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# Symbiotic Association between *Athanas dorsalis* (Alpheidae) and *Stomopneustes variolaris* (Echinoidea) from Visakhapatnam Coast, India

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**Abstract** The alpheid shrimp, *Athanas dorsalis* (Stimpson, 1865) is reported for the first time at Bay of Bengal (Visakhapatnam, east coast of India). The present study reports a new association between the rock boring intertidal dwelling sea urchin *Stomopneustes variolaris* (Lamarck, 1816) and the alpheidae, *A. dorsalis*. These shrimps were found among the spines between ambital region and oral end, preferring more towards oral surface. One to three individuals were found to inhabit sea urchins of diameter in the range of 48 mm to 76 mm. The black colour of the shrimp renders it cryptic by being camouflaged with the similar colour of the spines of the host. Thus the shrimp is protected from the predators. Also the shrimp derives its food from the algal bits nibbled by the host. The host does not seem to have any obvious advantage out of this association. Hence the relationship between the host and the shrimp is commensalism.

***Keywords:*** *intertidal region, symbiosis, alpheidae, cryptic, echinoidea*

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## 1. Introduction

Sea urchins (Echinoidea) provide a specific ecological niche for variety of organisms including, ctenophorans, turbellarians, polychaetes, molluscs, copepods, shrimps, crabs, ophiuroids and fishes [1,2,3,4]. The spines of the sea urchins provide refuge to these associated organisms from predators. These associations may be either facultative or obligatory. Shrimps belonging to the families Palaemonidae, Gnathophyllidae and Alpheidae are mostly commensals [5]. The alpheid shrimp genus *Athanas* (Leach, 1814) presently includes over 40 species in the eastern Atlantic and Indo-West Pacific region [6]. Most species inhabit coral reefs and rocky or muddy-sandy bottoms and some species live in symbiosis (commensalism) with other animals, such as thalassinideans, stomatopods and echinoderms [7-14].

The present study reports for the first time the occurrence and the association of Alpheid shrimp, *Athanas dorsalis* (Stimpson,1865) with the sea urchin, *Stomopneustes variolaris* (Lamarck, 1816), a tropical, rock boring, Indo-Pacific echinoid found in the intertidal region of Visakhapatnam. The significance of this association is discussed. The features of this association are compared with other symbiotic species reported earlier.

## 2. Material and Methods

**Figure 1.** Sea urchin Stomopneustes variolaris

Sea urchins were collected with the help of SCUBA divers between August and October 2012 from the rocky areas of the intertidal region of Visakhapatnam, 17°14' 30"N and 83°16' 25" E (east coast of India) during low tide. The collected sea urchins *S. variolaris* (Figure 1) were put into separate plastic bags and taken to the laboratory alive. The maximum diameter was measured perpendicular to oral-aboral axis using Vernier calipers and the shrimps associated with sea urchins were separated with tweezers. Their size (length from the tip of the rostrum to the posterior margin of the telson), sex (the appendix masculina on the endopod of the second pleopod is the main distinctive character of a functional male) and stomach contents were examined under compound microscope. Subsequently, shrimps were preserved in 70% ethanol.

# 3. Results

## 3.1. Description of the Symbiont *Athanas Dorsalis* (Figure 2a, b)

*A. dorsalis* is a small shrimp found clinging to sea urchin spines between ambital regions and oral end, preferentially more towards periphery of the oral surface. The length of the shrimp varied from 10 mm to 18 mm. The carapace was smooth and the rostrum was lanceolate in shape, reaching to the end of second antennular article. The ratio of the length to the breadth of the rostrum varied from 1.0 to 1.8. Extracorneal teeth were well developed. The supra and infracorneal teeth were absent. Stylocerite was curved inward with pointed tip. Scaphocerite was broad, reaching to end of antennular peduncle. Carpocerite was stout and as long as scaphocerite. First pereiopods were dissimilar in size and were chelate. Second pereiopods were with four carpals. In the third pereiopods, dactyls were provided with biunguiculate processes. Telson was 3.0-4.0 times as long as its breadth at the tip.

**Figure 2 (a).** Shrimp *Athanas dorsalis*

**Figure 2 (b).** Shrimp associated with *Stomopneustes variolaris*

## 3.2. Description of the Association

Out of the 51 shrimps 25 were males and 26 were females. Both male and female shrimps were together found in 17 specimens. Only males were seen in 5 sea urchins whereas only females were seen in 8 sea urchins. 4 out of the 17 sea urchins had paired shrimps. Also they had an additional shrimp at some distance, 3 being males and 1 female. The diameter of the sea urchin collected ranged from 30 mm to 80 mm. Out of these, shrimps were found to be associated with sea urchins of diameter ranging from 48 mm to 76 mm only (Figure 3). The average length of the shrimp *A.* dorsalis was (14.8 ± 2.5) mm. The number of shrimps associated per sea urchin were 1 to 3.

