

Branchiobdellida (Annelida: Clitellata) from Collections of the National Museum (Prague) and Recent Samples from Slovakia, with a Synopsis of Branchiobdellidans from the Czechia, Slovakia, and Bosnia and Herzegovina

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Abstract: Fifty-two samples of a total of 286 crayfish individuals from the Crustacean Collection of the National Museum (Prague) were examined for branchiobdellidan worms (Annelida: Branchiobdellida). These included an examination of jar debris, crayfish bodies and extracted crayfish gills. As a result 399 crayfish worms were found, separated and identified. In addition, 452 unidentified branchiobdellidan worms from the oligochaete collection of the same museum were identified at the species level. Crayfish individuals collected in Central and Western Slovakia during 2005–2011 were also studied for branchiobdellidan worms. The found branchiobdellidans belonged to four European species: *Branchiobdella parasita* (Braun, 1805), *B. pentadonta* Whitman, 1882, *B. hexadonta* Gruber, 1883 and *B. balcanica* Moszyński, 1938. A synopsis on branchiobdellidan fauna of the Czechia, Slovakia, and Bosnia and Herzegovina based on the material identified by us and scattered literature data is presented.

Key words: *Branchiobdella*, Europe, Czechia, Slovakia, Bosnia and Herzegovina

Introduction

Crayfish play an important ecological role in the functioning of freshwater ecosystems and biodiversity. In most European countries the indigenous freshwater crayfishes, *Astacus astacus* (Linnaeus, 1758), *Astacus leptodactylus* Eschscholtz, 1823, *Austropotamobius torrentium* (Schrank, 1803), *Austropotamobius pallipes* Kessler, 1876 and *Astacus pachypus* Rathke, 1837 are considered vulnerable or threatened and therefore are legally protected (SOUTY-GROSSEL et al. 2006). All this is a good reason for the recent increased interest at this group of animals (SOUTY-GROSSEL et al. 2006). An important part of crayfish studies are those involving their pathogens, parasites and ecto-

commensals, which could have a significant impact on their hosts. The main ectosymbionts on the freshwater crayfish are members of the order Branchiobdellida (Annelida: Clitellata). In Europe, this group is represented by eight species of the genus *Branchiobdella*: *B. astaci* Odier, 1823, *B. parasita* (Braun, 1805), *B. pentadonta* Whitman, 1882, *B. hexadonta* Gruber, 1883, *B. italica* Canegallo, 1928, *B. balcanica* Moszyński, 1938, *B. kozarovi* Subchev, 1978 and *B. papillosa* Nesemann and Hutter, 2002 (see SUBCHEV 2014).

Here we report on the results obtained from our laboratory work in the National Museum in Prague (NMP) in 2016 and field work in

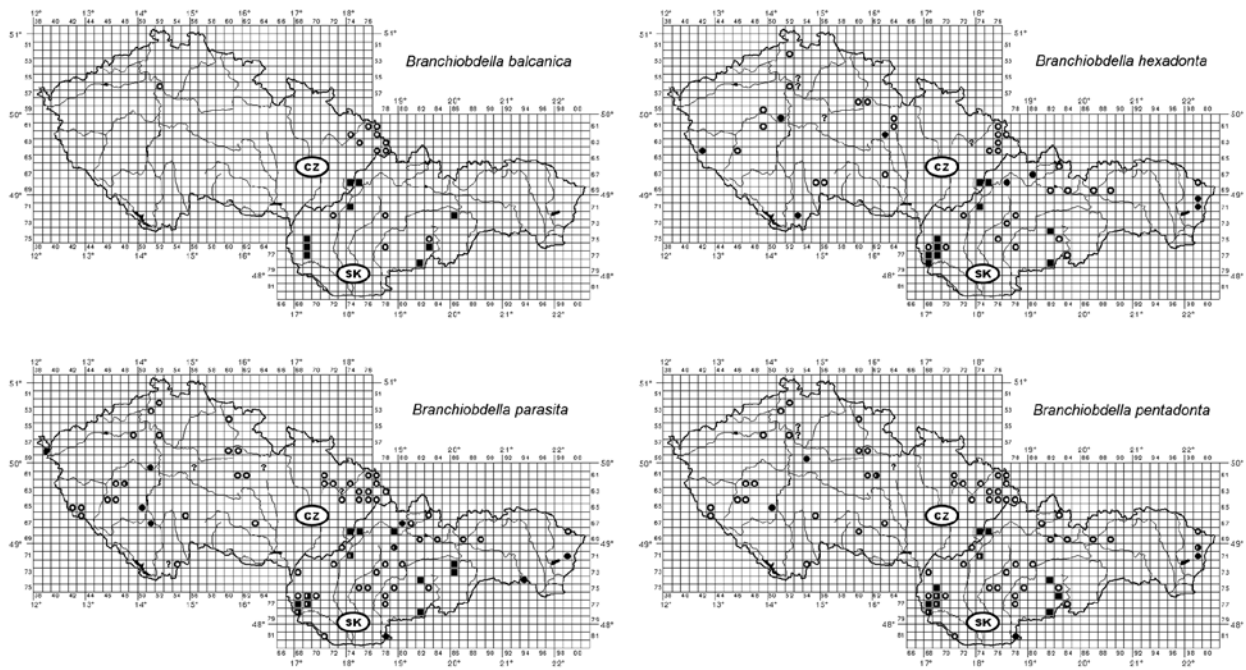


Fig. 1. Distribution of *Branchiobdella parasita*, *B. pentadonta*, *B. hexadonta* and *B. balcanica* in the Czechia (CZ) and Slovakia (SK); black discs – present results from the NMP collections, black squares – present results from field studies in Slovakia, white discs – literature data, half black discs and half black squares – our results coinciding with those already known in the literature.

Slovakia in 2005–2011. In NMP, we examined all available crayfish samples for branchiobdellidans. All worms found in crayfish samples as well as some unidentified branchiobdellidan worms in the Museum's oligochaete collection were identified. In Slovakia, the field work included collecting crayfish in different regions of the country, examining them for branchiobdellidans, which were later identified. In addition, a synopsis of branchiobdellidan fauna of the Czechia, Slovakia and Bosnia and Herzegovina was prepared.

