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The larva of *Parasetodes respersellus* (Rambur 1841) with notes on its habitat and European distribution (Trichoptera: Leptoceridae)

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Abstract

Two larvae collected from the River Tisza were recognized to belong to the genus *Parasetodes* according to the available generic description. The fact that *Parasetodes respersellus* is the only European/Western Palaearctic representative of the genus enabled us to describe the hitherto unknown larva of this species based on the collected specimens. Diagnostic features to distinguish the genus from other Central European genera are discussed. Possible species-specific characters are compared with those of other previously described species of the genus. Some notes on larval habitat and the European distribution of *P. respersellus* are given.

Key words: long-horned caddisflies, larval description, morphological characters, Hungary

Introduction

In the family of long-horned caddisflies (Leptoceridae), *Parasetodes* McLachlan 1880 is a small genus, which was included in Nectopsychini by Morse (1981) and was phylogenetically clustered weakly with *Leptocerina* Mosely 1932 and *Achoropsyche* Holzenthal 1984 and possibly with *Blyzophilus* Andersen et al. 1999 and *Nectopsyche* Müller 1879 by Malm & Johanson (2011). The genus is distributed in the Afrotropical, Palaearctic and Oriental Regions, represented by seven species and one subspecies (Morse 2014) which Malicky (2006, 2013b) was unable to differentiate. Among these species, *Parasetodes respersellus* (Rambur 1842) is the only species known from the Western Palaearctic Region (Graf et al. 2008; Malicky 2004, 2013b; Morse 2014).

Although the adults of *Parasetodes* species are well known, our knowledge of the larvae is more limited. A detailed generic description was given on the basis of larvae of *P. tumbanus* Marlier (Marlier 1962). Additionally, some characters of larvae of *P. maguirus* Mosely were mentioned and illustrated by de Moor (2002). Both species are distributed in the Afrotropical region (Morse 2014), and no information is yet available for larvae of species from the Palaearctic and Oriental regions. However, the above mentioned descriptions enable us to distinguish the larva of *Parasetodes* from those of other genera. At the same time, after the recent description of the larva of *Homilia leucophaea* (Forcellini et al. 2013), *Parasetodes respersellus* still represents the only Central European leptocerid genus with an unknown larva (Waringer & Graf 2011, 2013).

In 2013 two leptocerid larvae were collected along the River Tisza, Hungary, which were not identifiable according to currently used keys for Central European species (Lechthaler & Stockinger 2005; Waringer & Graf 2011, 2013). Notwithstanding, we were able to recognize that the specimens belong to the genus *Parasetodes* according to the generic description by Marlier (1962). The fact that *Parasetodes respersellus* is the only European representative of the genus enabled us to describe the hitherto unknown larva of this species based on the collected specimens.

