

BIODIVERSITY OF MARINE MOLLUSCS

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INTRODUCTION

The concept of biosphere reserve was mooted by UNESCO as early as 1971, in its Man and biosphere programme. UNESCO in larger global interests and with the idea of oneness of humanity transcending national frontiers, recognised the need for conservation of the worlds vanishing species and habitats. On that context, the man and biosphere programme committee in India started functioning under the direct patronage of Government of India and as much as 8 important areas have been brought under the category of biosphere reserves so far.

India is one of the 12 mega centres of biological diversity. Two of the major realms and three basic biomes including 10 biogeographic regions are represented in our country. Over 50,000 species of plants and 80,000 species of animals have been identified by biosystematists in different parts. A detailed biodiversity inventory is yet to be made. Micro flora and fauna are to be studied yet. Apart from India's geographic area of 3.28 million square km, by virtue of UN convention on the Law of sea, provides the country with additional sea surface of 2.1 million square km EEZ.

In the following text special emphasis is given in understanding the general biodiversity, molluscan biodiversity, its distribution, exploitation and management strategies in general are dealt with.

Important ecosystems under biosphere reserve

Major ecosystem classification under biosphere reserve is i) Coastal ecosystem, ii) Mangrove ecosystem, iii) Seagrass ecosystem, iv) Coral reef ecosystem and v) Littoral forests.

Coastal ecosystem

Coastal ecosystem is the interface between land and sea and, at their broadest level of definition, covers approximately 8% of the earth. They are exceptionally diverse and productive, particularly in shallow water tropical regions. Coastal environments have been described as four dimensional systems varying over both space and time in unique and interrelated ways. In this way, they contain distinctive ecological and biophysical features. More importantly, because of the fluid nature of the seas, whole biological communities rest as floating plankton based entities, distributed horizontally and vertically through broad ocean

spaces and are displaced overtime as these drift with ocean currents.

Mangrove ecosystem

Mangrove wet lands, the fragile and dynamic ecotone between the land and sea of the tropical and subtropical coastlines, constitute an important ecological asset and invaluable economic resource to the coastal communities. It acts as a barrier against cyclonic storm and prevents entry of seawater into land during storm surges and also acts as a buffer against flood and thereby avoids soil erosion in the coastal zone.

Coral reef ecosystem

Coral reefs are a special kind of shoreline or shallow-bottom habitat found in latitudes between 30°N and 30°S. A unique combination of conditions allows them to support an extremely complex biological community. The myriad shapes and crevices of the hard coral structures offer a variety of covers to animals. Corals grow wherever sea surface temperatures exceed 20°C throughout the year. They flourish wherever a shallow, hard substrate is kept silt-free by prevailing currents and waves. Corals do not survive in sediment-laden water, such as near the river discharge. Their dependence on intense sunlight restricts the depths of most living coral communities to less than about 50 m, although some corals will grow at depths of 100 m. The Indian and Pacific Oceans have the most extensive coral reef.

Seagrass ecosystem

Seagrasses are the marine plants inhabiting the shallow coastal waters in tropical and temperate zones. There are about 50 species classified into 12 genera, 9 of which

belong to the potamogetonaceae and the rest to Hydrocharitaceae of Monocote.

There are seven genera that are regarded as characteristic for the tropical seas and consist of *Enhalus*, *Thalassia* and *Halophila* belonging to Hydrocharitaceae and 4 genera *Halodule*, *Cynodocea*, *Styringodium* and *Thalassodendron* belonging to Potamogetonaceae. Except the genus *Thalassodendron* all the 6 genera occur in southern India. i.e. Lakshadweep, Andaman and Nicobar Islands, Gulf of Mannar and Godavari basin. The seagrass beds and coral reefs are the linked habitats for sea faunal communities with different life forms, which depend for their sustenance shelter and protection. They are considered to be the most productive shallow marine communities. Seagrass bind the sediments through their extensive root system and prevent siltation on to the corals. They act as buffers between mangroves and corals and act as monitors of the physical and biological factors that exist in common to their communities.

