Final Technical report
CLP project ID: 03418018
Habitat mapping and Conservation of the horseshoe crab in India

Submitted by
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Team Leader

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Team Leader
Date: 18.10.2019

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Section 1:

Summary

The population of the horseshoe crab and their habitats along the northeast coast of India is without doubt declining and degrading respectively at an alarming rate. Territory wise survey and community knowledge reveal less of horseshoe crab number now than ever before (due to accidental capture in fishing gear, poaching of adults and eggs, and degradation of nesting sites due to coastal development and pollution). Pertinent to different anthropogenic activities that render the long term persistence of the species and their habitat unlikely, this project was collaboratively developed. The project aims to stimulate and promote community collective action for horseshoe crab conservation through research, capacity building, and awareness creation. In addition, the project also aims to map all spawning ground along Odisha coast. Workshops and community forums have been initiated and the team conducted bycatch reduction training for 20 community horseshoe crab volunteers from five communities and increased the awareness of over three thousand community members. 20 college students have been trained in basic horseshoe crab research and monitoring protocols. Schools conservation education programs have been undertaken thereby building a youth generation that are agents of change for coastal resource management. Consequently, stakeholder and community support have been generated by project activities to contributing to reducing the threats to horseshoe crab thereby conserving them for both marine ecosystem integrity and enhanced local wellbeing. To conclusively derive any information with regard to such long-lived organisms, Government support is crucial for research organizations 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 horseshoe crab 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. We advocate that efforts should be focused on developing an effective management program that benefits both horseshoe crab and communities through elaborate dialogue and discussions between stakeholders, while simultaneously addressing other developmental needs. Overall, the findings appeared to suggest that local communities in the study area had little knowledge about the incredible marine creature or living fossils.
Background

*Tachypleus gigas* (Müller, 1795) (the Indian species of horseshoe crab) are present along the eastern coast of Odisha, India. The presence of these crabs in coastal zones indicates environmental health, as only optimal conditions are suitable for their survival, reproduction, and development. Although these crabs are ecologically important, the population of horseshoe crabs is decreasing over the years due to anthropogenic disturbances (e.g. overexploitation, release of untreated sewage, factory effluent, etc.), more than the natural causes (beach erosion) (Chatterji and Shaharom, 2009; Shin et al., 2009; Hu et al., 2010; Cartwright-Taylor et al., 2011). Among others, the physicochemical changes in the coastal environment such as beach morphology (erosion/accretion), sediment texture and water chemistry are severely affecting the horseshoe crab populations and thereby a shift or permanent loss of its spawning grounds at many places (Botton and Loveland, 1989; Penn and Brockman, 1994; Jackson et al., 2007; Hadnan et al., 2010; Hu et al., 2010; Pati et al. 2017; John et al. 2018). Under the sustained human intervention on the coastal habitats on one hand and vanishing breed/nursery grounds on the other, the long-term survival of these crabs is also a major concern to the scientists (Chen et al., 2004; Patti, 2008; Chatterji, 2013; Pati et al., 2015; Pati and Dash, 2016; Pati et al. 2017; John et al. 2018). The Indian Horseshoe crab *Tachypleus gigas* is categorized as “Data Deficient” (DD) in the International Union for Conservation of Nature (IUCN) Red List categories of 2009 and has been declared as a Schedule-IV species under the Indian Wildlife Protection Act (1972), also in 2009.

The populations of the horseshoe crab are recognized to be dwindling under increasing human threat over the years and there is hardly any improvement in this scenario (Chatterji and Shaharom 2009; Shin et al. 2009; Hu et al. 2010; Cartwright-Taylor et al. 2011, Nelson et al. 2015, Nelson et al. 2016b). No single factor is sufficient enough to explain these declining trends but it seems most likely that the negative pressures on horseshoe crab populations have resulted from pollution, degradation and loss of the estuarine spawning habitats, and commercial fishing activities (Berkson and Shuster 1999; Botton 2001; Nelson et al. 2016a; Pati et al. 2017; John et al. 2018; Vestbo et al. 2018). Among these, a major contributing factor is the continuous and increasing destruction of breeding grounds. This problem has been persistent and has been the focus of a large amount of conservation effort (Berkson et al. 2009; Pati et al., 2015; Pati and Dash, 2016; John et al. 2018).
addition to threats to breeding sites, there have been increasing reports and growing concern regarding the by-catch of the horseshoe crabs due to and in the fishing gear. This is in particular reference to commercial and small scale fishing firms, fishing communities as well and their potential impacts on horseshoe crab populations. Though this is a growing and alarming factor of threat for the horseshoe crabs, still the information on these operations and their damage assessment is scarcely available in the Indian context.

This project aims at the implementation of conservation measures to mitigate impacts on Horseshoe crab populations along the coast of Odisha, India, and focuses on raising conservation awareness among local stakeholders. The aims also include the identification and delineation of HSC spawning beaches, with all their environmental characteristics.

**Section 2:**

Overall Objectives

The overall goal of this project was to conserve the data deficient population of the Indian Horseshoe crab. This project has two objectives: Objective-I includes the identification and delineation of Horseshoe crab spawning beaches, with all their environmental characteristics. Objective-II includes comprehensive efforts to spread awareness, train and empower the local community in attempts to conserve the Horseshoe crab.

Specific Objectives

(1)To use high-resolution geospatial data to quantify coastal habitat characteristics that are ecologically relevant to Horseshoe crab spawning habitat suitability, and to survey and understand the abundance of Horseshoe crab from random coastal segments, by measuring habitat width and shoreline length.

(2)To build community capacity and conduct bycatch reduction training programs within the community.
(3) To understand the local perceptions and cultural values towards the Horseshoe crab and to assess the level of anthropogenic threats (such as trading, poaching, hunting, etc.) on the Horseshoe crab so that specific conservation and management priorities may be identified.

(4) To spread conservation awareness among the local fisher community and other stakeholders who live around Horseshoe crab breeding areas and nesting sites.

