

Larval Stages of a Goneplacid Crab, *Eucrate crenata*, Reared in the Laboratory

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The larval stages of Goneplacidae are poorly known. Only two species of known parentages have so far been reported on their larval stages. Thus, the larvae of *Goneplax angulata* (Pennant) as *G. rhomboides* Herbst were reported from Plymouth¹⁾ and from Mediterranean²⁾ and those of *Carcinoplax longimanus* (De Haan) from Sagami Bay³⁾. This report presents an additional information on the complete larval development of a goneplacid crab of the subfamily Carcinoplacinae.

The maruba-gani, *Eucrate crenata* De Haan is fairly common in Japan from Tokyo Bay to Nagasaki, further extending southward to Korea, China, Hong Kong, Seychelles, Andamans and Madras⁴⁾. The larvae have never been described before.

Materials and Methods

A female crab of 26 mm. in carapace width was trawled on April 26, 1977 in the Ohsaka Bay, Seto Inland Sea from 60 m. of water off Kariya, Awaji Island. The crab laid viable eggs about 2 months later on June 17 and the eggs hatched on July 11. The newly hatched larvae were reared together in a 500 l FRP tank with about 300 l. of filtered sea water. The rearing water was aerated throughout the experimental period. The main foods used were the rotifer and *Artemia* nauplii combined with soy bean waste, minced clam juice and marine G paste.

The following table summarizes the percentages of larvae at successive larval stages showing chronology of development.

Date	Percentage of larvae at each stage					Temperature (°C)	
	Zoea 1	Zoea 2	Zoea 3	Zoea 4	Zoea 5		Megalopa
July 11	100						26.0
12	100						26.6
13		100					27.6
14		100					—
15		5	95				28.5
16			100				28.3
17			40	60			28.9

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18	70	30	29.3
19		100	—
20		100	—
21		100	—
22		95	5
23		85	15
24			100

Measurements were taken under a microscope with an ocular micrometer eyepiece. Length from spine to spine in zoeae refers to the perpendicular distance from tip of rostral spine to tip of dorsal spine. Carapace length was measured in lateral profile from the anterior margin of ocular peduncle to mid-dorsal posterior margin. The width of telson was measured at anterior base of the outer spine on each side.

Description of Larval Stages

Zoea

There are 5 zoeal stages. Carapace has rostral, dorsal and lateral spines. All the spines are smooth. The rostral spine is straight, almost as long as carapace. The dorsal spine is distinctly longer than the rostral spine and slightly curves distally. The lateral spines are about 1/3 as long as the rostral spine. Ventral margin of carapace is smooth. Abdomen is slender with lateral knobs on somites 2 and 3. Those on somite 3 are very minute but persist during the whole zoeal stages. There are no lateral spines on any of the somites in all stages. The telson is slender and typically forked with a large lateral spine on each side, which is inserted at the same level as the third (inner most) pair of inner setae. The length of fork is about 1/2 times greater than width of telson and is finely serrated along the inner and the inner-dorsal edges. There are 3 pairs of inner setae in all stages without extra setae. The middle pair of inner setae are distinctly longer than others and slightly more than 1/3 as long as the telson fork. The central indentation on the hind margin is moderately wide and deep.

Antennule is simple and unjointed in all but the last stage, in which it is bifurcated. Antenna is about 2/3 as long as the rostral spine. The spinous process bears a row of spinules on the inner and the outer edges. The exopod is also spinous and as long as the spinous process, with 2 short spines on the outer edge at about proximal 2/5 and a row of spinules on the inner edge along its distal one half. Unjointed endopod appears from stage 3.

Mandible is well developed with a small unjointed palp in the last stage. Maxillule has an endopod of 2 segments with 6 setae on distal segment, while proximal segment may or may not has a rudimentary seta. Endopod of maxilla is unsegmented but bilobed with 3 and 5 setae respectively on proximal and distal lobe. Endopod of maxilliped 1 is of 5 segments, and that of maxilliped 2 of 3 segments with 1, 1 and 5 setae from proximal to distal segment. Their exopods bears swimming setae as are listed in the following table.

Pleopod buds appear from stage 3.

