Island Sustainability Pathways: Towards participatory fisheries governance in the Lakshadweep Islands

Project Report

January 2020

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Introduction

Social-ecological systems are complex, characterized by human communities that rely on natural systems for their lives and livelihoods. There exist many examples of social-ecological systems in marine and terrestrial realms across different geographical regions of the world. The Lakshadweep archipelago off the west coast of India is one such example.

These islands are India's only coral atolls and are home to about 65,000 people (2011 census) that directly or indirectly depend on the reef and the ocean around them. The main fishery practised here - the live-bait pole and line tuna fishery targets resilient, oceanic skipjack tuna using small, planktivorous bait-fish in a low-impact, selective manner that diverts fishing pressure off the sensitive coral reefs that constitute these atolls. Additionally, being a labour-intensive technique it is one of the major sources of livelihoods for the local community in Lakshadweep. It may thus be one of the last remaining examples of a sustainable fishery in India.

Background to the fishery

Historically, the pole and line fishery has its origins in the Maldives. From the Maldives, this fishery came to the culturally similar Minicoy Island of the Lakshadweep archipelago about 200 years ago. In the rest of the Lakshadweep Islands, only artisanal fisheries targeting reef and other offshore resources existed, until the 1960s. It was only in the 1960s that the pole and line fishery was transferred from Minicoy to the other inhabited islands of Lakshadweep by the Fisheries Department along with the introduction of mechanization. Since then, this has been the major fishery practised in the islands. Worldwide, pole and line fisheries are considered to be best-practice fisheries as they target the highly resilient, surface-schooling skipjack tuna, have little to no by-catch of non-target species and cause no damage to the marine habitat.

A pole and line fishing operation typically consists of two components, baitfishing followed by tuna fishing. Baitfishing is done in the lagoons and reefs surrounding the island whereas tuna fishing is an offshore activity. The baitfish are captured using nets and kept alive on-board the fishing vessels in circulatory holding tanks (Pic. 1a). After baitfishing, fishers head out to the open ocean in search of schools of tuna. Tuna schools are spotted by using natural indicators such as pelagic birds. Skipjack tuna (*Katsuwonus pelamis*) is the main target of this fishery, while other tuna species such as yellowfin tuna (*Thunnus albacares*), kawakawa (*Euthynnus affinis*), frigate tuna (*Auxis thazard*) and bullet tuna (*Auxis rochei*) are caught in

smaller quantities. On spotting a school of tuna, the speed of the boat is lowered and the live-bait is cast into the sea by hand, in small quantities, along the wake of the boat (Pic. 1b). This creates conditions similar to a pelagic feeding frenzy and triggers the tuna into following the boat. At the same time water is sprayed from water sprayers at the stern to create ripples that make it difficult to see the hooks from the fishing lines suspended in the water. 6-8 fishers standing on a platform at the stern with wooden poles and lines are then able to hook these hungry tuna following the boat. The use of barbless hooks enables easy unhooking of the tuna by a quick jerk of the hand. In addition to locating free-swimming schools of tuna in the open ocean, over the past decade fishers have also had the alternative of fishing at Fish Aggregating Devices (FADs). FADs are artificial structures that help attract and concentrate pelagic species such as tuna in one place thereby reducing the time and fuel spent on fishing (fishing effort) and providing a certain surety of catch. While FADs can thus increase fishing efficiency, they can also lead to catches of undersized individuals of large tuna species such as yellowfin tuna. Sustained removal of juvenile fish from the population can potentially affect yellowfin stocks in Lakshadweep.

Picture 1. a. Baitfishing for sprats using encircling nets in the lagoon; b. Offshore live-bait pole and line fishing operation.

While a small amount of pole and line caught tuna in Lakshadweep is kept aside for fresh sales or consumption, the majority is converted to a specialized indigenous product called *masmin*. After landing, tuna are filleted, boiled in brine, smoked and then thoroughly sun-dried (Pic. 2). This entire process of making *masmin* takes about 2 weeks. Majority of the *masmin* is exported from the islands to mainland India, in particular to Tuticorin, from where it is further exported to Sri Lanka. The fishing season in Lakshadweep lasts roughly from mid-September to mid-May.

Picture 2. a. Post-harvest filleting for *masmin*-making; b. The final product of the pole and line fishery – *masmin*.

Today, fisheries in Lakshadweep are on the brink of change. Large scale expansion plans to exploit the resources to their maximum potential are being chalked out. Besides, factors such as rising prices, low financial returns from *masmin* and difficulties in finding adequate amounts of baitfish, are posing operational challenges to this fishery and threatening a gradual shift from an offshore tuna fishery to an export-based reef fishery. Such a transition could compromise the health of the very coral reefs that constitute these atolls.

The pole and line fishery is the one link in the overall Lakshadweep scenario that is integral to the ecological and socio-economic stability of this archipelago. Dakshin Foundation's focus in Lakshadweep since November 2012 has, therefore, been on strengthening the pole and line fishery to ensure sustainable livelihoods while preserving marine biodiversity. The islands chosen for our work are Agatti, Kavaratti, Kadmat and Minicoy.

The broad objectives of our work in the Lakshadweep Islands are –

- To institute systems for monitoring of fishery resources that are long-term, participatory and cost-effective
- To conduct interdisciplinary research on crucial aspects of Lakshadweep's fisheries to generate knowledge and fill data gaps in order to inform sustainable fisheries management interventions
- To work collaboratively with the local fishing community, government agencies and other stakeholders to create a platform for co-management of fisheries

Over the years, our work has covered a broad spectrum of disciplines and approaches such as baitfish ecology, fishery economics, stakeholder dynamics, community-based fisheries monitoring, documentation of fishers' traditional ecological knowledge, developing contextualised community outreach materials and launching a fisheries co-management initiative. This document is a compiled report of Dakshin Foundation's work in the Lakshadweep Islands, highlighting chapter-wise the major focal areas of our research and interventions.

o Ecological assessment of baitfish populations

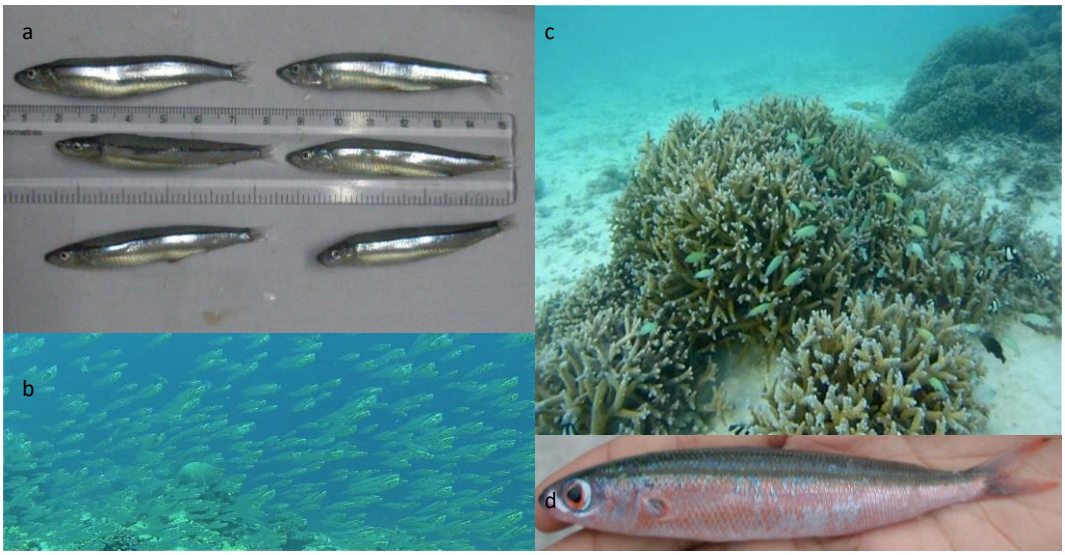
One of the major resource inputs as well as limiting factors in pole and line fisheries is baitfish. The International Pole and Line Foundation (IPNLF) in 2012 estimated the average annual quantity of baitfish required to meet global pole and line fishery demand to be 25,000 tonnes. In Lakshadweep, previous studies on baitfish have described commonly targeted species and families, harvest techniques and inter-island differences in baitfish preferences. The different families targeted vary considerably concerning their biology, life history, habitat preference, harvest methods etc. (Table 1, Pic. 3), but are all plankton-feeders and usually occur in large schools. Being planktivorous fishes from lower trophic levels in the marine food web, they are generally fast-growing, early maturing and more in numbers as compared to predators. Planktivores often constitute the natural diet of predatory fish such as tuna.

