Gulf and Caribbean Research

Volume 1 | Issue 3

January 1962

# Studies on the Larval Development of *Rithropanopeus harrisii* (Gould) of the Family Xanthidae (Brachyura)

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# STUDIES ON THE LARVAL DEVELOPMENT OF *RITHROPANOPEUS HARRISII* (GOULD) OF THE FAMILY XANTHIDAE (BRACHYURA)

by

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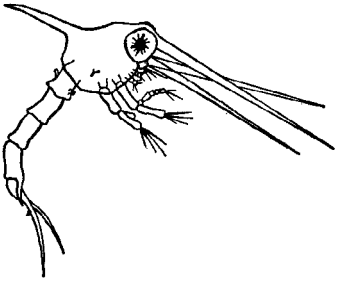
## INTRODUCTION

Because the early biologists did not see decapod larvae "in the act" of changing from one phase to another due to the fact that they were parts of planktonic collections and their parentage was unknown, each phase was given a generic and specific name of its own. Gurney (1924) did not concur with this practice, but was of the opinion that it is more profitable to assign larvae to definite genera or families, even if the reference proved to be wrong.

The chief difficulty encountered in rearing decapod larvae is the maintenance of a constant supply of suitable living food (Needham, 1959). The early embryonic studies of brachyuran crustaceans did not reveal complete life histories. This was due primarily to the lack of effective culture techniques. Birge (1883) gave no details of his culture methods in the study of the development of *Panopeus sayi* (Smith). Hyman (1925) gave no account of an attempt to culture larvae of xanthid crabs. In recent years the use of definite diets for the larvae has resulted in a knowledge of complete life histories. Knudsen (1959) used *Artemia* nauplii in feeding larvae of four xanthid crabs of the California coast. Chamberlain (1961) used various combinations of *Artemia* nauplii and two species of algae to feed larvae of three xanthid crabs of the North Carolina coast. His best results were with a diet of *Artemia* alone.

Former studies of brachyuran embryology at the Gulf Coast Research Laboratory were confined to the description of larvae taken in planktonic collections at or near the surface. Advanced larval forms are not found in such collections. It seldom happens that in planktonic material a series of stages of the same larvae is taken which is sufficiently complete to enable the genus to be determined. The remainder must be identified as nearly as possible by reference to published descriptions of larvae whose parentage is known, and such identification must in many cases be very speculative.

Hyman (1925) described a prezoeal, four zoeal and a megalops stage of *Neopanope texana sayi* (Smith) at Beaufort, North Carolina. Also in his studies is a description of a prezoeal and the first zoeal stage of *Eurypanopeus depressus* (Smith). Knudsen (1958, 1959, 1960) described culture methods and four zoeal stages and a megalops stage of four species of xanthid crabs from California. Prezoeae were described for two of these species. Chamberlain (1961) described culture methods and four zoeal stages and a megalops of *Neopanope texana sayi* (Smith) at Duke University Marine Laboratory, Beaufort, North Carolina.



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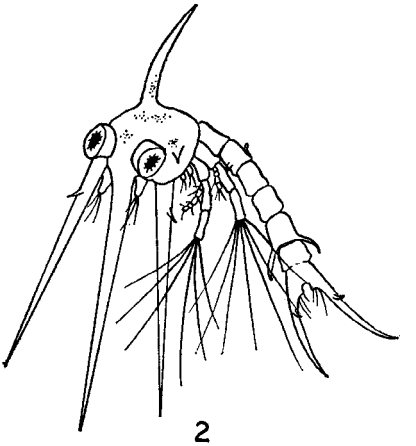

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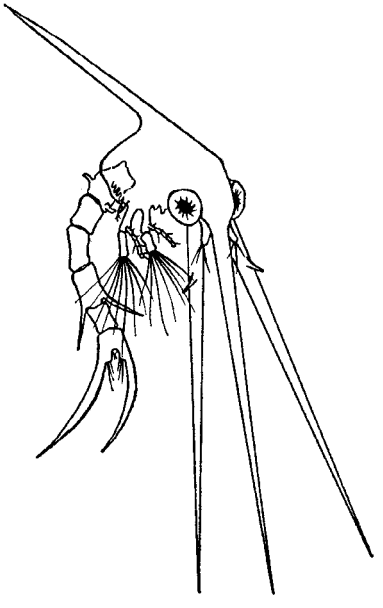