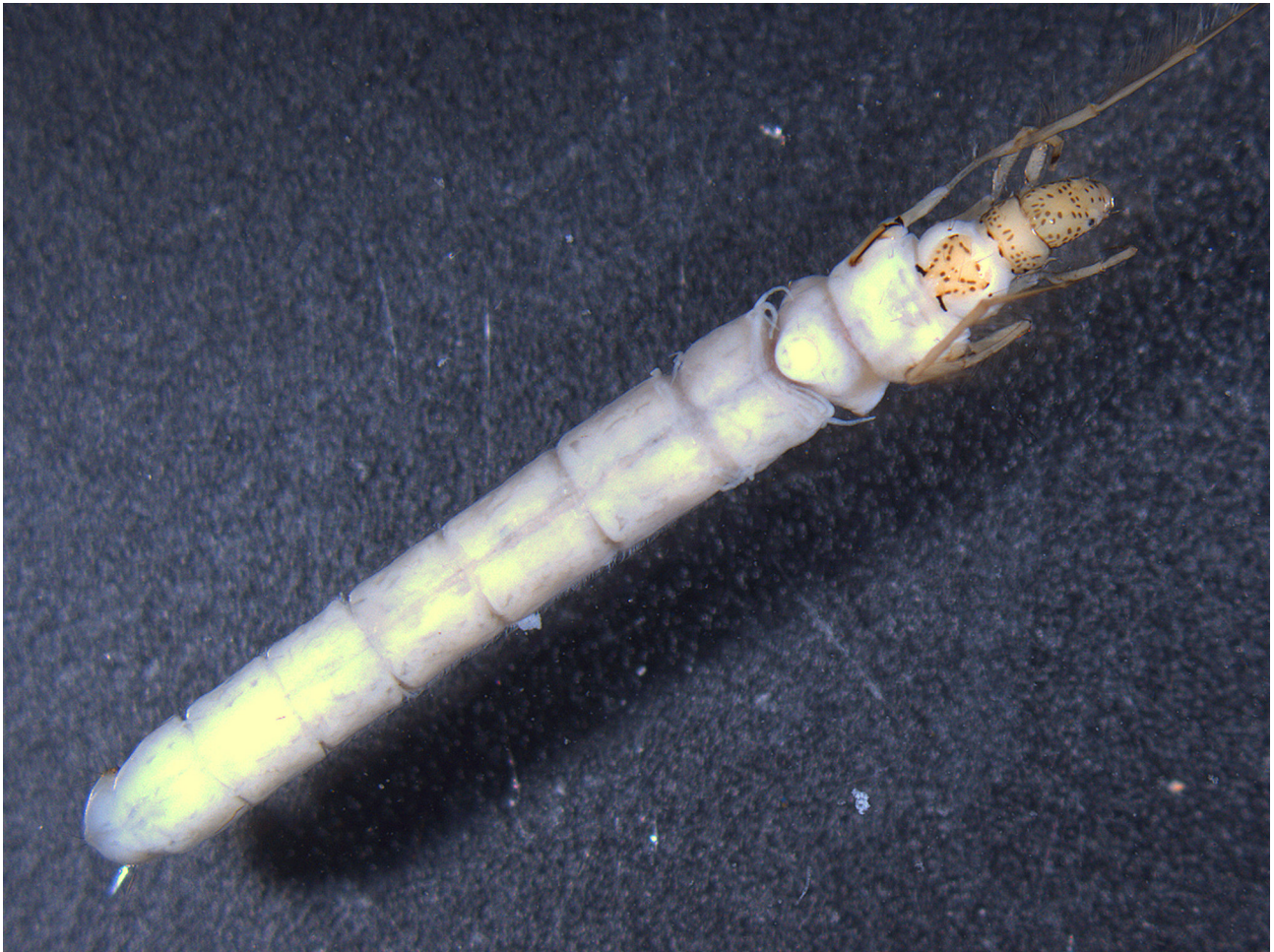


FIGURE 1. *Parasetodes respersellus* (Rambur 1841), final instar larva, dorsal.

Materials and methods

A final instar larva (estimated on the basis of the subocular ecdysial line on the head capsule and the size of the adults) of *P. respersellus* was collected on 13 August 2013 in the River Tisza at Olcsvaapáti (48°05'31.96"N, 22°22'47.28"E), while a fourth instar larva (estimated on the basis of body length and dimensions of the head) was found on 14 August 2013 in the same river at Benk (48°17'32.60"N, 22°15'13.14"E). The larvae were collected by “kick & sweep” method using a 25 cm wide hand net with a mesh size of 500 µm. The larvae were preserved in 70% ethyl-alcohol in the field.

In the laboratory, a Nikon SMZ745T stereomicroscope with QImaging MicroPublisher 3.3 RTV digital camera was used for detailed morphological investigations.

