

Final Evaluation Report

Your Details	
Full Name	Shrutika Hareshwar Raut
Project Title	Assessing diversity, population genetics, and conservation status of electric rays along Bay of Bengal, India
Application ID	37306-1
Date of this Report	4-10-2023 (October 4, 2023)

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Assessing the Status on the population biology of species belonging to the order Torpediniformes (Electric rays).				<p>Data on the abundance and diversity of species caught was gathered from three states along the eastern coast of India. The biological data including length-weight, sex ratio, and reproductive status of the respective species population was identified.</p> <p>In Tamil Nadu, where the team was based, a detailed biological study was carried out for a frequently caught species- <i>Narcine timplei</i> which is listed as Vulnerable according to IUCN Red List. This also included studying the electric organ characteristics of the understudied species, <i>Narcine timplei</i>.</p>
Studying the genetic diversity and biogeographic variation of electric rays across the east coast of India.				<p>DNA extraction and amplification were conducted on the samples, but this process is ongoing due to technical challenges faced during the standardisation. Successful PCR products will be soon outsourced for sequencing. The barcoding part of the study is ongoing. Once obtained, the generated contigs will be used for molecular phylogeny. Population genetic analysis is planned using software such as DNASP and will involve haplotype network analysis.</p>
Awareness training programs and education about the importance of Torpediniformes species for fishermen are to be conducted at the fish landing centres and at tourist beaches across the eastern states of India.				<p>Various awareness and education campaigns about electric ray protection were conducted successfully with many young and adult attendees. The campaigns led to positive responses from the citizens leading to an appreciation of the understudied and lesser known electric rays. Activities such as games, puzzles representing electric rays were included to create a fun learning experience for children, aiming to foster a pictorial memory.</p>

			Children showed enthusiastic participation in puzzles, quizzes, and scrambled words. As a reward, they received customised pouches featuring electric ray pictures and logos, activity booklets with electric ray facts, and school stationary. Awareness raised during fisher surveys also yielded positive responses from fishers. Many agreed to release electric rays when caught, given that they were not profitable in the market and were primarily caught as bycatch.
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2. Describe the three most important outcomes of your project.

- a) Traditional Knowledge Acquisition:** Uniquely conducted 243 surveys with fishers across the eastern coast of India, focusing on electric rays with 23 questions in the semi-structured questionnaires. The study was conducted at 15 artisanal villages across the 3 states on the east coast of India. There were six sites in Tamil Nadu, seven in Andhra Pradesh, and two in Odisha.

Outcome: Established a foundational baseline of traditional ecological knowledge, spotlighting the concerns over the diminishing populations of electric rays and underscoring the importance of integrating local insights with scientific studies. This integration of local insights with scientific research culminated in a peer-reviewed publication in the leading journal of ocean policy studies- *Marine Policy* titled "Assessing artisanal fishers' attitude and perception towards electric rays' conservation along the Indian coast." (<https://doi.org/10.1016/j.marpol.2023.105826>)

Table 1: Detailed study sites and number of interviews

State	District	Fishing villages sampled	No. of interviews
Tamil Nadu	Chennai	Covelong	20
		Neelankarai	13
		Kottivakam	4
	Ramnathpuram	Rameshwaram	4
		Olaikuda	7
		Mandapam	5
Andhra Pradesh	Vishakhapatnam	Jalaripeta	37
		Rushikonda	15
	Kakinada	Kakinada	8
	Prakasham	Pinnivaripalem	37
	Krishna	Machilipatnam	12
	Nellore	Mypadu	3
		Tuplipalem	10
Odisha	Puri	Puri	29
	Ganjam	Gopalpur	39

Table 2: Electric ray species identified by interviewed fishers and their IUCN categories.

