Its first record is from the 60s' (I. PINTÉR 1968), and it seems to keep spreading. By now, it has been found in numerous locations, mostly in warm, still, eutrophic waters. The CLECOM uses the name *F. clessiniana* (JICKELI, 1882) as a synonym for this species. This is based on the opinion of FALKNER & V. PROSCHWITZ (1995), however, other authors (e. g. GLÖER 2002a) find their arguments unconvincing to replace the established name *F. wautieri*.

(27) This species belongs to the rarest freshwater molluscs in Hungary. A part of its occurrence data is due to misidentification.

(28) According to the collection data, this is the most frequent freshwater mollusc in Hungary. However, in the past decade, decreasing stands of this species were observed in several locations.

(29) At the moment, there is no general agreement regarding the valid name of this taxon. This species is mentioned by the CLECOM as *A. septemgyratus* (ROSSMÄSSLER, 1835) based on the findings of FALKNER & al. (2002), but others (e. g. GLÖER 2002a) do not accept their arguments, and nominate the species as *A. leucostoma*. Without taking side in the nomenclatural argumentation, the name *A. leucostoma* was used according to the practice in the Hungarian literature (e. g. PINTÉR 1984) and to avoid confusing this species with *A. calculiformis* (see note 30.). This species belongs to the rarest freshwater molluscs in Hungary, it is restricted most likely to some alder-marshes in the Bükk Mountains, while other occurrence data are probably due to subfossil occurrences or misidentification.

(30) In the Hungarian literature (e. g. PINTÉR 1984, RICHNOVSZKY & PINTÉR 1979) its synonym, *A. septemgyratus* (ROSSMÄSSLER, 1835) is generally used.

(31) Although collection data suggest that it is not a rare species in Hungary, during our field work we got the impression, that its frequency has begun to decrease in the past decade (e. g. during the long-term monitoring project of the Kis-Balaton, it was found to disappear gradually, and in the final 4-5 years it has not been found at all).

(32) Although *G. laevis* is indicated in the literature (e. g. RICHNOVSZKY & PINTÉR 1979) as a frequent species, but the "real" *laevis* seems to disappear nowadays. Its populations were either hybridized with or displaced by a non-indigenous North American species, *G. parvus*. *G. parvus* is similar to *G. laevis* in shell morphology, therefore its appearance remained inconspicuous for a while. By now, *parvus* has already became wide-spread. In the recent few years, several series of specimens from various populations were examined anatomically (see: MEIER-BROOK 1983), but not any population, which is apparently *G. laevis,* was detected. The relationship of the two species in Hungary deserves further study.

(33) See note 32.

(34) This species is not mentioned by the CLECOM from Hungary, despite it was reported by MAJOROS (1987) (CT00 Soponya: a fish-pond near the village leg. MAJOROS 1984., 1985.; CT10 between Sárkeresztúr and Kálóz: Sárvíz, drift, leg. MAJOROS 1985.; CT77: Gödöllő: Juharos-hegy, alder forest, leg. MAJOROS 1985.). Since then, other occurrences were also found: XM69 Vindornyaszőlős: Berek, leg. I. PINTÉR 1972.; XN89 Novákpuszta: alder forest, leg. MAJOROS 1992., 1993., 1994., 1995., 1996., 1997.; XP70 Arak: Nagy-Kerek, alder forest, leg. MAJOROS 1994., 1995.; XP80 Lipót: Lipóti-csatorna leg. MAJOROS 1991. It is notable, that in some of these sites, only empty shells were collected, live specimens could only be found in the Szigetköz area (XN89, XP70, XP80) up to the present.

(35) The Hungarian occurrence of this species has not been published till now, and therefore it has not been mentioned by the CLECOM. Localities: DU76 Perkupa: Bódva, drift, leg. VARGA 1998.; Perkupa: a swamp, NE of the village, along the road to Dobódél, leg. VARGA 2003.; DU87 Tor-

naszentjakab: a swamp, W of the village, near the Sas-patak, leg. VARGA 1996., 2003.; XN99 Vámosszabadi: Duna, drift, leg. MAJOROS 1994.).

(36) This is an introduced species, not mentioned by the CLECOM from Europe. Its occurrence under natural conditions in Hungary was reported by DOMOKOS (1992) (DU82 Miskolc: Miskolctapolca, Tündérrózsás-tó, leg. KOVÁCS 1979., leg. DOMOKOS 1980.).