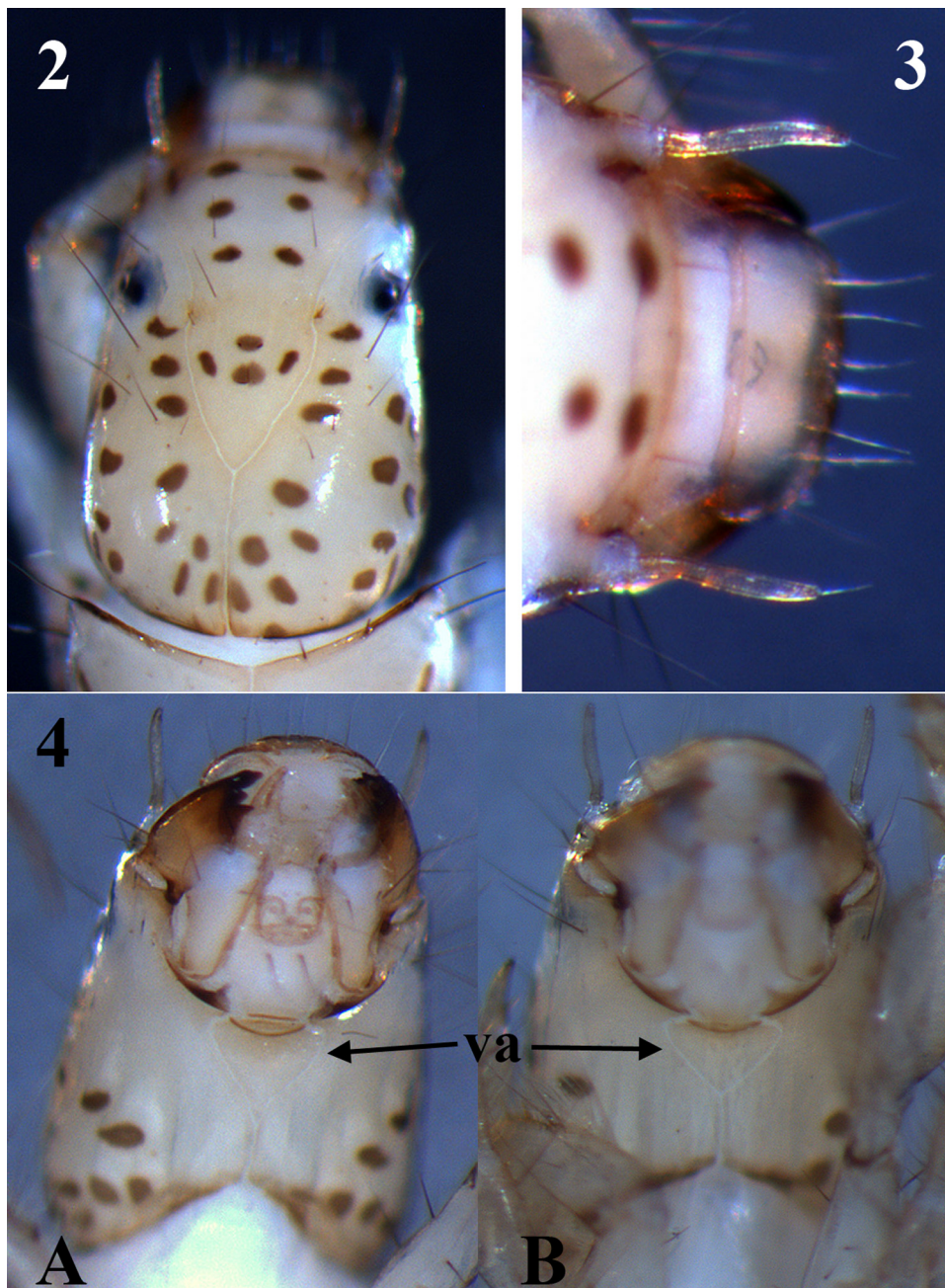
In the description of the larva, the nomenclature by Waringer & Graf (2011) was used for morphological characters. The description and dimensions are primarily given for the final instar larva, but those of the fourth instar larva in which it differs from the final instar larva are also presented in parentheses.

Description of the fifth-instar larva of *P. respersellus*

Body: Length of larva (Fig. 1) 18.9 (11.3) mm.

Head: Elongate: length 1.4 (1.3) mm, width 1.0 (0.9 mm); yellowish with pale areas around eyes. Muscle attachment spots on dorsal surface of head brown, well-defined, characteristically arranged (Fig. 2). Frontoclypeus elongate, triangular, with pointed posterior apex and constriction in middle part (Fig. 2). Subocular ecdysial line on the head capsule. Antennae long, slightly curved and reaching anterior edge of labrum (Fig. 2). Labrum

unicolored, yellow, with posteromedian mark (Fig. 3). Mandibles brown, compact, with two cutting edges. Ventral apotome (=gular sclerite, Fig. 4) simple, subtriangular, pointed to posterior apex, slightly more than half as long as head capsule on ventral midline, and situated anteriorly with single central hypocranial suture running posteriorly; ventral apotome yellow and concolorous with the ventral surface of head (Fig. 4).



