

**CONTRIBUTION TO THE ODONATA FAUNA OF THE RIVERS IN THE KÖRÖS–MAROS NATIONAL PARK, HUNGARY, WITH SPECIAL EMPHASIS ON GOMPHIDAE. PART I.**

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**ADATOK A KÖRÖS–MAROS NEMZETI PARK FOLYÓINAK SZITAKÖTŐ-FAUNÁJÁHOZ (ODONATA), KÜLÖNÖS TEKINTETTEL A FOLYAMI SZITAKÖTŐKRE (GOMPHIDAE). I. RÉSZ.**

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**ABSTRACT:** In 2013 systematic collections of Gomphidae exuviae were carried out at altogether 37 sampling sites along the Hungarian sections of the Fehér-Körös, Fekete-Körös, Kettős-Körös and Maros rivers. The sampling sites were visited four times, taking into account the phenology of gomphid species. Besides Gomphidae, exuviae of other species were also collected with faunistical aims. In addition, observational data on adult specimens were occasionally recorded. Collections resulted in the occurrence of 5640 exuviae (from which 5291 were exuviae of Gomphidae) and 112 adults were observed. Altogether 17 species were found, for which detailed records are given. The most important result is the co-occurrence of the four Hungarian gomphid species along all studied rivers. The distributional areas of *Onychogomphus forcipatus* and *Ophiogomphus cecilia* were remarkably expanded by our results. The composition of the Gomphidae assemblages varied widely among rivers and within a given river as well, according to habitat characteristics. In conclusion, stable and viable populations of Gomphidae exist along the studied rivers (Fehér-Körös may be an exception) with great significance in terms of nature conservation. Accordingly, either these populations or rivers deserve strict protection.

**Key words:** Gomphidae; Fehér-Körös; Fekete-Körös; Kettős-Körös; Maros; exuviae; abundances; nature protection

**KIVONAT:** 2013-ban a Fehér-, a Fekete- és a Kettős-Körös, valamint a Maros magyarországi szakaszának 37 mintavételi helyén végeztük el a folyami szitakötők (Odonata: Gomphidae) exuviumainak mennyiségi gyűjtését, a fajok kirepülési sajátosságainak megfelelően négy alkalommal. A folyami szitakötők mellett faunisztikai céllal más fajok exuviumait is összegyűjtöttük, valamint esetenként feljegyeztük a megfigyelt szitakötőimágókat is. Munkánk során összesen 5640 (ebből 5291 Gomphidae) exuviumot gyűjtöttünk be, emellett 112 példányt figyeltünk meg imágó alakban. Összesen 17 fajt mutattunk ki, ezek előfordulási adatait részletesen közöljük. Legfontosabb eredmény, hogy mind a négy vizsgált folyón megtaláltuk mind a négy hazai Gomphidae fajt, ezzel jelentősen kibővítve az *Onychogomphus forcipatus* és az *Ophiogomphus cecilia* elterjedési területét. A folyami szitakötők mennyiségi viszonyai folyónként és folyószakaszonként eltérőnek bizonyultak az élőhelyi sajátosságoknak megfelelően. Összességében (talán a Fehér-Körös kivételével) a vizsgált folyókban erős és életképes folyamszitakötő-populációk élnek, ami természetvédelmi szempontból nagy jelentőséggel bír. Eredményeink alapján mind a vizsgált folyószakaszok, mind a szitakötő-populációk védelemre érdemesek.

**Kulcsszavak:** Gomphidae; Fehér-Körös; Fekete-Körös; Kettős-Körös; Maros; exuvium; mennyiségi viszonyok; természetvédelem

## Introduction

Several faunistical studies have so far been carried out in the operational area of Körös–Maros National Park Directorate which focused either on aquatic macroinvertebrates (JUHÁSZ et al. 1998, 1999, 2000; MÓRA et al. 2001) or only on dragonflies (AMBRUS and OLAJOS 2000; AMBRUS et al. 1998b; OLAJOS et al. 1998). Further data concerning the Odonata fauna of the rivers located in this area have also been published in many other works (e.g. AMBRUS et al. 1996, 1998a; KOVÁCS and AMBRUS 2010; KOVÁCS et al. 2004, 2006; MÜLLER and MÁTYUS 2009; MÜLLER et al. 2006; VIZSLÁN és PINGITZER 1998–99). Accordingly, the Odonata fauna of these rivers is relatively well known.

In point of view of nature conservation, riverine dragonflies (Gomphidae) are the most important members of these Odonata assemblages, all of which are protected in Hungary [100/2012. (IX. 28.) VM regulation]. Moreover, *G. flavipes* and *O. cecilia* are species of community interest according to Annexes II and IV of the Habitats Directive of the European Union (COUNCIL OF THE EUROPEAN UNION 2006). Although many data are available on the occurrence of gomphid species (see references listed above) in the studied rivers, no accurate information on their abundances have been reported up to date.

In this study our aims were to give detailed data on the occurrence and abundance of gomphids along the entire Hungarian sections of the Fehér-Körös, Fekete-Körös, Kettős-Körös and Maros rivers, which are located in the operational area of Körös–Maros National Park Directorate. As far as we know, among the surveys concerning Gomphidae assemblages along these rivers, our study is the most intensive one carried out up to date, which allows to compare the abundances of the species between rivers, as well as between and within sites along a given river. Besides Gomphidae, faunistical data of other Odonata species are also presented.

## Materials and methods

Our study based on the systematic collection of exuviae. Collections were carried out at altogether 37 sampling sites (Fehér-Körös: 4; Fekete-Körös: 7; Kettős-Körös: 11; Maros: 15), which covered the entire Hungarian sections of the studied rivers (Table 1).

**Table 1.** Sampling sites along the studied rivers (listed downstream) with their administrative units, the exact geographical co-ordinates and the 2,5×2,5 km UTM-grid codes (\* = sites with retained water above a barrage; rb = right bank; lb = left bank).

Sampling site	River	Administrative unit	Co-ordinate		UTM code
			N	E	
Fehér-01*	Fehér-Körös, rb	Gyulavári (Gyula)	46°38'23.66"	21°18'50.01"	ES26A4
Fehér-02	Fehér-Körös, rb	Máriafalva (Gyula)	46°39'52.20"	21°17'49.52"	ES26A3
Fehér-03	Fehér-Körös, rb	Gyula	46°40'28.28"	21°17'26.74"	ES26A1
Fehér-04	Fehér-Körös, rb	Gyula	46°41'39.75"	21°16'40.85"	ES27B2
Fekete-01	Fekete-Körös, lb	Dénesmajor (Gyula)	46°40'14.84"	21°26'14.87"	ES36A3
Fekete-02	Fekete-Körös, lb	Gyula	46°41'29.37"	21°25'44.50"	ES37B4
Fekete-03	Fekete-Körös, lb	Gyula	46°42'30.30"	21°24'02.10"	ES37B1
Fekete-04	Fekete-Körös, lb	Gyula	46°42'52.66"	21°22'25.73"	ES27D3
Fekete-05	Fekete-Körös, rb	Sarkad	46°42'50.41"	21°21'00.36"	ES27D1
Fekete-06	Fekete-Körös, lb	Városerdő (Gyula)	46°42'04.39"	21°18'59.51"	ES27B4
Fekete-07	Fekete-Körös, rb	Szanazug (Doboz)	46°42'23.55"	21°16'55.21"	ES27B1
Kettős-01*	Kettős-Körös, rb	Doboz	46°43'08.50"	21°14'08.11"	ES17D3
Kettős-02*	Kettős-Körös, rb	road bridge (Doboz)	46°43'35.23"	21°13'18.10"	ES17D1
Kettős-03A*	Kettős-Körös, rb	Békés	46°44'28.76"	21°11'39.90"	ES17A4
Kettős-03B*	Kettős-Körös, rb	Békés	46°44'45.86"	21°11'08.05"	ES17A4
Kettős-04	Kettős-Körös, lb	Dánfok (Békés)	46°45'48.97"	21°09'05.49"	ES17A1
Kettős-05	Kettős-Körös, rb	road bridge (Békés)	46°47'08.01"	21°08'30.55"	ES18B2
Kettős-06	Kettős-Körös, rb	Békés	46°48'39.27"	21°07'13.74"	ES08D3
Kettős-07	Kettős-Körös, rb	Békés	46°49'47.53"	21°06'32.91"	ES08C4
Kettős-08	Kettős-Körös, rb	Mezőberény	46°51'11.73"	21°04'57.51"	ES08C1
Kettős-09	Kettős-Körös, rb	road bridge (Köröstarcsa)	46°53'00.03"	21°01'58.97"	ES09B4
Kettős-10	Kettős-Körös, rb	Köröstarcsa	46°53'48.67"	21°01'28.61"	ES09B1
Kettős-11	Kettős-Körös, rb	Köröstarcsa	46°54'58.94"	20°59'09.42"	DS99C4
Maros-01	Maros, rb	Nagylak	46°09'41.64"	20°42'15.21"	DS71D2
Maros-02	Maros, rb	Bökény (Magyarcsanak)	46°09'02.46"	20°39'27.76"	DS71B4
Maros-03	Maros, rb	Magyarcsanak	46°08'57.53"	20°36'02.78"	DS61D4
Maros-04	Maros, rb	Szilvás (Apátfalva)	46°09'59.12"	20°34'05.91"	DS61D1
Maros-05	Maros, rb	Apátfalva	46°10'43.43"	20°32'45.10"	DS61B3
Maros-06	Maros, rb	Apátfalva	46°11'13.46"	20°30'36.29"	DS61A2
Maros-07	Maros, rb	Makó	46°12'11.78"	20°27'11.12"	DS51C4
Maros-08	Maros, lb	Zugoly (Kiszombor)	46°12'35.46"	20°25'45.28"	DS51C1
Maros-09	Maros, lb	Kiszombor	46°12'50.95"	20°24'06.22"	DS51A3
Maros-10	Maros, lb	Kiszombor	46°13'10.62"	20°22'37.57"	DS51A1
Maros-11	Maros, lb	Klárafalva	46°13'27.26"	20°20'45.59"	DS41C3
Maros-12	Maros, lb	Deszk	46°14'13.56"	20°17'53.37"	DS42D2
Maros-13	Maros, lb	Deszk	46°14'12.54"	20°14'43.67"	DS42B2
Maros-14	Maros, lb	Deszk	46°14'19.87"	20°13'55.68"	DS42B2
Maros-15	Maros, lb	Marostó (Szeged)	46°14'31.21"	20°12'41.34"	DS32D4
Maros-15A	Maros, rb	Szeged	46°14'49.54"	20°12'30.52"	DS32D4

