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A NEW GENUS OF CYCLOPOID COPEPOD (CHONDRACANTHIDAE) PARASITIC ON HALIBUT FROM CALIFORNIA INSHORE WATERS

Masahiro Dojiri* and Penny Sue Perkins†

ABSTRACT: *Auchenochondria lobosa* gen. et sp. n. was recovered from the oral cavity of the California halibut, *Paralichthys californicus* (Ayers), collected in Agua Hedionda Lagoon, Carlsbad, California. The new genus is closely related to *Prochondracanthus* Yamaguti 1939, and *Rhynchochondria* Ho 1967, but can be distinguished from them by the possession of cephalothoracic processes, a long neck, a 2-segmented abdomen, and a distinctly 6-segmented first antenna. *Auchenochondria lobosa* gen. et sp. n. is the only known species of chondracanthid in which the mandible of the male is equipped with more teeth on both the convex and concave surfaces than that of the female.

While conducting a study on the biology of juvenile halibut, *Paralichthys californicus* (Ayers), Mr. David B. Innis, Lockheed Center for Marine Research, Carlsbad, California, recovered some parasitic copepods from the oral cavity of several young California halibut captured in a nearby saltwater lagoon. The copepod specimens were brought to our attention by Mr. Ronald M. Leithiser, also associated with Lockheed Center for Marine Research. Examination of the parasites revealed that they represent a new genus of Chondracanthidae.

The copepods were removed from the oral cavity of the hosts and preserved in 70% isopropyl alcohol. Five females and three males were cleared and dissected in 85% lactic acid. All drawings were made with the aid of a camera lucida.

Genus *Auchenochondria* gen. n.

Female: Body elongate. Cephalothorax with maxilliped bearing somite and first pedigerous somite possessing several processes. Neck long and slender, formed from elongation of intersegmental

area between first and second pedigerous somites. Second, third, and fourth pedigerous somites incompletely fused into trunk. Posterior processes present. Genital complex clearly separated from 2-segmented abdomen. Caudal ramus unmodified. Egg sacs long and cylindrical. First antenna 6-segmented; second antenna uncinuate, with accessory lobe. Mandible falcate and bilaterally denticulated; paragnath present; first maxilla a lobe bearing 2 lanceolate processes; second maxilla bipartite, terminal claw armed with teeth. Maxilliped 3-segmented, terminal segment clawlike. Legs 1 and 2 biramous, with 2-segmented rami. Legs 3 to 5 reduced to small knobs. Leg 6 represented by setae.

Male: Body dwarf and cyclopidiform, attached to female by second antennae. Body metamerism distinct. Genital segment with usual posteroventral ridges. Abdomen 3-segmented. Caudal ramus and cephalic appendages as in female; maxilliped 4-segmented. Legs 1 to 3 biramous, leg 4 uniramous; all with 2-segmented rami. Legs 5 and 6 present.

Type species: *Auchenochondria lobosa* sp. n.

Etymology: The generic name is a combination of the Greek words *auchen* = neck and *chondria* = cartilage. The specific name is from the Greek *lobos* = lobe. The name alludes to the elongate neck and lobelike cephalothoracic processes.

Gender: Feminine.

Auchenochondria lobosa sp. n.

(Figs. 1-40)

Material examined: 10 ♀♀, 7 ovigerous, with 6 attached ♂♂, recovered from oral cavity of 8 juvenile *Paralichthys californicus* (Ayers), caught by otter trawl in Agua Hedionda Lagoon, Carlsbad, California, 3 September 1977. Two ovigerous ♀♀

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FIGURES 1-6. *Auchenochondria lobosa* gen. et sp. n., female. 1. Body, ventral. 2. Body, lateral. 3. Body, dorsal. 4. Head, ventral. 5. Head, lateral. 6. Head, dorsal. Abbreviations: A = anterior lobe, AV = anteroventral lobe, DL = dorsolateral lobe, DM = dorsomedial lobe, VL = ventrolateral lobe, P₁ = leg 1, P₂ = leg 2, P₃ = leg 3, P₄ = leg 4, T₂ = second pedigerous segment, T₃ = third pedigerous segment, T₄ = fourth pedigerous segment, DPP = dorsal posterior process, VPP = ventral posterior process. Scale: 3 mm in 1, 2, 3; 1 mm in 4, 5, 6.

