

**SEA SHORE ANIMALS  
OF  
ANDAMAN & NICOBAR  
ISLANDS**

**B. K. TIKADER  
A. DANIEL  
N. V. SUBBARAO**

The Handbook on "Sea Shore Animals of Andaman and Nicobar Islands" is an attempt to provide an up-to-date information on sea shore animals from sponges to mammals. The Andaman and Nicobar Islands are comparable to those of the famous Galapagos Islands in the Pacific Ocean. They have unique fauna and are very important zoogeographically. The available information clearly indicates the diversity, richness and individuality of the sea shore faunal wealth of these islands and the virgin, natural beauty of these islands makes many a naturalist and tourist very much enthusiastic to have a glimpse of the animal life of these islands.

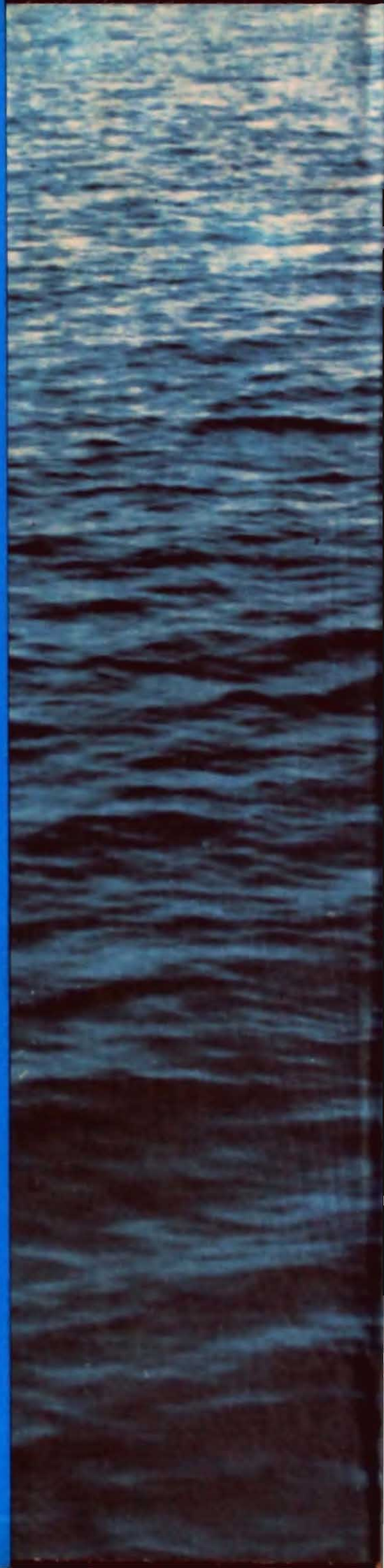
The book covers information on some groups such as Porifera, Coelenterata, Polychaeta, Crustacea, Mollusca, Echinodermata, Pisces, Reptilia, Aves, Mammalia, etc. which are discussed in brief.

It is hoped that this book will help in furthering interest in these fascinating, magnificent islands amongst students of Zoology, naturalists and tourists from India as well as abroad. The book has a number of colourful illustrations so as to give a visual appeal and to provide interesting reading.

Front and

Back Cover : Virgin and unique stag-horn coral reef, the most attractive sight on the shores of Andaman and Nicobar Islands.

Cover theme and design by Dr. B. K. Tikader





**SEA SHORE ANIMALS OF  
ANDAMAN & NICOBAR ISLANDS**



**“The face of reality is surrounded by the golden veil.  
Oh ! Provider-Of-The World, unveil  
the refulgent face that the truth-seeker  
can have a glimpse of the light of Reality”.**

# SEA SHORE ANIMALS OF ANDAMAN & NICOBAR ISLANDS

B. K. TIKADER  
A. DANIEL  
N. V SUBBA RAO



*Edited by the Director*  
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## FOREWORD



Located in the tropical region of the Bay of Bengal, the Andaman and Nicobar groups of Islands are extremely rich in flora and fauna. Being far removed from the mainland they have many endemic species of plants and animals. Because of the faunistic wealth they possess, the diversity and uniqueness they exhibit, these islands have often been referred to as 'Zoologists' Paradise'. Since the middle of 19th century they have evoked interest of both zoologists and naturalists. However, until recently very little information on the terrestrial and marine animal life of these islands was available. The Zoological Survey of India started conducting surveys of all the islands and established an Andaman and Nicobar Regional Station in 1977 at Port Blair. The National Institute of Oceanography, through various cruises, collected a large volume of data and material on physical, chemical and biological features of the Andaman Sea. Similarly, the Central Marine Fisheries Research Institute investigated the fishery potential of the islands including the possible sites for mariculture.

Dr. B. K. Tikader, Dr. A. Daniel and Dr. N. V. Subba Rao, the authors of this book on "Sea-Shore Animals of Andaman and Nicobar Islands" have visited and surveyed these islands fairly extensively. The Zoological Survey of India has brought out several valuable contributions on the fauna, but these have become scattered in a number of scientific publications. Dr. B. K. Tikader, Director, Zoological Survey of India has taken up the task of bringing out the information on the fauna of different groups in the form of books. His earlier books on "Birds of Andaman and Nicobar Islands" and "Glimpses of Animal Life of Andaman and Nicobar Islands" have been very well received. The present book is the third in the series.

It gives an account of the animals of the sea shore. The book is very well illustrated with a number of colour plates and I am sure it would be of much interest to students and research scholars of ecology and marine biology. I congratulate the authors for undertaking the task of publishing such books. They are indeed fulfilling the long-felt need of providing information of the fauna of these very interesting and important islands of our country.

Department of Ocean Development  
'Mahasagar Bhawan' Lodi Road,  
New Delhi-110 003.

2 April, 1986

A handwritten signature in black ink, appearing to read 'S. Z. Qasim'.

S. Z. QASIM

Secretary

## EDITOR'S PREFACE

The Andaman and Nicobar Islands, comprising 348 large and small islands and covering an area of 8,300 sq. km. are unique in their variety of fauna and flora. The isolation of these islands from the mainland has been responsible for the high degree of endemism and as many as 32 species and subspecies of mammals, 95 of birds and 23 of reptiles are endemic in these islands. With regard to the flora and fauna, a large number of species are common between these islands and the Indian mainland beside Burma and Malaysia. But so far as the sea shore animals and plants are concerned, they are similar to those of other Indian and Pacific Ocean Islands. The book, "**Sea Shore Animals of Andaman and Nicobar Islands**" gives some very useful, consolidated information on sea shore animals, and clearly indicates the diversity, richness and uniqueness of the sea shore faunal wealth of these magnificent and beautiful islands. The book is also provided with many beautiful colour illustrations.

The Authors have surveyed the Andaman and Nicobar Islands a number of times. Dr. A. Daniel, one of the co-authors of this book has been engaged for many years in the study of marine animals, particularly in the Bay of Bengal including the Andaman Sea and Dr. N. V. Subba Rao, the other co-author is an eminent malacologist who has also been engaged for many years in studying marine Mollusca of Andaman and Nicobar Islands.

It is my privilege to write the preface of this fascinating book by virtue of my position as editor and to this particular book of which I am the senior author. It is hoped that this well illustrated book will serve as an important informative document on sea shore animals of these islands, mainly for research scientists, tourists, naturalists and students, interested in marine life.

Zoological Survey of India  
Calcutta

**B. K. TIKADER**  
*Director*

# CONTENTS

	Page
Foreword by Dr. S. Z. Qasim .....	v
Editor's Preface .....	vii
Acknowledgements .....	xi
Introduction .....	1
Oceanographic Investigations of the Andaman Sea .....	4
Currents in the Indian Ocean and Bay of Bengal .....	7
Zoogeography of the Andaman Sea .....	14
Marine Environment and its zones .....	19
Rocky Shores .....	19
Sandy Shores .....	23
Muddy Shores .....	30
Mangroves .....	33
Plants in the Sea—Sea grasses .....	36
Living Floaters—Plankton .....	42
Perforations and Spicules—Sponges .....	43
Sailing Colonies—Pelagic Coelenterates .....	45
Floating umbrellas—Jelly Fishes .....	47
Flower Animals—Sea Anemones .....	48
Polyps with Skeletons—Corals .....	57
Marine Worms—Flat Worms, Ribbon Worms & Segmented Worms .....	69
Armoured Animals with Jointed Feet—Crustaceans .....	72

Soft Bodied Animals with Eight, Two, One or No Shells—Molluscs	86
Lace Work with Beaks—Bryozoans	100
Spiny Skinned Animals—Echinoderms	102
Sea Squirts and Tulips—Tunicates	121
Fins and Backbones—Fishes	122
Cold Blooded Air Breathers—Turtles, Crocodiles and Snakes	133
Flying Visitors of the Sea Shore—Birds	141
Warm Blooded Animals—Whales, Dolphins and Sea Cows	143
Selected Bibliography	145
Appendix	153

**List of Species of Marine Invertebrates Recorded from Andaman and Nicobar Islands**

a. Sponges	154
b. Coelenterates	154
c. Polychaetes	158
d. Crustaceans	160
e. Pycnogonids	165
f. Molluscs	165
g. Sipunculids	179
h. Echinoderms	179
Index	184

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We express our deep sense of gratitude to Dr. T. N. Khoshoo, former Secretary, and also the present Secretary, Shri T. N. Seshan, Department of Environment, Forests, and Wild Life, Government of India and to Prof. M. G. K. Menon, Member, Planning Commission and Scientific Adviser to the Prime Minister, for their keen interest in the publication of this book.

We are deeply indebted to Dr. S. Z. Qasim, Secretary, Department of Ocean Development, Government of India, for writing the foreword and for his personal interest and inspiration, which we have received all the time.

It is also our great privilege to thank Lt. Gen. T. S. Oberoi, Lt. Governor and Shri R. D. Kapoor, Chief Secretary of Andaman and Nicobar Islands, for their valuable help and various facilities given during the preparation of this book.

Thanks are also due to Dr. G. C. Rao, Officer-in-Charge, Zoological Survey of India, Port Blair and his staff, particularly Shri Nikhil Bhowmick, Shri Mihir Sil and Shri G. Ponnuswamy, Photographer, who accompanied one of us (BKT) for taking photographs of sea shore animals. We also wish to thank Dr. K. C. Jayaram, Dr. O. B. Chhotani, Dr. P. K. Talwar, Dr. V. C. Agrawal, Dr. T. D. Soota, Shri K. V. Surya Rao, Dr. D. R. K. Sastry, Dr. (Miss) Maya Deb, Dr. R. C. Basu, Shri K. N. Reddy, Dr. A. K. Sanyal, Shri B. P. Halder, Shri S. K. Mukherjee, Shri A. Misra, Shri Jyotsna Dasgupta, Shri Biswanath Roy, Shri S. Saha and Shri Bhanu Sinha of Zoological Survey of India and Shri A. R. K. Sastry of Botanical Survey of India. We record our thanks to Shri Sitaram Mandal for illustrations and Shri Anil Bhattacharyya, Smt. A. Chowdhury and Shri P. K. Bala for typing the manuscript. We also thank Shri Shyamal Tikader, who readily helped us in various ways.

We must thank the Directors of the Radiant Process Private Limited namely, Shri Nirad Baran Mukherjee and Shri Sudhir Chandra Mukherjee and their staff who were engaged in printing this book. Our thanks are also due to Shri Nirmal Banerjee of the same Press, who worked tirelessly in preparing layout of this book. We are also thankful to Shri G. Sivagurunathan, Publication and Production Officer, Zoological Survey of India, for his constant supervision of publication and printing of this book and his sustained efforts to keep the deadline of publication.

Last but not the least, we are thankful to Capt. Vijay Prasada, formerly of Indian Navy for many underwater photographs taken by him and given to us readily for publication. We thank Prof. R. L. Brahmachari of Indian Statistical Institute, Calcutta, for some photographs.

We also thank Dr. M. P. Nayar, Director, Botanical Survey of India, Calcutta, Dr. Biswapati Dasgupta, Principal, Government College Darjeeling, for valuable suggestions.

## INTRODUCTION

The Andaman and Nicobar islands are geologically young. These islands probably had their origin in the Tertiary period, which started about 63 million years ago and ended about 1 million years ago when Quaternary period started. For centuries, the islands remained cut off from the mainstream of history. Except for a few passing references by foreign travellers, nothing was known of these islands. It was believed in the past that the inhabitants were cannibals and hence these islands were avoided. The first real contact with the Indian mainland was established with the founding of a settlement in September, 1789 at Port Cornwallis, now known as Port Blair

Consequently, upon the increased role of East India Company in the affairs of the Indian subcontinent, there was ever increasing marine activity. The ideal location of these islands between India and Burma prompted many sea faring vessels to search for suitable ports. By 19th century, the islands had become important penal settlement areas. Englishmen visiting the islands on official work started taking notice of the rich and flourishing fauna off their coasts. Subsequently, scientific and oceanographic investigations were carried out on these islands. All such observations and results were reported in several obscure and rare publications. These are not easily accessible to ordinary readers or students. This prompted us to take up this work so as to present a glimpse of the varied facets of the marine life of these islands.

Zoogeographically, Andaman and Nicobar Islands occupy a unique position. These are close to the "Indo-Malayan region," which is considered to be a "faunistic center" from which other sub-divisions of the Indo-west Pacific Region recruited their fauna (Ekman, 1953) Although a certain degree of endemism is known among a few groups of terrestrial animals, the endemism among marine animals is not known, since our knowledge on many groups is far from satisfactory. Some of the typical Indo-west Pacific groups of shore animals are found in these islands. Giant clams (Tridacnidae) among molluscs and fishes such as sea moths (Pegasidae), whittings (Silliginidae), rabbit fishes (Siganidae) and plesiopids (Plesiopidae) which are restricted to the Indo-west Pacific Region are found in these Islands. Out of 50 species of

sea snakes known from the Indo-Pacific Region 26 are reported from the waters off these Islands. Dugong, a marine mammal which is endemic to Indo-west Pacific is recorded off these Islands. There are many more such marine animals which are typical of Indo-west Pacific and occur in these Islands. Although the Islands have a great diversity of marine fauna many groups are yet to be worked out in detail. This should be a pointer for one to take up detailed studies on the fauna of these Islands. We have attempted to give an introduction to the sea shore fauna of the islands.

Besides its interesting natural living resources, the Andaman sea is also of considerable interest from meteorological point of view. It has a strong influence on the meteorological conditions of the Indian subcontinent. It is the birth place of tropical cyclones which hit the east coast of India and Bangladesh every year

The bluishblack waters off the Bay Islands and their indented shoreline serve as home for myriad forms of marine life. The flamboyant colours displayed by various animals and their interesting habits kindle the inspiration of an enthusiastic student of biology and the layman alike. The real beauty of the marine life can be perceived if one walks along the shore during low tide. For those who do not have the opportunity to enjoy personally on the spot scenery of the shores of the islands, the modern technique of photography has come in handy.

Photography has become almost an indispensable tool of the marine biologist's trade, whether he applies it on the shore, underwater or in the laboratory. Field microscopes now exist, and thus photomicrography could theoretically be carried out in the field.

Before photography became a readily available tool, research biologists relied mainly upon drawings and words to communicate to others their field observations on living organisms. In recent years, primarily due to technological advances in camera equipments and in the quality of film emulsions, it has become possible to obtain excellent photographs, which can be reproduced successfully in publications of marine organisms in their natural environment. The media of still and cine photography, and more recently of videocassette recording, applied in the field have provided the lecturer on marine biology with powerful visual aids for transmitting information to his colleagues, to students, and to the general public.

Colour photographs of living organisms taken in the field are of particular value to the taxonomist when they are compared with preserved material, since preserved specimens lose their

colour, and soft tissues contract and often distort. The taxonomist may then be able to derive from photographs more characters to facilitate identification, since the form, colour and pigment patterns of living organisms can often be distinctive as can the particular ecological niche which they occupy.

The other details are As per 1981 census

Area	8,294 sq.kms.	
Population	1,58000 (as per Census 1981)	
Capital	Port Blair	
Distance from Calcutta	1,225 kms.	
Distance from Madras	: 1,191 kms.	
Headquarters of Andaman	Port Blair	
Headquarters of Nicobar	Car Nicobar	
Climate	i) Average Annual Rainfall	300 cm.
	ii) Max. temperature	30°C
	iii) Min. temperature	22°C
	iv) Relative humidity	80%

## OCEANOGRAPHIC INVESTIGATIONS OF THE ANDAMAN SEA

“The sea surges up with laughter and pale gleams the smile of the sea beach. Death-dealing waves sing meaningless ballads to the children, even like a mother while rocking her baby’s cradle. The sea plays with children, and pale gleams the smile of the sea beach.

On the sea shore of endless worlds children meet”

—Rabindranath Tagore

Man’s interest in the oceans is of great antiquity. But the real scientific study of the oceans started in the eighteenth century. The Challenger Expedition of 1872-76 was the major pioneering attempt at oceanographic research.

Oceanographic investigations of Indian waters started more than a century ago. The first organised expedition to the Islands was undertaken by Lieutenant Archibald Blair of the Indian Navy. In 1788, he was commissioned to survey the islands. He had two ships, namely “Elizabeth” and “Viper” under his command. The primary objective of the survey was to find out a suitable location for the establishment of a harbour in the islands. In connection with the laying of telegraph cables, HMS “Cyclops” recorded the topographical and physical features of the Bay of Bengal. Similar surveys were conducted by “Hydra” and “Serpent” in 1868 in the Bay of Bengal and Arabian Sea. Francis Day, an army officer and fishery biologist visited the islands in 1869. Later, (1872), Dr J. Wood-Mason, an officer of the Indian Museum, explored the islands for its marine fauna and flora.

Indian Ocean in general was surveyed by several research vessels, but only some of them touched these islands and recorded their observations. In 1874-75 the German ship “Gazelle” surveyed the Indian Ocean from Kerguelen to Cocos Keeling, Sumatra, Nicobars, Sri Lanka and up to Zanzibar

The biological work of the Marine Survey of India commenced in 1872 and marine fauna of the Andaman Islands was collected down to a depth of 50 metres. The RIMS Investigator I was launched in the year 1881, which marked the beginning of a significant maritime research in India. Dr J. Armstrong was the Surgeon Naturalist attached to the Investigator. Till 1884, work was confined to the fauna of shallow waters. In that year, deep-sea investigation was initiated at depths ranging from *ca* 570 m to 818 m,

but mostly around the mouths of the Ganges. In 1890-91, the Investigator made a haul from a depth of *ca* 3094 m between Colombo and Port Blair. It continued its work in Indian waters till 1908. It was replaced by Investigator II. Dr. R.B.S. Seymour Sewell was the Surgeon Naturalist (1925-33) in this ship and conducted his well-known oceanographic researches in the Bay of Bengal and Andaman Sea. The first record of these marine surveys was published by A. Alcock in 1902 under the title 'A Naturalist in the Indian Seas.'

Recently, the multinational and multidisciplinary International Indian Ocean Expedition (1960-65) in which 40 ships and scientists from 20 countries participated has increased our knowledge on the fauna and other features of the Andaman Sea. Later, several cruises were conducted in the Andaman sea by the Russian ship "Vityaz", "INS Kistna" and vessels of the National Institute of Oceanography. The acquisition of first oceanographic research vessel R.V. Gaveshani on 31st December, 1975 by the NIO was a landmark in the Indian Oceanographic research. This has been augmented by the vessel "Sagar Sampada" acquired by the DOD of the Government of India. In the territorial waters several scientific surveys and expeditions have been conducted by the scientists of the Zoological Survey of India.

A list of cruises conducted by various Indian and foreign vessels in the Andaman sea is given below. Some of the results of the latest investigations were published very recently (1981) "Sagar Sampada" has been cruising for the last few months in the waters of Bay of Bengal and Andaman Sea.

#### CRUISES IN THE BAY OF BENGAL COVERING ANDAMAN SEA

<i>Sl. No.</i>	<i>Year</i>	<i>Name of the vessel</i>	<i>Objectives</i>
1	1818-1849	R.V. Valdivia	Investigations on benthos, Touched Kondul
2.	1881-1905	Investigator-I	Biological investigations
3.	1908-1914 & 1921-1926	Investigator-II	Biological investigations
4.	1928-1930	R.V. Dana	Geophysical Survey & biological studies
5.	1947-1948	R.V. Albatross	-do-

<i>Sl. No.</i>	<i>Year</i>	<i>Name of the vessel</i>	<i>Objectives</i>
6.	1950-1952	R.V Galathea	Studies on benthos
7	1957-1958	Xarifa	Biological and Physical studies —Great Nicobar
8.	1957-1960	R.V ob	Geophysical, chemical and biological studies
9.	1960-1961	R.V Vityaz	Geological studies Studies on suspended matter in the deep waters of Northern and Central Indian Ocean & biology of trenches
10.	1964	I.N.S. Kistna	Grab and Snapper samples from Eastern shelf
11	1969	R.V Conrad	Wide angle seismic reflection and refraction surveys
12.	1968-1973	R.V Circe	Studies on the volume and structure of Bengal deep sea fan
13.	1970	I.N.S. Jamuna	Grab samples from Andaman Sea.
14.	1971	I.N.S. Investigator	Grab samples from Eastern Andaman Sea
15.	1972-1976	R.V Glomar Challenger	Geophysical studies and deep-sea drilling
16.	1976-1977	I.N.S. Darshak	Grab samples from Campbell Bay and Great Nicobar Islands
17	1976-1983	R.V Gaveshani	Living and non-living resources, physical and chemical oceanographic studies, and geophysical studies on East coast, deep-waters of Bengal fan and Andaman Sea
18.	1982	I.N.S. Shardul (INCOR Study)	Geophysical, oceanographic and biological studies from Visakhapatnam to Port Blair, and from Port Blair to Kamorta.
19.	1983	R.V Samudra Manthan	Geological and geophysical studies off East coast and Andamans.

## CURRENTS IN THE INDIAN OCEAN AND BAY OF BENGAL

God has given the earth to the faithful and the sea to the infidels — A Proverb

Oceans cover approximately 71 percent of the earth's surface. Indian Ocean is the third largest ocean and covers an area of 74,049,290 km<sup>2</sup> or some 14% of the earth's surface. It has an average depth of 4 km and attains its greatest breadth of 9000 km between the southern tip of Africa and Australia.

Indian Ocean has two arms extending in the north. These two arms are represented by the Arabian Sea in the west and the Bay of Bengal in the east. The Arabian Sea is connected to the Red Sea and the Persian Gulf, and meets the eastern arm at the southern limit of the Indian Peninsula.

Life in the sea or on the shore is influenced by several factors like waves, tides, ocean currents, salinity, temperature etc. The interplay of winds, currents and tides has its impact on the sea shore and consequently on the animals inhabiting the area. The sea water is always in motion, which may be either in horizontal direction or vertical direction. The slow (about 3 to 4 km/hour) horizontal movement of a mass of water over the surface of ocean is called drift, whereas the more speedily moving waters are known as ocean currents. The surface currents of the ocean are influenced by salinity, temperature, winds and earth's rotation. The deflecting force caused by the earth's rotation is known as coriolis force. It deflects moving things to the right in the Northern Hemisphere making the ocean surface currents to move in a clock-wise or anti-clockwise direction.

The ocean currents are of three types, namely wind currents caused by wind, density currents or convection currents caused by fluctuations in salinity and temperature and tidal currents caused by tides.

Currents have strong influence on living organisms. These help them in their dispersal and propagation and determine their 'life styles.' All major oceans have their typical currents, which move in a definite direction. The Indian Ocean has five important currents, namely West Australian Current, Somali Current, South-west Monsoon Drift, North-east Monsoon Drift and Agulhas current. A part of the cold Antarctic current that moves northwards along the coast of Western Australia is called the West Australian Current. It passes into the South Equatorial Current. During the South-west Monsoon period, *i.e.* from June to September, the northern branch of the South Equatorial Current flows along the North-east of Africa as the Somali current. The waters flowing from the South-west move towards the northern land-

locked part of the Indian ocean, across the Arabian sea and into Bay of Bengal.

During winter the North-east Monsoon winds cause the waters to flow from the North-east and it results in the North-east Monsoon Drift. It is the North Equatorial Current of the other Oceans.

The South Equatorial Current receives the West Australian Current and then branches into two Currents, namely the Mozambique Current and the Malagasy or Madagascar Current. The two again combine at the Cape of Agulhas, the southern tip of Africa and form the Agulhas Current, which ultimately joins the Antarctic Current.

The distribution of salinity in the Indian Ocean varies from place to place. At one end is the Persian Gulf where salinity reaches maximum with values of 40‰ and on the otherside the coastal waters of Bay of Bengal get diluted by 50‰.

The Bay of Bengal forms a distinct arm of the Indian Ocean. But it also receives waters from the Pacific. In the South-west region of Bay of Bengal, i.e. south of Great Nicobar there is a mixture of waters from the Pacific and the Indian Oceans. During November-April strong surface current enters through the strait of Malacca and forms an anticlockwise gyre. At the same time water from the equatorial region of the Indian Ocean also enters this part of the Bay.

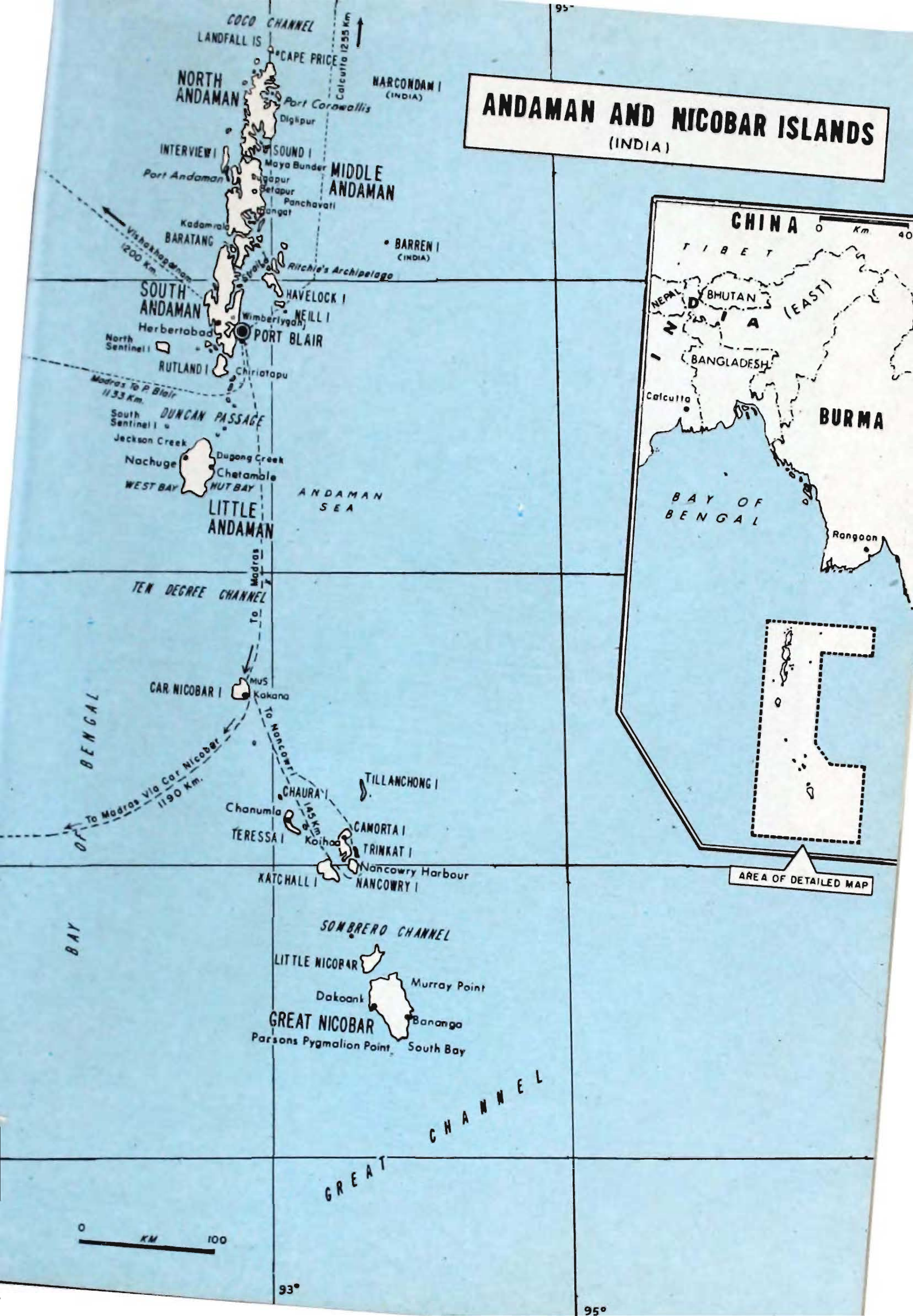
In the North-west region i.e. at the head of the Bay a Westerly Drift gets established in December. A clockwise current which disappears in December appears in January and continues till April, when a counter clock-wise current appears at the head. By May there appears an Easterly Drift and continues up to July. A clock-wise circulation appears in September on the east of Nicobar Islands. By October there are two anti-clockwise and one clock-wise currents in the Bay.

The annual cycle of north-east (December to April) and south-west monsoonal wind systems (June to October) with the intervening transitional periods reverse the atmospheric circulation and the surface currents of the Bay of Bengal and the Andaman Sea.

In the Bay of Bengal due to heavy influx of fresh water the surface waters are less saline and lie over the denser bottom water almost throughout the year. The Bay does not experience much of a winter cooling. Consequently, sinking and up-welling movements are not much pronounced. As there are several rivers draining into the Bay a number of biogenic elements such as silicates, phosphates, nitrates and carbonates find their way.

The Siphonophore, *Dimophyes arctica* which occurs in the Arctic and Antarctic oceans in abundance and in depths below 400 m in the Indian Ocean, comes to the lower boundary of the

# ANDAMAN AND NICOBAR ISLANDS (INDIA)



COCO CHANNEL  
LANDFALL IS  
CAPE PRICE  
NARCONDAM I (INDIA)  
Port Corawallis  
Diglipur  
Calcutta 1255 Km

NORTH ANDAMAN  
INTERVIEW I  
SOUND I  
MIDDLE ANDAMAN  
Port Andaman  
Maya Bunder  
Bugapur  
Betapur  
Panchavati  
Kadamala  
BARATANG  
RITCHEE'S ARCHIPELAGO  
BARREN I (INDIA)

SOUTH ANDAMAN  
HAVELOCK I  
NEILL I  
PORT BLAIR  
Herbertabad  
North Sentinel I  
RUTLAND I  
Chiriatapu  
Wimberlygan

DUNCAN PASSAGE  
WEST BAY  
LITTLE ANDAMAN  
JACKSON CREEK  
NACHUGE  
DUGONG CREEK  
CHATAMOLE  
MUT BAY  
ANDAMAN SEA

TEN DEGREE CHANNEL  
CAR NICOBAR I  
TILLANCHONG I  
CHAURA I  
CAMORTA I  
TRINKAT I  
TERESSA I  
KATCHALL I  
NANCOWRY HARBOUR  
NANCOWRY I  
To Madras  
To Madras Via Car Nicobar 1190 Km.

SOMBRERO CHANNEL  
LITTLE NICOBAR  
GREAT NICOBAR  
Murray Point  
Dakoank  
Bananga  
Parsons Pygmalion Point  
South Bay

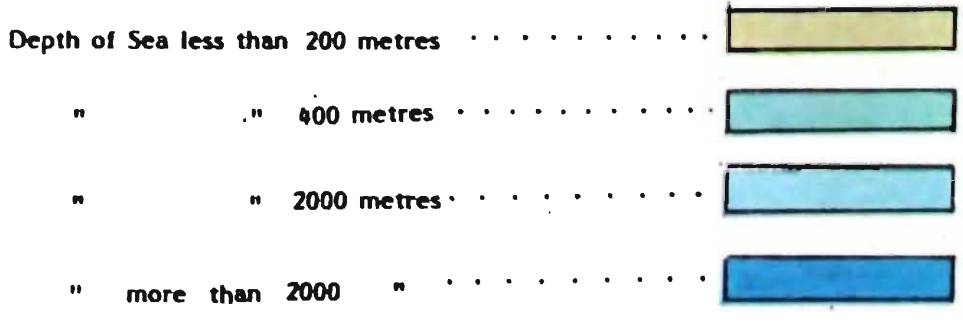
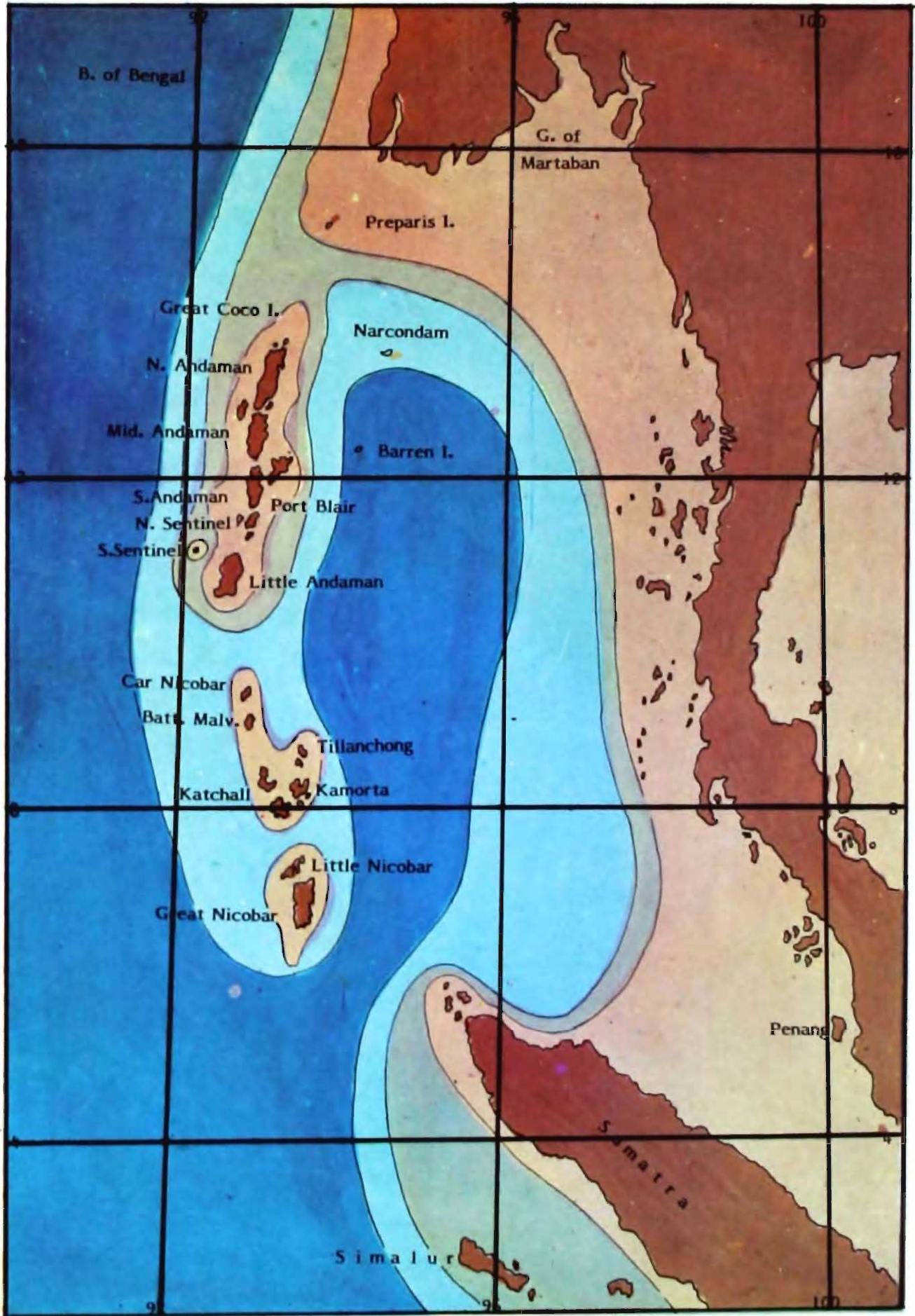


0 KM 100

93°

95°

# DEPTH CHART OF THE ANDAMAN SEA



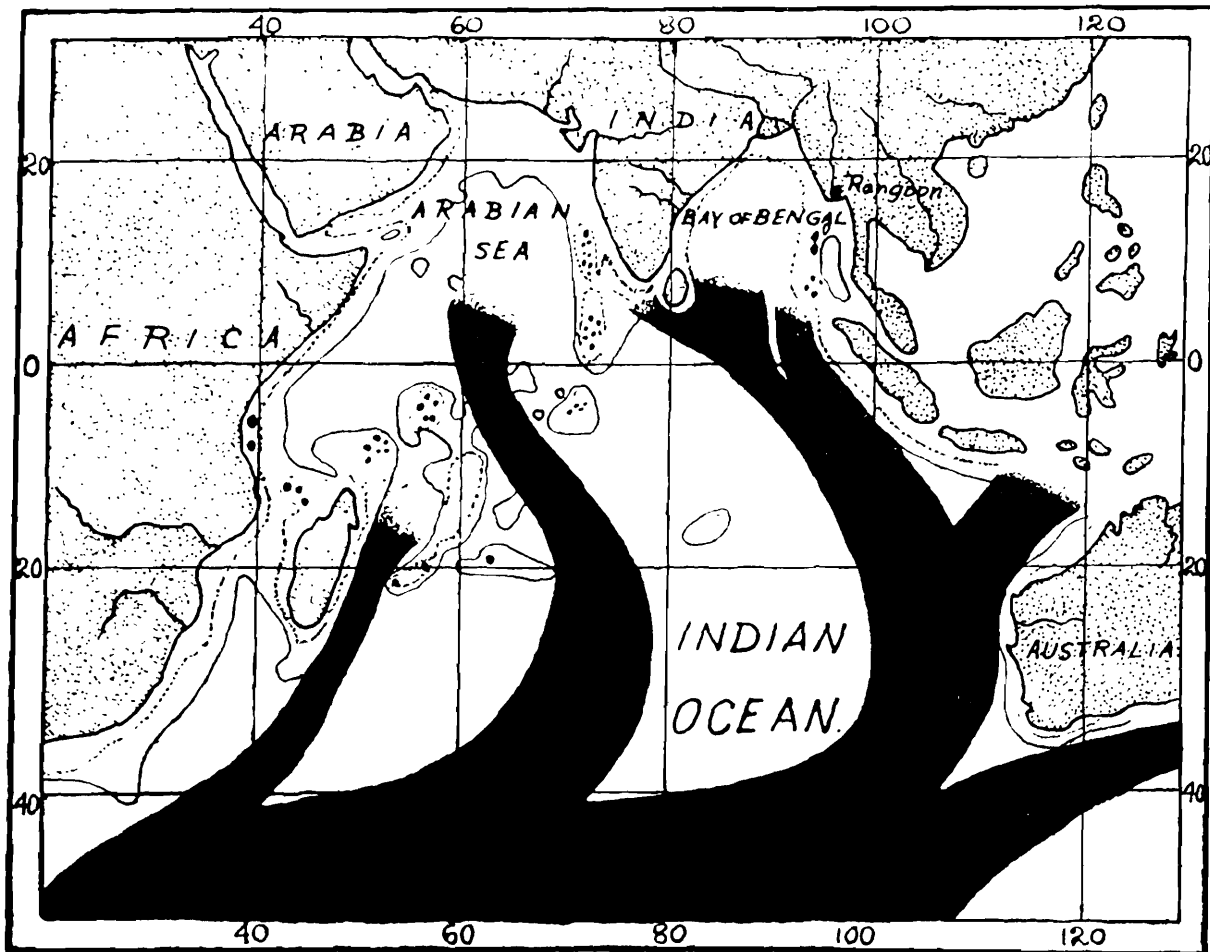
*Sagar Sampada*



A typical rocky coast



thermocline as far north as  $13^{\circ}12'$  NL between  $42^{\circ}04'$  and  $113^{\circ}20'$  EL. It is considered as a valuable "indicator species" of cold deep water mass (Totton, 1954, Daniel, 1954). The International Indian Ocean Expedition found it to occur in definite areas in the Indian Ocean during different months. In the Indian Ocean the upwelling of the deep, rich cold water mass occurs within this area ( $13^{\circ}12'$  to  $12^{\circ}42'$  SL), especially near gulf of Aden (August), Somali Coast (January, August and December), off Cochin (November), off Sri Lanka (February), Andaman Nicobar Islands (February, March, April, August and September), off Durban (January, August & December), South of Java (January & December) and in the mid-Oceanic region of the Equator (March, April, May, June, July, September, October, & December).



Distribution of bottom drift of Antarctic water

Knowledge of the upwelling regions in the Indian Ocean is of great importance because these regions are enriched by deeper waters and become areas of high primary production. Upon such productive areas depend our fisheries.

## ZOOGEOGRAPHY OF THE ANDAMAN SEA

The Andaman Sea is bounded on the east by Burma and the Malay Peninsula and on the opposite side by the chain of Andaman-Nicobar Islands and Sumatra. It is connected to the Bay of Bengal by various channels, but there are three main channels *viz.*, 1. The Preparis Channel on the northern part of Andaman islands. It has a depth of a little over 200 m. 2. Ten degree Channel separating the Andaman group of islands from the Nicobar group. It is about 150 km wide and 800 m deep and 3. Great Channel separating Great Nicobar Island from Sumatra. It is 15 m. deep.

The Andaman Sea is an enclosed basin. It occupies an area of about  $0.602 \times 10^6$  km<sup>2</sup> with an average depth of 1096 m. and enclosing water of volume— $0.660 \times 10^6$  km<sup>3</sup> (Lyman, 1966). The physical and chemical characteristics of the basin are influenced by the geographical features of the land enclosing it. The coastal regions on the two sides of the Andaman Sea differ widely from each other. In the east it is bounded by the long and narrow stretch of land extending in southerly direction to the southern most point of Malay Peninsula. There are a series of mountain ranges extending in north-south direction. They serve as catchment area for the rainfall during the south-west monsoon, and carry large volumes of freshwater into the basin. The important among these rivers are Irrawaddi, Sittang, Salween and Tenasserim, which flow into the northern end of the Andaman Sea.

On the west side, the Andaman Sea is separated from the Bay of Bengal by a scattered chain of islands, constituting primarily the Andamans and the Nicobars.

The Andaman-Nicobar Islands comprising 348 islands of various sizes, run in a more or less north-south direction between 6° 45' and 13° 45' North latitudes and 92° 10' and 94° 15' East longitudes. The total area of the islands is about 8,294 km<sup>2</sup>. These islands are broadly divided into two groups *viz.*, Andamans and Nicobars. The Andaman group consists of 324 islands, of which only 27 are inhabited (1981 Census). The main part of the group, collectively known as Great Andamans, include five closely adjoining islands called North Andaman, Middle Andaman, South Andaman, Baratang and Rutland. This group covers an area of 6,340 km<sup>2</sup>. Little Andaman (48 km long and 27 km wide) forms the southern extremity of the whole group. It is separated from Great Andamans by a strait called the Duncan Passage.

The Nicobar group of Islands, covering an area of 1954 km<sup>2</sup>,

comprises of 24 islands of which only 13 are inhabited (1981 Census). The distance between Car Nicobar, the northern most island and Pygmalion point, the southern most tip of the Great Nicobar is about 310 km. The Pygmalion point is about 144 km from Achin Head, the northern tip of Sumatra.

The islands have low ranges of hills enclosing narrow valleys. On the east coast of the islands there are several small freshwater streams opening into the Andaman Sea. In Middle Andaman and Great Nicobar there are steep ridges and valleys with perennial streams and rivers.

The mountain chain extending from Preparis Island to join the mountain system of Sumatra, Java and Malay Archipelago is part of the great Alpine Himalayan system. In the north it is connected to Arakan range in Upper Burma. The Burmese Malayan Arc is thus considered as a loop of the Himalayan Axis. This chain of mountains came to be slowly elevated till the ridge attained its maximum height of about 2700 m. above mean sea level. The Andaman Sea basin which originated in the beginning of Tertiary period had further sunk by the end of that period. As a result of the elevation of the ridge and sinking of the trough, there was a deposition of several hundred feet of clay above the sea level. The ridge elevation and trough sinking process led to the appearance of straits of Malacca in the Pleistocene. It indirectly connects the Andaman Sea with the Pacific ocean. The Andaman Sea is thus connected to the Bay of Bengal on one side and to the Pacific Ocean on the other. These channels have facilitated both Pacific and Indian Ocean fauna to colonise the Andaman Sea.

The seaward edge of the Andaman Nicobar ridge is bounded by a continental shelf that dips steeply seaward. The continental shelf is very much wider on the western side than on the eastern side. On the western side, the shelf is very irregular and drops steeply down to a depth of 500—600 m. On the eastern side of Andamans islands the bottom slopes to 400 m. The continental slope is almost absent. The western side has a number of coral banks *viz.*, North Bank followed by West, Middle and South Coral banks. Further south there are North and South Sentinel Islands and finally Dalrymple Bank. This chain of coral banks are at a distance of approximately 21 km from the coast. The rate of growth and extent of coral formation are richer on the western side than on the eastern side of Andaman and Nicobar Islands. It may be due to the influx of oceanic water brought by south-west monsoon and the consequent abundance of food supply. The coral reefs on the west are considered as barrier reefs. It

extends from latitude 10°26' N to 13°40' N covering a distance of approximately 320 km. It is separated from the coast line by a channel of about 80 m. On the eastern side the coral reefs are fringing type. There are a large series of raised coral benches extending from Outram and Lawrence Islands in the Ritchie Archipelago and passing through Havelock Island. The coral reef forms a terrace ranging from a few metres to over a kilometre in width.

Geodetic survey conducted by International Expeditions revealed a vast under-sea valley stretching 900 km long and 38 km wide. It is surrounded by mountain peaks and extends from Narcondam Island through the Burmese waters to the northern tip of Sumatra. The valley floor covered by muck and ooze is about 8-16 km across. The deepest point was estimated to be at 4500 m under the sea.

The physical conditions in the Andaman Sea are very much complicated. The 'Investigator' observations have shown that every day there is a double oscillation in the strength of the wind in the Andaman sea. The increase in wind force twice a day causes a thinning of the surface layers of the ocean. It results in an up-welling of water from below and the deeper water gets mixed with the surface layer. This vertical circulation of water produces corresponding effects on both temperature and surface salinity.

The surface currents are influenced by the direction of the prevailing winds. The direction of these winds is completely reversed every six months with the onset of the southwest and north-east monsoons. During the period of north-east monsoon (December to April) a strong flow of water occurs from the Sunda Sea to the Andaman Sea through the straits of Malacca. During this period of north-east monsoon i.e. January-February, low density surface water enters the Andaman sea through the Preparis Channel. It passes towards the west and south-west. The combined effects of this current and the one coming from Bay of Bengal set in a number of rotatory currents in the centre and north-west parts of the Bay.

The deep waters of the Andaman Sea are to some extent influenced by the cooler waters of the Antarctic Bottom Drift. The Ninety-east Ridge splits this Drift into two great streams, the western and eastern. The latter flows north-eastwards and on meeting the curve of the Malayan arc swings northwards to the entrance of the Bay of Bengal. It again splits into two streams, one passing into the Bay along its eastern side and the other passing

in a westward direction towards South India and Sri Lanka.

Besides the influence of these currents the waters in the Andaman Sea exhibit a phenomenon called "seiche," (Sewell, 1932). During each monsoon the less saline surface stratum is driven towards one side of the region by the strong winds and gets piled up. The deeper, more saline stratum is brought upwards. Depending upon the south-west and north-east monsoons, the periodic mixing of these two layers takes place at each end of the basin. It brings in a consequent periodic rise and fall in the salinity of coastal waters. Thus, the surface salinity of the coastal waters of the Andaman Sea exhibit a rhythmic rise and fall corresponding to the time of occurrence of "seiche." This periodic variation in the surface salinity causes periodic appearance of pelagic animal life. Small salps, Rhizostomus Medusae or certain species of pelagic crustacea normally inhabiting deeper waters may make their appearance in surface layers being carried there by the upward swing, 'upwelling' of deeper water (Sewell, 1932).

Recent studies (see Parulekar & Ansari, 1981) noted limited mixing between surface, subsurface and bottom waters. These studies have also indicated low biological productivity of the Andaman Sea. But this has been offset by the production of large quantities of detritus.

A close agreement was noticed between the rise and fall of the salinity and the tides. Towards south-west part of the Andaman sea the salinity rapidly rises and finally approximates to the one found in the oceanic waters of Bay of Bengal. The influx of open sea water in this region through Preparis Channel and Ten Degree Channel has not only affected the surface waters but also the bottom waters.

Andaman sea has low benthic production. It has been attributed to stratification of the water, allowing only limited mixing and to the oligotrophic nature of the sea.

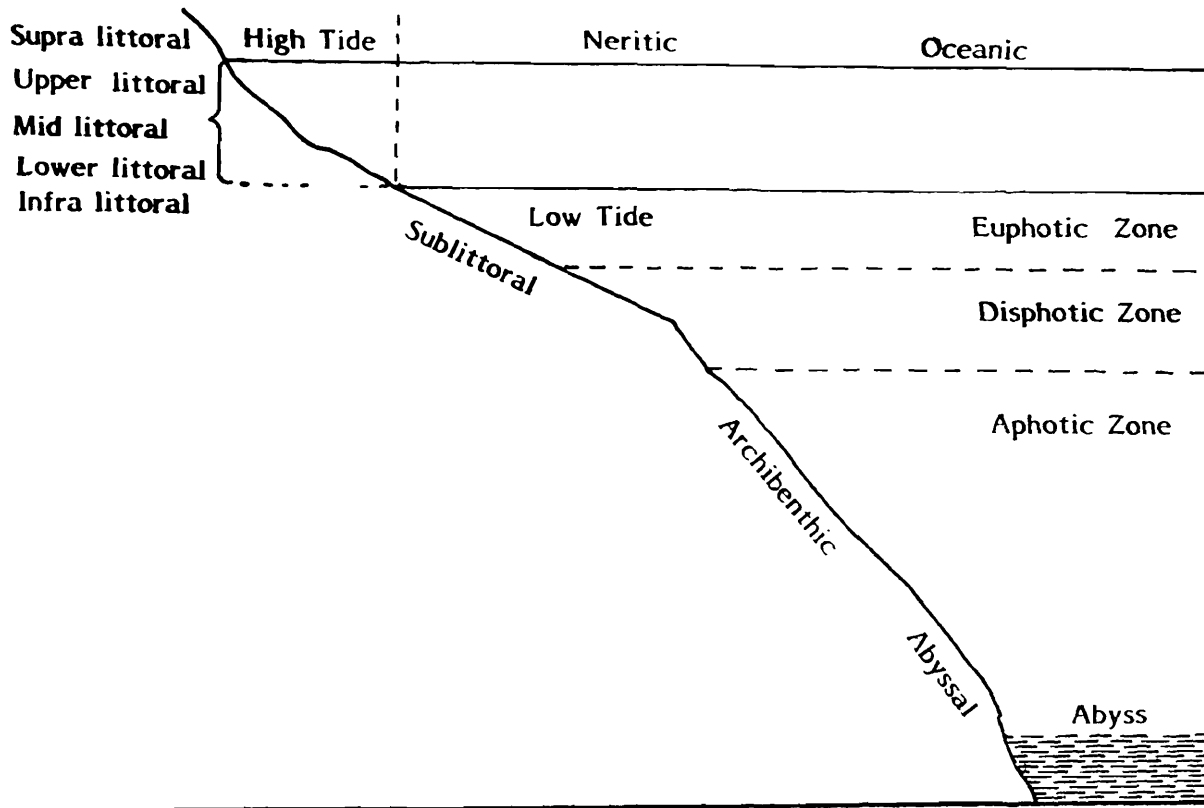
In the Andaman Sea the wave characteristics like zero crossing period and significant wave height vary from 6 to 12 sec. and 0.6 to 14 m. around Andaman and Nicobar Islands. During January-February the wave characteristics around the islands are mainly those of swell waves with a slight superimposed local sea waves (Gouveia *et al*, 1981).

