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Genus Gloiopotes and a New Species With Notes on Host Specificity And Intraspecific Variation (Copepoda: Caligoida)

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Examination of 94 recent collections of the genus *Gloiopotes* have made possible a reevaluation of the species and certain conclusions regarding host specificity and intraspecific variation. In 1964 Hewitt published an account of *Gloiopotes huttoni* with notes on the other species. In his paper he placed *G. watsoni* in synonymy with *G. huttoni* and attributed the differences to variation within the species. I have been able to show that the two are actually distinct and should be considered separate species. In addition a new species from the Gulf of Mexico is described below.

I am indebted to the following persons who generously donated material to me for inclusion in this study: Dr. Bruce Collette, Bureau of Commercial Fisheries; Dr. Robert Gibbs, Smithsonian Institution; Dr. Richard Gooding, University of Singapore; and Dr. Alan Lewis, University of British Columbia. A portion of the field work was supported by the National Science Foundation, U.S. Program in Biology.

All drawings were made with the aid of a camera lucida.

All material has been desposited in the Museum of Natural History, Smithsonian Institution.

Gloiopotes Steenstrup and Lutken, 1861

Gloiopotes Steenstrup and Lutken, 1861, p. 363. [Type-species=*G. hygomianus*.]
Lepeophtheirus, Thomson, 1889, p. 354 [refers to *L. huttoni* only].
Caligus, Marukawa, 1925, p. 1243 [refers to *C. longicaudatus* only].

Euryphoridae. First 3 thoracic segments fused with head. Fourth thoracic segment with winglike dorsal plate. Genital segment with posterior outer corners produced in female. Fifth legs conspicuous in both sexes. Abdomen 2-segmented. Caudal rami filiform. First antenna 2-segmented. Second antenna with strong claw. Second antenna claw of male with median accessory process. Postantennal and postoral processes present. Sternal furca present. Legs 1–3 biramose (Yamaguti, 1963, p. 103, erroneously cites leg 1 as uniramose). Leg 4 uniramose. Egg strings uniseriate.

Key to Females of *Gloiopotes*

1. Dorsal body surface without conspicuous ornamentation, posterior process of sternal furca with single point, distal posterior lobe of genital segment extending beyond end of 5th leg . . . . **hygomianus**
   Dorsal body surface with conspicuous ornamentation, posterior process of sternal furca bifid, distal lobe of genital segment not extending beyond end of 5th leg 2
2. Lateral margins of dorsal thoracic plate nearly parallel to anterior-posterior body axis, lateral margins of genital segment with conspicuous bulge bearing stout spines 3
   Lateral margins of dorsal thoracic plate at nearly 45° angle to anterior-posterior body axis, lateral margins of genital segment uniformly rounded, bearing small spines 4
3. Middle of 2nd abdominal segment with bulbous swelling, 5th leg extending to end of abdomen . . . . **ornatus**
   Middle of 2nd abdominal segment swollen but not bulbous, 5th leg not extending to end of abdomen . . . . **americanus**, new species
4. Genital segment longer than wide, tip of 5th leg not extending to end of abdomen . . . . **huttoni**
   Genital segment wider than long, tip of 5th leg extending to end of abdomen . . . . **watsoni**

Gloiopotes americanus, new species

Figures 1–24

Specimens studied.—Eight collections from *Istiophorus americanus* in the southwestern portion of the Gulf of Mexico made by various cruises of the Oregon at stations 1051, 1069, 1071, 1075, and 1145. Holotype ♀, USNM 120189, allotype ♂, USNM 120190, and 12 paratypes (4♀♀, 8 ♂♂) USNM 120191, from the collection made at station 1145 (28°17′ N, 87°52′ W). Also the following collections in the USNM labelled *Gloiopotes ornatus:* USNM 78600 from sailfish caught at Stuart, Fla.; USNM 102036 from sailfish caught at Pass-a-Grille, Fla.

Female.—Total length (including caudal rami) 10.90 mm (10.05–11.70 mm); greatest width (measured at widest part of cephalon) 4.95 mm (4.50–5.25 mm) based on an average of 136 specimens.

Body form as in figure 1. Dorsal surface of cephalon with rows of hairs and spinules as indicated in the figure. Most hairs bifurcate. Dorsal thoracic plate of segment bearing leg 4 winglike, inner posterior corner extending slightly over genital segment. Lateral edges of plates held nearly parallel to body axis. Genital segment (fig. 2) about as long as wide, narrowest anteriorly with posterior corners projecting posteriorly. Lateral margin of genital segment with slightly bulbous area bearing a row of spinules. Dorsal surface of segment with prominent spines (usually 3) on either side of midpoint. Abdomen (see fig. 2) 2-segmented; 1st segment about one-half as long as second segment; both segments with prominent spines on dorsal surface as in the figure; 2 prominent spines on ventral surface near posterior end of second segment. Abdomen comprises about 18.5 percent of total length. Caudal ramus (fig. 3) long and slender, bearing a notch on outer edge of anterior quarter. Each ramus with 5 plumose setae (2 at notch and 3 terminal) and several prominent spines (usually 8) on both surfaces.

Oral area with well-developed postantennal and postoral processes (fig. 4). Postantennal process usually with 3 tines; innermost tine occasionally bifurcate producing a 4-pointed process (fig. 5). Postoral process with 2 tines directed posteriorly. Both processes heavily pigmented.

First antenna (fig. 6) 2-segmented; basal segment with a process on anterior border and 23 stout plumose setae along anterior edge of distal half; 2nd segment with distal half sclerotized bearing 1 subterminal and 13 terminal naked setae. Second antenna (fig. 7) with well-developed claw, heavily pigmented at tip. Mouth tube (fig. 8) of usual caligoid type. Mandible a styliform process projecting within tube bearing 12 teeth at tip. First maxilla reduced to a group of 2 setae anterior to postoral process (see fig. 4). Second maxilla (fig. 9) long and slender, terminating in 2 weakly developed fringed spines. Maxilliped (fig. 10) with a well-developed claw usually pigmented at tip; adhesion area near distal end of basal segment. Sternal furca (fig. 11) with innermost tine bifurcate and heavily pigmented. Lateral to furca on each side is an accessory lobe, often bearing a process on outer corner.

Legs 1–3 biramose. Leg 1 (fig. 12) exopod 2-segmented. Last segment with 3 terminal spines and 4 inner setae. Two innermost spines bifurcate, each bearing a delicate median seta (fig. 13). Endopod (fig. 14) small, 2-segmented; 2nd segment with 3 setae. Leg 2 (fig. 15) exopod 3-segmented; each segment with a well-developed pigmented spine on outer distal corner; inner margin bearing a strongly recurved seta armed with stout plumosities. Endopod 3-segmented, armed as in the figure. Leg 3 (fig. 16) exopod 3-segmented with well-developed bifurcate spine representing 1st segment. Endopod 3-segmented. Basal segment fused with coxopod and difficult to distinguish. Fourth leg (fig. 17) uniramose, armed as in figure. Fifth leg projecting beyond outer distal corner of genital segment to end of abdomen, bearing 3 plumose setae (1 basal, 2 terminal). Terminus of leg 5 (fig. 18) with strong spines.

Egg strings uniseriate, 3.7 mm (3.3–4.2 mm) long, based on an average of 7 specimens.

Color in life bluish purple.

