

A new species of *Enterognathus* (Copepoda, Cyclopoida, Enterognathidae) collected from the Seto Inland Sea, western Japan

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Abstract

A new species of the endoparasitic copepod *Enterognathus* (Cyclopoida, Enterognathidae) is described from a crinoid host in the Seto Inland Sea, western Japan. This is a third species of the genus and its first occurrence in the Pacific Ocean. The new species is distinguished from two previously known congeners by the morphology of the body somites, caudal rami, antennae and legs. Crinoid parasites belonging to *Enterognathus* and the closely related genus *Parenterognathus* have a broad distribution from the northeastern Atlantic through the Red Sea to the West Pacific.

Keywords

Copepoda, Cyclopoida, Enterognathidae, Seto Inland Sea, symbiosis

Introduction

The cyclopoid copepod family Enterognathidae is a compact group accommodating only four genera and six species (Boxshall and Halsey 2004, Ohtsuka et al. 2010). All members are symbionts on Deuterostomia including crinoids, holothuroids and hemichordates (Boxshall and Halsey 2004). Two genera, *Enterognathus* Giesbrecht, 1900 and *Parenterognathus* Ohtsuka, Kitazawa and Boxshall, 2010 are endoparasites of crinoids, and have a wide distribution in the northeastern Atlantic and the Indo-West Pacific regions (Ohtsuka et al. 2010).

During a research cruise in the Seto Inland Sea, western Japan in 2011, we found an undescribed species of the genus *Enterognathus* in a benthic sample. The genus has hitherto consisted of only two species, *E. comatulae* Giesbrecht, 1900 from the northeastern Atlantic and *E. lateripes* Stock, 1966 from the Red Sea (Giesbrecht 1900, Stock 1966, Illg and Dudley 1980, Boxshall and Halsey 2004). This is its first occurrence in the Pacific Ocean. The present paper provides a detailed description of the new species with some zoogeographical notes on the genus.

Material and methods

A juvenile of the crinoid genus *Lamprometra* sp. (cf. Clark 1941, Messing 1997) was collected by a sledge net (mesh size 0.3 mm) at depths of 46.7–46.9 m in the central part of the Seto Inland Sea, western Japan (34°0.590'N, 132°44.32'E–34°0.599'N, 132°44.35'E) on November 7, 2011 (local time 1153–1158). A single specimen of the originally endoparasitic copepod described herein was attached to the outside of the host crinoid, possibly due to an accidental ejection from the intestine of the host during collection. It was preserved in 70% ethanol immediately after capture.

Terminology follows Huys and Boxshall (1991). The type specimen is deposited at the Kitakyushu Museum of Natural History and Human History (KMNH IvR). The host crinoid is deposited at the Atmosphere and Ocean Research Institute of the University of Tokyo.

Taxonomy

Enterognathus inabai sp. n.

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http://species-id.net/wiki/Enterognathus_inabai

Figs 1–2

Material examined. An adult female found from the crinoid *Lamprometra* sp. collected from the central part of the Seto Inland Sea, western Japan (34°0.590'N, 132°44.32'E–34°0.599'N, 132°44.35'E), at depths of 46.7–46.9 m, November 7, 2011.

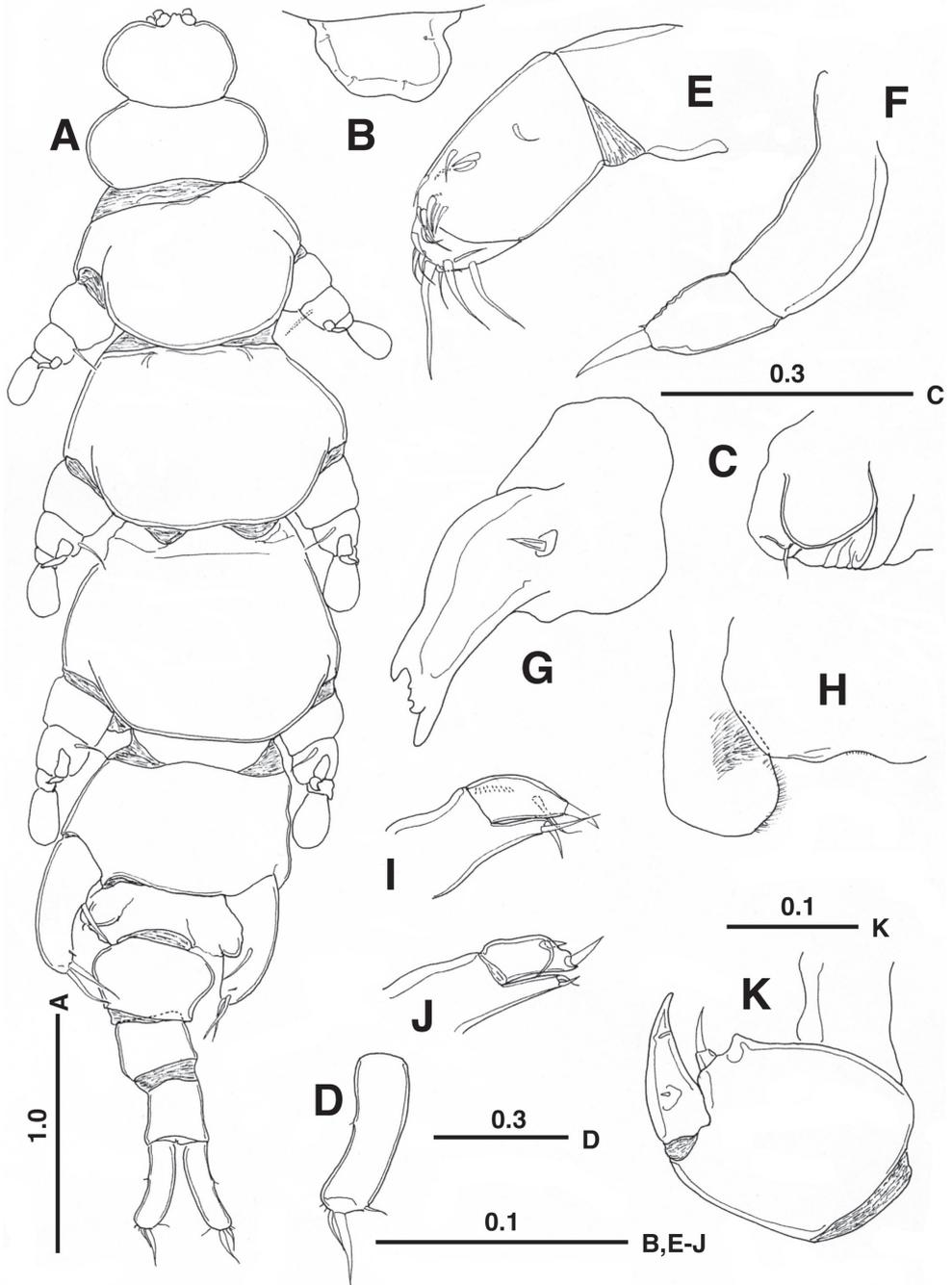


Figure 1. *Enterognathus inabai* sp. n. holotype female: **A** Habitus, dorsal view **B** Rostrum, dorsal view **C** Genital opening, right, dorsal view **D** Caudal ramus, left, dorsal view **E** Antennule **F** Antenna **G** Mandible **H** Labrum and paragnath, ventral view **I** Maxillule **J** Other maxillule **K** Maxilla. Scales in mm.

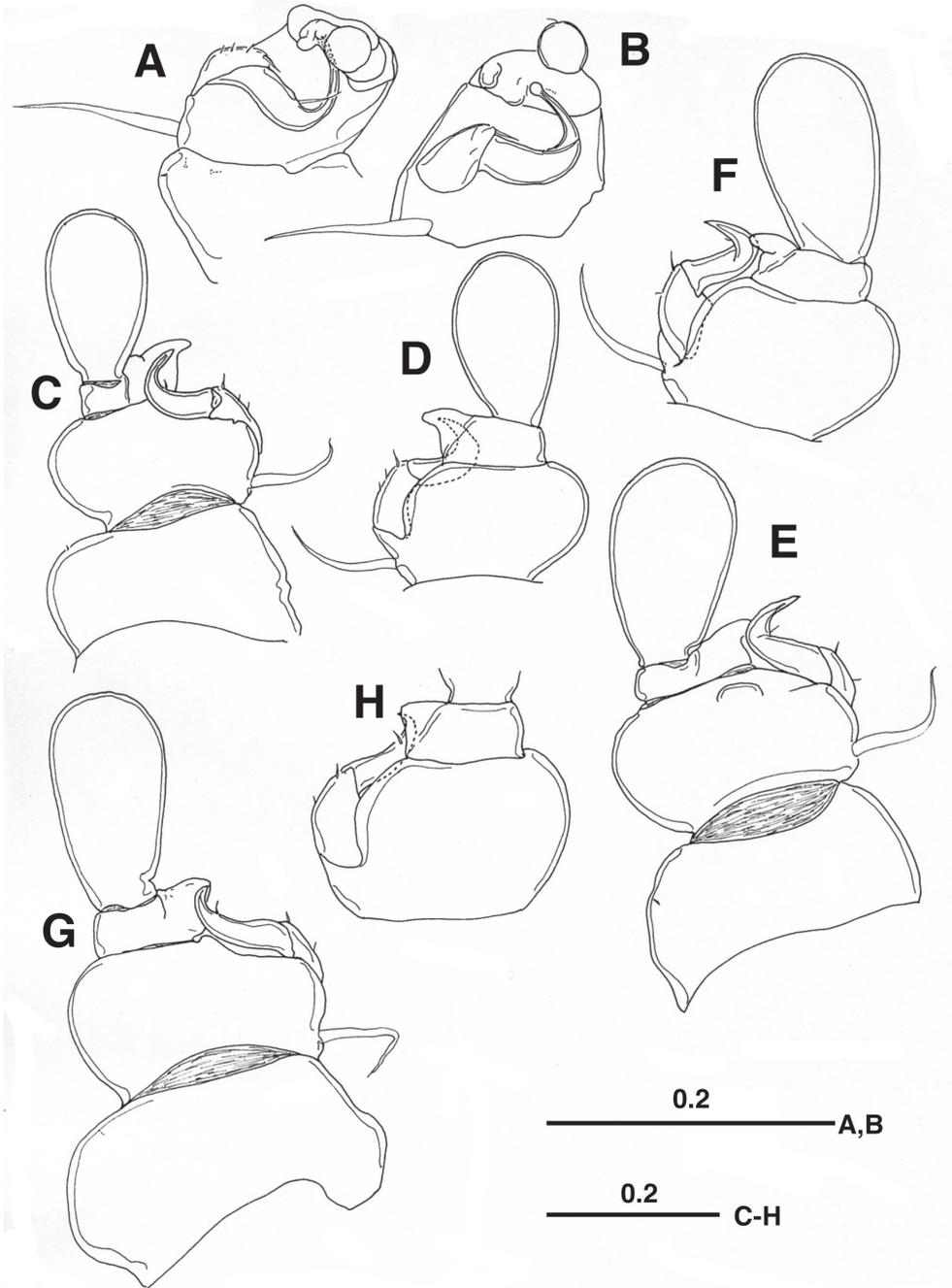


Figure 2. *Enterognathus inabai* sp. n. holotype female: **A** Leg 1, posterior view **B** Leg 1 excluding coxa (more or less flattened), posterior view **C** Leg 2, posterior view **D** Leg 2 excluding coxa, anterior view **E** Leg 3, posterior view **F** Leg 3 excluding coxa, anterior view **G** Leg 4, posterior view **H** Leg 4 excluding coxa and second endopodal segment, anterior view. Scales in mm.

Holotype. ♀, partly dissected, with appendages on 5 slides and body in a vial (KMNH IvR 500,539).

Description. Female. *Body* (Fig. 1A) 5.17 mm long, from anterior tip of rostrum to caudal ramus excluding caudal setae, flattened dorso-ventrally, weakly sclerotized, elongate, but tagmosis clearly defined. Cephalosome ca. 1.2 times wider than long; rostrum (Fig. 1B) defined basally, slightly asymmetrical with 2 pairs of hair-sensilla. First to fifth pedigerous somites about 2.5, 1.6, 1.6, 1.2 and 1.7 times wider than long, respectively; fourth pedigerous somite (slightly twisted toward right side in Fig. 1A) exhibiting maximum width; genital double-somite protruded laterally into triangular process; each genital opening (Fig. 1C) covered with operculum representing leg 6 and armed with minute seta; single copulatory pore possibly located on posteroventral surface as in *Enterognathus comatulae* (see Fig. 4 in Giesbrecht 1900) and *Parenterognathus troglodytes* (see Fig. 2M in Ohtsuka et al. 2010), but not clearly seen due to damage. First post-genital somite expanded anterolaterally; second and third (anal) free abdominal somites nearly as long as wide. Caudal rami (Fig. 1A, D) symmetrical, slightly curved outward, about 3.7 times as long as wide; caudal setae I to III rudimentary, IV slender, V thick and VI positioned subterminally.

Antennule (Fig. 1E) short, 3-segmented; first segment unarmed; second segment longest, with 10 short setae; third segment with 11 setae. *Antenna* (Fig. 1F) short, 2-segmented; basal segment long, unarmed; distal segment short, with 1 short seta and 1 rudimentary seta at tip. *Mandible* (Fig. 1G) with heavily sclerotized gnathobase; cutting edge with large and dorsal and ventral teeth and 2 smaller teeth; palp represented by simple seta. *Labrum* (Fig. 1H) with concave posterior margin. *Paragnath* (Fig. 1H) large, expanded distally, hirsute along inner margin. *Maxillule* (Fig. 1I) 2-segmented; proximal segment bearing praecoxal endite armed with 1 spiniform element and short seta distally; distal segment with 1 subterminal seta, 1 distal spine and row of spinules; other member of pair (Fig. 1J) abnormal, bilobed, with 2 spiniform elements and seta. *Maxillae* (Fig. 1K) connected by intercoxal sclerite; syncoxa with triangular process and single endite furnished with distal seta; basis with stout spine terminally; endopod represented by rudimentary seta. *Maxilliped* absent.

Legs 1–4 biramous, with 2-segmented rami. Legs 1 and 2–4 ventrally and ventrolaterally positioned on pediger, respectively. Leg 1 (Fig. 2A, B) with minute outer setule on coxa; basis furnished with developed naked outer seta basally; first exopodal segment with 3 setules and longer distal setal element on outer margin, second segment sickle-shaped, abruptly curved outward, terminated at round tip, with naked seta at outer midlength; first endopodal segment broad, with 2 rounded projections, second segment bulbous, with minute seta terminally. *Legs 2–4* (Fig. 2C–H) similar to each other, but gradually increasing in size; first exopodal segment bearing 3 or 2 setules/setal elements in legs 2 and 3–4, respectively; second exopodal segment curved outward, sharply pointed, with minute setule midway or subterminally; first endopodal segment produced outward into triangular process; second endopodal segment spatulate, unarmed.

Leg 5 (Fig. 1A) 1-segmented, with 1 basal and 2 terminal, developed setae and 1 minute seta subterminally. *Leg 6* (Fig. 1C) represented by genital operculum bearing minute seta.

Male unknown.

Etymology. The new specific name “*inabai*” is named in honor of the late emeritus Professor Akihiko Inaba (Hiroshima University) who made great contributions to the faunistic surveys of the Seto Inland Sea (Inaba 1983, 1988).

Comparison. The present new species is more closely related to *Enterognathus lateripes* from the Red Sea than to *E. comatulae* from the northeastern Atlantic in sharing synapomorphies such as reductions in segmentation and setation: (1) only one developed seta on the caudal ramus (2 developed setae in *E. comatulae*); (2) 2-segmented antenna lacking a basal seta (3-segmented, with a single seta on the first segment); (3) a single element on the maxillary basis (2 elements); (4) fewer elements on the distal endopodal and exopodal segments of leg 1 (more elements); (5) 3 developed setae on the fifth leg (4 developed setae).

However it is readily distinguished from *E. lateripes* in the following features: (1) pedigers 2–5 wider than long (longer than wide in the latter); (2) the first post-genital somite much wider than long (about as long as wide); (3) the second and third post-genital somites about as long as wide (longer than wide); (4) the caudal ramus with 6 setae (4 setae); (5) the terminal seta of the antenna shorter than the second segment (longer); (6) the fifth leg armed with 3 developed setae and 1 minute setule (3 developed setae only); (7) the shape of the distal endopodal segments of legs 1 and 2–4 bulbous and spatulate, respectively (more or less irregular-shaped).

Members of the Enterognathidae have been characterized by the possession of a maximum of 4 setae on the female caudal ramus (see Boxshall and Halsey 2004). However the new species clearly bears 6 setae on each caudal ramus. It is probable that highly reduced setae such seta I have been overlooked in previous works. In addition, the endopods of legs 1–4 of *E. lateripes* seem to have been misinterpreted by Stock (1966). Stock (1966) interpreted a projection between both rami as originating from the basis, but it is revealed in the present study that it comes from the first endopodal segment.

Giesbrecht’s (1900) descriptions of adults and copepodid stages of *E. comatulae* are so elaborate that we can provide some morphological and evolutionary comments on the genus. A copulatory pore is located ventrally in the middle of the genital double-somite in this species (Fig. 4 in Giesbrecht 1900). Although the area around the copulatory pore of the new species is damaged, it seems to be located as in *E. comatulae*, in consideration of the configuration of the paired gonopores. As already pointed out by Stock (1966), 4 post-genital somites are clearly illustrated in *E. comatulae* (Ab2-5 in Fig. 1 in Giesbrecht 1900). Giesbrecht (1900) seems to have misinterpreted his “second abdominal” somite (Ab2) as a real somite, possibly due to a clear suture line separating it from the genital somite. If a separate genital somite is retained, this might indicate that a reversal or secondary separation of the first post-genital somite from the genital somite has occurred as known in some other copepods (Huys and Boxshall 1991). The caudal ramus of the third copepodid stage of *E. comatulae* (Fig. 3 in Giesbrecht 1900) is similar to that of *E. inabai*, suggesting that this character might be neotenic.

Zoogeography. Ohtsuka et al. (2010) pointed out that the genera *Enterognathus* and *Parenterognathus* whose hosts are shallow- to deep-water crinoids are distributed in the northeastern Atlantic through the Red Sea to the West Pacific, and that their origin could have dated back to the early late Paleocene. The present discovery shows that the genus *Enterognathus* alone shows this broad distributional pattern in the Indo-West Pacific plus the northeastern Atlantic. These endoparasitic genera seem to have originated from warm, shallow waters along the southern Eurasian coast of the Tethys Sea in the Paleocene when the North American continent was already separated and located far from Eurasian continent, and simultaneously expanded their horizontal distribution to both the northeastern Atlantic and the Indo-West Pacific since then, as inferred by Ho (1988) for the commensal harpacticoid *Sunaristes* Hesse, 1867 which exhibits a similar modern distribution pattern. In addition, it may be that the ancestor of enterognathids had vertically colonized new frontiers or deep waters since then, because the monotypic *Parenterognathus* was collected from depths of 775–787 m (cf. Ohtsuka et al. 2010). Various symbioses between copepods and invertebrate hosts could have been newly established in shallow- to deep-waters since the Paleocene.

Key to species of *Enterognathus* (females only)

- 1 Two well developed setae on the caudal ramus; antenna 3-segmented with a single seta on first segment; 4 developed setae on fifth leg; body length <5 mm (3.8–4.5 mm) *E. comatulae* Giesbrecht, 1900
- Only a single well developed seta on the caudal ramus; antenna 2-segmented without a basal seta; 3 developed setae on fifth leg; body length >5 mm 2
- 2 Pedigers 2–5 wider than long; first post-genital somite much wider than long; second and third free abdominal somites about as long as wide; fifth leg armed with 3 developed setae and 1 minute setule; body length ca. 5.2 mm. *E. inabai* sp. n.
- Pedigers 2–5 longer than wide; first post-genital somite as long as wide; second and third free abdominal somites longer than wide; fifth leg furnished with 3 developed setae only; body length ca. 6.1–6.3 mm *E. lateripes* Stock, 1966

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A new genus, two new species and a new record of subfamily Cecidophyinae (Acari, Eriophyidae) from China

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Abstract

A new genus and two new species belonging to subfamily Cecidophyinae, namely *Kyllocarus reticulatus* **gen. n.**, **sp. n.** infesting *Lithocarpus brevicaudatus* (Skan) Hay. (Fagaceae) and *Gammaphytoptus schimae* **sp. n.** infesting *Schima superba* Gardn & Champ. (Theaceae) are described and illustrated. Both new species are vagrants on their respective host plants. *Cecidophyes digephyrus* Keifer, 1966 is newly recorded for China.

Keywords

Eriophyoidea, eriophyoid mites, Cecidophyini, Colomerini, taxonomy, China

Introduction

The subfamily Cecidophyinae holds two tribes, Cecidophyini and Colomerini, which were differentiated by the former scapular tubercles and setae are absent and the later tubercles and setae are present. So far, sixteen genera and thirty-three species are known from China (Huang 2001; Huang and Cheng 2005; Huang and Wang 2004, 2009;

Kuang 1987, 1995, 1997, 1998; Kuang and Hong 1992, 1995; Kuang and Luo 1992; Kuang, Luo and Wang 2005; Li et al. 2009; Song et al. 2008; Wang et al. 2009; Wei et al. 2009; Xue et al. 2009). Herein, one new genus and new species *Kyllocarus reticulatus* gen. n., sp. n., in the tribe Cecidophyini and another new species, *Gammaphytoptus schimae* sp. n., in the tribe Colomerini are described and illustrated.

Materials and methods

Specimens were located with the aid of a magnifying glass on plant material in the field, and specimens were collected into and preserved in a sucrose-ethanol solution (75%). The mites were cleared in Nesbitt's solution and mounted in Heinze medium on glass slides at room temperature according to Kuang (1986). Specimens were measured follows de Lillo et al. (2010). The morphological terminology and the generic classification follow Amrine et al. (2003).

Type specimens are deposited in the Department of Plant Protection, Guangxi University, Nanning. All measurement units are in micrometers (μm) and rounded off to the nearest full number, and are lengths when not specified. Specimens were examined with an Olympus CX41 (Philippines) microscope with phase contrast. The number of measured specimens is given in parentheses.

Taxonomy

Tribe Cecidophyini Keifer, 1966

Genus *Cecidophyes* Nalepa, 1887

Type species. *Phytopus galii* Karpelles, 1884.

Cecidophyes digephyrus Keifer, 1966, **rec. n.**

http://species-id.net/wiki/Cecidophyes_digephyrus

Diagnosis. Body fusiform. Prodorsal shield with frontal lobe present; median, admedian lines and submedian lines complete, connected with three transverse lines forming network; scapular tubercles and setae absent. Coxisternal plates sculptured with lines. Legs with normal segments and usual setae, tarsal empodium entire 6-rayed, tarsal solenidion knobbed. Dorsal opisthosoma evenly rounded, dorsal annuli 62–68, with elongated microtubercles; ventral annuli 62–68, with rounded microtubercles, setae *h1* absent. Female genital near coxisternal plates, coverflap with two rows of ridges.

Material examination. 10 females, Qingliangfeng National Nature Reserve, Lin'an City (30°10'N, 119°07'E), Zhejiang Province, China, 24. VII. 2007, from *Quercus* sp. (Fagaceae), collected by Guo-Quan Wang, mounted on individual slide.

Distribution. USA, China (Zhejiang).

Relation to host. The mites are vagrants on the surfaces of the leaves, no visible damage seen.

Remarks. Up to date, nine species of *Cecidophyes* have been known infesting *Quercus* spp.: *C. caliquerici* (Keifer, 1944) infesting *Q. lobata* Nee and *Q. marilandica* Muen., *C. digephyrus* Keifer, 1966 infesting *Q. vaccinifolia* Kell., *C. lyrata* Keifer, 1959 infesting *Q. lyrata* Walt., *C. pusilla* Keifer, 1962 infesting *Q. falcata* Michx., *C. quercialbae* Keifer, 1959 infesting *Q. alba* L., *C. querciphagus* (Keifer, 1939) infesting *Q. sp.*, *C. reticulatus* Livshitz, Mitrofanov et Vasil'yeva, 1979 infesting *Q. pubescens* Willd., *C. tampae* Keifer, 1966 infesting *Q. virginiana* and *C. tristernalis* (Nalepa, 1898) infesting *Q. cerris* L. Among them, only one species, *C. tampae* occurred in China. *C. digephyrus* is second *Cecidophyes* species from China (Keifer 1939, 1944, 1959a, b, 1962, 1966; Livshitz *et al.* 1979; Nalepa 1898; Xue *et al.* 2009).

Genus *Kyllocarus* Wang, Wei & Yang, 2012, gen. n.

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<http://species-id.net/wiki/Kyllocarus>

Type species: *Kyllocarus reticulatus* Wang, Wei & Yang, 2012, sp. n.

The new genus with flattened fusiform body, palp genual seta strongly angular prodorsal shield lacking scapular setae (sc) and tubercles, strong wide frontal lobe over gnathosoma, legs normal, except leg II lacking genual seta *l*^o. Sternal apodeme present; opisthosoma differentiated into broader smooth dorsal annuli and narrower microtuberculate ventral annuli; empodium simple; genitalia very close to coxae, bearing two ranks of numerous ridges.

Diagnosis. This cecidophyine mite is very near to *Kolacarus* in that the genual seta *l*^o is absent on Leg II; however, it differs from other cecidophyine mites in that palp genual seta *d* is bent or crooked, possibly minutely bifurcate. It differs from *Kolacarus* in that the mite has a wide, strong frontal lobe projecting from the prodorsal shield over the gnathosoma; *Kolacarus* has a normal palp genual seta *d*, and no frontal lobe on the anterior prodorsal shield.

Etymology. *Kyllo-* from Gr. *Kyllos*, crooked + *-carus* from *Acarus*; the name is masculine.