Stage 1. Length from spine to spine is about 1.9 mm (Fig. 1, A). Eyes are sessile. Abdomen is of 5 somites plus telson. There are no endopod on antenna (Fig. 1. E), no palp on mandible, and no outer setae on maxillule. Scaphognathite of maxilla ends proximally in a large feathered seta. Rudiments of posterior thoracic limbs are very minute. Telson, including fork, is about 2 1/2 times as long as wide (Fig. 1, C).

Stage 2. Length from spine to spine is 2.3 mm. Eyes are stalked. Maxillule has an outer feathered seta on basis. Proximal end of scaphognathite of maxilla is rounded.

Stage	Maxilliaed 1	Mavilliped 2
Zoea 1	4	4
Zoea 2	6	7
Zoea 3	8	9
Zoea 4	10	11
Zoea 5	12	13

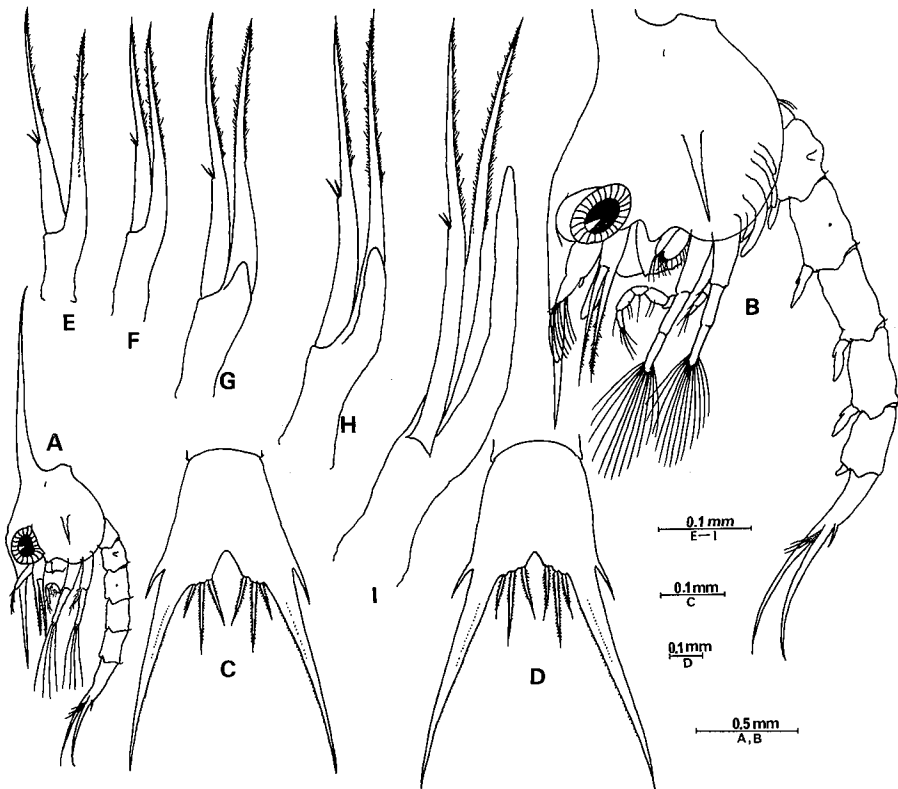


Fig. 1. *Eucrate crenata*, zoeae. A and B, stages 1 and 5, lateral; C and D, telson, dorsal, stages 1 and 5; E-I, antenna, stages 1-5.

Stage 3. Length from spine to spine is 3.2 mm. Abdominal somite 6 is segmented off from telson. Antennal endopod appears as small bud (Fig. 1, G). Rudiments of maxilliped 3 and legs 1-5 are still small but distinct. There are slight swelling of pleopod buds on abdominal somites 2-5.

Stage 4. Length from spine to spine is 3.9 mm. Antennal endopod is about 1/3 as long as the spinous process (Fig. 1, H). There is an outer simple seta on coxa of maxillule. Pleopod buds are distinct but still very small.

Stage 5. Length from spine to spine is about 4.7 mm. Antennule is bifurcated but segmentation is still indistinct, with 2 groups of aesthetes on the upper flagellum. Antennal endopod is unjointed and about 2/3 as long as the spinous process (Fig. 1, I). Mandible has an unjointed palp. Leg buds are large and well exposed from ventral margins of carapace (Fig. 1, B). Pleopods are large and slightly bifurcated but still shorter than respective abdominal somite.

