

THE LARVAL DEVELOPMENT OF THE TROPICAL LAND HERMIT *COENOBITA CLYPEATUS* (HERBST) IN THE LABORATORY ¹⁾

BY

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The hermit crabs of the family Coenobitidae are among the most conspicuous and characteristic elements of the terrestrial fauna of tropical marine beaches and atolls. At least one species, the coconut or robber crab, *Birgus latro* (L.), is of economic importance. The members of this family have become adapted for life on land but disperse each generation by means of larvae liberated into the sea. The complete larval development is not known for any member of this group and the first stage has been described for only a few. Borradaile (1899) first pointed out that the young of *Birgus latro* (L.) hatch as zoea larvae and do not have abbreviated development as some earlier workers had suggested. He soon described the first zoea and illustrated that stage including details of some appendages (Borradaile, 1900). Orlamünder (1942) described the embryological development of *Birgus* and treated the first zoea in detail. The earliest account of a *Coenobita* larva was that by Borradaile (1903) for *C. perlatus* H. Milne Edwards and again only the first larva was described. *Coenobita rugosus* H. Milne Edwards was the subject of a later study by Yamaguchi (1938) who included remarks on general reproduction and gave figures of the first zoea and the glaucothoe. No other account of larval development within this family is known. *Coenobita clypeatus* (Herbst), the only terrestrial hermit crab in the Western Atlantic, is distributed from Bermuda, southern Florida and the Bahamas through the West Indies to southern Brazil (Provenzano, 1959). The purpose of the present report is to provide a description of the complete larval development of *Coenobita clypeatus* (Herbst) based on laboratory rearings.

METHODS

Ovigerous females were collected under palmetto leaves on the southeast shore of Virginia Key, Biscayne Bay, Florida, in a hammock behind the beach. The animals were placed in terraria with access to sea water. Two hatchings were obtained in 1960, on 22 July and 24 August, and two more hatchings in 1961, both on 10 August. Larvae were placed into compartmented plastic trays in varying

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numbers per compartment each of which contained filtered sea water. Individual larvae were maintained in single numbered compartments of about 50 cc capacity. Freshly hatched *Artemia nauplii* were added to the compartments as food.

Temperature was approximately $29^{\circ}\text{C} \pm 1^{\circ}$. Salinity in 1960 was in the range of 33-36‰. In 1961 salinity was kept at $36.0\text{‰} \pm 0.5\text{‰}$.

The trays were examined daily for exuviae and dead specimens. Larvae were transferred every second day to freshly prepared trays. Larvae and exuviae of known history were preserved in 5-7% sea water-formalin, buffered with hexamethylene-tetramine or were rinsed in fresh water and preserved in 70% ethyl alcohol.

Staining of casts was done in Mallory's Acid Fuchsin Red and dissection of appendages was done in lactic acid, followed by mounting in Hoyer's medium. Drawings were made with the aid of a camera lucida; measurements were made with the aid of an ocular micrometer. Total length was measured from the tip of the rostrum to the posterior border of the telson exclusive of telson processes. Length of carapace was measured from the tip of the rostrum to the postero-lateral margin of the carapace.

Duration refers to time spent in a given stage by larvae which survived to moult to the succeeding stage.

The term stage as used herein refers to an intermoult phase of larval development.

The females from which larvae were obtained are deposited in the Marine Museum of the Institute of Marine Science, University of Miami.

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RESULTS

Coenobita clypeatus reared under laboratory conditions may attain the glaucothoe stage after 4, 5 or 6 zoeal intermoult.

First Zoea (figs. 1-10, I)

Size: TL 2.6-2.9 mm; CL 1.3-1.4 mm. Duration: 3-5 days.

The carapace has a pointed carinate rostrum curved slightly downward distally. The postero-lateral margins of the carapace are smooth and devoid of spines. The eyes are immobile. The second abdominal somite has a prominent curved medio-dorsal spine. The third and fourth somites each have a much reduced medio-dorsal spinelet. The fifth abdominal somite has a large curved medio-dorsal spine

and on each side one large straight lateral spine. The sixth somite is fused with the telson which is about as wide as it is long (fig. 3, I). There are 7 + 7 telson processes. The first or outermost process is a stout spine, the second a fine plumose hair and processes 3 to 7 are articulated plumose setae. The median telson notch is semi-circular.

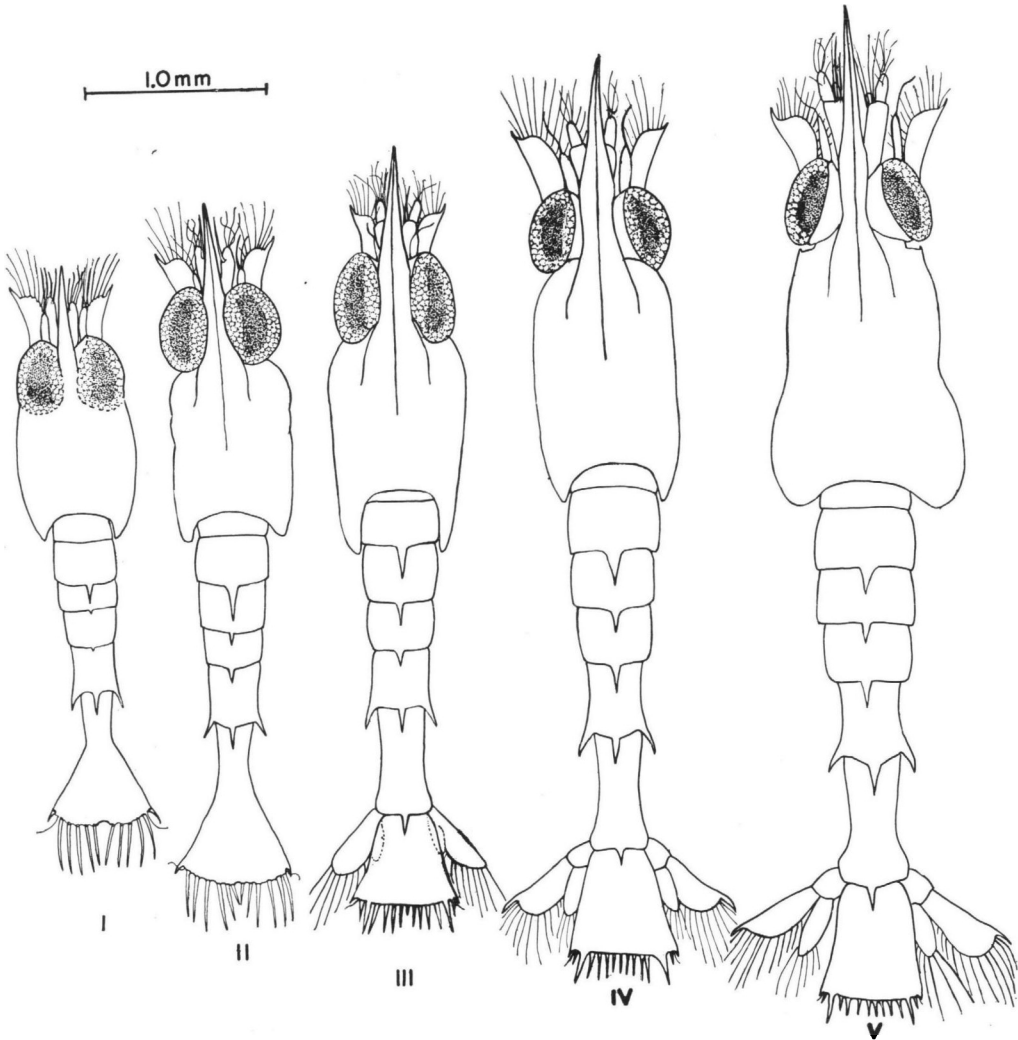


Fig. 1. *Coenobita clypeatus* (Herbst). Dorsal view of zoeal stages I to V.

The posterior half of the eyes is greenish yellow. There are red chromatophores on the labial palp, at the bases of antennules and antennae, and each mouth appendage. There is a yellow cast to the abdomen ventrally and over the medio-dorsal spine of the second abdominal somite. A large diffuse yellow patch is centered on the telson.