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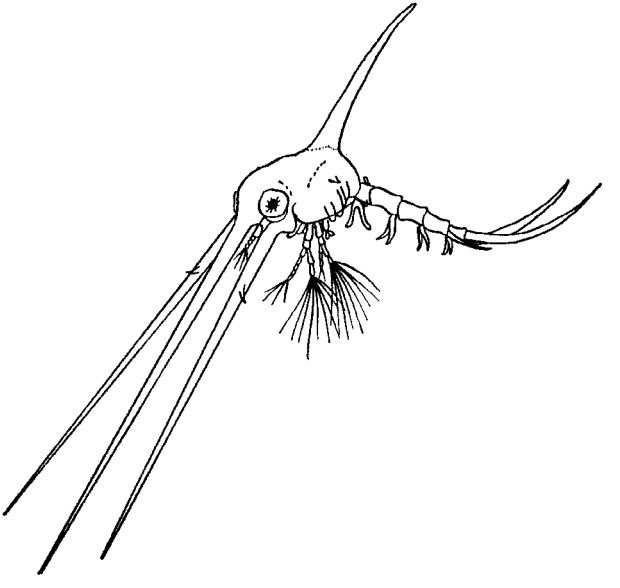

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## PLATE I

Figure 1
First Zoea

Figure 2
Second Zoea

Figure 3
Third Zoea

Figure 4
Fourth Zoea

This is a report of a study of the embryonic development of crabs of the family Xanthidae from Biloxi Bay. The larvae were hatched and reared in the laboratory. The work was supported by a Summer Research Grant from the National Science Foundation to the Gulf Coast Research Laboratory.

Acknowledgements are given to Dr. Gordon Gunter who arranged for the grant and made the facilities of the Laboratory available. C. E. Dawson identified the adult crabs. Dr. Harry Bennett assisted in making measurements.

## METHODS

In the present study culture methods used successfully by Knudsen (1958) and Chamberlain (1961) were employed and larvae taken from the plankton were used only to support observations of those reared in the laboratory.

Ovigerous females of *Rithropanopeus harrisii* (Gould) were collected from the estuarine water (salinity, 10.83 0/00 + 0.2 0/00) near the laboratory. They were found in oyster shells and other inaccessible places and were abundant from June 15 through August 12. These females were taken to the laboratory immediately and placed in shallow bowls containing water from the bay to await the incubation of their eggs. The more concave valve of an oyster shell was placed in the water under which the crab would retreat.

Immediately after hatching approximately thirty of the most active larvae were placed in each of two Petri dishes containing water from the bay. Once each day those remaining alive were removed with a pipette to a Petri dish of fresh bay water and were fed newly hatched *Artemia* nauplii. The dishes were kept in a closed cabinet to keep dust from settling on the surface of the water and to prevent the absorption of various fumes present in the laboratory. Aeration of water in the dishes was not necessary since the ratio of water volume to surface area allowed ample exchange of gases. The air temperature of the cabinet remained at 27° + 2° C.