Table 1. Names of the main species and groups targeted for baitfishing; methods and locations of fishing.

Baitfish species/groups	Family	Local Name (Minicoy /Other islands)	Method	Location
Spratelloides delicatulus	Clupeidae	*Hondeli/Hondeli*	Encircling net	Lagoon/ Reef
Spratelloides gracilis	Clupeidae	*Rahi/Rahi*	Encircling net	Reef
Chromis viridis	Pomacentridae	*Nila mahi/Nila mahi & Pachha challa*	Lift net	Lagoon
Apogons	Apogonidae	*Bodhi*	Lift net	Lagoon/ Reef
Fusiliers	Caesionidae	*Mukuram/ Dandi & Pachha challa*	Lift net	Lagoon/ Reef
Silversides	Atherinidae	*Phitham/Madam challa*	Encircling net	Lagoon

Minicoy Island, from where this fishery was first brought to the rest of the Lakshadweep is known to have several traditional management systems in place for the sustainable utilization of baitfish resources. Unfortunately, when this transfer

took place, only the technology got transferred and not the associated traditional management practices prevalent in Minicoy. Minicoy utilizes a wider variety of baitfish species as compared to the other islands that preferentially target *Spratelloides delicatulus and S. gracilis*. The practice of harvesting *S. delicatulus* at the time of spawning (*Manja challa*) has exacerbated the fishing pressure on its stocks. As a result, the pole and line fishery that had sustained itself with locally available baitfish stocks for decades is now finding it increasingly difficult and time-consuming to catch baitfish in sufficient quantities. Increased competition among fishers is also leading to newer, potentially unsustainable practices such as fishing for *S. delicatulus* in the night assisted with LED lights. Inherent difficulties in quantifying baitfish catch make it difficult to estimate the optimal amounts of baitfish required for a single pole and line fishing trip, thereby leading to over-harvest and subsequent wastage of baitfish resources.



Picture 3. Commonly used baitfish species in Lakshadweep – a. Sprats – *Spratelloides* spp. b. Apogons c. Green chromis – *Chromis viridis* d. Fusiliers.

Existing knowledge on the subject and interactions with fishers suggest that baitfish stocks are on the decline due to high fishing pressure or due to the impacts of larger global environmental phenomena or a combination of both. Our work in Lakshadweep attempts to understand the status of baitfish populations through long-term, fishery-independent, in-water monitoring of baitfish populations.

We launched the first round of in-water surveys of baitfish populations in December 2012. Our primary sampling approach has consisted of snorkelling-based lagoon

surveys and SCUBA-based reef surveys and over the years it has yielded insights on the densities of different baitfish species and their temporal variations. For example, in the 2015-2016 season, we observed a declining trend in the lagoon sprat and silverside baitfish for most islands, with Kavaratti showing no small silvery baitfish in the 60 odd transects laid in April of 2016 (Fig. 1). Minicoy showed a marginal recovery in these baitfish densities in March 2016 albeit with high error terms (Fig. 2). We were also able to detect island-wide differences in sprat and silverside lagoon densities which may be related to island wise differences in baitfishing pressure and local management practices. Kavaratti Island has most frequently been surveyed and our surveys over the years have shown site-specific temporal differences in the densities of baitfish (Fig. 2).

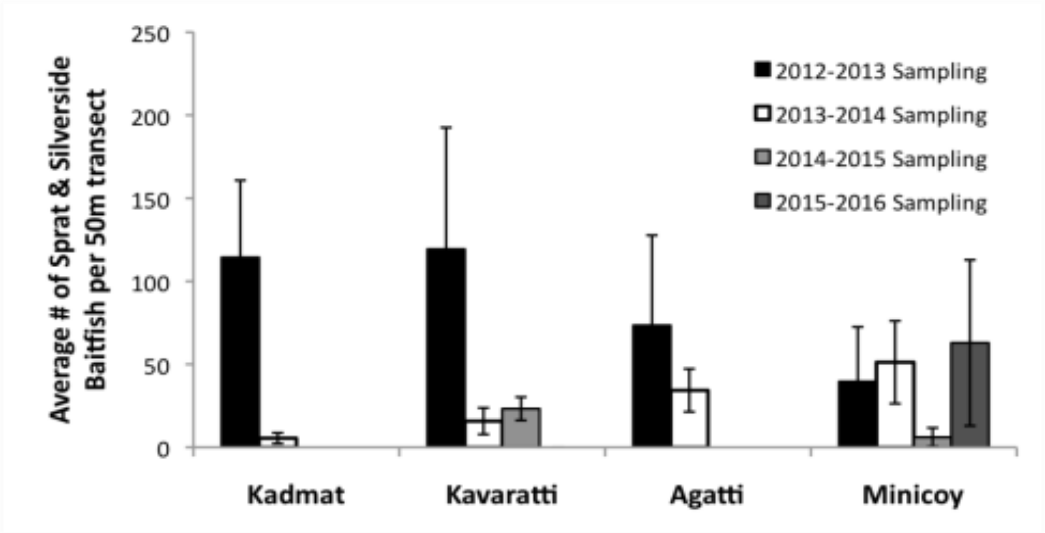


Figure 1. Average annual densities of sprat and silverside baitfish (*hondeli*, *rahi* and *madam challa*) observed in snorkelling based 50 meter lagoon transects. Agatti & Kadmat were only sampled in the first two seasons. Islands arranged in order of increasing fishing pressure. Error bars indicate ±1 S.E.

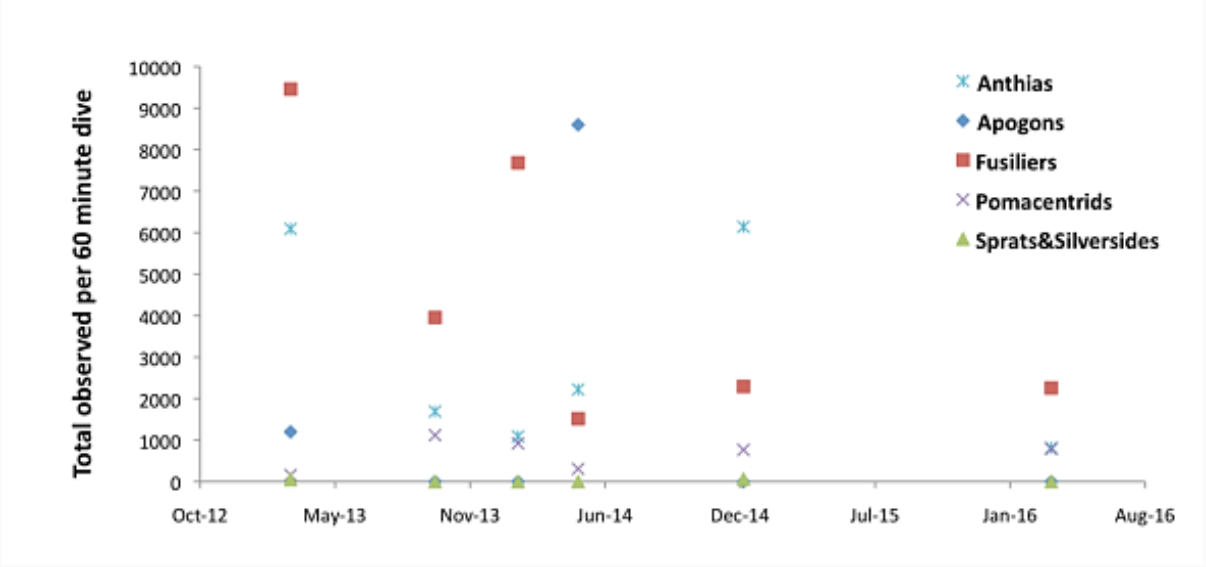


Figure 2. The total number of anthias (*bureki*), apogons (*bodhi*), fusiliers (*mukuram*), pomacentrids (*Nilamahi*) sprats and silversides (*hondeli*, *rahi*, or *madam challa*) observed at a particular Kavaratti reef sampling site (3 fusiliers) in 2012-2013, 2013-2014, 2014-2015 and 2015-2016 season.

