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Review of the buccal-attaching fish parasite genus *Glossobius* Schioedte & Meinert, 1883 (Crustacea: Isopoda: Cymothoidae)

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Abstract

Two species of *Glossobius* Schioedte & Meinert, 1883 are known from Australia: *Glossobius anctus* Bruce & Bowman, 1989 and *Glossobius impressus* (Say, 1818), the latter recorded here for the first time from Australia and southern Africa. *Glossobius ogasawarensis* Nunomura, 1994 is here placed in synonymy with *Glossobius auritus* Bovallius, 1885; whereas *Glossobius crassa* (Dana, 1853) is removed from synonymy with *G. auritus* and placed into *nomen dubium*. *Glossobius arimae* Nunomura, 2001 is transferred to the genus *Ceratothoa* Dana, 1852. A key to the species of *Glossobius* is presented.

Key words: Cymothoidae, *Glossobius*, southern Africa, Australia, fish parasite, Beloniformes

Introduction

Recently there has been considerable attention to the taxonomy of the family Cymothoidae Leach, 1814, notably from southern Africa (Hadfield *et al.* 2010, 2011, 2013, 2014a, b; Martin *et al.* 2014b); and Australia (Martin *et al.* 2013, 2014a). Knowledge of the buccal-attaching genera from Australia rests with the early works of Hale (1926), Avdeev (1978, 1979a, b), Bruce & Bowman (1989), and Bruce (1990). Martin *et al.* (2013, 2014a, 2015, in press) reviewed the genera *Ceratothoa* Dana, 1852, *Cymothoa* Fabricius, 1793 and *Smenispa* Özdikem, 2009. This contribution continues the revision of the Australian buccal-attaching Cymothoidae, with a review of the genus *Glossobius* Schioedte & Meinert, 1883, primarily parasitic on hosts of the order Beloniformes and including a redescription of *Glossobius impressus* (Say, 1818).

Schioedte & Meinert (1883), when describing *Glossobius*, included two species, *Glossobius laticauda* (= *Glossobius auritus* Bovallius, 1855) and *Glossobius linearis* (= *G. impressus*). More than a century later, Williams & Williams (1985) described a new species (*Glossobius hemiramphi* Williams & Williams 1985) and Bruce & Bowman (1989) comprehensively revised and provided a key to the species of the genus *Glossobius*, designated a type species and described a new species (*Glossobius anctus* Bruce & Bowman 1989). Subsequently, a further three species have been described (*Glossobius parexocoetii* Kononenko & Mordvinova, 1988; *Glossobius ogasawarensis* Nunomura, 1994; *Glossobius arimae* Nunomura, 2001) bringing the total number of *Glossobius* species to seven.

While examining specimens of *Glossobius* from Australian and southern African waters, it became apparent that of the two species of Japanese *Glossobius*, one is incorrectly placed in the genus and the other is a junior synonym, reducing the number of accepted species in the genus to five. We redescribe *G. impressus*, new to Australian and southern African waters; present a list of valid *Glossobius* species (see Table 1), and describe the known host-associations and the distribution of these cymothoids.

TABLE 1. Taxonomic and nomenclatural summary for *Glossobius*.

Original combination and authority	Status	Reference
<i>Glossobius albinae</i> Kononenko, 1986	= <i>Glossobius auritus</i> Bovallius, 1885	Bruce & Bowman, 1989
<i>Glossobius anctus</i> Bruce & Bowman, 1989	Valid	Bruce & Bowman, 1989
<i>Glossobius arimae</i> Nunomura, 2001	<i>Ceratothoa arimae</i> (Nunomura, 2001) comb. nov.	Present study
<i>Glossobius auritus</i> Bovallius, 1885	Valid	Bovallius, 1885
<i>Ceratothoa crassa</i> Dana, 1853	nomen dubium	Present study
<i>Glossobius hemiramphi</i> Williams & Williams, 1985	Valid	Williams & Williams, 1985
<i>Cymothoa impressa</i> Say, 1818	<i>Glossobius impressus</i> (Say, 1818) Valid	Bruce & Bowman, 1989
<i>Ceratothoa linearis</i> Dana, 1853	= <i>Glossobius impressus</i> (Say, 1818)	Bruce & Bowman, 1989
<i>Glossobius ogasawarensis</i> Nunomura, 1994	= <i>Glossobius auritus</i> Bovallius, 1885	Present study
<i>Glossobius parexocoetii</i> Kononenko & Mordvinova, 1988	Valid	Kononenko & Mordvinova, 1988

Material and methods

Specimens were borrowed from the Australian Museum, Sydney (AM) and the South Australian Museum, Adelaide (SAM). Methods (appendages dissection, temporary mount, digital inking, and species description) follow Martin *et al.* (2013, 2014a, b). Host nomenclature (references not provided) and distributions were obtained from *Fishbase* (Froese & Pauly 2015) and *Catalogue of Fishes* (Eschmeyer 2015).

Abbreviations: **AM**—Australian Museum, Sydney; **ANSP**—Academy of Natural Sciences Museum, Pennsylvania; **SAM**—South Australian Museum, Adelaide; **SMNH**—Swedish Museum of Natural History, Stockholm; **TOYA**—Toyama Science Museum, Toyama; **USNM**—National Museum of Natural History, Smithsonian Institution, Washington; **ZMMU**—The Zoological Museum of Moscow University, Russia. **Ovig.**—ovigerous.

Taxonomy

Family Cymothoidae Leach, 1814

Glossobius Schioedte & Meinert, 1883

Glossobius Schioedte & Meinert, 1883: 299.—Bruce & Bowman, 1989: 12.
Ceratothoa.—Richardson, 1905: 283.—Schultz, 1969: 155.—Kussakin, 1979: 287.

Types species. *Ceratothoa linearis* Dana, 1853 [junior synonym of *Glossobius impressus* (Say, 1818)]; by subsequent designation (Bruce & Bowman 1989).

