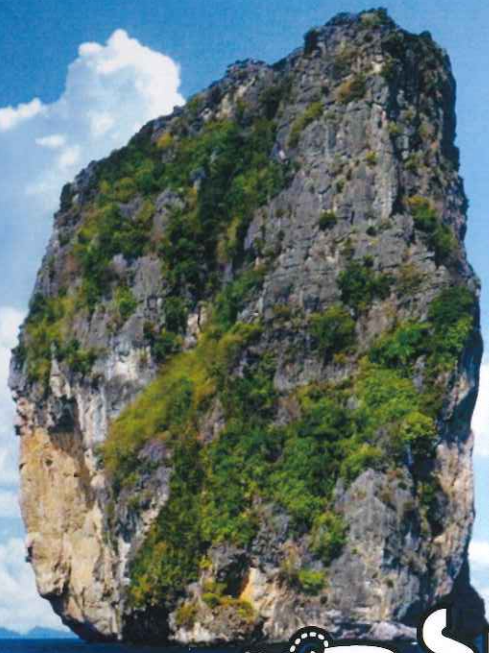
abstract



Post Graduate & Research
Dept. of Botany
MAHARAJA'S COLLEGE
ERNAKULAM
(A Government Autonomous College)
Affiliated to Mahatma Gandhi University
Centre of Excellence under
Government of Kerala

abstract

Workshop on

Coastal and Estuarine Ecosystem Conservation and Management

(Environment Management Training-EMT 2018)

3rd to 8th December 2018

Sponsored by
KERALA STATE COUNCIL FOR
SCIENCE, TECHNOLOGY & ENVIRONMENT
Govt. of Kerala

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abstract

About **"Coastal and Estuarine Ecosystem Conservation and Management".**

The focal theme of the workshop is **"Coastal and Estuarine Ecosystem Conservation and Management"**. Coastal ecosystem world over are facing the brunt of climate change impacts and estuarine ecosystem in particular are facing serious threats. Coastal and estuarine ecosystem are the vast biomes that connect continental lands and oceanic islands with their surrounding seas. Most of the world population resides in the coastal zone and the density of coastal economic development is increasing. Hence, these ecosystems are particularly important for integrating sound ecological management with sustainable economics. Coastal ecosystem includes mangroves; sea grasses; mudflats and intertidal areas. Estuarine ecosystems are characterized by high degree of organism mobility. These ecosystems are cited among the most productive biomes of the world. This points to a good level of ecosystem resilience. These ecosystems are adversely affected by human activities. Effective management practices are essential to conserve the pristiness of both systems. Broad theme of this workshop includes various ecosystem structures and perturbations, management practices and conservation measures.

abstract

Coastal and Estuarine Ecosystem Conservation and Management (EMT -2018)

Book of Abstracts
PG & Research Dept. of Botany, Maharaja's College, Ernakulam

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Dr. K.N. Krishnakumar, Principal, Maharaja's College, Ernakulam.

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Maharaja's College, Ernakulam

Flanked by backwaters and the teeming city of Kochi, Maharaja's College is located in an expansive ten-acre verdant campus. The institution was germinated as an elementary English school in 1845 and it was in 1875 that the institution became a regular college. Maharaja's College is a Centre of Excellence and a College with Potential for Excellence, two titles conferred on it by the Government of Kerala and the UGC respectively on account of its commendable academic performance and co-curricular achievements. NAAC reaccredited the College with A grade in 2006. It was reaccredited (third cycle) by the National Assessment and Accreditation Council in 2013 at 'A' level. This premier center of higher education, one of the oldest in Kerala is the headquarters of the Ernakulam Cluster of Colleges, an autonomous body set up chiefly to share the resources of a few select colleges in and around the city.

Estuarine and coastal ecosystems - an overview

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Coastal waters are waters near the shoreline of land masses. It includes the regions under the influence of freshwater runoff - the estuaries to the intertidal regions and the continental shelf region of the open sea. The structure and dynamics of each of these systems are different from one another. The shallow estuarine regions with seagrasses or mangroves have macrophytes as the primary producers whereas in the open water estuaries or deep fjords, the major primary producers are phytoplankton. The intertidal region with either rocky or sandy habitats are driven by the underlying geology, intensity of wave action and the availability of sediment in suspension. Continental shelves with undulating sea floor are important as fishing grounds. In tropical and subtropical coastal waters, this region includes coral reefs and upwelling systems.

Coastal systems are both very productive and very vulnerable. With a large proportion of the world's population living in the coastal zone, human activities have impaired the smooth functioning of the ecosystem. Valuable fish populations have been greatly reduced or eliminated due to, toxic effects of the pollutants, habitat destruction etc. A large proportion of the problems with coastal waters stem from the discharge of nutrients through sewage, land run off etc. To add to this are the disturbances connected with climate change like sea level rise, increased frequency of cyclones etc.

Coastal ecosystems perform many functions of benefit to

man, such as providing food, assimilating wastes, providing protection from erosion, supporting marine transportation and providing opportunities for recreation. To preserve these services, the healthy functioning of these ecosystems has to be maintained.

