

**TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LTD.
UPPUR THERMAL POWER (TPP) PROJECT (2X800 MW),
RAMANATHAPURAM DISTRICT, TAMILNADU**

**DETAILED IMPACT ASSESSMENT STUDY DUE TO THE CONSTRUCTION OF THE
INTAKE AND OUTFALL JETTY FOR UPPUR TPP ON THE SEAGRASS AND
DUGONG HABITATS IN AND AROUND THE PROJECT AREAS OF UPPUR TPP,
DISTRICT RAMANATHAPURAM, TAMILNADU**



**CONSULTANTS
WAPCOS LIMITED**

**A Government of India Undertaking
Chennai**

**Dr. T. THANGARADJOU
Assistant Professor and Principal Investigator**

**Prof. Dr. T. BALASUBRAMANIAN
Advisor**

**Prof. K. KATHIRESAN
Director and Dean, Coordinator**

**CENTRE OF ADVANCED STUDY IN MARINE BIOLOGY
FACULTY OF MARINE SCIENCES, ANNAMALAI UNIVERSITY
PARANGIPETTAI-608 502, TAMILNADU, INDIA**

2015



INTRODUCTION

Seagrasses- the submerged marine angiosperms - diverse functions

- ✚ Ecological engineers
- ✚ Biological indicators
- ✚ Biological sentinels
- ✚ Coastal canaries

Coastal developmental activities – impact seagrass ecosystems - around the core site of activity

Detailed Impact Assessment study on Construction of the intake and outfall Jetty for Uppur Thermal Power Project on the Seagrass and Dugong habitats in and around the project areas of the Uppur TPP, Ramanathapuram District

OBJECTIVES

- ➡ To conduct a detailed survey for the presence of seagrass beds in 100 x 100 m grid, 7 km along the shore on either side of the Jetty
- ➡ To map the location of seagrass beds / meadows in the surveyed areas along with co-ordinates along with the density
- ➡ To identify the species of seagrasses present in the region.
- ➡ To calibrate the turbidity units NTU and ppm given in the specification and provide the turbidity increase in terms of NTU and g/l.
- ➡ To identify the direct and indirect (due increase in turbidity) impact of construction activity on the seagrass beds.
- ➡ To suggest mitigation measures to protect the seagrass beds during the construction and operation phase of the power plant.
- ➡ To identify the *Dugong dugon* habitats in the project areas and to quantify the probable numbers and frequency of visit to the seagrass meadows in the project area.
- ➡ To identify the impacts of the project on the Dugongs, if any and to suggest the mitigation measures.

STUDY AREA

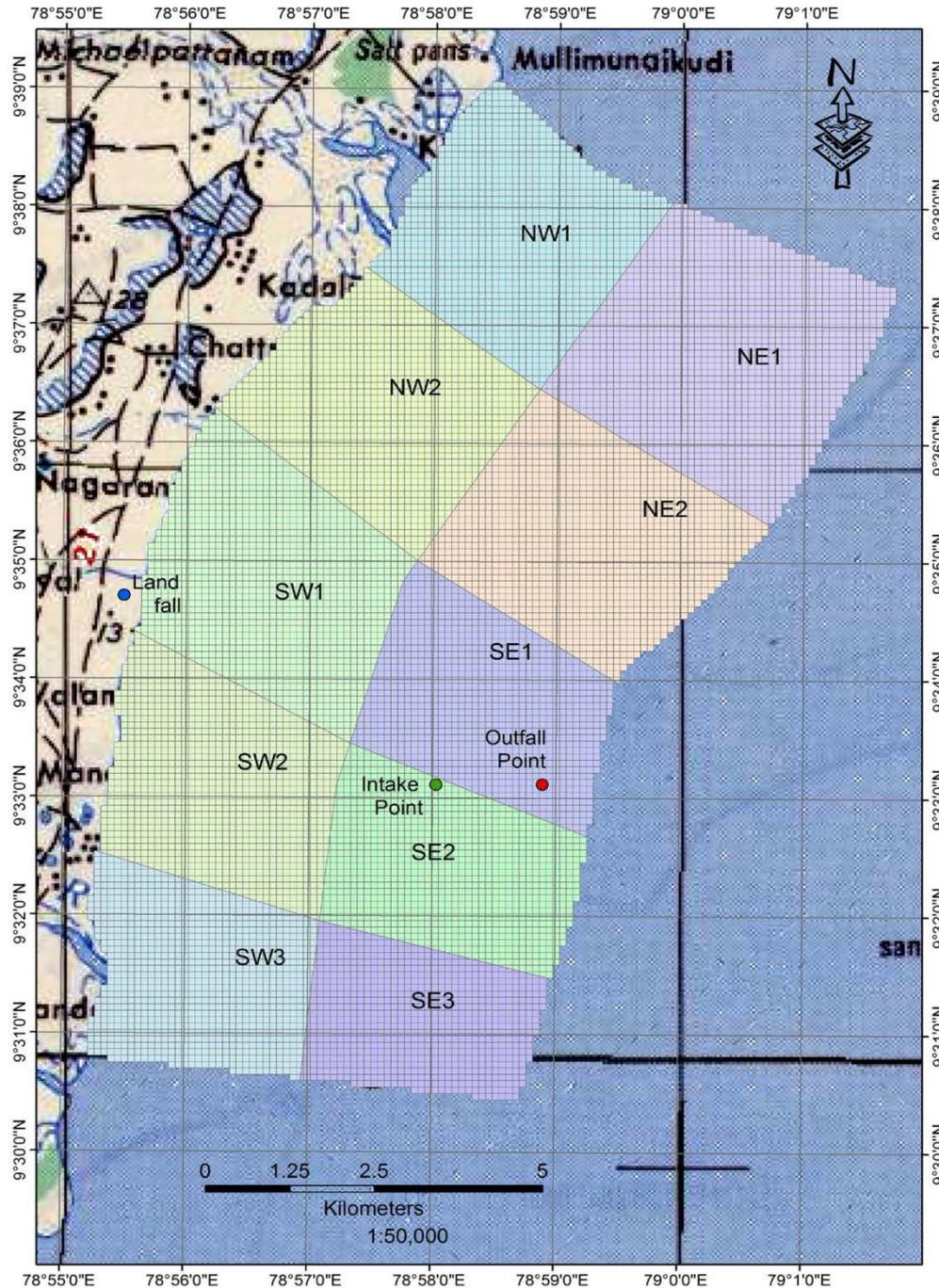
Uppur, Valamavoor and Thiruppalaikudi villages of Thiruvadanai Taluk, Ramanathapuram District.

Western side of East Coast Road Connecting Ramanathapuram and Pattukottai, at a distance of 29 km north of Ramanathapuram town.

Entire project site is divided into 10 region (North West 1 & 2, North east 1 & 2 South west 1, 2 & 3 and South east 1, 2 & 3)

100 x 100 m grid - 7 km along the shore on either side of the Jetty

Additional 2.4 km on the northern side of the jetty was covered by considering the geomorphological orientation of the coast so as to study entire stretch of seagrass beds (i.e. 16.4 km along the shore and 7 km perpendicular to the shore)



MATERIALS AND METHODS

✚ Distribution and biology of seagrasses

✚ Seagrass diversity Kannan and Thangaradjou (2006)

 Ramamurthy *et al.* (1992) / den Hartog (1970)