**OBJECTIVE 1-** To Use High-Resolution Geospatial Data to Quantify Coastal Habitat Characteristics that Is Ecologically Relevant

A total of 62 spots have been identified as horseshoe crab habitats along the Odisha coast and GIS-based maps with boundaries for the horseshoe crab habitats have been prepared. The details of locations, their geographical coordinates and altitude are presented in Plate-1, 2 which also indicates that there was a well-defined difference in the length and surging of the collection site. (Plate-3)

Plate-1: Location map of horseshoe crab
Plate-2: Density map of horseshoe crab

Plate-3: Showing 62 spot having latitude, longitude and their habitat length
Delineating a species range is challenging because many factors interact at multiple spatial scales to affect a species distribution. Species distributions models (SDM) can be used to identify factors mostly associated with a species presence and therefore, potentially define a range edge. We evaluated the utility of one popular SDM approach, maximum entropy models (e.g., MaxEnt) for determining the range edge for the horseshoe crab spawning habitat. A total of 62 sighting points were used in the Maxent modeling. The area under curve (AUC) value was higher than 0.987 (fig-5,6). Using the mapping and analysis software ArcGIS, we constructed and validated SDMs with 19 environmental predictor variables (Table-1). The potential distribution of horseshoe crab was predicted by the Maxent model for present and the upcoming hypothetical (2028) climatic scenario (Fig-7, 8). The approach used in this study is considered useful in predicting the potential distribution of horseshoe crab and can be an effective tool in conservation planning. The results show that there is a significant impact under future bioclimatic scenarios on the potential distribution of horseshoe crab along Odisha coastline in India.

A flowchart was prepared to summarize the full workflow and it serves as the basis of the analyses (Plate-4). In brief, first the data were summarized and environmental variables were selected. Next, Maxent modeling was completed, followed by predicting the current and future distribution of the horseshoe crab. Lastly, the resulting data comprehensively evaluated.
Plate-4: Processing methodology showing a summary of the full workflow
Table 1: Environmental variable used for modeling the habitat suitability distribution of *T. gigas* in this study

<table>
<thead>
<tr>
<th>Code</th>
<th>Environmental variables</th>
<th>Unit</th>
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</tr>
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<td>Mean diurnal temperature range</td>
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<tr>
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<tr>
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<td></td>
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<tr>
<td>Bio-6</td>
<td>Min temperature of the coldest month</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio-7</td>
<td>Temperature annual range</td>
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<td></td>
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<tr>
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<td>Mean temperature of wettest quarter</td>
<td>°C</td>
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<td></td>
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<tr>
<td>Bio-9</td>
<td>Mean temperature of driest quarter</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio-10</td>
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<td>°C</td>
<td>7.8</td>
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<td>Bio-19</td>
<td>Precipitation of coldest quarter</td>
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Plate-5: Omission rate, predicted area and ROC for the data modeling of horseshoe crab habitat distribution. (The regularized training gain describes how much better the Maxent distribution fits the presence data compared to a uniform distribution. The dark blue bars indicate that the gains from using each variable in isolation, the light blue bars indicate the gain lost by removing the single variable from the full model, and the red bar indicates the gain using all of the variables).

Plate-6: Results of the jackknife test of variables’ contribution in modeling horseshoe crab habitat distribution. (The regularized training gain describes how much better the Maxent distribution fits the presence data compared to a uniform distribution. The dark blue bars indicate that the gains from using each variable in isolation, the light blue bars indicate the gain lost by removing the single variable from the full model, and the red bar indicates the gain using all of the variables).
Plate-7: Showing the distribution and habitat suitability for HSC 2018

Plate-8: Showing the distribution and habitat suitability for HSC 2028
Objective-2: Building community capacity and conduct of bycatch reduction training programs within the community.

We organized and executed several activities which proved highly effective in improving and building the capacity of the local people and developing a thorough understanding of the project, horseshoe crab biology, ecology and conservation in general. Series of educational activities were successfully completed, each helping to increase the capacity of the community, providing them with the skills and knowledge required to conduct horseshoe crab protection and monitoring:

1. Walk and talks
2. Horseshoe crab bio-ecology talks
3. Ward-member training session
4. Merge scientific approach with community view and share with community again

In India, gillnets, set nets and bottom trawling nets are used in the continental shelf, open-ocean waters (beyond the Exclusive Economic Zone) and near estuaries to catch different types of pelagic fishes (Luther et al. 1997). Horseshoe crabs are known to be regularly caught as bycatch species in fishing nets (Kai and Morikawa, 1999; Iwaoka and Okayama, 2009; Smith et al., 2009; Pati et al. 2017; John et al. 2018). This has been a regular, first-hand observation of the present authors (Fig. 1). However, the quantification of horseshoe crab entangled in gillnets fisheries on this coast is yet to be done. Here, we have aimed at documenting the horseshoe crab bycatch using observer data (trained skippers) on the fishing net from 2018 to 2019. Additionally, this report highlights an ongoing program that is being implemented to ensure the safe release of entangled horseshoe crabs in gillnet operations. The section of this project is to make available new information regarding the incidental bycatch of T.gigas along the Balasore coast.

The coast of Balasore is stretched along the Bay of Bengal coast in an area of around 81 kilometers. This region has many rivers, canals, and rivulets that merge with the Bay of Bengal. The developmental map of the Balasore coastline is continually marked by incidents of sea erosion, groundwater depletion, water, air and solid waste pollution, unregulated tourism, and
industrialization—all fairly recent occurrences in history with significant implications for the fishermen communities. There are four major estuaries known for horseshoe crab (*Tachypleus gigas*) breeding ground. Balaramgadi estuary and its surrounding area are located 6 kilometers to the north of Chandipur, the well known, picturesque location. Balaramgadi is located at a latitude of 21°28'07.54"N and longitude 87°04'08.52"E in Balasore district. Mahisali estuary is the second estuary with the highest spotting of horseshoe crabs. It is located around 11.3 km away from Balaramgadi, towards the south direction with the coastal beach located at 21°24'32.92"S"N and 86°58'47.89"E. Kantiachira estuary is 16.5 km away from Balaramgadi estuary at the latitude of 21°22'30.69"N and 86°56'50.78"E longitude. The highest number of horseshoe crabs are found at Khanda estuary, located at 21°20'15.69"N and 86°54'46.42"E in Balasore. It is about 22.17 km away from Balaramgadi. Of late all these estuaries are being highly exploited and used as commercial fishery landing sites, having a large number of mechanized boats for fishing activity, point-source irrigation, jetty construction and other human disturbances which have lead to beach degradation and heavy pollution along with the high rate of unnatural and mechanical interference.