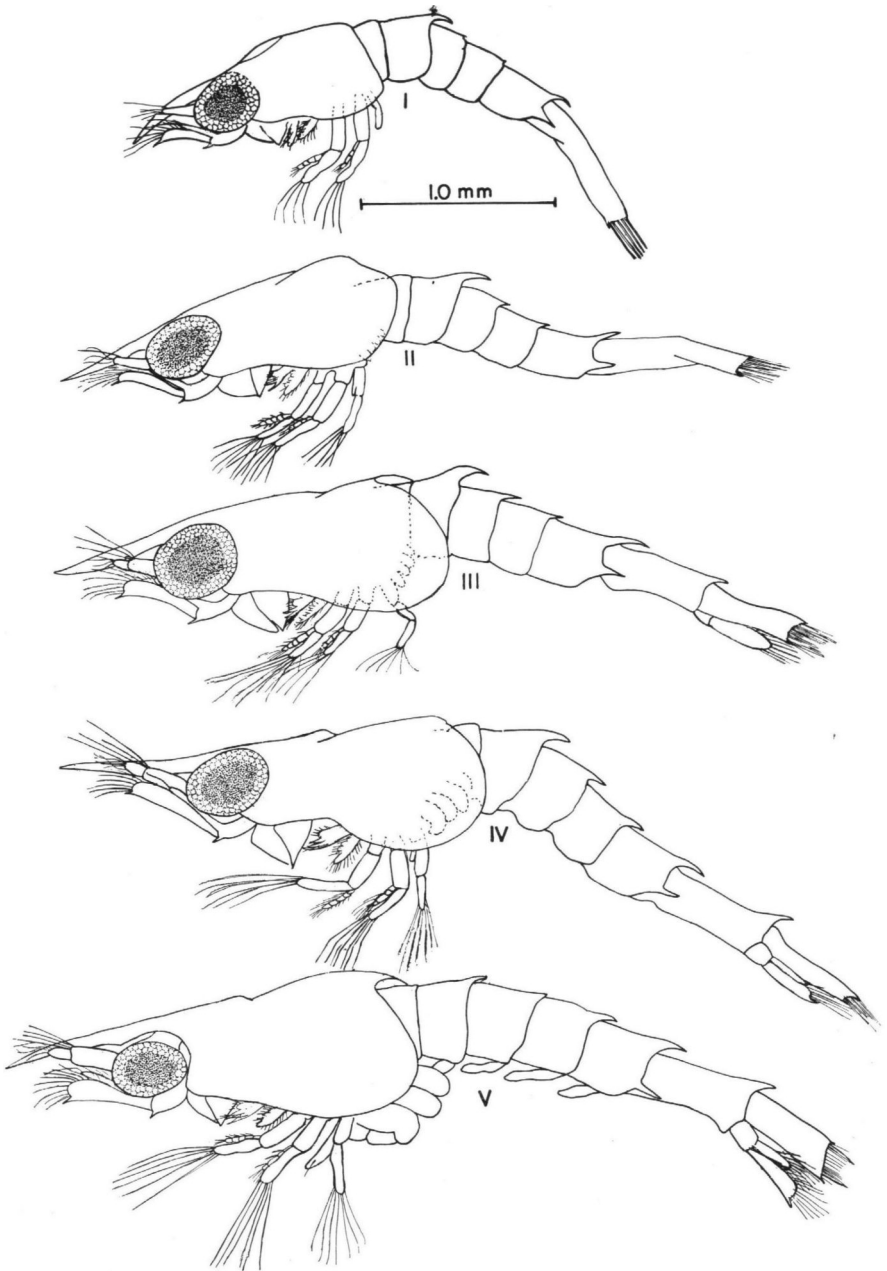


Fig. 2. *Coenobita clypeatus* (Herbst). Lateral view of zoeal stages I to V.

The antennule (fig. 4, I) does not reach to the tip of the rostrum but is about as long as the antenna. There are four large aesthetes, two smaller setae terminally and prominent plumose setae subterminally.

The antenna (fig. 5, I) has the endopodite fused to the basipodite and bears two terminal plumose setae. There is another much smaller seta less than half as long as the others situated subterminally. The antennal scale which articulates with the basipodite is slightly concave laterally and ends in a sharp tooth. There are nine plumose setae on the medial margin, the most proximal being much smaller than the others. A tenth seta, very reduced, is proximal to the anterolateral tooth.

The mandible is a simple toothed process.

The maxillule (fig. 6, I) has a three-segmented endopod with three setae on the terminal segment, and a short one distally on each of the two proximal segments. The basal endite bears two strong spines and two simple setae, while the coxal endite bears four plumose and two or three simple setae.

The maxilla (fig. 7, I) bears on the proximal lobe of the coxal endite, seven setae, on the distal lobe, four setae. On the proximal lobe of the basal endite there are five setae; there are four on the distal lobe. The bilobed endopodite bears four plus two setae. There are five short plumose setae on the scaphognathite.

The first maxilliped (fig. 8, I) bears a hooked process proximally on the medial margin of the basipodite. There are groups of two, three, and two setae along that margin. The exopodite bears four long natatory setae. The five-segmented endopodite bears five setae on the terminal segment. The penultimate segment bears two setae medio-distally. The next two segments proximally bear respectively one and two setae medially and both have a row of extremely fine setules on the lateral margin. The proximal segment bears three setae medially and a few very fine setules laterally.

The second maxilliped (fig. 9, I) bears only three setae on the medial margin of the basipodite. The exopodite bears four natatory setae. The four-segmented endopodite bears five setae on the terminal segment, two distally on the penultimate segment, two distally on the antepenultimate segment and three on the proximal segment. There are very fine setules on the lateral margin of both the penultimate and antepenultimate segments.

The third maxilliped (fig. 10, I) is a non-functional uniramous rudiment.

Second Zoea (figs. 1-10, II)

Size: TL 3.2 mm; CL 1.6 mm. Duration: 3-5 days.

The carapace is relatively unchanged except that the eyes are no longer immobile. The abdominal spines are somewhat more prominent. The telson (fig. 3, II) has an additional pair of plumose setae, shorter than the others, making a formula of 8 + 8. The median telson notch has become less distinct. In lateral view a few specimens show very small leg buds behind the third maxilliped.

The antennule (fig. 4, II) is larger but the processes are similar in number to those of the preceding stage.

The antenna (fig. 5, II) still has a fused endopodite armed with two large plumose terminal setae and one subterminal less than $\frac{1}{2}$ as long as the others. The

setule-bearing spine is still present at the base of the antennal scale. The first seta

