CHAPTER I

GENERAL INTRODUCTION
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1.0 Description of coastline

Oceans are the largest ecological regimes, which hold vast resources. Man has turned to the oceans to harness energy, food, medicine, fodder, fertilizer, fuel and many other industrial products. Oceans have an impact on continents through weather, river floods, and climatic irregularities. It is also a medium for shipping, communication and defence. The biome also harbours majority of ecological processes that are critical to the functioning of the ecosystems. These ecosystems are critically important to mankind, as they are most productive. However, the marine ecosystems are complex, ecologically sensitive and exceedingly valuable areas that are under enormous threats. Despite degradation, marine ecosystems have continued to provide invaluable benefits to human beings.

Vegetation growing along the coast such as mangroves, marine algae, seagrass and sand dune plants- between the land and the sea has important ecological roles to play in the maintenance of the coastal zones. In the first instance, the organic matter produced by such vegetation enhances the biological productivity of the coastal ecosystems (Wafar, 1987). For example, the extent of mangrove forests on the coast and the shrimp catch in the coastal waters have shown to be
related to each other. In the second instance, these coastal ecosystems serve as conduits for materials of land origin to sea. In the third instance, the structural role of this vegetation is such that they bind the sediments, prevent erosion and protect the shoreline.

1.1 Definition of coastal zone

The coastal zone comprises landward and seaward parts. The question of how far the limits should extend from the coastal line is still the subject of debate. The coastal zone, as defined by various scientific groups, usually covers wide area, which extend from the upper limit of a watershed to the outer limit of the continental shelf. The definition of coastal zone by policy makers, however, rarely coincides with a complete ecological system and is usually less extended. The International Geosphere-Biosphere Programme (IGBP) of the international Council of the Scientific Union (ICSU), includes the area extending from the landward margin affected by salt water to the outer edge of the continental shelf (IGBP, 1993).

A geological definition of the coastal zones in South-East Asia includes the areas from the gently sloping dealectic plain landward influenced by fluvial processes and covered by young fluvial deposits to seaward influenced by marine processes and covered by young marine and brackish deposits (Jelgersma, 1992). To understand the interaction between major components of
The ecosystem, coastal zone definition as suggested by the scientific groups shall be followed. However, to manage the coastal areas effectively the existing governmental definitions have to be respected and followed. Efforts should be made to harmonize the different definitions for a specific coastal zone to achieve the most potential benefits. The definition of the coastal zone may, therefore, vary to suit different purposes and situations.

The coastal zone in Asia and the Pacific is under severe and increased pressure from rapid urbanization, tourism development, industrialization, pollution and deterioration of the coastal ecosystems. Such pressure is exerted by the continued development in hazard-prone coastal areas and the potential impact of sea level rise associated with climatic change. The awareness of the importance of coastal zone issues is stimulated by the extension of rational jurisdiction from territorial waters to the Exclusive Economic Zone (EEZ) stipulated in the 1982 United Nations Convention on Law of the Seas (UNCLOS) that entered into force on 16 November 1994.

1.2 Major components of the coastal zone and their interaction

Covering its landward and seaward parts from the coastline, the coastal zone is a belt of about one million kilometers in length between land and ocean on our planet. In addition, the coastal zone is also an interface between land and ocean, and the atmosphere. The interactions between the atmosphere, hydrosphere,
lithosphere and biosphere make the coastal zone dynamic and the coastal processes complex.

1.3 Coastal systems

Coasts consist of almost equal parts of hard rock and soft sediments. Sedimentary, sandy or muddy coasts are still being shaped and are remarkably younger. The coast may be referred to as a natural system comprising four sub-systems, i.e. fresh water, land, shoreline and coastal water sub-systems. The land and the fresh water sub-systems refer to the landward part of the coastal zone, and the coastal water sub-system to that of the seaward part. The shoreline sub-system is a relatively narrow and dynamic transition area between the landward and seaward parts of the coastal zone, including foreshore, beach area, and coastal protection systems such as dunes and mangrove ecosystems (WCC, 1993).

