

INTERIM REPORT
Linking conservation and livelihoods in Lakshadweep's tuna fishery:
community-based monitoring of baitfish populations along a gradient of fishing pressure.

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OVERVIEW

Coconut production and tuna fishing constitute the two main sources of livelihood for Lakshadweep islanders. The tuna fishery in Lakshadweep has helped maintain low levels of reef fishing on the islands by diverting the pressure to these oceanic resources that are better suited to extraction than reef fish due to their shorter life spans, rapid growth rates and early maturity. The ecological sustainability of the tuna fishing industry depends both on the oceanic stock as well as that of reef and lagoon baitfish. The proposed project here attempts to understand the dynamics of baitfish stocks in three islands (Kadmat, Kavaratti and Agatti) with varying degrees of fishing pressure as well as establish a community-based catch monitoring effort to document baitfish resource exploitation.

Funding for this project was received in February of 2012, but unfortunately due to prior engagements work did not commence until July of 2012. Due to the Southwest monsoon and permit issues, the research team only made it to the islands by mid November. Fieldwork, including both ecological and social surveys, began in early December. In these past two months, through observations and informal interactions with various stakeholders, we have been able to learn a lot about the status of marine resources in the Lakshadweep islands. Inter-island transport has proven to be a little challenging logistically, but we now have a better understanding of the system and progress in the months to come should be better. This interim report is an account of our activities to date, current understandings and future plans regarding the RSG funded project.

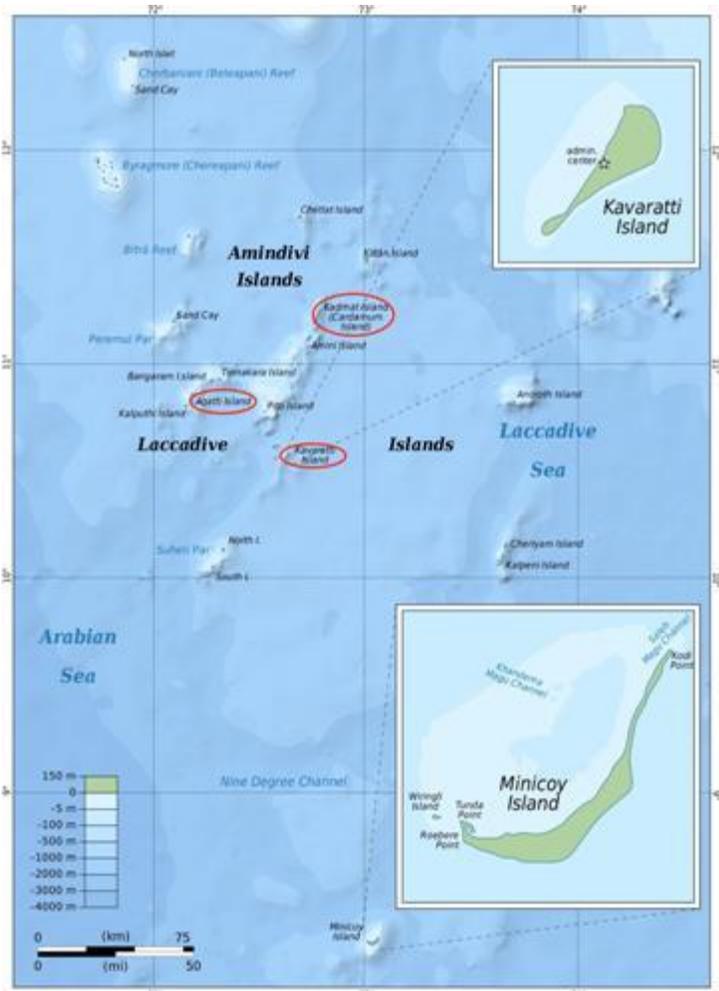


Figure 1. Map of Lakshadweep islands. Study islands: Kadmat, Kavaratti and Agatti are circled in red.

Table 1. Project objectives and current status.