Collections were made in 2013 at four occasions, taking into account the phenology of gomphid species and timed near their emergence peaks: (1) 10–13 May; (2) 21–23 May; (3) 7–8 June; (4) 23–26 June. Each sampling site consisted of a 20 metre long stretch of the river-bank, with two exceptions. Sampling site Kettős-3 consisted of two shorter stretches (Kettős-3A and Kettős-3B), because in the dense vegetation it was not possible to select such a continuous 20 metre long stretch that could have been checked for exuviae. Sampling site Maros-15A was marked out instead of Maros-15 where the flood washed the bank away after the first visit. In both cases data were pooled to estimate exuviae numbers on a 20 metre long stretch. The sampling sites along a given river differed in characteristics of the river-bed (e.g. sediment, paving) and river-bank (e.g. slope, riparian vegetation) representing various habitat types. During collections the riverside ground and the vegetation were searched intensively for the exuviae in an area of the bank 5–10 metre in width and all the gomphid exuviae found were collected. This method allowed us to estimate the abundances of the species.

Besides Gomphidae, exuviae of other species were also collected with faunistical aims. In addition, observational data on adult specimens were occasionally recorded.

Exuviae and adults were identified using keys and descriptions by ASKEW (2004), CHAM (2007), DIJKSTRA (2006), GERKEN and STERNBERG (1999). In the species list new records contain the following information: locality (as the code of the sampling site according to Table 1), date of collection, total number of individuals, in brackets the numbers of males and females as well (a third number indicates the number of individuals with undetermined sex) and names of collectors in alphabetic order. The dates of collection are listed in Hungarian order (YYYY.MM.DD). The names of collectors are given by abbreviations: DT = Tibor Danyik, FA = Anna Farkas, MA = Arnold Móra.

## Results and discussion

### Faunistics

General remarks – Collections resulted in the occurrence of 5640 exuviae (from which 5291 were exuviae of Gomphidae) belonging to 13 species (*Calopteryx splendens*, *Ischnura elegans*, *Platycnemis pennipes*, *Anax imperator*, *Anax parthenope*, *Brachytron pratense*, *Gomphus vulgatissimus*, *Gomphus flavipes*, *Ophiogomphus cecilia*, *Onychogomphus forcipatus*, *Epitheca bimaculata*, *Orthetrum cancellatum*, *Orthetrum albistylum*). In addition, 112 specimens belonging to 12 species were observed as adults (*Calopteryx splendens*, *Ischnura elegans*, *Platycnemis pennipes*, *Aeshna affinis*, *Anax imperator*, *Ophiogomphus cecilia*, *Onychogomphus forcipatus*, *Libellula depressa*, *Orthetrum cancellatum*, *Orthetrum albistylum*, *Sympetrum striolatum*, *Sympetrum meridionale*). Altogether 17 species were collected and/or observed.

Among the species found *G. flavipes* and *G. vulgatissimus* were the most frequent occurring at all sampling sites (37). *Ophiogomphus cecilia*, *C. splendens* and *P. pennipes*, species typical of lotic habitats, were also collected at almost all sites (29, 26 and 26 respectively). Besides the lotic ones, species typical of standing waters (e.g. ponds, marshes) were also found. Some of them, observed only as adults (e.g. *A. affinis*, *Sympetrum* spp.), are most likely to not being developed in the rivers but emerged from other nearby water bodies. At the same time, the

unexpected occurrences of other lentic species (e.g. *B. pratense*, *E. bimaculata*) collected as exuviae most probably indicate the modified conditions of the rivers (see below in details).

Since the Odonata fauna of the operational area of Körös–Maros National Park has already received much attention (see references in Introduction), on the whole, in our study no dragonfly species new to the fauna of this region were found.

**Fehér-Körös** – Altogether 240 exuviae were collected belonging to 11 species (*C. splendens*, *I. elegans*, *P. pennipes*, *A. imperator*, *A. parthenope*, *G. vulgatissimus*, *G. flavipes*, *O. cecilia*, *O. forcipatus*, *O. cancellatum*, *O. albistylum*) and further six adult individuals were observed belonging to two species (*I. elegans*, *O. cecilia*).

Among the studied rivers the least is known about the Odonata fauna of the Fehér-Körös (AMBRUS et al. 1998a, 1998b; JUHÁSZ et al. 2000; MÜLLER et al. 2006; VIZSLÁN and PINGITZER 1998–99), thus all new records are of great importance. Three species, *A. imperator*, *A. parthenope* and *O. cancellatum* were first recorded from the river. Furthermore, exuviae of *O. cecilia* and *O. forcipatus* were collected along the Hungarian section of the river for the first time. Although there is one-one record on the occurrence of both species along the Fehér-Körös in the literature, these data were based on adult specimens (AMBRUS et al. 1998b), which do not indicate the exact place of development. In our study, the highest number of species (all as exuviae) were found along the river section with retained water, where the altered habitat is well indicated by the presence of riverine species (e.g. Gomphidae) representing the original fauna, together with typical lentic ones (e.g. *Anax* species).

**Fekete-Körös** – Our collections resulted in the occurrence of 463 exuviae belonging to seven species (*C. splendens*, *P. pennipes*, *A. imperator*, *G. vulgatissimus*, *G. flavipes*, *O. cecilia*, *O. forcipatus*). In addition, observations on 34 adult specimens belonging to six species (*C. splendens*, *I. elegans*, *P. pennipes*, *O. cecilia*, *O. forcipatus*, *O. cancellatum*) were made.

The exuviae of all four gomphid species were found at all sampling sites along the Hungarian section of the Fekete-Körös. In the case of *O. forcipatus* and *O. cecilia* rather few occurrence data were published from the river up to date (JUHÁSZ et al. 1998, 2000; OLAJOS et al. 1998). This is especially evident for *O. cecilia*, which have so far been known from only two localities (JUHÁSZ et al. 2000). Accordingly, our collections resulted in data from several new localities for this two gomphid species (five localities for *O. forcipatus* and six ones for *O. cecilia*). Furthermore, *C. splendens* and *P. pennipes* were also collected or observed at almost all sampling sites, while in the case of *A. imperator* a single exuviae was found (at Fekete\_02). However, as far as we know, the latter is the first data of *A. imperator* from the Fekete-Körös.

**Kettős-Körös** – Altogether 795 exuviae were collected belonging to 13 species (*C. splendens*, *I. elegans*, *P. pennipes*, *A. imperator*, *A. parthenope*, *B. pratense*, *G. vulgatissimus*, *G. flavipes*, *O. cecilia*, *O. forcipatus*, *E. bimaculata*, *O. cancellatum*, *O. albistylum*). Further 31 specimens belonging to eight species (*C. splendens*, *P. pennipes*, *A. affinis*, *A. imperator*, *O. forcipatus*, *L. depressa*, *O. cancellatum*, *O. albistylum*) were observed as adults.

The exuviae of all four gomphid species were found along the Kettős-Körös, among which *O. forcipatus* and *O. cecilia* were first recorded from the river. Based on the data available up to date, the four gomphid species co-occur along a large section of the river (apart from the lowest section). It is worth noted that along the river section with retained water of standing character, not only the two *Gomphus* species but *O. forcipatus* and *O. cecilia*, although require higher current velocity and

coarse sediment, were also represented. Besides gomphid species, *C. splendens* and *P. pennipes* can be found along the entire section of the river, while the occurrence of the other species is much more sporadic. Among the latter species exuviae of *A. parthenope*, *B. pratense* and the rare and protected [100/2012. (IX. 28.) VM regulation] *E. bimaculata* were collected for the first time from the Kettős-Körös. These unexpected, primarily lentic species indicate the altered characters of habitats due to the barrage near Békés.

**Maros** – Collections resulted in the occurrence of 4142 exuviae belonging to seven species (*C. splendens*, *P. pennipes*, *G. vulgatissimus*, *G. flavipes*, *O. cecilia*, *O. forcipatus*, *O. cancellatum*). Further 41 specimens belonging to six species (*C. splendens*, *P. pennipes*, *O. cecilia*, *O. albistylum*, *S. striolatum*, *S. meridionale*) were observed as adults.

All four Gomphidae species were found as exuviae along the Maros river, although only one exuvia of *O. forcipatus* was collected. During earlier studies single exuviae of *O. forcipatus* were recorded at two localities (Kiszombor, Nagylak; Kovács et al. 2004), whereas in our study this species was detected at a new site (Maros-05, Apátfalva). However, based on the data available up to date, occurrence of *O. forcipatus* seems sporadic along the Maros and it is expected to be found mainly at the upper section of the river. On the other hand, for *O. cecilia* several new localities were revealed, thus it is evident (in accordance with literature data AMBRUS and OLAJOS 2000; AMBRUS et al. 1998a; KOVÁCS et al. 2004) that this species occurs along the entire Hungarian section of the Maros. Besides Gomphidae, *C. splendens* and *P. pennipes* were found at several sampling sites.