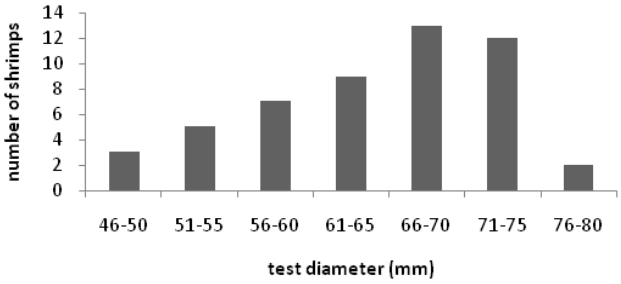


**Figure 3.** The relationship between the test diameter of *Stomopneustes variolaris* and the number of shrimps, *Athanas dorsalis* associated with sea urchin

# 4. Discussion

Organisms with an obligate symbiotic life style are restricted in their distribution and abundance by the availability of suitable hosts. Factors such as host morphology, size and distribution patterns are likely to affect symbionts abundance per host individual (intensity) and percentage of hosts occupied (prevalence) [15].

Several alpheid shrimps of genus *Athanas* (Leach, 1814) are found as commensals on sea urchins; *A. kominatoensis* (Kubo, 1942) associated with *Anthocidaris crassispina* (Agassiz, 1863s), *A. indicus* (Coutiere, 1903) and *A. acanthocarpus* (Miya and Miyake, 1968) with *Echinometra mathaei* (de Blainville, 1825) [7].

*Athanas dorsalis* is another pan-tropical shrimp found to be associated with various sea urchins species including *Heliocidaris erythrogama* (Valenciennes, 1846), *Heliocidaris tuberculata* (Lamarck, 1816), *Centrostephanus tenuispinus* (Clark, 1914), *Centrostephanus rodgersi* (Agassiz, 1863), *Tripneustes gratilla* (Linnaeus, 1758) and *Echinothrix diadema* (Linnaeus, 1758). Its association with sea urchin *S. variolaris* as commensal was reported in the Madgascar region [16], in Japanese waters [7] and in Gulf of Mannar, India [17]. In addition the present study reports the association between *S. variolaris and Athanas dorsalis* off the coast of Visakhapatnam, Bay of Bengal, India.

The intraspecies association of crustaceans on their hosts is likely to depend on host size, morphology, distribution and abundance [18]. The intensity and prevalence of the crustaceans-invertebrate association is diverse. Many species inhabit their host as single individual [18], while others occur in heterosexual pairs [19] or in groups of variable numbers on their hosts [20]. In the present study the association of species *A. dorsalis* with the host is found to be single or heterosexually paired or a single male or female in addition to and at some distance from the original pair. When the two pairs of *Athanas dorsalis are* associated with a single host they are distributed at the opposite ends maintaining some distance [21]. In the present study the association is restricted to single pair only.

The caridean shrimp *Gnathophylloides mineri* (Schmitt, 1933) lives in small aggregation on its host *Levicaris*

*mammillata* (Edmondson, 1931) often consisting of a male with several females and female aggregates around males (Patton et al, 1985). No such specific distribution of male and female was noticed in our study. As test diameter is increased the number of shrimps associated is also increased. The maximum number shrimps seen in a single sea urchin were found to be three in the test diameter range of 66 mm to 75 mm [22]. In the present study the female: male sex ratio is 1.04:1 slightly deviated from standard 1:1 ratio, with females predominating over the males. Similar observations were noted in *G. minera*, associated with *L. mammillata* and *A. indicus* in *E. mathaei* [9,22].

Due to predator's pressure in intertidal region *Athanas dorsalis* seems to utilize the sea urchin spines as a suitable refuge. Its protection is enhanced when its host *S. variolaris* burrows in rocks and crevices during day time and is active at night when predation is less intense. Added to this the shrimp prefers oral surface of the host thereby preventing its exposure to predators. Similar type of observation was noticed in the association of *Athanus indicus* and sea urchin *E. mathaei* [9].

The dark black colour of the shrimp *A. dorsalis* matches with that of sea urchin *S. variolaris* spines, thus being camouflaged by the latter. This makes the predators difficult to detect the shrimp and thus it is protected. Similar camouflage is seen in association of *G. mineri* with *Tripneustes gratilla* (Linnaeus, 1758) [23] and *A. indicus* with *E. mathaei* [9].

The constant presence of shrimp, A. dorsalis on the oral surface of the sea urchin suggests that the two partners share common foraging areas and the main dietary input for *A. dorsalis* is crumbs from sea urchin meal. Some sea urchins like *G. mineri* feed on the epithelium covering the sea urchin spines [9] while *A. dorsalis* does not seem to feed on the epithelium as the epithelium on spines and test are found to be intact and gut content did not reveal the same.

The significance of this association is that *A. dorsalis* derives the benefit of food and protection from the sea urchin. To support this contention, the gut contents of both the host and symbionts were found to be same i.e. algae. Also the positioning of the *Athanas dorsalis* in the oral end supports this view. Regarding protection from predators the camouflaging effect of the colour of the host and that of the shrimp supports this contention. There is no evidence that the host derives any benefit out of this association. Hence the type of association is commensalism.

## 5. Conclusion

The occurrence and association of alpheid shrimp *Athanas dorsalis* with sea urchin *Stomopneustes variolaris* is reported for the first time from Visakhapatnam coast. The association primarily is for the food and protection of the symbionts. The species specificity between the two is also suggested as *the S. variolaris* is not found to be associated with any other species of shrimp in the present study. The type of association is considered as commensalism.

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The authors declare that there is no conflict of interests regarding the publication of this paper.

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