

## STEPHOS MARGALEFI SP. NOV. (COPEPODA: CALANOIDA) FROM A SUBMARINE CAVE OF MAJORCA ISLAND (WESTERN MEDITERRANEAN)

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Received: February 1990

### ABSTRACT

*Stephos margalefi* sp. nov. is described as a new species from a submarine cave of Majorca (Balearic Islands). The main diagnostic character is the structure of the fifth legs in both sexes, which distinguish it of the 19 earlier known species of the genus *Stephos*.

KEY WORDS: *Stephos margalefi*, Copepoda, Calanoida, submarine caves

### INTRODUCTION

The genus *Stephos* is generally formed by species of small size (many of them hardly reach one millimeter) which live near the coast, in shallow waters, close to the bottom; some species colonize peculiar habitats, such as marine caves.

After the recent papers by STRÖMGREN (1969), FOSSHAGEN (1970), KOS (1972), ANDRONOV (1974), GREENWOOD (1978) and BOXSHALL *et al.* (1990) a total of 20 species are known, including one species, *S. seclusum*, recently described by Barr but not yet published.

The genus *Stephos* is distributed in different latitudes: from arctic to tropical zones and in the temperate zones, which is where most of their species have been described.

### MATERIAL

The specimens were collected on 18 September 1987 in a submarine cave, La Catedral (NE of Majorca, Balearic Islands, Spain; see ROS & GILI, 1985, and BIBILONI *et al.*, 1989, for a detailed description) by means of plankton catches carried out at midday with a net trailed by a diver for three minutes. In this time, several forward and backward runs were carried out in the cave, covering a total distance of 200 m. The net was conical, with a length of 80 cm, a mesh size of 60 µm and a mouth of 20 cm diameter.

The holotype, one adult female, body length 0.77 mm, is in the Institut de Ciències del Mar, Barcelona, Spain. The paratype, one adult female, body length 0.78 mm, is in the Rijksmuseum van

Natuurlijke Historie, Leiden, the Netherlands.

## HABITAT

The catches were made at different points and the copepods were always found in the same zone of the cave. This allows us to delimit the characteristic habitat where these animals live. The specimens are concentrated near the innermost part of the left tunnel of the cave (Fig. 1) and tend to be situated near the bottom. In this zone, the cave has a fine sand and mud substrate with continuous arrivals of detritus (like remains of sea-grasses and sea-weeds) from outside the cave. The entrance to the left tunnel of La Catedral cave is exposed to currents (due to the north winds dominating this zone), and thus the trophic inputs are assured.

The hydrodynamic effect of the currents determines the resuspension of the sediment, thus enhancing the feeding possibilities of the copepods. So their feeding habits are suspensivorous-detritivorous, and their localization in a well defined area of the cave would be a consequence of this.

The sample is composed of different zoological groups, especially of copepods: *Ridgewayia* spp., *Clausocalanus* spp., and one not yet identified harpacticoid genus.

## ADULT FEMALE

The overall length of 4 individual females ranged between 0.77 and 0.80 mm, with an average of 0.78 mm. The length of the cephalosoma is 0.57 mm and of the abdomen is 0.21 mm with a ceph/abd ratio = 2.73. The maximum body width is 0.25 mm, which is found in the first thoracic segment.

The cephalosoma is hard and strong and in dorsal view reminds one of *Clausocalanus*. The head is attached to the

first thoracic segment. So the anterior body consists of three thoracic segments plus the cephalosoma. The last segment, which is clearly delimited in the dorsal part, is formed by the union of the 4th and the 5th segments.

Each one of these segments has a pair of normal legs with endopods and exopods formed by three segments each, with the exception of the 5th pair, which has a single branch formed by an endopod divided into two segments.

## CEPHALOTORAX OR ANTERIOR BODY

The first antennae ( $A_1$ ) are made up of 24 segments. Each one of the four distal segments has a similar length and is a little more than twice the intermediary segments. The proximal segments are a little longer than the intermediary ones, but generally they are shorter than the distal segments (Fig. 2, b).