1.4 Ecologically Sensitive Ecosystems or Marine Critical Habitats

The coastal natural ecosystem includes both non-living (abiotic) and living (biotic) components. Therefore, the biological processes should also be considered together with the physical and chemical processes for investigating and understanding of the natural coastal zone system. Ecology is a science that
deals with the interactions of living forms (the biota) and their ecological environments (eco-environment). The earth can be seen as a natural ecosystem having biosphere as its living part and all the other non-living parts as its eco-environment.

The concept of ecosphere, as a transition zone between the lithosphere, hydrosphere and atmosphere has been introduced recently while dealing with ecological issues. The coastal ecosystems such as mangroves, marine algae, seagrasses, sand dunes and coral reefs etc are critically important because of their uniqueness, rich biodiversity, productivity and ecological as well as economic importance. In the International arena 'Critical Habitat' is a term used in the endangered species Act referring to the specific areas that contain physical or biological features essential to the conservation of a threatened or endangered species. However, these ecosystems are complex, ecologically sensitive and exceedingly valuable areas that are under enormous threat.

Marine critical habitats which includes both non-living and living components is a fragile balanced pattern easily affected by its neighbouring watershed landward and open or high seas. The coastal ecosystems are disturbed and threatened encountering several problems such as pollution, erosion, storm surges, siltation and anthropogenic pressures. Nearly 60% of the zone exploits the coastal resources (Kathiresan and Rajendran, 1996).
There are constantly increasing human pressure of various kinds to exploit these critical habitats or ecologically sensitive ecosystems and their resources for multiple economic activities. Critical habitats which have been found to be essential for the conservation of the biota and which may require special management consideration or protection. Even though some of the areas are undisturbed, there is urgent need to protect, conserve and manage both the disturbed and undisturbed areas for their sustainable uses. A number of coastal areas along the central west coast of India are rich in biodiversity and have uniqueness with regards to the flora and fauna that needs to be preserved as live natural heritage. These sites can serve as centres for education, research, recreation and eco-tourism. The economically important flora and fauna can be maintained as "germplasm" for conservation purpose. The sensitive ecosystems can be classified based on their naturalness, biological, ecological and socio-economic importance.

In this context, the sedimentary coasts may be divided into ecosystems that include shore lowland (coastal watershed), estuarine area (coastal land and coastal water), offshore water, and open shelf sea. They may be further subdivided into sub-ecosystems such as plains, wetland, estuaries, bays, gulfs, lagoons, coastal barriers, and into even smaller units such as ponds, salt marshes, mangroves, mud-flats, tidal delta, beaches, dunes, coral reefs and seagrass beds.
1.4.1 Mangrove Ecosystem

Mangroves form an important ecosystem of the coastal wetlands in India. Scattered in different geographical and geological zones, experiencing varying climatological conditions, the mangrove ecosystem of India shows rich biodiversity (Table 1.1).

Mangroves support a complex aquatic detrital food web and provide a unique habitat for a variety of animal and plant species. In the tropics, a substantial proportion of the coastlines is occupied by highly productive mangroves (Boto et al., 1984; Por, 1984). The important role played by mangrove ecosystem in supporting the functioning of nearby ecosystems such as terrestrial wetlands, seagrass beds and coral reefs has been well recognized. For centuries, human beings from tropics and sub-tropics have been utilizing mangroves for wood, charcoal food and fertilizers. The coastal inhabitants in particular have been deriving direct benefits from the ecosystem (Hemilton and Snedekar, 1984). The mangrove ecosystem also contributes to the economy of the coastal zone. Timber is one of the biggest resources extracted from mangroves. Other products such as honey, tannins, charcoal, etc. are also extracted from the mangrove forests. The litterfall of mangrove trees amounts to a large quantity of nutrients, which are circulated both within the mangrove forests, and in the adjacent marine ecosystem. Their leaf material is utilized by bacteria and fungi which forms the basis of an aquatic food web (Wafar et al., 1997). The
mangrove ecosystem comprises all the biotic components starting from microscopic forms to large size forms (Table 1.1).