On the whole, our initial surveys suggest a declining trend in baitfish populations in the lagoons and reefs. Supplementary data on environmental metrics of lagoon and reef sites can help further tease apart drivers of baitfish population variability in addition to island wise differences in fishing pressure. The preliminary results highlight potential anthropogenic and environmental drivers of baitfish population dynamics. However, long-term monitoring of batfish is necessary to better manage the fishery by employing diverse baitfishing practices, seasonal rotations, and conservation of spawning stocks.

While the first round of baitfish surveys has provided some insights, it has also revealed challenges and inherent difficulties in surveying small pelagic fishes such as baitfish which pose hurdles to the accurate estimation of baitfish abundance and understanding patterns in baitfish populations over space and time. Recognizing these limitations, we are currently in the process of reassessing and revising our survey protocols such that they are simple, scalable and cost-effective. Once such protocols have been developed and tested in the field, we hope to work closely with the local diver community in Lakshadweep and initiate a community-based in-water baitfish monitoring programme to ensure that data is collected regularly at larger spatio-temporal scales.

o Community-based fisheries monitoring

Monitoring of fisheries is important to all the stakeholders i.e. fishers, scientists and policymakers for understanding changing fishery trends and for decision-making around sustainable resource management. Comprehensive fisheries monitoring is a mammoth task that involves collection of large amounts of data on ecological as well as socio-economic parameters, over a long period of time. Conventional, research-led monitoring is often limited by logistical hurdles such as manpower and funding. Community-based monitoring is a relatively unconventional approach that involves local communities in monitoring of the resources that they depend upon. As local fishing communities interface with the ocean on a day-to-day basis, involving them in monitoring provides a platform for cost-effective data generation on a much larger spatial and temporal scale as compared to researcher-led monitoring. Additionally, regular monitoring enables fishers, who are the primary stakeholders in the fishery, to see patterns in resource availability and can also create a sense of stewardship towards the environment in their minds. This is all the more relevant for data-scarce systems such as the Lakshadweep Islands.

Picture 4. Initial meeting held in Agatti to gauge the feasibility of a community-based monitoring programme and design the monitoring datasheets with community input.

Our community-based fisheries monitoring (CBFM) programme is aimed at involving the local fishing community in Lakshadweep in long-term monitoring of the pole and line fishery. During our initial interactions with the community, fishers expressed interest in being part of such an initiative. Logbooks for community-based monitoring were co-created with the fishers before the launch of the programme. Thereafter, the programme was initiated in January 2014 in the islands of Agatti, Kadmat and Kavaratti and was expanded to include Minicoy in January 2015 (Pic. 4). Following an internal status survey in 2016, the monitoring logbooks were modified based on feedback received from fishers.

Over the years, the programme has taken root in the project islands and is growing in size as we continue our interactions with the community. The programme has demonstrated the ability to function as a platform for two-way sharing of knowledge on crucial aspects of the fishery such as catch and effort trends over time, spatial coverage of fishing grounds, inter-island differences in fishing strategies, presence of outside boats in Lakshadweep waters and dependence of fishers on Fish Aggregating Devices (FADs). Till date, a total of 50 boats have contributed to this community-generated dataset spanning 4037 fishing records, demonstrating the potential of local communities to engage with fisheries monitoring and generate valuable data on crucial aspects of Lakshadweep's fisheries. Interactions with participating fishers reveal that the regular, detailed and long-term monitoring helps them plan their day-to-day fishing trips better.

This programme envisages the democratization of knowledge by fostering community participation in knowledge creation. Some of the key results from this programme that showcase the kind of data that fishing communities can collect and their implications for fisheries management have been highlighted below. It is to be noted that the sample sizes for different analyses and even for components within them vary considerably and have been specified. To standardize comparisons between different islands or parameters, values have been expressed either in terms of percentages or averages, as appropriate. The averages expressed are per day per boat while the percentages have been calculated based on the total number of records available in the dataset for the given variable. As this community-generated dataset grows, it will be possible to carry out detailed analyses with higher sample sizes and precision leading to a finer understanding of fishery dynamics.

Baitfish utilization

Our primary focus in Lakshadweep has been on baitfish resources which are critical limiting factors in island fisheries, particularly the live-bait pole and line tuna fishery. Our CBFM programme has been able to capture trends in baitfish utilization across islands (Fig. 3)

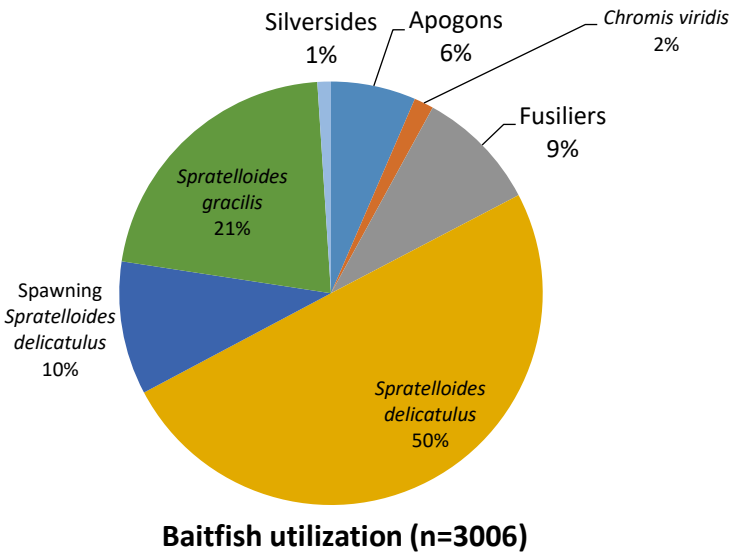


Figure 3. Baitfish utilization pooled across islands. Calculated based on the total number of available records for each species in the dataset. Numbers in brackets indicate sample size.

Sprats are the most commonly preferred and targeted species in the islands, followed by fusiliers. This corroborates with current fisher perspectives on declining baitfish stocks, especially of sprats. The targeted harvest of sprats, particularly *Spratelloides delicatulus* at the time of spawning i.e. *Manja challa* is a matter of grave concern. Additionally, potentially unsustainable practices such as baitfishing in the nights using LED lights need to be curbed. This practice is followed in some islands, particularly Agatti because of the increasing competition between fishers. As a result, *S. delicatulus* that usually spawns in the early hours of the morning does not get a chance to lay eggs and this can negatively affect stocks of this species. In recent times, the use of triggerfish as bait for catching yellowfin tuna has also started and needs to be monitored carefully in order to ensure that triggerfish stocks do not follow the same trajectory as the sprats.

