



Determining the offshore distribution, migration and movement of Olive Ridley sea turtles off Odisha coast in the Northern Indian Ocean

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**Project Period**  
 2007 to 2011

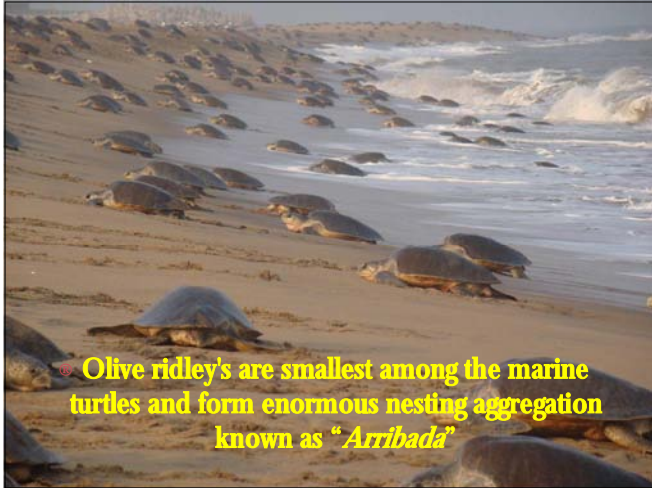
**FUNDED BY**  
 Director General of Hydrocarbons, Govt. of India

Planning an eco-compatible hydrocarbon exploration programme in critical coastal and marine habitat of olive ridley turtles along the orissa coast - a case study

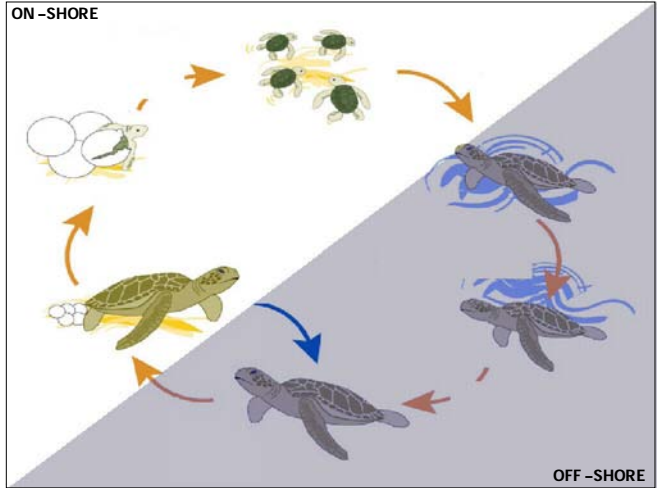


Collaborative Projects of

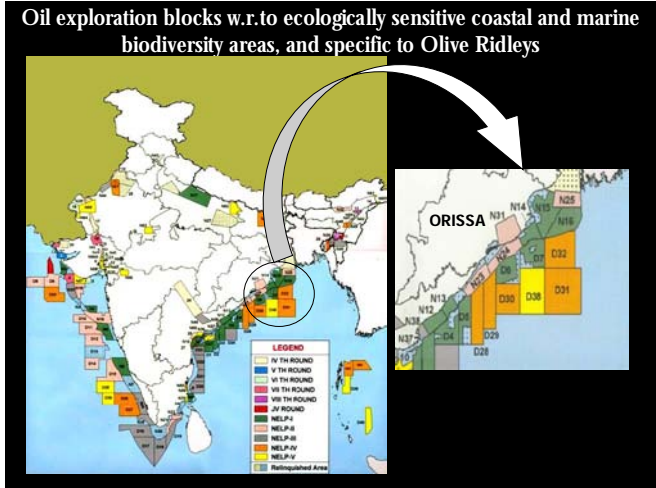




Olive ridley's are smallest among the marine turtles and form enormous nesting aggregation known as "Arribada"

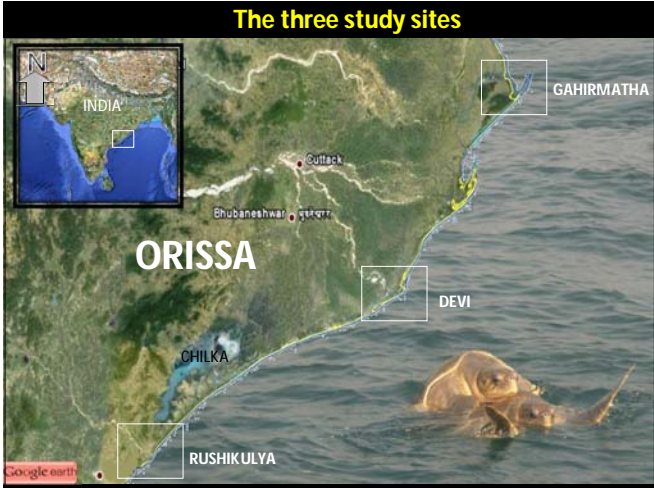


- Orissa coast supports 3 Olive ridley rookeries (mass nesting sites) at Gahirmatha, Devi and Rushikulya river mouth – **3 out of the 8 known in the world.**
- The breeding season begins in November** with the congregation of Olive ridleys in the offshore water of Orissa coast for **Mass nesting during February - March.**
- Ridleys remain in the coastal waters of Orissa from **November** (Pre-nesting arrival) **to April** (Post nesting departure)