FIGURES 2–4. *Parasetodes respersellus* (Rambur 1841), larva. 2, head, dorsal. 3, antennae and labrum, dorsal. 4, head, ventral: A, final instar larva; B, fourth instar larva; va=ventral apotome.

Thorax: All thoracic sclerites on pro- and mesonota yellow in color, with well-defined brown muscle attachment spots. Pronotum (Fig. 5) completely sclerotized, brown muscle attachment spots situated in posterior half. Anterior pronotal margin somewhat darker, with paler gap medially; posterior pronotal margin wider and darker medially and laterally. Mesonotal sclerite covering about half of mesonotum (Fig. 5), rounded anteriorly and tapering posteriorly. Mesonotum additionally with two small sclerites lying anterolaterally to the median large sclerite and bearing two long setae. Mesonotum also with dark posterior projections (pale brown in fourth instar larva) directed at right angle to longitudinal axis of body (dark pigmentation on pro- and mesonota paler, apparently brown in fourth instar larva, Fig. 5B). Metanotum (Fig. 5) membranous, without sclerotized patches, but

bearing two long setae anteromedially (setal area *sa1*), and groups of three setae in anterior corners (*sa3*). Setae in these groups arranged characteristically: anterior seta in each group shortest; median seta longest; posterior seta of intermediate size. Prosternum (Fig. 6.) with three pairs of small, very pale setae, two pairs anteriorly and one pair at bases of legs. Mesosternum (Fig. 6) with two small, very pale, anterior setae and two small, elongate, brown posterolateral sclerites. Metasternum (Fig. 6) with one median and two posterolateral sclerites, long seta situated anterior to each posterolateral sclerite and pair of short, very pale setae anteriorly. Coxopleurites of forelegs (foretrochantins) elongate, each tapering, its tip bending upwards; bearing one long setae. Trochanter and femur of each foreleg bearing one pale, strong spine on ventral margin in addition to dense row of fine setae (Fig. 7). Forefemora each very wide near middle, with convex dorsal edge and lobed ventral edge. Forefemora and foretibiae with long setae on their dorsal margins. Foretibiae each wider apically, making ventral margin sinuate; with prominent ventral spine distally. Foretarsi short, each with two long setae near base of tarsal claw. Tarsal claw of each foreleg simple, short and curved, with prominent basal spine. Mesopleurite divided into two halves by dark bar. Midlegs (Fig. 8) longer than forelegs. Midcoxae bearing several long setae. Two long and many bristle-like setae on ventral margins of each midtrochanter and midfemur. Dorsal margin setae and additional face setae (*as*, Fig. 8B) present on each midfemur. Ventral and dorsal margins of midtibia with several long setae, ventral setae stronger than dorsal setae. Ventral margin of each midtarsus with two strong setae. Tarsal claw of each midleg long and curved, with prominent basal spine. Metapleurites each divided into two halves by dark bar. Hind legs about two times longer than midlegs. Hind tibiae and femora without median constrictions. Hind femora and tibiae each in their full length, hind trochanters and tarsi each partly with two rows of dense setal fringes, one row on each of dorsal and ventral margins (Fig. 9). Ventral edge of hind tarsus bearing numerous strong setae. Hind tarsal claw very long, curved, with prominent basal spine.

Abdomen: Abdominal segment I with one dorsal and two lateral fleshy protuberances (humps). Two long setae situated anterolateral to dorsal protuberance. Each lateral protuberance with brown sclerite with anterior patch of numerous small setae and one long dark seta at its ventral margin and one shorter seta caudoventrally close to sclerite (Fig. 10); posterior process of sclerite brown, without dark bar. Ventral surface of abdominal segment I with two long setae. Gills present on abdominal segments II–VIII. Gills each consisting of various numbers of filaments: 4–6 on segment II, 2–3 on segment III, 1–2 on segments IV–VIII. These gills present in specific pattern (Fig. 11): ventrolateral and ventral gills in both presegmental and postsegmental positions on segment II; dorsal, ventrolateral and ventral in presegmental positions and ventral in postsegmental position on segment III; dorsal and ventral in presegmental positions and ventral in postsegmental position on each of segments IV–VI; dorsal in presegmental position and ventral in postsegmental position on segment VII; dorsal in presegmental position on segment VIII. Lateral fringe composed of dense tiny setae from near beginning of segments III to end of segment VII, larger bifid setae laterally on segment VIII. Dorsal sclerite on segment IX colorless, inconspicuous, with 3 pairs of setae arranged in one row: Pair of longer inner setae, pair of shorter outer setae, and pair of intervening setae as long as outer setae, but much thinner (Fig. 12). Lateral sclerites of anal prolegs with 5 long and 3 short setae. Anal claws short and strongly hooked, with 1 or 2 dorsal teeth, no ventral teeth. Anal region on either side of split smooth (Fig. 13).

