A New Genus of Calanoid Copepod from an Anchialine Cave in Belize

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Abstract

Brattstromia longicaudata gen. et sp. n. was obtained in great numbers from Giant Cave, Caye Caulker in Belize. It shows affinities to both *Ridgewayia* and *Exumella* in the Ridgewayiidae. It has a strong bifurcate rostum, elongate furcal rami, modified maxilliped and 1st leg, and very complex 5th legs of the male. The copepod inhabited the dark interior sections of the cave. It was obtained both in plankton tows and in baited traps.

Introduction

In recent years, several anchialine cave localities around the world have been investigated for copepods and interesting discoveries of both taxonomy and biogeography have been obtained (Boxshall & Iliffe 1986, 1987, Fosshagen & Iliffe 1985, 1988, 1989). Calanoids of the Ridgewayiidae dominated in caves in Bermuda (Sket & Iliffe 1980, Fosshagen & Iliffe 1985) where *Ridgewayia marki* Esterly was the most abundant species. In this investigation in Belize ridgewayiids also constituted an important part of the copepod fauna in caves. Members of the family have been found in shallow water in tropical and subtropical areas. The first species, *Ridgewayia typica* Thompson & Scott, 1903 was described from washings of pearl oysters in Ceylon. *Ridgewayia marki* has also been found associated with a coral in Bermuda (Esterly 1911), and *R. fosshageni* with an actiniarian in Panama (Humes & Smith 1974). Fosshagen (1970) described the two genera, *Exumella* and *Placocalanus* from dredgings in the Bahamas. At present there are about eight named species of *Ridgewayia,* two of *Exumella,*and two of *Placocalanus.* Most of the species have been obtained occasionally from dredgings and plankton tows. Collecting by divers, washings of corals, and the use of various traps in shallow water have in recent years yielded abundant material of this atypical group of calanoids.

Material and Methods

A great number of both adults and copepodids of the new species were collected from

submerged karstic caves in Belize. Giant Cave at Caye Caulker is one of the world's largest submarine caves. Over 3 km of submerged passageways have so far been surveyed with explorations still continuing. The single known entrance to the cave is located 15 m offshore at 5 m depth where a vertical shaft drops to 22 m depth. Columbus Caye Blue Hole is located about 2 km northwest of Columbus Caye. It is a single circular chamber 90 m in diameter, with a maximum depth of 50 m. While Giant Cave lies primary beneath the island of Caye Caulker and can be classed as anchialine, Columbus Caye Blue Hole, situated some distance from land, lacks any terrestrial influences and by definition (Stock et al., 1986) must be categorized as a submarine cave. The copepods were obtained in plankton tows from the water columm of Giant Cave where they swarmed just above the halocline in areas of total darkness and near anoxic areas on the bottom. Large numbers of specimens were also taken in traps from all sections of this cave. Lesser numbers were present in Columbus Caye Blue Hole.

Description of the Species

Brattstromia Fosshagen gen. n.
Pedigers 4 and 5 separated. Rostrum downturned, strong, and bifurcate. Urosome 4-segmented in female and 5-segmented in male. Furcal rami elongate, with long setae. 1st antenna 25-segmented with segment 2 partly divided into three segments. Maxilliped with the two proximal segments of endopod elongated and bearing some modified setae. 1st leg with a pointed median process on second basipod and a slightly modified outer corner of second segment of exopod. 5th leg of female with both rami 3-segmented, in male a complex grasping organ, right exopod with a claw-like last segment, right endopod 3-segmented and only slightly transformed, left exopod complex, and left endopod reduced and unarmed.
Type species: *Brattstromia longicaudata* gen. et sp. n.

Brattstromia longicaudata Fosshagen gen. et sp. n.
Material. The species was obtained at two localities along the seaward margin of the Belize barrier reef but situated about 100 km apart—Giant Cave at Caye Caulker and Columbus Caye Blue Hole at Columbus Caye.

The copepods were caught using advanced cave diving equipment and taken either with a plankton net, mesh size 93 μm, or in baited traps. In Giant Cave 16 samples were taken between 15 January and 24 February 1989 and thousands of specimens were obtained. In Columbus Caye Blue Hole about 70 specimens were taken with plankton net on 28 February 1989.

