ABSTRACTS OF PAPERS

"NEW PERSPECTIVES IN RESEARCH AND MANAGEMENT OF MANGROVE ECOSYSTEMS"

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A DOCUMENTATION ON HUMAN TRADITIONAL ACTIVITIES IN THE MALAYSIAN MANGROVE ECOSYSTEM

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This paper attempts to describe the various types of human settlements within or along fringes of mangrove forests in Malaysia. Also highlighted is the documentation on the diverse forestry and fishery traditional uses of mangrove resources by these communities.

Coastal human communities are highly dependent on the continued sustenance and viability of the mangrove ecosystem. Any form of extensive and uncontrolled conversional or destructional use, which is often oriented towards production of single goods, would be in direct conflict with the ecologically sound and sustained multiple use management system of these traiditonal communities. Clearly, the importance of the mangrove ecosystem to these communities should be given due considerations during the planning of mangrove development programs.

THE MANGROVES OF VIETNAM

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Vietnam is one of the countries in sourth east Asia where the mangroves well develop and cover an important area.

Previously the knowledge of mangroves in Vietnam was limited because there was a few of published papers about flora resources and vegetation in some zones.

The mangroves of Vietnam have been studied for ten years by the national project on mangrove ecosystem and its initial results were presented at the first national symposium on mangrove ecosystem held at Hanoi (1984).

Mangrove vegetation in Vietnam develops through a gradient of environmental conditions from humid monsoon tropic in the south to the transfigured monsoon tropic in the north.

Physiognomy of the vegetation and its floristic composition show the effect of geological gradients by reduction of the number of species; also height, density and succession change greatly betwen the rich mangrove vegetation in the south such as that in Camau peninsula to the poorer mangrove of Quang ninh province in the north.

The resources of Vietnam mangrove ecosystem are abdundant and valuable, particularly Rhizophora wood and tannin, shrimps, fish, moluscs, birds etc.

However a large area of mangroves has been destroyed for many years by the war and the unreasonable exploitation.

More than 50,000 ha of land sprayed by herbicides have been reafforested and the mangrove ecosystem is restoring gradually.

Nevertheless the destruction of mangroves for raising shrimp, for fuel and household items is still disseminating in some places. The utilization of other resources such as honey production, nipa sap and nipa alcohol is not carried out yet.

Some suggestions of rational utilizing and management of mangrove resources and a forestry-fishery model are mentioned.

REVIEW OF MANGROVE RELATED ACTIVITIES IN SRI LANKA

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Mangroves as a natural resources have received very little attention from both policy makers and research scientists in the past. Government policy for an accelerated economic development has exerted severe pressure on coastal ecosystems such as mangroves. Economic development from one hand and lack of proper understanding on dynamics of mangrove ecosystem on the other have resulted in rapid environmental degradations. A momentary panic has setup among scientists, planners, and decision makers to seek a balance between economic prosperity and natural forces. Scientists in Sri Lanka have responded positively to gather scientific information and the utilization of this information for a rational management of depleting coastal resources.

STRUCTURAL AND FUNCTIONAL STUDIES ON MANGROVES OF CAMAU PENINSULA IN SOUTHERN VIETNAM (Presentation)

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Preliminary results on structure and function of mangroves in the Camau peninsula considered to be the most beautiful mangrove in Vietnam were summarily presented.

The flora, distribution and zonation of mangrove species based on 3 typical transetts described. The variation of zonation determined by the all of external sources acting on a locality, especially, the tidal regimes and substratum were illustrated on mangrove forests in Camau. The biomass of Rhizophora and Avicennia forests were estimated.

In adition, the regeneration, replantation and reforestation on areas sprayed by herbicides were reported on rehabilitation and biomass.

Data of litter-fall, decomposition and export of particulate-organic matter involved the cycling of matter were also given.

Finally, some suggestions were devoted to discussion on the interaction between mangrove forests and aquaculture in the applied studies on mangroves of Camau peninsula.