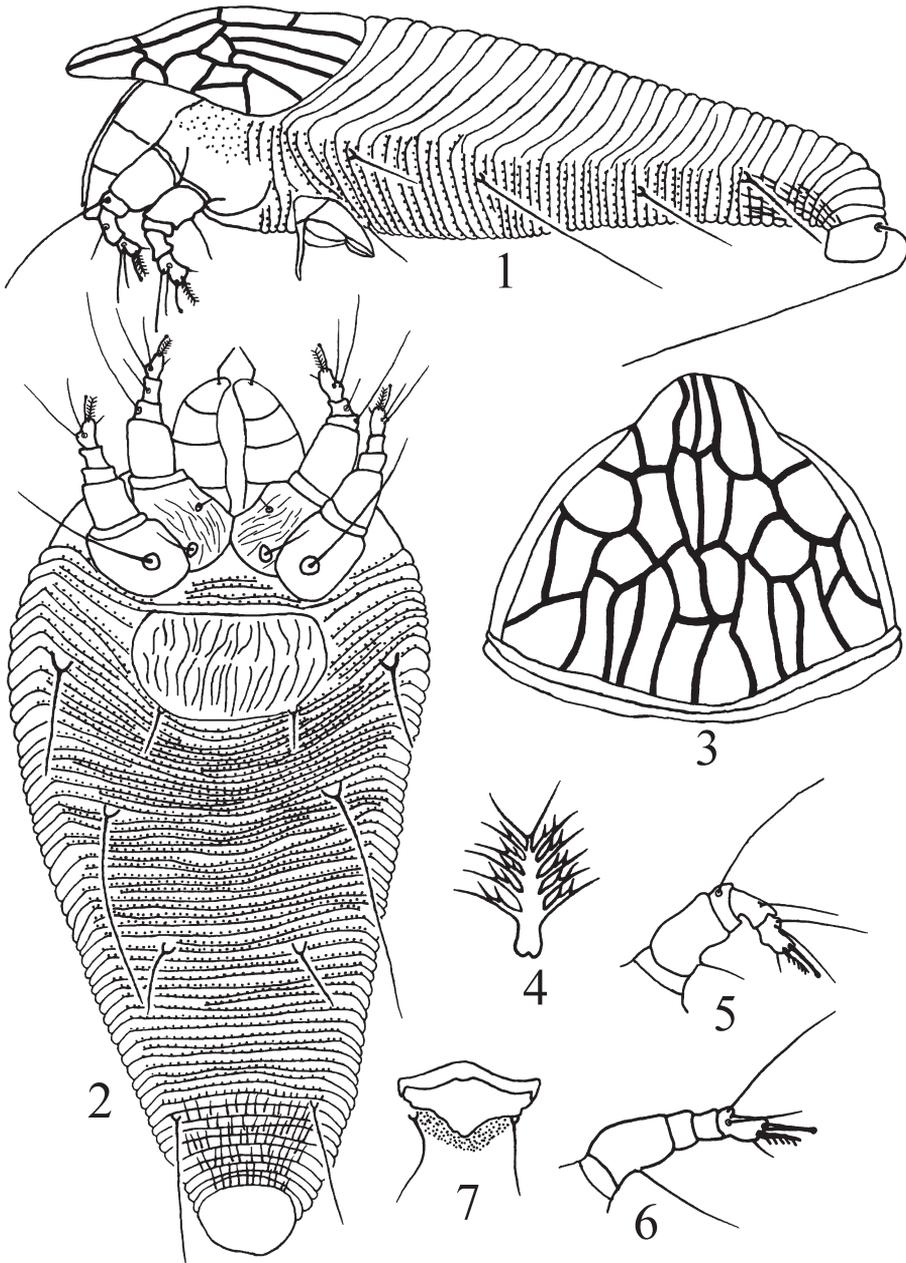
***Kyllocarus reticulatus* sp. n.**

urn:lsid:zoobank.org:act:7358B76E-13F4-4968-82F4-2500479953D0

http://species-id.net/wiki/Kyllocarus_reticulatus

Figs 1–7

Diagnosis. Body fusiform, white translucency or yellow. Gnathosoma curved obliquely downward, dorsal genual setae (*d*) bend forming obtuse angle at middle. Prodorsal



Figures 1–7. *Kolacarus reticulatus* sp. n. **1** lateral view of female **2** ventral view of female **3** anterior dorsal view of female **4** tarsal empodium **5** leg I **6** leg II **7** male genitalia

shield with frontal lobe present; all lines bold and connected with transverse lines forming network; scapular tubercles and setae absent. Coxisternal plates sculptured with lines, prosternal apodeme present, coxigenital annuli 4. Legs segments normal,

legs II with genual setae (l'') absent, tarsal empodium entire, 6-rayed, tarsal solenidion knobbed. Dorsal opisthosoma with shallow median furrow, dorsal annuli smooth; ventral annuli with rounded microtubercles, setae $h1$ absent. Female genitalia coverflap with two rows of ridges

Description. Female ($n = 11$). Body fusiform, white translucency or yellow, 172 (150–204), 75 (69–79) wide, 60 (54–63) thick.

Gnathosoma. Curved obliquely downward, 30 (28–31), coxal setae (ep) 6 (6–7), dorsal genual setae (d) bend forming obtuse angle at middle, 11 (10–12); cheliceral stylets 31 (30–33).

Prodorsal shield. 63 (58–70), 69 (65–74) wide, frontal lobe present; all lines bold; median, admedian and submedian lines complete, connected with transverse lines forming network; scapular tubercles and setae absent.

Coxisternal plates. Prosternal apodeme present, coxisternal plates I and II sculptured with lines; anterolateral setae on coxisternum I ($1b$) 3 (3–4), 13 (12–13) apart; proximal setae on coxisternum I ($1a$) 5 (5–6), 13 (12–13) apart; proximal setae on coxisternum II ($2a$) 31 (29–33), 29 (29–30) apart. Coxigenital annuli 4.

Legs. Segments normal. Legs I 34 (30–37), trochanter 2 (2), femur 11 (10–11), femoral setae (bv) 13 (10–15); genu 5 (4–5), genual setae (l'') 30 (29–32); tibia 7 (6–8), tibial setae (l') located laterally and distally, 15 (13–18); tarsus 8 (7–9), inner fastigial tarsal setae (ft) 27 (25–28), outer fastigial tarsal setae (ft'') 18 (15–20), unguinal tarsal setae (u) 5 (4–5); tarsal empodium entire, 12 (11–13), 6-rayed, tarsal solenidion 7 (6–8), knobbed. Legs II 27 (26–30), trochanter 2 (2), femur 10 (10–11), femoral setae (bv) 23 (20–25); genu 4 (4–5), genual setae (l'') absent; tibia 4 (4–5); tarsus 7 (6–7), inner fastigial tarsal setae (ft) 24 (23–25), outer fastigial tarsal setae (ft'') 14 (13–15), unguinal tarsal setae (u) 4 (4–5); tarsal empodium entire, 6 (5–7), 6-rayed, tarsal solenidion 7 (7–8), knobbed.

Opisthosoma. Dorsum with shallow median furrow, dorsal annuli 43, smooth; ventral annuli 63, with rounded microtubercles; setae $c2$ 23 (20–25), on ventral annulus 10th; setae d 71 (63–79), 42 (41–43) apart, on ventral annulus 22th; setae e 11 (8–13), 24 (23–25) apart, on ventral annulus 38th; setae f 24 (22–25), 24 (24–25) apart, on 10th ventral annulus from rear; setae $h1$ absent, setae $h2$ 31 (26–39).

Female genitalia. Near coxisternal plates, coverflap with two rows of ridges, 24 (23–25), 43 (38–49) wide, proximal setae on coxisternum III ($3a$) 9 (9–10), 23 (23–24) apart.

Male ($n = 2$). Body fusiform, 120–140, 58–61 wide.

Prodorsal shield. 53–55, 55–57 wide, frontal lobe present; all lines bold; median, admedian lines and submedian lines complete, connected with transverse lines forming network; scapular tubercles and setae absent.

Coxisternal plates. Prosternal apodeme present, coxisternal plates I and II sculptured with lines; anterolateral setae on coxisternum I ($1b$) 3, 11 apart; proximal setae on coxisternum I ($1a$) 5, 11 apart; proximal setae on coxisternum II ($2a$) 27, 28 apart. Coxigenital annuli 4.

Legs. Segments normal. Legs I 30, trochanter 2, femur 10, femoral setae (bv) 12; genu 4, genual setae (l'') 27; tibia 6, tibial setae (l') located laterally and distally, 12;

tarsus 7, inner fastigial tarsal setae (*ft*) 24, outer fastigial tarsal setae (*ft*^o) 15, unguinal tarsal setae (*u*) 4; tarsal empodium entire, 10, 6-rayed, tarsal solenidion 6, knobbed. Legs II 26, trochanter 2, femur 10, femoral setae (*bv*) 18; genu 4, genual setae (*l*^o) absent; tibia 4; tarsus 6, inner fastigial tarsal setae (*ft*) 21, outer fastigial tarsal setae (*ft*^o) 12, unguinal tarsal setae (*u*) 4; tarsal empodium entire, 5, 6-rayed, tarsal solenidion 7, knobbed.

Opisthosoma. Dorsum with shallow median furrow, dorsal annuli 42, smooth; ventral annuli 62, with rounded microtubercles; setae *c*2 20, on ventral annulus 10th; setae *d* 57, 40 apart, on ventral annulus 22th; setae *e* 7, 21 apart, on ventral annulus 38th; setae *f*20, 21 apart, on 10th ventral annulus from rear; setae *h*1 absent, setae *h*2 27.

Male genitalia. Near coxisternal plates, 36 wide, proximal setae on coxisternum III (*3a*) 8, 23 apart.

Type material. Holotype female, China: Zhejiang, Longquan City, Fengyangshan National Nature Reserve (27°53'N, 119°11'E), 27. VII. 2007, collected by Guo-Quan Wang, from *Lithocarpus brevicaudatus* (Skan) Hayata (Fagaceae). Paratypes, 10 females and 2 males.

Distribution. China (Zhejiang).

Etymology. The species is named after the network-form of the prodorsal shield.

Tribe Colomerini Newkirk & Keifer, 1975

Genus *Gammaphytoptus* Keifer, 1939

Type species: *Gammaphytoptus camphorae* Keifer, 1939.

Gammaphytoptus schimae sp. n.

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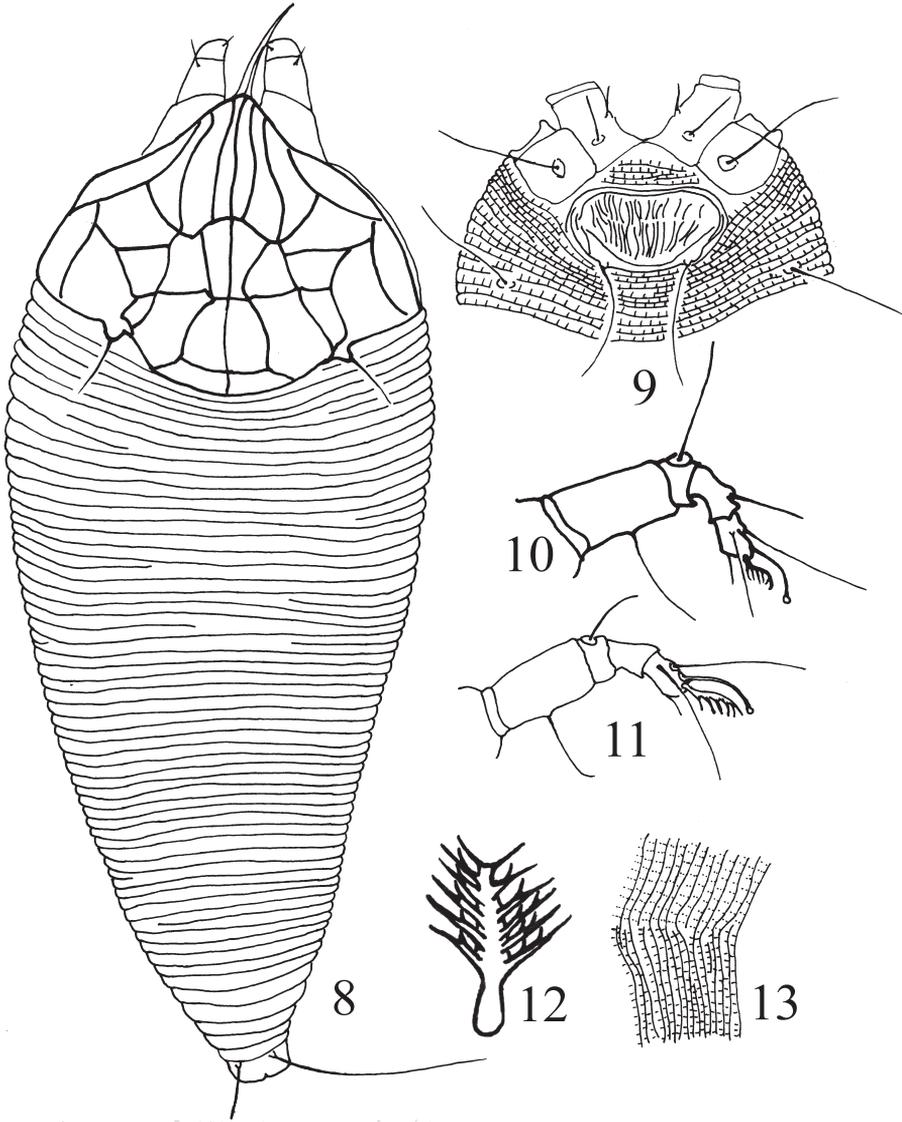
http://species-id.net/wiki/Gammaphytoptus_schimae

Figs 8–13

Diagnosis. Body fusiform, yellow. Gnathosoma curved obliquely downward, dorsal genual setae (*d*) bend forming obtuse angle at middle. Prodorsal shield with frontal lobe present; all lines bold and connected with transverse lines forming network; scapular tubercles and setae absent. Coxisternal plates sculptured with lines, prosternal apodeme present, coxigenital annuli 4. Legs segments normal, legs II with genual setae (*l*^o) absent, tarsal empodium entire, 6-rayed, tarsal solenidion knobbed. Dorsal opisthosoma with shallow median furrow, dorsal annuli smooth; ventral annuli with rounded microtubercles, setae *h*1 absent. Female genitalia coverflap with two rows of ridges.

Description. Female (n = 11). Body fusiform, yellow, 183 (169–200), 71 (65–78) wide, 44 (38–52) thick.

Gnathosoma. Curved obliquely downward, 34 (28–35), coxal setae (*ep*) 2 (2–3), dorsal genual setae (*d*) 10 (9–11); cheliceral stylets 30 (28–32).



Figures 8–13. *Gammaphytoptus schimae* sp. n. **8** dorsal view of female **9** coxigenital area of female **10** leg I **11** leg II **12** tarsal empodium **13** lateral view of annuli.

Prodorsal shield. 51 (48–52), 55 (50–63) wide, frontal lobe present; median, ad-median and submedian lines complete, connected with three transverse lines forming network; scapular tubercles placed at rear shield margin, 35 (31–39) apart, scapular setae (*sc*) 8 (8–9), directed backward and divergence.

Coxisternal plates. Prosternal apodeme present, coxisternal plates smooth; antero-lateral setae on coxisternum I (*lb*) 8 (7–9), 13 (12–13) apart; proximal setae on coxis-

ternum I (*1a*) 25 (19–31), 15 (14–15) apart; proximal setae on coxisternum II (*2a*) 35 (28–39), 28 (27–30) apart. Coxigenital annuli 4.

Legs. Segments normal. Legs I 36 (34–38), trochanter 2 (2), femur 12 (12–13), femoral setae (*bv*) 18 (15–22); genu 4 (4–5), genual setae (*l*ⁿ) 35 (31–40); tibia 10 (9–10), tibial setae (*l*) located 1/4 from apical, 8 (7–8); tarsus 8 (7–8), inner fastigial tarsal setae (*fi*) 20 (18–23), outer fastigial tarsal setae (*fi*ⁿ) 25 (23–28), unguinal tarsal setae (*u*) 5 (5–6); tarsal empodium entire, 7 (7–8), 6-rayed, tarsal solenidion 10 (9–10), knobbed. Legs II 31 (29–34), trochanter 2 (2), femur 11 (11–12), femoral setae (*bv*) 23 (19–27); genu 3 (3–4), genual setae (*l*ⁿ) 10 (7–12); tibia 7 (7–8); tarsus 8 (7–8), inner fastigial tarsal setae (*fi*) 10 (9–12), outer fastigial tarsal setae (*fi*ⁿ) 25 (22–29), unguinal tarsal setae (*u*) 5 (5–6); tarsal empodium entire, 8 (8–9), 6-rayed, tarsal solenidion 10 (9–11), knobbed.

Opisthosoma. Dorsum evenly rounded, dorsal annuli 59–60, with semi-translucency elongated microtubercles; ventral annuli 81, with filament microtubercles; setae *c*2 38 (35–40), on ventral annulus 13th; setae *d* 45 (37–50), 43 (38–45) apart, on ventral annulus 28th; setae *e* 27 (23–32), 25 (23–26) apart, on ventral annulus 44th; setae *f*38 (34–45), 23 (21–26) apart, on 7th ventral annulus from rear; setae *h*1 absent, setae *h*2 57 (53–65).

Female genitalia. Near coxisternal plates, coverflap with two rows of ridges, 17 (16–18), 30 (29–22) wide, proximal setae on coxisternum III (*3a*) 20 (17–25), 13 (13–14) apart.

Male. Unknown.

Type material. Holotype female, China: Zhejiang, Longquan City, Fengyangshan National Nature Reserve (27°53'N, 119°11'E), 28. VII. 2007, collected by Guo-Quan Wang, from *Schima superba* Gardn. et Champ. (Theaceae). Paratypes, 8 females.

Distribution. China (Zhejiang).

Etymology. The species is named from the generic name of the type host plant.

Remarks. This new species is similar to *G. zuihoensis* Huang & Wang, 2004, but they can be easily separated as follows: in *G. schimae*, median line is complete, setae *h*1 is absent and infesting *Schima superba* Gardn. & Champ.; in *G. zuihoensis*, median line is incomplete, setae *h*1 is present and infesting *Machilus zuihoensis* Hay. var. *zuihoensis* (Huang and Wang 2004).

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Immature stages and ecology of two species of the South African genus *Stripsipher* Gory & Percheron, 1833 (Coleoptera, Scarabaeidae, Cetoniinae, Trichiini)

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Abstract

Based on the study of newly accessible type material, *Stripsipher drakensbergi* Ricchiardi, 1998, is demoted to a junior synonym of *S. jansoni* Péringuey, 1908. The genus *Stripsipher* Gory & Percheron, 1833, thus, currently includes 12 species, but for none of these are larval stages and/or pupae currently known. The immature stages of *S. orientalis* Ricchiardi, 2008 and *S. jansoni* are described here for the first time and updated observations on distribution and ecology of both species are provided. Morphological affinities of *Stripsipher* with other Trichiini larvae are presented and the main diagnostic differences discussed. The larvae of both species are very similar to those of other representatives of the tribe Trichiini, with key differences found on the epipharynx. Based on the morphology of larvae and adults, it is suggested that *Stripsipher* is a member of the clade composed of Valgini, Trichiini and Cryptodontini.

Keywords

Trichiini, *Stripsipher*, New Synonym, South Africa, Immature stages, Larva, Pupa

Introduction

Following the latest revision, the genus *Stripsipher* currently includes 13 species (Ricchiardi et al. 2008) (see list below). For one of these, *S. jansoni* Péringuey, 1908, it had not been possible in the past to examine any type specimen and, therefore, the position of *incertae sedis* had been preferred for the species. Recently, the lectotype (here desig-

nated) has become accessible for analysis, courtesy of J Krikken of the Museum Naturalis, Leiden. Péringuey (1908) described this species from a pair, however the actual location of the female is unknown. This has now revealed that *S. jansoni* is actually a senior synonym of *S. drakensbergi* Ricchiardi, 1998. Therefore the current number of recognized species for the genus is reduced to 12.

An important contribution to this analysis could come from studies of larval characteristics of the species included in the genus. Unfortunately, there are still too few descriptions of Trichiini larvae and none currently known for the genus *Stripsipher*. Here, we provide the first description of the larvae of two species of this genus, which were conclusively identified through the rearing of cohorts collected in their natural environments.

Material and methods

The classification of the Cetoniidae used here follows Krikken (1984). A number of divergent classification systems have been proposed recently (e.g. Scholtz and Grebennikov 2005; Smith in Bouchard et al. 2011), but they remain equally controversial and not universally accepted.

The terminology for larval morphology follows Hayes (1929), Böving (1936), Richter (1966) and Sawada (1991). Hair-like setae of cranium and other structures were classified according to their relative size into two groups, medium to long (100–500 μm) and minute (20–50 μm , or less) setae, in order to give the most accurate information on chaetotaxy. Refer to Šípek et al. (2008; Fig. 12) for a detailed schematic figure. Morphological analysis and measurements were carried out using Olympus SZX9 and Olympus BX 40 light microscopes, both equipped with digital camera Olympus Camedia 5060. Mouthparts were dissected and if necessary mounted on slides in Liquide de Swan (e.g. Švácha and Danilevsky 1986). Photographs of beetles and larvae were taken using a Canon 550D digital camera equipped with a Canon MP-E 65/2,8 MACRO lens with 5:1 optical magnification. Final images were composed from multiple layer-focus pictures using Helicon Focus software. Structures examined at the scanning electron microscope JEOL 6380 were cleaned in 10% lactic acid for 24 hours, dried with critical point drying and mounted on aluminium plates. Drawings were made on the basis of photographs and all photographs were digitally enhanced (levels adjustment, background elimination, sharpening) using Adobe Photoshop.

Larval rearing

Eleven and 22 larvae of *S. jansoni* and *S. orientalis* were collected at Cobham (KZN southern Drakensberg) or Karkloof and Entumeni (KZN Midlands), respectively. Three to five specimens of each population were immediately fixed in 10% formalin, while the others were reared to adulthood in the laboratory, using their natural food sources (soil detritus and decomposing wood). They were kept in an environmental control room at

the University of KwaZulu-Natal at a constant temperature of 22°C during the summer, which was then gradually decreased during the colder seasons to a minimum of 15°C in winter (July–September). Larvae were kept in 10-litre buckets filled to approximately half capacity with their natural soil/wood. The surface layer of each bucket was sprayed with tap water at regular weekly intervals until pupation of the bulk of the larvae, but left to dry out thereafter. The success rate was about 80% for both species, with adults emerging in good conditions over a period of about two months, from late October to December.

Phylogenetic analysis

To test the phylogenetic position of *Stripsipher*, a previously published larval/adult morphological dataset (Micó et al. 2008, Šípek et al. 2009) was used, which was supplemented with new data. Methods of phylogenetic reconstructions follow Šípek et al. 2009. All bioinformatic analyses were carried out on the freely available Biportal (www.biportal.uio.no).

Abbreviations used

Province & country codes

LES	Kingdom of Lesotho
RSA	Republic of South Africa
SWA	Kingdom of Swaziland

RSA provinces

ECA	Eastern Cape
FST	Free State
GAU	Gauteng
KZN	KwaZulu-Natal
MPU	Mpumalanga
NCA	Northern Cape
NWE	North-West
LIM	Limpopo
WCA	Western Cape

Collection and specimen codes

ISAM	Iziko South African Museum, Cape Town (RSA)
MNHN	Museum National d’Histoire Naturelle, Paris (France)
ERC	Private Collection Enrico Ricchiardi, Turin (Italy).

RPC	Private Collection Perissinotto & Clennell, Durban (RSA)
RNHL	Netherlands Centre for Biodiversity, Naturalis (formerly known as National Museum of Natural History) , Leiden (Netherlands)
SANC	South African National Collection of Insects, Pretoria (RSA)
TMSA	National Museum of Natural History (formerly Transvaal Museum), Pretoria (RSA)
HT	Holotype
PT	Paratype
LT	Lectotype

Stripsipher species list

<i>Stripsipher braunsi</i>	Ricchiardi, 1998	WCA, ECA
<i>centralis</i>	Ricchiardi, 1998	KZN, FST, MPU
<i>jansoni</i>	Péringuey, 1908	ECA, KZN, LES, FST, MPU
= <i>drakensbergi</i>	Ricchiardi, 1998	Syn. nov.
<i>lamellatus</i>	Ricchiardi, 2008	KZN
<i>longipes</i>	(Swederus, 1787)	WCA, ECA, KZN, MPU, GAU, NWE
<i>orientalis</i>	Ricchiardi, 2008	ECA, KZN, MPU, GAU, NWE, NOP, SWA
<i>signatulus</i>	Ricchiardi, 2008	KZN
<i>spectralis</i>	Arrow, 1926	ECA, KZN
<i>superbus</i>	Ricchiardi, 2008	KZN
<i>turneri</i>	Arrow, 1926	ECA, KZN
<i>wernerii</i>	Ricchiardi, 1998	KZN
<i>zebra</i>	Gory & Percheron	WCA

Distribution and ecology

Stripsipher orientalis

This is a forest dwelling species (Figs 1A, C, E), which completes its larval development inside old tree trunks and branches, feeding on decaying, soft wood. It is distributed from the Eastern Cape north-eastwards, including KwaZulu-Natal, Swaziland, Mpumalanga, Gauteng, North–West and Limpopo (Fig. 2).

Larvae have been found in a variety of tree species (e.g. *Podocarpus* spp., *S. Endrödy-Younga* and *P. Istvan*, specimen data labels), mostly in relict afro-montane and coastal rainforests (e.g. Fort Fordyce, Umthamvuna, Karkloof, Entumeni, Monk's Cowl). Invariably, they attack old wood that has already been partly consumed by other saproxylic species, but is still suspended in the air or at least not directly in touch

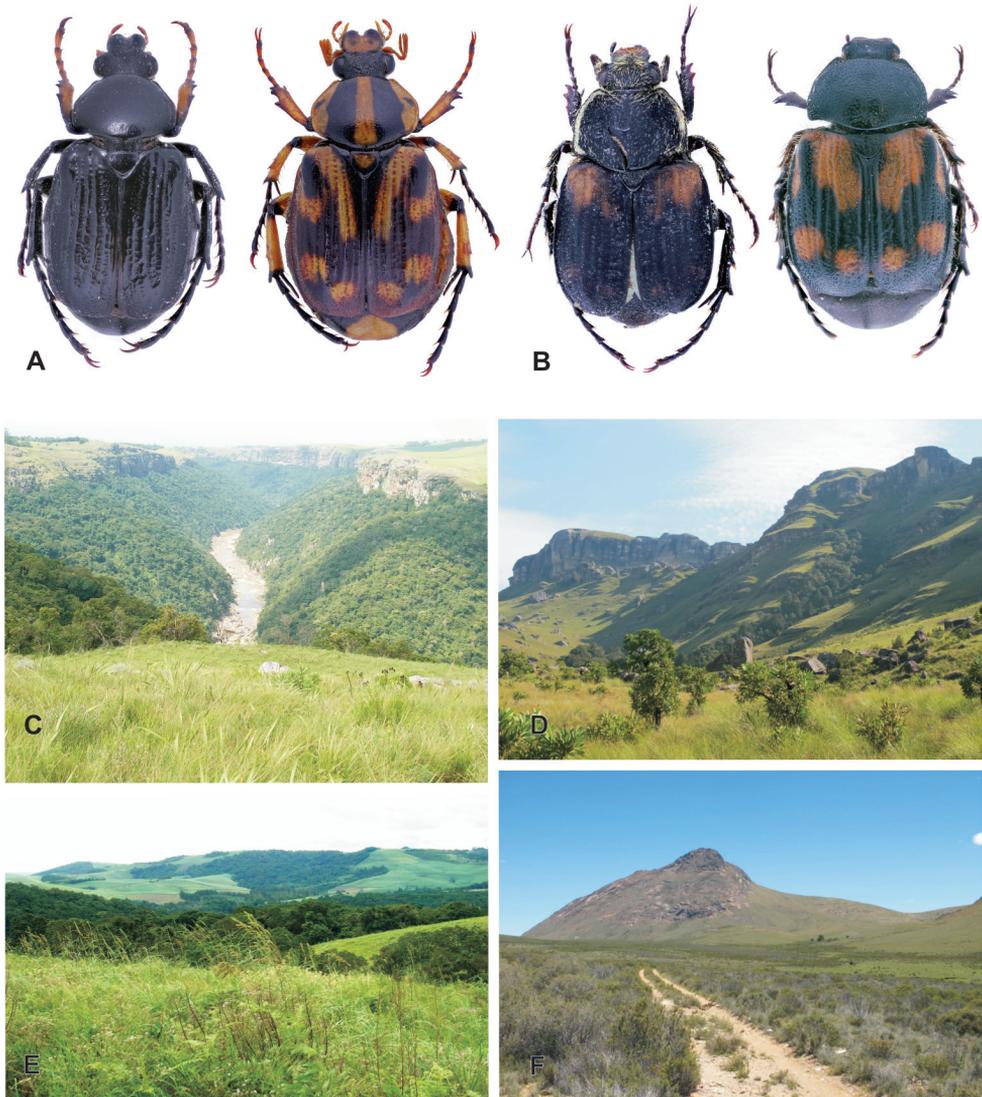


Figure 1. **A** *Stripsipher orientalis*: male (left, melanic form) and female (right, typical form) **B** *S. jansoni* male (left) and female (right) **C, E** dense riverine and afro-montane forest pockets are the preferred habitats of *S. orientalis* (**C** – Umthamvuna KZN **E** – Entumeni KZN) **D, F** mountain grassland habitats of *S. jansoni* (**D** – Cobham/Drakensberg KZN **F** – Compassberg ECA). (Fig. 1C–F Lynette Clennell).

with the ground, presumably in order to avoid soil predators (e.g. ants). They appear to avoid entirely dying or recently dead trunks and branches. Larvae have been reared successfully in captivity, in environmental control rooms in Durban, by one of the authors (R.P.).

