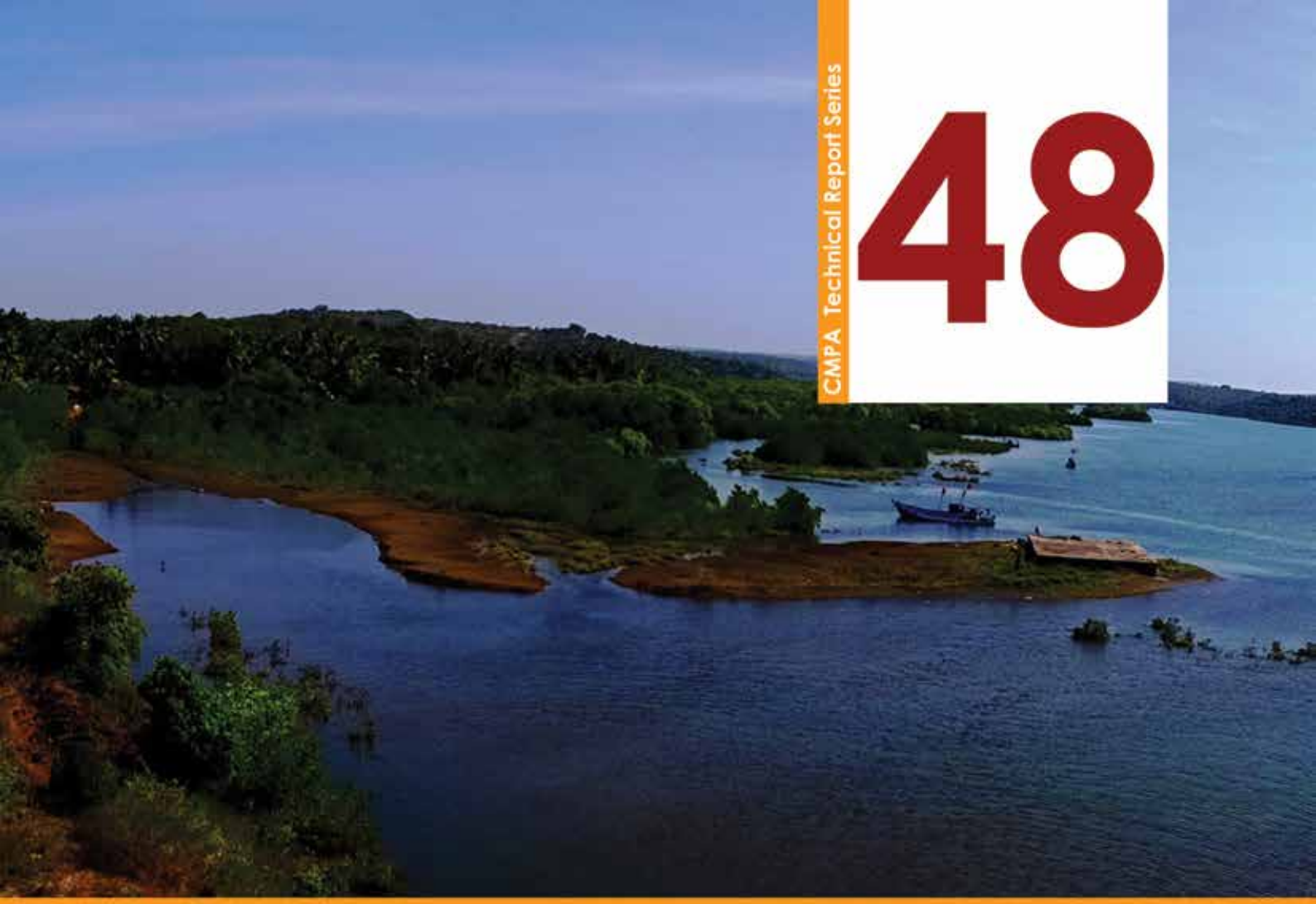

CMPA Technical Report Series

48

Rapid Biodiversity Assessment of Ansure Creek, Rajapur Ratnagiri, Maharashtra

October 2014

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On behalf of :

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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Indo-German Biodiversity Programme
Conservation and Sustainable Management of Coastal and Marine Protected Areas

CMPA Technical Report Series No. 48
Rapid Biodiversity Assessment of Ansure Creek, Rajapur
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Indo-German Biodiversity Programme
Conservation and Sustainable Management of Coastal and Marine Protected Areas

Chapters

Pages

List of Acronyms

BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
CMPA	Coastal and Marine Protected Areas
CR	Critically Endangered
DD	Data Deficient
EN	Endangered
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GmbH	Gesellschaft mit beschränkter Haftung
GPS	Global Positioning System
HTM	High Tide Mark
VI	Importance Value Index
LC	Least Concern
LTM	Low Tide Mark
MoEF&CC	Ministry of Environment, Forests and Climate Change
MTM	Mid Tide Mark
N	Number of species
Ppt	Parts per thousand
S	Standard Deviation
SE	Standard Error
TR	Transect
VU	Vulnerable

Executive Summary

India has an extensive coastline which is characterized by various complex ecosystems. At the same time, there are dependent populations and concerns of urbanization, industrialization and commercial activities which directly affect the coastal ecosystem and the marine environment. At the Eleventh Conference of Parties to the Convention on Biological Diversity (CBD-COP 11), the Government of India expressed its interest towards coastal and marine conservation.The study lists out the legal framework for 'protected areas' in coastal and marine areas in India, and outlines the procedures and the implications of the creation of such protected areas. Currently, the legal framework relating to coastal areas in India is highly fragmented, with a multiplicity of authorities and departments. This has also been supplemented from time to time with judicial interpretations, delegated legislations and elaboration of national policies.To assess the overall effectiveness of protection of fragile coastal and marine ecosystems, the demarcation of protected areas has to be further viewed in the broader context of other relevant laws. This also has to be viewed in the context of the international legal framework, in terms of obligations as well as normative standards. At the same time, it has to be taken into account that any regulation of a coastal area will affect the legal rights and obligations of the affected populations. Stakeholders also play an important role in the effectiveness and implementation of these regulations. On the basis of the review, the study suggests a participative, equitable and effective model of protection of coastal and marine environment.

Chapter 1

Introduction

The Ansure Creek is located in Rajapur Taluka, Ratnagiri District of Maharashtra State. It spreads approximately up to 6 km (straight-line distance) from Ansure Dande Wadi (west) to Gothiware (east). The Ansure Creek is characterized by mudflats and mangrove-forested areas, especially on its northern bank, though comparatively small mangrove patches are also seen on the southern bank.

A number of villages are located on both banks of the Creek. These include **Sagave (SAG)** that is located on southern bank of the Creek, an open mudflat region with intermittently distributed oyster rocks. Dense vegetation of Red mangroves, Mangrove Apple and Grey Mangroves was observed at the upper peripheral region of the Creek. Mollusc species like telescope shells, horn shells (Cerithids), dog whelks (Nassarids) and oysters were observed inhabiting various habitats. Brachyuran crabs and hermit crabs were observed almost in all the zones. **Dande Wadi (DW)** is located on the northern bank and has many shallow sandy runnels seen running perpendicular to the shore flowing into the creeklet. Substrate transition from soft muddy to coarse muddy to muddy–sandy and sandy was noticed respectively from the lower bank region to the relative upper periphery. **Varcha Mad (VM)** is located on the southern bank next to Sagave. The lower zone of this bank area consists of muddy bottom with shell sand and oyster rocks. **Gurav Wadi (GW)** is a large mudflat located on the northern bank and harbours dense vegetation of mangroves. **Mharshet (MHS)** is a small mangrove patch of 300 m width and 150 m length and situated on the southern bank of the Creek along the Mharshet village. The mudflat had medium soft muddy bottom with oyster rocks in the lower zone. Mature and dense patch of Grey Mangroves, Red Mangroves near the runnel followed by Mangrove Apple in the outer areas was the characteristic of **Bharade Wadi (BW)** overall habitat. The **Chinchadi Wadi (CW)** part of the southern bank consisted of sand, mud, and dead shell as a substrate. For **Khalchi Waki (KW**) upstream supra-littoral gravel-mixed habitat and downstream dense and mature strands of Grey Mangroves was the characteristic setting.

At **Karivane (KAR)** on the southern bank, a large number of oysters were observed fouling on rocks. Towards the middle zone, a large mudflat area was observed with loosely packed soft light brown mud. Red Mangrove, River Mangrove, Mangrove Apple and Yellow Mangrove were the commonly observed mangrove species. The main Creek of Ansure, joins at **Varchi Waki (VW)** with freshwater streams coming from nearby catchment areas.

Local people from the surrounding villages use some of the natural resources available in and around the Creek through fishing (fish, shellfish, crab in mangrove) and agriculture (mango orchards and rice fields). Each group of villages utilizes the specific area of the Creek without any conflict about exploitation of areas. Among the molluscs and shellfish, oysters are a known delicacy and are a major protein source in the diet of the populace. Some people also consume Telescope shells *(Telescopium telescopium)* as food. Aquaculture is also carried out at few places around and within the Creek. Shell mining was also observed at select sites within the Ansure Creek. Mined bivalves are used in lime production industries, fertilizers, toothpaste and cosmetics industries. Upcoming kharland bund in the vicinity of Ansure can have deleterious impacts due to habitat destruction.

Chapter 2

Study Methodology

Line Transect Sampling

Line transects were laid along the vertical gradient of the shore. In total, 10 transects were laid perpendicular to the creek. Depending upon the tidal amplitude, each intertidal area was divided into three parts: high water, mid water and low water. Sampling was done from low to high tide zone. These transects were laid randomly while considering accessibility, exposure and presence of mangrove patch with minimum 1 km distance apart. Most transects were surveyed during the low tide. Sample locations within a particular area were selected on the basis of their position in relation to the main creek or creeklet, type of substratum and surrounding macro habitat. The number of samples in comparison with the respective mudflat areas or mangrove cover along the banks is less, mainly due to inaccessibility of interior parts of the vegetation. The habitat/substrate characteristics described here are purely on the basis of visual observation.

Quadrat Sampling

50 cm x 50 cm (0.25 cm^2) quadrant and core samples (15 cm diameter and 12 cm depth) were collected for benthic studies along each transect in triplicates (replicate samples were taken at 10m distance). Ninety epibenthic samples (3 samples per zone) and eighty one endobenthic samples were collected. For endobenthos (Macrobenthos), samples from only nine transects were taken because remaining one transect (TR-1) was taken prior to the month of July, and collected using a different protocol. At TR-3, water had not receded during survey period, hence epi-benthic data at low tide zone was not collected.

Data such as number and size of the selected groups (molluscs and crabs) was measured on site. For other groups, only the number of specimens was recorded. All collected samples (except epi-benthic) were sieved on site and preserved with 10% Formalin solution with prior treatment of Rose Bengal.

Samples were sorted and counted based on taxonomic groups (polychaetes, amphipods, molluscs etc.) and kept in duly labeled vials.

Chapter 3

Data Analysis

All data was entered in an MS Excel software for further analysis.

Transect-wise Analysis

General species listing

All the species encountered during the survey that were readily identifiable on field were listed in a species checklist table. These species/groups were recorded within the quadrate: *Cerithideopsilla cingulata, Nassarius jacksonianus, Telescopium telescopium, Neritina violacea, Assiminea sp, Uca sp, Crassostrea bilineata, barnacles, hermit crabs and Elysia bengalensis.*

All samples (in triplicate) were averaged and then, based on species/groups monitored (within quadrant), given in the form of density/0.25 m^2. Endobenthos samples are given in density/m^2.

Standard Error

$$SE = S/\sqrt{n}$$

Where,

S is standard deviation and n is number of species

Standard deviation

$$SD = \sqrt{(\Sigma (x-\bar{x}))2/n}$$

Where, x is count of species $\bar{x}$ is mean or average of species count n is number of species

Species richness

The number of species per sample is a measure of richness.

Diversity Indices

By using Past software, analysis of biodiversity was carried out by calculating Shannon Diversity Index (H') and Buzas and Gibson's evenness (e^H/S). These indices are adopted for their low sensitivity to the sample size (Magurran, 1988).

Dominance= 1-Simpson index

$$D = \Sigma (ni/n)^2$$

Where, ni is number of individuals of taxon i.

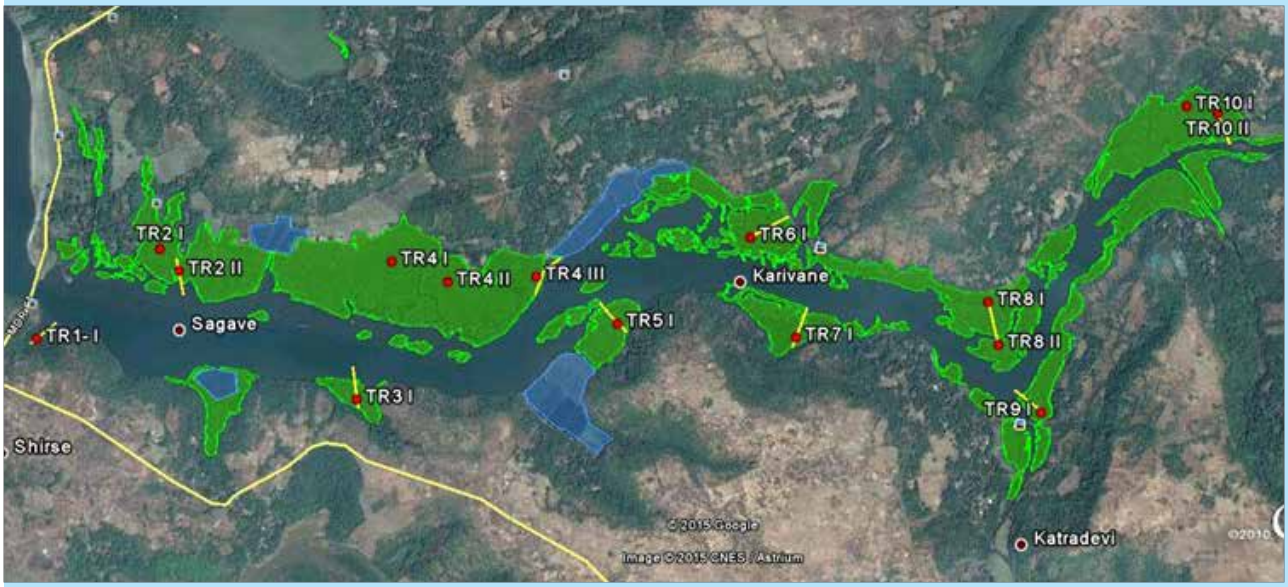
Shannon Diversity Index (H') = $- \Sigma pi \ln pi$

i.e. = $- \Sigma ni/N [\ln (ni/N)]$

Where, ni = importance value of the ith species

N = Importance value of all the species

Figure 1
Sampling Locations for Vegetation Analysis



Taxonomic Analysis

Identification of molluscs, crustaceans and polychaetes were performed by using standard references *viz*. Gosner (1971), Day (1967) and Apte (1998, 2012).

Vegetation Analysis

Minimum one to maximum three quadrats of size 10 m x 10 m were laid per site either along the same transects as laid for benthos samples or independently based on the forest patch size and its heterogeneity. The exact locations of the quadrats are provided in Annexure I B and Fig 1. All trees and shrubs > 10 cm girth were counted in these quadrats. Diameter of each individual (girth of the stem taken at 130 cm level) was measured manually at each sampling location. The seedlings and herbaceous cover (if any) were measured in four 1 x 1 m quadrat nested within each larger quadrat.

