CMPA Technical Report Series 07

Long-term Monitoring and Community-based Conservation of Olive Ridley Turtles in Odisha

January 2017

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

CMPA Technical Report Series No. 07
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Long-term Monitoring and Community-based Conservation of Olive Ridley Turtles in Odisha

Ridhi Chandarana, Muralidharan Manoharakrishnan, Kartik Shanker

(Indian Institute of Science, Dakshin Foundation & Madras Crocodile Bank Trust)

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Acknowledgments

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Executive Summary

Olive ridley turtles are flagships and icons for the conservation of coastal and marine ecosystems, as they use a wide variety of habitats. It is necessary to sustain long-term monitoring programmes for the assessment of population trends and the impact of perceived threats to these populations. Local monitoring and research programmes directly feed into training for local agencies and the information thus collected can inform long-term and large-scale studies and conservation planning and management.

In areas where marine turtles and local communities coexist, conflicts has emerged due to the shared spaces on land and at sea. With mounting pressure to conserve turtles, decisions to reduce this conflict are made without an understanding of the scenario on the ground. Many conservation measures fail when opinions and perspectives at the grassroots are not taken into consideration. At the Rushikulya mass nesting rookery, local fishers face livelihood losses due to conservation measures enforced during the turtle breeding season. The alternative livelihood options that have emerged as potential solutions in the past have failed to deliver. Making decisions and providing recommendations for policy for the use of this space without the necessary background only exacerbates the conflict and renders any action unsustainable. Our study, therefore, aimed to understand the reasons for the failure of past efforts at involving the community in conservation and the rationale behind the need for alternative livelihoods and in particular, the potential of tourism focused on turtles as an alternative livelihood.

To conclusively derive any information with regard to such long-lived organisms, Government support is crucial for research organisations

and conservation groups, so that they can monitor population health. A lack of support for such fields of research has led to severe lacunae and gaps in the field of knowledge of sea turtles from India in comparison to other global populations. For better-informed management decisions, it is imperative for research and management to work together in the coming years.

This project continued the long monitoring of olive ridley turtles in Odisha, which suggest that this population is stable but with significant inter-annual variation. The study on tourism at Rushikulya suggested that communities are ambivalent about its potential as an alternate livelihood, and that conservation itself may be able to provide a source of income. There were also many developmental issues that they felt were not given adequate attention by the state. We recommend that efforts should be focused towards developing an effective tourism programme that benefits both turtles and communities through elaborate dialogue and discussions between stakeholders, while simultaneously addressing other developmental needs.

Chapter 1

Monitoring Olive Ridley Populations

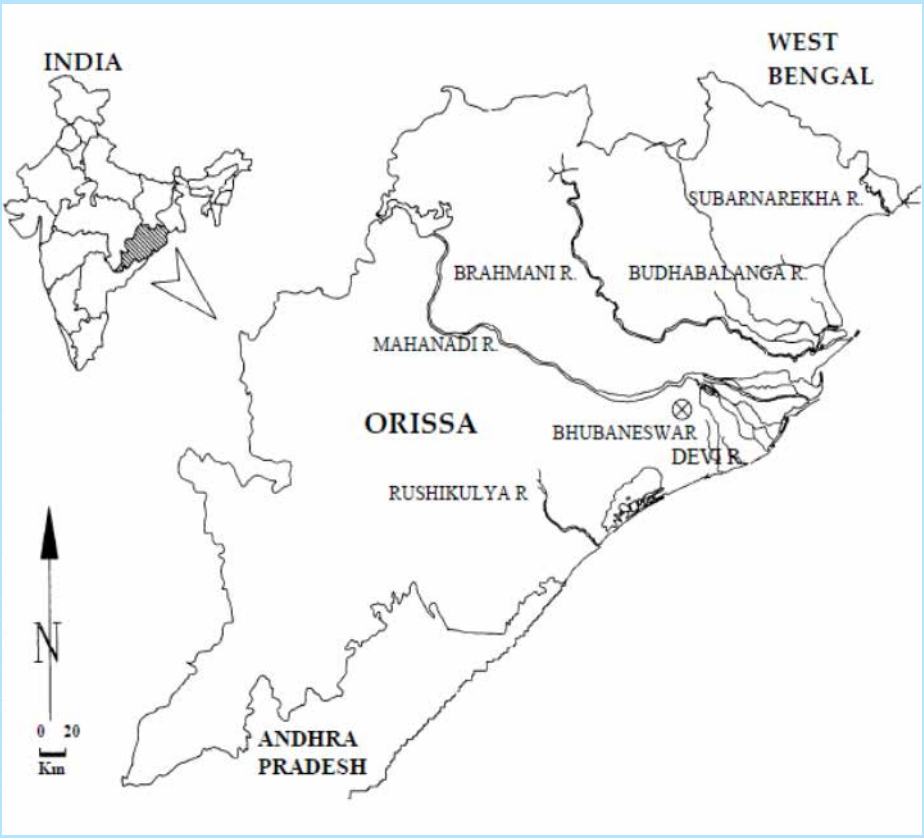
Introduction

Olive ridleys (*Lepidochelys olivacea*) are known to nest along both the coasts of India (with mass nestings or 'arribadas' only in Odisha) and at the Andaman and Nicobar Islands. These turtles have been categorized as 'Vulnerable' in the IUCN Red List and fall under Schedule I of the Indian Wildlife (Protection) Act (1972). Along with Kemp's ridleyturtle (*Lepidochelys kempii*), the olive ridley turtle is also known to nest in large synchronized groups known as 'arribadas'. This phenomenon in olive ridleys is found only in India, Costa Rica and Mexico. In recent times, arribadas have also been observed at Nicaragua and Panama (Honarvar *et al*. 2008). India hosts two major mass nesting sites in Odisha –Gahirmathaand Rushikulya– and the recently discovered minor mass nesting site at Cuthbert Bay in the Andaman Islands. Rushikulya has had the most consistent record of mass nesting over the last decade, with mass nesting reported only during some years at Gahirmatha(Shanker *et al*. unpubl. data). Nesting at Devi river mouth has reduced to such an extent that arribadas are no longer expected there. Monitoring mass nesting at Rushikulya and Gahirmatha can provide insights into population trends of olive ridley turtles.

The main threats faced by the olive ridleys in Rushikulya are anthropogenic, though activities such as mechanized fishing by trawlers and large gillnets are not as prevalent along the Ganjam coast as they are elsewhere in Odisha. Since the 1990s, more than a hundred thousand turtles have died after getting caught in shrimp trawls as incidental catch along the entire Odisha coast (Shanker and Choudhury 2006). Along with anthropogenic threats, natural threats such as predation by jackals, hyaenas, feral dogs, kites and crows affect sporadic nesting. It is imperative to manage these impacts and monitor the effects of climate change on population trends as well as the biology of this species.

Similar to other reptiles, marine turtles exhibit temperature-dependent sex determination (TSD). The incubation temperature determines the development as well as sex of hatchlings. The incubation temperature, in turn, depends

Figure 1
Map of the State of Odisha, Showing Mass Nesting Sites



The Southernmost Mass Nesting Site at the Rushikulya River Mouth is the Study Area

on external factors such as the air temperature and sand grain size and on internal factors such as clutch size. An unprecedented increase in air temperature is expected to lead to an unequal sex ratio and cause increased hatchling mortality which could be detrimental to turtle populations. Studies on TSD have been carried out in laboratories by manipulating incubation temperatures (Bézy *et al.* 2015), but no similar studies have been done in the wild in India.

After its discovery in 1994 (Pandav *et al.* 1994), the mass nesting in Rushikulya was not monitored continuously in the initial years. In the last decade, however, a considerable amount of monitoring and research has been carried out in the region. To study the effect of climate change and other threats on the olive ridley population, a long-term monitoring project using standardized census methods was initiated in 2007. This report summarizes the details of nest monitoring activities along with temperature (nest, air and sand) data and the mass nesting or arribada census, which was conducted in collaboration with the Odisha Forest Department.

Objectives

The main objective of this long-term monitoring project is to study the effects of climate and, in turn, temperature change, and other threats, on the population trends of olive ridley turtles in Odisha. These are divided on two main groups:

- Global factors such as climate change and
- Local factors such as beach erosion, predation and adult mortalities in populations of olive ridley turtles.

Study Area

The Rushikulya mass nesting site is at the mouth of the Rushikulya river in the state of Odisha, India. Siltation and seasonal flooding of the river

Figure 2
Emery Board Beach Mapping to Observe Beach Height with Horizon as a Level

Photo credit: Adhith Swaminathan and Muralidharan M.

causes the beach profile to vary, both seasonally and annually. The nesting site is a 4 km stretch of beach, north of the river mouth, where mass nesting occurs. *Casuarina equisetifolia* plantations run parallel to the coast at an average distance of 60 m from the high tide line (HTL). These plantations support nest predators of olive ridley turtles including the golden jackal (*Canis aureus*), striped hyaena (*Hyaena hyaena*), jungle cat (*Felis chaus*), jungle crow (*Corvus splendens*), black kite (*Milvus migrans*) and white-bellied sea eagle (*Haliaeetus leucogaster*).

Methods

Beach Monitoring

To monitor changes in turtle populations, the nesting beach and offshore waters are monitored during the peak nesting season (December–April). Beach monitoring involves patrolling the beach to count the number of nesting females, false crawls and dead turtles. While patrolling, some nests (~30) are relocated to a hatchery to record changes in temperature to study the effects of climate change.

Mapping points are set up at ~500 m or 1 km intervals from one end of the beach to the other. These mapping points can be either GPS locations or permanent poles that are placed along the tree line. Graduated poles are used for beach mapping and profiling using the 'Emery' method (Emery, 1961), starting at the tree line, along the contours of the beach, up to the low tide-line mark. One observer stands at the first pole and looks towards the second pole (the standard distance used is 15 m), where another observer moves a stick/pen along the pole until it matches the line of sight of the first observer

to a reference line (the horizon). This is repeated till the low tide mark.

The GPS location of the beach mapping point (this should ideally be at the same location every year), height of pole at observer, distance between poles and presence of vegetation are recorded (Figure 2). The slope of the beach at each point can be calculated using Pythagoras theorem.

Monitoring Nest Temperatures

In order to study the effects of climate change, data loggers are used to record the nest, sand and air temperatures over the course of the nesting season. This helps in obtaining the average temperature change as well as an estimate of the hatchling sex ratio for those nests. Data on the hatchling sex ratio and temperature can help study the effects of climate change on the population and thus aid the planning and implementation of conservation and management programmes.

The nest temperatures at the Rushikulya beach have been monitored since 2009. Nests located during daily beach patrols were relocated to the hatcheries within 2 hours of the eggs being laid. The clutch size was noted and the nest temperature was monitored in eight nests using digital temperature data loggers (HOBO Pendant), placed at the bottom of the nest, at a depth of about 45 cm, the average nest depth of olive ridleys (Lopez-Castro *et al*. 2004). The data loggers are programmed to record the temperature at 2 hour intervals. The nests were monitored and the data loggers were removed only after all the live hatchlings had emerged and the nest was excavated.

Sexing of Dead Hatchlings

Only dead hatchlings that are found in nests after all the live hatchlings emerge are used in this analysis. Dead hatchlings are counted, partially dissected and submerged in neutral buffered formalin. Protocols are followed as prescribed by Yntema and Mrosovsky (1980). The Adrenal Kidney Gonad Complexes (AKGs) are extracted from the body cavity and placed in cassettes which are then infiltrated with paraffin after the tissues are washed out in ethanol, followed by toluene. Once the tissues are embedded in paraffin blocks, the samples are sectioned in a microtome and adhered onto slides. The gonads are then stained using Haemotoxilin and Eosin. Care must be taken at all steps to ensure minimal damage to the gonad tissues as well as proper embedding and sectioning of samples.

Male Gonads

The male gonad (i.e. testis) is identified as it lacks both a dark cortex (outer portion of gonad) and a pronounced oviduct. The medulla (the inner portion of the gonad) is very well organized into a system of seminiferous tubules. The oviduct is usually degenerate as shown in Figure 3.

Female Gonads

The female gonad can be identified by its characteristically dark cortex, large, pronounced oviduct and somewhat disorganized medulla. Both the male and female possess oviducts at early developmental stages, and the stage of hatchling development at its death will determine the quality of the oviduct. Dead hatchlings can also be sexed by the presence or absence of an oviduct as the female hatchling usually has a very pronounced oviduct that extends away from the kidney, as shown in Figure 4.

Hatching Success

The hatching success was calculated for the hatchery nests as well as for the wild nests after mass hatching. The emergence success was calculated only for the hatchery nests.

The hatching success and emergence success were calculated as given in Box 1.

Mass Nesting Census

To estimate the number of female turtles nesting during an arribada, a strip transect method was used. The transects are placed every 100 m by the forest department in a straight line and ideally about 5 m apart so that each pole along the transect can be viewed from the previous pole at night using a small torch (best management practices document submitted to the O/o PCCF

Figure 3
Male Gonads

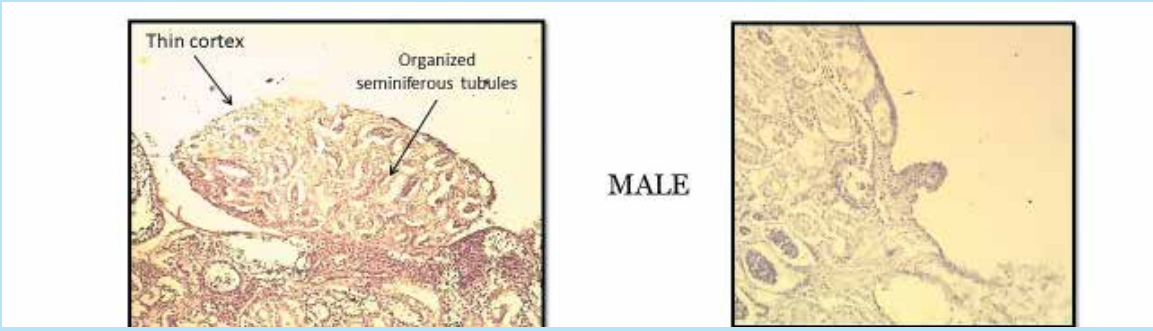
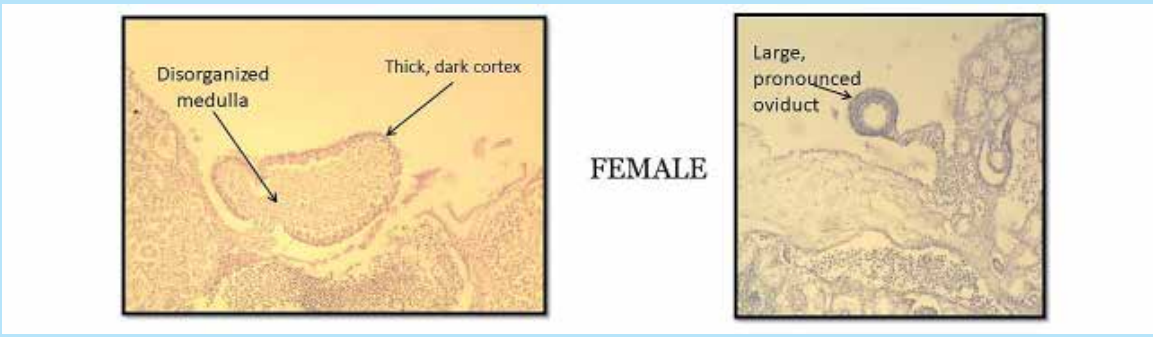


Figure 4
Female Gonads



Box 1

$$\textbf{Hatching Success (\%)} = \frac{\text{No of Shells}}{\text{(no of shells + no of undeveloped+ no of UH + no of P) X 100}}$$

$$\textbf{Emergence Success (\%)} = \frac{\text{No of Shells – (No of Live + No of Dead)}}{\text{(no of shells + no of undeveloped+ no of UH + no of P) X 100}}$$

$$\textbf{Estimate of Nesting} = \frac{\text{Total available nesting area (m2) × duration of arribada × sum total of egg laying turtles}}{\text{Width of transect × number of sampling periods × sum of length of transects × average duration of oviposition}}$$

(WL) and CWLW). Currently the Odisha State Forest Department maintains strip transects of 20m , and the researchers of the Indian Institute of Science and Dakshin Foundation maintain a parallel record of the mass nesting using variable strip widths to ensure better precision in the mass nesting estimates.