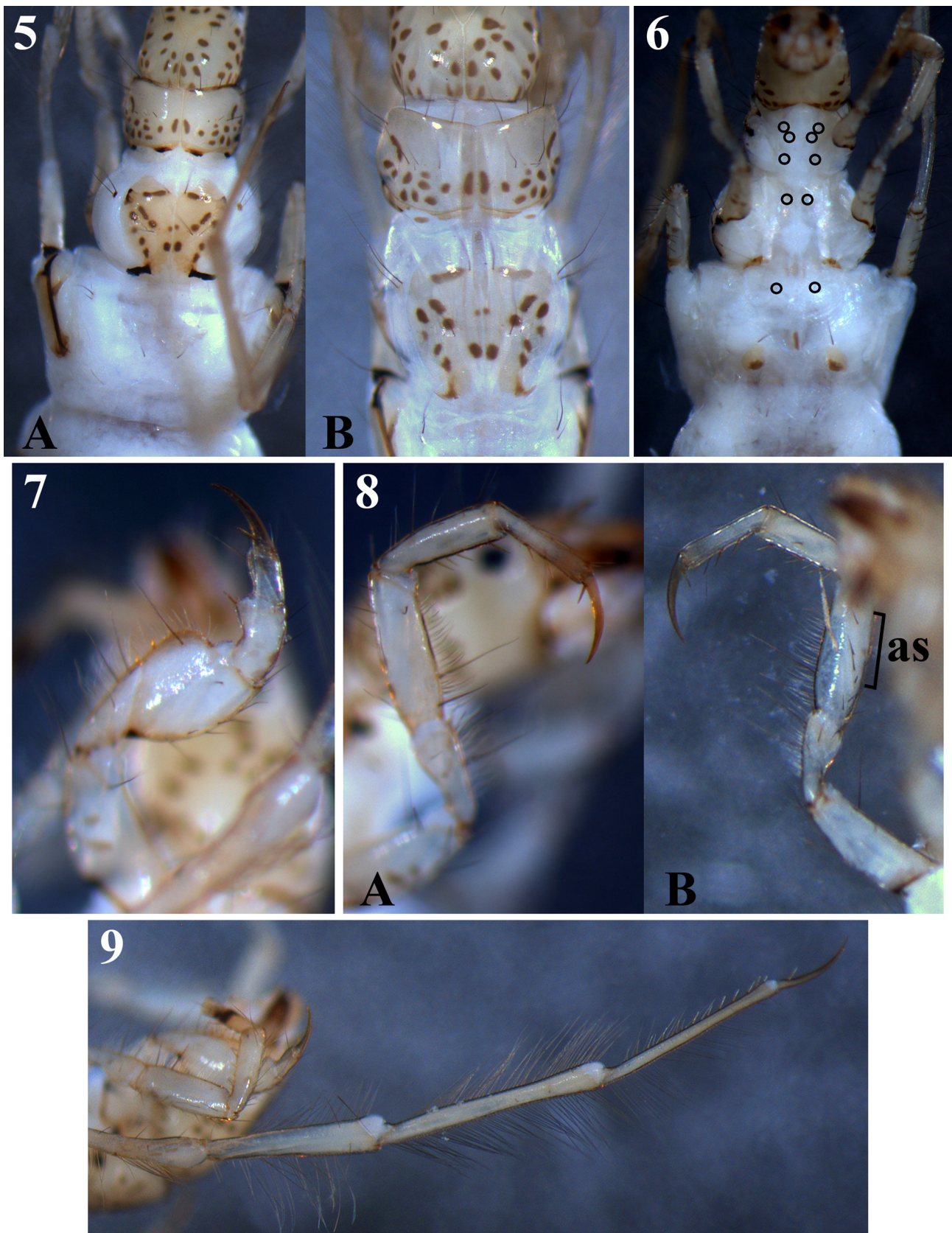
Larval case: Larval case straight, slightly tapering posteriorly, made of small overlapping plant pieces, with additional stem fragments attached longitudinally and irregularly (Fig. 14).

