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A redescription of the adult male and praniza of *Gnathia africana* Barnard, 1914 (Crustacea, Isopoda, Gnathiidae) from southern Africa

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Key words: *Gnathia africana*, redescription, taxonomy, morphology

Abstract. A redescription of the adult male and praniza of *Gnathia africana* Barnard, 1914 is provided from material collected at three localities along the South African coast and from syntypes and other material deposited by the original author. This redescription is based on light and scanning electron microscopy.

Knowledge of the gnathiids of the world reflects the location of scientists interested in these isopods rather than their actual distribution. Almost one quarter of the known species are described from Australia (Cohen and Poore 1994). Africa is poorly represented. The only records are those of Barnard (1914a,b, 1920, 1925) describing four species from southern Africa (*Gnathia africana* Barnard, 1914; *Gnathia spongicola* Barnard, 1920; *Gnathia disjuncta* Barnard, 1920; and *Gnathia cryptopais* Barnard, 1925) and a single record by Müller (1989) from Kenya (G*nathia wolffi* Müller, 1989). Although Monod (1926) recorded the southern African species in his monograph, he included Barnard's original descriptions without additional information. None of these works provided sufficient information on the morphology of the southern African species for their inclusion in the phylogenetic analysis of Cohen and Poore (1994), who supported Müller's (1991) suggestion that the African material needed redescription.

In the present study, males and larvae of *Gnathia africana* were collected from the intertidal zone of the west and south coasts of southern Africa and this material is used to redescribe the species. No females were found. Three populations of *G. africana* were compared with the type material in the South African Museum, Cape Town.

MATERIALS AND METHODS

Field work was undertaken during low tide at McDougall's Bay, De Hoop Nature Reserve and Jeffreys Bay. Sponges (possibly of the genera *Hymeniacedon* and *Polymastia*) and colonial tunicates were collected with a spatula and examined in a field laboratory under a dissection microscope for the presence of gnathiids. Fish were collected from intertidal pools with hand nets, cast nets and hand lines and placed in an aerated aquarium. Fish were anaesthetised with benzocaine (ethyl-4-aminobenzoate), identified using Smith and Heemstra (1986) and Branch et al. (1994), measured and examined for gnathiid larvae. Larvae were removed from fish, measured, categorised according to size and feeding status, and fixed in 70% ethanol. Both zupheae (with distinct segmentation) and pranizae (with a swollen intersegmental membrane) were taken.

For scanning electron microscopy specimens were rehydrated in a descending sequence of ethanol and washed in tap water in order to get rid of salt crystals and debris. The specimens from the sponges and tunicates were cleaned with a soft sable hair brush. They were then dehydrated to absolute ethanol and critical point dried. Specimens were mounted on aluminium stubs, sputter coated with gold and studied with the aid of a JEOL WINSEM JSM 6400 at 10 kV.

Type and other material examined by Barnard (1914a, b) was borrowed from the South African Museum, Cape Town.

RESULTS

Gnathia africana Barnard, 1914

Adult male Figs. 1-10, 23-29

Description: Total lengths of new material: 3.7-5.1 mm (mean 4.8 mm, n = 15) (McDougall's Bay); 3.0-4.4 mm (4.0 mm, n = 15) (De Hoop Nature Reserve); 2.9-4.2 mm (3.75 mm, n = 15) (Jeffreys Bay).

Cephalon. Rectangular, 1.4 times as wide as long, deep dorsal sulcus (Fig. 23), same width as median process, extending to median tubercle, lateral margins convex, few setae on dorsal posterior cephalon, posterior margin concave (Fig. 1). Sensory pits distributed randomly over dorsal surface of cephalon (Fig. 23). Setae as well as sensory pits ventrally on lateral sides of buccal cavity (Fig. 26). Well developed oval-shaped, bulbous, compound eyes on lateral margin of cephalon, length of eye slightly less than a third of cephalon (Fig. 24). Prominent paraocular ornamentation with five to seven tubercles forming ridge above eye, same length as eye, stretching from middle of eye