Investigations by the National Institute of Oceanography (1981) have revealed that water masses on the western and eastern margins of Andaman and Nicobar Islands have the same charac-

teristics to a depth of about 1500 m. Three important water masses have been identified in the Andaman Sea. There is Persian Gulf water at a depth range of 200 to 500 m. and beyond this and upto 900 m. is a mixture of Persian Gulf and Red Sea waters. The deep water has characteristics similar to that of Antarctic bottom water (Rama Raju *et al*, 1981). There is a limited water mixing at a depth below 1300 m. and this creates relatively stagnant water masses in the Central region on the eastern side of the Islands. The isolation of the Central basin of the Andaman Sea from its northern and southern regions by shallow sills also prevents water mixing thus making it stagnant and low in oxygen concentration (Ramesh Babu & Sastry, 1976).

## MARINE ENVIRONMENT AND ITS ZONES

The land gradually slopes into the sea and this transition zone of land and sea is commonly known as the sea shore. The margins of the continents that slope gradually into the sea are known as Continental Shelves. The continental shelf leads to the oceanic floor. The transition zone between the two is continental slope. Thus, sea shore gradually leads to the sea bottom which has a mass of water that lies over it.



Classification of Marine Environment

Vertically, marine environment is considered under two divisions, namely the sea bottom, which is called the benthic division and overlying waters known as pelagic division. All the divisions of the marine environment are dealt either with reference to the sea-bottom or the water mass. Broadly the various levels of sea can be classified as intertidal zone, neritic zone and oceanic zone. Intertidal zone which is subjected to alternate exposure and submergence by tides is the most dynamic zone. The waters over the continental shelves upto a depth of about 200 m. constitute the neritic zone. Intertidal and neritic zone together are often called as coastal seas. The shallow coastal seas are the happy abodes of almost four-fifths of all the plants and animals. Water from the edge of the continental shelf to high seas beyond include

oceanic zone and it constitutes offshore waters. The neritic and oceanic zone together form the pelagic division. Based on temperature range and light conditions vertically the oceanic zone is divided into subdivisions, such as the epipelagic (surface to 100 m.), the mesopelagic, the bathypelagic, the abyssopelagic and the hadopelagic. There is yet another way of classifying the pelagic division. It is based on the conditions of light at various levels. The upper zone which normally may extend up to 100m. depth is well lighted and suitable for photo-synthetic activity. It is known as euphotic zone. The next zone which extends up to 200 m. depth is dimly lighted and is known as disphotic zone. Water below this where there is little or no light is referred to as the "aphotic zone"

Tides are the major environmental factors that control life on the sea shore. On fullmoon and newmoon days the Sun, Moon and Earth are in the same line. The combined pull of the Sun and Moon results in tides of maximum range known as Spring Tides. At such times the difference between high and low tides is greatest. As a result, a maximum area of sea shore gets exposed. Twice a month, *i.e.* at the time of first and last quarter phases of the Moon, the Sun and Moon are at right angles relative to the Earth. During this time the Sun's influence partially cancels the pull of the Moon. At that time the difference between high and low tides is the smallest and the tides are called Neap Tides.

The region that falls within the tidal limits, between the high tide mark and low tide mark is the intertidal zone or littoral zone. The region above it is the supralittoral or supratidal zone. The seaward region below the littoral zone is the sublittoral or subtidal zone. The supratidal zone gradually merges with the land, while the sublittoral zone extends up to the end of the continental shelf. The supratidal zone is dampened only by the spring tides and the splash of the surf. The littoral zone is that where the tide ebbs and flows continuously. The sublittoral zone is that which is exposed only during the ebb of spring tides. In these three zones live a large number of animals and plants.

The region extending either between the tide levels or down to the level of attached plants is often referred to as eulittoral zone (40-60m.).

The above zones are with reference to the benthic division of the sea and are concerned with the sea bottom extending up to the edge of the continental shelf. Beyond the continental shelf the sea bottom is divided into bathyal (200m. to 1000m.) abyssal the sea floor below 1000m. to about 6000m., and beyond this it is

known as hadal zone. Often one finds in literature a reference to the bathyal zone as extending up to 200 m. and the division of sea bottom into three divisions, namely sublittoral, archibenthic and abyssal benthic.

The extent of the littoral zone varies from shore to shore. Geographical factors, the depth of coastal waters etc. determine the range of the littoral zone. The total littoral environment covers a modest area of roughly 1,50,000 km<sup>2</sup>. The dominant factors are the tide and surf

Sea shore may be rocky, sandy or muddy. Often it is interspersed with mangrove vegetation. Around the islands the littoral and sublittoral zones are occupied by underwater coral populations which display the flamboyancy of tropical life.

### ROCKY SHORES

In several of the islands the coast is rocky. Strong waves continuously hit the rocks and boulders creating hollows in the rock or breaking the rock into small pieces in course of time. The constant battle between the waves and the rocks also creates conditions for the formation of tide pools. At low tide several of these rocks are exposed and tide pools are also formed. The exposed rocks get heated up in the day time. Based on the nature of its exposure a rocky shore is conveniently divided into three zones viz., Supra-littoral, Mid-littoral and Sub-littoral zones. Each zone has its peculiar plant and animal communities. The flora and fauna of rocky shores exhibit a definite noticeable zonation. Life zones are much more evident here than on other kinds of shores. Although the actual areas and limits of the zonation may vary, and one species may replace another species depending on the region, there is generally a universal pattern of zonation. Depending on local conditions such as temperature, steepness of shores, tidal range, amount of protection and other factors the extent of the above mentioned three zones may vary, and in turn regulate the kind and number of biota.

*Supra-littoral zone* It is also known as the upper zone or the dry Upper-Beach zone. It is dampened only by the highest tides or by storm waves and the splash of the surf. It is the point of transition between true sea shore and land. Only a few species of animals inhabit the supra-littoral zone. The most characteristic of this zone are the periwinkles (*Littorina*) and neritids (*Nerita*). Periwinkles are so common in this zone that it is frequently referred to as the Littorina-zone. Sea-slaters are other animals that are found commonly in this zone.

Blue-green and green algae are found growing as encrustations on the rocky surface.

*Mid-littoral*, It is also known as the Middle zone or the Middle Beach zone. It is the true intertidal zone, subjected to daily ebb and flood of the tides. As such, the animals living in this zone are immersed in water during high tide and exposed to air and drying during low tide. Animals in this zone are more abundant than the above one. Several groups of animals live attached to rocks, hiding in their crevices or in the tide pools. Molluscs, crustaceans and rock boring worms like sipunculids are common in this zone. Acorn barnacles (*Balanus*) are often so abundant in this zone, that it is referred to as the 'Balanoid zone'. Under favourable conditions, barnacles inhabit the rocks in a dense layer beginning immediately at the lower limit of the Supra-littoral zone. Generally, the layers either diminish gradually or end sharply at the more or less permanently wetted low-tide mark. One should not conclude from this that barnacles do not grow below the low tide level, many species are often very much at home there. Some species are also found in the Supra-littoral zone.

Limpets, chitons, neritids, top shell and turban shell are some of the important molluscs that inhabit this zone. Sea urchins and tubicolous polychaetes also constitute major faunal elements of the zone.

*Sub-littoral* It is the lowest zone and bared only by the ebbing spring tides. As such, exposure to air is not as frequent as in the Mid-littoral. It is typically rich in animal and plant species.

Life on the rocky shore is mainly governed by tides. The animals and plants living on a rocky shore are constantly under pressure from the fast changing environment. The main problems are violent wave action, exposure to atmospheric air resulting in desiccation, excessive heat when the tide water recedes, intense light etc. The plant and animal species have developed ingenious techniques to overcome these problems of life. Broadly it resulted in two types of adaptations viz., morphological and behavioural. Some of the forms like limpets and barnacles have developed thick shells and strong power of attachment to withstand the force of battering waves. There are others which have developed soft and flexible bodies, such as sea weeds and hydroids. Hard shell also helps them to maintain the moisture inside. Active swimming forms like crabs and shrimps and a few molluscs hide themselves inside crevices. The crevice dwelling habit also helps to protect the animals from heat and exposure to atmospheric air

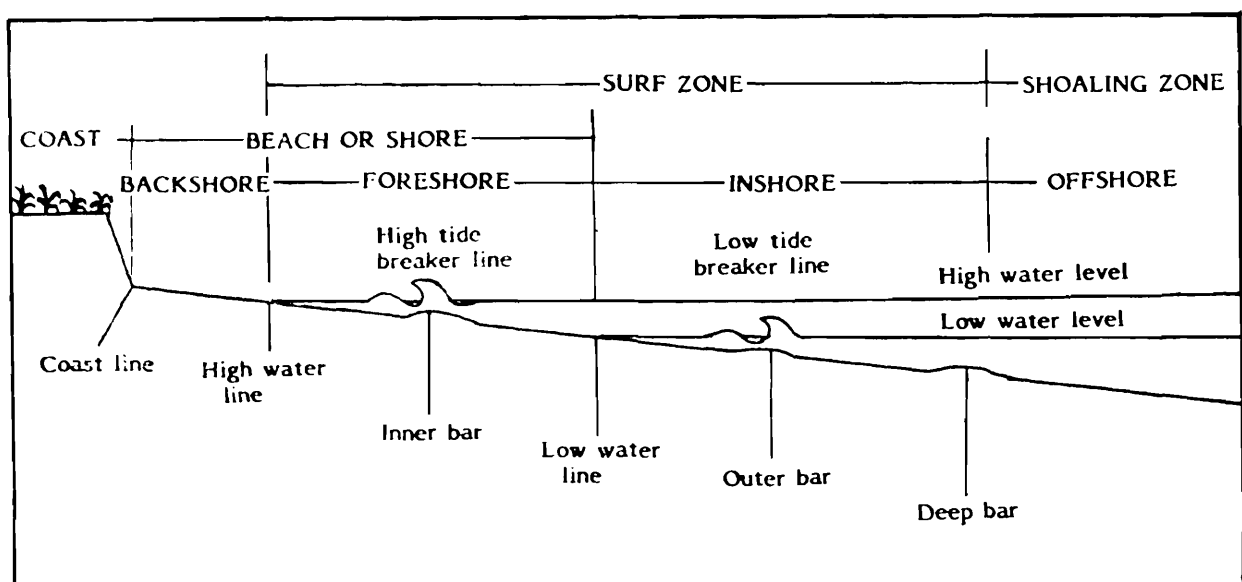
The animals of the rocky shore have developed different feeding methods. There are algal grazers like limpets, top shells and sea urchins, detritus feeders like crabs and filter feeders such as barnacles and bivalves.

### SANDY SHORES

Sandy shores are affected by many forces, some of which tend to inhibit colonization by plants and animals and, consequently the development of a community of many a species. For example, sandy shores more than any other type are affected by the movement of offshore currents. And in many regions, man's attempt to mould coastline have created innumerable problems in the form of beach erosion and shifting sands.

Beach sand can be of considerable interest. For, though we tend to think of beaches as expanses of white quartz sand, other colours and minerals occur on various beaches.

The zonation of life is not so marked as on rocky shore. The littoral zone of sandy beaches usually consists of a relatively uniform gradation of regions. It grades from a higher set of dunes above the high water mark to the gradually sloping shore beneath the low-water level. There may be an occasional tide pool, but there are few, if any, rugged irregular rocky zones. When undisturbed, the intertidal zone of sandy beaches is generally stable and clearly zoned. It varies only with normal spring and neap tides and occasionally with coastal storms.



Structure of a beach

The offshore zone is marine, extending seaward from the low-tide mark. The off-shore bar, when present, minimizes wave effects on shore, helping to stabilize the beach as habitat for plants and animals. Landward from the low-tide mark two zones are usually distinguishable, the foreshore, or low beach, and the backshore, or upper beach. The backshore is typically constructed of beach ridges (berms) that were built by successive high tides or in some cases, by slowly receding storm waters. The extent to which a beach slopes is related to the size of soil particles and to wave action and tides. In general, beaches of coarser materials tend to be steeper than those of fine sand. Water content, an important factor to life in the sand, is related to particle size, since capillary action is greater in sand than in gravel. Where wave action is slight, beach sands are likely to be of fine texture. But where turbulent waves vigorously wash the shore, sorting beach materials, the sands are of coarser nature. Often the texture of sand grades from coarse in the high-tide zone to fine along the low-tide level. The beaches in the islands are either exposed or sheltered. The sand grains are mostly fine and medium, siliceous or coralline with a variable shape from spherical to angular.

To a casual observer, the ebbing tide on a sandy beach reveals a barren, lifeless expanse of sand. But closer observation especially after digging, will reveal an interesting community. The pounding and washing waves do not favour colonization by attached plants and animals, nor do they allow for the manoeuvring of mobile animals. The predominant inhabitants are those that live buried in the sand or in tubes or burrows, these include a variety of molluscs, worms, and crustaceans. On many beaches, particularly lower beaches, numerous mounds and piles of castings (dirt surrounding burrow openings) appear as the tide withdraws. These indicate the presence of organisms beneath the surface. The variety of species is not great, but this is frequently offset by the abundance of individuals.

Even the surfaces of sandy beaches are not so devoid of life and activity as they might first seem. A number of animals frequent the area at low tide. The infauna of sandy shore is classified as microfauna, meiofauna and macrofauna, with reference to their size. The microscopic animals which include Protozoa and others fall under the first category. Animals of intermediate size (retained by a sieve mesh of 0.05 mm but may pass through 0.5 mm size mesh), are referred to as meiofauna which may be less common in coarser sands. The larger and conspicuous animals are referred to as macrofauna. Several groups are represented in the macrofauna. Polychaetes, molluscs, amphipods, sea-anemones, etc. are some of the important constituents of the fauna.



A view of Ross Island showing the effect of tidal erosion

Sandy beach at Corbyn's Cove with Coconut Plantation





A typical sandy shore in the Andaman

Mangrove vegetation along open shore





An Association of red mangrove, *Rhizophora apiculata* showing stilt roots and vivipary

Stilt Roots of *Bruguiera* sp. covered with edible oysters, *Crassostrea madrasensis*





G.Ponnuswamy

A typical mangrove area with pneumatophores  
Andamans

A fisherman operating cast net in the mangrove  
environment — Andamans



G.Ponnuswamy

Only a few coelenterates appear to have adapted to life in the sandy intertidal zone.

Polychaetes of the phylum Annelida, the segmented worms, are the most characteristic and abundant of the sandy intertidal animals. Most of them build tubes of calcium carbonate or tough mucus and sometimes cement sand grains into the structure. Some species simply burrow their way through the sand. A great many feed on plankton or organic debris, others prey on small animals such as crustaceans and other worms.

A variety of crustaceans inhabit sandy beaches but quantitative dominance is shown by copepods. The smallest are nearly microscopic copepods that squirm their way through the sand, feeding on other animals, algae, and organic debris. Copepods, in addition to certain protozoans and worms, constitute the interstitial fauna—animals that live in the spaces between sand grains and pebbles. Almost all typical groups of interstitial meiofauna excepting Mystacocarida and Bryozoa were recorded in the sandy beaches of these islands (Chandrasekhara Rao, 1980).

The mid-littoral zone of the sandy coast is occupied by several groups of micro—and macro fauna such as amphipods, isopods and anomuran crabs.

The pistol shrimps or snapping shrimps (*Alpheus*) live in burrows in the sand of tidal pools and shallow waters. These crustaceans possess an enlarged chela (pincerlike organ) that can be closed with such force as to produce a loud, popping noise. The shock-wave of the snapping chela stuns and inactivates small fishes and other small animals, making them easy prey to capture. This represents a unique adaptation for obtaining food. Snapping shrimps are seldom more than 2 inches in body length and are known to live at least eight hours outside water

One of those more commonly noticed is the fiddler crab (*Uca*) which makes its home in the beach ridges of the higher zone. When the lower beach is exposed, fiddlers in large groups move down into the lower beach to feed on small animals and bits of organic debris. A near relative, the sand crab or ghost crab (*Ocypode*), also lives in burrows, but usually in drier sand than the fiddler. The extremely light colour of the sand crab accounts for its second name; seen against light-coloured sand it is quite ghost-like.

Among molluscs, bivalves are common in the sandy beach. These live buried in sand. Cockles (*Cardium*) and clams of

various types (surf clams *Mactra*, razor clams *Cultellus*) wedge shells and tellinid shells (*Tellina*) are common in the midlittoral zone of sandy beaches.

A number of sea and shore birds come to beaches at low tide often finding abundant food. Examples are terns (*Sterna*), smaller shore birds such as sanderlings (*Calidris*) and sandpipers (*Tringa*). A patient beach watcher stationed on the sandy coasts of North Sentinel Island, Great Nicobar etc. may be rewarded with the rare scene of watching turtles crawling into the beach.

There are a number of advantages to life in the sand. Burrowing organisms have few natural enemies. Temperature and water content are fairly stable. This is in direct contrast to plants and animals that live above the ground on rocky shores, where they are constantly threatened with exposure to excessive heat and cold, as well as to drying out during low tides.

There are also a number of disadvantages to sandy shore living. But as we have seen the organisms of sandy shores are adapted in various ways for living in such difficult settings. Further many members of the community occupy certain zones, depending upon tolerance of the organisms and the zone's supply of requirements necessary for life. Much is yet to be learnt about sandy beach zonation as well as population growth maintenance and colonization.

#### MUDDY SHORES

Where the forces of coastal currents and wave action for some reason decrease, fine particles of mud-forming silt are deposited. The result is often a shore composed mainly of accumulated mud. Unlike most sandy and rocky shores, muddy shores are almost always flat and are called, "mud flats" and because they are flat, or lacking sharp inclines, muddy shores normally remain rather damp at low tide.

The offshore bars or barrier beaches receive the brunt of tides and waves. The waters behind the bars are relatively calm, with shores consisting mostly of mud flats.

Muddy shores can be formed only where sea currents are slow and weak, and where fine particles that form mud can settle out. Such conditions are found in sheltered bays and in mouths of coastal streams. In these areas, fine particles and organic matter are deposited to form muddy zones in which a rich and varied animal life develops. Because mud is more stable than

sand, it is generally inhabited by animals that construct permanent tubes and burrows. But because the proportion of sand to mud varies, the distribution of many of the inhabitants is apt to be patchy in any region.

As a rule, few algae or flowering plants have adapted to living on the bottoms of muddy estuaries and embayments. This is probably due to three limiting factors. One factor is the highly turbid condition of the water, which restricts light penetration and thereby, photosynthesis. The second factor is the absence of solid structure to which algae, at least, can attach. Third, the settling silt tends to cover and smother the plants.

The moderate to high content of organic materials in mud affects animal population in several ways. First, to the advantage of the animals, they find food in the partially decomposed organic matter. Another advantage is that a fine muddy shore retains more water than coarse sand, this suggests that animals need not burrow to escape drying out as receding tides expose the flats.

But to the disadvantage of burrowing animals especially bacterial decomposition reduces the mud's oxygen content. It also produces a great amount of hydrogen sulphide gas. Furthermore, the fine salt particles, easily held in water tend to clog the breathing organs and feeding structures of animals. Generally then the muddy intertidal zone is not an easy place on which or in which the animals can live.

In many instances the animal life of mud flats is distributed in two directions. First, a horizontal zone can be recognised determined primarily by tides. These zones, are represented by the uppermost, or high beach; the zone between the highest high tides and the lowest high tide, or middle-beach zone, and the low-beach zones. Second, vertical zones containing the epifauna, the animals that inhabit the surface, and the infauna, those that live below the mud surface can be noted.

The infauna of muddy intertidal zone consists predominantly of pelecypod molluscs, worms, a few crustaceans, and some fishes that spend at least part of their lives in underground habitats. A number of researchers have found that particular groups of burrowing animals are limited to various grades of soil, such as fine silt or coarse sand, and to various proportions of sand and mud. Certain annelids and round worms are restricted to such strata of very fine grain size.

As remarked earlier, the fiddler crab is often a resident of high sandy beaches. This little crustacean is also very much at home on muddy shores, provided that the consistency of the mud permits construction of burrows. The fiddler seems to be in the evolutionary process of moving away from the sea, for although it breathes through wetted gills, it can live for weeks without having to moisten its gill surfaces. The burrows are usually placed well above the hightide mark. If they are not, and water floods the area, the animal plugs the entrance to its burrow, creating a water-tight chamber that keeps it dry. When ranging about on the beach, the fiddler can be classified with the epifauna, when in the burrow, it belongs to the infauna.

Typically, hydroids of the phylum Coelenterata attach to some solid structure in the water. A few, however, are regular inhabitants of muddy intertidal shores.

*Cerianthus* is a coelenterate that resembles the anemones. It has a long worm-like body that is buried in a sandy mud with only the tentacles and mouth protruding. Although gastropod molluscs are not characteristic of soft mud, the epifauna of mud flats include an impressive variety of these animals, for example, small, sharp spired snails-including mud snail, *Nassarius* and *Cerithium*, nearly cover the surface in small patches and make walking barefoot uncomfortable. A number of shell-less gastropods are at home on the mud surface of bays and estuaries.

Food is also important in determining the number and kinds of individuals present among mud-flat burrowers. A substrate rich in organic food matter can obviously support more organisms than one that is poor in organic content.

A variety of polychaete worms have become adapted to life in muddy shores. *Marphysa mossambica* is remarkable for its tenacious living as it can survive even in highly deoxygenated muddy shores. Nereids are other common worms. They are capable of free swimming and many of them construct tubes. *Eurythoe*, *Eunice* and *Perinereis* are common forms.

The seamouse, *Aphrodite*, a hairy annelid worm 8 to 17 cms long is found on flats. It lives beneath the mud surface with only its posterior exposed. To obtain oxygen for respiration, *Aphrodite* manipulates its body to pull water underneath itself. It then forces the water over its sides to a respiratory duct on its back. Organic debris is taken for food, as the animal burrows slowly through the sandy mud.

Among the crustaceans adapted for burrowing in mud are a few shrimps and crabs. To move about an acorn worm extends its proboscis into the mud and then with the proboscis serving as an anchor, the rest of the body is pulled along. Actually the animals move about very little. Acorn worms feed on organic material found in the mud.

Molluscs of the muddy shore are represented by several species of gastropods like cerithids (*Cerithidea cingulata*), stenothyrids, (one species known), assiminiids (two species) and mud snail, *Nassarius*.

Several kinds of fishes live in their own mudflat burrows or in those of other animal e.g. goby fish.

### MANGROVES

Sea shore topography of the Islands is influenced by two types of forests, namely mangroves or tidal swamps and littoral forests or beach forests. Mangrove is one of the most productive coastal ecosystems. The word mangrove originates from the word 'Mangal', which means trees extending on the fringe of estuaries, lagoons, salt marshes, and coastal belt of tropical and sub-tropical regions. Development and luxuriance of mangal formations/communities depend on various individual factors and their interactions, such as substratum, its depth, consistency, interaction of frequency of flooding, soil and water salinity, and presence and extent of sheltered areas. Red Mangrove is dominated by the luxuriant growth of *Rhizophora* spp. while the white mangrove refers to *Avicennia* spp. The energy input from mangrove species vegetation to the water channels promotes the fertility of the soil and water. It has a diverse variety of photosynthetic bacteria, plankton, benthic diatoms, floating epiphytic and benthic algae, and halophytic marshy vegetation. The common mangrove species are *Rhizophora mucronata*, *R. apiculata*, *Avicennia marina*, *A. alba*, *A. officinalis*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, *S. apetala*, *Aegialitis rotundifolia*, *Aegiceras corniculatum* and the common mangrove palm—*Nipa fruticans*. Mangroves which cover 18 per cent (1150 Km<sup>2</sup>) of the Islands' area are exploited for their wood. It is used in plywood and matchwood industries. Mangroves are also important as buffer zones and in stabilizing the shore line.

The mangrove water ways support many brackishwater and some freshwater fishes, the cultivable fin fish and shell fish resources.

Mangroves are quite common in channels and bays in sheltered places. There are open shore mangroves also. Mangroves are very common in Wrightmyo near Port Blair, in North Andamans, Little Andaman, Camorta, Great Nicobar Island and Car Nicobar Island (Kimios Bay). Baratang and Havelock Islands have extensive and dense mangrove vegetation.

Mangrove vegetation of the islands is dealt in detail by Thottathi (1960, 1962), Gopinathan and Rajagopalan (1983) and Garge *et al* (1985). Mangroves of the Islands include 26 true mangrove and 15 allied species. Mangroves are restricted to a narrow coastal belt species and have a distinct zonation. Three distinct zones such as sea-ward proximal zone, the middle zone and the landward distal zone are recognised (Garge *et al*, 1985).

Seaward fringe is dominated by three species of *Rhizophora* namely, *R. apiculata*, *R. mucronata* and *R. stylosa*.

The middle zone is occupied by *Bruguiera* spp., *Lumnitzera littorea*, *Aegiceras corniculatum* and *Ceriops tagal* etc. are found.

The common species in the distal zone are *Heritiera littoralis*, *Acrostictum aureum*, *Phoenix paludosa* etc.

Gopinathan and Panigrahy (1983) observed three different types of association *viz.*, association of *Avicennia*—*Sonneratia* and *Rhizophora*, association of *Bruguiera*—*Excoecaria* and *Barringtonia* and association of *Pandanus*—*Thespesia* and *Hibiscus*.

Mangroves thrive on muddy swamps. These form the pioneer plants, in a succession of plant communities that gradually transform an intertidal area into a dry land.

Mangroves are also subjected to tidal influence and these support typical animal communities. These are also distinguished into aquatic, which always remain immersed in water, semi-aquatic, exposed to air at low tide and terrestrial, living above the tidal influence. There are certain borers which include molluscan borers (shipworms or Teredinids) and crustacean borers (*Sphaeroma*). The borers thrive well within the tidal limits.

Many of the animals of mangrove areas are common to mud flats. These include fiddler crabs, hermit crabs, cerithids and littorinids on the leaves of the plants. The mud skippers (Gobis) that walk and leap about are common sight on mangrove mud. The unique mangrove frog, *Rana cancrivora* is also recorded from

the mangroves of the islands. Serpent eagle is the prey bird feeding on crabs and birds.

Several molluscs are found in the mangrove forests. They live either on the surface of plants or by burrowing into them, or crawling on the muddy substratum of mangroves. Gastropod molluscs are common as epifauna whereas bivalves constitute infaunal elements and bore into the wood. Littorinids (*Littorina scabra*), neritids (*Nerita atropurpurea*, *Nerita articulata*) and edible oysters are common on the branches or proproots of mangrove trees. *Cerithidea quadrata* is also seen clinging to the proproots. Teredinids are common as borers and are represented by several species.

Crustaceans are represented by some burrowing crabs like *Sesarma longipes*, and *Cardiopoma carnifex*. Hermit crabs of the genus *Clibanarius* are also common. *Sphaeroma*, a woodboring isopod, is a common element of the infauna.

Mudskippers belonging to the genera *Periophthalmus* and *Boleophthalmus* are conspicuous in the muddy substratum of mangroves.

The mangrove floral and faunal communities form a food chain. The broad base of the food pyramid is formed of plants. Some of the littorinids feed on plants. Bottom dwelling snails feed on debris. The snails form the diet of a mud skipper. The fiddler crabs' diet includes edible scraps. Crabs are the favourite food of frogs and snakes. Thus mangroves support a wealth of hunters and the hunted.

The proproots of mangrove trees serve as good shelters and the detritus derived from vegetation of mangrove litter and the colonizing groups including bacteria, fungi, ciliates and nematodes form food for many herbivorous, omnivorous and carnivorous fishes. Most of the freshwater and marine fishes utilise the mangrove waterways as good nursery and breeding grounds. Hence, a good number of cultivable fin and shell fish seeds are available in this region which can be utilised for aquacultural practices.

## PLANTS IN THE SEA

### SEA GRASSES

Different islands are characterised by different beach vegetation. There occur on well developed sandy beaches of Car Nicobar the creeper *Ipomea* and the grass *Sporobolus*. At certain areas of the island, overhanging the wateredge, are *Calophyllum*.

Algae are common as encrustations on the rocks and other substrata. Green alga, *Enteromorpha* grows as encrustations. These are found higher up on the beach. Other green algae like *Caulerpa* and *Padina* occur in the sheltered areas. *Caulerpa* grows attached to the mud or sand-bottoms, rock, coral reef or the roots of mangrove plants. The plant consists of a thallus with a slender creeping rhizome. It bears colourless root like rhizoids on its lower surface and erect shoots on the upper surface.

Brown algae occur below the zone of green algae. This group is represented by *Sargassum*, which is generally abundant on rocky coasts. The plant remains attached to rocks by a holdfast or may be free floating. It bears cylindrical leafy fronds and berry-like air bladders in their axils. These help the plant to maintain buoyancy.

Red algae are highly specialized marine algae and occupy the lower zone on the sea shore. *Gracilaria* and *Halimeda* are some of the common forms. The former is the source of commercial product agar agar

Some of the marine algae (Chlorophyceae-green algae, Phaeophyceae-brown algae and Rhodophyceae—red algae) contribute to the formation of coral reefs. The coralline algae, *Lithothamnion* and *Lithophyllum* are conspicuous species growing on the windward reef edges. *Turbinaria* is another species growing on the windward reef front. The semicalcareous algae, *Halimeda* is common on all reefs. The algae, mainly the calcicolous ones do not grow on the leeward side. Other algae such as *Ulva*, *Sargassum*, *Laminaria*, etc. grow on the leeward shores of the islands.

In the sandy patches of windward reefs near the Camorta Island the angiosperm beds extend from the beach towards the reef front covering a width of about 100 m. The angiosperm bed is formed mainly of *Thalassia*. Even during low tide the bed was under 30 cms deep water. It supports typical fauna. The marine angiosperms have extensive roots and rhizomes. The leaves of



Sponges — Mostly of irregular shape, and different colour and either like a moss with holes all over or branched and yellow in colour or elephant-ear shaped with a horny skeleton.

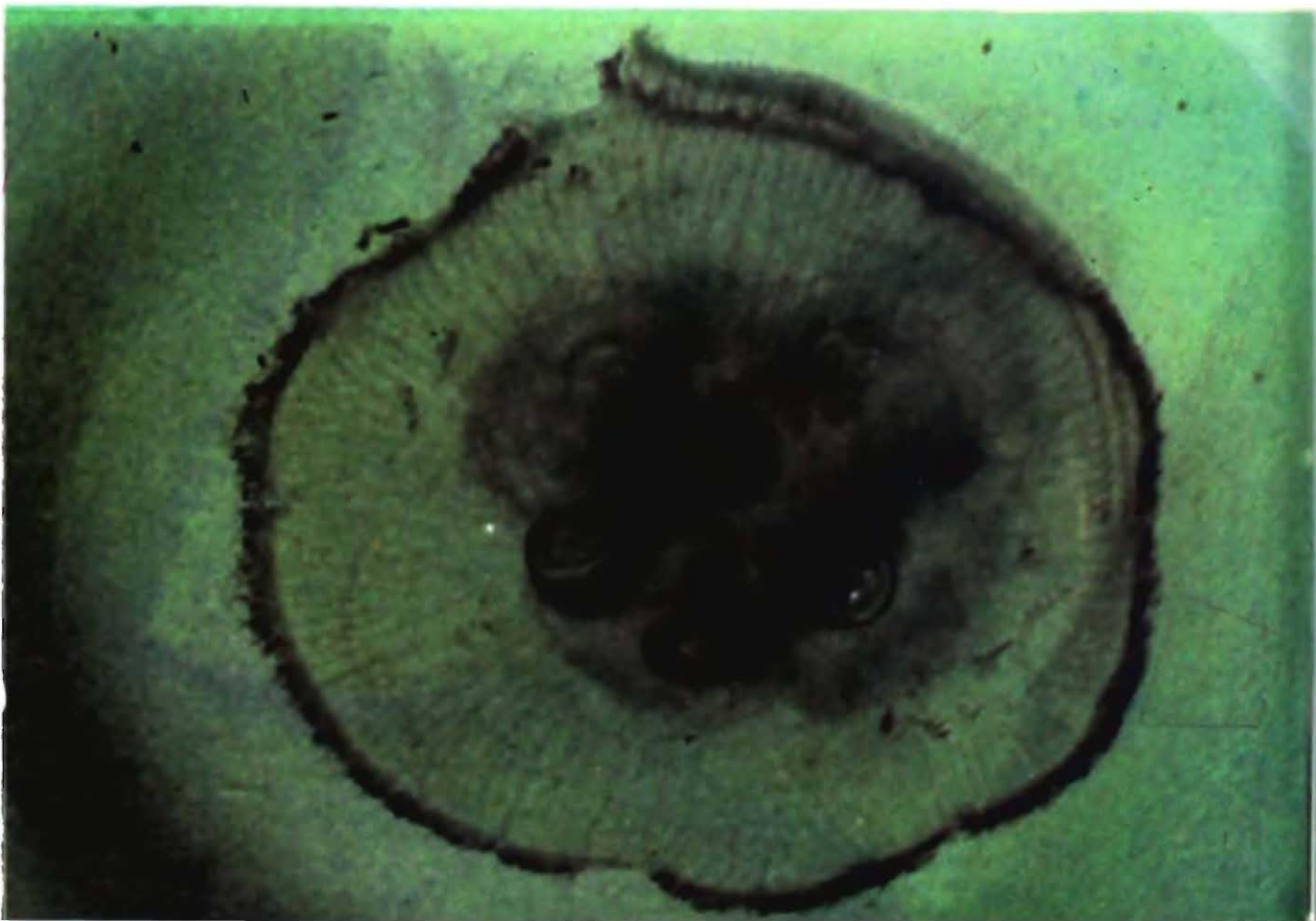
A reef habitat showing sponge and *Tridacna* among corals.





A rare but simple and vase-like calcareous giant sponge of deep waters, along with coral fish in the coral reef off the Jolly-Boy-Island.

Common Moon Jelly fish, *Aurelia aurita*, distributed world-wide, often grows to one meter diameter:





Sea anemone with its tentacles partly contracted and the mouth in the centre

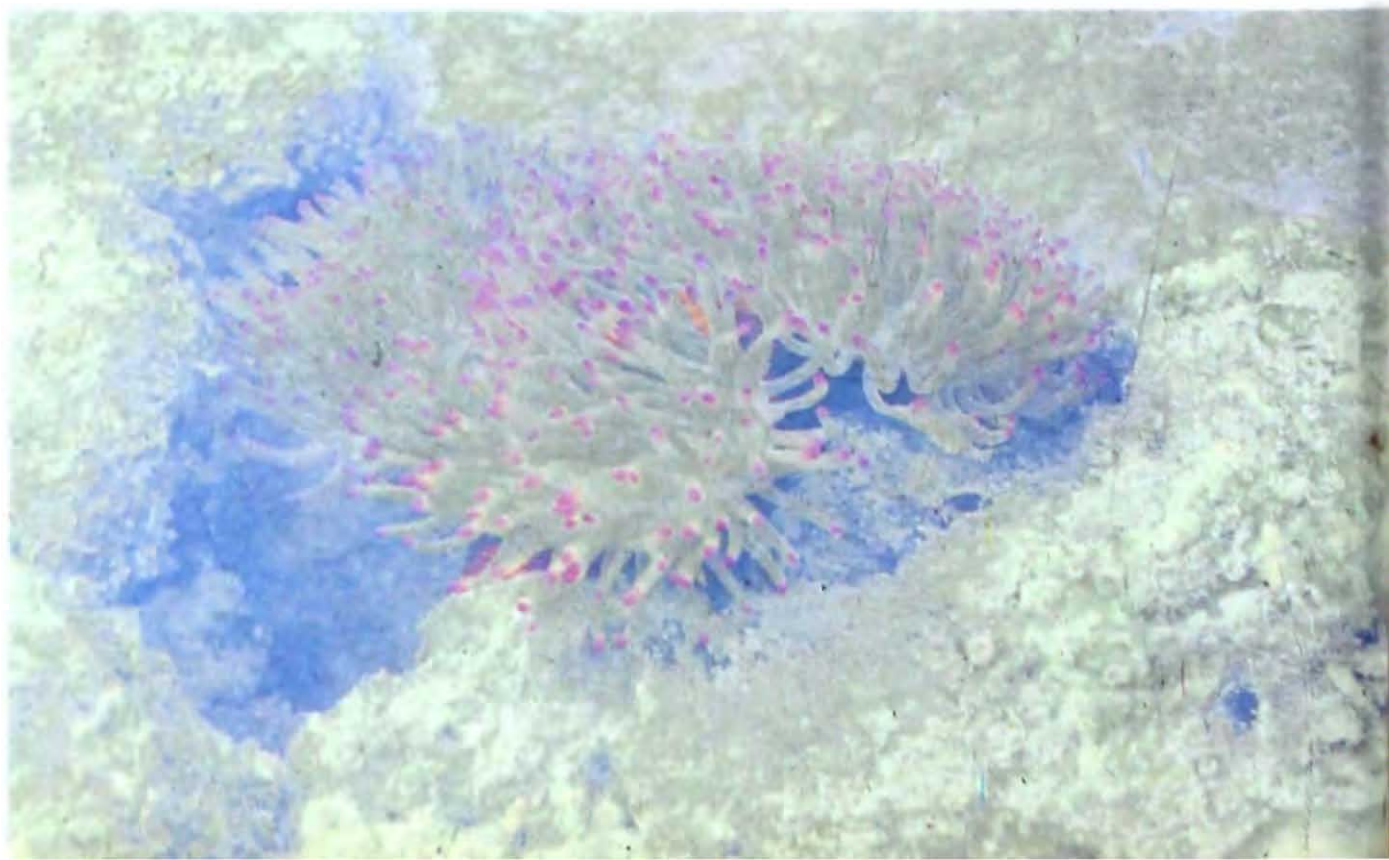
Sea anemone with fully extended tentacles in search of food.





Giant sea anemone, *Stoichactis*, on a coral boulder with its best known commensal, clown fish

Sea anemones in a tide pool. Anemone spreads its long tentacles, the tips of which are red and contain batteries of nematocysts.



these grasses provide suitable substratum for epiphytic algae. *Gracilaria* is a common form. *Holothuria atra* is the common sea cucumber inhabiting these beds.

Information on sea weed resources of the islands is available from the works of Srinivasan (1969, 1973) and Gopinathan and Panigrahy (1983). Sixty two species of marine algae are reported from these islands, which include 20 species of green algae, 19 species of brown algae and 23 species of red algae. Species of *Turbinaria*, *Sargassum*, *Padina* and *Gracilaria* constitute the dominant algae flora of the islands (Gopinathan and Panigrahy, 1983).

Among brown algae, *Sargassum* spp. and *Halymenia* spp. grow abundantly on rocks exposed to wave action. The red algae *Turbinaria* sp. and *Halimeda* sp. grow on coralline rocks.

“Mermaid’s umbrella” (*Acetabularia crenulata*) and ‘sea grapes’ (*Boergessenia forbesii*) are green algae which grow in extensive patches in the littoral region. The latter species is filled with water and quite turgid resembling a bunch of grapes.

## LIVING FLOATERS PLANKTON

The sea is a great space for life. Its inhabitants range from trillions of microscopic creatures to 30 metres long and 150 ton weighing whales. Plankton is a collective term used for floating microscopic plants and animals which are passively drifted by winds, currents and watermasses. Based on their size groups, they could be classified into ultranannoplankton nannoplankton microplankton, macroplankton and megaplankton. Many of the diatoms and dinoflagellates fall under the category of nannoplankton, whereas microplankton includes majority of microscopic animal groups. Large jelly fishes, fish larvae and other animal groups, which can be seen by the naked eye are included in macro and megaplankton. There is yet another classification of plankton which is based on their spatial distribution. The plankton that lives at the bottom is known as hypoplankton, while those frequenting surface water are referred to as epiplankton. The typical oceanic forms which lead a planktonic life throughout their life are known as holoplankton. Several benthic forms have a planktonic phase in their lives and such forms are classified as meroplankton.

The phytoplankton refers to the microscopic plants while zooplankton means the floating feeble animal organisms. Although a number of planktonic algae are available, the species representing Bacillariophyceae, Dinophyceae (dinoflagellates), Haptophyceae (including coccolithophores) and Cyanophyceae (blue-green algae) are more important in the biological wealth of the sea. The diatoms are unicelled, pill-box, needle, disc, chain or star-shaped structures, made up of silicious materials, and form the basic food plants of the sea. They are rich in proteins and vitamins. Different shapes and the presence of oil droplets, setae and flagella are responsible for feeble movement and buoyancy of the phytoplankton.

In seasons, when diatoms bloom and dinoflagellates glow, swarms of tiny shrimp like copepods spread across the seas to devour them.

The blooms of *Fragillaria oceanica* and coccolithophores indicate the sardine and choodai fishery, respectively. On the other hand, blooming of certain species of *Peridinium*, *Gymnodinium*, *Gonyaulax*, *Noctiluca miliaris* and *Trichodesmium erythraeum* are responsible for the discolouration of water. This phenomenon is known as "red tide" and it has deleterious effect on some fishes leading to mass mortality.

Zooplankton includes every major and minor taxonomic groups of animals, either for their entire life cycle (holoplankton) or for short periods (meroplankton) as in the case of the larval stages of polychaetes, crustaceans, bivalves, gastropods, echinoderms and fishes. Among zooplankters, copepods, infact are very important in the marine food chain, (copepod means carfooted, which is used to swim in a jerky way). Generally, these copepods are voraciously eaten by jelly-fish, Chaetognatha and fishes. Members of Chaetognatha are exclusively planktonic.

Recent studies (Madhupratap *et al*, 1981) in Andaman Sea have shown that Copepoda formed the dominant constituent of the zooplankton. Other major components of the zooplankton biomass are Chaetognatha, Tunicata, Crustacea (Ostracoda, Euphausiacea, and Decapoda larvae and adults), and fish eggs and larvae. Minor components of the zooplaknton are represented by coelenterates (Hydromedusae, Scyphomedusae, Siphonophora), molluscs (pteropods and heteropods), and crustaceans (Cladocera, Amphipoda, Mysidacea and Cirripedia).

The brightly coloured siphonophore such as *Physalia physalis* (Portuguese-man-of-war) and chondrophores, *Velella velella* and *Porpita porpita* have sails and air bladder to help in floating and various specialized structures like tentacles, used for feeding, stinging and reproduction.

## PERFORATIONS AND SPICULES SPONGES

Sponges are the most primitive and simplest multicellular animals. They inhabit all seas, living attached to rocks, corals and other substrata. Some may live attached to soft sandy or muddy bottoms.

Sponges are sedentary animals and do not have any movement. For this reason they were considered as plants until the discovery of internal water currents in 1765. Majority of the sponges prefer shallow water. But sponges can not withstand drying and hence are poorly represented in the littoral region. There are about 10,000 species of sponges and excluding about 150 species all are marine.

Sponges are often encrusting growths and are of irregular shape. However, there are certain commercially useful sponges which grow in regular and typical fan-like or vase-like forms. The sponges belonging to the family Clionidae bore into molluscan

shells or corals. They thus play an important part in the decomposition of these calcareous structures.

Sponges have no mouth or digestive cavity. As the name Porifera indicates, the entire body of a sponge is perforated with numerous pores. It has two types of openings which are contractile. The incurrent pores are known as ostia and are microscopic. Water passes out through the excurrent opening known as osculum. The diameter of the osculum is larger than that of ostia and it may sometime be as large as 8 mm. or so. The number and arrangement of ostia are variable. Sponges are filter feeders and minute organisms carried by the water current are used as food by the sponges.

The body of the sponge is supported by an internal skeleton, which may consist of either calcareous or siliceous spicules. Sometimes the internal skeleton may consist of a network of horny elastic material known as spongin.

The classification of sponges is based upon the internal skeleton. Structural variations of spicules are of taxonomic importance. In calcareous sponges the spicules are composed of calcium carbonate. Some of the commercially important sponges do not have calcareous spicules. They have either siliceous spicules or no spicules at all. The common bath sponge is an example of the latter. The glass-rope sponge and the Venus flower-basket are examples of the former category.

*Callyspongia* and *Poterion*—a large goblet-shaped sponge, are leuconoid sponges belonging to class Demospongiae. Sponges were noticed in waters off Havelock and Peal Islands.

Sea cups (*Phyllospongia calciformes*) grow commonly in the littoral waters of leeward shore.

## SAILING COLONIES PELAGIC COELENTERATES

While walking on the rocks or boulders scattered along the shore one often comes across jets of water coming out of soft bodied animals. These lump-like animals, in fully extended and active condition look like chrysanthemums or sunflower. These are sea anemones, which belong to the class Anthozoa meaning "flower animals". The sea anemones have the close relatives in corals, sea fans, sea whips which are the most familiar organisms on these islands. Jelly fishes and *Physalia* which often get stranded on the shore are also grouped along with the above animals in the phylum Coelenterata or Cnidaria. They are all "hollow-gutted" (coelenterata) and so named because of the pouch shaped gut, wherein the digestion of food takes place. Their body is cylindrical and has only one aperture which serves as a mouth and also as anus. The coelenterates are found in various shapes and structures.

Coelenterates have two basic life forms, polyp and medusa. Polyp is derived from the French word "poulpe", which means many footed, and refers to the several active tentacles surrounding the mouth. Polyps are tubular and at one end fixed firmly or loosely to some object or surface. Plant like growths known as hydroids, corals and sea anemones are called polyps. The medusa (the name is derived from its resemblance to the head and snaky-tresses of the "Gorgon Medusa", the mythological maiden whose hair was turned into serpents that terrified any one who looked at them) is saucer shaped or umbrella shaped. Just as a handle of the umbrella there hangs a tube at the end of which is situated the mouth. Tentacles are situated all along the margin of the 'umbrella'. Medusae are solitary and free swimming.

Coelenterates are mainly characterised by the microscopic thread capsules or nematocysts. These are useful in stinging and to hold the prey. That is why now-a-days taxonomists prefer the term Cnidaria (cnidos—thread) to these animals possessing nematocysts. The other group viz. Ctenophora include comb-jellies. The bodies of many of the coelenterates consist of two microscopic layers of cells which are connected together by a secretion of nonliving jelly. This jelly-like layer is well developed in jelly-fish thus making it bulky and more buoyant.

After a stormy day one may find several blue coloured disc-like structures or large blob-like structures, with blue and pink iridescence, stranded on the shore. These are popularly known as 'by the wind sailor' (*Ve/ella*) and the "Portuguese-man-of

war" (*Physalia*). These belong to pelagic coelenterates and found mostly in neritic waters. They belong to orders Chondrophora and Siphonophora. They are scarce in coastal water or on the shore, but they often get drifted and stranded on beaches.

Siphonophores are complex colonies, in which several polyp-like individuals and medusa-like individuals have combined together into a single workable unit. They are abundant in the tropical seas and constitute an important part of the marine plankton. There are about 158 valid species in the world's oceans. Of these, 120 species occur in the Indian ocean and 90 of them around Andaman and Nicobar Islands. Four species occur close to the coast, while others are collected from the continental shelf.

There are only three species which are of common interest or which may be encountered on the beach when they get washed ashore. These are Portuguese-man-of-war (a siphonophore) and by the wind sailor (*Velella*) and "blue-disc" (*Porpita*), the last two belong to order Chondrophora.

Portuguese-man-of-war is distributed in the middle latitudes in the Atlantic, Pacific and Indian Oceans. In the living condition it has a beautiful appearance. It has a float or pneumatophore which is coloured in beautiful shades of blue and long tentacles trailing downwards. The tentacles bear numerous nematocysts which inflict injuries to animals that come nearer. When *Physalia* colonies accumulate in large numbers on a beach one may get painful stings from dead tentacles on touch. An interesting phenomenon was observed by scientists in these colonial coelenterates. The populations of *Physalia* and *Velella* exhibit dimorphism (i.e. have two types of forms) in which the two forms are mirror images of each other. In *Physalia*, when one population with left handed sails is stranded on the shore, the other population with right handed sails is driven from the shore to the sea at an angle of 45° right or left of the down-wind direction. A similar condition is noted in *Velella* also, where the dimorphic forms exhibit sails with two directions (South West and North-West) on the pneumatophore—thereby preventing total stranding of entire population.

*Velella* looks like a single flat medusa. It bears a gas-filled rhomboidal float with a vertical slit like ridge on the top. The blue-coloured body is suspended from beneath this float. It has a tube like structure bearing a large mouth at its tip.

*Porpita* is disc-like and the colony looks like a single flat medusa. All the individuals (zooids), reproductive (gonozooids)

and feeding polyps (gastrozooids) are all massed together on the lower side of the disc. There is also a large cellular mass beneath the disc. It is traversed by several canals and is considered to be excretory in function.

Although not often recognised by a casual observer, hydroid stages of hydrozoans, sometimes mistaken for algae, make up a large part of the sedentary animals.

Many hydroids have a free-swimming medusa stage in their life cycle. These small jelly-fishes are released from each colony by thousands, and can be transported to considerable distance before they actually reproduce. Many are distributed in this way. Growth of hydroids is very rapid, with some species producing several generations a year. In one case on record, *Obelia* completely covered a floating raft within six weeks.

