

Distribution and Microhabitat Associations of an Apodous Holothurian: *Synaptula recta* (Semper, 1868) in the Shallow Coastal Waters of Selected Islands, Sri Lanka

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Abstract: Apodous holothurians lack tube feet and are characterized by their vermiform retractable bodies. Even though a few species of apodous holothurians were recorded from Sri Lankan waters a long time ago, there was no record available on their micro-habitats or on their distribution in the Northern coastal waters. Therefore, the present study was conducted to identify the distribution and microhabitat association of apodous holothurians in the shallow coastal waters of selected islands such as Mandaitivu, Velanai, Karainagar, Eluvaitivu and Punkudutivu, during October 2020 to December 2022. Sampling was performed in eight locations among the marine sponges and algae at a maximum depth of 0.5 m. Species identification was done using morphological characteristics and ossicle types. In this study, *Synaptula recta* (Semper, 1867), a tube-feetless sea cucumber species that belongs to the Family Synaptidae was recorded for the first time from the northern shallow coastal waters of Sri Lanka that associated with 13 species of sponges and four species of algae. *S. recta* were collected from the external surface, osculum and spongocoel of the sponges. Also, this species showed camouflage with that of respective sponge species. Results suggest that *S. recta* prefers marine sponges and algae as their microhabitats and is not found in the bottom sediments. Therefore, it is essential to protect the marine benthic communities such as algae and sponges to preserve the *S. recta* in the coastal waters of Sri Lanka.

Keywords: algae, sponges, sea cucumber, synaptidae

1. INTRODUCTION

Holothurians are one of the major components in the benthic communities and play a vital role in the marine ecosystem as deposit feeders, scavengers, and bioturbators. Globally, several species of holothurians are being harvested due to their high demand in food and pharmaceutical industries (Conand, 2001, Conand and Byrne, 1993, Bordbar et al., 2011). There are about 200 species of holothurians recorded from Sri Lankan waters, of which about 75 species are recorded from coastal waters, particularly about 50 species collected from the inter-tidal zones (Clark and Rowe, 1971, Kumara et al., 2005). At present, most of the sea cucumber stocks are depleted in the East and North-West coastal waters of Sri Lanka due to their demand in the export market (Dissanayake and Stefansson, 2012). Also, as a benthic faunal community, most of the species are under threat due to habitat degradation in the coastal waters of Sri Lanka. However,

despite their economic importance, microhabitats of the majority of the sea cucumber species including their juvenile stages are poorly understood (Dissanayake and Stefansson, 2012, Palomar-Abesamis et al., 2017). Therefore, it is essential to understand the microhabitats and the food requirements of juvenile stages to conserve their diversity and distribution in the wild.

Apodous holothurians belong to Order Apodida which includes species that have no tube feet, retractor muscles, respiratory trees or cuvierian tubes (James, 1982, Martins and Souto, 2020). Although there are about 350 valid species of Apodida recorded around the world (WoRMS, 2024), very little is known in Sri Lankan waters. James (1982) recorded ten species from the Indian Ocean belonging to nine genera (James, 1982). This study was conducted from 1963 -1970 in the Gulf of Mannar and Palk Bay on the East and West coasts of India. Two species belong to the *Synaptula* such as *S. recta*