Most adverse impacts on coastal ecosystems are characterised by decreasing species diversity. Monitoring of species diversity is a useful technique for assessing damage to the system, and maintenance of good species diversity is a positive management objective.

There is a need to consider the whole coastal zone, from the river basins through the estuaries and coastal waters to the continental shelves, as one large interacting system. Unless this is done, human actions in one part of the system may nullify attempts to improve the situation in another part. For a better future of the coastal zone, we need to differentiate the problems of the ecosystem into those which are properly understood, and hence effectively tackled; and those problems for which we lack a clear understanding. In the first category are the problems like pollution, habitat destruction, overexploitation of resources etc for which we have fool proof solutions. The only obstacle in taking the right action is the conflict of interest among the different stakeholders. However, an integrated scientific, social and economic management strategy can help in achieving progress in this matter. In the second category are problems that require more fundamental studies. For example, dealing with the combined effect of pollutants in the natural system that is subjected to tidal action and dredging requires simulation model techniques to make predictions with acceptable confidence limits. This in turn requires intensive and continuous level of data collection which is lacking in most cases. Thus, the challenge to the next generation of coastal

zone scientists is to deepen our understanding of these ecosystems and sharpen our modeling capabilities to the point at which the consequences of various courses of action can be predicted accurately. This will surely improve our awareness of the ecosystem dynamics and help us conserve the coastal regions without further deterioration.

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abstract

Conservation of Mangrove Ecosystem; Man and Climate

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Mangroves are diverse and unique group of plants growing in salty marine intertidal environment. It doesn't mean that these plants require salt water to survive but are able to withstand the high salt content in the habitat and environment. Like any other plants, mangrove species develop a wide range of characteristic features to adapt with the provided environment. Mangroves are distributed mostly in the tropical coastal regions spreading in more than 120 countries in the world. The largest mangrove in the world is the Sundarbans that spread in India and Bangladesh. Mangroves provide microhabitat for several inhabiting species including microorganisms. Itact as feeding and breeding sites for several birds, odonates, fishes, molluscs, aquatic invertebrates, etc. It provide necessary protection from natural calamities such as Tsunami, hurricanes, etc. It checks soil erosion from land to the sea. It acts as a filter where silt is being filtered. This provides a unique ecosystem for aquatic fauna, especially fishes. Several mangrove species are proved to be medicinally valuable. Several coastal communities depend upon mangroves for their livelihood.Mangrove habitats are considered to be the most carbon rich habitats on earth, more than that of tropical evergreen forests, as they largely involve in the sequestration of atmospheric carbon and act as a good carbon sink. Large quantity of carbon is being stored in the sediments, roots and vegetative parts of the plants. This would, in turn, help mitigate climate change and related aspects.

abstract

Conservation

Conservation of mangrove is a challenge to mankind. The general

believe that it is of least usefulis a major problem facing while conserving mangrove. Therefore, great effort towards awareness is the need of time towards the conservation of mangroves. Major threats that mangroves faces are as follows;

- Shrimp and other aquaculture – About 38% of world's mangrove is lost due to aquaculture practices (Elison, 2018).
- Change in the land use pattern
- Over usage of pesticides, weedicides, etc.
- Several construction activities

Possible conservation measures that can be taken

- Policies- strong policies to prevent loss of mangrove ecosystem
- Awareness
- Declaring as protected areas
- Prevent conversion of mangroves for other activities
- Individual and societal efforts.

Adequate efforts need to be taken to conserve the existing mangrovesto have a bright balanced ecological future.

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abstract

Remote Sensing – Coastal and Marine Ecosystem

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This abstract outlines the theory and use of satellite remote sensing (SRS) data for resolving challenges related to coastal and marine ecosystem. SRS data are used to locate fish stocks (frontal regions), locate areas of reef stress (reef bleach alert system) and delineate areas of high productivity (enriched chlorophyll biomass) in the wake of cyclone paths. Coupling SRS with models helps to estimate fish biomass on an ecosystem scale, generate potential fishing zones (PFZ), and detect meso-scale features such as eddies which generate chlorophyll biomass on a localized scale.Oceanographic processes such as fronts, eddies, meanders, rings and primary productivity linked to them are keys to identification of Potential Fishing Zones (PFZ). Altimeter satellite remote sensing data could identify mesoscale features (Eddies). Such data products can supplement the SST-Ocean color based PFZ and provide information in cloudy conditions too. Productive habitats and their vulnerability can also be assessed using the satellite data based oceanographic processes. Modelled, SRS and *in situ* data sets in combination can be used in the estimation of potential fishery resources in the exclusive economic zone (EEZ), which in turn can help in fishing fleet management.The biological relevance of numerical modelling and SRS at present is restricted to a few operational activities in fisheries. But the issues are complex and there are many uncertainties. The role of coastal processes in fish and shell fish production

abstract

and dynamics deserves further investigation with improved time series sampling of early life stages in marine organisms. Usually, investigations in fisheries biology lack timeseries environmental or other biological data sets. The combinationof satellite data sets with fisheries data can lead to robustconclusions. There is potential for satellite and numerical simulation data to serve in future as a surrogate for marine aquatic biomass. The lecture will address various case studies carried out in tropical marine conditions.