#### New records

Data based on exuviae  
(identified by A. Farkas)

***Calopteryx splendens*** (Harris, 1782) – Fehér-01: 2013.05.13., 1(1+0), FA-MA; 2013.06.07., 1(1+0), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fehér-02: 2013.05.13., 1(0+1), DT-FA-MA; 2013.05.23., 1(1+0), FA-MA – Fehér-03: 2013.06.07., 1(0+1), FA-MA – Fekete-02: 2013.06.23., 1(0+1), FA-MA – Fekete-03: 2013.05.13., 1(0+1), FA-MA – Fekete-04: 2013.05.13., 1(0+1), FA-MA; 2013.06.07., 2(1+0+1), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fekete-05: 2013.06.24., 1(1+0), FA-MA – Fekete-07: 2013.06.23., 1(1+0), FA-MA – Kettős-01: 2013.06.08., 1(0+1), FA-MA – Kettős-05: 2013.05.23., 1(0+1), FA-MA – Kettős-07: 2013.05.12., 1(0+1), FA-MA – Kettős-09: 2013.05.22., 1(0+1), FA-MA; 2013.06.24., 1(0+1), FA-MA – Maros-01: 2013.05.10., 8(7+1), DT-FA-MA; 2013.05.21., 1(1+0), FA-MA – Maros-02: 2013.05.11., 2(0+1+1), DT-FA-MA; 2013.05.21., 3(0+1+2), FA-MA – Maros-05: 2013.06.26., 1(0+1), DT-FA-MA – Maros-06: 2013.05.11., 1(0+1), DT-FA-MA – Maros-07: 2013.05.10., 1(1+0), DT-FA-MA; 2013.05.21., 1(1+0), FA-MA – Maros-08: 2013.05.10., 2(2+0), DT-FA-MA – Maros-10: 2013.05.10., 6(2+4), DT-FA-MA; 2013.05.22., 1(0+1), FA-MA – Maros-12: 2013.05.10., 2(2+0), DT-FA-MA – Maros-13: 2013.05.10., 1(1+0), DT-FA-MA; 2013.06.25., 1(0+0+1), FA-MA – Maros-15: 2013.05.10., 3(3+0), DT-FA-MA.

***Ischnura elegans*** (Vander Linden, 1820) – Fehér-02: 2013.05.23., 1(0+0+1), FA-MA – Fehér-03: 2013.05.12., 3(2+1), DT-FA-MA – Kettős-08: 2013.06.08., 1(1+0), FA-MA – Kettős-09: 2013.05.22., 1(0+0+1), FA-MA; 2013.06.08., 1(1+0), FA-MA – Kettős-10: 2013.06.08., 1(0+1), FA-MA.

- Platycnemis pennipes*** (Pallas, 1771) – Fehér-01: 2013.05.13., 13(4+9), FA-MA; 2013.05.23., 15(8+7), FA-MA; 2013.06.07., 31(19+12), FA-MA; 2013.06.23., 3(1+2), FA-MA – Fehér-02: 2013.05.13., 3(1+2), DT-FA-MA; 2013.05.23., 6(3+3), FA-MA; 2013.06.07., 3(1+2), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fehér-03: 2013.05.12., 2(1+1), DT-FA-MA; 2013.06.07., 2(0+2), FA-MA; 2013.06.23., 2(0+2), FA-MA – Fehér-04: 2013.05.13., 7(1+6), DT-FA-MA; 2013.06.07., 4(3+1), FA-MA – Fekete-01: 2013.05.13., 1(0+1), FA-MA; 2013.06.07., 4(3+1), FA-MA; 2013.06.23., 5(3+2), FA-MA – Fekete-02: 2013.05.13., 6(4+2), FA-MA; 2013.06.07., 3(1+2), FA-MA; 2013.06.23., 5(3+2), FA-MA – Fekete-03: 2013.06.23., 1(0+1), FA-MA – Fekete-04: 2013.05.13., 1(0+1), FA-MA; 2013.06.07., 3(1+2), FA-MA; 2013.06.23., 2(0+2), FA-MA – Fekete-05: 2013.05.12., 1(0+1), FA-MA; 2013.06.08., 1(0+1), FA-MA – Fekete-06: 2013.05.23., 1(1+0), FA-MA; 2013.06.23., 1(1+0), FA-MA – Kettős-01: 2013.06.08., 8(3+5), FA-MA; 2013.06.24., 3(0+3), FA-MA – Kettős-02: 2013.05.23., 2(1+1), FA-MA; 2013.06.07., 3(1+2), FA-MA; 2013.06.24., 2(1+1), FA-MA – Kettős-03A: 2013.06.08., 1(0+1), FA-MA; 2013.06.24., 4(2+2), FA-MA – Kettős-03B: 2013.06.08., 2(0+2), FA-MA; 2013.06.24., 1(1+0), FA-MA – Kettős-05: 2013.05.23., 3(1+2), FA-MA; 2013.06.08., 3(3+0), FA-MA; 2013.06.24., 1(1+0), FA-MA – Kettős-06: 2013.06.08., 4(3+1), FA-MA; 2013.06.24., 1(1+0), FA-MA – Kettős-07: 2013.05.12., 6(3+3), FA-MA; 2013.06.08., 3(1+2), FA-MA; 2013.06.24., 1(0+1), FA-MA – Kettős-08: 2013.05.23., 3(2+1), FA-MA; 2013.06.08., 5(2+2+1), FA-MA; 2013.06.24., 2(1+1), FA-MA – Kettős-09: 2013.05.12., 1(0+1), FA-MA; 2013.05.22., 5(2+3), FA-MA; 2013.06.08., 3(1+2), FA-MA; 2013.06.24., 2(1+1), FA-MA – Kettős-10: 2013.05.12., 2(0+2), FA-MA; 2013.06.08., 8(4+4), FA-MA; 2013.06.24., 2(2+0), FA-MA – Kettős-11: 2013.05.12., 2(2+0), FA-MA; 2013.06.08., 11(4+7), FA-MA; 2013.06.24., 1(0+1), FA-MA – Maros-01: 2013.05.10., 1(0+1), DT-FA-MA – Maros-02: 2013.05.11., 7(1+1+5), DT-FA-MA; 2013.05.21., 10(1+1+8), FA-MA – Maros-09: 2013.05.21., 2(2+0), FA-MA – Maros-10: 2013.05.10., 3(1+2), DT-FA-MA – Maros-15: 2013.05.10., 6(3+3), DT-FA-MA.
- Anax imperator*** Leach, 1815 – Fehér-01: 2013.06.07., 4(2+2), FA-MA – Fehér-02: 2013.05.23., 1(0+1), FA-MA – Fehér-03: 2013.06.07., 1(0+1), FA-MA – Fekete-02: 2013.06.23., 1(0+1), FA-MA – Kettős-05: 2013.05.23., 1(0+1), FA-MA – Kettős-08: 2013.06.08., 1(1+0), FA-MA – Kettős-09: 2013.05.12., 1(0+1), FA-MA.
- Anax parthenope*** (Selys, 1839) – Fehér-01: 2013.05.13., 1(1+0), FA-MA; 2013.05.23., 5(1+4), FA-MA; 2013.06.07., 6(3+3), FA-MA; 2013.06.23., 4(2+2), FA-MA – Kettős-03A: 2013.06.24., 1(1+0), FA-MA.
- Brachytron pratense*** (Müller, 1764) – Kettős-04: 2013.05.13., 1(1+0), FA-MA.
- Gomphus vulgatissimus*** (Linnaeus, 1758) – Fehér-01: 2013.05.13., 15(8+7), FA-MA; 2013.05.23., 3(3+0), FA-MA; 2013.06.23., 2(1+0+1), FA-MA – Fehér-02: 2013.05.13., 7(3+3+1), DT-FA-MA; 2013.05.23., 3(2+1), FA-MA – Fehér-03: 2013.05.12., 10(4+6), DT-FA-MA; 2013.06.23., 1(0+1), FA-MA – Fehér-04: 2013.05.13., 7(2+5), DT-FA-MA; 2013.06.07., 2(0+2), FA-MA – Fekete-01: 2013.05.13., 17(6+11), FA-MA – Fekete-02: 2013.05.13., 48(21+26+1), FA-MA; 2013.06.07., 2(0+2), FA-MA – Fekete-03: 2013.05.13., 56(27+29), FA-MA; 2013.06.07., 7(1+6), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fekete-04: 2013.05.13., 55(24+31), FA-MA; 2013.06.07., 14(5+9), FA-MA – Fekete-05: 2013.05.12., 17(9+8), FA-MA; 2013.06.08., 1(1+0), FA-MA – Fekete-06: 2013.05.13., 22(17+5), FA-MA; 2013.05.23., 2(1+1), FA-MA; 2013.06.07., 7(3+4), FA-MA; 2013.06.23., 3(2+1), FA-MA – Fekete-07: 2013.05.12., 9(3+6),

