Journal of Plankton Research Vol.21 no.4 pp.685–698, 1999

Two new species of Mysidacea (Crustacea), *Anchialina lobatus* and *Gastrosaccus sarae*, from South West Australia

S.U.Panampunnayil
National Institute of Oceanography, Regional Centre, Cochin 682018, India

Abstract. Descriptions of two new species, *Anchialina lobatus* and *Gastrosaccus sarae*, are given. *Anchialina lobatus* is distinguished from the other species of the genus by the presence of a hairy lobe on the first segment of the antennule, by the modified setae on the third segment of the mandibular palp and by the modification of the exopod of the third pleopod of the male. *Gastrosaccus sarae* is distinguished from the other species by the shape and armature of the telson.

Introduction

The genus *Anchialina* Kroyer is divided into two groups, the typica group and the grossa group, based on the modifications of the exopod of the third pleopod of the male. In Australian waters, the typica group is currently represented by four species, *A.dentata* Pillai 1964, *A.flemingi* W.Tattersall 1943, *A.typica* Kroyer 1861 and *A.pillai* Soo-Gun Jo & Murano 1992, and the grossa group is represented by two species, *A.grossa* Hansen 1910 and *A.penicillata* Zimmer 1915. *Anchialina lobatus* sp. nov., the third species of the grossa group from Australian waters, is described here. This species was collected from many stations between latitude 33°14′–35°16′S and longitude 114°28′–119°29′E.

The genus *Gastrosaccus* is represented in Australian waters by two species: *G.davei* Bacescu & Udrescu 1982 and *G.sorrentoensis* Wooldridge and McLachlan 1986. A third species, *G.sarae*, is described here. This species was collected from two stations between latitude 33°18′–34°52′S and longitude 115°01′–115°58′E.

All the samples were collected by a monofilament nylon net (mesh 33.5 µm, mouth area 1 m^2) from the upper 50 m of the water column. The type forms are deposited in the Reference Collection of the Indian Ocean Biological Centre, R.C., N.I.O., Cochin, India.

Anchialina lobatus sp. nov.

Material

Many adult and young males and females. Holotype adult male (IOBC-0500-10-50-1998). Allotype adult female (IOBC-0500A-10-50-1998). Paratypes five males and five females (IOBC-0500B-10-50-1998).

Description

Body stout and hispid. Carapace large, covering whole of thorax; posterior margin almost straight, anterior margin produced in front into broad triangular rostral plate extending to middle of first antennular segment, apex pointed and bent downwards like a hook; lateral margin covering basal part of eye stalks

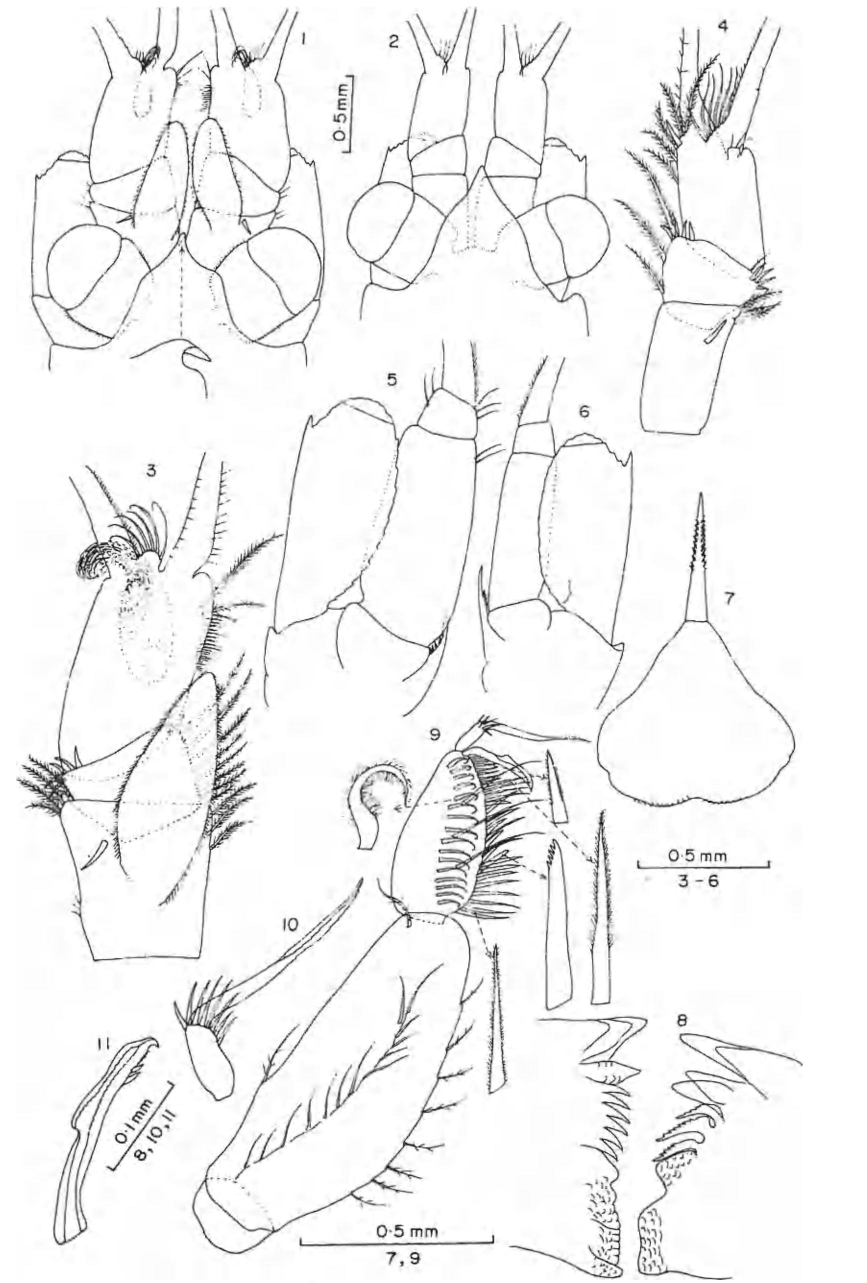
(Figure 1). In females, rostrum narrower, overreaching first antennular segment, apex bluntly pointed and straight (Figure 2). In immature and young males, rostrum as in female. Eyes longer than broad, occupying half of whole eye.