Littoral forests

These occur along the coast where a fair width of sandy beach with slight amounts of silt and good rain water supply occur. The annual temperature varies from 26°C to 29°C and mean winter minimum from 22°C to 25°C. Rainfall varies from 1200 mm to 4000 mm and number of rainy days from 60 to 200/year.

The soil had adequate lime but poor in nitrogen and other mineral nutrients. Water table is within 2 mtrs. Over wood consists of *Manilkara littoralis* (Andamans), *Calophyllum inophyllum*, *Derris indica*, *Manilkara hexandra*, *Salvadora persica*, *Gmelina asiatica*, *Pandanus* sp., *Spinifex littoreans*, etc. The ecosystem plays

an important role as a shelterbelt, harbouring ground for many herbivores and as sand dune stabilizer.

Molluscan resources and their biodiversity values

Strictly speaking, none of the organisms/plants are to be ignored as a component when biodiversity is concerned. However, many of the forms directly or indirectly useful to the mankind and they occupy a special place in the marine biodiversity. Among the molluscs, many such species are found and they may be classified broadly into the following groups.

1. The species, which are directly, consumed by mankind (food value) such as clams; edible oysters; mussels; scallops and cephalopods.
2. The species, which are useful for industrial purposes and by their ability to produce commercially valuable items (pearls) *i.e.* pearl oysters, abalones, chanks, etc.

Clams

Resources and distribution

A number of clam species belonging to the families Arcidae, Veneridae, Corbiculidae, Tridacnidae, Solenidae, Mesodesmatidae, Tellinidae and Donacidae are exploited along the Indian coast. The cultivable species belong to the first four above mentioned families.

Arcid clams are called blood clams, as their blood is red in colour due to the presence of haemoglobin. A single species, *Anadara granosa* is important. It occurs all along the Indian coast in soft muddy substratum and forms a fishery of some magnitude in the Kakinada bay.

Venerid clams are most sought, after the clam fisheries of India and three genera namely *Meretrix*, *Paphia* and *Katelysia* are important.

Along the Maharashtra coast *M. meretrix*, *K. opima* and *P. laterisulca* are the dominant species occurring in several estuaries and bays. In Goa, *M. casta* forms a fishery. Along the Karnataka coast, there are 14 estuaries with varying abundance of clams. *M. casta* is found in all the estuaries, *M. meretrix* in the Kallinadi and Coondapur estuaries, *P. malabarica* in the Mulky, Gurpur, Udyavara and Coondapoor estuaries and *K. opima* is found in Coondapur, Uppunda and Sita estuaries. Along the Kerala coast *P. malabarica* forms a fishery in Koduvally, Azhikkal, Karyamgod and Chittari estuaries and Ashtamudi lake. Other venerid clams form fisheries in several estuaries of Kerala state. Along the east coast, *M. casta* occurs at several places and forms a fishery at vellar estuary, Pulicat lake and Bhimunipatanam backwaters. *K. opima*, *P. malabarica* and *M. meretrix* contribute to the clam fisheries in the Kakinada bay. Along the Orissa coast *Meretrix* spp. occur in Chilka lake and Sonapur backwaters.

The back clam *Villorita cyprinoides* (Fam: Corbiculidae) contributes to the clam fisheries in Goa and in the Nethravathi, Gurpur, Udyavara, Swarna and Coondapoor estuaries in Karnataka. It is a major resource in the Vembanad lake and is also exploited in several backwaters, lakes and estuaries of Kerala.

The family Tridacnidae is represented in India by *Tridacna maxima*, *T. crocea*, *T. squamosa* and *Hippopus hippopus*. They are called as giant clams and occur in the Andamans.

Exploitation

Clams are fished by men, women and children all along the Indian coast. They are collected from the intertidal region to about

4 m depth. They are handpicked and also a hand-operated dredge is used. Plank-built non-powered boats are used for transport. Clams under one year age contribute in considerable numbers to the fishery. At many centres, November to April is the peak fishing season, as the new recruits become available to the fishery.

The clam production and the effort expended are not monitored on a countrywide basis. Nevertheless, surveys conducted, mainly by CMFRI at important production centres have given valuable information on the clam fisheries of the country. West coast accounts for 85.7% of the estimated annual production of about 45,000 t of clams. Kerala ranks top with 72.5% of the production followed by Karnataka, which accounts for 12.5%.

