

Additional Records of Deep-water Shrimps (Crustacea, Decapoda, Dendrobranchiata and Caridea) from off Northeastern Japan

Tomoyuki Komai¹ and Hironori Komatsu²

¹Natural History Museum and Institute, Chiba, 955–2 Aoba-cho, Chiba 260–8682, Japan
E-mail: komai@chiba-muse.or.jp

²Department of Zoology, National Museum of Nature and Science,
4–1–1 Amakubo, Tsukuba, Ibaraki 305–0005, Japan
E-mail: h-komatu@kahaku.go.jp

(Received 5 October 2015; accepted 22 December 2015)

Abstract Four deep-water species of shrimps are newly recorded from off Tohoku District, northeastern Japan: *Hepomadus gracialis* Spence Bate, 1888 (Dendrobranchiata, Aristeidae), *Pasiphaea exilimanus* Komai, Lin and Chan, 2012 (Caridea, Pasiphaeidae), *Nematocarcinus longirostris* Spence Bate, 1888 (Caridea, Nematocarcinidae), and *Glyphocrangon caeescens* Anonymous, 1891 (Caridea, Glyphocrangonidae). Of them, the bathypelagic *P. exilimanus* is new to the Japanese fauna. The other three species are abyssobenthic, extending to depths greater than 3000 m, and thus have been rarely collected. The newly collected samples of *H. gracialis* enable us to reassess diagnostic characters of the species. *Nematocarcinus longirostris* is rediscovered since the original description, and the taxonomy of the species is reviewed. *Glyphocrangon caeescens* is the sole representative of the family extending to off northern Japan.

Key words: *Hepomadus gracialis*, *Pasiphaea exilimanus*, *Nematocarcinus longirostris*, *Glyphocrangon caeescens*, redescription, new records

Introduction

Thanks to the recent study of extensive collections made by research vessels (Komai and Komatsu, 2009), the deep-water shrimp fauna (Dendrobranchiata and Caridea) off the northeastern part of Honshu (Tohoku District, ranging over Aomori, Iwate, Miyagi, Fukushima and Ibaraki Prefectures), Japan, occurring on the continental shelf to slope down to 1500 m depth, has been fairly well documented. In total, 20 species of Dendrobranchiata (Aristeidae, Benthescymidae, Penaeidae, Solenoceridae and Sergestidae) and 47 species of Caridea (Crangonidae, Hippolytidae *s.l.*, Nematocarcinidae, Ophlophoridae *s.l.*, Pandalidae and Pasiphaeidae) were listed from the area together with literature records.

This study deals with newly collected samples from off Tohoku District since 2008, and supplemented by other specimens deposited in the

National Museum of Nature and Science, Tsukuba (NSMT), Japan. The following four species are treated, all recorded from the area for the first time: *Hepomadus gracialis* Spence Bate, 1881 (Dendrobranchiata, Aristeidae); *Pasiphaea exilimanus* Komai, Lin and Chan, 2012 (Caridea, Pasiphaeidae); *Nematocarcinus longirostris* Spence Bate, 1888 (Caridea, Nematocarcinidae); and *Glyphocrangon caeescens* Anonymous, 1891 (Caridea, Glyphocrangonidae). Of the four, *H. gracialis*, *N. longirostris* and *G. caeescens* are abyssobenthic, extending to depths greater than 3000 m. *Hepomadus gracialis* was previously known only from the holotype collected by H.M.S. “Challenger” in 1875 and one recently reported specimen (Hayashi 1992), the present material enables us to reassess diagnostic characters of the species discussed by Pérez Farfante (1973). *Nematocarcinus longirostris* is rediscovered since the original description based on the

material collected also by H.M.S. "Challenger" in 1875, and the taxonomy of this species is reviewed with reexamination of the type material. The bathypelagic species *P. exilimanus*, heretofore known only from waters off Taiwan, is recorded from Japanese waters for the first time.

Material and Methods

Specimens examined in this study have been deposited in the institutions indicated by the following abbreviations: CBM: Natural History Museum and Institute, Chiba, Japan; ICMD: Instituto de Ciencias del Mar, Barcelona, Spain; NHM: Natural History Museum, London, U.K.; NSMT: National Museum of Nature and Science, Tsukuba, Japan; TM: Tasmanian Museum and Art Gallery, Hobart, Australia. Carapace length (cl) represents specimen size, measured from the posterior margin of the orbit to the midpoint of the posterodorsal margin of the carapace.

Burukovsky (2000a, 2003, 2012, 2013) has shown that the ornamentation of the ventral surface of the sixth pleomere is diagnostic in differentiating species of *Nematocarcinus*, naming the structure "ventrodorsal organ". Here, we employ an alternative term "ventral organ" for the structure, because the organ consists of a complex of main row of setal pores and posteriorly located spot (= posterior spots) on either side of the midline of the somite. The structure of the posterior spot varies according to species from a low blister-like protuberance to a rounded field of minute pits without a trace of elevation. Staining with methylene blue enhances the visibility of these structures.

Taxonomic Account

Infraorder Dendrobranchiata

Family Aristeidae

Hepomadus gracialis Spence Bate, 1881

[Japanese name: Beni-chihiro-ebi]

(Figs. 1–3)

Hepomadus gracialis Spence Bate, 1881: 190; 1888: 321,

pl. 52; Pérez Farfante, 1973: 449, fig. 5D, E; Hayashi 1983: 282, fig. 55a, b; 1992: 26, figs. 16, 17; Pérez Farfante and Kensley, 1997: 48.

Not *Hepomadus gracialis*: A. Milne-Edwards and Bouvier, 1909: 194, figs. 13–19, pl. 1, fig. 3. = *Hepomadus tener* Smith, 1884.

Material examined. RV "Wakataka-maru", 1995 cruise, stn D-2000, E of Miyako, Iwate Prefecture, 39°22.78'N, 147°07.69'E to 39°30.44'N, 143°10.76'E, 1949–2005 m, 7 November 1995, 1 female (cl 68.5 mm), NSMT-Cr 24272; stn J-2000, E of Oharai, Ibaraki Prefecture, 36°25.23'N, 141°32.52'E to 36°31.04'N, 141°43.61'E, 1845–1948 m, 10 November 1995, otter trawl, 5 females (cl 62.0–70.2 mm, one not measured because of damage), NSMT-Cr 20973.

RV "Tansei-maru", KT08-27 cruise, stn S3, off Shimokita Peninsula, Aomori Prefecture, 41°05.00'N, 143°49.88'E to 41°05.40'N, 143°51.51'E, 2879–3016 m, 30 October 2008, beam trawl with 3 m opening span, coll. H. Komatsu, 1 female (cl 34.1 mm), NSMT-Cr 19820; stn S4, similar locality, 41°11.78'N, 143°58.95'E to 41°11.88'N, 144°00.36'E, 2889–2995 m, 21 October 2008, beam trawl with 3 m opening span, coll. H. Komatsu, 2 males (cl 31.4, 34.5 mm), 2 females (cl 56.8, ca 65.2 mm), NSMT-Cr 19821; stn K3, off Kinkazan, Miyagi Prefecture, 38°26.49'N, 143°22.53'E to 38°25.49'N, 143°23.30'E, 2698–2814 m, 23 October 2008, beam trawl with 3 m opening span, coll. H. Komatsu, 2 males (cl 30.5, 32.7 mm), NSMT-Cr 19818; stn K4, off Kinkazan, 38°25.55'N, 143°32.58'E, 38°24.18'N, 143°33.03'E, 3137–3223 m, 23 October 2008, beam trawl with 3 m opening span, coll. H. Komatsu, 1 female (cl 70.2 mm), NSMT-Cr 19819.

RV "Shinkai-maru", 1991 cruise, Hyuga Basin, 1500 m, 3 April 1991, 2 males (cl 58.6, 59.5 mm), 6 females (cl 64.0–79.0 mm), NSMT-Cr 23453; same data, 5 females (cl 68.8–75.2 mm), NSMT-Cr 23462.

Description of females. Body integument glabrous, without short setae or pubescence.

Rostrum (Figs. 1, 2A) styliform, directed for-

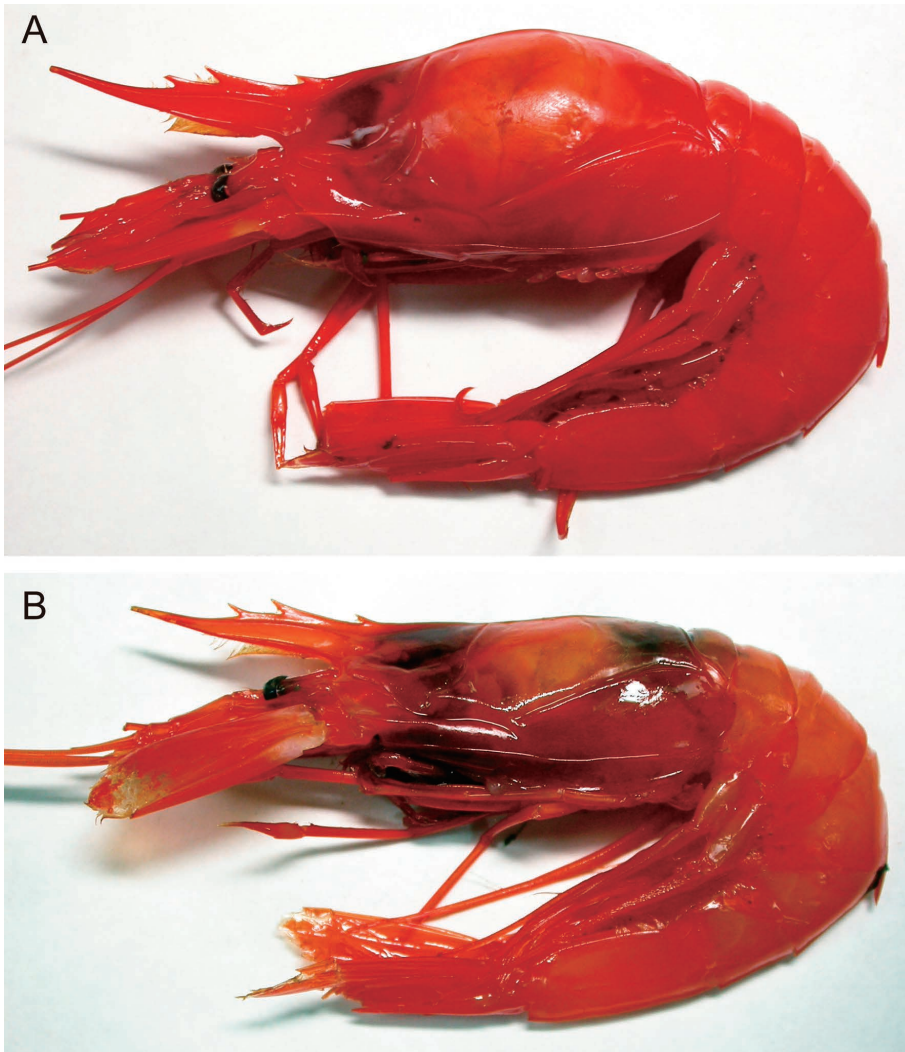


Fig. 1. *Hepomadus gracialis* Spence Bate, 1881, entire animals in lateral view. A, female (cl 56.8 mm), RV "Tansei-maru", KT08-27 cruise, stn S4, off Shimokita Peninsula, Aomori Prefecture, NSMT-Cr 19821; B, young male (cl 34.5 mm), same lot.

ward or slightly ascending, straight to slightly upturned, gradually tapering to acute tip in lateral view, 0.5 times as long as carapace, slightly overreaching distal end of antennular peduncle; dorsal margin armed with 3 teeth, first tooth located slightly posterior to orbital margin, and rather remote from second tooth; second and third teeth strongly compressed laterally, separated by interval varying from 0.6 of distance between first and second teeth, first tooth located proximal to midlength of rostrum; ventral margin

unarmed, slightly convex proximally; lateral surface with adrostral carina extending from level of orbital margin to midlength of rostrum, stronger and distinct basally, and much narrower carina along ventral margin, merging into orbital margin, in proximal 0.4.

