

First Zoa of *Petrolisthes trilobatus* (Crustacea: Decapoda: Anomura: Porcellanidae) Hatched in the Laboratory

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The first zoea of *Petrolisthes trilobatus* Osawa, 1996, from a female collected in Japan is described and illustrated. Its morphological characteristics are compared with those of other known species of the genus *Petrolisthes*. The first zoea of *P. trilobatus* appears very similar to those of *P. lamarckii*, *P. asiaticus* and *P. hastatus*. However, it could be distinguished from the others in having a spine on the lower posterior margin of the carapace, three pairs of setae on the postero-dorsal surface of the telson and minute spinules on the dorsal margins of the abdominal somites 2-5. Based on zoeal morphology, it is suggested that the zoeas of *Petrolisthes* could be divided into two groups: the first group (*P. coccineus*, *P. moluccensis*, *P. lamarckii*, *P. trilobatus*, *P. asiaticus*, *P. hastatus*, *P. pubescens*, *P. tomentosus*, and *P. carinipes*) and the second one (*P. ohshimai*, *P. armatus*, *P. boscii*, *P. tridentatus*, *P. tonsorius*, and *P. japonicus*).

The genus *Petrolisthes* Stimpson, 1858, is the largest among the family Porcellanidae and includes about 40 species in the Indo-West Pacific region (Kropp and Haig, 1994). *Petrolisthes trilobatus* lives in dead coral branches in coastal shallow waters. Its distribution is known from the southwestern part of Japan, Java Island of Indonesia, Thailand, and New Caledonia (Osawa, 1996).

The larval stages have been known in 15 species of this genus: *P. japonicus* (De Haan, 1849), *P. coccineus* (Owen, 1839), *P. carinipes* (Heller, 1861), *P. pubescens* Stimpson, 1858, *P. asiaticus* (Leach, 1820), *P. hastatus* Stimpson, 1858, *P. moluccensis* (De Man, 1888) and *P. tomentosus* (Dana, 1852) described by Osawa (1995, 1997), *P. lamarckii* (Leach, 1820) and *P. boscii* (Audouin, 1826) described by Yaqoob (1979a, b), *P. ohshimai* (Miyake, 1937) described by Sankarankutty and Bwathondi (1974), *P. armatus* (Gibbes, 1850) and *P. tridentatus* Stimpson, 1858 described by Gore (1970, 1971), *P. tonsorius* Haig, 1960, described by Pellegrini and Gamba (1985), and *P. rufescens* (Heller, 1861) described by Gohar and Al-Kholy (1957). However, the larval stage of *Petrolisthes trilobatus* Osawa, 1996, is completely unknown.

In this paper I describe the first zoeal stage of this species and compare its morphology to previously described zoeas from the same genus.

Materials and Methods

An ovigerous female of *Petrolisthes trilobatus* was

collected from Ishigaki Island (24° 20' N, 124° 12' E) of Japan, 13 June 2003. The zoeas hatched in the laboratory were reared by using the methods described by Ko (1995), at a constant water temperature of 25±1°C. The zoeas were fixed and preserved in 10% neutral formalin for later use. Dissected appendages were examined using a Leitz laborlux S microscope and drawings were made with the aid of a camera lucida. Setal counts on appendages and measurements were based on the mean of 10 specimens. Setal armature on appendages was described from proximal to distal segments and in order of endopod to exopod. The remaining zoeas and the spent female were deposited at Silla University, Korea.

Results

Petrolisthes trilobatus Osawa, 1996
(Fig. 1)

Zoea I

Carapace length (CL) 1.69±0.05 mm; rostral spine length 7.21±0.20 mm; posterior spine length 2.18±0.10 mm. Carapace (Fig. 1A, B) typically porcellanid, with extremely elongate rostral and posterior carapace spines; the former heavily armed overall with spinules to its tip and up to 4.3 times CL, while the latter about 1.3 times CL; both posterior spines bearing spinules to their tip, increasing in size near their basal portion (Fig. 1B); lower posterior margin of carapace with spine. Eyes sessile.

