

## NEBALIA SCHIZOPHTHALMA, A NEW SPECIES OF LEPTOSTRACAN (MALACOSTRACA) FROM DEEP WATERS OFF THE EAST COAST OF THE UNITED STATES

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### ABSTRACT

A new species of leptostracan, *Nebalia schizophthalma*, is described from a single female specimen from one of the deep-sea stations along the Gay Head-Bermuda Transect. The new species differs from all other known species of the Leptostraca in that the distal margin of the eye is strongly invaginated. Other unusual features include a short, upturned ocular scale, a small indentation along the ventral margin of the carapace, and the absence of strong spinelike setae on the fourth article of the antennule. The new species represents only the fifth species of leptostracan known, and the second in the genus *Nebalia*, from the east coast of North America.

As currently understood, the order Leptostraca comprises 32 species of marine crustaceans in 9 genera and 2 families (Martin *et al.*, 1996). Although leptostracan crustaceans are known from a wide variety of marine habitats and depths, surprisingly few species have been reported from the east coast of the Americas. Previous reports include *Nebaliella caboti* Clark, 1932, from Cabot Strait, Canada (Clark, 1932), and from off New Jersey (Hessler and Sanders, 1967); *Paranebalia longipes* (Willemöes-Suhm, 1875), from Bermuda, the Bahamas, and Florida (Willemöes-Suhm, 1875; Verrill, 1923; Clark, 1932; Brattegard, 1970); *Sarsinebalia typhlops* (Sars, 1869) from the Davis strait to the continental shelf off New Jersey (Dahl, 1985), and *Nebalia bipes* (Fabricius, 1780) from "Maine to Labrador" (Clark, 1932; Gosner, 1971, based in part on Packard, 1883) and from "Arctic North America" and Greenland (Dahl, 1985). Thus, leptostracan genera are well represented from this large geographic region (four of nine currently recognized genera), but the records still include only five leptostracan species.

As part of the epibenthic sled collections that formed the basis of an analysis of deep-sea faunal diversity, Hessler and Sanders (1967) examined collections of benthic in-

vertebrates taken along the Gay Head-Bermuda transect off the east coast of the United States (see Sanders *et al.*, 1965, and Materials and Methods, below). Two species of leptostracans were found among 310 other species of benthic invertebrates (161 of which were species of malacostracan Crustacea) identified from the epibenthic sled sample. Nearly all of the Leptostraca recorded from the collections made in 1964 were identified as *Nebalia typhlops* Sars, 1869. However, one specimen from station 64 HH proved to be a new and unusual species of the genus *Nebalia* and is described below. It was collected at 2,886 m; insofar as we are aware, this depth is greater than that known for any other nebaliid, exceeding the depth record for the Pacific hydrothermal vent-associated species *Dahlrella caldariensis* Hessler, 1984, by 563 m.

### MATERIALS AND METHODS

The single specimen upon which this report is based was collected as part of a seminal, in-depth analysis of deep-sea benthic diversity conducted in the mid-1960s (Hessler and Sanders, 1967). That study, the first based on deep-sea collections made with an epibenthic sled, comprised samples taken at five locations in August of 1964 off the eastern coast of the United States. Four of the samples, including the sample containing the new species, were taken along the Gay Head-Bermuda Transect, a transect of previously established anchor-dredge sampling localities (see Sanders *et al.*, 1965). Our spec-

imen was taken at station 64 HH, 21 August, 1964, for which the coordinates were 38°46.0'N, 70°06.0'W (Hessler and Sanders, 1967). All samples collected by the epibenthic sled were processed according to the protocol described by Sanders *et al.* (1965). There were five other leptostracans reported from this station (Hessler and Sanders, 1967: table 3), all of which belonged to the species *Sarsinebalia typhlops* (2 males, 3 females). The female holotype of the new species has since been deposited in the Crustacea collections of the Natural History Museum of Los Angeles County, LACM CR19642671. Several appendages were dissected from the specimen and illustrated using a *camera lucida*. These appendages, and the otherwise intact specimen, were examined and preserved in 70% EtOH.

Order Leptostraca Claus, 1880

Family Nebaliidae Samouelle, 1819

Genus *Nebalia* Leach, 1814

*Nebalia schizophthalma*, new species

Figures 1–6

*Holotype*.—1 female: LACM CR19642671 (Natural History Museum of Los Angeles County). August 1964, collected by R. R. Hessler.

*Type Locality*.—North Atlantic Ocean, Gay Head-Bermuda Transect, 38°46.0'N, 70°06.0'W, Station 64 HH, 2,886 meters.

