BEAUFORTIA

INSTITUTE OF TAXONOMIC ZOOLOGY (ZOOLOGICAL MUSEUM)
UNIVERSITY OF AMSTERDAM

Vol. 41, no. 5 October 22, 1990

REVISION AND NOTES ON THE BIOLOGY OF *ORCHOMENELLA RECONDITA* (STASEK, 1958) (AMPHIPODA, LYSIANASSOIDEA) AN ASSOCIATE OF SEA ANEMONES

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ABSTRACT

The amphipod symbiont of sea anemones originally described as *Allogaussia recondita* Stasek, 1958 is revised and allocated to the genus *Orchomenella* Sars, 1891 (sensu De Broyer, 1984, 1985). Preliminary data on the biology of the species are presented. The morphological adaptations toward a symbiontic life style are discussed and the unique variability and allometric growth of the telson is confirmed.

INTRODUCTION

In 1958, Stasek described a small yellowish amphipod found inside the intertidal aggregating sea anemone *Anthopleura elegantissima* (Brandt) on the central California coast as *Allogaussia recondita*, thus associating this North Pacific species with a genus of previously exclusively Antarctic distribution. *Allogaussia* Schellenberg, 1926 was later amalgamated by Barnard (1964) sub *Orchomene* Boeck, 1871 with *Orchomenella* Sars, 1891 and *Orchomenopsis* Sars, 1892. In later papers, Barnard (1967, 1969b) provisionally kept *Allogaussia* apart, but reallocated the species *A. recondita* to *Orchomene* (Barnard, 1967, p. 64).

The entire *Orchomene* complex is presently being revised by the first author (De Broyer, 1984, 1985, in prep.), while the second author has studied the biology and life cycle of *Orchomene recondita* (Stasek) on the coast of California (Vader, 1983, 1985; Vader & Lönning, ms.). In addition to some preliminary data on the biology of *O. recondita*, the present note gives a partial redescription and full illustrations of the species, discusses its correct generic allocation and the morphological adaptations toward a symbiotic life style, and confirms the unique variability and allometric growth of the telson.

Orchomenella (Orchomenella) recondita (Stasek, 1958) (Figs. 1-4)

Allogaussia recondita; Stasek, 1958: 119-124, figs. 1-3; Hurley, 1963: 134; Barnard, 1969a: 15.

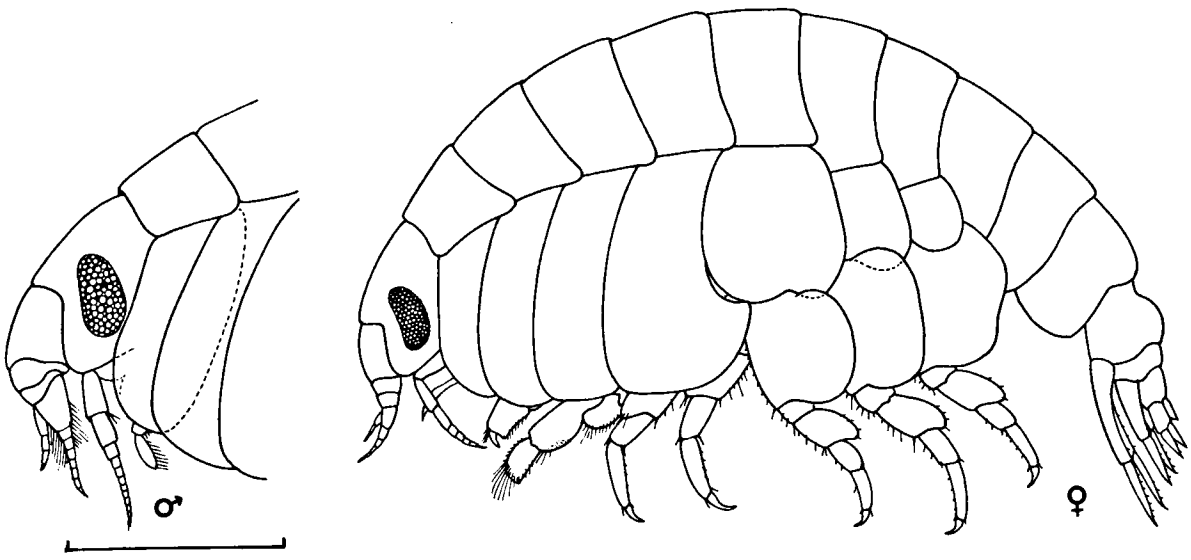

Fig. 1. *Orchomenella recondita. In toto:* ♀ ov., 8.0 mm; sample 1. Cephalon: ♂, 6.3 mm; sample 2. Scale: 1 mm.