Adults of the species are active from September to February, exhibiting a peak of records during the months of December (33% of total) and November (26%). They

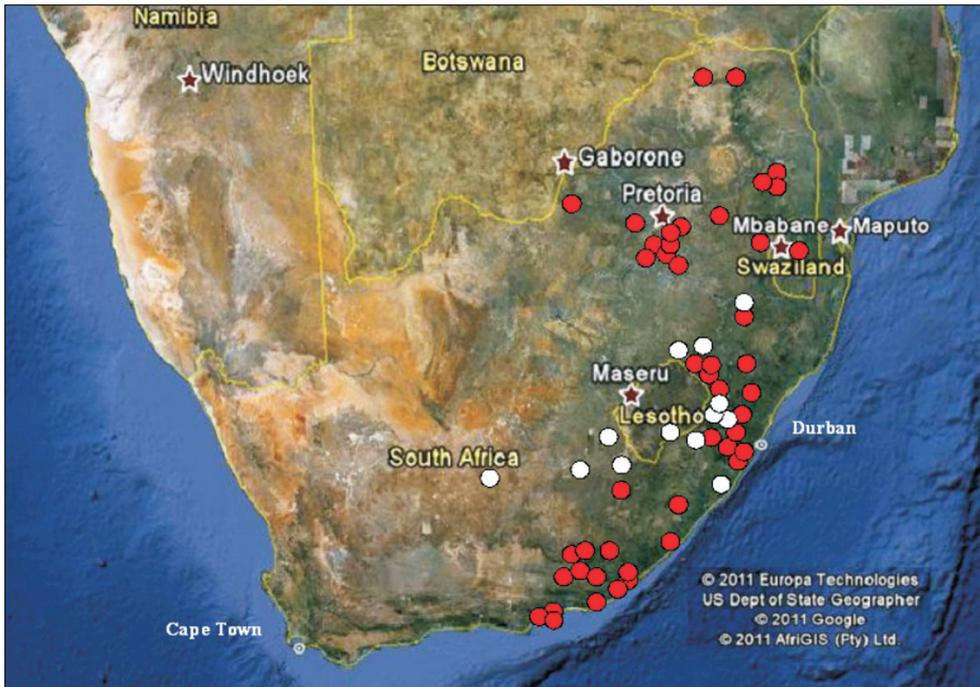


Figure 2. Distribution of *S. orientalis* (red circles) and *S. jansonii* (white circles).

have been observed flying in dense forests around decomposing wood during the hottest part of the day, or alternatively crawling on dead trunks/ branches and even in tunnels inside the wood. They feed on nectar, having been recorded on a variety of flower types, including *Buddlia saligna*, *Sizigium cordatum*, *Dalbergia obovata*, *D. armata* and *Protea caffra*. They have also been captured with fruit-baited traps on at least two occasions (S. Endrödy & M. Klimaszew and O. Bourquin, specimen data labels) and in Malaise traps (R. Miller, specimen data label), but not at sap flows.

Material examined. SOUTH AFRICA: HT♂, GAU, Johannesburg, W.G. Kobrow (ISAM); PT 1♀, GAU, Florida, 15 Oct 1976 (TMSA); PT 1♀, MPU, Graskop, Dec 1974, P.E. Reavell (TMSA); PT 1♀, KZN, Drakensberg, Cathedral Peak, 28 56 S, 29 13 E, under bark, 25 Nov 2003, M. Burger & R Müller (TMSA); PT 1♀, ECA, Transkei, Umtata, 25 Nov 1989, N. Duke (TMSA); PT 1♀, GAU, Witbank M.J.P, Dec 1961, A.R.I. Pretoria (TMSA); South Africa, KZN, 1 PT (#), New Hanover, Dec 1955, Natal A.R.I., M.B. Bayer legit (TMSA); PT 1♀, MPU, Belfast, 6 Dec 1988 (TMSA); PT 1♀, NWE, TUC, SE 2526 Ab, Zeerust, 22 Dec 1987, W.Z. Schultz (TMSA); PTs 6♀, MPU, Belfast, 25 38 S, 30 08 E, 15 Dec 1988, R.I. Mansfield (TMSA); PT 1♀, MPU, Berlin F.S. gorge, 25.32 S, 30.44 E, 23 Oct 1986, E-Y: 2304, intercept trap 42d, Endrödy-Younga (TMSA); PT 1♀, KZN, Himeville, Farm Meander (Brookland), 29 35 S, 29 42 E, Dec 1988, S. Mclean (TMSA); PT 1♀, ECA, East London, 2 Dec 1921, H.K. Munro (TMSA); PT 2♀, MPU, Belfast, 6 Dec 1988,

H.P. Terblanche (TMSA); PT 2♀, ECA, Kubusie Forest, Stutterheim, 3 Jan 1980, N.J. Duke (TMSA); PT 1♀, ECA, next Kologha Forest, 1092 m, 6 Km NE Stutterheim, 32 33 S, 27 22 E, day beating, 25 Nov 2000, Krüger & Dombrowsky (TMSA); PT 1♀, GAU, Jan Smuts, SE 2826 Aa, 27 Nov 1980, C.L. v/d Hoven (TMSA); PT 1♀, KZN, Weza Ingeli Forest, 30.32 S, 29.41 E, E-Y: 2692, hanging fruit traps, 18 Nov 1989, Endrody & Klimaszew (TMSA); PT 1♂, KZN, Ferncliffe Forest Res, 29 33 00 S, 30 20 30 E, 975 m, Mistbelt Mixed Forest, 23 Nov 1987, J.G.H. Londt (TMSA); PT 1♂, MPU, Barberton, Miss De Beer (TMSA); PT 1♂, MPU, Belfast, 25 38 S, 30 08 E, 15 Dec 1988, R.I. Mansfield (TMSA); PTs 2♂, ECA, Kubusie Forest, Stutterheim, 6 Jan 1982, N.J. Duke (TMSA); PT 1♂, ECA, Hogsback, 14 Feb 1978, N.J. Duke (TMSA); PT 1♂, ECA, The Haven, Transkei, 2 Jan 1981, N.J. Duke (TMSA); PT 1♂, ECA, East London: Buffalo Pass, 29 Sep 1984, N.J. Duke (TMSA); PT 1♂, KZN, Karkloof, 12 Feb 1929, Bill Marley (TMSA); PTs 5♂, GAU, Johannesburg, Emerentia, Sep 1974, H.R. Heburn (TMSA); PT 1♂, GAU, Magaliesburg, 26 00 S, 27 32 E, 16 Nov 1993, (TMSA); PT 1♂, GAU, Johannesburg, Transvaal, Nov 1931, G. Kobrow (TMSA); PT 1♂, GAU, Johannesburg, Transvaal, Nov 1934, G. Kobrow (TMSA); PT 1♂, KZN, "Northington", Dargle, 28 27 S, 30 04 E, 25 Jan 1988, baited forest trap near edge, O. Bourquin (TMSA); PT 1♂, ECA, Amatole, Isidenge For. St., B1, 32.41 S, 27.14 E, 15 Nov 1987, E-Y 2515, *Podocarpus* bark, Endrody-Younga (TMSA); PT 1♂, MPU, Belfast, 6 Dec 1988, H.P. Terblanche (TMSA); PT 1♂, ECA, Kubusie Forest, Stutterheim, C.P., 3 Jan 1980, N.J. Duke (TMSA); PT 1♂, ECA, Buffalo Pass E.L., 20 Dec 1979, N.J. Duke (TMSA); PT 1♂, ECA, Buffalo Pass E.L., 23 Oct 1979, N.J. Duke (TMSA); PT 1♂, ECA, East London, 29 Oct 1923, G. van Son (TMSA); PT 1♂, ECA, P. Elizabeth, 6 Jan 1910, on beach (TMSA); PT 1♂, ECA, G. town, Oct 1894, 7.Pym (TMSA); PT 1♂, GAU, Pretoria, Waterkloof, 25.43 S, 28.11 E, 5 Nov 1989, Endrody-Younga (TMSA); PT 1♀, ECA, Van Staden's Riv, near Thornhill, 33.55 S, 25.12 E, 06 Dec 1988, B. Grobbelaar (SANC); PT 1♀, ECA, Clark's Siding 1650 m, Dordrecht 31 24 S, 27 07 E, 21 Dec 2000, B.H. Catherine (SANC); PT 1♀, KZN, Royal Natal National Park, Natal Drakensberg, 1550 m asl, Tugela Gorge, Montane *Podocarpus* forest, in old log on the ground, 21 Oct 1993, Pajor Istvan (SANC); PT 1♀, ECA, Pt. Elizabeth, 1899, J.L. Drege (SANC); PT 1♀, MPU, Mariepskop, Blyderivier, D. Wessels (SANC); PT 1♀, LIM, Blouberg 1480 m, 23 05 20 S, 29 01 60 E, 04–07 Dec 1990, Chown, Steenkamp & McGeogh (SANC); PT 1♂, ECA, East London CP, Sep 1923, Ent. SN. 2649 (SANC); PT 1♂, KZN, Oribi Gorge, Oct 1993, M. Vogt (SANC); PT 1♂, GAU, Heidelberg, 26.31 S, 28.12 E, 25 Nov 1984, R. Oberprieler (SANC); PT 3♂, GAU, Kempton Park, 26.06 S, 28.15 E, from larva in rotten wood, Nov 1987, P. Wight (SANC); PT 1♂, GAU, Johannesburg TP, Dec 1953, G.A. Hepburn (SANC); PT 3♂, GAU, Centurion Lyttelton, 25 48 S, 28 11 E, 1460 m, 07 Nov 1999, A. Glanvill (SANC); PT 1♂, KZN, Cathkin Peak, Drakensberg Mnts, 28 46 S, 29 10 E, 1400 m, 18–20 Dec 1998, P.E. Reavell (SANC); PT 1♂, LIM, Lajuma Farm, Soutpansberg, 23 02 S, 29 20 E, 22 Nov 1997, R. Stals (SANC); PT 1♂, KZN, Pietermaritzburg, town bush, Malaise trap, Oct 1976, R. Miller (SANC); PT 1♂, ECA, Bedford, 30 Dec. 1994, R. Perissinotto & L. Clennell (RPC); PT 1♀,

KZN, Natal Midlands, Howick, 29°29'S, 30°14'E, 12 Dec. 1989, O Bourquin (ERC); PT 1♂, ECA, Amatole, Isigende For., Stat. A1, 32° 41' S, 27° 16' E, 28 Nov. 1987, Endrody-Younga (ERC); PT 1♂, GAU, Pretoria, Waterkloof, 25°43'S, 28°11'E, 18 Dec. 1988, Endrody-Younga (ERC); PT 1♂, GAU, Florida, 15 Oct. 1976 (ERC); PT 1♀, KZN, Karkloof For., 29°18'S, 30°13'E, 1300 m, 4 December 1989, Endrody-Younga & Klimaszew (ERC); PTs 3♀, ECA, Fort Fordyce, 18 Jan. 1998, R. Perissinotto L. Clennell (ERC); PT 2♂, KZN, Vernon Crookes, 30°16'S, 30°36'E, 28 Nov. 1998, R. Perissinotto & L. Clennell (ERC); PT 1♂, ECA, Cape Recife, 6 Dec. 1997, R. Perissinotto & L. Clennell (ERC); PT 1♂, ECA, Cape Recife, 17 Feb. 1996, R. Perissinotto & L. Clennell (RPC); PT 1♀, ECA, Alexandria Forest, 25 Sep. 1994, R. Perissinotto & L. Clennell (RPC); PT 1♂, ECA, Cathcart/Queenstown Road, 1 Dec. 1997, M. Burger (RPC); PT 1♂, ECA, Morgan Bay, 16 Oct. 1994, R. Perissinotto & L. Clennell (RPC); PT 1♂, ECA, Van Stadens Mouth, 20 Feb. 1994, R. Perissinotto & L. Clennell (RPC); PTs 1♂1♀, ECA, Near Bedford, 24 Nov. 1995, R. Perissinotto & L. Clennell (RPC); PT 1♀, ECA, Fort Brown, 29 Nov. 1996; R. Perissinotto & L. Clennell (RPC); PT 1♀, ECA, Woody Cape, 7 Oct. 1994, R. Perissinotto & L. Clennell (RPC); PT 1♂, ECA, 1 PT (♂), Fort Fordyce, 15 Feb. 1998, R. Perissinotto & L. Clennell (RPC); PTs 1♂1♀, KZN, Karkloof, 22–23 Jan 2000, R. Perissinotto & L. Clennell (RPC); PT 1♂, same data but 3 Feb 2002 (RPC); PTs 1♂1♀, MPU, Barberton, Makonjwa Mt. 1250 m, 27 Dec. 1995, P Stobbia (RPC); PTs 2♂1♀, KZN, Umthamvuna, 24 Oct. 2004, R. Perissinotto & L. Clennell (RPC); PTs 1♂1♀, KZN, Oriibi Gorge, 13 Nov. 2004, R. Perissinotto & L. Clennell (RPC); PTs 3♀, KZN, near Impendle, 11 Dec. 2004, R. Perissinotto & L. Clennell (RPC); PTs 1♂1♀, KZN, Pongola Bush N.R., 19 Dec. 2005, R. Perissinotto & L. Clennell (RPC); PTs 2♂2♀, same data but Oct. 2006 (RPC); 1♂, KZN, Cavern Resort, 29 Oct 2006, MDTP 92288 Coll III (RPC); 1♀, ECA, near Adelaide, 27 Dec 2007, R. Perissinotto & L. Clennell (RPC); 2♂3♀, KZN, Monk's Cowl, 31 Oct 2009, R. Perissinotto & L. Clennell (RPC).

SWAZILAND: PT 1♀, Mbabane, Sidwashini, 18 Nov 1990, N.J. Duke (TMSA).

Stripsipher jansoni

S. jansoni (Fig. 1B) is a mountain grassland inhabitant and is currently known from a small number of high altitude localities (Figs 1D, F): from the Compassberg (2300 m) in the Eastern Cape to the Kwamandlangampisi Mountain (2266 m) near Dirkiesdorp, in Mpumalanga (Fig. 2). An exception to this, possibly due to an error in identification, appears to be the record from the Mbotyi Forest (G. van Son, specimen data label) which is a coastal locality of elevation not exceeding approximately 500 m

Larvae of this mountain dweller have been found under stones and in crevices among rocks, where they feed on accumulations of decomposing grass litter or herbivore dung (Ricchiardi et al. 2008). Particularly well utilized appear to be the pellets of Rock hyrax, *Procapra capensis*, locally known as “dassie”, which at these high altitudes attract not only *S. jansoni*, but also scores of larvae of other Cetoniinae species (e.g.

Xeloma spp., *Rhinocoeta* spp., *Trichostetha* spp., *Rhabdotis* spp., *Leucocelis* spp. *Parelaphinis moesta*, *Hypselogenia geotrupina*) (Holm and Marais 1992, Holm and Perissinotto 2004, R.P. pers. observ.). Larvae from the Drakensberg (Cobham Nature Reserve) and the Kwamandlangampisi Mountain have been reared successfully in captivity, in environmental control rooms in Durban by R.P.

Reflecting its high altitude habitat, *S. jansoni* exhibits a delay in its adult activity, compared to *S. orientalis*. Records range from October to March, with peaks in December (48% of total) and January (24%). *S. jansoni* belongs to a species group within the genus that does not exhibit any feeding at the adult stage. Adults have been found crawling on the ground, flying low above the ground (10–50 cm) or resting on a variety of grasses. On one occasion, a female specimen was collected on yellow flowers of an unidentified shrub species on the Compassberg (R.P. pers. observ.), but it could not be established whether this was for the purpose of feeding or simply resting.

Material examined. SOUTH AFRICA: LT ♂ (*S. jansoni*), Natal, without additional data, (RNHL); HT♂ (*S. drakensbergi*), FST, Golden Gate N.P., 28 30 S, 28 31 E, I-1980, IC Sharp (SANC); PT 1♂ (*S. drakensbergi*), KZN, Drakensberg, 4-I-1925, D Kroom (ERC); PT 1♀ (*S. drakensbergi*), ECA, Embotyi Forest, Pondoland, 25/28-II-1957, G van Son (TMSA); PTs 3♂3♀ (*S. drakensbergi*), ECA, Compassberg, 2300 m, 15 Dec 1997, R Perissinotto & L Clennell (ERC, RPC); 2♂, same data but 27 Dec 1997 (RPC); 2♂1♀, same data but 28 Dec 1997 (RPC); 1♀, KZN, Cobham Nature Reserve, 10 Oct 1998, R Perissinotto & L Clennell (RPC); 1♂, same data but 14 Dec 1998 (RPC); 7♂3♀, same data but 13 Dec 1999 (RPC); 1♂, same data but 5 Feb 2000 (RPC); 1♀, same data but 8 Dec 2002 (RPC); 3♂, KZN, Bulwer Mt, 5 Mar 2000, R Perissinotto & L Clennell (RPC); 3♂2♀, FST, Zastron, 6 Jan 2000, R Perissinotto & L Clennell (RPC); 1♀, FST, Golden Gate, 11 Jan 2002, R Perissinotto & L Clennell (RPC); 1♂ [partly decomposed carcass], FST, Harrismith, 14 Dec 2002, R Perissinotto & L Clennell (RPC); 2♀ [partly decomposed carcass], MPU, Kwamandlangampisi Mt., Dirkiesdorp, 17 Dec 2005, R Perissinotto & L Clennell (RPC); 2♂1♀, same data but Nov 2006 (RPC); 1♂, ECA, Lady Grey, 14 Jan 2005, R Perissinotto & L Clennell (RPC); 1♀, ECA, larva Witteberge Jan 2005, emerged Durban Oct 2005, R Perissinotto & L Clennell (RPC); 1♂, ECA, Kramberg, 27 Dec 2007, R Perissinotto & L Clennell (RPC); 2♂, ECA, Matatiele, 7 Dec 2008, R Perissinotto & L Clennell (RPC).

LESOTHO: 1♂, High Orange Valley, 1500 m, 1906, E. Haug leg. (MNHN).

Larval morphology

Third instar larvae of the genus Stripsipher (Figs 3–6)

Material: 5 last instar larvae of *S. orientalis* (South Africa, KZN Karkoof, 29°18'55"S, 30°15'04"E, 1300 m asl, 14 Feb 2004, in rotten suspended tree branch, R. Perissinotto

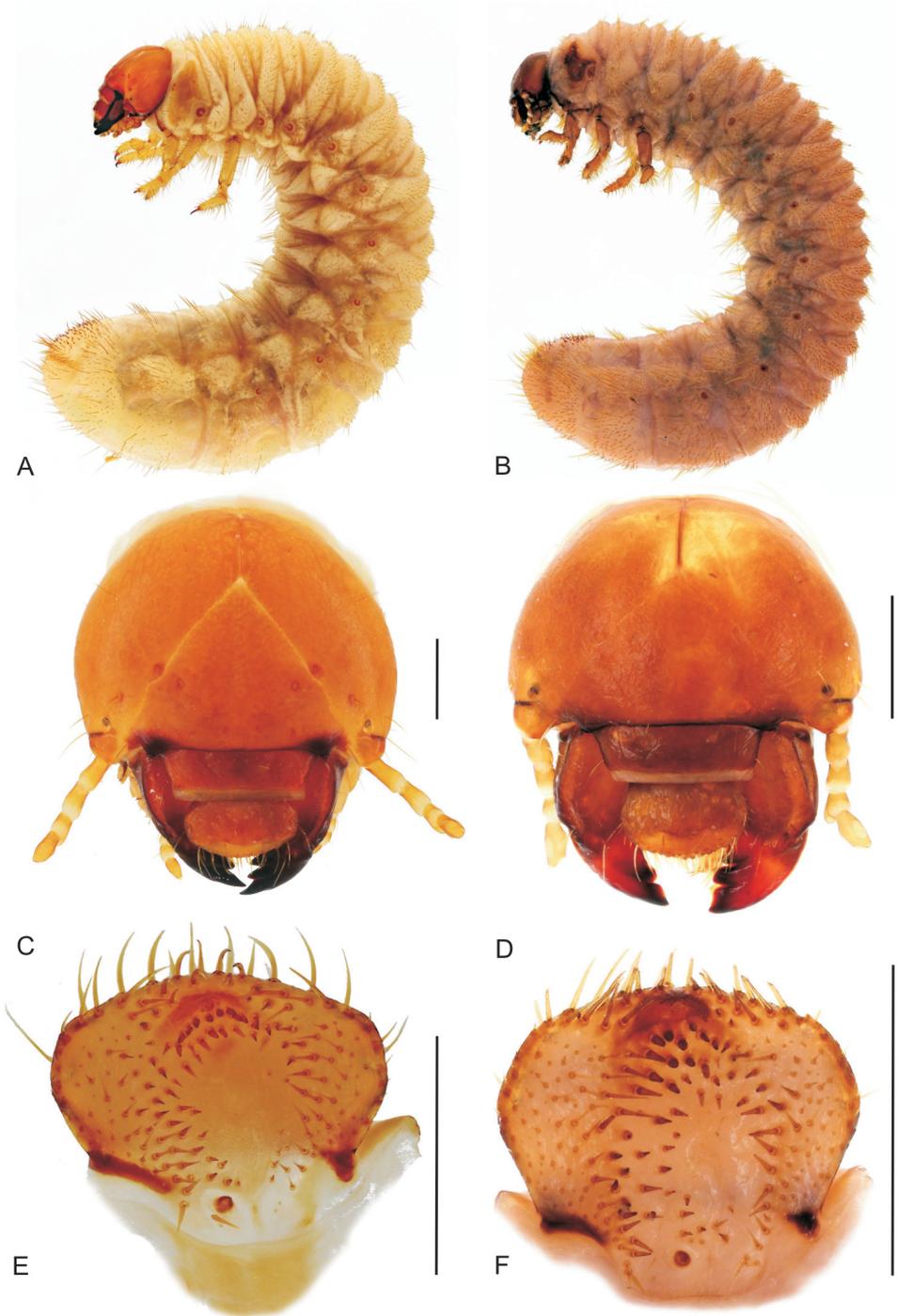


Figure 3. **A, B** habitus of fully grown larva (**A** – *S. orientalis* 51 mm **B** – *S. jansoni* 36 mm) **C, D** cranium of fully grown larva (**C** – *S. orientalis* **D** – *S. jansoni*) **E, F** Epipharynx (**E** – *S. orientalis* **F** – *S. jansoni*). Scale bar: 1 mm.

& L. Clennell lgt); 5 last instar larvae of *S. orientalis* (South Africa, KZN Entumeni, 28°52'43"S, 31°18'36"E, 854 m asl, Feb 2004, in decomposing but standing tree trunk, R. Perissinotto & L. Clennell lgt); 3 last instar larvae of *S. jansoni* (South Africa, KZN Cobham, 29°39'36"S, 29°23'02"E, 2560 m asl, 13 Dec 1999, underground, on plant detritus around rock boulder, R. Perissinotto & L. Clennell lgt).

Larvae C-shaped, grub like, abdomen 10-segmented, segments of thorax and abdomen almost equal, abdominal segments 7–9 somewhat elongated. Length of larvae studied (third instars) 33–51 mm. **Head capsule** (Figs 3C, D): maximum width between 2.8 and 4.2 mm. Surface of cranium with faint microsculpture, orange brown to brown, antennifer, postclypeus and labrum brown. Cranial chaetotaxy summarized in Table 1. Frontal sutures straight, slightly crooked in the anterior part. Epicranial insertions of antennal muscles distinct, more sclerotised than the surrounding area of epicranium or only indicated as a small depression near middle of frontal sutures. Clypeus trapezoidal, anteclypeus narrow and membranous, postclypeus heavily sclerotised with one exterior and one anterior clypeal setae on each side. Frontoclypeal suture distinct. A single pigmented stemma present on each side.

Antennae (Figs 3C, D): antennomeres (an) subequal in length (relative length: an I = an IV > an II > an III; an II about 2/3 of an I and an IV). Third antennomere (an III) with ventral, apical projection exhibiting a single sensory spot. Last antennomere (an IV) with two or three ventral and one dorsal sensory spot and a small apical sensory field with faint sensillae.

Labrum symmetrical, anterior margin convex with numerous setae. Medial part with transverse, emarginated protuberance. Dorsal labral surface with two transverse rows of setae. Posterior row with about 10 setae, anterior row with one paramedian and one lateral seta on each side.

Epipharynx (Figs 3E–F, 4A–B): Haptomerum with strong haptomeral process and two to four transversal arched rows of stout setae. Haptomeral process prominent, well sclerotised with apical field of five pores and several others scattered around. Acroparia with about 30 long setae, clithra and epizygum absent. Lateral margin of epipharynx heavily sclerotised, especially in distal part. Plegmata and proplegmata absent. Acanthoparia with seven to eight setae. Chaetoparia asymmetric, with right exhibiting seven to eight irregular rows of setae and left five to six. Setae of medial rows stout, spine-like. Dextiotorma bar-like, straight, longer than laeotorma, right pternotorma almost or entirely absent. Laeotorma triangular with posterior pternotorma. Sense cone of haptolachus with four pores, sclerotised plate absent. Crepis faintly sclerotised, indistinct.

Mandibles (Figs 4C–F): prominent asymmetrical, scrobis with several setae and a deep longitudinal furrow. Two prominent setae and two pores present on apical half of dorsal mandibular surface, and one posterior seta at distal end of longitudinal furrow. Patches of dorsomolar and ventromolar setae present on both mandibles, ventromolar setae concealed in a single rim, dorsomolar setae more or less separated in the respective rims. Stridulatory area present with about 20 transversal ridges (Figs 4C, D). Right mandible with two and left mandible with three scissorial teeth. Molar lobes of both

Table 1. Cranial chaetotaxy of *S. orientalis* and *S. jansoni*.