MANGROVE LITTER PRODUCTION AND DYNAMYCS IN FRINGE AND RIVERINE MANGALS IN DUTCH BAY, SRI LANKA

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Litter fall of mangroves in Erumathivu island (fringe type) and Kala Oya estuary (riverine type) in Dutch bay, Sri Lanka was measured from September 1985 to August 1986. The annual litter production in Erumathivu and Kala Oya estuary were 402.38 g/m² and 574.21 g/m² respectively. Mean daily litter production (g/m²,day) in any of the sites had no significant relationship with monthly rainfall and mean montly temperature. Annual litter production by Rhizophora mucronata (193.40 g/m² in Erumativu and 295.65 g/m² in Kala Oya) and Avicennia marina (182.51 g/m² in Erumathivu and 237.25 g/m² in Kala Oya) accounts for more than 90% of the total annual litter production in each mangal. Generally the leaves constitute the most important component of all litter materials. Variations in (mean) daily litter fall by various components of litter (ie. leaves, flowers, fruits/seedlings, branch wood and miscellaneous items) by R. mucronata and A. marina are also discussed. Phenological patterns of these two species in the two locations follow a similar periodicity.

PHOTOSYNTHETIC GAS EXCHANGE BY MANGROVES IN AUSTRALIA AND PAPUA NEW GUINEA

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Rates of photosynthesis and transpiration by a variety of mangrove species were measured at a number of geographical locations in northern Australia and Papua New Guinea. Despite the wide range of environmental conditions covered by the measurements, there was remarkably little variation in the rates of photosynthesis between species or location. This finding is interpreted in terms of the response of photosynthesis to light, temperature, vapour pressure deficit and salinity.

RESEARCH ON MANGROVE SOILS IN INDONESIA

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Researchs on mangrove soils have been conducted in several places in Indonesia, either as a part of soil survey activities in tidal land area or a special research on mangrove ecosystem. Field and laboratory data reveals that mangrove soils in Indonesia predominantly characterized by fine texture, half ripe to unripe, saline, and commonly contain a sulfidic material. Some coarse texture soils also occur especially in coral island. There are also some mangrove soils with a histic epipedon. Salinity content decrease regularly from the coast to the inland, and the adsorption site of the soil dominated by cations in the order of Na > Mg > Ca or K (zone of Avicennia, Bruguiera, Rhizophora), Mg > Ca > Na or K (Nypa zone), and Ca > Mg > Na or K (Melaleuca, fresh water zone). The higher content of sodium did not followed by a significant increase in pH value due to variable source of acidity. The sequence of soil distribution from the coast were: Halic Sulfic Hydraquents, Halic Sulfaquents, Histic Halic Sulfaquents, Terric Halic Sulfihemists, Typic Sulfaquents, Terric Sulfihemists, Terric Tropohemists, Typic Tropohemists. Mangrove soils are considered unsuitable for agriculture mainly due to salinity and acid sulphate problems.

SOME ECOLOGICAL FACTORS LIMIT THE ABUNDANCE OF CRABS AND GASTROPOD MOLLUSCS POPULATION LIVING ON THE ABANDONED TIN-MINE MANGROVE FOREST REFORESTATION SOIL

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In studying the abundance of certain benthic macrofauna which live in or on the abondoned tin-mine mangrove reforestation areas of different ages at Ta-Koa Pa, Phang, Nga Province, it is found that the areas of newly abandoned by the tin-miners and new reforestation are almost deserted by the macrobenthic animals. However, with the longer time periods, the return of the mangrove benthic animals are observed. In the old abandoned soils and long reforestation mangrove, the soil compositions, soil textures and certain ecological factors found to play the significant roles in limiting the abundance of the mangrove benthic species.

The abundance of crabs such as Uca lactea annulipes, Uca triangularis bengali and Sesma vesicular are usually found in the sediment of nearly equal proportion of sand silt and clay. The ceratids mollusc such a Cerithidea cingulata and Cerathium coralium are found mostly on soil of less sand but more silt and clay. The lowest numbers of all of these species are found at area which is a new abandoned tin-mine and recently planted mangrove seedling. The ecological factors at this location are shown to be the highest value of the cation exchange capacity (CEC), the amount of phosphorus and also sulfate.