Objective	Current Status
Social Assessment of Fisher folk perspectives	<i>Completed:</i> Preliminary interviews. <i>Planned:</i> Surveys in Kadmat, Kavaratti and Agatti from February onwards.
Catch monitoring	<i>Ongoing:</i> Interactions with fisher folk and fisheries managers to determine feasibility.
Ecological Assessment of Baitfish populations	<i>Completed:</i> Fish species and size identification. Preliminary surveys to determine optimal survey methodology and sample size. <i>Ongoing:</i> Population assessment on Kadmat island. <i>Planned:</i> Assessment in Kavaratti & Agatti starting in February.
Dynamics of baitfish fishery: Cost-benefit analysis, Comparison of atoll-wise management strategies	Not yet undertaken.

Table 2. Expenses incurred to date, this includes 2 months out of the proposed 9 months of fieldwork. All figures in British Pounds Sterling (£ Sterling). Exchange rate from Jan 3rd 2013: 1 £ Sterling = 1.624 USD; 1 £ Sterling = 88.395 INR.

Item & Description	Budgeted	Spent to date	Difference	Comments
Travel: Round trip Air fare between the mainland & Islands	1720	158	1562	Initial trip of the season undertaken in November 2012 via train and boat in order to transport gear and supplies.
Travel: Boat hire & local travel	1800	108	1692	November setup involved limited local travel and field sampling. Sampling on Kadmat island cheaper than the others.
Boarding & Lodging	1350	284	1066	Field rent & living expenses for November and December.
Field Assistant Wages	585	0	585	Field assistants will be hired from February onwards.
Dive Gear	425	409	16	1 BCD, 1 Regulator set, UW writing gear & Shipping.
Contingency	100	84	16	DAN Asia Pacific Dive Insurance.
Miscellaneous	0	53	-53	Additional expenses incurred: Wire fees (9.24), ATM fees (6.16) & Digital voice recorder (37.33)
Total	5980	1096	4884	

STATUS OF LAKSHADWEEP TUNA FISHERY

Traditional pole and line tuna fishing practised in Minicoy was introduced to the rest of the islands beginning in the 1960s. This technique is used to efficiently catch targeted sizes of skipjack tuna (*Katsuwonus pelamis*) in offshore waters surrounding the Lakshadweep atolls with minimal bycatch. Pole and line fishers catch small planktivores such as clupeids, pomacentrids, apogonids and caesionids, from reefs and lagoons and use these live-baits to chum for tuna in offshore waters. Tuna schools are sighted either by detecting feeding activity of seabirds or trolling for tuna. Upon finding a suitable sized tuna school, live baits are released into the water, which causes the tuna to go into a feeding frenzy. During this commotion, tuna are landed on the boat via the use of a pole with a hooked line. The landed tuna catch are brought back ashore, boiled, smoked and dried to produce a dried tuna product called *masmin*, a local favourite. This product is both consumed locally and exported to the mainland.

Today, tuna are harvested in Lakshadweep in three different ways: long lining, trolling and live-bait pole and line fishing. The fishery has been changing rapidly, especially since 2002 when Fish Aggregating Devices (FADs) were installed in offshore areas in Lakshadweep. Now fishing boats don't need to spend time locating tuna schools, they simply venture to the nearest FAD to catch tuna at day break. During the fishing season, as many as 60 boats can be found at a FAD on a given morning. These include long liners, trollers and pole and line fishing boats. The FADs have also reduced the need for live-baits, and fishermen have begun switching to artificial lures tied to the end of their pole and line hooks. From these FADs, fishermen catch skipjack of a variety of sizes along with yellowfin tuna (*Thunnus albacares*) and rainbow runners (*Elagatis bipinnulata*). Landed catch observed in Kadmat and Kavaratti islands consisted of many skipjack individuals that were under the size at first maturity (40 cm). Conversations with fishermen on Kadmat island have not revealed any concerns regarding baitfish resources, but this may not be the case in other islands where fishing pressure is higher. Fishermen seem more concerned with declining tuna catches and have attributed these changes to increased effort and changing oceanographic currents. Some have also noticed declines in catch since the establishment of the FADs.

Despite the changes, there are still numerous fishermen utilizing live baits in pole and line tuna fishing. The species used differs from island to island. In Minicoy, the fishery uses over 40 different species but in the islands that constitute a part of this study 2 main species of *Spratelloides* are used. These may be supplemented with others in times of scarcity.

Table 3. Main baitfish used in Lakshadweep tuna pole and line fishery including local name, method of harvest, area fished and time fished.