Quantitative analysis of vegetation profile from the representative locations mainly dealt with species richness (number of species and individuals), frequency, density, abundance and Importance Value Index (IVI). In addition to this, the growth parameters such as height and girth were used to determine the aboveground biomass. These readings were volunteered for the horizontal and vertical profile at the site. Growth of pneumatophores and seedlings was also noticed at few locations. The calculations were carried out by using the following formulae:

Frequency: This indicates distribution of a particular specie in a community. Frequency was calculated by using the following formula and expressed in percentage.

$$\text{Frequency} = \frac{\text{Total no. of quadrats in which sp. occurs}}{\text{Total number of quadrat sampled}} \times 100$$

Abundance and density: This represents numerical strength and distribution of species in a unit area. They were calculated by using following formulas:

$$\text{Density} = \frac{\text{Total no. of individuals of a species}}{\text{Total number of quadrat sampled}}$$

$$\text{Abundance} = \frac{\text{Total no. of individuals of a species}}{\text{Total number of quadrat in which sp. Occurs}}$$

Importance Value Index (IVI): This indicates the dominance as well as ecological success of the species. As it is the summation of relative density,

relative frequency and relative dominance, it considers the number, occurrences and area occupied by that species (Curtis and McIntosh 1950)

IVI = Relative Frequency + Relative Density + Relative Dominance where,

$$\text{Relative frequency} = \frac{\text{Frequency of species}}{\text{Sum of frequencies of all the species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Sum of densities of all the species}} \times 100$$

$$\text{Relative basal area} = \frac{\text{Basal area of a species}}{\text{Sum of the basal areas of all the species}} \times 100$$

Species Listing

The common species at every transect have been listed and their comparative presence (visual observation only) (range 1 minimum to 3 maximum indicative as +, ++, +++ respectively) at each tidal level has been denoted.

Chapter 4

Results and Observations

TR-1

GPS Location

Start: 16°33’11.36”N, 73°21’25.01”E

End: 16°33’7.62”N, 73°21’21.56”E

Figure 2
Map of TR-1 With Sampling Points

Figure 3
Habitat at TR-1

Physico-chemical Characteristics

TR-1	pH	Temperature in °C	Salinity in ppt
LTM	7.8	29.9	35
	7.81	30	35
	7.8	29.8	35
MTM	7.51	31.2	34
	7.53	30.3	34
	7.9	30.3	34
HTM	6.99	29.8	4
	6.12	29.8	33
	7.1	28.4	35

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	++	+	
Sonneratia alba	+		
Avicennia marina	+		
Acanthus ilicifolius	++		
Halophila beccari		+++	
Clithon oualaniensis		++	
Cerithideopsilla cingulata		+++	+++
Nassarius jacksonianus		+	+
Oysters	+	++	++
Neritina violacea		+	+
Telescopium telescopium	+	+	
Uca sp.			++
Brachyurans	+	+	+
Hermit crab	+	+	+

Figure 4
Benthic Composition at TR-1

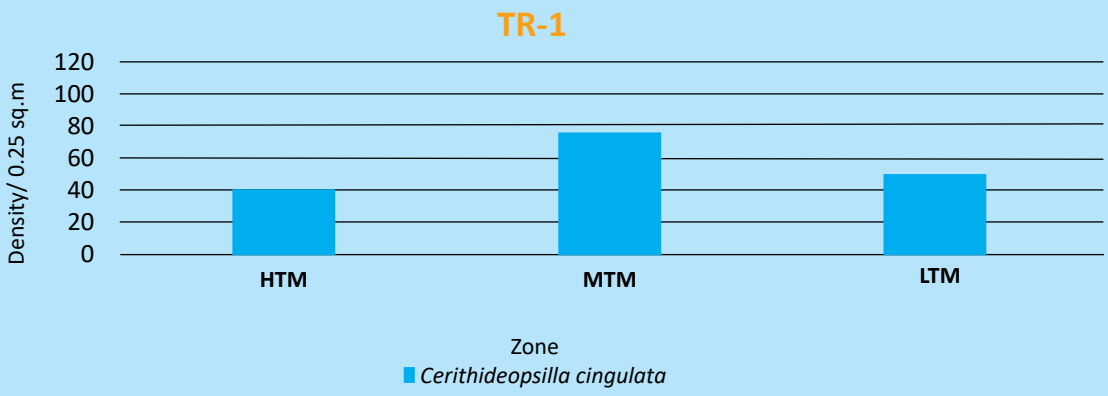


Figure 5
Size Class Distribution of C. Cingulata at TR-1

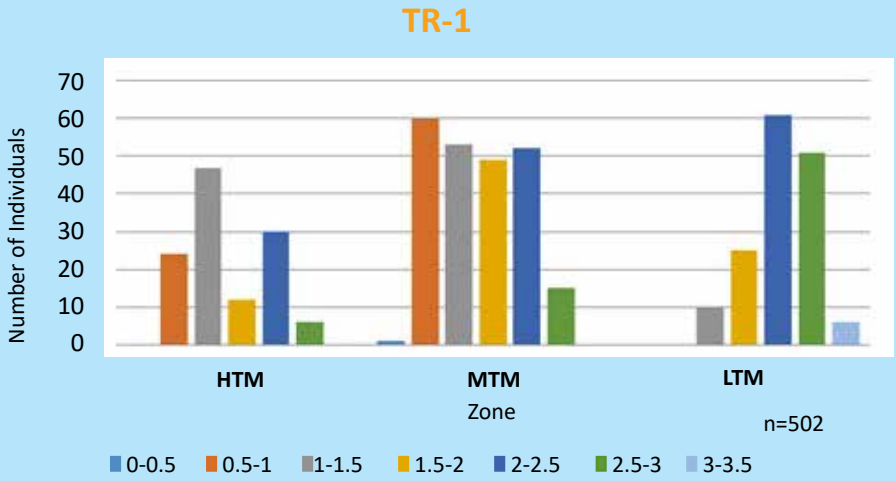


Figure 6
Endobenthic Composition at TR-1

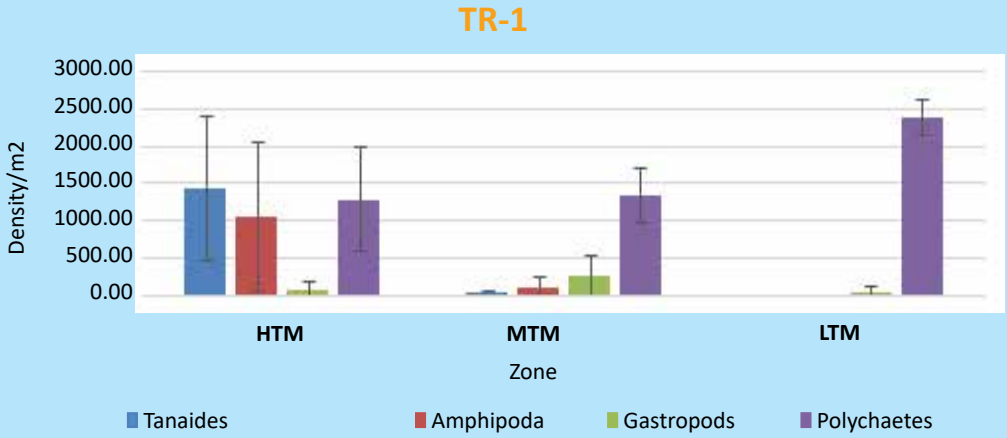
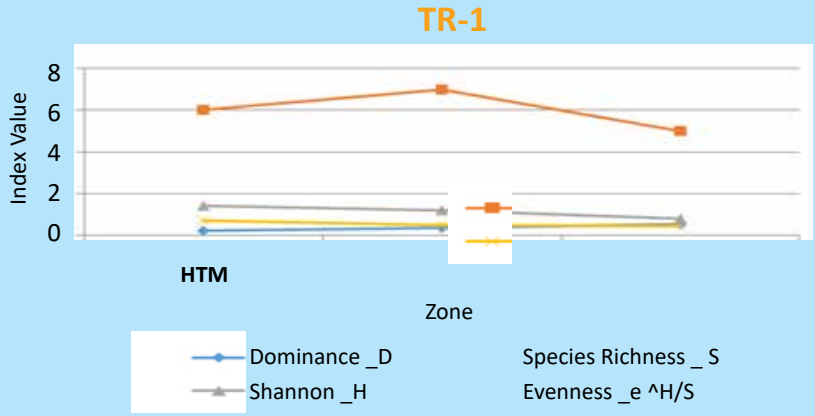


Figure 7
Species Diversity at TR-1



Observation

Species richness (Fig.7) was found decreasing from high to low tide zone. Dominance on the other hand increased marginally from high tide to low tide due to the presence of suitable heterogeneous habitat at mid and high tide zone for most taxa. *Cerithideopsilla cingulata* and polychaetes were most dominant in all the zones (Fig.4). Due to the presence of sandy habitat at low tide zone, density of polychaetes was higher than rest of the zones (Fig.6). Heterogeneous habitat made of muddy and sandy substratum was observed at mid tide zone which is the most preferred habitat for *C. cingulata* (Sreenivasan 1995).

TR-2

GPS Location

Start: 16°33’14.00”N, 73°21’42.53”E
End: 16°33’22.73”N, 73°21’42.80”E

Figure 13
Map of TR-2 with Sampling Points

Figure 9
Habitat at TR-2

Physico-chemical Characteristics

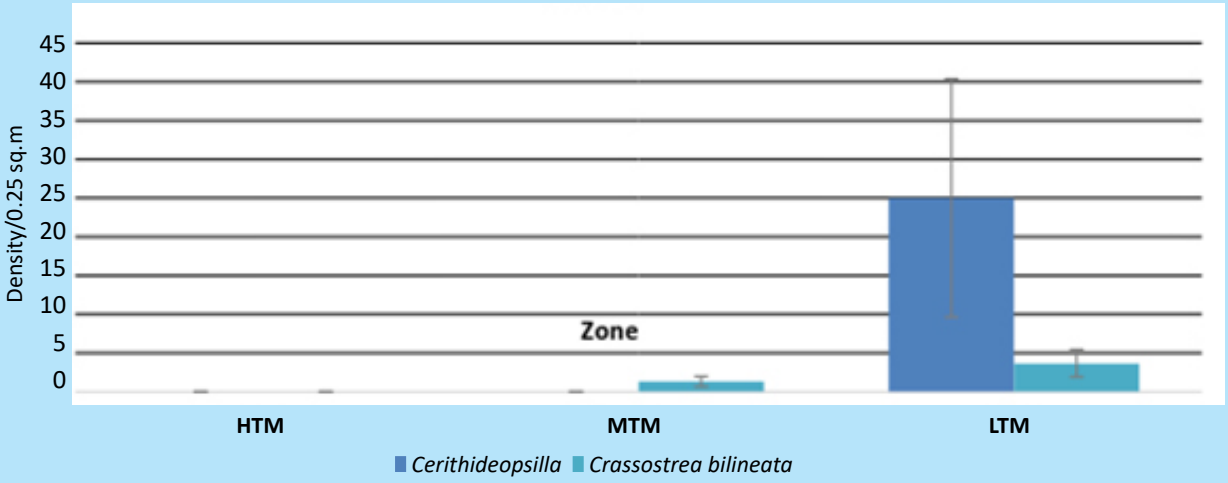
TR-2	pH	Temperature in °C	Salinity in ppt
LTM	7.4	34.37	35
	7.58	34.7	35
	6.8	33.5	33
MTM	6.88	34.5	34
	6.88	34.5	34
	6.88	34.5	34
HTM	6.99	32.4	24
	6.99	32.4	33
	6.99	32.4	37

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	++	+	
Sonneratia alba	+	+	
Avicennia marina	+	+	
Acanthus ilicifolius	++		
Cerithideopsilla cingulata			+++
Oysters			++
Telescopium telescopium	+		
Uca sp.			++
Brachyurans	+	+	+

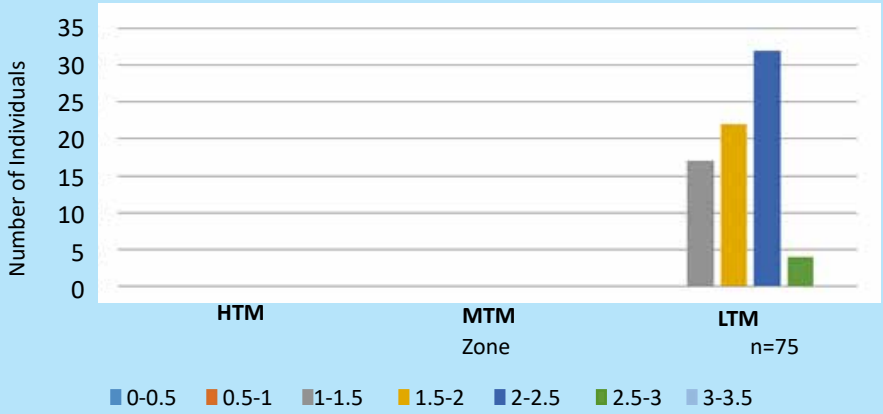
TR-2

Figure 10
Benthic Composition at TR-2



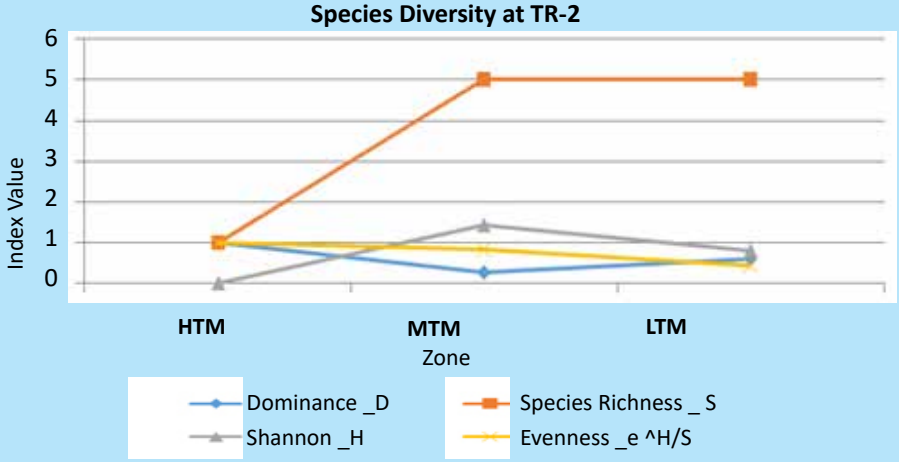
TR-2

Figure 11
Size Class Distribution of C. Cingulata at TR-2



TR-2

Figure 12
Species Diversity at TR-2



Observation

High species richness was observed (Fig.12)at low and mid tide zones. Comparatively, very low species richness at high tide zone was seen due to the presence of dense mangrove vegetation with hard muddy substratum. *C. cingulata* were observed only at low tide zone (Fig. 10), with size class from 1-1.5 cm to 2.5-3 cm (Fig.11).

TR-3

GPS Location

Start: 16°33'3.20"N, 73°22'10.24"E

End: 16°32'57.61"N, 73°22'10.62"E

Figure 13
Map of TR-3 with Sampling Points

Figure 14
Mangrove Forest at TR-3

Figure 15
Dense Prop Roots at TR-3

Physico-chemical Characteristics

TR-3	pH	Temperature in °C	Salinity in ppt
LTM	7.83	33.2	32
	7.83	32.9	32
	7.78	33.4	30
MTM	6.93	31.5	37
	7.06	31.6	39
	7.05	30.7	38
HTM	6.46	29.4	35
	7.04	29.5	33
	6.69	28.7	34

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	+++	+++	++
Sonneratia alba			+
Avicennia marina			+
Cerithideopsilla cingulata			+++
Polymesoda erosa		+	
Assiminea sp.		+	+
Oysters	+	+	++
Brachyurans	+	+	+
Hermit crabs			++

Observation

Dense vegetation and prop roots, prevented access and systematic sampling. Fauna could not be observed at high tide and mid tide zones (Fig 15). Samples for epibenthos could not be collected because water had not receded at low tide zone during the day of sampling. Endobenthic sample showed only dead shells, sand and soft mud without any living fauna.