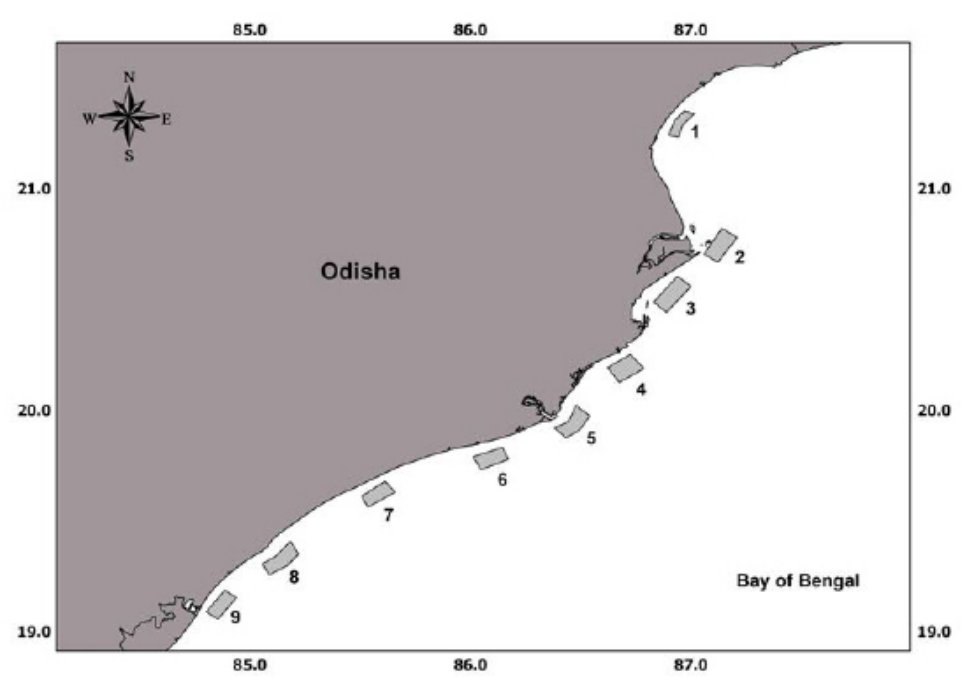
Care should be taken that only ovipositing females are counted while walking alongthe strip transect. To estimate the number of nesting females, the following variables are measured:

1. Total nesting area of arribada
2. Total duration of arribada
3. Width of transect
4. Transect length
5. Duration of oviposition (OPD)

Monitoring Offshore Populations

Olive ridleys nest all along the coast of India. However, seasonal congregations for mass nesting have been observed along the east coast only near select nesting beaches, mainly the river mouths of Devi andRushikulya and in Gahirmatha in

Figure 5
Nine Sampling Locations for Olive Ridley Congregations along the Odisha Coast



Odisha (Shanker *et al.* 2003). Although substantial literature exists on nesting (Shanker et al. 2003; Pandav Choudhury 2006), very little literature exists on the congregation of these mating sea turtles offshore along the coastline (Tripathy & Pandav, 2007) . The biotic and abiotic factors that influence such congregations are poorly understood as no data exist to explain why certain sites are used by large numbers of these turtles.

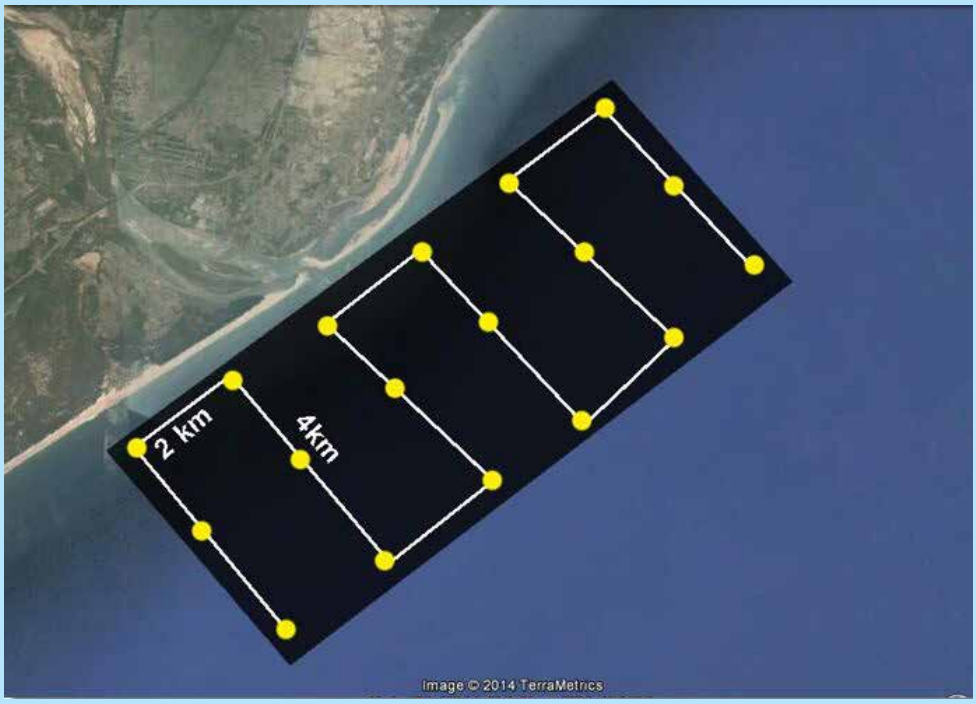
Distance sampling is a widely-used method for estimating the abundance and/or density of biological populations. The parameters measured include salinity, using a refractometer, surface water temperature, using a thermometer, and water depth. Location data were noted using a handheld GPS. Boat transects were carried out across the coast for sampling at these select sites. The primary design of these transects was within the confines of stratified random sampling within each sampling block. Since the coastline is 480 km long, the transects were located at ~48 km, and transect blocks of 40 km^2 have been monitored since 2014 (Fig. 5). The purpose of collecting abiotic factor variables is to create a profile and overlay them with the aggregation sites.

Offshore monitoring at Rushikulya by the Centre for Ecological Sciences (CES) team began in 2010. A line transect approach was followed to measure the changing offshore abundances of turtles during the breeding season. In 2010 and 2011, transects were conducted parallel to the coastline and were 10 km in length (5 km on either side of the river mouth). Four transects were established, which were 1 km apart from each other. From 2012 onwards, 14 line transects perpendicular to the coastline were established, each of which runs 4 km offshore in Rushikulya. In 2014, transects were established at the other monitoring locations on the coast, with six perpendicular (4 km) transects and five parallel transects (2 km) (Fig 6). This transect design was modified after examining the results from previous years to reduce the variance levels. The boat traverses transects at a constant speed (6–10 km/hour), and one observer on either side of the boat notes observations of single or mating turtle pairs.

The sites sampled include:

1. Chandipur
2. Gahirmatha
3. Hukithola
4. Jatadhar

Figure 6
Transect Design for Offshore Monitoring of Olive Ridley Congregations



5. Devi
6. NuaNai
7. Chilika
8. Rushikulya
9. Bahudha

As the transect starts, the Beaufort scale is used to quantify the sea state, starting time of transect, etc. Upon sighting a turtle, the sighting distance, sighting angle, direction (left or right side of the boat) and distance to be covered to the end of the transect are noted. A separate note for single surfacing turtles and mating pairs is maintained.

Distance sampling is by far the most widely used technique for line transects (Thomas *et al*. 2010). The analysis was carried out using the Distance (Version 6.0) software package. We sampled for turtles from the southernmost point (Bahuda) to the northernmost point (Hukitola). We could not sample the northern sampling blocks due to unavailability of the necessary permits for sampling in Gahirmatha.

Hatchling Orientation

Hatchling orientation refers to the movement of hatchlings towards the sea after emergence. Hatchlings follow visual cues like light, which, along with elevation differences, leads them towards water. However, high-intensity light from human settlements can affect their movement. Hatchling disorientation has adverse effects such as predation, desiccation and starvation (Karnad *et al*. 2009) .

An orientation test was conducted at Rushikulya on April 2013 from 2130 to 0130 hrs. The 3 km beach was divided into segments at the two extremes and in the mid-segment. Circular arenas of radius 2 m were constructed and divided into eight equal sectors—four sectors towards the land/estuary and four seawards (Fig. 7). A shallow pit was dug at the centre of each arena where hatchlings were placed. There were four conditions created for each arena—open, riverside closed, seaside closed and completely closed. For each condition, the sectors on the corresponding side were bordered by cardboard, ensuring that there were no holes to allow light to enter the arena. Twenty freshly emerged olive ridley (*Lepidochelys olivacea*) hatchlings were used for each experiment, and trials for each condition were done to minimize the error. The number of hatchlings in each sector

Figure 7
Orientation Arena Design for Hatchling Monitoring

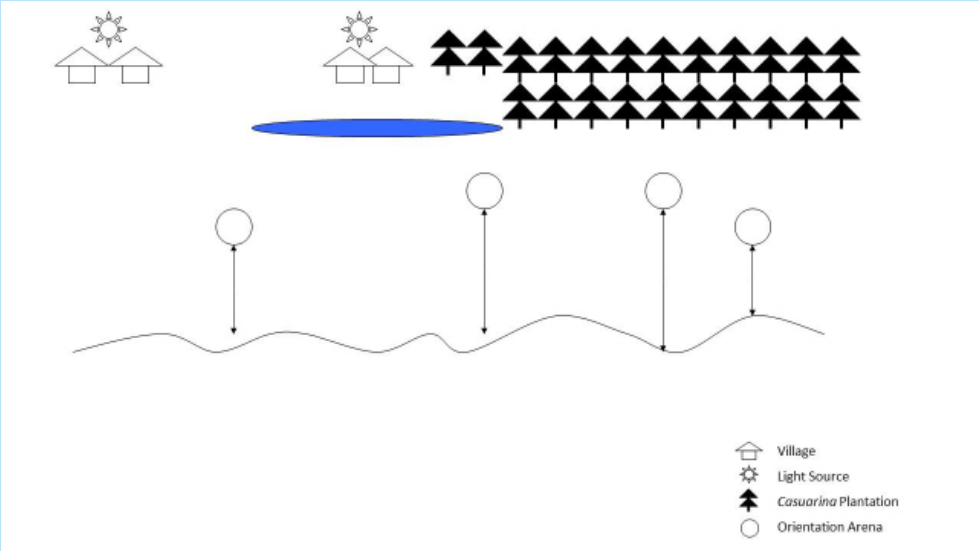
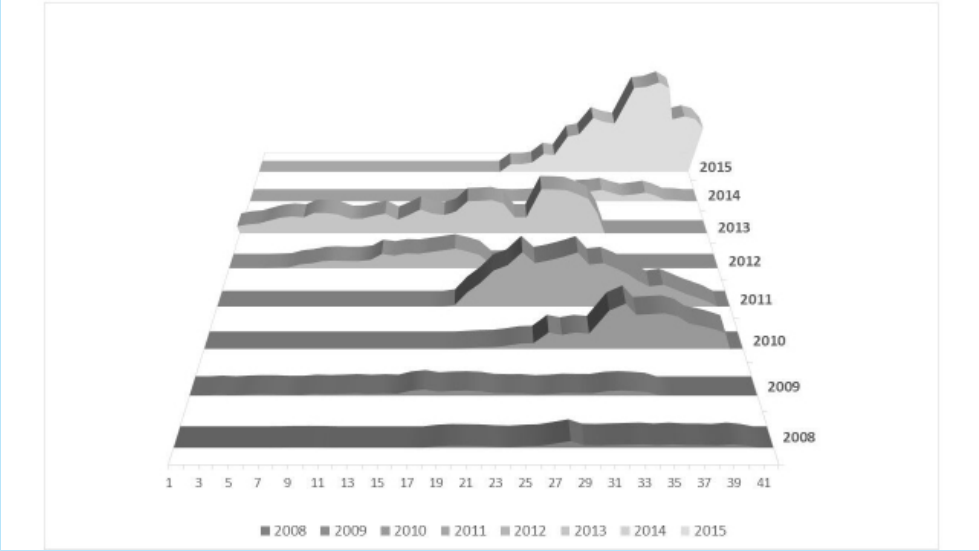


Figure 8
Arribada Nesting Distribution on the Rushikulya Beach



was counted. If any hatchling stayed inside the pit, the experiment was repeated again. It was ensured that there was no other light source on the beach except natural light (if any) and artificial illumination from human development. The areas were chosen such that there was no slope to direct the hatchlings in a particular direction.

Results

Beach Monitoring and Mortalities

The mass nesting beach of Rushikulya is highly dynamic, and the changing structure of the nesting beach causes differences in the nesting pattern along the entire beach as shown in Figure 8 and Figure 9. In comparison to the entire coast of Odisha, the Rushikulya beach witnesses minimal mortalities (Table 1). This is largely due to the nature of the fisheries in the region. The Ganjam coast, has no large fish landing centres, and most trawling activities are restricted to the Puri and Kendrapara districts, with stray instances of trawlers from the neighbouring state of Andhra Pradesh entering the coastal waters.