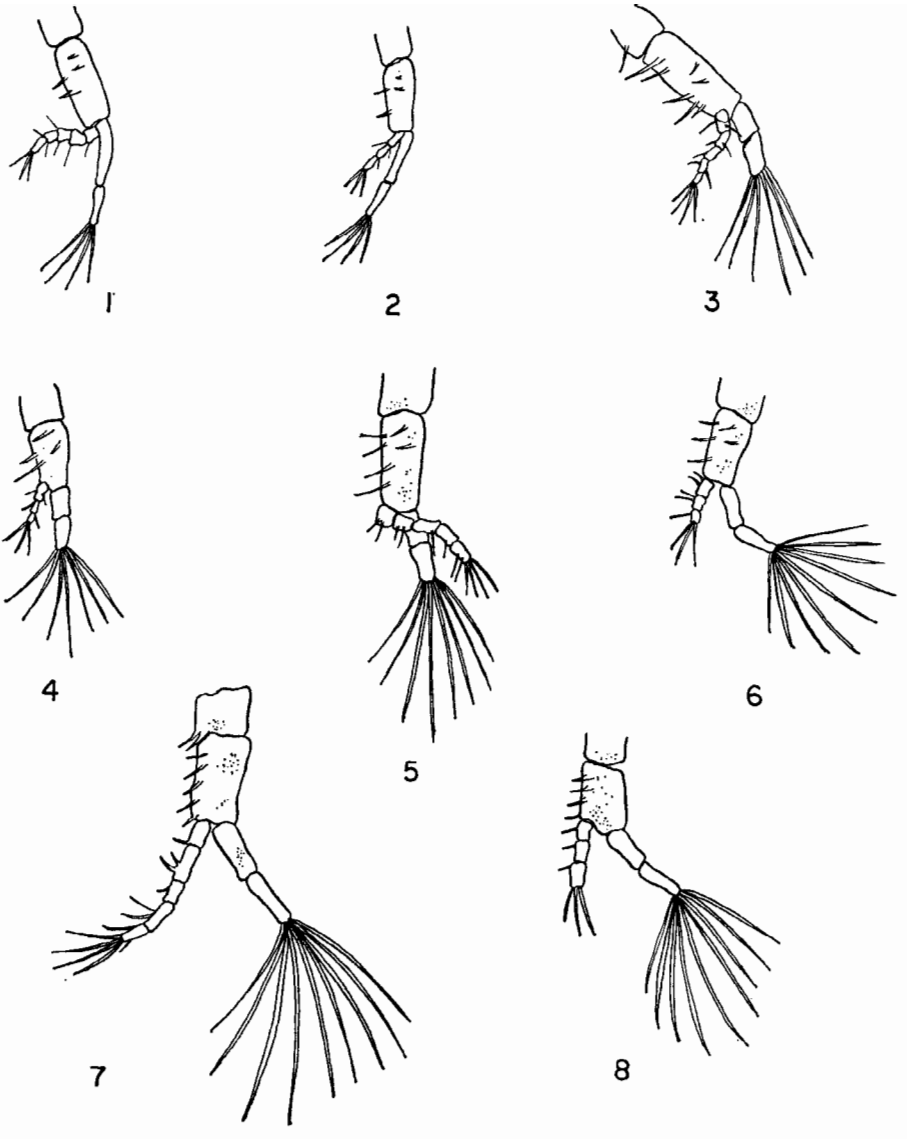
Between each use of the Petri dishes they were washed with a detergent powder and sterilized in a steam sterilizer.

Measurements were made by use of an ocular micrometer.

Larvae from individual cultures representing each stage were preserved in 5% formalin in sea water for morphological study.

## OBSERVATIONS

Ovigerous females of *Rithropanopeus harrisii* (Gould) were abundant from June 15 through August 12 with eggs at different stages of development. Newly deposited eggs were dark purple-brown, changing to lemon-yellow just before hatching. The length of the incubation period was not determined since it was not known when the eggs were deposited. The longest period between the collection of a female with eggs and the hatching of her eggs was twelve days (July 24 to August 5).




## PLATE II

Figure 1
First Maxilliped of
First Zoea

Figure 2
Second Maxilliped of
First Zoea

Figure 3
First Maxilliped of
Second Zoea

Figure 4
Second Maxilliped of
Second Zoea

Figure 5
First Maxilliped of
Third Zoea

Figure 6
Second Maxilliped of
Third Zoea

Figure 7
First Maxilliped of
Fourth Zoea

Figure 8
Second Maxilliped of
Fourth Zoea

Fungus infection was not noticed. A protozoan, *Zoothamnion* sp., or a related organism, was commonly attached to the egg masses and to the zoeae. This added more weight to the spine-burdened body of the larvae and interfered with their ability to capture the nauplii and most of them died without molting.

Several zoeae were observed in the process of molting. One had trouble getting the antennal spine out from the old shell. One pulled forward from the fissure on the dorsal surface of the carapace leaving the dorsal spine, for a time, parallel to the shell from which it came. This gave the appearance of two dorsal spines.

Accurate records were not kept on the duration of each larval stage. It was generally observed that more time was spent between the first and second zoeal stages and between the fourth zoeal and the megalops stages than the intermediate ones. One culture went from the first zoeal to the megalops in fifteen days. Newly hatched larvae of a related species, *Eurypanopeus depressus* (Smith), were only slightly larger than the *Artemia* nauplii and were not seen eating them. This probably accounts for their lack of development through the successive stages. The zoeae of *Rithropanopeus harrisii* (Gould) were larger and eagerly devoured the nauplii soon after young ones were fed to them.