TR-4

GPS Location

Start: 16°33’15.50”N, 73°22’37.77”E

End: 16°33’20.32”N, 73°22’40.13”E

Figure 16
Map of TR-4 with Sampling Points

Figure 17
Oyster Patch at TR-4

Figure 18
Mudflat ith High Density of Cingulata at TR-4

Physico-chemical Characteristics

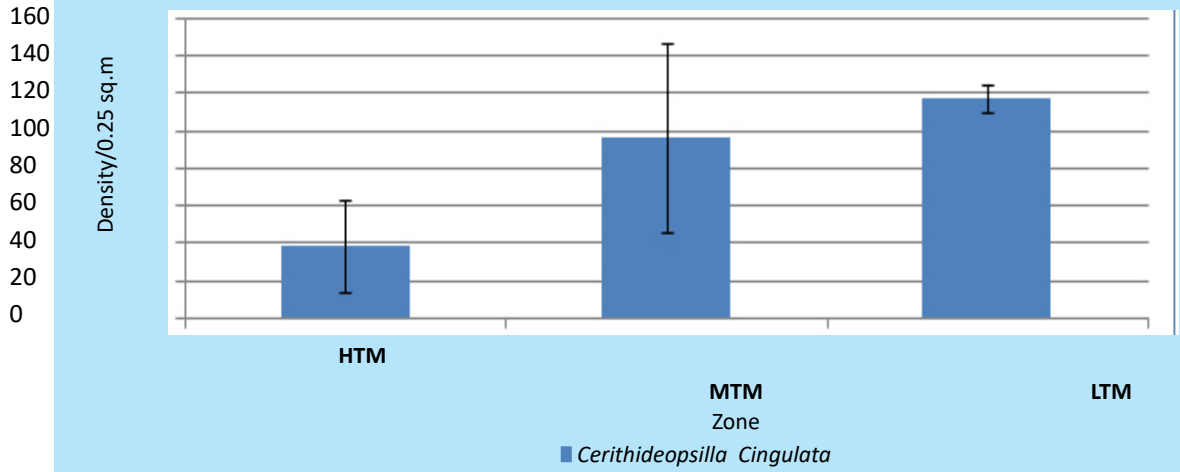
TR-4	pH	Temperature in °C	Salinity in ppt
LTM	7.66	29.8	17
	7.67	29.6	16
	7.47	29.2	14
MTM	7.53	29.2	26
	7.535	28.75	26
	7.54	28.3	26
HTM	-	-	-
	-	-	-
	-	-	-

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata		++	++
Ceriops tagal	++	++	
Acanthus ilicifolium	++		
Sonneratia alba		++	
Avicennia marina		+++	
Cerithideopsilla cingulata		+++	+++
Oysters		++	+++

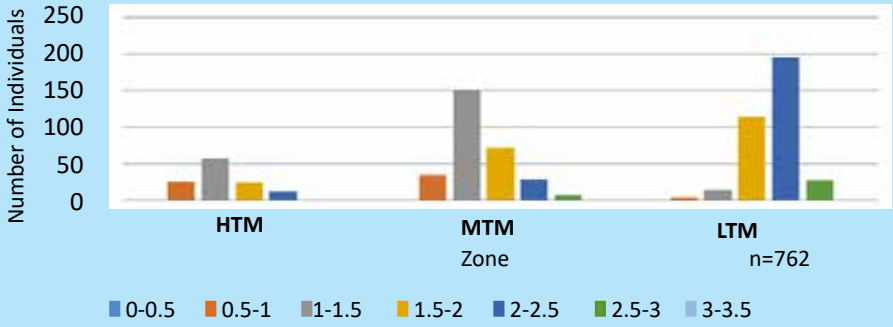
TR-4

Figure 19
Benthic Composition at TR-4



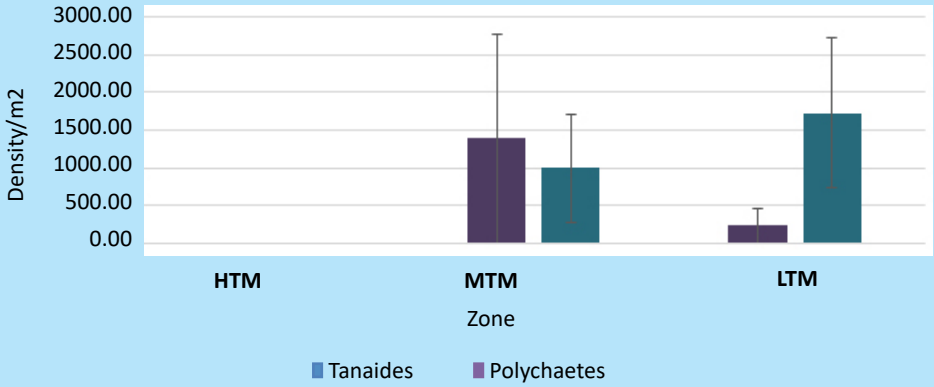
TR-4

Figure 20
Size Class Distribution of C. Cingulata at TR-4



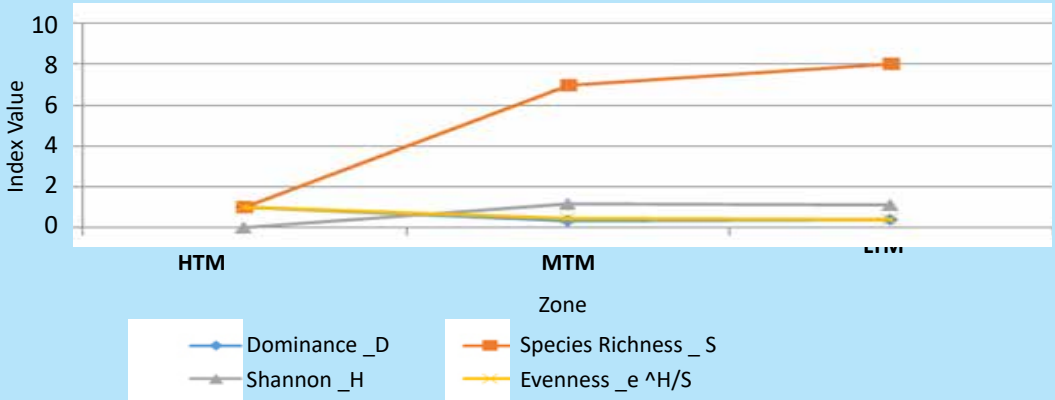
TR-4

Figure 21
Endobenthic Composition at TR-4



TR-4

Figure 22
Species Diversity at TR-4



Observation

Species richness was high at low tide zone whereas it was slightly lower at mid tide zone and low at high tide zone (Fig.22). *C. cingulata* were present in small size class at high tide zone compared to other zones (Fig.20). Open mudflat over entire transect served as preferred habitat for C. *cingulata*, hence dominant in all zones (Fig.19).

TR-5

GPS Location

Start: 16°33’14.56”N, 73°22’46.36”E

End: 16°33’11.41”N, 73°22’51.37”E

Figure 23
Map of TR-5 with Sampling Points

Figure 24
Habitat at TR-5

Figure 25
Low Tide Zone at TR-5

Physico-chemical Characteristics

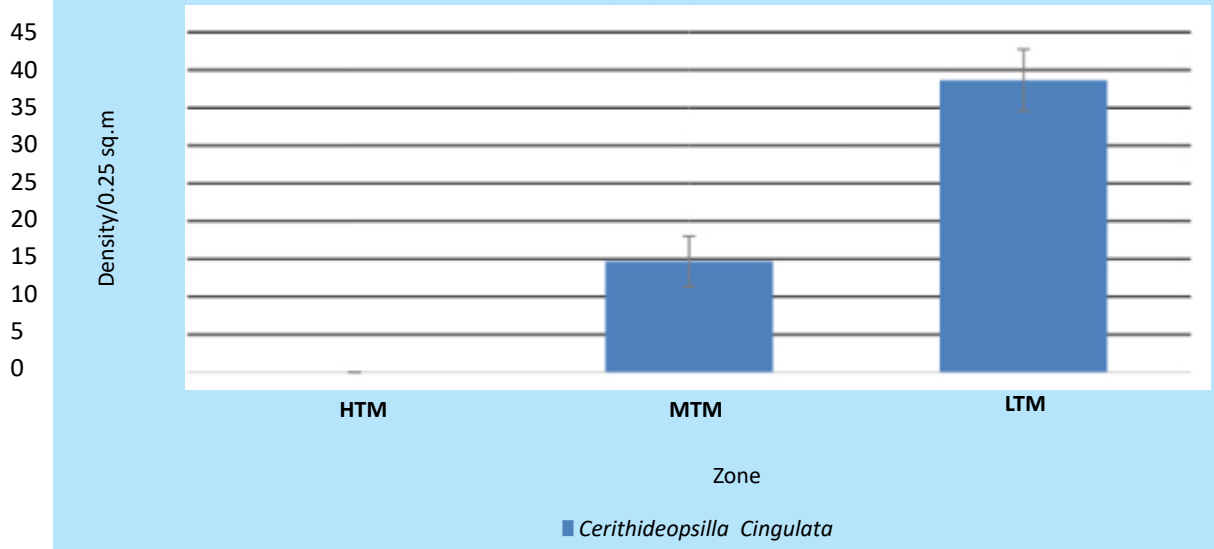
TR-5	pH	Temperature in °C	Salinity in ppt
LTM	7.65	30.7	38
	7.61	30.8	38
	7.63	30.8	38
MTM	7.27	31.2	27
	7.09	30.2	32
	7.09	29.6	35
HTM	6.81	29	38
	6.87	29.6	35
	6.84	29.9	36

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	+++	++	+
Avicennia marina	++		+
Avicennia officinalis	+	++	
Sonneratia alba	++	++	
Cerithideopsillacingulata		++	++
Telescopium telescopium	++		
Neritina violacea	++	+	
Cassidulaaurisfelis	++	+	
C. nucleus	+		
Littorariascabra	+		
Littorariaundulata	+		
Oysters			++
Mudskipper			++
Elysiabengalensis		+++	
Polychaeteeggcases		++	
Brachyurans	++		

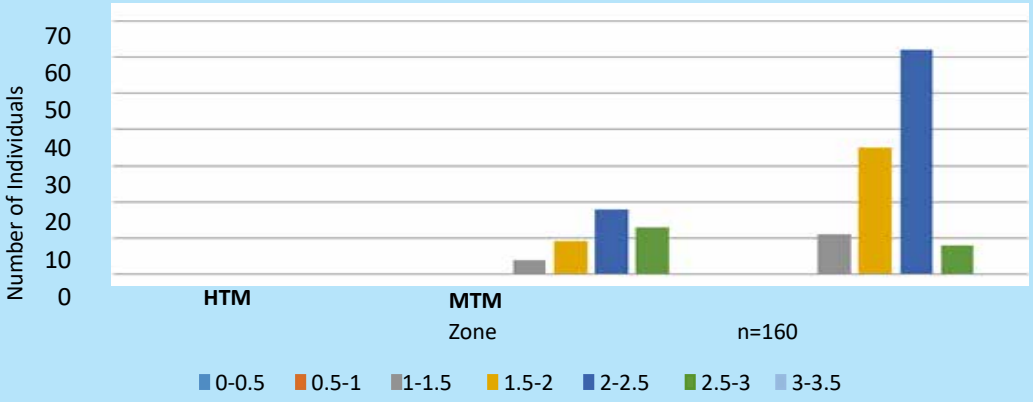
TR-5

Figure 26
Benthic Composition at TR-5



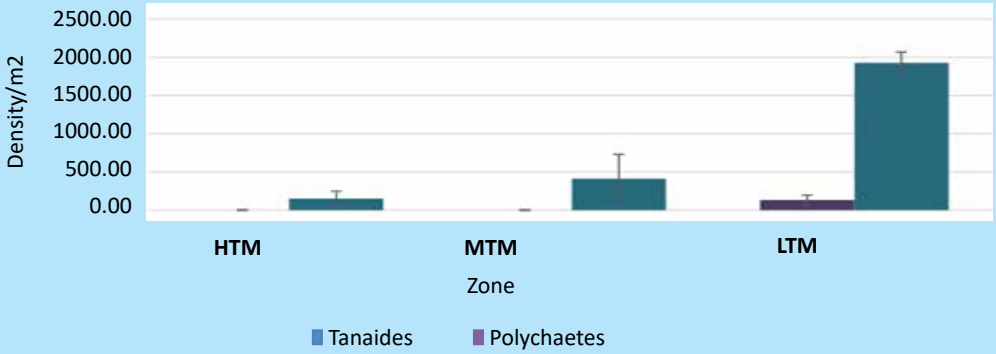
TR-5

Figure 27
Size Class Distribution of C. Cingulata at TR-5



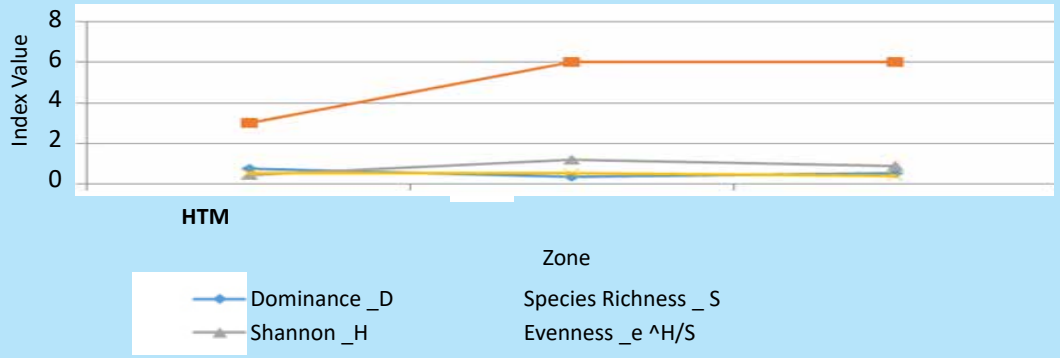
TR-5

Figure 28
Endobenthic Composition at TR-5



TR-5

Figure 29
Species Diversity at TR-5



Observation

Species richness was found increasing from high tide zone to low tide zone (Fig. 29). Less density of fauna was observed at high tide zone because of high intricate network of roots, hard muddy substratum and presence of nearby terrestrial vegetation. Dominance was high at high tide zone, whereas diversity was high at mid tide zone. *C. cingulata* were observed in the size class 1-1.5 to 2.5-3 cm predominantly at low tide zone due to open mudflats (Fig.27).

TR-6

GPS Location
Start: 16°33’23.63”N, 73°23’8.31”E
End: 16°33’26.75”N, 73°23’15.42”E

Figure 30
Map of TR-6 with Sampling Points

Physico-chemical Characteristics

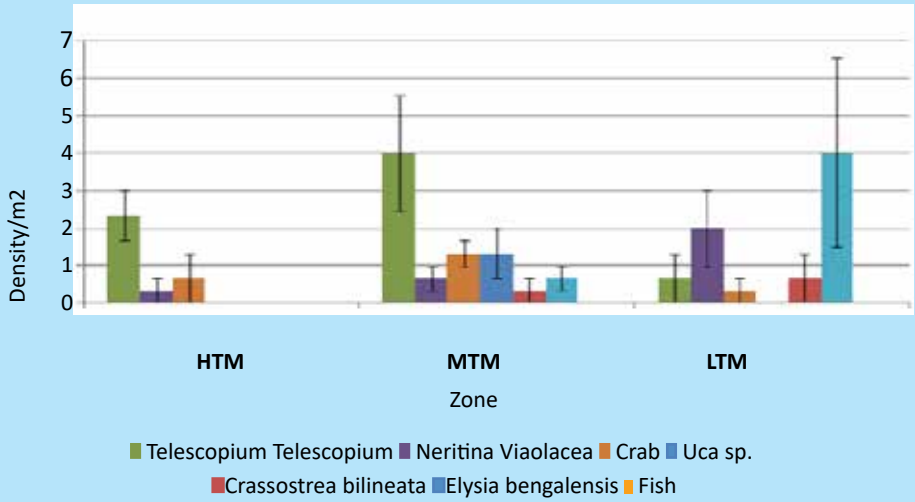
TR-6	pH	Temperature in °C	Salinity in ppt
LTM	7.07	31.5	18
	7.16	32.4	20
	7.23	29.8	17
MTM	7.17	31.1	17
	7.33	31.6	16
	6.6	31.8	15
HTM	7.46	30.6	16
	7.21	30.3	17
	7.14	30.1	18

Checklist of common species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	+	+++	+++
Sonneratia alba	++	+++	+
Avicennia marina	+	+++	+++
Telescopium telescopium	+	++	+
Cassidula aurisfelis	+	+++	+++
Cassidula nucleus	+	+	+
Littoraria scabra	++	+++	+++
E. bengalensis	+	+++	

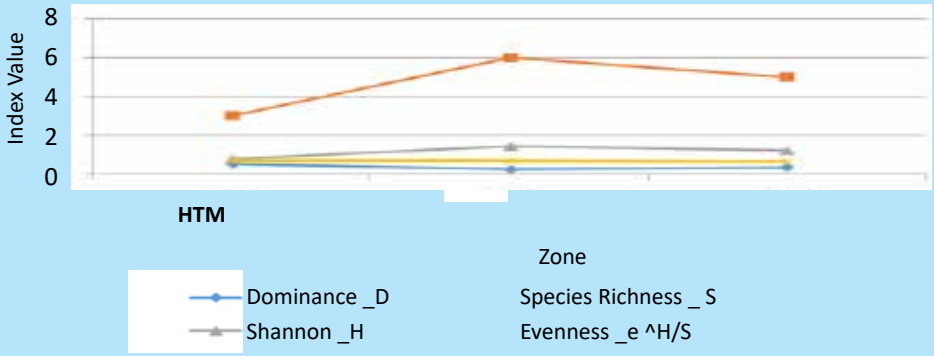
TR-6

Figure 31 : Endobenthic Composition at TR-6



TR-6

Figure 32 : Species Diversity at TR-6



Observation

Species richness was higher at mid tide zone and low tide zone as compared to high tide zone. Species diversity was low at high tide zone (Fig.32). Fauna was represented by *Telescopium telescopium, Neritina violacea and crabs* at all zones (Fig.31). Slug *Elysia bengalensis* were mostly seen at low tide zone due to the presence of mangrove leaf litter in the water puddles, a typical habitat of the slug (Fig.31).