### FLOATING UMBRELLAS

#### JELLY FISHES

One often encounters a shapeless mass of jelly on the beaches. It is a medusoid form. The typical medusa consists of a swimming umbrella, with the mouth at the lower concave or subumbrellar surface. The margin of the umbrella bears several tentacles. The umbrella may be a shallow, saucer-like structure (Discomedusae), or cuboidal (Cubomedusae) or deeply dome-shaped (Rhizostomae). The umbrella exhibits a tetradial symmetry, which is represented in a system of radial canals extending from the central stomach to the marginal ring canal. This four-sided symmetry of stomach pouches and reproductive organs can be seen through the transparent body of the jelly fish.

About 200 species of jelly fishes are reported from world seas. Many of them possess numerous stinging cells (nematocysts) and are capable of inflicting painful injuries. The jelly fishes of tropical waters are more dangerous than their temperate counterparts. Sea wasps (cuboidal jelly fish) of Indian Ocean are said to have caused deaths. These, are, however, not common along the shores of the islands. Sea wasps may range in size from 2.5 cms to 5.5 cms high, rarely being 26 cms high from margin to top of the umbrella.

The most common and widely distributed jelly fish is the moon jelly, *Aurelia aurita*. It occurs in all oceans and ranges in size from 10 to 26 cms in diameter. It is transparent and umbrella shaped. Numerous short tentacles fringe the margin. There are four symmetrically arranged horse-shoe shaped repro-

ductive organs within the body and can be seen through the top of the bluish or white umbrella. This is a relatively harmless jelly-fish. It feeds mainly on copepods which are collected on the sticky mucous surface of the umbrella. These are then carried by ciliary currents to the mouth lobes or pouches.

## FLOWER ANIMALS SEA ANEMONES

Sea anemones (Anthozoa), so named because of their superficial resemblance to flowers of plants, are common in rock pools attached to rocks or other substrata. When active the numerous long, gently waving tentacles look like petals of a beautifully coloured flower. Their body plan is based on a plan of eight and that is why they are known as octocorallians.

Sea anemones are soft and solitary animals. They have a long cylindrical body, which is attached at one end to the substratum. It is called a pedal disc. The free end of the column has a flat rayed disc, the oral disc. At the centre of the rayed disc, which gives the group its order name Actiniaria, lies the slit like mouth. It is surrounded by tapering and hollow tentacles, which may be arranged in a single ring or in multiple rings. The tentacles carry numerous "thread-like stings" or nematocysts, which sting and numb the victim or prey that comes nearer.

The number and arrangement of tentacles and the internal structure of the anemone are important characters in the identification of sea anemones. The mouth opens into a pharynx, which in turn leads to gastrovascular cavity. The pharynx is lined with several beating flagella and has flagellate grooves along which water currents pass. The hanging gullet or gastrovascular cavity is divided by mesenteries or membranous partitions, which extend from the wall of the column. These membranous partitions are infoldings of the lining of the body wall and help the sea anemone in expanding its digestive area so as to enable it to swallow a prey bigger than its normal size.

Anemones commonly live attached to rocks, shells, and wharf pilings in coastal waters throughout the world. Although they are apparently sedentary in their habits, anemones are motile, moving at a slow pace by gliding on their pedal disc. Some are known to swim. More than a thousand species of anemones are known from world oceans. They are brilliantly coloured—white, red, green and various combinations of them. Anemones feed on a variety of small animals, including fishes, which are captured by the tentacles. Sea anemones range in size from a couple of



Hemispherical colony of *Porites* sp.

Sea anemone with the extended tentacles which catch food and lead it to the mouth in the centre.





Corals extend over a vast area of the islands. Here these are seen partly exposed.

Corals growing on the reef edge, can be seen in calm water at the time of spring tides.





*Acropora* is the dominating genus of the islands and represented by several species. *Acropora armata* is shown here. (Above) Unique ecological zone of surge channel which harbour polychaetes and cones. (Below) A view of the coral reef exposed during low tide at Havelock Island.





.B.K.Tikader

Thickets of fragile stag-horn coral extend over vast areas of the islands providing ideal habitats for several reef dwelling animals.



B.K.Tikader



Collecting Zoological specimens in the reef area, off Havelock Island.

A colony of stag-horn coral, *Acropora* sp.





*Galaxea* sp. a star coral of variable form, the colony is generally dome-shaped and its entire surface, in living condition, is covered by soft flesh.

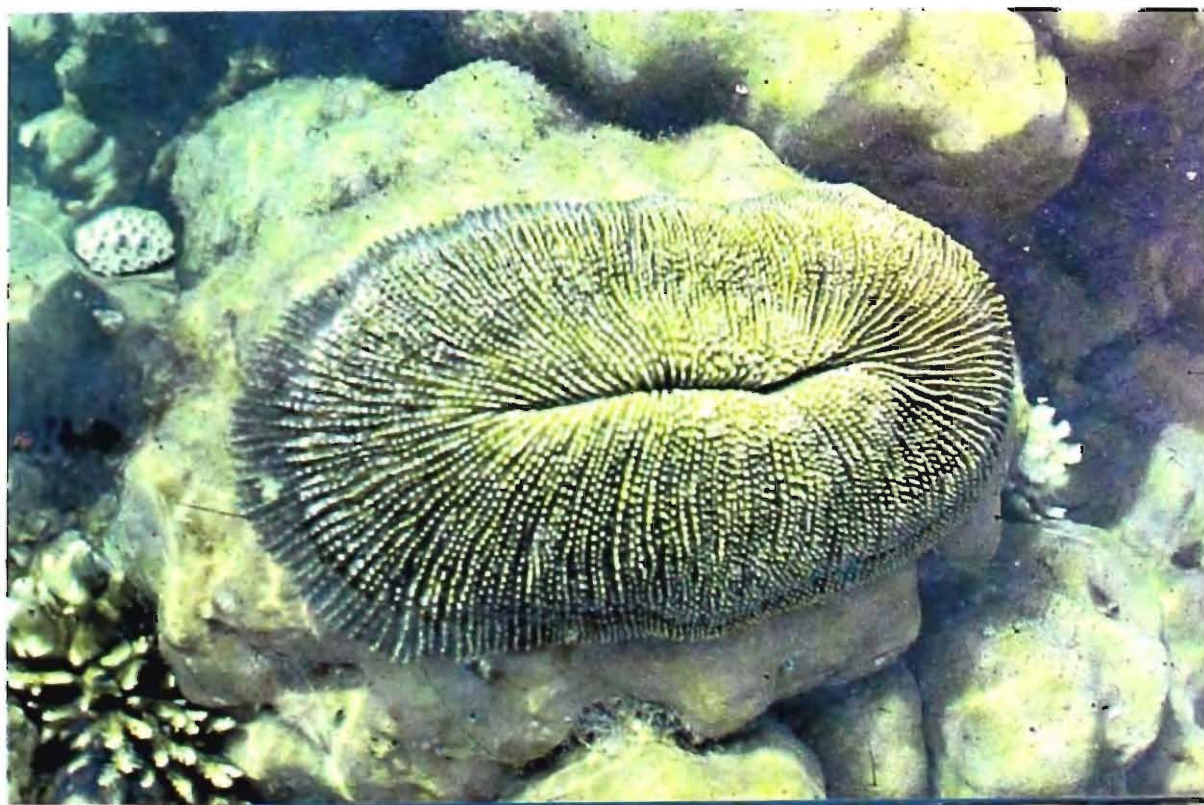
A zoanthid colony with tentacles retracted





Pink coloured *Pocillophora*, irregularly branched and the terminal branches have thick and blunt apex; and soft coral *Sarcophytum* (on the left) are numerous in the islands.

*Fungia echinata*, Solitary Coral or Mushroom Coral, the best known and most widely distributed coral showing the vertical septa, with dentate ridges radiating from the deep groove or fossa.





B.K.Tirader

Brain coral, *Lobophyllia corymbosa*; the sinuous calices are so convoluted as to give the coral an appearance of human brain, with extended tentacles polyps look green, but when contracted it looks dark brown.

*Leptoria phrygia*, a stony coral related to brain corals.



B.K.Tirader

centimetres to almost a metre in diameter. The largest anemone known in the world is *Stoichactis*, about a metre in diameter, occurs in the Great Barrier Reef.

Several species of sea anemones occur on the coasts of the Andaman and Nicobar islands. *Metridium* sp. occurs in abundance in the tropical region of the world, especially along the coasts of these islands. It is a handsome animal about 1 cm long and 8 cm in diameter and the colonies are usually brown, but reddish and yellow ones are sometimes found. It lives near the low-tide mark. There are numerous tentacles around the lobed and frilled oval disc, almost resembling many petalled chrysanthemum.

One often finds a greyish-brown, red-blotched anemone with a cream-coloured disc and numerous waving tentacles swiftly walking along in a pool. It is a 'cooperative movement', a classical example of commensalism between a hermit crab and a sea anemone. The crab searches for a young sea anemone and puts it on the shell it occupies. The anemone attaches to the shell and grows on it. In the process the pedal disc covers the entire shell. Both the parties receive the benefit of this association. When something attacks the hermit crab, it withdraws into the shell and the anemone with its stinging tentacles fights off the intruder. The crab on its part carries the anemone on its back and shares the food with its gaily attired jockey guard. When the crab transfers its house to a new shell, it carefully removes its associate from the 'old shell' and carries it to the new one. The 'body guard' also readily submits itself to its master without offering any resistance. *Adamsia* has its basal disc expanded for attachment to the molluscan shell, inhabited by the hermit crab. *Hydractinia* also grows on the shells of gastropods, occupied by hermit crabs.

Anemones have the capacity to regenerate. When *Metridium* is broken across the column, the lower piece can regenerate a new disc with tentacles, but the upper portion cannot do the same.

## POLYPS WITH SKELETONS CORALS

The term 'coral' is applied to any polyp that produces some sort of a skeleton, which may be hard and stony or horny or a mosaic of particles embedded inside the body. Broadly corals are of two types viz. soft corals (alcyonarians or octocorallians) and true or stony corals (scleractinian or madreporarian corals). In alcyonarians the skeleton is inside the body whereas in true corals it is completely outside and it is known as a theca or cup. The octo-

corallians have a body plan of eight and in true corals it is the plan of six.

Some of the soft corals that occur on these islands are horny gorgonians, sea-fans, the red organ-pipe coral, the blue coral *Heliopora* and several fleshy soft corals growing on the reefs. The interesting sea fans also belong to this group of alcyonarians but they are not common in shallow waters. The alcyonarian polyps bear a single circle of eight pinnate or feathery tentacles. The skeletons of alcyonarians are of various hues and colours like blue, red and yellow. Organ-pipe coral is often found washed ashore. In this the polyps are housed in vertical limestone tubes. The vertical tubes are connected by horizontal platforms. During low tide, on a clear day gorgonians can be seen through water on the seaward edge of the reef. These are never exposed. The red or precious coral which is fancied as a jewel is *Corallium*, but does not occur in Indian seas.

The structure of a coral polyp is similar to that of a sea anemone. In coral polyp the mouth is surrounded by six (or multiples of six) simple tentacles. In true corals each polyp secretes around itself a calcareous cup filled with radiating ridges which alternate with the internal partitions. The internal partitions are the digestive mesenteries situated in the gastrovascular cavity. Corals may be solitary individuals or colonies of several individuals. All corals start their life as a single polyp. In colonial forms the polyps may be widely separated, each occupying a separate cup or closely packed having a common wall. The coral polyps reproduce sexually and have a free swimming larval stage in their life history. The larva, after developing a mouth surrounded by tentacles and a gut, settles down at the bottom. The base starts enlarging and produces a skeleton. Additional polyps are produced by asexual reproduction i.e. budding and it ultimately leads to a vast colonial structure. When one generation of coral polyps dies new colonies develop within their cups. A dead colony lays the foundation for a new colony. Thus a coral colony is a work of several polyps. Depending upon the pattern of growth of each polyp, corals assume various shapes. Several popular names are used, which refer to their shapes, e.g. brain coral, stag-horn coral, mushroom coral etc. In solitary forms polyps occupy isolated little cups or disk-like skeletons.

During the day time polyps remain closed within their cups. At night when plankton is abundant in surface waters, the polyps become active. They extend their tentacles in active search of food. Small animals get entangled on the sticky surface of the tentacles and are carried to the mouth.

There are about twenty-five hundred species of true or stony corals distributed in world seas. About 135 species of corals of 59 genera were reported from these islands (Pillai, 1985) but only 15% are boulder forming, hard and wave resistant. Some of the common forms like *Acropora* and *Porites* are encrusting in nature. Corals live firmly attached to the bottom. Some solitary forms are attached when young but as adult they get free and settle down loosely on the substratum.

True corals can grow at any depth. Their growth is also variable. It varies with species, location, depth and various other factors. Reef building corals grow in shallow waters. They grow between latitudes 30°N and 30°S. They favour temperature ranging 21°C (about 70°F) or higher but never dropping lower than by a few degrees. The reefs generally do not extend below 150 feet.

Excepting a few, corals generally do not have any pigments in their skeletons. But in the living condition, they are variously coloured. This colour is imparted by the plant-like photosynthetic cells, brownish-yellow algae (zooxanthellae) that live within the tissue of the polyps. This animal-plant association is of mutual benefit. The plant gets the necessary gaseous supply from the coral and in the process it rapidly removes carbon dioxide and nitrogenous and phosphate wastes released by the coral. The animal-plant association is so strong that the reef building corals do not grow under conditions where the plants cannot survive.

The beautiful colours of the living coral reefs are often due to the flamboyant colourful animals that make reefs their homes. Some live attached while some move about gaily in the lanes and bylanes of these underwater coral cities. Some of the animals live attached to corals, while a few live inside the coral. Gall crabs live within branches of corals. The young female crab settles in the fork of a growing coral branch and becomes imprisoned as the coral growth continues. It is a sort of self imposed imprisonment. The 'prisoner' gets its food through the water currents that pass through numerous perforations of the coral chamber. The young ones when 'released' come out through these perforations. It is believed that the female crab mates with a male before it actually goes into its 'cellular life'

Coral reefs are not the handwork of coral polyps alone. There are several other animals and plants that add to the growth of a coral reef. Dead molluscan shells and forameniferans add to their structure. There are also hard, calcareous sea weeds. They

can grow in surf zone where the coral polyps may not be able to survive.

The reefs of the Andaman and Nicobar islands are fringing reefs. They lie close to shore in shallow water and continue to grow actively on the wave beaten seaward side, which slopes steeply downward into deep water. The reefs are partly exposed during low tide and one can easily wade through the seaward edge of the reef which is also known as the reef front. Their front is constantly under the attack of waves. The reef flats or platforms consist of dead coral, sand, some scattered living corals and various fauna and flora.

The reefs on the islands can be grouped under 'windward reefs' growing in the direction of prevailing winds, which are mostly monsoonal winds and the edges or reef fronts are 'generally slopy, but may vary from place to place' and channel reefs, growing in calm water of the channel, where there is less wind and consequently less wave action. In this the reef edges are usually steep. They are also known as leeward reefs. e.g. channels of South Andaman, and Camorta-Nancowry Complex. There is another kind known as Bay reefs, which are found in the Nancowry Bay. The wind and wave action are similar to that occurring in channel reef. *Porites* and *Favia* are the chief reef builders. Alcyonarian growth is also present. *Acropora* occurs in deep bays. Often corals form towers and knolls 4-5 m high and almost reaching up to the water surface. Coral knolls built mainly by *Porites* and *Favia* and *Acropora* on margin occur in the channels of the Ritchie Archipelago. Patch reefs grow in the back reef shoals of Nicobar Islands such as Camorta. Mostly the fragile species of corals grow on these. There is an abundant growth of alcyonarians.

Among solitary corals occurring in these islands, the mushroom coral, *Fungia* is the most common. It has a number of vertical partitions called the septa (sclerosepta) extending radially inwards from the theca towards the centre. The septa are connected by parallel bars called synapticula.



*Porites* sp., an important reef-building coral, grows to massive rounded form and flourishes in calm water with little wave action.

*Leptoria* sp. with polyps in an extended condition.





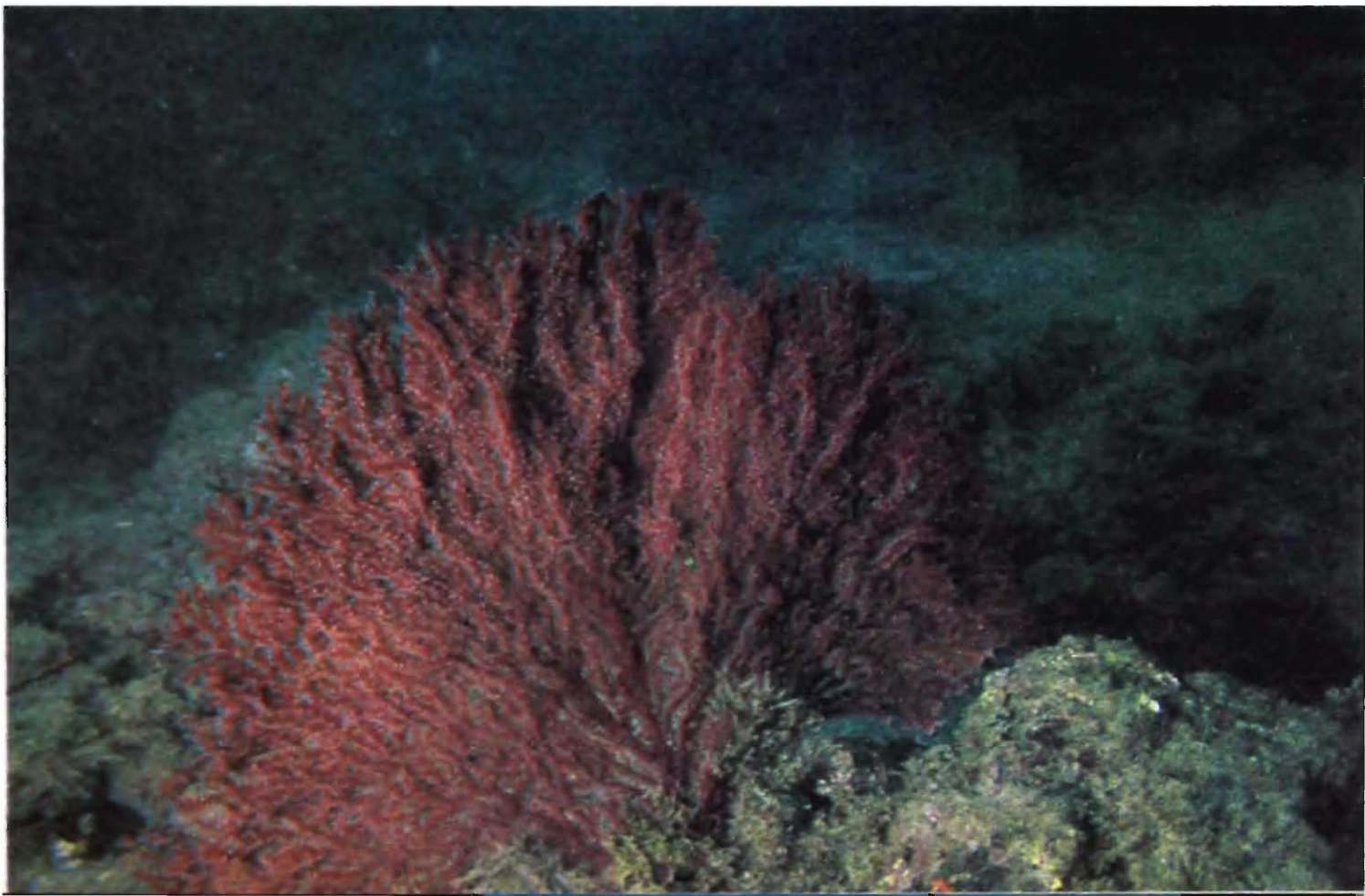
*Favites abdites* grows into large hemispherical boulders

The alcyonarian soft corals, *Sarcophytum* and *Lobophytum* are numerous in the islands.





Sea fans, gorgonian corals, plant-like in form and of different colours, not common in shore waters.





G.Ponnuswamy

Sea fans, gorgonian corals, plant-like in form and of different colours, not common in shore waters.



V. Jayaprada



Sea whips are horny corals which grow like plants at the base of a reef.

Plate coral *Montipora* sp. and stretched polyps of coral.

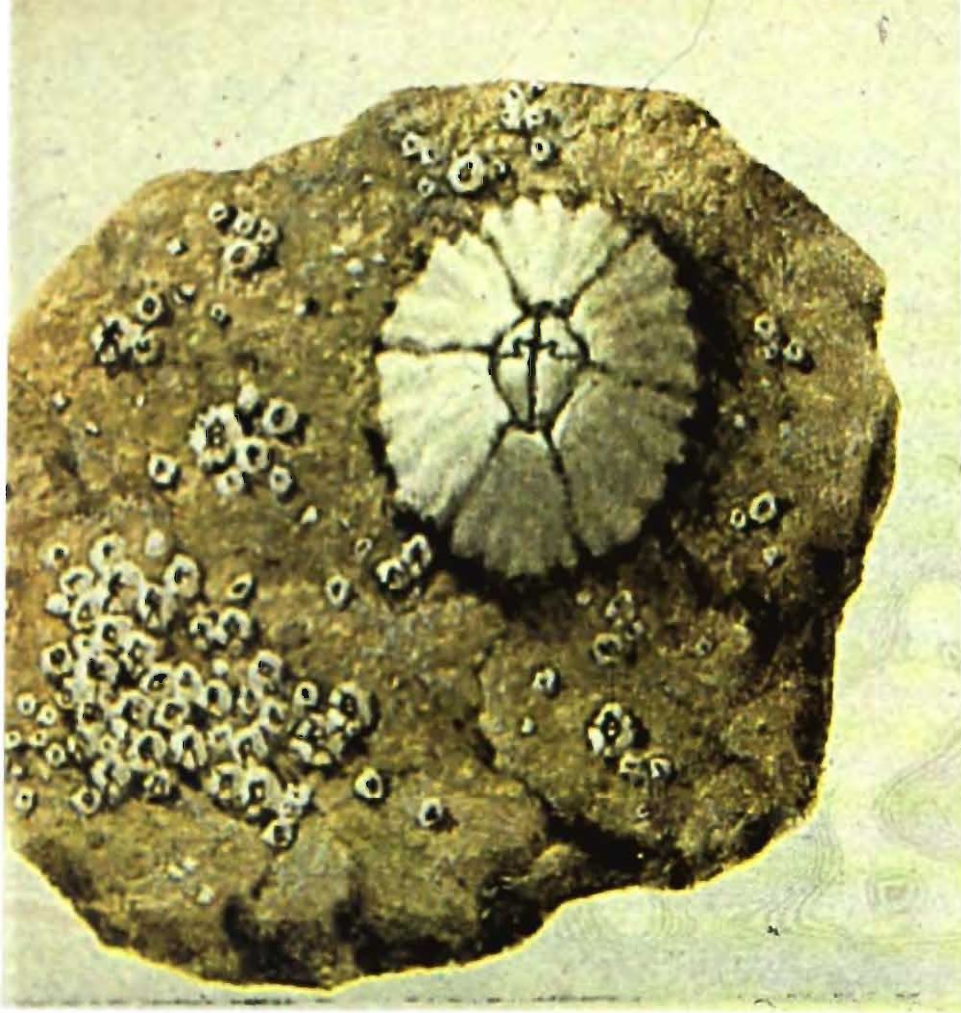




A spectacular show of the splendour of coral garden; a red sea-fan on the left, a soft coral; long, elongated sea-whips and orange coloured sponge attached to boulders.

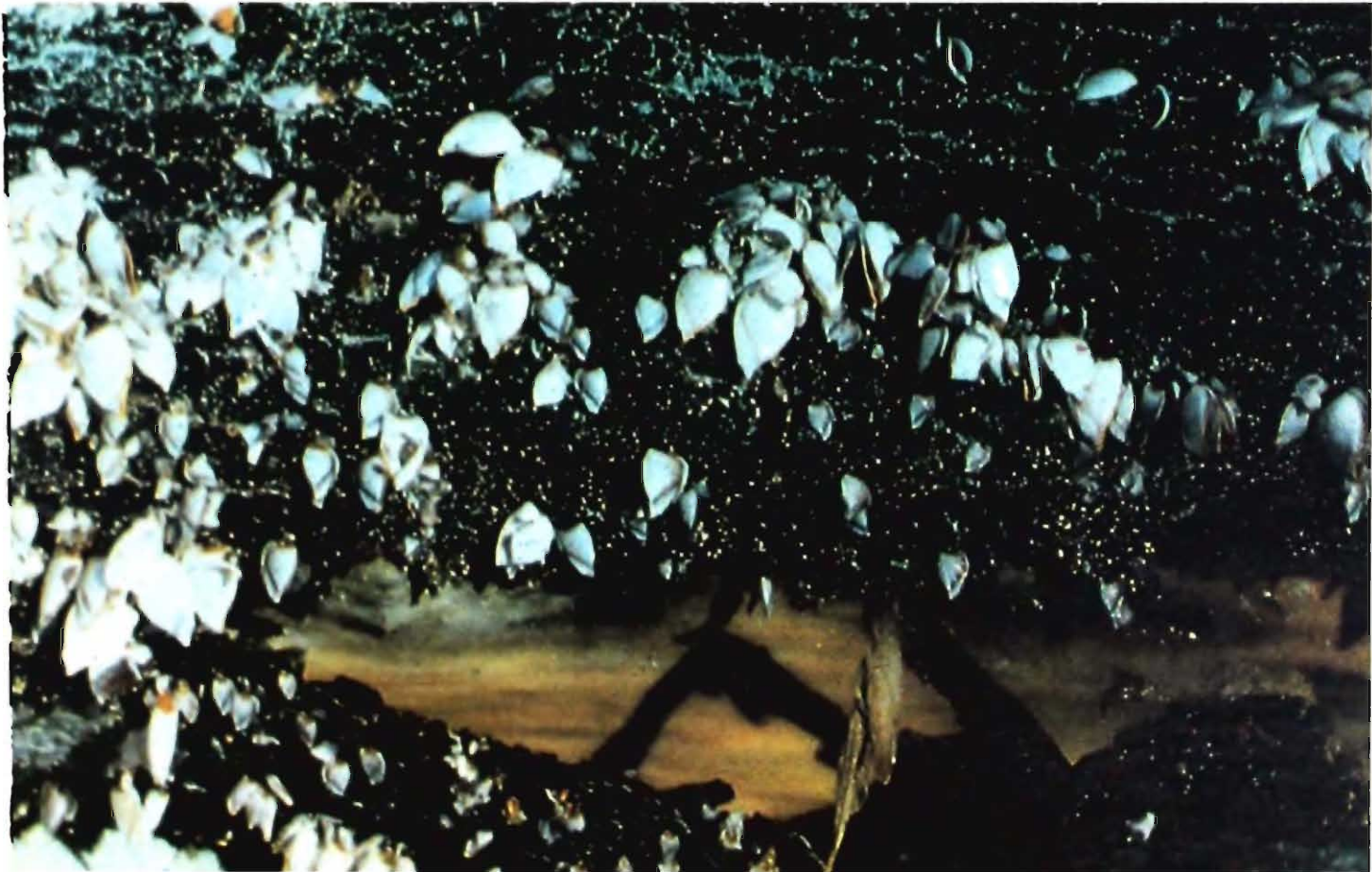
Rag-worm, *Nereis* sp. a common species.





Acorn barnacle, *Chthamalus malayanas*

Goose barnacle, or ships barnacle, *Lepas anatifera* is unlike a crab, but has a larva similar to that of a crab which settles on a floating object and also fouls ships bottoms





B.K. Tikader

Hermit crab, *Dardamus* sp. in tun shell

Hermit crab, *Dardamus* sp. feeding on a ray fish



B.K. Tikader

## MARINE WORMS

### FLAT WORMS, RIBBON WORMS AND SEGMENTED WORMS

At low tide when a stone is overturned several small worm-like creatures start crawling around. These marine worms are of several kinds. They are soft bodied and bilaterally symmetrical. Four important groups of marine worms are common in the intertidal region. They are flat worms (Platyhelminthes), round worms (Nematodes), ribbon worms or bootlace worms (Nemertean) and segmented worms (Polychaetes—Annelids). Although our knowledge on the worms of these islands is not up-to-date, it can be said that polychaetes are by far the most dominant group among the benthic macrofauna (Parulekar and Ansari, 1981)

Marine Flat worms belong to the group Turbellaria, which are precursors of liverflukes and tapeworms. The flat worms belonging to free-living Polyclada are very colourful and live in association with ascidian mats underneath a dead coral or stone. When disturbed, they make gliding movements. Some of the larger polyclads (about 5 cms) may look like sea slugs, which belong to an entirely different class of animals—Mollusca. In polyclads the body is dorsoventrally flattened, leaf like, more or less translucent, soft and contractile. The head end may be differentiated by a necklike constriction. It may bear a pair of sensory tentacles and two or more eyes or ocelli. The ocelli vary in number and arrangement.

The difficulty in collection and preservation seems to have discouraged study of these worms. As such our knowledge of the flat worms of the Andaman and Nicobar Islands is practically nil. Two kinds of polyclads occur on these islands. The 'magic-carpet' polyclad, *Pseudoceros coralliophilus*, which is common in the Indo-Pacific region, occurs on the coral reefs of the islands. It can be recognised by its orange and black bands on its body. *Thysanozoon* is another type of polyclad, but smaller than the former. It has a covering of papillae, each containing an extension of the intestine. Polyclads are carnivorous and feed on protozoans, coelenterates, molluscs, annelids and ascidians. A few tubellarians occur in the interstitial habitats as constituents of meiofauna.

Marine round worms have their close relatives in the hook-worms found in the intestine of man, especially children. Although round worms are commonly familiar to us as parasites, there are several free-living forms. Marine round worms are the largest of free living forms, some of the species attain a length of 5 cm. These worms are generally found buried in sand or mud. They

occur in abundance in soft muddy sands containing rich organic matter. There is one family of round worms occurring in marine habitats *viz.* Enoplidae. One has to make special efforts to collect the round worms.

Ribbon worms are dominant constituents of the meiofauna assemblage of littoral region. Their body is elongate, ribbon-like and highly contractile. The body is elastic and often it may stretch to several metres even. The ribbon worms are brightly coloured and often colour pattern is important in the identification of species. Ribbon worms are also hard to find as the majority live buried in sand or mud, and special techniques are involved in the collection and processing of the material for study.

Marine segmented worms include polychaetes, a name derived from the presence of several chaetae-like structures on either side of the body. Body types are diverse but all can be recognised by the presence of these bristles. They are chiefly marine or estuarine. Many of them are inconspicuous because they live buried in the substratum and are secretive in their habits.

Typically the polychaete has a segmented body. Each segment bears a pair of bunches of setae or fleshy paddle-like appendages called parapodia. The head region is well developed, and bears a pair of eyes, antennae and palps. The mouth is situated on the ventral side and the anus is in the posterior most segment. The polychaetes have adapted to different ecological niches and consequently there are modifications in the typical structure described above. There are exclusively pelagic forms. There are crawling polychaetes living underneath stone, in algae, in coral crevices, among hydroids, etc. These polychaetes have the typical body shape but majority of the segmented worms are more or less sedentary. They either burrow or bore into some structures or build tubes.

There are active 'wanderers' (Errantia), which include scale worms (*Harmathoe*), paddle-worms (*Phyllodoce*), ragworms (*Nereis*) and cat-worms (*Nephtys*). Sea-mouse (*Aphrodite*) is a short scale-worm, with the scales covered by a felt of long hairs that prevent sand grains from entering into its breathing system.

Paddle worms, as the name indicates, have a pair of flattened lobes projecting out on either side of each segment. These help in swimming. One has to be very careful in handling paddle worms as they may bite with their strong jaws, and can cause severe injury to the finger. In rag-worms the bristles are used as levers. They also have strong jaws like the paddle worms and

capture their prey moving among stones and sea weeds. Cat-worms, which resemble ragworms, feed on dead and decaying organic matter

The most common intertidal bristle worm is *Eurythoe complanata*, found under stones, or coral rubble or in crevices. Its setae are very slender and are arranged in bunches. They are very fragile and get easily broken and penetrate into the skin when handled. *Eunice afra* is another common intertidal polychaete living inside burrows of dead corals.

Some polychaetes are free living throughout their lives but some may live in parchment like membrane or in mud tubes as in the case of eunicids and polynoids respectively. Some of the sedentary forms which build tubes may leave them and move freely. *Pectinaria* moves about carrying its tube.

The most interesting polychaetes are stay-at-home feeders or tube dwellers. They depend on the sea for supply of food at their door step. These tube building forms employ various techniques in constructing the tubes and catching their food.

Several polychaetes have adapted themselves to burrowing. The burrows are lined with mucus and the worms move within the mucus lining. Some excavate simple burrows in the substratum, and bear no sensory appendages on the head, but develop special feeding structures. They do not have any tentacles to collect food but ingest sand or mud to absorb nourishment from it. The occurrence of circular holes in the beach may indicate the presence of lugworm (*Arenicola*). The lugworm has no teeth in its pharynx, which is used as a burrowing organ. The worm ingests the bottom sediment and absorbs the organic matter in it as food. The undigested material is thrown off as castings at the entrance of the burrow on the surface of the mud flat. Thus the worm leaves neatly coiled castings at the entrance to its burrow.

Tide pools are the home for some of the beautiful polychaetes like feather-duster worms (*Sabellids*). They build large tubes. The worm thrusts out its large feathery gill plumes at the entrance of the tube to collect food particles. All gill plumes are lined with cilia which set up water currents carrying the food particles towards the mouth. A slight disturbance makes the worm to withdraw into the tube.

There are smaller feather duster worms, *Spirorbis*, which build spiral, snail-like shell, attached to sea weeds or other structures. The dorsal most tentacle (or radiole) is modified into a long

stalked knob called an operculum. The gill plumes or radioles are small in size.

Peacock worms live in silt and mucus tubes. At high tide the tentacles are spread out like a peacock's tail to capture food. Sand mason, *Pectinaria* builds deep tunnels out of mucus, sand and stones. The head carries rows of setae, which are used in digging. Thread-like tentacles at high tide capture scraps of food.

Parchment worm (*Chaetopterus*) is the most interesting of all tube-building worms. It lives in membranous tubes embedded in the mud and encrusted with sand, small pebbles and debris. The tube is U-shaped and open at both ends. The bristles are fused to form fan-like structures, which set up a current of water flowing over the animal, and carry small organisms into the mouth.

Majority of the polychaetes occur in shallow littoral waters but one has to make special efforts to collect and preserve these bristle worms. About 160 species of bristle worms are recorded from the Andaman and Nicobar Islands. Several species of peanut worms (Sipunculids) boring into corals occur in the intertidal region of the island.

#### ARMoured ANIMALS WITH JOINTED FEET CRUSTACEANS

Some of the most familiar marine animals like crabs, prawns, shrimps, lobsters etc. are included in the class Crustacea. It is a large assemblage of very diverse groups, which are primarily aquatic, except woodlice. Several of the crustaceans occupy an important place in the food chain of oceans. The class includes about 30,500 species, which are mostly marine.

The name Crustacea is derived from Latin which refers to their outer carapace or shell. The dorsal shield or carapace is present in many groups, especially the marine macroscopic forms. Externally the body of a crustacean may be divided into three distinct regions—head, thorax and abdomen. In some, a few of the thoracic segments may be fused with the head to form a cephalothorax. The head bears five pairs of appendages, a pair of antennules, a pair of antennae, a pair of mandibles and two pairs of maxillae. The appendages on the thorax and abdomen are variously modified to carry on diverse functions like locomotion, feeding, respiration and copulation. They are distinguished from other Arthropods (jointed feet) by their gills.

Crustaceans exhibit a great diversity of form and habits. They occur in plankton, nekton and benthos extending from shore to abyssal depths. They also include interstitial inhabitants, burrowers and semisessile forms. They exhibit diverse feeding habits like filter-feeding, sand cleaning, plant feeding, carrion or detritus feeding, predatory as well as parasitic.

Based on size, Crustacea can be divided into two groups viz. Microcrustacea and Macrocrustacea. The former includes individuals measuring upto about 5 mm. Majority of the planktonic forms like cladocerans, copepods and ostracods fall within this category. Some of the microcrustaceans like cephalocarids, mystacocarids, and ostracods and a few copepods are benthic, while branchiurans and some copepods are parasitic. These crustaceans cannot be seen with a naked eye and one has to examine them under a microscope.

Macrocrustaceans can be easily spotted out and they are familiar objects on any sea shore. All such large crustaceans are grouped into two subclasses viz. Cirripedia (Cirri= tuft of curly hair and pedes= feet) and Malacostraca. A great majority of familiar forms are included in these two groups. Largest living crustaceans such as the giant coconut crab, giant spider crab and lobster are members of Malacostraca.

### **Barnacles : (Cirripedia)**

Barnacles are the most conspicuous on the sea shore. The barnacles are of two types, the acorn or sessile barnacles and the goose or stalked barnacles. They differ from each other in their appearance, which is mainly due to their adaptations to different environmental conditions. The sessile barnacle differs from the stalked one in the absence of a stalk and the shell is directly attached to the rock. But they have a free-swimming bivalved larval stage in their life history. The thoracic appendages set up water currents by their movements. Planktonic organisms are conveyed by the currents into the mouth.

The barnacle is protected from the battering waves and from being dried up by a thick shell, which retains some moisture inside it. The shell is made of six hard plates as a surrounding wall and the opening at the top is closed by a lid like cover consisting of another four plates.

The barnacles are generally found in intertidal or subtidal region with a distinct zonation. They live attached to rocks, pilings or boats, to the shells of molluscs and the carapace of

turtles. Barnacles are of economic importance when attached in large numbers fouling ship bottoms and clogging sea water thermal cooling systems.

*Balanus* is the common rock inhabiting barnacle represented by several species. Some species are found attached to gorgonian corals.

*Lepas anatifera* is the most common ship or goose barnacle on the shores of the islands. It lives attached by a soft stalk or peduncle to a variety of floating objects like a log of wood, cork etc. or even to pelagic molluscs. The stalk bears at its free end the main part of the body enclosed in a shell consisting of five calcareous plates. The goose barnacle is common throughout Indo-Pacific and the largest as long as 80 cms including the stalk is on record.

## **Malacostraca**

### **Crabs :**

The most conspicuous, large and familiar forms, such as crabs, lobsters prawns and shrimps belong to order Decapoda (deca ten, poda feet) under class Malacostraca. They have unusually heavily armoured exoskeleton. They appear in "long-tailed" (Macrura) or "short-tailed" (Brachyura) or "uneven-tailed" (Anomura) forms.

### **True crabs (Brachyura)**

The true crabs belong to Brachyura. In these crustaceans the abdomen is greatly reduced and held permanently flexed under the cephalothorax between the legs. It is conspicuous in females as it stores eggs but in males it is narrow and inconspicuous. Uropods are absent. There is a great diversity in their form and structure. True crabs run sidewise.

Crabs are common on any sea shore and they occupy different ecological niches. There are true crabs, commensal crabs, fiddler crabs, sand crabs, mole crabs, and hermit crabs. More than 350 species of crabs are known from these islands.

Many of the crabs live inside burrows. At low tide most crabs come out to feed and the beach may be seen literally strewn with them. Most of the crabs are adapted for crawling on the land but some species are adapted for swimming. Representatives of some genera go several kilometres inland and only periodically

visit the coast for reproduction e.g. coconut crab and a few hermit crabs.

## **Fiddler Crabs**

In the male, one of the chelipeds is greatly enlarged and it may account for half the total weight of the animal and is known as the "fiddle", hence the name fiddler crab. This cheliped is used in courtship and in defense. Female crabs do not have any "fiddle," and both the chelae are of the same size. In male the chela on the side opposite to the fiddle is used in feeding. When the fiddle is lost the opposite one develops into a fiddle and claw to be used in feeding develops and replaces the old one. Thus the fiddles may change from one side to the other

Fiddler crabs live near the high water mark. They make vertical burrows, 12 to 30 cm deep. The crabs emerge during low tide, but at slightest disturbance they quickly retreat into their burrows. *Uca vocans* (*U. marionis*) has a very strange behaviour. Just before high tide the crab closes its burrow from inside with fresh mud. These crabs are known for their rhythmicity, which synchronises with the tides. Large chelae are used for defense by many species. Large decapods such as lobsters, coconut crabs etc. have such strong chelae that they can cut a man's finger to the bones.

Ocypods (sharp-footed) commonly known as 'ghost-crabs' because of their protruding eyes are among the fastest running crabs. They live in U-shaped or Y-shaped burrows above the high water mark. Inside the burrow the eyestalks are pushed into protective grooves situated on the front edge of the carapace. The ghost crabs are generally active during night.

The fiddler crabs (*Uca*) and sand bubbler crabs (*Dotilla*) are common in the intertidal zone. They are small crabs, their size ranging from 0.8 cm to 2.5 cm wide. These crabs exhibit striking sexual dimorphism in that the males have one claw very much enlarged.

Dotillas are small crabs which are commonly seen on sandy coasts of Great Nicobar, Andamans etc. It lacks the enlarged chela of fiddler crab and does not exhibit any sort of waving movements in cheliped. It makes small holes and lives inside it. During high tide it confines itself to the burrow, but when the tide recedes it scrapes up the sand overlying it in the burrow. The sand is ingested and after extracting the organic content, the waste is thrown out in the form of balls. Several such balls accumulate in

concentric layers around the hole. This "castle building" habit of this tiny crab is really very interesting to watch.

Occupying the same habitat like the fiddler crabs are soldier crabs (Family Mycteridae). These are gregarious in nature and armies of them can be seen moving on sandy tidal flats. At the slightest disturbance they immediately burrow into the sand like a cork screw. Unlike other crabs, which have side wise movement, these run in forward direction.

There are commensal crabs, also known as pinnotherid crabs, which are smaller and inhabit polychaete tubes and burrows. Some are found in the mantle cavity of bivalves, like *Tridacna*. Pinnotherids have developed setae on their chelae, which help the crab in scraping the gill of the bivalves, and collect plankton passing through the current. Several species of crabs live as commensals in reef-building corals. Branching corals belonging to the families Pocilloporidae and Acroporidae, and gorgonids harbour several species of crabs. The crab gets settled on the branched coral and the latter grows around it ultimately imprisoning the crab inside. The presence of a crab inside the chamber of coral gives rise to a gall-like outgrowth. Hence they are also known as gall crabs. They carry on their life activities through the water that enters the chamber through several minute pores on the body of the coral. Crabs belonging to the families Porcellanidae and Xanthidae are generally found as facultative symbionts of living corals.

Swimming crabs (Portunidae) include some of the common edible crabs. As an adaptation to swimming the fifth leg is modified into an oval, leaf-like paddle. These are generally pelagic and littoral and are often caught in fishing nets.

### **Anomuran crabs :**

Sand crabs or mole crabs are burrowing in habit and have cylindrical body. A sand crab swallows sand as it burrows and collects the organic matter from it. The animals shift their position on the beach with the changing tides. *Emerita* and *Albunea* are common genera. *Emerita* is a plankton feeder. It forms a filter with the second antennae which collects plankton from the retreating waves.

On shores of these islands one commonly comes across a number of 'shells' moving at a fast speed. These are the mobile houses of the hermit crabs. In these crabs the abdomen is modified to fit into the spiral chamber of the gastropod shell. The abdomen



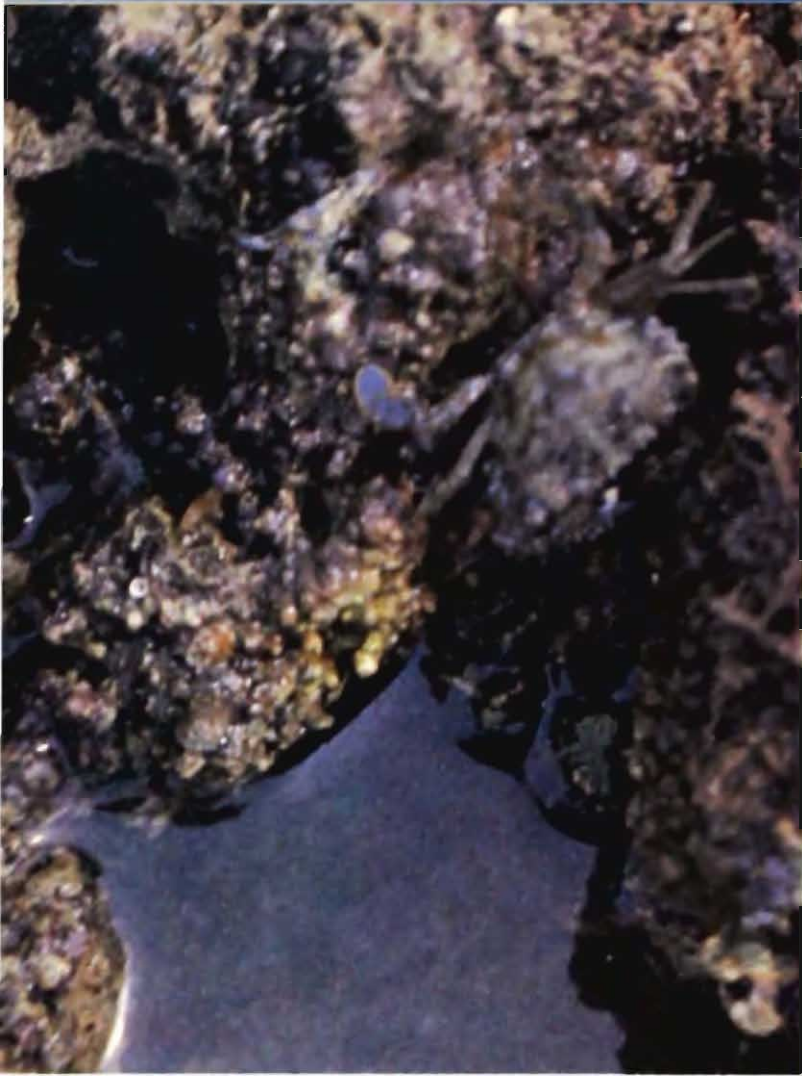
Giant Hermit Crab occupying the shell of *Fusinus*

.B.K.Tikader

Coconut crab, *Birgus latro*



G.Ponnuswamy



G. Ponnuswamy

*Thalamita* sp. a swimming crab, last digit of the last pair of legs is flattened like paddle for swimming.

Xanthid crab, *Eriphia laevimana*



G. Ponnuswamy



Ghost crab, *Ocypoda ceratophthalma* near its burrow. The crab makes a burrow in the sand, when disturbed they raise themselves high on their legs and race rapidly towards the burrow

Ocypodid crab, *Ocypoda* sp. at the entrance of its burrow





Fiddler crab, *Uca annulipes*, well known for its biological rhythm.

A grapsid crab, *Grapsus grapsus* of amphibious habit.



B.K. Tikader



Larva of a shrimp

Spiny lobster, *Panulirus versicolor*, inhabitant of a rocky sea bed



Scorpion-shrimp, a species collected from under a submerged log near the mouth of Cheema Nullah, 30 km. post on North-South Road, Great Nicobar Island. It measures about 30 cms. in length, apparently resembles *Thalassina anomala*.



is not greatly reduced as in *Brachyura*, but is twisted in right hand direction to fit into the righthanded spire of the shell.

The hermit crabs use empty shells of gastropods as their houses, but never attack the mollusc to get an entry into the shell. When the crab grows larger, it leaves its old shell and moves into a new shell. It is a common sight that a hermit crab and sea anemone live in association. The sea anemone gets attached to the shell occupied by the hermit crab. The latter helps the sea anemone by carrying it from place to place to get its food and in return gets protection.

There are land hermit crabs which visit the sea only during the breeding time. These belong to the family *Coenobitidae*. All carry about a small supply of water in their shells as they respire through gills. At least once a day they make a trip to the water edge. These feed on carrion or on sea weeds such as *Sargassum* or on other plant remains.

The very active hermit crabs, constantly moving about the intertidal region, belong to another family *Diogenidae*. These are characterised by having chelipeds of equal length or larger left chelae, and asymmetrical abdomen. Some of the pagurids have one of the chelae modified into an opercular chela which closes the aperture of the shell when the animal retracts inside. Some species are selective in their choice of the shell. The weight and the room available within the shell are the two important factors that decide the choice of a shell by the hermit crabs.

*Clibanarius* is the common hermit crab of backwaters. It differs from other pagurids in having equal sized chelae.

A few crabs are known to climb trees. The mangrove crab (*Aratus* sp.) is an excellent tree climber. It feeds around mangrove swamps during low tide. The most interesting hermit crab of the island is the coconut crab or robber crab (*Birgus latro*). It is found on South Sentinel and Great Nicobar islands. (Davis & Altevogt, 1976, Daniel & Prem Kumar, 1968). It is practically an air breather but it spends its juvenile period in the sea and it gradually shifts to terrestrial life. As it advances in age and grows in size, it develops a carapace of its own on the abdomen. Unlike the hermit crabs, the coconut crab does not require the protection of any external shell and the abdomen is also not asymmetrical. The robber crab has developed strong pincers or chelipeds, with which it can tear the fibrous covering of the coconut and break open the shell. But there is no clear evidence showing its act of breaking the coconut shell. *Birgus* may grow to 30 cms in length

and a sufficiently grown up specimen may weigh 4 to 8 kgs. It is nocturnal on the inhabited islands but diurnal on uninhabited islands.

## **Lobsters, Prawns and Shrimps**

Lobsters, prawns and shrimps are "long tailed" (*Macrura*) decapods. These are all free-swimming. Among these, lobsters are conspicuous by their heavy bodies. These are rarely seen by a casual collector, as these are usually found lurking under stones and in holes and crevices of rocky and coralline bottoms.

Lobsters are considered as a delicacy. *Panulirus* is the most common spiny-lobster, represented by two species. In lobster the abdomen is depressed. The cephalothorax is sub-cylindrical and eyes are not enclosed in separate orbits formed by the edges of the carapace. It lacks chelipeds, but has very large, strong and spiny antennae which are useful in defence. It is a solitary form and generally grows to large size.

Majority of the commercially important crustaceans belong to prawns and shrimps. Larger individuals are often referred to as prawns, while the smaller ones are called shrimps. The penaeid prawns are quite distinct from other decapods in that they shed their eggs directly into the water after fertilisation. Other decapods carry their eggs with them until they hatch. The eggs are carried by the female under the tail. The penaeid prawns are characterised by elongate and narrow body shape.

In the tide pools and coral reefs one often hears snapping sounds, produced by the snapping shrimp or pistol shrimp (*Alpheus*). One of the chelae is greatly enlarged and is as long as the body and its immovable finger has a groove that ends in a depression at the base. A peg-like structure on the movable finger is pushed into the depression when the chela is closed quickly, forcing a jet of water through the groove anteriorly. The finger closes with great rapidity, producing a snapping or popping noise. This water pistol is used in defence of territories, in battles with other males and also in catching prey.