Nest Temperatures and Hatching Success

The hatching success in the wild nests ranged from

Figure 9
Nesting Beach Dynamics at Rushikulya

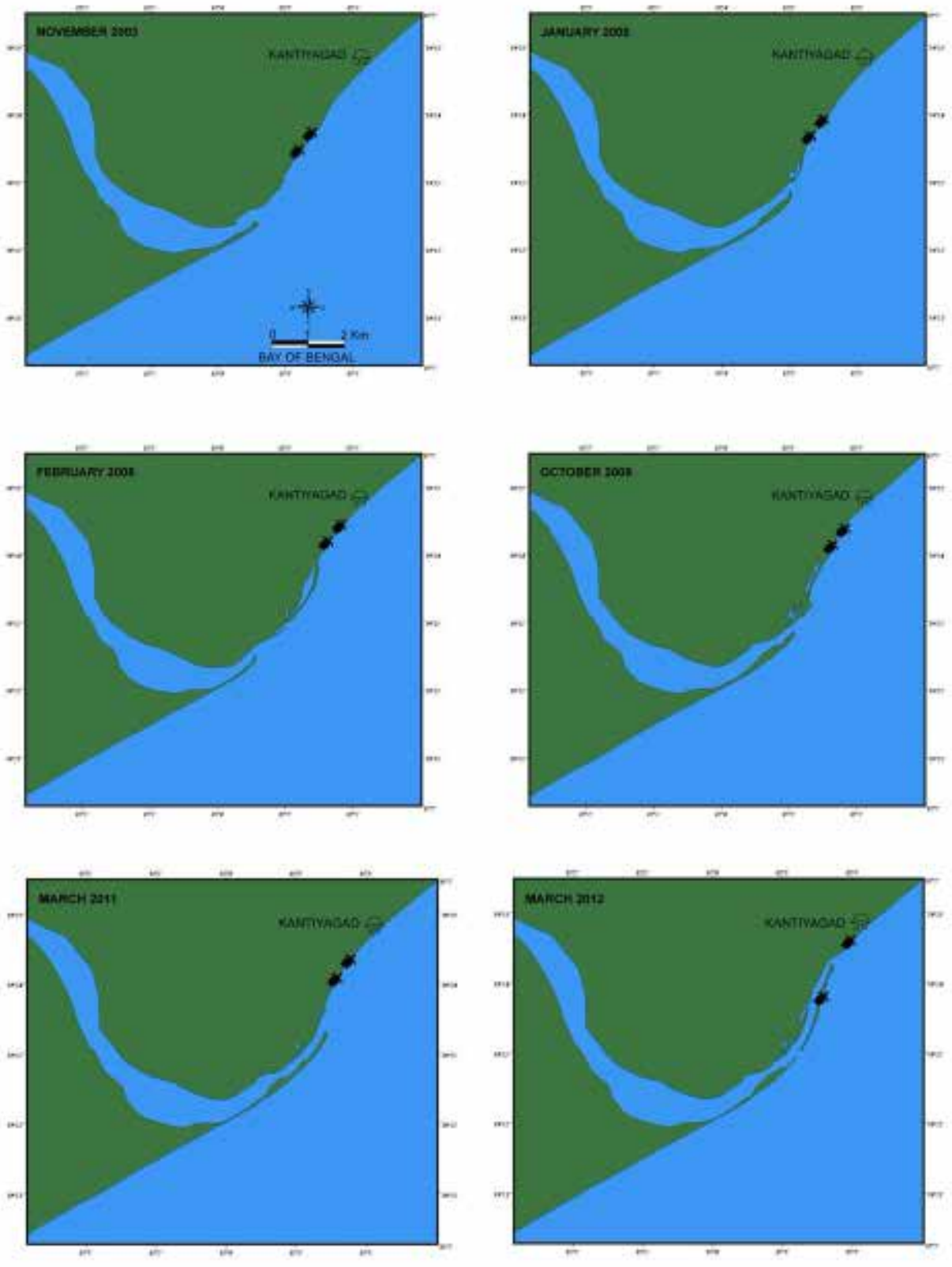


Table 1
Turtle Mortalities Observed at Rushikulya

Year	Female	Male	Not Determined	Total
2009				
December	3	2		5
2010				
January	6	2		8
February	7	1		8
July		1		1
2011				
January	7			7
February	17	7		24
March	12			12
April	1			1
September	2	3		5
November			41	41
December	16	30	1	47
2012				
January	8	7		15
February	21	7		28
March	3			3
April	5			5
August	1			1
September	1			1
October	5			5
November	6	2		8
December	9	2		11
2013				
January	95	45	1	141
February	10	12		22
March	22	17		39
April	14	7		21
May	2			2
November	131	16		147
December	27	15		42
2014				
January	31	49		80
February	2	4		6
March	1	2		3
October			1	1
November			25	25
December	39	19	9	67
2015				
January	52	63		115
February	41	77	12	130
March	1	2	8	11
April		2		2

Table 1 (*Cntd...*)
Turtle Mortalities Observed at Rushikulya

Year	Female	Male	Not Determined	Total
2014				
November	6	19	1	26
December	19	11		30
2016				
January	40	46		86
February	19	26	3	48
April	1			1
Grand total	**683**	**496**	**102**	**1281**

Table 2
Hatching Success Observed in the Wild after Mass Emergence

Year	Sample Size	Average Hatching Success	Average Clutch Size
2008	1928	84.17	122.26
2009	1237	92.05	114.11
2010	1032	74.55	112.35
2011	281	73.24	105.36
2012	241	84.65	121.23
2014	131	92.94	112.56
2015	207	65.58	109.94
Grand Total	**5362**	**83.15**	**116.65**

65.58 – 92.94% (mean = 83.15%) with an average clutch size of 116.94 eggs (Table 2, Figure 10). The mean hatching success in the wild observed at Rushikulya is much higher than at other globally known arribada nesting beaches with similar nesting densities. The hatching success observed in hatcheries was comparatively lower, with an average of 63.17%, which can largely be attributed to the small number of nests that have a large number of unhatched eggs (Table 3). These values influence the overall hatching success disproportionately due to the smaller sample size (~30). Improper fencing of hatcheries in 2016 led to a large number of nests being raided by feral dogs, and proper care needs to be taken in the placement and fencing of these enclosures.

Temperature Monitoring and TSD

The mean temperature of nests 3 and 4 exceeded the pivotal temperature, whereas the incubation period of nest 1 was extended to 69 days at a mean temperature of 27.1°C. The hatching and emergence success (both at 77%) was highest for nest 2 at an incubation temperature of 29.9°C (Table 4).

A sex ratio profile was developed using the pivotal temperature of 29°C and threshold range of temperatures (28°C and 30°C) as reported by Dimont and Mohanty-Hejmadi (1983). In 2008, the mean nest temperatures exceeded the pivotal temperature (28.2°C), which could have led to the production of more females than males. The mean nest temperature along with the expected sex ratios has been summarized in Table 5. As observed in the past couple of years, the highest temperature reported during the incubation period in 2013 was the highest (37.4°C) recorded during the duration of the study.

Hatching success observed in hatcheries was comparatively lower, with an average of 63.17%,

Figure 10
Hatching Success Observed in the Wild after Mass Emergence

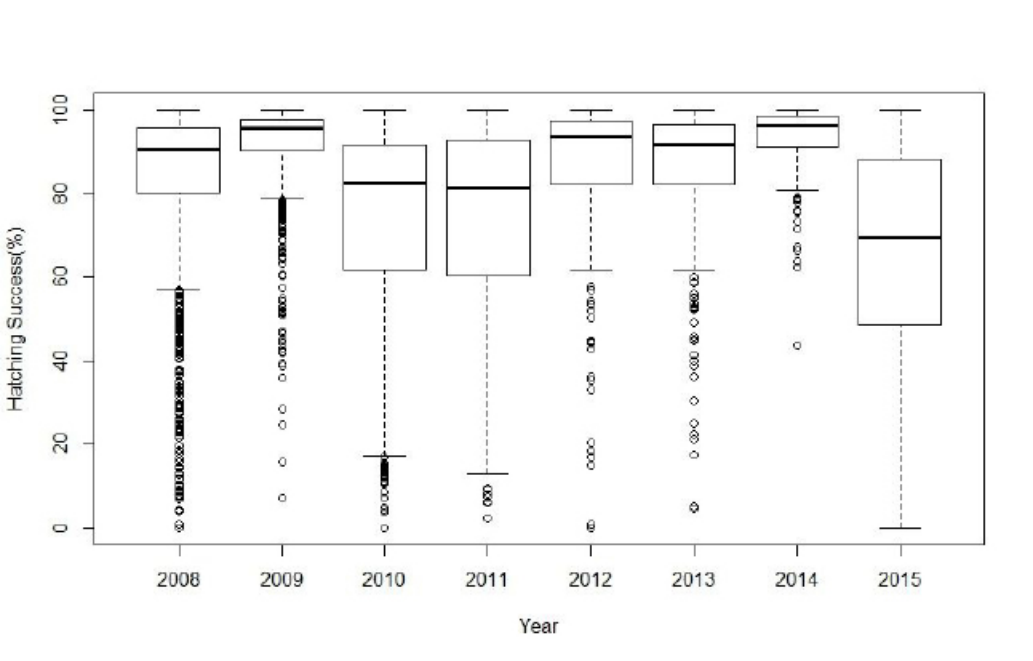


Table 3
Hatching Success Observed in Hatchery

Year	Average Clutch Size	Average Hatching Success	Average Emergence Success
2009	115.58	52.04	48.40
2010	125.42	79.10	76.99
2011	110.59	79.43	77.20
2012	116.83	61.53	51.63
2013	120.82	69.31	58.89
2014	126.44	54.07	52.01
2015	137.86	66.15	58.93
2016	113.81	48.75	46.23
Grand Total	**119.88**	**63.17**	**58.15**

which can largely be attributed to the small number of nests that have a large number of unhatched eggs (Table 3). These values influence the overall hatching success disproportionately due to the smaller sample size (~30). Improper fencing of hatcheries in 2016 led to a large number of nests being raided by feral dogs, and proper care needs to be taken in the placement and fencing of these enclosures.

Mass Nesting Estimates

Table 6 gives details of the mass nesting numbers from 2008 to 2016. While the numbers estimated do not match the existing records maintained by the state government, these results are indicative of the trends in population fluctuations. Mismatches in estimates have occurred over the years due to inconsistencies in the methods used. All the field staff and researchers involved in this project are trained specifically in methods pertaining to sea turtle monitoring in the presence of experienced field biologists. A detailed report regarding best management practices was submitted in 2015 to the PCCF (WL).

Table 4
Hatching Success and Incubation Temperatures Observed in Hatchery

Nest	Date of Relocation	Time to Hatch (days)	Mean Temperature (°C)	Hatching Success (%)	Emergence Success (%)
1	22-12-2012	69	27.13	58.02	55.00
2	03-02-2013	52	29.91	77.00	77.00
3	14-02-2013	50	31.56	33.00	32.00
1	06-02-2014	55	29.01	74.01	72.03
2	10-03-2014	50	32.09	73.08	68.00
1	26-01-2015	60	28.09	83.01	53.08
2	09-02-2015	49	30.06	91.02	48.03
2	10-2-2016	50	31.04	92.00	91.02
28	11-3-2016	51	31.08	50.04	45.04
30	13-3-2016	51	32.08	89.03	81.01
52	20-3-2016	50	32.08	55.02	55.02
53	20-3-2016	50	32.09	59.05	53.04
57	23-3-2016	50	32.06	95.08	95.08

Table 5
Nest Temperatures Recorded from Nests at Rushikulya, Odisha

Year	Incubation Period (Day/Month)	Mean Temperature(°C)	Variance	Predicted Sex Ratio (% Female)
2008	24/2 to 17/4 25/2 to 19/4 1/3 to 25/3	29.93 30.51 30.58		50 >50 >50
2009	12/2 to 14/3 13/2 to 14/3 19/3 to 10/4 21/3 to 10/4	30.71 32.04 31.90 31.88	1.44 1.08 8.47 3.79	>50 ~100 ~50 >50
2010	5/2 to 30/3 1/3 to 18/4	29.76 31.28	1.06 4.41	~50 >50
2011	10/2 to 5/4 24/2 to 16/4 28/2 to 19/4 4/3 to 23/4	28.73 29.66 31.16 31.47	2.27 2.11 1.43 1.79	~50 ~50 >50 >50
2012	18/1 to 21/3 16/2 to 7/4 29/2 to 22/4	28.18 30.14 30.24	4.05 2.33 1.34	~50 >50 >50
2013	22/12 to 1/3 3/2 to 27/3 14/2 to 5/4	27.13 29.91 31.56	1.21 3.94 6.08	~50 ~50 >50
2014	6/2 to 21/3 10/3 to 30/4	27.13 29.91 31.56	1.21 3.94 6.08	~50 ~50 >50
2015	2/3 to 21/4 28/2 to 19/4 26/1 to 17/3 9/2 to 31/3	32.01 31.07 29.00 30.08	22.71 4.51 5.31 5.11	~100 ~100 ~50 >50
2016	11/3 to 30/4 20/3 to 9/5 20/3 to 9/5 10/2 to 31/3 13/3 to 2/5 23/3 to 12/5	31.08 32.08 32.09 21.04 32.08 32.06	1.35 2.80 0.08 2.26 3.04 0.74	~100 ~100 ~100 ~100 ~100 ~100

Figure 11
Monthly Average Temperature Recorded for One Nest at Rushikulya

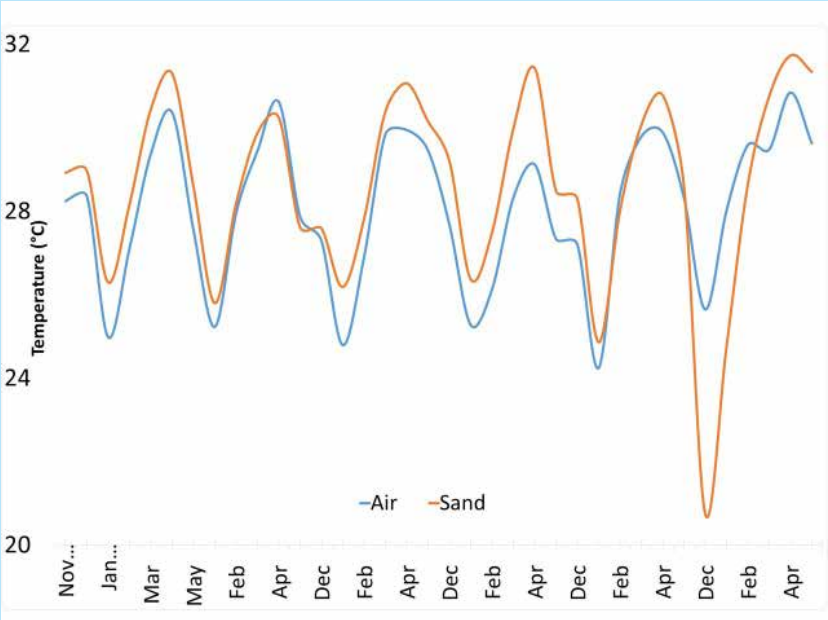
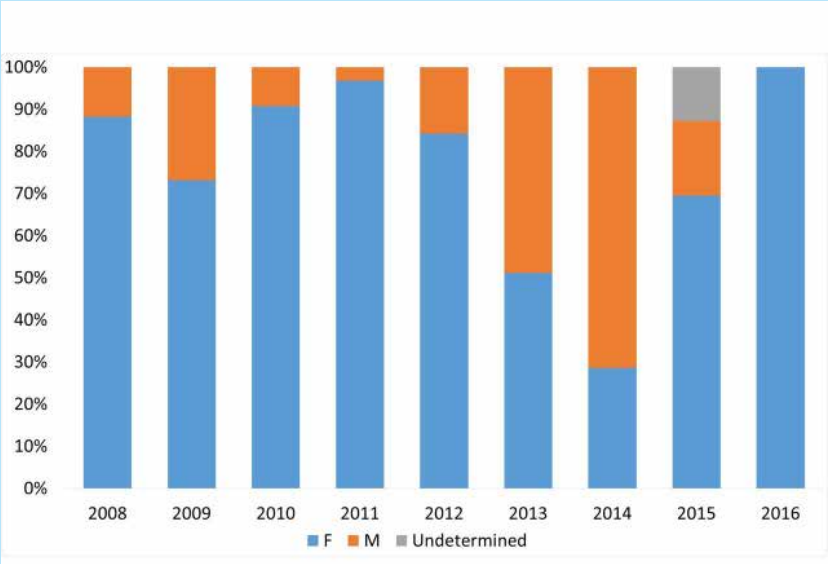


Figure 12
Observed Sex Ratios of Turtle Hatchlings Dissected



Hatchling Orientation

The direction and strength of the orientation were determined using circular the Oriana 4 statistics software package (Kovach Computing Systems). The length of the mean vector signified the consistency of hatchling orientation in a particular direction, whereas the mean vector was the mean angle at which they orient. The Rayleigh Test (Z) was used to determine if the orientation was significantly random for each segment within a particular arena.