Antennule (Fig. 1C). Elongate slightly swollen rod; 3

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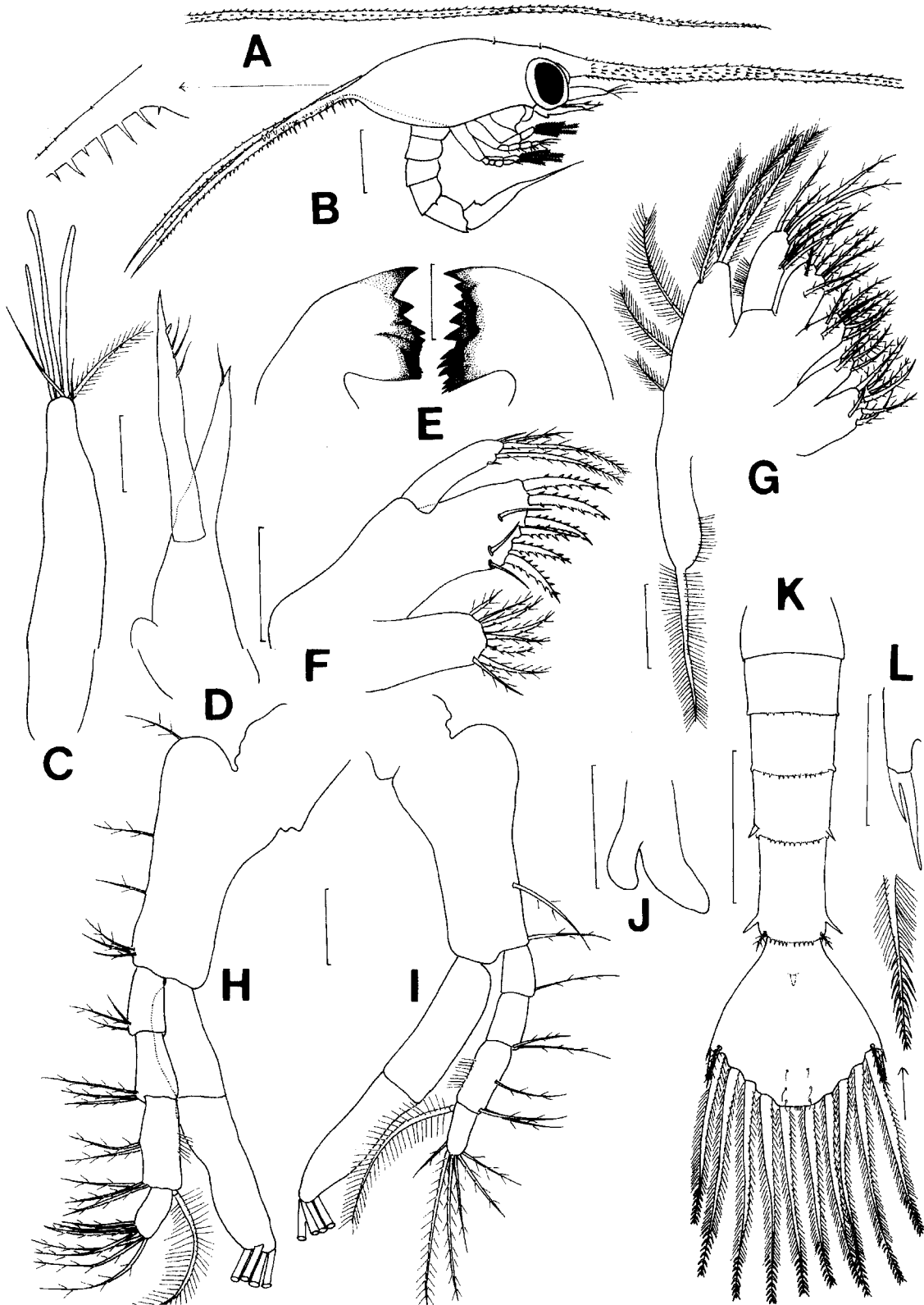


Fig. 1. *Petrolisthes trilobatus*, first zoeal stage. A, Rostral carapace spine. B, Lateral view of zoea. C, Antennule. D, Antenna. E, Mandibles. F, Maxillule. G, Maxilla. H, First maxilliped. I, Second maxilliped. J, Third maxilliped. K, Dorsal view of abdomen and telson. L, Outmost spine of telson. Scale bars = 0.5 mm (A, B, and K) and 0.1 mm (C-J and L).

aesthetascs, 2 simple (1 long and 1 shorter) and 1 plumose setae terminally; endopod bud absent.