- WHAT THE PROJECT WANTED TO FIND OUT ?**
- The **breeding congregation dynamics** of Olive ridleys in the off-shore waters of Orissa in time and space.
  - The **Onward and return migration path** of the Olive ridleys in the Bay of Bengal.
  - The **post nesting migration to the foraging grounds** in the marine environment and possible governing factors.
  - The factors affecting the **dynamics and ecological signature of the nesting beaches** and
  - The future of the on-shore nesting beaches with respect to **invasive developmental projects.**

- How was this conducted ?**
- Conducting off-shore congregation monitoring of olive ridleys.**
  - Monitoring of nesting beach dynamics, intensity of nesting and other ecological characteristics of onshore and offshore habitats.**
  - Satellite tracking of migrating Ridley's**
  - Monitoring coastal developmental activities.**

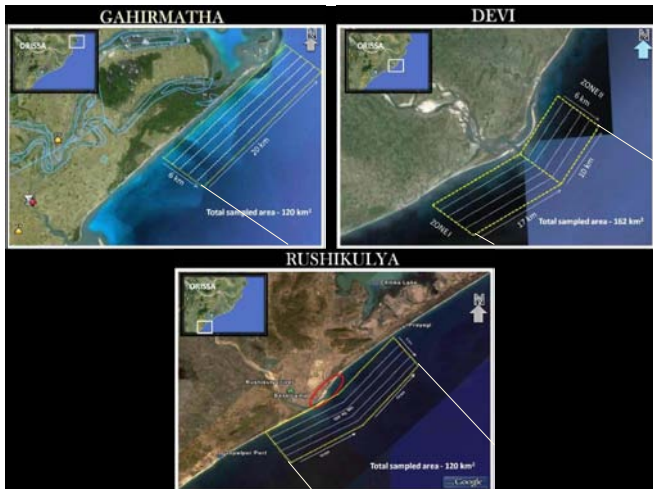


## OBJECTIVES

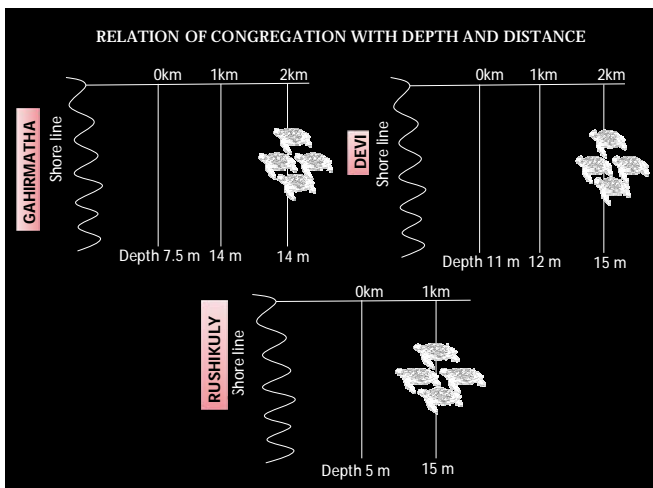
- ® To understand the **dynamics of the pre-nesting congregation** patch in space and time and
- ® To understand the impact of **fishing** with nesting.

## METHODS

- q Offshore line transect using a motorized boat having a width of 6 km (with 1 km interval) and length of 20 km encompassing an area of 120 km<sup>2</sup> was surveyed Nov- Apr. 2007-2010.
- q **Turtles sighting locations (GPS) in the transects including Distance and angle recorded. Density calculated using program DISTANCE 6.0.**
- q Sea depth was measured using laser depth sounder at every 1 km interval along the transect to create a bathymetry map.
- q **Location and number of fishing vessels encountered in the transect and adjacent areas.**



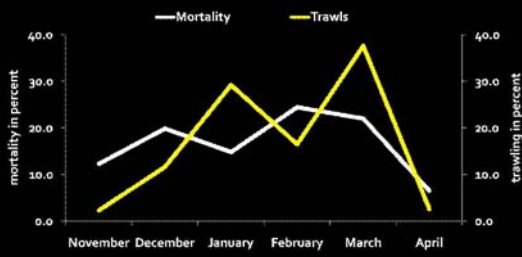
## RESULTS



## FISHERY INTERFACE

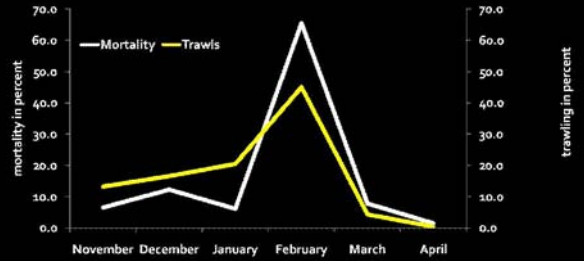


### Trawling pressure and turtle mortality at Gahirmatha



- Highest 40% of turtle mortality occurred during February
- Trawl activity was highest during March (38%)
- Total mortality in 2009-10 (N=2225)
- Total Trawlers encountered in 2009-10 (N = 6303)