The results of the Rayleigh test show that the orientation in each segment was significantly different from random, showing a strong directional movement of the hatchlings in the three different sections of the beach. Segment 8 shows a strong landward directionality (r=0.829, μ=308.87).

The results of the Rayleigh Test show that the hatchlings in each segment orientated significantly different from random. The hatchlings showed

Table 6
Daily Arribada Nesting Estimates at Rushikulya

Year	No. of Days	Mean Nesting Females	LCL	UCL	SE
2007	No arribada				
2008	1	53,138.00	41,372.00	64,904.01	5,883.00
	2	17,847.09	14,509.07	21,186.01	1,669.01
2009	1	30,828.02	25,017.08	36,638.05	2,905.02
	2	31,031.00	25,767.02	36,294.08	2,631.09
	3	9,785.09	7,514.05	12,057.03	1,135.07
2010	1	11,171.08	9,177.01	13,166.05	997.03
	2	46,732.04	40,925.00	52,539.08	2,903.07
	3	29,983.01	26,315.03	33,650.09	1,833.09
	4*	1,453.05	983.07	1,923.04	234.09*
	5	7,149.03	5,974.08	8,323.08	587.02
	6	2,416.09	1,834.05	2,999.04	291.02
	7	980.03	585.05	1,375.01	197.04
2011	1	28,123.00	23,215.09	33,030.01	2,453.05
	2	35,501.06	3,1297.09	39,705.04	2,101.09
	3	33,818.08	30,718.07	36,918.09	1,550.00
	4	24,368.09	22,356.04	26,381.04	1,006.03
	5	9,530.07	7,703.05	11,358.00	913.06
	6	12,928.08	11,161.08	14,695.08	883.05
	7	2,313.09	1,915.03	2,712.06	199.03
	8	4,530.07	3,723.07	5,337.08	403.05
2012	1	31,634.99	28,955.05	34,314.47	1,339.74
	2	9,588.86	8,633.87	10,543.86	477.05
	3	1,707.25	1,348.03	2,066.19	179.47
2013	1	16,347.00	14,487.72	18,206.63	929.73
	2	19,781.00	18,251.48	21,310.95	764.87
	3	59,290.00	55,462.47	6,3116.83	1,913.59
	4	30,458.00	27,025.33	33,890.06	1,716.32
	5	7,702.00	5,717.07	9,685.93	992.06
	6	8,972.00	7,869.29	10,074.31	551.26
2014	1	6,211.00	5,107.04	7,314.76	551.93
	2	8,638.00	6,394.03	10,881.09	1,121.97
2015	1	33,177.00	28,725.09	37,628.09	2,225.76
	2	44,703.00	40,316.08	49,088.88	2,193.02
	3	49,234.00	45,235.74	53,232.15	1,999.01
	4	25,043.00	21,696.49	28,388.94	1,673.11
	5	12,666.00	9,107.68	16,223.92	1,779.06
	6	6,116.00	4,879.86	7,351.42	617.89
2016	No Arribada				

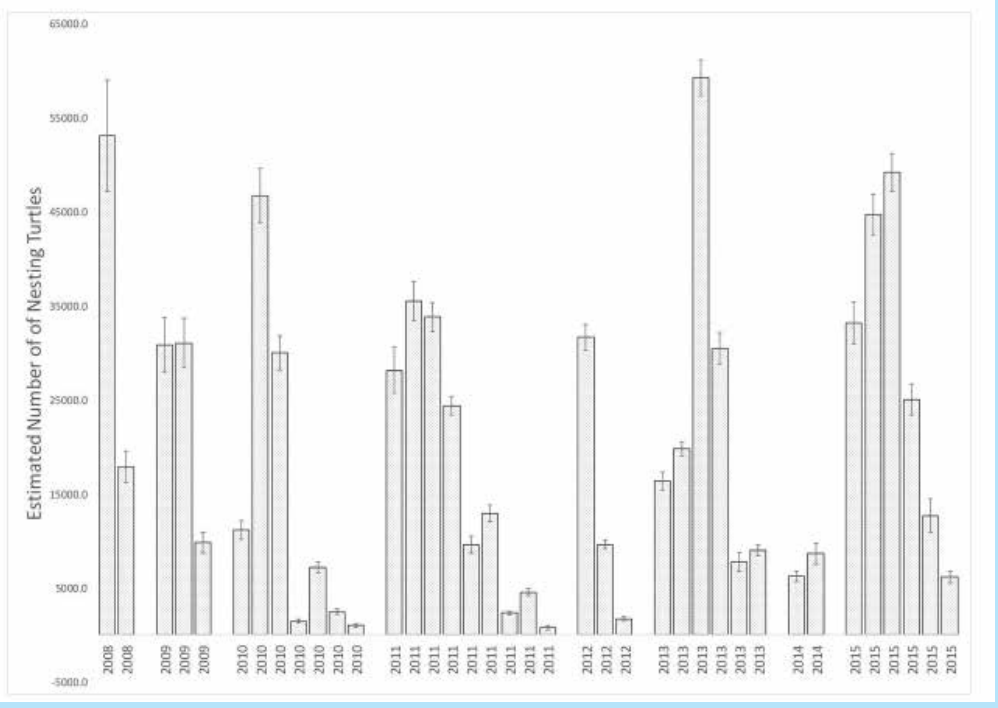
**Incomplete estimate due to gap in field sampling*

Table 7
Combined Mass Nesting Estimates at Rushikulya

Year	Estimate
2007	No Arribada
2008	70,985 (±15104.02)
2009	71,645 (±13345.05)
2010	98,433 (±13621.06)*
2011	151,828 (±19371.06)
2012	42,931 (±3993.04)
2013	142,550 (±13736.00)
2014	14,849 (±3347.09)
2015	170,939 (±20976.05)
2016	No Arribada

**Incomplete estimate due to gap in field sampling*

Figure 13
Daily Arribada Estimates at Rushikulya



directional orientation in segment 8 towards the sea at μ=227.61.

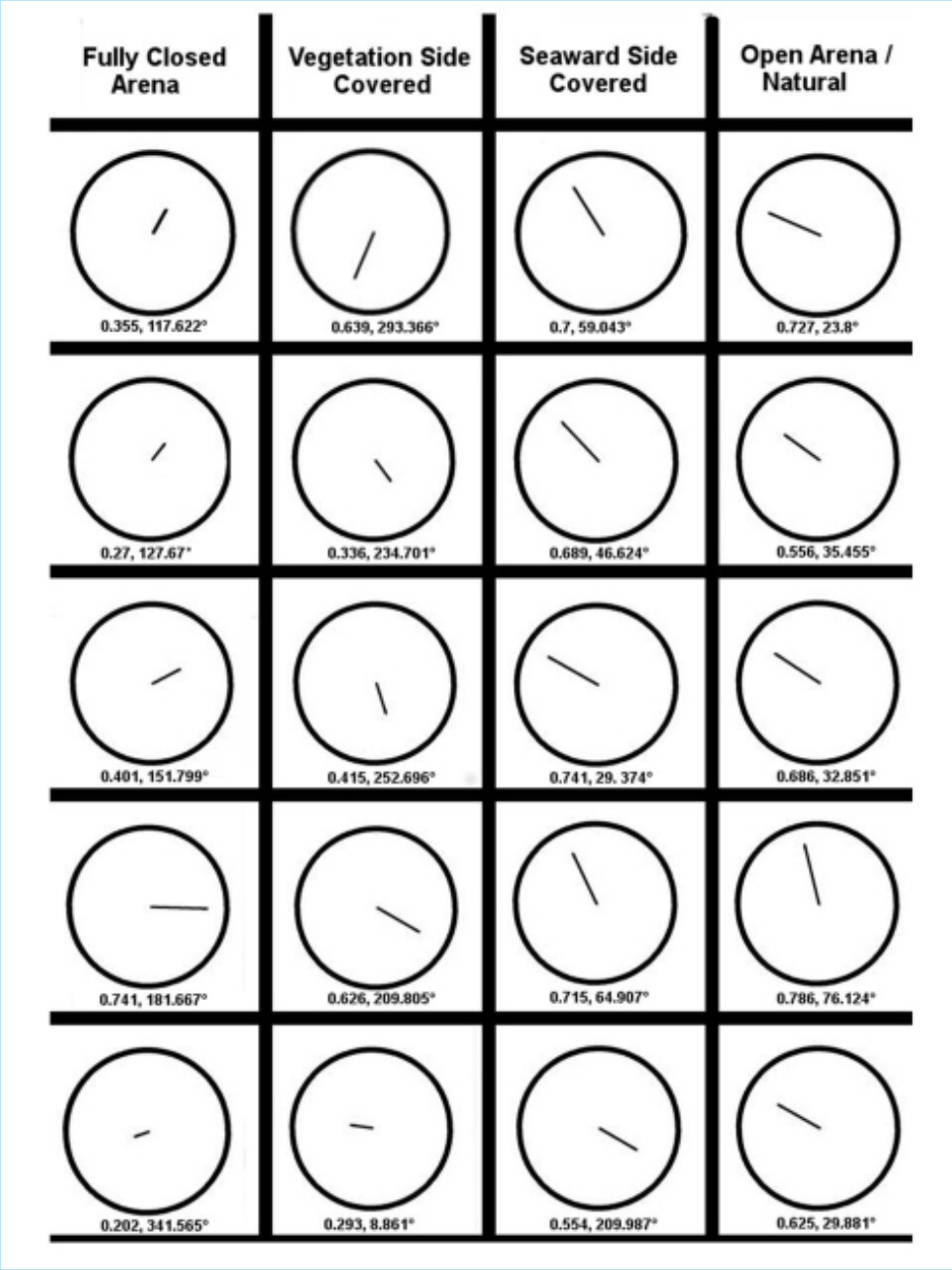
It was observed that the hatchlings of the seaside closed arenas oriented significantly different from random. In segments 16 and 32, the hatchlings showed strong landward orientation (r=0.699, μ=339.54, r=0.844, μ=328.39).

In the closed arena, the orientation of the hatchlings was random in segments 8 and 16, whereas it was in a specific direction in segment 32. The landward orientation in three arenas was evident from the mean vector or angle of orientation. However, for the riverside closed section, it was observed that the hatchlings headed into the sea as the cardboard obstructed the artificial light from the land.

Offshore Monitoring (2014–2016)

In 2014, a total of only 451 observations of turtles were made from only three out of the seven sampling locations (Bahuda, Rushikulya and Chilika). Most of the turtle sightings were

Figure 14
Hatchling Orientation Observed at Rushikulya



concentrated around Rushikulya (n=407). There were no turtle sightings in any of the other locations north of Chilika. We do not have data from Gahirmatha or Chandipur, and so the densities were calculated by pooling the data only from the sampled sites. The results depict a density estimate of 24.44 turtles/km^2 (p=0.49660, SE=0.05, n=3 sites). The average cluster size was 3.74 turtles. The summary of the model is given below. Please note that the density estimates of Rushikulya (average=23.546, S.E= 0.05) have contributed most to this estimate. The results for 2015 show that the greatest number of turtles was observed in Rushikulya (n=1751), the average cluster size of surfacing turtles was 2.9 turtles/ km^2 and the density estimate of 9.43 turtles/ km^2 (%CV=19.2). For the latest season (2016), the density estimates are about 134 turtles/ km^2 (SE=21.25, %CV=15.80), higher than those recorded by Tripathy in 2013 (density 35.1/km^2) (Table 8 and Fig. 15).

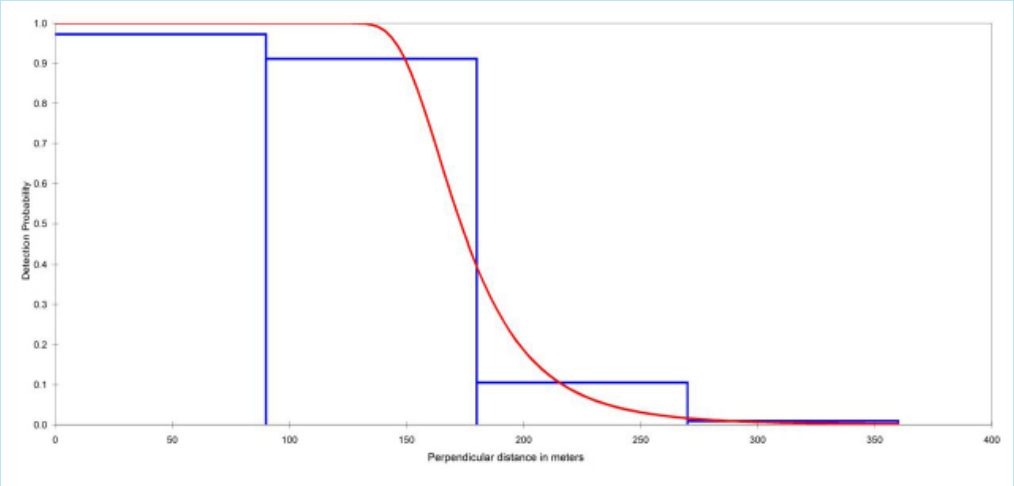
Table 8
Hatchling Orientation Observed at Different Beach Sections

	Segment 8	Segment 16	Segment 32
Open Arena			
Mean vector (μ)	308.870°	353.310°	327.260°
Length of mean vector (r)	0.829	0.492	0.709
Circular standard deviation	35.080°	68.280°	47.530°
Rayleigh test (Z)	13.748	4.833	10.050
Rayleigh test (p)	2.90E-7	0.007	9.92E-6
Riverside Closed			
Mean Vector (μ)	227.610°	171.910°	205.570°
Length of Mean Vector (r)	0.725	0.406	0.447
Circular Standard Deviation	45.930°	76.900°	72.750°
Rayleigh Test (Z)	10.520	3.300	3.990
Rayleigh Test (p)	5.22E-6	0.035	0.017
Seaside Closed			
Mean Vector (μ)	355.180°	339.540°	328.390°
Length of Mean Vector (r)	0.490	0.699	0.844
Circular Standard Deviation	68.420°	48.450°	33.320°
Rayleigh Test (Z)	5.526	9.784	14.260
Rayleigh Test (p)	0.003	1.43E-5	2.32E-7
Closed Arena			
Mean Vector (μ)	43.610°	59.620°	86.060°
Length of Mean Vector (r)	0.329	0.350	0.443
Circular Standard Deviation	85.420°	82.990°	73.120°
Rayleigh Test (Z)	2.167	2.455	3.924
Rayleigh Test (p)	0.114	0.085	0.018