Keywords: Ecosystem, modelling, SRS, data, marine resource management, fisheries

Further Reading:

George, Grinson (2014) Numerical Modelling and Satellite Remote Sensing as Tools for Research and Management of Marine Fishery Resources. In: Remote Sensing and Modeling: Advances in Coastal and Marine Resources. Coastal Research Library, 9 . Springer, pp. 431-452. ISBN 978-3-319-06326-3

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abstract

Coastal Ecosystems: Dynamics and Diversity

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Coastal ecosystems, found along continental margins, are the regions of remarkable biological productivity and are influenced by both terrestrial and marine processes. They include a wide range of habitat types, such as the rocky intertidal, salt marshes, sandy beaches, mangrove forests, soft-bottom bays, tidal creeks, coral and rocky reefs, seagrass beds and kelp forests. These ecosystems are often particularly sensitive to anthropogenic changes in upstream terrestrial systems and to direct coastal impacts. They generally occupy a narrow band from the edge of terrestrial systems into the marine realm, and are influenced byboth upstream terrestrial systems anddownstream marine systems. Despite [illegible] ecosystems provide a suite of essential ecosystem functions to both terrestrial and marine systems (Granek et al., 2010). Coastal marine ecosystems serve as nursery habitats for many marine species, filter terrestrial inputs to marine systems, and can accrete new land as well as buffering land from wave impacts (Feagin et al., 2010). Coastal ecosystems also provide a range of other direct benefits to humans, through fisheries, as sources of raw materials, through storm protection, and as areas for recreation (Koch et al., 2009). However, because, nearly 40% of human populations live on or near the coasts (Millennium Ecosystem Assessment 2005), these ecosystems often face a range of significant and growing anthropogenic threats. Many of these threats are compounded by the fact that marine coastal ecosystems are tightly connected to both terrestrial and marine realms; changes in adjacent terrestrial or marine systems can alter

abstract

coastal processes. Coastal ecosystems provide a wide array of goods and services, encompassing a broad range of habitat types and harbouring a wealth of species and genetic diversity. Despite the importance of, and threats to, coastal ecosystems, coastal ecosystem management is complicated by the fact that both science and management tend to occur within a 'box.' Marine biologists and ecologists often focus on marine species, communities, and processes, whereas terrestrial biologists and ecologists focus on parallel questions on land. As a result, we have a poorer understanding of the effects of terrestrial or marine activities on ecological processes in coastal ecosystems, and there are fewer data available to assess the potential impacts of a particular stressor or event or their interplay. This section provides background information on how these ecosystems work in terms of their components and processes and connectivity within and between ecosystems.

Key words: Coastal ecosystems, biodiversity, coastal processes, dynamics

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abstract

An Introduction to Pokkali Ecosystem

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The Pokkali tract which is comprised of low lying water logged areas along the saline coastal belt of Kerala is under the influence of tide, the amplitude of which may reach up to 1meter. These lands in their natural state are overgrown with mangroves and other saline resistant plants. Majority of Pokkali land lie between the Vembanad Lake and the Arabian Sea coast of Kerala state and is distributed in 33 Panchayaths two municipalities and one city corporation area in the districts of Ernakulam, Thrissur and Alappuzha. The fields are submerged with saline water during most of the time and the tidal amplitude has direct impact on the salinity and water level in the field. The distinctive feature of these saline soils from other saline soils found in India is that due to ingression of salt water from the sea, the soil becomes saline otherwise the soil is acidic. Soil is stiff impervious clay, rich in organic matter, bluish black in colour and is more than a meter deep. The soil is hard and it creates deep fissures when dry and sticky when wet. With regard to the nutrient status, the soil is highly fertile with respect to major nutrients, but low in Phosphorus content. During summer months, due to ingression of salt water from the sea, the soil becomes saline. But when the salinity is washed off in heavy monsoon rains, the inherent acidity of soil regenerate. The soil is highly acidic, the pH being 3.0-4.5. Water-soluble salts like sulphates and chlorides of Na and Mg are present in high proportion. In dry conditions white encrustations of aluminum hydroxide develop on soil surface. With the onset of monsoon the

abstract

salinity of soil gradually decreases and the water become fresh and fit for cultivation of paddy.

Pokkali farming is an unique system of cultivation, where rice is grown along with extensive aquaculture in an organic way in the water-logged wetlands along the coastal regions of Alappuzha, Thrissur and Ernakulam districts of Kerala. Alternatively, 'Pokkali' refers to a saline tolerant rice variety particularly cultivated in these tracts, which internationally known as the donor of *SalTol* QTL for saline tolerance. Its resistance to salinity is remarkable.

In these areas, the rice is cultivated from June to October, when the salinity level of the water in the fields is low, due to prevailing monsoon season. Since the tidal flows make the fields highly fertile, no manure or fertilizer are applied; the seedlings grow naturally. In order to survive in the water-logged field, the rice plant grows up to 130-200 cm. But as they mature, they bend over and collapse with only the panicles standing upright. Harvesting takes place by end-October. Only the panicles are cut about 30 cm from top and the rest of the stalks are left to decay in the water, which in time become feed for the prawns that start arriving in November–December. Then, the second phase of the Pokkali farming, the prawn filtration, begins.