Another colourful shrimp which occurs in the coral reefs is the banded coral shrimp of the family Stenopidae.

Some of the shrimps of the family Palaemonidae and Alpheidae are found as obligatory commensals in corals.

## **Mantis Shrimps (Stomatopoda)**

Living in crevices of rocks and corals is another group of crustaceans known as mantis shrimps. These shrimps have elongate and fairly large body with a well developed abdomen. The carapace is short and does not cover the posterior thoracic tergites. It is shieldlike and fused with the first two thoracic segments. The body is dorsoventrally flattened and carries filamentous gills on the abdomen. The shrimp swims with a looping motion. The mantis shrimp curls its abdomen under and darts suddenly. It has a strong blade-like posterior mouthpart. It folds and fits into a groove in a portion of the second appendage.

Mantis Shrimps are bottom dwellers and are predators. It lies concealed in a U or Y shaped burrow or a crevice, waiting for some fish to come within its reach. It can cut a fish into two pieces with the sharp blade. Often they are caught in drag nets.

Mantis shrimps may range in size from 5 cms to 30 cms as in the giant, *Squilla mantis*. Thirty-one species of stomatopods are known from these islands.

## **Shore Slaters and Sand Hoppers (Isopods and Amphipods)**

All the crustaceans described above are conspicuous by their size, but there are some crustaceans which are small but can be noticed if one is attentive on the shore. Near the high water mark and just above one often finds rapidly running shore slaters (*Ligia*). These are terrestrial and have a dorsoventrally depressed body. Many of the other related Isopoda are parasitic on fish (fish-lice) or burrow into wood. Submerged wooden structure or logs washed ashore may often yield a number of woodlice belonging to *Sphaeroma* or *Limnoria*. The body of an isopod is flexible and can curl up into a ball when disturbed. For this reason they are also called as 'pill-bugs'.

The other small familiar forms which generally hop and jump as one walks along the beach are sandhoppers (Amphipoda). These differ from the isopods in having the body flattened from side to side. The sand-hoppers lie concealed inside vertical burrows in wet sand or mass of sea weed or algae washed on the beach. Species of *Gammarus*, *Orchestia* etc. common on the coast, feed on both living and dead vegetation.

There are several other pelagic crustaceans like copepods and opossum-shrimps (Mysidacea) which serve as major items of food for several commercially important fishes and whales. They play a major role in the sustenance of marine fisheries.

## SOFT-BODIED ANIMALS WITH EIGHT, TWO, ONE OR NO SHELLS MOLLUSCS

Of all the life forms that add beauty to the sea-shore, sea-shells stand perhaps foremost. These jewels of the sea have fascinated and intrigued man for centuries. In sea-shells it is beauty for the sake of beauty. In the majority of the shells the colours and designs are of no value to the owner

The sea-shells exhibit an extra-ordinary diversity of shape, size and colour. The simplest have the shell in eight pieces as in coat-of-mail shells or univalved as in Gastropoda or two-valved as in Bivalvia or elephant-tusk-like as in Scaphopoda (*Dentalium*). In others, as in nudibranchs, it may be entirely absent or may be internal as in squids and slugs and certain cephalopods.

Mollusca (derived from the word molasses) are soft-bodied animals protected by a shell. The phylum is divided into five classes. Gastropoda and Bivalvia are common and conspicuous on any sea-shore. Of the other three groups, Cephalopoda, includes the most active swimmers and highly developed forms. *Dentalium* (Scaphopoda) is not commonly encountered along the shore, but live buried in the sand. These are generally not common on the sea-shore of Andaman and Nicobar Islands. The other small group includes chitons or coat-of-mail shells, common on the rocky shores of the islands.

### Coat-of-Mail Shells

*Chitons* or the coat-of-mail shells are bilaterally symmetrical with dorsoventrally flattened bodies. These are grouped under Polyplacophora (many plates) (also known as Loricata and Placophora). Shell consists of eight longitudinal series of successive plates or pieces. These plates are surrounded by and partly kept in position by a muscular girdle. The girdle may bear calcareous spicules or small spines. There is a head but without eyes and tentacles. Foot is flat and bordered by lateral or pallial grooves containing gills. The number of gills vary from species to species and even within the same species. Some species have minute eyes upon the surface of the shell plates.

The mouth, situated ventrally in the head, leads into a buccal cavity which in turn is connected to the pharynx and stomach. The intestine is coiled and opens to the outside by the anus. The radula is very long and enclosed in a tubular sheath.

The sexes are separate in chitons, but externally indistinguishable. The eggs are usually laid singly or in pairs at a time. The



Spiny chiton, *Acanthopleura spiniger* Sowerby, the largest chiton of the Islands in its natural habitat

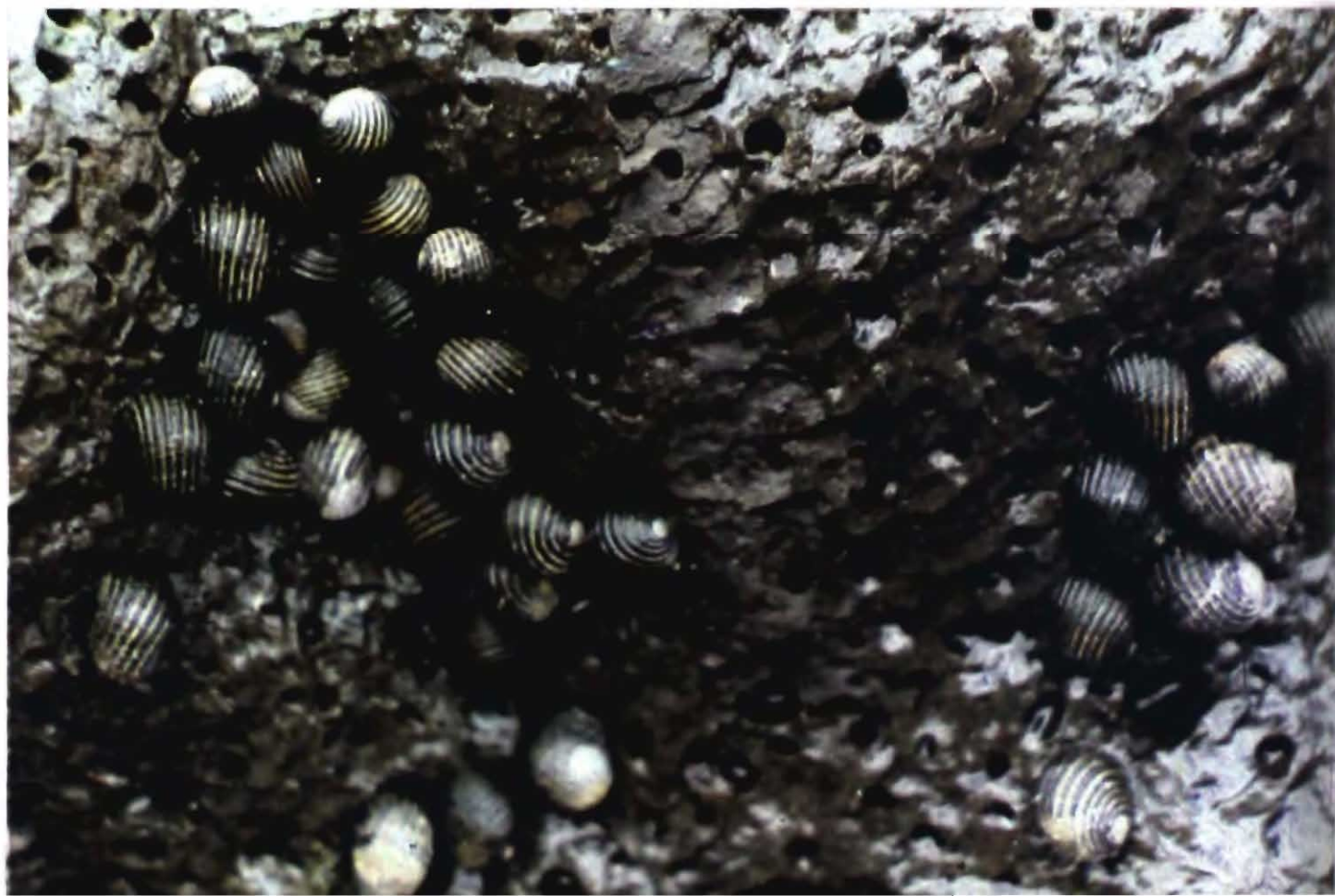
Chiton tucked in a depression of the rock; attached under its entire under surface and with flattened shape chiton easily withstand the waves





A star limpet, *Acmaea stellaris* Quoy and Gaimard abundant on rocks, among barnacles

A gregarious ribbed nerita, *Nerita costata* Gmelin. Common on the Islands





Textile cone, *Conus textile* Linnaeus,  
Common in shallow water

Sundial shell.  
*Architectonica perspectivum*  
Linnaeus, a rare shell





Mitre shell *Mitra stictica* (Link).  
Common in coral reefs from shallow  
water to 200 metres depth

Tiger cowry, *Cypraea tigris*, polished shell covered  
with mantle folds.



trochopore comes out rupturing the egg wall. The free-swimming stage may last for a few minutes or several days.

Chitons occur on rocky shores in the intertidal or upper littoral zones, where they attach themselves closely to the substratum and browse on algae. Some of the chitons (e.g. Winckworth's Chiton—*Ischnochiton winckworthi*) are found attached to empty bivalve shells in the upper littoral zone. If removed from the substratum, a chiton rolls itself into a ball-like structure.

Chitons are represented by thirteen species on the coasts of these islands. Excluding one species, which is known from deeper water, all chitons are known from the littoral zone. The size varies from 5 mm to 100 mm. The largest Indian Chiton, *Acanthopleura spiniger* is known from the Islands.

## Snails and Slugs

Gastropoda (stomach footed) which includes several common molluscs, are numerically the largest. It includes asymmetrical mollusca, with a spirally coiled univalve shell, which may be external, internal, or sometimes completely wanting, with a detorted and unsegmented body. The shell is generally coiled in a clockwise spiral, with aperture on the right. In some forms such as limpets the shell is a simple cap-like structure without the trace of any spire. The aperture or the mouth is generally closed by a calcareous 'door,' which is known as operculum. In some (ex *Turbo*) it is very solid and called the cat's eye.

The animal has a well-developed head, bearing eyes and tentacles. There is a well-developed foot, the ventral surface of which is modified into a flat creeping sole.

The molluscs included in this class exhibit a bizarre diversity of shell form and colour, internal organisation and feeding habits. The size may vary from the one-foot long scorpion shell to a coarse sand grain sized cyclostrematids. They are adapted to several different habitats extending from the high levels of the shore to the canyons of the ocean's bottom, and include swimmers (pteropods and heteropods) and floaters (Janthinids). Although some snails are remarkable for their pelagic habit and ability to swim, the majority of the gastropods crowd the littoral zone on the sea shore.

Several of the marine gastropods fall under the sub-class Prosobranchia. On rocky coasts limpets occur between tide marks. The large sized limpets, *Cellana* spp. are common on the rocks of

these islands. Limpets with a hole (Keyhole limpets) are, however, not very common. The ear-shells or abalones are found in crevices of rocks and also on the corals.

The islands once held a dominant place in shell trade. The much-sought-after shells were top shells (*Trochus*) and turban (*Turbo*) shells. A large number of curios, like shell-lamps, pendants etc. are made from *Trochus* and turban shells. Top-shells and turban shells are found in the crevices of large rocks or boulders. Sharing the same intertidal habitat with limpets, trochids, turbans and littorinids (periwinkles) are the neritids, quantitatively and qualitatively a dominant group on the shore.

*Trochus niloticus* is the commercially important species. There has been a regular fishery of this mollusc since 1900. During the second World War when the Islands came under the occupation of Japan, professional Japanese divers collected shells. About 500 tons of *Trochus* were fished in the year 1929 (Rao, 1937). *Trochus* and *Turbo* were once very common in the shallow littoral zone between 5 and 10 metres but over-collecting has resulted in the depletion of their numbers and during the later years of fishing Japanese could collect about 40 tonnes only. The growth of the shell in *Trochus* is quite fast up to 3 years, but slows down later. A 10 year old specimen measures 12 cm in diameter. These two commercially important gastropods viz. *Trochus niloticus* and *Turbo marmoratus* are not now very common on the Islands and may be considered as rare and endangered species of molluscs.

Nearly all the beautiful and highly prized molluscan shells are included in Gastropoda. Abounding in the coral reefs are some common molluscs like scorpion-shells or five fingered chanks (Strombidae), mitre shells, cones, muricids, olives, whelks and dog whelks. Their close allies living offshore include helmet or king shells, *Tibia*, an aristocrat among the sea shells and chanks.

The most conspicuous and beautiful shells are cowries. "Jewels of the depth" is the common name applied to this group. They are limited to shallow waters and found hiding under coral boulders and rocks in and around coral reefs. The little money-cowry is abundant on the coral reefs around Car Nicobar. Tiger-cowry is the largest among cowries. In cowries the mantle is large and covers the entire part of the shell. The shells are glossy as if artificially polished. About 180 living species are known.

A total of about 35 species are known from the Andaman and Nicobar islands.

Cones are considered as the molluscan aristocrats. Some of the rare cones have even fetched a fabulous price of \$ 2000. About 400 species are known from Indo-West Pacific, whereas the Andaman and Nicobar Islands have 50 species (Subba Rao, 1980). The cones occur in the coral reefs hiding in the crevices. Cones are carnivorous and are equipped with a poisonous sting in the proboscis. The species that are considered dangerous in the Indo Pacific region are *Conus geographus* Linnaeus, *Conus aulicus* Linnaeus, *C. tulipa* Linnaeus, *C. textile* Linnaeus and *C. marmoreus* Linnaeus. There are no records of fatal injuries to man by them in the Andamans. They are, however, capable of inflicting a serious sting and one should be careful in handling these species. The pride of any shell collector is the Glory-of-the-Sea, which possibly may occur off these islands.

The subclass Opisthobranchia includes interesting molluscs like sea-butterflies (pteropods), sea-hares and nudibranchs. Butterflies of the sea differ from other molluscs in the transformation of the foot into a pair of great winglike swimming fins arranged one on either side of the mouth. They are common in the plankton.

Naked-gilled gastropods, (nudibranchs) form a separate group by themselves. They are slug-like animals without shell of any kind and with no proper gills. The body is soft and worm-like with many elaborately branched tentacular processes on the back and sides. The skin is stiffened by calcareous spicules. They have a pair of oral tentacles and a pair of sensory organs, the rhinophores.

Nudibranchs live in shallow waters and glide about on sea weeds, corals, feeding on algae, molluscs and anemones. Born defenseless, some of the nudibranchs acquire their toxin by eating poisonous anemones and incorporating their armaments (nematocysts). Nudibranchs sport dazzling colours. In some the colouring is protective and mimetic, harmonizing with that of the sea weeds and animals amidst which they live. The order includes the sea-slugs or retractile gilled nudibranchs (Dorididae), finger-gilled nudibranchs (Polybranchidae) and fold-gilled nudibranchs etc.

Nudibranchs of these Islands are the least studied among Mollusca, largely due to the fact that they are the most difficult of all molluscs to preserve in their natural shape and colour. These have to be studied in the live condition and as such the information on the sea-slugs of the islands is extremely scanty.

Some of the common molluscs inhabiting midlittoral zone of (especially off Neil Island Coast) rocky coasts are large *Conus* sp., and *Vasum* sp. In crevices of reef flats around many islands, especially Car Nicobar, several species of molluscs can be noticed at low tide. Common among those are muricids, such as *Drupa*, and *Thais*, and mitrids (*Mitra*)-represented by 22 species. In the sublittoral sandy zones at a depth of 20 metre occur king shell (*Cassis cornuta*) and queen shell (*Cypraea rufa*).

A search in the algae such as *Caulerpa* sp. and *Halimeda* sp. may be a rewarding experience. Several interesting molluscs are found as algal associates. Majority of them are very small and it may not be easy to locate. Among such micromolluscs are bivalve gastropods, a peculiar group of opisthobranch molluscs. Two species are reported from Port Blair (Ganapati and Sarma, 1974).

There are some gastropods associated with star-fishes and sea-urchins. Some of them belong to the genus *Stylifera*, a parasitic genus.

### **Clams, Scallops, etc.**

The two-valved forms (Bivalvia) include several commercially important molluscs. The valves are kept in position by the elastic pad joining the two valves (ligament). The closing and opening of the valves is affected by adductor muscles.

Bivalves are laterally compressed with a bilateral symmetry. There is no head, radula or tentacles. The foot is an axe-shaped organ, particularly strong and of great mobility in the burrowing forms. The bivalves normally lie partly buried in the sand or mud. Although the majority of the species are sedentary a few such as the scallops are quite mobile and active. Some anchor themselves by a bunch of fine, silken threads, called byssus. In a few cases one valve is cemented to a stone or rock (oysters), and a few bore into wood (e.g. shipworms) and stone (e.g. piddocks). In bivalves the two mantle folds join posteriorly to form two apertures the incurrent (inhalent) and excurrent (exhalent). The burrowing forms have the margins of these apertures drawn out into a pair of long tubes. Nutrients are carried in by the water current passing through these siphons.

Most bivalves are filter-feeders. The giant clams have deviated from the conventional manner of feeding. They are generally found lying up side-down, with the hinge line of the shell at the bottom. The edges of the siphon and mantle are greatly



Sea slug, a nudibranch of the muddy shore

A tropical sea slug, *Phyllidia zeylanica* (Kelaart), a rare nudibranch characterised by pink tubercles and black lines





Venus Comb Murex.  
*Murex pecten* Lightfoot

Some shells of the islands



1. Ramose Murex — *Chicoreus ramosus*  
Common in shallow reefs
2. Scorpion shell — *Lambis chiragra*  
Shallow water species
3. Green turban — *Turbo marmoratus*  
— used for making table lamps and ornaments
4. Horned Helmet — *Cassis cornuta*  
— in reefs at 1 to 20 m depth
5. Horned Helmet — Juvenile
6. Horned Helmet — Viewed from the top.
7. Queen shell (locally called)  
— *Cypræcassis rufa*
8. Queen shell — Dorsal View
9. Chambered Nautilus — *Natilus pompilius*  
— Living colonies found in Southwestern Pacific.  
Dead shells carried to long distance



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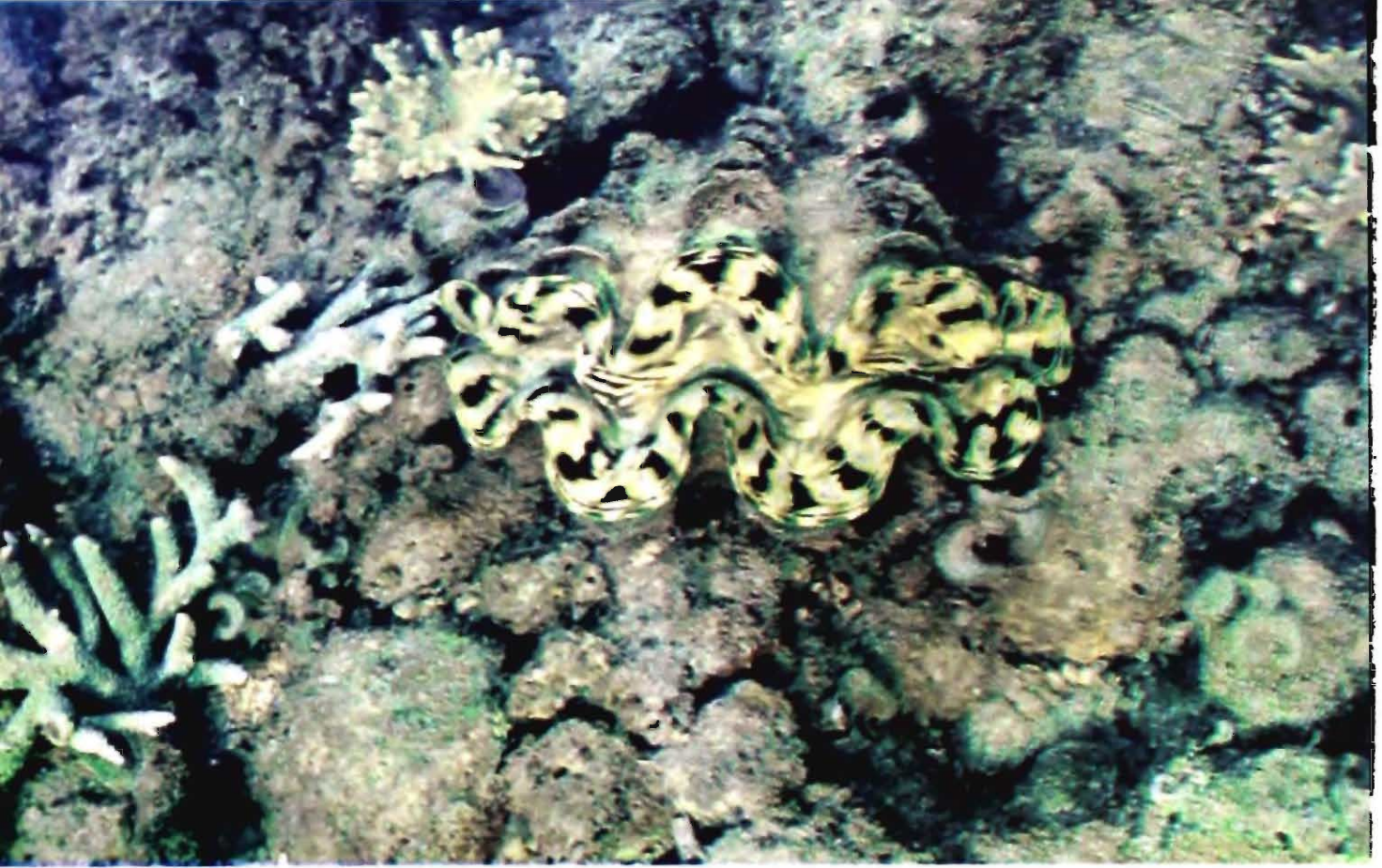
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8



9



The giant clam, the largest living mollusc. Margins of the clam are inhabited by microscopic algae, called Zooxanthellae. colour of the mantle varies depending on the colour of the type of plant that inhabits



thickened. When seen in nature on a coral reef they display an endless variety of gorgeous colours of the mantle frilling, ranging from light fawn, through greens and blues, and brown and combinations. In addition to normal bivalve feeding method, the giant clams have a supplementary source of food from unicellular algae Zooxanthellae. It is believed that the clam literally 'farms' these symbiotic algae, drawing off the surplus zooxanthellae which are then digested. The giant clams are eaten by the Nicobarese and other tribal people on the islands. One may often see several empty valves in a 'Olchu' village where they are used to store drinking water for pigs. Among the sedentary and epifaunal bivalves, giant clams are the most prominent. Wing-shells (Pteriids) are found attached to sea-fans (Gorgonids) or hydroid zoophytes. Its close allies, pearl oysters occur in the littoral reef flats up to a depth of about 10 m. Although there are four species, the black-lipped pearl oyster—*Pinctada margaritifera* is the common species of the islands. Black-lipped pearl oyster occurs in Smith Island, near Mayabunder, Chiriatapu, Hut Bay (Little Andaman), etc. (Alagarswami, 1983).

Edible oysters generally attach themselves to rocks or wooden structures. Rock oyster, *Saccostrea cucullata* and *Crassostrea madrasensis* are the two species occurring in the islands.

There are certain bivalves which bore into corals and act as important agents in the biodeterioration of reefs. There are 10 species of coral boring bivalves (Appukuttan, 1973). Lithopags and petricolids are the common boring bivalves.

Remarkable among bivalves are the two unrelated groups viz. scallops and file shells (Pectinidae and Limidae), which are capable of swimming. The scallops propel themselves through the water by the alternate and rapid opening and closing of their valves. Smaller scallops are met with in shallow waters. The other swimming bivalves like *Lima* are common in the intertidal zone. These molluscs swim quite actively, exposing a mass of brilliant, long, orange-red tentacles.

Elephant tusk shells are hard to find on the seashore of these islands.

### **Squids, Octopuses, etc.**

The most active and most highly developed among the invertebrates are squids, octopuses, cuttle-fish and their allies

(Cephalopoda or head-footed animals). The animals included in this group lead a free-swimming predatory life. They have a distinct head and large non-closing eyes. The front part of the foot is drawn out into long sucker-bearing arms and the hind part is modified into a funnel. A shell may be present or absent. Cuttle fishes have an internal shell, which is known as a cuttle bone. The cuttle bones are often washed ashore. Squids have a flexible, horn-like cartilaginous internal shell. Octopuses do not possess any shell. The sexes are separate and there is no metamorphosis.

Generally many of the Cephalopods occur off-shore. Only octopuses are noticed swimming or hiding in rockpools or coral reefs. Some of the cuttle bones and shells of *Nautilus* are washed ashore. One of the common octopuses is the blueringed octopus, *Hapalochlaena maculosa*, which is found generally in rock pools. Octopuses are very agile and when disturbed escape in a dark cloud of inky secretion.

*Nautilus* is represented by a single common species *N. pompilius*, the pearly nautilus. It lives at moderate depths. It has several internal chambers separated by septa, which are perforated in the middle and traversed by a vascular (tubular) prolongation called the siphuncle. The chambers are filled with air so that the shell can float.

## LACE WORK WITH BEAKS BRYOZOANS

Bryozoans or "moss animals" are a characteristic group which grow in plant-like colonies like hydroids. These are also known as "polyzoans" which mean many animals. Bryozoans are sedentary and colony forming coelomates. The colonies are usually attached to algae, rocks or some other fixed objects in the sea. Many bryozoans are specific to the type of substratum. Some of the bryozoan colonies like sea-mosses may be soft, flexible and plant-like, and others like the lace corals are hard, calcareous and more or less irregularly branched. Sea-mats grow as encrustations on the surface of a rock, shell, etc. Apart from temperature and wave action, the bathymetric distribution of bryozoans is primarily related to the availability of suitable substrata.

Gymnolaemata bryozoans constitute an important class represented by about 3000 living species occurring in world seas. They occur from between tide marks down to the great ocean depths. The greatest abundance of bryozoans occurs in the shallow waters of the continental shelf. The shore forms are small and inconspicuous. But the deep sea forms are generally large and often mistaken for sea weeds.

The bryozoan colony is formed by a group of zooids. The colony is supported by a compact skeleton which consists of box-like cavities.

The individual cell is known as zooecium. The animal within it is called zooid. Each zooid has a circular or crescentic lophophore bearing a series of slender, ciliated post oral tentacles. The lophophore with its tentacles can be withdrawn into the anterior part of the body which forms an introvert. There are no excretory organs, respiratory and circulatory systems.

Bryozoans of the islands are very poorly known. Marine bryozoans constitute one of the important groups of fouling communities. Species of *Bugula* are among the most abundant occurring on ship bottoms.

## SPINY SKINNED ANIMALS ECHINODERMS

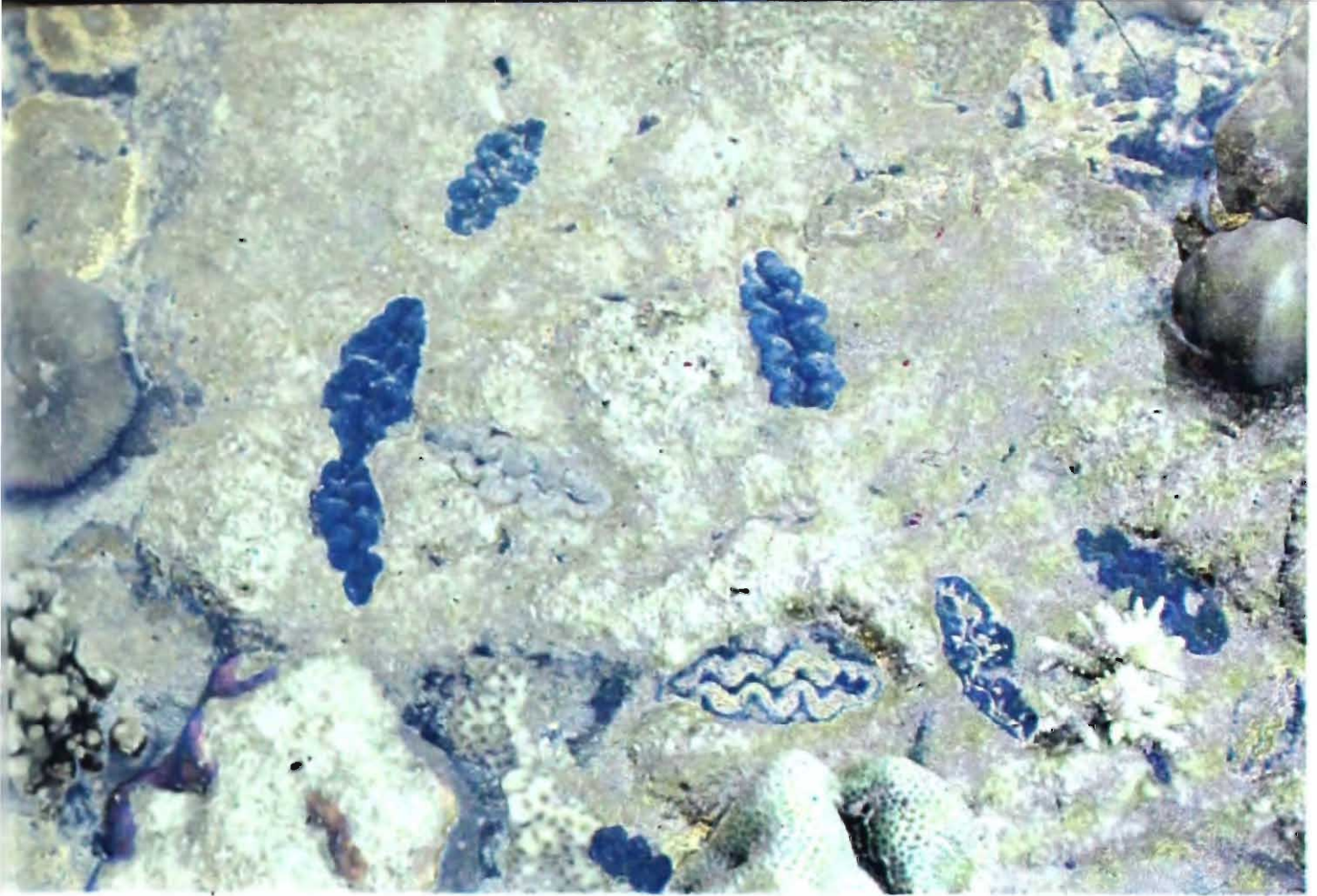
Next to shells and armoured or pincered crustaceans the most familiar forms on the shores of Andaman and Nicobar Islands are the spiny-skinned animals—the echinoderms. The group includes the feather-stars, sea-stars, brittlestars, sea-urchins and sea-cucumbers. They can be easily recognised by their spiny skin—sometimes with only tubercles or small projections—from which they derive their name Echinodermata (*echinos*, a hedgehog, *derma*, the skin).

The body plan of echinoderms is completely different from that of most other animal groups. Their body displays a five-part or pentamerous symmetry i.e. most of the organs are five or in multiples of five. This gave rise to their pentaradial symmetry, meaning two equal halves of the animal can be obtained by a cut along any of the five radii. Their skeleton consists of calcareous plates articulating with one another or fused rigidly into a compact shell or loosely embedded in the skin as microscopic spicules. Another interesting and unique feature of these animals is their hydraulic or water-vascular system evident externally by the fluid filled protruding, tube-like podia or tentacles. These serve the animals in various ways like food gathering, respiratory or locomotory activities.

Echinoderms are exclusively marine and only very few forms extend into the brackish or estuarine areas during periods of relatively high salinity. On the shore they occupy all types of available substrata such as corals, rocks, sand and mud, sea weeds and sponges while a few others live as epizoic on other animals like gorgonians.

The feeding habits of echinoderms too are quite varied. There are herbivores, carnivores, omnivores, deposit or detritus feeders, and suspension feeders. Some of the echinoderms exhibit great capacity to regenerate the organs lost accidentally or even voluntarily. The sexes are separate. The development is indirect, which involves a larval metamorphosis. Each group has its own characteristic, free-swimming larval stage.

The spiny skinned animals, sporting the mysterious “rule of five” (pentaradial symmetry) and the unique water vascular system, can be distinguished into five different classes viz. feather-stars and sea lilies (Crinoidea), the sea stars or star fishes (Asteroidea), the brittle-stars (Ophiuroidea), the sea-urchins, sand dollars, cake-urchins and heart urchins (Echinoidea) and sea cucumbers



Giant-clam, *Tridacna crocea*  
Wedged in a coral boulder

Rock oyster, *Saccostrea cucullata*





Star fish of sandy shore, *Astropecten* sp. a common starfish

Common Star fish, *Linckia laevigata* among coral boulders



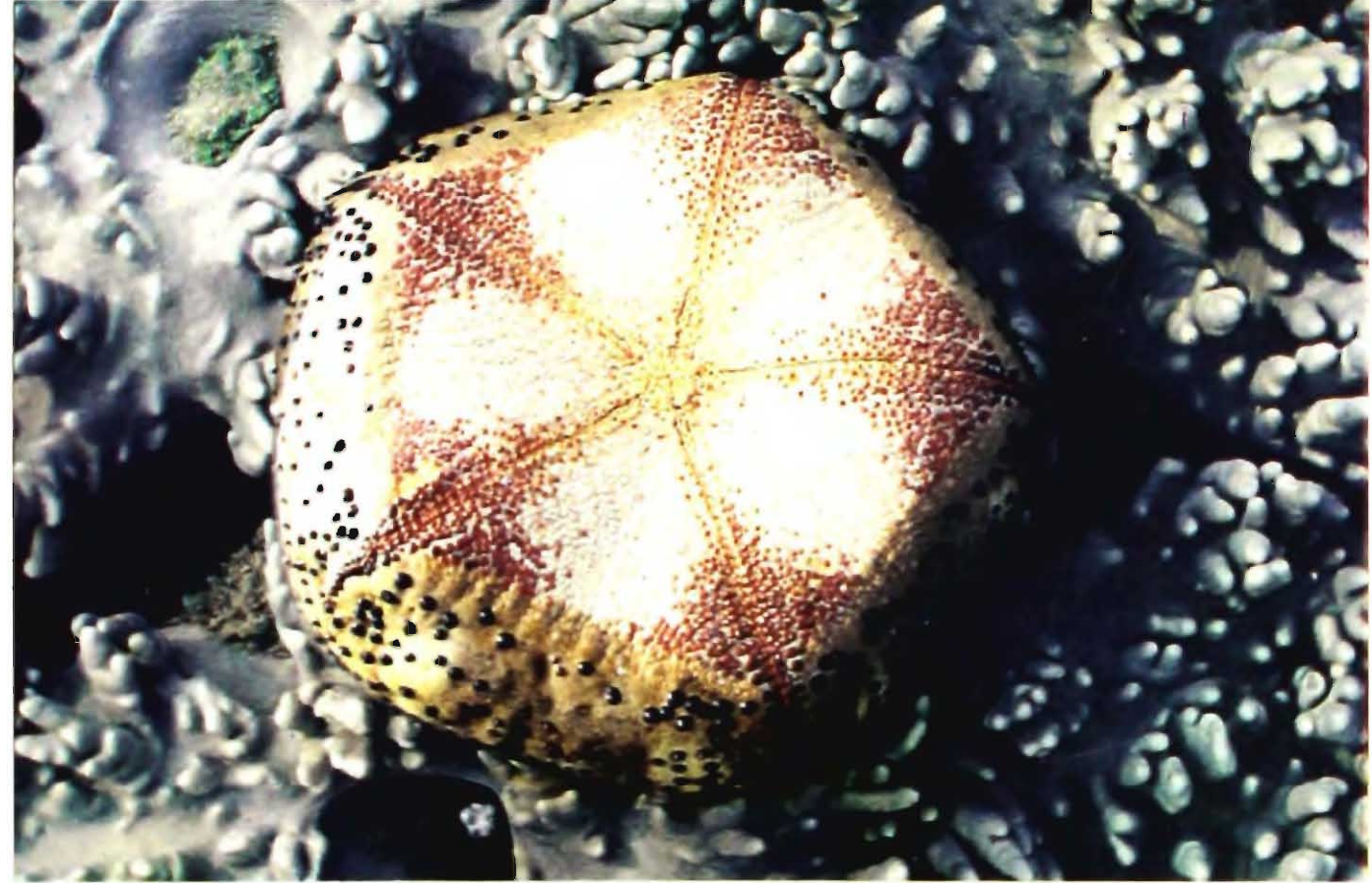


Crown of Thorns, *Acanthaster planci*  
voracious feeder of coral polyps · aboral view

Crown of Thorns,  
oral view

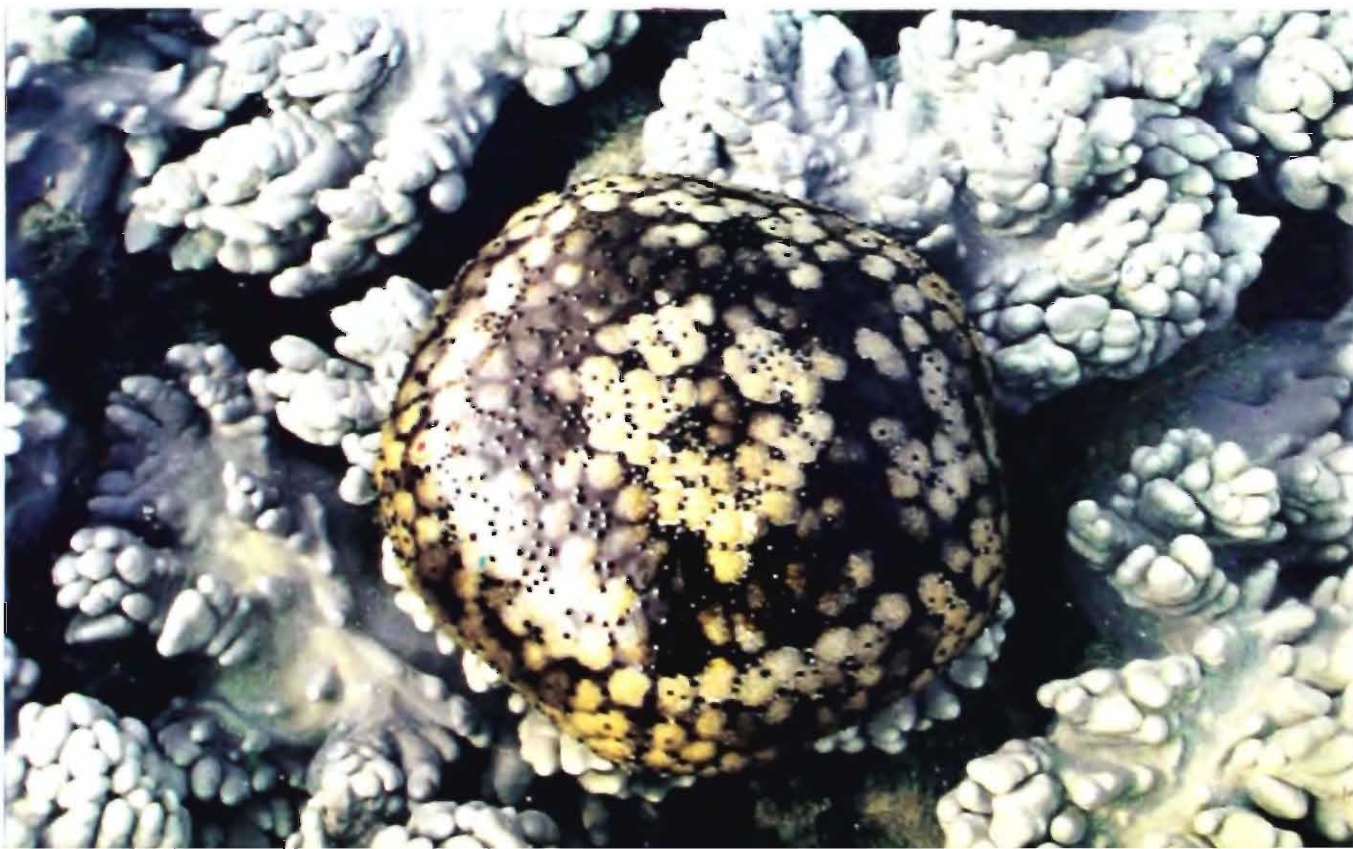


B.K. Tilader.



Cushion star, *Culcita novaeguineae* (oral view) camouflaged with soft coral in natural environment

Cushion star (Aboral view)





Brittle star, *Ophiocoma scolopendrina* in shingles — remains concealed in the crevices but can be noticed from the snake like movements of its arms.

A typical habitat among coral boulders showing a star fish (*Linckia laevigata*), a cushion star (*Culcita novaeguineae*), a sea cucumber (*Holothuria* sp.), a Giant clam (*Tridacna* sp.), tiger cowry (*Cypraea tigris*) and a sea slug.

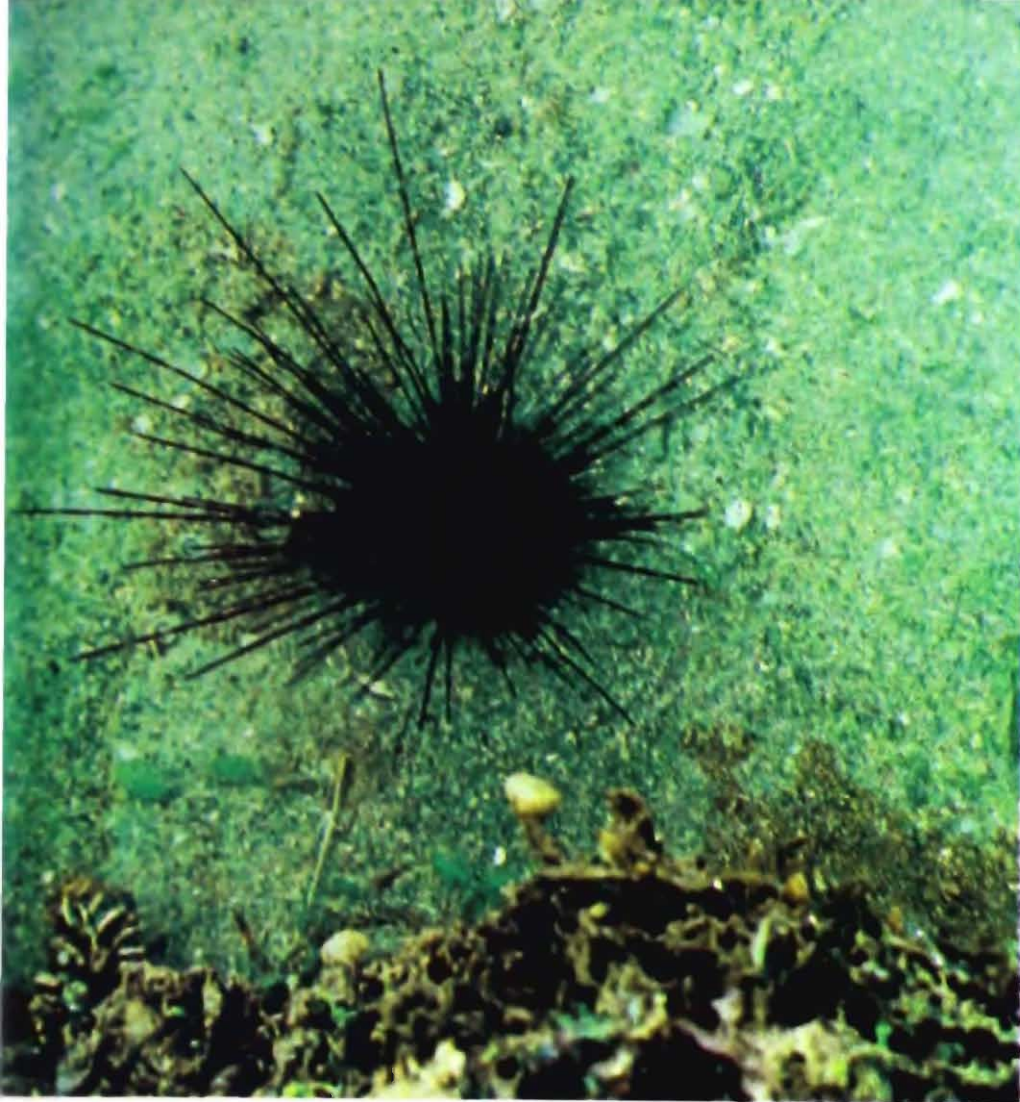




Sea urchin, *Tripneustes gratilla*, generally camouflages with algal bits held on aboral side with the help of tube feet.

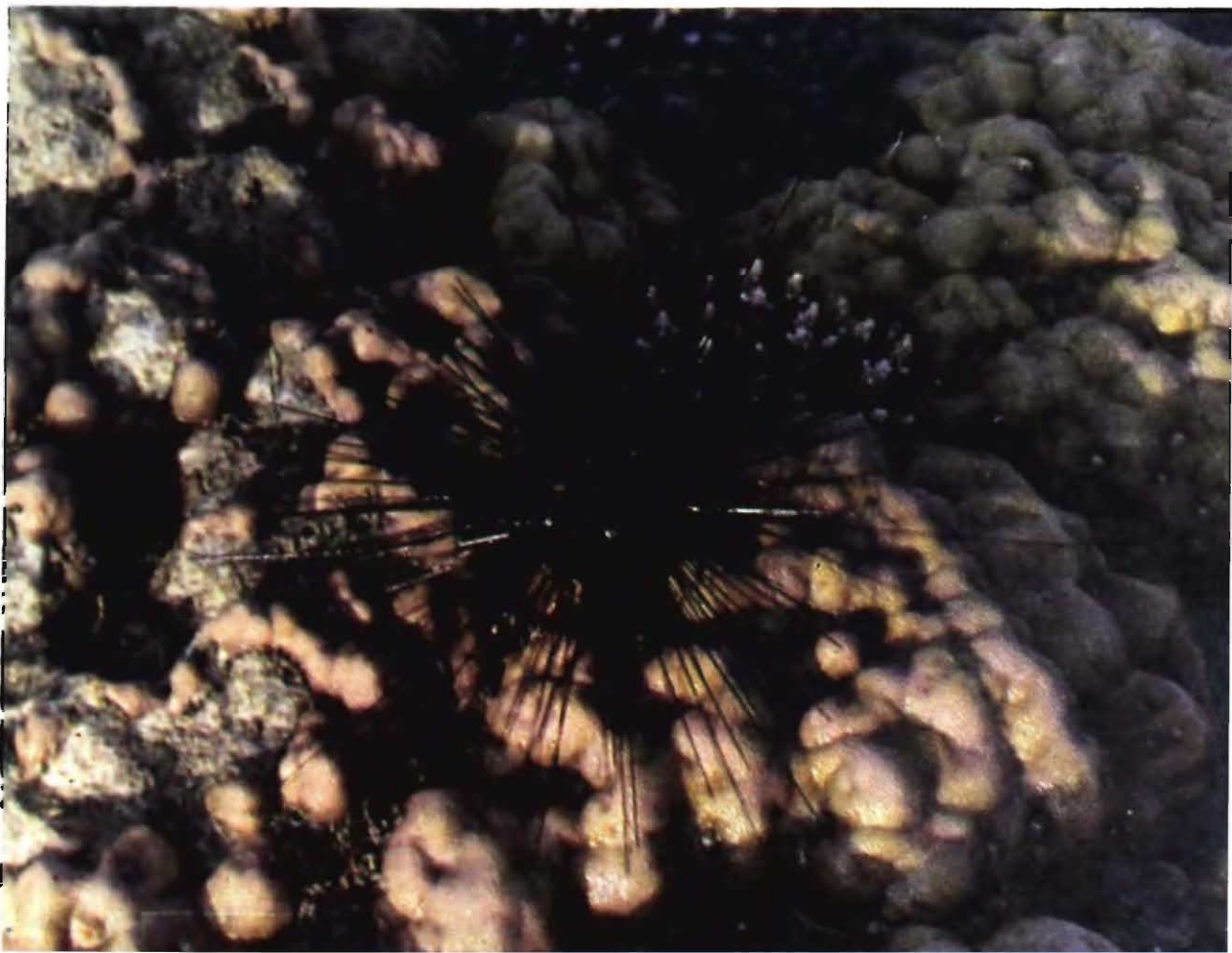
Sea urchin, *Stomopneustes variolaris* in a burrow under water





G.Ponnuswamy

Hatpin urchin, *Diadema setosum*, spines are hollow and penetrate human skin causing wounds

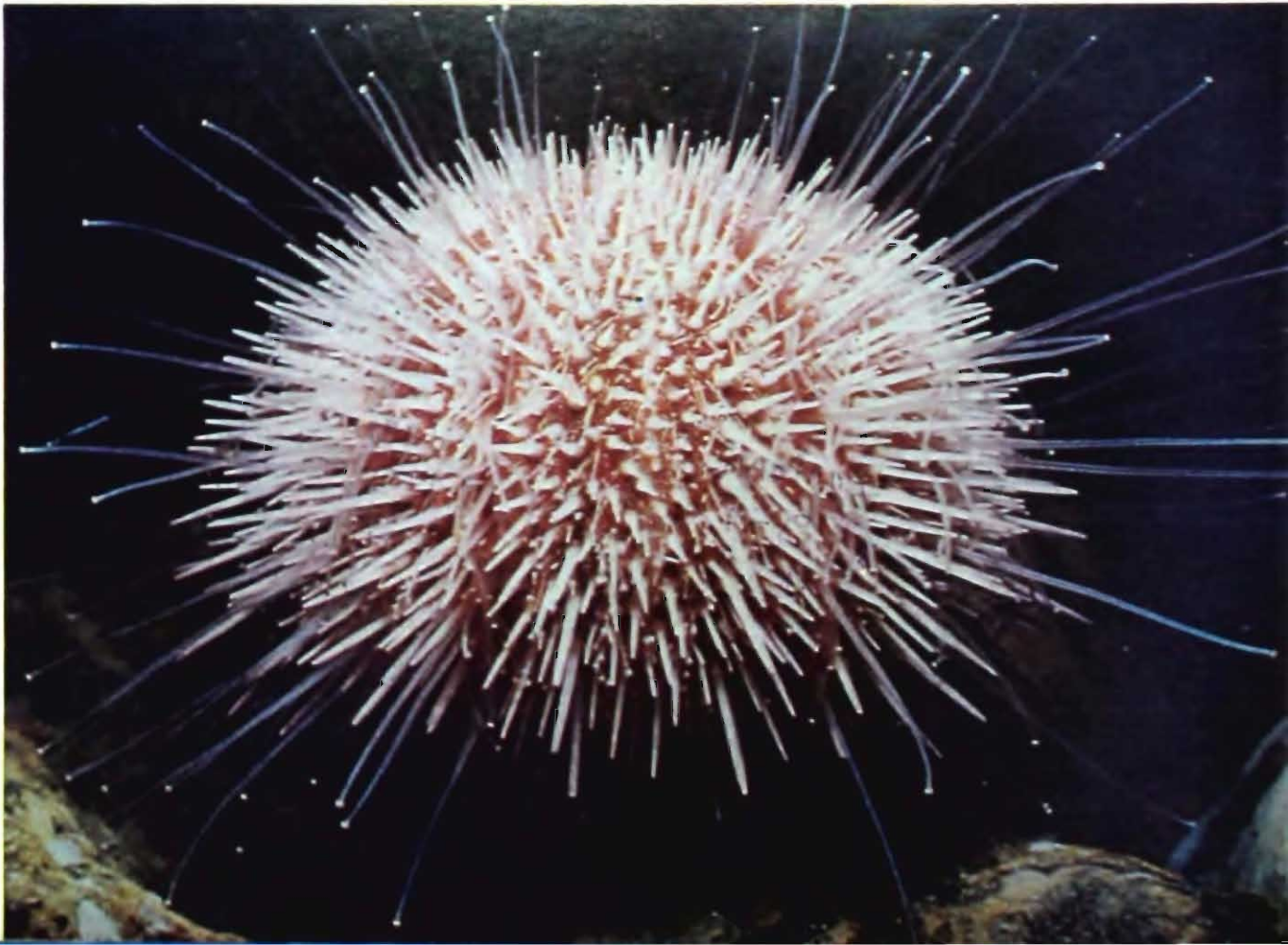


B.K. Tikader



Hatpin urchin, *Diadema setosum* with spines projecting from the crevice

The venomous sea urchin, *Toxopneustes pileolus*; showing tube feet, which extend several times the length of the spines, in search of a hold for movement.



