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DARWIN INITIATIVE

A Report for

PROJECT ORATSIMBA

A Baseline Socioeconomic Assessment of Lobster Fishing Communities in Southeast Madagascar

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1   Executive Summary

Since 2013, Project Oratsimba has supported impoverished small-scale lobster fishing communities in southeast Madagascar to establish Locally Managed Marine Areas (LMMAs). At the beginning of Phase III, a baseline socioeconomic assessment was conducted in three target and three control communities. Data was collected related to project progress indicators primarily to assess household poverty levels but also included involvement in unsustainable livelihood practices, knowledge of national and local fisheries regulations and involvement in fisheries management decision making. 553 households were surveyed between January and March 2019. In all communities, more than half of households surveyed were involved in lobster fishing and hand-woven pots were the most common gear reported. Whilst lobster fishing was the primary source of income for the majority of lobster fishing households, it was not the only source of income and there was evidence of livelihood diversification. Sea fishing for other target species, weaving and farming were commonly reported supplementary livelihoods. Using the Basic Necessities Survey Methodology (Wilkie, Wieland, & Detoeuf, 2015), 100% of lobster and non-lobster fishing households surveyed were below the locally defined poverty level. In all communities, fishing households had a higher Poverty Index and thus were wealthier than non-fishing households suggesting that lobster fishing plays a role in poverty alleviation in the Anosy region of southeast Madagascar.

Contents

2   Introduction

Across Madagascar, where 70.7% of the population live below the $1.90 international poverty line (UNDP, 2018), small-scale fisheries play a significant role in food security and poverty alleviation (Barnes-Mauthe, Oleson, & Zafindrasilivonona, 2013). Lobsters are the target species for small-scale fisheries in the southeast region of Anosy and catch from this regional fishery accounts for the majority of the country's lobster catch and export (Sabatini, Salley, & Ramanamanjato, 2007). Lobster fishing is a livelihood with few barriers to entry and is an important economic activity in Anosy, providing a vital income source for approximately 40 coastal communities (Long, 2017).

Artisanal fishers use traditional methods to catch lobsters; using hand woven vine lobster pots deployed from wooden dugout canoes (*pirogues,* Figure 1) for which spiny lobsters (*Panulirus spp.)* account for the majority of the catch. Once landed, lobsters are purchased on the beach, either by *rabbateurs,* who are employed by *collecteurs* (intermediaries), or directly by the *collecteurs* themselves*. Collecteurs* then transport lobsters to the regional capital of Fort Dauphin and sell them to merchants, who process the lobster for local and national markets, as well as international export. Empirical and anecdotal evidence suggest that declines in the regional stock are attributed to increased fishing effort, driven by rapid population growth and export market demand (Holloway & Short, 2014; Long, 2017; Sabatini et al., 2007). Despite declines in catch, the high economic value of lobsters, coupled with a lack of viable alternative livelihoods, compels fishers to continue fishing (Long et al., 2019).

Figure 1. Fishers in a *pirogue* returning to the landings beach.

SEED Madagascar (SEED) has been working in the Anosy region for more than 15 years across health, education, conservation and livelihoods projects. Since 2013, this has included Project Oratsimba, a community-based sustainable fisheries management project supporting communities to establish and manage LMMAs. Project Oratsimba began in Sainte Luce and Phase I (June 2013 to March 2014, funded by FAO's Smartfish) supported the establishment of a community-elected fisheries management committee, a periodic No Take Zone (NTZ), cross-visits to other LMMAs and joining MIHARI, Madagascar's LMMA network. Phase II (October 2014 to July 2016, funded by FAO's Smartfish) built on the successes of Phase I and expanded the activities, including the training of a community data collector and the establishment of a participatory monitoring programme of lobster catch composition and fishing effort. The visible benefits of sustainable fisheries management, through increased catch following NTZ openings and associated household income increase, acted as a catalyst for the neighbouring lobster fishing communities of Elodrato and Itapera to become interested in sustainable fisheries management. SEED informally supported these communities following requests from community members, to establish fisheries management committees and to map and pilot NTZs. During the interim phase (July 2017 to August 2018, funded by Blue Ventures) SEED continued to support the fisheries management committee in Sainte Luce, re-engaged community members in sustainable fisheries management in Elodrato and renewed communication with community leaders and fishers in Itapera, following a gap in project funding and subsequently reduced project activities. The participatory fisheries monitoring programme was also extended to include Elodrato and Itapera. A situational analysis to provide an in-depth context of the communities of the communities was carried out (SEED Madagascar, 2018), to inform the further development of Phase III.

Phase III (July 2018 – March 2021, funded by the [Darwin Initiative](#)) will strengthen the community-based fisheries management model in Sainte Luce and formally extend it to Elodrato and Itapera and equip communities with the skills and knowledge to manage their lobster fisheries. Stakeholders throughout the value chain will be incorporated to ensure economic viability of the fishery and increased compliance with national and local law. Phase III is also the first phase to conduct an in-depth socioeconomic assessment of target and control lobster fishing communities.

This study provides a socioeconomic baseline to assess the impact of Phase III of Project Oratsimba on project indicators related to household poverty levels, involvement in unsustainable livelihood practices and knowledge of national fisheries regulations. Additionally, in Sainte Luce (the only community with a functioning LMMA at the time of data collection), indicators on knowledge of local fisheries regulations and involvement in fisheries management decision-making were also assessed.

3   Methods

Prior to research, permission was sought from community leaders and the Direction Régional de l'Agriculture, Elevage et de la Pêche (the Regional Fisheries Ministry). This study adhered to SEED's Human Research Code of Ethics. Participation was voluntary and informed consent was obtained verbally due to low levels of literacy.

3.1 Study Sites

To assess the impact of project interventions, both target and control lobster fishing communities without an LMMA were surveyed. This will enable endline evaluations to employ a Before-After-Control-Impact methodology. This study was conducted in the three target communities involved in Project Oratsimba Phase III: Sainte Luce, Elodrato and Itapera (Figure 2) and the three control communities of Ambanihazo, Antsotso and Baie d'Italy.
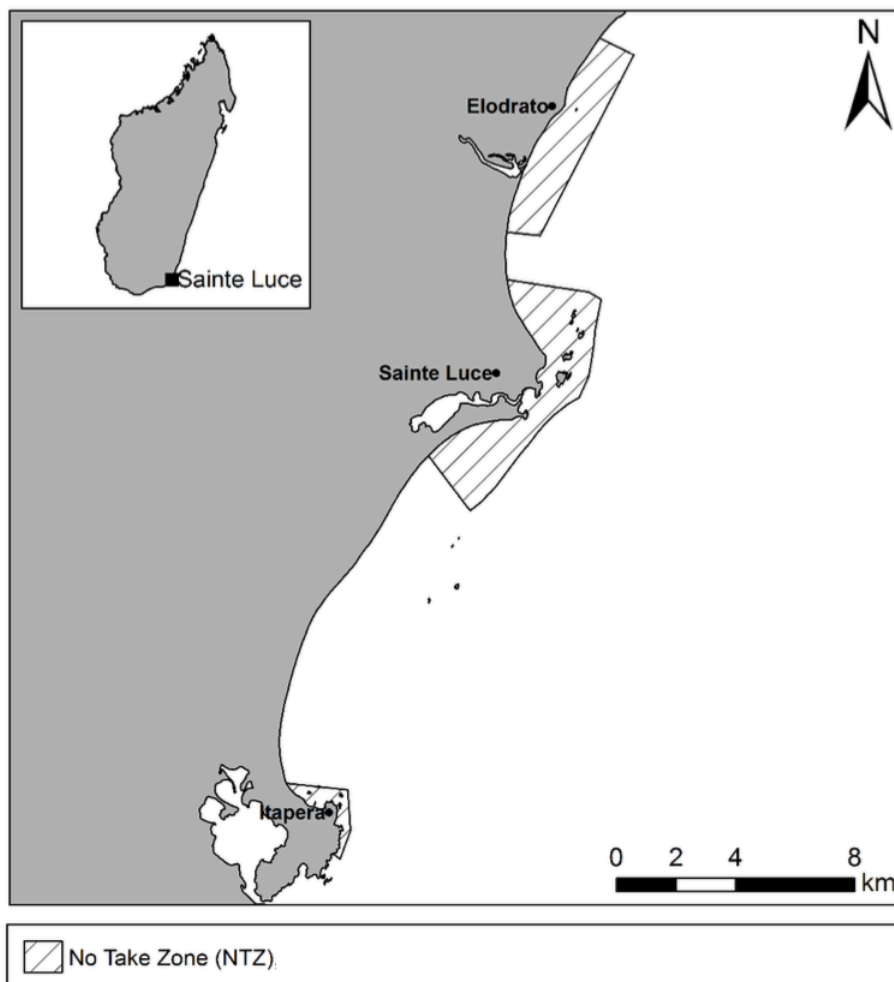

Figure 2. Location of the three target communities Elodrato, Itapera and Sainte Luce showing NTZs mapped during Project Oratsimba Phase I and II. The NTZs of Elodrato and Itapera have not been operational during Phase III so far. Ambanihazo and Antsotso are located approximately 9km and 15km North of Elodrato and Baie d'Italy is located approximately 40km south of Itapera

3.1.1 Sainte Luce

Sainte Luce is a lobster fishing centre and is the largest and oldest lobster fishing community east of the regional capital of Fort Dauphin (where lobsters are processed and sold to national and international markets). Local fishers believe Sainte Luce to be the birthplace of the livelihood in this region, with reports of fishing activity beginning around the 1960s. The community has a population of approximately 4,800 with an estimated 850 active fishers and is comprised of three hamlets; Ambandrika, Ampanastomboky and Manafiafy with a maximum walk of 45 minutes to the landings beach. SEED has been working in Sainte Luce since 2000 on health, conservation and sustainable livelihood projects and has an established Conservation Research Camp in Ambandrika. SEED related activities, as well as a nearby luxury eco-lodge, provide additional income source for households in Sainte Luce.