Orchomene recondita Barnard, 1964: 82-85; Barnard, 1967: 64; Vader, 1983: 145, 150; Vader, 1985: 49.

MATERIAL

Sample 1. *Date*: 17 October 1978. *Loc.*: Doran rocks, Bodega Bay, Sonoma Col., California. In the intertidal zone. *Coll.*: W. Vader. Numerous specimens.
Sample 2. *Date*: 11 January 1980. *Loc.* & *Coll.*: id. 56 specimens: 27 ♂♂, 5.1-6.8 mm; 18 ♀♀ ov. or mat., 6.3-8.1 mm; 11 ♀♀ imm., 5.1-6.8 mm.
Sample 3. *Date*: 16 March 1980. *Loc.*: Moss Beach, San Mateo Co., California. *Coll.*: *id.* 28 specimens (topotypic material): 3 ♂♂, 5.8-6.6 mm; 10 ♀♀ ov., 6.5-8.8 mm; 5 ♀♀, 5.5-7.6 mm; 10 juv., 2.6-3.6 mm.
Sample 4. *Date*: 5 June 1980. *Loc.*: Campbell Cove, Bodega Bay. *Coll.*: *id.* 33 specimens: ♂♂, ♀♀, juv. 4.0-8.2 mm.

DIAGNOSIS

Interantennal lobe subtriangular with broadly rounded apex. Ommatidian eye present. Coxa 1 subrectangular, with anterodistal angle broadly rounded. Coxa 5 slightly posterolobate, Coxa 6 clearly posterolobate. Epimeral plate 3 with posterodistal angle rounded, posterior margin slightly convex and smooth. Urosomite 1 with low rounded keel.

Antenna 2 short, subequal to antenna 1 in female and hardly longer than antenna 1 in male. Calceoli absent. Mouthparts basic. Epistome lobate, slightly produced in front of upper lip. Mandible with fully ridged, subcylindrical molar, hairy process medial. Maxilliped outer lobe semi-oval with two apical spines.

Gnathopod 1 with carpus a little shorter than subrectangular propodus, with posterior lobe broadly rounded; palm transverse. Gnathopod 2 chelate. Gill of coxa 4 narrowing distally in a tubuliform lobe. Gill lacking on coxa 7. Uropod 3 with inner edge of outer ramus setiferous in male. Telson notched to about 20%, or slightly emarginate, or entire, with a subrectangular to a subtriangular shape. Stomodeum extending to pereonite 4.

ADDITIONAL DESCRIPTION

The description given by Stasek (1958) is extensive with clear but incomplete illustrations. We