(Holothuroidea). About 300 species of echinoderms (i.e. fifty percent of the Indian echinoderms) occur around the Andaman and Nicobar Islands, of which one-third are intertidal or shallow water inhabitants.

### **Feather Stars and Sea Lilies (Crinoidea)**

These are unique among echinoderms in that they live with the oral surface uppermost. The group includes two types of animals commonly called as the sea lilies and feather stars. The sea lilies with their long stalk and a crown of arms inhabit deeper waters beyond 200 m and up to 5000 m.

The feather stars live in shallow intertidal waters. They have one or more circles of jointed appendages called cirri at the base for attachment to hard substrata and a crown of feather-like arms radiating from the centre and directed upwards. The mouth is situated in the centre. The arms are five at the base but in most species the number gets multiplied because of repeated forking. Some possess even 200 arms.

The feather stars are suspension feeders. Small planktonic organisms are caught by the arms and conveyed to the mouth.

Gonads develop in the arms, more usually in the side branches of the arms called pinnules. The larval form, which is characteristic, is called pentacrinoid.

The crinoids provide shelter to various other animals like myzostomes, polychaetes, copepods, shrimps, crabs, molluscs etc.

The crinoids are the least common echinoderms in the intertidal region. Of the nearly 30 species occurring at these islands, all are subtidal and inhabit depths ranging from 3 m to 200 m.

### **Sea Stars (Asteroidea)**

The general form of these animals is very familiar to every one. They are star shaped with a central disc and five radiating triangular arms and hence their name Asteroidea or sea stars (aster Star). Some of the common species such as *Astropecten* exhibit this typical form, but variations are common both in number and the shape of the arms. The number of arms may be six or more, as in species of *Luidia* or twenty, a regular feature in *Acanthaster planci*. The arms are long and cylindrical in *Linckia*, *Echinaster*, etc. while they are very short and not distinct from the central disc in *Patiriella* and *Culcita*.

The soft parts of the animal are protected by a skeleton made of overlapping or reticulating calcareous plates. The central disc contains all the organs of the body and their branches extend into the arms. The mouth is located on the lower side or the ventral side. The lower surface of each arm has a conspicuous groove into which protrude the tube feet of the water vascular system. They help the animal in crawling, clinging and digging.

Some of the star fishes live attached to the rocks or corals with the tube feet (e.g. *Asterina*, *Patiriella* and *Linckia*), while others occur openly on the sea beach or more frequently half or completely buried in the loose substratum (i.e. *Luidia*, *Astropecten*, *Archaster*).

The shallow-water forms are mostly carnivorous, feeding mainly on molluscs abundant on rocks, sand and corals. Star fish has a peculiar mode of feeding in which its stomach is forced out. While feeding on bivalves it applies constant force on the valves by applying its suckered tube feet. The pull on either side of the valves creates a gap. Then the stomach folds are introduced through the gap and the soft parts of the prey are digested. In *Astropecten* and others the stomach is everted to enclose the prey, which is then drawn into the disc and digested. The multi-armed Crown of thorns' star fish (*Acanthaster planci*) feeds voraciously on the coral polyps and causes extensive damage to reef flats when occurring in large numbers. It was responsible for large scale destruction of live corals in the Great Barrier Reef off Australia. There was 90% destruction in several of the coral reefs. The star fishes are however, controlled by the numerous, pincer-ed creatures the shrimps and crabs taking shelter on the coral which pinch off their tube feet. In the Great Barrier Reef a mollusc named *Charonia tritonis* was identified as a predator of this star fish. Some star fishes are opportunistic scavengers.

The capacity of star fishes to regenerate their lost parts is very remarkable. Sometimes, they regenerate so frequently that it is believed to be a regular method of reproduction. A single arm with a tiny bit of disc attached to it can grow all the lost parts. Thus comet forms of the variegated *Linckia multifora* and asymmetrical specimens of *Asterina* are very common.

The sand-burrowing forms are pale coloured while the rock inhabiting forms have a variegated colouration matching with the background of the habitat. However, *Linckia laevigata* shows a pleasant blue or red colouration, while *Linckia multifora* has a conspicuous variegated appearance. *Culcita* is some-times coloured brightly. The multiarmed *Acanthaster* is pink with red spines.

Star fishes have a characteristic larval form, known as bipinnaria.

More than 70 species of starfishes occur around the Andaman and Nicobar Islands. Most of them are intertidal forms inhabiting rocky or coral habitats.

### **Brittle Stars (Ophiuroidea)**

Brittle stars can be easily recognised by their arms resembling the tail ends of snakes, and due to this similarity they are also known as serpent stars (*Ophis* snake, *ura* tail). They are known as brittle stars because of the fragile nature of their arms, which readily snap off when handled.

Brittle-star resembles a starfish in having a body consisting of a central disc and five radiating arms. But the arms of brittle star are long, well marked off from the disc and well articulated facilitating movement and easy breaking. The arms are easily fragmented and regenerated. In basket-stars occurring in deep waters the arms are extensively branched, thus increasing the efficiency to collect planktonic animals. The tube feet in brittle stars are reduced to a tentacle-like extension devoid of any sucking disc. Unlike star fishes, which are sluggish, serpent stars are very agile and active, constantly waving their tentacles in surrounding waters, while the disc region is concealed in a crevice or under a rock.

During the process of constant movement the tentacles extend and help in respiration. At the same time they also serve as feelers and entangle microscopic animals, detritus particles in a mucous ball and convey it to the mouth. However, many are deposit feeders shovelling the substratum into the mouth with their broad teeth, which are arranged vertically in a series on the jaw plates.

Brittle stars occur on all types of substrata and from littoral to abyssal depths. They live concealed under rocks, crevices or coral bases. Some live with the disc buried in the intertidal sand among shingle beds. Some are epizooic on gorgonians (e.g. *Ophiothela danae*) while some take shelter in sponges, roots of sea grass and sea weed (e.g. *Ophiactis savignyi* and *Amphipholis squamata*).

Many of the species are very distinctly coloured and those belonging to the families Ophiocomidae and Ophiotrichidae are the most striking. The common *Ophiocoma* species are either

brilliantly black on both sides or paler and variegated on the lower side. *Ophiolepis superba* shows a fantastic red star-like patch on the disc and conspicuous bands on the arms. The arms of many forms of *Ophiothrix* show beautiful dark and pale lines extending the length of the arm or transverse bands on each segment. The characteristic larval form of brittle stars is called ophiopluteus.

On the shore habitats of the islands, brittle stars are conspicuous by their number and variety. About 70 different species of brittle stars occur in these islands, especially in the coral reefs around Car Nicobar. The most common ophiuroids on these islands are the smooth armed snake star, *Ophioplocus imbricatus* and the spiky armed, drab-coloured *Ophiarthrum elegans*.

### **Sea Urchins, Heart Urchins (Echinoidea)**

The common forms of this group are hemispherical in shape appearing as pin-cushions with long, radiating spines over it. These are generally called sea-urchins. There are also other kinds popularly called sand-dollars, cake-urchins and heart-urchins, depending on their shape and appearance.

The characteristic feature, which differentiates them from other groups is the compact shell or test formed of rigidly fused calcareous plates. The test forms a complete shell perforated only by minute pores for the passage of tube feet, anal and genital openings and mouth. The test bears the movable spines. The spines may be hollow or solid and range in size from microscopic to long and slender ones, as in sand-dollars and cake-urchins, to thick and heavy ones. The form and arrangement of the spines is variable. Even within the same individual the spines may vary depending on their place of occurrence on the test. In sand-dollars the spines are reduced to a fur-like covering. In *Toxopneustes pileolus*, numerous flower-like wide opened globiferous pedicellariae with poisonous sacs are found.

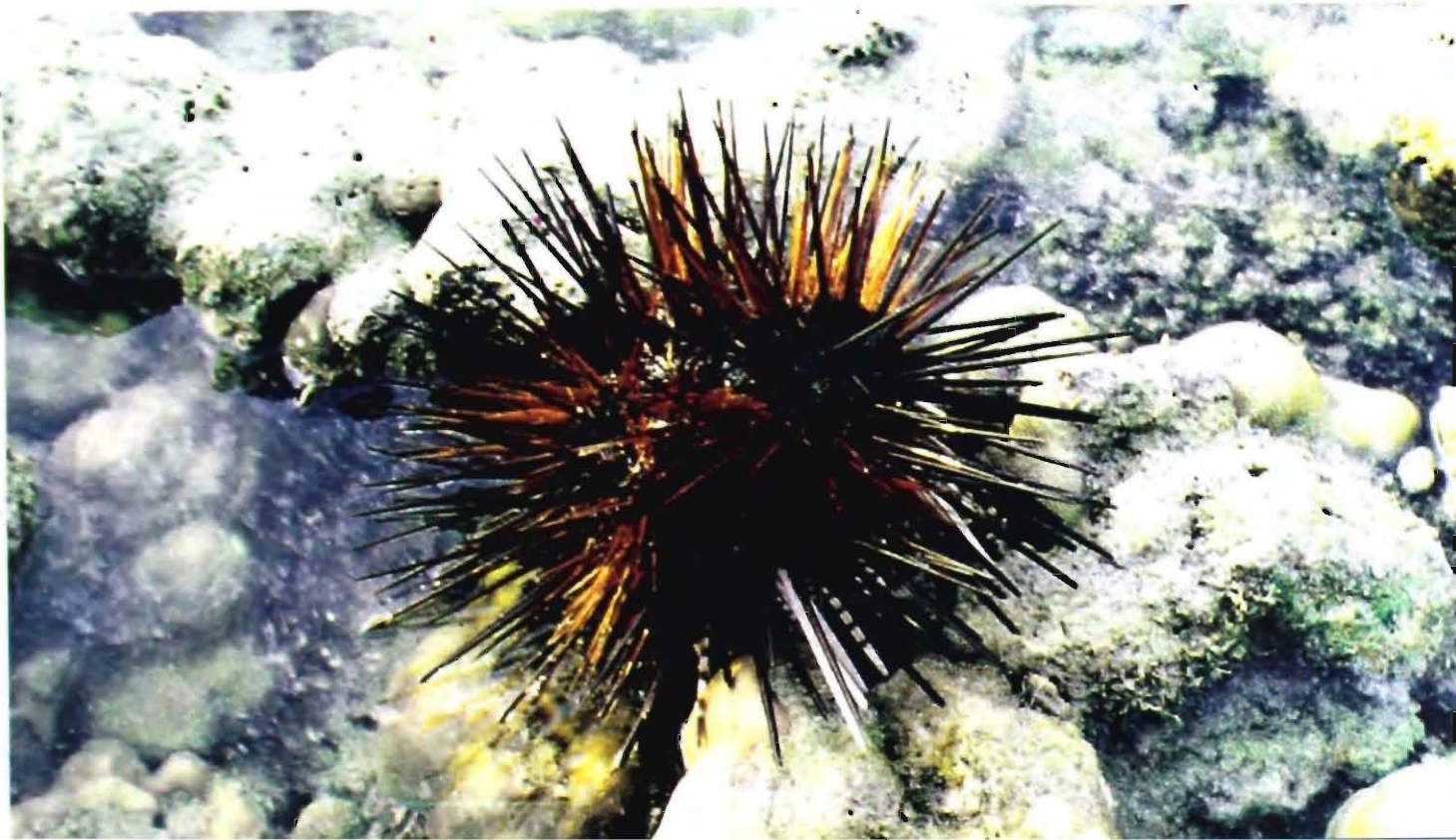
When the spines are removed from the test one can notice five bands of fine pores that start at the mouth beneath the test and end at the top. These are called ambulacral plates and alternate with five series of interambulacral plates. The tube feet of the ambulacral or water vascular system protrude through the holes on the ambulacral plates. In addition all the plates bear rounded button-head like tubercles for articulation of the spines with a ball-socket mechanism. The five radiating series of holes match the five arms of a star-fish.

In echinoids the mouth is always situated on the lower side at the centre or slightly anterior to it. The regular sea urchins,



Sea urchin, *Echinometra mathaei*, widely distributed in the Indo-pacific, makes shallow, circular depressions and lives there; common in sheltered reefs.

Sea urchin, *Echinothrix calamaris*, bears superficial resemblance to *Diadema*; the dark and light banding of spines is retained in the adults.





Sea cucumber, *Holothuria* sp. among coral boulders

Sea cucumber, *Holothuria* sp. with sand grains glued to its body





Sea cucumber, *Holothuria* sp. in shingle beds

Long sea cucumber, *Synapta maculata*





Long sea cucumber, *Synapta*, occurring in shingle beds shovelling the intertidal sand. It literally eats its way through the substratum passing the mud or sand through its alimentary tract and digesting the organic material in the process

Rare spiny sea cucumber, *Stichopus* sp. of deep water along with coral fish



sand-dollars and cakeurchins like *Clypeaster*, *Laganum* and *Echino-discus* have characteristic chewing apparatus called "Aristotle's Lantern", named after its discoverer Aristotle, in the 4th century B.C. This chewing apparatus is absent in the heart-urchins, which have taken to deposit feeding. The regular sea-urchins feed on the algae and its associated animals and occasionally on barnacles also. The sand dollars, cakeurchins and heart urchins ingest the bottom deposits while burrowing. The undigested matter is thrown out in the form of pellets through the anus. The anus is originally situated at the centre of the upperside or dorsal side but later shifted during evolution to far behind on the upper side in *Arachnoides placenta*, to the posterior end in heart urchins and to the lower side in sand dollars and cake urchins.

The echinoids occupy all types of substrata available in a marine habitat. The hemispherical *Stomopneustes*, *Toxopneustes*, *Diadema*, *Echinothrix* etc. and the slightly ovoid *Echinometra* and *Colobocentrotus* inhabit rocky and coral substrate while the flattened and heart-shaped forms burrow into sand or mud. An interesting adaptation to wave action is exhibited by *Colobocentrous*, which is almost limpet-like in appearance. The upper spines join together to form a mosaic surface and the tube feet below are massed together holding fast on wave beaten rocky shores. The hemispherical *Tripneustes* occurs on sandy grass beds covering itself with the grass blades or other debris. The intertidal forms like *Stomopneustes* and *Echinometra* make burrows in the rocks, coral bases and hard clay mounds to protect themselves from the dislodging effect of the waves. The small echinometrid, *Echinostrephus* lives at the mouth of cylindrical burrows made by it in rocks and corals and drops immediately to its bottom when disturbed. All the sand dollars, cake urchins and heart urchins live completely or half buried in sand or mud.

The sea urchins are dangerous because of their pointed and poisonous spines. In diadematids the spines are very brittle. They are minute and numerous in *Tripneustes*. In *Toxopneustes* there are globiferous pedicellariae with fangs and poisonous sacs which are large and gaping. Species of Echinothuriidae possess poisonous spines. But in general no intertidal species has poisonous spines on its body. In addition to this defensive role spines are also useful in locomotion. Sea urchins can climb vertical surface of rocks by stilt-walking.

The characteristic larval form of the group is known as echinopluteus. The Andaman and Nicobar islands support more than 70 species of which most of the regular echinoids are shallow water rocky or coral inhabitants.

## Sea Cucumbers (Holothuroidea)

Holothurians are popularly known as sea cucumbers because of their appearance, and *beche-de-mer* (*beche* spade) because the tentacles dig into the substratum and transfer it into the mouth during feeding.

Holothurians differ from other echinoderms in having an elongated cylindrical body and in the absence of a compact skeleton. The characteristic calcareous skeleton of other groups is reduced to minute scattered plates or spicules, which are embedded in the tough leathery skin. The spicules serve as useful taxonomic tools in identifying species.

In other groups of echinoderms (except the crinoids) the mouth is situated on the undersurface. But in sea cucumbers the mouth is situated at one end of the elongate body and the anus at the opposite end. There is only a functional differentiation of the body into dorsal and ventral. The podia or tube feet are the only structures revealing the basic pentaradial symmetry.

Sea cucumbers are characterised by a circular set of tentacles surrounding the mouth. They may be simple with a few branches or densely bushy. The tentacles have a sticky mucus material to which living and non-living particles adhere. When enough particles stick to the tentacle, it is put into the mouth and all the organic particles are scraped off.

The size of sea cucumbers ranges from about 2 cms., in forms like *Holothuria pyxis* to nearly 2 m in a feeding *Synapta maculata* (There are also interstitial forms, measuring 1 or 2 mm, living among the sand grains). In general, sea cucumbers measure from 18 cms to 31 cms in length. They crawl on the surface or burrow into the soft bottom. This has led to reduction of the podia on the functionally upper side, some times with the formation of a sole on the lower side. Some forms have completely lost the tube feet on the body. Because of their feeding habit of ingesting large amounts of the substratum the sea cucumbers are the prime reworkers of the marine mud, sand and oozes at all depths and can be compared to the earthworms of the terrestrial region. Some members have respiratory trees originating from the cloaca and extending into the body cavity. For respiratory purposes water is sucked in through the cloaca filling the branches of the respiratory tree and pumped out in a jet.

The sea cucumbers have a peculiar defensive adaptation. When threatened with danger the animals can sever the entire

digestive tube and the associated organs like the respiratory tubes and cuvierian tubules and throw them out through the cloaca. This process is called evisceration. All the eviscerated structures are later regenerated by the sea cucumber. The enemy is repelled by the eviscerated organs and sometimes also gets entangled in the sticky threads. Depending upon the intensity of irritation, sea cucumber may eviscerate all the organs or secrete only a number of sticky white threads, which are in fact the cuvierian tubules. The resemblance of secretions to white cotton threads gave the sea cucumber its popular name 'cotton spinner'.

The Andaman and Nicobar Islands are by far the richest in sea cucumbers compared with other known localities in the Bay of Bengal. About 60 species occur in the shallow waters of the islands and another 10 in the off shore regions. Auricularia is the characteristic larval form of sea cucumbers.

Sea cucumbers are commercially very important. In certain areas of the Indo-Pacific, the eviscerated mass or the soft skin are eaten raw. Generally the processed leathery skin which is sundried and freed off the calcareous spicules is called *Trepang* or *beche-de-mer*. It contains 35% to 50% of easily digestible proteins and imparts a delicate flavour to soup and other preparations. A good *beche-de-mer* industry thrives at Havelock. Of the 11 species used in the Indian *beche-de-mer* industry the most important are *Holothuria atra*, *H. scabra*, *Actinopyga mauritiana* and *Stichopus chloronotus*.

#### SEA-SQUIRTS AND TULIPS TUNICATES

Sea squirts found on the shores of the islands are of three types. There are solitary, simple ascidians. There are colonial forms, like *Botryllus* in which the individuals are united at their bases. There are also gelatinous encrustations of compound ascidians growing on rocks or on sea weeds. These sessile tunicates occur on a wide variety of substrata, including sand, rock, sea weeds and animal exoskeletons. There are yet other forms which one does not encounter often on the sea shore. These are the pelagic tunicates, which are mostly oceanic. Pelagic tunicates are found throughout Andaman sea. Appendicularians are more dominant and abundant than salps and doliolids (Madhupratap et al, 1981).

The tunicates are all marine, and occur at all depths of the sea. These are generally sedentary with a free swimming larval stage. The notochord, characteristic of all the chordates, is found only

in the tail of the larva hence the name Urochordata (*uro*, tail). The adults are degenerate forms enclosed in a protective mantle or "tunic," by which they have derived the name "Tunicata." The notochord disappears in the adult.

The adult of the simple Ascidian has the form of a wrinkled cylindrical leather-bag of about 10.5 cm length. It has a broad basal end by which it is firmly attached to a rock or other substratum in water. At the distal or free end, there are two openings—a terminal mouth (branchial aperture) and an atriopore. In the living animal, a current of water (carrying food organisms and oxygen) flows into the body through the mouth and passes out by the atrial aperture. When an ascidian is disturbed, it squirts out a stream of water forcibly through the atriopore, and due to this behaviour, it is named as Sea-Squirt.

The whole body of an ascidian is covered by a protective tunic or test. The tunic is made mainly of a carbohydrate-tunicine which is closely related to cellulose, a substance rarely found in animals. It is secreted by special mesoderm cells which lie under it. The test is almost a loose covering, but it is attached to the underlying body wall at some regions like the mouth and atriopore. The test is generally known as the cuticle. Ascidians are usually brightly coloured, because of the presence of coloured pigments in the transparent tunic. They are capable of changing their colour sporadically. The soft body wall is also known as the mantle which lies interior to the test. Below the mantle, lie layers of connective tissue enclosing muscle fibres. Around the oral and atrial apertures, there are strong sphincter muscles. In the rest of the mantle, there is an irregular network of musclefibres, both longitudinal and transverse. The body wall encloses a cavity which is different from the coelom. It is known as the atrial or peribranchial cavity, which opens to the exterior through the atriopore.



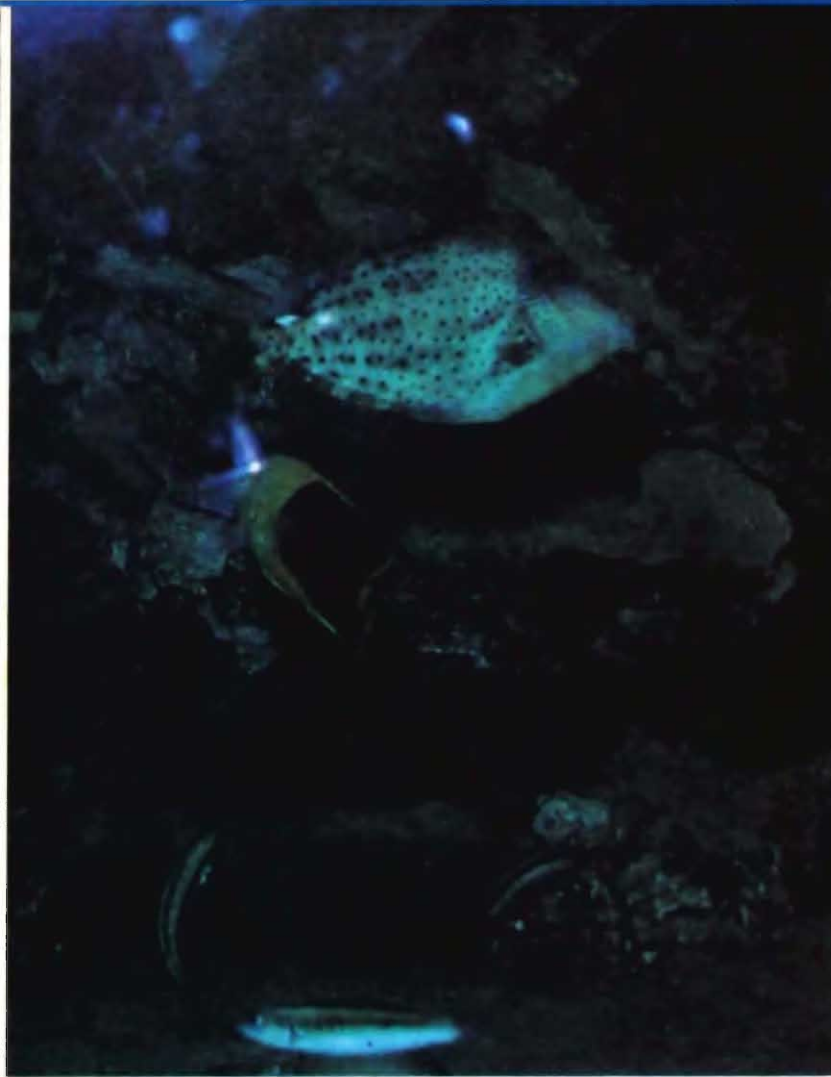
B.K. Tikader

Feather star, *Lamprometra palmata*

Deep water Feather star



Vijay Prasad



-B.K.Tilakder

"Bogus cleaner" which imitates a cleaning wrasse. It eats away pieces of flesh from other fishes

"Cleaning wrasse or doctor fish" — *Labroides dimidiatus* (Valenciennes). It is a compulsive cleaner and goes on with its job on anything that comes close to it. By eating the parasites on the body of other fishes it keeps them clean and healthy.



B.K. Tilakder



.B.K.Tikader

Sea horse, *Hippocampus hystrix* unlike a typical fish, it remains quiet, attached to vegetation with its prehensile tail.

Long-snouted Unicorn fish, *Naso unicornis* (Forsk.) with a pointed horizontal horn on its head in front of the eye, snout long and pointed; attains 60 cm. length; abundant in coastal waters and trawling grounds.



B.K.Tikader



Dragon fish — *Pterois volitans* (Linnaeus) Most dreaded and beautiful, gives a ferocious look with its fan-shaped breast fins (Pectoral) and well spread-out waving spines of the back fin

Scorpion fish, *Pteropterus antennatus* (Bloch) species with poisonous spines, widely distributed in the Indo-Pacific





'Blue-tang', *Acanthurus leucosternon* (Bennett), a beauty of tropical Indo-Pacific coral reefs, a poisonous erectile spine at the base of caudal fin, attains 30 cm. length.

An imperial angel fish *Pomacanthus imperator* (Young one) approaching its coral cave. The angel fishes are experts in the art of disguise and deception. It sports more brilliant colour when young than in the adult stage.





A perch-like fish, *Lutianus chrysothaenia* (Bleeker); predacious fish with a fairly large mouth, body olive green with 5 horizontal bands.

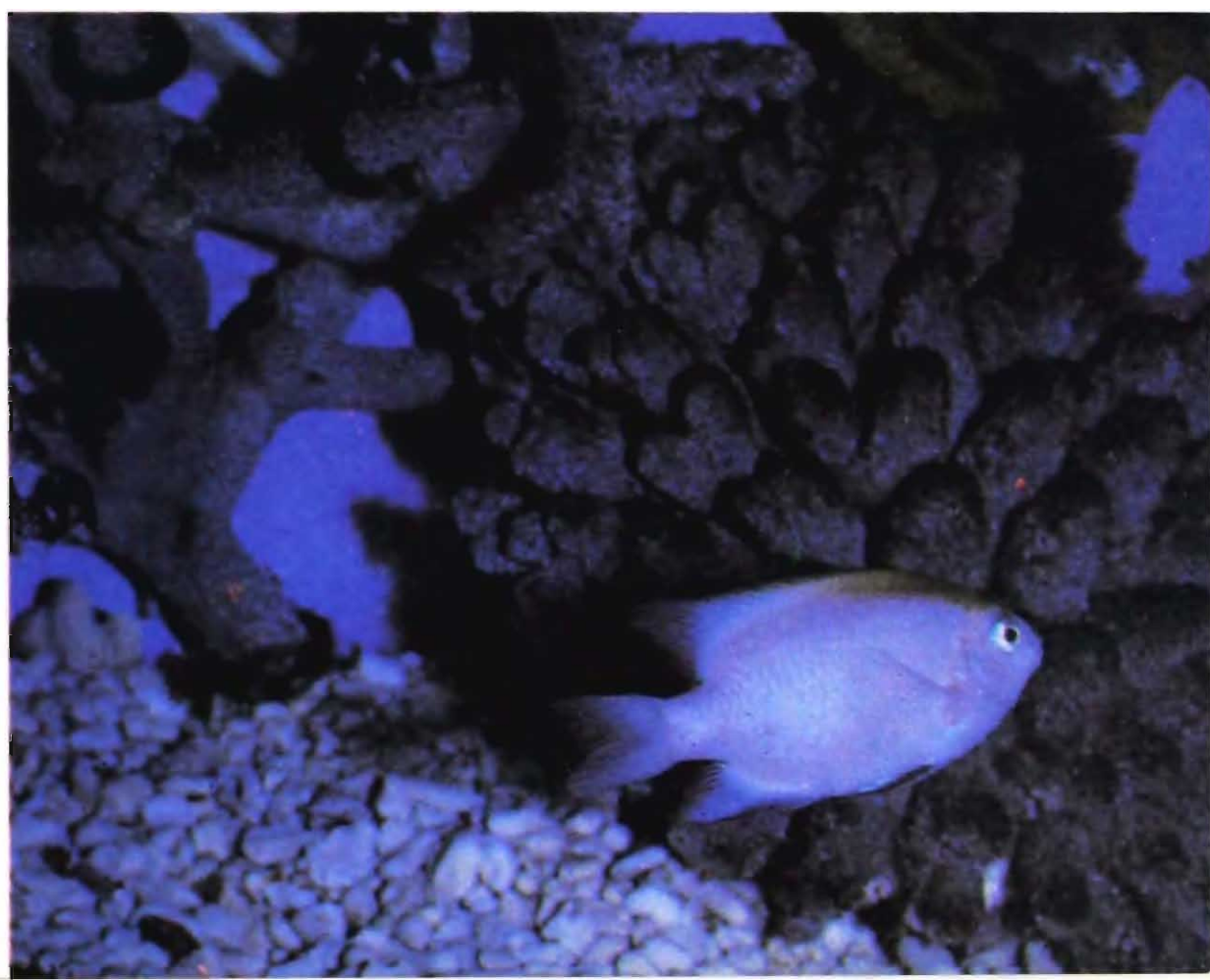
Four species of butterfly fish — Saddle-back butterfly fish, *Chaetodon ephippium* Cuvier (at the bottom) shows a well developed dorsal fin and a trace of eye band. white spotted butterfly fish, *Chaetodon klenii* Bloch shows distinct bluish colour in the interorbital region. Black Back butterfly fish, *Chaetodon melannotus* Schneider with a black spot. Bluespot butterfly fish, *Chaetodon plebeius* Cuvier

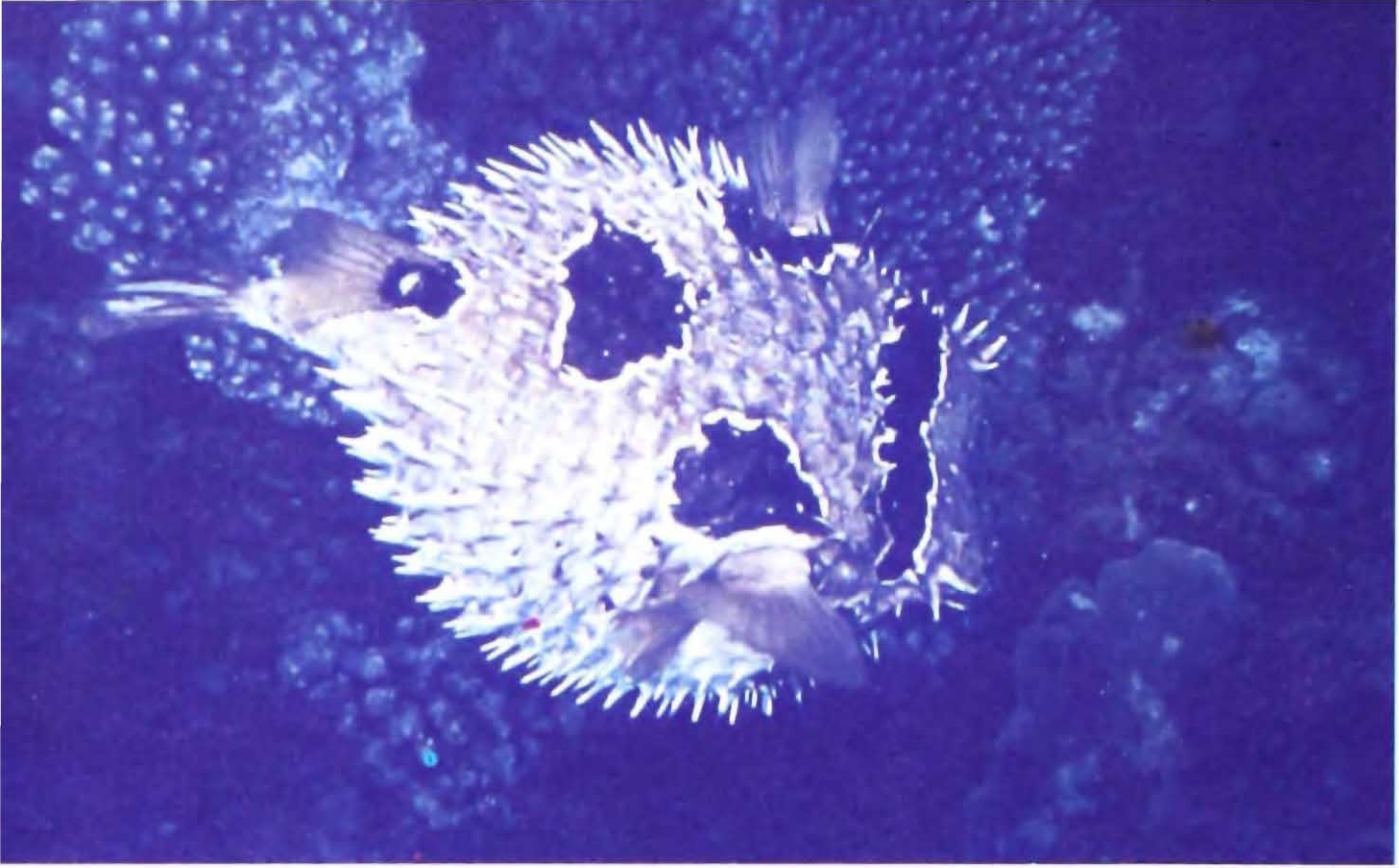




Banded angel fish, *Pygoplites diacanthus* (Boddaert) a beautiful coloured fish of the coral reefs.

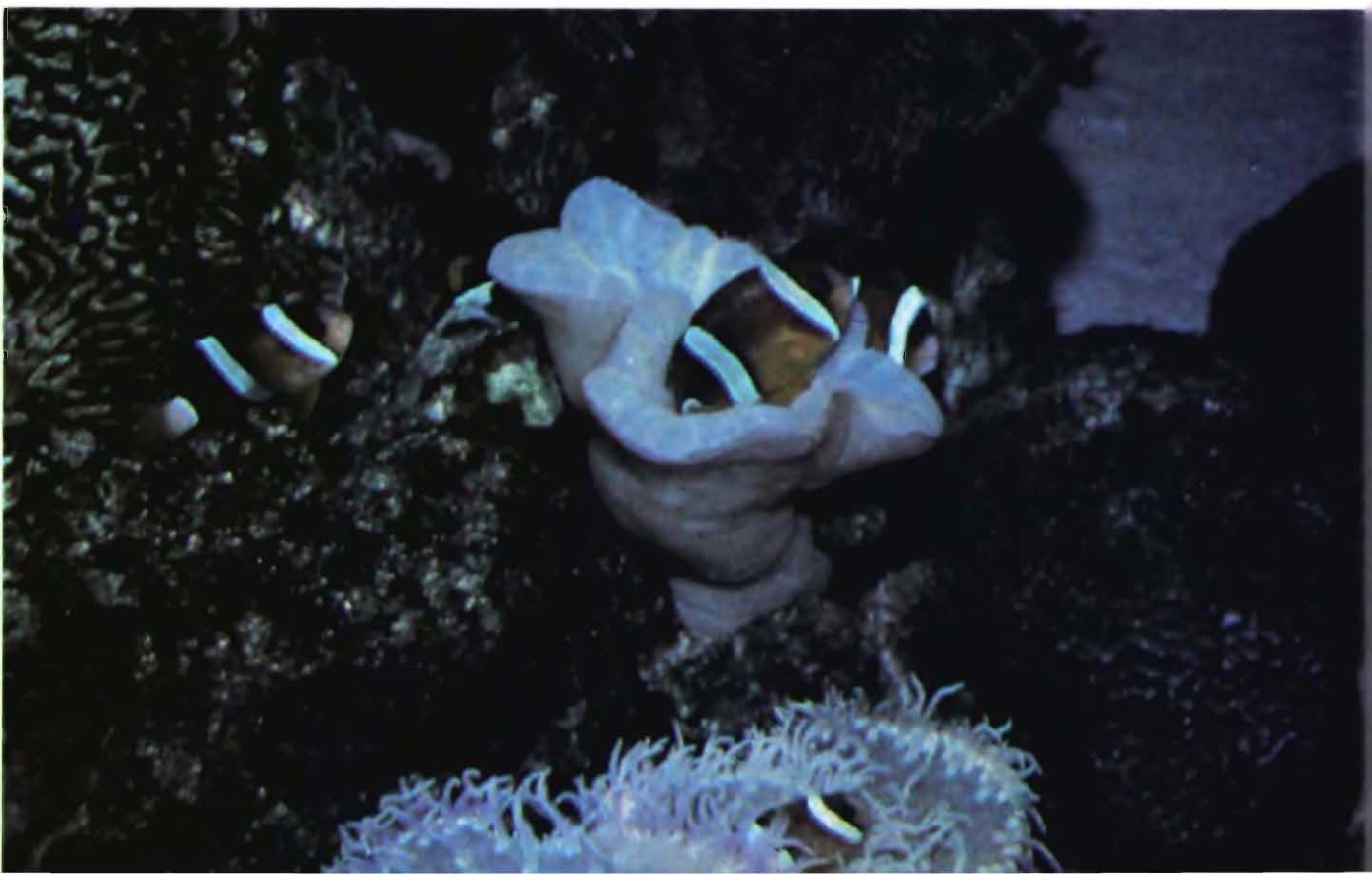
*Abduceduf sordidus* (Forskål) (Pomacanthidae), a species related to beautiful angel fishes.





Porcupine fish, *Tetrodon* sp. the flesh of which is poisonous to human beings and cause severe gastric troubles. It swallows air or water and inflates like a balloon so as to keep the spines in erect position.

The damsel fish or clown fish or anemone fish — (*Amphiprion sebae*) lives among the tentacles of the sea anemone, strange partnership of mutual benefit. The fish is immune to the stings of the sea anemone.



## FINS AND SCALES FISHES

The most spectacular and dazzling beauties of the coral reefs are the fishes. Walking along the low water mark and in tide pools one occasionally comes across darting flamboyant fishes. They are difficult to catch and also to 'catch a glance' as they swim around at a quick speed. Most shore fishes stay below the tossing waves and out of sight.

Sea shore fishes have evolved special adaptations to meet the demanding needs of this dynamic environment. They are small in size, but stoutly built, their bodies are flattened from side to side which is ideal for squeezing between rocks and corals. Some of the fishes have developed flattened undersurfaces, which makes it easier for them to hold on to rocks and escape from the batterings of waves. Many of the shore fishes are well camouflaged to match their surroundings. Some can even change colour and pattern.

The diet of rocky shore fishes is variable. The blennids have wide teeth that can remove barnacles attached to rocks. Sea scorpions' gaping mouths gulp in shrimps. The snake-like pipe fishes suck up tiny plankton.

The most interesting fishes of the littoral region are marine air breathing fishes, rock-skippers. The fishes live in crevices, fissures and pits of large massive rocks in the surf zone. These are very common on rocky coasts of Port Blair, Rutland Island, Cinque Island etc. The fishes belonging to the genus *Andamia* are smaller in size ranging from 48 mm to 70 mm. These blennids feed on the algae growing on the rocks (Rao & Hora, 1938). The structure of the fish is modified just as in hill stream fishes to withstand the swift and violent movements of water. Allied to *Andamia* and living in rock pools are *Salaria*s which prepare a sort of nest to brood the young. There is a small fish without scales or fins, and living inside the cloaca of Holothurians, called pearl fish (*Carapus*).

Some fishes have also developed methods to protect their eggs. The butter fish smears its eggs inside a clam shell. Spotted butter fish (*Scatophagus argus*) is one of the important food fish of the Islands (Menon et al, 1971)

Fishes of the sandy shores have evolved other means of adaptation. Flat fishes fringed with ribbon like fins are common. Some have their body colour matching with the sandy sea bottom.

Butterfly fishes (Chaetodontidae) are the most common and popular fishes of coral reefs. Angel fishes (Pomacanthidae) are another attractive group of reef fishes. Eels are common underneath the rocks or in crevices of corals. Some eels of the sandy coast hide by burying themselves.

Most fishes living in the coral reefs have established territories which they defend vigorously against intruders. Konrad Lorenz concluded from his observations that coral fishes have evolved these sharply contrasting patterns to warn or frighten potential intruders away from their territories. Most of the less brightly coloured coral fishes do not establish territories and are not hostile to their own kind. When two 'Poster coloured' fish of the same species meet, there is almost always a fight, the result of which is that the intruder is either driven off or killed. Some fishes become so angry at the sight of another fish carrying the same pattern that the two sexes must fade to a duller shade in order to approach each other and to spawn. Some of them change their pattern before 'sleeping' assuming a different "night dress."

Turquoise striped and shaped like a torpedo, the blenny lurks among the corals, ready to dart out and attack its prey, the other fish. Blennids are able to leave the water and crawl from pool to pool on their ventral fins.

The brilliant banding on the clown angel fish makes it one of the most conspicuous of tropical fish. Its blue stripes are more iridescent than the yellow parts of its body and are outlined distinctly in black. Clown fish lives among flower like sea anemones. It swims in and out of the tentacles of the sea anemone as though they were harmless blades of grass. It is believed that the clown-fish attracts other fishes towards the tentacles and for this reason the sea anemones tolerate their presence. Others believe that the clown-fishes share their food with the sea anemone.

Scorpion fishes, known for their venomous nature, are also inhabitants of shallow water coral reefs. These are also known as zebra fishes, turkey fishes, lion fishes, etc. The dorsal spines are generally long, slender and straight and have a venom organ. The dorsal spine is grooved on its side. The groove consists of a glandular tissue covered by a banded integumentary sheath.

The 'red big eye' is a large carnivorous nocturnal fish which in the day hides among the corals. The beautiful but deadly lion-fish has red and white striped dorsal spines containing venom which is potent enough to kill a man who steps on them. The poison glands are situated at the base of these spines. The spotted

pectoral fins with their curving white spines are shaped like exotic fans.

Leopard shark and parrot fish can also be noticed in the littoral waters.

Amongst the reef fish there are a series of "mouth breeders" in which the female carries the eggs around in her mouth, and later on the newly hatched young. One may even notice the young fish being literally "breathed out."

## **COLD BLOODED AIR BREATHERS TURTLES, CROCODILES AND SNAKES**

Reptiles of the Islands include some of the rare animals such as sea turtles, salt water crocodiles and sea snakes. Eighty species of reptiles and amphibians are known from these Islands. Of these about 31 species visit the sea shore at some part of their life. Some of these, especially turtles and salt water crocodiles are protected under the Wild Life (Protection) Act, 1972, which came into force in 1973.

Turtles are perhaps the most unappreciated of all animals. One can easily recognise them. But no body seems to show much interest or is very much amused at the sight of a turtle. They are funny looking and dull creatures. Their body is covered by a large shell formed by the fusion of spreadout backbone with the ribs.

Turtles do not form a conspicuous fauna on these islands. Firstly because, they lead most of their life in the sea only coming to the shore for breeding, secondly, there are very few localities on the islands where turtles breed in large numbers, thirdly, their shore visit is only during the night. All these factors contribute to make turtles on the shore a rare sight unless one makes a special effort to catch them on the shore.

Mating of turtles takes place in the sea. After mating, mother turtle starts on its journey to lay the eggs. In the sea, turtles are active swimmers and the flat forelimbs serve as oars for rowing through the water and the short hind limbs act as rudders. But when once it is out of water it is a gruelling journey for the turtle. Mother turtle painstakingly walks across the sand, on flat, paddle shaped flippers, to a chosen spot just above high water mark. During this journey it makes growling noise and it is interrupted by frequent stops for rest. The eyes start shedding tears, which are nothing but a contrivance to release the excess salt accumulated in the body during her life in the sea. The landward migration to lay eggs and the return journey leave their tracks on the sandy beach. The return track bears a central tail drag, which is quite different from that of the onward journey.

After reaching a suitable spot just above high tide level, the mother turtle starts digging a pit, 30 cms to a metre deep, using her hind flippers to fling the sand clear. When the pit is ready, she releases a clutch of eggs, the number varies from species to species. Finally, she makes a few random sweeps across the site in a last minute bid to camouflage her precious nest, thus exhibiting signs of parental care and affection.



Butterfly fishes (*Heinochus acuminatus*) living among corals and moving in a shoal are the most striking and developed a special tubular snout for seeking prey in tiny openings of coral.

#### Estuarine Crocodile





© S. Saha

Green Sea Turtle, *Chelonia mydas* (Linnaeus) best known of the marine species and the principal source of turtle soup.

Olive Ridley Turtle, *Lepidochelys olivacea* (Eschscholtz) can be differentiated from the green turtle by the five pairs of lateral shields on the carapace.





Crab plover (*Dromas ardeola*) roosting on an exposed mud flat

Blacknaped tern (*Sterna sumatrana*). Terns are also known as sea swallows because of their long, slender wings, forked tail and short feet



White bellied Sea eagle, *Haliaeetus leucogaster*. the majestic sea bird



As the mother is busy in releasing eggs and preparing the nest, the father turtle has been keeping vigil, swimming about nearby. It is said that males of many species, who should be considered less chivalrous, never visit the shore. As soon as mother turtle returns, they mate again to ensure the next clutch of eggs. This drama is enacted seven times during a single breeding season. Fortunately, for mother turtle, breeding takes place only once every three years.

After six or eight weeks, the eggs warmed up by the sun, hatch into baby turtles. Many eggs may never hatch. Some may be scooped up and eaten by man and other enemies. Hatchlings of the size of a man's palm break open the eggs. But the real danger for these little ones is in their long journey across the shore to the safety of the sea. Ghost crabs, hawks, frigate birds, night herons and men are all waiting to capture them for their tender, delicious meat.

Marine turtles are represented by seven species in all and five occur in the Indian Ocean region. Four species occur in the Andaman and Nicobar Islands. They are tortoise-shell turtle or Hawksbill (*Eretmochelys imbricata*), Green Sea turtle (*Chelonia mydas*), Olive Ridley turtle (*Lepidochelys olivacea*) and Leather back turtle (*Dermochelys coriacea*). The numbers of these four species have declined catastrophically during recent years. Turtles are exploited for their flesh (green turtles) for their shell (Tortoise shell turtle) and Ridelys for their eggs. The older the turtle the thicker and more valuable is its shell. Firmly attached to the underlying bone, these shells are forcibly separated by heat and then moulded into shape by immersing in hot water

Hawksbill frequents coastal waters, including bays and lagoons. It is the largest turtle occurring on the islands. Nesting population of hawksbill was discovered in the extreme north of the Little Andaman Island (Bhaskar and Whitaker, 1985) An adult green turtle weighs between 450 and 750 kg. In exceptional cases one may weigh 1200 kg. It feeds on marine algae and sea weeds but occasionally takes to molluscs or a crustacean diet. It is nicknamed as the "buffalo of the sea." The mother lays eggs usually during the early part of the night. Green turtles were seen nesting on the sandy beaches of South Sentinel Island. Monitor lizard (*Varanus* sp.) was an enemy of its eggs. (Davis and Altevogt, 1976).

Olive Ridley turtle, smallest of marine turtles occurs in coastal waters as well as open sea. It feeds on small crustaceans, molluscs, fishes and marine algae. The female lays 40 to 180 eggs. Its

flesh is much sought after. Leather back turtle, a pelagic species was observed nesting on the shore of West Bay on Little Andaman Island (Bhaskar and Whitaker, 1983).

Other reptiles which are commonly met with in the waters near the shore are sea snakes. They are usually oceanic forms occurring in the open sea, but sometimes may swim near to the shore. They are very active and agile in water but become completely sluggish when thrown out of water. Their bodies are flattened vertically and the tail from side to side thus enabling them to swim actively in water. Sea snakes are viviparous, giving birth to young ones and most of them breed in the sea.

It is generally believed that the centre of sea snake evolution lies off South east Asia. The islands being nearer to such centre should have a large number of sea snakes. About 26 species of snakes are known in the waters of these islands.

Habitat wise, sea snakes can be distinguished into two groups viz. those inhabiting estuaries and extending into freshwaters and visiting shore and those which are exclusively marine and never visit the shore.

Members of the family Colubridae frequent coastal waters, inhabit estuaries and ascend rivers up to tidal limits.

Nesting sites of *Laticauda*, an amphibious snake, are found on the shores of some of the islands in North Andamans. The snakes come in large numbers to lay their eggs (Whitaker, 1985).

The family Hydrophiidae includes the most specialised of the sea snakes. They have a compressed paddle like tail which enables them to dash off at speed by keeping the body rigid.

The only crocodile that one may chance to come across on these islands is the estuarine crocodile, *Crocodylus porosus*. It is the largest of all living crocodiles and is also a threatened species. It frequents mangrove swamps, or creeks. It is commonly seen in mangrove swamps near Diglipur in North Andamans, Little Andaman and Great Nicobar. The Surveys conducted in 1975-77 revealed the existence of about 80 breeding females (Whitaker and Whitaker, 1979). Habitat destruction, unchecked poaching of eggs and the nest guarding female, are responsible for the depletion in their numbers (Chowdhury and Bustard, 1980). The eggs are laid in cane, bamboo and tiger fern in the landward fringe of mangroves. To rehabilitate this rare species a crocodile sanctuary is contemplated at Port Mouat, on the south-west coast of South Andaman (Whitaker, 1985).

