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CONTENTS

1. GENERAL INTRODUCTION

Around 1400 species of holothurians are reported from various parts of World Oceans. In Indian waters, nearly 200 species belonging to 6 orders and 16 families are noticed. Of which 75 are restricted to shallow waters with a depth of 20 m. Among them around 15 species namely *Actinopyga miliaris, Actinopyga mauritiana, Actinopyga echinites, Actinopyga lecanora, Bohadschia argus, Bohadschia marmorata, Stichopus chloronotus, Stichopus variegatus, Stichopus horrens, Stichopus hermanni, Thelenota ananas, Holothuria nobilis, Holothuria atra, Holothuria scabra* and *Holothuria spinifera* and *Holothuria edulis* are commercially significant. Sea cucumbers with larger size and thick body wall are suitable for processing. According to James and James (1994), holothurians can be divided into three groups based on their commercial value *viz*. high, medium and low values. *Holothuria scabra, Holothuria nobilis* and *Thelenota ananas* have high values; species such as *Holothuria spinifera, Actinopyga echinites, Actinopyga miliaris, Bohadschia marmorata, Bohadschia argus, Stichopus variegatus* and *Stichopus chloronotus* have medium value while *Holoturia atra* and *Actinopyga mauritiana* have low market value.

Ecological distribution

Holothurians are distributed in different ecological niches as they adapted themselves to live in different habitats. They are found in many marine biotopes at all latitudes, from intertidal to deeper waters. They are benthic except some Elasipodida which are pelagic. Although some species live on hard substrates such as rocks, coral reefs or Epibiosis on plants or invertebrates, they more regularly inhabit soft bottoms, either living on the seabed in the sediment. The distribution of the various groups in coastal zones shows the predominance of Aspidochirotida between the tropics and of Dendrochirotida in temperate and higher latitudes (Conand, 1990). Holothurian diversity occurs in the tropical coastal area where the genus *Holothuria* comprises 114 species (Rowe, 1969). In deep water, holothurians account for a high percentage of total biomass where their abundance was discovered by the "Challenger" expeditions (Conand, 1990). In Indian waters their habitat distribution is as follows.

***Coral reef*:** Coral reef is a suitable place for species such as *Holothuria hilla, Holothuria pardalis, Holothuria arenicola* and *Holothuria impatiens.*

Rocky shores: *Holothuria moebi and Holothuria cinerascens* live on the rocky shores by attaching to the underside of the stones. In such species the tubefeet on the ventral side are well developed appearing like a sole (James, 1998).

Sandy shores: Species living on sandy beaches have the ability to bury themselves in sand with the help of tube-feet. *Holothuria atra* is one of the most common holothurians of India found in sandy bottoms and often coated with sand on its body. *Holothuria leucospilota* and *Stichopus variegatus* also prefer sandy bottom.

Mud flats: *Holothuria scabra* normally prefers mud flats in a half buried condition by keeping the posterior end of the body above the seafloor, whereas *Acuadina molpadioides* also abundant in muddy substratum, the whole animal occurs with buried in loose of fine mud (James, 1998).

***Seaweed and Seagrass meadow*:** Holothurians such as *Synpatula recta* live among the intertidal seaweed region and they crawl on the algae with the help of tentacles and anchors present in the body wall. However *Stichopus variegatus* is mostly associated with eel grass beds.

Bêche-de-mer

The term *Bêche-de-mer* is the French rendering of Portuguese name *Bicho-do-mar*, spade on the sea. It is also widely known as *Trepang* which is a Malay word. Although the term *Bêche-de-mer* denotes a sea cucumber in the trade parlance, this term refers to the processed holothurians.

The South-West Indian Ocean is recognized as one of the ten marine biodiversity hotspots in the world because of its high species richness and high level of endemism (Roberts *et al*., 2002; Allen, 2008). Butcher (2004) reported that many Southeast Asian countries had collected trepang for trade with China for many centuries, and during the late 1900s populations of sea cucumbers collapsed in many places because of over and use of technology. According to a report by the National Oceanic and Atmospheric Administration (NOAA), tropical and sub-tropical species that are heavily exploited globally (including Asia) and whose populations are seriously depleted include: *Holothuria fuscogilva, H. whitmaei, H. scabra and T. ananas*, and species that are heavily fished in certain countries including those in Asia are: *A. echinites, H. scabra versicolor, A. lecanora, A. miliaris, A. mauritiana, S. herrmanni, S. horrens and S. chloronotus*. Species that may be under potential fishing threats are *B. argus* and *H. fuscopunctata*. The temperate species of sea cucumbers, including *A. japonicus* has also been reported to be depleted in Democratic Peoples's Republic of Korea and Russian Federation (Anon, 2006; Konstantinova, 2004).

Economic importance

Economically, sea cucumbers are important in two main ways. First, some toxins that is of interest to pharmaceutical firms seeking to learn their medical value. Some compounds isolated to date exhibit antimicrobial activity or act as anti-inflammatory agents and anticoagulants. Second, as a gourmet food item in the orient, they form the

basis of a multimillion-dollar industry that processes the body wall for sale as *bêche-de-mer* or *trepang*. However, the high value of some species, the ease with which such shallow-water forms can be collected and their top-heavy age structures all contribute to over-exploitation and consequently collapse of the fishery in some regions. Sea cucumbers are also considered a delicacy in some countries of Southeast Asia; particularly popular are the pineapple roller *Thelenota ananas* and the red *Halodeima edulis*. They are well known as *bêche-de-mer* or *Trepang* in China and Indonesia. The sea cucumbers are dried, and the potentially poisonous entrails removed. The strong poisons of the sea cucumbers are often psychoactive, but their effects are not well studied. It does appear that some sea cucumber toxins restrain the growth rate of tumour cells, which has sparked interest from cancer researchers.

Food value: Holothurians are a delicacy in China, Japan and Korea. The Japanese and Koreans consume sea cucumber *Stichopus japonicus* in raw condition and they eat gonad, body wall and intestine of this animal. The Chinese consume only processed sea cucumber and they prefer only a body wall as delicacy. The product of sea cucumber is protein enriched and low fat content.

Pharmaceutical value: The sea cucumber has aphrodisiac qualities which has undoubtedly enhanced its popularity. The product derived from sea cucumber is used as a medicine for high blood pressure, muscular disorder and also recommended for cholesterol problems. The soup made out of *Bêche-de-mer* is believed to possess certain curative properties for whooping cough, bronchial inflammation and respiratory disorders (James, 1998).

Trade and export potential

The holothurians are often amongst the most valuable resources for small tropical island communities (Kinch *et al*., 2008; Purcell, 2010). Several species are highly priced by subsistence fishers (e.g. *Actinoypa mauritiana* and *Holothuria atra*) as a direct food source (Kinch *et al*., 2008) and by commercial operators (e.g. *Holothuria fuscogilva*, *H. whitmaei* [formerly *H. nobilis*] and *H. scabra*) due to the high demand from Asian markets (Conand & Byrne, 1993; Choo, 2008; Purcell, 2010). Conand (2004) identified 42 species under population stress as a result of commercial exploitation. Similarly, an international review of 28 countries found that 21 countries, including Australia, have overexploited holothurian stocks, 5 countries have declining stocks and Malaysia has 1 species close to extinction. Of the 28 countries reviewed, only Cuba has apparently stable stocks (Toral-Granda, 2006). Many holothurian fisheries, both tropical and temperate, are in varying stages of overexploitation (Friedman *et al*., 2010; Purcell, 2010), with limited or no scientific data available on stock size before or after fishing. Holothurians display particular characteristics that make them vulnerable to recruitment overfishing, including sessile, shallow water and patchy distributions. In addition, many holothurian

fisheries are based in developing countries, where local communities are dependent on the income but lack the resources to manage these relatively dynamic fisheries (Kinch *et al.*, 2008, Friedman *et al.*, 2010). However, a significant number of holothurian species in countries such as Australia are also overexploited (Kinch *et al.*, 2008). Sea cucumbers fished from the tropics are classified into four categories in the international food market according to their commercial values.

Global sea cucumber trade meant for the food market is controlled by China-Hong Kong-SAR, Singapore and Taiwan Province of China, with China-Hong Kong-SAR having the largest entrepreneur controlling 80 percent of the global import-export sea cucumber trade (Jaquemet and Conand, 1999). The dominance of China Hong Kong SAR is due mainly to its ability to serve as a conduit of goods to the hinterland of mainland China (Clarke, 2002). Producing countries all over the world export *trepang* to one of these three centres; from where they are re–exported mainly to Chinese consumers worldwide. China Hong Kong SAR, China, Singapore, Malaysia, Taiwan Province of China, Republic of Korea and Japan account for almost 90 percent of the total imports of trepang, with approximately 80 percent of the overall international trade destined initially for China, Hong Kong SAR (Bruckner *et al.*, 2003). From 1996 to 2000, 87% of re-exports of trepang from China Hong Kong SAR were designated for China (Clarke, 2002). According to Bruckner *et al.* (2003), in 2000 and 2001, Taiwan Province of China imported sea cucumbers from 28 countries and Singapore receives about 50 percent of its imports from China Hong Kong SAR, with Papua New Guinea, Tanzania and Madagascar being the other main suppliers. According to the FAO global statistics on sea cucumber, Indonesia is the largest trepang exporter in the world. About 40–80 percent of the trepangs are exported to China, Hong Kong SAR, with other markets being Japan, Republic of Korea, Singapore, Taiwan Province of China, Malaysia and Australia (Tuwo, 2004; Whitten *et al.*, 2002). The average annual price of Indonesian trepang exported from South Sulawesi from 1996 to 2002 ranged from USD 15.06/kg to USD 1.44/kg (Tuwo, 2004). The cultured *Actinoypa stichopus* fetched almost twice the price as the highest priced grade sandfish. Apart from the food trade, a large number, possibly hundreds of thousands of sea cucumbers are traded in the aquarium industry, but little data on species, quantities and source countries are available (Bruckner *et al.*, 2003).

Indian scenario

According to the FAO's annual statistics for 1984, the world echinoderm harvest in 1983 amounted to approximately 80,000 tonnes. In 1989 India exported 51.5 tonnes of *Bêche-de-mer* valued about 1.23 crores of rupees. Some of the companies in Singapore, Hong Kong, Thailand, Malaysia and Philippines are interested to import 10 tonnes every month. Hong Kong is the foremost country in the world by importing 5000 to 6000 tonnes of *Bêche-de-mer* every year. India chiefly exports the processed sea cucumber

to Singapore. The *Bêche-de-mer* is further processed to add the value of the product at Singapore and sending them to Hong Kong and Chinese markets (James, 1993). The data on the *Bêach-de-mer* collected from Gulf of Mannar and exported during the period between 1979 and 1986 are given in Table 1.

Table 1. Size-wise export of *Beche-de-mer* from India (values expressed in tonnes)

Year	Size range				Total
	4 - 6 inches	3 - 4 inches	2 - 3 inches	>2 inches	
1979-1980	7.03	13.99	18.30	2.18	41.50
1980-1981	4.76	9.33	15.87	3.50	33.46
1981-1982	2.05	6.99	45.68	13.37	68.09
1982-1983	3.60	19.19	22.37	2.91	48.07
1983-1984	3.05	22.64	39.02	15.50	80.21
1984-1985	2.85	12.55	—	—	15.40
1985-1986	2.12	8.77	—	—	10.89

Source: MPEDA Regional Office, Chennai

Bêche-de-mer industry

Processing methods for *Bêche-de-mer* believed to have been initiated by Chinese traders, include six stages: boiling, slitting the dorsal side, second boiling, gutting, smoke drying, and sun drying. These procedures vary according to the species processed. Processing considerably reduces the length and weight of the sea cucumber, and the final product weight is about 10% of the original weight (Durairaj *et al*., 1984). The Indian *Bêche-de-mer* industry is more than 1000 years old (Hornell, 1917). Palk Bay and Gulf of Mannar with their potential sea cucumber resources supported the *Bêche-de-mer* industry in India. The industry is grown tremendously due to the attractive price and increasing demand for *Beche-de-mer* in the international market. In 1980s and 1990s, the industry has generated considerable foreign exchange for India (Nithyanandan, 2003). However, the overexploitation resulted in depletion of holothurians population, lead to the conservation measures and ultimately halted this industry in India.

Legislation on Holothurians

In order to conserve the resources of sea cucumbers, Government of India imposed a ban on the export of *Bêche-de-mer* which is less than 3 inches length as a measure of conservation in the year 1982. However, it became impossible to regulate the catch of the undersized holothurians by the huge number of sea cucumber processing industries scattered along the Gulf of Mannar and Palk Bay regions. Subsequently in the 11th

July 2001 Notification, the Ministry of Environment and Forests, Government of India included all species of holothurians under Schedule-I category of the Wildlife Protection Act, 1972 and strictly banned their collection.

Holothurians diversity

The present compilation of published records available from literature revealed that 173 species of holothurians reported from Indian waters (Table 2). Andaman and Nicobar Islands harbours high number of species (98) followed by east coast (77). The number of holothurians species reported from west coast and Lakshadweep were 30 and 35 respectively (Sastry, 2005 & 2007).

Table 2. List of Holothurian species reported from different regions of Indian waters

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
Order ASPIDOCHIROTIDA Family HOLOTHURIIDAE				
1. *Actinopyga echinites* (Jäger, 1833)	+		+	+
2. *Actinopyga lecanora* (Jäger, 1833)			+	
3. *Actinopyga mauritiana* (Quoy and Gaimard, 1833)	+		+	+
4. *Actinopyga miliaris* (Quoy and Gaimard, 1833)	+		+	+
5. *Bohadschia argus* Jäger, 1833			+	+
6. *Bohadschia graeffei* (Semper, 1868)	+	+	+	+
7. *Bohadschia marmorata* Jäger, 1833	+		+	+
8. *Bohadschia tenuissima* Semper, 1868	+	+		
9. *Holothuria (Acanthotrapez) pyxis* Selenka, 1867			+	
10. *Holothuria (Cystipus) inhabilis* Selenka, 1867			+	
11. *Holothuria (Cystipus) rigida* (Selenka, 1867)			+	+
12. *Holothuria fuscogilva* Cherbonnier, 1890	+			
13. *Holothuria (Halodeima) atra* Jäger, 1833	+		+	+

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
14. *Holothuria (Halodeima) edulis* Lesson, 1830	+		+	
15. *Holothuria (Lessonothuria) pardalis* Selenka, 1867	+	+	+	+
16. *Holothuria (Mertensiothuria) exilis* Koehler and Vaney, 1908			+	
17. *Holothuria (Mertensiothuria) fuscocinerea* Jäger, 1833			+	+
18. *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)	+		+	+
19. *Holothuria (Mertensiothuria) pervicax* Selenka, 1867			+	+
20. *Holothuria (Metriatyla) albiventer* Semper, 1868			+	
21. *Holothuria (Metriatyla) ocellata* Jager, 1833	+	+		+
22. *Holothuria (Metriatyla) scabra* Jager, 1833	+	+	+	
23. *Holothuria (Microthele) nobilis* (Selenka, 1867)			+	+
24. *Holothuria coluber* (Semper, 1868)			+	
25. *Holothuria (Platyperona) difficilis* Semper, 1868			+	+
26. *Holothuria spinifera* Theel, 1886	+		+	
27. *Holothuria (Selenkothuria) erinaceus* Semper, 1868			+	
28. *Holothuria (Selenkothuria) moebii* Ludwig, 1875	+		+	
29. *Holothuria (Semperothuria) cinerascens (Brandt, 1835)*	+		+	+
30. *Holothuria (Stauropora) prompta* Koehler and Vaney, 1908			+	
31. *Holothuria (Theelothuria) kurti* Ludwig, 1892	+	+		
32. *Holothuria (Thymiosycia) arenicola* Semper, 1868	+		+	+
33. *Holothuria (Thymiosycia) gracilis* Semper, 1868			+	
34. *Holothuria (Thymiosycia) hilla* Lesson, 1830	+		+	+
35. *Holothuria (Thymiosycia) impatiens* Forskäl, 1775	+		+	+

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
36. *Holothuria (Thymiosycia) remollescens* Lampert, 1885			+	
37. *Holothuria rugosa* Ludwig, 1875			+	
Family LABIDODEMATIDAE				
38. *Labidodemas rugosum* (Ludwig, 1875)			+	+
39. *Labidodemas semperianum* Selenka, 1867			+	
Family STICHOPODIDAE				
40. *Apostichopus japonicus* Selenka, 1867			+	
41. *Stichopus chloronotus Brandt, 1835*			+	+
42. *Stichopus herrmanni* Semper, 1868	+		+	
43. *Stichopus horrens* Selenka, 1867			+	
44. *Stichopus varigatus* Semper, 1868			+	+
45. *Stichopus vastus* (Sluiter, 1887)			+	
46. *Thelenota ananas* (Jäger, 1833)				+
Family SYNALLACTIDAE				
47. *Allopatides dendroides Koehler and Vaney, 1905*			+	
48. *Amphigymna multiples Walsh, 1891*		+	+	
49. *Bathyplotes assimilis* Koehler and Vaney, 1905		+		
50. *Bathyplotes cinctus* Koehler and Vaney, 1905			+	
51. *Bathyplotes crenulatus* Koehler and Vaney, 1905			+	
52. *Bathyplotes papillosus* Koehler and Vaney, 1905	+			
53. *Bathyplotes profundus* Kohler and Vaney, 1905			+	
54. *Bathyplotes variabilis* Kohler and Vaney, 1905	+			

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
55. *Benthothuria cristatus* Koehler and Vaney, 1905			+	
56. *Bathyplotes distortus* Koehler and Vaney, 1905		+		
57. *Bathyzona incerta* Koehler and Vaney, 1905		+		
58. *Mesothuria abbreviata* Kohler and Vaney, 1908		+		
59. *Mesothuria incerta* Kohler and Vaney, 1910		+		
60. *Mesothuria multipes* Ludwig, 1893		+		
61. *Mesothuria squamosa* Kohler and Vaney, 1905	+			
62. *Pelopatides dissidens* Koehler and Vaney, 1905			+	
63. *Pelopatides gelatinosus* (Walsh, 1891)			+	
64. *Pelopatides ingisnis* Kohler and Vaney, 1905	+			
65. *Pelopatides modestus* Koehler and Vaney, 1905		+	+	
66. *Pelopatides mollis Koehler and Vaney, 1905*			+	
67. *Pelopatides ovalis* (Walsh, 1891)			+	
68. *Pelopatides verrucosus* Koehler and Vaney, 1905			+	
69. *Perizona magna* Koehler and Vaney, 1905		+		
70. *Pseudostichopus occultatus* Marenzeller, 1893			+	
71. *Pseudothuria duplex* Koehler and Vaney, 1905		+		
72. *Synallactes horridus* Koehler and Vaney, 1905	+			
73. *Synallactes pellucidus* Koehler and Vaney, 1905	+			
74. *Synallactes rigidus* Koehler and Vaney,1905			+	
Order DENDROCHIROTIDA Family PSOLIDAE				
75. *Psolidium rugosum* Koehler and Vaney, 1905		+		

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
76. *Psolus mannarensis* James, 1984	+			
77. *Psolus membranaceus* Koehler and Vaney, 1905		+		
78. *Psolus laevis* Koehler and Vaney, 1905		+		
79. *Psolus* sp.		+		
Family CUCUMARIIDAE				
80. *Aslia forbesi* (Bell, 1886)			+	
81. *Athyone* sp.	+			
82. *Cucumaria ardens* Koehler and Vaney, 1908	+			
83. *Cucumaria ariana* Koehler and Vaney, 1908		+		+
84. *Cucumaria frauenfedi* Ludwig	+			
85. *Cucumaria inflexa* Koehler and Vaney, 1908	+			
86. *Cucumaria turbinata* (Hutton, 1879)	+			
87. *Cucumaria* sp.	+			
88. *Cladolabes acicula* Koehler and Vaney, 1908			+	
89. *Havelockia versicolor (Semper, 1867)*			+	
90. *Hemithyone semperi (Bell, 1884)*	+			
91. *Leptopentacta bacilliformis* (Koehler and Vaney)			+	
92. *Leptopentacta imbricta* (Semper, 1867)	+			
93. *Leptopentacta javanicus* (Sluiter, 1881)	+	+		
94. *Pentacta quadrangularis* (Troschel, 1846)	+			
95. *Pseudocolochirus echinatus* (von Marenzeller, 1881)	+			
96. *Pseudocolochirus tricolor* (Sluiter, 1901)	+			