Distinction of the genus *Parasetodes* from other Central European leptocerid genera

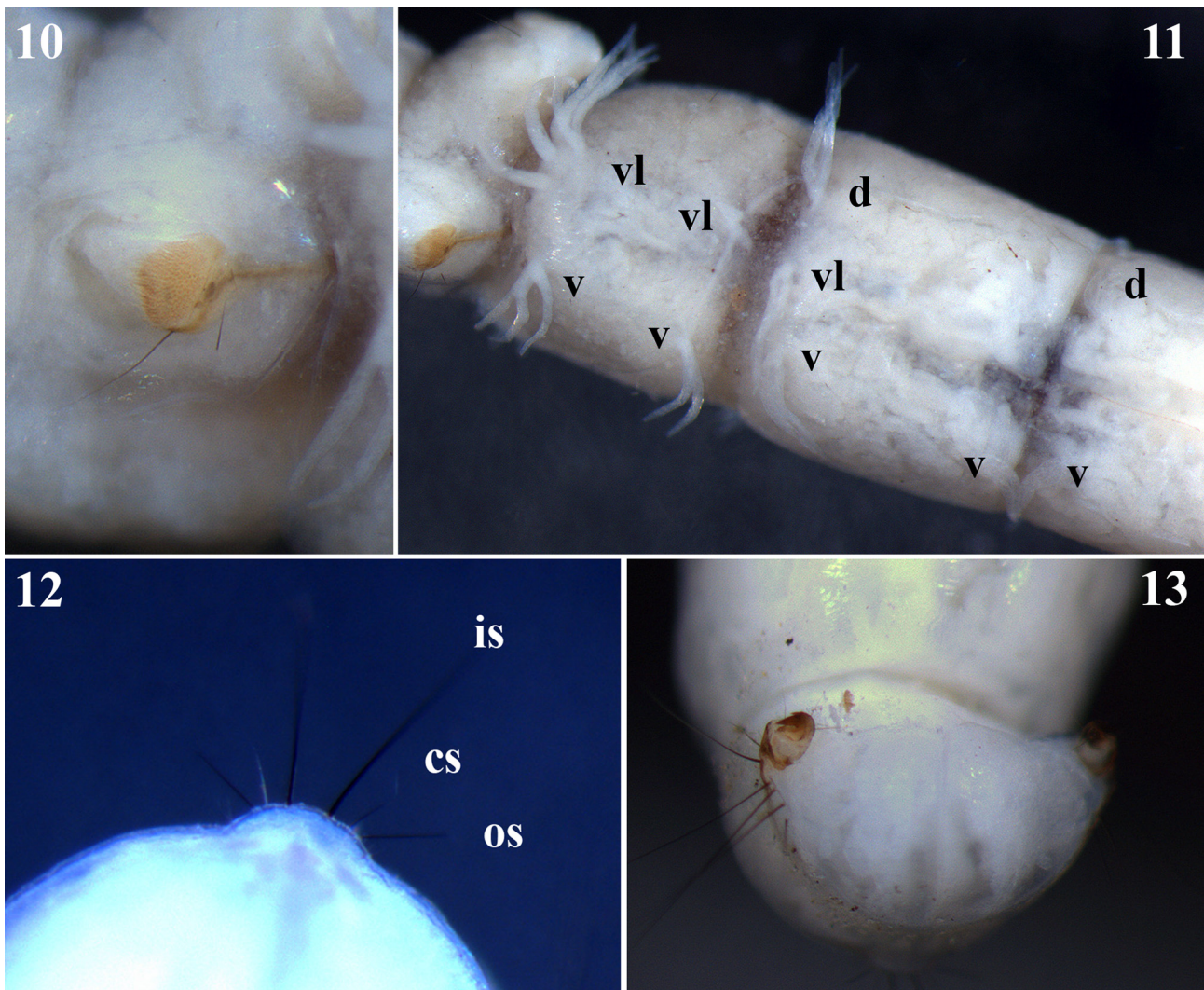
Mesonotum with dark posterior bars is only presented in two other Central European genera, *Athripsodes* and *Ceraclea* (Waringer & Graf 2011, 2013). These bars are slightly curved and slightly convergent anteriorly in *Athripsodes* and *Ceraclea*, while in *P. respersellus* they are directed laterad at a right angle to the longitudinal axis of the body. Furthermore, the genus *Parasetodes* is separated from the above mentioned genera by the combination of the following features:

- The ventral apotome is subtriangular, pointed at its posterior apex, but only slightly longer than the ventral midline of the head capsule and situated anteriorly (In genus *Ceraclea* the ventral apotome is polygonal, while in genus *Athripsodes* it is triangular, but reaches the posterior margin of the head.).
- Two rows of swimming setae are present on each hindleg (No swimming setae are on the legs in genera *Athripsodes* and *Ceraclea*).

- The posterior process of each lateral sclerite on abdominal segment I has no dark bar (There is a dark bar or stripe in the other two genera.).



FIGURES 5–9. *Parasetodes respersellus* (Rambur 1841), larva. 5, thoracic segments, dorsal: A, final instar larva; B, fourth instar larva. 6, thoracic segments, ventral; circles mark the positions of small pale setae on each segment. 7, left foreleg, left posterolateral. 8, right midleg: A, right posterolateral; B, left anteromesal. 9, left hind leg, left posterolateral.



FIGURES 10–13. *Parasetodes respersellus* (Rambur 1841), larva. 10, left lateral sclerite of abdominal segment I, left lateral. 11, left side of abdominal segments I–IV, left lateral, showing some gills on segments II–IV; d=dorsal, v=ventral, vl=ventrolateral. 12, abdominal segment IX, dorsal, showing 3 pairs of setae; cs=intervening (central) seta, is=inner seta, os=outer seta. 13, abdominal segment IX, ventral.

Comparison of *Parasetodes respersellus* with other species of the genus

The larva of *P. respersellus* can be compared with those of only two other *Parasetodes* species, *P. tumbanus* and *P. maguirus*. Features of *P. respersellus* meet the generic description based on the larva of *P. tumbanus* by Marlier (1962), except the dark posterior mesonotal bars, which were not mentioned in that work. In the key for Malaysian genera by Morse (2004), in which also *P. tumbanus* was illustrated, *Parasetodes* is included as a genus without dark posterior mesonotal bars. In figures by de Moor (2002), *P. maguirus* was illustrated with short dark posterior mesonotal bars converging anteriorly. Accordingly, the mesonotum with dark posterior projections directed at right angle to the longitudinal axis of the body seems to be a species-specific character for *P. respersellus*. However, it cannot be confirmed since the larvae of the other species are not known.

Habitat of *P. respersellus*

Water type: Adults of *P. respersellus* have been collected mainly along large rivers (e.g., Bertuetti et al. 2001; Laudee & Prommi 2011; Murgoci 1969; Uherkovich & Nógrádi 1990), but were also found along streams and small rivers in Hungary (Uherkovich & Nógrádi 1990; Oláh pers. comm.). The larvae were also collected along a

larger river, the upper Hungarian section of the River Tisza, with a width of 50–70 meters and depth more than 1.5 meters. The co-occurring caddisfly species were *Ceraclea dissimilis*, *Hydropsyche bulgaromanorum*, *H. contubernalis*, *H. modesta*, *H. ornatula*, *Mystacides longicornis/niger*, *Neureclipsis bimaculata* and *Oecetis notata*, all of them are typical species for the River Tisza and other larger rivers in Hungary (Móra et al. 2005; Uherkovich & Nógrádi 1997).

Microhabitat: Without knowing the larvae, our knowledge on the microhabitat of *P. respersellus* has been very limited. In the River Tisza larvae were collected in a mainly sandy (psammal > 60% substrate-coverage in the field) section, with varying proportions of silt, woody debris and coarse particulate organic matter. Along the River Ethiope in Nigeria *P. maguirus* larvae were collected along sections with coarse silt and sand (Arimoro et al. 2011), which also supports the preference of *Parasetodes* larvae for sandy sediment. Furthermore, some riparian and/or submerged vegetation seems to be required for larvae of *P. respersellus*, at least to build the larval case. Adults of the species were most recently collected along watercourses with dense vegetation in Hungary (Oláh pers. comm.), while larvae were collected at sites along the River Tisza characterized by dense riparian vegetation. The preference of *Parasetodes* larvae for vegetation is supported by Chakona et al. (2009), who found significant correlations between the abundance of *Parasetodes* sp. larvae and percentage of macrophytes and native forests along rivers in Zimbabwe.



