Syncrangon, a New Crangonid Genus, with Redescriptions of S. angusticauda (De Haan) and S. dentata (Balss) (Crustacea, Decapoda, Caridea) from East Asian Waters

Authors: Kim, Jung Nyun, and Hayashi, Ken-Ichi

Source: Zoological Science, 20(5) : 669-682

Published By: Zoological Society of Japan

URL: https://doi.org/10.2108/zsj.20.669

ZOOLOGICAL SCIENCE **20**: 669–682 (2003)

Syncrangon, a New Crangonid Genus, with Redescriptions of *S. angusticauda* (De Haan) and *S. dentata* (Balss) (Crustacea, Decapoda, Caridea) from East Asian Waters

Jung Nyun Kim[1]* and Ken-Ichi Hayashi[2]

[1]*Institute of Fisheries Sciences, Pukyong National University, Pusan 612-021, Korea*
[2]*Department of Applied Aquabiology, National Fisheries University, 2-7-1 Nagata-honmachi, Shimonoseki 759-6595, Japan*

ABSTRACT—A new genus of the crangonid shrimps, *Syncrangon*, is proposed for *Crangon angusticauda* De Haan, 1849 and *C.* (*Sclerocrangon*) *angusticauda* var. *dentata* Balss, 1914, both from East Asian waters. The new genus is readily distinguished from all known genera of the Crangonidae by the flattened middorsal carina and the deep groove on each lateral side of the middorsal carina on the third to sixth abdominal somites. *Syncrangon angusticauda* new combination has previously been assigned to the genus *Metacrangon*, while *S. dentata* new combination has not been reported since the original description. These two species are easily distinguished from each other by many characters, especially the rostral and abdominal features. They are redescribed and illustrated in detail.

Key words: Crustacea, Caridea, Crangonidae, new genus, East Asia

INTRODUCTION

The family Crangonidae, which is characterized by the subchlate first pereopod and the filiform third pereopod, is now recognized to contain about 160 species belonging to 20 genera (Holthuis, 1993). Ten years ago, the Crangonidae was one of the most poorly taxonomically progressed groups in the infraorder Caridea (Holthuis, 1993; Komai, 1994). Although several taxa were recently improved (Chan, 1996; Wicksten, 1996; Komai, 1996, 1997a, b; Hayashi and Kim, 1999; Kim and Komai, 2002), the taxonomic status of many taxa in the Crangonidae is incompletely known yet. One of the problematical species is *Metacrangon angusticauda* (De Haan, 1849). This species was originally described as *Crangon angusticauda* in "Fauna Japonica." Since then, it was often reported as *Sclerocrangon angusticauda* from the coastal waters of Japanese temperate region, especially seagrass beds and rocky or sandy shore (e.g., Ortmann, 1890; De Man, 1907; Parisi, 1919; Yokoya, 1933; Miyake, 1961; Miyake *et al*., 1962; Kikuchi, 1962, 1966, 1968; Harada, 1968; Fujino, 1978; Matsumiya *et al*., 1978; Sekiguchi, 1982; Imanaka *et al*., 1984). Zarenkov (1965), who divided the genera *Crangon* Fabricius, 1798 s.l. and *Sclerocrangon* G. O. Sars, 1883 s.l. into five genera, *Crangon* s.s., *Mesocrangon* Zarenkov, 1965, *Metacrangon* Zarenkov, 1965, *Rhynocrangon*, Zarenkov, 1965, *Sclerocrangon* s.s., placed this species in the genus *Metacrangon*. Recent authors have followed his classification (e.g., Miyake, 1982, 1991, 1998; Ito and Watanabe, 1992; Komai *et al*., 1992; Komai, 1994, 1999; Minemizu, 2000). In spite of many publications about the faunal study, the generic position of *M. angusticauda* is unsettlsed (Komai, 1994), and no detailed description of this species has been published. Another taxon, *Crangon* (*Sclerocrangon*) *angusticauda* var. *dentata* Balss, 1914 was described by Balss (1914) from off Zushi [original spelled as "Dzushi"] and Negishi, Yokohama, Pacific coast of central Japan, at depths of 45–130 m. It, however, has not been reported since the original description. The taxonomic status of this taxon remained unclear. Material from the Pacific coast of central Japan and the southern part of the Sea of Japan has enabled us to diagnose it as a distinct species.

Close examination of many specimens of these two species collected from various East Asian localities reveals that there is no precise genus, to which they can be referred. The present study, therefore, proposes a new genus *Syncrangon* for these two species. *Syncrangon* is more closely related to *Sclerocrangon* than to *Metacrangon* and also has characteristic features, which warrants its separation at the generic level. *Syncrangon angusticauda* and *S. dentata*, are readily distinguishable from each other in a number of differences such as the rostral features, the

* Corresponding author: Tel. +82-51-620-6097;
FAX. +82-51-741-4228.
E-mail: jnkim@mail1.pknu.ac.kr

armament of the carapace and abdomen, the relative length of the telson, the scaphocerite and the dactylus of fifth pereopod, and the vertical distribution.

Specimens examined in the present study are deposited in the Kitakyushu Museum and Institute of Natural History (KMNH) with a code of IvR, National Fisheries University, Shimonoseki (NFU), Showa Memorial Institute, National Science Museum, Tokyo (NSMT) with a code of Cr R, and the Laboratory of Invertebrate Zoology, Department of Marine Biology, Pukyong National University, Pusan (PUIZ). Specimens formerly belonging to the Zoological Laboratory of Kyushu University, Fukuoka (ZLKU) are now deposited in KMNH. The postorbital carapace length (CL), which was measured from posterior margin of the orbit to the posterior middorsal margin of the carapace, is used as an indication of the size of the specimens.

SYSTEMATICS

Family Crangonidae Haworth, 1825

Syncrangon new genus

Diagnosis. – Body small, rather robust; integument moderately firm and sculptured. Rostrum short, reaching to or slightly beyond distal margin of cornea, directed forward, depressed, with acute or subacute apex; ventral plane moderately deep; lateral margin unarmed. Carapace with gastric region not depressed below general level of carapace; middorsal carina with 2 prominent spines; submedian gastric region without spine or longitudinal carina; cardiac region with 2 transverse grooves; postorbital carina distinct but unarmed; hepatic spine strong, supported by short or long carina; branchiostegal spine strong, nearly straight; pterygostomian spine much smaller than antennal spine; orbital cleft moderately deep; longitudinal suture extending posteriorly from just superior to antennal spine; hepatic groove distinct. Third to sixth abdominal somites with flattened middorsal carina accompanied by deep groove on either lateral side, that of sixth somite notched posteriorly; pleura of first to fifth somites rounded or bluntly produced ventrally, without any spine or tooth marginally; sixth somite with posteroventral angles nearly parallel, not flared laterally in dorsal view. Telson tapering to acute tip, with submedian carinae and median groove, bearing 3 pairs of small dorsolateral spines. First to fifth abdominal sternites with median spines, at least in males and non-spawning females. Eye with cornea well developed, eyestalk with rounded dorsal tubercle. Proximal antennular segment with acute spine on longitudinal carina on ventral surface. Stylocerite broad, rather square. Scaphocerite broad, 1.69–2.68 times as long as width, with well developed blade; lateral margin straight or slightly convex. Palm of first pereopod with distomesial spine ('thumb') articulated at base; merus with dorsodistal tooth but without distolateral tooth, mesial margin with obtuse tooth. Second pereopod chelate, reaching about anterior 1/3 of palm of first pereopod. Fourth and fifth pereopods with dactylus subspatulate, propodus with or without small spines. Pleurobranchs of fourth to eighth thoracic somites inclined anteriorly. Endopod of second to fourth pleopods divided into 2 segments, but that of fifth pereopod small and not segmented in females; all endopods small, not segmented in males, without appendix interna in both sexes; in males second pleopod with appendix masculina well developed, endopod vestigial.

Branchial formula as follows (r: rudimentary):

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

Type species. – *Crangon angusticauda* De Haan, 1849 by the present designation.

Species included. – *Syncrangon angusticauda* (De Haan, 1849) new combination and *Syncrangon dentata* (Balss, 1914) new combination.

Distribution. – Sea of Japan from Tsugaru Strait to Yuya Bay, northeastern coast of East China Sea (Jeju Island and Amakusa Islands), Pacific coast of Japan from Inubozaki to Kii Peninsula, and Seto Inland Sea; intertidal to 130 m.

Etymology. – The genus name is derived from the Greek prefix *syn-* (together) plus the generic name *Crangon*, referring to the taxonomic relation to the genus *Crangon* and related genera. Gender is feminine.

Remarks. – *Syncrangon* is unique in the Crangonidae in the third to sixth abdominal somites with a flattened middorsal carina accompanied by a deep groove on either lateral side.

Although the species of the new genus previously assigned to *Sclerocrangon* or *Metacrangon*, *Syncrangon* is more closely related to *Sclerocrangon* than to *Metacrangon* in having the non-depressed gastric region on the carapace, in the lack of the submedian spines of the carapace, and in the vestigial endopod of the second pleopod being much shorter than the appendix masculina in males. However, in addition to the abdominal grooves, the new genus is further distinguished from the latter two genera by having the following features: the possession of two transverse grooves on the cardiac region of the carapace, the lack of the lateral carina of the sixth abdominal somite, the non-flared posteroventral angle of the sixth abdominal somite, the movable distomesial spine ('thumb') of the palm of first pereopod, and the mesial spine on the merus of first pereopod. The movable distomesial spine ('thumb') of the palm of first pereopod is an unique character in the genus *Crangon* and related genera (*Argis* Krøyer, 1842, *Sclerocrango*n, *Notocrangon* Coutière, 1900, *Neocrangon* Zarenkov, 1965, *Mesocrangon*, *Metacrangon*, *Rhynocrangon*). This character is shown in

Paracrangon Dana, 1852 and some species of *Philocheras* Stebbing, 1900.

Comparison of the fecundity also supports that *Syncrangon* differs from both *Sclerocrangon* and *Metacrangon*. The egg size and number of the genus *Crangon* and related genera, including *Sclerocrangon* and *Metacrangon*, are summarized by Zarenkov (1965). In *Syncrangon* the eggs are 0.46–0.56×0.34–0.38 mm in diameter and about 600 in number. These are smaller and much more than those of *Metacrangon* (1.75–2.50×1.50–2.20 mm in diameter; less than 50 in number) and are much smaller than those of *Sclerocrangon* (2.15–5.00×2.00–4.85 mm in diameter; about 52–1735 in number). The egg size and number in *Syncrangon* are similar to those of *Crangon* (see Zarenkov, 1965; Komai, 1994).