✚ Seagrass biomass, percentage cover and canopy height

✚ Turbidity and Total Suspended Solids measurement- **Nephlo Turbidity meter**

✚ Seagrass distribution maps

▪ Trimble Juno 3B hand held GPS with an accuracy of 1 m

▪ GPS data were used for plotting seagrass distribution maps

▪ Seagrass cover of the region was broadly classified into 6 classes

 Dense / Interrupted Dense

 Sparse / Interrupted Sparse

 Barren / Seagrass algal bed

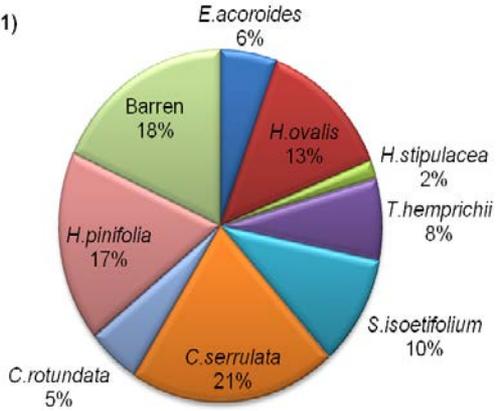
Seagrass species recorded in the region

S. No.	Species	NW1	NE1	NW2	NE2	SW1	SE1	SW2	SE2	SW3	SE3
1	<i>Enhalus accorides</i>	+	-	+	-	+	-	+	-	-	-
2	<i>Halophila ovalis</i>	+	+	+	+	+	+	+	+	+	+
3	<i>H. ovata</i>	-	+	-	-	-	+	+	-	-	-
4	<i>H. stipulacea</i>	+	+	-	+	-	+	-	-	-	+
5	<i>Thalassia hemprichii</i>	+	-	-	-	-	-	-	-	-	-
6	<i>Syringodium isoetifolium</i>	+	+	+	+	+	+	+	+	+	+
7	<i>Cymodocea serrulata</i>	+	+	+	+	+	+	+	+	+	+
8	<i>C. rotundata</i>	+	-	+	-	+	-	+	-	-	-
9	<i>Halodule pinifolia</i>	+	+	+	+	+	+	+	+	+	+
10	<i>H. uninervis</i>	-	+	+	+	-	+	+	+	+	-
11	<i>H. wrightii</i>	-	+	-	-	-	-	-	-	-	-
		8	8	7	6	6	7	8	5	5	5

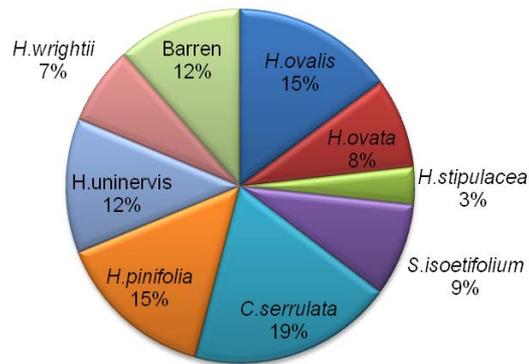
(+ denotes presence of the species; - denotes absence of the species)

Percentage⁷ cover

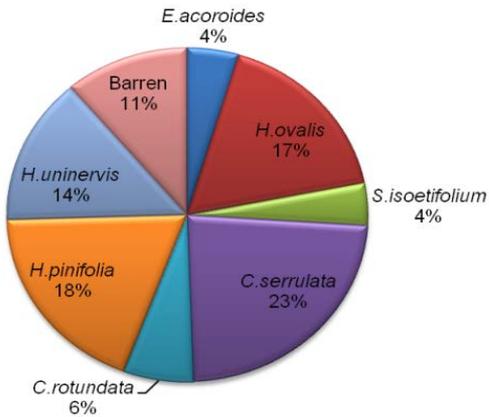
Region 1 (NW1)



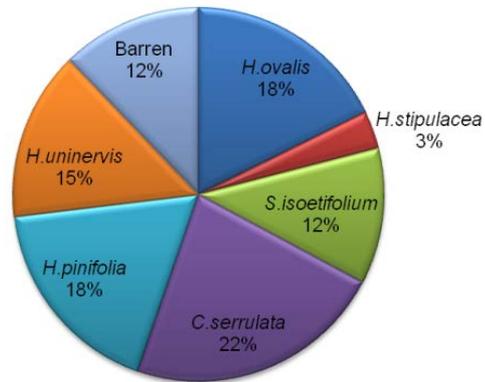
Region 2 (NE1)



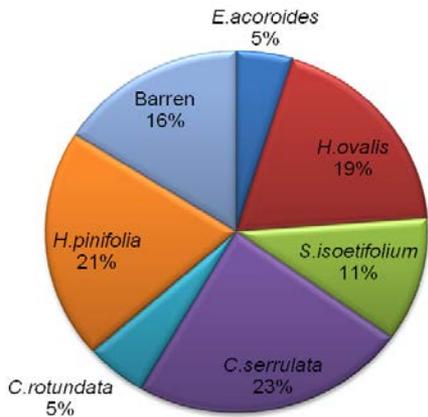
Region 3 (NW2)



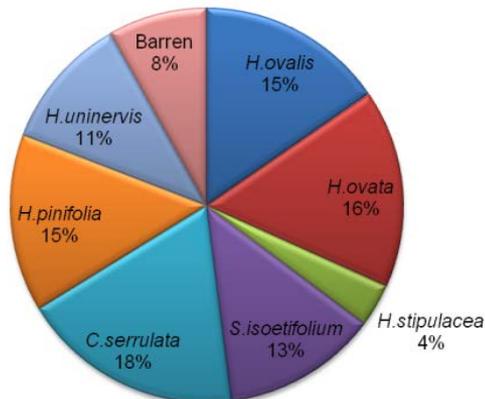
Region 4 (NE2)



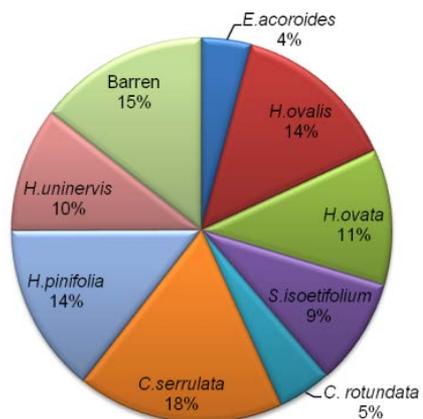
Region 5 (SW1)



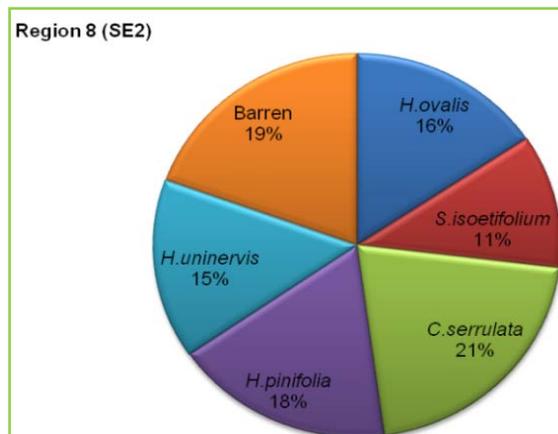
Region 6 (SE1)



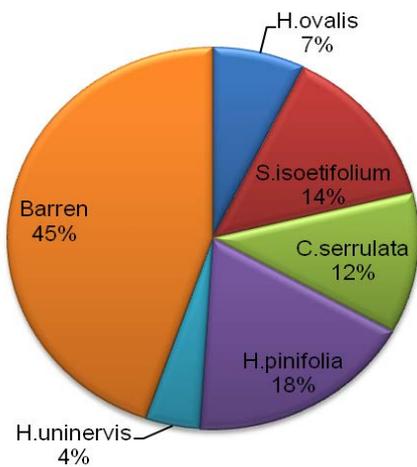
Region 7 (SW2)



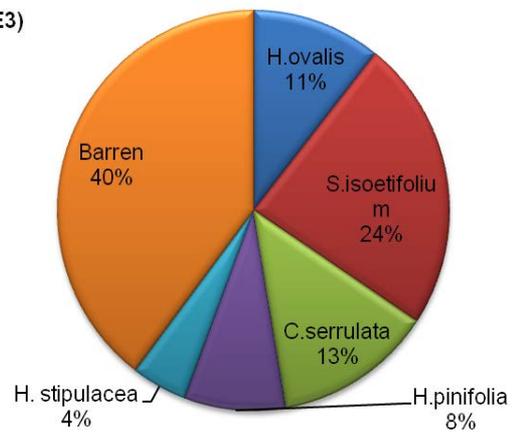
Region 8 (SE2)