Materials and Methods

Fifty-two samples of a total of 286 crayfish individuals from the crustacean collection of the NMP were examined for branchiobdellidans. This included an examination of the crayfish bodies, jar debris and extracted crayfish gills. In addition, 452 unidentified branchiobdellidan worms preserved in ethanol in the oligochaete collection of the NMP were also examined and identified. All of the worms were identified by the body shape and body dimension as described in SUBCHEV (2014). In the cases of badly preserved or young specimens difficult to identify, the worms were infiltrated in glycerine and their jaws were examined under a light microscope to confirm the iden-

tification on the basis of comparison with SUBCHEV's (2014) descriptions.

Field collections of crayfish and their examination for a possible presence of branchiobdellidan worms were carried out in Slovakia in 2005–2011. This included 27 localities in Central Slovakia visited by us and an unknown number of localities in Western Slovakia visited by colleagues. Branchiobdellidans found on the crayfish surface (the gill chamber was not examined) were preserved in 70% ethanol. The worms found were identified using keys published by SUBCHEV (1984), GELDER et al. (1994), ČERMÁKOVÁ & BÁDR (2002). Some of the collected branchiobdellidans were stained with picric acid or borax carmine and mounted in Canada balsam either for further details needed for identification or for studying the spermatheca; the latter results are still to be published.

For mapping the distribution of branchiobdellidans in the Czechia and Slovakia, the grid square system of BUCHAR (1982) was used. Grid square numbers of Czech settlements are listed in PRUNER & MÍKA (1996). In the case of Slovak settlements or localities outside settlements in both countries, an online BioLib application (NOVÁK & ZIČHA 2016) was used for calculating the grid square number based on GPS coordinates. When constructing the maps of Bosnia and Herzegovina, GPS coordinates were

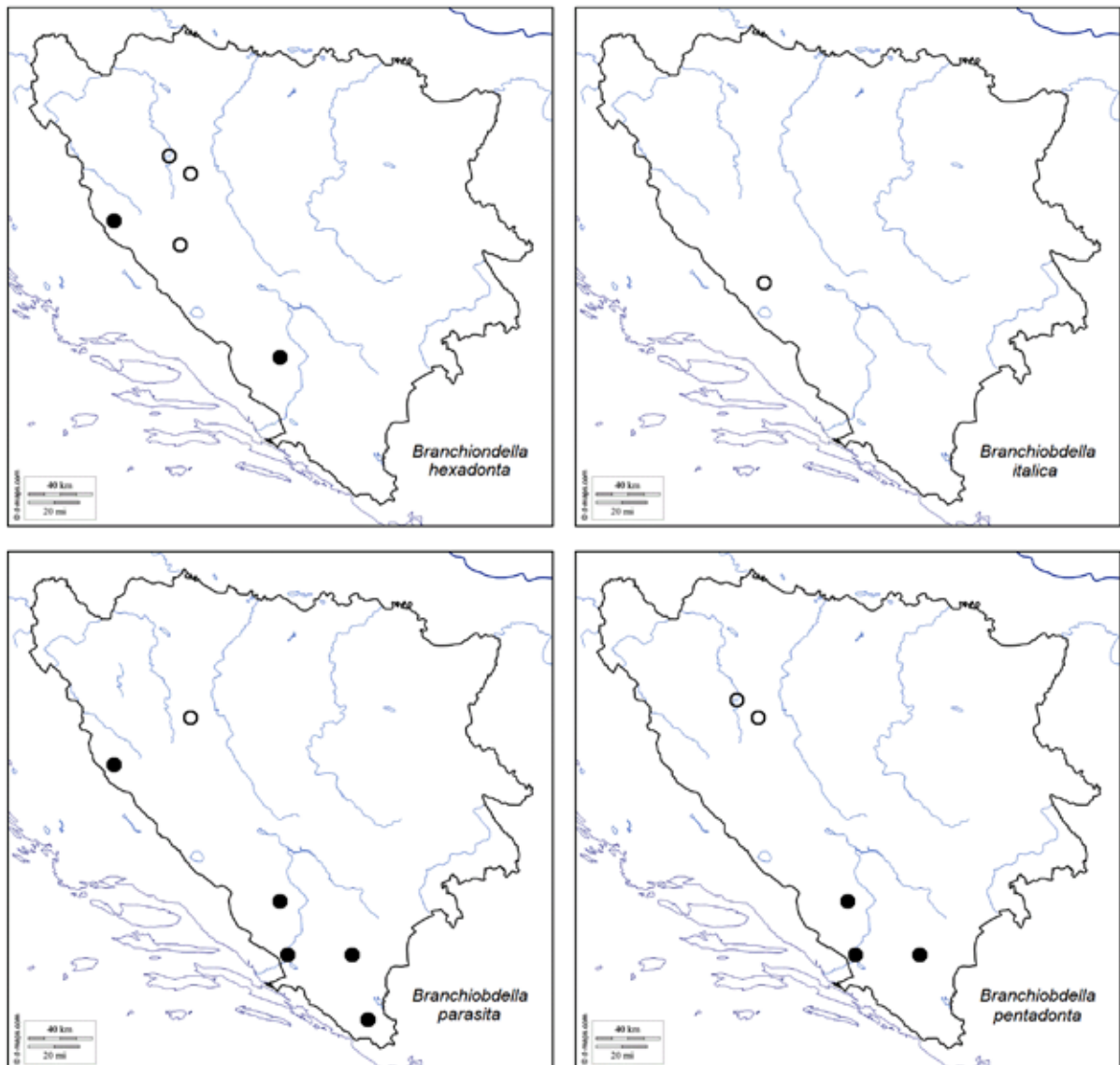


Fig. 2. Distribution of *Branchiobdella parasita*, *B. pentadonta* and *B. hexadonta* in Bosnia and Herzegovina; black discs – present results, white disc – literature data.

shown on the map directly. A basic map of Bosnia and Herzegovina was downloaded from d-maps.com (DALET 2016) and details were added using the MS Paint 6.0 programme (Windows).