Mangroves were looked upon as wastelands and were reclaimed for developmental purposes and human settlements. With rapid industrial development and the increase in human population, mangroves were threatened with reclamation, habitat destruction and over exploitation. These processes exerted tremendous pressure and danger to these ecologically and economically important forests. For instance, reclamation of mangrove forests brought permanent geomorphologic changes. The examples that could be cited are Mumbai in Maharashtra and Vembanad Lake in Cochin backwaters at Kerala, which showed depletion of mangroves. Apart from above man made changes, some natural changes also occurred by earthquakes, sea level rise, floods, siltation and changes in river courses due to tectonic movements etc.

Mangrove forests serve as a link between terrestrial and marine ecosystems (Chapekar, 1994). Import of nutrients from the land to the mangroves and export of matter from the mangroves to the sea is one of the important features of energy flow. The floral elements in mangrove forests responsible for primary productivity are angiosperms; phytoplankton and marine algae while those responsible for secondary and tertiary productivity are zooplankton and benthic animals and fishes respectively. The litterfall of mangrove trees amounts to a large quantity of nutrients.
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Compiled from various published reports
1.4.2 Coral Reef Ecosystem

Coral ecosystem is known to be diversified and productive ecosystem among all the marine ecosystems of tropical zone (Wells, 1988). Due to their organic and inorganic resources, reefs are of direct economic importance. India has about 19,000 km² of major reef area including islands and coastline. Coral reefs are massive limestone structures built up through the constructional cementing processes and depositional activities of the animals of the class Anthozoa (order Scleractinia) and all the other calcium carbonate secreting animals and the calcifying algae. The value of coral reefs, both for the biosphere and human utilization is well known. Reefs are the centers of high biological productivity, sites of carbon dioxide sink, ecosystems of very rich biodiversity helping in shoreline protection, sources of huge deposits of calcium carbonate and centers of scientific research. Additionally, they are providing us with many natural raw materials for deriving pharmacological products especially the life saving drugs (Gopinadha Pillai, 1997).

Coral reefs are diverse and vulnerable ecosystems characterized by a complex interdependence of plants and animals (Devaraj, 1997). Reef resources are traditional sources of food and income to the local coastal people. In India, the coastal people are harvesting most of the biological resources especially algae, reef fishes, holothurians, shrimps, lobsters, crabs, molluscs etc. Significant increase in human population and poverty and also utilization and competition...
for these reef resources has resulted in indiscriminate harvest of the biodiversity of the coral reefs. The reefs are the most threatened among the coastal and marine habitats. 20% of the Indian reefs have been lost or seriously damaged (World Resources, 1992-93). The flora and fauna associated with this ecosystem is increasingly at risk. due to unplanned, uncoordinated coastal development in most parts of the world has caused lot of destruction of coastal coral reefs and their associated ecosystems.

Indiscriminate overexploitation of corals and reef-associated organisms from our reefs in the last few decades has affected immense damage to this tropical marine ecosystem (Pillai 1975, 1985, 1996; Pillai and Madan Mohan, 1986; Pillai and Jasmine 1996; Salm, 1981; Rashid, 1988; Patel, 1988). Other than the anthropogenic impacts, the natural calamities like, cyclones, sea level variations, current pattern changes, increased nutrient levels etc. also affect the health of the coral reefs directly or indirectly. Sediment deposition over the coral reefs due to erosion of coasts caused by destruction of coastal vegetation has become a major problem in all the coral reef areas. Sedimentation and siltation are not only related to anthropogenic impacts but can also be caused by natural events like current patterns, upwelling etc. the mudflats formed over the reef areas in the Gulf of Kuchchh could be due to the sediment deposits. Man’s use of coral reefs is all too often taken to uncontrolled extremes, which represent a threat to the reefs.
Coral reefs are a resource of great value to man now and in the future. There are many measures which can be taken to protect reefs and sustain their ability to support life.