### Trawling pressure and turtle mortality at Devi

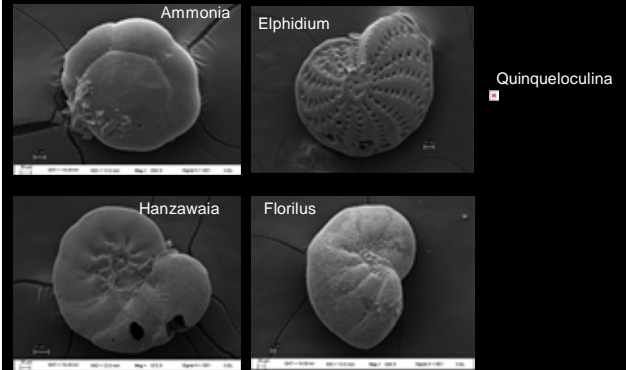


- Highest of 65% mortality was recorded during February
- Near shore trawling activity was highest during this time frame (46% trawls)
- Total mortality in 2009-10 (N=1900)
- Total trawlers encountered in 2009-10 (N=5200)

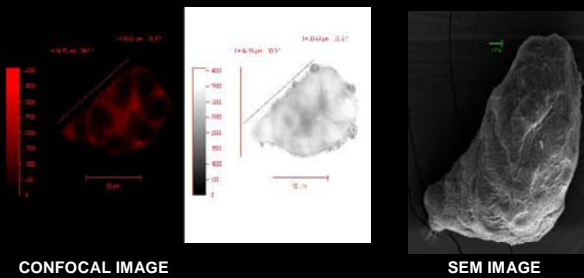
### MEIOBENTHIC COMMUNITY STRUCTURE IN THREE OLIVE RIDLEY TURTLE ROOKERIES ALONG THE COAST OF ORISSA



### Dominant Foraminifera in three rookeries



### Testate Amoebae (Euglyphidae) – First reports from Indian coastal settings



Rushikulya

### FINDINGS

1. The breeding congregation of Ridley's takes place in the off-shore waters of Odisha coast **close to the nesting sites by November**. The congregation begins within **5 km** from coastline in November and gradually moves to **1 & 3 Km** from the coastline during **January-March** where the **average depth ranged 10 - 20 meter**. The breeding congregation disperses after mass nesting i.e. during **April**
2. Near shore **trawling activity during breeding season** was found to be a major threat to turtles.
3. Three mass nesting sites exhibit distinct, **benthic faunal communities signatures** with foraminifera and tested amoeba dominant., perhaps contributing to the bio-luminescence characteristics of the aribada sites.

## 2. ON-SHORE MONITORING



## OBJECTIVES

- Ø To understand the dynamics of beach geomorphology for successful *Arribada*.
- Ø To understand the factors that contribute to the hatching success with respect to the changes in the nesting beach geomorphology during the incubation period.