Antennule longer and stouter in male; first segment with one stout dorsal spine and large mid dorsal hairy lobe extending almost to middle of third segment. In young male measuring 7.5 mm, lobe not fully developed; second segment short with row of 7–8 long plumose setae on inner margin, setae becoming shorter posteriorly, outer and inner distal angle with row of 3–4 spines, third segment longer than first segment, inner margin armed with one long and many short plumose setae, dorsal lobe present; bundle of long setae present on ventral side; base of outer flagellum swollen and fringed with setae (Figure 3). In female, antennular peduncle slender, first segment as long as third with one stout mid dorsal spine; second segment with three plumose setae on inner margin and row of four spines on outer and inner distal angles; third segment with one spine and two long setae on inner distal angle; outer flagellum swollen and fringed with setae (Figure 4).

Antennal scale little more than three times as long as broad, extending little beyond second segment of antennule, apex broadly rounded extending beyond small outer denticle; peduncle stout, second segment five times as long as third and as broad as scale; sympodal spine with secondary spinules (Figure 5). In female, scale 2.7 times as long as broad, broader than second segment of peduncle (Figure 6).

Labrum with long median process armed with 9–10 pairs of teeth on dorsal surface (Figure 7). Mandibles well developed, spine row of left mandible formed from row of strong spines, that of right mandible formed from three bunches of pectinate spines (Figure 8). Mandibular palp stout, second segment twice as long as third, sparsely setose; third segment with an outer row of short curved plumose setae and an inner row of long and short pectinate setae with six club-shaped processes with serrated tip in between; terminal seta long and bent at middle, basal part swollen, distal part long and spiniform with serrated margin, bent middle part with cluster of spinules; subterminal seta peculiarly modified; thick, leaf like with long stout basal part, distal part flattened with serrated margin and two stout barbs (Figures 9–11). In female, mandibular palp slender, second segment nearly twice as long as third, third segment as usual for the genus without any modified setae (Figure 12). In 7.5 mm young male, terminal setae not yet modified and as in adult female (Figure 13). Maxillule with large pseudexopod, inner lobe with 11 plumose setae and outer lobe with several barbed spines on distal border (Figure 14). Maxilla as usual for the genus, exopod with 18 long plumose setae; distal segment of endopod ovate with plumose setae and fine hairs; endites well developed and heavily setose (Figure 15).

First thoracic endopod similar in both sexes. Basis well developed without any lobes, dactylus small, bearing long curved nail; exopod and epipod present (Figure 16). Second thoracic endopod with well-developed basis, merus broad, especially at distal part and with blunt triangular expansion on inner margin, dactylus with long nail (Figures 17 and 18). In young male (7.5 mm), lamellar expansion still not fully developed and almost vestigial (Figure 19). Second thoracic endopod in



Figs 1–11. *Anchialina lobatus* sp. nov. male. **Fig. 1.** Anterior part of body. **Fig. 2.** Anterior part of body, female. **Fig. 3.** Antennule. **Fig. 4.** Antennule of female. **Fig. 5.** Antenna. **Fig. 6.** Antenna of female. **Fig. 7.** Labrum. **Fig. 8.** Mandibles. **Fig. 9.** Mandibular palp. **Fig. 10.** Terminal seta of same. **Fig. 11.** Sub terminal seta of same.

Figs 12–19. *Anchialina lobatus* sp. nov. male. **Fig. 12.** Mandibular palp of female. **Fig. 13.** Tip of mandibular palp of young male. **Fig. 14.** Maxillule. **Fig. 15.** Maxilla. **Fig. 16.** First thoracic endopod. **Fig. 17.** Second thoracic limb. **Fig. 18.** Same, tip of endopod enlarged. **Fig. 19.** Second thoracic endopod of young male.

female simple without lamellar expansion (Figure 20). Endopod of third to eighth thoracic limbs similar in form, sixth joint divided into four subjoints, distal joint with three long plumose setae and one long curved stout spine serrated on inner margin; dactylus small, tipped with two short setae (Figures 21–24). Exopod of thoracic limbs 13-segmented, basal plate with small denticle on outer distal corner. Genital appendage of male with 10–13 inwardly curved setae on apex and many long plumose setae on posterior margin (Figure 25).

In male, first to fifth abdominal somites with well-developed pleural plates directed backwards, with posterior corner rounded in anterior three somites and spiniform in posterior two somites. In female, first abdominal somite with rounded pleural plates.

Pleopods in male with large rectangular sympods, pseudobranchial lamellae broad, bilobed and rounded. First pleopod uniramous and 8-segmented (Figure 26). Second pleopod with 12-segmented exopod and 11-segmented endopod (Figure 27). Third pleopod with 11-segmented endopod; exopod 14-segmented with complicated distal part, first to eighth segments with pair of long plumose setae, segments 9, 11 and 12 externally produced into lobes, twelfth segment as long as preceding three segments combined together, inner distal angle with one long spine extending beyond terminal segment and one mid dorsal spine; thirteenth segment short, one-third of twelfth segment with one thick granulated spine on outer distal corner and one slender spine on inner distal corner; fourteenth segment terminating in two long and one short stout spines (Figures 28 and 29). In young males (7.5 mm), lobiform processes still in vestigial condition (Figure 30). Fourth pleopod with 11-segmented exopod and 10-segmented endopod (Figure 31). Fifth pleopod with 10-segmented exopod and 9-segmented endopod (Figure 32).

In female, first pleopod simple, styliform and with few setae (Figure 33). Second to fifth pleopods thin flattened plates ~1.4 times as broad as long and bearing few setae (Figure 34).

