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THE FIRST *ANILOCRA* AND *PLEOPODIAS* ISOPODS
(CRUSTACEA: CYMOTHOIDAE) PARASITIC ON
JAPANESE FISHES, WITH THREE NEW SPECIES

Ernest H. Williams, Jr. and Lucy Bunkley Williams

Abstract.—*Anilocra prionuri*, new species, is described from *Prionurus scalprus*, *Girella punctata*, and *Stephanolepis cirrhifer* from the Kii Peninsula to Miyakejima; *Anilocra clupei*, new species, from *Sardinella zunasi* from Matsushima Bay to Hiroshima; *Pleopodias superatus*, new species, from off Yui, Japan. *Anilocra prionuri* is distinguished by a slightly produced third segment on antenna 1, and by the length of antennae, uropods, and lobe of head; *A. clupei* by a produced third segment on antenna 1, swellings in both sides of the anterior dactyls, and pleotelson shape; *Pleopodias superatus* by length of antennae, pereonite 7 extending over pleonite 1 and 2, and a posteriorly notched pleotelson. *Anilocra prionuri* apparently has multiple broods interspersed with vegetative growth stages. An injury to the third segment of antenna 1 in *A. clupei* apparently triggered the partial regeneration of the flagellum segments.

Isopods in the genera *Anilocra* and *Pleopodias* have not been reported from Japanese waters. We studied fish parasitic isopods and fish collections for isopods at 20 marine and fisheries laboratories throughout Japan (Hokkaido through the Yaeyama Islands). We identified two new species of *Anilocra* and one of *Pleopodias* from this material.

Materials and Methods

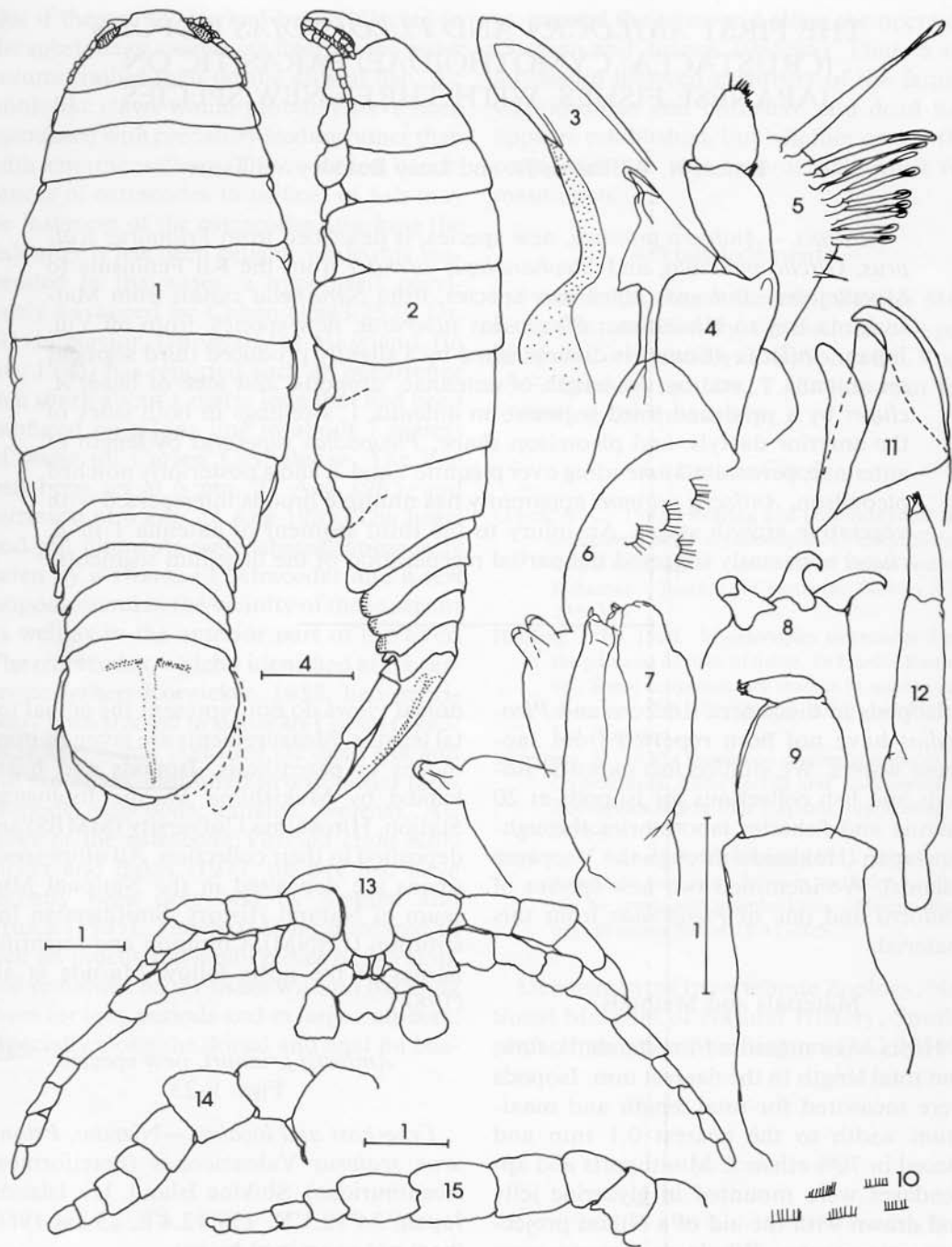
Hosts were measured for standard, fork, and total length to the nearest mm. Isopods were measured for total length and maximum width to the nearest 0.1 mm and placed in 70% ethanol. Mouthparts and appendages were mounted in glycerine jelly and drawn with the aid of a Nikon projection microscope. Whole specimens were drawn using a Nikon SMZ-10 stereoscope and built-in camera lucida. Pleotelsons of the illustrated specimens were drawn in a natural or slightly depressed position; therefore, the length of pleotelsons in illustrated