For this study, in each event, the observers have recorded whether the horseshoe crab was (i) entangled (E), (ii) dead (D) and (iii) whether it was released alive (L), or discarded or died and decomposed. Data were collected by trained observers as part of a program to monitor the discarded bottom set gillnets. 1408 specimens of horseshoe crab were rescued from different parts of the Balasore coast (Plate-10). In the majority of the cases, the specimens were sighted and collected by the volunteers as part of routine checks during the year, which was performed along the coasts of Balasore. Usually, the volunteers carry out the horseshoe crab monitoring activities along the coasts, periodically twice in a month.

Thus, a survey was conducted twice in a month along the 81 kilometers the shoreline, closest to the horseshoe crab rich areas described here. All horseshoe crabs found were individually observed, identified and marked. Data recorded on each stranded individual includes the following: observer’s name, stranding date, species, and horseshoe crab number by the day, location, condition of the carcass (decomposition state), the gender of the carcass (as externally observed) and field notes by the observers. All animals were segregated on the shore and kept in a separate dry area to avoid recounts.
It was then followed by untangling and releasing each individual and assessing its basic life conditions (whether it is alive, inactive/drowned or dead). Those individuals recorded as inactive/drowned were rescued and kept in a saline water tank till its full activeness was restored. It was then released into the wild, natural waters.

For statistically comparing each horseshoe crab in entanglement, live and dead with seasons and years, Student’s t-test was performed using GraphPad InStat Version 3.0. Box plot was performed using SPSS version 23.0 (Statistical Package for Social Sciences, Inc., Chicago, III). The level of significance was at p<0.05. (Plate-9)

The data obtained in this study highlight the significance of incidental catch, bycatch and continually hampering of the Indian horseshoe crabs due to the unceasing and longline fishery along the coast of Balasore district of India. Though, there are many threats that persist to horseshoe crab populations on Odisha coast, including high predation by wild animals and loss of breeding habitat due to anthropogenic and coastal developments (Mishra et al. 2015; Behera et al. 2015; Pati and Dash 2016), our study strongly indicates that bycatch is one of the prominent, direct threat to the Indian horseshoe crabs.

The number of the entangled individual was substantially high during winter, a time when there is no restriction in fishing activity. The bycatch was low during summer since the Government of the region bans fishing activity during this period, to allow for natural breeding in the marine animals. The reduction in the number of bycatch in the rainy seasons could be attributed to the restriction on fishing by the government during the late summer and early rainy seasons.

The need of the hours is working for, nurturing, synthesizing and implementing developed solutions in the best practices. This includes the routine activity of the fishermen, in the development and design of fishing gear and their manufacturers, creating and sustaining coordinated efforts and synergy among researchers, the regional government and non-government organizations. This can bring about and apply specialist knowledge for the development of solutions for reducing bycatch and successful mitigation strategies that can be implemented to reduce and gradually stop the direct and indirect fatal occurrences for the horseshoe crabs.
We increasingly partnering with fishermen and their community as a whole, with the Sarpanch (A sarpanch is a decision-maker, elected by the village-level constitutional body of local self-government called the village government in India) and conducting bycatch rescue training programs to reduce the incidence of harm to the horseshoe crabs (Pati 2019). Complementing this research and drawing from the field of community-based surveys, we designed a suite of outreach initiatives to educated and train the fishermen and their families to reduce bycatch. This enables us immediate and timely rescue and release of the horseshoe crabs, as and when they are entrapped in the fishing processes. Our approaches have grown to form a community conservation network that unites all the residents of the local coastal regions, the fishermen, regional politicians and administrators and create a combined and sustained effort of conservationists in the Balasore coast (Pati, 2017). Informative workshops for regional sea-based workers, professionals and fishing firms are also being done along with a novel effort of curriculum enrichment for schoolchildren in the coastal belt, which makes them educated and aware of the need and importance of the horseshoe crab conservation along with the menace of bycatch. In order to augment our efforts and add a scientific approach to this an innovative step for fishing nets is being developed, wherein the aim is to modify the manufacturing materials of nets and redesign them in such a way that, even while fishing, the horseshoe crabs would avoid coming near them. This may include structural changes and inclusion of repellants specific for the horseshoe crabs, which would enable them to keep them far from the fishing net. Over and above all this we are supplementing these efforts by sharing them across all communities of the entire coastal and adjoining areas wherein the locally resonant media and formed local committees are helping us. On the qualitative front, organization of public events such as regional festivals (Raskhya bandhan, Banner exhibition in Ganesh Puja mandap, Leaflet distribution in Baroni Bath), parades, and art competitions is being gradually started and encouraged to spread the maximum knowledge of the horseshoe crabs of India.
Plate-9: Boxplot of *T. gigas* stranded in fishing nets during 2018-2019

Boxes represent the 25% and 75% quartiles, the horizontal line is the median (50% quartile), the bars are 95% confidence intervals, and the dots represent outliers. E – Entangled, L – Live, D – Dead, S – Summer, R– Rainy, W - Winter, Y – (2017-18), Z – (2018-19)

Table-2: Showing horseshoe crab entangled in types of fishing nets

<table>
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<th>Net types</th>
<th>Mesh size:</th>
<th>Mesh type and material</th>
</tr>
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<tbody>
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<td>Kabala jaal</td>
<td>2 cm</td>
<td>Monofilament, nylon</td>
</tr>
<tr>
<td>Koni / Ghagrajaal</td>
<td>13.5 cm</td>
<td>Multifilament, high-density polyethylene</td>
</tr>
<tr>
<td>Ilishjaal</td>
<td>6.5 cm</td>
<td>Monofilament, nylon</td>
</tr>
<tr>
<td>Chandijaal</td>
<td>13.5 cm</td>
<td>Monofilament, nylon</td>
</tr>
<tr>
<td>Bhetkijaal</td>
<td>15–20 cm</td>
<td>Multifilament, nylon</td>
</tr>
<tr>
<td>Disco jaal</td>
<td>14 cm,</td>
<td>Multifilament, cotton</td>
</tr>
</tbody>
</table>
Objective-3: Understanding the local perceptions and cultural values towards the horseshoe crab and to assess the level of anthropogenic threats (such as trading, poaching, hunting, etc.) on the horseshoe crab.

