

# First Zoeal Stage of *Macromedaeus orientalis* (Takeda et Miyake, 1969) (Crustacea: Decapoda: Xanthidae) Reared in the Laboratory

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*Macromedaeus orientalis*

*Macromedaeus distinguendus*

Antenna

Zoea

The first zoeal stage of *Macromedaeus orientalis* (Takeda et Miyake, 1969) is described and illustrated. Its morphological characteristics are compared with those of other known species of the subfamily Xanthinae. The first zoeas of *M. orientalis* and *M. distinguendus* are similar, but they can be distinguished from each other by the characteristic of antenna. The former has a smooth antenna with a rounded tip, while the latter has a serrated antenna with a spinous tip.

*Macromedaeus orientalis* (Takeda et Miyake, 1969) originally referred to as *Microcassiope* Guinot, was transferred to *Macromedaeus* Ward by Yamaguchi et al. (1976) due to the close resemblance to *M. distinguendus* (De Haan, 1835). In the genus *Macromedaeus* so far only one species, *M. distinguendus*, has been reported from Korea (Kim, 1973; The Korean Society of Systematic Zoology, 1997). Serène (1984) listed 12 Xanthinae genera including *Macromedaeus* of which the larvae in Korea and the adjacent waters are only known for *Leptodius exaratus* (H. Milne Edwards, 1834) by Fielder et al. (1979) and Terada (1980), *M. distinguendus* by Terada (1980), *Cycloxanthops truncatus* (De Haan, 1837) by Hong (1977), Suzuki (1979) and Terada (1980), *Nanocassiope granulipes* (Sakai, 1939) by Ko and Clark (in press) and *Paraxanthias elegans* (Stimpson, 1858) by Terada (1990).

*M. orientalis* mainly inhabits the rocky beaches with stones or crevices of rock at the low tidal mark, but sometimes down to 40 m depth (Takeda, 1977). It is known to occur on the coasts of Japan and Indonesia (Takeda, 1977) and now found for the first time from Korea. However, the larval stages of this species are unknown. Therefore, the purpose of this paper is to describe its first zoeal stage and to compare its morphology with the previously described zoeas from the same subfamily.

## Materials and Methods

In June 2001 an ovigerous female of *Macromedaeus orientalis* (Takeda et Miyake, 1969) was collected from Gonli Island in Tongyeong, Kyeong Sang Nam Do, Korea. The zoeas collected from laboratory-hatched

specimens were reared using methods described by Ko (1995) at a constant water temperature of 25°C. Larvae were fixed and preserved in 10% neutral formalin. Dissected appendages were examined and drawn using a Leitz Laborlux S microscope with camera lucida. Setal counts on appendages and measurements were based on the mean of 10 specimens of zoeas. The sequence of the zoeal description (see Clark et al., 1998) is based on the malacostracan somite plan and described from anterior to posterior. Setal armature on appendages is described from proximal to distal segments and in order of endopod to exopod. The remaining zoeal stages and the spent female were deposited in Silla University, Korea.

## Results

### First Zoea (Figs. 1, 2)

Size. Carapace length  $0.48 \pm 0.01$  mm. Distance from tip of dorsal spine to tip of rostral spine  $1.84 \pm 0.05$  mm.

Carapace (Fig. 1A, B). Dorsal spine straight and long, curved distally and approximately equal in length to rostral spine; rostral spine slightly shorter than antenna; lateral spine short; 1 pair of posterodorsal setae; each ventral margin without setae; eyes sessile.

Antennule (Fig. 1C). Uniramous, endopod absent; exopod unsegmented, with 3 terminal aesthetascs plus a long and a minute terminal setae.

Antenna (Fig. 1B, D). Protopod not spinulate, slightly longer than rostral spine with rounded tip; endopod absent; small exopod with minute seta.

Mandible (Fig. 1E). Asymmetrical; right molar and left molar processes with 3 and a teeth, confluent with incisor process, respectively; endopod absent.

