

## A new species of *Stellicola* Kossmann, 1877 (Copepoda, Lichomolgidae) off the Atlantic Coast of the Iberian Peninsula

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### Abstract

This is the first report of a *Stellicola* in the Atlantic Ocean. Members of the genus had previously been found only in the Indo-Pacific. A new species, *Stellicola hochbergi*, is described and compared with *S. caeruleus* (Stebbing, 1900), *S. femineus* Humes & Ho, 1967, *S. illgi* Humes & Stock, 1973, and *S. novaecaledoniae* Humes, 1976. *Stellicola hochbergi* may be distinguished from its congeners by: a) endopod of leg 4 with formula of 0–1; II, 1; b) third segment of the exopod of leg 3 with formula of III, I, 5; c) genital segment with two dorsal elevations; d) free segment of leg 5 more than 3:1; and e) genital segment much wider than long (135 × 220 μm).

### Introduction

In the lichomolgid genus *Stellicola* Kossmann, 1877, Humes & Ho (1967) included a group of species usually associated with asteroid echinoderms. Later, a reassessment of the diagnostic characters (Humes & Stock, 1972, 1973) divided the species of this genus into three different genera: *Stellicola*, Kossmann, 1877, *Astericola* Rosoll, 1889, and *Synstellicola* Humes & Stock, 1972, based on the number of terminal claws of the second antenna, number of segments in the urosome, and elongation of the basis of leg 4.

In the course of research on the parasitic fauna associated with cephalopods from the continental shelf of the NW Iberian Peninsula, a single female copepod representing a new species of the genus *Stellicola* was found, living probably accidentally, in the gills of the short-finned squid *Illex coindetii* (Verany, 1839). To date 17 species in the genus have been reported from the IndoPacific.

*Stellicola hochbergi*, new species, is described and compared with its more closely related congeners. The new species is the first record of the genus in the Atlantic Ocean.

### Material and methods

Collections were carried out from a fishing ground off the coast of Galicia (NW Iberian Peninsula), at a depth of 100–400 m, in the area between the parallels 42°05'N to 45°15'N, and the meridians 70°W to 90°20'W, between November 1992 and November 1993. Squid samples of *Illex coindetii* (Verany, 1839) were randomly collected from the by-catch of both otter and pair trawlers. The copepod was preserved in 70% ethanol. It was later stained with chlorazole black and dissected under a stereomicroscope. Permanent mounts were made in lactophenol and sealed with Entellan. All figures were drawn with the aid of a camera lucida. The letter after explanation of each figure refers to the scale at which it was drawn.

Family Lichomolgidae Kossmann, 1877

Genus *Stellicola* Kossmann, 1877

*Stellicola hochbergi*, new species

(Figures 1 and 2)

*Type material*: One female from the gill of the squid *Illex coindetii* (Verany, 1839) caught in northwestern Spanish Atlantic waters. The holotype (3 slides) has been deposited in the Museo Nacional de Ciencias Naturales of Madrid, Spain (MNCN 20.04/1334).

*Description:* Femal (the holotype): body cyclopiriform (Figure 1a), with a broad flattened prosome. Total length (not including setae on caudal rami) 1.2 mm and greatest width 0.8 mm based on one specimen in lactophenol. Ratio of length to width of prosome about 1 : 1. Ratio of length of prosome to that of urosome 2.4 : 1. Segment of leg 1 fused with cephalosome. Epimera of segments 1–3 as illustrated. Segment of leg 4 small, without expanded epimera, partially covered in dorsal view by tergum of preceding segment.

Segment of leg 5 trapezoidal,  $97 \times 239 \mu\text{m}$ . Genital segment (Figure 1b) wider than long,  $135 \times 220 \mu\text{m}$ , areas of attachment of egg sac located posterolaterally. Dorsally with two longitudinal posterior elevations more or less sclerotized. Each egg sac attachment area (Figure 1b,d) characterized by: one seta,  $50 \mu\text{m}$ , mounted on an elongated, well sclerotized base; unilaterally spinulose seta,  $24.5 \mu\text{m}$ ; and small spinous process. Three postgenital segment  $40 \times 102$ ,  $29 \times 89$  and  $40 \times 81 \mu\text{m}$  (greatest width) from anterior to posterior.

Caudal ramus (Figure 1b) about 0.8 times longer than wide. One outer anterolateral seta  $67 \mu\text{m}$ , dorsal seta  $57 \mu\text{m}$ , outermost terminal seta  $150 \mu\text{m}$ , innermost terminal seta  $117 \mu\text{m}$ , and two long median setae  $338 \mu\text{m}$  (outer) and  $450 \mu\text{m}$  (inner).

