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Newly Obtained First Zoeae of Three Species of *Sesarma* (Crustacea, Brachyura)

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By
Keiji Baba and Yasushi Fukuda

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This paper describes newly obtained first zoeae of the estuarine crabs, *Sesarma intermedium* (de Haan), *S. plicatum* (Latreille), and *S. erythrodactylum* Hess, and the relationships of the known larvae of *Sesarma* species are discussed.

The genus *Sesarma* is one of the typical forms of the estuarine crabs and 12 species are known to occur in Japan (Sakai, 1939; Miyake, 1963). Little is known of their larval forms, so that the information so far obtained is not sufficient enough to identify the larvae. Historically, Aikawa is the first to establish the systematics of the brachyuran larvae, his studies depending mostly upon the material of plankton and hatching (Aikawa, 1929, 1933, 1937). Yatsuzuka (1957) described the morphological changes in the development of 8 species of crabs including two species of *Sesarma*. Detailed description of complete larval development of *Sesarma dehaani* was given as one of our serial studies of the biology of estuarine crabs (Baba & Miyata, 1971), followed by other two publications concerning the complete larval developments of the allied genera *Helice* and *Chasmagnathus* (Baba & Moriyama, 1972; Baba & Fukuda, 1972). Recently Terada (1974) reported the post-larval developments of 9 species of the Grapsidae including three *Sesarma* species. He discussed in detail the morphology of each stage of the larvae and the useful key to the larvae was given. However, as far as the *Sesarma* larvae are concerned, the relationships still remain uncleared. The purpose of this paper is to provide first the description of the first zoeae of *Sesarma* newly obtained, i. e., *S. intermedium* (de Haan), *S. plicatum* (Latreille), and *S. erythrodactylum* Hess, and then discuss the relationships of the known larvae. This means that the problem is raised here to realize the difficulties in identifying the larvae of *Sesarma*.

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Description of first zoeae newly obtained

Sesarma intermedium. First zoeae were obtained directly by hatching, the ovigerous females being taken from the estuary of the Shirakawa River, Kumamoto on July 5, 1971.

Size: 0.73mm in distance between tips of rostral and dorsal spines.

Description of first zoea: Cephalothorax with dorsal and rostral spines, both

stout ; lateral spine absent ; eyes immovable. Abdomen consists of five segments and telson ; first segment covered by carapace ; second segment with a well-developed spine on each lateral margin which is directed anteriorly ; likewise a small posteriorly directed lateral spine present on third segment ; fourth and fifth segments unarmed mid-laterally, but armed with a distinct spine posterolaterally ; the spine on fifth segment much more pronounced. Telson B-type (AIKAWA, 1929); fine setae present in part on inner margin and along outer margin of forked spine.

Following chromatophores are present (for details of systematic distribution refer to AIKAWA, 1929): antennal, labral, mandibular, maxillar, second maxillipedal, abdominal, precardiac, subcardiac, optic, and median ocular.

Antennule unsegmented, conical, with four aesthetascs distally. Antennal protopod with well-developed spinous process and exopod ; spinous process almost reaches the tip of rostrum, with two rows of spinules ; exopod short, about 1/4 of spinous process, a single seta springing from distal third (B2-type by AIKAWA, 1933).

Incisor and molar processes distinct in mandible ; incisor process with three external teeth and a few internal denticles ; molar process cylindrical, its masticatory surface concave. Maxillule with two-segmented endopod and basal and coxal endites ; distal segment of endopod with four terminal and a single lateral marginal setae ; proximal segment short, with a distinct distal lateral seta ; basal endite simple, with five short plumose bristles ; coxal endite with six bristles. Maxilla consists of unsegmented endopod, basal and coxal endites, and scaphognathite ; endopod slightly bilobed distally ; distal lobe with three long setae and proximal two ; basal endite feebly bilobed ; four plumose setae on distal lobe and five on proximal lobe ; coxal endite simple, furnished with five setae ; scaphognathite terminating in a sharp point ; four plumose setae on outer margin.

First maxilliped consists of protopod, five-segmented endopod and exopod ; hair formula of endopod is 5, 2, 1, 2, 2 ; four well-developod natatory setae on exopod. Three segmented endopod and functional exopod with four natatory setae of second maxilliped ; hair formula of endopod represented by 6, 1, 0. Third maxilliped poorly developed.

Sesarma plicatum. First zoeae were obtained from ovigerous females caught at the estuary of Shirakawa River, Kumamoto on June 22, 1971.

SIZE : 0.70mm.

DESCRIPTION OF FIRST ZOEA : All features are almost equal to those of the preceding species, but minor discrepancies are noted below : (1) Subcardiac chromatophore is absent from this species. (2) Posterolateral marginal spine of fifth abdominal segment is almost reduced in this larva. (3) Forked spines of telson are furnished with fine setae as in *S. dehaani* (BABA & MIYATA 1971), much more thickly beset than in the preceding. (4) Setation of coxal and basal endites of maxilla is 7, 8.