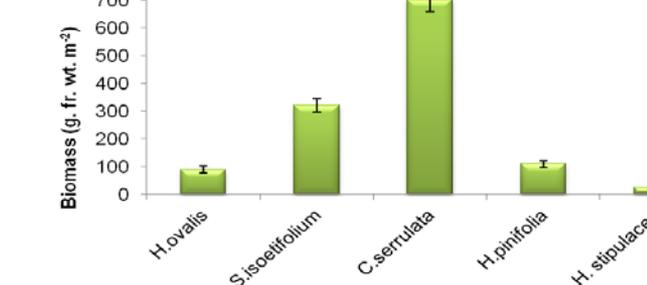
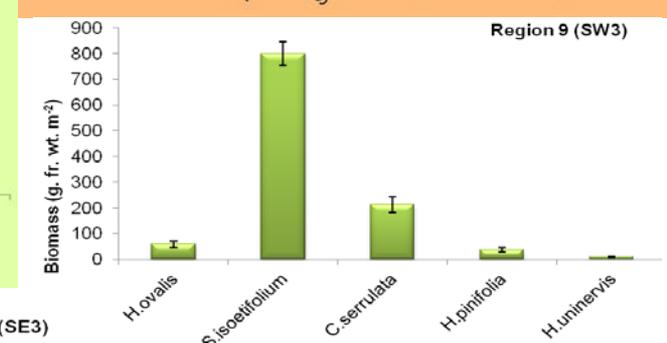
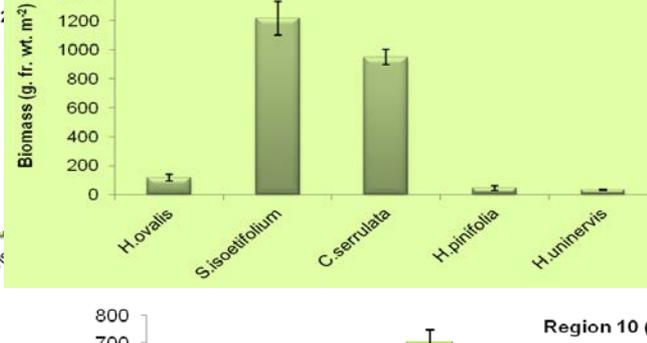
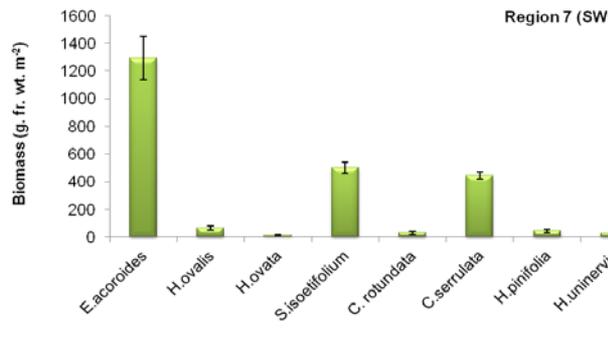
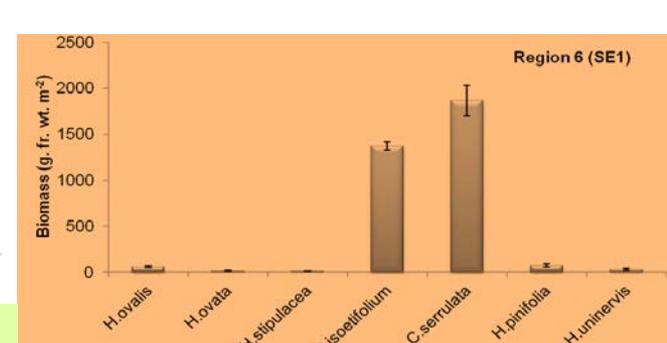
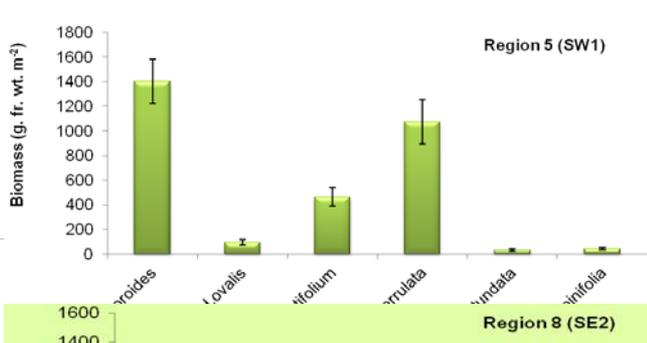
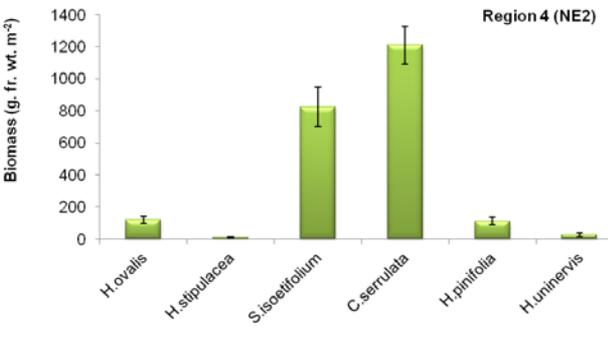
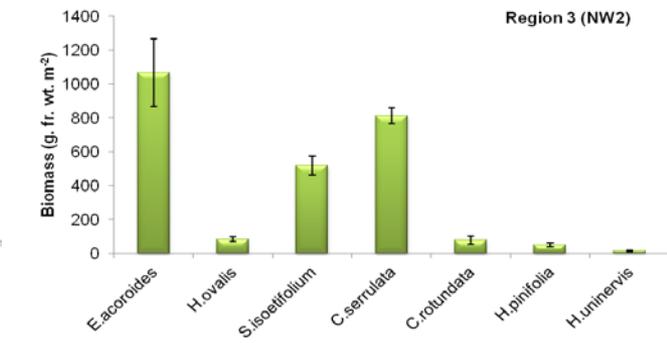
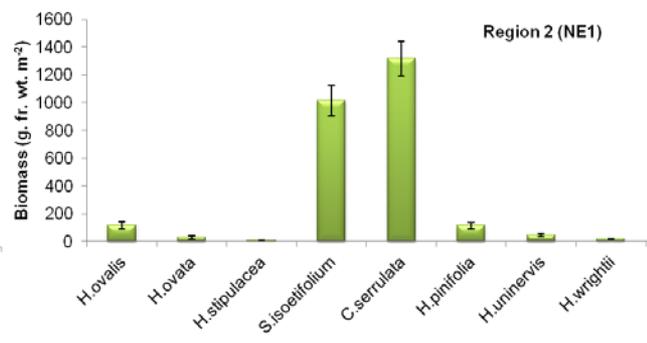
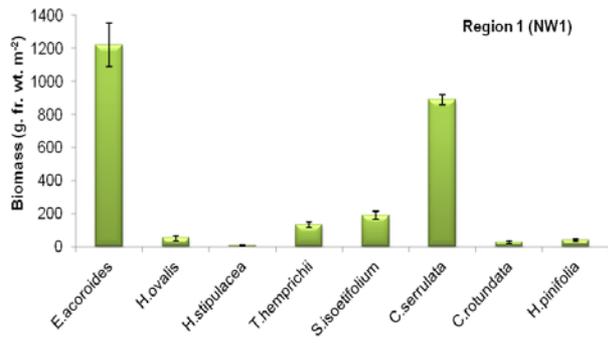
Region 9 (SW3)