Male.—Total length (including caudal rami) 9.28 mm (8.85–10.05 mm); greatest width (measured at widest part of cephalon) 3.75 mm (3.45–4.05 mm) based on an average of 25 specimens. Body form as in figure 19. Cephalon and thoracic segments ornamented dorsally as in female. Thoracic segment bearing legs 4 with dorsal plates as in female. Genital segment (fig. 20) rounded, 1.5 x 1.7 mm, slightly longer than wide with 5th legs projecting from outer distal corners to about middle of abdomen. Spinules on dorsal surface as indicated in figure. Abdomen 2-segmented; 2nd segment twice as long as 1st, both segments with dorsal spinules. Caudal rami as in female.

Oral area in general as in female. Second antenna (fig. 21) with terminal claw and accessory subterminal claw. Inner distal corner of basal segment with adhesion area. Maxilliped basal segment (fig. 22) with sclerotized knobs as indicated in figure. Other cephalic appendages as in female.

Legs 1–4 as in female.

Leg 5 (fig. 23) projecting posteriorly from genital segment, armed with 1 plumose seta near base and heavy spines along inner edge to tip as in figure. Leg about 2.2 mm long measured along inner edge from origin to tip, extending to about middle of abdomen. Leg 6 (fig. 24) represented by an outer plumose seta and 2 inner spines near junction of genital segment and abdomen.

Remarks.—*Gloiopotes americanus* can be separated from *G. watsoni* and *G. huttoni* by the presence of a spinose bulge along the lateral margins of the genital segment of *G. americanus*. Also the outer margins of the winglike plates of *G. americanus* are nearly parallel to the anterior-posterior axis of the body while those of *G. watsoni* and *G. huttoni* are at an angle of nearly 45°.

This new species can be separated from *G. ornatus* by the nature of the spinose bulge along the margins of the abdomen of the female.

In *G. ornatus* the bulge is conspicuous, whereas in *G. americanus* it is only slight (see pl. 1). The males of these two species can be separated on the basis of leg 5 extending nearly to the end of the abdomen in *G. ornatus* whereas it extends only slightly beyond the middle of the abdomen in *G. americanus* (see pl. 2).

So far *G. americanus* has only been recorded from the sailfish *Istiophorus americanus* with all collections from the Gulf of Mexico except one collection from Stuart, Fla. It may be that this species is restricted to this host.

Gloipotes ornatus Wilson

Figures 25–26

Gloiopotes ornatus Wilson, 1905, p. 127; 1907, p. 699; 1919, p. 315; 1932, p. 415; 1936, p. 32.—Rathbun, 1905, p. 93.—Yamaguti, 1936, p. 5; 1963, p. 104.—Rao, 1951, p. 254.—Shiino, 1954, p. 277; 1959, p. 349.—Heegaard, 1963, p. 174.—Hewitt, 1964, p. 95.

Specimens studied.—Twenty-one collections from *Tetrapturus albidus* and 6 collections from *Makaira nigricans* from various M/V *Delaware* cruises in the western North Atlantic, 1 collection from *M. nigricans* caught off Beaufort, N.C., and 7 collections in the USNM (including types) from both hosts cited above (5 collections off east coast of U.S. and 2 from Caribbean).

Body form and ornamentation as in *G. americanus*.

The adult females of *G. ornatus* tend to be larger than those of *G. americanus*. Total length 11.72 mm (10.50–12.90 mm); greatest width 5.23 mm (4.50–5.70 mm) based on an average of 136 specimens.

Adult males total length 9.75 mm (9.00–11.10 mm); greatest width 3.93 mm (3.45–4.50 mm) based on an average of 128 specimens. The 5th legs of males extend posteriorly well beyond middle of abdomen (see fig. 26 and pl. 2).

Since *G. ornatus* and *G. americanus* cannot be separated on appendage characters, a description of the appendages of *G. ornatus* is not given here. The descriptions and figures of *G. americanus* appendages apply to *G. ornatus* as well.

Remarks.—This species cannot be distinguished from *G. americanus* on the basis of the appendages. However, the adult females can be separated by certain characters of the genital segment and abdomen. In *G. ornatus* there is a distinct lateral bulbous expansion of the second abdominal segment that is not present in *G. americanus*. Also, the lateral swollen areas of the genital segment are more pronounced in *G. ornatus* (see pl. 1). The 5th legs of the female *G. ornatus* extend to the end of the abdomen or slightly beyond, whereas the 5th legs of *G. americanus* do not (compare figs. 2 and 25, and see pl. 1). The only specimens of this species studied by the author were collected from the northwestern Atlantic Ocean and Caribbean Sea. So far, it has not been collected from the sailfish *Istiophorus americanus* but has been found on all other species of billfish examined.

Gloiopotes huttoni (Thompson)

FIGURES 27–37

Lepeophtheirus huttoni Thompson, 1889, p. 354.—Wilson, 1907, p. 701.
Gloiopotes huttoni Bassett-Smith, 1899, p. 440.—Rao, 1951, p. 254.—Shiino, 1954, p. 278.—Yamaguti, 1963, p. 104.—Hewitt, 1964, p. 86.
Caligus longicaudatus Marukawa, 1925, p. 1243; 1949, p. 927.
Gloiopotes longicaudatus Shiino, 1954, p. 273; 1957, p. 364; 1958, p. 105; 1959, p. 348; 1963, p. 343.—Heegaard, 1963, p. 174.—Ho, 1963, p. 87.—Yamaguti, 1963, p. 104.—Hewitt, 1964, p. 94.
Gloiopotes species Yamaguti, 1936, p. 4.
Gloiopotes costatus Wilson, 1919, p. 313.—Yamaguti, 1936, p. 5 [spelled *constatus*].—Shiino, 1954, p. 277.—Heegaard, 1963, p. 174 [spelled *constatus*].—Yamaguti, 1963, p. 103.—Hewitt, 1964, p. 94.
Gloiopotes zeugopteri Rao, 1951, p. 248.—Shiino, 1959, p. 349.—Yamaguti, 1963, p. 104.—Hewitt, 1964, p. 95.

SPECIMENS STUDIED.—Nine collections from *Tetrapturus audax*, 1 collection from *Makaira indicus*, 2 collections from *Istiophorus orientalis*, all from various sites in the Indian Ocean collected during the International Indian Ocean Expedition; 2 collections from *T. audax* collected off Peru during the Southeastern Pacific Biological Oceanographic Program; 5 collections in the USNM labeled as *G. costatus* from billfishes (labeled "swordfish" or "marlin") from the eastern Pacific; 1 collection in the USNM from *M. audax* from Hawaii.

FEMALE.—Body form as in figure 27. Total length 13.75 mm (11.70–15.15 mm); greatest width 6.20 mm (5.10–7.20 mm) based on an average of 65 specimens. Specimens from *I. orientalis* tend to be smaller (12.15 x 5.40 mm average) based on an average of 10 specimens.

Dorsal surface of cephalon with rows of bifurcate hairs and spinules arranged as indicated in figure. Dorsal thoracic segment bearing leg 4 with winglike plates. Lateral edges of plates held at an angle to anterior-posterior axis of body. Genital segment (fig. 28) longer than wide (length from anterior shoulder to end of posterior lobe not including leg 5). Lateral edges of genital segment with small spinules. Dorsal surface of segment with 2 rows of prominent spines as in *G. ornatus* and *G. americanus*. Posterior lobe of genital segment well developed and projecting well beyond middle of leg 5. Abdomen 2-segmented with spinules as in figure 28. Caudal rami (fig. 29) as in *G. ornatus* and *G. americanus*. Sternal furca as in figure 30.

Appendages as in *G. ornatus* and *G. americanus*.

