

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

BATHYPONTIA (COPEPODA: CALANOIDA): SIX SPECIES, ONE NEW, FROM THE SARGASSO SEA¹

BY GEORGIANA B. DEEVEY

*Florida State Museum, University of Florida
Gainesville, Florida 32601*

The genus *Isocalanus* Wolfenden 1906 is congeneric with *Bathypontia* Sars 1905 (Grice and Hulsemann, 1965). Ten species have been described: *B. elongata* Sars 1905, *Isocalanus minor* Wolfenden 1906, *I. major* Wolfenden 1906, *B. minor* Sars 1907, *B. spinifera* Scott 1909, *B. elegans* Sars 1920, *B. longiseta* Brodsky 1950, *B. similis* Tanaka 1965, *B. longicornis* Tanaka 1965 and *B. regalis* Grice and Hulsemann 1967. *B. minor* Sars and *I. minor* Wolfenden are different species, so Sars' species has been renamed *B. sarsi* Grice and Hulsemann 1965. *B. longicornis* Tanaka is very similar to *B. elongata* Sars, the only difference apparent in the descriptions being that *B. longicornis* has the first leg with a 1-segmented endopod, whereas *B. elongata* has a 2-segmented endopod on the first leg. Sars (1925, p. 356; 1924, Pl. 126, Fig. 12), however, confused the 2nd and 3rd legs of *B. elongata*, and described the long spine on the 2nd basipod segment of the 3rd leg as being on the 2nd leg; Tanaka (1965, Fig. 242i) described and figured this spine on the 3rd leg for *B. longicornis*. This long external spine on the 2nd basipod segment of the 3rd leg only is characteristic of all species of *Bathypontia*.

Grice and Hulsemann (1965) stated, without documentation, that *B. elegans* Sars is synonymous with *B. major* (Wolfenden). Wolfenden (1906, 1911) described *B. major* from a single immature female 3.9 mm (1906) or 3.6 mm (1911) long, collected in a 3,000 m haul west of the Cape

¹Contribution No. 577 from the Bermuda Biological Station. This work was supported by Grants GA-31736 and GA-36512 from the National Science Foundation.

Verde Islands in 1903. The status of *B. major* is uncertain; it might be an immature female of *B. elongata*, or of an otherwise undescribed species, but it differs from the immature female of *B. elegans* in the shape of the rostrum, the segmentation of the 4th and 5th thoracic segments, the segmentation of the endopod of the 1st leg, and the shape and proportions of the 5th legs. *B. elegans* Sars is therefore here considered a valid species.

B. elongata Sars is the commonest species, having been reported from 18°N to 12°S in the Indian Ocean (Grice and Hulsemann, 1967), from 22°50'S to 5°11'S in the eastern Pacific (Wilson, 1950), from the Gulf of Guinea between 1°30'N and 5°27'N (Vervoort, 1965), the Caribbean Sea at 15°N (Ovree and Foyo, 1972) and throughout the North Atlantic up to 63°38'N south of Iceland (Farran, 1908; Sars, 1925; Jespersen, 1940; Lysholm et al., 1945). *B. spinifera* Scott was described from 1°4.5'S, 127°52.6'E in the Halmahera Sea, and has also been recorded from 5°48'N-27°31'S in the Indian Ocean (Grice and Hulsemann, 1967). *B. similis* Tanaka was described from Sagami Bay and Suruga Bay on the Pacific coast of Japan. It has also been found at 2°38'S in the Indian Ocean (Grice and Hulsemann, 1967), at 11°N in the Caribbean Sea and at 22°N in the Gulf of Mexico (Park, 1970). *B. minor* (Wolfenden) was described from 2 females caught in the Atlantic west of the Cape Verde Islands; Park (1970) has recorded it from 22°N in the Gulf of Mexico and 19°N in the Caribbean Sea, and Grice and Hulsemann (1965) from 26°N in the Atlantic. *B. sarsi* Grice and Hulsemann has a questionably spotty distribution record in that it was described from 2 specimens caught off the Azores, and has been reported from the Philippines and the China Sea off Formosa (Wilson, 1950), from 1°30'N in the Indian Ocean (Grice and Hulsemann, 1967) from 36°N in the Atlantic (Lysholm et al., 1945) and from the Strait of Yucatan, the Caribbean Sea and Florida Current (Ovree and Foyo, 1964, 1967, 1972). The male described by Wheeler (1970) as *B. sarsi* does not belong to this species. *B. elegans* Sars was described from 4 stations off the Azores; Grice and Hulsemann

(1967) listed *B. major* (= *B. elegans*?) from a station at 22°11'S, 64°53'E in the Indian Ocean. *B. longiseta* Brodsky from the northwest Pacific, *B. longicornis* Tanaka from the Pacific coast of Japan, and *B. regalis* Grice and Hulsemann from 2°38'S, 65°E in the Indian Ocean have not been noted from other localities.

Zooplankton samples were collected monthly between July 1968 and September 1970 over 4 depth levels between the surface and 2,000 m at Station "S", 32°10'N, 64°30'W, in the Sargasso Sea off Bermuda (Deevey and Brooks, 1971). A total of 46 specimens belonging to 6 species of *Bathypontia* were obtained during this period, of which 36 were mature individuals and 10 immature. The adult specimens include 10 *B. similis* Tanaka, 4 *B. spinifera* Scott, 13 *B. minor* (Wolfenden), 5 *B. elongata* Sars, 2 *B. elegans* Sars, and a single female belonging to a new species. Although 1 *B. minor* female was caught within the upper 500 m, the other specimens were taken between 500 and 2,000 m depths.