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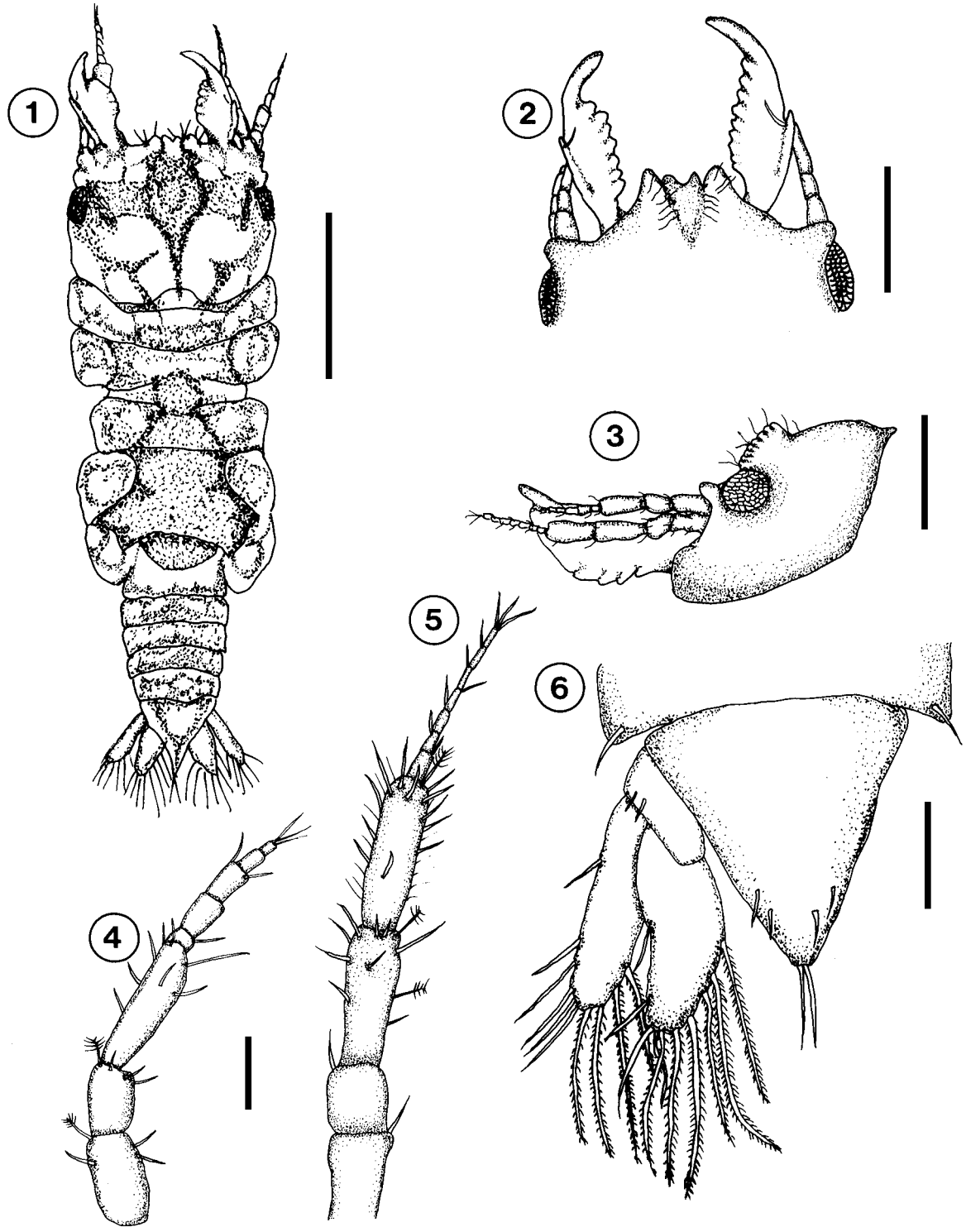
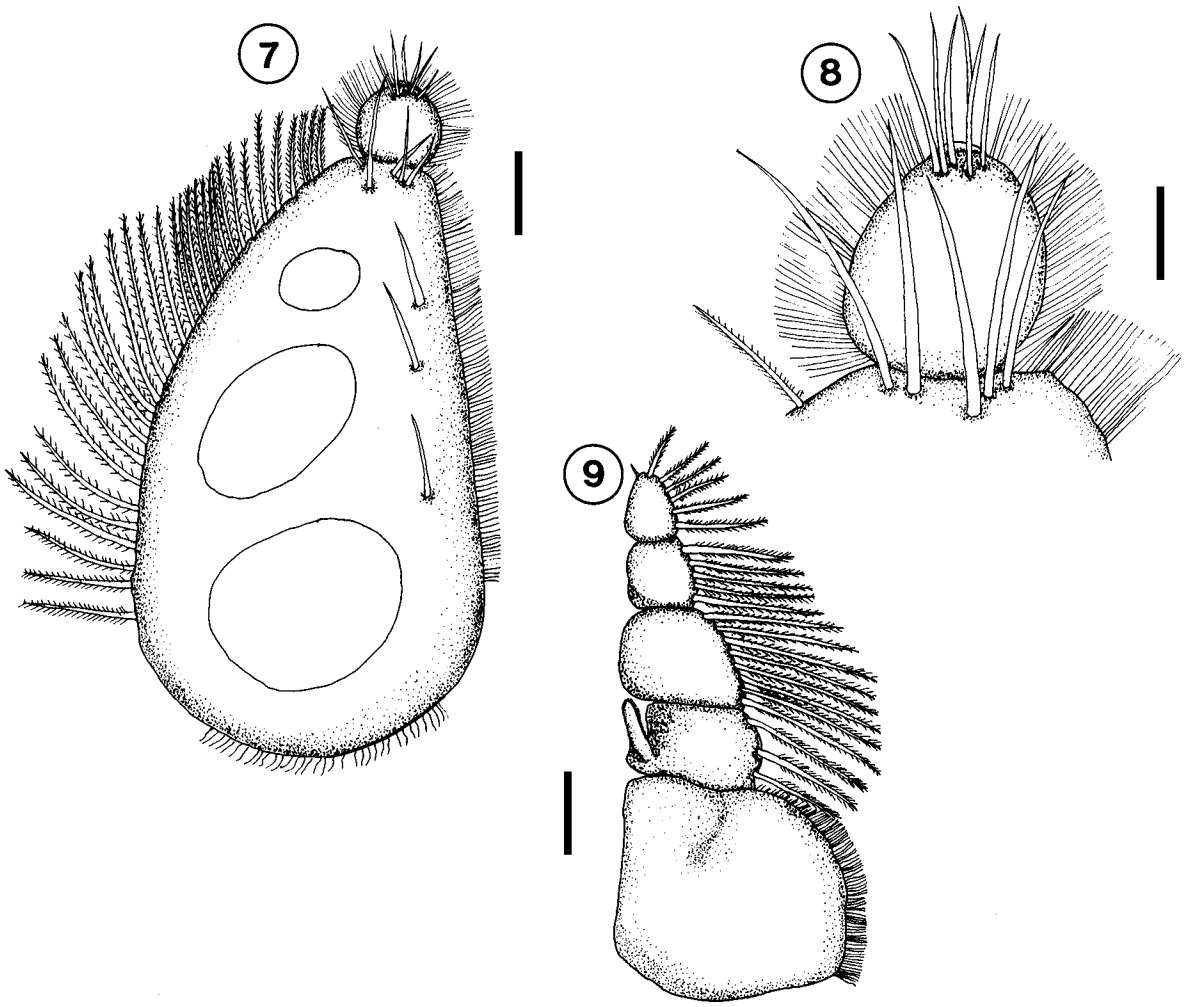


Figs. 1-6. Microscope projection drawings of a male *Gnathia africana* Barnard, 1914 collected at McDougall's Bay. **Fig. 1.** Full length dorsal view. **Fig. 2.** Frontal border and mandibles. **Fig. 3.** Lateral view of cephalon, antennae and mandible. **Fig. 4.** First antenna. **Fig. 5.** Second antenna. **Fig. 6.** Telson and uropods. Scale bars: Fig. 1 = 1 mm; Figs. 2, 3 = 500 μm; Figs. 4-6 = 100 μm.



Figs. 7-9. Microscope projection drawings of mouthparts of a male *Gnathia africana* Barnard, 1914 collected at McDougall's Bay. **Fig. 7.** Pylopod. **Fig. 8.** Articles 2 and 3 of pylopod. **Fig. 9.** Maxillipede. Scale bars: Figs. 7, 9 = 100 µm; Fig. 8 = 50 µm.

posteriorly, ridge adorned with setae (Figs. 3, 24). Posterior median tubercle present, elongated (Fig. 23).