Telson 1.6 times longer than last abdominal somite, three times as long as broad at base, lateral margin except one-fifth of basal part armed with 30–32 unequal spines, terminal spine longer and stouter; apical cleft one-sixth of telson length and armed with 30–35 teeth on each margin, all spines with secondary spinules (Figures 35 and 36).

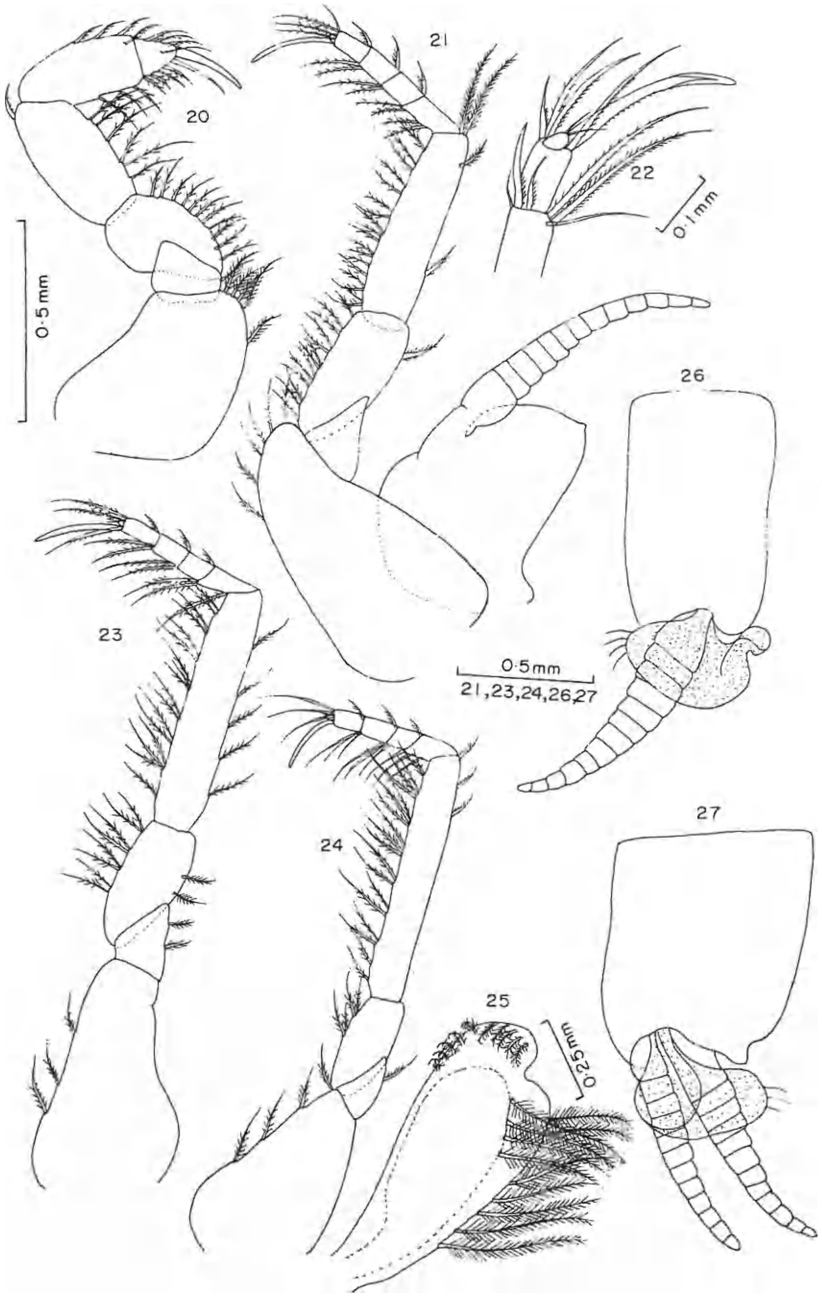
In female, lateral margin of telson armed with 20–22 spines and cleft armed with 20–25 teeth on each margin (Figure 37).

Endopod of uropod distinctly overreaching telson, armed along inner margin with dense row of long and short spines, spines with spinules; exopod broader and shorter than endopod and armed with 19–21 spines on outer margin (Figures 38 and 39).