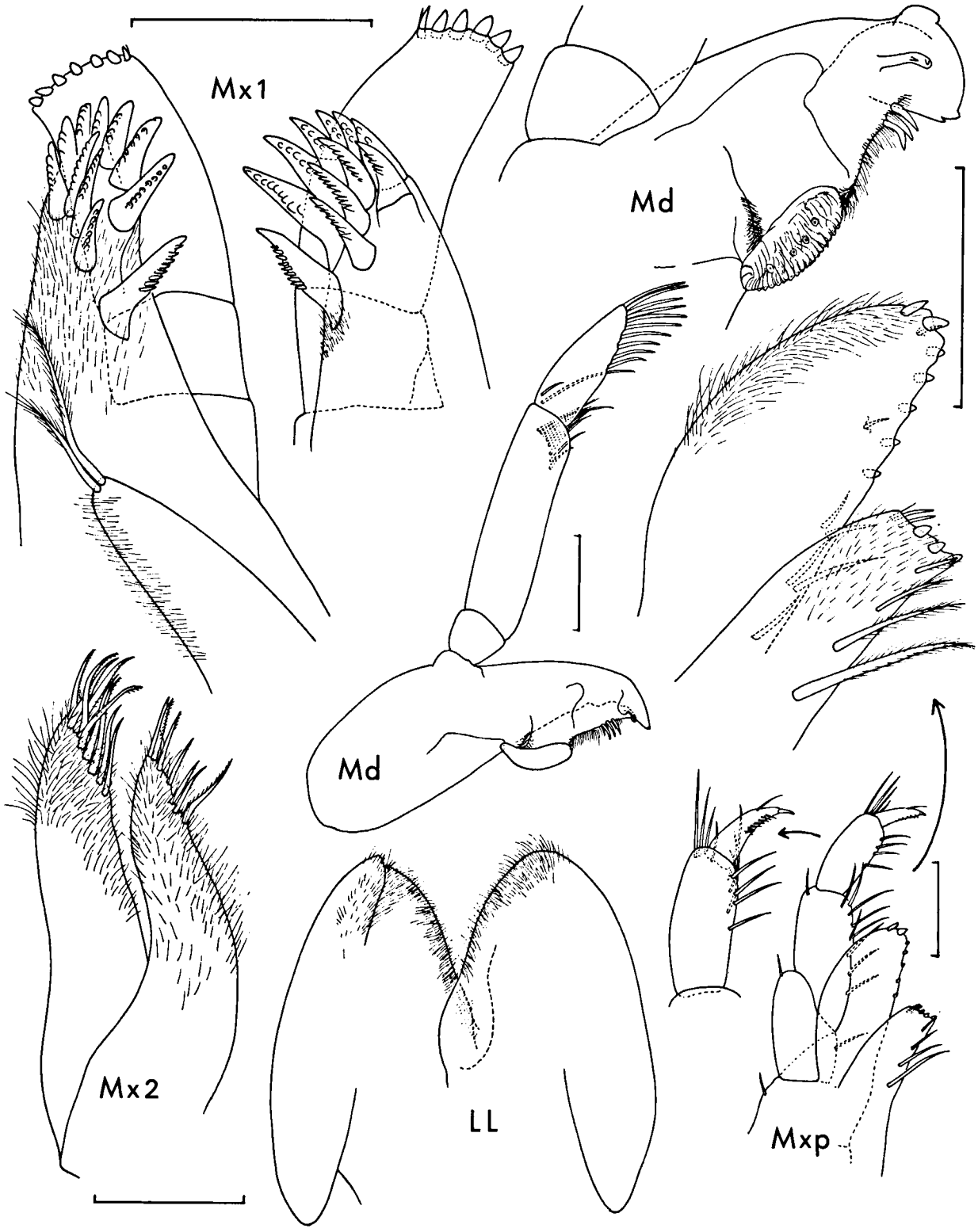

Fig. 2. *Orchomenella recondita.* Mouthparts. ♀ ov., 7.3 mm; sample 2. Md and LL: ♀ mat., 8.1 mm; sample 1. Md enlarged: ♂, 5.8 mm; sample 4. Scale: 100 µm.

have therefore restricted our description to the most salient points, although we have completely reillustrated the species (Figs. 1-4).

Mandible: incisor convex with a blunt tooth on both extremities; *lacinia mobilis* digitiform with five distal cusps; accessory spine row with 3 spines, continued by a crest of setae; palp proximal to molar, central to the dorsal side of the mandibular body. Lower lip: apex of outer lobes slightly truncate on the inner side but not slightly excavate as figured by Stasek (in fig. 2,D). Maxilla 1: outer lobe with 11 dentate spines in two ranks: a distal marginal rank of 8 spines, the most proximal spine the largest, separate from the rest and symmetrical in shape on both maxillae, a second internal rank of three smaller and thinner spines. Gnathopod 1: propod with transverse palm (not "slightly chelate" as in Stasek 1958), slightly convex and denticulate.

Telson (fig. 4): short and notched to 15-20% of its length in juveniles (2.6-3.6 mm) and immature males (5.1-5.9 mm), with a length-breadth ratio of 1.10 to 1.23; subrectangular (or quite triangular in a an aberrant specimen), entire or slightly emarginate in presumed mature males (5.8-6.8 mm) with a length-breadth ratio of 1.40 to 1.45; short and notched to 20%, or more elongate and entire (l/b ratio: about 1.10 to 1.20) in immature females (5.5-6.7 mm); short and notched to 21% (l/b ratio: about 1.10), or more elongate, entire and subtriangular to nearly triangular (l/b ratio: 1.26 to 1.30) in ovigerous or mature females (6.3-8.8 mm).

GENERIC ALLOCATION

De Broyer (1984, 1985) has divided the *Orchomene* (s. l.) complex into four genera, after a cladistic analysis using a large set of characters. The taxa with unspecialized button-shaped molars are grouped in the genera *Orchomenella* Sars (with a number of subgenera) and *Allogaussia* Schellenberg s. str. (with only 2 or 3 Antarctic species). *"Allogaussia" recondita* has unspecialized mouthparts and an entire telson, but none of the synapomorphies that typify that genus, i.e. the elongate peduncle segments 2 and 3 of antenna 1, the absence of a callynophore, the strongly expanded basis of pereopod 5, the strongly posterolobate coxa 5 and the enlarged peduncle of uropod 3.