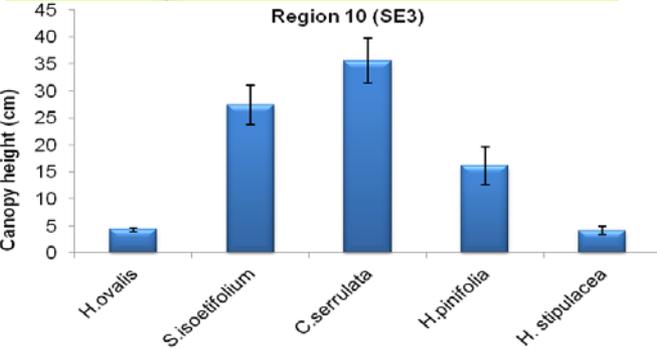
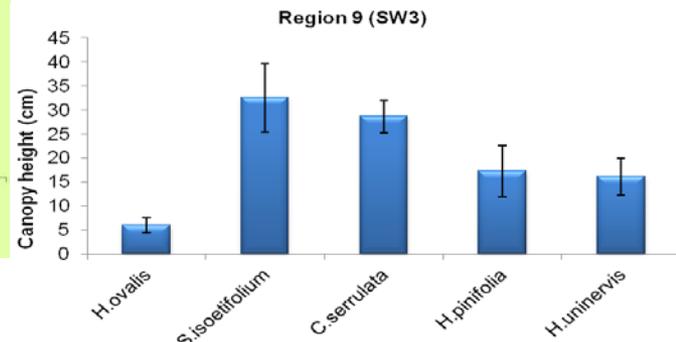
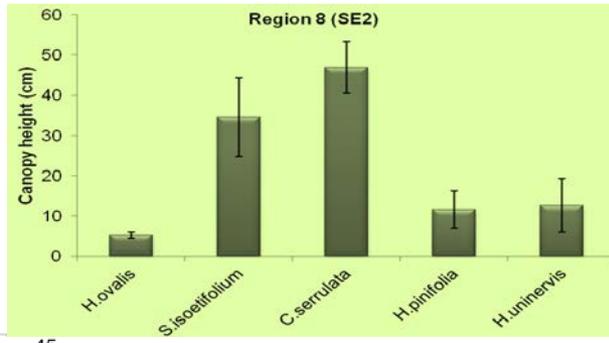
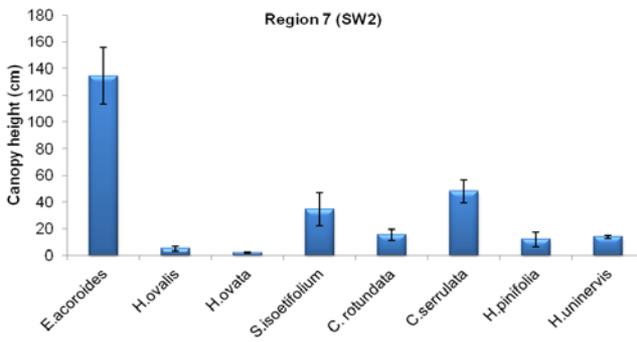
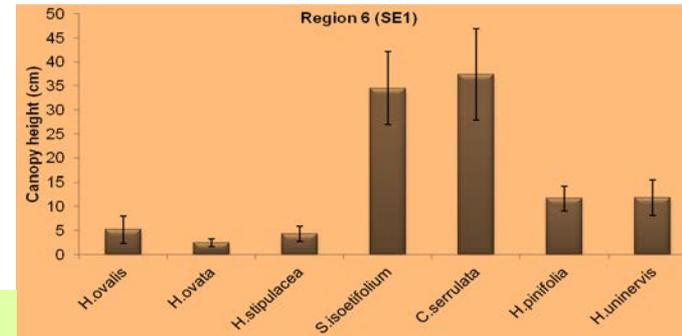
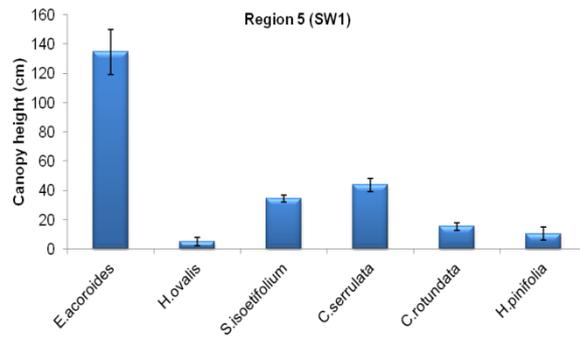
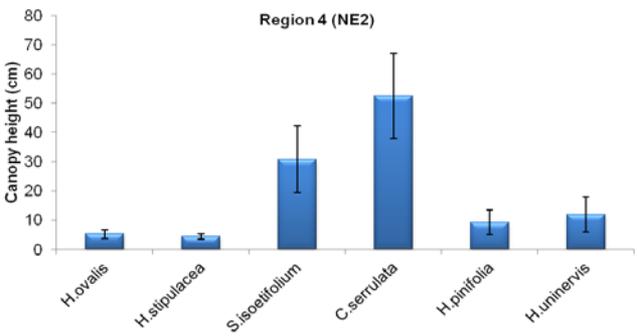
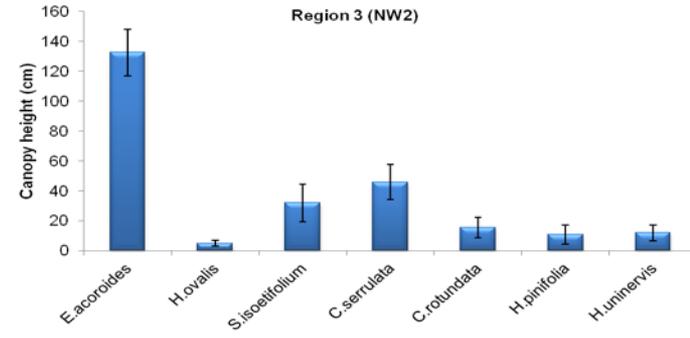
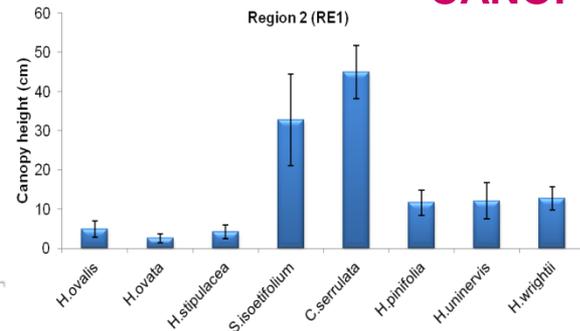
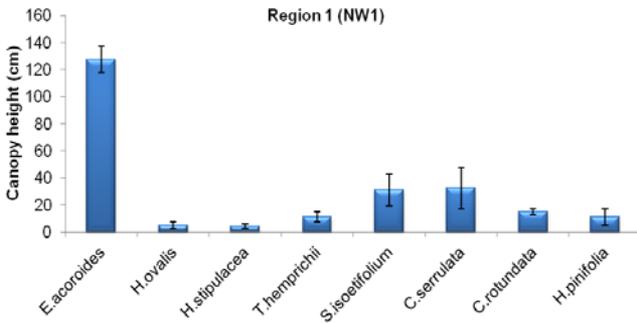
Region 10 (SE3)