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
97. *Pseudocolochirus violaceus* (Theel, 1886)	+			
98. *Stolus conjungens* (Semper, 1867)	+	+		
99. *Stolus rapax* (Koehler and Vaney, 1908)	+			
100. *Stolus buccalis* (Stimpson, 1855)	+	+		
101. *Thorsonia investigatoris* (Koehler and Vaney, 1908)	+			
102. *Thyone congugens* (Semper, 1868)	+			
103. *Thyone papuensis* Theel, 1886	+			
104. *Thyone dura Koehler and Vaney, 1908*			+	
105. *Thyone herdmani (Pearson, 1914)*	+			
106. *Trachythyone alcocki* (Koehler and Vaney)			+	
Family PHYLLOPHORIDAE				
107. *Actinocucumis typicus* Ludwig, 1875	+	+	+	
108. *Afrocucumis africana* (Semper, 1868)				+
109. *Oschimella ehrenbergi* (Selenka, 1868)		+		
110. *Phyllophorus celer* Koehler and Vaney, 1908			+	
111. *Phyllophorus intermedius* Koehler and Vaney, 1908		+		
112. *Phyllophorus brocki* (Ludwig, 1875)	+			
113. *Phyllophorus (Phyllophorella) parvepides* H.L. Clark, 1921	+			
114. *Phyllophorus (Phyllophorella)* sp.	+			
115. *Phyllophorus (Phyllophorella) cebuensis* (Semper, 1867)	+			
116. *Phyrella fragilis (Ohshima, 1912)*			+	+
117. *Phyllophorus spiculata (Chang, 1935)*	+			

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
118. *Pseudocucumis acicula* (Semper, 1867)			+	
Order DACTYLOCHIROTIDA Family YPSILOTHURIDAE				
119. *Ypsilothuria bitentaculata* (Ludwig, 1875)			+	
Order ELASIPODIDA Family DEIMATIDAE				
120. *Deima blakei* Theel, 1886			+	
121. *Deima validum* Theel, 1879			+	
122. *Ophnurgus glaber* Walsh, 1891			+	
123. *Ophnurgus conservata* Koehler and Vaney, 1905				+
124. *Ophnurgus invalidus* Koehler and Vaney, 1905	+			
Family LAETMOGONIDAE				
125. *Apodogaster alcocki Walsh, 1891*			+	
126. *Benthogone fragilis* Koehler and Vaney, 1905	+			
127. *Laetmogone spongiosa Theel, 1879*			+	
128. *Laetmogone violacea Theel, 1879*		+		
Family PSYCHROPOTIDAE				
129. *Benthodytes typica Theel, 1882*			+	
130. *Benthodytes glutinosa* Perier, 1896			+	
131. *Filithuria elegans* Koehler and Vaney, 1905			+	
132. *Psychropotes minutes* Koehler and Vaney, 1905				+
Family PELAGOTHURIIDAE				
133. *Euriplastes obscura Koehler and Vaney, 1905*			+	

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
Order APODIDA Family SYNAPTIDAE				
134. *Anapta gracilis* Semper, 1867	+			
135. *Chondrocloca baselli* (Jager)			+	+
136. *Euapta godeffroyi* (Semper, 1868)				+
137. *Lapidoplax* sp.			+	
138. *Leptosynapta* sp.			+	
139. *Ophiodesoma grisea* (Semper, 1868)			+	+
140. *Patinapta ooplax* (von Marenzeller, 1882)			+	
141. *Patinapta conferta* Koehler and Vaney, 1905	+			
142. *Patinapta denticulata* Koehler and Vaney, 1905	+			
143. *Protankyra errata* Koehler and Vaney, 1905			+	
144. *Protankyra innominata Ludwig, 1875*	+		+	
145. *Protankyra pseudodigitata (Semper, 1867)*			+	
146. *Protankyra similes (Semper, 1867)*	+			
147. *Protankyra tristis Koehler and Vaney, 1905*	+			
148. *Protankyra sp.*			+	
149. *Protankyra timida* Koehler and Vaney, 1905			+	
150. *Psamothuria ganapati* Rao, 1968	+			
151. *Synapta maculata (Chamisso and Eysenhardt, 1821)*			+	+
152. *Synaptula recta* (Semper, 1868)	+		+	+
153. *Synaptula striata* (Sluiter, 1887)	+		+	
154. *Synaptula* sp.	+			

Order/Family/Species	Eastern Coast	Western Coast	A & N Islands	Laksha-dweep
Family CHIRIDOTIDAE				
155. *Polycheria rufescens (Brandt, 1835)*			+	+
156. *Trochodota havelockensis Rao, 1975*			+	
Family MYRIOTRICHIDAE				
157. *Molpadia muscules (Risso, 1826)*			+	
158. *Ankyloderma contortum Koehler and Vaney, 1905*	+			
159. *Ankyloderma danielssenii* Theel, 1886			+	
160. *Ankyloderma intermedium* Koehler and Vaney, 1905	+			
161. *Ankyloderma musculus* (Risso)			+	
162. *Ankyloderma polymorphium* Koehler and Vaney, 1905	+			
163. *Trochostoma albicans* Koehler and Vaney, 1905	+			
164. *Trochostoma andamanense* Walsh, 1891			+	
165. *Trochostoma ecalcareum* Koehler and Vaney, 1905	+			
166. *Trochostoma elongatum* Koehler and Vaney, 1905			+	
167. *Trochostoma pauperum* Koehler and Vaney, 1905	+			
Order MOLPADIIDA Family CAUDINIDAE				
168. *Acaudina irania Heding, 1940*	+	+	+	
169. *Acaudina leucoprocta (Clark, 1938)*	+			
170. *Acaudina molpadioides* (Semper, 1868)	+	+	+	
171. *Paracaudina australis* (Semper, 1868)	+		+	
OTHERS				
172. *Eupyrgus scaber Lutken, 1857*	+			
173. *Scotothuria herring Hansen, 1978*				+
Total	**77**	**30**	**98**	**35**

2. OBJECTIVES OF THE STUDY

Rationale

The Office of the Chief Wildlife Warden, Department of Environment and Forests, Andaman and Nicobar Administration, has requested the Zoological Survey of India, Port Blair vide letter No. CWLW/WL/144/81 dated 12th May, 2011 to undertake the 'Status survey of sea cucumber in territorial waters of Andaman and Nicobar Islands' in order to examine the proposal of Coast Guard/ANC for delisting of the species to enable commercial exploitation by Indian fishermen, and hence the present status survey has been conducted.

Period of study

The present study was conducted during September 2011 to December 2012.

Aim and objectives

Attention to the commercial exploitation of marine invertebrates including holothurians increased during recent years and progress has been made in the knowledge of stock dynamics and fisheries management. Although marine invertebrates yield lower landing in quantity in comparison with fin-fishes, their economic value compensates for this difference by accounting nearly 40% of the value of the world fishery trade. Apart from the economic importance of the Echinoderms (holothurians), they are a vital component in the food chain at various trophic levels and play an important role through grazing, predation and structure and function of marine communities.

There has been a growing concern in recent years, over the status of holothurians for the sustenance and survival of these organisms. As a result, there is an increasing awareness now-a-days, for conservation and management along with judicial exploitation of these animals at international levels. Though several studies are being carried out on the echinoderms as well as holothurians of Andaman and Nicobar Islands, no specific studies on the status and standing stock of these economically important resources is available and hence the present study.

The prime objectives of the proposed study are:

1. To assess the abundance of holothurians resource in selected places of Andaman and Nicobar Islands.
2. To study the species diversity and density of Holothurians.
3. To monitor the status of Holothurians especially on the economically important species.

3. STUDY AREA

The Andaman and Nicobar Islands are situated in the Bay of Bengal within 6° and 14°N latitudes, 92° and 94° E longitudes. They are also called the Bay Islands. There are 572 islands in the Andaman and Nicobar archipelago with a total land area of 8293 sq. km. of these, thirty eight islands are populated. The Andaman and Nicobar groups are separated by the Ten Degree Channel which is about 90 miles (150 km) wide and 400 fathoms deep. The Andaman group consists of more than 324 islands with an area of 1953 sq km and Nicobar group comprises 24 islands with the land mass of 1841 sq km. The Andaman and Nicobar islands have a continental shelf of 35,000 sq. km. with enriched faunal and floral diversities. The entire coastline of these islands is wavy with many long, narrow creeks, lagoons and bays supporting sandy, rocky, muddy beaches and mangroves. There are 106 protected areas in these islands, 96 designated as wildlife sanctuaries, 9 national parks and one biosphere reserve. There are about 8640 species of fauna and 2500 species of flora reported from these islands. About 4% of marine species are endemic.

The Andaman and Nicobar islands are boardered by fringing reef on their eastern side, and a barrier reef on their western side between 10°26′ N and 13°40′ E for a distance of about 360km. These islands offer a varied and complex animal life of which the colourful coral reefs constitute the most fragile and interesting faunal element as elsewhere in the Indo-Pacific Reefs. Majority of these coral reefs are of fringing type occurring close to the shore which covers an area of 948.8 sq km. The coral reef fauna and flora from these islands includes 750 species of fishes, 1422 species of molluscs, 430 species of echinoderms, 112 species of sponges, 474 species of hard corals and 111 species of soft corals, 746 species of crustaceans and 64 species of algae.

Andaman and Nicobar Islands with one fourth of the total coastline of India and about 80 percent of the total Exclusive Economic Zone (EEZ) have significant fishery potential. However, this potential is yet to be tapped. The substantial loss to the fishery sector amounting to about Rs. 2331.92 crores caused by the high intensity earth quake of December 26, 2004 followed by a powerful tsunami has further affected fisheries in Andaman and Nicobar Islands. The present level of marine fish production in Andaman and Nicobar Islands is 30,000 tonnes which is about 12 percent of the estimated potential. Most of the produce is consumed locally. The exports are insignificant and have declined between 1996 and 2000. Marine fish production in Andaman and Nicobar Islands is faced with a complete lack of strategy to promote this activity.

The status surveys of sea cucumbers were conducted at 196 stations in Andaman and Nicobar Archipelago (Fig. 1 and Table 3).

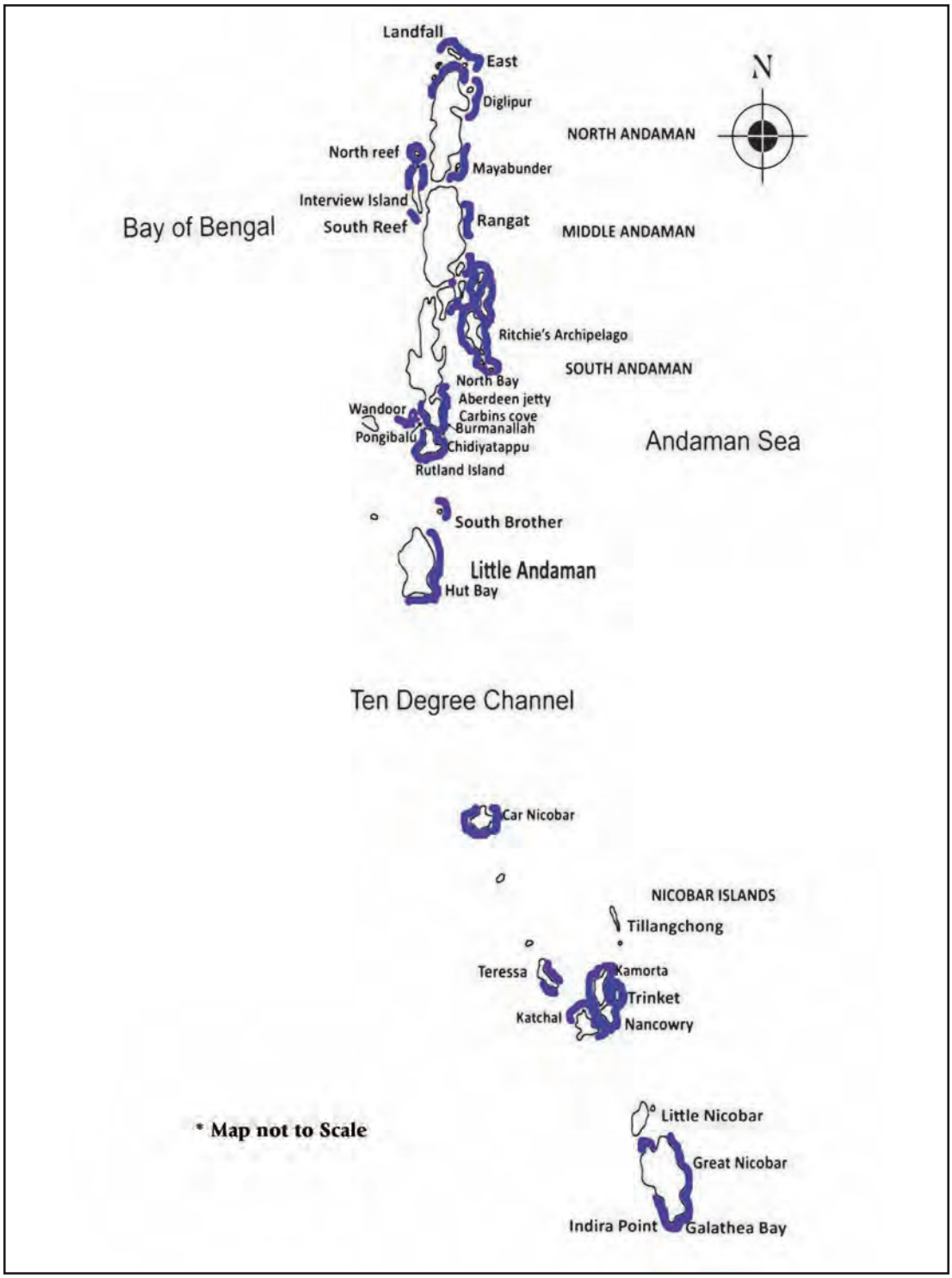


Fig. 1 Map showing area surveyed for Holothurians

Table 3: Area surveyed and their GPS coordinates (GARMIN 12 Channel)

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
1.	North and Middle Andaman District	Diglipur and adjoining areas	Landfall Island-St.1	13°39.721′N	093°01.905′E
2.			Landfall Island- St.2	13°39.481′N	093°01.496′E
3.			East Island	13°38.172′N	093°02.572′E
4.			Elizabeth Bay	13°29.890′N	092°54.849′E
5.			Excelsior Island	13°26.150′N	093°05.416′E
6.			Table Island-St.1	13°24.865′N	093°04.105′E
7.			Table Island - St.2	13°25.687′N	903°05.971′E
8.			Table Island - St.3	13°25.327′N	093°04.021′E
9.			Ross Island-St.1	13°18.142′N	093°04.226′E
10.			Ross Island-St.-2	13°18.167′N	093°04.261′E
11.			Smith Island-St.1	13°18.230′N	093°04.141′E
12.			Smith Island-St.2	13°18.406′N	093°04.207′E
13.			Kalipur Beach	13°13.269′N	093°02.420′E
14.			Durgapur Beach- St.1	13°16.260′N	093°02.439′E
15.			Durgapur Beach- St.2	13°16.121′N	093°02.402′E
16.			Durgapur Beach- St.3	13°16.094′N	093°02.459′E
17.			Durgapur Beach- St.4	13°16.127′N	093°02.414′E
18.			Durgapur Beach- St.5	13°16.081′N	093°02.510′E
19.			Durgapur Beach- St.6	13°16.093′N	093°02.433′E
20.			Arial Bay Light House	13°16.903′N	093°02.768′E
21.			Shibpur offshore - St.1	13°14.053′N	092°03.475′E
22.			Shibpur offshore - St.2	13°14.309′N	092°03.481′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
23.	North and Middle Andaman District	Mayabunder and its adjoining areas	Karmatang Beach -St.1	12°84.518′N	092°93.873′E
24.			Karmatang Beach- St.2	12°51.103′N	092°53.403′E
25.			Rail Island- St.1	12°57.081′N	092°54.458′E
26.			Rail Island- St.2	12°59.035′N	092°54.063′E
27.			Rail Island- St.3	12°59.033′N	092°54.137′E
28.			German Jetty	12°55.432′N	092°54.073′E
29.			Karlo Island- St.1	12°56.221′N	092°53.379′E
30.			Karlo Island- St.2	12°55.511′N	092°53.491′E
31.			Karlo Island- St.3	12°56.282′N	092°53.541′E
32.			Sound Island- St.1	12°56.167′N	092°58.113′E
33.			Sound Island- St.2	12°56.156′N	092°58.123′E
34.			Sound Island- St.3	12°56.997′N	092°59.120′E
35.			Sound Island- St.4	12°56.172′N	092°58.127′E
36.			Avis Island- St.1	12°54.987′N	092°55.958′E
37.			Avis Island- St.2	12°54.917′N	092°55.954′E
38.			Interview Island- St.1	12°59.304′N	092°43.245′E
39.			Interview Island- St.2	12°59.673′N	092°42.594′E
40.			Interview Island- St.3	12°59.125′N	092°42.981′E
41.			North Reef Island-St.1	13°04.487′N	092°42.489′E
42.			North Reef Island-St.2	13°03.933′N	092°42.912′E
43.			M.G. College Adjoining Area	12°52.673′N	092°57.052′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
44.	North and Middle Andaman District	Long Island and Adjoining areas	North Passage Island-St.1	12°17.410′N	092°55.603′E
45.			North Passage Island-St.2	12°18.121′N	092°55.718′E
46.			Guitar Island- St.1	12°20.351′N	092°54.543′E
47.			Guitar Island - St.2	12°20.323N	092°54.529′E
48.			Guitar Island - St.3	12°21.136′N	092 °55.218′E
49.			Guitar Island- St.4	12°20.903′N	092°55.232′E
50.			Company Basti, Long Island- St.1	12°21.774′N	092°55.378′E
51.			Company Basti, Long Island- St.2	12°21.749′N	092°55.410′E
52.			Lalaji Beach, Long Island-St.1	12°24.412′N	092°56.837′E
53.			Lalaji Beach, Long Island-St.2	12°24.354′N	092°56.912′E
54.			Simgal Nali, Long Island	12°22.530′N	092°55.109′E
55.	South Andaman District	North Wandoor	Loha Barrack Croc. Sanctuary	11°38.035′N	092°38.722′E
56.			Mahua Dera	11°38.765′N	092°35.837′E
57.			Kurma Dera	11°39.693′N	092°35.520′E
58.		North Bay	North Bay- St.1	11°41.962′N	092°45.219′E
59.			North Bay- St.2	11°42.070′N	092°45.415′E
60.			North Bay- St.3	11°41.866′N	092°45.138′E
61.			North Bay- St.4	11°42.074′N	092°45.143′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
62.	South Andaman District	Rutland Island	Rutland Island- St.1	11°27.307N′	092°36.098′E
63.			Rutland Island- St.2	11°23.812′N	092°41.251′E
64.			Rutland Island- St.3	11°23.737′N	092°40.838′E
65.			Rutland Island- St.4	11°24.233′N	092°39.952′E
66.			Rutland Island- St.5	11°27.307N′	092°36.098′E
67.			Rutland Island- St.6	11°23.812′N	092°41.251′E
68.			Rutland Island- St.7	11°29.456′N	092°36.889′E
69.			Rutland Island- St.8	11°29.447′N	092°36.832′E
70.			Rutland Island- St.9	11°28.514′N	092°40.390′E
71.			Rutland Island- St.10	11°26.506′N	092°36.861′E
72.			Rutland Island- St.11	11°30.109′N	092°37.123′E
73.			Rutland Island- St.12	11°05.421′N	092°40.050′E
74.			Rutland Island- St.13	11°30.505′N	092°37.413′E
75.			Rutland Island- St.14	11°24.127′N	092°40.423′E
76.			Rutland Island- St.15	11°25.767′N	092°36.624′E
77.		Pongibalu	Pongibalu- St.1	11°30.956′N	092°39.206′E
78.			Pongibalu- St.2	11°30.958′N	092°39.201′E
79.			Pongibalu- St.3	11°30.951′N	092°39.230′E
80.		Cinque	Cinque Island	11°18.660′N	092°42.570′E
81.		Button Islands	North Button Island	12°18.859′N	093°04.027′E
82.			Middle Button Island	12°16.741′N	093°01.832′E
83.			South Button Island- St.1	12°13.376′N	093°01.156′E

Sl. No.	District	Locality/ Area		Name of the Study Site	Latitude	Longitude
84.	South Andaman District	Ritchie's Archipelago	Button Islands	South Button Island- St.2	12°13.378′N	093°01.270′E
85.				South Button Island -St.3	12°13.479′N	093°01.290′E
86.				South Button Island- St.4	12°13.376′N	093°01.156′E
87.			Inglis Island	Inglis Island- St.1	12°08.937′N	093°06.931′E
88.				Inglis Island- St.2	12°08.946′N	093°06.261′E
89.			Rani Jhansi Marine National Park	Henry Lawrence Island- St.1	12°10.005′N	093°01.750′E
90.				Henry Lawrence Island- St.2	12°11.237′N	093°05.474′E
91.				Henry Lawrence Island- St.3	12°12.598′N	093°03.883′E
92.				Henry Lawrence Island- St.4	12°10.005′N	093°01.750′E
93.				Henry Lawrence Plot-1/A	12°12.589′N	093°04.419′E
94.				Henry Lawrence Plot-1/B	12°12.593′N	093°04.479′E
95.				Outram Island- St.1	12°12.456′N	093°05.753′E
96.				Outram Island-2	12°17.101′N	093°04.728′E
97.				Outram Island- St.3	12°12.456′N	093°05.753′E
98.				Outram Island- St.4	12°13.357′N	093°02.341′E
99.				Outram Canal	12°13.357′N	092°02.206′E
100.				Outram Plot-1/A	12°14.621′N	093°04.041′E
101.				Outram Plot-1/B	12°14.569′N	093°04.049′E
102.				John Lawrence Island- St.1	12°10.114′N	093°01.568′E