Species	AP	OR	TN	Overall	Percentage	IUCN status
<i>Torpedo marmorata</i>	67	65	0	132	54.3	VU
<i>Torpedo fuscomaculata</i>	78	33	21	132	54.3	DD
<i>Torpedo panthera</i>	30	34	22	86	35.4	EN
<i>Torpedo zugmayeri</i>	0	0	0	0	0.0	NE
<i>Torpedo sinuspersici</i>	17	6	10	33	13.6	DD
<i>Heteronarce prabhui</i>	33	31	0	64	26.3	DD
<i>Narke dipterygia</i>	38	0	13	51	21.0	VU
<i>Narcine maculata</i>	52	6	0	58	23.9	VU
<i>Narcine prodorsalis</i>	25	12	0	37	15.2	EN
<i>Narcine lingula</i>	22	15	0	37	15.2	VU
<i>Narcine timplei</i>	13	41	18	72	29.6	VU
<i>Narcine atzi</i>	9	15	0	24	9.9	VU
<i>Benthobatis moresbyi</i>	13	7	0	20	8.2	LC
Do not know	0	0	12	12	4.9	-
All or could not differentiate?	42	0	23	65	26.7	-

Values indicate number of respondents identified each species.



Figure 1: State-wise post-capture usage of electric rays. Values indicate percent of response received for each category.

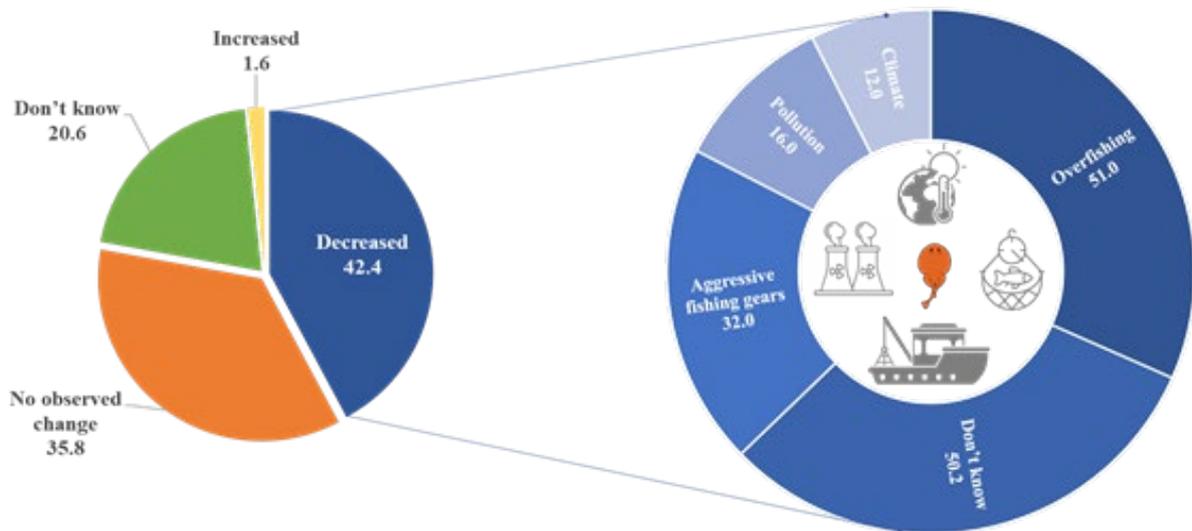


Figure 2: Fishers' perception on the population trend for electric rays. Possible reasons for the population decline. Values indicate percent of response received for each category (sum of the percent is not 100% as many fishers indicated multiple reasons for population decline).



Figure 3: Volunteers and Team members surveying the coastal fisherfolks on the perception and attitude towards electric rays in Andhra Pradesh, Tamil Nadu, and Odisha

b) Population Dynamics Data: Collected comprehensive data on the population dynamics of electric ray species in three eastern states of India. As we were based in Chennai, a detailed biological study was conducted on a frequently caught

species, *Narcine timplei*, at the Covelong fish landing centre. This involved assessing the length-weight relationship of adults and embryos, sex ratio, and reproductive stages. Additionally, an analysis of the electrocytes present in the electric organ of *Narcine timplei* was carried out to decipher their relationship with the length and disc width, further shedding light on their unknown biology.

