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SOME NEW AND INTERESTING SPECIES OF CADDISFLIES (INSECTA, TRICHOPTERA) FOUND IN CROATIA

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The paper discusses the biological and ecological characteristics and distribution of 12 caddisfly species that have been ascertained to be rare, or even discovered for the first time, in Croatia: *Rhyacophila palmeni, R. vulgaris, Glossosoma conformis, Wormaldia pulla, Hydroptila forcipata, Plectrocnemia geniculata, Micrasema minimum, Limnephilus graecus, Ceraclea riparia, Oecetis notata, Setodes punctatus and S. bulgaricus*. Of these, the species that have been newly established for Croatia are: *Plectrocnemia geniculata, Ceraclea riparia, Oecetis notata* and *Setodes bulgaricus*, while the presence of the species *Rhyacophila vulgaris, Micrasema minimum* and *Setodes punctatus* has been established with confidence in the Croatian fauna for the first time (precise data of localities).

Key words: *Rhyacophila palmeni, R. vulgaris, Glossosoma conformis, Wormaldia pulla, Hydroptila forcipata, Plectrocnemia geniculata, Micrasema minimum, Limnephilus graecus, Ceralea riparia, Oecetis notata, Setodes punctatus, S. bulgaricus*, South Europe

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U radu se daje osvrt na biološke i ekološke značajke te rasprostranjenost 12 vrsta tulara koje su utvrđene kao rijetke ili po prvi puta u fauni Hrvatske: *Rhyacophila palmeni, R. vulgaris, Glossosoma con-*

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formis, Wormaldia pulla, Hydroptila forcipata, Plectrocnemia geniculata, Micrasema minimum, Limnephilus graecus, Ceraclea riparia, Oecetis notata, Setodes punctatus i *S. bulgaricus*. Po prvi puta u fauni Hrvatske utvrđene su sljedeće vrste: *Plectrocnemia geniculata, Ceraclea riparia, Oecetis notata* i *Setodes bulgaricus* dok je prisustvo vrsta *Rhyacophila vulgaris, Micrasema minimum* i *Setodes punctatus* potvrđeno po prvi puta sa sigurnošću u fauni Hrvatske (točni podaci nalaza).

Ključne riječi: *Rhyacophila palmeni, R. vulgaris, Glossosoma conformis, Wormaldia pulla, Hydroptila forcipata, Plectrocnemia geniculata, Micrasema minimum, Limnephilus graecus, Ceraclea riparia, Oecetis notata, Setodes punctatus, S. bulgaricus*, južna Europa

INTRODUCTION

Trichoptera are an order of holometabolous aquatic insects. Worldwide about 14,548 recent and 685 fossil species of caddisflies are known (Morse, 2015), all belonging to the group of aquatic insects with a relatively large degree of biodiversity. Phylogenetically they are most similar to the Lepidoptera group (butterflies and moths), with which they share a common ancestor, when they split into two groups, orders, and evolved separately. It is generally accepted that both orders are monophyletic (Morse, 1997) and together constitute the super order Amphiesmenoptera (Holzenthal *et al.*, 2007). In the larval stage Trichoptera live in aquatic biotopes, while Lepidoptera live in terrestrial biotopes. Trichoptera have colonised all the continents except Antarctica, while the greatest degree of biodiversity is exhibited in Central and Southern America, and in Asia (Morse, 2015). The larvae have differing ways of feeding and several groups can be distinguished accordingly: shredders, grazers, predators, filtering carnivores and filterers (Graf *et al.*, 2008b; Pauls *et al.*, 2008; Vitecek *et al.*, 2015a, 2015b).

The first extensive systematic research into adult Trichoptera in Croatia based on the collection of adults was carried out at the end of the 20th century in the Plitvice Lakes area (Kučinić, 2002). In these investigations in the National Park, 75 caddisfly species were recorded (Kučinić, 2002). A large number of species were either recorded for the first time in the fauna of Croatia during this research or were confirmed the first time through the finds of adults, since in many years of previous limnological research they had been recorded in Croatia only in the larval stage (e.g., Matoničkin, 1987; Habdija, 1989). Faunistic data concerning caddisflies based on collected larvae are sometimes extremely dubious because of the difficulties of determination or because determination can be carried out only to the level of genus (Habdija 1989). Limnological investigations have larvae as their primary subject of research, while faunistic research is concerned with the adult phase. In order to establish the exact composition and structure of Trichoptera fauna in a given area, adult forms have to be collected for each species, particularly the males, since in a certain number of genera the females cannot be determined to species level (Malicky, 2004).

Research in the Plitvice area was continued at a later date, and as a result approximately 89 caddisfly species have been recorded in the district, which is the greatest diversity of this group in any area in Croatia (e.g., Kučinić 2002; Previšić *et al.*, 2007, 2010, 2013; Šemnički *et al.*, 2011). As well as in the Plitvice Lakes area, rather extensive systematic Trichoptera research was carried out in the last two decades in Croatia in the Krka National Park (Kučinić *et al.*, 2011), the Cetina River region (e.g., Graf *et al.*, 2008a; Waringer *et al.*, 2009; Vučković, 2011; Previšić *et al.*, 2014) and the basin of the Dobra River (e.g., Cerjanec, 2012; Ibrahimi *et al.*, 2012). In the same period a fairly large number of faunistic papers were published in which a relatively large number of previously unre-

corded Trichoptera species are referenced (e.g., Kučinić, 2002; Kučinić *et al.*, 2011, 2014; Cerjanec, 2012; Previšić *et al.*, 2013; Ćuk & Vučković, 2014) with the result that the Croatian fauna now numbers about 200 reliably identified caddisfly species (M. Kučinić, unpublished data). In the same period taxonomical research developed, and four caddisfly larvae previously unknown in Croatia were described (e.g., Graf *et al.*, 2008a; Kučinić *et al.*, 2008; Waringer *et al.*, 2009; Previšić *et al.*, 2014). Six Trichoptera taxa (one subspecies and five species) have been collected and described for science with type localities in Croatia (e.g., Kučinić & Malicky, 2002; Malicky *et al.*, 2007; Oláh, 2010, 2011; Kučinić *et al.*, 2013; Previšić *et al.*, 2014).

This paper provides a review of 12 caddisfly species that have been determined for the first time or are featured as rare species in the Croatian fauna. Each species is accompanied with data about the localities of the find, the region of the find, the period of the find, some biological characteristics and distribution.

MATERIAL AND METHODS

Research area and methods in which material was collected

The collection of specimens (adults) was carried out during daytime with an entomological net and at night with UV lamps and halogen bulbs. Specimens were collected in the following aquatic biotopes: the Jarak Stream and the Slapnica River (upper part), Mt Žumberak – a mountain area in NW Croatia; Bliznec brook on Mt Medvednica – a mountain area in central Croatia close to the city of Zagreb; the Kupa, Dobra and Kamačnik rivers in which the research areas are located in the following regions: Gorski Kotar, the central mountain area in Croatia, and Kordun, an inland area of Croatia; Kuti Lake and the Neretva and Mislina rivers in Dalmatia, the Mediterranean part of Croatia.