FA-MA; 2013.05.23., 10(1+9), FA-MA; 2013.06.08., 1(1+0), FA-MA – Kettős-01: 2013.05.12., 6(0+6), FA-MA; 2013.06.24., 1(0+1), FA-MA – Kettős-02: 2013.05.12., 3(1+2), FA-MA; 2013.05.23., 2(1+1), FA-MA – Kettős-03B: 2013.06.08., 6(3+3), FA-MA; 2013.06.24., 1(1+0), FA-MA – Kettős-04: 2013.05.13., 16(6+9+1), FA-MA; 2013.05.23., 3(0+3), FA-MA – Kettős-05: 2013.05.12., 14(6+8), FA-MA; 2013.05.23., 1(0+1), FA-MA – Kettős-06: 2013.05.12., 45(20+25), FA-MA; 2013.06.08., 2(0+2), FA-MA – Kettős-07: 2013.05.12., 33(13+20), FA-MA; 2013.06.08., 1(0+1), FA-MA; 2013.06.24., 1(1+0), FA-MA – Kettős-08: 2013.05.11., 54(25+29), FA-MA; 2013.05.23., 2(0+2), FA-MA – Kettős-09: 2013.05.12., 8(2+6), FA-MA; 2013.05.22., 2(0+2), FA-MA – Kettős-10: 2013.05.12., 27(6+21), FA-MA – Kettős-11: 2013.05.12., 64(31+33), FA-MA – Maros-01: 2013.05.10., 30(19+10+1), DT-FA-MA; 2013.05.21., 4(3+1), FA-MA; 2013.06.26., 1(1+0), DT-FA-MA – Maros-02: 2013.05.11., 163(61+99+3), DT-FA-MA; 2013.05.21., 32(17+15), FA-MA; 2013.06.26., 1(1+0), DT-FA-MA – Maros-03: 2013.05.10., 7(6+1), DT-FA-MA; 2013.05.21., 4(4+0), FA-MA – Maros-04: 2013.05.11., 4(2+2), DT-FA-MA; 2013.05.21., 4(2+2), FA-MA – Maros-05: 2013.05.11., 249(132+117), DT-FA-MA; 2013.05.21., 55(28+27), FA-MA; 2013.06.26., 9(6+2+1), DT-FA-MA – Maros-06: 2013.05.11., 182(74+102+6), DT-FA-MA; 2013.05.21., 10(5+5), FA-MA; 2013.06.26., 2(2+0), DT-FA-MA – Maros-07: 2013.05.10., 111(47+62+2), DT-FA-MA; 2013.05.21., 2(0+2), FA-MA – Maros-08: 2013.05.10., 62(27+34+1), DT-FA-MA – Maros-09: 2013.05.10., 45(25+20), DT-FA-MA – Maros-10: 2013.05.10., 260(128+128+4), DT-FA-MA; 2013.05.22., 1(0+1), FA-MA – Maros-11: 2013.05.10., 9(5+4), DT-FA-MA – Maros-12: 2013.05.10., 31(19+11+1), DT-FA-MA – Maros-13: 2013.05.10., 233(103+117+13), DT-FA-MA – Maros-14: 2013.05.10., 308(155+149+4), DT-FA-MA; 2013.05.22., 2(1+1), FA-MA; 2013.06.25., 1(1+0), FA-MA – Maros-15: 2013.05.10., 329(156+143+30), DT-FA-MA – Maros-15A: 2013.05.22., 1(0+1), FA-MA.

***Gomphus flavipes*** (Charpentier, 1825) – Fehér-01: 2013.05.23., 7(5+2), FA-MA; 2013.06.07., 8(5+3), FA-MA; 2013.06.23., 4(1+3), FA-MA – Fehér-02: 2013.05.23., 10(4+5+1), FA-MA; 2013.06.07., 3(1+2), FA-MA; 2013.06.23., 2(1+1), FA-MA – Fehér-03: 2013.06.07., 4(2+2), FA-MA; 2013.06.23., 3(2+1), FA-MA – Fehér-04: 2013.06.07., 11(8+3), FA-MA – Fekete-01: 2013.06.07., 4(1+3), FA-MA – Fekete-02: 2013.06.07., 3(1+2), FA-MA – Fekete-03: 2013.06.07., 4(2+2), FA-MA; 2013.06.23., 3(3+0), FA-MA – Fekete-04: 2013.06.07., 13(7+6), FA-MA; 2013.06.23., 4(0+3+1), FA-MA – Fekete-05: 2013.06.08., 3(1+2), FA-MA; 2013.06.24., 1(0+1), FA-MA – Fekete-06: 2013.05.23., 8(6+2), FA-MA; 2013.06.07., 19(7+12), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fekete-07: 2013.05.23., 8(5+3), FA-MA; 2013.06.23., 1(0+1), FA-MA – Kettős-01: 2013.06.08., 19(11+8), FA-MA; 2013.06.24., 22(11+11), FA-MA – Kettős-02: 2013.05.23., 27(13+13+1), FA-MA; 2013.06.07., 7(2+5), FA-MA; 2013.06.24., 10(5+5), FA-MA – Kettős-03A: 2013.06.08., 12(6+6), FA-MA; 2013.06.24., 5(2+3), FA-MA – Kettős-03B: 2013.06.08., 34(15+18+1), FA-MA; 2013.06.24., 5(3+0+2), FA-MA – Kettős-04: 2013.05.23., 9(4+5), FA-MA; 2013.06.07., 2(1+1), FA-MA; 2013.06.24., 8(3+5), FA-MA – Kettős-05: 2013.05.23., 12(4+7+1), FA-MA; 2013.06.08., 2(1+1), FA-MA; 2013.06.24., 22(9+13), FA-MA – Kettős-06: 2013.06.08., 6(2+4), FA-MA; 2013.06.24., 35(10+24+1), FA-MA – Kettős-07: 2013.06.08., 1(0+1), FA-MA; 2013.06.24., 16(6+9+1), FA-MA – Kettős-08: 2013.05.23., 31(13+18), FA-MA; 2013.06.08., 1(0+1), FA-MA; 2013.06.24., 20(9+9+2), FA-MA – Kettős-09: 2013.05.22., 8(4+4), FA-MA; 2013.06.08., 5(3+2), FA-MA; 2013.06.24., 18(6+12), FA-MA –



Kettős-10: 2013.06.08., 1(1+0), FA-MA; 2013.06.24., 5(2+3), FA-MA – Kettős-11: 2013.06.08., 2(1+1), FA-MA; 2013.06.24., 2(1+1), FA-MA – Maros-01: 2013.05.21., 41(22+17+2), FA-MA; 2013.06.26., 29(11+17+1), DT-FA-MA – Maros-02: 2013.05.21., 46(29+17), FA-MA; 2013.06.26., 109(58+45+6), DT-FA-MA – Maros-03: 2013.05.21., 27(10+17), FA-MA; 2013.06.26., 61(25+26+10), DT-FA-MA – Maros-04: 2013.05.21., 25(14+10+1), FA-MA; 2013.06.26., 31(11+18+2), DT-FA-MA – Maros-05: 2013.05.21., 65(37+24+4), FA-MA; 2013.06.26., 43(20+23), DT-FA-MA – Maros-06: 2013.05.21., 54(33+21), FA-MA; 2013.06.26., 32(11+11+10), DT-FA-MA – Maros-07: 2013.05.21., 32(19+10+3), FA-MA; 2013.06.24., 38(14+14+10), FA-MA – Maros-08: 2013.05.21., 91(39+44+8), FA-MA; 2013.06.25., 35(18+11+6), FA-MA – Maros-09: 2013.05.21., 74(33+39+2), FA-MA; 2013.06.25., 83(41+35+7), FA-MA – Maros-10: 2013.05.22., 59(22+36+1), FA-MA; 2013.06.25., 55(25+25+5), FA-MA – Maros-11: 2013.05.22., 53(24+29), FA-MA; 2013.06.25., 145(67+77+1), FA-MA – Maros-12: 2013.05.22., 47(15+32), FA-MA; 2013.06.26., 48(28+20), DT-FA-MA – Maros-13: 2013.05.22., 98(51+43+4), FA-MA; 2013.06.25., 107(45+45+17), FA-MA – Maros-14: 2013.05.22., 42(26+16), FA-MA; 2013.06.25., 68(36+29+3), FA-MA – Maros-15: 2013.06.26., 53(25+28), FA-MA – Maros-15A: 2013.05.22., 73(34+37+2), FA-MA.

***Ophiogomphus cecilia*** (Fourcroy, 1758) – Fehér-02: 2013.05.23., 2(1+1), FA-MA; 2013.06.23., 1(0+1), FA-MA – Fehér-03: 2013.06.07., 1(0+1), FA-MA – Fehér-04: 2013.06.23., 1(0+1), FA-MA – Fekete-01: 2013.05.13., 1(1+0), FA-MA; 2013.06.07., 2(0+2), FA-MA – Fekete-02: 2013.05.13., 1(1+0), FA-MA; 2013.06.07., 3(0+3), FA-MA; 2013.06.23., 2(1+1), FA-MA – Fekete-03: 2013.06.07., 3(0+3), FA-MA; 2013.06.23., 2(0+2), FA-MA – Fekete-04: 2013.06.07., 8(4+4), FA-MA; 2013.06.23., 1(1+0), FA-MA – Fekete-05: 2013.06.08., 2(1+1), FA-MA – Fekete-06: 2013.05.23., 1(1+0), FA-MA – Fekete-07: 2013.06.23., 1(0+1), FA-MA – Kettős-01: 2013.06.08., 1(1+0), FA-MA – Kettős-03B: 2013.06.08., 1(1+0), FA-MA – Kettős-04: 2013.06.07., 1(0+1), FA-MA – Kettős-05: 2013.05.23., 1(1+0), FA-MA; 2013.06.08., 2(2+0), FA-MA; 2013.06.24., 2(2+0), FA-MA – Kettős-07: 2013.06.24., 1(1+0), FA-MA – Maros-01: 2013.05.10., 3(3+0), DT-FA-MA; 2013.05.21., 7(3+4), FA-MA; 2013.06.26., 1(1+0), DT-FA-MA – Maros-02: 2013.05.11., 3(2+1), DT-FA-MA; 2013.05.21., 6(2+4), FA-MA – Maros-03: 2013.05.10., 3(3+0), DT-FA-MA; 2013.05.21., 2(2+0), FA-MA; 2013.06.26., 1(0+0+1), DT-FA-MA – Maros-04: 2013.05.11., 8(4+4), DT-FA-MA; 2013.05.21., 8(2+6), FA-MA – Maros-05: 2013.05.11., 4(2+2), DT-FA-MA; 2013.05.21., 21(10+11), FA-MA; 2013.06.26., 2(1+1), DT-FA-MA – Maros-06: 2013.05.11., 6(4+2), DT-FA-MA; 2013.05.21., 7(3+4), FA-MA – Maros-07: 2013.05.21., 2(2+0), FA-MA – Maros-08: 2013.05.10., 2(2+0), DT-FA-MA; 2013.05.21., 16(8+7+1), FA-MA – Maros-09: 2013.05.10., 2(2+0), DT-FA-MA; 2013.05.21., 8(3+5), FA-MA – Maros-10: 2013.05.10., 11(11+0), DT-FA-MA; 2013.05.22., 19(10+8+1), FA-MA; 2013.06.25., 1(0+1), FA-MA – Maros-12: 2013.05.22., 1(0+1), FA-MA – Maros-13: 2013.05.10., 2(1+1), DT-FA-MA; 2013.05.22., 9(3+6), FA-MA – Maros-14: 2013.05.10., 1(0+1), DT-FA-MA; 2013.05.22., 4(1+3), FA-MA – Maros-15A: 2013.05.22., 1(1+0), FA-MA.