Sl. No.	District	Locality/ Area		Name of the Study Site	Latitude	Longitude
103.	South Andaman District	Ritchie's Archipelago	Rani Jhansi Marine National Park	John Lawrence Island-St.2	12°08.853′N	093°00.310′E
104.				John Lawrence Island-St.3	12°10.114N′	093°01.568′E
105.				John Lawrence Island-St.4	12°03.020′N	093°02.202′E
106.				John Lawrence Island-St.5	12°02.962′N	093°02.212′E
107.				John Lawrence Plot -1/A	12°03.090′N	093°02.343′E
108.				John Lawrence Plot -1/A	12°03.045′N	093°02.354′E
109.			Wilson Island	Wilson Island- St.1	12°07.099′N	092°57.653′E
110.				Wilson Island- St.2	12°07.498′N	092°57.598′E
111.				Wilson Island- St.3	12°07.099′N	092°57.653′E
112.			Nicholson Island	Nicholson Island- St.1	12°06.376′N	092°57.347′E
113.				Nicholson Island- St.2	12°06.739′N	092°57.235′E
114.				Nicholson Island- St.3	12°06.739′N	092°57.235′E
115.			Peel	Sir William Peel Island	12°03.025′N	093°00.203′E
116.			Havelock Island	Wall	12°03.313′N	092°57.730′E
117.				Elephant Beach	12°00.578′N	092°56.838′E
118.				Radha Nagar Beach	11°59.050′N	093°57.253′E
119.				South Havelock	11°53.274′N	093°01.439′E
120.			Sir Huge Ross Island	Sir Huge Rose Island-St.1	11°47.433′N	093°05.045′E
121.				Sir Huge Rose Island-St.2	11°47.063′N	093°04.616′E
122.				Sir Huge Rose Island-St.3	11°46.924′N	093°04.599′E

Sl. No.	District	Locality/ Area		Name of the Study Site	Latitude	Longitude
123.	South Andaman District	Ritchie's Archipelago	Neil Island	Laxmanpur -2, Neil Island	11°50.793′N	093°00.666′E
124.				Laxmanpur -1, Neil Island	11°50.826′N	093°00.554′E
125.				Howrah Bridge-2	11°49.727′N	093°00818′E
126.				Beach of Pearl Park Beach Resort	11°50.766′N	093°00795′E
127.				Middle point	11°50.857′N	093°01.140′E
128.				Ramnagar Beach-3	11°48.400′N	093°01.440′E
129.				Sunset point	11°51.941′N	093°00667′E
130.				Neil Island-St.1	11°50.120′N	093°01.402′E
131.				Neil Island-St.2	11°50.165′N	093°01.846′E
132.				Neil Jetty -1	11°50.246′N	093°01.850′E
133.				Neil Jetty -2	11°50.780′N	093°02.609′E
134.		Mahatma Gandhi Marine National Park		Tarmguli Island- St.1	11°34.138′N	092°33.836′E
135.				Tarmugli Island- St.2	11°33.410′N	092°33.349′E
136.				Tarmugli Island- St. 3	11°33.260′N	092°33.295′E
137.				Grub Island	11°35.334 N	092°35.739′E
138.				Belley Island- St.1	11°34.095′N	092°33.841′E
139.				Belley Island- St.2	11°34.799′N	092°34.215′E
140.				Chester Island- St.1	11°35.194′N	092°34.708′E
141.				Chester Island -St.2	11°35.233′N	092°34.688′E
142.				Grub Island- St.1	11°35.275′N	092°35.571′E
143.				Grub Island- St.2	11°35.406′N	092°35.713′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
144.	South Andaman District	Mahatma Gandhi Marine National Park	Red Skin Island	11°34.318′N	092°35.705′E
145.			Jolly Bouy Island- St.1	11°30.368″N	092°36.933′E
146.			Jolly Bouy Island- St.2	11°30.611′N	092°36.996′E
147.			Twins Island, St. 1	11°23.773′N	092°33.097′E
148.			Twins Island, St. 2	11°23.330′N	092°33.003′E
149.		Little Andaman Island and Adjoining Areas	Dugong Creek	10°48.499′N	092°34.428′E
150.			South Brother Island	10°56.250′N	092°36.976′E
151.			Pathar Nallah	10°53.384′N	092°32.045′E
152.			Kalapathar	10°39.292′N	092°34.769′E
153.			Hut Bay- St.1	10°37.775′N	092°33.836′E
154.			Hut Bay- St.2	10°35.576′N	092°32.832′E
155.			Hut Bay- St.3	10°35.531′N	092°32.764′E
156.			Harminder Bay	10°33.006′N	092°32.710′E
157.	Nicobar District	Car Nicobar Island	Kimous- St.1	09°07.562′N	092°46.338′E
158.			Kimous- St.2	09°07.335′N	092°46.592′E
159.			Kimous- St.3	09°07.587′N	092°46.316′E
160.			Kakana- St.1	09°07.798′N	092°48.662′E
161.			Kakana- St.2	09°07.353′N	092°48.047′E
162.			Kakana- St.2	09°07.750′N	092°48.678′E
163.			Lapathy	09°13.978′N	092°48.002′E
164.			Tsunami Memorial	09°13.998′N	092°48.071′E
165.			Ship Wreck	09°10.883′N	092°50.123′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
166.	Nicobar District	Car Nicobar Island	Parka	09°11.203′N	092°49.877′E
167.			Parka to Tamaloo	09°11.084′N	092°49.851′E
168.			Tamaloo	09°11.350′N	092°49.498′E
169.			Arong- St.1	09°10.314′N	092°43.493′E
170.			Arong- St.2	09°10.219′N	092°43.251′E
171.			Malacca-St.1	09°10.410′N	092°49.648′E
172.			Malacca-St.2	09°10.490′N	092°49.714′E
173.			Malacca-St.3	09°09.701′N	092°50.128′E
174.		Nancowry group of Islands	W.Entrance, Nancowry	07°59.517′N	093°30.373′E
175.			Balubasthi, Nancowry	08°01.398′N	093°33.305′E
176.			Safed Balu, Trinket	08°06.567′N	093°33.420′E
177.			Katchall Island	07°58.952′N	093°24.351′E
178.			Channel, Trinket	08°06.260′N	093°33.235′E
179.			Open Sea side, Trinket	08°02.083′N	093°36.326′E
180.			Alukiya, Kamorta	07°59.502′N	093°29.493′E
181.			Kardip, Kamorta	08°02.178′N	093°33.103′E
182.			Chmpin Island	08°01. 670′N	093°33.123′E
183.			Teressa Island	08°13.686′N	093°10.913′E
184.		Great Nicobar Island & its adjoining areas	B/Quarry- St.1	06°59.842′N	093°56.778′E
185.			B/Quarry- St.2	07°00.011′N	093°56.824′E
186.			Laxman Beach	07°01.454′N	093°55.267′E
187.			Joginder Nager	06°56.372′N	093°54.999′E

Sl. No.	District	Locality/ Area	Name of the Study Site	Latitude	Longitude
188.	Nicobar District	Great Nicobar Island & its adjoining areas	Gandhi Nagar	06°51.056′N	093°53.769′E
189.			Sastry Nagar	06°47.856′N	093°53.177′E
190.			Galathea Bay	06°47.992′N	093°50.549′E
191.			Galathea Mouth	06°49.220′N	093°51.900′E
192.			Kopen Heat	06°50. 923′N	093°47.983′E
193.			Chingen Basti	06°58. 307′N	093°55.748′E
194.			Navy Dera	07°07. 571′N	093°53.133′E
195.			Afra Bay	07°10.812′N	093°44.541′E
196.			Indira Point	06°45.512′N	093°49.646′E

4. MATERIAL AND METHODS

Assessment of Holothurians

Reef Walks: Intertidal reef areas have been surveyed by reef walks wherever possible. The data were collected quantitatively by employing quadrate (10 × 10 m) at every 10m interval perpendicular to shore of the islands.

Subtidal surveys: The undersea survey has been conducted by SCUBA diving to estimate the status, diversity and density of holothurians to the maximum depth of 30m in the selected regions of Andaman and Nicobar Islands where the distribution of these was frequently reported.

The assessment of holothurians on the subtidal region has been performed by Line Intercept Transect (LIT) method (English *et al.*, 1994) with the help of SCUBA diving and underwater videographic monitoring. The transect area has been standardized depending upon the availability of holothurian beds on the reefs. Holothurians were quantified by employing 10 × 10 m quadrant at every 10m interval along the transect line on the reef area. The numerical density and abundance of these echinoderms have also been estimated. The data were converted for number of holothurians recorded per $100m^2$ area.

Species diversity: The species diversity of holothurians was calculated according to the Shanon-Weiner formula.

$H' = \Sigma\ Pi/nPi$

Where Pi = proportion of the *i*-th species in the collection and H′= Diversity of a theoretically infinite population.

Personal interaction: Besides field surveys, the personal interaction with fishermen and traders were made at all the places of study to gather information about the present status of the availability of holothurians. Apart from that discussions were made with the officials of Forests Department and research institutions to update the information about the past and present status on holothurians in Andaman and Nicobar waters. Also information pertaining to poaching and illegal fishing of holothurians was collected wherever possible, despite the ban on fishing of these sea cucumbers as they included in Schedule-I category of Wildlife (Protection) Act, 1972 by the Ministry of Environment and Forests, Government of India.

5. RESULTS AND DISCUSSION

HOLOTHURIANS

1. Status of Holothurians

Extensive undersea and intertidal surveys were conducted at 196 stations covering entire Andaman and Nicobar waters to assess the present status, diversity, distribution and density of different species of holothurians. Among the areas surveyed, 22 stations fall under North Andaman, 21 stations in Middle Andaman, 52 stations in South Andaman, 53 stations in Ritchie's Archipelago, 8 stations in Little Andaman and 40 stations in Nicobar Islands (Table 1). The assessment was made from the intertidal area to 30m depth with an interval of 5m depth. The area from the shoreline to maximum of 3 km offshore regions was surveyed during the study at all the places. In general the availability of holothurians was found in all the stations of study and they inhabited from intertidal region to a maximum of 30 m deep in the subtidal region.

2. Diversity and distribution of Holothurians

The diversity and distribution of holothurians reported from different places at Andaman and Nicobar Islands during the present study period are given in Table 4. The present survey encountered 30 species of holothurians belonging to 10 genera, against the 100 species reported earlier in literature. Among them maximum of 23 species reported from Ritchie's Archipelago and minimum of 11 species at Great Nicobar Island with the species diversity (H′) of 1.21 and 0.80 at these two areas respectively. Out of the 30 species reported, the following 14 species are commercially important.

1. *Actinopyga mauritiana*
2. *Actinopyga miliaris*

3. *Actinopyga lecanora*
4. *Actinopyga echinites*
5. *Holothuria atra*
6. *Holothuria (Metriatyla) scabra*
7. *Holothuria (Halodeima) edulis*
8. *Holothuria (Microthele) nobilis*
9. *Bohadschia marmorata*
10. *Bohadschia argus*
11. *Thelenota ananas*
12. *Stichopus horrens*
13. *Stichopus chloronotus*
14. *Stichopus hermanni*

Table 4: Distribution of holothurians encountered during the survey

Sl. No.	Species	North Andaman	Middle Andaman	South Andaman	MGMNP	Ritchie's Archipelago	RJMNP	Little Andaman Island	Car Nicobar Island	Nancowry Islands	Great Nicobar Island
1.	*Actinopyga mauritiana*	+	+	+	+	+	+	+	+	+	+
2.	*Actinopyga miliaris*	+	–	+	–	+	+	+	–	+	–
3.	*Actinopyga lecanora*	–	+	+	–	+	–	–	+	+	–
4.	*Actinopyga echinites*	+	+	–	–	–	–	+	+	–	+
5.	*Holothuria cinerascens*	–	–	+	–	+	–	–	–	+	–
6.	*Holothuria (Thymiosycia) hilla*	+	+	+	+	+	+	+	–	+	+
7.	*Holothuria (Thymioscycia) impatiens*	+	+	+	+	+	+	+	+	+	+
8.	*Holothuria atra*	+	+	+	+	+	+	+	+	+	+
9.	*Holothuria (Acanthotrapeza) pyxis*	+	+	–	–	+	–	–	–	+	–
10.	*Holothuria leucospilota*	–	–	+	–	–	+	+	+	+	–

Sl. No.	Species	North Andaman	Middle Andaman	South Andaman	MGMNP	Ritchie's Archipelago	RJMNP	Little Andaman Island	Car Nicobar Island	Nancowry Islands	Great Nicobar Island
11.	*Holothuria (Mertensiothuria) fuscocinerea*	–	+	+	–	–	–	+	–	–	–
12.	*Holothuria (Metriatyla) scabra*	+	–	+	–	–	–	–	–	–	–
13.	*Holothuria (Halodeima) edulis*	+	+	+	+	+	+	+	+	+	+
14.	*Holothuria (Microthele) nobilis*	+	+	–	+	+	+		+	+	–
15.	*Holothuria coluber*	+	–	–	–	–	–	–	–	+	+
16.	*Holothuria (Mertensiothuria) pervicax*	+	+	–	–	+	–	+	+	–	–
17.	*Holothuria arenicola*	–	–	+	–	–	+	+	+	+	–
18.	*Bohadschia marmorata*	+	+	+	+	+	+	+	+	+	+
19.	*Bohadschia argus*	+	+	+	+	+	+	–	–	+	–
20.	*Bohadschia graeffei*	+	+	+	+	+	+	+	+	+	+
21.	*Labidodemas semperianum*	+	–	–	+	+	–	–	–	–	–
22.	*Stolus buccalis*	–	+	–	–	+	+	–	+	–	–
23.	*Thelenota ananas*	+	+	+	+	+	+	+	–	+	–
24.	*Stichopus horrens*	–	–	+	–	+	+	–	–	+	–
25.	*Stichopus chloronotus*	+	+	+	+	+	+	+	+	+	+
26.	*Stichopus hermanni*	+	+	+	+	+	+	+	+	+	–
27.	*Stichopus vastus*	+	+	–	–	+	+	+	–	–	–
28.	*Synapta maculata*	+	+	+	+	+	+	+	+	+	+
29.	*Euapta godreffroyi*	–	–	+	+	+	+	–	–	–	–
30.	*Acaudina molpadioides*	+	+	+	+	–	–	–	+	+	–
	Total number of species	**21**	**21**	**22**	**16**	**23**	**20**	**18**	**17**	**22**	**11**
	Species diversity (H')	**1.10**	**1.09**	**1.14**	**0.91**	**1.21**	**1.03**	**0.96**	**0.95**	**1.12**	**0.80**

MGMNP- Mahatma Gandhi Marine National Park; RJMNP- Rani Jhansi Marine National Park

3. Key characters and diagnostic features of Holothurians

The key characters and diagnostic features of 30 species of holothurians recorded during the study period in Andaman and Nicobar Islands are given below.

Order ASPIDOCHIROTIDA Grube, 1840
Family HOLOTHURIIDAE Ludwig, 1894

1. *Actninopyga mauritiana* (Quoy and Gaimard, 1833), Fig. 2

Common Names: Surf Red-fish in Mauritius & White spotted sea cucumber

Description: The shape is cylindrical with a flat underside; length upto 300 mm and live weight varies from 0.5 to 1.0 kg. The tube feet are firmly attached to rocks to prevent the animal from being washed away by the waves.

Colour: Colour in living condition is brick red above and white below.

Habitat: Usually found where the surf breaks on the outside of the reef.

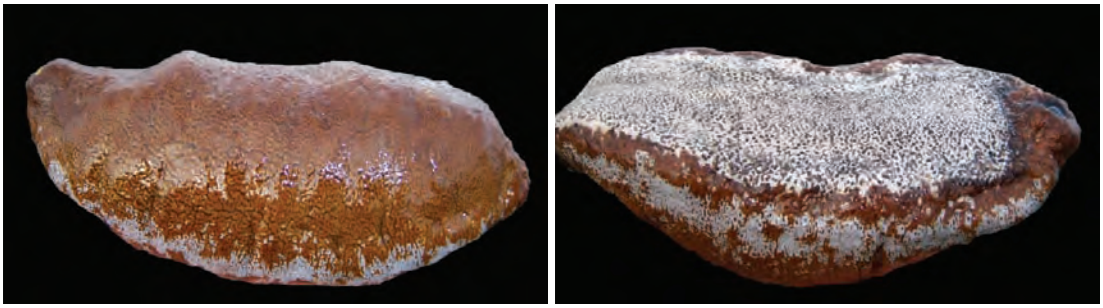


Fig.2 *Actinopyga mauritiana* (Quoy and Gaimard, 1833) (Dorsal & ventral views)

Distribution: ***India***: Gulf of Mannar, Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Aldabra, Chagos, Comores, Eastern Africa, Kenya, Madagascar, Mascarene Basin, Mauritius, Mozambique, Red Sea, Seychelles, Somalia, Tanzania and West Indian Ocean.

2. *Actinopyga miliaris* (Quoy and Gaimard, 1833), Fig. 3

Common name: Black Fish & North Australian Sea Cucumber

Description: Length of the specimens ranged from 120 to 300 mm and the weight varied from 0.5 to 2 kg. They are massive cylindrical forms with rough surface. Anal teeth are very distinct.

Colour: Colour is green and black.

Habitat: Found mainly in waters less than 10 m depth on pure sand. They also live on the reef flats among live corals and on algal beds.

Fig. 3 *Actinopyga miliaris* (Quoy and Gaimard, 1833)

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

3. *Actinopyga lecanora* (Jaeger, 1833), Fig. 4

Common name: White tipped sea cucumber

Description: The size of the specimens can be > 300 mm in length.

Colour: It is a light grey or brown sea cucumber, with light speckled patches particularly around the somewhat attenuated posterior end.

Habitat: It is often concealed amongst coral or rubble of reefs.

Fig. 4 *Actinopyga lecanora* (Jaeger, 1833)

Distribution: ***India***: Andaman and Nicobar Islands; ***Elsewhere***: East Africa, Eastern Africa, Kenya, Madagascar, Mascarene Basin, Mauritius, Mozambique, Somalia and Tanzania.

4. *Actinopyga echinites* (Jaeger, 1833), Fig. 5

Common name: Deep water red fish

Description: The body is wider in the middle and tapers at both ends. The upper surface is wrinkled, often with fine sand settled over it. It attaches itself to rocks with its tube feet.

Colour: Colour of the animal is uniformly brown.

Habitat: It occurs at a depth between 3 and 7m and inhabits both hard (rocky area) and soft substratum (sand).

Distribution: ***India***: Andaman and Nicobar Islands, Gulf of Mannar and Lakshadweep; ***Elsewhere***: Northern Australian reefs, Western Indian Ocean, East Africa and Madagascar, South-East Arabia, Ceylon, East Indies, Philippines, China, South Japan and South Pacific Island.

Fig. 5 *Actinopyga echinites* (Jaeger, 1833)

5. *Holothuria cinerascens* (Brandt 1835), Fig. 6

Description: Ranges in length from 30 to 200 mm. robust, sub-cylindrical with dorsal and ventral sides sharply differentiated. Dorsal surface covered with uniformly distributed numerous papillae. Ventrally beset with crowded robust pedicels.

Colour: In living condition, it is reddish-brown with some of the papillae and pedicels yellowish in colour.

Habitat: This species is found in rocky shores. Individuals were often found attached firmly at the rock edges by the three rows of pedicels on the ventral side.

Distribution: ***India***: Gulf of Mannar, Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa and Madagascar, Red Sea, South-East Arabia, Maldives, Ceylon area, East Indies, Philippines, China, South Japan, South Pacific Island and Hawaii.

Fig. 6 *Holothuria cinerascens* (Brandt, 1835)

6. *Holothuria (Thymiosycia) hilla* (Lesson, 1830), Fig. 7

Description: Length from 50 mm to 200 mm. body long and cylindrical with blunt ends, body wall soft. Dorsal and ventral sides demarcated in the living condition. Papillae sparsely arranged and have expanded bases. Ventral side has numerous pedicels arranged in three rows.

Colour: In living condition, the colour of the specimen is chocolate brown and the large specimen is golden brown with a circular pale area around the appendages.

Fig. 7 *Holothuria (Thymiosycia) hilla* (Lesson, 1830)

Habitat: It is a fungitive species always found under coral stones.