Genus *Bathypontia* Sars 1905

Body elongate, head separate or partially fused with 1st thoracic segment, 4th and 5th thoracic segments usually separate, last segment asymmetrical in some species. Rostrum usually large, a stumpy or rounded plate of chitin sometimes bifid at tip, without filaments. Female urosome of 4 segments, male's of 5, caudal rami usually very short. First antenna of 22–23 segments. Male right first antenna modified, of 19–20 segments. Rami of antenna 2 and mandibular palp about equal. Maxilla 1 with well-developed exopod, endopod absent. Maxilla 2 strong, with 6 or more long curved spines, serrulate distally. Maxillipeds weak. Leg 1 endopod with 1–2 joints, 1st and 2nd exopod segments without outer edge spines. Leg 2 with 2–3-jointed endopods; legs 3–4 with 3-jointed endopods. Legs 1–4 with 3-jointed exopods. Leg 2 with outer edge spine of right 2nd exopod segment much larger than other edge spines in some species, especially in the males. Marked asymmetry of leg 2, due to enlargement of this spine, occurs most notably in male *B. spinifera*, and to a lesser extent in male *B. elongata*, *B. elegans*, *B. longicornis*, and *B. similis*; leg 2 symmetrical in male *B. minor* (Wolfenden). Female 5th legs 3-jointed, usually symmetrical, with an apical spine and usually a small external spine. Male 5th legs of 4–5 segments, in some species almost symmetrical, in others notably asymmetrical, the left leg sometimes with a plumose seta on the 2nd basipod segment.

KEY TO FEMALES OF *BATHYPONTIA*

1. Mature females over 4 mm long 2
Mature females less than 4 mm long 3
2. Last segment of P5 at least twice as long as preceding segment,
genital segment almost as long as 3 following segments
..... *B. elegans* Sars
Last segment of P5 little longer than preceding segment, genital
segment slightly longer than following segment *B. elongata* Sars
3. Th5 asymmetrical in dorsal view 4
Th5 symmetrical in dorsal view 5
4. Left side of Th5 longer than right, apical spine of P5 as long
as or longer than leg, no outer edge spines leg 1
..... *B. longiseta* Brodsky
Right side of Th5 longer than left, apical spine of P5 about as
long as leg, outer edge spines on exopod segment 3 of leg 1
..... *B. similis* Tanaka
5. P5 with single apical spine, no accessory spine
..... *B. minor* (Wolfenden)
P5 with apical spine and small accessory spine 6
6. P5 asymmetrical, small 2nd spine asymmetrically placed on the 2
legs *B. intermedia* new species
P5 symmetrical 7
7. Mature females 3 mm or more long, Th5 pointed in dorsal view,
rounded in lateral view *B. spinifera* Scott
Mature females less than 3 mm long, Th5 pointed in dorsal and
lateral view *B. sarsi* Grice and Hulsemann

KEY TO MALES OF *BATHYPONTIA*

1. Mature males over 4 mm long 2
Mature males less than 4 mm long 4
2. Caudal rami about twice as long as wide *B. elegans* Sars
Caudal rami about as long as wide 3
3. Endopod of leg 1 2-jointed *B. elongata* Sars
Endopod of leg 1 1-jointed *B. longicornis* Tanaka
4. B2 of left P5 with a long plumose seta 5
B2 of left P5 without a long seta 6
5. Bunch of hairs on inner side of B2 of right P5, long distal spine
about $\frac{2}{3}$ as long as distal segment *B. spinifera* Scott
No hairs on inner side of B2 of right P5, distal spine less than
half as long as distal segment *B. similis* Tanaka
6. P5 not markedly asymmetrical, both legs about the same length
..... *B. regalis* Grice and Hulsemann
P5 notably asymmetrical 7
7. Distal spines on both P5 very long, no accessory spines
..... *B. minor* (Wolfenden)
Distal spine of right P5 short, distal accessory spines on both P5
..... *B. sarsi* Grice and Hulsemann

Bathypontia intermedia, new species

Figures 1 and 2

Material: 1 female, 3.60 mm total length, cephalothorax 2.85 mm to tip of Th5, urosome 0.80 mm. Caught in a No. 2 net night haul, 11 July 1970.

Locality: Station "S", 32°10'N, 64°30'W, 500–1,000 m.

Type-specimen: On 2 slides, to be deposited in the National Museum of Natural History, Smithsonian Institution.