***Onychogomphus forcipatus*** (Linnaeus, 1758) – Fehér-02: 2013.05.13., 1(0+1), DT-FA-MA; 2013.06.23., 5(1+4), FA-MA – Fekete-01: 2013.06.23., 15(6+9), FA-MA – Fekete-02: 2013.06.07., 1(0+1), FA-MA; 2013.06.23., 19(11+8), FA-MA – Fekete-03: 2013.06.23., 3(0+3), FA-MA – Fekete-04: 2013.06.07., 1(0+1), FA-MA – Fekete-05: 2013.06.24., 2(1+1), FA-MA – Fekete-06: 2013.06.23., 1(1+0), FA-MA – Fekete-07: 2013.06.23., 6(2+3+1), FA-MA – Kettős-02: 2013.06.24.,

3(2+1), FA-MA – Kettős-03A: 2013.06.24., 3(0+3), FA-MA – Kettős-03B: 2013.06.24., 1(1+0), FA-MA – Kettős-04: 2013.06.07., 1(0+1), FA-MA; 2013.06.24., 11(7+4), FA-MA – Kettős-05: 2013.06.24., 11(5+6), FA-MA – Kettős-06: 2013.06.24., 1(0+1), FA-MA – Kettős-07: 2013.06.24., 2(2+0), FA-MA – Maros-05: 2013.06.26., 1(0+0+1), DT-FA-MA.

***Epitheca bimaculata*** (Charpentier, 1825) – Kettős-04: 2013.05.13., 1(1+0), FA-MA.

***Orthetrum cancellatum*** (Linnaeus, 1758) – Fehér-01: 2013.06.07., 1(1+0), FA-MA – Kettős-04: 2013.05.13., 1(1+0), FA-MA – Maros-05: 2013.06.26., 1(1+0), DT-FA-MA.

***Orthetrum albistylum*** (Selys, 1848) – Fehér-02: 2013.05.23., 1(0+1), FA-MA; 2013.06.07., 1(0+1), FA-MA – Kettős-02: 2013.06.24., 1(0+1), FA-MA – Kettős-08: 2013.06.24., 1(1+0), FA-MA – Kettős-10: 2013.06.24., 1(0+1), FA-MA.

Data based on adults  
(identified by A. Móra)

***Calopteryx splendens*** (Harris, 1782) – Fekete-02: 2013.06.07., 1(1+0), FA-MA – Fekete-03: 2013.06.23., 2(1+1), FA-MA – Fekete-04: 2013.06.23., 8(6+2), FA-MA – Fekete-06: 2013.06.23., 1(1+0), FA-MA – Kettős-08: 2013.06.24., 2(2+0), FA-MA – Kettős-10: 2013.06.24., 3(3+0), FA-MA – Maros-01: 2013.06.26., 25(25+0), DT-FA-MA – Maros-09: 2013.06.25., 4(2+2), FA-MA.

***Ischnura elegans*** (Vander Linden, 1820) – Fehér-02: 2013.05.23., 5(0+0+5), FA-MA – Fekete-04: 2013.06.23., 12(7+5), FA-MA.

***Platycnemis pennipes*** (Pallas, 1771) – Fekete-07: 2013.06.23., 1(1+0), FA-MA – Kettős-06: 2013.06.24., 2(1+1), FA-MA – Kettős-08: 2013.06.24., 4(2+2), FA-MA – Kettős-10: 2013.06.24., 4(3+1), FA-MA – Kettős-11: 2013.06.24., 2(1+1), FA-MA – Maros-01: 2013.06.26., 1(1+0), DT-FA-MA – Maros-09: 2013.06.25., 4(3+1), FA-MA.

***Aeshna affinis*** Vander Linden, 1820 – Kettős-08: 2013.06.24., 3(0+3), FA-MA.

***Anax imperator*** Leach, 1815 – Kettős-07: 2013.06.08., 4(4+0), FA-MA.

***Ophiogomphus cecilia*** (Fourcroy, 1758) – Fehér-02: 2013.05.23., 1(1+0), FA-MA – Fekete-02: 2013.06.07., 1(0+1), FA-MA – Maros-02: 2013.05.11., 1(0+1), DT-FA-MA.

***Onychogomphus forcipatus*** (Linnaeus, 1758) – Fekete-02: 2013.06.07., 1(0+1), FA-MA – Fekete-04: 2013.06.23., 1(0+1), FA-MA – Fekete-07: 2013.06.23., 1(1+0), FA-MA – Kettős-04: 2013.06.07., 1(0+1), FA-MA; 2013.06.24., 2(1+1), FA-MA – Kettős-08: 2013.06.24., 1(1+0), FA-MA.

***Libellula depressa*** Linnaeus, 1758 – Kettős-07: 2013.06.08., 1(0+1), FA-MA.

***Orthetrum cancellatum*** (Linnaeus, 1758) – Fekete-04: 2013.06.23., 1(1+0), FA-MA – Fekete-06: 2013.06.23., 2(2+0), FA-MA – Fekete-07: 2013.06.23., 2(2+0), FA-MA – Kettős-08: 2013.06.24., 1(1+0), FA-MA.

***Orthetrum albistylum*** (Selys, 1848) – Kettős-05: 2013.06.24., 1(0+1), FA-MA – Maros-09: 2013.06.25., 1(1+0), FA-MA.

***Sympetrum striolatum*** (Charpentier, 1840) – Maros-06: 2013.06.26., 1(0+1), DT-FA-MA.

***Sympetrum meridionale*** (Selys, 1841) – Maros-06: 2013.06.26., 3(3+0), DT-FA-MA – Maros-09: 2013.06.25., 1(0+1), FA-MA.

## Gomphidae assemblages

Both *G. flavipes* and *G. vulgatissimus* occurred at all sampling sites (Fig. 1–2), thus being presented the most frequent gomphid species. Similarly, *O. cecilia* was also recorded from all four studied rivers, and was only absent from the uppermost section of the Fehér-Körös and the lowest section of the Kettős-Körös (Fig. 3). *Onychogomphus forcipatus*, although found along all studied rivers, was collected at the fewest sampling sites: occurred at one locality both along the Fehér-Körös and the Maros, while it was absent, the same as *O. cecilia*, from the lowest section of the Kettős-Körös (Fig. 4). Based on literature data, *G. flavipes* and *G. vulgatissimus* are known from all four of the former rivers, while *O. cecilia* and *O. forcipatus* were only found in the Fekete-Körös and Maros rivers (AMBRUS 2000; AMBRUS et al. 1996, 1998a, 1998b; JUHÁSZ et al. 1998, 2000; KOVÁCS and AMBRUS 2010; KOVÁCS et al. 2004, 2006; MÜLLER et al. 2006; OLAJOS et al. 1998). Accordingly, the distributional areas of the latter two species were remarkably expanded by our results. The co-occurrence of the four Hungarian gomphid species is relatively infrequent in Hungary (DÉVAI et al. 2010; JAKAB and DÉVAI 2008) and may be attributed to the high habitat heterogeneity of the rivers.

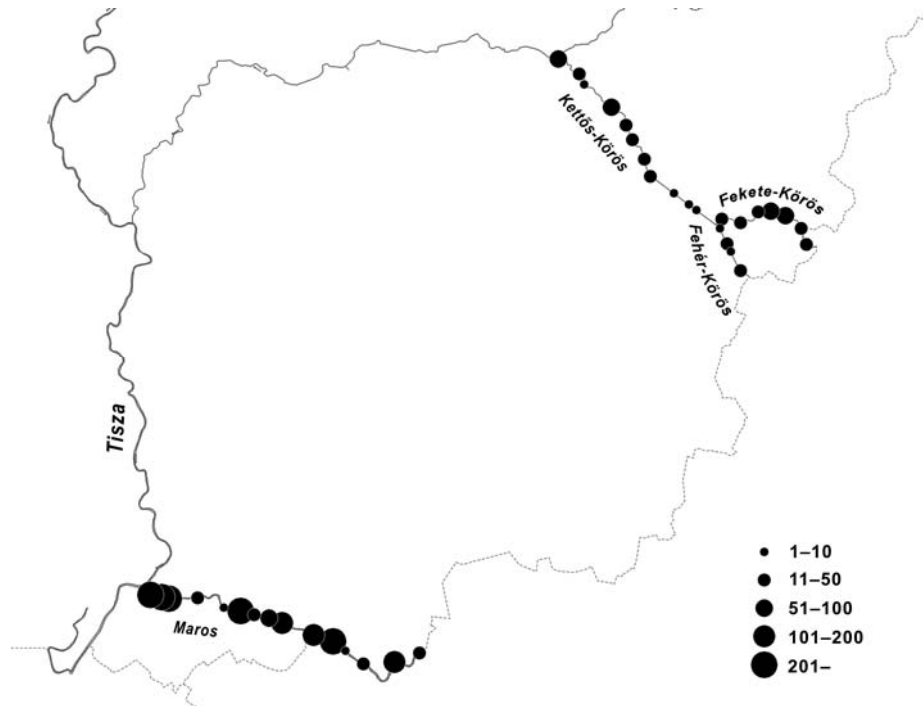
Comparing the studied rivers, apparently the Maros was the most favourable for gomphids: mean number of exuviae on a 20 metre long stretch was much higher here than at the other three rivers. Among the latter rivers, the Fekete-Körös and the Kettős-Körös had fairly similar mean numbers of exuviae, whereas for the Fehér-Körös this value was about the half of those (Fig. 5). The much higher density of gomphids in the Maros may be attributed to its close-to-natural condition, whereas the Körös rivers suffered from marked anthropogenic modifications (e.g. deforestation, damming up, channelization).

