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ASSESSMENT OF FISHERY RESOURCES AND HEALTH STATUS OF ROCHE PARK PATCH MANGROVE AREA, TUTICORIN, SOUTHEASTERN INDIA

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Abstract: Environmental health, fishery status and socio-economic status of depending fishermen were assessed in Roche Park mangrove area, Tuticorin during March 2010. Physical, chemical and biological parameters of water and sediments were analyzed and found that all the parameters were will with in the limits and no impact was found on the flora and fauna. Significant amount of fishermen and women fish in this area and earn between rupees 200 and 500. This mangrove area is affected by all the coastal developmental activities as it occurs very near to Tuticorin town. Proper management and further research are needed to protect this ecologically and commercially important ecosystem.

***Key words**: Patch mangroves, Rocke Park, fishery, environmental health, Management*

INTRODUCTION

Mangrove ecosystems cover approximately 15 million hectares globally, with 6.9 million hectares in the Indo-Pacific region, 4.1 million hectares in South and Central America and the Caribbean, and 3.5 million hectares in Africa (Lacerda and Diop, 1993). They are developed along estuaries, coasts and river mouths of tropical and subtropical inter-tidal regions of the world. They often form dense forests or patches and occupy inter-tidal muddy shores. Typical mangrove habitats are periodically inundated by tides. Mangrove ecosystems are considered as one of the most dynamic marine ecosystems and have been shown to sustain more than 70 direct human activities, ranging from fuel wood collection to fisheries (Dixon, 1989; Lucy, 2006).

The ecological role of mangroves is challenging and range from nursery and feeding habitat to complex ecosystem services like water quality maintenance and carbon export (Ronnback, 2001). Mangroves export a large portion of their net production as leaf and woody litter. Much of this material is transported elsewhere by water currents, as it is being acted upon by micro-organisms, zooplankton, ciliates, nematodes, and other organisms. These organisms break the detritus into ever smaller fragments. A small detritus particle constitutes a protein rich food source for larger marine organisms (Ogden and Gladfelter, 1983). Accumulated mangrove litter may wash into rivers and streams when rain or tides inundate the forest. Consequently, mangrove litter may decompose either in the source forest or in the river, with nutrients being retained or exported (Conacher *et al.,* 1996).

One of the important functions of mangroves is trapping of sediment, and thus acting as sinks to the suspended sediments (Woodroffe, 1992; Wolanski *et al.,* 1992; Wolanski, 1995; Furukawa *et al.,* 1997). Dissolved organic matter concentrations are higher in mangroves than in other systems (Ogden and Gladfelter, 1983). In terms of absolute nutrient requirements, however, it is probable that the systems would rank in the order: mangroves > seagrass beds > coral reefs (Ogden and Gladfelter, 1983). They are feeding, breeding and nursery grounds to fishes, crustaceans, mollusks etc. Nearly 80% of the fish catches are directly or indirectly dependent on mangrove and other coastal ecosystems worldwide (Kjerfve and Macintosh, 1997). Many studies have provided evidence that mangroves act as nursery habitat for juveniles of commercially important fish species (Chong et al., 1990; Robertson and Duke, 1990; Williamson et al., 1994; Sheaves, 1995; Vance et al., 1996; Al-Khayat and Jones 1999; Lee, 1999; Nagelkerken et al., 2000). Few works have also compared fish communities in mangroves with adjacent habitats, such as mudflats (Chong et al., 1990), seagrass beds and shallow coral reefs (Nagelkerken et al., 2000) and sandy beaches (Williamson et al., 1994). The nursery function of the mangroves is due mainly to the availability of shelter for juvenile organisms and to an abundant supply of organic detrital food (Ogden and Gladfelter, 1983).

Numerous and abundant organisms have their earlier life stages in the mangrove regions and later move away from these systems or migrate offshore. In this way, the mangroves act as nurseries, providing food and shelter for these juvenile organisms. Due to these juveniles and their migrations, mangrove regions are also excellent fishing grounds for larger predatory fishes (Ogden and Gladfelter, 1983). Gradients of organic material emanating from mangroves adjacent to seagrass beds provide a source of food which enhances growth of suspension-feeders close to the mangroves (Ogden and Gladfelter, 1983).