dorsal views do not represent the actual total lengths. Measurements are given in mm, means in parenthesis. Isopods and hosts loaned by Mukishima Marine Biological Station, Hiroshima University (MMBS) are deposited in their collection. All other specimens are deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Common and scientific names of the hosts follow Masuda et al. (1984).

Anilocra prionuri, new species Figs. 1-23

Type-host and locality.—Nizadai, *Prionurus scalprus* Valenciennes (Perciformes: Acanthuridae), Shikine Island, Izu Islands Japan, 34°19.1'N, 139°12.4'E, 25 Jul 1960 (host not examined by us).

Additional hosts and localities.—*P. scalprus*, off Seto Marine Biological Laboratory, Kii Peninsula, Wakayama Prefecture, Honshu, Japan, 7 Feb 1951, 7 Feb 1953, 15 Nov 1957; Miyakejima, Izu Islands, Japan (J. T.



Figs. 1-15. *Anilocra prionuri*, 1, 2, 13. Female holotype with oostegites; 3-12, 14, 15. Female paratype lacking oostegites: 1, Dorsal view; 2, Lateral view; 3, Incisor process of mandible; 4, Mandible and palp; 5, Apex of distal segment of mandibular palp; 6, Distal lobes of maxilla 2; 7, Maxilla 2; 8, Apex of maxillipedal palp; 9, Maxilliped; 10, Scales on maxilliped; 11, Apex of maxilla 1; 12, Maxilla 1; 13, Head, ventral view; 14, Antenna 1; 15, Antenna 2. (Scale of 4, 7, 9, 12 equal; scale bars in mm.)

Moyer, pers. comm.); mejina, *Girella punctata* Gray (Girellidae), off Seto Marine Biological Laboratory, 4 Apr 1954; kawahagi, *Stephanolepis cirrhifer* (Temminck and Schlegel) (Tetradontiformes: Monacanthidae); off Seto Marine Biological Laboratory, 19 May 1956; unknown host, off Seto Marine Biological Laboratory, 1958 (hosts not examined by us).

Site of infection.—Beneath eye or on side of head of host (not observed by us).

Specimens studied.—11 (all females).

Type specimens.—Holotype (female), USNM 231071; 10 paratypes, USNM 231072-231078.

Description.—Body elongate-oval, length-width ratio 2.69–3.46 (2.96). Antennae 1 compressed, third segment slightly enlarged, extending to just before to just beyond posterior margin of head, 8-merous. Antennae 2 extending to just anterior of to just posterior of posterior margin of pereonite 1, 10-11-merous. Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1 and anterior portion of antennae 2. Head only slightly constricted at level of antennae. Head width-length ratio 1.4–1.6 (1.5). Distance between eyes 38–49% (45%) of head width. Distal portion of incisor process of mandible slender, proximal portion expanded. Distal segment of mandibular palp with 12 setae, 1 seta at distal outer corner of second segment. Maxilla 1 with 4 stout recurved spines at distal end. Maxilla 2 with 1 long spine on inner lobe and 2 smaller spines on outer lobe. Maxillipedal palp with 3 recurved spines at distal end. Posteroventral angle of pereonite 7 produced ventrally into rounded lobe. Pereonite 7 extending over approximately $\frac{2}{3}$ to almost all of pleonite 1. Shortest pereonite 2, longest 6. Dactyls of pereopods 1–4 without swellings on margins. Pereopod 7 abruptly longer than other pereopods. Pleotelson with low median ridge, 1.1–1.3 (1.2) times longer than wide (damaged ones as wide as long to slightly wider than long). Uropods extending pos-

terior of posterior margin of pleotelson, endopod extending beyond posterior end of exopod. Endopods of pleopod 2 with simple proximomedial lobe; endopods of pleopods 3–5 with complexly folded proximomedial lobes, increasing in size and complexity from 3 to 5.

Male.—Unknown (see *Anilocra* sp.).