From mid-November to mid-April, as monsoon withdraws and when the salinity is high, prawn farming / fish culture is done. The traditional prawn filtration is taken up during the high saline phase that sets in December/January. The prawn seedlings, which swim in from the sea and the backwaters after the rice harvest, feed on the leftovers of the harvested

crop. The rice crop, which get no other fertilizer or manure, draw nutrients from the prawns' excrement and other remnants.

Pokkali fields, which once spread across 25,000 hectares with major share on Ernakulam district, have now shrunk to 5,000 hectares, according to a state government report. Of this, only 1,000 hectares are still used for pokkali.

The organically-grown Pokkali is renowned for its peculiar taste and its high protein content. Pokkali rice and the value added products made out of Pokkali rice have special taste and cooking qualities with medicinal properties. It is believed that, Pokkali rice provide the energy to fishermen to stay at sea all day. Pokkali, Cheruvirippu and Chettivirippu are the ruling traditional cultivars of the tract. Pokkali varieties have very good initial seedling vigour (attains a height of 40-45 cm within a period of one month), luxuriant growth habit, very high tillering capacity (average 12-16 tillers), long panicles (>25 cm) with large number (120-160) of medium to long bold grains. All the traditional varieties/cultivars have red kernels.

Due to the unique system of Pokkali cultivation and use of distinctive Pokkali cultivars in combination with peculiar soil and agro-climatic conditions of the region, the rice produced in the tract has exclusive cooking quality and distinct organoleptic characteristics of taste and flavour that attracted consumers in domestic market. Rice and value added rice products, from the tract, like rice flour, rice flakes, broken rice, rice bran and brown rice having these special characteristics has won a unique position with considerable position in the rice trade as 'Pokkali rice' and "Pokkali rice

products". It also has reputation as medicinal rice that is used traditionally in health care systems. Pokkali rice is processed and prepared adopting the traditional system of paddy processing.

The brand *Pokkali* has received a GI tag from the Geographical Indications Registry Office, Chennai.

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abstract

Estuarine Bio-geochemical Cycles

Dr. Prashob Peter K J

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The term biogeochemistry is gaining more and more interest among research community and policy makers. This shift towards multidisciplinary approach has gained momentum from 2000 onwards. This is mainly because of the signature of man on his environment is rapidly increasing and evolving and must be understood in order to take apt measures to keep the systems and surroundings sustainable. In order to quantify the impact of human interventions, it is vital to understand the natural processes which are cross linked to each other at regional and global scale. Moreover, scientist from various disciplines such as, chemists, geologist, oceanographers, meteorologists and biologists have to overlook the boundaries of their discipline to gain insight into each others discipline for understanding processes in their area of study. In this regard, biogeochemistry can be regarded as an integrative field in which bogeochemical cycles including the interactions between biological, chemical and geological process are studied to determine the sources, sink and fluxes of elements through different reservoirs within ecosystems. The fluxes of pollutants and their relationship with sources and sink are also an integral part of biogeochemical studies.As estuaries function as a bridge between land, rivers and oceans, understanding their biogeochemistry will open windows towards the sustainable management of resources. Hence, the major goal of this interactive session of this workshop is to introduce to state-of-the-art overview of estuarine biogeochemistry. Biogeochemical cycle will be addressed per element (carbon, nitrogen, phosphorus and oxygen) and also in an integrated approach by combining cycling in sediments and at the land ocean interface scale.

Keywords: Biogeochemistry,Estuary

abstract

Diversity Assessment of Higher Plants in Wetland Ecosystem

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Mangrove ecosystems are populated by halophytic trees, shrubs, and other plants that growin brackish to saline tidal waters of tropical and subtropical coastlines. In general, mangroves are restricted to the intertidal zone from approximately meansea level to the highest high tide water level. Several scientific methods have been adopted for the sampling of the vegetation in a mangrove ecosystem, which includes quadratsampling, transect sampling and GPS based methods. Several diversity indices have been used to study the αand β diversity. In order to prepare good quality herbarium of mangrove species, some special consideration and attention is needed.

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abstract

Coastal Ecosystem and Pollution

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Estuaries are ideal habitat for variety of organisms, which provides many economic and ecological benefits to humans. These areas are becoming contaminated byvarious anthropogenic activities due to a quick economic growth and urbanization. Estuaries have served as repositories for the disposal of industrial and municipal wastes, sewage sludge and dredged material. These contaminants are associated with heavy metals, hydrocarbons and radioactive materials.

Pollutants primary enter into estuaries via pipeline discharges, atmospheric deposition, run off from land etc.The composition and structure of the fauna, flora and habitats of estuaries has been changing at an unusual rate in last decades.The consequences of such changes taking place in coastal ecosystems may have consequences at global level leading to an unbalance in fluxes of energy and minerals at the interface between land and sea.