Group of setae	epicranium				frons				clypeus		labrum			
	DES	PES	AES	EES	PFS	EFS	AFS	AAS	ACS	ECS	PLS	PMS	ELS	LLS
<i>S. orientalis</i>														
Long and medium setae	2(1)	1(2)	1	5–10	1	0	0	1	1	1	4–6	1	1	14–22
minute setae	0–2	2–5(0)	0 (1)	0–3	1	1	1	0	0	0 (1)	0–2	0 (1)	0	0
<i>S. jansoni</i>														
Long and medium setae	2	1–2	1	8–9	1	0	0	1	1	1	3–6	1	1	19–16
minute setae	0–2	0–3		0–1	0–1	0	0	0	0	0	0–2	0	0	0

Abbreviations: AAS = setae on anterior frontal angle; ACS = anterior clypeal setae; AES = anterior epicranial setae; AFS = anterior frontal setae; DES = dorsoepicranial setae; ECS = exterior clypeal setae; EES = exterior epicranial setae; EFS = exterior frontal setae; ELS = exterior labral setae; LLS = setae on lateral labral lobe; PES = posterior epicranial setae; PFS = posterior frontal setae; PLS = posterior labral setae; PMS = paramedial labral setae. Numbers in brackets indicate a rarely occurring state. For explanation of length categories of setae see ‘Material and methods’.

mandibles with sharp projections; posterior margin of calyx in medial aspect concave on right mandible, flattened and convex on left; brustiae with three to four and 10–12 setae on right and left mandible, respectively.

Maxilla (Figs 5, 6A, B): dorsal surface of cardo and dorsal and ventral surfaces of labacobarria with hair-like setae and pores; ventral side of cardo bald. Dorsal surface of stipes with 10–20 slender hair-like setae in one to three longitudinal rows; oblique row of two to six well sclerotised spine-like stridulatory teeth and an anterior truncate process (blunt tubercle) distad to the row (Figs 5A, B, G, H, 6B). Stipes with few ventral setae. Galea and lacina entirely fused forming mala, galeo-lacinal suture dorsally visible as desclerotised line (Fig. 6B), entirely absent on ventral face (Fig. 6A). Galean portion of mala with single falcate unci and several long and stout hair-like setae in longitudinal rows; lacinal part of mala with two reduced unci fused at their base and two apical stout spine-like setae (Figs 5E–F); dorsomedial side with numerous and very long hair-like setae. Ventral surface of mala with row of three to five stout setae and few long setae. Maxillary palps four-jointed, with basal joint often partially retracted into the palpifer, making palps appear three-jointed (Figs 5A, B, 6A, B). Penultimate joint usually with two setae.

Hypopharyngeal sclerome (Figs 5C, D) asymmetrical with strong protruding and pointed truncate process. Tufts of tegumentary expansions (= phoba, sensu Böving, 1936) present on left lateral lobe, hypopharyngeal sclerome proximal to truncate process and below hypopharyngeal sclerome, but present or absent near its right proximal border. Right lateral lobe not sclerotised.

Ligula (Figs 5C, D) dorsally with numerous setae, proximal setae stout conical and short, posterior setae hair-like, long. Dorsal surface of ligula with pit-like organ in

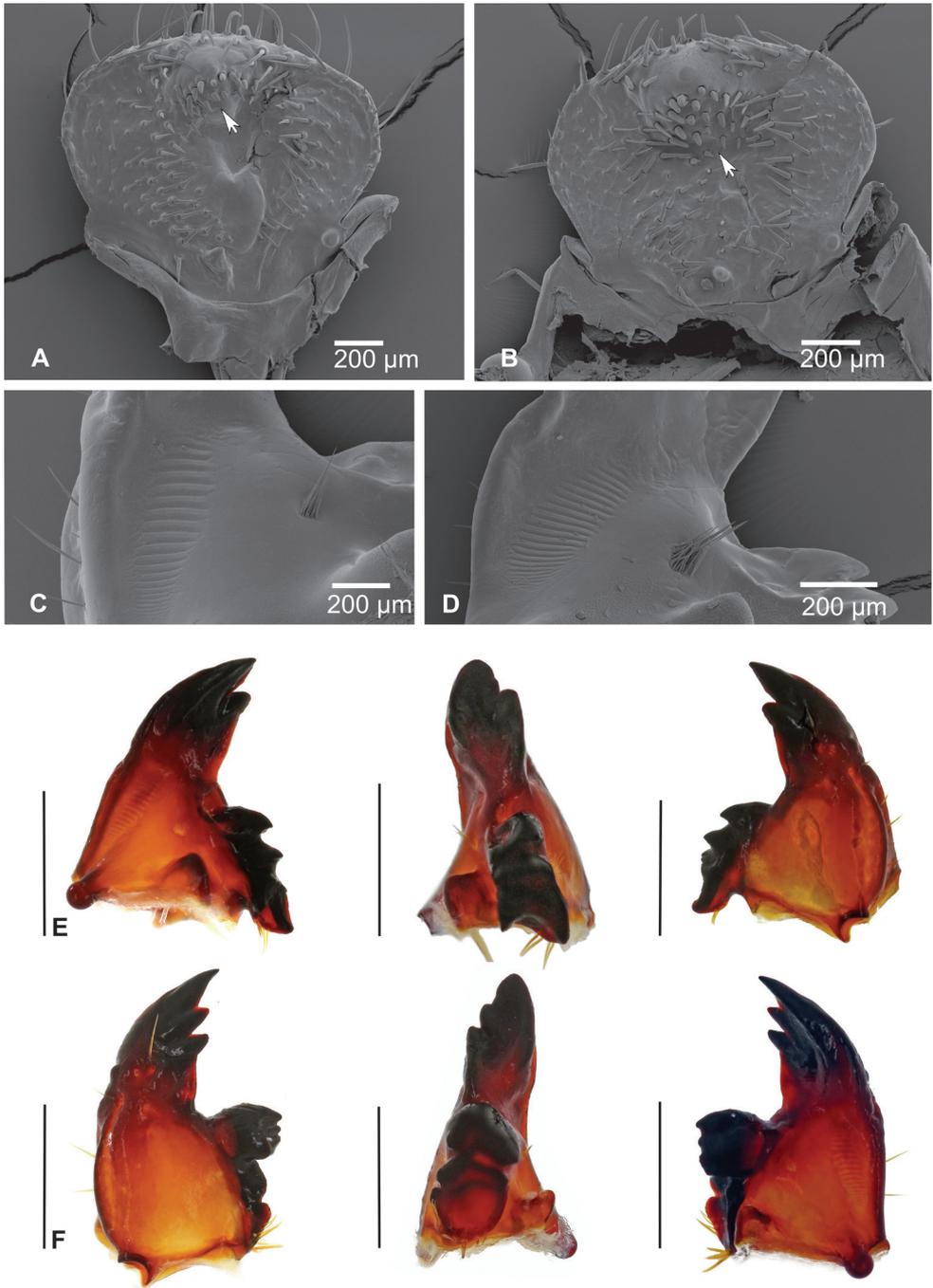


Figure 4. **A, B** SEM images of epipharynx, (**A** – *S. orientalis* **B** – *S. jansoni*) **C, D** right mandible, detail of the stridulatory area (**C** – *S. orientalis* **D** – *S. jansoni*) **E** – *S. orientalis*, right mandible: ventral, medial and dorsal aspect **F** – *S. orientalis*, left mandible: dorsal, medial and ventral aspect. Scale bar: 1mm (when not otherwise specified).

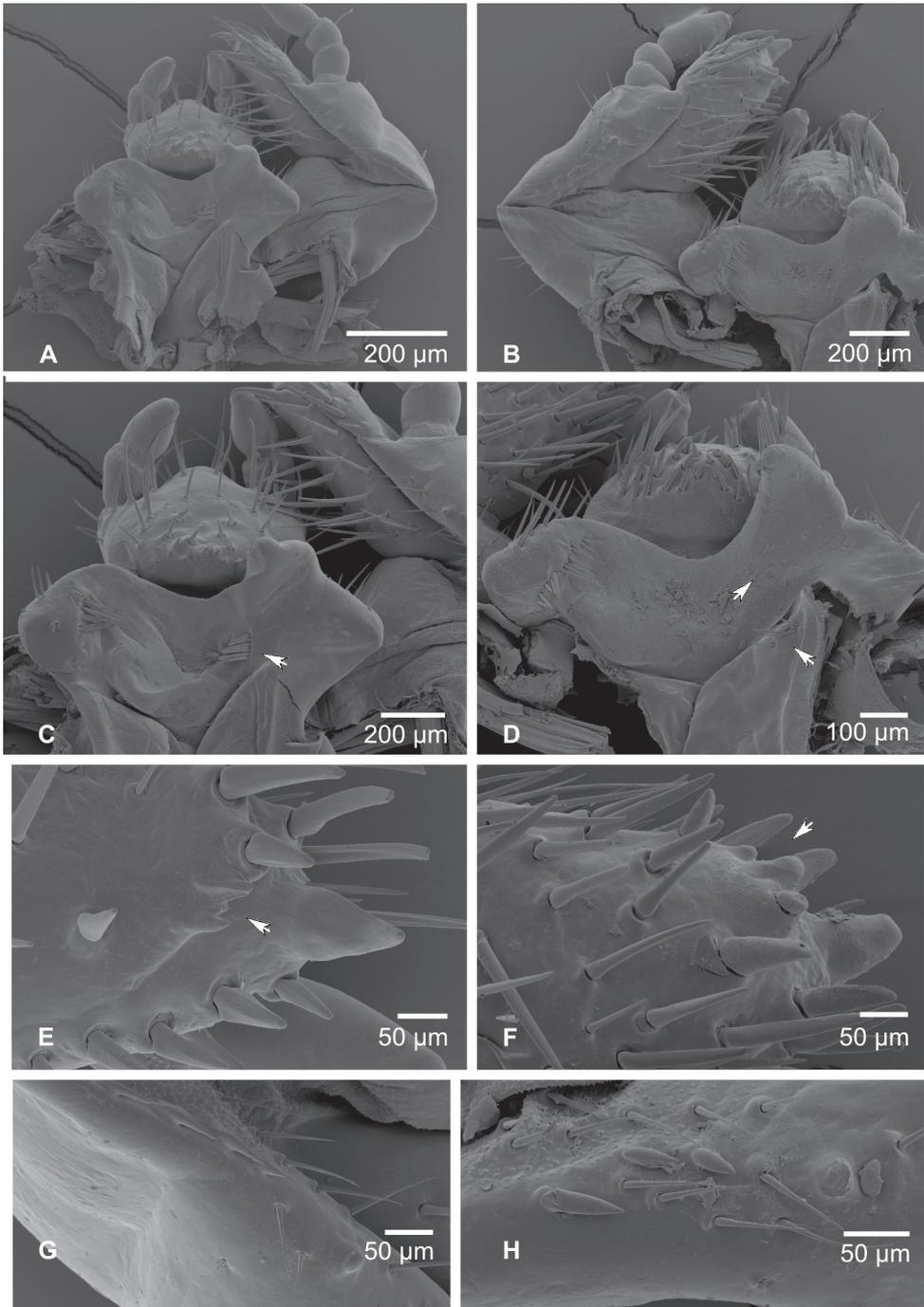


Figure 5. **A, B** Labio-maxillary complex and hypopharynx, dorsal aspect (**A** – *S. orientalis* **B** – *S. jansoni*) **C, D** Labium and hypopharynx, SEM image (**C** – *S. orientalis* **D** – *S. jansoni*) **E, F** apex of maxilla, unci, latero medial aspect (**E** – *S. orientalis* **F** – *S. jansoni*) **G, H** stridulatory teeth of maxilla (**G** – *S. orientalis* **F** – *S. jansoni*).

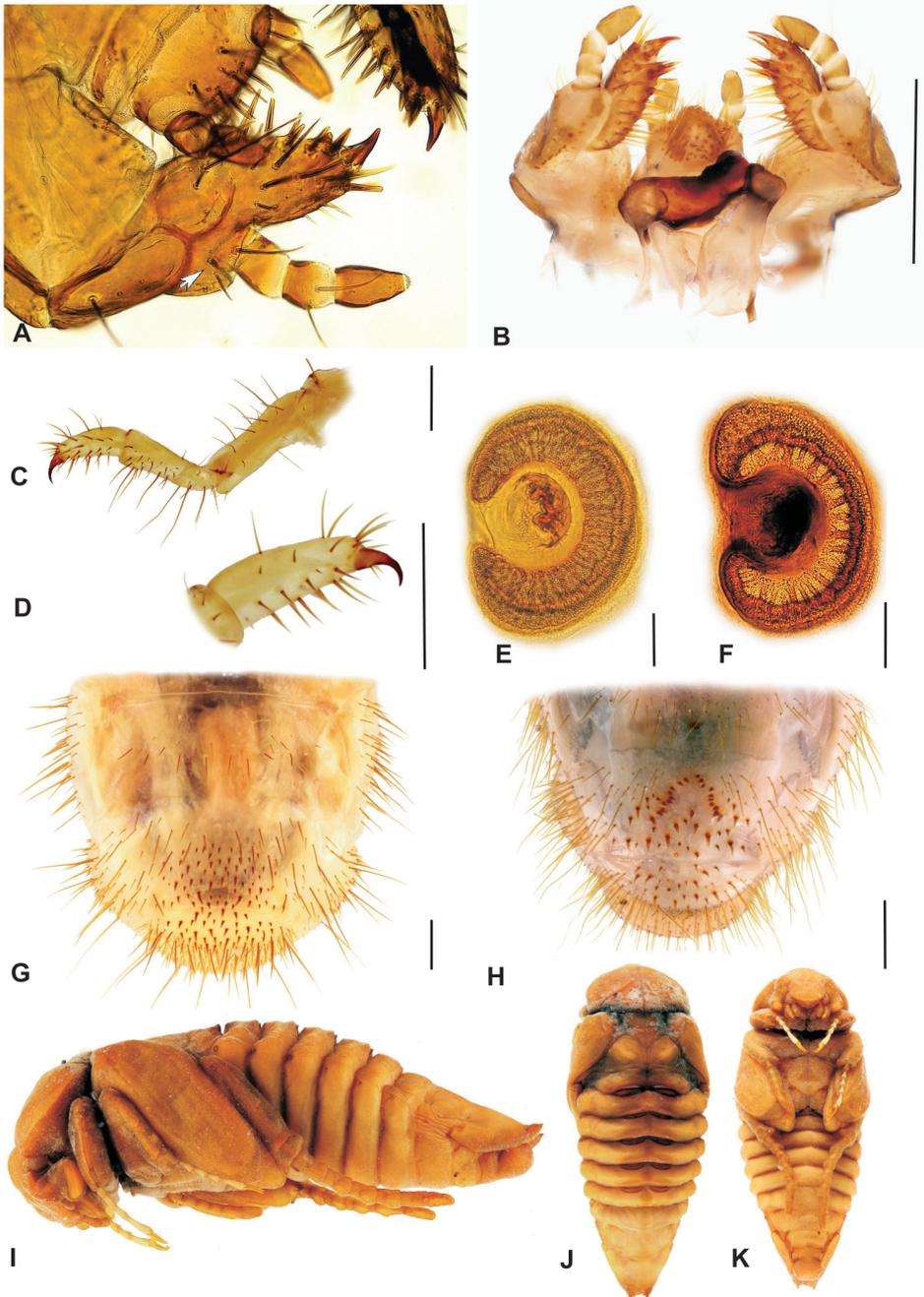


Figure 6. **A** *S. orientalis*, labium and maxilla, ventral aspect (arrow indicating basal joint of maxillar palpus retracted into palpiger) **B** – *S. jansoni*, labiomaxillar complex, dorsal aspect **C**, **D** *S. orientalis*, metathoracic leg **C** – general view, lateral aspect, **D**–metatibiotarsus with claw; **E**, **F** – thoracic spiracles (**E** – *S. orientalis* **F** – *S. jansoni*) **G**, **H** last abdominal segments, ventral aspect (**G** – *S. orientalis* **F** – *S. jansoni*) **I**, **J**, **K** *S. jansoni* pupa, lateral, dorsal, and ventral aspect (14.8 mm). Scale bar: 1 mm.

the medial portion and several pores in the distal half. Posterior margin with pair of long paramedian setae. Labial palpi two-segmented.

Thorax (Figs 3A, B): Prothorax with single dorsal lobe, meso- and methatorax with three well developed lobes. Each dorsal sublobe of thoracic segments with one to three rows of short setae, posterior row with short setae interspersed with long setae. Prothoracic sclerite covering almost the whole lateral portion of prothorax, posterior border with median projection extending almost behind the distal margin of mesothoracic spiracle. Mesothoracic spiracle (Figs 6E, F) with C-shaped respiratory plate; distance between lobes of respiratory plate almost equal to the maximum diameter of respiratory plate. Respiratory plate with 12–25 holes across diameter. All pairs of legs (Figs 3A, B, 6C, D) subequal and with similar tarsal claws; claws falcate, sharp pointed and bearing two proximal setae (Fig. 6D).

Abdomen (Figs 3A, B, 6G, H): ten-segmented. Dorsa of abdominal segments I–VI with three sublobes, segments VII and VIII with only two. Each sublobe bearing three to five rows of short setae, posterior one or two rows with long setae interspersed between the short ones. Abdominal spiracles similar to mesothoracic spiracles, but slightly smaller. Size of spiracles decreasing caudad. Smallest spiracle on abdominal segment VIII, reaching about two thirds of the size of the mesothoracic one. Raster either without palidium and with fused teges composed of numerous hamate setae (septula absent, Fig. 6G), or with palidium consisting of paired oblique rows of pali (Fig. 6H). Each row of approximately ten pali, extending forward and inwards, thus forming a “V” or “U” on the medial portion of last abdominal segment, enclosing a small septula. Teges composed of few hamate setae. Ventral anal lip with 20–40 hamate setae, dorsal lip with several long hair-like setae; same setae present also on ventrolateral and ventroanterior portions of last abdominal segment.

Morphology of pupa (Figs 6I–K)

Length 14.8–19.4 mm, maximal width 6–8.2 mm. Exarate, testaceous, surface glabrous. Head bent ventrally. Mouthparts and antenna well separated. Labrum tumid, clypeus slightly concave. Maxilla elongated and conical. Compound eyes distinct. Thorax: pronotal disk convex. Lateral margins of pronotal disc distinct. Meso- and metanotum differentiated. Mesonotum with triangular posterior projection. Pterotectae free, closely compressed around body and almost equal in length. Spines and spurs on tibiae rudimentary, tarsomeres well defined. Abdomen: dorsally with nine visible, progressively narrowing segments. Terga of segments I–VI with five pairs of gin traps (*sensu* Hinton 1946) or dioneiform organs (*sensu* Costa et al. 1988, Fig. 6J). First pair heavily sclerotised, with straight or slightly concave anterior and concave posterior margin. Subsequent gin traps less sclerotized, sickle-like, convex on both margins. Tergum of first abdominal segment with transversal row of protuberances ahead of gin traps. Spiracles on first four abdominal segments functional, with sclerotized ring, first spiracular pair covered by pterothecae. Spiracles on abdominal segments V–VIII

non-functional and rudimentary. Last abdominal segment with pair of small, pointed, non-articulated urogomphi. Genital ampula of male pupae spherical and prominent.

Diagnostic characters of *S. orientalis* Ricchiardi, 2008 (Figs 3A, C, E; 4A, C, E, F; 5A, C, E, G; 6A, C–E, G).

Material: five last instar larvae (South Africa, KZN Karkoof, 29°18'55"S, 30°15'04"E, 1300 m asl, 14 Feb 2004, in rotten suspended tree branch, R. Perissinotto & L. Clennell lgt.); five last instar larvae (South Africa, KZN Entumeni, 28°52'43"S, 31°18'36"E, 854 m asl, Feb 2004, in decomposing but standing tree trunk, R. Perissinotto & L. Clennell lgt).

Body length 34–51 mm, cranium width between 3.9–4.2 mm ($n = 5$). Chaetotaxy as in table 1. Antenna with 3 ventral sensory spots ($n = 9$; in a single case only two ventral sensory spots present). Haptomerum of epipharynx with two transversal arched rows of 12–13 (7–9) stout setae respectively and a proximal sclerotised area (Figs 3E, 4A). Acanthoparia asymmetric, right half with approximately 55–60 setae, left with 40–45. Maxilla: stipes dorsal with a single row of approximately 10 slender hair-like setae and two to four narrow stridulatory teeth (Fig. 5G). Ventral face of mala with a row of four to six stout conical setae. Lacinial unci pointed (Fig. 5E). Tufts of tegumentary expansions (= phoba, *sensu* Böving, 1936) on the hypopharyngeal sclerome proximal to truncate process present, but absent below the hypopharyngeal sclerome (near to its right proximal border) (Fig. 5C). Dorsal part of ligula with approximately 40 conical to long hair-like setae (Fig. 5C). Size of thoracic spiracles 0.42–0.43 x 0.3–0.32 mm (length x width). Respiratory plate with 20–25 holes across diameter (Fig. 6E). Body vestiture more or less sparse; setae on dorsum of ninth abdominal segment separated by bald area into two fields. Raster without palidium and septula, teges fused (Fig. 6G). Hamate setae of teges subequal in size and shape.

Diagnostic characters of *S. jansoni* Péringuey, 1908 (Figs 3B, D, F; 4B, D, F; 5B, D, F, H; 6B, F, H).

Material: three last instar larvae; two pupae (South Africa, KZN Cobham, 29°39'36"S, 29°23'02"E, 2560 m asl, 13 Dec 1999, underground, on plant detritus around rock boulder, R. Perissinotto & L. Clennell lgt).

Body length 33–36 mm, cranium width 2.7–2.8 mm ($n = 3$). Chaetotaxy as in table 1. Antenna with 2 ventral sensory spots. Haptomerum of epipharynx (Figs 3F, 4B) with three to four transversal rows of four to eight stout setae, proximal sclerotised area absent. Acanthoparia asymmetric; right half with approximately 55–62 setae, left with 40–50. Maxilla (Figs 5B, 6B): stipes dorsal with one or two rows of approximately 10–18 slender hair-like setae and two to six conical stridulatory teeth (Fig. 5H). Ventral face of mala with row of three stout conical setae (occasionally another stout seta preceding the row, reaching about $\frac{1}{2}$ of the size of the following three), lacinial unci obtuse. Ligula dorsal with 50–60 short conical to long hair-like setae (Fig. 5D). Size of thoracic spiracle 0.35–0.40 x 0.24–0.26 mm (length x width). Respiratory plate with 12–16 holes across diameter. Body vestiture more or less dense, setae on dorsum of ninth abdominal segment not separated by bald area into two fields. Palidium of raster consisting of paired oblique rows (Fig. 6H). Each row of ap-

proximately ten pali, extending forward and inwards thus forming an inverted “V” or “U” shaped row on the medial portion of last abdominal segment, enclosing a small septula. Teges composed of few hamate setae. Two distinct types of hamate setae present on teges, small and large with broadened base. Large hamate setae about three times longer than pali.

Discussion

Comparison of *Stripsipher* with other Trichiinae larvae

Currently, information of immature stages of Trichiinae (sensu Krikken 1984) is only available for 38 species in 15 genera (including the tribes Cryptodontini, Incaini, Osmodermatini, Trichiini; Šípek in press). Beside the herein described two species, only larvae of *Clastocnemis quadrimaculatus* (Afzel, 1817), *Platygenia barbata* (Afzel, 1817), *Coelocorynus desfontainei* Antoine, 1999 and *C. opacicauda* Arrow, 1926 are known from sub-Saharan Africa (Jerath and Unny 1965; Šípek et al. 2009). Since it has been suggested that the Trichiinae may be paraphyletic (Micó et al. 2008, Šípek et al. 2009), it is important at this stage to discuss the differences of immature *Stripsipher* with those known from other Trichiinae genera.

Larvae of *Osmoderma* and *Platygenia* have fused abdominal segments IX and X, which is in contrast to what is found in all other known Trichiinae, which have a ten-segmented abdomen. Moreover, larvae of *Osmoderma* lack visible stemmata and the shape of their tarsal claw also differs significantly from that of all other Trichiinae.

The morphology of the epipharynx is amongst the most critical characters separating *Stripsipher* from all other non-African Trichiini (e.g. Medvedev 1952, Ritcher 1966, Morón 1983, Zhang 1984, Delgado-Castillo and Morón 1991, Sawada 1991, Morón 1995, Klausnitzer and Krell 1996). In *Stripsipher* (as well as in *Clastocnemis* and *Coelocorynus*) the haptomeral process is located distad to a transverse row of stout setae and the proximal end of dexiotorma is straight (Figs 7A, B). In all the remaining Trichiinae, on the other hand, the row of haptomeral setae is interrupted by a strong process and the dexiotorma is bent mesally at its proximal end (Fig. 7C).

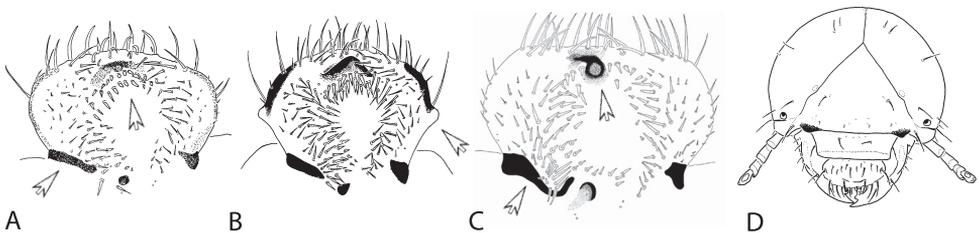


Figure 7. A–C morphology of epipharynx: **A** – *S. orientalis* **B** – *Coelocorynus desfontainei* (from Šípek et al. 2009) **C** – *Gnorimus nobilis* **D** – *S. orientalis*, schematic diagram of cranial chetotaxy.

African Trichiinae

As stated above, larvae of only four genera of Trichiinae are known from sub-Saharan Africa. Apart from body size, *Platygenia* larvae can also be separated from the rest by the fusion of abdominal segments IX and X. Larvae of *Coelocorynus* are characterized by strong lateral tubercles on epipharynx (Fig. 7B) and a drastic reduction of lacinial unci. The larvae of *Clastocmenis quadrimaculatus* seem to be the most similar to the larvae of *Stripsipher*. However, the description provided by Jerath and Unny (1965) is incomplete, so the only difference that can be derived from this lies in the number of lacinial unci. While in *Clastocmenis* there is a single lacinial uncus, two small unci can be observed in *Stripsipher* larvae.