The assessment of stakeholder perception was done by conducting questionnaire surveys in the fishing villages along with the Indian horseshoe crab habitat in the region. The local community had suffered heavy losses due to continuous natural calamities in the area, therefore delay in the fieldwork helped in the normalization of the situation at the field and the respondents gave us their valuable time for the questionnaire (Approx. 45 mins per interview) and provided unbiased information (Plate 12-14). To achieve this, we consciously worked on rapport establishment with the locals. The people appreciated the effort of the team and CONSERVATION LEADERSHIP
PROGRAMME (CLP) on supporting towards the conservation of horseshoe crabs and understanding the human dimension in its conservation. After every interview people were asked how they felt about the interview, and we got 97.7% positive responses.

Interviews were focused upon the fishing-based communities located near the horseshoe crab habitat in Subarnarekha river estuary, Panchupada-Bardia River estuary and Budhabalanga River Estuary. In total, 388 interviews were conducted with local households (n=388) in Odia languages, following structured sampling for household selection and snowball sampling for key informant selection. Unstructured interviews and conversations with the locals during the pilot survey were used to guide the framework for the semi-structured questionnaire, consisting of open and close-ended questions.

Key Informants were individuals residing/working at the project site upon various social activities and had a basic understanding of conservation and other awareness activities. They had a good understanding of local issues and what approach can be taken to tackle the issue.

Plate-12: Interview with fishermen
Overall perception:

93.5% of the respondents were able to identify the Indian horseshoe crabs when pictorial aid was shown to them with different crab species, but only 3.1% were able to differentiate between the two species.

According to 50.8% of the respondents, the population of Indian horseshoe crab has decreased over the last 10 years, while 25.4% were unaware of the population trend. When asked if the Indian horseshoe crab should be conserved, 67.7% of the respondent positively and when asked why Indian horseshoe crab should be conserved, the most common answer was “Existential Value” by 44.8%
respondents. Other common answers were “Commercial Value” (16.3 %) and “Ecological Value” (3.9%).

Trading assessment

Hundreds of horseshoe crabs are killed in Odisha, the only home of these animals in the country, for its meat and shells which are supplied to Jharkhand, Bihar, Chhattisgarh and other states. Many indigenous community, believe that horseshoe crab meat has aphrodisiac qualities. Myths suggest that consumption of the meat can also ensure a longer life. However, there is no scientific theory to support this. Many quacks (quacks that dishonestly pretend to have medical skills and knowledge) also crush the crab shells and mix them with water to prepare a paste, which is applied to scars and some quacks sell crab blood mixing with mustard oil for joint pain etc.

During the survey, six poachers have been identified with the help of local communities and appointed as an executive volunteer in the CLP conservation project for a period of 6 months with a minimum incentive of Indian Rs. 2000 for the rehabilitation of each poacher. The poachers have been further motivated and converted to small scale aquaculture farmers by the end of this project. (Plate15-16)

Plate-15: Person selling horseshoe crab in the local market in Jharkhand
Plate-16: Certain discussion with fishing villagers to reduce the mortality rate of endangered horseshoe crabs

OBJECTIVE-4: Spreading conservation awareness among the local fisher community and other stakeholders who live around horseshoe crab breeding areas and nesting sites.

Implemented Activities

By-catch release

The project has released trapped horseshoe crab back to the sea. Hundreds of live Horseshoe crabs that were trapped in fishing nets and jetty stones were removed and released into seawater to avoid heavy mortality. Additionally, the fishermen, surrounding population and boat person, in particular, were made aware of the urgency of the situation for the protection of horseshoe crab and its breeding ground by team ABC (Plate-17).
Plate-17: Removing of the trapped horseshoe crab and releasing back into the wild environment

Beach patrolling

Beach patrols have been conducted during the new moon and full moon day in Mahisali, Khandia, Khapra, Bahabalpur, Balaramgadi, Kantiachira estuary. During patrolling Beach surveys are being done to record any stranded Horseshoe crab carcasses(Plate 18-19).

Plate-18: Beach monitoring and hydrological assessment by CLP team
Education and awareness

In order to propagate awareness about the need of conserving horseshoe crab, a living fossil, a group of people from different walks of life having concern for the environment, observed Raksha Bandhan in a unique manner in different coastal villages along Balasore coast. The Awareness was organized by the project team from the Association for Biodiversity Conservation & Research (ABC). They celebrated the whole day by doing several awareness activities on the theme of Horseshoe crab to create awareness among students, youth and the local community. The initiative is aimed at inspiring a growing generation, knowledgeable and motivated to take positive actions to conserve Horseshoe crab. In order to bring more awareness among the People especially among the young group (School students) about the unique crab and its conservation, a series of Young Voices Arts competition was conducted and a wall art competition was carried out and to encourage the participants, the certificates and memento was given to the best three winners of this competition (Plate 20, 21, 23 24, 25). Moreover, the conch playing competition was held among the coastal women to add the cultural value of these unique crabs in their minds. Educational programs have so far been conducted in 10 schools, 4 colleges’and seven coastal communities. First time in India, Std
IX student of Saraswati Sishu Vidya Mandir, Remuna Ku. Krishna Priya Barik exhibited a Horseshoe crab project at a School level science exhibition (Plate-22).

Plate-20: 2nd Horseshoe crab conservation ceremony

Plate-21: Wall painting competition for Community Awareness along with coastal villages
Plate-22: Horseshoe crab project at school level science exhibition by a student

Plate-23: Art Competitions under the banner “Know me, save me”
Plate-24: Interaction between CLP team and School student for Horseshoe crab conservation

Plate-25: Celebration of Wildlife week on the theme of Horseshoe crab conservation
Art is one key method that helps people feel the importance of horseshoe crab. Through the power of true pieces of art, the viewer’s eyes open and appreciate the beauty and, through this, the wonderful uniqueness and preciousness of this living fossils horseshoe crab. Art offers not only visual beauty but also a therapeutic sense of serenity; connecting emotions through the interpretation of what one see in any particular piece of art. The art done by CLP team member Kesu Das has very special meaning and a special message (connection between Varunani/Jaldevi/Goddess of sea and horseshoe crab) to society (Plate-26, 27).