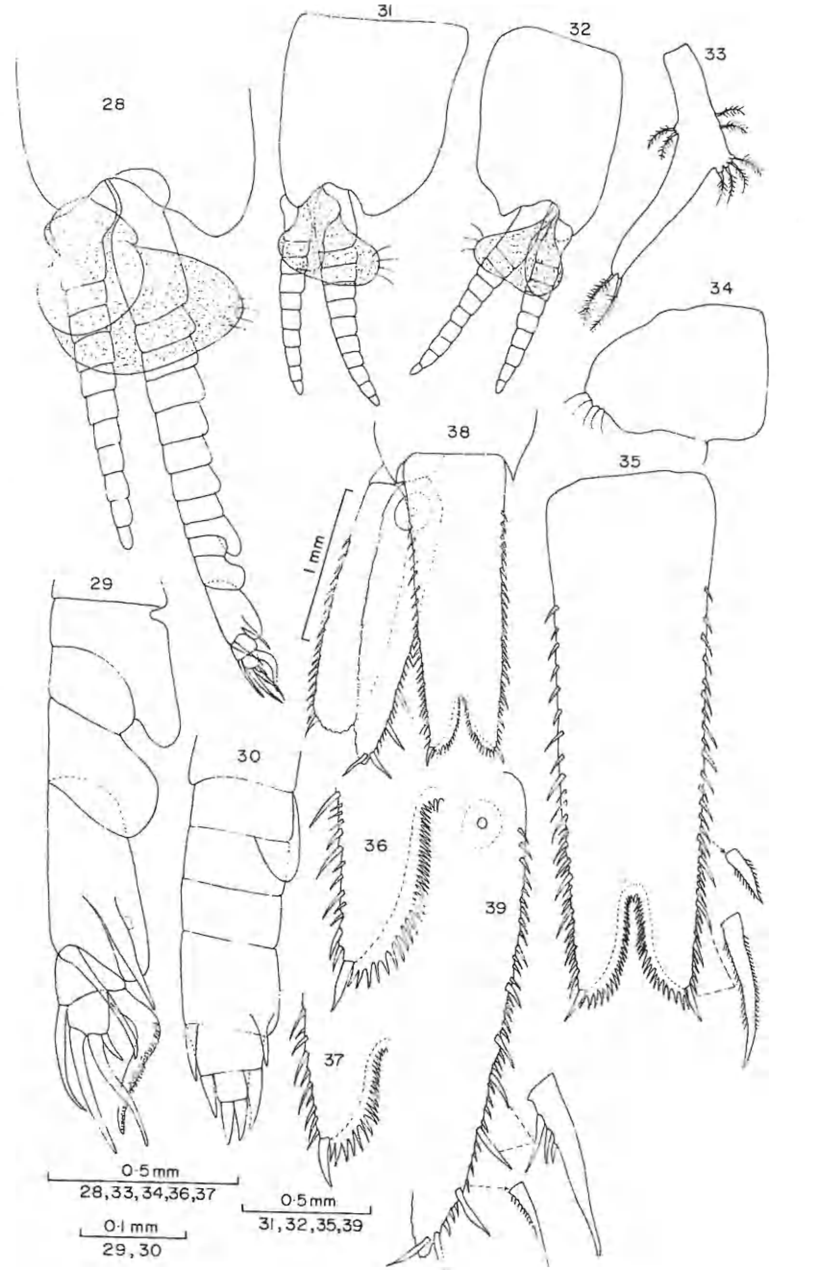
Adult male 8–8.2 mm. Adult female 5.7–6.3 mm.

Remarks

Anchialina lobatus sp. nov. belongs to the grossa group of the genus *Anchialina* in having lobiform processes among the distal modifications of the third pleopod



Figs 20–27. *Anchialina lobatus* sp. nov. male. **Fig. 20.** Second thoracic endopod of female. **Fig. 21.** Third thoracic limb. **Fig. 22.** Same, tip of endopod enlarged. **Fig. 23.** Fifth thoracic endopod. **Fig. 24.** Eighth thoracic endopod. **Fig. 25.** Male appendix. **Fig. 26.** First pleopod. **Fig. 27.** Second pleopod.



Figs 28–39. *Anchialina lobatus* sp. nov. male. **Fig. 28.** Third pleopod. **Fig. 29.** Same, tip of exopod enlarged. **Fig. 30.** Same, tip of exopod of young male. **Fig. 31.** Fourth pleopod. **Fig. 32.** Fifth pleopod. **Fig. 33.** First pleopod of female. **Fig. 34.** Fifth pleopod of female. **Fig. 35.** Telson. **Fig. 36.** Same, tip enlarged. **Fig. 37.** Same, of female. **Fig. 38.** Posterior part of body. **Fig. 39.** Endopod of uropod.

of the male. The other species belonging to this group are *A.grossa* Hansen 1910, *A.obtusifrons* Hansen 1912, *A.penicillata* Zimmer 1915, *A.sanzoi* Coifmann 1936, *A.dantani* Nouvel 1944, *A.zimmeri* Tattersall 1951, *A.media* Ii 1964 and *A.madagascariensis* Nouvel 1969. The new species is easily distinguished from the other species of the grossa group by the presence of a well-developed hairy lobe on the first segment of the antennule, the modified terminal setae of the mandibular palp and the modifications of the exopod of the third pleopod of the male.

Etymology

The specific name refers to the lobe on the antennule of the male.

***Gastrosaccus sarae* sp. nov.**

Material

Adult males, 2; adult females, 6; immature males, 13; young females, 10; immature females, 14.

Holotype adult female (IOBC-0501-10-50-1998), allotype adult male (IOBC-0501A-10-50-1998). Paratypes two adult females, two immature males (IOBC-0501B-10-50-1998).