A recent key to the genera of the family Crangonidae has been provided by Holthuis (1993). To include *Syncrangon* his key may be readily augmented as follows:

14. Endopod of second male pleopod with the appendix masculina shorter than the blade ..... *Rhynocrangon*
– Blade of endopod of second male pleopod strongly reduced, much shorter than appendix masculina... 14a
14a. Carapace without transverse groove on cardiac region. Sixth abdominal somite with sharp or obtuse submedian carinae and its lateral sides not grooved..... ..... *Sclerocrangon*
– Carapace with two transverse grooves on cardiac region. Sixth abdominal somite with flattened middorsal carina and its lateral sides grooved..... *Syncrangon*

Syncrangon angusticauda (De Haan, 1849) new combination (Figs. 1–3)

Crangon angusticauda De Haan, 1849: 189, pl. 45, fig. 15 [type locality: Japan]; Stimpson, 1860: 25; Herklots, 1861: 147 (list); Nakazawa, 1927: 1028, fig. 1978.

Cheraphilus angusticauda – Kinahan, 1862: 57 (list).

Sclerocrangon angusticauda – Ortmann, 1890: 533; De Man, 1907: 408; 1920: 251 (list); Parisi, 1919: 90, pl. 6, fig. 6; Yokoya, 1933: 40; Miyake, 1961: 9; Miyake *et al*., 1962: 124; Kubo, 1965: 624, fig. 1809; Kikuchi, 1962: 140; 1966: table 7; 1968: 180; Harada, 1968: 82; Fujino, 1978: 25; Matsumiya *et al*., 1978: 28; Sekiguchi, 1982: 25; Imanaka *et al*., 1984: 52.

Crangon (*Sclerocrangon*) *angusticauda* – Ortmann, 1895: 179; Balss, 1914: 65.

Metacrangon angusticauda – Zarenkov, 1965: 1765 (list); Miyake, 1982: 71, 189 (list); 1991: 189 (list); 1998: 188 (list); Ito and Watanabe, 1992: 107; Komai *et al*., 1992: 195 (list); Komai, 1994: 97; 1999: 59; Minemizu, 2000: 114, 2 unnumbered figs.

Mesocrangon sp. – Kojima and Hanabuchi, 1981: 45.

Material Examined. – **Pacific coast of central Japan.** Off Amatsukominato, Boso Peninsula, 13 Apr. 1941, coll. Ocean Research Institute, University of Tokyo, 1 ♂ (3.4 mm), 1 ♀ (4.2 mm), 9 ovig. ♀ (5.6–6.4 mm), NFU 530-2-2286. –Tokyo Bay, 35°20.0′N, 139°40.5′E, 25 m, beam trawl, 19 July 1993, coll. J. Ueda, 1 ovig. ♀ (6.2 mm), NFU 530-2-2287. –Hayama, Sagami Bay, 8 Feb. 1962, 1 ovig. ♀ (5.9 mm), NSMT-Cr R: 1992. –Kurosaki, Sagami Bay, rocky shore, 18 Mar. 1964, 1 ♂ (4.0 mm), NSMT-Cr R: 2225. –Nachikatsuura, Kii Peninsula, *Zostera* bed, 23 Dec. 1982, coll. K. Nomura, 1 ♀ (4.9 mm), NFU 530-2-2288.

Seto Inland Sea. Bisan Strait and Harimanada Sea, 20–40 m, small trawl, Jan. 1989, coll. K. Yokoyama, 1 ♀ (6.8 mm), 1 ovig. ♀ (6.1 mm), NFU 530-2-2289. –Mashima Island, off Hirao, Suounada Sea, tide pool, hand net, 31 July 1997, coll. T. Hamano, 1 ♂ (2.4 mm), NFU 530-2-2290. –Off Ohzai, Beppu Bay, shrimp trawl, 24–25 May 1978, 1 ♂ (3.8 mm), NFU 530-2-2291. –Beppu Bay, date unknown, coll. K. Ogawa, 1 ovig. ♀ (6.0 mm), NFU 530-2-2292.

Northeastern coast of East China Sea. Hamduck, Northeast of Jeju Island, 10 m, *Zostera* bed, beam trawl, 10 June 1994, coll. J. N. Kim, 1 ♀ (4.5 mm), PUIZ 77. –Tomioka Bay, Amakusa Islands, *Zostera* bed, 24 Apr. 1959, coll. T. Kikuchi, 6 ♂ (2.2–4.0 mm), 1 ♀ (6.7 mm), 4 ovig. ♀ (6.8–7.0 mm), ZLKU 2108–2118. –Tomioka Bay, Amakusa Islands, 19 July 1959, 1 ♂ (3.3 mm), 1 ♀ (5.0 mm), KMNH IvR 000,018. –Amakusa Islands, 27 May 1967, 1 ♂ (3.9 mm), 4 ♀ (4.0–6.2 mm), 10 ovig. ♀ (5.0–6.4 mm), KMNH IvR 000,019.

Sea of Japan. Toyama Bay, *Gelidium amansii* bed, 22 July 1977, coll. N. Horii, 1 ♂ (2.0 mm), NFU 530-2-2293. –Yuya Bay, 10–30 m, beam trawl, coll. K. Kojima, referred to *Mesocrangon* sp. by Kojima and Hanabuchi (1981); 13 Dec. 1976, 1 ♀ (5.9 mm); 3 Feb. 1977, 1 ♀ (6.8 mm); 15 Mar. 1977, 1 ovig. ♀ (7.6 mm); 20 Aug. 1977, 1 ♀ (2.6 mm); 27 Feb. 1989, 1 ♀ (6.2 mm), 1 ovig. ♀ (6.9 mm); date unknown, 1 juv. (1.7 mm), NFU 530-2-2294.

Type material. – No longer extant (Yamaguchi, 1993).

Diagnosis. – Rostrum 0.20–0.33 times as long as carapace, triangular, rounded or subacute distally. Carapace slightly longer than wide; middorsal carina moderately high; carina continued from hepatic spine short and oblique. First and second abdominal somites without middorsal carina; third to fifth somites with low flattened middorsal carina, that of fifth somite smooth, not produced posteriorly; pleura of first to fifth somites rounded ventrally. Telson 0.72–0.84 times as long as carapace in females. Scaphocerite 0.45–0.56 times as long as carapace in females, 0.63–0.71 times in males. Fifth pereopod with carpus as long as or longer than dactylus.

Description of females. – Body (Fig. 1) stout, depressed dorsoventrally. Integument moderately firm, sculptured, covered with pubescence and sparse long plumose setae.

Rostrum (Figs. 1 and 2*a*) short, reaching or falling slightly short of distal end of cornea, 0.20–0.33 times as long as carapace, triangular, rounded distally in large specimens, subacute in small specimens, directed forward; dorsal surface concave, with somewhat raised lateral margins; ventral carina obtuse, moderately deep, distal margin

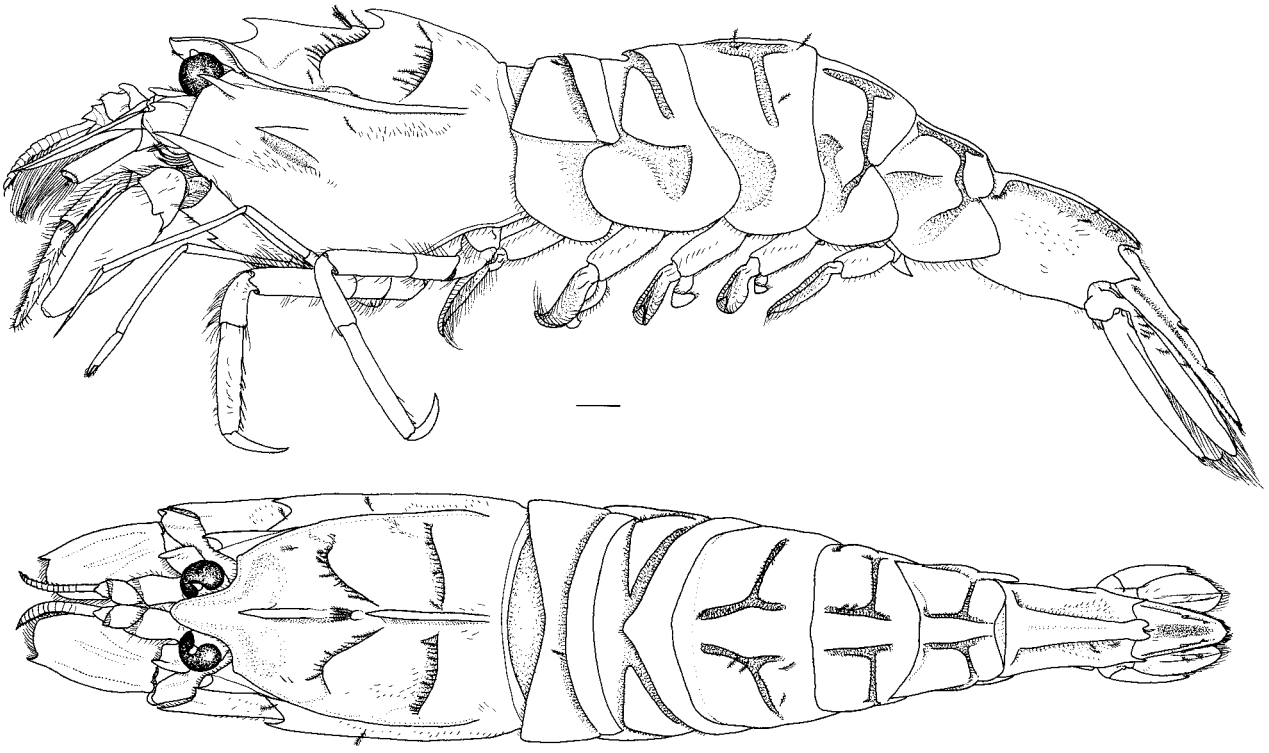

Fig. 1. *Syncrangon angusticauda* (De Haan, 1849). Female (CL 5.9 mm; NFU 530-2-2294) from Yuya Bay. Entire animal in lateral view (top) and dorsal view (bottom). Scale 1 mm.