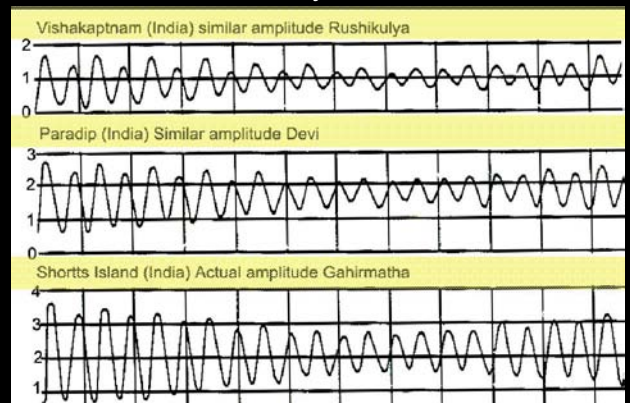
## RESULTS

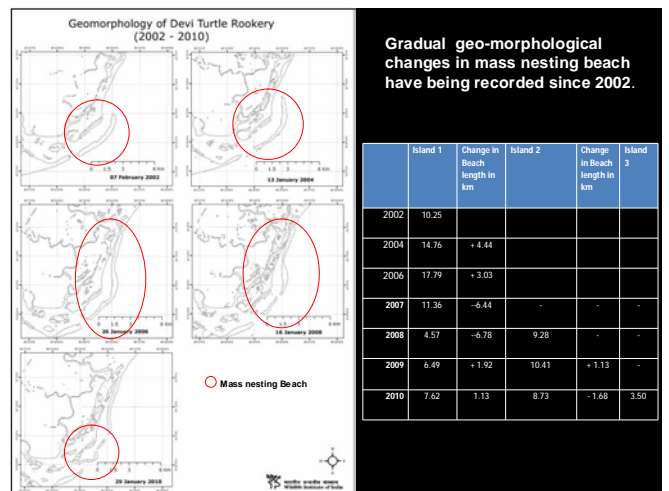
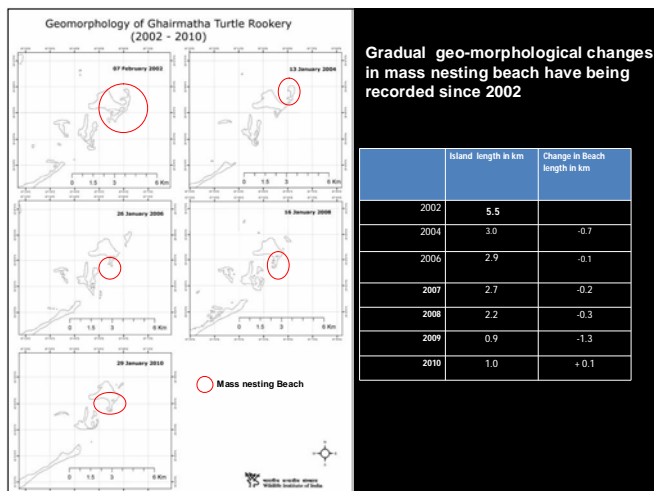
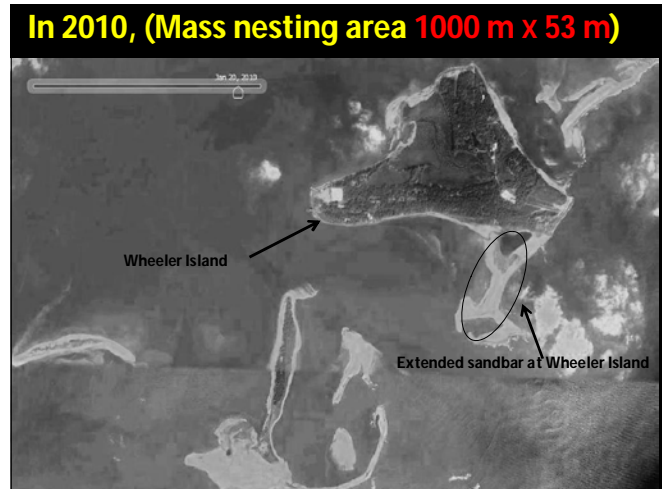
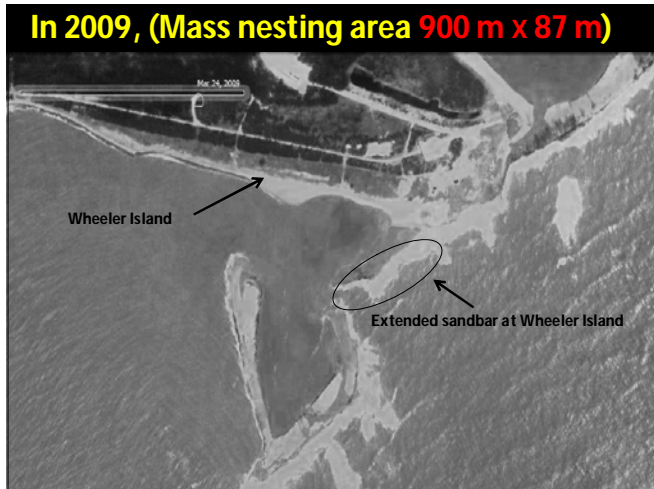
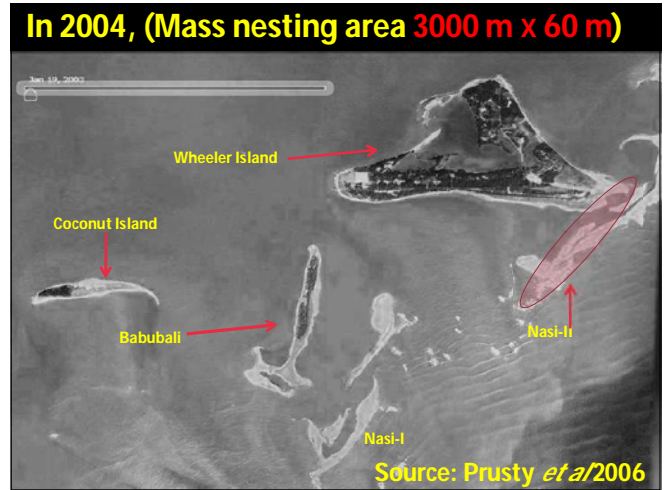
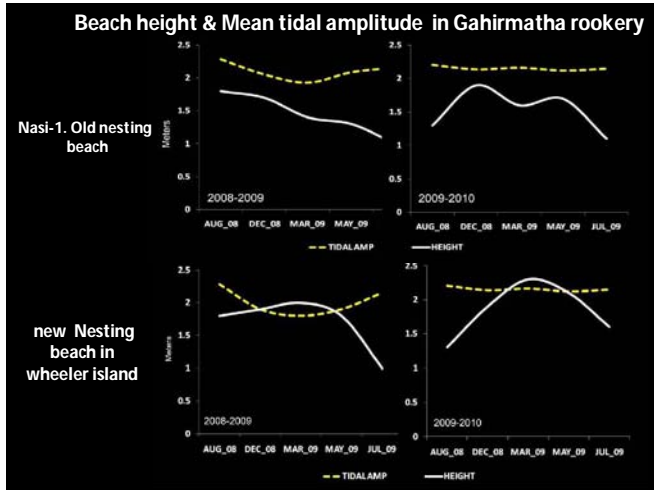


