Biodiversity and Conservation of Estuarine Ecosystem Krishnapatnam, Andhra Pradesh, India

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Abstract
Sand dunes and dune sands are widely distributed on the Krishnapatnam port. It mainly occurs Suryalanka to Dugarajapatnam. The coastal line of Andhra Pradesh is long and smooth with inundation only in the extreme south in Pulicat Lake and between the Godavari and the Krishna delta. Estuaries and lagoons have brackish water which shows high biological productivity than fresh or sea water. Hence it has wide range of aquatic, terrestrial flora and fauna. Present study aims to explore the flora and fauna of the Krishnapatnam along with the various threats for its eco-degradation which helps to plan necessary conservation methods. The paper deals with 445 species of angiosperms belonging to 343 genera and 117 families of Krishnapatnam, Nellore District, Andhra Pradesh. Among these, 365 species belonging to 279 genera of 96 families. Monocotyledons include 77 species belonging to 61 genera of 18 families. Pteridophytes includes 3 species of 3 genera. Among 117 families, leguminosae is dominant family with 54 species in this area.

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1. Introduction

Two attributes of biodiversity according to International Conservation Point of view are species richness (The number of species in an area) and Endemism (Species restricted to a given region and occur nowhere else). Krishnapatnam satisfies both the attributes of biodiversity by having rich and numerous flora and fauna. Endangered Green sea turtles are found only on the beaches of Krishnapatnam. Calamus rotang and Cappris rotund folia are endemic to this area only.

2. Study area

Description of the study area:
Krishnapatnam is located in Lat. 14º15.153’N; Long 80º 07.385’E of Andhra Pradesh coast, Bay of Bengal. The tide of this coast is semi-diurnal in nature and the mean tidal variation is of the order of 0.7 m at spring tides and 0.3 m at neap tides. The exposure of intertidal area is about 100-150 m during low tide. Kandleru brackish water creek having 45 km length, 20-200 m width and 1-12 m depth confluences into Bay of Bengal at Krishnapatnam. The salinity profile of this creek is 0-5 ppm during November-December, 25 ppm during May-June and 10-15 ppm during rest of the months. Krishnapatnam Port Corporation Limited is constructing an all - weather port in this area, designed to accommodate 2, 00,000DWT ships in stages with an expansion plan of 30 berths handling capacity. This port has potential to develop as a hub for coal, containerized cargo, petrochemicals and shipbuilding/repairing facilities. Biodiversity, the variability of live forms on Earth. It is the Key to sustaining health, wealth, food, fuel, and all of the vital services we depend on. Its magnificence enriches our cultural and religious traditions. Each Plant and animal is part of a complex web of life. Humans are also part of nature’s rich diversity; we use this diversity to enhance our well - being. Simply, Biodiversity is the variety of life on Earth and how living things interact with each other. Bio diversity consists of all the species of plants and...
animals and other life forms on the earth and also the variability that exists within each species.

Biodiversity can be small, big, bold, and beautiful. All the living things and their habitats in the sea, on land and in the air are a part of biodiversity. Without biodiversity, humans could not exist.

Biodiversity or Biological diversity refers to the wide variety of ecosystems and living organisms i.e. Plants, Animals, their habitats and their genes. Biodiversity is the foundation of life on the earth. It is crucial for the functioning of ecosystems which provide us with products and services without which we cannot live. Oxygen, food, fresh water, fertile soil, medicines, shelter, protection from storms and floods stable climate and recreation—all have their source in nature and healthy ecosystems.

Figure 1: Map of Krishnapatnam Estuarine ecosystem

FF Khandaleru river which flows West to East direction. The Creek having 45 Km length 22-200m width and 1-12m depth and merge in to Bay of Bengal at Krishnapatnam. The shoreline changes around the krishnapatnam port were studied duplicating the erosion in the both and Northern and southern parts. The Extreme northern parts again showing the accretion. This is possibly due to the one more creek supplying the sediment in the mouth most of the northern part experiencing dominantly erosion and southern part shows miner erosion. Khandaleru river lying almost perpendicular to the sea coast with free flow of water from the river to the sea and from sea to the river under the influence of tides.

