The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Divya Panicker
Project title	Developing with dolphins: ecological and anthropogenic factors affecting estuary use and behaviour of humpback dolphins in the southwest coast of India.
RSG reference	11202-1
Reporting period	March 2012 – August 2013
Amount of grant	£5995
Your email address	Divya_145@yahoo.com
Date of this report	31st August 2013

1. Please 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 distribution and demography of dolphins in and around the study sites			X	Distribution and demography was assessed through shore watches conducted with two observers over four seasons (as opposed to three seasons that were initially planned) in a major (Kochi), minor (Munambam) and intermediate (Ashtamudi) port. A coastal survey was carried out in an area of 480 km^2 between Kochi and Munambam during March-April 2013 to assess the distribution, diversity and group sizes of marine mammals in the near shore areas.
Assessing intensity of estuary use by Indo-pacific humpback dolphins and identifying key factors that could influence their distribution			X	Ecological factors such as water quality and prey availability were assessed using quantitative and qualitative methods. Water parameters such as salinity, turbidity, pH and depth were measured over three seasons in the three ports using quantitative techniques. As it was not possible to quantify prey availability using the method originally proposed (see section 2), qualitative data on prey availability in the three estuaries across the three ports was assessed through questionnaire surveys. Anthropogenic factors such as boat number, boat type and fishing pressures in the estuary was quantified through direct observations. The data collected on the ecological and anthropogenic factors that may determine dolphin distribution and usage of the estuary area will be used in habitat usage analysis programmes such as Resource Selection Function to identify those factors that significantly influence dolphin occurrence.
Assessing variations in immediate behavioural			X	Behavioural data were collected using group scans performed through direct observations. Behavioural variations in

responses in Indo-pacific humpback dolphins to ecological and anthropogenic factors				dolphins are being compared between the study sites and in response to the ecological and anthropogenic factors that were measured.
Photo identification of humpback dolphins in the estuarine areas			x	A total of 8522 photos were taken for photo identification. Numbers of individuals are currently being assessed from this effort. A photo catalogue of the identified individuals would be prepared and this would serve as database for future studies on population estimates and ranging behaviour of dolphins in this area.
Evaluating attitudes of and raising awareness among coastal stakeholders		X		We aimed to conduct interviews on perceptions of fishermen towards marine mammals and awareness programs with fishermen, port and forest authorities and tourist operators. We were able to conduct 60 semi-structured interviews with fishermen across the three sites. A talk on the current study was delivered to masters students in marine biology of Cochin University of Science and technology. A talk on the study was also given as part of a training workshop on 'Habitat eco-biology of selected Apex predators and Macrophytes' at to scientists at The Central Marine Fisheries Research institute (CMFRI). Information exchange and capacity building programmes with the forest department, port authorities and local schools are being organised and would be conducted over the next 2 months. The report from the study is being prepared in the local language to distribute among fishermen and authorities in the study area.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Prey availability: One of the challenges for the study was assessing prey availability in the estuary. During the recce (March-April 2012) it was clear that fishermen were using different gears across areas in Kochi and in between seasons. This made it very difficult to compare between seasonal data

and quantify catch accurately in a short period of time. In the estuaries of Munambam and Ashtamudi, most of the fishermen were actually fishing from land during certain seasons using Chinese fishing nets or cast nets. Though the fishermen had great knowledge of the estuarine fish, the fishing method employed resulted in a biased spatial and temporal coverage of the area. Very few fishermen operated using mono filamentous gill nets in the estuaries of Munambam and Ashtamudi, those that did had irregular timings and landing sites making it extremely time intensive to sample the same. Due to the above said reasons it would be difficult to compare prey availability between the ports too. Recognising that (unbiased) quantitative data could be obtained only through a rigorous and field intensive method (a separate study in itself), we decided to tap the wealth of knowledge of the fishermen who have been operating in this area with more than 20 years of experience to assess the key estuarine fish species and their seasonal differences in occurrence in the estuary. We also assessed the fisherman's perspective of what estuarine fish the dolphins were feeding on based on their continued interactions or observations over the years. This qualitative data is compared over the seasonal patterns of estuary usage by dolphins.

