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Aquatic macroinvertebrates from soda pans and adjacent wetland habitats of the Hungarian Puszta region with first records of four species from Hungary

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Owing to their limited geographical distribution and unique ecological characteristics, Pannonian salt marshes and soda pans are considered among the most vulnerable aquatic habitats in Europe. Despite the unique nature of the soda pans and adjacent wetlands, little is known about their aquatic macroinvertebrate fauna, and there is a shortfall in the knowledge about the distribution range of species inhabiting these waterbodies in Central Europe. In this paper hundreds of detailed new records of 228 aquatic macroinvertebrate taxa belonging to 46 families and eleven higher taxa groups are given from 55 localities within two saline Puszta plains in SE Hungary. We report here the first occurrence records of four species from the Hungarian fauna, one aquatic beetle (*Helophorus grandis* Illiger, 1798) and three non-biting midge species (*Allocladius arenarius* Strenczke, 1860; *Limnophyes ninae* Saether, 1975; *Tribelos donatoris* (Shilova, 1974)), and also highlight new occurrences of dozens of halobiont and halophilic taxa which are considered as extremely rare in Europe, but are particularly characteristic for, and occasionally may be rather common in these special aquatic spots. New data help us to reveal recent spatial distribution of these unique species, and provide a basis for future conservation actions and distributional studies.

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Introduction

Owing to their limited geographical distribution and unique ecological characteristics, Pannonic salt marshes and soda pans (PSMSP) are among the most vulnerable European aquatic habitats (Boros et al. 2014a). These unique habitats are classified as wetlands of international importance designated under the Ramsar Convention (Ramsar Convention Secretariat 2004). Soda pan habitats are also listed in Annex I of the EU Habitat Directive 92/43/EEC (Anonymous 1992), thus considered to be of high priority in the Natura 2000 Network. Based on the Bird Directive 79/409/EEC (Anonymous 1979) many bird protection sites were designated on soda pans (Boros et al. 2014a).

One of the largest sets of inland soda pans in Europe and 99 % of the total surfaces of Pannonian salt steppes with salt marshes are located in Hungary (Boros et al. 2014a). Besides its unique ecological value, the so called Hungarian Puszta with its millennia-old alkaline landscape is an outstanding cultural heritage shaped by different activities of a pastoral human society. However, several PSMSP were thoroughly destroyed or cultivated in the past for agricultural purposes. Due to the significant (85 %) loss of these saline habitats during the last 60 years in the Carpathian Basin, recently they are "ex lege" protected sites in Hungary (Act No. LIII. of 1996 on Nature Conservation). Nowadays, due to their unstable water balance and small size these pans are particularly threatened by the climate change combined with human activities, mainly water abstraction and use (Boros et al. 2014a).

Many of PSMSP, preserved in near-pristine state, are inhabited by exceptionally unique wildlife that gives great scientific value and conservational priorities to these waterbodies. Although the appearance forms of PSMSP are various (for detailed definitions see Boros et al. 2014a), their common characteristics are shallow (maximum 1–2 metres deep) water, medium or small water surface and lakebed belonging entirely to the littoral zone. For aquatic macroinvertebrate these shallow, quickly warming up saline water bodies with relatively large water surface compared to their low depth, and without aquatic vertebrate predators provide higher chance for faster development and an increased survival rate to enhance their fitness. Detailed description of the salinity and ionic characteristic of PSMSP and

Table 1. List of sampling sites from the sodic ponds and adjacent wetland habitats of the Hungarian "Puszta" region with codes, names (administrative units), conductivity and pH (environmental variables were measured at once in May), year and date of samplings, geo-coordinates and ETRS codes. Names of the sites were left in the original Hungarian form, being more identifiable. Sp, spring; Su, summer; Au, autumn; –, no data (not sampled); D, dried up. The "a", "a+", and "b" marks refer to the date of sampling and these codes are used in the list of species. The dates of collection are listed according to the Hungarian order (MM.DD). All samples were collected in 2015 by Pál Boda, Zoltán Csabai, Anna Farkas and Arnold Móra.

Code	Name (Administration Unit)	Conductivity (µS/cm)	pH	Sp (a)	Sp II. (a+)	Su (b)
K01	intermittent ditch, Kardoskúti-puszta (Kardoskút)			3.21.	5.7.	D
K02	swamp, Kardoskúti-puszta (Kardoskút)	3634	8.1	3.21.	5.7.	D
K03	ditch, Kardoskúti-puszta (Kardoskút)	1336	8.2	3.21.	5.7.	D
K04	Fehér-tó, South end of the West basin (Kardoskút)	4816	9.3	3.21.	5.7.	6.20.
K05	Fehér-tó, near the dam in the West basin (Kardoskút)	5668	9.0	3.21.	5.7.	D
K06	Fehér-tó, near the dam in the East basin (Kardoskút)	6778	9.2	3.21.	5.7.	D
K07	Fehér-tó, East end of the East basin (Kardoskút)	–	–	–	5.7.	D
K08	Csáki-lapos (Kardoskút)	2278	7.9	3.25.	5.7.	D
K09	ditch near the road, Kardoskúti-puszta (Kardoskút)	4642	8.5	3.24.	5.7.	D
K10	Lófogó-ér (Kardoskút)	2124	8.2	3.24.	5.7.	D
K11	Kis-Bogárzó, shoreline, South (Kardoskút)	–	–	3.24.	D	D
K12	Kis-Bogárzó, Shoreline, North (Kardoskút)	–	–	3.24.	D	D
K13	Kis-Bogárzó, South (Kardoskút)	1993	8.2	3.25.	5.4.	6.20.
K14	csatorna, Nagy-Sóstó South (Kardoskút)	–	–	–	5.4.	D
K15	Nagy-Sóstó, shoreline, South (Kardoskút)	2388	7.9	3.24.	5.4.	–
K16	Nagy-Sóstó, South (Székkutas)	–	–	3.24.	5.4.	–
K17	track pudle, Nagy-Sóstó (Kardoskút)	–	–	3.24.	D	D
K18	Nagy-sóstó, É (Székkutas)	1395	8.6	3.25.	5.4.	–
K19	temporary ditch, Nagy-Sóstó, North (Kardoskút)	–	–	–	5.4.	D
K20	temporary, deeper puddle (Kardoskút)	–	–	–	5.4.	D
K21	csatorna, Nagy-Sóstó É (Kardoskút)	3251	8.3	–	5.4.	D
K22	Fecskés-mocsár, large (Székkutas)	–	–	3.25.	5.4.	–
K23	Fecskés-mocsár, small (Székkutas)	500	7.6	–	5.4.	6.20.
K24	csatorna, Fecskés-mocsár (Székkutas)	627	8.2	–	5.4.	D
K25	drinking-trough, Fecskés-mocsár (Székkutas)	1046	7.9	3.25.	5.4.	D
K26	small swamp patches, Fecskés-mocsár (Székkutas)	844	7.6	3.25.	5.4.	6.20.
K27	Kis-Sóstó, South (Orosháza)	4670	8.8	3.21.	5.6.	6.20.
K28	Kis-Sóstó, North (Orosháza)	2468	8.6	3.21.	5.6.	6.20.
K29	Dankó II. water course (Orosháza)	3965	8.5	–	5.6.	D

related habitat in the Carpathian Basin can be found in Boros et al. (2014b). Both temporary and perennial types exist, but the actual time when these habitats dry out highly depends on the yearly precipitation and other climatic or geochemical circumstances (Simon et al. 2011). PSMSP might be natural stepping stones in aquatic invasion for non-indigenous species (Ricklefs 2004, Gilbert & Lechowicz 2005). Thus, mapping and screening these habitats and their surroundings is crucial not only from the point of view of the conservation of native biodiversity as a whole, but also fundamental in early detection, management and control of Invasive Alien Species.

PSMSP habitats support a diverse array of native biota adapted to saline environment conditions (Horváth et al. 2013, Lukács et al. 2013, Borics et al. 2014, Boros et al. 2014a, 2014b, Stenger-Kovács et al. 2014, Bolgovics et al. 2016). Saline biota which includes halotolerant, halophilic and halobiont species is particularly interesting due to the fact that relatively few macroinvertebrate species are able to tolerate highly saline conditions. These species might have wide geographic distribution, but always have restricted habitat specificity with various sizes of local populations. However, our distributional knowledge of halotolerant, halophilic and halobiont macroinvertebrate species is both scarce and scattered (Petri et al. 2012, Cozma et al. 2014). To reveal the real and complete distributional ranges of species, inhabiting such unique habitats like PSMSP, is an important task for ecologists and conservation experts to complete the so called "Wallacean shortfall": because the lack of knowledge and data, geographical distributions of such species contain many gaps (Brown & Lomolino 1998, Bini et al. 2006). Additionally, filling up the gaps in the distributions must be the first steps in undertaking effective conservation actions.

The main goals of the present paper are to provide baseline data of an "as wide as possible" spectrum of aquatic macroinvertebrates from PSMSP and adjacent wetland habitats of the Hungarian Puszta region and complement the European distributional range of several taxa.

Coordinates		ETRS
20°36.8401' E	46°27.8911' N	E513N265
20°36.8315' E	46°27.8367' N	E513N265
20°36.3466' E	46°27.7899' N	E513N265
20°37.0060' E	46°27.9800' N	E513N265
20°37.6824' E	46°28.3463' N	E513N265
20°37.8464' E	46°28.3419' N	E513N265
20°38.8489' E	46°28.4725' N	E513N265
20°36.8637' E	46°28.5672' N	E513N265
20°37.1330' E	46°28.6660' N	E513N265
20°37.1129' E	46°28.7009' N	E513N265
20°36.8454' E	46°29.6358' N	E513N265
20°36.4552' E	46°29.8728' N	E513N265
20°36.7950' E	46°29.6754' N	E513N265
20°36.4679' E	46°29.9634' N	E513N265
20°36.2219' E	46°29.9171' N	E513N265
20°36.1513' E	46°29.9078' N	E513N265
20°36.2007' E	46°29.9136' N	E513N265
20°36.2808' E	46°30.4416' N	E513N265
20°36.6809' E	46°30.5154' N	E513N265
20°37.1278' E	46°30.5287' N	E513N265
20°37.1776' E	46°30.5469' N	E513N265
20°35.5926' E	46°30.7371' N	E513N265
20°35.2512' E	46°30.8044' N	E513N265
20°35.5473' E	46°30.9305' N	E513N265
20°35.8223' E	46°30.9191' N	E513N265
20°36.0522' E	46°31.0029' N	E513N265
20°37.9397' E	46°31.3379' N	E513N265
20°37.8727' E	46°31.4242' N	E513N265
20°39.9109' E	46°31.8165' N	E513N266

Material and methods

Study site

The research area is located in the Körös-Maros National Park, SE Hungary, covering two saline plains, Kardoskút Puszta and Csanád Puszta (Fig. 1). It is located in a semi-arid to semi-humid climatic region, where the mean yearly air temperature is 9.8–9.9 °C, the mean yearly precipitation is 520–550 mm, and most of which falls in the spring and autumn (Mezősi 2009).

In the middle of the Kardoskút Puszta plain, one of the biggest endorheic shallow soda pans of Hungary, the Kardoskúti Fehér-tó (Kardoskút White Lake) can be found, which is a nature conservation site under the Ramsar Convention since 1979. The lake is surrounded by ancient native and secondary established grasslands and croplands. The present names of the grasslands and water filled basins (Fecskés, Kis-Bogárzó, Nagy-Bogárzó) refer to the former lakes and waterlogged areas. All around, there are several smaller and temporarily existing deeper spots that provided proper habitat for macroinvertebrates during inundations in spring (see Table 1). Csanád Puszta has a nature origin; it is a primarily formed saline plain consisted of three different parts (Kopáncs Puszta, Montág Puszta and Királyhegyes Puszta). During the last century Csanád Puszta began to lose the saline characteristics, however, several former saline marshes, ponds and pools with decreased salinity can still be found scattered all over the territory (Molnár et al. 2016).

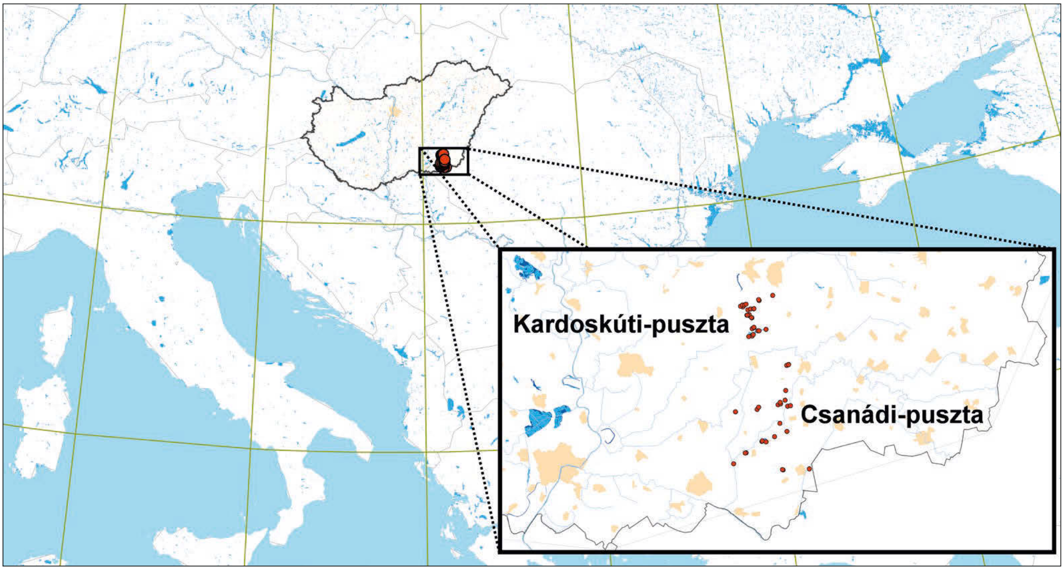

Fig. 1. Map of the study area with positions of the sampling sites (●).

Table 1. (continued).

Code	Name (Administration Unit)	Conductivity (µS/cm)	pH	Sp (a)	Sp II. (a+)	Su (b)
C01	edge of the village of Csanádpalota (Csanádpalota)	4858	8.5	3.22.	5.7.	–
C02	Tehénjárás (Csanádpalota)	–	–	3.22.	5.7.	–
C03	Belezi-csatorna	–	–	3.22.	5.7.	–
C04	Dáli-szikesek, South (Makó)	1523	8.2	3.22.	5.6.	–
C05	Dáli-szikesek, North 1 (Királyhegyes)	2066	7.9	3.22.	5.6.	–
C06	Dáli-szikesek, North 2 (Királyhegyes)	–	–	–	5.6.	–
C07	Csikóspusztai-tó, swamp, East (Királyhegyes)	–	–	3.22.	5.6.	D
C08	Csikóspusztai-tó, open water, East (Királyhegyes)	1388	8.3	3.22.	5.6.	6.20.
C09	Csikóspusztai-tó, shoreline, South (Királyhegyes)	–	–	3.22.	5.6.	D
C10	Liliomos (Királyhegyes)	–	–	3.23.	5.6.	–
C11	Hangai-tavak (Királyhegyes)	1218	7.5	3.24.	5.5.	–
C12	Száraz-ér (Királyhegyes)	991	7.8	3.23.	5.5.	–
C13	Nagy-bogárzó (Makó)	–	–	3.23.	5.6.	6.20.
C14	Nagy-bogárzó (Makó)	–	–	3.23.	5.6.	6.20.
C15	Nagy-zsombék (Makó)	835	7.7	3.23.	5.6.	6.20.
C16	Nagy-zsombék (Makó)	–	–	–	5.6.	
C17	Vásárhelyi-lapos (Makó)	526	7.4	–	5.5.	6.21.
C18	unnamed perennial water course (Tótkomlós)	730	8.2	–	5.5.	6.21.
C19	Kákás-fertö (Tótkomlós)	–	–	3.23.	D	D
C20	Nagy-mocsár (Ambrózfalva)	–	–	–	5.5.	6.21.
C21	flooded area (Ambrózfalva)	1711	7.5	–	5.5.	–
C22	Kopáncspusztai-járandó (Nagyér)	2136	8.0	3.23.	5.5.	–
C23	Külsö-legelö (Nagyér)	–	–	3.23.	D	D
C24	Czigándi-bogárzó (Békéssámson)	595	6.5	3.24.	5.5.	6.20.
C25	temporary small marsh (Békéssámson)	1050	7.4	3.24.	5.5.	D
C26	unnamed intermittent water course (Békéssámson)	–	–	3.24.	D	D

Sampling and evaluation

Thorough faunistic samplings were performed in the early spring (21–25 March 2015), late spring (4–7 May 2015) and summer (20–21 June 2015) periods at a total of 55 sampling sites (Table 1). Autumn sampling was not possible due to nearly all sampling sites dried out completely. During the sampling campaign all type of saline wetlands and adjacent waterbodies were sampled from shallow saline lakes, to soda pans, as well as marshes with open waters, salt marshes and soda pools. The specimens were collected using standard pond nets (mesh sizes of 250 and 500 µm) above the substrate, on the water surface and among the vegetation. Chironomid pupal exuviae were captured manually from the water surface. In case of Ephemeroptera, Trichoptera, Megaloptera only larval stages, while for Heteroptera and Coleoptera only adult stages were collected and identified. For Odonata, larvae and exuviae were collected and observational data of adults were taken into consideration too. For Diptera: Chironomidae both larvae and pupal exuviae were collected and identified. The specimens were identified in the laboratory by specialists using microscopes and the most up-to-date keys and descriptions.