Biodiversity is complex, dynamic and varied like no other feature of the Earth. List of innumerable plants and animals and microbes physically and chemically unite with the atmosphere, and hydrosphere into one environmental system which makes it possible for millions of species. Man’s activities highly influencing the Biodiversity. By changing biodiversity, strongly affect human well-being and also the well-being of every other living creature.

Biodiversity is everywhere. It occurs both on land and in water, from high altitudes to deep ocean trenches and it includes all organisms, from microscopic bacteria to more complex plants and animals. Although many tools and data sources have been developed, it is very difficult to measure the biodiversity precisely still today. The number of species on the earth ranges from 5 to 30 million species and only 1.7 - 2 million species has been indentified based on” Millennium Ecosystem Assessment”.

The current Knowledge of the number of the species inhabiting the earth is still incomplete. Estimates vary from 8 to 14 million species. Now today about 1.7 million species have been described while many more species are waiting for discovery. India is one among the 17 megadiverse nations of the world with only 2.4% of the geographical area accounts for 7-8% of the recorded species of the world spread over 45,500 species of plants and 91,000 species of animals that have been documented so far. The present study deals with the Biodiversity of Krishnapatnam, Nellore District, Andhra Pradesh, India.

3. Materials and Methods

Study was undertaken in the Krishnapatnam, flora and fauna explored by frequent visits during 2013-2014. Photographs of both native and migratory birds were taken. Flora collected, and preserved in Herbarium, at N.B.K.R. Medicinal Plant Research Centre, Vidyanagar, and Nellore District, for future reference.

4. Results and Discussion

The Krishnapatnam port Area Estuarine Ecosystem (KPAEE) encompassing the kandaleru mangroves is the area of mangroves along the east coast of India the area is rich in floral and faunal diversity and generates significant ecological and economic benefits such as shore line protection sustaining livelihoods and carbon sink services. There are 12 species of mangroves, of which 9 are true mangroves and they rest associated mangrove species there are important nesting sites for turtle species notably the endangered olive ridley turtle. The area serves as the growth and development of numerous fin and shellfish. It is an important bird area with a recorded population of 160 bird species in recognition of its National and global biodiversity significance a part of the KPAEE in addition to the biodiversity significance of the area it is also of enormous economic significance. The recent rapid economic changes and emergence of large scale production activities in KPAEE. Currently the main production sectors operating in the landscape, seascapes are fisheries aquacultures,
The present paper deals with the aims to mainstream biodiversity conservation in to the production sectors of KPAEE through(1) cross sectoral planning in the KPAEE that mainstreams biodiversity conservation considerations.(2) enhanced capacity of sector institution for implementing biodiversity friendly sector plants(3)improved community livelihoods and sustainable natural resources . it is anticipated that production activities in at least 9000 ha of the KPAEE mainstream biodiversity conservation objectives in turn improving the conservation prospects of several globally significant species apart from contributing to the socio economic well being of the region.

Due to Krishnapatnam sea port and fishing activities in the area there is a tremendous pollution pressure was observed.

Krishnapatnam is a highly production area for the phytoplankton and related Zoo plankton ecology and Biodiversity of Mangrooves.