Edible oysters

Resources and distribution

In India six species of oysters namely the India backwater oyster, *Crassostrea madrasensis* (Preston), Chinese oyster *C. rivularis* (Gould), west coast oyster *C. gryphoides* (Schlotheim), Indian rock oyster *Saccostrea cucullata* (Born), Bombay oyster *Saccostrea cucullata* (Awati and Rai) and giant oyster *Hyostissa hyotis* (Linnaeus) are found. The first four mentioned above have commercial value.

C. madrasensis is euryhaline *i.e.* it tolerates wide variations in salinity. It inhabits backwaters, creeks, bays and lagoons and occurs from the intertidal region to 17 m depth in Orissa. Oyster beds are found in the Bahudi estuary near Sonapur and at the mouth of the Chilka lake. In Andhra Pradesh, oyster beds are

located in the Sarada estuary, Bhimunipatnam backwater, Upputeru Canal (Kakinada), Krishnapatnam and Gokulapalli backwater. Regular exploitation has been reported in the Gokulapalli area. Tamil Nadu has rich oyster resources. In the Pulicat backwater, oyster beds over 10 ha with an estimated standing stock of 1,320 t. In the Ennore backwater 45 ha oyster beds support a standing stock of 18,600 t and the oysters are regularly exploited by fisherfolk throughout the year. In Muthupet swamps extensive oyster beds occur. At Thirumallaivasal 75 t of oyster population has been estimated in beds covering about 25 ha area. Oyster beds exist in Killai backwater, Pazhayar, Vaigai and Tambraparni estuaries and at Tuticorin. In the Andamans, *C. madrasensis* occurs at Port Blair, Havelock Island, Mayabender and Dighlipur. The Kerala coast supports small oyster populations. In the Ashtamudi and Vembanad lakes, Cochin backwaters, Mahe estuary and the creeks of Dharmadam, Valapatnam. Nileshtar and Chandragiri, oyster populations have been recorded and there is regular exploitation. In Karnataka oysters are regularly fished from Nethravathi, Mulki, Udyavara, Venkatapur, Coondapoor and Kali estuaries.

C. gryphoides is also a euryhaline species occurring along the north Karnataka, Goa and Maharashtra coasts. In Maharashtra, it is exploited regularly from several creeks. It occurs in water upto 7 m depth.

C. rivularis is found along the Gujarat coast and also occurs in Maharashtra together with *C. gryphoides* in the Mahim, Ratnagiri and Jayatpur creeks.

Saccostrea cucullata occurs all along the main land coast and Andamans and

Lakshadweep Islands. It is found in shallow coastal waters, attached to the rocks and boulders and can withstand surf and wave action in the marine environment.

Exploitation

The oysters occur in shallow waters and form subsistence fisheries at several centres along the Indian coast. The production is mostly utilised for local consumption. Men, women and children collect the oysters at low tide and various implements are used to dislodge the oysters from the bed. The production of the oysters from the natural grounds is not monitored regularly in the country. However, by the surveys conducted by CMFRI at some of the important production centres the annual catch is estimated at less than 2,000 t. *C. madrasensis* is the dominant species from the fisheries point of view.

Mussels

Resources and distribution

Of the two species of commercially important mussels, the green mussel *P. viridis* is widely distributed and found in small beds in Chilka lake, Visakhapatnam, Kakinada, Madras, Pondicherry, Cuddalore and Porto Novo on the east coast and extensively around Quilon, Alleppey, Cochin, Calicut to Kasargod, Mangalore, Karwar, Goa, Bhatia creek, Malwan, Ratnagiri and the Gulf of Kutch on the west coast. It is also found in Andamans. *P. viridis* occurs from the intertidal zone to a depth of 15 m. On the other hand, *P. indica* has restricted distribution and is found along the southwest coast from Varkala near Quilon to Kanyakumari and from there to Tiruchendur along the southeast coast. Recently the brown

mussel has been observed at Visakhapatnam. It occurs from the intertidal region to a depth of 10 m.

Exploitation

Kerala state can be called as the Mussel fishery zone of India since extensive beds of both the green and brown mussels occur in this state which also accounts for the bulk of the mussel production in the country.