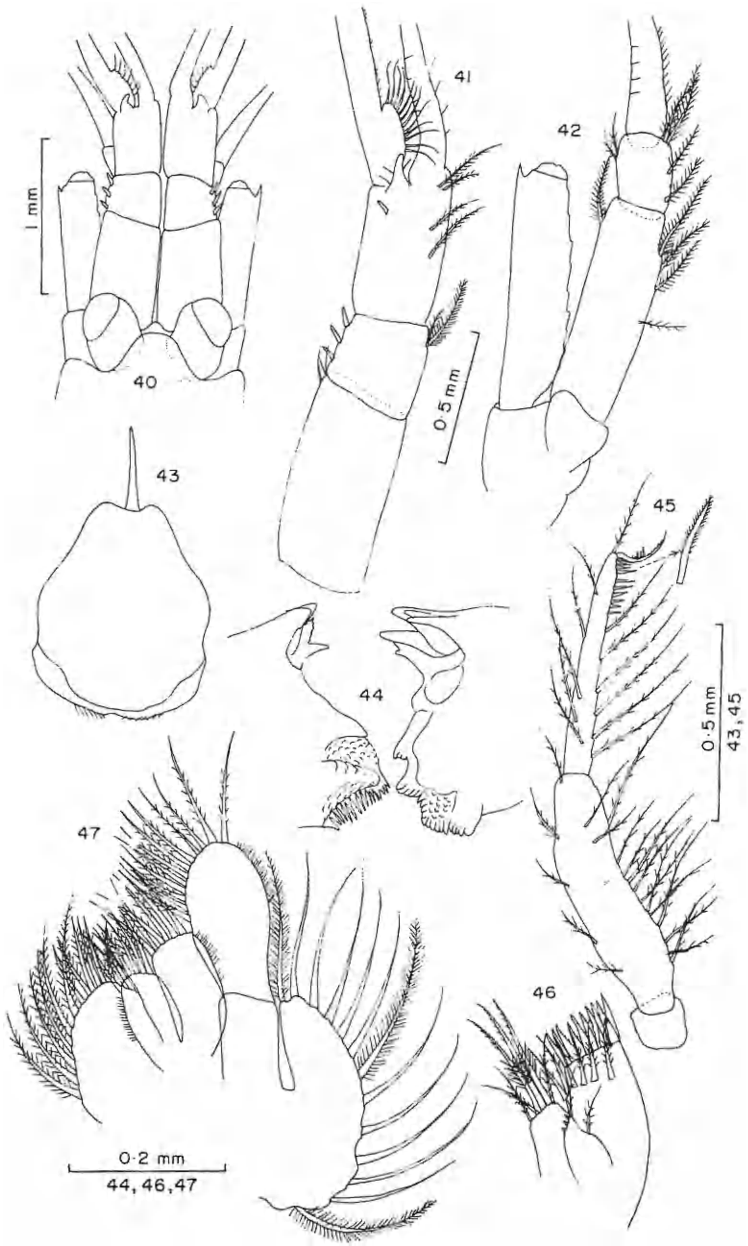
Description

Female. General form slender. Carapace produced in front into apically rounded broad conical rostrum covering basal part of eyestalks; posterior margin emarginate leaving ultimate and dorsal part of penultimate segments, laterally covering thorax and first abdominal segment. Eyes moderate in size, cornea occupying less than a third of whole eye (Figure 40).

First segment of antennular peduncle longest, second segment short with three sharp outer dorsal spines, third segment with one dorsal spine and one finger-like lobe, basal part of outer flagellum swollen and fringed with setae (Figure 41). Antennal scale 4.5 times as long as broad, just overreaching second segment of antennule, outer margin straight and terminating in strong spine, apex rounded and extending beyond outer spine; peduncle longer and stouter than scale, second segment 2.6 times longer than third, second and third segments carrying few plumose setae (Figure 42).

Labrum longer than broad and produced in front into long spine, about a third of lip proper (Figure 43). Mandibles without spine row (Figure 44); mandibular palp slender, second and third segments subequal and furnished with long setae (Figure 45). Inner lobe of maxillule with five plumose and three stout barbed setae; outer lobe with three small denticles on inner margin and 10 strong spines on distal border (Figure 46). Maxilla with prominent basal lobe, distal lobe deeply bifid, second segment of endopod with plumose setae and fine hairs; exopod with 13 long plumose setae (Figure 47).

First thoracic endopod short, setose along inner margin, basis with well-developed gnathobasic lobe, dactylus with several spine-like pectinate setae,



Figs 40–47. *Gastrosaccus sarae* sp. nov. female. **Fig. 40.** Anterior part of body. **Fig. 41.** Antennule. **Fig. 42.** Antenna. **Fig. 43.** Labrum. **Fig. 44.** Mandibles. **Fig. 45.** Mandibular palp. **Fig. 46.** Maxillule. **Fig. 47.** Maxilla.

epipod large (Figures 48 and 49). Second thoracic endopod similar to first, dactylus with several long spine-like setae, nail absent (Figures 50 and 51). Thoracic endopods 3–8 similar in structure with 7–11 carpopropodal segments, setose along inner margin. Basal plate of second to fifth exopod with prominent denticle on outer distal corner (Figures 52–54).

First abdominal somite with large rounded pleural plates. Fifth abdominal somite with ridge-like projection at posterior end.

First pleopod uniramous, sympod long, distally armed with row of nine long plumose setae; endopod one-third length of sympod, single-segmented and with plumose setae (Figure 55). Pleopods second to fifth rudimentary, rod like and armed with many long plumose setae (Figures 56 and 57).

Telson little longer than last abdominal segment, 3.2 times as long as broad at base, steadily narrowing towards apex, distal part half width of basal part, lateral margin armed throughout with 22 irregularly short and long stout sharp spines not forming definite series, gap between first, second and third spines long, second pair of spines dorsal in position, terminal pair of spines longer and stouter; cleft one-sixth length of telson and armed with 23–25 pairs of closely set spines (Figures 58 and 59).

Uropods subequal, slightly shorter than telson, endopod with 13–16 sharp spines on inner margin, first spine almost on statocyst; exopod armed with 17 spines, successively increasing in length (Figures 60 and 61).

Adult female 9.7 mm.

Male. Similar to female except for following points. Rostrum narrower (Figure 63). Antennule with basal part of outer flagellum swollen and bilobed, proximal lobe densely hirsute, distal lobe fringed with thick setae (Figure 64). Carpopropodal segments of thoracic endopods varying from six to 10 (Figure 65).