Plate-26: Painting shows the bond between Sea and Horseshoe crab and the holistic approach to create a good affinity among community and tourists towards Horseshoe crab
Plate-27: Arts connecting emotions and giving special message to the society

Beach cleaning event

In an effort to facilitate nesting and to conserve the living fossil, “Horseshoe crab” in the different estuary in Balasore district, the team executes an awareness cum cleaning event about five km stretch along the sea beach. Members of the Association for Biodiversity Conservation & Research (ABC), in association with National Service Scheme (NSS) volunteers of Fakir Mohan University, conducted a beach-cleaning program in a bid to safeguard marine flora and fauna along the Balasore coast (Plate-28).

Seventy volunteers from the ABC and the F. M. University, along with wildlife activists and other stakeholders, took part in the drive and cleaned a huge quantity of garbage from the beach in order to
make the place suitable for the horseshoe crab. Apart from members, some local fishermen also took part in the drive carried out at Horseshoe crab breeding ground. The students got a beautiful exposure to the Biodiversity of the Costal Balasore along with practical lessons in Conservation from team ABC and the faculties of the Fakir Mohan University.

Plate-28: Habitat cleaning event for Horseshoe crab breeding

Distribution of leaflets

We have distributed leaflets in local language among the people in coastal areas during village festivals and local festivities such as Baroni-Snana where thousands of Devotees across the Odisha took a holy dip, to create awareness to conserve the valuable species (Plate-29).

Conservation with spiritual value

On the occasion of Sri Ganesh puja, Raising broader awareness of the efforts of local communities and Indigenous people linking culture and spirituality with Horseshoe crab Conservation at Koshamba Nagar, Balasore, India (Plate-30)
Plate-30: Raising awareness of the efforts of local communities and Indigenous people linking culture and spirituality with Horseshoe crab conservation

Plate-29: Leaflet distribution in the fishing market and landing areas

The team also organized a writing poem contest with the theme “Only for horseshoe crab” at Utkala, NoCCi business part. For this poetry contest on the topic “only for horseshoe crab”, we received numerous entries in Oriya language. The team is planning to combine all poems and release a book for reader.
Section 3:

Achievements and Impacts

Through related project activities, a body of skilled and knowledgeable community members have been secured and stimulated to support community collective action to protect horseshoe crab and their habitats (Plate-31). Over three thousand (3000) individuals comprising school students and community members have been reached through awareness and capacity building programs. Community members and fishermen who previously did not appreciate the importance of horseshoe crab; especially the feeding relationship between the horseshoe crabs, jellyfish and fish are now well acquainted with the relationship. They now understand that more availability of horseshoe crabs is more availability of fishes. College student groups, numbering about 100, studying biology and biodiversity in different colleges in Balasore Coast were trained in horseshoe crab protection and management thereby inspiring knowledge transfer in their respective communities. They were subsequently recruited for different educational programs. Accordingly, they are serving as agents of change for the communities. They were involved with data collection, education, etc. They have also acquired immense research skills and knowledge for their future conservation work. Different local artist groups numbering 40 were engaged in a learning sharing platform to determine their role in conserving the horseshoe crab and over 5000 leaflets made and distributed. Overall, the project has increased the understanding of locals on horseshoe crab populations and their habitat and also helped in influencing local community action through the volunteer group. 10 The partnership has been created particularly amongst the communities and the different organization (Balasore Kalakendra, Horseshoe crab foundation, Horseshoe crab research unit at FM University, Yuva Vikas, The New HOPE, Banadhulira Phula) as both have been involved in every stage of the project and their roles spelled out to them. This ultimately will help in meeting the project purpose thereby contributing to the sustainable conservation of the horseshoe crab. The IUCN has accepted group leader Dr. Siddhartha Pati as SSC member and Dr. Pati is actively working with IUCN to upgrade the IUCN status of horseshoe crab.
Plate-31: Impact of our work

Problems encountered and lessons learned

The project team learned the following lessons during project implementation:

- It does not take only funds but also strong local commitment is needed and/or required for intensive consultations and economic-related activities (to gain trust and accelerate the empowering processes)
- Recognition/adoption of customary regulations and reinforcing self-determination is a key requirement for community collective action
- Livelihood supports and capacity building (e.g. skills to increase economic production; and explore ways to resolve limited market access) is very fundamental to getting the rural poor to act.
- Communities desire a recognized local level governance system with authority and self-management as they proposed among other things a community-based horseshoe crab station.
Future planned activities
Recommendation

- Species population data and habitat characterization:
- The volunteer team should constantly be empowered, motivated to continue the drawn monitoring program. This will always make data available for efficient and effective management decisions.
- Other projects should address the by-catch interaction problems
- Future work should envisage building a community-owned ecotourism center to regulate tourism in the area.
- Small water vessels should be acquired to aid the research of inaccessible but potential nesting sites.
- Other projects and organizations should collaborate with the ABC to facilitate alternative livelihood training programs in the horseshoe crab nesting area.

LOOKING FORWARD
The team has started a very important community-based participatory process in horseshoe crab conservation in Sundarban. The team would work collaboratively with WTI, WWF, MOEF and also the team wishes to liaise with other bodies in sourcing funds to mitigate threats of fisheries interaction and over-exploitation of marine life. The team is liaising with Fakir Mohan University and different coastal colleges to encourage more students to undertake their under-graduate thesis work on horseshoe crabs to better build relevant data for holistic management processes.
Section 4:

Media article/coverage in both local and English language for awareness and knowledge

**Raksha Bandhan celebrated in B’war**

For horseshoe crab protection

UBACHAK MOHANTY □ BALESWAR

In order to propagate awareness about the need of conserving horseshoe crabs, a living fossil, a group of people from different walks of life having concern for environment, observed Raksha Bandhan on Sunday in a unique manner. They celebrated the whole day by doing several awareness activities among students, youths and local community.

A ‘Young Voices Arts Competition’ was conducted holding a wall art test and certificates and mementos were given to the best three winners. Besides, a conch playing competition was held among coastal women to add cultural value about the unique crabs.

Baleswar DFO (Wildlife) Biswaraj Panda, Head of the Department Bioscience and Biotechnology of Pakir Mohan University Prof Bishnu Prasad Dash, executive director of Association for Biodiversity Conservation and Research (ABC) Siddhartha Pati, social activist Sarita Singh, convener of the event artist Kesu Das, Senior Reader Gobinda Chandra Biswal of Siddheswar College, Dr Sasmita Dash of Pakir Mohan Autonomous College and representative of different organisations were present as key persons or guests.