Diagnosis: Body oblong, head separated from Th1, Th4 and 5 separate, 5th thoracic segment pointed in dorsal view, rounded laterally (Fig. 1a, b). Urosome around 30% of cephalothorax length; genital segment swollen ventrally, relatively long, as long as 2 following segments together, which are each of about the same length. Caudal rami relatively long, as long as anal segment, with 3 caudal setae, the 2nd much longer than the others, and a 4th short inner seta. Rostrum prominent, single, rounded and bent downwards. Antenna 1 (Fig. 2d) of 23 segments, extending not quite to end of cephalothorax. Antenna 2 endopodite slightly longer than exopodite, which is 6/7 the length of the endopodite (Fig. 1c). Mandible blade (Fig. 1d) strongly developed, palp with 5 long setae on exopodite, 8 on endopodite. Maxilla 1 (Fig. 1e) with 10 fairly stiff setae of varying lengths on 1st inner lobe, 2nd and 3rd inner lobes and basis each with 1 seta, 8 setae on exopodite and 3 on outer lobe. Maxilla 2 (Fig. 2a) strongly developed, distal portion with 6 strong subequal setae plus 3 shorter ones, all with distal combs, and proximal portion with 6 shorter strong subequal setae. Maxilliped (Fig. 1f) weak, basal segment with strong distal spine, 2 small spines distally, 1 median and 1 proximal. Leg 1 (Fig. 2f) with 2-jointed endopod; 2 slim outer edge spines, difficult to see, noted on exopod segment 3. Leg 1 B2 with a distal internal long curving seta. Legs 2–4 with 3-segmented endopods. B1 of legs 1–3 (Fig. 2b, c, f) with a plumose seta and a bunch of hairs on inner edge; B1 of leg 4 (Fig. 2e) with hairs only. Legs 2 and 4 with sharp external denticle on B2; leg 3 B2 with long slightly curved external spine almost as long as exopod segment 1 (Fig. 2b). Exopod segment 1 of leg 2 with a distal internal spine-like seta, exopod segment 2 with a slightly longer outer edge spine. Plumose setae of legs 1–4 jointed. Leg 5 (Fig. 1g) 3-jointed, asymmetrical, basal segment slightly longer than 2nd segment, 3rd segment of right leg about twice as long as 2nd segment, with distal spine as long as 2 distal segments, and a small distal external spine; distal segment of left leg slightly shorter, not twice as long as 2nd segment, apical spine slightly longer than 2 distal segments, and 2nd small external spine set back from the tip of the distal segment about 1/3rd of the length of this segment.

Remarks: *B. intermedia* new species differs from all other known female *Bathypontia* in having asymmetrical 5th legs. Like *B. spinifera*, it is intermediate in size between the larger *B. elongata*, *B. elegans*, and

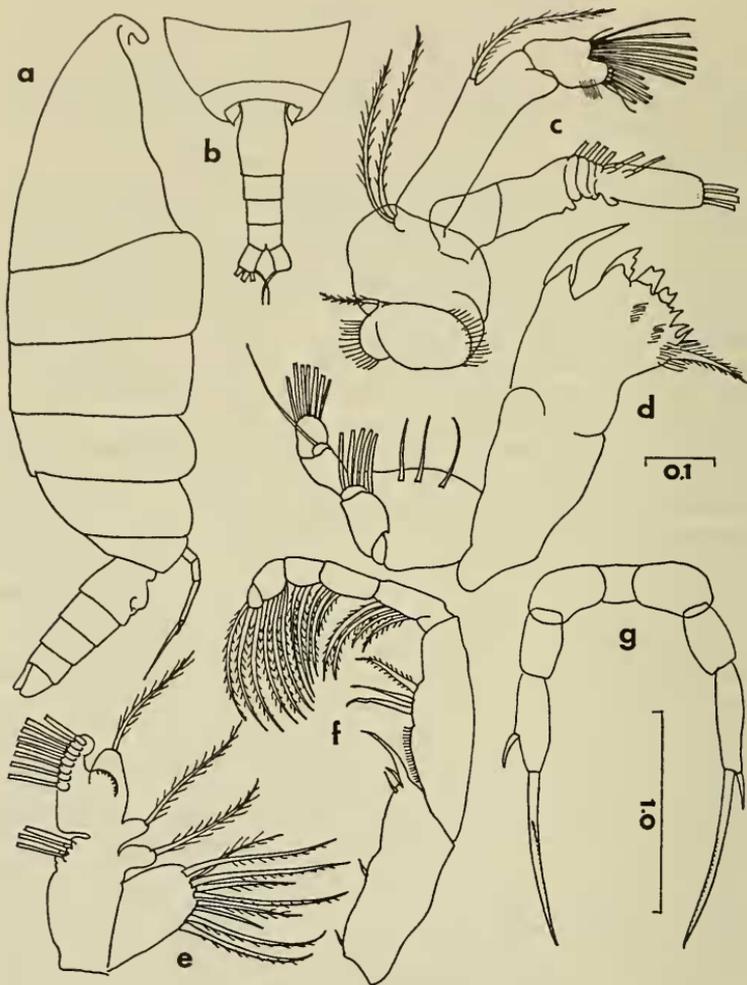


FIG. 1. *Bathypontia intermedia*, new species, female. a, Lateral view. b, Dorsal view of 4th and 5th thoracic segments and urosome. c, Antenna 2. d, Mandible. e, Maxilla 1. f, Maxilliped. g, 5th legs. Scale at bottom right for Figs. a, b; at center right for Figs. c-f. Scale in mm.