MALE.—Body form and dorsal ornamentation in general like *G. ornatus* and *G. americanus*. Total length 10.84 mm (10.05–12.75

mm); greatest width 4.29 mm (3.75–4.95 mm) based on an average of 28 specimens. The specimens from *I. orientalis* tend to be smaller than those from other hosts (10.16 x 4.13 mm), average of 10 specimens. Genital segment (fig. 33) longer than wide (2.55 x 2.17 mm). Fifth legs extend posteriorly to about middle of abdomen. Dorsal surface of genital segment and abdomen with spines usually arranged as in figure. This arrangement may vary from specimen to specimen even within the same collection.

Appendages as in *G. ornatus* and *G. americanus*.

Remarks.—I have examined the type specimens of *G. costatus* Wilson and determined this species to be synonymous with *G. huttoni*. Lewis (1967) points out that the tripartite spine of leg 3 is actually bipartite and does not differ from *G. ornatus* as claimed by Wilson. My own examination of the type specimens confirms Lewis' conclusions.

Gloiopotes watsoni Kirtisinghe

Figures 38–39

Gloiopotes watsoni Kirtisinghe, 1934, p. 167.—Rao, 1951, p. 254.—Shiino, 1959, p. 348.—Yamaguti, 1963, p. 104.—Hewitt 1964, p. 95.
Gloiopotes auriculatus Barnard, 1957, p. 11.—Hewitt, 1964, p. 95.

Specimens studied.—Eight collections from *Makaira nigricans*, 4 collections from *Tetrapterus audax*, 4 collections from *Makaira indicus*, 6 collections from *Istiophorus orientalis*, all from the Indian Ocean; 1 collection from *Makaira nigricans*, collected off Peru during the Southeastern Pacific Biological Oceanographic Program; 5 USNM collections from *Makaira nigricans* from Taiwan, Hawaii, and Panama Bay; 2 USNM collections from *Istiophorus orientalis* off the Pacific coast of Mexico; and 2 USNM collections from "marlin" caught off Tahiti.

Female.—Body form in general as in *G. huttoni* except for differences noted below. Total length 12.16 mm (10.80–13.80 mm). Greatest width 5.56 mm (4.480–6.45 mm) based on an average of 91 specimens. The average length and width measurements varied from one host group to the next, those copepods on *I. orientalis* having the smallest average size and those on *T. audax* largest (see p. 12).

Dorsal plates of 4th thoracic segment with lateral margins held at an angle to long axis of the body as in *G. huttoni*.

Genital segment (fig. 38) wider than long (3.0 x 3.2 mm), average of 91 specimens from 4 hosts. Lateral margins rounded, without conspicuous bulge, ornamented with row of small spinules. Dorsal surface ornamented as in *G. huttoni*. Posterior lobe shorter than in *G. huttoni* (see pl. 3). Abdomen and caudal ramus as in *G. huttoni*.

The appendages of *G. watsoni* cannot be distinguished from *G. ornatus*, *G. americanus*, or *G. huttoni* with the result that descriptions of appendages of those species apply to *G. watsoni* as well.

MALE.—Body form in general as in *G. huttoni*. Total length 11.45 mm (10.45–12.75 mm) based on an average of 36 specimens from all 4 hosts in the Indian Ocean. As in the female those specimens from *I. orientalis* tend to be smaller (10.65 mm. average) than other hosts. Dorsal surface ornamented with hairs and spinules as in *G. huttoni*.

Genital segment (fig. 39) about as wide as long (2.6 x 2.6 mm). Fifth leg usually extends posteriorly beyond middle of abdomen. Abdomen and caudal rami as in *G. huttoni*.

Appendages as in *G. huttoni*.

REMARKS.—Females of this species can be separated from *G. huttoni* by the nature of the genital segment. In *G. watsoni* the genital segment is wider than long whereas it is longer than wide in *G. huttoni*. The posterior lobe is shorter in *G. watsoni*. In *G. huttoni* the posterior lobe of the genital segment extends nearly as far as the 5th leg (see pl. 3). In *G. huttoni* the tip of the 5th leg extends only to about the posterior three-fourths of the abdomen, whereas in *G. watsoni* it extends to the end of the abdomen. Males of the two species differ in the nature of the genital segment. In *G. huttoni* the segment is longer than wide, whereas in *G. watsoni* it is nearly square.

Gloiopotes hygomianus Steenstrup and Lütken

FIGURES 40–42

Gloiopotes hygomianus Steenstrup and Lütken, 1861, p. 363.—Bassett-Smith, 1899, p. 458.—Stebbing, 1900, p. 670.—Wilson, 1907, p. 702.—Rao, 1951, p. 254.—Shiino, 1954, p. 278; 1960, p. 533.—Yamaguti, 1963, p. 103.—Hewitt, 1964, p. 95.—Lewis, 1966, p. 11.

SPECIMENS STUDIED.—Two collections from the western North Atlantic, 1 collection from Socorro Island (eastern Pacific), 1 collection from the Indian Ocean, and 4 collections in the USNM (3 Hawaii, 1 Puerto Rico), all from *Acanthocybium solandri*.

FEMALE.—Body form as in figure 40. Total length 16.7 mm (15.9–17.7 mm); greatest width 6.2 mm (6.0–6.5 mm) based on an average of 8 specimens from 4 collections.

Shiino (1960) has provided a good description of both sexes of this species except for the changes recommended below. Shiino considers the first antenna as 3-segmented. The distal segment is heavily sclerotized on its outer half and appears 3-segmented, but I could find no evidence of segmentation at the midpoint of the distal segment. Consequently, the 1st antenna should be considered 2-segmented in all species of the genus. The process referred to as the "second maxilla" by Shiino should be called the 1st maxilla, "first maxilliped" as 2nd maxilla, and "second maxilliped" as maxilliped, to be consistent with more recent literature. The process referred to as the "first maxilla" is now considered to be the postantennal process.

The appendages of female and male are generally as in other species of the genus. The sternal furca (fig. 41) with the large posterior process with only a single point rather than bifid as in other species of the genus.

Male.—Body form as in figure 42. Total length 12.1 mm (11.7–12.5 mm); greatest width 4.8 mm (4.2–5.7 mm) based on an average of 6 specimens from 3 collections.

Remarks.—This species is cosmopolitan in distribution and is restricted to *Acanthocybium solandri*. Both sexes can be separated easily from the other species of the genus on the basis of the following points: the shape of the dorsal plate of the segment bearing legs 4, the nature of the sternal furca, the dorsal surface of *G. hygomianus* lacking the spinules and hairs found on the other species, the innermost distal spine of leg 4 of *G. hygomianus* being only slightly longer than the other 2 spines (in the other species this spine is nearly twice the length of either of the other 2).

Host Specificity

It has been almost impossible to make positive statements on the relationships between copepods parasitic on fish and their hosts owing to lack of understanding of the systematics and ecology of both groups. It is hoped that revisionary work by systematists in both groups will reveal the relationships that exist between these animals. Large collections of material are desirable and usually necessary for this kind of work. The 94 collections of the genus *Gloiopotes* forming the basis of this study have brought to light certain features of host specificity heretofore unrecorded. Since the phylogeny and ecology of parasites often reflect that of their hosts, this aspect of the study of parasitic copepods should be a useful tool to the ichthyologist.

For purposes of determining host specificity in the genus *Gloiopotes*, only those collections seen by the author have been considered. Collections with dubious host names and literature records have not been used. The genus *Gloiopotes* apparently is restricted to the Istiophoridae, Xiphidae, and to the scombrid genus *Acanthocybium*. The exact taxonomic position of *Acanthocybium* is in doubt, but studies of larval development of *Acanthocybium* by Walter Matsumoto (Bureau of Commercial Fisheries, Honolulu) suggest affinities between *Acanthocybium* and billfishes (R. H. Gibbs, pers. comm.). If one accepts the premise that a phylogenetic relationship to billfishes may exist, then the fact that it is the only known host for *G. hygomianus* supports this point of view (all other species of *Gloiopotes* are found on billfishes). *A. solandri* is cosmopolitan in distribution and *G. hygomianus* has been collected from it (8 collections) in the Atlantic and Indo-Pacific Oceans.

