The First Zoeal Stages of *Pugettia quadridens quadridens* (De Haan) and *Macrocheira kaempferi* (Temminck) (Crustacea, Brachyura, Majidae)

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ヨツハモガニとタカアシガニの第1期ゾエアについて

クモガニ科ヨツハモガニ *Pugettia quadridens quadridens* (De Haan) とタカアシガニ *Macrocheira kaempferi* (Temminck) の2種の雌ガニを室内で飼育し，第1期ゾエアを得ることができた。これら2種の幼生の外部形態を観察するとともに，すでに報告されている同種の幼生との比較観察をおこなった。 (村岡健作)

The description of larvae of the decorator crab, *Pugettia quadridens quadridens* have been given by several authors. Aikawa described the larvae of the first zoeal stage obtained from the ovigerous female in 1927 (in Japanese) and in 1929 (in English). Kurata (1969) described two zoeal and one megalopa stages including the several illustrations of the appendages of each stage. Iwata (1970 a, b) made the detailed observations on the features of the pre-zoeal and the first zoeal stages based on materials which have been taken in Hokkaido. In the larvae of the giant spider crab, *Macrocheira kaempferi*, the first report was made by Aikawa (1941), but he described only the first zoeal stage. Tanase (1967) provided the first description of the complete larval development. Kurata (1969) described two zoeal and one megalopa stages and compared with the features of the functional appendages given by Tanase.

The purpose of this paper is to provide details of the first zoeal stages of two crabs, *P. quadridens quadridens* and *M. kaempferi* obtained from the ovigerous female.

Pugettia quadridens quadridens (De Haan)

(Fig. 1, A–H)

The ovigerous females were collected from algae growing on the rocky shore at Hayama in the Miura Peninsula. The crabs were placed in compartmented glass vessels which filled with filtered sea water, and maintained in laboratory of dark condition until the larvae hatched. The eggs hatched in April 1981 and the broods were reared partly in small glass vessels. Larvae lived for 4–5 days and then died

without moulting.

Parent females were identified by Dr. T. Sakai.

Dimension: Tip of dorsal to tip of rostral spines: 1.3–1.4 mm.

Description:

The carapace has a gibbose dorsal spine which curves caudally. The rostral spine is short and the carapace is devoid of lateral spines. The eyes are not stalked.

The antennule is a small thumb-like bud and bears 2 long aesthetascs and 1 seta on its apex.

The antenna has a spinous peduncle more than twice length of the rostrum. The endopod is shorter than the exopod. The exopod is about a half length of spinous peduncle and bears a long terminal seta and two short ones.

The maxillule consists of the coxal endite, basal endite and two-segmented endopod, with 1 seta on the first segment and four terminal setae on the second segment.

The maxilla consists of the coxal and basal endites, unsegmented endopod and scaphognathite. The bilobed coxal and basal endites bear 4, 4 and 5, 4 setae on the distal portion respectively. The endopod consists of two segments, of which the proximal one bears 1 seta, while the distal 4 setae. The scaphognathite bears 8 soft plumose hairs and 3 short setae on the external margin.

The first maxilliped has a long endopod and exopod. The setation of the five segments of the endopod is 3, 2, 1, 2, 5. The exopod bears 4 plumose natatory hairs on its distal portion.

The second maxilliped has a short endopod and a long exopod. The two-segmented endopod has a setation of 1, 4. The exopod bears 4 plumose natatory hairs on its apex.

The third maxilliped and thoracic legs are present as the small buds.

The abdomen consists of five segments and a telson. The second abdominal segment bears a pair of short lateral knobs. The telson is bifurcated; the outer lateral margin of furca is furnished with a pair of lateral spines and the inner margin of furca with three pairs of spines (A-type, according to Aikawa, 1929).

Macrocheira kaempferi (Temminck)

(Fig. 1, I–Q)

Larvae hatched from ovigerous female which kept in a tank of the Kanazawa Aquarium in Kanazawa-city, Ishikawa Prefecture, on 20 February 1978. It seems probable that the ovigerous crab was taken from the Pacific coast of the Boso Peninsula.

Dimension: Tip of dorsal to tip of rostral spines: 2.8–2.9 mm.

Proximal to distal portions of lateral carapace spine: 0.4 mm.

Description:

The carapace has a dorsal spine which curves a slight backward. The rostral

spine is about twice length of antenna. The lateral spine is shorter. The eyes are not stalked.

The antennule bears 2 long aesthetascs and 1 seta.

The antenna consists of a spinous peduncle, endopod and exopod. The spinous peduncle has the rows of spinules along the lateral margin. The endopod is small. The exopod 3 unequal spines on its distal portion.

The maxillule consists of the coxal and basal endites and endopod. The bi-segmented endopod is furnished with 1 seta on the proximal segment and with 4 terminal and 2 subterminal setae on the distal segment.