Mussels are exploited during September-April. Good low tide, clear water and sunny days are favourable for fishing. Women and children collect the mussels from the inter-tidal areas. Mussels are collected by handpicking and the chisel or a knife is used to dislodge the mussels from the rocks. Men either swim or use a canoe to reach the fishing grounds and exploitation is restricted to 5 m depth. They may use masks and carry a nylon bag tied to their waist to keep the catch. Both full time and part-time divers are engaged in the mussel fishery.

Perna viridis fishery

The major mussel landing centres in the Cannanore-Calicut area are Koduvally, Mahe, Chombala, Moodadi and Thikkodi, Elathur, Challium and South Beach. About 325 full-time and 336 part-time divers and 340 canoes are deployed. The production from Cannanore-Calicut are estimated at 3043 t, 3074 t and 2597 t during 1981-82, 1982-83 and 1983-84 respectively. The catch per unit effort varied from 44.3 to 60.4 kg/canoe. The standing stock of the mussels in this area has been estimated at 15,887 hectares of mussel beds and the density varies from 20 mm to 129 mm with 50-90 mm group contributing to the bulk of the catches.

In the Majali-Bhatkal area of Karnataka, the fishing season is from April to June and

36.5 t of mussels were landed in 1982-83. The standing stock from 5 ha mussel beds has been estimated at 206 t.

At several places in Goa and Maharashtra mussels are regularly exploited and form subsistence fishery. At a few east coast centres mussels are collected in small quantities for local consumption.

Perna indica fishery

The important fishing centres are Kovalam, Avaduthura, Vizhinjam, Mulloor, Pulinkudi, Chowara, Enayam, Colachal, Kadiyapatnam and Muttom. About 300 catamarans, 520 active and 270 part time fishermen are deployed in the brown mussel fishery. The annual production is estimated at 500 t and the standing stock at 1,586 t. Peak landings are during November-January. The population density of mussels is about 5-8 kg/m².

Scallops

Resources and distribution

Scallops are the unique swimming bivalves of the Super family Pectinidae. There are about 400 living species in this family inhabiting all the seas of the world from Polar regions to the tropics occupying the intertidal region down to 3000 m. About 20 scallop species are commercially important. Scallops are suspension feeding bivalves which feed mainly on suspended detrital material and phytoplankton. The longevity of the scallops ranges from 3 to 20 years. The total world landing of scallops is estimated to be 14.48 lakhs mt contributing to 15% of the total mollusc landing of 96.47 lakhs mt.

In India scallop resources have not been studied in detail. Occurrence of few species is

reported. *Pecten plica* (Linen), *Pecten tranquebaricus* (Gmelin), *Pecten splendidulus* Sowerby, *Pecten crassicosatus* Sowerby and *Amusium pleuronectus*. Mariculture of this species in India is yet to be initiated.

Cephalopods

Resources and distribution

Squids and cuttle fishes are another important group of molluscs. Exploratory fishing have revealed the existence of squids and cuttle fish resources in the continental shelf and oceanic areas. The common species available in the Indian waters are 1. *Sepia elliptica*, 2. *S. pharaonis*, 3. *S. inermis*, 4. *Loligo duvaucelli*, 5. *Sepioteuthis lessoniana* and 6. *Octopus dofusii*. These cephalopod species are found distributed in the Arabian sea, Bay of Bengal and Andaman seas. They are exploited as bycatch of fish and prawns in many type of gears such as shore seines, boat seines, hooks and lines and trawl nets operated from variety of crafts. Cephalopods demand high price in the current market. Many products such as frozen cuttle fish, squids and fillets are being exported from India. Apart from food purpose, cuttle bones are also exported for various product development. To enhance the population and culture of cuttle fish, attempts were made and preliminary success was achieved in India in the larval development of *S. pharaonis*.

