General Article

Need for monitoring and conservation of marine floral and faunal biodiversity in the coastal region of Karnataka, India

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Marine environment of India consists of unique ecosystems are known for their aesthetic beauty and provides habitat for numerous biological species. Mangroves are unique ecosystem of tropics and sub-tropics which support naturally diverse groups of aquatic and terrestrial organisms. These ecosystems serves has a haven for many varieties of birds and other fauna. Several Islands of Karnataka is an excellent place to enjoy the seascape, the mangroves with waves wading at their roots, several water birds and the spectacular dusk. Marine organisms have some physical and special adaptations that are unique to their lifestyle. Many species of seabirds spend much of their time in and around the seawater that have special types of behavior. The practice of coastal regions by monitoring of marine flora and fauna is an important topic of study in the coastal zone of Karnataka, India forms a good baseline work for the assessment of human–animal interactions. The comprehensive catalogues can be prepared separately for the marine flora and the fauna in order to recognize priority areas for maintenance in the coastal and non-coastal regions of Karnataka, India.

Keywords: Arabian Sea; Coastal Zone; Estuary; Mangroves; Marine birds; Marine flora and fauna

Introduction

Analogous to the many other ecosystems, the marine environment is rich sources of biological diversity¹. Biodiversity is an important component for economic and social development of most of the developing countries in the world. The conservation and sustainability of the biodiversity is critical importance in meeting the human demand of the sources viz., food, fodder, fiber, fuel and other needs of raising the population of the world². Among 17 mega-diverse countries India is one of the leading one in the world. India alone accounts for 7–8 % of the world’s recorded plant and animal species of the 2.4 % of the world’s area². India is a rich country known for its enormous biodiversity, with unique grasslands, forests, deserts and varying agro-climatic conditions and inland water resources comprising rivers, canals, lagoons, reservoirs and lakes, and also coastal regions, the sea and estuaries. Also, tropical marine ecosystems of the Indian subcontinent harbor a large number of species belonging to various habitats that include mangrove swamps, estuaries, lagoons, muddy, sandy/rocky shores, and oceanic islands³.

National level

India has a coastline of about 7517 km with about 25% of its population living in coastal areas (about 5423 km along the mainland and 2094 km the Andaman and Nicobar, and Lakshadweep Islands)⁴. Among the Asian countries, India ranks second in aquaculture, is the fourth largest producer of fish, and one of the top leading exporters of sea foods. Coastal areas are some of the most important habitats of the biosphere including an estuaries, backwaters and coastal wetlands. These areas are highly preferred for setting up commerce, industry and military and establishments for residential purposes.
The most biologically productive regions of the world oceans are the Arabian sea of western coast of India. The biologically productivity of the basin shows strong seasonality with blooms occurring in summer monsoon (June-August) and winter monsoon (December-February) in the tropical region. The summer bloom is driven by upwelling along the coast of Somalia, Arabia and the southern parts of the west coast of India. Oceanography of the Indian coastal region is dominated by three seasons, viz. southwest monsoon (June to September), northeast monsoon (October to January) and fair weather period (February to May). Karnataka consist of three beaches - sandy (75%), rocky (11%) and muddy flat (14%) along the total length of 280 km. Average wind speed during the southwest monsoon period is about 35 kmh⁻¹ (9.7 ms⁻¹), frequently rising up to 45–55 kmh⁻¹ (12.5–15.3 ms⁻¹). The average wind speed during northeast monsoon prevail around 20 kmh⁻¹ (5.6 ms⁻¹).

Over 11,000 faunal (10,400 invertebrates and 625 vertebrates) and over 800 floral (624 algae, 50 mangroves, 32 angiosperms, 71 fungi, 14 lichens, 12 sea grass) species have been identified from Indian coastal areas. According to the recent estimation 42 species of shrimps/prawns, 112 species of brachyuran crabs, 14 species of hermit crabs and nine species of lobsters are reported from eight estuaries and coastal (offshore) waters of Karnataka State. A total of 69 species belonging to 39 genera, 19 families and 3 orders were recorded in the Netrani Island of Karnataka. Wafar et al. reviewed the status of coastal and marine biodiversity of Indian Ocean Countries with a total of 34,989 species (animalia – 30894, archaea – 4, bacteria – 864, chromista – 773, fungi – 75, plantae – 1690 and protozoa - 689). The seas are the ultimate receptacle for land-based pollution and it is interesting to assess the stress on coastal areas caused by this pollution. Anthropogenic metal inputs have influenced the bioavailability of metal supply in these aquatic ecosystems. Due to coastal upwelling, the coastal waters of the southwestern coast of India are among the most productive regions in the world, supporting abundant invertebrate and fish populations, many of which are harvested as food.