1.4.3 Sand Dune Ecosystems

The sand dune vegetation is totally different plant community, which grows on sandy shores beyond the highest high tide level and is formed by the accumulation of wind blown sand deposited on the shore from the subtidal and intertidal regions. Wind is one of the most important factors in the dune system (Untawale, 1980), which helps in the formation, movement and also distribution of the dunes. Sand dune vegetation helps in the prevention of sand erosion by decreasing wind speed at ground level. Secondly, it functions as a self-supporting community where plants are mutually dependent for protection and nutrient supply. This vegetation also has ability to tolerate a hostile environment of high winds, salt spray, and sandblast, covering by sand, sandy soil and little water (Desai, 1995).

Sand dune vegetation has a significant role to play in the coastal regions. These species not only minimize the erosion, but also stabilize the dune region and increase the organic matter (Barson & Calder, 1981). The over-exploitation of beach sand and indiscriminate cutting of coastal vegetation results in erosion of coastal areas. Dune system is being illegally used for housing, industries and
other developmental activities. Therefore, it is necessary to have strict and effective management policies for conservation and protection of sand dune vegetation.

1.4.4 Marine Benthic Algae

Among the marine ecosystems, seaweed ecosystems have been recognized to be important in relation to other organisms of the sea (Fuse, 1962). Their roles in nutrient cycling and fixing energy in the coastal regions are also very important (Littler & Arnold, 1982). Seaweeds are found growing on different substrata, depending on nature of their holdfast (Hartog Den, 1972). Seaweed's have contributed to human life especially as utility in natural ecosystems, food for man, livestock and as industrial materials. Considering their significant potentials, it is being said that, seaweed’s can become our food and energy resources of the 21st century (Leeper, 1976).

Beneficial effects from the use of seaweeds extracts have been obtained on plants, their crop yield, seed germination and their resistance to fungal and insect attack (Dhargalkar and Untawale, 1980). Development of coastline, particularly related to increased population pressure in coastal areas, leads to alienation and fragmentation of habitats available for macroalgae on the coast. Reduction in water quality can lead to a reduction in the depth of the photic zone (Walker and Mc Comb, 1992), and hence to a direct loss of macroalgae habitat.
1.4.5 Seagrass Ecosystem

Seagrass ecosystem is characteristics of marine as well as estuarine environment in the tropical and temperate regions. They generally grow in shallow coastal waters from the intertidal zone to depths up to 10m. These ecosystems are considered to be very productive and serve as nursery and breeding grounds for marine organisms (Dhargalkar and Shaikh, 2000; Qasim and Bhattachhiri, 1971; Mc Roy and Mc Millan, 1977, Hudson et al., 1970). Seagrasses also act as sediment stabilizers (Orth, 1977), provide a suitable substratum for epiphytes and a good source of food for marine herbivores, as well as fodder and manure.

Seagrass ecosystem in the Asian regions is being threatened by both natural and human induced disturbances. Natural stresses are mostly due to cyclones, tidal waves, volcanic activity, grazing and competition, shifting sediments, pests and diseases (Fortes, 1988). The extent of their effects on the integrity of the resources, though largely unknown, may be viewed partly in the context of the fisheries resources, which are depleted beyond the level of biological sustainability. Marine fisheries, which provide more than 60% of the animal protein required in coastal diets, partly depend upon seagrass, ecosystem for productivity and maintenance (Kikuchi, 1974, 1980; Pollard, 1984 and Thayer & Phillips, 1977).
Seagrasses play a significant role in the detritus based food chain and stabilization (McRoy and Mcmillan, 1977). Disappearance of the seagrass cover caused erosion of surface substrates and reduction of organic material content in the sediments.