Diagnosis (female). *Cephalon* not immersed in pereonite 1, anterolateral margin concave. *Eyes* present. *Pereonite* 1 anterolateral margins minute or projecting laterally, anterior margin straight or slightly convex. *Pleonite* 1 overlapped by pereonite 7, narrower than pleonites 2–5.

Antennula bases contiguous, peduncle articles 1–3 of similar size and bigger than other articles, peduncle articles 1–3 anterodistal margins produced, terminal articles without setae. *Coxae* not overlapping adjacent pereonites. *Brood pouch* arising from coxae 1–4 and 6. *Mandible* articles 1–3 articulated. *Maxilla* with well-defined medial and lateral lobes. *Maxilliped* palp article 3 apex with multiple recurved spines.

Pereopods 5–7 basis with raised carina. *Uropod rami* not extending beyond pleotelson posterior margin.

Remarks. *Glossobius* can be recognized by the cephalon not being immersed in pereonite 1; pereonite 1 with minute anterolateral margins or margins projecting laterally; cephalon anterolateral margins concave; antennule bases contiguous; pleopods with transverse ridges, endopods with weak proximomedial lobes, endopods 2–5 with depressions; and expanded posterior margin of pereopods 4–7 bases. For male diagnosis see Bruce & Bowman (1989).

Other similar buccal-attaching genera differ from *Glossobius* in the following characteristics: *Ceratothoa* pereonite 1 anterolateral margins projecting forward; pereonite 6 longer than *Glossobius*; anterior margin of pereonite 1 indented (Bruce & Bowman 1989); *Cinusa* Schioedte & Meinert, 1884: pereonite 3–4 widest anteriorly; antennae slender (Hadfield *et al.* 2010); brood pouch arising from coxae 2–5 (Hadfield 2012); *Lobothorax* Bleeker, 1857: pereonite 1 anterolateral margins rounded, with strongly developed lobes, dorsally concave and flattened, extending past rostrum; pleopod exopods with proximolateral lamella (Yu & Bruce 2006); brood pouch arising from coxae 2–4 and 6 (Hadfield 2012); *Cymothoa* Fabricius, 1793: antennula basally widely separated; cephalon rostrum ventrally folded (Hadfield 2012); pleopods with fleshy and thick folds (Martin *et al.* 2013); and *Smenispa*, 2009: pleopods 3–5 have large folds, and pereon and pleon are co-linear with subparallel lateral margins (Martin *et al.* 2014a).

Species of *Glossobius* (see Table 1) are restricted to beloniform fishes. *Glossobius arimae* Nunomura, 2001 was the only species associated with a non-beloniform fish and did not morphologically agree with the genus; *G. arimae* is here transferred to the genus *Ceratothoa* (see remarks in section *Ceratothoa arimae* (Nunomura, 2001) comb. nov.). *Glossobius* species display different levels of host specificity towards beloniform hosts. *Glossobius anctus* and *G. parexocoetii* are known from one host species, *G. hemiramphi* is known from two host species of the genus *Hemiramphus*, *G. impressus* is known from six host species of the family Exocoetidae, and *G. auritus* is known from five host species from two families. Despite the different levels of host preference for *Glossobius*, all species appear to be cosmopolitan (see comments on distribution for each species).

Key to the species of *Glossobius*

1. Body with scattered pigmentation; posterior margins of pereonites 3–5 with median point; posterior margin of pleotelson rounded *Glossobius parexocoetii*
– Body without scattered pigmentation; posterior margins of pereonites 3–5 without median point; posterior margin of pleotelson not rounded 2
2. Rostrum acute; pleopod 1 lateral margin weakly convex; uropod exopod longer than endopod *Glossobius hemiramphi*
– Rostrum rounded or blunt; pleopod 1 lateral margin strongly convex; uropod exopod similar or shorter than endopod 3
3. Labrum prominent, posterolateral margins produced; pleon as wide as or less wide than pereonite 7 width; coxae 2–7 anteroventral margins broader than posteroventral margins *Glossobius anctus*
– Labrum small, posterolateral margins narrowly rounded; pleon wider than pereonite 7 width; coxae 2–7 anteroventral margins similar size to posteroventral margins 4
4. Body subparallel; pereonites 1 and 2 with large bulbous lateral lobe; pereopod 3 dactylus larger and longer than other dactyli, two or more times longer than pereopod 3 propodus *Glossobius impressus*
– Body sub-rhomboid; pereonites 1 and 2 without bulbous lateral lobe; pereopod 3 dactylus no longer or no larger than other dactyli, less than twice or less as long as pereopod 3 propodus *Glossobius auritus*

Glossobius impressus (Say, 1818)

Figures 1–3

Cymothoa impressa Say, 1818: 397.—De Kay, 1844: 48.

Ceratothoa linearis Dana, 1853: 752, pl. 50: figs 1 (a–d).—Gerstaecker, 1882: 260.—Stebbing, 1893: 354.—Richardson, 1900: 221; 1901: 529.

Ceratothoa exocoetii Cunningham, 1871: 499, pl. 59: fig. 5.—Gerstaecker, 1882: 260.

Glossobius linearis.—Schioedte & Meinert, 1883: 301, pl. 12: figs. 1–9.—Hansen, 1895: 18, pl. 2: figs. 2–2d.—Brian & Dartevelle, 1949: 176.

Ceratothoa impressa.—Richardson, 1905: 234–236, figs. 236–240; 1913: 2, 6.—Fowler, 1912: 292–293, pl. 83.—Tattersall, 1921: 214.—Stephensen, 1948: 43–44, fig. 9.—Schultz, 1969: 155–156, fig. 233.—Anonymous, 1971: 16–17.—Lincoln,

1971a: 103–104, photograph facing p. 90; 1971b: 184.—Trilles, 1972: 7–9, figs. 3–24, photographs 5, 6; 1973: 1253–1255, pl. 2: figs. 14–16.—Bowman, 1978: 217.—Kussakin, 1979: 287, fig. 153.—Kurochkin, 1980: 289.