The marine environment of India consists of unique ecosystems known for their aesthetic beauty and provides habitat for numerous biological species especially shrimps and fishes. Two of the major marine ecosystems that are important along the Indian coast are the mangroves and the coral reefs. Mangrove vegetation protects land against sea erosion. Major mangrove foresters are found on the southeastern coast and minor are found on the southwestern coast of India. Also, this environment consisting of intertidal regions, the estuaries, seaweed and sea grass beds, mangrove forests, and coral reefs has a direct impact on human civilization because it provides social and economic benefits. In addition to the phytoplankton in the seawater, larger, multicellular intertidal and benthic algae are important primary producers in coastal ecosystems.

Coastal Zone of Karnataka

Coastal Zone of Karnataka is a very multifaceted vibrant delicate environment, which perform important function. The coastline comprises of headland, promontories, rocky shores, sandy spits, barrier beaches, open beaches, embayment, estuaries, inlets, bays, marshy land and offshore islands. Coastal ecosystem play important role on maintaining biodiversity and integrity of the coasts. The coastal zone of Karnataka, with a population of over 1,500 persons per square kilometer, is one of the most densely populated coastal zones of the world. Settlements in the Indian coastal region consists 22 urban agglomerations and 1044 villages. The region supports high degree of economic development such as agricultural and horticultural activities, fishing and aquacultures, sand and shell mining industry, harbor development, trade and transport etc. which naturally have their toll on coastal ecosystems, including mangroves. This zone is endowed with 320 km of coastline from Ullal in south to Majali in north with 27,000 km² of continental shelf and 87,000 km² and Exclusive Economic Zone in Karnataka. About 80% of the shelf area lies between 0 and 72 m depth. Its contribution to the total marine fish production of the country has varied from 6 to 14 % annually. A complete of 184 species of fish fauna from 41 families were recorded along the western coast of Netrani Island (offshore) near Murdeshwara, Karnataka, India.

The Western Ghats of India which run parallel to the coastline is indeed an integral part of the coast. Fourteen rivers which originate in these Ghats run westward and join the Arabian Sea (Figure 1). These rivers carry silt and organic debris from the forested hinterland into the estuarine areas and the
coastal sea and contribute greatly to the productivity and diversity of the coastal ecosystems. Tides travel long distances, even 20-30 kms interior, through many of these rivers, making the saline aquatic habitat suitable for several marine and estuarine organisms. More than half of the industrial establishments in Karnataka as well as majority of the populated cities are situated in its coastal region. The rapid population growth and uncontrolled development in the coastal zone have led to major pollution impacts on streams, estuarine, and coastal environment. These are subjected to severe threats due to anthropogenic pressures in the coastal areas over the years, which in turn lead to the loss of marine biodiversity. Domestic sewage, industrial wastes, pesticides and oil spillages are important causes for the marine pollution in India.

**Arabian Sea**

Arabian Sea is one of the most biologically productive regions of the world oceans. The Southwest monsoon results in intense flow along the west coast of India. This accounts for the high productivity and fisheries potential in this area. Arabian Sea is subject to large semi-diurnal tides with amplitudes of 1-8 m and is influenced by the biannual reversal of the monsoon winds. These two factors result in the flushing of Indian coastal areas which helps in dispersing pollutants.

**Estuary**

Estuaries are usually biological highly productive zones. The complete salinity range from 0-35 ppt is seen from the head (river end) to the mouth (sea end) of an estuary. They also act as a filter for some dissolved components in river water; these precipitate in the zone where river water meets seawater. More important is the trapping of suspended mud and sand carried by rivers which leads to delta formations around estuaries. These estuaries are enormously affected by anthropogenic interventions. The banks of estuarine channels form a favored location for human settlements, which use the estuaries for fishing and commerce, but now also for dumping municipal and industrial wastes. Also, they are used for navigation of recreational boats and fishing vessels and for the transport of iron and manganese ores from the vicinity to the near ports. Consequently, many estuaries in Karnataka are sensitive ecosystems that may be subjected to pollution and contamination due to shipping activities. There are also small shipbuilding units located along the banks of these estuaries that are involved in construction, repair and maintenance of small ships and barges. Both the estuaries are fringed with mangroves along the banks.