oblique in lateral view. Carapace (Figs. 1 and 2*a*) slightly longer than wide; gastric region not depressed below general level of carapace; middorsal carina moderately high, extending from just posterior of rostral base to nearly posterior margin of carapace, armed with 2 prominent anteriorly curved spines and median small tubercle, anterior spine somewhat smaller than posterior spine, arising from just behind level of posterior orbital margin, posterior spine arising from about 1/2 of carapace, median tubercle situated in front of posterior spine, with several long plumose setae anteriorly; antennal spine moderately strong, slightly ascending, reaching level of anterior 1/3 of rostrum, accompanied by shallow furrow inferiorly; branchiostegal spine strong, directed forward, reaching tip of rostrum, supported by sharp carina extending to anterior 1/5 of carapace; pterygostomian spine weak; hepatic spine strong, reaching level of base of anterior middorsal spine, supported by oblique short carina, followed by hepatic groove along inferior part of its base; orbital notch deep; 2 transverse grooves between middorsal carina and postorbital carina on cardiac region, bearing setae on posterior margin, anterior groove (cervical groove) curved anteriorly, extending from base of posterior middorsal spine to nearly 1/2 of postorbital carina, posterior groove slightly curved posteriorly, extending from posterior 1/4 of middorsal carina to posterior 1/4 of postorbital carina; postorbital carina continued from rostral lateral margin and slightly curved downward just behind antennal spine, and extending nearly to posterior end of middorsal carina; longitudinal suture originating from anterior margin of carapace just superior to antennal spine, extending backwards along postorbital carina to almost 1/2 of carapace.

Four posterior thoracic sternites each with high median ridge, especially that on fifth somite with acute process anteriorly, diminishing in size posteriorly in non-spawning specimens; these ridges except for that on fifth somite vanished in spawning specimens.

Abdomen (Fig. 1) having first and second somites without middorsal carina; third to sixth somites furnished each with flattened middorsal carina, those of third to fifth somites low, that of third somite convex laterally, those of fourth and sixth somites narrowed posteriorly, that of sixth somite high, faintly grooved at anterior 2/3 medially and notched posteriorly; each carina with marginal setae. Tergum of first somite with transverse groove medially, parallel with posterior margin; that of second somite with X-shaped transverse groove in dorsal view, junction of transverse grooves (X-shaped groove) produced anteriorly into blunt protuberance in lateral view; those of third to fifth somites with T-shaped deep grooves on each lateral side of middorsal carina. Lateral margin of first somite with longitudinal carina throughout its length; that of second somite with longitudinal broad groove continued from anterior transverse groove on tergum; those of third and fourth somites concave anteriorly, that of fourth somite with short transverse groove posteriorly continued from T-shaped groove on tergum; that of fifth with 2 oblique grooves, inferior groove continued from T-shaped groove on

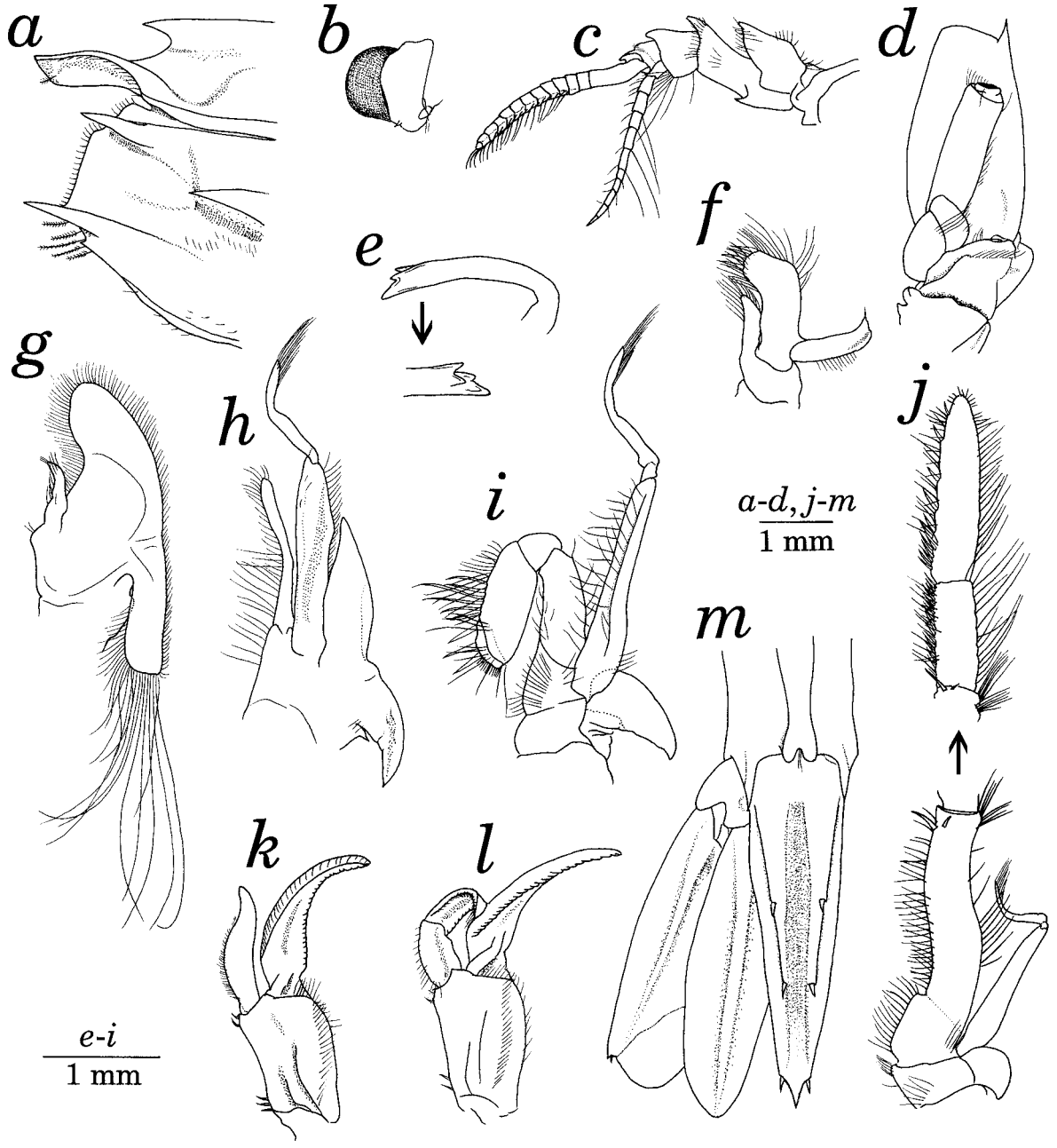

Fig. 2. *Syncrangon angusticauda* (De Haan, 1849). Female (CL 5.9 mm; NFU 530-2-2294) from Yuya Bay. Appendages dissected from left side. *a*, anterior part of carapace, lateral; *b*, eye, ventral; *c*, antennule, lateral; *d*, antenna, ventral; *e*, mandible, external and internal; *f*, maxillule, external; *g*, maxilla, external; *h*, first maxilliped, external; *i*, second maxilliped, external; *j*, third maxilliped, flexor; *k*, first pleopod, ventral, exopodal setae omitted; *l*, second pleopod, ventral, exopodal setae omitted; *m*, telson and uropod, dorsal.

tergum. Pleura of first to fifth somites rounded ventrally. Sixth somite 0.49–0.58 times as long as carapace, 1.56–1.88 times as long as proximal depth, provided with anterior transverse short groove followed by longitudinal deep groove under middorsal carina; posterolateral process strong, sharply pointed; posteroventral corner sharply pointed. Telson (Fig. 2*m*) 0.72–0.84 times as long as carapace, tapering into acute tip, with paired submedian carinae and deep median groove; 2 pairs of dorsolateral spines on submedian carinae, anterior pair situated at about anterior 2/5, posterior pair at about 1/2 between anterior pair and posterior end of telson; posterolateral corner with small spine on each side of acute tip.

Anterior five abdominal sternites in non-spawning specimens each with sharp median process, those processes directed anteriorly on first and second sternites, directed ventrally on third and fourth sternites, directed posteriorly on fifth sternite; those processes except that of fifth sternite reduced to tubercles in spawning specimens; acute preanal spine present.

Eye (Fig. 2*b*) with cornea well developed, as long as eyestalk; eyestalk somewhat inflated basally, provided with rounded dorsal tubercle and minute ventral spine.

Antennule (Fig. 2*c*) with peduncle falling slightly short of 1/2 of scaphocerite; distal segment with rather acute process dorsally, proximal 2 segments with blunt protuberance at distolateral angle; proximal segment almost twice as long as distal 2 segments combined, with acute spine on ventral margin. Stylocerite broad, rather square, reaching anterior 1/3 of proximal segment; lateral margin nearly straight, terminating in blunt projection anteriorly. Outer flagellum reaching beyond scaphocerite by at least distal 1/3, composed of 7–15 articles, increasing with growth, bearing aesthetascs ventrally. Inner flagellum with setae on each article, almost as long as and more slender than outer one.

Antenna (Fig. 2*d*) with scaphocerite moderately stout, 0.45–0.56 times as long as carapace, 1.69–2.27 times as long as width, lateral margin slightly convex; distolateral spine straight, slightly exceeding distal margin of rounded blade. Basicerite with blunt ventrolateral process; carpocerite reaching level of distal 1/4 of scaphocerite.