## FLYING VISITORS OF THE SEA SHORE BIRDS

When walking on the beach, you often notice flocks of birds taking to their wings when disturbed. There are some wheeling around the cliffs above your head. Birds fly, swim and dive above, on, and in the shallow waters. For many kinds of birds the sea shore offers a veritable feeding and breeding ground. The Andaman and Nicobar Islands are rich in avifauna and a total of 242 species and subspecies of birds are reported. Twelve major sea bird families are found to nest on the world's islands, confined to warmer seas. Five families (Phaethonitidae, Burhinidae, Dromadidae, Charadriidae and Laridae) of sea shore birds occur in the Andaman and Nicobar islands. Besides, there are birds belonging to five other families which frequent mangroves and marshy areas. Many of the shore birds belong to the family Charadriidae. About 50 species of birds are found along the shores of the Islands (Tikader 1984, Tikader & Das, 1985).

Many of the birds are seasonal visitors to the islands. The great stone plover frequents coastal beaches and reefs in pairs or in small parties. It has a very active foraging habit, and lays eggs in shallow scoops on exposed sand bank. There is a crab plover but is not very common. Seven species of plovers are known from Islands (Tikader & Das, 1985). Plovers, lapwings and their allies are small to medium sized birds. They are ground birds and never perch on a tree.

Turnstone, a winter visitor to the islands moves in flocks of five to twenty. Turnstones are waders that really do turn stones as they search for insects, molluscs and crustaceans. These slender birds change their 'apparel' to black caps in summer and in winter they have white or streaky head.

Reef heron is common on rocky and coral reef areas and sandy shores. It wades in shallow water, suddenly darts at the prey which includes fishes, molluscs and crustaceans. It nests in mangrove trees, sometimes on rocks and in hollows.

Sea gulls are not seen on the islands. But there are 'sea swallows' or terns that are much like the gulls. However, they are slenderly built, smaller but swifter in flight. But on the ground they are not as agile as gulls. Terns are champion divers and swimmers and pursue a chosen victim beneath the waves with swift and dogged determination. The prey is captured by swooping from the air and is swallowed in flight.

Kingfishers are another group of birds which can be easily identified by their strong bills. Kingfishers are represented by 10 species and subspecies on these Islands.

Some of the birds are cliff dwellers. They spend most of their life on cliffs, nesting colony at breeding time and feeding along the sea shore. Many birds spend their lives foraging and nesting on or near the shore.

The white bellied sea eagle (*Haliaeetus leucogaster*) is a mighty bird which frequents sea shore. Fish and sea snakes serve as delicacies to this eagle. It may be seen perched on branches of trees or coral reefs.

### **Birds of Sands**

Sea shore bird life is perhaps most abundant on low, sandy and muddy shores. These areas form the favourite foraging grounds as they are rich in small food animals.

On a sandy beach small, nimble sanderlings dart after the receding waves to snatch sand hoppers. Higher up the beach are found ringed plovers which run quickly, pause and pick up their prey. There are groups of lesser sand plovers and large sand plovers.

### **Birds of Muddy Shore**

On muddy shores, long-legged, long-billed red shanks probe and prey. Many birds of the mud flats have bills made for special ways of feeding. Curlews thrust their long, downcurved bills deep down. Birds' bills probe mud for molluscs and other burrowing animals living at different depths. The beaks of curlews vary in length from 10 cm to 20 cm. Red shank has a smaller beak, sanderling has still smaller beak and ringed plovers which feed on gastropods have very small beaks. The diet of the bird is determined by the length of its beak.

Hovering on the horizon and following a ship is the graceful satin-white, long-tailed Tropic-Bird-*Phaethon lepturus* (Daudin). It is an oceanic bird found singly and spends most of its life sailing over the open sea. It dives headlong to fish from quite a height. One may notice this bird while sailing in a ship.

## WARM BLOODED ANIMALS WHALES, DOLPHINS AND SEA COWS

Mammals are very rarely seen in the coastal waters of the islands. Some of them may be sighted while sailing in a boat or ship, while some may be seen stranded on the shore or caught in a gill net.

Two groups viz. Cetacea (whales and dolphins) and Sirenia (sea cows) are noticed off these islands. These marine mammals are now declared as endangered and one rarely lands into the 'danger' of coming face to face with these animals. These are protected by the Wild Life (Protection) Act of 1972.

There are a few reports of the occurrence of whales in the Andaman Sea. Perhaps Kloss (1902) was the first person to make a reference to whales. Large Killer whales were seen off Nancowry, Little Andaman and Middle Andaman. There was a report of whales getting stranded at a distance from Campbell Bay. Occasionally false killer whales (*Pseudorca crassidens*) were seen or caught off these Islands (James, 1985).

Dolphins occasionally show out of the sea water and display their characteristic behaviour—swimming alongside and crossing the bow of moving ships. The authors noticed dolphins' piloting' their ship when it was sailing on a journey from Port Blair to Neil Island. A blackskinned dolphin measuring 2.02 m in length (68 kg. weight) was caught off Port Blair (Sivaprakasam, 1980).

There had been stray reports of the occurrence of the sea cow, *Dugong dugon* in Andaman and Nicobar Islands. A sea cow measures 2 to 3 metres in length. It is distributed from Diglipur in the North Andamans to Campbell Bay in Great Nicobar. James (1985) gave an account of catches of sea cow. Sea grass beds within the 10 m limit are the favourite habitat of sea cow. There is a Dugong creek in Little Andamans, which perhaps derived its name from the presence of dugong population there. But now there is depletion in their numbers. Ongies used to catch sea cows for the delicious meat. The lower jaw of dugong is placed in front of a ongies' hut to ward off evil spirits.

Although, the whales, sea cows and other marine mammals are related to primitive ungulates, elephants and other mammals with which we are familiar, their body shape is entirely different. As an adaptation to the aquatic life they have secondarily acquired a superficially fishlike, streamlined body. The tail is modified to suit the swimming life. They do not have any hind limbs. Marine

mammals have several inches thick layer of dermal fat or blubber. It acts as an insulating layer and keeps the body temperature constant. It also serves as a storage reservoir of food and adds to the bouyancy of the animal. Just like all other mammals they give birth to young ones and suckle them on milk.

Of the three types of animals mentioned above dolphins are interesting. A dolphin is believed to be very intelligent. It swims faster than a whale or a sea-cow and can keep pace with a ship travelling at 30 knots or over. It is supposed to have a remarkable sonar equipment. Its sound perception may even surpass that of the bat and is highly selective. Its echo location is not merely sensing an echo but also its ability to interpret, evaluate and identify that echo and distinguish between steel ships, wooden ships, sail boats, submarines and whales.

The common dolphin of the Islands is *Delphinus delphis*. It can be easily recognised by its 2.40 to 3.60 m. long body, a long beak and a 'laughing' face. Dolphins and whales are carnivorous and feed on fish, crustaceans or molluscs. A young dolphin begins to munch small squids at about four months of age.

The dolphins and whales are air breathers and come to the surface at intervals to breathe air. A dolphin can stay under water for about six minutes without coming up for taking in air. In motion during most of his 30 years life span, it dozes only in snatches, partially submerged, eyes closed for 30 seconds but sometimes for as long as five minutes.

Dolphins and whales are offshore inhabitants whereas sea cows inhabit shallow water sea and estuaries. Sea cows are purely herbivorous.

Sea cow resembles a whale in its fish-like form, in the absence of external hind limbs, and in the modification of pectoral limbs into paddles. But differs from it in having a moderate sized and rounded head, a small mouth, separate nostrils, and in the absence of dorsal fin.

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## APPENDIX

### LIST OF SPECIES OF MARINE INVERTEBRATES RECORDED FROM ANDAMAN AND NICOBAR ISLANDS

Life in the Sea off Andaman and Nicobar Islands is varied and complex. Some of the inquisitive readers may like to get an idea of the species composition of the marine animals of the islands. Hence a list of species of some of the important groups is provided here. Since vertebrates have been dealt with in several old and recent publications they have been excluded from the foregoing list. Invertebrates are by far numerous in number and there is no single publication dealing with all the groups. The list appended here is compiled after consulting the literature and the National Zoological Collections in the Zoological Survey of India.

Some of the groups like sponges, coelenterates and sipunculids did not receive much attention of the recent authors. Even the classification is in a confused state. Hence we have mentioned only family or class name without going into the details of their position in the classification. The list will provide the necessary basic information and impetus for any one to take up further studies on various groups. A thorough check up of individual species may reduce their number or may add more species to the faunal list appended here.

## a SPONGES

Phylum PORIFERA

Class : HEXACTINELLIDA

1. *Aphrocallistes beatrix* Gray
2. *A. bocagei* Wright
3. *Euplectella aspergillum* Schulze
4. *E. regelia* Schulze
5. *Farrea occa* Carter
6. *Hexactinella minor* Dendy & Burton
7. *Hyalonema aculeatum* Schulze
8. *H. affine* (Brandt)
9. *H. affine pauperum* Schulze
10. *H. indicum* Schulze
11. *H. machrenthali* Schulze
12. *H. pirum* Schulze
13. *Lophocalyx spinosa* Schulze
14. *Pheronema circumpalatum* Schulze
15. *P. raphanus* Schulze
16. *Semperella cucumis* Schulze

Class : CALCAREA

17. *Pericharax heteroraphis* Pilejaeff

Class : DEMOSPONGIAE

18. *Agelas nata* Burton & Rao
19. *Anthisigmella cannaria* Carter
20. *Astrophellia serpentina* Wilson
21. *Azorica pfeifferae* Carter
22. *Biemna liposigma* Burton
23. *B. tubulata* Dendy
24. *Bubaris columnata* Burton
25. *Calyx clavata* Burton
26. *Chalina exigua* Kirkpatrick
27. *Cinachyra arabica* Carter
28. *C. australiensis* Carter
29. *Cliona ensifera* Sollas
30. *C. lobata* (Hane)
31. *C. mucronata*
32. *C. quadrata*
33. *Craniella cranium* (Mueller)
34. *C. dactyloidea* Carter
35. *Damiriopsis bronstedti* Burton
36. *Dercitus plieatus* var. *simplex* Carter
37. *Discondermia gorgonoides* Burton
38. *Donatia andamanensis* Dendy & Burton
39. *D. repens* (Schmidt)
40. *Dragmaxia donnani* Bowerbank
41. *Ecionemia carteri* Dendy
42. *Ectyobatzella enigmatica* Burton & Rao
43. *Erylus lendenfeldi* Sollas
44. *Fibularia ovulum* Lamarck
45. *Gelliodes fibulatus* Ridley
46. *Gellius flagellifer* Dendy & Rao
47. *Hymeniacidon massa* Carter

48. *Kirkpatrickia spiculophila* Burton & Rao
49. *Paratetilla bacca* Selenka
50. *Petromica masslis* Dendy
51. *Petrosia testudinaria* (Lamarck)
52. *Phyllospongia foliascens* Pallas
53. *Poecillastra eccentrica* Dendy & Burton
54. *P. tenuilaminaris* Sollas
55. *Protoschmiditia cerebrum* Burton
56. *Protostylissa foetida*
57. *Raspailia viminalis* Schmidt
58. *Sigmaxiynissa fibulata* (Ridley)
59. *Stelletta cavernosa* (Dendy)
60. *S. clavosa* Ridley
61. *S. hackeli* Sollas
62. *S. orientalis* Thiele
63. *S. tricotriaena* Dendy & Burton
64. *S. validissima* Thiele
65. *Tedania nigrescens* Sahnmidt
66. *Tenacia frondifera* Bowerbank
67. *Tethya diploderma* Schmidt
68. *Tetilla cranum* Muller
69. *T. dactyloidea* (Carter)
70. *Thoosa hancocki* Hinds & Holmes

## b COELENTERATES

Phylum — CNIDARIA

Class — HYDROZOA

1. *Anthohydra psammobionta*  
Salvini-Plawen & Rao
2. *Antenella secundaria* (Gmelin)
3. *Clytia noliformis* (Mc Vradly)
4. *Halamohydra andamanensis* Rao
5. *H. chouhani* Rao
6. *Hebella crateroides* Ritchie
7. *Laomedea (Obelia) bistrata*
8. *Macrorhynchia philippina* (Kirchenpaure)
9. *Macrorhynchia phoenacea* (Busk)
10. *Monoserius pennarius* Linnaeus
11. *Nigellastrum mutulatum* (Busk)
12. *Sertularella polyzonias* var. *cornuta*  
Ritchie
13. *S. guardridens* var. *cornuta* Ritchie

Class — Anthozoa

Order — Alcyonaria

14. *Acamptogorgia rubra* Thomson
15. *A. tenuis* Thomson, Simpson & Henderson
16. *Acanthogorgia muricata* Verrill
17. *A. verrilli* Thomson & Henderson
18. *A. glomerata* Thomson, Simpson & Henderson
19. *A. racemosa* Thomson, Simpson & Henderson
20. *Acis ceylonensis* Thomson & Henderson
21. *A. indica* Thomson & Henderson

22. *A. pustulata* Thomson & Henderson
23. *A. rigida* Thomson, Simpson & Henderson
24. *A. spinosa* Thomson & Henderson
25. *A. ulex* Thomson, Simpson & Henderson
26. *Alcyonium klunzengeri* Thomson & Simpson
27. *Anthogorgia racemosa*
28. *Bebryce mollis* Phillipi
29. *Cactogorgia celosioides* Simpson
30. *Caligorgia flexilis* Hickson
31. *Callistephanus koreni* Wright & Studer
32. *Calicogorgia tenuis* Thomson,  
Simpson and Henderson
33. *Cavernularia obesa* Valenciennes
34. *Ceratoisis gracilis* Thomson & Henderson
35. *Chironephthya asperula*
36. *Chironephthya variabilis* Hickson
37. *Chrysogorgia dichotoma*  
Thomson & Henderson
38. *C. flexilis* Wright & Studer
39. *Dendronephthya arbuscula* Henderson
40. *D. booleyi* Henderson
41. *D. cervicornis* Wright & Studer
42. *D. divaricata* Gray
43. *D. lanifera* Holm
44. *D. rubescens* Henderson
45. *Echiomuricea andamanensis* Thomson,  
Simpson & Henderson
46. *E. ochracea* Thomson, Simpson & Henderson
47. *E. reticulata* Thomson, Simpson & Henderson
48. *E. splendens* Thomson & Henderson
49. *Echinogorgia flabellum* Esper
50. *E. intermedia* Studer
51. *E. macrospiculata* Thomson,  
Simpson & Henderson
52. *E. multispinosa* Thomson & Henderson
53. *E. pseudosassapo* Koll
54. *E. ramulosa* Gray
55. *Elasmogorgia flexilis* Hickson
56. *Eumuricea ramosa* Thomson, Simpson &  
Henderson
57. *Funiculina gracilis* Thomson & Simpson
58. *Gorgonella granulata* Esper
59. *Isis hippuris* Linnaeus
60. *Juncella racemosa* Valenciennes
61. *J. trilineata* (Young)
62. *Keroeides gracilis* Whitelegge
63. *Lepidogorgia verrilli* Wright & Studer
64. *Lituaria phalloides* (Pallas)
65. *Lophogorgia lutkeni* Wright & Studer
66. *Melitodes ornata* Thomson,  
Simpson & Henderson
67. *M. philippinensis* Wright & Studer
68. *M. variabiles* (Hickson)
69. *Menacella gracilis* Thompson & Henderson
70. *Muricella bengalensis* Thomson & Henderson
71. *M. complanata* Wright & Studer
72. *M. robusta* Thomson, Simpson & Henderson
73. *M. rubra* Thomson
74. *Nicella pustulosa*, Thomson,  
Simpson & Henderson
75. *N. flabellata* Thomson & Henderson
76. *Parisis fruticosa* Verrill & Henderson
77. *Parisis indica* Thomson
78. *Paramurica indica* Thomson & Henderson
79. *Pennatula pendula* Thomson & Henderson
80. *Placogorgia indica* Thomson & Henderson
81. *P. orientalis* Thomson & Henderson
82. *Plexaura indica* Ridley
83. *Plexauroides praelonga* Ridley
84. *Polizella australis* Gray
85. *Protocaulon indicum* Thomson & Henderson
86. *Psammogorgia ridleyi* Thomson & Simpson
87. *Pteroeides chinense*
88. *P. crassum* Kolliker
89. *P. esper* var. *armatum* Thomson & Simpson
90. *P. hymenocaulon* Bleeker
91. *P. intermedium* Thomson & Simpson
92. *P. lacazii* var. *spinatum* Kolliker
93. *P. macandresi* Kolliker
94. *P. robustum* Thomson & Simpson
95. *Sarcophytum ehrenbergi* Marenzeller
96. *S. plicatum* Schenk
97. *Scirpearia hicksoni*
98. *S. verrucosa*
99. *Scirrporella moniliforme* Wright & Studer
100. *Sclerophytum densum* Pratt
101. *S. hirtum* Pratt
102. *S. querciforme* Pratt
103. *Siphonogorgia mirabilis* Klunzinger
104. *S. rotunda* Harrison
105. *Solenocaulon sterrokoloneum* Germanos
106. *S. tortussum* Gray
107. *Stonella horrida* Thomson & Henderson
108. *Suberogorgia kolliker* var. *ceylonensis*
109. *S. ornata* Thomson, Simpson & Henderson
110. *Subrepanda subrepanda* Doder
111. *Telesto arborea* Wright & Studer
112. *T. rubia* Hickson
113. *Tubipora musica* Linnaeus
114. *Umbellula purpurea* Thomson & Henderson
115. *Verrucella flabellata* Whitelegge
116. *Virgularia juncea* Pall
117. *V. rumphi*

#### Sea anemones—Actiniaria

In the list given here fourteen families including twenty two genera embracing twenty nine species, reported authentically from the Indian waters, are enumerated. As very limited work has been done on the Actinarians of the Andaman and Nicobar Islands in particular and since, many of these species are likely to occur in the Islands, the total list is given.

Family — Edwardsiidae

1. *Edwardsia tinctris* Annandale
2. *E. pudica* (Klunzinger)
3. *E. jonesii* Seshaiya & Cuttress

Family — Haloclavidae

4. *Metapeachia tropica* (Panikkar)

Family — Halcampidae

5. *Mena chilkaea* (Annandale)  
(= *Phytoesetes chilkaea* Annandale)
6. *Mena limnicola* (Annandale)  
(= *Halianthus limnicola* Annandale)

Family — Haliactiidae

7. *Pelocsetes exul* Annandale
8. *P. minima* Panikkar
9. *Stephensonactis ornata* Panikkar
10. *Phytocoetes gangeticus* Annandale
- 10a. *Phytocoeteopsis ramunni* Panikkar

Family — Boloceroididae

11. *Boloceractis gopalayi* Panikkar

Family — Nevadneidae

12. *Nevadne glauca* (Annandale)  
(= *Gyrostoma glaucum* Annandale)

Family — Actiniidae

13. *Anemonia indicus* Parulekar
14. *Bunodosoma granulifera* (Leseur)
15. *Anthopleura midori* Uchida
16. *Anthopleura asiatica* Uchida
17. *Anthopleura pacifica* Uchida
18. *Anthopleura panikkarii* Parulekar
19. *Paracondylactis indicus* Dave
20. *Actiniogeton sultana* (Carlgren)
21. *Cribrinopsis robertii* Parulekar

Family — Stoichactiidae

22. *Stoichactis giganteum* (Forskal)

Family — Phymanthidae

23. *Phymanthus loligo* (Ehrenberg)

Family — Acontiophoridae

24. *Acontophorum bombayensis* Parulekar

Family — Metridiidae

25. *Metridium senile* var. *fimbriatum* (Verrill)

Family — Aiptasiidae

26. *Neoaipiasia commensali* Prulekar

Family — Aiptasomorphidae

27. *Aiptasiomorpha luciae* (Verrill)

Family — Diadumenidae

28. *Diadumene schilleriana* (Stoliczka)

Family — Cerianthidae

29. *Cerianthus andamanensis* Alcock

Family — Zoanthidae

30. *Epizoanthus stellae*

## STONY CORALS

Class — Anthozoa

Order — Scleractinia

Family — Thamnasteriidae

1. *Psammocora contigua* (Esper)
2. *P. profundacella* Gardiner

Family — Pocilloporidae

3. *Stylophora pistillata* (Esper)
4. *Seriatopora crassa* Quelch
5. *S. hystrix* (Dana)
6. *S. stellata* Quelch
7. *Pocillopora ankei* Scheer and Pillai
8. *P. brevicornis* (Lamarck)
9. *P. damicornis* (Linnaeus)
10. *P. eydouxi* Milne Edwards and Haime
11. *P. meandrina* var. *nobili* Verrill
12. *P. verrucosa* (Ellis and Solander)

Family — Acroporidae

13. *Acropora armata* (Brook)
14. *A. botryoides* (Brook)
15. *A. brueggemanni* (Brook)
16. *A. calamaria* (Brook)
17. *A. canalis* (Quelch)
18. *A. cancellata* (Brook)
19. *A. clathrata* (Brook)
20. *A. clavigera* (Brook)
21. *A. conigera* (Dana)
22. *A. corymbosa* (Lamarck)
23. *A. digitifera* (Dana)
24. *A. diversa* (Brook)
25. *A. dumosa* (Brook)
26. *A. echinata* (Dana)
27. *A. efflorescens* (Dana)
28. *A. formosa* (Dana)
29. *A. grandis* (Brook)
30. *A. gravaida* (Dana)
31. *A. humilis* (Dana)
32. *A. hyacinthus* (Dana)
33. *A. intermedia* (Brook)
34. *A. irregularis* (Brook)
35. *A. millepora* (Ehrenberg)
36. *A. monticulosa* (Bruggemann)
37. *A. multiacuta* Nemenzo
38. *A. nasuta* (Dana)

39. *A. nobilis* (Dana)
40. *A. pacifica* (Brook)
41. *A. palifera* (Lamarck)
42. *A. palmerae* Wells
43. *A. pinguis* Wells
44. *A. plantaginea* (Lamarck)  
[ = *A. humilis* (Dana)]
45. *A. polymorpha* (Brook)
46. *A. pulchra* (Brook)
47. *A. rambleri* (B. Smith)
48. *A. rectina* Nomenzo
49. *A. robusta* (Dana)
50. *A. secale* (Studer)
51. *A. squarrosa* (Ehrenberg)
52. *A. surculosa* (Dana)
53. *A. variabilis* (Klunzinger)
54. *A. virgata* (Dana)
55. *Astreopora listeri* Bernard
56. *Montipora cocosensis* Vaughan
57. *M. composita* Crossland
58. *M. digitata* (Dana)
59. *M. florida* Nomenzo
60. *M. foliosa* (Pallas)
61. *M. fruiticosa* Bernard
62. *M. hispida* Dana
63. *M. peltiformis* Bernard
64. *M. tortuosa* (Dana)
65. *M. turgescens* (Dana)

Family — Agariciidae

66. *Coeloseris mayeri* Vaughan
67. *Leptoseris fragilis* Milne Edwards and Haime
68. *L. papyracea* (Dana)
69. *Pachyseris gemmae* Nomenzo
70. *P. rugosa* (Lamarck)
71. *P. speciosa* (Dana)
72. *Pavona clavus* (Dana)
73. *P. decussata* (Dana)
74. *P. duerdeni* Vaughan
75. *P. explanulata* (Lamarck)
76. *P. obtusa* (Quelch)
77. *P. praetorta* (Dana)
78. *P. varians* Verrill
79. *P. xarifae* Scheer and Pillai

Family — Siderasteridae

80. *Pseudosiderastrea tayami* Yabe and Sugiyama

Family — Fungiidae

81. *Cycloseris costulata* (Ortmann)
82. *C. cyclolites* (Lamarck)
83. *C. distorta* (Michelin)
84. *C. hexagonalis* Milne Edwards and Haime
85. *C. sinensis* Milne Edwards and Haime
86. *Fungia danai* Milne Edwards and Haime
87. *F. echinata* (Pallas)
88. *F. fungites* (Linnaeus)

89. *F. horrida* Dana
90. *F. paumotensis* Stutchberry
91. *F. repanda* Dana
92. *F. scutaria* Lamarck
93. *F. somerville* Gardiner
94. *Fungiacyathus symmetrica* (Pourtales)
95. *Herpitoglossa simplex* (Gardiner)
96. *Herpolitha limax* (Esper)
97. *Polyphyllia talpina* (Lamarck)

Family — Poritidae

98. *Alveopora daedalea* (Forsk.)
99. *Goniopora columna* (Dana)
100. *G. peteolata* Bernard
101. *G. planulata* (Ehrenberg)
102. *G. stokesi* Milne Edwards and Haime
103. *G. tenuidens* (Quelch)
104. *Porites eridani* Umbgrove
105. *P. lobata* Dana
106. *P. lutea* Milne Edwards and Haime
107. *P. nigrescens* Dana
108. *P. porites* (Pallas)
109. *P. solida* (Forsk.)
110. *P. tenuis* (Verrill)

Family — Faviidae

- 110a. *Coelaseris magiri* Vaughan
111. *Cyphastrea microphthalmia* (Lamarck)
112. *Diploastrea helipora* (Lamarck)
113. *Echinopora horrida* (Dana)
114. *E. lamellosa* (Esper)
115. *Favia fava* (Forsk.)
116. *F. pallida* (Dana)
117. *F. rotumana* Gardiner
118. *F. speciosa* (Dana)
119. *F. stelligera* (Dana)
120. *F. valenciennesi* (Milne Edwards and Haime)
121. *Favites abdita* (Ellis and Solander)
122. *F. complanata* (Ehrenberg)
123. *F. flexuosa* (Dana)
124. *F. halicora* (Ehrenberg)
125. *Goniastrea benhami* Vaughan
126. *G. pectinata* (Ehrenberg)
127. *G. planulata* (Milne Edwards and Haime)
128. *G. retiformis* (Lamarck)
129. *Hydnophora exesa* (Pallas)
130. *H. laxa* (Dana)
131. *H. microconos* Lamarck
132. *Leptastrea purpurea* (Dana)
133. *Leptoria phrygia* (Ellis and Solander)
134. *Oulastrea crispata* (Lamarck)
135. *Oulophyllia aspera* (Quelch)
136. *Platygyra daedalea* (Ellis & Solander)
137. *P. lamellina* (Ehrenberg)
138. *P. sinensis* (Milne Edwards & Haime)
139. *Plesiastrea versipora* (Lamarck)
140. *Trachyphyllia geoffroyi* (Audouin)

- Family — Rhizangiidae  
 141. *Culicia rubeola* (Quoy and Gaimard)
- Family — Oculinidae  
 142. *Galaxea clavus* (Dana)  
 143. *G. fascicularis* (Linnaeus)
- Family — Merulinidae  
 144. *Merulina ampliata* (Ellis and Solander)  
 145. *Merulina laxa* Dana  
 146. *Scapophyllia cylindrica*  
 (Milne Edwards and Haime)
- Family — Mussidae  
 147. *Euphyllia glabrescens* Chamisso & Eysenhardt  
 148. *Lobophyllia corymbosa* (Forsk.)  
 149. *L. hemprichii* (Ehrenberg)  
 150. *Mussa angulosa* (Pallas)  
 151. *Symphyllia nobilis* (Dana)  
 152. *S. radians* Milne Edwards and Haime  
 153. *S. recta* (Dana)  
 154. *Echiniphyllia aspersa* (Ellis & Solander)  
 155. *Mycedium elephantotus* (Pallas)  
 155a. *Pectinia lactuca* (Pallas)
- Family — Caryophylliidae  
 156. *Caryophyllia arcuata* Milne Edwards & Haime  
 157. *C. clavus* Scacchi  
 158. *C. grayi* Milne Edwards and Haime  
 159. *Deltocyathus andamanicus* Alcock  
 160. *Euphyllia glabrescens* (Chamisso and Eysenhardt)  
 161. *Heterocyathus aequicostatus* Milne Edwards and Haime  
 162. *Paracyathus indicus* Duncan  
 163. *Physogyra lichtensteini* (Milne Edwards and Haime)  
 164. *Plerogyra sinuosa* (Dana)  
 165. *Polycyathus andamanensis* (Alcock)  
 166. *P. verrilli* Duncan
- Family : — Flabellidae  
 167. *Placotrochus laevis* Milne Edwards and Haime
- Family — Dendrophylliidae  
 168. *Balanophyllia affinis* (Semper)  
 169. *B. scabra* Alcock  
 170. *Dendrophyllia arbuscula* Horst  
 171. *D. micranthus* (Ehrenberg)  
 172. *D. minuscula* Bourne  
 173. *Enallopsammia amphelioides* (Alcock)  
 174. *E. marenzelleri* Zibrowius  
 175. *Heteropsammia michelini* Milne Edwards and Haime  
 176. *Tubastrea coccinea* (Ehrenberg)  
 177. *Turbinaria crater* (Pallas)  
 178. *T. peltata* (Esper)  
 179. *T. veitua* Bernard

## c POLYCHAETES

Phylum ANNELIDA

Class Polychaeta

Family Aphroditidae

Subfamily Aphroditinae Savigny,

[ = HERMIONINAE Grube ]

1. *Aphrodita talpa* Quatrefages
2. *Aphrogenia alba* Kinberg
3. *Hermonia hystrix* (Savigny)
4. *Pontogenia nuda* Host

Subfamily POLYNOINAE Malmgren

5. *Admetella longipedata* McIntosh
6. *Allmaniella ptycholepis* (Grube)
7. *Eunoe pallida* (Ehlers)
8. *Gastrolepidia clavigera* Schmarda
9. *Halosydna (Hyperhalosydna) striata* (Kinberg)
10. *Harmothoe ampullifera* (Grube)
11. *H. dictyophora* (Grube)
12. *H. imbricata* (Linn.)
13. *H. minuta* (Potts)
14. *Iphione muricata* (Savigny)
15. *Lepidasthenia microlepis* Potts
16. *Lepidonotus cristatus* (Grube)
17. *L. glaucus* (Peters)
18. *L. hedleyi* Benham
19. *L. jacksoni* Kinberg
20. *L. melanogrammus* Haswell
21. *L. tenuisetosus* (Gravier)
22. *L. (Thormora) jukesi* (Baird)
23. *Scalissetosus fragilis* (Claparede)

Subfamily Polyodontinae Pflugfelder

24. *Panthalis oerstedii* Kinberg
25. *Polyodontes maxillosus* (Ranzani)
26. *P. melanonotus* (Grube)

Subfamily SIGALIONINAE Malmgren

27. *Psammolyce zeylanica* Willey
28. *Sthenolepis japonica* (McIntosh)

Family Palmyridae Kinberg

[ = CHRYSOPETALIDAE Ehlers ]

29. *Bhawania goodei* Webster

Family Amphinomidae Savigny

30. *Amphinome rostrata* (Pallas)
31. *Chloeia amphora* Horst
32. *C. flava* (Pallas)
33. *C. flava pulchella* Baird
34. *C. fusca* McIntosh
35. *C. parva* (Baird)
36. *Euprosine foliosa* Audouin & Milne-Edwards
37. *Eurythoe complanata* (Pallas)
38. *E. pervecarunculata* Horst

39. *Notopygos hispidus* Potts  
 40. *N. labiatus* McIntosh  
 41. *N. variabilis* Potts
- Family Phyllodocidae Williams  
 Subfamily Phyllodocinae Williams  
 42. *Eulalia albo-picta* Marenzeller  
 43. *Phyllodoce fristedti* Bergstrom  
 44. *P. malmgreni* Gravier  
 45. *P. quadraticeps* Grube  
 46. *P. (Anaitides) madeirensis* Langerhans  
 47. *P. (Anaitides) tenussima* Grube
- Family Pilarcidae St. Joseph  
 48. *Synelmis albini* (Langerhans)
- Family Hesionidae Malmgren  
 49. *Hesione intertexta* Grube  
 50. *H. splendida* Savigny  
 51. *Leocrates claparedii* (Costa)  
 52. *L. filamentosus* Ehlers  
 53. *Ophiodromus angustifrons* (Grube)
- Family Syllidae Grube  
 54. *Syllis (Syllis) gracilis* Grube  
 55. *S. (Typosyllis) armillaris* (Mueller)  
 56. *S. (Typosyllis) exilis* Gravier  
 57. *S. (Typosyllis) okadai* Fauvel  
 58. *Trypanosyllis gigantea* (McIntosh)  
 59. *T. zebra* (Grube)
- Family Nereidae Johnston  
 60. *Ceratonereis anchylochaeta* Horst  
 61. *C. mirabilis* Kinberg  
 62. *C. tripartita* Horst  
 63. *Namalycastis indica* (Southern)  
 64. *Nereis (Neanthes) cricognatha* (Ehlers)  
 65. *N. (Nereis) coutierei* Gravier  
 66. *N. (Nereis) jacksoni* Kinberg  
 67. *Perinereis aibuhitensis* Grube  
 68. *P. brevicirris* (Grube)  
 69. *P. cultrifera* var. *hellerei* Grube  
 70. *P. cultrifera* var. *typica* (Grube)  
 71. *P. neocaledonia* Pruvot  
 72. *P. nigropunctata* (Horst)  
 73. *P. nuntia* var. *typica* (Savigny)  
 74. *P. singaporiensis* Grube  
 75. *P. suluana* Horst  
 76. *P. vancaurica* Ehlers  
 77. *Platynereis dumerilii* Audouin & Milne-Edwards  
 78. *P. pulchella* Gravier  
 79. *P. polyscalma* Chamberlin  
 80. *Pseudonereis anomala* Gravier  
 81. *P. rotnestiana* Augener  
 82. *P. variegata* (Grube)  
 83. *Tylonereis bogoyawlenskyi* Fauvel
- Family Nephtyidae Grube  
 84. *Nephtys (Aqilaophamus) malmgreni* Theel
- Family Glyceridae Grube  
 [ including Goniadidae Kinberg ]  
 85. *Glycera cirrata* Grube  
 86. *G. prashadi* Fauvel  
 87. *G. rouxii* Audouin & Milne-Edwards  
 88. *G. tessellata* Grube
- Family Eunicidae Savigny  
 Subfamily Eunicinae Savigny  
 89. *Eunice afra afra* Peters  
 90. *E. afra paupera* Grube  
 91. *E. afra punctata* Peters  
 92. *E. antennata* (Savigny)  
 93. *E. aphroditois* (Pallas)  
 94. *E. australis* Quatrefages  
 95. *E. grubei* Gravier  
 96. *E. indica* Kinberg  
 97. *E. marenzelleri* Gravier  
 98. *E. norvegica* (Linnaeus)  
 99. *Eunice tentaculata* Quatrefages  
 100. *E. (Palolo) siciliensis* Grube  
 101. *Lysidice collaris* Grube  
 102. *Marphysa mossambica* Petters  
 103. *M. sanguinea* (Montagu)
- Subfamily Onuphinae Kinberg  
 104. *Hyalinoecia tubicola* (Mueller)  
 105. *Onuphis (Nothria) conchylega* Sars  
 106. *O. (Nothria) holobranchiata* Marenzeller  
 107. *O. (Onuphis) aucklandensis* Augener  
 108. *Rhampobranchium chuni* Ehlers
- Subfamily Lysaretinae Kinberg  
 109. *Oenone fulgida* (Savigny)
- Subfamily Lumbrinerinae Malmgren  
 110. *Lumbrinereis sphaerocephale* (Schmarda)  
 111. *L. tetraura* (Schmarda)
- Subfamily Arabellinae Hartman  
 [ = Arabellidae Hartman ]  
 112. *Arabella iricolor iricolor* (Montagu)  
 113. *A. mutans* (Chamberlin)  
 114. *Drilonereis filum* (Claparede)
- Family Spionidae Grube  
 115. *Nerinides knight-jonesi* de-Silva
- Family Magelonidae Cunningham & Ramage  
 116. *Magelona japonica* Okuda
- Family Cirratulidae Carus  
 117. *Cirriiformia filigera* (Delle Chiaje)  
 118. *C. punctata* (Grube)  
 119. *C. tentaculata* (Montagu)

Family Trochochaetidae Pettibone

[ Disomidae Mesnil including  
Pecilochaetidae Hennerz

120. *Poecilochaetus serpens* Allen

Family Chaetoptridae Malmgren

121. *Mesochaetopterus minutus* Potts

Family Orbiniinae Hartman

Subfamily Orbiniinae Hartman

122. *Nainreis laevigate* (Grube)

123. *Scoloplos marsupalis* Southern

Family Opheliidae Malmgren

124. *Armandia lanceolata* Willey

125. *A. leptocirris* Grube

126. *Travisia arborifera* Fauvel

Family Capiteliidae Grube

127. *Capitellethus dispar* Ehlers

128. *Dasybranchus caducus* (Grube)

129. *Notomastus latericeus* Sars

Family Arenicolidae Johnston

130. *Arenicola brasiliensis* Nonato

Family Maldanidae Malmgren

131. *Asychis gotoi* (Izuka)

132. *Axiothella australis* Augener

133. *Euclymene annandalei* Southern

134. *E. grossa* Baird

135. *Maldane sarsi* Malmgren

Family Sternaspidae Carus

136. *Sternaspis scutata* (Renier)

Family Oweniidae Rioja

137. *Owenia fusiformis* Delle Chiaje

Family Flabelligeridae Saint Joseph

138. *Pherusa eruca indica* (Fauvel)

Family Sabellariidae Johnston

139. *Idanthysus pennatus* (Peters)

140. *Lygdamis indicus* Kinberg

Family Pectinariidae Quatrefages

141. *Pectinaria antipoda* Schmarda

142. *P. (Amphictene) crassa* Grube

Family Ampharetidae Malmgren

Subfamily Ampharetinae Chamberlin

143. *Amphicteis gunneri* (Sars)

Family Terebellidae Grube

Subfamily Trichobranchinae Malmgren

[Trichobranchidae, Hesse, includes Canephoridae

and Tricholbranchidea Malmgren]

144. *Terebellides stroemi* Sars

Subfamily Thelepininae Malmgren

145. *Streblosoma persica* (Fauvel)

146. *Thelepus cincinnatus* (Fabricius)

Subfamily Terebellinae Grube

[including Amphitricacea and Artacamacea Malmgren]

147. *Eupolymnia nebulosa* (Montagu)

148. *Loimia meduse* (Savigny)

149. *Nicolea gracilibranchis* (Grube)

150. *Terebella ehrenbergi* Grube

Family Sabellidae Malmgren

Subfamily Sabellinae Rioja

151. *Branciomma nigromaculata* (Baird)

152. *B. serratibranchis* (Grube)

153. *Hypsicomus phaeotaenia* (Schmarda)

154. *Sabella fusca* Grube

155. *S. melanostigma* Schmarda

156. *Sabellastrare sanctijosephi* (Gravier)

Family Serpulidae Savigny

Subfamily Spirorbinae Chamberlin

157. *Spirorbis (Dexiospira) foraminosus* Busch

Subfamily Serpulinae MacLeay

158. *Ditrupa arietina* Mueller

159. *D. arietina* var. *monilifera* Fauvel

160. *Pomatostegus stellatus* (Abildgaard)

161. *Spirobranchus giganteus* (Pallas)

## d CRUSTACEANS

Phylum ARTHROPODA

Class Crustacea

Subclass Cirripedia

Order Thoracica

Family Lithotryidae

1. *Lithotrya nicobarica* Reinhardt

Family Iblidae

2. *Ibla cumingi* Darwin

Family Chthamalidae

3. *Chthamalus malayensis* Pilsbry

Family Balanidae

4. *Balanus tintinnabulum tintinnabulum* Linnaeus

5. *B. tintinnabulum occator* Darwin

6. *B. tintinnabulum volcano* Pilsbry

7. *B. tintinnabulum validus* Darwin

8. *B. amphitrite variegatus* Darwin

9. *B. madrasensis* Daniel  
10. *B. perforatus* Bruguiere
- Family Creusidae
11. *Creusia spinulosus euspinosus* Broch
- Family Pyrogomidae
12. *Pyrgoma grande* (Sowerby)
- Family Tetracitidae
13. *Tetracitella squamosa viridis* Darwin  
14. *T. squamosa patellaris* Darwin
- Subclass Malacostraca  
Order Decapoda  
Suborder Natantia  
Family Penaeidae
15. *Aristeomorpha woodmasoni* Calman  
16. *Aristeus coruscans* Wood Mason  
17. *A. crassipes* Wood Mason  
18. *A. edwardsianus* Johnson  
19. *A. rostridentatus* Spence Bate  
20. *A. virilis* (S. Bate)  
21. *Benthesicymus investigatoris* Anderson  
22. *Gennadas alcocki* Kemp  
23. *Haliporus microps* (S. I. Smith)  
24. *Hymenopenaeus aequalis* (S. Bate)  
25. *Metapenaeopsis andamanensis*  
(Wood Mason & Alcock)  
26. *M. coniger* (Wood Mason)  
27. *M. mogiensis* (Rathbun)  
28. *M. philippii* (Bate)  
29. *M. stridulans* Alcock  
30. *Metapenaeus ensis* (de Haan)  
31. *Parapenaeus fissurus* (Bate)  
32. *P. investigatoris* Alcock & Anderson  
33. *Penaeopsis rectacuta* (Bate)  
34. *Penaeus canaliculatus* Olivier  
35. *P. indicus* Milne Edwards  
36. *P. semisulcatus* de Haan  
37. *Solenocera choprai* Nataraj  
38. *S. annectens* Wood Mason  
39. *Trachypenaeus asper* Alcock
- Family Sergestidae
40. *Sergestes bisulcatus* Wood Mason  
41. *S. rubroguttatus* Wood Mason
- Section Caridea  
Family Alpheidae
42. *Alpheus frontalis* H.M. Edwards  
43. *A. macrosceles* Alcock & Anderson  
44. *A. strenuus* Dana
- Family Anchistioidea
45. *Anchistioidea compressus* Paulson
- Family Atyidae
46. *Caridina brachydactyla brachydactyla*  
de Man
47. *C. gracilivostris gracilivostris* de Haan  
48. *C. prashadi* Tiwari & Pillai  
49. *C. servatirostris* de Man  
50. *C. typus* H. M. Edwards
- Family Cranagonidae
51. *Aegeon andamanensis* (Wood Mason)  
52. *A. medium* (Alcock & Anderson)  
53. *A. orientalis* Henderson  
54. *A. propensalata* (Bate)  
55. *Pontophilus angustirostris* de Haan  
56. *P. candidus* Kemp  
57. *P. gracilis* S. I. Smith  
58. *P. incisus* Kemp  
59. *P. lowisi* Kemp  
60. *P. plebs* Kemp  
61. *P. sabsechota* Kemp  
62. *Prionocrangon ommatosteres* Wood Mason
- Family Disciidae
63. *Discias exul* Kemp
- Family Glyphocrangonidae
64. *Glyphocrangon caeca* Wood-Mason  
65. *G. gilesii* Wood-Mason  
66. *G. investigatoris* Wood-Mason  
67. *G. smithii* Wood-Mason
- Family Gnathophyllidae
68. *Gnathophyllum fasciolatum* Stimpson  
69. *Hymenocera elegans* Heller  
70. *Phyllognathia ceratophthalma* (Balss)
- Family Hippolytidae
71. *Angasia armata* (Paulson)  
[ = *Tozeuma armatum* Paulson ]  
72. *Gelastocaria paronae* (Nobili)  
73. *Hippolysmata prima* (Borradaile)  
74. *H. vittata* Stimpson  
75. *Hippolyte commensalis* Kemp  
76. *H. ventricosa* H. M. Edwards  
77. *Latreutes mucronatus* Stimpson  
78. *L. porcinus* Kemp  
79. *L. pygmaeus* Nobili  
80. *Paralatreutes bicornis* Kemp  
81. *Phycocaris simulans* Kemp  
82. *Saron marmoratus* (Olivier)  
83. *S. neglectus* de Haan  
84. *Thor amboinensis* (de Haan)  
[ = *Thor discosomatis* Kemp ]  
85. *T. maldivensis* Borradaile  
86. *T. paschalis* (Heller)
- Family Hoplophoridae
87. *Azanthephyra armata* A. M. Edwards  
88. *A. curtirostris* Wood-Mason

89. *A. eximea* S.I. Smith  
90. *A. sanguinea* Wood-Mason
- Family Nematocarinidae
91. *Nematocarinus undulatus* Bate  
[ =: *N. paucidentatus* Bate ]
92. *N. tenuirostris* Bate
- Family Palaemonidae
93. *Anchistus custos* (Forsk.)  
[ =: *Anchistus inermis* (Miers) ]
94. *A. demani* Kemp  
95. *A. miersi* de Man  
96. *A. pectinis* Kemp  
97. *Conchodytes biunguiculatus* (Paulson)  
98. *C. tridacnae* Peters  
99. *Coralliocaris graminea* (Dana)  
100. *C. superba* (Dana)  
101. *Harpiliopsis beaupresi* (Audouin)  
102. *H. depressus* var. *spinigera* (Ortmann)  
[ =: *H. depressus* var. *gracilis* Kemp ]
103. *Jocaste lucina* (Nobili)  
104. *Leander tenuicornis* (Say)  
104a. *Leptocarpus potamuscus* (Kemp)  
105. *Macrobrachium australe* (Guerin Meneville)  
106. *M. equidens* (Dana)  
107. *M. hendersoni hendersoni* (de Man)  
108. *M. lar* (Fabricius)  
109. *M. latidactylus* (Thallwitz)  
110. *M. placidulum* (de Man)  
111. *M. scabriculum* (Heller)  
112. *Palaemon (Palaeander) semmelinki* (de Man)  
113. *P. (Palaemon) debilis* Dana  
[ =: *Leander beauforti* Roux ]
114. *Palaemonella lata* Kemp  
115. *P. vestigialis* Kemp  
116. *Periclimenes (Harpilius) agag* Kemp  
117. *P. (H.) amygone* de Man  
118. *P. (H.) andamanensis* Kemp  
119. *P. (H.) brevicarpalis* (Schenkel)  
120. *P. (H.) digitalis* Kemp  
121. *P. (H.) diversipes* Kemp  
122. *P. (H.) elegans* (Paulson)  
123. *P. (H.) inornatus* Kemp  
124. *Periclimenes (H.) leptopus* Kemp  
125. *P. (H.) proximus* Kemp  
126. *P. (H.) seychellensis* Borradaile  
127. *P. (H.) spiniferus* de Man  
128. *P. (H.) tenuipes* Borradaile  
129. *Periclimenes (Periclimenes) impar* Kemp  
130. *P. (P.) vex* Kemp  
131. *P. (P.) signatus* Kemp  
132. *Urocaridella gracilis* Borradaile  
133. *Vir orientalis* (Dana)
- Family Pandalidae
134. *Chlorocurtis miser* Kemp
135. *Chlorotocella gracilis* Balss  
136. *Chlorotocoides spinicauda* (de Man)  
137. *Chlorotocus crassicornis* var. *andamanensis* Anderson  
138. *Heterocarpus alphonssi* Spence Bate  
139. *H. ensifer* A. M. Edwards  
140. *H. gibbosus* Bate  
141. *H. wood masoni* Alcock  
142. *Plesionika alcocki* (A.R.Y. Anderson)  
143. *P. bifurca* Alcock & Anderson  
144. *P. ensis* (A. M. Edwards)  
145. *P. martia* (A. M. Edwards)  
146. *P. ocellus* (Spence Bate)  
147. *P. unidens* Spence Bate  
148. *Thalassocaris crinita* (Dana)
- Family Pasiphaeidae
149. *Leptocheila aculeocaudata* Paulson  
150. *L. pugnax* de Man  
151. *L. robusta* Stimpson  
152. *Parapasiphaea gilesii* Wood-Mason  
153. *Pasiphea sivado* (Risso)  
154. *P. unispinosa* Wood-Mason  
155. *Psathyrocaris infirma* Wood-Mason
- Family Psalidopodidae
156. *Psalidopus huxleyi* Wood-Mason  
157. *P. spiniventris* Wood-Mason
- Family Styrodactylidae
158. *Styrodactylus amarynthidis* de Man
- Section Stenopodidea  
Family Stenopidae
159. *Richardina spongicola* Alcock & Anderson  
160. *Spongicola andamanica* Alcock
- Suborder Reptantia  
Section Macrura  
Family Eryonidae
161. *Pentacheles gibbus* Alcock  
162. *P. hextii* Alcock  
163. *Polycheles ceratus* Alcock  
164. *P. phosphorus* Alcock
- Family Nephropsidae
165. *Nephrops thomsoni* var. *andamanica* Wood-Mason  
166. *Nephropsis ensirostris* Alcock  
167. *N. stewarti* Wood-Mason
- Family Axiidae
168. *Iconaxiopsis andamanensis* Alcock
- Family Callianassidae
169. *Callianassa lignicola* Alcock & Anderson  
170. *Callianidea typa* Milne Edwards