Meinertia impressa.—Nierstrasz, 1915: 89–90; 1918: 119.

Codonophilus impressus.—Nierstrasz, 1931: 131.

Glossobius impressa.—Avdeev, 1981: 1160, 1164; 1982a: 70.

Glossobius impressus.—Avdeev, 1982b: 65–67, fig. 2, no. 4; 1985: 89.—Bruce & Bowman, 1989: 22–26, figs. 15–17.—Kensley & Schotte, 1989: 183–185, fig. 83(B).—Williams & Williams, 2000: 155.—Luque, Vieira, Takemoto, Pavanelli & Eiras, 2013: 1449–1470.

Not *Ceratothoa impressa*.—Berkeley & Houde, 1978: 636 [= *Glossobius hemiramphi* Williams & Williams, 1985].

Type and type locality. The holotype is held at the Academy of Natural Sciences Museum, Pennsylvania (ANSP 1608). Type locality is Cape May, New Jersey from an unknown host (Bruce & Bowman 1989).

Material examined. ♀ (ovig. 25 mm), 29°17.00'S, 153°49.00'E, east of Evans Head, New South Wales, Australia, 7 November 1978, coll. FRV “Kapala” (AM P53749); Note: specimen with missing antennule and antenna, broken rostrum and a missing dactylus on left pereopod 1 (ventral view) without host data. ♀ (ovig. 32 mm), 22°S, 4°W, off Namibia, from the mouth of flying fish, coll. Nelson (SAM C345).

Ovigerous female. Length 25 mm, width 6 mm (Australian specimen, AM P53749).

Body 3.7 times as long as greatest width, body dorsal surface smooth and polished in appearance, body widest at pereonite 1–4, narrowest at pereonite 7, body lateral margins subparallel. *Cephalon* 0.8 times longer than wide, visible from dorsal view. *Frontal margin* apex rounded, (broken). *Eyes* well-developed, 0.3 times width of head. *Labrum* lateral margin convex, anterior margin broad.

Pereonite 1 anterior margin produced and smooth, anterolateral angle with distinct produced bulbous lobe and laminar flange; pereonite 2 with distinct produced bulbous lobe and laminar flange similar to pereonite 1, posterolateral angles narrowly rounded; pereonite 7 posterior margin weakly arched. *Coxae* 2–3 posteroventral angles with weak produced points; 4–7 with weakly oblique carina. *Pleonites* 2–5 not overlapped by pereonite 7, pleonites 2–5 similar width to pereonite 7; pleonite 5 with posterolateral angles not overlapped by lateral margins of pleonite 4. *Pleotelson* 0.4 times as long as anterior width, lateral margins convex, posterior margin weakly emarginate.

Pereopod 1 basis 1.1 times as long as greatest width; ischium 1.3 times as long as basis; merus proximal margin with slight bulbous protrusion; carpus with rounded proximal margin; propodus 1.4 times as long as wide; dactylus slender, 1.2 times as long as propodus, 3.2 times as long as basal width. Pereopod 2 propodus 1.2 times as long as wide; dactylus 1.4 times as long as propodus. Pereopod 6 basis 0.6 times as long as greatest width, ischium 1.1 times as long as basis, propodus 1.4 times as long as wide, dactylus 2.5 times as long as propodus. Pereopod 7 basis 0.6 times as long as greatest width; ischium 1.2 times as long as basis, without protrusions; merus proximal margin with bulbous protrusion, merus 0.3 times as long as ischium, 0.4 times as long as wide; carpus 0.3 times as long as ischium, without bulbous protrusion, 0.6 times as long as wide; propodus 0.8 times as long as ischium, 1.4 times as long as wide; dactylus slender, 1.8 times as long as propodus, 3.7 times as long as basal width.

Pleopod 1 exopod 0.7 times as long as wide, lateral margin strongly convex, distally weakly rounded, mesial margin straight, peduncle 0.3 times as long as wide, without retinaculae.

Uropod not extending beyond pleotelson posterior margin, peduncle 1.0 times longer than rami length, peduncle lateral margin without setae; marginal setae absent. *Endopod* apically slightly pointed, 2.5 times as long as greatest width, lateral margin proximally convex, mesial margin weakly convex. *Exopod* similar length to endopod, 2.5 times as long as greatest width, apically rounded, lateral margin weakly convex, terminating with no setae, mesial margin weakly convex.

Colour. Cephalon to pereonites 1–3 and appendages appearing dark brown to black, gradually lightening towards posterior end of body, similar to that observed by Bruce & Bowman (1989).

Size. Ovigerous female: 24–40 mm, pre-ovigerous female: 28–39 mm, mature male: 8–11 mm (Bruce & Bowman 1989).

Remarks. *Glossobius impressus* can be identified by the prominent lateral lobes on pereonites 1 and 2; broad rostrum; median emargination of pleotelson posterior margin; slender, long and weakly twisted pereopod 3 dactylus, twice as long as pereopod 3 propodus; bulbous protrusion on pereopods 6 and 7 merus; and strongly convex lateral margins of pleopods. Males have distinct eyes; lack the distinct lateral lobes on pereonites 1 and 2; subparallel bodies; pereonites 1–6 of similar length; smooth pleopod margins and similar pereopod morphology as seen in Trilles (1972) and Bruce & Bowman (1989).