Results

In crayfish samples from the Crustacean Collection of the NMP, a total of 399 branchiobdellidan worms were found. They were isolated from eight crayfish samples from the Czechia, four from Slovakia, six from Bosnia and Herzegovina and one from each of Croatia, Greece, Bulgaria and Romania (Table 1). Most of the hosts were *Astacus astacus* L. but in the crayfish samples from Bosnia and Herzegovina branchiobdellidan worms were found also on

Austropotamobius torrentium (SCHRANK, 1803) and *Austropotamobius pallipes* KESSLER, 1876 (Table 1). The worms found belonged to three *Branchiobdella* species: *B. parasita*, *B. pentadonta* and *B. hexadonta*. Specimens of *B. parasita* were present in the samples from all six countries excluding Greece; *B. pentadonta* was absent only in samples from Greece and Bulgaria; and *B. hexadonta* was only absent from Bulgaria (Table 1). As expected (see SUBCHEV 2014), *B. parasita* and *B. pentadonta* were found exclusively in jar debris and, in some cases, still fixed on the crayfish body, while *B. hexadonta* was found exclusively in the gill chambers.

Branchiobdellidans from the Oligochaeta Collection of the NMP belonged to four *Branchiobdella* species, i.e. those three species

Table 1. *Branchiobdella* spp. found in crayfish samples in the Crustacean Collection of the National Museum Prague. *Bpa* = *B. parasita*, *Bpe* = *B. pentadonta*, *Bh* = *B. hexadonta*, *Bb* = *B. balcanica*; *A.a.* = *A. astacus*, *A.t.* = *A. torrentium*, *A.p.* = *A. pallipes*.

Locality Stream (<u>lake, pond</u>): near by <i>settlement</i> , year of collection	Grid square	Host	<i>Branchiobdella</i> spp., number of worms found			
			<i>Bpa</i>	<i>Bpe</i>	<i>Bh</i>	<i>Bb</i>
Czechia						
unkn. above <i>Kladivo</i> : <i>Libá</i> , 1963	5839	<i>A.a.</i>	1	-	-	-
unkn.: <i>Štítary</i> by <i>Horšovský Týn</i> , 413 m a.s.l.	6442	<i>A.a.</i>	-	-	1	-
unkn.: <i>Klení</i> by <i>Benešov nad Černou</i> , 694 m a.s.l., 1993	7253	<i>A.a.</i>	-	-	5	-
unkn.: <i>Dobřichovice</i> , 205 m a.s.l., 1906	6051	<i>A.t.</i>	-	-	1	-
Blanice : <i>Žďárské Chalupy</i> by <i>Protivín</i> , 419 m a.s.l., 1941	6751	<i>A.a.</i>	1	-	-	-
Výmola : <i>Břeží</i> , 330 m a.s.l., 1977	5954	<i>A.a.</i>		1		
Klabava : 500 m of “ <i>Tři Trubky</i> ”, <i>Strašice</i> , 1994	6248	<i>A.a.</i>	5	-	-	-
Krounka : <i>Kutřín</i> , 447 m a.s.l., 2009	6162	<i>A.a.</i>	-	6	-	-
Slovakia						
<i>Zázrivá tuň.</i> , 500 m from the inflow of Biela into Zázrivský potok : <i>Zázrivá</i> , 1959	6780	<i>A.a.</i>	-	-	2	-
Manínský potok : <i>Považská Teplá</i> by <i>Považská Bystrica</i> , 1959	6877	<i>A.a.</i>	-	-	6	-
Zázrivský potok : <i>Zázrivá</i> , 1959	6780	<i>A.a.</i>	3	-	30	-
Dunaj : <i>Kováčov</i> , 1986	8178	<i>A.a.</i>	1	1	-	-
Bosnia and Herzegovina						
Vrijeka under its spring: <i>Hatelji</i> , 2006		<i>A.p.</i>	-	3	2	-
Bregava : <i>Stolac</i> , 2006		<i>A.p.</i>	-	1	1	-
Upstream of Korana : <i>Bosansko Grahovo</i> , 2008		<i>A.t.</i>	4	-	4	-
Žvatić : <i>Dobrić</i> , 2008		<i>A.p.</i>	1	165	23	-
Izvidžačko : <i>Dobrić</i> , 2015		<i>A.a.</i>	4	-	-	-
A canal of Trebišnjica : <i>Trbnje</i> , 2015		?	9	-	-	-
Croatia						
Rašaška : <i>Rogolji</i> , 2006		<i>A.a.</i>	7	57	10	-
Greece						
Angititis : <i>Kokinogia</i> , 2015		?	-	-	3	-
Bulgaria						
Nejkovska and its inflow at the confluence with Kotlenska : <i>Gradets</i> , 2010		<i>A.a.</i>	1	-	-	-
Romania						
Lacu Roșu : <i>Lacu Roșu</i> , 1974		<i>A.a.</i>	-	-	2	7

mentioned above and *B. balcanica*. The worms were collected on crayfish individuals from the Czechia (three localities), Slovakia (two localities), Ukraine (one locality) and FYRO Macedonia (one locality) (Table 2). *Branchiobdella parasita* was found in samples from the Czechia, Slovakia and Ukraine, *B. pentadonta* in samples from Slovakia and Ukraine, *B. hexadonta* in samples from the Czechia, Slovakia and FYRO Macedonia and *B. balcanica* only in a sample from Romania (Table 2).

Branchiobdellidans were found on crayfish individuals from 23 sites in Slovakia (Table 3): 17 sites in Western Slovakia (on both *A. astacus* and *A. torrentium*) and six sites in Central Slovakia (containing *A. astacus* only). The collected branchiobdelli-

dans were *B. parasita*, *B. pentadonta*, *B. hexadonta* and *B. balcanica*.

For the distribution of *Branchiobdella* spp. in the Czechia and Slovakia, and Bosnia and Herzegovina, see Fig. 1 and Fig. 2, respectively. For detailed information on localities where *Branchiobdella* spp. have been found in these three countries, see Tables 1–3 (new data) and Table 4 (literature data).

Discussion

The four *Branchiobdella* species found in the NMP collections confirmed their presence (SUBCHEV, 2014) in Bosnia and Herzegovina, Bulgaria, Czechia, Croatia, Greece, Slovakia and Romania but

Table 2. *Branchiobdella* spp. identified in the Oligochaeta Collection of the National Museum Prague. *A.a.* = *A. astacus*, *A.t.* = *A. torrentium*.