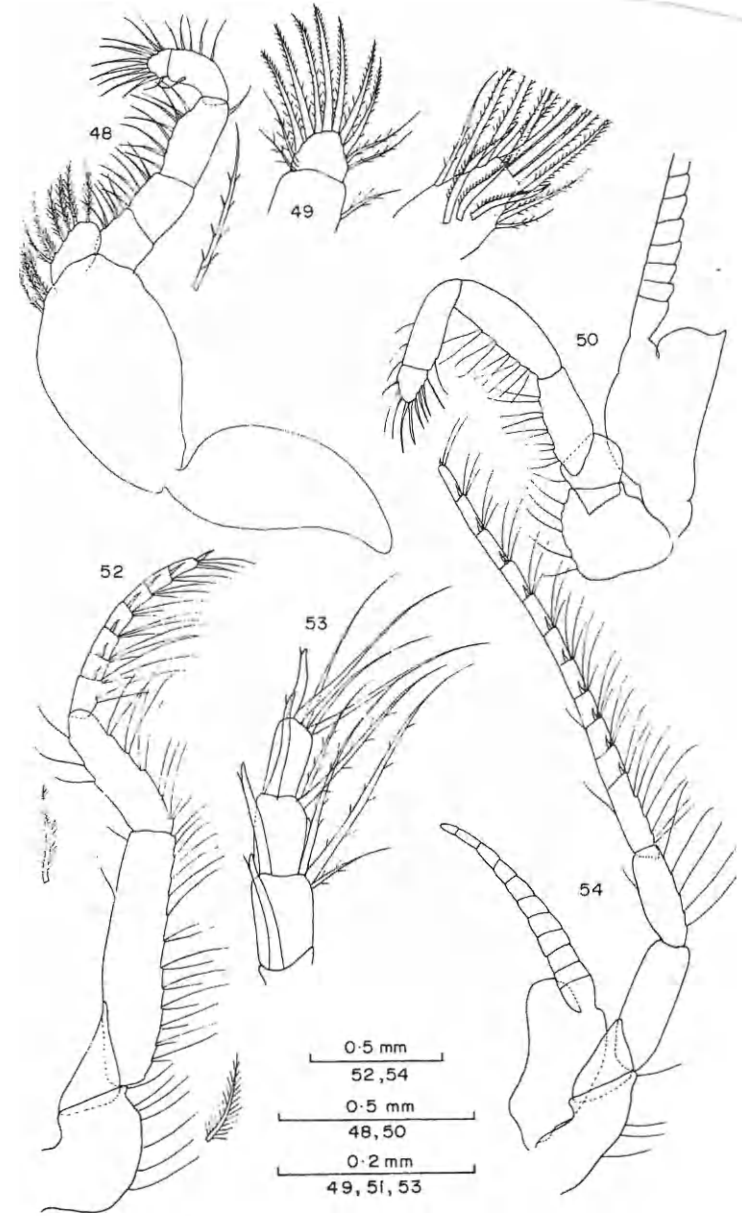
All pleopods biramous. First pair with 8-segmented exopod and unsegmented endopod; sympod with 10 long plumose setae on outer margin (Figure 66). Second pair with 8-segmented exopod and 7-segmented endopod (Figure 67). Exopod of third pair long, 4-segmented, segments successively decreasing in length, fourth segment terminating in two stout spines, one spine longer and barbed; endopod 7-segmented and shorter than first segment of exopod (Figures 68 and 69). Fourth and fifth pleopods with 7-segmented exopod and rudimentary endopod (Figures 70 and 71).

Telson three times as long as broad at base, steadily narrowing distally, distal end one-third width of basal part, lateral margin armed with 24–25 short and long stout spines not arranged in definite series, cleft one-sixth length of telson and armed with 21–22 pairs of spines (Figure 72).

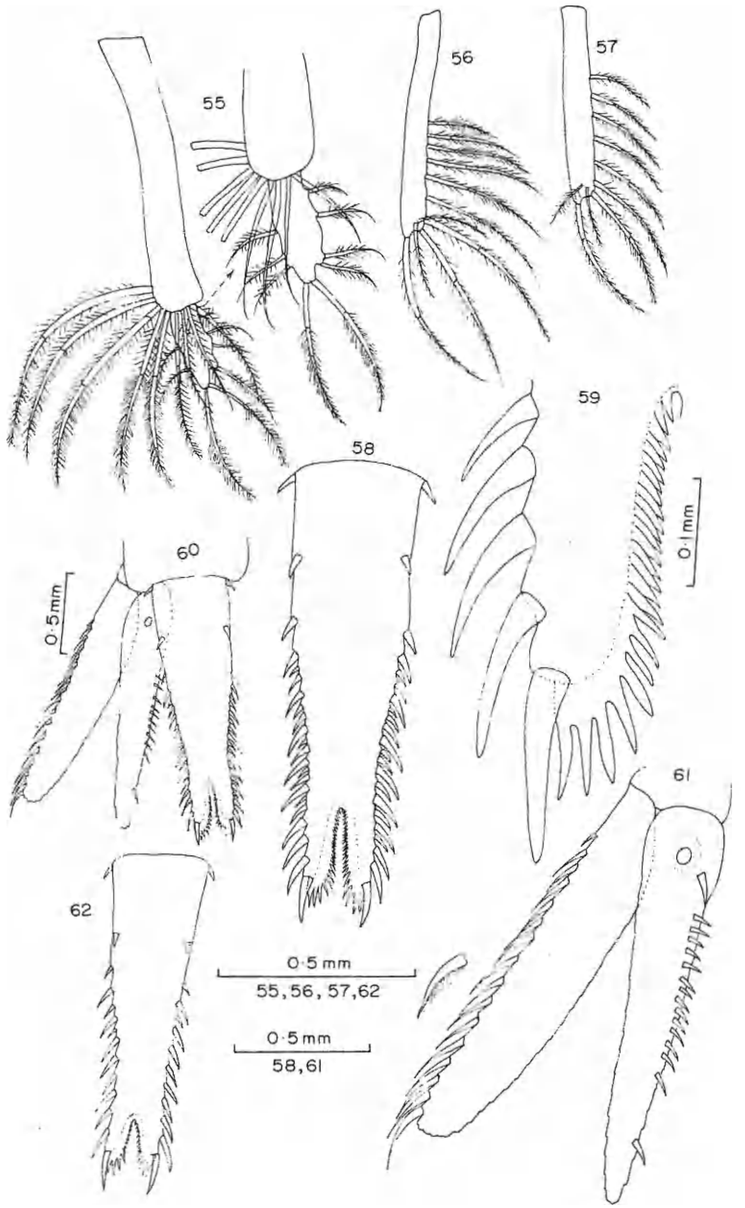
Endopod of uropod distinctly longer than exopod, armed with 13 sharp spines on inner margin; exopod broader and armed with 16 spines on outer margin (Figure 73).

Immature male and female agree in form and armature of telson with that in adult, but with fewer lateral spines (Figure 62).