A step further sheds light on island-level nuances (Fig. 4)

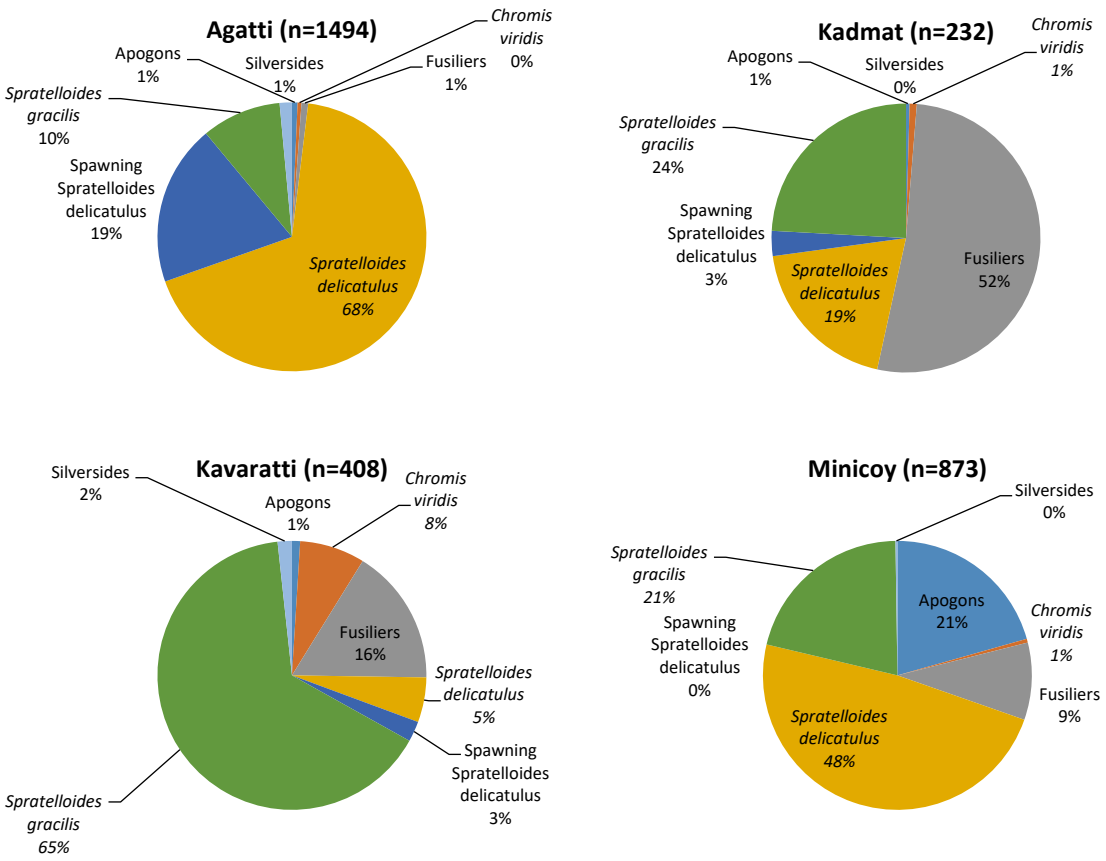


Figure 4. Inter-island baitfish preferences. Calculated based on the total number of available records for each species in the dataset. Numbers in brackets indicate sample size.

The differences in preferences and trends in baitfish harvest across our 4 project islands are evident. As per the dataset, Agatti fishers use the highest amount of sprats, particularly *Spratelloides delicatulus*, including spawning populations of *S. delicatulus*. In Kavaratti, *S. gracilis* is the most preferred baitfish species. In Minicoy and Kadmat, the pressure seems to be relatively more evenly distributed on the different species of baitfish harvested. Minicoy is the only island where Apogons (*Bodhi*) are substantially targeted in addition to sprats and fusiliers. This could be because of the existence of customary laws for species-specific management in Minicoy that regulate Apogon fishing during the breeding season in order to allow its stocks to recuperate. These laws also allot individual coral boulders or *Magao* to fishers for a given fishing season and thus put the onus of stewardship on the fishers themselves (interviews with key informants and fisherfolk; Hoon et al. 2003; Sivadas & Wesley, 2006). Such mechanisms need to be strengthened in Minicoy and replicated in other islands to ensure that there is adequate supply of baitfish for tuna fishing operations.

Differences between FAD and FAD-free fishing

Fish Aggregating Devices (FADs) are commonly used to augment catches in pelagic fisheries across the world. Their scale however, varies from place to place and ranges from artisanal to industrial. The rationale behind deployment of FADs is typically that they provide fishers a certain surety of catch while reducing the amount of time and fuel spent on fishing. In Lakshadweep too, tuna fishers resort to offshore FADs from time to time, whereas at other times they fish for free-swimming schools of tuna independent of FADs. Our community-generated dataset has been documenting the use of FADs and trends therein (Fig. 5-7).

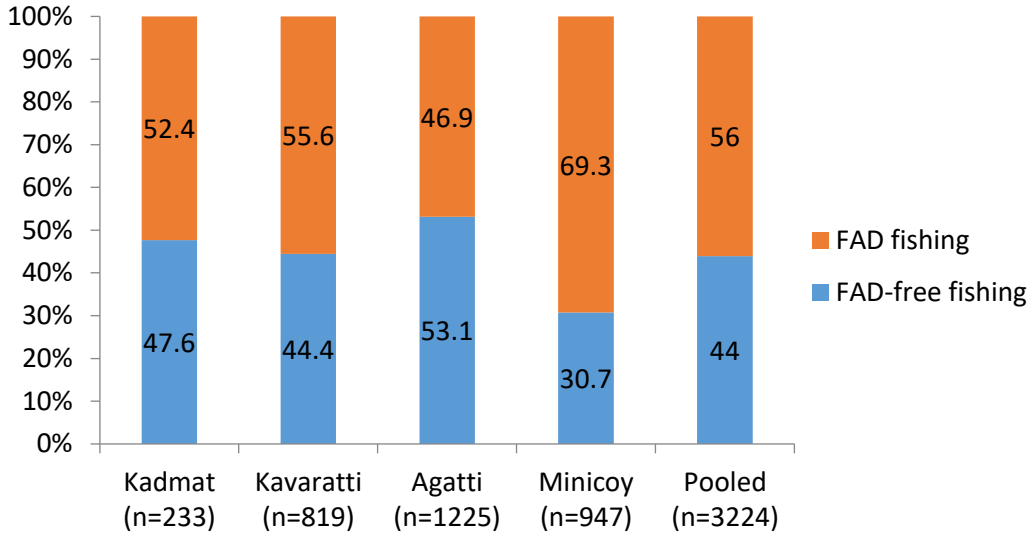


Figure 5. Island-wise and pooled trends in the relative frequencies of days fished at FADs versus days fished without FADs. Numbers in brackets indicate sample size.

Other than Minicoy, most other islands show an almost 50-50 proportion of FAD use, without a clear trend (Fig. 5). The reason for more focus on FADs in Minicoy is likely to be its geographical isolation from the rest of the Lakshadweep archipelago and the absence of other islands or fishing grounds close by. In other islands too, dependence on and use of FADs varies with factors such as time, season, availability of free-swimming tuna schools etc.

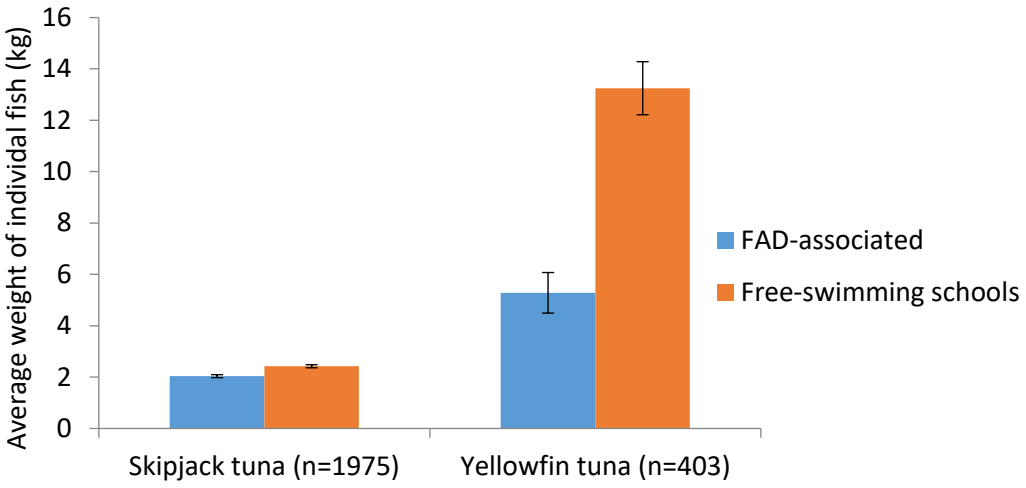


Figure 6. Differences in average weight of skipjack and yellowfin tuna caught at FADs and without FADs. Error bars indicate ± S.E.

