

**Large branchiopods
(Crustacea: Anostraca, Notostraca, Spinicaudata, Laevicaudata)
of the middle Dyje river area, Czech Republic**

VÍT ZAVADIL¹, DAVID KRÁL² & ANTONÍN REITER³

¹ ENKI, public benefit corporation, Dukelská 145, CZ-379 01 Třeboň, Czech Republic;
e-mail: arnoviza@seznam.cz

² Department of Zoology, Faculty of Science, Charles University in Prague, Viničná 7, CZ-128 43 Praha 2,
Czech Republic; e-mail: kral@natur.cuni.cz

³ South Moravian Museum in Znojmo, Přemyslovců 8, CZ-669 45 Znojmo, Czech Republic;
e-mail: reiter@znojmuzeum.cz

ZAVADIL V., KRÁL D. & REITER A. 2013: Large branchiopods (Crustacea: Anostraca, Notostraca, Spinicaudata, Laevicaudata) of the middle Dyje river area, Czech Republic. *Acta Musei Moraviae, Scientiae biologicae* (Brno) **98(1)**: 1–40. – Distribution data on large branchiopods (Anostraca, Notostraca, Spinicaudata, Laevicaudata) from the middle Dyje river area are summarised. Recently, in the period 1997–2013, the following seven species have been recorded in this area: *Branchipus schaefferi* Fischer, 1834, *Chirocephalus carmuntanus* (Brauer, 1877), *Eubranchipus grubii* (Dybowski, 1860), *Streptocephalus torvicornis* (Waga, 1842), *Triops cancriformis* (Lamarck, 1801), *Leptestheria dahalacensis* (Rüppell, 1837), *Imnadia yeyetta* Hertzog, 1935 and *Lynceus brachyurus* O. F. Müller, 1776. Finding of the clam shrimp *Imnadia yeyetta* represents the first reliable country record for the Czech Republic and so far the northernmost known occurrence spot of the species. Findings of the fairy shrimp *Chirocephalus carmuntanus* represent a new records from the Czech Republic after more than 30 years and findings of the fairy shrimp *Streptocephalus torvicornis* represent the only known findings of adults in the wild in the Czech Republic since 1957, the species was thus rediscovered in southern Moravia after 40 years. Ecology, phenology, habitat preferences, syntopic occurrence, keeping and breeding in semicaptivity and conservation status of large branchiopods recorded in the study area are discussed.

Key words. Crustacea, Branchiopoda, Anostraca, Notostraca, Spinicaudata, Laevicaudata, clam shrimp, fairy shrimp, tadpole shrimp, distribution, faunistics, ecology, conservation status, floodplains, Czech Republic

Introduction

So far only scarce literature data on large branchiopods have been available from the middle Dyje river area, related to a single site, the “Červený rybníček” pool (HRABĚ 1954, KUBÍČEK 1965). This documents the level of historical knowledge on the fauna of branchiopods in the region. Consistent survey of large branchiopods was started there first in the year 1997, when the fairy shrimp *Streptocephalus torvicornis* was “rediscovered” after 40 years. Almost at the same time, in the years 1995–1998, the first records of summer species were made in the surroundings of Hevlín and Hrabětice. A part of these data was included in the survey reports by MARTIŠKO (1998) and MARTIŠKO & MARTIŠKOVÁ (2002). Some of the records were documented in museum collections

(mainly the findings by V. Škorpíková and M. Škorpík) but not published. These records drew attention of the authors also to the area of the southeastern Znojmo region. The survey was intensified there after the large floods in 2002 (ANONYMUS 2002). At that time, occurrence of three species was confirmed at a number of sites and a new species for the Czech Republic was found – the clam shrimp *Imnadia yeyetta*. The fact that the middle Dyje river area is rich in branchiopods and, at the same time, it is still only poorly studied, is further documented by a discovery of the first site of the clam shrimp *Lynceus brachyurus* in the region in 2009. By the beginning of the year 2013 numerous field records as well as rich voucher material, deposited in the South Moravian Museum in Znojmo and other institutions, was already available from the area of interest. Here we thus aim to analyse all known material and present the results.

Material and Methods

Large branchiopods were caught using a hand net or a strainer, in some cases also the material of dead individuals found in drying puddles was collected. Spring species were searched for at the time of their phenological optimum, summer species after torrential rains and floods after a certain lapse of time. The locality “Červený rybníček” pool was surveyed systematically throughout the study period. Other repeatedly confirmed sites were surveyed in the years favourable for the development of large branchiopods. Due to large-scale flooding of an extensive area around the confluence of the Jevišovka and Dyje rivers in September and October 2002, it was possible to study the size of the area inhabited by summer species, even at places (e.g. on arable land) where suitable water bodies seem to occur only exceptionally and in long time intervals.

Higher classification of the above mentioned large branchiopods groups as well as the names of the particular species of large branchiopods were taken from MARTIN & DAVIS (2001). All plants are identified by Antonín Reiter and their nomenclature was adopted from KUBÁT *et al.* (2002).

The material is deposited in the following collections (curator names in parentheses): JMZ – South Moravian Museum in Znojmo (Antonín Reiter), NMP – National Museum, Praha, Czech Republic (Petr Dolejš). Other used abbreviations include: BR – Biosphere Reserve under UNESCO, NP – national park, PP – nature monument, MTA – military training area. Details given for the particular records include: number of square of the mapping grid used in the Czech Republic (cf. PRUNER & MÍKA 1996) and its part (quarter) marked with a, b, c, d. Site number according to the map in Fig. 1 is given in square brackets, followed by municipality name and a more detailed description of the locality. Following the colon, date of the record is given as well as a method of data collection – either observation (observ.) or collection of voucher material (fix.). Number of individuals is also specified – males (M), females (F), adult (ad.), juvenile (juv.) or undistinguished specimens (spec.). Names of the author of the finding (leg.), determination (det.), and revising determination (revid.) and, where appropriate, name of the museum collection where the material is deposited (coll.) are given in

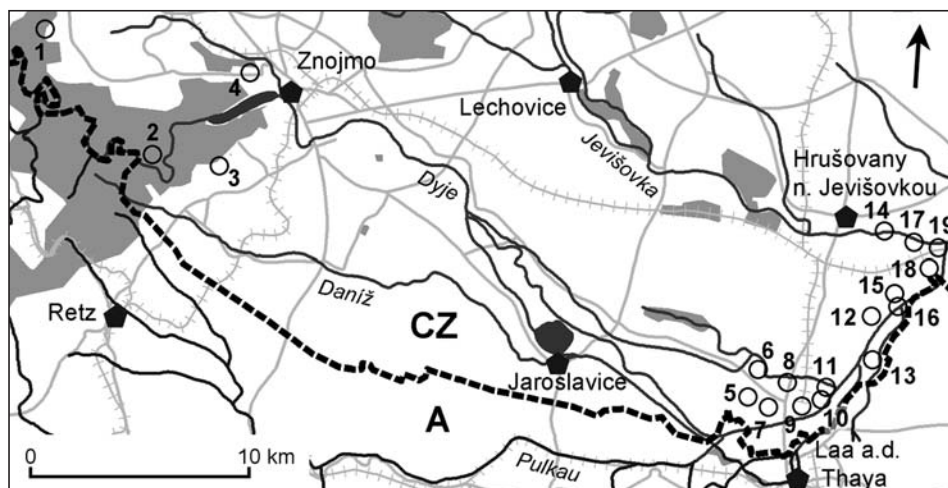


Fig. 1. Map of the study area showing localities of large branchiopods.
Obr. 1. Orientační mapa studovaného území se zákresem nálezových lokalit.

parentheses. In voucher specimens deposited in the South Moravian Museum, catalogue number of the sample in the zoological collection (No. x) is also mentioned. Other abbreviations: E = east, eastern, eastwards; N = north, northern, northwards; S = south, southern, southwards; W = west, western, westwards; NE = north-east, north-eastern, north-eastwards; analogically other directions. Following the list of localities of the species, its distribution in the study area is summarised and discussed with data from the nearest regions of its known occurrence.

Study area and localities

Large branchiopods were studied in the middle Dyje river area (Fig. 1). This is not a generally and unequivocally defined area, we understand this term rather tentatively. In the upper part it is delineated by a section with a canyon-like deep cut valley at the margin of the Bohemian Massif, i.e. the area of the Vranov reservoir and Podyjí National Park. The lower part of the study area has a less distinct boundary and it more or less continuously changes to the broad floodplain of the lower Dyje river area. For the purpose of this study, we defined the boundary as a confluence of the Dyje and Jevišovka rivers. This also corresponds with the boundary of the area of interest (collection area) of the South Moravian Museum in Znojmo, which participated significantly in collection of the material in the field. Localities in the following list are arranged in order of geographical position, from west to east (Fig. 1).

- [1] **“Na Pyramidě” pool** (cascade of two pools in a woodland depression in the western part of the Podyjí NP, NW of Lukov village). Coordinates: 48°52'30"N, 15°53'50"E, altitude: 430 m.
- [2] **“Černá luža” pool** (cascade of three pools in a woodland spring area in the central part of the Podyjí NP, SE of Podmoli village). Coordinates: 48°49'40"N, 15°58'43"E, altitude: 380 m.
- [3] **Popice – small quarries behind the Popice chapel** (the locality is situated in the Podyjí NP, W of Popice village). Coordinates: 48°49'11"N, 16°00'27"E, altitude: 320 m.
- [4] **“Červený rybníček” pool** (small-scale protected area (nature monument = PP), designated in 1956, NW of Znojmo-Hradiště village). Coordinates: 48°51'42"N, 16°01'33"E, altitude: 325 m.
- [5] **Hevlín, flooded ruts in the field road 2 km W of the church.** Coordinates: 48°45'11"N, 16°21'15"E, altitude: 185 m.
- [6] **Field east of the “Hevlínské jezero” pool** (the locality neighbours the PP Hevlínské jezero in the east, NW of Hevlín vilage). Coordinates: 48°45'52"N, 16°21'31"E, altitude: 185 m.
- [7] **Hevlín, puddle in the field SWW of hte village** (along both sides of former military road). Coordinates: 48°44'53"N, 16°21'02"E, altitude: 180 m.
- [8] **Hevlín, puddle in the field S of the “Černá strouha” channel** (1.1 km N of the church). Coordinates: 48°45'36"N, 16°22'53"E, altitude: 180 m.
- [9] **Hevlín, puddle in the field S and SE of village** (around causeway of former railway line). Coordinates: 48°44'57"N, 16°23'29"E, altitude: 175 m.
- [10] **Hevlín, puddle in the field E of village.** Coordinates: 48°45'06"N, 16°23'49"E, altitude: 175 m.
- [11] **Hevlín, puddle in the field 2.2 km NE of the church.** Coordinates: 48°45'38"N, 16°23'50"E, altitude: 175 m.
- [12] **Hrabětice, “Trávní dvůr” area, field 800 m SSW of the cannery** (flooded ruts in the field road). Coordinates: 48°47'23"N, 16°25'36"E, altitude: 175 m.
- [13] **Hrabětice, “Trávní dvůr” area, puddle in the field on right bank of the Dyje river 2 km S of the cannery.** Coordinates: 48°46'25"N, 16°25'47"E, altitude: 175 m.
- [14] **Hrušovany nad Jevišovkou, flooded field in the floodplain of the Jevišovka river, 2 km E of village.** Coordinates: 48°49'38"N, 16°25'48"E, altitude: 175 m.
- [15] **Hrabětice, “Trávní dvůr” area, puddle in the field N of the cannery.** Coordinates: 48°47'55"N, 16°26'05"E, altitude: 175 m.
- [16] **Hrabětice, “Trávní dvůr” area, 600 m SEE of the cannery** (temporarily flooded oxbow lake on the edge of floodplain forest). Coordinates: 48°47'46"N, 16°26'33"E – 48°48'02"N, 16°26'57"E, altitude: 170 m.
- [17] **Jevišovka, puddle in the field 1.2 km NWW of railway station.** Coordinates: 48°49'20"N, 16°27'06"E, altitude: 175 m.
- [18] **Hrušovany nad Jevišovkou / Jevišovka, “Trávní dvůr” area, flooded field SW of railway station Jevišovka.** Coordinates: 48°48'44"N, 16°27'23"E, altitude: 175 m.
- [19] **Jevišovka, flooded field between the village and the railway station** (including melioration channels). Coordinates: 48°49'19"N, 16°27'52"E, altitude: 175 m.

List of records and comments on the particular species

ANOSTRACA

Branchipodidae

Branchipus schaefferi Fischer, 1834 (Figs 2, 7A–B, 9A)

Distribution range. Distribution of the fairy shrimp *Branchipus schaefferi* covers warm and temperate zones of Europe from Spain, France and Italy including Sardinia, Sicily and Malta in the west, over Central European countries to the Black Sea coast in the Danube delta and in Crimea, and further northeast to central parts of the European part of Russia to the 55th parallel north. Most of the findings of the species come from the



Fig. 2. Localities with confirmed occurrence of *Branchipus schaefferi* – closed circles.

Obr. 2. Lokality s prokázaným výskytem *Branchipus schaefferi* – plná kolečka.

Pannonian lowland, i.e. from Central Europe. The species range extends further in North Africa, approximately to the tropic of Cancer. In Asia, the species is found in Turkey and in countries on the eastern Mediterranean Sea coast, over the Arabian peninsula to Pakistan (BRTEK & THIÉRY 1995, BRTEK 2005).

Distribution in the Czech Republic. Occurrence in the Czech Republic is situated inside the species range. It is our commonest fairy shrimp species. The first reports on occurrence of *B. schaefferi* in Bohemia come from the works by FRIČ & PRAŽÁK (1866) and FRIČ (1871). The then available knowledge on distribution of the species in the former Czechoslovakia was summarised by HRABĚ (1937) and a half-century later in an unpublished form by LEYPOLD (1989b). Further recent records were given e.g. by ZAVADIL & HONCŮ (1997), ZAVADIL (2001), MERTA & ROLEČEK (2005). The species was never connected with floodplains of rivers. In both Bohemia and Moravia, occurrence of the species is concentrated mainly in military training areas (ZAVADIL *et al.* 2009).