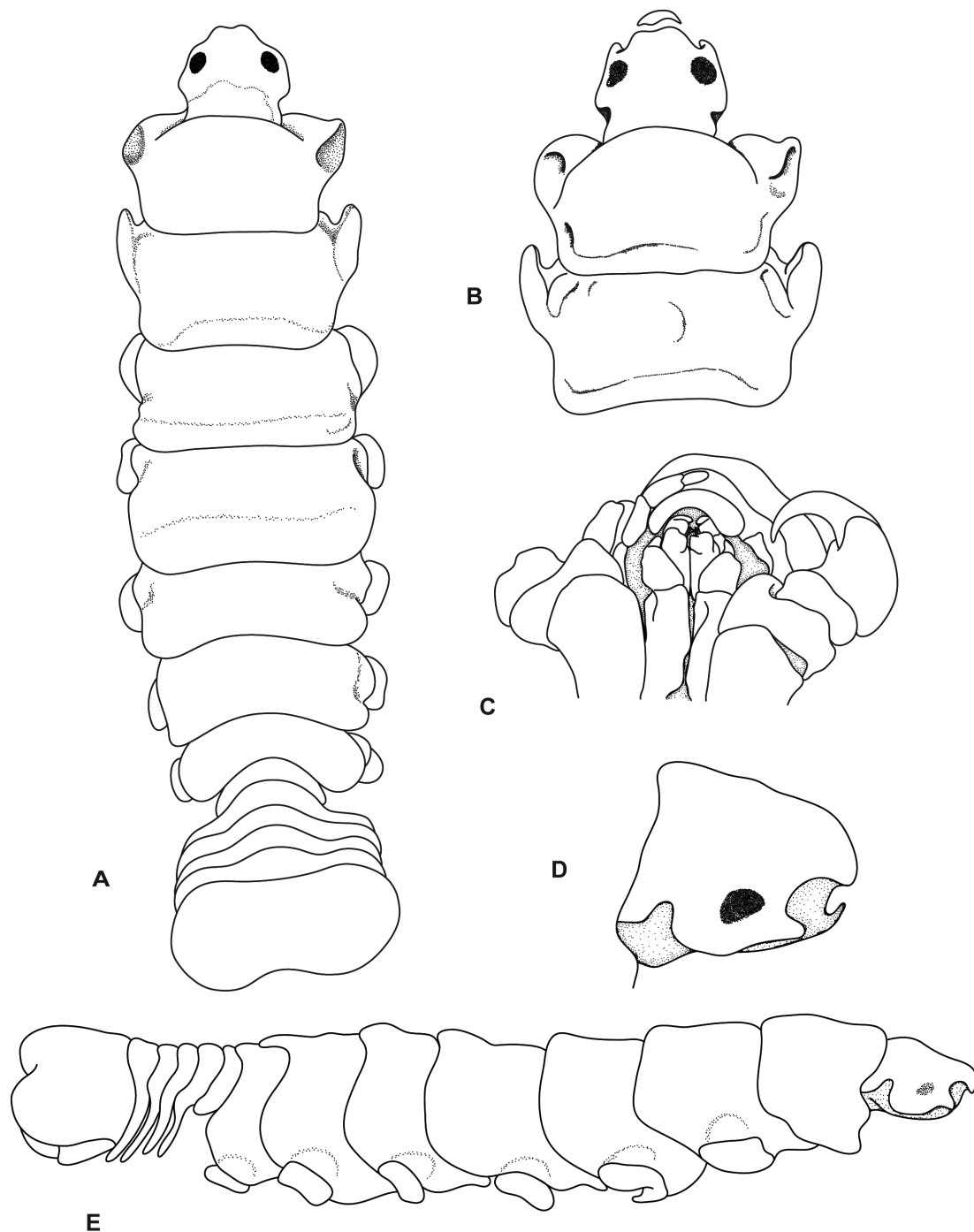


FIGURE 1. *Glossobius impressus* (Say, 1818), Australian ovigerous female (25 mm; AM P53749). A, dorsal view of body; B, dorsal view of pereonites 1, 2 and cephalon; C, ventral view of mouthparts; D, lateral view of cephalon; E, lateral view of body.

The variations observed in the Australian specimen (in comparison to the holotype) are the slender subparallel body, 3.7 times longer than wide (3.5 times longer than wide in holotype); less prominent lateral lobes on pereonites 1 and 2; pereonite 7 posterior margin not overlapping pleon; pleotelson length and width size similar to pleonites 2–5 (pleotelson greatest length approximately 0.5 times as long as pleonites 2–5). The African specimen is more similar to the holotype, differing in the more slender antennae and the subequal uropodal rami. Kensley & Schotte (1989) described the Caribbean specimen as having small but distinct eyes, uropod reaching half way along the posterior margin of pleotelson and exopod shorter than endopod.

Glossobius anctus differs from *G. impressus* in that it does not have prominent lateral lobes on pereonites 1 and 2; larger labrum (2.0 times); longer than wide pleopods, with smoother endopod and exopod margins; broader coxae margins and a pleotelson with a subtruncate posterior margin.

