

# First Zoeas of *Eualus leptognathus* (Decapoda: Caridea: Hippolytidae) Hatched in the Laboratory

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## ABSTRACT

The first zoeas of *Eualus leptognathus* are described and illustrated in detail from laboratory-hatched material. Morphological comparison is made with previous description of this species from Japan. Minute rostrum and two anteroventral denticles behind pterygostomian spine on the carapace readily distinguish the first zoeas of *Eualus leptognathus* from those of *Eualus sinensis*, the only known zoeas of *Eualus* from Korean waters.

**Key words:** first zoeas, *Eualus leptognathus*, Hippolytidae, Caridea

## INTRODUCTION

The genus *Eualus* contains about 30 species in world wide (Chace, 1997; Komai and Hayashi, 2002). Of these, six species are attributed to *Eualus* from Korean waters: *E. biunguis* (Rathbun, 1902); *E. leptognathus* (Stimpson, 1860); *E. macilentus* (Krøyer, 1841); *E. middendorffi* Brashnikov, 1907; *E. sinensis* (Yu, 1931); and *E. spathulirostris* (Yokoya, 1933) (Kim and Kim, 1997; Cha et al., 2001; Kim and Choi, 2006; Kim et al., 2006).

There is a larval description belonging to *Eualus* from Korean waters. Yang et al. (2001) described the first zoeas of *E. sinensis* hatched from ovigerous female collected in Sangju, southern Korea. Beyond Korean waters, Yamashita and Hayashi (1984) described nine zoeal and one postlarval stages of *E. leptognathus* hatched from ovigerous females collected in Miyazima, the Seto Inland Sea, Japan. The earlier description of *E. leptognathus* given by Yamashita and Hayashi (1984), however, is restricted to brief comments and illustrations, particularly in descriptions of the antennule, maxillule, maxilla, and the first to third maxillipeds.

In the present study, therefore, the first zoeas of *E. leptognathus* are described and illustrated in detail. They are compared with those of *E. sinensis*, the only known larvae of *Eualus* from Korean waters.

## MATERIALS AND METHODS

On 12 May 2006, ovigerous females of *Eualus leptognathus*

were collected from Jangmok, southern Korea (34° 59'N 128° 40'E). Ovigerous females were maintained in 2 L glass beakers, containing well-aerated natural seawater until hatching occurred. On 14 May 2006, more than 100 larvae hatched from one female. Newly hatched zoeas were preserved in 5% neutral formalin for later examination, and dissected in lactophenol. Dissected appendages were examined using a Olympus BX60 microscope, and drawings were made with the help of a camera lucida. Measurements and setal counts on appendages are based on ten specimens. The setal armature on the appendages is described from the proximal to the distal segments. Body length (BL) and carapace length (CL) were measured from the postorbital margin to the telson, excluding posterior processes, and from the postorbital margin to the posteromedian border of the carapace, respectively. The chromatophore pattern was determined by observation on live larvae. Females and the first zoeas were deposited in the Invertebrate Resources Bank of Korea (IRBK), Seoul National University, Korea, under accession numbers, IRBKAR003491 and IRBKAR003492, respectively.

## RESULTS

First zoea (Fig. 1)

Size: BL, 1.52 (1.50-1.53) mm; CL, 0.45 (0.44-0.46) mm.