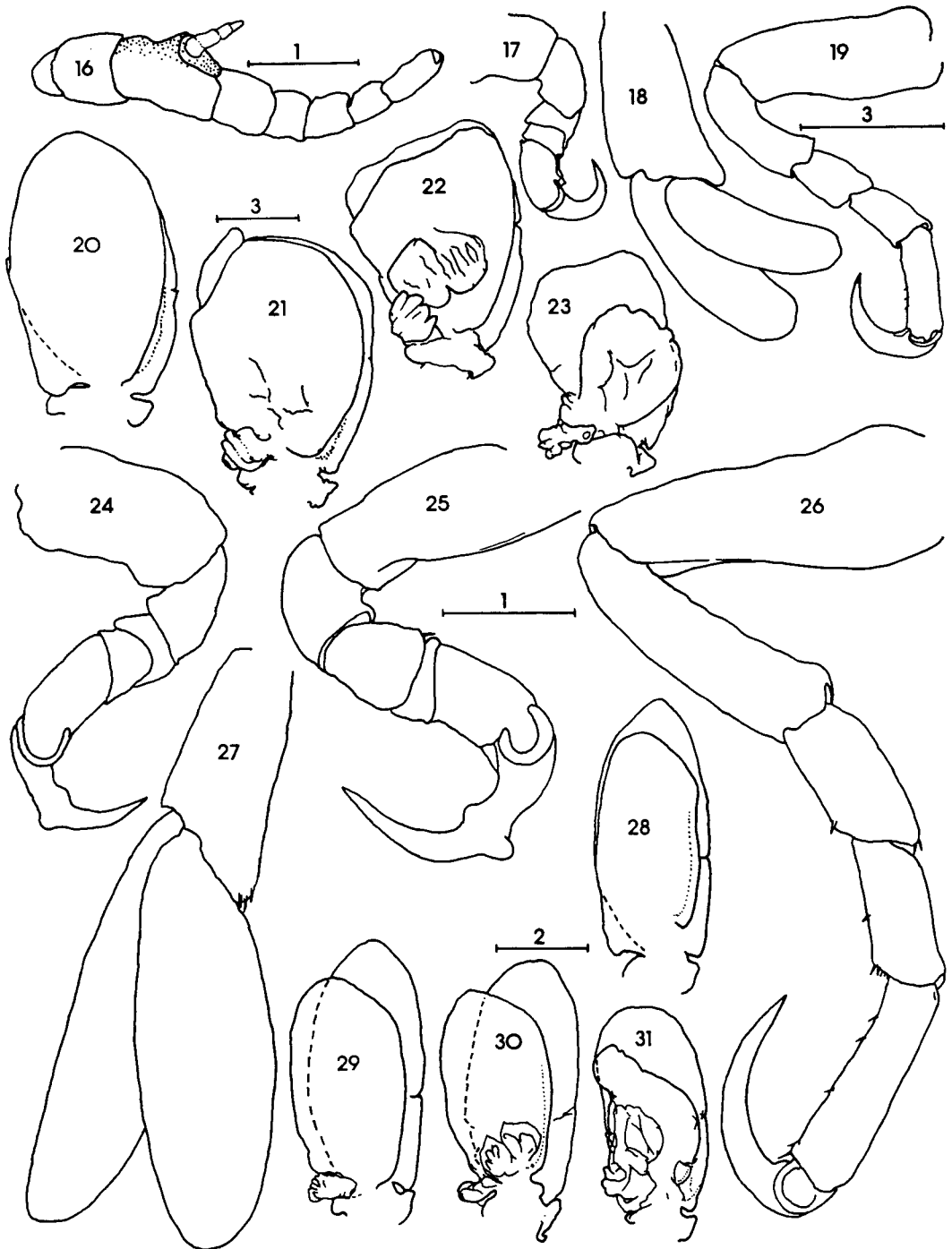
Female (N = 11).—Total length 32.6–47.2 (39.1), maximum width 9.1–16.8 (13.4). The longest, widest, shortest, and most narrow females lacked oostegites. Length-width ratios of the 5 females with oostegites varied from 2.75 to 3.20, the 6 without oostegites 2.69 to 3.46. Both groups averaged 2.96.

Geographic distribution.—*Anilocra prionuri* is known to occur from the Inland Sea to the Izu Islands of Japan (along the southern Pacific coast of Honshu). It was not observed in the Ryukyu Islands. The type and most frequently reported host has a temperate distribution from Matsushima Bay, Miyagi Prefecture to Taiwan (Masuda et al. 1984). This isopod may also be restricted to temperate areas.

Etymology.—The specific name is from the genus of the host.

Japanese standard common name.—Nizadai-yodori-mushi (shin-shô) = parasitic isopod attaching to nizadai.