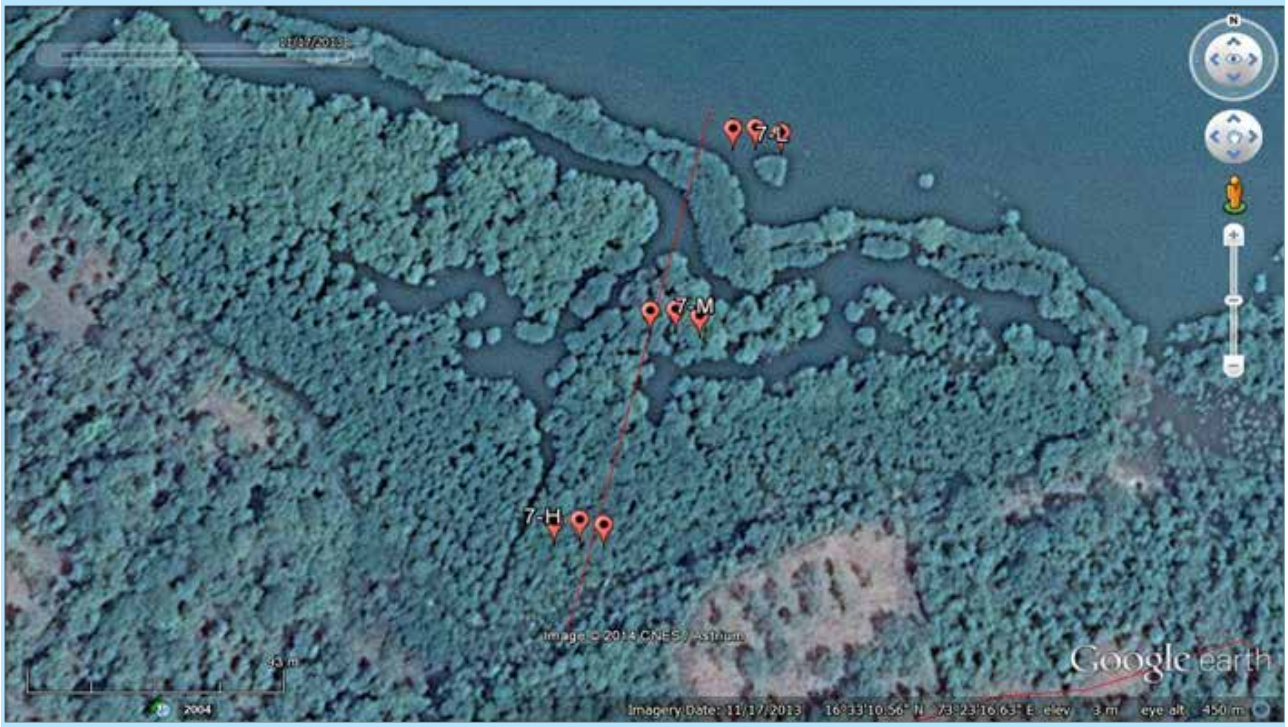
TR-7

GPS Location

Start: 16°33’13.60”N, 73°23’18.17”E

End: 16°33’8.10”N, 73°23’15.77”E

Figure 33 : Map of TR-7 with Sampling Points



Physico-chemical Characteristics

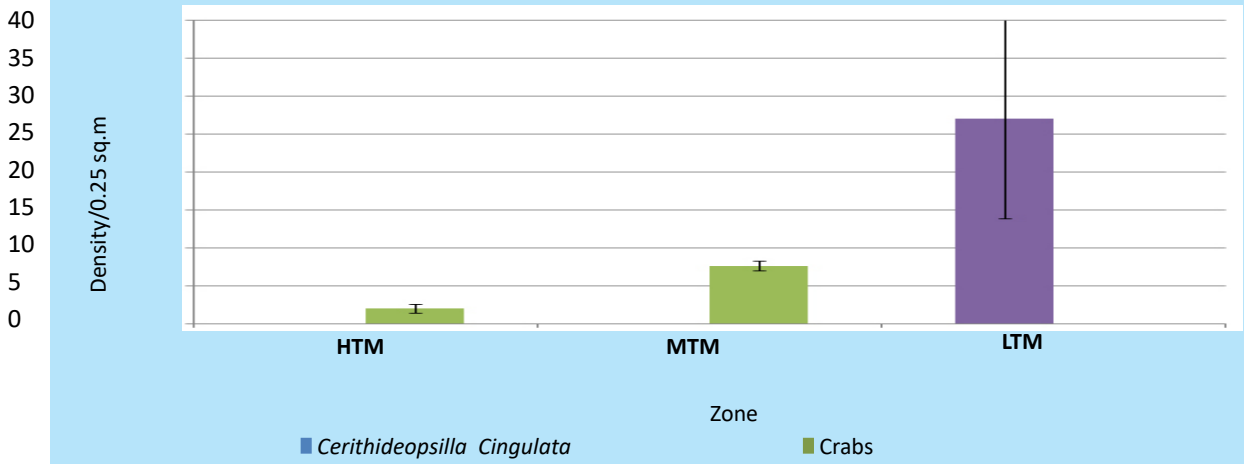
TR-7	pH	Temperature in °C	Salinity in ppt
LTM	7.52	34	43
	7.62	33	22
	7.62	32.4	24
MTM	7.4	31.9	31
	7.31	30.6	30
	7.03	30.8	33
HTM	6.56	35.6	9
	7.37	31.8	13
	6.16	30.2	9

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	+++	+++	+++
Avicennia marina	+	+	+
Telescopium telescopium	+	++	+
Oysters	++	+	++
Cerithideopsillacingulata	+	+	++

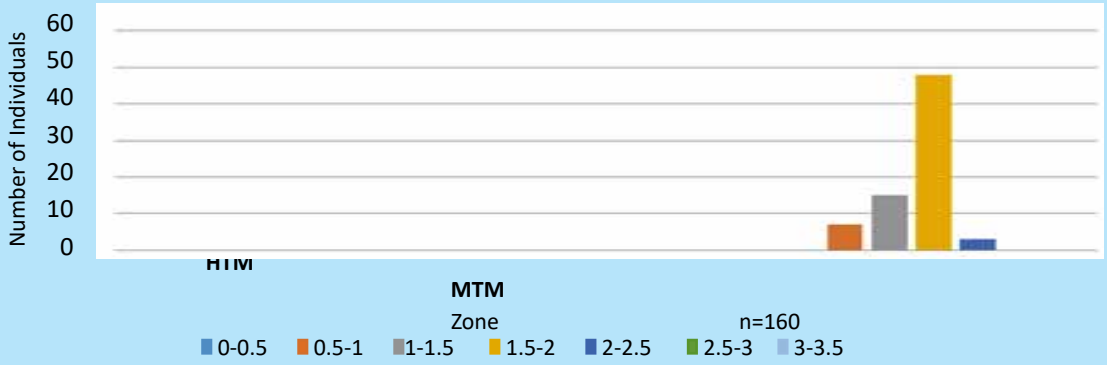
TR-7

Figure 34
Benthic Composition at TR-7



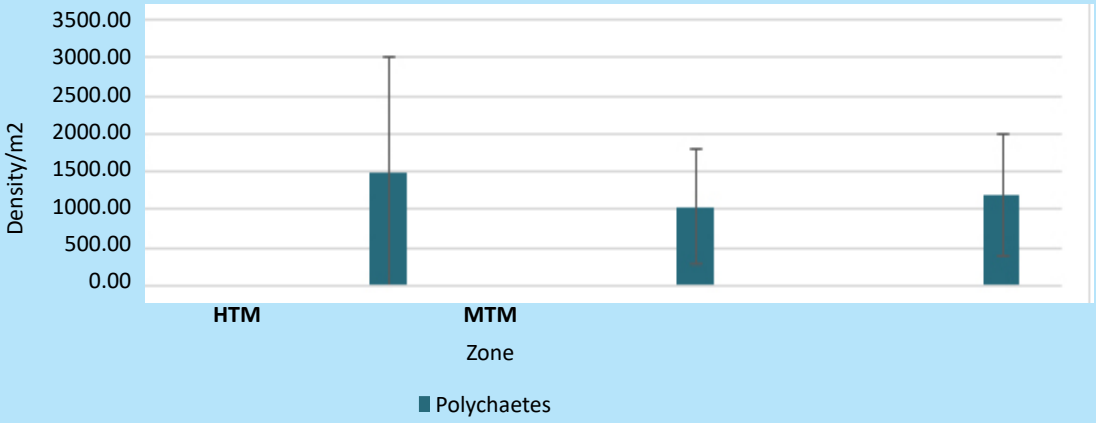
TR-7

Figure 35
Size Class Distribution of C. Cingulata at TR-7



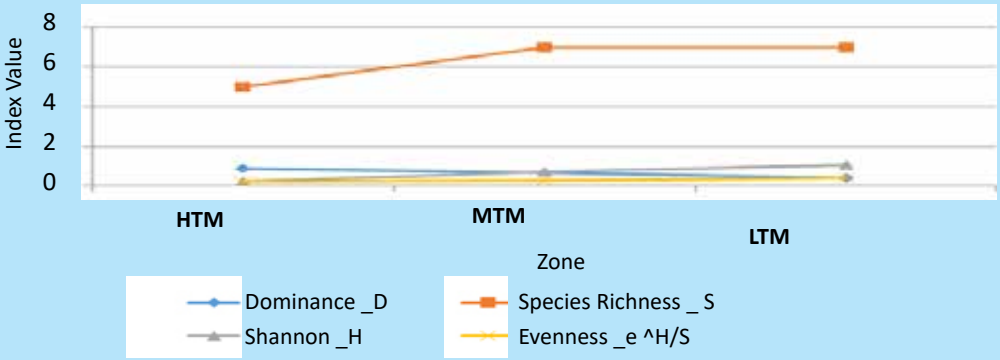
TR-7

Figure 36
Endobenthic Composition at TR-7



TR-6

Figure 37
Species Diversity at TR-7



Observation

Species richness was observed to be low at high tide zone and same at mid and low tide zone (Fig.37). *C. cingulata* were observed only at low tide zone in size class 0.5-1 to 2-2.5 cm (Fig.35). Endobenthic samples showed dominance of polychaetes over the entire transect (Fig.36).

TR-8

GPS Location

Start: 16°33’15.63”N, 73°23’46.11”E

End: 16°33’8.67”N, 73°23’47.49”E

Figure 38
Map of TR-8 with Sampling Points

Figure 39
Habitat at TR-8

Physico-chemical Characteristics

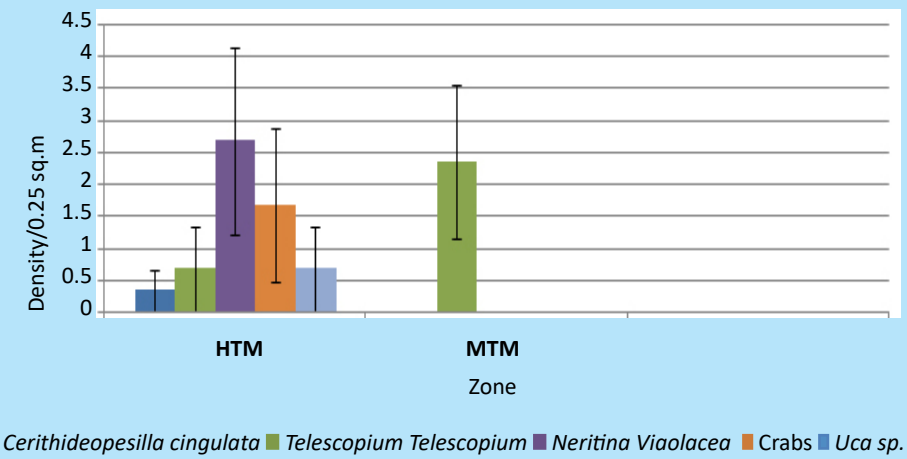
TR-8	pH	Temperature in °C	Salinity in ppt
LTM	7.41	31.4	23
	7.39	31.6	23
	7.4	31.4	24
MTM	7.03	35.4	30
	7.04	33.2	30
	7.2	32	32
HTM	6.38	30.4	20
	6.38	30.4	20
	6.38	30.4	20

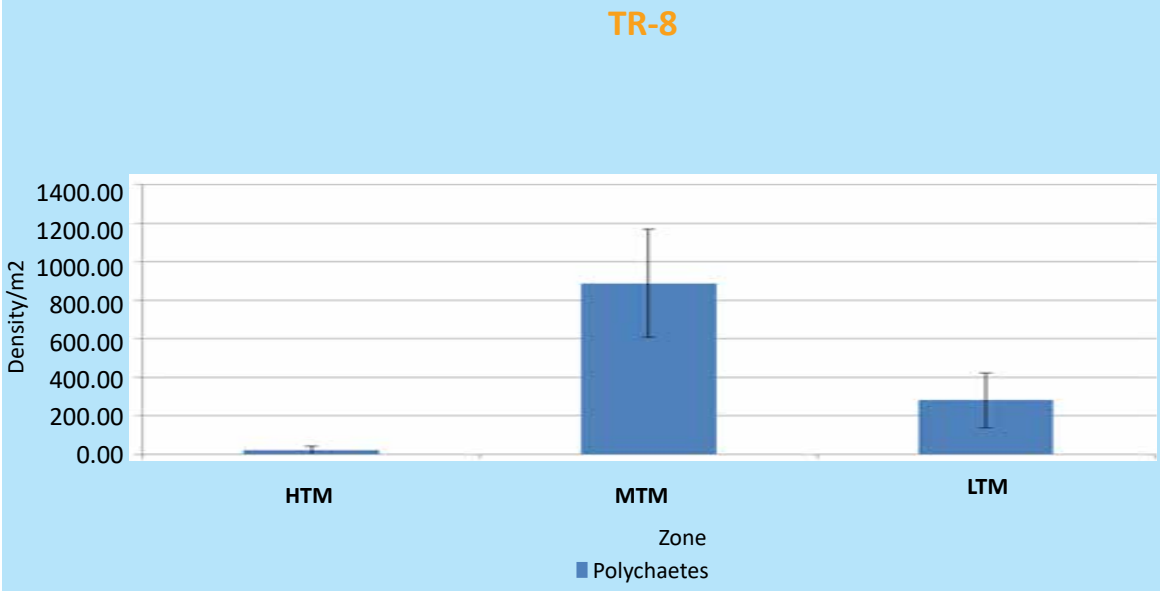
Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophoramucronata	++	+++	+++
Avicennia marina	+	++	+++
Cassidulaaurisfelis	+	++	
Cassidula nucleus	+	++	+
Littorariascabra		++	++
Elysia bengalensis	+++	++	
Neritina violacea		++	+
Cerithideopsillacingulata		+	++
Assimineasp.		++	+

