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A DESCRIPTION OF THE LABORATORY-REARED FIRST AND SECOND ZOEAE OF *PORTUNUS XANTUSII* (STIMPSON) (BRACHYURA, DECAPODA)

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***Portunus xantusii* (Stimpson) was reared in the laboratory from the egg through the second zoeal stage. The larvae were reared under simulated day and night conditions at a temperature range of 23 to 26.5 C and a salinity range of 33.5 to 33.6‰. The first two zoeal stages are fully described and figured.**

INTRODUCTION

Portunus xantusii (Stimpson), a swimming crab, is found from Santa Monica Bay, California (Rathbun 1930) to Chile (Johnson and Snook 1927). This study describes the first and second zoeal stages as an aid to the identification of this crab in plankton samples.

MATERIALS AND METHODS

An ovigerous *P. xantusii* was captured in San Pedro Bay, near Seal Beach, California, on August 27, 1971, and transported to the laboratory at California State University, Long Beach, where it was placed in an aerated 8 liter container. The eggs hatched approximately 3 hr after the crab was captured. Thirty-five first zoeae were placed in each of ten 266 mm plastic cups. The study was conducted at ambient laboratory temperatures ranging from 23 to 26.5 C and day and night conditions were simulated. Sea water was obtained from Seal Beach and transported to the laboratory in 19 liter plastic carboys. The water was filtered through two number one Whatman qualitative filter papers. The salinity of the water varied from 33.5 to 33.6‰. The larvae were transferred daily, by means of a pipette, into clean cups containing new sea water. The water in these cups was not aerated. Nourishment for the zoeae was provided in the form of freshly-hatched *Artemia salina* nauplii.

In order to avoid mortality due to bacterial infection, a commercial preparation of penicillin and streptomycin was used. The volume of sea water used each day was treated with 0.2 cc of the preparation per liter of sea water.

All zoeae and exuviae were preserved in a 5% solution of formalin. From 5 to 10 specimens were used to study external anatomical variation. Appendages were dissected with fine insect pins and mounted in glycerin. All figures were drawn with the aid of a camera lucida.

RESULTS

All series of armature are listed in the description from proximal to distal.

First Zoea

The carapace of the first zoea (Figure 1-A) has a rostral and dorsal spine, and a pair of lateral spines. The mean of the perpendicular

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distance between the tip of the rostral spine and the tip of the dorsal spine is 1.09 mm. There is a small hair or setule present above each lateral spine. The eyes are not stalked. The abdomen (Figure 1-B) consists of five segments or somites and a bifurcated telson. The postero-