Megalopa

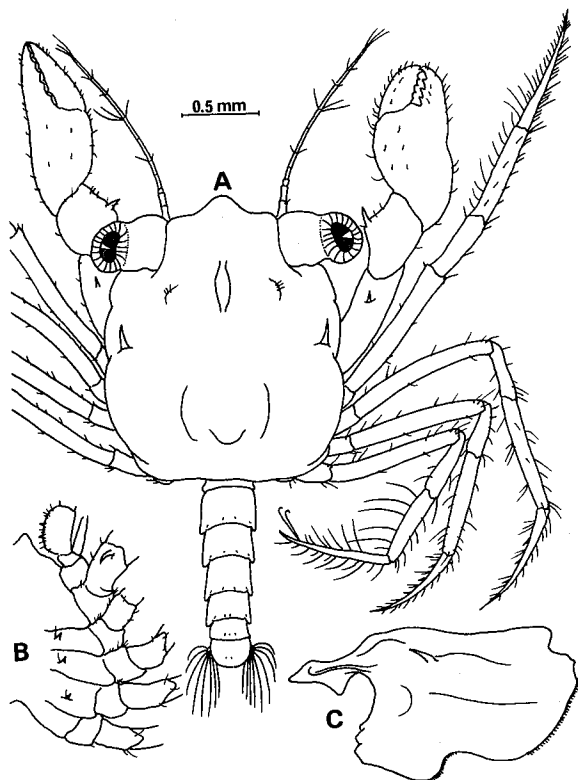


Fig. 2. *Eucrate crenata*, megalopa. A, dorsal; B, thorax and proximal segments of legs, ventral; C, carapace, lateral.

Carapace length is about 1.9 mm. Rostrum is squarish with somewhat elevated edges and wider than long, producing in the center almost horizontally into a short, blunt prominence. Carapace has a pair of inconspicuous dorsal protuberances behind eyes, a large cardiac hump, and a pair of pointed epigastric spines near lateral edge (Fig. 2, A and C).

Abdomen is of 6 somites plus telson, and a little shorter than carapace less rostrum. There are no spines on any of the somites. Telson is a little wider than long and tapers posteriorly. Well developed pleopods are present on somites 2-5. Uropods are about 1/2 as long as telson with 8 or 9 setae on exopod.

Antennule is composed of a

peduncle of 3 segments, upper flagellum of 5 segments with many aesthetes on segments 2-4, and a short lower flagellum of 2 segments. Antenna is composed of peduncle of 3 segments and a flagellum of 8 segments with long setae on segment 5. Mandible assumes a form of cutting tooth and is heavily calcified with a 2 jointed palp. Maxillule and maxilla are greatly developed with numerous setae and spines on the inner edge and around scaphognathite, while their endopods are degenerated with a few rudimentary setae. Maxilliped 3 armed with 2 small but distinct teeth on the inner edge of ischium.

Cheliped is stout, reaching beyond tip of antenna, with a hook on ventral edge of ischium (Fig. 2, B), a small spine on the dorsal edge of merus and a large spine on the dorsal anterior edge of carpus. Fingers are nearly as long as palm, with 4 or 5 teeth along the pinching edges. Legs 2-4 are slender and long without spines on all but the terminal segments, which are somewhat longer than respective propodi with 3 or 4 barbed spines on the ventral edges. Their propodi and dactyli are covered by many simple setae. Leg 5 is somewhat shorter than the preceding walking legs with 1 or 2 feelers in addition to many plumose setae on distal two segments, but has no barbed spines on dactylus. There is a spine on sterna corresponding to legs 2-4 (Fig. 2, B).

There is a large epipod on maxillipeds 1-3, arthrobranchs on maxilliped 3 and leg 1 (cheliped) and 1 arthrobranch on legs 2 and 3.

Discussion

Among the known larvae of Goneplacidae, zoeae and megalopa of *E. crenata* closely resemble those of *Goneplax* sp. described by Menon⁵⁾ from India, but are much less armed with spines and setae than those of *Goneplax angulata*^{1,2)} and of *Carcinoplax longimanus*³⁾ as are summarized in Table 1.