Remarks.—*Anilocra prionuri* seems to be intermediate between the species of *Anilocra* with geniculate or produced third segment of antennae 1, and those species with no enlargement of this segment. By being consistently intermediate, *Anilocra prionuri* differs from all other species of this genus, all having this segment either distinctly produced or not produced. *Anilocra prionuri* most closely resembles *A. acanthuri* Williams and Williams, known from Puerto Rico, British and U.S. Virgin Islands, Dominican Republic, Cuba, Jamaica, Bahamas, and south Florida, U.S.A. (Williams and Williams 1981), in body shape (length-width ratio 2.9 vs. 2.96) and size (29 to 40 vs. 32.6 to 47.2), and primary host family (Acanthuridae). *Anilocra prionuri* differs



Figs. 16–23. *Anilocra prionuri*, female paratype lacking oostegites: 16, Antenna 1 with damaged third segment and auxiliary flagellum; 17, Pereopod 1; 18, Uropod; 19, Pereopod 7; 20, Pleopod 2; 21, Pleopod 3; 22, Pleopod 4; 23, Pleopod 5. (Scale for 17–19 equal; 20–23 equal; scale bars in mm.)

Figs. 24–31. *Anilocra clupei*, female paratype with oostegites: 24, Pereopod 1; 25, Pereopod 4; 26, Pereopod 7; 27, Uropod; 28, Pleopod 2; 29, Pleopod 3; 30, Pleopod 4; 31, Pleopod 5. (Scale for 24–27 equal; 28–31 equal; scale bars in mm.)

from *A. acanthuri* by having a temperate distribution instead of a tropical to subtropical distribution, attaching to the face of its host instead of beneath the pectoral fin, having longer antennae 1 and 2, having uropods which extend to or beyond the posterior margin of the pleotelson instead of not extending to the posterior margin, having an elongate instead of a broad lobe of the head which extends between bases of antennae 1 and 2 instead of only between antennae 1.

Dr. Jack T. Moyer (pers. comm.) has frequently observed what appear to be specimens of *Anilocra prionuri* on the face of *Prionurus scalprus* at Miyakejima. He observed three and four isopods on one side of the face of a single host.

The largest females of *A. prionuri* lack oostegites. These probably represent vegetative growth stages between broods and indicate this species has multiple broods on its host and a long term host association. The condition is similar to that found in females of *Mothocya bohlkeorum* Williams and Williams (1982).

One female (35.8 × 12.4) without oostegites has an antenna 1 on the left with nine segments and one on the right with a miniature, auxiliary flagellum on the third segment (Fig. 16). The condition appears to be the result of a partial regeneration after an injury.

Anilocra clupei, new species

Figs. 24–45

Type-host and locality.—Sappa, *Sardinella zunasi* (Bleeker) (Clupeiformes: Clupeidae), Matsushima Bay, Miyagi Prefecture, 39°50.6'N, 141°07.9'E, 10 Sep 1951 (host not examined by us).

Additional locality.—*S. zunasi*, shore of Mukaishima Marine Biological Station, Hiroshima Prefecture, Japan, 1973 (MMBS—no numbers).

Site of infection.—Along side of head of the host.

Specimens studied.—5 (females).

Type specimens.—Holotype, USNM 231070; 4 paratypes (MMBS—no numbers).

Description.—Body elongate, length-width ratio 3.30–3.57 (3.44). Antennae 1 compressed, 8-merous, extending from middle to $\frac{3}{4}$ length of eye, third segment enlarged. Antennae 2 extending onto pereonite 2, 10-merous. Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1 and anterior portion of antennae 2. Head slightly constricted at level of antennae. Head width-length ratio 1.2. Distance between eyes 35–44% (39%) of head width. Distal portion of incisor process of mandible slender, proximal portion expanded. Mandibular palp with 11 setae on distal segment. Maxilla 1 with 4 slightly recurved spines at distal end. Inner lobe of maxilla 2 with 1 large and 1 small recurved spine, 2 small spines on outer lobe. Distal segment of maxillipedal palp with 3 recurved spines. Anteroventral angle of pereonite 1 produced ventrally and slightly anteriorly. Posteroventral angle of pereonite 7 slightly produced ventrally. Pereonite 7 extending over approximately $\frac{1}{3}$ of pleonite 1. Shortest pereonite 2, longest 6. Dactyls of pereopods 1–4 with swellings on both sides, swellings on outer margin higher than those on inner margin. Pereopod 7 abruptly longer than other pereopods. Pleotelson expanded along lateral margin to a width greater than width of pleonite 5, with low median ridge, 1.32–1.40 (1.36) times longer than wide, lateral margins up-turned so that pleotelson scoop-shaped. Uropods extending beyond posterior end of pleotelson, endopods and exopods subequal in length. Endopods of pleopod 2 with simple proximomedial lobe; endopods 3–5 with complexly folded proximomedial lobes and pockets, much larger and more complex in pleopod 5.

Male.—Unknown (see *Anilocra* sp.).

Female (N = 5).—Total length 27.4–28.3 (27.7), maximum width 7.7–8.3 (8.1), all gravid. No remnants of appendix masculinum present.

Geographic distribution.—*Anilocra clupei* is known to occur from the western portion of the Inland Sea of Japan to the northern Pacific coast of Honshu (approximately $\frac{3}{4}$ of the length of the Pacific coast of Honshu). We did not find this isopod on *Sardinella zunasi* in the Ryukyu Islands. This isopod may be restricted to the temperate portion of Japan.

