A CONTRIBUTION TO THE BIOLOGY AND LARVAL DEVELOPMENT OF THE PISTOL SHRIMP, ALPHEUS CRASSIMANUS (HELLER)

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Larval stage of the pistol shrimp (*Alpheus crassimanus*) found along the shore at Karachi, (Manora Island, Buleji rocks and Break waters) was obtained by rearing the animal in the laboratory. The first larval stage is described and illustrated to help in their identification in the plankton. This paper also records the observations on the habit and habitat of the adult and larval forms.

Introduction

The morphology, physiology and habit of this common shrimp, which is popularly called "pistol shrimp" or "snapping shrimp" due to the noise it makes when picked or disturbed by any other animal, are intimately related to its environment. The structural adaptation of this animal to the conditions under which it lives is striking and is found to be of interest to the biologist. The present investigation on the life history and habit and habitat of the animal was undertaken during the winter of 1963. There is lack of adequate knowledge regarding the larval stages of the Decapod crustacea in this region. Previously no attempt has been made to rear various species of crustacea in Pakistan. The larval stage of *A. crassimanus* have been hitherto unknown. Gohar and Al-Kholy (1960) have reared some species of the family Alpheidae and obtained the larval stages from Red Sea. They discussed the larvae of *Alpheus ventrosus* (Herbst) and *Alpheus rapax* (Forsk). Banner and Banner[1] contributed to the knowledge of the Alphid shrimp of the Pacific Ocean. Coutiere[2,3], gave a note on *Alpheus edwardsi* and in 1906 recorded several species from Maldive and Laccadive Islands. The identification of the present species was made with the help of the key given by Barnard[4] in the descriptive catalogue of South African Decapod crustacea. Webb[5] described nine stages in the life history of *Alpheus ruber* (Maline Edwards) and two of *Athanas nitescans*.[6]

Gurney[7] described the first larval stage of *Alpheus ventrosus* and the last larval and first post larval stage of *A. pacificus* (Dana). Gohar and Al-Kholy[8] completed the study of the larval stages of *A. pacificus* and described nine larval stages in detail. Prasad and Tampi[9] have described the first larvae of *A. rapacida* (De Mann) and *A. strenuus* (Dana). It is previously recorded from Nicobar Island, coasts of India, East Indies, Red sea and Australia. The present work contributes to our knowledge of the larvae of Decapoda, helping in their identification in the plankton.

Material and Method

The collection was made from Manora Island, break water and Buleji rocks, Karachi, during May to November, 1963. Several female *A. crassimanus* kept in captivity in the laboratory of Marine Fisheries Department at West Wharf, were noticed to be carrying a large mass of light-green eggs underneath the abdomen. The eggs proved, on examination, to be fertile and in a late stage of development i.e. eye pigment of first larvae and the pulsation of its heart was noted. Some eggs removed from the abdomen, were placed in the sea water. The next day all the eggs appeared healthy and the embryos, in most cases, showed a fairly regular heart beat. The same day in the afternoon the eggs attached to the abdomen of female hatched into the first larval stage while those detached from the abdomen could not hatch at the same time. After three hours some of the eggs had burst the shell but the young had disintegrated. This shows that the eggs attached to the abdominal appendages get constant supply of oxygen through the agitation of water which is the basic necessity for its development. The young hatched directly from the egg on abdomen appeared quite vigorous. They were preserved in the 5% formaline to study their structure. Study was made after making permanent slides stained in borax carmine. The dissection of larvae was made under binoculor microscope to study the different parts. Drawing was made with the help of Camera lucida, habit was studied both in the field and in the aquarium in the laboratory. Several specimens were collected under stones at low tide and kept in captivity to study their behaviour under laboratory conditions.

Habit and Habitat

A. crassimanus is specialized for life on a shore of loose stones and soft substratum of sand or mud. It always relies on burrowing or remaining under stones to escape from its enemies. When placed in the aquaria with sand in the bottom, shrimps remained over it but when a stone is placed in the corner it always travels towards it to hide underneath. It walks with the help of its thoracic appendages but takes a fast leap backward, the pleopods at the same time beating rapidly. Minor chelae are scarcely used in defence while the big chela has a peculiar type of strong jerking movement with the help of which it attacks the enemy. It was observed in the laboratory that the bigger animals like crabs and other shrimps avoid the range of its attack and mostly remain at a distance. It was noted that the "pistol" if properly "fired" on any part of the body of enemy it either breaks it or at least causes some injury to it. In an aquarium one small fish and a shrimp were placed to observe the behaviour of both the animals. The fish attempted several times to take it but every time the shrimp 'fired' towards it till the fish caught it on the middle, smashed and ate it.

Although generally omnivorous like most Decapods, *A. crassimanus* appears to prefer animal food. The mud substratum it inhabits, contains many small worms, molluscs and crustaceans. In the laboratory it takes *Nereis* very willingly, while some dead crustacea are also acceptable to it when hungry. In the field some were caught while eating worms longer than themselves. The animal can withstand wide range of temperature and salinity. The water of the muddy shore at break-water with loose stones is found to be warm at mid-day and at low water it is more saline.