Holotype. Adult female, total length 1.16 mm from Giant Cave, Caye Caulker, Belize on 19 January 1989 at 25 m depth 250 m from the entrance. One vial deposited in the British Museum (Natural History), BM(NH), London. Cat. No. 1990. 1222.

Paratypes. 20♀♀ and 20♂♂ in one vial and 3♀♀ and 2♂♂ dissected on 9 slides from the same locality as the holotype. Deposited in BM (NH) Cat. Nos 1990.

1223-1242. 20♀♀ and 20♂♂ in one vial from the same locality deposited in US National Museum of Natural History, Washington, D. C. (USNM) Cat. No. 244270.

Etymology. The genus is named for Professor Emeritus Hans Brattström, Department of Marine Biology, N-5065 Blomsterdalen, Norway, for taking his students to exotic places and for his encouragement to work on this group of animals. The species name *longicaudata* refers to the elongated furcal rami and setae of the urosome.

Adult female (Figs 1 and 2)

Total length of 20 individuals from Giant Cave ranged between 1.11 and 1.17 mm, mean 1.13 mm. In dorsal view posterior corner of prosome evenly rounded. Genital segment produced midventrally. Furcal rami about one third the length of the urosome. Longest furcal seta slightly shorter than the length of prosome.

1st antenna reaches back to the furcal ramus. Particularly long setae on the free segments 3, 7, 9, 12, 18, 21, and 24.

2nd antenna with exopod and endopod of about equal length. First segment of endopod with two setae near the middle of inner margin, and along middle of inner margin of second segment three small setae and a lobe with six setae. Terminal part of endopod with seven setae.

Mandible with pointed teeth on gnathobase, a palp with four setae, and an elongated last segment of endopod with 11 setae.

1st maxilla with four setae on second and third inner lobes. Endopod well defined from the basis, and bearing three lobes with 4, 4, and 7 setae respectively. Exopod with 11 setae of which the four distal ones differ in structure from the others.

2nd maxilla very similar to a *Ridgewayia* species with well-developed lobes and bearing 6, 3, 3, 3, 4, 3, and 6 setae respectively.

Maxilliped strongly developed. A group of three setae placed in middle of inner margin of last segment of basipod. The elongated first and second segments of endopod, bear modified setae, most of which have tips in the form of sharp comb-like structures.

1st leg bears a strong median process on posterior side of second basipod. Exopod with long and strong outer spines, outer distal part of second segment with a weakly serrate process.

2nd to 4nd legs very similar to a *Ridgewayia* species. 3rd and 4th legs with an outer seta on second basipod.

5th leg with both rami 3-segmented and very similar to that of *Exumella*. Second basipod bears a long outer seta. Last segment of exopod with a small outer spine, three subequal strong distal spines, and three inner setae. Endopod with 1, 1, and 6 setae on first, second, and third segments respectively.

Adult male (Fig. 3)

Total length of 20 individuals ranged between 1.01 and 1.07 mm, mean 1.04 mm. Differs from female in its 5-segmented urosome, geniculate right 1st antenna, and in 5th legs. Right 1st antenna 23-segmented with partial divisions of segments 2 and 18.