Coordinates		ETRS
20°44.6311' E	46°14.5722' N	E514N262
20°40.8704' E	46°14.5181' N	E514N262
20°40.7814' E	46°14.5594' N	E514N262
20°33.8286' E	46°15.2331' N	E513N262
20°35.6354' E	46°16.2871' N	E513N263
20°35.5183' E	46°16.2753' N	E513N263
20°37.9306' E	46°17.3857' N	E513N263
20°37.9905' E	46°17.4373' N	E513N263
20°38.5277' E	46°17.3277' N	E513N263
20°39.7506' E	46°17.8312' N	E514N263
20°41.5437' E	46°18.3220' N	E514N263
20°40.5618' E	46°19.1423' N	E514N263
20°34.2364' E	46°20.3610' N	E513N263
20°34.2305' E	46°20.3735' N	E513N263
20°37.3328' E	46°20.5620' N	E513N263
20°37.5684' E	46°20.7806' N	E513N263
20°40.3505' E	46°20.9819' N	E514N264
20°40.7196' E	46°21.0700' N	E514N264
20°40.6648' E	46°21.2187' N	E514N264
20°41.7138' E	46°20.8191' N	E514N264
20°42.1270' E	46°20.8692' N	E514N264
20°41.3703' E	46°21.4207' N	E514N264
20°41.4921' E	46°22.3750' N	E514N264
20°41.7043' E	46°24.8629' N	E514N264
20°41.9894' E	46°24.9462' N	E514N264
20°41.9748' E	46°24.9265' N	E514N264

In May, in cases of 33 sampling sites, exploratory measurement of some chemical and physical variables, including pH and conductivity, were conducted using a YSI Exo2 multiparameter water quality sonde. To explore the relationships between salinity parameters (conductivity and pH) and numbers of species, Spearman correlation tests were conducted using PAST 3.0 software package (Hammer et al. 2001). Scatterplots and fitting linear regression were done using MS Excel software.

Results

Altogether 13268 specimens were collected and identified, which belong to 228 aquatic macroinvertebrate taxa (9 Mollusca (8 Gastropoda and 1 Bivalvia), 5 Hirudinea, 4 Crustacea, 1 Araneae, 1 Ephemeroptera, 25 Odonata, 30 Heteroptera, 104 Coleoptera, 3 Trichoptera, 46 Diptera). In the list of species we gave the code of locality, the code of sampling date, the total number of individuals, and where appropriate, the life stages (i = adults, e = larval or pupal exuviae, l = larvae). To shorten the length of the text, letters are used for coding the date of samplings as the "a" refers to first date in spring (21–25 of March), "a+" refers to the second date in spring (04–07 of May) and "b" codes refers to the summer sampling date (20–21 of June) (for more information about the exact date of sampling see Table 1). After the name of the species we marked with "HB", "HP" and "FHP" all those species, which are known to be halobiont, halophilic or facultative halophilic, respectively (cf. Galewski 1971, Hebauer 1974, Zinchenko et al. 2017 and discussion part of this paper).

List of species and locality data

Gastropoda
(identified by Bálint Pernecker)

Acroloxidae

Acroloxus lacustris (Linnaeus, 1758) – C18b, 1; K18a, 3.

Lymnaeidae

Lymnaea stagnalis (Linnaeus, 1758) – C03a+, 2.

Stagnicola palustris (O. F. Müller, 1774) – C15a, 2; C20a, 3; C21a+, 4.

Planorbidae

Anisus spirorbis (Linnaeus, 1758) – C01a, 15; a+, 3; C02a, 5; a+, 1; C03a, 7; a+, 1; C04a, 9; a+, 14; C05a, 9; a+, 21; C06a+, 18; C07a, 18; a+, 6; C08a, 18; a+, 1; C09a, 4; a+, 19; C10a, 12; a+, 22; C11a, 4; a+, 6; C12a, 18; a+, 5; C13a, 12; a+, 2; C14a, 8; C15a, 17;

a+, 8; C16a+, 25; C17a+, 13; C18a+, 27; b, 1; C19a+, 8; C20a, 11; C21a+, 11; C22a, 16; a+, 12; C23a, 5; C24a, 17; a+, 14; C25a, 8; a+, 9; K01a, 15; a+, 10; K02a, 12; a+, 1; K03a, 13; a+, 8; K04a, 2; a+, 1; K05a, 2; K06a, 1; K07a+, 21; K08a, 15; a+, 4; K09a, 2; a+, 2; K10a, 6; a+, 13; K11a, 4; K13a, 2; a+, 4; K15a, 2; a+, 1; K18a, 2; K19a+, 12; K21a+, 4; K22a, 5; a+, 21; K23a+, 10; K24a+, 5; K25a, 2; a+, 2; K26a, 21; a+, 3; K27a, 15; a+, 8; K28a, 14; a+, 12; K29a+, 8.

Planorbarius corneus (Linnaeus, 1758) – C03a, 1; C04a, 1; C05a, 1; a+, 1; C06a+, 2; C07a, 2; C09a, 3; C09a+, 4; C10a, 9; C10a+, 3; C11a, 3; C12a, 5; C13a, 5; C13a+, 2; C14a, 3; C14a+, 3; C15a, 2; C15a+, 3; C17a+, 21; C18a+, 2; C19a+, 5; C20a, 5; C21a+, 7; C24a, 1; C24a+, 2; K03a+, 1; K08a+, 6; K08b, 1; K10a, 2; K15a, 1; K15a+, 1; K16a, 2; K16a+, 1; K18a, 2; K18a+, 1; K19a+, 1; K22a, 1; K23a+, 2; K24a+, 6; K25a, 1; K26a, 3; K26a+, 3.

Planorbis planorbis (Linnaeus, 1758) – C12a, 3; C12a+, 1; C15a, 1; C20a, 1; C21a+, 6.

Segmentina nitida (O. F. Müller, 1774) – C04a, 3; C05a, 1; C09a, 4; C09a+, 6; C10a, 6; C10a+, 18; C11a, 4; C11a+, 7; C12a, 4; C12a+, 1; C13a, 3; C13a+, 1; C14a, 5; C14a+, 1; C15a, 6; C15a+, 5; C16a+, 1; C17a+, 20; C20a, 1; C21a+, 13; K15a, 2; K16a, 2; K16a+, 4; K18a, 5; K18a+, 3; K22a, 3; K23a+, 5; K24a+, 6; K25a, 2; K25a+, 2; K26a, 4; K26a+, 2.

Physidae

Haitia acuta (Draparnaud, 1805) – C02a, 9; a+, 3; C03a, 10; a+, 6; C05a, 1; C06a+, 2; C12a, 1; a+, 1; C14a+, 1; K02a, 1; K03a, 2; a+, 2; K14a+, 7; K15a, 16; K15a+, 13; K16a, 6; a+, 2; K17a, 2; K18a, 5; a+, 8; K21a+, 1.

Bivalvia
(identified by Bálint Pernecker)

Sphaeriidae

Musculium lacustre (O. F. Müller, 1774) – C10a+, 2; C17a+, 4.

Hirudinea
(identified by Kristóf Málnás)

Erpobdellidae

Dina lineata (O. F. Müller, 1774) – C10a, 1; C11a, 1; a+, 1; C12a+, 1; C14a, 2; a+, 1; C17a+, 1; C21a+, 2; K18a, 1; K26a+, 1.

Glossiphoniidae

Alboglossiphonia hyalina (O. F. Müller, 1774) – K16a, 2.

Glossiphonia nebulosa Kalbe, 1964 – K18a, 2.

Haemopidae

Haemopis sanguisuga (Linnaeus, 1758) – C03a+, 2; C12a+, 3; C17a+, 1.

Hirudinidae

Hirudo verbana Carena, 1820 – C05a+, 2; C11a+, 1; C14a+, 1; C22a+, 1.

Aranea
(identified by Zoltán Csabai)

Cybaeidae

Argyroneta aquatica (Clerck, 1757) – C03a, 1; a+, 1; C05a, 2; a+, 1; C06a+, 1; C07a, 1; a+, 8; C08a, 2; a+, 2; C09a, 1; a+, 10; C10a, 20; a+, 15; C11a+, 4; C12a+, 1; C13a, 2; a+, 2; C14a, 2; a+, 1; C17a+, 4; C20a, 1; C21a+, 8; C22a, 8; a+, 8; C24a, 2; a+, 8; K15a, 1; K16a+, 2; K18a, 1; K27a, 2; a+, 2.

Crustacea
(identified by Péter Mauchart)

Asellidae

Asellus aquaticus (Linnaeus, 1758) – C02a, 14; a+, 5; C03a, 21; a+, 17; C04a, 19; a+, 31; C05a+, 13; C06a+, 4; C08a, 1; C10a, 10; a+, 11; C11a, 19; a+, 24; C12a, 13; a+, 11; C13a, 10; a+, 14; C14a+, 10; C15a, 16; a+, 6; C16a+, 9; C17a+, 8; C18a+, 11; C19a+, 8; C20a, 8; C21a+, 18; C23a, 2; C24a, 17; a+, 19; C25a, 1; C26a, 1; K02a, 4; a+, 5; K03a, 6; a+, 13; K08a, 18; a+, 16; K09a, 12; a+, 2; K10a, 18; a+, 16; K14a+, 9; K15a, 16; a+, 21; K16a, 7; a+, 2; K17a, 1; K18a, 13; a+, 27; K19a+, 8; K20a+, 2; K21a+, 6; K22a, 31; a+, 2; K23a+, 11; K24a+, 2; K25a, 12; a+, 9; K26a, 9; a+, 14; K29a+, 20.

Niphargidae

Niphargus hrabei S. Karaman, 1932 – C12a, 3; C14a, 2.

Niphargus valachicus Dobreanu, 1933 – C13a+, 2; C17a+, 1.

Triopsidae

Lepidurus apus (Linnaeus, 1758) – K22a+, 1.

Ephemeroptera
(identified by Csaba Deák)

Baetidae

Cloeon dipterum (Linnaeus, 1761) – C01a, 13; C03a, 7; a+, 7; C04a, 4; a+, 5; C05a, 22; a+, 4; C06a+, 5; C07a, 13; a+, 7; C08a, 10; a+, 2; C09a, 4; a+, 14;

C10a, 6; a+, 16; C11a, 8; C12a, 8; a+, 2; C13a, 7; C14a, 7; a+, 3; C15a, 14; a+, 1; C16a+, 7; C17a+, 7; C18a+, 30; b, 3; C19a+, 7; C20a, 6; C21a+, 18; C22a, 16; a+, 9; C24a, 2; a+, 11; C25a, 7; a+, 8; C26a, 3; K01a, 16; a+, 7; K02a, 9; a+, 2; K03a, 8; a+, 13; K04a, 7; a+, 3; K07a+, 12; K08a, 10; a+, 8; K09a, 9; a+, 7; K10a, 9; a+, 4; K13a, 5; a+, 10; b, 4; K14a+, 6; K15a, 13; a+, 3; K16a, 3; a+, 11; K18a, 6; a+, 8; K21a+, 8; K22a, 10; a+, 1; K23b, 4; K24a+, 8; K25a, 9; a+, 5; K26a, 7; a+, 7; K27a, 14; a+, 11; K28a, 9; a+, 11; b, 3.

Odonata

(identified by Arnold Móra)

Aeshnidae

Aeshna affinis Vander Linden, 1820 – C03a+, 2l; C24a+, 1l; K07a+, 2l; K08a+, 4l; K13a+, 5l; K22a+, 2l; K25a+, 1l; K27a+, 1l.

Aeshna isoceles (O. F. Müller, 1767) – C17b, 1e; K07b, 1l; K08b, 6l; K13b, 2l; K15a, 2l; a+, 2l; K16a, 3l; a+, 2l; K21a+, 1l; K27b, 1i; b, 1l.

Anax imperator Leach, 1815 – C05a, 2l; C06a+, 2l; C07a+, 1l; C10a, 1l; a+, 1l; C12a+, 1l; C13a+, 2l; C14a, 1l; a+, 2l; C17a+, 4l; b, 1i; C18a+, 4l; b, 4e; C19a+, 2l; b, 4e; C21a+, 1l; K01a, 1l; K03a, 3l; a+, 1l; K08a, 1l; a+, 1l; b, 1i; K18a, 1l; K24a+, 2l; K27a+, 1l.

Anax parthenope (Selys, 1839) – K13b, 2i; K27b, 10i; K28b, 2i.

Brachytron pratense (O. F. Müller, 1764) – C02a+, 1i; C09a+, 1i; C10a+, 1i; C11a+, 1i; C14a+, 1i; C18a+, 1i; C19a+, 3i; C21a+, 1i; C22a, 1i; a+, 1l; C24a+, 2i; K07a+, 2i; K09a+, 3i; K15a, 2l; K16a, 1l; K21a+, 2i; K23a+, 1i; K26a+, 1i; K27a+, 1i; K28a+, 1i.

Coenagrionidae

Coenagrion puella (Linnaeus, 1758) – C22a, 1l; K23b, 2i.

Coenagrion pulchellum (Vander Linden, 1825) – C19b, 2i; K09a+, 1i; K15a+, 1i.

Enallagma cyathigerum (Charpentier, 1840) – K04a+, 2i; K06b, 3i; K13b, 6i; K27a+, 1i; b, 8i; K28a+, 1i.