**Mangroves**

Mangroves are a unique habitat and are largely inspired by sea level changes and wave energy. These are specialized ecosystems consisting of diverse groups of tropical trees and shrubs adapted to grow in intertidal regions. There are over 4500 species of flowering plants (38% endemic), 14 species of mangroves belonging to 8 families, 330 butterflies (11% endemic), 156 reptiles (62% endemics). A total of 151 species of foraminifera belonging to 65 genera, 41 families and seven suborders are recorded from eight and ten sites of western and eastern coastal region of peninsular India. Also, 59 species of foraminifera belonging to 32 genera, 24 families and five suborders were identified from the cores of Chithrapu and Kumbla of Karnataka sites. Also, mangroves support several flora and fauna and serve as nursery grounds as well as nutrient sources to economically and ecologically important organisms such as prawn, fishes and many other invertebrates. The sum total of the 78 species of filamentous fungi on woody litter belonging to 45 genera comprising 46 ascomycetes, one basidiomycete and 31 deuteromycetes were reported from the mangroves of Karnataka (Karwar, Gangavati, Honnavar, Kundapura, Mulky) region along the west coast of India. As the continental runoff is also a manifestation of monsoonal cycle, anthropogenically added components are also assumed to be strongly modulated by natural (monsoonal) forcing. Therefore, explanation between natural versus anthropogenic inputs to coastal bodies such as estuaries is not simple by conventional means. Further, ports are vulnerable to invasion as they are naturally and anthropogenically disturbed habitats.

Mangroves are unique inter-tidal ecosystem of tropics and sub-tropics which support genetically diverse groups of aquatic and terrestrial organisms. These mangroves are also a haven for many varieties of birds, including Bulbuls, Sunbird, Pigeons, Gulls, Kites, Egrets, Herons, Plovers, Sandpipers, Petrels, Loons, Grebes, Shearwaters, Boobies, Cormorants, Bitterns, Storks, Ibises, Gooses, Flamingoes, Jacanas, Shanks, Terns, Skimmers, Harriers, Falcons and other birds. There
are several Islands is an excellent place to enjoy the seascape, the mangroves with waves wading at their roots, several water birds and the spectacular dusk.

**Marine bird fauna**

Birds are very specific to their respective habitats and are also the key indicators of the environment being susceptible to any change in the habitat or variation in the environment. There are about 574 species of birds in South India including marine birds. The ocean and the seashore provide a protection for many species of birds. Also, seabirds depend on the ocean for their survival. They built their nests in a variety of habitats: in tree branches, on cliff ledges along a rocky coast, on patches of vegetation, among pebbles and sand on beaches.

Marine birds have some physical and special adaptations that are unique to their lifestyle. Many species of seabirds that spend much of their time in and on the water have webbed feet for paddling and swimming. Various species of marine birds search either in shallow water or in the sand along the water’s edge for their food. They also play a crucial role in the mass and energy fluxes between terrestrial and aquatic food chains. As such, the lack of geo-referenced data on marine biodiversity and high resolution climate outputs for the oceans (e.g. seawater temperatures, pH, salinity, etc.) exclude investigation of the impacts of climate change on the marine biodiversity. The effects on marine birds and their habitats were investigated from the disturbing Indian Ocean tsunami of December 26th 2004. However, the science of marine avifauna and associated flora and fauna is very much required for the understanding biodiversity and conservation. The biodiversity of marine flora and fauna is an enormously stunning reserve for the development of a widespread range of applications in food sources, manufacturing of pharmaceuticals and cosmetics.

Little is known about the species composition and distribution of marine organism including bird fauna and others in the coastal regions along the Indian subcontinent, Karnataka (Madsen, Hussain, Madhyastha, 20 species of shell fishes, 225 species of crustaceans, 105 species of fishes and 177 species of marine birds, Pandé, Shivashankar et al., Achar and Shivashankar; Kerala, Maharashtra, Lakshadweep Archipelago (25 species of birds and 46 species of Cetaceans belonging to 28 genera, 82 species of birds including 31 are pelagic and shore birds are reported from Lakshadweep, eight species of pelagic birds from three families; Maharashtra, Tamil Nadu, Arabian Sea; Eastern Coast of India and Indian Ocean).

**Other marine organisms**

The sum of 14 species of corals belonging to 11 genera, 92 species of fishes, six species of sponges, two species of jellyfish, one species of holothuria, seven species of nudibranchs, 25 species of zooplankton, 15 species of bivalves, 16 species of phytoplankton, 48 species of gastropods, three species of cephalopods, 17 species of crabs, two species of shrimps and four species of lobsters are recorded from the Netrani Island of Karnataka along the southwest of Indian coast.