Carapace (Figs. 1, 2A) with sharp postrostral carina extending to about 0.8 length of carapace and followed by minute tubercle located near posterior margin; dorsal margin in lateral view strongly arcuate posterior to cervical groove in

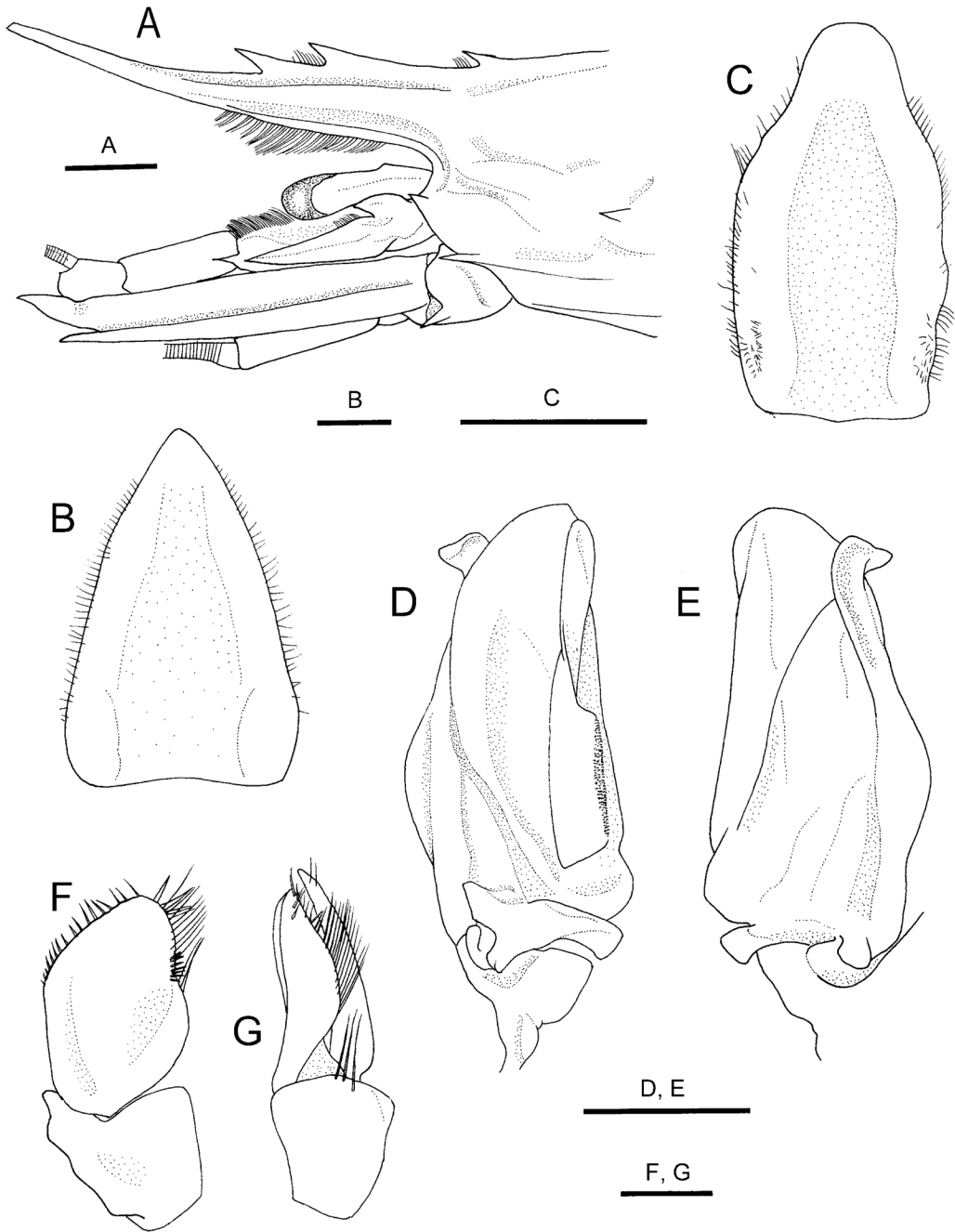


Fig. 2. *Hepomadus gracialis* Spence Bate, 1881. A, B, young female (cl 34.1 mm), RV "Tansei-maru", KT08-27 cruise, stn S3, off Shimokita Peninsula, Aomori Prefecture, NSMT-Cr 19820; C, female (cl 70.2 mm), RV "Tansei-maru", KT08-27 cruise, stn K4, off Kinkazan, Miyagi Prefecture, NSMT-Cr 19819; D–G, male (cl 58.6 mm), RV "Shinkai-maru", Hyuga Basin, Miyazaki Prefecture, NSMT-Cr 23453. A, anterior part of carapace and cephalic appendages, lateral view; B, C, thelycum, median plate on thoracic sternite 7, ventral view; D, left petasma, dorsal view; E, same, ventral view; F, left appendix masculina, dorsal view; G, left appendices interna and masculina, mesial view. Scale bars: 5 mm for A, C, D, E; 2 mm for F, G; 1 mm for B.

adults (less arcuate in young specimens). Orbital or supraorbital tooth absent; antennal tooth small, acute, slightly directed dorsally; branchiostegal tooth vertically compressed, buttressed by short sharp carina extending to level of hepatic tooth; hepatic tooth small. Cervical groove distinct, sinuous, extending from base of hepatic tooth to dorsal midline of carapace, ending there at about 0.4 of carapace length; postcervical groove faint, largely concave except for almost straight, short dorsal portion, ending at 0.7 of carapace length; hepatic groove almost horizontal; orbito-antennal groove short, curved; branchio-cardiac groove deep, extending from near posterolateral margin of carapace to posterior end of hepatic groove.

Thelycum with median plate on thoracic sternite 7 (Fig. 2B, C) very elongate, reaching between midlength and anterior margin of thoracic sternite 6, roughly lanceolate, with gently undulate, or irregular, lateral margins, and rather abruptly tapering anteriorly forming usually obtuse, occasionally acute, triangular projection; ventral surface of median plate faintly concave; thoracic sternite 8 weakly convex ventrally, convexity often embraced posteriorly by shallow semicircular depression.

Pleon (Fig. 1) with middorsal carina extending from anterior 0.3 of third pleomere through sixth pleomere, carina rounded on third, sharp from fourth posteriorly. First and second pleomeres with deep transverse groove at anterior 0.4 and anterior 0.3, respectively. Posterodorsal margin of third pleomere bearing prominent tooth, its length about 0.6 of distance between transverse groove and posterior margin of somite; posterodorsal margins of fourth and fifth pleomeres unarmed or armed with small tooth. Sixth pleomere strongly compressed laterally, unarmed or armed with small tooth at posterior end of middorsal carina; posteroventral angle with subacute tooth; lateral surface with 2 prominent cicatrices, occasionally fused into one. Telson gradually narrowing posteriorly, with 4 pairs of minute lateral spines, posteriormost pair flanking triangular posteromedian projection; dorsal surface with

short, shallow median sulcus disappearing anterior and posterior portion; ventrolateral margin bi-lobate proximally, anterior lobe separated from posterior lobe by deep obliquely longitudinal groove.

Eyestalk (Fig. 2A) widened distally, somewhat compressed dorsoventrally, with small, low protuberance on dorsal surface proximally. Cornea slightly dilated, darkly pigmented, less than half of eyestalk in length.

Antennular peduncle (Figs. 1, 2A) about 0.6 times as long as carapace; stylocerite produced distally into very slender, sharp tooth, barely reaching base, or extending to midlength, of acute distolateral tooth; first segment bearing sharp ventromesial carina; dorsal flagellum strongly flattened, about twice length of third segment of antennular peduncle, ventral flagellum extremely long.

Antennal scale (Figs. 1, 2A) about 2.0 times as long as broad, and surpassing antennular peduncle by 0.2 of its own length; lateral rim produced distally into sharp tooth far falling short of broadly rounded lamella; antennal flagella incomplete in all specimens examined.

Endopod of maxilla with 4–6 curved spiniform setae in upper row and 5–10 similar setae in lower row.

Third maxilliped (Fig. 3A) reaching distal end of antennular peduncle, not sexually dimorphic. Dactylus 0.5–0.6 times as long as propodus, terminating in blunt tip; mesial margin widened abruptly at distal end of proximal fourth forming excavation bearing stiff setae on its proximal side. Propodus to ischium strongly compressed; propodus about 0.8 times as long as carpus; merus subequal in length to carpus and about 0.7 times as long as ischium. Exopod long, flagellum-like, overreaching distal end of merus.

First pereopod (Fig. 3B) extending as far as third maxilliped; chela 0.8–1.0 times as long as carpus; merus with ventrolateral subterminal spine. Second pereopod (Fig. 3C) reaching distal end of second or third segment of antennular peduncle; chela 0.7–1.0 times as long as carps; merus with ventrolateral subterminal spine. Third

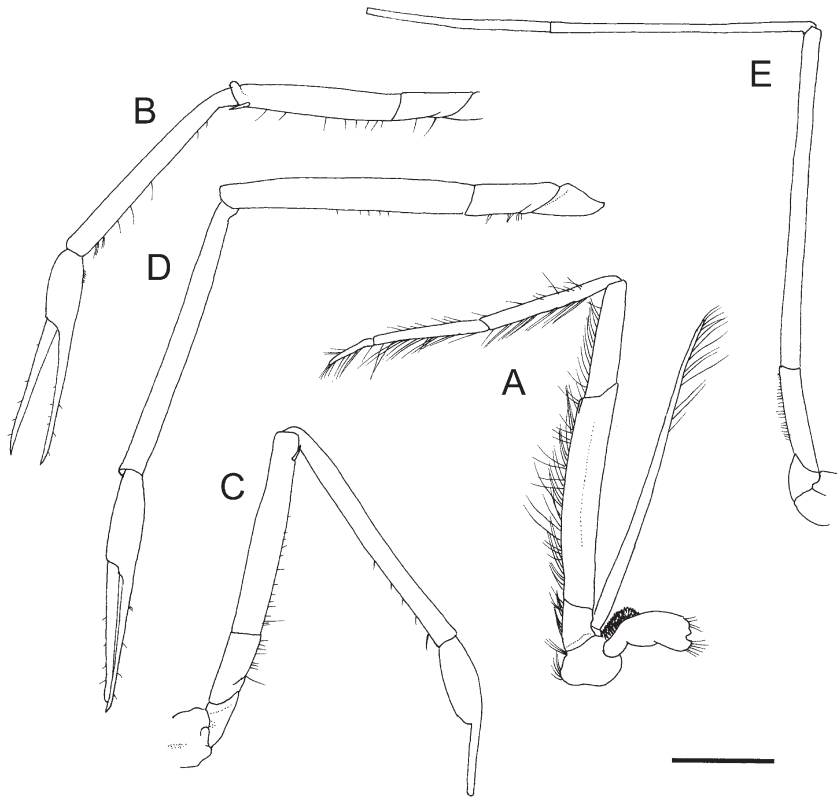


Fig. 3. *Hepomadus gracialis* Spence Bate, 1881, young male (cl 30.6 mm), RV "Tansei-maru", KT08-27 cruise, stn K3, off Kinkazan, Miyagi Prefecture, NSMT-Cr 19819. A, left third maxilliped, lateral view; B, left first pereopod, lateral view; C, right second pereopod, lateral view (chela damaged); D, left third pereopod, lateral view; E, left fourth pereopod, lateral view (distal part of propodus and dactylus missing). Scale bar: 5 mm.

pereopod (Fig. 3D) reaching distal end of antennular peduncle or exceeding it by almost 0.5 length of dactylus; chela 0.7–0.9 times as long as carpus; merus unarmed. Fourth pereopod (Fig. 3E) slender, overreaching antennular peduncle by length of dactylus and 0.2 to 0.5 that of propodus; dactylus very slender, slightly tapering distally, rather rod-like. Fifth pereopod similar to fourth pereopod, overreaching antennular peduncle by length of dactylus and 0.5 to entire length of propodus. Coxae of last 3 pairs of pereopods produced mesially into plates covered with long setae and bearing anteriorly prominent, blunt tooth.

Pleopods (Fig. 1) elongate, becoming shorter posteriorly, first pleopod with exopod about 0.8 times as long as carapace.

Uropod with endopod foliaceous, tapering from

midlength to narrowly rounded tip, overreaching telson by about 0.2 of its own length; dorsal surface with 2 contiguous longitudinal carinae on midline. Exopod distinctly overreaching endopod; lateral limb narrowing posteriorly, terminating in small acute tooth; dorsal surface with deep longitudinal groove flanked by carinae lateral to midline (carina mesial to groove becoming distinct proximally, while carina lateral to groove becoming sharp distally); posterior lamella separated by distinct diaeresis, soft, broadly rounded.

Description of males. Generally similar to females except for sexual characters. Thoracic sternite 7 bearing small, lanceolate median plate. Sternite 6 with distinct median ridge terminating anteriorly into small tubercle. Sternite 8 with small median tubercle.

Coxa of fifth pereopod bearing prominent, flat-

tened process at anteromesial angle; gonopore large, encircled by lip-like flange.

Petasma (Fig. 2D, E) with median lobe widened distally from distal extremity of cincinnuli-bearing portion occupying about half-length of median lobe and terminating in rounded margin, and with elongate, subelliptical, sclerotized lapel on inner surface, extending along distomesial margin. Lateral lobe very broad proximally, tapering distally to broadly rounded distal margin; dorsal surface with obliquely longitudinal groove extending from base of articular sclerite to distolateral margin; ventral costa with distal 0.4–0.5 of its length free from adjacent portion of ventrolateral margin, and strongly curved laterally forming short, sinuous projection well beyond distolateral margin; articular sclerite produced proximomesially into strong, subrectangular process situated immediately distal to large, plate-like, mesially directed projection of protopod of pleopod.

Appendix masculina (Fig. 2F, G) embracing appendix interna, broad, roundly subrhomboidal in general outline in dorsal view, bearing marginal setae consisting of mixture of spiniform or slender setae, on distal portion. Appendix interna narrow, elongate, gently tapering distally to rounded extremity, and extending almost as far as, or somewhat beyond, appendix masculina.

Coloration in life. Body and appendages entirely scarlet red; cornea darkly pigmented (Fig. 1).

Size. Largest male cl 59.5 mm, largest female cl 79.0 mm.

Distribution. Known with certainty only from off Pacific coast of Japan, at depths of 1500–3223 m.

Remarks. *Hepomadus gracialis* was originally described on the basis of a single female specimen. The type locality was originally indicated as “mid South Atlantic” at a depth of 1875 fathoms (= 3375 m) (Spence Bate, 1881), but later corrected to “near Yokohama”, Japan, at a depth of 1875 fathoms (Spence Bate, 1888). The actual sampling point (*Challenger*, station 237, 34°37'N, 140°32'E) is located SE of Nojima-

zaki, Boso Peninsula, not near Yokoyama. There have been only a few subsequent records of the species since the original description (A. Milne-Edwards and Bouvier 1909; Hayashi 1992). However, Pérez Farfante (1973), who reviewed the taxonomy of the congeneric *H. tener* Smith, 1884, referred the record of *H. gracialis* by A. Milne-Edwards and Bouvier (1909) to *H. tener*. Hayashi (1992) reported on a single male specimen (cl 26.8 mm) from off Honshu, Japan, although details of the sampling locality and depth were not specified.

As argued by Pérez Farfante (1973), *H. gracialis* and *H. tener* are very similar to each another. Pérez Farfante (1973) discusses three characters in differentiating *H. gracialis* and *H. tener*: (1) the dorsum of the carapace is strongly arched posterior to the postcervical sulcus in *H. gracialis*, whereas it is almost straight or very slightly arched, with the convexity extending beyond the postcervical sulcus in *H. tener*; (2) the postrostral carina is interrupted, disappearing on the cardiac region, becoming distinct again and extending almost to the posterior margin of carapace in *H. gracialis*, rather than uninterrupted, extending posteriorly about 0.8 the length of the carapace in *H. tener*; (3) the endopod of the maxilla bears more numerous, curved strong spiniform setae in the subterminal rows in *H. gracialis* than in *H. tener* (five or six setae in the upper row and five or nine setae in the lower row in *H. gracialis*, whereas zero to four setae in the upper row and zero to five setae in the lower row in *H. tener*).