Numbered collection sites are presented in Fig. 1: **Central Croatia**: Mt Medvednica, Bliznec Stream, Medvednica Nature Park Administration (location 1); the Jarak Stream (cca 690 mns, near the mountain lodge Vodice) (Žumberak and Samoborsko gorje Nature Park) (location 2), the upper part of the Slapnica Stream, location Rampa – Mt Žumberak (Žumberak and Samoborsko gorje Nature Park) (location 2a); the **Kordun and Gorski kotar regions** – the Dobra River, the sites the village of Gornja Dobra (location 3); the Dobra River, the sites the village of Trošmarija (location 4); the Dobra canyon (location 5); the village of Jarče Polje (location 6); the village of Lešće (location 7); the village of Novigrad na Dobri (location 8); the mouth of the Dobra River (location 9); the Kupa River, village of Kamanje (location 10); the mouth of the Kamačnik River (location 11); the Kamačnik River, a site located in the central part of the course (location 12); Sabljaci Lake (location 13); **Dalmatia**: – Kuti Lake, sites close to the village of Badžula (location 14); the Neretva River; sites of the city of Opuzen (location 15); the Mislina River; sites located in the village of Mlinište (location 16).

Laboratory work

The caddisfly material collected is a part of or forms the basis of four Trichoptera collections. The material collected in Gorski Kotar and Kordun is the basis of the Cerjanec Trichoptera Collection (private collection of Darko Cerjanec); material collected in the Mt Žumberak area is the basis of the Kutnjak Trichoptera Collection, kept in the Croatian Natural History Museum in Zagreb; the material collected in Dalmatia is part of the Central Collection of Trichoptera in the Croatian Natural History Museum in

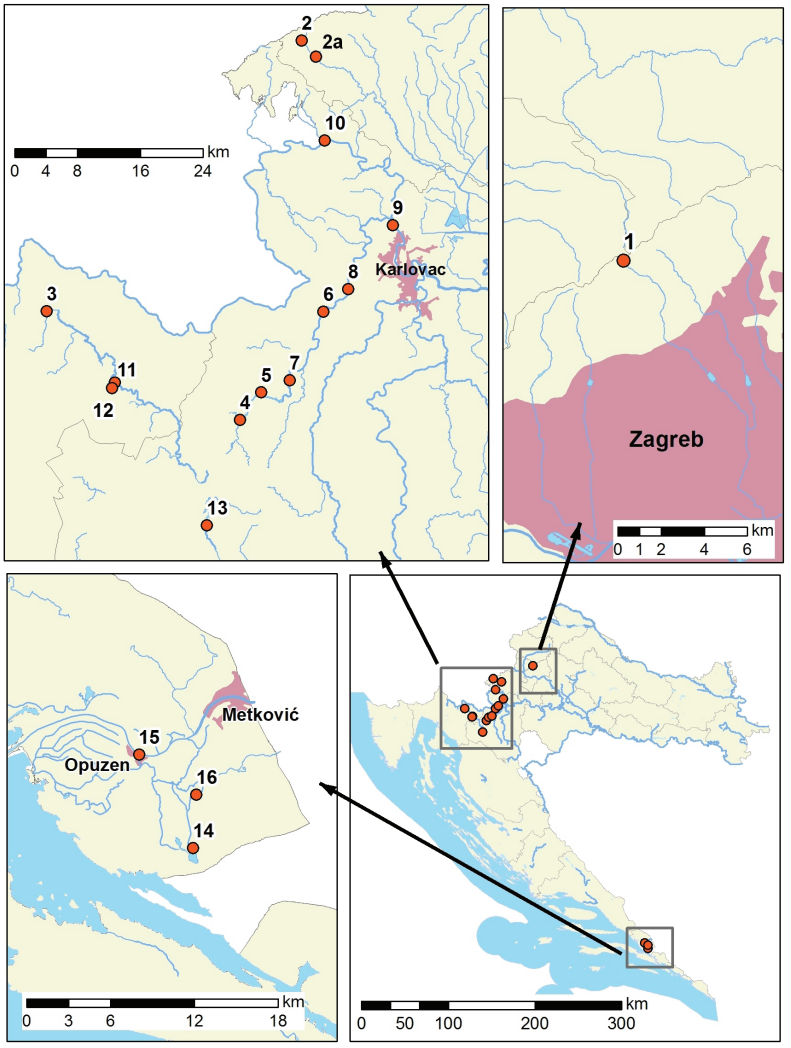

Fig. 1. Localities of collected Trichoptera presented in this paper: 1 – Bliznec Stream, 2 – Jarak Stream, 2a – the Slapnica stream, 3 – the village of Gornja Dobra (the Dobra River), 4 – the village of Trošmarija (the Dobra River), 5 – the Dobra canyon, 6 – the village of Jarče Polje (the Dobra River), 7 – the village of Lešće (Dobra River), 8 – the village of Novigrad na Dobri (the Dobra River), 9 – the mouth of the Dobra River, 10 – the Kupa River, village of Kamanje, 11 – the mouth of the Kamačnik River, 12 – the Kamačnik River, a site located in the central part of the course, 13 – Sabljaci Lake; **Dalmatia**: 14 – Kuti Lake, village of Badžula, 15 – the Neretva River, Opuzen, 16 – the Mislina River, village of Mlinište.

Zagreb and of the NIP-Trichoptera Collection, also deposited in this Museum in Zagreb; material collected on Mt Medvednica is a part of the NIP-Trichoptera Collection. As well as material collected at the end of the 20th century in the Neretva valley, prepared on entomological pins (several specimens of the species *Limnephilus graecus*, the central

collection of Trichoptera in the CNHM in Zagreb), all the other material collected is stored in 80% or 96% alcohol.

Macrophotography was performed using a Leica Wild MZ8 stereomicroscope and an Olympus SP-500 UZ digital camera, processed with the computer programme Olympus Quick Photo Camera 2.2.

For determination of collected specimens we used standard references: Kumanski (1985) and Malicky (2004). Systematic presentation follows Morse (2015). Maps of distribution for the species: *Plectrocnemia geniculata*, *Wolmaldia pulla*, *Micrasema minimum, Ceraclea riparia, Oecetis notata, Setodes punctatus* and *Setodes bulgaricus* were made according to Fauna Europaea (de Jong *et al.*, 2014).