1.5 Biodiversity

Biodiversity is an index to assess the health and product of the critical habitat. Exact definition of biodiversity is, "the variability among the living organisms from all sources including, inter alia, terrestrial, coastal and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystem. The world's wealth of the biodiversity is found in highly diverse marine and coastal habitat.

Biodiversity is the term used to describe the total variety of living organisms at different levels: genetic, species, ecosystem diversity, which are closely interrelated in a complex way. Most species can only survive if the genetic diversity within their population is maintained at a sufficient level so that their capacity for adaptation to environmental changes is not impaired. Genetic diversity can only be maintained if the population of a species is kept above a minimum critical size. Species diversity is dependent upon the maintenance of the ecosystem diversity, while survival of an ecosystem may rely upon the presence of particular species. There are about 30 million species of living
organisms estimated on the earth. The relative abundance of species, the age and structure of populations, the pattern of communities in a region, change in the community composition, ecological processes etc are also important as expressions of biodiversity.

Marine biodiversity is known to be one of the richest among all the living ecosystems. Marine biodiversity can be divided into coastal and oceanic. Of the 33 extant animal phyla, only 11 occur on land while rest are found in the seas. Fifteen of them are exclusively marine and other five make up more than 95% of the marine species. The coastal and marine biotopes host nearly the entire extant diversity of basic animal body plans, and also contains far greater diversity in body size, from whales to plankton, than is found on land. Further, it has shown that filter feeders create extra levels in aquatic food chains that tend to be more complex than terrestrial ones (Margulis & Schwartz, 1988).

1.6 Socio-economic studies

An understanding of the relationship between livelihood and biodiversity is essential in planning conservation strategies, which are socially and ecologically sustainable. This has influenced conventional resource planning in integrated conservation and development projects in favour of major food crops and species of commercial importance. Socio economic study aims at understanding the present utilization pattern of the marine resources and the area by the local
people, the nature and magnitude of interdependency. Coastal ecosystems are very rich in natural resources and are highly productive. Most of the world’s growing population live in the coastal areas, or within easy reach of them. The human interventions take place mainly in the transitional zone consisting of the areas where the marine areas meet the land masses, where river flow into the sea and where fresh water meets brackish water. This zone is subjected to tremendous environmental, developmental, political, social and economic pressures.

The large scale commercial exploitation of fish by the trawlers, which use high technology fishing practices, inflict serious damage on the marine ecosystem in terms of its carrying capacity and biodiversity. The marine resources are the primary sources of livelihood for the coastal communities, and fish constitutes the most valuable resource amongst them all. In the last few decades, the utilization of these marine resources has created great stress on the marine ecosystem in general and on the livelihood of the traditional and small scale fishing communities in particular.

This crisis of over exploitation of the biological resources points at the necessity of a shift in paradigm towards sustainable development and optimal utilization of resources. For instance, the world’s fishing grounds are coming under growing pressure from overexploitation. This brings the risk that their future sustainable yield will be reduced and certain species will be eliminated and that
the competition between different types of fishing operators will cause serious economic and social distress to the users apart from having serious ecological repercussions.

The degeneration of other components in the marine ecosystem such as mangrove, is a case of great concern. The destruction of mangroves deprives many fish species of important spawning and nursery areas with consequent knock on effects on fish population and biodiversity in off-shore areas. The increased quantities of silt being washed into the sea as a result of mangrove depletion affects coral reefs and other important coastal habitats such as seaweed, sea grass beds etc.