The remaining 4 species of *Gloiopotes* are related more closely to each other than to *G. hygomianus*. Two species (*G. ornatus* and *G. americanus*) are found only in the Atlantic, and the other 2 (*G. huttoni* and *G. watsoni*) are restricted to the Indo-Pacific. The istiophorids from which these collections were made are also divided into Atlantic and Indo-Pacific species. In the Atlantic, *G. americanus* has been found only on *I. americanus* (10 collections) and it is the only species of *Gloiopotes* so far collected from that host. *G. ornatus* is found on *T. albidus* (22 collections) and on *M. nigricans* (10 collections) and is the only species of *Gloiopotes* from those hosts. In the Indo-Pacific, both *G. huttoni* and *G. watsoni* have been collected from *T. audax* and *I. orientalis*. In 22 collections from *T. audax*, 14 of these were *G. huttoni* and 8 *G. watsoni*, indicating about a 2 : 1 prevalence of *G. huttoni*. In 16 collections from *I. orientalis* only 4 were *G. huttoni* while 12 were *G. watsoni*, indicating a 3 : 1 prevalence of *G. watsoni*. All 18 collections from the genus *Makaira* (14 *M. mazara* and 4 *M. indicus*) were *G. watsoni*.

A single collection of *G. huttoni* in the USNM from *Xiphius gladius* collected off California is insufficient on which to base any conclusions regarding relationships with this host. I hope that future collections from this host will fill the gap. So far, no copepods have been collected from *Tetrapturus brevirostris*.

A summary of number of collections of the 5 species of *Gloiopotes* and their distribution among the host species is as follows:

	Indo-Pacific		Atlantic		Cosmopolitan
	huttoni	*watsoni*	*ornatus*	*americanus*	*hygomianus*
Makaira nigricans		14	10		
" *indicus*	1	3			
Tetrapturus albidus			22		
" *audax*	14	8			
Istiophorus americanus				10	
" *orientalis*	4	12			
Acanthocybium solandri					8

Variation

Recent papers by Hewitt (1964) and Lewis (1967) have alluded to the wide range of intraspecific variation in the genus *Gloiopotes*. Both of these authors have considered *G. huttoni* and *G. watsoni* as synonymous species. Analysis of the 50 collections from the Indo-

Pacific reported herein clearly shows them to be distinct species. This would account for some of the variation cited by these authors. I have critically examined collections of each of these two species in order to determine the extent of intraspecific variation.

In one particularly large sample of *G. huttoni* taken from *T. audax* off Chile (Cruise 14, R. V. *Anton Bruun*, sta. 565), 50 adult females were randomly selected. The distribution of individuals throughout the size range is as follows:

length (in mm.)	*no. of indiv.*	*length (in mm.)*	*no. of indiv.*
13.80–13.95	1	15.30–15.45	21
14.10–14.25	1	15.60–15.75	4
14.40–14.55	3	15.90–16.05	3
14.70–14.85	6	16.20–16.35	1
15.00–15.15	9	16.50–16.65	1

The body of the animal was divided into 5 regions; cephalon, leg 4 segment, genital segment, abdomen, and caudal ramus. Each of these regions was measured along its dorsal anterior-posterior median axis, and the percentage of the total body length that each comprised was determined. The results of these measurements are as follows:

	cephalon	*leg 4 seg.*	*gen. seg.*	*abdomen*	*caudal ramus*
percent of total length	48.4	7.5	15.6	20.0	8.5
range	44.5–51.0	5.4–9.8	10.8–22.3	17.4–25.0	7.2–10.0

These same proportions in individuals in the lower, middle, and upper thirds of the total length range were considered separately to determine the correlation, if any, between the total length and the relative component lengths. These results are as follows:

length and range (in mm)	*cephalon*	*leg 4 seg.*	*gen. seg.*	*abdomen*	*caudal ramus*
13.80–14.70	49.1	7.2	14.9	20.1	8.7
(9 spec.)	45.5–50.5	6.5–8.7	10.8–19.0	17.4–25.0	7.6–10.0
14.85–15.45	48.7	7.2	15.6	20.0	8.5
(32 spec.)	47.6–51.0	5.9–9.8	12.8–17.6	19.2–22.9	7.2–9.4
15.75–16.50	47.7	7.4	16.2	20.2	8.5
(9 spec.)	44.5–49.1	6.4–8.9	14.4–22.3	18.2–21.0	8.0–9.4

The figures above indicate that the cephalon becomes proportionately shorter with increased total length and the genital segment proportionately longer. This change may have some relationship to the production and development of eggs within the body of the animal. Eggs are produced within the cephalon and migrate via the oviducts to the genital segment, where they are stored prior to release as egg strings. It is not known how many times a single female will produce egg strings, but it is apparently more than once; I have often observed developing eggs within the oviducts in females already carrying egg strings. The decrease in proportion of the cephalon in larger (older?) adults may reflect a reduction in their egg-producing organs. Egg strings were present on most individuals in all size groups.

In order to determine possible host influence on these same characters, adult females of *G. watsoni* from 4 hosts in the Indian Ocean were examined. These results are as follows:

		percent of total length				
host	*avg. tot. length (in mm)*	*cephalon*	*leg 4 seg.*	*gen. seg.*	*abdomen*	*c. ramus*
I. orientalis	11.6	50.2	7.1	14.8	18.0	9.9
3 colls.	(11.3-12.0)	(47.4-52.5)	(4.5-9.3)	(12.0-19.4)	(16.7-19.1)	(8.0-12.2)
M. nigricans	11.6	50.5	7.1	14.6	17.4	10.4
4 colls.	(10.5-12.6)	(46.5-52.4)	(4.3-8.9)	(11.9-19.7)	(15.0-19.7)	(8.6-11.5)
M. indica	12.7	49.8	6.9	14.7	18.0	10.6
4 colls.	(11.9-13.4)	(47.6-52.4)	(4.5-9.3)	(11.5-19.8)	(16.3-20.8)	(8.4-13.9)
T. audax	13.1	50.2	7.5	14.6	18.0	9.7
1 coll.	(12.6-13.5)	(49.5-51.2)	(6.7-8.9)	(13.7-15.5)	(16.1-19.5)	(8.9-11.1)