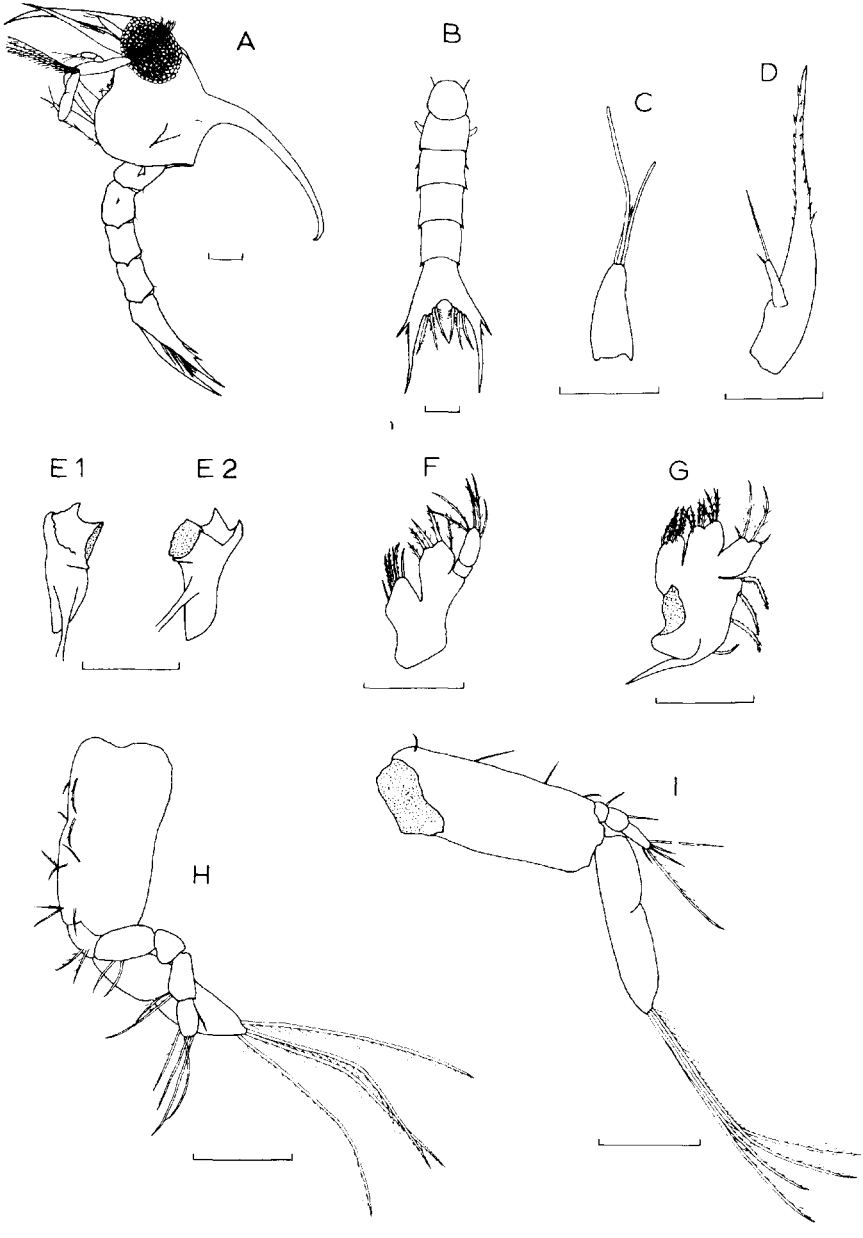

FIGURE 1. First zoea of *Portunus xantusii* (Stimpson). A, lateral view; B, ventral view of abdomen; C, antennule; D, antenna; E-1 and E-2, right and left mandibles respectively; F, maxillule; G, maxilla; H, first maxilliped; I, second maxilliped. Scale = 0.1 mm.

lateral edges of somites three through five extend caudally as spines, overlapping the adjacent somite. The second somite bears a pair of lateral hooks and the third somite, a pair of lateral spines. A pair of setules is present on the posterodorsal border of somites two through five. The first somite has no ornamentation. Each furca of the telson has three plumose setae on the inner margin, two smooth and unequal spines on the outer margin, and another smooth spine (not shown in Figure) on the dorsal side posterior to the latter two. The antennule (Figure 1-C) bears two long, unequal aesthetes and one seta. The antenna (Figure 1-D) has a protopodite which terminates as a long denticulate spine, and a shorter exopodite bearing two unequal terminal setae. The right and left mandibles (Figure 1, E-1 and E-2 respectively) differ slightly in structure. The two-segmented endopodite of the maxillule (Figure 1-F) has no armature on the first segment and six setae on the terminal segment, most of which are plumose. The basipodite and coxopodite bear five and six setae respectively, most of which are plumose. Four plumose setae fringe the border of the scaphognathite of the maxilla (Figure 1-G). The bilobed endopodite has two setae on each lobe. The bilobed basipodite and coxopodite bear 4-4 and 3-3 plumose setae respectively. The protopodite of the first maxilliped (Figure 1-H) has a setal arrangement of 2-2-3-3, most of which are plumose. The five-segmented endopodite has a formula of 2, 2, 0, 2, 5. The protopodite of the second maxilliped (Figure 1-I) has an arrangement of 1-1-1-1, and the three-segmented endopodite has a formula of 1, 1, 5. The exopodite of the first and second maxillipeds is incompletely segmented and bears four long plumose setae.

Second Zoea

The mean of the distance from rostral spine to dorsal spine of the second zoea (Figure 2-A) is 1.28 mm. This is an increase of 17% over the previous stage. Setules on the carapace have increased to six and there are two setules on the dorsal spine. There is a plumose seta on each side of the ventrolateral margin of the carapace. The eyes are now stalked. The posterolateral spines of somites three through five of the abdomen (Figure 2-B) have increased considerably in size. The telson has added a naked seta on each side of the furcal angle and there has been a reduction in size of the smaller spine on the outer margin of each furca. The antennule (Figure 2-C) now bears five aesthetes and one very small seta (not shown in the Figure). Other than the increase in size, the antenna (Figure 2-D) and mandibles (Figure 2, E-1, and E-2) are unchanged. There is no change in the armature of the endopodite of the maxillule (Figure 2-F), but the basipodite now has seven setae. The setation of the coxopodite is generally six and rarely seven. A seta has been added to the lateral border of the protopodite, below the endopodite. There are seven setae on the border of the scaphognathite of the maxilla (Figure 2-G), and the formula of the bilobed endopodite is now 2–4. There is no change in the armature of the basipodite and coxopodite. The armature of the protopodite and endopodite of the first maxilliped (Figure 2-H) is unchanged. The now completely segmented exopodite has generally six plumose setae, rarely five and seven. The protopodite and endopodite of the second maxilliped (Figure 2-I) have no armature change. The plumose setae of the still incompletely segmented exopodite have increased to six.