Examination of the newly collected samples has revealed that the shape of the carapace dorsum varies with growth: in young specimens (Fig. 1B), the shape of the dorsum is similar to that described for *H. tener* by Pérez Farfante (1973). Large specimens (>cl 50 mm; Fig. 1A) show a posteriorly arched dorsum of the carapace, said to be typical for *H. gracialis*. In all of the present specimens, the postrostral carina is entire, not interrupted on the cardiac region as described by Pérez Farfante (1973); the posterior extension is variable from the 0.8 of the carapace length to nearly to the posterodorsal margin of

the carapace. Thus the second character is not reliable as a diagnostic character.

The number of the spiniform setae on the endopod of the maxilla was counted for two specimens (male, NSMT-Cr 19818 and female, 20973). The setae in the upper row are four (male, NSMT-Cr 19818) or six (female, NSMT-Cr 20973) and those in lower row are five (male, NSMT-Cr 19818) or 10 (female, NSMT-Cr 20973). Indeed, the counts of endopodal setae on the maxilla are more numerous than those reported by Pérez Farfante (1973) for *H. tener*.

The structure of the male and female copulatory organs shown by the Japanese specimens is also very similar to those described and illustrated by Pérez Farfante for *H. tener*. The petasma of the two fully matured males in the present series seems to be relatively wider when compared with the figure of Pérez Farfante (1973), but the male specimen illustrated by Pérez Farfante (1973) is much smaller than the present two male specimens, and thus the discrepancy might be due to size-related variation.

With regard to the large specimens (>cl 50 mm), the shape of the dorsum of the carapace seems to be still useful for differentiation of the two taxa. Our examination supports the observation of Pérez Farfante (1973) that the spiniform setae on the maxilla endopod are more numerous in *H. gracialis* than in *H. tener*. Thus we maintain *H. tener* as a good species for the time being. However, future study using genetic data might reveal that the two taxa are actually conspecific.

The present study demonstrates that this species is not uncommon in waters off Japan at depths greater than 1500 m.

Infraorder Caridea

Family Pasiphaeidae

Pasiphaea exilimanus Komai, Lin and Chan, 2012

[New Japanese name: Yubinaga-shira-ebi]

(Fig. 4)

Pasiphaea exilimanus Komai, Lin and Chan, 2012: 301, figs. 5–7, 21D.

Material examined. RV “Wakataka-maru”, stn WA07-D510, off Ohfunato, Iwate Prefecture, 39°04.2'N, 142°11.8'E to 39°05.3'N, 142°12.0'E, bottom depths 505–513 m, 17 October 2007, trawl, coll. H. Komatsu, 1 female (cl 20.0 mm), NSMT-Cr 24274.

Distribution. Previously known only from off Taiwan; bathypelagic. Now newly recorded from Japan.

Remarks. *Pasiphaea exilimanus* was originally described on the basis of material from bathypelagic waters off Taiwan (Komai *et al.*, 2012), with no subsequent records. The present specimen is identified with this species with little hesitation because of the following diagnostic features (Komai *et al.*, 2012): rostrum terminating in sharp tooth, reaching frontal margin, with anterior margin evenly concave (Fig. 4A); carapace with dorsal surface rounded except for short ridge supporting rostrum (Fig. 4A, B); branchiostegal sinus shallow (Fig. 4A); branchiostegal tooth submarginal, exceeding well beyond anterolateral margin (Fig. 4A); first to sixth pleomeres rounded dorsally, no posterodorsal median tooth on third or sixth pleomere (Fig. 4C); telson 0.7–0.8 times as long as sixth pleomere, shallowly grooved in dorsal midline, posterior margin very slightly concave medially (Fig. 4D, E); first pereopod with fingers 0.8 length of palm (variation range in the species 0.8–0.9), merus with 3 spines on ventral margin (variation range in the species 2–9), ischium and basis devoid of spinules on ventral margin (Fig. 4E); and ischium and basis of second pereopod devoid of spinules on ventral margin (Fig. 4F). Only minor differences from the type series are evident in the lower number of meral spines of the second pereopod (13 versus 15–20) and the slightly shorter fingers of the second pereopod (1.1 times as long as palm versus 1.2–1.4 times as long) (Fig. 4F), which we consider to be intraspecific variation.

The present specimen extends the geographical range of this species northerly to Tohoku District, northeastern Japan.

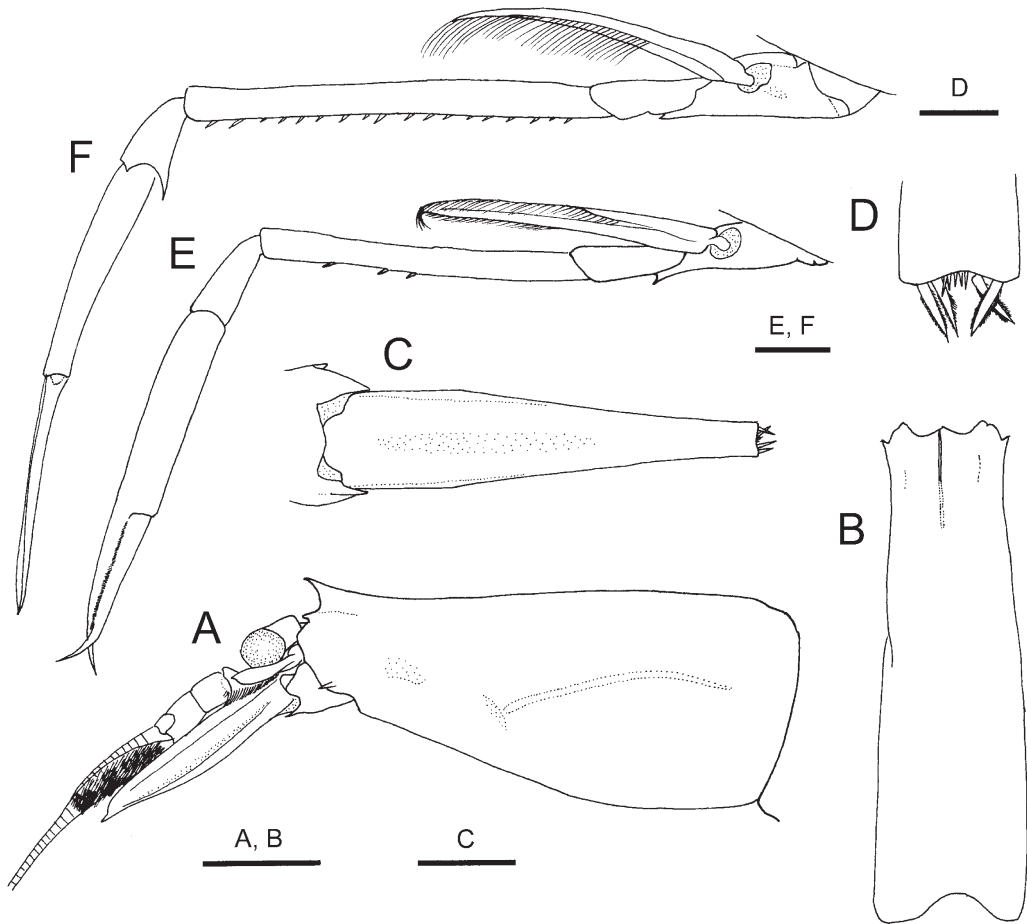


Fig. 4. *Pasiphaea exilimanus* Komai, Lin and Chan, 2012, female (cl 20.0mm), RV "Wakataka-maru", stn WA07-D510, off Ohfunato, Iwate Prefecture, NSMT-Cr 24274. A, carapace and cephalic appendages, lateral view; B, carapace, dorsal view; C, posterior part of sixth pleomere and telson, dorsal view; D, posterior part of telson, dorsal view (posterior spines damaged); E, left first pereopod, lateral view; F, left second pereopod, lateral view. Scale bars: 5 mm for A, B; 2 mm for C, E, F; 0.5 mm for D.

Family Nematocarinidae

Nematocarcinus longirostris Spence Bate, 1888

[Japanese name: Tsunonaga-itoashi-ebi]

(Figs. 5–7, 8A)

Nematocarcinus longirostris Spence Bate, 1888: 806, pl. 132, fig. 2; Hayashi, 1988: 444, fig. 156b; 2007: 90, fig. 37b; Tiefenbacher, 1990: 230 (in part); Burukovsky, 2000b: 283, fig. 1a; 2003: 114, fig. 32; 2004: 558 (key); 2012: 133, fig. 45.

? *Nematocarcinus longirostris*: Yaldwyn and Webber, 2011: 189.

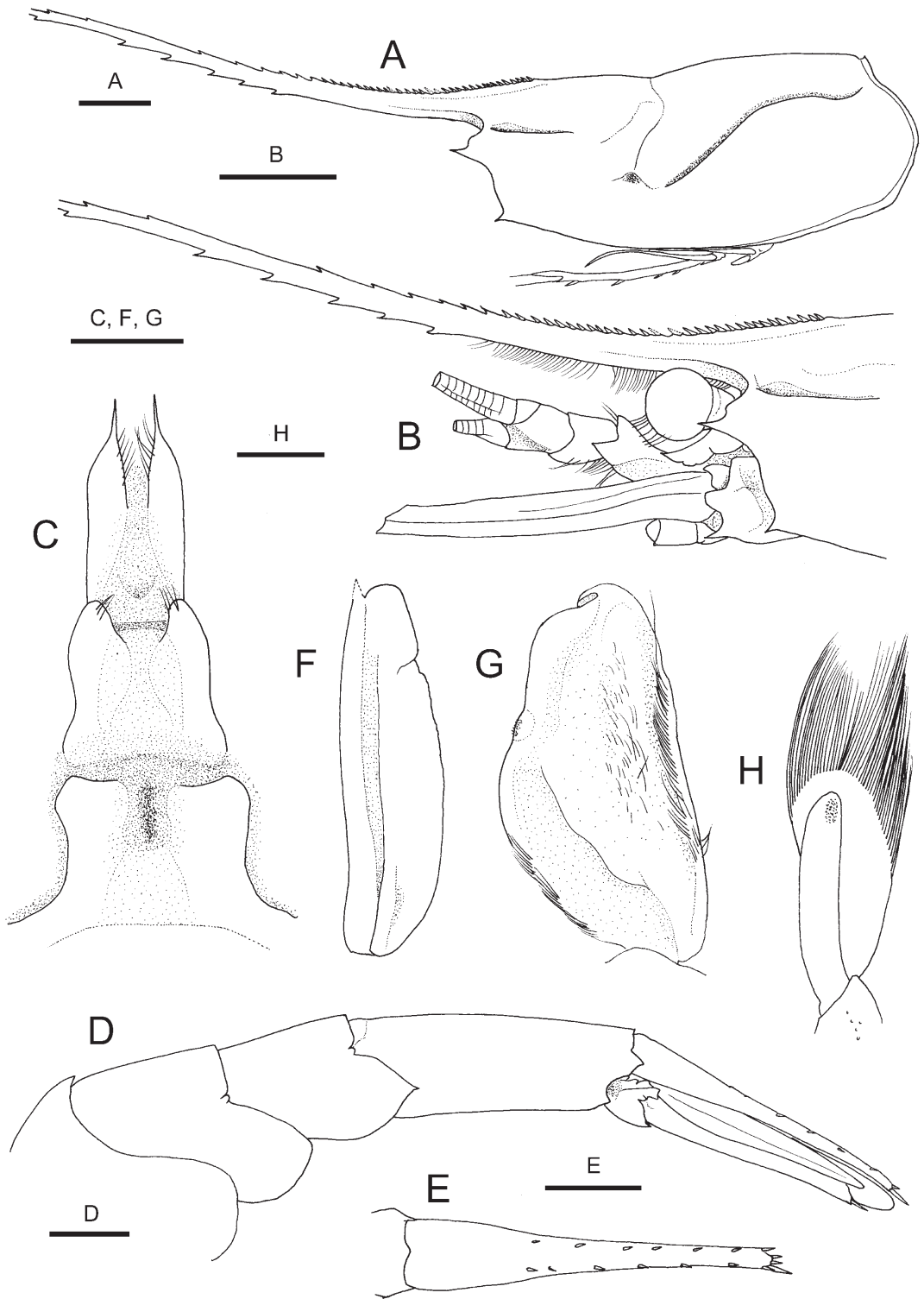
Nematocarcinus proximatus: Spence Bate, 1888: 808 (in part).

Nematocarcinus batei Burukovsky, 2000b: 284, fig. 1b, v; 2003: 62, fig. 14; 2012: 85, fig. 24. **Syn. Nov.**

Not *Nematocarcinus longirostris*: Barnard, 1950: 671, fig. 125a–k; Yaldwyn, 1965: 326 (list); Zarenkov, 1968: 158, fig. 5; Kensley, 1968: 317; 1972: 36 (key), fig. 16a; Ledoyer, 1979: 142; Kirkwood, 1984: 31, fig. 41; Gorny, 1999: 373; Thatje *et al.*, 2005: 292, figs. 2–5 (larvae); Boschi and Gavio, 2005: 198, table 1 (list). = *Nematocarcinus sigmoideus* Macpherson, 1984.

Not *Nematocarcinus longirostris*: Ledoyer, 1989: 69; Sieg and Wägele, 1990: 128, fig. 252. = *Nematocarcinus lanceopes* Spence Bate, 1888.

Material examined. Original syntypes of *Nematocarcinus longirostris*. "Challenger", stn



237, SE of Nojima-zaki, Boso Peninsula, central Japan, 34°37'N, 140°32'E, 1875 fathoms (about 3375 m), 17 June 1875, 10 specimens, including 3 males (cl 17.0, 26.5 mm, one badly damaged) and 7 females (cl 25.5–33.6 mm), NHM 1888: 22. A lectotype was selected by Burukovsky (2000a), but it is difficult to identify it in the present condition. See *Remarks*.

Paralectotype of *Nematocarcinus proximatus* Spence Bate, 1888. “Challenger”, stn 237, SE of Nojima-zaki, Boso Peninsula, central Japan, 34°37'N, 140°32'E, 1875 fathoms (about 3375 m), 1 female (cl 26.8 mm), NHM 1888: 22.