3.1.2 Elodrato

Elodrato is the target community located furthest north of Fort Dauphin and has a population of 4,200 and approximately 250 fishers. In the past, Elodrato was a farming community, however, cultural exchange and migration from Sainte Luce is said to have brought fishing skills and knowledge to the community. Due to its location on the National Road 12 (RN12), road building also provides a source of income for this community which is not present in Itapera or Sainte Luce. Five hamlets form this community: North Ebakika, South Ebakika, North Esohihy, South Esohihy and Elodrato. Whilst the hamlet of Elodrato is administratively part of another community, it is located on the landings beach. The five communities collectively make up one fishery using the same landings beach and fishing ground and are considered one community for the purpose of Project Oratsimba and LMMA management. Fishers in this community have a maximum travel of 2 hours to the landings beach by foot and boat.

3.1.3 Itapera

Itapera is the most isolated target community, despite being located closest to the regional capital of Fort Dauphin and is directly accessible only by foot. Itapera is smaller than other target communities, comprising of one large densely populated village located on the landings beach. The community has a population of 1,600 and approximately 100 fishers. Itapera is the target community where migrant fishers, from the southwest, cause the most tension. Disunity in this community is characterised by disagreements between residents and migrants in terms of fisher gear used and designation of rights over fishing grounds. Migrants have been present at least since 2001, but possibly as far back as the 1970s. They initially brought diving equipment (masks, snorkels and spears) and coastal gill nets to fish for turtles and sharks and have since become involved in lobster fishing.

3.1.4 Control Communities

Little is known about the three control lobster fishing communities: Ambanihazo, Antsotso and Baie d'Italy. Ambanihazo, and Antsotso use the fishing grounds adjacent to the north of Elodrato with populations of 2,400 and 1,500 respectively and have a maximum travel time of 2.5 hours to the landings beach. Antsotso has no hamlet located on the landings beach. Baie d'Italy is the only community located south of Fort Dauphin and consists of one hamlet located on the landings beach with a population of 1,300.

3.2   Survey Design

The survey collected baseline data to assess the impact of Project Oratsimba Phase III interventions in three target and three control lobster fishing communities in the Anosy region of southeast Madagascar. Demographic data was collected to give an insight into the community and individual participants. Quantitative data was collected to measure progress towards indicators on household poverty levels (using the Basic Necessities Survey methodology (section 3.2), livelihood practices and knowledge of national lobster fishery regulations. In Sainte Luce, the only community in early 2019 with a functioning LMMA and associated *dina* (local customary law, in the process of legal ratification at the time of surveying), data was also collected on knowledge of local fisheries regulations and involvement in past fisheries management decision-making. The full survey is provided in Appendix A. Prior to data collection, control communities were visited to assess suitability for selection.

Figure 3. Picture cards used during surveying to test participants knowledge on national fisheries regulations.

3.3 Basic Necessities Survey

The Basic Necessities Survey is a participatory approach to measure household poverty levels. It uses the definition of poverty as a lack of basic necessities, and creates a locally defined Poverty Index, based on ownership or access to items considered basic necessities by 50% or more of participants (Wilkie et al., 2015). Two focus groups, divided by gender, were conducted in each of the target and control communities between November and December 2018. The aim of these focus groups was to determine assets (such as spoons and cooking pots) and services (such as money to visit a doctor and access to drinking water from a well or tap) that community members consider as basic necessities. Village leaders selected eight to ten participants from unrelated households with varying levels of household wealth. Results from the focus groups were used to inform the design of the basic necessity list used in the survey. Items not considered as basic necessities by focus group participants were deliberately inserted to encourage participants to think about which items to select as basic necessities rather than selecting all items.

During surveying, picture cards illustrating each item included in the list were shown in a pre-chosen random order. Participants were first asked if they owned or had access to the item, and then if the item was a basic necessity that "*every household in the community should have and no family should have to do without*" (Wilkie et al., 2015). Items selected as basic necessities by less than 50% of household across all six communities were deemed not to be basic necessities and were excluded from further analysis. Weightings for each item were determined from the percentage of households selecting the item as a basic necessity. A Poverty Index score for each household was calculated by combining the weightings of the items actually owned by the household to create a poverty score and dividing this by the weighting of all the basic necessity items combined, the maximum possible score. Poverty Index scores lie on a scale where 0% represents a household living in extreme poverty, as they have no access to any of the locally defined basic necessity items and 100% represents a household being at or above the locally defined poverty line, as they have access to all of the basic necessity items (Wilkie et al., 2015).

3.4 Survey Distribution

Prior to surveying, the survey team was trained on the purpose of the survey, survey conduct and data entry. The survey was pre-tested in a lobster fishing village, Ambinanibe Bay, a small lobster fishing community on the outskirts of the regional capital of Fort Dauphin, in January 2019. Pre-testing evaluated the suitability of the survey questions and procedure and identified where adjustments were required.

The final survey was administered to lobster and non-lobster fishing households in three target and three control communities between January and March 2019. In communities with inland hamlets that are not involved in lobster fishing, surveys were only conducted in hamlets involved in lobster fishing as identified by community leaders. This was in line with the scope of Project Oratsimba Phase III activities. Households were randomly chosen using a dice and spinner from a random starting location. Spatial sampling was also attempted using satellite images and randomly selected coordinates from community and hamlet boundaries, but this proved unfeasible due to the dispersed nature of hamlets and households, given the limited time required for application. Surveys were conducted at

various times of day to control against timing of gender specific activities and minimise gender bias. The minimum age for surveying was 18, and where possible, heads of households were surveyed. If the head of the household was unavailable, another adult was chosen. Surveys were conducted by externally hired Malagasy translators while SEED staff inputted data into mobile phones using the mobile data collection software ODK (Open Data Kit).

3.5   Statistical Analysis

Statistical analysis was performed in R using version 3.3.2. To test for statistically significant differences between group means, Wilcoxon rank sum and Kruskall Wallis tests were used. Post-hoc pairwise comparisons were also conducted using Wilcoxon rank sum tests. Chi-square tests of independence were used to test for statistically significant relationship between categorical variables. Generalized linear modelling and stepwise model simplification were used to examine the effect of community and lobster fishing household status on Poverty Index.

4   Results

The data presented in this report is the result of 553 household surveys conducted between January and March 2019 across three target communities (271 households, 49.0% of sample size) and three control communities (282 households, 51.0% of sample size) (Table 1). The aim was to survey 100 households in each community over a period of five days. In reality, the actual number of surveys conducted in each community depended on the population, time available for surveying (some communities required more travel time by foot or vehicle) and events occurring within the community, such as funerals. Unless otherwise stated, results presented are combined for households who do and do not engage in lobster fishing. In each community it was estimated that at least 10% of households were surveyed based on population estimates provided by community leaders (Table 1). The total number of households was not available from community leaders and it was not possible to count the number of households in the field or via satellite images.

Table 1. Household surveys conducted by community (n=553).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Households surveyed	95	74	102	82	98	102
Proportion of sample (%)	17.2	13.4	18.4	14.8	17.7	18.4
Households in community surveyed (%)	10.4	27.3	10.8	15.0	31.0	40.0

4.1   Community Demographic Characteristics

Population size varied considerably between communities, although these are estimates provided by community leaders as census data was unavailable (Table 2). Population estimates provided for Elodrato, Ambanihazo and Antsotso also included inland hamlets not involved in lobster fishing, outside the scope of Project Oratsimba and this study. In Elodrato, one of the hamlets involved in Project Oratsimba Phase III is administratively part of another community and was not included in the population estimates but uses the same landings beach and, for the purpose of this project, is considered one community managing a single LMMA. Fishers in this region report moving between fishing grounds and the pressure placed on a local lobster stock does not entirely come from the local community. Ideally, control communities should have similar population numbers, but due to time and resource limitations, it was not possible to explore lobster fishing communities further along the coast.