(37) CLECOM mentions Central European *Unio* subspecies from Hungary, namely *U. pictorum latirostris* KÜSTER, 1853, *U. pictorum tisianus* NESEMANN, 1993, *U. tumidus zelebori* ZELEBOR, 1851, *U. crassus cytherea* KÜSTER, 1836, *U. crassus ondovensis* HAZAY, 1885, *U. crassus albensis* HAZAY, 1885. Although PINTÉR (1984) or RICHNOVSZKY & PINTÉR (1979) do not see the sense of distinguishing subspecies of these species, if we accept the view, that the forms occurring in Hungary has a more restricted distribution area than the whole species, the range size corrections seem to be justified.

(38) This species spreads due to fish-farming activities, and it has already appeared in numerous fish-ponds. CLECOM mentions Central European *Anodonta* subspecies from Hungary, namely *A. anatina attenuata* HELD, 1836 and *A. cygnea solearis* HELD, 1839. PINTÉR (1984) or RICHNOVSZKY & PINTÉR (1979) do not see the sense of distinguishing subspecies of these species. Moreover, even the clear separation of *A. anatina* and *A. cygnea* seems problematic (VARGA & al. 1998-99): examining large series of specimens from the same locality, only one of the forms can generally be detected among the live specimens at the same time, however shells of both forms can frequently be found in the deposit. This finding gives the impression, that shell morphology is largely influenced by environmental factors, and seem to support the opinion of SOÓS (1943) and HAAS (1969) who believed that *anatina* is not an identical species but belongs to *cygnea*.

(39) This species appeared in Hungary about 20 years ago (PETRÓ 1984b). Since then, it has dispersed rapidly in various aquatic biotopes: in the main rivers and lakes as well as in minor fishponds or irrigation canals. Further spreading is expected. Its frequency is largely underestimated by the collection data.

(40) The stands of this species are decreasing, e. g. it has disappeared entirely from the Lake Balaton. Its present frequency is over-estimated by the collection data (VARGA & al. 1998-99).

(41) This species has only recently appeared in the Hungarian section of the River Danube (CSÁNYI 1998-99, VARGA & UHERKOVICH 2002), and therefore has not been mentioned by the CLECOM from Hungary. The increase in the number of occurrences, between 1998 and 2003, indicates the speed of its dispersion. Localities: CR29 Mohács: Duna, 1440. str. km, leg. CSÁNYI 1999.; CS31 Baja: flood area in the right bank of the Duna, leg. UHERKOVICH 1998.; Baja: Duna, 1483. str. km, leg. CSÁNYI 1999.; CS33 Bogyiszló: Duna, boat-harbour, leg. VARGA 2000.; CS34 Fajsz – Domboripuszta: Duna 1507. str. km, leg. CSÁNYI 1999.; Dombori-üdülőtelep: Duna, ferry boat harbour, leg. VARGA 2000.; CS35 Uszód: Duna, 1523.5 str. km, leg. CSÁNYI 1999.; Gerjen – Meszes: Duna, 1516. str. km, leg. CSÁNYI 1999.; Gerjen: Duna, ferry boat harbour, leg. UHERKOVICH 2000.; CS36 Paks: Duna, down from the nuclear power plant, leg. CSÁNYI 1999.; Paks: Duna, over the outflow of the nuclear power plant, leg. FEHÉR & KONTSCHÁN 2003.; CT09 Süttő: Duna, boat-harbour, 1744 str. km, leg. JUHÁSZ & BÉKÉSI 2001.; CT29 Tát: Kőgát, Duna, leg. RAYMANN 2003.; CT39 Szob: Hideg-rét, Duna 1707.5 str. km, leg. KOVÁCS & JUHÁSZ 2003.; Pilismarót: Duna, 1709.2 str. km, leg. KOVÁCS & TÓTH 2003.; Esztergom: Duna, Prímási-sz., leg. RAYMANN 2003.; CT40 Dunaújváros: Dunaferr Ironworks III. pump-station, leg. SZÉKELY 2002.; CT49 Zebegény: Duna, harbour, 1703.7 str. km, leg. KOVÁCS & JUHÁSZ 2002.; Zebegény: Duna at the inflow of Bőszobi-patak, 1704.3 str. km, leg. KOVÁCS 2003.; Nagymaros: Duna, leg. FEHÉR, GLÖER & JUEG 2003.; Pilismarót: Duna, ferry station, leg. RAYMANN 2003.; Visegrád: Duna, at the inflow of Lepence-p., leg. RAYMANN 2003.; Dömös: Duna, river-harbour, leg. RAYMANN 2003.; CT56 Budapest: Duna, Árpád-híd, leg. RAYMANN 2003.; CT57 Budapest: Palotai-sz., Duna, leg. HUNYADI 2003.; CT58 Leányfalu: Duna, river-harbour, leg. RAYMANN 2003.; Szentendre: Duna, leg. RAYMANN 2003.; Horány: Szürkő-sz., Duna, leg. RAYMANN 2003.; Dunakeszi: 1 km N of the ferry boat harbour, Duna, leg. HUNYADI 2003.; Alsógőd: Duna, leg. ERŐSS 2003.; CT59 Kismaros: Morgó-patak, leg. KOVÁCS & JUHÁSZ 2003.; Kismaros: Duna, 1689. str. km, leg. KOVÁCS & JUHÁSZ 2003.; Vác: Duna, river-harbour, leg. RAYMANN 2003.; Tahitótfalu: Duna, ferry-boat sta-