Frontal border. Produced, superior frontolateral process conical, with seven to ten long simple setae on outer border and three on inner ventral border (Figs. 2, 25). Mediofrontal process inferior, divided concavely into two triangular lobes with obtuse points, no inferior frontolateral process (Fig. 25). External scissura deeply excavated. Supraocular lobe prominent, extending laterally.

Antennae. Antenna 2 longer than antenna 1 (Fig. 28). Antenna 1 with three peduncle articles, with third one largest, flagellum with five articles, article 2 and 3 largest, articles 3 and 4 with one aesthetascs setae each, article 5 terminating in one aesthetascs and two to three simple setae, few setae on each article (Fig. 4). Antenna 2 with four peduncle articles, article 3 and 4 largest, flagellum with seven articles, article 1 largest, article 7 terminating in three to four simple setae, few setae on each article, except article 4 of peduncle with 20 to 25 setae (Fig. 5). Antennae slightly curved inwards.

Mandible. Long, same length as cephalon, twice as long as wide, curved inwards with eight to ten processes on dentate blade, tussle of setae between processes (Fig. 27). Apex cylindrical, distally raised in lateral view at 45°. Prominent incisor, terminating in sharp point (Fig. 2). Single mandibular seta extending from base of incisor process. Carina unarmed, forming ridge on lateral margin extending from basal neck to halfway along mandible (Fig. 27). Few short simple setae distributed randomly on dorsal surface of blade. Internal lobe and pseudoblade absent.

Maxilliped. Five-articled, proximal article largest with slender endite (Fig. 9). Endite contiguous with article 2, almost reaching article 3. Distal four articles with plumose setae on lateral margin in order of 3-8-5-6. Palp 2.5 times as long as wide. No coupling hooks.

Pylopod. Three articles (Fig. 7). First article greatly enlarged, mesial border fringed with plumose setae, lateral setae short and simple, three simple setae near lateral border and five distally on posterior surface (Fig. 7). Three areolae. Second article oval, 1.25 times as