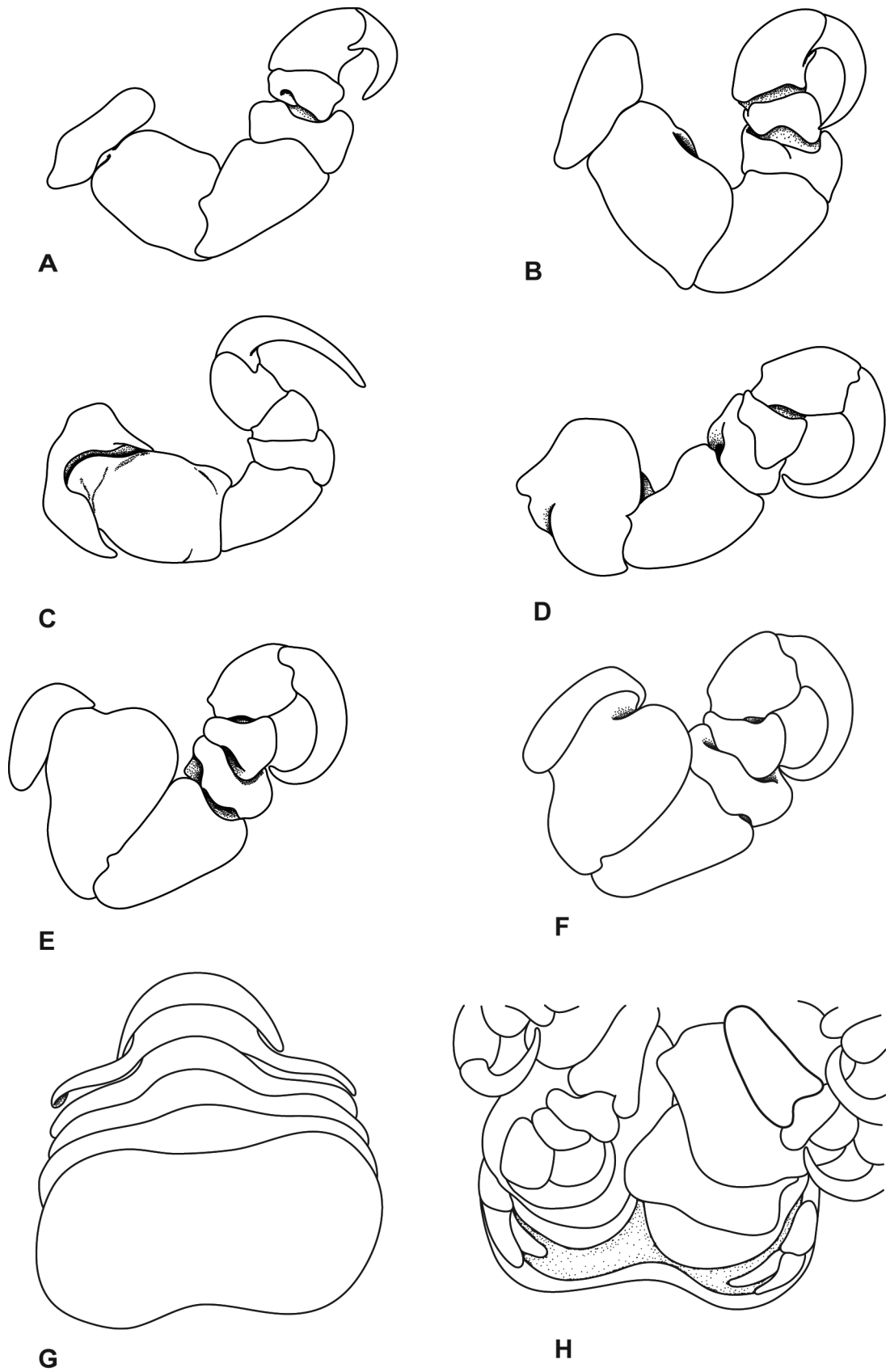


FIGURE 2. *Glossobius impressus* (Say, 1818), Australian ovigerous female (25 mm; AM P53749). A–F, pereopods 1, 2, 3, 4, 6, 7 respectively; G, dorsal view of pleon and pleotelson; H, ventral view of pleotelson.