"Allogaussia" recondita conforms in most of its characters to the genus *Orchomenella* Sars sensu De Broyer, 1984. The molar is button-shaped, and the outer plate of the maxilliped has 2 distal spines. De Broyer (1984) has subdivided *Orchomenella* in the subgenera *Orchomenella* s. str., *Orchomenopsis* Sars 1892, *Orchomenyx* De Broyer 1984 and an as yet unnamed *pacifica-magdalenensis-tabasco* group.

"A". recondita is closer to the subgenus *Orchomenella* than to any other subgenus but it shows a number of apomorphic traits. It has short second antennae in male, no calceoli, a distal narrow lobe at the gill of coxa 4 (autapomorphy), an entire or emarginate telson and no gills on pereopod 7.

BIOLOGY

Orchomenella recondita is an obligate symbiont of the common intertidal aggregating sea anemone *Anthopleura elegantissima* (Brandt). These amphipods spend their entire life-cycle, inclusive the moulting and reproduction processes, in the gastrovascular cavity of their host, where they live of the secretion products (i.a. extruded zooxanthellae) and the semidigested prey of the sea anemones. The amphipods are extremely patchily distributed, with patches with mean densities of up to 6 amphipods per host alternating with large areas covered with apparently similar aggregations of *Anthopleura* in which no amphipods are found.

Orchomenella recondita has seasonal reproduction and a 1-year life-cycle, with usually two consecutive broods of 8-15 young in early spring. The amphipods in adjacent colonies often are up to some weeks "out of phase" in attainment of maturity and onset of reproduction, which reinforces the impression of very low vagility of the amphipod symbionts. (Data extracted from Vader & Lönning, ms., see also Vader, 1983, 1985).