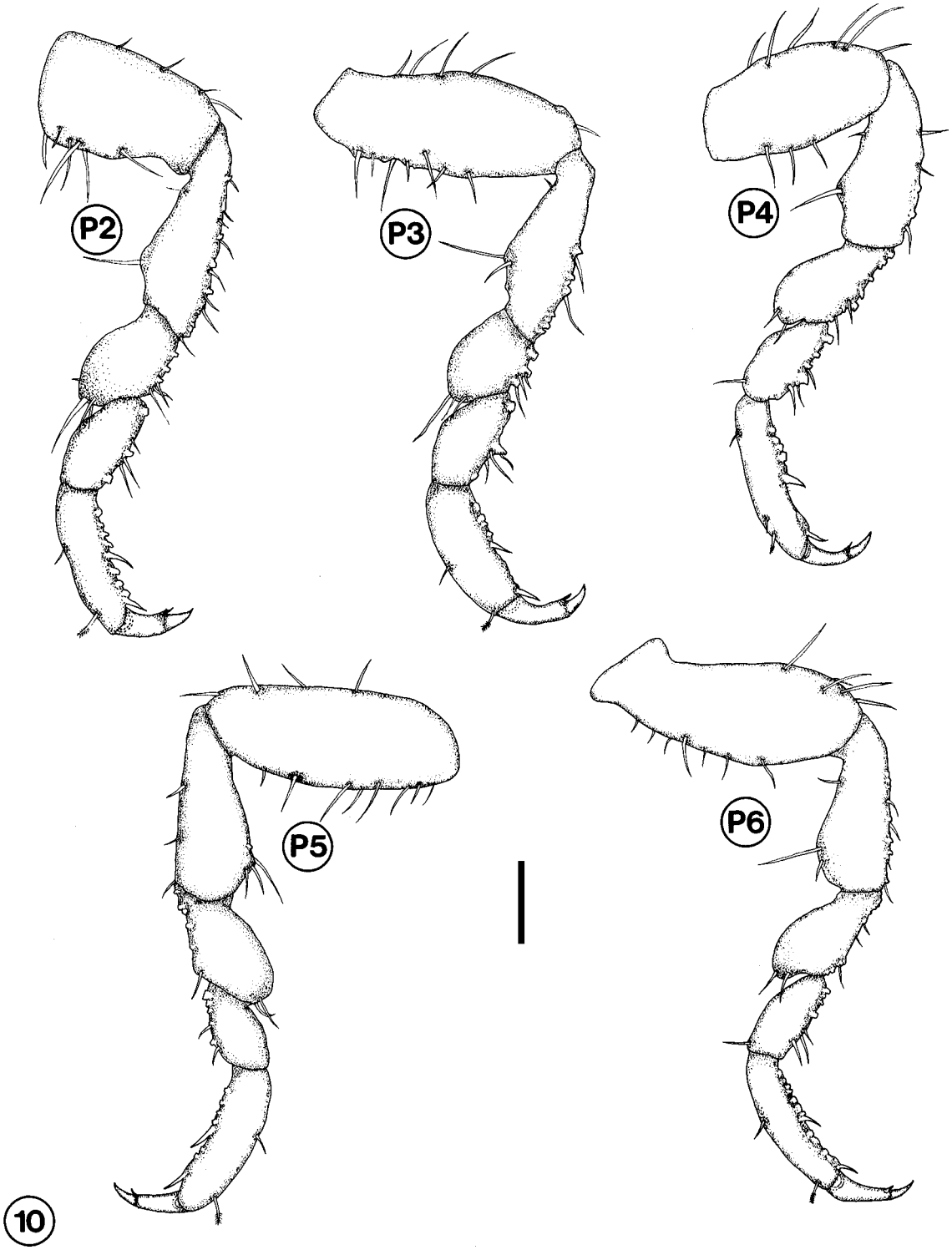
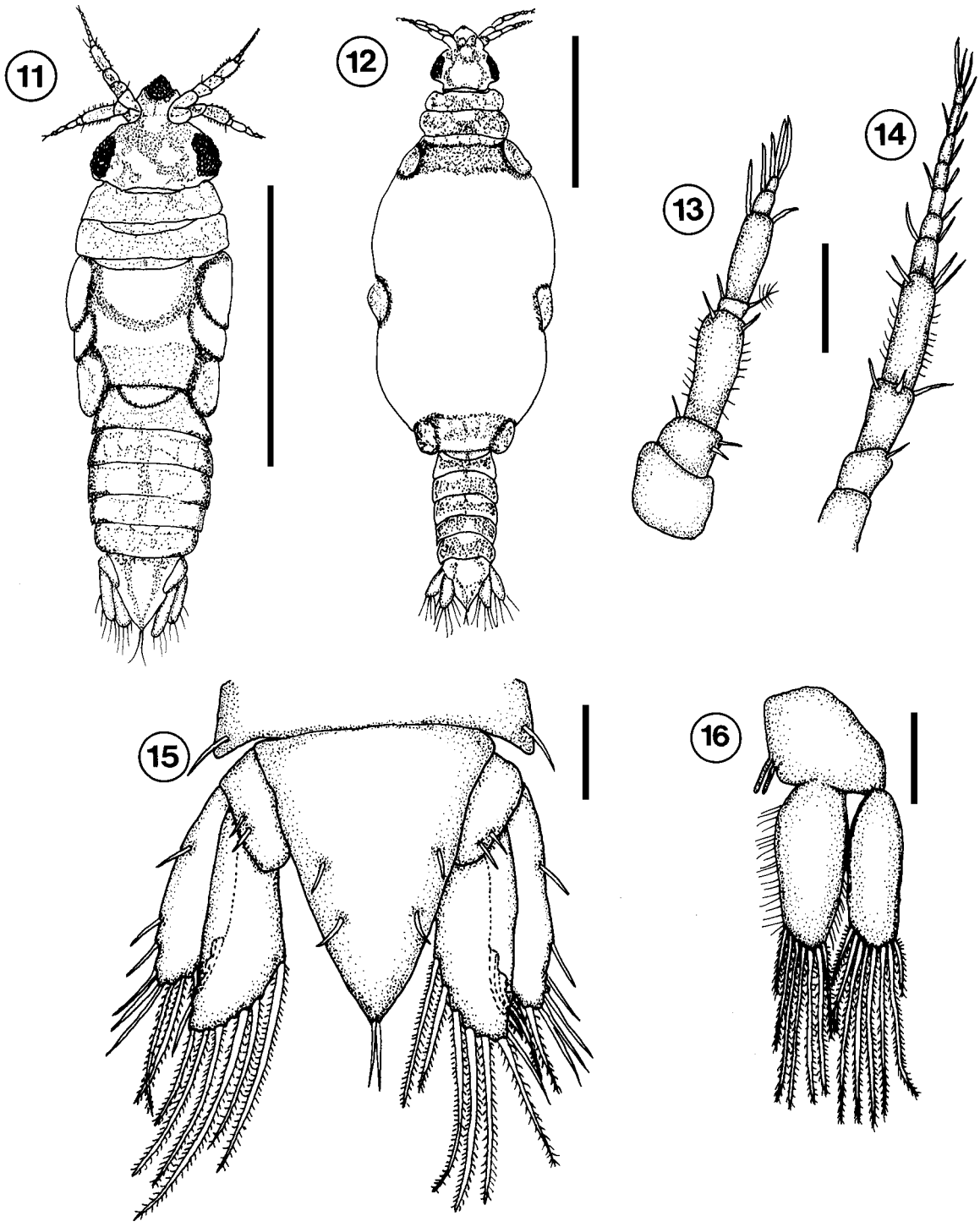
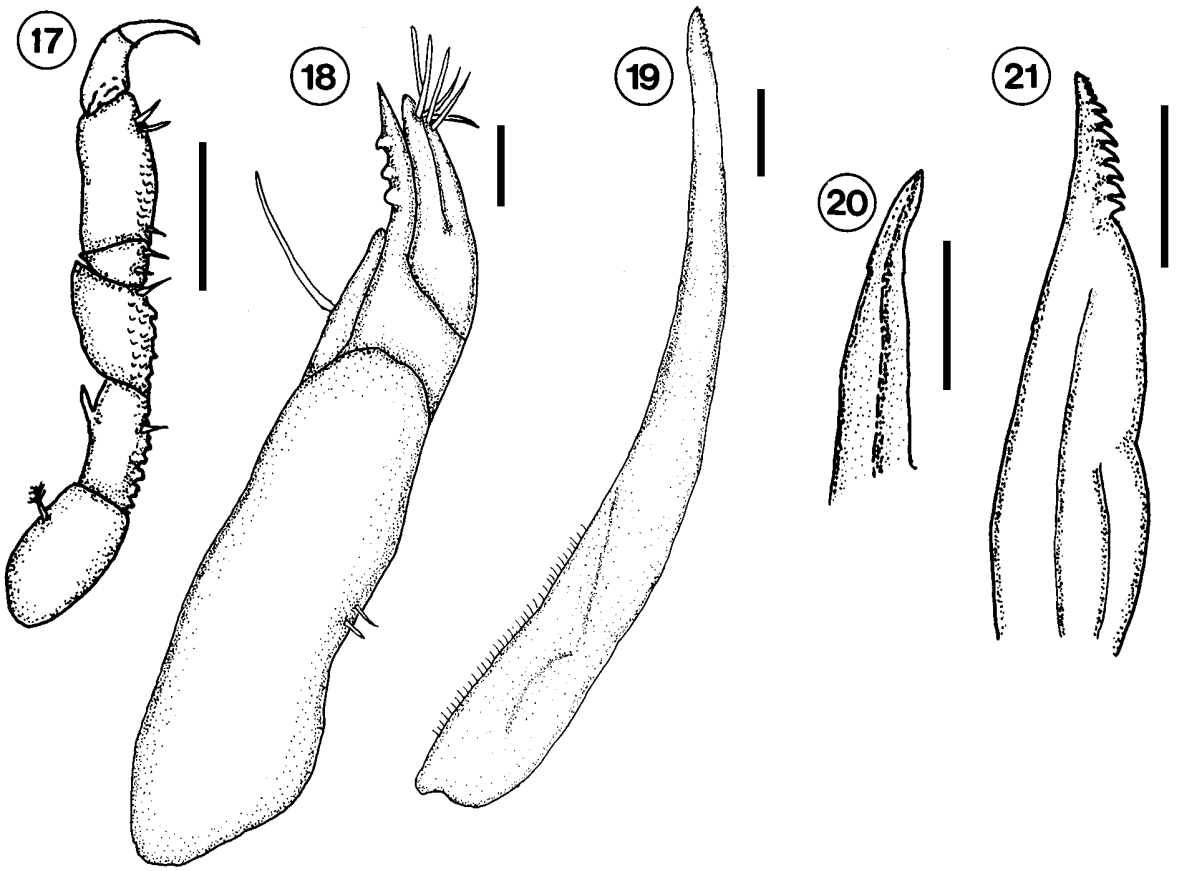


Fig. 10. Microscope projection drawings of pereopods 2 to 6 (P2–P6) of a male *Gnathia africana* Barnard, 1914 collected at McDougall's Bay. Scale bar = 200 µm.