FIGURE 14. *Parasetodes respersellus* (Rambur 1841), larval case.

Notes on the European distribution of *P. respersellus*

Distribution by countries: Malicky (2006) stated that the species has a wide distribution ranging from Western Europe to Bali. The known distribution of *P. respersellus* was most recently summarized and illustrated by Buczyńska et al. (2014). According to them, *P. respersellus* is a rare species in Europe with records only from France, Greece, Hungary, Italy, Romania, Russia (Kaliningrad Region) and Ukraine. However, three out of the

seven countries, Greece, Russia and Ukraine, were not included in the Fauna Europaea (Malicky 2013b), suggesting that that database should be updated.

The species was described from France in the middle of the 19th century (Rambur 1842), but, to our best knowledge, has not been collected in the country since that time. In the 1960s, *P. respersellus* was a “typical species of the Great Hungarian Plain” in Hungary (Uherkovich & Nógrádi 1990), but then, despite the intensive collections carried out throughout the country, it was not collected for a long time (Nógrádi & Uherkovich 2002), and was re-found only in 2011 (adults, Oláh pers. comm.) and 2013 (larvae, present work). Similarly, in Romania the species was last collected in the 1960s along the Lower Danube (Ciubuc 2004). In Italy *P. respersellus* was found at some localities along the River Po between 1996 and 1998 (Bertuetti et al. 2001; Valle 2001). In Greece it was collected in 2004 at a single locality (Malicky 2005). The only record from Ukraine (Stibletsov 2013) dates back to 2011 (Stibletsov, pers. comm.). In Russia the species was collected in the same year (Buczyńska et al. 2014).

On the basis of the records mentioned above, *P. respersellus* apparently disappeared from Central Europe at the end of the 1960s, and after some 30 years its distributional area has been extended again. However, it is difficult to say whether it is due to a natural fluctuation of the distributional area, or related to climatic or other environmental changes (e.g., improvement in the ecological state of European rivers). The latter is hypothesized because other *Parasetodes* species are sensitive to geomorphological degradation (Chakona et al. 2009) and wastewater input (Arimoro et al. 2011).

Distribution by ecoregions: According to the ecoregion concept of Illies (1978), *P. respersellus* is known to occur in the Italian region, the Hellenic Western Balkans, the Hungarian Lowlands, the Pontic Province and the Western Plains (Graf et al. 2008). According to the new records from the Donetsk region, Ukraine (Stibletsov, pers. comm.), and from Courish Spit, Russia (Buczyńska et al. 2014), the species also occurs in the Eastern Plains ecoregion and the Baltic Province. On the other hand, the allocation of the species in the Hellenic Western Balkan region seems to be questionable: Graf et al. (2008) referred to data in the publication by Malicky (2005), but, according to the map and the coordinates presented in that work, the locality is in the Eastern Balkan rather than the Western Balkan ecoregion (although very close to the border line between the two ecoregions).

Conclusions

Parasetodes respersellus seems to be a rare species in Europe according to the few records based on collection of adults. However, the increasing numbers of new findings may disprove this statement. The present description of the larva of *P. respersellus*, in combination with the intensive European monitoring programs according to the AQEM protocol in the frame of the EU Water Framework Directive focusing on collection of larvae (Hering et al. 2003), may increase the chance to rediscover or discover the species in many European countries. For example, many rare species were found as larvae during an intensive nationwide survey in Hungary (Móra et al. 2006), and first records of some species from the country were also based on collection of larvae (Deák & Portelechi 2014; Málnás et al. 2012).

The morphological characters of *P. respersellus* described here may help to clarify the generic description, which has some inconsistency concerning some features, such as the mesonotum with (de Moor 2002; present study) or without (Morse 2004) posterior dark projections, or dorsal sclerite on segment IX with two (Marlier 1962) or three (present study) pairs of setae. Other characters, such as additional setae on midfemora, setae on the foretrochantins, and the coloration pattern on the head, may also assist in its identification (similar to other genera, see Waringer & Graf 2013), but more species of the genus should be studied to clarify the importance of these features.

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