Catalogue №	<i>Branchiobdella</i> species, number of worms	Host	Country, Stream/lake/pond: near-by settlement (grid square), year of collection
P6j-112/2002	<i>B. pentadonta</i> , 4	A.a	Ukraine, unkn.: Chynadiiovo (7403), N/A
P6j-114/2002	<i>B. hexadonta</i> , 1	<i>Astacus</i> sp.	FYRO Macedonia, Ohrid : Ohrid (N/A), N/A
P6j-116/2002	<i>B. hexadonta</i> , 11	A. a.	Czechia, unkn.: Polička (6263), 1909
P6j-117/2002	<i>B. parasita</i> , 21 <i>B. pentadonta</i> , 23 <i>B. hexadonta</i> , 49	A. a.	Slovakia, unkn.: Remetské Hámre (7199), 1962
P6j-118/2002	<i>B. parasita</i> , 138 <i>B. pentadonta</i> , 47 <i>B. hexadonta</i> , 97	A. a.	Slovakia, Vihorlat PLA, Morské oko (7099), 1962
P6j-120/2002	<i>B. parasita</i> , 54 <i>B. hexadonta</i> , 7	A.t.	Czechia, unkn.: Chýnvice – Dubečský Mlýn (6051), 1963
P6j-122/2002	cocoons at the ventral part of abdomen (<i>B. parasita</i> ?); cocoons in the gill chamber (<i>B. hexadonta</i> ?)	A.a.	Czechia, Chrast by Chrudim, 1904
P6E-4020	<i>B. parasita</i> , 27	Unkn.	Slovakia, Izra : Slanská Huta (7494), 1932
P6E-4021 P6E-4022	<i>B. parasita</i> , 3 <i>B. pentadonta</i> , 1	Unkn.	Czechia, unkn.: Čimelice (6550), 1962

Table 3. *Branchiobdella* species found on crayfish in Slovakia in 2005-2011. *Bpa* = *B. parasita*, *Bpe* = *B. pentadonta*, *Bh* = *B. hexadonta*, *Bb* = *B. balcanica*; *A.a.* = *A. astacus*, *A.t.* = *A. torrentium*.

Locality Stream/lake/pond: near-by settlement	Grid square	Host	<i>Branchiobdella</i> spp.			
			<i>Bpa</i>	<i>Bpe</i>	<i>Bh</i>	<i>Bb</i>
Unkn.: Cvičná lúka, Bratislava – Koliba	7868	<i>A.t.</i>	+	+	+	-
Račí potok: Vajnory	7769	<i>A.t.</i>	+	-	-	-
Vydrlica: Železná studnička	7868	<i>A.a.</i>	-	+	-	-
Vydrlica: Železná studnička	7868	<i>A.t.</i>	+	+	-	-
Vypustený rybník: Železná studnička	7868	<i>A.a.</i>	+	-	-	-
Vypustený rybník: Železná studnička	7868	<i>A.t.</i>	+	-	-	-
Unkn.: Dračí Hrádok	7768	<i>A.t.</i>	-	+	+	-
Cúrský potok: Borinka	7768	<i>A.t.</i>	+	+	-	-
Kostolný: Pernek	7669	<i>A.a.</i>	+	+	-	+
Kostolný: Pernek	7669	<i>A.t.</i>	+	+	-	-
Javorinka: Kuchyňa	7669	<i>A.t.</i>	+	+	-	+
Kamenný potok: Papiernička	7669	<i>A.a.</i>	+	+	+	-
left tributary of Kamenný potok: Modra	7669	<i>A.a.</i>	-	+	+	+
Lučanka: Limbach	7769	<i>A.a.</i>	+	+	+	+
Rohožník: Rohožník	7569	<i>A.a.</i>	-	+	+	-
Sološnický potok: Sološnica	7569	<i>A.a.</i>	-	+	-	+
Kubrický potok: Kubrá	7174	<i>A.a.</i>	+	+	+	+
Opatovský potok: Opatová	7174	<i>A.a.</i>	+	+	+	+
Tovarský potok: Nebrová	6874	<i>A.a.</i>	+	+	+	+
Zubák: Horná Breznica	6875	<i>A.a.</i>	+	+	+	+
Krtíšok: Modrý Kameň – Dolina	7882	<i>A.a.</i>	+	+	+	+
Jablonka: Višňové, Višňovská dolina [valley]	6879	<i>A.a.</i>	+	-	-	-
Nemecká: Blato	7482	<i>A.a.</i>	+	+	+	-
Unkn.: Muránska Lehota	7286	<i>A.a.</i>	+	-	-	+
Unkn.: Ploské	7386	<i>A.a.</i>	+	-	-	-
Tuhársky: Stará Halič	7683	<i>A.a.</i>	-	+	-	+

also provided new information on their distribution in these countries. The field work in Slovakia resulted in significant widening of our knowledge about the distribution of *Branchiobdella* members in this country (for details see below). As most of the material identified in the present study was from crayfish collected in Czechia, Slovakia and Bosnia and Herzegovina, a synopsis of branchiobdellidan fauna in these countries is presented below.

Czechia: VEJDOVSKÝ (1884), in his monograph on systematics and morphology of the Oligochaeta, presented the first record of branchiobdellidans (*B. parasita*) from Czechia; however, this was without any information on their locality in the country. The first faunistic paper dealing with the genus *Branchiobdella* in the Czechia was that by STRAŠKRABA (1956) who gave six localities for *B. hexadonta* and one for *B. pentadonta*. Later, POP (1965) mentioned Prague as a locality of *B. pentadonta orientalis* POP, 1965, which now is considered as a synonym of *B. balcanica* (see SUBCHEV 2014). BÁDR (2000) reported *B. parasita* and *B. italica* on *A. astacus*, in addition to the three above-mentioned species. However, ČERMÁKOVÁ & BÁDR (2002) corrected their earlier report stating *B. pentadonta* was a misidentification for *B. italica*. The first and so far only report of *B. astaci* in the Czechia was that by SUBCHEV (2012) who found this species in *A. astacus* labelled “Bohemia (Czechia)” in the collection of the Natural History Museum in London. Thus, so far the known *Branchiobdella* spp. in the Czechia are five: *B. astaci*, *B. parasita*, *B. pentadonta*, *B. hexadonta* and *B. balcanica*. The remaining known European *Branchiobdella* spp., i.e. *B. italica*, *B. papillosa* and *B. kozarovi*, are not expected to be found in this country. *Branchiobdella italica* is associated only with *A. pallipes* (see SUBCHEV 2014), which does not occur in Czechia, while *B. papillosa* is known only from one locality in Austria (SUBCHEV 2014), and the geographical range of *B. kozarovi* does not include the Czechia (see FARD & GELDER 2011, SUBCHEV 2014). However, the latter species has been introduced beyond its native range with the introduction of its host *A. leptodactylus*, e.g. in Poland and Belgium (SUBCHEV 2014), showing that such an introduction is also possible for the Czechia. New localities for branchiobdellidans in the country are given also in ADÁMEK & ŘEHULKA (2000) and ĎURIŠ et al. (2001, 2006). The former authors did not identify the found worms but, according to the description of their location on the hosts (the carapace and gill chamber), these most probably were *B. pentadonta* (or *B. balcanica*) and *B. hexadonta*. ĎURIŠ et al. (2001) and ĎURIŠ et al. (2006) also published new localities for