Monsoon sampling: At the start of the project, we had not planned to do direct observations on dolphins during the monsoon season anticipating rough weather conditions. However, once the study progressed we thought it was absolutely essential to collect information on the monsoon usage patterns and behaviours of humpback dolphins as this season had a distinct impact on water conditions and prey availability. This data was also crucial to reveal the seasonal patterns of dolphin usage during one annual cycle. Furthermore there is no information on monsoon distribution or behaviour of humpback dolphins along the Kerala coast. This led us to plan a new season of data collection in the three ports during highly unpredictable weather conditions. We were able to successfully complete this season of data collection however this extra time and effort resulted in an extension of the study period. I would like to thank RSGF for giving us this extra time to complete the same.

Intermediate port: The proposed study included a major and minor port for data collection. During our initial field recce (March-April 2012) and discussions with experts in the field such as Dr A. Bijukumar from Kerala University, we found that Ashtamudi port, an intermediate port had a good population of dolphins. Dolphin activity in this site appeared to be highest across the region. This port was situated 136 km south of Kochi near the town of Kollam. It served as home to one of the largest fishing harbours in the region with high boat activity and connected to the second largest wetland system in the state. This site along with Kochi and Munambam gave my study a gradient of anthropogenic activities from a minor, intermediate and major port. This required us to set up an observation site here and organise lodging and travel to the port regularly. Equal sampling effort was invested in Ashtamudi as in Kochi and Munambam.

Field assistant: The most suitable field assistants for the project were local fishermen in the three sites. The fishermen, however, were involved in fishing activities through the season and would also bring in their own biases into data collection. Fearing this, I decided to involve non-local student participants for data collected from across the country to work on the project by creating a volunteer program for students. This would expose students to marine mammal research in a dynamic estuarine environment with high anthropogenic pressures. This opportunity was advertised through the social media and we got an overwhelming response from students from different parts of the country.

3. Briefly describe the three most important outcomes of your project.

Dolphin usage across the three ports: One of the important outcomes was that dolphins were found to avoid the major port, preferred the intermediate port while using the minor port as expected ($G= 868.87$, $p<0.001$). No significant difference was seen in fishing vessels using the three ports, however the major port harboured high number of speedboats, shipping, non-fishing motor and tourist vessels, which were absent in the other ports. Further analysis on temporal and spatial interactions between boat types, fishing intensity and dolphin presence and behaviour is being looked into currently.

Time activity budgets: Overall, dolphins spend more time foraging (58%) and traveling (20%) and less time in other activities such as milling (10%) and socialising (5.5%) in the three ports. However, in the major port, compared to other ports, dolphins spent more time travelling (29%) and displayed no milling activity due to increased boat traffic (n=2592 scans). Conversely, milling was high in the intermediate port (20%) suggesting this area was suitable for resting along with feeding ($G: 179.8$, $p<0.001$). On a seasonal scale (n= 648 scans/season, 4 seasons), occurrence in the estuarine areas and foraging activity in dolphins dropped during monsoon and peaked in premonsoon ($R=0.96$). Furthermore the interview surveys with fishermen reveals that the most abundant fish caught is mullet (95% of interviewees) which occurs highest during the summer (90%) and pre-monsoon (81%) seasons and lowest during the monsoon season (66%). On a diurnal scale (n=36 scans/day), dolphin occurrence (52%) peaked in the afternoon with the predominant activity being foraging (60%). Fishing intensity and boat traffic is highest in the morning when dolphin occurrence and foraging activity was low ($G:99.7$, $p<0.001$).

Habitat modelling is being done for the three estuaries using ecological parameters that have been collected over the seasons. This would further be correlated with intensity of dolphin use in the estuaries.

Coastal survey: The coastal survey was conducted between the major and minor ports in an area of 480 km^2 using the line transect method. A total survey effort of 76.5 km was invested during March & April 2013. Twenty pods of humpback dolphins, three pods of finless porpoises and one pair of Bryde's whale were observed during the survey. The mean group size for humpback dolphins was 3.2 (range: 1-15). Distribution maps in relation to ecological parameters such as distance from estuary mouth, depth, salinity and turbidity are being prepared. The sighting of Bryde's whale is the first recorded live sighting on the west coast of India. The whales were found in depth of 21 m and 8-12 km from shore and exhibited milling behaviour. This corroborates with data collected through interviews, where there were reports of regular sightings of whales in the region usually in 25-40 m depths feeding on large shoals of sardines.