tion, leg. RAYMANN 2003.; CU30 Ipolydamásd: Ipoly, at the former border-station, leg. JUHÁSZ & VARGA 2003.

(42) This species has recently appeared in the Hungarian section of the River Danube (CSÁNYI 1998-99, VARGA & UHERKOVICH 2002), and therefore has not been mentioned by the CLECOM from Hungary. Down from Budapest, it was found in each sites together with *C. fluminea*, but generally, in lower abundance (UTM grid cells CS31, CS33, CS34, CS36, CT40, see note 41.). Up to the present it has not been found over Budapest.

(43) This form has been considered by Hungarian authors (e. g. RICHNOVSZKY & PINTÉR 1979) as a morphological variation of *S. corneum*, therefore there are no exact data about its distribution and frequency in Hungary. Recently, KORNIUSHIN (1994, 2001) has shown that this is a separate species. Until the revision of Hungarian material is done, in anticipation an estimated LF score (4) is given to this species.

(44) In the River Danube, its stands decreased in a large extent, therefore its present frequency is over-estimated by the collection data.

(45) This species has recently appeared in the Hungary (VARGA & JUHÁSZ 2002), and therefore has not been mentioned by the CLECOM from Hungary. Localities: CT09 Süttő: Duna, boat-harbour, 1744. str. km, leg. BÉKÉSI & JUHÁSZ 2001.; CT39 Szob: Hideg-rét, Duna, 1707.5 str. km, leg. JUHÁSZ & KOVÁCS 2002.; Pilismarót: Sas-hegy, Duna, 1709.7 str. km, leg. KOVÁCS & TÓTH 2003.; Pilismarót: Duna, ferry-boat station, leg. RAYMANN 2003.; CT49 Zebegény: Duna, ferry boat harbour, 1703.7 str. km, leg. JUHÁSZ & KOVÁCS 2002.; CU30 Ipolydamásd: Ipoly, at the former border-station, leg. KOVÁCS & VARGA 2003.; Ipolydamásd: Ipoly, N of the village, leg. FEHÉR, GLÖER & JUEG 2003.

(46) This species is disappearing recently, therefore collection data over-estimates its present frequency.

(47) This species is not mentioned by the CLECOM from Hungary and its presence is really doubtful (PETRÓ & PÓNYI 1991). Although this species is represented by one single shell in the collection of the HNHM (YM09 Balatonakali: Balaton, drift, leg. I. PINTÉR 1968.) (see FEHÉR & GUBÁNYI 2001), this is most probably of subfossil origin.

(48) Despite this species is mentioned by RICHNOVSZKY & PINTÉR (1979) from Hungary: XN92 Kislőd: Torna-patak; XM78 Vonyarcvashegy: Örzse-kút, its recent occurrence is questionable.

(49) An invasive species, appeared in Hungary at the end of the XVIIIth century (RICHNOVSZKY & PINTÉR 1979). Since then, it has dispersed not only in the natural aquatic ecosystems, but in artificial irrigation canals too. Collection data most probably underestimates its frequency.