Awardee of CLP Future Conservation award 2018, Pati who is working on a project supported by the Rufford foundation, UK, explained about the ecological and economical importance of this valuable species and how countries like Japan and the USA are protecting the species and even Japan has declared this animal as its national monument.

The executive director of Baleswari Kala Kendra explained the awareness of this species in terms of ecological and socio-cultural.

The rare species estimated to be at least 300 million, year-old, till a few years back, was found in abundance along the Chandipur coast while nowadays only dead crabs are found there, said Biswal. Unrestricted trawler and mechanised boat movement is causing their deaths and hindering their incoming to the base, the speakers observed. Notably, the blood of the crab helps fight dreaded diseases.
Over 900 carcasses of endangered horseshoe crabs found on beaches

Asit Senapati | TNN

Kendrapada: Carcasses of over 900 endangered horseshoe crabs were found on the beaches in Kendrapada and Balasore districts last week by members of People for Animals and research team of the association for biodiversity conservation (ABC).

As many as 520 horseshoe crabs were found trapped in fishing nets in Balasore's Khanda estuary by the team from ABC. “We released 50 horseshoe crabs that were alive into the sea,” said marine biologist and director of ABC, Odisha, Dr Siddhartha Pati, who is also a researcher with Fakir Mohan University, Balasore.

He said fishing nets are usually left hanging below the boat or just along the water’s edge by the fishermen. “As a result, many female horseshoe crabs swimming towards the shore to lay eggs get caught in the net. Once the water recedes, they are left in the nets to die,” added Pati.

The PFA members found more than 400 dead horseshoe crabs on the beaches in Madali, Chinchidi and Hukitola in Kendrapada district. Most of them were found after getting entangled in fishing nets. “Many horseshoe crabs bore injuries pointing to the fact that they probably got entangled in gill net. This is their breeding season and many mating pairs must have died,” said Sudhanshu Parida, the secretary PFA, Kendrapada.

According to the Odisha Marine Fishing Regulation Act 2012, trawlers are supposed to fish beyond 5 km from the normal sea coast and beyond 20 km from a marine sanctuary. “But most fishermen violate the norm and horseshoe crabs get entangled in the trawler nets and die,” added Parida.

Principal chief conservator of forests (Wildlife) Sanjeeb Tripathy said, “It is illegal on the part of fishermen to catch or kill horseshoe crabs as it is a protected animal under the Wildlife Protection Act, 1972. Forest and fisheries officials organise awareness camps for fishermen to protect this sea animal as it has medicinal value. We will take action against the persons who kill horseshoe crabs.”

Three years back, a team of scientists from the Zoological Survey of India, Kolkata, surveyed the Odisha coast to submit a status report about horseshoe crabs to the government for its conservation and management, said Dr Basudev Tripathy, a senior scientist of ZSI, Kolkata.

Two decades back, horseshoe crabs were found in large numbers but now the species is confined to specific pockets like Eakakul, Madali and Hukitola in Kendrapada district and Balaramnadi, Khanda and Chandipur beach in Balasore district, said Dr Tripathy.
Drive to clean beaches

SIBDAS KUNDU

Balasore: Members of the Association for Biodiversity Conservation & Research (ABC), in association with National Service Scheme (NSS) volunteers of Fakir Mohan University, conducted a beach-cleaning programme on April 1 in a bid to safeguard marine flora and fauna along the Balasore coast.

Seventy volunteers from the ABC and the university, along with wildlife activists and other stakeholders, took part in the drive and cleared a huge quantity of garbage from the beach in order to make the place suitable for the horseshoe crab. This was the second annual beach cleaning carried out by the team.

Apart from members, some local fishermen also took part in the drive carried out at Chandipur and Balramgadi beaches.

“It is an effort to facilitate the nesting of marine organisms such as horseshoe crab and turtles. The drive will boost eco-tourism in the region,” said Sidharth Pati, a marine biologist and conservationist at Association for Biodiversity Conservation and Research.

Pati is also co-ordinating the programme on the conservation of the horseshoe crab supported by the Rufford Foundation, UK.

“We live in the vicinity of a living fossil,” he said talking about the horseshoe crab.

The head of environmental science department at Fakir Mohan University, Surendu Kumar Dey, briefed the importance of the valuable marine creature and their role in maintaining the marine ecosystem.

Reader in zoology at Siddheswar College Gobinda Chandra Biswal pointed out that the breeding of the horseshoe crab and sea turtle was being hindered by the piles of garbage, plastics, nets and mechanized boats.

“Everyone should rise to the occasion and a collective effort is required to create awareness about the marine environment,” said Biswal.

Another key member of the team, artist Kesu Das, said: “Since childhood, the sea beach has been very close to us. Through my art and activities, I always try to protect it.”
ପାଇଁର, ବସୁ (୨୦.୨୦.୨୦)

କାରଣରେ କେଉଳ କୋବା ବିପରୀତ ଉଭୟ କାର୍ଯ୍ୟ ପ୍ରାଦେଶିକ ରଜୋଯୋଗ ସମୀକ୍ଷା ବିଭାଗ ଏବଂ ବିଶ୍ୱାସ ବିଭାଗ ସମୁଦରରେ ଓଇ ଶ୍ୱେତ୍ବ ରହିବା ପାଇଁ ତାହାରେ ଏକ ଏକ ପକ୍ଷୀର ସଂଖ୍ୟା ପରାମେତ୍ରକାଳରେ ପ୍ରତିଷ୍ଠାନ କରାଇବାରେ ଏମାନେ ଏକ ବ୍ୟବସ୍ଥା ପ୍ରତିଷ୍ଠାକର ନାମ ପରିବର୍ତ୍ତନ କରାଇବାରେ ଏମାନେ କେଉଁଟି କାରଣରେ ଉଦ୍ଦେଶ୍ୟ କରାଇବାରେ।

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For much of human history the ocean's surface was a distant, often invisible world. Today, with the threat of climate change, much of marine life is threatened by pollution, overfishing, and habitat loss. gratefully, marine science has grown into a vast and exciting field, with many curious and enthusiastic individuals contributing to its study. Siddharta Pati, a renowned marine biologist and conservationist, is one such individual. Pati has made significant contributions to marine conservation and research, and his work has been recognized by the Wildlife Conservation Society (WCS). Pati's research focuses on the conservation of marine ecosystems and the protection of endangered species.