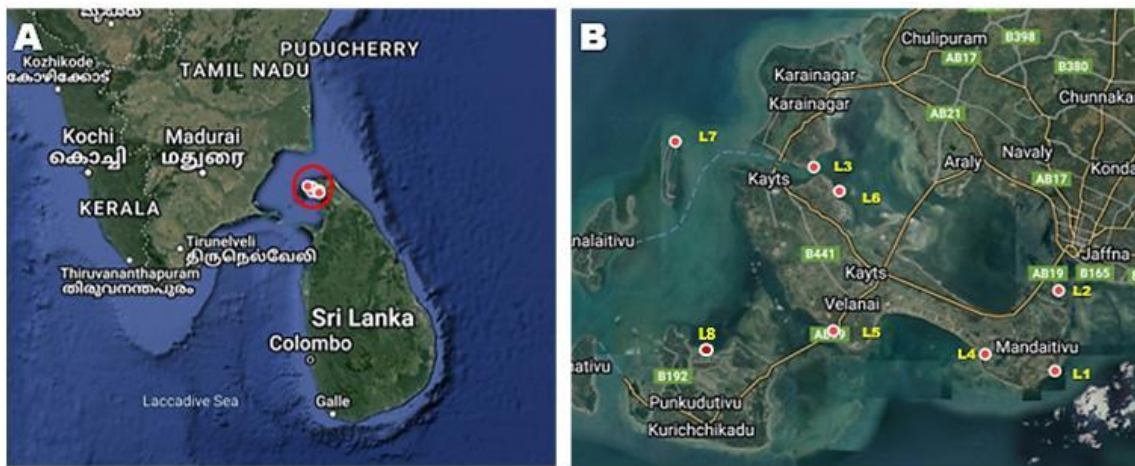


Figure1: Sampling sites in the coastal waters of selected islands, Northern Province, Sri Lanka (L1 and L2: Mandaitivu island, L3: Karainagar island, L4: Allaipiddy – Velanai island, L5: Velanai island, L6: Kayts – Velanai island, L7: Eluvaitivu island and L8: Punkudutivu island).

inhabiting algae (Semper, 1868) and *S. striata* inhabiting a sponge named *Petrosia testudinaria* (Sluter, 1888) reported in this study (James, 1982). Even though, these two species were reported from Sri Lankan waters in 1971, the habitat or micro-habitat of the other species was not reported (Clark and Rowe, 1971, Kumara *et al.*, 2005).

The present study was carried out to identify the apodous holothurian species- *Synaptula recta* inhabiting the shallow waters around the selected islands of Northern Sri Lanka.

2. MATERIALS AND METHODS

2.1 Sample collection and identification of microhabitats

The present study was conducted at 8 locations in the coastal waters of selected islands such as Mandaitivu, Karainagar, Velanai, Eluvaitivu and Punkudutivu of Northern Province, Sri Lanka, which is located in the Palk Bay. The sampling was performed during the low tide period from October 2020 to August 2022 (Figure 1). The sampling area was limited to a 20 m × 20 m plot from the coastline, and the maximum depth of the water was 0.5 m. Samples were collected by handpicking methods among the marine algae and sponges. The microhabitats of each sample were

recorded carefully. Particularly for the sponge-associated holothurians, microhabitats such as on the surface, inside the oscula and the spongocoel were carefully analyzed. Morphological characteristics of all collected samples were recorded immediately, and the photographs were taken using Vivo V15, model 1819, Android smart-phone, 12 MP camera. After that, collected samples were packed in clean polythene bags and brought to the Department of Zoology, University of Jaffna for further identification. Microscopic images were taken through the eye piece of the compound microscope using the above same smart-phone.

2.2 Identification

The *S. recta* was identified based on the morphological characteristics and ossicle types (Ong *et al.*, 2016, James, 1982, Ong and Wong, 2015). The size of the ossicles was measured microscopically using ocular micrometer. The sponges (Thomas 1985; Dendy 1905; Van Soest *et al.* 2014; Sivaleela 2014; Hooper and Van Soest 2002), and algae (Stegenga, 2011) were identified as per the detailed diagnostic characters given in the taxonomic keys. For sponges, spicules were prepared (Hooper, 2000) and examined to confirm the species (Hooper and Van Soest, 2002).

3. RESULTS AND DISCUSSION

3.1 Taxonomy and Characteristics of Apodous Holothurians

In the present study, a single species of apodous holothurian *Synaptula recta* (Semper, 1868) was recorded from all eight locations along the coastal waters of selected islands of Northern Sri Lanka. This is the first record of apodous holothurian from these locations.

The taxonomy of the species is given below.

Phylum : Echinodermata

Subphylum : Echinozoa

Class : Holothuroidea

Subclass : Paractinopoda

Order : Apodida

Family : Synaptidae

Genus : *Synaptula*

Species : *Synaptula recta* (Semper, 1868)

3.1.1 Species description

Long, vermiform and retractable body covered with thin skin. Terminal mouth has a circular opening at the center of the oral disc around which tentacles are arranged in a single circle. The total length of the specimens examined varied from 25 to 200 mm and the resting time their size ranged between 6 to 100 mm. Although size is highly variable depend on the resting time, active time and stress. The number of tentacles varies from 9 to 13, majority of the specimens having 10 tentacles. The number of pairs of digits in each tentacle varies from 10 to 25. The number of digits depends on the size of the specimens and all the digits are webbed. The outside of the tentacles is studded with numerous rounded adhesive papillae. The skin is transparent with numerous anchors and anchor plates as small specks. Skin is adhesive to the touch. Basal region of the body has holes (Figure 2).