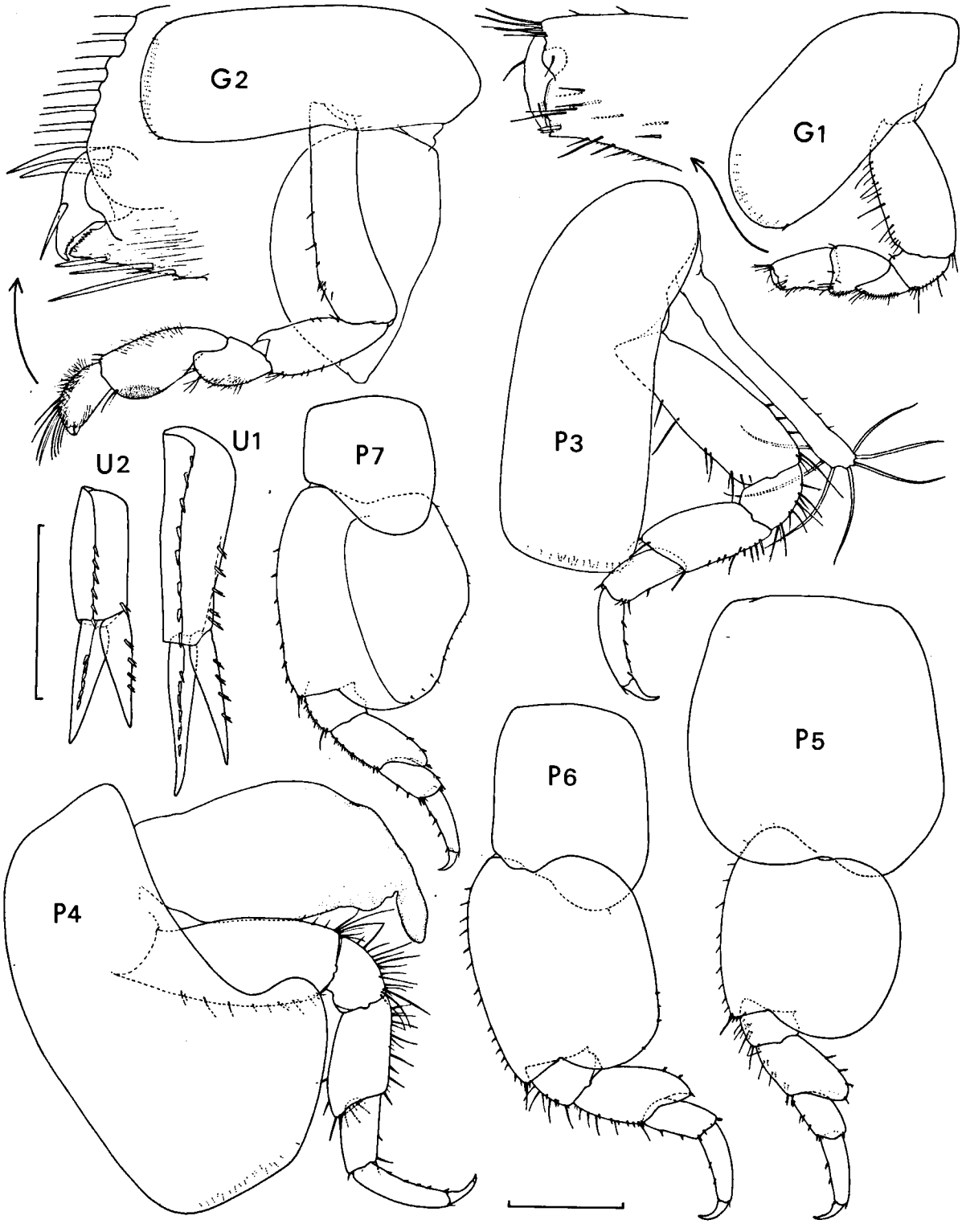

Fig. 3. *Orchomenella recondita.* ♀ ov., 7.3 mm; sample 2. Scale: 0.5 mm.

DISTRIBUTION

The very patchy distribution of *O. recondita*, coupled with its specialized and hidden habitat, makes the species very easy to overlook. Its host *Anthopleura elegantissima*, occurs from southern Alaska to Baja California, but *O. recondita* has hitherto only been found from the type-locality Moss Beach just south of San Francisco (Stasek, 1958) along the coast of northern California and southern Oregon north to Newport, Oregon (Vader & Lönning, ms.). Neither Vader & Lönning, nor Barnard (1969a: 15) succeeded in finding *O. recondita* in southern California. Limited sampling along the outer coast of Washington and on the San Juan islands were likewise without result.

MORPHOLOGICAL ADAPTATIONS TOWARD A SYMBIOTIC WAY OF LIFE IN *O. RECONDITA*

O. recondita is an obligate associate of *Anthopleura elegantissima*. Such host-specificity, especially in the presence of several other closely related *Anthopleura* species in its biotope (cf. Lönning & Vader, 1984), strongly indicates a long history of association.

A review of the different amphipod associates of sea anemones (Vader, 1983) nevertheless has revealed few outstanding morphological adaptations toward this type of symbiosis, except in the case of the micropredatory *Acidostoma* spp. Lysianassoid amphipods, such as *O. recondita* and *Onisimus normani* Sars that live in the gastrovascular cavity and eat secretory products of the host and its semidigested prey, have a diet that does not deviate much from that of the generalized free-living Lysianassoidea, and their mouthparts are very similar to those of freeliving congeners.

A common trait in many associates of sea anemones, as well as of sponges, tunicates and echinoderms, is a reduced sexual dimorphism. There is little needs for swimming males in animals that spend their lives as inquilines, but the tendency toward reduced sexual dimorphism goes further than this: in the sea anemone symbiont *Stenothoe brevicornis* Sars, a member of a genus with non-swimming but usually quite strongly sexually differentiated males, the males were long presumed unknown because they look just like the females (Vader, 1983).

The reduced sexual dimorphism in *O. recondita*, shown by short second antennae and absence of calceoli, can therefore be understood as an adaptation toward a symbiontic way of life.

The other outstanding features of *O. recondita*, viz. the loss of the gill on pereopod 7 and the entire telson cannot easily be explained as adaptations toward symbiosis. Many associated Lysianassoidea, it is true, have entire or slightly emarginate telsons, but in many others it is deeply cleft, and a survey of taxa like *Orchomene* s. str., *Orchomenella* and *Onisimus* s. l. (i.e. *Boeckosimus* plus *Pseudalibrotus*), in which telsons vary and both free-living and associated species are present, shows no significant correlations between telsonic form and way of life, where known.

ACKNOWLEDGEMENTS

The authors wish to thank Mrs Katia Bouckaert who prepared most of the illustrations.