Rearing Experiments

Three rearing experiments were conducted during May to November, 1963. In these experiments berried female were collected and brought to the laboratory in polyethylene bucket with sea water. The shrimp were kept alive in the aquarium, (16″×18″) containing sea water. Only one animal at a time was placed in each aquarium as they break their limbs when placed together. This was also to ensure that the larvae found in an aquarium were spawned by the shrimp under observation. The sea water was changed frequently. The berried female was fed on flesh of crab in the beginning but afterwards when the spawn was mature, it refused any type of food.

First Experiment.—This took place from 23rd May to 1st June. Two berried shrimps were brought to the laboratory and were placed in different aquaria. The one with a comparatively mature spawn hatched after 5 days of captivity and during this time it could hardly eat any thing. The larvae were quite healthy and showed vigorous movement. Most of the time it had been swimming at the surface of the container towards the light. The shrimp was removed from the aquarium and was placed in another container. The larvae were preserved in 5% formaline. The next shrimp with an immature spawn could not hatch till the end. Every day it was examined and it was surprising to note that every day the bulk of attached eggs was reducing till it vanished from the abdomen. Neither the larvae nor the eggs were seen in the aquarium. It had to be concluded that in the absence of the food the animal had eaten its own eggs.

Second Experiment.—In this rearing experiment, 4th to 15th July, 13 shrimps were brought to the laboratory. Only one female was berried. It was kept in the aquarium. On the evening of 10th hatching took place. The larvae were placed in separate container. The larvae died in the first stage within four days, and were preserved in 5% formaline.

Third Experiment.–During 19th October to 15th November the female *Alpheus* was kept in captivity. This time proper food was provided to the female, but instead of taking the food it ate up its own eggs. On 25th the reduction in the mass of eggs was noted. Till 15th November there was no trace of either the larvae or the eggs in the water of the aquarium or in the abdomen of female.

Conclusions

In the light of above experiments we can conclude that if the spawn is mature there are chances of successful hatching, otherwise the immature spawn is taken by the female under captivity as its food, no matter what precautionery measures are taken to feed it. To rear the larvae successfully, suitable food and the prevention of crowding are necessary. Prevention from crowding is not a difficult job but the proper food could hardly be provided within the aquarium.

Eggs.—One hundred to hundred and fifty eggs were counted in each average-sized female shrimp. The viable eggs are light-green in colour. Observations were taken when the first larval stage hatched. Egg measures on the average 0.500 mm.

First Larval Stage

Measurement.—Length, (tip of the antennule to the tip of the telson) =2.5 mm.; Length of carapace=0.53888 mm.; Length of abdomen=0.7222 mm.; Length of telson=0.7431 mm.

Description.—The larva of *A. crassimanus* (Figs. 1 and 2) resembles the adult in general shape. It is perfectly transparent when freshly metamorphosed, except for the dark eyes and several red pigment spots on the thorax and abdomen. However, shortly after the hatching, several colour changes were observed. The eyes which are brown at first become almost black after some time. After undergoing its early development in the egg it hatches at a stage when all the periopods are present and are equipped with feathery exopodites and endopodites. This we call the first larval stage.[10]