Outcome: The study provided a deeper understanding of species within the Torpediniformes, capturing biological metrics like sex ratios, length, weight, and reproductive states. This information is crucial for formulating effective conservation strategies and understanding regional biodiversity. The biological data of a total of 216 individuals of the order Torpediniformes belonging to various species such as *Narcine timplei*, *Narcine maculata*, *Narke dipterygia*, *Torpedo panthera*, *Torpedo fuscomaculata*, and *Torpedo marmorata* across the east coast of India were recorded. The study not only offered a deeper understanding of species within the Torpediniformes order but also provided specific insights into the biology and population dynamics of *Narcine timplei*. Manuscript preparation is underway to translate this comprehensive data into a peer-reviewed publication, further contributing to the academic understanding of the species.

c) Awareness and Education: Initiated awareness campaigns at fish landing centres and tourist beaches, targeting local communities and researchers. Engaged young school-going children with interactive games like puzzles, scrambled words, and activity booklets filled with electric ray facts and pictures while showing them and preserved samples in airtight bags. Conducted surveys with fishers, emphasising the alarming decrease in electric ray populations, even though they are mostly caught as bycatch. This awareness prompted a positive response from many fishers. Launched a dedicated website <https://projectrays.wordpress.com/> as an educational resource on electric rays of India and their conservation.

Outcome: Successfully heightened awareness about the vulnerability and significance of electric rays among both adults and young ones. As a direct result of the fisher surveys and outreach, many fishers committed to releasing electric rays alive whenever possible and unintentionally caught. The use of games and activity booklets not only made learning fun for children but also ensured that the knowledge imparted was memorable and lasting, fostering a new generation aware of marine biodiversity. The website may pose as a tool for locals, students, and scholars, helping a new generation understand more about sea life. the challenges electric rays face and how we can save them.



3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

During the project, we encountered a few unexpected challenges. Our fieldwork on the Tamil Nadu and Andhra Pradesh coasts was briefly halted by cyclones in September and December 2022, leading to missed study opportunities. Additionally, our interactions with fishers revealed a prevailing belief that electric rays were not caught in significant numbers, leading them to assume their fishing practices had minimal impact on the species. To address this misconception, we explained the broader aspects of overfishing and highlighted how the unintentional catch of electric rays, coupled with benthic net usage that affects shrimps and other

endangered rays, posed a larger threat to marine biodiversity than initially perceived. After these discussions, the fishers exhibited a deeper understanding of the ecosystem's delicate balance and committed to releasing accidentally caught electric rays whenever feasible. Additionally, we faced technical challenges during our molecular studies for population genetics. The processes of DNA extraction and standardising PCR reactions proved more time consuming than anticipated, with several failed attempts. We also encountered issues with preserved tissue samples from other states, where they did not exhibit bands in DNA gel electrophoresis. Even when we managed to extract DNA successfully, we often struggled to obtain the PCR product, causing further delays in sequencing. These molecular study challenges added another layer of complexity to our project's execution.

4. Describe the involvement of local communities and how they have benefited from the project.

The involvement of local communities was pivotal for our project. Their deep rooted insights and cooperation, especially from the fishers, enriched our research efforts. Despite their hectic schedules, these fishers generously participated in our questionnaire surveys. The most valuable outcome was the mutual learning between our team and the fishing communities. Their insights and experiences with electric rays, as well as their views on conservation and sustainable fishing, enriched our understanding. This collaboration has empowered these communities to advocate for electric ray conservation and pass on the message to peers and future generations.

While our project team primarily conducted field surveys in Tamil Nadu, we recognised the importance of language and regional understanding for our efforts in Andhra Pradesh and Odisha. Thus, we collaborated with local volunteers to lead the surveys in these states. Local volunteers like Soumya Ranjan Biswal, and Ganpati Sahu (Odisha Paryavaran Sanrakshan Abhiyan), Sri Chakra Pranav Tamarapalli and his team (East Coast Conservation Team), were recruited along with Sanjeev Varma and Ramakrishna (Animal Warriors Conservation Society), who shouldered significant responsibilities. Trained by us, they not only managed biological and fisher surveys effectively but also displayed immense growth, emerging as budding citizen scientists in their communities. While both were carrying out the surveys, to cover more survey area and time, interns, both undergraduates and post-graduates, for short durations were given opportunities. They received comprehensive on-field training, including data collection, surveys, and practical research skills, and were duly recognised with experience certificates. Moreover, our efforts with young individuals through interactive games and puzzles have instilled a sense of responsibility in them. We are confident that these young minds will carry forward the conservation message to their peers, establishing themselves as change makers in their communities.