*Description of Female*.—Carapace and rostrum (Fig. 1a, b, d, e). Total length 8.13 mm. Rostrum elliptical, length 1.13 mm, width 0.43 mm; rostrum lacking setae or other ornamentation. Carapace length in lateral aspect 3.62 mm, carapace length in dorsal aspect 2.48 mm, carapace height 2.16 mm; posteriormost margin of carapace extending to middle of pleonite 4; carapace smooth, lacking ornamentation; small fold present along ventral margin of carapace, 1.49 mm from anteriormost margin.

*Eye* (Fig. 1b, c). Eye extending anteriorly to half length of rostrum; distal margin of eye invaginated medially along frontal plane, invagination equivalent to approximately one-tenth length of eye; apices of terminal dorsal and ventral lobes formed by invagination well rounded; eye surface smooth, unornamented, with ommatidia covering at least ventral lobe (pigment difficult to observe in preserved specimen). Ocular plate equal in length to eye but covering only proximal two-thirds of eye; plate slender, curving upward slightly in lateral aspect, tapering sharply to rounded apex.

*Antennule and Antenna* (Fig. 2a–d). Antennule anteriorly directed; peduncle consist-

ing of 4 articles; first article short, unornamented; second article longest, approximately 1.5 times length of third article; second article with long, plumose seta arising from proximal portion of anterior margin, with subterminal row of at least 4 long, simple setae on posterior margin and cluster of many simple setae on anterodistal margin; third article 0.40 mm long, posterodistal margin expanded slightly, article bearing small subterminal cluster of setae on anterior margin; fourth article less than half length of third, 0.17 mm long, with pronounced row of 12 simple setae on distolateral margin; antennular scale arising from anterodistal face of article 4, ovoid, 0.33 mm long, bearing dense row of simple setae along posterior and distal margin; flagellum slightly shorter than peduncle, consisting of 7 to 9 articles [distalmost end is damaged], proximalmost article longest showing evidence of fusion of multiple articles; each flagellar article with anterodistal cluster of 5 to 6 simple setae and single seta arising distolaterally. Antenna with peduncle of 3 articles, each subrectangular in shape; first article broadest, bearing large, acute process at distal end of anterior margin, distal process covered in short setae; second article subequal in size to third article; second article lacking ornamentation other than acute distal process on anterior margin, process much smaller than that of first article; third peduncular article with row of long setae along entire anterior margin, each bearing fine setules; long, plumose seta arising from posterior margin at midlength, subterminal row of 18 long, densely plumose setae and terminal row of 10 sparsely plumose setae; antennal flagellum with 11 articles, proximalmost longest; each flagellar article with 2 simple setae on anterodistal margin.

*Mandible* (Fig. 3a). Mandible with well-developed molar process, consisting of concave grinding surface, covered by dense rows of short setae and with longer, more widely spaced setae at periphery (see Martin *et al.*, 1996: fig. 6f); incisor process subtriangular, slightly shorter than molar process, bearing small patch of fine setae on proximodistal margin; palp 3-articulate, with first and third article subequal in length, second article only slightly shorter; first article unornamented; second article with 1 seta arising at midlength and second, longer seta subterminally; terminal article of palp with row of many fine