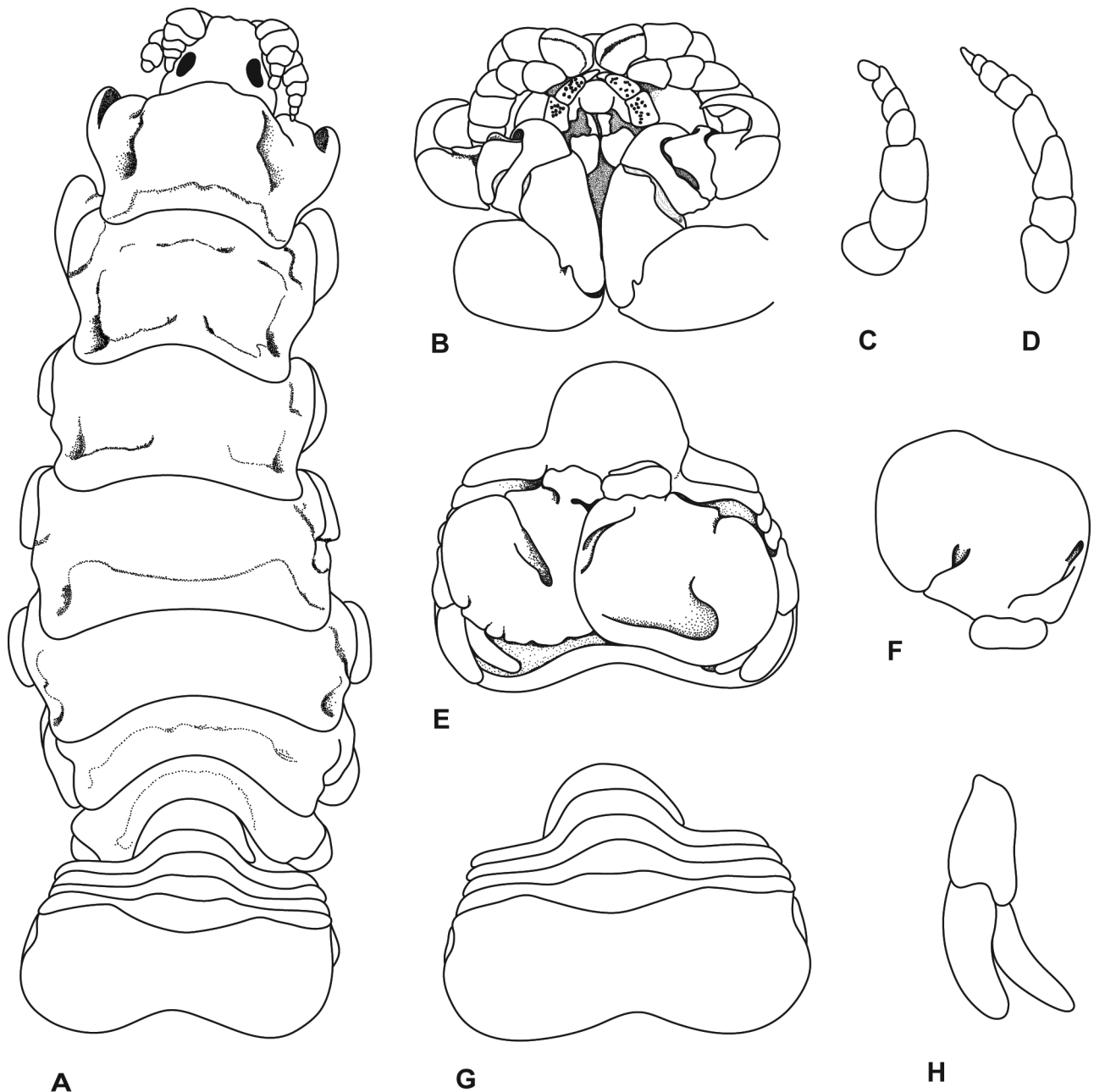


FIGURE 3. *Glossobius impressus* (Say, 1818), southern African ovigerous female (32 mm; SAM C345). A, dorsal view of body; B, ventral view of mouthparts; C, antennula; D, antenna; E, ventral view of pleotelson; F, pleopod 1 exopod; G, dorsal view of pleon and pleotelson; H, uropod.

Glossobius impressus has been reported from four genera of Exocoetidae: *Cheilopogon* Lowe, 1841, *Cypselurus* Swainson, 1838, *Exocoetus* Linnaeus, 1758 and *Hirundichthys* Breder, 1928. *Glossobius impressus* has previously only been known to occur in the tropical and subtropical oceans (Bruce & Bowman 1989; Williams & Williams 2000). Current material from New South Wales and southern Africa indicates that the species can occur in warm-temperate waters.

Distribution. Indian Ocean: Makassar Strait (Nierstrasz 1915); South Pacific Ocean: New South Wales, Australia (present material), New Caledonia (Trilles 1972); South Atlantic Ocean: southern Africa (present material), Brazil (Schioedte & Meinert, 1883; Kensley & Schotte 1989; Luque *et al.* 2013); North Atlantic Ocean: Cape May, New Jersey (Say 1818); Gulf Stream, Florida (Dana 1853, Schioedte & Meinert 1883); Cape Verde (Cunningham 1871); Caribbean (Kensley & Schotte 1989; Williams & Williams 2000); Senegal (Kensley & Schotte 1989).

Hosts. Known from the family Exocoetidae; spotfin flying fish *Cheilopogon furcatus* (Mitchill, 1815) (see Avdeev 1982b), bandwing flying fish *Cheilopogon exiliens* (Linnaeus, 1771), *Cypselurus* sp. (see Avdeev 1982b) *Exocoetus* sp. (see Avdeev 1982b; Luque *et al.* 2013), mirrorwing flying fish *Hirundichthys speculiger* (Valenciennes, 1847) (see Avdeev 1982b; Kensley & Schotte 1989; Bruce & Bowman 1989), fourwing flying fish *Hirundichthys affinis* (Günther, 1866) (see Bruce & Bowman 1989; Williams & Williams 2000).

Accidental host occurrence includes swordfish *Xiphius gladius* (Linnaeus, 1758) (see Trilles 1972) and yellowfin tuna *Thunnus albacares* (Bonnaterre, 1788) (see Bruce & Bowman 1989) *Coryphaena* sp. (Avdeev 1982b) and *Sphyræna* sp. (Avdeev 1982b) as exocoetid fishes are part of their diet (Bruce & Bowman 1989).

***Glossobius anctus* Bruce & Bowman, 1989**

Glossobius anctus Bruce & Bowman, 1989: 13, figs. 9–10.—Bruce, Lew Ton & Poore, 2002: 177.

Type and type locality. 18°25'S, 118°52'E, North West Shelf, Western Australia; deposited at the Australian Museum, Sydney (holotype AM P35743; paratype AM P35744) and the National Museum of Natural History, Washington (paratypes USNM 227110, 227112 and 227113) (Bruce & Bowman 1989).

Remarks. *Glossobius anctus* is readily identified by the subparallel body shape; cephalon not immersed in pereonite 1; anterolateral pereonite 1 margin smooth; anteroventral coxae margins broad; fleshy and produced labrum; pleotelson subtruncate and antennule article 1 straight.

Glossobius anctus and *G. impressus* have a near identical morphology of pereopod 1 with merus proximal margin with slight bulbous protrusion; pereopod 7 basis with raised carina; cephalon not immersed in pereonite 1; and all pleopods are laminar. The host distribution of both species of *Glossobius* overlap. *Glossobius parexocoetii* is reported only from *Parexocoetus brachypterus* (Richardson, 1846) where the host is widespread in the Indo-Pacific region and has a separate population in the eastern tropical Pacific Ocean, whereas the host distribution of *G. anctus* (*Euleptorhampus viridis* (van Hasselt, 1823)) includes the tropical and temperate regions of the Pacific, Atlantic and Indian Oceans (Froese & Pauly 2015). *Glossobius anctus* differs from *G. impressus* by lacking the bulbous lobe on the anterolateral margins of pereonites 1 and 2; and the broader anterior margins of all coxae. *Glossobius parexocoetii* is also similar to *G. anctus* in the subparallel pereon; pleonite 1–5 of subequal length and width; and pleotelson lateral margin straight; but differs from the latter in having the rostrum more acute; anterolateral margins of pereonites 1–3 acute; the presence of a medial point on the posterior margins of pereonites 4–5 and the less broad anterior margins of the coxae.

Distribution. Known from the tropical and subtropical Indian and Pacific Oceans with records from Hawaii, Japan, and eastern and western Australia. (Bruce & Bowman 1989).

Hosts. The ribbon halfbeak *Euleptorhampus viridis* (van Hasselt, 1823).

***Glossobius auritus* Bovallius, 1885**

Glossobius auritus Bovallius, 1885: 12–17, pl. 3: figs. 24–33.—Stebbing, 1893: 354, pl. 15.—Bruce & Bowman, 1989: 16, figs. 11, 12.