In the case of all studied rivers the two *Gomphus* species were dominant: along the Maros and especially along the Fekete-Körös *G. vulgatissimus*, along the Kettős-Körös *G. flavipes* was the most dominant, while along the Fehér-Körös similar relative abundances were obtained for this two species (Fig. 5). The relative abundances of *O. cecilia* and *O. forcipatus* were much lower in all rivers, and the ratios of these species in the assemblages were only considerable along the Fekete-Körös.

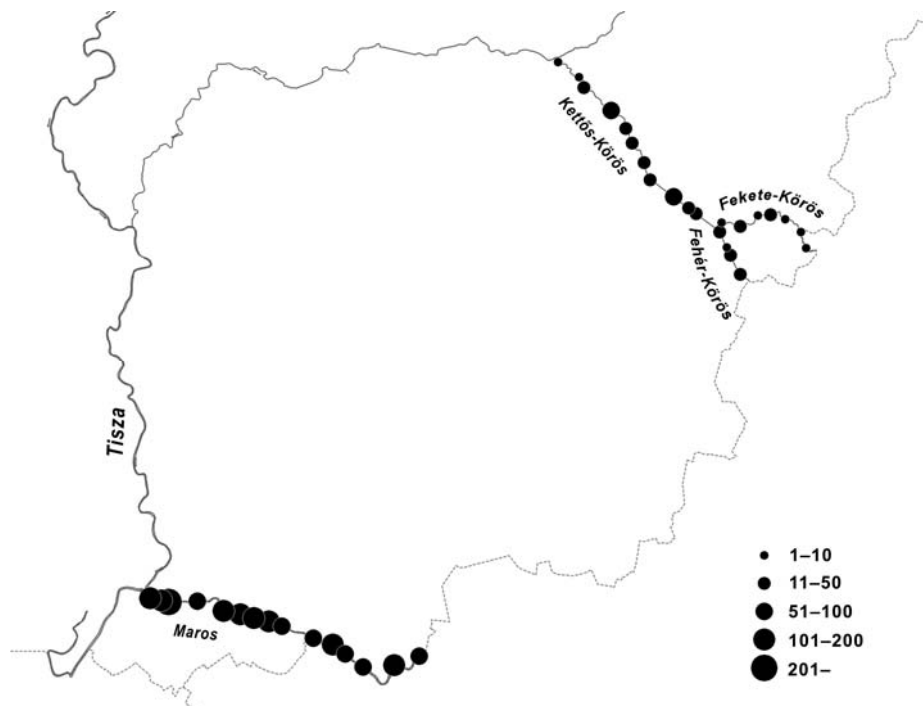
No obvious trends could have been revealed in the changes of the composition of gomphid assemblages. The number of individuals and the relative abundances varied widely among sites within a given river according to habitat characteristics (Figs. 6–8).

Based on our results the populations of all gomphid species are small and vulnerable along the Fehér-Körös, most likely due to the strongly modified condition of the river. In contrast, all species have strong and viable populations along the Fekete-Körös. The populations of two *Gomphus* species are large and strong along the entire section of the Kettős-Körös, while the population of *O. forcipatus* is smaller but stable, particularly along the upper reaches. In contrast, the low number of individuals indicates a vulnerable population of *O. cecilia* along this river. Strong and stable populations of *G. flavipes*, *G. vulgatissimus* and *O. cecilia* exist along the entire Hungarian section of the Maros, while the population of *O. forcipatus* is rather small and vulnerable.

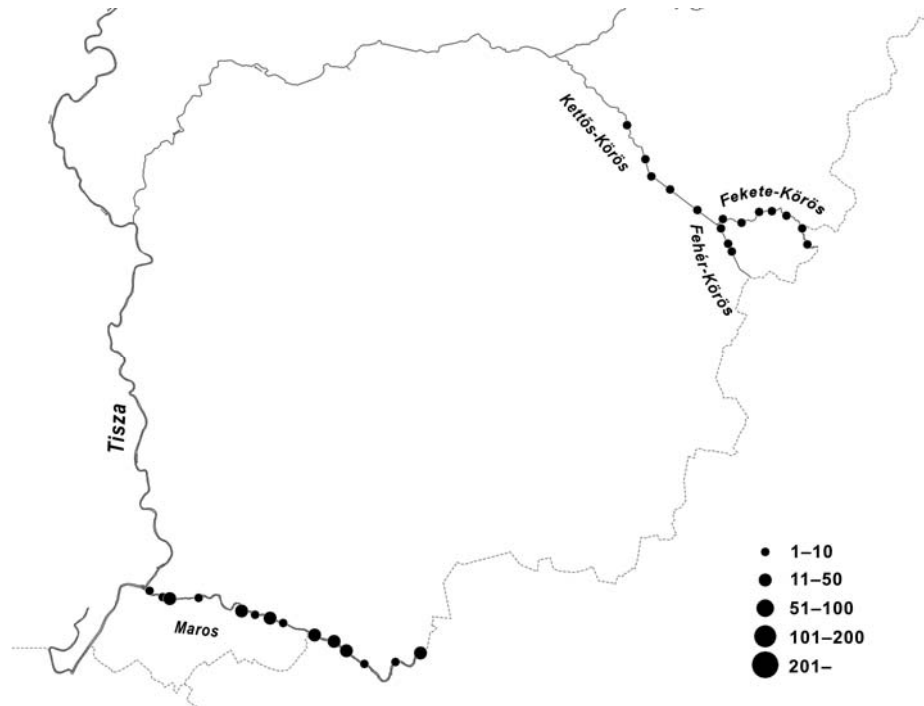
In conclusion, the Gomphidae have stable and viable populations along the studied rivers (Fehér-Körös may be an exception) with great significance in terms of nature conservation. Accordingly, either these populations or rivers deserve strict protection.



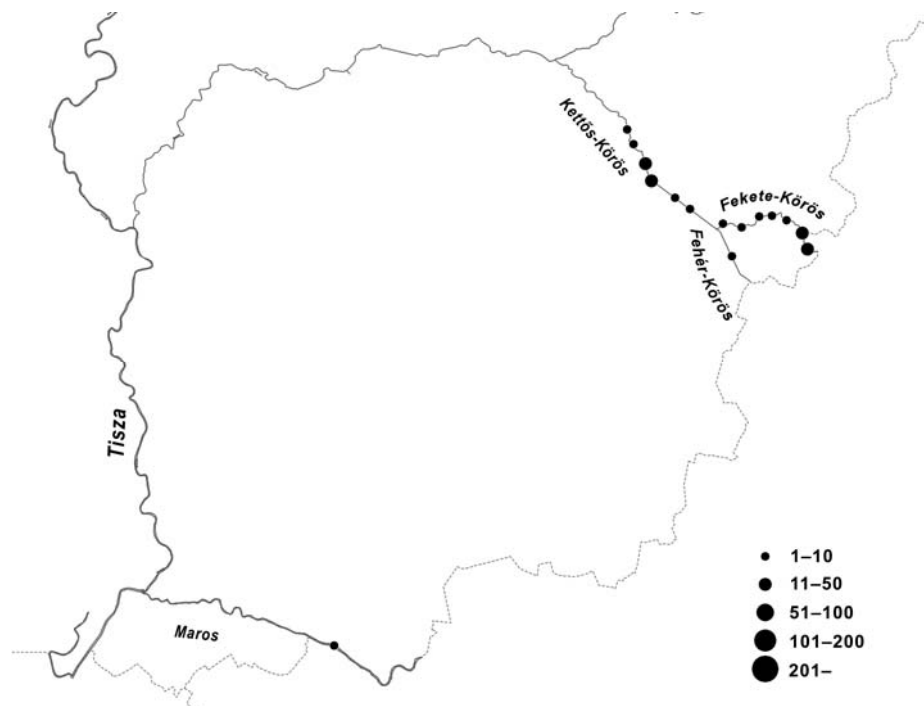
**Figure 1.** Occurrences of *G. vulgatissimus* along the studied rivers based on collection of exuviae carried out in 2013 (the size of the dots indicate the number of individuals on 20 meters).



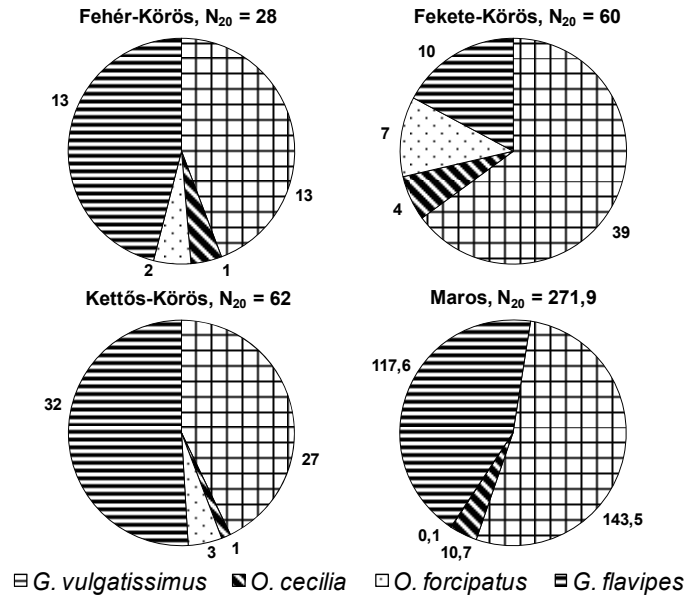
**Figure 2.** Occurrences of *G. flavipes* along the studied rivers based on collection of exuviae carried out in 2013 (the size of the dots indicate the number of individuals on 20 meters).