5. Are there any plans to continue this work?

Yes, we have plans to continue our research. We aim to carry out long-term monitoring of electric ray populations in India. Given that our understanding of their ecological characteristics, behaviours, and electric discharges remains limited, there

is much more to explore. Additionally, we are looking to expand our conservation and awareness activities to other Indian states to further address the challenges faced by electric rays.

6. How do you plan to share the results of your work with others?

We have actively disseminated the results of our project through various platforms. Firstly, we are making the project's findings accessible to the public via our dedicated website, <https://projectrays.wordpress.com/>. Additionally, during our awareness campaigns, we created informative posters and guides to disseminate knowledge about electric rays' basic biology and ecology. In terms of academic dissemination, I presented the research results on the population biology of *Narcine timplei*, titled "Notes on some biological aspects of numbfish *Narcine timplei* from Covelong, Chennai," at the Student Conference on Conservation Science (SCCS)-Bangalore in 2022. I also presented the ongoing project work on electric rays at the SMBE EVERYWHERE GLOBAL SYMPOSIUM GENETICS OF ADAPTATION (GS6) held at NCBS, Bangalore.

Furthermore, our team organized a 1-day symposium titled "Batoids (Rays) of India" on March 24, 2023, with an aim to raise awareness about the understudied group of rays in India, attended by over 100 participants, during which I presented and spoke about the biology and ecology of electric rays along with the overall project results. Dr. Amit Kumar, team member, presented the results of fishers' traditional ecological knowledge for the conservation of electric rays in India at OSICON-23, hosted by the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad.

We are thrilled to share that our research, "Assessing artisanal fishers' attitude and perception towards electric rays' conservation along the Indian coast," has been published in the esteemed journal, Marine Policy (Volume 157)- (<https://doi.org/10.1016/j.marpol.2023.105826>). All acknowledgments for funding support, including Rufford, have been duly mentioned during every presentation, symposium, and publication. The results obtained from other project objectives, including biology and population genetics, will also be compiled, and submitted for publication in relevant scientific national and international journals.

7. Looking ahead, what do you feel are the important next steps?

We propose the following important next steps for electric ray conservation in India:

1. Expand Surveys: Cover both the east and west coasts of India comprehensively to gain population, biology, and diversity data.
2. Long-term Monitoring: Monitor electric ray populations to understand their dynamics, given their vulnerable and data-deficient status.
3. Publish Results: As this is the inaugural biological study on these species, share findings in international journals to boost conservation efforts.
4. Raise Awareness: Educate fishing communities, schools, and locals across the Indian coasts about the threats to electric rays to foster protection.

5. Research & Impact Assessment: Due to limited data on electric rays' habitat and biology, assess the effects of threats like fishing and pollution to inform future conservation plans.

8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, we prominently displayed the Rufford Foundation logo in various aspects of our project. The logo was integrated into all our presentations, symposiums, and publications. Additionally, we had it on the customised t-shirts used during our awareness drives and was included in the training and identification materials provided to our local volunteers and interns. The foundation's logo was also showcased on activity booklets and games utilised during our awareness sessions. Moreover, we highlighted The Rufford Foundation's contribution by printing its logo on the customised prizes and certificates awarded to youngsters upon the successful completion of tasks and victories in games throughout our campaigns.

9. Provide a full list of all the members of your team and their role in the project.

I, Shrutika Raut (Principal Investigator) - Overseeing the project's design, management, and finances. Handling reporting and correspondence with project donors. Direct involvement in fieldwork in Tamil Nadu. Training volunteers for surveys and data collection. In charge of the volunteers and field assistants and ensure their reporting, training, study, and safety. Performing the identification of rays through morphological studies, organize awareness campaigns and prepare electric ray identification charts.