Ischnura elegans (Vander Linden, 1820) – C01a, 14l; a+, 10l; C04a+, 1i; C05a, 8l; a+, 2i; C06a+, 3i; a+, 4l; C07a, 5l; a+, 2i; a+, 4l; C08a, 10l; a+, 5l; C10a+, 2i; a+, 5l; C11a+, 6i; C12a, 10l; a+, 5l; C13a, 4l; a+, 6l; C14a, 8l; a+, 1i; a+, 1l; C17a+, 1l; b, 1l; C18a+, 15i; a+, 5l; b, 10i; b, 1l; C19a+, 2i; a+, 9l; b, 20i; C21a+, 3i; a+, 11l; C22a, 4l; a+, 3i; C24a+, 2i; C25a+, 3i; K01a, 1l; a+, 1i; K02a, 1l; K03a, 19l; a+, 4l; K04a+, 3i; b, 10i; K06b, 5i; b, 2l; K08a, 6l; a+, 3i; a+, 7l; b, 4i; K09a, 9l; K09a+, 8i; a+, 2l; K13a, 29l; K13a+, 13i; a+, 19l; b, 3i; b, 5l; K14a+, 2i; a+, 4l; K18a, 1l; K18a+, 5i; a+, 5l; K21a+, 1i; a+, 3l; K23a+, 2i; b, 5i; b, 1l; K24a+, 3i; a+, 7l; K25a, 2l; a+, 2i; K26a, 9l; a+, 4i; a+, 6l; K27a, 9l; a+, 7i; a+, 10l; b, 10i; K28a, 14l; K28a+, 6i; a+, 13l.

Ischnura pumilio (Charpentier, 1825) – C01a, 26l; a+, 4i; C02a, 7l; a+, 2i; C03a+, 1l; C05a, 26l; a+, 2i; a+, 4l; C06a+, 3i; a+, 2l; C07a, 16l; a+, 6i; a+, 4l; C08a, 2l; C09a+, 2i; a+, 1l; C10a, 15l; a+, 8i; a+, 7l; C11a+, 5i; C12a, 5l; C13a, 4l; a+, 4l; C14a, 6l; a+, 3l; C15a, 3l; a+, 2i; C18a+, 23i; a+, 7l; C19a+, 3i; a+, 14l; b, 1i; C21a+, 3l; C22a, 15l; a+, 9i; a+, 5l; C24a, 5l; a+, 2i; C25a, 7l; a+, 3i; a+, 4l; K01a+, 3i; K02a, 4l; K03a, 3l; a+, 2i; a+, 4l; K04a+, 5i; b, 20i; K05a+, 3i; K06a+, 4i; b, 20i; b, 6l; K07a+, 4i; K08a, 12l; a+, 1l; b, 1i; K09a, 2l; K10a, 7l; K13a+, 5i; a+, 10l; b, 10i; b, 4l; K14a+, 1l; K15a, 3l; K19a+, 3i; K21a+, 5i; a+, 2l; K22a, 2l; K23b, 6i; K24a+, 1i; a+, 3l; K25a, 3l; a+, 1i; a+, 4l; K26a, 6l; a+, 3i; K27a, 16l; a+, 8i; a+, 10l; b, 10i; b, 7l; K28a, 3l; a+, 5i; a+, 7l; K29a+, 1l.

Lestidae

Lestes barbarus (Fabricius, 1798) – C01a+, 4l; C05a+, 5l; C17b, 1i; K01a+, 1l; K02a+, 7l; K04a+, 5l; b, 10i; K05a+, 1l; K06a+, 33l; b, 10i; K07a+, 19l; b, 10i; K08a+, 2l; K09a+, 1l; K10a+, 6l; K13b, 8i; K19a+, 14l; K20a+, 3l; K22a+, 4l; K23b, 10i; K26b, 1i; K27a+, 15l; b, 10i; K28a+, 8l.

Lestes dryas Kirby, 1890 – FHP – K07a+, 2l; b, 4i.

Lestes macrostigma (Eversmann, 1836) – FHP – K04b, 3i; K06b, 3i; K27b, 1i; K28b, 1i.

Lestes virens (Charpentier, 1825) – K07b, 2i.

Sympecma fusca (Vander Linden, 1820) – C19b, 3i; K06b, 1i; K13a, 1i; K27b, 1i; b, 1l.

Libellulidae

Crocothemis erythraea (Brullé, 1832) – C18b, 10i; C19a+, 9l; K09a+, 2l.

Libellula depressa Linnaeus, 1758 – C14a+, 1i; K27b, 1i.

Libellula fulva O. F. Müller, 1764 – C25a+, 1i; K27b, 2i.

Libellula quadrimaculata Linnaeus, 1758 – C07a+, 1i; C19a+, 1i.

Orthetrum albistylum (Selys, 1848) – C07a+, 1l; C18a+, 9l; b, 10i; C19a+, 1i; a+, 4l; b, 1e; C21a+, 3l; K01a+, 3l; K08a, 1l; a+, 2l; b, 1i; b, 1l; K09a, 3l; a+, 3l; K10a, 2l; a+, 2l; K14a+, 1l; K27b, 2i.

Orthetrum coerulescens (Fabricius, 1798) – C02a, 1l.

Sympetrum fonscolombii (Selys, 1840) – FHP – C05a+, 1i; C19a+, 3l; K06b, 3i; K13b, 1i.

Sympetrum meridionale (Selys, 1841) – C02a+, 2l; C05a+, 7l; C07a+, 2l; C15b, 1i; C19b, 1i; C22a+, 22l;

C24a+, 3l; b, 10i; K02a+, 2l; K03a+, 4l; K04b, 2i; K06b, 4i; K07a+, 7l; b, 10i; K08b, 1i; b, 5l; K09a+, 2l; K10a+, 6l; K13a+, 9l; b, 20i; K22a+, 5l; K23b, 10i; K24a+, 3l; K26a+, 1l; K27a+, 9l; b, 10i; K29a+, 1l.

Sympetrum striolatum (Charpentier, 1840) – C05a+, 1l; C06a+, 2l; C19b, 1i; C22a+, 1l; K02a+, 8l; K03a+, 1l; K07a+, 1l; K10a+, 5l.

Platycnemididae

Platycnemis pennipes (Pallas, 1771) – C02a+, 1i.

Heteroptera

(identified by Pál Boda)

Nepidae

Nepa cinerea Linnaeus, 1758 – C02a, 1; C03a, 1; a+, 2; C05a, 1; C11a+, 1; C14a+, 1; C17a+, 1; C18a+, 2; b, 11; K08b, 8; K15a+, 1; K16a, 1; a+, 2; K18a, 1; K21a+, 1.

Ranatra linearis (Linnaeus, 1758) – C05a+, 1; C06a+, 1; C18a+, 1; b, 9; K08b, 4; K13a, 1; a+, 1; K14a+, 1; K15a+, 1; K16a+, 1; K23b, 1.

Micronectidae

Micronecta scholtzi (Fieber, 1860) – K14a+, 3.

Corixidae

Callicorixa praeusta praeusta (Fieber, 1848) – K28a, 1.

Corixa affinis Leach, 1817 – HP – C05a, 1; C19b, 1; K03a, 1; K04a, 1; a+, 9; K06a+, 3; b, 10; K07b, 1; K13a, 1; K13a+, 7; b, 8; K18a, 1; K20a, 1; K23b, 2; K27a, 3; b, 11.

Corixa punctata (Illiger, 1807) – C05a, 2; C08a+, 4; C18b, 2; C19b, 1; K04a+, 1; K06b, 1; K13a, 1; b, 6; K23b, 6; K27a+, 1; b, 6; K28a, 1.

Cymatia coleoptrata (Fabricius, 1777) C05a, 1.

Cymatia rogenhoferi (Fieber, 1864) – FHP – K06a+, 2; b, 9.

Hesperocorixa linnaei (Fieber, 1848) – C01a, 2; a+, 1; C04a, 2; a+, 2; C05a, 1; C07a, 1; C09a, 1; C11a, 1; C15a, 1; C16a+, 1; C25a, 1; K03a, 2; K16a, 2; K22a, 1; K23b, 7.

Paracorixa concinna concinna (Fieber, 1848) – FHP – C08a, 2; a+, 1; K04a, 9; b, 7; K06a, 2; a+, 2; b, 9; K13a, 6; a+, 1; b, 6; K27a, 1; a+, 1; b, 5.

Sigara falleni (Fieber, 1848) – C01a, 1; K13a, 1; K18a+, 1.

Sigara lateralis (Leach, 1817) – FHP, HP – C01a, 7; a+, 6; C04a, 1; a+, 2; C05a, 1; C06a+, 1; C07a, 10; C08a, 17; a+, 6; C09a+, 1; C12a, 2; a+, 4; C15a, 6; a+, 8; C16a+, 7; C19a+, 1; b, 11; C21a+, 1; C22a, 4; a+, 1; C25a+, 2; C26a, 9; K03a+, 1; K04a, 28; a+, 29; b, 23; K05a, 26; K05a+, 33; K06a, 16; a+, 22; b, 33; K07a+, 1; K10a+, 3; K11a, 14; K13a, 29; a+, 8; b, 19; K16a, 6; K18a, 5; a+, 13; K20a+, 10; K23b, 7; K25a, 7; a+, 5; K27a, 15; a+, 28; b, 7; K28a, 7; a+, 4; b, 6.

Sigara striata (Linnaeus, 1758) – C18a+, 1; K13a, 21; a+, 1; b, 1; K16a, 3; K18a, 1; a+, 1; K27b, 1; K28a, 1.

Naucoridae

Ilyocoris cimicoides cimicoides (Linnaeus, 1758) – C04a, 1; a+, 1; C05a, 1; a+, 1; C06a+, 1; C07a, 1; C09a, 1; C11a+, 1; C16a+, 1; C18a+, 1; C18b, 11; C22a+, 1; K04a+, 1; K06a+, 1; K07a+, 1; K13a, 1; a+, 1; K15a, 1; K18a+, 1; K23a+, 2; b, 1; K28a+, 1.

Notonectidae

Anisops sardeus sardeus Herrich-Schaeffer, 1849 – FHP – C08a, 3; a+, 6; K04a+, 2; b, 1; K13b, 3; K23b, 2; K27b, 1.

Notonecta glauca Linnaeus, 1758 – C01a, 5; C02a, 2; a+, 1; C03a, 1; C05a, 6; C07a, 4; C12a, 1; C14b, 2; C18a+, 1; b, 5; C19b, 1; C24a, 1; C25a+, 1; K03a, 4; K04a, 1; K06a, 1; a+, 1; b, 3; K07b, 2; K08a, 2; b, 2; K10a, 1; a+, 1; K15a, 6; K16a, 5; K22a, 1; K23b, 5; K27b, 3; K29a+, 1.

Notonecta viridis Delcourt, 1909 – C08a+, 1; K04a+, 1; K06a+, 1; K07b, 3; K13a, 1; a+, 8; b, 2; K27a+, 4; b, 4.

Pleidae

Plea minutissima minutissima Leach, 1817 – C01a+, 1; C02a+, 1; C06a+, 1; C12a+, 1; C18a+, 3; C22a, 1; a+, 1; K03a+, 3; K06a+, 3; K07a+, 2; K08a+, 1; K09a+, 1; K10a+, 6; K13a+, 1; K15a, 2; a+, 2; K16a, 1; a+, 2; K18a, 4; a+, 5; K22a+, 2; K23a+, 4; b, 1; K25a+, 2; K27a+, 1; K28a+, 1; b, 1; K29a+, 1.

Mesoveliidae

Mesovelia furcata Mulsant & Rey, 1852 – K28b, 1.

Hydrometridae

Hydrometra gracilenta Horváth, 1899 – C07a, 1; C11a+, 1; K08a, 4; a+, 1; b, 2; K09a+, 1.

Hebridae

Hebrus pusillus (Fallén, 1807) – C06a+, 1; K08a, 2.

Hebrus ruficeps Thomson, 1871 – C07a+, 1; C17a+, 1; K16a, 1.

Veliidae

Microvelia buenoi Drake, 1920 – K15a, 13; K16a, 21; a+, 7; K17a, 2; K18a, 1.

Microvelia pygmaea (Dufour, 1833) – C03a+, 1; K01a+, 1; K08b, 1; K15a, 1; K26a, 1.

Microvelia reticulata (Burmeister, 1835) – C02a, 1; a+, 9; C04a+, 6; C05a, 6; a+, 2; C06a+, 3; C07a, 2; a+, 1; C08a+, 1; C09a+, 2; C10a, 1; a+, 3; C15a, 10; C16a+, 1; C17a+, 7; b, 1; C18a+, 5; C19a+, 3; C21a+, 3;

C22a, 5; C24a, 1; C25a, 4; K02a, 3; a+, 1; K03a+, 1; K06a+, 1; K08a, 6; a+, 8; b, 1; K09a, 3; a+, 11; K10a, 3; a+, 5; K15a, 1; a+, 6; K16a, 3; a+, 11; K17a, 1; a, 4; K18a+, 4; K22a, 1; K23a+, 1; K25a, 6; a+, 1; K26a, 3; a+, 2; K27a+, 2.

Gerridae

Aquarius paludum paludum (Fabricius, 1794) – K27b, 1; K28a+, 1.

Gerris argentatus Schummel, 1832 – C01a, 1; a+, 1; C02a, 1; a+, 2; C03a, 1; C05a, 1; C06a+, 2; C07a, 1; C12a, 1; a+, 2; C16a+, 1; C23a, 1; C25a, 3; K03a, 1; K07a+, 2; K08a, 3; a+, 7; b, 2; K09a, 1; K11a, 1; K13a+, 3; K14a+, 1; K15a, 4; K16a, 1; a+, 4; K17a, 2; K18a, 1; K27a+, 2.

Gerris asper (Fieber, 1860) – C11a, 1; C12a, 1; K18a, 1.

Gerris odontogaster (Zetterstedt, 1828) – C01a, 6; C02a, 1; a+, 3; C04a, 2; C04a+, 11; C05a, 1; a+, 1; C06a+, 5; C07a, 1; a+, 7; C08a+, 3; C12a+, 1; C14a, 1; a+, 2; C18a+, 8; b, 2; C19a+, 8; b, 3; C21a+, 1; C22a, 8; C22a+, 2; C23a, 2; C24a, 1; C25a, 4; K02a, 1; K03a, 4; a+, 1; K04a+, 1; K05a, 2; K06b, 1; K07a+, 8; K08a, 7; b, 2; K09a+, 1; K10a+, 2; K13a, 3; a+, 3; K15a, 1; K17a, 1; K18a, 1; K22a, 3; K23a+, 3; b, 1; K25a, 2; K26a+, 1; K27a, 1; a+, 1; K28a+, 1; b, 1.

Gerris thoracicus Schummel, 1832– C01a, 1; a+, 1; C22a, 1; K04a+, 10; K06b, 2; K13a, 2; a+, 1; K27a, 1; b, 2.

Coleoptera

(identified by Zoltán Csabai (majority), Zoltán Kálmán (Helophoridae, Dryopidae), Andor Lökkös (Hydraneidae, Scirtidae))

Dryopidae

Dryops anglicanus Edwards, 1909 – K03a+, 1.

Dryops rufipes (Krynicki, 1832) – C04a+, 4; C10a+, 2; C11a+, 4; C24a, 15; K22a, 6; K26a+, 6.

Dryops similaris Bollow, 1936 – C05a+, 1; C06a+, 1; C09a+, 1; C17a+, 1; C21a+, 1; C24a, 5; a+, 5; K03a+, 2; K08a+, 3; K10a+, 1; K19a+, 3; K23a+, 10; b, 1; K24a+, 2; K28a+, 3; K29a+, 1.

Dytiscidae

Agabus bipustulatus (Linnaeus, 1767) – C02a+, 5; C03a+, 2; C05a+, 4; C07a+, 1; C09a+, 4; C12a+, 5; C13a+, 1; C14b, 2; C15a+, 1; C17a+, 1; C18a+, 5; C22a+, 3; C24a+, 2; C25a+, 3; K01a+, 8; K02a+, 5; K03a+, 6; K04a+, 2; K07a+, 8; K09a+, 2; K10a+, 4; K15a+, 1; K22a+, 1; K23a+, 3; K24a+, 2; K25a+, 6; K26a+, 9; K28a+, 1; K29a+, 10.