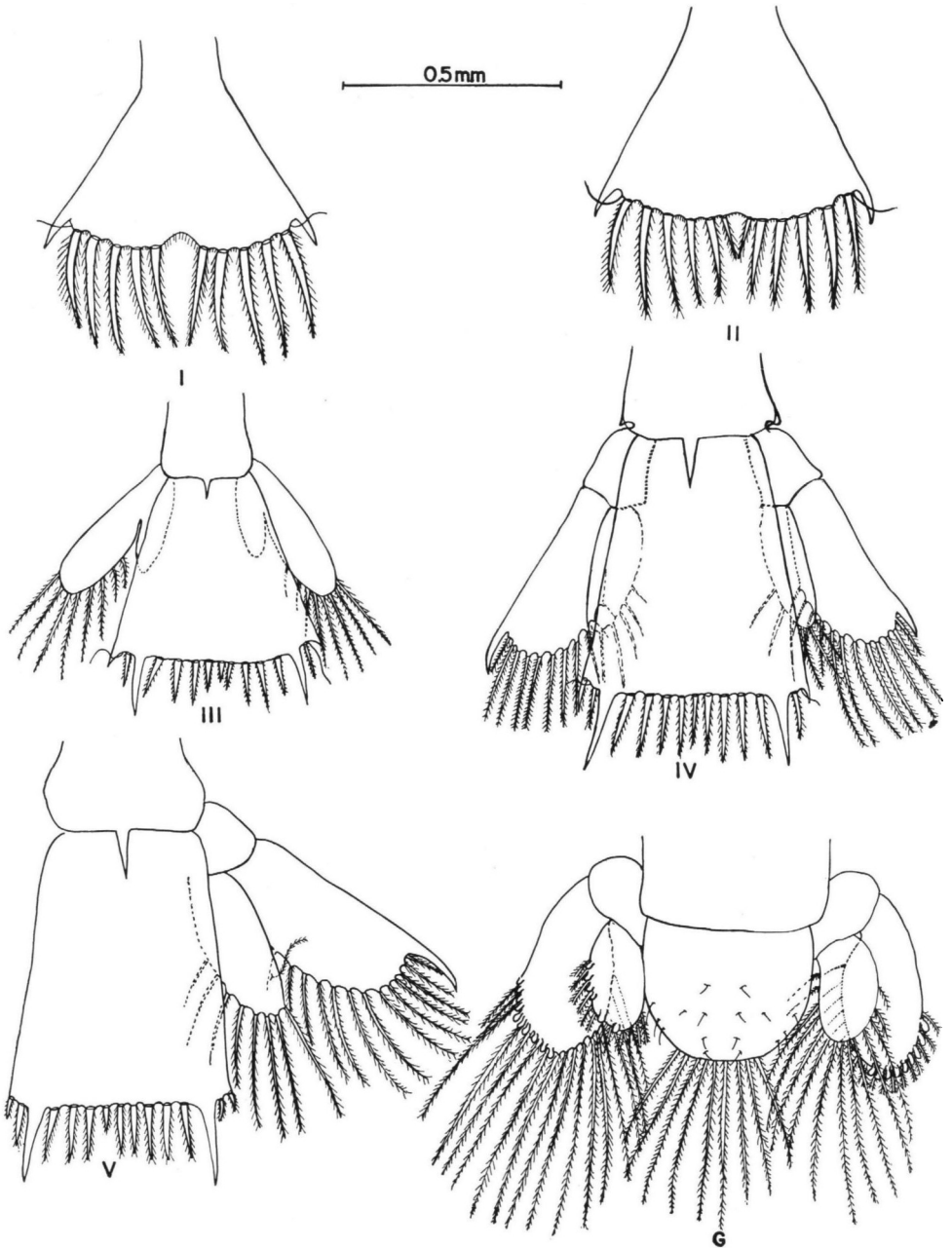


Fig. 3. *Coenobita clypeatus* (Herbst). Telson of zoeal stages I to V, and glaucothoe (G).

proximal to the terminal tooth of the scale is larger but the total count may have increased only by one or not at all, making 10 or 11 plumose setae.

The mandible has a few more minute corneous teeth.

The maxillule (fig. 6, II) is unchanged with regard to the endopodite, except that the seta on the proximal segment is not evident. The basal endite now has four strong spines and two setae, and the coxal endite bears six or seven setae.

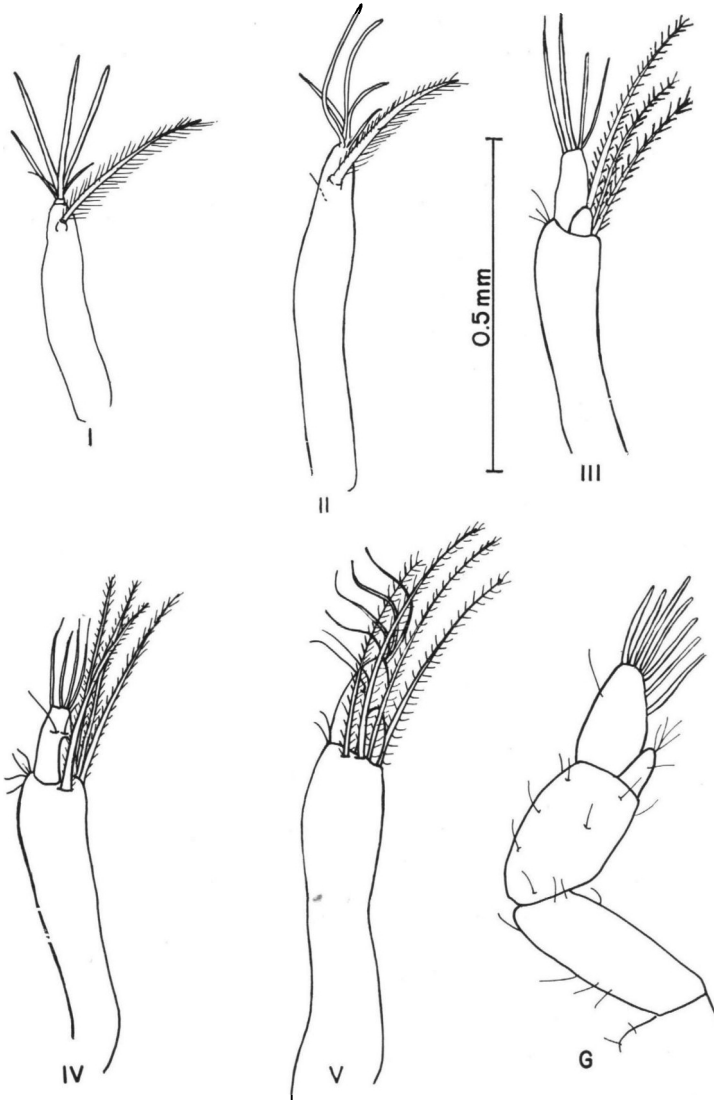


Fig. 4. *Coenobita clypeatus* (Herbst). Antennule of zoeal stages I to V, and glaucothoe (G).

The maxilla (fig. 7, II) bears on the four lobes of the two endites (proximally to distally) seven, four, five and four setae. The endopodite bears five setae and the scaphognathite has seven plumose setae.

The first maxilliped (fig. 8, II) bears several groups of setae along the medial

margin of the basipodite. The exopodite bears five or six natatory setae. The terminal segment of the five-segmented endopodite bears four setae terminally, with one proximally on the lateral margin. The penultimate segment bears two medial setae; the antepenultimate one lateral and one medial seta. The two proximal segments each bear a lateral and two or three medial setae.

The second maxilliped (fig. 9, II) bears only three setae along the medial margin of the basipodite. The exopodite bears five or six natatory setae. The four-segmented endopodite bears five setae on the terminal segment, two medial setae distally on the penultimate segment and a single seta mid-way on the lateral margin of that segment. The antepenultimate segment bears two medial setae and one seta laterally. The proximal segment bears only two medial setae.

The third maxilliped (fig. 10, II) consists of an exopodite bearing five or six natatory setae, and a lobe representing the endopodite.

Third Zoea (figs. 1-10, III)

Size: TL 3.8 mm; CL 1.9-2.2 mm. Duration: 3-4 days.

Leg buds are present, even well-developed in some specimens. The sixth abdominal somite is distinct and bears uropods. The exopodite of the uropod has no sharp tooth at the external margin, but bears 8 or 9 plumose setae. The endopodite is an unarmed bud. The telson (fig. 3, III) is armed with 8 + 1 + 8 processes. The first process is a tooth, the second a hair, the third an articulated spine. The fourth is a large fused spine. Processes 5 to 8 are articulated plumose spines and in most of the material there is a median spine in addition.

The antennule (fig. 4, III) is segmented. There are three large plumose setae and a short lobe at the distal end of the basal segment with three or four small setae on the opposing side. The terminal segment bears three or more aesthetes.

The antenna (fig. 5, III) may have 10 to 13 plumose setae on the medial margin of the scale. There is a minute tooth laterally at the base of the antennal scale and, nearer the base of the articulated endopodite which terminates in a single seta, there is a large spine.

The mandible is not changed except for addition of a few small teeth.

The maxillule (fig. 6, III) is largely unchanged. The three-segmented endopodite bears three terminal setae. There is one on the middle segment, but on the proximal segment there is none distinguishable in the present material. The basal endite bears four strong teeth and two simple setae. The coxal endite bears four large curved plumose setae and four smaller ones.

The maxilla (fig. 7, III) has seven to nine setae on the proximal lobe of the coxal endite, four on the distal lobe. There are five or six setae on the proximal lobe of the basipodite, and four or five on its distal lobe. The unsegmented endopodite is slightly bifurcated and bears two setae proximally, three distally. The scaphognathite has from eight to eleven short plumose setae.