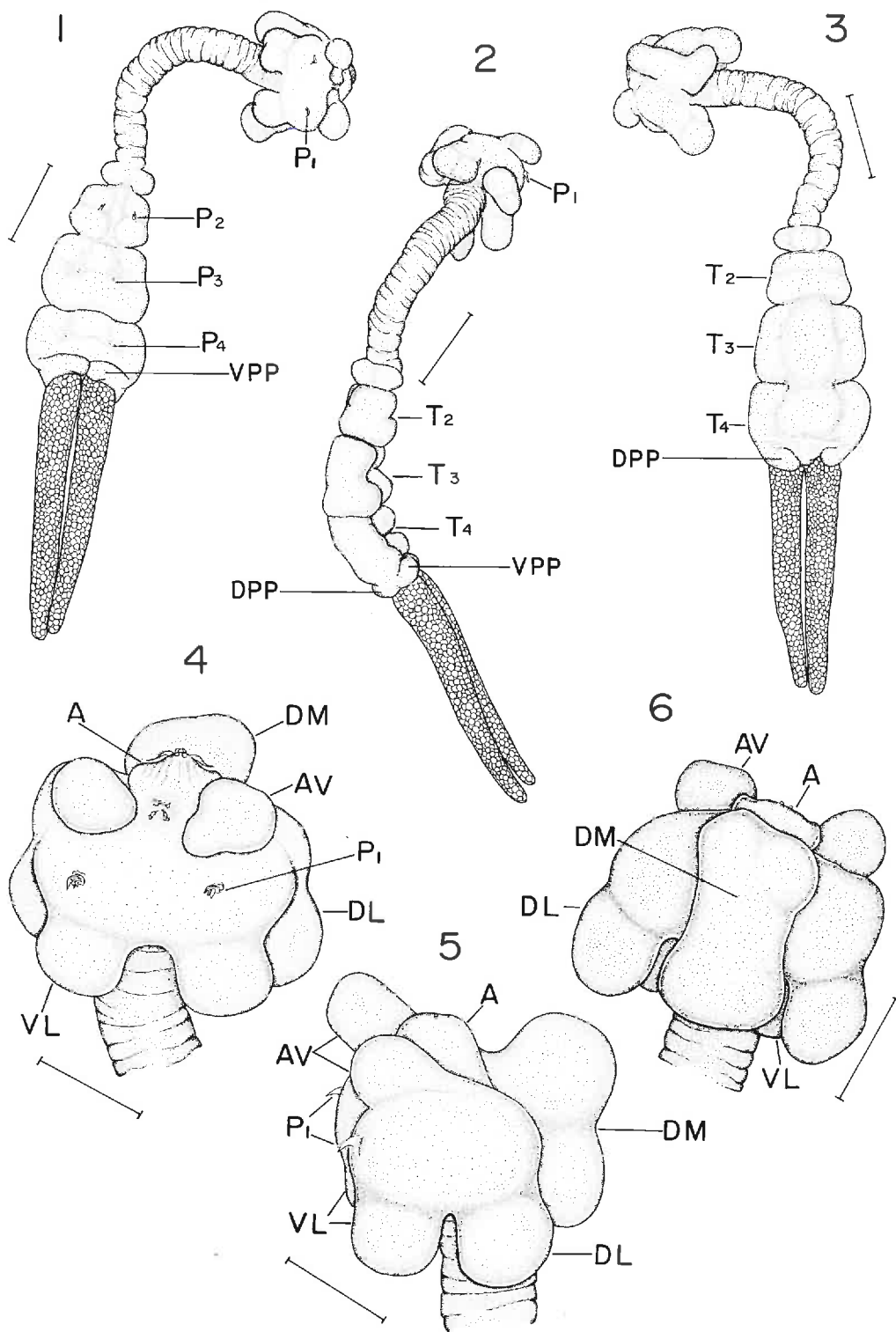


TABLE I. *Measurements (mm) of female Auchenochondria lobosa gen. et sp. n.*

	Length	Width
Body	13.14 (10.21-14.86)	2.63 (1.96-2.81)
Head	1.49 (1.26-1.69)	2.21 (1.95-2.34)
Neck	4.67 (4.17-5.86)	0.78 (0.63-0.89)
Second pedigerous segment	1.83 (1.77-2.04)	1.89 (1.68-2.21)
Third pedigerous segment	1.62 (1.42-1.89)	2.53 (2.25-2.74)
Fourth pedigerous segment	2.24 (1.93-2.41)	2.56 (2.29-2.87)
Egg sacs (from 2 specimens)	4.97-6.12	0.65-0.78

recovered from 2 juvenile *P. californicus* captured from same locality, 25 March 1978. Two of the 12 female specimens found with 2 dwarf ♂♂ attached to each. Trunk of parasite in vomerine region surrounded by host tissue; neck often coiled and imbedded near premaxillary; head sometimes extending into nasal cavity. Holotype ♀ (USNM 171274) with 2 attached ♂♂, and paratypes (4 ♀♀, 1 ♂) (USNM 171429) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., remaining paratypes in senior author's collection.

Female: Body (Figs. 1-3) slender. Cephalothorax (Figs. 4-6) possessing maxilliped and leg 1 bearing somites. Head with anterior lobe surmounted by first and second antennae, as well as with large dorsomedial lobe, and paired dorsolateral, anteroventral, and ventrolateral lobes. Shape of cephalothoracic lobes variable. Neck long and slender. Trilobed portion at base of neck, presumably part of second pedigerous segment, bearing a hump dorsally and 2 posterolateral lobes ventrally. Third and fourth pedigerous segments with dorsal and ventral depressions; dorsal depressions common to both segments, ventral depressions separate and irregular, resulting in lobed appearance of trunk. Fourth pedigerous segment bearing 2 pairs of posterior processes—1 dorsal, 1 ventral; together they partially encircle genital and abdominal segments. Genital complex (Figs. 7-9) globose and possessing a pair of dorsal setules. Abdomen attached ventrally to genital segment, distinctly 2-segmented, with second segment (anal segment) bearing a pair of dorsal setules. Caudal ramus (Fig. 10) equipped with 6 naked setae and 1 long ventral setule, with longest terminal seta almost 5 times longer than caudal ramus. Egg sacs cylindrical, extruded ventrally, and containing multiseriate eggs.