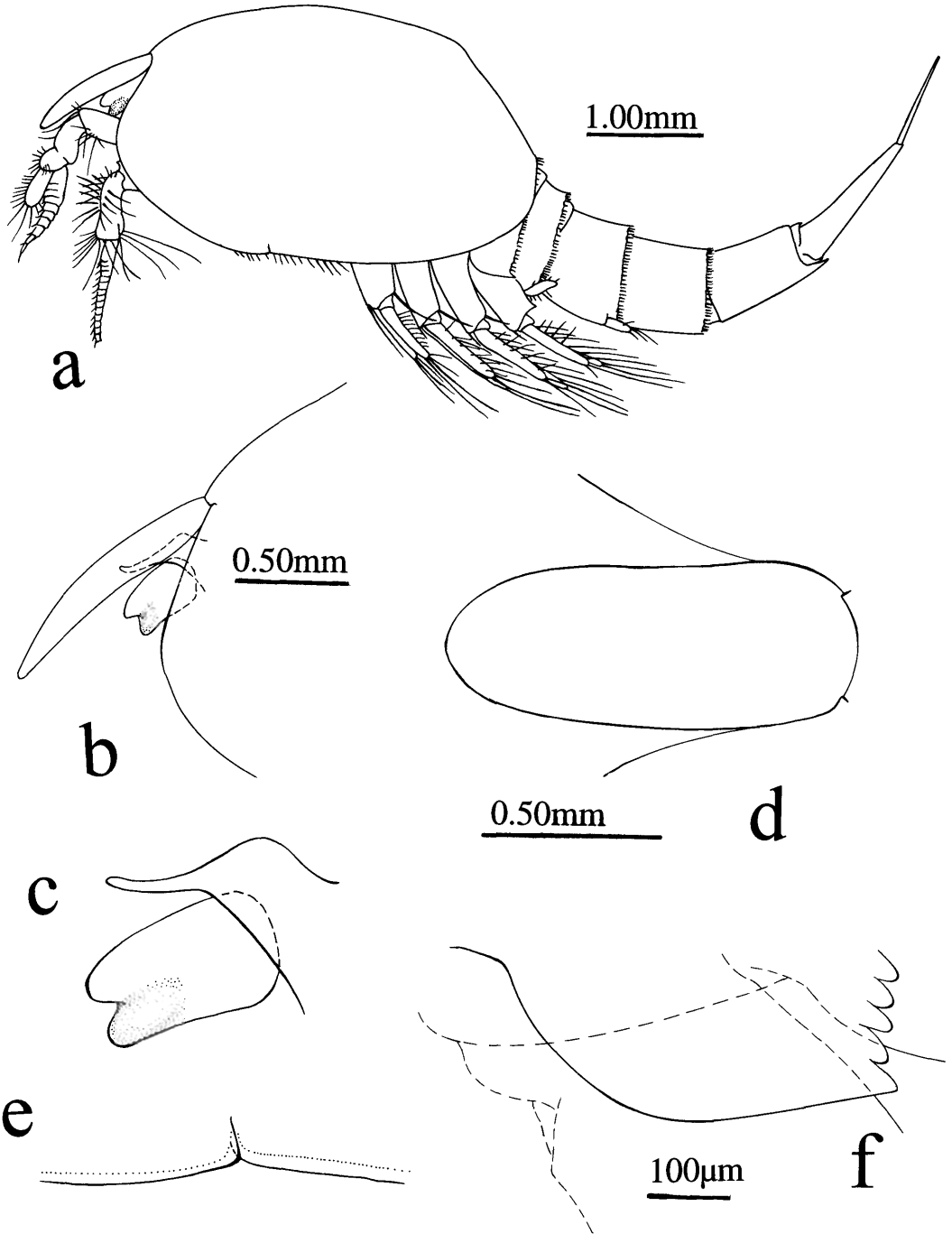


Fig. 1. *Nebalia schizophthalma*, new species, holotype female. a, whole animal; b, anterior, left side; c, eye, left; d, rostrum, dorsal aspect; e, cleft of ventral margin of carapace; f, epimeron of pleonite 4, left.