Phylogenetic relationships

To evaluate the phylogenetic relationships of the genus *Stripsipher*, both larval and adult morphological characters of the two species were coded into a data matrix used in previous phylogenetic studies of the Cetoniinae (Micó et al. 2008, Šípek et al. 2009). Not surprisingly, results do not differ significantly from those obtained in previous works. However, the genus *Stripsipher* proved to be firmly nested within the Trichiini-Cryptodontini-Valgini clade (Fig. 8). This finding supports the empiric observation

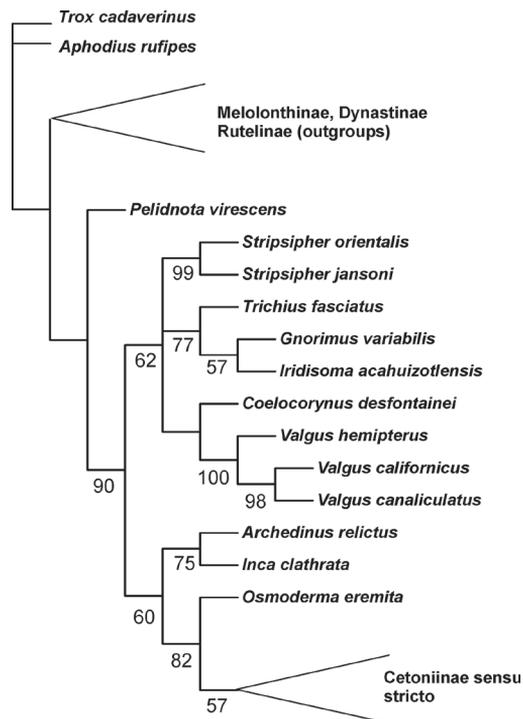


Figure 8. Phylogenetic position of the genus *Stripsipher*, based on the morphological data matrix of Micó et al. (2008) and Šípek et al. (2009).

that the larvae of *Stripsipher* strongly resemble the known larvae of all other Trichiinae, with the exception of those belonging to the genera *Osmoderma*, *Inca*, *Archedinus* and, so far as can be derived from the brief description in Jerath and Unny (1965), also of the genus *Platygenia*. Regardless of the controversial position of the genus *Valgus* within a clade comprised of Trichiini and Cryptodontini members, this study supports once again the hypothesis that the Trichiinae (*sensu* Krikken, 1984) represent a paraphyletic group (see also Browne and Scholtz 1998; Micó et al. 2008; Smith et al. 2006).

Acknowledgements

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Taxonomic study of the genus *Prorophora* Ragonot, 1887 (Lepidoptera, Pyralidae, Phycitinae) in China, with description of a new species

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Abstract

The genus *Prorophora* Ragonot, 1887 is newly recorded for China. Of the three species treated here, *Prorophora* (*Reisserempista*) *binacantha* sp. n. is described as new; *P.* (*Prorophora*) *albidogilvella* Roesler, 1970 and *P.* (*Reisserempista*) *mongolica* Roesler, 1970 are diagnosed and newly recorded for China. Images of adults and illustrations of genital structures are provided, along with a key to the known species.

Keywords

Lepidoptera, Pyralidae, Phycitinae, *Prorophora*, new species, new record, China

Introduction

Prorophora was established by Ragonot in 1887, with *P. curvibasella* Ragonot, 1887 as the type species from Namangan, Turkestan (now Uzbekistan). Following Ragonot, Hampson (1912) described *P. dialeuca* from Sri Lanka and Marion (1957) described *P. grisealella* from Senegal. Roesler (1970) established the subgenus *Reisserempista*, with *Prorophora* (*Reisserempista*) *mongolica* Roesler, 1970 as the type species. The same author

(1973) revised part of the Phycitinae species of the Palaearctic Region, in which he treated *Aproceratia* Amsel, 1950 as a synonym of *Epischidia* Ragonot, 1901, and transferred the latter genus to *Prorophora* as a subgenus. Roesler (1973) proposed a system of three subgenera: *Prorophora* Ragonot, 1887, *Epischidia* Ragonot, 1901 and *Reisserempista* Roesler, 1970, based on the characters of the maxillary palp, the male antenna and the female antrum. As *Epischidia* Ragonot, 1901 is both a homonym and a synonym of *Epischidia* Rebel, 1901 (Fletcher and Nye 1984), Roesler (1987) substituted *P. (Aproceratia)* Amsel, 1950 for *P. (Epischidia)* Ragonot. Later on, Falkovitsch (1999) described *P. halothamni* from Uzbekistan and Asselbergs (2004) described *P. (Prorophora) kazachstaniella* from Kazakhstan. To date, the genus *Prorophora* comprises three subgenera with twelve valid species, which occur in North Africa, Southeast Europe and Asia.

In the present paper, we report three species from China based on the specimens collected in Inner Mongolia Autonomous Region, Gansu Province and Ningxia Hui Autonomous Region. A key to all the known species, diagnoses for *Prorophora* Ragonot, 1887 and subgenera *Reisserempista* Roesler, 1970 and *Prorophora* Ragonot, 1887 are provided. The new species *P. binacantha* sp. n. is described in the subgenus *Reisserempista*. The type specimens are deposited in the Insect Collection, College of Life Sciences, Nankai University, Tianjin, China.

Taxonomic accounts

Prorophora Ragonot, 1887

<http://species-id.net/wiki/Prorophora>

Prorophora Ragonot, 1887: 252. Type species: *Prorophora curvibasella* Ragonot, 1887, by monotypy.

Aproceratia Amsel, 1950: 224. Type species: *Proceratia rhexogramma* Meyrick, 1937 (= *Myelois albunculella* Staudinger, 1879), by monotypy. Synonymised by Roesler (1973).

Reisserempista Roesler, 1970: 55. subgenus of *Prorophora* Type species: *Prorophora (Reisserempista) mongolica* Roesler, 1970, by monotypy.

Diagnosis. *Prorophora* is characterized by the frons with a distinct laterally compressed projection (Fig. 2). It is similar to *Gymnancyla* Zeller, 1848, but can be distinguished by the following characters: the maxillary palp absent or discernible; the transtilla tiny thorn-shaped if present, the 8th sternum is rarely extended in the male genitalia; and the antrum usually sclerotized strongly in the female genitalia. In *Gymnancyla* Zeller, the maxillary palp is developed, reaching end of the second segment of the labial palp; the transtilla is usually triangular, the 8th sternum is distinctly extended in the male genitalia; and the antrum is inconspicuous or weakly sclerotized in the female genitalia.

Distribution. Mongolia, Russia (Ural), Uzbekistan, Kazakhstan, Turkey, Iraq, Iran, Afghanistan, Pakistan, Lebanon, Palestine, Egypt, Sudan, Senegal and Sri Lanka. Newly recorded for China (Gansu, Inner Mongolia, Ningxia).

Key to species of the genus

- 1 Maxillary palp discernible 2
- Maxillary palp absent (subgenus *Prorophora*) 8
- 2 Male antennal segments 3–9 curved; female antrum with scent scale tuft posterolaterally (subgenus *Reisserempista*) 3
- Male antennal segments 3–9 not curved; female antrum without scent scale tuft posterolaterally (subgenus *Aproceratia*) 4
- 3 Valva with one sclerotized band extending from below base of costa to about 2/3 of ventral margin; signum extending from entrance to posterior 1/3 of corpus bursae (Figs 6, 9) ***P. (Reisserempista) binacantha* sp. n.**
- Valva without sclerotized band; signum being a small sclerotized subrounded plate (Roesler, 1973: fig. 25) (Figs 7, 10) ***P. (Reisserempista) mongolica***
- 4 Costa 2/3 length of valva; corpus bursae with one or two sclerotized plates at entrance 5
- Costa about as long as valva; corpus bursae without plate at entrance 7
- 5 Gnathos with lateral arms widening from base to apex 6
- Gnathos with lateral arms widening in posterior half (Falkovitsch, 1999: fig. 8) ***P. (Aproceratia) halothamni***
- 6 Phallus with one cornutus, transtilla absent; corpus bursae with two sclerotized plates at entrance (Roesler, 1973: fig. 21) ***P. (Aproceratia) albunculella***
- Phallus with five cornuti, transtilla membranous; corpus bursae with one sclerotized plate at entrance (Roesler, 1973: fig. 22) ***P. (Aproceratia) eberti***
- 7 Costa furcate at apex, valva without sclerotized band; antrum longer than wide, apophyses anteriores longer than apophyses posteriores (Roesler, 1973: fig. 23) ***P. (Aproceratia) afghanella***
- Costa acute at apex, valva with one sclerotized band extending from below base of costa to near end of ventral margin; antrum as long as wide, apophyses anteriores shorter than apophyses posteriores (Roesler, 1973: fig. 24) ***P. (Aproceratia) senganella***
- 8 Forewing with an obvious longitudinal white stripe 9
- Forewing without obvious longitudinal white stripe 10
- 9 Forewing with a white stripe extending from middle of upper margin of cell to termen (Hampson, 1912: pl. G, fig. 34) ***P. (Prorophora) dialeuca***
- Forewing with a wide white stripe extending from base to postmedian line along costal margin (Marion, 1957: pl. 1, fig. 5) ***P. (Prorophora) grisealella***
- 10 Phallus without, or with one cornutus 11
- Phallus with more than two cornuti 12
- 11 Culcita one pair, sacculus straight at apex; signum hemispheroidal, with a sclerotized plate at entrance of corpus bursae (Roesler, 1973: fig. 19) (Figs 5, 8, 11) ***P. (Prorophora) albidogivella***

- Culcita absent, sacculus acute at apex; signum ovate, without sclerotized plate at entrance of corpus bursae (Roesler, 1973: fig. 18).....
 *P. (Prorophora) curvibasella*
- 12 Phallus with two cornuti (Roesler, 1973: fig. 20).....
 *P. (Prorophora) sacculicornella* Roesler
- Phallus with three to five cornuti (Asselbergs, 2004: fig. 7).....
 *P. (Prorophora) kazachstaniella*

Subgenus *Reisserempista* Roesler, 1970

Diagnostic characters. Maxillary palp present. Male antenna with basal 3–9 flagellomeres curved, flagellomeres 5–9 each with one thorn on dorsal surface; culcita absent. Female antrum with a pair of scent scale tufts posterolaterally (shed easily), accessory sac present.

Prorophora (Reisserempista) binacantha sp. n.

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http://species-id.net/wiki/Prorophora_binacantha

Figs 1–3, 6, 9

Type material. Holotype ♂ – **China, Inner Mongolia Autonomous Region:** Mt. Helan (38.8°N, 105.7°E), Alxa Zuoqi, 1683 m, 29.VII.2010, coll. Hongxia Liu and Zhiwei Zhang. Paratypes: 1 ♂, 1 ♀, Erenhot (43.6°N, 112.0°E), 960 m, 02.VIII.2002, coll. Zhiqiang Li and Dandan Zhang, genitalia slide nos. LJY10019 ♂, LJY10289 ♀; 1 ♂, 1 ♀, Buyant (41.8°N, 107.0°E), Urad Houqi, 1075 m, 17.VIII.2006, coll. Zhiwei Zhang, genitalia slide nos. LJY10292 ♂, LJY11034 ♀; 30 ♂♂, 15 ♀♀, Mt. Helan (38.8°N, 105.7°E), Alxa Zuoqi, 1683–1836 m, 29.VII.–03.VIII.2010, coll. Hongxia Liu and Zhiwei Zhang, genitalia slide nos. LJY10658 ♂, LJY11031 ♂, LJY11028 ♀; **Ningxia Hui Autonomous Region:** 1 ♂, Yinchuan (38.4°N, 106.2°E), VI.1986, genitalia slide no. LJY10028 ♂; 5 ♂♂, Suyukou (38.7°N, 105.9°E), Mt. Helan, 2000 m, 10.VIII.2005–09.VIII.2006, coll. Xinpu Wang, Feng Yang and Qi He, genitalia slide nos. LJY09037 ♂, LJY09065 ♂, LJY10195, ♂.

Diagnosis. This species is similar to *P. (Reisserempista) mongolica* Roesler, 1970, but can be distinguished by the following characters: the forewing dark brown along veins between antemedian and postmedian lines; in the male genitalia, the valva with one spine at ventral 2/3, and the phallus with 3–5 cornuti; in the female genitalia, the elongate signum extending from the entrance to posterior 1/3 of the corpus bursae. In *P. (Reisserempista) mongolica*, the forewing is yellowish brown along veins between antemedian and postmedian lines; the valva lacks the ventral spine, and the phallus has two cornuti; the signum is a small sclerotized subrounded plate, located in posterior 1/4 of the corpus bursae.

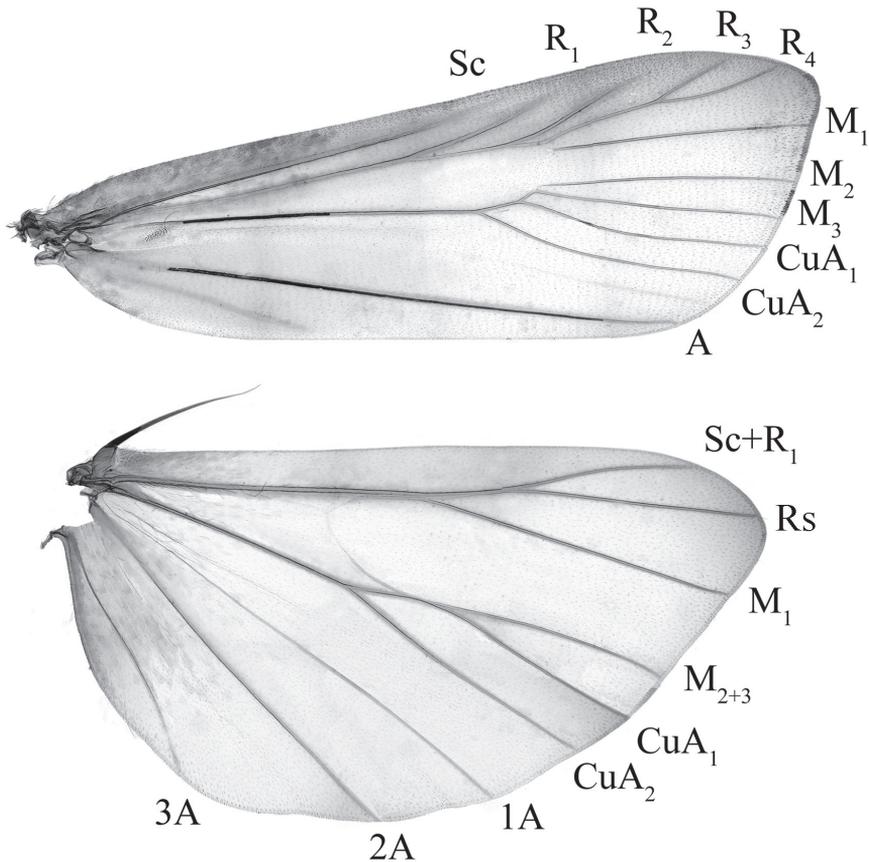
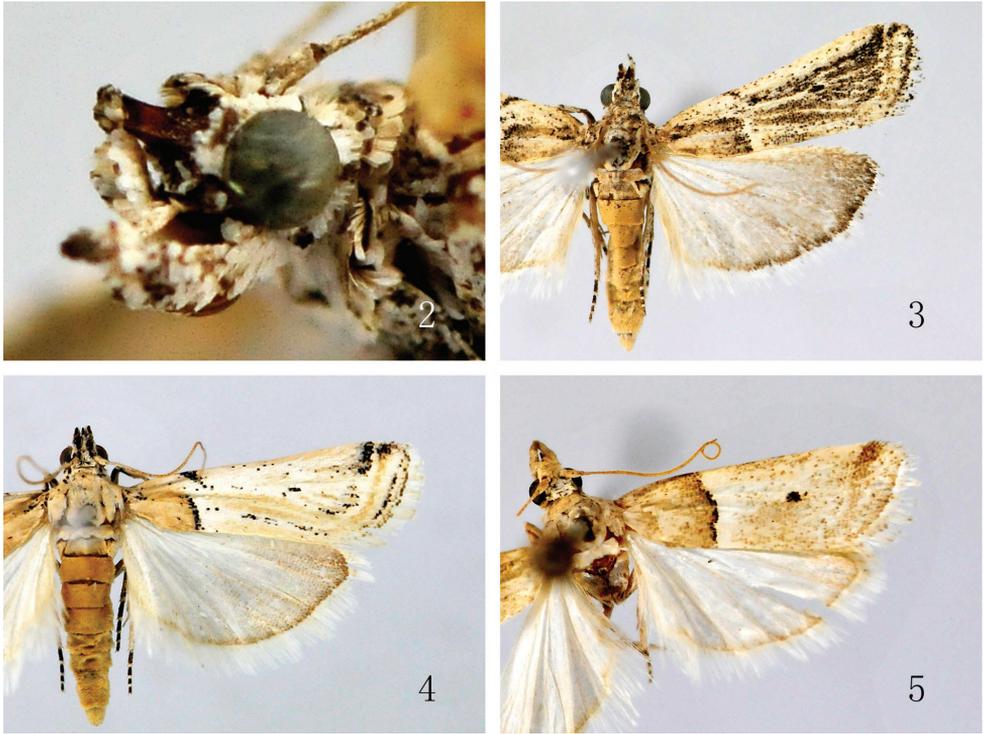


Figure 1. Wing venation. *Prorophora (Reisserempista) binacantha* sp. n., paratype, slide No. LJY10292W.

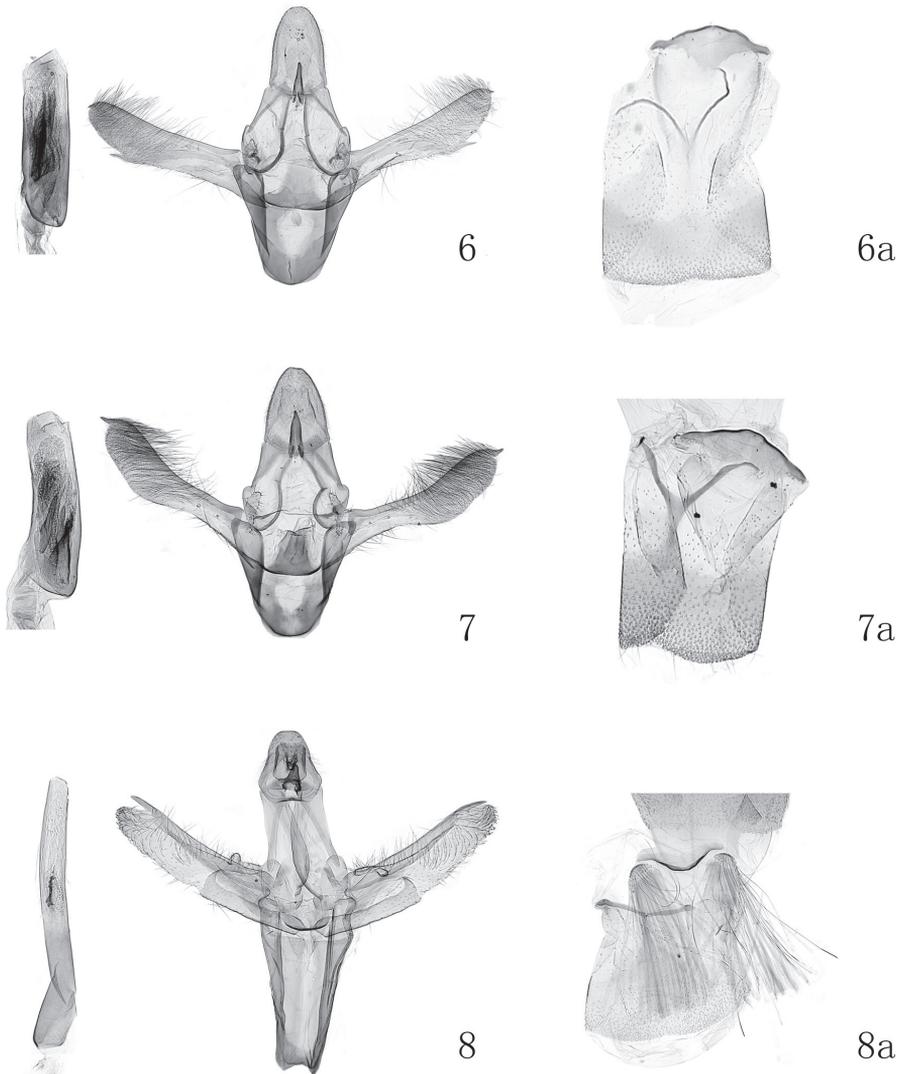
Description. Adult (Figs. 1, 2, 3) with wingspan 16.0–19.0 mm. Vertex greyish white, with two longitudinal short black stripes. Antennal scape greyish brown to dark brown, 2.5–3.0 times as long as wide; flagellum dorsally greyish white ringed with yellowish brown, ventrally overall yellowish brown; dense cilia on ventral surface as long as wide of flagellum. Labial palp with first and second segments greyish white, mixed with brown and dark brown; third segment dark brown, about 1/3 length of second. Proboscis yellowish brown, greyish white at base. Patagium, thorax and tegula greyish white mixed with dark brown. Forewing: venation (Fig. 1); ground coloration pale greyish brown, dark brown along veins between antemedian and postmedian lines; antemedian line greyish white, extending from costal 1/3 to dorsal 2/5, obliquely straight, edged with a broad dark brown band along inner side posteriorly, with a thin dark brown band along outer side anteriorly; discocellular stigmata brownish black, clearly separated; postmedian line greyish white, curved slightly inward at middle, edged with a broad dark brown band along inner side, with a thin yellowish brown band along outer side; termen pale dark brown; cilia greyish white. Hindwing greyish



Figures 2–5. Adults of *Prorophora* spp. **2** Head of *P. (Reisserempista) binacantha* sp. n. (lateral view), paratype, male **3** *P. (Reisserempista) binacantha* sp. n., holotype, male **4** *P. (Reisserempista) mongolica*, male **5** *P. (Prorophora) albidogilvella*, female.

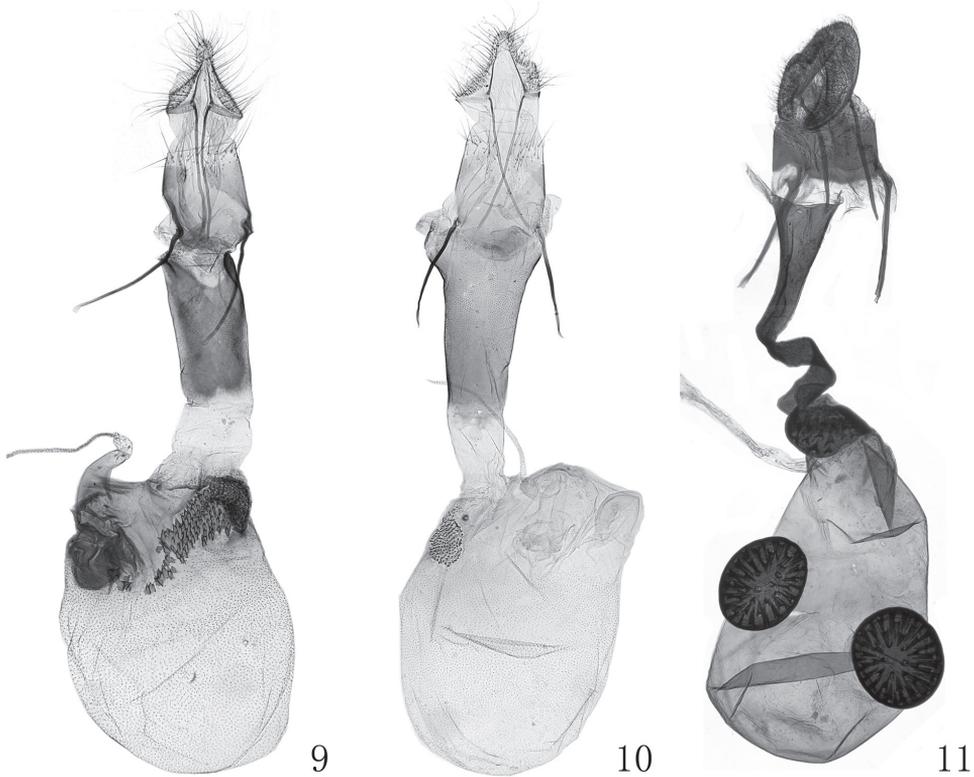
brown, outer margin dark brown; cilia greyish white. Legs with femura and tibiae greyish white, mixed with black; tarsi dark brown, mixed greyish white, ringed with greyish white at apex of each tarsomere. Abdomen pale yellow to yellowish brown dorsally, grayish white ventrally, mixed with dark brown.

Male genitalia (Fig. 6). Uncus broad tongue-shaped, wide at base, narrowed slightly toward blunt apex, length 1.2–1.5 times basal width. Gnathos about half length of uncus. Transtilla present as a pair of sclerotized tiny plates. Valva with dorsal and ventral margins nearly parallel, utmost width about 1/5 length; sclerotized band extending from below base of costa to about ventral 2/3, then produced to a strong free apical spine. Costa slightly exceeding end of valva, produced to a small down-curved apical spine. Clasper as long as gnathos, covered with sparse fine setae, ear-shaped, dentate along outer margin; sacculus slender, about 2/5 length of valva. Vinculum longer than 3/5 length of valva, rounded anteriorly. Juxta trapezium-shaped; anterolateral side extending outward, gradually sharpened, curved backward. Phallus stout, obviously shorter than valva, almost full of sclerotized thorns; cornuti composed of 3–5 sclerotized unequally lengthened thorns, placed medially, longest one about 1/4 length of phallus.



Figures 6–8. Male genitalia of *Prorophora* spp. **6** *P. (Reisserempista) binacantha* sp. n., paratype, slide No. LJY09037 **7** *P. (Reisserempista) mongolica*, slide No. LJY10022 **8** *P. (Prorophora) albidogilvella*, slide No. LJY09075 **6a–8a** 8th abdominal segment and culcita.

Female genitalia (Fig. 9). Papillae anales subtriangular, round posteriorly. Apophyses anteriores slightly shorter than apophyses posteriores. Antrum nearly as wide as eighth tergum, about twice as long as wide, parallel sided, concave medially on posterior margin. Ductus bursae straight, as wide as antrum, about $2/3$ length of antrum. Corpus bursae ovate, membranous, about twice as long as antrum; signum being a sclerotized elongate plate with dense thorns, extending from entrance to posterior $1/3$ of corpus



Figures 9–11. Female genitalia of *Prorophora* spp. **9** *P. (Reisserempista) binacantha* sp. n., paratype, slide No. LJY10289 **10** *P. (Reisserempista) mongolica*, slide No. LJY10018 **11** *P. (Prorophora) albidogilvella*, slide No. LJY11081.

bursae, narrowing gradually; accessory sac arising from posterior 1/3 of corpus bursae, with a few scattered thorns basally; ductus seminalis from posterior end of accessory sac.

Distribution. China (Inner Mongolia, Ningxia).

Etymology. The specific name is derived from the Latin prefix *bin-* (= two, double), and *acanthus* (= spinous), referring to the valva having an apical spine on the costa and a strong free apical spine on the ventral margin.

***Prorophora (Reisserempista) mongolica* Roesler, 1970**

http://species-id.net/wiki/Prorophora_mongolica

Figs 4, 7, 10

Prorophora (Reisserempista) mongolica Roesler, 1970: 55; Roesler, 1973: 76; Roesler, 1987: 394. [Holotype: ♂, Chovd aimak, Mongolia, deposited in Hungarian National Museum, Budapest, Hungary].