the Czechia of *Branchiobdella* species on *A. astacus* and on the invasive crayfish *Orconectes limosus* (Rafinesque, 1817), respectively. Recent information about Czech species of *Branchiobdella* present in several unpublished (but available online) reports, bachelor and diploma theses (NOVÁKOVÁ & FIALOVÁ 2012, LOŽEK 2015, ŽVAKOVÁ 2003, ŠÍDOVÁ 2003, KRISTIAN 2005, ŠRÁMKOVÁ 2014). Among the latter sources, there are some cases of misidentifications. The illustrations of jaws in NOVÁKOVÁ & FIALOVÁ (2012) and ŠRÁMKOVÁ (2014) referring to *B. astaci* are actually jaws of *B. parasita*. In both cases, there is a small difference in the dimensions of the dorsal and ventral jaws, which is due to their different orientation on the slide but these differences are clearly not enough to distinguish between *B. astaci* and *B. parasita*. The record of *B. italica* by NOVÁKOVÁ & FIALOVÁ (2012) relied only on the jaw structure (one big median tooth and four-five less lateral teeth) and is most probably a result of misidentification as more than five teeth with different dimensions are present also in *B. pentadonta* (see KOZAROV et al. 1972, HALGOS 1972). In addition, NOVÁKOVÁ & FIALOVÁ (2012) were studying *A. torrentium* but *A. pallipes* is the only known host of *B. italica* to date (SUBCHEV 2014). Besides *O. limosus*, LOŽEK (2015) reported a second invasive crayfish, *Pacifastacus leniusculus* (Dana, 1852) as a host of *B. parasita* and *B. pentadonta* in the Czechia. From the summarised information (Tables 1-4), it could be concluded that the most widespread *Branchiobdella* species in Czechia are *B. parasita* and *B. pentadonta* followed by *B. hexadonta* and *B. balcanica*, while *B. astaci* seems to be very rare. It is worth mentioning that the usual microhabitat of *B. astaci* and *B. hexadonta* on a crayfish's body is the gill chamber (SUBCHEV 2014). However, in many cases the branchiobdellidans were collected only from live crayfishes, which means that the gill chamber of fixed crayfishes were not examined and, therefore, the possible presence of *B. astaci* and (or) *B. hexadonta* were overlooked. This means that the frequency of occurrence of these two branchiobdellidan species in the Czechia could be higher. All but two of ten localities in the Czechia where branchiobdellidans were found by us (Table 1, 2) are new for this country.

Slovakia: According to HALGOŠ (1972), the early faunistic records of branchiobdellidans in the former Czechoslovakia were reported by STRAŠKRABA (1956) and ZAJONC (1965). Actually, the latter author reported a locality of two *Branchiobdella* species, *B. parasita* and *B. pentadonta*, for Slovakia, from the Žitava River, while STRAŠKRABA'S (1956) localities are now in the

Table 4. Localities in the Czechia, Slovakia and Bosnia and Herzegovina where *Branchiobdella* spp. were found. *Ba* = *B. astaci*, *Bpa* = *B. parasita*, *Bpe* = *B. pentadonta*, *Bh* = *B. hexadonta*, *Bb* = *B. balcanica*; *A.a.* = *A. astacus*, *A.t.* = *A. torrentium*, *P.l.* = *P. leniusculus*, *O.l.* = *O. limosus*; ? = host unidentified; +? = only cocoons found.