3.1.2 Colour

The coloration of the studied specimens ranged from pinkish purple to a fairly bright red with a pattern of longitudinal lilac stripes on a pale

background in living conditions. In 5% formalin, the colours turned duller (Figure 2).

3.1.3 Type of Ossicles

The dermic ossicles of *S.recta* consist of anchors, anchor plates and miliary granules. Two smooth and equal-sized flukes are present in anchors. The vortex is free from knobs. The average size of the anchor is 224µm x 15.4µm. The anchor plates are symmetrical structures having more or less oval shape. The broad anterior end has six large toothed holes of uniform size. The posterior end has three small holes of which the central one is the largest. The connecting bridge is smooth. Average length of anchor plates is 200 mm and the breadth is 178 mm (Figure 2).The miliary granules are small and numerous in the body wall and tentacles. They comprise flower-shaped and tiny oval shaped miliary granules with less than 15 µm in diameter.

3.2 Microhabitat associations of *S. recta*

In the present study, *S. recta* were found to live on sponge and algae in the coastal waters of Northern Sri Lanka was identified. Specimens with various size ranges were observed in all the sites. They were found to crawl on the algae and sponge with the help of the tentacles and anchors which stick to the algae and sponge. They were found either outside or inside the sponges particularly on osculum and inside the spongocoel during the daytime when sampling. However, local fishermen from Mandaitivu-Jaffna lagoon area reported that this species usually detached from the sponge or algae during night time and freely float on the water (they called as 'worm').

In this study, the association of *S. recta* with that of 13 species of sponges (Figure 3) and 4 species of algae (Figure 4) were reported (Table 1). *S. recta* were observed in both external surface and internal structure (osculum and spongocoel) of sponges *Dysidea fragilis*, *Hyattella tubaria*, *Haliclona caerulea* and *Spongia* sp while other sponge species harbour *S. recta* on their surface.



Figure 2: Whole specimen of apodous holothurian *Synaptula recta* and its identification features. (A: live specimen of *S. recta*; B: measuring the total length of *S. recta*; C: tentacles; D: digits of the tentacles; E: anchor; F: anchor plate; G: military granules indicated by arrow; H: articulation between anchor and anchor plates; I: ossicles arrangement on the dermal region of the body wall; J: association between *Gelliodes pumila*- sponge (yellow arrow) and *S.recta* (red arrow); scale bars size: A and C -3 cm, D - 150µm; E, F, G - 50µm, H - 200µm, I - 250µm, J - 3cm).



Figure 3: Microhabitat association of *S. recta* and sponge species. (Sponge species: A: *Spongia* sp.; B: *Hyattella tubaria*; C: *Dysidea fragilis*; D: *Haliclona caerulea*; E: *Haliclona* sp. 1; F: *Haliclona* sp. 2; G: *Haliclona* sp. 3; H1 & H2: *Haliclona* sp. 4; I: *Gelliodes pumila*; J: *G. incrustans*; K: *Callyspongia diffusa*; L: *Callyspongia* sp- 1; M: *Callyspongia* sp-2. All scale bars are in same size = 2cm).