The situation explained above necessitates the need for immediate action to protect the most valuable resources. The significance of declaring "Marine Protected Areas" or as "Marine Biosphere Reserves" become evident as these serve as replenishment areas for marine resources and should be designed to maintain the genetic diversity of key species. It is necessary to find out the extent of dependency on these resources- for livelihood, fuel, sanitation, etc. to be able to gauge the magnitude of problems that the people will encounter after the declaration of the areas as protected. This entails assessment of the extent and nature of dependency of various classes of people on diverse marine resources. This also underlies the importance of a socio-economic study along with the
ecological and technical ones. The interface between the natural and socio-economic system is the realm of coastal zone management.

1.7 Marine Pollution

Many countries experience significant pollution in their coastal waters, especially in enclosed and semi-enclosed bays and estuarine areas embodied by coasts where rapid urbanization and industrialization have taken place. Marine pollution may originate from rivers, or seepage from pipelines or ground water. Pollutants include pathogenic microbes, toxic chemicals, nutrients and suspended solids. Pollution, both industrial and domestic along the coastal regions has created hazards to the marine life. Several studies have been carried out on the effect of sewage on the marine populations (Allen Hancock Foundation, 1965; Hume et al., 1962). As benthic algae represent a major part of the lowest trophic level, anything affecting them may also influence organisms at higher tropic levels. Reduction of numbers of red and brown algae from sewage-polluted areas has been attributed to the toxic effects of the compounds present in the sewage (Nasar and Aleen 1948; Hartog, 1959). Beach contamination by oil spills from tankers has been reported from time to time. Natural hazards such as earthquakes, volcanoes, landslides and subsidence that occur on land also affect the coastal zone.
Coastal farming or aquaculture may cause harmful algal blooms, deteriorate water quality, damage critical habitats as well as nursery grounds, pose serious socio-economic and human health problems if application of bio-active compounds (including pesticides and antibiotics) and discharge of organic wastes are not properly controlled. Increases in nutrients can contribute to blooms of phytoplankton, particularly dinoflagellates and diatoms, and several other groups of photosynthetic micro-organisms. Several algal blooms cause visible coloration of the water, which has led to the common terms “red tides” (the color may be red, brown, yellow or green). Blooms of certain algal species are associated with toxic effects on fish and shellfish.

1.8 Coastal hazards

1.8.1 Beach erosion

About one-third of the world’s coastline consists of beaches, generally made up of sand, gravel or their mixtures. A world-wide study on coastline changes, which has been undertaken by the International Geographical Union’s Commission on the Coastal Environment (IGU-CCE) between 1972 AND 1984 has found that in recent decades there has been erosion of more than 70 percent of the world’s sandy coastlines, less than 10 percent having prograded, while the remaining 20-30 percent have either remained stable or been subject to alterations with no net changes (Bird, 1985).
Factors affecting coastal erosion include physical agents, human activities and the lithological character of the coastline. Among coastal physical processes, intense storms and sediment budget are the two important factors. Human activities such as building of dams and breakwaters, and quarrying for sand and gravel or for minerals such as ilmenite, tin or gold, cause alterations and imbalances in the sediment budget, coastal processes and relative sea level. In brief, beach erosion is being resulted from either decreased supply of sediment to the beach or increased losses of the sediment from the beach, or combination of both processes.

The socio-economic impact of coastal erosion is negative by jeopardizing the public safety against flood, typhoons, etc. and public life by contamination of drinking water. To protect the beach from erosion, coastal engineering technologies have advanced in recent years. The bio-engineering measures such as plantation of sand dune vegetation, mangroves along the coast are preferably adopted now.

The present work is designed, therefore to assess the physico-chemical and biological state of these ecologically sensitive ecosystems along the central west coast of India, carry out a socio-economic study of the impacts and conduct laboratory studies that would help in our efforts to protect these vegetation and reforest the affected areas. Coastal ecosystems, besides having dynamic
oceanographic characteristics are also subjected to the increased human interferences, as it is easily accessible. The monitoring of the theoretical and experimental aspects to determine the ecological status help us to assess and possibly predict the state of coastal ecosystems.