The strong thick rostrum is downturned and does not carry rostral filament.

The second antennae ( $A_2$ ) have two basipods followed by a longer endopod and a shorter exopod; both are divided into two

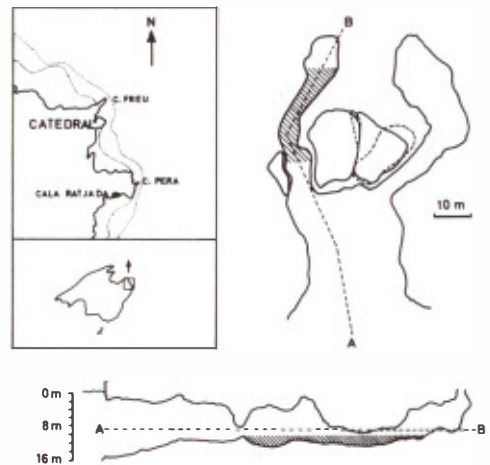


FIGURE 1. Geographic situation of the submarine cave La Catedral at the NE of Majorca (left). Axial projection (right) and section (bottom) of the cave. Sampling area: stripped.

segments. The second basipod holds one outer seta and the first segment of the exopod, two setae (one basal, very similar to that of the second basipod, and another shorter, situated distally, in the second third of the total length).

After that, we find a very short second segment which ends in two groups of five setae each. The endopod is formed by two similar segments, the distal one being shorter than the basal. This last segment holds a pair of setae situated near their union with the second segment.

This last segment shows a seta in the middle part of the outer margin and another one, very similar, on the inside margin, ending in five distal setae of equal length (Fig. 4, a).

The mandible (Md) has a strong cutting blade, with a cutting tooth, a longer, curved inside cutting tooth separated from the first by a semicircular cleft followed by 7 teeth

of small and decreasing size, ending in sharp points.

One of the borders of the masticatorial plate is fine and uniform; the other one shows a group of fine hairs in its central part.

The palps carry three setae in the inner part, showing a smooth border without setae in the outer part.

The endopod is formed by two equal segments: the first one holds four setae in the inner border, while the second one has between 6-10 terminal setae. The exopod is formed by four segments of similar length but of decreasing width. Every segment has a basal seta and the distal segment ends in two setae of similar appearance and length to those of the appendix.

The maxillae (Mx) are formed by an exopod and an endopod, both inserted on a biarticulated basipod. The maxillae are constituted by several lobes with numerous setae (fig. 4, c).

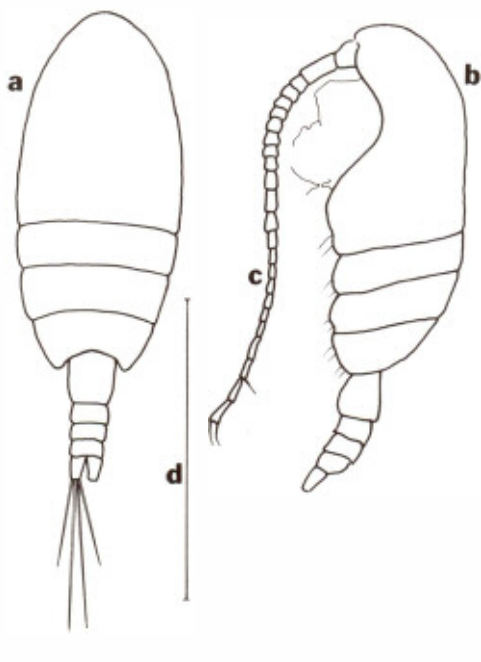


FIGURE 2. *Stephos margalefi* n. sp. (female). a: dorsal view; b: lateral view; c: antenna (A<sub>1</sub>); d: 0.5 mm.