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abstract

Microbial Diversity of Coastal Ecosystem

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Among the major habitats of the biosphere, the marine realm which covers 70 % of the earth's surface is the largest continuous ecosystem on earth and provides largest inhabitable space for living organisms, particularly microbes. The term 'microorganism' encompasses an extensive and diverse assemblage of organisms, such as bacteria, viruses, protists and fungi which exhibit widely different morphological, ecological and physiological characteristics. Microorganisms, which have been evolving on earth for at least 3.8 billion years out of its 4.6 billion year existence, have provided conditions on the planet that have made it habitable for all other species. Microbes which account for more than 90% of ocean biomass constitute an integral part of the ocean and play many important roles in the earth system. Marine microorganisms provide critical ecosystem services in terms of regulating marine food webs, producing oxygen (about 50% of all the oxygen on earth), biogeochemical cycling, assuring ecosystem integrity, and carbon dioxide uptake and buffering (carbonate system).They are the major primary producers in the ocean, dictate much of the flow of marine energy and provide us important products and services which are of use to our societies. At the same time, some marine microorganisms are responsible for potentially negative impacts such as the spread of human and fish diseases and the contamination of fisheries and aquaculture products with toxic substances.The coastal marine environment is a dynamic system and harbours a rich andvaried diversity of

microbes.Over the past years,it has encountered an exponential rise in population density and subsequent increase inanthropogenic activities inflicting major pressures on the microbial diversity. The past few decades of marine microbiology and microbial oceanography have witnessed remarkable progress. Advances range from the unanticipated recognition of the large biomass of the oceanic picoplankton to the determination of the complete genome sequences of some of the most abundant inhabitants of the oceanic microbial world. Molecular biological and metagenomic applications have made substantial contributions to the discovery and description of several new and unsuspected metabolic features of marine microbes making the marine environment an emerging 'gold mine' fornovel bioactive compounds. Knowledge on the microbial density, diversity and functions in marine ecosystem will certainly facilitate to discover, understand and utilization of the marine microorganisms.

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Dynamics of Macrobenthic community structure in Kole wetlands, Kerala

Dr. Vineetha.S

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Wetlands experience dynamic hydrofluxes which is a major determinant of the biotic community structure. The habitat loss and fragmentation caused by hydrological alterations can affect the benthic fauna, which form an integral part of aquatic environment that constitute an important link in the food web. The benthic response to drawdown conditions is important as hydrological extremes with enhanced drought and flooding episodes is predicted in the climate changing scenario. Maranchery Kole wetland, a part of Vembanad Kole wetlands (Ramsar site) behaved as different systems within a short span of two years such as wet phase, dry phase, paddy phase and channel phase due to agricultural activities. The difference in benthic community among the phases were studied and compared it to a part of the wetland, which remained stable throughout the study period. The benthic fauna belonged to 4 phyla (Annelida, Arthropoda, Mollusca and Chordata) and 7 classes (Oligochaeta, Insecta, Gastropoda, Bivalvia, Pisces, Crustacea, and Hirudinea). Oligochaetes (68.45%) and insect larvae (30.8%) were the most abundant. The numerical abundance of benthos varied significantly between the phases; wet phases were characterized by more abundance as the increased habitable area increased the abundance. The direct and indirect effects caused by reduced habitable area in dry phase due to habitat desiccation and paddy phases due to compartmented paddy root structures

resulted in reduced numerical abundance in both dry and paddy phases. Oligochaetes were the most abundant benthic group in wet (74.11%), channel (60.39%) and stable (88.76%) phases but the most abundant benthic group were insects in dry (75%) and paddy (61%) phases. In dry and paddy phases the habitat fragmentation would have impacted the insect fauna less, as insects have active dispersal instead of passive dispersal in oligochaetes. Twenty seven species of oligochaetes were recorded from the families Naididae, Tubificidae and Lumbriculidae. Species richness and diversity was slightly higher in dry and paddy phases (disturbed phase) than flooded and stable phases (undisturbed phase). Even though, the hydrological alterations caused stress to the benthic organisms, the benthic population and diveresity was maintained during the different phases through its survival strategies.

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Analysis of Water Quality Parameters

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Water is one of the most essential items needed by man, plants and other living beings for their survival.It maintains the ecological balance between various groups of living organisms and their environment. India has a great potential of water resources, both fresh and marine and a great variation in environmental conditions provide a wide range of habitats and contrasts with its varied physical and meteorological features.

Water temperature was measured using a precision mercury thermometer with an accuracy of ±0.01° C. pH measurements were made using a portable pH meter (Perkin Elmer, accuracy, ± 0. 01). Total hardness, calcium, magnesium and alkalinitywere estimated using methods of Trivedy and Goel (1986). Nutrients nitrate, nitrite, silicate and phosphate were estimated by following the methods of Strickland and Parsons, (1972) and Jia-Zhong Zhang *et al.*, (2006).