The first maxilliped (fig. 8, III) is unchanged. The basipodite has a seta near

the proximal hooked process and distally two, three and two more marginal setae. The terminal segment of the endopodite has five setae; there are two on the

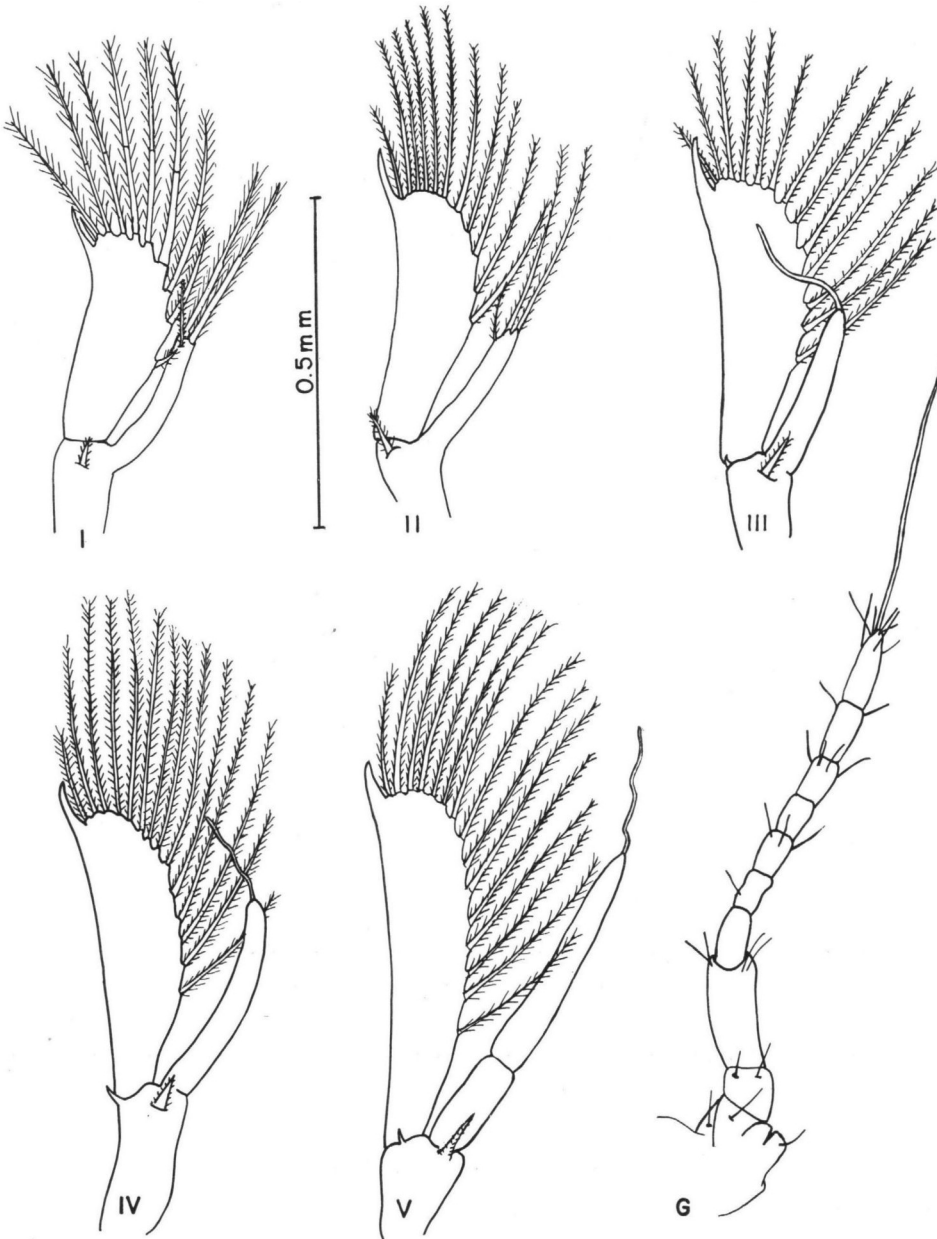


Fig. 5. *Coenobita clypeatus* (Herbst). Antenna of zoeal stages I to V, and glaucothoe (G).

penultimate segment. A medial and a lateral seta are present on the antepenultimate

segment. The two proximal segments each have one lateral and two medial setae. The exopodite bears six to eight natatory setae.

The second maxilliped (fig. 9, III) is also unchanged and may have six or eight natatory setae on the exopodite. The four-segmented endopodite has five setae on

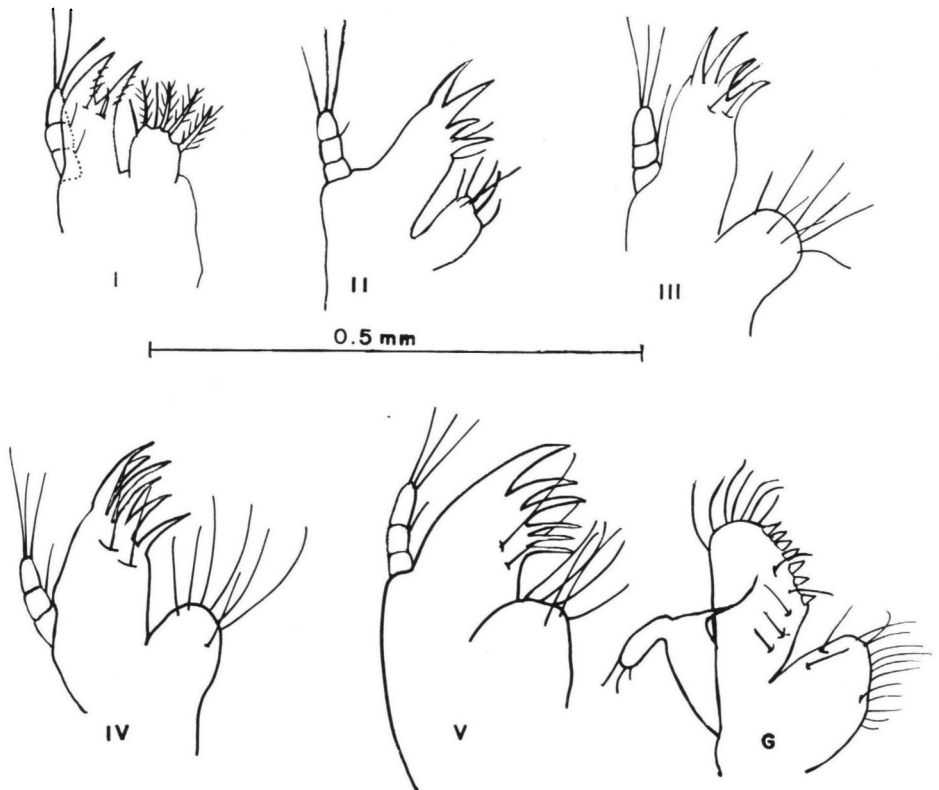


Fig. 6. *Coenobita clypeatus* (Herbst). Maxillule of zoeal stages I to V, and glaucothoe (G).

the terminal segment, one lateral and two medial on each of the next two segments and two medially on the proximal segment. There are three setae on the medial margin of the basipodite.

The third maxilliped (fig. 10, III) has a lobe representing the endopodite and an exopodite which terminates in six natatory setae.

Fourth Zoea (figs. 1-10, IV)

Size: TL 4.6 mm; CL 2.1-2.3 mm. Duration: 3-4 days.

Leg buds may be small or larger and in fact change in size during the stage. The telson is unchanged (it may or may not have a medial spine) but the uropods are distinctly changed (fig. 3, IV). The exopodites now bear a sharp tooth on the

postero-lateral margin in addition to 11 to 13 plumose setae and the endopodites now bear five to seven plumose setae. (In terminal stage IV, seven to eight).