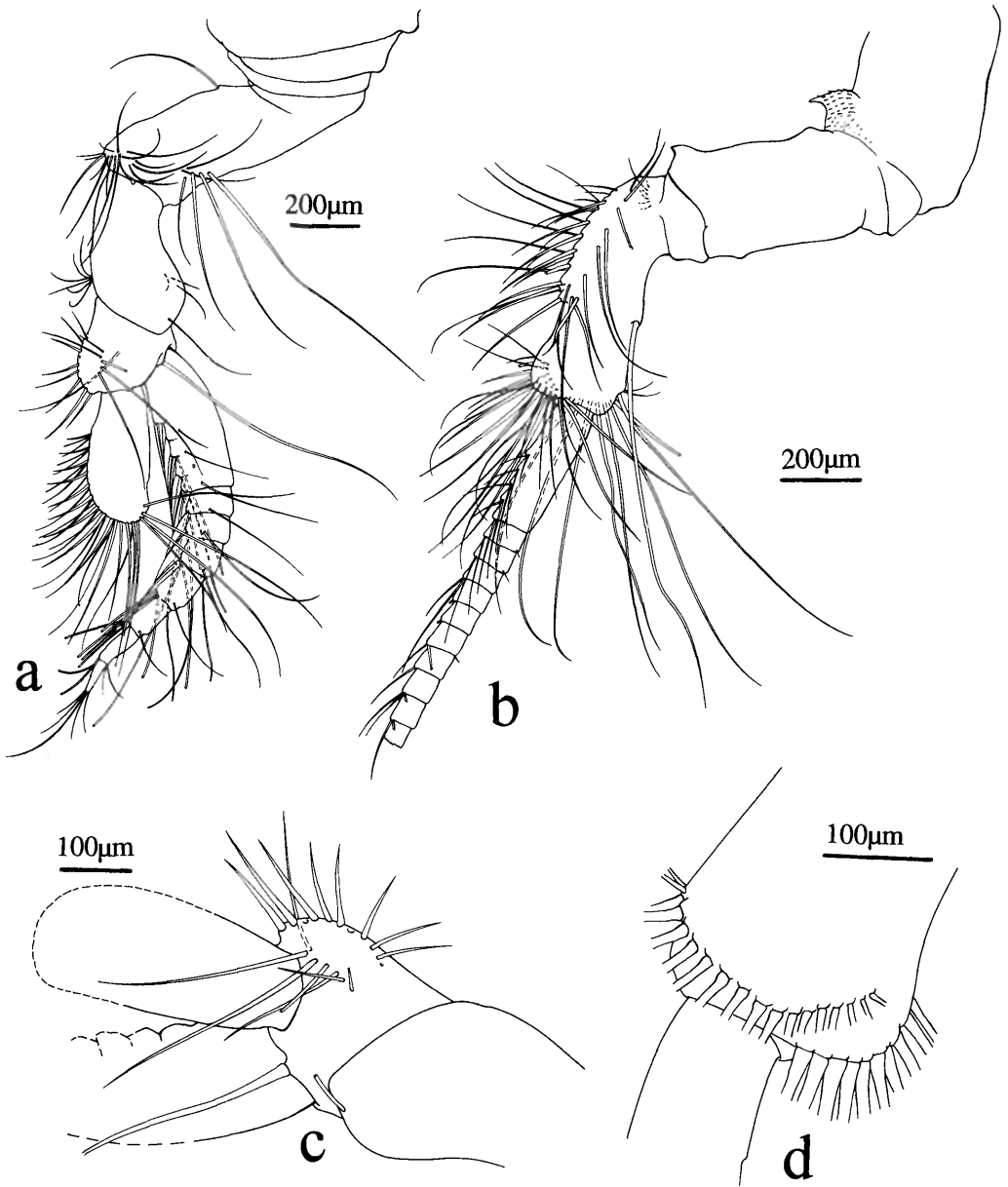


Fig. 2. *Nebalia schizophthalma*, new species, holotype female. a, antennule; b, antenna; c, antennular scale; d, distal face of third peduncular article of antenna, showing setal rows.

setae along anterior margin and row of approximately 25 larger, simple setae along posterior margin, overlapped by row of less than 10 shorter, curved setae at apex.

Maxillule (Fig. 3c). Protopod with two endites, distalmost larger; both endites with setose medial margin, each bearing 2 long, densely plumose setae on distomedial margin;

medial margins of both endites with dense row of robust, apically serrate setae; palp elongate, nearly 5 times combined lengths of endites, with proximal cluster of 9 long, plumose setae and remainder of palp bearing 11 long, widely spaced grooming setae.

Maxilla (Fig. 3b). Protopod with four endites, with first and third endites subequal in

size; second endite less than two-thirds size of first and third endites; fourth endite minute; medial margins of second and third endites well rounded. Endopod 2-articulate, proximal article longer; medial margin of endopod setose; distal article of endopod with terminal seta nearly equal in length to entire endopod; exopod two-thirds length of endopod, with row of plumose setae along entire lateral margin.

Thoracopods (Fig. 4). Thoracopods not extending beyond ventral margin of carapace; thoracopod endopods slightly longer than exopods, setose along entire medial margin; distal margin of each thoracopod bearing cluster of many elongate, plumose setae; thoracopod 1 with 2-articulate endopod; exopod notably shorter than endopod, with setose lateral margin and flat distal margin, bearing 2 elongate setae; epipod slightly larger than exopod; thoracopod 4 endopod 2-articulate, distal article minute; exopod arising from distal half of endopod; exopod broad, platelike, and with flat distal margin (not well rounded); epipod more than 2 times length of exopod but not extending as far distally, tapering distally to form rounded apex; thoracopod 8 with uniaarticulate endopod, margins slightly indented distally where first and second article have fused; exopod 0.5 times length of endopod, with row of long setae along lateral margin; epipod 0.65 times length of endopod, more narrow than exopod, tapering toward base of limb; thoracopods 2 and 3 and 5 through 7 not dissected and presumed most similar to thoracopod 4.

Pleonite 4 epimeron (Fig. 1f) with curved anterior margin and straight posterior margin (not curved inward as in other taxa); dentition of posterior border of pleonites 4 through 7 well defined, with each tooth tapering to form subtriangular apex.

Pleopods (Fig. 5). Pleopods 1 through 4 with subrectangular protopods; protopods of pleopods 1 and 2 with long (0.6 times length of exopod), subterminal simple seta on posterior margin, lacking on pleopods 3 and 4; exopod of pleopod 1 0.56 mm long, with 12 stout setae in setal row, preceded proximally by 2 longer simple setae; exopods of pleopod 2 and 3 0.68 mm long, each bearing 5 pairs of robust setae along posterior margin; posterior margin of protopod of pleopod 4 having 5 minute serrations; exopod of pleopod 4 0.63 mm long, with 6 paired simple setae. Pleopod 5 composed of 2 articles; first

article short, 0.25 times length of second; second article with 5 robust setae along distolateral margin. Pleopod 6 uniaarticulate, with 6 robust setae along lateral margin, distalmost seta longest; cirlet of acute teeth present on distal margin of pleopod, at base of terminal seta.

