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Research Article

Comparative Study of Appendages in Relation to their Habitat in Lobsters of Genus Scyllaridae and Palinuridae

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Abstract

A detailed study on the structure of appendages of two species *Panulirus ornatus* (rock lobster) belonging to the family Palinuridae and *Thenus orientalis* (sand lobster) of the family Scyllaridae has been carried out. Pigment variation in the appendages and the variation in the specific appendages have been noted and these changes were interpreted. Structural variation with respect to their mode of life has been discussed.

INTRODUCTION

Arthropods dominate our seas, land and air and have done so for hundreds of millions of years. Among the arthropods, crustaceans present us with a rich history of morphological change, much of which is still represented among extant forms [1]. Crustacea largely interact with their environment via their appendages; thus vast amounts of variation exist among the different appendages of a single individual and between appendages from different species. According to the St. Lawrence Global Observatory, lobsters prefer rocky ocean bottoms covered with algae. They can hide in the rocks, and the algae makes it easier for them to blend in. The algae also attracts food for the lobsters. When lobsters cannot find rocks, they will burrow into pebbles, sand, or clay. Lobsters stay at the entrance of their shelters, claws out so they can defend themselves.

Studies on the relative growths and morphometric characters of lobsters have been done by Backus [2] on *Panulirus interruptus* and Lyons [3] on different species of scyllarid lobster. Studies on the functional morphology of mouth parts and the pereiopods on *N. norvegicus* have been carried out by Farmer [4]. Some aspects of the fishery and biology of *T. orientalis* was done by Mohan [5]. Age and growth of the sand lobster *Thenus orientalis* (Lund) from Bombay waters was studied by Kagwade and Kabli [6]. Epithelial cytological studies and function in the digestive gland of *Thenus orientalis* (Decapoda: Scyllaridae) was carried out by Johnston et al., [6]. Molecular and morphological investigations of shovel nosed lobsters *Thenus spp* (Crustacea: Decapoda: Scyllaridae) in Thailand by Apinan Lamsuwansuk et al., [7]. In view of the extensive literature that has been published on spiny and Mud (sand) lobsters, there has been no detailed description of certain parts of the animal's anatomy, in particular the appendages. Hence, an attempt has been made on the comparative study of appendages in two species (*Panulinus ornatus* and *Thenus orientalis*) relating their adaptation to mode of life.

MATERIALS AND METHODS

The male and the female specimens of the species *Panulirus ornatus* (Fabricius) and *Thenus orientalis* (Lund) of the family Palinuridae and Scyllaridae respectively, were obtained from catches of the commercial fishing trawls operating in the costal water of the Bay of Bengal from the Visakhapatnam fishing harbor. The specimens collected were brought to the laboratory. The specimens of the species wise were identified and segregated basing on their color pattern and spines on the carapace. Sex wise were identified and also separated basing on their sexual dimorphism. All the appendages were carefully removed from the body segments; demarcations were noted and then photographed. The representative photographs presented in Figure 1-4.

RESULTS AND DISCUSSION

Characters of the species

***Thenus orientalis* (Lund, 1793): Flathead locust lobster**, Carapace flat, widest in front, distinctly narrowing posteriorly; lateral margins straight, with only 2 teeth, one at the end, the other in the anterior fourth, posterior ¾ without teeth. Anterior tooth forming part of the orbit, which is situated at the antero-lateral angle of carapace. Upper surface of carapace with numerous

Figure 1 Male speciesof Panulirusornatus (Fabricius).

Figure 2 Female speciesof Panulirusornatus (Fabricius).

Figure 3 Male species of Thenusorientalis (Lund).

small granules and a median carina with 3 sharp teeth; a sharp tooth behind the orbit. Anterior large segment of antenna with 3 sharp triangular teeth on inner half of distal margin, some small teeth at either side of these. Posterior large segment ending in a large, sharply pointed, inward curved tooth; outer margin with 3 smaller teeth. Abdomen granular with transverse groove over middle of each segment; fifth segment with a sharp spiniform tooth in the middle of posterior margin.