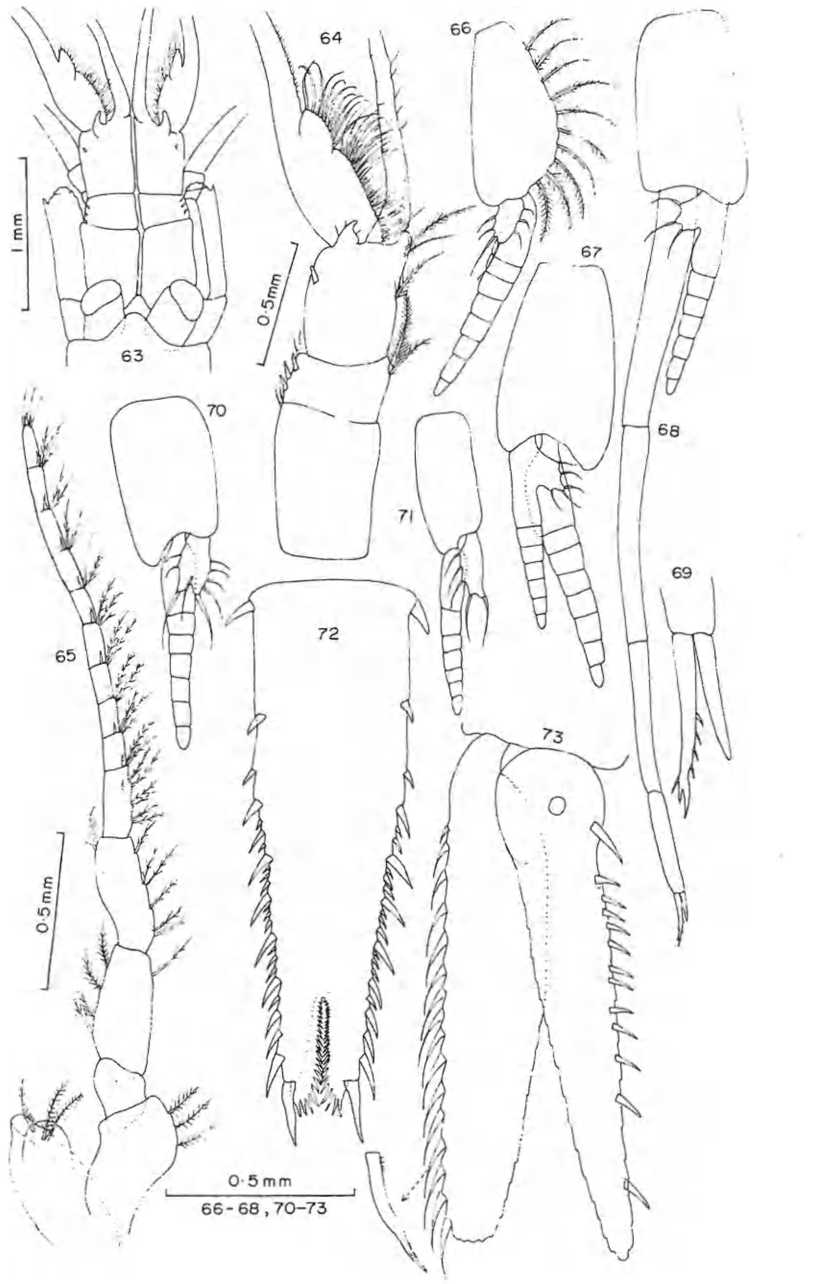
Adult male 7.3 mm.



Figs 48–54. *Gastrosaccus sarae* sp. nov. female. **Fig. 48.** First thoracic endopod. **Fig. 49.** Same, tip enlarged. **Fig. 50.** Second thoracic limb. **Fig. 51.** Same, tip of endopod enlarged. **Fig. 52.** Third thoracic endopod. **Fig. 53.** Same, tip enlarged. **Fig. 54.** Eighth thoracic limb.



Figs 55–62. *Gastrosaccus sarae* sp. nov. female. **Fig. 55.** First pleopod. **Fig. 56.** Third pleopod. **Fig. 57.** Fifth pleopod. **Fig. 58.** Telson. **Fig. 59.** Same, tip enlarged. **Fig. 60.** Posterior part of body. **Fig. 61.** Uropod. **Fig. 62.** Telson of young female.



Figs 63–73. *Gastrosaccus sarae* sp. nov. male. **Fig. 63.** Anterior part of body. **Fig. 64.** Antennule. **Fig. 65.** Eighth thoracic endopod. **Fig. 66.** First pleopod. **Fig. 67.** Second pleopod. **Fig. 68.** Third pleopod. **Fig. 69.** Same, tip of endopod enlarged. **Fig. 70.** Fourth pleopod. **Fig. 71.** Fifth pleopod. **Fig. 72.** Telson. **Fig. 73.** Uropod.

Remarks

The genus *Gastrosaccus* differs from the genus *Haplostylus* in having a multisegmented endopod on the third pleopod of the male and from the genus *Iiella* in the absence of lateral spines on the sides of the frontal median process of the labrum. The new species belongs to the genus *Gastrosaccus* and can be easily distinguished from the other species of the genus by the shape and armature of the telson.

Etymology

This species is named in honour of my late mother, Sara.

Acknowledgements

I express my sincere thanks to the Director, National Institute of Oceanography, Goa, and the Scientist-in-Charge, Regional Centre of National Institute of Oceanography, Cochin, for encouragement and providing facilities for this work.