First antenna (Fig. 11) 6-segmented, first 2 segments partially fused; armature of segments: 4, 7, 8, 4, 3, 7 + 1 aesthete. Second antenna (Fig. 12) bipartite, basal part carrying a stout seta; second part a recurved claw bearing 1 posterior and 1 anterior knob; accessory lobe possessing 4 setae.

Labrum (Fig. 13) consisting of 2 rounded flaps, each with a small process at its posterolateral corner. Lateral lobe present at base of mandible (Fig. 13). Mandible (Fig. 14) 2-segmented; terminal falcate segment with 31 to 35 teeth on convex surface

and 10 to 13 teeth on concave surface. Paragnath lobe bearing 4 spinules apically. First maxilla (Fig. 15) a protrusion possessing 2 lanceolate processes and several spinules. Second maxilla (Figs. 16-17) bipartite, basal part robust and unarmed; apical claw carrying 2 setae, 1 tooth near base and 7 teeth at tip. Maxilliped (Fig. 18) 3-segmented, first segment robust and unarmed; second segment with a row of spinules; terminal segment a claw bearing a small accessory spine.

Legs 1 and 2 (Figs. 19-20) biramous, rami 2-segmented, spine (Roman numerals) and setal (Arabic numerals) formula as follows:

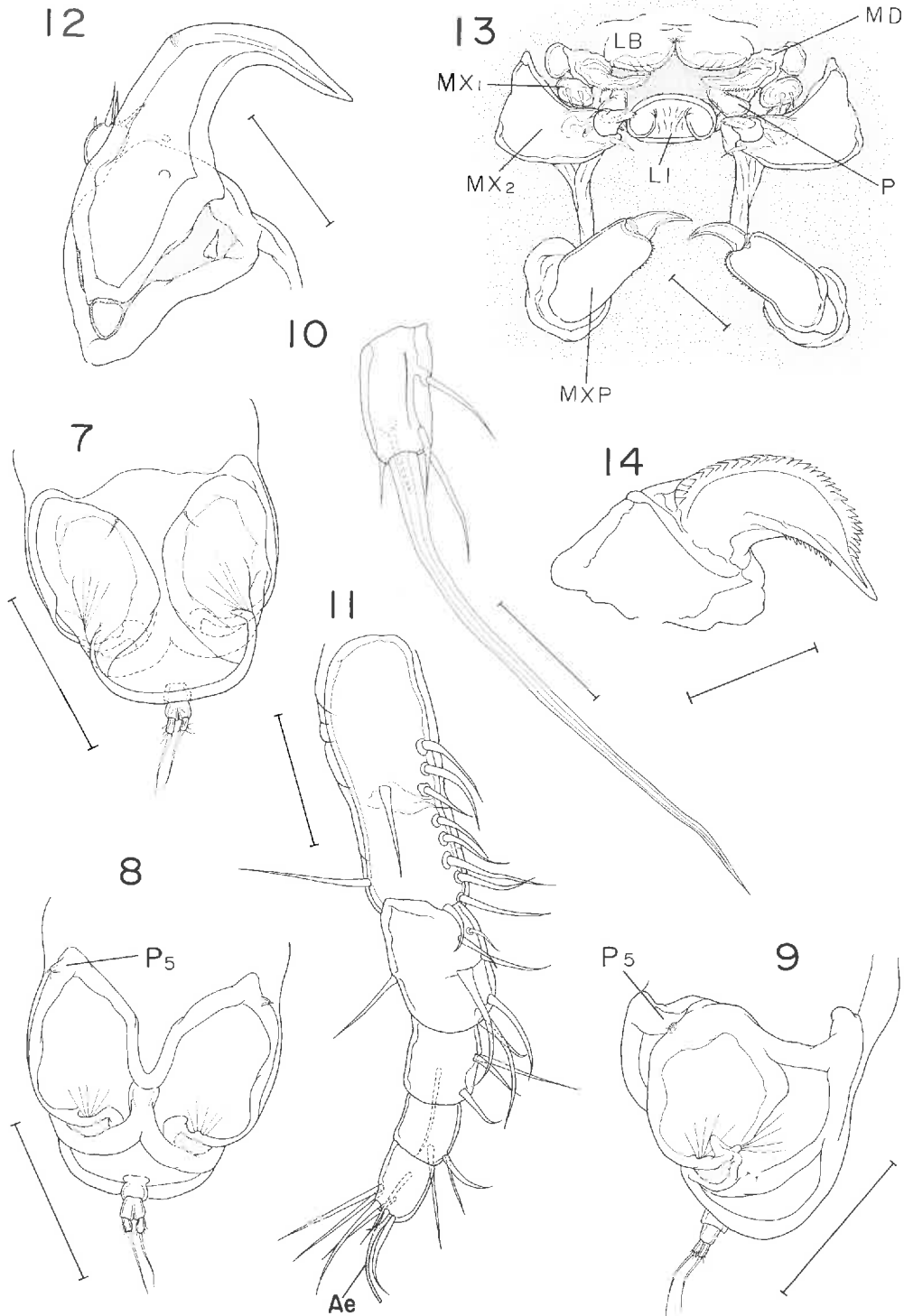
P ₁ Protopod	0-0; 1-0	exp 1-0; 4-1-4 end 0-1; 2-1-6
P ₂ Protopod	0-0; 1-0	exp 1-0; 2-1-6 end 0-1; 1-1-4