Interview survey: Perceptions of fishermen were found to be both positive and negative towards marine mammals in the study area. Informal interviews and media reports state that gill net, purse seine and trawl net fishermen claimed that humpback dolphins were often a nuisance as they stole fish from their net resulting in loss of the catch. The Chinese fishing net and cast net fishermen said that humpback dolphin foraging techniques such as chasing fish towards the shore, provided a better catch for them (92.5% of interviewees). From the 60 fishermen interviews conducted, 48.9% of fishermen felt dolphin numbers have increased due to no hunting pressure on them and 36.2% felt that their numbers have decreased. Almost all fishermen were aware of laws against hunting of marine mammals (97.7%) however there was some evidence of local consumption of marine mammals caught as bycatch (38.6%).

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

During the study period, seven residential and two non-residential volunteers were trained in marine mammal research methodologies such as shore based scan sampling for dolphin usage, photo identification and techniques in environmental data collection. Volunteers were mainly students doing their undergraduate or graduate degree with a keen interest in marine research. The study provided them with an opportunity to learn marine mammal research methods and marine mammal behaviours and exposed them to the dynamics between fisheries, port activities and marine mammals. Additionally seven trained volunteers assisted in boat-based line transect surveys to assess distribution of marine mammals along the Kochi and Munambam coast.

During environmental data collection, in addition to the volunteers, local fishermen and tour operators assisted the PI and volunteers. Fishermen were particularly interested in environmental changes and how they affected fish and dolphins leading to many stimulating discussions and knowledge transfer.

In addition to informal interactions, semi structured interviews were conducted with 60 fishermen throughout the study period thereby informing them about the study and complementing the local knowledge on marine mammals and threats they face.

Regular updates were given on the progress of the project and its findings to the Cochin port authorities. The authorities have taken an active interest and often provided inputs for the study based on their extensive knowledge on the study area and reported sightings of marine mammals. Prior to this study, authorities were not even aware of the presence of humpback dolphins in the harbour as there were limited studies done in this area.

I participated in a training workshop on 'Habitat eco-biology of selected Apex predators and Macrophytes' organised at the Central Marine Fisheries Research Institute (CMFRI), Cochin, Kerala where I also presented my work titled 'Estuary use and behaviour of humpback dolphins in ports along the Kerala coast' as a talk. The workshop was attended by 25 scientists from regional marine research centres as well as the headquarters of CMFRI. The discussions held during the workshop led to discussions on the kind of marine mammal research to be undertaken by CMFRI in the near future.

I delivered a talk titled 'Estuary use and behaviour of humpback dolphins in ports along the Kerala coast' for marine biology students at the Cochin University of Science and Technology (CUSAT) elucidating the importance of my study and its nuances. Following this some of the students joined the volunteer program to learn more about my current marine mammal study.

Timely reports and brief communications regarding the study were provided to the Indian coastguard, Cochin port authorities, Kerala forest department, Central Industrial Security Force, Geological Survey of India and Taj vivanta, Cochin.

5. Are there any plans to continue this work?

The current study has provided an ideal platform to undertake more studies both within and outside the estuarine region. This study revealed the presence of large cetaceans such as Bryde's whale in near shore waters, which reflects the critical need for further studies on whales in the region. To

address these points, we would like to conduct a survey on marine mammal distribution and diversity over a larger spatial scale along the coastal waters across different seasons, which will also place the current study in context.

With an overactive fishery operating in the study area, our data has shown positive and negative interactions with the same. It is very important to assess the increasing conflict between dolphins and fishermen occurring along the Kochi and Kollam coast. We are keen to continue interview surveys to assess perceptions across a larger group of fishermen using different gears. This would lay the groundwork to initiate robust community based programs to address conflict situations.

During the study, a wealth of knowledge was gained from fishermen during informal chats. This has inspired us to document fishermen stories and perspectives to marine mammals in the form of a children's book, which can be used in the rural and urban schools to raise awareness.

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

We would share our findings in the form of a report with all relevant authorities such as Cochin port trust, Kerala forest department, Indian coastguard, Geological Survey of India, tourist operators and fishermen associations. The findings of the study would also be translated into the local language, Malayalam and provided to the key informants and fishermen from the study area.

We plan to publish popular articles highlighting the results of the study and other factors about this system in local newspapers accessed by the general public. Talks and activities with local school children are being organised.