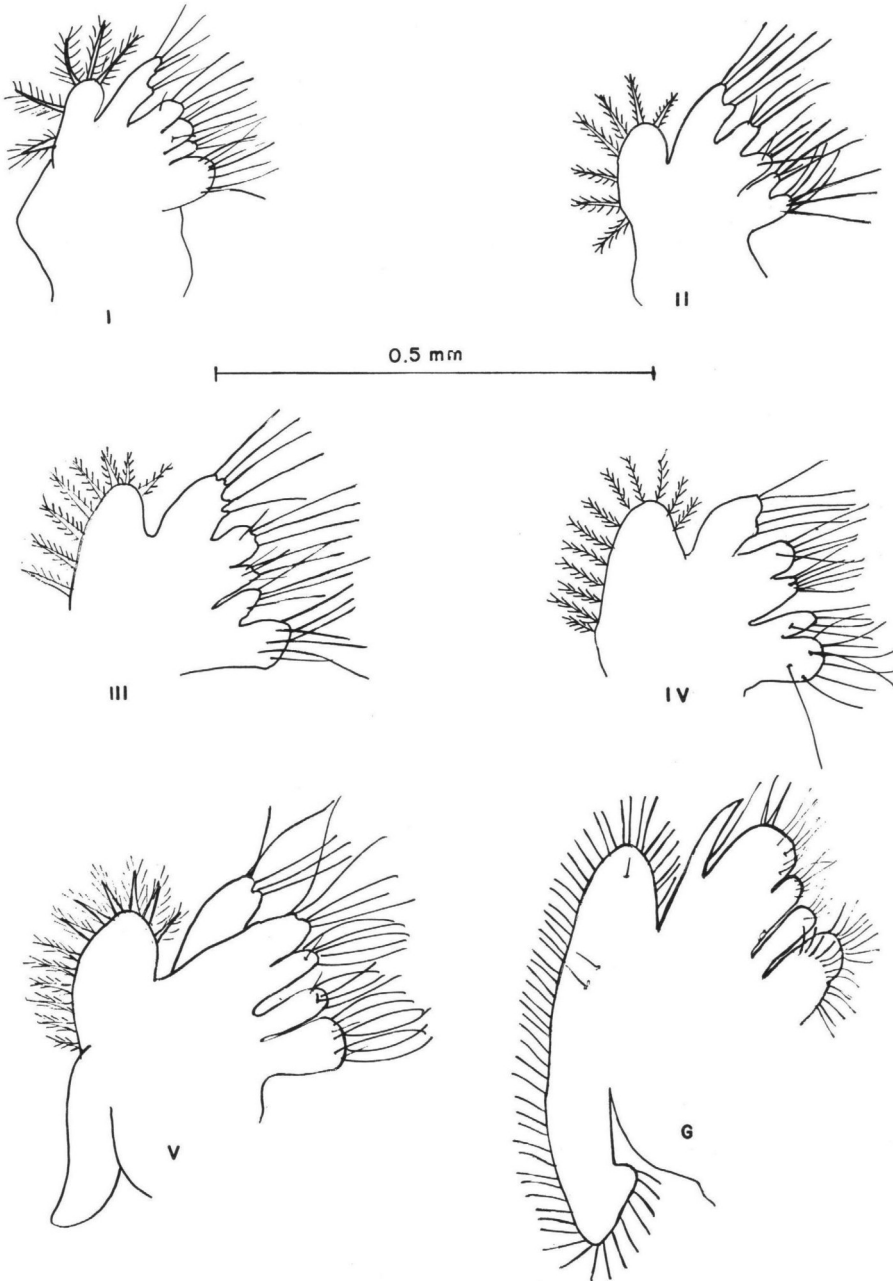


Fig. 7. *Coenobita clypeatus* (Herbst). Maxilla of zoeal stages I to V, and glaucothoe (G).
The antennule (fig. 4, IV) has four large plumose setae at the distal end of the

basal segment and a short pointed lobe at the origin of the three. There are about four small setae medially. There is a larger lobe or segment bearing about five aesthetes terminally and two setae subterminally.

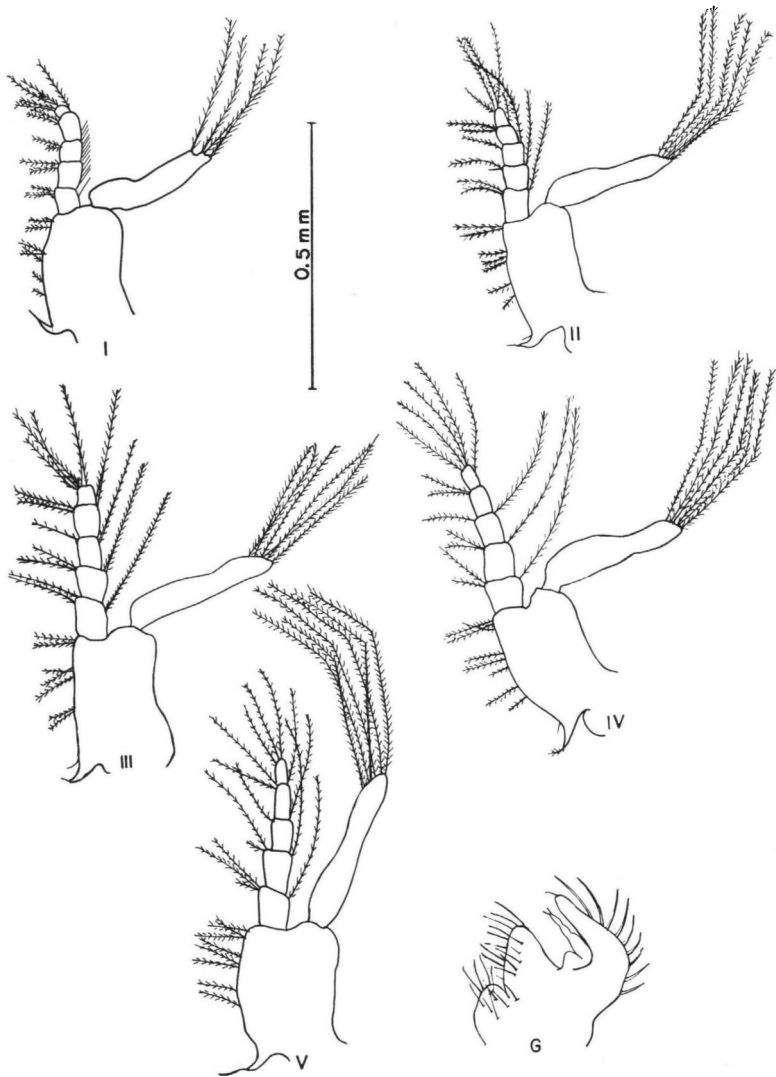


Fig. 8. *Coenobita clypeatus* (Herbst). First maxilliped of zoeal stages I to V, and glaucothoe (G).

The antenna (fig. 5, IV) has 13 to 15 setae on the scale. The articulated endopodite is about $\frac{2}{3}$ as long as the scale.

The mandible is unchanged.

The maxillule (fig. 6, IV) is unchanged with respect to the endopodite but the basal endite now bears six strong teeth or spines and two setae and the coxal endite bears four plus four setae.

The maxilla (fig. 7, IV) bears on the proximal lobe of the coxopodite eight to ten setae; the distal lobe has four. The proximal lobe of the basipodite has six setae; the distal lobe five. The endopodite has five or six setae. The scaphognathite bears 11 to 13 setae or up to 16 in a terminal stage IV.

The first maxilliped (fig. 8, IV) bears groups of two, three and three setae distally to the curved proximal process on the medial margin of the basipodite. The exopodite bears six or seven natatory setae. The five-segmented endopodite bears five setae on the terminal segment, two medially on the penultimate, one lateral and one medial on the antepenultimate segment, one lateral and two medial on each of the two proximal segments.

The second maxilliped (fig. 9, IV) bears three setae on the medial margin of the basipodite. The exopodite may bear up to eight natatory setae. There are five setae on the ultimate segment of the endopodite, two setae mediolaterally on the penultimate segment with one laterally midway along that segment. The antepenultimate segment bears two medial and one lateral setae. The proximal segment has two medial setae.

The third maxilliped (fig. 10, IV) has the basipodite deeply lobed. The articulated exopodite has six or seven natatory setae on indistinct distal segments. The endopodal lobe has a single subterminal seta.

Fifth Zoea (figs. 1-10, V)

Size: TL 4.7-5.5 mm; CL 2.3-2.7 mm. Duration: 4-6 days.

This stage possesses very well-developed pereopod buds and pleopod buds without setae (one specimen which moulted to glaucothoe did have setose pleopods). The medio-dorsal spines on the abdomen are nearly all equally prominent. The telson (fig. 3, V) may or may not have a median spine depending upon the preceding stage, but the telson formula is either $8 + 1 + 8$ processes or $8 + 8$. The uropods may have on the endopodites and exopodites seven or eight and 13 or 14 plumose setae, respectively. At least some individuals have an additional branched hair submarginally on the endo-uropodite.

The antennule (fig. 4, V) terminates in four large and three small aesthetes and there are two more subterminally. Distally on the basal segment there are four long plumose setae with a short unarmed lobe arising at the base of the group of three setae, and laterally there are about four small setae.

The antenna (fig. 5, V) now possesses a two-segmented endopodite which is very nearly equal in length to the scale and which terminates with one process. The scale bears 14 or 15 plumose setae. The spine at the endopodite reaches halfway up the basal segment. The spine at the base of the scale is much shorter.

The maxillule (fig. 6, V) is unchanged from the preceding stage.