TROPHIC NICHE BREADTH AND NICHE OVERLAP IN SOME MANGROVE GOBIES OF PAGBILAO (PHILIPPINES)

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Out of the 128 fish species belonging to 54 families recorded for this locality 54% was benthopelagic and 39% strictly benthic. The highest number of species of 15 was represented by family gobiidae.

Among the 5 common species investigated, Gnatholepis Calliurus and Ctenogobius criniger had the highest niche overlap and between Gnatholepis calliurus and Oxyurichthys ophthalmonema existed the lowest niche overlap. Highest niche breadth was recorded for Ctenogobius criniger and the lowest for Gnatholepis calliurus. The mangrove gobies investigated can be considered as generalists rather than specialists in their diet.

FOOD CHAINS IN TROPICAL AUSTRALIAN MANGROVE HABITATS: A REVIEW OF RECENT RESEARCH

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This paper summarises recent work on the structure and function of tropical mangrove food chains in Australia. The stimulus for this work was provided by 1) the lack of knowledge of food chains in S.E. Asian mangrove areas, and ii) a belief that current models of mangrove food chains (based mainly on work in Florida) were inadequate for our species-rich forests.

In tropical Australia the proportion of mangrove leaf production removed by insect herbivores ranges from 0 to 35 percent for different mangrove species, but averages less than 3 percent for the dominant forest types. When leaves are shed from trees in low-intertidal regions more than one quarter of leaf fall is shredded immediately by sesarmid crabs prior to microbial decomposition in subtidal regions of the forest. Consumption by crabs is likely to be much higher in forest regions not regularly flushed by tides. Bacterial densities and productivities on the mud surface are some of the highest yet recorded for marine sediments and bacterial densities are similarly high on decomposing leaf material. Meiofaunal densities are low, and meiofauna are not significant grazers on bacteria.

Zooplankton densities are high and vary among microhabitats and times, and zooplankton are the major food source of juvenile fish within mangrove forests.

Penaeid prawns feed on floculant detrital material, and prawns and small juvenile fish are the major prey of large

predatory fish. Several important food chain links remain to be quantified, but already it appears that S.E. Asian mangrove food chains have some unique qualities.

MICROBIAL DECOMPOSITION OF EXCOECARIA AGALLOCHA LEAVES IMMERESED IN THE BRACKISH WATERS

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Litter-bag-insitu-experiments with the leaves of Excoecaria agallocha were carried out for a period of 150 days in a brackish water environment. Bacterial population in the water, loss of dry weight, percentage nitrogen and percentage protein in the litter were estimated. An increase in the bacterial count was noticed up to 60th day and then a decreasing trend was noticed. There was a steady increase in the percentage nitrogen content, till about 90 days except for an initial period of decrese. However, the rate of increase in the subsequent two months was relatively slower than the previous months. Percentage protein was calculated by multiplying the percentage nitrogen by the factor 6.25. The weight of the litter gradually decreased at the close of the experiment. The study revealed that the rate of decomposition was quicker.
The ecological implication of nutrient flux in terms of secondary production has been discussed.

GROWTH REGULATION IN MANGROVES WITH SPECIAL REFERENCE TO ETHYLENE : A PROMISING AREA FOR FUTURE RESEARCH

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Mangroves are adapted to grow under a unique set of environmental conditions. While most aspects of research and management of mangroves have progressed considerably, the hormonal regulation of their growth and development remains essentially untouched. Knowledge on this aspect can be highly beneficial not only for a better understanding and management of mangroves but also for our progress in plant science research in general.

Plant response to environmental conditions and survival through stresses is mediated through hormones. Of all known plant hormones, ethylene is gaining increasing attention. This gaseous hormone has its regulatory role in almost every aspect of plant growth and is thought to modulate the action of even other hormones. Some of the most fascinating effects of ethylene are found in aquatic/marsh plants and during flooding stress in land plants. Mangroves which are a unique category of marsh plants appear to be an ideal group to examine ethylene relationships in plants. A thorough examination of the literature on structure and functioning of mangroves indicate that ethylene may be a key regulator of their growth and development in the inter-tidal zone. Investigations in this area may enable us to understand the environmental requirements and developmental and functional behaviours of mangroves better and thereby manage them more effectively. Ethylene biology of mangroves would therfore be a promising and challenging area of future research.