Tuticorin coastal area favours the growth of mangroves. The mangroves inside the Gulf of Mannar Marine Biosphere Reserve area have been meticulously studied and reported. But patches, still productive part of the valuable ecosystem lying close to the sub-urban areas of Tuticorin have been left un-recorded. Roche Park lies close to Tuticorin fishing harbour and there is about 10-15 hectares of stunted mangroves. Two species viz. *Avicennia marina* and *A. officinalis* have been recorded with 40 and 60% occurrence respectively. This is a tidal creek/flat and the flat is semi-diurnally flushed by tides. There is also a considerable stretch of 20-25 hectares of mangroves along the roadside heading to the port from Roche Park. The present study was taken up with the intentions to assess the mangroves based fishery resources available to artisanal fishermen in fishing villages and to collect baseline data on environmental quality, like physical, chemical and biological parameters at 10 randomly selected sites near mangrove areas in Tuticorin.

MATERIALS AND METHODS

Assessment on fishery, common available species, fish landing, water quality assessment, sediment quality assessment, biological parameters and bioaccumulation of heavy metals in fish tissues was carried out during March 2010 in the Roche park patch mangrove area. Fishery details were collected from the fishermen who fish in the Roche Park mangrove area. Field sampling and identification in the laboratory was done to identify the mangrove and associated species. For the physico chemical, biological and microbial analysis, samples were collected from 10 randomly fixed sites. Temperature, Salinity, pH, conductivity, total suspended solids, turbidity, dissolved oxygen, BOD, nutrients (Nitrate, Nitrite, Silicate and Phosphate), oil and grease and heavy metals (Cu, Zn, Cr, Cd and Hg) in the water samples and grain size, texture, pH, oil and grease, organic carbon and heavy metals (Cu, Zn, Cr, Cd, and Hg) in the sediment samples were analyzed using standard methods. Heavy metals analysis was carried out in organisms such as *Sardinella* sp., *Terapon* sp., *Siganus* sp., *Scylla seratta, Penaeus indicus* and *Portunus pelagicus*. Phytoplankton and zoo plankton samples were collected from the surface water at all the stations for the quantitative estimation using Sedgewick Rafter Counting Cell. Macro and meio benthos were quantified separately using 1mm and 63μm mesh sieves. Total Heterotrophic Bacteria (THB) was analyzed using pour plate method both in water and sediments.

RESULTS

Fishing in the mangrove areas along the Tuticorin coast is being done throughout the week apart from Sunday. The crafts used in this mangrove area are fibre boats and Katamarans. Nearly, 10 fibre boats and 10 Katamarans are engaged in fishing in and around mangrove ecosystem of this area. About 40 fishermen from Inigonagar and Thirespuram fishing villages are doing fishing activities in this area. The gears used in this area include gillnets such as maya Valai and murrel valai, push net, crab net, prawn net and long line are also in operation. They earn about Rs. 200 to 500 per day according to the catch. Few fishermen deploy barrier nets in the water flowing channels and earn up to Rs. 250 per day. About 15 Fisher women from Thirespuram village collect prawns and crabs by hand picking and earn about Rs. 200 to 500 per day. During the low tides, some fishermen and women collect clams by hand picking especially *Donax cureatus* for the meat and they earn around Rs. 40 per kg and the shells are also being sold to the shell traders in Thirespuram village. The commonly occurring commercially important fin fishes include cat fishes (*Arius* sp.), mullets (*Mugil cephalus*), *Terapon* sp., rabbit fishes (*Siganus canaliculatus, S. javus*), snappers (*Lutjanus argentimaculatus* and *Lethrinus* sp.), carangids and silver bellies. The commercially important shell fishes include prawns (*Penaeus monodon, Penaeus indicus* and *Penaeus semisulcatus*), crab (*Scylla serrata, S. tranquebarica, Portunus pelagicus* and *P. sanguinolentus*) and clams (*Donax cureatus*). Among them *Mugil cephalus* was the fish species predominantly caught here with 2095 Kg/year between April 2009 and March 2010 followed by *Arius* sp. with 1325 Kg/year. Among the shell fishes *Portunus pelagicus* was the dominant species with 315 Kg/year. Details of the landing data during the period between April 2009 and March 2010 is given in the fig. 1.