Dr. Amit Kumar - Co-developed the foundational project concept and idea. Coordinated with local volunteers and managed legal matters during awareness campaigns on local beaches. Worked jointly with Shrutika Raut in fieldwork and project activities. Specialized in molecular work, assisting particularly with the population genetics component. Guided the team in manuscript preparation, data analysis, and editing for publication in international journals.

Dr. S. Prakash - Assisted in drafting and conducting the questionnaires and ensuring research quality. Utilized his multilingual and communication skills during surveys with fishers as he is well known by the fisher's community. Played a significant role in awareness campaigns, educating both young and adults about electric rays. Will provide guidance on publishing the project results in international journals.

10. Any other comments?

- We are extremely grateful to The Rufford Foundation for providing support and consideration through the small grant award for this work.
- We would like to thank the volunteers for their unstinted help during questionnaire surveys and biological data collection.
- We would also like to thank Vinu Siva, Subbu, and K. Kunjulakshmi for their support during the field surveys in various locations.

- We are grateful to fishers at various locations across the east coast of India who were co-operative during the surveys and shared with us their traditional knowledge.

Event posters and banners:



SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY
Raja-Sandhi Salai, Chennai - 600119, Tamil Nadu
CENTRE FOR CLIMATE CHANGE STUDIES

Electric rays
Need our help

ELECTRIC RAY FACTS
Capable of producing electric discharges from **2 to 220 volts** (depending on species)
They are slow-moving and propel themselves with their tails
Favorite food is small fish and invertebrates like polychaets and shrimps
Possess a pair of kidney-shaped electric organs to produce electricity to stun prey and for defense.
Gives live birth to 6-8 pups

Out of the **68** species globally, **31** are at risk... of extinction (VU, EN, NT, CR) according to IUCN red list (International Union for Conservation of Nature)

While **15** are data deficient (DD) or yet to be evaluated (NE)

Fearing the electric shocks and minimal sale, fisherman often discard the captured electric rays as bycatch

Balance
Electric rays are essential link in the food web

THREATS
OVERFISHING AND BYCATCH
Electric rays are usually taken as bycatch when fishermen target other highly sought species of tuna, sardines and swordfish.
CLIMATE CHANGE
The warmer waters affects shark and ray behaviors, important habitats like coral reefs which act as nursery grounds for rays are affected climate change.
HABITAT LOSS
Significant destruction of the habitat by trawlers, sea bed mining, dredging, and other human disturbances causing decrease of population.

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY
DEEMED TO BE UNIVERSITY
ONE DAY ONLINE SYMPOSIUM ON
BATOIDS (RAYS) OF INDIA
The symposium aims to raise awareness and bring attention to the species-rich yet under-studied group of Rays in India.

Theme I : Taxonomy and phylogeny
Theme II: Ecology and Behaviour
Theme III: Rays in fisheries
Theme IV: Socio-cultural perceptions

14th March 2023; 9:15 AM - 1 PM
on ZOOM
Anyone interested to learn about rays can attend
List of confirmed speakers (so far)

Dr. Shoba Joe Kizhakkudan
Central Marine Fisheries Research Institute, Chennai
Dr. Amit Kumar
Sathyabama Institute of Science and Technology, Chennai
Trisha Gupta
University of Oxford, United Kingdom
Dr. Divya Karnad
Aahoka University, Haryana
Shrutika Raut
Sathyabama Institute of Science and Technology, Chennai

E-certificates will be provided to all the active participants
To register, click here or scan: <https://forms.gle/bQYYdpQzRTuNajjZ3>

Organizers:
Dr. Amit Kumar
Ms. Shrutika Raut
Dr. S. Prakash
Ms. Kunjulakshmi
Patrons
Dr. Mariaseena Johnson, Chancellor
Dr. Marie Johnson, President
Vice- Presidents
Mr. J. Arul Selvan
Ms. Maria Bernadette Tamilarasi
Ms. Maria Catherine Jayspriya
Dr. T. Sasipraba, Vice Chancellor

Supported by Rufford Foundation
Email: training.cccs@gmail.com
or call: 904448221 for more info.