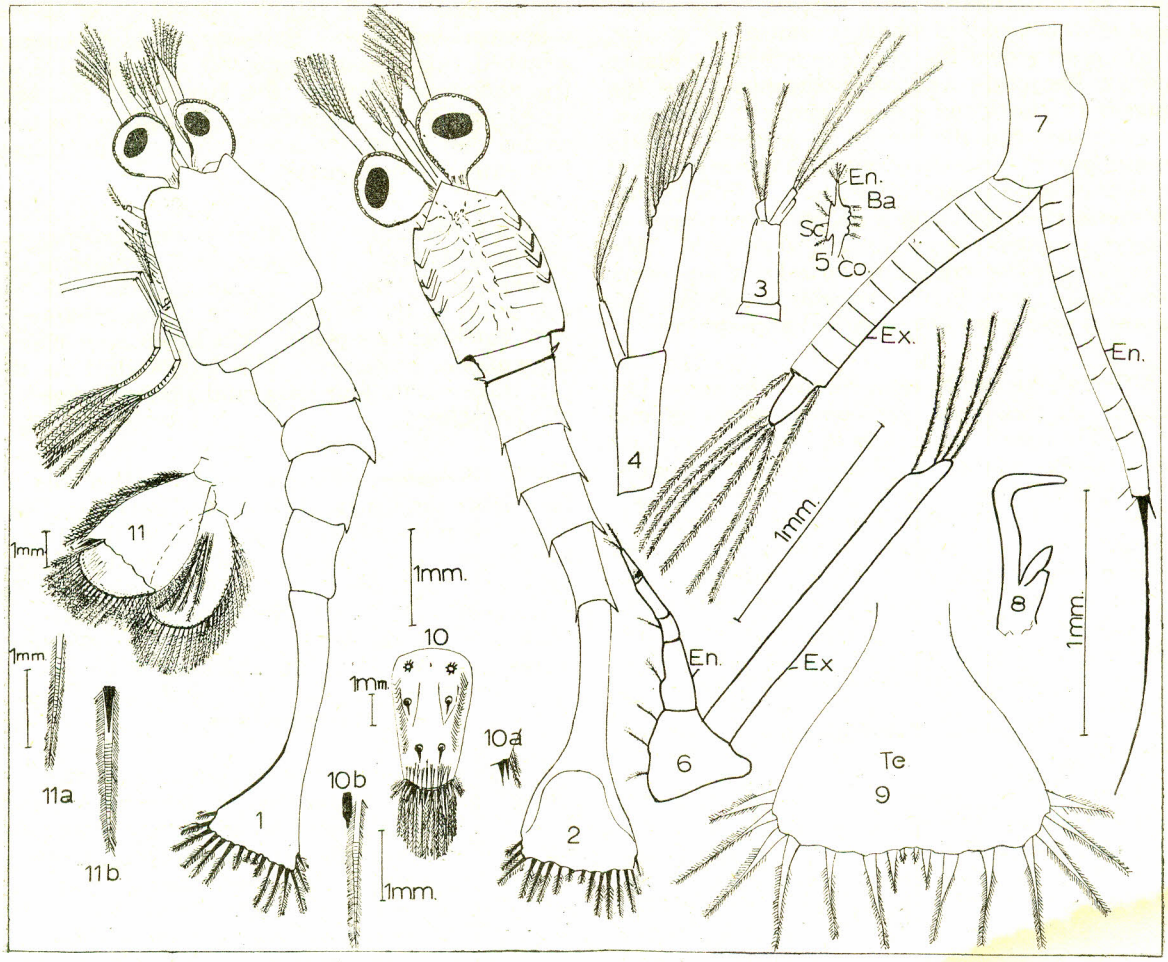

PLATE 1.—ALPHEUS CRASSIMANUS (HELLER) 1ST LARVA.

Figs. 1.—First larva (latero-dorsal view); 2 First larva (ventral view); 3 Antennule; 4 Antenna; 5 Maxilla; 6 First maxillipede; 7 Second maxillipede; 8 Third maxillipede; 9 Telson. Female *A. Crassimanus* (Heller); 10 Telson; 10 (a) Terminal margin (showing the spine); 10 (b) Distal marginal spine and hair position; 11 Uropodes and Exopod; 11 (a) Uropod hair; 11 (b) Uropod spine and hair position; **Abbreviations.** An.= Antennule; En.= Endopod; Max.= Maxillipede; Th.= Thorax Ant.= Antenna; Co.= Cona; Ex.= Exopod; Te.= Telson; Ur.= Uropod; Ba.= Basis; Sc.= Scophognathite.

The general shape of the body is elongated with a carapace which lacks the grooves and details of the mature adult. Unlike the ventral surface of the carapace the dorsal surface is smooth and curves gradually down to the lateral edges. The ocular lobe does not project much over the base of the eye stalks. The rostrum is very small, situated between the bases of antennules. (Figs. 1 and 2).

The body is clearly divided into two parts. The anterior part is covered by the carapace, which is slightly less than one-third of the body length. The posterior edge of the carapace is nearly straight and covers the basal portion of the maxillipeds. The narrower posterior parts is divided into abdomen of six segments and an unsegmented telson. The abdominal somites are provided with lateral spines. The junctions of the abdominal segments are marked by slight pointed abdominal spines. (Figs. 1 and 2) The telson is much more elongated but not forked, bears 16 spines, eight on either side of the midpoint. The spines are setose except their basal portion which is smooth. The central pair of spines is the smallest and is surrounded by a pair of slightly larger spines. The latter in turn are enclosed by 4 larger spines on either side. The spines on extreme ends of telson are small (Fig. 9)., Antennule (Fig. 3) is smaller than antenna; divided at the distal end, one bears 3 long plumose setae while the other smaller one bears only two plumose setae. Apical segment of peduncle produced into two flagella outer and inner, the outer bears three long plumose setae and the inner flagellum with two spines.

Antenna (Fig. 4) with exopodite and endopodite, the exopod, which is larger, bears eight long, plumose setae while the endopod is smaller and possess two comparatively smaller plumose setae. Endopod is slender, and bears two segments while the exopod is unsegmented. Scaphognathite (Fig. 5) with 12 plumose small setae. First maxilliped (Fig. 6) with short endopod which is segmented and bears two small plumose setae at the last segment and one at second segment; one at the first segment; three at the base. While the exopod is long and unsegmented, and possesses four long apical plumose setae at the terminal end.

Second maxilliped (Fig. 7) with endopodite segmented and ending in one long and two small spines, all are non-plumose; exopod segmented, bears a pair of long plumose setae at the base of last segment and four long plumose setae at the tip of the last segment (apical). Rudiment of third maxilliped with underdeveloped exopod and endopod is noted to be without any setae. The telson and uropod of the female *A. crassimanus* is shown in Figs. 10, 10a, 10b, 11, 11a, 11b.

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