A total of 2,733 people were accounted for in this study. Mean household size was lowest in Ambanihazo (4.4±1.8) and highest in Itapera (5.9±2.2). The mean number of children was lowest in Ambanihazo (2.8±1.3) and highest in Itapera (4.0±1.6). The mean number of adults 65 or over was similar across communities except for Ambanihazo. The mean age of individuals accounted for in this study was 23.7±11.3 years and was lowest in Itapera (19.5±8.4 years) and highest in Ambanihazo (27.6±14.3 years). In all communities, the majority of individuals accounted for in the survey were below 18, ranging from 53.2% in Elodrato to 79.1% in Ambanihazo and few individuals were aged 65 or over ranging from 2.2% in Antsotso to 6.0% in Ambanihazo. This pyramidal age structure is typical of fishing

villages in Madagascar (Epps, 2008). Overall, 75.1% of households surveyed were involved in lobster fishing but this varied between communities from 54.7% in Elodrato to 87.3% in Baie d'Italy. The proportion of people accounted for in this study who were active lobster fishers was lowest in Elodrato, 16.7% and highest in Baie d'Italy, 27.0% (Table 2).

Table 2. Community demographics (sd is standard deviation, n=552 except for household size, lobster fishing households and active lobster fishers n=553).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Population estimate	4200	1600	4800	2400	1500	1300
Household size (mean ±sd)	4.6+2.2	5.9+2.2	5.1+2.1	4.4+1.8	4.7+2.2	5.1+2.0
Household size (range)	1 - 12	1- 12	1 - 13	1 - 10	1 - 13	1 - 11
Children below 18 (mean per household ±sd)	3.0+1.6	4.0+1.6	3.1+1.5	2.8+1.3	3.2+1.5	3.6+1.7
Adults 65 or over (mean per household ±sd)	0.1+0.4	0.1+0.4	0.1+0.4	0.3+0.5	0.1+0.3	0.1+0.3
Age (mean ±sd)	25.1+12.9	19.5+8.4	23.6+8.4	27.6+14.3	23.0+9.7	23.0+12.0
Age (range)	0 - 97	0 - 85	0 - 80	0 – 100	0 - 100	0 - 87
Children below 18 (%)	53.2	72.1	70.9	79.1	65.7	61.8
Adults 65 or over (%)	2.5	2.5	2.5	6.0	2.2	1.9
Lobster fishing households (%)	54.7	82.4	83.3	59.8	80.6	87.3
Active lobster fishers (%)	16.7	21.9	23.8	17.6	25.0	27.0

4.2   Participant Demographic Characteristics

Demographic characteristics of individual participants by community are provided in Table 3.Overall, 60.0% of participants surveyed were heads of household, 54.1% of participants were female and 40.7 % of participants were fishers. The mean age of participants was 37.6+15.6 with a minimum of 18 (only adults over the age of 18 were surveyed) and a maximum of 90. There were 25.7% participants who had no formal education ranging from 14.7% in Sainte Luce to 48.0% in Baie d'Italy. From those participants who have had some form of formal education, they generally had low levels of formal education with most not completing primary school with a mean of 3.6+3.1 years, ranging from 1.8+2.2 in Baie d'Italy to 4.4+2.8 in Sainte Luce. The number of years of education was based on the number of levels of education completed and does not account for levels which had been repeated. 36.3% of participants had completed primary school, 0.9% had completed secondary school and 0.4% had completed a university degree (Table 3).

Table 3. Participant demographic characteristics sd is standard deviation,
n=553 except education n=549 and age n=451).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Head of household (%)	51.6	71.6	53.9	63.4	61.2	61.8
Female (%)	62.1	41.9	57.8	51.2	53.1	54.9
Active fisher (%)	26.3	54.1	40.2	36.6	42.9	44.1
Age (mean±sd)	36.3 ± 15.3	35.9 ± 15.6	38.2 ±14.9	40.4 ±17.5	35.6 ± 14.3	39.4 ± 15.7
No formal education (%)	22.1	25.7	14.7	24.4	18.4	48.0
Years of formal education (mean±sd)	3.9 ± 3.3	3.2 ±2.8	4.4 ±2.8	3.9 ±3.3	4.2 ±3.2	1.8 ± 2.2
Completion of primary school (%)	41.5	32.4	49.5	41.5	45.4	9.9

4.3 Basic Necessities Survey

At the beginning of the survey period, 19 participants considered all assets as basic
necessities, and it was considered that this was due to a lack of understanding of the
question asked. This highlighted the need to refine the Basic Necessities Survey
methodology and these responses were removed for the determination of the Basic
Necessities List. The final list of basic necessities included in analysis is given in Table 4 with
basic necessity ownership by community given in Appendix B. 11 assets out of the 33
original items (assets and services) were not considered basic necessities by more than 50%
of households and were removed from further analysis, these included: cement floor, metal
roof, *Vezo pirogue* (a traditional dugout canoe used typically by migrant fishers originating
from the west coast of Madagascar with a sail and outrigger), fibreglass motorboat, bicycle,
foam mattress, mobile phone, motorcycle, television, solar panel and generator.

Table 4. Basic necessity item identification (n=534).

Basic Necessity Item	Participants identifying item as basic necessity (%)
Metal spoon	99.4
Cooking pot for rice	98.7
Tin plate	98.5
Metal cooking tripod	98.3
Mahampy mat, hand woven reed mat	97.6
Plastic bucket	97.2
Water from a well or tap in the community	93.1
Money to send all school age kids to school	92.3
Money to visit a doctor	90.8
Enough money to be able to save money	90.1
Shoes	89.3
Lobster pot (wooden)	87.8
Fleece blanket	83.5
Antanosy pirogue, wooden dugout canoe native to Anosy	79.2
Zebu, dry adapted indicine cattle	76.6
Glass cup	74.5
Bed	68.4
Lobster pot (metal)	63.9
Latrine	63.5
Large cooking pot for celebrations	63.1
Life jacket	59.9
Radio	56.6

4.3.1 Poverty Levels

Poverty Index scores lie on a scale where 0% represents a household in extreme poverty having access to none of the items defined as basic necessities and 100% represents a household being at or above the locally defined poverty level having access to all of the items defined as basic necessities (Wilkie et al., 2015). No household in any community had access to all of the items defined as basic necessities. This means that all households surveyed were considered to be below the locally defined poverty level. Mean Poverty Index differed little between target communities, 64.3%±11.5, and control communities, 62.2%±13.1 (Table 5, Figure 4), other than Baie d'Italy which was statistically significantly poorer than the other control and target communities (Appendix C).

Table 5. Poverty Index (%) for target and control community households (n=553).

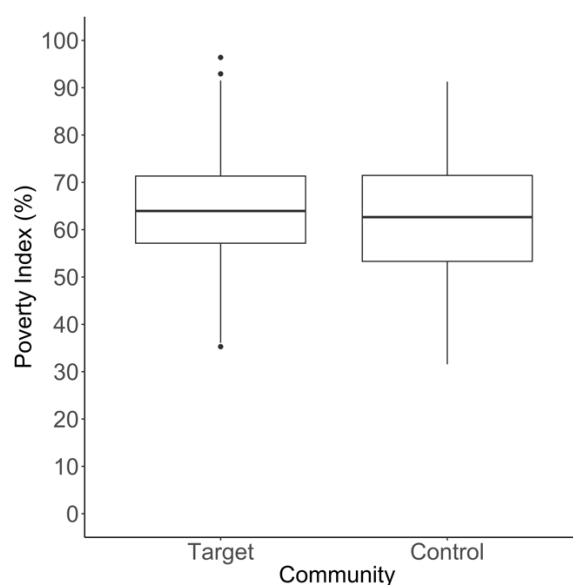|	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Mean (+standard deviation)	62.9+11.8	62.4+11.9	67.0 +10.6	65. 4+11.2	66.2+12.3	55.8 +12.6
Minimum	35.3	36.1	36.1	40.7	41.2	31.6
Maximum	91.5	92.9	96.4	91.3	90.0	86.5

Figure 4. Poverty Index (%) for target and control community households (n=553).

Lobster fishing households had a statistically higher mean Poverty Index and thus were wealthier, compared to non-lobster fishing households in all communities (Table 6, Figure 5, Appendix C). Lobster fishing is a vital economic activity in the Anosy region of Madagascar and the results therefore suggest that lobster fishing plays an important role in poverty alleviation, a recognised role of small-scale fisheries, particularly those in developing countries (Barnes-Mauthe et al., 2013). Project Oratsimba Phase III aims to contribute to poverty alleviation through promoting sustainable, community-based fisheries management using a periodic NTZ model. The application of this model has demonstrated to result in an increase in the price fishers receive for the lobster catch (Long, 2017). The Poverty Index of households was broadly similar across communities (Figure 5, Appendix C). However, households in Baie d'Italy were comparatively poorer and future evaluations will need to account for this. It is not known why Baie d'Italy was comparatively poorer. It is perhaps worth noting that community members perceive that this community has the lowest level of external support (from governmental or non-governmental organisations). Results suggest that control communities selected were sufficiently similar to serve as suitable controls to enable the impact of Project Oratsimba Phase III on household poverty levels to be evaluated.

Table 6. Mean Poverty Index (% +standard deviation) for lobster fishing
and non-lobster fishing households (n=553).