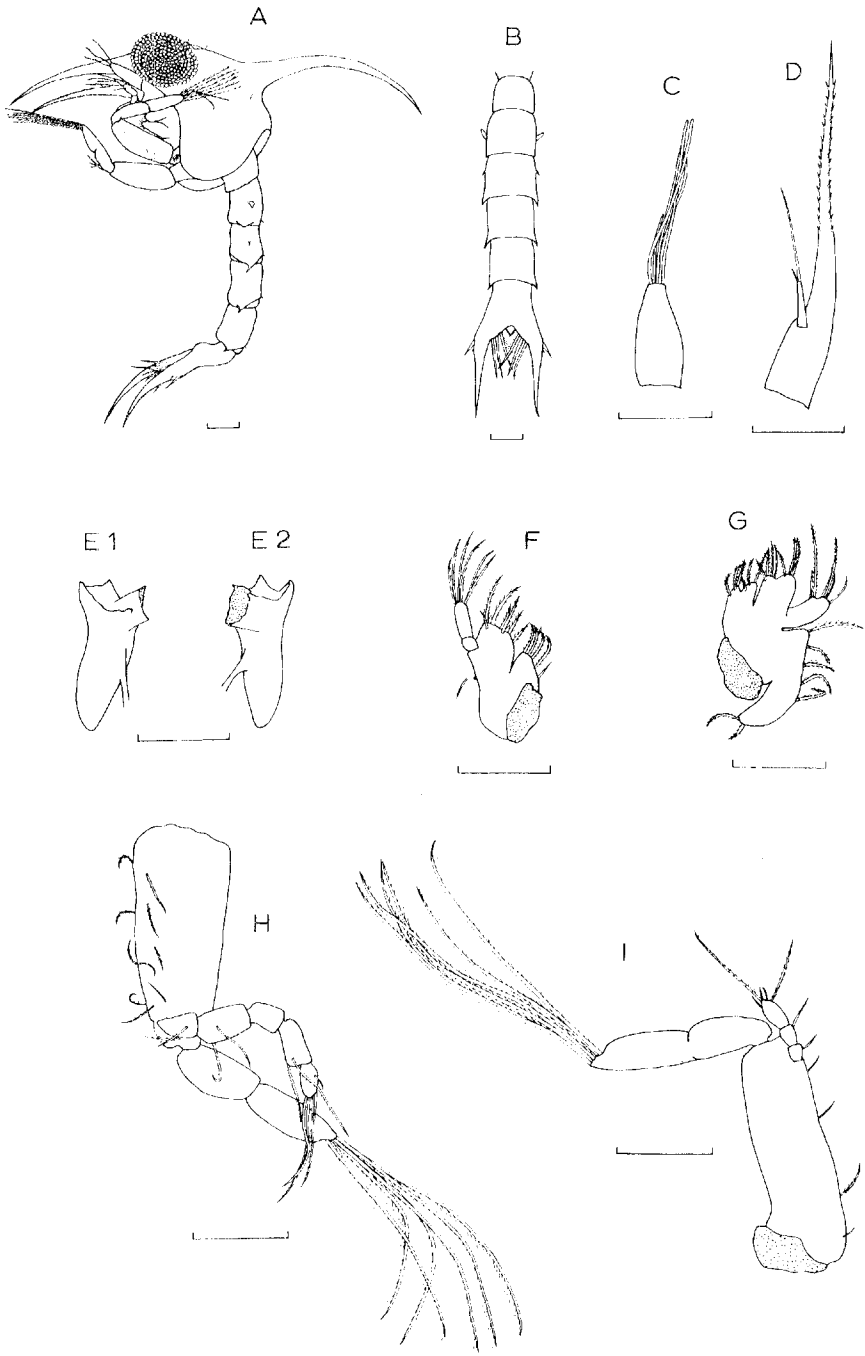

FIGURE 2. Second zoea of *Portunus xantusii* (Stimpson). A, lateral view; B, ventral view of abdomen; C, antennule; D, antenna; E-1 and E-2, right and left mandibles respectively; F, maxillule; G, maxilla; H, first maxilliped; I, second maxilliped. Scale = 0.1 mm.

DISCUSSION

Of the initial 350 zoeae, three molted into the second zoea 9 days after hatching and another two molted 11 days after hatching. All second zoeae died within 4 days after reaching this stage, and all zoeae were dead 15 days after hatching. This very high mortality was probably due to the high temperatures at which the larvae were kept. The ambient temperature of the collecting area was to be approximated during the study, but the cooling unit which was to be used became inoperative.

Since hatching of the eggs occurred only 3 hr after the capture of the ovigerous crab, embryonic development took place almost entirely under natural conditions. Therefore, there should be very few differences, if any, between the first zoea described and that found in nature. However, since the second zoea described developed at abnormally high temperatures, differences between it and that found in nature might exist.

Lebour (1928) stated that there are four to five zoeal stages in the family Portunidae and five zoeal stages in the subfamily Portuninae. Accordingly, *P. xantusii* should have five zoeal stages. However, Costlow, and Bookhout (1959) reported as many as eight zoeal stages in *Callinectes sapidus* Rathbun reared under laboratory conditions. They also indicated that this number might not be representative of that found under natural conditions.

Lebour (1928) stated that it is practically impossible to distinguish among the zoeae of *Portunus, Bathynectes,* and *Polybius. Callinectes* might also be added to these genera. Length ratios such as the lateral spine to rostrum ratio and the antennal exopod to antennal peduncle ratio have been suggested by Roberts (1969) as a means of separating the genera of Portunidae. However, as Roberts further indicated, much more knowledge of larval histories is needed to establish the validity of these ratios in separating the genera.

Since portunid larval stages are very similar, it is necessary to use a combination of diagnostic characters to identify species. Those characters most useful are: the perpendicular distance between the tip of the rostrum and the tip of the dorsum, and the armature of the antennule, maxillule, and mixilla.

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