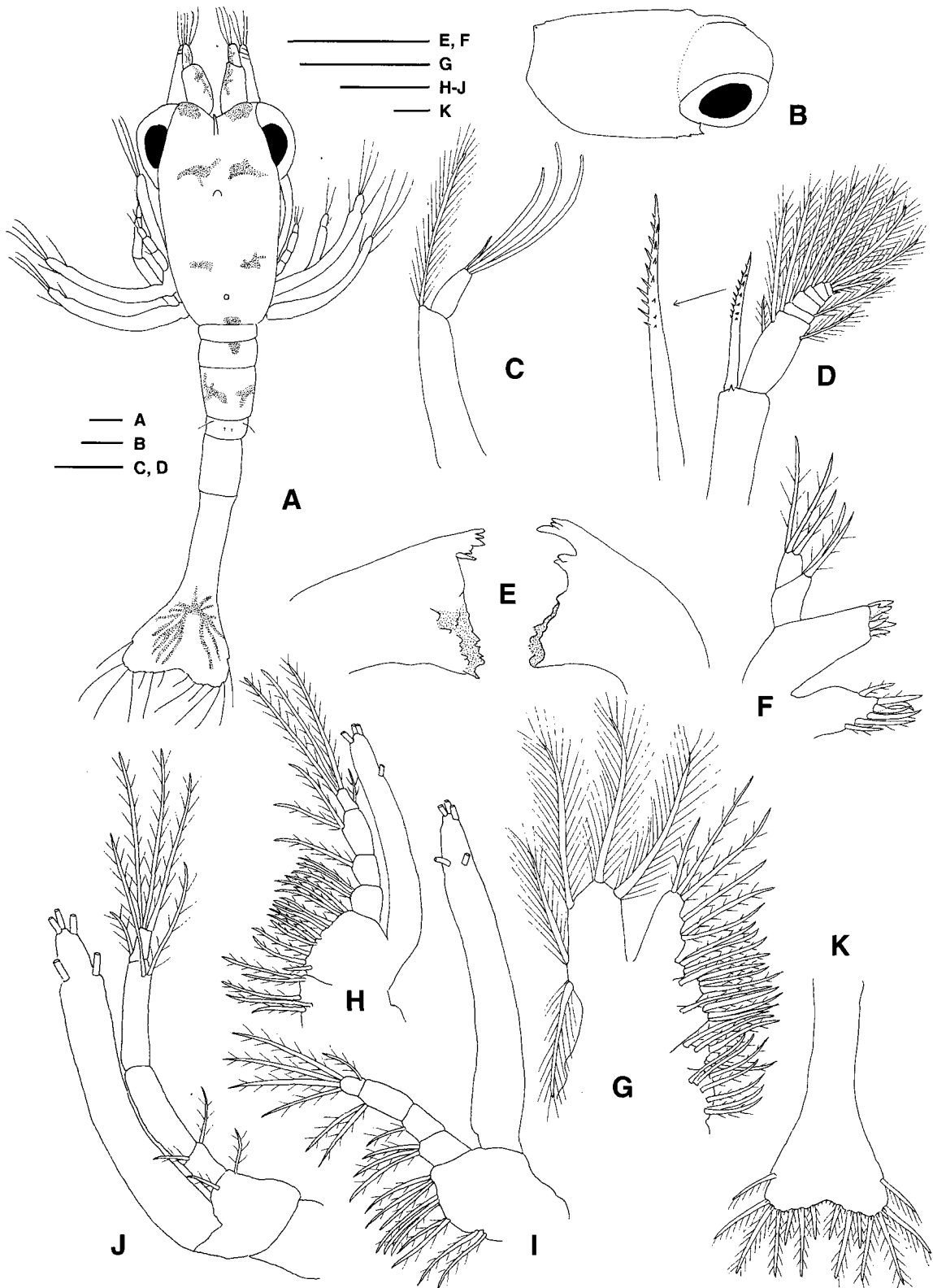
Carapace (Fig. 1A, B). Rostrum simple, minute, not extending beyond eyes in dorsal view; anterior and posterior dorsomedian papillae present; supraorbital and antennal spines absent; anteroventral margin with 2 denticles behind pterygostomian spine; posteroventral margin smooth; eyes sessile, without dorsal papillae.

Antennule (Fig. 1C). Peduncle with long plumose seta;

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**Fig. 1.** First zoea of *Eualus leptognathus* (Stimpson, 1860). A, habitus, dorsal; B, carapace and eye, lateral; C, antennule; D, antenna; E, mandibles; F, maxillule; G, maxilla; H, first maxilliped; I, second maxilliped; J, third maxilliped; K, telson, dorsal. Scale bars=0.1 mm (A-K).

inner flagellum not differentiated; outer flagellum with 3 aesthetascs and short simple seta.