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Microalgal Diversity along the Kerala coast

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Microalgae, both planktonic and benthic are ecologically very significant as the entire renewable resources in aquatic ecosystems are either directly or indirectly generated by virtue of their capacity of synthesizing organic matter. Study on diversity of microalgae is of primary importance in aquatic ecology for assessing water quality, habitat integrity, habitat carrying capacity and trophic web stability. Direct microscopic observation, correct identification and accurate enumeration are essential to document species composition and biomass and are the only means to assess the morphological changes within the algal communities as a response to environmental variations.

An attempt was made to analyse the microalgal diversity, both planktonic and benthic from southwest coast of India (from Vaadi 8° 52' 01N 76°34' 26E, in the south to north Mahe, 11°42' 18N 75° 32' 36E), along with two open sea cruise data.

Qualitative analysis of planktonic microalgae from the southwest coast of India includes 285 species from coastal and estuarine stations and 57 species collected from offshore waters during FORV SagarSampada cruises. Thirtyone species were found common, both in coastal and offshore waters. Altogether, 311 species were found distributed among 89 genera in 7 classes/groups viz; cyanophyceae (9 genera), chlorophyceae (22 genera), bacillariophyceae (52 genera), dinophyceae (16 genera), chrysophyceae (1 genus), dictyochophyceae (1 genus) and coccolithophorids (1

genus).Physico-chemical variables such as temperature, salinity, pH, nitrate, nitrite, phosphate, silicate, dissolved oxygen and primary productivity influenced the distribution and abundance of microalgal species.

Maximum standing crop and chlorophyll *a* were obtained when the mean N:P ratios were lower and Si:N ratios were higher. The planktonic microalgal standing crop and chlorophyll *a* values are well supported by the higher Si:N ratios along the coastal and estuarine stations. Benthic microalgae were found distributed at a depth of 5cm in the sediment column along the southwest coast of India.About 88% of the total microphytobenthos were found to be diatoms. During this study, eleven species of toxic microalgae were recorded among three taxonomic classes, indicating the possibility of potential threat of harmful blooms in the coastal environment of southwest India.

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Benthic meiofauna of Cochin backwaters

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The term 'benthos' was originally used by Haeckel as derived from the Greek word for 'depths of the sea'. It belongs collectively to all aquatic life forms that live in, on or near the benthic biotope. They form food for higher trophic levels, take part in the biomineralisation process in sediment and a good ecological indicator. Benthos comprises a diverse number of life forms, ranging from microscopic bacteria to larger megafauna and they exhibit different feeding mode and distributional pattern. They usually divided into three functional groups; infauna, epifauna and hyperbenthos, i.e., those organisms living inside the substratum, on the surface of the substratum and just above it, respectively. According to their size, benthic animals are classified into three groups, the macro, meio and microbenthos. The macrobenthos defined as organism retained in the sieve having mesh size between 0.5 mm and 1 mm. The major taxonomic groups represented among macrofauna of the estuary were polychaetes, crustaceans and molluscs along with hydrozoans, cirripedians, echinoderms and other groups. The suspension feeding population was dominated in the macrofaunal communities of the estuary. However, meiofaunal (63 to 500 µm) communities in the estuary were mainly represented by nematodes, harpacticoid copepods, foraminiferan, and other groups. Nematodes are the major representative of meiofaunal communities in the estuary. The smallest size

group, microbenthos were not considered in this study. The distributional pattern of these benthic groups can be used for understanding the ecological status of the estuary by using various marine biotic indices. In this study, benthic assessment of northern Cochin backwaters (KodungallureAzhikode estuary) depicted a moderately disturbed ecological environment in marine biotic indices based assessment.

Keywords. *Benthos,Meiofauna, Cochin Backwaters,*

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abstract

Coastal Fishery Resources of India-Present Status and Management Concern

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The marine fisheries sector in India has witnessed a remarkable growth during the last five decades andit plays asignificant role in Indian economy. In India, four million people depend for their livelihood on marine fisheries sector which provides employment to nearly one million fishermen and contributes significantly to the export earnings of the country. India is the largest country in the Indian Ocean region comprising a coastline of 8129 km with estimated fishery potential yield of 4.41 million tonnes. About 58% of the resources are available at a depth of 0-50 m, 35% at 50-200 m and 7% from beyond 200 m depth. The marine fish landings in India have increased from 0.58 million tonnes in 1950 to 3.83 million tonnes in 2017, which forms about 87% of the estimated fishery potential. More than 80% of the current fish production comes from the intensively fished coastal waters. The major species landed can be grouped under pelagic, demersal, crustaceans and molluscs. Pelagic finfishes aredominant group in the marine fish landings and contributing more than 54% of the total landings. Indian oilsardine, mackerel, ribbon fish, lesser sardines and Bombay duck contributes almost 60% of the pelagic fish landings. Demersal finfishes contribute around 27% to total landings. Crustaceans included high value resources like shrimps, crabs and lobsters and the contribution from this group is 13%. Molluscs comprising squids, cuttlefish, clams and oysters accounts for the remaining 6%. In the last four years maximum landings were recorded along the Gujarat coast

abstract

and contributing around 20% of the total landings in the country.