## DESCRIPTION OF LARVAE OF *Rithropanopeus harrisii* (Gould)

The zoeae of *Rithropanopeus harrisii* (Gould) are the most striking of the several species of xanthid crabs of Biloxi Bay due to the elongated rostral and antennal spines. These appendages give the animal a very awkward appearance, yet it is quite active and a good swimmer.

### FIRST ZOEA
(Plate I, Figure 1)

Carapace—The rostral spine is an extension of the anterior end of the carapace between the unstalked, compound eyes. It is about 930 microns long, which is only slightly less than the combined lengths of the cephalothorax and the abdomen. It begins as a relatively stout process and gradually tapers to a sharp point. It is entirely smooth, having no setae as is found in many xanthid larvae. The size and weight of this spine, together with the two antennal spines which are almost as long, make the anterior end of the animal proportionately heavier than the remainder of the body and account for its awkwardness and cause it to swim backward. The dorsal spine projects backward from near the posterior margin of the carapace. It is about 300 microns long and has a slight posterior hook at the tip. It extends upward and backward approximately parallel to a line from rostral spine. There is a short lateral spine extending from each side of the carapace. These are more easily observed when looking at the animal from a dorsal view.

Appendages—The antennule is short and unsegmented with a tuft of three or four long hairs at the distal end. The spinous antenna is about 775 microns long. It is entirely smooth with the exception of the *anlage* of a flagellum located near the proximal end. In a front view the two

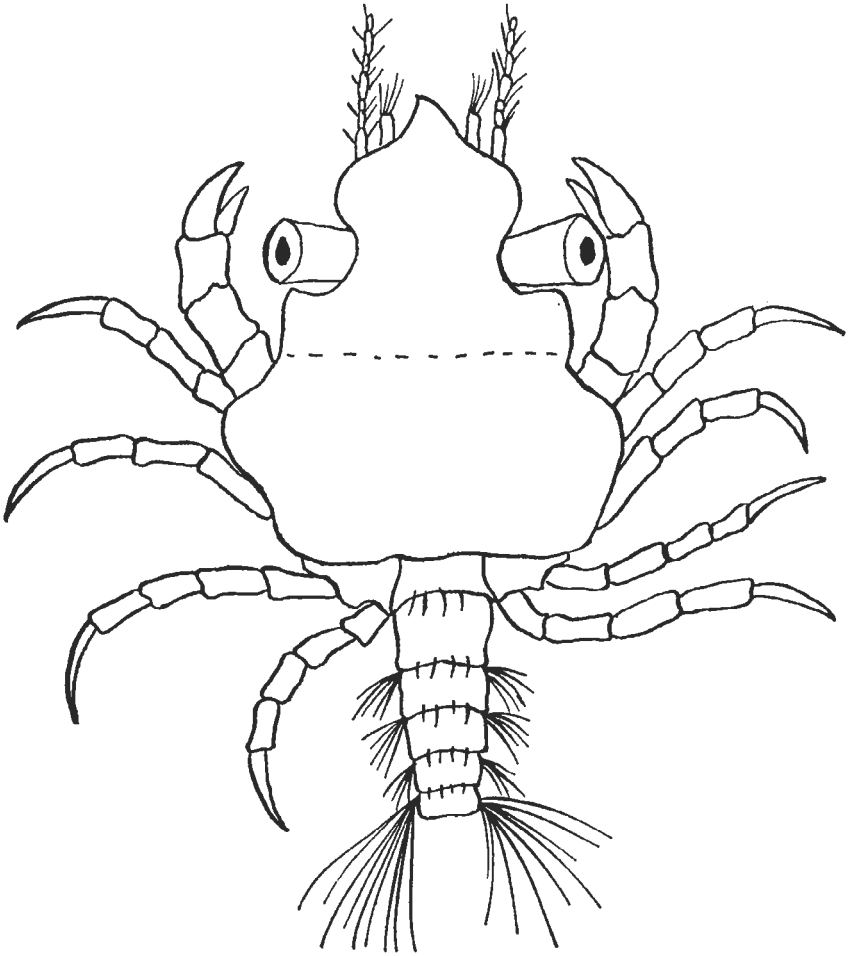


**PLATE III**

Megalops

antennae and the rostral spines project from the head almost parallel with one another. In preserved specimens the antennal spines diverge out at lateral angles. The mandible is scarcely discernible but the two pairs of maxillae can be seen under the ventral margin of the carapace. The first maxilliped (Plate II, Figure 1) is composed of a five-segmented endopodite with three terminal swimming hairs. There are short setae between each segment. There is a two-segmented exopodite with four long swimming hairs at the distal end. The second maxilliped (Plate II, Figure 2) is like the first except that the endopodite is smaller and has only three segments. The remaining appendages have not developed sufficiently to be evident.