Antenna (Fig. 1D). Endopod with single seta subterminally; exopod slender rod, longer than endopod, with 3 setae and single spinule subterminally.

Mandibles (Fig. 1E). Asymmetrical, heavily dentate processes; no palp.

Maxillule (Fig. 1F). Coxal and basal endites each with 8 and 9 setae, respectively; endopod with single subterminal spinule, long subterminal seta and 3 terminal (1 long and 2 shorter) setae.

Maxilla (Fig. 1G). Lobes of coxal endite each with 7+4 setae, respectively; those of basal endite with 7+7 setae; endopod with 8 setae in three groups of 3+1+4; scaphognathite with 6 soft plumose setae around outer margin, and long plumose posterior process.

First maxilliped (Fig. 1H). Coxa without seta; basis setae progressing distally 1, 1, 1, 3; endopod setae 3, 3, 2+3, one plumose and 7 distal setae; exopod with 4 long natatory setae distally.

Second maxilliped (Fig. 1I). Coxa without seta; basis setae 1, 1; endopod setae 1, 2, 1+2, one plumose plus 6-7 distal setae; exopod as in first maxilliped.

Third maxilliped (Fig. 1J). Small biramous bud.

Abdomen (Fig. 1K). Somites 2-5 with minute spinules on dorsal margins; lateral spines on somites 4 and 5; pair of setae on dorsal margin of somite 5.

Telson (Fig. 1K). Seven pairs of posterior processes present, long and plumose except for first and second; first (outermost) process (Fig. 1L) stout bifid spine,

second short plumose seta, from third to seventh processes armed with distinct hooklets or hooklike spinules at tips; three pairs of minute setae on posterior dorsal surface; anal spine present on ventral surface.

Discussion

Ko (2001) provided a key for identification of the known zoeas of the porcellanid crabs at the generic level (*Petrolisthes*, *Enosteoides*, *Pachycheles*, and *Neopisosoma*). She described the zoeal characteristics of the genus *Petrolisthes* as an exopod of the antenna with 1-3 setae and an endopod of the maxillule with a subterminal spinule. The first zoea of *P. trilobatus* coincides well with her criteria. Table 1 compares the zoeal characteristics among 15 known species of the *Petrolisthes* except for *P. rufescens*, the zoeal study of which by Gohar and Al-Kholy (1957) was not informative enough for use within the scope of this study. The first zoea of *P. trilobatus* appears to be very similar to those of *P. lamarckii*, *P. asiaticus*, and *P. hastatus* by possessing an exopod of the antenna with three setae plus a spinule, an endopod of the maxillule with four setae plus a spinule, a basis of the first maxilliped with 1, 1, 1, 3 setation, a basis and the first segment of the endopod in the second maxilliped each with 1, 1 setation and a seta, and a telson with a bifid outermost spine as shown in Table 1. However, they can be easily distinguished from each other by the following characteristics, such as the carapace, abdominal somites, and dorsal surface of the telson:

Table 1. Comparison of the first zoeal characteristics in 15 species of the genus *Petrolisthes*