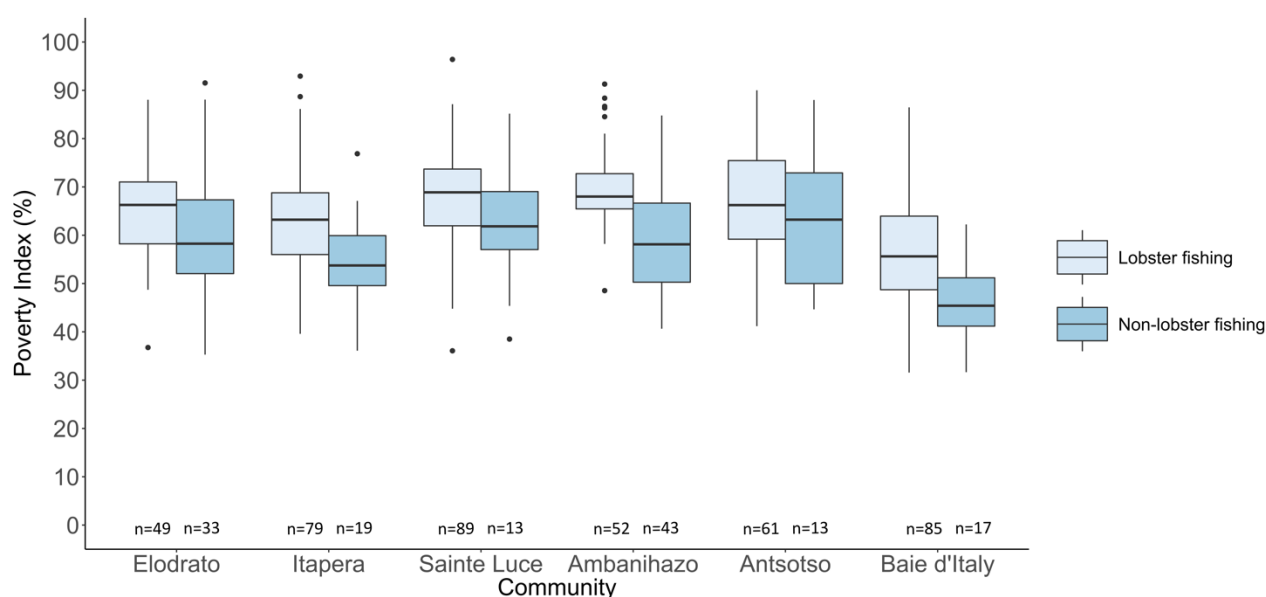|	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Lobster fishing households	65.3 +10.7	64.1 +11.4	68.0 +10.2	69.3 +8.6	67.1 +11.7	57.1 +12.6
Non-lobster fishing households	59.9 +12.4	54.3 +14.4	61.9 +9.2	59.6 +12.2	62.4 +14.4	46.9 +9.2

Figure 5. Poverty Index for lobster fishing and non-lobster fishing households (n=553).

4.3.2 Zebu Ownership

Zebu, a dry-adapted indicine cattle, play a central role in Malagasy culture and are seen as a symbol of status and wealth. Zebu are used as an informal banking system with households using zebu as a way of storing wealth for future expenses. Increased ownership is one of the reported benefits of NTZ openings in Sainte Luce in previous phases with purchases increasing by 75% in 2016 (Skinner, Burtenshaw-deVries, Long, Randrianantenaina, & Ellis, 2016). Zebu ownership varied between communities, however in all communities the percentage of households owning zebu was higher for lobster fishing households compared to non-lobster fishing households. Mean zebu ownership varied between communities but in Sainte Luce and Antsotso, mean ownership was lower in lobster fishing households (Table 7). However, due to their cultural significance, it is possible that self-reported zebu ownership could be inaccurate. SEED is piloting zebu ownership as a contextually appropriate indicator of wealth and will also be exploring other methods for collecting this data. Zebu ownership will be monitored throughout Phase III.

Table 7. Zebu ownership for lobster and non-lobster fishing households (n=553).

| | | Target communities | | | Control communities | | |
		Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Household ownership (%)	fishing	57.7	23.0	30.6	93.9	54.4	47.2
	non-fishing	41.9	7.7	23.6	48.5	52.7	15.4
Household ownership (mean ± standard deviation)	fishing	2.4 (±3.5)	0.6 (±1.4)	0.9 (±2.3)	6.0 (±6.6)	2.6(±3.7)	0.9(±1.7)
	non-fishing	2.1 (±4.3)	0.1 (±0.3)	1.4 (±3.3)	2.8 (±5.2)	4.1 (±5.5)	0.2 (±0.6)

4.3.3 Comparison to Western Madagascar

The presence or absence of common household items and house construction materials can also be used to determine the relative wealth of communities using the Material Style of Life methodology (Pomeroy et al., 2004). Items included in the Basic Necessities Survey are also Material Style of Life indicators of wealth used in a study of fishing communities in the Kirindy-Mite Marine Protected Area in west Madagascar. Comparison between these regions allows for relative wealth of target communities to be understood in a broader context. The data suggests that the relative wealth of target communities in the southeast is similar to that of fishing communities in the west, although ownership of foam mattresses and solar panels differs greatly (Jones, 2011).

Table 8. Material Style of Life comparison with fishing villages of the Kirindy-Mite Marine Protected Area in West Madagascar.

| | Household ownership (%) | |
	Southeast Madagascar (target communities)	West Madagascar (Jones, 2011)
Cement floor	9.2	6.2
Metal roof	8.1	9.3
Radio	43.2	54.2
Foam mattress	22.1	62.7
Bed	71.2	68.0
Mobile phone	31.7	27.1
Television	4.8	6.7
Solar panel	24.0	0.4
Generator	3.3	7.1

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4.4 Livelihoods

Participants listed and ranked income generating activities that their household participates in. Nine categories of activities were identified: **lobster fishing and buying** including six *collecteur* or *rabbateur* only households and six lobster fishing and *collecteur* or *rabbateur* households across all households surveyed, **other sea fishing** targeting marine species other than lobsters, **freshwater fishing** using mosquito nets or similar materials conducted mainly by women, **farming** income generating crops or livestock, **small business** such as market stalls, cafes or bars**, weaving** reeds into traditional bags, hats and mats, one household buying woven products, two households selling woven vine lobster pots, **casual work** providing casual services such as construction, rice transplanting and security, **formal employment** such as teaching, hospitality and road building and, **SEED** income generated directly through SEED projects such as community data collectors, construction workers or embroiderers. SEED does not currently operate in control communities. Households could report participation in multiple activities and multiple activities of the same category. Eight households reported no income generating activities. Although lobster fishing villages were targeted, lobster fishing was the most practiced activity in only three of the communities surveyed; Sainte Luce, Antsotso and Baie d'Italy. Weaving was the most practiced activity in Elodrato, Itapera and Ambanihazo (Table 9).

Table 9. Household involvement (%) in income generating activities (n=553).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Lobster fishing and buying	54.7	82.4	83.3	70.0	84.7	88.2
Other sea fishing	34.7	82.4	72.5	37.8	64.3	86.3
Freshwater fishing	4.2	39.2	10.8	8.5	0.0	28.4
Farming	55.8	24.3	32.4	47.6	58.2	52.0
Small business	27.4	40.5	18.6	19.5	16.3	25.5
Weaving	78.9	77.0	62.7	76.8	87.8	8.8
Casual work	3.2	2.7	5.9	9.8	3.1	2.0
Formal employment	25.3	2.7	6.9	13.4	10.2	1.0
SEED	0.0	1.4	20.6	0.0	0.0	0.0
None	0.0	1.4	2.0	2.4	0.0	2.9

Most households participated in more than one income generating activity, only 43 households participated in one income generating activity. The maximum number of income-generating activities was nine, reported by one household in Sainte Luce. The mean number of income generating activities per household ranged from 2.9$\pm$1.3 in Elodrato and Ambanihazo to 3.7$\pm$1.2 in Itapera. The difference between target and control communities was not statistically significant (W = 35910, p 0.21) however the difference across communities was statistically significant (Kruskal-Wallis chi-squared = 23.8, df = 5, p<0.01) (Table 10). Antsotso and Itapera had a higher mean number of income generating activities per household compared to other communities. Pairwise comparisons show Antsotso was significantly different (p<0.05) compared to Elodrato, Baie d'Italy and Elodrato. Itapera was significantly different (p<0.05) to all communities except Antsotso. Pairwise comparisons between other communities were not significantly different (p>0.05).