Biology. *Branchipus schaefferi* is a summer species, in Europe eurytopic and widespread, found in different habitats (BRTEK & THIÉRY 1995). It is distributed patchily in suitable habitats at low and medium altitudes of up to 700 m a.s.l. all around the country (ZAVADIL *et al.* 2009). In Slovakia, adult individuals were recorded from April till late September with a maximum in summer months (BRTEK 2005). Findings from the Czech Republic come from April till as late as the end of November. In case of non-freezing weather, the fairy shrimps are able to live till December (ZAVADIL & HONCŮ 1997, ZAVADIL *et al.* 2009). In an extremely warm winter, *B. schaefferi* can survive even till mid January, as recorded e.g. in January 2007 (observed in semicaptivity in outside reservoirs near

Čelákovice (Bohemia), Kavka pers. comm.). In the country, the species inhabits sparsely vegetated and especially quite bare puddles and depressions with clayish (less often sandy) or muddy bottom on field roads, tank training areas and racing circuits. It also occurs in spills in fields. Extreme findings are available from cattle footprints, holes in asphalt roads or puddles on paved or panel roads filled with water (ZAVADIL & HONCŮ 1997, ZAVADIL 2001, BRTEK 2005). Development of these fairy shrimps in warmed summer puddles is very fast, they can thus reach sexual maturity already two weeks after hatching (BRTEK 1962, 2005). Syntopic occurrence of this fairy shrimp with *Streptocephalus torvicornis*, *Triops cancriformis* and *Leptestheria dahalacensis* is known from Slovakia. In the Znojmo region, the species was recorded along with the tadpole shrimp *Triops cancriformis* and clam shrimps *Leptestheria dahalacensis* and *Imnadia yeyetta*.

New records

7264a; [5] **Hevlín**, flooded ruts in the field road 2 km W of the church: 1.x.2002 – tens of spec. observ., 22 spec. fix. (leg. & det. A. Reiter, coll. JMZ).

7264a; [6] **Hevlín**, puddle in the field E of “Hevlínské jezero” pool: 1.vii.1995 – several spec. observ. (leg. Martiškovi & Slechan, det. P. Pařil, MARTIŠKO & MARTIŠKOVÁ 2002); 7.x.1995 – several spec. fix. (leg. V. Škorpíková, det. P. Pařil); 30.x.1995 – 2 spec. fix. (leg. & det. M. Škorpík, coll. JMZ – No. 6849); 7.v.1996 – 6 spec. fix. (leg. A. Reiter, det. M. Černý, revid. D. Král, coll. NMP); 22.vii.1997 – tens of ad. spec. observ., 10 fix. (leg. & det. D. Král, coll. NMP); 6.viii.1997 – tens of spec. observ., 10 fix. (leg. J. Vilimová, det. D. Král, coll. NMP); 9.ix.2002 – tens of spec. observ., 24 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6837); 23.ix.2002 – tens of ad. spec. observ., 42 spec. fix. (leg. D. Král, A. Reiter, M. Štambergová, det. D. Král, 24 spec. coll. JMZ – No. 6835, 6836, 18 spec. coll. NMP); 1.x.2002 – tens of spec. observ. (A. Reiter); 7.x.2002 – tens of ad. spec. observ., 7 spec. fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det. D. Král, coll. NMP); 22.x.2002 – several spec. observ. (A. Reiter).

7264a; [11] **Hevlín**, puddle in the field 2.2 km NE of the church: 1.x.2002 – 1 M fix. (leg. & det. A. Reiter, coll. JMZ – No. 6840).

7264b; [12] **Hrabětice**, “Trávní dvůr” area, field 800 m SSW of the cannery: 1998 – observ. on two sites approx. 100 m from each other (MARTIŠKO 1998); flooded ruts in the field road: 24.v.1995 – tens of spec. observ. (leg. & det. Martiškovi & P. Koutný, MARTIŠKO & MARTIŠKOVÁ 2002); 8.vi.1995 – tens of spec. observ. (leg. & det. Martiško, Tomařtík & Šilhavá, MARTIŠKO & MARTIŠKOVÁ 2002); 30.x.1996 – tens of spec. observ. (leg. & det. Martiškovi, MARTIŠKO & MARTIŠKOVÁ 2002); 23.v.2003 – tens of spec. observ., 4 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6834); 12.v.2005 observ. (P. Horák, pers. comm.); 22.v.2005 tens of spec. observ. (A. Reiter); 13.vii.2005 tens of spec. observ. (A. Reiter).

Summary of distribution in the study area. Four newly recorded localities of *B. schaefferi* are situated in wider surroundings of the municipalities of Hevlín and Hrabětice. They include puddles and ruts made in fields and field roads. The field near the “Hevlínské jezero” pool (see below for characteristics) is the only relatively regularly checked locality; the species was recorded there most often in May, with the latest occurrence in late October. Considering character of the localities and their relative nearness, spreading of eggs e.g. by agricultural machinery is likely and thus, occurrence of the species in other suitable sites in the area can be expected. The closest occurrence in the country is reported from the confluence of the Dyje and Morava rivers near Hrušky (square no. 7267) from the year 1977 (SUKOP & SEDLÁK 1999a); the historical finding made near Ivančice in 1937 (KAPLER 1939) is even a bit closer to the study area. In the Pálava BR, the species has not been recorded at all according to SUKOP & SEDLÁK (1999a). Later surveys have documented only three recent sites near the lower Dyje,

Morava and Svratka rivers, besides the study area (ZAVADIL *et al.* 2009). In Lower Austria, a number of *Branchipus schaefferi* localities is known from the area north of Vienna, about 25 km SSW of our records (EDER & HÖDL 2003). In 2010 the species was newly recorded also near the Austrian town of Laa an der Thaya (EDER 2012), i.e. in close proximity of the study area.

Chirocephalidae

Chirocephalus carnuntanus (Brauer, 1877) (Figs 3, 7C–D, 9G)

Distribution range. The fairy shrimp *Chirocephalus carnuntanus* is considered to be a Pannonian element. In the Pannonian zoogeographical region, the species is found from southern Moravia and north-eastern Austria in the northwest through southern Slovakia (including the East-Slovak lowland), Hungary, Romania to the northern, lowland part of Serbia (BRTEK 1958, 1962, 1976; BRTEK & THIÉRY 1995; STOICESCU 1991; EDER *et al.* 1996). In western Slovakia (Danube lowland), this fairy shrimp was confirmed at 34 localities during a several-year intensive survey in the middle of the 20th century (BRTEK 1958, 1962). Outside the Pannonian region, the species was recorded in two isolated areas: in central Bohemia and in the Moscow region in Russia (SCHÄFERNA 1931, HRABĚ 1937, BRTEK & THIÉRY 1995, BRTEK 2005).

Distribution in the Czech Republic. The species *Chirocephalus carnuntanus* was first recorded in Bohemia near Slaný in 1929 (SCHÄFERNA 1931, HRABĚ 1937, BRTEK 2005) at the altitude of 260 m. It was collected there by Schäferna also in the 1930s. The site became extinct after the World War II (KAVKA 2000, Leypold pers. comm., Laňka pers. comm., Král, Štambergová & Zavadil unpubl. data from the years 2001, 2002 and 2009). After the World War II, the species was recorded at the locality “Červený rybníček” pool in the Znojmo region at the north-western edge of its continuous range in 1956 (KUBÍČEK 1965). The last published record from Moravia came from the year 1957, in 1958 the locality was polluted by dung-water from the local agricultural cooperative and was not checked any more (KUBÍČEK 1965). Later occurrence was reported by HIMMEL (1966), from 12 April 1964. Afterwards the species was collected there first in 2000 after decontamination of the locality (leg. A. Reiter, det. M. Černý). Since that it has not been recorded in the Znojmo region any more. A new site was discovered south-east of Brno by F. Lysák in 2009 (ZAVADIL *et al.* 2009).

Biology. It is a spring species of lowland periodical pools arising after snow melting mainly in ploughed fields and pastures (BRTEK 1962). It was described by BRTEK (2005) to occur also in deep ditches along roads filled with water and in muddy rural wetlands. In Slovakia, it was sometimes found in swamps with sparse sedge vegetation or with a layer of decaying leaf litter on the bottom (BRTEK 2005). In Slovakia, adult individuals are found from late March till mid May, rarely till the first ten-day period of June (BRTEK 1976). In the “Červený rybníček” pool, fairy shrimps occurred from late March till the second ten-day period of June. However, at the newly discovered locality south-east of Brno, the species was not found on 9 May 2010, although it was present there on 2 May 2010 (Sychra pers. comm., Zavadil unpubl. data).

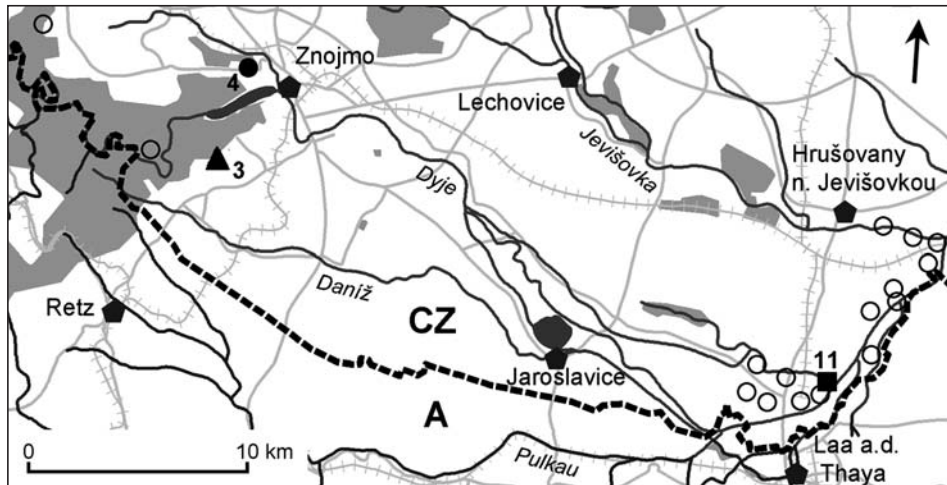


Fig. 3. Localities of *Chirocephalus carnuntanus* and *Streptocephalus torvicornis* (closed circle), *Imnadia yeyetta* (square) and *Lynceus brachyurus* (triangle).

Obr. 3. Lokality výskytu *Chirocephalus carnuntanus* a *Streptocephalus torvicornis* (plné kolečko), *Imnadia yeyetta* (čtvereček) a *Lynceus brachyurus* (trojúhelník).

In Slovakia, syntopic occurrence with fairy shrimp *Drepanosurus hankoi* (Dudich, 1927), tadpole shrimp *Lepidurus apus* and clam shrimp *Cyzicus tetracerus* is known as well as with some other species of large branchiopods which do not occur in the Czech Republic (BRTEK 2005). In the Czech Republic, it is known to occur along with the fairy shrimps *Streptocephalus torvicornis*, *Branchipus schaefferi* and *Drepanosurus hankoi* and the tadpole shrimp *Triops cancriformis* and perhaps also with *Eubbranchipus grubii* (SCHÄFERNA 1931, KUBÍČEK 1965, ZAVADIL *et al.* 2009, Merta pers. comm.).

New records

7162a; [4] **Znojmo-Hradiště**, “Červený rybníček” pool: 29.iii.2000 – 8 juv. F, 4 juv. M, 2 ad. F, 2 ad. M fix. (leg. A. Reiter, det. F. Kubiček, revid. D. Král, 7 juv. F, 4 juv. M, 1 ad. F, 1 ad. M coll. JMZ – No. 6841, 1 juv. F, 1 ad. F, 1 ad. M coll. NMP); 11.v.2000 – 2 F, 2 M fix. (leg. A. Reiter, det. F. Kubiček); 19.v.2000 – several F & M fix. (leg. M. Škorpík, det. F. Kubiček); 11.vi.2000 – 3 F fix. (leg. M. Škorpík, det. F. Kubiček); 5.iv.2013 – tens of juv. spec. observ., several fix. (leg. & det. A. Reiter, coll. JMZ); 16.iv.2013 – hundreds of ad. spec. observ., several fix. (leg. & det. A. Reiter, coll. JMZ); 22.iv.2013 – hundreds of ad. spec. observ. in the smaller pool, several ad. spec. observ. in the larger pool, several fix. (leg. & det. A. Reiter, D. Král, coll. NMP & JMZ).

Summary of distribution in the study area. The above mentioned collections represent the only known records since 1966, thus confirming occurrence of the species in southern Moravia after more than 30 years. Interestingly enough, neither HÖDL & EDER (2000), EDER & HÖDL (2003) nor EDER (2012) mentioned any localities of *Chirocephalus carnuntanus* in Lower Austria, i.e. a large area between the Moravian sites and the centre of the species range in the Pannonian region. This further emphasises isolation,

importance and level of endangerment of the population surviving in the middle Dyje river area.

***Eubbranchipus grubii* (Dybowski, 1860)**

(Figs 4, 7E–F, 8A)

Distribution range. The fairy shrimp *Eubbranchipus grubii* is a West-Palaearctic species of the forest and forest-steppe zones. Its occurrence has been recorded in France (THIÉRY 1991), Switzerland (SAIAH & PERRIN 1990), Germany (GOSPODAR & WINKELMANN-KLOCK 1982, GRABOW 1998, MAIER 1998), Denmark (DAMGAARD & OLESEN 1998), Austria (FOISSNER 1996, EDER *et al.* 1996, FRESNER & SAMPL 2000, GOTTWALD & WEISSMAIR 2000), Hungary (FORRÓ 1990) and also in Slovakia (LUKÁŠ 2000, BRTEK 2005), Poland, Romania and Ukraine (BRTEK 1976).