No significant deviation in the physical parameters of the water samples was found between the stations during the study period. Temperature level fell between 31.1 and 31.5 ºC; salinity was between 34 and 36 ppt; pH was between 7.9 and 8; EC was between 30.2 and 30.8 mS/cm; turbidity was between 5.1 and 7.6 NTU; TSS level was between 80 and 110 mg/l. Chemical parameters also did not show any significant deviations between the stations. Dissolved oxygen level was between 4.9 and 5.3 mg/l; BOD

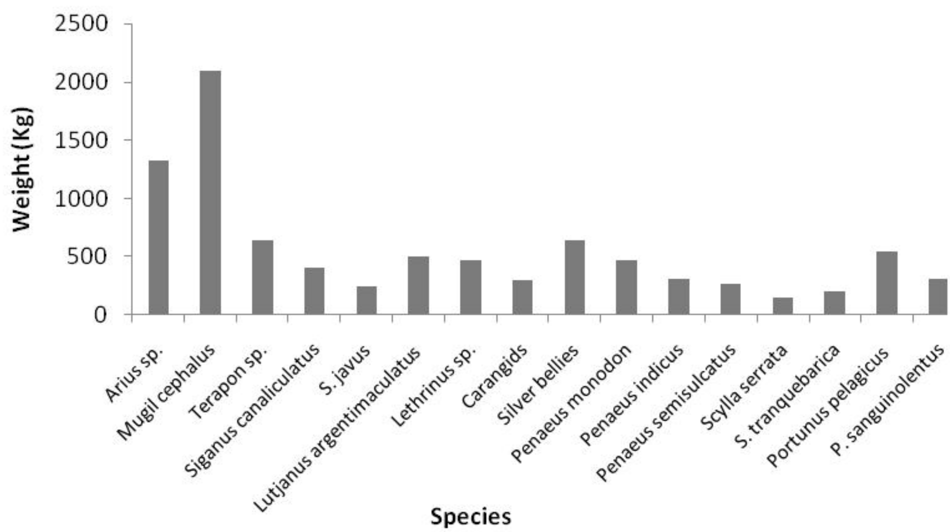

Fig. 1. Landing data during April 2009 to March 2010

Table 1. Physico-chemical parameters of the water samples

Physicochemical parameters	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Temperature (^{0}C)	31.1	31.2	31.2	31	31.3	31.4	31	31	31	32
Salinity (ppt)	34	36	36	36	36	35	35	35	35	36
pH level	7.9	7.9	7.9	8	8	8	8	8	8	8
EC (mS/cm)	30.3	30.2	30.2	30	30.3	30.5	30	30	31	31
TSS (mg/l)	110	100	107	98	100	90	93	80	88	110
Turbidity (NTU)	7.6	6.8	7.3	6.5	6.6	5.9	6.3	5.1	5.4	7.4
DO (mg/l)	4.9	5	5.1	5.1	5.2	5.1	5.1	5	5.1	5
BOD (mg/l)	2	1.9	1.6	1.6	1.4	1.7	1.6	1.7	1.9	1.8
Nitrate (¼g/L)	2.45	2.01	2.89	3.6	2.38	2.98	2.8	2.8	2.1	3.2
Nitrite (¼g/L)	1.01	0.99	1.1	2	1.18	1.99	2	2	0.9	1.5
Silicate (¼g/L)	4.1	6.5	3.8	4.2	5	4.9	5.1	5	5.1	4.8
Phosphate (¼g/L)	0.99	1.41	0.93	1.3	0.9	1.73	0.9	1.9	1	2
Oil and grease (mg/l)	0.71	0.65	0.69	0.7	0.77	0.75	0.9	0.6	0.6	0.7

Table 2. Physico-chemical parameters of the sediment samples

Marine sediment analysis	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
pH	8.1	8.1	8	8.1	8	8	8	8.1	8.1	8.1
Oil and grease (mg/kg)	0.31	0.39	0.45	0.37	0.5	0.51	0.5	0.4	0.52	0.48
Organic carbon (%)	1.98	1.53	2.28	2.99	2.3	2.99	2.8	2.8	2.65	2.78

Table 3. Microbial parameters of the sediment samples

Bacteriological analysis	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Totel Heterotrophic Bacteria (CFU/ml)	101X10^3	110X10^3	108X10^3	90X10^3	99X10^3	80X10^3	88X10^3	115X10^3	65X10^3	53X10^3
Coliform count/100ml in water	NIL	NIL	NIL	NIL	NIL	4	4	2	NIL	NIL
Totel Heterotrophic Bacteria (CFU/gm)	210X10^3	200X10^3	205X10^3	190X10^3	175X10^3	193X10^3	196X10^3	220X10^3	100X10^3	93X10^3
Coliform count/gm in sediment	NIL	NIL	NIL	NIL	NIL	2	4	2	NIL	NIL