Species	Antenna exopod	Maxillule endopod	Maxilliped 1 basis	Maxilliped 2		Telson outermost spine	Authors
				basis	endopod		
<i>Petrolisthes</i>							
<i>P. coccineus</i>	3S, 2P	4+1P	1, 1, 2, 2(3)	1, 1	1, 2, 1+2, 3(4)+2	bifid	Osawa, 1995
<i>P. moluccensis</i>	3S, 1(2)P	4+1P	1, 1, 2, 3	1, 1	1, 2, 3, 4+2	bifid	Osawa, 1997
<i>P. lamarckii</i>	3S, 1P	4+1P	1, 1, 1, 3	1, 1	1, 2, 1+2, 5+1	bifid	Yaqoob, 1979a
<i>P. trilobatus</i>	3S, 1P	4+1P	1, 1, 1, 3	1, 1	1, 2, 1+2, 5+1	bifid	Present study
<i>P. asiaticus</i>	3S, 1P	4+1P	1, 1, 1, 3	1, 1	1, 2, 3, 4+2	bifid	Osawa, 1997
<i>P. hastatus</i>	3S, 1P	4+1P	1, 1, 1, 3	1, 1	1, 2, 3, 4+2	bifid	Osawa, 1997
<i>P. pubescens</i>	3S, 1P	4+1P	1, 1, 2(3), 3	1, 1	1, 2, 1+2, 4+2	bifid	Osawa, 1995
<i>P. tomentosus</i>	3S, 1P	3+1P	1, 1, 2, 3	1, 1	1, 2, 3, 4+2	bifid	Osawa, 1997
<i>P. carinipes</i>	3S, 2P	4+1P	1, 2, 2, 3	1, 1	1(2), 2, 1+2, 3(4)+2	bifid	Osawa, 1995
<i>P. ohshimai</i>	3S, 1P	2+1P	6	1, 1	2, 2, 1, 5	-	Sankarankutty and Bwathondi, 1974
<i>P. armatus</i>	2S	3+1P	1, 1, 2, 3	1, 1	2, 2, 1+2, 5+1	-	Gore, 1970
<i>P. boscii</i>	3S, 1P	4+1P	2, 2, 2, 3	1, 2	2, 2, 1+2, 5+1	-	Yaqoob, 1979b
<i>P. tridentatus</i>	1S	3+1P	2, 2, 2, 3	1, 2	2, 2, 1+2, 5+1	-	Gore, 1971
<i>P. tonsorius</i>	1S	4+1P	2, 2, 3, 3	1, 2	2, 2, 1+3, 5+1	-	Pellegrini and Gamba, 1985
<i>P. japonicus</i>	2(3)S	3+1P	2, 2, 3, 3	1, 3	2, 2, 1+2, 5+1	-	Osawa, 1995

S = seta, P = spinule, - = not bifid.

1. Lower posterior margin of carapace with 2 spines
P. lamarckii
2. Lower posterior margin of carapace without spine
P. asiaticus
3. Lower posterior margin of carapace with a spine
4
4. Abdominal somites 2-5 with minute spinules on dorsal margins; postero-dorsal surface of telson with 3 pairs of setae
P. trilobatus
– Abdominal somites 3-5 with minute spinules on dorsal margins; postero-dorsal surface of telson with 4 pairs of setae
P. hastatus

According to Table 1, the known zoeas from *Petrolisthes* seem to be divided into two groups by using characteristics such as the first segment of the endopod of the second maxilliped and telson. The first group comprises *P. coccineus*, *P. moluccensis*, *P. lamarckii*, *P. trilobatus*, *P. asiaticus*, *P. hastatus*, *P. pubescens*, *P. tomentosus*, and *P. carinipes*, with a seta on the former and a bifid outermost spine on the latter, whereas the second one includes *P. ohshimai*, *P. armatus*, *P. boscii*, *P. tridentatus*, *P. tonsorius*, and *P. japonicus*, with two setae on the former and not bifid outermost spine on the latter. Especially, a bifid outermost spine of the telson can not be found in any other known zoeas of the porcellanid genera, the *Pachycheles*, *Neopisosoma*, *Polyonyx*, and *Enosteoides* (see Knight, 1966; Gore, 1977; Konishi, 1987; Werding and Müller, 1990; Ko, 1999, 2001). Considering the zoeas of four porcellanid genera and Brachyura have telsons with simple spines, the first group is assumed to be more primitive than the second one within the genus *Petrolisthes*.

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