Rostrum broad with slightly angular lateral margins.

First antenna (Figure 1e) 7-segmented, about  $346 \mu\text{m}$  long, lengths of segments (measured along their posterior nonsetiferous margins), 61, 130, 48, 53, 36, 15 and  $15 \mu\text{m}$ , respectively. Formula for armature 4, 13, 6, 3, 4 + 1 aesthete, 2 (lacking one aesthete) and 8 setae (possible aesthete with the same structure as remaining setae). All setae naked, except one seta with short hairs on fifth segment and two setae on the seventh segment.

Second antenna (Figure 1f)  $330 \mu\text{m}$  long and 3-segmented. First segment with 1 seta and two setules. Second segment with 1 seta, 2 setules and 2 additional setules on distal margin. Third segment,  $160 \mu\text{m}$  along its outer edge,  $105 \mu\text{m}$  along its inner edge, with a single claw  $69 \mu\text{m}$  along its axis, 4 setae and 3 setules. All setae naked.

Labrum (Figure 1g) with two divergent posteroventral lobes, deeply incised medially. Paragnaths not observed.

Mandible (Figure 2a) with serrate fringe along its convex margin; concave margin with a row of spinules which continues on the posterior surface of base. Lash

moderately long with small lateral spinules. First maxilla (Figure 2b) with 4 elements. Second maxilla (Figure 2c) 2-segmented, first segment unarmed, second segment with barbed seta, large inner spine with unilateral spines, and terminal process with row of strong graduated teeth, 2 proximal spines larger. Maxilliped (Figure 2d) 3-segmented, first segment unarmed, second segment with 2 setae, third segment with small spine and terminal spiniform process. All elements naked.

Ventral surface, between maxillipeds and first pair of legs (Figure 1h) slightly protuberant.

Legs 1–4 (Figures 2e–h) with 3-segmented rami except for endopod of leg 4 which is 2-segmented. Formula for armature as follows:

P1	coxa	0–1	basis	1–0	exp	I–0; I–1; III,I,4
					end	0–1; 0–1; I,5
P2	coxa	0–1	basis	1–0	exp	I–0; I–1; III,I,5
					end	0–1; 0–2; I,II,3
P3	coxa	0–1	basis	1–0	exp	I–0; I–1; III,I,5
					end	0–1; 0–2; I,II,2
P4	coxa	0–1	basis	1–0	exp	I–0; I–1; II,I,5
					end	0–1; II,1

Inner coxal seta of legs 1–3 long, plumose, not observed in leg 4. Basis progressively more elongated laterally from leg 1 to leg 4, 5.8 times longer than wide. Exopod of leg 4  $66 \mu\text{m}$  long. First segment endopod  $30 \times 14.5 \mu\text{m}$ , with its inner distal naked seta  $22.5 \mu\text{m}$ . Second segment  $32 \times 13.7 \mu\text{m}$ , with its two naked spines  $35.5 \mu\text{m}$  (outer) and  $76 \mu\text{m}$  (inner) and its inner plumose seta  $45 \mu\text{m}$ .

Leg (Figure 1c) with free segment,  $58.7 \times 16.6 \mu\text{m}$ , with inner and outer borders smooth, and carrying two smooth terminal elements: a long seta  $133 \mu\text{m}$  and spine  $22.8 \mu\text{m}$ . Adjacent finely barbed seta on body  $38 \mu\text{m}$ .

Leg 6 (Figure 1d) probably represented by two unequal setae on area of attachment of egg sac.

Male unknown.

*Etymology:* This species is named after Dr F. G. Hochberg (Santa Barbara Museum of Natural History, California, USA), for his valuable contribution to the knowledge of parasites associated with cephalopods and for his generous help and suggestions.