171. *Gebicula exigua* Alcock  
 Family Thalassinidae
172. *Thalassina anomala* (Herbst)  
 Section Anomura  
 Family Galatheidae
173. *Elasmonotus cylindrophthalmus* Alcock  
 174. *Munida andamanica* Alcock  
 175. *M. microps* Alcock  
 176. *M. squamosa* var. *prolixa*  
 177. *M. microps* var. *lasiocheles* Alcock  
 178. *M. tricarinata* Alcock  
 179. *M. vigiliarum* Alcock  
 180. *Munidopsis dasypus* Alcock  
 181. *M. unguifera* Alcock & Anderson  
 182. *M. wardeni* Anderson  
 183. *M. (Bathyankyristes) tenax* Alcock  
 184. *M. (Elasmonotus) cylindrophthalmus* Alcock  
 185. *M. (Galathodes) reqla* Alcock & Anderson  
 186. *Munidopsis (Galathodes) triaena* Alcock & Anderson  
 187. *M. (G.) trifida* Henderson  
 188. *M. (Orophorhynchus) ceratophthalmus* Alcock  
 Family Uroptychidae  
 189. *Ptychogaster investigatoris* Alcock & Anderson  
 190. *Uroptychus nigricapillis* Alcock  
 Family Coenobitidae  
 191. *Birgus latro* (Linnaeus)  
 192. *Coenobita cavipes* Stimpson  
 193. *C. clypeata* (Herbert)  
 194. *C. perlata* (H. M. Edwards)  
 195. *C. ruqosa* H. M. Edwards  
 Family Paguridae  
 196. *Aniculus aniculus* (Herbst)  
 197. *A. strigatus* (Herbert)  
 198. *Calcinus gaimardii* (H. M. Edwards)  
 199. *C. herbstii* de Man  
 200. *C. latens* (Randall)  
 201. *Clibanarius arethusa* de Man  
 202. *C. corallinus* (H. M. Edwards)  
 203. *C. humilis* Dana  
 204. *C. longitarsus* (de Haan)  
 205. *C. merguiensis* de Haan  
 206. *C. olivaceus* Henderson  
 207. *C. striolatus* Dana  
 208. *Dardanus deformis* (H. M. Edwards)  
 209. *D. euopsis* (Dana)  
 210. *D. guttatus* (Olivier)  
 211. *D. megistos* (Herbst)  
 212. *D. varipes* (Heller)  
 213. *D. vulnerans* (Thallwitz)  
 214. *D. woodmasoni* (Alcock)
215. *Diogenes avarus* Heller  
 216. *D. custos* (Fabricius)  
 217. *D. merguiensis* de Man  
 218. *Nematopagurus squamichelis* Alcock  
 219. *Paguristes balanophilus* Alcock  
 220. *Paguristes ciliatus* (Heller)  
 211. *P. mundus* Alcock  
 222. *P. puniceus* Henderson  
 223. *Pagurus pergranulatus* (Henderson)  
 234. *P. zebra*  
 235. *Spiropagurus spiriger* var. *lophomeris* Alcock  
 236. *S. spiriger profundorum* Alcock  
 237. *Sympagurus bicristatus* var. *indicus* Alcock  
 238. *S. monstrosus* (Alcock)  
 Family Pylochelidae  
 239. *Pylocheles miersi* Alcock & Anderson  
 240. *Parapylocheles scorpio* Alcock  
 Family Alburnidae  
 241. *Alburnea symnista* (Linnaeus)  
 Section Brachyura  
 Family Portunidae  
 242. *Portunus minutus* (Shen)  
 243. *P. emarginatus* Stephenson & Campbell  
 244. *P. sanguinolentus* (Herbst)  
 245. *P. pelagicus* (Linnaeus)  
 246. *P. granulatus* (Milne Edwards)  
 247. *Scylla serrata* (Forsk.)  
 248. *Thalamita integra* Dana  
 249. *T. admete* Herbst  
 250. *T. chaptali* Audouin & Savigny  
 251. *T. crenata* (Latreille)  
 252. *T. prymna* (Herbst)  
 253. *Charybdis (Goniohellenus) truncata* (Fabricius)  
 Family Grapsidae  
 254. *Grapsus albolineatus* Lamarck  
 255. *Metopograpsus frontalis* Mirs  
 256. *Pachygrapsus minutus* A.M. Edwards  
 257. *P. planifrons* de Man  
 258. *Sesarma (Chiromantes) bidens* (de Haan)  
 259. *Metaplex distincta* M. Edwards  
 260. *Ptychognathus dentatus* de Man  
 261. *Plagusia depressa* var. *immaculata* Lamarck  
 262. *Perenon planissimum* (Herbst)  
 Family Ocypodidae  
 263. *Ocypoda cordimana* Desm.  
 264. *O. ceratophthalma* (Pallas)  
 265. *Uca annulipes* (Latreille)  
 266. *U. marionis excisa* Mobill  
 267. *Dotilla myctiroides* (M. Edwards)  
 268. *D. wichmanni* de Man  
 269. *Macrophthalmus convexus* Stimpson

270. *M. telescopicus* (Owen)
- Family Mictyridae
271. *Mictyris longicarpus* Latreille
- Family Xanthidae
272. *Atergatis dilatatus* de Haan
273. *A. floridus* (Rumph)
274. *Atergatopsis signata* (Adams & White)
275. *Actaea cavipes* (Dana)
276. *A. hirsutissima* (Ruppell)
277. *A. speciosa* (Dana)
278. *A. tomentosa* (M. Edwards)
279. *Carpilodes rugutus* (Latreille)
280. *C. tristis* Dana
281. *Chlorodiella laevisissima* (Dana)
282. *C. niger* (Forskall)
283. *Chlorodopsis areolata* (M. Edwards)
284. *C. melanochira* (M. Edwards)
285. *C. pilumnoides* (White)
286. *C. spinipes* (Heller)
287. *Cymo anderecssyi* (Audouin)
288. *Domecia hispida* Eydoux & Souleyet
289. *Etisus dentatus* (Herbst)
290. *E. laevimanus* Randall
291. *Eurycarcinus grandieri* M. Edwards
292. *E. maculatus* (M. Edwards)
293. *Epixanthus dentatus* (White)
294. *E. frontalis* (M. Edwards)
295. *Eriphia smithii* Macleay
296. *Jonesius minuta* Sankarankutty
297. *Leptodius cavipes* (Dana)
298. *L. exaratus* (Milne Edwards)
299. *L. nudipes* (Dana)
300. *L. sanguineus* (M. Edwards)
301. *Pilumnus hirsutus* Stimpson
302. *P. heterodon* Sakai
303. *P. vespertilio* (Fabricius)
304. *Phymodius sculptus* (Milne Edwards)
305. *P. nugulatus* (M. Edwards)
306. *Platypodia granulosa* (Ruppell)
307. *Trapezia cymodoce* (Herbst)
308. *T. ferruginea* Latreille
309. *T. ferruginea* var. *intermedia* Miers
310. *T. ferruginea* var. *areolata* Dana
311. *Tetralia glaberrima* (Herbst)
312. *Xanthia larmarckii* (Milne Edwards)
313. *X. notatus* (Dana)
314. *Zozymus aeneus* (Linnaeus)
315. *Zozymodes pumilus* (Jacquinot)
- Family Calappidae
316. *Calappa hepatica* (Linnaeus)
317. *C. philargius* (Linnaeus)
318. *Matuta leanksii* Leach
319. *Matuta lunaris* (Forskall)
- Family Leucosiidae
320. *Arcania undecimspinosa* de Haan
321. *A. tuberculata* Bell
322. *Leucosia pallida* Bell
323. *Myra fugax* (Fabricius)
324. *M. pentacantha* Alcock
325. *Nursila dentata* Bell
326. *Tlos patus* Borradaile
- Family Parthenopidae
327. *Aulacolambrus hoplonotus* Adam & White
- Family Maiidae
328. *Menaethius monoceros* Latreille
329. *Paratymolus hastatus* Alcock
330. *Pseudomicippa tenuipes* M. Edwards
331. *Schizophrys aspera* (M. Edwards)
332. *Tylocarcinus styx* (Herbst)
- Family Gecarcinidae
333. *Cardisoma carnifex* (Herbst)
- Family Raninidae
334. *Lyreidus channeri* Wood Mason
335. *Notopus dorsipes* (Fabricius)
- Family Dorippidae
336. *Cymonoinops glaucomma* Alcock
337. *Dorippe astuta* Fabricius
338. *Dorippe dorsipes* (Linnaeus)
339. *D. faechino* (Herbst)
340. *Ethusa (Ethusina) descicens* Alcock
341. *E. indica* Alcock
342. *Ethusa pyqmaea* Alcock
- Family Cancridae
343. *Kraussia integra* (de Haan)
344. *K. nitida* Stimpson
- Family Homolodromidae
345. *Arachnodromia baffini* Alcock & Anderson
- Family Dynomenidae
346. *Acanthodromia margarita* Alcock
- Family Dromiidae
347. *Conchoecetes artificiosus* (Fabricius)
348. *C. andamanicus* Alcock
349. *Dromia (Cryptodromia) bullifera* Alcock
350. *D. cranioides* de Haan
351. *D. (Petalomera) granulata* Stimpson
352. *D. unidentata* Rueppell
- Family Homolidae
353. *Homola andamanica* Alcock
354. *H. megalops* Alcock
355. *Paramalopsis boasi* Wood Mason

Family Latreillidae  
356. *Latreillopsis bispinosa* Henderson

Family Gonoplacidae  
357. *Carcinoplax longimanus* de Haan  
358. *C. longipes* (Wood Mason)  
359. *Ceratoplax ciliata* Stimpson  
360. *Camatopsis rubida* Alcock & Anderson  
361. *Eucrata crenata* de Haan  
362. *Hepthopelta lugubris* Alcock  
363. *Libystes alphonsi* Alcock  
364. *L. edwardsi* Alcock  
365. *Litochira beaumontii* Alcock  
366. *L. quadrispinosa* Zehntner  
367. *Notonyx vitreus* Alcock  
368. *Psopheticus stridulans* Wood Mason  
369. *Typhlocarcinus nudus* Stimpson  
370. *Xenophthalmodes moebii* Richters

Family Pinnotheridae  
371. *Pinnotheris purpureus* Alcock  
372. *Tetrias fischeri* (A. M. Edwards)  
373. *Xanthasia murigera* White  
374. *Xenophthalmus obscurus* Henderson

Family Hymenosomidae  
375. *Elamena (Trigonoplax) unguiformis* de Haan  
376. *E. truncata* (Stimpson)  
377. *Hymenicus woodmasoni* Alcock

Order Stomatopoda  
Family Lysiosquillidae  
378. *Acanthosquilla acanthocarpus* (Miers)  
379. *Heterosquilla insignis* (Kemp)  
380. *H. spinosa* (Wood Mason)  
381. *Lysiosquilla maculata* (Fabricius)  
382. *L. sulcirostris* Kemp.

Family Squillidae  
383. *Anchisquilla fasciata* (de Haan)  
384. *Clorida decorata* Wood Mason  
385. *Harpiosquilla annandalei* (Kemp)  
386. *H. harpax* (de Haan)  
387. *H. indica* Manning  
388. *Harpiosquilla raphidea* (Fabricius)  
389. *Leptosquilla schemeltzii* (A.M. Edwards)  
390. *Oratosquilla gonypetes* (Kemp)  
391. *O. indica* (Hansen)  
392. *O. interrupta* (Kemp)  
393. *O. perpensa* (Kemp)  
394. *Squilloides leptosquilla* (Brooks)  
395. *S. tenuispinis* (Wood Mason)

Family Eurysquillidae  
396. *Manningia andamanensis* Ghosh

Family Pseudosquillidae  
397. *Pseudosquilla ciliata* (Fabricius)

Family Gonodactylidae  
398. *Chorisquilla andamanica* Manning  
399. *C. gyrosa* (Odhner)  
400. *C. spinosissima* (Pfeffer)  
401. *Gonodactylus chiraga* (Fabricius)  
402. *B. falcatus* (Forskall)  
403. *B. platysoma* Wood Mason  
404. *Haptosquilla glyptocercus* Wood Mason  
405. *H. lenzi* (Holthuis)  
406. *H. pulchella* (Miers)  
407. *H. nefanda* (Kemp)

## e PYCNOGONIDS

Family — Nymphonidae  
1. *Nymphon andamanense* Calman

Family — Pallenidae  
2. *Pallenopsis alcocki* Calman  
3. *P. ovalis* Loman

Family — Phoxichilidiidae  
4. *Anoplodactylus cribellatus* Calman

Family — Ammotheidae  
5. *Endeis mollis* (Carpenter)

Family — Colossendeidae  
6. *Colossendeis colossea* Wilson  
7. *C. macerrima* Wilson  
8. *Rhopalorhyncus kroyeri* Wood Mason

## f MOLLUSCS

Phylum MOLLUSCA  
Class Polyplacophora  
Order: LEPIDOPLEURIDA  
Chitons or Coat-of-Mail Shells

Family Lepidopleuridae  
1. *Lepidopleurus andamanicus* Smith

Family Acanthochitonidae  
2. *Acanthochitona mahensis* Winckworth  
3. *A. penetrans* Winckworth

Family Cryptoplacidae  
4. *Cryptoplax larvaeformis* (Burrow)  
form *oculatus* (Quoy and Gaimard)

Family Ischnochitonidae  
5. *Calliostochiton pulchellus* (Gray)

6. *Ischnochiton alatus* (Sowerby)  
7. *I. bouryi* Dupuis  
8. *I. winckworthi* Leloup
- Family Chitonidae
9. *Acanthopleura spiniger* (Sowerby)  
10. *Chiton granoradiatus* Leloup  
11. *C. huluensis* (Smith)  
12. *C. pulcherrimus* (Sowerby)  
13. *Squamopleura imitator* Nierstraz
- Class Gastropoda  
Order : ARCHAEOGASTROPODA  
Family Haliotidae  
Ear-Shells or Abalones
14. *Haliotis (Haliotis) asinina* Linnaeus  
15. *H. (H.) diversicolor* Reeve  
16. *H. (Ovinotis) ovina* Gmelin  
17. *H. ruqosa* Reeve  
18. *H. (Sanhaliotis) varia* Linnaeus
- Family Fissurellidae  
Key hole limpets
19. *Diadora bombayana* Sowerby  
20. *D. funiculata* (Reeve)  
21. *D. granifera* (Pease)  
22. *D. pipleopsoides* (Reeve)  
23. *D. rupelli* (Sowerby)  
24. *D. subquadrata* (Nevill)  
25. *D. ticaonica* (Reeve)  
26. *Emarginula clypea* A. Adams  
27. *E. eximia* A. Adams  
28. *E. scabriuscula* A. Adams  
29. *Macroschisma canalifera* (G. & H. Nevill)
- Family Patellidae  
Limpets
30. *Cellana radiata enneaqona* (Reeve)  
31. *C. radiata radiata* (Born)  
—Indo Pacific Limpets  
32. *C. testudinaria* (Linnaeus)  
—Common Turtle Limpet  
33. *Patella (Scutellastra) flexuosa*  
Quoy and Gaimard—Star Shaped Limpet
- Family Acmaeidae  
True Limpets
34. *Acmae achates* Reeve  
35. *A. inconspicua* Linnaeus  
36. *A. minutissima* Smith  
37. *A. saccharina* (Linnaeus)  
—Pacific Sugar Limpet
- Family Lepitidae
38. *Saptadanta nasika* Prashad and Rao
- Family Trochidae  
Top Shells
39. *Angaria delphinus* (Linnaeus)
- Common Delphinula
40. *A. distorta* (Linnaeus)  
—Distorted Delphinula
41. *Clanculus clanguloides* (Wood)  
—Secret Clanculus
42. *C. margaritarius* Philippi  
—Beautiful Clanculus
43. *C. microdon* A. Adams  
44. *Chrysostoma paradoxum* (Born)  
—Paradox Top
45. *E. fossulatus* Sowerby  
46. *E. asper* (Gmelin)  
47. *Euchelus atratus* (Gmelin)  
—Blackish Margarate
48. *Monilea callifera* (Lamarck)  
49. *M. masoni* Nevill  
50. *M. nucleus* Philippi  
51. *M. subplicata* Nevill  
52. *Monodonta (Monodonta) australis*  
Lamarck
53. *M. (M.) labio* Linnaeus  
54. *Solariella infundibulum* Watson  
55. *Tectus (Tectus) fenestratus* (Gmelin)  
—Fenestrate Top
56. *T. (T.) mauritanus* (Gmelin)  
57. *T. (T.) pyramis* Born  
—Pyramid Top
58. *T. (T.) incrassatus* Lamarck  
59. *T. (T.) maculatus* Linnaeus  
—Maculata Top
60. *T. (T.) niloticus* Linnaeus  
—Commercial Trochus
61. *T. (Infundibulus) radiatus* Gmelin  
—Radiate Top
62. *T. (T.) stellatus* Gmelin  
63. *T. (Infundibulus) tentorium*  
Gmelin
64. *Umbonium vestiarium* (Linnaeus)  
—Common Button Top
- Family Stomatellidae
65. *Stomatella haliotideia* Sowerby  
66. *S. sulcifera* Lamarck
- Family Turbinidae  
Turban shells
67. *Astrea (Astralium) semicostata* (Kiener)  
—Half ribbed star shell
68. *Liotia cidaris* (Reeve)  
69. *L. varicosa* Reeve  
70. *Turbo (Lunatica) brunneus* (Roeding)  
—Brown Pacific Turban
71. *T. (Lunella) cinerea* Born  
—Smooth Moon Turban
72. *T. (Turbo) cochleus* Linnaeus  
73. *T. (T.) marmoratus* Linnaeus  
—Great Green Turban

74. *T. (T.) petholatus* Linnaeus  
—Tapestry Turban
75. *T. (Lunella) porphyrites* (Martyn)
76. *T. (Turbo) spinosus* Gmelin
- Family Cyclostrematidae
77. *Cyclostrema micqns* A. Adams
- Family Neritidae  
Nerites
78. *Clithon oualaniensis* (Lesson)  
—Guamanian Nerite
79. *Nerita (Theliostyla) albicella* Linnaeus  
—Ox-Palate Nerite
80. *N. (Amphinerita) articulata* Gould
81. *N. (Theliostyla) chamaeleon* Linnaeus  
—Chameleon Nerite
82. *N. (T.) costata* Linnaeus  
Costate Nerite
83. *N. (A.) georgina* Recluz
84. *N. (Amphinerita) grayana* Recluz
85. *N. (Theliostyla) patula* Recluz
86. *N. (T.) planospira* Anton  
—Flat spired Nerite
87. *N. (Ritena) plicata* Linnaeus  
—Plicate Nerite
88. *N. (Amphinerita) polita* Linnaeus  
—Polished Nerite
89. *N. (A.) semirugosa* Recluz
90. *N. (Theliostyla) squamulata*  
Le Guillou
91. *Neritina (Dostia) violacea* (Gmelin)  
—Violet Nerite
- Order : MESOGASTROPODA  
Family Littorinidae  
periwinkles
92. *Littorina (Littorinopsis) scabra scabra*  
(Linnaeus)—Scabra Periwinkle
93. *L. (Littoraria) undulata* Gray—Undulate  
Periwinkle
94. *Nodilittorina (Granulilittorina) millegrana*  
(Philippi)
95. *Nodilittorina (Nodilittorina) pyramidalis*  
*pyramidalis* (Quoy & Gaimard)
- Family Rissoidae
96. *Rissoina abnormis* Nevill
97. *Rissoina ambigua* Gould
98. *R. media* Schwartz
99. *R. mohensternii* Deshayes
100. *R. obeliscus* Recluz
101. *R. oryza* var. *sublaevigata* Nevill
102. *R. striata* Quoy
103. *R. striolata* A. Adams
104. *R. zygantia* Deshayes
- Family Assimineidae
105. *Assiminea brevicula* (Philippi)
- Family Turritellidae  
Turritellas
106. *Turritella duplicata* (Linnaeus)  
Duplicate Turritella
107. *T. fastigiata* Adam & Reeve  
—Printed Turritella
108. *T. infracontracta* Smith
109. *T. (Haustator) monilifera* Adam and Reeve
- Family Architectonicidae  
Sundials
110. *Architectonica laevigata* (Linnaeus)  
Smooth Sundial
111. *A. perspectivum* (Linnaeus)  
Clear Sundial
112. *Heliacus (Torinista)*  
*dorsuosus* (Hinds)
- Family Vermetidae  
Worm Shells
113. *Dendropoma (Spiroglyphus)*  
*andamanicus* (Prashad and Rao)  
Andaman Wormshell
114. *Tenagodus muricata* (Born)  
Beaded Wormshell
- Family Planaxidae  
Planaxis Snails
115. *Planaxis acutus* Krauss  
Acute Planaxis
116. *P. ineptus* Gould
117. *P. nicobaricus* Frauenfeld  
Nicobar Planaxis
118. *P. sulcatus* Born  
Sulcate Planaxis
119. *P. suturalis* Smith
- Family Modulidae  
Modulus Snails
120. *Modulus tectum* Gmelin  
Tectum Modulus
- Family Potamididae  
Horn Snails
121. *Cerithidea (Cerithidiopsilla)*  
*cingulata* (Gmelin)
122. *C. obtusa* (Lamarck)
123. *C. quadrata* Sowerby
124. *Telescopium (Telescopium)*  
*telescopium* (Linnaeus)  
Telescope Snail
125. *Terebralia palustris* (Bruguere)  
Mud Creeper

- Family Cerithiidae  
Ceriths
126. *Cerithium armatum* Born  
127. *C. balteatum* Philippi  
128. *C. citrinum* Sowerby  
(Yellow Cerith)  
129. *C. columna* Sowerby  
130. *C. nodulosum* Bruguiere  
Giant Knobbed Cerith  
131. *Clypeomorus moniliferus* (Kiener)  
132. *Rhinoclavis aspera* (Linnaeus)  
Rough Vertagus  
133. *R. (Rhinoclavis) sinensis* (Gmelin)  
Obelisk Vertagus  
134. *R. vertagus* (Linnaeus)  
Common Vertagus
- Family Cerithiopsidae
135. *Cerithiopsis pulvis* Issel
- Family Epitoniidae  
Wentletraps
136. *Eglisia tricarinata* Adams & Reeve  
137. *Epitonium gracilis* (Sowerby)  
138. *E. multicosata* (Sowerby)  
139. *E. varicosa* (Lamarck)  
Varicose Wentletrap
- Family Janthinidae  
Purple Sea snails
140. *Janthina fragilis* (Lamarck)  
Fragile Purple sea snail
- Family Xenophoridae  
Carrier Shells
141. *Tugurium indicum* (Gmelin)  
Indian Carrier shell  
142. *Xenophora calculifera* (Reeve)  
Fragment Carrier shell  
143. *X. exustus* Reeve  
144. *X. pallidula* (Reeve)  
Pallid Carrier shell  
145. *X. solariodes* (Reeve)  
Solar Carrier shell
- Family Calyptraoidea  
Cup-saucer shells
146. *Calyptraea (Crucibulum) extincorium* Lamarck  
147. *Crepidula walshi* Hermannsen  
Slipper shell
- Family Amaltheidae
148. *Amalthea (Amathina) tricarinata* (Linnaeus)
- Family Strombidae
- True Conchs
149. *Lambis (Harpago) chiragra chiragra* (Linnaeus)  
Chiragra Conch  
150. *L. (Lambis) crocata crocata* Link  
Orange Spider Conch  
151. *L. (L.) lambis* (Linnaeus)  
Spider Conch  
152. *L. (Millepes) scorpius indomaris* Abbott  
Scorpion Conch  
153. *Rimella cancellata* (Lamarck)  
154. *Strombus (Canarium) erythrinus erythrinus* Dillwyn  
Elegant Conch  
155. *S. (C.) fragilis* (Roeding)  
156. *S. (C.) labiatus labiatus* (Roeding)  
Plicate Conch  
157. *S. (C.) labiatus olydius* (Duclos)  
158. *S. (C.) mutabilis* Swainson  
159. *S. (Dolomena) dilatatus dilatatus* Swainson  
Dialate Conch  
160. *S. (D.) marginatus marginatus* Linnaeus  
Marginate Conch  
161. *S. (D.) marginatus succinctus* Linnaeus  
Tunic Conch  
162. *S. (D.) plicatus pulchellus* Reeve  
Pretty Conch  
163. *S. (D.) variabilis variabilis* Swainson  
Variable Conch  
164. *S. (Euprotomus) aurisdianae aurisdianae* Linnaeus  
Diana Conch  
165. *S. (Gibberulus) gibberulus gibberulus* Linnaeus  
Humped Conch  
166. *Strombus (Laevistrombus) canarium* Linnaeus  
Dog conch  
167. *S. (Lentigo) lentiginosus* Linnaeus  
Silver Conch  
168. *Terebellum terebellum* (Linnaeus)  
Terebellum Conch  
169. *Tibia powisii* (Petit)  
Powis Tibia  
170. *T. unicornis* Dillwyn
- Family Naticidae  
Moon Shells
171. *Natica adansoni* Blainville  
Adansor's Moon  
172. *N. euzona* (Recluz)  
173. *N. gracilis* (Recluz)  
174. *N. (Stigmaulax) sulcata* (Born)  
Sulcate Moon  
175. *N. tigrina* (Roeding)  
Tiger Moon  
176. *N. (Tectonatica) violacea* Sowerby

- Violet Moon
177. *Polinices (Neverita) albumen* (Linnaeus)  
Egg-white Moon
178. *P. chinensis* (Lamarck)
179. *P. (Polinices) mamilla* (Linnaeus)
180. *P. (Mamilla) melanostomus* (Gmelin)  
Black mouth Moon
181. *P. (Mamilla) zanzibarica*  
(Recluz)  
Zanzibar Moon
182. *Sinum laevigatus* (Lamarck)  
Ear Moon
- Family            Cypraeidae  
Cowries
183. *Adusta onyx adusta* (Lamarck)
184. *Arabica arabica arabica* (Linnaeus)  
Arabian cowrie
185. *Arestorides argus argus* (Linnaeus)  
Eyed cowrie
186. *Basilitronea isabella isabella* (Linnaeus)  
Isabella cowrie
187. *Bistolida hirundo neglecta* (Sowerby)
188. *B. kieneri depriesteri* Schilder
189. *B. stolidata stolidata* (Linnaeus)
190. *Chelycypraea testudinaria* (Linnaeus)  
Turtle cowrie
191. *Cribraria cribraria cribraria* (Linnaeus)  
Sieve cowrie
192. *Cypraea eranthema* Linnaeus
193. *C. tigris pardalis* Shaw  
Tiger cowrie
194. *Erosaria erosa erosa* (Linnaeus)  
Eroded cowrie
195. *E. erosa phagedaina* (Melvill)
196. *E. lamarckii redimita* (Melvill)  
Lamarck's cowrie
197. *E. ocellata* (Linnaeus)  
Ocellate cowrie
198. *E. poraria poraria* (Linnaeus)
199. *Erronea caurica corrosa* (Gronov)
200. *E. erronea bimaculata* (Gray)
201. *E. erronea erronea* (Linnaeus)
202. *Gratiadusta pallida pallida* (Gray)  
Pallid cowrie
203. *G. walkeri surabajensis* (Schilder)
204. *Lyncia lynx lynx* (Linnaeus)  
Lynx cowrie
205. *Mauritia mauritiana mauritiana* (Linnaeus)  
Hump back cowrie
206. *M. mauritiana regima* (Gmelin)
207. *Melicerona felina melvilli* (Hidalgo)  
Cat cowrie
208. *M. listeri listeri* (Gray)  
Cat cowrie
209. *Monetaria (Ornamentaria) anulus anulus*  
(Linnaeus)

- Gold ring cowrie
210. *M. (Monetaria) moneta moneta* (Linnaeus)  
Money cowrie
211. *Mystaponda vitellus dama* (Perry)  
Pacific deer cowrie
212. *Palmadusta asellus asellus* (Linnaeus)  
Ascellus cowrie
213. *P. asellus vespacea* (Melvill)
214. *P. clandestina clandestina* (Linnaeus)  
Clandestine cowrie
215. *P. clandestina malaysiae* Schilder & Schilder
216. *P. clandestina momiliaris* Lamarck
217. *P. (Eupaulonaria) fimbriata fimbriata* (Gmelin)  
Fimbriate cowrie
218. *P. (E.) microdon microdon* (Gray)
219. *P. punctata atomaria* (Gmelin)
220. *P. ziczacundata* (Lamarck)  
Undulating cowrie
221. *Ponda carneola carneola* (Linnaeus)  
Carnelian cowrie
222. *Proterato gallinacea* (Sowerby)
223. *P. sulcifera sulcifera* (Sowerby)
224. *Pustularia cicercula cicercula* (Linnaeus)  
Chilk Pea cowrie
225. *P. globulus globulus* (Linnaeus)  
Globular cowrie
126. *Ravitronea caputserpentis reticulum* (Gmelin)  
Snake head cowrie
127. *R. gangranosa reentsii* (Dunker)
128. *Staphylaea staphylaea laevigata* (Dautzenberg)
129. *S. staphylaea staphylaea* (Linnaeus)  
Grape cowrie
130. *Talparia talpa talpa* (Linnaeus)  
Mole cowrie
- Family            Triviidae
132. *Trivia oryza* (Lamarck)
- Family            Cassididae  
Helmet shells or King shells
233. *Casmaria ponderosa ponderosa* (Gmelin)  
Heavy Bonnet
234. *Cassis cornuta* Linnaeus  
Horned Helmet or King shell
235. *Cypraecassis rufa* Linnaeus  
Bullmouth Helmet—Queen shell
236. *Phalium (Phalium) areola* (Linnaeus)  
Checkerboard—Bonnet
237. *P. (P.) glaucum* (Linnaeus)  
Gray Bonnet
238. *Phalium (Semicassis) bisulcatum*  
(Schubert and Wagner)  
Japanese Bonnet
- Family            Cymatiidae  
Tritons
239. *Charonia (C.) tritonyx* (Linnaeus)

- Trumpet Triton  
 240. *Cymatium exile* (Reeve)  
 241. *C. pileare* (Linnaeus)  
 Common Hairy Triton  
 242. *C. pfeifferianum* (Reeve)  
 Pfeiffer's Hairy Triton  
 243. *C. truncatus* (Hinds)  
 244. *Gyrineum (G.) qyrineum* (Linnaeus)  
 Tadpole Triton

Family Bursidae  
 Frog shells

245. *Bursa (Bursa) granularis* (Roeding)  
 Granulate Frog shell  
 246. *Bursa (Ranella) bufonia* (Gmelin)  
 Warty Frog shell

Family Tonnidae  
 Tun shells

247. *Tonna olearium* (Bruguere)  
 248. *T. perdix* (Linnaeus)  
 Pacific Partridge Tun  
 249. *T. sulcosa* (Born)  
 Banded Tun

Order Neogastropoda  
 Family Muricidae  
 Murex shells, Rock shells &  
 Drupes

250. *Chicoreus brunneus* (Linnaeus)  
 Adusta Murex  
 251. *C. microphyllus* (Lamarck)  
 Curly Murex  
 252. *C. ramosus* (Linnaeus)  
 Ramose Murex  
 253. *Drupa (D.) morum morum* Roeding  
 Purple Drupe  
 254. *D. (D.) ricinus ricinus* Linnaeus  
 Prickly Drupe  
 255. *D. (Drupina) lobata* (Blainville)  
 Drupe Lobate  
 256. *D. (Ricinella) rubusidaeus* Roeding  
 257. *Drupella concatenata* (Lamarck)  
 258. *Haustellum haustellum* (Linnaeus)  
 259. *Mancinella bufo* (Lamarck)  
 Toad Purpura  
 260. *Morulaanaxeres* (Kiener)  
 261. *M. granulata* (Duclos)  
 262. *M. uva* (Roeding)  
 262a. *Murex pecten* Lightfoot  
 Venus Comb Murex  
 263. *Murex trapa* Roeding  
 Rare spined Murex  
 264. *M. tribulus* Linnaeus  
 Caltrop Murex  
 265. *M. troscheli* Lischke  
 Troschel's Murex

266. *Muricopsis orri* Cernohorsky  
 Orr's Muricop  
 267. *Naquetia capucinus* (Roeding)  
 Mangrove Murex  
 268. *N. triqueter* (Born)  
 Triquetra Murex  
 269. *Purpura buccinea* (Deshayes)  
 270. *P. persica* (Linnaeus)  
 Persian Purpura  
 271. *Rapana rapiformis* (Born)  
 Turnip shaped Rapa  
 272. *Thais armigera* (Link)  
 Belligerent Rock shell  
 273. *T. hippocastanum* (Linnaeus)  
 Chestnut Rock shell  
 274. *T. intermedia* (Kiener)  
 Intermediate Rock shell  
 275. *T. panama* (Roeding)  
 Rudolph's Purpura  
 276. *T. tissoti* (Petit)  
 Tissot's Rock shell  
 277. *T. tuberosa* (Roeding)  
 Tuberose Rock shell  
 278. *Vitularia miliaris* (Gmelin)

Family Coralliophilidae  
 Coral shells

279. *Coralliophila abnormis* Smith  
 280. *C. fusoides* Nevill  
 281. *C. neritoidea* (Lamarck)  
 Violet Coral shell  
 282. *Rapa tenuis* Martini

Family Pyrenidae  
 Dove shells

283. *Mitrella philippina* Dunker  
 284. *Pyrene conspersa* (Gaskoin)  
 285. *P. contaminata* (Gaskoin)  
 286. *P. flava* Linnaeus  
 Yellow Dove shell  
 287. *P. palumbrina* (Gould)  
 288. *P. paradalina* (Lamarck)  
 289. *P. parvula* Dunker  
 290. *P. (Meta) philippinarum* (Recluz)  
 Cone shape Dove shell  
 291. *P. (Pyrene) turturina* (Lamarck)

Family Buccinidae  
 Whelks, Neptunes, Phos  
 and Enginas

292. *Babylonia spirata* (Linnaeus)  
 spiral Babylon  
 293. *Cantharus fumosus* (Dillwyn)  
 Smoky Gobelt  
 294. *C. undosus* (Linnaeus)  
 Waved Gobelt  
 295. *Engina crenulata* Kiener

- Crenulate Engina  
296. *E. (E.) mendicaria* (Linnaeus)  
Striped Engina
297. *E. trifasciata* Reeve  
298. *Nassaria laevior* Smith  
299. *Phos blainvillei* Deshayes  
300. *P. senticosus* Linnaeus  
Common Pacific Phos
- Family Volemidae  
Melongenae
301. *Pugilina cochlidium* (Linnaeus)  
Spiral Melongena
302. *P. pugilina* (Born)
- Family Nassariidae
303. *Nassarius albescens gemmuliferus* (A. Adams)  
304. *N. arcularis plicatus* (Roeding)  
Cake Nassa
305. *N. bimaculosa* Adams  
306. *N. coronatus* (Bruguiera)  
Coronate Nassa
307. *N. globosus* Quoy & Gaimard  
Globose Nassa
308. *N. idyllius* (Melvill & Standen)  
309. *N. livescence* (Philippi)  
310. *N. moestus* (Hinds)  
Gloomy Nassa
311. *N. nakayamai* (Habe)  
312. *N. pullus* (Linnaeus)  
Black Nassa
313. *N. vibex* (Say)  
314. *N. vittatus* (A. Adams)  
315. *N. (Hebra) horridus* (Dunker)  
Horrid Nassa
316. *N. (H.) nigra* (Hombron & Jacquinot)  
317. *N. (H.) subspinosus* Lamarck  
318. *N. (Hima) paupera* (Gould)  
319. *N. (Nassarius) arcularius* (Linnaeus)  
Cake Nassa
320. *N. (Niotha) distortus* (A. Adams)  
Distorted Nassa
321. *N. (Niotha) echinatus* (A. Adams)  
322. *N. (Niotha) nigellus* (Reeve)  
323. *N. (Niotha) solendidulus* (Dunker)  
324. *N. (Niotha) venusta* (Dunker)  
325. *N. (Plicarularia) callispira* A. Adams  
326. *N. (P.) cemelus* (von Martens)  
327. *N. (P.) novaezelandiae* (Reeve)  
328. *N. (Telasco) gaudiosus* (Hinds)  
329. *N. (Zeuxis) comptus* (A. Adams)  
330. *N. (Z.) crematus* (Hinds)  
Burned Nassa
331. *N. (Z.) olivaceus* (Bruguiera)  
Olive Nassa
332. *N. (Z.) pictus* (Dunker)
- Family Fascioliidae  
(Tulips and Spindles)
333. *Fasciolaria filamentosa* Lamarck  
Filamentous Horse conch
334. *F. (Pleuroploca) trapezium* (Linnaeus)  
Trapezium Horse Conch
335. *Fusinus nicobaricus* Lamarck  
Nicobar Spindle
336. *Latirus craticulatus* Linnaeus  
337. *L. (Latirus) gibbulus* (Gmelin)  
Gibbose Latirus
338. *L. lanceolatus* Reeve  
339. *L. (Latirus) polygonus* (Gmelin)  
Many angled Latirus
340. *L. (Mazzalina) smaragdulus* (Linnaeus)  
Precious stone shell
341. *Peristernia nassatula* (Lamarck)  
Fine-net Peristernia
- Family Olividae  
Olive shells
342. *Ancilla ampla* (Gmelin)  
White mouth Ancilla
343. *A. monilifera* (Reeve)  
Necklace Ancilla
344. *Oliva caerulea* Roeding  
Purple mouth Olive
345. *O. miniacea* (Roeding)  
Red mouth Olive
346. *O. irisans* Lamarck  
347. *O. maura* Lamarck  
348. *O. nigrita* von Martens  
349. *O. oliva* (Linnaeus)  
Common Olive
350. *O. sericea* (Roeding)  
Orange mouth Olive
351. *O. undata* Lamarck  
352. *Olivancillaria (Agaronia) gibbosa* Born
- Family Mitridae  
Mitters
353. *Cancilla filaris* (Linnaeus)  
File Miter
354. *C. interlirata* (Reeve)  
355. *C. isabella* (Swainson)  
356. *C. philippinarum* (A. Adams)  
357. *Domiporta praestantissima* (Roeding)  
Most superior Miter
358. *D. rufilirata* (Adams & Reeve)  
359. *Imbricaria conularis* (Lamarck)  
360. *I. punctata* (Swainson)  
Bone like Miter
361. *Mitra coffea* Schubert & Wagner  
Coffe Miter
362. *M. (Mitra) ambigua* Swainson  
363. *M. (M.) cardinalis* (Gmelin)  
Cardinal Miter

364. *M. (M.) imperialis* Roeding  
Imperial Miter
365. *M. (M.) mitra* (Linnaeus)  
Episcopal Miter
366. *M. (M.) stictica* (Link)  
Pontifical Miter
367. *M. (Nebularia) aurantia* (Gmelin)  
Orange Miter
368. *M. (N.) chrysalis* Reeve  
Chrysalis Miter
369. *M. (N.) chrystoma* Broderip  
Gold mouth Miter
370. *M. (N.) contratca* Swainson
371. *M. (N.) coronata* Lamarck  
Coronate Miter
372. *M. (N.) cucumerina* Lamarck  
Kettle Miter
373. *M. (N.) doliolum* Kuster
374. *M. (N.) maesta* Reeve
375. *M. (N.) rupellii* Reeve
376. *M. (N.) tabanula* Lamarck
377. *M. (N.) ticaonica* Reeve
378. *M. (N.) turgida* Reeve
379. *M. (Strigatella) acuminata* Swainson
380. *M. (S.) litterata* Lamarck  
Littered Miter
381. *M. (S.) mecurtata* Reeve
382. *M. (S.) paupercula* (Linnaeus)  
Poverty Miter
383. *M. (S.) retusa* Lamarck  
Blunted Miter
384. *M. (S.) scutulata* Gmelin
385. *Neocancilla antoniae* (H. Adams)
386. *N. circula* (Kiener)
387. *N. clathrus* (Gmelin)  
Clathrus Miter
388. *N. granatina* (Lamarck)  
Flecked Miter
389. *N. papilio* (Link)  
Butterfly Miter
390. *Pterygia crenulata* (Gmelin)  
Crenulate Miter
391. *P. fenestrata* (Lamarck)  
Fenestrate Miter
392. *P. dactylus* (Linnaeus)  
Finger Miter
393. *Scabricola (Scabricola) caerulea* (Reeve)
394. *Subcancilla flammea* (Quoy & Gaimard)
- Family            Vexillidae  
                         Ribbed Miters
395. *Vexillum acuminatum* (Gmelin)
396. *V. acupictum* Reeve  
Pinpricked Mitre
397. *V. amabile* (Reeve)
398. *V. daedalum* (Reeve)
399. *V. deshayesi* (Reeve)
400. *V. exasperatum* (Gmelin)  
Roughened Miter
401. *V. gruneri* (Reeve)  
Gruner's Miter
402. *V. luculentum* (Reeve)  
Black banded Miter
403. *V. melongena* (Lamarck)
404. *V. obeliscus* (Reeve)
405. *V. plicarium* (Linnaeus)  
Plaited Miter
406. *V. sculptile* (Reeve)
407. *V. taeniatum* (Lamarck)  
Ribbioned Miter
408. *Zieliarus woldemarii* (Kiener)  
Woldemar's Miter
- Family            Vasidae  
                         Chank shells
409. *Turbinella pyrum fusus* Sowerby  
Andaman Chank
410. *Vasum (Vasum) ceramicum* (Linnaeus)  
Ceramic Vase
411. *V. (V.) turbinellus* (Linnaeus)  
Common Vase
- Family            Harpidae  
                         Harp shells
412. *Harpa amouretta* Roeding  
Minor Harp
423. *H. davidis* Roeding  
David Harp
414. *H. harpa* (Linnaeus)  
True Harp
- Family            Cancellariidae  
                         Nutmegs
415. *Cancellaria elegans* Sowerby  
Elegant Nutmeg
416. *C. lambarti* Sowerby
417. *C. melanostoma* Sowerby
418. *Scalptia lamellosa* (Hinds)  
Lamellose Nutmeg
419. *Scalptia obliquata* (Lamarck)  
Oblique Nutmeg
- Family            Marginellidae  
                         Marginellas
420. *Marginella angustate* Sowerby  
Narrow Marginella
421. *M. lateritia* Melvill & Sykes
422. *M. louisae* Bourguignat
423. *M. persica* Nevill
424. *M. scripta* (Hinds)
425. *M. sordida* (Reeve)
- Family            Turridae  
                         Turrids
426. *Gemmula congener congener* Smith

- Melvill's Turrid
427. *G. gilchristi* (Sowerby)  
428. *G. hombroni* (Hedley)  
429. *G. speciosa* (Reeve)  
Splendid Turrid  
430. *G. vagata* Smith  
431. *Lophiotoma abbreviata abbreviata* (Reeve)  
432. *L. abbreviata ustulata* (Reeve)  
433. *L. acuta* (Perry)  
Marbled Turrid  
434. *L. albina* (Lamarck)  
435. *Turricula javana* (Linnaeus)  
Java turrid  
436. *Turris spectabilis* Reeve
- Family Conidae  
Cones
437. *Conus achatinus* Hwass  
438. *C. adansoni* Lamarck  
439. *C. amadis* Gmelin  
Amadis Cone  
440. *C. andamanensis* Smith  
441. *C. araneosus* Solander  
442. *C. arenatus* Hwass  
Fleabite Cone  
443. *C. aulicus* Linnaeus  
Princely Cone  
444. *C. bandanus* Hwass  
445. *C. biliosus* (Roeding)  
Bilious Cone  
446. *C. canonicus* Hwass  
Tiger Cone  
447. *C. chaldaeus* (Roeding)  
Vermiculate Cone  
448. *C. capitaneus* Linnaeus  
Weasel Cone  
449. *C. catus* Hwass  
Cat Cone  
450. *C. ceylanensis* Hwass  
451. *C. characteristicus* Fischer  
452. *C. coronatus* Gmelin  
Crowned Cone  
453. *C. distans* Hwass  
Distant Cone  
454. *C. ebraeus* Linnaeus  
Hebrew Cone  
455. *C. eburneus* Hwass  
Ivory Cone  
456. *C. edwardi* Preston  
457. *C. emaciatius* Reeve  
False Virgin Cone  
458. *C. episcopus* Hwass  
459. *C. figulinus* Linnaeus  
460. *C. flavidus* Lamarck  
Yellow Pacific Cone  
461. *C. generalis* Linnaeus  
General Cone
462. *C. geographus* Linnaeus  
Geography Cone  
463. *C. hyaena* Hwass  
464. *C. insculptus* Kiener  
465. *C. janus* Hwass  
466. *C. litteratus* Linnaeus  
Lettered Cone  
467. *C. lividus* Hwass  
Lived Cone  
468. *C. masoni* G. H. Nevill  
469. *C. miles* Linnaeus  
Soldier Cone  
470. *C. miliaris* Hwass  
Thousand spot Cone  
471. *C. millepunctatus* Lamarck  
472. *C. mitratus* Hwass in Bruguiere  
Miter like Cone  
473. *C. monile* Hwass  
Necklace Cone  
474. *C. mutabilis* Reeve  
Hyena Cone  
475. *C. nicobaricus* Hwass  
Nicobar Cone  
476. *C. nobilis* Linnaeus  
Noble Cone  
477. *C. nussatella* Linnaeus  
Nussatella Cone  
478. *C. pennaceus* Born  
Feathered Cone  
479. *C. pretiosus* G. & H. Nevill  
480. *C. scabriusculus* Dillwyn  
Leader Cone  
481. *C. straturatus* Sowerby  
482. *C. striatus* Linnaeus  
Striate Cone  
483. *C. terebra* Born  
Terebra Cone  
484. *C. tessulatus* Born  
Tessellate Cone  
485. *C. textile* Linnaeus  
Textile Cone  
486. *C. tulipa* Linnaeus  
Tulip Cone  
487. *C. virgo* Linnaeus  
Virgin Cone  
488. *C. zonatus* Hwass  
Zoned Cone
- Family Terebridae  
Auger shells
489. *Duplicaria duplicata* Linnaeus  
Unrolled Auger  
490. *D. raphanula* Lamarck  
491. *D. roseata* Adams & Reeve  
492. *D. straminea* Gray  
493. *D. tricolor* Sowerby  
494. *Hastula albula* Menke

495. *H. alveolata* Hinds  
496. *Terebra aceculina* Lamarck  
497. *T. acuminata* Gray  
498. *T. affinis* Gray  
Similar Auger  
499. *T. andamanica* Melvill & Sykes  
( = *T. pertusa* Born )  
Perforated Auger  
500. *T. areolata* (Link)  
Fly spotted Auger  
501. *T. cingulifera* Lamarck  
502. *T. commaculata* (Gmelin)  
Many Spotted Auger  
503. *T. crenulata* Linnaeus  
Crenulata Auger  
504. *T. deshayesi* Reeve  
505. *T. dimidiata* (Linnaeus)  
Dimidiate Auger  
506. *T. exigua* Deshayes  
507. *T. laevigata* Gray  
508. *T. maculata* (Linnaeus)  
Marlin spike  
509. *T. nebulosa* Sowerby  
Red coloured Auger  
510. *T. oculata* Linnaeus  
511. *T. succeneta* (Gmelin)  
512. *T. undulata* Gray  
Undulata Auger
- Subclass Opisthobranchia  
Order Cephalaspidea  
Family Acteonidae  
Acteons
513. *Acteon virgatus* (Reeve)  
Striped Acteon  
514. *Solidula coccinatus* (Reeve)
- Family Hydatinidae  
515. *Hydatina eximia* Deshayes
- Family Bullidae  
Bubble shells
516. *Bulla ampulla* (Linnaeus)
- Family Atyidae  
Bubble shells
517. *Atys amygdalus* Sowerby  
518. *A. cylindricus* Helbling  
Cylindrical Atys  
519. *A. elongatus* A. Adams  
520. *A. ferruginosa* Chemnitz  
521. *A. hyalina* Watson  
522. *A. naucum* Linnaeus  
White Pacific Atys  
523. *A. nonscripta* A. Adams  
524. *Haminoea ambigua* A. Adams  
525. *H. curta* A. Adams
- Family Cylindrobullidae  
526. *Cylindrobulla pusilla* Nevill
- Family Retusidae  
527. *Volvula perangusta* A. Adams
- Family Scaphandridae  
528. *Acteocina olivaeformis* (Issel)  
529. *Cylichna darnleyensis* Brazier
- Family Philinidae  
530. *Philine truncatissima* Sowerby
- Order Pyramidellacea  
Family Pyramidellidae  
Pyrams
531. *Odostomia decorata* Philippi  
532. *Pyramidella auricate* Chemnitz
- Subclass Pulmonata  
Order Basommatophora  
Family Ellobiidae  
Cassidulas
533. *Auriculastra subula* (Quoy & Gaimard)  
534. *Cassidula labrella* Deshayes  
535. *C. nucleus* (Gmelin)  
536. *Ellobium aurisjudae* Linnaeus  
Judas Ear Cassidula  
537. *Melampus caffer* Kuster  
538. *M. castaneus* Muehlfeldt  
537. *M. faciatus* Deshayes  
548. *Pythia albovaricosa* Pfeiffer  
540. *P. castanea* Lesson  
542. *P. scarabeus* Linnaeus  
Common Pythia
- Family Siphonariidae  
False limpets
543. *Siphonaria acuta* Quoy and Gaimard  
544. *S. siphonaria* Sowerby
- Class Scaphopoda  
Tusk shells  
Family Dentaliidae
547. *Dentalium aprinum* Linnaeus  
—Boars' Tusk  
548. *D. insolitum* Smith  
549. *D. variable* Deshayes
- Class Bivalvia  
Order Nuculoida  
Family Nuculidae  
Nut Clams
550. *Nucula (Leionucula) cumingii* Hinds  
551. *N. (L.) layardi* A. Adams  
552. *N. (Nucula) marmorea* Hinds  
553. *N. (N.) mltralis* Hinds