RV “Tansei-maru”, KT08-27 cruise, stn K3, off Kinkazan, Miyagi Prefecture, 38°26.49'N, 143°22.53'E to 38°25.49'N, 143°23.30'E, 2698–2814 m, 23 October 2008, 1 male (cl 27.5 mm), 1 female (30.3 mm), NSMT-Cr 19835; stn M4, off Miyako, Iwate Prefecture, 39°32.05'N, 143°41.97'E to 39°30.24'N, 143°41.67'E, 3150–3201 m, 22 October 2008, beam trawl with 3 m span opening, coll. H. Komatsu, 3 females (28.5–30.9 mm), 2 ovigerous females (cl 30.1, 30.6 mm), NSMT-Cr 19836; stn S4, E of Shimokita Peninsula, Aomori Prefecture, 41°11.78'N, 143°58.95'E to 41°11.88'N, 144°00.36'E, 2889–2995 m, 21 October 2008, beam trawl with 3 m opening span, coll. H. Komatsu, 2 females (cl 24.3, 27.1 mm), NSMT-Cr 19837.

Comparative material. *Nematocarcinus hiatus* Spence Bate, 1888. Holotype: “Challenger”, stn 169, off East Cape, New Zealand, 37°34'S, 179°22'E, 1260 m, 10 July 1874, sex not determined (cl 16.0 mm), NHM 1888: 22.

Nematocarcinus proximatus. Lectotype [designated by Burukovsky (2000a: 168)]: “Chal-

lenger”, stn 146, near Marion Island, southwestern Indian Ocean, 46°46'S, 45°31'E, 1375 fathoms (= 2475 m), 29 December 1873, female (cl 28.0 mm), NHM 1888: 22. Paralectotypes: “Challenger”, stn 188, Arafura Sea, 09°59'S, 139°42'E, 28 fathoms (= 50.4 m), 10 September 1874, 5 males (cl 19.8–26.6 mm), 6 females (cl 15.2–27.3 mm), 1 specimen (sex not determinable, cl 25.0 mm), NHM 1888:22.

Nematocarcinus sigmoideus Macpherson, 1984. Southeastern Atlantic. Valdivia I Expedition, Valdivia Bank, 25°05'S, 06°03'E, 18 May 1982, coll. E. Macpherson, 2 ovigerous females (cl 30.4, 31.4 mm), ICMD 393/1994; Valdivia Bank, 25°32'S, 13°31'E, 27 May 1982, coll. E. Macpherson, 2 ovigerous females (cl 29.0, 34.1 mm), ICMD 294/1994; stn P-2, Valdivia Bank, 25°24.9'S, 06°02.6'E, 908 m, coll. E. Macpherson, 1 male (cl 28.9 mm), ICMD 73/1996; stn P-18, Valdivia Bank, 28°15'S, 14°18.6'E, 412–420 m, 26 May 1982, coll. E. Macpherson, 1 female (cl 17.0 mm), ICMD 75/1996.

Southwestern Indian Ocean. “Marion Dufresne”, MD.08 cruise, stn 44, CP 199, Crozet Island, 46°10'S, 51°14'E, 1500 m, 15 April 1976, 1 female (damaged), CBM-ZC 12982; “Marion Dufresne”, MD.50 cruise, stn 34, CP 152, St. Paul Island, 38°39.11'S, 77°25.15'E, 1050–1100 m, 23 July 1986: 1 male (damaged), CBM-ZC 12983.

Tasmania. RV “Soela”, stn S03/86/38, W of Cape Sorel, 42°22.4'S, 144°37.9'E, 1376–1404 m, 17 May 1986, demersal trawl, 1 female (cl 35.0 mm), TM G3538; same data, 2 ovigerous females (cl 26.2, 28.7 mm), TM G3539; same

Fig. 5. *Nematocarcinus longirostris* Bate, 1888. A–C, original syntype, male (cl 26.5 mm), “Challenger” stn 237, off Boso Peninsula, Japan, NHM 1888: 22; D–F, parts from fragmental syntypes, same lot; G, H, male (cl 27.5 mm), RV “Tansei-maru”, KT08-27 cruise, stn K3, off Kinkazan, Miyagi Prefecture, NSMT-Cr 19835. A, carapace, lateral view; B, anterior part of carapace and cephalic appendages, lateral view (most parts of antennular flagella and distal portion of scaphocerite broken off); C, sternal prominences on sixth to eighth thoracomeres, ventral view; D, posterior part of third pleomere to telson, lateral view (pleopods omitted); E, telson, dorsal view (longer spine on right posterolateral angle missing); F, left antennal scale, dorsal view, distolateral tooth and mesial margin damaged; G, endopod of left first pleopod, ventral view; H, appendices interna and masculina of left second pleopod of male, mesial view. Scale bars: 5 mm for A, B, D, E, F; 2 mm for C, G; 1 mm for H.

data, 4 ovigerous females (cl 26.0–29.5 mm), TM G3544; stn S03/86/54, off west coast of Tasmania, 41°53.1'S, 144°24.3'E, 1368–1388 m, 24 May 1986, scampi net, 1 ovigerous female (not measured), TM G3540; stn S03/86/32, off Pieman Head, 41°48.0'S, 144°26.0'E, 992–1000 m, 16 May 1986, demersal trawl, 3 females (cl 25.2–26.3 mm), 8 ovigerous females (cl 25.6–30.2 mm), TM G3541; stn S03/86/33, W of Granville Harbour, 41°49.6'S, 144°23.2'E, 1366–1370 m, 16 May 1986, demersal trawl, 1 female (cl 24.8 mm), 4 ovigerous females (cl 27.0–37.7 mm), TM G3542; same data, 5 ovigerous females (cl 26.1–32.0 mm), TM G3543; stn 03/86/39, W of Tasmania, 1300–1400 m, 6 ovigerous females (cl 28.6–33.6 mm), TM G3545; stn S03/86/40, W of Tasmania: 1 ovigerous female (cl 37.8 mm), TM G3546; stn S03/86/42, W of Tasmania, 11 ovigerous females (cl 25.4–32.8 mm), TM G3547; stn S04/86/3, E of Tasmania, 1 female (cl 26.2 mm), 2 ovigerous females (cl 26.2 mm), TM G3548; stn 04/86/6, NE of St. Helens, 41°16'S, 148°48'E, 1300–1400 m, 2 females (cl 21.2, 21.7 mm), 4 ovigerous females (cl 25.4–32.6 mm), TM G3549; stn S04/86/29, W of Tasmania, 1 female (cl 28.6 mm), 3 ovigerous females (cl 26.6–29.2 mm), TM G3550.

Nematocarcinus tenuipes Spence Bate, 1888. Japan. Off Shionomisaki, Kii Peninsula, 1000 m, 22 June 1992, dredge, coll. S. Nagai, 1 female (cl 15.9 mm), CBM-ZC 1189; TRV "Toyoshio-maru", 1998-04 cruise, stn 3, E of Cape Toi, Miyazaki Prefecture, 31°00'43"N, 131°41.45'E, 1383–1390 m, 15 May 1998, ORI net accidentally on bottom, coll. T. Komai, 2 males (cl 19.9 mm, one damaged), CBM-ZC 5543; RV "Tansei-maru", KT04-06 cruise, stn KN-1(1), Shima Spur, Kumano Sea, 34°00.50'N, 136°54.43'E, 767–774 m, 1 May 2004, beam trawl, coll. T. Akiyama, 1 male (cl 11.5 mm), 9 females (cl 12.5–15.9 mm), CBM-ZC 9895.

Redescription. Rostrum (only two specimens with nearly intact rostrum; Figs. 5A, B, 8A) curving slightly dorsad, far overreaching distal end of antennular peduncle, 1.0–1.2 times as long as carapace; dorsal margin armed with

38–45 small teeth becoming more widely spaced anteriorly, about posterior 30 teeth movable with distinct basal sutures, of them 7–11 teeth postrostral; ventral margin with 4–6 small teeth in distal half and 2 rows of setae extending beyond level of distal end of antennular peduncle (see also Fig. 6A, B). Carapace (Figs. 5A, B, 8A) with postrostral ridge faintly sinuous or nearly straight in lateral view, slightly falling short of midlength of carapace; postorbital longitudinal groove deep; cervical and branchiocardiac grooves distinct, particularly latter groove deeply demarcated compared with other congeneric species; hepatic depression also deep. Antennal and pterygostomial teeth well developed, sharp; suborbital lobe obtuse, but clearly delineated; anterolateral margin between antennal and pterygostomial teeth slightly sinuous.

Posterior thoracic sternites each with paired prominences. Prominences on sixth thoracic sternite in males (Fig. 5C) with lateral margins nearly straight and parallel in posterior 0.7, distal parts each tapering into slender, elongate terminal spine; in non-spawning females (Fig. 6D), general shape of prominences similar to that of males, but terminal spines absent. Prominences on seventh sternites in males and non-spawning females with gently sinuous lateral margins. Prominences on eighth sternites forming rounded lobes slightly expanded anterolaterally.

Pleon (Fig. 5D) with first to fourth pleura rounded, fifth pleuron with small, acute posteroventral tooth directed posteriorly. Third pleomere with posterodorsal margin of tergum moderately produced posteriorly. Sixth pleomere approximately twice as long as fifth pleomere, 2.5–2.6 times as long as high; ventral organ (Fig. 7) consisting of pair of posterior spots of subovate fields of minute pits (length/width 1.4–2.4; 3.1–3.2 in one specimen is unusual; see "Remarks") and pair of single or double row of setal pores extending to level of anterior end to posterior end of each spot; posterior spots never elevated, separated by 1.5–2.9 width of one spot; preanal tooth spiniform.

Telson (Fig. 5E) overreaching posterior mar-

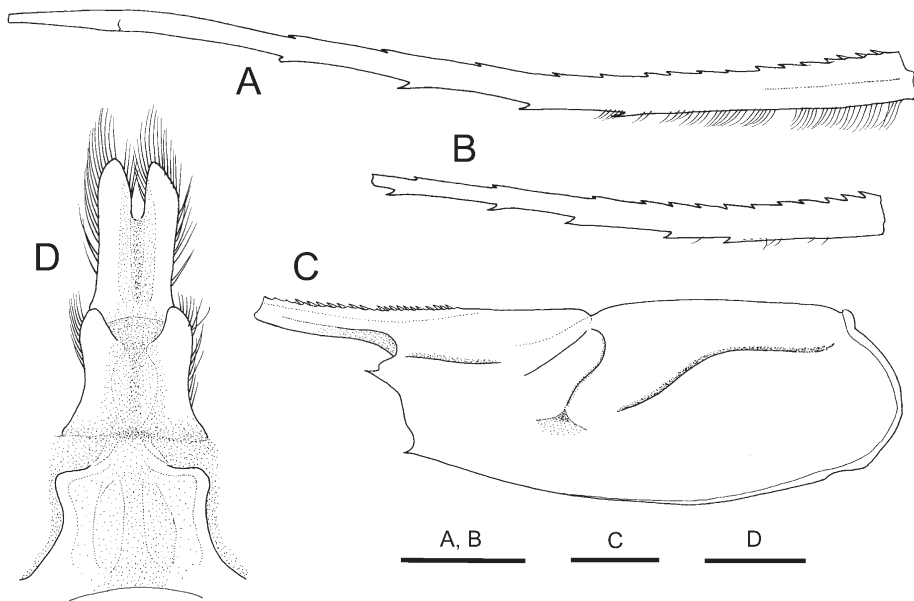


Fig. 6. *Nematocarcinus longirostris* Bate, 1888. A, B, fragments from original syntypes, "Challenger", stn 237, off Boso Peninsula, Japan, NHM 1888: 22; C, D, paralectotype of *Nematocarcinus proximatus* Bate, 1888, off female (cl 26.8 mm), "Challenger", stn 237, off Boso Peninsula, Japan, NHM 1888: 22. A, B, fragments of rostrum, distal portion, lateral; C, carapace, lateral, rostrum damaged; D, sternal lobes on sixth to eighth thoracic somites, ventral. Scale bars: 5 mm for A–C; 2 mm for D.

gin of uropodal endopod, but not reaching exopod, 1.1 times as long as sixth pleomere, armed with 6–8 small dorsolateral spines on either side, arranged in single row; posterior margin produced into small bluntly triangular process, armed with 2 pairs of spines, lateral pair more than twice as long as mesial pair.

Eye (Fig. 5B) subpyriform; cornea dilated, distinctly broader than eyestalk, darkly pigmented, its width about 0.1 of carapace length.

Antennular peduncle (Fig. 5B) moderately stout, reaching midlength of antennal scale. Stylocerite reaching midlength of first segment, not notched in lateral view. Distal 2 segments subequal in length to proximal 2 segments combined.