Locality Stream/lake/pond: near-by settlement	Grid square	Host	<i>Branchiobdella</i> sp.					References
			Ba	Bpa	Bpe	Bh	Bb	
Czechia								
Lučina: Domaslavice	6276/ 6376	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
Lučina: Šumbark	6276	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
unkn.: Česká Třebová	6064/ 6164	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
unkn.: Jindřichův Hradec	6855/ 6856	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
unkn.: Hořovice	6149	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
unkn.: Zbečno	5949	<i>A.a.</i>	-	-	-	+	-	Straškraba (1956)
Morávka: Nošovice	6376	<i>A.a.</i>	-	-	+	-	-	Straškraba (1956)
unkn.: Praha		?	-	-	-	-	+	Pop (1965)
Bílý potok: Zbraslav by Brno	6763	<i>A.a.</i>		+	+	+	-	Bádr (2000)
from Bířička to Roudnička: <i>Hradec Králové</i>	5860- 5861	<i>A.a.</i>	-	+	+	+	-	Bádr (2000)
Pšovka: unkn.		<i>A.a.</i>	-		+?	+?		Adamek, Řehulka (2000)
Holotovský potok: Petřvald	6176	<i>O.l.</i>	-	+	+	-	+	Ďuriš et al. (2001)
Dubina: Karviná	6177	<i>O.l.</i>	-	+	+	-	-	Ďuriš et al. (2001)
Holotovecký potok: unkn.	6176	<i>A.a.</i>	-	+	+	+	+	Žvaková (2003)
unkn.: Pstruží	6475/ 6476	<i>A.a.</i>	-	+	+	+	-	Žvaková (2003)
unkn.: Raškovice	6376	<i>A.a.</i>	-	+	+	-	-	Žvaková (2003)
Labe: Obříství	5652	<i>O.l.</i>	-	+	+	+	+	Žvaková (2003)
Holotovecký potok: unkn.	6176	<i>A.a.</i>	-	+	+	+	+	Šídová (2003)
Křivý potok: unkn.	6177	<i>A.a.</i>	-	+	-	-	+	Šídová (2003)
Labe: Obříství	5652	<i>O.l.</i>	-	+	-	-	-	Kristian (2005)
Svinenský potok: Rychnov u Nových Hradů	7254	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Tributary to Luční potok: Třebušín	5351	<i>A.t.</i>	-	+	+	-	-	Kristian (2005)
Ohře: Počedělice	5649	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Huníkovský potok: Huníkov	5252	<i>A.t.</i>	-	+	+	+	-	Kristian (2005)
Budišovka: Dolní Guntramovice	6171/ 6271	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Budišovka: Čermenský Mlýn	6272	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Čermná: Klokočůvek	6272	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Rybník: Starojická Lhota	6473	<i>A.a.</i>	-	+	+	-	-	Kristian (2005)
Pustějovský potok: Pustějov	6274	<i>A.a.</i>	-	+	+	-	+	Kristian (2005)
Ondřejnice: Hukvaldy	6375	<i>A.a.</i>	-	+	+	-	+	Kristian (2005)
Morávka: Morávka	6477	<i>A.a.</i>	-	+	+	-	+	Kristian (2005)
unkn.: Raškovice	6376	<i>A.a.</i>	-	+	-	-	-	Kristian (2005)
Lomná: Městská Lomná	6478	<i>A.a.</i>	-	-	+	-	+	Kristian (2005)
Křivec: Třinec	6378	<i>A.a.</i>	-	+	-	-	+	Kristian (2005)
Stonávka: Dolní Třanovice	6277	<i>A.a.</i>	-	+	+	+	+	Kristian (2005)
Důlský potok: Albrechtice	6277	<i>A.a.</i>	-	+	-	-	+	Kristian (2005)
Křivý potok: Stonava	6177	<i>A.a.</i>	-	+	-	-	+	Kristian (2005)
Labe: Obříství	5652	<i>O.l.</i>	-	+	+	+	+	Ďuriš et al. (2006)
unkn.: Hladké Životice	6373	<i>A.a.</i>	-	+?	-	+?	-	Subchev & Gelder (2010)
unkn.: Jindice by Uhlířské Janovice	6056	<i>A.a.</i>	-	+?	-	+?	-	Subchev & Gelder (2010)
Orlice: Ústí nad Orlicí	6064	<i>A.a.</i>	-	+?	+?	-	-	Subchev & Gelder (2010)

Table 4. Continued.

Locality Stream/lake/pond: near-by settlement	Grid square	Host	Branchiobdella sp.					References
			Ba	Bpa	Bpe	Bh	Bb	
unkn.: Skuteč	6161-6162	A.a.	-	+?	+	-	-	Subchev & Gelder (2010)
Chejlava: Týniště	6247	A.t.	-	+	+	-	-	Nováková & Fialová (2010)
Hůrecký potok: Letiny	6248	A.t.	-	+	+	-	-	Nováková & Fialová (2010)
Přešínský potok: Ždírec	6447	A.t.	-	+	+	-	-	Nováková & Fialová (2010)
Podhrázský potok: Hůrky	6446	A.t.	-	+	-	-	-	Nováková & Fialová (2010)
Zlatý potok: Svojkovice	6446	A.t.	-	+	+	+	-	Nováková & Fialová (2010)
Luční potok: Rudník	5460	A.t.	-	+	+	-	-	Šrámková (2014)
Luční potok: Třebušín	5351	A.t.	-	+	+	-	-	Šrámková (2014)
Huníkovský potok: unkn.	5252	A.t.	-	+	+	+	-	Šrámková (2014)
Zubřina: unkn.	6543	A.t.	-	+	+	-	-	Šrámková (2014)
Medvědí potok: unkn.	6643	A.t.	-	+	+	-	-	Šrámková (2014)
Tributary to Novosedlský potok: unkn.	6542	A.t.	-	+	-	-	-	Šrámková (2014)
Chejlava: Týniště	6247	A.t.	-	+	+	-	-	Šrámková (2014)
Rakovský potok: unkn.	6247	A.t.	-	+	+	-	-	Šrámková (2014)
unkn.: Čáslavice by Moravské Budějovice		P.l.	-	+	+	-	-	Ložek (2015)
Černovický potok: unkn.		O.l.	-	+	-	-	-	Ložek (2015)
Slovakia								
Unkn.: Nová Baňa		?	-	-	-	+	+	Pop (1965)
Žitava: unkn.		?	-	+	+	-	-	Zajonc (1965)
Vydrica: Bratislava – Železná studienka	7868	A.t.	-	+	+	-	-	Halgoš (1972)
a canal: Gabčíkovo	8171	A.a.	-	+	+	-	-	Halgoš (1972)
Cíferský potok: Cífer	7670	A.a.	-	+	+	+	-	Halgoš (1972)
unkn.: Viničné in Trnianska dolina	7769	A.a.	-	+	+	-	-	Halgoš (1972)
Harmónia: Modra	7669	A.a.	-	+	+	-	-	Halgoš (1972)
unkn.: Turecký vrch [peak] by Jablonové	7668	A.a.	-	+	+	+	-	Halgoš (1972)
Unkn.: Šaštín	7368	A.a.	-	+	+	-	-	Halgoš (1972)
Hováďský jarok: Višňové	7272	A.a.	-	+	+?	+	+	Halgoš (1972)
Hamranský potok: Soblahov	7174	A.a.	-	+	+	-	-	Halgoš (1972)
Kubrický potok: Kubrica	7174	A.a.	-	+	+	-	-	Halgoš (1972)
Unkn.: Horná Súča	7073	A.a.	-	+	+	-	-	Halgoš (1972)
unkn.: Malá Lehotka by Prievidza	7278	A.a.	-	+	+?	+	+	Halgoš (1972)
Unkn.: Kamenec pod Vtáčnikom	7377	A.a.	-	+	+	+	-	Halgoš (1972)
Velčice: Velčice	7575	A.a.	-	+	+	-	-	Halgoš (1972)
Unkn.: Topolčianky	7576	A.a.	-	+	+	+	-	Halgoš (1972)
unkn.: Devičany	7078	A.a.	-	+	+?	+	+	Halgoš (1972)
Sikenica: Kmeťovce	7778	A.a.	-	+	+	-	-	Halgoš (1972)
Richňavský jarok: Banská Štiavnica	7579	A.a.	-	+	+	-	-	Halgoš (1972)
Unkn.: Banská Bystrica	7280	A.a.	-	+	+	-	-	Halgoš (1972)
Trstenec: Malatíny	6982	A.a.	-	+	+	+	-	Halgoš (1972)
Unkn.: Liptovský Hrádok	6984	A.a.	-	+	+	-	-	Halgoš (1972)
Teplica: Vavrišovo	6984	A.a.	-	+	+	+	-	Halgoš (1972)
Unkn.: Dolný Kubín	6781	A.a.	-	+	+	-	-	Halgoš (1972)
Zimník: Trstená	6683	A.a.	-	+	+	+	-	Halgoš (1972)
Unkn.: Gerlachov	6987	A.a.	-	+	+	+	-	Halgoš (1972)
Unkn.: Levoča – Levočské Lúky	6989	A.a.	-	+	+	+	-	Halgoš (1972)

Table 4. Continued.