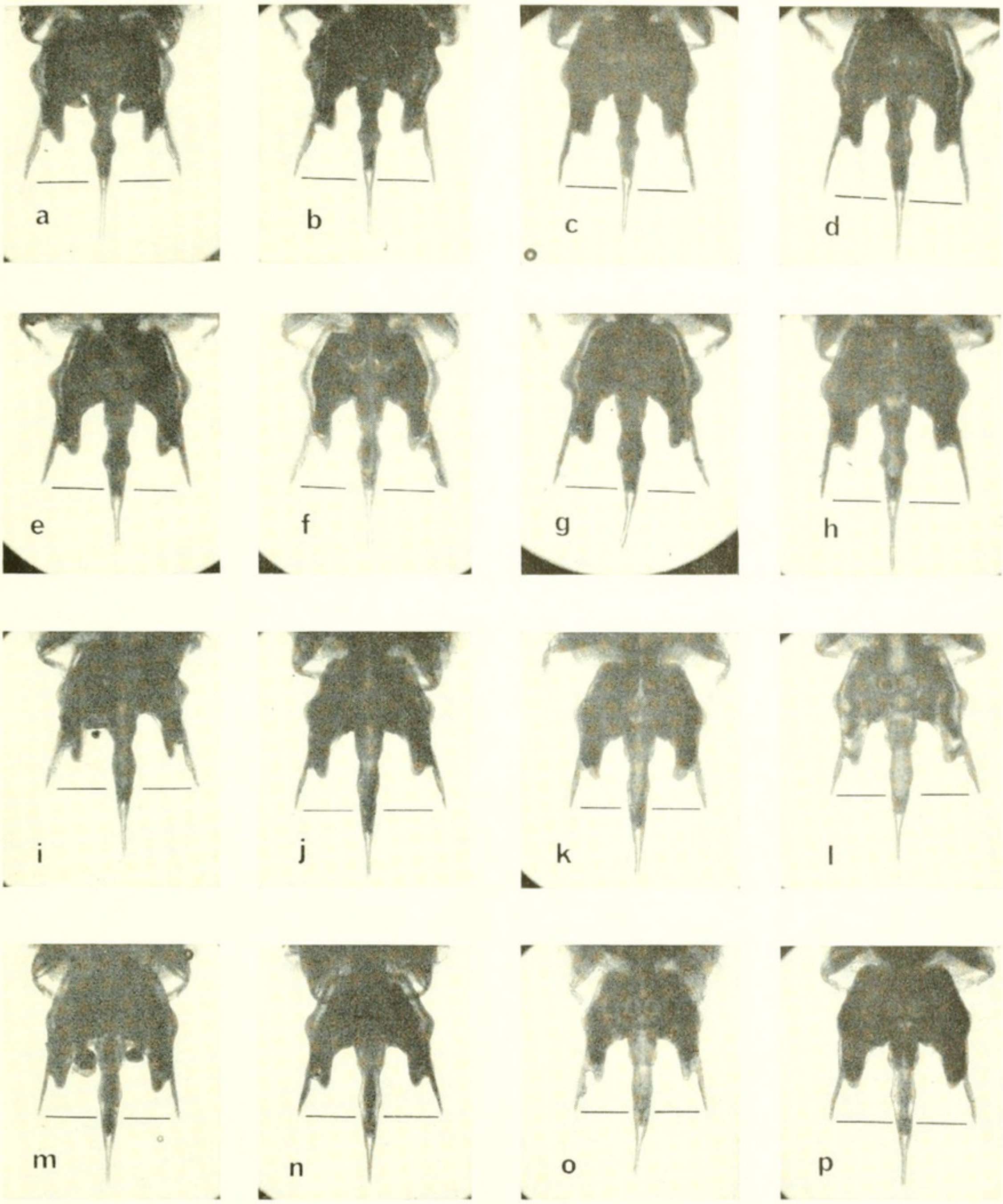
Although the average sizes of the adult females of *G. watsoni* vary depending on the host (shortest on *I. orientalis* and longest on *T. audax*), the components seem to remain in about the same proportion and no correlation can be drawn.

There was no single sample of *G. watsoni* large enough to permit a meaningful study of a single population.

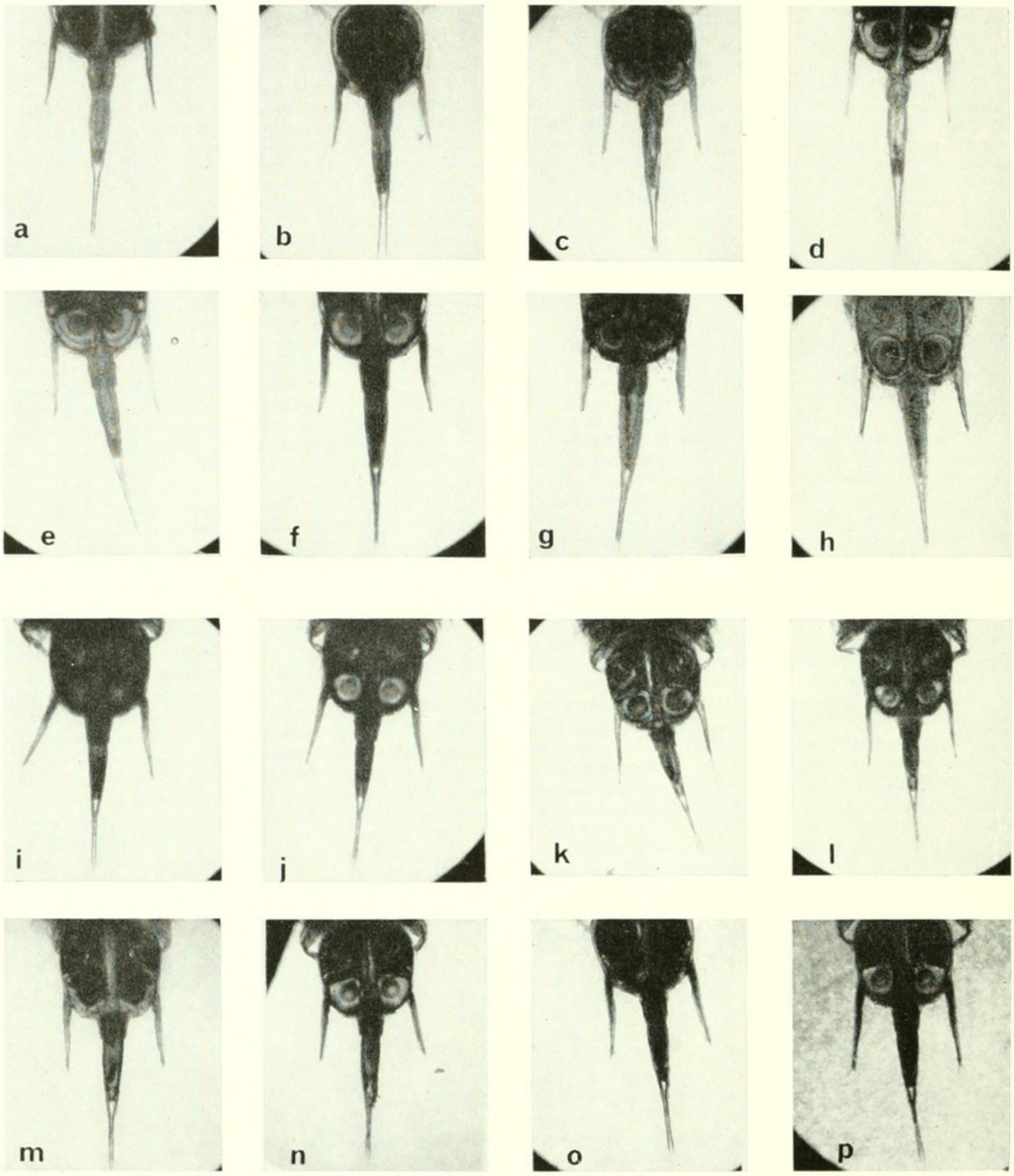
The use of the dorsal thoracic plate as a means of separating species has been used by some authors (Wilson 1907, 1919, and Hewitt 1964). There is considerable variation in the shape of this structure and it cannot be relied on as a good taxonomic character (see figs. 43–47). The Atlantic species can be separated from the Indo-Pacific ones by the angle of inclination at which the outer edges of these plates are held to the anterior-posterior body axis. The Atlantic species have the edges held nearly parallel whereas the Indo-Pacific ones are at a much greater angle (compare figs. 1, 27, and 38). This character is of no further value in separating species.