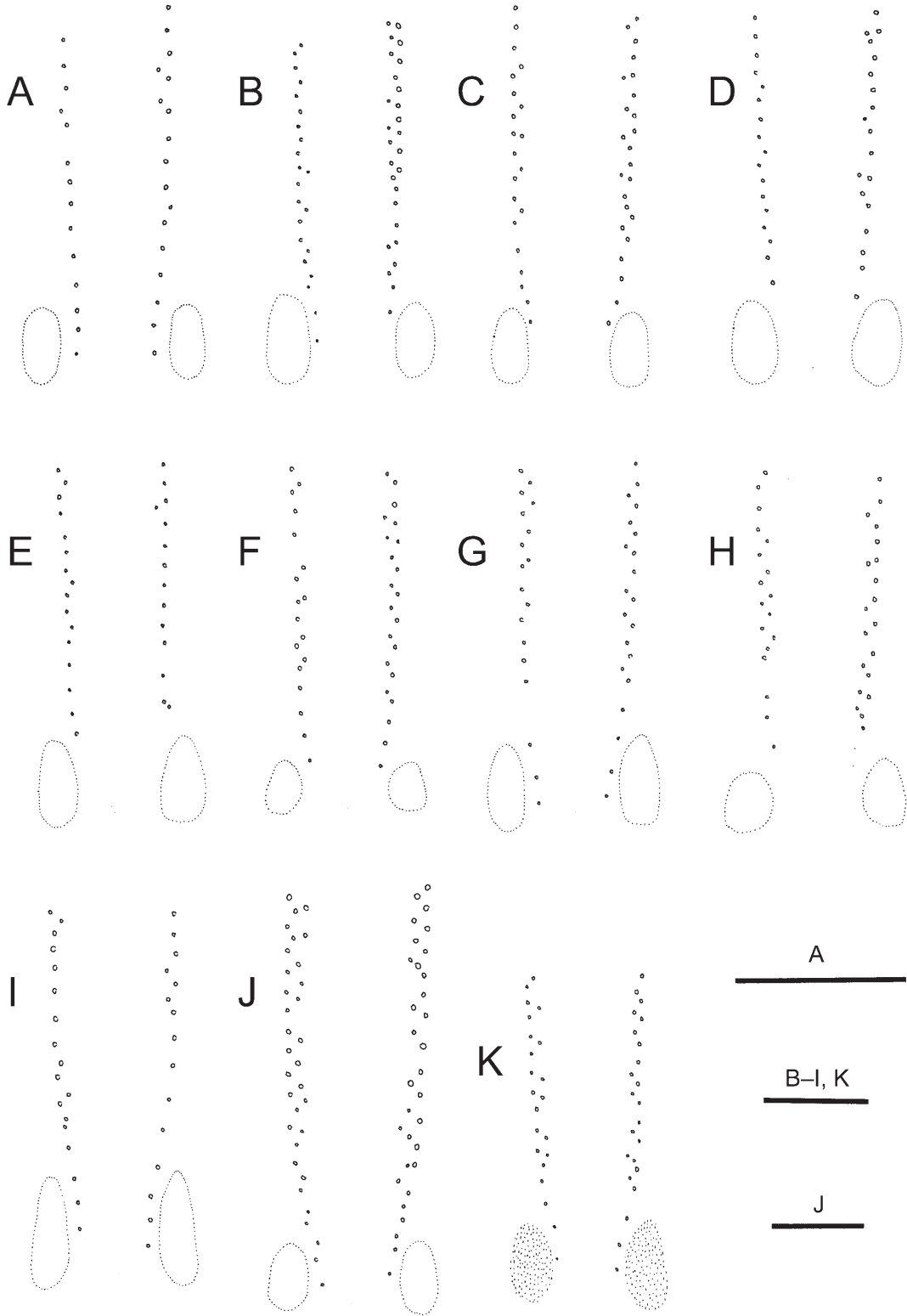
Antennal peduncle (Fig. 5B) with basicerite bearing small but distinct ventrolateral distal tooth. Carpocerite short, far falling short of distal margin of first segment of antennular peduncle. Antennal scale about 3.6 times as long as wide, with slightly sinuous lateral margin terminating

in small distolateral tooth slightly overreaching rounded lamella; dorsal surface with deep longitudinal groove lateral to midline.

Third maxilliped (Fig. 8A) overreaching distal end of antennular peduncle by length of ultimate segment, but not reaching distal margin of antennal scale. Antepenultimate segment with row of some movable spines on ventrolateral margin (Fig. 5A).

First to fifth pereopods missing or fragmental if preserved.

Male first pleopod elongate suboval with generally gently convex mesial margin and slightly sinuous lateral margin; appendix interna strongly reduced in small field of cincinnuli located slightly distal to midlength of mesial margin; mesial margin with numerous stiff setae on proximal 0.4; distal margin with distinct fold; lateral margin slightly elevated, with numerous short to long stiff setae; ventral surface with shallow proximomesial depression defined by obliquely longitudinal rim and with longitudinal field of



short to long setae lateral to midline. Male second pleopod with appendix masculina elongate subovate (about twice as long as wide), slightly longer and broader than appendix interna; distal margin with numerous long stiff setae. Uropod without distinctive features.

Coloration in life. Body and appendages entirely scarlet; basicerite and proximal part of antennal scale translucent; cornea darkly pigmented (Fig. 8A).

Size. Largest male cl 27.5 mm, largest female cl 33.6 mm, ovigerous females cl 30.1–30.6 mm.

Distribution. Previously known with certainty only from the type locality, off Boso Peninsula, Japan, at depth of 3470 m (see *Remarks*). The newly collected specimens came from off Aomori to Miyagi Prefectures, at depths of 2698–3201 m.

Remarks. *Nematocarcinus longirostris* was originally described on the basis of 10 specimens, including three males and seven females (one ovigerous) collected from off Boso Peninsula, Japan (Spence Bate 1888), although Spence Bate (1888) did not designate a holotype for the taxon. Subsequently, there have been several records from other regions under the name *N. longirostris*, i.e., Southern Ocean (Zarenkov, 1968; Kirkwood, 1984; Ledoyer, 1989; Gorny, 1999), Southwest Atlantic Ocean off Argentina (Thatje *et al.*, 2005, larvae), South Africa (Barnard, 1950; Kensley, 1968), southwestern Indian Ocean (Ledoyer, 1979) and New Zealand (Yaldwyn and Webber, 2011). Zarenkov (1968) suggested that five *Nematocarcinus* species, i.e., *N. proximatus* Spence Bate, 1888, *N. longirostris* Spence Bate, 1888, *N. hiatus* Spence Bate, 1888, *N. altus* Spence Bate, 1888 and *N. agassizi* Faxon, 1893 were closely similar for each other and that among them *N. proximatus* might eventually be proved to be synonymous with *N. longirostris*. Macpherson (1984) described a new

species, *N. sigmoideus*, on the basis of material from Valdivia Bank, southeastern Atlantic and South Africa with an examination of the type material of *N. lanceopes* and *N. longirostris*, and showed that the South African population previously assigned either to *N. lanceopes* (see Stebbing, 1914; Calman, 1925) or *N. longirostris* (cf. Barnard, 1950; Kensley, 1968) actually represented his new species. Tiefenbacher (1990) also examined the type material of *N. lanceopes*, *N. longirostris*, *N. proximatus* and *N. altus*, and concluded that *N. proximatus* and *N. altus* were junior subjective synonyms of *N. longirostris*. Burukovsky (2000a, 2000b) also reexamined the type material of the taxa described by Spence Bate (1888), and concluded that *N. altus*, *N. lanceopes*, *N. longirostris* and *N. proximatus* were all distinct. One of them *N. altus*, was subsequently transferred to a new genus, *Segonzackomaius* Burukovsky, 2011 (Burukovsky, 2011). Burukovsky (2000b) referred four fragmental individuals among the 10 original syntypes to *N. longirostris*. That author indicated that the drawing of the ventral surface of the sixth pleomere (Burukovsky, 2000a) was taken from the lectotype, but the lectotype designation was not explicitly made in the text. The other five individuals were referred to *N. tenuipes* Spence Bate, 1888. A further fragment, consisting only of the sixth pleomere, telson and uropods, was designated as the holotype of his new taxon *N. batei* Burukovsky, 2000b. Burukovsky (2003, 2012) repeated the accounts of *N. longirostris* and *N. batei* similar to those in Burukovsky (2000b). Hayashi (2007) questioned the validity of *N. batei*, and did not treat the taxon in his review on Japanese species of *Nematocarcinus*.

The senior author had examined the type series of *N. longirostris* on loan from NHM in 1995. At that time, the majority of the specimens were already badly damaged; only two speci-

Fig. 7. *Nematocarcinus longirostris* Spence Bate, 1888, diagrammatic figures of the posterior part of the ventral surface of the sixth pleomere, showing variation in the setal pore arrangement and the shape of the posterior spots. Only outlines of posterior spots are shown in A–J. A–J, original syntypes, “Challenger”, stn 237, off Boso Peninsula, Japan, NHM 1888: 22; K, female (cl 24.3 mm), RV “Tansei-maru”, stn S4, E of Shimokita Peninsula, Aomori Prefecture, NSMT-Cr 19837. Scale bars: 1 mm.

mens (male cl 17.0 mm and female cl 33.6 mm) had the cephalothorax and pleon still connected. Matching of separated cephalothorax and pleon of other specimens proved too difficult. In 2015, the original syntypes of *N. longirostris* were again borrowed in order to confirm if the lectotype designation by Burukovsky (2000b) was appropriately made and to assess the validity of *N. batei*.

We found that the 10 specimens, representing the original syntypes, were lumped into a single lot; eight more or less damaged cephalothoraxes and 10 more or less damaged or fragmented pleons are preserved (two cephalothoraxes are missing); and no lectotype of *N. longirostris* nor holotype of *N. batei* were separated or properly labeled, neither were the five specimens referred to *N. tenuipes* by Burukovsky (2000b) labelled. Given the complex situation, we tried to identify the lectotype of *N. longirostris* and the holotype of *N. batei* based on the comparison of the figures in Burukovsky (2000b: Fig. 1). However, it was not possible to identify the lectotype of *N. longirostris*, as the pattern of the setal pores on the ventral surface of the sixth pleomere of no specimen closely fits the figure of the lectotype in Burukovsky (2000b, 2003, 2012). Regrettably, Burukovsky (2000b, 2003, 2012) did not give further information on the lectotype other than the figure of the ventral organ of the sixth pleomere. On the other hand, the holotype of *N. batei* could be successfully identified, because Burukovsky (2000b) clearly mentioned that the holotype consisted of a sixth pleomere, telson and uropods and the observed pattern of the setal pores on the ventral surface of the sixth pleomere on one of the fragmented pleons matches the figure of Burukovsky (2000b, fig. 1v). The sixth pleomere of the holotype of *N. batei* is the longest among the ten sixth pleomeres (see Table 1), and it is safely assumed that it was detached from the largest specimen in the type series (female, cl 33.6 mm) with the sixth pleomere, telson and uropods missing.

Examination of the eight cephalothoraxes has shown that they are very similar in having rela-

tively numerous, narrowly spaced postrostral spines on the carapace (7–12) and the deeply demarcated branchiocardial groove. In particular, the latter character is critical. On the other hand, ten examples of sixth pleomeres are available. The arrangement of setal pores and the shape and distance of the posterior spots on the ventral surface of the sixth pleomere is fairly variable individually, as summarized (Table 1) and figured (see Fig. 7). The arrangement of setal pores tends to become from single to double row with an increase of the size of the sixth pleomere. The shape and size of the posterior spot is sometimes different from left to right (*cf.* Fig. 7B, H, K). Although Burukovsky (2000b) identified five specimens in the type series of *N. longirostris* with *N. tenuipes*, our examination of the comparative specimens of *N. tenuipes* (see above “Comparative material”) does not support his identification. None of the comparative specimens of *N. tenuipes* does have such a deeply demarcated branchiocardial groove as in the type specimens of *N. longirostris*. It seems unlikely that any specimen in the original syntypic series of *N. longirostris* does represent *N. tenuipes*. On the other hand, it is noteworthy to mention that one of the ten sixth pleomeres has comparatively narrow posterior spots (Fig. 7I), which suggests that it might represent a species other than *N. longirostris*. In this fragment, the entire pleon is preserved, but it is not possible to match it to any of the eight cephalothoraxes preserved. The real identity of that specimen remains unknown.

Nematocarcinus batei was distinguished from *N. longirostris* only by the different arrangement of the setal pores and the more widely separated posterior spots on the sixth pleomere (Burukovsky, 2000b, 2003, 2012, 2013). However, as mentioned above, these features are individually variable without clear distinction (Table 1; Fig. 7). The carapace of the holotype of *N. batei* is very similar to the other specimens in the type series, particularly in having a deeply demarcated branchiocardial groove. Consequently, we came to the conclusion that *N. batei* is conspecific with *N. longirostris*, relegating it to a junior

Table 1. *Nematocarcinus longirostris* Spence Bae, 1888. Variation in ventral organ of sixth pleomere (PM 6).

No.	PM 6 length (mm)	Setal pores	Posterior spot length/width (left, right)	Distance between posterior spots	Fig. 7	Remarks
Syntype 1	11	single (a few pores doubled)	2.0, 2.0	2.9 of one spot width	A	male
Syntype 2	14.7	partially doubled	2.1, 2.0	2.2 of one spot width	B	
Syntype 3	16.1	partially doubled	2.2, 1.9	2.0 of one spot width	C	
Syntype 4	16.4	single (left) or partially doubled (right)	1.8, 1.8	1.8 of one spot width	D	
Syntype 5	16.6	single (a few pores doubled)	2.3, 2.0	1.9 of one spot width	E	
Syntype 6	17.6	partially doubled	1.4, 1.4	2.3 of one spot width	F	
Syntype 7	18.3	partially doubled	2.4, 2.2	2.4 of one spot width	G	
Syntype 8	18.7	doubled	1.3, 1.6	1.9 of one spot width	H	ovigerous
Syntype 9	18.8	single (a few pores doubled)	3.1, 3.2	2.8 of one spot width	I	
Syntype 10	20.6	doubled, a few pores tripled	1.7, 2.1	2.3 of one spot width	J	female; holotype of <i>N. batei</i>
NSMT-Cr 19837	cl 24.3	doubled	1.9, 2.0	1.8 of one spot width	K	

subjective synonym of *N. longirostris*.

The newly collected specimens agree very well with the type series in every diagnostic aspect (see below), and represent the rediscovery of this rarely collected species.

As has been suggested by previous authors (Zarenkov, 1968; Tiefenbacher, 1990), *N. longirostris* is very similar to *N. lanceopes*, *N. proximatus* and *N. sigmoideus*, particularly in having an elongate rostrum (far overreaching the distal margin of the antennal scale) with numerous dorsal teeth (>35). Burukovsky (2000b, 2003, 2012) differentiated *N. longirostris*, *N. lanceopes*, *N. proximatus* and *N. sigmoideus* primarily by using the structure of the ventral organ of the sixth pleomere (cf. Burukovsky, 2012, 2013). Setal pores are arranged in a single or double (sometimes partially triple) row in *N. longirostris* (Fig. 7) and *N. proximatus* (cf. Burukovsky, 2012, fig. 56e), rather than always single in *N. lanceopes* (cf. Burukovsky, 2012, fig. 44b) and *N. sigmoideus* (Burukovsky, 2012, fig. 63). The posterior spots are separated more widely in *N. lanceopes* (cf. Burukovsky, 2012, fig. 44b) than

in *N. longirostris* (Fig. 7), *N. proximatus* (cf. Burukovsky, 2012, fig. 56e) and *N. sigmoideus* (cf. Burukovsky, 2012, fig. 63). Furthermore, *N. proximatus* is differentiated from the other three species by the possession of only one ventral tooth on the rostrum (Figs. 8A, 9C), rather than having more than two.