Sesarma erythrodactylum. On July 14, 1971 ovigerous females were taken

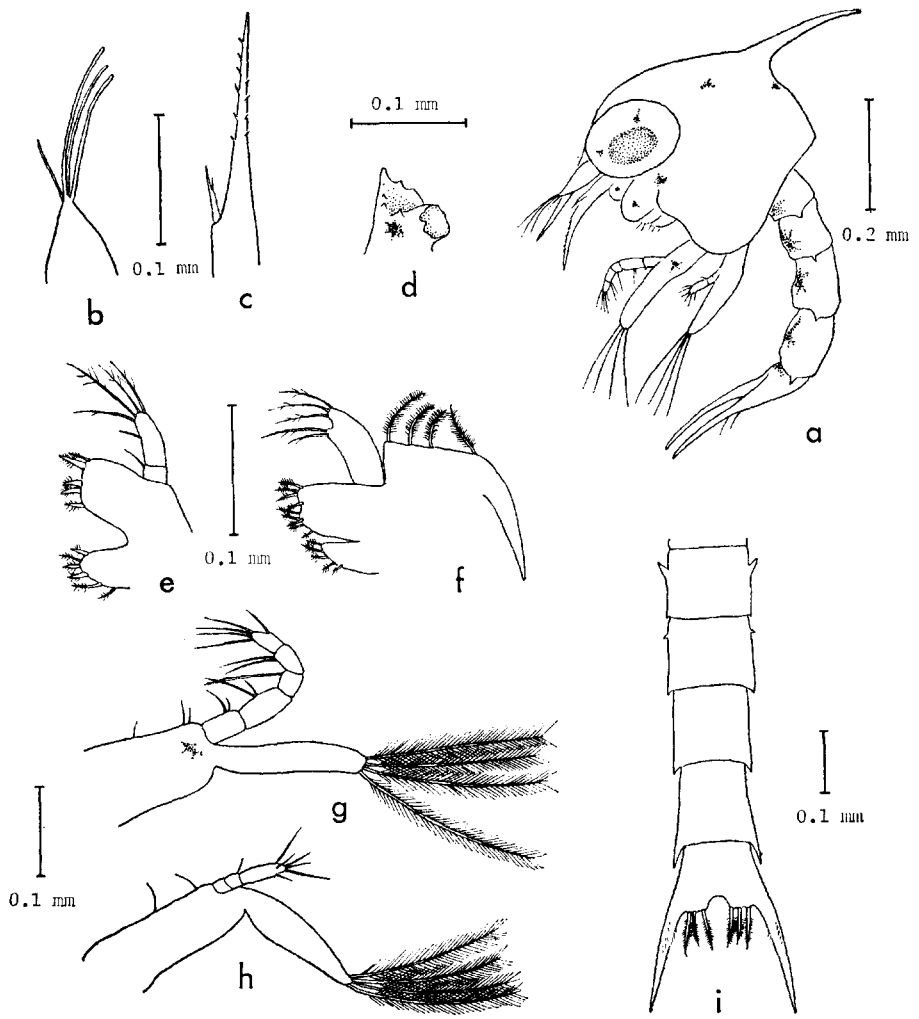

Fig. 1. *Sesarma intermedium*, first zoea.
a, lateral view ; b, antennule ; c, antenna ; d, mandible ; e, maxillule ; f, maxilla ; g, first maxilliped ; h, second maxilliped ; i, abdominal segments.

from the bank of Shirakawa River mouth. First zoeae were obtained by hatching.

SIZE : 0.74mm.

DESCRIPTION OF FIRST ZOEA : Very similar to *S. intermedium*. This larva differs in having (1) the forked spines of telson quite smooth without fine setae, (2) the posterolateral marginal spine of fifth abdominal segment less pronounced, (3) the setation of maxillal endites represented by 7, 7.

Discussion

No confusion will arise in determining the larvae of *Sesarma* species when collected together with those of the estuarine crabs. It is obvious that the ab-

sence of the lateral spine of the carapace and the setation of the endopod of the maxilla represented by 5 are quite constant through all the known species of *Sesarma*. Of 12 recorded species from Japan, four of which are rare, just half number of the species (6) are treated here for comparison, the species as listed below:

1. *Sesarma haematocheir* (de HAAN)
2. *S. dehaani* H. MILNE EDWARDS
3. *S. pictum* (de HAAN)
4. *S. plicatum* (LATREILLE)
5. *S. erythrodactylum* HESS
6. *S. intermedium* (de HAAN)

Details of morphology and ecology of first zoeae in these 12 species are discussed.

ANTENNULE. Based upon the material from Kumamoto we recognized three aesthetascs and one seta in *S. dehaani* (BABA & MIYATA, 1971). A careful re-examination showed that the setation of 3-1 is quite constant in all the species. However very recently TERADA (1974) reported that the number of sensory hairs is 5 (three aesthetascs and two setae) in the three species he examined.