In his latest project, Pati has teamed up with the Orissa Post to promote marine conservation. The project aims to raise awareness about the importance of marine conservation and to encourage young people to get involved in conservation efforts. Pati believes that by involving young people in conservation projects, we can create a new generation of conservationists who will help to protect our oceans for generations to come.

Pati's work has taken him to many remote locations around the world, and he has encountered many interesting species along the way. One of his favorite species is the horseshoe crab, a prehistoric creature that has survived for millions of years. The crabs are abundant in the Gulf of Mexico and are used in medical research. Pati has been working to protect the crabs from overfishing and habitat loss, and he has been successful in raising awareness about the importance of conservation.

Pati's work has been recognized by many organizations, and he has received several awards for his contributions to marine conservation. He is a member of the Association for Biodiversity Conservation and Research (ABC), and he has been honored by the Conservation Leadership Programme (CLP) in Indonesia. The CLP is a partnership that includes the Wildlife Conservation Society (WCS), Save the Langur Foundation, and the Conservation Leadership Programme (CLP) in Indonesia.

In an interview with Pati, he expressed his concern about the decline in the number of horseshoe crabs in the Ganges River in Orissa, and he called for the protection of this species. Pati has been working with local communities to raise awareness about the importance of conservation, and he has been successful in creating a network of conservationists who are working to protect the crabs.

Pati's work has inspired many young people to get involved in conservation efforts. He has been visiting schools and universities to talk about the importance of marine conservation, and he has been encouraging young people to get involved in conservation projects. Pati has also been working with local communities to raise awareness about the importance of conservation, and he has been successful in creating a network of conservationists who are working to protect the crabs.

In conclusion, Pati's work has been invaluable in protecting marine ecosystems and the species that depend on them. His efforts have inspired many young people to get involved in conservation efforts, and he has been a role model for those who are passionate about protecting our oceans.

**WILDLIFE WARRIOR**

Siddharta Pati was among three Indians selected to receive the Future Conservationist Award given by the Conservation Leadership Programme (CLP) in Indonesia. The award supports the work of early career conservationists and recognizes their contributions.

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Fishing takes a toll on horseshoe crabs, researchers worried

UNREGULATED fishing of horseshoe crabs along Odisha coast, one of the few places in the country where the species is found, has led to the decline in its population raising concern among the conservationists.

The State is home to two of four varieties of the species found globally. Those are found along the north-east coast of Balasore and Kendrapara districts.

The crabs used to migrate in large numbers regularly to breed. But, unregulated fishing activities along the coast and lack of awareness among local fishermen about horseshoe crab’s economic importance are leading to their declining population, said Dr. Anil Chatterji, a noted horseshoe crab researcher and former scientist of Biological Oceanography Division of National Institute of Oceanography (NIO), Goa.

Though known for their medicinal properties and high demand among the biomedical companies, little effort is made by the Government to conserve the horseshoe crabs.

Every year, horseshoe crabs die in large numbers after getting entangled in fishing nets. Recently, the scientists had found around 500 crab carcasses in Balasore district.

Nearly three decades back, the horseshoe crabs were found in large numbers across the coast but now their presence is limited to pockets like Balaramgadi, Chandipur beach, Khadiza estuary of Balasore district, Ekalakia, Madal and Hukitola beach in Kendrapara district.

Scientists of NASA have been researching on the horseshoe crab, said Dr Chatterji adding it is high time for the government to help horseshoe crab researchers, one of them being Dr Siddhartha Pati of Pukur Mohan University, to conserve the marine species.

The Association of Bio-diversity and Conservation, with the help of Wildlife Trust of India (WTI), has been involved in horseshoe crab conservation and research work in Odisha.

Horseshoe crab blood contains a chemical that makes its blood clot in the presence of even the most minute trace of bacteria as a result many biomedical companies throughout the globe use the crab’s blood to make vaccines.
Bio heritage tag sought for horse shoe crabs

POST NEWS NETWORK

Balasore, July 16: In the face of global outcry over disintegration of endangered horse shoe crabs, a group of experts got together at a programme jointly organised by NOCI Cultural Academy and Kanya Anmol on the marine species here Tuesday.

The participants urged government to accord bio-heritage tag to the species. Prof Buishnupradad Das of the Biotechnology department of FM University, lecturer Gobinda Chandra Biswal, Dr Sidharth Pati, poet Rabinarayan Das and artist Kesu Das emphasized the need to protect the horse shoe crabs.

“Several countries have initiated steps to protect the species. The Centre and the states have done little to protect the marine species,” they noted adding that the government has major role to protect the endangered crabs.
Crabs in Crisis

The living fossil that survived for 450 million years is now facing a threat of extinction in India.

Conservation can truly happen when the first responders in the coastal communities are sensitised on its importance and when the government implements the wildlife laws effectively.

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Enculturation drive
Several number of biomedicine conservationists and social workers have come together to start ‘Horseshoe Crab Foundation’, which has taken up aggressive campaigns such as blood donation camps, organise literary meet, staging competition among school children and setting up installations and paintings in various parts of the city and tourism spots like Chandigarh for the mass sensitisation.

Conservation efforts will be far from reality, added Dash, who has done thorough research on the horseshoe crabs and has been advocating for its conservation.

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A day for horseshoe crabs in international calendar

Global conference deliberates on the endangered species and the next course of action for its conservation

POST NEWS NETWORK

Balasore, June 25: Expressing concern over the protection of endangered marine species like horse-shoe crabs, a global conference has decided to mark June 29 of every year as International Day for Horse-shoe Crab.

The international meet held in China from June 15 to 20, was organized by the International Union for Conservation of Nature (IUCN). Six experts from Balasore attended the conference. On return, they said that people living in coastal areas in Balasore and other districts will be sensitized about protection of this red-listed species. Experts at the meet had proposed to include a chapter on horse-shoe crabs in textbooks.

Prof Bidhu Prasad Das (head of Biotechnology in FM University) had put forth a scheme on the marine creature while Golindia Chandra Basu (Director of Association for Biodiversity Conservation and Research) and Siddhanta Pratistha Das (head of NOCL Cultural Academy) put up a sand animation on the crabs and drew attention of the researchers. Anthropology lecturers at FM University Sama Das, Dr Basanta Tripathy, Shekha Sojan and Bhuvaneswar Baid were among those who attended the meet.