Distribution in the Czech Republic. The first reports on the occurrence of *E. grubii* in Bohemia come already from the works by FRIČ (1871, 1893). The then available knowledge on the species distribution in the former Czechoslovakia was summarised by HRABĚ (1937) and a half-century later in an unpublished form by LEYPOLD (1989b). Other recent data on its occurrence were reported e.g. by SOUČEK (1990), BERAN (1993), MOCEK (1997) and KAVKA (2000). In Bohemia, the records are concentrated to the eastern and middle Labe (= Elbe) river area (ZAVADIL *et al.* 2009). The following historical reports on the species occurrence are available from Moravia: between Lednice, Přitluky and Rakvice villages (ZIMMERMANN 1923); pools along the Dyje river near Břeclav – collections from the year 1923 (ZAVŘEL 1923); near Olomouc (years 1924, 1925), Kroměříž (HRABĚ 1937), Brno and Hodonín (SPANDL 1926); near Břeclav (VALOUŠEK 1926), near Vranovice and in the Moravský kras (= Moravian Karst) area near Rudice village (HRABĚ 1937). Recent data on the species occurrence in the Litovelské Pomoraví area (= Morava river area around Litovel) are mentioned by MĚKOTOVÁ *et al.* (1996). Records in the Pálava BR were summarised by SUKOP & SEDLÁK (1999a), in the whole Czech Republic by ZAVADIL *et al.* (2009). According to their findings, the species is a typical inhabitant of pools in floodplain forests. In Moravia, *E. grubii* occurs in floodplains of practically the whole middle and lower parts of the Morava river, lower Dyje, Svratka and Odra rivers (MERTA 2000, ZAVADIL *et al.* 2009). There are only few records outside these areas. Recent distribution of *E. grubii* well corresponds with that of preserved floodplain forests.

Biology. In the Czech Republic, *Eubbranchipus grubii* is almost fully restricted to spring periodical pools connected with floodplains of lowland rivers. It inhabits pools both in woodlands and in secondary forest-free areas (ŠRÁMEK-HUŠEK 1940, MERTA 2000). In the country, however, there are much less pools in secondary forest-free areas, therefore *E. grubii* may appear as a seemingly forest species. Under suitable conditions, egg hatching and development of larvae may occur already during winter (SAIAH & PERRIN 1990, KALLINOWSKY 1955). However, hatching regularly takes place when pools become filled with water in spring (in the Czech Republic usually at the turn of February and March). In the wild the last individuals die in late May, exceptionally in late June (Merta pers.).



Fig. 4. Localities with confirmed occurrence of *Eubranchipus grubii* – closed circles.

Obr. 4. Lokality s prokázaným výskytem *Eubranchipus grubii* – plná kolečka.

comm.). The species thus lives almost exclusively in spring periodical waters arising after snow melting, adults from February till early May, rarely also in November and December (VALOUŠEK 1951, BRTEK 1962, 1976, SUKOP & SEDLÁK 1999a). In our country, the species has been found in syntopy mainly with tadpole shrimp *Lepidurus apus*, or with clam shrimp *Cyzicus tetracerus*, i.e. with species which have not been found in the middle Dyje river area. In Bohemia, it is rarely found in syntopy with fairy shrimp *Branchipus schaefferi* (Zavadil unpubl. data). Syntopy with the species *Chirocephalus carnuntanus*, *Streptocephalus torvicornis* and *Triops cancriformis* is, or rather was, quite an exceptional phenomenon at the locality “Červený rybníček” pool, which has not been recorded even in Slovakia, despite intensive research (BRTEK 2005).

New records

7161a; [1] **Lukov**, “Na Pyramidě”, forest pool: 15.iv.2013 – hundreds of spec. observ., several fix. (leg. & det. A. Reiter, coll. JMZ); 2.v.2013 – hundreds of spec. observ., several fix. (leg. & det. L. Merta, A. Reiter, V. Zavadil, coll. JMZ).

7161d; [2] **Podmolí**, “Černá luža”, forest pool: 29.iii.2000 – 2 F, 3 M fix. (leg. A. Reiter, det. F. Kubíček, coll. JMZ – No. 6842); 17.iv.2005 5 F, 6 M fix. (leg. & det. A. Reiter, coll. JMZ – No. 7016); 23.iv.2005 several spec. observ. (A. Reiter); 2.iv.2009 10 spec. observ. (A. Reiter); 11.iv.2013 hundreds of spec. observ., several fix. (leg. & det. A. Reiter, coll. JMZ); 2.v.2013 – hundreds of spec. observ., several fix. (leg. & det. L. Merta, A. Reiter, V. Zavadil, coll. JMZ).

7162a; [4] **Znojmo-Hradiště**, “Červený rybníček” pool: reportedly cultivated larvae from collected mud – spring 1991 (leg. V. Škorpíková, det. F. Kubíček) & 18.x.1994 (leg. & det. I. Kocourek) [authors were not able to check voucher material and revise determination].

7164d / 7264b; [16] **Hrabětice**, “Trávní dvůr” area, 600 m SEE of the cannery, temporarily flooded oxbow lake on the edge of floodplain forest: 19.iv.2005 hundreds of spec. observ., 11 F, 17 M fix. (leg. & det. A. Reiter,

coll. JMZ – No. 7017, 7018); 9.iv.2008 10 F, 4 M fix. (leg. & det. A. Reiter, coll. JMZ – No. 7019); 29.iv.2010 hundreds of spec. observ. (A. Reiter); 18.iv.2013 hundreds of spec. observ., several fix. (leg. & det. A. Reiter, coll. JMZ); 2.v.2013 – several spec. observ. (leg. & det. L. Merta, V. Zavadil).

Summary of distribution in the study area. It is the first record of the species in the middle Dyje river area. The alleged finding from the “Červený rybníček” pool would rank among untypical localities in our country, outside a floodplain of a larger watercourse. So far, five such places have been known in the area of the present Czech Republic (ANONYMUS 1876, Hlaváč pers. comm., Neudertová pers. comm., Zavadil unpubl. data). However, no voucher material is available from the “Červený rybníček” pool, only a hand-written information on hatching of larvae (see New records in this chapter). Moreover, the species was not confirmed at the locality later on during quite an intensive research, we thus consider its occurrence there as questionable, unless it is documented again. Neither the pool near Lukov nor that near Podmolí are typical alluvial localities. They are situated in a woodland belt along the Dyje river, but above the upper edge of a deep-cut valley of the river. The former is located more than 2.3 km away from the river, and about 140 m above the river bed level. The latter is found only approx. 0.5 km from the river but still approx. 120 m above the river bed level. Moreover, the pools are not surrounded by floodplain vegetation but by a thermophilous oak-hornbeam forest. Only the locality near Hrabětice can thus be classified as a characteristic habitat, similar to the sites of occurrence in the lower Dyje river area (cf. SUKOP & SEDLÁK 1999a). After canalization of watercourses in the 1970s, the number of suitable sites as well as numbers of the species declined, however, since the year 1990 the number of sites has been increasing again due to controlled flooding in the Pálava BR. The sites mentioned by KAPLER (1938) – Dolní Věstonice and Nové Mlýny, and by VALOUŠEK (1951) – Vranovice are closest to the study area. Interestingly enough, in Lower Austria the species shows continuous occurrence in floodplains of the lower Morava and Dyje rivers, while no localities, not even historical, are known from floodplains of the middle Danube river in the surroundings of Vienna (HÖDL & EDER 2000, EDER & HÖDL 2003).

Streptocephalidae

Streptocephalus torvicornis (Waga, 1842)

(Figs 3, 7D)

Distribution range. Range of the species covers Europe and south-western Asia, in the south extending deep to Sub-Saharan Africa (summarised e.g. by BRTEK 1962, 1976; BRTEK & THIÉRY 1995; HAMER *et al.* 1994; THIÉRY 1996). In Europe it is known from all countries neighbouring the Czech Republic, in the north up to the line connecting the cities of Halle – Warsaw – Saratov – Ufa; in Russia it partly extends to Turkmenistan and western Siberia (BRTEK 1962, 1976, 2005; BRTEK & THIÉRY 1995; ZWOLSKI 1959). In Lower Austria the species has not been recorded so far (HÖDL & EDER 2000), the closest site to our country (cca 120 km SE) is reported from Burgenland, from the vicinity of the Neusiedlersee lake, with occurrence evidenced in 1996 (EDER 2012).

Distribution in the Czech Republic. Considering the huge species range, the Czech Republic is situated more or less on its margin. Only historical data are known from

Bohemia (FRÍČ & PRAŽÁK 1866, MRÁZEK 1919, SCHÄFERNA 1931), which were summarised by HRABĚ (1937, 1954), BRTEK (1962) and LEYPOLD (1989b). Most of our localities became extinct already during the 19th century or around the World War I. Between the world wars, the species was recorded in the Slaný area in Bohemia (SCHÄFERNA 1931). Occurrence at this locality was not confirmed after the World War II and the species remained known only from a single site near Znojmo (HRABĚ 1954, BRTEK 1962, KUBÍČEK 1965); it was recorded there for the last time in 1957 along with *Chirocephalus carnuntanus* (KUBÍČEK 1965). The species was cultivated from mud collected at this locality after the year 1986 (KAVKA 2000) and has been bred under seminatural conditions up to now (Kavka pers comm.).

Biology. It is a summer species. In Slovakia it was observed from the last ten-day period of April till late October (BRTEK 1962, 1976, 2005). Kavka (pers. comm.) mentions occurrence from the second half of May till autumn (exceptionally till early December) in captive shrimps kept in outdoor pools. Near Znojmo, the species was observed from the second ten-day period of April till the first ten-day period of December. It inhabits mainly rather large and permanent, non-vegetated pools with muddy or clayish bottom in depressions, soil pits and rather permanent puddles in field depressions and on field roads. The pools can be periodical but also permanently filled with water, with fluctuating water level. In Slovakia, habitats of the species include also floods near river banks and village ponds (BRTEK 2005). In his experiments, HRABĚ (1944) proved that eggs in this species do not need to undergo drying or short freezing to be able to develop. In Slovakia, the species is known to occur in syntopy with *Branchipus schaefferi*, *Triops cancriformis*, *Leptestheria dahalacensis*, *Cyzicus tetracerus* and other species of large branchiopods, which do not occur in the Czech Republic. In our country, it has been recorded along with *Triops cancriformis*, *Branchipus schaefferi*, *Chirocephalus carnuntanus*, *Drepanosurus hankoi* and perhaps also with *Eubbranchipus grubii* (SCHÄFERNA 1931, KUBÍČEK 1965, Kubiček pers. comm., Zavadil unpubl. data). The possible syntopy with *E. grubii* still needs to be confirmed (see the text in *E. grubii*).

New records

7162a; [4] **Znojmo-Hradiště**, “Červený rybníček” pool: 20.viii.1997 – 1 M fix. (leg. & det. V. Zavadil, according to photo revid. J. Brtek); 17.iv.2000 – 2 F, 3 M fix. (leg. M. Škorpík, det. F. Kubiček); 11.v.2000 – 11 F, 11 M fix. (leg. A. Reiter, det. F. Kubiček, revid. D. Král, 10 F, 10 M coll. JMZ – No. 6843, 1 F, 1 M coll. NMP); 23.ix.2002 – several juv. fix. (leg. D. Král, A. Reiter, M. Štambergová, det. D. Král, 2 coll. NMP); 1.x.2002 – 1 juv. F fix. (leg. A. Reiter, det. D. Král, coll. JMZ – No. 6844); 7.x.2002 – tens spec. observ. (D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det. D. Král); 5.xi.2002 – 8 juv. F, 11 juv. M fix. (leg. A. Reiter, det. D. Král, 6 F, 9 M coll. JMZ – No. 6845, 6846, 2 F, 2 M coll. NMP); 27.xi.2002 – 2 juv. F, 4 juv. M fix. (leg. A. Reiter, det. D. Král, 1 F, 3 M coll. JMZ – No. 6847, 1 F, 1 M coll. NMP), 6.xii.2002 – 6 juv. spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6848).

Summary of distribution in the study area. The above mentioned collections represent the only known findings of adults in the wild in the Czech Republic since 1957, the species was thus rediscovered in southern Moravia after 40 years. The closest known recent localities are quite distant (over 120 km), it thus is an extremely isolated population of the species.

NOTOSTRACA

Triops cancriformis (Lamarck, 1801) (Figs 5, 7A, 7C, 8B–F, 9A)

Distribution range. In Europe, the tadpole shrimp *Triops cancriformis* is a eurytopic and widespread species, occurring in different habitats (BRTEK & THIÉRY 1995). It inhabits a vast area. In Europe it occurs from the Iberian peninsula, France and Great Britain in the west, through Belgium, Netherlands, Denmark to southern Sweden in the north. It also inhabits countries of Central Europe, i.e. Germany, Czech Republic, Austria, Slovakia and Hungary. In southern Europe it is found in the Balearic Islands, Corsica, Sardinia, Sicily and Malta, in Italy, Croatia, Serbia, Macedonia, Bulgaria and Romania. From there the range extends over Ukraine to Russia, in the north as far as to the Petchora river area. In Africa, the species inhabits the whole northern part of the continent from Morocco to Egypt, with a projection southwards to Mali. It is also found in Namibia and Botswana. The range further extends in Asia in the south of the Arabian peninsula, in countries of the eastern Mediterranean, in the Caucasus region and further to southwestern Siberia to Kazakhstan, Uzbekistan and Kyrgyzstan over the regions of the Caspian and Aral Seas to the area south of Lake Balkhash. More to the south, there is an isolated part of the range in northern Pakistan and India, separated by high mountains from the rest (BRTEK & THIÉRY 1995, BRTEK 2005).

Distribution in the Czech Republic. The tadpole shrimp *Triops cancriformis* is one of the commonest large branchiopods of the country. The Czech Republic is situated inside its distribution range. The species was recorded in the area in the second half of the 19th century by PRACH (1862), FRIČ (1864) and FRIČ & PRAŽÁK (1866). Occurrence of the tadpole shrimp in the country was first summarised by MAYER (1936a,b). *Triops cancriformis* is distributed patchily in suitable habitats all around the country from the lowest altitudes up to 870–885 m a.s.l. (MERTA *et al.* 2008, MATĚJŮ & ZAVADIL 2012). Records in the Pálava BR were summarised by SUKOP & SEDLÁK (1999b). The closest locality to the middle Dyje river area – the Lednické rybníky fishponds – is mentioned by LOSOS & HETEŠA (1972).