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| <p>Family           Nuculanidae<br/>Nut clams and Yoldias</p> <p>554. <i>Nuculana (Saccella) brookei</i> (Hanley)<br/>555. <i>N. (Nuculana) retusa</i> (Hinds)<br/>556. <i>Yoldia (Yoldia) nicobarica</i> (Bruguere)<br/>—Nicobar Yoldia</p> <p>Order            Arcoida<br/>Family           Arcidae<br/>Ark Clams</p> <p>557. <i>Anadara antiquata</i> (Linnaeus)<br/>—Antique Ark<br/>558. <i>A. granosa</i> (Linnaeus)<br/>—Granular Ark<br/>559. <i>A. lischkei</i> (Dunker)<br/>560. <i>A. rhombea</i> (Born)<br/>561. <i>A. uropigmelana</i> (Bory)<br/>562. <i>Arca avellana</i> Lamarck<br/>—Hazelnut Ark<br/>563. <i>A. ventricosa</i> Lamarck<br/>564. <i>Barbatia amygdalumtostum</i> (Roeding)<br/>—Almond Ark<br/>565. <i>B. coelata</i> (Reeve)<br/>566. <i>B. helblingi</i> (Bruguere)<br/>567. <i>B. lacerata</i> (Linnaeus)<br/>568. <i>B. plicata</i> (Dillwyn)<br/>569. <i>B. tenella</i> (Reeve)<br/>570. <i>Scapharca clathrata</i> (Reeve)<br/>571. <i>S. inaequalis</i> (Bruguere)<br/>572. <i>S. pilula</i> (Reeve)<br/>573. <i>Trisidos tortuosa</i> (Linnaeus)<br/>—Propellor Ark</p> <p>Family           Glycemerididae<br/>Bitter sweet clams</p> <p>574. <i>Glycemeris castaneus</i> Lamarck<br/>575. <i>G. lividus</i> Reeve</p> <p>Order            Mytiloida<br/>Family           Mytilidae<br/>Sea Mussels and Date Mussels</p> <p>576. <i>Botula cinnamoma</i> (Lamarck)<br/>577. <i>Lithophaga gracilis</i> Philippi—Date Mussel<br/>578. <i>L. (Lithophaga) laevigata</i> Quoy and Gaimard<br/>579. <i>L. malaccana</i> Reeve<br/>580. <i>Modiolus philippinarum</i> Hanely<br/>—Philippine Mussel<br/>581. <i>M. tulipa</i> (Lamarck) Tulip Mussel<br/>582. <i>Perna viridis</i> (Linnaeus)—Green Mussel<br/>583. <i>Septifer (Septifer) bilocularis</i> (Linnaeus)<br/>—Box mussel</p> <p>Family           Pinnidae<br/>(Pen shells)</p> <p>584. <i>Atrina (Servatrina) pectinata</i><br/>(Linnaeus)—Comb pen shell<br/>585. <i>A. (Atrina) vexillum</i> (Born)</p> | <p>—Indo Pacific pen shell<br/>586. <i>Pinna muricata</i> Linnaeus<br/>—Prickly pen shell</p> <p>Order            Pterioida<br/>Family           Pteriidae<br/>Winged oysters &amp; Pearl oysters</p> <p>587. <i>Electroma ovates</i> Quoy and Gaimard<br/>588. <i>Pinctada anomiodes</i> (Reeve)<br/>—Pearl oyster<br/>589. <i>P. margaritifera</i> (Linnaeus)<br/>—Black lip Pearl oyster<br/>590. <i>P. vulgaris</i> (Schumacher)<br/>—Peal oyster<br/>591. <i>Pteria reticulata</i> (Reeve)<br/>—Winged oyster</p> <p>Family           Isognomonidae<br/>Tree oysters</p> <p>592. <i>Isognomon ehippium</i> (Linnaeus)<br/>—Saddletree oyster<br/>593. <i>I. isogonum</i> (Linnaeus)<br/>—Pacific Tree oyster<br/>594. <i>I. legumen</i> (Gmelin)<br/>595. <i>I. nucleus</i> (Lamarck)<br/>596. <i>I. perna</i> (Linnaeus)<br/>—Rayed Tree oyster</p> <p>Family           Malleidae<br/>Hammer oysters</p> <p>597. <i>Malleus albus</i> Lamarck<br/>—White Hammer oyster<br/>598. <i>M. malleus</i> (Linnaeus)<br/>—Common Hammer oyster<br/>599. <i>M. regularis</i> (Forsk.)<br/>600. <i>Vulsella vulsella</i> (Linnaeus)<br/>—Sponge Finger oyster</p> <p>Family           Pectinidae<br/>Scallops and Moon Scallops</p> <p>601. <i>Amusium andamanicum</i> Smith<br/>—Andaman Moon scallop<br/>602. <i>A. pleuronectes</i> (Linnaeus)<br/>—Asian Moon scallop<br/>603. <i>Chlamys albolineata</i> (Sowerby)<br/>—White lined scallop<br/>604. <i>C. pallium</i> (Linnaeus)<br/>—Royal clock scallop<br/>605. <i>C. squamosa</i> (Gmelin)<br/>—Squamose Scallop<br/>606. <i>Dacatopecten (D.) amiculum</i> (Philippi)<br/>—Cloak scallop<br/>607. <i>D. flabelloides</i> (Reeve)<br/>608. <i>Flexopecten distans</i> Lamarck<br/>609. <i>Pecten aspera</i> Sowerby<br/>—File Scallop<br/>610. <i>P. cretatus</i> Reeve</p> |
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611. *P. pyxidata* Born  
—Box scallop
- Family Plicatulidae  
Kitten Paws
612. *Plicatula plicata* Linnaeus  
—Pacific kitten's Paw
- Family Spondylidae  
Thorny oysters
613. *Spondylus anacanthus* Mawe  
—Nude Thorny oyster
614. *S. hystrix* Roeding
615. *S. microlepas* Lamarck
616. *S. multisetosus* Reeve  
—Many spined Thorny oyster
- Family Anomiidae  
Jingle shells
617. *Placuna (Placuna) placenta* (Linnaeus)  
—Windopane oyster
- Family Ostreidae  
True oysters
618. *Crassostrea madrasensis* (Preston)
619. *Saccostrea cucullata* (Born)  
—Hooded oyster
- Family Gryphaeidae  
True oyster
620. *Hyotissa hyotis* (Linnaeus)  
—Honey comb oyster
- Family Limidae  
File clams
621. *Lima (Mentellum) fragilis* (Gmelin)  
—Frigile Lima
622. *Limaria inflata* (Gmelin)  
—Inflated Lima
- Order Veneroidea  
Family Lucinidae  
Lucina clams
623. *Codakia punctata* (Linnaeus)  
—Punctate Lucina
624. *Loripes ceylonensis*
625. *Lucina philippina* Reeve
626. *L. ovulum* Reeve
627. *L. simplex* Reeve
- Family Ungulinidae  
(Diplodon clams)
628. *Diplodonta bullata* Dunker
- Family Chamidae  
Jewel Boxes
629. *Chama aspersa* Reeve
630. *C. brassica* Reeve
631. *C. multisquamosa* Reeve
632. *C. reflexa* Reeve  
—Reflexed Jewel Box
- Family Galeommatidae  
(Parasitic clams)
633. *Scintilla faba* Deshayes
634. *S. lactea* Sowerby
- Family Carditidae  
Cardita clams
635. *Beguina semiorbiculata* (Linnaeus)
636. *Cardita calyculata* Linnaeus
637. *C. variegata* Bruguiere  
—Variegate Cardita
638. *Cardites cardioides* Reeve
- Family Crassatellidae  
Crassatella Clams
639. *Crassatella radiata* Sowerby  
—Radiate Crassatella
- Family Cardiidae  
The Cockles
640. *Cardium arenicolum* Reeve
641. *Corculum cardissa* (Linnaeus)  
—True heart cockle
642. *Ctenocardia hystrix* (Reeve)
643. *Fragum fornicatum* (Sowerby)  
—Arching strawberry cockle
644. *F. unedo* (Linnaeus)  
—Unedo Cockle
645. *Laevicardium australe* (Sowerby)  
—Austral cockle
646. *Lunulicardia hemicardia* (Linnaeus)  
—Pacific half cockle
647. *Lyrocardium lyratum* (Sowerby)  
—Lyrate cockle
648. *Nemocardium exasperatum* (Sowerby)  
—Exasperate cockle
649. *Papyridea (P.) papyracea* Chemnitz
650. *Trachycardium elongatum* (Bruguiere)  
—Elongate Cockle
651. *T. flavum* (Linnaeus)  
—Pacific yellow cockle
652. *T. leucostoma* (Born)
653. *T. unicolor* (Sowerby)  
—Unicolor Cockle
- Family Tridacnidae  
Giant Clams
654. *Hippopus hippopus* (Linnaeus)  
—Bear Paw Giant clam
655. *Tridacna crocea* Kamarck  
—Crocus Giant clam
656. *T. maxima* (Roeding)  
—Elongate Giant clam

657. *T. squamosa* Lamarck  
—Fluted Giant clam
- Family Mactridae  
Mactra clams or Trough or Surf clams
658. *Mactra achatina* Holten  
—Agate Mactre
659. *M. antiquata* (Spengler)  
—Antique Mactre
660. *M. apicina* Deshayes
661. *M. decora* Deshayes
662. *M. hepatica* Deshayes
663. *M. maculata* Gmelin  
—Maculate Mactra
664. *M. macomaeformis*
665. *M. violacea* Gmelin  
—Violet Mactra
666. *Meropesta nicobarica* (Gmelin)  
—Nicobar Mactra
- Family Mesodesmatidae  
Wedge clams
667. *Atactodea glabrata* Lamarck
- Family Solenidae  
Jack knife clams
668. *Solen aspersus* Dunker
669. *S. brevis* Gray
- Family Cultellidae  
Razor clams
670. *Cultellus lividus* Dunker
671. *C. (Cultellus) maximus* Gmelin
672. *Phaxus (Ensiculus) cultellus* (Linnaeus)  
—Cultellus clam
673. *Siliqua (Siliqua) radiata* (Linnaeus)  
—Sunset siliqua
- Family Tellinidae  
Tellins
674. *Apolymetis papyracea* (Gmelin)  
—Paper Groved Macoma
675. *Gastrana polygona* (Gmelin)
676. *Macoma (Psammotreta) ala* (Hanley)
677. *M. (Macalia) bruguieri* (Hanley)
678. *M. (Psammacoma) candida* (Lamarck)
679. *M. (Scissulina) dispar* (Conrad)
680. *M. (Scutarcopagia) lingua-felis* Linnaeus
681. *M. (Psammatrete) micans* (Hanley)
682. *M. (Scissulina) reticulata* (Sowerby)
683. *M. (Scutarcopagia) scobinata* Linnaeus  
—Rasp Tellin
684. *M. (Psammacoma) truncata* (Jonas)
685. *Strigilla (Aeretica) splendida* (Anton)
686. *Tellina (Arcopagia) angulata* Linnaeus
687. *T. (Serratina) capsoides* Lamarck  
Box like Tellin
688. *T. (Arcopagia) carnicolor* Hanley
689. *T. (Arcopagia) casta* Hanley
690. *T. (Angulus) corbuloides* Hanley
691. *T. (A.) incisa* Preston
692. *T. (Arcopagia) inflata* Gmelin
693. *T. (Angulus) lanceolata* Gmelin
694. *T. (Tellinides) opalina* Gmelin
695. *T. (Moerella) ostracea* Lamarck
696. *T. (Tellinides) ovalis* Sowerby
697. *T. (Quidnipagus) palatum* (Iredale)  
—Palate Tellin
698. *T. (Pharaonella) perna* Spengler
699. *T. (Moerella) philippinarum* Hanley
700. *T. (Arcopagia) pinguis* Hanley
701. *T. (A.) remies* Linnaeus
702. *T. (A.) robusta* Hanley
703. *T. (Cadella) semen* Hanley
704. *T. (Tellinides) sinuata* Spengler
705. *T. (Omala) texturata* Sowerby
706. *T. (Moerella) subtruncata* Hanley
707. *T. (Tellinella) staurella* Lamarck
708. *T. (T.) virgata* Linnaeus
709. *T. (Pharaonella) perna* Spengler
- Family Donacidae =  
Donax & Bean clams
710. *Donax (Plebidonax) compressus* Lamarck
711. *D. (Latona) cuneatus* Linnaeus  
—Cuneate Donax
712. *D. (L.) faba* Schroeter  
—Pacific Bean Donax
713. *D. (L.) incarnatus* Gmelin
714. *D. (Paradonax) nuxfages* Preston
- Family Psammobiidae
715. *Asaphis deflorata* (Linnaeus)  
—Gaudy Asaphis
716. *Gari (Psammobia) pulchella* Lamarck
717. *G. (P.) pulcherriana* Deshayes
718. *G. (Grammatomya) squamosa* (Lamarck)
719. *G. (Psammobia) suffusa* Reeve
720. *G. (P.) tenuis* Deshayes
721. *Sanguinolaria (Psammotella) elongata* (Lamarck)  
—Elongate Gari
722. *Sanguinolaria (Psammotella) oblonga* (Deshayes)
- Family Scrobiculariidae
723. *Scrobicularia ceylanica* Smith
- Family Semelidae
724. *Abra convexion* Smith
725. *A. maxima* Sowerby
726. *Cumingia rostrata* H. Adams
727. *C. striata* Ruppel

- Family Trapeziidae  
 728. *Coralliophaga venerupoides* Nevill  
 729. *Trapezium rostratum* Lamarck  
 730. *T. (Neotrapezium) sublaevigatum* (Lamarck)

- Family Vesicomysidae  
 Calypto clams  
 731. *Vesicomys indica* Smith

- Family Veneridae  
 732. *Anomalocardia (Anomalocardia) flexuosa* (Linnaeus)  
 733. *Circe scripta* (Linnaeus)  
 —Script venus  
 734. *Clausinella callophylia* (Philippi)  
 735. *Gafrarium divaricatum* (Gmelin)  
 —Forked venus  
 736. *G. pectinatum* (Linnaeus)  
 —Pectinate venus  
 737. *G. tumidum* Roeding  
 —Tumid venus  
 738. *Lioconcha ornata* (Lamarck)  
 —Ornate Pitar venus  
 739. *Meretrix meretrix* (Linnaeus)  
 740. *Paphia malabarica* (Schroeter)  
 —Malabar venus  
 741. *P. tatrix* (Schroeter)  
 —Textile venus  
 742. *Periglypta puerpera* (Linnaeus)  
 —Youthful venus  
 743. *P. reticulata* (Linnaeus)  
 —Reticulate venus  
 744. *Tapes litteratus* (Linnaeus)  
 —Littered venus  
 745. *T. (Ruditapes) variegatus* (Sowerby)  
 Variegate venus  
 746. *Venus (Antigona) lamellaris* Schumacher  
 —Lamellate venus  
 747. *V. toreuma* Gould—Embossed venus

- Order Myoida  
 Family Corbulidae  
 748. *Corbula crassa* Hinds

- Family Pholadidae  
 Piddocks  
 749. *Jouannetia globosa* Quoy  
 750. *Martesia multistriata* Sowerby  
 751. *Martesia striata* (Linnaeus)—Striate Martens  
 752. *Pholas orientalis* Linnaeus—Oriental piddock

- Family Teredinidae  
 Shipworms  
 753. *Bactronophorus thoracites* (Gould)  
 754. *Bankia bipinnata* (Turton)  
 755. *B. rochi* Moll  
 756. *Dicyathifer manni* (Wright)

757. *Lyrodus pedicellatus* (Quatrefages)  
 758. *Nausitora dunlopei* Wright  
 759. *N. hedleyi* Schepman  
 760. *Nototeredo edax* (Hedley)  
 761. *Uperotus rehderi* (Nair)

- Order Pholadomyoidea  
 Family Pandoridae  
 Pandora clams

762. *Pandora zelanica*

- Family Myochamidae  
 False clams

763. *Myodora quadrata* (Smith)

- Family Verticordidae

764. *Verticordia eburnea* Wood Mason and Alcock

- Class Cephalopoda

- Order Nautiloidea

- Family Nautilidae

765. *Nautilus pompilius* Linnaeus  
 —Chambered Nautilus

- Order Sepioida

- Family Sepiidae

- Cuttle fish

766. *Sepia brevimana* Steenstrup

767. *Sepiella inermis* (Ferussac & d'Orbigny)

- Family Sepiolidae

768. *Euprymna berryi* Sasaki

769. *Iniotheuthis japonica* Verrill

770. *I. maculosa* Goodrich

- Family Enoploteuthidae

771. *Abralia andamanica* Goodrich

- Order Teuthida

- Family Loliginidae

772. *Loligo duvauceli* d'Orbigny

773. *Sepioteuthis lessoniana* Lesson

- Order Octopoda

- Family Octopodidae

- Octopus

774. *Hapalochlaena maculosa* Robson

775. *Octopus arborescens* (Hoyle)

776. *O. cyaneus* Gray

777. *O. elegans* Brock

778. *O. globosus* Apelloef

779. *O. horridus* Ferrussac

780. *O. microphthalmus* Goodrich

781. *O. nierstrazi* Adam

782. *O. niveus* Lesson

783. *O. rugosus* (Bosc)

784. *O. vulgaris* Lamarck

785. *Teretocopus alcocki* Robson

Order Argonautida  
Family Argonautidae  
Paper nautilus

786. *Argonauta bottgeri* Maltzan

## g SIPUNCULIDS

Phylum SIPUNCULA

There had been a confusion regarding the classification of the group at the level of class and order, hence the names are not given.

Family Sipunculidae

1. *Sipunculus inclusus* Sluiber
2. *Sipunculus nudus* Linnaeus
3. *S. robustus* Keferstein
4. *Siphonosoma australe* (Keferstein)
5. *S. cumanense* (Keferstein)
6. *S. vastum* (Selenka & Bulow)
7. *Phascolopsis gouldii* (Pourtalies)

Family Phascolosomatidae

8. *Phascolosoma andamanensis* Jhonson
9. *P. antillarum* Grube & Oersted
10. *P. nigrescens* Keferstein
11. *P. pacificum* Keferstein
12. *P. scolops* (Selenka & de Man)
13. *P. spinosum* Jhonson
14. *P. perlucens* Baird

Family Golfingiidae

15. *Themiste lageniformis* Baird

Family Aspidosiphonidae

16. *Aspidosiphon exostomus* (Jhonson)
17. *A. havelockensis* Haldar
19. *A. klunzingeri* Seleuka & de Man
20. *Cloeosiphon aspergillus* (Quatrefages)

## h ECHINODERMS

Class CRINOIDEA  
Order ARTICULATA  
Family BOURGUETICRINIDAE

1. *Bathycrinus woodmasoni* A. H. Clark

Family PENTACRINIDAE  
2. *Comastrocrinus ornatus* (A. H. Clark)

Family COMASTERIDAE  
Subfamily CAPILLASTERINAE

3. *Comatella maculata* (P. H. Carpenter)
4. *Capillaster mariae* A. H. Clark  
Subfamily COMASTERINAE
5. *Comaster gracilis* (Hartlaub)
6. *C. multibrachiata* (P. H. Carpenter)
7. *C. parvus* A. H. Clark  
Subfamily COMACTININAE
8. *Comatula brevicirra* (Bell)
9. *C. micraster* A. H. Clark

Family MARIAMETRIDAE

10. *Dichrometra protectus* (J. Mueller)
11. *Selenometra aranea* (A. H. Clark)
12. *Stephanometra monacantha* (Luetken)

Family COLOMBOMETRIDAE

13. *Oligometra intermedia* A. H. Clark

Family EUDIOCRINIDAE

14. *Eudiocrinus minor* A. H. Clark
15. *E. ornatus* A. H. Clark

Family HIMEROMETRIDAE

16. *Amphimetra philiberti* (J. Mueller)
17. *Craspidometra acuticirra* (P. H. Carpenter)
18. *Heterometra bengalensis* A. H. Clark

Family CALOMETRIDAE

19. *Neometra spinosissima* A. H. Clark

Family CHARITOMETRIDAE

20. *Glyptometra invenusta* (A. H. Clark)
21. *Permissometra occidentalis* A. H. Clark

Family THALASSOMETRIDAE

22. *Crotometra eridanella* A. H. Clark
23. *Thalassometra peripolos* A. H. Clark

Family ANTEDONIDAE

24. *Eumetra indica* A. H. Clark
25. *Iridometra nana* (Hartlaub)
26. *Psathyrometra mira* A. H. Clark
27. *P. inusitata* A. H. Clark
28. *Sarometra nicobarica* A. H. Clark

Class ASTEROIDEA  
Order PLATYASTERIDA  
Family LUIDIIDAE

29. *Luidia integra* Koehler
30. *L. limbata* (Sladen)
31. *L. maculata* Mueller and Troschel
32. *L. savignyi* (Audouin)

Order PAXILLOSIDA  
Family ASTROPECTINIDAE

33. *Astropecten griegi* Koehler  
34. *A. hemprichi tamilicus* Doederlein  
35. *A. monacanthus* Sladen  
36. *A. polyacanthus* Mueller and Troschel  
37. *A. zebra* Sladen  
38. *Craspidaster hesperus* (Mueller and Troschel)  
39. *Dipsacaster pentagonalis* Alcock  
40. *D. sladeni* Alcock  
41. *Persephonaster coelochilus* Alcock
- Family PORECELLANASTERIDAE
42. *Porecellanaster coeruleus*  
43. *Sidonaster batheryi* Koehler
- Family BENTHOPECTINIDAE
44. *Cheiraster snyderi* Fisher
- Order VALVATIDA  
Family ARCHASTERIDAE
45. *Archeaster typicus* Mueller and Troschel
- Family GONIASTERIDAE
46. *Anthenea rudis* Koehler  
47. *A. pentagonula* (Lamarck)  
48. *Anthenoides sarissa* Alcock  
49. *Asteroceramis fisheri* Koehler  
50. *Calliaster mammillifer* Alcock  
51. *Dorigona nora* Alcock  
52. *Iconaster pentaphyllus* Alcock  
53. *Mediaster florifer* Alcock  
54. *Nymphaster belli* Koehler  
55. *N. ternalis* Koehler  
56. *Ogmaster capella* (Mueller & Troschel)  
57. *Pentagonaster arcuatus* Sladen  
58. *Pseudarchaster mozaicus* Wood Mason & Alcock  
59. *Rosaster confinis* (Koehler)  
60. *Stellaster equestris* (Retzius)
- Family OREASTRERIDAE
61. *Culcita novaeguinea* Mueller and Troschel  
62. *C. schmideliana* Retzius  
63. *Protoreaster lincki* (Blainville)
- Family OPHIDIASTERIDAE
64. *Andora frianti* Koehler  
65. *A. lemonnieri* Koehler  
66. *Chaetaster vestitus* Koehler  
67. *Ferdina offreti* Koehler  
68. *Fromia armata* Koehler  
69. *F. indica* Perrier  
70. *Leiaster callipeplus* Fisher  
71. *Linckia guildingii* Gray  
72. *L. laevigata* (Linnaeus)  
73. *L. multifora* (Lamarck)  
74. *Nardoa aegyptica* (Gray)  
75. *N. carinata* Koehler  
76. *Ophidiaster armatus* Koehler
77. *Tamaria dubiosa* Koehler  
78. *T. fusca* Gray  
79. *T. hirsuta* (Koehler)  
80. *T. tubifer* Sladen
- Family ASTERINIDAE
81. *Anseropoda pellucidus* Alcock  
82. *Asterina burtoni* Gray  
83. *A. sarasini* (Koehler)  
84. *Disasterina spinosa* Koehler  
85. *Patiriella pseudoexigua* Dartnall  
86. *Paranepanthima brachiata* Koehler  
87. *Tegulaster ceylonica* (Doederlein)
- Order SPINULOSIDA  
Family PTERASTERIDAE
88. *Euretaster cribrosus* (von Martens)
- Family ECHINASTERIDAE
89. *Cribrella mutans* Koehler  
90. *Dictyaster xenophilus* Wood Mason & Alcock  
91. *Echinaster callosus* Marenzelleri  
92. *E. luzonicus* (Gray)  
93. *E. purpureus* (Gray)
- Family VALVASTERIDAE
94. *Valvaster striatus* Perrier
- Family ACANTHASTERIDAE
95. *Acanthaster planci* (Linnaeus)
- Family METRODIRIDAE
- 95a. *Metrodira subulata* Gray
- Family ZOROASTERIDAE
96. *Zoroaster adamu* Koehler  
97. *Z. carinatus* Alcock  
98. *Z. gilesii* Alcock
- Order FORCIPULATIDA  
Family ASTERIIDAE
99. *Distolasterias mozophorus* Alcock and Wood Mason  
100. *Sclerasterias nitida* Koehler
- Family BRISINGIDAE
101. *Brisinga andamanica* Alcock and Wood Mason  
102. *B. gracilis* Koehler  
103. *Freyella indica* Koehler
- Family OPHIOMYXIDAE
104. *Ophiomyxa australis* Luetken
- Family ASTEROSCHEMATIDAE
105. *Asteroschema fastosum* Koehler  
106. *A. subfastosum* Doederlein  
107. *Ophiocreas sibogae* (Doderlein)

- Family GORGONOCEPHALIDAE
108. *Astrocladus exigus* (Lamarck)
- Order OPHIURIDA
- Family OPHIACANTHIDAE
109. *Ophiocamax fasciculata* Lyman
110. *O. rugosa* Koehler
111. *Ophiocantha abnormis* Lyman
112. *O. composita* Koehler
113. *O. indica* Ljungman
114. *O. pentagona* Koehler
115. *O. sociabilis* Koehler
116. *O. vestita* Koehler
117. *Ophiomitra integra* Koehler
118. *Ophioplinthaca rudis* (Koehler)
- Family OPHIACTIDAE
119. *Ophiactis delagoa* (Balinsky)
120. *O. savignyi* (Mueller and Troschel)
121. *O. modesta* Brock
- Family AMPHIURIDAE
122. *Amphipholis misera* Koehler
123. *A. squamata* (Delle Chiaje)
124. *Amphioplus andrea* (Lutken)
125. *A. hastatus* (Ljungman)
126. *A. intermedius* (Koehler)
127. *Amphiura dispar* Koehler
128. *A. septemspinosa* H. L. Clark
129. *Ophiocentrus dilatatus* (Koehler)
130. *Ophiocnida picteti* de Loriol
- Family OPHIOTRICHIDAE
131. *Macrophiothrix demessa* (Lyman)
132. *M. koehleri* A. M. Clark
133. *M. longipeda* (Mueller and Troschel)
134. *M. speciosa* (Koehler)
135. *Ophiopteron elegans* Ludwig
136. *Ophiiothrix aristulata* Lyman
137. *O. ciliaris* (Lamarck)
138. *O. diligens* Koehler
139. *O. exigua* Lyman
140. *O. lepidus* de Loriol
141. *O. propinqua* Lyman
142. *O. proteus* Koehler
143. *O. purpurea* von Martens
144. *O. trilineata* Lutken
145. *O. vigelandi* A. M. Clark
- Family HEMIEURYALIDAE
146. *Ophiomoeris tenera* (Koehler)
- Family OPHIONEREIDIDAE
147. *Ophionereis dubia* (Mueller & Troschel)
148. *O. porrecta* Lyman
149. *Ophiochiton modestus* Koehler

- Family OPHIOCOMIDAE
150. *Ophiarthrum elegans* Peters
151. *O. pictum* (Mueller and Troschel)
152. *Ophiocoma brevipes* Peters
153. *O. dentata* Mueller and Troschel
154. *O. erinaceus* Mueller and Troschel
155. *O. pica* Mueller and Troschel
156. *O. scolopendrina* (Lamarck)
157. *Ophiocomella sexradia* (Duncan)
158. *Ophiomatrix annulosa* (Lamarck)
159. *Ophiopsila pantherina* Koehler
- Family OPHIODERMATIDAE
160. *Bathypectinura heros* (Lyman)
161. *Ophiorachnella gorgonia* (Mueller & Troschel)
162. *O. infernalis* (Mueller and Troschel)
163. *Ophiarachna incrassata* (Lamarck)
164. *Ophiopeca custos* Koehler
165. *Gymnopetta indica* (Koehler)
- Family OPHIURIDEA
166. *Homalophiura inflata* (Koehler)
167. *Ophiernus adpersus* Lyman
168. *Ophioceramis tenera* Koehler
169. *Ophiolepis cincta* Mueller and Troschel
170. *O. superba* H. L. Clark
171. *Ophiomusium elegans* Koehler
172. *O. simplex* Lyman
173. *O. scalare* Lyman
174. *Ophiopyren bispinosus* Koehler
175. *Ophiolepis nodosa* (Duncan)
176. *Ophiura aequalis* (Lyman)
177. *O. flagellata* (Lyman)
178. *O. forbesi* (Duncan)
179. *Ophiura kinbergi* Ljungman
180. *Ophiolypus granulatus* Koehler
181. *Ophiomusa relicta* (Koehler)
182. *Ophioplocus imbricatus* (Mueller & Troschel)
183. *Ophiozonelle bispinosa* (Koehler)
- Order CIDAROIDA
- Family CIDARIDAE
184. *Eucidaris metularia* (Lamarck)
185. *Prionocidaris baculosa* (Lamarck)
186. *P. brevicollis* (deMeijere)
187. *P. verticillatus* (Lamarck)
188. *Procidaris purpureata* Wyville-Thompson
189. *Sterocidaris alcocki* (Anderson)
190. *S. indica* Doderlein
191. *Stylocidaris lorioli* Koehler
192. *S. tiara* Anderson
193. *S. albidens* H. L. Clark
- Order ECHNOTHURIOIDA
- Family ECHINOTHURIIDAE
194. *Hygrosoma luculentum* (Agassiz)
195. *Phormosoma bursarium* A. Agassiz

- Order            DIADEMATOIDA  
Family           DIADEMATIDAE
196. *Astropyga radiata* (Leske)  
197. *Centrostephanus nitidus* Koehler  
198. *Chaetodiadema granulatatum* Mortensen  
199. *Diadema savignyi* Michelin  
200. *D. setosum* (Leske)  
201. *Echinothrix calamaris* (Pallas)  
202. *E. diadema* (Linnaeus)
- Family            ASPIDODIADEMATIDAE
203. *Aspidodiadema nicobaricum* Doederlein
- Order            SALENIODIA  
Family           SALENIIDAE
204. *Salenia sculpta* Koehler
- Order            PHYMOSOMATOIDA  
Family           STOMECHINIDAE
205. *Stomopneustes variolaris* (Lamarck)
- Order            ARBACIOIDA  
Family           ARBACIIDAE
206. *Coelopleurus vittatus* Koehler  
207. *Pygmaeocidaris prionigera* (Agassiz)
- Class            ECHINOIDEA  
Order            TEMNOPLEUROIDA  
Family           TEMNOPLEURIDAE
208. *Mespilia globulus* (Linnaeus)  
209. *Microcyphus ceylanicus* Mortensen  
210. *Paratrema doederleini* (von Martens)  
211. *Printechinus impressus* Koehler  
212. *Prionechinus agassizi* Wood Mason & Alcock  
213. *Salmacis bicolor* L. Agassiz  
214. *Temnopleurus apodus* Agassiz & H.L. Clark  
215. *T. proctalis* (Koehler)  
216. *T. toreumaticus* (Klein)  
217. *Temnotrema scillae* (Mazetti)  
218. *Trigonocidaris versicolor* Koehler
- Family            TOXOPNEUSTIDAE
219. *Gymnechinus robbilliardi* (de Loriol)  
220. *Toxopneustes pileolus* Lamarck  
221. *Tripneustes gratilla* (Linnaeus)
- Order            ECHINOIDA  
Family           ECHINOMETRIDAE
222. *Colobocentrotus atratus* (Linnaeus)  
223. *Echinometra mathaei* (Blainville)  
224. *Echinostrephus molaris* (Blainville)
- Order            HOLECTYPOIDA  
Family           ECHINONEIDAE
225. *Echinoneus cyclostomus* Leske
- Order            CLYPEASTEROIDA  
Family           CLYPEASTERIDAE
226. *Clypeaster reticulatus* (Linnaeus)
- Family            ARACHNOIDEA
227. *Arachnoides placenta* (Linnaeus)
- Family            FIBULARIIDAE
228. *Echinocyamus crispus* Mazetti  
229. *Fibularia ovulum* Lamarck
- Family            LAGANIDAE
230. *Laganum depressum* Lesson  
231. *L. laganum* (Leske)  
232. *L. retinens* Koehler  
233. *L. versatile* Koehler  
234. *Peronella lessueuri* (Valenciennes)  
235. *P. macroproctes* Koehler  
236. *P. rubra* Doederlein  
237. *P. rutlandi* (Koehler)
- Family            ASTRICLYPEIDAE
238. *Echinodiscus aurius* Leske  
239. *E. bisperforatus* Leske
- Family            PERICOSMIDAE
240. *Pericosmus macronesius* Koehler
- Family            SCHIZASTERIDAE
241. *Brisaster indicus* Koehler  
242. *Faorina chinensis* Gray  
243. *Moira stygia* (Agassiz)  
244. *Prymna investigatoris* Koehler
- Family            AEROPSIDAE
245. *Acesta ovata* A. Agassiz & H. L. Clark
- Family            BRISSIDAE
246. *Brisopsis luzonica* Gray  
247. *B. oldhami* Alcock  
248. *B. parallela* Koehler  
249. *Gymnopatagus magnus* A. Agassiz & H.L. Clark  
250. *Metalia spatangus* (Linnaeus)  
251. *M. sternalis* (Lamarck)  
252. *Maretia planulata* (Lamarck)
- Family            LOVENIIDAE
253. *Areolampas glauca* (Wood Mason & Alcock)
- Family            SPATANGIDAE
254. *Breynia vredenburgi* Anderson  
255. *Lovenia subcarinata* Gray
- Family            ASTEROSTOMATIDAE
256. *Argopatagus vitreus* A. Agassiz
- Class            HOLOTHUROIDEA  
Order            ASPIDOCHIROTIDA  
Family            HOLOTHURIIDAE
257. *Actinopyga echinites* (Jaeger)  
258. *A. lecanora* (Jaeger)

259. *A. mauritiana* (Quoy & Gaimard)  
 260. *A. miliaris* (Quoy & Gaimard)  
 261. *Bohadschia marmorata* Jaeger  
 262. *B. argus* Jaeger  
 263. *B. vitiensis* Semper  
 264. *Holothuria (Acanthotrapeza) pyxis* Selenka  
 265. *H. (Cystipus) inhabilis* Selenka  
 266. *H. (Cystipus) rigida* Selenka  
 267. *H. (Halodeima) atra* Jaeger  
 268. *H. (Halodeima) edulis* Lesson  
 269. *H. (Lessonothuria) pardalis* Selenka  
 270. *H. (Mertensiothuria) exilis* Koehler & Vaney  
 271. *H. (Mertensiothuria) leucospilota* (Brandt)  
 272. *H. (Metriatyla) scabra* Jaeger  
 273. *H. (Platyperona) difficilis* Semper  
 274. *H. (Selenkothuria) erinaceus* Semper  
 275. *H. (Selenkothuria) glaberrima* Selenka  
 276. *H. (Semperothuria) cinerascens* Brandt  
 279. *H. (Stauropora) prompta* Koehler & Vaney  
 278. *H. (Thymiosycia) arenicola* Semper  
 279. *H. (Thymiosycia) hilla* Lesson  
 280. *H. (Thymiosycia) impatiens* Forskal  
 281. *H. (Thymiosycia) impatiens* var. *bicolor* Clark  
 282. *H. (Thymiosycia) remollescens* Lampert  
 283. *Labidodemas rugosa* (Ludwig)  
 284. *L. semperianum* Selenka
- Family STICHOPODIDAE
285. *Stichopus chloronotus* Brandt  
 286. *S. horrens* Selenka  
 287. *S. variegatus* Semper
- Family SYNALLACTIDAE
288. *Synallactes rigidus* Koehler & Vaney  
 289. *S. woodmasoni* (Walsh)  
 290. *Bathyplores cinctus* Koehler & Vaney  
 291. *B. crenulatus* Koehler & Vaney  
 292. *B. profundus* Koehler & Vaney  
 293. *Pelopatides dissidens* Koehler & Vaney  
 294. *P. gelatinosus* (Walsh)  
 295. *P. modestus* Koehler & Vaney  
 296. *P. mollis* Koehler & Vaney  
 297. *P. ovalis* (Walsh)  
 298. *P. verrucosus* Koehler & Vaney  
 299. *Allopatides dendroides* Koehler & Vaney  
 300. *Benthothuria cristatus* Koehler & Vaney
- Order DENDROCHIROTIDA  
 Family CUCUMARIIDAE
301. *Trachythyrone alcocki* (Koehler & Vaney)
302. *Leptopentacta bacilliformis* (Koehler & Vaney)  
 303. *Cladolabes acicula* (Semper)
- Order DACTYLOCHIROTIDA  
 Family YPSILOTHURIIDAE
304. *Ypsilothuria bitentaculata* (Ludwig)
- Order APODIDA  
 Family SYNAPTIDAE
305. *Synapta maculata* (Chamisso & Eysenhardt)  
 306. *Synaptula recta* Semper  
 307. *S. striata* (Sluiter)  
 308. *Opheodesma grisea* (Semper)  
 309. *Patinapta ooplax* (Marezeiler)  
 310. *Protankyra errata* Koehler & Vaney  
 311. *P. innominata* Ludwig  
 312. *P. timida* Koehler & Vaney
- Family CHIRIDOTIDAE
313. *Polycheira rufescens* (Brandt)
- Family MYRIOTROCHIDAE
314. *Ankyroderma danielsseni* Theel  
 315. *A. musculus* (Risso)  
 316. *Trochostoma andamanense* Walsh
- Order MOLPADIDA  
 Family MOLPADIIDAE
317. *Molpadia andamanense* Walsh  
 318. *M. brevicaudatum* Koehler & Vaney  
 319. *M. elongatum* Koehler & Vaney  
 320. *M. musculus* Risso  
 321. *M. musculus* var. *acutum* Koehler & Vaney  
 322. *M. musculus* var. *undulatum* Koehler & Vaney  
 323. *Acaudina molpadioides* (Semper)  
 324. *Paracaudina australis* (Semper)
- Order ELASIPODIDA  
 Family DEIMATIDAE
325. *Apodogaster alcocki* Walsh  
 326. *Deima validum* Theel  
 327. *Orphurgus glober* Walsh
- Family PELAGOTHURIIDAE
328. *Euriplastes obscura* Koehler & Vaney
- Family PSYCHROPOTIDAE
329. *Benthothyrone typia* Theel  
 330. *B. sanguinolenta* Theel  
 331. *Filithuria elegans* Koehler & Vaney

## ALPHABETICAL INDEX

- | A                                     |   | C                              |
|---------------------------------------|---|--------------------------------|
| <i>Acanthaster planci</i> 111, 112    |   | Cake urchins 114               |
| <i>Acanthopleura spiniger</i> 91      |   | Calidris 30                    |
| <i>Acropora</i> 59, 60                |   | Callyspongia 44                |
| Actiniaria 48                         |   | Calophyllum 36                 |
| <i>Actinopyga mauritiana</i> 121      |   | Camorta island 36              |
| <i>Adamsia</i> 57                     |   | Campbell Bay 143               |
| <i>Aegialitis rotundifolia</i> 33     |   | <i>Cardiopoma carnifex</i> 35  |
| <i>Aegiceras corniculatum</i> 33      |   | Cardium 29                     |
| <i>Albunea</i> 76                     |   | <i>Cassis cornuta</i> 94       |
| <i>Alpheus</i> 29                     |   | Cat's eye 91                   |
| <i>Amphipholis squamata</i> 113       |   | Cat-worms 71                   |
| Amphipoda 85                          |   | <i>Caulerpa</i> 36, 94         |
| <i>Andamia</i> 131                    |   | <i>Cellana</i> 91              |
| Angel fishes 132                      |   | Cephalopoda 100                |
| Anomuran crabs 76                     |   | <i>Cerianthus</i> 32           |
| <i>Aphrodite</i> 32, 70               |   | Cerithidea 22                  |
| Appendicularians 121                  |   | <i>Cerithidea cingulata</i> 33 |
| <i>Arachnoides placenta</i> 119       |   | <i>Cerithidea quadrata</i> 35  |
| <i>Archaster</i> 112                  |   | <i>Cerithium</i> 32            |
| <i>Arenicola</i> 71                   |   | Cetacea 143                    |
| Aristotle's Lantern 119               |   | Chaetodontidae 132             |
| Armoured animals with jointed feet 72 |   | Chaetognatha 43                |
| Ascidians 121                         |   | <i>Chaetopterus</i> 72         |
| <i>Asterina</i> 112                   |   | Charadriidae 141               |
| Asteroidea 111                        |   | <i>Charonia tritonis</i> 112   |
| <i>Astropecten</i> 111 112            |   | <i>Chelonia mydas</i> 139      |
| <i>Aurelia aurita</i> 47              |   | <i>Chiton</i> 22, 86           |
| <i>Avicennia</i> 33                   |   | Cladocera 43                   |
| <i>Avicennia alba</i> 33              |   | Clams 94                       |
| <i>marina</i> 33                      |   | <i>Clibanarius</i> 35, 83      |
| <i>officinalis</i> 33                 |   | Clown fishes 132               |
|                                       | B | <i>Clypeastar</i> 119          |
| <i>Balanus</i> 22, 74                 |   | Cinque island 131              |
| Barnacles 22, 74                      |   | Cirripedia 43, 73              |
| Barringtonia 34                       |   | Coat of mail shells 86         |
| <i>Beche-de-mer</i> 120               |   | Cockles 29                     |
| Birds of sands 142                    |   | Coconut crab 83                |
| Birds of muddy shore 142              |   | Coelenterata 45                |
| <i>Birgus</i> 83                      |   | Cold Blooded Air Breathers 134 |
| <i>Birgus latro</i> 83                |   | <i>Colobocentrotus</i> 119     |
| Bivalve 86, 94                        |   | Colubridae 140                 |
| <i>Boleophthalmus</i> 35              |   | Cones 93                       |
| <i>Botryllus</i> 121                  |   | <i>Conus aulicus</i> 93        |
| Brachyura 74                          |   | <i>geographus</i> 93           |
| <i>Bruguiera gymnorrhiza</i> 33       |   | <i>marmoreus</i> 93            |
| Brittle stars 113                     |   | <i>textile</i> 93              |
| Bryozoans 101                         |   | <i>tulipa</i> 93               |
| "Buffalo of the sea" 139              |   | Corals 57                      |
| <i>Bugula</i> 101                     |   | <i>Corallium</i> 58            |
| Burhinidae 141                        |   | Copepods 29                    |
| Butterfly fishes 132                  |   | Cotton spinner 121             |
|                                       |   | Cowries 92                     |
|                                       |   | Crabs 74                       |

*Crassostrea madrasensis* 99  
Crinoidea 111  
Crocodiles 134  
*Crocodylus porosus* 140  
Crustaceans 72  
Cubomedusae 47  
*Culcita* 112  
Cultellus 30  
Curlew 142  
Currents 7  
Cyclostrematids 91  
*Cypraeacassis rufa* 94

D

*Delphinus delphis* 144  
*Dentalium* 86  
*Dermochelys coriacea* 139  
*Diadema* 119  
Diatoms 42  
*Dimophyes arctica* 8  
*Dinoflagellates* 42  
Discomedusae 47  
Doliolids 121  
Dolphins 143  
Dorididae 93  
*Dotilla* 75  
Dromadidae 141  
*Drupa* 94  
*Dugong dugon* 144

E

*Echinaster* 111  
Echinoderms 102  
*Echinodiscus* 119  
Echinoidea 114  
*Echinometra* 119  
*Echinostrephus* 119  
*Echinothrix* 119  
Eels 132  
Elephant tusk shell 99  
*Emerita* 76  
*Enteromorpha* 36  
*Eretmochelys imbricata* 139  
Errantia 70  
*Eunice* 32  
*Eunice afra* 71  
*Eurythoe* 32  
*Eurythoe complanata* 71

F

*Favia* 60  
Feather-duster worms 71

Feather stars 111  
Fiddler crabs 29, 75  
Flat worms 69  
Floating umbrellas 47  
Flower animals 48  
*Fragillaria oceanica* 42  
Fungia 60

G

*Gammarus* 85  
Gastropoda 86  
Giant clams 94  
Glass-rope-sponge 44  
Glory-of-the sea 93  
*Gonyaulax* 42  
Gorgonids 58  
Gracilaria 36  
Green Sea turtle 139  
*Gymnodinium* 42  
Gymnolaemata 101

H

*Halimeda* 41, 94  
*Haliaeetus leucogaster* 142  
*Hapalochlaena maculosa* 100  
*Harmathoe* 70  
Hawksbill 139  
Heart Urchins 114  
*Heliopora* 58  
Helmet or king shells 54  
Heteropods 43, 91  
Holoplankton 43,  
*Holothuria atra* 41, 121  
*Holothuria scabra* 121  
*Holothuria pyxix* 120  
*Holothurians* 120  
*Holothuroidea* 120  
*Hydractinia* 57  
Hydromedusa 43  
Hydrophiidae 140

I

Interstitial fauna 29  
Ipomea 36  
*Ischnochiton winckworthi* 91  
Isopoda 35, 85

- J
- Janthinids 91  
Jelly fishes 47
- K
- Key hole limpet 92  
King fishers 142
- L
- Laganum* 63  
Lapwings 141  
Laridae 141  
*Laticauda* 140  
Leather turtle 139  
Leopard shark 133  
*Lepas anatifera* 74  
*Lepidochelys olivacea* 139  
*Ligia* 85  
*Lima* 99  
*Limnoria* 85  
Limpets 22, 91, 92  
*Linckia* 111  
*Linckia laevigata* 112  
*Linckia multifora* 112  
*Lithophyllum* 36  
Lithopags 99  
*Lithothamnion* 36  
*Littorina scabra* 25  
Littorinids 92  
Living floaters 42  
Lobsters 84  
Loricata 86  
Lug worm 71  
*Luidia* 112
- M
- Macroplankton 42  
Macrura 84  
*Mactra* 30  
Magic carpet 69  
Malacostraca 74  
Mangroves 33  
Mantis shrimp 85  
*Marphysa mossambica* 32  
Marine worms 69  
Modusao 45  
Megaplankton 42  
*Metridium* 57  
Microplankton 42  
*Mitra* 94  
Mitrids 94
- N
- Molluscs 86  
Monitor lizard 139  
Moss Animals 101  
Muddy shores 30  
Muricids 94
- Nanoplankton 42  
Nancowry 60  
*Nassarius* 33  
*Nautilus* 100  
    *pompilius* 100  
*Nematodes* 69  
*Nemertean*s 69  
*Nephtys* 70  
*Nereis* 70  
*Nerita articulata* 35  
*Nerita atropupurea* 35  
*Nipa fruticana* 33  
*Noctiluca miliaris* 42
- O
- Octopuses 99  
*Ocypode* 29  
*Ocypods* 75  
Olive Ridley turtle 139  
*Ophiactes savignyi* 113  
*Ophiarthrum elegans* 114  
Opisthobranchia 93  
*Ophiolepis superba* 114  
*Ophioplocus imbricatus* 114  
*Ophithala danae* 113  
*Ophiothrix* 114  
Ophiuroidea 113
- P
- Paddle-worms 70  
Padina 36  
Pandanus 26  
*Panulirus* 84  
Parchment-worm 72  
Parrot fish 113  
*Patiriella* 112  
Peacock-worm 72  
Pearl Oysters 99  
Pectinaria 71  
Peile Island 44  
Pelagic coelenterates 45  
*Perinereis* 32  
*Peridinium* 42  
Periwinkles 21, 92  
Petricolids 99  
*Periophthalmus* 35  
*Phaethon lepturus* 142

Phaethonitidae 141  
*Phyllodoce* 70  
*Phyllospongia calciformes* 44  
*Physalia* 45, 46  
*Physalia physalis* 43  
 Phytoplankton 42  
 Piddocks 94  
*Pinctada margaritifera* 99  
 Pistol shrimps 29, 84  
 Placophora 86  
 Plankton 42  
 Platyhelminthes 69  
 Plovers 141  
 Polybranchidae 93  
 Polychaetes 32, 69  
 Polyplacophora 86  
 Polyyps with skeleton 57  
 Pomacanthidae 132  
 Porifera 44  
*Porites* 59, 60  
*Porpita* 45, 46  
*Porpita porpita* 43  
 Portuguese—Man-of-War 46  
*Poterion* 28  
*Pseudoceros coralliophilus* 69  
*Pseudorca crassidens* 143  
 Pteropods 43, 91

Q

R

Ragworms 70  
*Rana cancrivora* 34  
 Razor clams 30  
 Reef fishes 133  
 Reef heron 141  
 Reptiles 134  
 Rhinophores 93  
*Rhizophora* 33, 34  
     *apiculata* 33  
     *mucronata* 33  
     *styiosa* 34  
 Rhizostomae 47  
 Ribbon worms 69  
 Robber crab 83  
 Rutland Island 131

S

Sabellids 71  
*Saccostrea cucullata* 99

Sailing colonies 45  
*Salaris* 131  
 Salps 121  
 Sanderlings 30  
 Sand dollars 114  
 Sand mason 72  
 Sand pipers 30  
 Sandy shores 23  
*Sargassum* 41  
 Scallops 94  
 Scaphopoda 86  
*Scatophagus argus* 131  
 Scorpion fishes 132  
 Scorpion shell 92  
 Scyphomedusae 27  
 Sea anemones 48  
 Sea Butterflies 93  
 Sea cows 143, 144  
 Sea cucumbers 102, 120  
 Sea cups 44  
 Sea fans 58  
 Sea gulls 141  
 Sea lilies 111  
 Sea mouse 70  
 Sea snakes 140  
 Sea stars 102, 111  
 Sea squirts 121  
 Sea urchins 102, 114  
 Segmented worms 69  
*Sesarma longipes* 35  
 Ship worms 34, 94  
 Shore slaters 85  
 Shrimps 84  
 Sirenia 143  
 Snakes 134  
 Snails and slugs 91  
 Snapping shrimps 29  
*Sonneratia alba* 33  
     *apetala* 33  
 South Sentinel Island 132  
*Sphaeroma* 35, 85  
 Spiny skinned animals 102  
*Sporobolus* 36  
*Squilla mantis* 85  
 Squids 99  
*Sterna* 30  
*Stichopus chloronotus* 121  
 Stomatopoda 85  
*Stomopneustes* 119  
*Stoichactis* 57  
*Stylifera* 94  
 Sub littoral 22  
 Surf clams 30  
*Synapta maculata* 120

T	U
<i>Tellina</i> 30	<i>Uca</i> 29
Terns 30	<i>Uca marionis</i> 75
<i>Thais</i> 94	<i>Uca vocans</i> 75
<i>Thalassia</i> 36	Ultranoplankton 42
Thespesia 34	
Thysanozoon 69	V
<i>Tibia</i> 92	<i>Varanus</i> 139
Top shell 92	<i>Vasum</i> 94
Tortoise-shell turtle 139	<i>Velella</i> 45, 46
<i>Toxopneustes</i> 119	<i>Veleva veleva</i> 43
<i>Toxopneustes pileolus</i> 114	Venus flower basket 44
<i>Trepang</i> 121	
<i>Trichodesmium erythraeum</i> 42	W
Tringa 30	Wanderers 70
<i>Tripneustes</i> 119	Warm blooded animals 143
<i>Trochus</i> 92	Whales 143
<i>Trochus niloticus</i> 92	Whelks 92
Tulips 121	
Tunicata 121	
Turban shell 22	
<i>Turbinaria</i> 36	
<i>Turbo</i> 92	
<i>Turbo marmoratus</i> 92	
Turnstone 141	Z
Turtle 134	Zoecium 101



Dr. Benoy Krishna Tikader hails from Joydihi, a small village in the District of Khulna, now in Bangladesh. He was educated at the University of Calcutta and obtained Ph.D. and D.Sc. degrees for his outstanding and meritorious contributions on spiders. Besides, Fauna volumes on spiders and scorpions his recent important publications include *Threatened Animals of India*, *Birds of Andaman & Nicobar Islands* and *Handbook on Indian Testudines*. His hobby includes photography of nature and Wildlife and many of the photographs that have appeared in the pages of the book are by him. Dr. Tikader is at present the Director of the Zoological Survey of India and is a member of the Indian Board for Wildlife.



Dr. Augustine Daniel obtained his Post-graduate and Ph.D. Degrees from the University of Madras. He started his research career with investigations on the marine foulers and borers, in the Forest Research Institute. For some time he was with the Central Marine Fisheries Research Institute, Cochin. After joining the Zoological Survey of India, he organised the Marine Survey Unit which grew up into the present Marine Biological Station. Dr. Daniel is at present Joint Director-in-Charge of Marine Biological Station and the Environmental Monitoring Wing, at Madras.

Dr. Nalluri Venkata Subba Rao, obtained his post-graduate degree from Agra University and the Ph.D. degree from the University of Calcutta. Since joining the Zoological Survey of India in 1960 he has been actively engaged in the study of various aspects of Indian molluscs. For a brief period he worked as an Associate Curator in Molluscs in the Museum National D'Histoire Naturelle, Paris. His forthcoming books include a "Handbook on Freshwater Molluscs of India" and "Fauna of India: Mollusca: Neritidae"