Distribution: ***India***: Palk Bay, Gulf of Mannar, Andaman and Nicobar Islands, Maldives and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South-East Arabia, Maldives area, Sri Lanka, Bay of Bengal, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan, South Pacific Island and Hawaii.

7. *Holothuria (Thymiosycia) impatiens* (Forskal, 1775), Fig. 8

Common name: Mottled Sea Cucumber & Impatient Sea Cucumber

Description: Length from 60 to 240 mm. Body bottle shaped with a long neck. Superficially the body can not be differentiated dorsally and ventrally. Papillae scattered fairly evenly over the surface and not in series. Skin is usually sandy to touch.

Colour: In living condition, the general body colour is light brown with 4 to 5 dark brown transverse bands on the dorsal side at the anterior end. A few dark brown blotches are also found on the dorsal side on the rest of the body. The ventral side is uniformly light brown with three dark bands of the dorsal side extending to the ventral side near the anterior end.

Fig. 8 *Holothuria (Thymiosycia) impatiens* (Forskal, 1775)

Habitat: It is often found under the dead coral stones.

Distribution: ***India***: Andaman and Nicobar Islands, Gulf of Mannar and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, Arabia, Maldives, Sri Lanka, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan, South Pacific Island and Hawaii.

8. *Holothuria atra* (Jaeger, 1833), Fig. 9

Common names: Black Sea cucumber & Lolly Fish

Description: Length from 90-500 mm but known to grow up to 600 mm. body elongate, sub-cylindrical and capable of considerable extension. Posterior end is blunt. Mouth is in the form of a transverse slit and surrounded by a conspicuous papillose collar. There are 20 tentacles in double row. Pedicels numerous and crowded on the ventral side. Papillae are rather thicker than the pedicels and sparsely arranged.

Colour: In living condition, the colour is black or very dark brown or reddish-brown. The pedicels have white sucker disc and the papillae have white tips the stock of the pedicels and papillae are always black. The tentacles and the peristomes are dark brown.

Habitat: It is always found fully exposed in shallow water on sandy bottom.

Fig. 9 *Holothuria atra* (Jaeger, 1833)

Distribution: ***India***: Andaman and Nicobar Islands, Palk Bay, Gulf of Mannar and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, Arabia, Maldives, Sri Lanka, Persian Gulf, East Indies, Philippines, Northern Australia, South Japan, South Pacific Island and Hawaii.

9. *Holothuria (Acanthotrapeza) pyxis* (Selenka, 1867), Fig. 10

Description: The length of the specimens varied from 270-450 mm. The body is tubular. The posterior region is bulged and blunt with the anterior end narrow. A number of projections are found on the dorsal side. Some of them are 20 mm in length. They are not arranged in order. On the ventral side, there are four bands of pedicels.

Colour: Dorsal side is brownish-pink with some of the tubercles blackish brown. The ventral side is light brown, with spaces between the bands of the pedicels yellow.

Habitat: The species is always found under the large stones with the posterior end bulged with water tucked in crenices.

Distribution: ***India***: Andaman Islands; ***Elsewhere***: East Indies

Fig.10. *Holothuria (Acanthotrapeza) pyxis* (Selenka, 1867)

10. *Holothuria leucospilota* (Brandt, 1835), Fig.11

Description: Large and snake –like forms with leathery skin. The pedicels are large with well developed sucking discs. The tentacles are 20 in number and are ventrally placed.

Colour: Reddish-brown in live condition about looks black on contraction.

Habitat: The species has the peculiar habit of tucking its bulged posterior end in the crenice. Sometimes it can be seen under coral stones.

Distribution: ***India***: Andaman and Nicobar Islands, Gulf of Mannar and

Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, Arabia, Maldives, Sri Lanka, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan, South Pacific Island and Hawaii.

Fig.11 *Holothuria leucospilota* (Brandt, 1835)

11. *Holothuria (Mertensiothuria) fuscocinerea* (Jaeger, 1833), Fig. 12

Description: The length of the specimen is 120 mm. The body is long and tubular with 20 large ventral tentacles. Tentacles on ventral side are arranged in three, though not distinct bands. The papillae on the dorsal side are scattered.

Colour: Colour in living condition is brownish; more or less mottled, ventral side is pale gray.

Fig. 12 *Holothuria (Mertensiothuria) fuscocinerea* (Jaeger, 1833)

Habitat: It is usually found sandy as well as rocky areas.

Distribution: ***India***: Andaman; ***Elsewhere***: Sri Lanka, Philippines, Japan, Fiji, Samoa, Australia and Celebes.

12. *Holothuria (Metriatyla) scabra* (Jaeger, 1833), Fig. 13

Common name: Sand Fish Sea Cucumber

Description: The length of the species is 300 – 400 mm. the body is robust with both the ends blunt. The dorsal side is convex and the ventral side is flat. The skin is very thick and slimy to touch. On the dorsal side, there are many small papillae which are mainly scattered and often inconspicuous. On the ventral sides the pedicels are densely distributed without any arrangement. Each dark spot on the ventral side represents one pedicel.

Colour: In the living condition is grey to black on the dorsal side, and white ventrally.

Habitat: It is found in muddy-sandy regions and prefers less saline waters.

Distribution: ***India***: Andaman and Nicobar Islands, Gulf of Mannar and Palk Bay; ***Elsewhere***: Mascarene Islands, East Africa, Red Sea, Arabia, Maldives, Sri Lanka, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan, South Pacific Island and Hawaii.

Fig. 13 *Holothuria (Metriatyla) scabra* (Jaeger, 1833)

13. *Holothuria (Halodeima) edulis* (Lesson, 1830), Fig.14

Common name: Edible cucumber

Description: Length from 90 mm to 300 mm. body elongate, narrow at the anterior end and blunt at the posterior end. Minute papillae found on the dorsal side of the body. Numerous pedicels present on the ventral side. There are 20 medium-sized tentacles surrounded by a rim of black papillae. Skin is smooth and thin.

Colour: Body colour is bright rose pink which may be obscured by varying degrees of black pigments. The black colour is well marked on the dorsal side where it varies from grey to intense black and at the side it is replaced by pink. On the ventral side there is no black colour.

Habitat: It is usually found in shallow depth.

Distribution: ***India***: Andaman Islands and Gulf of Mannar; ***Elsewhere***: East Africa, Red Sea and South-East Arabia.

Fig.14 *Holothuria (Halodeima) edulis* (Lesson, 1830)

14. *Holothuria (Microthele) nobilis* (Selenka, 1867), Fig.15

Common names: Whitefoot Sea Cucumber & Blackteat fish

Description: The length varied from 250 mm to 400 mm. the body is tubular and massive in shape. Live weight varies from 2 to 3 kg in fresh condition. Body wall is 10-15 mm in thickness. Pedicels and papillae are indistinguishable. Dorsal papillae are more thinly scattered than the ventral pedicles. Anus is surrounded by five calcified papillae.

Colour: This species can be seen in two colour forms, white and black.

Habitat: The species lies freely in the lagoon in the adult stage and often covered with a coat of sand. Young white forms live among the algae. The white form is found in more than 3 m deapth.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep, ***Elsewhere***: Aldabra, Chagos, Comores, East Africa, Eastern Africa, Kenya, Madagascar, Mascarene Basin, Mauritius, Red Sea, Seychelles, Somalia, South Africa, Tanzania and West Indian Ocean.

Fig.15 *Holothuria (Microthele) nobilis* (Selenka, 1867)

15. *Holothuria coluber* (Semper, 1868), Fig. 16

Description: It is a black sea cucumber with white papillae and 20 yellow tentacles. It is a long (500-600mm) species with a firm, thick body wall, and a tough tegument. Spicules include spinose cup and saucer' tables and rosettes.

Fig. 16 *Holothuria coluber* (Semper, 1868)

Colour: Uniformly black in colour.

Habitat: This species is found on reefs, usually with its posterior wedged below rocks on reef flats.

Distribution: ***India***: Andaman Islands; ***Elsewhere***: East Indies, North Australia, Philippines and South Pacific Islands.

16. *Holothuria (Mertensiothuria) pervicax* (Selenka, 1867), Fig. 17

Common name: Stubborn Sea Cucumber

Description: The length of the specimen ranges from 70 mm to 120 mm. They are sub-cylindrical in shape. The dorsal and the ventral sides are well differentiated. On the ventral side there are a number of pedicels arranged closely without any evidence of band formation. The papillae are scattered on the dorsal side. The tentacles are definitely ventral in position. In living condition, the dorsal side is brown with 5 to 7 honey coloured transverse bands of different widths.

Colour: The ventral side is lighter, mottled with white and light violet on a brown background. The cloacal opening is surrounded by a dark violet ring with some portion of the inner cloacal wall of the same colour.

Habitat: It s usually found in sandy areas.

Fig.17 *Holothuria (Mertensiothuria) pervicax* (Selenka, 1867)

Distribution: ***India***: Andaman and Nicobar Islands, Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South East Arabia, Maldives, Sri Lanka, Persian Gulf, East Indies, Philippines, Northern Australia, South Pacific Island and Hawaii.

17. *Holothuria arenicola* (Semper, 1868), Fig. 18

Description: Body is slender and vermiform. Mouth is small and surrounded by tentacles ventrally. Pedicels small and not conscipicous and arranged in three bands ventrally. Anus is terminal in position and surrounded by five groups of four to six short papillae.

Colour: Body colour is white and on the dorsal side, three pairs of reddish-brown spots are present.

Habitat: It inhabits in the sand, under the stones and it is very difficult to take out the specimen completely.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: West Indies, Zanzibar, Fiji, Tahiti, Galapagos and East Coast of Australia.

Fig. 18 *Holothuria arenicola* (Semper, 1868)

18. *Bohadschia marmorata* (Jaeger, 1833), Fig. 19

Common names: Marble Sea Cucumber & Chalky Sea Cucumber

Description: Body short and thick with the lower surface slightly flattened. It grows to a large size of 400mm. Body colour is golden brown with small brown dots.

Colour: Sometimes the colour is yellowish brown with black spots.

Habitat: Occurs on coarse coral sand at depths of 2-6 m. It is also seen in the intertidal region covered by a coating of fine mud.

Distribution: ***India***: Gulf of Mannar, Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Aldabra, East Africa, Eastern Africa & Madagascar, Kenya, Madagascar, Mascarene Basin, Mozambique, Red Sea and Seychelles.

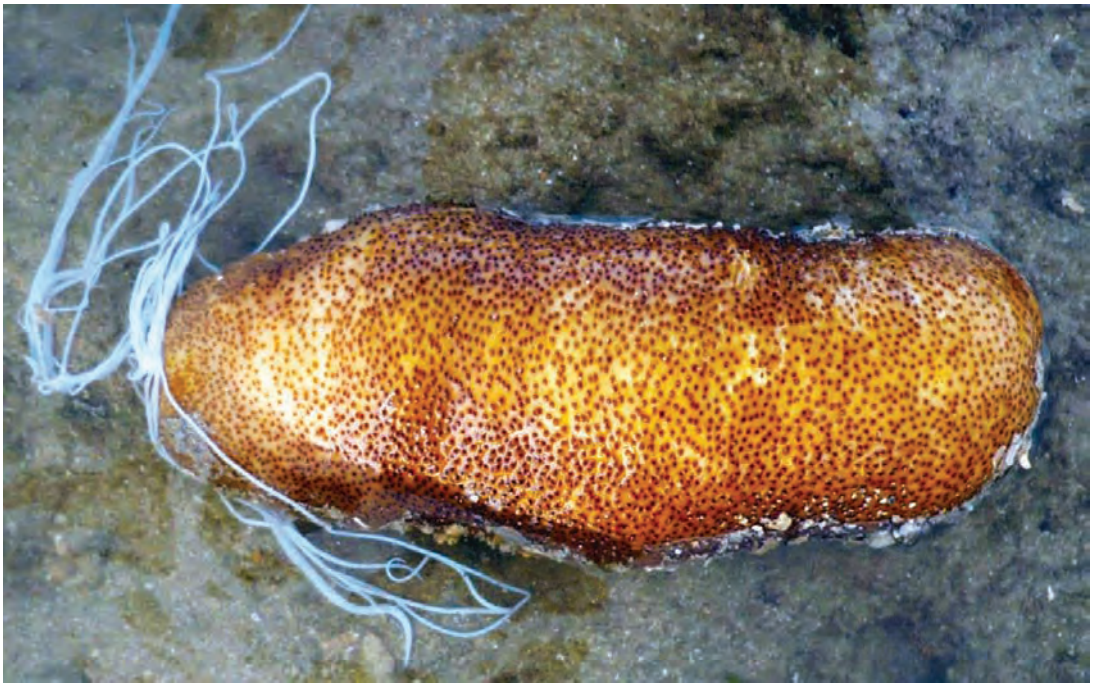


Fig. 19 *Bohadschia marmorata* (Jaeger, 1833)

19. *Bohadschia argus* (Jaeger, 1833), Fig. 20

Common names: Leopardfish, Tigerfish & Ocellated Sea Cucumber

Description: Body is cylindrical with very smooth surface. At the slightest disturbance the sticky threads are thrown out. It grows to a large size of 600 mm in length. Live weight is 1-2 kg. Distinct eye like spots are found all over the body which are encircled with light yellow, white grey colours. The eye spots are situated at a particular angle.

Colour: In living condition, it is brown or black.

Habitat: Occurs on coarse sand in 2-6 m depth. A few pieces of shell and coarse sand usually stick to body.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Ceylon, East Indies, Philippines, Northern Australia, South Pacific Islands, China and South Japan.

Fig. 20 *Bohadschia argus* (Jaeger, 1833)

20. *Bohadschia graeffei* (Semper, 1868), Fig. 21

Common name: Graffiti Sea Cucumber

Description: The length of the species is variable from 15 cm to 18 cm. Underside is grainy. Upper side of the species is rough in structural conformation. Body thickness is 4mm. Papillae are low.

Colour: Body colour is pale cream with brown speckling.

Habitat: Reef slopes, close to the coast. Abundant on bottom of mixed corals and calcareous red algae. Depth range- 0-25 m but it is mostly found in 0-10 m.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Red Sea.

Fig. 21 *Bohadschia graeffei* (Semper, 1868)

Family LABIDODEMATIDAE

21. *Labidodemas semperianum* (Selenka, 1867), Fig. 22

Common name: White Sea Cucumber

Description: The length of the species ranges between 85-250 mm. Spicules are spinose tables and sometimes buttons and rods.

Colour: It is a white, almost translucent sea cucumber, with yellow tube feet and a dark posterior end.

Habitat: This species can be found buried in sand below rocks of the outer coral reef flat.

Distribution: ***India***: Andaman and Nicobar Islands; ***Elsewhere***: East Indies, Philippines, Northern Australia and South Pacific Island.

Fig. 22 *Labidodemas semperianum* (Selenka, 1867)

Order DENDROCHIROTIDA Grube, 1840
Family CUCUMARIIDAE Ludwig, 1894

22. *Stolus buccalis* (Stimpson, 1856), Fig. 23

Description: It is small in size ranges from 70-110 mm, firm and cylindrical species, with a smooth tegument. It is found in coastal habitats south to temperate regions, below stones on intertidal flats. It is mostly distributed in tropical, Indo-west Pacific Ocean.

Colour: Specimen is dark purple- black in colour with red colour tentacles.

Habitat: Usually found concealed under rock or in narrow crevices

Distribution: ***India***: Gulf of Mannar, Andhra Pradesh, Palk Bay, Gulf of Kachchh, Andaman and Nicobar Islands; ***Elsewhere***: East Africa & Madagascar, South East Arabia, Persian Gulf, West Indies, Ceylon, East Indies, North Australia, Philippines, China and South Japan

Fig. 23 *Stolus buccalis* (Stimpson, 1856)

Family STICHOPODIDAE Haeckel, 1896

23. *Thelenota ananas* (Jaeger, 1833), Fig. 24

Common name: Pineapple Sea Cucumber

Description: This species grows to a massive size 700 mm in length. The weight of a live specimen varies from 3 to 6 kg. It is seen in massive form with numerous large pointed teats in groups of two or three all over the upper surface.

Colour: Colour of the specimen in live condition is reddish-orange on the upper side. Tube feet are bright orange colour on the lower surface.

Habitat: It is found on clean sandy bottom at a depth of 2-30 m.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Maldives, East Indies, North Australia, China, South Japan and South Pacific islands.

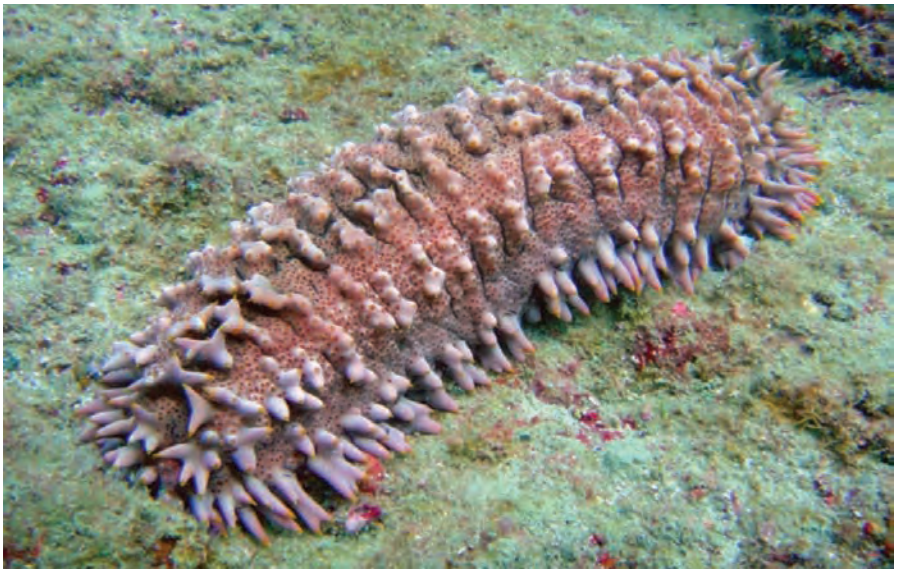


Fig. 24 *Thelenota ananas* (Jaeger, 1833)

24. *Stichopus horrens* (Selenka, 1867), Fig. 25

Description: It is a medium-sized species (to 300 mm) with a smooth tegument but large and irregular papillae. The big tubercles and irregular body form give an "irregular, soft and almost repulsive" appearance. Spicules are tables and large "C" bodies.

Fig. 25 *Stichopus horrens* (Selenka, 1867)

Colour: This species is variable in colour from grey to green/black. It is often variegated with dark patches.

Habitat: *S. horrens* many be found on reefs, below rocks on flats.

Distribution: ***India***: Andaman and Nicobar Islands; ***Elsewhere***: East Indies, North Australia, China, South Japan, South pacific Islands, Philippines and Hawaii.

25. *Stichopus chloronotus* (Brandt, 1835), Fig. 26

Common names: Black sea cucumber & Green fish cucumber

Description: The maximum length of the body is 300 mm. Body quadrangular in cross section with four rows of large finger like processes at the angles.

Colour: Green in colour. The tip of the finger like processes is sometimes orange in colour. The tentacles and the tube feet are ash-coloured and the stalks of tentacles are white.

Habitat: Usually found only beyond low water mark.

Distribution: ***India***: Andaman and Nicobar Islands, Lakshadweep, Gulf of Mannar; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Madagascar, Red Sea, Maldives, Ceylon, Bay of Bengal, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan, South Pacific Island and Hawaii.

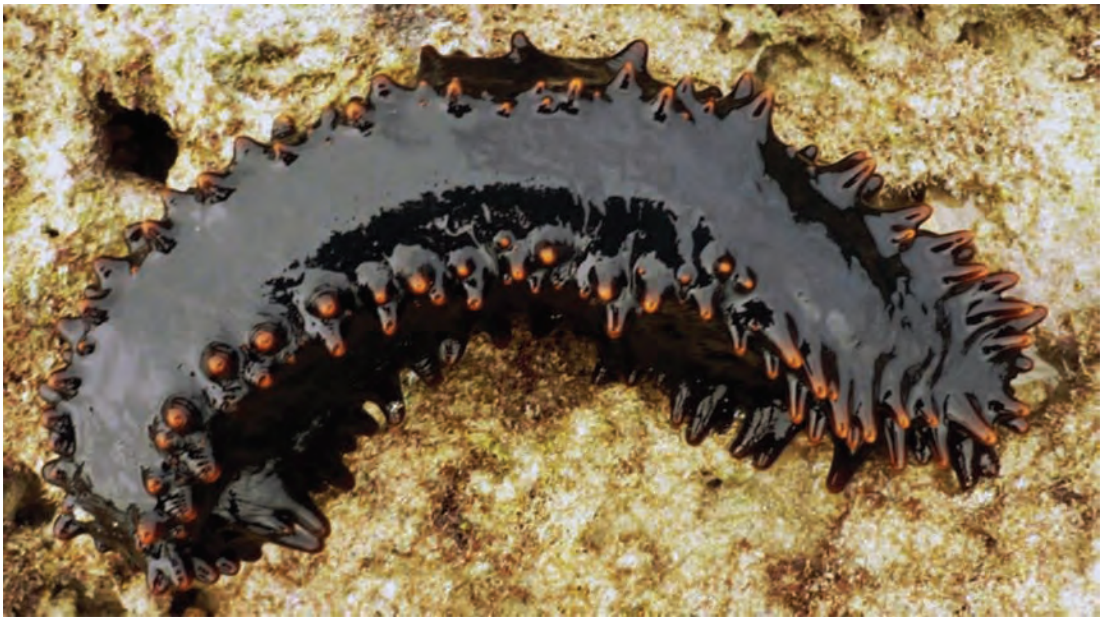


Fig. 26 *Stichopus chloronotus* (Brandt, 1835)

26. *Stichopus hermanni* (Semper, 1868), Fig. 27

Common name: Curry fish & Hermann's sea cucumber

Description: The maximum length of the species is 900 mm. Body massive and loaf like in appearance. The tubercles are prominent.