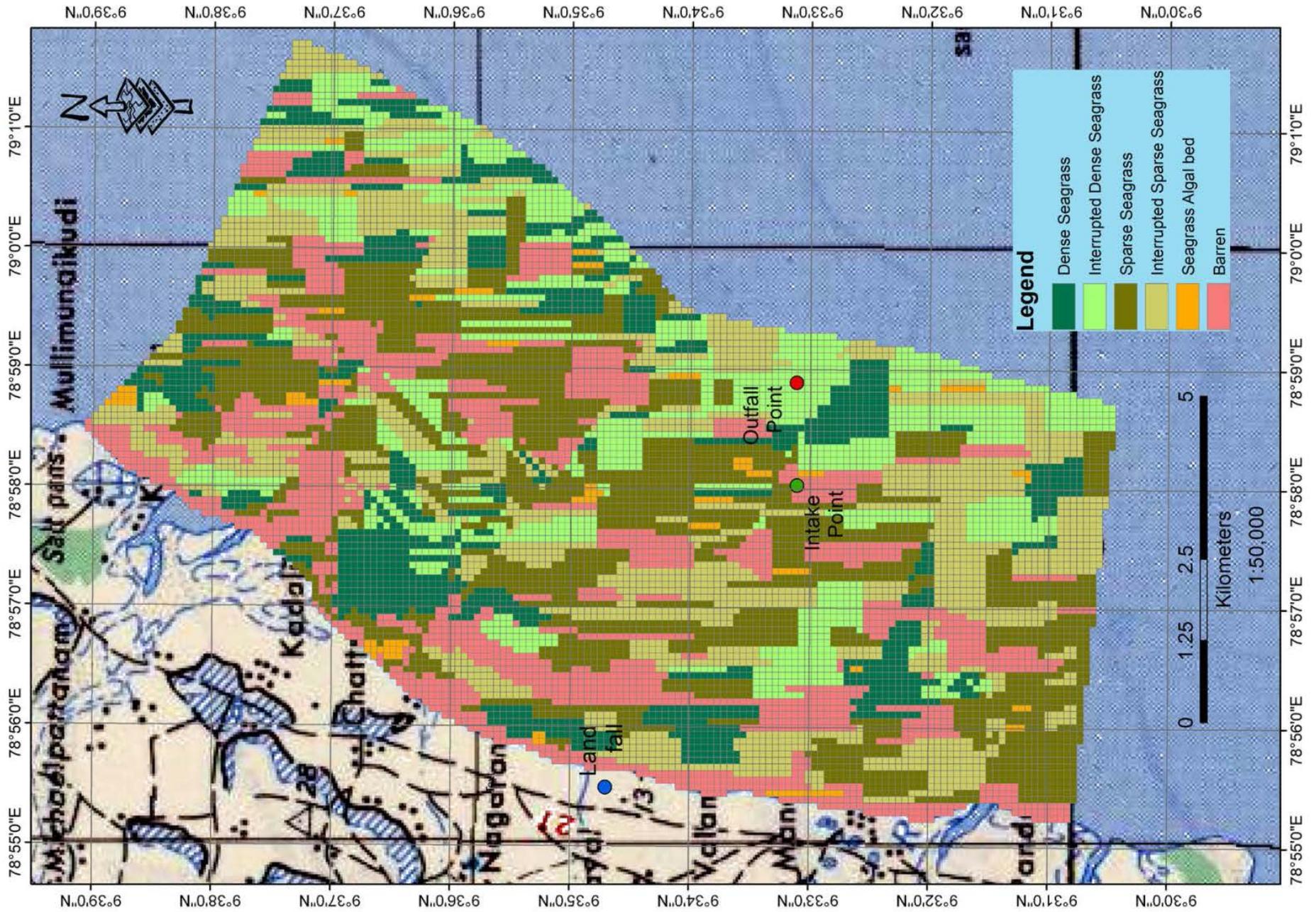
BIOMASS OF THE SEAGRASSES



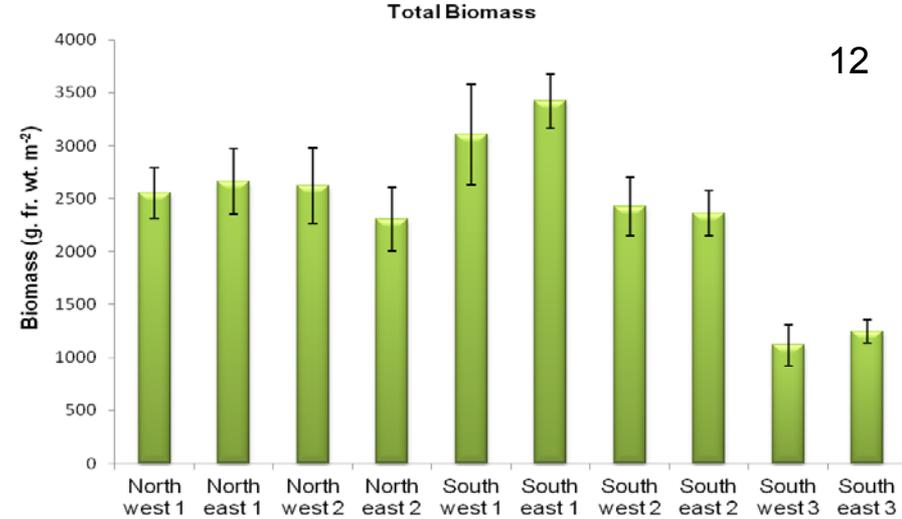
CANOPY HEIGHT OF THE SEAGRASSES



SEAGRASS MAPPING IN THE UPPUR REGION



Sl. No.	Class	No. Grids
1.	Dense Seagrass	1565
2.	Interrupted Dense Seagrass	1843
3.	Sparse seagrass	3138
4.	Interrupted Sparse Seagrass	2444
5.	Seagrass Algal Bed	169
6.	Barren	2250
Total cover		11409



49 % of the grids are covered by sparse and interrupted sparse seagrass
 30% of the grids are covered by dense / interrupted dense beds
 20 % of the grids are barren and 1% seagrass algal beds

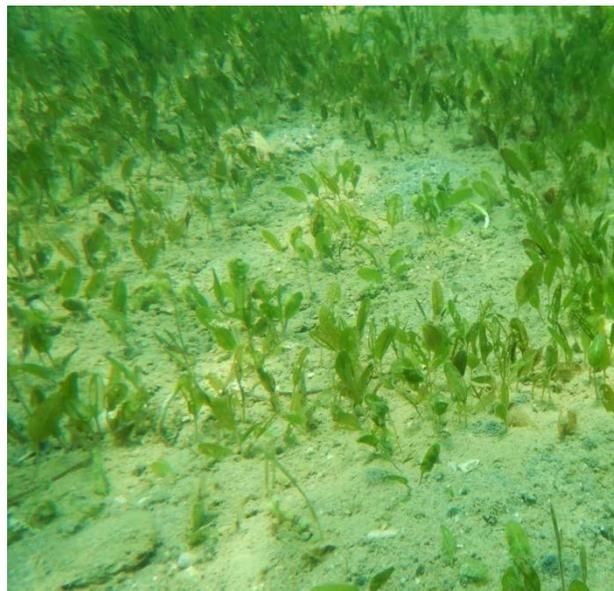
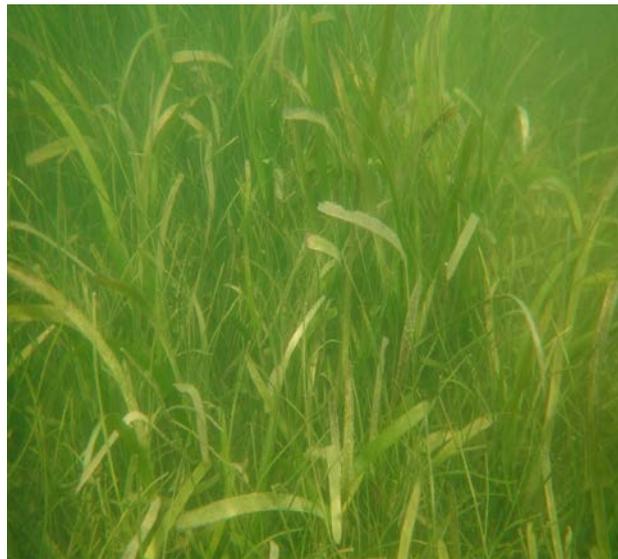
Seagrass beds along the shore up to 3 km range perpendicular to the coast are experiencing with high siltation

Most of these seagrass species are annual plants hence they will replenish the biomass at the end of the year immediately after the north east monsoon season.