Coxa of leg 1 highly sclerotized and forming a prominent spiniform process on outer distal corner (Fig. 19). Second segment of endopod of leg 2 (Fig. 20) bearing 4 small setae, a small outer knob, and a large terminal spine; some specimens bearing a setule near proximal side of outer knob. Leg 3 (Fig. 21) represented by a small knob with a moderately long seta and 3 setules. Leg 4 (Fig. 22) also a knob carrying a seta and a small ventral digitiform process. Leg 5 (Fig. 23) consisting of a small protrusion tipped with 3 slender setae, situated on genital complex. Leg 6 represented by 2 setae near egg laying apparatus. Measurements given in Table I.

Male: Dwarf body, with ventral flexion; attached to either dorsal or ventral posterior processes of female (Fig. 24). Body (Fig. 25) 2.47 (2.35 to 2.63) by 0.65 mm (0.64 to 0.67 mm), with distinct metamerism. First pedigerous somite not incorporated into head. Urosome shorter than prosome. Genital segment (Fig. 26) possessing a pair of ventral ridges. First 2 abdominal segments (Fig. 27) each bearing a single row of minute spinules. Anal segment (Fig. 27) with 2 dorsal setules and 2 pairs of closely associated patches of spinules near distal end of ventral surface. Caudal ramus (Fig. 27) essentially as in female, except for a small group of spinules at base of each lateral seta and near bases of long spiniform seta.

First antenna (Fig. 28) as in female, except fifth segment which has armature of 2 + 1 aesthete. Second antenna (Fig. 29) stouter than in female, with 1 inner and 3 anterior hyaline lobes. Accessory lobe tipped with 4 setae, 2 of which possess small lobes at their bases.

Labrum as in female. Mandible (Fig. 30) bearing 66 teeth on convex and 47 teeth on concave surfaces. Paragnath (Fig. 31) a long lobe carrying many long spinules. First maxilla as in female but somewhat stouter. Second maxilla (Fig. 32) differing from female in possessing 8 teeth at tip of claw. Maxilliped (Fig. 33) 4-segmented; first segment unarmed and almost as long as remaining segments combined; second segment bearing long rows of spinules and a digitiform process on inner surface; third segment small and unarmed; terminal segment unguiform, with a proximal setule and 2 distal accessory spines.



FIGURES 7-14. *Auchenochondria lobosa*, female, continued. 7. Genital complex, dorsal. 8. Genital complex, ventral. 9. Genital complex, lateral. 10. Caudal ramus, ventral. 11. First antenna, ventral. 12. Second antenna, posterior. 13. Oral area, ventral. 14. Mandible, dorsal. Abbreviations: Ae = aesthete, LB = labrum, LI = labium, MD = mandible, MX₁ = first maxilla, MX₂ = second maxilla, MXP = maxilliped, P = paragnath, P₅ = leg 5. Scale: 0.5 mm in 7, 8, 9; 0.04 mm in 10, 11, 12, 13; 0.02 mm in 14.

TABLE II. A comparison of *Auchenochondria* gen. n. with two closely related genera of Chondracanthidae.

	<i>Auchenochondria</i> gen. n.	<i>Prochondracanthus</i> Yamaguti 1939	<i>Rhynchochondria</i> Ho 1967
<i>Female</i>			
Cephalothoracic processes	Present	Absent	Elongate rostrum
Neck	Long	Short	Short
Abdomen	2-segmented	1-segmented	Fused to genital segment
First antenna	6-segmented	5-segmented	Indistinctly 6-segmented
No. of legs	6 pairs	6 pairs	3 pairs
<i>Male</i>			
Head and first pedigerous somite	Separate	Fused	Fused
Abdomen	3-segmented	2-segmented	1-segmented

Legs 1-3 (Figs. 34-36) biramous. Leg 4 (Fig. 37) uniramous. All 4 legs possessing 2-segmented rami with formula on these legs as follows:

P ₁ Protopod	0-0; 1-0	exp I-0; III-I-5 end 0-1; I-6
P ₂ Protopod	0-0; 1-0	exp I-0; II-I-6 end 0-1; III-4
P ₃ Protopod	0-0; 1-0	exp I-0; I-I-6 end 0-1; II-3
P ₄ Protopod	0-0; 1-0	exp I-0; I-I-5

Leg 5 (Fig. 26) represented by a knob bearing 3 setae, situated on ventral surface of pregenital segment. Leg 6 (Fig. 26) represented by 3 setae in vicinity of ventral ridges of genital segment; 2 rows of spinules present at base of leg 6.