Here, we try to assess other diagnostic characters for discriminating *N. longirostris* and the three allied species. As noted above, *N. longirostris* can be distinguished from all of the latter three species by the deeply demarcated branchio-cardial groove on the carapace (Figs. 5A, 6C). In the other four species, this groove is not so deep (cf. Komai *et al.* 1996, figs. 1A, 2 for *N. lanceopes*; this study, Figs. 9A, 10A for *N. proximatus*; Fig. 11A for *N. sigmoideus*). Furthermore, as shown by Macpherson (1984), *N. longirostris* can be separated from *N. lanceopes* and *N. sigmoideus* by having more numerous postrostral spines on the carapace (seven to 11 versus seven or less). The relatively narrow sternal prominences and the presence of an elongate anterior spiniform tooth on each prominence on the sixth

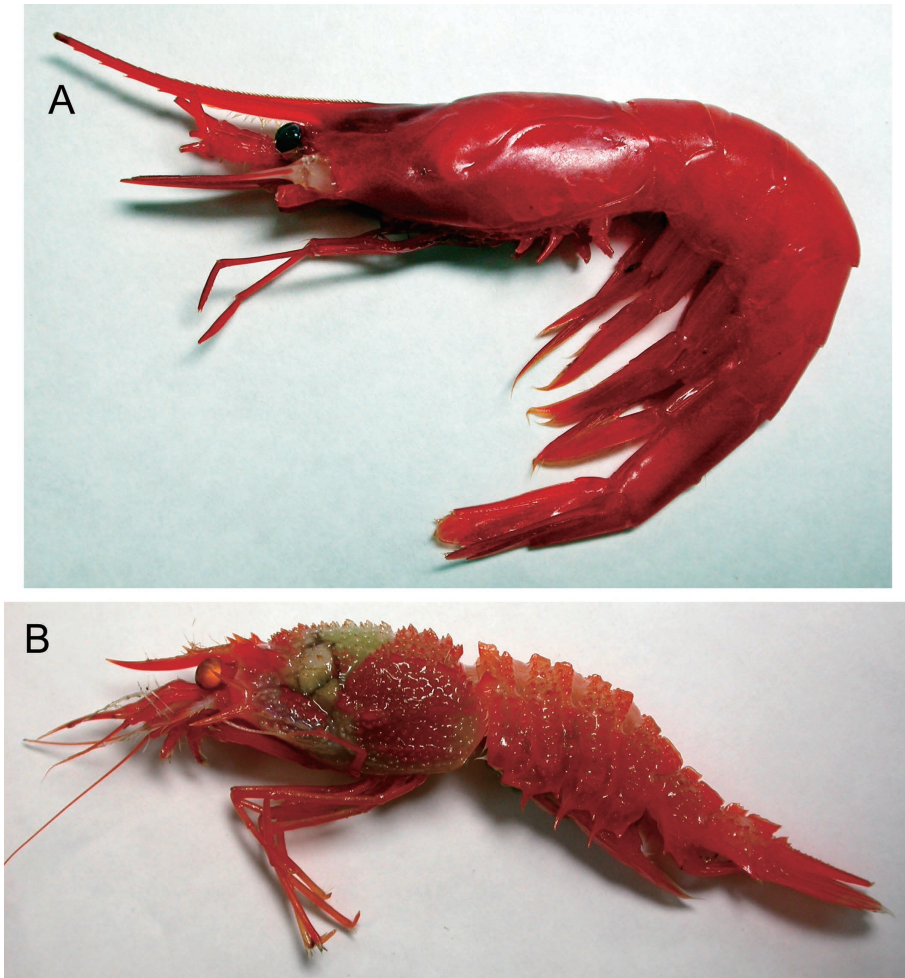


Fig. 8. A, *Nematocarcinus longirostris* Spence Bate, 1888, entire animal in lateral view, showing coloration in life, female (cl 30.9mm), RV "Tansei-maru", KT08-27 cruise, stn M4, off Miyako, Iwate Prefecture, NSMT-Cr 19836. B, *Glyphocrangon caecescens* Anonymous, 1891, ovigerous female (cl 30.9mm), entire animal in lateral view, showing coloration in life, RV "Tansei-maru", KT08-27 cruise, stn K3, off Kinkazan, Miyagi Prefecture, NSMT-Cr 19836.

thoracomere also distinguish *N. longirostris* (Figs. 5C, 6D) from the other four species (Komai *et al.* 1996, fig. 1E for *N. lanceopes*; this study, Fig. 9B for *N. proximatus*; Fig. 12A–C for *N. sigmoideus*); *N. sigmoideus* is characteristic in having a small convexity on the lateral margin of the prominence on the seventh thoracomere (Fig. 12A–C), which is absent in the other four species. As Komai *et al.* (1996) indicated, *N. lanceopes* is characteristic in having more numerous dorsolateral spines on the telson when compared to *N. longirostris*, *N. proximatus* and *N. sigmoid-*

eus (11–13 versus eight to 10).

The anterior two pleopods of the male seem to provide possibly diagnostic characters. The endopod of the first pleopod is less tapered in *N. longirostris* (Fig. 5G) than in *N. lanceopes* (*cf.* Komai *et al.*, 1996, fig. 1F) and *N. sigmoideus* (Fig. 11F); the distal margin bears a fold in *N. longirostris*, which is absent in *N. lanceopes* and *N. sigmoideus*. The appendix masculina of the second pleopod is relatively shorter in *N. longirostris* (Fig. 5H) than in *N. lanceopes* (Komai *et al.*, 1996, fig. 3I) and *N. sigmoideus* (Fig. 10F)

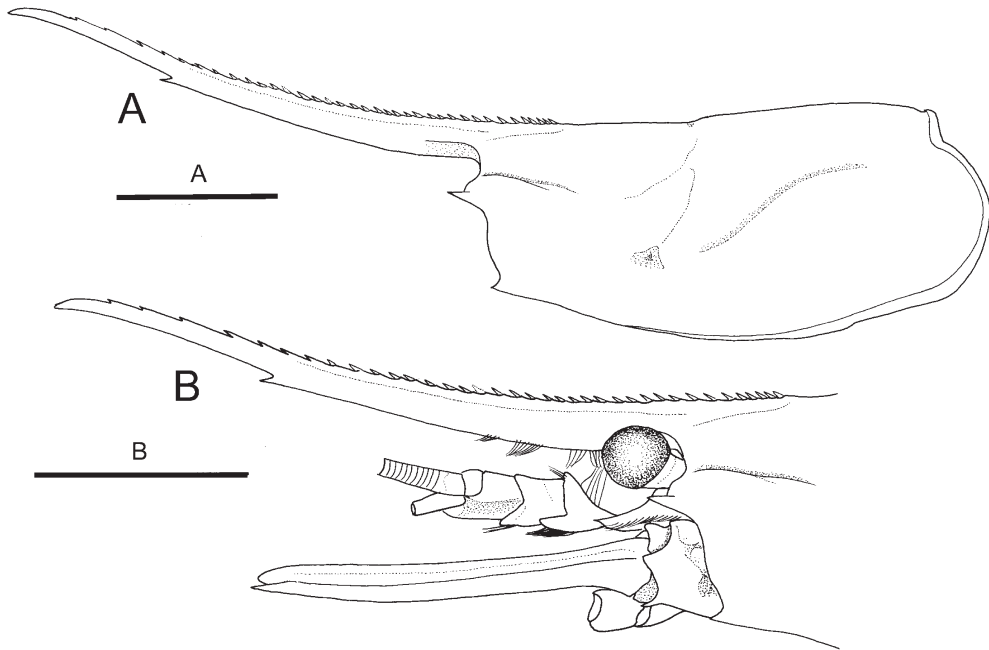


Fig. 9. *Nematocarcinus proximatus* Bate, 1888, lectotype, female (cl 28.0 mm), "Challenger", stn 146, near Marion Island, NHM 1888: 22. A, carapace, lateral view (setae omitted); B, anterior part of carapace and cephalic appendages (antennular flagella broken off, antennal flagellum missing). Scale bars: 10 mm.

and relatively narrower in *N. longirostris* and *N. lanceopes* than in *N. sigmoideus*. *Nematocarcinus proximatus* is not considered in the comparison of these male pleopodal characters, because the only available samples from fragments of the paralectotype lot seem to show immature condition (cf. Fig. 10E, F).

The holotype of *N. hiatus* has a rostrum missing the distal part anterior to the distal margin of the antennal scale and the entire pleon missing (Fig. 13A, B). Nevertheless, it is estimated that the rostrum distinctly overreaches the distal margin of the antennal scale from the preserved part, as in *N. longirostris*, *N. lanceopes*, *N. proximatus* and *N. sigmoideus*. The preserved rostrum is armed with 27 movable spines on the dorsal margin (distalmost one is missing), of which six are postrostral, and five ventral teeth. The short interruption of the dorsal rostral spines above the orbit seems to be abnormality. Other diagnostic characters include the shallow branchiocardial groove on the carapace (Fig. 13A), relatively broad thoracic prominences (Fig. 13D), non-

inflated cornea (Fig. 13B, C), relatively long stylocerite nearly reaching to the distal margin of the first segment of the antennular peduncle (Fig. 13B, C), and the subtruncate distal margin of the lamella of the antennal scale (Fig. 13C). With these characters, *N. hiatus* is clearly distinguished from *N. longirostris*. In addition, the evenly convex lateral margins of the seventh thoracic prominence distinguish *N. hiatus* from *N. sigmoideus*.

Nematocarcinus novaezealandicus Burukovsky, 2006, described from waters around New Zealand at depths of 872–1170 m, is also very similar to *N. longirostris* and the other close relatives in having an elongated rostrum with numerous dorsal teeth (>30). Burukovsky (2012, 2013) distinguished *N. novaezealandicus* from *N. longirostris* by the different structure of the ventral organ on the sixth pleomere. In *N. novaezealandicus*, the setal pores are arranged in a single row, and the posterior spot is distinctly narrowed anteriorly (Burukovsky 2006, fig. 1; 2012, fig. 48). However, as shown in this study,

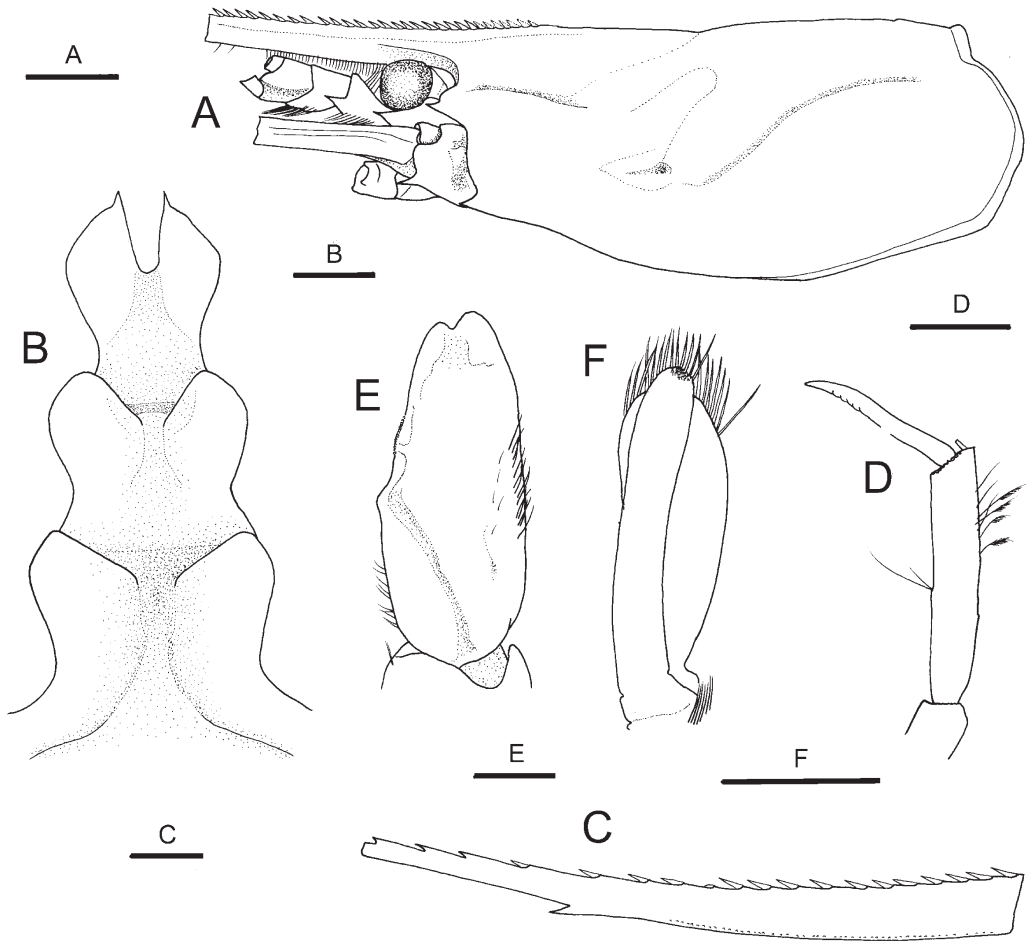


Fig. 10. *Nematocarcinus proximatus* Bate, 1888. A, B, paralectotype, male (cl 21.5 mm), "Challenger" stn 188, Arafura Sea, NHM 1888: 22; C–F, paralectotypes, same lot, fragments of various parts. A, carapace and cephalic appendages, lateral (antennular and antennal flagella missing, distal portion of scaphocerite broken off); B, sternal lobes on sixth to eighth thoracic somites, ventral, setae omitted; C, distal portion of rostrum, lateral, setae omitted; D, dactyl and propodus of third or fourth pereopods, lateral, setae on distal margin of propodus missing; E, endopod of male first pleopod, ventral; F, appendices interna and masculina, mesial. Scale bars: 5 mm for A; 2 mm for B, C; 1 mm for D–F.

the setal pores are arranged in a single or double (sometimes partially triple) row in *N. longirostris*, and in this regard, it is difficult to discriminate the two species. The shape of the posterior spot seems to be still different between the two species. In addition, Burukovsky's (2006, 2012) figures seem to show fewer postrostral spines and a non-inflated cornea in *N. novaezealandicus*. Distinction between *N. novaezealandicus* and *N. hiatus* is not clear, as suggested by Burukovsky (2013: 126), but the extension of the

antennular stylocerite seems to differ between the two taxa. In *N. novaezealandicus*, the stylocerite falls far short of the distal margin of the first segment of the antennular peduncle (Burukovsky, 2006, fig. 1a; 2013, fig. 48a), rather than nearly reaching to it in *N. hiatus* (Fig. 13B, C).