Colour: In living condition, it is dark yellow with irregular brown patches and pink tube feet.

Habitat: Occurs on algal beds and clean sand bottoms between depths 3 and 30 m.

Distribution: ***India***: Gulf of Mannar, Andaman and Nicobar Islands, Lakshadweep and Palk Bay; ***Elsewhere***: Aldabra, East Africa, Eastern Africa, Kenya, Madagascar, Mascarene Basin, Mozambique, Red Sea, Seychelles, South Africa, Tanzania and West Indian Ocean.

Fig. 27 *Stichopus hermanni* (Semper, 1868)

27. *Stichopus vastus* (Sluiter, 1887), Fig. 28

Common name: Star sea cucumber

Description: This sea cucumber can grow upto a length of 500mm. and reach maximum weight of 2.5 kg. The body is wider in the middle, tapering at both ends and covered with a bright smooth skin.

Colour: The upper surface is uniformly brown with zigzag bands at all over the body. Uniformly brown in colour with black patches.

Habitat: It is commonly found in the depth of 1-3 m. It occurs in sand and rocky substrata.

Distribution: ***India***: Andaman Islands, ***Elsewhere***: North Australia and Maldives.

Fig. 28 *Stichopus vastus* (Sluiter, 1887)

Order: APODIDA Brandt, 1835
Family: SYNAPTIDAE Östergren, 1898

28. *Synapta maculata* (Chamisso and Eysenhardt, 1821), Fig. 29

Common name: Conspicuous sea cucumber

Fig.29 *Synapta maculata* (Chamisso and Eysenhardt, 1821)

Description: The structure of the body is like a snake. It can reach more than 2 m in length. Body wall is very thin and almost transparent when extended.

Colour: It is tan to brown in colour with black margins. The whole body surface has small white rings which are closely arranged.

Habitat: It is usually found on the reef flat.

Distribution: ***India***: Gulf of Mannar, Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, Madagascar, Maldives, South East Arabia, Persian Gulf, East Indies, Philippines, Northern Australia, China, South Japan and South Pacific Island.

29. *Euapta godreffroyi* (Semper, 1868), Fig. 30

Common name: Sticky snake sea cucumber

Description: It is a medium to large species up to 400 mm in length), with 15 tentacles, each with numerous pairs of digits.

Colour: Body colour is creamy white with grey, with green or brown longitudinal stripes.

Fig. 30 *Euapta godreffroyi* (Semper, 1868)

Habitat: It is found in intertidal pool, in sand, beneath stones. This species is found on reefs, concealed among rubble of reef flat or slope.

Distribution: ***India***: Andaman and Nicobar Islands and Lakshadweep; ***Elsewhere***: Mascarene Island, Red Sea, Maldives, East Indies, North Australia, Philippines and South Pacific Island.

Order: MOLPADIIDA Müller, 1850
Family: CAUDINIDAE Heding, 1931

30. *Acaudina molpadioides* (Semper, 1868), Fig. 31

Description: This sea cucumber is loaf shaped and its maximum length is about 300mm. Body surface is thick and covered with a fine coat of sand and is browned coloured with black patches.

Colour: Uniformly brown in colour.

Habitat: This species is commonly found in shallow reef environments. Depth range is 2-15m.

Distribution: ***India***: Andaman and Nicobar Islands, Gulf of Kachchh, Andhra Pradesh, West Bengal, and Gulf of Mannar. ***Elsewhere***: Northern Australia.

Fig. 31 *Acaudina malpadioides* (Semper, 1868)

4. Density of holothurians

The data on the density of holothurians collected from different depths of 10 regions viz. North Andaman, Middle Andaman, South Andaman, MGMNP, Ritchie's Archipelago, RJMNP, Little Andaman, Car Nicobar Island, Nancowry Islands and Great Nicobar Island covering entire Andaman and Nicobar Archipelago is given in table 5. It was observed that the numerical density of all the species of holothurians reported during the study was maximum at North Andaman (1179 nos. /100m^2) followed by Ritchie's Archipelago (1038 nos./100m^2) and Middle Andaman (1004 nos./100m^2). However the minimum density was registered at Car Nicobar Island (410 nos./100m^2), Fig. 32. The density at different depths and different regions varied from 33 to 251 at 25m depth of Great Nicobar Island and inter-tidal region of North Andaman respectively (Fig. 33).

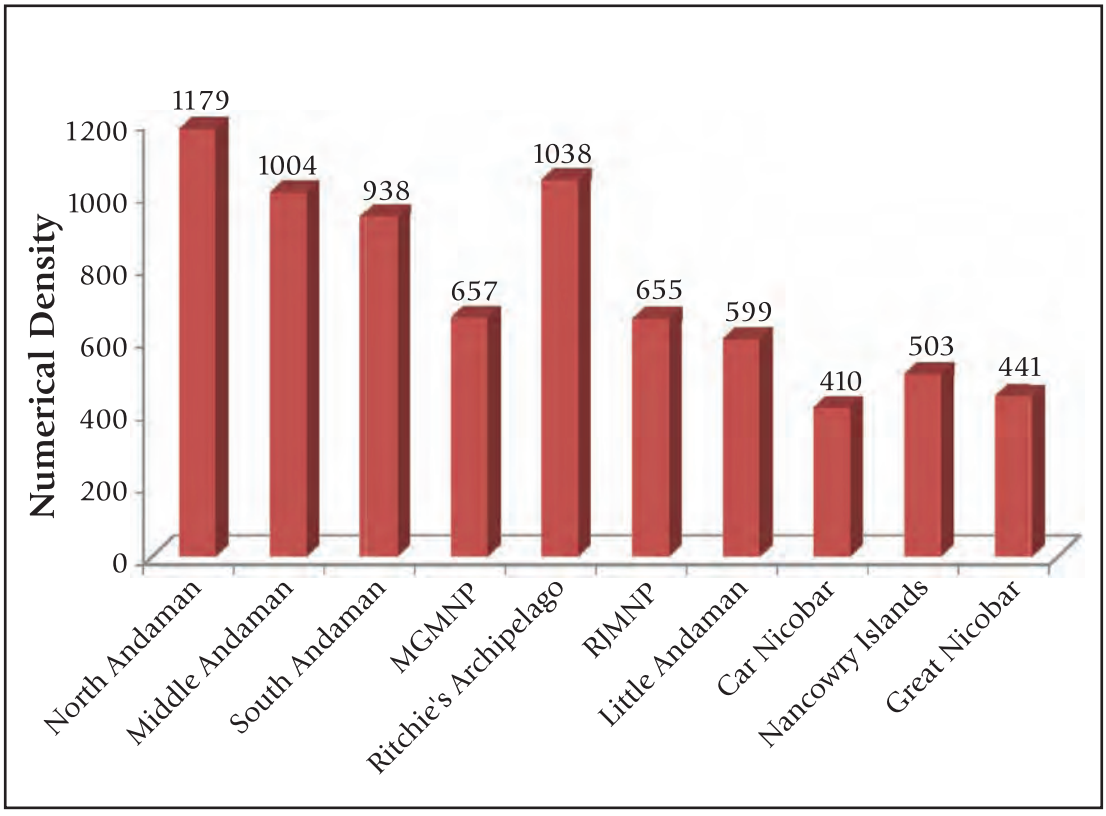


Fig. 32 Density (nos./100m^2) of holothurians at different regions of A&N Islands

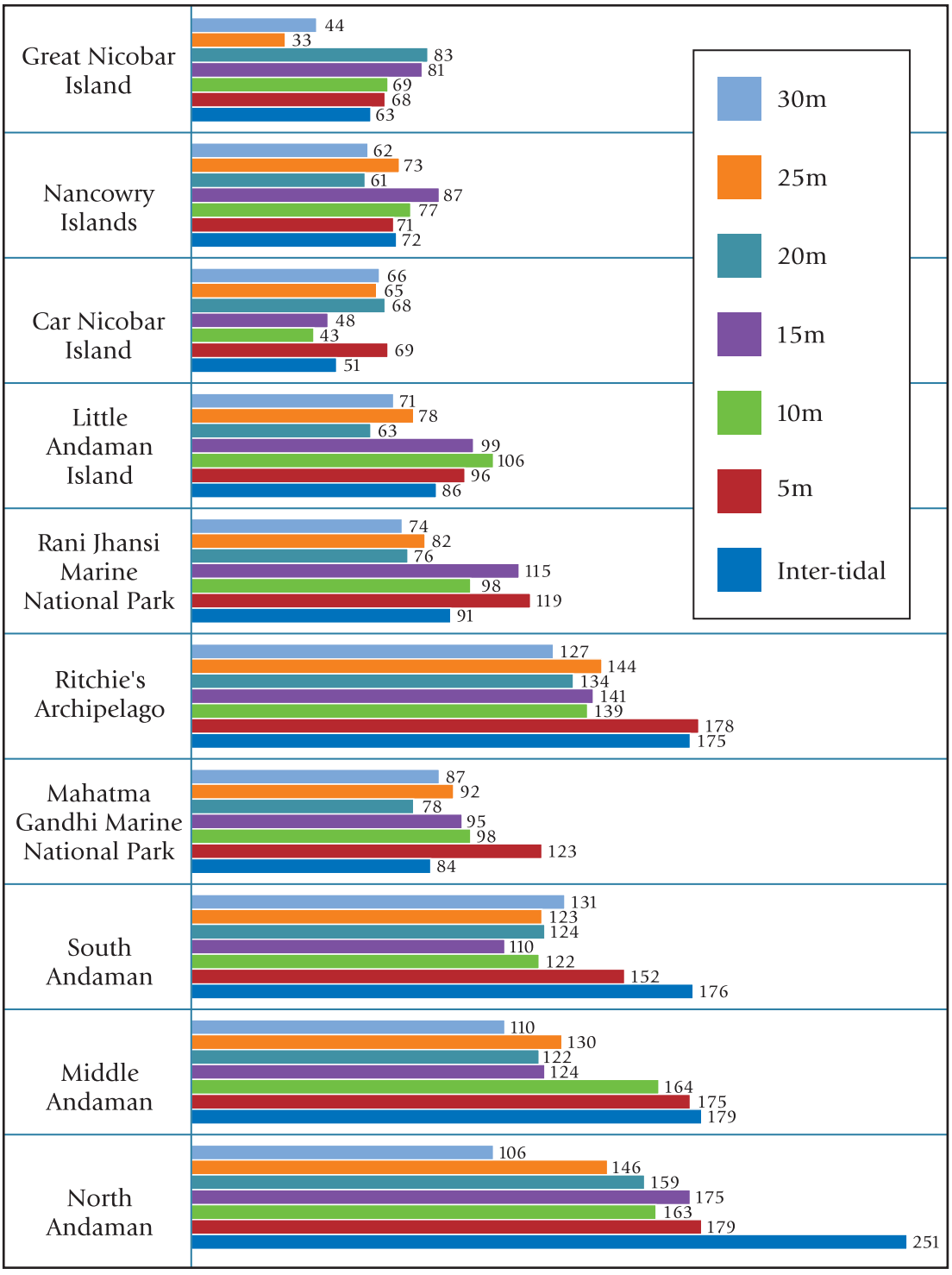


Fig. 33 Depth-wise density (nos./100m^2) of holothurians at different regions of A&N Islands

5. Density of economically important holothurians

Table 6 depicted the combined density of 14 economically important species of holothurians at different regions of Andaman and Nicobar Islands. The numerical density of 694 ind./100m^2 recorded as maximum at Ritchie's Archipelago and minimum of 252 ind./100m^2 at Nancowry Islands (Fig. 34). Among the 14 species, only 6 species viz. *Actinpyga mauritiana*, *Actinopyga miliaris, Holothuria atra, Holothuria (Halodeima) edulis, Bahadschia marmorata* and *Stichopus horrens* were found at all the regions of the study. *Holothuria atra* was the predominant species in terms of numerical density as its occurrence varied between 60 and 280 ind./100m^2 at Nancowry Islands and Rtichie's Archipelago respectively. The sub-dominant species was *Actinipyga mauritiana* and its density ranged from 60 ind./100m^2 at Car Nicobar Island to 222 ind./100m^2 at South Andaman. Next to these *Sticophus choloronotus* showed the dominance and their values were at the range of 62 to 218 ind./100m^2 at Nancowry Islands and North Andaman. The density of remaining 11 species was less than 47 ind./100m^2 at all the places of study.

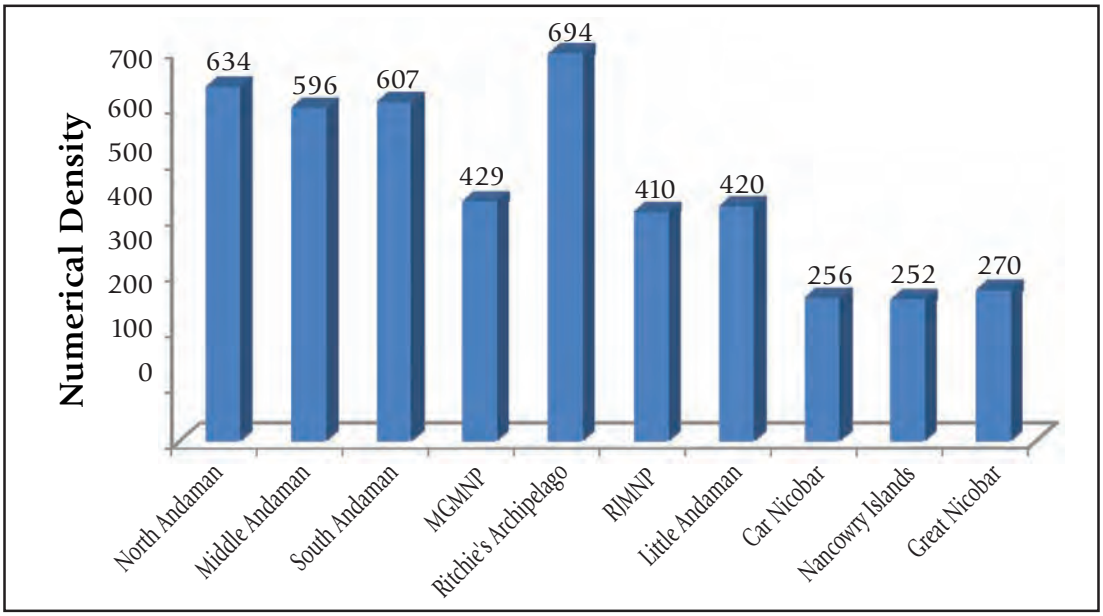


Fig. 34 Density (ind./100m^2) of commercially important holothurians at different regions of A&N Islands

The numerical densities of 14 species of commercially important species of holothurians along with their length-wise and depth-wise frequency of occurrence were given in tables 26-39. The results obtained for the individual species are given below.

(1) *Actinopyga mauritiana* (Quoy and Gaimard, 1833)

Actinopyga mauritiana was commonly found at all 10 regions as well as all the depths i.e. intertidal to 30m during the survey (Table 7 & Fig. 35). The numerical density of this species ranged from 60 to 222 Ind./100m^2 at Car Nicobar Island and South Andaman respectively. However the density at different depths was maximum (19 ind./100m^2)

at 10m in South Andaman with the total length of 16-30cm while the minimum of 1 ind./100m^2 at most of the areas with different depths and different length groups.

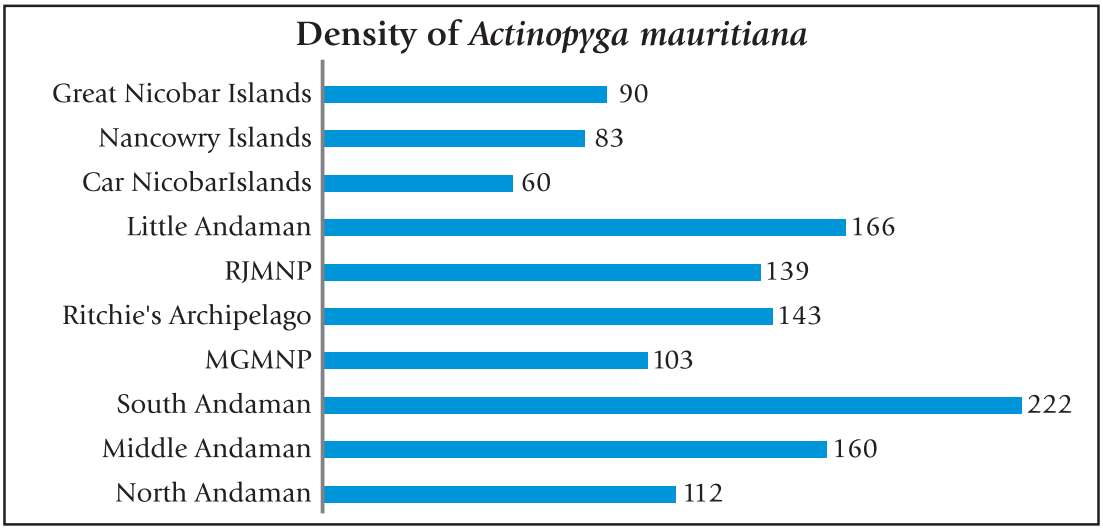


Fig. 35 Density (ind./100m^2) of *Actinipyga mauritiana* at different regions of A&N Islands

(2) *Actinopyga miliaris* (Quoy and Gaimard, 1833)

The *Actinoopyga miliaris* was found only 7 areas of the study in Andaman and Nicobar Islands and it was not recorded in Mahatma Gandhi Marine National Park (MGMNP), Car Nicobar Island and Great Nicobar Island (Table 8 & Fig. 36). In general the numerical density was very low and it varied from 3 to 8 ind./100m^2 at Rani Jhansi Marine National Park (RJMNP) and North Andaman respectively. The species represented in all length groups and occurred at most of the depths surveyed in different areas with single individual per 100m^2.

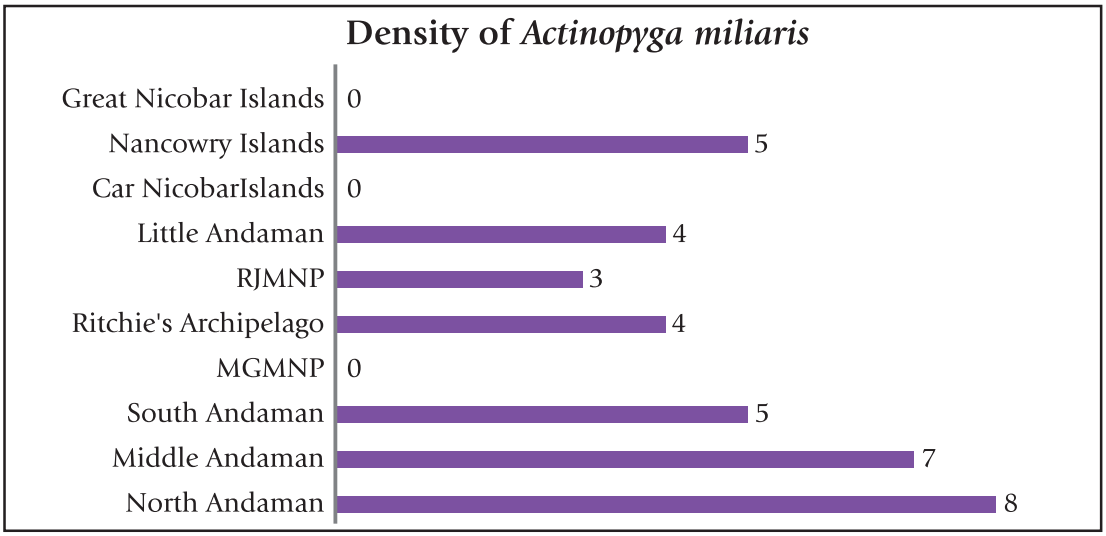


Fig. 36 Density (ind./100m^2) of *Actinopyga miliaris* at different regions of A&N Islands

(3) *Actinopyga lecanora* (Jaeger, 1833)

Actinopyga lecanora found only at North Andaman, Middle Andaman, Little Andaman Island, Car Nicobar Island and Great Nicobar Island. The density of the species was encountered as minimum of 5 ind./100m^2 at Car Nicobar Island and maximum of 9 ind./100m^2 at Middle Andaman (Table 9 & Fig. 37). The density at different depths and different length group was either 1 ind./100m^2 or 2 ind./100m^2.