Table 10. Mean income generating activities per household (n=553).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Mean (±standard deviation)	2.9$\pm$1.3	3.7$\pm$1.2	3.3$\pm$1.4	2.9$\pm$1.3	3.4$\pm$1.0	3.1$\pm$1.4
Minimum	1.0	0.0	0.0	0.0	1.0	0.0
Maximum	6.0	6.0	9.0	7.0	6.0	7.0

4.4.1 Lobster Fishing Household Livelihoods

Whilst lobster fishing and buying was only the most widely practiced income generating activity in three of the communities surveyed, it was the most important activity for lobster fishing households (excluding *collecteur* or *rabbateur* only households) in all of the communities; ranging from 50.2% of households in Ambanihazo to 80.0% in Itapera (Figure 6).This suggests that lobster fishing is a primary income generating activity rather than a supplementary activity. Therefore, in target communities, local fisheries regulations implemented as a consequence of Project Oratsimba Phase III will directly affect fisher's livelihoods. Other livelihoods indirectly associated with lobster fishing, such as small businesses who sell the products of lobster fishing, will also be affected, although livelihoods indirectly associated with lobster fishing are not explored in this study.
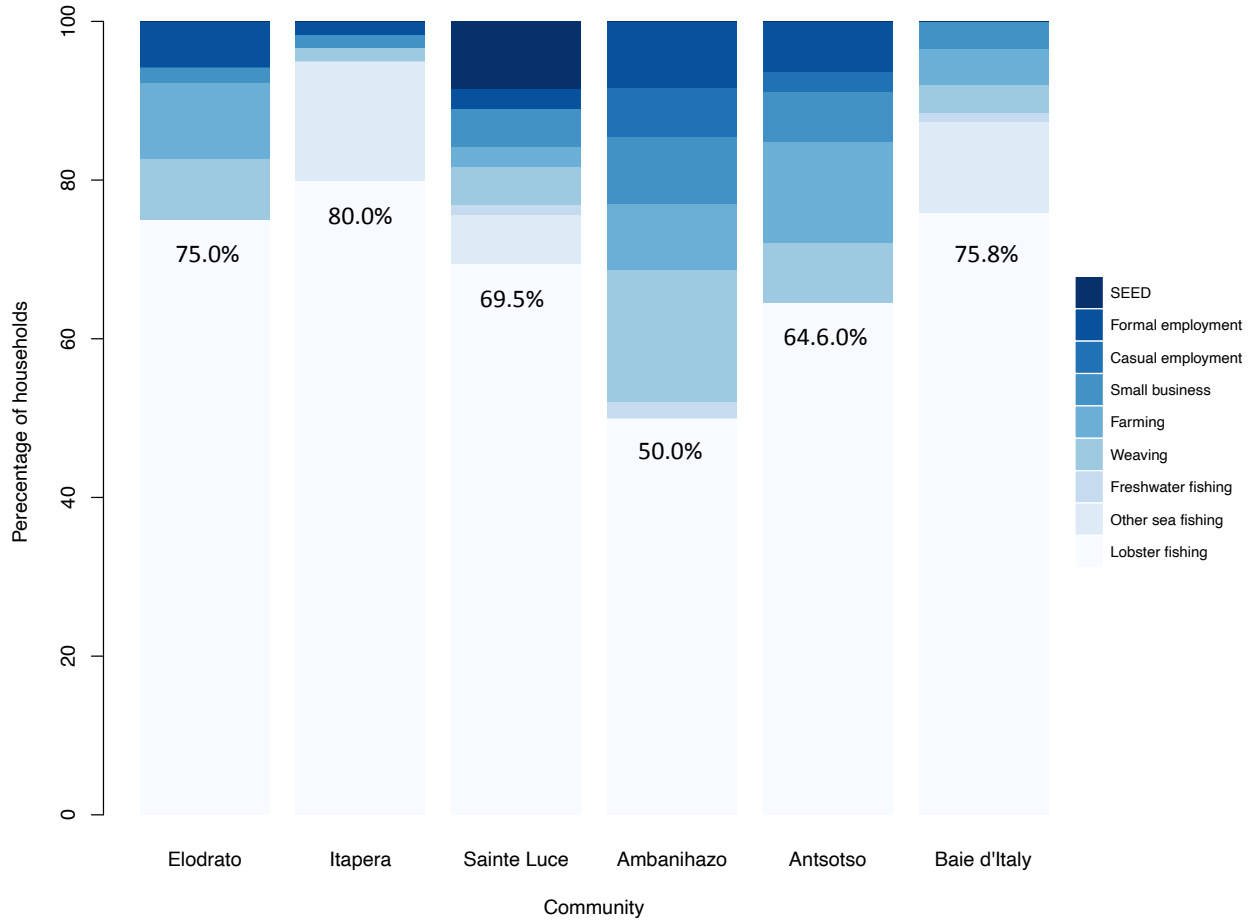
Figure 6. Most important income generating activity for lobster fishing households (%, n=415).

Lobster fishing households did not rely entirely on lobster fishing for income. Only three households depended entirely on lobster fishing for income and 36 households depended entirely on lobster and other sea fishing. This suggests that income generating activities in lobster fishing households are diversified and also include non-marine based activities. The mean number of income generating activities was lowest in Baie d'Italy, 3.3±1.2, and highest in Itapera, 3.9±1.0 (Table 11). The difference in the mean number of activities per lobster fishing household between target and control communities was not statistically significant (W=19316, p=0.06), however, the difference across communities was statistically significant (Kruskal-Wallis chi-squared = 18.3, df = 5, p-value <0.01). Baie d'Italy had the lowest mean income generating activities per lobster fishing household and lobster fishing households income was less diversified whereas Itapera had the highest mean and livelihood activities were more diversified. Pairwise comparisons show Baie d'Italy was significantly different (p<0.05) compared to Itapera and Antsotso and Itapera was significantly different (p<0.05) compared to Sainte Luce. Pairwise comparisons between other communities were not significantly different (p>0.05).

Table 11. Income generating activities per lobster fishing household (n=415).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Mean (+ standard deviation)	3.7+1.1	3.9+1.0	3.5+1.3	3.5+1.1	3.6+0.9	3.3+1.2
Minimum	1.0	2.0	2.0	1.0	2.0	2.0
Maximum	6.0	6.0	9.0	7.0	6.0	7.0

Participants were asked to state the activity that would bring the most income if they could not participate in their main income generating activity. The most commonly reported primary supplementary activity for lobster fishing households varies between communities (Figure 7). In Itapera, Sainte Luce and Baie d'Italy, other sea fishing was the most common supplementary activity and is practiced by more than half of households. In Elodrato, Ambanihazo and Antsotso, there was no supplementary activity identified by the majority of households. The most commonly reported supplementary activity was weaving in Elodrato, 36.7% of households, and Ambanihazo, 31.1% of households and weaving and farming in Antsotso, 29.9% of households for each activity. Just 14.6 % of households reported lobster fishing as the primary supplementary activity, providing further evidence to suggest that lobster fishing is the most important income generating activity for lobster fishing households.
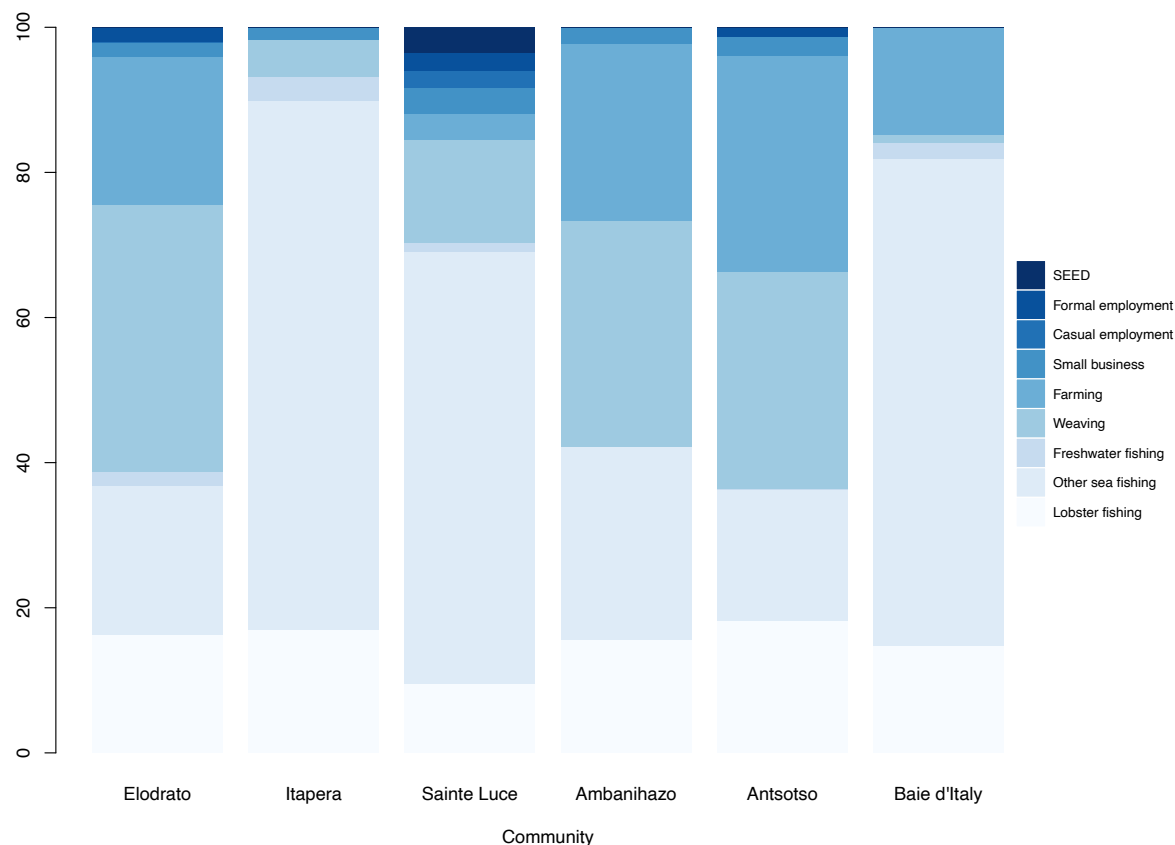

Figure 7. Primary supplementary income generating activity for lobster fishing households (%, n=412).

