



DISTRIBUTION AND NEW ADDITIONS TO THE CLASS: HOLOTHUROIDEA IN THE GULF OF MANNAR ISLANDS, INDIA

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ABSTRACT

Holothurians are commercially important echinoderms, included in the Schedule – I category of the ‘Wildlife Protection Act, 1972’. The present status of holothurians in terms of diversity and distribution has been studied from 5 different islands in Gulf of Mannar Marine National Park. Ecological observations of 8 species of Holothurians (*Bohadschia marmorata*, *Holothuria atra*, *Holothuria edulis*, *Holothuria leucospilota*, *Actinopyga miliaris*, *Stichopus horrens*, *Pseudocolochirus violaceus*, *Synaptula media*) under 6 genera and 4 families, of which two species (*Stichopus horrens*, *Synaptula media*) are reported for the first time in shallow reefs at Gulf of Mannar as well as in Indian coast. The community structure was evaluated using standard ecological parameters such as percentage of cover, species richness (SR), Shannon index (H') and evenness index (J').

KEY WORDS: *Synaptula media*, Holothurians, Thoothukudi, Vembar, Gulf of Mannar.

INTRODUCTION

Holothurians or sea cucumbers are a fascinating and conspicuous group of marine animals of the ocean littoral zone and common in tropical and temperate regions. They live chiefly among corals but are also found among rocks and in muddy and sandy flats. They are distributed from the shore to the greatest depths. Their lengths range from a few millimeters to more than 2 m and they occur in all color combinations: white, black, red, blue, green, yellow, violet etc. Some of them are really very beautiful while alive and are in great demand for aquaria. The product *Beche-de-mer* derived from processed holothurians is commercially important and considered as a delicacy in China, Japan and Korea. Besides, the sea cucumber has aphrodisiac qualities and the pharmacological properties for treatment of high blood pressure, muscular disorder and cholesterol problems (James, 1998). According to FAO's annual statistics for 1984, the world echinoderms harvest in 1983 amounted to approximately 80,000 tonnes. For the past several years, the Palk Bay and the Gulf of Mannar with their potential of sea cucumber resources supported this industry in India (Raghunathan, 2008).

Around 1400 species of holothurians have been reported from various parts of the world oceans. In Indian waters, nearly 200 species belonging to 6 orders and 16 families have been recorded of which 31 species alone have been reported from the Gulf of Mannar and Palk Pay. Among them 12 species such as *Actinopyga miliaris*, *A.mauritiana*, *A. echinites*, *Bohadschia argus*, *B.marmorata*, *Stichopus chloronotus*, *S. variegates*, *Thelenota ananas*, *Holothuria nobilis*, *Holothuria atra*, *H.scabra* and *H.spinifera* are commercially important (James and James, 1994).

Considerable amount of literature is available on the holothurians of Indian Seas since the pioneering study of Coiller (1830). Thurston (1887) described 7 and 16 species

of holothurians in Rameswaram and neighbouring islands respectively. Thurston (1894) also reported 10 species of holothurians from intertidal and shallow waters of Tuticorin and Pamban region of Gulf of Mannar. Subsequently several studies were made in Indian waters on Echinoderms, in general or holothurians in particular by various authors. Among them, studies on holothurians from Andaman (Bell, 1887, Rao, 1973, 1975, Soota *et al.*, 1983), Rameswaram (Bell, 1889, Thurston, 1887), Krusadai and neighbouring islands (Gravelly, 1927), Chennai (Gravelly, 1941), Gulf of Kachchh (Gideon *et al.*, 1957, Gopalakrishnan, 1969), Mumbai (Sane and Chhapgar, 1968), Waltair (Rao, 1968), Kanyakumari (Mary Bai and Ramanathan, 1977), Malvan (Parulekar, 1981) and Lakshadweep (Mukhopadhyay and Samanta, 1983) were also significant contributions to holothurian diversity. Apart from these, studies on holothurian taxonomy (James, 1967, 1968, 1986a and b), resources and its industry (James, 1973, 1983, 1986c, 1989, 1991, 2001, James and Baskar, 1994) and zoogeography (James 1986a, James *et al.*, 1993) are also worth mentioning.