TR-8

Figure 40
Benthic Composition at TR-8





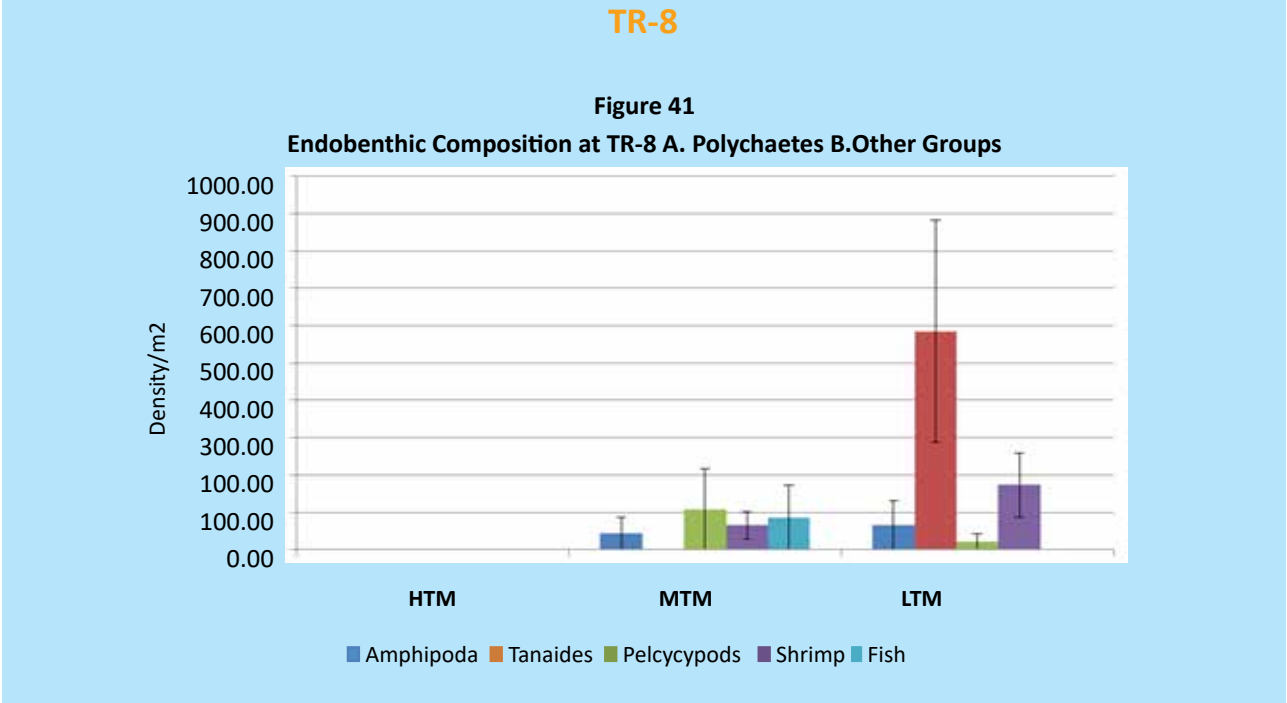
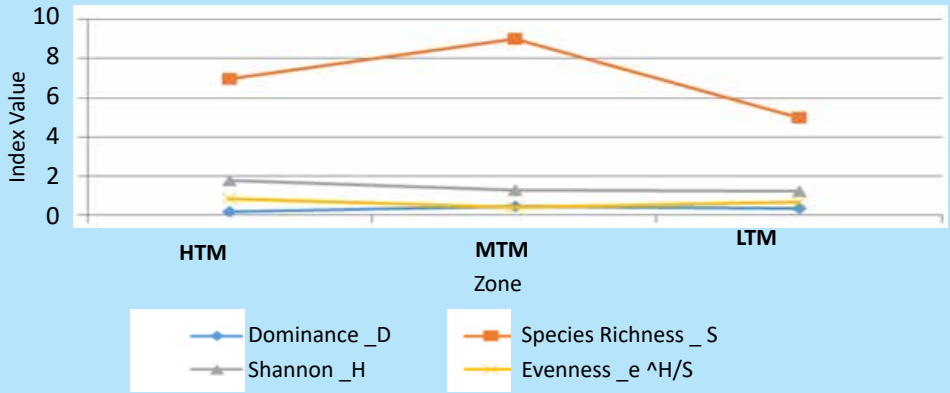


Figure 41
Endobenthic Composition at TR-8 A. Polychaetes B.Other Groups

TR-8

Figure 42
Species Diversity at TR-8



Observation

At high tide zone, species were more evenly distributed when compared to low tide and mid tide zones. At high tide zone, *Neritina violacea* were dominant with presence of a few *Cerithideopsilla cingulata* (Fig.40). *T.telescopium* dominated the mid tide zone along with Elysia bengalensis. (Fig.41). Polychaetes were present in all three zones; but a higher density was observed at mid tide zone due to soft muddy substratum (Fig.41 A and B).

TR-9

GPS Location

Start: 16°33’2.12”N, 73°23’49.60”E

End: 16°32’58.44”N, 73°23’55.04”E

Figure 43
Map of TR-9 with Sampling Points

Figure 44
Intertidal Mudflat at TR-9

Physico-chemical Characteristics

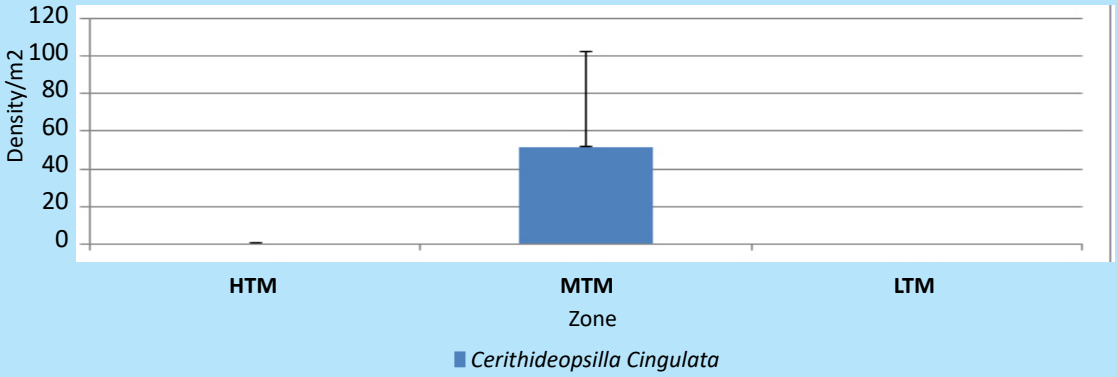
TR-9	pH	Temperature in °C	Salinity in ppt
LTM	7.20	27.3	3
	7.25	27.1	8
	7.33	27.4	10
MTM	7.49	26.9	11
	7.28	28	15
	7.28	28	15
HTM	7.5	27.6	12
	7.7	22.1	10
	7.7	26.8	10

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	++	+++	
Avicennia marina	++	++	
Aegiceras corniculatum	++	+++	
Ceriops tagal	+	+++	+
Cassidula aurisfelis	+	++	
Cassidula nucleus	+	++	+
Littoraria scabra	++	++	
E. bengalensis	++	++	
Neritina violacea	++	++	+
Cerithideopsilla cingulata	++	+++	+++
Assiminea sp.	+	++	++

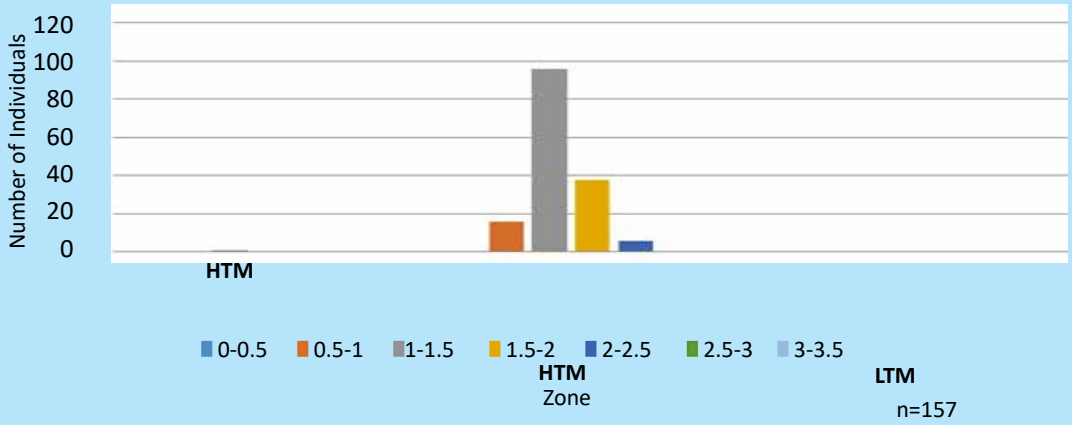
TR-9

Figure 45
Benthic Composition at TR-9



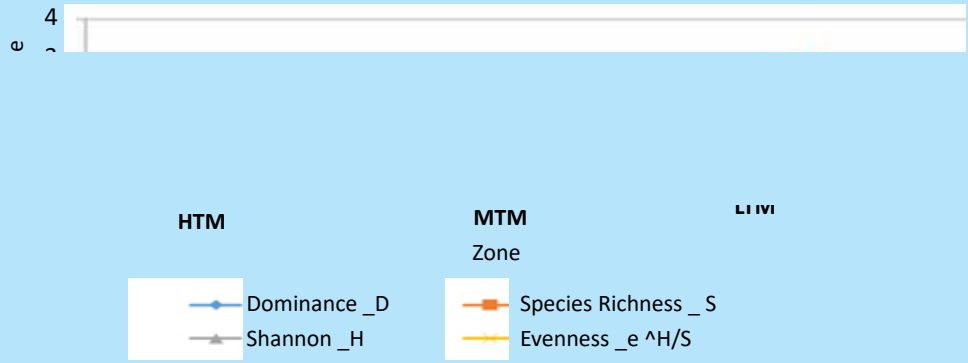
TR-9

Figure 46
Size Class Distribution of *C. Cingulata* at TR-9



TR-9

Figure 47
Species Diversity at TR-9



Observation

Species richness was observed to be increasing from high tide zone to low tide zone (Fig.47). *C. cingulata* was present only at mid tide zone (size class 0.5-1 to 2-2.5 cm) (Fig.46). Cerithids were absent at low tide zone due to fine and soft muddy substratum which is not favoured by cerithids (Rao and Sukumar 1981).

TR-10

GPS Location

Start: 16°33’37.17”N, 73°24’19.63”E

End: 16°33’41.80”N, 73°24’18.88”E

Figure 48
Map of TR-10 with Sampling Points

Figure 49
Mangrove Forest at TR-10

Physico-chemical Characteristics

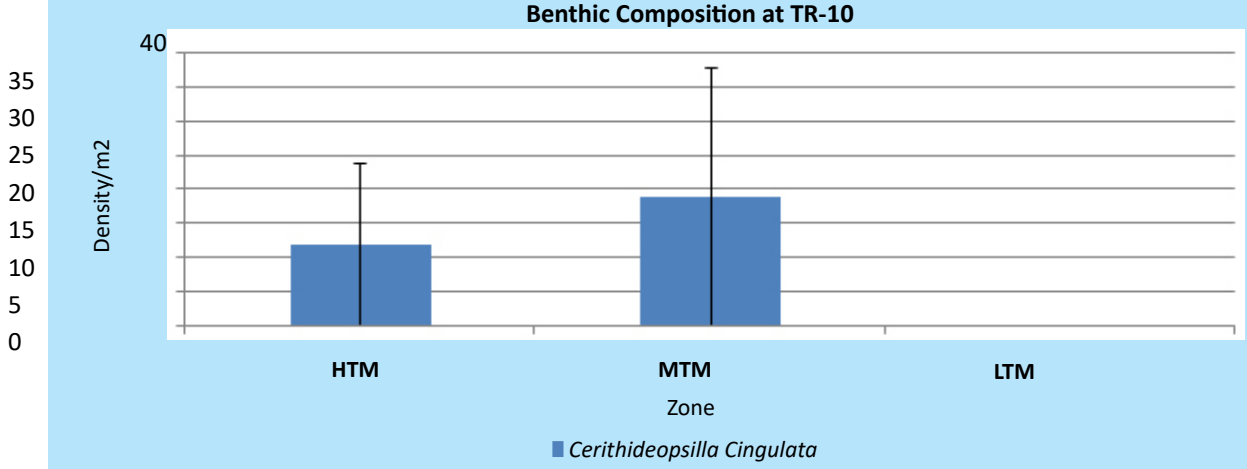
TR-10	pH	Temperature in °C	Salinity in ppt
LTM	7.43	31.4	10
	7.43	31.4	10
	7.22	31	14
MTM	7.2	29.1	18
	7.22	29	17
	7.45	28.4	19
HTM	7.62	28.5	19
	7.62	28.5	19
	7.62	28.5	19

Checklist of Common Species

Species Name	HTM	MTM	LTM
Rhizophora mucronata	++	++	++
Avicennia marina	+	+	+
Excoecaria agallocha	++	++	+++
Lumnitzera racemosa	+++	+++	++
Ceriops tagal	+++	+++	+
Aegiceras corniculatum	++	++	++
Kandelia candel	++	+++	+
Sonneratia alba	+++	++	+
Acanthus ilicifolius	+	+	+
Cassidula aurisfelis	++	+++	+
Clithon oulaniensis			+++
Clithon cf corona			++
E. bengalensis	++	+++	
Neritina violacea	++	+++	+++
Cerithideopsilla cingulata		++	
Brachyuran crabs	++	++	+