Nematocarcinus agassizi, known from the eastern Pacific, can be distinguished from *N. longirostris* by the different pattern of the rostral armature and the different shape of the posterior spots of the ventral organ of the sixth pleomere.

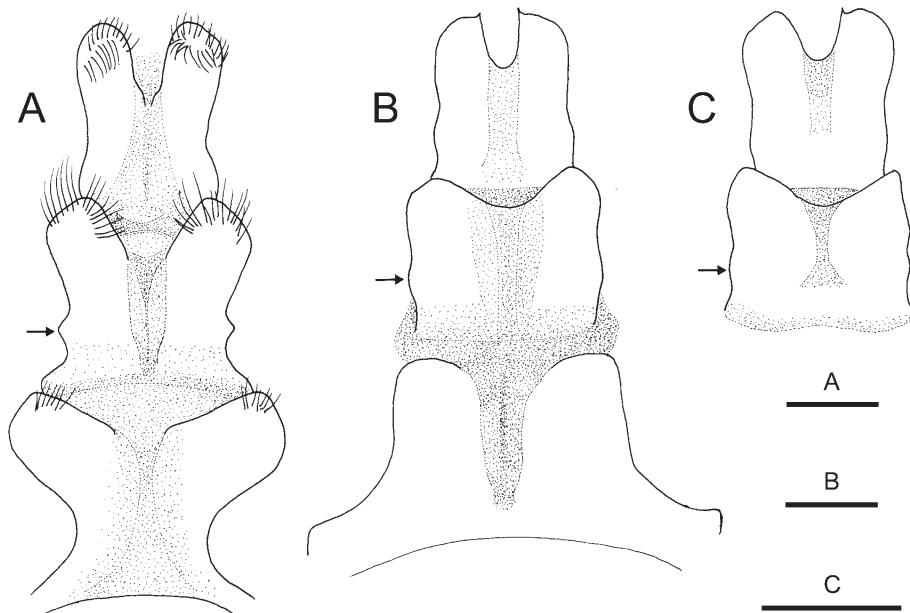


Fig. 12. *Nematocarcinus sigmoideus* Macpherson, 1984. Sternal prominences on sixth to eighth (A, B) or sixth and seventh (C) thoracomeres, ventral view. A, male (cl 28.9 mm), Valdivia Bank, ICMD 1996/73; B, female (cl 17.0 mm, Valdivia Bank, ICMD 1996/75; C, female (cl 21.2 mm), NE of Saint Helens, Tasmania, TM G3549. Scale bars: 2 mm for A, C; 1 mm for B.

In *N. agassizi*, the dorsal margin of the rostrum is unarmed in the distal half (Faxon, 1895, pl. 42 fig. 1); the posterior spots diverge posteriorly and are separated by more than 4 widths of one spot (Burukovsky, 2012, fig. 22g). Furthermore, the posterodorsal margin of the third pleomere is more strongly produced in *N. agassizi* (cf. Burukovsky, 2012, fig. 22b) than in *N. longirostris*. Cardoso and Burukovsky (2014) synonymized *N. agassizi* under *N. gracilipes* Filhol, 1884, but this synonymy has been rejected by Hernandez-Payan and Hendrickx (in review).

Considering the close morphological similarities and geographical distributional pattern, the vast majority of the previous records of *N. longirostris* from the southern hemisphere could be referred to either the Antarctic endemic *N. lanceopes* (cf. Ledoyer, 1989; Sieg and Wägele, 1990) or the circumpolar *N. sigmoideus* (cf. Barnard, 1950; Yaldwyn, 1965; Kensley, 1968, 1972; Ledoyer, 1979; Kirkwood, 1984; Gorny, 1999; Thatje *et al.*, 2005; Boschi and Gavio, 2005). One of the specimens used by Ledoyer

(1979) was reexamined (CBM-ZC 12982), and found to actually represent *N. sigmoideus*. Yaldwyn and Webber's (2011) record of *N. longirostris* from New Zealand waters was based on material from the Kermadec Trench at abyssal depths of 5230–5340 m. This record needs to be verified, and its inclusion in the synonymy remains questionable. The presently available data suggests that *N. longirostris* is restricted to depths greater than 2500 m.

Family Glyphocrangonidae

Glyphocrangon caecescens Anonymous, 1891

[New Japanese name: Futayubi-toge-hirata-ebi]

(Fig. 8B)

Glyphocrangon sculpta var. *caecescens* Anonymous, 1891: 54; Huys *et al.*, 2014: 20.

Glyphocrangon caecescens Wood-Mason in Wood-Mason and Alcock, 1891: 357; Wood-Mason and Alcock, 1894: pl. 7, fig. 1; Chace, 1984: 5 (key); Komai, 2004: 450, figs. 32, 33, 116.

Glyphocrangon rimapes Spence Bate, 1888: 523 (in part); Rice 1981: 276 (in part), fig. D.

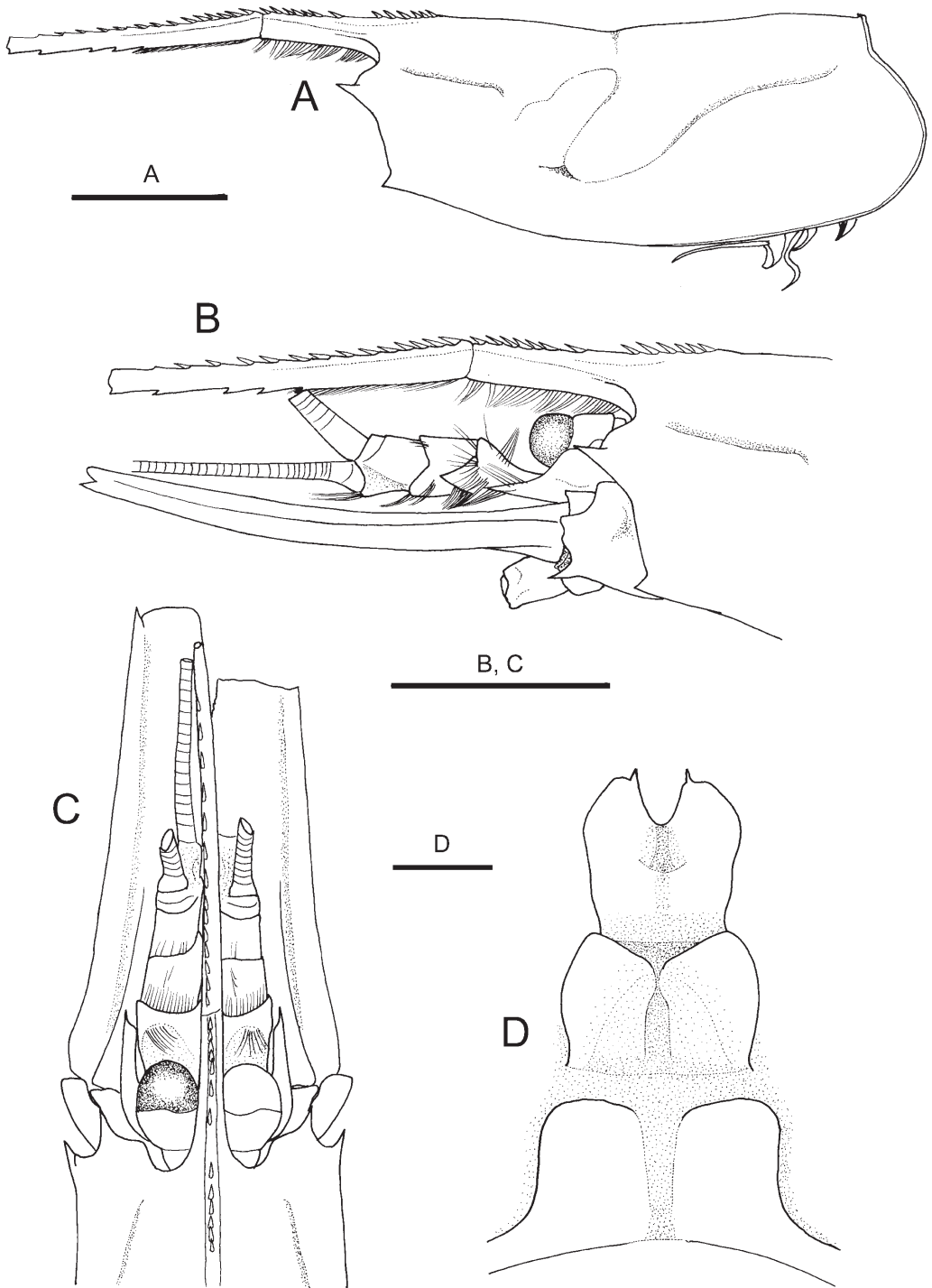


Fig. 13. *Nematocarcinus hiatus* Spence Bate, 1888. Holotype, sex unknown (cl 16.0 mm), New Zealand, NHM 1888: 22. A, carapace, lateral view (rostrum damaged with distal portion missing); B, anterior part of carapace and cephalic appendages, lateral view (antennular flagella damaged, antennal flagellum missing); C, same, dorsal view (distal portion of right scaphocerite broken off); D, sternal prominences on sixth to eighth thoracomerites, ventral view. Scale bars: 5 mm for A–C; 1 mm for D.

Glyphocrangon rimapes (not of Spence Bate, 1888): Brand and Takeda, 1996: 272, fig. 6C, D.

Material examined. RV “Tansei-maru”, KT08-27 cruise, stn K3, off Kinkazan, Miyagi Prefecture, 38°26.49'N, 143°22.53'E to 38°25.49'N, 143°23.30'E, 2698–2814m, 23 October 2008, beam trawl, coll. H. Komatsu, 2 ovigerous females (cl 29.9, 32.6 mm), NSMT-Cr 19846.

Coloration in life. Body and appendages generally red, gastric region of carapace translucent; cornea light brown, with reflecting pigment (Fig. 8B).

Distribution. Bay of Bengal, Mid-Indian Basin, Philippines (Davao Bay, Mindanao), and Japan (off Miyagi Prefecture to Tosa Bay); 2698–3431 m.

Remarks. *Glyphocrangon caecescens* was originally described on the basis of a single male specimen from the Bay of Bengal [the authorship of the name was attributed to Anonymous (1891), instead of the more traditional Wood-Mason in Wood-Mason and Alcock (1891), see Huys *et al.* (2014)]. There have been no other records for this name until Komai (2014) re-described the species. Komai (2004) referred specimens from Japan, including one of the paratypes of *G. rimapes* Spence Bate, 1888, one from the Philippines identified with *G. rimapes* by Brand and Takeda (1996), and one from the Mid-Indian Basin, to *G. caecescens*. Among the Indo-West Pacific congeners, *G. caecescens* is readily recognized by the possession of three pairs of dorso-lateral teeth on the rostrum, sharp, conical tubercles on the intercarinal spaces on the carapace, the anterior fourth carina on the carapace being primarily divided in two parts by a distinct notch, and terminally bifid dactyli of the fourth and fifth pereopods in spawning females.

The present two ovigerous specimens agree well with *G. caecescens* in the diagnostic characters cited above, but differ from the previous descriptions in the color of the body and the cornea of eye. Wood-Mason in Wood-Mason and Alcock (1891) described the living color as “pale pink, corneae dull yellow”. Komai (2004) described the color of the cornea as “without

dark pigmentation in preservative”. In the present specimens, however, the body is generally red; the cornea is light brown and reflective (see Fig. 8B); in ethanol preservative, the cornea becomes dark brown. Recent studies by Komai and Chan (2008, 2013) demonstrated that the body color in species of *Glyphocrangon* occasionally varies intraspecifically. For the time being, we refer the present specimens to *G. caecescens*, but further comparison using additional specimens and genetic data will be necessary in order to fully assess the specific status of the geographically separated populations.

In addition to *G. caecescens*, the following seven species of *Glyphocrangon* are known from Japanese waters: *G. formosana* Komai, 2004, *G. hastacauda* Spence Bate, 1888, *G. humilis* Komai, 2006, *G. major* Komai, 2004, *G. perplexa* Komai, 2004, *G. runcinata* Komai, 2004 and *G. stenolepis* Chace, 1984 (Komai, 2004; 2006; 2011). *Glyphocrangon caecescens* is easily distinguished from these species by the possession of three pairs of dorsolateral teeth on the rostrum, the covering of sharp tubercles or granules on the intercarinal spaces on the carapace, the usual presence of three pleural teeth on the fifth pleomere and the horizontally bifurcate terminus of each dactylus of the fourth and fifth pereopods in spawning females. The species is the most northerly extended to the Tohoku District among the congeneric species. None of the other seven species occur in the area north of the Boso Peninsula.

Acknowledgments

We thank Paul F. Clark and Miranda Lowe (Natural History Museum, London), Michel Ledoyer, Enrique Macpherson (Centro de Estudios Avanzados de Blanes, Girona) and Andrew Rozefelds (Tasmanian Museum and Art Gallery) for loaning the comparative and type materials and for Cédric d’Udekem d’Acoz (Royal Belgian Institute of Natural Sciences) and Sammy De Grave (Oxford University Museum of Natural History) for their kind help in obtaining copies of

important literature. The manuscript was benefited by comments and suggestions by S. De Grave. We also thank M. E. Hendrickx (Unidad Académica Mazatlán Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México) for allowing us to cite his manuscript under review process. The junior author's cordial thanks are extended to the captain and the crew of the RV "Tansei-maru" of JAMSTEC for their generous help in collecting specimens on board during the KT08-27 cruise. Tsunemi Kubodera and Gento Shinohara (NSMT) kindly provided us with the specimens collected during the 1995 cruise of RV "Wakataka-maru" of the Fisheries Research Agency, Japan.