Pale yellowish brown in colour with the granules of a darker brown. Tips of the teeth whitish. Tail fan with a yellow tinge.

***Panulirus ornatus* (Fabricius, 1798): Ornate spiny lobster,** Carapace rounded, covered with numerous spines and tubercles of different sizes. Flagella of antennules longer than antennular peduncle, rostrum absent; bases of antennae separated by a broad antennular plate bearing 1 pair of principal spines anteriorly and a second pair, half the size of the first, in middle of the plate. Each abdominal segment smooth, without a transverse groove. Legs without pincers.

Bluish or greenish in color, spines on carapace yellow; anterior part of carapace on and near the bases of the frontal horns and the anterior spines with a vermicular pattern of pale and dark lines; abdomen with a broad, dark transverse band over the middle of the segments, each segment with a large pale spot on sides and an additional oblique elongate mark higher up on the second, third and fourth segments; no transverse white band along posterior margin of the segments; antennular flagella banded; legs with distinct, sharply defined dark and pale blotches.

As with virtually as other Malacostraca, there are five cephalic, eight thoracic and six abdominal segments, where cephalic and thoracic segments fused together to form a cephalothorax covered by shield like carapace. All the segments bear paired appendages and can be identified by those appendages. Apart from their individual color pattern, structures of their appendages are as follows:

Antennules: These are situated at the anterior end of the body immediately below the paired antennal spines. Each antennule consists of three segments and a pair of dorsoventrally flattened many jointed flagella which are deep brown in color. These carry chemosensory organs.

Antennae: Antennae are located next to the antennules, In *P. ornatus*, each antennae is composed of a protopodite of two segments and the basal segment called coxopodite, which are fused together and attached to the distal segment of the endopodite. The stridulating pad on the coxopodite is light olive green in colour, and the antennal flagellum is pale red in colour. The most striking feature of the flagellum is its extreme length, measuring up to 60cm and throughout its length it is spiny.

Figure 4 Female species of Thenusorientalis (Lund).

In *T. orienalis*, the coxa and basis of antennae are modified into peculiar 'flap-like'or 'shovel-like' structures bearing a no.of spines at their anterior ends. Antennae are the tactile organs.

Mandible: There are two mandibles one on each side of the Mouth. Each Mandible is a hard plate like structure with a palp of three segments. These are stout and triangular in shape.

Maxillae: These are thin and foliaceous. The protopodite bears soft hairs towards their edges. These are used to pass food back to the jaws for crushing and ingestion.

Maxillipeds: First Maxilliped is flat and thin, the two segments of the prtopodite appear as thin plates, their inner edges are fringed with setae. The function of this is as that of Maxillae. The second and third maxillipeds are leg-like, so that they can grip the food. Third Maxilliped is long and slender and extends towards the anterior margin of the antennular somite. The tips of the dactylus and propodus are setose, while ischium, merus and carpus bears on the inner side.

Pereiopods: Five pairs of walking legs or pereiopods are present as like the other lobsters. Pereiopod 1 is shorter than the succeeding, which are similar in form and size. The posterior half of the propodus and the entire dactylus are fringed with seate on the lateral margins. All the pereiopods end in a pointed dactylus except the fifth pereiopod of female.

Pleopods: Unlike the segments of cephalothorax, the segments of the abdomen are not fused. They are attached to each other in such a way as to allow flexibility to the body. The first abdominal segment is devoid of any appendage. So, the first pleopod is situated on the ventral side of the second abdominal somite. There are four pairs of pleopods (swimmerets) present in both the spiny and the slipper lobsters.