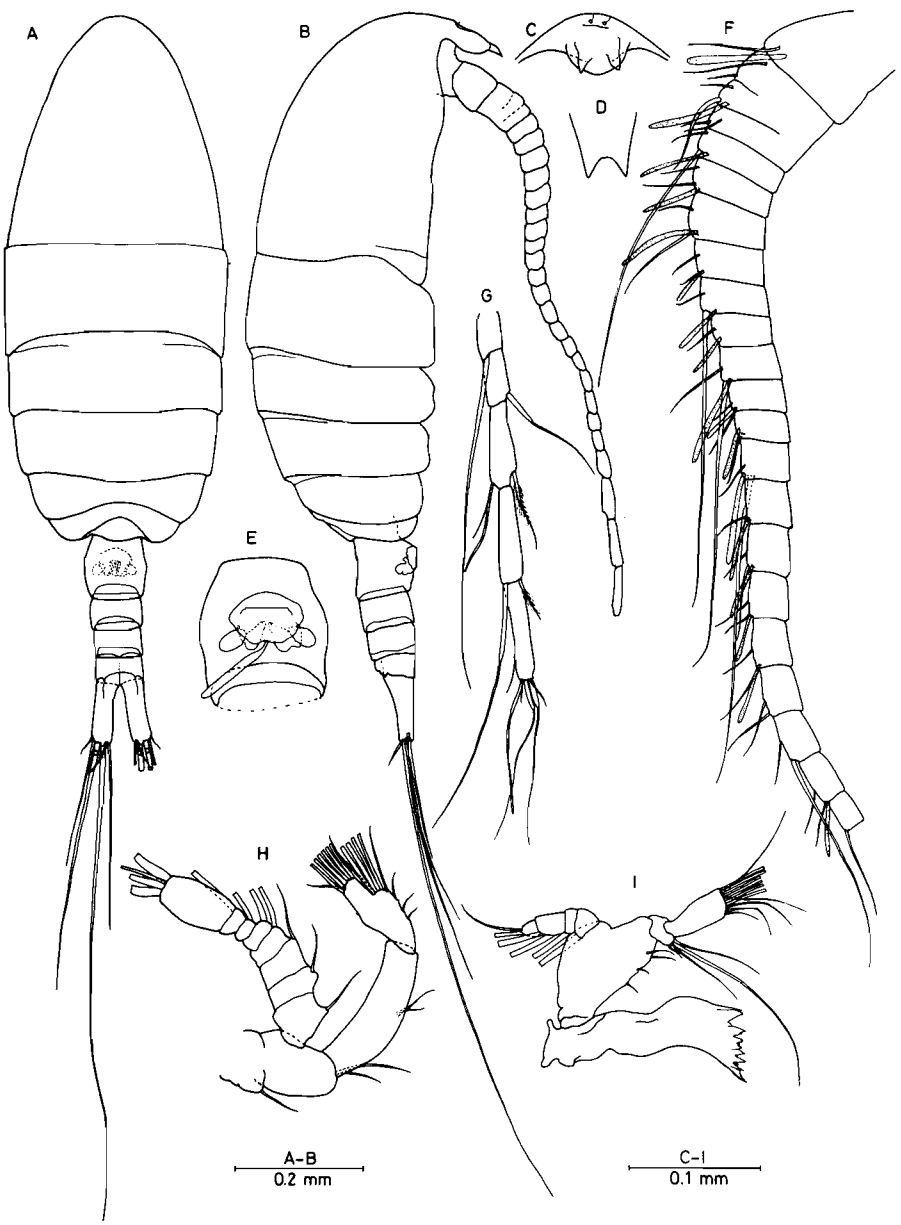

Fig. 1. *Brattstromia longicaudata* gen. et sp. n. Female.
A. Dorsal view. B. Lateral view. C. Rostrum ventral view. D. Rostrum frontal view. E. Genital segment with spermatophore, ventral view. F. 1st antenna segments 1-20. G. 1st antenna segments 21-25. H. 2nd antenna. I. Mandible.

5th legs with highly modified exopods, 3-segmented on both sides, a 3-segmented right endopod and a reduced bulbous left one.