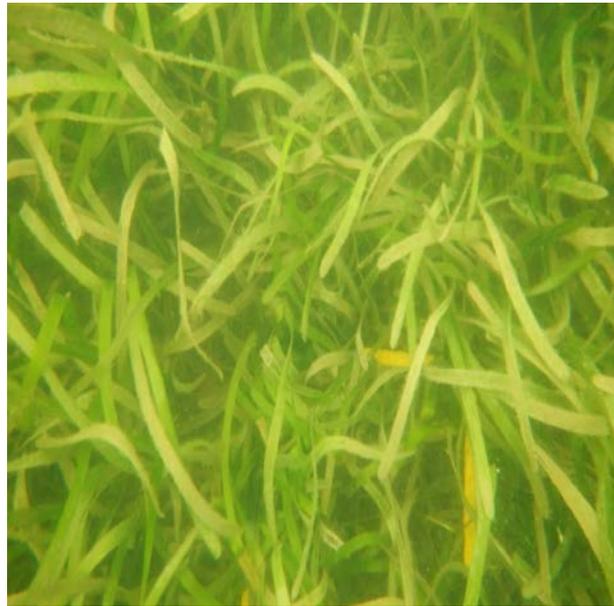
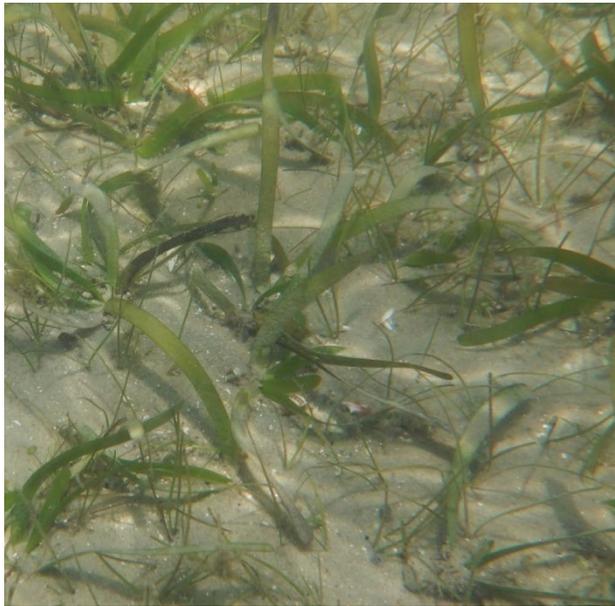
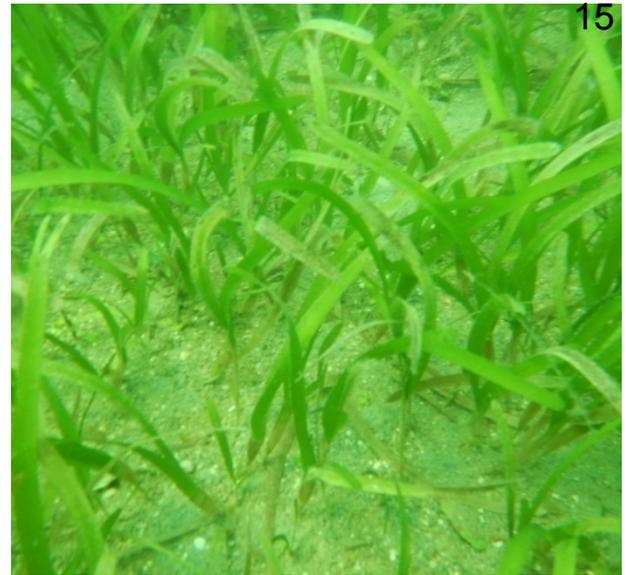
Meadows supports interesting marine - star fishes, sea cucumbers, sea horse, sea anemones, jellyfish etc.

Ranges of environmental variables recorded from the seagrass meadows of India and Palk Bay

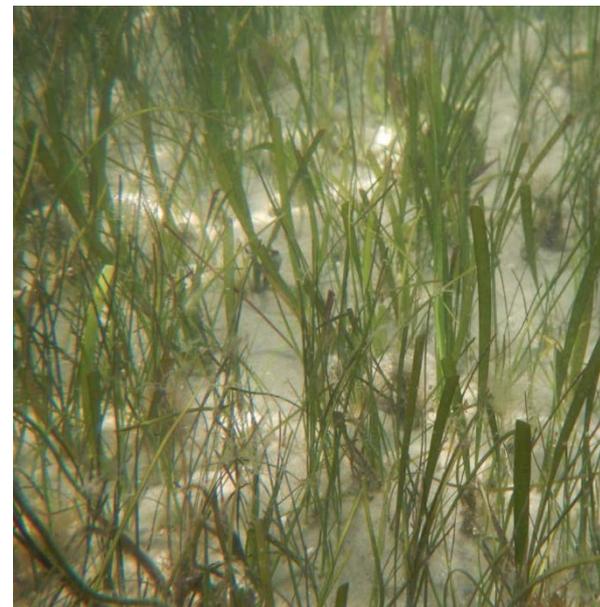
ECOLOGICAL PARAMETER	INDIA	PALK BAY
Atmospheric Temperature (°C)	17.2 - 38	25.5 – 37.7
Surface Water Temperature(°C)	24 - 36.2	25 – 36.2
Water pH	7.0- 8.9	7.0 – 8.9
Salinity (‰)	18.32 – 39.4	28 – 39.4
Turbidity (NTU)	1.1 – 283	110 – 283
DO (ml)⁻¹	3.15 - 13	3.19 – 8.1
LUX	28000 - 144000	DNA
LEC (k)	0.54 – 6.23	1.24 – 6.23
Phosphate (µM)	0.02 – 20.12	0.02 – 20.12
Nitrate (µM)	0.25 – 19.2	0.25 – 7.3
Nitrite (µM)	0.02 – 20.58	0.02 – 20.58
Silicate (µM)	0.18 – 77.36	0.18 – 77.36
POC (µgCl)⁻¹	0.28 – 5.9	0.59 – 2.86
Sediment salinity	26 – 36	33 - 35
Sediment pH	7.1 – 8.3	7.1 – 8.3
Sediment Eh (mV)	(-)73.3 – 56.3	-62.2 – 56.3
Sediment Temperature (°C)	27.6 – 30	DNA
Nitrogen (kg/ha)	34.22 - 68.41	DNA
Phosphorus (kg/ha)	25.41 – 52.26	DNA – Data not available



HEALTHY SEAGRASS MEADOWS IN THE UPPUR REGION



HEALTHY SEAGRASS MEADOWS IN THE UPPUR REGION



HEALTHY SEAGRASS MEADOWS IN THE UPPUR REGION

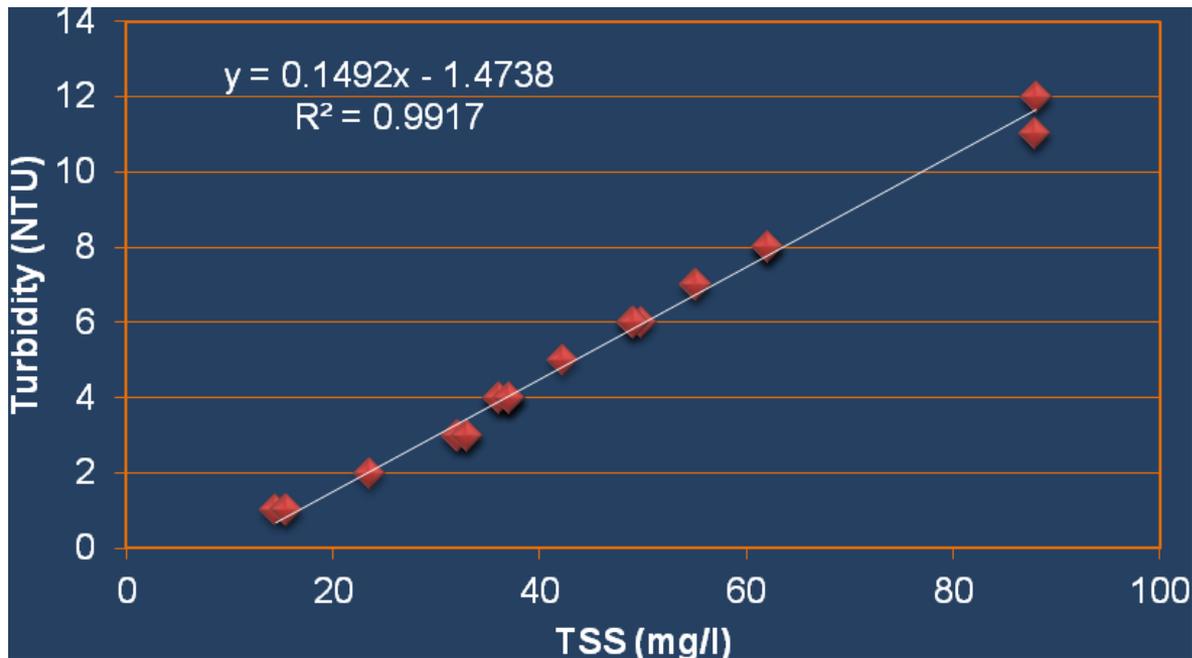


MARINE ANIMALS ASSOCIATED WITH THE SEAGRASS MEADOWS IN THE UPPUR REGION



MARINE ANIMALS ASSOCIATED WITH THE SEAGRASS MEADOWS IN THE UPPUR REGION

DETERMINING CORRELATION BETWEEN NEPHLO TURBIDITY UNIT (NTU) AND TOTAL SUSPENDED SOLIDS (TSS) IN THE NATURAL WATERS



**Turbidity recorded during the survey period
14.661 and 88.04 mg/l (ppm) or 1 – 12 NTU**

**Turbidity during base line survey
29.2 - 66.2 mg/l (ppm) or 2 – 6 NTU**

Expected increase of 20 ppm (mg/l) turbidity during the construction period
up to 600 m region