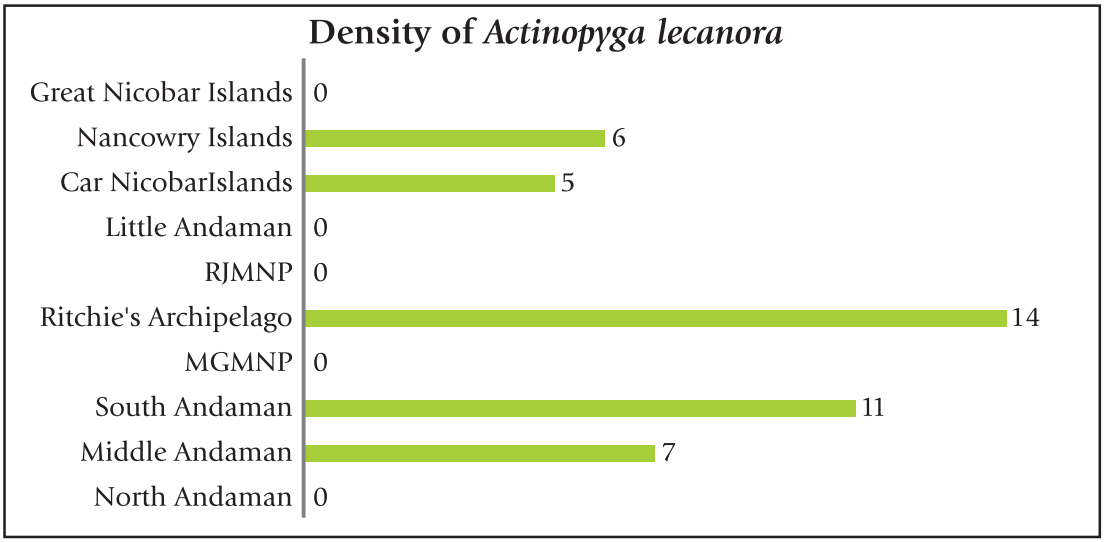


Fig. 37 Density (ind./100m^2) of *Actinopyga lecanora* at different regions of A&N Islands

(4) *Actinopyga echinites* (Jaeger, 1833)

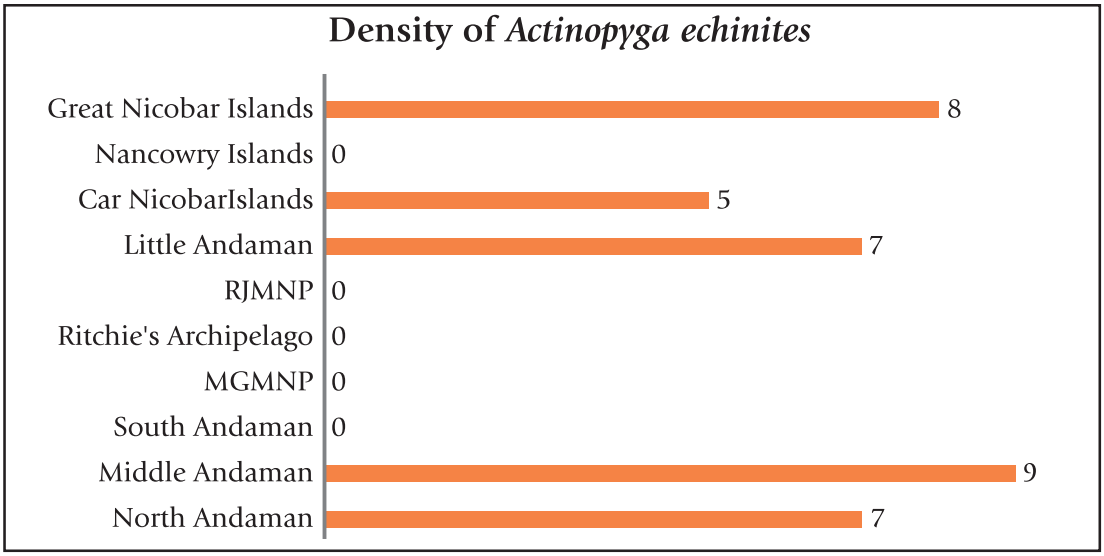


Fig. 38 Density (ind./100m^2) of *Actinopyga echinites* at different regions of A&N Islands

This species was noticed only at 5 areas of study viz. North Andaman, Middle Andaman, Little Andaman Island, Car Nicobar Island and Great Nicobar Island. The density of *Actinopyga echinites* was very low and ranged between 5 and 9 ind./100m^2 at Car Nicobar Island and Middle Andaman respectively (Table 10 & Fig. 38). The density at different depths and length groups was single at wherever reported except intertidal region of North Andaman and 5m depth of Middle Andaman where the density was 2 ind./100m^2.

(5) *Holothuria atra* (Jaeger, 1833)

Holothuria atra was the dominant species in terms of numerical density during the study period at all the areas surveyed. This species was represented at all the depths and length groups of all 10 areas of study. The density showed low *i.e.* 60 ind./100m^2 at Nancowry Island and high *i.e.* 280 ind./100m^2 at Ritchie's Archipelago (Table 11 & Fig. 39). However, the maximum density was recorded as 25 ind./100m^2 at intertidal region of North Andaman under the length group of 31-45cm and the minimum of single individual at few depths and areas.

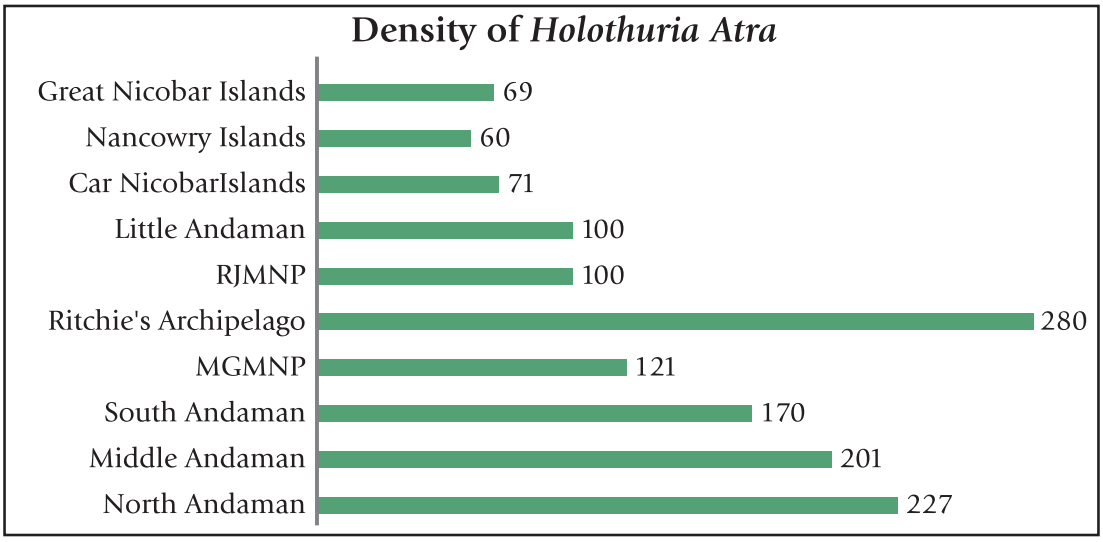


Fig. 39 Density (ind./100m^2) of *Holothuria atra* at different regions of A&N Islands

(6) *Holothuria (Metriatyla) scabra* (Jaeger, 1833)

Holothuria (Metriatyla) scabra is presently very rare species in Andaman and Nicobar Islands though it was common in 1980s. During the survey it was found only at North Andaman and South Andaman areas. At other places the species could not be observed. The density of the species was 3 and 5 ind./100m^2 at South Andaman and North Andaman respectively in the intertidal region, 10m, 15m, 25m and 30m depths (Table 12 & Fig.40).

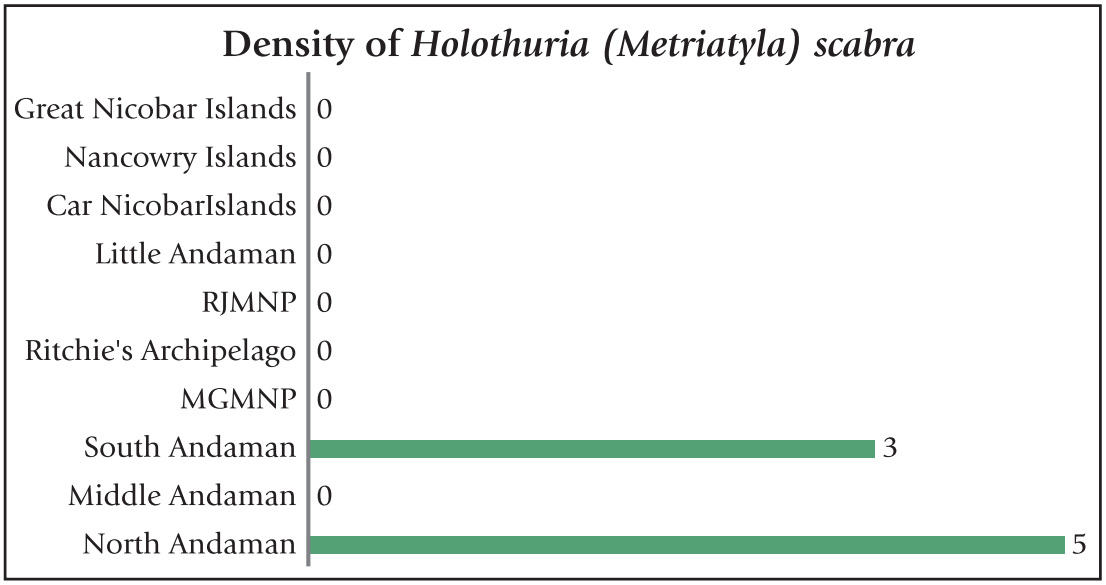


Fig. 40 Density (ind./100m^2) of *Holothuria (Metriatyla) scabra* at different regions of A&N Islands

(7) *Holothuria (Halodeima) edulis* (Lesson, 1830)

This species was found at all 10 areas surveyed in Andaman and Nicobar Islands. It is also distributed at all the depths i.e. intertidal to 30m. The density of the species was 3 ind./100m^2 at Car Nicobar & Nancowry Islands to 20 ind./100m^2 at North Andaman during the survey (Table 13 & Fig.41). However the density at different depths and size groups was either 1 or 2 ind./100m^2 at the places where it was noticed.

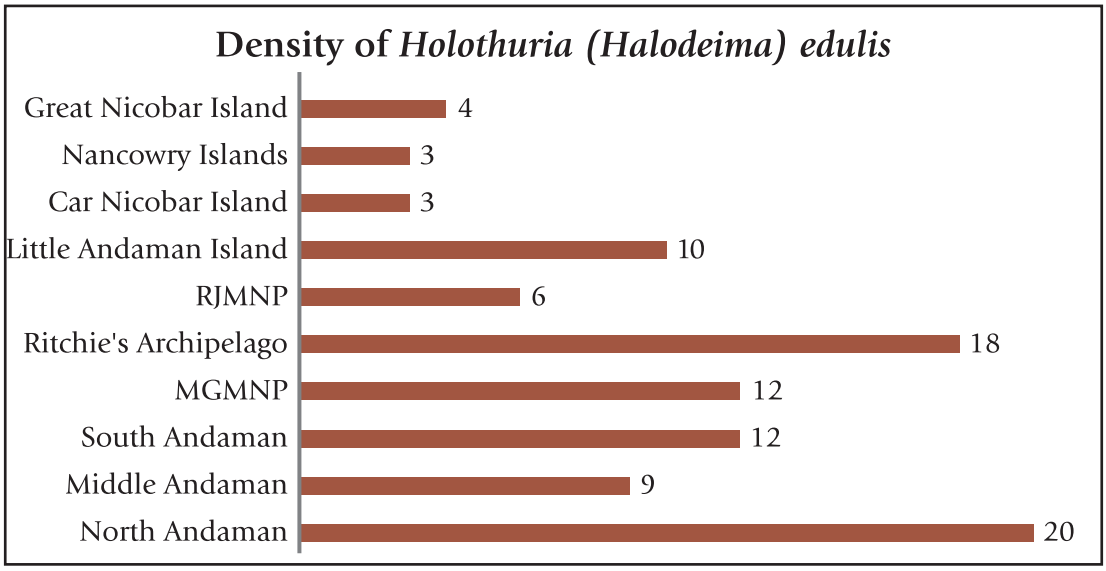


Fig. 41 Density (ind./100m^2) of *Holothuria (Halodeima) edulis* at different regions of A&N Islands

(8) *Holothuria (Microthele) nobilis* (Selenka, 1867)

Holothuria (Micorthele) nobilis was reported at 7 areas of Andaman and Nicobar Islands excepting South Andaman, Little Andaman and Great Nicobar Island. The density of this species was low as it was showed minimum i.e. 4 ind./100m^2 at three areas such as Middle Andaman, Car Nicobar & Great Nicobar and the maximum of 7 ind./100m^2 at both North Andaman and Ritchie's Archipelago (Table 14 & Fig. 42). Only a single specimen of the species was represented at different depths as well as different size groups wherever found.

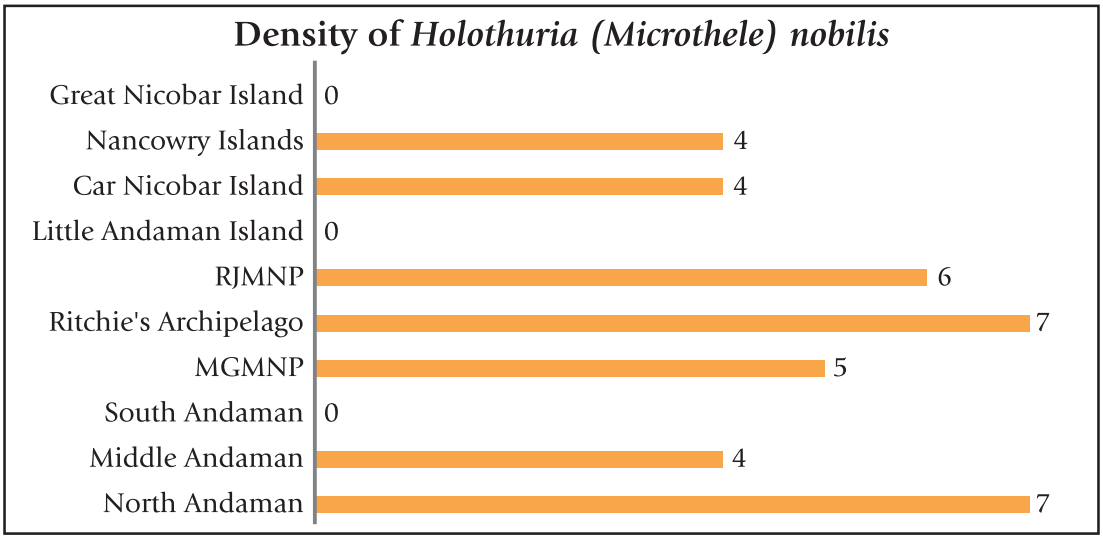


Fig. 42 Density (ind./100m^2) of *Holothuria (Halodeima) edulis* at different regions of A&N Islands

(9) *Bohadschia marmorata* (Jaeger, 1833)

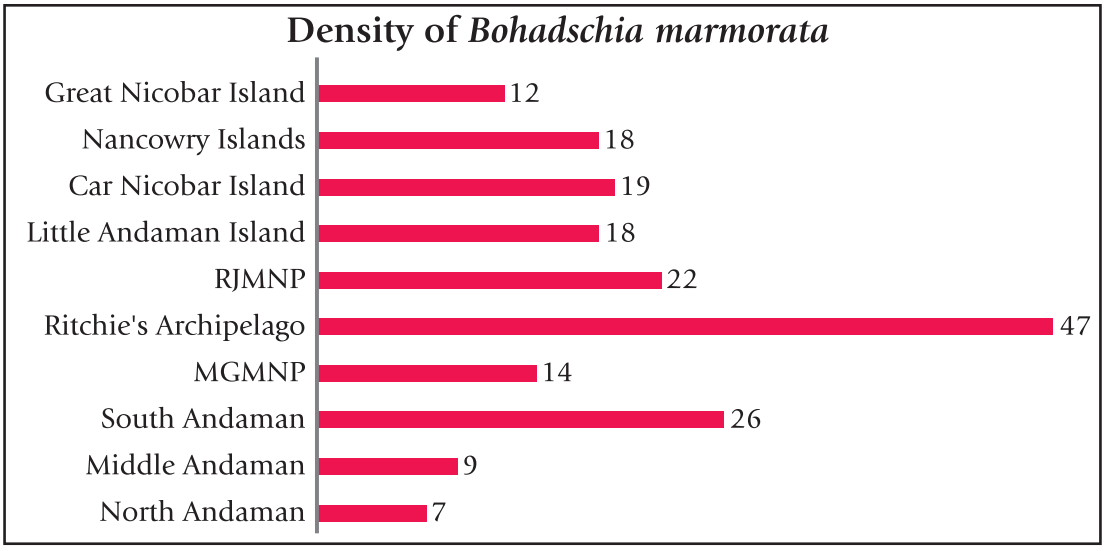


Fig. 43 Density (ind./100m^2) of *Bohadschia marmorata* at different regions of A&N Islands

Bohadschia marmorata was commonly found at all the areas of surveys conducted in Andaman and Nicobar Islands. However, the density showed as maximum (47 ind./100m^2) at Ritchie's Archipelago and minimum (7 ind./100m^2) at North Andaman (Table 15 & Fig.43). The density at different depths was maximum (5 ind./100m^2) in 15m , 25m and 30m with the length group of 31-45cm, 16-30cm and 16-30cm respectively.

(10) *Bohadschia argus* (Jaeger, 1833)

Bohadschia argus was least abundant holothurians found at 7 areas of study except Little Andaman, Car Nicobar Island and Great Nicobar Island. The density of the species ranged between 4 and 7 ind./100m^2 at both North Andaman & Nancowry Islands and Ritchie's Archipelago respectively (Table 16 & Fig. 44). The density at different depths as well as length groups was less than 2 ind./100m^2 at the places wherever reported.

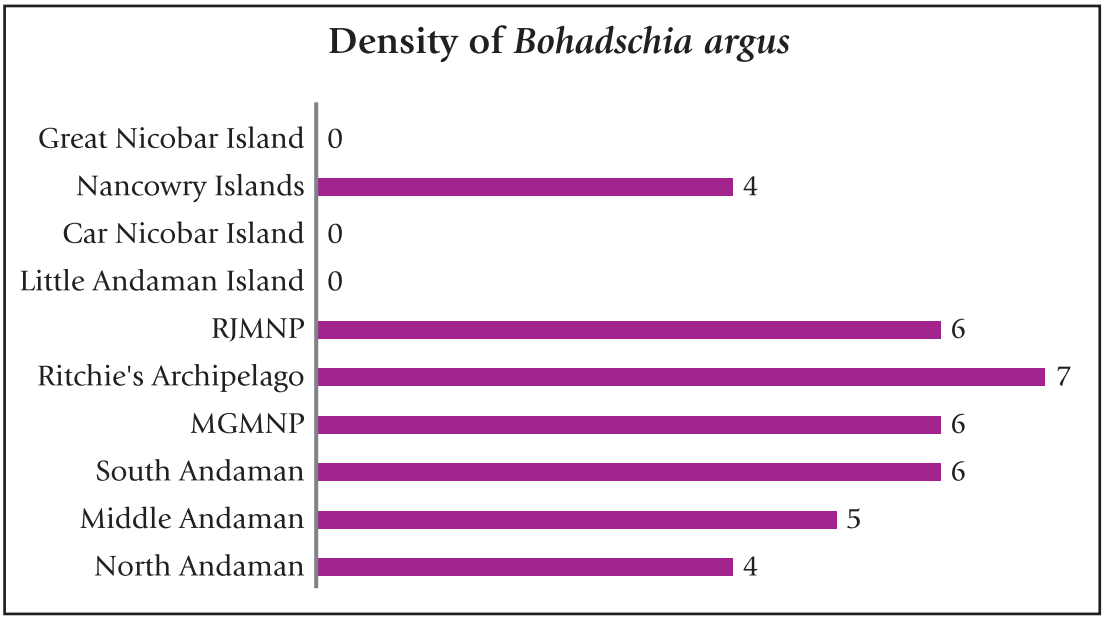


Fig. 44 Density (ind./100m^2) of *Bohadschia argus at* different regions of A&N Islands

(11) *Thelenota ananas* (Jaeger, 1833)

Thelenota ananas is one of the largest holothurians found at 8 areas in Andaman and Nicobar Islands except Car Nicobar Island and Great Nicobar Island. Though it was found in most of the places of survey, their density of occurrence was meager. The density ranged from 4 ind./100m^2 at both Little Andaman and Nancowry Islands to 9 ind./100m^2 at Middle Andaman (Table 17 & Fig. 45). This particular species is restricted to sub-tidal regions as they were recorded between 5 and 30m during the study.