**Lacunae in understanding marine organisms in Karnataka**

The practice of coastal locations by continuous monitoring of marine flora and fauna is an important topic of study in the coastal region of Karnataka, India, grouping baseline distributional descriptions to assess human–bird interactions. Also, the conservation and sustainable use of marine biodiversity and associated organisms is very essential. While the biological research of marine flora and fauna in India, has been working on for a long time, there are several groups of living organisms, about which there is no proper scientific information available. In India, Karnataka consists of 26 estuaries with more than 70,000 ha. of water-spread area and 8000 ha. of brackish water area, making the important locations of the coastal regions (viz., Uttara Kannada, Udupi and Dakshina Kannada) of Karnataka is very rich in marine, estuarine and riverine biodiversity (Figure 1). Knowledge on the marine floral and faunal composition, distribution, abundance and activities in these coastal regions of Karnataka, southwestern India are totally lacking. The coastal town of these regions is situated at the mouth of streams and rivers (e.g., River Kali joining in Karwar), where it merges with the expansive Arabian Sea, in Uttar Kannada district.
There are several beaches or seashore is a beautiful natural bay, with small hills and islands in the coastal region of Karnataka, India as it is known today. Salient and most striking thing is the cleanliness of the beach along this side. Sea is shallow here and the gentle waves caressing the shore are soothing. Seashore is ideal for long walks and some fresh air. Coastal region’s sandy and rocky coastal stretch is home to a variety of rich flora and fauna with distinctive morphological characters on par with the marine ecosystem. This makes these shorelines more conspicuous and rich in biodiversity profile. This regions form the ecotourism spots for both native and foreign peoples.

The sandy shore lying together to the rocky stretch is full of pebbles, boulders and small rocks submerged in water during high tide and form an ideal environment for macroflora (macro algae). Rocky shore is dotted with crevices, cliffs, pools and other features which have increased the biodiversity by providing secured coverage for variety of organisms and seaweeds. In spite of environmental physical stresses such as temperature, salinity, solar radiation, desiccation, tide and severe wave action, the biodiversity is relatively rich here. The island’s rich biodiversity provides enormous opportunity for nature lovers.

Nonetheless data on the species composition of marine flora and fauna and its environments is quiet paucity, on the source of existing data it is conceivable to categorize the disturbed and undisturbed areas along the coast. Similarly, comprehensive catalogues can be prepared separately for the marine flora and the fauna in order to recognize priority areas for maintenance in the coastal and non-coastal regions of Karnataka, India.
Conclusions
The future work should be fulfilling the goals of the biodiversity assessment marine flora and fauna in both coastal and non-coastal (estuaries) region; to estimate the marine organisms associated flora (mangrove and coastal vegetation) and other fauna; to examine the relationship between biological parameters on marine organisms; to determine the physico-chemical factors in the seawaters and their effects on the ecological status of marine organisms associated with flora and surrounding fauna; to examine the change in patterns in the population densities and composition of marine flora and fauna in the various coastal and non-coastal (estuaries) region with reference to human disturbance levels. Further, to evaluate the impact of anthropogenic perturbations; to identifying the threats to marine organisms and to developing the methods for the conservation of the marine flora and marine fauna in their various marine habitats or environs of the coastal region of Karnataka, India.

Habitat injury, prohibited encroachment of oceanic habitat and overfishing are the principal threats to the common marine organisms in the coastal and non-coastal region of coastal regions of Karnataka. This should be quantified for the understanding the threats faced by the marine organisms. This study highlights that there is an vital prerequisite to protect and conserve as well as create responsiveness among local people about marine organisms in and around the coastal and non-coastal region. A conservation strategy that sets highlighting on refining habitat extent and quality, such that the connectivity between marginal and core populations is reconstructed within the marine habitat.

The forthcoming of seashore of coastal and non-coastal regions of Karnataka depends largely on documenting the ecological benefits they offer explicitly or implicitly, sustainable use of these resources and appropriate management interferences. In view of these identifies, an exhaustive and holistic management approach for an all round sustainable development of coastal region is immediately required so that it may provide an opportunity to conserve them in the region’s ecosocial gradient.

References


51. Kurup, D. N. and Zacharias, V. J., Birds of Lakshadweep Islands, India. Forktail, 1994, 10, 49-64.