Pearl oysters

Resources and distribution

The pearl oysters belong to the genus *Pinctada* Roding under the family Pteriidae. They occur in the seas of the tropical and subtropical regions of the world. From Indian waters, six species of pearl oysters have been

reported, namely *Pinctada fucata* (Gould), *P. margaritifera* (Linnaeus), *P. chemnitzii* (Philippi), (Reeve) *P. anomioides* (Reeve) and *P. atropurpurea* (Dunker). Among them *P. fucata*, called the Indian pearl oyster, is the most dominant and contributes to the pearl fisheries of the Gulf of Mannar and the Gulf of Kutch. The black-lip pearl oyster, *P. margaritifera*, is confined to Andaman and Nicobar group of islands. Recently several specimens of *P. margaritifera* were collected from the Gulf of Mannar.

Exploitation

The pearl fisheries of the Gulf of Mannar have been well documented and so far 38 pearl fisheries were conducted during 1663 to 1961. During this century the fishery was conducted in 1900, 1908, 1296 to 1928 and 1955 to 1961. It is obvious that the pearl fisheries were erratic with long gaps of unproductive periods between short spells of productive fisheries. This was due to the periodic decline of fishable quantities of pearl oyster population in the banks. There are about 65 pearl banks or paars betweenanyakumari and Rameswaram. The pearl fishing season is generally February-May. The oysters are towed by the Government's motorised boats to a pre-determined pearl bank early in the morning and the divers work on the boats till afternoon. Without any diving aids, by holding their breath they descend to the bottom with the help of a stone attached to a rope, pick up oysters by hand and deposit them in a bag slung to their waist. Each dive lasts for a maximum of 90 seconds. The divers get one-third of the pearl oysters as their share and the rest goes to the Government. In the evening the catch is auctioned in lots of 1000 oysters. The

oysters are placed in gunny bags and are left to rot for a week. They are then washed and the pearls are collected.

Current status for resources

SCUBA diving was introduced in India for the survey of pearl banks in 1958 under the auspices of the FAO. The surveys conducted by CMFRI during 1975 to 1986 showed revival of pearl oyster population in some of the banks of the Gulf of Mannar but the yield was not consistent except for 3 or 4 paars. During this period, for a total diving effort of 595 hours in various paars, 2,39,000 oysters were fished, incursion of uneconomic pearl oyster species like *P. sugillata*, *P. anomioides* and *P. atropurpurea* was noticed and on an average they formed 10.36% of the population. Predation of the oysters by the gastropod *Cymatium cingulatum* and *Murex virgineus* leading to heavy mortality was noticed. In successive years the population was composed almost entirely of less than one year old pearl oysters. Because of their young age they were of no use for the production of natural pearls in the fishery.

There was no improvement in the Gulf of Kutch pearl oyster beds since 1968, although a few oysters could be gathered.

Chank

Resources and distribution

Chank beds may be defined as those areas where fine sand of silky texture, superficially muddy coloured with loosely lying small corals and other paar detritus adjacent to the margins of the rocky sea beds.

Under the genus *Xancus* five well marked sub-species of the central form *Xancus pyrum*

(Linn) in different localities. They are 1. *Xancus pyrum* var. *obtusa*, 2. var. *acuta*, 3. var. *globossa*, 4. var. *comorinensis*, 5. var. *fuscus*.

Chank flesh is of late taken as food which has rich protein and minerals. Chank operculum is used for making incense sticks and cost Rs.1500/kg. The sinistral form of chank, which is a freak and considered sacred value costs from Rs.500/- for a chank less than 45 mm dia to Rs.50,000/- for a perfect chank of 65 mm or more. Chanks are exploited mostly for chank bangle industry.

Abalone

Abalones are marine gastropods commonly known as 'ear shells' occupying intertidal rocky areas found in both northern and southern hemisphere but larger varieties exist in temperate regions.

Resources and distribution

There are about 100 species of abalones distributed throughout and only about 10 are commercially important and mostly confined to temperate waters. In the Indian ocean abalones are found from the Arabian sea and the Persian Gulf to the Bay of Bengal around Andamans and Nicobar Islands as well as near Sri Lanka. The common Indian species is *Haliotis varia* which is found under the boulders at extreme low tide at Pamban, Krusadai Island, Tuticorin and other coral reefs along south east coast and is quite small not exceeding 1-1.5 inch in length. In the world over, commercial exploitation of abalones are existing in Australia, China, Japan, Mexico, New Zealand, South Africa and the USA. In India there is no commercial exploitation of abalones.