The status of holothurians was assessed in 6 islands along the Thoothukudi coast, Gulf of Mannar. In Gulf of Mannar, 21 islands located between Rameswaram and Thoothukudi covering an area of 623 ha have been declared as Marine Park by Ministry of Environment and forest, Government of India and Tamil Nadu Forest Department. About 3600 species of flora and fauna have been recorded in this area. This area also harbours rare and endangered species of sea turtles, dolphins, dugong and whales. More than 600 species of fishes have been recorded from the Gulf of Mannar.

MATERIALS AND METHODS

An extensive survey of Holothurians was conducted during 2007 to 2008 in various regions of the Gulf of

Mannar Biosphere Reserve. SCUBA gears were used for surveying the sub-tidal regions. The surveys were carried out in the Vembar group of Islands (Upputhanni, Puluvichalli and Nallathanni) and Tuticorin group of Islands (Van, Koswari, Kariyachalli and Vilanguchalli) in the Gulf of Mannar. The patchy reef area other than the island periphery was also surveyed; locally known to be Mainland. Organisms were observed and photographed underwater (Canon Power Shot S45 with underwater housing). Specimens were not collected as the study area falls under the marine protected area. The length of the animal mentioned in this work is the maximum length of the crawling animal measured underwater. Characters used in this study for the identification of species are: general shape and body profile; colour and pattern; morphology of foot and foot sole and oral tentacles.

Quantitative data were obtained at each dive site by using the adapted belt transect method (Bianchi *et al.*, 2003) counting all the species observed along 5 transects of 2 m width (including 1 m on each side of the diver) at depths upto 20 m. The data obtained through the study were analyzed with several biological indexes such as species richness (SR, the total number of species observed), abundance (the number of individuals of each species), the Shannon index (H' , calculated as $H' = - \sum p_i \log_2 p_i$, where p_i is n_i / N , n_i is the number of individuals of the i th-species, and N is the total number of individuals), and the evenness index (J' , indicating how the abundances are partitioned

across the species). Density measurements (colonies/m²) were obtained by estimating a surface area of about 100m² for each transect, which was calculated considering the width of the belt of observation (2m) and the length of the transect of about 50 m. Underwater photographs were made with a Canon S45 digital camera.

RESULT

A total of 8 species of holothurians under 6 genera and 4 families were identified from the study location of which 2 species (*Stichopus horrens*, *Synaptula media*) of holothurians were reported for the first time in Gulf of Mannar Islands as well as in India. 5 species were observed in Van Island of which *Holothuria atra* was maximum (39.58 % ± 4.3) and *Actinopyga miliaris* minimum (6.82 % ± 3.1). In Koswari Island, 6 species were reported, 5 species in Kariyachalli Island, 8 species in Upputhanni Island, 7 in Pulivichalli Island and 5 species in Nallathanni Island. Maximum and minimum percentage cover of Holothurians is presented in figure 1. The underwater photographs taken from the study sites during the study period are presented as plates numbered 1&2. *Holothuria atra*, *Holothuria edulis*, *Holothuria leucospilota*, *Stichopus horrens* and *Actinopyga miliaris* were observed in all the study station, but *Synaptula media* was observed at only one study site, Upputhanni Island, Vembar group, Gulf of Mannar.