Abdomen—There are five segments—the sixth being indiscernibly fused with the telson. There is a blunt process on the postero-ventral margin of the second segment. The fifth segment extends into a pair of long postero-lateral spines. The cornua of the telson are slender and greatly elongated (418 microns long) with a dorsal hook at the tip of each. There is a short dorsal and three barbed median spines on each cornu.

## SECOND ZOEA

(Plate I, Figure 2)

Carapace—The rostral spine has increased in length to about 1985 microns and remains smooth to the tip. The dorsal spine has become slightly arched and is about 500 microns long. The lateral spines remain the same as in the first zoea. Pigmentation of the cephalothorax under the carapace has darkened from an orange color to a brownish-orange.

Appendages—The eyes have become stalked. The antennule is still unsegmented and retains its tuft of three or four distal hairs. The antennal spine is now 930 microns long. The other features remain unchanged from the first zoeal stage. The mandible and the two maxillae remain as they were in the former stage. There are now six swimming hairs on the exopodite of the first maxilliped (Plate II, Figure 3) and seven on that of the second (Plate II, Figure 4). *Anlagen* of the third maxillipeds and the pereiopods can be seen.

Abdomen—A line separating the sixth segment from the telson has become slightly visible. The cornua of the telson are now about 465 microns long and the dorsal spine of each has become more evident.

## THIRD ZOEA

(Plate I, Figure 3)

Carapace—The rostral spine is now about 1500 microns long and remains smooth to the tip. The dorsal spine is 775 microns in length. Other features of the carapace have had a proportionate increase in size.

Appendages—The antennule is slightly larger. The antennal spines are now about 1394 microns in length. The exopodite of the first maxilliped (Plate II, Figure 5) has eight swimming hairs and that of the second (Plate II, Figure 6) has nine. The third maxilliped now shows as a three-segmented exopodite with several setae. The first pereiopod shows a chela. The other four periods are well started and *anlagen* of the pleopods are present.

Abdomen—The telson is now distinctly divided from the sixth segment. The ventro-lateral spines of the fifth segment are about 175 microns long or twice the length of the segment. The cornua of the telson are 542 microns in length. A fourth pair of median spines has appeared between the cornua.

## *FOURTH ZOEA*

(Plate I, Figure 4)

Carapace—The rostral spine is now 1643 microns long and remains smooth to the tip. The dorsal spine is 666 microns long. The lateral spines remain unchanged throughout the series.

Appendages—The antennule has become more conical and is segmented. The number of distal hairs has increased. The antennal spine is 1472 microns in length. The *anlage* of the flagellum located near the proximal end of the antenna has become a very evident spike. There are nine swimming hairs on the terminal segment of the exopodite of both the first and second maxillipeds (Plate II, Figures 7 and 8). Other features of these two appendages and those of the third maxilliped remain unchanged from the third zoea. The pereiopods are well developed and the pleopods have become biramous.

Abdomen—The blunt processes of the second segment described in the first zoeal stage have persisted throughout the series and have become horn-like in the fourth stage. The abdomen has added no new characters. The cornua of the telson are now 600 microns long.

## MEGALOPS

(Plate III)

Only three zoeae molted into the megalops. Two of these remained in the fourth and last zoeal stage three days each. The other remained as a fourth zoeal larva for five days. This extended time of the latter must have been due to infestation with the protozoan, *Zoothamnion sp.* referred to in Observations. The thoracic appendages of this megalops were deformed—being extended posteriorly. The two normal specimens were retained for further development. They are awkward and move slowly but feed well on the *Artemia* nauplii.

Carapace—The long rostral spine has been reduced to a short, ventrally bent projection between the stalked eyes. The lateral and dorsal spines are absent. The carapace is about 800 microns wide.

Appendages—They were not studied in detail.

Abdomen—The six-segmented abdomen is carried folded under the cephalothorax. It is 800 microns long.

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