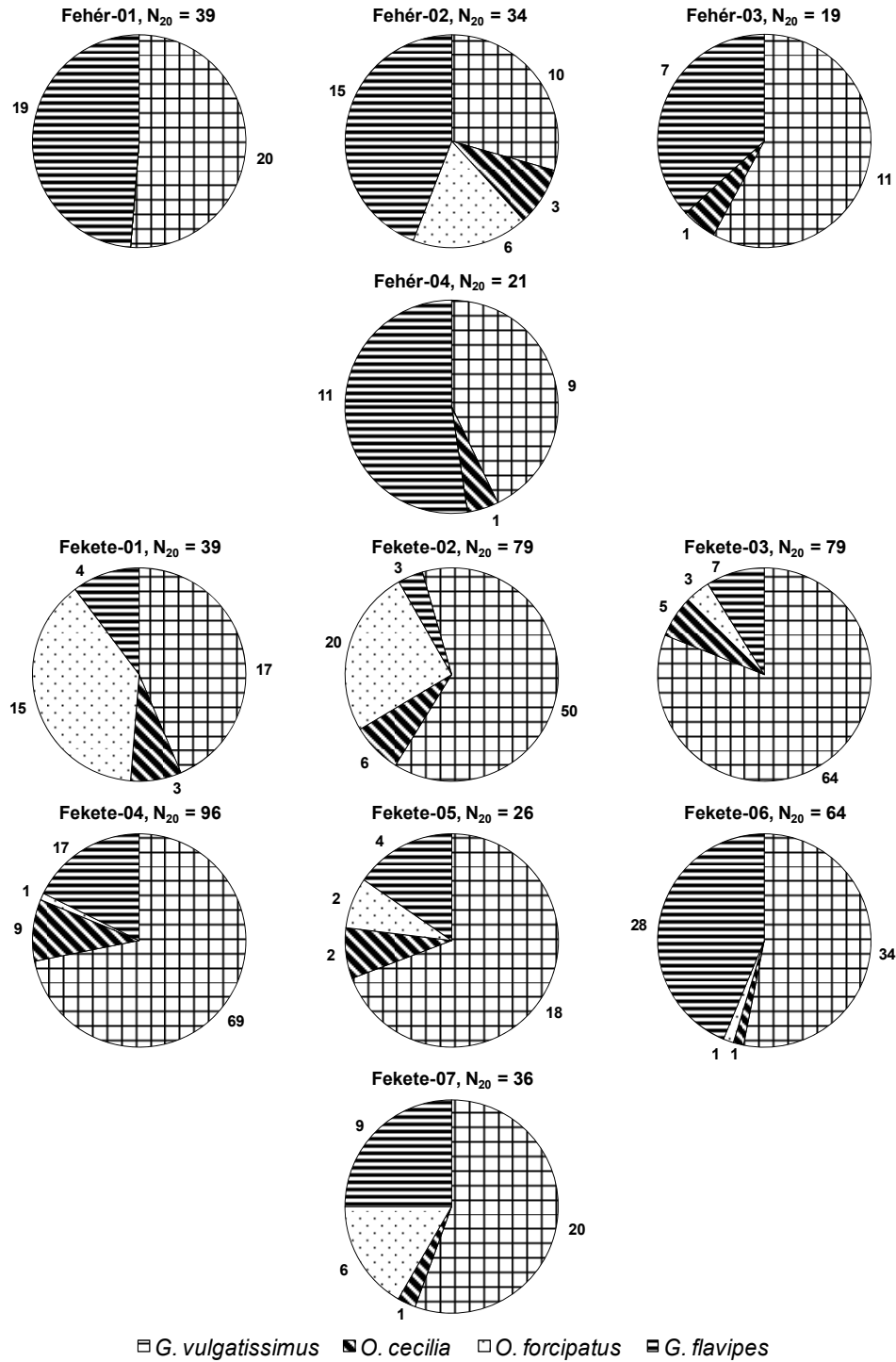
**Figure 3.** Occurrences of *O. cecilia* along the studied rivers based on collection of exuviae carried out in 2013 (the size of the dots indicate the number of individuals on 20 meters).



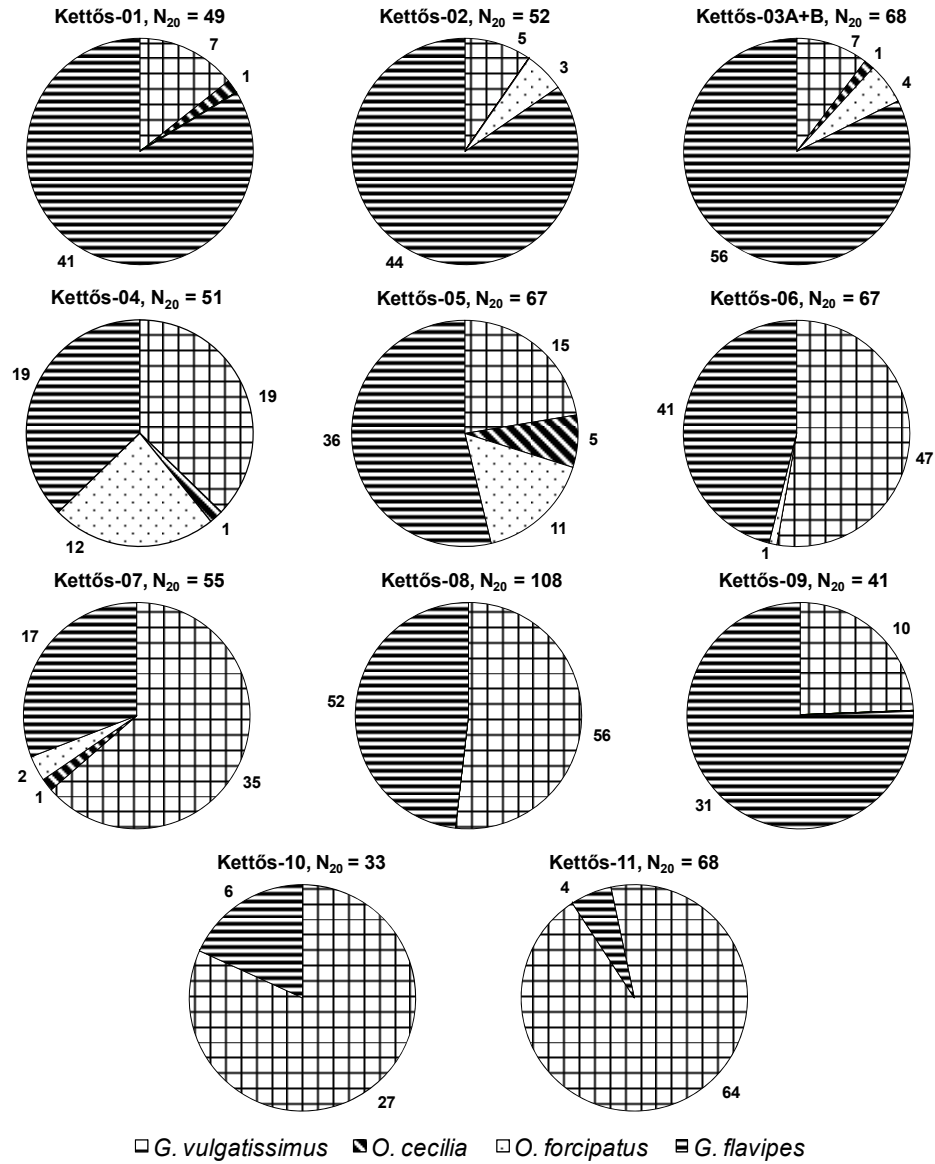
**Figure 4.** Occurrences of *O. forcipatus* along the studied rivers based on collection of exuviae carried out in 2013 (the size of the dots indicate the number of individuals on 20 meters).



**Figure 5.** Relative abundances and mean numbers of individuals (on a 20 metre long stretch) of Gomphidae along the studied rivers ( $N_{20}$  = mean total number of individuals of Gomphidae on a 20 metre long stretch; numbers indicate mean numbers of individuals of each species, while slices show their relative abundances).