DETAILS OF DUGONG DUGON HABITATS, THE PROBABLE NUMBERS AND FREQUENCY OF VISITS TO THE SEAGRASS MEADOWS IN THE PROJECT AREA

- Dugongs - selective on their food habit - prefer seagrasses such as *Halophila* sp., *Halodule uninervis*, *Cymodocea* sp., and *S. isoetifolium*
- Voracious eaters (40 kg / day/animal) with their mouth modified to suit the feeding habit.
- Dugong, once abundant in Indian water – recent reports indicate 200 individuals in Indian waters
- Decline in Palk Bay region - specific threats such as habitat loss and degradation, vessel strikes, gill netting, poaching and accidental catch in net.
- About 70% of the fishermen reported occasional sighting of Dugong in the region.
- 65% of the fishermen have sighted Dugongs within last 3 years - minimum of one Dugong was sighted per month in the Palk Bay

- Tedious to figure out the exact number of Dugongs – regional migratory in nature and selective in feed preference.
- Numbers are tentative and not provided with exact time periods of sightings; No data on exact population in the region.
- At least one animal per month in the region Palk Bay provides an insight of comparatively lesser population in the region.
- There is no ways and means of ensuring that all these animals sighted are same population or different.
- There is no sighting of dugong and there are no evidences for Dugong feeding scars in the region.

Dugong feeding²²

- ➡ Animal is usually 3 m long and 450 kg in weight
- ➡ New born calf 1 m long and 35 kg weight
- ➡ Alive up to 70 years 14-17 years to mature

Consume 40-50 kg of seagrass / day

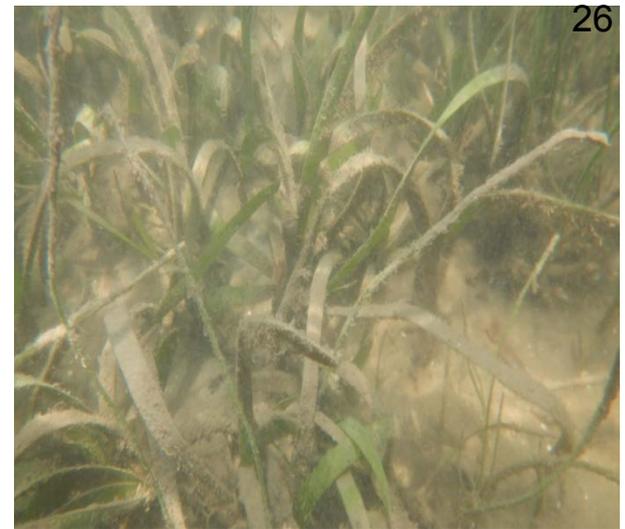
Prefers - rich in nitrogen and poor in fiber



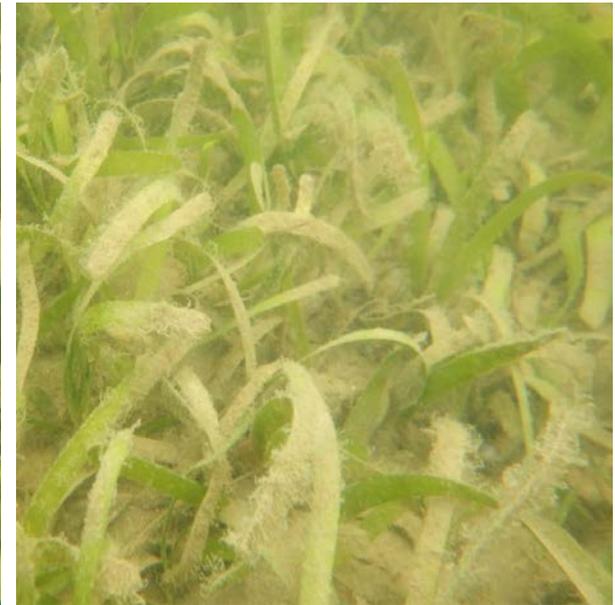
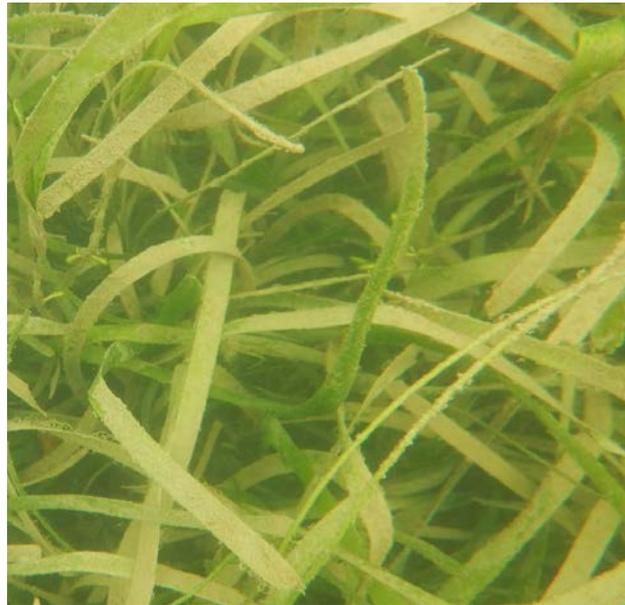
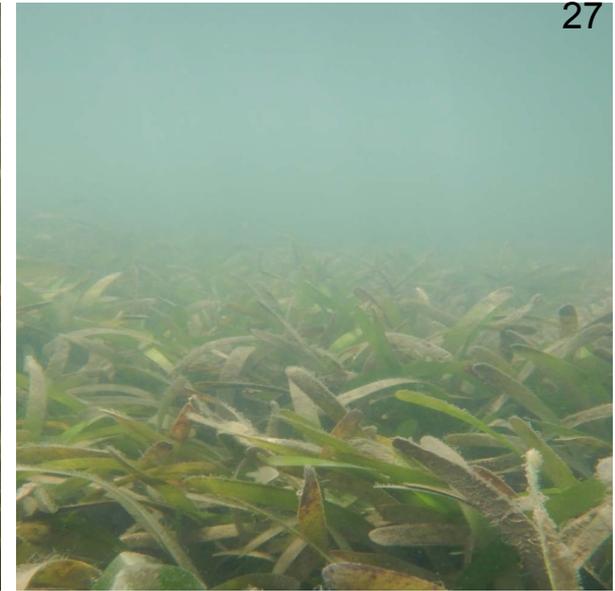
IMPACT OF THE INCREASE IN TURBIDITY AND DIRECT IMPACT DUE TO CONSTRUCTION ACTIVITY ON THE SEAGRASS BEDS

- Possibilities of **physical damage** to the seagrass beds in the regions of piling- may extend over an area of 5 m buffer as handling area
- Physical damages may lead to the **habitat fragmentation**. Proposed 20 m gap between the consecutive piling is an advantage and provides **substantial buffer to the recovery of the beds** so as to maintain the integrity of the seagrass meadows.
- Negligible effects on the wave characteristics
- Existing literatures indicates that the turbidity of the seagrass beds of India varies from **1.1 to 283 NTU** where as it ranges between **110 and 283 NTU** in case of Palk Bay.
- The **persistence of such turbidity for the longer durations** of more than 10 days may have profound effect on the productivity of the seagrass beds.