References

- Anonymous 1891. Appendix No. XIII. In: Administration Report of the Indian Marine for the Official Year 1890–91, pp. 52–57. The Government Central Press, Bombay.
- Barnard, K. H. 1950. Descriptive catalogue of South African decapod Crustacea (crabs and shrimps). *Annals of the South African Museum*, 38: 1–837.
- Boschi, E. E. and M. A. Gavio 2005. On the distributions of decapod crustaceans from the Magellan Biogeographic Province and the Antarctic Region. *Scientia Marina*, 69, Supplement 2: 195–200.
- Brand, T. and M. Takeda 1996. *Glyphocrangon* shrimps from the western Pacific collected by the R/V Hakuho-Maru during the KH-72-1 cruise. *Bulletin of the National Science Museum, Tokyo*, 22: 263–281.
- Burukovsky, R. N. 2000a. Taxonomy of shrimps from the genus *Nematocarcinus* (Crustacea, Decapoda, Nematocarcinidae). 1. Description of disto-ventral organ and revision of *N. productus*, *N. tenuipes*, *N. intermedius*, *N. parvidentatus*, *N. longirostris*, and *N. proximatus*. *Zoologicheskii Zhurnal*, 79: 161–170. [In Russian with English abstract.]
- Burukovsky, R. N. 2000b. Taxonomy of shrimps from the genus *Nematocarcinus* (Crustacea, Decapoda, Nematocarcinidae). 2. Revision of *N. longirostris* and *N. altus*, correction of species diagnosis in *N. sigmoideus* and *N. lanceopes*, and description of new species, *N. batei* and *N. romenskyi*. *Zoologicheskii Zhurnal*, 79: 282–290. [In Russian with English abstract.]
- Burukovsky, R. N. 2003. Shrimps of the Family Nematocarcinidae. 250 pp. Kaliningrad Izdatel'istvo KGGU, Kaliningrad. [In Russian.]
- Burukovsky, R. N. 2004. Taxonomy of shrimps of the genus *Nematocarcinus* (Decapoda, Nematocarcinidae). A review of taxonomic characteristics and a key to identifying species of the genus. *Zoologicheskii Zhurnal*, 83: 549–561. [In Russian with English abstract.]
- Burukovsky, R. N., 2006. Systematics of shrimps of the genus *Nematocarcinus* (Decapoda, Nematocarcinidae). *Zoologicheskii Zhurnal*, 85: 441–447. [In Russian with English abstract.]
- Burukovsky, R. N. 2011. A new shrimp genus of the family Nematocarcinidae (Decapoda, Caridea). *Zoologicheskii Zhurnal*, 90: 1–9. [In Russian with English abstract.]
- Burukovsky, R. N. 2012. Deep Sea Shrimps of the Family Nematocarcinidae (History of Study, Systematic, Distribution, and Biology). 287 pp. Prospekt Nauki, St. Petersburg. [In Russian.]
- Burukovsky, R. N. 2013. Shrimps of the family Nematocarcinidae Smith, 1884 (Crustacea, Decapoda, Caridea) from Taiwan and the Philippines collected by the TAIWAN, PANGLAO 2005 and AURORA expeditions in the western Pacific. In Ahyong, S. T., T.-Y. Chan, L. Corbari and P. K. L. Ng (eds.): *Tropical Deep-Sea Benthos 27. Mémoires du Muséum national d'Histoire naturelle*, (204): 155–189.
- Calman, W. T. 1925. On macrurous decapod Crustacea collected in South African waters by the S. S. "Pickle". With a note on specimens of the genus *Sergestes* by H. J. Hansen. *Reports of the Fisheries and Marine Biological Surveys, South Africa*, 4: 1–26.
- Cardoso, I. A. and R. Burukovsky 2014. *Nematocarcinus* Milne Edwards, 1881 (Crustacea, Decapoda) from Southwestern Atlantic, including the Southern Mid-Atlantic Ridge area. *Zootaxa*, 3887: 437–458.
- Chace, F. A., Jr. 1984. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907–1910, part 2: families Glyphocrangonidae and Crangonidae. *Smithsonian Contributions to Zoology*, 397: 1–63.
- Faxon, W. 1895. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission steamer "Albatross," during 1891, Lieut.-Commander Z. L. Tanner, U. S. N., commanding. XV. The stalk-eyed Crustacea. *Memoirs of the Museum of Comparative Zoölogy at Harvard College*, 18: 1–292, pls. A–H, J–K, 1–57.
- Gorny, M. 1999. On the biogeography and ecology of the Southern Ocean decapod fauna. *Scientia Marina*, 63(Supplement 1): 367–382.
- Hayashi, K. 1983. Prawns, shrimps and lobsters from Japan (12). Family Aristeidae (Aristeinae) — Genera *Aristaeomorpha* and *Hepomadus*. *Aquabiology*, (27): 280–283. [In Japanese.]
- Hayashi, K. 1988. Prawns, shrimps and lobsters from Japan (44). Family Nematocarcinidae — Genus *Nema-*

- tocarcinus*. *Aquabiology*, (59): 442–445. [In Japanese.]
- Hayashi, K. 1992. Dendrobranchiata Crustaceans from Japanese Waters. 300 pp. Seibutsukenkyusha, Tokyo. [In Japanese.]
- Hayashi, K. 2007. Caridean shrimps (Crustacea: Decapoda: Pleocyemata) from Japanese Waters, Part 1. Oplophoroidea, Nematocarcinioida, Atyoidea, Stylo-dactyloidea, Pasiphaeoidea and Psalidopodoidea. 292 pp. Seibutsukenkyusha, Tokyo. [In Japanese.]
- Huys, R., M. E. Y. Low, S. De Grave, P. K. L. Ng and P. F. Clark 2014. On two reports associated with James Wood-Mason and Alfred William Alcock published by the Indian Museum and the Indian Marine Survey between 1890 and 1891: implications for malacostracan nomenclature. *Zootaxa*, 3757: 1–78.
- Kensley, B. F. 1968. Deep sea decapod Crustacea from west of Cape Point, South Africa. *Annals of the South African Museum*, 50: 283–323.
- Kensley, B. 1972. Shrimps & Prawns of Southern Africa. 65 pp. South African Museum, Cape Town.
- Kirkwood, J. M. 1984. A guide to the Decapoda of the Southern Ocean. ANARE Research Notes, 11: 1–47.
- Komai, T. 2004. A review of the Indo-West Pacific species of the genus *Glyphocrangon* A. Milne Edwards, 1881 (excluding the *G. caeca* Wood-Mason, 1891 species group) (Crustacea: Decapoda: Caridea: Glyphocrangonidae). In Marshall, B. and B. Richer de Forges (eds.): *Tropical Deep-Sea Benthos Vol. 23. Memoires du Museum national d'Histoire naturelle, Paris, (191): 375–610.*
- Komai, T. 2006. A review of the *Glyphocrangon caeca* Wood-Mason & Alcock, 1891 species group, with descriptions of six new species (Crustacea: Decapoda: Caridea: Glyphocrangonidae). In B. Richer de Forges and J.-L. Justine (eds.) *Tropical Deep-Sea Benthos Vol. 24. Memoires du Muséum national d'Histoire naturelle, Paris, (193): 243–264.*
- Komai, T. 2011. Deep-sea shrimps and lobsters (Crustacea: Decapoda: Dendrobranchiata and Pleocyemata) from the Sagami Sea and Izu Islands, central Japan. *Memoirs of the National Museum of Nature and Science*, 47: 279–337.
- Komai, T. and T.-Y. Chan 2008. Further records of deep-sea shrimps of the genus *Glyphocrangon* A. Milne-Edwards, 1881 (Crustacea: Decapoda: Caridea) from the Philippines, with descriptions of three new species. *Raffles Bulletin of Zoology, Supplement*, 19: 39–62.
- Komai, T. and T.-Y. Chan 2013. New records of *Glyphocrangon* (Crustacea: Decapoda: Caridea: Glyphocrangonidae) from the recent French expeditions off the Mozambique Channel and Papua New Guinea, with description of one new species. In Ahyong, T. S., T.-Y. Chan, L. Corbari and P. K. L. Ng (eds.): *Tropical Deep-Sea Benthos Vol. 27. Mémoires du Muséum national d'Histoire naturelle, Paris, (204): 107–128.*
- Komai, T. and H. Komatsu 2009. Deep-Sea shrimps and lobsters (Crustacea: Decapoda: Penaeidea, Caridea, Polychelidea) from northern Japan, collected during the Project “Research on Deep-sea Fauna and Pollutants off Pacific Coast of Northern Honshu, Japan, 2005–2008.” In Fujita, T. (ed.): *Deep-sea Fauna and Pollutants off Pacific Coast of Northern Japan. National Museum of Nature and Science Monographs, (39): 495–580.*
- Komai, T., C.-W. Lin and T.-Y. Chan 2012. Bathypelagic shrimps of the caridean genus *Pasiphaea* (Crustacea: Decapoda: Pasiphaeidae) from waters around Taiwan, with descriptions of four new species. *Journal of Crustacean Biology*, 32: 295–325.
- Komai, T., I. Takeuchi and M. Takeda 1996. Deep-sea shrimps (Crustacea: Decapoda: Caridea) from the Antarctic Sea collected during the JARE 35 Cruise. *Proceedings of the National Institute of Polar Research Symposium on Polar Biology, (9): 179–206.*
- Ledoyer, M. 1979. Caridea (Crustacea, Decapoda) des Iles Kerguelen, Crozet, Marion et Prince Edward, et du sud de Madagascar (Banc Walters), des campagnes MD.03, MD.04 et MD.08 du M/S “Marion-Dufresne”. Publication no. 44 du C.N.F.R.A. Campagnes MD.08/ Benthos — Premiers Résultats, 1979: 137–153.
- Ledoyer, M. 1989. Mysidacea et Caridea (Crustacea) de la campagne MD 42/Sibex du “Marion-Dufresne” entre les îles Kerguelen et la baie Prydz (Antarctique). *Mésogée*, 49: 67–70.
- Macpherson, E. 1984. Crustáceos Decápodos del Banco Valdivia (Atlántico sudoriental). *Resultados Expediciones Científicas, (12): 39–105.*
- Milne-Edwards, A. and E. L. Bouvier 1909. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78), in the Caribbean Sea (1878–79), and along the Atlantic coast of the United States (1880), by the U.S.N. Coast Survey Steamer “Blake”, Lieut.-Com. C.D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U. S. N. Commanding. 44. Les Pénéides et Sténopides. *Memoirs of the Museum of Comparative Zoology at Harvard College, 27: 177–274, pls. 1–9.*
- Pérez Farfante, I. 1973. Morphological study of diagnostic characters in western Atlantic *Hepomadus* (Crustacea, Decapoda, Penaeidae). *Fishery Bulletin*, 71: 441–453.
- Pérez Farfante, I. and B. Kensley. 1997. Penaeoid and sergestoid shrimps and prawns of the world. *Mémoires du Muséum national d'Histoire naturelle, (175): 1–233.*
- Rice, A. L. 1981. The status of *Glyphocrangon rimapes* Bate, 1888 (Crustacea, Decapoda, Glyphocrangonidae). *Bulletin of the British Museum, Natural History (Zoology)*, 40: 275–285.
- Sieg, J. and J. W. Wägele (eds) 1990. *Fauna der Antarktis. 197 pp. Verlag Paul Parey, Berlin.*

- Spence Bate, C. 1881. On the Penaeidae. *Annals and Magazine of Natural History*, (5) 8: 169–196, pls. 11, 12.
- Spence Bate, C. 1888. Report on the Crustacea Macrura collected by the Challenger during the years 1873–76. Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the years 1873–76, (24): i–xc, 1–942, pls. 1–157.
- Stebbing, T. R. R. 1914. South African Crustacea. Part VII of S.A. Crustacea, for the Marine Investigations in South Africa. *Annals of the South African Museum*, 15: 1–55, pls. 1–12.
- Thatje, S., R. Bacardit and W. E. Arntz 2005. Larvae of the deep-sea Nematocarinidae (Crustacea: Decapoda: Caridea) from the Southern Ocean. *Polar Biology*, 28: 290–302.
- Tiefenbacher, L. 1990. Beiträge zur Taxonomie von *Nematocarinus longirostris* Bate, 1888 und *Nematocarinus lanceopes* Bate, 1888, neu für die westliche Antarktis. *Spixiana*, 13: 229–235.
- Wood-Mason, J. and A. Alcock. 1891. Natural history notes from H.M. Indian marine survey steamer "Investigator", Commander R. F. Hoskyn, R. N., commanding. Series II, No. 1. On the results of deep-sea dredging during the season 1890–1891. *Annals and Magazine of Natural History*, (6) 8: 353–362.
- Wood-Mason, J. and A. Alcock. 1894. Illustrations of the Zoology of the Royal Indian Marine Survey Steamer Investigator, under the Command of Commander A. Carpenter, R. N., D. S. O., Crustacea Part 2. Pls. 6–8. Government Printer, Calcutta.
- Yaldwyn, J. C. 1965. Antarctic and subantarctic decapod Crustacea. In van Mieghem, J. and P. van Oye (eds.): *Biogeography and Ecology in Antarctica. Monographiae Biologicae*, volume 15, pp. 324–332. Dr. W. Junk Publishers, The Hague.
- Yaldwyn, J. C. and W. R. Webber. 2011. Annotated checklist of New Zealand Decapoda (Arthropoda: Crustacea). *Tuhinga*, 22: 171–272.
- Zarenkov, N. A. 1968. Crustacea Decapoda collected in the Antarctic and antiboreal regions by the Soviet Antarctic Expeditions. In Bykhovskii, B. E. (ed.): *Biological Reports of the Soviet Antarctic Expedition (1955–1958)*, pp. 153–201. Akademy Nauk, SSSR, Moscow. [In Russian.]