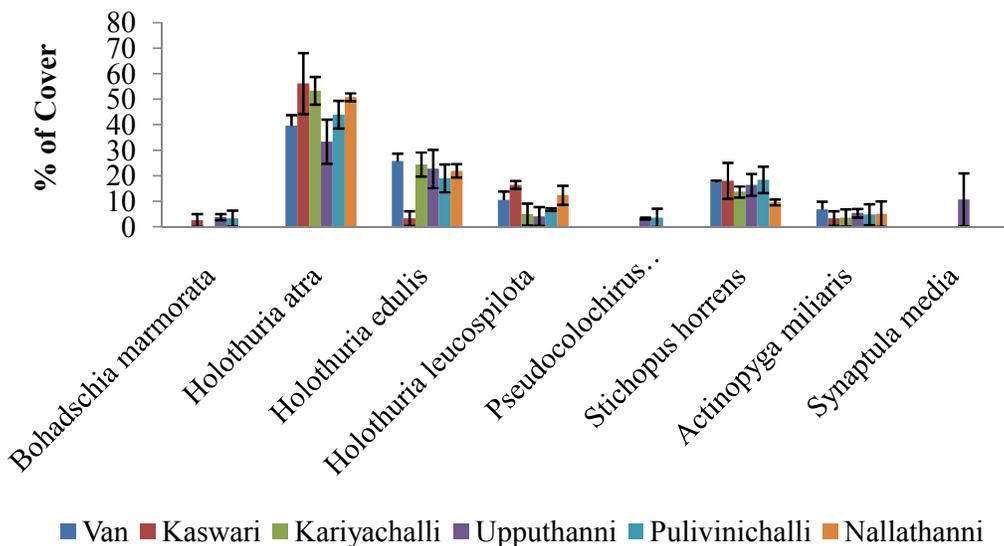


FIGURE 1: Mean percentage cover (± standard error of mean) of Holothurians at Thoothukudi and Vembar group of islands, Gulf of Mannar.

Species diversity index studies were conducted for all the islands in the Thoothukudi and Vembar groups, Gulf of Mannar. Higher Pielou’s Evenness (J) was observed in Upputhanni Island (0.89) and minimum was in Koswari Island (0.78). Maximum Shannon – Wiener’s diversity (H)

was observed in Upputhanni Island (2.69) and minimum in Nallathanni Island (1.87). Simpson species index (D) was highest in Upputhanni Island (0.82) and the lowest in Nallathanni Island (0.65) (Figure 2). The list of species reported during the study period is given below.

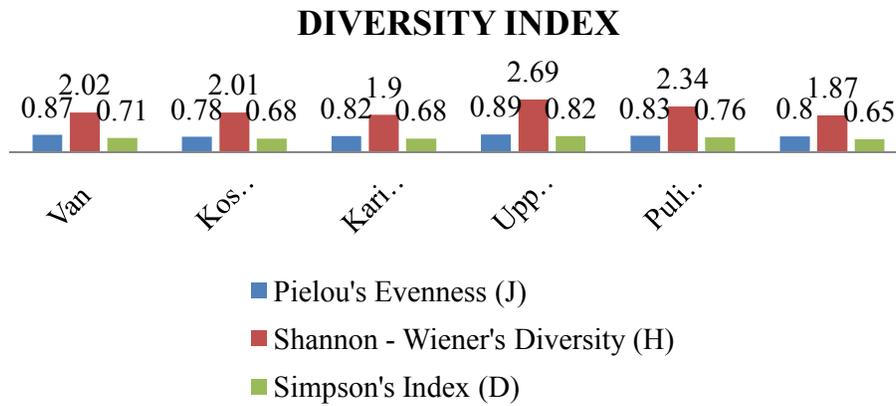


FIGURE 2: Diversity index calculation of Holothurian species at Thoothukudi and Vembar group of islands, Gulf of Mannar.

SYSTEMATIC POSITION (Figure 3 & 4)

Phylum: Echinodermata

Subphylum: Echinozoa

Class: Holothuroidea

Order: Aspidochirotida

Family: Holothuriidae

Genus: *Bohadschia*

1. *Bohadschia marmorata* (Jaeger, 1833)

B. marmorata is a sea cucumber with a variable mixture of brown and/or yellow, usually with small brown spots on

its upper surface, but frequently with large angular dark patches (*B. marmorata* photo). Its cuvierian tubules are readily ejected. Spicules are short branched rods. *B. marmorata* is found on reefs, usually more or less buried on sand of flats or lagoons.