Biology. It is a summer species. In Slovakia, it occurs from April till late September with a peak in summer months (BRTEK 2005). Findings in the Czech Republic come from late April till early November (ZAVADIL & HONCŮ 1997, Zavadil unpubl. data). However, captive tadpole shrimps kept in a puddle on the periphery of a municipality in the Čelákovice area (Bohemia) survive repeatedly till mid December; once they were even observed under an ice cover more than 1 cm thick (Kavka pers. comm.). In the Znojmo area, the species was recorded from May till October. *Triops cancriformis* inhabits sparsely vegetated and especially quite bare puddles and depressions with clayish (less often sandy) or muddy bottom, usually of a temporary but also of rather long-term character. Also bare puddles on field roads, in fields, tank training areas and racing circuits. Exceptionally also fishponds with fluctuating water level. According to BRTEK (2005), *Triops cancriformis* may be even found in waters where *Lepidurus apus* finish their life cycle. In Slovakia, it is known to occur in syntopy with *Streptocephalus*



Fig. 5. Localities with confirmed occurrence of *Triops cancriformis* – closed circles.

Obr. 5. Lokality s prokázaným výskytem *Triops cancriformis* – plná kolečka.

torvicornis, *Branchipus schaefferi*, *Leptestheria dahalacensis* and *Cyzicus tetracerus* (and other species which do not occur in the Czech Republic). In our country, syntopic occurrence with *Branchipus schaefferi*, *Streptocephalus torvicornis*, *Chirocephalus carnuntanus*, *Leptestheria dahalacensis*, *Imnadia yeyetta* and perhaps also with *Eubranchipus grubii* has been reported. Syntopy with the latter species still needs to be examined. The most numerous populations in the Czech Republic are found, or rather were found, in large-scale military training areas as well as in small-scale exercise areas. Remnants of these populations are still present in abandoned military training areas, such as in the former MTAs of Mladá and Ralsko, existing MTAs of Hradiště and Brdy-Jince and in some smaller exercise areas such as near Dobřany, Jihlava, Kolín, Žatec etc. (ZAVADIL & HONCŮ 1997, ZAVADIL 2001, MAŠTERA *et al.* 2009, MATĚJŮ & ZAVADIL 2012, Zavadil unpubl. data).

New records

7162a; [4] **Znojmo-Hradiště**, “Červený rybníček” pool: 23.ix.2002 – 5 juv. observ. (leg. D. Král, A. Reiter, M. Štambergová, det. D. Král); 1.x.2002 – 5 juv. observ., 3 fix. (leg. A. Reiter, det. A. Reiter, coll. JMZ – No. 6816); 7.x.2002 – 1 juv. [ca 2.5 cm long] spec. fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det. D. Král, coll. NMP);

7264a; [6] **Hevlín**, puddle in the field E of the “Hevlínské jezero” pool: 1.vii.1995 – tens of spec. observ. (leg. & det. Martiškovi & Slechan, MARTIŠKO & MARTIŠKOVÁ 2002); 7.x.1995 – several spec. fix. (leg. V. Škorpíková, det. P. Pařil); 30.x.1995 – several spec. observ., 5 fix. (leg. & det. M. Škorpík, det. A. Reiter, coll. JMZ – No. 6850); 7.v.1996 – 3 spec. fix. (leg. A. Reiter, det. M. Černý, revid. D. Král, coll. NMP); 22.vii.1997 – tens of ad. spec. [ca 3–3.5 cm long] observ., 2 fix. (leg. & det. D. Král, coll. NMP); vii.1997 – observ. (V. Škorpíková); 6.viii.1997 – tens of spec. observ., 3 fix. (leg. J. Vilimová, det. D. Král, coll. NMP); 21.viii.2002 – observ. (V. Škorpíková); 3.ix.2002 – tens of spec. observ., 5 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6819);

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9.ix.2002 – tens of spec. observ. (A. Reiter); 23.ix.2002 – tens of spec. observ., 6 fix. (leg. D. Král, A. Reiter, M. Štambergová, det. A. Reiter, 6 spec. coll. JMZ – No. 6815, 6820); 1.x.2002 – tens of spec. observ. (A. Reiter); 7.x.2002 – tens of ad. spec. observ., 1 fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det. D. Král, coll. NMP); 22.x.2002 – several spec. observ. (A. Reiter); flooded ruts in the fallow S of “Hevlínské jezero” pool (ca 150 m SW of previous findings): 24.iv.2009 – 10 juv. spec. [15 mm long] observ. (A. Reiter).

7264a; [7] **Hevlín**, puddle in the field SW of the village (along both sides of former military road): 7.x.2002 – remnants of several spec. observ., 1 fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det.

7264a; [8] **Hevlín**, puddle in the field S of the “Černá strouha” channel, 1.1 km N of the church: 18.vi.2010 – hundreds of juv. spec. observ. (V. Křivan).

7264a; [9] **Hevlín**, puddle in the field S and SE of village (around causeway of former railway line): 1.x.2002 – remnants of several spec. observ. (A. Reiter).

7264a; [10] **Hevlín**, puddle in the field E of village: 7.x.2002 – remnants of several spec. observ., 1 fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Štáhlavský, det. D. Král, coll. NMP); vii 2010 – 10 spec. observ. (R. Němec); melioration channel along the field: 27.iv.2006 – several juv. spec. observ. (K. Černá, P. Janšta, M. Fikáček, D. Král, J. Prokop, J. Straka, P. Šípek, H. Šípková, J. Vilimová, det. D. Král). D. Král, coll. NMP).

7264a; [11] **Hevlín**, puddle in the field 2.2 km NE of the church: 4.ix.2002 – remnants of tens of spec. observ. (A. Reiter); 23.ix.2002 – ca 10 spec. observ., 3 fix. (leg. D. Král, A. Reiter, M. Štambergová, det. A. Reiter, 2 spec. coll. JMZ – No. 6817, 1 spec. coll. NMP); 1.x.2002 – ca 10 spec. observ., 3 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6814).

7164b; [14] **Hrušovany nad Jevišovkou**, flooded field in the floodplain of the Jevišovka river, 2 km E of village: 8.vii.2009 – tens of spec. observ., 6 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 7021); 30.vii.2009 – 2 spec. observ. (A. Reiter).

7264b; [15] **Hrabětice**, “Trávní dvůr” area, puddle in the field N of the cannery: 24.x.2002 – remnants of several spec. observ. (A. Reiter).

7164b; [17] **Jevišovka**, puddle in the field 1.2 km NWW of railway station: 8.vii.2009 – 5 spec. observ. (A. Reiter); 20.vi.2012 – 5 juv. spec. observ. [ca. 10 mm long](A. Reiter).

7164b; [18] **Hrušovany nad Jevišovkou / Jevišovka**, “Trávní dvůr” area, flooded field SW of railway station Jevišovka, including melioration channel: 15.v.1996 – hundreds of spec. observ. in melioration channel (leg. & det. Martiškovi, MARTIŠKO & MARTIŠKOVÁ 2002); 25.v.1996 – 1 spec. observ. in puddle in the field (leg. & det. Tomaščík, MARTIŠKO & MARTIŠKOVÁ 2002); 1998 – observ. in melioration channel (MARTIŠKO 1998); 14.ix.2002 – several dead spec. observ. (leg. D. Horal, BERKA et al. 2003); 16.x.2002 – 10 spec. observ., 2 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6813).

7164b; [19] **Jevišovka**, flooded field between the village and the railway station puddle in the field: 4.ix.2002 – hundreds of spec. observ., 5 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6818); 8.vii.2009 – 5 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 7020).

Summary of distribution in the study area. Most of the twelve confirmed localities of *T. cancriformis* are situated in wider surroundings of the municipalities of Hevlín, Hrabětice, Hrušovany nad Jevišovkou and Jevišovka. The locality “Červený rybníček” pool west of Znojmo is an exception, however, presence of the species was recorded there only in the autumn of 2002 and since that it has not been confirmed any more. Habitats in the south-eastern Znojmo region include puddles and ruts made in fields and field roads, flooded fields after torrential rains or floods. It also inhabits drainage canals, which seem to be used as a refuge by the species in dry years. *T. cancriformis* is thus the most frequently recorded large branchiopod in the study area and it shows a considerable habitat plasticity. The field near the “Hevlínské jezero” pool (see below for characteristics) is the only regularly checked locality. The earliest records of the species were made in the last ten-day period of April, the latest records in the second half of

October. The study area is connected with relatively close Moravian localities in the lower Dyje river area (SUKOP & SEDLÁK 1999b), and especially with the occurrence in Lower Austria. In the latter region, the species inhabits floodplains of the lower Morava, Dyje and middle Danube river areas, a number of localities are situated north of Vienna, only approx. 25 km SE of the study area (EDER & HÖDL 2003). In 2010 the species was newly recorded also in the surroundings of the Austrian town of Laa an der Thaya (EDER 2012), i.e. in close vicinity of the study area.

SPINICAUDATA

Leptestheriidae

Leptestheria dahalacensis (Rüppell, 1837) (Figs 6, 7A, 8B–F, 9A)

Distribution range. In Europe, the clam shrimp *Leptestheria dahalacensis* is known to occur in Sicily, Balearic Islands, Po basin, Bavaria, Belgium and Czech Republic. Most findings come from the countries which include a part of the Pannonian lowland. The range further extends from Macedonia through Romania, Moldova, Ukraine and the European part of Russia to the Ural Mts (summarised e.g. by STRAŠKRABA 1962, 1966; BRTEK 1976, 2005; BRTEK & THIÉRY 1995). Recent data from Central Europe can be found in the following papers: BRTEK (1976), BERCZIK (1978) – Hungary; EDER *et al.* (1996), HÖDL & EDER (1996) – Austria: Burgenland and Lower Austria; KRAUS *et al.* (2001) – Germany: Bavaria and Hessen; STRAŠKRABA (1962, 1966), BRTEK (1976, 2005): Slovakia. The species is also present in the eastern part of Central and North Africa. In Asia, the range extends from Turkey, Caucasus region and southern coast of the Caspian Sea through Iraq, Iran, southern part of Central Asia, northern India and over western China and Mongolia to Far East to eastern China and the Amur river area in Russia (BRTEK 2005).

Distribution in the Czech Republic. *Leptestheria dahalacensis* inhabits mainly warmer areas of the country in south-eastern Moravia. It was first reported there by VALOUŠEK (1926), from “a pool on Gemže in Břeclav in June 1925”. Other published records from south-eastern Moravia include: Břeclav (collected in 1936), Věstonice (collection from 1952) and Lednice (collection from 1958), (VALOUŠEK & KAPLER 1936; HRABĚ 1937, KAPLER 1960; STRAŠKRABA 1962, 1966). Occurrence of *Leptestheria dahalacensis* was later recorded also in fishponds stocked with fish embryo near the Nesyt fishpond (LOSOS & HETEŠA 1972) and in the 1980s mass occurrence was found in fishponds near Pohřelice (SUKOP & ČAJ 1994, SUKOP & SEDLÁK 1999c). The clam shrimp was also reported from fishponds near Dolní Věstonice (ADÁMEK & SUKOP 1992). In Bohemia, *Leptestheria dahalacensis* is known only from two former localities. LEYPOLD (1989a) and KAVKA (2000) published the finding by D. Horal from 1986 from the bank of the Vltava river in the Mělník region. At that time, LEYPOLD (1989a) assumed that it was the first record of the species in Bohemia. Among the data which we gathered later, however, there is another unpublished record of an earlier date from another part of Bohemia (Příkryl pers. comm.). Localities in the Czech Republic are situated on the northern



Fig. 6. Localities with confirmed occurrence of *Leptestheria dahalacensis* – closed circles.

Obr. 6. Lokality s prokázaným výskytem *Leptestheria dahalacensis* – plná kolečka.

margin of the species range and, when Czech records are compared with literature data, they rank among four northernmost sites of occurrence of the species in the whole range (BRTEK & THIÉRY 1995, BRTEK 2005).

Biology. *Leptestheria dahalacensis* ranks among thermophilous, summer species of our fauna of large branchiopods. Slovak records come from later April till late September, with a peak in summer months (STRAŠKRABA 1962, BRTEK 2005). In the Znojmo region, it was collected from April till October, with maximum occurrence in September and October, which was due to the floods in August 2002. *Leptestheria dahalacensis* inhabits sparsely vegetated depressions in periodically flooded meadows, sparsely vegetated periodical pools in pastures, bare puddles on field roads, in fields, tank training areas and racing circuits (BRTEK 1976, STRAŠKRABA 1966, KAVKA 2000). It can also occur in fishponds with herbivorous fish stock, in fishponds with fluctuating water level free of fish and in small fishponds stocked with fish embryo (LOSOS & HETEŠA 1972, SUKOP & ČAJ 1994, BRTEK 2005, Zavadil unpubl. data). In Slovakia, syntopic occurrence with *Branchipus schaefferi*, *Streptocephalus torvicornis*, *Triops cancriformis*, *Cyzicus tetracerus*, *Imnadia yeyetta* and *Limnadia lenticularis* is known. In our country, the species was recorded along with *Branchipus schaefferi*, *Triops cancriformis* and in the middle Dyje river area also with *Imnadia yeyetta*. Although BRTEK & THIÉRY (1995) consider *Leptestheria dahalacensis* to be an eurytopic and widespread species, occurrence in the Czech Republic is limited by the fact that the sites are situated on the northern margin of the range. Animals at the edge of their adaptability seem to behave in a different way. In the Czech Republic, occurrence

of *L. dahalacensis* is connected with low altitudes and warm areas. These regions are significantly affected by intensive agricultural activities, therefore the number of localities is low.

New records

7264a; [6] **Hevlín**, puddle in the field E of “Hevlínské jezero” pool: 1.vii.1995 – tens of spec. observ. (leg. Martiškovi & Slechan, det. P. Pařil, MARTIŠKO & MARTIŠKOVÁ 2002); 7.x.1995 – several spec. fix. (leg. V. Škorpíková, det. P. Pařil); 30.x.1995 – 8 spec. fix. (leg. M. Škorpík, det. A. Reiter, coll. JMZ – No. 6851); 7.v.1996 – 4 spec. fix. (leg. A. Reiter, det. M. Černý, revid. D. Král, coll. NMP); 22.vii.1997 – tens of ad. spec. observ., 6 fix. (leg. & det. D. Král, coll. NMP); 6.viii.1997 – tens of spec. observ., 10 fix. (leg. J. Vilimová, det. D. Král, coll. NMP); 3.ix.2002 – tens of spec. observ., 5 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6829); 9.ix.2002 – tens of spec. observ., 8 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6828); 23.ix.2002 – tens of spec. observ., 31 fix. (leg. D. Král, A. Reiter, M. Štambergová, det. A. Reiter, 19 spec. coll. JMZ – No. 6826, 6827, 3 spec. NMP); 1.x.2002 – tens of spec. observ. (A. Reiter); 7.x.2002 – tens of ad. spec. observ., 5 fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Šťáhlavský, det. D. Král, coll. NMP); 22.x.2002 – several spec. observ. (A. Reiter); flooded ruts in the fallow S of “Hevlínské jezero” pool (ca 150 m SW of previous findings): 24.iv.2009 – 5 juv. spec. [ca 4 mm long] observ. (A. Reiter).