The maxilla (fig. 7, V) bears upon the proximal lobe of the coxopodite nine setae, on the distal lobe five. On the proximal lobe of the basal endite there are six setae and there are five on the distal lobe. The endopodite bears five setae.

The scaphognathite which bears about 15 plumose setae has an unarmed posterior projection.

The first maxilliped (fig. 8, V) is essentially unchanged. The exopodite may carry six natatory setae.

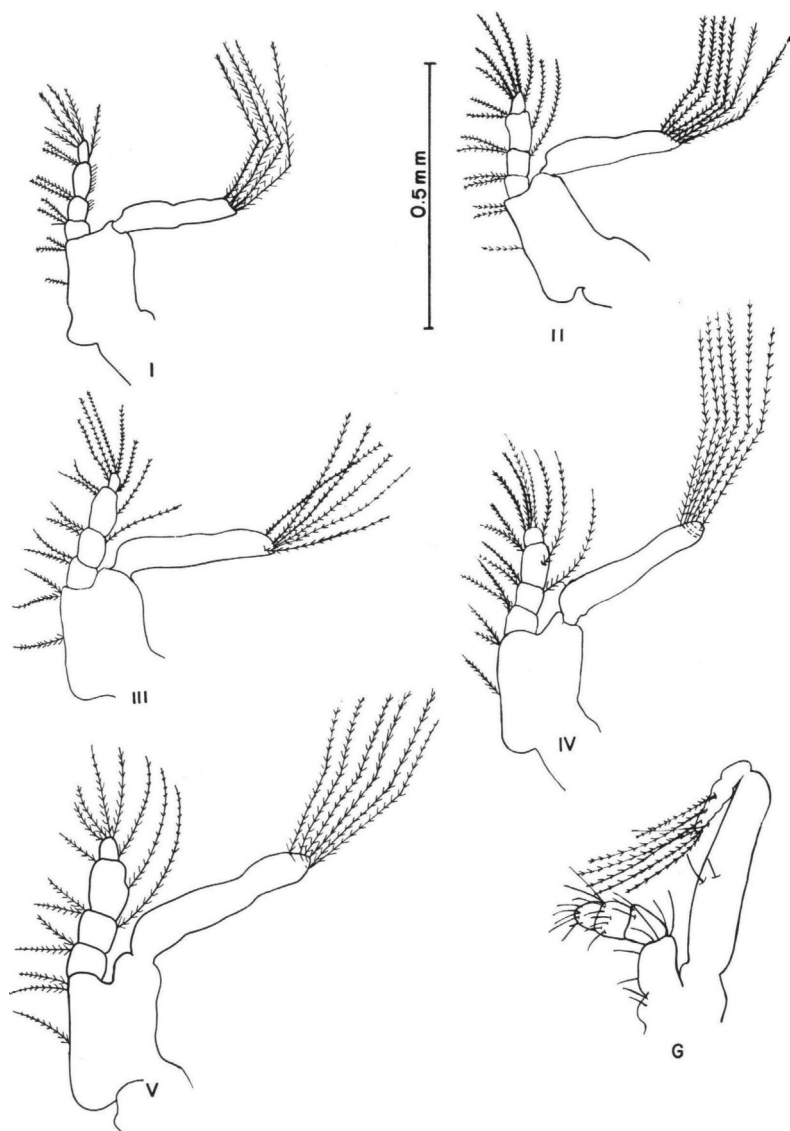


Fig. 9. *Coenobita clypeatus* (Herbst). Second maxilliped of zoeal stages I to V, and glaucothoe (G).

The second maxilliped (fig. 9, V) is also unchanged and the exopodite may have eight natatory setae.

The third maxilliped (fig. 10, V) is biramous. The jointed exopodite has

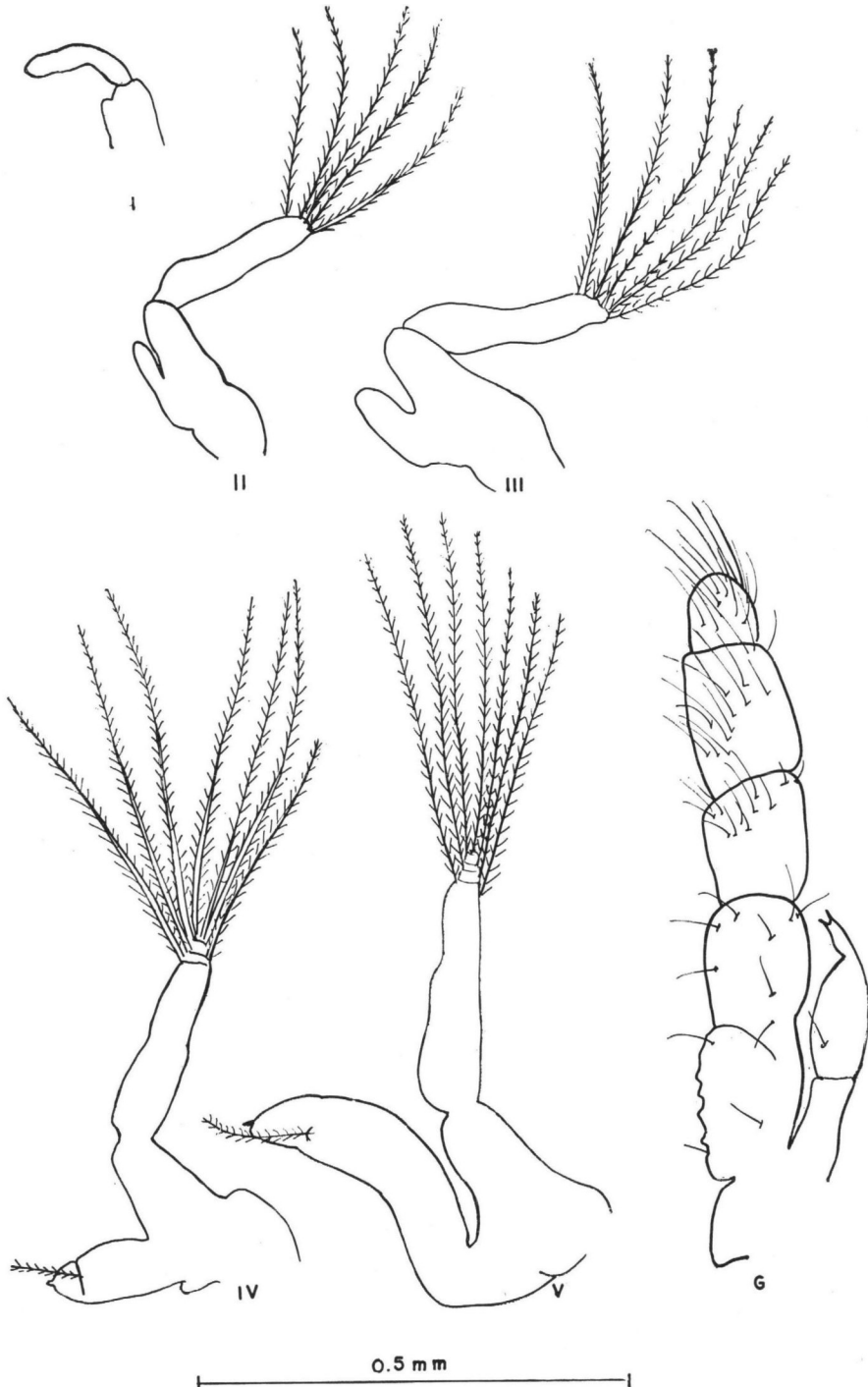


Fig. 10. *Coenobita clypeatus* (Herbst). Third maxilliped of zoeal stages I to V, and glaucothoe (G).

seven natatory setae. The endopodite is a large unsegmented process with a sub-terminal plumose seta.

Sixth Zoea

Duration: 4-6 days.