DEVELOPMENT OF MANGROVE FOREST RESEARCH IN BANGLADESH

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Bangladesh is a large delta of the Bay of Bangal and the largest mangrove forest of the world, "The Sunderbans" stands on its emergent coast. The Chokoria Sunderbans is another mangrove forest of Bangladesh which is under the Cox's bazar Forest Division in the south eastern part of Bangladesh. Besides these natural mangrove forests, a very extensive mangrove plantation has been raised along the whole coastline of Bay of Bengal starting from Teknaf to Patharghata and the offshore islands.

The present paper includes the results and findings of two successive national inventories carried out in the Sunderbans. The mangrove afforestation, reforestation and tree planting strategy in the coastal region have been discussed describing the experiences in raising the artificial mangrove plantation. Bangladesh Spece Research and Remote Sensing Organization (SPARRSO) has conducted two research projects on mangrove supported by UNESCO entitled "Development of Computer Technique for Rapid Mangrove Forest Inventory in Sunderbans" and "Mangrove forest inventory using aerial photography and other Remote Sensing Technique". The salient features of these projects have been included in the paper. Besides, the rsearch activities on the mangrove forest species conducted at the Bangladesh Forest Research Institute(BFRI) Chittagong, and Plantation Trial Units (PTU) of Barisal and Khulna districts have been discussed. The future prospects and constraints in the research on mangrove forest in Bangladesh have also been discussed.

STATUS OF MEROPLANKTON RESEARCH IN MANGROVE AREAS OF INDONESIA

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This paper describes the extent and results of some researches on meroplankton in Indonesia, with particular reference to those found within and around the mangrove areas. The results suggest that differences in species composition exist among different sites. One possible factor which affects the larval composition is the type of bottom, namely coral reef or mud.

Problem of larval identification has caused the limitation in meroplankton study. Therefore the need for further and more detailed study on meroplankton, especially the fish larvae is emphasized. Meanwhile, the initiation of taxonomic study of mangal ichtyoplankton is suggested.

THE IMPORTANCE OF MANGROVE ECOSYSTEMS FOR THE AVIFAUNA - PERSPECTIVE FOR FUTURE RESEARCH

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Many species of birds in the Asian Region feed, roost bread and shelter in mangroves. Moreover certain countries have characteristic avifauna of the mangrove habitat. Large number of birds that migrate use the mangrove habitat, and the associated mud flats. These habitats are however rapidly being destroyed throughout the region, with respect to the avifauna, there is very little research on the avifauna of mangroves. The Asian Wetland Inventory Project (organised jointly by ICBP, IUCN, IWRB and WWF) is currently preparing a status report of the Wetlands - mangroves being part of this. The role played by avifauna in the mangrove ecosytem has not been investigated in detail and suggestion to determine these and also detail information pertaining to species diversity, composition and degree of inter-dependence is proposed for future research considerations.

GEARS FOR SAMPLING AND MODIFICATIONS IN APPLYING ELEFAN PROGRAMMES TO FISH IN THE MANGROVES

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The type of gear used depends on the objectives of the study. An otter-trawl net, a hoop trap net, a gill net and a lift net were used to sample fish in the mangroves. The lift net and the hoop trap net did not give good results. Gill net gave samples suitable to study the reproduction of fish. Since it was selective, only the Otter-trawl net samples were suitable to study the population dynamics. Of these samples alone were suitable for running ELEFAN programmes. Since most of the fish in the mangroves emigrate L_{oo} is not recorded in the catch. The mortality is also an overestimate since it includes the emigration as well. Attempts are made to improve the accuracy of parameter estimation in population dynamics by simple mathematical manupulation.