The maxilla consists of the coxal and basal endites, endopod and scaphognathite. The bilobed coxal and basal endites bear 4, 4 and 4, 5 setae respectively. The bilobate endopod bears 3 setae on each lobe and its margin are covered with numerous fine hairs. The scaphognathite bears 15 marginal plumose hairs.

The first maxilliped has a long endopod and slender exopod. The five-segmented endopod bears a setation of 3, 2, 1, 2, 5. The exopod bears 4 plumose natatory hairs on the apical tip.

The second maxilliped has a short endopod and a long exopod. The three-segmented endopod has a setation of 1, 1, 6. The exopod bears 4 plumose hairs on its apex.

The abdomen consists of five segments and one telson. The second and third abdominal segments bear a pair of small knobs on each lateral margin. The telson is bifurcated; the outer lateral margin of furca is furnished with three pairs of spines and the inner lateral margin of furca with 6 spinous and 1 or 2 fine setae which are without setulae.

Remarks

The larvae of *P. quadridens quadridens* were first reported by Aikawa in 1927. Yang (1968), however, is dubious whether its larva corresponds to the zoea of this species. He states that the features of its zoea is different from that of the zoea described in Aikawa's later report (1929) on the same species. As Yang point out, it seems to be the zoea of other species for having the lateral spine on the carapace. In this paper, therefore, the comparisons of the morphological features are restricted to his later report in accordance with this view (Table 1). Kurata (1969) described two zoeal and one megalopa stages reared from hatching, but did not give the description on the minute features of the antennule and the first maxilliped. He described that the endopod of the second maxilliped consists of three segments, whereas with the exception of his own account, its endopod consists of two segments in the larvae already described and in present material as well. According to Rice (1980), the number of the segment of the endopod for zoea of the subfamily Pisinae is two segments, so that it seems to me that Kurata did not give the correct observations. Iwata (1970 a, b) observed the development of the pre-zoeal