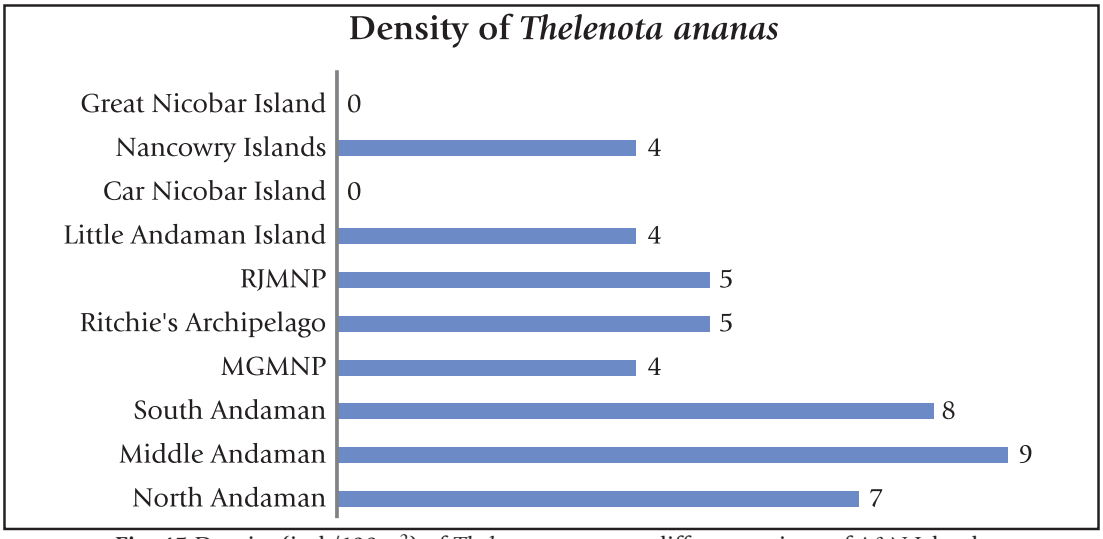


Fig. 45 Density (ind./100m^2) of *Thelenota ananas* at different regions of A&N Islands

(12) *Stichopus horrens* (Selenka, 1867)

Stichopus horrens can be seen in very low frequency at the islands of Andaman and Nicobar Islands. The density ranged from 3 ind./100m^2 at RJMNP to 5 ind./100m^2 at Nancowry Islands (Table 18 & Fig. 46). Most of the study areas did not show any individuals of this species.

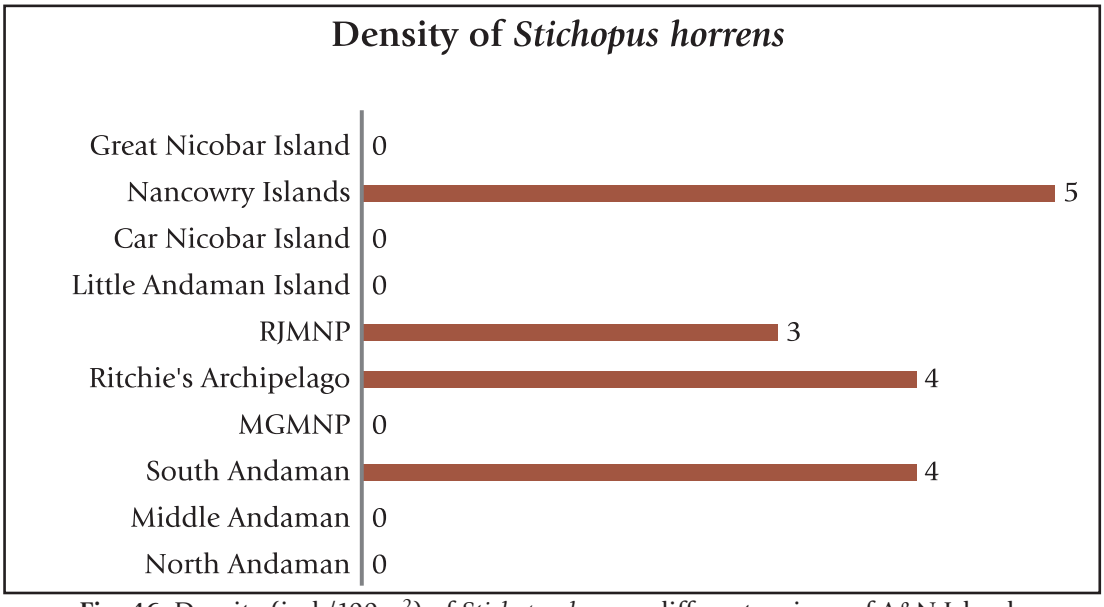


Fig. 46 Density (ind./100m^2) of *Stichopus horrens* different regions of A&N Islands

(13) *Stichopus chloronotus* (Brandt, 1835)

Stichopus chloronotus is one of the dominant species in Andaman and Nicobar Islands in terms of numerical density. The occurrence of this species was noticed at

all depths as well as all areas of the study. The minimum density was recorded as 62 ind./100m^2 at Nancowry Islands and maximum as 218 ind./100m^2 at North Andaman Island for *Stichopus chloronotus* (Table 19 & Fig. 47). However the density at different depths was higher (22 ind./100m^2) in the intertidal region of South Andaman with the size group of 5-15cm.

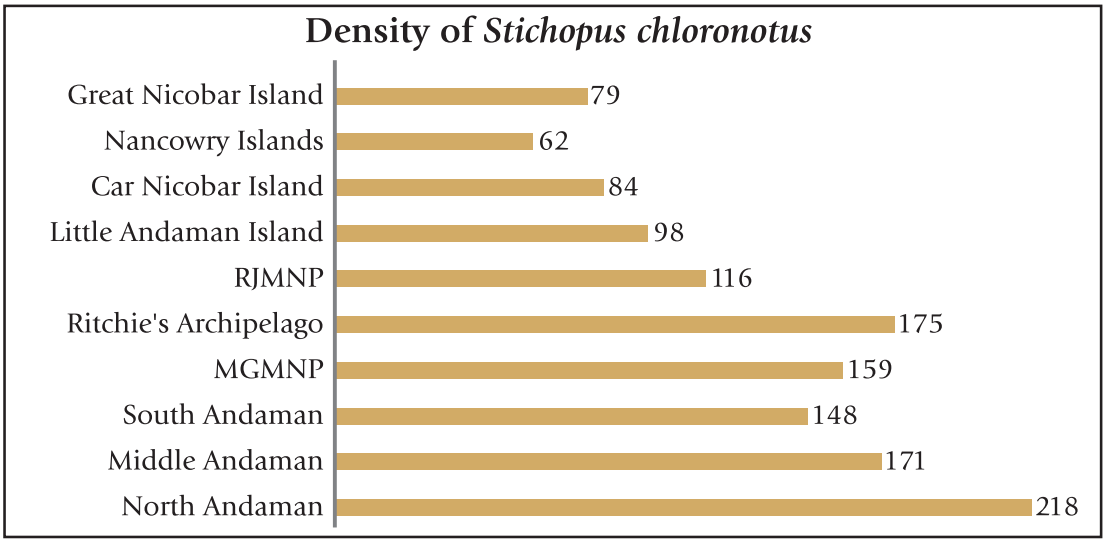


Fig. 47 Density (ind./100m^2) of *Stichopus chloronotus* different regions of A&N Islands

(14) *Stichopus hermanni* (Semper, 1868)

Out of 10 areas surveyed, *Stichopus hermanni* was found only at 4 areas such as South Andaman, Ritchie's Archipelago, RJMNP and Nancowry Islands as their occurrence was

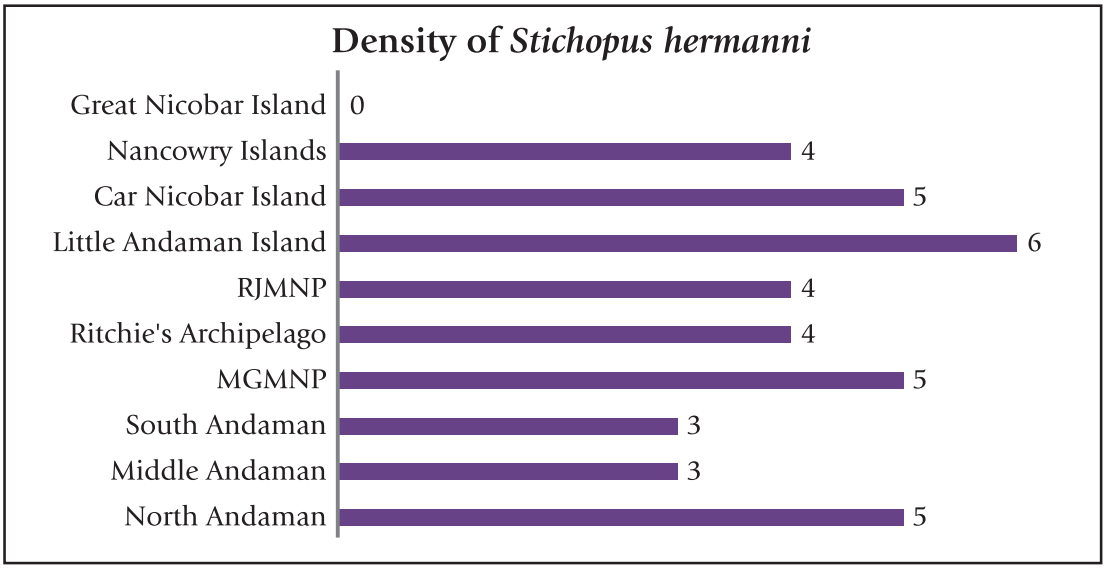


Fig. 48 Density (ind./100m^2) of *Stichopus hemanni* different regions of A&N Islands

uncommon. Accordingly, the density of the species also recorded only 5 ind./100m^2 at Nancowry Islands, 4 ind./100m^2 at South Andaman and Ritchie's Archipelago and 3 ind./100m^2 at RJMNP (Table 20 & Fig. 48). *Stichopus hermanni* was observed only at sub-tidal region i.e. between 5 and 30m depths.

6. Total length of economically important holothurians

The total length range of 14 economically important species of holothurians is given in table 21. The maximum length of the largest specimen of the individual species was recorded for *Thelenata ananas* (44.9cm) at Middle Andaman and the minimum of 28.1cm for *Stichopus horrens* at Nancowry Islands. Apart from that the maximum length of the species such as *Actinopyga mauritina*, *Actinopyga miliaris*, *Actinopyga lecanora*, *Holothuria (Halodeima) edulis* and *Bohadschia marmorata* was greater than 40cm at RJMNP, Middle Andaman, South Andaman, Car Nicobar and South Andaman respectively.

7. Total wet weight of economically important holothurians

The mean total wet weight of the commercially important holothurians was measured at all the places of study and the data are presented in table 22. It was observed that a total weight of *Actinopyga miliaris* and *Thelenota ananas* showed a maximum of 950gm at North Andaman and Middle Andaman respectively. However minimum total weight of 220 gm was recorded for *Stichopus horrens* at Ritchie's Archipelago. Besides, a total weight more than of 900gm for *Actinopyga mauritiana* was observed at RJMNP and Great Nicobar Islands; *Actinipyga miliaris* at Middle, South and Little Andamans; *Thelenata ananas* at North Andaman, South Andaman, Ritchie's Archipelago and RJMNP.

The scrutiny of the data acquired from the status survey of holothurians of Andaman and Nicobar Islands revealed that, an overall density of the 30 species of holothurians found during the survey was abundant in Andaman group of islands i.e. 599 to 1179 ind./100m^2 and minimum in Nicobar group of islands i.e. less than 503 ind./100 m^2. Likewise similar trend was shown for the 14 commercially important species found in these islands, and it was maximum i.e. 410-694 ind./100m^2 at Andaman group and minimum at Nicobar group (252-270 ind./100m^2). Among the 14 species of economical significance, the numerical density of three species viz. *Holothuria atra*, *Actinopyga mauritiana* and *Stichophus chloronotus* was very high when compared with other species. In the present study the density of these three holothurians ranged from 60 to 280 ind./100m^2, 60 to 222 ind./100m^2; and 62 to 218 ind./100m^2 respectively while the density of the remaining 11 species was less than 47 ind./100m^2 at all the places of study. The present results could be comparable with the finding of Adeline Pouget (2005) on the distribution of holothurians in the fringing reef of Grande Terre, Mayotee, East Africa coast, Indian Ocean where density was assessed for 11 species in 20

different stations. The study observed that density of *Holothuria atra* was 88 individuals 10^{-4} m^2; *Stichopus chloronotus,* 120 individuals 10^{-4} m^2; *Bohadschia atra*, 280 individuals 10^{-4} m^2; *Holothuria nobilis,* 80 individuals 10^{-4} m^2; and altogether density of all the species was 880 individuals 10^{-4} m^2.

The specimen densities observed during the present survey in Andaman and Nicobar Islands appear to be higher than those recorded in other islands of Indian Ocean. At Reunion Island, where the *Holothuria atra* is the dominant species (Conand and Mangion, 2002), the maximum density in the biotope was 0.25 specimens $10^{-4}m^2$; 40 specimens 10^{-4} m^2 of *Holothuria nobilis* in Mayotte.

The total length of presently observed three dominant species in Andaman Nicobar Islands varied from 7.5–32.9cm at Nancowry Island to 7–39.5cm at Great Nicobar Island for *Holothuria atra*; 10.5–35.5cm at South Andaman to 5.5–44 cm at RJMNP for *Actinopyga mauritiana*; and 6–31cm at North Andaman to 8.1–43.1cm at Ritchie's Archipelago for *Stichopus chloronotus.* However, mean total weight of *Holothuria atra* ranged from 390 to 470gm at Car Niocobar and North Andaman. *Actinopyga mauritiana* ranged from 750 to 910gm at Middle Andaman and Great Nicobar Island, and *Stichopus choloronotus* varied from 270 to 410gm at North Andaman and Ritchie's Archipelago respectively.

Holothurians play an important ecological role in nutrient cycling and bio-turbation processes in marine benthic communities (Uthicke, 1999; Skewas *et al*., 2002; Mangion *et al*., 2004; Purcell, 2010). Holothurians contribute to the oxygenation of the upper sediment levels and play a role in bio-turbation that, in turn, may increase the productivity of benthic micro-algae (Uthicke and Klumpp, 1998; Uthicke *et al*., 2009) providing increased food sources for other species. The ecological consequences of the removing holothurians by fishing are unknown (Bellachambers *et al*., 2011). However, given that they have important functions in their environment, it is likely that removal of these animals may reduce the overall productivity of coral reefs (Uthicke *et al*., 2004, Friedman *et al*., 2010). Holothurians are susceptible to overfishing, and these fisheries are typically characterized by boom and bust cycles (Conand and Byrne, 1993; Uthicke and Benzie, 2000; Kinch *et al*., 2008; Uthicke *et al*., 2009; Anderson *et al*., 2010), with most fisheries severely over exploited (Conand 2004; Toral-Granda, 2006), Friedman *et al*., 2010; Purcell, 2010). Despite commercial importance of holothurians, their biology, ecology and population dynamics remain poorly understood (Friedman *et al*., 2010). Information on growth rates, larval ecology, recruitment processes, habitat use, their ecological role and fisheries biology is scant and in some cases only available for a few species (Friedman *et al*., 2010; Purcell, 2010).

Table 5: Density of Holothurians at areas surveyed in Andaman and Nicobar Islands

Areas	Depth							Total density (ind./100m^2)
	Inter-tidal	**5m**	**10m**	**15m**	**20m**	**25m**	**30m**	
North Andaman	251	179	163	175	159	146	106	**1179**
Middle Andaman	179	175	164	124	122	130	110	**1004**
South Andaman	176	152	122	110	124	123	131	**938**
MGMNP	84	123	98	95	78	92	87	**657**
Ritchie's Archipelago	175	178	139	141	134	144	127	**1038**
RJMNP	91	119	98	115	76	82	74	**655**
Little Andaman Island	86	96	106	99	63	78	71	**599**
Car Nicobar Island	51	69	43	48	68	65	66	**410**
Nancowry Islands	72	71	77	87	61	73	62	**503**
Great Nicobar Island	63	68	69	81	83	33	44	**441**

Table 6: Density of economically important holothurians (ind./100m^2) at areas surveyed in A & N Islands

Sl. No.	Species	North Andaman	Middle Andaman	South Andaman	MGMNP	Ritchie's Archipelago	RJMNP	Little Andaman	Car Nicobar	Nancowry Islands	Great Nicobar Island
1.	*Actinopyga mauritiana*	112	160	222	103	143	139	166	60	83	90
2.	*Actinopyga miliaris*	8	7	5	-	4	3	4	-	5	-
3.	*Actinopyga lecanora*	7	9	-	-	-	-	7	5	-	8
4.	*Actinopyga echinites*	7	9	-	-	-	-	7	5	-	8
5.	*Holothuria atra*	227	201	170	121	280	100	100	71	60	69
6.	*Holothuria (Metriatyla) scabra*	5	-	3	-	-	-	-	-	-	-
7.	*Holothuria (Halodeima) edulis*	20	9	12	12	18	6	10	3	3	4
8.	*Holothuria (Microthele) nobilis*	7	4	-	5	7	6	-	4	4	-
9.	*Bohadschia marmorata*	7	9	26	14	47	22	18	19	18	12
10.	*Bohadschia argus*	4	5	6	6	7	6	-	-	4	-
11.	*Thelenota ananas*	7	9	8	4	5	5	4	-	4	-
12.	*Stichopus horrens*	-	-	4	-	4	3	-	-	5	-
13.	*Stichopus chloronotus*	218	171	148	159	175	116	98	84	62	79
14.	*Stichopus hermanni*	5	3	3	5	4	4	6	5	4	-
Total density (ind./100m^2)		**634**	**596**	**607**	**429**	**694**	**410**	**420**	**256**	**252**	**270**

Table 7: Density of *Actinopyga mauritiana* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	6	5	10	3	9	8	2	7	6	5	8	2	4	6	7	8	2	6	4	3	1	**112**
Middle Andaman	8	10	12	18	14	10	11	5	8	6	4	7	8	2	5	8	6	3	4	5	6	**160**
South Andaman	17	14	16	15	20	18	3	19	11	8	7	9	10	8	5	6	4	7	8	8	9	**222**
MGMNP	7	4	3	5	6	8	4	5	8	4	6	8	5	2	4	8	5	2	5	3	1	**103**
Ritchie's Archipelago	8	5	8	12	5	3	4	8	7	9	10	3	8	4	11	13	2	5	8	7	3	**143**
RJMNP	6	6	11	7	13	10	11	5	8	7	5	8	1	4	2	4	8	6	5	4	8	**139**
Little Andaman Island	4	7	9	15	14	2	15	12	12	11	8	9	7	3	8	6	5	4	8	2	5	**166**
Car Nicobar Island	2	6	4	2	1	4	3	1	2	5	4	2	2	1	3	2	4	5	2	2	3	**60**
Nancowry Islands	8	6	2	4	5	2	4	3	5	8	4	2	1	2	1	5	3	5	6	5	2	**83**
Great Nicobar Island	5	8	5	6	7	3	2	5	6	4	3	8	6	2	4	3	1	2	3	2	5	**90**

Table 8: Density of *Actinopyga miliaris* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ $100m^2$)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	0	1	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	8
Middle Andaman	0	1	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	1	0	0	1	7
South Andaman	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	5
MGMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ritchie's Archipelago	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	4
RJMNP	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3
Little Andaman Island	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	4
Car Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nancowry Islands	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	5
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9: Density of *Actinopyga lecanora* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	2	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	7
Middle Andaman	1	0	0	0	2	2	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	9
South Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MGMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ritchie's Archipelago	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RJMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little Andaman Island	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	7
Car Nicobar Island	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	5
Nancowry Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Nicobar Island	1	1	0	0	0	0	1	0	1	0	1	0	0	2	0	0	0	0	1	0	0	8

Table 10: Density of *Actinopyga echinites* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ $100m^2$)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	2	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	7
Middle Andaman	1	0	0	0	2	2	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	**9**
South Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MGMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ritchie's Archipelago	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RJMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little Andaman Island	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	**7**
Car Nicobar Island	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	**5**
Nancowry Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Nicobar Island	1	1	0	0	0	0	1	0	1	0	1	0	0	2	0	0	0	0	1	0	0	**8**