B. longicornis and the smaller *B. minor*, *B. sarsi*, *B. similis*, *B. regalis*, and *B. longiseta*. The caudal rami are proportionately longer than in other species, except *B. elegans*. The mandible blade is strongly toothed and resembles that of *B. elegans* and *B. elongata*, and is unlike that of *B. sarsi*, *B. minor* and *B. similis*. The basal segment of the maxilliped

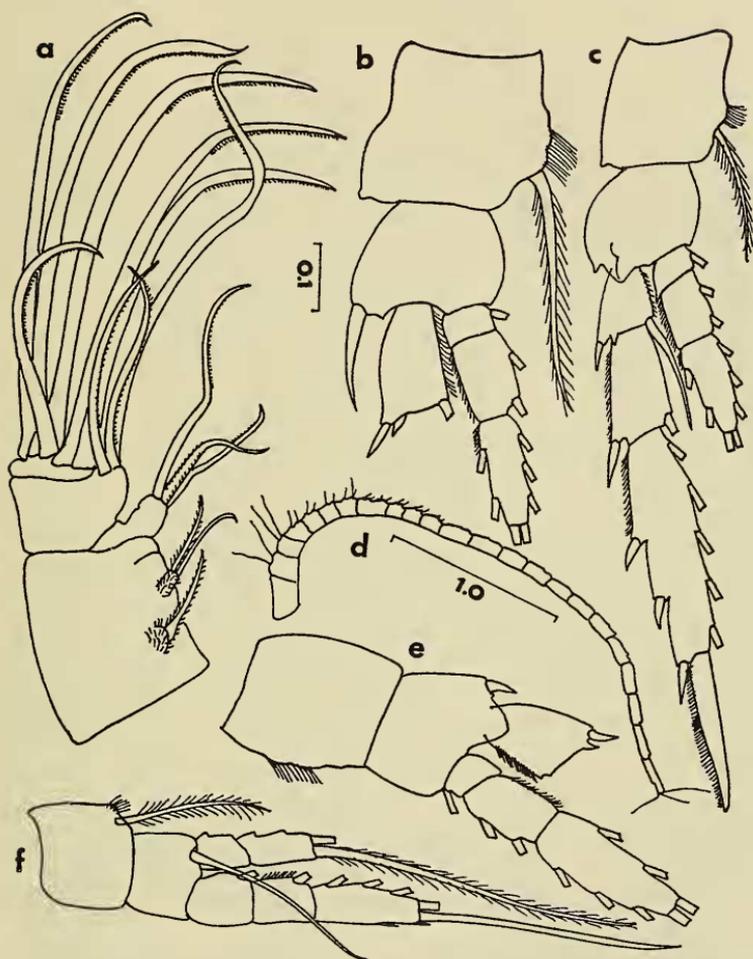


FIG. 2. *Bathypontia intermedia*, new species, female. a, Maxilla 2. b, Leg 3. c, Leg 2. d, First antenna. e, Leg 4. f, Leg 1. Scale by d for Fig. d, between a and b for Figs. a-c, e, f. Scales in mm.

has an intermediate number of spines, between *B. spinifera* and *B. minor* with 1 distal spine and *B. elegans* with 7 spines. *B. intermedia*, new species, also differs from other species in the numbers of setae on the various segments of maxilla 1. The 5th thoracic segment is pointed in dorsal view, as in *B. spinifera* and *B. sarsi*. The 2nd caudal seta is very long, as in *B. elegans*; unfortunately it was broken on this specimen, but even so was twice as long as the urosome.

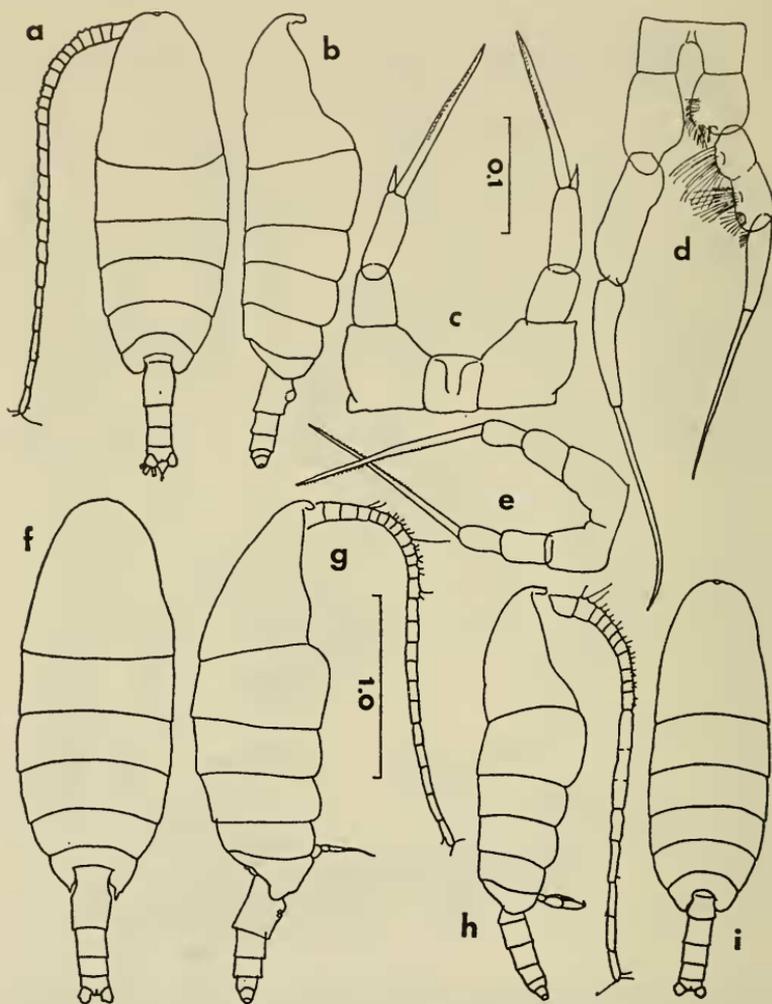


FIG. 3. a and b, Dorsal and lateral views of *Bathypontia minor* (Wolfenden) female. c, 5th legs of *B. similis* female. d, 5th legs of male *B. minor*. e, 5th legs of female *B. minor*. f and g, Dorsal and lateral views of female *B. similis*. h and i, Lateral and dorsal views of male *B. minor*. Scale beside g for Figs. a, b, f-i, beside c for Figs. c-e. Scales in mm.