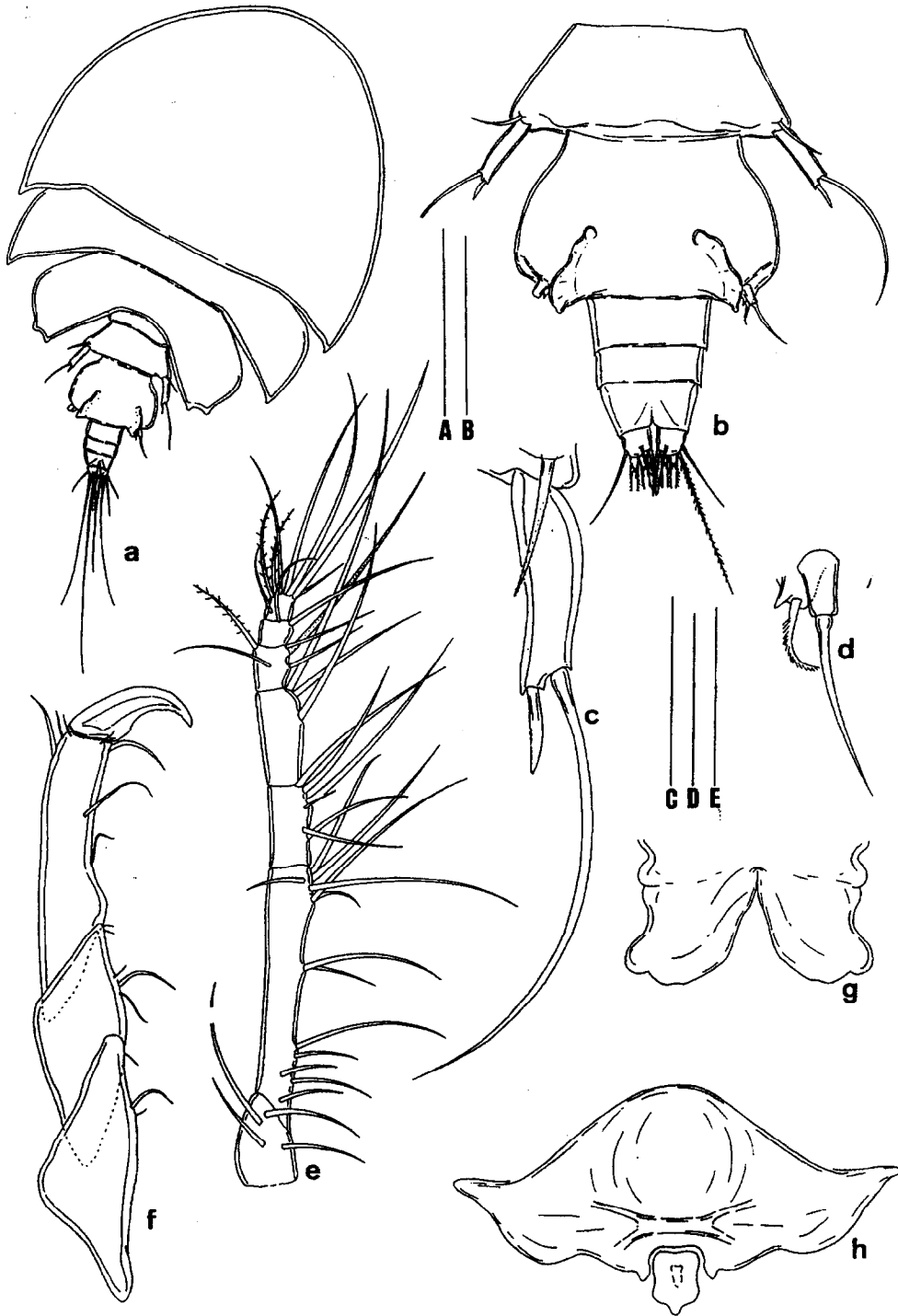


Figure 1. *Stellicola hochbergi*, female (holotype): a, dorsal (A); b, urosome, dorsal (B); c, leg 5, dorsal (C); d, area of attachment of egg sac, dorsal (C); e, first antenna (D); f, second antenna (D); g, labrum (E); h, area between maxilliped and first pair of legs, ventral (D). Scale bars, A: 40  $\mu\text{m}$ ; B, 150  $\mu\text{m}$ ; C, 50  $\mu\text{m}$ ; D, 100  $\mu\text{m}$ ; E, 100  $\mu\text{m}$ .