Right exopod with second segment bearing a long extension on proximal inner

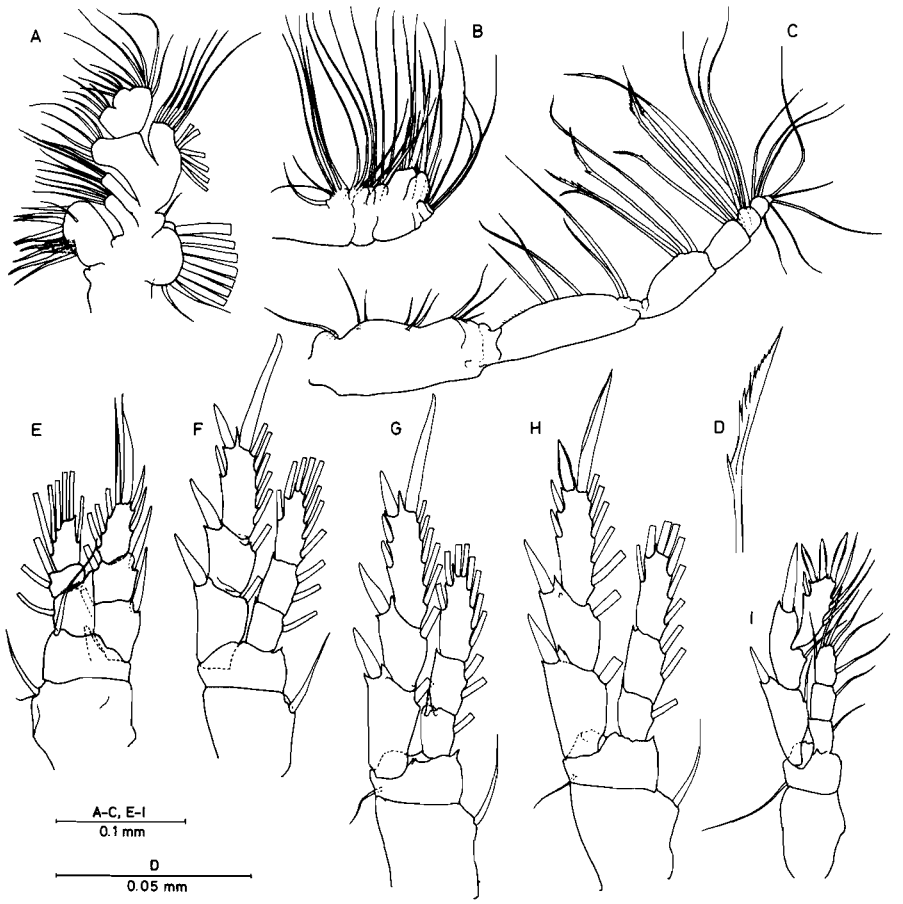

Fig. 2. *Brattstromia longicaudata* gen. et sp. n. Female.
A. 1st maxilla. B. 2nd maxilla. C. Maxilliped. D. Modified seta from second segment of endopod of maxilliped. E. 1st leg. F. 2nd leg. G. 3rd leg. H. 4th leg. I. 5th leg.

margin. Extension broad at first, then bending into a right angle and narrow until its tip. A long seta situated at base of the extension. Segment armed at midlength on outer margin with a strong spine reaching the end of the segment. Third segment slender, spine-like, and curved inwards. Right endopod armed with six setae on last segment.

Left leg bears a slender process on anterior side of second basipod. First and second segments of exopod with a strong, smooth outer spine, the second one twice the length of the first one. Third segment of exopod with flexible lappets, a fan-shaped outer one with a serrated inner part, a pointed beak-shaped middle one, and a rounded inner one with a distinct notch on its margin. Left endopod unarmed, irregular, broadest at distal part where rounded protuberance is situated.

Remarks

Brattstromia longicaudata was the most abundant copepod collected from the Belize