Bathypontia similis Tanaka

Figures 3c, f, g; 4f

Bathypontia similis Tanaka, 1965, p. 45, Fig. 241a-k.*Bathypontia similis*.—Park, 1970, p. 543, Figs. 386-402.*Material*: 9 females, 2.6-2.9 mm long, 1 damaged male.

Three females and the male were caught between 500 and 1,000 m in August 1968, June and October 1969, and January 1970. Three females were taken between 1,000 and 1,500 m in November 1968, August and October 1969, and the remaining 3 females were found in 1,500-2,000 m hauls collected in March and June 1969 and June 1970. The specimens were therefore evenly distributed throughout the water column between 500 and 2,000 m depths. Park's (1970) specimens were caught over a similar overall depth range of 509-1,900 m. Tanaka stated only that his specimens were "from deep layer."

The female (Fig. 3f, g) is recognized by the asymmetry of the 5th thoracic segment; the 5th legs (Fig. 3c), however, are identical in structure with those of female *B. sarsi* (Sars, 1925, Pl. 127, Fig. 16) and *B. spinifera* (Scott, 1909, Pl. 3, Fig. 16). The male 5th legs (Fig. 4f) resemble those of the *B. spinifera* male (Fig. 4g) in having a plumose seta on the 2nd basipod segment of the left leg, but differ in the proportions of the segments and length of distal spines and in lacking a bunch of hairs on the 2nd basipod segment of the right leg. The male leg 2 is asymmetrical with a larger outer edge spine on exopod segment 2 of the right leg.

Distribution: Pacific coast of Japan, 2°38'S in the Indian Ocean, Caribbean Sea and Gulf of Mexico, Sargasso Sea at 32°N.

Bathypontia minor (Wolfenden)

Figure 3a, b, d, e, h, i

Isocalanus minor Wolfenden 1906, p. 36, Pl. 12, Figs. 1-5; 1911, p. 349, Pl. 38, Figs. 6-8, Textfig. 78a, b.*Bathypontia minor*.—Grice and Hulsemann, 1965, p. 249, Fig. 19(e)-(q).*Bathypontia minor*.—Park, 1970, p. 541, Figs. 372-385.*Material*: 8 females 2.5-2.8 mm long; 5 males 2.3-2.45 mm long.

One female was caught within the upper 500 m in August 1970, but 5 females and the 5 males were taken between 500 and 1,000 m depths in October and December 1968, June and July 1969, and June, August and September 1970; 2 females were collected between 1,000 and 1,500 m in September 1970. This species, therefore, occurs primarily between 500 and 1,000 m depths in the Sargasso Sea. Also, although they appear to be living within the permanent thermocline where seasonal changes do not occur, most of the specimens were collected in summer. Roe (1972) recorded this species from a day depth of 940 m, and from 580-800 m at night in the Canary Island region. Park's (1970) specimens were found between 980 and 1,900 m, and