MORPHOLOGY AND ANATOMY OF THE ROOT SYSTEM OF SONNERATIA ALBA IN RELATION TO FUNCTIONING

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Mangrove roots have to survive in a highly anaerobic saline mud. Some of the most significant adaptations and growth behaviours are thought to be found in the root systems of these species. Some aspects of the root system of Sonneratia alba were examined to expand our knowledge of mangrove root functioning.

Each of the three components in this root system namely cable roots, pneumatophores and feeder roots, has a distinct structure and function. The cable roots and pneumatophores are covered with suberized layers making them impermeable to the outside saline water. Feeder roots, without an outer suberized layer possess a distinct endodermis allowing for ion selectivity. Plagiotropic cable roots have a small stele, an extensive aerenchymatous cortex for air storage and produces negatively geotropic pneumatophores at places.

As the pneumatophore emerges from the flooded soil to the air it undergoes dramatic structural changes and develop certain stem characters. It does not possess a functional root cap, the graviperception organ in normal roots. Instead it develops a prominent starch sheath, the graviperception tissue in shoots. Vasculature also tends to change into that of a stem. The pneumatophore becomes photosynthetic and this probably assists in regulating the 0_2 and CO_2 levels in the air spaces. The outer protective zone consists of alternating bands of small, suberized dark cells and large, colourless cells. The outermost suberized layer peels off by cell seperation in the colourless band inner to it. Large amounts of

calcium oxalate crystals accumulate in the outer phloem of the pneumatophore but not in the cable roots or feeder roots. This calcium oxalate deposition may be important in the regulation of growth of the pneumatophore as well as the entire plant. The sodium contents in the pneumatophores are also much higher than those of cable roots or feeder roots and are similar to the values in the leaves. With the emergence of the pneumatophore to air the thickness of the cortical aerenchyma zone decreases and the girth of wood increases dramatically.

THE EFFECT OF SALINITY ON THE GROWTH OF SONNERATIA ALBA IN SOLUTION CULTURE

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Seedlings of S. alba were grown for three months in nutrient solutions containing either 0%, 25%, 50% or 100% sea water. Plants grew poorly in both 0% and 100% sea water treatments. Growth was greatly stimulated in 25% and 50% sea water treatments. Shoot length, leaf numbers, leaf areas and the dry weights of shoots and roots were much higher in these treatments than in 0% and 100% treatments. Root lengths however increased gradually with increasing salinity with 100% sea water producing the longest roots.

Percentage water contents in the shoots were significantly lower in 0% and 100% sea water treatments than 25% and 50% treatments. This corresponded with a visual observation that plants in 0% and 100% sea water treatments showed a mid day wilt which did not occur in 25% and 50% sea water treatments. Collectively this indicates a difficulty for the plants to maintain maximum turgor both in the absence of sea water and in 100% sea water, particularly under actively transpiring conditions.

MANGROVES IN THE WEST COAST OF SRI LANKA WITH SPECIAL REFERENCE TO THEIR MACROFAUNA

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Mangroves in the west coast are not extensive and, in most places, limited to a narrow strip boardering lagoons and estuaries. A clear ecological zonation such as that described in the mangroves of south-east Asian countries etc. is difficult to discern, except for a Rhizophora Bruguiera zone towards the edge of water followed on the land side by a zone containing other core species. The low level of tidal fluctuations as well as persistent and long term human interference appear to be the major factors that led to the disappearence or non-establishment of proper ecological zonation. Three types of mangroves, namely, fringing, riverine and degraded scrub, could be distinguished on the basis of the nature of major flora.

A general paucity of macrofauna, in numbers as well as in diversity, was observed in the west coast mangroves in contrast to the great variety of fauna described in mangrove of other countries. However, the fauna is dominated by grapsid crabs and cerethidian gastropods, which constitute the true mangrove fauna. Penaeid and caridean prawns and shrimps, the portunid crab Scylla serrata, oysters and other bivalves, are common in the adjoining lagoons and estuaries, and are occasionally found within mangroves themselves. These species, which are also found in lagoons and estuaries with no associated mangroves, constitute the facultative mangrove macrofauna. Such species, as well as their larval forms which form a major component of the zooplankton, form important links in the estuarine food chains.