Agabus labiatus (Brahm, 1791) – C04a, 2; C07a, 1; C09a, 1; C11a, 8; C12a, 1; C13a, 1; C15a, 7; a+, 1; C18b, 1; C20a, 4; C22a, 1; C23a, 1; C24a, 3; C25a, 1; K03a+, 2; K04a+, 1; K08a, 3; K14a+, 1; K15a, 1; K19a+, 1; K21a+, 1; K22a, 1 ; K23a+, 1; K28a, 1.

Agabus lotti Turner, Toledo & Mazzoldi, 2015 – C02a+, 3; C03a+, 4; C04a+, 4; C06a+, 2; C07a+, 1; C09a+, 7; C10a+, 14; C11a, 1; a+, 1; C12a+, 11; C13a, 1; a+, 1; C14a, 2; a+, 3; C15a, 4; a+, 7; C16a+, 4; C17a+, 4; C18a+, 11; C19a+, 1; C20a, 4; C21a+, 1; C22a, 2; a+, 9; C23a, 14; C24a+, 13; C25a+, 8; K01a, 1; a+, 12; K02a, 1; a+, 9; K03a+, 7; K04a+, 3; K05a, 2; a+, 3; K07a+, 4; K08a, 3; a+, 5; K09a, 1; a+, 3; K10a, 1; a+, 1; K11a, 1; K13a+, 2; K14a+, 3; K15a+, 6; K18a+, 3; K19a+, 17; K20a+, 1; K21a+, 3; K22a+, 6; K23a+, 6; K24a+, 13; K25a+, 5; K26a+, 17; K27a+, 1; K28a+, 3; K29a+, 12.

Agabus striolatus (Gyllenhal, 1808) – C18a+, 1.

Bidessus nasutus Sharp, 1887 – C01a+, 7; C07a+, 1; C11a, 1; C14a+, 1; C15a, 1; C19a+, 1; C22a+, 1; K01a+, 1; K03a+, 3; K04a+, 1; K05a+, 1; K07b, 9; K11a, 2; K13a+, 1; b, 3; K15a, 13; a+, 2; K18a, 3; K20a+, 2; K27a+, 1; b, 2; K28a+, 1.

Bidessus unistriatus (Goeze, 1777) – K04a+, 2; K07b, 2; K08a, 1; K09a, 1; K25a+, 1; K27b, 1.

Clemnius decoratus (Gyllenhal, 1810) – C10a, 1; a+, 12; C11a, 1; a+, 5; C12a, 1; C13a+, 1; C14a, 2; a+, 1; C17a+, 15; C22a+, 1; C24a+, 2; K07b, 1; K15a, 1; K16a, 1; a+, 1; K18a, 3; K24a+, 1; K26a, 1.

Colymbetes fuscus (Linnaeus, 1758) – C01a, 1 C04a+, 1; C07a, 1; C14b, 1; C18b, 3; C25a, 1; K02a, 2; a+, 1; K04a+, 4; K05a, 1; K06a, 1; K07a+, 1; K10a, 1; a+, 1; K11a, 1; K12a, 1; K13a, 1; a+, 3; K20a+, 1; K22a, 1; K23b, 2; K25a, 1; K27a, 2; a+, 1; K28a, 1.

Cybister lateralimarginalis (De Geer, 1774) – C01a, 2; C04a+, 5; C05a, 1; C19a+, 2; C22a+, 1; K03a+, 1; K04a+, 19; K06a+, 11; K07a+, 2; K08a+, 3; b, 15; K10a+, 2; K13a+, 2; K14a+, 1; K15a, 2; K16a, 1; K22a, 1; K23b, 3; K25a, 1; K27a, 2; a+, 15; K28a+, 3.

Dytiscus dimidiatus Bergsträsser, 1778 – C05a+, 1; K08a+, 2; b, 1; K23b, 1; K29a+, 1.

Dytiscus marginalis Linnaeus, 1758 – C05a+, 1; C24a+, 1; C25a+, 1; K03a, 1; K13a+, 1; K21a+, 2; K22a+, 3; K23a+, 1; K24a+, 1; K26a+, 1.

Eretes sticticus (Linnaeus, 1767) – FHP – K04a+, 4; K13a+, 3.

Graphoderus austriacus (Sturm, 1834) – C01a, 1; a+, 8; C04a, 1; a+, 4; C05a, 8; a+, 2; C06a+, 3; C07a, 3; a+, 7; C09a+, 2; C11a+, 2; C12a+, 2; C13a, 1; C14a, 5; b, 1; C15a, 1; C16a+, 4; C17a+, 1; C18a+, 3; b, 4; C20a, 4; C21a+, 1; C22a, 8; a+, 1; C24a+, 2; K03a, 1; a+, 4; K04a+, 9; K05a+, 1; K06a+, 3; K07a+, 1; K08a, 3; a+, 1; b, 1; K10a+, 6; K13a+, 4; K15a, 8; a+, 2; K22a+, 2; K23a+, 2; b, 1; K26a, 1; K27b, 1; K28a+, 3.

Graphoderus cinereus (Linnaeus, 1758) – C01a+, 2; C05a, 2; a+, 1; C06a+, 2; C11a+, 2; C13a, 1; C14a+, 1; C16a+, 1; C18b, 1; C19a+, 2; C21a+, 2; C24a+, 1; K02a, 2; K05a+, 1; K07b, 2; K08a+, 1; K10a+, 1; K11a, 1; K14a+, 1; K21a+, 1; K23b, 1; K27a+, 1.

Graptodytes bilineatus (Sturm, 1835) – C01a, 1; C02a+, 2; C04a+, 4; C09a+, 5; C10a, 2; a+, 4; C11a, 7; a+, 3; C12a, 4; C13a+, 1; C14a, 1; a+, 1; C15a, 4; C17a+, 15; C18a+, 1; C20a, 7; C22a, 4; a+, 9; C24a, 6; a+, 12; C25a, 3; a+, 2; K01a, 3; K02a, 1; K04a+, 1; K08a, 5; a+, 1; K10a+, 3; K15a, 4; a+, 2; K19a+, 3; K21a+, 1; K22a+, 1; K23a+, 2; K24a+, 1; K25a+, 1; K26a, 2; a+, 8; K29a+, 1.

Graptodytes granularis (Linnaeus, 1767) – C09a+, 6; C11a+, 2.

Hydaticus grammicus (Germar, 1830) – C07a+,1; C10a+, 1; C17a+, 1; C18b, 2; K08a+, 1; K19a+, 1; K23a+, 1; K25a+, 1.

Hydaticus seminiger (De Geer, 1774) – C03a+, 1; C07a, 1; C11a+, 2; C12a, 1; C13a+, 2; C14a+, 1; b, 2; C19a+, 1; C22a, 1; K01a+, 1.

Hydaticus transversalis (Pontoppidan, 1763) – C04a, 1; C05a, 2; C10a+, 1; C12a+, 2; C13a+, 1; C14a+, 2; C14b, 2; C15a, 1; C17b, 1; C18b, 1; C19a+, 2; C21a+, 1; C22a, 1; K08a+, 1.

Hydroglyphus geminus (Fabricius, 1792) – C01a+, 4; C02a+, 1; C03a, 2; C04a, 2; a+, 2; C05a, 11; a+, 2; C06a+, 2; C07a, 15; a+, 5; C09a, 9; a+, 4; C10a, 5; a+, 3; C11a, 9; a+, 5; C12a, 15; C13a, 6; a+, 11; C14a, 2; a+, 2; b, 2; C15a, 7; a+, 6; C16a+, 6; C17a+, 5; C18a+, 18; b, 3; C19a+, 6; b, 1; C20a, 5; C21a+, 6; C22a, 5; a+, 6; C24a, 4; a+, 2; C25a+, 7; C26a, 2; K01a, 2; a+, 2; K02a, 10; a+, 1; K03a+, 18; K05a, 1; a+, 1; K06a+, 6; K07b, 1; K08a, 13; a+, 2; K09a, 3; a+, 2; K10a, 14; a+, 5; K11a, 2; K13a+, 7; b, 1; K14a+, 4; K15a, 14; a+, 1; K16a, 1; a+, 1; K17a, 2; K18a, 4; a+, 4; K19a+, 10; K20a+, 4; K21a+, 1; K22a, 3; a+, 3; K23a+, 6; b, 1; K24a+, 3; K25a, 11; K25a+, 8; K26a, 4; a+, 1; K27a, 8; a+, 2; K28a+, 7; K29a+, 8.

Hydroporus angustatus Sturm, 1835 – C04a, 5; C09a, 1; C11a, 4; C13a, 2; C15a, 3; C20a, 2; C21a+, 1; C22a, 1; C24a, 3; a+, 3; C25a, 1; K08a, 3; K10a, 1; K13b, 1; K18a, 1; K26a, 2.

Hydroporus fuscipennis Schaum, 1868 – C02a+, 1; C15a+, 1; C18a+, 2; C21a+, 1; C23a, 1; C24a, 7; K07a+, 1; K08a+, 1; K10a+, 1; K19a+, 1; K23a+, 4; K26a+, 1; K28a+, 2.

Hydroporus hebaueri Hendrich, 1990 – C03a+, 4; C04a+, 1; C05a+, 2; C07a, 1; C09a+, 14; C10a+, 13; C11a+, 6; C12a+, 20; C13a+, 20; C14a+, 9; C15a, 1; a+, 1; C17a+, 14; C18a+, 18; C19a+, 1; C21a+, 1; C22a+, 3; C24a+, 3; C25a+, 4; K01a+, 7; K02a+, 1; K04a+, 2; K07a+, 1; K15a+, 1; K18a+, 1; K24a+, 2; K25a+, 1; K26a+, 17; K28a+, 2; K29a+, 1.

Hydroporus palustris (Linnaeus, 1761) – C03a, 1; a+, 2; C12a+, 1; C14b, 1; K03a+, 1; K07b, 1; K21a+, 1; K29a+, 2.

Hydroporus planus (Fabricius, 1781) – C01a+, 10; C02a+, 4; C03a+, 1; C04a+, 3; C09a+, 7; C10a+, 1; C11a+, 8; C13a+, 2; C15a+, 7; C18a+, 4; C21a+, 2; C22a+, 4; C24a+, 2; C25a+, 5; K01a+, 3; K02a+, 2; K03a+, 21; K04a+, 7; K05a, 3; a+, 2; K06a, 1; a+, 3; K07a+, 8; K08a, 1; a+, 4; K10a+, 3; K11a, 1; K13a+, 7; K14a+, 5; K15a+, 10; K16a+, 7; K18a+, 17; K19a+, 15; K20a+, 4; K21a+, 6; K22a+, 1; K23a+, 6; K24a+, 4; K25a, 1; a+, 5; K26a, 1; a+, 4; K27a, 1; a+, 3; K28a+, 8; K29a+, 9.

Hydroporus striola (Gyllenhal, 1826) – C23a, 1; K10a+, 1; K13b, 1.

Hydrovatus cuspidatus Kunze, 1818 – C02a+, 1; C04a+, 1; C11a+, 7; C18a+, 3; C25a+, 1; K08a+, 1; K15a+, 2; K18a+, 2; K23a+, 1.

Hygrotus confluens (Fabricius, 1787) – K04a, 1.

Hygrotus impressopunctatus (Schaller, 1783) – C01a, 3; C02a+, 1; C04a, 3; a+, 1; C05a, 2; a+, 3; C06a+, 2; C07a, 5; a+, 5; C09a+, 5; C10a, 3; a+, 1; C11a, 5; a+, 3; C12a, 8; a+, 3; C13a+, 1; C14a, 5; a+, 2; b, 1; C15a, 3; a+, 4; C16a+, 2; C17a+, 2; C18a+, 6; C19a+, 1; b, 1; C20a, 2; C21a+, 3; C22a, 3; a+, 5; C23a, 3; C24a, 3; a+, 3; C25a, 2; a+, 1; K01a+, 5; K02a, 5; K03a+, 9; K04a+, 1; K05a, 2; K06a, 5; K07b, 1; K08a, 6; a+, 2; b, 2; K09a, 4; K10a+, 1; K11a, 1; K13a+, 3; b, 2; K15a, 4; a+, 2; K16a, 3; K19a+, 2; K22a, 3; a+, 2; K23a+, 4; K24a+, 1; K25a+, 1; K26a, 3; a+, 6; K27a+, 1; b, 1; K28a+, 4; b, 2; K29a+, 3.

Hygrotus inaequalis (Fabricius, 1776) – C04a, 1; C11a, 1; C12a, 2; C13a+, 1; C14b, 4; C15a, 2; C17a+, 2; b, 3; C18a+, 1; C19a+, 2; C21a+, 5; C22a, 3; a+, 1; C24a+, 1; K08a+, 1; K09a, 1; K13b, 2; K15a, 10; a+, 1; K20a+, 1; K23b, 1; K27b, 1.

Hygrotus parallellogrammus (Ahrens, 1812) – HP – C07a, 1; C13a+, 1; C15a+, 1; C22a, 2; a+, 1; K01a+, 1; K03a+, 2; K04a+, 6; K06a, 3; a+, 1; b, 1; K07b, 2; K08a, 1; K09a, 1; K13a+, 2; b, 7; K15a, 1; a+, 1; K28a+, 1.

Hyphydrus anatolicus Guignot, 1957 – C04a, 1; C05a, 1; C18b, 1; C19a+, 2; C21a+, 2; C22a, 1.

Hyphydrus ovatus (Linnaeus, 1761) – C03a+, 2; C18b, 1; C21a+, 1.

Ilybius ater (De Geer, 1774) – C14a+, 1.

Ilybius pseudoneglectus (Franciscolo, 1972) – C13a+, 1; C18a+, 1; b, 1; C26a, 1; K08a+, 1.

Ilybius quadriguttatus (Lacordaire, 1835) – C04a+, 1; C11a+, 1; C12a+, 6; C13a+, 3; C18a+, 1; b, 4; C24a+, 1; K09a+, 1; K10a+, 1; K16a+, 3; K21a+, 7; K26a+, 1.

Ilybius subaeneus Erichson, 1837 – C05a+, 8; C06a+, 2; C12a+, 1; C14a+, 1; C18a+, 3; b, 10; C19a+, 2; C21a+, 3; C24a+, 2; K03a+, 2; K08a+, 1; K09a+, 1; K21a+, 2; K23a+, 2; K29a+, 1.

Laccophilus minutus (Linnaeus, 1758) – C01a, 1; a+, 5; C04a, 8; a+, 5; C05a, 4; C06a+, 3; C07a, 4; C09a, 1; a+, 1; C11a, 2; C12a, 2; a+, 2; C13a, 2; a+, 3; C14a, 1; a+, 2; b, 3; C15a, 6; a+, 6; C18a+, 1; b, 1; C20a, 1; C21a+, 1; C22a, 1, C25a, 1; K01a, 2, K02a, 6; K03a, 1; a+, 11; K04a+, 4; K07a+, 4; K08a, 1; a+, 2; K09a, 4; K10a, 4; a+, 4; K13a+, 3; K14a+, 5; K16a, 1; K18a+, 6; K19a+, 2; K20a+, 1; K21a+, 4; K22a+, 1; K23b, 1; K24a+, 3; K25a+, 2; K26a, 1; K27a, 1; a+, 5; b, 4; K28a+, 1; K29a+, 8.

Laccophilus poecilus Klug, 1834 – C01a, 1; a+, 2; C04a, 1; a+, 1; C05a, 3; a+, 1; C07a, 2; a+, 1; C08a+, 1; C10a, 2; C11a+, 1; C12a, 3; a+, 2; C13a+, 1; C14a, 5; a+, 2; b, 4; C15a+, 1; C16a+, 4; C17a+, 6; C18a+, 4; b, 1; C19a+, 2; C20a, 1; C21a+, 4; C22a+, 2; C25a+, 1; K01a, 2; a+, 1; K03a+, 1; K04a+, 1; K07a+, 1; b, 1; K08a, 9; a+, 1; K09a, 1; a+, 3; K13a+, 1; K14a+, 2; K16a, 1; K21a+, 3; K23a+, 5; K26a, 1; K28a+, 1.