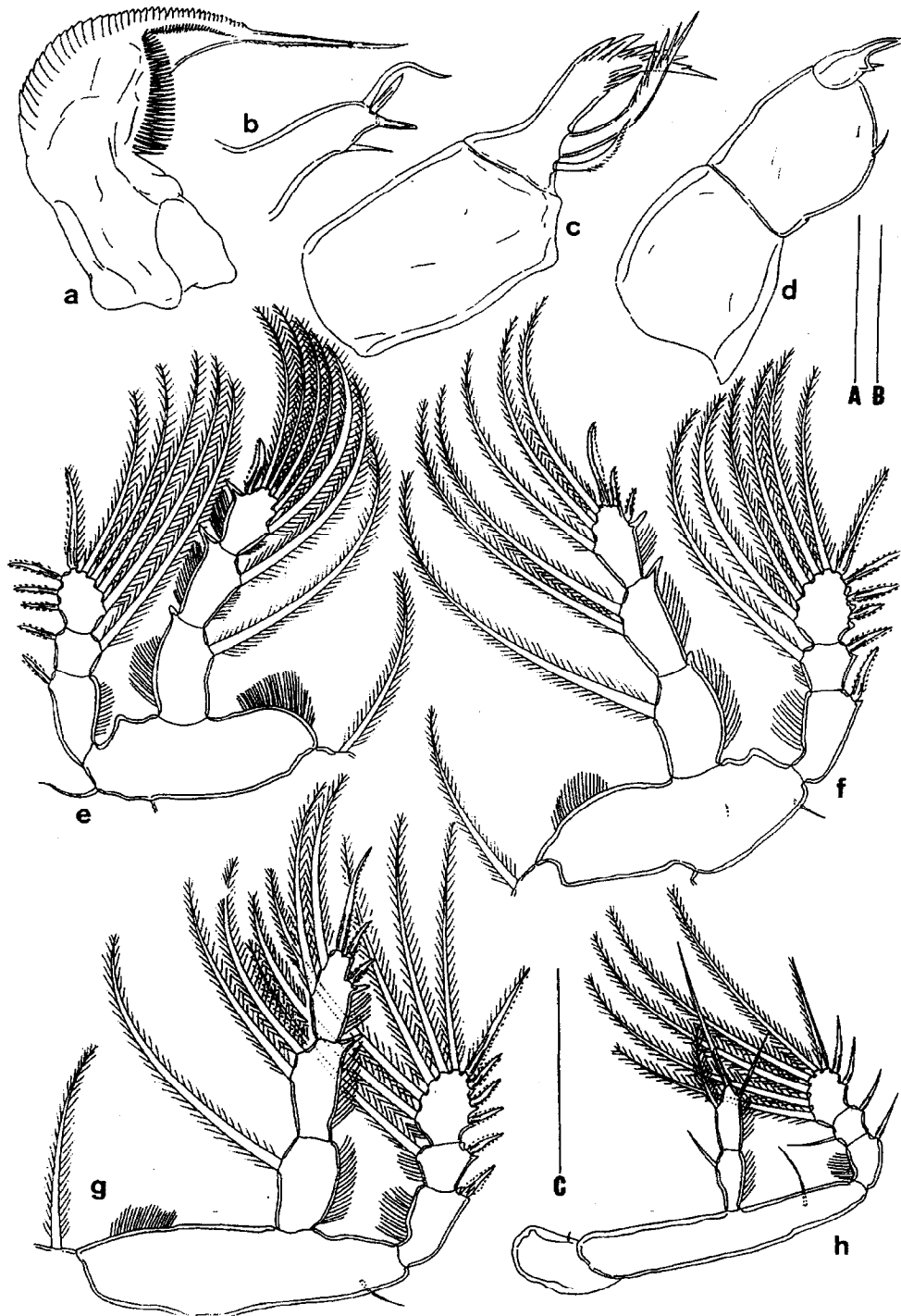


Figure 2. *Stellicola hochbergi*, female (holotype): a, mandible, posterior (A); b, first maxilla, posterior (A); c, second maxilla, posterior (A); d, maxilliped, posterior (B); e, first leg, anterior (C); f, second leg, anterior (C); g, third leg, anterior (C); h, fourth leg, anterior (C). Scale bars, A: 50  $\mu\text{m}$ ; B, 50  $\mu\text{m}$ ; C, 100  $\mu\text{m}$ .

## Discussion

*Stellicola hochbergi* constitutes the eighteenth species recognized in the genus. *Stellicola* species are mainly associated with asteroid echinoderms, with the following exceptions: *S. curticaudatus* (Thompson & A. Scott, 1903), *S. elegans* (Thompson & A. Scott, 1903), *S. longicaudata* (Thompson & A. Scott, 1903) which were collected from washing dredged invertebrates; *S. pleurobranchi* Kossmann, 1877 associated with the tectibranch mollusc *Pleurobranchus* (see Humes & Stock, 1973); and *S. hochbergi* recovered from the cephalopod mollusc *Illex coindetii*. However, it is not completely certain that this cephalopod is a host for *S. hochbergi*. The fact that only one specimen was found from about 600 cephalopods examined and that most of the previously described species are associated with asteroid echinoderms suggest a possible contamination from echinoderms captured together with the squid in the trawling fishery, these species were: *Astropecten irregularis*, *Astropecten aurantiacus*, *Asterina gibbosa*, *Asterias rubens*, *Luidia ciliaris*, *Ophidiaster ophidianus*, *Echinaster sepositus*, and *Marthasterias glacialis*. Before the discovery of *S. hochbergi*, all the species within the genus were found in Indo-Pacific areas, *S. hochbergi* is the first record of the genus in the Atlantic Ocean.