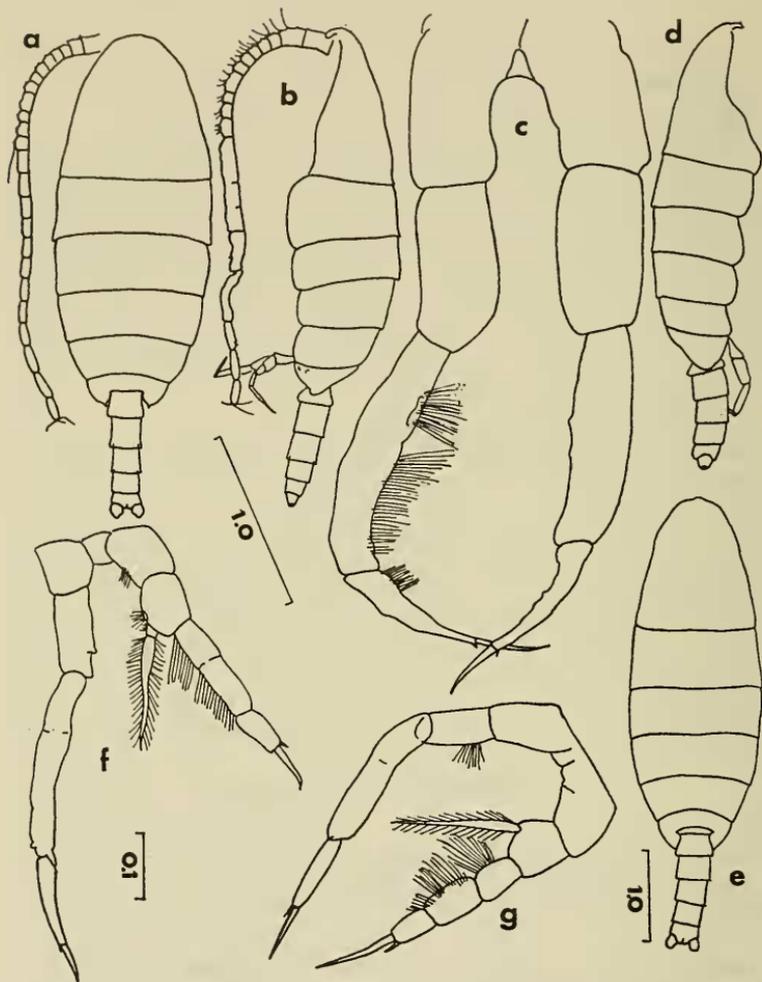


FIG. 4. a. Dorsal view of male *B. spinifera* with left antenna 1. b. Lateral view of male *B. spinifera* with right antenna 1. c. 5th legs of male *B. elongata*. d and e, Lateral and dorsal views of male *B. elongata*. f, 5th legs of male *B. similis*. g, 5th legs of male *B. spinifera*. Scale at left center for Figs. a, b; at lower right for Figs. d, e; at bottom left for Figs. c, f, g. Scales in mm.

Grice and Hulsemann's (1965) female was from approximately 1,000 m. Wolfenden's specimen was caught in a 1,500-0 m haul.

B. minor is distinguished by its relatively small size and the 5th legs of both sexes (Fig. 3d, e). The female 5th legs are symmetrical, the

male's notably asymmetrical, but both have very long distal spines and no accessory spines. Leg 2 is symmetrical in both sexes.

Distribution: 20°–32°N in the Atlantic, Caribbean Sea and Gulf of Mexico.

Bathypontia spinifera Scott

Figure 4a, b, g

Bathypontia spinifera Scott, 1909, p. 183, Pl. 3, Figs. 1–16.

?*Bathypontia sarsi*.—Wheeler, 1970, p. 12, Figs. 77–90.

Material: 4 males, 2.60–2.80 mm long.

One male was taken in a 500–1,000 m sample collected in August 1969, one in a 1,000–1,500 m haul in January 1969, and two from depths of 1,500–2,000 m in May and September 1970. Scott (1909) obtained 2 females and a male from a vertical haul, 1,000–0 m. Grice and Hulsemann's (1967) specimens were from an overall depth range of 1,000–2,000 m. This species, like *B. similis*, was fairly evenly distributed between 500 and 2,000 m depths.

At first sight these males were thought to be males of *B. similis*, because their size is smaller than described for *B. spinifera*. Males of *B. similis* and *B. spinifera* (Fig. 4a, b) are identical in appearance, with symmetrical pointed 5th thoracic segments, viewed dorsally. All 4 specimens, however, have the characteristic 5th legs (Fig. 4g) of *B. spinifera* (Scott, 1909, Pl. 3, Fig. 15), with a bunch of hairs on the inner side of the 2nd basipod segment of the right leg, and the partially fused 1st and 2nd exopodite segments proportionately much shorter than in the *B. similis* male right leg. The male described and figured by Wheeler (1970, Fig. 90) as *B. sarsi* has identical 5th legs, and agrees in other characters, such as the marked asymmetry of leg 2, with the description of *B. spinifera*.

Distribution: 1°4.5'S in the Halmahera Sea, 5°48'N–27°31'S in the Indian Ocean, 32°N in the Sargasso Sea.

Bathypontia elongata Sars

Figures 4c–e; 5a, b, d, g, h

Bathypontia elongata Sars, 1905, p. 24; 1924, Pl. 126, Figs. 1–17; 1925, p. 356.

?*Isocalanus major* Wolfenden 1906, p. 37, Pl. 12, Figs. 6–11; 1911, p. 347, Pl. 38, Figs. 3–5, Textfig. 77.

Bathypontia elongata.—Farran, 1908, p. 87, Pl. 9, Figs. 16, 17.

Bathypontia elongata.—Grice and Hulsemann, 1967, p. 38, Figs. 271–274.

Material: 3 females, 4.7–5.2 mm; 2 males, 5.0–5.1 mm; 1 immature male 3.85 mm.

The males and 1 female were collected between 500 and 1,000 m in November 1968 and May and July 1970; 2 females and the immature male were taken in 1,000–1,500 m hauls in August 1968, October 1969 and June 1970. The depth range was therefore 500–1,500 m. Farran's