Discussion

In the present study a wider MRI range was set for freshwater molluscs than in the study of SÓLYMOS (2004) for terrestrial ones. The highest MRI score (11) was given to three – one of them is of unclear systematic position – Pannonian endemic Hydrobiid taxa, which occur within very restricted ranges, and are known only from one, or a few localities. *Theodoxus prevostianus,* a species with only a few known populations dispersed within a larger range, got a lower score (10). This is equal to the highest score in the SÓLYMOS' system (2004), which has been given for the rarest terrestrial mollusc, *Kovacsia kovacsi* (PINTÉR & VARGA, 1972). Considering the difference between the distribution ranges and the population densities of the rarest terrestrial and the rarest aquatic taxa, it seems reasonable to set a higher upper bound for the freshwater molluscs' MRI range.

Twenty-seven indigenous taxa were ranked within the range between 6 and 11, and were therefore, considered to be rare according to the quartile definition of rarity (GASTON 1994, WILLIAMS & al. 1996). On the one hand, except for *Unio crassus*, every freshwater mollusc species, protected in Hungary, got an MRI score higher than or equal to 6, but it is worthy of note, that two of the five species listed in the Annex II. of the European Habitats and Species Directive (Council of Europe 1992) got an MRI score below 6 (*Anisus vorticulus, U. crassus*). On the other hand, there are numerous taxa – for example, *Bythiospeum oshanovae, Bythinella austriaca, Valvata macrostoma, Planorbis carinatus, Anisus leucostoma, Gyraulus riparius, Gyraulus rossmaessleri, Sphaerium solidum, Sphaerium rivicola,* and *Pisidium pseudosphaerium* – in the rarest upper quartile which are not yet protected in Hungary. In the course of setting further conservation priorities in Hungary, the designation of these species for protection is worth considering.

HNHM and MMGY has the two largest mollusc collections in Hungary, with approximately 45-45000 freshwater and terrestrial mollusc lots from Hungary, but they represent the main geographical regions in different proportions. For example, in the collection of the MMGY, 31% of the lots is from the Northern Mountains, while this rate is only 17% in the HNHM, in contrast, the representation of the Transdanubian Mountains is 15% in the collection of the MMGY, and 34% in the collection of the HNHM. The two databases were found to differ in a large extent, even if the basic data were converted into species-in-grid-cell records. MMGY database consists of 12265 (4788 of them are freshwater) records, HNHM database consists of 13156 (3989 freshwater) records, but only 5521 (1670 freshwater) of them overlap, thus the transformation into species-in-grid-cell records could not negotiate the difference arising from the different geographical representation. In spite of this, species' frequencies, derived from the two different dababases, correlated positively and LF scores were found to be the same for most of the species (fig. 1a).

Effect of the increasing faunistical exploration – i. e. the growing database – was modelled by comparing the species' frequencies and the LF scores derived only from the data of the HNHM with those derived from the whole database. The whole database consisted of 8117 species-in-grid-cell records of freshwater species (23263 records altogether), roughly two times more than the HNHM database, while the increase in the number of the explored grid cells was only 28.5% (648 vs. 833). Therefore, the average species-per-grid-cells rate (i.e. the "exploration of the explored grid cells") was higher for the whole database, and this explains why did the increase in the size of the basic data-set result in higher frequencies for most of the species (Fig. 1b). Thus, deficient basic data seemed to result negative bias for most of the species, but it is worthy of note, that in the cases of some very well explored species, where the increase in the total number of the explored cells did not entail the increase of the known occurrences, the use of the larger database gave lower species' frequencies. Due to the very strong relationship between the two databases, species were arranged in a similar order by their rarity. In this relationship the smaller database functions as a sample – in statistical sense – of the larger database and in this sense, our "whole" database is also a sample of the whole fauna. We can conclude, that further increase in the exploration status of the fauna – even our "whole" database represents a poorly explored status – is going to result further changes in the calculated frequency rates and LF scores. However, if there are no systematic sampling errors, incomplete exploration status does not affect the prediction of the species belonging to the rarest quartile.

Frequency rates, calculated from the available distribution data, were sometimes in striking contrast to our field experience and subjective opinions. Thorough examination of these cases revealed that in most of the cases, the distribution data represented improperly the real frequency of the species, due to the latest changes in the composition of the fauna. Compared to the misrepresentation of certain geographical regions in the basic data-sete or to the incomplete exploration of the fauna, this error factor seemed to be much more important. This gave grounds for us to place greater emphasis on the correction factors within the MRI index than SÓLYMOS (2004) did.

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