Patterns in tuna catches and differences between the two modes of fishing viz. FAD-based and FAD-free are also visible in our dataset. Average size of both skipjack and yellowfin tuna (*Thunnus albacares*) is smaller at FADs as compared to FAD-free fishing (Fig. 6). This is of particular concern for yellowfin tuna stocks as they may be faced with the threat of growth overfishing. This aspect needs to be closely monitored, especially keeping in mind the fisheries development plans that aim to harvest the yellowfin resources of the Lakshadweep EEZ.

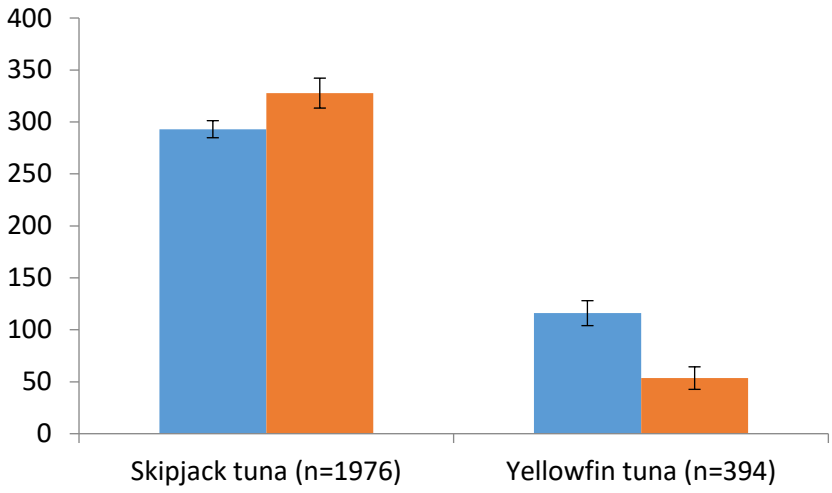


Figure 7. Differences in average numbers caught (per boat) of skipjack and yellowfin tuna at FADs and without FADs. Error bars indicate ± S.E.

In general, skipjack tuna catches are higher at FADs whereas yellowfin tuna catches are higher without FADs (Fig. 7). However, the differences are not very stark and can vary based on season and tuna availability etc. Fishers resort to FADs more when tuna availability is low, but in times of bumper catches such as the 2016-17 season, most skipjack tuna were caught from nearshore waters, without having to go to FADs.

Temporal patterns

This community-generated dataset has also revealed the potential of this approach to reveal temporal patterns in specific aspects of fisheries such as fuel consumption (Fig. 8).

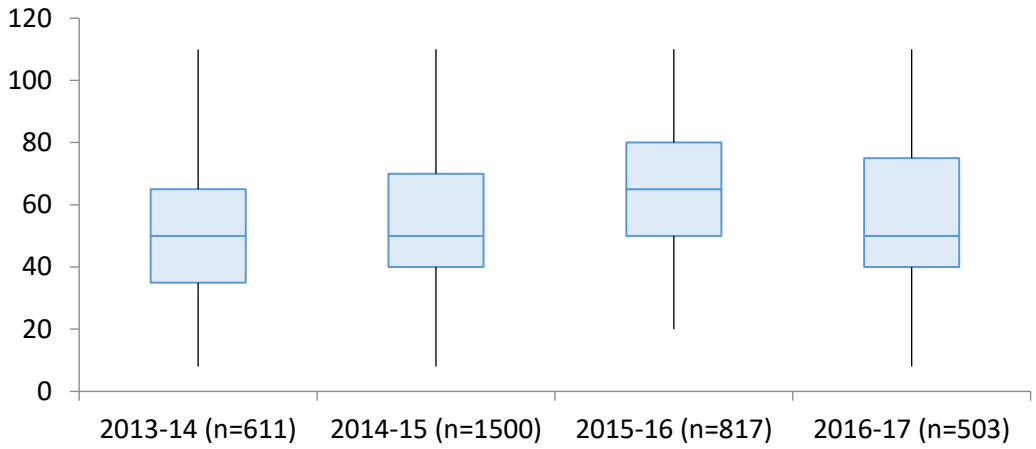


Figure 8. Season-wise patterns in daily fuel consumption per boat

Barring outliers, most boats consume around 50-70 litres of diesel per trip. Differences over time arise due to differences in tuna availability and distribution as well as the time and fuel spent searching for baitfish in the particular season. With more and more fishers building bigger boats with wheelhouses, the daily average fuel consumption is likely to go up.

Similarly, catch trends over time are also visible (Fig. 9).

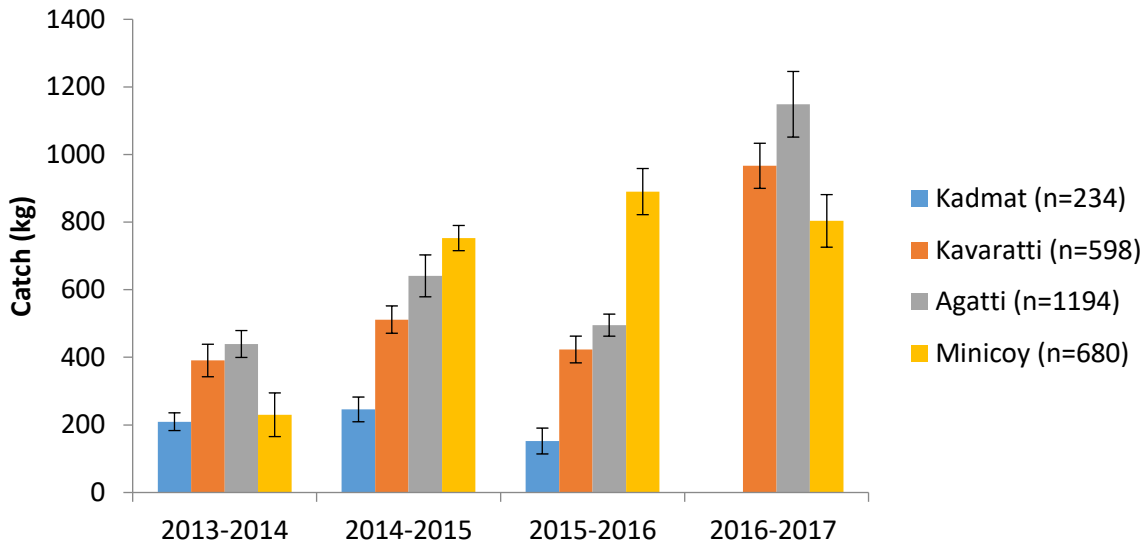


Figure 9. Island-wise and fishing season-wise daily average catch per boat

Daily average catches per boat have been increasing since 2013-14. The increase in 2017 can be particularly attributed to a bumper season for tuna catch. Additionally, more and more fishers are converting their tuna boats into bigger boats capable of multi-day fishing. These boats are more efficient, capable of staying at sea for longer and this might be another reason for an increase in average daily tuna catches. Such temporal patterns will get more and more accurate and informative as the programme grows in size and time. On the whole, the results demonstrate the value of community-based monitoring as a long term, large-scale and consistent data generating platform.

0 Mapping the *masmin* commodity chain

One of the major factors limiting the growth of Lakshadweep's pole and line fishery is considered to be the lack of proper market access. The majority of the tuna caught in Lakshadweep is exported as a specialized dried tuna product known as *masmin*. Fishers often complain of stagnating prices for this indigenous product. As a first step towards addressing market-related problems, we attempted to understand the dynamics of Lakshadweep *masmin* marketing by mapping its commodity chain in the 2014-2105 season. We conducted detailed interviews of pole and line tuna marketing agents (n=5) to better understand the fishery market dynamics. Semi-structured interviews were loosely divided into nine sections which provided information on the general tone, history of the trade, production costs, transportation and fate of *maas* after leaving the islands, price establishment, business structure, trade regulations, management and issues faced by the traders. The key findings from this short study were as follows -

A majority of the skipjack tuna in Lakshadweep is exported as *masmin* (>70-80%, key informant interviews). The major actors involved in the value chain and the trade route for *masmin* are local fishermen from the Lakshadweep Islands, traders/agents from Lakshadweep/Mangalore/Kochi/Beypore, exporters/wholesalers from Tuticorin, wholesalers, retailers and consumers from Sri Lanka and other countries (Fig. 10). The interview survey revealed that most traders are unclear about the fate and rate of *masmin* once they trade it to the next person. Based on our interviews, Sri Lanka appears to be the largest market for *masmin,* but smaller markets in Singapore and mainland India are believed to exist.