Lewis (1967, p. 63) points out the variation in the postantennal process of *G. huttoni* (?). I found the same variation in the number of points (3 or 4) on the process (see figs. 4 and 5) in all species. As Lewis also points out, this variation may be present in the same individual (right side differing from left). Twenty-one female specimens of *G. watsoni* in 3 collection from *M. indica* in the Indian Ocean were examined. Ten showed 4 points on both sides, 9 had 3 on both, and 2 had 3 on one side and 4 on the other.

Another character selected for study was the 2 rows of stout spines on the dorsal surface of the female genital segment. Typically each



Gloiopotes ornatus, female: *a–d*, from *Tetrapturus albidus; e–h*, from *Makaira nigricans*. *Gloiopotes americanus*, female: *i–p*, from *Istiophorus americanus*.



Gloiopotes huttoni, male: *a–f*, from *Tetrapturus audax; g, h*, from *Makaira indica. Gloiopotes watsoni*, male: *i–l, from Makaira nigricans; m, n*, from *Istiophorus orientalis; o*, from *M. indica; p*, from *Tetrapturus audax.*

row consists of 3 spines but occasional variation was noted (some rows have 1, 2, or 4 spines). In the large sample of 50 adult females of *G. huttoni* from a single population, 12 (24 percent) varied from the usual 3–3 arrangement. In this sample there was a higher incidence (33 percent) of variation in the lower third length range (shortest); a somewhat lower incidence (25 percent) in the middle third group; and lowest incidence (11 percent) in the upper third group (longest). In addition, 123 females from other collections of both *G. huttoni* and *G. watsoni* were examined, and 30 (24 percent) of these varied from the 3–3 formula. The actual distribution of specimens from this last group is as follows:

spine formula	2–2	2–3	3–3	3–4	4–4	3–1
no. of specimens	2	13	93	12	1	2

This variation seems to occur with similar frequency in the other species of the genus except *G. hygomianus* (genital segment of this species has no spines).

There is considerable variation in the configuration of the female genital segment within each species (see figs. 48–55). In spite of this variation, the genital segment is of major importance as a taxonomic character for separating females of the genus.

Similar variation in the characters discussed above also occurs in the Atlantic species (*G. ornatus* and *G. americanus*) and it was felt that no purpose would be served in repeating the same analysis on them. Preliminary investigation showed that the results would be essentially the same.

Males also showed some variation in the aforementioned characters but to a lesser degree.