Maxillule (Fig. 1F). Coxal endite with 7 setae; basal

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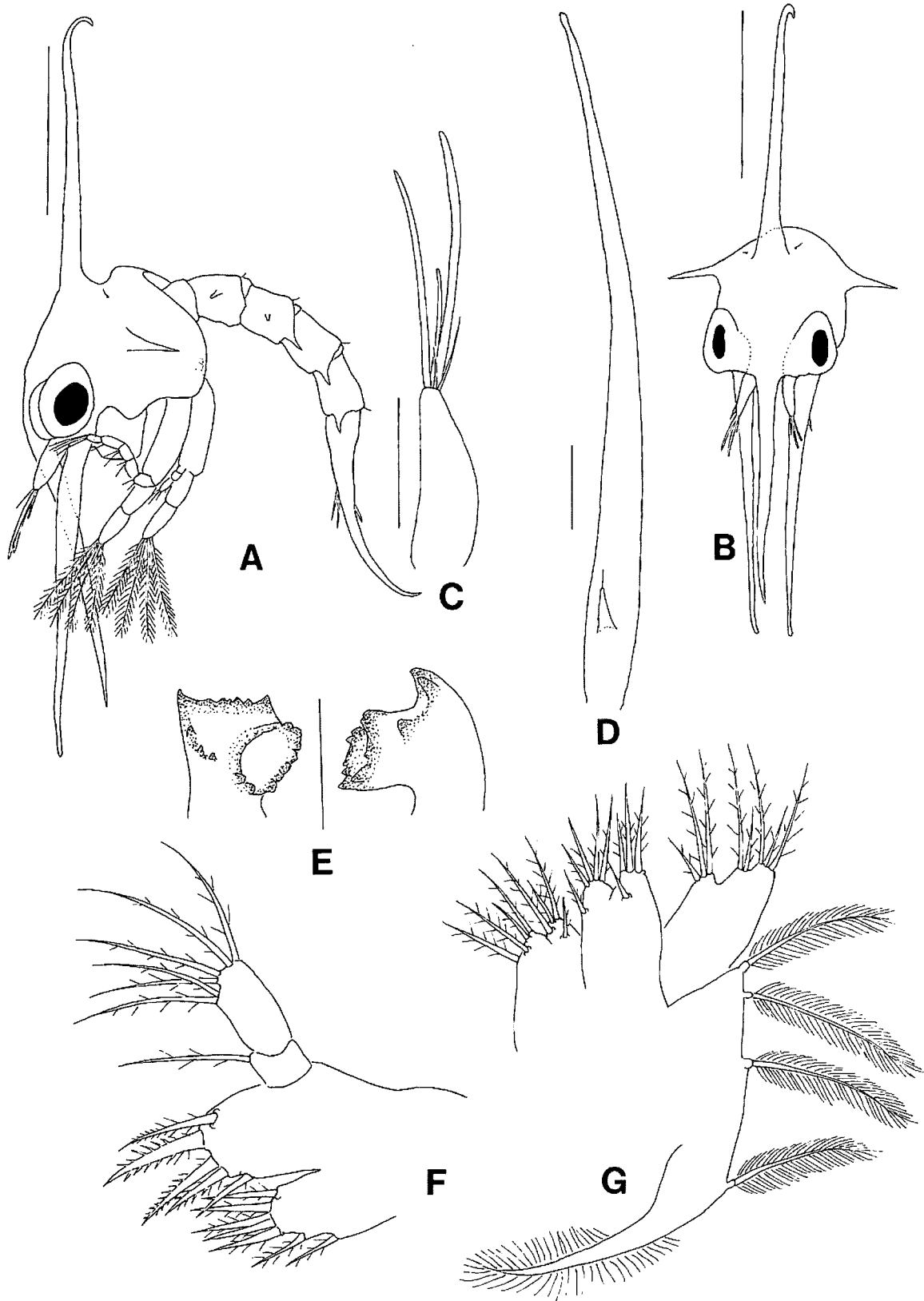


Fig. 1. *Macromedaeus orientalis*, first zoeal stage. A, Lateral view. B, Anterodorsal view of carapace. C, Antennule. D, Antenna. E, Mandibles. F, Maxillule. G, Maxilla. Scale bars = 0.1 mm (C, F, G), 0.25 mm (E), and 0.5 mm (A, B, D).