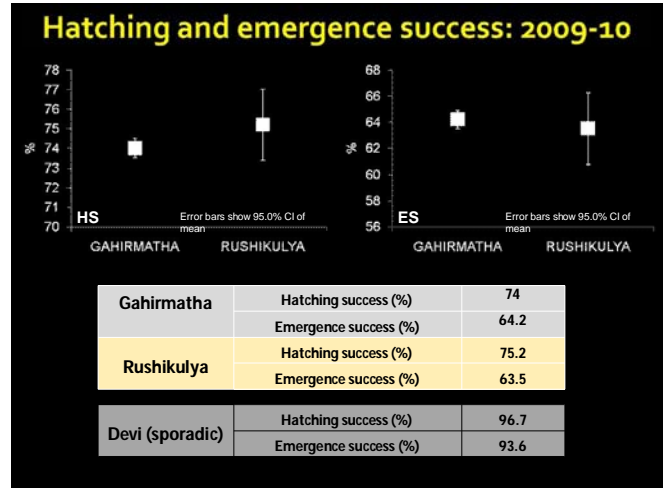
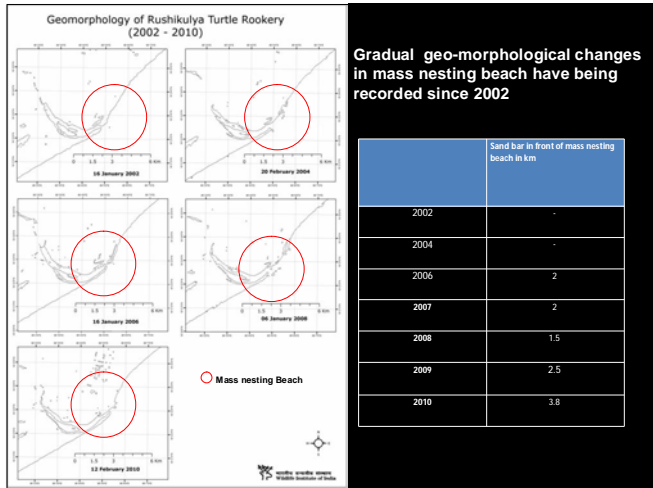
### ARRIBADA AND SPORADIC NESTING RECORDED DURING THE STUDY PERIOD

| YEAR | GAHIRMATHA                | DEVI     | RUSHIKULYA |
|------|---------------------------|----------|------------|
| 2007 | ARRIBADA                  | SPORADIC | SPORADIC   |
| 2008 | SPORADIC                  | SPORADIC | ARRIBADA   |
| 2009 | ARRIBADA                  | SPORADIC | ARRIBADA   |
| 2010 | ARRIBADA I<br>ARRIBADA II | SPORADIC | ARRIBADA   |

Typical Tide Curves from full moon to new moon period at three comparative study sites







- ### FINDINGS
- Nesting density (**4 to 5 turtles/m<sup>2</sup>**) was high in Gahirmatha as compared to Rushikulya (**0.80 to 1 turtle/m<sup>2</sup>**) during nesting season.
  - The **high density of nesting** in limited available area resulted in **heavy loss of nests in Gahirmatha due to incubation period erosion**. The nest loss due to erosion was 30 % of total nest.
  - Even with **sporadic nesting the Devi rookery contributed high hatching success due to low erosion (HS=96.7%)**.



- ### OBJECTIVES
- Understanding the **patterns of pre and post nesting migration** and marine habitat utilization in time and space by Olive ridleys.
  - Understanding the **factors affecting the migration** in the marine environment.

### Methods for tracking migration

SIRTRACK KIWISAT 101, Platform Terminal Transmitter (PTT) 0.5 W, built in Salt Water Switch and Surface Time Counter was used.

- SIKA ANGHOR FIX 3+ epoxy was used to attach the transmitter onto the turtle carapace.

All the PTTs were linked with ARGOS Satellite System and movements tracked in the Northern Indian Ocean.

67 PTT's were deployed.

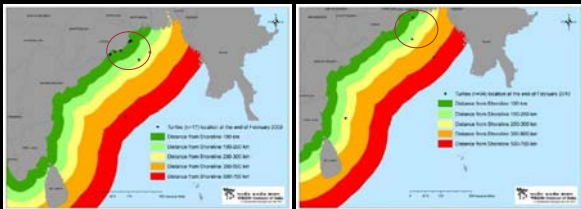
| YEAR           | LOCATION  | NUMBER |
|----------------|-----------|--------|
| 2007 (mar-apr) | ORISSA    | 30     |
| 2009 (Feb-apr) | ORISSA    | 32     |
| 2010 ( Feb)    | SRI LANKA | 5      |
|                | TOTAL     | 67     |

# RESULTS

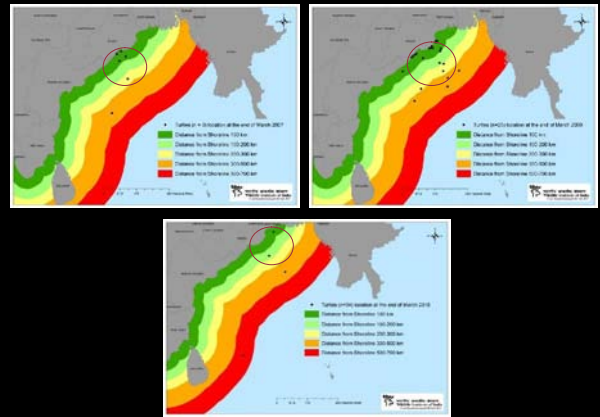


- Ⓡ **2007**
  - PTT's responded from March to September.
- Ⓡ **2008**
  - No deployment of PTT.
- Ⓡ **2009**
  - PTT's deployed in February are still responding (n=2) over a period of 520 days (Min 180 days, Max 520+ days)
- Ⓡ **2010**
  - PTT deployed in Sri Lanka. All stopped working (N=5, 150 days, ).