Table 11: Density of *Holothuria atra* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	12	20	25	4	10	13	15	14	10	15	13	14	15	8	7	6	3	5	6	8	4	**227**
Middle Andaman	9	8	18	1	9	20	11	15	12	5	6	8	7	10	14	12	8	6	11	5	6	**201**
South Andaman	8	10	12	8	9	15	5	6	4	7	5	15	6	8	9	7	5	6	8	6	11	**170**
MGMNP	2	1	5	7	8	6	7	8	9	5	8	9	5	4	7	5	8	6	5	2	4	**121**
Ritchie's Archipelago	12	10	22	15	15	20	8	10	11	16	18	14	10	11	14	15	20	12	9	10	8	**280**
RJMNP	8	5	4	3	5	6	4	2	5	7	6	5	2	4	8	2	1	8	6	5	4	**100**
Little Andaman Island	3	5	6	4	5	2	3	6	5	8	6	5	4	2	3	6	5	8	5	6	3	**100**
Car Nicobar Island	2	3	2	4	5	6	3	2	1	5	2	3	5	2	4	5	2	5	6	3	1	**71**
Nancowry Islands	2	3	1	2	3	5	4	6	3	2	5	3	2	1	3	2	5	2	3	2	1	**60**
Great Nicobar Island	2	1	3	2	5	3	2	5	6	3	2	4	5	6	3	2	5	2	2	5	1	**69**

Table 12: Density of *Holothuria (Metriatyla) scabra* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	5
Middle Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Andaman	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3
MGMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ritchie's Archipelago	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RJMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little Andaman Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nancowry Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 13: Density of *Holothuria (Halodeima) edulis* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	2	1	1	2	2	1	0	0	1	1	1	1	2	1	1	2	0	1	0	0	0	**20**
Middle Andaman	0	1	1	1	0	0	0	1	0	1	0	0	0	1	0	0	2	0	0	1	0	**9**
South Andaman	1	0	0	0	1	0	0	2	1	0	2	1	0	0	0	1	0	0	0	3	0	**12**
MGMNP	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	2	3	1	1	**12**
Ritchie's Archipelago	0	1	1	1	2	1	0	0	3	2	0	1	1	1	0	0	1	0	1	0	2	**18**
RJMNP	0	1	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	**6**
Little Andaman Island	1	0	2	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	2	1	**10**
Car Nicobar Island	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	**3**
Nancowry Islands	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	3
Great Nicobar Island	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	**4**

Table 14: Density of *Holothuria (Microthele) nobilis* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	1	0	0	0	1	0	0	0	0	2	1	0	0	1	0	0	1	0	0	0	0	7
Middle Andaman	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	4
South Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MGMNP	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1		0	0	0	5
Ritchie's Archipelago	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	7
RJMNP	1	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	6
Little Andaman Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Nicobar Island	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	4
Nancowry Islands	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	4
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 15: Density of *Bohadschia marmorata* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	0	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	1	7
Middle Andaman	0	1	1	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	1	1	**9**
South Andaman	0	2	3	1	0	0	0	0	1	2	2	0	0	2	2	1	2	2	2	1	3	**26**
MGMNP	1	0	0	0	2	0	0	0	1	0	2	2	1	0	2	0	0	0	1	0	2	**14**
Ritchie's Archipelago	1	0	0	2	3	3	2	3	2	2	2	5	2	2	1	2	5	2	2	5	1	**47**
RJMNP	0	1	2	1	2	0	1	2	0	1	2	3	0	1	2	0	1	2	0	1	0	**22**
Little Andaman Island	1	0	0	2	1	0	2	1	2	0	1	2	1	0	2	0	0	0	2	1	0	**18**
Car Nicobar Island	1	1	0	2	1	0	2	0	0	0	0	2	1	0	2	1	0	3	0	1	2	**19**
Nancowry Islands	1	1	1	0	2	1	0	1	0	1	2	0	1	0	2	0	1	2	1	0	1	**18**
Great Nicobar Island	0	0	0	1	0	0	1	0	0	2	0	1	1	0	0	1	0	1	2	0	2	**12**

Table 16: Density of *Bohadschia argus* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	4
Middle Andaman	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	5
South Andaman	0	1	2	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	6
MGMNP	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	6
Ritchie's Archipelago	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	1	1	7
RJMNP	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	6
Little Andaman Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nancowry Islands	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	4
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 17: Density of *Thelenota ananas* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	0	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	0	1	7
Middle Andaman	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	1		1	1	9
South Andaman	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	1	1	1	0	1	8
MGMNP	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0	4
Ritchie's Archipelago	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	5
RJMNP	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	5
Little Andaman Island	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	4
Car Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nancowry Islands	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0		1	0	4
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 18: Density of *Stichopus horrens* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Middle Andaman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Andaman	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	4
MGMNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ritchie's Archipelago	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	4
RJMNP	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	3
Little Andaman Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nancowry Islands	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0	5
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 19: Density of *Stichopus chloronotus* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	19	20	9	15	12	14	12	15	13	20	15	10	8	6	0	7	10	0	8	5	0	**218**
Middle Andaman	15	14	17	18	16	1	20	5	6	8	7	4	6	2	3	5	8	4	6	3	3	**171**
South Andaman	22	10	12	5	6	1	7	8	9	5	4	6	8	7	6	5	8	2	4	5	8	**148**
MGMNP	5	8	12	15	14	18	1	9	15	7	8	2	6	5	4	2	3	6	5	8	6	**159**
Ritchie's Archipelago	14	20	15	12	14	16	8	9	8	9	5	6	4	2	3	6	5	8	9	2	0	**175**
RJMNP	4	5	2	3	6	9	8	7	5	6	9	8	4	2	6	5	8	9	6	3	1	**116**
Little Andaman Island	5	4	3	6	5	2	3	5	6	5	8	5	6	4	5	6	8	5	7	0	0	**98**
Car Nicobar Island	0	2	3	5	4	6	0	0	7	5	2	3	6	9	8	5	3	2	5	6	3	**84**
Nancowry Islands	1	2	5	3	1	2	5	3	0	2	3	5	2	3	6	5	4	5	2	0	3	**62**
Great Nicobar Island	2	8	0	8	5	6	2	5	1	8	5	6	6	5	5	2	0	2	3	0	0	**79**

Table 20: Density of *Stichopus hermanni* at areas surveyed in Andaman and Nicobar Islands

Depth	Intertidal			5m			10m			15m			20m			25m			30m			Total density (ind./ 100m^2)
Length (Cm)	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	5-15	16-30	31-45	
AREAS																						
North Andaman	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	5
Middle Andaman	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3
South Andaman	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	3
MGMNP	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	5
Ritchie's Archipelago	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0		1	0	4
RJMNP	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	4
Little Andaman Island	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	0	0	1	6
Car Nicobar Island	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	5
Nancowry Islands	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	4
Great Nicobar Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 21: Total length (cm) of economically important holothurians at areas surveyed in Andaman and Nicobar Islands

Sl. No.	Species	North Andaman	Middle Andaman	South Andaman	MGMNP	Ritchie's Archipelago	RJMNP	Little Andaman	Car Nicobar	Nancowry Islands	Great Nicobar Island
1.	*Actinopyga mauritiana*	8.2- 41.7	7.2-38.6	10.5-35.5	9-42.2	10.5-4.1	5.5-44	6.2-38.9	9.1-37.1	5.3-41.5	6.7-40.9
2.	*Actinopyga miliaris*	6.8-40.1	7.2-42.9	6.1-37.1	–	10.1-6.2	9.1-40.6	8.8-41.5	–	7.9-40.7	–
3.	*Actinopyga lecanora*	–	8.1-39.6	7.9-41.8	–	11.1-7.5	–	–	9.1-39.8	10.4-36.2	–
4.	*Actinopyga echinites*	8.9- 35.2	10.2-33.7	–	–	–	–	5-32.8	6.2-34.1	–	7.3-32.1
5.	*Holothuria atra*	9.6-35.1	8.7-38.2	11.4-36.8	7.2-37.1	6.6-35.1	6.8-33.3	7.9-36.1	5.2-33.8	7.5-32.9	7-39.5
6.	*Holothuria (Metriatyla) scabra*	8.1-27.8	–	6.8-24.1	–	–	–	–	–	–	–
7.	*Holothuria (Halodeima) edulis*	5.5-32.1	7.2-35.1	6.8-38-9	7.3-38.1	8.1-39.1	5.1-40.2	6.3-41.3	9.1-42.2	5.7-31.9	7.4-37.6
8.	*Holothuria (Microthele) nobilis*	5.9-31.5	6.8-33.3	–	7.5-32.7	8.1-34.2	5.6-31.8	–	6.3-34.3	7.4-32.1	–
9.	*Bohadschia marmorata*	8- 38.9	7.9-35.7	9.1-44.1	8.2-43.2	8.9-40.8	7.7-38.7	7.9-39.1	5.8-36.8	8.1-40.6	10.2-37.8
10.	*Bohadschia argus*	10.3-28.5	9.6-35-2	11.1-32.7	7.4-34.8	11.4-37.8	6.3-33.8	–	–	5.6-32.1	–
11.	*Thelenota ananas*	13-40.6	12.1-44.9	14.2-42.7	12.7-39.2	11.6-43.6	11.9-43.1	10.6-37.3	–	12.8-41.7	–
12.	*Stichopus horrens*	–	–	6.9-26.8	–	5.7-26.8	8.8-27.9	–	–	10.1-28.1	–
13.	*Stichopus chloronotus*	6-31	6.5-38.2	5.8-34.7	6.8-41.6	8.1-43.1	7.3-36.6	7.1-35.5	8.1-37.7	7.7-37.7	5.1-33.8
14.	*Stichopus hermanni*	9.1-35.1	10.2-36.7	5.8-31.2	5.3-32.2	6.6-34.2	5.7-36.6	5.5-33.1	6.9-34.8	7.2-38.8	–

Table 22: Total wet weight (gm) of economically important holothurians at areas surveyed in Andaman and Nicobar Islands

Sl. No.	Species	North Andaman	Middle Andaman	South Andaman	MGMNP	Ritchie's Archipelago	RJMNP	Little Andaman	Car Nicobar	Nancowry Islands	Great Nicobar Island
1.	*Actinopyga mauritiana*	820	750	755	810	820	900	850	850	800	910
2.	*Actinopyga miliaris*	950	900	900	–	850	810	920	–	870	–
3.	*Actinopyga lecanora*	–	790	800	–	800	–	–	830	740	–
4.	*Actinopyga echinites*	580	450	–	–	–	–	470	450	–	460
5.	*Holothuria atra*	470	460	450	410	420	400	410	390	400	440
6.	*Holothuria (Metriatyla) scabra*	350	–	320	–	–	–	–	–	–	–
7.	*Holothuria (Halodeima) edulis*	300	310	330	335	340	400	410	410	290	320
8.	*Holothuria (Microthele) nobilis*	350	360	–	300	310	300	–	325	330	–
9.	*Bohadschia marmorata*	790	760	840	820	800	790	810	760	810	780
10.	*Bohadschia argus*	400	420	380	430	440	410	–	–	400	–
11.	*Thelenota ananas*	900	950	910	830	910	900	830	–	870	–
12.	*Stichopus horrens*	–	–	230	–	240	220	–	–	240	–
13.	*Stichopus chloronotus*	270	360	360	380	410	320	335	380	375	310
14.	*Stichopus hermanni*	400	420	380	390	410	440	370	410	430	–

6. SUMMARY

1. The present status survey along 196 stations covering entire Andaman and Nicobar Islands has been conducted during September 2011 to December 2012 to assess the diversity, density and standing stock on holothurians since its ban for fishing from 11th July, 2001 under Wildlife (Protection) Act, 1972.
2. Extensive undersea and intertidal surveys revealed the occurrence of holothurians throughout the sublittoral zone of continental shelf of Andaman and Nicobar Archipelago up to the depth of 30m surveyed.
3. The data on the density of holothurians were collected from different depths and summarized to 10 regions viz. North Andaman, Middle Andaman, South Andaman, MGMNP, Ritchie's Archipelago, RJMNP, Little Andaman, Car Nicobar Island, Nancowry Islands and Great Nicobar Island covering entire Andaman and Nicobar Archipelago.
4. The present survey encountered only 30 species of holothurians belonging to 10 genera, against the 98 species reported earlier in literature. Among them a maximum of 23 species were encountered at Ritchie's Archipelago and minimum of 11 species at Great Nicobar Island with the species diversity (H') of 1.21 and 0.80 at these two areas respectively.
5. Out of 30 species reported, 14 species are commercially important. They are, *Actinopyga mauritiana, Actinopyga miliaris, Actinopyga lecanora, Actinopyga echinites, Holothuria atra, Holothuria (Metriatyla) scabra, Holothuria (Halodeima) edulis, Holothuria (Microthele) nobilis, Bohadschia marmorata, Bohadschia argus, Thelenota ananas, Stichopus horrens, Stichopus chloronotus* and *Stichopus hermanni*.
6. It was observed that the numerical density of all the species of holothurians reported during the study was maximum (1179 ind./100m^2) at North Andaman followed by Ritchie's Archipelago (1038 ind./100m^2) and Middle Andaman (1004 ind./100m^2). However the minimum density was registered at Car Nicobar Island (410 ind./100m^2).
7. The depth-wise density of holothurians indicated that, 5m depth region showed the highest values i.e. 1230 ind./100m^2 followed by intertidal and 10m depth with the values of 1228 and 1079 ind./100m^2 respectively. In general, the density of holothurians was lowest (878 ind./100m^2) at 30m depth in Andaman and Nicobar Islands.
8. The combined numerical density of the 14 economically important species of holothurians at different regions of Andaman and Nicobar Islands recorded a maximum of 694 ind./100m^2 at Ritchie's Archipelago and minimum of 252 ind./100m^2 at Nancowry Islands.

9. Among the 14 species, only 6 species viz. *Actinopyga mauritiana*, *Actinopyga miliaris*, *Holothuria atra*, *Holothuria (Halodeima) edulis*, *Bahadschia marmorata* and *Stichopus horrens* were found at all the regions of the study.

10. *Holothuria atra* was the predominant species in terms of numerical density as its occurrence varied between 60 and 280 ind./100m^2 at Nancowry Islands and Rtichie's Archipelago respectively. The sub-dominant species was *Actinipyga mauritiana* and its density ranged from 60 ind./100m^2 at Car Nicobar Island to 222 ind./100m^2 at South Andaman. Next to these two species *Sticophus chloronotus* showed the dominance and their values were at the range of 62 to 218 Ind./100m^2 at Nancowry Islands and North Andaman. The denisty of remaining 11 speceis was less than 47 ind./100m^2 at all the places of study.

11. The maximum total length of *Holothuria atra* was 39.5cm recorded at Great Nicobar Island, 44 cm at RJMNP for *Actinopyga mauritiana*; and 43.1cm at Ritchie's Archipelago for *Stichopus chloronotus.* However, mean total weight of *Holothuria atra* was 470gm at North Andaman; 910gm at Middle Andaman for *Actinopyga mauritiana* and 410gm at Ritchie's Archipelago for *Stichopus choloronotus*.

12. It was observed that the density of economically important species such as *Holothuria (Metriatyla) scabra*, *Actinopyga echinites*, *Holothuria (Microthele) nobilis* and *Stichopus horrens* was significantly very low and they were observed as uncommon.

13. It was surprising to note that *Holothuria scabra* found only in North Andaman with less than 5 ind./100m^2, though it was abundant in the year 1980s. It indicates that the population of *Holothuria scabra* in Andaman and Nicobar Islands under near extinction.

14. The data acquired from the status survey of holothurians of Andaman and Nicobar Islands revealed that, overall density of 30 species of holothurians found during the survey was abundant in Andaman group of islands i.e. 599 to 1179 ind./100m^2 and minimum in Nicobar group of islands i.e. less than 503 ind./100 m^2.

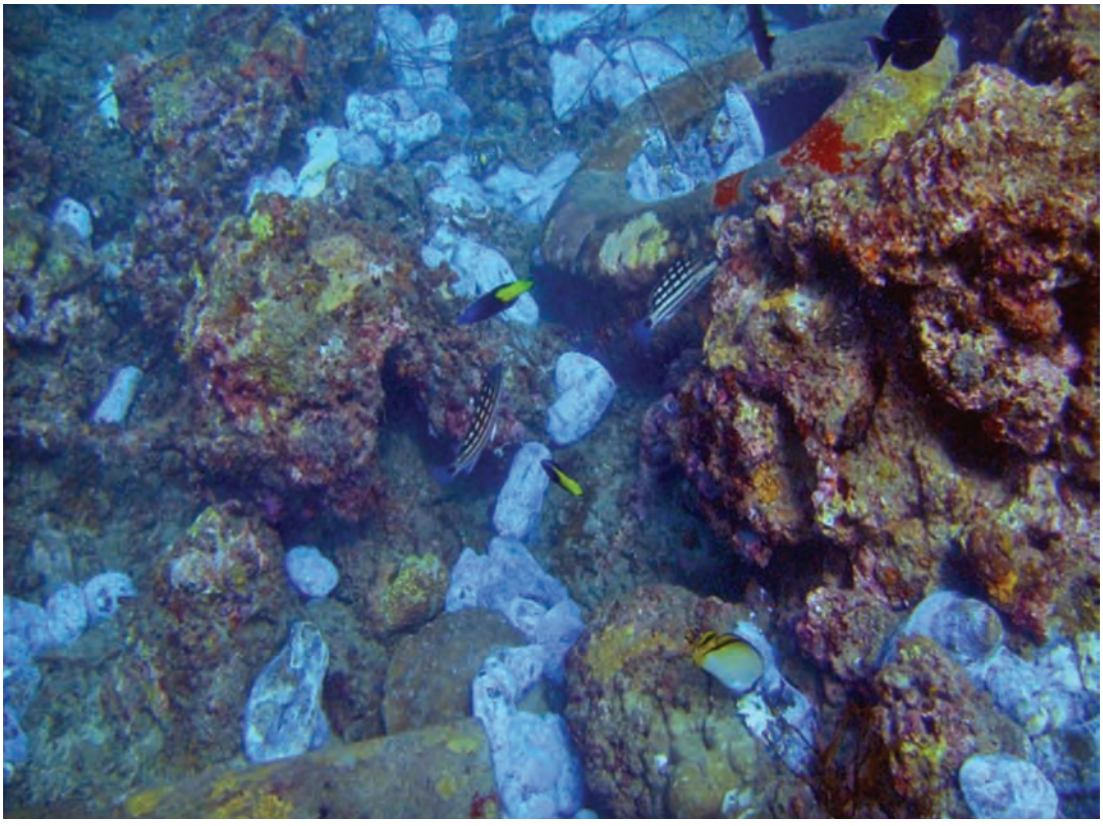
15. Likewise similar trend was shown for the 14 commercially important species found in these islands, and it was maximum i.e. 410-694 ind./100m^2 at Andaman group and minimum at Nicobar group (252-270 ind./100m^2).

16. The results on standing stock of holothurians in Andaman and Nicobar waters estimated in the present study are quite significant as the natural stock was marginally higher than their density in East African coast where the holothurians fishery exists actively.

17. The survey indicates that the ban on fishing of holothurians in Indian waters and inclusion of these organisms in Schedule-I of Wildlife Protection Act (1972) since 2001 made a greater impact for the recovery of their natural population as most of the species reached an optimal size over the 12 year period.
18. Scientific research should be encouraged to find out the reproductive cycle, spawning behaviour, longevity, fecundity and zoogeography which will helpful to draw effective management strategies for conservation.
19. Stringent measures may be taken to prevent the intrusion of foreign poachers in the territorial waters Andaman and Nicobar Islands.

7. ILLEGAL FISHING AND POACHING

1. Although ban has been imposed for fishing of holothurians since 2001 as per the Wildlife (Protection) Act, 1972, sporadic reports on poaching and illegal fishing of these species in Andaman and Nicobar waters have also been observed.



Sea cucumbers abandoned by Burmese poachers at South Andaman after interception by law enforcing authorities

Seized boat of Burmese poachers

2. As published by the newspaper '*The Daily Telegram*' Port Blair edition, it is understood that poachers from neighboring countries especially Burma and also from Indonesia are entering the territorial waters of Andaman and Nicobar Archipelago for illegal harvesting of the sea cucumbers. During the calendar years 2011 and 2012 alone more than 20 occasions the Burmese boats were intercepted in Andaman and Nicobar waters and the personnel were apprehended by the Indian Coast Guards, Indian Navy and A&N Police force for poaching the sea cucumbers. On each occasion 200 to 400 kg of commercially important sea cucumbers were seized from the poachers. Besides sea cucumber, the poachers are also targeting country's rare and precious biological wealth

Seized boat equipped with air-compressor and cylinders for underwater collection of sea cucumbers

such as top shell *Trochus niloticus*, turban shell *Turbo marmoratus*, king shell *Cassis cornuta*, giant clams, organ pipe coral *Tubipora musica* etc.

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