The study of phytoplankton, zooplankton and zoo benthos were identified in krishnapatnam coastal area of Bay of Bengal during summer season .Among the major taxonomic groups, bacillariophyceae was the most dominant phytoplankton species. Based on study of zooplankton,it appeared that the area is mostly preferred by Cladocera (Daphnias sp., Allonella sp.and Moinasp), falled by Rotifera (Brachionus sp. and Keratella sp.), Copepoda (Cyclops sp.; Naupliinarva)) and Potozoa (Acanthocystis sp.) were identified. Zoobenthos was dominated byForaminifera (11 sp.) followed by Ophiuroides (7 sp.), Ostracoda (3 sp), Polychaeta (1 sp.).An average counts for phytoplankton, zooplanktons, zoobenthos were computed as 165/ml,1825/m3 and 17750/m2 respectively. Higher diversity indices for all these groups phytoplankton,zooplankton and zoobenthos were ranged as 2.615, 2.072 and 2.18 respectively. Macrophytes like Halophila ovalis popularly called sea grass and Syringodium isoetifolium are more common in the central zone, around the Krishnapatnam.

The creek is a brackish water body flowing east towards Bay of Bengal and harbors’ to excellent mangrove growth near the sea. There has been noticeable mangrove island in the creek locally referred to as Poleramma Kurru, Chirna kurrur,and Pedda kuru. Here Avicennia marina and Avicennia officinalis,Rhizophora macronata,Rhizophora apeculata,Bruggergeria gymnorrhiza, Ceriops decandra, and Exoceora agallocea species were found in this area.

Primary Consumers:

The diverse and rich benthic invertebrate fauna in krishnapatnam are detrivorous primary consumers, excepting the pelagic zooplankton which feeds on phytoplankton, isopods, amphipods, juvenile and sub-adult permaed prawns, species of the lamellibranches Modella and Crabs are all avifauna. Species of Cerithidea are most abundant ecological indicators in inter-tidal brackish waters. The edible Oysters, on the other hand are filter-feeders in shallow waters. Filtering large quantities of detritus, suspended in water. Also, in the food web of Krishnapatnam items like detritus, Polychaetes, amphipods and penaeid prawns may be considered as ‘Keystone prey’ and Carnivorous fish may be considered as ‘Keystone Predators’.

Aquatic Fauna:

Fishes are the most common secondary consumers in aquatic ecosystems in Krishnapatnam with the inflow Sea water and fresh water. Kalyana Murthy and Rao (1972) have analyzed the food of 37 species of fishes from the Krishnapatnam. Fish in turn contribute as the food of not only aquatic birds which are the tertiary or top consumers. Diversity wise, detrivorous fishes from the major category.

Krishnapatnam has rich diversified fish species, mostly marine species, some truly brackish water and a few freshwater species. Major brackish water fishes are Mullets and Catfish. An average 1200 tons of fish and Crustaceans are harvested annually, of which prawns constitute 60% followed by Mullets. Sea food exports include white and tiger prawns, jelly fish, fin fish and Green crabs.

Vegetation along with krishnapatnam port:

Bacopa floribunda (R.Br.) Slender Rare herb Scyphiphora hydrophyllaceae shrub found in the wet sandy soils of Krishnapatnam.

Causurina sps, Anacardium occidentalis and Ficus religiosa, F. benghalensis are the dominant trees are found along the coastal line. Plenty of Borassus flabellifer trees are found in this area.
Salt Marshes are abundantly occupied by halophytic species like *Aleuropous lagopoides*, *Etriplex repens*, *Cressa cretica*, *Crotaleria retusa*, *Cyperus haspan*, *Fimbristylis ferrugenea*, *Salicornia brachiata*, *Sesuvium portulacastrum*, etc. Similar Halophytic species scattered along the banks of Buckingham canal.

Common shrubs like *Azima tetracantha*, *Cassia auriculata*, *Excoecaria agallocha*, *Gmelina asiatica*, *Jatropha gossypifolia*, *Lawsonia inermes*, *Maytenus emarginatus*, *Pandanus tectoreus*, *Salvadora parscs*, *Ziziphus mauritiana* etc., grow on the margins of Marshes and along the canals. On the bunds of the canals trees like *Azadirachta indica*, *Borassus flabellifer*, *lepisanthus tetraphylla*, *Sapindus emarginatus*, *Syzizium cumini*, *Thespesia populnea* etc., appear here and there.