Currently we are working on a manuscript to be submitted to a peer-reviewed journal reporting the findings of the study.

For a larger community of wildlife biologists and students, we would be presenting a poster showcasing this study at the Students Conference for Conservation Science in Bangalore in September 2013.

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

March 2012 to July 2013. The anticipated length of the project was from March 2012 – March 2013. However an extension of 6 months was required due to unforeseen circumstances (see section 2).

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

The exchange rate for the budget was 1GBP = 77.3 INR which was the exchange rate when the grant was received.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Travel to study sites for PI and advisor	95	91	+4	

Local travel to and between the study sites	329	802	-473	As an extra site, which was 308 km south of Kochi and sampling in monsoon season was added, there was a requirement to travel much more than originally planned. Also the study design required us to sample across different times of the lunar cycle to take into account any variation caused by spring or neap tides hence there was a need to visit study sites three to four times instead of consecutive days this also required more travel time. However this was adjusted with budget heads where we didn't spend as much as planned.
Lodging at study sites	379	156	+223	Lodging was provided by K.S.Radhakrishnan and. A. Jayakumar for the PI and volunteers. A nominal fee of 13 pounds was charged every month for the boarding of volunteers.
Field assistant wages	747	Not applicable	+747	Due to non-availability of field assistants, this budget item was used to create a volunteer programme where lodging and food was provided to residential volunteers
Food for field assistants	374	Not applicable	+374	Due to non-availability of field assistants, this budget item was used to create a volunteer programme where lodging and food was provided to residential volunteers
Food for residential volunteers	374	707	-333	All meals for residential volunteers were provided as there was no stipend or salary provided through the study period.
Personal cost	963	963	0	At actuals
Equipment for project	891	1375	-484	A DSLR camera, which was budgeted as 661 cost 949 with 75-300mm telephoto lens. This was absolutely essential for developing a photo identification catalogue and capturing behaviours exhibited by the dolphins during the study. 2 binoculars were purchased 220 pounds. Additionally we purchased a Dictaphone for recording interviews with fishermen.
Boat hire charges (inclusive of diesel and labour)	1230	1096	+134	Boat charges were lower than expected in Munambam.
Ocean floor substrate charts	54	0	+54	Ocean floor substrate maps were accessed from the geological survey of India, however we were not able to use these maps as the substrate mapping survey was done at a much earlier date and the substrate would have changed from then.

Water quality, salinity & temperature tests	270	127	+143	We purchased a salinity refractometer and a pH meter. We also bought the materials to make a secchi disk and depth measurer. The money saved from this was used to buy the Dictaphone mentioned above.
Supplies and materials (Stationary, cells)	38	38	0	
Communications	55	81	-26	
Printing of poster, educational resources, reports, Postage & freight	270	120	+150	Printing of reports to the authorities and fishermen is pending. The remaining money would also be used to prepare posters for conferences and schools.
Medical expenses	40	29	+11	
Contingency @ 5% of total	260	260	0	This item head was used completely due to certain repairs that were required to the vehicle and equipment and other miscellaneous expenses. This was also used to adjust with other item heads, which had exceeded the proposed amount.
Total	5995	5845	150	See section on Printing of poster, educational resources and reports

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

This study has given us an excellent foundation to build future studies. Some of the next important next steps would be to look at the following:

1. During the study, dolphins were found to be foraging 60% of the time, which highlights the importance of estuaries as feeding sites for this species. This region would be very useful to study foraging strategies and behaviour in humpback dolphins.
2. Dolphin movements in the estuary seemed to be related with prey availability during the course of this study. This calls for an in-depth study into the behaviour and life cycles of dolphin prey-species such as mullet in the region, which has a direct impact on dolphin presence and behaviour.
3. Dolphin pods in Ashtamudi were seen to have many calves in the group, which suggest that this might be a nursing ground in addition to feeding grounds. This region would serve as a good study site for further studies on demography, social organisation and communication between humpback dolphins.
4. Population estimates and habitat use studies should be conducted outside the estuary to form a complete story of numbers of humpback dolphins using the area and what factors determine selection of different habitats.
5. There is a growing sense of negative interaction with humpback dolphins especially older individuals damaging fishing nets. Studies on conflict with fisheries are essential to assess the extent of the problem and identify conflict groups or individuals and the drivers for this conflict behaviour.
6. The presence of marine mammals in the area is largely unknown to the local residents in this region except for marine fishermen. This indicates the need for large-scale awareness programs, which highlight the importance of mega aquatic fauna for coastal ecosystems.