Traders noted that lack of infrastructure support (storage facilities, ice plants etc), increasing competition with mainland producers and rising costs are hampering their profitability. Traders and agents seemed open to changing the tuna product that is exported as long as the adequate commodity chain that ensures profits and traceability is established. Most fishers also agreed that the main problem with the pole and line tuna fishery is the markets and not the catch or production.

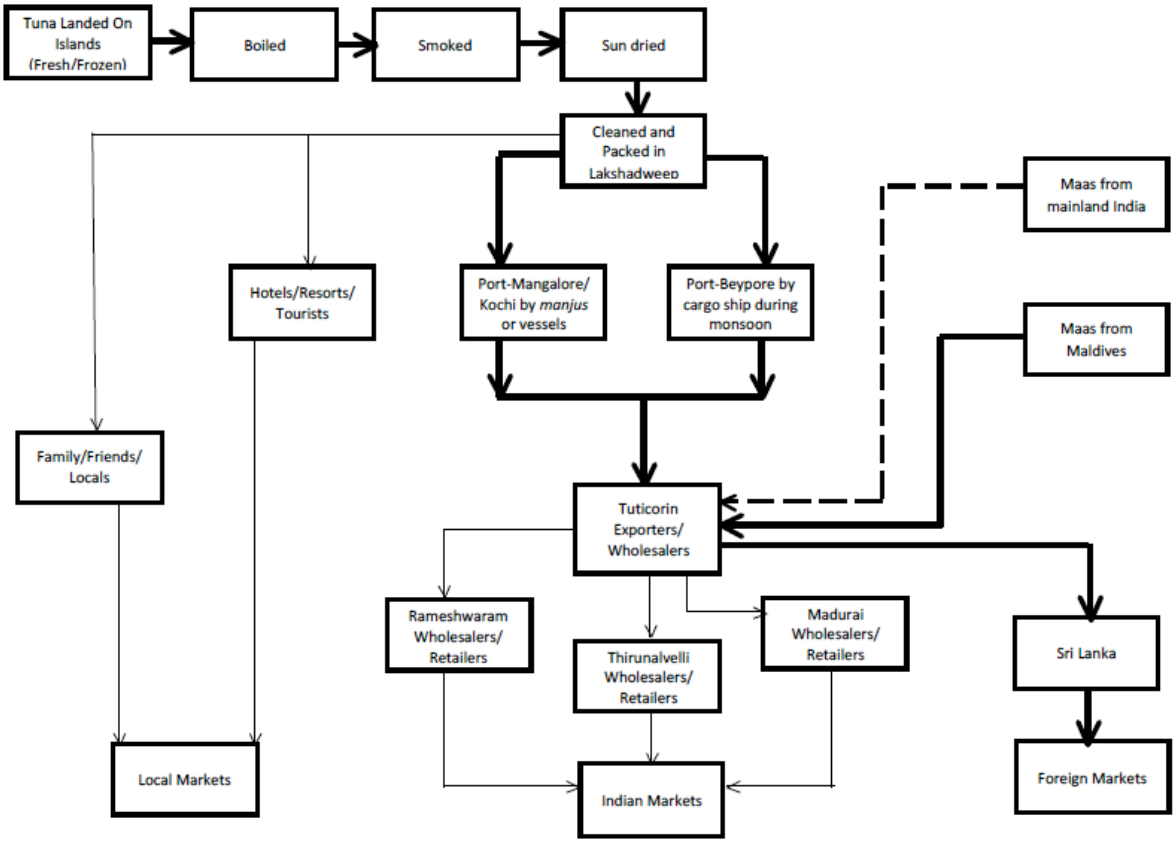


Figure 10. Commodity chain of the Lakshadweep tuna fishery based on semi-structured interviews of Lakshadweep *maas* agents conducted during the 2014-2015 season.

o Documenting traditional systems of governance, associated knowledge and usage of commons in Minicoy

Minicoy, the southernmost island of the Lakshadweep archipelago differs greatly in its historical and social-ecological context from the rest of the Lakshadweep islands. The people of Minicoy (*Minicoyans*) are unique in terms of their race, language and other socio-cultural-religious practices, which are similar to the Maldives. The language spoken in Minicoy is Mahl, which is a dialect of Dhivehi, the language of the Maldives. Minicoy is home to well-developed customary management regimes and a plethora of traditional ecological knowledge that have evolved over the years. Our work in Minicoy seeks to document these traditional systems of governance, the knowledge and practices associated with them. In addition to documentation, this work also aims to inform our immediate interventions regarding fisheries management on the island and to strengthen the existing systems of resource governance on the island based on a thorough understanding of the challenges facing them. A few key findings from this component have been highlighted below.

Customary institutions for the governance of fisheries

The *Jamaat* is a customary institution in Minicoy that has been formed explicitly for deciding rules and management practices related to fishery resources and fishing practices. These rules are framed on the basis of underlying traditional ecological knowledge that is transferred through generations and learned through experiences and direct observations. For example, there is a temporal ban on catching the baitfish *Bodhi* (Apogons) during its breeding season (May-September) and the *Jamaat* enforces this ban by imposing a fine on violators. The last three decades have seen the evolution of this *Jamaat* from a single authority known as the *Aarukkatti*, who is usually one of the most knowledgeable fishermen on the island, to a registered union known as the *Maliku Masverin Jamaat* which has a President, Secretary and other office bearers as mandated by the formal state laws.

Picture 5. A village house in Minicoy.

Customary institutions for the governance of land and other common resources

Another institution in Minicoy is the "village system" under which the populace of the entire island is divided into 11 villages, each headed by two Moopans and two Moopathis (i.e. male and female village heads respectively). The village houses, locally known as *Avah*, are responsible for the overall governance of land and resources that comes under the jurisdiction of each of these villages. Village assemblies, called *Baemedu* are attended by all the adult male members of the village. The word of the *Moopan* is held in high regard even now, with one Moopan looking after the external affairs and the other one dealing with internal matters. They also look after and administer the common properties like village boats, ponds, coconut trees and other spaces in a village. However, the role of the *Moopathi* is limited to festivals and other collective activities which involve women and young girls. They are in charge of keeping the common areas clean and carrying out all the post-harvest tuna processing work and the preparation of copra, coir etc.