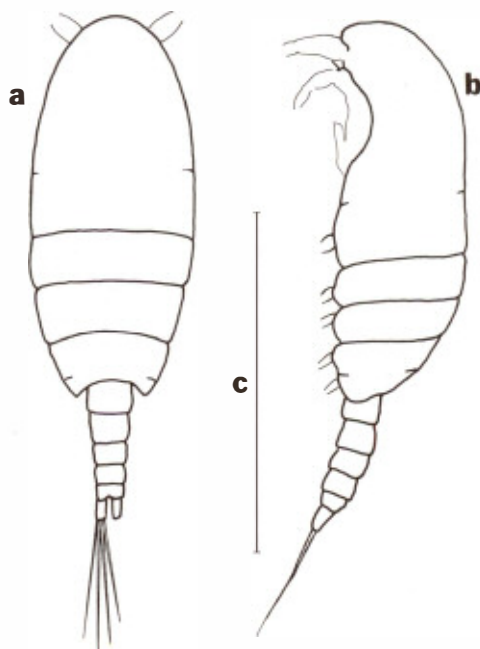


FIGURE 3. *Stephos margalefi* n. sp. (male). a: dorsal view; b: lateral view; c: 0.5 mm.

The first maxilliped (Mxp<sub>1</sub>) shows a bisegmented basipod followed by the exopod. Both the B<sub>1</sub> and the B<sub>2</sub> hold several lobes (5) and all of them end in three plumous setae, but the first one carries four setae (Fig. 4, d).

The second maxilliped (Mxp<sub>2</sub>) is formed by two basipods followed by the exopod with five segments. The distribution of the setae can be seen in figure 4, e.

The first pair of legs (L<sub>1</sub>) is made up of an exopod formed in turn by three regular segments with no characteristic aspect. The endopod in one segment, shows a strong digitation in the outer upper part (Fig. 5, L<sub>1</sub>). Both segments are linked to the second basipod.

The second pair of legs (L<sub>2</sub>) is formed by three segmented exopods and two segmented endopods. The first segment of the exopod is longer than it is wide; the second one shows a length twice its width and the third one is three times longer. The endopod, on the other hand, has the first segment as long as it is wide, and the second one is about three times longer than the first.

Meanwhile, the exopod shows a strong terminal spine and one seta; the endopod, with no spine, ends in a pair of setae.

The third and fourth pair of legs (Fig. 5, L<sub>3</sub> and L<sub>4</sub>) show normal three-segmented exopods and endopods. Both pairs end in a strong spine and one seta of similar length (in the 3rd pair) and with a spine, a little longer than the seta, in the 4th pair.

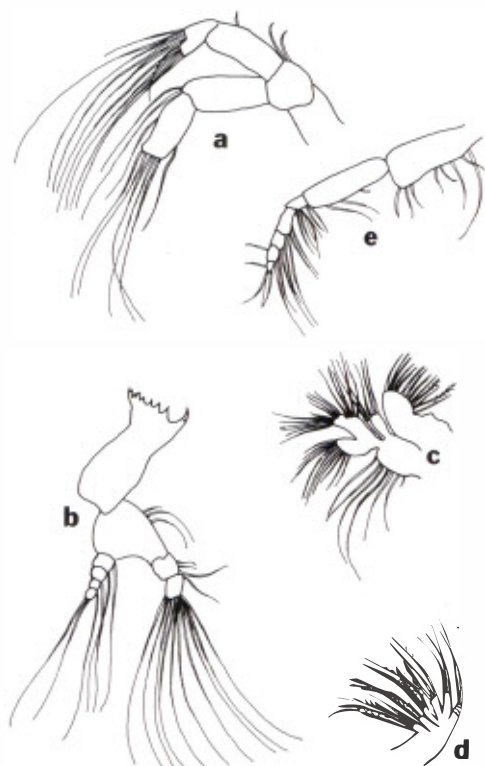


FIGURE 4. *Stephos margalefi* n. sp. (female). a: second antenna (A<sub>2</sub>); b: Mandible (Md); c: maxillae (Mx); d: first maxilliped (Mxp<sub>1</sub>). e: second maxilliped (Mxp<sub>2</sub>).