Table 9
Turtle Sighting and Density Estimation

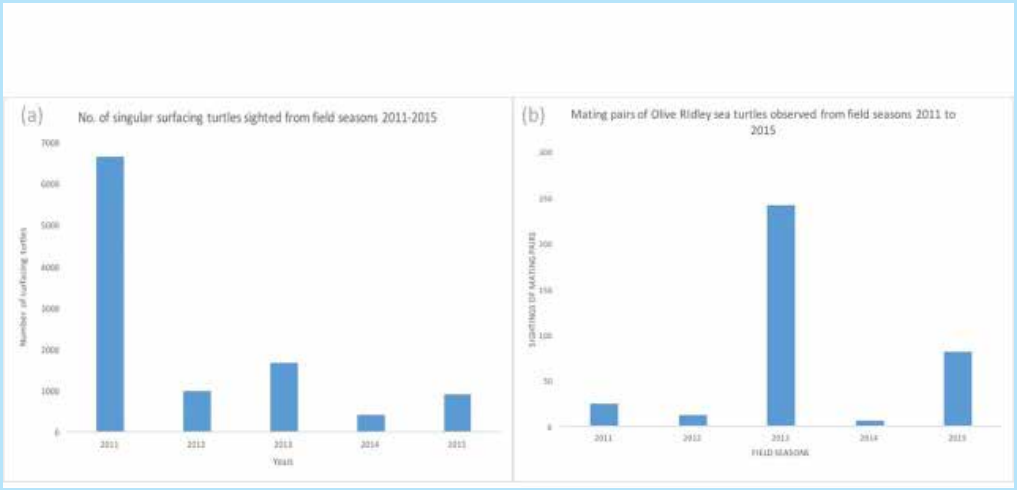
Point Parameter	Standard Estimate	Percent Error	Coef. of Variation	95% Percent	Confidence Interval
DS	134.13	21.195	15.80	98.358	182.91
E(S)	1.0030	0.58394E-03	0.06	1.0018	1.0041
D	134.53	21.258	15.80	98.650	183.46

Figure 15
Detection Function of Turtle Sighting Versus Distance in 2016



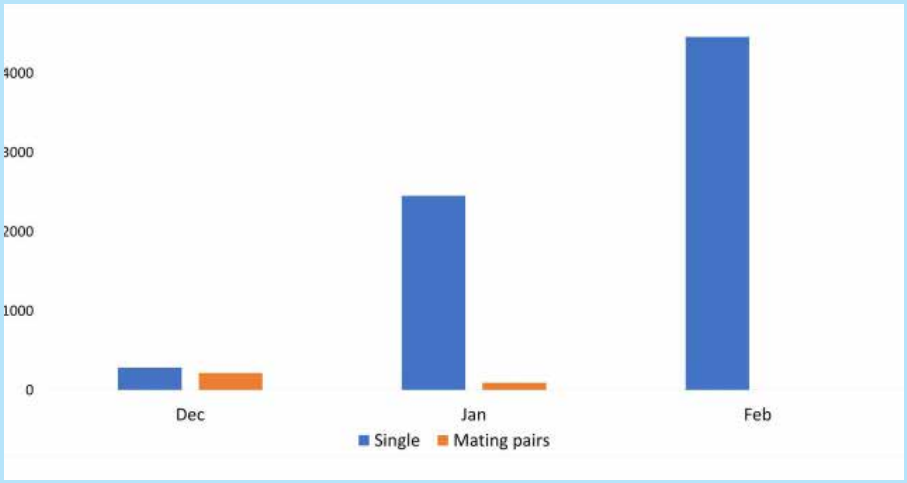
(N=7571, Y Axis is Detection Probability and X Axis is the Perpendicular Distance in Metres)

Figure 16
The Numbers of (A) Single Turtles and (B) Mating Pairs of Surfacing Turtles



Observed from 2011 to 2015

Figure 17
Numbers of Surfacing Single Turtles and Mating Pairs of Turtles



Encountered Each Month in Rushikulya in 2015–2016

Figure 18
Surfacing Turtles Observed at Different Locations in 2016

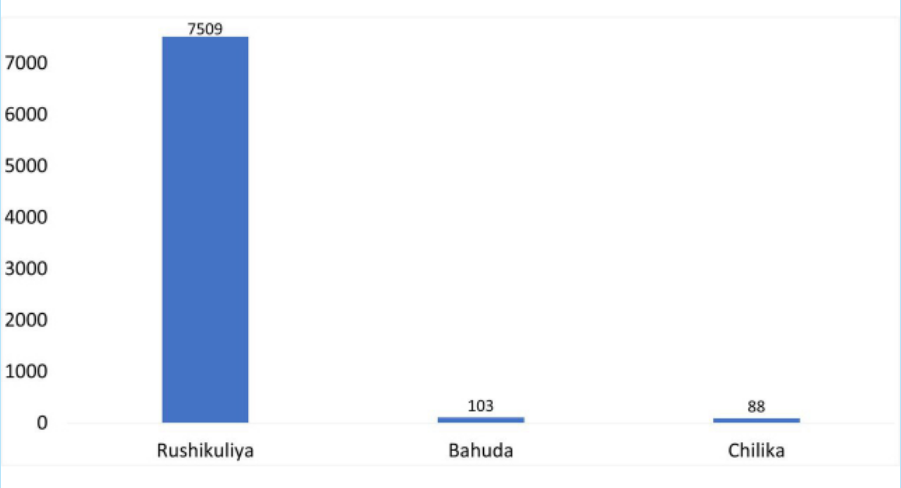
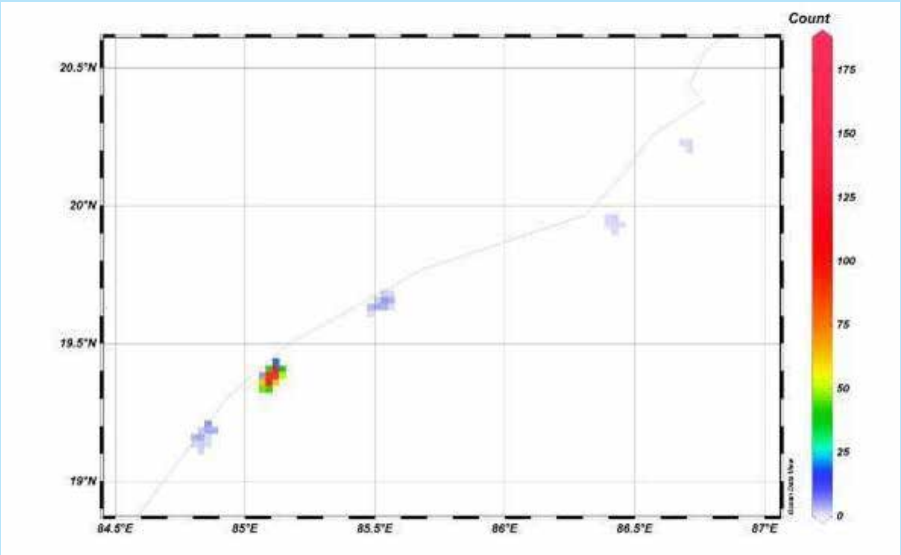


Figure 19
The Distribution of Turtle Congregations along the Entire Odisha Coast



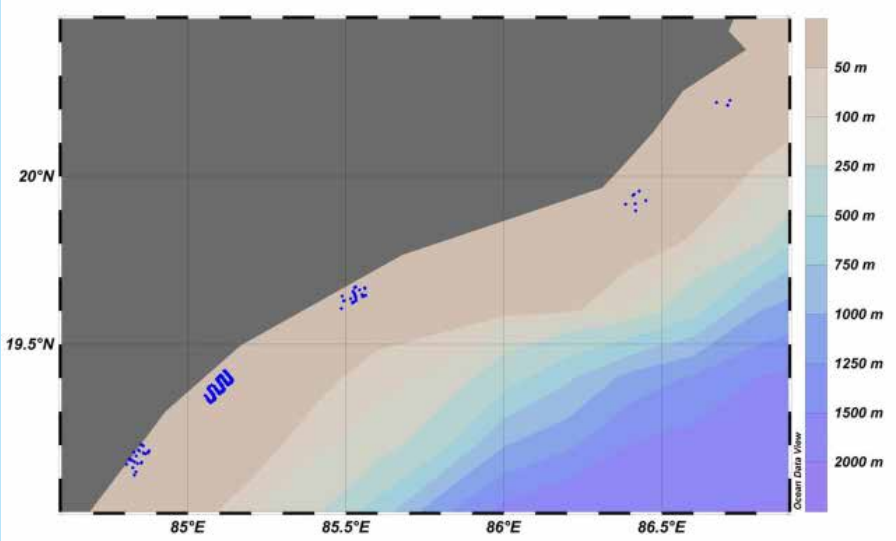
The Index on the Right Indicates the Number of Turtles Counted in Surveys at Each Location

Discussion

Climate change is known to have an effect on the distribution and biology of animals (Parmesan and Yohe 2003). This project is monitoring the changes in incubation temperatures and their corresponding effects on sea turtle sex ratios and mortality rates. As Rushikulya hosts a significant proportion of the olive ridleys nesting in Odisha, it serves as a suitable location for a long-term project, thereby serving as an index beach for monitoring the health of populations (Shanker et al. 2004). In collaboration with the Forest Department, monitoring procedures have been standardized and successfully applied to the census of mass nesting populations. The continued data collection from these and other nesting sites of olive ridley turtles along the Indian coast will allow us to monitor the nesting trends at these different sites. By monitoring the temperatures, we will also be able to determine the offspring sex ratios of these populations. Continued nest monitoring is also the most cost-effective way of arriving at trends in the adult populations of the olive ridleys that nest along these coasts.

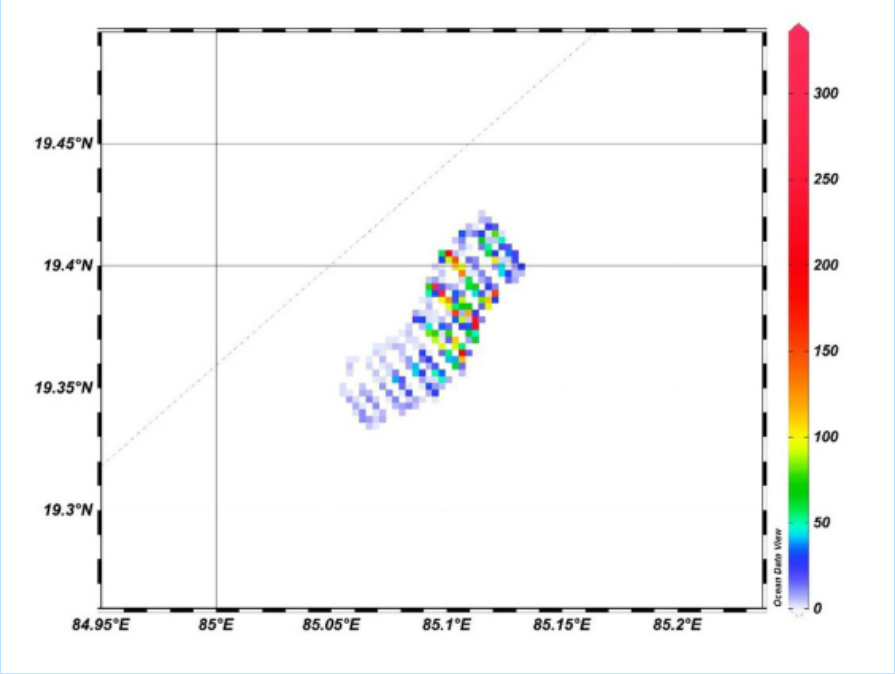
Offshore surveys of olive ridleys need to be carried out in a more systematic and thorough manner

Figure 20
Distribution of Turtle Congregations along the Entire Odisha Coast



The Index on the Right is the Depth Range, and All Congregations were Observed Close to the Shoreline

Figure 21
Spatial Distribution of Turtle Congregations in Rushikulya in 2016



along the entire Odisha coast for better clarity on regions of high conflict with fishing practices. As olive ridleys are known to prefer dynamic beaches close to estuaries, the nesting distribution is largely based on the nesting beach availability and is known to shift in its distribution over time. Nesting beach dynamics are largely governed by the effects of longshore drift as well as flooding and silt deposition from estuaries. Both these phenomena affect the Rushikulya nesting beach, and this feature in itself is known to be a preferred beach characteristic for olive ridley turtles. The offshore monitoring protocol has gone through several levels of correction and improvization over the years, but replicating the sampling strategy at other locations along the coast will help us understand the dynamics of offshore congregations of turtles better. The information

gathered so far indicates a more widespread distribution throughout the coast in the months of November–January, with movements to form denser aggregations close to the mass nesting beaches by early February.

With the limited number of beaches available for nesting turtles and with increased patrolling by agencies, sporadic nesting numbers may appear to have increased spatially but may only be a temporary shift. Our long-term data appear to be in accordance with other global nesting populations, with nesting abundances constantly fluctuating, with very variable nesting numbers.
The data derived from monitoring temperatures and dissecting dead hatchlings also seems to depict fluctuations in the trends of sex ratios and indicate a bias towards production of females. This sampling, though, is restricted to a few nests translocated to hatcheries, and there is no standard sampling size due to the uncertainty in obtaining large samples of dead hatchlings.

To conclusively derive any information with regard to such long-lived organisms, it is crucial to provide supporting research organizations with the necessary permissions in a timely manner to monitor their health. Several answers with regard to their biology and behaviour such as what happens to the eggs in females during years with no arribadas require a level of invasive techniques using laparoscopy and other tools which have not been employed due to stringent protection measures that are meant to protect the turtles from hunting/poaching. A lack of support for such field research has led to severe lacunae as well gaps in the field of knowledge of sea turtles from India in comparison with other global populations. For better informed management decisions to be made, it is imperative that researchers and managers work together in the coming years.

All the details mentioned in the report are based on experiences and recommendations of various sea turtle biologists from India and the IUCN/SSC Marine Turtle Specialist Group. We have taken utmost care to include all the factors that are involved in monitoring sea turtle populations for the best management practices that can be followed by the Odisha Forest Department.

Chapter 2

Sea Turtles, Conservation and Alternative Livelihoods

Introduction

Across the globe, there has been a need for shift in livelihoods due to reduced access to natural resources diminishing returns from natural extractive processes. This reduction is partly due to increased modernization and commercialization (Ghate *et al*. 2013). Habits and practices that were once sustainable are being replaced by faster, more extractive techniques (Pauly *et al.* 2002). This is especially true in the case of fishing, where, with modernization of gear and boats, the capacity to catch has increased manifold (Mathew 2003). This over-exploitation has been worsened by the fact that monitoring of the common resource is not easy as boundaries are harder to determine in marine systems.

There is a rising need for alternative livelihoods as the dependability of natural resources is decreasing. Incomes such as those derived through fishing have become unreliable and unstable in many areas. Marine fishers are also subject to unpredictable weather conditions and the risks associated with their lives when out at sea.

Rise of Conflict

A situation of conflict arises when conservation interests restrict local communities in their use of resources without providing alternatives (Berkes 2004). Fishers experience intense financial pressures due to a global decline in catches (Allison and Ellis 2001) and incomes. In areas with charismatic marine life such as sea turtles, coral reefs, whales, etc., conflict arises when they hinder fishing activities and even cause losses in the form of damaged nets (Godley *et al*. 1998). This conflict deepens with the involvement of different actors practicing conservation and the protection measures through legal frameworks that are in place to protect turtles (Sridhar *et al*. 2011). With transboundary ranges, the conservation of long-distance migratory species such as sea turtles elicits international attention. This can leave fishers feeling cornered and can even plant seeds of resentment in the community against turtles because of the attention and aid they receive. Witnessing conservation activities and the funding that goes into these operations, many communities do not perceive any benefits

of conservation to their societies. They assume that benefits (such as large amounts of money) accrue to others and believe that they end up bearing all the costs (Ashley and Dilys 1998).