Figs. 11-16. Microscope projection drawings of *Gnathia africana* Barnard, 1914 larvae collected at McDougall's Bay. **Fig. 11.** Full length dorsal view of zuphea. **Fig. 12.** Full length dorsal view of praniza. **Fig. 13.** First antenna. **Fig. 14.** Second antenna. **Fig. 15.** Telson and uropods with fringing setae. **Fig. 16.** Left pleopod. Scale bars: Figs. 11, 12 = 500 μm; Figs. 13-16 = 100 μm.



Figs. 17-21. Microscope projection drawings of mouthparts of *Gnathia africana* Barnard, 1914 praniza larva collected at McDougall's Bay. **Fig. 17.** Gnathopod. **Fig. 18.** Maxillipede. **Fig. 19.** Maxillule. **Fig. 20.** Paragnath. **Fig. 21.** Mandible. Scale bars: Figs. 17, 20 = 100 µm; Figs. 18, 19, 21 = 50 µm.

long as wide, margins setose, six simple setae distally on posterior surface (Fig. 8). Third article minute with fringing setae.

Pereon. One and a half times as long as wide, wider than cephalon (Fig. 1). Pereonite 1 fused with cephalon, dorsally visible, not reaching lateral margins, divided into three regions by posterior margin of cephalon, anterior border convex, posterior margin straight (Fig. 1). Pereonite 2 and 3 of similar size, widest part of body, lateral margins pointing anteriorly. Pereonite 3 with anterior constriction, but not separating pereonite 2 and 3. Prominent anterior constriction of pereonite 4 separating it from pereonite 3. Pereonite 4 with shallow median groove extending as dorsal sulcus to pereonite 6. Pereonite 5 with areae laterales. Pereonite 5 and 6 not fused, but separation not distinct. Pereonite 6 at least twice as long as other pereonites (Fig. 1), 1.3 times as long as wide, posterior margin deeply concave, with lobi laterales, no lobuii. Pereonite 7 dorsally visible, small with rounded posterior margin, overlapping first pleonite. Setae on anterior margins of pereonites 1, 2 and 3, rest of pereon sparsely setose. Sensory pits randomly distributed on pereonites 1, 2 and 3.

Pleon. Pleon and pleotelson slightly less than a third of total length (Fig. 1). Five pleonites dorsally visible, epimera not distinct.

Pleotelson. Triangular, base as wide as length or wider, lateral margins straight, four simple setae on dorsal surface near apex, distal apex terminating in a pair of simple setae (Fig. 6).

Pereopods. Pereopod 2 basis elongated with eight to twelve simple setae anterior, four to seven posterior simple setae (Fig. 10). Ischium as long as basis but not as wide, three to five anterior setae, posterior tubercles with simple setae in between. Merus half the length of ischium with anterior bulbous protrusion, simple setae on bulbous protrusion, posterior margin with tubercles as well as simple setae. Carpus of almost same size and shape as merus, but without anterior bulbous protrusion. Propodus about twice the length of carpus, prominent tubercles fringe posterior side, two elongated spines ending in sharp points situated on middle and distal part of posterior side respectively, only a few simple setae anteriorly with one plumose seta distally. Dactylus half the length of propodus, terminates in sharp posterior pointing unguis, prominent spine on posterior side

proximal to unguis, few simple setae on dorsal and ventral sides of spine. Pereopods 3 to 6 similar to pereopod 2 (Fig. 10), differ only in direction, pereopods 4 to 6 directed posteriorly and pereopods 2 and 3 anteriorly.

Pleopods. Exopod and endopod almost of similar size. Both fringed distally with seven to nine long plumose setae, few shorter simple setae on lateral margins. Plumose setae as long as pleopod.

Penes. Prominent with two contiguous papillae, as long as wide (Fig. 29).

Uropod. Rami extending beyond apex of pleotelson, endopod longer and wider than exopod, both with long fringing setae, endopod with inner six setae plumose, exopod with inner four setae plumose, rest of setae simple (Fig. 6). Uropodal basis with two simple setae.

Praniza larva Figs. 11-22, 30-36

Description: Total length of material examined: 1.1-3.9 mm (n = 50)

Cephalon. Posterior margin slightly wider than anterior margin, almost as wide as long, lateral margins straight parallel, few setae on dorsal posterior cephalon, posterior margin straight (Fig. 33). Many sensory pits distributed randomly over dorsal surface of cephalon. Compound eyes large, well developed, oval-shaped, bulbous, on lateral margins of cephalon, length of eye almost same as cephalon (Fig. 32). No sulcusses or tubercles on dorsal cephalon. Medio-anterior margin of cephalon straight with lateral concave excavations to accommodate first articles of antennae.

Labrum. Prominent, two fifths length of cephalon, semicircular with apical process, truncated posterior margin, anterior margin concave (Fig. 33). Ventral part of labrum gutter-like with central groove, covers mandibles dorsally and laterally.

Antennae. Antenna 2 longer than antenna 1. Antenna 1 with three peduncle articles, third one largest, flagellum with four articles, article 2 largest, articles 2 and 3 with one aesthetascs setae each, article 4 terminating in one aesthetascs and two simple setae, few setae on each article (Fig. 13). Antenna 2 with four peduncle articles, article 4 largest, flagellum with seven articles, article 1 largest, article 7 terminating in three to four simple setae, few setae on distal end of each article (Fig. 14). Antennae straight.

Mandible. Stout, swollen at base, distal margin styliform with nine to ten teeth on mesial margin, two teeth small and situated at tip of mandible, seven to eight teeth larger, triangular and backwards directed (Figs. 21, 36).

Gnathopod. Smaller than pereopods, seven articles, dactylus strongly hooked, only few simple setae, many pectinate scales on inner and lateral sides (Figs. 17, 34).