7264a; [11] **Hevlín**, Hevlín, puddle in the field 2.2 km NE of the church: 23.ix.2002 – tens of spec. observ., 29 fix. (leg. D. Král, A. Reiter, M. Štambergová, det. A. Reiter, 27 spec. coll. JMZ – No. 6824, 6825, 2 spec. coll. NMP); 1.x.2002 – ca 350 spec. observ., 108 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6821–6823); 7.x.2002 – hundreds of ad. spec. observ., 9 fix. (leg. D. Král, M. Škorpík, M. Štambergová, F. Šťáhlavský, det. D. Král, coll. NMP).

7264b; [13] **Hrabětice**, “Trávní dvůr” area, puddle in the field on right bank of the Dyje river 2 km S of the cannery: 3.ix.2002 – 1 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 6831).

7164b; [14] **Hrušovany nad Jevišovkou**, flooded field in the floodplain of the Jevišovka river, 2 km E of village: 8.vii.2009 – tens of spec. observ., 8 fix. (leg. & det. A. Reiter, coll. JMZ – No. 7023); 30.vii.2009 – 10 spec. observ. (A. Reiter).

7164b; [17] **Jevišovka**, puddle in the field 1.2 km NWW of railway station: 8.vii.2009 – 5 spec. observ. (A. Reiter); 20.vi.2012 – tens of spec. observ. [ca 4 mm long] (A. Reiter); 4.vii.2012 – remnants of hundreds of spec. observ. in dried up puddles (A. Reiter).

7164b; [18] **Hrušovany nad Jevišovkou / Jevišovka**, “Trávní dvůr” area, flooded field SW of railway station Jevišovka: 4.ix.2002 – ca 10 spec. observ., 3 fix. (leg. & det. A. Reiter, coll. JMZ – No. 6830); 23.ix.2002 – several spec. observ., 1 fix. (leg. D. Král, A. Reiter, M. Štambergová, det. D. Král, 1 spec. coll. JMZ – No. 6832).

7164b; [19] **Jevišovka**, flooded field between the village and the railway station: 8.vii.2009 – 5 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 7022).

Summary of distribution in the study area. The above mentioned collections from seven localities of the south-eastern Znojmo region represent the first records from the middle Dyje river area. All these localities are puddles in fields and their origin is connected either with floods or intensive precipitation. The closest known area of occurrence in Moravia is the surroundings of Pohorelice (SUKOP & ČAJ 1994, SUKOP & SEDLÁK 1999c). In Lower Austria, records of *L. dahalacensis* after the year 2000 come mainly from the confluence of the Morava and Danube rivers and from the floodplain of the Danube NW of Vienna (EDER & HÖDL 2003). In 2010, the species was newly discovered also in the surroundings of the Austrian town of Laa an der Thaya (EDER 2012), i.e. in close vicinity of the study area.

Limnadiidae

Imnadia yeyetta Hertzog, 1935

(Figs 3, 9A–B)

Distribution range. The clam shrimp *Imnadia yeyetta* was described from Camargue (the Rhône delta in southern France) and the closest site to the type locality in Europe is situated in the Znojmo region in the middle Dyje river area. There is a wide gap between the type locality and the Znojmo region. *Imnadia yeyetta* is classified as a European faunistic element (STRAŠKRABA 1966) with a maximum of records in the Danube river area. Most records come from flood areas of both larger and smaller rivers in Burgenland in Austria (EDER *et al.* 1996, HÖDL & EDER 1996) and from the surroundings of Vienna (FOISSNER 1996), in the Záhorie and Danube lowlands and in the Košice basin in Slovakia, in the areas of the Tisza and Danube rivers in Hungary, in Romania, Serbia and Macedonia (STRAŠKRABA 1962, 1965, 1966; BRTEK 1976, 1992, 2005; BRTEK & THIÉRY 1995; LUKÁŠ 2000). The species thus occurs mainly in the Pannonian lowland in a relatively small part of Europe.

Distribution in the Czech Republic. Comparing the only finding in the country (KRÁL & ŠTAMBERGOVÁ 2005, ZAVADIL *et al.* 2013) with the above-mentioned papers (STRAŠKRABA 1966, BRTEK & THIÉRY 1995, BRTEK 2005), it can only be concluded that it is the northernmost occurrence in the whole species range.

Biology. It is a summer species. In its distribution range, *Imnadia yeyetta* has been recorded from late April till October. *Imnadia yeyetta* inhabits periodical pools grown with grass in steppe pastures (however, there are no such habitats in the country any more), pools in old, periodically flooded river arms, but also non-vegetated as well as vegetated puddles in fields and field roads (STRAŠKRABA 1962; BRTEK 1976, 1992, 2005). In the study area, *I. yeyetta* was found only after floods, i.e. when the Dyje river got spilt from its bed. It has not been recorded after torrential rains unlike the other three syntopically living species of large branchiopods which were observed in puddles created by the rain. In Slovakia, *Imnadia yeyetta* was found in syntopy with *Branchipus schaefferi*, *Streptocephalus torvicornis*, *Triops cancriformis*, *Cyzicus tetracerus*, *Leptestheria dahalacensis*, *Limnadia lenticularis* and other species of large branchiopods which do not live in the Czech Republic (BRTEK 2005). In our country, it was recorded along with *Branchipus schaefferi*, *Triops cancriformis* and *Leptestheria dahalacensis*. Syntopy of four species of large branchiopods is an exceptional phenomenon in the country, known only from the Znojmo region.

New record:

7264a; [11] Hevlín, Hevlín, puddle in the field 2.2 km NE of the church: 23.ix.2002 – 2 M fix. (leg. D. Král, A. Reiter, M. Štambergová, det. D. Král, 1 M coll. JMZ – No. 6831, 1 M coll. NMP).

Summary of distribution in the study area. In the Czech Republic, the first finding after the flood in 2002 was made in a corn field of the spilt Dyje river. The individual was borrowed from JMZ in order to confirm the determination and take a photo (Fig. 19). The

species was included in the national red list of branchiopods (KRÁL & ŠTAMBERGOVÁ 2005). In the autumn of 2004 and 2006, we took samples of mud from the locality. In a garden pool near Čelákovice (Bohemia), *Imnadia yeyetta* hatched repeatedly in the years 2005–2008. The clam shrimps hatched from mid June till mid August (Kavka pers. comm.). In 2008, about eight individuals hatched after the second watering in August (during the first watering, only *Leptestheria dahalacensis* hatched). Hatching depends on water temperature and it also should be taken into consideration that the clam shrimps are bred there behind the northern margin of their distribution range. In captivity the last adults were observed as late as in September. After torrential rains in the Znojmo region, when the river, however, did not spill out of its bed to the fields, this species was not observed, while other species of large branchiopods were. The first record in our country has thus been the last record. The closest localities are situated in Lower Austria, where records of this clam shrimp made after the year 2000 come mainly from the confluence of the Morava and Danube rivers, and also from floodplains of the Danube NW of Vienna (EDER & HÖDL 2003). In 2010 the species was newly recorded in a close vicinity of the study area, near the town of Laa an der Thaya (EDER 2012).

LAEVICAUDATA

Lynceidae

Lynceus brachyurus O. F. Müller, 1776

(Figs 3, 9C–D)

Distribution range. The clam shrimp *Lynceus brachyurus* is a Holarctic species missing from the southern parts of this region. However, in North America its range extends as far as to California in the south, and in the north to Alaska and western Canada, where it exceeds the polar circle. In Europe the southern boundary of its range goes from central Germany through Austria, Hungary and Romania (BRTEK 2005). The southernmost record is available from the area of the lower Danube river. BRTEK & THIÉRY (1995) mention the westernmost records in Europe from the 9th meridian east in Germany and Denmark. From there the range of *Lynceus brachyurus* extends north and northeast to both the European and Siberian parts of Russia, where its occurrence is more or less limited by boundaries of the continent. In Europe it even occurs far above the polar circle in Norway and around the estuary of the Pechora river. Occurrence above the polar circle in Siberia along the lower parts and estuaries of the Ob, Yenisei, Yana and Kolyma rivers documents ecological requirements of the species. Findings from the Czech Republic come from the southern margin of the species range in the wider sense.

Distribution in the Czech Republic. In the area of the current Czech Republic, *Lynceus brachyurus* was first recorded by FRIČ (1875), VÁVRA (1904) and HRABĚ (1937). Based on scattered findings made in several different parts of the country (MERTA *et al.* in prep.) it is difficult to draw any conclusions. Four localities are situated in the surroundings of large rivers (the other localities are not, though). This is probably due to hydrological

conditions along watercourses, where a sufficient amount of pools is available. The Czech Republic is situated outside the centre of distribution of *Lynceus brachyurus*, its localities are thus probably behind the limits of its climatic optimum. It is important that *Lynceus brachyurus* still occurs in the Czech Republic, although it was supposed to be extinct in the country by KRÁL & ŠTAMBERGOVÁ (2005). Recently, i.e. in the 21st century, the species has been recorded even at four localities (MERTA *et al.* in prep.).

Biology. *Lynceus brachyurus* is a late spring species with a maximum occurrence in May. It usually lives near the bottom or among submerged vegetation (BRTEK 2005, Fott pers. comm.). Collections from Slovakia come from late March till early June. According to STRAŠKRABA (1962), unless the water dries up, the last individuals can be observed in the Czech Republic as late as in October. However, we did not find similar data elsewhere in the literature. *Lynceus brachyurus* inhabits mainly sparsely vegetated depressions and ditches in periodically flooded sedge meadows, sparsely vegetated periodical pools in pastures and meadows, blind river arms and periodical pools with a layer of decomposing leaves in the bottom. In Slovakia it was recorded in syntopy with *Lepidurus apus* and *Cyzicus tetracerus*. In our country, syntopic occurrence with other species of large branchiopods is not known (Fott pers. comm., Merta pers. comm.), which is also confirmed by our observation. Although BRTEK & THIÉRY (1995) consider *Lynceus brachyurus* to be a eurytopic species occurring in different habitats in a huge distribution range, its occurrence in our country cannot be classified in the same way. This is probably due to the fact (besides the threats described in a separate chapter) that in our country the species lives on a margin of its ecological span and also that the landscape in the Czech Republic went through much more intensive negative changes (mainly draining) than in other countries inhabited by the species (Canada, Russia, Scandinavia etc.).

New records

7162c; [3] *Popice*, temporary pool in small abandoned quarry 300 m W of chappel on heath: 3.v.2009 – tens of spec. observ., 8 fix. (leg. & det. D. Král, coll. NMP; 5.v.2009 – 25 spec. fix. (leg. A. Reiter, det. D. Král, coll. JMZ – No. 7024); 22.v.2010 – 22 spec. fix. (leg. & det. A. Reiter, coll. JMZ – No. 7025); 2.v.2013 – tens of spec. observ., several fix. (leg. & det. L. Merta, A. Reiter, V. Zavadil, coll. JMZ).

Summary of distribution in the study area. The first record in the study area was made in 2009, at the same locality also in 2010 and 2013. The site was checked in the years 2011 and 2012 too, but it was free of water already in early May. The species was previously classified as regionally extinct in the national red list of branchiopods (KRÁL & ŠTAMBERGOVÁ 2005), it will be thus possible to revise this classification in the future. The closest published localities are situated in Lower Austria in floodplains of the Morava and Danube rivers, however, occurrence of the species has not been confirmed there since 1970 (EDER & HÖDL 2003, EDER 2012).

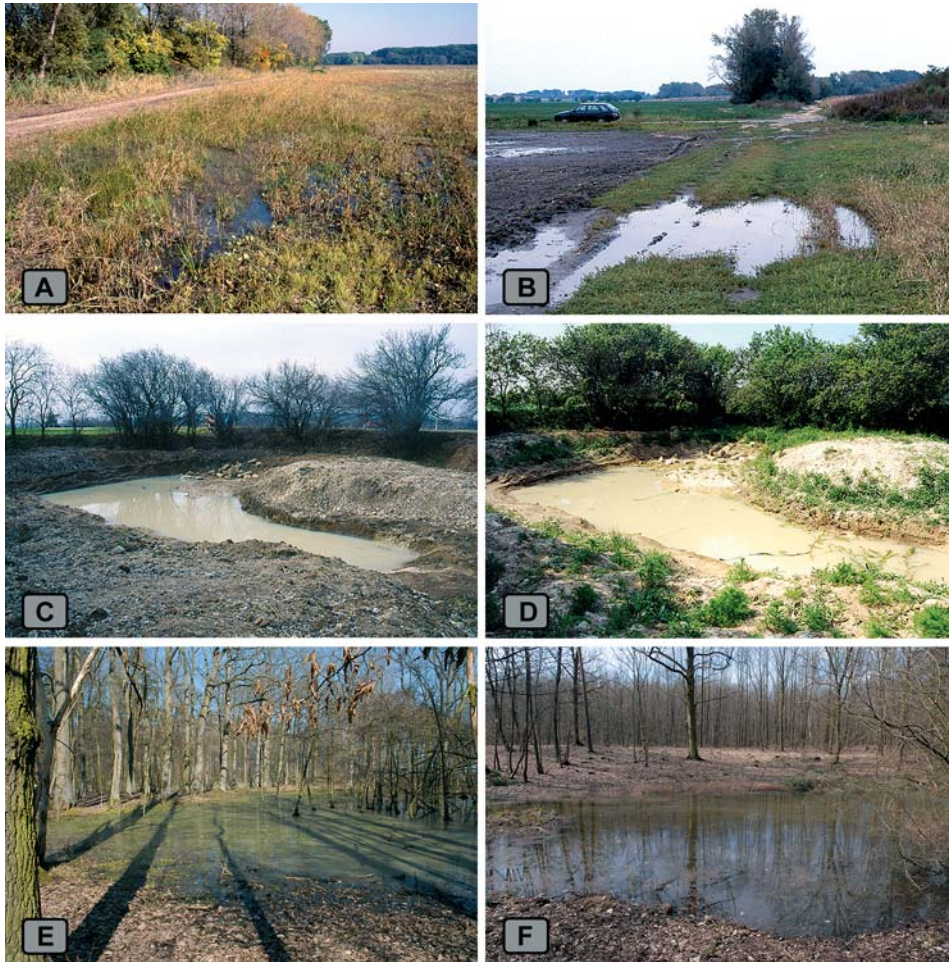


Fig. 7A–F. **A.** Hevlín, locality [6], September 2002 (photo by A. Reiter). Repeatedly flooded field with syntopic occurrence of *Branchipus schaefferi*, *Triops cancriformis* and *Leptestheria dahalacensis*. **B.** Hevlín, locality [5], 1.x.2002 (photo by A. Reiter). Place of occurrence of *Branchipus schaefferi* in ruts in a field road. **C.** The “Červený rybníček” pool, locality [4], 29.iii.2000 (photo by A. Reiter). Locality shortly after the pools were deepened, at this stage already with the occurrence of *Chirocephalus carnuntanus*. **D.** The “Červený rybníček” pool, locality [4], 11.v.2000 (photo by A. Reiter). Locality at the time of mass occurrence of *Chirocephalus carnuntanus* and *Streptocephalus torvicornis*. **E.** The “Na Pyramidě” pool, locality [1], 15.iv.2013 (photo by A. Reiter). Place of occurrence of *Eubbranchipus grubii* on a plateau above the Dyje valley in the Podyjí NP. **F.** The “Černá luža” pool, locality [2], 11.iv.2013 (photo by A. Reiter). Place of repeated occurrence of *Eubbranchipus grubii* on a plateau above the Dyje valley in the Podyjí NP.