RESULTS AND DISCUSSION

As a results of the research 12 new or rare species of Trichoptera species have been in the fauna of Croatia: *Rhyacophila palmeni* McLachlan, *R. vulgaris* Pictet, *Glossosoma conformis* Neboiss, *Wormaldia pulla* McLachlan, *Hydroptila forcipata* Eaton, *Plectrocnemia geniculata* Mclachlan, *Micrasema minimum* McLachlan, *Limnephilus graecus* Schmid, *Ceraclea riparia* Albarda, *Oecetis notata* Rambur, *Setodes punctatus* Fabricius and *S. bulgaricus* Kumanski. The following species have been for the first time in the fauna of Croatia: *Plectrocnemia geniculata*, *Ceraclea riparia*, *Oecetis notata* and *Setodes bulgaricus* while the presence of the species *Rhyacophila vulgaris, Micrasema minimum* and *Setodes punctatus* was recorded for the first time with the precise data (localities) in the Croatian fauna. According to Fauna Europaea (de Jong *et al.*, 2014) these species is present in the fauna of Croatia, but in this database there are no data about localities of the species records.

The highest number of species, four, was recorded for the family Leptoceridae, two for the family of Rhyacophilidae, and one each for the families Glossosomatidae, Polycentropodidae, Hydroptilidae, Philopotamidae, Brachycentridae and Limnephilidae. With these research efforts, the number of caddisfly species in the Croatian family has risen to just above 200 (M. Kučinić, unpublished data), and accordingly a relatively high degree of understanding of the faunistic characteristics of this group of aquatic insects in Croatia has been achieved. This conclusion must inevitably be drawn when the number of Trichoptera species identified in Croatian fauna is compared with the numbers in relatively well explored areas in the fairly immediate environs of Croatia: Italy (Cianficconi, 2002), Slovenia (Krušnik & Urbanič, 2002), Hungary (Nógrádi & Uherkovich, 2002) and Bosnia and Herzegovina (e.g., Marinković-Gospodnetić, 1970, 1978, 1979; Stanić-Koštroman, 2009; Stanić-Koštroman *et al.*, 2012). In such analyses it is necessary to pay attention to the size of the research areas, the hydrological features of the areas being compared and the degree to which the fauna of each one is known.

Rhyacophila palmeni McLachlan, 1879 (family Rhyacophilidae)

Finds: the Dobra River – Gornja Dobra 15.XI.2010., 1 ♀; the Dobra River – Lešće 18.XI.2009., 1 ♂, 15.VI.2010., 1 ♂, 27.VIII.2010., 1 ♂, 25.IX.2010., 3 ♂♂; the Dobra River – Jarče Polje 19.V.2010., 1 ♀, 10.VI.2010., 1 ♀, 19.VIII.2010., 8 ♀♀, 27.IX.2010., 1 ♀, 13.X.2010., 2 ♀♀, 5.XI.2010., 2 ♂♂, 1 ♀, 14.XI.2010., 1 ♂; the Dobra River – Novigrad na Dobri 9.VI.2010., 1 ♀, 29.VII.2010., 1 ♂, 18.VIII.2010., 1 ♂, 1 ♀, 15.IX.2010., 2 ♀♀, 16.IX.2010., 8 ♂♂, 9 ♀♀, 12.X.2010., 2 ♂♂, 11.XI.2010., 1 ♂; the mouth of the Dobra River 30.XI.2009., 4 ♂♂, 1 ♀, 14.V.2010., 1 ♂, 14.VII.2010., 1 ♂, 27.VIII.2010., 1 ♂, 13.IX.2010., 1

♀, 14.X.2010., 2 ♂♂, 2 ♀♀, 23.X.2010., 3 ♂♂, 7.XI.2010., 2 ♂♂, the mouth of the Kamačnik River 27.VII.2010., 1 ♀, 31.X.2010., 1 ♂, 1 ♀, 15.XI.2010., 1 ♂; the Kupa River – Kamanje 6.XI.2010., 1 ♂, 7.XI.2010., 1 ♀.

The species *Rhyacophila palmeni* (Fig. 2) was recorded for the first time in Croatia in the area of the Dobra, Kamačnik and Kupa rivers (e.g., Cerjanec, 2012; Ibrahimi *et al.*, 2012), with quite a large number of finds. This species has a typical disjunct range consisting of two parts separated from each other. Part of the north-east population of *R. palmeni* extends over Italy, Slovenia and Croatia; the second part, with the south-eastern populations, is found in Greece and Kosovo (Ibrahimi, *et al.,* 2012; Malicky, 2005). Research lasting more than a century in Bosnia and Herzegovina (e.g., Klapálek, 1899; Kučinić *et al.,* 2008; Marinković Gospodnetić, 1970, 1978, 1979; Radovanović, 1935; Stanić-Koštroman 2009; Stanić-Koštroman *et al.,* 2012) and in the areas of the Mediterranean part of Croatia (Graf *et al.,* 2008; Waringer *et al.,* 2009; Kučinić *et al*., 2011; Vučković, 2011; Karaouzas *et al.,* 2015) did not record the species *R. palmeni*, which indicates that this species does not live in these areas. Because of the interesting distribution of *R. palmeni*, future taxonomic research should be directed at determining the molecular features of the NW and SE populations and providing detailed analyses of the morphological characteristics of larvae and adults. That is, similar investigations into the genus *Drusus* in the Balkans have revealed interesting taxonomic characteristics of isolated populations and very strong speciation processes that lead to a large number of closely related or highly similar species (e.g., Kučinić *et al.,* 2014, 2015; Previšić *et al.,* 2014; Vitecek *et al*., 2015a, b;).

In Croatia, *R. palmeni* has been recorded in the imago stage in May and June, and in the summer to autumn period, from July to November. According to Malicky (2005) the flight

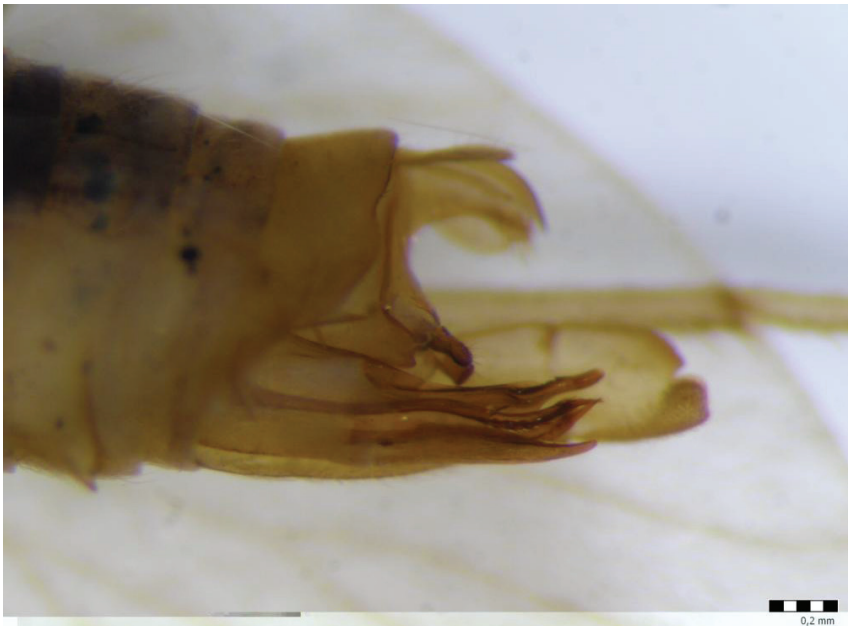

Fig. 2. Male genitalia of *Rhyacophila palmeni* in lateral view.

period of the imago is from mid-April to mid-October. According to the way in which the larvae feed, it belongs among the predatory caddisfly species (Graf *et al.*, 2008b).