Etymology.—The specific name is from the family of the host.

Japanese standard common name.—Sappa-yadori-mushi (shin-shô) = parasitic isopod attaching to sappa.

Remarks.—Only three known species of *Anilocra* have both a produced third segment in antennae 1 and swelling in both sides of the dactyls of the anterior pereopods. *Anilocra leptosoma* Bleeker, known from Indonesia to the Gulf of Suez and South Africa (Bowman and Tareen 1983), has a more slender body than *A. clupei*, a head more abruptly narrowed at the level of the antennae, and a pleotelson with parallel sides for the proximal $\frac{2}{3}$ and a sharply angular distal end, instead of sub-oval with a concave dorsal surface. *Anilocra cavicauda* Richardson, 1910, known only from the Philippines, has a head and pleotelson shape similar to *A. leptosoma*. The lateral margins of the pleonites are up-curved in *A. cavicauda* but not in *A. clupei*; the pleotelson is more narrow (1.8 length width ratio vs. 1.45); the median ridge is absent; coxae of pereonites 6–7 extend to middle instead of $\frac{2}{3}$ or more length of lateral margin of pereonites; and the uropods extend only to the posterior end of the pleotelson instead of well beyond. *Anilocra alloceraea* Koelbel, 1879, known only from Sumatra, has a head and body shape very similar to *A. leptosoma* and different from *A. clupei*, the pleotelson does not have the concave dorsal surface of *A. clupei*, and posterior ends of the basis, endopod and exopod of the uropods are not acute in *A. clupei*.

The four *Sardinella zunasi* hosts for the paratypes of *A. clupei* were 92–94 (93.3) in

fork length. Host size was not available for the holotype.

Anilocra species

Figs. 47–53

Host and locality.—Katakuchi-iwashi, *Engraulis japonicus* Temminck and Schlegel (Clupeiformes: Engraulidae), Kagoshima Bay, Kagoshima Prefecture, Kyushu, Japan, 7 Feb 1978 (hosts not examined by us).

Male (N = 3).—USNM 231083, total length 13.8–14.6 (14.2), maximum width 2.4–2.7 (2.6). Antennae 1 8-merous, antennae 2 10-merous. Penes lobes not discernable. Appendix masculina of pleopod 2 linear with unmodified apex, as long as endopod. No pigment spots apparent. Attached on body of host.