Pleopods of *P.ornatus* are brown in colour with a narrow pale yellow pigment margin. The pleopods of males have only exopod and an endopodite is absent. In *T. orientalis* both the male and female pleopods bear exopod and endopod. Structurally, the second pleopod of male is similar to the first pleopod. But in female, 4th pleopod is modified and reduced in size.

Uropod: The telson, not a true segment, forms a central portion of the powerful tail fan, but carries no appendages. This is flanked by the uropods, broad-flattened appendages, modified from the pleopods of the last abdominal segment. The powerful musculature of the abdomen and the blade like aspect of the tail fan are the adaptation of the backward swimming escape response common to all the lobsters.

Morphological differences in sex can be made out. In males, the paired genital openings are situated ventrally on the coxopodites of the fifth periopod which are greatly enlarged to form crescent shaped cups. The external sexual organs appear like fleshy pads, anteriorly broader with a tuft of short setae. The curved slit like opening of the external organs are protected by thin lightly closing chitinous tips arising from the pads. Because of the enlarged coxopodite, the last segment of the thoracic sternum is greatly constricted and longer than the female. There is no chela on the fifth dactylus. The pleopods have only the exopodites in *P. ornatus*, both exopodites and endopodites in *T. orientalis*. The third walking leg is the longest, helping in clasping the female during copulation.

In female, the paired genital openings are situated on the coxopodites, of the third periopods, the anterior margin of which is elevated and protected with chitinous flaps. The last segment of the thoracic sternum is not constricted. The pleopods have both the exo and endopodites. The fifth dactylus is chelate, formed by the two spur-like extensions of the distal part of the dactylus, and bears setae. It is used for scraping the surface of the spermatophore to release spermatozoa and in caring for the eggs attached to the underside of the tail. The third pereiopod is of normal size.

The appendages like maxilla are used in the crushing and ingestion of food. Maxillipedes [8], are used to grip the food. Periopods [9-11], are useful in walking. Pleopods also known as swimmerets help the animal to freely suspend or float in the respective habitat. Uropod acts as a powerful tail. Pigment variation is seen in each lobster species which state that each species can be morphologically differentiated. But the pigment variation within the sexes cannot be seen. As *Thenus orientalis*, the sand lobster is seen buried in the sand, was pigmented brown all over the body. Whereas in the other Palinuridae species we can see a lot of variation in the pigment distributed all over the body. The reason is that they are coralline forms.

CONCLUSION

Studies of the preferred ecological habitats within one genus show that each species has peculiar environmental requirements within a generally acknowledged sympatric area. The substrates selected by lobsters vary from thick, soft mud suitable for burrows to rocky or cobbled areas to reefs of limestone or coral. *Panulirus ornatus* occupy the sea ward and landward lagoon areas [4]. Many slipper lobsters are found on soft substrates and this has been confirmed by George and Griffin [5]. The suitability of a habitat is a function of the physiological tolerances of the animal and the presence of food, suitable substrate, predators and competitors. The characteristic colors of lobster are due to the presence of carotenoids, mainly astaxanthin, lying in the pigmented layer just beneath the epicuticle of the exoskeleton.

The palinuridae exploit a limestone and coral reef habitat with sandy bottoms. Shelters cannot be made very easily and the most common shelter available consists of crevices and ledges that cannot be defended very effectively by sealing off a narrow entrance with two broad claws. For open shelter defense it appears more effectively to present led to the palinurid morphological development of greatly enlarged, strong and spiny antennae, and to the behavioral development of the communal sheltering. Ogren [6], has suggested that the flattened antennal appendages and the flanged later-carapacial surfaces of scyllarides, commonly thought to be used for burial in soft substrates, are a development that affords protection by concealing the animal on the hard substrates on which it is collected.

Part from their coloration, structure of antennae and pleopods, there is no significant difference in the structure of appendages in these two lobsters. The spiny and slipper lobster, have remarkably similar morphological features. This, and the similarities of their behavioural ecological and larval characteristics, strongly suggests the close affinities of these two families.

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