

RECORD OF *ATHANAS INDICUS* (COUTIERE) (DECAPODA : ALPHEIDAE)
ASSOCIATED WITH *STOMOPNEUSTES VARIOLARIS* (LAMARCK)
(ECHINODERMATA : ECHINOIDEA) FROM VISAKHAPATNAM COAST

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The alpheid shrimp *Athanas indicus* associated with the sea urchin *Stomopneustes variolaris* is reported from the Visakhapatnam coast and it is the first record of this species from the Indian peninsula. The barnacle *Balanus amphitrite*, a parasitic gastropod of the family Stiliferidae, and the goby *Koumansiasis macrocephalus* are reported as other symbionts of the sea urchin. The association of the shrimp and the goby is related with their feeding habits. Experiments have shown that they find their host by photoreception. The association of the snails may be related with their breeding habits as they were never collected without their egg masses. In spite of the ubiquitous settlement of barnacles, the occurrence of *B. amphitrite* is reported because of its successful attachment on the test of the sea urchin.

INTRODUCTION

Studies on animal associations in the marine environment are very extensive, but these studies from Indian waters are attempted intensively only in the recent years by Jones and his associates (Jones, 1959, 1960, 1964; Jones and Mahadevan 1965; Jones and Sankaran Kutty 1960) and Mahadevan and Nagappan Nair (Mahadevan and Nagappan Nair 1965 *a, b*; Nagappan Nair and Mahadevan 1965 *a, b, c*). The surface of the echinoderm body, in spite of a number of protective devices such as spines and pedicellariae, forms an attractive niche for a variety of symbionts ranging from protozoans to fish (Hyman 1955; Davenport 1966 and Dales 1966). While engaged in the studies on the biology of the sea urchin *Stomopneustes variolaris* (Lamarck), a few symbionts were found cohabiting the sea urchin. The present paper deals with the symbionts of the sea urchin along with some observations on their relationships with the host urchin.

OBSERVATIONS

Athanas indicus (Coutiere) (Fig. 1)

There are atleast 30 species of the genus *Athanas* Leach, from the Indo-pacific region and 13 of them are from the Indian Ocean region. But only two species, *A. polymorphus* Kemp (Kemp 1915, from Chilka Lake) and *A. dorsalis* (Stimpson) (Sankaran Kutty 1962, from Gulf of Mannar) are on record from the Indian peninsula. In the present paper the authors report a third species, *A. indicus* (Coutiere), associated with the sea urchin *Stomopneustes variolaris* (Lamarck) from the Visakhapatnam coast and this is the first record of this species from the Indian peninsula. This shrimp has previously been reported from the sea urchins belonging to the genera *Echinometra*, *Diadema* and *Anthocidaris*.

Several specimens of *A. indicus* associated with the sea urchin *Stomopneustes variolaris* have been collected from the rocky shores of Kailasa hill, Waltair, Yarada and Pudimadaka along the Visakhapatnam coast.

The shrimps are of uniform dark pink colour appearing almost black, with a narrow white line on the middle of the outer surface of the palm running parallel to its long axis and a transparent line on the first five abdominal pleura. The total length ranged from about 6 to 20 mm.

Except for the following variations, the specimens agree with the previous descriptions (Banner and Banner 1960; Miya and Miyake 1968). The outer antennular flagellum is 5 to 18 segmented, most with 12 to 15. The diminutive appendix masculina on the endopod of the 2nd pleopod of females (three out of four) reported by Miya and Miyake, was noticed in more than 90 per cent of the females (31 out of 34).

ECOLOGY

The shrimps were found to dwell amongst the spines of the ambital region or in the space between the oral flattening and the rock. Usually one to two individuals and occasionally three were found to inhabit an urchin. The shrimps were found to cling to the spines of the urchin or to the rocks, with their thoracic legs 3, 4 and 5, while the first legs are extended forwards and the second pair folded underneath the body. The shrimps are agile and escape quickly, when the urchin is disturbed, on to a nearby urchin or retreat into a crevice.

Johnson (1969) observed, in the banded cleaning shrimp *Stenopus hispidus*, that the stranger shrimps of the same sex when paired were very aggressive and fought to death, while those of opposite sex form breeding pairs after initial fighting. Though *A. indicus* occurs often in pairs, no such behaviour is found and they may not occur in male female pairs. It is, however, seen that specimens of *A. indicus* clamour for a few minutes to hide themselves one underneath the other and aggregate at a corner into a clump.

To know whether there is any chemoreception involved in host-finding, as in the case of the polynoid *Arctonoe fragilis* and the star-fish *Evasterias troschellii* (Davenport 1966), the modified Y-tube olfactometer of Davenport was used. The results of the experiment are shown in Table I.

The Table shows that 2/3 of the individuals gave 'O' reaction while the remaining 1/3 gave +ve and -ve responses with nearly equal frequency.

To know whether the shrimps find their host by photoreception, the observations of Dix (1969) were repeated. The shrimps were released at a distance of about one foot from the urchin and their movements observed. Soon after their release they swam on to the urchin within seconds. Out of the 36 specimens released in batches, each of four to five, only one small individual has taken the maximum time of one minute to notice the urchin.

From the above two observations it is clear that the shrimps find their host by photoreception. The advantage of photoreception is that they can find the hosts more quickly than when dependent on chemoreception (Dix 1969).

TABLE I
Results of the Y-maze experiments*

Reaction	No. of Specimens		
	Kailasa Hill	Pudimadaka	Total
0	14	10	24
+ve 0	3	2	5
+ve —ve	2	0	2
—ve, 0	2	3	5
Total	21	15	36

*Maximum time allowed for each run is ten minutes. A second run was made when a positive or negative response is recorded to ensure that the response is not due to any cause other than chemoreception.

Balanus amphitrite amphitrite (Fig. 2)

Only a single urchin with two barnacles of 5 and 7 mm. in diameter respectively at the base, was collected from Mukkam, a few miles North of Visakhapatnam. Eight smaller barnacles and a few cypris stages were found settled on the larger ones.

Stiliferid (Fig. 3)

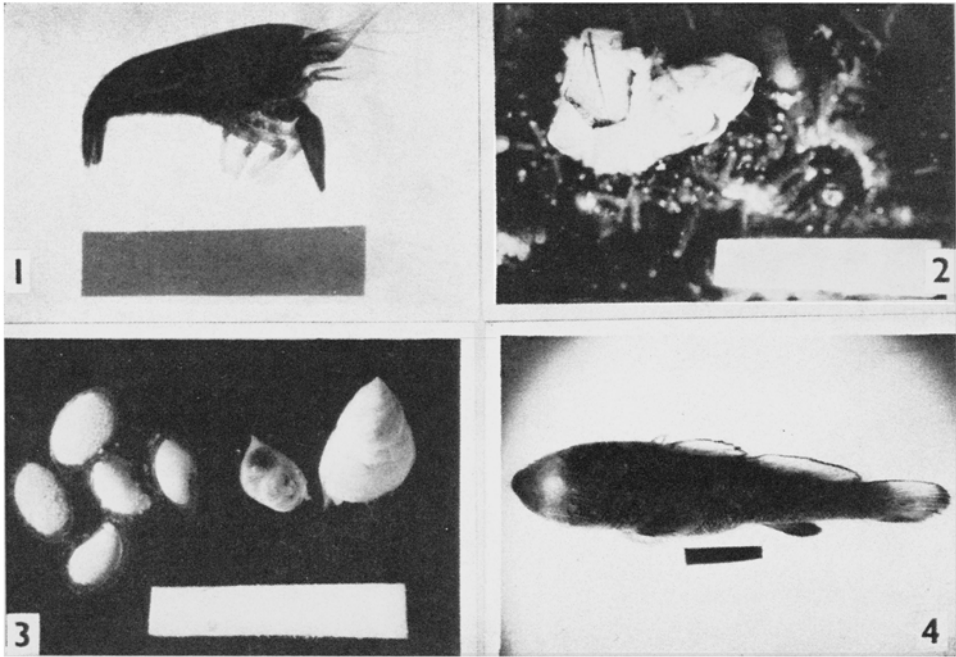
The stiliferids have white translucent glossy shell. These were found in pairs, in small depression made on the test. Each pair consisted of one larger and one smaller individual. They were always found along with their egg cases fastened to the small spines surrounding the depressions. The depressions are clean without any tissue. The specimens were collected during March and April of 1969 from the shingle beach of Waltair.

Koumansiasis macrocephalus (Fig. 4)

These gobioid fishes were found moving amongst the spines of the sea urchin at Kailasa Hill, Waltair, Yarada and Pudimadaka shores. These are black in colour, ranging in size from 1.5 to 6 cm. in total length. Like the shrimps, these fish escape quickly when the urchin is disturbed. All the ten individuals used in the Y-maze experiment gave 'O' reaction at the end of 30 min, but quickly swam to the urchin when released in a tray. So, it is concluded that these also find their hosts by photo-reception. This fish was previously collected only once from a rock-pool (Rao 1968).

Host-symbiont relationships

The dark colour of the shrimp, matching with the colour of the sea urchin, makes it difficult for the enemies to notice its presence. They are also protected



FIGS. 1-4. (1) *Athanas indicus* (Coutiere); (2) *Balanus amphitrute amphitrute*, amongst the spines; (3) Stiliferids with egg masses; (4) *Koumansiasis macrocephalus* Rao.
(NOTE : The paper strips in all figures are of 1 cm length).

from its enemies by the spines of the host when on the test and are not at all noticeable when present in between the oral flattening and the rock. The faecal pellets of the shrimp consisted of algal bits. As the host urchin also is a herbivore, grazing on the algal vegetation, the shrimp gets its food along with the sea urchin protected by the latter. The shrimps were found among the spines and tube feet of the oral side, when exposed during the low tide. Thus they may be getting protection against the problems of temperature and desiccation.

As the barnacles are known to occur ubiquitously on a variety of substrata, their occurrence on the sea urchin test, may be, merely accidental. The barnacle *Ulophysema oresundense* was reported to parasitise the heart-urchin *Echinocardium cordatum* in the Oresund (Brattstrom, 1936). Boolootian (1964) reported that *Balanus concavus pacificus* settles abundantly on larger specimens of the sand-dollar *Dendraster excentricus*. Moore and McPherson (1963) reported the occurrence of *Balanus trigonus* on *Tripneustes esculentus* and *Lytechinus variegatus*. But the settlement of *B. trigonus* does not seem to be successful, as one of the two specimens collected dropped off when placed in formalin, and in both, the area of the test underneath the barnacle is intact and the tissue undamaged. But in the present case the area of the test where *B. amphitrute* settled is clean and devoid of soft tissue, and thus *B. amphitrute* seems to be more successful than *B. trigonus*. From this point of view its occurrence on *S. variolaris* is reported here.

The stiliferids were always collected along with their egg masses and never without them. Their association with the sea urchin may, perhaps, be related with the breeding habits of the stiliferid, as in the case of the gastropod *Epitonium* sp., and the coral *Fungia* (Bosch 1965).

The gobioid fishes are black in colour and match well with the dark colour of the host urchin. The gut contents of the fish consisted of small organisms such as copepods, isopods, tanaidaceans, chironomid larvae and sometimes small crabs, all found to inhabit the algae on which grazes the sea urchin. The fish while feeding on its food, if threatened, finds its way to the sea-urchin and thus gets protection from the spines of the host and by the concealing colouration.

CONCLUSIONS

The association of the symbionts with the sea urchin is in no case beneficial to the urchin, and in no case obligatory. To make the relationship of the symbionts with the urchin clear, they have been categorized into the following types based on the definitions of Cheng (1967).

Type of the association	Symbiont	Advantages to the symbiont
Commensalism	<i>A. indicus</i> <i>K. macrocephalus</i>	(a) Protection by concealing colouration and protection by the spines. (b) Food associated with the host.
Parasitism	Stiliferid	(a) Adults feed on surface tissue and are protected by the spines. (b) Eggs firmly fastened to the spines and are protected by the spines.
Phoresis	<i>B. amphitrite</i>	(a) Provided with substratum and incidentally protection also.

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