Ceratothoa laticauda.—Gerstaecker, 1882: 258.—Richardson, 1904: 23.—Trilles, 1973: 1252, pl. 2: figs. 12, 13.—Kurochkin, 1980: 289.

Glossobius laticauda.—Schioedte & Meinert, 1883: 309, pl. 12: figs. 10–16.—Stebbing, 1893: 354.—Van Name, 1936: 490.—Brian & Darteville, 1949: 181.—Trilles, 1979: 258.

Codonophilus laticauda.—Nierstrasz, 1931: 131.

Codonophdus auritus.—Nierstrasz, 1931: 132.

Glossobius laticaudus.—Avdeev, 1982b: 66.

Glossobius albinae Kononenko, 1986: 331.

Glossobius ogawarensis Nunomura, 1994: 41, figs. 5, 6, pl. (E–G) [new synonymy].

Ceratothoa angulata.—Ravichandran, Rameshkumar & Trilles, 2011: 232, fig. 1 (a).

Not *Cymothoa laticauda* Milne Edwards, 1840: 274 [nomen dubium].

Not *Ceratothoa crassa* Dana, 1853: 753–754, pl. 50: figs. 2a, b, b', c [nomen dubium].

Type and locality. The syntypes of *Glossobius auritus* Bovallius, 1885 (RMS Isopod no. 4971, 3475 and 3476) are

held at the Swedish Museum of Natural History, Stockholm (SMNH), from an unknown locality (Bruce & Bowman 1989).

Remarks. *Glossobius auritus* is recognised by the rhomboid-like body; minute anterolateral projections on pereonite 1; rounded or blunt rostrum; small labrum; moderate coxae size; and emarginate pleotelson posterior margin. The species differs from other species in the following characteristics: *G. impressus* with large bulbous lateral lobes on anterolateral margins of both pereonites 1 and 2 (Bruce & Bowman 1989); *G. anctus* with a large labrum and large coxae (Bruce & Bowman 1989); *G. hemiramphi* and *G. parexocoetii* with an acute rostrum.

Dana (1853) described a dried *G. crassa* specimen, from an unknown host from the southwestern Pacific. Bruce & Bowman (1989) mentioned that pereopod 6, uropod and pereonite 1 morphology clearly distinguish *G. crassa* from *G. anctus*. However, Dana's (1853) figures of the body shape, pleonites 2–5 width and length, and truncate pleotelson are in agreement with *G. anctus*. As it is impossible to resolve the species identity without the type specimen, which is no longer extant, *Glossobius crassa* is here deemed *nomen dubium* and removed from synonymy.

Glossobius ogawarensis Nunomura, 1994 was described from the narrowhead flying fish *Cypselurus angusticeps* Nichols & Breder, 1935 from the vicinity of the Bonin Islands, Ogasawara, Japan. Nunomura (1994) compared the new species only to *G. hemiramphi*, and distinguished it on the basis of differences in the number of antennule and antenna segments, anterior tip of cephalon, carpus length on pereopods and the broader bases of pereopods 5–7. *Glossobius ogawarensis* agrees well with the description of *G. auritus* given by Bruce & Bowman (1989), specifically the body rhomboid-like, rostrum blunt, projections on pereonite 1 minute, merus dilated on pereopods, pleotelson posterior margin emarginate and the well-developed posterior expansion of pereopods 5–7. *Glossobius ogawarensis* is here placed into junior synonymy with *G. auritus*.

Ravichandran's *et al.* (2011) figure of *Ceratothoa angulata* (Richardson, 1910) from the host *Hyporhamphus dussumieri* (Valenciennes, 1847) is a misidentification and refers to *G. auritus*. The sub-rhomboid body, dark coloration with black anterior becoming lighter toward posterior, pereonite 1 anterolateral margins forming two "bosses" (in reference to prominent lateral lobes) which project laterally, rostrum truncate in dorsal view, pleotelson posterior margin truncate with median emargination, and uropod curving medially with endopod slightly longer than exopod are important characteristics that define the species (Bruce & Bowman 1989).

Distribution. Reported from the west Pacific: (Trilles 1973; Bruce & Bowman 1989; Nunomura 1994); Atlantic (Trilles 1973; Bruce & Bowman 1989; Kononenko 1986); Indian Ocean (Trilles 1973; Bruce & Bowman 1989; Ravichandran *et al.* 2011).

Hosts. It is likely that *G. auritus* is a cosmopolitan species considering the number of host species it uses. This species has been reported from clearwing flyingfish *Cypselurus comatus* (Mitchill, 1815) (see Bruce & Bowman 1989) known from the Western Atlantic region (Froese & Pauly 2015); Japanese flyingfish *Cheilopogon agoo* (Temminck & Schlegel, 1846) (see Bruce & Bowman 1989) known from the Northwest Pacific region (Froese & Pauly 2015); Mediterranean flyingfish *Cheilopogon heterurus* (Rafinesque, 1810) (see Kononenko 1986) known from the eastern Atlantic region (Froese & Pauly 2015); and *Cypselurus angusticeps* (see Nunomura 1994) and *Hyporhamphus dussumieri* (see Ravichandran *et al.* 2011), known from the Indo-Pacific region (Froese & Pauly 2015).

***Glossobius hemiramphi* Williams & Williams, 1985**

Glossobius hemiramphi Williams & Williams, 1985: 147, figs. 1–25.—Bruce & Bowman, 1989: 19, figs. 13,14.—Bakenhaster, McBride & Price, 2006: 283, fig. 5.

Type and type locality. The holotype (USNM 213532), allotype (USNM 213533) and paratypes (USNM 213534–213541) were collected offshore Guanica Bay, Puerto Rico from host ballyhoo *Hemiramphus brasiliensis* (Linnaeus, 1758) and are deposited at The National Museum of Natural History, Smithsonian Institution, Washington.

Remarks. *Glossobius hemiramphi* is identified by the subparallel body shape; rostrum subacute, antennula and antenna stout, lack of bulbous lobe on pereonite 1, pleotelson posterior margin emarginate and broad carinae on pereopod 7 basis.