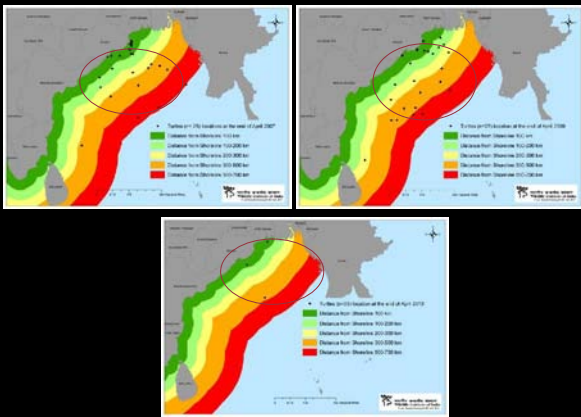
## LOCATIONS OF PTT FITTED TURTLE S DURING FEBRUARY



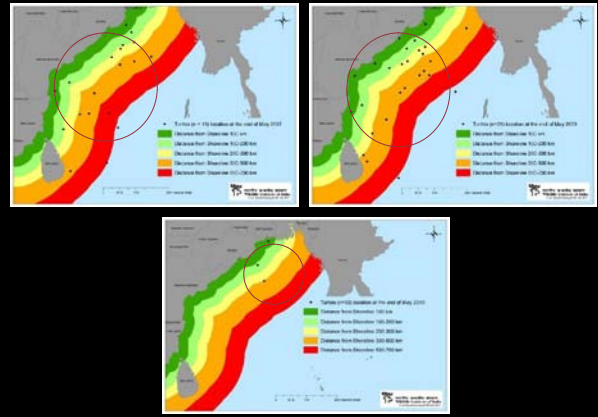
## LOCATIONS OF PTT FITTED TURTLE S DURING MARCH



## LOCATIONS OF PTT FITTED TURTLE S DURING APRIL

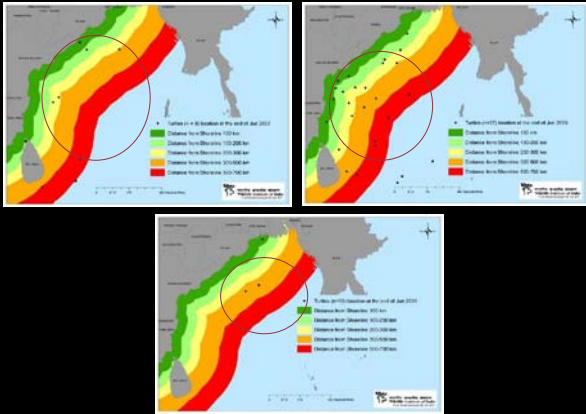


## LOCATIONS OF PTT FITTED TURTLE S DURING MAY

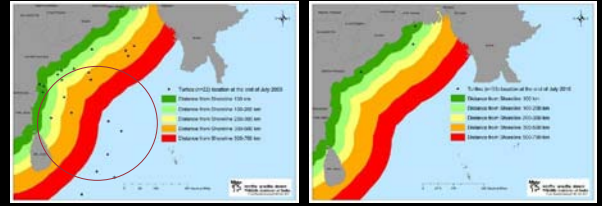




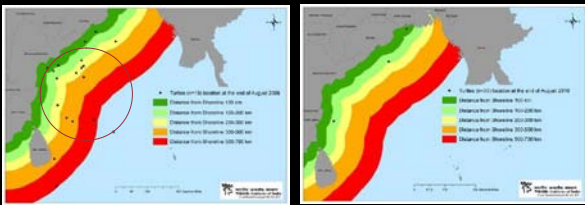
LOCATIONS OF PTT FITTED TURTLES DURING JUNE



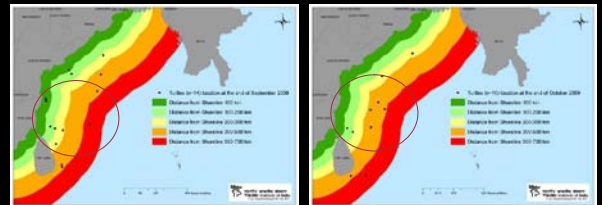
LOCATIONS OF PTT FITTED TURTLES DURING JULY



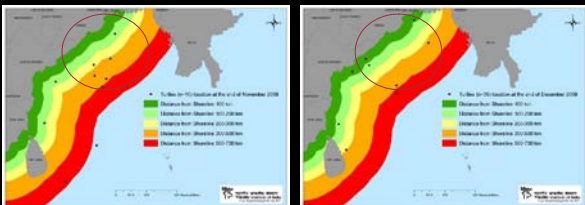
LOCATIONS OF PTT FITTED TURTLES DURING AUGUST