Maxilliped. Large, cylindrical, elongated base, endite reduced (Fig. 35). Palp with three articles, first article acute with five to seven teeth distally and single long simple seta ventrally, articles 2 and 3 with many long simple setae (Fig. 18). Basis with many large pectinate scales ventrally.

Maxillae. Not visible.

Maxillule. Long, slender, swollen base, stretching past distal margin of labrum (Fig. 19). Six to eight teeth on distal inner margin.

Paragnaths. Elongated, terminates in sharp point, no teeth (Fig. 20).

Pereon. Almost twice as long as wide, wider than cephalon. Pereonite 1 fused with cephalon, dorsally visible, anterior and posterior borders shallow convex (Fig. 33). Pereonite 2 with anterior constriction separating it medianly from pereonite 1 (Figs. 30, 31). Pereonite 3 widest part of body. Pereonite 4 twice as wide as long, lateral sides tapering towards rounded posterior margin, posterior margin stretching over pereonite 5 (Figs. 12, 31), lateral shields at leg attachment. Pereonite 5 consists of elastic membrane with bulbous shields on lateral sides at leg attachment (Fig. 30). Pereonite 6 rectangular, posterior margin slightly concave. Pereonite 7 dorsally visible, small with rounded posterior margin, overlapping first pleonite. Many sensory pits randomly distributed over all pereonites.

Pleon. Pleon and pleotelson same length as pereon. Five pleonites dorsally visible (Figs. 11, 12). Single simple setae, on each posterior lateral side of each pleonite.

Pleotelson. Triangular, longer than wide, lateral margins straight, four simple setae on dorsal surface, distal apex terminating in pair of simple setae (Fig. 15).

Uropod. Endopod extending beyond apex of pleotelson, exopod reaching apex. Endopod longer and wider than exopod, both with long fringing setae, endopod with mesial six setae plumose, exopod with mesial four setae plumose, rest of setae simple (Fig. 15). Uropodal basis with two simple setae.

Pleopods. Exopod and endopod of almost similar size. Both fringed distally with seven to nine long plumose setae, few shorter simple setae on lateral margins (Fig. 16). Plumose setae almost as long as pleopod.

Pereopods. Pereopod 2 basis elongated with single feather-like bristle and three to four simple setae anterior, two to three posterior simple setae (Fig. 22). Ischium three quarters length of basis and almost as wide, three to five anterior setae. Merus half the length of ischium with anterior bulbous protrusion, single serrated spine and two simple setae on bulbous protrusion, posterior margin with simple setae. Carpus of almost same size and shape as merus, but without anterior bulbous, tubercles and single serrated spine on posterior margin. Propodus about twice the length of carpus, prominent tubercles and pectinate scales on posterior side, two elongated serrated spines ending in sharp points situated on middle and distal part of