It is interesting to note here that the loss of armatures seems to be associated with the increase in the number of zoeal stages. If it is taken as granted that the larvae of ancestral decapods were very well armed with many spines and setae and their evolution has occurred toward loss of armatures, then it would be justified to assume that the species with greater number of zoeal stages should be more advanced in evolution than those with fewer number of zoeal stages. The diameter of newly laid eggs of *C. longimanus* measured about 1.1 mm., while those of *E. crenata* only 0.33 mm. The increase in the number of zoeal stages may be one of the inevitable results of the strategy for existence which has been chosen by *E. crenata*, producing a greater number of smaller eggs than in the primitive forms to secure the better chance of survival in the competitive environments.

The common characters of the larvae of Goneplacidae which may distinguish them as a whole from those the other Brachyryncha are in the slender appearance, in the form of antenna and telson in zoeae, and in the presence of a pair of epibranchial spines on carapace, the structure of antenna and the number of setae on uropods in megalopa.

Table 1. Comparison of armatures among the known larvae of Goneplacidae.

Characters	<i>G. angulata</i> ^{1,2)}	<i>C. longimanus</i> ³⁾	<i>Goneplax</i> sp. ⁵⁾	<i>E. crenata</i>
<i>Zoea</i>				
No. of stages	4	4	5	5
Carapace; ventral margin	Serrated	Serrated	Smooth	Smooth
Abdominal somite; lateral knobs,	On somites 2-4 or 5	On somites 2-5	On somite 2 only	On somitdes 2 and 3
hind margin,	Smooth	Serrated	Smooth	Smooth
postero-lateral spines	On somites 3-5	On somites 3-5	Absent	Absent
Telson; no. of outer spines,	2	2	1	1
extra inner setae	2 pairs	2 pairs	?	Absent
<i>Megalopa</i>				
Carapace; rostral lateral corner,	Rounded	Spinous	Rounded	Rounded
epibranchial spines	Present	Present	Present	Present
Abdominal somites; postero-lateral spines	On somites 4 and 5	On somites 3-5	Absent	Absent
Cheliped; ischium,	1 hook	1 h. + 2 sp.	1 hook	1 hook
merus,	1 spine	5 sp.	2 sp.	1 sp.
carpus,	?	8 sp.	1 sp.	1 sp.
palm	?	10 sp.	several sp.	Smooth
Legs 2-5; coxa,	1 hook	1 hook	1 hook	Smooth
ischium,	1 sp.	1 sp.	?	Smooth
merus	1 sp.	2 sp.	?	Smooth
Sternal spine	?	At base of legs 2-4	?	At base of legs 2-4
No. of setae on uropod	8	8-9	8	8-9

References

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マルバガニ, *Eucrate crenata*, の飼育幼生

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実験室内でふ化・飼育した材料にもとづいて、マルバガニ幼生の外部形態の特徴を記載した。幼生期はゾエア5期とメガロバ1期とから成る。ゾエア幼生は瘦身で、甲に額角棘、背棘および側棘がある。腹節は第2, 3節に側突起があるが、後側棘はない。尾節は典型的に分岐し、1対の明瞭な外側棘がある。尾叉は小棘列がある。内側剛毛は全期にわたり3対で、尾節後縁中央間戟は中庸程度に広く、深い。第2触角は長さが額角棘の約2/3で、基節突起は内外縁に小棘列があり、外肢は棘状で基部から約2/5の位置に2外側棘があり、それより先は内側に小棘列がある。

メガロバは、1対の前腮棘があり、額角は角ばって中央は短かく突出する。第2触角は3節の基節と8節の鞭とからなり、鞭第5節に長毛がある。腹部は6節と尾節とから成り、尾肢に8~9毛がある。鉗脚は、坐節に鉤棘、長節に1背棘、前節内縁に1鉤棘がある。歩脚1—3基部腹甲上に各1棘がある。第4歩脚先端に1~2触毛がある。

マルバガニ幼生は既知のほかの Goneplacidae 幼生に較べて、棘や剛毛が少ない特徴が注目され、それが幼生期数の増加と関連して起っている事実を指摘した。