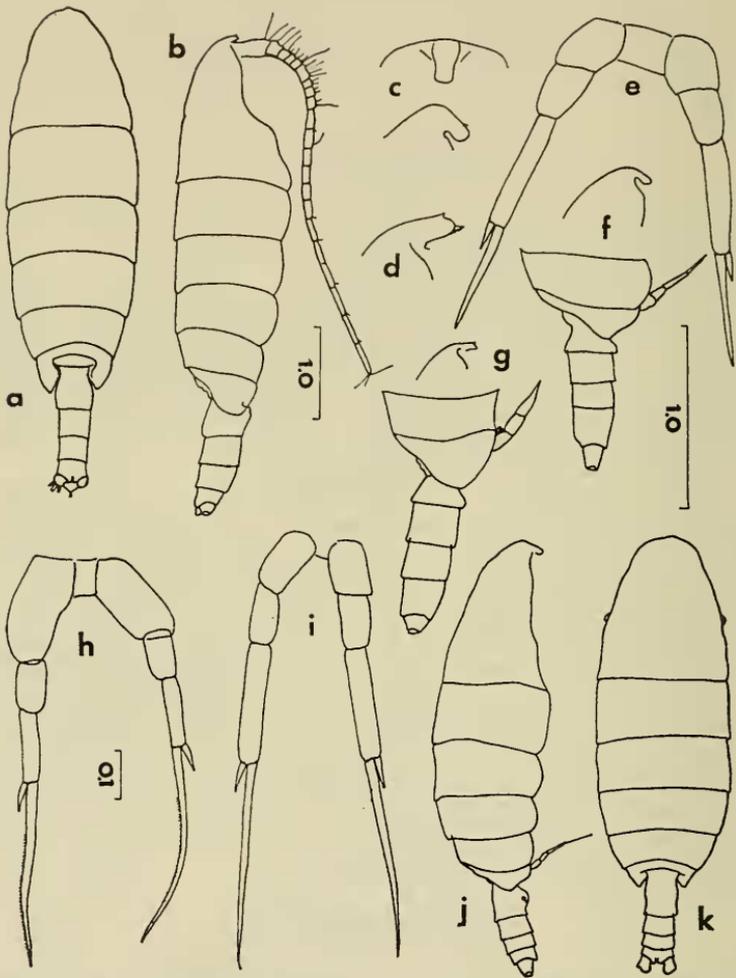


FIG. 5. a and b, Dorsal and lateral views of female *B. elongata*. c, Ventral and lateral views of *B. elegans* rostrum. d, Lateral view of *B. elongata* rostrum. e, 5th legs of immature female *B. elegans*. f, Lateral view of rostrum, 4th and 5th thoracic segments, and urosome of immature female *B. elegans*. g, Lateral view of rostrum, 4th and 5th thoracic segments, and urosome of immature male *B. elongata*. h, 5th legs of female *B. elongata*. i, 5th legs of female *B. elegans*. j and k, Lateral and dorsal views of female *B. elegans*. Scale beside b for Figs. a, b, j, k; at right center for Figs. f, g; at lower left for Figs. c-e, h, i. Scales in mm.

(1908) specimens were caught at 600 and 700 fathoms, Lysholm, Nordgaard and Wiborg's (1945) specimens with 1,500 m and 2,000 m of cable out, and Jespersen's (1940) with 1,800 m of wire out. Roe (1972) recorded specimens from 720 m, 900 m and 940 m, and Owre and Foyo (1972) from 435 m. Grice and Hulsemann (1967) listed sampling depths of 1,000–2,000 m, 225–1,930 m, and 750–2,000 m; most of Wilson's (1950) specimens were caught in 0–300 fathom hauls. Vervoort (1965) recorded a male from a night surface sample in the Gulf of Guinea; most of Sars' specimens were collected in 0–1,500 to 0–5,000 m hauls, but he also listed one specimen from a surface sample. This species apparently lives primarily between 500 and 1,500 m depths, and would not be found normally below 2,000 m.

B. elongata is distinctive because of its large size, the shape of the rostrum (Fig. 5d), the proportions of the urosome (Figs. 4d, e; 5a, b, g) and the 5th legs (Figs. 4c; 5h); the male leg 2 is asymmetrical. Wolfenden's (1906, Pl. 12, Figs. 6, 8–10) immature female *B. major* resembles the female *B. elongata* in the shape of the rostrum, the proportions of the 5th legs, and the setation of the maxilliped and maxilla 2. *B. major* is here considered synonymous with *B. elongata*.

Distribution: North Atlantic up to 63°38'N, Gulf of Guinea, Caribbean Sea 18°N–12°S in the Indian Ocean, eastern Pacific Ocean.

Bathypontia elegans Sars

Figure 5c, e, f, i–k

Bathypontia elegans Sars, 1920, p. 26; 1924, Pl. 127, Figs. 1–11.

Material: 2 females, 4.2 & 4.6 mm long, 1 immature female 3.47 mm long.

One female was collected in October 1968 from depths of 1,000–1,500 m; one female and one immature female were caught in July 1970 in a haul from 1,500–2,000 m. Grice and Hulsemann's (1967) specimen, identified as *B. major*, was taken in a 350–2,500 m haul in the Indian Ocean. This species apparently lives at greater depths than *B. elongata*, and is also rare, having been recorded only once, and without documentation, since it was described by Sars in 1920. Sars's specimens were collected in 0–2,500 m and 0–3,000 m hauls near the Azores.

This species is almost as large as *B. elongata*, from which it differs primarily in the shape of the rostrum (Fig. 5c, f, j), the proportions of the urosome (Fig. 5j, k), and the 5th legs (Fig. 5e, i). In the female the distal segment of the 5th legs is at least twice as long as the preceding segment. This is also true of the 5th legs of the immature female (Fig. 5e), which differ from those of the adult female in the length of the longer distal spine. The 5th legs figured by Wolfenden (1906, 1911) for his immature female *B. major* are quite different from those of the immature female *B. elegans*, and, therefore, the two species cannot be synonymous. The 5th legs of male *B. elegans* differ strikingly

from those of male *B. elongata*, since both legs terminate in long distal spines (Sars, 1924, Pl. 127, Fig. 11).