MANGROVE PALYNOLOGY:
EVOLUTION OF MANGROVE FLORA FROM CRETACEOUS TO RECENT

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A current trend in mangrove research is the study of the pollen and spores found preserved in continental deposits and marine sediments. Palynological studies help to trace the evolution of mangrove flora through time and space. Palynologicts have used mangroves as experimental stations to study the process of sedimentation and maturation of organic matter under anaerobic conditions. They have identified and successfully correlated several fossil sedimentary basins where mangroves once flourished. The detection of fossil mangrove deposits have provided not only supporting evidence to the positions of the continents and oceans during the different periods of earth's history but also to changes in the floristic composition of the mangroves.

While continental drift and other geological phenomena adversely affected the mangroves, the second phase of destruction has begun in the recent past mainly due to increased human interference. There is sufficient palynological evidence to prove that the mangroves flourished well till the recent past in several tropical sites.

Within the frame work of UNDP/UNESCO on mangrove ecosystems, a global review of the evolution of mangrove flora of some select areas (Indian subcontinent, Sri Lanka Borneo, Java, Malaysia, Thailand, Burma, China, Japan, Australia, Africa, Tropical America, Europe) as well as some core mangrove taxa (Aegialitis, Avicennia, Brownlowia, Hypa, Rhizophoraceae, Sonneratia) is presented.

DEVELOPMENT OF MANGROVE SWAMPS OF THE WEST COAST OF SRI LANKA FOR AQUACULTURE

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During recent years great interest has been envinced on the development of mangrove swamps in aquaculture. Considerable area of the mangrove swampy sediments in the South West coast of Sri Lanka exhibit extremely acidic soil conditions upon exposure to the air as a result of pond construction. This paper summarizes some of the chemical properties of the sediments, hazards, problems and some reclamation measures important in developing these mangrove swamps in aquaculture with a minimal impact on the environment.

The sediments were characterized by low pH (range 2.3 to 4.6) high concentrations of acetate soluble sulphates (range 567 mg/kg to 5270 mg/kg) available iron (range 680 mg/kg to 1687 mg/kg) exchangeable aluminium and soil organic matter (range 9.1 mg/kg to 11 mg/kg).

Heavy mortality during South West and North east monsoonal rainy periods, poor survival slow growth, low production and poor fertilizer response were observed in the fish ponds constructed in these areas.

Unreclaimed ponds seem to have a significant impact on the mangrove environment. Water derived from the drainage of pond areas reduced pH significantly in the environment.

Reclamation measures such as drying and flushing, growing of protectional vegetational cover on dikes and liming improved the conditions of the ponds minimizing the impact on the environment.

SOME BACTERIOLOGICAL ASPECTS OF MANGROVE ECOLOGY

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The bacteriology of mangrove ecosystems is scantily studied . Moreover, it was indicated that judicious use of native micro organisms to obtain metal values was preferable to the use of drastic chemical treatments, which might harm the ecology. A case in point is the removal of tin from alluvial sands in the mangrove regions of S. Thailand, which will be illustrated.

A similar situation exists in the estuarine mangrove regions of Goa, India, where iron ore loading in barges creates a heavy sediment, not amenable to conventional dredging operations . Using an area adjascent to these operations, but free from mining disturbances, in the Konkan region of West Coast of India, studies were carried out to compare the bacteriological flora of the 2 areas and the bacterial ecological picture obtained was compared. Both the areas harboured bacteria involved in nutrient recycling such as the cellulose degraders, starch hydrolyzers and phosphate solubilizers in varying quantities, but the quantitative picture was different for these areas. It is to be confirmed whether this was due to unnatural disturbances as mining activity in the area and, if so, this has any deleterious effect on the role of microorganisms. These aspects will be amply illustrated and described.