Rhycophila palmeni is to be found in river and stream types of karst habitats in Croatia, colonising the epirhithral, metarhithral and hyporhithral areas in running waters in the larval stage in about the same proportions (epirhithral – 30%, metarhithral 40%, hyporhithral 30%) (Graf *et al.*, 2008b).

Rhyacophila vulgaris Pictet, 1834 (family Rhyacophilidae)

Finds: Žumberak Mt., the Slapnica Stream, Rampa 18.VII.2000., 3 ♂♂, 18.X.2000. 5 ♂♂, 4.IX.2000. 5♂♂.

The species *Rhyacophila vulgaris* (Fig. 3) is cited by Radovanović (1935) for the area of Dalmatia, but in more recent systematic research in the areas of the Cetina and Krka rivers we have not recorded it (e.g., Graf *et al.*, 2008a; Waringer *et al.*, 2009; Kučinić *et al.*, 2011; Vučković, 2011). Research in the Žumberak region discovered *R. vulgaris* at only one site on the Slapnica River (Kutnjak Trichoptera Collection), with 13 collected specimens. The find in Žumberak can be considered at the moment the only reliable find of this interesting species in the fauna of Croatia.

Adult *Rhyacophila vulgaris* specimens appear in summer and autumn (Graf *et al.*, 2008b). According to their manner of feeding, the larvae belong to the predatory type. The species most often colonises the epirhithral zone (60%) of streams, and features much less in the area of the hypocrenal (20%) and metarhithral zones (20%) of streams (Graf *et al.*, 2008b). *Rhyacophila vulgaris* is distributed in Central Europe, including Italy and Slovenia (Cianficconi, 2002; Malicky, 2005; Krušnik & Urbanič, 2002; de Jong *et al.*, 2014).

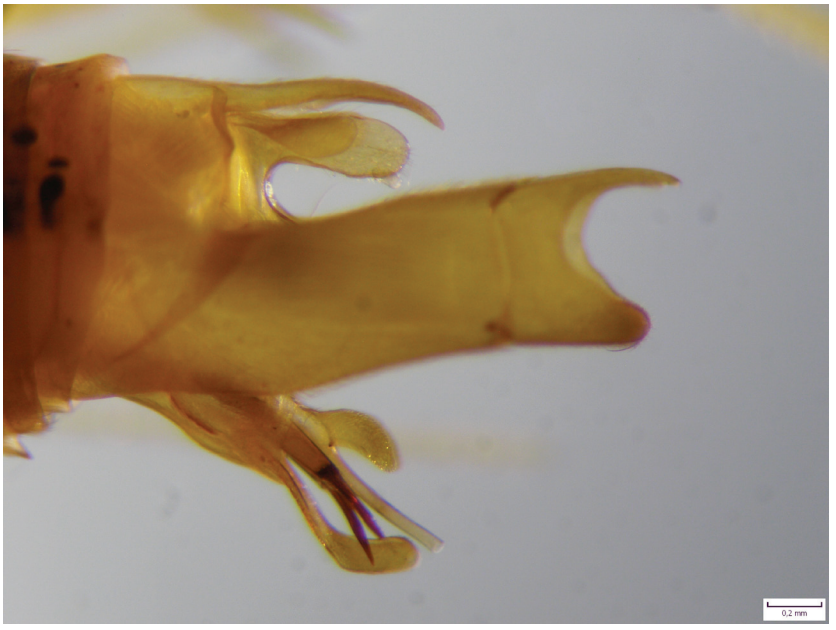

Fig. 3. Male genitalia of *Rhyacophila vulgaris* in lateral view.

Glossosoma conformis Neboiss, 1963 (family Glossosomatidae)

Finds: Mt Medvednica, Bliznec Brook, Medvednica Nature Park Administration 11.VIII.2014., 4 ♂♂.

Previous research had recorded this species only in the Papuk area (Previšić *et al.*, 2013) and thus the finding in Bliznec Brook is the second finding of the species in Croatia. According to their manner of feeding, *G. conformis* larvae are on the whole grazers and scrapers (80%) and to a lesser extent collectors (20%) (Graf *et al.*, 2008b). The species appears most often in the epirhithral zone of smallish, mostly upland and mountain streams, as was also recorded in our research.

Previous studies of the *Glossosoma* genus identified three species in the fauna of Croatia: *Glossosoma bifidum* McLachlan, 1879, *G. discophorum* Klapálek, 1902 and *G. neretve* Marinković-Gospodnetić, 1988 (e.g., Kučinić, 2002; Waringer *et al.*, 2009; Malicky, 2014). Now under way are molecular investigations of the genus *Glossosoma* in Croatia and Bosnia and Herzegovina for the sake of exact establishment of the appearance and distribution of the species *G. discophorum* and *G. neretve* in the area of central mountainous Croatia and the Mediterranean karst area.

Adults of *Glossosoma conformis* occur most often in spring and summer, occasionally in autumn as well (Graf *et al.*, 2008b). Malicky (2005) states that in Greece and Central Europe the adults will occur in June and July. *Glossosoma conformis* is distributed over the whole Europe except for Iceland, the Iberian Peninsula and Turkey (Malicky, 2005; de Jong *et al.*, 2014).

Wolmaldia pulla (McLachlan, 1878) (family Philopotamidae)

Finds: Medvednica Mt, stream Bliznec, Management of the Medvednica Nature Park, 11.VIII.2014., 3 ♂♂.

The record of the species *Wormaldia pulla* in the region of Bliznec Brook (Mt Medvednica) is the second of this caddisfly species in Croatia. The first information about *W. pulla,* as with data about *G. conformis*, can be found in the research of Previšić *et al.* (2013) in the Papuk area. Data about the period of the find, i.e., emergence and the temporal dynamics of the imago in Croatia derive from this research alone, and refer to the month of August. Much more detailed information in the literature refers to the months of June, July and August as the flight period of adult forms and their appearance (Malicky, 2005).

According to the manner in which they feed, the larva of *Wormaldia pulla* belong to the passive filter feeder type (Graf *et al.*, 2008b).

Wormaldia pulla is distributed in Central Europe, Italy, Slovenia and the Balkan Peninsula (Cianficconi, 2002; Krušnik & Urbanič, 2002; Malicky, 2005; de Jong *et al.*, 2014) (Fig. 4a).