Distribution: East Africa; Red Sea to Australia; Indonesia; Malaysia; Philippines; South Japan and India: Gulf of Mannar, Andaman, Lakshadweep.

Genus: *Holothuria*

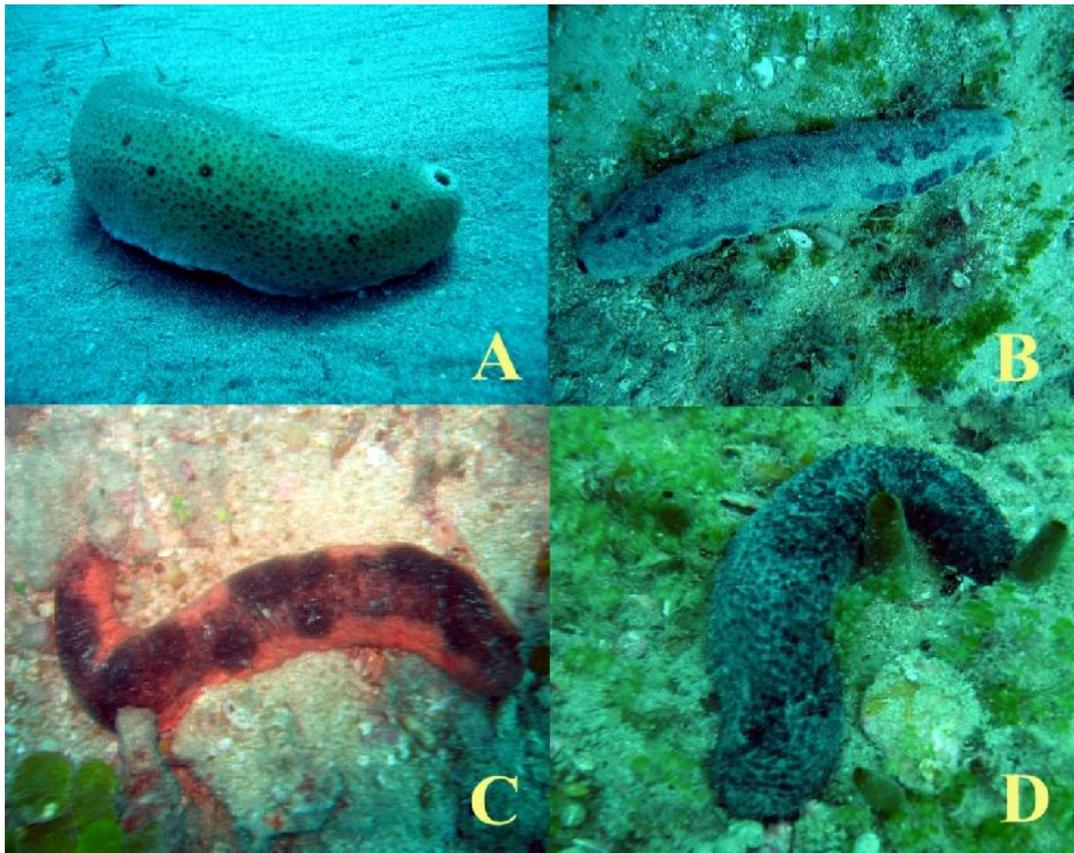


FIGURE 3: Underwater photos (Canon S45) from Gulf of Mannar (A - *Bohadschia marmorata*, B - *Holothuria atra*, C - *Holothuria edulis*, D - *Holothuria leucospilota*)

2. *Holothuria atra* Jaeger, 1833

Holothuria atra is a sausage-shaped sea cucumber that can grow to a length of 60 centimetres (24 in) but 20 centimetres (7.9 in) is a more common size. It has a smooth, pliable, entirely black skin which often has sand adhering to it, especially in smaller individuals. The mouth is on the underside at one end and is surrounded by a fringe of 20, black, branched tentacles. The anus is at the other end.