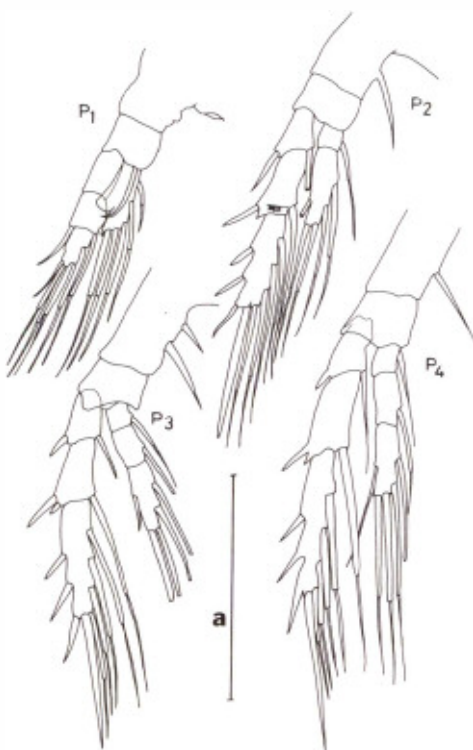


FIGURE 5. *Stephos margalefi* n. sp. (female). P<sub>1</sub>-P<sub>4</sub>: first, second, third and fourth pairs of legs. a = 100 mm.

TABLE I. Size (in  $\mu\text{m}$ ) of male and female specimens of *Stephos margalefi* n. sp.

	Females				Mean	Males				Mean
Total length	780	772	804	778	783	747	739	731	731	731
Length of cephalosoma(c)	569	569	585	577	575	536	575	536	528	534
Length of abdomen (a)	211	199	219	211	210	211	203	195	203	203
Ratio c/a					2.73					2.63
Width (maximum)	244	247	260	252	251	236	228	228	229	230
Length of furcal rami (l)	32	32	32	32	32	32	37	36	36	35
Width of furcal rami (av)	24	24	24	24	24	23	23	21	23	22
Ratio l/av					1.3					1.5

Spines are similar in length to the distal segment. The first basipod of the third pair of legs shows setae of different length, whereas the first basipod of the fourth pair of legs has only one seta.

Except for the first segment of the first pair of legs, all the segments of the four legs show a strong spine at the distal part of the outer margin. In the inner margin of all segments of exopods of the four legs there are setae made up of two parts: the basal one, the ramus, of circular section, is well constituted; and the distal half part is plumous and much more feeble.

The 5th leg ( $L_5$ ; Fig. 6) is formed by one branch only, composed of two segments of similar length and width. The distal segment ends in an inclined border showing several teeth in "saw" and in the outer margin has a strong spine of similar length to the width of the segment.

ABDOMEN OR LAST BODY

The abdomen is formed by four segments plus the furca. The genital segment, which shows a ventral and posterior protuberance, is twice as long as the 2nd and 3rd segments, which are very similar to it, and a little longer than the 4th (or anal) segment.

The furcal ramus is likewise longer than the anal segment and its length is about one and a half times its width. The furca shows four setae: the two central ones are longer than the lateral one, and not much longer than the total length of the abdomen.

ADULT MALE

The average length of the four individuals was 0.74 mm, with a range of 0.73-0.74.

The average length of cephalosoma was 0.53 mm, and the abdomen measured 0.20 mm with a ratio between them of 2.63. The sexes hardly show any difference in size (Table I).

The maximum body width was 0.23 mm.

The cephalosoma is very similar to that of the female (strong, robust and composed of the head and the first thoracic segment, although in some specimens a slight division can sometimes be distinguished). Like the female, the body is three-segmented, the last segment of which represents the fusion between the 4th and 5th segments, and, as in the head, a first segment. Here, in some specimens, we can also observe the union line between both segments.

Both the first antennae and the different mouth parts (mandible, maxillae and maxillipeds) show an identical constitution to the female. Likewise, the four first pairs of legs are also similar in both sexes. Only the 5th pair is different and very characteristic in the male: large and with an elaborate structure (Fig. 6, b).