References

Bacescu,M. and Udrescu,A. (1982) New contributions to the knowledge of the Mysidacea from Australia. *Trav. Mus. Hist. Nat. Grigore Antipa*, **24**, 79–96.
Coifmann,I. (1936) Mysidacei del Mar Rosso: Studies del materiale raccolto dal Prof. L. Sanzo durante la campagna idrografica della R. Nave Ammiraglio Magnaghi (1923–24). *R. Comitato Talassografico Italiano*, **233**, 1–52.
Hansen,H.J. (1910) The Schizopoda of the Siboga Expedition. *Siboga Exped.*, **37**, 1–120.
Hansen,H.J. (1912) Reports on the scientific results of the expedition to the eastern tropical Pacific, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer 'Albatross', from October, 1904 to March 1905. Lieut-Commander L.M. Garret, U.S.N. commanding. 27. The Schizopoda. *Mem. Mus. Comp. Zool. Hav.*, **35**, 175–296.
Ii,N. (1964) *Fauna Japonica Mysidae*. Biogeographical Society of Japan, Tokyo, 610 pp.
Kroyer,H.N. (1861) Et bidrag til Kundskab om Krebsdyrfamilien Mysidae. *Naturhist. Tidsskr. Kjobenhavn*, ser. 3, **1**, 1–75.
Nouvel,H. (1944) Diagnoses de Mysidaces nouveaux de la mer Rouge et du Golfe d'Aden. *Bull. Soc. Hist. Nat. Toulouse*, **79**, 255–269.
Nouvel,H. (1969) Mysidaces recoltes par S. Frontier a Nosy - Be. *V. Anchialina madagascariensis* n. sp. *Bull. Soc. Hist. Nat. Toulouse*, **105**, 340–356.
Pillai,N.K. (1964) Report on the Mysidacea in the collection of the Central Marine Fisheries Research Institute, Mandapam Camp, South India. *Mar. Biol. Assoc. India*, **6**, 1–41.
Soo-Gun Jo and Murano,M. (1992) Two new species belonging to the subfamily Gastrosaccinae (Mysidacea). *Crustaceana*, **63**, 185–198.
Tattersall,W.M. (1943) Biological results of the last cruise of the Carnegie. IV. The mysids. In Ault,J.P. (Commander), *Scientific Results Cruise VIII of the Carnegie During 1928–1929. Biology IV*. Publication of the Carnegie Institute, Washington, Vol. 551, pp. 61–72.
Tattersall,W.M. (1951) A review of the Mysidacea of the United States National Museum. *Bull. US Nat. Mus.*, **201**, 1–292.
Wooldridge,T. and McLachlan,A. (1986) A new species of *Gastrosaccus* (Mysidacea) from western Australia. *Rec. West. Aust. Mus.*, **13**, 129–138.
Zimmer,C. (1915) Schizopoden des Hamburger Naturhistorischen (Zoologischen) Museum. *Mitt. naturh. Mus. Hamburg*, **32**, 152–182.

Received on August 3, 1998; accepted on November 20, 1998

Journal of Plankton Research Vol.21 no.4 pp.699–719, 1999

Zooplankton bacterivory at coastal and offshore sites of Lake Erie

Soon-Jin Hwang[1] and Robert T.Heath

Department of Biological Sciences and Water Resources Research Institute, Kent State University, Kent, OH 44242, USA

[1]Present address: Water & Environment Research Center, Kyonggi Development Institute, Suwon, Korea 442-070

Abstract. Two size classes of zooplankton (microzooplankton: 40–200 μm; rotifers and nauplii, but protists were excluded; and macrozooplankton: >200 μm; cladocerans and copepods) bacterivory at coastal and offshore sites in Lake Erie, USA, were determined *in situ* using both fluorescent and radiolabeled bacteria during the summers of 1993 and 1994. Bacterial abundance, cellular carbon content and productivity were significantly higher at the more eutrophic coastal site ($P < 0.01$). Bacterivorous rotifers usually dominated total rotiferan abundance at both sites. All cladocerans except *Leptodora kindtii* grazed bacteria, but most copepods did not. Microzooplankton (especially rotifers) were generally more important bacterial grazers than macrozooplankton (primarily cladocerans) at both sites, and accounted for 56 and 71% of total zooplankton bacterivory at the coastal and offshore sites, respectively. However, on four occasions (out of 16 cases) when cladoceran biomass was >60% of total zooplankton biomass, macrozooplankton bacterivory accounted for 54–95% of total bacterivory. Total zooplankton generally consumed <50% of bacterial productivity at the coastal site, while zooplankton bacterivory often exceeded bacterial productivity at the offshore site. Zooplankton consumed an average of 27 and 14% of daily bacterial standing stock at the coastal and offshore site, respectively. Considering the total community bacterivory, zooplankton were often more important bacterial predators than protists. Our results demonstrate the importance of bacteria as a carbon source for zooplankton in the Lake Erie food web, where rotifers can contribute significantly to total zooplankton bacterivory.

Introduction

Although much attention traditionally has focused on zooplankton grazing of phytoplankton, bacteria apparently represent a large portion of the diet of some zooplankton species (Haney, 1973; Pourroit, 1977; Rieper, 1978). Heterotrophic nanoflagellates (Bloem and Bar-Gilissen, 1989; Sanders *et al.*, 1989; Berninger *et al.*, 1991; Simek and Straskrabova, 1992), rotifers (Sanders *et al.*, 1989; Ooms-Wilms *et al.*, 1995), and large zooplankton, such as *Daphnia* (Porter *et al.*, 1983; Riemann, 1985; Geertz-Hansen *et al.*, 1987; Vaque and Pace, 1992), apparently can graze significant portions of bacterial standing stock. Although zooplankton bacterivory has recently received increasing attention in freshwater ecosystems (e.g. Bjornsen *et al.*, 1986; Geertz-Hansen *et al.*, 1987; Kankaala, 1988; Urabe and Watanabe, 1991; Hart and Jarvis, 1993; Hlawa and Heerkloss, 1994; Ooms-Wilms *et al.*, 1995), the relative importance of bacterivory by the various macro- and microzooplankton taxa has seldom been assessed *in situ*, and remains uncertain.

Coastal and offshore communities of the Laurentian Great Lakes differ greatly in structure and function of the base of the food web. Coastal regions of Lake Erie often are turbid and highly productive (Krieger and Klarer, 1991; Hwang, 1995). These eutrophic environments generally contain an abundance of filamentous cyanobacteria, bacteria and rotifers, but not large filter-feeding