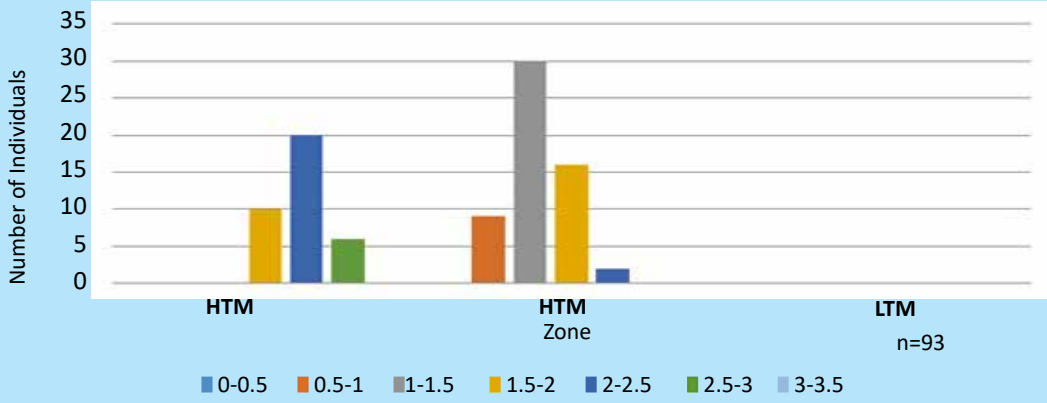
TR-10

Figure 50
Benthic Composition at TR-10

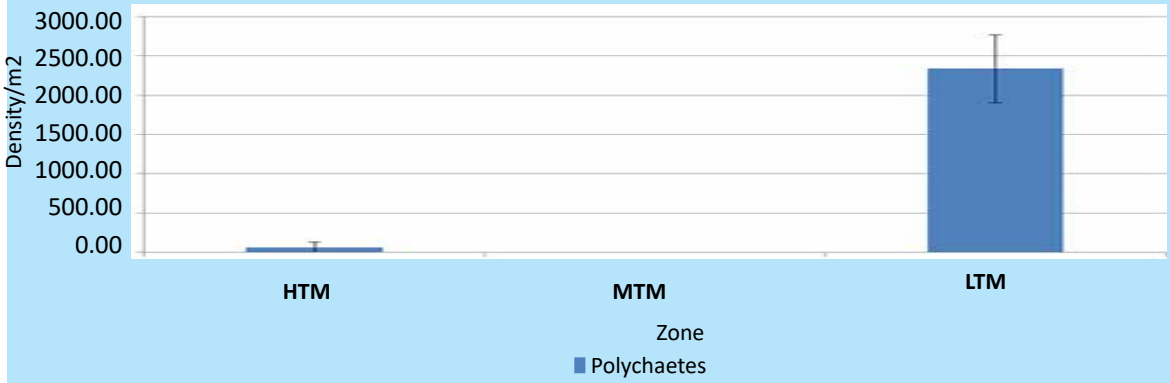


TR-10

Figure 51
Size Class Distribution of C. Cingulata at TR-10

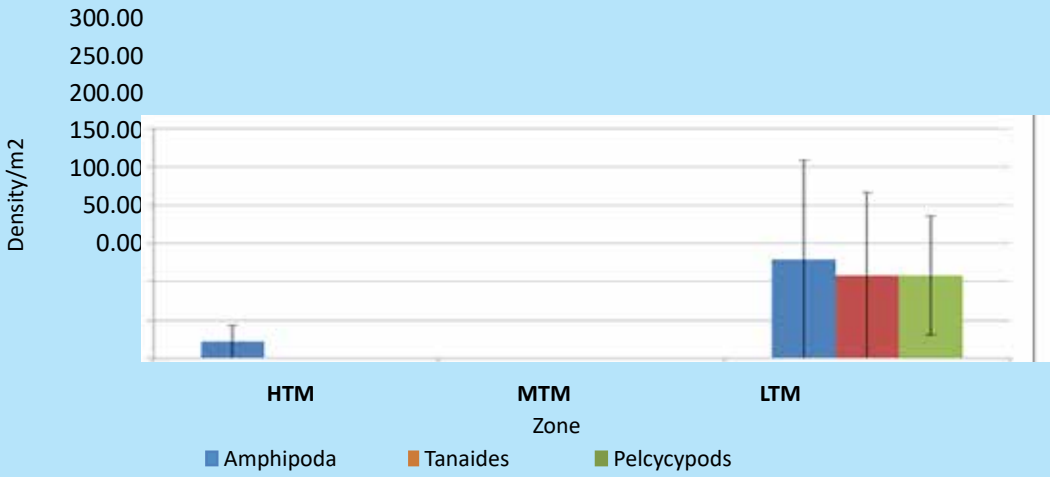


TR-10



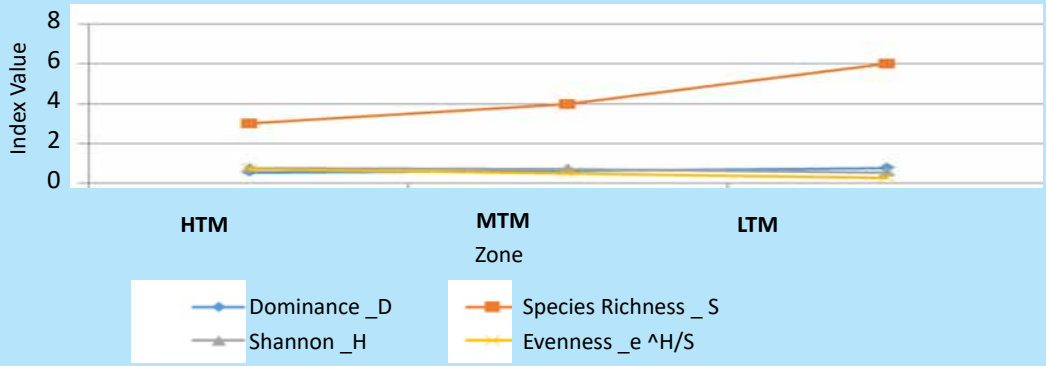
TR-10

Figure 52
Endobenthic Composition at TR-10 A. Polychaetes B.Other Groups



TR-10

Figure 53
Species Diversity at TR-10



Observation

Species were more evenly distributed at low tide zone as compared to other zones (Fig.53). *C. cingulata* were only found at high and mid tide zones (Fig.50). Polychaetes were abundant at low tide zone (Fig. 52 A) probably because of the presence of soft substratum.

Chapter 5

Summary of Findings

Fauna

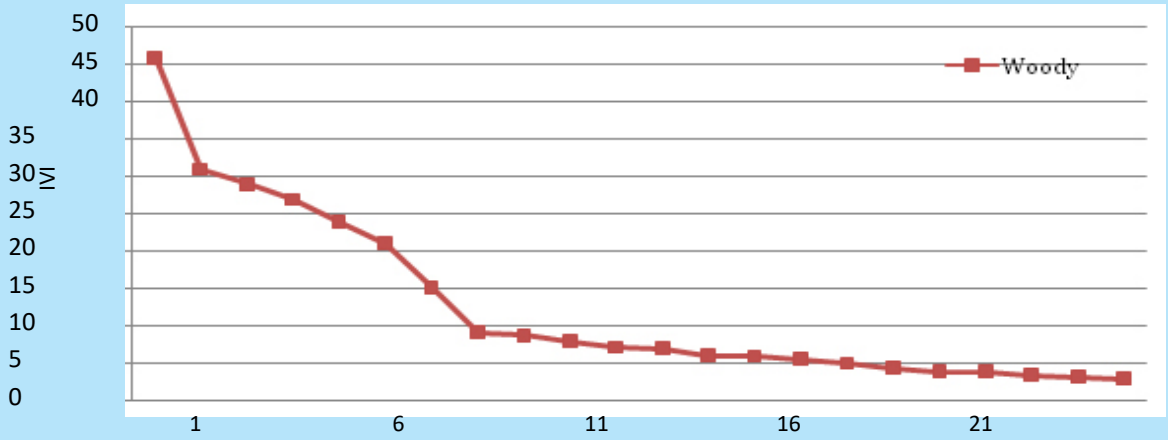
Overall, the faunal composition at Ansure Creek was found to be dominated by molluscan species like *Cerithideopsilla cingulata* which was present almost at all sampling sites. Gastropods species like *Telescopium telescopium* and *Neritina violacea* were also found in the study area. General observation suggests the presence of oysters at all sampling sites.Endobenthos were found composed of polychaetes, amphipods and tanaids. Highest diversity value (Shanon and Evenness) was found at TR-8, with the highest number of taxa recorded in the transect. Epibenthic composition included 6 gastropod species, 4 arthropod groups whereas endobenthos included 1 annelid group, 4 arthropod groups and 2 molluscan groups.

Physico-chemical parameters were found to be in the normal range. Low salinity at HTL at TR1 and 7 was due to freshwater input from nearby settlement and agriculture areas. Reasons for low salinity at LTM at TR9 could not be ascertained.

Vegetation

Ansure Creek harbours mudflats and mangroves, especially on its northern bank though comparatively smaller mangrove patches are seen on southern bank. Northern bank mangroves of the creek are distributed over two villages i.e., downstream Ansure, Dandekar Wadi and upstream Ansure, Khalchi Waki. Most of these areas (about 158 ha) are lined by dense mangrove cover mainly composed of *Avicennia marina*, *A. officinalis, Sonneratia apetala, S. alba*, and *Rhizophora mucronata* along with significant proportion of mangrove associates such as *Acanthus ilicifolius, Thespesia populnea, Salvadora persica, Sesuvium portulacastrum, Clerodendrum inerme, Derris trifoliatus, Cynodon dactylon* and many *Cyperus spp*. Zonation of mangrove species was observed in the ecosystem with *Rhizophora mucronata* distributed on the seaward side while *Avicennia spp*. and Sonneratia spp. were found on the landward side of the forests due to variable tidal inundation.

Figure 54
Important Value Index Curve of Woody Species Recorded



Species Composition and Diversity

In total, 22 species were recorded from mangroves which included 14 mangrove species and 8 mangrove associates, including one seagrass *Halophila beccarii* and a *pteridophyte Acrostichum aureum*. The IVI calculated on the basis of relative densities, basal cover and frequencies clearly shows high dominance. In case of woody species, seven species contributed up to 66.66 % of dominance. These species were *A. officinalis, R. mucronata, S. alba, A. marina, S. apetala, A, corniculata* and *E. agalocha*. The importance of A. marina was higher due to the large basal cover they contributed while *R. mucronata* showed high density. This trend was seen across all the sites. The species other than these seven species were rarely distributed and showed a trailing trend in Fig. 54.

All the sites studied were more or less identical in terms of species composition and richness; however species abundance varied marginally.

Chapter 6

Use of Natural Resources by Local Communites

The Ansure Creek displays a strong connection with the local people who depend on themangrove biodiversity for their sustenance. The two major villages located in the immediate vicinity of the Ansure Creek viz. Ansure (encompassing small hamlets such as Ansure, Dande and Hurse) and Sagave (encompassing the Shirse, Karivane and Gothiware hamlets) depend on the area's relatively unpolluted natural resources for fishing, agriculture and associated activities for their livelihoods. Marine fishing activities, mango orchards and rice fields are the most important livelihood supports for the local populace. The fishing community as well as other locals (non-fishermen) depend upon the Creek and mangroves for fish, shellfish, crab, fuelwood etc.

Fishing is the major occupation of the people residing in Ansure and Sagave villages. Fishing takes place in the entire vicinity of the Ansure Creek which has rich fish fauna that is harvested by the locals. The fishing activity in the Ansure Creek is carried out throughout the year. According to the information gathered from local fishermen, traditional nets such as Wavari net, Budi net, Dol net and Rampan net, are used along the coast and in the Creek. Dol is a hand-woven net which can take 4 to 5 months for one human being to weave but it is considered stronger than machine-woven nets. Remarkably, weaving and repairing nets is also a source of income in the study area.

Fisheries

Some commonly harvested fishes include *Etroplus suratensis* (Kalunder), *Scatophagus argus* and *Ephippus orbis* (Wadawood *Liza parsia* (Boi/Boir), *Gerres filamentosus* (Shetaka), *Lutjanus rivulatus* (Tambosa), *Siganus vermiculatus* (Mutri), *Rachycentron canadum* (Modusa), *Sardinella fimbriata* (Pedava), *Epinephelus tauvina* (Gobara), *Sillago sihama* (Renava). Shellfish fishery includes crabs, prawns and molluscs.

Vaan is a community fishing practice in which all households from a 'wadi' or hamlet participate. A long Dol net is used for 'Vaan' during the low tide. It is stretched and tied on bamboo supports

Figure 55
Special Net called 'Vaan'

Figure 56
Map Crab Fishing Areas within Ansure Creek

in a semicircular manner. After a fortnight during high tide, people gather the trapped fish, crabs or shrimps. After being weighed, the catch is evenly distributed amongst participating households.

Crab Fishing Areas

A special indigenous method of crab fishing is carried out with the help of rods and hooks, and '*wam*' fish *(Monopterus albus)* is usually used as bait. For commercial crab fishing, specially designed bamboo mats or cylindrical net traps are used by the fishers. Crabs are stored in buckets or bamboo baskets and sold within 1-2 days in the local markets. Crab fishing areas are marked in Fig. 56.

Oyster fishing is one of the major activities in the Ansure Creek area. Oysters are a known delicacy and a major source of protein in the diet of the local populace. Traditional methods are used for oyster fishing in the swamps within the mangroves. *Crassostrea bilineata* (formerly known as *Crassostrea madrasensis*) and Saccostrea cucullata form beds on the mudflats and also attach to the inter-tidal rocks.

Oyster Fishing Areas

Oyster fishery is primarily done by only women in the study area. A small part of the harvest is used for consumption and the rest is sold in the local markets. The catch is higher in summer months and besides providing a high protein diet, it is a means of additional income for the family. The average collection per day during low tides is in the range of 1 to 4 kg. The major collection sites are shown inFig. 57.

Figure 57
Map Olyster Collection Areas within Ansure Creek

Figure 58
Map *T. Telescopium* Collection Areas within Ansure Creek

Telescopium Telescopium

Some people in the area also consume *Telescopium Telescopium*, a gastropod mollusc, (locally known as '*walaye*'). Telescopium fishing areas are confined only to the interior parts of the creek, and collected and consumed specially by the low income groups of the community. Fig. 58 and 59.

Bivalve Harvesting

Earlier, almost the entire Creek area was used for bivalve fishery(Fig.60) but due to shell mining in the recent years, bivalve resources have depleted (according to local knowledge). In the present study however, estimates have not been made in terms of people involved in bivalve collection and its trade, quantity and the overall role in sustaining rural economy in the vicinity

Figure 59
Telescopium Telescopium

Figure 60
Map Bivalve Fishery Areas in the Past within Ansure Creek

Figure 61
Polymesoda Erosa

Figure 62
Map Traditional Bivalve Harvesting Area and Present Bivalve Shell Mining Area with in Ansure Creek

Figure 63
Present Bivalve Fishery Area Confined towards Creek Mouth

of the creek. The species of bivalves commonly harvested are *Tegillarca granosa* (Rangane), *Polymesoda erosa* (Mharay) and *Meretrix meretrix* (Mule).

Shell Mining

For the past few years, the area of Ansure Creek highlighted in red (Fig.62) has been leased out for mining of empty shells. These shells are usedby various industries for the production of lime, fertilisers, toothpaste, cosmetics etc. The area of the Creek leased out for mining, overlaps the area in which traditionally there was predominant harvest of bivalves. Though the mining is for dead shells, the activity itself has largely destroyed the bivalve habitat. People have reported a drastic decline in bivalve population since shell mining started. Bivalve harvesting is currently confined to the mouth of Creek where shell mining is not done.

Need for Further Studies

From the present study, it is apparent that the Ansure Creek has abundant mangrove associated fauna, and livelihoods of the local community is closely linked to its resources. Hence, comprehensive seasonal studies are required to be undertaken for proper documentation and evaluation of the natural resources, its ecological significance and quantification of dependency of locals on these resources. Accurate mapping is important, as it will allow for the development of regulated harvesting regimes that can help in sustainable harvesting.

Chapter 7

Disturbances and Potential Threats

Upcoming kharland bund has the potential to destroy large tracts of mangroves and may alter benthic faunal communities.

- The associate *Halophila beccariii* is globally vulnerable and requires conservation priority. Species such as *Bruguiera cylindrica, Kandelia candel, Rhizophora apiculata* and *Sonneratia caseolaris* were found occasionally with moderate size of populations. Afforestation programme for the same can be undertaken at select sites.
- Small scale use of mangroves for fuel needs monitoring and quantification. Mangrove leaves are used during drought as fodder for cattle or for domestic use. Dependency of locals on the same requires assessment.
- Upcoming large infrastructure projects (power plant) in the vicinity of Ansure can have indirect impacts through change in land use as well as changes in environmental parameters that may occur.
- Systematic studies are required to establish the impact of shell mining on local bivalve population.