A recent revalidation of marine fisheries potential has revealed that the fishing pressure on the stock in coastal waters has increasedsignificantly and signs of over exploitation of species are becoming increasingly evident and further increase in effort in the coastal waters would be detrimental to sustainable yield.Excessive fishing effort, inappropriate exploitation patterns, juvenile fishing,post-harvest loses, habitat degradation, pollution, climate change are major hurdles in coastal water fishery.A guidelines for ensuring sustainability, ecosystem conservation, eliminating destructive gears, reducing by-catch and discards, diversification of fishing into new areas, new resources and eventuallygrowing a working model for an informed participatory management of coastal fisheries resources of the country is the need of the hour. This can be achieved only jointly by all the stakeholders including fishers, researchers, policy developers and implementers.

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Coastal Environment Conservation using Biotechnological Aspects

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Applications of biological processes to manage ecosystem conservation is an area of environmental research nowadays. The problems of marine ecosystem have been understated in environmental research until very recently. Likewise, the coastal areasharbor a unique ecosystem in the form of mangroves as well as corals and a variety of different species. Unlike the mainland ecosystem these unique areas are having less ecological amplitude and hence prone to large scale degradation with smallest change in climatic and environmental conditions. The immense inflow of non-biodegradable as well as sewage wastes to the marine environment is creating havoc in these sensitive areas. Biotechnological innovations can be effectively used to conserve and manage these ecosystems.

Much progress has been made in the area of ex-situ conservation of marine micro algae as algal culture techniques has been perfected. Similarly, ex-situ conservation methods have been adopted for the conservation of mangrove plants. Sea weeds can also be conserved like that in controlled environments. Pollution with PHC (petroleum hydrocarbon) pollutants is one of the grave threats in marine and costal environment as sea routes are still the major means of petroleum transportation. The Engineered microbes can be effectively used to manage petroleum hydrocarbon pollutants and it has been proved since the time of 'superbug' by Ananda chakraborthi. Microbes as well as microbe derived enzymes immobilized in various inert substrates, were in use for the purpose.

The cellular analysis of reef degradation and oxidative stress has been one of the important methods to monitor the

health of Reef. The presence of xenobiotics in the corals can also be monitored using biotechnological tools. Isolation and Culture of coral reefs and restoration of the reefs in the restored marine ecosystem is widely practiced for the conservation of these important ecosystem.

Biotechnological tools have ben effectively used in restoration of the mangrove ecosystem of Sundarbans. Technologies has been established for the large-scale multiplication of mangrove plant species. Genetic diversity analysis and improving salt tolerance by mangrove associated plants are also areas of focus in this regard.

More developments in this area can give us more tools to counter the serous problem of degradation of coastal areas and restoration of the same.

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Identification of Mangroves along the Kerala Coast

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Mangroves being one of the unique ecosystems of the world, comprises of diverse groups of trees, shrubs, palms, vines and ferns that are salt tolerant and are well adapted to the intertidal regions. They form an interphase ecosystem between land and sea along the tropical and subtropical coastline of 128 countries and territories.Globally 71 species of true mangroves are identified, of which 39 species are reported in India. The present study identified 18 species of true mangrove and 38species mangrove associate from 117 sites along ten districts of Kerala. The Rhizophoraceae family represented 7 species under four genera: *Rhizophora, Bruguiera, Ceriops* and *Kandelia* followed byFamily Avicenniaceae with three species of *Avicennia;A. officinalis, A. marina* and *A. alba.*Family Sonneratiaceae (*Sonneratia alba* and *S. caseolaris*)and Euphorbiaceae (*Excoecaria agallocha* and *E. indica*) were represented by two species each. *Aegiceras corniculatum* and *Lumnitzera racemosa* were the single representatives of the family Mrysinaceae and Combretaceae respectively. The ferm family Pteridaceae was exemplified by a single species;*Acrostichum aureum.*

For centuries, there exist an everlasting bond between mangroves and human. Being the most productive and biologically important ecosystem, the goods and services they provide are innumerable. But during the recent years the increasing population pressure, industrial and urban development has significantly destroyed this pristine ecosystem.The Indian mangrove cover has drastically declined from 6470km^2(1987) to 4921 km^2(2017). The mangrove cover of Kerala has also decline from 700 km^2 to about 9 km^2(2017). The ecological importance of these ecosystems was never realized and is destroyed on large scale. This alarming rate of destruction and degradation has devastating effects on biodiversity, food security and livelihoods of many coastal communities.