Material examined. China, Inner Mongolia Autonomous Region: 1 ♂, Chengguan-zhen, Dengkou County (40.3°N, 107.0°E), 1000 m, 19.VIII.2002, coll. Zhiqiang Li and Dandan Zhang; 31 ♂♂, 15 ♀♀, Buyant (41.8°N, 107.0°E), Urad Houqi, 1075 m, 17.VIII.2006, coll. Zhiwei Zhang; 2 ♂♂, 4 ♀♀, Mt. Helan (38.8°N, 105.7°E), Alxa Zuoqi, 1836 m, 03.VIII.2010, coll. Hongxia Liu and Zhiwei Zhang; **Gansu Province:** 1 ♀, Minqin County (38.6°N, 103.0°E), 1343 m, 26.VII.2006, coll. Xinpu Wang and Xiangfeng Shi. (genitalia slide nos. LJY09048 ♂; LJY10022 ♂; LJY10027 ♂; LJY11032 ♂; LJY09036 ♀; LJY10018 ♀; LJY11030 ♀).

Diagnosis. Adult (Fig. 4) with wingspan 15.0–18.0 mm. This species is characterized by the forewing with yellowish brown basal field edged with black on outer margin posteriorly, pale yellowish brown along veins between antemedian and postmedian lines; the costa exceeding end of valva and produced to an apical spine curved backward, the phallus with two cornuti in the male genitalia (Fig. 7); the corpus bursae densely covered with tiny spines, the subrounded signum located at posterior 1/4 of the corpus bursae, and the ductus seminalis from posterior margin of the corpus bursae near the ductus bursae in the female genitalia (Fig. 10).

Distribution. China (Inner Mongolia, Gansu); Mongolia.

Subgenus *Prorophora* Ragonot, 1887

Diagnostic characters. Maxillary palp absent. Male culcita absent or one pair. Female antrum elongate; two signa prominent on surface of corpus bursae, covered with conical spines on inner surface; ductus seminalis from posterior part of corpus bursae.

***Prorophora (Prorophora) albidogilvella* Roesler, 1970**

http://species-id.net/wiki/Prorophora_albidogilvella

Figs 5, 8, 11

Prorophora albidogilvella Roesler, 1970: 50. [Holotype: ♂, Gobi Altaj aimak, Mongolia, deposited in Hungarian National Museum, Budapest, Hungary].

Prorophora (Prorophora) albidogilvella Roesler, 1970: Roesler, 1973: 65; Roesler, 1987: 394.

Material examined. China, Inner Mongolia Autonomous Region: 1 ♂, 4 ♀♀, Ejn Qi (41.9°N, 101°E), 927 m, 17–18.VII.2006, coll. Xinpu Wang and Xiangfeng Shi; **Gansu Province:** 1 ♂, Minqin County (38.6°N, 103.0°E), 1343 m, 26.VII.2006, coll. Xinpu Wang and Xiangfeng Shi. (genitalia slide nos. LJY09075 ♂; LJY11074 ♀; LJY11081 ♀).

Diagnosis. Adult (Fig. 5) with wingspan 15.0–18.0 mm. This species is conspicuously different from its congeners by the costa distally thornlike and separated from the valva, and the apex-straight sacculus with a dorsoapical spine in the male genitalia

(Fig.8); and by the ductus bursae curved in S shape distally, and having a sclerotized ring-shaped plate at the entrance of the corpus bursae which is covered with pyramid-like thorns on inner surface in the female genitalia (Fig. 11).

Distribution. China (Inner Mongolia Autonomous Region, Gansu); Mongolia.

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Two new freshwater fish species of the genus *Telestes* (Actinopterygii, Cyprinidae) from karst poljes in Eastern Herzegovina and Dubrovnik littoral (Bosnia and Herzegovina and Croatia)

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Abstract

Two new species, *Telestes dabar* and *T. miloradi*, are described on the basis of morphological comparisons of isolated geographical populations of fishes identified earlier as *T. metohiensis*. A lectotype is designated for *T. metohiensis*, whose range is shown to include waters of Gatačko, Cerničko, and Nevesinjsko poljes in Eastern Herzegovina. *Telestes dabar* from Dabarsko Polje (Eastern Herzegovina) and *T. miloradi* from Konavosko Polje (south Croatia) share with *T. metohiensis* the following combination of characters that distinguish them from the rest of the genus *Telestes*: pharyngeal teeth in one row, usually 5–4; preoperculo-mandibular canal not communicating with the infraorbital canal; mouth subterminal, the tip of the mouth cleft on or below the level of the ventral margin of the eye; postcleithrum minute or absent; ventral portion of the trunk with a dark stripe on a pale background; and dorsal portion of trunk uniformly dark and bordered ventrally by a dark midlateral stripe. *Telestes dabar* and *T. miloradi* are distinguishable from *T. metohiensis* in usually having 8½ branched dorsal-fin rays (vs. usually 7½), 9 or 10 gill rakers (vs. 7–10,

usually 8), and the dark stripe on the ventral portion of the trunk below the main pigmented area of the back narrow and usually not reaching posteriorly to the caudal peduncle (vs. dark stripe wide and extending posteriorly to the caudal peduncle). *Telestes dabar* is distinguished from *T. miloradi* by having scales on most of the body situated close to one another and overlapping in a region behind the pectoral girdle and usually on the caudal peduncle (vs. overlapping scales on most of the body); the lateral line usually incomplete and interrupted, with 24–69, usually 54–65, total scales (vs. lateral line usually complete, with 55–67 total scales); scales above and below the lateral line slightly smaller than lateral-line scales (vs. of about equal size); head width 43–52% HL (vs. 48–58% HL); and lower jaw length 10–12% SL or 36–41% HL (vs. 8–10% SL or 33–38% HL). *Telestes miloradi*, a very local endemic species, is known only by historical samples. *Telestes dabar* is an abundant fish in Dabarsko Polje, but its range is critically restricted during the dry season by a few permanent sources. Nothing is known about its occurrence in underground karst waters.

Keywords

Cypriniformes, West Balkans, Alpha Taxonomy and new taxa

Introduction

Karst basins in Croatia and Bosnia and Herzegovina are populated by many local endemic species most of them belonging to the cyprinid subfamily Leuciscinae (Mrakovčić et al. 2006; Kottelat and Freyhof 2007; Jelić et al. 2008; Zupančič 2008). Among leuciscine cyprinids of the Dinaric karst, most numerous is a group of species that was formerly assigned to the genus *Phoxinellus* Heckel, 1843. In a revision of this group (Zupančič and Bogutskaya 2002; Bogutskaya and Zupančič 2003) ten *Phoxinellus* species were divided into two groups, one with two subgroups. Later (Freyhof et al. 2006), based on nuclear and mtDNA sequences, *Phoxinellus* was found to be paraphyletic because it includes three unrelated monophyletic units. The scientific name *Phoxinellus* was therefore restricted to species having plain colouration, a small or absent postcleithrum, no genital papilla, and an almost entirely naked body (species included: type species *P. alepidotus* Heckel, 1843, *P. dalmaticus* Zupančič & Bogutskaya, 2000, and *P. pseudalepidotus* Bogutskaya & Zupančič, 2003). Species having an irregularly spotted colour pattern, a large postcleithrum, an increased number of precaudal anal-fin pterygiophores, and a large female genital papilla were assigned to a new genus, *Delminichthys* Freyhof, Lieckfeldt, Bogutskaya, Pitra & Ludwig, 2006 (species included: type species *D. adpersus* (Heckel, 1843), *D. ghetaldii* (Steindachner, 1882), *D. jadovensis* Zupančič & Bogutskaya, 2002, and *D. krbavensis* Zupančič & Bogutskaya, 2002). Finally, species having a small or absent postcleithrum, no genital papilla, a dark midlateral stripe from the head to the caudal peduncle, and non-overlapping scales were assigned to *Telestes* (*T. croaticus* (Steindachner, 1866), *T. fontinalis* (Karaman, 1972), and *T. metohiensis* (Steindachner, 1901)), bringing the total number of species of *Telestes* to 11. These generic assignments were later supported by a molecular phylogenetic study based on the same mitochondrial but different nuclear markers (Perea et al. 2010).

Zupančič and Bogutskaya (2002) and Bogutskaya and Zupančič (2003) re-described *T. metohiensis* based on 251 specimens (including syntypes) from Nevesinjsko Polje, Gatačko Polje, Cerničko Polje, and Dabarsko Polje karsts in Bosnia and Herzegovina, and from Ljuta River in Konavle Region [Konavosko Polje] in southern Croatia. Bogutskaya and Zupančič (2003: 375) mentioned that the syntypes from the Ljuta River were distinguished by having $8\frac{1}{2}$ branched anal-fin rays (vs. usually $7\frac{1}{2}$ in most other syntypes). Specimens from Dabarsko Polje (Vrijeka and Opačica rivers) were also only tentatively identified as *metohiensis* because of having overlapping scales (vs. non-overlapping, narrowly to widely spaced) and usually $8\frac{1}{2}$ branched anal-fin rays (Zupančič and Bogutskaya 2002: 417). Since 2003, we have examined additional material of the entire *T. metohiensis* species complex, and two species – one from Ljuta River in Konavosko Polje and one from Dabarsko Polje – are described here as new.

Methods

Measurements were made point to point to the nearest 0.1 mm and follow methods used by Bogutskaya and Zupančič (2010) for *Squalius* species. In most aspects, they coincide with the scheme by Kottelat and Freyhof (2007: fig. 1), but a few clarifications of the latter are as follows. Standard length (SL) was measured from the anteriormost point of the upper lip (not of the snout) to the end of the hypural complex. Head length (HL) was measured from the anteriormost point of the upper lip to the posteriormost point of the opercular membrane. Interorbital width was measured including the skin fold. The term ‘length of dorsal fin’ is used for the length of the dorsal-fin base, and the term ‘depth of dorsal fin’ is used for the length of the longest ray of the dorsal fin. Respective terms are used for the measurements of the anal fin. The last two branched rays articulating on a single pterygiophore in the dorsal and anal fins are noted as “ $1\frac{1}{2}$ ”. Total lateral-line scale count includes all pored scales, from the first one just behind the posttemporal bone to the posteriormost one located on the bases of the caudal-fin rays. Total number of lateral-row scales includes all scales, pored and non-pored, from the first one just behind the posttemporal bone to the posteriormost one located on the bases of the caudal-fin rays. Osteological characters were examined from dissections and from radiographs. Statistical analyses were performed with Microsoft Excel and Statistica 6.0 packages.

Abbreviations used: NMW, Naturhistorisches Museum, Wien; SMNH, Slovenian Museum of Natural History; PZC, Collection of P. Zupančič, Dolsko (Slovenia); SMF, Senckenberg Museum, Frankfurt a. Main; ZISP, Zoological Institute, Russian Academy of Sciences, St Petersburg; ZMH, Zoologisches Museum und Institut, Universität Hamburg; (cephalic sensory canals) CIO, infraorbital canal; CPM, preoperculo-mandibular canal; CSO, supraorbital canal; and CST, supratemporal canal.

Results

Telestes dabar sp. n.

urn:lsid:zoobank.org:act:4A50A07B-57BD-472B-9B00-6941D8C6779A

http://species-id.net/wiki/Telestes_dabar

Figs 1a, 2a, 3a

Holotype. NMW 95295, 79.1 mm SL, BOSNIA & HERZEGOVINA: Dabarsko Polje, Opačica River at Potkom, 43°5.9'N, 18°7.6'E, 15 Sept. 2006, coll. Zupančič.

Paratypes. NMW 95300, 6, 55.2–71.1 mm SL, same data as holotype; PZC 525, 72, 32.5–51.3 mm SL, same data as holotype; PZC 526, 13, 48.0–73.8 mm SL, same data as holotype; PZC 565, 21, 35.5–56.7 mm SL, same locality, 8 July 2011; ZISP 54995, 15, 38.1–58.9 mm SL, same locality, 8 July 2011; SMNH 444, 35.5–60.8 mm SL, same locality, 8 July 2011; PZC 279, 12, 44.2–71.9 mm SL, BOSNIA & HERZEGOVINA: Dabarsko Polje, Vrijeka River, 24 May 2001; PZC 521, 13, 54.0–62.6 mm SL, same locality as 279, 15 Sept. 2004; PZC 575, 18, 40.5–69.8 mm SL, same locality as 279, 15 Sept. 2006.

Diagnosis. *Telestes dabar* is distinguished from *T. metohiensis* and *T. miloradi* by having the following combination of characters: slightly curved dark stripe (obvious in live and preserved specimens) present from just behind operculum to vertical just anterior to origin of anal fin, this stripe narrow and separated from dark pigmented area on back along its entire length; scales on most of body not overlapping but situated close to one another; scales overlapping behind pectoral girdle along lateral line and usually



Figure 1. **a** *Telestes dabar*, holotype, female, 79.1 mm SL, NMW 95295, Bosnia & Herzegovina: Opačica River, Dabarsko Polje **b** *Telestes metohiensis*, female, 82.1 mm SL, PZC 293, Bosnia & Herzegovina: Zavidolka River (Zalomka River system), Nevesinjsko Polje.



Figure 2. **a** *Telestes dabar*, male paratype, live specimen, ZISP 54995, 58.9 mm SL, Bosnia & Herzegovina: Opačica River, Dabarsko Polje **b** *Telestes metohiensis*, live specimen, male, 86.2 mm SL, PZC 567, Bosnia & Herzegovina: spring Ljeskovik in Zalomka River, Nevesinjsko Polje **c** *Telestes metohiensis*, live specimen, male, 84.5 mm SL, PZC 566, Bosnia & Herzegovina: Zovidolka River (Zalomka River system), Nevesinjsko Polje.

on caudal peduncle; snout with fleshy tip projecting over upper lip; mouth subterminal with tip of mouth cleft at or below level of ventral margin of eye; lateral line usually interrupted, with 24–69 total lateral-line scales; branched dorsal-fin rays usually $8\frac{1}{2}$; branched anal-fin rays usually $8\frac{1}{2}$; gill rakers 9 or 10; total vertebrae 39–41, mode 40; abdominal vertebrae 22–24, mode 22; caudal vertebrae 16–18, mode 17; head width 43–52% HL; and lower jaw long, length 10–12% SL.

Description. Morphometric data are summarised in Table 1a, selected counts in Tables 2–4. General appearance can be seen in Figs 1a and 2a. Body compressed, elon-



Figure 3. a *Telestes dabar*, alizarin stained specimen, PZC 575, 63.7 mm SL, Bosnia & Herzegovina: Vrijeka River, Dabarsko Polje **b** *Telestes metohiensis*, alizarin stained specimen, 63.3 mm SL, PZC 312, Bosnia & Herzegovina: spring Ljeskovik in Zalomka River, Nevesinjsko Polje.

gate. Caudal-peduncle depth only slightly less than half maximum body depth; head length greater than maximum body depth. Eye small, its diameter smaller than snout length. Snout fleshy, slightly to markedly projecting beyond upper lip (similar to a feature Kottelat and Freyhof [2007: fig. 39] called the “rostral cap,” which covers all or part of upper lip); snout terminating laterally in prominent crease along anterior edge of first infraorbital. Mouth subterminal, tip of mouth cleft at level of ventral margin of eye or, more frequently, below it. Lower jaw-quadrant junction at vertical through anterior half of eye. Length of lower jaw 10–12% SL or 36–41% HL, or 102–132% depth of operculum.

Dorsal fin with $7\frac{1}{2}$ (9 specimens), $8\frac{1}{2}$ (151) or $9\frac{1}{2}$ (1) branched rays, $8\frac{1}{2}$ in holotype. Dorsal-fin origin above posterior end of pelvic-fin base. Anal fin with $8\frac{1}{2}$ (153) or $9\frac{1}{2}$ (8) branched rays, $8\frac{1}{2}$ in holotype. Outer margin of anal fin slightly concave or almost straight. Caudal fin moderately forked, lobes weakly pointed, with 9+8 principal branched rays.

Total gill rakers (Table 2) 9 (20) or 10 (20), 10 in holotype. Pharyngeal teeth 5–4, hooked, slightly serrated (examined in 5 specimens).

Scales covering entire body including pre-pectoral area and abdomen, non-overlapping on most parts of body but overlapping in triangular-shaped area just behind pectoral girdle and usually on caudal peduncle at least behind anal fin (Fig. 3a); lateral-line scales always overlapping, sometimes a few posteriormost scales not overlapping. Scales irregularly set but close to one another. Most flank scales oval, somewhat deeper than long; scales on caudal peduncle more elongated (longer than deep) having prominent posterior attenuation. Trunk scales smaller than lateral-line scales but not con-

Table 1a. Morphometric data of *T. dabar*.

	<i>T. dabar</i>								
	Holo- type	females, n=26				males, n=13			
		min	max	mean	SD	min	max	M	SD
SL, mm	79.1	60.3	81.8	67.8		55.5	69.0	61.1	
Maximum body depth (% SL)	21.6	21.6	26.0	23.6	1.3	21.7	25.0	22.6	0.9
Depth of caudal peduncle (% SL)	9.8	9.8	12.4	11.0	0.7	10.0	12.4	11.2	0.7
Depth of caudal peduncle (% length of caudal peduncle)	47.9	47.7	59.6	53.6	4.3	44.6	62.2	52.9	5.2
Maximum body width (% SL)	13.4	11.4	16.0	13.7	1.2	12.0	22.0	14.2	2.6
Predorsal length (% SL)	55.3	53.5	58.7	56.9	1.1	53.8	57.3	55.5	1.2
Postdorsal length (% SL)	36.3	32.8	36.6	35.2	1.0	34.4	37.2	35.8	1.0
Prepelvic length (% SL)	51.6	50.4	55.5	52.7	1.4	50.6	54.4	52.2	1.0
Preanal length (% SL)	71.2	68.3	73.2	70.8	1.3	68.6	71.9	69.9	1.0
Pectoral – pelvic-fin origin length (% SL)	24.5	24.5	27.7	25.6	0.9	22.3	26.5	24.1	1.2
Pelvic – anal-fin origin length (% SL)	20.2	17.2	20.2	19.0	0.6	16.6	20.3	18.4	1.3
Length of caudal peduncle (% SL)	20.6	18.5	21.9	20.5	0.8	19.2	23.5	21.2	1.1
Dorsal-fin base length (% SL)	10.3	9.3	12.3	10.9	0.8	9.9	12.2	11.2	0.7
Dorsal fin depth (% SL)	18.9	16.6	20.2	18.6	1.4	18.5	21.8	19.7	0.9
Anal-fin base length (% SL)	12.1	9.2	12.1	10.6	0.8	10.3	12.4	11.2	0.5
Anal fin depth (% SL)	12.3	11.9	14.8	13.2	0.8	13.4	17.2	15.9	1.1
Pectoral fin length (% SL)	19.9	18.1	21.2	19.9	0.8	22.5	26.7	24.2	1.3
Pelvic fin length (% SL)	14.8	12.9	16.3	14.9	0.9	16.3	17.7	16.9	0.5
Head length (% SL)	27.1	25.6	28.7	27.1	0.9	26.6	29.6	28.1	1.0
Head length (% body depth)	125.1	104.0	125.1	115.3	5.9	110.8	135.1	124.3	7.6
Head depth at nape (% SL)	17.4	17.1	19.3	18.1	0.7	17.0	18.8	18.2	0.5
Head depth at nape (% HL)	64.2	62.4	70.7	66.8	2.3	60.6	69.3	65.0	2.7
Maximum head width (% SL)	13.5	11.6	14.6	13.6	0.7	12.4	14.5	13.6	0.6
Maximum head width (% HL)	50.0	42.8	52.3	50.1	2.4	44.7	52.1	48.3	2.4
Maximum cranial width (% cranium roof length)	68.9	61.9	72.6	65.8	3.1	59.7	68.8	64.4	2.5
Snout length (% SL)	8.5	7.4	9.2	8.1	0.5	7.8	9.0	8.5	0.4
Snout length (% HL)	31.4	27.7	32.8	29.7	1.3	28.5	31.7	30.3	1.1
Eye horizontal diameter (% SL)	6.6	5.9	7.2	6.6	0.4	6.3	7.8	6.8	0.4
Eye horizontal diameter (% HL)	24.4	22.1	26.8	24.5	1.5	22.1	26.8	24.3	1.4
Eye horizontal diameter (% interorbital width)	74.5	66.3	81.9	73.3	4.7	69.5	82.0	74.4	4.7
Postorbital distance (% HL)	53.0	48.8	54.0	52.2	1.4	47.1	53.0	50.2	1.9
Interorbital width (% SL)	8.9	8.2	9.6	9.1	0.4	8.5	9.9	9.2	0.4
Interorbital width (% HL)	32.8	31.3	36.0	33.4	1.2	29.0	35.6	32.7	1.9
Length of upper jaw (% HL)	28.6	24.5	30.5	27.8	1.9	26.2	29.5	27.7	1.1
Length of upper jaw (% SL)	7.7	6.6	8.5	7.5	0.6	7.0	8.6	7.8	0.5
Length of lower jaw (% SL)	10.6	9.5	11.2	10.2	0.5	9.7	11.5	10.9	0.5
Length of lower jaw (% HL)	39.2	35.8	40.7	37.6	1.3	35.6	41.1	38.6	1.6
Length of lower jaw (% interorbital width)	119.7	106.4	123.4	112.6	4.4	110.2	129.8	120.2	6.4
Length of lower jaw (% depth of operculum)	110.2	102.4	120.0	108.2	4.5	105.7	131.7	116.6	8.2

Table 1b. Morphometric data of *T. miloradi*.

	<i>T. miloradi</i>								
	Holo- type	females, n=9				males, n=3			
		min	max	mean	SD	min	max	Mean	SD
SL, mm	66.7	34.1	66.7			57.9	61.8		
Maximum body depth (% SL)	22.4	21.7	25.8	23.5	1.5	19.6	24.6	23.0	2.9
Depth of caudal peduncle (% SL)	11.4	10.4	11.6	11.2	0.4	9.6	11.3	10.8	1.0
Depth of caudal peduncle (% length of caudal peduncle)	53.8	49.8	54.8	52.4	2.1	41.8	52.8	49.1	6.4
Maximum body width (% SL)	14.3	12.9	15.3	14.6	0.7	11.4	16.8	15.0	3.1
Predorsal length (% SL)	55.9	55.9	57.7	57.0	0.7	54.3	54.9	54.5	0.3
Postdorsal length (% SL)	35.2	32.8	35.3	34.3	1.0	35.4	35.6	35.5	0.1
Prepelvic length (% SL)	51.6	51.5	53.3	52.3	0.9	50.0	50.2	50.1	0.1
Preanal length (% SL)	72.8	68.2	72.8	70.3	1.9	68.2	68.4	68.3	0.1
Pectoral – pelvic-fin origin length (% SL)	25.1	25.1	27.6	26.2	1.1	23.3	25.0	24.4	1.0
Pelvic – anal-fin origin length (% SL)	20.8	16.6	20.8	18.3	1.7	17.6	18.4	18.2	0.5
Length of caudal peduncle (% SL)	21.2	20.5	22.1	21.3	0.7	21.4	23.0	22.0	0.9
Dorsal-fin base length (% SL)	11.6	9.9	11.6	10.9	0.7	11.2	12.6	12.2	0.8
Dorsal fin depth (% SL)	19.6	19.2	20.9	19.8	0.8	20.9	22.1	21.4	0.6
Anal-fin base length (% SL)	12.4	10.7	12.4	11.9	0.6	11.8	11.9	11.8	0.1
Anal fin depth (% SL)	13.2	0.0	15.0	12.5	4.7	13.7	15.5	14.3	1.0
Pectoral fin length (% SL)	21.7	18.5	21.7	20.8	1.0	23.5	25.4	24.8	1.1
Pelvic fin length (% SL)	15.6	13.6	15.6	14.6	0.8	16.9	17.6	17.2	0.4
Head length (% SL)	26.8	25.4	28.0	27.0	0.8	26.5	29.0	28.2	1.4
Head length (% body depth)	119.9	105.0	119.9	115.0	6.0	117.6	135.4	123.5	10.3
Head depth at nape (% SL)	18.3	16.9	18.3	17.6	0.5	16.7	19.0	18.2	1.4
Head depth at nape (% HL)	68.1	62.5	68.1	65.1	2.3	62.9	65.7	64.7	1.6
Maximum head width (% SL)	14.1	12.3	14.5	14.0	0.7	12.6	16.9	15.4	2.5
Maximum head width (% HL)	52.5	48.7	53.6	52.0	1.5	47.5	58.2	54.6	6.2
Maximum cranial width (% cranium roof length)	62.8	59.6	73.9	66.0	5.0	58.3	65.2	62.9	4.0
Snout length (% SL)	9.0	8.0	9.7	8.9	0.5	8.5	8.6	8.6	0.0
Snout length (% HL)	33.7	31.4	34.7	33.0	1.2	29.5	32.4	30.5	1.7
Eye horizontal diameter (% SL)	6.5	6.3	6.9	6.5	0.2	6.6	6.7	6.7	0.0
Eye horizontal diameter (% HL)	24.4	22.5	26.4	24.2	1.4	22.9	25.2	23.7	1.3
Eye horizontal diameter (% interorbital width)	70.2	64.7	83.0	71.3	5.9	69.4	83.4	74.1	8.1
Postorbital distance (% HL)	49.1	48.9	51.6	50.2	1.2	50.2	51.0	50.5	0.5
Interorbital width (% SL)	9.3	8.1	9.7	9.2	0.5	8.0	9.6	9.1	0.9
Interorbital width (% HL)	34.8	31.9	34.8	34.1	0.9	30.2	33.1	32.1	1.7
Length of upper jaw (% HL)	27.9	26.0	28.1	27.2	0.9	23.5	25.1	24.0	0.9
Length of upper jaw (% SL)	7.5	6.6	7.9	7.3	0.4	6.7	6.8	6.8	0.1
Length of lower jaw (% SL)	9.3	8.4	10.4	9.5	0.6	8.7	10.4	9.8	1.0
Length of lower jaw (% HL)	34.7	33.1	38.4	35.3	1.8	32.9	35.9	34.9	1.7
Length of lower jaw (% interorbital width)	99.8	99.8	114.3	103.7	6.1	108.5	109.1	108.7	0.4
Length of lower jaw (% depth of operculum)	104.0	95.6	104.0	101.1	2.9	95.6	107.1	103.3	6.7

Table 1c. Morphometric data of *T. metohiensis*.