level was between 1.4 and 2 mg/l; oil and grease level was between 0.58 and 0.86 mg/l; calcium was between 360 and 480 mg/l; magnesium was between 1184 and 1354 mg/l; nitrate level was between 2.01 and 3.55 µg/l; nitrite level was between 0.91 and 2.01 µg/l; phosphate level was between 0.86 and 2.01 µg/l; silicate level was between 3.8 and 6.5 µg/l. All the analyzed parameters in the soil samples did not deviate significantly between stations. Organic carbon level was between 1.5 and 2.99%; soil pH was between 8 and 8.1; oil and grease level was between 0.31 and 0.521 mg/g. Details of physico-chemical parameters of water and sediment samples are given in the Tables 1 and 2.

Certain macro algal species were found attached with mangrove roots and hard substrata in the mangrove areas. The algal species such as *Enteromorpha* sp., *Chaetomorpha* sp. and *Hypnea* sp. were common. Phytoplankton density was observed between 181.89 and 242.36 cells/l in the study stations while zooplankton density was between 144556 and 198364 no/m^3. Details of the phyto and zooplankton densities are given in the

Table 4. Heavy metal concentration in the water samples

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/l)	30	10	10	20	10	10	10	10	20	10
Copper (¼g/l)	30	20	10	20	10	10	20	10	10	10
Mercury (¼g/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/l)	20	10	10	25	20	10	10	20	20	20
Cadmium (¼g/l)	10	10	20	10	10	10	20	20	30	30

Note: *BDL - Below Detectable Level

Table 5. Heavy metal concentration in the sediment samples

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	41	30	30	51	25	28	31	25	48	30
Copper (¼g/g dry wt)	40	28	21	41	33	26	43	24	20	20
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	40	30	25	58	43	26	20	42	40	45
Cadmium (¼g/g dry wt)	20	30	28	30	20	20	43	48	50	45

Table 6. Heavy metal concentration in *Sardinella* sp.

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	28	36	26	43	10	10	10	10	20	18
Copper (¼g/g dry wt)	10	20	10	20	11	10	10	10	BDL	BDL
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	BDL	10	BDL	BDL	10	10	20	20

Table 7. Heavy metal concentration in *Terapon* sp.

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	20	10	10	21	13	10	11	10	10	20
Copper (¼g/g dry wt)	10	10	BDL	10	BDL	BDL	10	BDL	BDL	BDL
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	20	10	20	BDL	BDL	20	10	10

Table 8. Heavy metal concentration in *Siganus* sp.

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	10	10	10	BDL	BDL	BDL	BDL	10	10	10
Copper (¼g/g dry wt)	10	10	BDL	10	10	BDL	10	10	20	10
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	BDL	BDL	BDL	BDL	BDL	10	BDL	BDL

Table 9. Heavy metal concentration in *Scylla seratta*

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	10	10	20	BDL	BDL	BDL	10	BDL	10	10
Copper (¼g/g dry wt)	10	10	10	BDL	BDL	BDL	BDL	10	10	10
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	BDL	BDL	BDL	BDL	BDL	BDL	10	10

Table 10. Heavy metal concentration in *Penaeus indicus*

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	10	10	10	20	10	20	BDL	BDL	10	10
Copper (¼g/g dry wt)	10	10	10	10	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	10	BDL	BDL	BDL	BDL	BDL	10	20

Table 11. Heavy metal concentration in *Portunus pelagicus*

Metal	St-1	St-2	St-3	St-4	St-5	St-6	St-7	St-8	St-9	St-10
Zinc (¼g/g dry wt)	10	10	10	BDL	BDL	BDL	BDL	10	20	10
Copper (¼g/g dry wt)	10	10	10	10	BDL	BDL	BDL	BDL	10	10
Mercury (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (¼g/g dry wt)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium (¼g/g dry wt)	10	10	BDL	BDL	BDL	BDL	BDL	BDL	10	10