Over 14 organisations, experts, researchers, artists, teachers and students associated with work and research on the horse-shoe crab from 20 countries including the USA, China, Japan, Vietnam, Hong Kong, Thailand, Denmark and Malaysia deliberated on the endangered species and the next course of action for its protection and conservation.

Of four species of horse-shoe crabs found in Asia and the USA, two are in India. River mouth areas and some coastal areas of Balasore are the only places in the country where horse-shoe crabs come to lay eggs during tides. Many have been carrying out research on the marine species for the last four decades at Chandipur and Balasore.

Link to media coverage

- [https://scroll.in/article/926796/horseshoe-crab-the-living-fossil-that-survived-for-450-million-years-is-facing-a-threat-in-india](https://scroll.in/article/926796/horseshoe-crab-the-living-fossil-that-survived-for-450-million-years-is-facing-a-threat-in-india)
- [https://m.dailyhunt.in/news/india/english/odishatv-epaper-odishatv/blue+blood+crab+in+danger+of+being+wiped+out+from+balasore+shores-newsid-96310687](https://m.dailyhunt.in/news/india/english/odishatv-epaper-odishatv/blue+blood+crab+in+danger+of+being+wiped+out+from+balasore+shores-newsid-96310687)
- [https://localwire.me/experts-call-for-conservation-of-horseshoe-crabs/](https://localwire.me/experts-call-for-conservation-of-horseshoe-crabs/)
Plate-32: CLP member interact with community leader at Mahisali

Plate-33: Community health check up blood donation camp for horseshoe crab conservation
Plate-34: Kesu Das with ABC volunteers at khandia during beach survey
Plate-35: Horseshoe crab expert Dr. Anil Chatterji and Prof Bisnu Prasad Dash interact with project member at field

Plate-36: Interaction with different leader at different coastal villages
Plate-37: Best art collection by student

Plate-38: A banner for horseshoe crab conservation ceremony
Plate-39: A Banner for 3rd Rakshya Bandhan Utsav 2019

Plate-40: Sand animation by Horseshoe crab heroes during Baroni holy bath for community awareness
Plate-41: Our advisory member holds a horseshoe crab carapace during community participation event

Plate-42: Mr. Biswaraj Panda, Divisional Forest Officer delivered a talk on the importance of horseshoe crab in an awareness program on horseshoe crab conservation
Plate-43: Dr. Pati demonstrating fishers to rescue capture horseshoe crab

Plate-44: Wall paint by CLP horseshoe crab hero at different coastal village
Plate-45: Dr. Pati invited as a resource person in an awareness programme by Forest department at Talsari.

Plate-47: Poster installed at Durga Mandao by team member Kesu Das
Appendix I: Leaflet distributed in different cultural and religion ceremony
## Appendix II: Questionnaire

<table>
<thead>
<tr>
<th>SNo.</th>
<th>Questions</th>
<th>HSC- Horseshoe Crab</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Justification</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Would you answer a few questions for our research? (To be asked after the introduction) If no, can you please give reason?</td>
<td>It is important to know the reason behind non-respondents (may prove to be important for strategizing future studies).</td>
</tr>
<tr>
<td>2</td>
<td>Can we voice record the interview, it will make the interview proceed faster? Would you be interested in being a part of a documentary/movie?</td>
<td>To make interview process faster; To make short documentary to be submitted to grant organization.</td>
</tr>
<tr>
<td>4</td>
<td>What is your name?</td>
<td>To check if these factors have any correlation with perception/information.</td>
</tr>
<tr>
<td>5</td>
<td>What is your age?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>What is your educational background?</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Is fishing your primary occupation? Do you have any other sources of income (for e.g., laborer; post-processing etc.)?</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Which type of fishing are you involved in? For how long you been have involved in this type of fishing?</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Can you point which among the pictures is &quot;lakshman-patha&quot;; Is it known by any other name locally?</td>
<td>To check if the interviewee is aware of HSC.</td>
</tr>
<tr>
<td>10</td>
<td>Where have you seen HSC?</td>
<td>which areas do HSC occupy along the beach.</td>
</tr>
<tr>
<td></td>
<td>Do you have any photographic proof? (If yes, can you show it to us?)</td>
<td>will act as strong proof of dog predating on HSC.</td>
</tr>
<tr>
<td>11</td>
<td>Are there any stories associated with HSC/ why is it called &quot;lakshaman patha&quot;? (to be asked with 2e)</td>
<td>To obtain info on cultural significance.</td>
</tr>
<tr>
<td>13</td>
<td>When is the best time of the year to see &quot;lakshaman-patha&quot;? (probe reproduction of HSC)</td>
<td>To know when HSC reproduce; also, cultural significance of HSC; significance of HSC in tourism industry.</td>
</tr>
<tr>
<td>14</td>
<td>Has the population of HSC in your lifetime: Increased; Decreased; Remained same</td>
<td>Perception about the population of HSC.</td>
</tr>
<tr>
<td>15</td>
<td>Does it get caught in nets?</td>
<td>To know more about HSC-fishermen interaction (if present).</td>
</tr>
<tr>
<td>16</td>
<td>Does HSC affect your fishing operation (e.g.- damage to nets)? (If yes, how?)</td>
<td>To probe if trade (incl. local) of HSC is prevalent.</td>
</tr>
<tr>
<td>17</td>
<td>What is the economic importance of HSC? (Is HSC sold over here?)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>What are the factors affecting HSC according to you? (Ask details of the factors stated)</td>
<td>To know in detail what factors acc to fishermen affect HSC. Ratings of factors to know their perception of impact.</td>
</tr>
<tr>
<td>19</td>
<td>Has the catch (from standing and cast nets) over your lifetime: Increased; Decreased; Remained Same; Fluctuated</td>
<td>Preliminary; does catch trends and trends of HSC have any correlation?</td>
</tr>
</tbody>
</table>
Appendix III: Poem and literature for horseshoe crab conservation
Appendix IV: Poster for horseshoe crab awareness drive

I AM HORSESHOE CRAB TELLING, PLEASE SAVE US.
Appendix V: Certificate distributed during different Horseshoe crab outreach programme
Appendix VI: Awareness stickers during Rakhya Bandhan  
Awareness stickers for fishermen
The art shows how CLP helped horseshoe crab conservation

References