Telson and caudal furca (Fig. 6a, b). Telson short, length 1.12 mm. Anal plate with invagination as shown (Fig. 6b). Caudal rami each with sparse short, setulate setae along medial border; single terminal spinelike seta, approximately half as long as furca.

*Etymology*.—The specific name refers to the unique morphology of the eye; the epithet is a feminine noun formed by the Greek compounded adjectives *schizo-*, meaning split, and *ophthalmos-*, meaning eye.

*Remarks*.—Leptostraca appears to be one of very few crustacean groups that exhibits variability in the gross morphology of the eye. In *Paranebalia belizensis* Modlin, 1991, and *P. longipes*, the eyes are tuberculate. The eyestalks of *Nebaliella* Thiele, 1904, are long and strongly curved and lack visual elements (Walker-Smith, 1998). Perhaps the most extreme example of eye morphology is found in the deep-sea vent-associated species *Dahlrella caldariensis*, in which the adult eyes are slender, anteriorly denticulate, and exceed the length of the rostrum (Hessler, 1984: 657). In the genus *Nebalia* Leach, 1814, eye morphology tends to be more conservative, with most species having an eye that is slightly dilated distally but otherwise not noteworthy. The new species differs from all other species of *Nebalia* in possessing an eye that is distinctly invaginated distally, resulting in an eye that appears “bilobed,” with visual pigment only in the lower lobe. To our knowledge, the most similar eye belongs to the comparatively shallow-water species *Nebalia daytoni* from southern California. However, in *N. daytoni* Vetter, 1996, the eyestalk is more flattened distally, with only small protrusions at the dorsal and ventral extremities of the “face” of the eye, and it is fully pigmented (Vetter, 1996).

From deep-water habitats along the eastern coast of the United States, few leptostracan specimens are known to be available for study. The paucity of collection efforts might contribute to the apparent lack of diversity in the region. Given the patchy distribution