ABBREVIATIONS USED IN THE FIGURES

G 1, 2	gnathopod 1, 2
LL	lower lip
Md	mandible
Mx 1, 2	maxilla 1, 2
Mxp	maxilliped
P 3-7	pereopod 3-7
T	telson
U 1-3	uropod 1-3

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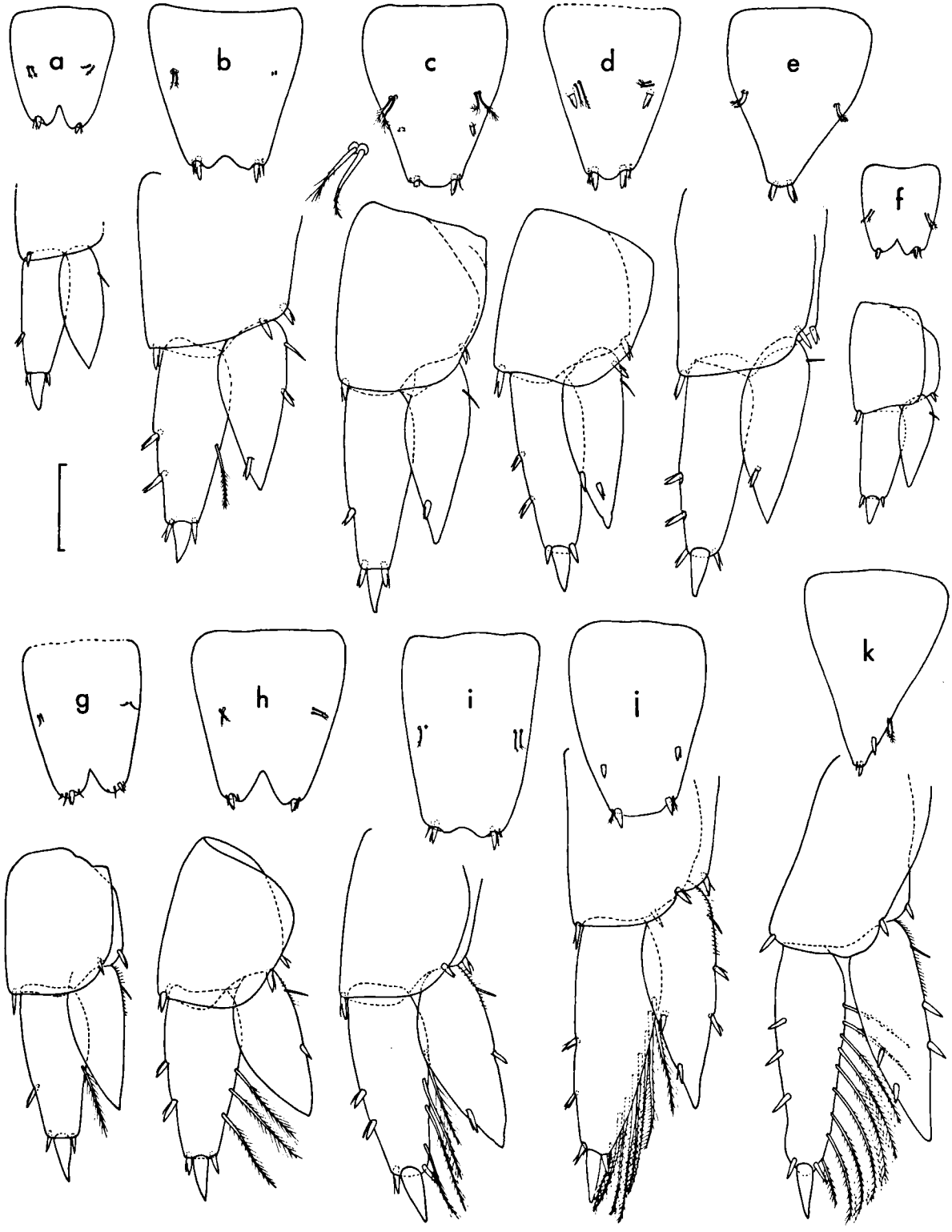

Fig. 4. *Orchomenella recondita*. T and U 3. a-e: females; a: ♀ imm., 5.5 mm; sample 2. b: ♀ ov., 7.3 mm; sample 2. c: ♀ ov., 8.1 mm; sample 2. d: ♀ mat., 7.4 mm; sample 2. e: ♀ ov., 8.2 mm; sample 3. f-k: males; f: ♂ imm., 4.0 mm; sample 4. g: ♂, 5.8 mm; sample 4. h: ♂, 5.4 mm; sample 2. i: ♂, 6.2 mm; sample 2. j: ♂, 6.3 mm; sample 2. k: aberrant telson in ♂, 5.9 mm; sample 1. Scale: 100 μm.

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Received: November 20, 1989

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