Laccornis kocae (Ganglbauer, 1906) – C03a, 1; C04a, 2; a+, 1; C07a+, 1; C10a, 1; C12a, 1; a+, 1; C15a, 1; a+, 2; C17a+, 4; C20a, 7; C23a, 2; C24a, 1; a+, 2; K01a, 1; a+, 4; K08a, 2; K14a+, 1; K15a+, 3; K19a+, 2; K22a, 1; K23a+, 2; K24a+, 2; K25a+, 2; K26a+, 3; K29a+, 3.

Liopterus haemorrhoidalis (Fabricius, 1787) – C05a, 1; C07a, 1; a+, 1; C09a+, 2; C10a, 3; a+, 3; C11a, 1; a+, 1; C12a, 1; C14a, 4; a+, 1; C15a, 1; a+, 1; C16a+, 1; C17a+, 3; C18b, 1; C20a, 8; C21a+, 4; C22a, 1; a+, 1; C23a, 2; C24a, 4; a+, 5; C25a, 2; a+, 2; K01a, 1; a+, 4; K05a, 1; K08a, 2; a+, 2; K11a, 1; K13a, 1; K14a+, 1; K16a, 1; a+, 2; K18a, 1; K19a+, 6; K21a+, 1; K22a+, 3; K23a+, 3; K24a+, 1; K25a, 1; a+, 2; K26a, 7; a+, 2; K27a+, 1; K28a+, 1; K29a+, 1.

Porhydrus obliquesignatus (Bielz, 1852) – C06a+, 1; C22a, 1; a+, 3; C24a+, 5; K13b, 2; K17a, 1; K23a+, 1; b, 3; K27b, 1; K28b, 1.

Rhantus bistriatus (Bergsträsser, 1778) – K03a+, 1; K04a+, 1.

Rhantus grapii (Gyllenhal, 1808) – C11a, 1; a+, 1.

Rhantus suturalis (MacLeay, 1825) – C04a+, 2; C05a, 10; a+, 3; C06a+, 1; C07a, 7; a+, 2; C09a+, 5; C10a+, 2; C11a+, 3; C12a+, 6; C13a, 1; a+, 3; C14a, 4; a+, 5; b, 10; C15a, 2; a+, 2; C16a+, 3; C17a+, 2; C18a+, 2; b, 3; C20a, 1; C22a, 4; a+, 1; C24a+, 2; C25a, 3; a+, 4; C26a, 2; K01a, 8; a+, 7; K02a, 10; a+, 5; K03a, 3; a+, 5; K07a+, 3; K08a, 7; a+, 1; K10a, 1; a+, 1; K11a, 1; K13a+, 3; K14a+, 2; K15a, 4; a+, 4; K18a, 1; a+, 1; K19a+, 3; K21a+, 1; K22a+, 2; K23a+, 3; K24a+, 6; K26a, 2; a+, 12; K28a+, 1; K29a+, 1.

Gyrinidae

Gyrinus colymbus Erichson, 1837 – C18a+, 1.

Gyrinus distinctus Aube, 1836 – C18a+, 2; K08a+, 2; K13a+, 1; K27a+, 1; b, 2; K28a+, 1.

Gyrinus substriatus Stephens, 1829 – K27a+, 1.

Haliplidae

Haliplus fluviatilis Aube, 1836 – C07a, 1; C12a, 1; a+, 1; C14b, 1.

Haliplus immaculatus Gerhardt, 1877 – K03a, 2; K18a, 1.

Haliplus maculatus Motschulsky, 1860 – HB – C25a+, 1; K15a, 1.

Haliplus ruficollis (De Geer, 1774) – C03a, 1; C09a, 1; a+, 3; C17a+, 1; C18a+, 1; K01a+, 1; K07a+, 1; K15a, 1; K23a+, 2.

Peltodytes caesus (Duftschmid, 1805) – K03a+, 1; K04a+, 1; K05a, 1; K15a, 6; a+, 2; K16a, 1; K18a+, 5.

Helophoridae

Helophorus aquaticus/aequalis – C01a+, 13; C02a+, 9; C04a+, 6; C05a+, 2; C09a+, 21; C10a+, 2; C11a+, 24; C13a+, 2; C16a+, 6; C17a+, 2; C18a+, 2; C19a+, 10; C21a+, 1; C22a+, 1; C24a+, 10; C25a+, 9; K01a+, 19; K02a+, 7; K03a+, 24; K04a+, 5; K05a+, 12; K06a+, 9; K07a+, 12; K08a+, 2; K10a+, 7; K13a+, 20; K19a+, 11; K20a+, 10; K21a+, 2; K23a+, 12; K24a+, 8; K25a+, 6; K26a+, 6; K27a+, 8; K28a+, 11; K29a+, 18.

Helophorus brevipalpis Bedel, 1881 – C02a+, 1; C12a+, 1; C17a+, 1; C25a+, 3; K03a+, 1; K04a+, 6; K08b, 1; K19a+, 1; K27a+, 1; b, 1; K28a+, 2.

Helophorus grandis Illiger, 1798 – C04a+, 1; C13a+, 1; C18a+, 2; C19a+, 2; C22a+, 3; C25a+, 1; K04a+, 3; K23a+, 3; K24a+, 3; K27a+, 6.

Helophorus griseus Herbst, 1793 – C18a+, 1; K03a+, 5; K04a+, 4; K05a+, 1; K23a+, 2; K27a+, 3; K28a+, 3; K29a+, 1.

Helophorus liguricus Angus, 1970 – C02a+, 1; C19a+, 2; K04a+, 1; K21a+, 2.

Helophorus micans Faldermann, 1835 – HP – C01a+, 2; C04a+, 1; C09a+, 3; C10a+, 1; C11a+, 2; C12a+, 1; C19a+, 1; C22a+, 6; C24a+, 5; C25a+, 3; K01a+, 6; K02a+, 1; K03a+, 3; K04a+, 27; K05a+, 2; K07a+, 2; K10a+, 1; K13a+, 3; K21a+, 2; K23a+, 5; K25a+, 7; K26a+, 1; K27a+, 3; K28a+, 8; K29a+, 3.

Helophorus minutus/paraminutus – C01a+, 11; C02a+, 1; C04a+, 1; C09a+, 3; C10a+, 7; C11a+, 3; C12a+, 3; C13a+, 2; C16a+, 2; C18a+, 2; b, 1; C19a+, 2; C22a+, 9; C24a+, 1; C25a+, 4; K01a+, 4; K02a+, 1; K03a+, 27; K04a+, 28; K05a+, 2; b, 1; K07a+, 7; K08b, 4; K13a+, 3; b, 11; K19a+, 2; K20a+, 3; K23a+, 10; b, 1; K24a+, 1; K25a+, 11; K26a+, 23; K27a+, 2; b, 2; K28a+, 1; b, 2.

Helophorus montenegrinus Kuwert, 1885 – C01a+, 1; C04a+, 2; C06a+, 1; C09a+, 2; C10a+, 1; C12a+, 2; C13a+, 1; C21a+, 1; C22a+, 2; C25a+, 2; K01a+, 4; K02a+, 1; K03a+, 1; K04a+, 5; K05b, 1; K06a+, 1; K19a+, 3; K24a+, 2; K27a+, 2; b, 1; K28a+, 6; b, 1; K29a+, 3.

Helophorus nubilus Fabricius, 1777 – C17a+, 1; K03a+, 1; K04a+, 3; K07a+, 4; K23a+, 1.

Helophorus redtenbacheri Kuwert, 1885 – C01a+, 2; C14a+, 1; K23a+, 2.

Hydraenidae

Hydraena palustris Erichson, 1837 – C17a+, 4.

Limnebius atomus (Duftschmid, 1805) – C04a, 1; C24a, 1.

Ochthebius bernhardi Jäch & Delgado, 2008 – K27b, 1.

Ochthebius lividipennis Peyron, 1858 – C04a+, 1; K05a+, 1; K06b, 3; K08b, 1; K13b, 1; K25a, 1; K27b, 1.

Ochthebius meridionalis Rey, 1885 – C26a, 1; K05a, 1; K06b, 7; K13b, 3; K16a+, 1; K27b, 1.

Ochthebius minimus (Fabricius, 1792) – C14b, 1; K13b, 1.

Hydrochidae

Hydrochus angustatus Germar, 1824 – C17b, 1; K08b, 1; K23b, 1; K27b, 1.

Hydrochus elongatus (Schaller, 1783) – C24a+, 1; K07a+, 1; K10a+, 2.

Hydrochus flavipennis Kuster, 1852 – C05a+, 1; C17a+, 1; C18a+, 4; C19a+, 1; K23a+, 2.

Hydrophilidae

Anacaena limbata (Fabricius, 1792) – C03a+, 3; C04a, 4; a+, 11; C05a, 1; C07a, 2; C09a+, 3; C10a+, 7; C11a, 11; a+, 5; C13a, 1; C14a+, 4; b, 1; C15a, 6; C20a, 5; C21a+, 4; C23a, 2; C24a+, 2; C25a+, 1; K01a+, 1; K03a+, 1; K05a, 1; K06b, 1; K08a, 2; a+, 1; K21a+, 1; K26a+, 2; K29a+, 1.

Berosus frontifoveatus Kuwert, 1888 – C01a, 1; C11a, 1; C15a+, 1; C16a+, 7; C20a, 1; C25a+, 1; K01a, 1; a+, 1; K04a+, 6; K05a+, 2; K06a+, 4; K09a, 2; K10a, 1; a+, 7; K13a+, 16; b, 4; K20a+, 1; K23b, 1; K25a, 1; a+, 4; K26a, 1; K27a, 2; a+, 2.

Berosus fulvus Kuwert, 1888 – HB – K04a+, 1; K13a+, 2.

Berosus geminus Reiche & Saulcy, 1856 – C12a, 1; C18a+, 1; K02a, 1; K03a, 1; K05a, 1; K10a, 2.

Berosus signaticollis Charpentier, 1825 – C04a+, 1; C07a, 1; a+, 1; C09a+, 1; C12a, 1; C15a+, 2; C17a+, 1; C18a+, 3; C20a, 1; C22a+, 2; C26a, 1; K01a, 4; a+, 5; K02a, 9; K03a+, 1; K04a, 1; K05a, 1; K06a+, 1; K10a, 7; a+, 1; K11a, 2; K12a, 1; K15a+, 2; K22a+, 1; K23a+, 2; K26a, 1; K27a+, 2.

Berosus spinosus (Steven, 1808) – HB – K04a, 2; a+, 18; K05a, 3; a+, 11; K06a, 1; a+, 3; K10a, 2; K13a, 1; a+, 3; K25a, 1; a+, 1.

Coelostoma orbiculare (Fabricius, 1775) – C05a, 1.

Cymbiodyta marginella (Fabricius, 1792) – C02a+, 3; C03a, 1; C04a, 5; a+, 6; C05a, 2; a+, 3; C07a, 7; a+, 1; C09a+, 4; C10a, 4; a+, 9; C11a, 6; a+, 14; C12a, 5; C13a, 2; a+, 1; C14a, 4; b, 1; C15a, 9; a+, 2; C17a+, 5; C18a+, 1; b, 1; C19a+, 2; C20a, 8; C21a+, 5; C22a, 2; a+, 7; C23a, 9; C24a, 10; a+, 11; C25a, 1; a+, 11; K01a+, 1; K02a, 2; a+, 2; K04a, 1; K05a, 2; K06b, 2; K07a+, 1; K08a, 7; a+, 4; b, 1; K09a, 3; a+, 1; K10a, 3; a+, 2; K13b, 3; K15a, 3; a+, 12; K16a+, 1; K19a+, 2; K22a+, 2; K23a+, 7; K26a, 4; a+, 3; K28a+, 3; K29a+, 2.

Enochrus affinis (Thunberg, 1794) – C04a+, 3; C05a+, 3; C06a+, 1; C07a, 1; a+, 2; C09a+, 5; C11a, 2; C19a+, 1; C20a, 4; C22a+, 8; C23a, 1; C24a, 1; a+, 2; C25a+, 1; K01a+, 1; K08a+, 1; b, 2; K23a+, 2; K24a+, 3; K29a+, 1.

Enochrus ater (Kuwert, 1888) – C03a, 1.

Enochrus bicolor (Fabricius, 1792) – HP – C02a+, 1; C15a, 2; a+, 1; C19b, 1; C20a, 2; C25a+, 1; C26a, 1; K03a+, 1; K04a+, 12; K05a+, 4; K06a+, 1; b, 1; K09a+, 1; K10a, 1; K13a+, 7; K14a+, 1; K18a+, 1; K29a+, 1.

Enochrus coarctatus (Gredler, 1863) – C11a+, 2; C12a, 1; C13a, 2; C14a, 2; b, 1; C15a, 3; K07a+, 1; K15a, 1; K23b, 4.

Enochrus hamifer (Ganglbauer, 1901) – HB – C01a, 2; a+, 4; C20a, 1; C22a, 4; a+, 2; C23a, 2; K01a, 2; K02a, 7; a+, 2; K03a, 2; a+, 1; K04a, 1; a+, 8; K05a, 14; a+, 3; K06a, 4; a+, 2; b, 2; K07a+, 1; b, 4; K08a, 3; b, 1; K09a, 2; a+, 1; K10a, 1; a+, 2; K13a+, 4; b, 1; K27a, 6; b, 2; K28a+, 1; K29a+, 1.

Enochrus ochropterus (Marsham, 1802) – K08b, 1.

Enochrus quadripunctatus (Herbst, 1797) – C01a, 2; a+, 3; C02a+, 1; C03a, 1; C04a, 2; a+, 10; C05a, 1; a+, 6; C06a+, 1; C07a+, 1; C09a+, 7; C10a, 1; a+, 4; C11a, 5; a+, 2; C12a, 6; C13a, 1; a+, 2; C14a, 1; C15a, 2; a+, 13; C16a+, 4; C18a+, 1; b, 3; C19a+, 8; b, 1; C20a, 8; C21a+, 1; C22a, 10; a+, 18; C23a, 25; C24a, 10; a+, 8; C25a, 1; a+, 9; C26a, 3; K01a, 1; a+, 7; K02a, 3; a+, 5; K03a, 2; a+, 13; K04a, 1; a+, 2; K05a, 9; a+, 4; K06a+, 1; K07a+, 3; K08a, 1; a+, 2; b, 4; K10a+, 9; K11a, 5; K12a, 1; K13a, 1; a+, 2; b, 4; K14a+, 4; K15a, 6; a+, 2; K16a+, 1; K19a+, 10; K22a, 2; a+, 7; K23a+, 25; b, 2; K24a+, 8; K25a, 1; a+, 3; K26a, 18; a+, 7; K27b, 5; K28a, 1; a+, 14; K29a+, 6.

Enochrus testaceus (Fabricius, 1801) – C05a, 2; C07a+, 2; C09a, 2; a+, 2; C10a, 1; C11a+, 1; C13a, 3; a+, 1; C14a, 1; C20a, 1; C24a, 1; a+, 1; K02a, 1; K03a+, 2; K08a+, 2; K09a+, 1; K16a, 1; a+, 4; K18a, 1; K26a, 1; K27a+, 2; b, 1; K28a, 3.

Helochares lividus (Forster, 1771) – FHP – K13b, 1.

Helochares obscurus (O. F. Müller, 1776) – C04a+, 8; C05a, 1; a+, 3; C06a+, 1; C07a+, 1; C09a+, 3; C11a, 3; a+, 4; C12a, 3; a+, 1; C13a+, 1; C14a, 1; C18a+, 1; b, 2; C19b, 1; C20a, 1; C21a+, 3; C22a, 1; a+, 3; C24a+, 1; C25a+, 1; K01a+, 1; K02a, 1; a+, 1; K03a+, 2; K05a, 3; K08a, 5; a+, 2; K10a, 1; a+, 4; K13a+, 1; K14a+, 1; K17a, 1; K23a+, 6; b, 2; K24a+, 1; K26a, 3; a+, 1; K27b, 2; K28a+, 2; K29a+, 2.

