

## A new genus of Platycopioida (Copepoda) from a marine cave on Bermuda

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### Abstract

*Nanocopia minuta* was collected from an inland marine cave on Bermuda. This new genus is reminiscent of *Platycopia* in its cephalic appendages and in the 5th legs of the male. The 1st leg has a 3-segmented exopod and a 1-segmented endopod. The other legs show reductions with no armature along the inner margin of the exopods and with 2-segmented endopods in the female. Only 2nd and 3rd legs bear two outer spines on the first exopodal segment.

Owing to similarities in sexual characters, mouthparts, and modifications of the swimming legs, *Nanocopia* and *Platycopia* are considered more closely related to each other than either is to *Antriscopia*.

Platycopioida now contains three genera of which two are found only in Roadside Cave. The order has retained several primitive characters and seems to have separated early from the gymnoplean stem.

### Introduction

Through cave diving several new copepods were found in inland marine caves on Bermuda (Sket & Iliffe, 1980; Fosshagen & Iliffe, 1985). Among them were two new platycopiids, *Antriscopia prehensilis*, and a species to be described here, both found in Roadside Cave only. We considered this cave to be a refugium for rare and primitive copepods (Fosshagen & Iliffe, 1985). Since then also a misophrioid, *Speleophria bivexilla*, has been described from the same locality (Boxshall & Iliffe, 1986).

Roadside Cave is a small limestone cave 110 m from the nearest shore at Harrington Sound. It consists of a small entrance into a single room containing a saltwater-filled fissure about 8 m long by 1 m wide and 6 m deep. The bottom consists of bare breakdown rubble.

Prior to the cave-records from Bermuda the Platycopiidae comprised the single genus *Platycopia*. At present there are six species, the last one to be described was by Andronov (1985) from Mauritania. He points out that all species probably have five urosomal segments of both sexes and that there is a movable articulation between first and second segments. *Platycopia* lives close to the bottom from the shore down to c. 120 m with a wide distribution in the Atlantic from Norway, United States, Bahamas, and western Africa (Sars, 1921; Wilson, 1946; Fosshagen, 1972). The Platycopiidae for a long time has held an obscure systematic position within Calanoida (Andronov, 1974), but the discovery of *Antriscopia* led us to erect the order Platycopioida, with a position as an early branch off the gymnoplean lineage of Copepoda.

Characteristic features of the order are: Sym-

metrical 1st antennae and 5th legs in both sexes, prehensile 1st antennae on both sides in the male of *Antrisocopia*, urosome with five segments in both sexes and two outer spines on first exopodal segment of 2nd to 5th legs.

The new species clearly belongs to the order, however, it shows some divergent characters of the legs to be described below.

## The species

### Order *Platycopioida*

Major body division between pediger 5 and segment posterior to it. Urosome with five segments in both sexes. 1st antennae of male symmetrical, nongeniculate or geniculate on both sides. 2nd-5th legs, except for 4th and 5th legs in *Nanocopia*, with two outer spines on first exopodal segment. 5th legs well-developed, symmetrical in both sexes, modified or not in male.

### Family *Platycopiidae* Sars, 1911 (emend.)

The family consists of the three genera, *Platycopia* Sars, 1911, *Antrisocopia* Fosshagen, 1985 and *Nanocopia* gen.n. Body compact with all pedigers free. Rostrum pointed. 1st antennae short, with proximal part thickened and consisting of several fused segments. 2nd antennae with exopod longer than endopod. Mandibular blade slender with few and strong teeth, endopod 1-segmented. 1st maxilla with strong spines on first inner lobe, reduced number of setae on other lobes. 2nd-5th legs flattened and strong, particularly with strong spines on the exopods. 5th legs modified in males of *Platycopia* and *Nanocopia*, in *Antrisocopia* alike in both sexes.

### *Nanocopia Fosshagen gen.n.*

Body truncate. 1st and 2nd pedigers extended ventrally. 5th pediger reaches backwards nearly half the length of urosome. Cephalic appendages

reminiscent of *Platycopia*, generally with fewer setae and less coarse spines.