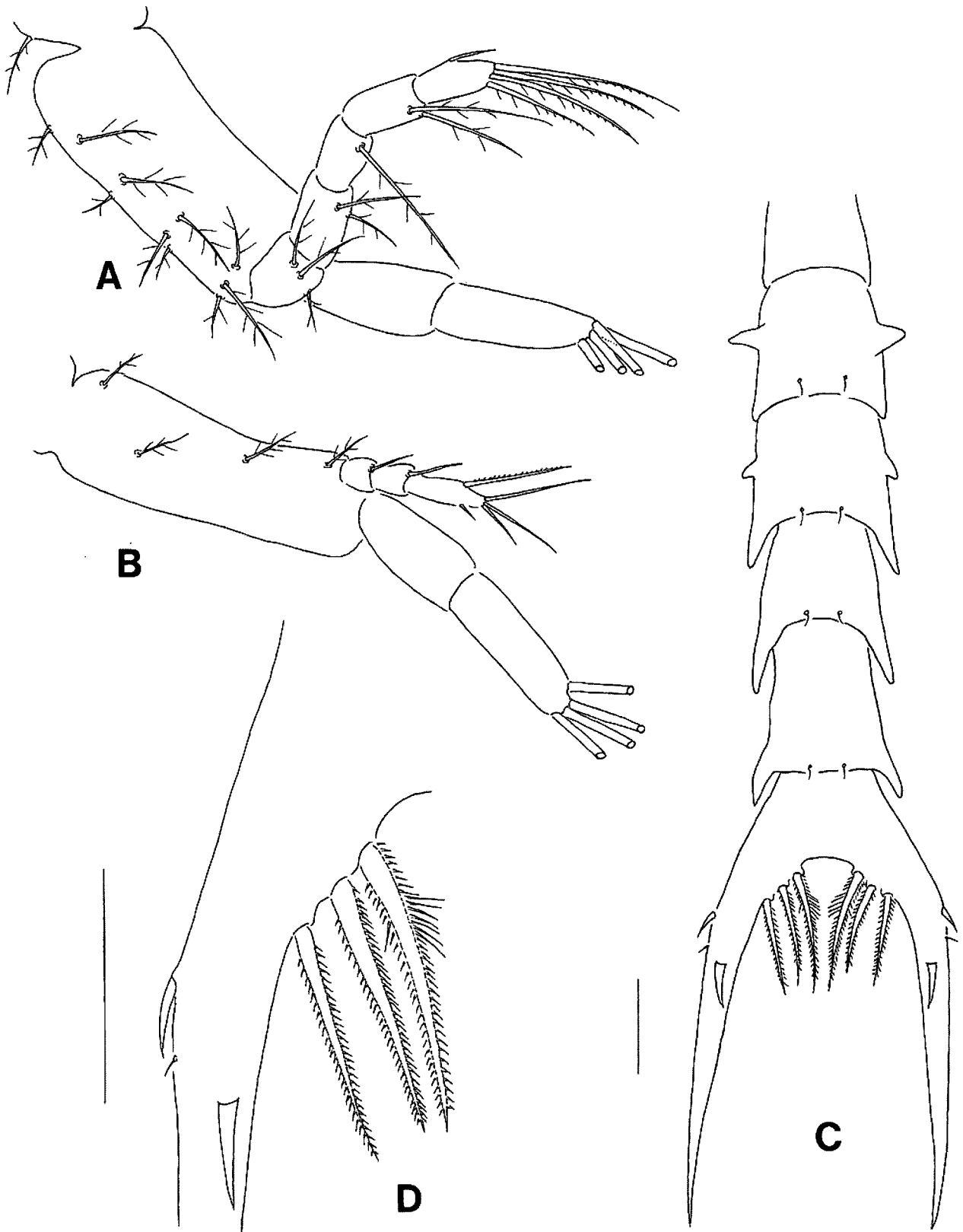


Fig. 2. *Macromedaeus orientalis*, first zoeal stage. A, First maxilliped. B, Second maxilliped. C, Third maxilliped. D, Pereiopods. E, Fork of telson. F, Dorsal view of abdomen and telson. Scale bars = 0.05 mm (C), 0.1 mm (A, B, E), 0.25 mm (D), and 0.5 mm (F).

endite with 5 setae; endopod 2-segmented, proximal segment with 1 seta, distal segment with 4 terminal plus 2 subterminal setae.

Maxilla (Fig. 1G). Coxal endite bilobed with 4+4 setae; basal endite bilobed with 5+4 setae; endopod with 3 middle+2 subterminal+3 terminal setae; exopodal (scaphognathite) margin with 4 plumose setae plus 1 distal stout process.

First maxilliped (Fig. 2A). Coxa with 1 seta; basis with 10 setae arranged as 2, 2, 3, 3; endopod 5-segmented with 3, 2, 1, 2, 5 (1 subterminal+4 terminal) setae, respectively; exopod 2-segmented, distal segment with 4 terminal natatory setae.