When the communities feel victimized or excluded from use of resources that they feel they are entitled to, they may retaliate through protests and active lobbying but more often resort to indirect means such as "sabotage and non-cooperation" (Holmes 2017). This can render conservation activities ineffective.

Community-based Conservation

It is generally assumed that the last strongholds of wildlife are areas where urbanization has not reached and in relatively 'unspoilt' locations. Conservation activities are usually concentrated in areas which are mostly still rural. Fortress conservation has been practised in these areas where the communities are excluded from conservation activities and have failed on many accounts (Siurua 2006; Berkes 2004). It has been pointed out that it is unjust that the people most affected are not involved in making decisions that concern them and their use of resources. This has led to the trend of involving the local communities in conservation. Another factor that gave momentum to this movement is a major change in perspective wherein human beings began to be viewed as a part of the ecosystem and not just controllers of it (Berkes 2004; Stem *et al*. 2003).

Most traditional fishing communities are marginalized and poor and often do not have the luxury to practice 'conservation' as defined by modern (typically Western) conservation biologists unless they can harvest some benefits from it. Traditional practices that may be beneficial for fish resources and marine habitats are generally not considered 'conservation'. Given modern contexts, and overexploitation of fish stocks by commercial operations and degradation of habitat, conservation of iconic species such as sea turtles becomes a luxury they cannot afford. In this scenario, unless they receive tangible benefits from conservation, they are unlikely to invest time or effort (Stem *et al*. 2003).

Involving the community in a meaningful way is thus important. However, several questions remain. To begin with, what exactly is a community? What is the unit or the scale at which community-based conservation is practised? A community can have differential stakes within and may not be a homogenous group with uniform resource-use policies (Ashley and Roe 1998) . Hence, Berkes (2004) suggests that it is would be more prudent to work with institutions rather than communities. He defines institutions as the sets of principles and rules communities lives by.

Conservation + Development = Ecotourism?

One of the fastest growing sectors today, tourism has turned out to be a major driver of socio-economic progress (Anon. 2014). As a labour-intensive industry, it is one of the largest generators of employment, providing jobs to a wide array of people ranging from low skilled labourers to highly skilled planners and managers thereby, showing potential as an alternative source of livelihood (Ashley & Roe 1998). It is one of the few remaining industries that are still relevant in rural parts and can bring about development (Ashley and Roe 1998).

A popularly touted solution to combine conservation with community development is ecotourism. Ideally, ecotourism caters to a niche of tourists who are believed to be more responsible in their activities and generate minimal impacts (Meletis & Harrison 2010; Stem et al. 2003). Theoretically, ecotourism is an idealistic solution as it can create awareness about conservation, generate revenue and bring about community development and the participation of the community in it can aid their empowerment (Stem *et al*. 2003).

Ecotourism has been growing more rapidly than conventional tourism. Specifically, the number of ecotourists is increasing three times faster than conventional tourism (Das and Chatterjee 2015).

There is a shift in the kind of demand tourists are making. Experiences such as close contact with wildlife and adventure are more sought after than conventional destinations.

Historically, there have been instances of using tourism to bring about development in the community. In 1994, when the first non-racial government came into power in South Africa, tourism was the primary strategy "to fight the apartheid legacies of poverty and unemployment among the rural communities endowed with natural and cultural tourism resources" (Musinguzi 2012). Travel to rural locations also enables tourists to explore cultures that haven't been completely exposed to modernization. It is almost like travelling to the past, and some tourists specifically look for such experiences (Kiper *et al*. 2011).

Sea turtles are considered especially attractive for ecotourism (L. Campbell 2006) . In fact, sea turtles may be the most popular animals on the planet for nature-based tourism (Senko et al. 2011). Sea turtle-based ecotourism is being practised successfully in many parts of the world such as Brazil, Costa Rica, Malaysia, Australia and even Velas, a small village in Ratnagiri district of Maharashtra, India (Wilson and Tisdell 2003; Nulkar 2013–2014). In fact, tourism is so strongly linked to turtles in some locations that a decline in turtle populations may result in a corresponding loss in tourism revenue (Meletis & Harrison 2010). Hence, if turtles, as is the case with turtle tourism, become a source of income for the community, the community will render the turtles protection as they now hold some value for the community. This is one way of striving for sustainability of both conservation as well as the tourism programme (Okazaki 2008; Stem et al. 2003). Additionally, the skill set the community can develop can be used in other industries as well, helping them feel empowered (Ashley and Roe 1998).

One of the mandates of ecotourism is that the local community residing there be involved (Sirakaya et al. 1999). Involvement can be of many types. If the goal is to provide employment, as is the case with providing an alternative livelihood, then it may not be necessary to involve the community in the decision-making process. But if what is desired is a long-term, mutually dependent, self-sustaining partnership that aims at development of the community and not just providing employment, the community needs to be involved in the decision-making process and feel ownership of the venture (Ashley & Roe 1998). This mutual dependence will be the incentive for protecting what will now be a resource (turtles) and a source of income, employment, empowerment and development. One of the facets of this ecotourism attraction that tourists demand is the interactions and cultural exchange these communities can provide (Ashley and Roe 1998). Hence, their involvement is imperative.

Possible Reasons for Failure and Prepping for Ecotourism

The shape and direction tourism takes will depend on the power distribution amongst the different stakeholders, with the interests of those possessing the most power getting primacy (Ashley and Roe 1998). One of the chief causes for failure of ecotourism as a concept to bring about community development is its inability to ensure equity in distribution of benefits (Das and Chatterjee 2015; Okazaki 2008). If there is inequity in distribution, and benefits of tourism are restricted to elites (as is common) who might not be the ones bearing the cost, then it will not have the support of the larger part of the community (Ashley and Dilys 1998; Berkes 2004). Success in these ventures can be attained only if decisions are aligned with the socio-economic development of the community (Okazaki 2008). A tourism destination is not isolated from the people residing there, and interaction with local culture can provide tourists with a more holistic experience. Ecotourism is expected to appeal to a more conscientious group, who are aware of the impacts that result from their visit. There are many cases where the communities are ridden with poverty and receive limited benefits from ecotourism (Hill *et al*. 2016). It should be kept

in mind that ecotourism is not the mechanism that will bring about changes that ensure equity. Ecotourism is not the replacement of institutional reforms, which are the only way to ensure benefits reach local communities through ecotourism (Hill et al. 2016). These reforms are necessary to address inequity which ecotourism can bring in and not the other way around.

It is evident from case studies around the world that in many cases ecotourism functions in isolation and does not benefit conservation or bring about development and this is usually a result of lack of transparency and dialogue between stakeholders. If every stakeholder is given the responsibility of sharing their perspective, needs and role with regard to the development of such a venture, and with such clarity, success will have greater odds (Sproule 1996). Often, problems are common between stakeholders and arise due to a series of activities not just by one stakeholder. These can be brought out and effectively solved through partnerships that allow co-management, thereby ensuring the onus is not on any one stakeholder (Okazaki 2008).

Co-management should ideally arise from the community, but in many cases this may not happen due to limited access to education within rural communities and the mind set that such planning may require. This may be due to lack of exposure to little else from their local livelihood options. Although ideally, the initiative for co-management should not be top–down, it can be facilitated by the government by providing support in the form of legislation that "recognize local rights over land and resources" (Berkes, 2004). Capacity building and empowerment of communities can go a long way in determining the support of the communities and, thus, success of the programme. Capacity-building efforts can strengthen local institutions, and this social capital "functions as a lubricant to accelerate participation, power redistribution and collaboration" (Berkes 2004; Okazaki 2008). As Okazaki put it, "empowerment is more than participation in decision-making; it must also include the processes that lead people to perceive themselves as able and entitled to make decisions". He reiterates that effective participation of the community is not just providing them with employment and some benefits but sharing responsibilities and equity in the decision-making process. If tourism is thrust upon the community, without involving them in the decision making process, it could result in "backlash" where they could exhibit negative behaviour towards tourists, and such instances can take a long time to be fixed (Okazaki 2008). Even if intentions of power redistribution are present, the community has to be prepared for it. As Okazaki points out, such an approach is usually time consuming as there are many barriers such as lack of education, inexperience, dearth of funds, etc. Often, this initial effort is not present, which influences the long-term sustainability of the programme (Okazaki 2008).

The reason why top-down approaches have been criticized is that even though they could provide employment to communities, there may be limited trickle-down of benefits. Hence efforts have been made to invert the pyramid, with the widest part reserved for the community (Ashley and Roe 1998). Additionally, one of the most effective ways of preventing leakage of tourism benefits to outsiders at bay is by keeping the community in control (Ashley and Roe 1998).

The Flip Side

A major problem with ecotourism is ambiguity in its definition, which has led to many forms of exploitative tourism in the name of ecotourism (Meletis and Harrison 2010). There are also growing concerns that an increasing focus on development and empowerment of the community is "diluting the conservation agenda" (Berkes 2004). Ecotourism generally markets destinations that are ecologically sensitive. These areas are typically more vulnerable to degradation, and uncontrolled tourism can negatively impact such ecosystems (Stem *et al.* 2003).

Even if a destination is frequented by many tourists, the benefits often fail to reach the people residing there and when they do, they are not always equitable and stable as they are

Figure 22
Past Efforts by Different Agencies in Rushikulya

Photo Credit: John Dutton

subject to seasonal fluctuations and sensitive to local economic and political events (Stem et al. 2003). In case an ecotourism programme falls apart, the members of the community who are dependent on tourism for their livelihoods are left with no alternatives (Stronza 2001).

Inequity in distribution of benefits to members of the community can induce jealousy, creating divides within the community and exacerbate existing ones (Sproule 1996), and this leads to increased social stratification (Stronza 2001).

These are some concerns that require thought and discussion amongst the different stakeholders. If ecotourism, through proper management and planning can be what it promises on paper, it has the potential to be one of the most effective strategies that combine education, awareness, conservation and community development.

The Mass Nesting Beach of Rushikulya

Rushikulya, in southern Odisha, is a globally important mass nesting rookery of the olive ridley sea turtle. One of the two current mass nesting sites on the mainland coast of India, it is located north of the Rushikulya river mouth and close to the fishing villages of Purnabandha, Gokurkhuda, Podampeta and Kantigada (Bateswar). These coastal villages are located just off a national highway (NH5) and are about 140 km from the state capital (Bhubaneswar), making the rookery quite easily accessible. Most of the fishermen in this region are artisanal fishermen. Telugu is widely spoken in this region as many fishermen have migrated here from neighbouring Andhra Pradesh (Tripathy 2009). The Odias (generally the land owners, with occupations varying from farming, labour and, in earlier times, preparation of alcohol to a whole assortment of jobs) and Noliyas (Telugu-speaking community) coexist in many of the villages, sharing space and resources like wells and casuarina plantations.

Rushikulya, being a mass nesting site, has a long history of research and conservation starting in the early 1990s (Sridhar and Shanker 2011). There has been a constant influx of outsiders ranging from scientists to NGOs, tourists, the media, etc. This has been possible due to the fact that it is not yet a protected area and the site is easily accessible. This constant presence of conservationists and researchers has played

Figure 23
Sharing Space on the Beach, an Existing Issue Worsens when Turtles Arrive

Photo Credit: Muralidharan. M

a definite role in shaping the mindsets of the local communities. It has aided movements such as getting the communities to stop collection of eggs. Another interesting development was the initiation of community-led NGOs in the village to protect turtles. But not all of the impacts are positive—feelings of injustice and unfairness have cropped up over the interest that turtles receive. Resentment grows in them when they witness instances such as the death of a turtle receiving more attention than the death of a fisherman. In a history of coexistence, these feelings were exacerbated by the fishing ban and constant presence of conservation activities (Sridhar *et al.* 2011).

The decline in fish catch is a real problem in Rushikulya, and issues over sharing of space and resources between fishers and turtles are prominent. Conservation activities have, for a long period, pushed the community's needs into the background. The need for an alternative livelihood seems imminent. As the communities here share a deep cultural connection with turtles, which they believe to be a reincarnate form of Lord Vishnu, they have been tolerant of conservation schemes (Campbell 2003).

Many attempts at setting up alternative livelihoods have been made, but none have had a lasting impact. One of the primary reasons for this is that the community was never consulted as an equal stakeholder. A complete top-down approach was employed where decisions were made for the community and programmes thrust upon them. As Berkes (2004) points out, "programs often need to encompass a broader view of the livelihood needs of local people and their knowledge and interests." Many of these programmes also failed because there was hardly any follow-up.

During the turtle breeding period, which begins with the arrival of turtles offshore to mate and ends with the departure of hatchlings, plenty of tourists come to see the different stages of the breeding period. A large number of tourists flock to the site during the arribada. Given the presence of existing tourism at the site and drawing from other turtle tourism sites from around the world, exploration of ecotourism as an alternative livelihood for the fishers was initiated. There have been attempts in the past to harvest benefits from tourism by different agencies including the forest department and the

Integrated Coastal Zone Management and some opportunistic ones by the community itself. None of these have been sustained. Tourism might not generate sufficient economic benefits, as is the case presently. Hence, if benefits beyond cash, such as skills, community development and supporting infrastructure are targeted, there might be more support for it in the community (Ashley and Roe 1998).

One of the major reasons for the failure of these mostly top-down initiatives is the lack of understanding of how the community works and its relationship with the turtles. This understanding can only emerge from dialogue and engaging with the community. Generally, planning agencies are unaware of how the community space is used on a daily basis. To make decisions and give policy recommendations on the use of this space without the necessary background exacerbates the conflict and renders any action unsustainable.

Our study therefore aimed to understand the reasons for the failure of past efforts at involving the community in conservation, the rationale behind the need for alternative livelihoods and, in particular, the potential of tourism focused on turtles as an alternative livelihood. The current volume of tourism provides very little benefit to the community as a whole, and only a few individuals receive some money, which is hardly a reliable and constant source of income. We carried out a study to understand how the communities perceived this tourism and how it could be carried out more effectively, if so desired by the different stakeholders.

Objectives

This study aims to bridge the gaps in knowledge and to determine the different stakeholders in this landscape and their roles and extent of involvement.

1. To understand the current state of the communities in possible conflict with turtles
   - 1.1 The governance and power dynamics in these communities
   - 1.2 The problems these communities face, their causes and solutions as perceived by them
   - 1.3 Their needs in terms of alternative livelihoods such as
   - 1.3.1 Tourism (perception of different actors in terms of its potential benefits, problems, type, development, management, etc.
2. To understand the current dynamics of stakeholders and turtles
   - 2.1 How the different stakeholders perceive turtles
   - 2.2 Current conservation efforts and how they are perceived
   - 2.3 Threats to turtles as perceived by the stakeholders and efforts to mitigate them
3. To outline suitable recommendations for community development and a potential tourism programme

Methods

With greater involvement of different stakeholders in the management of common property resources, it is important to assess perceptions, attitudes and opinions to understand the positions of the stakeholders. Combining qualitative data with quantitative data can provide a comprehensive picture and lead to more practical solutions (White *et al.* 2012) . A mixed-methods approach involving quantitative and qualitative data was employed to address our questions.