Baitfish Species or Group	Local Name	Method of harvest	Area	Time
<i>Spratelloides delicatulus</i>	Hondeli	Encircling net	Lagoon	Day and Night
<i>Spratelloides gracilis</i>	Rahi	Mid water trawl net	Reef slope	Day
Pomacentrids	Pachha Challa	Bottom set lift net	Coral heads in lagoon	Day
Apogonids	Bodi	Bottom set lift net	Coral heads in lagoon	Day

During the fishing season, November through April, active fishermen go tuna fishing almost on a daily basis. They have specially designed tuna boats that measure 10-13 m on deck and are fitted with water circulation tanks to hold live baitfish (Figure 2). Fishing trips begin at 3 am in the

morning when fishermen target *Spratelloides delicatulus* with torches and encircling nets in the lagoon. This may take anywhere from 45 minutes to 1.5 hours. Once they have sufficient amount of bait for the days tuna fishing they motor to the FAD, taking about 1.5 hours, getting there by day break to start fishing for tuna. If fishermen are unable to catch sufficient amounts of *S. delicatulus*, fishermen wait for sunrise to catch *S. gracilis*, pomacentrids or apogonids, thus delaying their arrival at the FAD to begin tuna fishing. Boats return to the island by 11am after which the process of boiling, smoking and drying the tuna begins.

Preliminary interviews with fishermen have helped us develop our questionnaire for the semi-structured interviews that we will be carrying out from February onwards. Our interactions have also highlighted the difficulty associated with fishery dependent catch monitoring. Researcher led monitoring is possible, but unfortunately is restricted to the handful of fishermen comfortable with letting a female researcher onboard, considering the odd hours and time spent at sea. Additionally, the lack of concern regarding baitfish populations may limit the number of fishermen interested in recording baitfish catch themselves. Nonetheless, attempts are being made in this direction.

As for tuna catch monitoring, the fishermen use logbooks provided by the fisheries department. This data is collected by the fisheries office as proof of active fishing and is required in order to get fuel at subsidized cost. Thus, as it's often the case, fishermen falsify numbers in order to get subsidized fuel. The ability to extend this to a community-based monitoring programme, one in which the resource users benefit, is being discussed with fishermen and fisheries officials.

Based on our interactions and review of fisheries department literature, other islands that may be of interest to this baitfish work are: Minicoy, Kalpeni and Bitra. Minicoy is the original and oldest pole and line fishery in Lakshadweep, and over the years it has evolved a fine scale management system to maintain healthy baitfish stocks. Kalpeni, a recent island (< 4-5 year ago) to start live-bait tuna pole and line fishing, may pose interesting baitfish population densities indicative of fishing pressure. Bitra is one of the main islands exploited by many Lakshadweep islanders, fishermen from around Lakshadweep, mainly Agatti, Kiltan and Chetlat set up camp on Bitra to fish the nearby shallow banks (Chereapani and Beleapani) that otherwise would have been too far to access. If possible, trips may be undertaken to these islands to assess the status of the fishery as well as help inform Dakshin Foundation of future directions of community-based conservation in the Lakshadweep archipelago.