Distribution: East Africa; Red Sea; throughout the western Pacific to the Hawaiian Islands and India: Gulf of Mannar, Palk Bay, Andaman, Lakshadweep.

3. *Holothuria edulis* Lesson, 1830

H. (Halodeima) edulis is a small to large (< 300 (400) mm) sea cucumber that is dark red/black above and pink below. It is a cylindrical species with rounded ends, a smooth tegument, and a pliable body wall (*H. edulis* photo). Spicules are tables with a small disc. *H. edulis* can be found on reefs, exposed or concealed amongst rubble. In the seas around India it is found only in the Gulf of Mannar and the Andamans.

Distribution: East Africa; Red Sea; throughout the western Pacific to the Hawaiian Islands, Philippines and India: Gulf of Mannar, Andaman.

4. *Holothuria leucospilota* (Brandt, 1835)

H. (Mertensiothuria) leucospilota is a black/red, medium to large (400-500 mm), cylindrical and elongate sea cucumber. Its body is soft, pliable, and covered with soft

papillae. There are 20 black tentacles. The cuvierian tubules are readily ejected (*H. leucospilota* photo). Spicules are low spired tables and simple buttons (*H. leucospilota* spicules). *H. leucospilota* may be found on reefs and coastal rocky shores, south to New South Wales, usually more or less concealed below rocks. It is common on reef flats.

Distribution: East Africa; Madagascar to western Pacific, Hawaiian Islands and India: Gulf of Mannar, Palk Bay, Andaman, Lakshadweep.

Genus: *Actinopyga*

5. *Actinopyga miliaris* (Quoy and Gaimard, 1833)

Actinopyga miliaris is a black sea cucumber with a smooth tegument with small scattered, soft papillae. This species of sea cucumber can reach a maximum length of 300 mm. Its live weight ranges from 0.5 to 2 kg. The body is cylindrical, with the upper side arched and the lower side flat. The spicules include only small rods. *A. miliaris* is found on reefs and in coastal waters. In the seas around India it is found in the Gulf of Mannar, the Andamans and the Lakshadweep.

Distribution: Aldabra, Comores, Eastern Africa, Kenya, Madagascar, Mascarene Basin, Mauritius, Mozambique Red Sea, Seychelles Tanzania, West Indian Ocean and India: Gulf of Mannar, Palk Bay, Andaman, Lakshadweep.

Family: Stichopodidae

Genus: *Stichopus*



FIGURE 4: E - *Actinopyga miliaris*, F - *Stichopus horrens*, G - *Pseudocolochirus violaceus*, H - *Synaptula media*.

6. *Stichopus horrens* Selenka, 1867

S. horrens is a variable, grey to green/black sea cucumber. It is often variegated with dark patches. It is a medium-sized species (to 300 mm) with a smooth tegument but large and irregular papillae (*S. horrens* photo). The big tubercles and irregular body form give an "irregular, soft and almost repulsive" appearance (Clark, 1946). Spicules are tables and large "C" bodies (*S. horrens* spicules). *S. horrens* mostly in sea grass bed and many be found on reefs, below rocks on flats. In the seas around India it is only found in the Gulf of Mannar.

Distribution: Maldives to Australia; New Caledonia; New Guinea; Indonesia; Malaysia; Philippines; Southern Japan to the Hawaiian Islands and India: Gulf of Mannar.