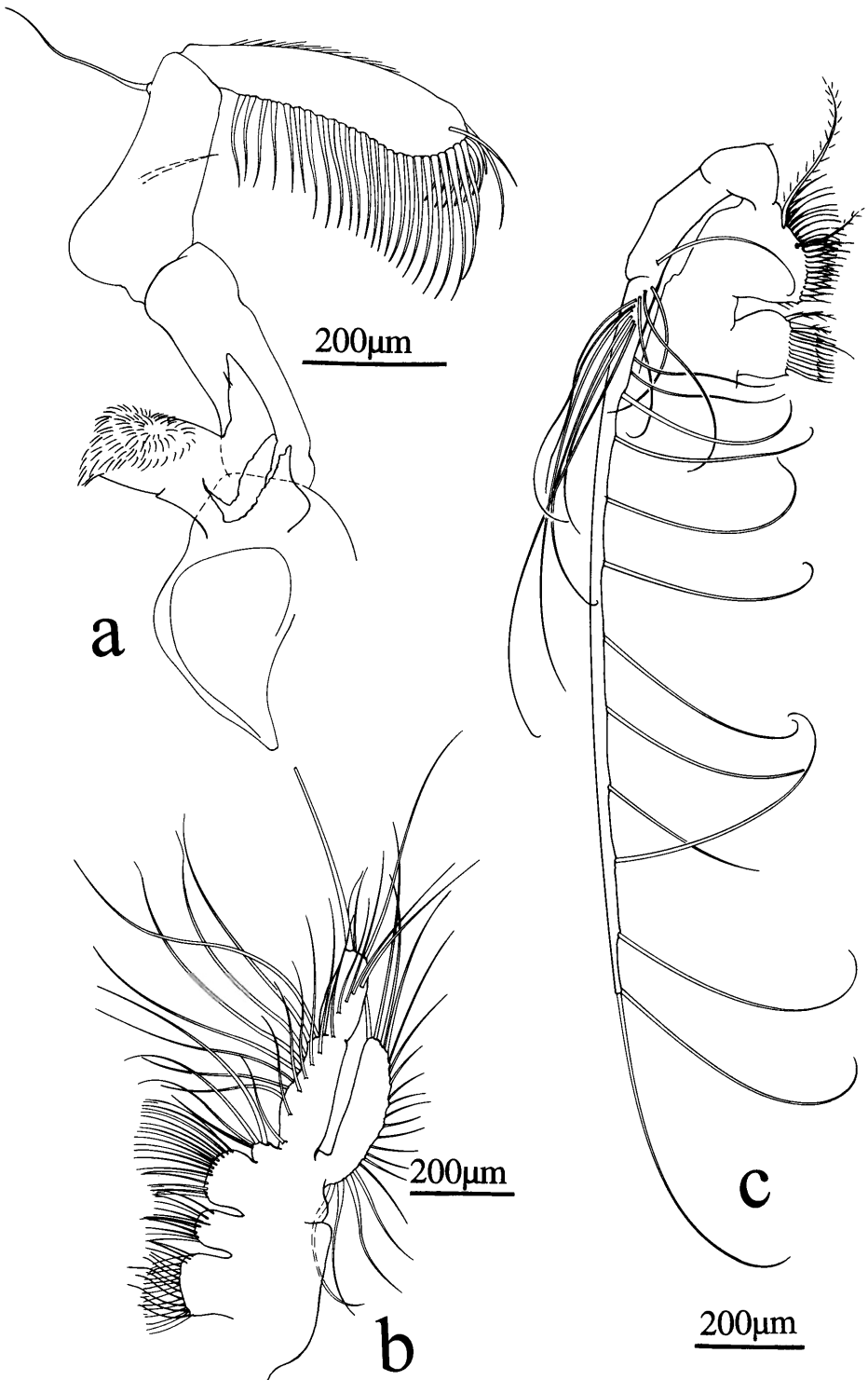


Fig. 3. *Nebalia schizophthalma*, new species, holotype female. a, mandible and mandibular palp, left; b, maxilla, left; c, maxillule and maxillary palp, right.