Distribution and diversity of the marine macro algae from selected coasts of Kerala, Tamil Nadu and Lakshadweep islands

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The diversity and distribution of algae in the aquatic ecosystems is a topic of great significance. Marine and freshwater systems provide several important ecological and economic services. The marine macro algae or seaweeds are simple photosynthetic plants and one of the important living resources that contribute greatly to the economy of coastal regions. The distribution and density vary according to geological characters of the substrata and the quantity and quality of light and temperature. Benthic forms grow on rocks, sand, mud, corals and other hard substrata, provide a three dimensional structural habitat for other marine organisms and are consumed by an array of animals. They also stabilize the marine environment by absorbing nutrients, producing metabolites, serving as bio-indicators and showing signs of degrading water quality. Along with ecological relevance, seaweeds possess great economic importance, as human and animal food, fertilizers, stabilizers and stiffeners in food and cosmetic industry and medicine.Utilization of seaweed biomass for making value added products are very much limited in our country. Seaweed resources in the coastal regions are inadequate to meet the growing demands for agar, carrageenan and algin production. It is highly essential to cultivate the commercially important seaweeds to support and to meet the demand of raw materials for the seaweed industries and also adopt adequate measures to conserve them. Hence the seasonal studies on distribution and diversity of this group of primary producers is of great relevance. The seasonal changes in the distribution of seaweeds can be due to the variation in rainfall, salinity, nutrients and light intensity. The present study was conducted to understand the diversity and distribution of marine algae in selected coasts of Kerala, Tamil Nadu and Lakshadweep islands.The maximum diversity and species richness was observed during the post-monsoon seasons from the all the sites selected for the study. A total of 69 species belonging to Chlorophyceae, Phaeophyceae and Rhodophyceae were identified. The most abundant group was Rhodophyceae dominated by 33 species, followed by Chlorophyceae with 22 and Phaeophyceae of 14 species. In Kerala the highest macroalgal diversity was observed in Thirumullavaram of Quilon district and maximum representation was from Rhodophyceae followed by Chlorophyceae and Phaeophyceae. Among the coasts selected in Tamil Nadumaximum diversity was seen in Chlorophyceae compared to the other two groups. Sites selected from Kavaratii possessed maximum diversity compared to those of Agatti, Kilton and Kadamath islands of Lakshadweep and the group Rhodophyceae showed highest macroalgal diversity followed by Chlorophyceae and Phaeophyceae.

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Harmful Algal Blooms (HABs) – an overview

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Microalgae or phytoplankton are considered as the primary food source in the aquatic ecosystem. Even though algal proliferation or "algal blooms" are considered beneficial, at time this phenomenon can have negative effects causing severe economic losses to aquaculture, fisheries and tourism operations, and having major environmental and human health impacts. Algal bloom appeared to be colored red, green, brown, yellow, orange, white etc and was red, when such an instance was first reported, and hence referred as 'red tide' and is now popularly called as Harmful Algal Blooms (HABs).Around 300 species including diatoms, dinoflagellates, cyanobacteria, raphidophytes, prymnesiophytes and silicoflagellates can at times cause blooms, while only 80 or so have the capacity to produce potent toxins. Based on the toxicity events, human poisoning syndromes have been classified as follows, Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP), Neurotoxic Shellfish Poisoning (NSP), Amnesic Shellfish Poisoning (ASP), Ciguatera Poisoning and Cyanobacterial toxins. Of these six groups of toxins, four (DSP, NSP, PSP, CFP) were mainly produced by dinoflagellates, and the others ASP and Cyanobacterial toxins by diatoms and Cyanobacteria (Blue Green Algae) respectively. Besides toxins, algal blooms can cause mass mortality of fish and invertebrates by clogging their gills and also by depletion of dissolved oxygen (anoxia) by death and decaying of the bloom.

Harmful Algal Blooms are global phenomenon, reported from over 30 countries including India. Analysis of occurrence of bloom events has shown that HABs in the Indian waters have increased in frequency, intensity and coverage during the last two decades. The first recorded observation on algal blooms in Indian waters is by James Hornell in 1908. Since then, there have been several reports on various algal blooms dominated by blooms of *Noctiluca scintillans*, *Trichodesmium* spp. etc from the EEZ of India. Harmful algal blooms, especially of *Noctiluca scintillans* and *Trichodesmium* spp. is a regular phenomenon in the Indian waters since 1970s. But the first record of Paralytic Shellfish Poisoning (PSP) was recorded during 1981 from coasts of Tamilnadu, Karnataka and Maharashtra. In 1981, PSP resulted in the death of 3 persons and hospitalization of 85 peoples due to the consumption of affected mussel *Meretrixcasta* in Tamil Nadu. An outbreak of PSP has occurred in Kumble near Mangalore following the consumption of clams during 1983. In September 1997, an outbreak of PSP was reported from Vizhinjam, Kerala, resulting in the death of 7 persons and hospitalization of over 500 persons, following consumption of mussel, *Pernaindica*. During 2004, an unusual nauseating smell came off sea and engulfed the coastal areas of Kollam to Vizhinjam, southwest coast of India. More than 200 persons, especially children, complained of nausea and breathlessness for short duration due to the smell. This was coincided with algal blooms and massive fish kills also. The causative organism was *Cochlodiniumpolykrikoides* and *Noctiluca*.

In marine and coastal water environments, cultural eutrophications (anthropogenic inputs of nutrients) have been demonstrated to be a major contributing factor to eutrophication and subsequent algal blooms. The frequency and extend of HABs are reported to be increasing in the Indian waters. These blooms adversely affects the living resources by depleting dissolved oxygen, cause PSP in

humans which is fatal, destroy the coastal aquaculture and adversely affects the entire marine ecosystems. It is necessary to accurately identify and establish the early monitoring programmes of these phenomenons in order to decrease damage.

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