Data Collection

Data collection was carried out using methods such as semi-structured interviews, informal discussions, questionnaires, field notes and passive observation of meetings.

Local community members were interviewed with a range of questions to obtain opinions and perspectives from the local communities regarding village governance, village problems, turtle conservation and its effect on the community, beliefs and values associated with turtles, alternative livelihoods and in particular turtle-centred tourism and its management.

Table 10
Stakeholder Type, Number of Respondents, Sampling Strategy and Data Collection Technique

Stake Holder Group	Data Collection Technique	Sampling Technique	No. of Respondents	Effort
Local Community Members Village leaders (Sarpanch, ward members, president, representatives of the temple committee), SHG members, auto drivers, shopkeepers, local journalist and a high school teacher	Semi structured interviews	Non probability convenient sampling Expert sampling Snow ball sampling	103 (Puranabandha= 24; Gokurkhuda – Odia sahi=13; Gokurkhuda – noliasahi =28; Podampetta = 26; Nuagao=8)	128 hours 45 minutes
Government Officials Forest Department (6), district administration (4), tourism department (2) fisheries department (3).	Semi structured interviews	Expert sampling	15	Approx. 15 hours
Other Key Informants Wildlife scientists, NGOs, tour operator, journalist	Semi structured interviews	Expert sampling	27	Approx. 14 hours
Tourists	Questionnaires	Non probability convenient sampling	13	2 hours 20 minutes

An oral questionnaire was administered to tourists who had come to see turtles. As they are also stakeholders and would determine the success of a potential tourism venture by controlling demand, this questionnaire was expected to help understand their expectations.

Informal discussions were held with community members to build rapport and trust. These discussions also bring to light themes that were not previously considered by us.

Passive observations of meetings such as village meetings, Forest Department meetings and an Orissa Marine Resources Conservation Consortium (OMRCC) meeting helped improve understanding of the complexity of the study site. All the local community interviews were conducted in the local language, recorded (with individuals' consent) and transcribed later.

Stakeholders' Workshop

In order to get the stakeholders on a common platform and to initiate discussion, a stakeholders' workshop was held during which the preliminary results of the study were presented. This was a useful exercise as comments and opinions were immediately responded to with feedback/counter opinions by other stakeholders and it provided the stakeholders the opportunity to engage with each others' stance on various issues.

Data Analysis

The data were coded into the themes that were addressed in the objectives. Microsoft Excel was used to store, code and analyse the data. The data were analysed using an inductive approach, resulting in broad, exploratory themes. Descriptive statistics were employed.

Results and Discussion

Local Community Respondent Characteristics

Our sample consists of male and female respondents ranging in age from 18 to 73. Most of our respondents are fishers and fish sellers as the sites are chiefly fishing villages. Seventy-six percent of the interviewees did not have toilets at home, and of the remaining that did, not all of them were comfortable with using them (Table 2). Only 18% of the respondents had finished

Table 11
Local Community Respondent Characteristics

Average Local Community Respondent Characteristics	
Age (Years)	39 (range = 18- 73)
Gender	Female (24%) and Male (76%)
Marital Status	Married (80%) and Unmarried (20%)
Own House	100% (either bought/inherited/acquired through government schemes)
Toilets at Home	Yes (24%) and No (76%)
Occupation	Chiefly fishers. Occasional shop owners, auto drivers, students and labourers
Educational Qualification	Refer to Table 3

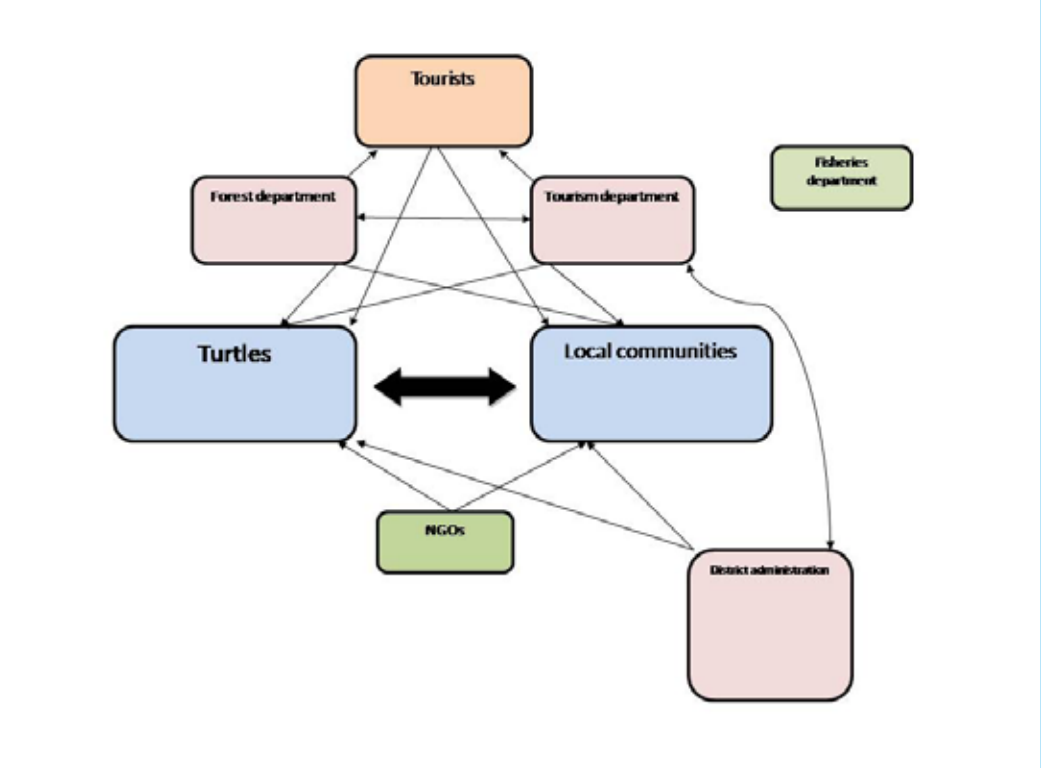
Table 12
Educational Qualifications of Community Respondents (In %)

No Education	19	**Lower Secondary Education**	23
Primary Education	13	**Higher Secondary Education**	3
Upper Primary Education	24	**Higher Studies**	18

Table 13
Stakeholder Groups and Their Roles

Forest Department	Fisheries Department	District Administration	Community and Turtles	NGOs, Scientists, Researchers
• Caretakers of turtles on land and sea • Restrict fishers from fishing during high turtle density • Provide employment to locals as turtle squad members • Provide benefits to the village in the form of aid in developmental activities • As per state law, power to initiate/manage ecotourism ventures if they are in protected areas or involve protected species • Hold meetings with the community members to raise awareness about turtles and encourage their protection	• Offer loans and subsidies for purchase of boats and nets • Compensation for the fishing ban • Responsible for regulating the entry of trawlers and other state vessels, thereby protecting local rights	• Responsible for providing land and water and carrying out other developmental acitivities • All activities to be carried out have to go through them and with their consent	• Share space and resources • The relationship between them are of: • Mutual benefit— a source of revenue for the community. Hatchlings and eggs are voluntarily protected by the community. • Mutual loss— turtles get killed in nets, fishermen nets get damaged, loss of fish as turtles eat them, fishermen aren't permitted to fish because of turtles.	• Can facilitate smooth exchange between stakeholders • Can offer expert opinion on matters related to turtles • Can help protect rights of less powerful players, thereby striving for equity • Can provide skill development training

Figure 24
Stakeholders: Extent of Influence and Magnitude of Role



The Size of the Box Reflects the Magnitude of the Role They Play and the Length of the Arrow the Closeness of Relationship and Extent of Influence

schooling and pursued higher education but an even higher percentage (19%) had no education at all (Table 3).

Players Involved and their Roles

In this landscape, each stakeholder has specific roles and tasks. Some could overlap and in Rushikulya, turtle conservation causes quite a bit of an overlap. For instance, the Forest Department is responsible for protecting the turtles the Fisheries Department is responsible for providing compensation to the families that are affected during the turtle breeding period. The roles of the different stakeholders are elaborated in Table 4, and the complexity of the interactions is depicted in Figure 2.

Problems Perceived by the Community

To get the support of the community, it is important to target issues that they perceive as problems. We interviewed the community members and asked them to list the problems faced by the community as a whole, problems they individually faced and problems that fishers in particular faced.

We grouped the problems reported into four categories:

- *Fishing related*—complaints about catch reduction, unavailability of fish, fishing-related mortalities, etc.
- *Turtle related*—inconvenience caused due to turtle presence. This includes tearing of nets, inability to go fishing, destruction of fish left to dry on the beach, being harassed on account of turtles by officials, etc.
- *Development-related problems*—complaints about water, electricity, medical facilities, lack of roads, etc.
- *Government aid related*—complaints about unfairness in distribution of items given for compensation, no response to complaints, etc.

Development problems were the most pressing, followed by complaints about inequity in

government aid distribution. Turtle-related problems were of least concern among the four categories. This suggests that the communities would most welcome assistance towards development issues.

Some of these villages do not have access to basic amenities like access to clean drinking water, sanitation and medical facilities. These quotes bring out the dire need for development in these villages:

"There is not a single drop of water in the village. Village is dying because of water scarcity."

A respondent highlights the issues of bumpy roads and lack of medical facilities as causes.

"There was a delivery case, and it was very troublesome for the pregnant woman to go."

There seems to be a perceived disregard from the side of the district administration to resolve these issues. Villagers have complaints that when officials come to visit the village, the water supply is plentiful and it stops after they leave. Constant complaints have not borne fruit. In the effort to complain at the government office, they also lose a day of work, worsening their economic situation.

"We have to demand and bring about development. That is how the situation is."

Need for an Alternative Livelihood

Another issue that is significant is the lack of employment. Children are educated, but there are no jobs for them. The fishers are noticing a reduction in the fish catch; competition from other states as well as within the state is intense, resulting in a gradually declining catch for everyone.

Respondents, when asked about change in fish catch:

"Because modern technology has come. The trawlers that come and fish kill with gill nets, kill with ring nets, because of which they take off all the young fish. The local people that are there, it is very problematic for them. It affects them. Fish is reducing because they fish fast. Instead of one quintal they take hundreds of quintals, because of which fish is getting over."

"When we were kids in the river canal there was so much fish that people couldn't dry it, make sutti or sell it. Now it has become such that people are not getting fish to eat curry also."

Of the respondents who had an opinion about the change in fish catch, 77% said that it had decreased, 15% said it fluctuated, while 8% said it had increased (most from Odiasahi who don't go fishing)

The primary reasons for the decline in the fish as perceived by the respondents is unsustainable fishing practices such as the large-scale fishing practised by trawlers from Andhra Pradesh, fishing of larvae and gravid females, spreading nets across the mouth of the river and prohibiting migration and, thus, breeding.

This unsustainable fishing has been a result of modernization, and this quote shows a respondent's perspective:

"Government has made these larvae nets through scientists. These companies are manufacturing them. Lot of loss is happening. Government has created nets of different kinds for different fishes. Finally, they also invented masoori nets (to catch larvae). They brought out these nets, I am seeing now ... I am 64 years old now. I can't see that quality in fish anymore."

Another respondent on the need for employment:

"Here Jayshree company was there where 1000 people were working when we were kids, but now only 40 people are enough because of the mechanized zamana."

In general, respondents indicated that incomes are decreasing and there is an urgent for an

Table 14
Community Attitude towards Turtles

Positives Associated with Turtle Presence	Negatives Associated with Turtle Presence
Source of employment (tourism or conservation)	Disrupt fishing activities
Eat jellyfish that are toxic to their fish and, hence, increase fish catch	Damage fishing nets
Suppress natural disasters	Take up too much space on the beach
They are a source of pride as they have made the village famous on a global scale.	Make the communities vulnerable to problems with the forest department as there have been instances of power abuse. Also, there is ignorance on the part of the fishers.
Maintain balance in the ecosystem and keep the environment clean	Turtles receive more aid than do fishers and induce resentment.
The joy turtle viewing gives	Eat fish from the nets
Bring about development of the village	
Rescue from drowning	
View turtle as a form of god	

alternative livelihood. Many respondents spoke about the Forest Department not employing enough people to carry out conservation work, suggesting that employment offered for conservation activities is valuable to the community. Some fishers even return from other states where they had gone to work in time to carry out these conservation activities.

Village Governance: Who Calls the Shots?

These communities are governed strong institutions including the panchayats and local committees that are respected throughout the community. There are elected committees that look after the village and ensure adherence to village rules. The responsibilities of these committees range from solving personal problems within a household such as fights due to alcoholism to land disputes between members of the community and are the link between the district administration and the rest of the village. They are responsible for communicating details about government schemes. The village-elected committee usually has a lot of power. Members elected are elders, educated or rich and influential and are believed to have the capacity to govern the village.

If the committee declares a day of no fishing, the entire village follows it. If rules are broken, the offenders are fined. In Odia communities, these institutions are not as strong as in Noliya communities. The Noliya communities take pride in the confidence that they have the capacity to resolve all their problems amongst themselves and very rarely require police assistance. If the community is to be involved it would be essential to have a discussion with the village committee and get its support first. There are of course times when the committee induces distrust as there have been allegations of corruption by the committee where it is believed to have kept a portion of what the villagers are entitled to from various government schemes, but for most part the committee is revered and respected.

Perceptions Associated with Turtles

The communities have positive as well as negative feelings associated with turtles. As the community is the closest and longest observer of turtles in this area, it could be useful to determine their perception of population trends: 89 percent of the respondents felt that there had been an increase in turtle numbers over the years as opposed to 9 percent who believe

Figure 25
For Increase in Turtle Population as Perceived by Local Communities

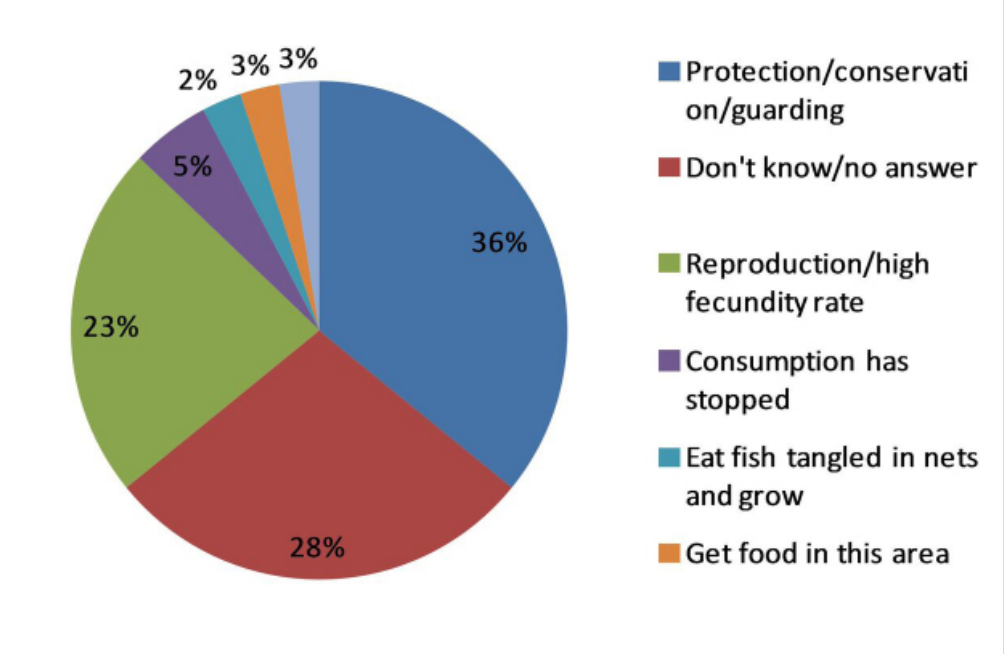
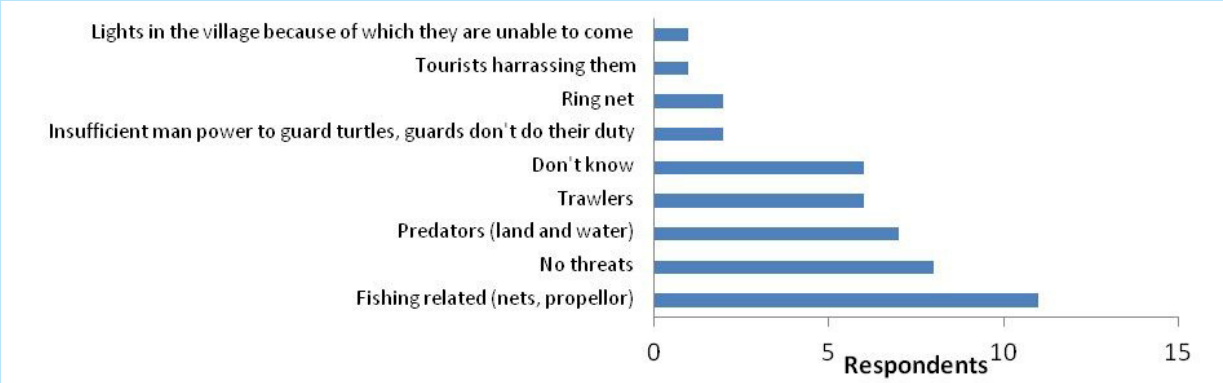


Figure 26
Threats to Turtles as Perceived by Local Communities



the population has declined (2 percent said they could not tell).