Locality Stream/lake/pond: near-by <i>settlement</i>	Grid square	Host	<i>Branchiobdella</i> sp.					References
			Ba	Bpa	Bpe	Bh	Bb	
Lovinka: <i>Lovinobaňa</i>	7583	<i>A.a.</i>	-	+	+?	+	+	Halgoš (1972)
Bálský potok: <i>Fil'akovo</i>	7784	<i>A.a.</i>	-	+	+	-	-	Halgoš (1972)
Morské oko: Vihorlat [peak]	7099	<i>A.a.</i>	-	+	+	-	-	Halgoš (1972)
Unkn.: <i>Parihuzovce</i>	6899	<i>A.a.</i>	-	+	+	+	-	Halgoš (1972)
Unkn.: <i>Bratislava</i>	7868	<i>A.a.</i>	+	+?	+?	-	-	Subchev & Gelder (2010)
Bosnia and Herzegovina								
unkn.: <i>Podrašnica</i> between <i>Ključ</i> and <i>Mrkonjić Grad</i>	N/A	?	-	+	+	+	-	Karaman (1967)
Tributaries to Sana: <i>Ključ</i>	N/A	?	-	-	+	+		Karaman (1967)
unkn.: <i>Glamoč</i>	N/A	?	-	-	-	+	-	Karaman (1967)
unkn.: <i>Livno</i>	N/A	?	-	-	-	-	+	Karaman (1967)

Czechia. HALGOŠ (1972) published the results of his extensive investigations on the branchiobdellidans of Slovakia, reporting 23 localities with some of the following four species: *B. parasita*, *B. pentadonta*, *B. hexadonta* and *B. pentadonta orientalis* Pop, 1965 (= *B. balcanica*, see above). Additional branchiobdellidan material from Slovakia was found also in the crayfish collection of the Natural History Museum in Vienna by SUBCHEV & GELDER (2010); this included *B. astaci* from Bratislava, which was the first report of this species in the country. (In the same paper *Branchiobdella* cocoons were found in a crayfish sample labelled “Slovakia (Moravia)” but actually Moravia is a region now located in Czechia and not Slovakia.). The frequency of occurrence of the different *Branchiobdella* species in Slovakia is similar to that in the Czechia, with *B. astaci* being found only at one site so far (Tables 1-4). The five localities in Slovakia where branchiobdellidans were found in the collections of the NMP (Table 1 and 2) are new for this country, while the sixth one in Morske Oko Lake (Table 1) had been already reported by HALGOŠ (1972) as a site with *B. parasita* and *B. pentadonta*. Thirteen localities with *Branchiobdella* (grid squares: 6874, 6875, 6879, 7286, 7386, 7482, 7569 – two localities, 7683, 7768 – two localities, 7882 – two localities) based on our recent field studies are also new for Slovakia (for details, see Table 3).

Bosnia and Herzegovina: The first report of branchiobdellidans *B. parasita*, *B. pentadonta* and *B. hexadonta* for Bosnia and Herzegovina was by KARAMAN (1967). GEORGÉVITCH (1957) reported the locality “Yadre” (river?) as a site where he found some of the species that he described as new, specifying that it is located in Herzegovina; we

failed to find such a geographic object in Bosnia and Herzegovina and most probably he was referring to the River Jadro, which is now in Croatia. SUBCHEV & GELDER (2010) found *B. hexadonta* on *A. pallipes* in several samples from the collection of the Natural History Museum in Vienna labelled only “Europe, Herzegovina” and without further details. All localities found by us in the recent study are new and thus the known area of branchiobdellidan fauna in Bosnia and Herzegovina has been widened. However, all these localities are in Herzegovina while we have still no information about the occurrence of *Branchiobdella* species in Bosnia, the major part of this country. The two other European species, *B. astaci* and *B. balcanica*, also could be expected in Bosnia and Herzegovina as they, together with those already known for this country, *B. parasita*, *B. pentadonta* and *B. hexadonta*, occur in neighbouring Croatia (KLOBUČAR et al. 2006). The rest of the European *Branchiobdella* species, *B. kozarovi* and *B. papillosa*, are unlikely to occur in Bosnia and Herzegovina for reasons mentioned above in the sections on the Czechia and Slovakia.