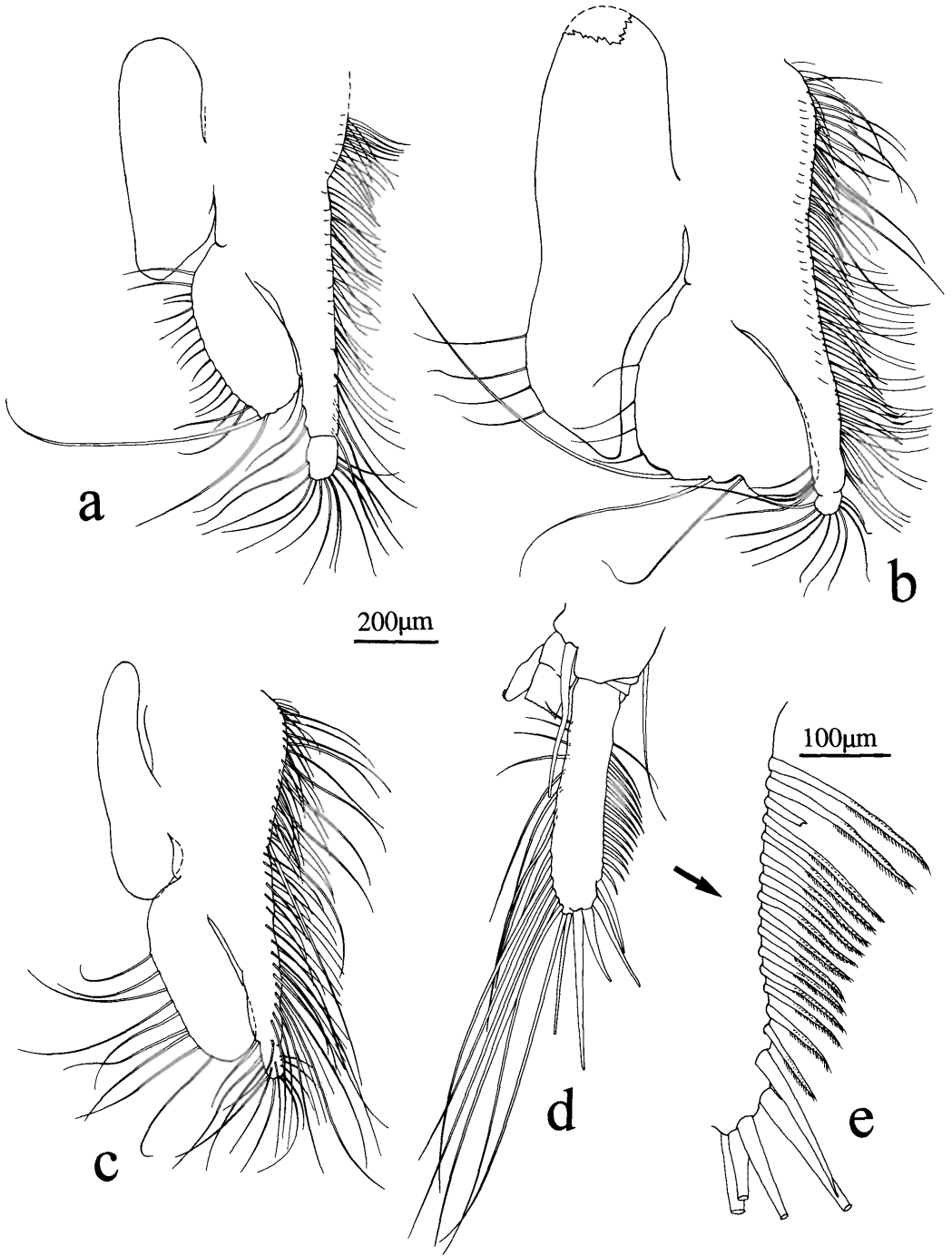


Fig. 4. *Nebalia schizophthalma*, new species, holotype female. a, thoracopod 1, left side, posterior face; b, thoracopod 4, left side, posterior face; c, thoracopod 8, left side, posterior face; d, pleopod 1, left side, distal article of endopod not shown; e, setal row of exopod of pleopod 1.

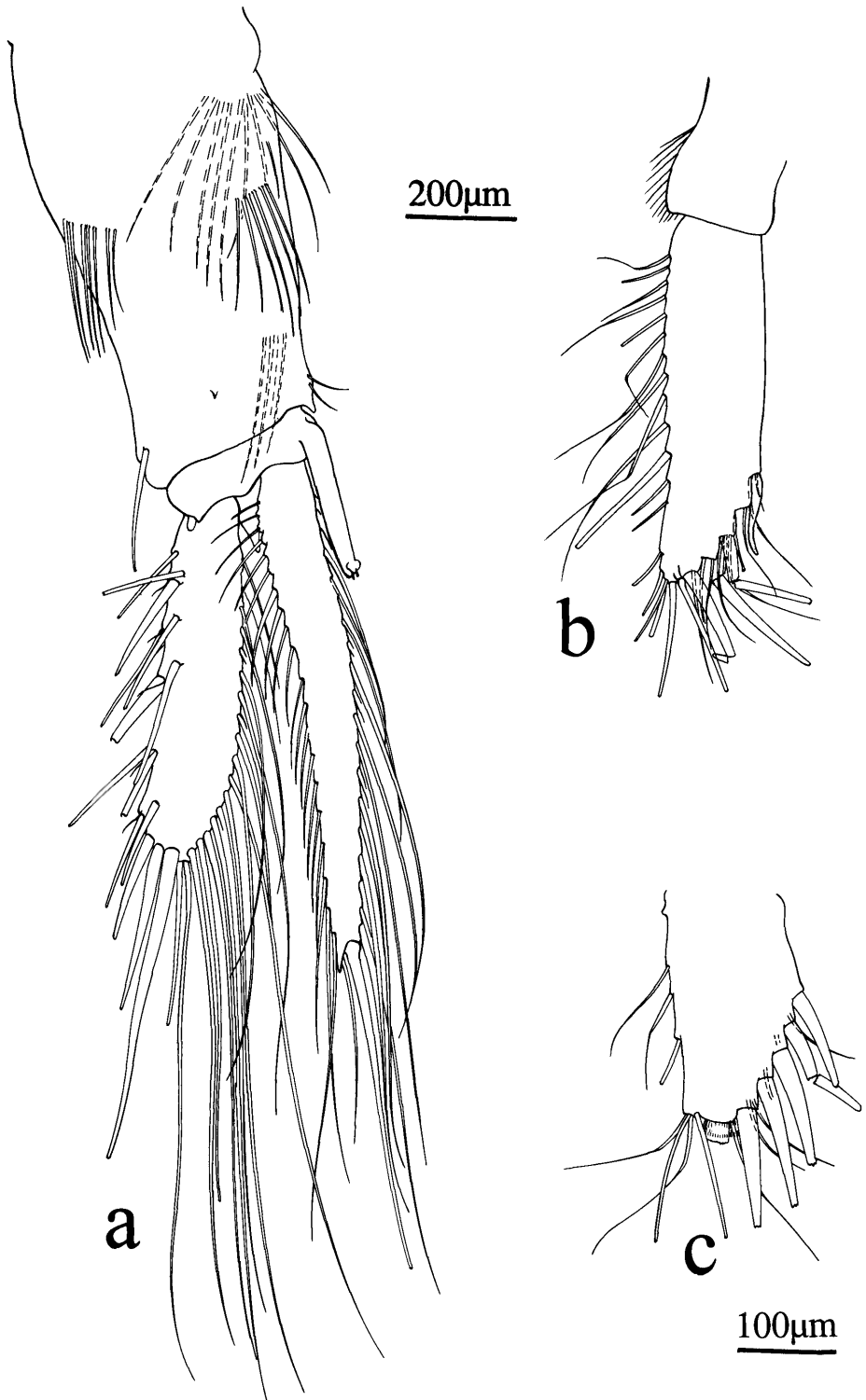


Fig. 5. *Nebalia schizophthalma*, new species, holotype female. a, pleopod 4, left side; b, pleopod 5, left side; c, pleopod 6, left side (distalmost setae omitted).