Discussion

Occurrence of large branchiopods and their habitats in the study area

Findings of large branchiopods in the middle Dyje river area come from two sub-areas, divided by a relatively large gap (see also Fig. 1). The first sub-area includes close vicinity of the Znojmo town. The main site there is the only historically known locality – the “Červený rybníček” pool. This locality is undoubtedly very isolated. Considering its character as well as the species present, it is unique even on higher than a regional level. Its history during the second half of the 20th century is discussed below. Out of the species spectrum recorded, especially occurrence of *Chirocephalus carnuntanus* is remarkable. This species is considered to be a Pannonian element, however, the area west of Znojmo is not included in the North-Pannonian biogeographical subprovince (sensu e.g. CULEK 1995) and the locality can thus be regarded as occurrence on a margin of the continuous range of the species. Syntopic occurrence with *Eubbranchipus grubii*, which usually shows different ecological requirements, is also noteworthy. Presence and viability of population of the latter species at the locality still needs to be confirmed in a more convincing way. Another locality near Znojmo is the “Černá luža” pool – a forest pool with the repetitive occurrence of *Eubbranchipus grubii*. According to current knowledge, this locality is also relatively isolated and untypical from the ecological point of view. However, there is a larger number of similar pools on impermeable (caolinized) substrates on platforms above the Dyje valley, or other smaller watercourses in the region, therefore, occurrence of the species may be evidenced also at other localities. This assumption has been recently confirmed by the finding of a similar locality “Na Pyramidě” in the spring 2013, regularity of the occurrence in this site and/or existence of other similar localities should be proven in the future. The third site in the surroundings of Znojmo includes small quarries behind the Popice chapel in the heath area in the Podyjí NP. It also is a relatively isolated locality, however, in general not contrasting with the stochastic character of the so-far known distribution of the present species *Lynceus brachyurus*.

The other sub-area with a larger number of localities showing a similar character is situated in the south-eastern part of the Znojmo district, in floodplains of the Dyje and Jevišovka rivers near their confluence. From the regional biogeographical point of view, this sub-area is a much more logical space of occurrence of species of the steppe or

Obr. 7A–F. A. Hevlín, lokalita [6], září 2002 (foto A. Reiter). Opakovaně zaplavované pole se syntopickým výskytem *Branchipus schaefferi*, *Triops cancriformis* a *Leptestheria dahalacensis*. B. Hevlín, lokalita [5], 1.x.2002 (foto A. Reiter). Místo výskytu *Branchipus schaefferi* ve vyjetých kolejích polní cesty. C. Červený rybníček, lokalita [4], 29.iii.2000 (foto A. Reiter). Lokalita nedlouho po prohloubení tůň, v této fenofázi již s výskytem *Chirocephalus carnuntanus*. D. Červený rybníček, lokalita [4], 11.v.2000 (foto A. Reiter). Lokalita v době masového výskytu druhů *Chirocephalus carnuntanus* a *Streptocephalus torvicornis*. E. Tůň Na Pyramidě, lokalita [1], 15.iv.2013 (foto A. Reiter). Místo výskytu *Eubbranchipus grubii* na plošině nad údolím Dyje v NP Podyjí. F. Tůň Černá luža, lokalita [2], 11.iv.2013 (foto A. Reiter). Místo opakovaného výskytu *Eubbranchipus grubii* na plošině nad údolím Dyje v NP Podyjí.

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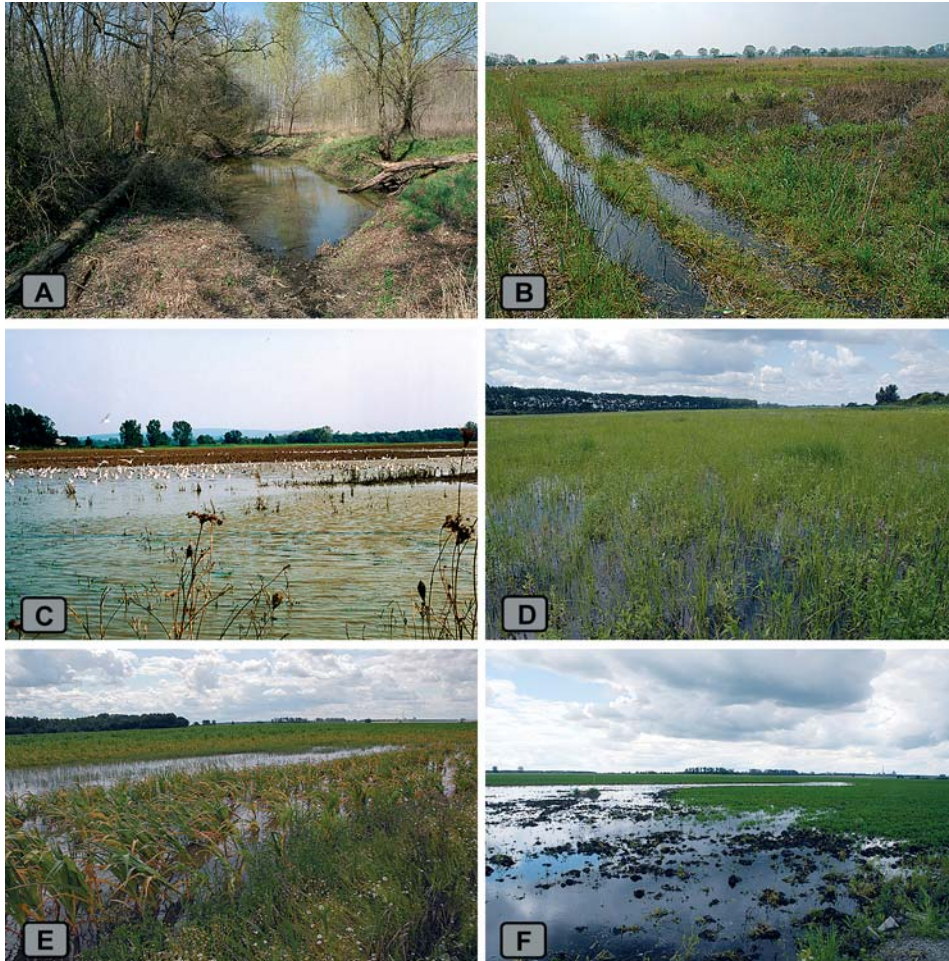


Fig. 8A–F. **A.** Hrabětice, the “Trávní dvůr” area, locality [16], 19.iv.2003 (photo by A. Reiter). Place of repeated occurrence of *Eubbranchipus grubii*. **B.** Hevlín, locality [6], 24.iv.2009 (photo by A. Reiter). Flooded ruts in a set-aside, already at this stage inhabited by non-adult *Triops cancriformis* and *Leptestheria dahalacensis*. **C.** Hrušovany nad Jevišovkou / Jevišovka, locality [18], 16.x.2002 (photo by A. Reiter). Typical puddles in fields after the summer flood in the year 2002 with mass occurrence of *Triops cancriformis* and *Leptestheria dahalacensis*. Rich food availability attracted numerous water and wetland birds. **D.** Hrušovany nad Jevišovkou, locality [14], 8.vii.2009 (photo by A. Reiter). Field puddles becoming overgrown with vegetation, with the occurrence of *Triops cancriformis* and *Leptestheria dahalacensis*. **E.** Jevišovka, locality [17], 8.vii.2009 (photo by A. Reiter). Another field wetland with repeated occurrence of *Triops cancriformis* and *Leptestheria dahalacensis*. **F.** Jevišovka, locality [17], 14.vi.2012 (photo by A. Reiter). Even after a one-time torrential rain during an otherwise abnormally dry season of 2012, the species *Triops cancriformis* and *Leptestheria dahalacensis* hatched at this site.

forest-steppe biome, represented in our country by the North-Pannonian subprovince (CULEK 1995), which does extend to this region. This species group includes the newly evidenced clam shrimp *Imnadia yeyetta*, and partly also all three relatively common summer species – *Branchius schaefferi*, *Triops cancriformis* and *Leptestheria dahalacensis*. Similarly, the occurrence of *Eubbranchipus grubii* in this area is also more typical from the ecological point of view. The latter species, connected mainly with floodplains of larger rivers, is common in the lower Dyje and Morava river areas (ZAVADIL *et al.* 2009). Habitats similar in their character to the latter area are found in fragmentary remains nowhere else than here, in the floodplain enclave called the “Trávní dvůr” area, quite far up the Dyje river stream. Besides *Eubbranchipus grubii*, a number of other species occurs there, having their ecological optimum and distribution range in the Czech Republic restricted mainly to the lower Dyje river area and confluence of the Dyje and Morava rivers. This is well-documented e.g. in wetland and floodplain plant species. Distribution range restricted to the lower Dyje river area, especially the confluence with the Morava river, and single distal localities in the “Trávní dvůr” area are found e.g. in *Euphorbia palustris*, *Leonurus marrubiastrum*, *Lycopus exaltatus* and *Viola elatior* (DRLÍK *et al.* 2005). It is thus rather surprising that the occurrence of *Eubbranchipus grubii* was confirmed there during a systematic survey at a single locality so far, while *Lepidurus apus* which can be classified in the same ecological group, has not yet been recorded. This may be due to considerable fragmentation and degradation of floodplains in the region, but also due to relative remoteness of this area, connected with insufficient survey intensity.

The gap between the two sub-areas with recent findings of large branchiopods in the middle Dyje river area is about 30 km in size. It includes mainly the most intensively managed large-scale farmland areas of the Znojmo region, where only a minimum number of the previous spectrum of wetland localities (represented mainly by salt marshes) has been preserved. The two sub-areas are connected by the Dyje river. It runs in a narrow belt between farmland areas, however, a large part of the watercourse runs in its natural bed and creates a small number of blind river arms and floodplain pools. In this space, it may be possible to expect some other, not yet documented refuges of *Eubbranchipus grubii* which might interconnect the atypical occurrence near Znojmo with the typical locality in the “Trávní dvůr” area.

Obr. 8A–F. A. Hrabětice, Trávní dvůr, lokalita [16], 19.iv.2003 (foto A. Reiter). Místo opakovaného výskytu *Eubbranchipus grubii*. B. Hevlín, lokalita [6], 24.iv.2009 (foto A. Reiter). Zaplavené koleje v úhuru, již v této fenofázi oživené nedospělými *Triops cancriformis* a *Leptestheria dahalacensis*. C. Hrušovany nad Jevišovkou / Jevišovka, lokalita [18], 16.x.2002 (foto A. Reiter). Typické louže v polích po letní povodni v roce 2002 s masovým výskytem *Triops cancriformis* a *Leptestheria dahalacensis*. Bohatá potravní nabídka přilákala množství vodních a mokřadních ptáků. D. Hrušovany nad Jevišovkou, lokalita [14], 8.vii.2009 (foto A. Reiter). Zarůstající polní louže s výskytem *Triops cancriformis* a *Leptestheria dahalacensis*. E. Jevišovka, lokalita [17], 8.vii.2009 (foto A. Reiter). Další polní mokřad s opakovaným výskytem *Triops cancriformis* a *Leptestheria dahalacensis*. F. Jevišovka, lokalita [17], 14.vi.2012 (foto A. Reiter). I po jednorázovém přívalovém dešti během jinak abnormálně suché sezóny 2012 se na této lokalitě vylíhly druhy *Triops cancriformis* a *Leptestheria dahalacensis*.

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Fig. 9A–G. **A.** Hevlín, locality [11], 1.x.2002 (photo by A. Reiter). Locality of the first record of the clam shrimp *Imnadia yeyetta* in the Czech Republic. Syntopic occurrence of *Branchipus schaefferi*, *Triops cancriformis* and *Leptestheria dahalacensis* was also recorded. **B.** *Imnadia yeyetta*, a male captured at the locality [11] near Hevlín on 23.ix.2002 (photo by J. Fott). Voucher specimen deposited in the South Moravian Museum in Znojmo under the catalogue number 6831. **C.** *Lynceus brachyurus*, captured at the locality [3] near Popice on 22.v.2010 (photo by A. Komendová). **D.** Popice, locality [3], 5.v.2009 (photo by A. Reiter). Locality of repeated occurrence of *Lynceus brachyurus* at the time of phenological optimum in 2009. **E.** The “Červený rybníček” pool, locality [4], 24.iv.2003 (photo by A. Reiter). Locality at the time of maximum water level (in this year already without confirmed occurrence of large branchiopods). **F.** The “Červený rybníček” pool, locality [4], 28.vi.2012 (photo by A. Reiter). In 2012, the locality dried out for the first time since the pools were deepened. **G.** The “Červený rybníček” pool, locality [4], 8.iv.2013 (photo by A. Reiter). Locality at the time of occurrence of *Chirocephalus carmuntanus*. Management treatments are well visible – removal of vegetation and soil surface disturbance.