Annexures

Annexure 1

Sampling Locations

A. Sample Locations for TR-1 to TR-10 (Macrofauna)

TR_name	Latitude	Longitude
TR-1-H	16.55211796	73.35598952
TR-1-M	16.55268978	73.35644828
TR-1-L	16.55315687	73.35694714
TR-2-H	16.55631422	73.36188888
TR-2-M	16.55510143	73.36182684
TR-2-L	16.55388961	73.36181376
TR-3-H	16.54933533	73.36961744
TR-3-L	16.55088914	73.36951036
TR-3-M	16.55020368	73.36953186
TR-4-H	16.55564456	73.37781326
TR-4-L	16.55430515	73.37715699
TR-4-M	16.55519382	73.3774346
TR-5-L	16.55404502	73.37954575
TR-5-H	16.55316992	73.38093588
TR-5-M	16.55346142	73.38023667
TR-6-L	16.55656304	73.38564211
TR-6-H	16.55743123	73.38761765
TR-6-M	16.55702673	73.38685523
TR-7-H	16.55224911	73.38771387
TR-7-L	16.55377872	73.38838078
TR-7-M	16.55305715	73.38807096
TR-8-H	16.55436043	73.39605512
TR-8-L	16.55242629	73.39645015
TR-8-M	16.55334811	73.39621326
TR-9-L	16.55063339	73.39717531
TR-9-H	16.54958573	73.39855404
TR-9-M	16.55005274	73.39784727
TR-10-H	16.56161054	73.40524583
TR-10-L	16.56033797	73.40538978
TR-10-M	16.56095198	73.40532259

All subsamples were taken at 10m distance from each other

B. Locations of Quadrats Laid for Vegetation Analysis

Sl. No.	Transect No. / Site	Quadrat No.	Latitude	Longitude
1	TR1	TR1 I	16.552521°	73.356080°
2	TR2	TR2 I	16.556098°	73.361238°
3		TR2 II	16.555223°	73.362045°
4	TR3	TR3 I	16.550120°	73.369534°
5	TR4	TR4 I	16.555608°	73.370971°
6		TR4 II	16.554791°	73.373327°
7		TR4 III	16.554998°	73.377050°
8	TR5	TR5 I	16.553132°	73.380461°
9	TR6	TR6 I	16.556566°	73.386043°
10	TR7	TR7 I	16.552583°	73.387960°
11	TR8	TR8 I	16.553993°	73.396029°
12		TR8 II	16.552292°	73.396468°
13	TR9	TR9 I	16.549596°	73.398249°
14	TR10	TR10 I	16.561797°	73.404368°
15		TR10 II	16.561507°	73.405671°

Annexure 2
Raw Data for Epibenthos, Endobenthos Abundance and Length Data (In Cm) of Cerithideopsilla Cingulata of Each Transect

TR-1

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
1	1	LTM	51	0	0	0	0	1	0	0	0	0	0	0
1	2	LTM	67	0	0	0	0	0	0	0	33	0	0	0
1	3	LTM	35	0	0	0	0	0	0	0	0	0	0	0
1	4	MTM	12	0	0	0	2	0	0	0	0	0	0	0
1	5	MTM	105	7	0	0	0	0	0	0	0	0	0	0
1	6	MTM	113	0	0	0	0	0	0	0	0	0	0	0
1	7	HTM	29	0	0	0	0	0	0	0	0	0	0	0
1	8	HTM	37	0	0	0	0	0	0	0	0	0	0	0
1	9	HTM	53	0	0	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
1-HTM	2468.21	3052.78	0.00	3247.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-HTM	1364.01	129.91	0.00	1104.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-HTM	64.95	0.00	0.00	0.00	324.76	0.00	0.00	0.00	64.95	0.00	0.00
1-MTM	714.48	0.00	0.00	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-MTM	1428.96	0.00	0.00	64.95	844.39	0.00	0.00	0.00	0.00	0.00	0.00
1-MTM	1948.58	389.72	0.00	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-LTM	2273.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-LTM	2857.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-LTM	2078.49	0.00	0.00	0.00	194.86	0.00	0.00	0.00	0.00	0.00	0.00

Size Class Data for *C. cingulata*

TR_ID	Zone	Size (in cm)
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1	LTM	1.6
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1	LTM	1.8
1	LTM	1.9
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Size Class Data for *C. cingulata*

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Size Class Data for *C. cingulata*

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Size Class Data for *C. cingulata*

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1	HTM	1.3
1	HTM	1.3
1	HTM	1.3
1	HTM	1.3
1	HTM	1.3
1	HTM	1.3

TR-2

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
2	1	HTM	0	0	0	0	0	0	0	0	0	0	0	0
2	2	HTM	0	0	1	0	0	0	0	0	0	0	0	0
2	3	HTM	0	0	0	0	0	0	0	0	0	0	0	0
2	4	MTM	0	0	0	0	0	0	0	0	0	0	0	0
2	5	MTM	0	0	1	0	0	2	0	2	0	1	0	0
2	6	MTM	0	0	0	1	0	0	0	2	0	0	0	0
2	7	LTM	22	0	0	0	0	0	0	3	8	0	0	0
2	8	LTM	53	0	0	0	0	0	0	1	2	0	0	0
2	9	LTM	0	0	1	0	0	2	0	7	0	0	0	0

Size Class Data for C. cingulata

TR_ID	Zone	Size (in cm)
2	LTM	1.0
2	LTM	1.2
2	LTM	1.3
2	LTM	1.3
2	LTM	1.4
2	LTM	1.4
2	LTM	1.5
2	LTM	1.6
2	LTM	1.7
2	LTM	1.7
2	LTM	1.8
2	LTM	1.9
2	LTM	1.9
2	LTM	2.0
2	LTM	2.1
2	LTM	2.1
2	LTM	2.1
2	LTM	2.2
2	LTM	2.3
2	LTM	2.4
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2	LTM	2.5
2	LTM	2.6
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2	LTM	1.0
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2	LTM	1.1
2	LTM	1.1
2	LTM	1.1
2	LTM	1.2
2	LTM	1.2
2	LTM	1.3
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2	LTM	1.7
2	LTM	1.8
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2	LTM	1.9
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2	LTM	2.1
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2	LTM	2.2
2	LTM	2.2
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2	LTM	2.5
2	LTM	2.5
2	LTM	2.5

TR-3

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritacrepidularia	Assiminea	Crabs	Ucasp	Oyster	Barnacles	Hermit crab	Elysiacfbengalensis	Fish
3	1	LTM	0	0	0	0	0	0	0	0	0	0	0	0
3	2	LTM	0	0	0	0	0	0	0	0	0	0	0	0
3	3	LTM	0	0	0	0	0	0	0	0	0	0	0	0
3	4	MTM	0	0	0	0	0	0	0	0	0	0	0	0
3	5	MTM	0	0	0	0	0	0	0	0	0	0	0	0
3	6	MTM	0	0	0	0	0	0	0	0	0	0	0	0
3	7	HTM	0	0	0	0	0	0	0	0	0	0	0	0
3	8	HTM	0	0	0	0	0	0	0	0	0	0	0	0
3	9	HTM	0	0	0	0	0	0	0	0	0	0	0	0

Endobenthos

Endobenthic samples showed only dead shells.

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
3-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-LTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-LTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3-LTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TR-4

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Ucasp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
4	1	LTM	131	0	0	0	0	0	0	0	0	0	0	0
4	2	LTM	106	0	0	0	0	0	0	1	0	0	0	0
4	3	LTM	117	0	0	0	0	0	0	3	0	0	0	0
4	4	MTM	198	0	0	0	0	0	0	0	0	0	0	0
4	5	MTM	57	0	0	2	0	0	0	0	0	0	0	0
4	6	MTM	36	0	0	0	0	0	0	3	0	0	0	0
4	7	HTM	12	0	0	0	0	0	0	0	0	0	0	0
4	8	HTM	16	0	0	0	0	0	0	0	0	0	0	0
4	9	HTM	89	0	0	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
4-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-MTM	584.58	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-MTM	2403.25	0.00	0.00	4156.98	0.00	0.00	0.00	0.00	129.91	0.00	0.00
4-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-LTM	3442.50	0.00	0.00	714.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4-LTM	1753.73	129.91	129.91	0.00	194.86	0.00	0.00	0.00	129.91	0.00	0.00
4-LTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TR_ID	Zone	Size (in cm)
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4	MTM	2.2
4	MTM	2.2
4	MTM	2.2
4	MTM	2.2
4	MTM	2.3
4	MTM	2.3
4	MTM	2.3
4	MTM	2.4
4	MTM	2.4

4	MTM	2.4
4	MTM	2.4
4	MTM	2.5
4	MTM	2.5
4	MTM	2.5
4	MTM	2.6
4	MTM	2.6
4	MTM	2.7
4	HTM	0.6
4	HTM	0.8
4	HTM	0.9
4	HTM	1.0
4	HTM	1.1
4	HTM	1.4
4	HTM	1.5
4	HTM	1.6
4	HTM	2.0
4	HTM	2.1
4	HTM	2.2
4	HTM	2.3
4	HTM	0.6
4	HTM	0.7
4	HTM	0.8
4	HTM	0.9
4	HTM	0.9
4	HTM	1.1
4	HTM	1.2
4	HTM	1.2
4	HTM	1.3
4	HTM	1.4
4	HTM	1.5
4	HTM	1.7
4	HTM	1.9
4	HTM	2.0
4	HTM	2.1
4	HTM	2.2
4	HTM	0.7
4	HTM	0.7
4	HTM	0.9
4	HTM	0.9
4	HTM	0.9
4	HTM	0.9
4	HTM	0.9
4	HTM	0.9
4	HTM	0.9

4	HTM	0.9
4	HTM	0.9
4	HTM	0.9
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.0
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1
4	HTM	1.1

4	HTM	1.1
4	HTM	1.1
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.2
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.3
4	HTM	1.4
4	HTM	1.4
4	HTM	1.4
4	HTM	1.4
4	HTM	1.4
4	HTM	1.4
4	HTM	1.5
4	HTM	1.5

4	HTM	1.5
4	HTM	1.5
4	HTM	1.5
4	HTM	1.5
4	HTM	1.6
4	HTM	1.6
4	HTM	1.6
4	HTM	1.6
4	HTM	1.7
4	HTM	1.7
4	HTM	1.7
4	HTM	1.7
4	HTM	1.8
4	HTM	1.8
4	HTM	1.8
4	HTM	1.8
4	HTM	1.8
4	HTM	1.9
4	HTM	1.9
4	HTM	1.9
4	HTM	2.0
4	HTM	2.0
4	HTM	2.1
4	HTM	2.1
4	HTM	2.3
4	HTM	1.5
4	HTM	1.5

TR-5

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Ucasp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
5	1	LTM	40	0	0	0	0	0	0	0	0	0	0	0
5	2	LTM	31	0	0	0	0	0	0	2	0	0	0	0
5	3	LTM	45	0	0	0	0	0	0	3	0	0	0	0
5	4	MTM	18	0	1	0	0	0	0	0	0	2	2	0
5	5	MTM	8	0	0	0	0	0	0	0	0	1	0	0
5	6	MTM	18	0	0	0	0	0	0	0	0	0	26	0
5	7	HTM	0	0	0	0	0	2	0	0	0	0	0	0
5	8	HTM	0	0	2	0	0	0	0	0	0	0	0	0
5	9	HTM	0	0	0	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
5-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-HTM	324.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-HTM	129.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-MTM	1039.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.95	0.00	0.00
5-MTM	194.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-LTM	2208.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-LTM	1818.68	0.00	0.00	194.86	194.86	0.00	0.00	0.00	0.00	0.00	0.00
5-LTM	1753.73	0.00	0.00	194.86	0.00	64.95	0.00	0.00	0.00	0.00	0.00

Size Class Data for C. cingulata

TR_ID	Zone	Size (in cm)
5	LTM	1.8
5	LTM	1.9
5	LTM	2.0
5	LTM	2.1
5	LTM	2.1
5	LTM	2.1
5	LTM	2.2
5	LTM	2.3
5	LTM	2.3
5	LTM	2.3
5	LTM	2.3
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.5
5	LTM	2.7
5	LTM	1.3
5	LTM	1.4
5	LTM	1.5
5	LTM	1.5
5	LTM	1.5
5	LTM	1.6
5	LTM	1.6
5	LTM	1.7
5	LTM	1.7
5	LTM	1.8
5	LTM	1.8
5	LTM	1.8
5	LTM	1.8

5	LTM	1.9
5	LTM	2.0
5	LTM	2.1
5	LTM	2.1
5	LTM	2.1
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.3
5	LTM	2.3
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.5
5	LTM	2.6
5	LTM	2.7
5	LTM	1.1
5	LTM	1.1
5	LTM	1.2
5	LTM	1.2
5	LTM	1.2
5	LTM	1.3
5	LTM	1.3
5	LTM	1.4
5	LTM	1.4
5	LTM	1.5
5	LTM	1.5
5	LTM	1.6
5	LTM	1.7
5	LTM	1.7
5	LTM	1.7
5	LTM	1.7
5	LTM	1.8
5	LTM	1.8
5	LTM	1.8
5	LTM	1.9
5	LTM	1.9
5	LTM	1.9
5	LTM	1.9
5	LTM	2.0
5	LTM	2.0
5	LTM	2.0
5	LTM	2.1

5	LTM	2.1
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.3
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.4
5	LTM	2.5
5	LTM	2.5
5	LTM	2.6
5	LTM	2.6
5	MTM	1.2
5	MTM	1.4
5	MTM	1.5
5	MTM	1.6
5	LTM	1.7
5	MTM	1.7
5	MTM	1.8
5	MTM	1.9
5	LTM	1.9
5	LTM	1.9
5	LTM	2.0
5	LTM	2.0
5	MTM	2.0
5	MTM	2.0
5	MTM	2.0
5	LTM	2.0
5	LTM	2.1
5	MTM	2.1
5	MTM	2.1
5	LTM	2.1
5	LTM	2.2
5	MTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.3

5	LTM	2.3
5	LTM	2.4
5	MTM	2.4
5	LTM	2.5
5	LTM	2.5
5	MTM	2.5
5	MTM	2.6
5	MTM	2.7
5	MTM	2.9
5	LTM	1.9
5	LTM	2.1
5	LTM	2.1
5	MTM	2.2
5	LTM	2.2
5	LTM	2.2
5	LTM	2.3
5	MTM	2.4
5	MTM	2.5
5	MTM	2.6
5	MTM	2.6
5	MTM	2.6
5	MTM	2.7
5	MTM	2.8
5	MTM	1.2
5	MTM	1.5
5	MTM	1.6
5	MTM	1.7
5	MTM	1.7
5	MTM	2.0
5	MTM	2.0
5	MTM	2.1
5	MTM	2.1
5	MTM	2.2
5	MTM	2.2
5	MTM	2.2
5	MTM	2.2
5	MTM	2.3
5	MTM	2.5
5	MTM	2.6
5	MTM	2.7
5	MTM	2.7

TR-6

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
6	1	HTM	0	0	1	0	0	0	0	0	0	0	0	0
6	2	HTM	0	0	3	1	0	2	0	0	0	0	0	0
6	3	HTM	0	0	3	0	0	0	0	0	0	0	0	0
6	4	MTM	0	0	1	0	0	2	2	1	0	0	1	0
6	5	MTM	0	0	5	1	0	1	2	0	0	0	1	0
6	6	MTM	0	0	6	1	0	1	0	0	0	0	0	0
6	7	LTM	0	0	0	0	0	0	0	0	0	0	2	0
6	8	LTM	0	0	2	3	0	1	0	2	0	0	1	0
6	9	LTM	0	0	0	3	0	0	0	0	0	0	9	0

TR-7

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
7	1	HTM	0	0	1	0	0	1	0	0	0	0	0	0
7	2	HTM	0	0	0	0	0	2	0	0	0	0	0	0
7	3	HTM	0	0	0	3	0	3	0	0	0	0	0	0
7	4	MTM	0	0	0	1	0	9	0	11	0	0	0	0
7	5	MTM	0	0	1	0	0	7	0	0	0	0	0	0
7	6	MTM	0	0	1	0	0	7	0	1	0	0	0	0
7	7	LTM	43	0	0	1	0	0	0	49	0	0	0	0
7	8	LTM	37	0	0	0	0	0	0	28	0	0	0	0
7	9	LTM	1	0	1	0	0	0	0	8	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
7-HTM	4546.69	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-MTM	2533.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-MTM	584.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.95	0.00
7-MTM	64.95	0.00	0.00	0.00	0.00	64.95	0.00	0.00	0.00	0.00	0.00
7-LTM	844.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-LTM	2728.02	0.00	0.00	0.00	0.00	0.00	0.00	64.95	0.00	0.00	0.00
7-LTM	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.95	0.00	0.00

TR_ID	Zone	Size (in cm)
7	LTM	0.6
7	LTM	0.7
7	LTM	0.8
7	LTM	0.8
7	LTM	0.9
7	LTM	1.0
7	LTM	1.1
7	LTM	1.1
7	LTM	1.3
7	LTM	1.3
7	LTM	1.4
7	LTM	1.4
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.7
7	LTM	1.7
7	LTM	1.7
7	LTM	1.8
7	LTM	1.8
7	LTM	1.9
7	LTM	1.9
7	LTM	1.9
7	LTM	2.0
7	LTM	2.0
7	LTM	2.0
7	LTM	2.0
7	LTM	2.0
7	LTM	1.2
7	LTM	1.3
7	LTM	1.4
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.5
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.6
7	LTM	1.7
7	LTM	1.7
7	LTM	1.7
7	LTM	1.7
7	LTM	1.7
7	LTM	1.7
7	LTM	1.8
7	LTM	1.8
7	LTM	1.8
7	LTM	1.8
7	LTM	1.8
7	LTM	1.8
7	LTM	1.9
7	LTM	1.9
7	LTM	1.9
7	LTM	2.0
7	LTM	2.0
7	LTM	0.6