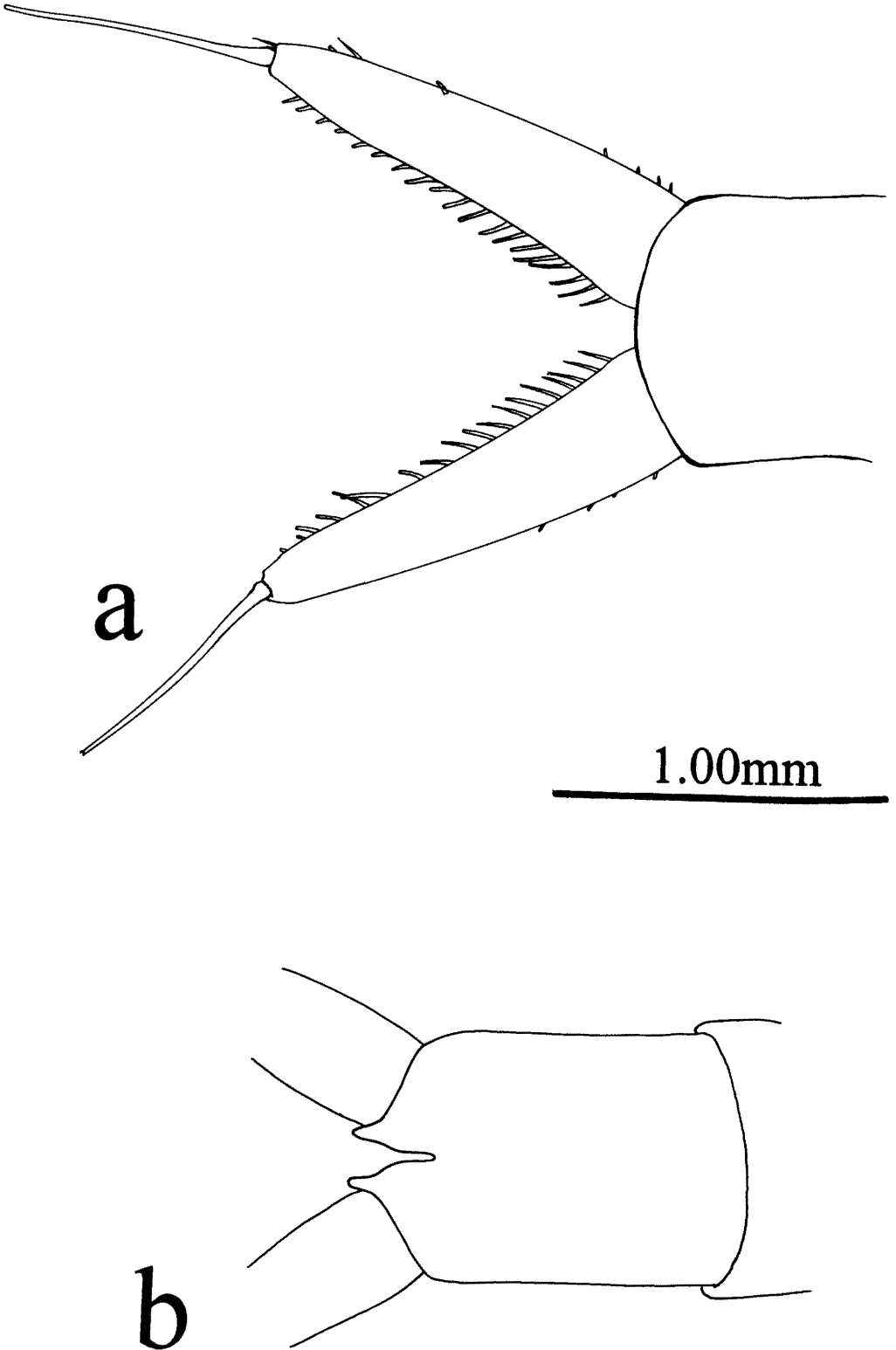


Fig. 6. *Nebalia schizophthalma*, new species, holotype female. a, caudal rami, left and right, dorsal aspect; b, anal plate, ventral aspect.

of many leptostracan species (e.g., Vetter, 1996), the methods of sampling for these small invertebrates should provide for extensive coverage of different benthic as well as pelagic habitats. There are collections of both sorted and unsorted material housed at various institutions that contain additional specimens of Leptostraca from western Atlantic waters. Examination of the specimens in these collections will lead to a better understanding of the Leptostraca occurring off the East Coast, through the discovery of new material and/or the reinterpretation of previous reports.

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