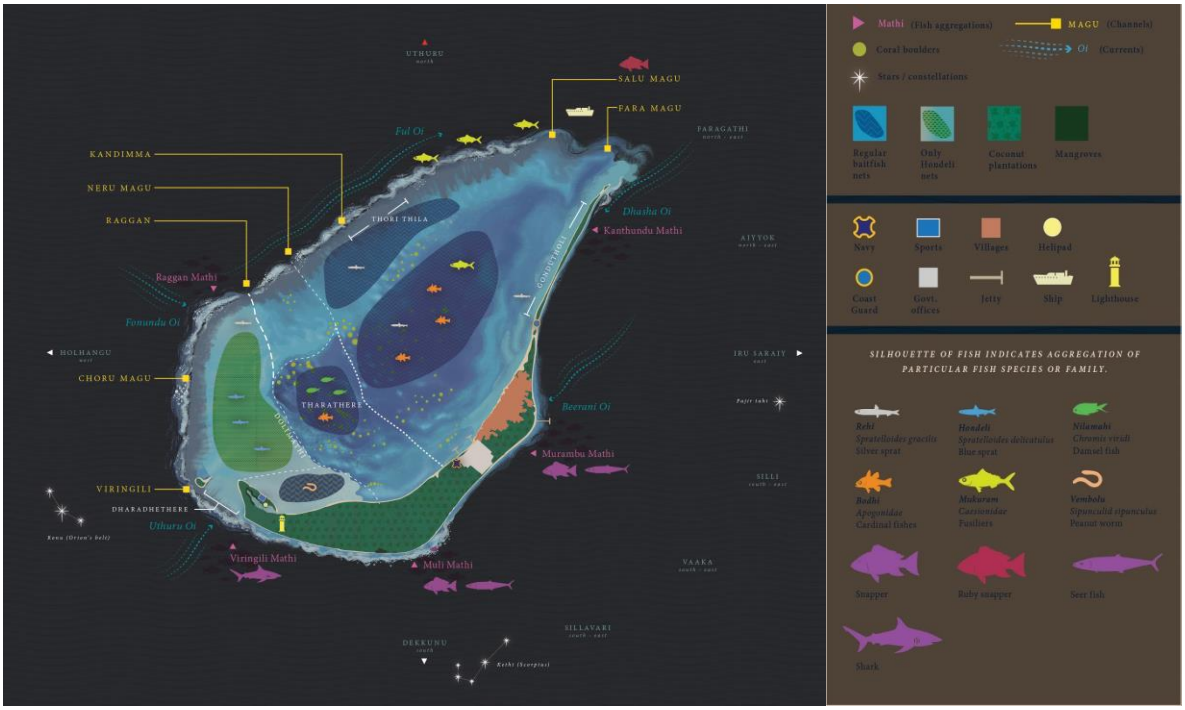
Challenges faced by the traditional governance systems

Through oral histories and detailed interviews with a total of 28 key informants and office-bearers of the above-mentioned customary institutions, our work (in progress) is documenting the current status of these systems and institutions as well as the challenges they face. While the village system and the *Jamaat* still wield considerable influence, a gradual sense of individual assertion can be observed, with a few cases of individuals moving away from the communal systems altogether.

Preliminary findings suggest that potential drivers for these are largely internal, aided by external factors such as increased exposure to the world due to improved communication technology. Locally, the lack of conscious efforts to pass on traditional ecological knowledge to younger generations has led to eroding knowledge systems and a subsequent disregard towards "custom". Consequently, efforts to register traditional institutions such as the *Jamaat* as "formal", legal entities have materialized in an attempt to reinforce their legitimacy.

Usage of commons – practices and their associated knowledge

Through interviews of fishers and other key informants, we were able to map the spatial distribution and usage patterns of marine commons in Minicoy (Pic. 6). The information generated through these interviews has been digitized and illustrated by a designer. Such community-generated maps can serve as a source of evidence and be a useful tool in safeguarding the Minicoy community's access rights to their traditional fishing grounds and common spaces.



Picture 6. Spatial distribution and usage pattern of marine commons of Minicoy.

The text below describes the information represented on the map -

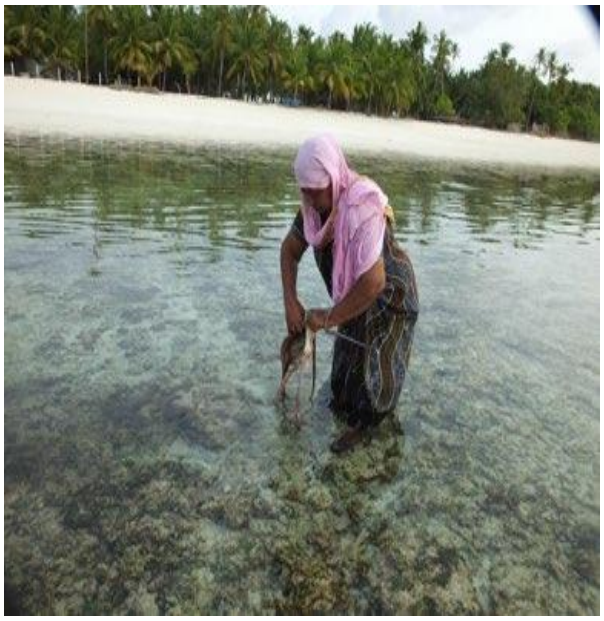
- Entrances: There are 7 lagoon entrances which the people of Minicoy have been traditionally using to venture out into the open sea. These entrances are natural channels formed on the reef among which the *Neru Magu* channel is the one

usually frequented by the fishermen as a shortcut to the open sea. Fishers keep aside a day every year before the fishing season begins, for collective cleaning of the *Neru Magu* channel.

- Currents and fish aggregation points: Fishers have extensive knowledge of the directionality and seasonality of the ocean currents which are known in Mahl as *Oi*. *Mathis* are fish aggregation points which are formed where currents meet the reef. For example, *Murambu Mathi*, *Muli Mathi* etc. However, the area constituting a *Mathi* can range from points near the reef to a few nautical miles from the reef. Some of the baitfish used in pole and line fishing such as fusiliers (known as *Mukuram* in Mahl) and other reef and pelagic fish are also caught from these *Mathis*. The *Minicoyans'* knowledge about the directions, currents and stars were of immense help to them during the days when traditional fishing boats (*Mas odi*) that were dependent on the winds were used and sophisticated tools for navigation were not available.
- Baitfish and the use of nets: Within the lagoon, there are areas designated for catching baitfish species like *Hondeli* and *Rahi* (sprats), which are caught with techniques that are entirely different from those employed to catch other baitfish species. They are usually caught from shallow areas in the lagoon where coral presence is comparatively sparse so that corals are not damaged while hauling the nets.
- *Magao*: *Magaos* are coral boulders that act as individual baitfish reserves. Each tuna fishing boat on the island selects and marks one *Magao* before the beginning of the fishing season, which is exclusively for their own baitfish collection. The *Magaos* of each boat are decided in a meeting attended by the owners and captains of all tuna fishing boats on the island. All the unclaimed coral boulders are open access. Clusters of coral boulders called *Thara* are the main breeding grounds for batfish e.g. *Tharathere* and *Dharadhethere*. Similarly, points like *Thori Thila*, *Gondutholi*, *Dolimathi* etc. are fishing grounds formed due to differences in the depth of the ocean. The names given to these points in Mahl convey the exact feature and terrain of the locations they represent.

o Documenting the traditional octopus fishery of Lakshadweep

In the past three years, in addition to our long-term engagement with pole and line fishery, we have expanded our reach to another subset of Lakshadweep's fishing community viz. the octopus hunters. The octopus fishery of Lakshadweep has traditionally been a small-scale, subsistence fishery, having only a small inter-island market. However, it is also the only fishing activity that involves women and this was one of the reasons we wanted to study this fishery further (Pic. 7). In a collaborative project with the Centre for Action Research on Environment Science and Society (CARESS), Chennai, and Blue Ventures, United Kingdom, we conducted a project to obtain a deeper understanding of the octopus fishery in these islands and the challenges it is facing.



Picture 7. A woman gleaning for octopuses in the intertidal reefs of Lakshadweep.

Similar to our larger community-based fisheries monitoring programme for tuna fisheries, we initiated community-based octopus fisheries monitoring, wherein octopus hunters recorded data about their catch and effort into logbooks. We also conducted interviews of octopus hunters to understand the octopus commodity chain and resource management issues, if any. In addition to the present, limited, inter-island market for octopus, we learnt that the octopus hunters believe that there is potential for the octopus market of Lakshadweep to reach mainland India. Given the very small scale of the fishery, no customary management practices for octopus resources currently exist, other than the closure on fishing activity during the month of Ramadan every year. However, octopus hunters recognize the need to collectively address issues like destructive hunting techniques that involve breaking corals and

improper waste disposal that negatively affects octopus as well as other fishery resources. We also carried out a rapid ecological assessment in Agatti to understand the optimal habitat conditions, for octopuses to thrive.

Picture 8. Training and capacity building workshop for community-based octopus fisheries monitoring for octopus hunters in Agatti.