Note: *BDL - Below Detectable Level

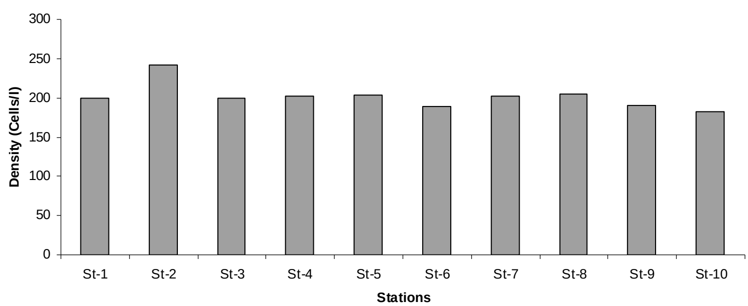

Fig. 2. Phytoplankton density

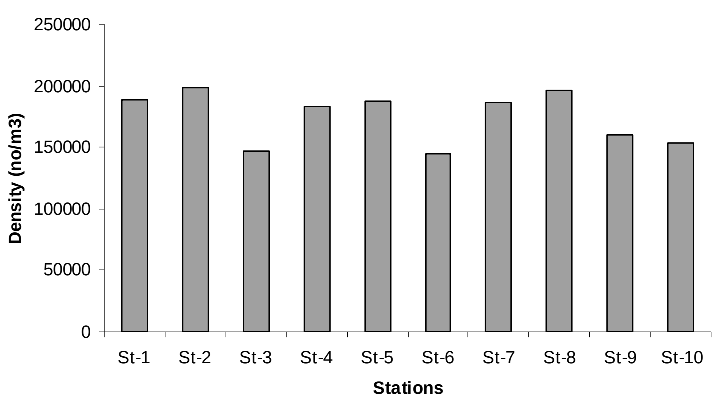

Fig. 3. Zooplankton density

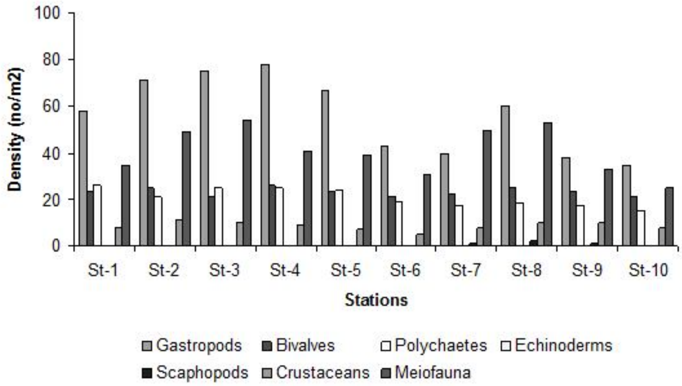

Fig. 4. Density of benthic macro and meiofauna

figures 1 and 2. Among the macro benthic communities gastropods were the dominant category in all the stations followed by bivalves and polychaetes while the density of meiobenthos was between 25 and 54 m^{-2}. Details of the benthic macrofauna is given in the figure 3. Total heterotrophic bacteria count was between 51 and 110 m^3 in the water samples and between 96 and 233 m^3 in the sediment samples. Details of the microbial parameters are given in the Table 3.

Among the five analyzed heavy metals in the water samples, mercury was below detectable range while zinc, copper, chromium and cadmium were between 10 and 30 µg/l in all the stations. In the sediment samples, mercury was below detectable range in all the stations. Zinc level was between 28 and 51 µg/g dry weight; copper level was between 20 and 43 µg/g dry weight; chromium level was between 20 and 58 µg/g dry weight; cadmium level was between 20 and 50 µg/g dry weight. In *Sardinella* sp. below detectable range was found for mercury and other metals were between 10 and 43 µg/g dry weight. In *Terapon* sp. below detectable range was found for mercury and chromium in all the stations and other metals were between 10 and 20 µg/g dry weight. In *Siganus* sp. below detectable range was found for all the five examined heavy metals in most of the stations. In *Scylla serrata*, *Penaeus indicus* and *Portunus pelagicus* below detectable range was found for all the five examined heavy metals in most of the stations. Details of the heavy metal concentration in water, sediment and animal samples are given in the Tables 4 to 11.

DISCUSSION

Mangrove forests provide livelihood to millions of people worldwide directly or indirectly. According to Ronnback (2001), each hectare (ha) of mangrove habitat has potential to produce 1.0-11.8 tons fisheries catch per year with a market value of US dollar 900-12,400 in developing countries. Such productivity is much higher than 10-370 kg/ha/year proposed for coral reef (Alcala, 1988). Despite their ecological and commercial importance, mangroves are destructed significantly all over the world. Destruction of mangroves will allow terrigenous sediments to flow onto seagrass beds and coral reefs, possibly causing temporary damage to the former and permanent damage to the latter. There will be an excessive outflow of particulate and dissolved organic matter which may cause smothering, shading and eutrophication. Later, nutrient inputs to other systems will be reduced; seagrasses, at least, will be less productive. Finally, refuges and nursery grounds for various fishes and invertebrates will be destroyed and secondary productivity on seagrass beds and reefs will be reduced (Ogden and Gladfelter, 1983).