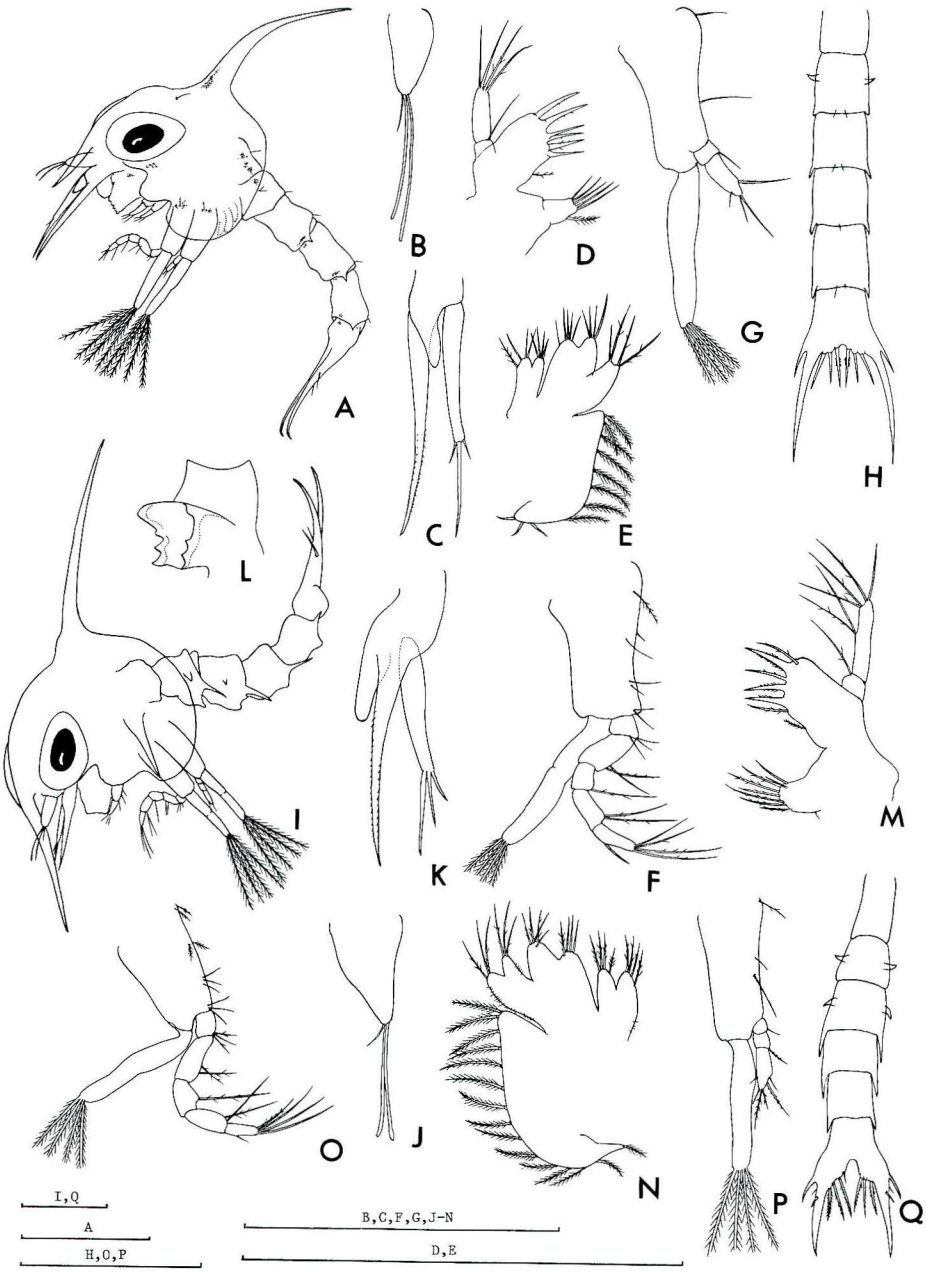

Fig. 1. *Pugettia quadridens quadridens* (de Haan), first zoeal stage (A–H) and *Macrocheira kaempferi* (Temminck), first zoeal stage (I–Q). A, zoea, lateral view; B, antennule; C, antenna; D, maxillule; E, maxilla; F, first maxilliped; G, second maxilliped; H, abdomen; I, zoea, lateral view; J, antennule; K, antenna; L, mandible; M, maxillule; N, maxilla; O, first maxilliped; P, second maxilliped; Q, abdomen.

Bar scales represent 0.5 mm.

Table 1. Comparison of main characteristics in the first zoeal stages of two majid crabs, *P. quadridens quadridens* and *M. kaempferi*

	A	B	C	D	E	F	Source
P. q. quadridens	2, 3	1, 4	4	10	3, 3, 1, 2, 5	1, 3	Aikawa, 1929
P. q. quadridens	?	1, 4	4	10	?, ?, ?, 2, 5	0, 1, 4	Kurata, 1969
P. q. quadridens	2, 2	1, 4	5	5	3, 2, 1, 3, 5	1, 4	Iwata, 1970a
P. q. quadridens	1, 1	1, 4	5	5	3, 2, 1, 3, 5	1, 4	Iwata, 1970b
P. q. quadridens	2, 1	1, 4	4	11	3, 2, 1, 2, 5	1, 4	This paper
M. kaempferi	2, 2	1, 6	5	15	?, ?, ?, ?, 5	1, 1, 6	Aikawa, 1941
M. kaempferi	2, 1	1, 4	5	12–13	3, 2, 1, 2, 5	1, 6	Tanase, 1967
M. kaempferi	?	1, 6	6	?	?, ?, ?, ?, ?	1, 1, 6	Kurata, 1969
M. kaempferi	2, 1	1, 6	6	15	3, 2, 1, 2, 5	1, 1, 6	This paper

A, number of aesthetascs and setae of antennule; B, C, setation of the endopods of the maxillule (B) and the maxilla; D, number of hairs of scaphognathite of the maxilla; E, F, setation of endopods of the first maxilliped (E) and the second maxilliped.

and the first zoeal stages attributed to *P. quadridens quadridens* from Hokkaido, the northern Japan. The comparison was made between the features of the first zoeal stage in the species described by Iwata and that of the same stage in the present material. The most outstanding difference is chiefly in the setation of appendages. In Iwata's account, the maxilla is furnished with 5 setae on the distal segment of the endopod and with 5 hairs on the lateral margin of the scaphognathite (Table. 1), while in the present material the maxilla possesses 4 setae on the endopod and 11 hairs on the scaphognathite. According to Sakai (1976) the adult crab of *P. quadridens quadridens* from Hokkaido is enormous in size as compared with that of same species taken from Sagami Bay. Moreover, he states that the characteristics of the crab resemble somewhat features of *P. richi* Dana from the Pacific side of Canada and U. S. A. However, I have not yet examined the larva and crab of the same species from Hokkaido. Thus, it is, at present, impossible to say whether the morphological differences between the both larvae are suggesting the characters of species or subspecies, or the result of error.

Aikawa (1941) provided the first description of the first zoeal stage of *M. kaempferi* based on the matrial hatched out in the aquarium of Misaki Marine Biological Station, University of Tokyo. In general, Aikawa's report agrees very closely with characteristics given here except in the setal formula of the endopod of the second maxilliped (Table 1). Tanase (1967) observed the development of larvae of the this species and gives the setal formula of the both endopods of the maxillule an the second maxilliped as 1, 4 and 1, 6 respectively. However, his description is inadequate on the first zoeal stage. He probably overlooked 2 subterminal setae on the distal segment of the endopod of the maxilla in the first zoeal stage, and failed to notice the one joint of the proximal portion in the endopod of the second maxilliped as well. In all of the first zoeal stage of the same

species, with the exception of Tanase's reared material, the endopod of the maxilla bears 6 setae on the distal segment, and the endopod of the second maxilliped consists of three segments; the proximal and middle segments each bear 1 seta, and the distal one bears 6 setae.

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