Despite its small scale, the octopus fishery has areas of management concern that can be explored further. In addition to gathering baseline information about the octopus fishery, this study helped us forge new relations with other fisher communities of Lakshadweep, especially with the women. We plan to build on this network and continue with outreach and awareness activities for sustainable management of this fishery.

o Fish for the Future - Community Outreach Calendar Series

Since 2015, we have been producing outreach materials designed specifically to reach out to the local fishing community in Lakshadweep with a message of sustainable natural resource management. They also showcase the efforts of fishing boats actively participating in our community-based fisheries monitoring programme. While previous editions conveyed the key findings from our work in an illustrated form, the 2018 and 2019 calendar editions introduced concepts such as participatory governance, community-based management and fisheries co-management in simple language and using complementary artwork. The calendars are printed in the local languages Malayalam and Mahl, in addition to English. The calendars are well-received and distributed in all the inhabited islands.

Picture 9. Dakshin's Fish for the Future 2018 outreach calendars on display in public places in Agatti and Kavaratti.

0 Stakeholder mapping for planning co-management interventions

Fisheries co-management is envisaged as a platform for multiple stakeholders to engage and come up with sustainable and mutually acceptable solutions to local issues. As a first step towards this, we conducted a stakeholder mapping exercise to understand the fisheries ecosystem of Lakshadweep and the significant stakeholders therein, for effectively planning our co-management interventions in the islands.

Through interviews of key informants from our existing networks and snowballing further, we were able to get an overall picture of the key stakeholders in Lakshadweep's fisheries. Through these interviews, the exercise also tried to assess the capacities of different stakeholders and their perceptions regarding developmental needs at the local level. It also shed some light on the dynamics within stakeholders and the power centres in the community.

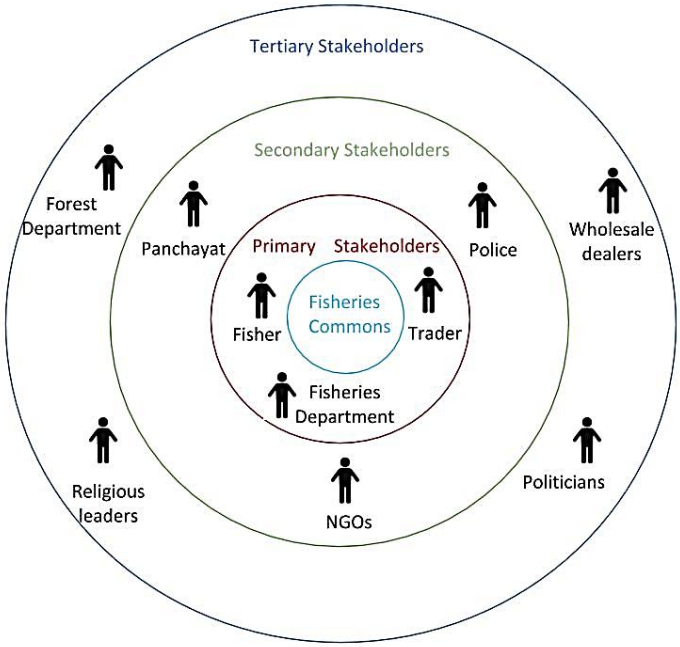


Figure 11. An infographic showing different stakeholders in Lakshadweep's fisheries ecosystem.

The stakeholder mapping exercise helped us understand the different constituents of the fisheries scenario ranging from fishers and traders to the fishery managers within the government and local politicians and leaders, their degrees of involvement and influence on fisheries (Fig.11). This understanding helped us plan our initial co-management interventions and community meetings

comprehensively. However, this is still a preliminary understanding and while it has been helpful, our continued engagement with the community over time keeps adding new layers to our understanding of the ground realities in Lakshadweep. In the upcoming seasons, we plan to build on this knowledge and get a more nuanced understanding of inter-stakeholder dynamics.

o Launch of fisheries co-management in Kavaratti, Agatti and Minicoy

Over the past two years, along with scoping activities, community mapping exercises and action research on various aspects of Lakshadweep's fisheries, interventions to create a fisheries co-management framework were also initiated. An introductory meeting with the Administrator, U.T. of Lakshadweep and the Lakshadweep Fisheries Department was held in May 2018. The year that followed involved a lot of community mobilization through one-to-one/group conversations in Kavaratti, Agatti and Minicoy which helped us understand the issues on the ground and also set the context for the planned interventions. In May 2019, Dakshin and the Fisheries Department launched a collaborative project on fisheries co-management in Lakshadweep. A total of 3 consultation meetings for the key stakeholders were held in Kavaratti, Agatti and Minicoy over May and June 2019 jointly with the Fisheries Department. A consultation could not be carried out in Kadmat, our other project site due to logistical limitations arising due to bad weather and expiration of entry permits, but we plan to do this at the next opportunity.

Picture 10. Fishers and governmental officials at the launch of the fisheries co-management initiative at Kavaratti Island.

The agenda for these meetings was as follows –

1) To introduce co-management as an approach to manage fisheries commons and touch upon its key concepts
2) To demonstrate co-management in action by facilitating a dialogue between the main stakeholders to discuss potential ways of addressing the current issues facing the baitfish fishery

3) To gauge the potential for community reserves to enhance baitfish populations

Picture 11. Stakeholders voting through a show of hands at the consultation meeting in Kavaratti, May 2019.

All 3 meetings were conducted in a consultative format with detailed discussion sessions for fishers and other stakeholders to express their views and concerns. The meetings were attended by boat owners and pole and line fishers from the above-mentioned islands, and other stakeholders such as representatives of the local Village (Dweep) Panchayat and the Dept. of Science and Technology.

A brief summary of the key discussion points and resolutions from these meetings is given below:

	Kavaratti	Agatti	Minicoy
Ban on light fishing	Fishers agreed to discontinue the practice.	Fishers asked for a post-meeting opinion survey of individual boat-owners. In the survey, the majority expressed the need to ban the practice.	Fishers agreed to discontinue the practice.
Regulation on the use of small-meshed nets	The need for regulation was not felt.	In the opinion survey, fishers expressed the need to regulate the practice.	Fishers agreed to phase out small-meshed nets in a period of one year.
Dumping of tuna waste in island lagoons	Fishers agreed to discontinue the practice.	In the opinion survey, fishers expressed the need to regulate the practice.	Not a major issue in Minicoy.

- The discussion on community reserves was preliminary at this stage, but the idea was well-received and can be revisited in the future.
- In addition to the meeting agenda, in Agatti and Minicoy, fishers themselves brought up the issue of illegal fishing in Lakshadweep waters as a severe problem threatening local livelihoods and sought redress for this through official means.

The meetings in Kavaratti, Agatti and Minicoy (Pic. 12) successfully brought the local fishers and decision-making agencies to the discussion table for a constructive dialogue on fisheries management. In the near future, we plan to leverage the momentum generated by this first round of consultations and follow up closely with fishers and the Fisheries Department to establish a resilient fisheries co-management platform in Lakshadweep.

Picture 12. Stakeholder meetings in Minicoy, Agatti and Kavaratti.

Conclusion

Our interdisciplinary research and interventions over the past few years have paved the foundation for a co-management framework in the Lakshadweep Islands. This was enabled by the strong networks formed with the local fishing community as well as with the local administration in Lakshadweep over the years. The first round of community consultation meetings for fisheries co-management in Kavaratti, Agatti and Minicoy was very well-received. The fishers of Lakshadweep have demonstrated the potential and expressed interest in taking collective action for participatory and equitable fisheries governance. However, this is just the first step. Long-term and sustained engagement with the fishing community as well as other stakeholders is needed to take these interventions forward. Going forward, we plan to build upon the foundation created thus far and conduct research and interventions that are holistic and solution-oriented. Our work has evolved, since its inception in November 2012 and continues to evolve based on our interactions with the local community and various government departments in Lakshadweep. In the future too, ensuring the sustainability of fisheries in Lakshadweep in order to balance conservation needs along with livelihoods, will be the core focus of our work.

Acknowledgements

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Photographs and Illustrations

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