1.9 Conservation and management

There has been a worldwide concern over the damages caused to the coastal areas due to man-made and natural changes. The enormous degree of marine environmental pollution and destruction of mangroves as well as sand dune vegetation has led to the concept of conservation of the important areas. Coastal areas are rich and unique in flora and fauna. These areas are to be conserved with proper management implication.

In any situation a wide range of environmental, social and economic factors, conditions the appropriate management response. The major aspect of the natural environment that can be managed is the human action which can rapidly destroy or degrade the natural environment. With care and planning, human action can maintain the natural environment, so that it can sustain the long term economic, cultural and scientific needs of the society.
1.10 Studies at Malvan (Maharashtra)

Selection of the sites dealt for case studies was done after surveying the sites and were mainly based on the biodiversity status of the area. It was decided to select only one site along the central west coast of India such as Malvan – an Open coast ecosystem (Maharashtra) to be dealt in detail for biodiversity status and also for convenience. In order to understand the changes that had taken place, the detailed studies were carried out. The details of these site is given in separate chapter.

1.11 Importance of the study

The coastal ecosystems in the world such as mangroves, coral reefs, seagrass beds, seaweeds, sand dunes are of global concern. They are important for millions of people around the world as they provide both subsistence and cash-crop fisheries. They have been considered as Marine Critical Habitats (MCHs) because of their uniqueness, rich biodiversity, productivity and ecological as well as economic importance (Untawale et al., 1980). These habitats in India are also categorized under “ecologically sensitive regions” under Coastal Regulation Zone (CRZ-1) Act 1990. In an International arena “Critical Habitat” is a term used in the Endangered species Act referring to the specific areas that contain physical or biological features essential to the conservation of a threatened or endangered species. Critical habitat is defined as specific areas that have been found to be essential to the conservation of a species, and which may require special management considerations or protection (Usha, 1999). Critical habitat
determined using the best available scientific and commercial information about
the physical and biological needs of the species.

1.12 Need for monitoring of coastal waters at Malvan

Due to human activities, 6.5 millions tons of litter find their way into the oceans
each year. Several million tons of top soil with a fertilizer value of over 100
crores of rupees are discharged annually into the sea due to erosion. The sewage,
fertilizer use on land and extensive use of detergents have all doubled the rate at
which nutrients are added to the coastal zone (Naqvi, 1996).

Over 1,50,000 tons of non-biodegradable plastics find their way into sea and
physically endangered the lives of the marine fauna and threatened biological
productivity. The plastic hinders transfer of nutrient supply and accelerates the
process of anaerobiosis and thus causing mortality. The industrial pollutants
entering the oceans are increasing out of proportion. Nearly 15 phyla of filter
feeders that are exclusively found in the oceans, are being affected by such a
effect (D'Souza, 1996).

If the resources that are available in the coastal zone are to be utilized on a
sustainable basis, due attention has to be given to understand the physico-
chemical and biological characteristics of coastal waters. This area was studied
to be declared as Marine Park due to the high biodiversity status (Untawale 1980).

There are constantly increasing human pressure of various kinds to exploit marine resources for multiple economic benefits. Hence there is urgent need to protect and conserve, particularly Marine Critical Habitats on the sustainable basis.

1.13 Objectives of the present study

The present study was carried out keeping in mind the importance of Marine Critical Habitats in general along the entire west coast of India and along the central west coast of India in particular.

In the recent years, human interferences have caused changes that are too fast for an ecosystem to cope up with. But if the adverse impacts associated with rapid environmental changes can be anticipated and the way the ecosystems might respond, to these can be understood, then it is extremely easy to mitigate these.

The main objectives of the study are

- Assessing the status of biodiversity along the central west coast of India.
- Delineating the causes for the changes in biodiversity.
- Assessing the ecologically sensitive ecosystems along the central west coast of India and differentiating them.
• Studies on physico-chemical, biological and socio-economic aspects along Malvan.

• Conservation and management aspects.