4.5 Lobster Fishing Gear

Three types of lobster fishing gear were reported: pots, nets and the use of masks and snorkels. Control communities reported more diversified fishing practices for lobster fishing compared to target communities; 49.3% of control community fishing households used only one gear compared to 70.2% of target community lobster fishing households. 11 households reported using all three gears; seven in Baie d'Italy and four in Itapera.

Pots were the most popular gear used for lobster fishing in all communities, with only three households surveyed reporting they do not use pots (Table 12, Figure 8). Lobster pots are essential for lobster fishing: 97.6% of lobster fishing households identified pots as a basic necessity. More lobster fishers only used pots in target communities (70.9% of fishers), compared to control communities, (49.1% of fishers). The number of pots owned per household ranged from one to 150 (Table 12), while three households were unsure of the number of pots owned. The mean number of pots per household was higher for target communities (19.6$\pm$22.2), compared to control communities (15.8 $\pm$ 12.7), although this difference was not statistically significant (W = 16765, p-value = 0.2) across communities the difference was statistically significant (Kruskal-Wallis chi-squared = 72.8, df = 5, p<0.01). Households in Baie d'Italy used the fewest lobster pots and pairwise comparisons show the mean number of pots used in this community were significantly different (8.2$\pm$5.6 pots per household, p<0.05) compared to all other communities. Households in Ambanihazo used the most lobster pots and pairwise comparisons show the mean number of pots used were significantly different (22.1$\pm$15.0 per household, p<0.05) compared to Baie d'Italy and Elodrato. Pairwise comparisons between other communities were not significantly different (p>0.05). Participants were questioned about pot ownership in December 2018 as surveying took place during the national lobster fisheries closure, during which it is illegal to fish for lobsters in Madagascar between January and March. 27 households who reported using lobster pots did not report owning lobster pots, three households were unsure of the number of pots owned.

Table 12. Lobster fishing gear used(n=415).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Pot	100.0	96.7	100.0	98.0	100.0	100.0
Net	36.5	60.7	0.0	59.2	48.1	47.2
Mask and snorkel	0.0	11.5	2.4	0.0	0.0	10.1

Table 13. Lobster pot ownership by community (n=382).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Mean (±standard deviation)	18.5±23.6	19.5±17.7	20.3±24.5	22.1±15.0	20.5±12.8	8.2±5.6
Minimum	150.0	120.0	150.0	100.0	50.0	20.0
Maximum	1.0	2.0	1.0	5.0	2.0	1.0

Figure 8. Hand woven vine lobster pot.

Nets were the second most popular lobster fishing gear; used by 28.3% of households in target communities and 50.2% of households in control communities (Table 12). One household reported using only a net; nets were mainly used in addition to pots with 96.4% of target and 99.1% of control community net users also using pots. Sainte Luce was the only community which did not report using nets for lobster fishing. Fishing for lobster using nets is prohibited through the *dina* (local law), although at the time of surveying the *dina* was a customary law in the process of becoming legally ratified (the *dina* has since become legally ratified in September 2019).

Mask and snorkels were the third and least reported lobster fishing gear used, reported by just 4.3% of households in two target communities, Itapera and Sainte Luce, and one control community, Baie d'Italy (Table 12). No household reported masks and snorkels as the only gear used. Masks and snorkels were mainly used in addition to pots with 77.9% of target and 100.0% of control freediving households also using pots. In Sainte Luce, two households reported freediving for lobsters despite the *dina* prohibiting fishing for lobsters using a mask and snorkel. Previously, it was thought using masks and snorkels only occurs in the target community of Itapera, where semi-nomadic *Vezo* fishers from western Madagascar brought

this gear with them became involved in lobster fishing. In the other two target communities, Elodrato and Sainte Luce it is taboo to use a mask and snorkel and this taboo was used to incorporate the prohibition of masks and snorkels into the Sainte Luce *dina* (SEED Madagascar, 2018).

There was a mean of 1.46 ±0.9 active fishers per lobster fishing household in 2018 with two households reporting no active fishers and one household reporting a maximum of seven active fishers (Table 14). The mean number of active fishers varied little between test and control communities and this difference was not statistically significant (W = 22122, p= 0.5). There was also no statistically significant difference across communities (Kruskal-Wallis chi-squared =5.1, df=5, p=0.4). This suggests that whilst total population and the number of fishing households varies across communities (Table 1 and Table 2) individual households relied on similar numbers of fishers to contribute to household income generated through lobster fishing.

Table 14. Active lobster fishers per lobster fishing household in 2018 (n=415).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Mean (±standard deviation)	1.4±0.9	1.6 ± 1.1	1.5±0.9	1.3±0.8	1.4±0.7	1.6±1.0
Minimum	0.0	1.0	0.0	1.0	1.0	1.0
Maximum	5.0	5.0	5.0	6.0	4.0	7.0

4.5.1 Pirogue Ownership

Pirogue ownership amongst fishers is associated with the freedom to sell catch without being restricted to a particular buyer (*rabbateur* or *collecteur).* Fishers fishing from a *pirogue* owned by a *collecteur* are obliged to only sell to the *pirogue* owner. Fishers who own their own *pirogues* are not restricted in who they sell their catch to and are able to obtain a higher price. In 2018, lobster was bought for 22,000Ar/kg ($6.35) from fishers using a *pirogue* owned by a *collecteur* compared to 25,000Ar/kg ($7.20) from fishers who own a *pirogue* (SEED Madagascar, 2018)*.* In all communities, less than 50% of fishing households owned a *pirogue* (Table 15). This study was however limited as it failed to consider shared ownership of *pirogues.* Buying a *pirogue* is a significant economic investment costing 500,000Ar ($145) in 2018 with maintenance costs on top of this. Prior to *collecteurs* providing *pirogues*, fishers formed teams, sharing the costs of the *pirogue* and maintenance and associated profits. Although this structure is less formalised now, it is still likely to account for the higher ownership reported in this study compared to a study conducted in 2018 which calculated *collecteur* ownership of individual *pirogues* (SEED Madagascar, 2018). *Pirogue* ownership will be monitored throughout Phase III as part of the projects efforts to ensure economic viability of the fishery.

Table 15. Pirogue ownership in lobster fishing households (n=415).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Household ownership (%)	13.7	32.4	40.2	37.8	19.4	40.2

4.6 Knowledge of National Fisheries Regulations

Knowledge of the three main national lobster fishery regulations was assessed;

i) The national closed season for lobsters occurs yearly between January 1st and March 31st inclusive, during which time it is illegal to fish for lobsters throughout Madagascar. Participants were asked if fishing for lobster between January and March is allowed.

ii) The prohibition on landing berried females prohibits bringing berried (egg bearing female) lobsters back to shore (Figure 9). Participants were shown a picture of a berried lobster and asked if they caught the lobster would they bring it back to shore.

iii) The minimum landing size of 20cm is the legal minimum landing size (MLS) for lobsters caught to be bought back to shore. Participants were randomly shown one of four pictures of varying sizes of lobsters (10cm, 14cm, 18cm, and 20cm) and asked if they caught the lobster would they bring it back to shore.

Knowledge was assessed for lobster fishers and non-fishers to assess community knowledge of these regulations. 40.33% of participants surveyed were active lobster fishers. 45 participants were unwilling or unable to answer questions about one or more of the national lobster fishery regulations.

30.9% of participants correctly answered all three questions. Differences in correct knowledge of all three national lobster fishery regulations were not statistically significant between test and control communities (chi-squared = 1.2, df = 1, p-value = 0.3) but were statistically significant across communities (chi-squared = 19.6, df = 5, p-value <0.01). Correct knowledge of individual regulations varied. In all communities, more than half of participants demonstrated correct knowledge of the national closed season and MLS. Sainte Luce and Baie d'Italy were the only two communities where more than half of participants demonstrated correct knowledge of the prohibition on landing berried lobsters (Table 16).

Increasing knowledge and awareness of national regulations is crucial to increasing compliance with national regulations which are poorly enforced by the state which will in turn, along with local regulations, improve the sustainability of the lobster fishery (Long et al., 2019). Compliance with national lobster fishery regulations is low. For example, in Sainte Luce 48.2% lobster catch was below the MLS in 2015 and 2016 (Long, 2017). Economic necessity coupled with *rabbateur* and *collecteur* demand for lobster drives fishers to catch berried and undersized lobsters in contravention to national regulations. Phase III of Project Oratsimba will increase compliance by working with a variety of stakeholders in the value chain; with fishers and the wider community to increase knowledge and understanding of national lobster fishery regulations, with *rabbateurs, collecteurs* and exporters to reduce the

demand for illegal lobsters and with community management structures and state actors to build enforcement capacity. This will support fishers in changing their behaviour to adopt more sustainable fishing practices.