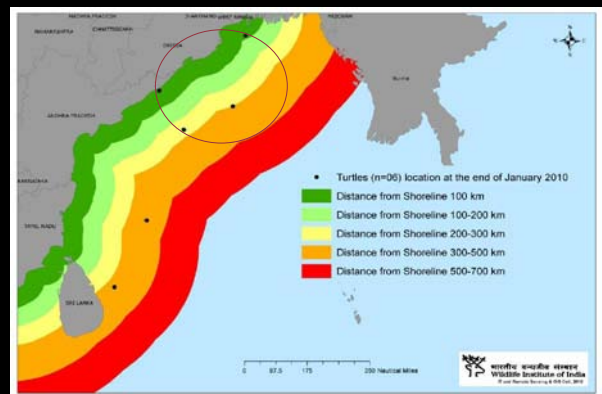
LOCATIONS OF PTT FITTED TURTLES DURING SEPTEMBER & OCTOBER



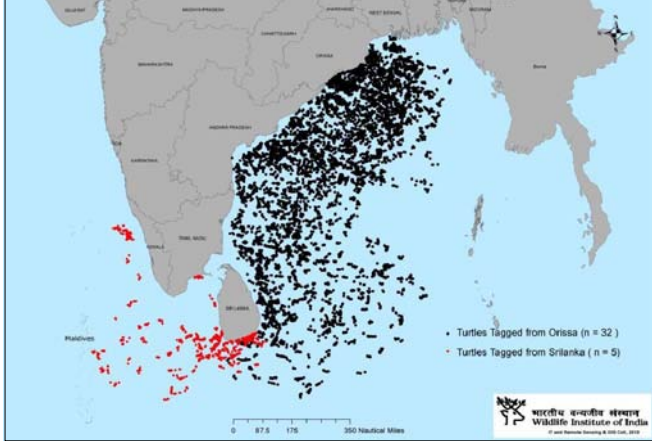
LOCATIONS OF PTT FITTED TURTLES DURING DECEMBER



LOCATIONS OF PTT FITTED TURTLES DURING JANUARY



**Overall marine habitat utilization of Olive Ridlyes nesting in India and Sri Lanka**



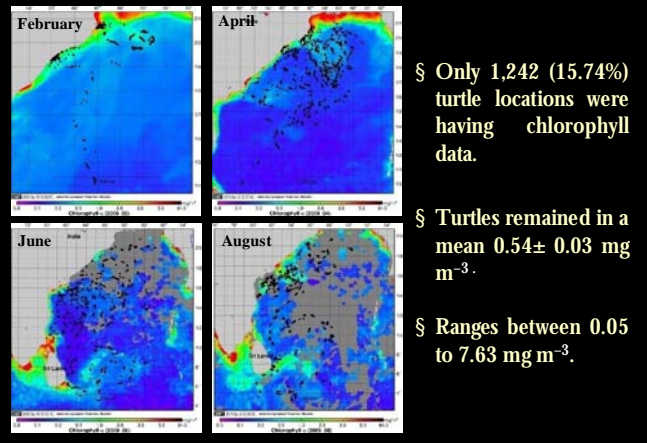
**ACTIVE TRANSMITTER**



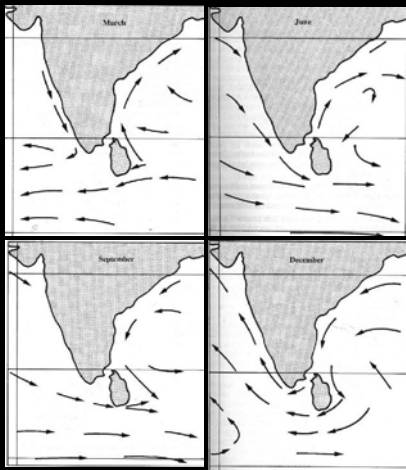
**Factors examined for ridlyes movement in marine environment**

- § Chlorophyll -a
- § Sea Surface Temperature (SST)
- § Sea Surface Currents
- § Sea Winds

**Spatial Distribution of Turtle Locations With respect to Chlorophyll - a**

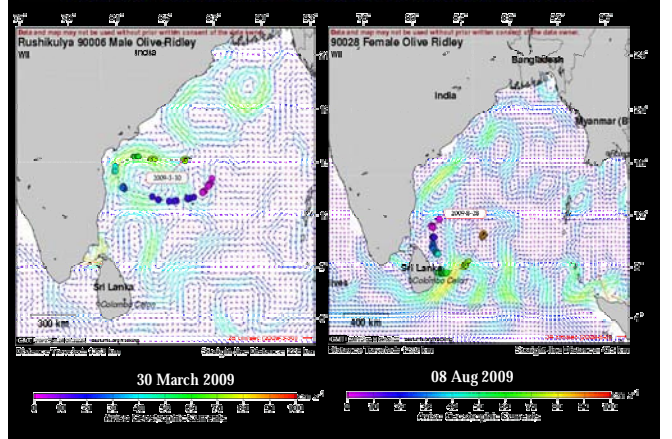


**Pattern of Currents in the Bay of Bengal at Coarse Resolution**



Surface Currents Sri Lanka (Source: H.M. hydrographic Office)

**Pattern of Sea Surface Currents and Turtle Movement**



## FINDINGS

- ⊙ The satellite data reveals that the turtles are not migrating beyond 3° N in the Northern Indian Ocean. Foraging habitat is restricted around the southern Sri Lankan coasts.
- ⊙ Olive ridley turtles started post nesting migration by **May** towards Sri Lankan coast and return migration to Odisha coast begins by **September-October** and peaks in **November** reaching the Odisha coast.
- ⊙ Turtles are confined in breeding congregation within 25 km of the offshore habitat during **November to March**