Continued loss of mangrove forests will have serious ecological and socio-economic impacts, especially on coastal communities that rely directly on mangrove products and services for their livelihoods. The effects of human activities on mangroves have far exceeded those of natural events over the past few decades. Economic development, rapid population growth and high population densities in coastal areas are the main drivers for mangrove degradation and loss (van Lavieren *et al.,* 2012). With almost half of the world's population living within 150 km of a coastline, it is not surprising that there has been widespread clearing and degradation of mangroves for coastal development, conversion to aquaculture or other resource use, as well as pollution (van Lavieren *et al.,* 2012). They are being destroyed for the immediate tangible benefits: woodchip production, aquaculture, housing, firewood, export posts, tourism and other uses (David, 2007).

It was observed in this study that Roche Park area in Tuticorin coast favours the growth of mangroves. They show a stunted growth which can be attributed to the lack of fresh water inflow. Mangroves in Roche Park survive despite the lack of fresh water because they have developed salt resistance. Normally mangroves absorb salt together with water and are constantly confining it by transferring it to the leaves or to other tissues (Popp, 1995). *Avicennia* trees are known to support a wide range of salinity, and can thus develop in areas submitted to higher evaporation and thus characterized by higher pore water salinities (Lambs *et al*., 2008). Likewise, the examined mangrove area is also dominated by *Avicennia* spp. Other two important ecosystems such as coral reefs and seagrasses occur nearby Roche Park area and all three systems are inter-connected in numerous ways. A flow of dissolved nutrients from mangroves has been shown to enhance primary productivity of seagrasses. Seagrass beds and mangroves enhance secondary productivity of coral reefs by providing alternative feeding sites (Ogden and Gladfelter, 1983). Tuticorin region is traditionally high productive in terms of fishery and this productivity can be attributed to the interlink between these three ecosystems.

Significant amount of fishery happens in Roche Park mangrove area and significant amount of fishermen and women depend on this area for their livelihood. It is reported that in Fiji and India, approximately 60% of the commercially important coastal fish species are directly associated with mangrove environments (Ronnback, 2001). The contribution of mangrove related species to total fisheries catch is 67% in Eastern Australia (Hamilton and Snedaker, 1984) and 49% of the demersal fish resources in the Southern Malacca strait. The contribution of subsistence fisheries to total catch supported by mangroves has been estimated at 10-20% in Sarawak, 56% in Fiji and 90% in Kosrae (Ronnback, 2001). Mangrove forests were also found to be important nursery areas in studies done in Australia (Robertson and Duke, 1987). In this study also it was learnt that a significant quantity of fin fish and shell fish are caught in this mangrove area which include commercially important fishes, crabs, prawns and mollusks.

Physico-chemical parameters of an area can play a driving role in the occurrence, diversity and health of the resources like corals, seagrasses and mangroves. The increase of nutrient concentrations within coastal waters can elicit either positive or negative responses in the ecological health of systems, including the alteration of species richness and abundance (Faulkner, 2004); productivity (Nixon, 1992); and fishing yields (Cederwall and Elmgren, 1980). Investigations have previously assessed environmental changes caused by anthropogenic inputs of nutrients and organic material (Carmouze and Vasconcelos, 1992) and time- and tide-series observations of physico-chemical, nutrient and sediment parameters (Dittmar and Lara, 2001) in coastal systems. Physical, chemical, biological and micobial parameters of water and sediment samples were well with in the limits in this study and no hazardous limit of any parameter including heavy metals was recorded and no significant impact on the floral and faunal diversity of the mangrove area was observed because of the environmental parameters.

Since the Roche Park area is situated very near to the Tuticorin town, it suffers with all the coastal developmental activities. The major threats to this mangrove area include road extension, salt pans and pollution from nearby fishing harbour and Tuticorin Thermal Power Station (TTPS). Apart from all the human induced disturbances, natural factors such as global climate change can make the situation worse. Hence, immediate action is needed to protect this ecologically and commercially important mangrove area. If this area is left unnoticed with out proper management, it is very obvious that it will make a huge impact in the fishery of this region and subsequently the livelihood of the depending fisher folk.

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