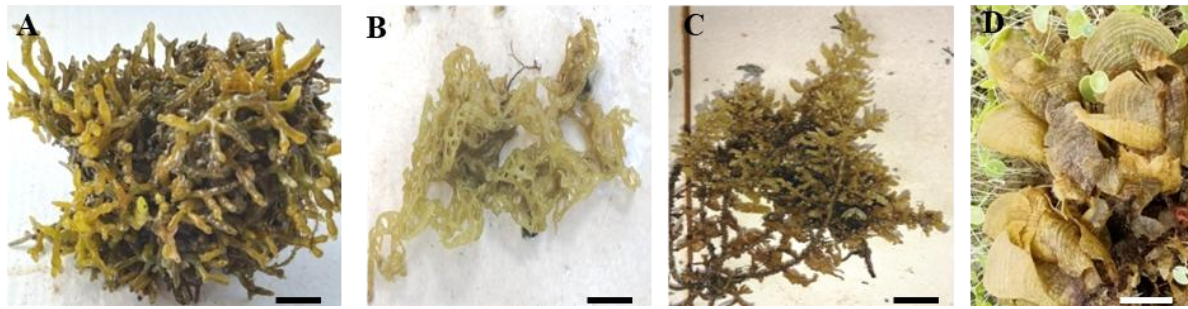


Figure 4. Microhabitat association of *S. recta* and algae species.(Algae species: **A:** *Gracilaria salicornia*; **B:** *Hydroclathrus clathratus*; **C:** *Sargassum* sp.; **D:** *Padina pavonica*; All scale bars are in same size = 3cm.

Table 1: Microhabitat associations and distribution of *Synaptula recta* from the coastal waters of selected islands, Northern Province, Sri Lanka (L- indicate the sampling locations).

Microhabitat associations		Locations (L)							
		Mandaitivu island		Karainagar island	Velanai island			Eluvaitivu island	Punkudutivu island
		L1 9.604810°N, 80.000912°E	L2 9.643793°N, 80.002542°E		L4 9.613011°N, 79.966529°E	L5 9.624268°N, 79.892026°E	L6 9.691760°N, 79.894940°E		
Sponges	<i>Spongia</i> sp.		x						
	<i>Hyattella tubaria</i>	x	x					x	
	<i>Dysidea fragilis</i>		x		x				
	<i>Haliclona caerulea</i>				x				
	<i>Haliclona</i> sp. 1						x		
	<i>Haliclona</i> sp. 2							x	
	<i>Haliclona</i> sp. 3		x						
	<i>Haliclona</i> sp. 4								x
	<i>Gelliodes pumila</i>		x						
	<i>Gelliodes incrustans</i>				x			x	
	<i>Callyspongia diffusa</i>		x		x	x			
	<i>Callyspongia</i> sp. 1		x						
	<i>Callyspongia</i> sp. 2			x	x				
Algae	<i>Padina pavonica</i>							x	
	<i>Gracilaria salicornia</i>			x		x	x	x	
	<i>Hydroclathrus clathratus</i>							x	
	<i>Sargassum</i> sp.	x						x	

S. recta – algae association was notable at Eluvaitivu coastal waters, where a large number of *S. recta* were observed on algae such as *Padina pavonica*, *Gracilaria salicornia*, *Hydroclathrus clathratus* and *Sargassum* sp (Figure 4). Sim et al. reported that members of the Family Synaptidae were found only on sponges (Sim et al., 2008). The present study

revealed that the average size (29 cm length x 8 cm width) of the sponge and algae can contain more than 25 numbers of *S. recta*, but it depends on the size of the algae and the size and number of the canals in the sponge. In this association, *S. recta* shows camouflage as the colour of sponges and algae for getting protection from predators.

3.3 Distribution

S. recta is known from Red Sea, Sri Lanka, Bay of Bengal, North Australia, French Somalia, Pakistan, Maldives, India (Lakshadweep Islands, Madras, Andaman & Nicobar Islands), Myanmar, Gulf of Mannar, Cocos Keeling Islands, Malaysia, Indonesia (Java, Salayer, Sulawesi, Timor, Kai Islands), Philippines, Vietnam, Papua New Guinea, Caroline Islands, Singapore and South Pacific Islands (James, 1982; Massin, 1999; Ong et al., 2016). Even though *S. recta* was reported from Sri Lanka around 40 years back (Clark and Rowe, 1971), this is the first record from the Northern coastal waters of Sri Lanka. It seems that this species is occurring in the coastal shallow waters where it inhabits among the sponges and algae.

4. CONCLUSION

The present study revealed that compared to other holothurian, *S. recta* prefers to live among selected sponge and algal species and avoid settling on the bottom of coastal waters. Thirteen species of sponges and four species of algae were identified as their microhabitats in the shallow coastal waters of Northern Sri Lanka.

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