DISCUSSION

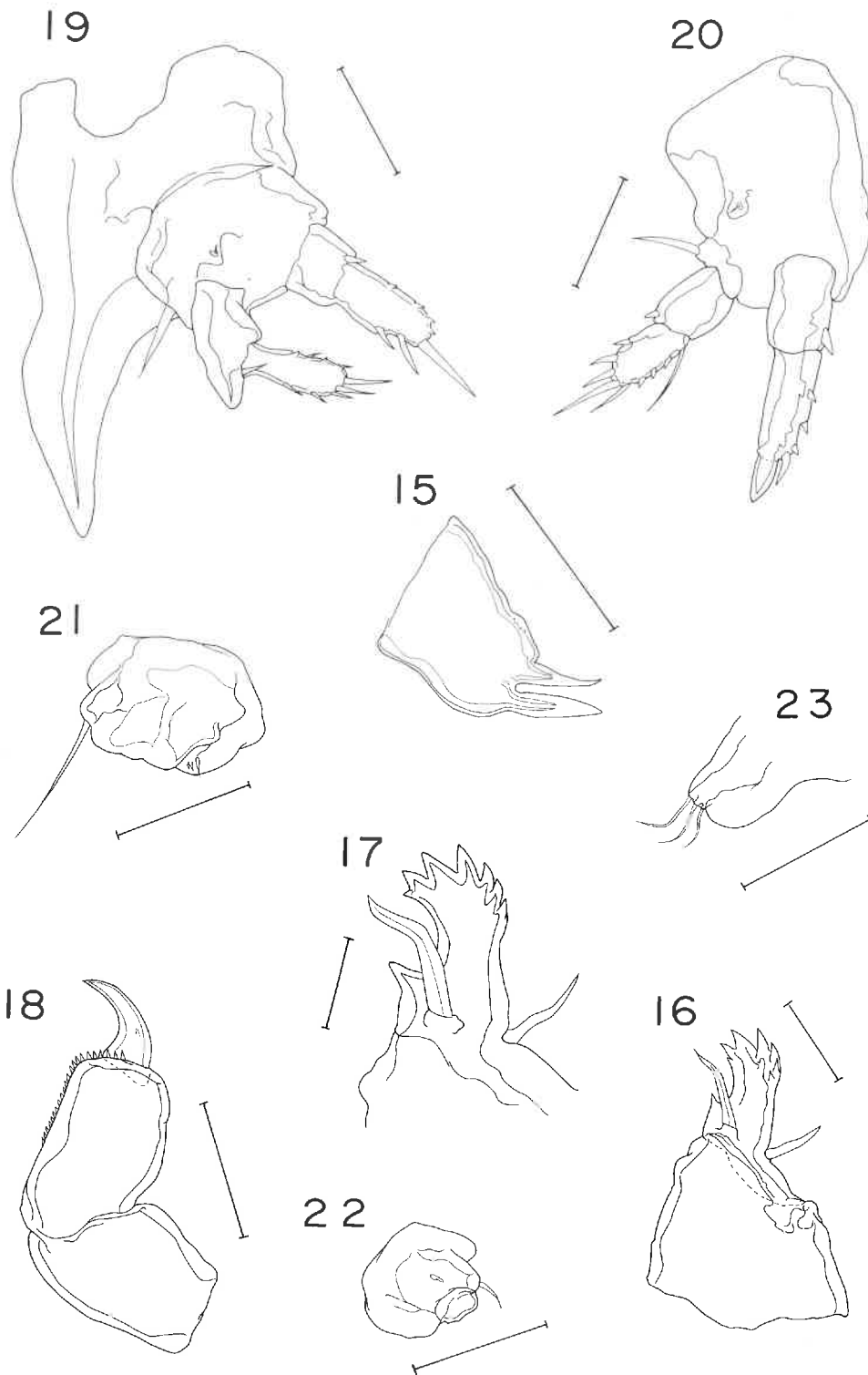
The two genera, *Brachiochondrites* Markewitsch 1940, and *Lernentoma* Blainville 1822, belonging to the chondracanthid subfamily Lernentominae, possess extremely long necks similar to *Auchenochondria*. According to Ho (1970), the members of Lernentominae possess a head composed solely of the antennal portion of the cephalosome with the mouth parts located at the base of the neck. Consequently, the neck is formed from the elongation of the premandibular portion

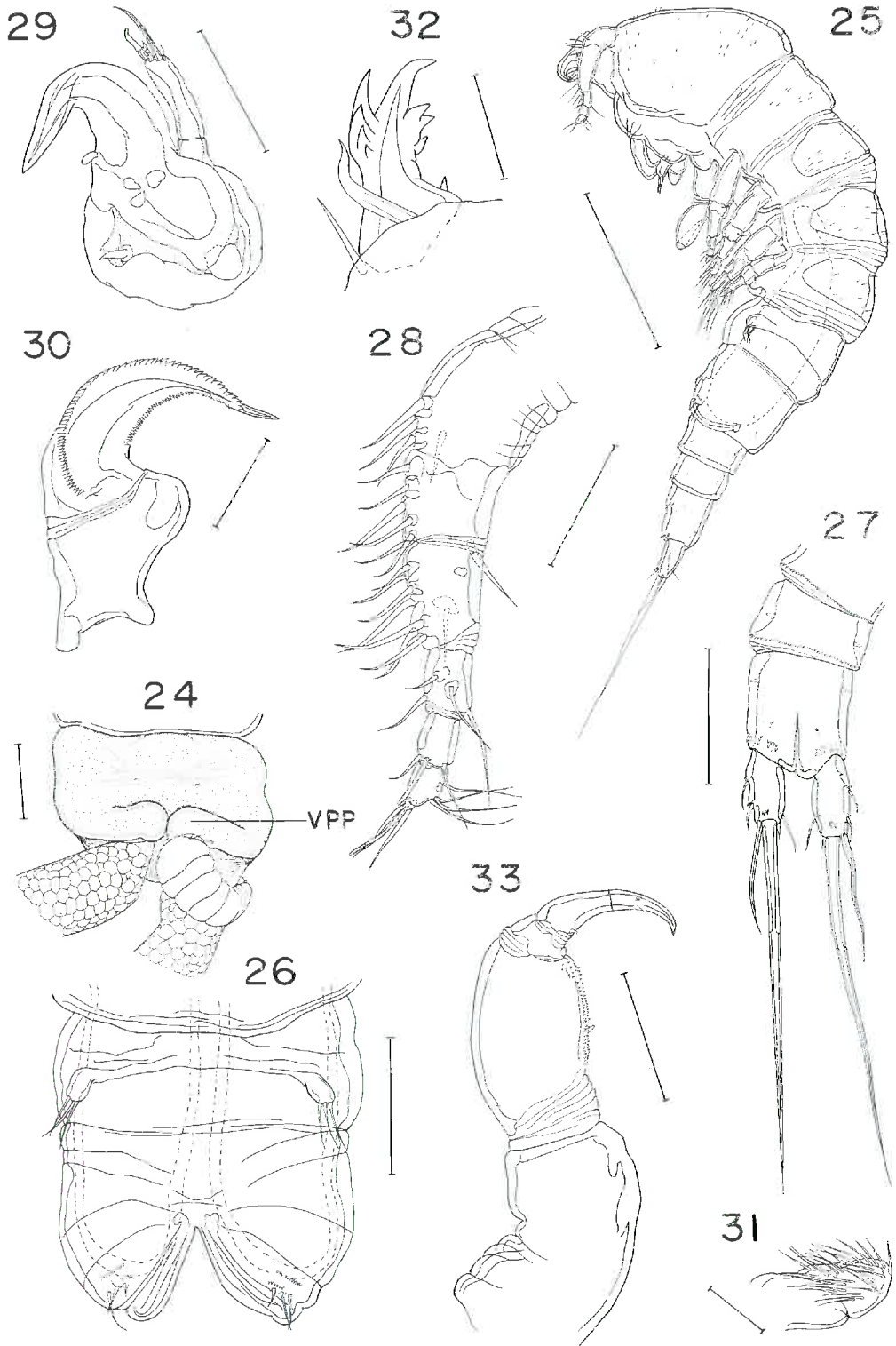
of the organism. On the other hand, the subfamily Chondracanthinae is characterized by the possession of a head that has incorporated all the mouth parts and frequently the first pedigerous somite. Because *Auchenochondria* possesses a head incorporating the mouth parts, and both the maxilliped and leg I bearing somites, it clearly belongs to the subfamily Chondracanthinae.

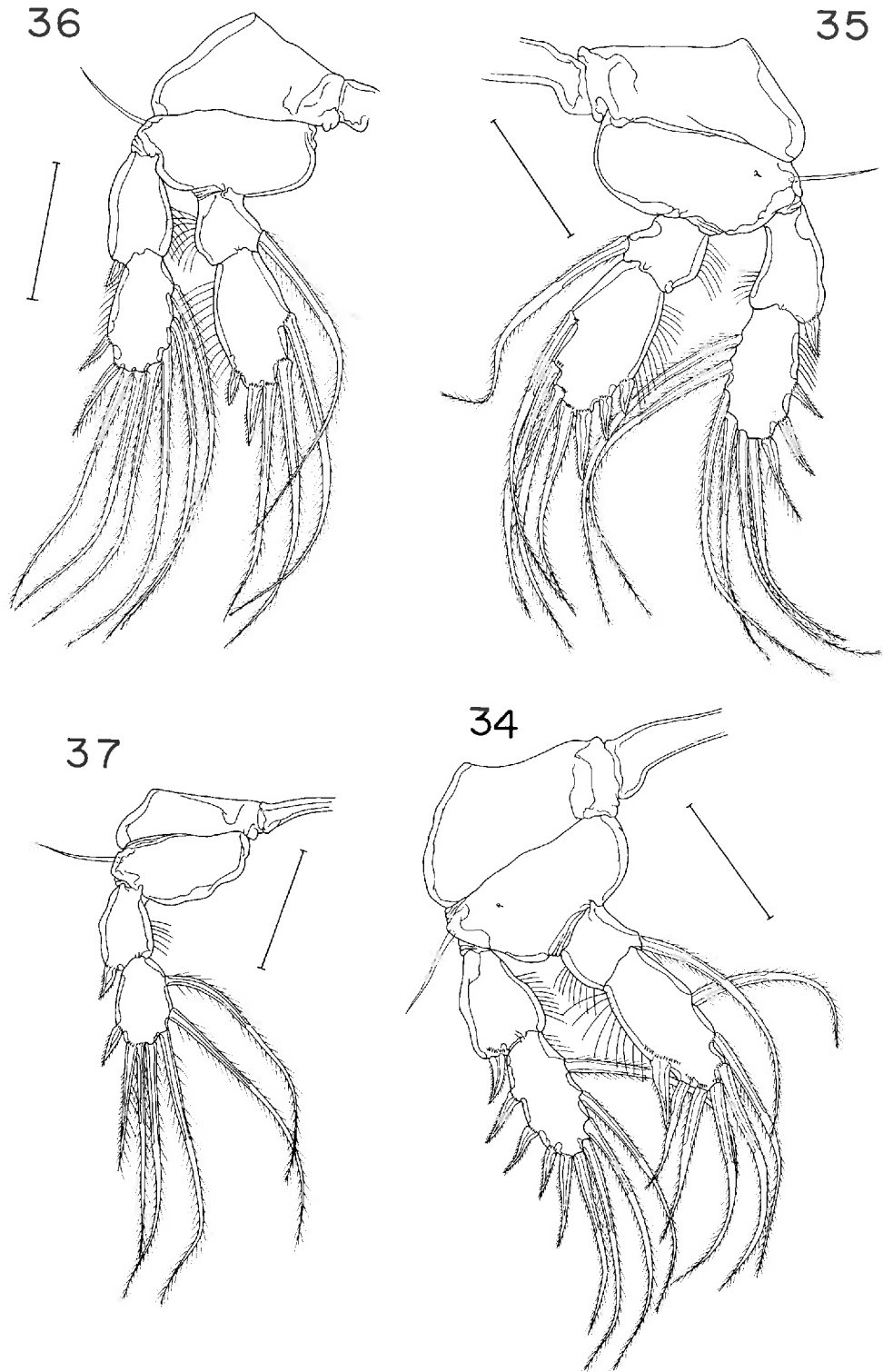
Prior to the discovery of *Auchenochondria*, there were five genera of Chondracanthinae with elongated necks. They are *Markevitchelinus* Titar 1975, *Medesticaste* Krøyer 1863, *Pterochondria* Ho 1973, *Scheherazade* Leigh-Sharpe 1934, and *Strabax* Nordmann 1864. The female of *Auchenochondria* is distinguished from the females of these five genera by the possession of a distinct genital complex and abdomen, the presence of unmodified legs 1 and 2, and the presence of legs 3, 4, 5, and 6. Although the male of *Scheherazade* remains unknown, the male of *Auchenochondria* is distinct from the males of the remaining four genera by the presence of a distinctly 3-segmented abdomen, and the possession of six pairs of legs, the first four of which are unmodified.

FIGURES 15-23. *Auchenochondria lobosa*, female, continued. 15. First maxilla, antero-inner. 16. Second maxilla, posterior. 17. Tip of second maxilla, posterior. 18. Maxilliped, outer. 19. Leg 1, anterior. 20. Leg 2, anterior. 21. Leg 3, ventral. 22. Leg 4, ventral. 23. Leg 5, ventral. Scale: 0.02 mm in 15, 16; 0.04 mm in 18, 21, 22; 0.01 mm in 17; 0.05 mm in 19, 20; 0.1 mm in 23.

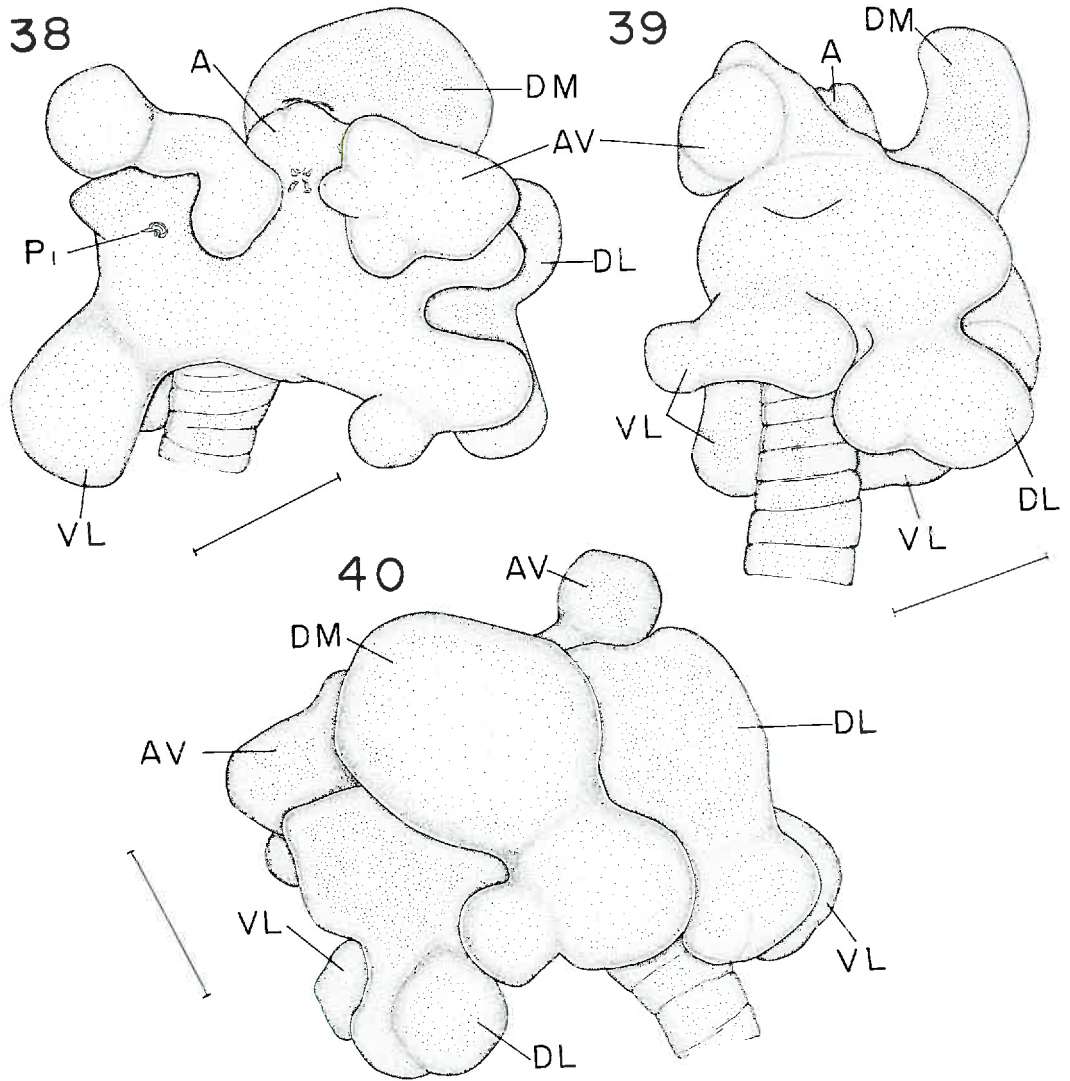
FIGURES 24-33. *Auchenochondria lobosa*, male. 24. Male attached to ventral posterior processes of female. 25. Body, lateral. 26. Fifth pedigerous segment and genital segment, ventral. 27. Postgenital segments and caudal rami, ventral. 28. First antenna, anterodorsal. 29. Second antenna, anterior. 30. Mandible, dorsal. 31. Paragnath, ventral. 32. Tip of second maxilla, posterior. 33. Maxilliped, anterior. Abbreviation: VPP = ventral posterior process. Scale: 1 mm in 24; 0.5 mm in 25; 0.1 mm in 26, 28, 29, 33; 0.2 mm in 27; 0.04 mm in 30, 32; 0.02 mm in 31.







FIGURES 34-37. *Auchenochondria lobosa*, male, continued. 34. Leg 1, anterior. 35. Leg 2, anterior. 36. Leg 3, anterior. 37. Leg 4, anterior. Scale: 0.1 mm in 34, 35, 36, 37.



FIGURES 38-40. *Auchenochondria lobosa*, female, aberrant specimen. **38.** Head, ventral. **39.** Head, lateral. **40.** Head, dorsal. Abbreviations: A = anterior lobe, AV = anteroventral lobe, DL = dorsolateral lobe, DM = dorsomedial lobe, P₁ = leg 1, VL = ventrolateral lobe. Scale: 0.1 mm in 38, 39, 40.

Using the characteristics outlined by Ho (1970), *Auchenochondria* appears closely related to *Prochondracanthus* Yamaguti 1939, and *Rhynchochondria* Ho 1967. These three genera are allied to one another and distinguishable from the remaining chondracanthid genera by the possession of 1) a cephalothorax possessing both maxilliped and leg 1 bearing somites, 2) a neck formed from the intersegmental area between the first and second pedigerous segments in the female, 3) an unmodified caudal ramus with six setae in both

the female and male, 4) an unmodified first antenna in the female, 5) an accessory lobe on the second antenna of both the female and male, 6) at least three pairs of legs in the female and three pairs of unmodified legs in the male, and 7) a distinct abdomen in the male.

The three genera, *Auchenochondria*, *Prochondracanthus*, and *Rhynchochondria* are distinguishable from each other by the details of various structures as shown in Table II.

Auchenochondria lobosa is the only known species of chondracanthid in which the man-

dible of the male is equipped with more teeth on both the convex and concave surfaces than that of the female. Furthermore, the male maxilliped is unusual in possessing an additional segment with respect to that of the female.

The cephalothoracic lobes may be incised in varying degrees and may exhibit asymmetry (Figs. 38-40).

Prior to the discovery of *Auchenochondria lobosa*, the California halibut, *Paralichthys californicus*, had been reported to harbor four other species of parasitic copepods in southern California waters. Ho (1972, 1975) reported *Holobomolochus proluxus* (Cressey 1969); *Taeniacanthodes haakeri* Ho 1972; *Lepeophtheirus bifidus* Fraser 1920 (?); and *Acanthochondria soleae* (Krøyer 1838) (?), from this species of fish.

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