Table 16. Participants (%) demonstrating correct knowledge of national fisheries regulations by community, participants that did not answer one or more questions are excluded (n=508).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
All three national regulations	33.3	26.1	38.6	21.4	18.9	42.9
National closed season	73.3	76.8	93.1	64.3	70.5	93.9
Minimum landing size	65.3	55.1	74.3	70.0	53.7	59.2
Prohibition on landing berried females	40.0	46.4	50.5	38.6	27.4	67.4

Figure 9. National law prohibits the landing of berried female (egg bearing) lobsters.

4.7 Knowledge of Local Fisheries Regulations (Sainte Luce)

At the time of surveying, Sainte Luce was the only community with a functioning LMMA and associated *dina.* Knowledge of two regulations contained within the *dina* was assessed;

   i) Knowledge on the prohibition of using a mask and snorkel for fishing was assessed by asking participants whether it is permitted to fish using a mask and snorkel in Sainte Luce.
   ii) Knowledge of NTZ closures was assessed by asking participants whether fishing was permitted in the first NTZ closure of 2019 (May).

All participants surveyed were aware of and able to answer questions about local lobster fishery regulations. Almost all participants, 97.1%, had correct knowledge of the prohibition of masks and snorkels whereas few participants, 11.8%, had correct knowledge of an upcoming NTZ closure. Project Oratsimba Phase III will continue to monitor knowledge of and compliance with local fisheries regulations throughout Phase III along with national regulations (section 5.6). The results from this survey highlight the need for widespread advertisement of planned NTZ closures. Following this survey, community education sessions in collaboration with the Riaky Committee (fisheries management committee) were conducted to raise awareness of local regulations with a particular focus on the upcoming NTZ closure. This will be repeated throughout this phase and will be replicated in the other target communities prior to NTZ closures.

Figure 10. Display of *dina* (local law) of Sainte Luce, illustrating practices which are prohibited and permitted.

4.8   Unsustainable Livelihood Practices

Household participation in unsustainable livelihoods detrimental to marine, freshwater and terrestrial biodiversity was assessed by asking households about their involvement in the sale of shark (meat and/or fins), sale of charcoal, firewood or timber, mosquito net river fishing and the consumption of bushmeat (Table 17). In all communities, the sale of shark meat and fins was the most widely reported unsustainable livelihood activity. As a result, in September 2019, the participatory monitoring programme in target communities was extended to collect data on sharks and related species (elasmobranchs, with assistance from Blue Ventures). Involvement in unsustainable livelihoods will be monitored as part of Project Oratsimba Phase III. Improving the sustainability of the lobster fishery will maintain lobster fishing as a livelihood in target communities where few livelihoods exist. This will help to mitigate the threats posed to marine biodiversity such as targeting endangered species in the wider fishery and terrestrial biodiversity, such as increased pressure on threatened littoral forests (Ingram, Whittaker, & Dawson, 2005).

Table 17. Household (%) participation in unsustainable livelihood activities. Responses where participants were unsure if their household was involved in one or more activities were removed (n=526).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Sale of shark meat or fins	34.4	54.2	59.8	36.3	61.1	66.3
Sale of charcoal, firewood or timber	22.2	31.9	37.1	17.5	41.1	34.8
Involvement in mosquito net fishing	20.0	45.8	40.2	22.5	33.7	31.5
Consumption of bushmeat	3.3	4.2	6.2	3.8	7.4	0.0

4.9 Gender and Involvement (Sainte Luce)

In Sainte Luce, the only community with an established and functioning LMMA in early 2019, participants were asked if they felt involved in previous decision making regarding the NTZ. There was a statistically significant relationship between reported feeling of involvement in fisheries management decision and gender (chi-square = 15.8, df=1, p<0.01). The proportion of men who reported involvement is higher (88.4%), than the proportion of women (50.9%). Project Oratsimba Phase III has identified this as an area of improvement for the third phase and is seeking to increase the involvement of women in all three target communities in fisheries management through: women only meetings and education sessions, identification and training of Women Marine Ambassadors to deliver women's educations sessions, increased representation of women on the management committees and gender workshops with all management committee members. The attendance of females at project activities will be monitored throughout Phase III.

Figure 11. Women play a key role as *rabbateurs* in the lobster fishery, collecting and weighing the catch before the lobsters are sold for export.

5   Summary

The data presented in this study forms the baseline for project success indicators related to household poverty levels, involvement in unsustainable livelihood practices, knowledge of national and local fisheries regulations and involvement in fisheries management decision-making, for which the project aims to influence. The study also provides evidence for the role of lobster fishing in poverty alleviation in southeast Madagascar. The differences presented in poverty levels, fishing gear usage and livelihoods across the three target communities will need to be considered during project implementation, particularly with respect to extending the LMMA model piloted in Sainte Luce. This study has informed the development and implementation of Phase III project activities such as the expansion of the participatory monitoring programme to include sharks and elasmobranch species as well as efforts to increase the involvement of women in community-based fisheries management through the identification of Women Marine Ambassadors. Progress towards project success indicators will be monitored throughout Phase III.

6   Acknowledgements

References

Barnes-Mauthe, M., Oleson, K. L. L., & Zafindrasilivonona, B. (2013). The total economic value of small-scale fisheries with a characterization of post-landing trends: An application in Madagascar with global relevance. *Fisheries Research*, *147*, 175–185. https://doi.org/10.1016/j.fishres.2013.05.011

Epps, M. M. (2008). *A Socioeconomic Baseline Assessment : Implementing the socioeconomic monitoring guidelines in southwest Madagascar*.

Holloway, G., & Short, S. (2014). Towards a more adaptive co - management of natural resources – increasing social - ecological resilience in southeast Madagascar. *Madagascar Conservation & Development*, *9*(1), 36–48. https://doi.org/10.4314/mcd.v9i1.7

Ingram, J. C., Whittaker, R. J., & Dawson, T. P. (2005). Tree structure and diversity in human-impacted littoral forests, Madagascar. *Environmental Management*, *35*(779–798). https://doi.org/10.1007/s00267-004-0079-9

Jones, B. (2011). *Socio-economic monitoring: A baseline assessment of the fishing villages of the Kirindy-Mite MPA*.

Long, S. (2017). Short-term impacts and value of a periodic no take zone (NTZ) in a community-managed small-scale lobster fishery, Madagascar. *PLoS ONE*, *12*(5), 1–23. https://doi.org/10.1371/journal.pone.0177858

Long, S., Thurlow, G., Jones, P. J. S., Turner, A., Randrianantenaina, S. M., Gammage, T., … Ndriamanja, J. R. (2019). Critical analysis of the governance of the Sainte Luce Locally Managed Marine Area (LMMA), southeast Madagascar. *Marine Policy*. https://doi.org/10.1016/j.marpol.2019.103691

Pomeroy, S. R., Parks, J. E., Watson, L. M., Pomeroy, R. S., Parks, J. E., & Watson, L. M. (2004). *How is your MPA doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness.* Gland, Switzerland: IUCN.

Sabatini, G., Salley, S., & Ramanamanjato, J. (2007). A Review of the Spiny Lobster Fishery in the Tolagnaro (Fort-Dauphin) Region. *Biodiversity, Ecology and Conservation of Littoral Ecosystems in Southeastern Madagascar, Tolagnaro (Fort Dauphin)*, 299–308.

SEED Madagascar. (2018). *Situational Analysis of the Lobster Fishing Communities of Sainte Luce, Ebakika and Itapera*.

Skinner, F., Burtenshaw-deVries, A., Long, S., Randrianantenaina, S., & Ellis, E. (2016). Phase two project for community lobster fishery management in the village of Sainte Luce (Project Oratsimba) Final report July 2016, (July), 1–43.

UNDP. (2018). *Human Development Indices and Indicators. 2018 Statistical Update*. *United Nations Development Programme*. Retrieved from http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

Wilkie, D., Wieland, M., & Detoeuf, D. (2015). *A guide to the modified Basic Necessities Survey: Why and how to conduct BNS in conservation landscapes*. New York, USA: WCS.

Appendix A - Survey

Baseline Survey

Vakio amin'ny mpandray anjara ny taratasy fanekena
Read consent information sheet to participant.

1.1 Ianao ve ny loham-pianakaviana? Raha tsia, mpifaninona ianao sy ny loham-pianakaviana?
Are you the head of the household? If not, what is your relation to the household head?