1st leg with 3-segmented exopod and 1-segmented endopod. Exopods of 2nd-5th legs of female with strong outer and distal spines and devoid of armature along the inner margin. Only 2nd and 3rd legs bear two outer spines on first exopodal segment. Endopods of 2nd-5th legs of female 2-segmented with spinous setae. 5th legs of male modified. Exopod ending in an elongated flexible lappet, endopod 3-segmented with first segment bearing a strong and distally curved spine.

### *Nanocopia minuta Fosshagen gen. et sp.n.*

**Material.** This species was obtained at only one locality: Roadside Cave, Hamilton Parish, 27 August 1982 (1 ♀, 1 ♂) with long-handled dip-net at a depth of 0–1.5 m, and 28 August 1984 (1 copepodid – total length 0.21 mm) while swimming with a fine-meshed plankton-net.

**Holotype.** Adult female, total length 0.27 mm, from Roadside Cave 27 August 1982 at a depth of 0–1.5 m. Dissected and mounted on 10 slides. Deposited in the American Museum of Natural History (AMNH). Cat. No. 16.314.

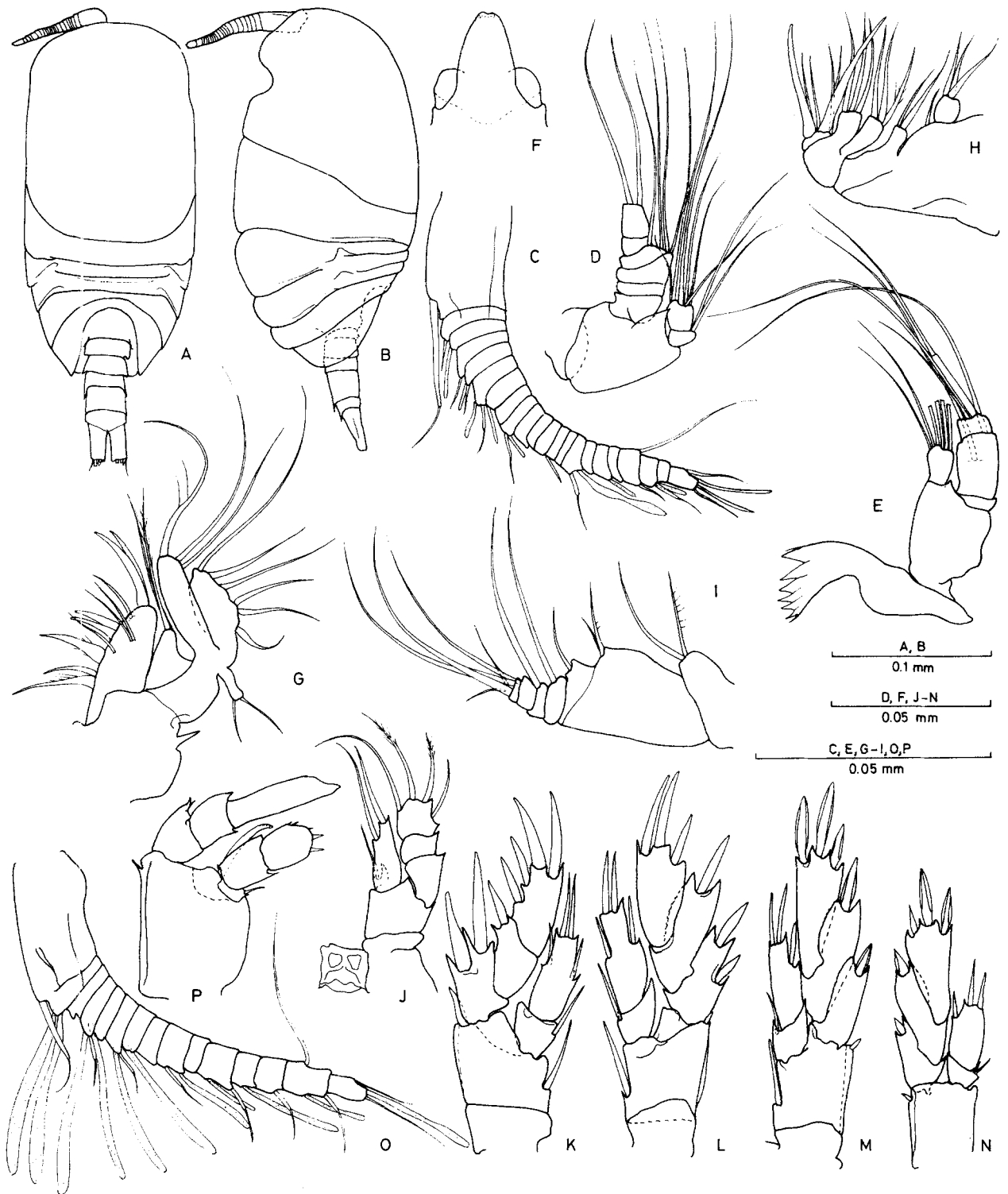
**Allotype.** Adult male, total length 0.25 mm, from the same locality and date as the holotype. Dissected and mounted on 5 slides. Deposited in AMNH, Cat. No. 16.315.