In a few instances glaucothoes were obtained after six zoeal stages. In such series the characteristics of the ultimate or metazoeal stage were similar to the ultimate zoea of other shorter series. For instance a zoea VI which yielded a glaucothoe was compared in detail with a terminal stage IV and with a terminal stage V. The more prominent characters are listed below:

TABLE I

Comparison of characters of the ultimate zoea in three series terminating in IV, V and VI zoeal stages

Terminal zoeal stage	IV	V	VI
Setae on antennal scale	15	14-15	14
Natatory setae on mxp ¹	6	6	6
on mxp ²	7	7-8	7
on mxp ³	7	7	7
Telson processes	17	17	17
Endo-uropodal setae	7-8	7-8	8
Exo-uropodal setae	13	11-13	13
Scaphognathite setae	16	15	17

Usually only the ultimate zoea possessed pleopodal buds. In longer developmental stages, the ultimate zoea was in general not further developed than the ultimate stage of a shorter series, but the preceding stages were less developed than the same number in the shorter series. Thus a stage IV from a long series (five or six stages) would be less well-developed than a terminal stage IV. Ordinarily the advanced development might be marked by greater setation, but there is sufficient variability in this character in most appendages to preclude determination of intermolt or stage from setation of an appendage alone.

Glaucothoe stage (figs. 3-10, G; 11, 12)

Size: TL 4.3 mm; CL 1.7-2.0 mm; length from medial posterior carapace margin to posterior telson 2.1 mm. Duration: up to 31 days for one specimen which very closely approached moult to first crab, up to 26 days for other specimens which died before moulting.

The carapace is sub-equal in length to the abdomen including the telson (the illustration shows the abdomen longer than the carapace). The prominent rounded rostrum extends well beyond the front. The subquadrangular telson (fig. 3, G) is somewhat broader than long and is armed posteriorly with nine long plumose setae. There are three smaller setae on each lateral margin and dorsally there are five additional pairs. The suboval exopodite of the uropod bears 17 or 18

long plumose setae plus a few smaller ones laterally and a postero-lateral row of about 10 blunt corneous spines. The endopodite of the uropod bears about 12 long plumose setae and about six blunt corneous spines.

The cornea of the eye is not apparently wider than the eyestalk. The eyestalk

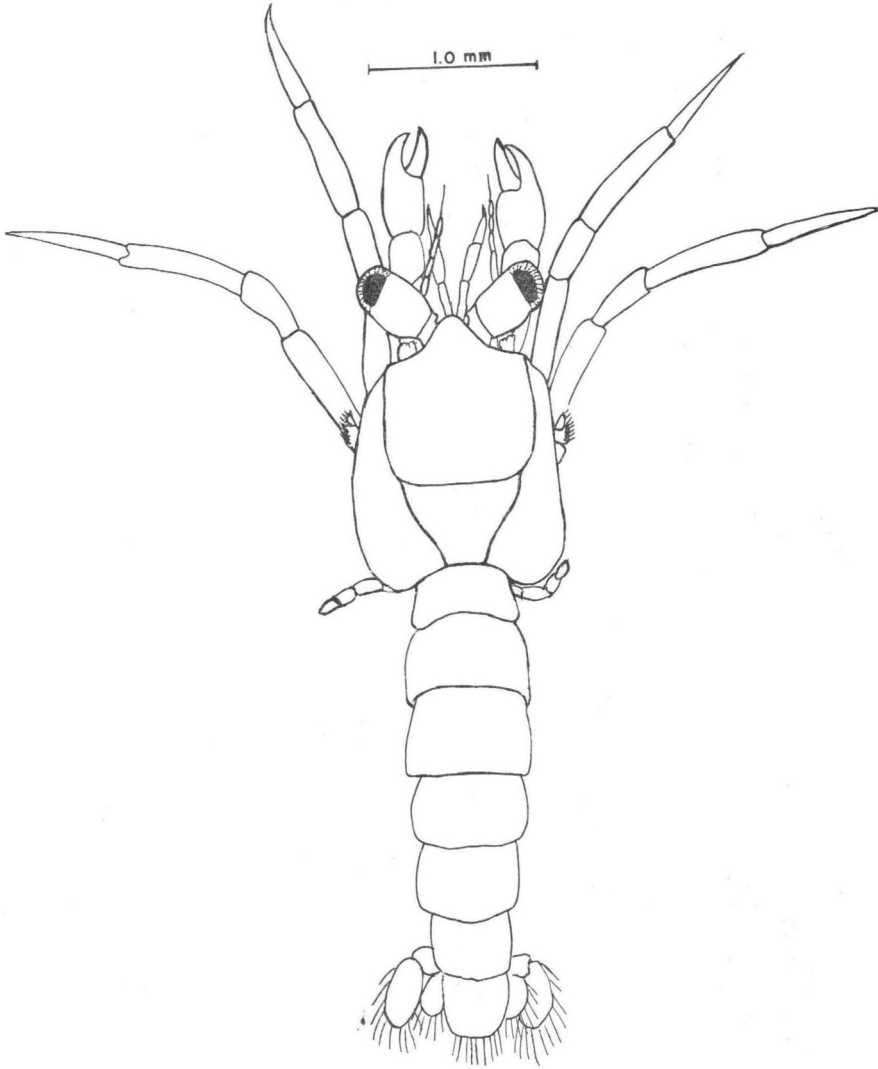


Fig. 11. *Coenobita clypeatus* (Herbst). Dorsal view of glaucothoe stage.

is less than two times longer than wide. No ocular scales are apparent. The eye reaches to the base of ultimate segment of the antennular peduncle.

The segmented antennule (fig. 4, G) reaches to the last segment of the antenna. The proximal segments have a few short setae. The ultimate segment represents the fused external flagellum and bears a number of aesthetes. There is a small

lobe ventrally at the base of the ultimate segment, which represents the unsegmented inner flagellum, armed with four or five short setae.

The antenna (fig. 5, G) reaches to the base of the movable dactyl of the

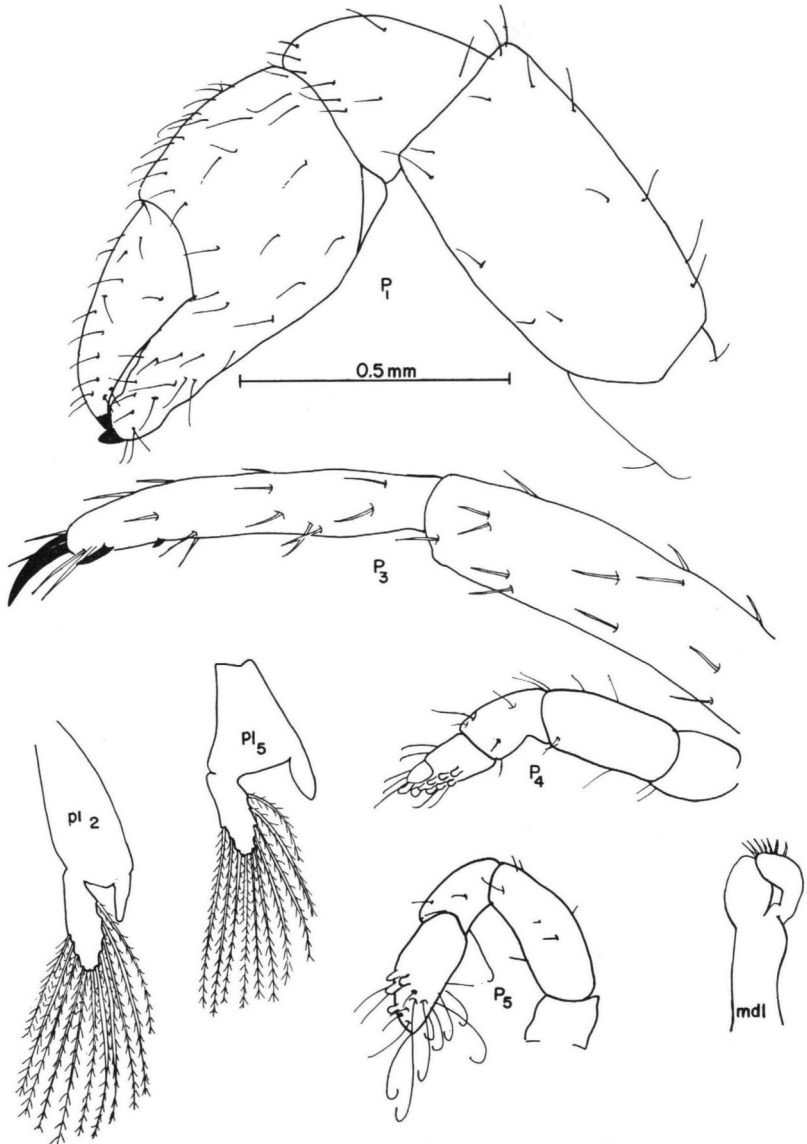


Fig. 12. *Coenobita clypeatus* (Herbst), glaucothoe stage. P₁, first right pereiopod; P₃, P₄, P₅, third, fourth, and fifth left pereiopods; mdl, mandible; pl₂, pl₅ pleopods of the second and fifth abdominal somites.

cheliped. The scale is reduced to a double knob (?) and in addition to the peduncular segments there are seven flagellar segments, each with a few distal

setae, except the last which bears more than any other, including one seta as long as the combined lengths of the five distal segments.