Electric Rays Of India

Torpedo panthera, *Benthobatis moreletii*, *Narcine atzi*, *Torpedo fuscumaculata*, *Narcine timlei*, *Narke dipterygia*, *Narcine prodorsalis*, *Torpedo marmorata*, *Narcine maculata*, *Narcine lingua*, *Torpedo sinuspersici*, *Heteronarce poobhui*

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
CENTRE FOR CLIMATE CHANGE STUDIES

In association with
TAMILNADU TOURISM DEVELOPMENT CORPORATION
Presents
Electric ray awareness campaign

Let's protect ELECTRIC RAYS

JOIN US TO KNOW THESE SUPERCOOL GROUP OF RAYS!
We invite you to join us!
Together, we will do fun learning about electric rays through interactive games and activities!
Electric rays are endangered and need our attention today more than ever! Let us save them before they are gone!

fun games Competitions

Saturday, 8 April 2023
Blue Flag beach, Kovalam Chennai- 603112
Start at 04:00 pm

Fun learning ALL ARE WELCOME!!

Contact Person: Dr. Amit Kumar: 9094486533
For more details, visit <https://projectrays.wordpress.com/> or scan

Rufford

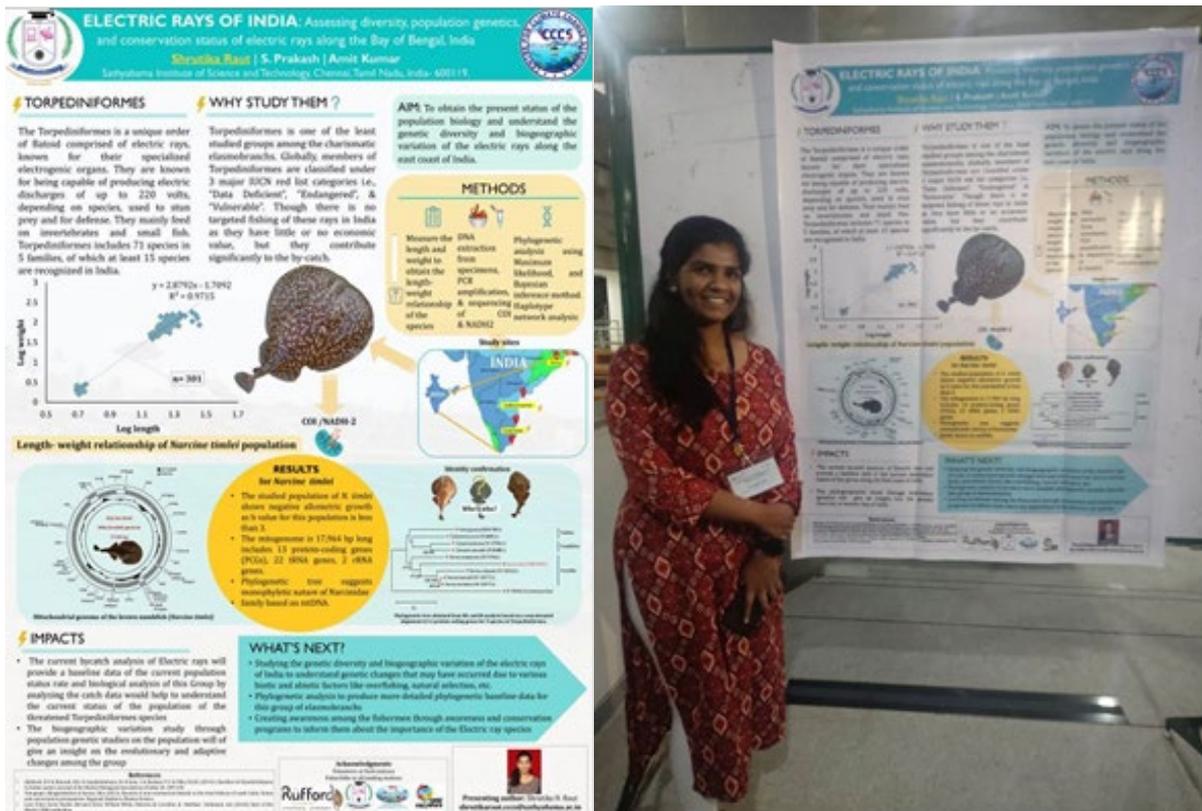
Awareness campaign:







Conferences and presentations



REC

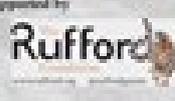
ELECTRIC RAYS OF INDIA

Shrutika Raut, S. Prakash, Amit Kumar



Centre for Climate Change Studies
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Supported by Rufford

Amit's screen

REC

Acknowledgements:

THANK YOU



Volunteers at field stations

<p>Soumya Ranjan Biswal Odisha Paryavaran Samrakshan Abhiyan</p>	<p>Sri Chakra Pranav Tamarapalli East Coast Conservation</p>	<p>Sanjeev Varma Animal warriors conservation society</p>
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Fisherfolks at all landing stations

Amit's screen

Microsoft PowerPoint 2019 - Rufford

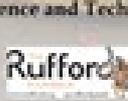
Notes on some biological aspects of vulnerable numbfish *Narcine tinnie* (Elasmobranchii: Torpediniformes) from Covelong, Chennai

Shrutika Raut, S. Prakash, Amit Kumar

[@ShrutikaRaut19](#)
[@AmitKumar_434](#)

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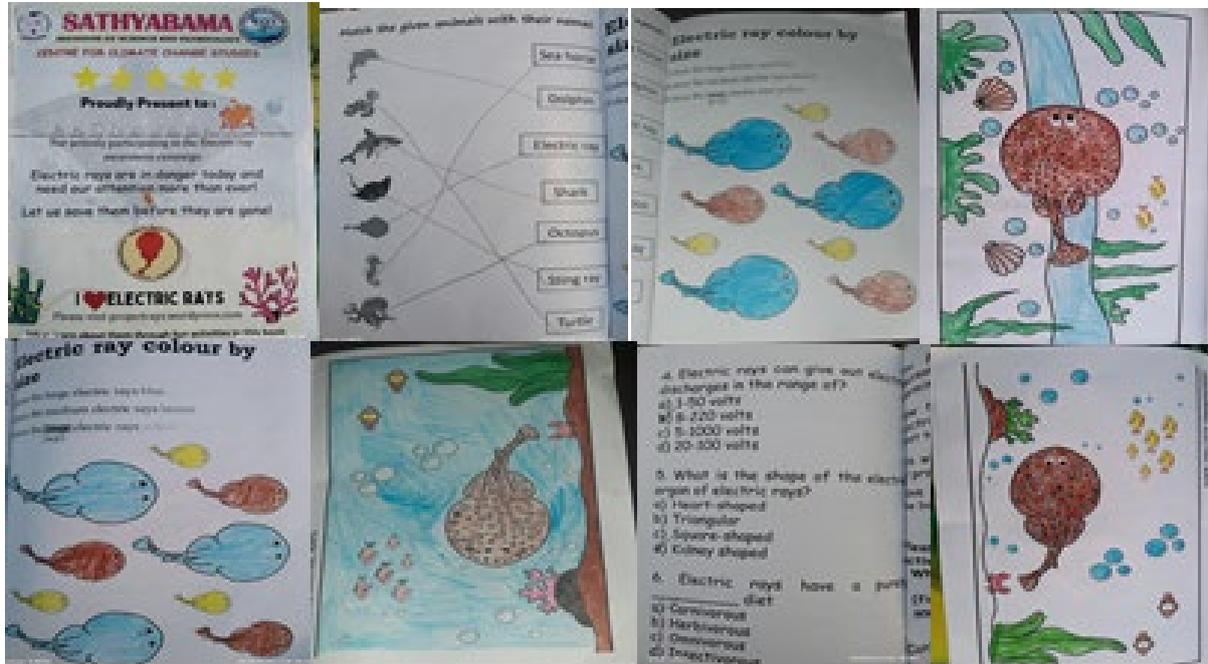





Survey and biology data collection:



Activity booklet activities completed by young ones:



Printed t-shirt:



Website snippets:

