

A New Species of the Ghost Shrimp Family Ctenochelidae (Crustacea: Decapoda: Axiidea) from Japan

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A new species of the ghost shrimp genus *Ctenocheloides* (Decapoda: Axiidea: Ctenochelidae), *C. nomurai*, is described on the basis of two male specimens from the shallow subtidal bottom of Arita Bay, Kushimoto, Wakayama Prefecture, Japan. The new species differs from its sole known congener, *C. attenboroughi* Anker, 2010, in the structure of the carapace, the well developed crista dentata of the third maxilliped, the strongly asymmetrical chelipeds, and the chelate fifth pereopod. The two type specimens were found under a rock on soft bottom, suggesting that the new species is a burrower like other callianassooid species.

Key Words: Crustacea, Decapoda, Axiidea, Ctenochelidae, *Ctenocheloides*, new species, Japan.

Introduction

Within the superfamily Callianassoidea (Decapoda: Axiidea), only two genera are characterized by a comb-like row of teeth on the cutting edge of the elongate finger of at least one cheliped, viz., *Ctenocheles* Kishinouye, 1926 and *Ctenocheloides* Anker, 2010. Both genera are currently assigned to the family Ctenochelidae, although the classification of its family and its related taxa is still in a state of flux (cf. Tudge *et al.* 2000; Lin *et al.* 2007; Anker 2010; Sakai 2011).

In 1997, Mr Keiichi Nomura of the Kushimoto Marine Park Center, Japan, collected two specimens of a very unusual ghost shrimp from a subtidal soft bottom in Arita Bay, Kushimoto, Wakayama Prefecture, during routine investigations of the fauna in local waters. These specimens have a comb-like row of teeth on each finger of the right cheliped and exhibit substantial similarities to *Ctenocheloides attenboroughi* Anker, 2010. The latter is the type species of its monotypic genus, and is represented only by the holotype from Madagascar. This paper serves to describe the second species of the genus, *C. nomurai* sp. nov., with discussion of the differentiating characters between the two species. The generic diagnosis of *Ctenocheloides* is emended to accommodate the present new species.

The type specimens are deposited in the Natural History Museum and Institute, Chiba (CBM) in Chiba, Japan. The carapace length (cl: distance from the frontal margin to the posterodorsal margin of the carapace, in mm) is used as a standard measurement. Higher classification follows that of Anker (2010).

Infraorder **Axiidea** de Saint Laurent, 1979

Superfamily **Callianassoidea** Dana, 1852

Family **Ctenochelidae** Manning and Felder, 1991

Subfamily **Ctenochelinae** Manning and Felder, 1991

Ctenocheloides Anker, 2010

Type species. *Ctenocheloides attenboroughi* Anker, 2010.

Emended diagnosis. Carapace with cervical groove deep or shallow, suture-like; gastric prominence present, while cardiac prominence present or absent; linea thalassinica running along entire length of carapace; frontal margin slightly convex, without rostral spine or median ridge. First pleomere without pleura; third to fifth pleomeres without setal rows. Sixth pleomere without lateral projections. Eyestalk somewhat flattened dorsoventrally; cornea well pigmented, dorsal, subterminal. Antennular peduncle shorter and not stouter than antennal peduncle. Antennal scaphocerite well developed, subacute distally. Scaphognathite of maxilla lacking long seta on posterior lobe. Second maxilliped without exopod, with small or minute epipod. Third maxilliped without exopod; ischium-merus pediform; merus with prominent spine mesially; propodus and dactylus slender. Chelipeds with ischia each bearing row of minute denticles on ventral margin; meri each with tiny denticle on ventral margin; finger of at least one side slender, longer than palm, prominently pectinate. Second pereopod chelate. Third pereopod with subrectangular propodus, with distal spine on ventral margin. Male first pleopod uniramous. Male second pleopod biramous, generally similar to third to fifth pleopods in structure, but shorter and narrower, with appendices interna and masculina arising distal to mid-length of endopod. Female first and second pleopods unknown. Third to fifth pleopods foliaceous, each with slender, digitiform appendix interna. Uropodal exopod ovate, without lateral incision, fringed with row of spinules noticeably increasing in size posteriorly.

Composition. *Ctenocheloides attenboroughi* and *C. nomurai* sp. nov.

Ctenocheloides nomurai sp. nov.

Figs 1–7

Material examined. Holotype: male (cl 7.3 mm), Arita Bay, Kushimoto, Wakayama Prefecture, 13 m, sand bottom, under rock, 30 April 1997, SCUBA diving, coll. Keiichi Nomura, CBM-ZC 11250.

Paratype: 1 male (cl 7.1 mm), same data as holotype, CBM-ZC 11251.

Description. Carapace (Figs 1A, 2B, 3A, B) subequal in length to first and second abdominal somites combined; frontal margin slightly convex, without rostral spine, carina or any other median ridge; anterolateral projection subtriangular with blunt tip; gastric region slightly elevated compared with cardiac region, with low, rounded prominence; cervical groove crossing midline one-third of way forward from posterior margin, very shallow, thus delineation of dorsa oval weak; cardiac region smooth, lacking cardiac prominence; linea thalassinica distinct, extending to posterolateral margin of carapace; anterolateral margin below anterolateral projection deeply notched; branchiostegal margin rounded, extending as far as anterolateral projection; posterolateral submarginal ridge distinct.

Thoracic shield on seventh thoracomere (Fig. 2E) with distinct submedian carinae converging posteriorly; lateral parts membranous.

Pleon (Figs 1B, 2B, C) moderately long; length ratio of pleomeres 1: 1.6: 0.5: 0.5: 0.9. First pleomere with tergite divided into two parts; anterior part small, glabrous, widely trapezoidal, well sclerotized; posterior part large, also trapezoidal, widened posteriorly, poorly sclerotized, with sparse setae dorsally; pleuron not developed; sternite with distinct oblique suture extending medially from posterolateral angle of anterior part of tergite to area posterior to base of first pleopod. Second pleomere longest, anterior part entirely membranous, tergite and pleura formed in posterior two-thirds; tergite with scattered setae, posterodorsal margin slightly concave; pleuron without distinct anterior lobe, posterior lobe defined, rounded; no setal row on pleuron; sternite convex, visible in lateral view. Third to fifth pleomeres with numerous scattered setae, these becoming longer on pleura laterally and ventrally; pleura well defined, rounded posterolaterally; no distinct setal row on any pleuron. Sixth pleomere trapezoidal, slightly narrowed posteriorly, 1.2–1.3 times wider than long; dorsal surface with scattered setae; lateral margin with trace of notch anteriorly.

Telson (Fig. 2D) subtriangular, about 1.1 times as long as wide, lateral margin with trace of constriction anterior to midlength; posterior margin rounded, unarmed; dorsal surface without distinct ridges, with median tuft of long setae slightly anterior to midlength and several long setae laterally.

Eyestalk (Fig. 3A, B) reaching distal margin of first segment of antennular peduncle; lateral margin regularly convex posterior to cornea; anteromesial projection subacutely

pointed; cornea convex, located subterminally and laterally.

Antennular peduncle (Fig. 3A, B) falling short of distal end of fourth segment of antennal peduncle. First segment concave dorsally, about twice as long as second segment. Third segment about twice as long as second segment. Flagella slightly longer than peduncle; dorsal flagellum thicker and slightly shorter than ventral flagellum, with about 20 articles, distal 4 or 5 of which bearing aesthetascs on ventral surface; ventral flagellum with long setae along ventral margin, usually grouped in pairs at distoventral end of each article.

Antennal peduncle (Fig. 3A, B) slightly more slender than antennular peduncle, with supernumerary segmentation in distolateral portion of second segment. Fourth segment elongate, about twice as long as fifth segment. Fifth segment slightly widened distally. Scaphocerite small, distally acute.

Epistome slightly produced, without setae.

Mandible (Fig. 3C, D) with 3-segmented palp, third segment spatulate, tapering distally to rounded tip, fringed with setae; incisor process bearing essentially 3 rounded teeth on cutting margin; molar process very short, partly fused with incisor, with 1 small denticle. Maxillule (Fig. 3E) with 2-segmented endopod, first segment much longer than second segment; second segment articulated to first segment at right angle, tapering distally; basal endite with row of robust, spine-like setae arranged in double row along truncate distal margin; coxal endite not particularly enlarged, distally rounded, with numerous marginal setae. Maxilla (Fig. 3F) with endopod tapering distally to curved tip; basal and coxal endites each deeply subdivided; scaphognathite reaching anterior to midlength of endopod. First maxilliped (Fig. 3G) with small, rounded endopod; basal endite elongate subovate; coxal endite produced as far as basal endite; exopod broad, overreaching basal endite by about half its length, slightly narrowing distally to rounded tip, bearing marginal setae; epipod large, bilobed, with posterior lobe elongate. Second maxilliped (Fig. 3H) with merus and ischium fused; flexor margin of ischiomerus with row of long setae; carpus short, cup-shaped; propodus subrectangular, almost as wide as long, and about half as long as of ischiomerus; dactylus short, subsemicircular, slightly longer than wide, about half as long as propodus, tip with stout serrate setae; exopod absent; epipod slender, strap-like, devoid of podobranch.

Third maxilliped (Fig. 4A) pediform; endopod fringed with long setae on ventral margin. Basis with spinule on ventral margin. Ischium about 2.5 times as long as wide in lateral view; ventromesial margin with well-developed crista dentata, this becoming higher distally and consisting of more than 10 irregular, subtriangular, blunt to subacute teeth (Fig. 4B). Merus about 3.0 times as long as wide in lateral view, slightly longer than ischium, ventrolateral margin armed with 1 small spine distal to midlength, ventromesial margin unarmed, slightly expanded mesially. Carpus widened distally, slightly shorter than merus, unarmed, concave ventroproximally. Propodus subrectangular, about 2.2 times longer than wide, subequal in length to carpus, slightly tapering distally. Dactylus about 3.0 times longer than wide,

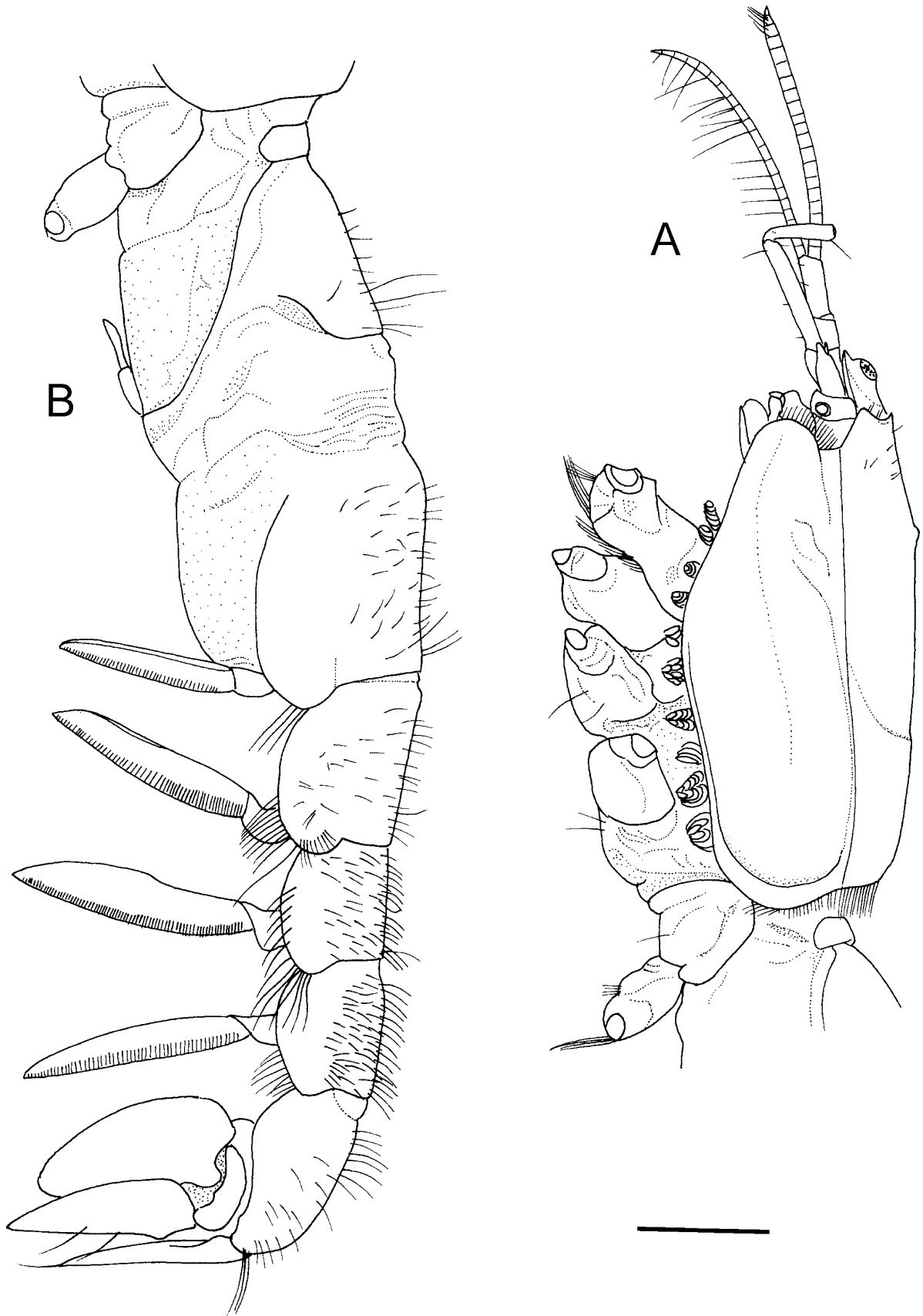


Fig. 1. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. A, cephalothorax and cephalic appendages, lateral view (thoracic appendages removed); B, pleon and pleopods, lateral view (setae partially omitted). Scale bar: 2 mm.

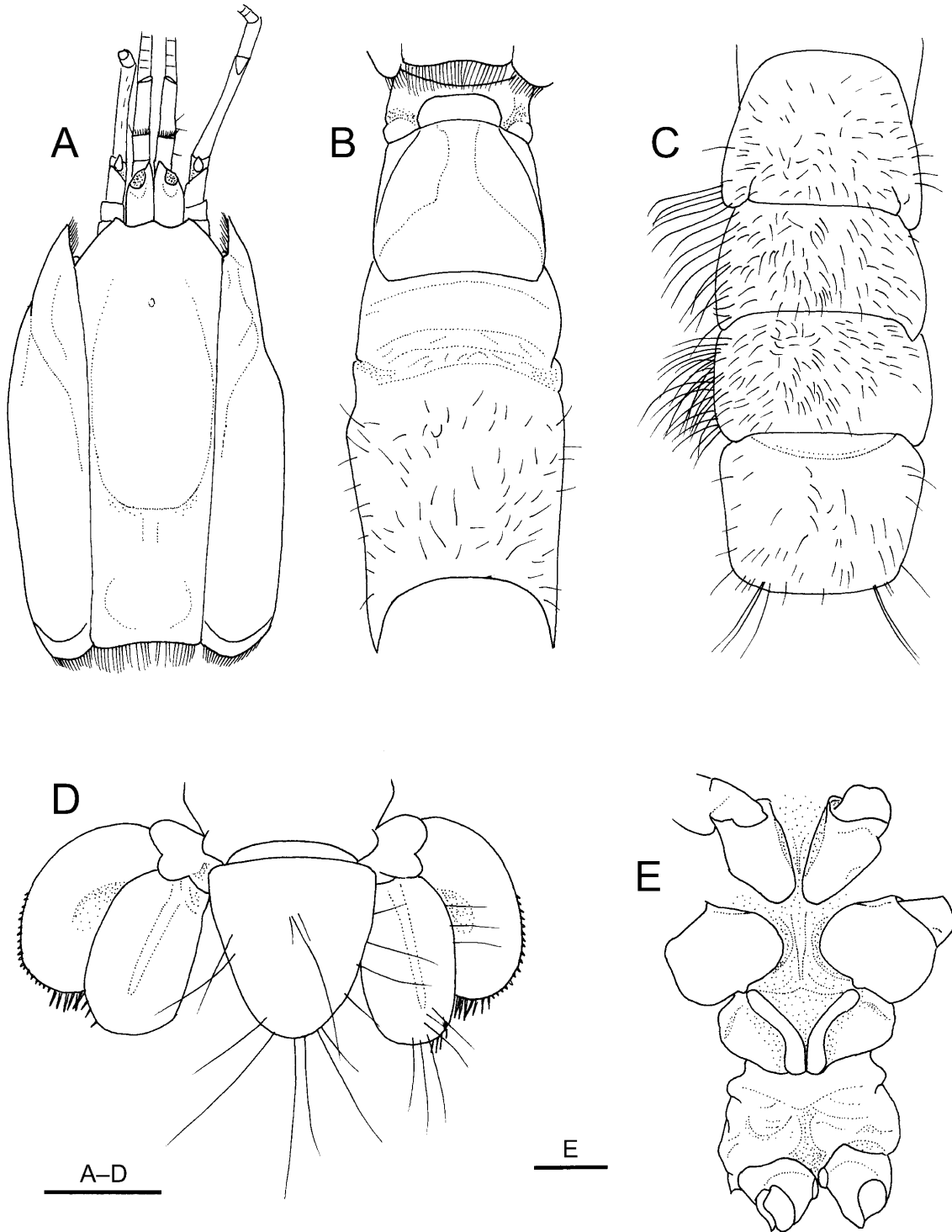


Fig. 2. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. A, carapace and cephalic appendages, dorsal view; B, first and second pleomere, dorsal view; C, third to sixth pleomeres, dorsal view (lateral setae omitted from right side); D, telson and uropods, dorsal view (marginal setae on uropod omitted); E, coxae of third to fifth pereopods and thoracic sternum, ventral view (setae omitted). Scale bars: 2 mm for A–D; 1 mm for E.

about 0.8 times as long as propodus, gradually tapering distally to blunt apex, distinctly narrower than propodus. Arthrobranchs small, fully lamellar.

Right cheliped (Fig. 5A, B) with ischium somewhat widened distally, dorsal margin slightly concave, unarmed, ventral margin concave, with row of 7 denticles increasing in size distally, distalmost 2 spine-like. Merus about 2.0 times as long as wide; dorsal margin gently convex,

with sparse setae; lateral surface slightly convex, with shallow distal concavity accommodating proximal margin of carpus; ventral margin slightly convex, with 1 min denticle at about midlength. Carpus short, about 1.8 times wider than long, unarmed; proximal margin evenly convex. Palm slightly narrowing distally, somewhat compressed laterally, cross section suboval; dorsal margin nearly straight in lateral view, non-carinate, with row of sparse setae; lateral sur-

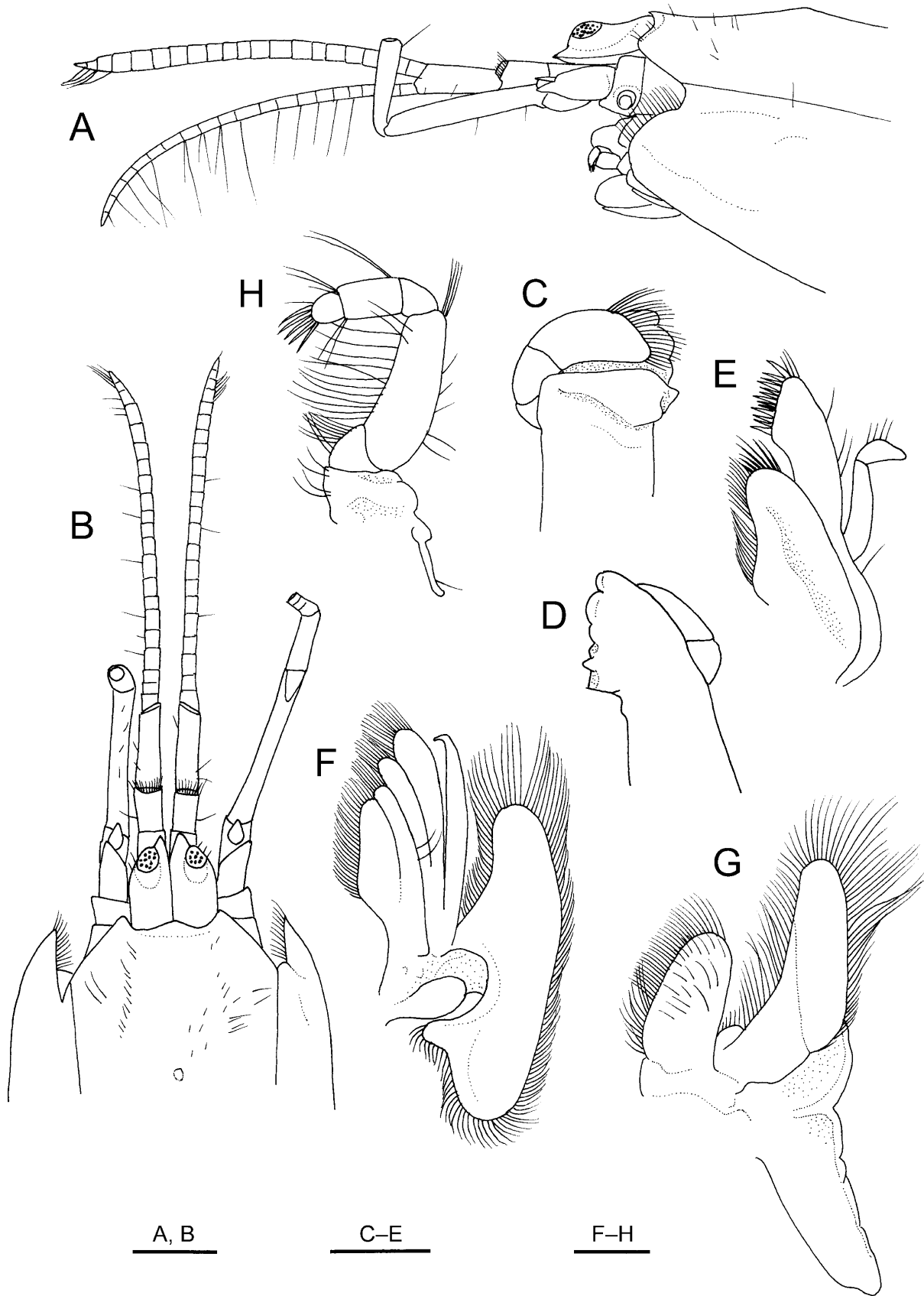


Fig. 3. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. A, anterior part of carapace and cephalic appendages, lateral view; B, same, dorsal view; C, left mandible, inner view; D, same, outer view; E, left maxillule, outer view; F, left maxilla, outer view; G, left first maxilliped, outer view; H, left second maxilliped, outer view. Scale bars: 1 mm for A, B; 0.5 mm for C–H.

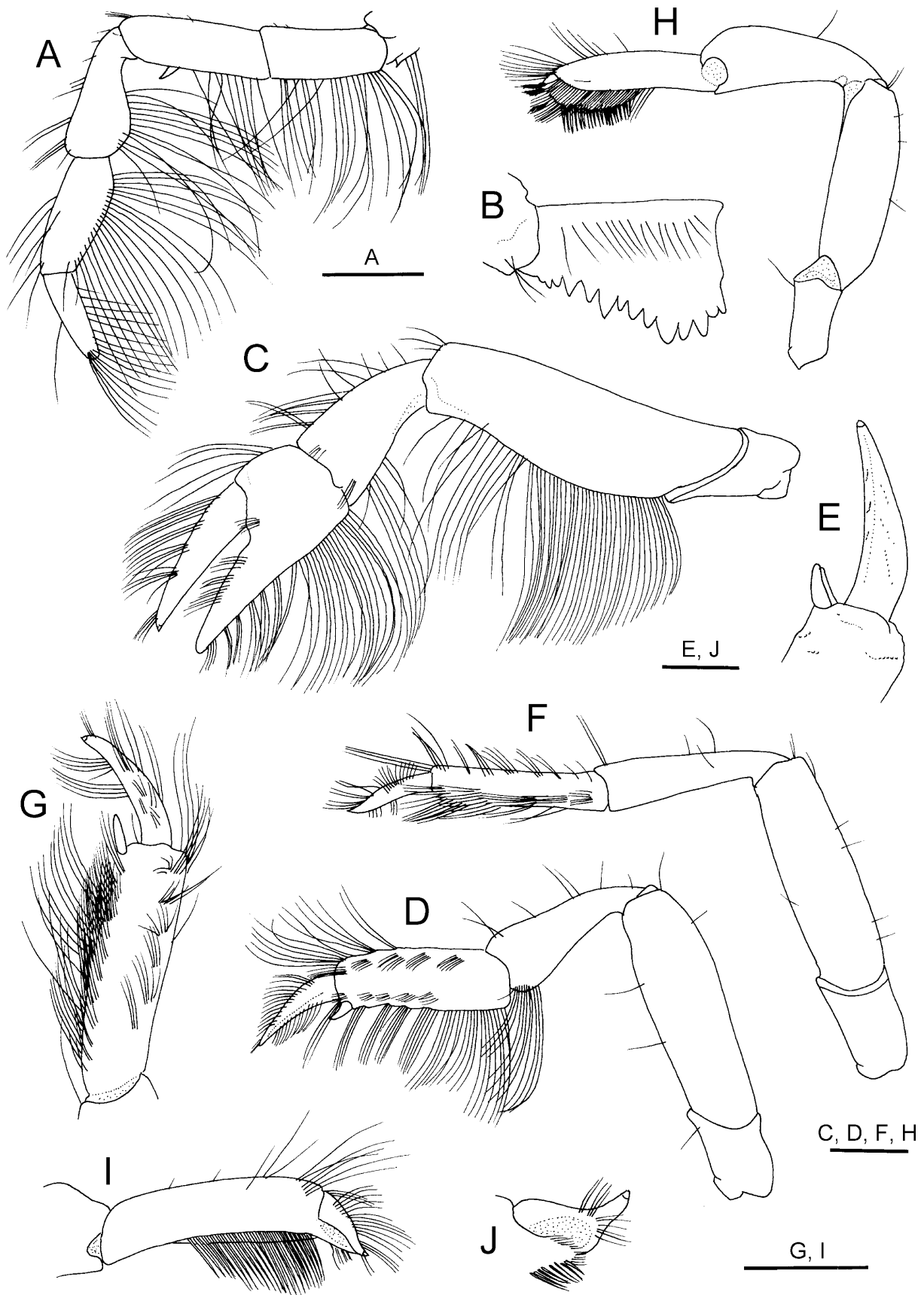


Fig. 4. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. Left thoracic appendages. A, third maxilliped, lateral view; B, ischium of third maxilliped, dorsal (inner) view; C, second pereopod, lateral view; D, third pereopod, lateral view; E, dactylus and distal part of propodus of third pereopod, lateral view (setae omitted); F, fourth pereopod, lateral view; G, dactylus and propodus of fourth pereopod, lateral (perpendicular) view; H, fifth pereopod, outer view; I, dactylus and propodus of fifth pereopod, inner view; J, dactylus and fixed finger of fifth pereopod, showing flexor surface of dactylus. Scale bars: 1 mm for A, C, D, F–I; 0.5 mm for B, I, J.

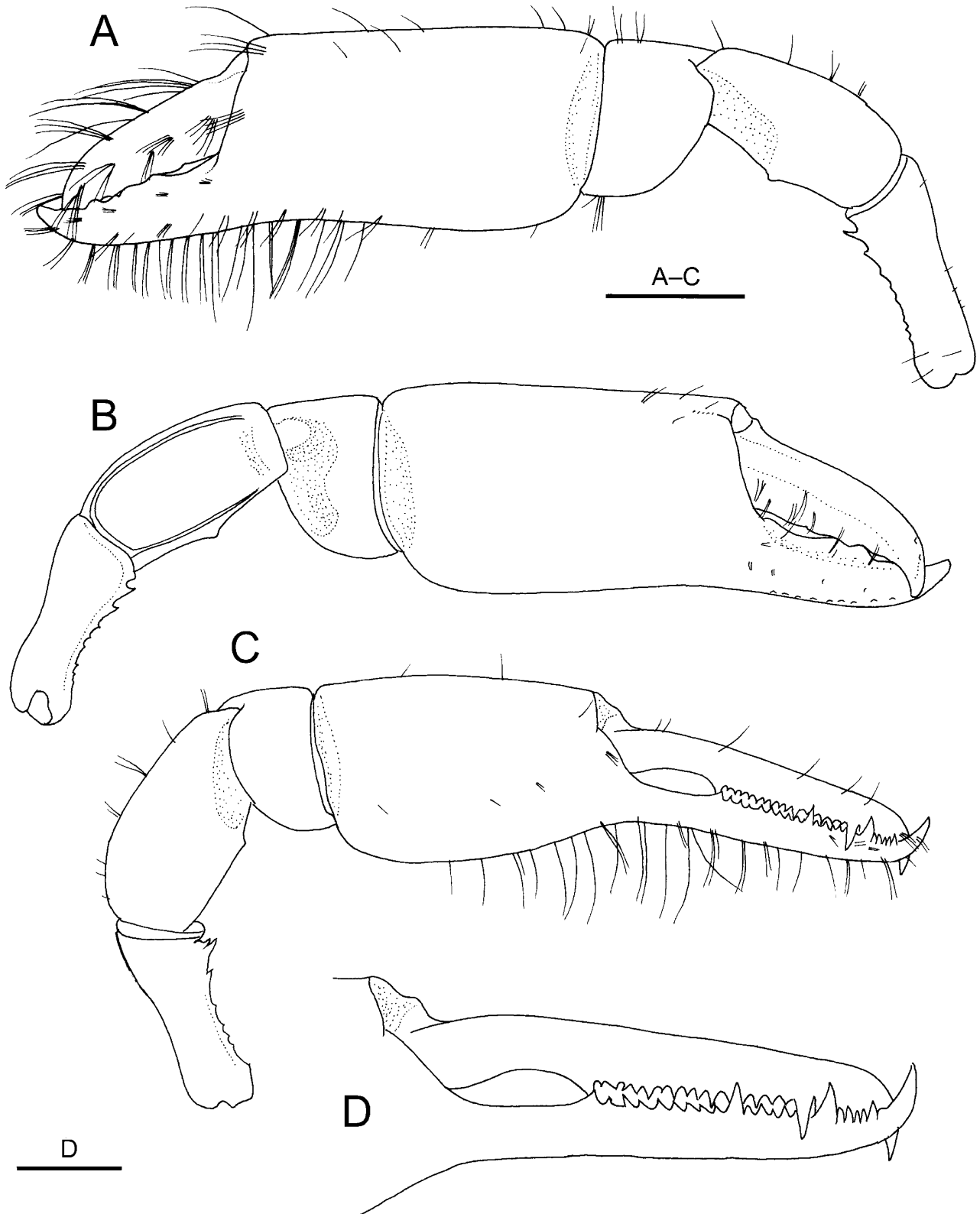


Fig. 5. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. A, left cheliped, lateral view; B, same, mesial view; C, right cheliped, lateral view; D, same, close up of fingers, lateral view. Scale bars: 2 mm for A-C; 1 mm for D.

face smooth, gently convex, glabrous; mesial surface more strongly convex than lateral surface, also glabrous; ventral margin gently convex, with row of sparse setae extending onto fixed finger. Fingers slender, about 1.1 times longer than palm, terminating in strongly curved, acute tips crossing each other; cutting edges of fingers each with comb-like

row consisting of about 20 acute, unequal teeth; on fixed finger, 2 teeth located at distal 0.3 and 0.1 prominent; On dactylus, one tooth located at distal 0.2 prominent.

Left cheliped (Fig. 5C) subequal in length to right cheliped. Ischium slightly widened distally; dorsal margin slightly concave, unarmed; ventral margin concave, with

Table 1. *Ctenochelopsis nomurai* gen. et sp. nov. Gill formula.

	Maxillipeds			Pereopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	0	0	0	0	0	0	0	0
Arthrobranchs	0	0	2	2	2	2	2	0
Podobranchs	0	0	0	0	0	0	0	0
Epipods	1	1	0	0	0	0	0	0
Exopods	1	0	0	0	0	0	0	0

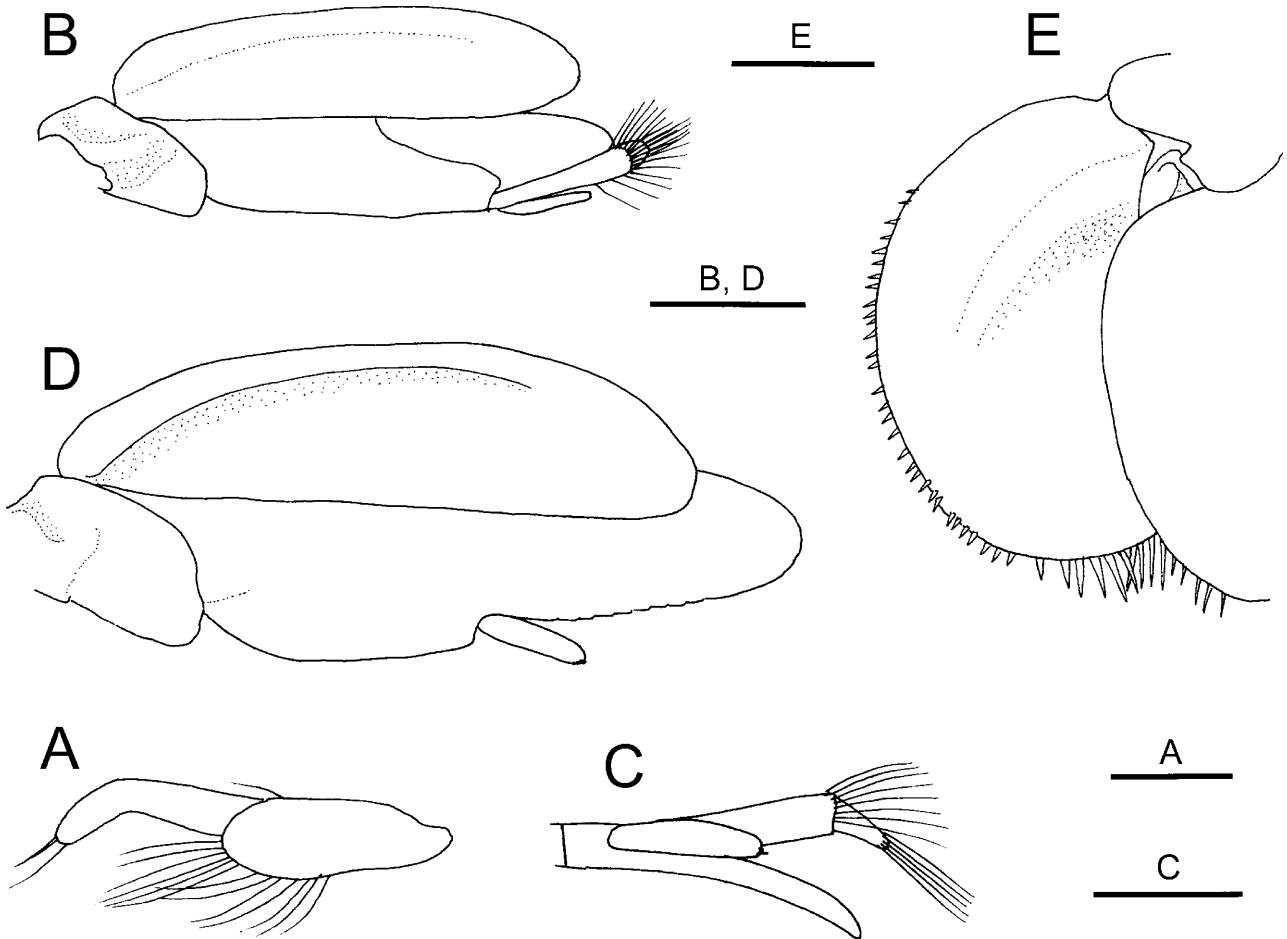


Fig. 6. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250. A, left first pleopod, ventral (posterior) view; B, left second pleopod, dorsal (anterior) view (marginal setae on rami omitted); C, appendices interna and masculina and distal part of endopod of left second pleopod, mesial view; D, left third pleopod, dorsal (anterior) view (marginal setae on rami omitted); E, exopod and lateral half of endopod of left uropod, dorsal (perpendicular) view (setae omitted). Scale bars: 1 mm for B, D, E; 0.5 mm for A, C.

row of minute denticles increasing in size distally, distal-most 2 spine-like. Merus about 2.0 times as long as wide; dorsal margin slightly convex, with sparse setae; lateral surface slightly convex, with shallow distolateral concavity accommodating proximal margin of carpus; ventral margin slightly convex, with 1 min denticle at midlength. Carpus short, about 1.8 times longer than wide, unarmed; proximal margin evenly convex. Palm somewhat compressed laterally, subrectangular in lateral view, about 1.7 times as long as wide; dorsal margin nearly straight, non-carinate, with sparse setae; lateral and mesial surfaces almost glabrous; ventral margin slightly sinuous, non-carinate, with row of tufts of long setae in distal half, extending onto fixed finger.

Fingers (Fig. 5D) crossing at tip when closed, terminating in somewhat curved, subacute tips, with very narrow hiatus proximally; cutting edges each with 3 very low, obtuse teeth; dactylus about 0.7 times as long as palm, with row of tufts of long setae on dorsal margin and on midline of both lateral and mesial surfaces.

Second pereopod (Fig. 4C) moderately stout, strongly compressed laterally. Ischium short, unarmed. Merus about 3.2 times longer than wide; dorsal margin faintly sinuous, almost glabrous; ventral margin sinuous, fringed with numerous long setae. Carpus widened distally, with long setae distally on ventral margin. Chela subtriangular in general outline, about 1.8 times as long as carpus, slightly wider



Fig. 7. *Ctenocheloides nomurai* sp. nov., holotype, male (cl 7.3 mm), CBM-ZC 11250, entire animal in lateral view.

than carpus; palm short, about half as long as carpus, with row of long setae on ventral margin extending onto fixed finger (setae becoming shorter distally on fixed finger); fingers each terminating in minute corneous claw, cutting edges unarmed, with small hiatus proximally when closed; dactylus about 2.3 times as long as palm, with tufts of setae on dorsal margin.

Third pereopod (Fig. 4D) with ischium short, unarmed. Merus about 3.2 times as long as wide. Carpus about 0.6 times as long of merus, widened distally, distoventral margin furnished with tufts of long stiff setae. Propodus subrectangular, about 3.0 times as long as wide, slightly longer than carpus; dorsal margin with tufts of long setae in distal half; lateral surface with rows of tufts of short setae dorsally and ventrally; ventral margin with long setae forming tufts in distal half, and with 2 small spines at distal angle (Fig. 4E). Dactylus about 0.6 times as long as propodus, slightly curving, tapering distally in minute corneous claw, with numerous setae dorsally and ventrally (Fig. 4E).

Fourth pereopod (Fig. 4F) more slender than third. Coxa large, suboval, its mesial margin carinate. Merus about 3.3 times as long as wide. Carpus 0.8 times as long as merus, slightly widened distally, with sparse setae. Propodus subrectangular, about 3.0 times as long as wide, subequal in length to carpus; lateral surface with tufts of setae adjacent to dorsal margin; ventral margin slightly convex, concealed by thick setae, bearing 1 spine (more than 0.1 times as long as dactylus) opposed to dactylus at distal angle (Fig. 4G). Dactylus about half as long as propodus, slightly curved, tapering to minute corneous claw, with setae on margins and surfaces.

Fifth pereopod (Fig. 4H) chelate. Coxa with papilla-like gonopore. Merus about 3.3 times as long as wide. Carpus about 0.7 times as long as merus, widened distally, almost glabrous. Propodus subequal in length to carpus; ventral margin furnished with grooming apparatus consisting of several rows of stiff setae on distal 0.6, extending onto outer surface; fixed finger rounded, reaching to midlength of dac-

tylus (Fig. 4I). Dactylus strongly twisted, subtriangular, rather abruptly tapering to elongate distal part, about 0.4 times as long as propodus, concave proximally on flexor surface to accommodate fixed finger (Fig. 4I, J).

Gill formula summarized in Table 1.

Male first pleopod (Fig. 6A) with protopod elongate subovate in general shape; ramus subequal in length to protopod, curved mesially, bearing 2 apical setae. Male second pleopod (Fig. 6B) smaller than third to fifth pleopods; protopod short, articulation to rami strongly oblique; endopod subequal in length to exopod, but slightly overreaching latter, with oblique suture extending from base of appendices interna and masculina to midlength of lateral margin; appendix interna (Fig. 6C) rod-shaped, arising at distal one-third of endopod; appendix masculina (Fig. 6C) arising at base of appendix interna, distally overreaching endopod, 2-articulated; proximal article slightly widened distally, bearing stiff setae on distal margin, distal article slightly deflexed, about half as long as proximal article, tapering distally to rounded apex, bearing tuft of setae apically. Third to fifth pleopods (cf. Fig. 6D) with exopods and uropods elongate-oval; endopods subequal in length to exopods, but distinctly overreaching latter distally, each with rod-shaped, projecting appendix interna; exopods each with longitudinal ridge on dorsal surface adjacent to lateral margin.

Uropod with short protopod, this with shallow notch on outer margin. Rami ovate, each with low, longitudinal ridge on dorsal surface. Exopod (Fig. 6E) with row of spinules inserted on margin above fringing setal rows, extending from proximal one-third to distomesial margin, distomesial spines much longer than lateral spinules; no notch on lateral margin; dorsal surface with shallow excavation proximomesially. Endopod reaching posterior margin of telson.

Coloration in life. Body and appendages entirely milky white; brown color seen in holotype due to deposition of fine particles probably derived from sediment. See Fig. 7.

Distribution and habitat. Known only from Arita Bay, Kushimoto, Wakayama Prefecture, Japan, at depth of 13 m.

Table 2. Comparison of differentiating characters between *Ctenocheloides nomurai* sp. nov. and *C. attenboroughi* Anker, 2010.

Characters	<i>C. nomurai</i> sp. nov.	<i>C. attenboroughi</i>
Carapace: cervical groove	very shallow, suture-like	deep
Carapace: cardiac prominence	absent	present
Sixth abdominal somite	wider than long, with faint lateral constrictions	as wide as long, with distinct lateral constrictions
Antennal peduncle	overreaching antennular peduncle by 0.3 length of fourth segment	overreaching antennular peduncle by 0.5 length of fifth segment
Mandible: incisor process	with 3 rounded teeth	with 1 triangular tooth
First maxilliped: endopod	rudimentary, showing as rounded lobe	better developed, reaching to midlength of basal endite
Second maxilliped: epipod	better developed, slender, strap-like	rudimentary
Third maxilliped: crista dentata	well developed, with more than 10 narrowly spaced teeth	poorly developed, consisting of 5 widely spaced teeth or denticles
Third maxilliped: merus	unarmed on ventromesial margin	armed with prominent tooth located at midlength and directed mesially
Chelipeds	strongly dissimilar, finger of left shorter than palm, not pectinate	slightly dissimilar, both fingers longer than palm, pectinate
Second pereopod: chela	distinctly wider than carpus	subequal in width to carpus
Fifth pereopod	chelate, propodus without ventrodiscal spine	non-chelate, propodus with ventrodiscal spine

The two specimens were found under a rock on a sandy mud substrate, suggesting that the new species is a burrower as in other callianassoid species.

Remarks. As mentioned above, one of the diagnostic characters of the new species is the pectinate fingers of the right cheliped, suggesting a possible relationship to *Ctenocheles* and *Ctenocheloides*. In the lack of a rostral spine and a rostral carina and the absence of a lateral incision of the uropodal exopod, the new species is assignable to *Ctenocheloides*. In species of *Ctenocheles*, the rostrum is spike-like, with a dorsal carina extending onto the anterior part of the carapace; and the uropodal exopod bears a distinct lateral incision (cf. Kishinouye 1926; Ward 1945; Powell 1949; Le Loeff and Intes 1974; Rodriguez 1978; Rabalais 1979; Manning and Felder 1991; Matsuzawa and Hayashi 1997; Sakai 1999).

Differentiating characters between *Ctenocheloides nomurai* sp. nov. and *C. attenboroughi* are summarized in Table 2. Major differences, requiring an emendation of the original generic diagnosis, involve the degree of development of the cervical groove of the carapace, the presence or absence of a cardiac prominence on the carapace, the degree of development of the crista dentata of the third maxilliped, the degree of cheliped asymmetry, and the structure of the fifth pereopod.

Anker (2010: 1802, table 1) indicated that there are two arthrobranchs on the fifth pereopod in *Ctenocheloides attenboroughi*, but there are no arthrobranchs there in *Ctenocheloides nomurai* sp. nov., nor in other callianassoid taxa (e.g., Poore 1994). Reexamination of the gill formula of *Ctenocheloides attenboroughi* is necessary to confirm the presence of arthrobranchs on the fifth pereopod.

Etymology. It is my pleasure to dedicate this interesting new species to Mr Keiichi Nomura, recognizing his contributions to decapod taxonomy and his collecting efforts.

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Addendum

After the manuscript of this article was accepted for publication, an article describing a new species of *Ctenocheloides* has been published by Anker and Pachelles (2013). *Ctenocheloides almeidai* Anker and Pachelles, 2013, described from Brazil, differs from *C. nomurai* sp. nov. in the presence of a cardiac prominence on the carapace, the clearly delimited cervical groove on the carapace, and the possession of a row of acute teeth on the cutting edge of fingers of the non-pectinate side of cheliped. Thus, *Ctenocheloides nomurai* sp. nov. is the third species representing the genus.