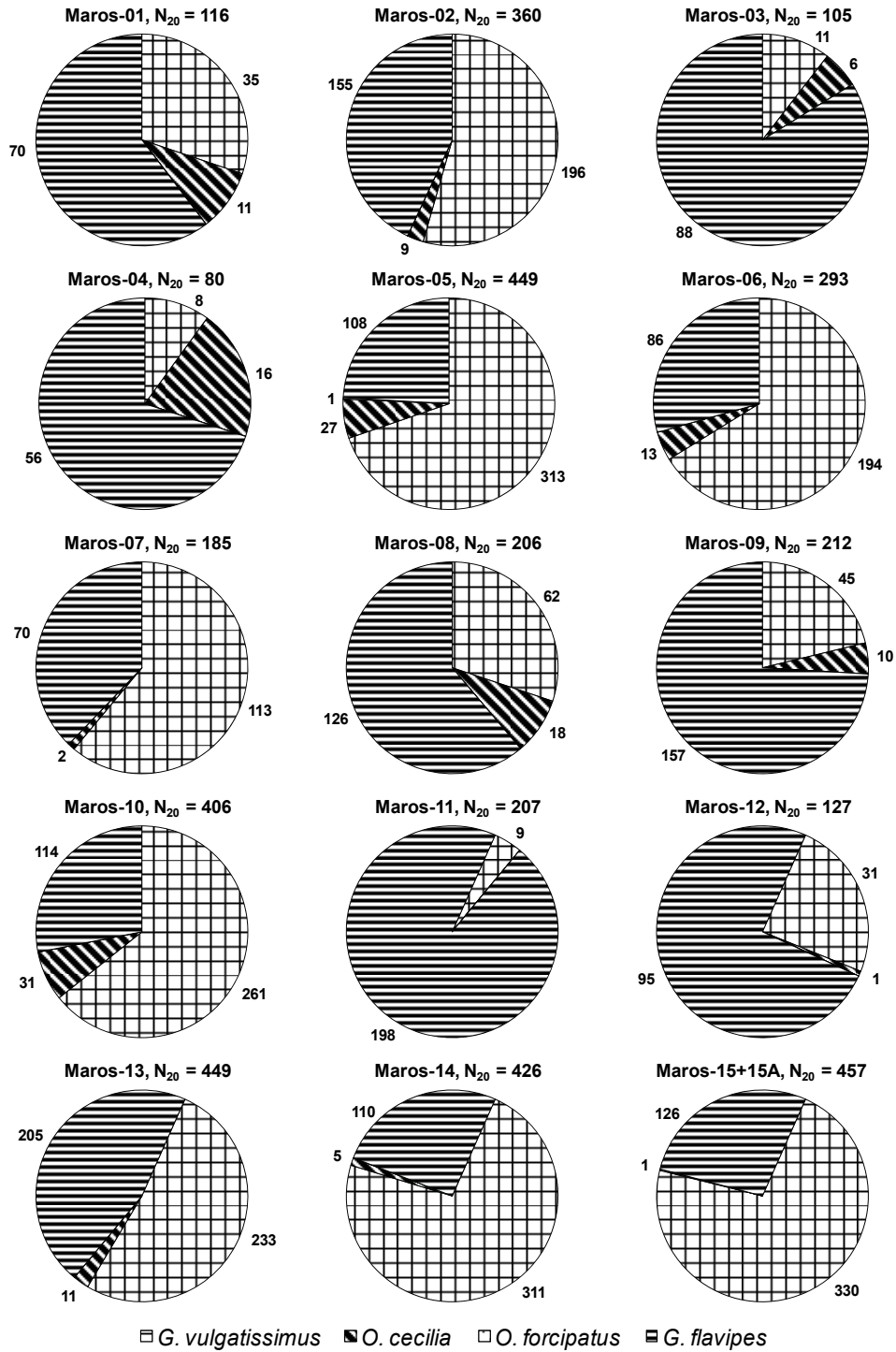


**Figure 6.** Relative abundances and numbers of individuals of Gomphidae at each sampling site along the Fehér-Körös and Fekete-Körös ( $N_{20}$  = total number of individuals of Gomphidae on the 20 metre long stretch; numbers indicate numbers of individuals of each species, while slices show their relative abundances).



**Figure 7.** Relative abundances and numbers of individuals of Gomphidae at each sampling site along the Kettős-Körös ( $N_{20}$  = total number of individuals of Gomphidae on the 20 metre long stretch; numbers indicate numbers of individuals of each species, while slices show their relative abundances).





**Figure 8.** Relative abundances and numbers of individuals of Gomphidae at each sampling site along the Maros ( $N_{20}$  = total number of individuals of Gomphidae on the 20 metre long stretch; numbers indicate numbers of individuals of each species, while slices show their relative abundances).

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## References

- AMBRUS, A. – OLAJOS, P. (2000): Folyami szitakötők (Gomphidae) monitorozása a Körös-Maros Nemzeti Park Igazgatóság működési területén. – Research report, Debrecen, 15 pp.
- AMBRUS, A. – BÁNKUTI, K. – CSÁNYI, B. – GULYÁS, P. – JUHÁSZ, P. – KOVÁCS, T. (1998a): Larval data to the Odonata fauna of Hungary. – *Odonata – stadium larvale* 2: 41–52.
- AMBRUS, A. – BÁNKUTI, K. – CSÓKA, GY. – KOVÁCS, T. (1998b): Faunistical data to the Odonata fauna of the Körös-Maros National Park. – *Odonata – stadium larvale* 2: 53–60.
- AMBRUS, A. – BÁNKUTI, K. – KOVÁCS, T. (1996): Lárva és imágó adatok Magyarország Odonata faunájához [Larval and imaginal data to the Odonata fauna of Hungary]. – *Odonata – stadium larvale* 1: 51–68.
- ASKEW, R.R. (2004): The dragonflies of Europe. Second edition. – Harley Books, Colchester, 308 pp.
- CHAM, S. (2007): Field guide to the larvae and exuviae of British dragonflies. Volume 1: Dragonflies (Anisoptera). – The British Dragonfly Society, Peterborough, 76 pp.
- COUNCIL OF THE EUROPEAN UNION (2006): Council directive 2006/105/EC of 20 November 2006 adapting Directives 73/239/EEC, 74/557/EEC and 2002/83/EC in the field of environment, by reason of the accession of Bulgaria and Romania. – *Official Journal of the European Union* 49/L363: 368–408.
- DÉVAI, GY. – MÁTYUS, B.I. – MISKOLCZI, M. – JAKAB, T. (2010): Folyami szitakötők (Odonata: Gomphidae) előfordulási sajátosságai a Tiszában exuviumvizsgálatok alapján [Occurrence features of riverine dragonflies (Odonata: Gomphidae) in River Tisza based on investigations of exuviae]. In: LÓKI, J. (ed.): *Interdiszciplinaritás a természet- és társadalomtudományokban. Tiszteletkötet Szabó József geográfus professzor 70. születésnapjára* [Interdisciplinarity in the natural and social sciences. Honorary volume on the occasion of Professor József Szabó's 75<sup>th</sup> birthday]. – Debreceni Egyetem Természetföldrajzi és Geoinformatikai Tanszéke, Debrecen, p. 61–70.
- DIJKSTRA, K.-D.B. (edit.) (2006): Field guide to the dragonflies of Britain and Europe. – British Wildlife Publishing, Gillingham, 320 pp.
- GERKEN, B. – STERNBERG, K. (1999): Die Exuvien Europäischer Libellen (Insecta, Odonata). – Arnika & Eisvogel, Höxter & Jena, VI + 354 pp.
- JAKAB, T. – DÉVAI, GY. (2008): A folyami szitakötők előfordulása Magyarországon a lárva- és exuviumadatok alapján [The occurrence of the riverine dragonfly-species (Odonata: Gomphidae) in Hungary according to data of larvae and exuviae]. – *Acta Biologica Debrecina Supplementum Oecologica Hungarica* 18: 53–65.
- JUHÁSZ, P. – KISS, B. – OLAJOS, P. (1998): Faunisztikai kutatások a Körös-Maros Nemzeti Park területén [Faunistical investigations in the operational area of the Körös-Maros National Park]. – *Crisicum* 1: 105–125.

- JUHÁSZ, P. – KISS, B. – OLAJOS, P. – GRIGORSZKY, I. (1999): Faunisztikai kutatások a Körös–Maros Nemzeti Park működési területén levő "szentély" jellegű holtmedrekben [Faunistical research on the "sanctuary" oxbows of River Körös]. – *Crisicum* 2: 99–110.
- JUHÁSZ, P. – KISS, B. – OLAJOS, P. – GRIGORSZKY, I. (2000): Vízi makroszkópikus gerinctelenek faunisztikai vizsgálata a Körös-Maros Nemzeti Park működési területén. – *Crisicum* 3: 141–156.
- KOVÁCS, T. – AMBRUS, A. (2010): Lárva és exuvium adatok Magyarország Odonata faunájához III. [Larval and exuvial data to the Odonata fauna of Hungary III.]. – *Folia historico-naturalia Musei Matraensis* 34: 29–35.
- KOVÁCS, T. – AMBRUS, A. – JUHÁSZ, P. (2006): Lárva és exuvium adatok Magyarország Odonata faunájához II. [Larval and exuvial data to the Odonata fauna of Hungary II.]. – *Folia historico-naturalia Musei Matraensis* 30: 167–179.
- KOVÁCS, T. – AMBRUS, A. – JUHÁSZ, P. – BÁNKUTI, K. (2004): Lárva és exuvium adatok Magyarország Odonata faunájához [Larval and exuvial data to the Odonata fauna of Hungary]. – *Folia historico-naturalia Musei Matraensis* 28: 97–110.
- MÓRA, A. – CSABAI, Z. – MÜLLER, Z. (2001): Vízi makroszkópikus gerinctelenek vizsgálata a Körös–Maros Nemzeti Park illetékességi területén (Odonata, Coleoptera, Trichoptera). – *A Puszta* 2000: 90–138.
- MÜLLER, Z. – MÁTYUS, B.I. (2009): A Tisza magyarországi és a főbb mellékfolyók torkolatközeli szakaszán 2004-ben végzett két vizsgálatsorozat odonatológiai eredményei [Odonatological results of the two investigation series in 2004 on the Hungarian reach of River Tisza and its major tributaries near their confluences to the mainstream]. – *Studia odonatologica hungarica* 10: 11–20.
- MÜLLER, Z. – JUHÁSZ, P. – KISS, B. (2006): Faunistical results of the Odonata 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: 333–338.
- OLAJOS, P. – KISS, B. – JUHÁSZ, P. (1998): A Körös-Maros Nemzeti Park szitakötő (Odonata) faunisztikai kutatása [Faunistical research on the dragonfly (Odonata) fauna of the Körös-Maros National Park]. – *Odonata – stadium larvale* 2: 61–70.
- VIZSLÁN, T. – PINGITZER, B. (1998–99): Adatok Magyarország szitakötő-faunájához (Odonata) III. [Data to the Odonata fauna of Hungary III]. – *Folia historico-naturalia Musei Matraensis* 23: 179–190.