Antenna (Fig. 1D). Peduncle with distal spine; endopod slightly overreaching end of scale, about  $1.06 \times$  scale, with 2 rows of denticles on distal half; scale 6-segmented, with 5 terminal segments, 12 marginal plumose setae, and minute distolateral tooth.

Mandibles (Fig. 1E). Palps absent; left mandible with *lacinia mobilis* (=movable spine) at base of incisor part; right mandible with 2 spines between molar process and incisor process.

Maxillule (Fig. 1F). Coxal endite with 7 plumodenticulate setae; basal endite with 5 cuspidate setae; endopod 2-segmented, each with 2 and 3 plumodenticulate setae, respectively.

Maxilla (Fig. 1G). Coxal endite bilobed, each with 7 and 4 plumodenticulate setae, respectively; basal endite bilobed, with 4 plumodenticulate setae on each lobe; endopod with 9 plumodenticulate setae arranged 3, 2, 1, 3; scaphognathite with 5 marginal plumose setae.

First maxilliped (Fig. 1H). Coxa with 5 plumodenticulate setae; basis with 12 plumodenticulate setae arranged 3, 3, 3, 3; endopod 4-segmented, with 3, 1, 2, 3+1 plumodenticulate setae; exopod with 4 (1 subterminal+3 terminal) natatory setae, terminal setae disposed asymmetrically.

Second maxilliped (Fig. 1I). Coxa with plumose seta;

basis with 9 plumodenticulate setae arranged 1, 2, 3, 3; endopod 4-segmented, with 3, 1, 2, 4+1 plumodenticulate setae; exopod with 5 (2 subterminal+3 terminal) natatory setae, terminal setae disposed asymmetrically.

Third maxilliped (Fig. 1J). Coxa unarmed; basis with 2 plumodenticulate setae; endopod 4-segmented, with 2, 0, 2, 3+1 plumodenticulate setae; exopod with 5 (2 subterminal+3 terminal) natatory setae, terminal setae disposed asymmetrically.

Pereopods. Absent.

Abdomen (Fig. 1A). Composed of 5 abdominal somites; sixth somite not differentiated; all abdominal somites without spine; fourth somite with tuft of dorsal setae; pleopods absent.

Telson and uropod (Fig. 1K). Telson triangular, with deep median concavity; posterior margin with 7 pairs of processes; 2 outermost pairs plumose only on inner side; bases of all processes except outermost with row of minute spinules; anal spine present (not shown). Uropod absent.

Chromatophores (Fig. 1A). Red chromatophores present on: peduncle and outer flagellum of antennule; superolateral margin of each eye; dorsally on carapace; coxa and basis of first maxilliped; exopods of second and third maxillipeds; dorsally on second and third abdominal somites; laterally on third and fifth abdominal somites; and dorsally on telson.

**Table 1.** Morphological comparison between descriptions of the first zoeas of *E. leptognathus*. ?=data unknown

	Yamashita and Hayashi (1984)	Present study
Antennule		
outer flagellum	?	3 aesthetascs and 1 simple seta
Antenna		
endopod	reaching end of scale, with denticles	slightly overreaching end of scale, about $1.06 \times$ scale, with 2 rows of denticles on distal half
scale	6-segmented, with 12 marginal setae	6-segmented, with 12 marginal setae and distolateral tooth
Maxillule		
coxa endite	?	7 setae
basal endite	?	5 setae
Maxilla		
coxa endite	?	7+4 setae
basal endite	?	4+4 setae
First maxilliped		
coxa	?	5 setae
basis	?	3, 3, 3, 3 (12) setae
endopod	4-segmented (? , ? , ? , ? setae)	4-segmented (3, 1, 2, 3+1 setae)
Second maxilliped		
coxa	?	1 plumose seta
basis	?	1, 2, 3, 3 (9) setae
endopod	4-segmented (? , ? , ? , ? setae)	4-segmented (3, 1, 2, 4+1 setae)
Third maxilliped		
coxa	?	unarmed
basis	?	2 setae
endopod	4-segmented (? , ? , ? , ? setae)	4-segmented (2, 0, 2, 3+1 setae)
Pereopods	rudiments of first and second pereopods present	absent