Threats to conservation

As a result of human activities, both inland

and offshore are getting affected and the resources are rapidly deteriorating. Developmental works on the coastal area modifies the coastal ecosystem to large extent. The various induction such as current, fertiliser, petroleum and thermal plants are potential factors for biodegradation of the marine biodiversity by way of dumping their industrial wastes in the coastal region. The other form of coastal pollution is the untreated disposal of domestic wastes which accounts for approximately 3.88 MT litters a day in Tamil Nadu alone.

Developmental activities like construction of ports, harbours, breakwaters and beach resorts also hampers the natural ecosystem and leads to biodegradation and vanishing of certain vulnerable species from the natural environment. Dredging for the purpose of new navigational routes are also a greater extent inflict physical damage to the macro and micro level forms especially, coral reefs, etc. Due to the modern world increased demand, the operation of minor and major vessels throughout the world has, to a sizeable extent polluted the marine environment by way of oil spillage, waste disposals and marine litters, which in turn hampered the faunal composition.

Apart from this, the ever increasing demand by mankind for the oil and minerals has led to the submarine oil exploration activities and mining for minerals in larger interests. However, these activities invariably results in the physical disturbance and pollute the area of operation which in turn affects the biological components of the ocean bed and results in the disturbance of the living condition of animal species and composition. On the long run, unmindful of these effects, results in the complete elimination of the species.

Management strategies

For the purpose of management of the biodiversity many steps had been taken.

They are identification of biosphere reserve areas, demarkation and protection.

Nation wide mapping of coastal areas by remote sensing techniques coupled with land surveys to assess the rate of degradation of the ecosystem.

Amendment and enactment of National policy with relevance to the protection of respective ecosystem.

- * Export trade control order.
- * Coast Guard Act.
- * Other legislation in relation in exploitation of species for export such as size, weight, fishing regulations, earmarking area of traditional and mechanised fishing.
- * Research and development activities such as ecology, qualitative studies of organic production, species inventory, periodical survey of the population and its seasonal abundance and changes, controlled breeding and sea ranching.

IDENTIFICATION OF COMMERCIALY IMPORTANT MARINE MOLLUSCS

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INTRODUCTION

Molluscs are soft-bodied animals which have developed the capacity to build their own "house". The house or shell is built of calcium carbonate and is a good example of the architectural skills of these animals. The mollusc carries its house on its back throughout its life. The shell is used in the classification of molluscs. It provides the mollusc with protection. However, some among the group have vastly reduced shells, present inside the body, or the shell may be absent.

The Phylum Mollusca is the second largest group of living organisms comprising more than 100,000 species. The Mollusca are extremely old in terms of evolution. The first mollusc appeared as far back as the Cambrian period, approximately 500 million years ago.

CLASSIFICATION

The Mollusca are classified into six major classes:

- i) Monoplacophora (Neopilina galathaea),
- ii) Amphineura (Chitons),
- iii) Bivalvia (Clams),
- iv) Gastropoda (Cones, Cowries, etc.),
- v) Scaphopoda (Tusk shells),
- vi) Cephalopoda (Nautilus, Squid, Cuttlefish, Octopus)

- i) Class **Monoplacophora**: This was supposed to have become extinct 350 million years ago. However, in 1957, a few living specimens were recovered from Costa Rica and the species was named *Neopilina galathaea*.
- ii) Class **Amphineura**: Mouth and anus at opposite ends are symmetrical and more or less elongated body; mantle provided with numerous spicules embedded in a cuticle.
- iii) Class **Bivalvia**: The shell is made up of 2 valves joined to each other by a ligament and hinge. There are about 20,000 living species of bivalves. Most of these are marine and live on the sea bed or burrow in sand. Some of the bivalves have thread-like structures called byssus threads by which they anchor themselves to rocks (e.g., *Mytilus* or mussels).

The bivalves, as the name suggests, have two shelly valves into which the animal can withdraw for protection. These valves are brought together by one or two strong adductor muscles and forced ajar by a rubberlike wedge or resilium, which acts much the same way as a rubber wedge placed in the hinged side of a closing door.