**Etymology.** From nanos (G)-small, kope (G)-oar, and minutus (L)-minute. Both the generic and specific name refer to the small size of the animal.

## Description

### *Adult female (Fig. 1, A-N)*

The single specimen was 0.27 mm in total length. The prosome is truncate with pedigers having a narrow dorsal and a widened and extended lateral



*Fig. 1. Nanocopia minuta* gen. et sp.n. A-N ♀, O, P ♂. A. Dorsal view (1st antenna drawn in a somewhat oblique position). B. Lateral view. C. 1st antenna. D. 2nd antenna. E. Mandible. F. Labrum. G. 1st maxilla. H. 2nd maxilla. I. Maxilliped. J. 1st leg. K. 2nd leg. L. 3rd leg. M. 4th leg. N. 5th leg. O. 1st antenna. P. 5th leg.

part. Particularly the 1st and 2nd pedigers are extended laterally, and they seem together with a wide gap between the 1st and 2nd legs to form a ventral chamber. The last pediger extends backwards beyond 2nd urosomal segment, and forms a dorsal depression in which the urosome is inserted.

The urosome is 5-segmented, about one third the length of the prosome. There is a distinct articulation between 1st and 2nd segments, the 4th segment is elongated. The caudal rami are twice as long as wide.

The 1st antenna is 22-segmented, reaching nearly to 1st pediger, widest proximally and tapering gradually towards the distal end. The strong first segment has one long and one short ridge running length-wise the antenna. The 2nd antenna has a stout 6-segmented exopod of which the two distal segments are much narrower than the others. The endopod is small and 2-segmented. The distal margin of basipod between the two rami ends in a point.

The mouthparts are very similar to those of *Platycopia* (cf. *P. inornata* Fosshagen, 1972), however, lacking the coarse and irregular spines of the first inner lobe of 1st maxilla, which are substituted by simpler and smoother ones. The labrum has rounded lappets which seem to be devoid of spines or setules.

The 1st leg has a 3-segmented exopod and a 1-segmented endopod. The exopod is only armed on last segment with 3 apical setae and 1 medial seta on outer margin. The endopod tapers towards the distal end where it has 2 setae. A small seta is situated on the anterior side near the base of the segment. A distinctly sculptured intercoxal sclerite joins the two legs.