NATURAL ENVIRONMENTAL FACTORS AFFECTING MANGROVE GROWTH IN THE EARLY STAGE - A STUDY FROM THE EXPERIMENTAL PLANTATIONS IN SAUDI ARABIA, ABU DHABI AND PAKISTAN

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The objective of the study is to know suitable environmental conditions for growing mangrove species. The areas of experimental plantation belong to desert climate, and are most severe for mangrove growth. Little rainfall, no river water, high salinity of sea water and big difference of temperature during the day and year. Soil had also been lost at most of the plantation areas and only sand and gravel remain. It has been confirmed that Avicennia marina and Rhizophora stylosa grow in such hazardous natural conditions, and were studied the environmental factors affecting their growth. The areas of plantation were not suitable for their growth but were suitable for studying such subjects because of simple environmental conditions compared with humid tropics. It is considered that the results of the study will be useful for not simply the plantation of mangroves in arid zone but also that in humid tropic zone.

THE ROLE OF AMINO ACIDS IN THE INTERNAL NITROGEN CYCLE OF MANGROVE FORESTS IN NORTHERN AUSTRALIA

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Estimates of dissolved and particulate material fluxes, via tidal transport, from a northern Australian mangrove forest system have revealed that nitrogen and phosphorus appear to be largely conserved within the forest. Only 10 - 13% of the annual forest nitrogen requirement, for example, is estimated to be exported from the forest, the remaining fraction presumably recycled in-situ. Studies of amino acid pools and fluxes in and from the sediments reveal that a significant proportion of the forest N cycle may be associated with such compounds. The high concentration of free dissolved amino acids (DFAA) in the sediment pore waters, and in particular the presence of the rarely reported b-glutamic acid, a major component of the below-ground DFAA, is attributed to the high activity of anaerobic bacteria (probably mainly sulphate reducers) in these sediments. Flux chamber experiments showed that negligible efflux of DFAA from the sediments into the overlying tidal waters occured unless the sediment surface bacteria were poisoned with mercuric chloride or glutaraldehyde. After poisoning, rates of DFAA efflux ranged from 27-89 $mgN.m^{-2}.\ day^{-1}$ accounting for between 10-20% of the nitrogen required to support the very high levels of bacterial production (up to 3 $gC.m^{-2}\ .day^{-1}$) measured in surface sediments (0 -. 1cm depth). This rate of N flux is also very comparable to the rate of N uptake required for the forest primary production.

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These results, along with examination of previous data regarding the N content of mangrove litter suggest that two major schemes of internal N cycling operate within the forest system:

(1) Below-ground DFAA production, diffusion/convection to the sediment surface layers, and uptake buy sediment surface bacteria,

(ii) efficient retention of N by the trees, thus preventing large losses via litterfall and subsequent tidal transport form the system.

The extent to which these essentially independent recycling schemes are linked will be determined by the rate at which inorganic N from the sediments is taken up by the trees to provide the N required for new plant growth.

AN ASSESSMENT FOR CONSERVATION OF CULTIVABLE JUVENILE FISH STOCK IN PICHAVARAM MANGROVE, SOUTH INDIA

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Pichavaram mangrove inhabits a variety of aquatic forms among which the juveniles of finfishes and shrimps constitute a valuable resource. Juveniles of 10 species of finfishes and 7 species of shrimps have been recorded as cultivable forms. Data, useful for the purpose of juvenile fish stock assessment in this area, have been collected for a period of one year and are summarised here. Fishery exploitation through artisanal fishery and its impact on the natural ecosystem (of this biotope) are discussed. Suggestions for the conservation of juvenile fish stock from the point of view of their utilization as seed in brackish water culture practices are also included.

PERSPECTIVES IN CONSERVATION AND MANAGEMENT OF KUMARAKAM MANGROVES AND BIRD SANCTUARY,KERALA, INDIA

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Kumarakam ($9^{o}37'N$; $76^{o}26'E$), situated about 15km west of Kottayam, on the eastern bank of the Vembanad estuary, is famous as a bird sanctuary as well as a tourist resort. The bird sanctuary owes its existence to a 1 km long mangrove vegetation. Continued holding of a large area of land by a European family with conservation ideas and practices, when matched by a typical topography,rendered the mangrove vegetation and the sanctuary a long lease of life. Today, nowhere along Kerala Coast, one would see such a long chain of mangroves as that of Kumarakam, giving shelter to a variety of rich, avian fauna. The Kumarakam mangroves are the last oasis in a desert of man-made coastal environment, which, even in the recent past, was made rich by the presence of a highly luxuriant mangrove vegetation, all along the myriad backwater systems of Kerala.