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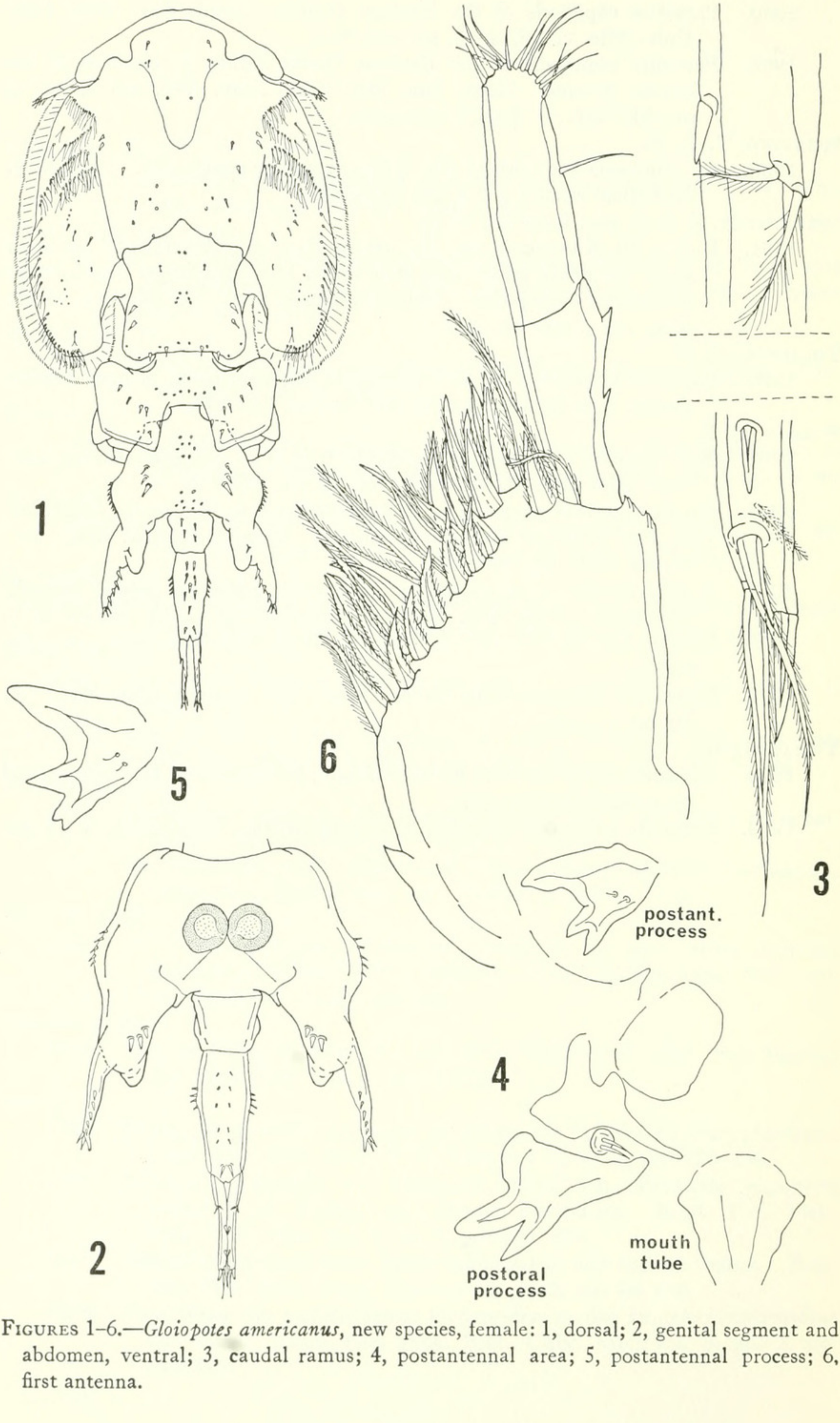
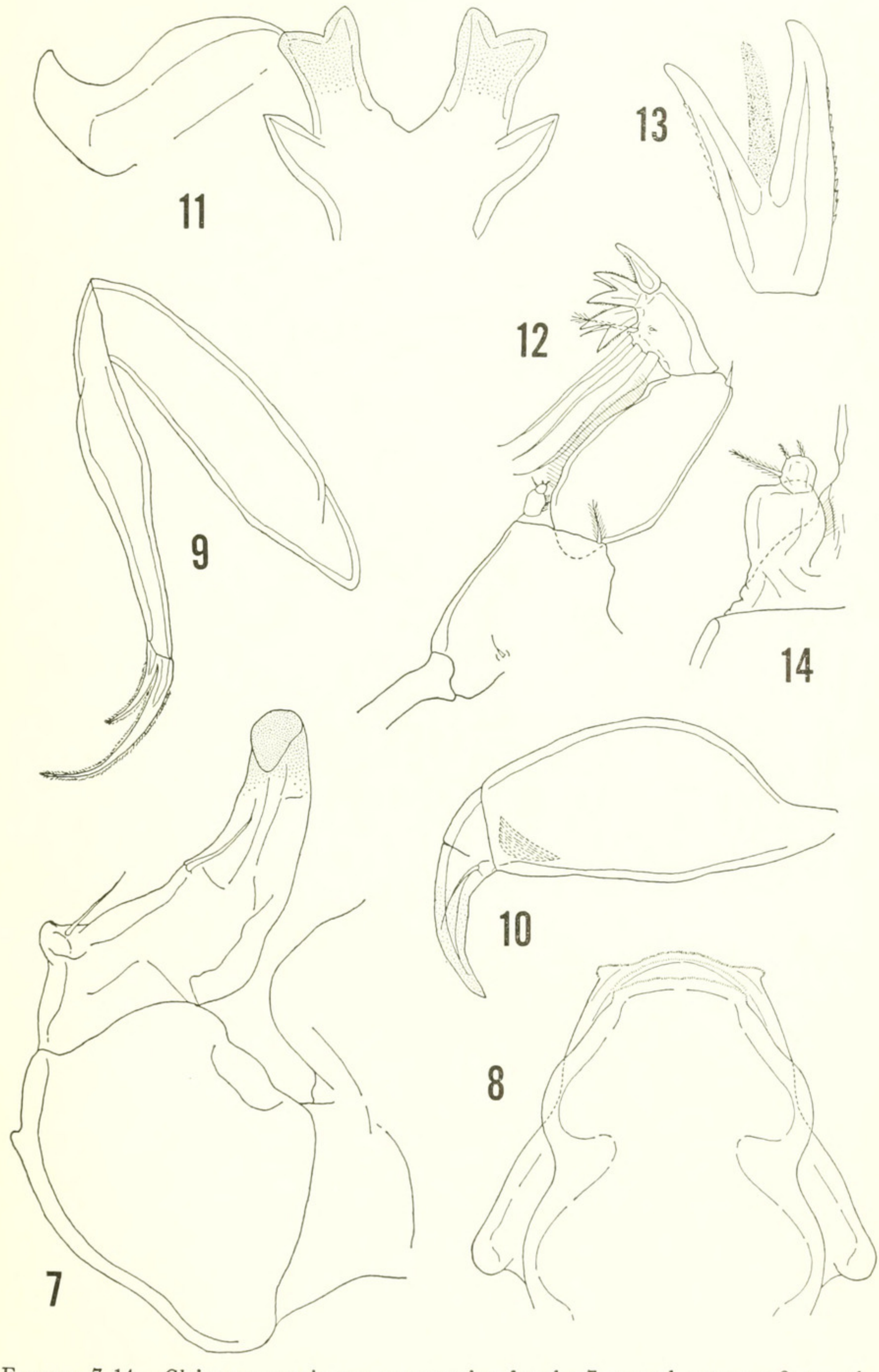
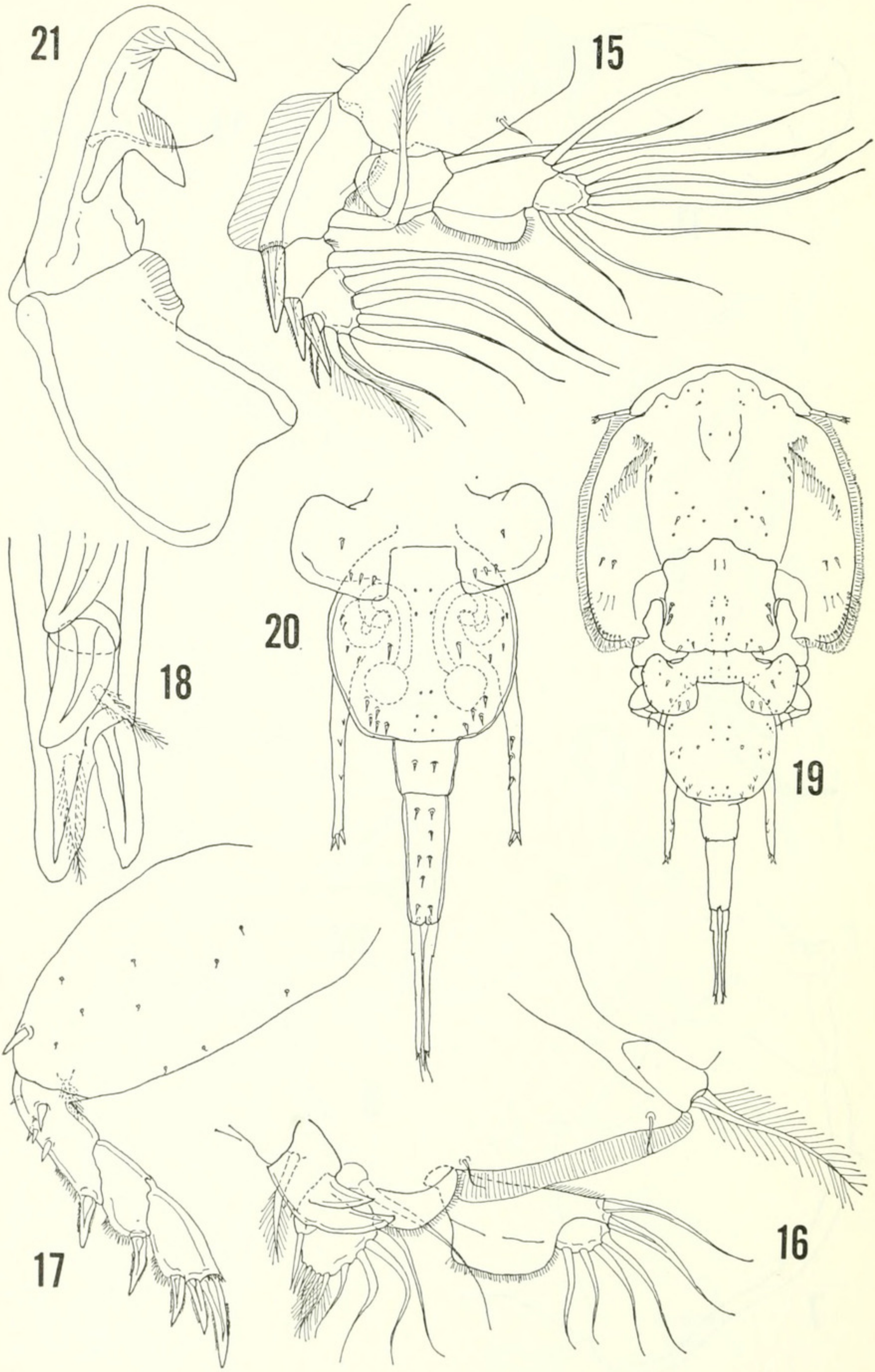