Distribution: 32°–38°N in the Atlantic, 22°11'S in the Indian Ocean.

LITERATURE CITED

- BRODSKY, K. A. 1950. Calanoida of the Far Eastern Seas and Polar Basin of the USSR (In Russian; Translated 1967). Keys to the fauna of the USSR, No. 35. Zool. Inst. Acad. Sci. USSR, Moscow-Leningrad, 440 pp.
- DEEVEY, G. B. AND A. L. BROOKS. 1971. The annual cycle in quantity and composition of the zooplankton of the Sargasso Sea off Bermuda. II. The surface to 2,000 m. *Limnol. Oceanogr.* 16(6):927–943.
- FARRAN, G. P. 1908. Second report on the Copepoda of the Irish Atlantic Slope. Fisheries, Ireland, Sci. Invest., 1906, II. (1908), 104 p., 10 Pl.
- GRICE, G. D., AND KUNI HULSEMAN. 1965. Abundance, vertical distribution and taxonomy of calanoid copepods at selected stations in the northeast Atlantic. *J. Zool.* 146(2):213–262.
- and ———. 1967. Bathypelagic calanoid copepods of the western Indian Ocean. *Proc. U.S. Nat. Mus.* 122(3583):1–67.
- JESPERSEN, P. 1940. Non-parasitic Copepoda. *The Zoology of Iceland* 3(33):1–166.
- LYSHOLM, B., O. NORDGAARD AND K. F. WIBORG. 1945. Copepoda from the "Michael Sars" North Atlantic deep-sea expedition 1910. "Michael Sars" North Atlantic Deep-Sea Exped. 1910. 5(7):1–60.
- OWRE, H. B., AND M. FOYO. 1964. Plankton of the Florida Current. Part IX. Additions to the list of Copepoda, with descriptions of two rare species. *Bull. Mar. Sci. Gulf Carib.* 14(2):342–358.
- AND ———. 1967. Copepods of the Florida Current. Fauna Caribaea No. 1, Crustacea, Part 1: Copepoda. Institute of Marine Science, University of Miami, p. 1–137, 900 Figs.
- AND ———. 1972. Studies on Caribbean zooplankton. Description of the program and results of the first cruise. *Bull. Mar. Sci.* 22(2):483–521.
- PARK, T. 1970. Calanoid copepods from the Caribbean Sea and Gulf of Mexico. 2. New species and new records from plankton samples. *Bull. Mar. Sci.* 20(2):472–546.
- ROE, H. S. J. 1972. The vertical distributions and diurnal migrations of calanoid copepods collected on the SONDA Cruise, 1965. I. The total population and general discussion. *J. mar. biol. Ass. U. K.* 52:277–314.
- SARS, G. O. 1905. Liste préliminaire des Calanoidés recueillis pendant les campagnes de S.A.S. le Prince Albert de Monaco, avec

diagnoses des genres et des espèces nouvelles. Part 1. Bull. Mus. Oceanogr. Monaco, No. 26, pp. 1-24.

- SARS, G. O. 1907. Notes supplémentaires sur les Calanoidés de la Princesse-Alice. Bull. l'Inst. Oceanogr. Monaco, No. 101, pp. 1-27.
- . 1920. Calanoidés recueillis pendant les campagnes de S. A. S. le Prince Albert de Monaco. (Nouveau supplément). Bull. l'Inst. Oceanogr. Monaco. No. 377, pp. 1-20.
- . 1924, 1925. Copépodes particulièrement bathypélagiques provenant des campagnes scientifiques du Prince Albert I de Monaco. Résult. Camp. scient. Prince Albert I, Fasc. 69, Pls. 1-127 (1924), pp. 1-408 (1925).
- SCOTT, A. 1909. The Copepoda of the Siboga Expedition. Part I. Free-swimming, littoral and semi-parasitic Copepoda. Siboga Exped., Monogr. No. 29a, 323 pp., 69 Pls.
- TANAKA, O. 1965. The pelagic copepods of the Izu Region, Middle Japan Systematic Account XIII Parapontellidae, Acartiidae and Tortanidae. Publ. Seto Mar. Biol. Lab. 12(5):379-408.
- VERVOORT, W. 1965. Pelagic Copepoda. Part II. Copepoda Calanoida of the families Phaennidae up to and including Acartiidae, containing the description of a new species of Aetideidae. Atlantide Rep. No. 8, pp. 9-216.
- WHEELER, E. H., JR. 1970. Atlantic deep-sea calanoid Copepoda. Smithsonian Contrib. Zool., No. 55, p. 1-31.
- WILSON, C. B. 1950. Copepods gathered by the United States Fisheries Steamer "Albatross" from 1887 to 1909, chiefly in the Pacific Ocean. U.S. Nat. Mus. Bull. 100, 14(4):1-441, 36 Pls.
- WOLFENDEN, R. N. 1906. Plankton Studies. Part 2. Copepoda. Rebman Ltd., London, p. 25-44, Pls. 8-14.
- . 1911. Die Marinen Copepoden der Deutschen Südpolar-Expedition 1901-1903 II. Die Pelagischen Copepoden der Westwinddrift und des Südlichen Eismeeers mit Beschreibung mehrerer neuer Arten aus dem Atlantischen Ozean. Deutsche Südpolar-Exped. 12(Zool. 4):182-380, Pls. 22-40.