Assessment of particular localities

“Na Pyramidě” pool [1] – Occurrence of the fairy shrimp *Eubranchipus grubii* was recorded in the both pools. The vegetation of pools is composed of *Juncus effusus* and *Glyceria* sp., water level is covered with *Lemna minor* in the growing season, the bottom is covered by a thick layer of decomposing leaf litter. Pools are surrounded by older oak-hornbeam forest, several alders grows inside the larger pool (Fig. 7E). Water level fluctuates significantly; the maximum height after snow melting is about one meter, pools drying up completely in dry years. The locality was found by the systematic survey of temporal forest pools in the spring 2013.

“Černá luža” pool [2] – Occurrence of the fairy shrimp *Eubranchipus grubii* was recorded only in the lowest of three pools, where the vegetation is composed of *Juncus effusus*, *Phalaris arundinacea*, *Glyceria* sp., *Persicaria mitis*, water level is covered with *Lemna minor* in the growing season, the bottom is covered by a thick layer of decomposing leaf litter and herb necromass (Fig. 7F). Water level fluctuates significantly; the maximum height after snow melting is 1.5 m, in average years the pool dries out completely during summer. The fairy shrimps were caught accidentally during a survey aimed at amphibians (cf. REITER & HANÁK 2000), in the years 2001 and 2002 the site was checked in spring with a negative result, further presence of the species was recorded in 2005, 2009 and 2013. The pool has not been threatened in any way so far.

Popice – small quarries behind the Popice chapel [3] – It is an irregularly flooded depression about 100 m² in size, which is, when dried out, overgrown with xerothermic vegetation (fescue grassland) with low coverage in the upper part of the slopes, the bottom is inhabited by larger grass species, sedge and aspen shoots (Fig. 9C). The locality also is an important habitat of other wetland species, e.g. the Italian crested newt (*Triturus carnifex*) and regionally rare species of water beetles (REITER & HANÁK 2000, Reiter & Zavadil unpubl. data). The locality is not directly threatened, management measures aimed to reduce succession of woody plants and undesirable overgrowing of the site are undertaken in accordance with the management plan of the Podyjí National Park (REITEROVÁ & ŠKORPÍK 2012).

Obr. 9A–G. A. Hevlín, lokalita [11], 1.x.2002 (foto A. Reiter). Lokalita prvního nálezu *Imnadia yeyetta* v České republice. Syntopicky byly zjištěny také druhy *Branchipus schaefferi*, *Triops cancriformis* a *Leptestheria dahalacensis*. B. *Imnadia yeyetta*, samec odchycený na lokalitě [11] u Hevlína 23.ix.2002 (foto J. Fott). Dokladový exemplář uložený v Jihomoravském muzeu ve Znojmě pod inventárním číslem 6831. C. *Lynceus brachyurus*, odchycený na lokalitě [3] u Popic 22.v.2010 (foto A. Komendová). D. Popice, lokalita [3], 5.v.2009 (foto A. Reiter). Lokalita opakovaného výskytu *Lynceus brachyurus* v okamžiku fenologického optima výskytu v roce 2009. E. Červený rybníček, lokalita [4], 24.iv.2003 (foto A. Reiter). Lokalita v období maximálního naplnění vodou (v tomto roce již bez doloženého výskytu velkých lupenonožců). F. Červený rybníček, lokalita [4], 28.vi.2012 (foto A. Reiter). V roce 2012 lokalita poprvé od prohloubení tůň zcela vyschla. G. Červený rybníček, lokalita [4], 8.iv.2013 (foto A. Reiter). Lokalita v době výskytu *Chirocephalus carnuntanus*. Patrně jsou managementové zásahy – odstranění vegetace a narušení půdního povrchu.

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“Červený rybníček” pool [4] – It is a depression created during trial kaolinite mining (Figs 7C–D, 9E, 9G). The site is listed as a wetland of local importance (CHYTIL *et al.* 1999). Occurrence of the species *Chirocephalus carnuntanus* and *Streptocephalus torvicornis* has been known there since the 1950s (HRABĚ 1954, BRTEK 1962, KUBÍČEK 1965). In the 1950s it was a pool on impermeable substrate which was supplied with rain water. Water level fluctuated significantly at that time and the pool was often free of water, it was also free of water vegetation (KUBÍČEK 1965). On 12 April 1964, a large number of the fairy shrimp *Chirocephalus carnuntanus* was found there by HIMMEL (1966), who also described how to protect the locality from washes from a nearby silage pit. No data on the occurrence of the fairy shrimp are available from the 1970s and 80s, the locality was probably filled with water at least in some years, as suggested by findings of amphibians (REITER & HANÁK 2000). However, in June 1984 the site was visited by KUCZMAN (1984), who found it completely dry with three small places showing signs of previous flooding; the largest of them was 70×20 cm in size. According to the reports by local people, water was present there only in periods of high precipitation. The site was polluted by agricultural waste including more or less empty packages for chemicals. KUCZMAN (1984) suggested the site to be further monitored. In the 1990s the pool was usually dry and overgrown with ruderal vegetation, however, fairy shrimps hatched repeatedly from collected sediment samples in 1991 and 1994 (Škorpíková & Kocourek pers. comm.). The hatched larvae were identified by F. Kubíček and I. Kocourek as *Eubranchipus grubii* (Kubíček pers. comm., Škorpíková pers. comm.). Successful hatching of larvae and captive breeding of *Streptocephalus torvicornis* from dry mud collected at this site is reported by KAVKA (2000). In 1997, one adult male of the latter species was found in a rain water puddle. In the winter of 1999/2000, two pools (5×5 and 15×5 m in size, maximum depth 1.2 m) were constructed at the locality. In the following season of 2000, mass occurrence of *Chirocephalus carnuntanus* and *Streptocephalus torvicornis* was recorded there. However, the pools do not dry out and fish were found in the larger of them in 2001; fairy shrimps did not appear in that year (ten checks in the growing season). In 2002, six negative checks were made during spring and summer, but occurrence of *Streptocephalus torvicornis* and larvae of *Triops cancriformis* were found in the smaller of the pools between September and December. In the growing season 2012, the locality dried up completely and the soil surface was disturbed intentionally during the winter 2012/2013. Consequently, the occurrence of *Chirocephalus carnuntanus* was reconfirmed in both pools in the spring 2013.

Since the year 2000, when the bottom of both pools was formed by caolinite substrate free of vegetation, gradual development of wetland vegetation has been recorded, in the smaller one with dominating *Sparganium* sp. and *Alopecurus* sp., in the larger one also with *Eleocharis* sp., *Alisma plantago-aquatica*, *Persicaria* sp. and other species; in both pools a part of the bottom and water column is still free of vegetation. Amphibians have also come back to the site – *Bombina bombina*, *Bufo bufo*, *Pseudepidalea viridis*, *Hyla arborea*, *Rana dalmatina* (REITER & HANÁK 2000, Zavadil unpubl. data) and numerous occurrence of many groups of water invertebrates, mainly insects, has been recorded. Large insect species with multi-year development show lower

abundance in the smaller pool, which probably dried out for a short time in the summer 2001 and in several subsequent years. The remaining part of the locality outside pools (ca 50%) was overgrown with tall ruderal vegetation (*Calamagrostis* sp., *Cirsium arvense*, etc.). Since 2003, this vegetation has been mown and removed regularly and it has been gradually changing towards a sparse grassland. The site management plan (KŘIVAN 2011) includes further occasional removing of vegetation as well as disrupting of soil surface. In addition, two more shallow pools are suggested to be created in the field adjacent to the locality in the west (at occasionally wet places), and their possible inoculation with substrate from the existing locality (KŘIVAN 2011). In the “Červený rybníček” pool, extinction of one generation of fairy shrimps was probably caused by fish which were introduced to the newly created pools. Potential of *Chirocephalus carnuntanus* eggs at the locality was able to survive several year flooding and fairy shrimps emerged again after 13 years of absence. It is thus important to continue with management of the site, as supposed in the recently approved management plan (KŘIVAN 2011).

Field east of the “Hevlínské jezero” pool [6] – A regularly managed (ploughed) field, in its bedrock there probably is an impermeable layer of caolinite (the PP Hevlínské jezero pool actually is a historical mining pit), and therefore large puddles (up to 1 ha) are formed in the field after heavy rains, persisting for several weeks to months (Fig. 7A). A damaged draining/irrigation system which goes through the site may also play its role. In the area flooded for longer periods of time, there is a community of subhalophilous plants suggesting slight salination of the soil (dominated by *Bolboschoenus koshevníkowi*, in abundance *Plantago major* ssp. *winteri*, *Pulicaria dysenterica*, *Lythrum hyssopifolia*, *Potentilla supina* etc.). The locality was discovered in July 1995 (Martiško pers. comm.). Since that, occurrence of the studied groups of large branchiopods has been recorded there during four seasons (1995, 1996, 1997 and 2002), while in the years 1999, 2000 and 2001 the locality was checked each time after long-term flooding but with a negative result. Occurrence of *Triops cancriformis* was recorded most often, followed by *Leptestheria dahalacensis*, the lowest number of records was made in *Branchipus schaefferi*. However, abundant simultaneous occurrence of all three species was recorded in the optimum stage of development of the community in the years 1995, 1996 and 2002. This situation was observed once in May (1996), once in early July (1995, leg. J. Martiško, det. P. Pařil), once in September (2002) and twice in October (1995, 2002). In 2009, occurrence of *Triops cancriformis* and *Leptestheria dahalacensis* was also recorded in the area neighbouring the PP Hevlínské jezero in the south, which is set aside in a long term and overgrown with connected fallow, partly wetland and ruderal vegetation (Fig. 8B). The two species developed there in ruts already in the last ten-day period of April. This locality is difficult to protect. Its situation could be improved by limited use of fertilizers and pesticides in vicinity of the occasionally flooded plots.

Localities in the area between the south-western margin of the cadaster of **Hevlín** in the south and **Jeviřovka** in the north-east [5, 7–15, 17–19] were mostly discovered due to floods in August 2002. The area is situated in the former flood zone of the Dyje river and the lower Jeviřovka river. It is sometimes called the “**Trávní dvůr**” area, the woodland

part of this area is protected as a Site of Community Interest of the same name. During an extraordinary flood in 2002, this area was flooded again due to the damage of protective dikes. In the past, only *Triops cancriformis* was found in a drainage canal south-west of the railway station at Jevišovka and *Branchipus schaefferi* in ruts on roads in the central part of the “Trávní dvůr” area (MARTIŠKO 1998, MARTIŠKO & MARTIŠKOVÁ 2002). All newly recorded localities have the character of shallow puddles in fields (Figs 8C, 8F, 9A). They were mainly rape, wheat, barley and corn stubbles, occurrence of *Triops cancriformis* was recorded also in unmown flooded sunflower fields. Practically at all of these localities, development of wetland vegetation classified according to the catalogue of habitats of the Czech Republic (CHYTRÝ *et al.* 2001) as vegetation of bare bottoms in warm areas (dominated by *Limosella aquatica*, *Lythrum hyssopifolia*, *Ranunculus sceleratus*, *Veronica anagalloides*) was recorded at the same time. In some puddles, occurrence of grown-up individual of *Persicaria amphibia* was found, indicating rather permanent watering of the plots. Out of the studied groups of large branchiopods, occurrence of *Triops cancriformis* was recorded in most of the checked puddles, and *Leptestheria dahalacensis* in about a half of the localities; the latter two species were usually found in syntopy. Occurrence of *Branchipus schaefferi* and *Imnadia yeyetta* was recorded at two and one localities, respectively. In the spill 2.2 km NE of the church at Hevlín (Fig. 9A), syntopic occurrence of all four species was found in 2002. In 2009, puddles in fields with grown-up corn (Fig. 8E) were inhabited again by *T. cancriformis* and *L. dahalacensis*. The same species were observed in the northern part of the area also in 2012 – in a clover field, partly ploughed (Fig 8F). Management of this set of localities is difficult; an important thing is to preserve the current state enabling occasional patchy flooding of suitable plots during floods or heavy rains. Targeted management should be aimed at periodically filled drainage canals, used as refuges at least by some species in rather dry years.

Within this area, which can be described as wider surroundings of the floodplain enclave of “Trávní dvůr”, a locality of *Eubbranchipus grubii* was also found in 2005 and confirmed in 2009, 2010 and 2013 [16]. The latter locality is of a different character, it is a series of pools in a blind arm of the Dyje river, occasionally filled with water (Fig. 8A). The pools are situated in close proximity of a protective dike (on its air side) and are surrounded with partly ruderalized vegetation of a floodplain forest. At present, the pools are not in need of management.

Conservation of large branchiopods in the study area

In Central Europe, large branchiopods rank among generally endangered animals, all species are included in regional red lists covering the areas of the Dyje, lower Morava and middle Danube rivers (see Table 1). Based on the data from the last ten years, classification in the particular categories of the red list of invertebrates of the Czech Republic (KRÁL & ŠTAMBERGOVÁ 2005) seems to be outdated, the newly proposed classification will be published elsewhere. In any case, most of our species rank among rare and endangered organisms. There are several causes of decline of large branchiopods in the Czech Republic. Some species, however, disappeared from the region too soon to

Table 1. Classification of large branchiopods in the published red lists (only species documented in the study area are included).**Tabulka 1.** Klasifikace velkých lupenonožců z dříve publikovaných červených seznamů (uvedeny pouze druhy známé ze sledované oblasti).