7. Presence of Bryde's whales and reports of whale species from fishermen indicate these waters may support larger cetaceans. Distribution surveys across the different seasons would show the diversity of marine mammals using the area further assessing the importance of this region for this group of animals.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

The RSGF logo was used in reports that were provided to the Cochin port authorities, Indian coastguard and Taj vivanta on preliminary findings of the study. The RSGF logo was used for two audio-visual presentations given at CMFRI and CUSAT.

Funding from RSGF for the study was highlighted in permission letters and all other correspondence with government agencies, other organisations, institutions, media and experts consulted in the field. The same was also emphasised in posters for call for volunteers for the project, which was widely circulated across the country through social media and wildlife groups.

RSGF logo and name would be made use of in all relevant documents, official reports, media releases, popular articles, talks, posters and scientific publications prepared for this study or reporting the findings of this study.

11. Any other comments?

We would like to thank Rufford foundation for Small grants for awarding us this grant without which this study would not be possible. This study has added great value to marine mammal research in India, and more so in the region where the study took place.

Photos:

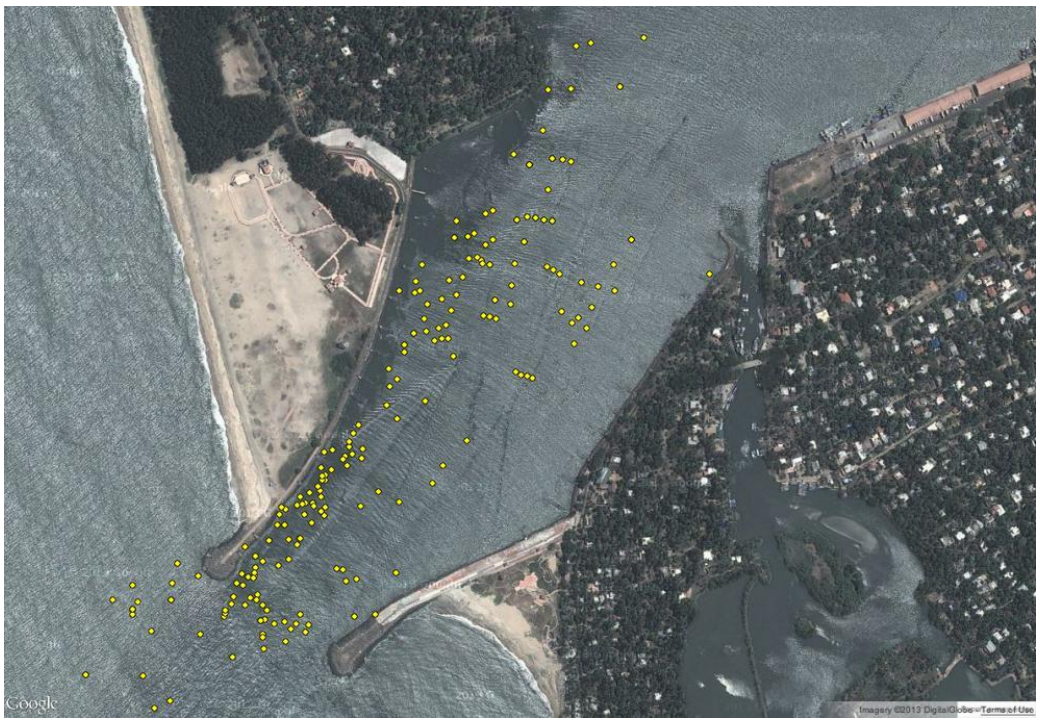

Figure 1: Map of dolphin locations in Munambam estuary

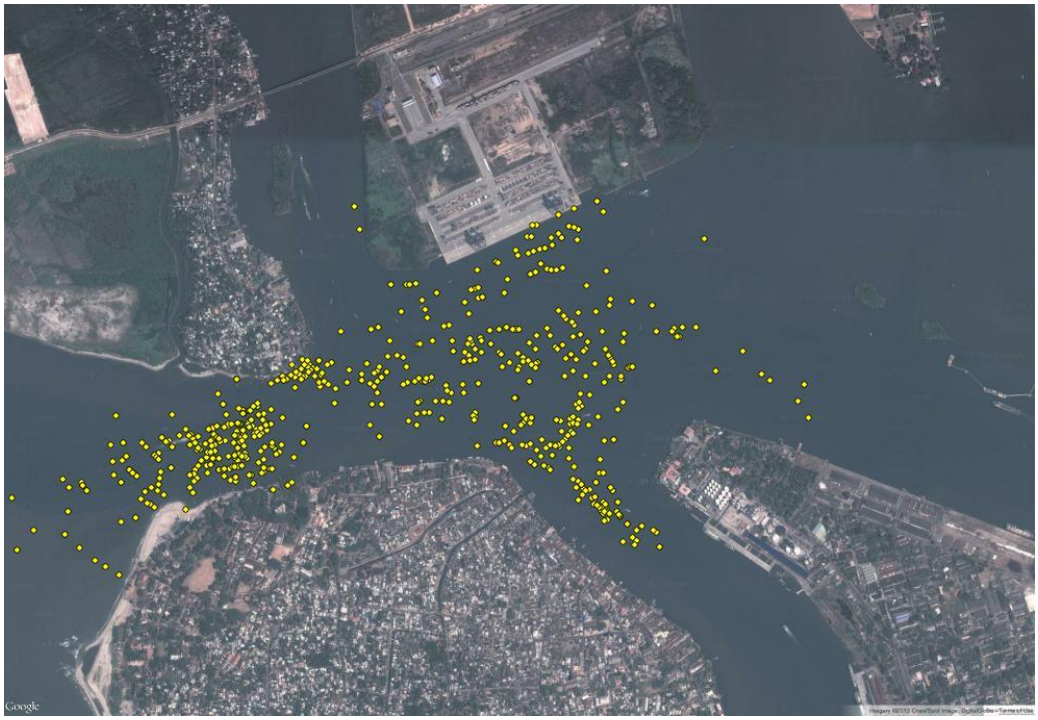

Figure 2: Maps of dolphin locations in Kochi estuary

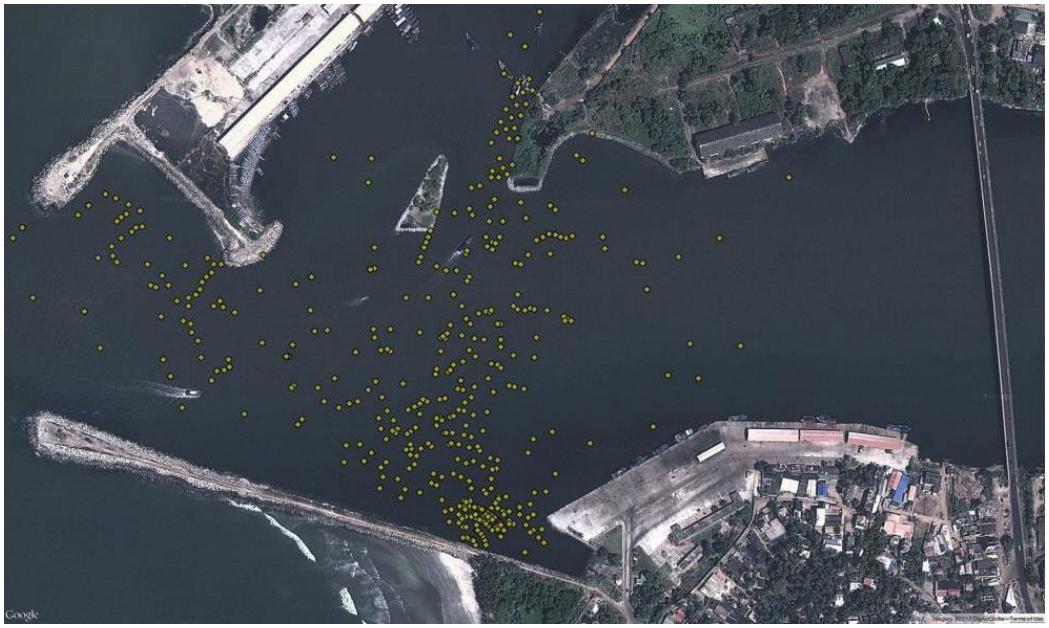

Figure 3: Maps of dolphin locations in Ashtamudi estuary

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