Hydroptila forcipata Eaton, 1873 (family Hydroptilidae)

Finds: the Dobra River – Trošmarija 29.IV.2010., 2 ♂♂, 9 ♀♀, 25.V.2010., 1 ♀, 23.VI.2010., 1 ♀; the Dobra canyon 24.V.2010., 2 ♀♀, 28.VI.2010., 2 ♂♂, 1 ♀, 25.VIII.2010., 2 ♂♂, 3 ♀♀; the Dobra River – Lešće 25.IV.2010., 7 ♀♀, 26.V.2010., 9 ♂♂, 21 ♀♀; the Dobra River – Jarče Polje 10.VI.2010., 1 ♀, 19.VIII.2010., 12 ♂♂, 50 ♀♀; the Dobra River – Novigrad na Dobri 9.VI.2010., 2 ♀♀, 7.VII.2010., 1 ♂, 2 ♀♀, 18.VIII.2010., 1 ♂, 16.IX.2010., 3 ♂♂, 20 ♀♀; the mouth of the Dobra River 27.IV.2010., 24 ♂♂, 2 ♀♀, 14.V.2010., 1 ♀, 11.VI.2010., 9 ♀♀, 18.VI.2010., 1 ♀, 14.VII.2010. 14 ♂♂, 58 ♀♀, 27.VIII.2010. 10 ♂♂, 18 ♀♀; the mouth

of the Kamačnik River 27.VII.2010., 1 ♀; the Kupa River – Kamanje 27.IV.2010., 42 ♂♂, 77 ♀♀, 18.VI.2010., 1 ♀, 15.VII.2010. 1 ♂, 11 ♀♀.

Like all other species of the numerous Hydroptilidae family, adults of the species *Hydroptila forcipata* too are small in size, with a forewing length of 3 to 4 mm (Malicky, 2004). The records at a dozen sites in the areas of the Dobra, Kupa and Kamačnik rivers, with relatively numerous populations, suggest that this species might well be recorded in other parts of Croatia, particularly in the aquatic habitats of medium-sized to large rivers in the country. Adults appear in Greece from April to October, and in central Europe from May to October (Malicky, 2005). Our investigations established that adults of *H. forcipata* are present from April to September.

Larvae of the species *H. forcipata* live on algae (Graf *et al.*, 2008b). This species occurs in the area of the hyporhithral (50%) and the epipotamol (50%) zone of aquatic biotopes (rivers) (Graf *et al*., 2008b).

The species *Hydroptila forcipata* occurs in Eurasia and its range covers large parts of Europe and Turkey including the Balkan Peninsula, Italy and Slovenia (Cianficconi, 2002; Krušnik & Urbanič, 2002; Malicky, 2005).

Plectrocnemia geniculata McLachlan, 1871 (family Polycentropodidae)

Finds: Mt Žumberak, the Jarak Stream (cca 690 mns) 30.VIII.2000., 1♂.

The find of the species *Plectrocnemia geniculata* in the Slapnica River (Mt Žumberak) is the first of this caddisfly species in Croatia. In Europe this species has a typical disjunct range consisting of two parts (Fig. 4b). This species is also distributed in North Africa (Malicky, 2005). Adults appear in Greece from April to October (Malicky, 2005).

Larvae of this species lives in varied microhabitats e.g., on stone, cobbles, macrophytes etc. (Graf *et al.*, 2008b). *Plectrocnemia geniculata* occurs in aquatic habitats in the

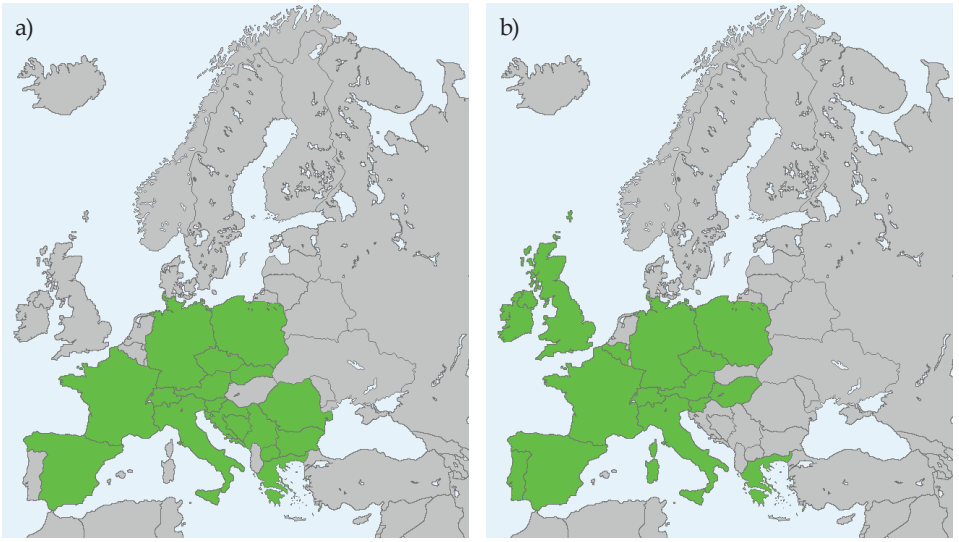

Fig. 4 a-b. Distribution of *Wormaldia pulla* (a) and *Plectrocnemia geniculata* (b) in Europe (according to Fauna Europaea) (de Jong *et al*., 2014).

area of the eucrenal (60%), the hypocrenal (30%) and the epirhithral zone of aquatic biotopes (spring and upper part of stream) (Graf *et al.*, 2008).

Because of the interesting distribution area of *Plectrocnemia geniculata* like that of the species *Rhyacophila palmeni* (Fig. 4b) (de Jong *et al.*, 2014) future taxonomic research should include molecular and morphological analyses of larvae and adults of the northwest (NW) and southeast (SE) populations.

Micrasema minimum McLachlan, 1876 (family Brachycentridae)

Finds: the Dobra River – Trošmarija 29.IV.2010., 16 ♀♀, 25.V.2010., 114 ♀♀; the Dobra River – canyon 29.IV.2010., 7 ♂♂, 10 ♀♀, 24.V.2010., 6 ♀♀; the Dobra River – Lešće 25.IV.2010., 12 ♂♂, 312 ♀♀, 26.V.2010. 1 ♂, 5 ♀♀; Dobra – Jarče Polje 26.IV.2010., 7 ♂♂, 795 ♀♀, 19.V.2010., 10 ♀♀; the Dobra River – Novigrad na Dobri 26.X.2010., 8 ♂♂, 14 ♀♀; the mouth of the Dobra River: 27.IV.2010., 17 ♂♂, 212 ♀♀; the Kamačnik River, a site located in the central part of the course 29.VI.2010. 1 ♀; the mouth of the Kamačnik River 28.IV.2010., 6 ♂♂, 230 ♀♀, 29.VI.2010., 1 ♀, 27.07.2010., 1 ♀; Sabljaci Lake 12.V.2010., 4 ♀♀, 27.VI.2010., 1 ♀; the Kupa River – Kamanje 27.IV.2010., 8 ♂♂, 256 ♀♀.

Research in the drainage basin of the Dobra River established the species *Micrasema minimum* (Fig. 5a) at 10 sites, including not only the Dobra, Kamačnik and Kupa rivers, but also Sabljaci Lake. These are the first precise data about this species in Croatia, which clearly is not rare, at least in this area, where it is to be found in very numerous populations. The species *M. minimum* lives on the whole in the metarhithral zone where running water is concerned (80%) and is much less to be seen in the epirhithral and hyporhithral zones (10% each). The food of the larvae of this species is very diverse and we can classify them as grazers, scrapers and shredders (Graf *et al.*, 2008b). The adults emerge in spring and summer, in a single generation (Graf *et al.* 2008b).

Micrasema minimum is distributed over most of Europe, except in Albania and northern regions (Malicky, 2005; de Jong *et al.*, 2014) (Fig. 5b).

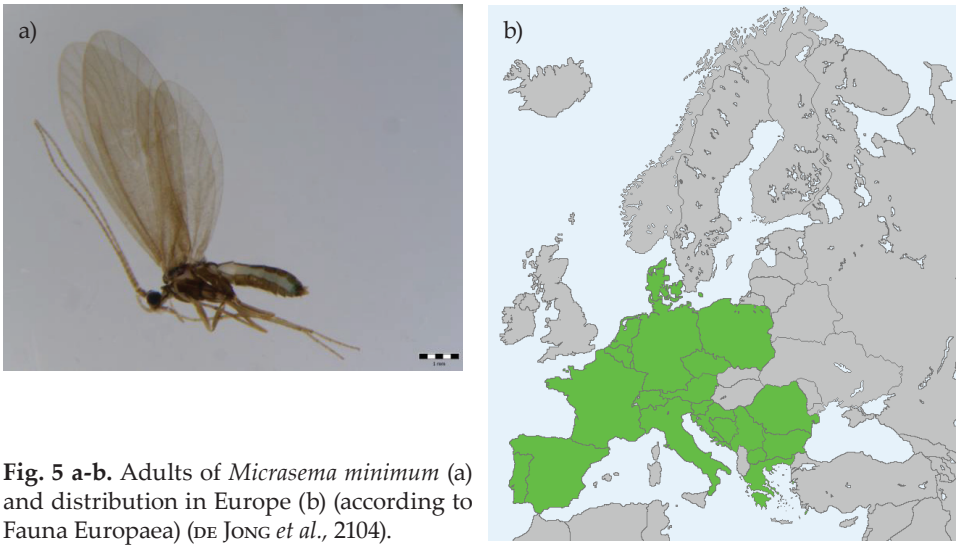

Fig. 5 a-b. Adults of *Micrasema minimum* (a) and distribution in Europe (b) (according to Fauna Europaea) (de Jong *et al.*, 2104).

Limnephilus graecus Schmid, 1956 (family Limnephilidae)

Finds: Lake Kuti, village of Badžula 4.IV.2015., 1 ♂, 6 ♀♀ (1 ♀ was allocated to barcoding analysis); the River Neretva, town of Opuzen 3.IV.2015., 3 ♂♂ (1 ♂ was allocated to barcoding analysis); the River Mislina, village Mlinište 4.IV.2014., 1 ♀. All collected specimens were deposited in the NIP-Trichoptera collection. Some specimens of *L. graecus* collected in the valley of the Neretva were deposited in the Central Collection of Trichoptera (CNHM).

Limnephilus graecus (Figs. 6-7) is a very interesting Mediterranean, early spring and spring species, established so far at three sites in Croatia, in the area of Kuti Lake, the Neretva River and the Mislina River. A review of the caddisfly specimens of the Central Trichoptera Collection of the CNMH in Zagreb demonstrated the presence of this species in a few specimens from the previous research (det. H. Malicky). During research into caddisfly fauna this year in the same area, the species *L. graecus* was ascertained in the three areas mentioned, that is at the same sites (all specimens have been deposited in the NIP Collection, CNMH Zagreb). Finds of the species *L. graecus* at these sites with data from Bosnia and Herzegovina (Marinković-Gospodnetić, 1978) show the westernmost points in the range of this Mediterranean and European species (Fig. 8).

The previously relatively rare finds of *Limnephilus graecus* were consequent upon its biological features, above all its early and rather short period of emergence in the spring, April, May and early June (Malicky, 2005). It is almost certain that emergence actually starts in March, as indicated by our finds of adults at the very beginning of April (April 3, 2015).

Limnephilus graecus inhabits not only riverine but also lacustrine habitats, as well as artificial irrigation channels. In such anthropogenic types of habitat we recorded it during our research in the immediate vicinity of Kuti Lake (the village of Badžula). Finds of *L. graecus* in the Neretva by Opuzen, where there is a considerable degree of salinity because of the influx of seawater from the Adriatic, shows that this species will also

Fig. 6. Adults of *Limnephilus graecus.*

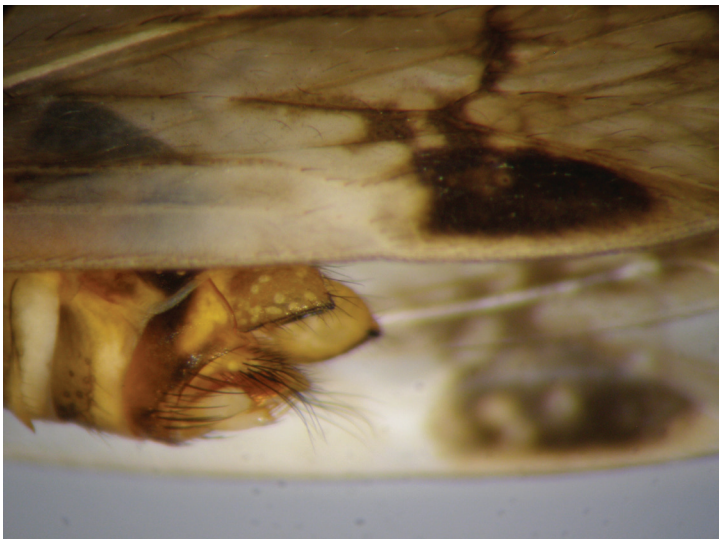

Fig. 7. Male genitalia o*f Limnephilus graecus* in lateral view.

inhabit brackish aquatic habitats with quite a high amount of salinity. Records of *L. graecus* in Greece in similar types of habitat (Malicky, 2005) also indicate these rare caddisfly biological features, i.e., the ability to inhabit such types of habitat. In the fauna of Croatia, brackish habitats are also recorded as being inhabited by subspecies *Triaenodes ochreellus lefkas* Malicky, 1974 (Malicky, 2005).

As well as Croatia, the range of *L. graecus* encompasses the Mediterranean areas of Greece, Albania, Montenegro and Bosnia and Herzegovina (Chojka, 1977; Marinković-Gospodnetić, 1978; Malicky, 2005; Oláh & Kovács, 2014) (Fig. 8).

Ceraclea riparia (Albarda, 1874) (family Leptoceridae)

Finds: the Dobra River – Jarče Polje 10.VI.2010., 2 ♂♂, 3 ♀♀, 19.VIII.2010., 10 ♂♂, 144 ♀♀.

Data from the locality of Jarče Polje on the Dobra River referred to the first finds of the species *Ceraclea riparia* in Croatia. According to this research *C. riparia* was recorded in June and August, although references indicate the possibility that the adults appear in the autumn (Graf *et al.*, 2008b). This species occurs in aquatic habitats in the area of the epipotamal (50%) and the metapotamal zone (50%) of watercourses.

Ceraclea riparia is distributed in Eurasia and its range encompasses the areas of central and southern Europe (the species is not found in Iceland, Italy, Scandinavia, the United Kingdom,…) (de Jong *et al.*, 2014) (Fig. 9a), spreading to the east as far as the Amur and China (Malicky, 2005).

Oecetis notata (Rambur, 1842) (family Leptoceridae)

Finds: the mouth of the Dobra River 14.VII.2010., 1 ♂, 27.VIII.2010., 5 ♂♂; the Kupa River – Kamanje 17.VIII.2010., 2 ♂♂, 9 ♀♀.

Fig. 8. Distribution area of *Limnephilus graecus*: red triangles – our data, green squares – literature data (Chojka, 1977; Marinković-Gospodnetić, 1978; Malicky, 2005; Oláh & Kovács, 2014).

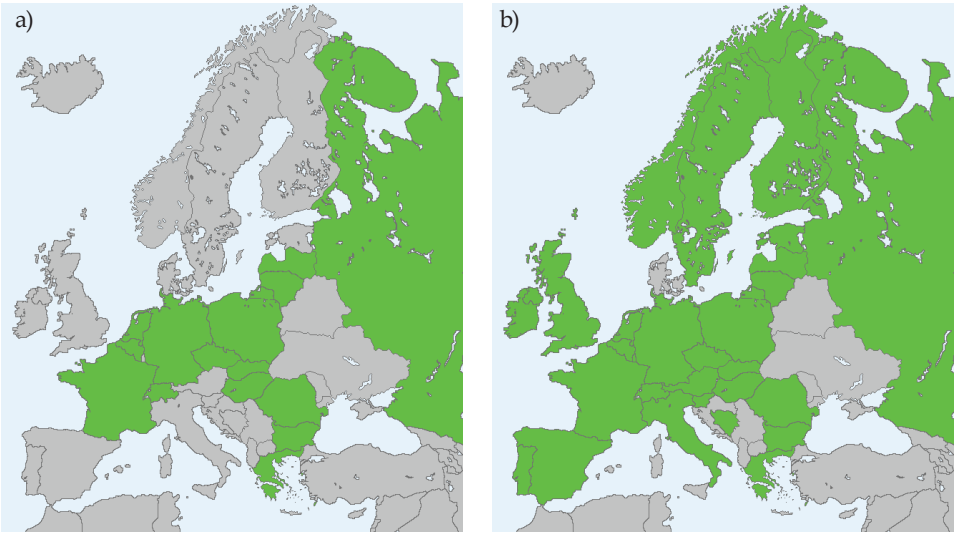

Fig. 9 a-b. Distribution of *Ceraclea riparia* (a) and *Oecetis notata* (b) in Europe (according to Fauna Europaea) (de Jong *et al.*, 2014).

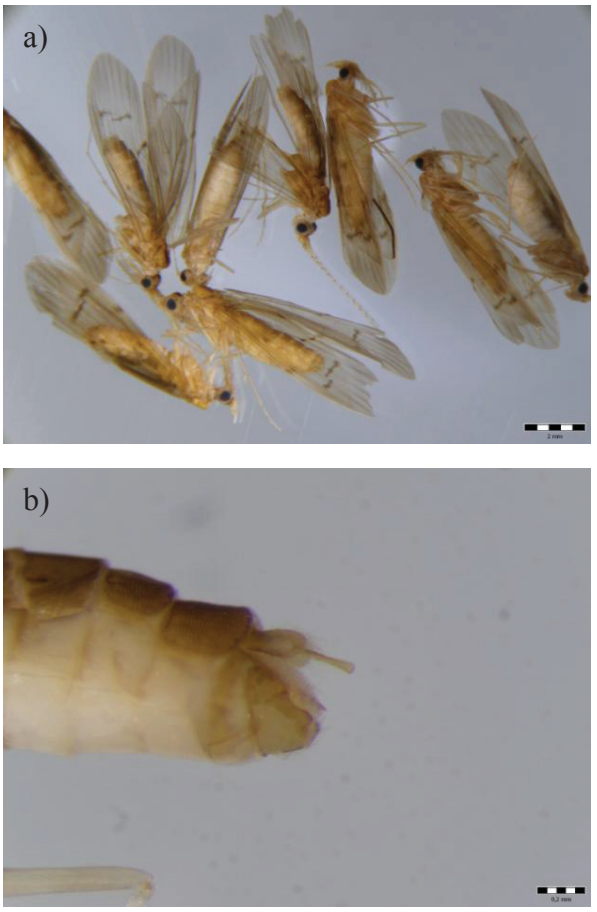

Fig. 10 a-b. Adults of *Oecetis notata* (a) and posterior part of abdomen and male genitalia (b).

Oecetis notata (Figs. 10 a-b) was recorded for the first time in the fauna of Croatia in the areas of the Dobra and Kupa rivers. According to this research, adults were recorded in the summer, July and August. Malicky says that in Greece the emergence of *O. notata* is a little earlier, in June (Malicky, 2005). The species *O. notata* is univoltine: it has one generation a year (Graf *et al.*, 2008b). It lives in the hyporhithral (40%), the epipotamal (40%) and the littoral zones of streams (20%). In terms of their feeding habits, *O. notata* larvae can be classified into the predatory type.

Oecetis notata is distributed in Eurasia and its range covers Europe (without e.g., Albania, Iceland, Republic of Macedonia, Serbia – according to Fauna Europaea) (Živić *et al.*, 2002; de Jong *et al.*, 2014) (Fig. 9b), extending to the east as far as the Amur and China (Malicky, 2005).

Setodes punctatus (Fabricius, 1793) (family: Leptoceridae)

Finds: the Dobra River – Jarče Polje 6.VII.2010., 1 ♀, 19.VIII.2010., 22 ♂♂, 46 ♀♀; the Dobra River – Novigrad na Dobri: 7.VII.2010. 1 ♂; the mouth of the Dobra River: 14.VII.2010., 15 ♂♂, 17 ♀♀.

With records at three sites on the Dobra River, *Setodes punctatus* was established for the first time in the fauna of Croatia with the precise data – localities. The number of specimens collected during these studies indicates that there are relatively numerous population of *S. punctatus* along the Dobra River. Adult specimens were collected in summer, in July and August. References in the literature suggest that the emergence and appearance of adults might be somewhat earlier, in June (Malicky, 2005) or later, in the autumn (Graf *et al.*, 2008b).

The species *Setodes punctatus* lives in the epipotamal as much as in the metapotamal (40% each), and somewhat less (20%) in the hyporhithral zone of streams (Graf *et al.*, 2008b).

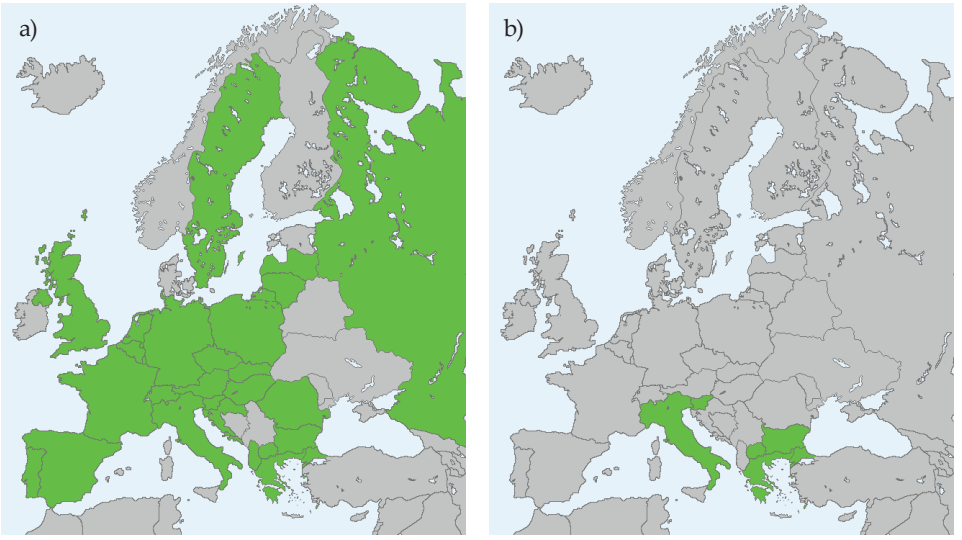

Fig. 11 a-b. Distribution of *Setodes punctatus* (a) and *Setodes bulgaricus* (b) in Europe (according to Fauna Europaea) (DE JONG *et al.*, 2014).

Setodes punctatus is a Eurasian species and its range extends over Europe but not the northern (Iceland, Norwegian, Finland) and western parts (Ireland) (Fig. 11a) (DE JONG *et al.*, 2014), spreading to the east as far as the Amur and China (MALICKY, 2005).

Setodes bulgaricus Kumanski, 1976 (family: Leptoceridae)

Finds: the Dobra River – Jarče Polje 1 ♂; the mouth of the Dobra River 3 ♂♂.

The records on the Dobra River have enabled this species (Figs. 12 a-b) to be determined in the fauna of Croatia for the first time. In older literature the spe-

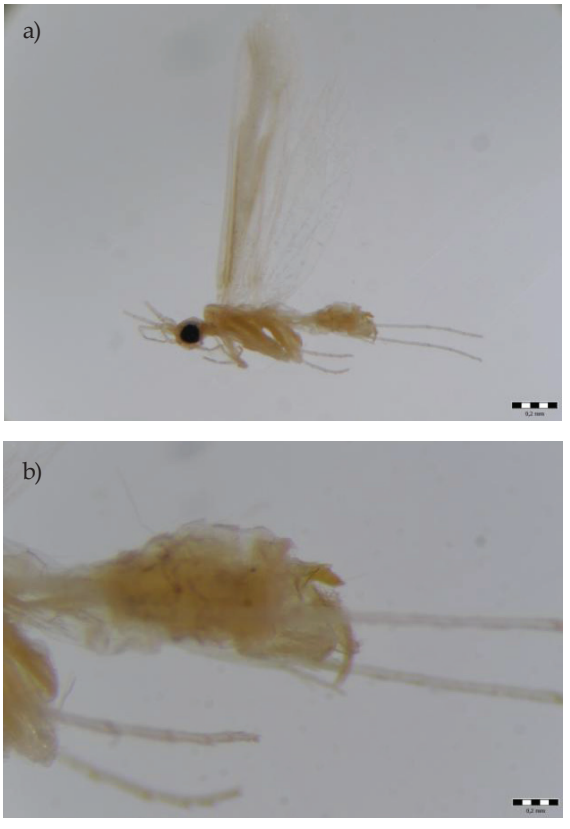

Fig. 12 a-b. Adult of *Setodes bulgaricus* (a) and posterior part of body and male genitalia in a lateral view (b).

cies is listed as a subspecies of *Setodes viridis* ssp. *bulgaricus* Kumanski, 1976 (Malicky, 1983), but because of its specific morphological features its taxonomic status has been modified and it now has the status of a separate species, *Setodes bulgaricus* (Malicky, 2004; Morse, 2015). Like all species of the Leptoceridae family it is small in size and the length of the forewings comes to 6-7 mm (Malicky, 2004). The adults emerge from their aquatic habitats in the summer months (Graf *et al.*, 2008b).

According to Fauna Europaea (de Jong *et al.*, 2014) and Malicky (2005) the area of distribution of the species *Setodes bulgaricus* is the Balkan Peninsula, Slovenia, Apennine Peninsula and Turkey (Fig. 11 b) (de Jong *et al.*, 2014).

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SAŽETAK

Nalazi nekih novih i zanimljivih vrsta tulara (Insecta, Trichoptera) u Hrvatskoj

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Fauna Trichoptera Hrvatske sustavno se istražuje u posljednjih 20-tak godina, prvenstveno prikupljanjem adultnih oblika. Ovim radom daje se prikaz bioloških i ekoloških značajki te rasprostranjenost 12 vrsta tulara koje su utvrđene kao rijetke ili po prvi puta u fauni Hrvatske: *Rhyacophila palmeni, R. vulgaris, Glososoma conformis, Wormaldia pulla, Hydroptila tineoides, Plectrocnemia geniculata, Micrasema minimum, Limnephilus graecus, Ceraclea riparia, Oecetis notata, Setodes punctatus, S. bulgaricus*. Te vrste utvrđene su na području Medvednice, Žumberka, Gorskog kotara, Korduna i Dalmacije. Po prvi puta u fauni Hrvatske utvrđene su sljedeće vrste: *Plectrocnemia geniculata, Ceraclea riparia, Oecetis notata* i *Setodes bulgaricus* dok je prisustvo vrsta *Rhyacophila vulgaris, Micrasema minimum* i *Setodes punctatus* potvrđeno po prvi puta sa sigurnošću na našem području. Najveći broj vrsta (4) utvrđen je za porodicu Leptoceridae, dvije vrste utvrđene su za porodicu Rhyacophilidae, a po jedna za porodice Glossosomatidae, Hydroptilidae, Polycentropodidae, Philopotamidae, Brachycentridae i Limnephilidae. S ovim podatcima fauna Trichoptera Hrvatske broji oko 200 vrsta (M. Kučinić, neobjavljeni podatci).