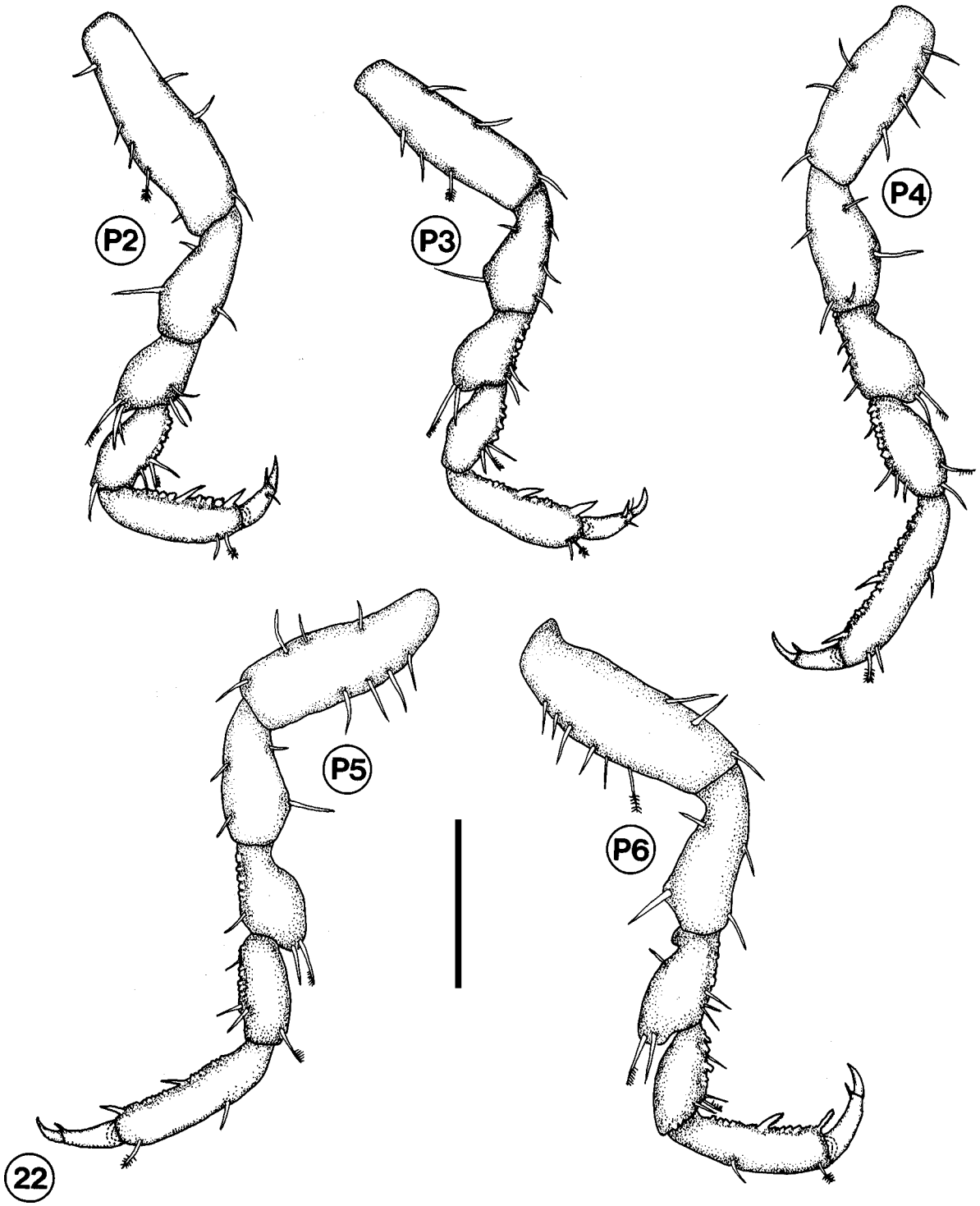
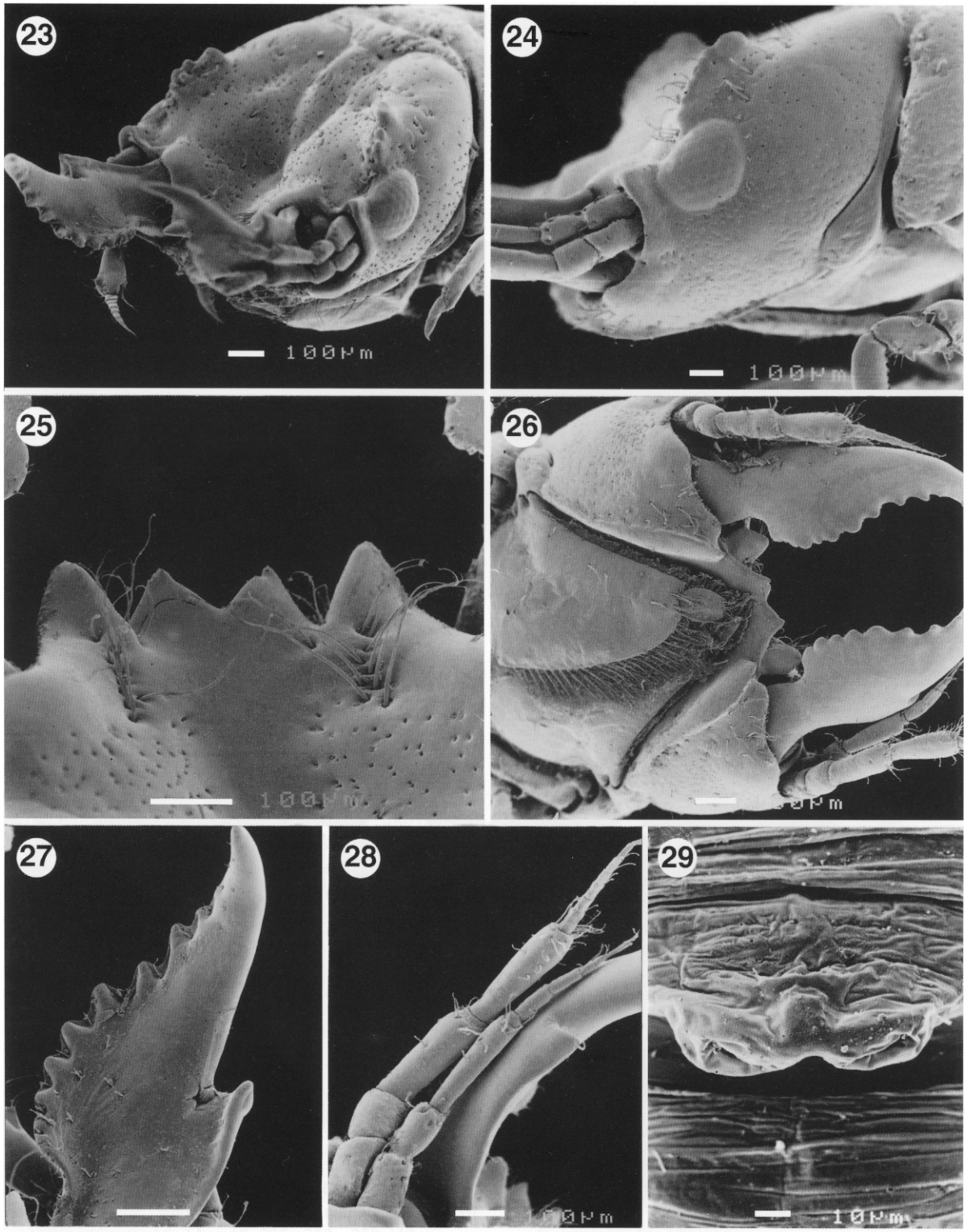
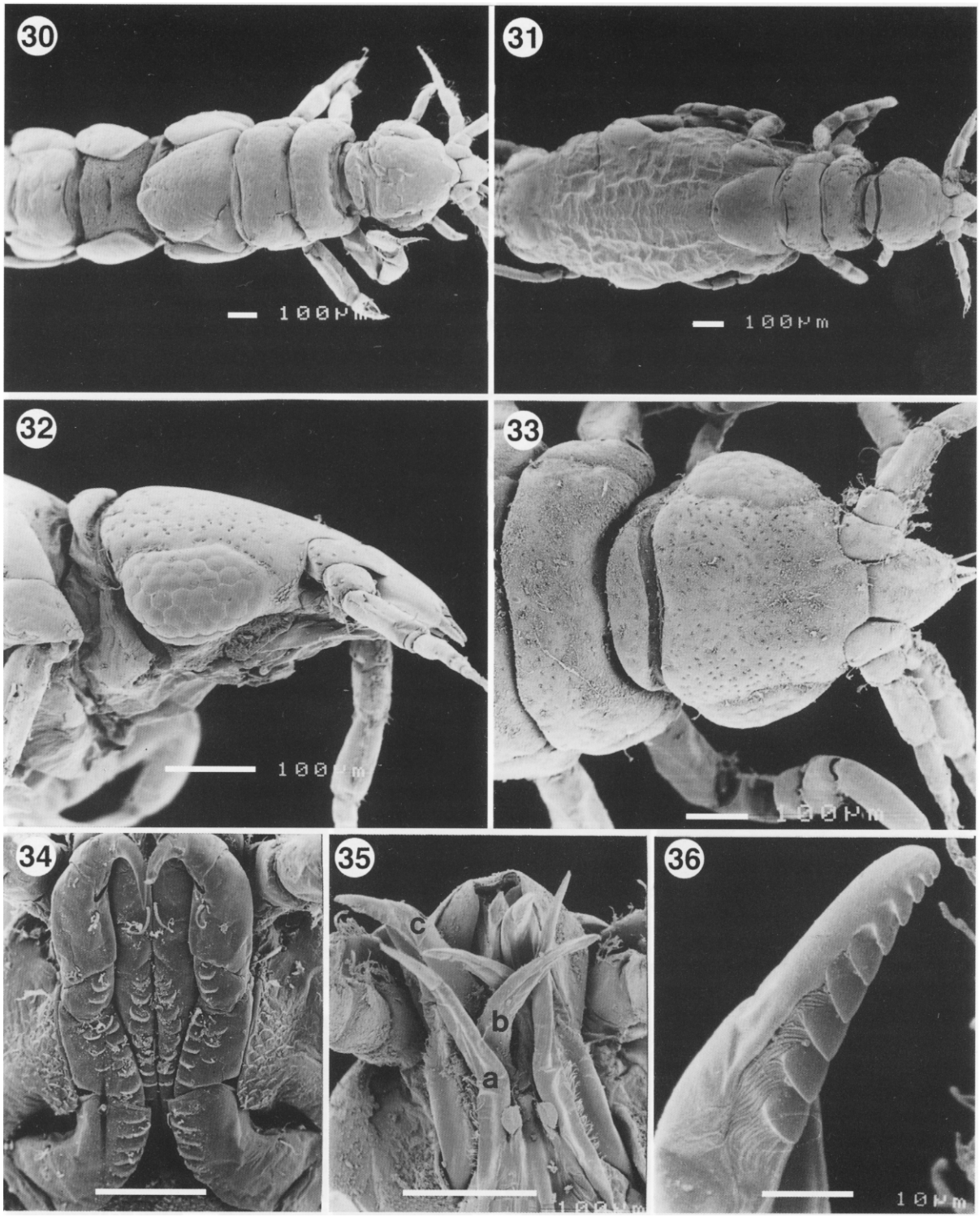