The 2nd to 5th legs have 3-segmented exopods and 2-segmented endopods. The coxa has one spine on distal outer corner, the spine on 2nd leg is the strongest. A long spinous seta is situated proximally on the inner margin of 2nd to 4th legs. The exopods are armed only along the outer and apical margins, and with spines varying in shape and size from one leg to another. The first exopodal segment has 2 very long and strong spines in 2nd leg, 2 subequal stout spines in 3rd leg, 1

short spine on an extended outer corner of 3rd and 4th legs. The second segment has a single spine in each leg but of unequal size; situated on a greatly extended part in 3rd to 5th legs. The third segment has 4 spines (2 lateral, 2 strong apical) in 2nd leg and 3 spines (2 apical, 1 short subapical) in 3rd to 5th legs. The first endopodal segment is short and bears one inner seta. The second segment is elongated with 2 apical long spinous setae; a medial outer and inner spine in 2nd and 3rd legs, and only one outer spine in distal part of 4th and 5th legs.

#### *Adult male (Fig. 1, O, P)*

The total length of the single specimen is 0.25 mm. It differs from the female in the slightly modified 1st antennae and in the 5th legs. The 1st antennae are 15-segmented, caused by fusion of segments in the distal half. In the proximal half there are longer and thinner aestetascas than in the female.

The 5th legs are generally of the same structure as in *Platycopia* but with simpler exopods devoid of spines. The 3-segmented exopod ends in a flattened and thin appendage. The endopod is 3-segmented with a narrow first segment bearing a strong curved spine near outer margin, and a small seta on inner margin. The next two segments are of equal length, the distal one has small spinules near its apex.

#### Remarks

This copepod is one of the smallest ever recorded. Though extensive collecting has been done in many caves of Bermuda, mostly with fine-meshed (0.09 mm or smaller) nets, platycopiids were only obtained twice in Roadside Cave. A sample from August 1982 which contained both *Antrisocopia* and *Nanocopia* was probably taken while stirring up sediments from the bottom. A single copepodid of *Nanocopia* from August 1984 was observed alive in a petri disk with sediments. The animal stayed quiet on the bottom for long

periods of time, then suddenly it moved very fast to another site and stayed there. This behaviour is in contrast to that of the slender and delicate misophrioid, *Speleophria bivexilla*, from the same cave which was observed swimming in a smooth and gliding fashion in the free water-masses.

## Discussion

The genus is readily referred to the Platycopiidae by its cephalic appendages and the two spines on the first exopodal segment of 2nd and 3rd legs.

*Antriscopia* has retained many ancestral characters, such as geniculate 1st antennae on both sides as the only sexual dimorphism, 5-segmented urosome of both sexes, and well-developed 2nd to 5th legs, only slightly modified and with 3-segmented rami, conditions much like those put forward by Boxshall *et al.* (1984) to denote a hypothetical ancestral copepod.

The mouthparts of *Antriscopia*, however, are specialized with few and strong setae and most certainly they are raptorial. *Nanocopia* has slightly modified 1st antennae and complex 5th legs of the male, sexual characters much like that of *Platycopia*. In both genera the mouthparts are less modified and reduced than in *Antriscopia*. The 2nd to 5th legs in *Nanocopia* have become extremely modified and the most reduced ones of the three genera, with loss of armature along the inner margin of the exopods, only one spine on first exopodal segment of 4th and 5th legs in female, and 2-segmented endopods of females. In contrast to the general reduction of the legs of *Nanocopia* the exopod of the 1st leg is 3-segmented whereas the two other genera have 2-segmented exopods. Some of the structural changes of the legs might be seen in connection with the extended lateral parts of 1st and 2nd pedigers and the widened gap between 1st and 2nd legs.

In view of the sexual characters, very similar mouthparts, and the advanced character state of the swimming legs, *Nanocopia* and *Platycopia* seem to be more closely related to each other than to *Antriscopia*.

The robust and compressed shape of *Nanocopia* suggests a benthic habitat. It is probable that the

animal occupy small crevices in the porous and fissured rock and only occasionally enter the more open water of a cave.

Similar marine biotopes have been demonstrated in Lanzarote, Canary Islands where animals inhabiting a large cave also were found in the groundwater and in artificial wells some distance away from the sea (Wilkens *et al.*, 1986).

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