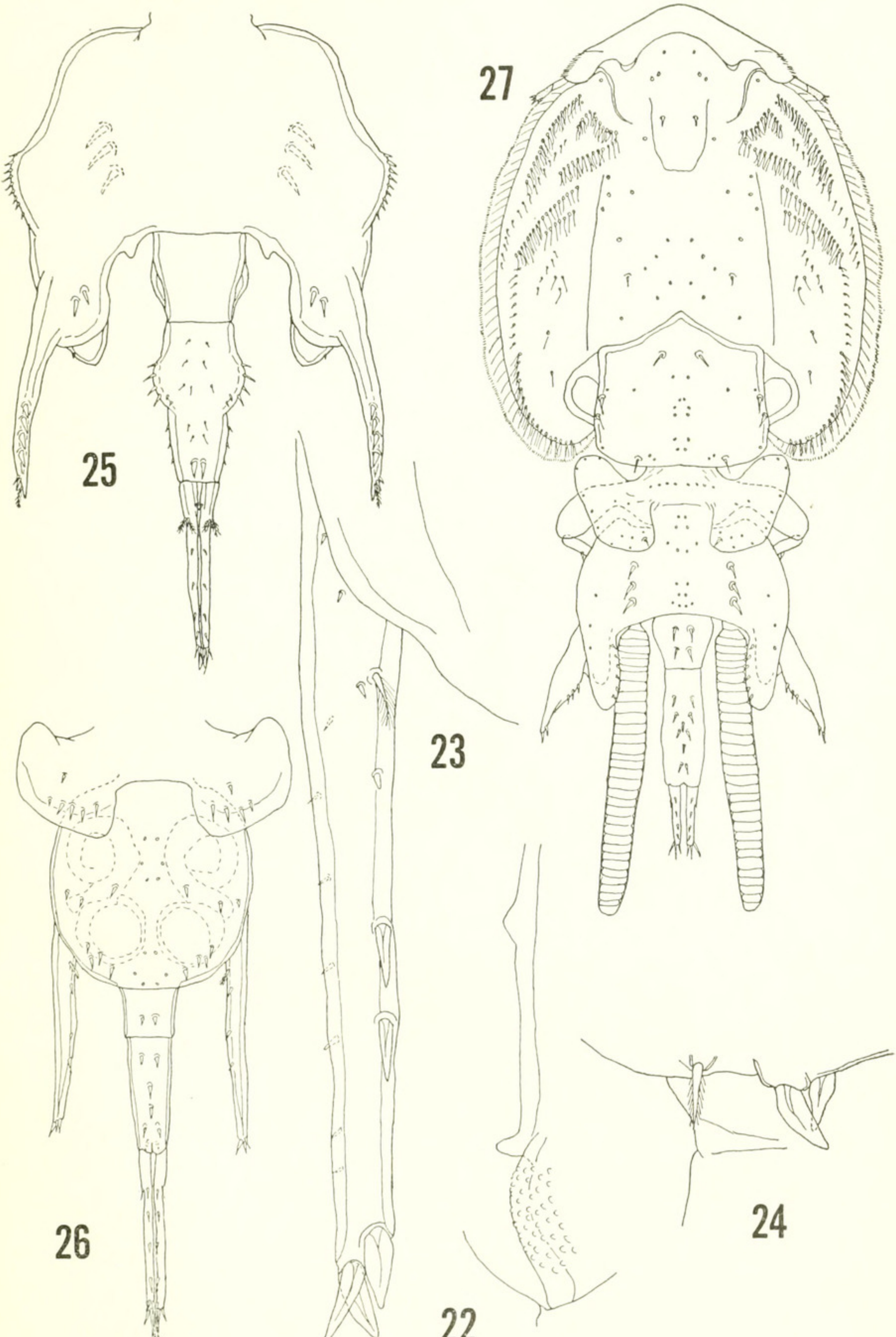
FIGURES 1–6.—*Gloiopotes americanus*, new species, female: 1, dorsal; 2, genital segment and abdomen, ventral; 3, caudal ramus; 4, postantennal area; 5, postantennal process; 6, first antenna.



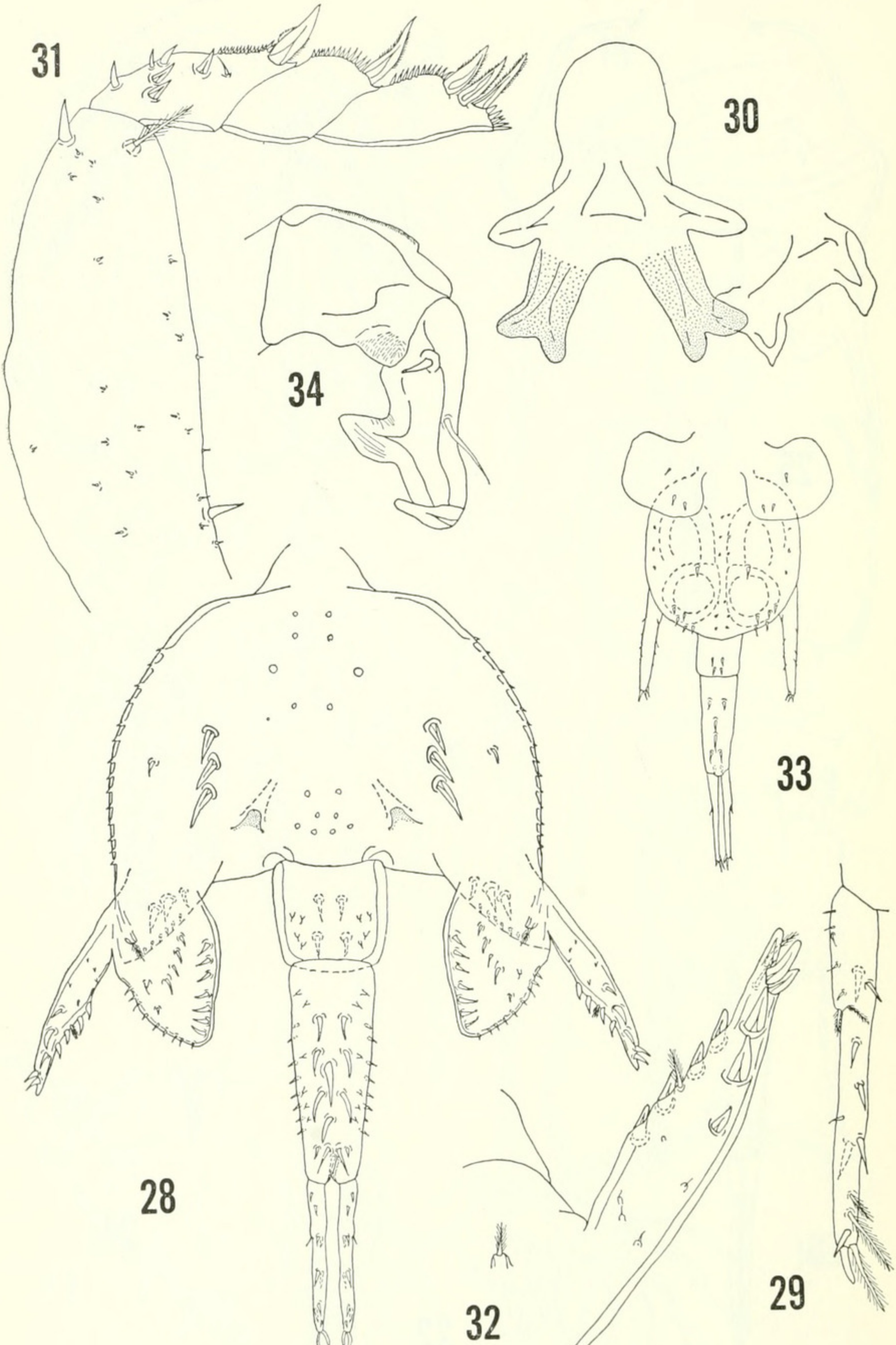
FIGURES 7–14.—*Gloiopotes americanus*, new species, female: 7, second antenna; 8, mouth tube; 9, second maxilla; 10, maxilliped; 11, sternal furca; 12, first leg; 13, bifid spine on first leg; 14, endopod of first leg.



FIGURES 15–21.—*Gloiopotes americanus*, new species, female: 15, second leg; 16, third leg; 17, fourth leg; 18, end of fifth leg. Same, male: 19, dorsal; 20, genital segment and abdomen, dorsal; 21, second antenna.



FIGURES 22–27.—*Gloiopotes americanus*, new species, male: 22, inner edge of maxilliped; 23, fifth leg; 24, sixth leg. *Gloiopotes ornatus*, female: 25, genital segment and abdomen, ventral. Same, male: 26, genital segment and abdomen, dorsal. *Gloiopotes huttoni*, female: 27, dorsal.



FIGURES 28–34.—*Gloiopotes huttoni*, female: 28, genital segment and abdomen, dorsal; 29, caudal ramus; 30, sternal furca; 31, fourth leg; 32, fifth leg. Same, male: 33, genital segment and abdomen, dorsal; 34, second antenna.