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References

- ADÁMEK Z. & ŘEHULKA J. 2000. Choroby a komenzálové raků zjištěné v České republice v roce 1998. Bulletin VÚRH Vodňany 36 (1-2): 28-32.
- BÁDR V. 2000. Výskyt potočnic r. *Branchiobdella* v České republice a jejich možná patogenita – předběžná zpráva. Bulletin VÚRH Vodňany 36 (1-2): 33-40.
- BUCHAR J. 1982. Způsob publikace lokalit živočichů z území Československa. Věstník Československé Společnosti Zoologické 46: 317-318.
- ČERMÁKOVÁ J. & BÁDR V. 2002. Determinační znaky evropských zástupců třídy Branchiobdellae. In: BRYJA J. & ZUKAL J. (Eds.), Zoologické dny Brno 2002, Sborník abstraktů z conference, 14-15 února 2002. Ústav biologie obratlovců AV ČR, Brno, pp. 22-23.
- DALET D. 2016. d-maps.com. <http://d-maps.com/m/europa/bosnie/bosnie04.gif>. (Accessed 19 September 2016)
- ĎURIŠ Z., HORKÁ I., KRISTIAN J. & KOZÁK P. 2006. Some cases of macro-epibiosis on the invasive crayfish *Orconectes limosus* in the Czechia. Bulletin Francais de la Peche et de la Pisciculture 380-381: 1325-1337.
- ĎURIŠ Z., HORKÁ I. & VAVŘÍČEK O. 2001. K populační ekologii raků na Karvinsku. Acta Facultatis Rerum Naturalium Universitatis Ostraviensis 200, Biologia - Ekologia 8: 118-126.
- FARD A. N. & GELDER S. R. 2011. First report of *Branchiobdella kozarovi* Subchev, 1978 (Annelida: Clitellata) in Iran, and its distribution in the eastern Euro-Mediterranean subregion. Acta Zoologica Bulgarica 63 (1): 105-108.
- GELDER S. R., DELMASTRO G. B. & FERRAGUTI M. 1994. A report on branchiobdellidans (Annelida: Clitellata) and a taxonomic key to the species in northern Italy, including the first record of *Cambarincola mesochoreus* on the introduced American red swamp crayfish. Bollettino di Zoologia 61: 179-183.
- GEORGÉVITCH J. 1957. Les Branchiobdellides de Yugoslavia. Bulletin de l'Academie Serbe des Sciences Mathematiques et Naturelles, N. S. 18 Sciences Naturelles 5: 5-24.
- HALGOŠ J. 1972. Príspevok k poznaniu ektoparazitických červov radu Branchiobdellida na Slovensku (Annelida, Clitellata). Acta Rerum Naturalium Musei Nationalis Slovaci Bratislava 18 (1): 63-69.
- KARAMAN M. 1967. Branchiobdellidae Jugoslavije. Buletin i Punimeve Shkencore të Fakulteti Filozofik të Prishtinës 4: 39-64.
- KLOBUČAR G., MAGUIRE I., GOTTSTEIN-MATOČEC S. & GELDER S. 2006. Occurrence of Branchiobdellida (Annelida: Clitellata) on freshwater crayfish in Croatia. Annales de Limnologie 42 (4): 251-260.
- KOZAROV G., MICHAILOVA P. & SUBCHEV M. 1972. Studies on Branchiobdellidae (Oligochaeta, Annelida) in Bulgaria. Annuaire de l'Université de Sofia, Faculté de biologie 64 (1): 77-89. (In Bulgarian).
- KRISTIAN J. 2005. K výskytu a ekologii potočnic rodu *Branchiobdella* (Annelida, Clitellata) ve vybraných regionech České republiky. Bachelor thesis. University of Ostrava, Faculty of Science. Ostrava. 38 p.
- LOŽEK F. 2015. Společenstvo potočnic na nepůvodních druzích raků ČR. Diploma thesis. University of South Bohemia in České Budějovice. Faculty of Fisheries and Protection of Waters. 38 p. Available at: https://theses.cz/id/y4jblv/DP_Lozek.pdf
- NOVÁK J. & ZICHA O. 2016. Nástroj pro výpočet mapovacích čtverců metodou KFME – <http://www.biolib.cz/cz/toolKFME/>. (Accessed 19 September 2016).
- NOVÁKOVÁ K. & FIALOVÁ K. 2012. Výskyt potočnic rodu *Branchiobdella* na raku kamenáči na Plzeňsku. Středoškolská odborná činnost 2011/2012. Gymnázium Blovice, Blovice. 26 p. Available at: <https://socv2.nidv.cz/archiv34/getWork/hash/b139bf1c-6203-11e1-be9d-faa932cbcfda>
- POP V. 1965. Systematische Revision der europäischen Branchiobdelliden (Oligochaeta). Zoologische Jahrbüher, Abteilung für Systematik Ökologie und Geographie der Tiere 92 (2-3): 219-238.
- PRUNER L. & MÍKA P. 1996. Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny. Klapalekiana 32 (Suppl.): 1-115.
- ŠÍDOVÁ A. 2003. Analýza rozmístění potočnic rodu *Branchiobdella* na racích ve vybraných lokalitách severní Moravy. Bachelor thesis. University of Ostrava, Faculty of Science. Ostrava. 44 p.
- SOUTY-CROSSET C., HOLDICH D. M., NOËL P. Y., REYNOLDS J. D. & HAFNER P. (Eds.) 2006. Atlas of crayfish in Europe. Muséum national d'Histoire naturelle, Paris, 187 p. (Patrimoines naturels, 64).
- ŠRÁMKOVÁ L. 2014. Stanovištní druhové preference epizoických potočnic rodu *Branchiobdella* na raku kamenáči. Bachelor thesis. Západočeská univerzita v Plzni. Fakulta pedagogická. Plzeň. 57 p. Available at: https://otik.uk.zcu.cz/bitstream/handle/11025/19154/Lucie_Sramkova_BP.pdf?sequence=1
- STRAŠKRABA M. 1956. Komenzálové v žaberní dutině *Astacus astacus* L. ze Slezska. Přírodovědecký sborník *Ostravského kraje* 17 (4): 593-596.
- SUBCHEV M. 2014. The Genus *Branchiobdella* Odier, 1823 (Annelida, Clitellata, Branchiobdellida): a Review of its European Species. Acta Zoologica Bulgarica 66 (1): 5-20.
- SUBCHEV M. A. 1984. On Hungarian Branchiobdellids (Oligochaeta: Branchiobdellidae). Miscellanea Zoologica Hungarica 2: 47-50.
- SUBCHEV M. A. 2012. *Branchiobdella* (Annelida: Clitellata) species found in crayfish collection of London Natural History Museum. Acta Zoologica Bulgarica 64 (3): 319-323.
- SUBCHEV M. A. & S. R. GELDER 2010. Branchiobdellida (Annelida: Clitellata) found in the crayfish collection of the Natural History Museum in Vienna, Austria, with a re-description of *Branchiobdella papillosa* Neesemann & Hutter, 2002. Acta Zoologica Bulgarica 62 (1): 33-42.
- VEJDOVSKÝ F. 1884. System und Morphologie der Oligochaeten. F. Rívnáč, Prague. 172 p.
- ZAJONC I. 1965. Červy ako vonkajšie parazity našich rakov. Polovníctvo a rybárstvo 13: 24.
- ŽVAKOVÁ L. 2003. Potočnice rodu *Branchiobdella* (Annelida, Oligochaeta) a jejich vazby na druhy raků v ČR. Bachelor thesis. University of Ostrava, Faculty of Science. Ostrava. 43 p.

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