A quote from one of the respondents brings out this perceived increase aptly:

"when I put out my net fish are not visible, only turtles are."

Although this is not a reliable measure of the population trend, it does indicate that they might not offer much support for a programme they believe is not necessary.

We further went on to ask why they thought there was an increase and 50% of the respondents attribute this perceived increase to protection activities carried out in Rushikulya. The second largest cause quoted by them is the natural fecundity of the turtles (Figure 2).

Major Threats to Turtles as Perceived by Different Stakeholders

In comparison to other parts of the Odisha coast, relatively few dead turtles wash ashore along the beaches of Rushikulya. The fishers are in the constant presence of turtles and have the opportunity to observe them and the threats they face. They feel that the highest cause of mortality is fishing related (Figure 3). Although

their nets are not the cause, as their nets can easily be torn by turtles, they feel the propellers of their boats can injure turtles and result in death. Nets such as trawl nets and ring nets, due to their prolonged time of immersion, do not allow turtles to surface for oxygen, thereby causing death by drowning.

The Forest Department and fisheries department are of the opinion that the largest cause of mortality in this region is by the trawlers. On land, predators that feed on turtle eggs are perceived as the biggest threat to them. Hence, there is unanimous agreement among stakeholders who work in proximity to the site that the primary threat to turtles is from trawl fishing. There was no representation of trawler owners and fishers, and it would be interesting to document what in their perception the largest threat to turtles is.

Conservation Activities

Currently, the beach is patrolled every night by village members hired by the Forest Department, World Wildlife Fund (WWF) and research scholars of the Indian Institute of Science (IISc) and Dakshin Foundation. This patrolling by the Forest Department and WWF is to protect nests from predators and poachers, while IISc and Dakshin are monitoring the turtle population. In addition, the entire mass nesting area is fenced off to further exclude predators. The Forest Department uses two speed boats and two trawlers for protection in offshore waters. As mentioned in the earlier section, the community believes this protection is effective, as does the government, including the Forest Department and fisheries department.

There is also a fishing ban that is active from 1 November to 31 May every year that dictates special restrictions for areas which have/had turtle congregations. Officials of the Forest Department and fisheries department unanimously feel that the ban has been effective in protecting turtles. However, our data shows that the ban is not strictly implemented in this region. Most of the fishers are not even aware of the existence of the ban and those who are do not have clarity regarding its provisions. This has lead to their exploitation by the authorities on some occasions and their ignorance leads them to tense situations with the authorities.

Perceptions Associated with Tourism

Perceived Benefits of Tourism by the Communities

The community experience a fair amount of exposure to tourism, but they do not view it as a potential alternative source of livelihood. For them, it is an opportunistic means to make money quickly. There is no equity in the distribution of benefits, which has resulted in some conflicts within the community. In any case, they do not view these one-off benefits as a substantial addition to their income. Some collective benefits that they associate with tourism are village popularity, which could assist and accelerate development and promote greater interaction with the outside world: the presence of outsiders positively affects good behaviour on the part of the villagers and encourages cleanliness in the village.

The community is not yet at a stage to come up with initiatives to harvest benefits of tourism on its own without aid or assistance. The members of the community do not have the necessary exposure or experience, but they show willingness for any task that will give them economic benefits.

Type of Tourism Envisioned by Different Stakeholders

When exploring tourism as an alternative livelihood in Rushikulya, especially ecotourism as it concerns a Schedule I species, it is important to ensure consensus of stakeholders on the definition and type of tourism desired. Through our interviews, we found little agreement between stakeholders.

Local communities envision something similar to mass tourism, where the area is thronged by people. This is because their primary motivation is economic gain and greater employment opportunities. Respondents expressed a desire for the tourism to develop the way it is at popular mass tourism destinations such as Puri.

Table 15
Who should Hold Power for the Tourism Venture?

Stakeholder	Opinion
Forest Department	Partnership between the community and the forest department
Fisheries Department	Tourism department with involvement of forest department
Local Communities	Village leaders/committee with support from government or NGO
Ngos/Scientists	Community with support from government. Joint management, multi-stakeholder body
Tourism Department	Tourism department, forest department and the community
District Administration	Tourism department with involvement of forest department

Although the Forest Department terms the kind of tourism they wish to implement as ecotourism, it is not completely aligned with definitions of ecotourism. Their involvement of local communities is equated to providing jobs that provide hospitality to tourists. This is not true involvement as the communities are not involved in any decision making processes and do not have any real control. The tourists that the Forest Department is targeting are VIPs—this tourism falls into the category of high value–low volume tourism.

Scientists/NGOs imagine a low impact, tents-for-accommodation kind of tourism. Some scientists feel high value–low volume tourism will not work out as it is a once in a lifetime phenomenon and will lead to further managerial complications such as who will be restricted and who will be allowed.

The tourism department strives for something more similar to nature tourism, which basically involves travel to 'nature'-rich places. The department also views community involvement as providing the community with jobs.

The fishers in Rushikulya have accepted their position in society along the fringes. They do not seem to realize that, in many cases, they can demand rights to decision making. This acceptance on their part will perpetuate the tendency of the authorities to leave them out of the decision-making process. Unless a community feels politically and socially empowered by participation in the tourism venture, it is not possible to gain its support in a meaningful manner (Das & Chatterjee 2015).

Motivation for Tourism

The motivation to initiate tourism for three out of the five forest officials interviewed and the director of the tourism department is the need for tourists to be able to access this natural phenomenon and not primarily to provide an alternative livelihood. This motivation is more tourist-centric than community- or conservation-centric.

For the community, it is collective, community benefits like the cleanliness of the village, behaviour of the children, publicity for the village and a source of income, although not substantial. NGOs feel tourism can give support for conservation through campaigns.

Who should Manage?

This is a critical question as this will decide the power distribution and the direction in which the tourism will proceed.

A respondent from the tourism department felt that it should not be under the exclusive control of the Forest Department because the latter would pursue a conservation agenda alone. He said:

"The problem is most of these nature enclaves are in the control of Forest Department and that needs to change. If you want to conserve nature you have to create a whole army of nature lovers who will protect it"

Concerns Associated with Tourism

Several concerns were expressed about tourism, including concerns about safety (especially for women, a rise in the prices of commodities, concerns about tourists dirtying the beach and harassing turtles by sitting on them, and fear about uncontrollable mass tourism which results in destruction of the ecosystem.

Tourism can be a supplementary source of livelihood in these communities. It cannot be their primary source of livelihood as it is seasonal in nature, unpredictable at this stage and focused on just one attraction. For it to be a venture that will truly benefit the members of the community and to ensure that they are equal stakeholders, a lot of dialogue and planning is necessary, along with a policy that will reinforce equity.

Conservation as an Alternative Livelihood

"When the WII (Wildlife Institute of India) started the project with Bivash (Pandav) working, during 1990 something and then of course we continued working after that ... the total money we have spent in this area ... in Orissa is to the tune of over three and a half crores."
B. C. Choudhury

Through the course of this study, we found that local communities viewed conservation activity-related employment as a valuable source of livelihood. Respondents feel that the Forest Department should employ more people for larger durations, especially as they are restricting their regular fishing activities. As Dr B.C. Choudhury points out, a lot of money, at least on paper, goes into the community in the form of conservation-associated costs. If these funds were better utilized keeping in mind the development of the community and not just conservation, it could result in a win-win situation.

Tourist Perspectives

As the arribada did not occur last year, the number of tourists we could interview was relatively small (N=13). This is not sufficient to carry out a robust tourist profiling exercise, but it was evident that almost all the tourists had a special interest in nature. Their visits were mostly combined with other wildlife spots such as Mangalajodi and Bhitnoi. The tourists felt that trained guides would enrich their experience. Most tourists were interviewed when they had come to view turtle–mating, and as this is a relatively expensive activity which involves the hiring of a boat and a driver, the tourists who came were economically well off. Most felt homestays would work well and that they would enjoy the experience of living with locals. More data are required to create a better profile of the tourists.

Stakeholders' Workshop

The workshop discussion started with bringing forth the issue of lack of clarity in the fishing ban that is in place in Rushikulya. There was clarification that the ban is implemented by the fisheries department and not the Forest Department and that it is focussed on protecting turtles. There was consensus that conversion of Rushikulya into a protected area will not benefit any of the stakeholders, be it conservationists or fishers or turtles.

A list of recommendations was generated through the course of the workshop as given below:

- Lower-level committees in the villages should be formed during the initial phases of the project for effective implementation.
- Administrative bottlenecks should be addressed before initiating a tourism programme.
- Ecotourism can be combined with other attractions, including boating, temple tourism and beach tourism.
- Conservation as an alternative livelihood can be explored.
- Better compensation schemes are required.
- Turtle conservation could be treated as a

heritage which should be conserved, with efforts to shift to a system of sustainable management.

- It was suggested that the blanket fishing ban be replaced with a more dynamic ban where the congregation is constantly monitored and the restricted area and period are decided accordingly. The practicality, logistics and possibility of this were discussed. It was recommended that the local fishermen who regularly go out to sea can report on the dynamics of the congregation.
- If an intervention of any kind is to be made, it should be for a decent period of time with exit strategies in place, as usually such a programme falls apart after the intervening agency leaves. Unless there is a possibility of long-term commitment, such programmes should not be initiated.
- It was also suggested that the profiles of tourists should be studied to ascertain what their interests are, what other attractions can be offered, what their spending power, etc.
- It was suggested that two or three alternative models be examined in consultation with a few experts on the basis of the data collected through the study.
- It was felt that tourism here should be explored cautiously and, as of now, only be considered along the lines of temporary relief or as a supplementary income source and not as an alternative livelihood.
- The workshop participants were informed about the government's plans for investing INR ~100 crores for ecotourism in the state over the next 5 years and suggested that plans be made for meaningfully 'leveraging' that for the community.
- Successful working models of turtle tourism involving the community should be examined to determine their reasons for success so that ecotourism does not suffer the fate of all the other attempted alternative livelihoods.

Recommendations

From the observations in this study, it looks like tourism is there to stay at Rushikulya, in some form. Our efforts should now be towards developing an effective tourism programme that benefits both turtles and communities. Numerous partners will have to work together to achieve these goals. There is need for elaborate dialogue and discussion between stakeholders.

Community should be an Equal Partner

It is of vital importance that the community be an equal partner, and for this equity, the top agencies have to be willing to share power. There should be provisions to keep big corporations out of the area.

As Sproule (1996) points out, it is not the "quantitative dimensions of participation" that matter, it is the qualitative ones. For the community to feel empowered, the number of people employed will not be as important as what positions of power they hold. They need to feel ownership towards the venture.

Garnering and Maintaining Trust

It is clear that fishers and other community members value the jobs that conservation activities provide them. But certain instances like wages not being paid on time, and such lapses can accelerate the loss of hard-earned trust and support. This lack of transparency builds resentment and breeds corruption. Such outcomes can be kept in check by forming a separate monitoring body.

Ensuring Benefits

If training and skill development are provided to the community, these might be more valued than cash. In Rushikulya, when members of the community who have been employed by the Forest Department to provide protection to turtles were interviewed, they displayed a definite pride because of the position they held. Other benefits such as availability of easy loans for start-ups and agencies that specialize in training should be offered.

Combining Tourism with Other Strategies

As turtle tourism in Rushikulya is one-attraction-based and seasonal, suggestions were made to combine it with other nearby attractions and offer it as a sort of package. During the off season, beach tourism can be promoted in Rushikulya. Supplementary attractions such as a high-quality information centre and turtle merchandise can be helpful as these offer people a chance to experience a bit of the turtle mania in the off season as well. To reduce tension in Rushikulya, a combination of mitigation strategies will prove more effective than isolated efforts. This will remove the burden from any one strategy and offer a buffer by allowing a fallback on other strategies. For example, compensatory schemes in combination with ecotourism and conservation-related employment may work well. While dealing with compensation, the needs of the community should be kept in mind so that the compensation can address those. It might be more fruitful to address the collective needs of the community than to provide individual compensatory measures.

Another solution to involve the community more meaningfully is to give the educated youth of the area opportunities to collect data for the Forest Department. This provides employment to them and can build a valuable dataset for the Forest Department.

Monitoring Body

Tourism can begin as a supplementary source of income. This should be followed by regular assessments and monitoring, and depending on its success, it has the potential to become an alternative livelihood.

Before the initiation of such a programme, the necessary groundwork should be carried out. The local communities should be provided with associated training and skill development.

In such ventures, follow-up is crucial as programmes can fizzle out quite easily in the initial stages. In addition, there is a need for constant dialogue, transparency and combined effort by all the stakeholders.

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About the Study

The study *Long-term monitoring and community-based conservation of Olive Ridley Turtles in Odisha* has aimed to understand the reasons for the failure of past efforts at involving the community in conservation, the rationale behind the need for alternative livelihoods and in particular, the potential of tourism focused on turtles as an alternative livelihood. To conclusively derive any information with regard to such long-lived organisms, Government support is crucial for research organisations and conservation groups so that they can monitor population health. A lack of support for such fields of research has led to severe lacunae and gaps in the field of knowledge of sea turtles from India. The study of tourism at Rushikulya suggested that communities are ambivalent about its potential as an alternate livelihood, and that conservation itself may be able to provide a source of income. The study recommends that efforts should focus towards developing an effective tourism programme that benefits both turtles and communities through elaborate dialogue and discussion between stakeholders, while simultaneously addressing other developmental needs.

The CMPA Project

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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.

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