Hydrobius fuscipes (Linnaeus, 1758) – C01a, 4; C04a, 1; a+, 1; C05a, 1; C06a+, 3; C07a, 1; C09a, 3; a+, 1; C10a, 1; C11a, 3; a+, 5; C15a, 2; a+, 2; C20a, 1; C21a+, 1; C22a, 1; a+, 2; C23a, 1; C24a, 8; a+, 4; C25a, 4; C26a, 1; K01a+, 2; K02a+, 1; K03a+, 1; K04a, 1; a+, 2; K05a, 7; a+, 1; K06a, 1; b, 1; K08a, 2; K10a, 1; K11a, 1; K13a, 1; a+, 2; K15a+, 2; K16a+, 1; K20a+, 1; K22a+, 1; K25a+, 1; K26a, 2; K27a, 3; K29a+, 1.

Hydrochara caraboides (Linnaeus, 1758) – C04a, 1; a+, 4; C05a, 1; a+, 2; C07a, 2; C10a+, 4; C11a, 1; a+, 5; C12a+, 3; C13a, 2; a+, 3; C14a, 5; a+, 3; b, 1; C15a, 2; C16a+, 2; C17a+, 4; b, 1; C18a+, 2; C20a, 2; C21a+, 4; C25a, 1; K01a+, 1; K04a+, 1; K07b, 1; K13a, 1; a+, 1; K15a+, 1; K19a+, 1; K23a+, 2; K26a, 1; a+, 2.

Hydrochara dichroma (Fairmaire, 1892) – FHP – C10a+, 1; C13a+, 1; C15a, 1; C16a+, 2; C23a, 3; K01a, 1; a+, 2; K02a, 1; a+, 1; K03a, 2; a+, 2; K04a+, 3; K05a, 2; K08a+, 3; b, 1; K12a, 1; K13a+, 1; b, 1; K15a, 1; K25a, 1; K26a, 1; a+, 1; K28a+, 1.

Hydrochara flavipes (Steven, 1808) – C01a+, 2; C02a+, 1; C04a+, 4; C05a+, 4; C06a+, 1; C07a+, 4; C09a+, 3; C11a+, 4; C13a+, 1; C14a+, 2; b, 1; C15a+, 2; C18a+, 2; b, 1; C22a+, 2; C24a+, 1; K01a+, 1; K02a+, 2; K03a+, 2; K04a+, 1; K06a+, 1; K07a+, 5; K08a+, 1; K10a+, 3; K13a+, 1; K15a+, 3; K18a+, 1; K19a+, 2; K21a+, 1; K22a+, 4; K23a+, 6; K24a+, 1, K25a+, 1; K28a+, 3.

Hydrophilus aterrimus Eschscholtz, 1822 – C17a+, 5; K15a, 2.

Hydrophilus piceus (Linnaeus, 1758) – C04a+, 1; C05a+, 1; C06a+, 2; C07a+, 1; C08a+, 1; C11a, 1; C15a, 1; C19a+, 1; C22a, 1; a+, 1; K03a, 1; a+, 2; K10a+, 1; K13a+, 3; K14a+, 1; K15a, 8; a+, 1; K18a, 1; K22a, 1; a+, 2; K23b, 1; K27a+, 1.

Limnoxenus niger (Gmelin, 1790) – C04a, 1; a+, 3; C05a, 2; a+, 4; C06a+, 1; C09a+, 1; C16a+, 1; C18a+, 2; b, 1; C22a, 1; a+, 4; K03a+, 3; K05a, 3; K07b, 1; K08a+, 1; K10a+, 5; K15a+, 1; K19a+, 4; K21a+, 1; K23a+, 5; K27a, 1; a+, 1; K28a+, 4.

Noteridae

Noterus clavicornis (De Geer, 1774) – C01a, 8; C03a, 2; a+, 4; C04a+, 2; C05a, 3; C06a+, 1; C07a, 1; a+, 1; C08a+, 1; C09a, 2; a+, 2; C12a, 12; a+, 6; C14a+, 1; C15a, 6; a+, 2; C16a+, 10; C17a+, 4; C18a+, 11; C19a+, 8; C21a+, 3; C22a+, 1; C25a, 1; a+, 1; K01a, 10; a+, 4; K02a, 3; K03a, 1; a+, 9; K04a+, 3; K06a+, 1; K07a+, 7; b, 2; K08a, 10; a+, 3; K09a, 1; a+, 1; K10a, 5; a+, 3; K13a+, 7; b, 2; K14a+, 3; K15a, 1; a+, 1; K17a, 1; K18a, 2; a+, 1; K20a+, 1; K21a+, 4; K22a+, 1; K23a+, 2; K27a, 3; a+, 7; b, 1; K28a+, 3.

Noterus crassicornis (O. F. Müller, 1776) – C01a, 1; a+, 3; C02a, 5; a+, 4; C03a, 11; a+, 3; C04a, 4; a+, 2; C05a, 8; a+, 3; C07a, 5; a+, 3; C08a, 2; a+, 1; C09a, 10; a+, 5; C10a, 6; a+, 6; C11a, 7; a+, 3; C12a, 1; C13a, 5; a+, 9; C14a, 8; a+, 3; b, 1; C15a, 8; a+, 4; C16a+, 3; C17a+, 3; b, 1; C18a+, 2; C19a+, 1; C20a, 3; C21a+, 7; C22a, 5; a+, 5; C24a, 6; a+, 10; K03a+, 2; K07a+, 1; b, 1; K08a, 3; b, 1; K09a, 2; a+, 1; K10a, 5; K14a+, 2; K15a, 10; a+, 2; K16a, 5; a+, 3; K18a, 2; a+, 3; K21a+, 2; K24a+, 4.

Scirtidae

Cyphon laevipennis Tournier, 1868 – C04a+, 1.

Spercheidae

Spercheus emarginatus (Schaller, 1783) – C03a, 2; C04a+, 1; C05a, 8; a+, 4; C06a+, 1; C07a, 5; a+, 2; C08a, 2; a+, 1; C09a, 1; a+, 2; C10a, 4; a+, 7; C11a, 3; a+, 5; C12a, 1; a+, 1; C13a, 1; a+, 1; C14a, 2; a+, 5; C15a, 2; C16a+, 1; C17a+, 4; C18a+, 7; C21a+, 4; C22a, 5; C23a, 1; C24a, 1; a+, 6; C25a+, 1; K01a, 1; a+, 1; K02a, 1; a+, 1; K03a+, 1; K04a+, 1; K07a+, 5; K08a, 3; a+, 3; K09a+, 1; K13a, 1; a+, 2; K15a, 1; K21a+, 1; K22a, 1; a+, 2; K25a, 1; K26a, 2; K27a, 3; a+, 2; K28a, 4; a+, 3; K29a+, 1.

Trichoptera
(identified by Arnold Móra)

Limnephilidae

Limnephilus affinis/incisus – C07a, 1; C12a, 9; C20a, 2; K01a, 4; K02a, 1; K03a, 4; K04a, 5; K27a, 1.
Limnephilus flavicornis (Fabricius, 1787) – C03a, 1; C10a+, 1; C11a, 1; C12a, 2; K26a, 1.

Polycentropodidae

Holocentropus stagnalis (Albarda, 1874) – C17a+, 1.

Diptera
(identified by Arnold Móra)

Chironomidae: Chironominae

Chironomus annularius Meigen, 1818 – C08a, 6l; C15a+, 2e; C16a+, 4l; C18a+, 1l; C26a, 7e; K03a, 1e; K04a, 3l; K09a, 6e; a, 2l; K13a, 5e; a, 7l; a+, 4e; a+, 18l; b, 1l; K17a, 2e; K18a, 7e; a+, 2e; a+, 11l; K20a+, 3l; K23b, 2l; K25a, 5e; a+, 5e; K27a, 12e; a, 3l; a+, 3e; a+, 24l; b, 1l; K29a+, 1l.

Chironomus balatonicus Dévai, Wülker & Scholl, 1983 – C15a+, 2e; K17a, 7e; K27a+, 4e; a+, 3l; K27b, 2l.

Chironomus balatonicus/plumosus – C08a, 1l; K13a, 4l; b, 1l.

Chironomus luridus Strenzke, 1959 – K15a, 2e.

Chironomus pallidivittatus Edwards, 1929 – C06a+, 2l; C15a+, 1e; C19a+, 16e; K23b, 3l; K27a+, 1e.

Chironomus parathummi Keyl, 1961 – C03a, 1l; C16a+, 3l; C25a+, 5l; K03a, 1l; K04a, 12l; K08a, 5l; K09a, 2l; K13a+, 1l; b, 4l; K15a, 1l; K16a, 3l; K18a, 1l; K23a+, 8l; K25a, 1l; K29a+, 3l.

Chironomus piger Strenzke, 1956 – C01a, 2e; a, 2l; C02a+, 1l; C15a, 7e; a, 2l; C16a+, 5l; C20a, 3l; C25a+, 1l; C26a, 1e; K03a, 1e; a, 3l; K05a, 1e; K09a, 7e; a, 2l; K10a, 1e; K13a, 4e; a+, 3e; a+, 19l; K17a, 1l; K18a, 3e; a+, 2e; a+, 20l; K20a+, 3l; K21a+, 23l; K23a+, 35l; K25a, 15e; a, 4l; a+, 1e; K27a, 7e; a, 5l; a+, 3e; a+, 5l.

Chironomus plumosus (Linnaeus, 1758) – C15a+, 1e; C26a, 3e; K18a, 7e; a, 4l; a+, 3e; a+, 3l.

Chironomus pseudothummi Strenzke, 1959 – C03a, 23e; a, 1l; C05a, 1e; C06a+, 1l; C07a, 1e; C09a, 1e; C18a+, 1l; C22a, 1e; C26a, 1e; K01a, 5e; a, 5l; K02a, 7e; K03a, 1e; a, 2l; K04a, 2l; K08a, 8e; a, 5l; K09a, 2e; K15a, 7e; K18a, 7e; K22a, 10e; K27a, 1l; K28a, 1e.

Chironomus uliginosus Keyl, 1960 – C06a+, 3l; C12a, 1l; C16a+, 4l; K01a, 4l; K03a, 6l; K04a, 2l; K08a, 1l; K15a, 1l; K16a, 3l; K17a, 2l; K18a, 1l; K23a+, 7l; K27a+, 1l.

Cryptochironomus obreptans (Walker, 1856) – C15a+, 2e.

Cryptochironomus supplicans (Meigen, 1830) – K18a+, 1l.

Dicrotendipes notatus (Meigen, 1818) – C03a, 12l; C04a, 2l; C05a, 1l.

Endochironomus tendens (Fabricius, 1775) – C18a+, 2l.

Glyptotendipes barbipes (Staeger, 1839) – K01a, 1l; K03a, 2l; K08a, 2l; b, 1l; K13a, 8l; a+, 1p; a+, 2l; b, 6l; K27a, 1l; a+, 1e.

Glyptotendipes cauliginellus (Kieffer, 1913) – C18a+, 1l; K08a+, 1e.

Glyptotendipes foliicola Contreras-Lichtenberg, 1997 – C11a, 1l; C15a, 1l; K22a, 12l.

Glyptotendipes pallens (Meigen, 1804) – K18a, 4l; K27a+, 2l.

Kiefferulus tendipediformis (Goetghebuer, 1921) – C21a+, 1l; K18a, 2l.

Microchironomus deribae (Freeman, 1957) – K06b, 8l.

Micropsectra cf. ***notescens*** – C03a, 36e.

Micropsectra junci (Meigen, 1818) – C03a, 1e.

Paratanytarsus grimmii (Schneider, 1885) – K09a, 8e; a, 2l; K17a, 16e; K18a, 4l.

Paratanytarsus inopertus (Walker, 1856) – C03a, 1e; K09a, 2e.

Polypedilum tritum (Walker, 1856) – C09a, 1l; C10a, 1l; C14a+, 1l; C16a+, 1l; C17a+, 1l; C21a+, 6l; C24a, 1l; K15a, 1l; K18a, 1l; K26a, 1l.

Synendotendipes impar (Walker, 1856) – C21a+, 1l; K15a, 7l; K16a, 1l.

Tribelos donatoris (Shilova, 1974) – C04a, 1l; C22a, 2l; C23a, 9l; K01a, 5l; K02a, 2l; K03a, 5l; K22a, 1l; K26a, 1l.

Chironomidae: Orthocladiinae

Acricotopus lucens (Zetterstedt, 1850) – C09a, 4e; C16a+, 1l; C19a+, 1e; K09a, 2e; K15a, 1e; K17a, 3e; K18a, 3e; a+, 1e; a+, 1l.

Allocladius arenarius (Strenzke, 1960) – K06a, 8e; K28a, 1e.

Corynoneura coronata Edwards, 1924 – C03a, 4e.

Corynoneura scutellata Winnertz, 1846 – C03a, 4e; C04a, 8e; C09a, 1e; K02a, 11e; K15a, 8e; K22a, 1e; K27a, 2e; K28a, 1e.

Cricotopus bicinctus (Meigen, 1818) – C03a, 1e.

Cricotopus ornatus (Meigen, 1818) – C01a, 14e; a, 1l; C03a, 2l; C06a+, 3e; a+, 4l; C07a, 3l; C08a, 13l; C15a+, 2e; C16a+, 2l; C19a+, 2e; C26a, 1e; a, 1l; K01a, 1l; K02a, 3l; K03a, 3e; a, 10l; K04a, 40l; K05a, 15e; a, 1l; K06a, 16e; a, 4l; K08a, 1l; K09a, 4e; a, 6l; K10a, 1l; K13a, 4e; a, 21l; a+, 4e; a+, 20l; K15a, 1e; K16a, 1l; K17a, 5e; K18a, 5l; a+, 19l; K20a+, 4l; K23a+, 6l; K25a, 2e; a, 10l; a+, 3e; K27a, 11e; a, 26l; a+, 10e; a+, 48l; K28a, 2e; a, 13l; a+, 1l.

Cricotopus sylvestris (Fabricius, 1794) – C01a, 21e; C09a, 1e; C16a+, 1l; K03a, 3l; K04a, 1l; K09a, 16e; a, 3l; K13a, 1l; a+, 3l; K15a, 2e; K16a, 1l; K17a, 12e; K18a, 3e; a, 2l; a+, 2e; a+, 5l; K22a, 1e; K25a, 2e; K27a, 1e; a, 6l.

Hydrobaenus lugubris Fries, 1830 – K15a, 1e.

Hydrobaenus pilipes (Malloch, 1915) – C03a, 1l; K18a, 1e.

Limnophyes ninae Saether, 1975 – K15a, 1e; K27a, 2e.

Nanocladius dichromus (Kieffer, 1906) – C03a, 2e.

Psectrocladius obvius (Walker, 1856) – C15a+, 8e.

Chironomidae: Tanypodinae

Macropelopia nebulosa (Meigen, 1804) – C26a, 2e; K17a, 1e.

Paramerina cingulata (Walker, 1856) – C03a, 8e.

Procladius cf. ***choreus*** – C01a, 1e; C03a, 1p; K17a, 3e; K18a, 1e.