	<i>T. metohiensis</i> , Gatačko and Cerničko poljes								
	lectotype	females, n=25				males, n=10			
		min	max	mean	SD	min	max	mean	SD
SL, mm	87.9	60.26	102.1	74.9		54.4	75.7	63.1	
Maximum body depth (% SL)	23.9	19.9	25.1	22.5	1.4	20.7	24.1	22.5	1.0
Depth of caudal peduncle (% SL)	11.3	9.7	11.9	10.7	0.5	10.4	11.8	11.2	0.5
Depth of caudal peduncle (% length of caudal peduncle)	61.5	46.7	61.5	53.0	4.1	46.7	55.7	51.0	3.1
Maximum body width (% SL)	16.0	11.1	16.4	14.3	1.7	14.1	15.6	14.8	0.6
Predorsal length (% SL)	57.6	49.4	60.1	56.5	2.2	53.7	57.7	55.7	1.3
Postdorsal length (% SL)	33.4	31.0	36.5	33.7	1.6	32.5	38.0	35.2	1.6
Prepelvic length (% SL)	52.0	46.0	55.9	52.7	1.9	50.4	53.8	51.9	1.3
Preanal length (% SL)	69.1	65.6	73.6	70.2	1.9	67.1	69.7	68.5	0.9
Pectoral – pelvic-fin origin length (% SL)	27.5	24.7	29.7	27.0	1.3	24.1	27.2	25.5	1.1
Pelvic – anal-fin origin length (% SL)	19.8	16.4	20.1	18.5	1.1	15.6	18.2	17.0	0.8
Length of caudal peduncle (% SL)	18.3	19.1	22.3	20.3	1.2	20.9	22.8	22.0	0.6
Dorsal-fin base length (% SL)	11.1	9.5	11.5	10.8	0.6	10.8	13.6	12.0	1.0
Dorsal fin depth (% SL)	17.6	14.9	18.3	17.2	0.8	16.3	19.6	18.5	1.1
Anal-fin base length (% SL)	11.3	9.1	12.0	10.9	0.7	10.0	13.2	11.9	1.1
Anal fin depth (% SL)	12.3	12.4	15.3	13.7	0.8	12.8	15.4	14.3	1.0
Pectoral fin length (% SL)	18.4	17.0	19.8	18.4	0.8	22.7	25.3	23.6	0.8
Pelvic fin length (% SL)	12.9	12.4	15.3	13.7	0.8	15.4	17.7	16.6	0.7
Head length (% SL)	27.0	23.8	28.2	26.6	1.1	26.1	28.2	27.3	0.6
Head length (% body depth)	112.9	111.0	132.5	120.4	6.6	114.4	131.8	122.8	5.2
Head depth at nape (% SL)	17.4	15.5	18.7	17.3	0.8	15.9	18.1	17.3	0.7
Head depth at nape (% HL)	64.6	62.9	71.8	65.1	2.2	58.5	66.1	63.5	2.7
Maximum head width (% SL)	14.8	12.9	15.7	14.8	0.7	14.5	15.7	14.9	0.4
Maximum head width (% HL)	54.9	50.6	59.3	55.7	2.7	52.8	56.9	54.7	1.6
Maximum cranial width (% cranium roof length)	63.5	62.9	78.6	68.6	4.4	65.4	71.7	68.2	2.7
Snout length (% SL)	8.1	7.3	8.8	8.2	0.4	8.5	9.4	8.9	0.4
Snout length (% HL)	30.0	27.9	33.1	30.8	1.6	31.2	34.2	32.5	1.1
Eye horizontal diameter (% SL)	6.0	4.6	6.9	5.9	0.5	5.3	6.8	6.0	0.4
Eye horizontal diameter (% HL)	22.4	19.4	25.2	22.1	1.5	19.5	24.8	22.1	1.8
Eye horizontal diameter (% interorbital width)	70.7	57.0	80.2	68.2	6.9	60.2	71.8	65.1	4.3
Postorbital distance (% HL)	51.9	47.9	55.6	51.9	2.4	46.2	53.1	50.8	2.3
Interorbital width (% SL)	8.5	7.7	9.2	8.7	0.4	8.4	9.8	9.3	0.5
Interorbital width (% HL)	31.6	29.6	34.8	32.6	1.7	30.8	35.8	34.0	1.5
Length of upper jaw (% HL)	27.8	27.0	31.0	29.2	1.0	27.0	30.9	29.0	1.1
Length of upper jaw (% SL)	7.5	6.4	8.3	7.8	0.4	7.5	8.4	7.9	0.3
Length of lower jaw (% SL)	9.9	8.3	11.3	10.3	0.8	9.5	11.0	10.3	0.6
Length of lower jaw (% HL)	36.7	35.0	42.2	38.7	2.2	34.8	41.2	37.8	2.1
Length of lower jaw (% interorbital width)	116.0	106.5	132.5	120.6	6.4	101.6	121.9	113.7	6.9
Length of lower jaw (% depth of operculum)	107.2	106.5	117.9	112.5	3.0	109.6	119.2	112.7	3.5

Table 1d. Morphometric data of *T. metohiensis*.

	<i>T. metohiensis</i> (<i>affinis</i> nomen museale), Nevesinjsko Polje								
	lectotype	females, n=33				males, n=14			
		min	max	mean	SD	min	max	M	sd
SL, mm	87.9	57.8	113.8	79.5		57.7	86.2	70.4	
Maximum body depth (% SL)	23.9	19.3	24.1	21.8	1.1	19.8	23.8	21.6	1.4
Depth of caudal peduncle (% SL)	11.3	9.0	12.0	10.7	0.7	9.6	12.3	11.1	0.7
Depth of caudal peduncle (% length of caudal peduncle)	61.5	42.7	60.0	54.2	4.5	43.6	59.9	51.8	4.2
Maximum body width (% SL)	16.0	11.6	17.6	14.5	1.4	11.0	16.6	14.3	1.7
Predorsal length (% SL)	57.6	54.2	59.4	57.1	1.3	54.4	58.4	56.3	1.0
Postdorsal length (% SL)	33.4	29.9	36.4	34.0	1.3	33.8	36.5	35.2	0.7
Prepelvic length (% SL)	52.0	51.6	55.1	53.3	1.0	50.1	54.6	51.6	1.2
Preanal length (% SL)	69.1	67.8	73.4	70.9	1.3	65.9	70.3	68.8	1.3
Pectoral – pelvic-fin origin length (% SL)	27.5	24.2	30.0	25.9	1.2	21.7	25.4	23.8	1.0
Pelvic – anal-fin origin length (% SL)	19.8	16.7	44.1	19.4	4.6	15.6	19.9	17.5	1.3
Length of caudal peduncle (% SL)	18.3	18.0	21.3	19.7	0.9	20.0	23.2	21.4	0.8
Dorsal-fin base length (% SL)	11.1	9.4	12.9	11.1	0.8	8.1	12.1	10.4	1.2
Dorsal fin depth (% SL)	17.6	15.8	20.4	17.9	1.4	15.9	21.8	18.0	1.5
Anal-fin base length (% SL)	11.3	9.4	12.0	10.9	0.6	10.5	13.2	11.4	0.7
Anal fin depth (% SL)	12.3	10.6	15.0	13.1	1.1	12.0	16.2	14.0	1.4
Pectoral fin length (% SL)	18.4	18.0	21.9	20.2	1.0	21.8	26.4	23.8	1.4
Pelvic fin length (% SL)	12.9	12.5	15.6	14.1	0.8	14.2	17.5	15.7	0.9
Head length (% SL)	27.0	26.7	29.4	27.8	0.8	26.3	30.1	28.0	1.1
Head length (% body depth)	112.9	114.5	142.6	127.4	6.6	116.5	142.9	130.0	8.5
Head depth at nape (% SL)	17.4	16.5	18.7	17.6	0.6	15.7	18.8	17.3	0.9
Head depth at nape (% HL)	64.6	60.0	67.9	63.4	1.8	57.1	65.9	62.0	2.9
Maximum head width (% SL)	14.8	13.7	16.6	14.9	0.6	13.3	16.2	14.7	0.8
Maximum head width (% HL)	54.9	50.5	61.2	53.7	2.3	51.0	57.4	53.0	2.4
Maximum cranial width (% cranium roof length)	63.5	64.9	79.6	72.5	4.3	66.3	75.8	69.1	2.8
Snout length (% SL)	8.1	7.9	9.8	8.7	0.5	7.7	9.3	8.6	0.4
Snout length (% HL)	30.0	29.4	33.4	31.3	1.1	27.2	33.0	30.8	1.6
Eye horizontal diameter (% SL)	6.0	4.7	7.7	6.1	0.7	5.4	8.0	6.3	0.7
Eye horizontal diameter (% HL)	22.4	17.3	27.3	21.9	2.5	20.6	26.4	22.5	2.0
Eye horizontal diameter (% interorbital width)	70.7	52.0	86.7	67.5	8.3	59.8	92.5	73.1	11.9
Postorbital distance (% HL)	51.9	49.7	57.2	53.3	1.9	48.1	54.4	51.2	1.8
Interorbital width (% SL)	8.5	8.0	10.0	9.0	0.6	7.5	9.9	8.7	0.8
Interorbital width (% HL)	31.6	29.7	35.9	32.5	1.9	26.2	34.8	31.2	2.7
Length of upper jaw (% HL)	27.8	26.7	30.5	28.7	0.9	27.4	29.8	28.5	0.8
Length of upper jaw (% SL)	7.5	7.2	8.7	8.0	0.4	7.3	8.9	8.0	0.5
Length of lower jaw (% SL)	9.9	10.0	12.2	10.7	0.5	10.0	12.5	11.0	0.9
Length of lower jaw (% HL)	36.7	36.3	43.8	38.5	1.5	36.3	44.0	38.9	2.5
Length of lower jaw (% interorbital width)	116.0	110.0	133.8	121.2	6.0	109.1	138.7	123.0	9.8
Length of lower jaw (% depth of operculum)	116.5	110.8	133.8	116.1	4.9	111.5	132.3	118.5	7.0

Table 2. Gill-raker counts in *Telestes dabar*, *T. miloradi* and *T. metohiensis*.

	7	8	9	10	mean	SD
<i>T. dabar</i>			20	20	9.5	0.51
<i>T. miloradi</i>		1	11	6	9.3	0.57
<i>T. metohiensis</i> , Gatačko Polje	2	33	15	1	8.3	0.58
<i>T. metohiensis</i> , Nevesinjsko Polje	6	28	12	1	8.2	0.67

siderably so. All scales well ossified, usually visible without staining. In live specimens, scales clearly visible because of some silver highlights (Fig. 2a). Lateral line complete (2 specimens), long but incomplete (5) or interrupted (33) as in specimen in Fig. 3a; if interrupted, gaps typically comprising absence of a few scales in a few places, 24–69 in total (Table 3), 65 with one interruption in holotype. Lateral line making clear curvature above anal-fin origin. Number of scales in total lateral series 62–69 (modal range 65–67), 68 in holotype.

Parietal segment of CSO lacking, CPM not communicating with CIO, terminating over the upper margin of opercular antedorsal process. CSO complete with 8, rarely 7 or 9, pores. CIO complete with 14–17 pores and with 4 canal openings on first infraorbital. CPM complete or interrupted between the angulo-articular and preoperculum and/or between preoperculum and operculum, CPM with 14–17 pores (4, rarely 5, canal openings on dentary, and 7–9, usually 8, canal openings on preoperculum). CST complete, with 5–7 pores or narrowly interrupted in middle.

Total vertebrae (Table 4) 39 (49), 40 (101) or 41 (11), 40 in holotype; abdominal vertebrae 22 (101), 23 (58) or 24 (2), 22 in holotype; caudal vertebrae 16 (9), 17 (82) or 18 (70), 18 in holotype; predorsal vertebrae 13 (24), 14 (126) or 15 (11), 14 in holotype; intermediate vertebrae 3 (123) or 4 (38), 3 in holotype. Most frequent vertebral formulae 22+17 (41), 22+18 (60) and 23+17 (40), 22+18 in holotype.

Colouration. In live specimens, dark back contrasting sharply with pale area below lateral midline, even in small specimens. Black midlateral stripe extending from head to caudal peduncle forming ventral border of darkly pigmented area on

Table 3. Total lateral-line scale and total lateral-series scales counts in *Telestes dabar*, *T. miloradi* and *T. metohiensis*.

	Total lateral-line scales							Total lateral-series scales			
	0–53	54–57	58–61	62–65	66–69	70–73	mean	SD	range	mean	SD
<i>T. dabar</i>	5	17	8	7	3		54.2	9.58	62–69	66.6	2.41
<i>T. miloradi</i>		6	5	5	2		60.3	3.91	58–69	62.8	2.93
<i>T. metohiensis</i> , Gatačko Polje		11	10	25	5		61.0	3.92	56–71	63.5	3.74
<i>T. metohiensis</i> , Nevesinjsko Polje	1	9	11	19	5	2	61.1	5.32	60–71	65.0	3.07

Table 4a. Vertebral counts in *Telestes* species endemic in Croatia and Bosnia and Herzegovina. Total vertebrae.

	38	39	40	41	42	mean	SD
<i>T. dabar</i>		49	101	11		39.8	0.56
<i>T. miloradi</i>		1	10	11		40.5	0.60
<i>T. metohiensis</i> , Gatačko Polje	6	33	12	2		39.2	0.68
<i>T. metohiensis</i> , Nevesinjsko Polje	10	112	35			39.2	0.52
<i>T. croaticus</i>	5	21				38.8	0.40
<i>T. fontinalis</i>	1	7	3			39.2	0.60
<i>T. karsticus</i>			2	2	3	41.1	0.89
<i>T. polylepis</i>			2	9	6	41.2	0.66
<i>T. turskyi</i>		2	9	6	1	40.3	0.77
<i>T. ukliva</i>					8	42.0	0

Table 4b. Vertebral counts in *Telestes* species endemic in Croatia and Bosnia and Herzegovina. Vertebral formulae.

	21+17	22+16	22+17	22+18	22+19	23+16	23+17	23+18	23+19	24+16	24+17	24+18	24+19
<i>T. dabar</i>			41	60		8	40	10		1	1		
<i>T. miloradi</i>			1	6	1		4	10					
<i>T. metohiensis</i> , Gatačko Polje		6	28	2		5	10	2					
<i>T. metohiensis</i> , Nevesinjsko Polje		7	58	12		33	24						
<i>T. croaticus</i>	2	3	16			5							
<i>T. fontinalis</i>		1	1			7	3						
<i>T. karsticus</i>				1			1	2	1			2	
<i>T. polylepis</i>				1			1	8	4		1	2	
<i>T. turskyi</i>			1	4		1	5	6	1				
<i>T. ukliva</i>									3				5

back. Another black lateral stripe occurring more ventrally, on otherwise pale ventral portion of trunk; this stripe extending from eye or opercle (or just behind opercle) to at least vertical through point halfway between origins of pelvic and anal fins, sometimes extending as poorly coalesced spots onto caudal peduncle. Dash-like black marking present along internal procurrent rays of caudal-fin dorsal lobe, and elongate black blotch present at bases of 3rd–7th branched rays of dorsal fin. Black pigment also occurring on rays of dorsal and caudal fins, but its intensity varying among individuals. Peritoneum black. This general pattern of pigmentation retained in formaldehyde-fixed and ethanol-preserved specimens. Live specimens collected from May through September, both males and females, exhibiting yellowish-orange pigment at bases of all fins, especially pectoral and anal fins, and yellowish pigment on iris and along anterior, dorsal and posterior margins of operculum. Colouration of specimens in cold season unknown.

Table 4c. Vertebral counts in *Telestes* species endemic in Croatia and Bosnia and Herzegovina. Abdominal, caudal and predorsal vertebrae in *Telestes dabar*, *T. miloradi* and *T. metobiensis*.

	Abdominal vertebrae						Caudal vertebrae						Predorsal vertebrae						
	21	22	23	24	Mean	SD	15	16	17	18	19	mean	SD	12	13	14	15	mean	SD
<i>T. dabar</i>		101	58	2	22.4	0.51		9	82	70		17.4	0.59		24	126	11	13.9	0.46
<i>T. miloradi</i>		8	14		22.6	0.49			5	16	1	17.8	0.50			15	7	14.3	0.5
<i>T. metobiensis</i> , Gatačko Polje		36	17		22.3	0.47		7	42	4		16.9	0.46		3	38	12	14.2	0.50
<i>T. metobiensis</i> , Nevesinjsko Polje	1	92	64		22.4	0.51	2	43	105	7		16.7	0.56		2	124	31	14.2	0.42
<i>T. croaticus</i>	2	19	5		22.1	0.52		8	18			16.7	0.47			21	5	14.2	0.40
<i>T. fonimalis</i>		2	9		22.8	0.40		7	4			16.4	0.50			2	9	14.8	0.40
<i>T. karsticus</i>		1	4	2	23.1	0.69			1	5	1	18.0	0.58			4	3	13.4	0.53
<i>T. pohlepis</i>		1	13	3	23.1	0.49			2	11	4	18.1	0.60			1	16	13.9	0.24
<i>T. turskyi</i>		5	13		22.7	0.46		1	6	10	1	17.6	0.62		16	2		13.1	0.32
<i>T. uklina</i>			3	5	23.6	0.52				5	3	18.4	0.52	2	5	1		12.9	0.64

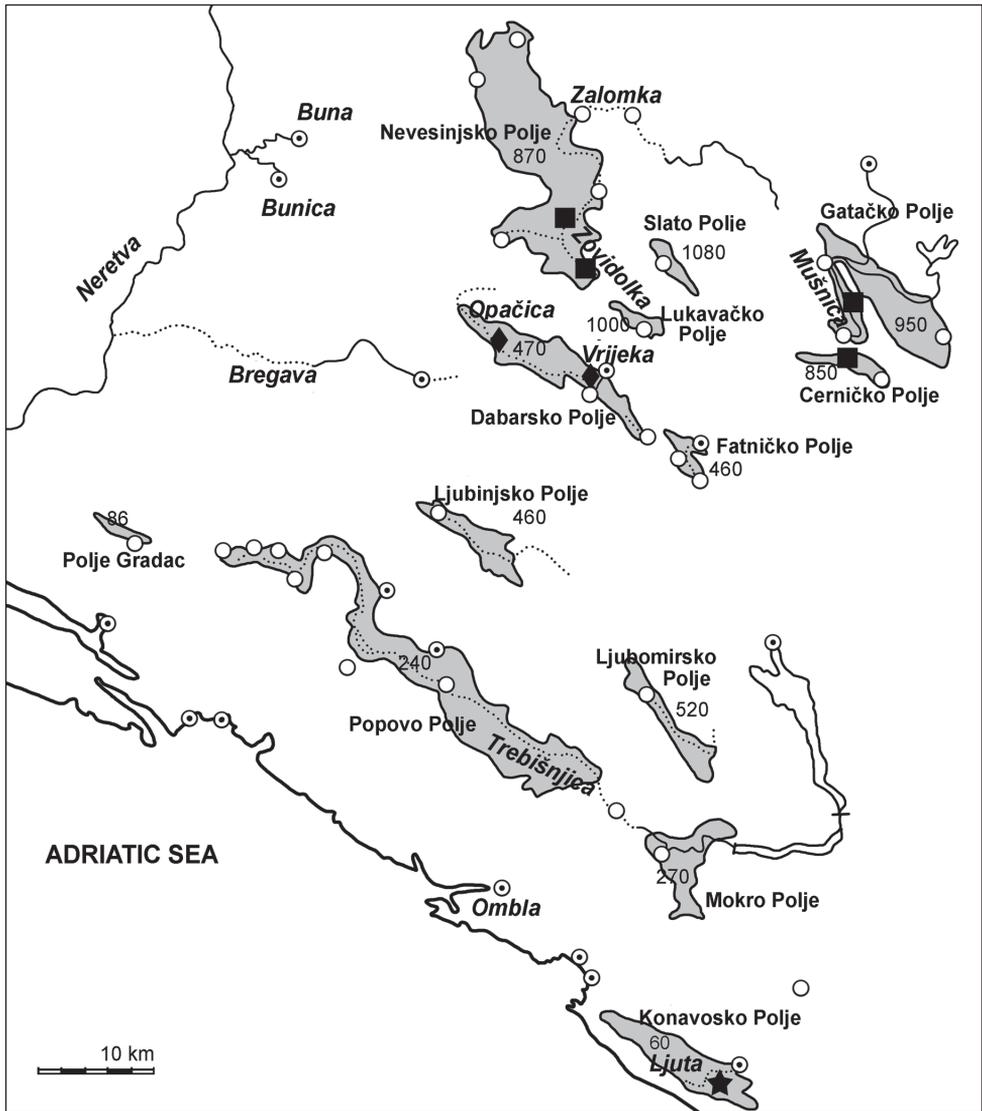


Figure 4. Map of distribution of *Telestes dabar* (diamond), *T. miloradi* (star) and *T. metohiensis* (square) in karst fields of Eastern Herzegovina and Dubrovnik littoral; white circles show ponors and white circles with black dots - springs.

Sexual dimorphism. Genital papilla absent in both males and females. Most morphometric characters not significantly different between males and females (Table 1a) with five exceptions. In males, distance between origins of pectoral and pelvic fins longer than in females ($P < 0.0001$), dorsal fin deeper ($P < 0.02$), anal fin deeper ($P < 0.0001$), pectoral fin longer ($P < 0.0001$), pectoral fin often reaching pelvic-fin origin in males, and pelvic fin longer ($P < 0.0001$), pelvic fin often reaching anal-fin origin in males.



Figure 5. **a** Habitat of *Telestes dabar*: Opačica River at Potkom, Dabarsko Polje (type locality) **b** Opačica River 100 m away from the spring (8 July 2011) **c–d** habitat of *Telestes metohiensis*: Nevesinjsko Polje; **c** – spring Ljeskovik in Zalomka River (8 July 2011) **d** Zovidolka River at Udbine (8 July 2011). All in Bosnia and Herzegovina.

In samples collected in May, ripe males with small but prominent conical breeding tubercles. Tubercles regularly covering entire body, including dorsal and ventral surfaces of caudal peduncle, except for ventralmost surface of head. Single tubercle located on each scale. On all fins (except for caudal fin), tubercles present on both sides along all rays and on fin membrane, being particularly dense along marginal rays. Tubercles forming rows along outer margins of operculum and pectoral fin; tubercles in those rows larger than others on body. Degree of tubercle development varying between males with regard to both size of tubercles and their location. Tubercles always present on head, back, and pectoral fin. Males retaining tubercles, though reduced in size and density, until September.

Distribution. The new species is known from two rivers, Vrijeka and Opačica, in the Dabarsko Polje of Eastern Herzegovina in Bosnia and Herzegovina (Fig. 4).

Habitat and biology. From May through September *T. dabar* is found in shallow water of those river sections that are adjacent to and filled from underground

springs. There is no current, and the water is clean (Fig. 5a). Females with eggs and just-spent females were caught on 24 May 2001 in Vrijeka River and mature males and just-spent females on 31 May 2000 in Opačica River. The size of the ripe eggs was 1.3–1.7 mm in diameter. In all examined samples females predominate. The smallest spent female was 45.0 mm SL, and the smallest ripe male 43.7 mm SL. No other fishes were caught in Opačica together with *T. dabar* while *D. ghetaldii* were collected in Vrijeka.

Etymology. The specific name, *dabar*, refers to the type locality, Dabarsko, or Dabar Polje; it is a noun in apposition.

***Telestes miloradi* sp. n.**

urn:lsid:zoobank.org:act:9A45C6CE-B7BF-4593-BAF6-0D10C45C78EA

http://species-id.net/wiki/Telestes_miloradi

Fig. 7

Holotype. NMW 95296 (ex 51169), 66.7 mm SL; CROATIA: stream Ljuta at Gruda [misspelt Grinda in Steindachner (1901: 197)], 1901, coll. Kolombatovič.

Paratypes. NMW 51169, 13 (? syntypes [now paralectotypes] of *Paraphoxinus metohiensis*), 31.4–62.6 mm SL, same data as holotype; NMW 51170, 4 (syntypes [now paralectotypes] of *Paraphoxinus metohiensis*), 57.9–66.4 mm SL, same data as holotype; NMW 51171, 3 syntypes [now paralectotypes] of *Paraphoxinus metohiensis*, 74.6–83.1 mm SL, same data as holotype; NMW 51173, 1 syntype [paralectotype] of *Paraphoxinus metohiensis*, 119.3 mm SL, same data as holotype.

Diagnosis. *Telestes miloradi* is distinguished from *T. metohiensis* and *T. dabar* by having the following combination of characters: slightly curved, relatively narrow dark stripe (obvious in most preserved specimens) present on ventral portion of trunk from just behind operculum to vertical at or anterior to origin of anal fin, this stripe separated from dark pigmented area on back along its entire length; scales on most of body not overlapping; mouth subterminal with tip of mouth cleft at or below level of ventral margin of eye; snout not fleshy; lateral line complete with 55–67 total scales; branched dorsal-fin rays 8½; branched anal-fin rays 8½; gill rakers usually 8–10, mode 9; total vertebrae usually 40 or 41; abdominal vertebrae 22–23, mode 23; caudal vertebrae 16–18, mode 18; head width 48–58% HL, and lower jaw short, length 8–10% SL.

Description. Morphometric data are summarised in Table 1b, selected counts in Tables 2–4. General appearance can be seen in Figs 7a and 7b. Body compressed, elongate. Caudal peduncle depth equal to or only slightly less than half maximum body depth; head length greater than maximum body depth. Eye small, its diameter smaller than snout length. Snout not fleshy, rostral cap covering only part of upper lip, at least in preserved specimens. Mouth subterminal, tip of mouth cleft

at level of ventral margin of eye or, more frequently, below it. Lower jaw-quadrate junction at vertical through anterior half of eye. Length of lower jaw 8–10% SL or 33–38% HL, or 96–107% depth of operculum (equal to depth of operculum on average).

Dorsal fin with 8½ branched rays. Dorsal-fin origin above posterior end of pelvic-fin base. Anal fin with 8½ branched rays. Outer margin of anal fin slightly concave. Caudal fin moderately forked, lobes weakly pointed, with 9+8 principal branched rays. Total gill rakers (Table 2) 8 (1 specimen), 9 (11) or 10 (6), 10 in holotype. Pharyngeal teeth 5–4, hooked, slightly serrated (examined in 5 specimens).

Scales covering entire body including pre-pectoral area and abdomen, overlapping on most parts of body. Scales regularly set; lateral-line scales and scales above and below it of about equal size. Lateral line complete (Table 3), 55–67 scales in total, 61 in holotype. Lateral line not curving above anal-fin origin. Number of scales in total lateral series 58–67 (modal range 62–64), 63 in holotype.

Parietal segment of CSO lacking. CPM not communicating with CIO, terminating over upper margin of opercular antedorsal process or communicating with CIO (on one side in 3 specimens). CSO complete with 8, rarely 7 or 9, pores. CIO complete with 14–16 pores and with 4 canal openings on first infraorbital. CPM complete, with 14–16 pores (4 canal openings on dentary, and 7–9, usually 8, on preoperculum). CST complete, with 5 or 7 pores.

Total vertebrae (Table 4) 39 (1), 40 (10) or 41 (11), 41 in holotype; abdominal vertebrae 22 (8) or 23 (14), 23 in holotype; caudal vertebrae 17 (5), 18 (16) or 19 (1), 18 in holotype; predorsal vertebrae 13 (15) or 14 (7), 14 in holotype; intermediate vertebrae 3 (12) or 4 (9), 3 in holotype. Vertebral formulae 22+17 (1), 22+18 (7), 23+17 (5) and 23+18 (10), 23+18 in holotype.

Colouration. In preserved specimens, dark back contrasting sharply with pale area below lateral midline. Dark midlateral stripe extending from head to caudal peduncle forming ventral border of darkly pigmented region on back (faded in some specimens). Another, more conspicuous, dark lateral stripe, occurring on ventral portion of trunk, narrow and not extending posterior to vertical through origin of anal fin. Peritoneum dark.