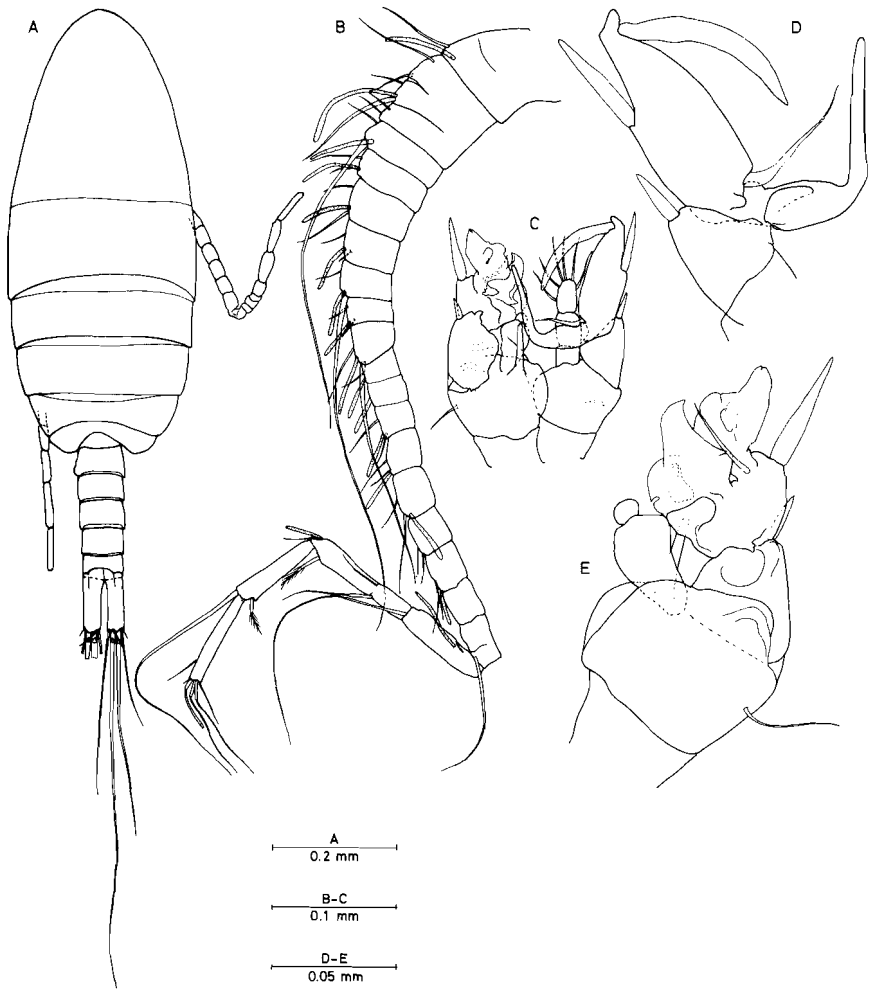

Fig. 3. *Brattstromia longicaudata* gen. et sp. n. Male.
A. Dorsal view. B. Right 1st antenna. C. 5th legs anterior view. D. Exopod right 5th leg. E. Left 5th leg posterior view.

caves. More than 2000 specimens were obtained in Giant Cave on 19 January 1989 with a diver-held plankton net from a swarm of copepods in 25 m depth at 250 m penetration from the entrance. At the furthest penetration of 500 m on 12 February 1989, 34 specimens were taken from near a black sulfurous sediment flow on the floor.

The copepod was also obtained in baited traps. Crushed land crabs which was left over night in plastic bottle attracted a number of copepods.

A trap on 27 January 1989 in the entrance passage and first room at 40-60 m penetration gave 112 specimens of *B. longicaudata* and 82 specimens of an undetermined *Exumella* species. Similar trap on 1 February 1989 at 200-350 m penetration gave more than 500 specimens of *B. longicaudata* and none of *Exumella* sp.

Throughout in the investigation in Giant Cave the salinity varied between 34 and 36 ‰ and the temperature between 27.5 and 29.1°C.

Discussion

Brattstromia longicaudata fits well into the Ridgewayiidae on account of the distinctly set off third segment of exopod of the 5th legs in females. Unique characters to the species are the bifurcate strong rostrum, the elongated furcal rami, the modifications on the maxilliped, and the 5th legs of the male.

It is most reminiscent of *Ridgewayia* in the appendages of the cephalosome and in the legs. The differences are, however, most obvious in the maxilliped, 1st leg, and the 5th legs of the males. The elongation of the maxilliped with its modified setae might be connected with its special way of feeding. It is suggested that its sharp-edged setae might have a cutting function.

An elongated maxilliped but with differently modified setae is also present in *Exumella.* The observation of both *B. longicaudata* and *Exumella* sp. from the same baited traps in Giant Cave may indicate a similar way of feeding. These two copepods, well equipped with sensory organs (aesthetascs) on the 1st antenna, and with their specialized mouthparts might well be able to deal with carcasses of larger animals which happen to be in the caves.

On the 1st leg there is a slight modification in the outer distal corner of second segment of exopod as in *Ridgewayia,* and *Boholina,* though not as prominent, and a process on posterior side of second basipod reminiscent of that in *Boholina* (Fosshagen & Iliffe 1989). We pointed out (op. cit.) that *Boholina,* only found in a single cave in the Philippines, showed affinities to the Ridgewayiidae.

The 5th legs of the female have the same segmentation and armature as that of *Exumella polyarthra* Fosshagen, only differing in details.

The right 5th leg of the male shows features from both *Exumella* and *Placocalanus* whereas the complex left leg is more reminiscent of species of *Ridgewayia.*

Acknowledgements

This research was supported by a grant from the Smithsonian Institution's Caribbean Coral Reef Ecosystems Program awarded to Thomas Iliffe. Serban Sarbu served as a research assistant on the expedition and assisted with cave diving collections and sorting of specimens. Invaluable logistical and cave diving assistance was provided by Frank Bounting of the Belize Diving Services at Caye Caulker. We gratefully acknowledge the Belize Department of Archaeology and Commissioner Harriot W. Topsey for granting us permission to carry out these cave investigations. Logan McNatt also provided assistance with the studies. This is contribution No. 309, Caribbean Coral Reef Ecosystems (CCRE) Program, Smithsonian Institution.

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