Second maxilliped (Fig. 2B). Coxa without seta; basis with 4 setae; endopod 3-segmented, with 1, 1, 5 (2 subterminal+3 terminal) setae, respectively; exopod 2-segmented, distal segment with 4 terminal natatory setae.

Third maxilliped (Fig. 2C). Rudimentary, biramous.

Pereiopods. Absent

Abdomen (Fig. 2F). Five somites; somite 2 with 1 pair of lateral processes directed laterally; somite 3 with a pair of lateral processes directed posteriorly; somites 2-5 with short posterolateral processes and a pair of posterodorsal setae; pleopod buds absent.

Telson (Fig. 2E, F). Each fork long, not spinulate, with 1 stout lateral spine, 1 minute lateral seta and 1 stout dorsomedial spine; each posterior margin with 3 spinulate setae.

## Discussion

Ko (2002) reported that the general morphology of the first zoeas of the family Xanthidae as follows: carapace with all spines; endopod of maxillule with 1, 2+4 setae; endopod of maxilla with 3+2+3 (5+3) setae; endopod of first maxilliped with 3, 2, 1, 2, 5 setae. The first zoea of *M. orientalis* corresponds well with other xanthid zoeas on the respect of the above four characteristics (Table 1). Martin (1984) attempted to divide the xanthid zoeas into six groups based primarily on the antennal characteristics. However, the characteristics of the antenna are somewhat variable among the zoeas of the subfamily Xanthinae. According to Martin's criteria, the zoeas of *Cycloxanthops truncatus*, *Leptodius exaratus*, *Macrome-*

*daeus distinguendus*, and *Nanocassiope granulipes* can be included in Type I group, in which antennal exopods are less than 1/4 length of protopod and never armed with more two terminal setae. The zoea of *Paraxanthias elegans* can be included in Type III group, in which antennal exopod is longer than that of Type 1 and armed with three terminal setae. However the first zoea of *M. orientalis* can not be assigned to any of the Martin's groups, because of its antennal protopod that is not serrated with rounded tip. Such morphology of antenna can be easily seen in the zoeas of the subfamily Actaeinae, especially in *Gaillardiiellus orientalis* (Odhner, 1925), *Actaea semblatae* (Guinot, 1976) and *Novactaea bella* Guinot, 1976 (Ng and Clark, 1994; Lim and Ng, 1997; Ko, 1999, 2002). Therefore, it is considered that the placement of *M. orientalis* in the subfamily Xanthinae is questionable on the basis of zoeal morphology. Moreover, the zoea of *M. distinguendus* closely resembles those of *Leptodius exaratus* and *Nanocassiope granulipes* but not that of *M. orientalis*.

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Table 1. Comparison of the first zoeas in the subfamily Xanthinae

| Species                           | Carapace |    |    | Antenna  |     |             | Maxillule end. | Maxilla end. | Maxilliped 1 end. | Maxilliped 2 end. | Telson fork | Sources                |
|-----------------------------------|----------|----|----|----------|-----|-------------|----------------|--------------|-------------------|-------------------|-------------|------------------------|
|                                   | DS       | RS | LS | Protopod |     | Exopod Seta |                |              |                   |                   |             |                        |
|                                   |          |    |    | Tip      | LP  |             |                |              |                   |                   |             |                        |
| <i>Cycloxanthops truncatus</i>    | +        | +  | +  | S        | 13% | 2           | 1, 2+4         | 3+2+3        | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Suzuki, 1979           |
| <i>Leptodius exaratus</i>         | +        | +  | +  | S        | 7%  | 1           | 1, 2+4         | 5+3          | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Terada, 1980           |
| <i>Macromedaeus distinguendus</i> | +        | +  | +  | S        | 9%  | 1           | 1, 2+4         | 3+2+3        | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Terada, 1980           |
| <i>M. orientalis</i>              | +        | +  | +  | R        | 4%  | 1           | 1, 2+4         | 3+2+3        | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Present study          |
| <i>Nanocassiope granulipes</i>    | +        | +  | +  | S        | 12% | 1           | 1, 2+4         | 3+2+3        | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Ko and Clark, in press |
| <i>Paraxanthias elegans</i>       | +        | +  | +  | S        | 26% | 3           | 1, 2+4         | 5+3          | 3, 2, 1, 2, 5     | 1, 1, 5           | 1LS+1ML     | Terada, 1990           |

DS, dorsal spine; RS, rostral spine; LS, lateral spine; S, spinous; R, rounded; LP, length to protopod; end., endopod; +, present; ML, minute lateral seta.

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