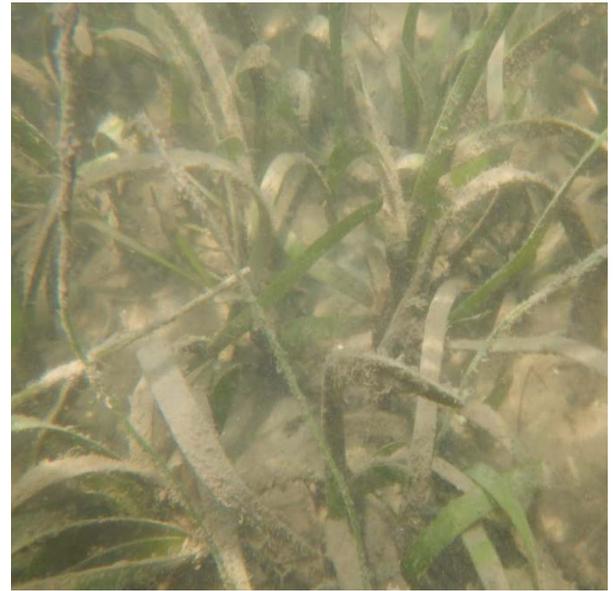
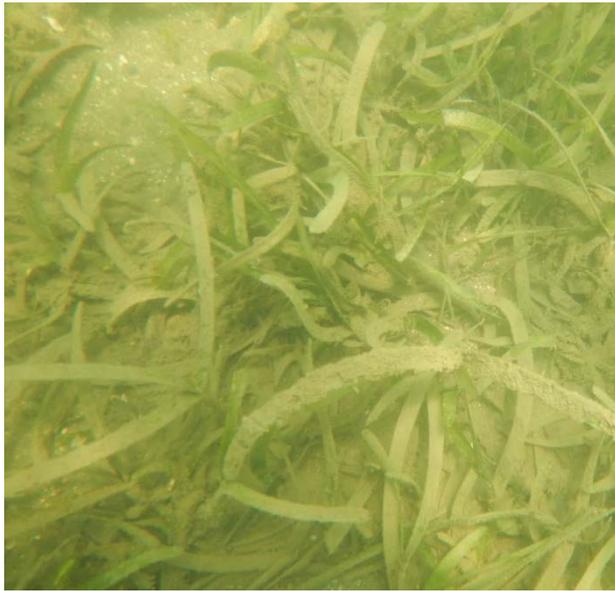
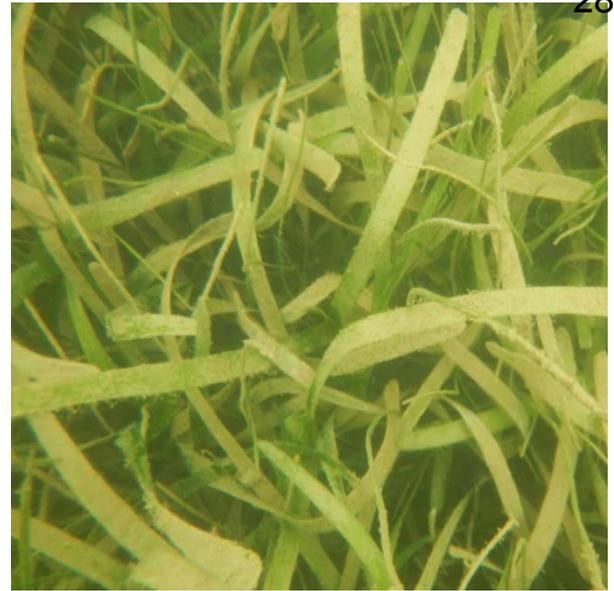
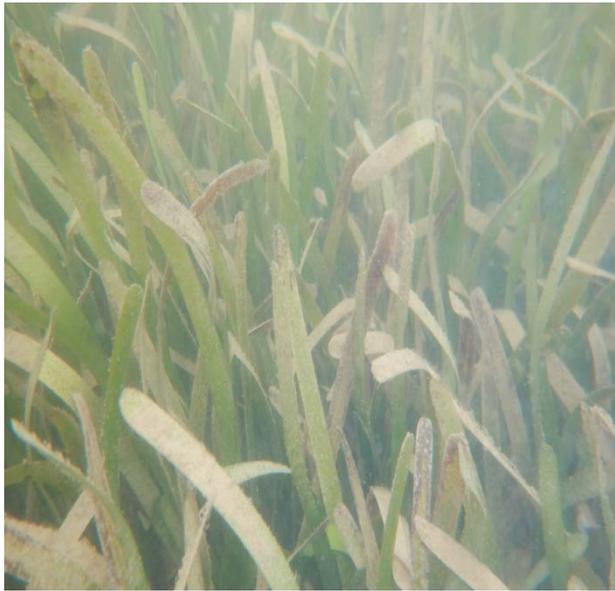
- Turbidity mediated nutrient enrichment processes in the region during the construction phase may trigger the algal overgrowth in the region.
- Results supports that the raise in temperature due to coolant water will not really affect the seagrasses of the region, as the temperatures recorded for the Indian seagrasses ranges between 24 – 36.2°C while it is between 25 - 36.2°C in Palk Bay.
- The summer average of 31.5 °C in Palk Bay plus the expected maximum increase of seawater due to release of outfall water (0.75°C) would only result with 32.25°C, which is very much less than the maximum temperatures recorded for the region.



Siltation observed over the seagrass meadows in the Uppur region



Siltation observed over the seagrass meadows in the Uppur region



Siltation observed over the seagrass meadows in the Uppur region

MITIGATION MEASURES TO PROTECT THE SEAGRASS BEDS DURING THE CONSTRUCTION AND OPERATION PERIODS OF THE POWER PLANT

MITIGATION MEASURES DURING CONSTRUCTION PHASE

- Monitoring of turbidity must be regulated at every high and low tides and piling activities should be avoided in case of any high turbidity indications than the predicted values.
- Monitoring of nutrient levels including micro and macro algal blooming symptoms during the entire period of construction must be ensured.
- Suitable changes in the construction activities (including stopping piling activities) for short durations must be implemented. However, there will be not by issues in continuing above water construction activities during those phases.
- Piling activities must be avoided during post monsoon period (January to March months), when regeneration of the seagrasses occurs immediately after the north east monsoon.

MITIGATION MEASURES DURING CONSTRUCTION PHASE

- Regulated loading of piling materials in the planned tract must be ensured without causing much damage to adjacent 100 m grids
- Should avoid any disposal of solid wastes including of construction materials in and around the planned tracts so as to reduce solid waste accumulation in the seagrass area
- Monitoring of the seagrass meadows of the region during dry and wet seasons should be continued so as to ensure the health of the seagrasses in the region.
- A short term awareness session must be conducted to the laborer involved in construction of the inlet and outlet pipes before the start of the project so as to ascertain the importance of seagrass resources and to conserve dugongs and its habitat.

MITIGATION MEASURES DURING OPERATION PERIOD

- **Monitoring of seagrass beds** around the area at **every alternate year** has to be ensured so as to assess the health of the seagrass beds including the changes in species composition, so as to ensure the food sources for dugongs.
- Ensure the distribution of (*Halophila spp.*, *Halodule uninervis*, *Cymodocea sp.* and *Syringodium isoetifolium*) with its maximum density levels so as to ensure the presence of feeding grounds for dugong in the region. *Ensuring the feeding grounds in the region would ensure the survival of the existing population in the region.*
- **Conduct awareness about the good fishing practices** so as to avoid accidental killing and poaching of the dugongs in the region, which will lead to reduction in population of dugong. Failing which the reduction of dugong population by other means would rather correlated with the operation of power plant.

MITIGATION MEASURES DURING OPERATION PERIOD

- Restoration of seagrass beds in the denuded areas has to be taken up as CSR activity besides taking up the mangrove restoration activities in the coastal areas so as to ensure the coastal protection and also seabed stabilization.
- Consult with local communities to encourage their active participation in conservation efforts and establish education, awareness and information programmes for the local fisher folk.
- Make provisions to appoint couple of Marine Biologist in the environmental monitoring team so as to ensure the day to day monitoring of seagrass ecosystem around the project site.

THANK YOU