Mouthparts similar to other crangonids. Mandible (Fig. 2*e*) armed with 4 teeth distally, ventral tooth stronger than other 3 teeth. Maxillule (Fig. 2*f*) with proximal endite slightly tapered; distal endite strongly curved inward, distal margin rather rounded, with 7 strong spines; palp moderately curved upward, with stout seta apically, distoventral margin concave. Maxilla (Fig. 2*g*) with endite reduced; endopod slender, curved inward; scaphognathite broad, anterior lobe slightly curved inward, posterior lobe somewhat elongated, posterior margin fringed with long setae. First maxilliped (Fig. 2*h*) with endopod elongate, overreaching anterior margin of epipod; exopod with peduncle longer than endopod, caridean lobe narrow, with well developed lash; epipod moderately large, triangularly elongated, posterior lobe falcate. Second maxilliped (Fig. 2*i*) with endopod pediform, dactylus with 3 spines on mesial margin and assemblage of short setae distally, propodus with several spines and scattered setae on mesial margin; exopod with well developed lash; epipod well developed, wing-like shape. Third maxilliped (Fig. 2*j*) rather depressed dorsoventrally, exceeding distal end of scaphocerite by 1/2 of ultimate segment; distal 2 segments with serial stout setae on mesial margin; ultimate segment longer than penultimate segment, about 4.5 times as long as width; penultimate segment about 2.5 times as long as width; antepenultimate segment shorter than distal 2 segments combined, armed with 2 small subdistal spines on ventral surface; exopod with well developed lash; coxal lateral process (epipod) small, rounded laterally.

First pereopod (Fig. 3*a*, *b*) stout, reaching beyond distal end of scaphocerite by 1/2 of palm; chela (Fig. 3*b*) with palm 2.28–2.85 times as long as width, cutting edge strongly oblique and feebly convex; distomesial spine ('thumb') strong, articulated at base; carpus short, armed with strong lateral spine distoventrally and distolateral blunt process; merus with rather weak spine on dorsodistal margin and moderately strong spine on middle of mesial margin. Second pereopod (Fig. 3*c*, *d*) chelate, slender, reaching distal end of scaphocerite; chela (Fig. 3*d*) with dactylus about 0.35 times as long as palm, fingers with numerous minute spinules on anterior 1/2 of both cutting edges; carpus 1.71–2.09 times as long as chela; coxa with wing-like process laterally. Third pereopod (Fig. 3*e*, *f*) slender, overreaching distal end of scaphocerite by dactylus; dactylus (Fig. 3*f*) short, 0.40–0.64 times as long as propodus, tapering distally, bearing fine setae distally; carpus 1.22–2.13 times as long as distal 2 segments combined. Fourth pereopod (Fig. 3*g*, *h*) stouter than third pereopod, reaching distal end of scaphocerite, strongly setose; dactylus (Fig. 3*h*) slightly compressed laterally, subspatulate, apex terminating in corneous spine inserted on dorsal lobule; propodus 1.53–1.90 times as long as dactylus, ventral margin with 4–8 serial stout setae; carpus 0.81–1.00 times as long as dactylus. Fifth pereopod (Fig. 3*i*, *j*) similar but less setose than fourth pereopod, falling slightly short of distal end of scaphocerite; propodus 1.56–2.00 times as long as dactylus, ventral margin with 3–7 serial stout setae; carpus 1.00–1.23 times as long as dactylus.

Five pleurobranchs present on fourth to eighth thoracic somites, inclined anteriorly.

First pleopod (Fig. 2*k*) with endopod not segmented, reaching about 1/2 of exopod; mesial margin with fine setae. Second pleopod (Fig. 2*l*) with endopod reaching about 1/2 of exopod, 2-segmented, distal segment with marginal setae, proximal segment with rather long setae on mesial margin. Endopods of third and fourth pleopods similar to that of second, diminishing in size posteriorly; that of fifth pleopod vestigial, not segmented.

Uropod (Fig. 2*m*) with endopod reaching tip of telson; exopod falling slightly short of tip of telson, with small spine just mesial to acute posterolateral spine, transverse suture distinct.

Eggs small, globular, 0.46–0.56×0.34–0.38 mm in diameter and about 600 in number in specimen of CL 5.1 mm.

Description of males. – Body smaller and more slender than in females.

Sixth somite 0.68–0.79 times as long as carapace, 1.80–2.14 times as long as proximal depth. Telson 0.88–1.06 times as long as carapace.

Outer antennular flagellum (Fig. 3*k*) overreaching scaphocerite by more than distal 1/2, composed of 10–18 articles.

Scaphocerite (Fig. 3*k*) 0.63–0.71 times as long as carapace, 2.13–2.68 times as long as width, lateral margin nearly straight; distolateral spine entirely exceeding distal margin of truncate blade.

First pleopod (Fig. 3*l*) with endopod very short, narrowed distally, with short setae on mesial and distal margins. Second pleopod (Fig. 3*m*) with endopod strongly reduced, rounded laterally, fringed with plumose setae; appendix masculina (Fig. 3*n*) longer than endopod, reaching

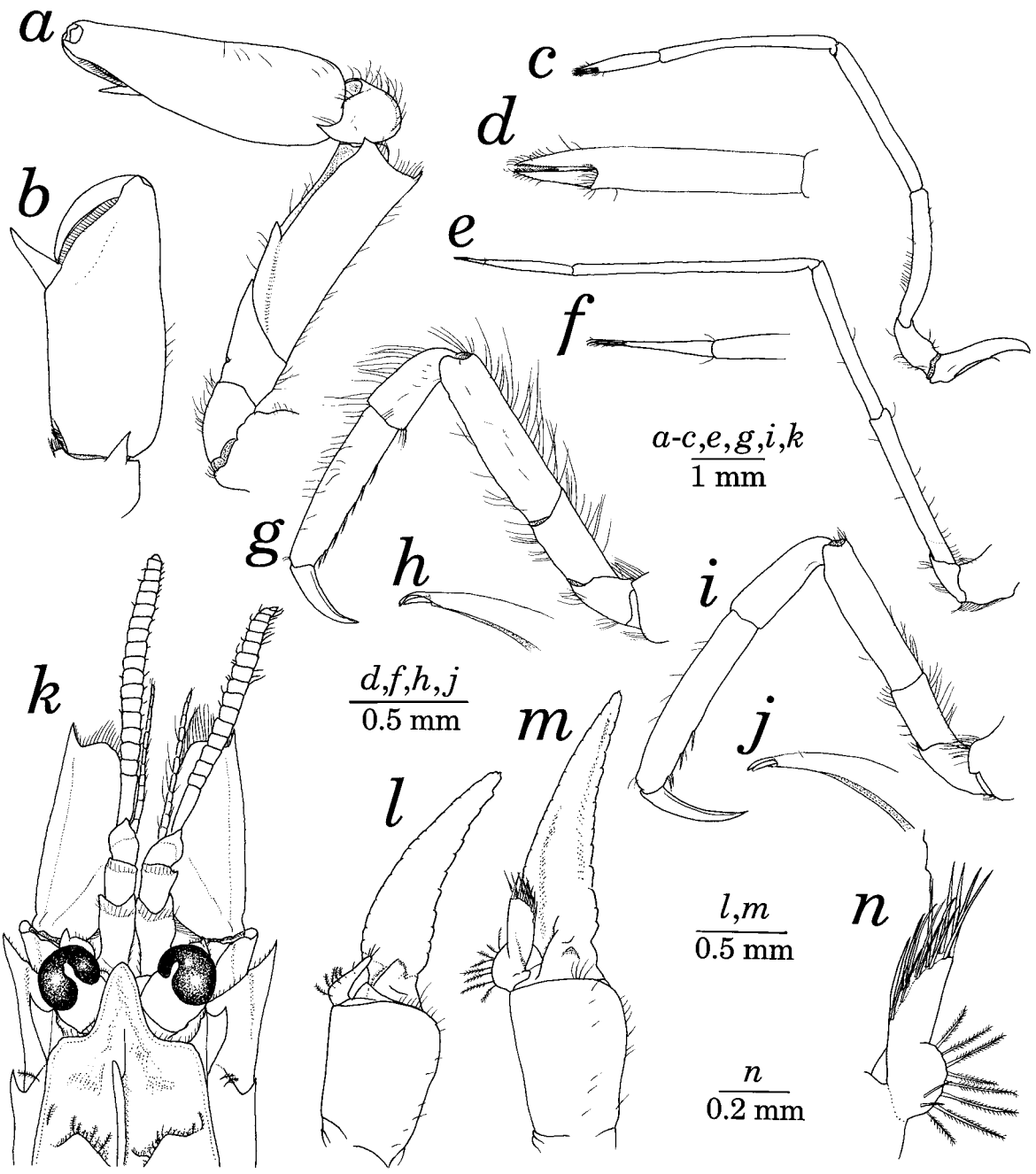

Fig. 3. *Syncrangon angusticauda* (De Haan, 1849). *a–j*, female (CL 5.9 mm; NFU 530-2-2294) from Yuya Bay; *k-n*, male (CL 3.8 mm; NFU 530-2-2291) from Beppu Bay. Appendages dissected from left side. *a*, first pereopod, lateral; *b*, same, chela, flexor; *c*, second pereopod, lateral; *d*, same, chela, lateral; *e*, third pereopod, lateral; *f*, same, dactylus, lateral; *g*, fourth pereopod, lateral; *h*, same, distal part of dactylus, lateral; *i*, fifth pereopod, lateral; *j*, same, distal part of dactylus, lateral; *k*, anterior part of carapace and cephalic appendages, dorsal; *l*, first pleopod, ventral, exopodal setae omitted; *m*, second pleopod, ventral, exopodal setae omitted; *n*, same, endopod and appendix masculina, dorsal.

proximal 1/4 of exopod, mesial margin somewhat ridged, bearing many stout setae dorsally. Endopods of third to fifth pleopods small, diminishing in size posteriorly.

Coloration. – The coloration of the body is variable. Specimens from off Amatsukominato, Pacific coast of central Japan: carapace and abdomen dark brown mottled yellowish white except for sixth abdominal somite always dark brown. Specimen from Kurosaki, Sagami Bay: dorsal part of carapace grayish brown; dorsal part of first to fifth abdominal somites yellowish white, sixth abdominal somite brown; ventral part of carapace, pleura of first to fifth abdominal somites and telson brownish black. Minemizu (2000: 114) published two similar color photographs of this species from Osezaki, Suruga Bay. He described them as follows: body black except for cephalic appendages, first to third and fifth abdominal somites white; posterodorsal margin of carapace

with 2 blue spots.

Size. – Males CL 2.0–4.0 mm, females CL 2.6–6.8 mm, ovigerous females CL 5.0–7.6 mm, juvenile CL 1.7 mm.

Distribution. – Pacific coast of central Japan (Inubozaki, Boso Peninsula, Tokyo Bay, Sagami Bay, Izu Peninsula, Suruga Bay, Ise Bay, and Kii Peninsula), Seto Inland Sea (Harimanada Sea, Bisan Strait, Suounada Sea, and Beppu Bay), northeastern coast of East China Sea (Jeju Island, Shishiki Bay, Nagasaki Pref., and Amakusa Islands), Sea of Japan (Toyama Bay, off Tottori Pref., Sakai Channel, Shimane Pref., and Yuya Bay) and Tsugaru Strait (Hakodate); intertidal to 40 m.

Ecological note. – This species commonly occurs in algal and seagrass beds (Stimpson, 1860; Miyake, 1961; Kikuchi, 1962, 1966, 1968; Fujino, 1978; present study). In Tomioka Bay, Amakusa Islands, Japan, the species appears principally in the *Zostera* belt from January to June, and this period coincides with the ovigerous season of the species (Kikuchi, 1966). They feed on large amphipods and megalopa of crabs but do not contain other organisms or sand particles in their stomach (Kikuchi, 1966).

Remarks. – Since the original description by De Haan (1849), the present species has been described in fragmentary form by subsequent authors (e.g., Ortmann, 1890; De Man, 1907; Parisi, 1919; Nakazawa, 1927; Kubo, 1965). Our observations show that the following several important characteristics have not been mentioned by them: a small tubercle is present in front of the posterior median spine on the carapace; the distomesial spine ('thumb') is articulated on the propodus of first pereopod at base; the merus of first pereopod is provided with a spine on the middle of mesial margin; and the appendix masculina on the second pleopod in males is longer than the endopod. Most of these features are useful for generic recognition in the Crangonidae.

Kojima and Hanabuchi (1981) reported an unidentified species of *Mesocrangon* in their ecological study in Yuya Bay, southern Sea of Japan. Reexamination of the specimens used by Kojima and Hanabuchi (1981) has shown that they actually represent *S. angusticauda*.

Syncrangon dentata (Balss, 1914) new combination (Figs. 4–6)

Crangon (*Sclerocrangon*) *angusticauda* var. *dentata* Balss, 1914: 65, fig. 40 [type locality: Negishi, Yokohama, Tokyo Bay and off Zushi, Sagami Bay, Pacific coast of central Japan].

Sclerocrangon angusticauda var. *dentata* – De Man, 1920: 251 (list).

Material Examined. – **Pacific coast of central Japan.** Tokyo Bay, 35°20.0´N, 139°40.5´E, 25 m, beam trawl, 22 Mar. 1995, coll. J. Ueda, 3 ♂ (3.0–3.4 mm), NFU 530-2-2295. – Amadai-ba, Sagami Bay, 62–65 m, 19 July 1962, 1 ♂ (2.4 mm), NSMT-Cr R: 2048. –Off Northwest of Jogashima Island, Sagami Bay, 61–62 m, 6 Feb. 1964, 1 ♀ (4.3 mm), NSMT-Cr R: 2205. –Off Northwest of Jogajima Island, Sagami Bay, 65–75 m, 13 Feb. 1965, 1 ♂ (2.8 mm), 2 ♀ (3.5, 3.7 mm), NSMT-Cr R: 2332.

Sea of Japan. Off Tsushima Island, 34°16.0´N, 129°31.5´E, 105 m, sand and shells, 5 Aug. 1968, coll. RV *Genkai-Maru* of the Fukuoka Fisheries Research Laboratory, 1 ♀ (2.2 mm), KMNH IvR 000,020.

Type material. – Syntypes: 1 ♀ , Negishi, Yokohama, Tokyo Bay, 45 m, coll. F. Doflein; 2 juvs., Zushi, Sagami Bay, 130 m, 9 Nov. 1904, coll. F. Doflein, deposited in Zoologisches Sammlung des Bayerischen Staates, München. However, the type material could not be located (Dr. T. Komai of the Natural History Museum and Institute, Chiba, pers. comm.).

Diagnosis. – Rostrum 0.32–0.41 times as long as carapace, terminating in conical projection, lateral margins nearly parallel. Carapace slightly shorter than wide; middorsal carina considerably high, carina (branchial carina) continued from hepatic spine long and directed backward. First to second abdominal somites with short middorsal carina, each produced anteriorly as blunt process; third to fifth somites with relatively high but dorsally flattened middorsal carina, that of fifth somite weakly produced posteriorly; pleura of first to fifth somites bluntly produced ventrally. Telson 0.91–0.95 times as long as carapace in females. Scaphocerite 0.60–0.68 times as long as carapace in females, 0.69–0.78 times in males. Fifth pereopod with carpus shorter than dactylus.

Description of females. – Body (Fig. 4) small, moderately stout, subcylinderical. Integument moderately thick, sculptured, covered with fine setae, particularly each carina with sparse long plumose setae.

Rostrum (Figs. 4 and 5*a*) broad and short, 0.32–0.41 times as long as carapace, directed forward, terminating in conical projection in dorsal view; dorsal surface concave, lateral margins nearly parallel; ventral carina obtuse, deep, distal margin with lobe-like projection in lateral view. Carapace (Figs. 4 and 5*a*) slightly shorter than wide; gastric region not depressed below general level of carapace; middorsal carina very high, extending from just posterior of rostral base to posterior margin of carapace, armed with 2 strong spines anteriorly curved and median small tubercle, anterior spine directed forward, arising from level of posterior orbital margin, posterior spine larger than anterior one, arising from about posterior 1/3 of carapace, median tubercle situated just in front of posterior spine, bearing several long plumose setae anteriorly; antennal spine moderately strong, rather ascending, falling short of end of rostrum, with shallow furrow inferiorly; branchiostegal spine strong, slightly convergent, directed forward, reaching or reaching slightly beyond end of rostrum, supported by sharp carina extending anterior 1/6 of carapace; pterygostomian spine minute; hepatic spine moderately strong, supported by long longitudinal carina (branchial carina) extending to level of posterior end of middorsal carina, followed by hepatic groove along inferior part of its base; orbital notch moderately deep; 2 transverse cardiac grooves with marginal setae posteriorly, anterior groove (cervical groove) extend-

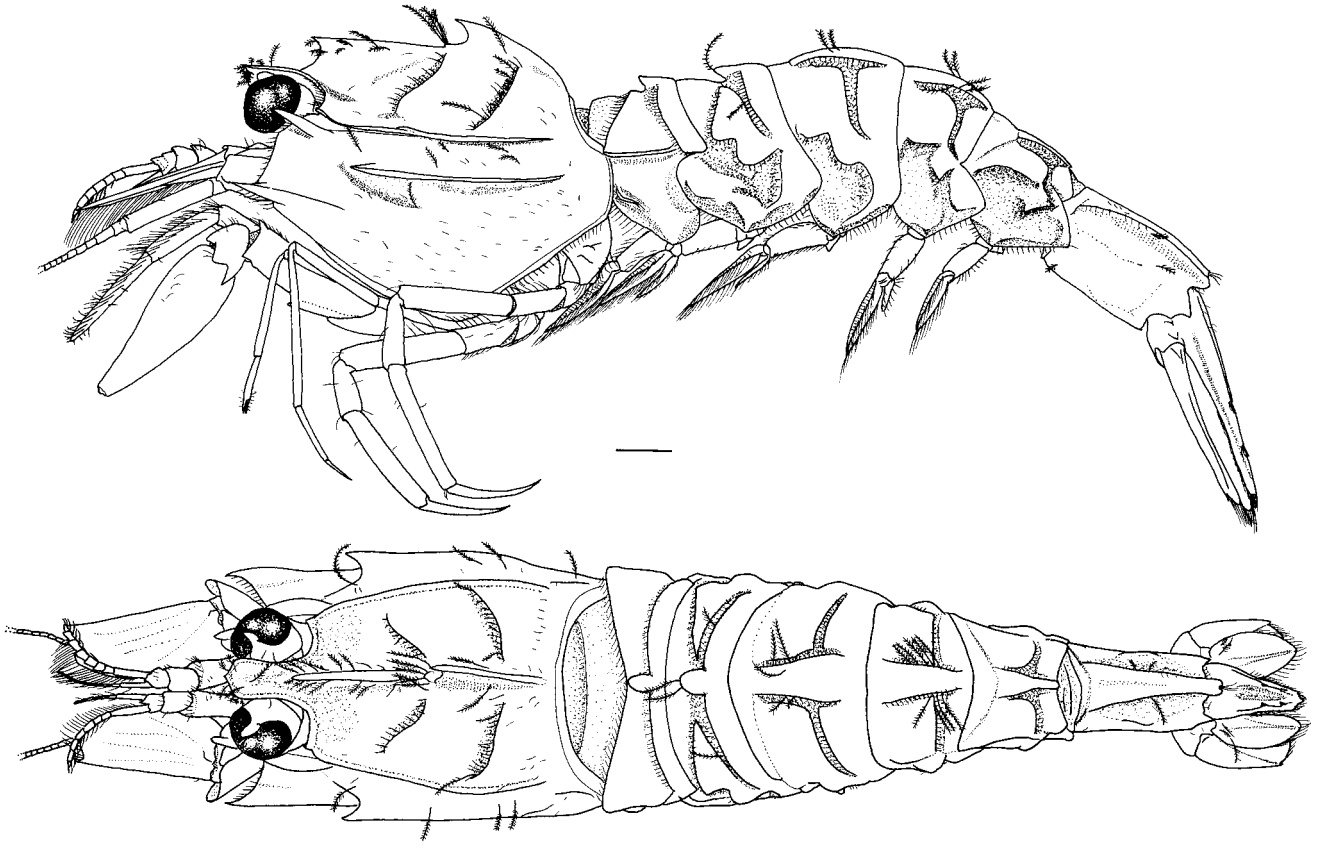

Fig. 4. *Syncrangon dentata* (Balss, 1914). Female (CL 4.3 mm; NSMT-Cr R: 2205) from off Northwest of Jogashima Island, Sagami Bay. Entire animal in lateral view (top) and dorsal view (bottom). Scale 1 mm.

ing from base of median tubercle to anterior 1/3 of postorbital carina, posterior groove extending from posterior 1/5 of middorsal carina to posterior 1/3 of postorbital carina; postorbital carina continued from lateral margin of rostrum, extending from level of posterior end of middorsal carina; longitudinal suture situated on antennal spine, extending backwards along postorbital carina to level of 1/2 of carapace.

Four posterior thoracic sternites furnished each with median ridge, diminishing in size posteriorly in non-spawning specimens.

Abdomen (Fig. 4) provided with relatively high, but dorsally flattened middorsal carina on first to sixth somites, those of first and second somites short, with strong blunt process anteriorly, that of third somite broadened posteriorly, those of fourth to sixth somites narrowed posteriorly, that of fifth somite somewhat produced posteriorly, that of sixth somite weakly grooved at anterior 2/3 medially and notched posteriorly; each carina with marginal setae. Terga of first and second somites with transverse groove posteriorly, continued from posterolateral margin of middorsal carina, parallel with posterior margin, that of second somite with anterior transverse groove continued from posterior groove; those of third to fifth somites with T-shaped deep groove. Lateral margin of first somite with longitudinal carina throughout its length; that of second somite with oblique broad groove continued from anterior transverse groove on tergum; third to fifth somites strongly sculptured. Pleura of first to fifth somites strongly sculptured, bluntly produced ventrally, that of first somite with short sinuous carina anteriorly, those of fourth and fifth somites bluntly produced posteriorly. Sixth somite 0.56–0.73 times as long as carapace, 1.44–1.68 times as long as proximal depth, provided with longitudinal deep groove on lateral margin under middorsal carina; posterolateral spine strong; posteroventral corner pointed. Telson (Fig. 5*l*) moderately long, 0.91–0.95 times as long as carapace, provided with paired submedian carinae and moderately deep middorsal groove; submedian carinae armed with 2 pairs of dorsolateral spines, anterior pair situated at 1/2 of telson, posterior pair at distal 1/4 of telson; posterior margin sharply pointed, with paired lateral spines.

Anterior five abdominal sternites provided each with sharp median process, these processes directed ventrally on anterior 4 sternites, directed posteriorly on fifth sternite in non-spawning specimens; preanal spine acute.

Eye (Fig. 4) large, with cornea moderately large; eyestalk provided with rounded dorsal tubercle, without ventral spine.

Antennule (Fig. 5*b*) with peduncle reaching 1/2 of scaphocerite; proximal 2 segments of peduncle with blunt distolateral process; proximal segment distinctly longer than distal 2 segments combined, with acute spine on ventrome-

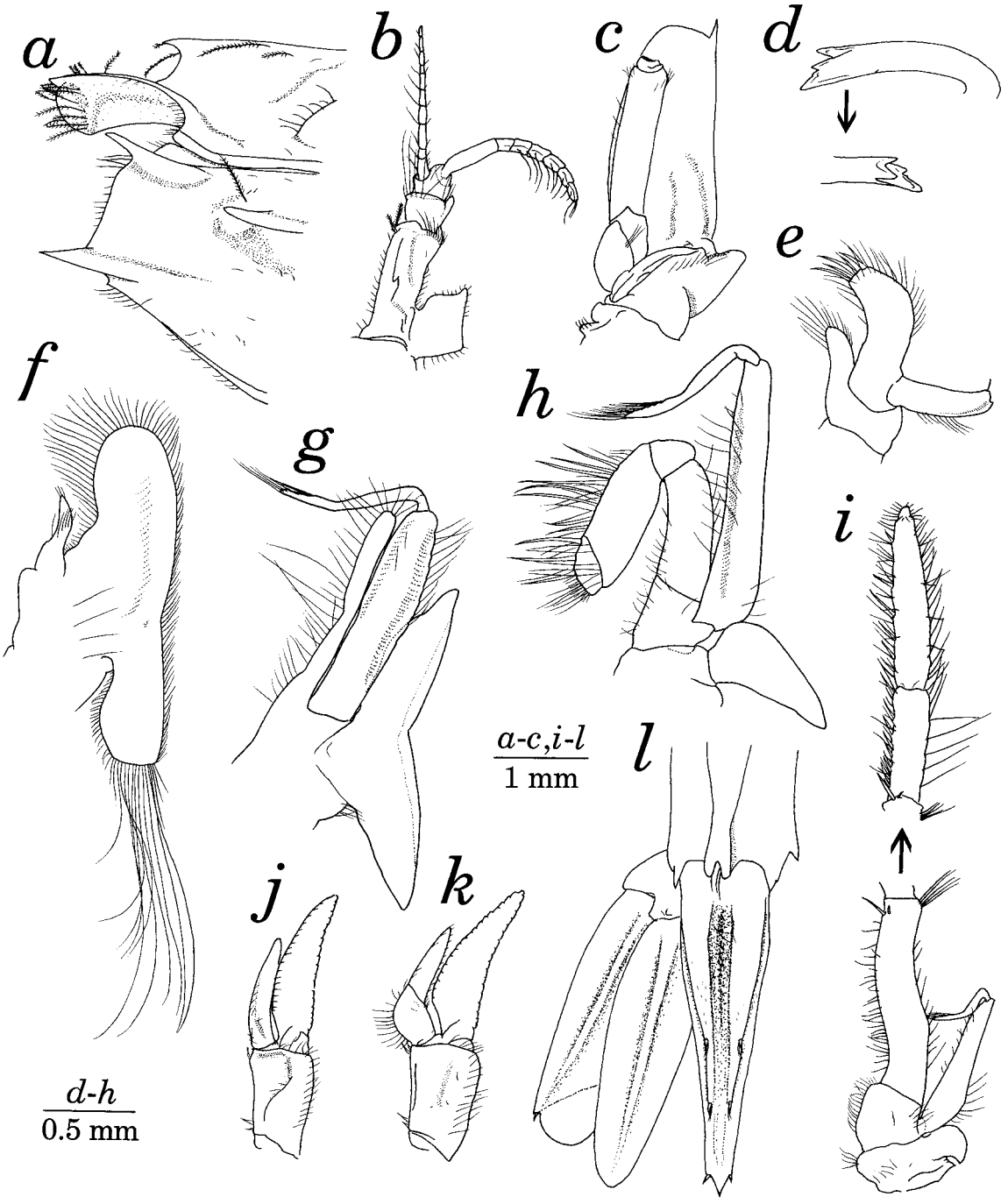

Fig. 5. *Syncrangon dentata* (Balss, 1914). Female (CL 4.3 mm; NSMT-Cr R: 2205) from off Northwest of Jogashima Island, Sagami Bay. Appendages dissected from left side. *a*, anterior part of carapace, lateral; *b*, antennule, ventral; *c*, antenna, ventral; *d*, mandible, external and internal; *e*, maxillule, external; *f*, maxilla, external; *g*, first maxilliped, external; *h*, second maxilliped, external; *i*, third maxilliped, flexor; *j*, first pleopod, ventral, exopodal setae omitted; *k*, second pleopod, ventral, exopodal setae omitted; *l*, uropod and telson, dorsal.

sial ridge. Stylocerite broad, subsquare, slightly reaching beyond 1/2 of proximal segment; lateral margin slightly concave, terminating in obtuse process anteriorly. Outer flagellum overreaching distal end of scaphocerite by at least distal 1/5, composed of 7–9 articles, increasing with growth, bearing aesthetascs on ventral margin. Inner flagellum setose, subequal in length to and more slender than outer one.

Antenna (Fig. 5*c*) with scaphocerite broad, 0.60–0.68 times as long as carapace, 2.00–2.14 times as long as width, lateral margin slightly sinuous; distolateral spine exceeding distal margin of rounded blade. Basicerite with ventrolateral process rounded, divergent laterally; carpocerite reaching level of distal 1/5 of scaphocerite; flagellum shorter than body length.

Mouthparts similar to those of *S. angusticauda* (Fig. 5*d*–*i*). Third maxilliped (Fig. 5*i*) overreaching distal end of

scaphocerite by 1/2 of ultimate segment, strongly setose particularly on mesial margin; distal 2 segments with serial spines mesially; ultimate segment about 5 times as long as width; penultimate segment about 3 times as long as width; antepenultimate segment shorter than distal 2 segments combined, bearing 2 small subdistal spines ventrally; exopod with lash well developed; epipod with lateral margin rounded.

First pereopod (Fig. 6*a*, *b*) moderately stout, overreaching distal end of scaphocerite by 1/2 of palm; chela (Fig. 6*b*) with palm 2.13–2.60 times as long as width, cutting edge strongly oblique and convex; distomesial spine ('thumb')

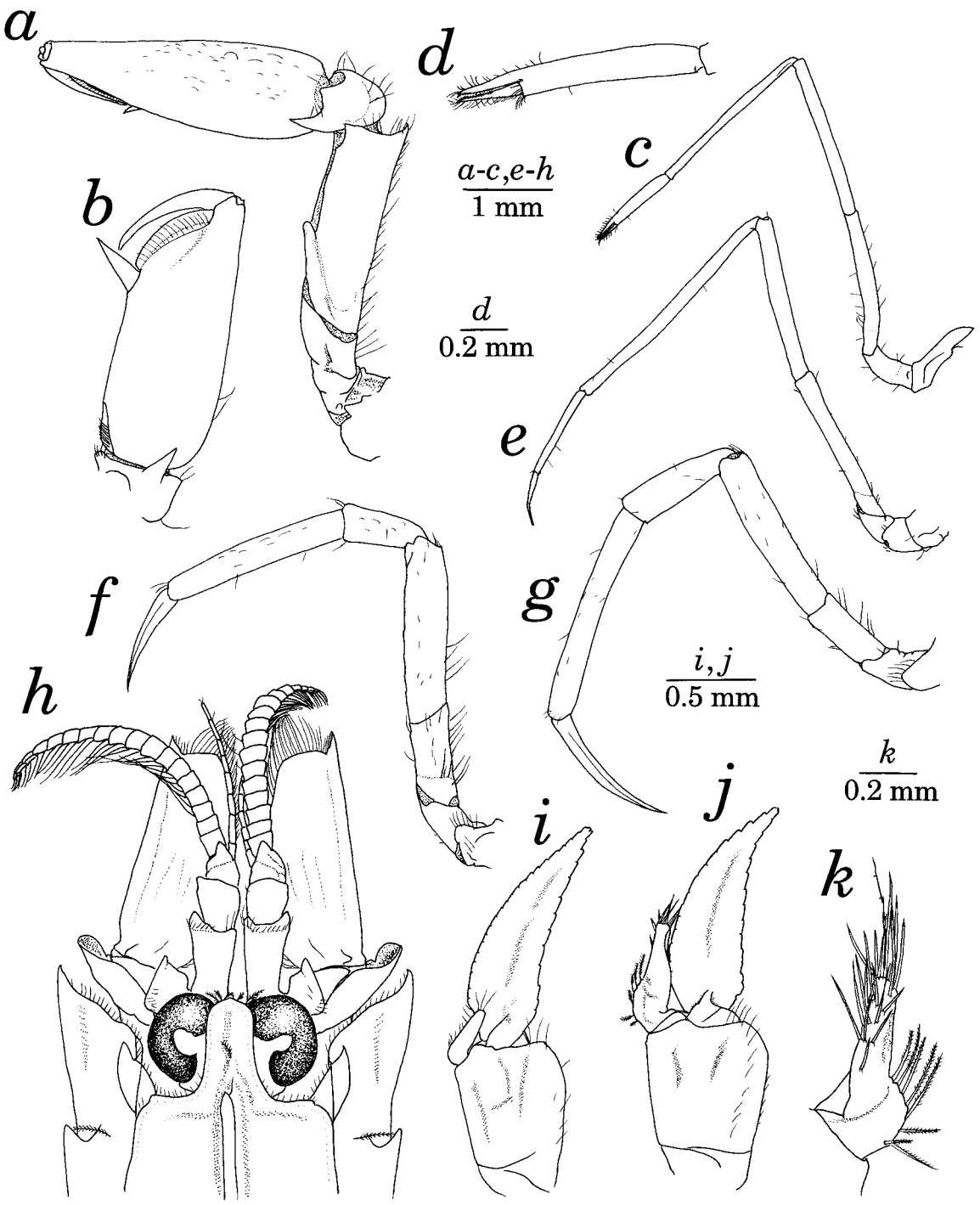

Fig. 6. *Syncrangon dentata* (Balss, 1914). *a*–*g*, female (CL 4.3 mm; NSMT-Cr R: 2205) from off Northwest of Jogashima Island, Sagami Bay; *h*-*k*, male (CL 3.4 mm; NFU 530-2-2295) from Tokyo Bay. Appendages dissected from left side. *a*, first pereopod, lateral; *b*, same, chela, flexor; *c*, second pereopod, lateral; *d*, same, chela, lateral; *e*, third pereopod, lateral; *f*, fourth pereopod, lateral; *g*, fifth pereopod, lateral; *h*, anterior part of carapace and cephalic appendages, dorsal; *i*, first pleopod, ventral, exopodal setae omitted; *j*, second pleopod, ventral, exopodal setae omitted; *k*, same, endopod and appendix masculina, dorsal.

strong, movable; carpus armed with strong lateral spine on distoventral corner and distolateral strong protuberance; merus with rather strong spine on dorsodistal margin and moderate subacute spine on midmesial margin. Second pereopod (Fig. 6*c*, *d*) slender, slightly reaching beyond distal end of scaphocerite; chela (Fig. 6*d*) with dactylus 0.35 times as long as palm, fingers with numerous minute spinules on both cutting edges distally; carpus 1.78–2.00 times as long as chela; merus subequal with carpus in length; coxa with lateral process. Third pereopod (Fig. 6*e*) slender, overreaching distal end of scaphocerite by distal 2 segments; dactylus 0.63–0.67 times as long as propodus; carpus 1.30–1.70 times as long as distal 2 segments combined; merus shorter than carpus. Fourth pereopod (Fig. 6*f*) moderately stout, slightly reaching beyond distal end of scaphocerite; dactylus subspatulate, acute distally; propodus 1.29–1.67 times as long as dactylus; carpus 0.50–0.78 times as long as dactylus; merus slightly shorter than propodus. Fifth pereopod (Fig. 6*g*) similar to fourth pereopod, reaching distal end of scaphocerite; propodus 1.30–1.76 times as long as dactylus; carpus 0.67–0.86 times as long as dactylus.

Pleurobranchs present on fourth to eighth thoracic somites.

First pleopod (Fig. 5*j*) with endopod not segmented, reaching distal 1/3 of exopod, with sparse short setae mesially. Second pleopod (Fig. 5*k*) with endopod reaching distal 1/3 of exopod, curved laterally, with 2 segments, distal segment with short setae marginally, proximal segment with short setae mesially. Endopods of third and fourth pleopods similar to that of second, diminishing in size posteriorly; that of fifth pleopod small, not segmented.

Uropod (Fig. 5*l*) with endopod extending beyond tip of telson; exopod failing to reach distal margin of endopod, with small spine just mesial to acute posterolateral spine, transverse suture distinct, oblique.

Description of males. – Body rather smaller and more slender than females.

Sixth somite 0.71–0.82 times as long as carapace, 1.54–1.85 times as long as proximal depth. Telson 0.96–1.15 times as long as carapace.

Outer antennular flagellum (Fig. 6*h*) reaching beyond scaphocerite by more than distal 1/2, composed of 9–18 articles.

Scaphocerite (Fig. 6*h*) 0.69–0.78 times as long as carapace, 2.06–2.52 times as long as width; distolateral spine totally exceeding distal margin of truncate blade.

First pleopod (Fig. 6*i*) with endopod very short, curved laterally, rounded distally, with marginal setae mesially. Second pleopod (Fig. 6*j*, *k*) with endopod rudimentary, rounded laterally, fringed with setae; appendix masculina (Fig. 6*k*) elongate, longer than endopod, reaching proximal 1/3 of exopod, bearing many stout setae on dorsal margin. Endopods of third to fifth pleopods vestigial, diminishing in size posteriorly.

Coloration. – Unavailable.

Size. – Males CL 2.4–3.4 mm, females CL 2.2–4.3 mm

Distribution. – Pacific coast of central Japan (Tokyo Bay and Sagami Bay) and southern Sea of Japan (Tsushima Island); 25–130 m.

Remarks. – This species was first described as *Crangon* (*Sclerocrangon*) *angusticauda* var. *dentata* by Balss (1914) based on one female and two juvenile specimens. Balss (1914) compared his specimens with those of the nominal typical form and pointed out the following morphological differences in the abdomen and telson between the two forms: (1) the first and second somites armed each with a middorsal process anteriorly (absent in the typical form); (2) the third and fourth somites provided each with a high broad middorsal carina (low in the typical form); (3) the middorsal carinae of fifth and sixth somites pointed posteriroly (rounded in the typical form); and (4) the telson without any spine (two pairs of dorsal spines present in the typical form). Also, he additionally mentioned that the rostrum was anteriorly broader than that of typical form and that the middorsal carina of the carapace was higher than that of the typical form. Our comparison confirmed that all but the fourth character are reliable in distinguishing the two species. We have found that there are three pairs of dorsolateral spines on the telson in our specimens. It is reasonable to consider that the spines were missing in the syntypes or that Balss (1914) overlooked the presence of the spines.

Close comparison has revealed the following many additional differences which justify the separation of Balss' (1914) form as a distinct species: (1) the rostrum is longer in *S. dentata* than in *S. angusticauda* (0.32–0.41 times as long as carapace versus 0.20–0.33 times); (2) the ventral carina of the rostrum is deeper in *S. dentata* than in *S. angusticauda*; (3) the carina continued from the hepatic spine on the carapace is longer in *S. dentata* than in *S. angusticauda*; (4) the ventral margin of the pleura on the first to fifth abdominal somites is bluntly produced in *S. dentata*, while rounded in *S. angusticauda*; (5) in females, the telson is longer in *S. dentata* than in *S. angusticauda* (0.91–0.95 times as long as carapace versus 0.72–0.84 times); (6) the comparative length of the scaphocerite in relation to the carapace in females is longer in *S. dentata* than in *S. angusticauda* (0.60–0.68 times as long as carapace versus 0.45–0.56 times); and (7) the carpus of fifth pereopod is shorter than the dactylus in *S. dentata*, while longer than the dactylus in *S. angusticauda* (0.67–0.86 times as long as dactylus versus 1.00–1.23 times). Also, the known vertical distribution differs between the two species, *S. dentata* occurring in rather deeper water than *S. angusticauda* (25–130 m as against intertidal to 40 m).

The present species has been recorded only from Negishi, Yokohama, Tokyo Bay and off Zushi, Sagami Bay, Pacific coast of central Japan. The present material from Tsushima Island, southern Sea of Japan extends the known geographical range of the species.

ACKNOWLEDGMENTS

We wish to express our sincere thanks to the following scientists and institutions for donations or loans of specimens in this study: Drs. Tatsuo Hamano, Naojirou Horii, Taiji Kikuchi, Kikkuo Kojima, Yoshitaka Yabumoto and Koji Yokogawa, and Mrs. Keiichi Nomura, Kazutoshi Ogawa and Junji Ueda, and NSMT, Fukuoka Fisheries Research Laboratory and Ocean Research Institute, University of Tokyo. We are grateful to Drs. Sammy De Grave, Martin Lindsey Christoffersen and Masatsune Takeda for kindly reviewing the manuscript. We also thank Dr. Tomoyuki Komai for information about the syntypes of *Syncrangon dentata* and for critical reading of the manuscript. This work was supported by Korean Research Foundation Grant (KRF-2001-050-D00038) for the senior author (JNK).

REFERENCES

Balss H (1914) Ostasiatische Decapoden II. Die Natantia und Reptantia. In "Dekapoden, part 7 in volume 2 of Beiträge zur Naturgeschichte Ostasiens" Ed by F Doflein, Abh Bayer Akad Wiss, München, 2 (supplement), 10: 1–101, 1 pl

Chan TY (1996) Crustacea Decapoda Crangonidae: Revision of the three closely related genera *Aegaeon* Agassiz, 1846, *Pontocaris* Bate, 1888 and *Parapontocaris* Alcock, 1901. In "Résultats des Campagnes MUSORSTOM, Volume 15" Ed by A Crosnier, Mém Mus natn Hist nat 168: 269–336

Coutière H (1900) Note préliminaire sur les Crustacés décapodes provenant de l'expédition antarctique belge. C R Acad Sci 130: 1640–1643

Dana JD (1852) Crustacea, Part I. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. 13: 1–685, atlas 1–17 (1855), pls 1–96

Fabricius JC (1798) Supplementum Entomologiae Systematicae [Not seen]

Fujino T (1978) Palaemonidae and others of Macrura. In "Fauna and flora of the sea around the Amakusa Marine Biological Laboratory. Part II. Decapod Crustacea (revised edition)" Eds by T Kikuchi and S Miyake. Cont Amakusa Mar Biol Lab Kyushu Univ 245: 19–25 [In Japanese]

Haan W de (1833–1850) Crustacea. In "Fauna Japonica sive Descriptio Animalium, quae in Itinere per Japoniam, Jussu et Auspiciis Superiorum, qui Summum in India Batava Imperium Tenent, Suscepto, Annis 1823–1830 Collegit, Notis, Observationibus et Adumbrationibus Illustravit" by PF von Siebold, ix-xvi, i-xxxi, vii-xvii, pp 1–243, pls A–J, L–Q, 1–55, circ tab 2 Lugduni-Batavorum, Leiden

Harada E (1968) Seasonal changes in distribution and abundance of some decapod crustaceans. Ecology and biological production of Lake Naka-umi and adjacent regions, 5. Spec Publ Seto Mar Biol Lab 2: 75–103

Haworth AH (1825) A new binary arrangement of the macrurous Crustacea. Phil Mag Jour 65: 183–184

Hayashi K, Kim JN (1999) Revision of the East Asian species of *Crangon* (Decapoda: Caridea: Crangonidae). Crust Res 28: 62–103

Herklots JA (1861) Symbolae carcinologicae I. Catalogue des Crustacés qui ont servi de base au système carcinologique de M.W. de Haan, rédigé d'aprés la collection du Musée des Pays-Bas et les Crustacés de la Faune du Japon. Tijdschr Ent 4: 116–156

Holthuis LB (1993) The recent genera of the caridean and stenopodidean shrimps (Crustacea, Decapoda) with an appendix on the order Amphionidacea. Nationaal Natuurhistorisch Museum, Leiden

Imanaka T, Sasada Y, Suzuki H, Segawa S, Masuda T (1984) Crustacean decapod fauna in Kominato and adjacent waters middle Honshu: A provisional list. J Tokyo Univ Fish 71: 45–74

Ito M, Watanabe S (1992) Secondary sexual characteristics of *Metacrangon angusticauda* (De Haan). Res Crust 21: 107–111 [In Japanese with English abstract]

Kikuchi T (1962) An ecological study on animal community of *Zostera* belt, in Tomioka Bay, Amakusa, Kyushu (II). Community composition. (2) Decapod crustaceans. Rec Oceanogr Wks Jap Spec Num 6: 135–146

Kikuchi T (1966) An ecological study on animal communities of the *Zostera marina* belt in Tomioka Bay, Amakusa, Kyushu. Pub Amakusa Mar Biol Lab Kyushu Univ 1: 1–106

Kikuchi T (1968) Faunal list of the *Zostera marina* belt in Tomioka Bay, Amakusa , Kyushu. Pub Amakusa Mar Biol Lab Kyushu Univ 1: 163–192

Kim JN, Komai T (2002) *Sclerocrangon gasuyebi* Yokoya synonymized with *Sclerocrangon salebrosa* (Owen) (Decapoda, Caridea, Crangonidae). Crustaceana 74: 1335–1347

Kinahan JR (1862) On the Britannic species of *Crangon* and *Galathea*; with some remarks on the homologies of these groups. Trans Royal Irish Acad 24: 45–113

Kojima K, Hanabuchi S (1981) Ecological studies on decapod crustaceans in Yuya Bay, the Japan Sea–I. A list of the species caught and seasonal change in the species composition. Bull Seikai Reg Fish Res Lab 56: 39–54 [In Japanese with English summary]

Komai T (1994) Nihonkai no rikutanasei koebirui (Tarabaebika, Moebika, Ebijakoka) no bunruigakuteki gaiyou. [Taxonomic synopsis of Caridea (Pandalidae, Hippolytidae, Crangonidae) occurring on continental shelf of the Sea of Japan]. Cont Fish Res Jap Sea Block 31: 81–107

Komai T (1996) The crangonid shrimp, *Argis sadoensis* (Yokoya, 1933), a junior synonym of *Argis crassa* (Rathbun, 1899). Crustaceana 69: 542–545

Komai T (1997a) Revision of *Argis dentata* and related species (Decapoda: Caridea: Crangonidae), with description of a new species from the Okhotsk Sea. J Crust Biol 17: 135–161

Komai T (1997b) A review of the *Metacrangon jacqueti* group, with descriptions of two new species (Decapoda, Caridea, Crangonidae). Zoosystema 19: 651–681

Komai T (1999) Decapod Crustacea collected by L Döderlein in Japan and reported by Ortmann (1890-1894) in the collection of the Musée Zoologique, Strasbourg. In "Preliminary taxonomic and historical studies on Prof Ludwig Döderlein's collection of Japanese animals made in 1880-81 and deposited at several European museums" Ed by T Nishikawa, Nagoya Univ, Nagoya, pp 53–101

Komai T, Maruyama S, Konishi K (1992) A list of decapod crustaceans from Hokkaido, northern Japan. Res Crust 21: 189–205 [In Japanese with English abstract]

Krøyer H (1842) De hidtil bekjendte nordiske Krangon-Arter, beskrevne. Naturh Tidsskr, Køvenhavn 4: 217–276 [Not seen]

Kubo I (1965) Macrura. In "New Illustrated Encyclopedia of the Fauna of Japan. Part 2" by KY Okada, S Uchida, T Uchida and others, Hokuryukan, Publ Co Ltd, Tokyo, pp 592–629, figs 891–1031 [In Japanese]

Man JG de (1907) On a collection of Crustacea, Decapoda and Stomatopoda, chiefly from the Inland Sea of Japan; with descriptions of new species. Trans Linn Soc Lond Ser 2 9: 387–454, pls 31–33

Man JG de (1920) Decapoda of the Siboga Expedition. IV. Families Pasiphaeidae, Stylodactylidae, Hoplophoridae, Nematocarcinidae, Thalassocaridae, Pandalidae, Psalidopodidae, Gnathophyllidae, Processidae, Crangonidae and Glyphocrangonidae. Siboga Exped 39a3: 1–318

Matsumiya Y, Imamura H, Oka M (1978) Shishikiwanno ebiruini tsuite. [Shrimps in the Shishiki Bay]. Trans Nagasaki Biol Soc

15: 27–29 [In Japanese]
Minemizu R (2000) Marine decapod and stomatopod crustaceans mainly from Japan. Bun-Ichi Co Ltd, Tokyo [In Japanese]
Miyake S (1961) Fauna and flora of the sea around the Amakusa Marine Biological Laboratory. Part II. Decapod Crustacea. Cont Amakusa Mar Biol Lab Kyushu Univ, pp 1–30 [In Japanese]
Miyake S (1982) Japanese crustacean decapods and stomatopos in color. Vol. I. Macrura, Anomura and Stomatopoda. Hoikusha, Oksaka, 1st printing [In Japanese]
Miyake S (1991) Japanese crustacean decapods and stomatopos in color. Vol. I. Macrura, Anomura and Stomatopoda. Hoikusha, Oksaka, 2nd printing [In Japanese]
Miyake S (1998) Japanese crustacean decapods and stomatopos in color. Vol. I. Macrura, Anomura and Stomatopoda. Hoikusha, Oksaka, 3rd printing [In Japanese]
Miyake S, Sakai K, Nishikawa S (1962) A fauna-list of the decapod Crustacea from the coasts washed by the Tsushima warm current. Rec Oceanogr Wks Jap Spec Num 6: 121–131
Nakazawa T (1927) Decapoda. In "Illustration of Japanese Zoology", Tokyo, pp 992–1124 [In Japanese]
Ortmann A (1890) Die Unterordnung Natantia Boas. Die Decapoden-Krebse des Strassburger Museums, mit besonderer Berücksichtigung der von Herrn Dr Döderlein bei Japan und bei den Liu-Kiu-Inseln gesammelten und z. Z. im Strassburger Museum aufbewahrten Formen. Theire I. Zool Jahrb Syst 5: 437–542, pls 36–37
Ortmann A (1895) A study of the systematic and geographic distribution of the decapod family Crangonidae Bate. Proc Acad Nat Sci Phila 47: 173–197
Parisi B (1919) I Decapodi giapponesi del Museo di Milano, VII. Natantia. Atti Soc Ital Sci Nat 58: 59–99, pls 3–6
Sars GO (1883) Oversigt af Norges Crustaceer med foreløbige Bemaerkninger over de nye eller mindre bekjendte Arter. Forhandlinger Videnskabs-Selskkabet I Christiania, 1882, 18: 1–124, 6 pls
Sekiguchi H (1982) Scavenging amphipods and isopods attacking the spiny lobster caught in a gill-net. Rep Fish Res Lab Mie Univ 3: 21–30
Stebbing TRR (1900) South African Crustacea, Part 1. Mar Invest S Afr 1: 14–66, pls 1–4
Stimpson W (1860) Prodromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, C Ringgold et J Rodgers Ducibus, observavit et descripsit. Proc Acad Nat Sci Phila 12: 22–47
Wicksten MK (1996) *Neocrangon zacae* (Chace, 1937) synonymized with *N. resima* (Rathbun, 1902), and compared with *N. communis* (Rathbun, 1899) (Decapoda: Caridea: Crangonidae). Proc Biol Soc Wash 109: 39–43
Yamaguchi T (1993) A list of species described in the Crustacea volume of Fauna Japonica as belonging to the Japanese fauna. In "PF von Siebold and natural history of Japan, Crustacea" The Carcinological Society of Japan, Tokyo, pp 571–596
Yokoya Y (1933) On the distribution of decapod crustaceans inhabiting the continental shelf around Japan, chiefly based upon the materials collected by S. S. *Sôyô-Maru*, during the years 1923–1930. J Coll Agr Toyko Imp Univ 12: 1–222
Zarenkov NA (1965) Revisija rodov *Crangon* Fabricius i *Sclerocrangon* GO Sars (Decapoda, Crustacea). [Revision of the genera *Crangon* Fabricius and *Sclerocrangon* G. O. Sars (Decapoda, Crustacea)]. Zool Zh 44: 1761–1775

(Received September 21, 2002 / Accepted February 28, 2003)