At two places that is near Burada dibba, Chintala dibba close to Kandaleru estuary. Here mangrove species viz, *Aegiceras corniculatus*, *Avicennia marina*, *Excoecaria agallocha*, *Lumnitzera racemosa* are prominent with their characteristic pneumatophores rising above the water level. The bio-diversity and food chains were prospers in Krishnapatnam during earlier days, perhaps due to the fertilizing of the waters by the mangrove leaves and due to the extra habitats that the mangrove root system and the trunks provided. If mangroves are restored to their original native soil of Krishnapatnam, the biodiversity and food chains may be promoted once again.

Floral diversity of Krishnapatnam

![Figure 1: Ficus benghalensis with Borassus flabellifer](image1)

![Figure 2: Calotropis gigantia](image2)

![Figure 3: Spinifex littoreus (Burm.f.) Merr.](image3)

![Figure 4: Opuntia strictata (Haw.)](image4)
Threats to Krishnapatnam:

Krishnapatnam faces several anthropogenic, developmental, industrial and environmental issues threatening not only the livelihoods of fisher folk and also the very survival of this ancient lake itself. Major threats are pollution from sewage, pesticides, industrial wastes from numerous fish processing units and oil spills from mechanized boats carries through Kandaleru and Upputeru estuaries draining in to the Krishnapatnam. Marine chemicals and salt manufacturing industries and Shrimp farming affected the Krishnapatnam along with disturbing the livelihood of fishermen and agricultural workers. It has serious impact on aquaculture development.

Major ecological threats to the Krishnapatnam are, Mega Power Plant Projects. It has maximum effect on biotic component of the ecosystem of krishnapatnam. Un ethical practice of fishing through ‘Padi-Valai’, fishing net with very fine mesh has affected the aquatic resources. Edible oysters of the lagoon were lost now due to heavy siltation. This also causes rapid shrinking of water spread area of the krishnapatnam.

In order to assess the levels of heavy metals and pesticides in water samples collected from krishnapatnam. The concentration of heavy metals and pesticides in water were below in concentrations except for Zinc, mercury and Hexachloro cyclohexane (HOH) low level of mercury concentration was noted in sea water at krishnapatnam creek water. Rapid growth of industrial developmental activities, Power projects is the major cause of increased pollutants. Conservation of Krishnapatnam Both State and Central Governments have been taken so many measures to protect the biodiversity of the Krishnapatnam. Mangrove Pockets have to be developed along the Varagali and Momidi which helps in soil binding. Exotic species have to be eradicated from Mangrove habitats to prevent the alteration of native habitats. The most important conservational aspect of Biodiversity of krishnapatnam is to be build up to create awareness in public through communication, cooperation and education.

Environmental impacts and climatic change on biodiversity in Krishnapatnam:

Climate change has its own specific impacts on the biodiversity. These impacts were already felt, but rather sporadically, since the past 30 years. Industrialization threats to marine flora especially in krishnapatnam these developments will make already vulnerable, traditional, and artisanal fisher flow more destroyed in displacing the lively hood of fishermen. Un preceded scale of development along the krishnapatnam port area in India. East coast of India polluted rapidly due to power plants Aqua culture so on. Krishnapatnam representing the tidal range of 0.7m spellings doom for large tracts of intertidal and near shore marine areas.

Conclusion

Sand dunes and dune sands are widely distributed on the Krishnapatnam port. It mainly occurs Suryalanka to Dugarajapattanam. The coast line of Andhra Pradesh is long and smooth with inundation only in the extreme south in Pulicat Lake and between the Godavari and the Krishna delta.

The observed salinity values ranged between 20 and 35 PSU with high salinity (35PSU) during summer and post monsoon seasons. The minimum Salinity Values (20PSU) were recorded during pre monsoon and monsoon season.