Fig. 22. Microscope projection drawings of pereopods 2 to 6 (P2–P6) of *Gnathia africana* Barnard, 1914 praniza larva collected at McDougall's Bay. Scale bar = 200 μm.



Figs. 23-29. Scanning electron micrographs of a male *Gnathia africana* Barnard, 1914 collected at McDougall's Bay. **Fig. 23.** Anterio-lateral view of cephalon. **Fig. 24.** Lateral view of cephalon. **Fig. 25.** Dorsal view of superior frontolateral and mediofrontal processes with simple setae. **Fig. 26.** Ventral view of cephalon. **Fig. 27.** Dorsal view of right mandible. **Fig. 28.** Lateral view of left antennae. **Fig. 29.** Ventral view of penes. Scale bar: Fig. 27 = 100 µm.



Figs. 30-36. Scanning electron micrographs of *Gnathia africana* Barnard, 1914 larvae collected at McDougall's Bay. **Fig. 30.** Dorsal view of cephalon and pereon of zuphea larva. **Fig. 31.** Dorsal view of cephalon and pereon of praniza larva. **Fig. 32.** Lateral view of cephalon. **Fig. 33.** Dorsal view of cephalon. **Fig. 34.** Ventral view of gnathopods of a praniza larva. **Fig. 35.** Ventral view of (a) maxillipedes, (b) maxillule and (c) mandibles of a praniza larva. **Fig. 36.** Teeth on mandible of a praniza larva. Scale bar: Fig. 34 = 100 µm.

posterior side respectively, only a few simple setae anteriorly with single feather-like bristle distally. Dactylus half the length of propodus, terminates in sharp posterior-pointing unguis, prominent spine on posterior side proximal to unguis, few simple setae on dorsal and ventral sides of spine. Pereopods 3 to 6 (Fig. 22), similar to pereopod 2, differ only in direction, pereopods 4 to 6 directed posteriorly and pereopods 2 and 3 anteriorly.

T y p e m a t e r i a l : Syntype: In the collection of the South African Museum, Cape Town (SAM-A2553). Original author designated no holotype.

T y p e l o c a l i t y : St. James, False Bay (34°8.2'S, 18°27.4'E)

O t h e r l o c a l i t i e s : Lüderitz (26°40'S, 15°3'E), McDougall's Bay (29°45'S, 16°45'E), De Hoop Nature Reserve (34°28'S, 20°30'E) and Jeffreys Bay (34°2.2'S, 24°56.5'E).

M a t e r i a l e x a m i n e d : Material in the collection of the South African Museum, Cape Town, collected from the tubes of serpulid worms (SAM-A2693).

N e w m a t e r i a l : 95/09/09-01, 96/12/20-01 and 98/04/01-01 in the collection of the authors, all material collected from sponges.

O t h e r m a t e r i a l : In the collection of the South African Museum, Cape Town (SAM-A12614).

DISCUSSION

Populations of *Gnathia africana* differed in body size. The largest specimens were found at McDougall's Bay (west coast) with a progressive decrease in the size southwards. The specimens from De Hoop were intermediate in size with the smallest individuals collected at Jeffreys Bay (south east coast). This is in line with the phenomenon that animals on the southern African west coast tend to grow larger than the same species on the south and east coasts (Branch et al. 1994).

Gnathia africana adult males can be distinguished from the other southern African species by means of its medianly divided mediofrontal process, sensory pits and prominent paraocular process. According to Müller (1991), *G. africana* is similar to *Gnathia firingae* Müller, 1991 from Réunion Island in overall body proportions, in its frontal border and in the presence of the anterior constriction of pereonite 4 separating pereonite 4 from pereonite 3. *G. africana* differs from *G. firingae* in possessing prominent paraocular ornamentation, sensory pits randomly distributed over the cephalon and in lacking long simple setae distributed over both the cephalon and pereon. *G. africana* (3.8-5.2 mm) is also almost twice the size of *G. firingae* (1.7-2.1 mm).

The zuphea larva (Figs. 11, 30) differs from the praniza larva (Figs. 12, 31) only in the absence of the elastic membrane between pereonites 4 and 6. Segmentation between pereonites 3 and 7 is therefore indistinct. The praniza larvae are larger due to the stretched pereon.

The abundance of sensory pits on the dorsal body of *G. africana* larvae appears to be similar to those found by Davies (1981) on larvae of *Gnathia maxillaris* (Montagu, 1804). According to Charmantier et al. (1987), *Paragnathia formica* (Hesse, 1864) lacks these sensory pits. The bodies of *G. maxillaris* larvae are covered with scales, in contrast to the smooth body surface of *G. africana.* The larvae of *Caecognathia calva* (Vanhöffen) as illustrated by Wägele (1987) have narrower uropods than *Gnathia africana*. Although the larvae of *G. africana* appear to be similar in basic morphology to those of *G. maxillaris, Caecognathia calva* and *Paragnathia formica*, differences in the number of teeth on the mouthparts were also found.

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