ANTENNA. According to AIKAWA (1933), the antennae which possess the exopods with a single and two setae are called B2- and B3-type, respectively. TERADA (1974) noted that the B3-type is found in *S. haematocheir*, but other two species, *S. dehaani* and *S. pictum*, show the B2-type. He considered this character as distinct, using it in the key. As described in the present paper the antennae of three species examined are all B2-type; furthermore re-examination of first zoeae of *S. haematocheir* obtained in Kumamoto proves that it is also B2-type. TERADA emphasized the difficulty of confirming the presence of the fine additional seta in the case of B3-type. It therefore remains questionable whether we overlooked the presence of another seta on the exopod in *S. haematocheir* or this difference falls into variation. Variable within individuals is the number of denticles of the spinous process, to which any standard should not be given for identification.

MANDIBLE. No difference was noted among six species.

MAXILLULE. Two-segmented endopod and coxal and basal endites are the principal composing parts. Setation of endopod is 5-1, quite constant in all species. The basal endite with five bristles is the basic character, not variable in all species. The coxal endite is however reported to have 6 setae (or bristles) in *S. pictum* and five in *S. haematocheir* and *S. dehaani* (TERADA, 1974). As seen in this paper the number of bristles is equally 5, and further examination of first larvae of *S. pictum* reveals the setation 5 which is different from TERADA's.

MAXILLA. Unsegmented endopod is bilobed distally with 3-2 (5 in total) setae, which number is characteristic of this genus; in *Helice* and *Chasmagnathus* the setation is 2-2. Basal endite has 9 setae in *S. dehaani*, *S. pictum*, *S. haematocheir* and *S. intermedium* (BABA & MIYATA, 1971; TERADA, 1974; this paper), but variable as 7 in *S. plicatum* and *S. erythrodactylum*; the coxal endite has 8 setae in three species examined by TERADA (1974) and *S. plicatum*, whereas 6 in *S. dehaani* (BABA & MIYATA, 1971), 5 in *S. intermedium*, and 7 in *S. erythrodactylum*. Due

to the hardness of preparing the exact part of the appendage for examination the setation seems to be misunderstood.

First maxilliped. The setation of endopod (5, 2, 1, 2, 2), and four natatory setae seem to be of generic importance. No difference was noted among the species.

Second maxilliped. The endopod setation (6, 1, 0) and the presence of four natatory setae are uniformly equal in all the species. Terada (1974) counted the number of setae on the protopod as invariable in the three species he examined.

Telson. The telson is B-type by Aikawa (1929). The presence or absence of the fine setae on the forked spine seems more or less important to classify the larvae. For instance, in *Sesarma dehaani*, *S. haematocheir*, *S. intermedium*, and *S. plicatum* the fine setae are present but completely absent from *S. pictum* and *S. erythrodactylum*. Aikawa (1937) described the first zoea of *S. plictum* as having the telson fork with fine setae, which fact is different from ours (Terada, 1974; this paper).

Chromatophores. Aikawa (1929) studied the systematic importance of the distribution of chromatophores. The carapacial of the secondary system is variable in the present genus; three species treated as newly obtained in this paper have no carapacial, whereas it is present in other three species. However the secondary group represented by the carapacial, second maxillipedal, etc. is said to be of no systematic significance (Aikawa, 1929). The primary system seems constant through all the species of *Sesarma*, exclusive of the viceral group, which is sometimes difficult to see. For instance, the median cardiac and postcardiac are absent from the three species newly described in this paper, and the subcardiac is also missing in *S. plicatum*. Gurney (1942) suggested that reliable results can only be obtained by examination of healthy specimen under different conditions of expansion and retraction, as the chromatophores are sometimes very difficult to see even in life. And therefore the present comparison does not seem to be justified.

Size. A distance between tips of rostral and dorsal spines is measured. As has been recorded previously (Baba & Fukuda, 1972), the largest is the larvae of *S. dehaani* with the size of 0.85mm. The others are more or less smaller, the minimum size being 0.70mm. The size is therefore not useful in classifying the larvae of *Sesarma*, but it is more important in separating this genus from other estuarine crabs, such as *Helice* and *Chasmagnathus*, both 1.14mm or more.

Occurrence of hatching. The data for hatching season were obtained at the estuary of Shirakawa River, Kumamoto in 1971, as shown below:

Sesarma dehaani. -Late in May to early in August.

S. intermedium. -Middle in June to middle in July.

S. plicatum. -Middle in June to late in July.

S. pictum. -Middle in June to late in July.

S. haematocheir. -Early in July to early in August.

S. erythrodactylum. -Early in July to middle in August.

Hatching of *Chasmagnathus convexus* occurs late in March to late in April, followed by that of *Helice tridens tridens* until early in August.

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