Kumarakam is well represented by mangroves and mangrove associates such as Acanthus ilicifolius, Acrostichum aureum, Ardisia littoralis, Avicennia officinalis, Barringtonia racemosa, Bruguiera gymnorrhiza, Cerbera odollam, Clerodendrum inerme, Derris trifoliata, Dolichondrone spathacea, Excoecaria agallocha, E.indica, Flagellaria indica, Heritiera littoralis, Hibiscus tiliaceus, Kandelia candel, Morinda citrifolia, Pandanus fascicularis, Pongamia pinnata, Premna serratifolia, Rhizophora apiculate, Sonneratia caseolaris, Stenochlaena palustris, Terminalia catapa and Thespesia populnea besides the epihytic Dendrophthoe falcata and VIscum orientale.

The fact that the management of the area has been entrusted with the Kerala Tourism Development Corporation (KTDC) shows the priority of interest the Government attaches to the area. This policy, together with the economic consideration of monocultural plantations by the side of the mangroves, has become an immediate threat to the habitat and, therefore, of its management. The developmental scenario emerging from the above is analysed, in the paper, to evaluate the impact of tourism on the natural habitat, based on biocybernetics. It is also brought out as to how replantation of rubber, which now forms a buffer zone to the sanctuary, can effectively counter the cause conservation and management.

GUIDELINES FOR THE PROTECTION AND MANAGEMENT OF MANGROVE AND ESTUARINE WETLAND IN INDONESIA

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Indonesia's mangrove resources are growing in importance. As a consequence of past and present human activities those resources have been deplated. Keen competition for use of the mangrove resource is apparent and is likely to intensify in the future. This policy document. stresses the importance of mangroves to the Nation and the need for the Government to manage and protect them. A set of basic principles for the management and protection of mangroves is provided, together with an outline of some actions which local and state governments (Pemerintah Pusat dan Daerah) should take in order to achieve a balance between the use of mangrove resources and their conservation.

CONSERVATION OF CHORAO MANGROVE ISLAND IN THE BACKWATERS ON MANDOVI ESTUARY, GAO, INDIA

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Chorao Island, which lies in the backwaters of Mandovi estuary of Goa (India), has extensive mangroves towards the western low lying tip. Earlier the backwater area of this island was protected by the bunds of laterite stones, and was used for paddy cultivation and fish farming. Gradually the mangroves have grown over about 250 ha area, making the land useless for agricul ture.

Mangrove flora of this island is represented by 12 genera and 15 species. The dominant plants are Rhizophora sp., Avicennia sp., Sonneratia sp, and Exocaeria sp. The faunal elements commonly seen are many varieties of fishes prawns, crabs and oysters. Brackishwater crocodiles and otters have also been observed. The avifauna of this mangrove forest is very rich and consists of resident as well as migratory birds.

Taking into consideration, luxurient flora and fauna of this mangrove island, it was acquired by the Govt. and declared as a bird sanctuary, giving it full protection form poaching and deforestation.

During the first phase of development, mangrove afforestation programme was undertaken in about 150 ha. around this island in collaboration with Forest Department. The mangrove nursery in an intertidal region has been established with about 100,000 seedlings of Rhizophora mucronata, Avicennaia officinalis, A. marina, Sonneratia alba, and Kandelia rheedii.

In the second phase a crocodile farm particularly for Crocodilus porosus and watch towers for bird watching are planned. In the same vicinity an Environmental Educational Centre is also being set up by the WWF-India. On the outskirts of the forested area, the brackishwater fish farm has been planned alongwith a hatchery. Goa is famous as one of the most popular tourist places in India. Chorao being close to Panaji City, it is suggested by Wildlife Advisory Board to open Chorao Bird Sanctuary for tourists.

The people of this island are being regularly contacted to convince them about the importance of mangroves. The Nature Club students, researchers, as well as social workers are using this area for education, recreation and research.