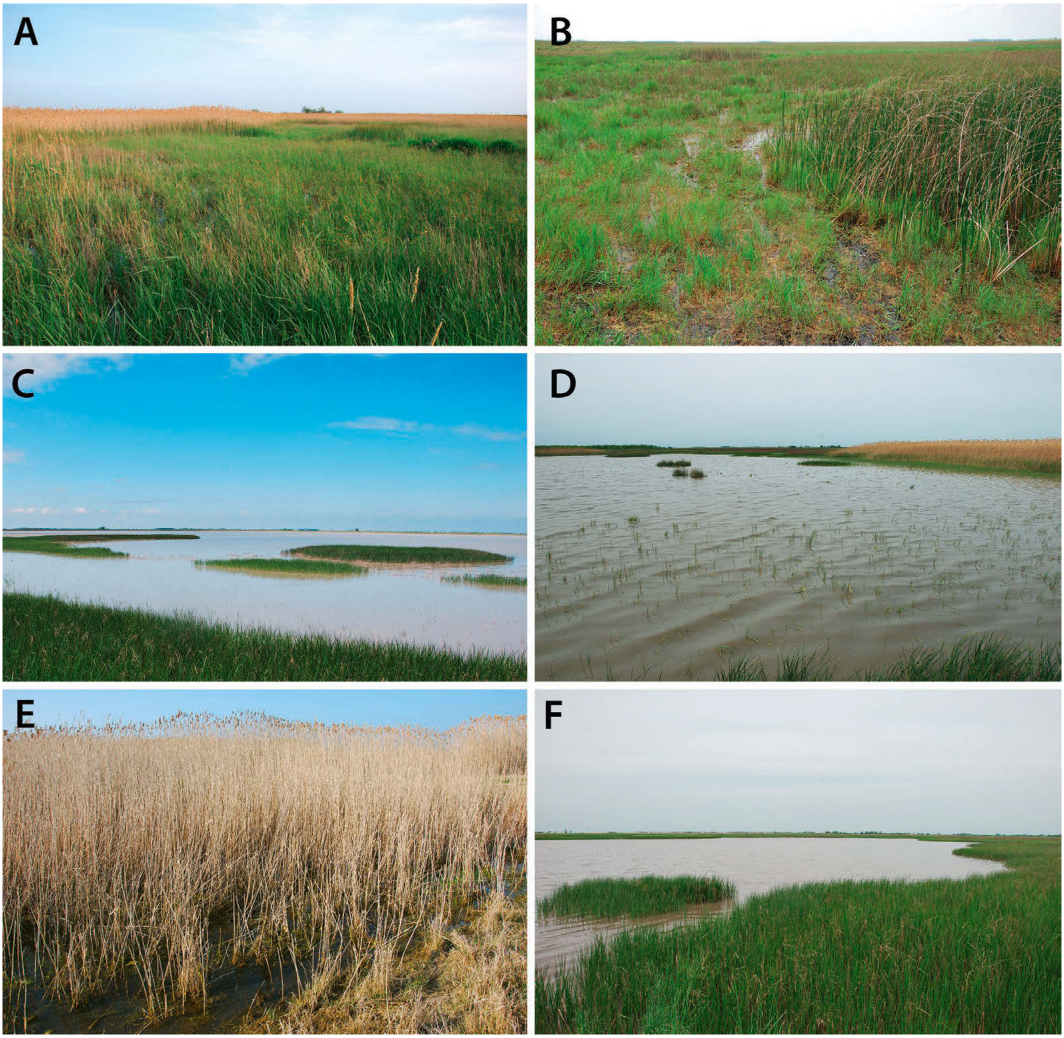

Fig. 2. Pictures of six typical habitats from which the species new for the Hungarian fauna were collected. **A.** Dáli-szikesek, South (Makó, Code: C04); **B.** Kopáncspusztai-járandó (Nagyér, Code: C22); **C.** Fehér-tó, South end of the West basin (Kardoskút, Code: K04); **D.** Kis-Sóstó, South (Orosháza, Code: K27); **E.** Nagy-Sóstó, shoreline, South (Kardoskút, Code: K15); **F.** Kis-Sóstó, North (Orosháza, Code: K28). All pictures were taken in spring aspect by Arnold Móra. *Helophorus grandis* were collected from A, B, and C; *Tribelos donatoris* from A and B; *Eretes sticticus* from C; *Limnophyes ninae* from D and E; and *Allocladius arenarius* from F.

Procladius* cf. *sagittalis – C01a, 4e; C03a, 1e; K17a, 1e; K18a, 2e.

Psectrotanypus varius (Fabricius, 1787) – C19a+, 2e; K22a, 3e; K24a+, 1l; K25a, 1p; a, 6e; a+, 4e.

Tanypus punctipennis Meigen, 1818 – C15a+, 4e; K17a, 5l; K18a, 2l; a, +2l.

Xenopelopia falcigera (Kieffer, 1911) – C03a, 2e; C04a, 6e; a, 1l; C05a, 4e; a, 8l; C07a, 4e; a, 9l; C08a, 2l; C09a, 1e; a, 2l; C10a, 3l; C11a, 2l; C12a, 2l; C13a, 3l; C15a, 1p; C20a, 2l; C22a, 7e; a, 1l; C24a, 2l; K01a, 5e; a, 4l; K02a, 4e; K03a, 1l; K08a, 4e; a, 3l; K09a, 1e; K10a, 2l; K15a, 3e; a, 3l; K18a, 1l; K22a, 6e; K25a, 1p; a, 2e; K26a, 4l; K27a, 5e; a+, 1l; K28a, 1e.

Salinity conditions and their relationships with species richness

The conductivity and pH values for a majority of our sites were given in Table 1. Both of them are strongly, positively and significantly correlated (conductivity: $r = 0.47$, $p = 0.0059$; pH: $r = 0.47$, $p = 0.0065$) with the numbers of species which prefers more or less saline waters (halobiont, halophilic and halotolerant species altogether) (Fig. 2A,B), while only weak and non-significant relationships can be seen with the numbers of other species (conductivity: $r = -0.24$, $p = 0.17$; pH: $r = -0.23$, $p = 0.20$) (Fig. 2C,D).

Discussion

General remarks

The first records from Hungary were given here for four species (Coleoptera: *Helophorus grandis*, Diptera: *Allocladius arenarius*, *Limnophyes ninae*, *Tribelos donatoris*). *H. grandis* was long-awaited to be found in Hungary (Csabai et al. 2002), the species occurs in all neighbouring countries excluding the southern ones (Przewoźny 2018). Contrarily, the occurrence of these chironomid species were not expected (Móra & Dévai 2004), but could have not been excluded due to their sporadic and less known European distribution (see Spies & Sæther 2013). Five species are protected in Hungary (*Argyroneta aquatica*, *Lestes dryas*, *Lestes macrostigma*, *Aeshna isoceles* and *Libellula fulva)*, another species (*Hirudo verbana*) is listed as EU species of community interest (Anonymous 1992) and in CITES (II), further two (*Niphargus valachicus*, *N. hrabei*) are listed as vulnerable in the IUCN Redlist (Sket 1996a, 1996b). Two non-native species were also found (*Haitia acuta*, *Anisops sardeus*); however, none of them were represented in high numbers of individuals or were found at many sites.

The salinity of the sampled habitats varied widely (e. g. conductivity between 500 and 6800 μS/cm), and encompassed wide pH and salinity gradients, thus, the faunal composition was an interesting mixture of halobiont and halophil species and more or less halotolerant marsh-dwelling species. Aquatic invertebrates vary substantially in their tolerance to saline conditions (e. g. Galewski 1971, Cuppen 1983, 1986, Berezina 2003, Gioria 2014).

Within all higher taxa (order), several common and eurytopic species with wide geographic distribution, broad habitat specificity and usually large population size were detected (e. g. *Anax* spp., *Ischnura* spp., *Gerris* spp., *Noterus* spp., *Laccophilus* spp., *Chironomus* spp.) (e. g. Csabai 2000, Andersen et al. 2013, Boda et al. 2015, Boudot & Kalkman 2015). Macroinvertebrate fauna of the sites with transition salinity are mainly composed of further species, known as potential inhabitants of sodic habitats (e. g. *Haemopis sanguisuga*, *Anisus spirorbis*, *Sympetrum* spp., *Sigara* spp., *Haliplus* spp.). Four species regarded as halobiont (Galewski 1971, Hebauer 1974) were detected throughout the sampling area (*Haliplus maculatus* Motschulsky, 1860; *Enochrus hamifer* (Ganglbauer, 1901); *Berosus fulvus* Kuwert, 1888 and *Berosus spinosus* (Steven, 1808)). Further 14 halophilic or facultative halophilic species were found: *Enochrus bicolor* (Fabricius, 1792); *Helophorus micans* Faldermann, 1835; *Hygrotus parallellogrammus* (Ahrens, 1812); *Corixa affinis* Leach, 1817; *Anisops sardeus sardeus* Herrich-Schaffer, 1849; *Cymatia rogenhoferi* (Fieber, 1864); *Eretes sticticus* (Linnaeus, 1767); *Helochares lividus* (Forster, 1855); *Hydrochara dichroma* (Fairmaire, 1892); *Lestes dryas* Kirby, 1890; *Lestes macrostigma* (Eversmann, 1836); *Paracorixa concinna* (Fieber, 1848); *Sigara lateralis* (Leach, 1818); and *Sympetrum fonscolombii* (Selys, 1840). These are the most characteristic species of the highly saline waters across Europe that were recorded during this survey (Boros et al. 2014a, Zinchenko et al. 2017, Ambrus et al. 2018).

The number of species along gradients of salinity (estimated via conductivity) tends to decrease with increases in salinity, only few species being able to tolerate and survive highly saline conditions. This finding is consistent with the results of previous studies that salinity has negative effects on species richness by direct (Piscart et al. 2005, Kefford et al. 2006) or indirect way (e. g. through declining macrophyte diversity) (Vadstrup & Madsen 1995, Krasznai-K. et al. 2018). Comparing the number of salinity-related species (halobiont and halophilic) with the number of those considered as non-tolerant, or to some extent neutral to salinity, a different trend can be seen along the salinity gradient (Fig. 3). The numbers of salinity-related species are increasing with the increasing conductivity and pH, while the numbers of species from the non-related group are slightly decreasing. This finding is supported by previous results: the salinity can have a significant effect on macroinvertebrate communities (Kefford 1998), but having either a positive (e. g. in case of Heteroptera) (Van de Meutter et al. 2010) or a negative (e. g. in case of Trichoptera, Ephemeroptera, Mollusca) (Horrigan et al. 2007, Dunlop et al. 2008) effect on the distribution pattern of group of species. It must be stated that the measurements of salinity parameters were made in the spring at high water-level. That time the summer overconcentration, which is so typical in case of such sodic water bodies, has not been observed yet, so our results should be evaluated according to this fact. It is very likely that the observed trends would have been even stronger in the summer, when the

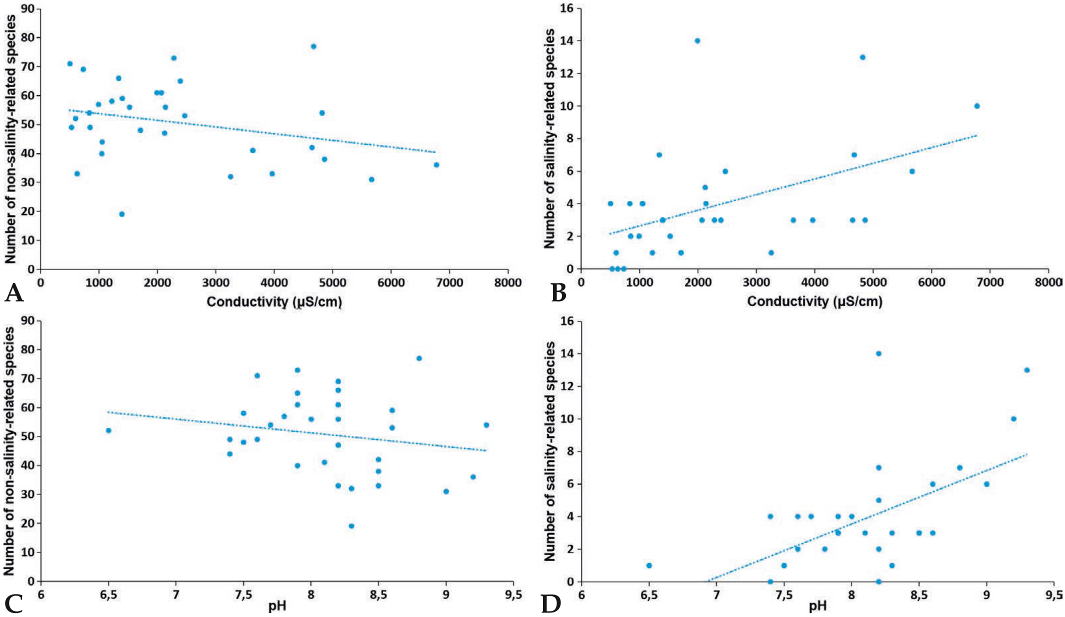

Fig. 3. Relationship between conductivity (A, B) and pH (C, D) and the numbers of species non-related (A, C) and related (B, D) with salinity.

conductivity and pH are usually much higher than in May.

Notes on selected species

Helophorus grandis Illiger, 1798 – The distributional range is mostly from Western to Northern Europe. The Eastern border of the distributional pattern runs through France, Switzerland, Austria, Germany, Poland, the Ukraine, the Baltic States and Finland, but it also occurs in Asian Turkey (Przewoźny 2018). According to our knowledge the species has no former occurrence data from the Carpathian Basin, excluding a misidentification (Bellstedt & Merkl 1987) as stated by Angus (1992). We found the beetle in high numbers in 10 sampling sites. Habitat preference of the species is known to be almost the same as *H. aequalis*.

Allocladius arenarius (Strenzke, 1960) – In spite of it has known as a Holarctic species, it has been recorded from only a few European countries. The limited distributional range in Europe may be because this small-sized species is often overlooked in samples and hardly identifiable in any life stages. Larvae of *A. arenarius* are burrowing in the sediment of saline or brackish lentic habitats; however, there are some records from lotic environments (Ferrington & Sæther 2011).

Limnophyes ninae Sæther, 1975 – Holartic species, which is known from several countries from Europe. Habitat preference of *L. ninae* is poorly known, but specimens were collected from ditches and ponds so far (Langton & Visser 2003).

Tribelos donatoris (Shilova, 1974) – Eastern Palaearctic species, but it has occurrence data from small forested ponds in Russia and Macedonia in the Western Palearctic region (Pankratova 1983), too. Based on our results, the larvae are inhabitants of temporary, lowland lentic habitats, like swamps and marshes in Hungary.

Haliplus maculatus Motschulsy, 1860 – Many of the records from Hungary, Austria, Czech, Slovakia, Romania, Yugoslavia, Soviet Union and from Middle East date back before 1930. *H. maculatus* has not been found for a long time, and it was listed as extinct in Europe by van Vondel (1997). Since then, there is only one confirmed recent record from Central Europe (Fülöpháza, Hungary; Ködöböcz et al. 2006). This is considered as a halobiont species and generally occurs in temporary saline pools and ditches (van Vondel 1997).

Hydroporus hebaueri Hendrich, 1990 – Distribution area of the species covers the eastern Mediterranean and the Balkan peninsula. It has been recorded from Greece, Bulgaria, Montenegro, Hungary, Albania and Turkey. Only three recent records have been known from Hungary so far (Ádám 1986, Szivák et al. 2010). Most probably it is because the species produces very high abundance during early spring and subsequently completely disappears from these habitats. The reason for this is still unknown, but cannot be excluded that it partly follows a semi ground-water related lifestyle. Consequently, this species may be more common in the Hungarian lowlands and hilly areas than the records indicate.

Laccornis kocae (Ganglbauer, 1904) – It is the least specialized member of its genus with the most plesiomorphic characters (Wolfe & Roughley 1990). The species has a very narrow distribution range; it has been only known from Austria, Croatia, Hungary, the Ukraine and Russia, recently detected in Slovakia (Nilsson & Hájek 2018). Hungarian occurrences are widely spread over the lowlands and hilly areas (Csabai et al. 2015). Lifestyle of the species is poorly known, it seems to prefer shallow marshes and temporary waters, but is known from densely vegetated permanent waterbodies.