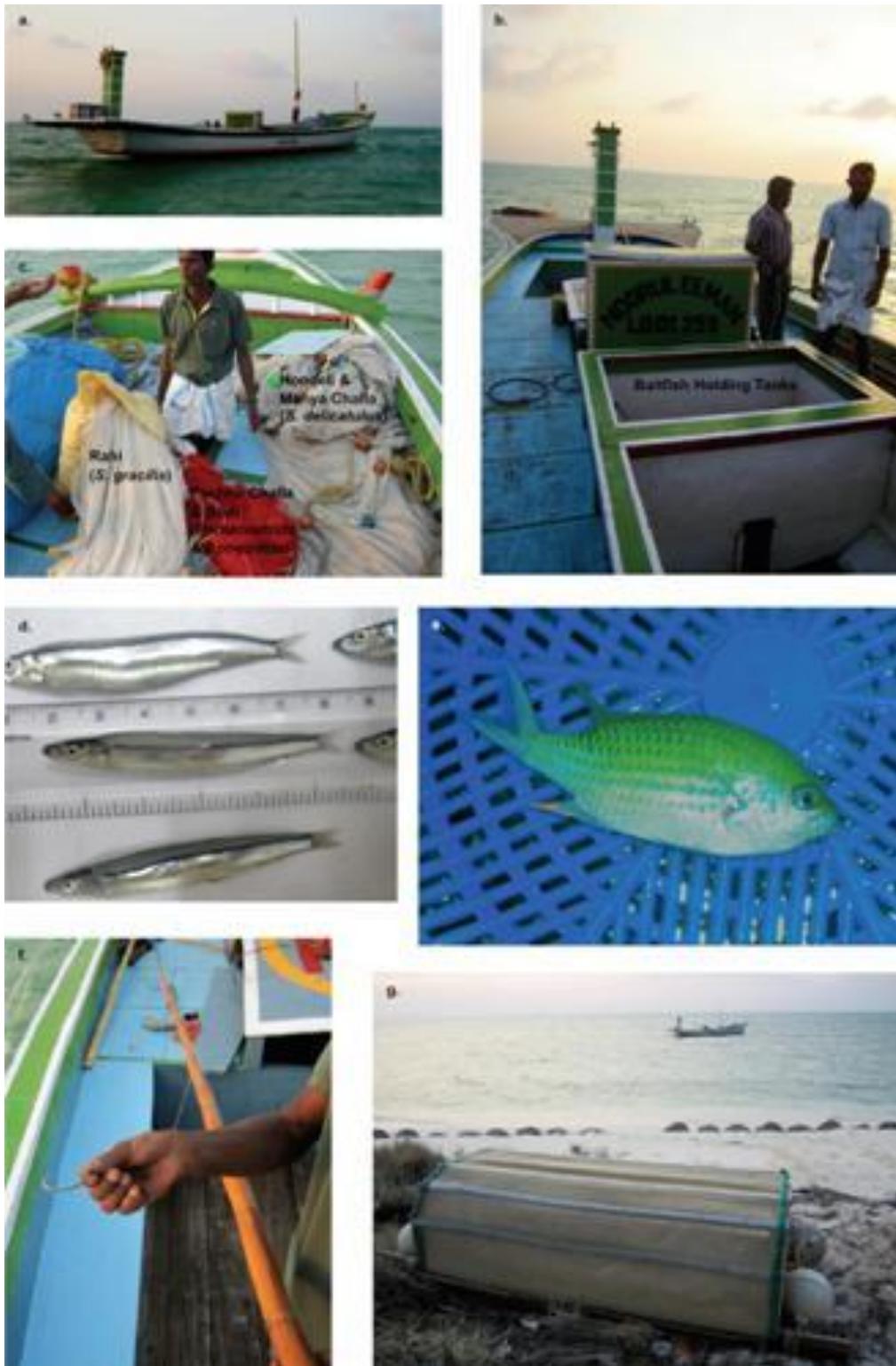


Figure 2. Live-bait pole and line tuna fishing in Lakshadweep islands, India; a) Agatti tuna fishing boat F.V. Noorul Eeman, b) On deck of Noorul Eeman showing baitfish holding tanks, c) Boat captain, Mr. Abdul Naseer, displaying three different nets used to catch different species of baitfish, d) “Rahi” or *Spratelloides gracilis* used as tuna live bait, e) “Pachha Challa” or *Chromis viridis* used as tuna live bait, f) Pole and line with special hook used in live-bait tuna fishery and g) In-water holding tank for baitfish for overnight storage. (Photo credit: Mahima Jaini)

FISHERY INDEPENDENT BAITFISH POPULATION ASSESSMENT



Figure 3. School of *Pterocaesio tile* observed off the reef in Kadmat. (Photo credit: Anne Heloise Theo)

In-water estimation of planktivorous fish poses problems due to their small sizes and highly variable nature. Over the last month I have familiarized myself with the species used as baitfish in Lakshadweep and calibrated my underwater identifications and size estimations. The small silvery fish (sprats, silversides, herrings, sardines and anchovies) are difficult to distinguish underwater and require more fine scale observation. An attempt is being made here to distinguish these species underwater based on swimming and schooling behaviour, size and habitat.

The species sampled for this project belong to the following families: clupeidae, engraulidae, atherinidae, caesionidae, pomacentridae and apogonidae, each differing in habitat and behaviour. Based on observations of these species different protocols have been established to quantify their abundance on the reef and in the lagoon.