Order: Dendrochirotda

Family: Cucumariidae

Genus: *Pseudocolochirus*

7. *Pseudocolochirus violaceus* (Theel, 1886)

The ovate body of an adult sea apple can grow up to 7.8 inches (200 mm) long. A central mouth-like cavity is surrounded by feathery tentacles, which add additional length. Sea apples, like many echinoderms, have rows of tube feet which help them move over and adhere to structures. The bodies and tentacles of sea apples come in many different colorings. The Australian species has a primarily purple body, red feet, and purple and white tentacles. The sea apple feeds primarily on plankton, which it filters from the water with its tentacles. It alternately brings each tentacle to its mouth, scraping off the captured plankton. Sea apples usually feed at night at which time their delicate tentacles are less at risk from predators.

Distribution: Northern Australia and Philippines and India: Gulf of Mannar, Andamans.

Order: Apodida

Family: Synaptidae

Genus: *Synaptula*

8. *Synaptula media* Cherbouner and Feral, 1985

Synaptula media is a species of sea cucumber in the family Synaptidae in the phylum Echinodermata, found on coral reefs in the Gulf of Mannar region. This small cucumber is blue with white lines and dashes, the tentacles are dirty blue coloured with fine blue lines. They are radially symmetric and have a water vascular system that operates by hydrostatic pressure, enabling them to move around by use of many suckers known as tube feet. Sea cucumbers are usually leathery, gherkin-shaped animals with a cluster of short tentacles at one end. They live on the subtidal region, where it may form dense aggregations on a wide variety of massive sponges and corals. It apparently gains at least part of its nutrition from the waste products of host animals.

Distribution: New Caledonia; New Guinea; Micronesia; Philippines and India: Gulf of Mannar.

DISCUSSION

Nearly 200 species of holothurians are known from the seas around India, of which about 75 species are from the shallow waters within 20 m depth. Of these about 10 species are of commercial value. A study of the systematic of holothurians is interesting as not much information is available. The Gulf of Mannar marine national parks are

well known for the richness of marine biodiversity including holothurians. Thurston (1894) reported 10 species of holothurians from Rameswaram and neighbouring islands. Of these only *Bohadschia marmorata* has some commercial value. Gravely (1927) recorded 13 species of holothurians from Krusadai Island in the Gulf of Mannar. Of these *Holothuria scabra* is the most important species. James (1986a) listed 23 species from the Gulf of Mannar and Palk Bay. Naganathan, (2005) reported 30 species of holothurians belonging to 4 Orders, 6 Families and 12 Genera.

The shallow water holothurian community at the six study sites of the Gulf of Mannar marine national park islands showed very low species diversity during the study period. In this study, 8 species under 6 genera and, 4 families were reported of which one species was reported for the first time from India. The assemblage of holothurians studied at SCUBA depths (30 m) is described on the basis of several standard ecological indexes, such as species richness (SR), Shannon index (H') and evenness Index (J'). Based on this maximum species diversity, richness and evenness were reported at Upputhanni Islands and minimum at Nallathanni Island. A similar trend of decreasing abundance and species diversity of holothurians was also observed earlier in the Gulf of Mannar (Raghunathan, 2008).

This might be attributed to distributional changes in the species composition as reported by James (1986a). During his study on the distribution of Indian echinoderms, it was noted that some species, which were absent at a particular place, were found to be common after a few years and vice – versa. Notably James (1986a) could not find a single specimen of *Holothuria (Salenkothuria) erinaceus* and *Phyrella fragilis* in south point of Port Blair during 1965, however, these species were found to be common in the same locality during 1975. Similarly, Gravely (1927) reported *Stichopus chloronotus* to be common around Rameswaram but during years 1963 to 1968 when intensive collections were made, not a single specimen of the above species was seen around Rameswaram (Raghunathan, 2008). All this shows that some changes in the species composition have take place time to time and it is very difficult to predict the factors that contributed to the changes. Detailed investigations on seasonal changes, reproduction, spawning behaviour, longevity, fecundity and zoogeography of holothurians will be helpful to draw management strategies for conserving these declining resources.

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