The abdomen has 5 segments. The first and second are longer than the third and fourth. The anal segment is the shortest and its length is smaller than that of the furca. These, like the female, are provided with four setae of similar size.

## REMARKS

The 20 known species of the genus *Stephos* are listed in Table II. The first nine species are distributed in temperate and boreal regions (except *S. morii*, collected in Australian waters), and all of them have a similar general size and morphology. The most similar species to *S. margalefi*, *S. gyrans*, was collected in the Mediterranean Sea. The 5th legs of the males form a complex grasping organ differing greatly from species to species. All temperate and boreal species have a swollen penultimate segment bearing "membranous lamellae" (J. Barr, pers. comm.). At the same time, the shape of the last prosomal segment, the 5th legs, and the genital segment of the females are important systematic characters (A. Fosshagen, pers. comm.) In this way, the structure of both male and female 5th legs shows a morphological form that distinguishes *S. margalefi* from other members of the genus described earlier. Specifically, the length of the segments in the right 5th leg and the terminal segment of the 5th right leg of males are very different from those of the other known species (Fig. 6).

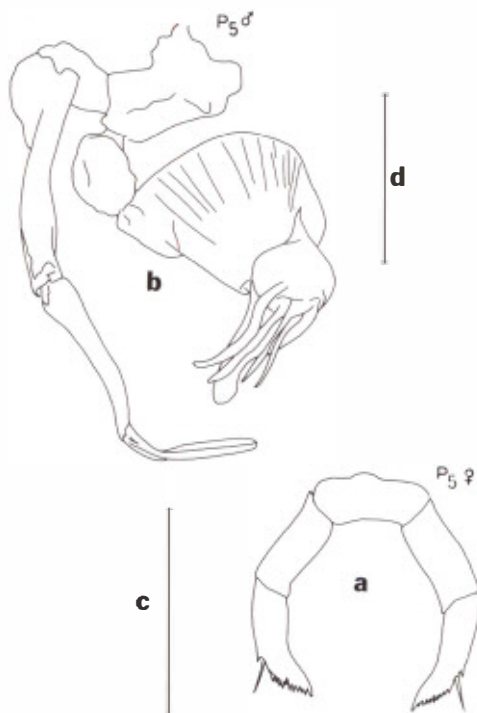


FIGURE 6. *Stepbos margalefi* n. sp. a: fifth pair of legs (female); b: fifth pair of legs (male). c and d: 100 mm.

TABLE II. The 19 species of the genus *Stephos* known before the description of *S. margalefi*.

<i>S. gyrans</i> (giesbrecht, 1892)
<i>S. lamellatus</i> Sars, 1902
<i>S. arcticus</i> Sars, 1902
<i>S. morii</i> Greenwood, 1978
<i>S. tsuvazakiensis</i> Tanaka, 1966
<i>S. scotti</i> Sars, 1902
<i>S. minor</i> Scott, 1892
<i>S. kurilensis</i> Kos, 1972
<i>S. fultoni</i> Scott, 1898
<i>S. lucayensis</i> Fosshagen, 1970
<i>S. deichmannae</i> Fleminger, 1957
<i>S. rustadi</i> Strömberg, 1969
<i>S. maculosus</i> Andronov, 1974
<i>S. tropicus</i> Mori, 1942
<i>S. exumensis</i> Fosshagen, 1970
<i>S. antarcticum</i> Wolfenden, 1908
<i>S. longipes</i> Giesbrecht, 1902
<i>S. pentacanthos</i> Quin-Chao, 1974
<i>S. canariensis</i> Boxshall, Stock & Sánchez, 1990
<i>S. seclusum</i> Barr (not yet published)

## DERIVATIO NOMINIS

The new species is named as an homage to Dr. Ramon Margalef, who at different times introduced the authors to the study of marine zooplankton.

## ACKNOWLEDGEMENTS

Thanks are due to Dr. A. Fosshagen for valuable help and advice, and to Dr. D.J. Barr for his aid and helpful suggestions. Also thanks to Mr. J. Lenard, for his help during the plankton sampling.



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