The mandible (fig. 12, mdl) consisting of a stalked cup-like process has a three-segmented palp which bears about nine stout setae or processes on the terminal segment.

The maxillule (fig. 6, G) has lost the segmentation of the endopodite which is now a flexed lobe terminating in two or three very short inconspicuous setae. There is a process bearing a large seta and there is another shorter seta proximally. The basipodite bears a series of short corneous cone-like spines and some simple setae distally. The coxopodite bears about 15 setae.

The maxilla (fig. 7, G) has upon the proximal lobe of the coxal endite a double series of setae, about 10 terminally, about 15 subterminally. The distal lobe bears three terminal setae and one sub-terminal. The proximal lobe of the basal endite bears six, the distal lobe about 11 setae. The unsegmented endopodite bears one or more very fine, almost indistinguishable processes (not illustrated) at the acute terminus and a large seta about mid-way which extends well beyond the tip of the endopodite. The scaphognathite bears from 49 to 56 setae.

The first maxilliped (fig. 8, G) consists of a short broad unsegmented exopodite, bearing eight to ten plumose setae laterally. The endopodite is short, narrow and indistinctly segmented. The basipodite is lobed and bears numerous setae medially on each lobe.

The second maxilliped (fig. 9, G) consists of a large segmented exopodite bearing at least seven plumose setae and a smaller but stout four-segmented endopodite bearing strong simple setae distally on each segment.

The third maxilliped (fig. 10, G) consists of a reduced indistinctly segmented exopodite bearing a single seta medially and a large five-segmented endopodite armed with a large number of strong simple setae on the distal segments.

The chelipeds are equal and similar, the manus is two times longer than high (fig. 12, P₁). There is a row of setae on the medio-dorsal margin. There are additional setae scattered over all surfaces of the hands. The chelipeds do not reach to the end of the propodi of the second pereopods. The second and third pereopods (fig. 12, P₃) have the dactyli about equal in length to the propodi. There are scattered stout setae on all segments. In addition to setae there are two small strong corneous spines on the distal ventral margin of each dactyl, and the terminus is corneous.

The fourth pereopod (fig. 12, P₄) bears a few simple setae on the carpus and merus. The propodus bears a double row of corneous granules or blunt spines and a few long setae. The dactyl is short and stout and terminates in a corneous process.

The fifth pereopod (fig. 12, P₅) bears a few large corneous granules or spines distally on the propodus and a number of very long curved setae. The proximal segments bear a few short simple setae.

Paired pleopods (figs. 12, Pl₂, Pl₅) are present on abdominal somites 2 to 5.

They are biramous, the inner branch being a simple unarmed lobe, the outer branch bearing 11 setae on somites 2 to 4 and on somite 5 bearing 10 setae.

In one 1960 series, glaucothoes were produced five times from zoea IV and 13 times from zoea V. In 1961 larvae from one female (♀ D) produced glaucothoes three times from zoea IV, and 9 times from zoea V while larvae from another female (♀ G) under similar conditions produced glaucothoes 15 times from zoea V and twice from zoea VI.

The specimen which lived for 31 days as glaucothoe assumed a non-swimming behavior about one week before it died. The abdomen although still symmetrical externally, was coiled. The animal spent much time in a shell provided for it but which was too large for it to carry about. The propodi of the walking legs had assumed a distinctly reddish orange color, much as in the crab but not as dense.

DISCUSSION

The first zoea of *Coenobita clypeatus* differs in minor features from previously described larvae of this genus. Borradaile (1903) did not describe or illustrate a postero-medio-dorsal spine of the second and fifth abdominal somites of *C. perlatus*. The more sharply curved rostrum illustrated by Borradaile for that species might indicate that he worked with newly hatched larvae which had not yet fully expanded all processes. Much more similar in general appearance to the first larva of *C. clypeatus* is the first zoea of *C. rugosus* as illustrated by Yamaguchi (1938). All the abdominal spines found in *C. clypeatus* were illustrated by Yamaguchi for *C. rugosus*. The antennule and antenna of both species are similar except perhaps for an apparently segmented endopodite on the antenna of *C. rugosus* which may be erroneously represented by Yamaguchi. The text of Yamaguchi's paper is in Japanese and the English résumé does not contain a detailed description of this appendage. The mandible and the maxillule are similar in both species, except that the shorter distal setae on the segments of the maxillary endopod, which are difficult to see under most conditions, are not illustrated by Yamaguchi. The first maxilliped of *C. clypeatus* has a prominent proximal hook which is not apparent in my copy of Yamaguchi's figure. The second and third maxillipeds are essentially similar in both species as one might expect.

The first zoea of *Birgus latro* was described by Borradaile (1900) but his illustrations do not show the complete setation of the appendages. The work of Orlamünder (1942) was much more detailed and accurate and corresponds well with first zoeae of *Birgus* which I have examined. Orlamünder illustrated for the first time the postero-medio-dorsal spine of the fifth abdominal somite which gives to that somite an armature similar to that of *Coenobita*. The most obvious feature which will separate the first zoea of *Birgus* from that of *Coenobita* is the absence in *B. latro* of the prominent spine on the second abdominal somite and the absence of the lesser spines on the third and fourth somites, all of which are present and readily distinguished in *Coenobita*. Discussion of similarities or

differences between the later zoeal stages of *C. clypeatus* and those of other members of the family must await detailed studies on the larvae of additional species.

Yamaguchi gave a few figures of the glaucothoe of *C. rugosus* and from these we may see that the antennae of both species have the same number of segments on the flagellum and perhaps equally significant, both have an extremely long terminal seta. Both species have similar telsons, and, as nearly as can be distinguished, similar uropods in the glaucothoe stage. The telson armature, at least with respect to the posterior margin, is similar also, there being nine large plumose setae medially and three shorter ones on each side. The shape of glaucothoe telsons seems to vary considerably among the few genera of marine hermit crabs which have been studied so that it may be especially significant from the generic standpoint that the proportions of length to width of the telson in these two species are similar.

So far as the writer is aware, there is no additional information on the larval stages of Coenobitidae. Of the papers describing early stages of hermit crabs in other families, too few are sufficiently detailed to warrant comparison of sequential larval development at this time. Especially needed are comparative studies on the zoeal appendages and on the glaucothoes of known parentage, such as provided for the zoeae of *Catapaguroides timidus* (P. Roux) by Dechancé (1961) and for the glaucothoes of *Catapaguroides timidus* and *Clibanarius erythropus* (Latreille) by Dechancé & Forest (1958). It is hoped that studies now under way at this laboratory and others will help fill some of the gaps.

RÉSUMÉ

Le pagure terrestre *Coenobita clypeatus* a été élevé en laboratoire à partir de l'oeuf; quatre, cinq ou six stades zoé ont été obtenus, suivis de la métamorphose en glaucothoé. L'auteur décrit et illustre la morphologie externe, appendices inclus, pour cinq stades zoé et pour la glaucothoé.

Le nombre des stades est variable suivant les individus dans les conditions de laboratoire et les variations dans la sétation des appendices s'accroissent progressivement au cours du développement.

Dans la famille des Coenobitidae les premières zoés de *Birgus latro* et de deux espèces de *Coenobita* au moins présentent un caractère commun: une épine postéro-médio-dorsale et une paire d'épines latérales sur le cinquième somite abdominal. Les premières zoés des deux espèces de *Coenobita* ont en commun la présence d'épines médio-postéro-dorsales sur les somites abdominaux deux, trois et quatre. Les stades glaucothoé de *Coenobita clypeatus* et de *C. rugosus* montrent les caractères distinctifs suivants: un flagelle antennaire de sept segments avec une soie distale extrêmement longue sur le segment terminal, et un telson légèrement plus large que long, portant sur le bord postérieur neuf longues soies plumeuses et trois paires de soies plus courtes. Les comparaisons détaillées des stades larvaires de *C. clypeatus* avec ceux d'autres espèces de la même famille ou d'autres familles nécessitent des études détaillées complémentaires.

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