Sexual dimorphism. Genital papilla absent in both males and females. Most morphometric characters not significantly different between males and females (Table 1). In the three male specimens examined, dorsal fin deeper than in females ($P=0.0105$); pectoral fin longer ($P<0.001$), pectoral fin nearly reaching pelvic-fin origin in males and well short of pelvic fin in females; and pelvic fin longer ($P<0.0001$), pelvic fin almost reaching anal-fin origin in males, well short of anal fin in females.

Distribution. The new species is known from Ljuta River in Konavosko Polje, also called Konavoska Ljuta, of Dubrovnik littoral (Fig. 4). Only historical NMW samples are known to us.

Etymology. The species is named for Milorad Mrakovčić, Zagreb, in recognition of his many contributions to the study of freshwater fishes in the Adriatic basin.

Comparative remarks

Telestes dabar, *T. miloradi*, *T. metohiensis*, *T. croaticus*, and *T. fontinalis* are distinguished from all congeners by having the pharyngeal teeth in one row, 5–4 or 5–5 (vs. usually 2.5–5.2 or 2.5–4.2), having the preoperculo-mandibular canal terminating in a free pore at the upper margin of the opercular antedorsal process and not communicating with the infraorbital canal (vs. communicating), and in lacking a postcleithrum (vs. postcleithrum present). All five species possess a dark midlateral stripe from the head to the caudal peduncle that forms the ventral border of the darkly pigmented area on the back. This feature is similar to that in some other *Telestes* species (Kottelat and Freyhof 2007: 282–289). Within this group, *T. dabar*, *T. miloradi*, and *T. metohiensis* differ from *T. croaticus* and *T. fontinalis* in having an additional black lateral stripe occurring on the otherwise pale ventral portion of the trunk. This character was considered unique for *T. metohiensis* (Kottelat and Freyhof 2007: 284). In *T. dabar* and *T. miloradi* this ventral stripe (Fig. 1a, 2a, 7) is narrow and extends from just behind the operculum maximally to a vertical through the origin of the anal fin. In *T. metohiensis*, the stripe (Fig. 1b, 2b–c) is wide and usually extends posteriorly to the caudal peduncle where it merges with the main pigmented area. The pale area between the dark area on the back and the ventral stripe varies in length and depth, being the smallest in females (Fig. 1b, 2b–c).

Besides the presence of the ventral stripe, *Telestes dabar* and *T. miloradi* are further distinguishable from *T. croaticus* and *T. fontinalis* by usually having 8½ branched dorsal-fin rays (vs. usually 7½). *Telestes dabar* differs from *T. croaticus* by usually having 40 total vertebrae (vs. usually 39) (Table 4); a maximum head width of 42–52% HL (averaging 50% HL in females and 48% HL in males), which is considerably smaller than the head depth at nape, 61–71% HL (averaging 67% HL in females and 65% HL in males) (vs. the maximum head width only slightly smaller than the head depth or about equal to it); and a smaller size, up to 82 mm SL (vs. up to 160 mm). *Telestes dabar* can be further distinguished from *T. fontinalis* by having 5–4 pharyngeal teeth (vs. 5–5); a usually long, though slightly incomplete and narrowly interrupted, lateral line that reaches the posterior half of the caudal peduncle and has 24–69, usually 54–65, total scales (vs. a short, incomplete, and widely interrupted lateral line terminating in the area between the pectoral and anal fins with usually 23–37 total scales); usually 17 or 18 caudal vertebrae (vs. 16); usually 13 or 14 predorsal vertebrae (vs. 15) (Table 4); 3 or 4 intermediate vertebrae (vs. 5); and a moderately compressed body without any ventral keel (vs. a markedly laterally compressed body and a scaled ventral keel in front of the pelvic fins).

Telestes miloradi further differs from *T. croaticus* and *T. fontinalis* in usually having a long, complete lateral line with 55–67 scales vs. an often incomplete and interrupted lateral line with (18–45)51–70 and (17)23–37(56) scales, respectively. The new species further differs from *T. croaticus* in having 8–10, most frequently 9, gill rakers, (vs. 8–9, most frequently 8); usually 40 or 41 total vertebrae (vs. 38 or 39); 22–23, mode 23, abdominal vertebrae (vs. 21–23, mode 22); and 17–19, mode 18, caudal vertebrae

(vs. 16–17, mode 17) (Table 4). *Telestes miloradi* can be further distinguished from *T. fontinalis* by having 5–4 pharyngeal teeth (vs. 5–5); usually 40 or 41 total vertebrae (vs. 38–40, usually 39); 17–19, usually 18, caudal vertebrae (vs. 16–17, often 16) (Table 4); 3 or 4 intermediate vertebrae (vs. 5); and a moderately compressed body without a ventral keel (vs. a markedly laterally compressed body and a scaled ventral keel in front of the pelvic fins).

Telestes miloradi differs from *T. croaticus*, *T. fontinalis*, *T. metohiensis*, and *T. dabar* in having comparatively well-overlapped scales, especially on the anterior part of the flank and on the caudal peduncle; and scales of about the same size in the lateral line and above and below it (vs. scales usually non-overlapping on most of the body, and scales above and below the lateral line smaller than the lateral-line scales). The scale pattern in *T. miloradi* is very similar to the pattern found in most leuciscine fishes, e.g. *T. karsticus* Marčić & Mrakovčić, 2011 (Fig. 8), *T. turskyi* (Heckel, 1843), *T. ukliva* (Heckel, 1843). The presence of overlapping scales is a plesiomorphic feature for the Leuciscinae (Bogutskaya 1990, 1991), as is an interconnection of CPM and CIO (e.g., *T. karsticus*). In addition to overlapping scales, a few specimens of *T. miloradi* exhibit interconnected CPM and CIO.

In this study, we compared specimens of *T. metohiensis* from Gatačko, Cerničko, and Nevesinjsko poljes and found that specimens from the Nevesinjsko Polje (labeled as *affinis* by Steindachner although the name *affinis* was never published), though somewhat different in usually having smaller and more scattered scales, are similar to *T. metohiensis* from the Gatačko and Cerničko poljes in all other aspects examined by us (Tables 1c–d, 2–4). We suppose that a reason for Steindachner's opinion could be the differences evident between the NMW specimens of *T. metohiensis* from the Gatačko Polje (Mušnica River, Gacko) and those from the Nevesinjsko Polje (Zalomka River) (Fig. 6). Additional material examined by us revealed that the differences noted above in scales may be size-dependent: larger specimens of *T. metohiensis* in both poljes usually have more densely set scales. A specimen of *T. metohiensis* from Gatačko Polje, NMW 51176:3 (87.9 mm SL) is designated here as lectotype to ensure taxonomic stability in the event that *T. metohiensis* from the Nevesinjsko Polje is recognised as taxonomically distinct in the future.

Both *T. dabar* and *T. miloradi* are distinguishable from *T. metohiensis* by usually having $8\frac{1}{2}$ branched dorsal-fin rays (vs. usually $7\frac{1}{2}$: $7\frac{1}{2}$ found in 192 specimens and $8\frac{1}{2}$ in 22); 39–41, modes 40 and 41, total vertebrae (vs. 38–40, rarely 41, mode 39); 16–19, modes 17 and 18, caudal vertebrae (vs. 15–17, usually 16 or 17) (vs. 15–17, usually 16 or 17) (Table 4; differences are statistically significant at $P < 0.0001$); and more numerous gill rakers, 9 or 10 (vs. (7)8–9(10), most frequently 8) (Table 2). *Telestes dabar* further differs from *T. metohiensis* in usually having an interrupted lateral line with 24–69, usually 54–65, total scales (vs. usually complete with 58–65 scales) (Table 3; difference is statistically significant at $P < 0.0001$). The scale pattern also distinguishes *T. dabar* from *T. metohiensis*. In *T. dabar*, the scales (Fig. 3a) are densely set, but they do not overlap on most parts of the body except behind the pectoral girdle and on the caudal peduncle; the scales above and below the lateral line are only slightly



Figure 6. *Telestes metohiensis*. **a** NMW 51176:3, lectotype, 87.9 mm SL, ‘Mušica’ [Mušnica] River **b** NMW 51090 (labelled as *affinis* nomen museale), 57.9 mm SL, Zalomska [Zalomka River].

smaller than the lateral-line scales; and the scales are oval, somewhat deeper than long, on the flanks and elongated, longer than deep with a prominent posterior attenuation, on the caudal peduncle. In *T. metohiensis* the scales are more or less widely spaced and do not overlap on the entire body except for the lateral line; this feature can be seen in live specimens, Fig. 2b); the scales (Fig. 3b) above and below the lateral line usually are considerably smaller than the lateral-line scales; and the scales are almost circular on both the flanks and the caudal peduncle. *Telestes dabar* is further distinguished from *T. metohiensis* by having a black-and-white general colouration except for yellowish-orange pigmentation of the fin bases and yellow pigmentation in the iris and along the operculum in adults (vs. yellowish-green or greenish-bronze pigmentation of the whole body and fins in both young and adults, Fig. 2b–c). With regard to the morphometric features, *T. dabar* is rather similar to *T. metohiensis*, differing only in having a narrower head, maximum head width 12–15% SL or 43–52% HL and maximum cranial width 60–73% cranium roof length (vs. 13–17% SL or 51–59% HL, and 64–80% cranium roof length) (Table 1; differences are statistically significant at $P < 0.0001$).

Besides the characters mentioned above, *Telestes dabar* differs from *T. miloradi* in having the lateral-line scales larger than the scales above and below it (vs. of about equal size); usually an interrupted lateral line making a sharp curvature upward above the anal-fin base (vs. complete and making no sharp curvature); the length of lower jaw 10–12% SL, 36–41% HL, 102–132% depth of operculum (vs. 8–10% SL, 33–38% HL, 96–107% depth of operculum) (Table 1; differences are statistically significant at $P < 0.0001$).



Figure 7. *Telestes miloradi*, Croatia: Ljuta River at Gruda, Konavosko Polje **a** Holotype, male, 66.7 mm SL, NMW 95296 **b** paratype, female, 119.3 mm SL, NMW 51173.



Figure 8. *Telestes karsticus*, PZC 504, 62.6 mm SL, Croatia: Sušik River, Danube drainage.

Comments on the distribution and conservation of *T. dabar*, *T. miloradi* and *T. metohiensis*

The three *Telestes* species are known from four of the 13 main karst poljes located in Eastern Herzegovina (Bosnia and Herzegovina) and in Dubrovnik littoral area (Croatia) (Fig. 4). These karst poljes are part of a high-karst geotectonic unit known as Dinaric Karst, which consists of Mesozoic carbonate formations. The depth of soluble and highly karstified rocks here exceeds 3000 m (Milanović 1981, 2006). A polje (means “field” in many Slavic languages) is a large closed depression draining underground with a flat floor. Its streams may be permanent, intermittent and perennial, and, in natural conditions, a polje is subject to periodic flooding and becomes a lake. In Eastern Herzegovina and in the Dubrovnik littoral area stepwise poljes are distributed from

60 m up to 1,080 m above sea level (Fig. 4). Streams and rivers appear from temporary or permanent springs and sink underground through swallow holes called ponors. In general, hydro-systems of all poljes under consideration (Fig. 4), except for the Konavosko Polje with direct connection to the Adriatic Sea and the Polje Gradac with no springs or surface flows, belong to the Neretva drainage area and form a complex net of underground flows. Within the Neretva drainage, the poljes belong to catchments of the Buna River (Slato and Nevesinjsko), the Bregava River (Lukavačko and Dabarsko), and the Trebišnjica River (Gatačko, Fatničko and others). At present, no one polje has a direct groundwater (surface) flow connection with Neretva or its tributaries. Historically, interconnections between variable surface streams and between them and the main Neretva course occurred during different geological epochs. Fish distributions can provide some evidence of this. Conversely, very local distribution of some fishes may indicate the isolation of some surface drainage systems for a long time.

Slato [Zlato] Polje (1,020–1,080 m above sea level) is situated at the highest elevation of all Eastern Herzegovina poljes. Ćurčić (1915a) reported finding no fishes at Slato Polje, and no fishes are known from later literature or from museum collections. The Slato Polje is connected with Nevesinjsko Polje through a narrow valley that is now dry. The Nevesinjsko Polje, the largest polje in Eastern Herzegovina, has a surface area of 170 km² and is located at an elevation from 870 m to 800 m above sea level. The lowest point is Biograd Ponor, which is the terminus of the Zalomka River that starts at Raščelica near the Gatačko Polje. This river has a permanent flow only between Fojnica and Črni Kuk. Along the river bed downstream from Črni Kuk there are a lot of ponors. The most prominent leakage zone is in the Rilja section where the Zalomka is active only 213 days per year, on average (Milanović 1981, 2006). In the warm season almost the entire river bed of the Zalomka within the Nevesinjsko Polje is dry, and fishes are found in its upper section only. Only four species are known from there: *Salmo* sp., *Squalius* cf. *squalus*, *Squalius svallize* Heckel & Kner, 1858, *Phoxinus* sp. (PZ personal observations). Ćurčić (1915a) reported that *Paraphoxinus metohienis* was the most numerous species around Fojnica, but at present only *Phoxinus* sp. was found there by PZ. Further downstream, *T. metohiensis* occurs in those very short river sections that are adjacent to permanent springs such as Ljeskovik. This species also occurs in upper reaches of the Zavidolka River that temporarily flows to the Zalomka in the east from the Biograd Ponor (our data). *Delminichthys ghetaldii* is absent from the Nevesinjsko Polje and the Zalomka system.

Dabarsko Polje, about 20 km long and 1 to 3 km wide, is located close to the Nevesinjsko Polje but isolated from it. The Dabarsko Polje lies more than 400 m of elevation below the Nevesinjsko Polje. At present, the Dabarsko Polje is a closed basin without a possibility for surface runoff. All waters of the Dabarsko Polje catchment flow through underground karst conduits toward the springs of the Bregava River, though historically the Polje drained to the Bregava River canyon that is now dry. The lowest point is the Ponikva Ponor (471 m above sea level), the terminus of a single permanent stream in the polje, the Vrijeka River, which is only 2.5 km long (Milanović 1981, 2006). The Opačica River located in the northwestern part of the polje is longer

but intermittent. Only two native species occur in Dabarsko Polje: *D. ghetaldii* and *T. dabar* (recorded earlier under the name *Phoxinellus metohiensis*) in Vrijeka and only *T. dabar* in Opačica (our data). *Delminichthys* (as *Phoxinellus*) *ghetaldii* was first recorded in Sušica and Ljelješnica cave springs by Čurčić (1915a) and then confirmed by PZ's findings in a stream flowing from the Ljelješnica Cave (Zupančič and Bogutskaya 2002) and in the Vrijeka. It is relatively less abundant in Vrijeka than *T. dabar*. A trout has been introduced into Vrijeka.

The small Lukavačko Polje (2.5 km²) is located at an elevation of 852–880 m east from the Dabarsko Polje. The two poljes are divided by about 400 m of elevation. Fatničko Polje is also a small closed basin (5.6 km²) located southeast from the Dabarsko Polje at a much lower elevation, 462–470 m above sea level. The Fatničko Polje is divided from the Dabarsko Polje by an extremely karstified limestone ridge which is about 2 km wide. The most prominent karst features of the Fatničko Polje are the Obod temporary spring and the Pasmica Ponor. About 85% to 90% of the Fatničko Polje water flows to the Trebišnjica springs and 10% to 15% to the Bregava springs (Milanović 1981, 2006). Čurčić (1915a, 1915b), Taler (1953a, 1953b), Sabioncello (1967) and Vuković (1977) reported *P. metohiensis* from the Lukavačko and Fatničko poljes. However, no extant samples confirm these reports. In 1998–2001, PZ found only *D. ghetaldii* in Fatničko Polje and no *D. ghetaldii* or *T. metohiensis* in the Lukavačko Polje (Zupančič and Bogutskaya 2002). No other data have been received since then.

Gatačko Polje (37.6 km²) consists of two geomorphologically and hydrogeologically interconnected units: Gatačko Polje itself and Small Gatačko Polje. The largest ponor zone is situated in Small Gatačko Polje along the 8 km long tectonic contact between flysch sediments and karstified limestone, from Srdevići to the Šabanov Ponor (936 m above sea level). The entire Gatačko Polje belongs to the catchment area of the Trebišnjica River, except a very small eastern part. The longest underground flow (35 km) in Eastern Herzegovina is between the Srdevići Ponor and the Trebišnjica Springs. The main flow in the Gatačko Polje is the Mušnica River with its tributary Gračanica. The Mušnica is formed by three streams, Vrba, Ulinjski Potok and Jasenički Potok. They flow from the Cemern and Lebršnik mountains. The Mušnica goes from the eastern to the western border of the polje and along its western border southwards before it completely sinks in the Šabanov Ponor. The flow of the Mušnica River re-appears in the Cerničko Polje where it is named the Ključka River. It originates in a large cave, Vilina Pečina and terminates about 300 m downstream in a ponor that has a recharge capacity of approximately 20 m³ s⁻¹ (Milanović 2006). *Telestes metohiensis* (in *Paraphoxinus* or *Phoxinellus* by earlier authors), *Phoxinus* sp. and *Alburnus neretvae* Buj, Sanda et Perea 2010 are known to occur in Mušnica. *Phoxinus* sp. and, probably, *Salmo* sp. occur in Gračanica. Many literature sources (see in Zupančič and Bogutskaya 2002) reported *Paraphoxinus metohiensis* from the Gračanica River at Gacko, but we know of no extant samples. Only *T. metohiensis* was found (PZC) in short karstic streams of the Cerničko Polje.

Telestes metohiensis or close species are absent from other poljes except for the Konavosko Polje. This polje is located rather far in the south from poljes inhabited by *T.*

metohiensis and *T. dabar*. The Konavosko Polje or Polje Konavli is the lowermost polje in the region (elevation 60 m above sea level) with surface of 48 km². It is developed along the most important overthrust of the entire dinaric karst region (“High Karst Overthrust”). The largest spring Konavoska Ljuta is located at this contact. In natural conditions it was a temporary flooded polje. Main flows are Ljuta and its tributaries Konavočica and Opačica. At present, a tunnel between the polje and the sea coast drains the polje (Milanović 2006). No recent records exist of a *Telestes* species in the Ljuta or other springs of the Konavosko Polje. However, we think that efforts are worth trying to find *T. miloradi*, a new species, described here from the Konavoska Ljuta before it is finally considered extinct. It is known that many species from *Phoxinellus*, *Telestes* and *Delminichthys* genera are able to enter karstic underground waters during droughts and dramatic water table level fluctuation (Milanović 2006; Jelić, 2008; Marčić et al. 2011). However, this phenomenon probably depends considerably on the degree of development, size and depth of caverns, siphonic lakes and pools of estavelles.

The ranges of *T. metohiensis* and *T. dabar* are extremely small at least during the dry season and in surface water bodies. The recognition of *T. dabar* as a distinct species will require its Red List evaluation and a re-evaluation of *T. metohiensis* (now considered as Vulnerable) because of the loss of a part of its former presumed range. *Telestes dabar* would probably deserve the Critically Endangered status because of its very restricted distribution (IUCN 2010). Both species are threatened by habitat destruction, in particular by construction of tunnels for the draining of poljes and controlling their inundations, lining of river beds to obstruct water flow into ponors and reversible communication with estavelles.

Key to *Telestes* species of isolated karst river systems of the Adriatic basin in Bosnia and Herzegovina and Croatia, including Krbavsko Polje

- 1a Pharyngeal teeth in two rows, usually 2.5–5.2 or 2.5–4.2. Preoperculo-mandibular canal communicating with infraorbital canal. Postcleithrum present, of moderate size **2**
- 1b Pharyngeal teeth in one row, usually 5–4. Preoperculo-mandibular canal not communicating with infraorbital canal. Postcleithrum minute or absent..... **3**
- 2a Branched dorsal-fin rays 8½ and branched anal-fin rays 9½. Total lateral-line scales 60–68..... ***T. ukliva***
- 2b Branched dorsal-fin rays 7½ and branched anal-fin rays 8½. Total lateral-line scales 72–79..... ***T. turskyi***
- 3a Black stripe on ventral portion of trunk narrow and not reaching caudal peduncle. Branched dorsal-fin rays usually 8½ **4**
- 3b Black stripe on ventral portion of trunk absent or present; if present, stripe wide anteriorly and extending posteriorly to caudal peduncle. Branched dorsal-fin rays usually 7½..... **5**

- 4a Scales overlapping on most of body, scales approximately same size in, above and below lateral line. Lateral line not curving above anal-fin origin. Lower-jaw length 8–10% SL *T. miloradi*
- 4b Scales non-overlapping on most of body, though densely set. Lateral-line scales larger than scales above and below lateral line. Lateral line making clear curvature above anal-fin origin. Lower-jaw length 10–12% SL *T. dabar*
- 5a Body strongly compressed, abdomen with weakly scaled ventral keel in front of pelvics. Lateral line short, incomplete, terminating between pectoral and anal fins, and usually widely interrupted, with 17–56, usually 23–37, total scales. Branched anal-fin rays $7\frac{1}{2}$ *T. fontinalis*
- 5b Body slightly compressed, abdomen rounded. Lateral line long, slightly incomplete or complete, usually terminating on caudal peduncle, and narrowly interrupted, with 24–70, usually 54–68, total scales. Branched anal-fin rays usually $8\frac{1}{2}$ **6**
- 6a Black stripe on ventral portion of trunk present *T. metohiensis*
- 6b Black stripe on ventral portion of trunk absent *T. croaticus*

Comparative material

Telestes karsticus. PZC 577, 7, 547–750 mm SL, CROATIA: Sušik River at Tomići, Dobra River system (Danube drainage), 24 June 2005, coll. Zupančić.

Telestes metohiensis. All from BOSNIA AND HERZEGOVINA. **Gatačko Polje**: NMW 51176:3, lectotype, mm SL, 87.9 mm SL, ‘Mušica bei Imotski’ [misspelling, should be Mušnica River, Gatačko Polje; Imotski is probably an error because Steindachner (1901: 198) clearly indicated that the specimens had been received from karst waters and streams near Gacko, a town in the north of Gatačko Polje (43°09.4'N, 18°31.8'E); see also Zupančić & Bogutskaya 2002], 1899, coll. Redel, Sturani [Sturany]; NMW 51176:1–2, 72.2–82.5 mm SL, same data as holotype; NMW 12972, 1 paralectotype, 92.2 mm SL, same data as holotype; NMW 12973–75 (in one jar with 12972), 3 paralectotypes, 59.2–95.3 mm SL, same data as holotype; NMW 51172, 2 paralectotypes, 92.0–97.8 mm SL, same data as holotype; NMW 51174, 2 paralectotypes, 76.4–88.5 mm SL, same data as holotype; NMW 51175, 3 paralectotypes, 66.8–75.9 mm SL, same data as holotype; SMF 805, 2, 53.2–65.6 mm SL, Gacko; ZMH 15137, 7, 51.2–64.4 mm SL, Gacko, Herzegovina; **Cerničko Polje**: PZC 223, 9, 45.0–90.6 mm SL, source of Ključka River in Vilina Pečina (cave), 43°5.6'N 18°29'E, 16 May 2003, coll. Zupančić; PZC 330, 9, 46.0–88.7 mm SL, same locality and collector, 23 May 2001; PZC 337, 4, 73.7–85.4 mm SL, same locality and collector, 20 Aug. 2000; PZC 368, 4, 49.0–62.2 mm SL, spring at Ključ, 43°5.6'N 18°29.6'E, 23 May 2000, coll. Zupančić; PZC 503, 7, same locality and collector, 3 Aug. 2000. **Nevesinjsko Polje**: (NMW syntypes [now paralectotypes] of *P. metohiensis* labeled as *Paraphoxinus affinis* [handwritten by Steindachner; never published], nomen museale) NMW 9368–9372, 5, Zalomska [Zalomka River], 1896, coll. Hawelka; NMW 51088, 10, 47.6–57.9 mm SL, same

data as above; NMW 51089, 10, 49.6–58.1 mm SL, same data as above; NMW 51092, 5, 51.9–65.5 mm SL, same data as above; NMW 51093, 8, 47.4–58.7 mm SL, same data as above; NMW 51094, 10, same data as above; NMW 51090, 5 (not labeled as syntypes of *P. metohiensis* though exclusion of these specimens from the type series is not evident from the original description), 47.6–57.9 mm SL, same data as above; NMW 51091, 4 (not labeled as syntypes, as above), 63.5–87.1 mm SL, same data as above; PZC 206, 3, 50.4–73.6 mm SL, Batuška River (Zalomka system), 43°19.3'N 18°7.1'E, 9 May 2000, coll. Zupančič; PZC 355, 17, 39.6–63.8 mm SL, same locality and collector, 21 May 2001; PZC 356, 6, 53.2–66.1 mm SL, same locality and collector, 5 May 2000; PZC 312, 19, 50.1–79.8 mm SL, spring Ljeskovik in Zalomka River near Rast and Odžak, 43°12.1'N 18°12.4'E, 21 May 2001, coll. Zupančič; PZC 313, 14, 49.1–78.7 mm SL, same locality and collector, 1 July 2002; PZC 567, 7, 45.1–86.2 mm SL, same locality and collector, 8 July 2011; PZC 358, 2, 38.2–42.0 mm SL, spring in Zalomka River at Budisavlje, 43°13.3'N 18°13.1'E, 22 May 2011, coll. Zupančič; PZC 523, 15, 39.5–90.9 mm SL, Zovidolka [Zavodoka, Zovidolska] River at Udbine, 43°8.6'N 18°14.7'E, 15 Sept. 2006, coll. Zupančič; PZC 293, 12, 49.1–99.2 mm SL, Zovidolka [Zavodoka, Zovidolska] River at Udbine, 43°8.6'N 18°14.7'E, 29 Aug. 2006, coll. Zupančič; PZC 315, 17, 57.8–81.4 mm SL, same locality and collector, 16 July 2002; PZC 523, 15, 39.5–90.9 mm SL, same locality and collector, 15 Sept. 2006; PZC 524, 13, 39.5–90.9 mm SL, same locality and collector, 15 Sept. 2006; PZC 566, 45, same locality and collector, 8 July 2011.

Telestes polylepis. NMW 18931–41, 11, paralectotypes, 93.6–107.2 mm SL, CROATIA: Josefthal [Josipdol], 1866; NMW 49713, 3, syntypes, 86.7–90.7 mm SL, CROATIA: Dobra River, 1866; NMW 49714–1, lectotype, 85.9 mm SL, CROATIA: Mresnitza [Mrežnica] River, 1866; NMW 49715, 2, paralectotypes, 80.8–84.1 mm SL, same data as lectotype.

Telestes turskyi. NMW 49629-1, lectotype, 129.5 mm SL, CROATIA: Čicola River [tributary of Krka], Dernis [Drniš] “Heckels Reise, 1840”; 17, paralectotypes, 55.3–102.3 mm SL.

Telestes ukliva. NMW 49639-1, lectotype, 85.0 mm SL, CROATIA: Sign “[aus der Cettina]”, “Heckels Reise, 1840”; NMW 49639-2 and 3, 2, 83.3–84.8 mm SL, same data as lectotype; NMW 49635, 3, paralectotypes, 58.0–75.8 mm SL, same data as lectotype; ZMH 15095, 1, CROATIA: Cetina.

Other extensive comparative material is listed in Zupančič and Bogutskaya (2002) and Bogutskaya and Zupančič (2003).

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