TR-8

Epibenthos

TrID	z	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
8		1	HTM	0	0	0	0	0	0	2	0	0	0	0	0
8		2	HTM	1	0	0	3	0	4	0	0	0	0	0	0
8		3	HTM	0	0	2	5	0	1	0	0	0	0	0	0
8		4	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		5	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		6	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		7	MTM	0	0	4	0	0	0	0	0	0	0	3	0
8		8	MTM	0	0	0	0	0	0	0	0	0	0	5	9
8		9	MTM	0	0	3	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
8-HTM	64.95	0.00	NIL	0.00	0.00	0.00	64.95	Nil	0.00	0.00	0.00
8-HTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-HTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-MTM	389.72	0.00		0.00	0.00	0.00	0.00		64.95	0.00	0.00
8-MTM	1364.01	129.91		0.00	64.95	324.76	0.00		129.91	0.00	259.81
8-MTM	909.34	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-LTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-LTM	389.72	0.00		779.43	0.00	64.95	0.00		259.81	0.00	0.00
8-LTM	454.67	194.86		974.29	0.00	0.00	0.00		259.81	0.00	0.00

Size Class Data for C. cingulata

TR_ID	Zone	Size (in cm)
8	HTM	1.7

TR-9

Epibenthos

TrID	z	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
8		1	HTM	0	0	0	0	0	0	2	0	0	0	0	0
8		2	HTM	1	0	0	3	0	4	0	0	0	0	0	0
8		3	HTM	0	0	2	5	0	1	0	0	0	0	0	0
8		4	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		5	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		6	LTM	0	0	0	0	0	0	0	0	0	0	0	0
8		7	MTM	0	0	4	0	0	0	0	0	0	0	3	0
8		8	MTM	0	0	0	0	0	0	0	0	0	0	5	9
8		9	MTM	0	0	3	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
8-HTM	64.95	0.00	NIL	0.00	0.00	0.00	64.95	Nil	0.00	0.00	0.00
8-HTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-HTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-MTM	389.72	0.00		0.00	0.00	0.00	0.00		64.95	0.00	0.00
8-MTM	1364.01	129.91		0.00	64.95	324.76	0.00		129.91	0.00	259.81
8-MTM	909.34	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-LTM	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-LTM	389.72	0.00		779.43	0.00	64.95	0.00		259.81	0.00	0.00
8-LTM	454.67	194.86		974.29	0.00	0.00	0.00		259.81	0.00	0.00

Size Class Data for C. cingulata

TR_ID	Zone	Size (in cm)
9	MTM	0.7
9	MTM	0.7
9	MTM	0.7
9	MTM	0.7
9	MTM	0.7
9	MTM	0.8
9	MTM	0.8
9	MTM	0.9
9	MTM	0.9
9	MTM	0.9
9	MTM	0.9
9	MTM	0.9
9	MTM	0.9
9	MTM	1.0
9	MTM	1.0
9	MTM	1.0
9	MTM	1.0
9	MTM	1.0
9	MTM	1.0
9	MTM	1.0
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.1
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.2
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9	MTM	1.8
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9	MTM	2.0
9	MTM	2.1
9	MTM	2.1

9	MTM	2.2
9	MTM	2.2
9	MTM	2.2
9	MTM	1.2
9	MTM	1.2
9	MTM	1.4
9	HTM	1.3

TR-10

Epibenthos

TrID	Q. No.	Zone	Cerithideopsilla cingulata	Nassarius spp.	Telescopium telescopium	Neritina violacea	Assiminea	Crabs	Uca sp	Oyster	Barnacles	Hermit crab	Elysia cf bengalensis	Fish
10	1	LTM	0	0	0	0	0	0	0	0	0	0	0	0
10	2	LTM	0	0	0	2	0	0	0	0	0	0	0	0
10	3	LTM	0	0	1	0	0	0	0	0	0	0	0	0
10	4	MTM	0	0	2	3	0	0	0	0	0	0	0	0
10	5	MTM	57	0	0	2	0	0	0	0	0	0	0	0
10	6	MTM	0	0	2	4	0	3	0	0	0	0	0	0
10	7	HTM	36	0	0	0	0	0	0	0	0	0	0	0
10	8	HTM	0	0	0	0	0	0	0	0	0	0	0	0
10	9	HTM	0	0	0	0	0	0	0	0	0	0	0	0

Endobenthos

TrID-Zone	Polychaetes	Amphipoda	Isopoda	Tanaides	Gastropods	Pelecypods	Sponge	Flatworm	Shrimp	Fish larvae	Fish
10-HTM	194.86	64.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-HTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-MTM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-LTM	3182.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-LTM	2078.49	389.72	0.00	0.00	0.00	64.95	0.00	0.00	0.00	0.00	0.00
10-LTM	1753.73	0.00	0.00	324.76	0.00	259.81	0.00	0.00	0.00	0.00	0.00

Size Class Data for C. cingulata

TR_ID	Zone	Size (in cm)
10	MTM	0.7
10	MTM	0.9
10	MTM	0.9
10	MTM	0.9
10	MTM	0.9
10	MTM	0.9
10	MTM	0.9
10	MTM	1.0
10	MTM	1.0
10	MTM	1.0
10	MTM	1.0
10	MTM	1.1
10	MTM	1.1
10	MTM	1.1
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10	MTM	1.1
10	MTM	1.1
10	MTM	1.1
10	MTM	1.1
10	MTM	1.2
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10	MTM	1.2
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10	MTM	1.3
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10	MTM	1.5
10	MTM	1.6
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10	MTM	1.6
10	MTM	1.6
10	MTM	1.6
10	MTM	1.7
10	MTM	1.7
10	MTM	1.7
10	MTM	1.8
10	MTM	1.9
10	MTM	1.9
10	MTM	2.0
10	MTM	2.2
10	MTM	2.4
10	HTM	1.6
10	HTM	1.7
10	HTM	1.8
10	HTM	1.8
10	HTM	1.9
10	HTM	1.9
10	HTM	1.9
10	HTM	1.9
10	HTM	2.0
10	HTM	2.0
10	HTM	2.0
10	HTM	2.1
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10	HTM	2.1
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10	HTM	2.3
10	HTM	2.3
10	HTM	2.4
10	HTM	2.4
10	HTM	2.4
10	HTM	2.4
10	HTM	2.5
10	HTM	2.5
10	HTM	2.5
10	HTM	2.6
10	HTM	2.6
10	HTM	2.7

Annexure 3
Raw data collected during vegetation surveys

A. Trees and shrubs(Macrofauna)

1	*Aegiceras corniculata*	Myrsinaceae	S	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	5	5
2	*Ceriops tagal*	Rhizophoraceae	S	0	0	1	0	0	0	2	0	3	0	1	0	0	0	3	10	10
3	*Clerodendrum inerme*	Verbenaceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
4	*Kandelia candel*	Rhizophoraceae	S	1	0	0	2	0	0	0	1	2	0	0	0	0	0	0	6	6
5	*Lumnitzera racemosa*	Rubiaceae	S	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	6	6
6	*Salvadora parsica*	Salvadoraceae	S	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2
7	*Caesalpinia crista*	Caesalpiniaceae	SC	0	0	0	0	0	0	0	0	0		2	0	0	0	0	2	2
8	*Dalbergia horrida*	Fabaceae	Sc	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
9	*Derris scandens*	Fabaceae	Sc	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
10	*Derris trifoliata*	Fabaceae	Sc	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
11	*Avicennia marina*	Avicenniaceae	T	0	4	3	3	3	1	2	0	0	5	0	2	0	3	2	28	28
12	*Avicennia officinalis*	Avicenniaceae	T	4	1	2	0	1	1	1	0	1	0	0	3	0	0	1	15	15
13	*Bruguiera cylindrica*	Rhizophoraceae	T	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	4	4
14	*Bruguiera gymnorhiza*	Rhizophoraceae	T	0	1	0	0	1	0	0	0	2	0	0	0	0	0	1	5	5
15	*Excoecaria agallocha*	Euphorbiaceae	T	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	4	4
16	*Pongamia pinnata*	Fabaceae	T	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3	3
17	*Rhizophora apicalata*	Rhizophoraceae	T	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2	2
18	*Rhizophora mucronata*	Rhizophoraceae	T	0		1	0	0	3	0	1	3	0	0	3	0	0	2	13	13
19	*Sonneratia alba*	Sonneratiaceae	T	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	4	4
20	*Sonneratia apetala*	Sonneratiaceae	T	0	0	0	0	0	1	0	1	0	0	0	0		0	0	2	2
21	*Thespepsia populnea*	Malvaceae	T	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
				5	**6**	**7**	**6**	**5**	**8**	**7**	**3**	**12**	**11**	**11**	**10**	**6**	**12**	**9**	**118**	

B. Ground cover expressed on % coverage; p = present, indicates very low percentage)

	Herbs/ undershrubs																
1	*Acrostichum aureum*	Pteridaceae		5			10									15	
2	*Aeluropus lagopoides*	Poaceae		p									p				
3	*Crotolaria verrucosa*	Fabaceae		p											P		
4	*Cynodon sp.*	Poaceae				p				10							
5	*Cyperu sexaltatus*	Cyperaceae								p	p						
6	*Cyperusiria*	Cyperaceae				p						p					
7	*Fimbristyllis littoralis*	Cyperaceae										p					
8	*Acanthus ilicifolius*	Acanthaceae						50		25				10			13

C. Seedling density of different species per quadrat

1	*Aegiceras corniculata*	Myrsinaceae	0	0	0	7	0	0	0	0	0	8	0	0	0	0	0	15	15
2	*Ceriops tagal*	Rhizophoraceae	0	0	5	0	2	0	2	0	3	0	1	0	0	0	3	16	16
3	*Clerodendrum inerme*	Verbenaceae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	*Kandelia candel*	Rhizophoraceae	1	0	0	2	0	0	0	4	5	0	0	0	0	0	0	12	12
5	*Lumnitzera racemosa*	Rubiaceae	0	0	0	0	0	0	0	0	0	0	13	0	0	9	0	22	22
6	*Avicennia marina*	Avicenniaceae	0	10	7	3	6	9	15	0	0	5	0	9	0	3	2	69	69
7	*Avicennia officinalis*	Avicenniaceae	4	5	2	0	4	1	1	0	4	0	0	4	0	0	1	26	26
8	*Bruguiera cylindrica*	Rhizophoraceae	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	4	4
9	*Bruguiera gymnorhiza*	Rhizophoraceae	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	4	4
10	*Excoecaria agallocha*	Euphorbiaceae	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	4	4
11	*Pongamia pinnata*	Fabaceae	0	0	0	0	0	0	0	0	0	5	1	0	1	0	0	7	7
12	*Rhizophora apicalata*	Rhizophoraceae	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2	2
13	*Rhizophora mucronata*	Rhizophoraceae	0	6	9	0	3	8	0	4	8	0	0	6	0	0	2	46	46
14	*Sonneratia alba*	Sonneratiaceae	0	0	0	0	0	0	0	0	0	5	3	0	5	0	0	13	13
15	*Sonneratia apetala*	Sonneratiaceae	0	0	0	0	0	2	0	4	0	0	0	0		0	0	6	6
16	*Thespepsia populnea*	Malvaceae	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
			5	**22**	**23**	**12**	**16**	**22**	**20**	**12**	**22**	**23**	**12**	**21**	**10**	**9**	**9**	238	238

D. GBH (Girth at 1.3m height) of each individual of all the species recorded in the quadrats

Quadrats	Species	GBH (cm)	Area of cross se-crion	Basal Cover (cm2)
TR1 I	*Avicennia officinalis*	48	576.00	
		39	380.25	
		24	144.00	
		35	306.25	
	Kandelia candel	23	132.25	1538.75
TR2 I	*Avicennia marina*	48	576.00	
		39	380.25	
		24	144.00	
		35	306.25	
	Avicennia officinalis	52	676.00	
	Bruguiera gymnorhyza	31	240.25	2322.75
TR2 II	*Aegiceras corniculata*	15	56.25	
	Avicennia marina	32	256.00	
		61	930.25	
		52	676.00	
	Avicennia officinalis	43	462.25	
		28	196.00	
	Rhizophora mucronata	25	156.25	2733.00
TR3 I	*Aegiceras corniculata*	17	72.25	
	Kandelia candel	15	56.25	
		16	64.00	
	Avicennia marina	75	1406.25	
		40	400.00	
		35	306.25	2305.00
TR4 I	*Avicennia marina*	69	1190.25	
		15	56.25	
		27	182.25	
	Avicennia officinalis	24	144.00	
	Bruguiera gymnorhyza	29	210.25	1783.00
TR4 II	*Avicennia marina*	71	1260.25	
	Avicennia officinalis	69	1190.25	
	Excocaria agalocha	34	289.00	
		28	196.00	
	Rhizophora mucronata	25	156.25	
		27	182.25	
		22	121.00	
	Sonneratia alba	33	272.25	3667.25
TR4 III	*Ceriopsis tagala*	15	56.25	
		15	56.25	

Quadrats	Species	GBH (cm)	Area of cross se-crion	Basal Cover (cm2)
	Avicennia officinalis	54	729.00	
	Excocaria agalocha	21	110.25	
	Rhizophora apiculata	21	110.25	2238.50
TR5 I	*Kandelia candel*	19	90.25	
	Rhizophora mucronata	23	132.25	
	Sonneratia alba	20	100.00	
	Avicennia marina	58	841.00	
	Avicennia officinalis	48	576.00	1739.50
TR6 I	*Ceriopsis tagala*	20	100.00	
		22	121.00	
		15	56.25	
	Kandelia candel	17	72.25	
		18	81.00	
	Avicennia officinalis	48	576.00	
		31	240.25	
		32	256.00	
		17	72.25	
		15	56.25	
		17	72.25	
		22	121.00	1824.50
TR7 I	*Aegiceras corniculata*	15	56.25	
		16	64.00	
		19	90.25	
		19	90.25	
	Avicennia marina	32	256.00	
		33	272.25	
		50	625.00	
		47	552.25	
		40	400.00	
	Pongamia pinnata	38	361.00	
	Sonneratia alba	28	196.00	2963.25
TR8 I	*Ceriops tagala*	23	132.25	
	Lumnitzera racemosa	23	132.25	
		15	56.25	
		18	81.00	
		19	90.25	
	Caesalpinia crista	15	56.25	
		15	56.25	
		15	56.25	
	Bruguiera cylindrical	17	72.25	
	Pongamia pinnata	25	156.25	
	Sonneratia alba	25	156.25	
		26	169.00	1214.50
TR8 II	*Avicennia marina*	44	484.00	

Quadrats	Species	GBH (cm)	Area of cross se-crion	Basal Cover (cm2)
	Avicennia officinalis	41	420.25	
		38	361.00	
		15	56.25	
	Bruguiera gymnorhiza	15	56.25	
		22	121.00	
	Rhyzophora mucronata	25	156.25	
		24	144.00	
		28	196.00	2436.00
TR9 I	*Dalbergia horrida*	15	56.25	
	Derris scandens	16	64.00	
	Excocari aagalocha	31	240.25	
	Pongamia pinnata	35	306.25	
	Sonneratia alba	32	256.00	
	Thespesia populnea	35	306.25	1229.00
TR10 I	*Clerodendron inermis*	15	56.25	
		15	56.25	
		15	56.25	
	Lumnitzera racemosa	18	81.00	
		17	72.25	
		20	100.00	
	Salvadora persica	16	64.00	
		16	64.00	
		16	64.00	
		15	56.25	
		16	64.00	
	Bruguiera cylendrica	23	132.25	866.50
TR10 II	*Ceriopsis tagala*	16	64.00	
		18	81.00	
		19	90.25	
	Avicennia marina	44	484.00	
		48	576.00	
	Avicennia officinalis	41	420.25	
	Rhizophora mucronata	28	196.00	
		25	156.25	
		24	144.00	

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Established to support the achievement of the Aichi targets of the Convention on Biological Diversity, the Project's overall goal is to contribute to conservation and sustainable use of biodiversity in selected areas along the coast of India. Taking into consideration the economic importance of the coastal zone for large segments of the population, the Project's approach is people-centered, thus ensuring the support for conservation by those depending on coastal ecosystems.

CMPA Technical Report Series

48

Rapid Biodiversity Assessment of Ansure Creek, Rajapur Ratnagiri, Maharashtra

October 2014

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of :

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

Indo-German Biodiversity Programme
Conservation and Sustainable Management of Coastal and Marine Protected Areas