## DISCUSSION

Yamashita and Hayashi (1984) described nine zoeal and one postlarval stages of *Eualus leptognathus* from Japanese waters. Several differences are observed between the description of the first zoeas of *E. leptognathus* provided by Yamashita and Hayashi (1984) and that obtained in the present study: the endopod and scale of antenna and the pereopods (Table 1). The previous authors described the scale of antenna as having 12 marginal setae. However, we observed that the scale of antenna had 12 marginal plumose setae and a distolateral tooth. The earlier authors probably overlooked a distolateral tooth because this tooth is minute in the first zoeas.

The only member of the genus *Eualus* for which larvae are described from Korean waters is *E. sinensis* (Yang et al., 2001). In the first zoeas of *E. sinensis*, the rostrum is absent, while the carapace has no anteroventral denticles and pterygostomian spine. The first zoeas of *E. leptognathus* are readily distinguished from those of *E. sinensis* by having minute rostrum and two anteroventral denticles behind pterygostomian spine on the carapace.

## ACKNOWLEDGEMENTS

The authors are grateful to Mrs. S.K. Lee and T.S. Park for the help with collection of the ovigerous females. This work was supported by a grant from the National Research Resource Bank Program KOSEF/MOST (R21-2005-000-10013-0).

## REFERENCES

- Cha, H.K., J.U. Lee, C.S. Park, C.I. Baik, S.Y. Hong, J.H. Park, D.W. Lee, Y.M. Choi, K. Hwang, Z.G. Kim, K.H. Choi, H. Sohn, M.H. Sohn, D.H. Kim and J.H. Choi, 2001. Shrimps of the Korean Waters. National Fisheries Research and Development Institute, Busan, pp. 1-188 (in Korean).
- Chace, F.A., Jr., 1997. The caridean shrimps (Crustacea, Decapoda) of the 'Albatross' Philippine Expedition, 1907-1910. Part 7: Families Atyidae, Eugonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Processidae, and Hippolytidae. *Smithson. Contrib. Zool.*, 587: 1-106.
- Kim, H.S. and W. Kim, 1997. Order Decapoda. *In* The Korean Society of Systematic Zoology, ed., Lists of Animals in Korea (excluding Insects). Academy Publishing Co., Seoul, pp. 212-223 (in Korean).
- Kim, J.N. and J.H. Choi, 2006. Two caridean shrimps (Crustacea: Decapoda) from Korean continental slope of the East Sea. *Korean J. Syst. Zool.*, 22: 51-55.
- Kim, J.N., J.H. Choi and C.W. Ma, 2006. Two hippolytid shrimps of the genus *Eualus* (Crustacea: Decapoda: Caridea) from Korea. *J. Fish. Sci. Tech.*, 9(2): 83-90.
- Komai, T. and K.-I. Hayashi, 2002. A new species of the hippolytid shrimp genus *Eualus* Thallwitz, 1891 (Crustacea: Decapoda: Caridea) from Toyama Bay, the Sea of Japan. *Proc. Biol. Soc. Washington*, 115: 382-390.
- Yamashita, K. and K.-I. Hayashi, 1984. Larvae of Decapoda, Macrura in the vicinity of Miyazima aquarium, Miyazima, the Seto Inland Sea III. *Eualus leptognathus* (Stimpson) (Caridea, Hippolytidae). *Proc. Japanese Soc. Syst. Zool.*, 28: 19-28 (in Japanese).
- Yang, H.J., H.S. Ko and C.H. Kim, 2001. The first zoeal stage of *Eualus sinensis* (Yu, 1931) (Decapoda, Caridea, Hippolytidae) with a key to the known first hippolytid zoeae of Korea and adjacent waters. *Crustaceana*, 74: 1-9.

Received May 23, 2005  
Accepted October 25, 2006