Among the seventeen species previously described in the genus, *S. elegans* (Thompson & Scott, 1903) was poorly described, but may be easily distinguished from *S. hochbergi* by a ratio of the length of distal and proximal segment of leg 4 endopod about 2 : 1. (see Thompson & A. Scott, 1903: 280). This ratio is about 1 : 1 in *S. hochbergi*.

*Stellicola hochbergi* is closely related to *S. caeruleus* (Stebbing, 1900), *S. femineus* Humes & Ho (1967), *S. illgi* Humes & Stock (1973) and *S. novaecaledoniae* Humes (1976a) by having posterior dorsal sclerotized elevations on the genital segment, or a free segment of leg 5 equal or more than 3 : 1, or both features combined. However, the armature of the leg 3 exopod is III,I,5 in *S. femineus*, *S. illgi*, *S. novaecaledoniae* and *S. hochbergi*, while in *S. caeruleus* is II,I,5. Among species in the genus, only *S. caeruleus*, *S. novaecaledoniae* and *S. hochbergi* possess two posterior dorsal elevations on the genital segment, more developed in the former species. All setae on the first antenna are naked in *S. illgi* and *S. novaecaledoniae*, whereas *S. femineus*, *S. caeruleus* and *S. hochbergi* have several setae with short hairs. Among these five species, only *S. caeruleus* has a free segment of leg

5 less than 3 : 1 (over 2,4 : 1), the remaining species have a free segment of leg 5 equal or more than 3 : 1 (over 4.2 for *S. novaecaledoniae*, 4 : 1 for *S. femineus*, 3.3 : 1 for *S. illgi* and 3.5 : 1 for *S. hochbergi*). Besides, with regard to the disposition of the row of spinules along concave margin in the mandible, it is possible to distinguish two group of species. *Stellicola caeruleus*, *S. novaecaledoniae* and *S. illgi* with a more or less continuous and slightly concave row of spinules, and *S. femineus* and *S. hochbergi* with two well differentiate segments forming an acute angle between them, the proximal one concave with the bigger spinules, and the distal one more or less convex with minutes spinules (see Humes & Ho, 1967; Humes & Stock, 1973; Humes, 1976a).

Despite having been collected from the omastrephid squid *Illex coindetii*, it is doubtful that this squid is the true host of *S. hochbergi*. Any of the several echinoderms in the same trawl are likely host. Future collections of *Stellicola hochbergi* around its type locality could give more information about its commensal specificity and a complete anatomical study of the male.

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## References

- Humes, A. G., 1976a. Cyclopoid copepods associated with asteroid echinoderms in New Caledonia. *Smith. Contr. Zool.* 217.
- Humes, A. G., 1976b. Distribution and hosts of *Stellicola* (Copepoda, Cyclopoida) associated with *Linckia* (Asteroidea) in the Indo-West Pacific. *Beaufortia* 321: 49-61.

- Humes, A. G., 1986. Synopsis of copepods associated with asteroid echinoderms, including new species from the Moluccas. *J. Nat. Hist.* 20: 981–1020.
- Humes, A. G. & J.-S. Ho, 1967. New species of *Stellicola* (Copepoda, Cyclopoida) associated with starfishes in Madagascar, with a redescription of *S. caeruleus* (Stebbing, 1900). *Bull. Brit. Mus. (Nat. Hist.)*, Zool. 15: 201–255.
- Humes, A. G. & J. H. Stock, 1972. Preliminary notes on a revision of the Lichomolgidae, Cyclopoid Copepods mainly associated with marine invertebrates. *Bull. Zool. Mus., Univ. Amsterdam* 2: 121–133.
- Humes, A. G. & J. H. Stock, 1973. A revision of the family Lichomolgidae Kossmann, 1877, cyclopoid copepods mainly associated with the marine invertebrates. *Smith. Contr. Zool.* 127: 308 pp.
- Stebbing, T. R. R., 1900. On Crustacea brought by Dr. Willey from the South Seas. *Zoological Results based on material from New Britain, New Guinea, Loyalty and elsewhere collected during the years 1895, 1896 and 1897*, part 5: 605–690.
- Thompson, I. C. & A. Scott, 1903. Report on the Copepoda collected by Professor Herdman, at Ceylon, in 1902. *Rept. Govt. Ceylon Pearl Oyster Fish. Gulf of Manaar*, part I, suppl. rept. 7: 227–307.