Glossobius anctus and *G. parexocoetii* are the most similar species to *G. hemiramphi* in having a subparallel

body shape, antennula and antenna stout, and similar uropod morphology. *Glossobius hemiramphi* differs from *G. anctus* in having broader anterior margins of coxae, posterior margins of pereonites 1–7 deeply concave, and a rounded rostrum. *Glossobius parexocoetii* differs from *G. anctus* in having narrower anterior margins of coxae, pleonites posterior margins linear and pleotelson posterior margin rounded.

Bakenhaster *et al.* (2006) described the annual life cycle and defined terms and characteristics for each developmental phase for *G. hemiramphi*. Important developmental stages by Bakenhaster *et al.* (2006) are as follows; embryo (marsupial stage occurring before shedding of embryonic membrane layers; may have limbs; lack distinct appendages); pre-manca or pullus I (first marsupial stage; has distinct appendages; lacks uropodal and pleotelsonic setae); manca or pullus II (final marsupial; free swimming and infective stage; six pairs of spinose pereopods; setose pleopods, uropods and pleotelson); male (reduced pigmentation, penes and pereopods 7 present; lack setation); ovigerous female (bearing marsupiumites).

Distribution. Western Atlantic: Georgia, Florida, Bermuda, Bahamas, Haiti, Puerto Rico, Virgin Islands, Yucatan Peninsula, Mexico; Eastern Atlantic: Dakar, Senegal, Angola, Liberia, Sierra Leone, Guinea, Ghana (see Bruce & Bowman 1989).

Hosts. *Hemiramphus brasiliensis* (Linnaeus, 1758) (see Williams & Williams 1985) and *Hemiramphus bermudaensis* Collette, 1962 (see Bruce & Bowman 1989).

***Glossobius parexocoetii* Kononenko & Mordvinova, 1988**

Glossobius parexocoetii Kononenko & Mordvinova, 1988: 103, figs. 1–3.

Type and type locality. The holotype (ZMMU No.Mc 1033) and paratype (ZMMU No.Mc 1034) were collected off Conakry, Guinea, from sailfin flyingfish *Parexocoetus brachypterus* (Richardson, 1846) and deposited at The Zoological Museum of Moscow University (ZMMU).

Remarks. *Glossobius parexocoetii* is identified by the subparallel body shape, rostrum subacute, slender antennula and antenna, lack of bulbous lobe on pereonite 1, rounded pleotelson posterior margin and subequal uropod rami.

Kononenko & Mordvinova (1988) provided figures of the antennula, antenna, mouthparts and uropods of the female and male *G. parexocoetii* type. The female and male share similar morphological characteristics: 3 maxillula setae, 7 antennula segments, 9 antenna segments and subequal uropod rami lengths. The female differs from the male by having: maxilliped article 3 with 2 setae (compared to 1 seta), maxilla with 10 setae (compared to 4 setae), and the article 3 of the mandibular palp is without a setae (compared to 1 seta).

Glossobius parexocoetii differs from *G. impressus* in the less prominent lateral lobes on pereonite 1, pereonite 4 subrectangular, pleonites 1–5 with concave posterior margins, antenna with 9 segments (compared to 8 segments), and pleotelson posterior margin rounded (Kononenko & Mordvinova 1988).

Distribution. Reported from the tropical eastern North Atlantic Ocean (Kononenko & Mordvinova 1988).

Hosts. Reported from *Parexocoetus brachypterus* (Kononenko & Mordvinova 1988).

Species excluded from *Glossobius*

***Ceratothoa arimae* (Nunomura, 2001) comb. nov.**

Glossobius arimae Nunomura, 2001: 29, figs. 1, 2.

Type and locality. The holotype (TOYA Cr-12844), allotype (TOYA Cr-12845) and paratypes (TOYA Cr-12846–12854) are held at the Toyama Science Museum, Japan. Type locality is Ohshima Bay, Tokyo Prefecture, from *Labracoglossa argentinventris* Peters, 1866 (Nunomura 2001).

Remarks. Examination of photographs kindly provided by Dr Yamauchi of *G. arimae* show that the species unambiguously belongs to, and is here transferred to the genus *Ceratothoa*. The species shows the following generic characters: pereonite 1 anterolateral margins broad and slightly produced; pleotelson narrower than pereonite 7, posterior margin rounded; and large carinae on basis of pereopods 4–7.

Ceratothoa arimae has only been reported from *Labracoglossa argenteiventris* Peters, 1866 of the family Kyphosidae, which occurs from central Honshu to Kyushu, Japan in the northwestern Pacific (Froese & Pauly 2015). The only other reported *Ceratothoa* species using hosts from the family Kyphosidae is *Ceratothoa banksii* (Leach, 1818) attaching to *Girella tricuspidata* (Quoy & Gaimard, 1824) in Australian waters (Martin *et al.* 2015). *Ceratothoa banksii* differs from *C. arimae* in having a subparallel or subquadrate body shape; pereonites lightly coloured; the cuticle posterior margin of each pereonite is thickened and noticeably darker anteriorly; pereonites 1–4 laterally straight; pleotelson posterior margin subtruncate, and anterior margin similar in width or wider than pereonite 7.

Ceratothoa arimae is most similar to *Ceratothoa imbricata* (Fabricius, 1775) in the rhomboid-like body shape (pereonites 1–4 increasing in width and lateral margins straight; pereonites 5–7 decreasing in width, lateral margins convex) narrow or slightly broad anterolateral margins of pereonite 1, and pleotelson less narrow than pereonite 7. However, *C. imbricata* has the posterior part of the pereonites darker than anterior part, and has only been reported from host *Trachurus* sp. (Carangidae) (Martin *et al.* 2015); whereas *C. arimae* has the posterior part of the pereonites lighter than the anterior region, and is reported from demersal host *Labracoglossa argenteiventris* (Kyphosidae).

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