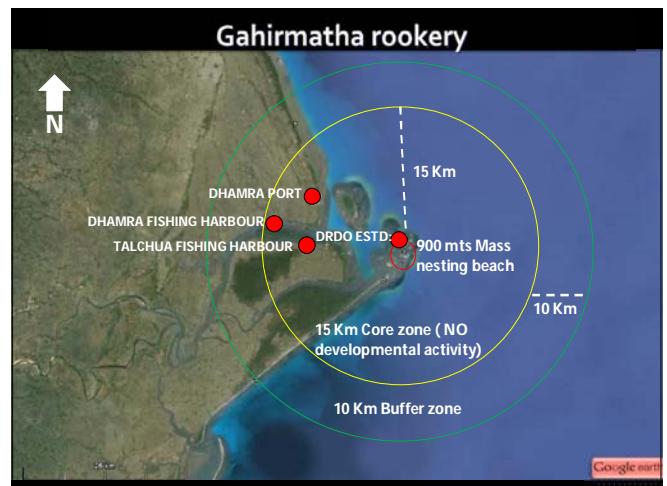
- ⊙ During **April to May** and **September to October**, turtles largely used migratory path between 50 and 100 km in the offshore water.
- ⊙ The Olive ridley turtles nesting in Sri Lanka are following a different migratory route and foraging area in the Arabian Sea.
- ⊙ Chlorophyll-a, surface temperature and wind direction do not seem to be the factors determining the migration, however, surface water current especially localized eddies are the contributing factors.

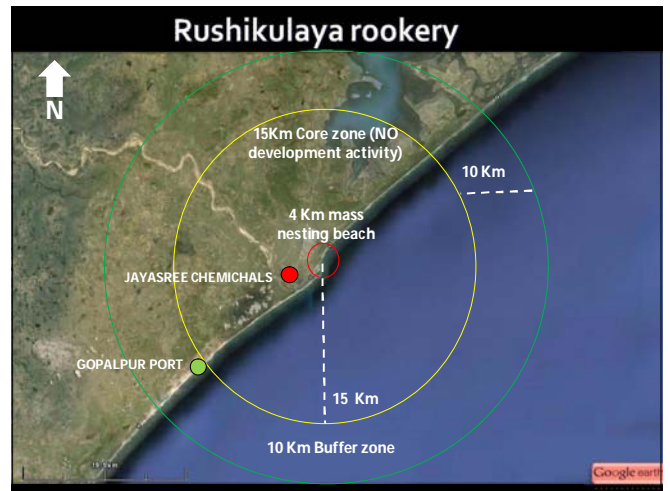
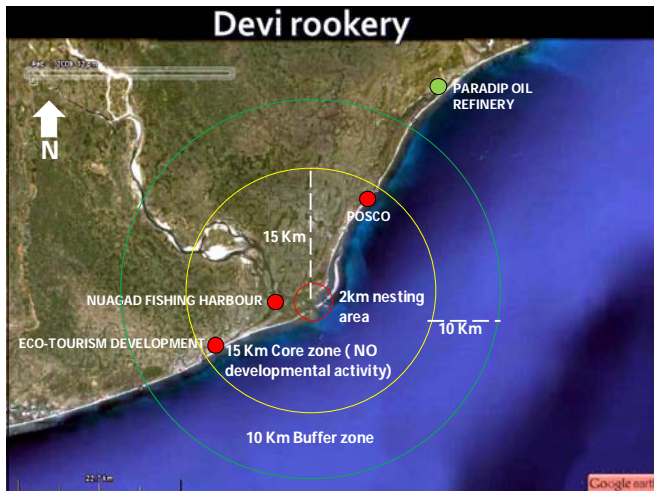
## DEVELOPMENTAL ACTIVITIES



## Impact of developmental activities on the coastal habitats

- ⊙ We suspect enhance erosion and pollution due to dredging and other infrastructure projects along coast
- ⊙ In addition, light pollution will be a major threat to nesting turtles as well as hatchlings behaviour of turtles.
- ⊙ Plantations and alien vegetation along the coast will reduce the nesting space and provide shelter to nest predators.





### Recommendations of the study

- Based on the study results it is proposed to be recommend that the hydro-carbon exploration need to avoid the first **50 km of the marine habitat** along all the three mass nesting sites in Odisha.
- The exploration activities beyond **50 km** may take place during **November to April** as turtles are confined in breeding congregation within 25 km of the offshore habitat.
- During **April to May** and **September to October**, the exploration between 50 to 100 km in the offshore water will require caution and controlled activities.
- Post exploration related infrastructure development on the onshore turtle habitat must avoid the **15 km radius zone** of all the three nesting beaches with an additional **10 km buffer zone beyond 15 km** where activities with mitigatory measures can be taken up.

### Stakeholders Workshop Sharing Findings



### Ongoing and proposed activities relevant to the present study

- Monitoring of morphological changes of the mass nesting sites along the Orissa coast, Sundarbans and Andhra Coast vis-à-vis nesting densities.
- Changes in Benthic faunal monitoring along the Orissa Nesting Beaches.
- Continuation of satellite tracking studies at an interval of 2-3 years for detecting any changes on the migration patterns of sea turtles vis-vis offshore developmental activities.

### Acknowledgements

- Directorate General of Hydrocarbon, Govt. of India
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- DFO, ACF and Range Officers of Rajnagar, Paradeep, Kujang, Puri, Khallikote and Berhampur Forest Divn.
- Project Field Staff at Gahirmatha, Devi and Rushikuluya.



There is a future ahead !