Mangroves swamps are also acquires of nutrients and support highly productive marine food chain mangroves serve as a unique habitats for wild animals and harbor large number of birds larvae.
and juvenile of fishes significant the fishery resources they contribute to the lively hood of coastal folks in terms of forest produce and fishing resources conservation of mangrove areas for human habits habitation aquaculture, agriculture, rapid growth of industrial developmental activities are also major threat to mangroves. Mangroves are recognized wildly for their ecological and economic function. Mangrove wet lands play an important role in stabilizing shore lines and protect the coast by acting as barriers against storms surges and heavy tides they are self generating and self perpetuating littoral formation playing a major role in the global cycle of carbon, Nitrogen, Sulphur, they act as sink for sediments and detritus draining from coastal catchments in help in the tertiary accumulation of waste. Encroachment in mangrove area for agriculture aquaculture and industrial pollution is making adverse impact on mangroves are this area. Krishnapatnam where the kandaleru creek mergers with Bay of Bengal. Here two important mud plants Burada dibba and chintala dibba. At both of these places good number of Mangrove plants found in the influx of brackish water and fresh water. Two small islands which are actually broad mud flats to the south of krishnapatnam port were surveyed. The places surveyed of surrounded by brackish water bay of Bengal and of Kandaleru creek mangroves are found at the fringe and interior and they are dense Avicenia marina is the dominant species. Brugeria gymnorrhiza, Ceariops decandra are also found in this area. But they distributes sparsely. At two places that is near Varagali and Momidi canal close to the kandaleru creek small mangrove packets are located 9 species are mangroves belonging to four families prominent over here. They include Aegiceras corniculatus of Myrsiraceae, Avicenina marina of Aveceiaceae, Excoecaria agallocha of Euphorbiaceae and Lumintzera racemosa of Combretaceae. As per as aquatic fauna is concerned richest fish diversity found in the krishnapatnam there is a temporarily jetty in krishnapatnam and a fish landing plat form in pulicat. six temporary jetties’ in the krishnapatnam port. Occurrence of living fossils Lingula translucida Dall (Brachiopoda,Lingulidae) along krishnapatnam coast of Bay of Bengal Birds, famous Siberian cranes and near160 species of birds were recorded in this area, 26 species of mammals, 17 reptiles such as the monitor lizard, the Russel’s viper and are a foot to establish at krishnapatnam, 3 species of sea turtles, Cara cases of olive ridleys were recorded from the krishnapatnam harbor beech. Sporadic nesting occurs along this coast Mangroves swamps are also acquires of nutrients and support highly productive marine food chain mangroves serve as a unique habitats for wild animals and harbor large number of birds larva and juvenile of fishes significant the fishery resources they contribute to the lively hood of coastal flocks in terms of forest produce and fishing resources conservation of mangrove areas for human habits habitation aquaculture, agriculture.

The most impart ant conservational aspect of marine biodiversity of coastline of Krishnapatnam port is to be build up to create awareness in public through communication, co operation and education especially to protect the wetlands in this area and also native flora and fauna.

Protection and conservation of Biodiversity is the urgent need of the hour in order to maintain the balance of nature and support the availability of natural resources for future generations Assessment of Biodiversity of a particular region is very important to formulate appropriate conservation strategies. Priority should be given to in-situ conservation by protecting the natural habitats. Each village panchayat of India should have the PBR (People’s Biodiversity Register) according to the Biodiversity Act-002. PBR is record of traditional knowledge and practices of sustainable use of local bio-resources and conservation of biodiversity. They may form an appropriate instrument for designing conservation efforts. The plant species are chosen with the twin goal of raising the bio-shields and deriving livelihood to the local communities, creating awareness among local resident about the numerous benefits imparted by the coastal ecosystem on mankind. To avoid the pollution along the Krishnapatnam coast area, Pongamea pinnata,Tamarindus indica, Ficus benghalensis, F. religiosa, Anacardium occidentalis are the suitable plants for this area.

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