Ilybius pseudoneglectus (Franciscolo, 1972) – The distributional range for the species is along the Adriatic Coast from Italy to Croatia, as well as Montenegro and Greece (Fery & Nilsson 1993). From Hungary, it has been found only in Hortobágy (E Hungary, Hájek & Csabai 2009) and Cserkút, Mecsek Mountains (SW Hungary, Csabai 2013 unpublished data).

Eretes sticticus (Linnaeus, 1767) – In the last decades this species was found in several localities in the Pannonian basin and it seems that it is recently spreading to the north from the Mediterranean. First data for Hungary arise from this survey but these records have already been published in Hájek et al. (2014/2015) as well. For more information, we refer to that paper.

Conclusion

To gain the knowledge of the species composition and to understand the mechanisms shaping the communities of the saline habitats is crucial and one of the most important section of basic research. Here, the first occurrence records of four species from the Hungarian fauna were reported and new occurrences of dozens of halobiont and halophilic taxa were highlighted. These taxa are considered as extremely rare in Europe, but are particularly characteristic for, and occasionally may be rather common in these special aquatic spots. As we found, they have unique species composition and salinity can cause bias in macroinvertebrate communities. New data help us to reveal recent spatial distribution of these unique species, and provide a basis for future conservation actions and distributional studies.

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References

Ádám, L. 1986. Adephaga of the Kiskunság National Park II: Dytiscidae-Gyrinidae (Coleoptera). Pp. 143–151 in: Mahunka, S. (ed.). The fauna of the Kiskunság National Park I. Budapest (Akadémiai Kiadó).

Ambrus, A., Danyik, T., Kovács, T. & Olajos, P. 2018. Magyarország szitakötöinek kézikönyve. Budapest (Magyar Természettudományi Múzeum – Herman Ottó Intézet).

Andersen, T., Cranston, P. S. & Epler, J. H. (eds) 2013. Chironomidae of the Holarctic region. Keys and diagnoses, Part 1: Larvae. Insect Systematics & Evolution, Suppl. 66: 1–573.

Angus, R. B. 1992. Insecta, Coleoptera, Hydrophilidae, Helophorinae. Süßwasserfauna von Mitteleuropa 20(10/2): 1–144.

Anonymous 1979. Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC). Official Journal of the European Communities 22(L103): 1–18.

– – 1992. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities 35 (L206): 7–50.

Bellstedt, R. & Merkl, O. 1987. Hydraenidae, Hydrochidae, Spercheidae, Helophoridae, Hydrophilidae and Georissidae of the Kiskunság National Park (Coleoptera). Pp. 169–174 in: Mahunka, S. (ed.). The fauna of the Kiskunság National Park II. Budapest (Akadémiai Kiadó).

Berezina, N. A. 2003. Tolerance of freshwater invertebrates to changes in water salinity. Russian Journal of Ecology 34: 261–266.

Bini, L. M., Diniz-Filho, J. A. F., Rangel, T. F., Bastos, R. P. & Pinto, M. P. 2006. Challenging Wallacean and Linnean shortfalls: knowledge gradients and conservation planning in a biodiversity hotspot. Diversity and Distributions 12: 475–482.

Boda, P., Bozóki, T., Vásárhelyi, T., Bakonyi, G. & Várbíró, G. 2015. Revised and annotated checklist of aquatic and semi-aquatic Heteroptera of Hungary with comments on biodiversity patterns. ZooKeys 501: 89–108. doi:10.3897/zookeys.501.8964

Bolgovics, Á., Ács, É., Várbíró, G., Görgényi, J., Kiss, K. T., Földi, A., Nagy-László, Z., Trábert, Z. & Borics, G. 2016. Benthic diatom-based lake types in Hungary. Fundamental and Applied Limnology 189: 105–116.

Borics, G., Lukács, B. A., Grigorszky, I., Nagy-László, Z., Bolgovics, Á., Szabó, S., Görgényi, J. & Várbíró, G. 2014. Phytoplankton-based shallow lake types in the Carpathian basin: steps towards a bottom-up typology. Fundamental and Applied Limnology 184: 23–34.

Boros, E., Ecsedi, Z. & Oláh, J. (eds) 2014a. Ecology and management of soda pans in the Carpathian Basin. Balmazújváros (Hortobágy Environmental Association).

– – , Horváth, Z., Wolfram, G. & Vörös, L. 2014b. Salinity and ionic composition of the shallow astatic soda pans in the Carpathian Basin. Annales de Limnologie – International Journal of Limnology 50: 59–69.

Boudot, J. P. & Kalkman, V. J. (eds) 2015. Atlas of the European dragonflies and damselflies. The Netherlands (KNNV Publishing).

Brown, J. H. & Lomolino, M. V. 1998. Biogeography. 2nd ed., Sunderland, Massachusetts (Sinauer Press).

Cozma, J. N., Juhász, P., Müller, Z., Olajos, P. & Kiss, B. 2014. The true bug (Heteroptera: Nepomorpha, Gerromorpha) fauna of some soda pans and sodic water bodies of Great Hungarian Plain. Natura Somogyiensis 25: 41–50.

Csabai, Z. 2000. Vízibogarak kishatározója I. (Coleoptera: Haliplidae, Hygrobiidae, Dytiscidae, Noteridae, Gyrinidae). In: Vízi Természet- és Környezetvédelem sorozat 15. Budapest (Környezetgazdálkodási Intézet). [in Hungarian]

– – , Gidó, Z. & Szél, G. 2002. Vízibogarak kishatározója II. (Coleoptera: Georissidae, Spercheidae, Hydrochidae, Helophoridae, Hydrophilidae). Vízi Természet- és Környezetvédelem sor. 16. kötet. Budapest (Környezetgazdálkodási Intézet). [In Hungarian]

– – , Boda, P., Boda, R., Bódis, E., Danyik, T., Deák, C., Farkas, A., Kálmán, Z., Lökkös, A., Málnás, K., Mauchart, P. & Móra, A. 2015. Aquatic macroinvertebrate fauna of the Kis-Sárrét Nature Protection Area with first records of five species from Hungary. Acta Biologica Debrecina Oecologica Hungarica 33: 9–70.

Cuppen, J. G. M. 1983. On the habitats of three species of the genus *Hygrotus* Stephens (Coleoptera: Dytiscidae). Freshwater Biology 13: 579–588.

– – 1986. The influence of acidity and chlorinity on the distribution of *Hydroporus* species (Coleoptera, Dytiscidae) in the Netherlands. Entomologica Basiliensia 11: 327–336.

Dunlop, J. E., Horrigan, N., McGregor, G., Kefford, B. J., Choy, S. & Prasad, R. 2008. Effect of spatial variation on salinity tolerance of macroinvertebrates in Eastern Australia and implications for ecosystem protection trigger values. Environmental Pollution 151: 621–630.

Ferrington, L. C. Jr. & Sæther, O. A. 2011. A revision of the genera *Pseudosmittia* Edwards, 1932, *Allocladius* Kieffer, 1913, and *Hydrosmittia* gen. n. (Diptera: Chironomidae, Orthocladiinae). Zootaxa 2849: 1–314.

Fery, H. & Nilsson, A. N. 1993. A revision of the *Agabus chalconatus*- and *erichsoni*-groups (Coleoptera: Dytiscidae), with a proposed phylogeny. Entomologica Scandinavica 24: 79–108.

Galewski, K. 1971. A study on morphobiotic adaptations of European species of the Dytiscidae (Coleoptera). Polskie Pismo Entomologiczne 41: 487–702.

Gilbert, B. & Lechowicz, M. J. 2005. Invasibility and abiotic gradients: the positive correlation between native and exotic plant diversity. Ecology 86: 1848–1855.

Gioria, M. 2014. Habitats. Pp. 307–362 in: Yee, D. A. (ed.). Ecology, systematics, and natural history of predaceous diving beetles (Coleoptera: Dytiscidae). New York (Springer).

Hájek, J. & Csabai, Z. 2009. First records of *Ilybius pseudoneglectus* in Hungary (Coleoptera: Dytiscidae). Folia Entomologica Hungarica 70: 87–91.

– – , Hendrich, L., Vyhnálek, V. & Csabai, Z. 2014/2015. *Eretes* diving beetles in Central Europe – witnesses of climate change? Aquatic Insects 36: 267–271.

Hammer, Ø., Harper, D. A. T. & Ryan, P. D. 2001. PAST: Paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4 (1): 9 pp.

Hebauer, F. 1974. Über die ökologische Nomenklatur wasserbewohnender Käferarten. Nachrichtenblatt der Bayerischen Entomologen 23: 87–92.

Horrigan, N., Dunlop, J. E., Kefford, B. J. & Zavahir, F. 2007. Acute toxicity largely reflects the salinity sensitivity of stream macroinvertebrates derived using field distributions. Marine and Freshwater Research 58: 178–186.

Horváth, Z., Vad, C. F., Vőrős, L. & Boros, E. 2013. Distribution and conservation status of fairy shrimps (Crustacea: Anostraca) in the astatic soda pans of the Carpathian basin: the role of local and spatial factors. Journal of Limnology 72 (1): 103–116.

Kefford, B. J. 1998. The relationship between electrical conductivity and selected macroinvertebrate communities in four river systems of south-west Victoria, Australia. International Journal of Salt Lake Research 7: 153–170.

– – , Nugegoda, D., Metzeling, L. & Fields, E. J. 2006. Validating species sensitivity distributions using salinity tolerance of riverine macroinvertebrates in the southern Murray–Darling Basin (Victoria, Australia). Canadian Journal of Fisheries and Aquatic Sciences, 63: 1865–1877.

Ködöböcz, V., Juhász, P., Kiss, B. & Müller, Z. 2006. Faunistical results of the Coleoptera investigations carried out in the frames of the ecological survey of the surface waters of Hungary (ECOSURV) in 2005. Folia Historico-Naturalia Musei Matraensis 30: 349–355.

Krasznai-K., E. Á., Boda, P., Borics, G., Lukács, B. A. & Várbíró, G. 2018. Dynamics in the effects of the species-area relationship vs. local environmental factors in bomb crater ponds. Hydrobiologia 823 (1): 27–38.

Langton, P. H. & Visser, H. 2003. Chironomidae exuviae. Key to pupal exuviae of the West Palaearctic Region. In: World Biodiversity Database CD-ROM Series. Multimedia Interactive Software 1.0. Amsterdam (University of Amsterdam, Expert Center for Taxonomic Identification).

Lukács, B. A., Sramkó, G. & Molnár, V. A. 2013. Plant diversity and conservation value of continental temporary pools. Biological Conservation 158: 393–400.

Mezösi, G. 2009. The physical geography of Hungary. Switzerland (Springer).

Molnár, Á., Molnár, Z., Kotymán, L. & Balogh, G. 2016. A Csanádi puszták növényzete és növényzeti változásai az elmúlt 10 évben. Crisicum 9: 37–63. [in Hungarian]

Móra, A. & Dévai, G. 2004. Magyarország árvaszúnyog-faunájának (Diptera: Chironomidae) jegyzéke az elöfordulási adatok és sajátosságok feltüntetésével. Acta Biologica Debrecina Supplementum Oecologica Hungarica 12: 39–207.

Nilsson, A. N. & Hájek, J. 2018. Catalogue of Palearctic Dytiscidae (Coleoptera). Internet version 2018-01-01. http://www.waterbeetles.eu/documents/PAL_CAT_Dytiscidae_2018.pdf [accessed 22-June-2018]

Pankratova, V. J. 1983. Lichinki i kukolki komarov podsemeystva Chironominae fauni SSSR (Diptera, Chironomidae = Tendipedidae). Leningrad (Akademija NAUK SSSR). [in Russian]

Petri, A., P.-Holló, I., Nagy-László, Z. & Deák, C. 2012. Dél-alföldi szikes jelleggel összefüggésbe hozható állóvizek makroszkopikus vízi gerinctelen faunájának összehasonlítása. Acta Biologica Debrecina Oecologica Hungarica 28: 141–165. [in Hungarian]

Piscart, C., Moreteau, J. C. & Beisel, J. N. 2005. Biodiversity and structure of macroinvertebrate communities along a small permanent salinity gradient (Meurthe River, France). Hydrobiologia 551: 227–236.

Przewoźny, M. 2018. Catalogue of Palearctic Hydrophiloidea (Coleoptera). Internet version 2018-01-01. http://waterbeetles.eu/documents/PAL_CAT_Hydrophiloidea_2018.pdf [accessed 26-June-2018]

Ramsar Convention Secretariat 2004. Ramsar handbook for the wise use of wetlands. Handbook 10, Wetland inventory: a Ramsar framework for wetland inventory. 2nd ed., Gland, Switzerland (Ramsar Secretariat).

Ricklefs, R. E. 2004. A comprehensive framework for global patterns in biodiversity. Ecology Letters 7: 1–15.

Simon, S., Mádl-Szönyi, J., Müller, I. & Pogácsás, G. 2011. Conceptual model for surface salinization in an overpressured and a superimposed gravity flow field, Lake Kelemenszék area, Hungary. Hydrogeology Journal 19: 707–711.

Sket, B. 1996a. *Niphargus hrabei*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2017.3. www.iucnredlist.org [downloaded 02-July-2018]

– – 1996b. *Niphargus valachicus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2017.3. www.iucnredlist.org [downloaded 02-July-2018]

Spies, M. & Sæther, O. A. 2013. Fauna Europaea: Chironomidae. In: Pape, T. & Beuk, P. (eds). Fauna Europaea: Diptera, Nematocera. Fauna Europaea version 2017.06. www.fauna-eu.org [last visited 30-June-2018]

Stenger-Kovács, C., Lengyel, E., Buczkó, K., Tóth, F. M., Crossetti, L. O., Pellinger, A., Zámbóné Doma, Z. & Padisák, J. 2014. Vanishing world: alkaline, saline lakes in Central Europe and their diatom assemblages. Inland Waters 4: 383–396.

Szivák, I., Deák, C., Kálmán, Z., Soós, N., Mauchart, P., Lökkös, A., Rozner, G., Móra, A. & Csabai, Z. 2010. Contribution to the aquatic macroinvertebrate fauna of Mecsek Mountains with the first record of *Limnius opacus* in Hungary. Acta Biologica Debrecina Oecologica Hungarica 21: 197–222.

Vadstrup, M. & Madsen, T. V. 1995. Growth limitation of submerged aquatic macrophytes by inorganic carbon. Freshwater Biology 34: 411–419.

Van de Meutter, F., Trekels, H., Green, A. J. & Stoks, R. 2010. Is salinity tolerance the key to success for the invasive water bug *Trichocorixa verticalis*? Hydrobiologia 649: 231–238.

van Vondel, B. J. 1997. Insecta: Coleoptera: Haliplidae. In: Schwoerbel, J. & Zwick, P. (eds). Süßwasserfauna von Mitteleuropa, Band 2, 3 und 4, Insecta: Coleoptera: Haliplidae, Noteridae, Hygrobiidae. Stuttgart, Jena, Lübeck, Ulm (Gustav Fischer Verlag).

Wolfe, G. W. & Roughley, R. E. 1990. A taxonomic, phylogenetic, and zoogeographic analysis of *Laccornis* Gozis (Coleoptera: Dytiscidae) with the description of Laccornini, a new tribe of Hydroporinae. Quaestiones Entomologicae 26: 273–354.

Zinchenko, T. D., Golovatyuk, L. V., Abrosimova, E. V. & Popchenko, T. V. 2017. Macrozoobenthos in saline rivers in the Lake Elton basin: spatial and temporal dynamics. Inland Water Biology 10: 384–398.