	Czech Republic¹	Slovakia²	Lower Austria³	Pálava BR⁴
<i>Branchipus schaefferi</i>	CR	not included	CR	not present
<i>Chirocephalus carnuntanus</i>	CR	VU	not present	not present
<i>Eubranchipus grubii</i>	CR	VU	VU	EN
<i>Streptocephalus torvicornis</i>	CR	VU	not present	not present
<i>Triops cancrivorus</i>	CR	VU	EN	CR
<i>Imnadia yeyetta</i>	CR	EN	EN	not present
<i>Leptestheria dahalacensis</i>	CR	EN	EN	CR
<i>Lynceus brachyurus</i>	RE	not included	RE	not present

Red list categories: RE – regionally extinct/pro území ČR vymizelý; CR – critically endangered/kriticky ohrožený; EN – endangered/ohrožený; VU – vulnerable/zranitelný. Not included = species present in the particular region but not classified as endangered in terms of the red list/druh přítomný v daném regionu avšak nezahrnutý do regionálního červeného seznamu; not present = species absent in the particular region/druh v daném regionu nezjištěný.

¹from/podle KRÁL & ŠTAMBERGOVÁ (2005); ²from/podle HUDEC (2001); ³from/podle HÖDEL & EDER (2000) – categories were determined according to the verbal description, in the original paper indicated as/kategorie byly určeny podle slovního popisu, který je v citované studii uveden takto: “ausgestorben oder verschollen” (= RE), “vom Aussterben bedroht” (= CR), “stark gefährdet” (= EN), “gefährdet” (= VU); ⁴from/podle SUKOP & SEDLÁK (1999a, b, c).

be able to apprehend concrete causes. We can thus conclude on some general and global causes only: climate changes, and especially dry periods in spring. Concerning definite causes, total draining of the landscape is most important, along with the decline or even absence of grazing, mainly in lower altitudes, connected with trampling by cattle and erosion activity of herds concentrated at wet areas and natural watering places. Decline of grazing is connected with overgrowing of the landscape with vegetation. Other causes include army transformation, use of a different military technology, abandonment of military training areas and their overgrowing and housing development. At some places, this year's generations of large branchiopods were exterminated by unrestrained fish stocks. Their further occurrence was limited by excessive deepening of the pools, which prevents regular drying of the sites (e.g. in the “Červený rybníček” pool). Use of chemicals and eutrophication of water (washes of rainwater sewerage to rivers which spill out of their beds during floods, washes from fields), connected with development of filamentous algae which kill large branchiopods indirectly (cf. BRTEK 2005, EDER *et al.* 1997), also have a very negative effect. Setting fields aside and crop changes in cultivated fields have been also playing an important role in recent years.

Restriction of rivers to artificial beds, construction of anti-flood dikes, construction of water reservoirs in lowlands (e.g. a large area of occurrence of spring species of large branchiopods was destroyed in Moravia by construction of the Nové Mlýny reservoirs) have destructive effects on both spring and summer species. Even today, draining of floodplain forests, piping water away from periodical pools to rivers, and connecting pools in floodplain forests with watercourses has been practised at some places. Naturally, blind river arms, meanders, small pools and canals in floodplain forests get filled with sediments in the course of time and require at least occasional management, however, inconsiderate mud removal from blocked canals causes penetration of fish to the canals and, above all, changes in hydrological conditions which affect crustaceans negatively. This leads to extinction of populations of large branchiopods. In *Leptestheria dahalacensis* there is another threat: changes of fishponds stocked with fish embryo to fishponds with non-fluctuating water level and renewal of abandoned fishponds, connected with restoration of fish or duck breeding (often both).

In spite of that, the potential of eggs in the bottom of some fishponds in southern Moravia seems to be still quite rich and, if suitable conditions for hatching and development of the species occur after many years, clam shrimps are able to increase in numbers very fast (LOSOS & HETEŠA 1972, SUKOP & ČAJ 1994, SUKOP & SEDLÁK 1999c). In such cases they may cause problems to fishermen. Direct killing of clam shrimps using chemicals, as practised some 25 years ago, is culpable, though. This indicates that all clam shrimp species should be included in the list of Specially Protected Animals. If clam shrimps occur in a fishpond stocked with fish larvae and prevent the larvae from growing, the situation should be solved in cooperation with nature conservation authorities.

It is also necessary to remove mud from blocked canals from time to time, or even make the canals navigable. However, if large branchiopods are present in the canal, a sufficient measure is to dig a system of pools near the canal and inoculate them with sediment from the canal.

The potential of eggs at places of previous occurrence of large branchiopods (e.g. in fields or pastures) also seems to be quite rich and, if suitable conditions for their hatching and development occurred after many years, summer species of large branchiopods may appear there again after torrential rains and increase in numbers.

Maintenance of habitats by motocross, four wheelers, movements of military vehicles etc. is also important for summer species of large branchiopods (e.g. MAŠTERA *et al.* 2009). Such management is definitely beneficial to branchiopods, no matter whether they are unrestrained actions or planned conservation measures. In the study area, there is, or rather was, only few such places. Possible restoration of movements of military vehicles or attracting activities of bikers and four wheeler riders to the sites should be considered.

Conservation of periodic wetlands in arable fields is rather difficult and problematic and so far it has not been implemented in the country. It should be based on the currently used farming practices (including ploughing and sowing) but only if the site is not flooded at the given time. The choice of crops seems to be very important. Suitable crops

are those providing bare soil between individual plants (e.g. beet, corn, hops, onion or garlic). On the contrary, rape is not suitable. It is also necessary to restrict the use of fertilizers, herbicides and insecticides at the sites of occurrence of large branchiopods, including their close surroundings. Prohibition of any drainage including repairs of existing, often outdated dewatering systems is also badly needed. Localities with higher potential presence of large branchiopods could be identified as candidates for special protection (e.g. as a temporarily protected area or a significant landscape element).

Syntopic occurrence of the community of large branchiopods of periodical waters and of the ephemeral wetland plant community documents existence of a reserve of viable diaspores of both these ecologically similar, although systematically unrelated groups of organisms in a wide area of the former flood zone of the middle Dyje river. In our opinion, in the years without large-scale floods, large branchiopods are able to hatch in drainage canals and different types of periodical water habitats (blind river arms, floodplain pools, marshes in fields) which are quite abundant especially in the eastern surroundings of Hevlín and also in the “Trávní dvůr” area (eggs of large branchiopods survive for many years without the opportunity to hatch). This assumption is documented by the findings made by MARTIŠKO (1998) and MARTIŠKO & MARTIŠKOVÁ (2002), however, the situation requires more systematic research to be able to identify and protect the possible refuges.

After the floods in August and September 2002, *Triops cancriformis*, *Leptestheria dahalacensis* as well as *Branchipus schaefferi* were widespread throughout the flooded landscape in huge numbers. Most of them managed to reach maturity, therefore the reserve of eggs produced must have been enormous. We believe that this is the reason why occurrence of these species has been relatively frequent since the year 2003, even at newly created small watered places or under marginally suitable conditions. Before the flood of 2002, nothing similar was recorded in the Znojmo region for tens of years. Concerning the middle Dyje river area, only isolated findings by MARTIŠKO (1998) and MARTIŠKO & MARTIŠKOVÁ (2002) are available. No records of large branchiopods are known from the middle Dyje river area even from the break of the 19th and 20th centuries, when e.g. the botanical research there was quite advanced (e.g. OBORNY 1886, HIMMELBAUR & STUMME 1923). Since the year 2002 much more data have been available. However, this is of course also affected by the fact that the study of large branchiopods has been more intensive since that.

Further studies should be also aimed at the possible occurrence of the spring species *Eubbranchipus grubii* and *Lepidurus apus* in floodplain forests of the “Trávní dvůr” area, which is a wetland of above-regional importance according to CHYTIL *et al.* (1999). Its habitats approximately correspond with the character of floodplain vegetation in the Pálava BR, where both of the above-mentioned species are relatively common (SUKOP & SEDLÁK 1999a,b).

The following large branchiopod species are reported from sites relatively close to the study area:

- *Lepidurus apus* (Linnaeus, 1758): a number of localities in floodplains of the lower Dyje and Morava rivers are reported in the eastern part of southern Moravia by SUKOP & SEDLÁK (1999b). This area is connected with the continuous occurrence in floodplains of the lower Dyje and Morava rivers reported from Lower Austria even from recent years (EDER & HÖDL 2003, EDER 2012).
- *Cyzicus tetracerus* (Krynicky, 1830): data on extinct localities near Podivín (Moravia) are reported by SLANINOVÁ-POKORNÁ (1997), the closest locality to the study area was Dolní Věstonice (Moravia). In Austria, the closest localities to our country are concentrated in the area of confluence of the Morava and Danube rivers (EDER & HÖDL 2003), the most recent finding of the species comes from 2006 (EDER 2012).
- *Eoleptestheria ticinensis* (Balsamo-Crivelli, 1859): lives in north-eastern Austria and in the West-Slovak lowland (= Západoslovenská nížina) in Slovakia (EDER *et al.* 1996, BRTEK 2005). Its presence in our country thus cannot be excluded. At the historical locality on the southern outskirts of Vienna, the species was last recorded in 1879. The only recent locality, which is also closest to our border, is situated near the confluence of the Morava and Danube rivers (EDER & HÖDL 2003), the most recent record from this locality (Markthof) is reported by EDER (2012) from 2010.
- *Tanymastix stagnalis* (Linnaeus, 1758): EDER & HÖDL (2003) mention a historical locality (the last record from 1965) near the lower Morava river, EDER (2012) reports the last record for Lower Austria from 1975. Locality of this species is even closer to our country than that of *Eoleptestheria ticinensis*.
- *Chirocephalus schadini* (Smirnov, 1928) is reported by EDER & HÖDL (2003) from near the lower Morava river, at the locality Marchegg the species was observed even in 2010 (EDER 2012). Occurrence of this fairy shrimp species is even closer to our country than the locality of *Eoleptestheria ticinensis* and moreover, it is a recent record.
- *Limnadia lenticularis* (Linnaeus, 1761) is reported from a larger number of localities from the floodplains of the Morava and Danube rivers in Austria (EDER & HÖDL 2003) and from the area of confluence of the Morava and Danube rivers from 2002. The most recent record made in Lower Austria (locality not specified) is mentioned by EDER (2012) from 2010. Findings of this species are also relatively close to our country.

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Summary

Velcí lupenonožci (Crustacea: Anostraca, Notostraca, Spinicaudata, Laevicaudata) středního Podyjí (Česká republika)

V předkládané práci shrnujeme veškeré publikované historické prameny s nálezy lupenonožců ze středního Podyjí. Prameny jsou ovšem jen dva: HRABĚ (1954) a KUBÍČEK (1965) a oba se zabývají jedinou lokalitou, kterou je přírodní památka Červený rybníček u Znojma (obr. 7C–D, 9E a 9G). Lokalita v té době hostila prokazatelně dva druhy lupenonožců. Ve druhé polovině padesátých let dvacátého století byla kontaminována močůvkou a od té doby byla navštívena jen dvěma autory. HIMMEL (1966) zde ještě v roce 1964 nalezl žábřonožku panonskou (*Chirocephalus carnuntanus*), avšak KUCZMAN (1984) v roce 1983 shledal místo bez vody. Poté nebylo místo sledováno. Až teprve po nález jediného exempláře žábřonožky divorohé (*Streptocephalus torvicornis*) v roce 1997 byl zahájen soustředěný průzkum této lokality a výzkum lupenonožců ve středním Podyjí vůbec. Ten byl ještě více na lupenonožce zacílen po povodni koncem léta roku 2002. Tehdy byl na sledovaném území zaznamenán nový druh škeblovky pro území České republiky, a to škeblovka hladká (*Imnadia yeyetta*) (obr. 9A–B). Od té doby byli lupenonožci v zájmové oblasti sledováni v příhodných letech pravidelně a cíleně. Výzkum byl v roce 2009 prozatím dovršen nálezem hrašníka zobcovitého (*Lynceus brachyurus*) (obr. 9D). Tento druh byl ještě v roce 2005 považován na území ČR za vyhynulý KRÁL & ŠTAMBERGOVÁ (2005). České názvosloví používáme podle práce KRÁL & ŠTAMBERGOVÁ (2005). Název škeblovka hladká pro druh *Imnadia yeyetta* je přejat z práce ZAVADIL *et al.* (2013).

Ve sledované oblasti byly, kromě výše uvedených druhů, nalezeny autory příspěvku tyto další druhy: žábřonožka sněžní (*Eubranchipus grubii*), žábřonožka letní (*Branchipus schaefferi*), listonoh letní (*Triops cancriformis*) a škeblovka rovnohřbetá (*Leptestheria dahalacensis*).

V seznamu jednotlivých druhů popisujeme celkový areál rozšíření druhu, jeho rozšíření v České republice a biologii. Nejdůležitějším bodem u každého druhu jsou nové, dosud nepublikované nálezy, které řadíme v kvadrátech zoologického mapování ve smyslu PRUNER & MIKA (1996) v jednotlivých subkvadrátech a, b, c, d. Shrnujeme rozšíření konkrétních druhů v dané oblasti a porovnáváme s výskytem či absencí především v dolním Podyjí a v Rakousku, případně ve zbylé části České republiky a na Slovensku.

U nejvýznamnějších lokalit lupenonožců předkládáme jejich podrobnější popis a charakteristiku: 1) ekologicky pozoruhodné lokality Na Pyramidě (obr. 7E) a Černá luža (obr. 7F) – výskyt žábřonožky sněžní mimo říční aluvium; 2) lokalita u Popic s nálezem vzácného druhu (hrašník zobcovitý) – obr. 3, 8C) lokalita Červený rybníček s výskytem vzácných druhů (žábřonožka panonská, ž. divorohá a listonoh letní); 4) lokalita východně od Hevlínské jezera se syntopickým výskytem žábřonožky letní, listonoha letního a škeblovky rovnohřbeté (např. obr. 7A); 5) lokality mezi Hevlínem a Jevišovkou, kde byla nalezena škeblovka hladká ve společnosti se š. rovnohřbetou, listonohem letním a žábřonožkou letní (obr. 9A).

Dále diskutujeme problematiku ohrožení a ochrany lupenonožců v zájmové oblasti a význam jednotlivých lokalit.

Vzhledem k nedávnému objevu nového druhu škeblovky pro naše území a výskytu některých druhů lupenonožců v nedaleké oblasti Rakouska či v dolním Podyjí, uvažujeme o teoretické možnosti nález dalších druhů lupenonožců ve středním Podyjí. Jedná se o druhy *Lepidurus apus*, *Cyzicus tetracerus*, *Eoleptestheria ticinensis*, *Tanyastix stagnalis*, *Chirocephalus schadini* a *Limnadia lenticularis*.

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