Table 4. Sampling protocols for assessing baitfish populations on the reef and in the lagoon. The two reef sampling methods are devised to determine the optimal method for sampling planktivores on reefs. Whereas, the two lagoon methods target two different groups – residents and migratory species.

Region	Sampling Method	Baitfish families recorded
REEF	60 minute timed swims observing species within 10m of diver ((8-12m deep)	Mainly caesionids, pomacentrids and apogonids but also clupeids, engraulids, atherinids
	Three 50m x 10m transects at beginning of the reef slope (8-12m deep)	Mainly caesionids, pomacentrids and apogonids but also clupeids, engraulids, atherinids
LAGOON	5 minute point counts around coral heads	Mainly pomacentrids and apogonids but also caesionids
	Fifteen 50m x 5m timed swims	Mainly clupeids, engraulids, atherinids but also caesionids

Due to the high variability in the distribution and abundance of the small planktivores in the lagoon (mainly the clupeids), a preliminary survey of thirty-three 50m timed swims was conducted. For each transect the snorkeler noted the species, size and number of pelagic planktivorous fish that swam within 2.5 m distance on both sides of the observer. The data was grouped cumulatively at different sample sizes starting at two and going up to 33, and the

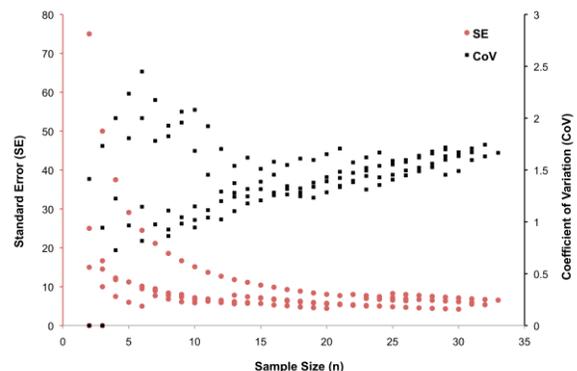


Figure 4. Change in SE and CoV with increasing sample size for clupeid densities observed in 50m x 5m timed swims.

standard error (SE) and coefficient of variation (CoV) were calculated for both. A bootstrap was applied to the transect data to generate 5 different levels of replication for each sample size ranging from two to 32. The SE and CoV were plotted against sample size to determine the optimal sampling size for lagoon transects (Figure 4). The data showed immense variability and CoV did not show signs of reduction with increased sampling effort. But, beyond a sample size of 15, the SE showed minimal reduction despite greater sampling effort. Thus, n=15 was determined as the optimal sample size for lagoon 50m x 5m timed swims to record small pelagic planktivores (clupeid, engraulid and atherinids).

Currently, the baitfish population assessment for Kadmat islands is underway. Assessments on Agatti and Kavaratti are planned for February.

OTHER AREAS OF INTEREST

The Lakshadweep archipelago poses an interesting system to study. Currently it is connected to the mainland in limited ways, keeping its natural marine resources relatively protected from external markets. Recently the development corporation has initiated the instalment of ice plants in almost all the islands. This may lead to changes in reef and oceanic exploitation rates especially if complemented with subsequent improvements in air and ship connectivity with the mainland.

Other than the commercial tuna and shark fishery, recreational fisheries dominate the islands. Subsistence fishing on the reef is a common and widespread practise. During spring tides, one can observe a diverse array of community members searching the intertidal reef for octopus and cowries. Octopus meat is considered a delicacy and is prized by the islanders. Where as, cowries are collected for sale on the mainland due to their ornamental value. A community-based monitoring programme targeting these species has the potential of involving a wide variety of community members. Outreach programmes educating the community about these species maybe one way of getting them involved.

SUMMARY

Steady progress has been made in the field over the course of the past two months. Currently, the focus is to wrap up ecological sampling on Kadmat, initiate work on Kavaratti and Agatti and subsequently conduct surveys of fisher perspectives. Information regarding the dynamics of the live baitfish tuna fishery will be gathered via surveys of fishermen and fishery officials. Keeping up this momentum we hope to accomplish the primary tasks proposed in the RSG proposal by May 2013 before the onset of the southwest monsoon. The secondary goal of establishing a community-based baitfish monitoring programme may be redefined as informed by our social surveys.