Anilocra species

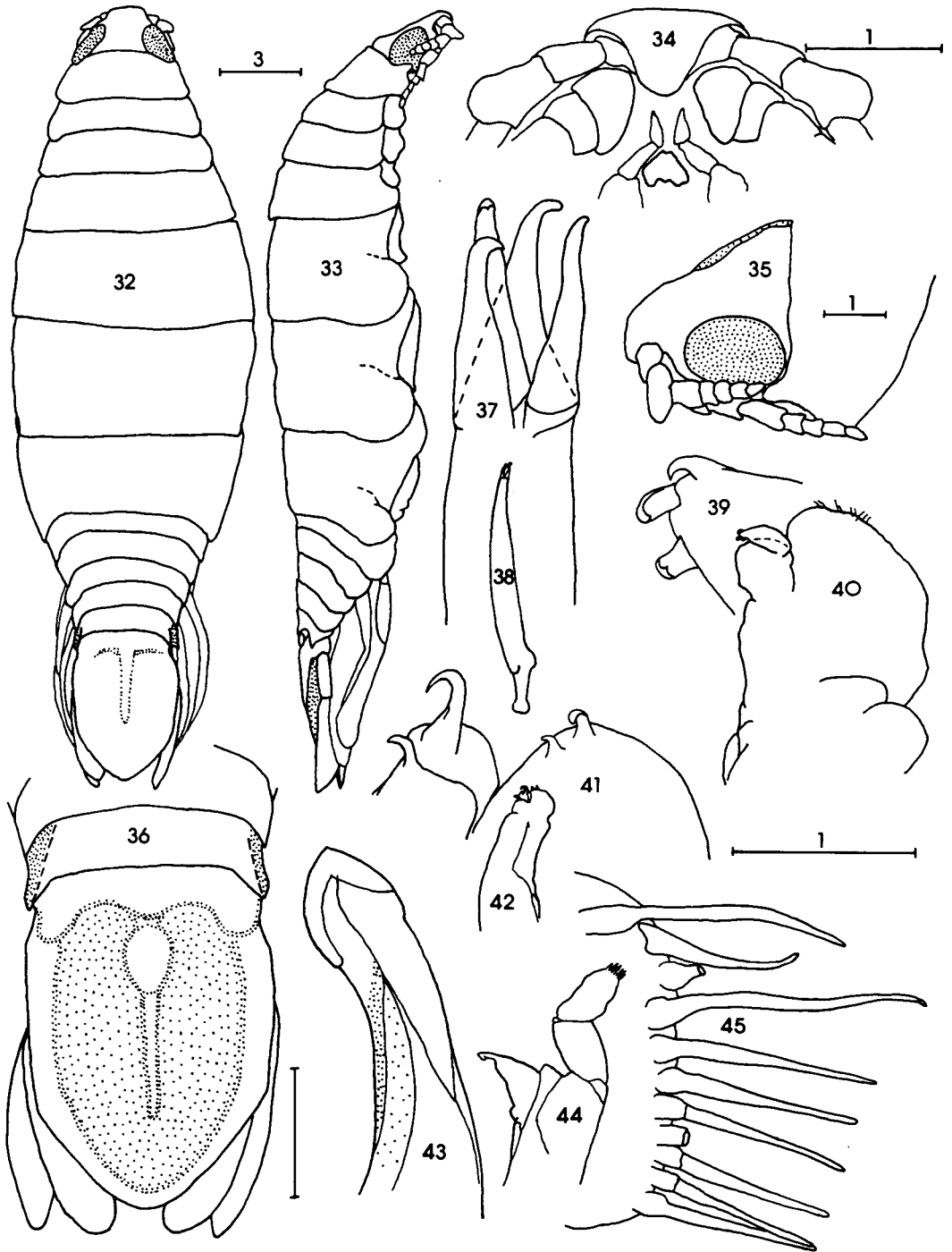
Figs. 54–61

Host and locality.—Kibinago, *Spratelloides gracilis* (Temminck and Schlegel) (Clupeidae), Kochi, Kochi Prefecture, Shikoku, Japan, 20 Dec 1984 (hosts not examined by us).

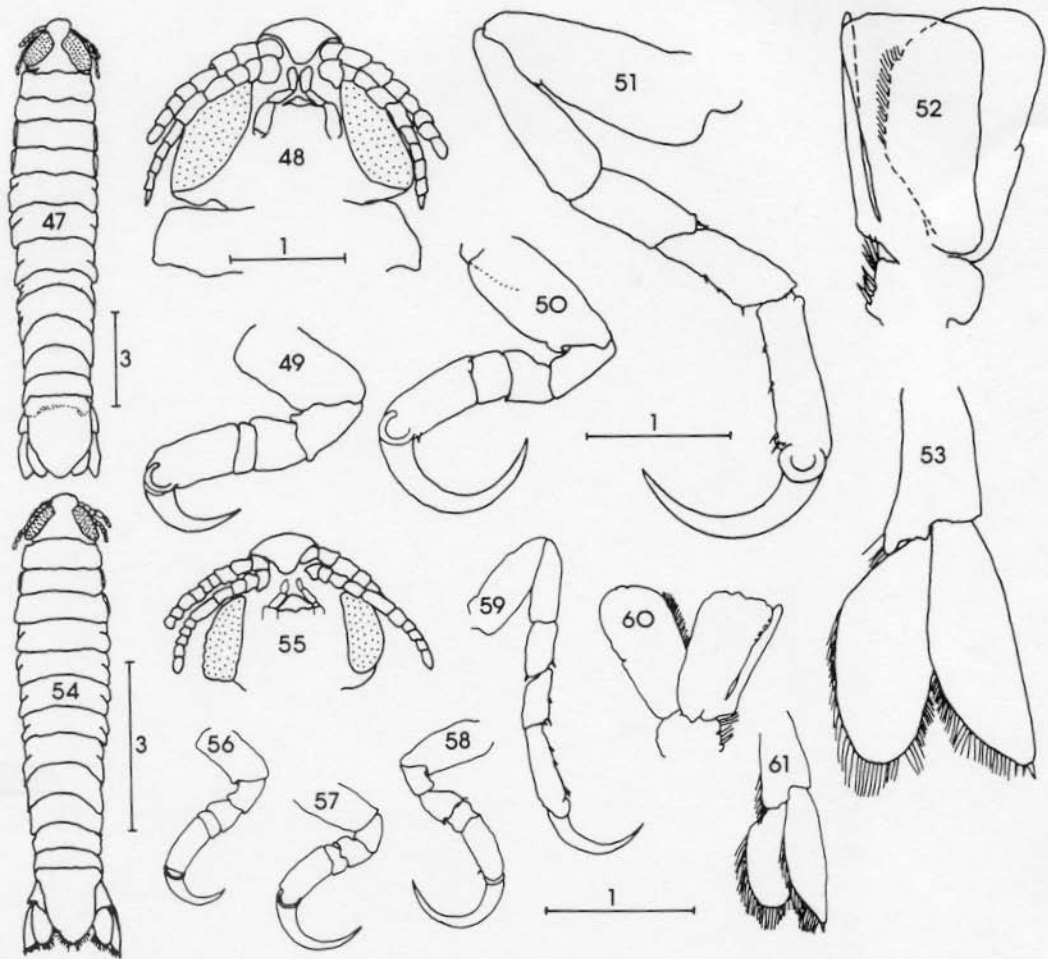
Male (N = 2).—USNM 231061, total length 8.9 and 9.1, maximum width 1.6 and 1.7. Antennae 1 8-merous, antennae 2 10-merous. Penes lobes not discernable. Appendix masculina of pleopod 2 linear with unmodified apex, as long as endopod. Pigment spots scattered over dorsal surface. Attached on the lateral dorsal surface behind head of host.

Remarks.—The two *Anilocra* sp. seem to represent males of two different species, because the smaller ones (9.0) are well pigmented while the larger (14.2) lack pigment. They may represent one or both of the males of *Anilocra prionuri* or *A. clupei*, the only *Anilocra* species known from this general geographic area. We are unable definitely to match either male with the females of the new species.

The *Spratelloides gracilis* and *Engraulis*



Figs. 32-45. *Anilocra clupei*, 32-36. Female holotype with oostegites; 37-45. Female paratype with oostegites: 32, Dorsal view; 33, Lateral view; 34, Head, ventral view; 35, Head, lateral view; 36, Posterior end, dorsal view; 37, Apex of maxilla 1; 38, Maxilla 1; 39, Apex of maxillipedal palp; 40, Maxilliped; 41, Distal lobes of maxilla 2; 42, Maxilla 2; 43, Incisor process of mandible; 44, Mandible and palp; 45, Apex of distal segment of mandibular palp. (Scale for 38, 40, 42, 44 equal; scale bars in mm.)



Figs. 47-53. *Anilocra* sp. from *Engraulis japonicus*: 47, Dorsal view; 48, Head, ventral view; 49, Pereopod 1; 50, Pereopod 3; 51, Pereopod 7; 52, Pleopod 2; 53, Uropod. (Scale for 49-53 equal; scale bar in mm.)

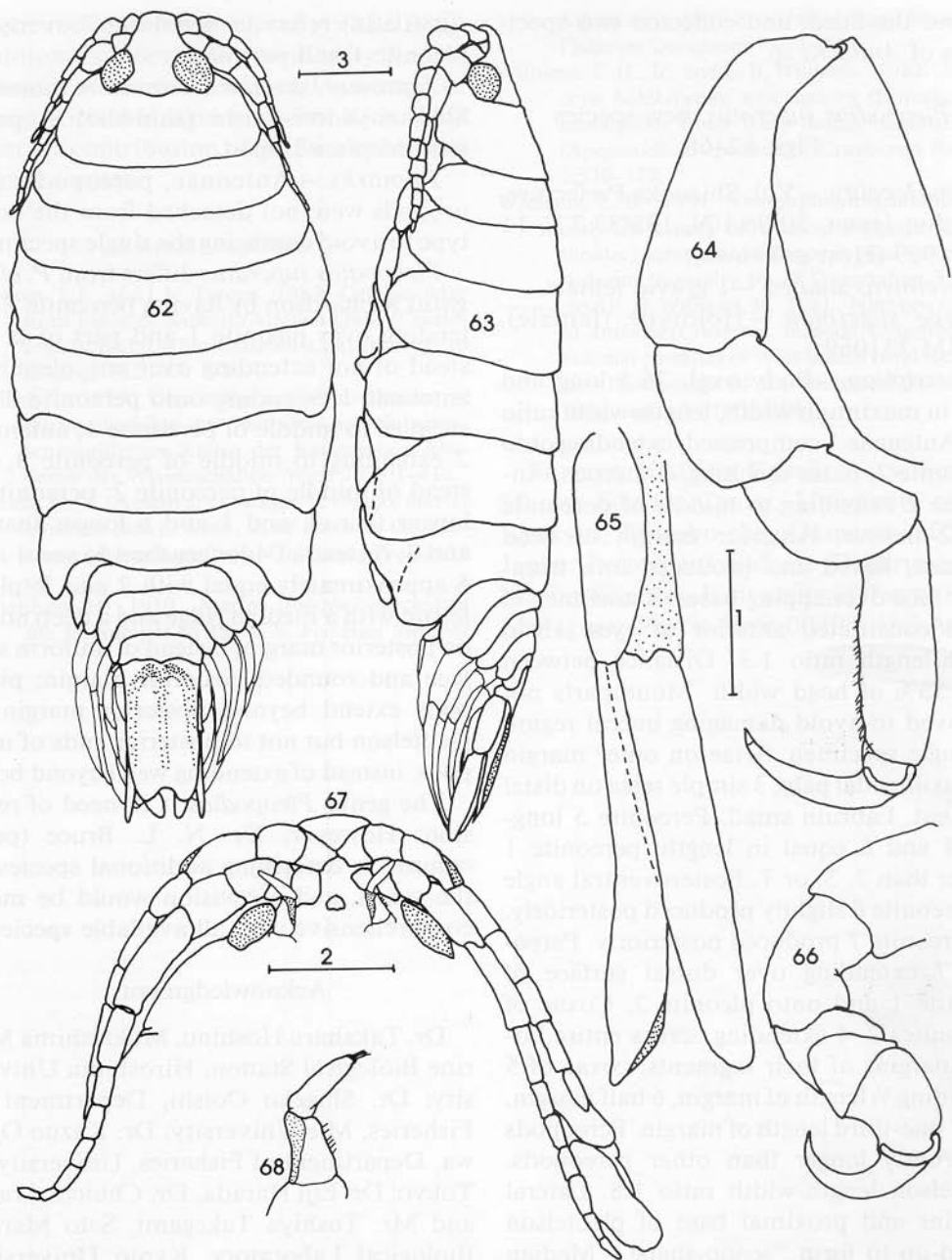
Figs. 54-61. *Anilocra* sp. from *Spratelloides gracilis*: 54, Dorsal view; 55, Head, ventral view; 56, Pereopod 1; 57, Pereopod 3; 58, Pereopod 4; 59, Pereopod 7; 60, Pleopod 2; 61, Uropod. (Scale for 55-61 equal; scale bars in mm.)

japonicus may be serving as intermediate hosts for these *Anilocra* sp. Williams (1984) demonstrated a life cycle involving intermediate hosts (Cardinalfishes—Apogonidae) with similar small males (micromales) and *Chromis* sp. (Pomacentridae) as final hosts.

The specimens of *Anilocra* sp. from *Engraulis japonicus* were together in a vial with specimens of *Nerocila phaiopleura* Bleeker (Cymothoidae). If this is a representative

subsample, then *N. phaiopleura* occurred much more frequently on the *E. japonicus* collected in Kagoshima Bay than did the *Anilocra* sp. Whether both isopods occurred on the same specimen of host was not clear, as the species of isopods were not distinguished by collectors.

Dr. Kazuo Ogawa (pers. comm.) observed large numbers of *Spratelloides gracilis* off Kochi. He estimated 1-2% were infected with an isopod on the dorsal side



Figs. 62–68. *Pleopodias superatus*, female holotype with oostegites: 62, Dorsal view; 63, Lateral view; 64, Pereopod 7; 65, Uropod; 66, Pereopod 1; 67, Head, ventral view; 68, Mandibular palp. (Scale for 64–66 equal; scale bars in mm.)

behind the head, and collected two specimens of *Anilocra* sp.

Pleopodias superatus, new species
Figs. 62–68

Type locality.—Yui, Shizuoka Prefecture, Honshu, Japan, 50°06.1'N, 138°33.7'E, 11 Apr 1969 (Host unknown).

Specimens studied.—1 gravid female.

Type specimen.—Holotype (female), USNM 231069.

Description.—Body oval, 26.5 long and 10.4 in maximum width, length-width ratio 2.5. Antennae 1 compressed, extending onto pereonite 2, bases touching, 8-merous. Antennae 2 extending to middle of pereonite 3, 12-merous. Anterior margin of head truncate, flexed and produced into triangular lobe overlapping bases of antennae 1. Head constricted anterior of eyes. Head width-length ratio 1.3. Distance between eyes 33% of head width. Mouthparts not removed to avoid damaging buccal region of single specimen. Setae on outer margin of maxillipedal palp, 3 simple setae on distal segment. Labrum small. Pereonite 5 longest, 4 and 6 equal in length; pereonite 1 longer than 2, 3, or 7. Posteroventral angle of pereonite 6 slightly produced posteriorly, of pereonite 7 produced posteriorly. Pereonite 7 extending over dorsal surface of pleonite 1 and onto pleonite 2. Coxae of pereonites 2–4 extending across entire lateral margins of their segments, coxae of 5 extending $\frac{2}{3}$ length of margin, 6 half margin, and 7 one-third length of margin. Pereopods 7 abruptly longer than other pereopods. Pleotelson length-width ratio 1.8. Lateral margins and proximal base of pleotelson curled-up to form "scoop-shape." Median ridge from anterior margin to $\frac{3}{4}$ length of pleotelson, posterior margin deeply emarginate. Uropods elongate, extending beyond posterior ends of pleotelson and pleopods, rami subequal. Pleopods extending only slightly beyond posterior end of pleotelson.

Etymology.—The specific name *supera-*

tus (Latin) refers to pereonite 7 overlying pleonite 1 and part of 2.

Japanese standard common name.—Shinkai-yadori-mushi (shin-shô) = parasitic deep-sea isopod.

Remarks.—Antennae, pereopods, and uropods were not detached from the holotype to avoid damaging the single specimen.

Pleopodias superatus differs from *P. elongatus* Richardson by having pereonite 7 extending over pleonite 1 and part of 2, instead of not extending over any pleonites; antennae 1 extending onto pereonite 2 instead of to middle of pereonite 1; antennae 2 extending to middle of pereonite 3, instead of middle of pereonite 2; pereonite 5 longer than 4, and 1 and 6 longer than 2 and 3, instead of 4 longer than 5, and 1 and 6 approximately equal with 2 and 3; pleotelson with a median ridge and a deep notch on posterior margin, instead of uniform surface and rounded posterior margin; pleopods extend beyond posterior margin of pleotelson but not to posterior ends of uropods, instead of extending well beyond both.

The genus *Pleopodias* is in need of revision. However, Dr. N. L. Bruce (pers. comm.) is describing additional species in the genus, and a revision would be more comprehensive with all available species.

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