Head of Household **loham-pianakaviana**	Wife **Vady (vavy)**	Husband **Vady (lahy)**
Son **Zanaka lahy**	Daughter **Zanaka vavy**	Mother **Reny**
Father **Ray**	Brother **Rahalahy**	Sister **Rahavavy**
Aunt **Nenitoa**	Uncle **Dadatoa**	Grandmother **Renibe**
Grandfather **Raibe**	Cousin **Zanakin'ny mpirahalahy na mpirahavavy**	Friend **Namana**
Joint head of household **Samy loham-pianakaviana**	No head of household **Tsy misy loham-pianakaviana**	(specify other) **Hafa (hazavao tsara)**
Don't know **Tsy hay**	Prefer not to say **Tsy tiana holazaina**	

1.2 Iza ny anarana fiantsoana ny loham-pianakaviana?
What is the surname of the household head?

> **Ny anarana fiantsoana dia hampiasaina hamantarana ny tokantrano fotsiny fa tsy ilaina amin'ny fanaovana tatitra**
> Surname will only be used to identify houses and will not be used in reporting.

1.3 Efa misy firy taona niorenan'ny tokatranonareo eto amin'ity fokotany ity?
How long has your household lived in this Fokontany?

> **Azafady tanisao ny isan'ny taona nahalasa mponina azy.**
> Please specify total number of years or year became resident.

1.4 Firy taona ianao?
What is your age?

> **Raiso ny taona nahaterahany raha tsy tadidiny ny taonany**
> If age unknown use year of birth.

1.5 Lahy / vavy?
What is your gender?

Male	Female	Other	Prefer not to say
Lahy	Vavy	Hafa	Tsy tiana holazaina

1.6 Hatraiza ny fianarana vitanao?
What is the highest level of education you have completed?

T1		
T2		
T3		
T4		
T5		
T6/6eme		
T7/5eme		
T8/4eme		
T9/3eme		
T10/2nd		
T11/1ere		
T12/terminal/baccalaureate		
Bachelor's degree		Master's degree
(specify other) Hafa (Inona)	Don't know Tsy fantatra	No formal education Tsy nianatra tany an-tsekoly
Prefer not to say Tsy tiana holazaina		

1.7 Firy ny isan'ny vehivavy monina ao anatin'ny tokantrano raha miampy ny mpandray anjara?
What is the total number of females living in this household including participant?

> **Ny dikan'ny teny hoe monina ao anaty tokantrano dia olona iray sakafo sy trano nandritra ny roa herinandro lasa teo. Tsy anatin'izany ny olona miasa na mianatra ivelany.**
> Living in a household is defined as those people who ate and slept in the household in the previous two weeks. This does not include family members who are away studying, working etc..

1.8 Taonan'ny vehivavy voalohany
Age of female (including participant)
1, 2 ….

> **Rehefa tsy fantatra ny taona dia ampiasaina ny taona nahaterahana.**
> If age unknown use year of birth.

1.9 Firy ny isan'ny lehilahy ao anatin'ny tokantrano raha miampy ny mpandray anjara?

What is the total number of males living in this household including participant?

> **Tsy maintsy olona iray sakafo sy trano mandritra ny 2 herinandro lasa teo. Tsy anisan'izany ny olona miasa sy mianatra ivelany.**
> Living in a household is defined as those people who ate and slept in the household in the previous two weeks. This does not include family members who are away studying, working etc.

1.10 Taonan'ny lehilahy voalohany

Age of male (including participant)

1, 2 ….

> **Rehefa ny taona tsy fantatra, ampiasaina ny taona nahaterahanambara dia avelao malalaka.**
> If age unknown use year of birth.

2.1 Inona daholo ny asa mampidi-bola ao anaty tokantranonareo?

What activities provide your household with money?

> **Aza vakina ny valiny etsy ambany ary tsy anatiny ny asa tsy mampidi-bola ao anatin'ny tokantrano fa sakafo fotsiny**
> Do not read options, do not include activities that only bring food and not money into the household.

Lobster fishing **Mamovo na manjono oratsimba**
Fishing fish - handline, nylon net **Manjono trondro: vintana, harato**
Fishing - diving for sea cucumbers **Manjono: Mirika cocombre de mer**
Freshwater fishing - mosquito net or lamba or mahampy or woven material **Jono an-dranomamy: Lay (mostikera) na lamba na atsidina na fitaovana norarena**
Freshwater fishing – handline **Jono an-dranomamy: vintana**
Collector **collecteur**
Rabbateur
Selling raw fish - inside community or to nearby communities, not to collector **Varotra trondro manta: eto an-toerana na amin'ny toerana manodidina fa tsy amin'ny collecteur**
Selling cooked fish **Varotra trondro masaka**
Shop keeping / tea room Botika / Gargotier
Farming - crops (specify in next question) Voly (anotanio tsar any zavatra amboleny)
Farming- livestock (pigs, zebu, ducks, chickens, **specify in next question) Fiompiana (kisoa, omby, gana, akoho)** azavaho amin'ny fanontaniana manaraka
Guardian of another persons zebu. **Mpiaraka ombin'olona**
Mahampy weaving: any product **Rary vita amin'ny mahampy: izay rary ataony**
Selling raw mahampy reeds **Varotra mahampy**
Logging /selling - timber **Fikapana hazo / varotra hazo trano**
Selling firewood and charcoal **Varotra kitay na arina (charbon)**
Laundry **Sasa**
Casual work (dobakandro): weeding **Asa antselika (dabokandro): ava**
Casual work (dobakandro): rice transplanting **Asa antselika (dabokandro): ketsa**
Carpenter **Mpandrafitra**
Construction/building (inside community) **Mandrafitra eto an-toerana**
Teacher **Mpampianatra**
Road building / for SARA **Miasa lalana amin'ny SARA**
Mining / QMM
SEED/ **ONG Azafady**
Manafiafy Lodge **Hotely Manafiafy**
Don't know **Tsy fantatra**
Other, please specify **Hafa (inona)**
Prefer not to say **Tsy tiana hambara**

2.1.1 Inona ny fitaovana entinao mamovo na manjono oratsimba?
What gear is used to fish for lobster?

Pot **vovo**
Net **harato**
Trap **fandrika**
diving **mirika**
don't know **tsy fantatra**
prefer not to say **tsy tiana holazaina**
other (please specify) **zavatra hafa (inona?)**

2.1.1 Inona ny voly mampidi-bola ao anaty tokantranonareo?
What crops are farmed?
Tsy ilaina ny voly tsy mampidi-bola na ny atao sakafo fotsiny
Do not include crops only farmed for food. Do not read options.

Banana **Akondro**
Beans **Voamaina**
Cassava **Balahazo**
Coconut **Voanio (coco)**
Jackfruit **Apalibe**
Lychee **Ledisy**
Maize/corn **Katsaka (tsako)**
Mango **Manga**
Orange **Voahangy**
Peach **Paiso**
Pineapple **Mananasy**
Pink pepper **baie rose**
Pumpkin **Taboara**
Rice **vary**
Sweet potato **Bageda**
Tarot **Tsonjo**
Other, please specify **Hafa (inona)**
Don't know **Tsy fantatra**
Prefer not to say **Tsy tiana hambara**

2.1.2 Inona ny biby ompianao ka mampidi-bola anaty tokantranonareo?
What livestock are farmed?

Tsy ilaina ny biby ompiana atao sakafo fotsiny
Do not include livestock only farmed for food. Do not read options

Chicken **Akoho**
Ducks **Kana**
Geese **Gisa**
Goat **Osy**
Pigs **Kisoa**
Zebu **Omby**
Other, please specify please specify **Hafa (inona)**
Don't know **Tsy fantatra**
Prefer not to say **Tsy tiana hambara**

2.2 Aiza amin'ireo asa ireo ny tena mampidi-bola ao anaty tokatranonareo?
Of these activities, can you tell me which provides your household with the most money?

2.2.1 Raha tsy afaka manao an'io asa io ianao dia inona koa ny asa hafa ataonao tena mampidi-bola ao anaty tokatranonareo ankoatran'io?
If you cannot do this activity, what activity provides your household with the most money?

2.2.2 Raha tsy afaka manao an'io asa io ianao dia inona koa ny asa hafa ataonao tena mampidi-bola ao anaty tokatranonareo ankoatran'io?
 If you cannot do this activity, what activity provides your household with the most money?

2.2.3 Raha tsy afaka manao an'io asa io ianao dia inona koa ny asa hafa ataonao tena mampidi-bola ao anaty tokatranonareo ankoatran'io?
If you cannot do this activity, what activity provides your household with the most money?
        .

2.3.1 Mivarotra vombon'antsantsa ve ny ato an-tokatranonareo?
Does your household sell shark fins for money?

Yes	No	Don't know	Prefer not to say
Eny	**Tsia**	**Tsy fantatra**	**Tsy tiana hambara**

2.3.2 Mivarotra vatany na nofon'antsantsa ve ny ato anaty tokantranonareo?
Does your household sell shark meat for money?

2.3.3 Mivarotra charbon ve ny ato anaty tokatranonareo?
Does your household sell charcoal for money?

2.3.4 Mivarotra kitay ve ny ao anaty tokatranonareo?
Does your household sell firewood for money?

2.3.5 Mivarotra hazotrano ve ny ao anaty tokatranonareo?
Does your household sell timber (wood for construction) for money?

2.3.6 Mivarotra vokatra azo amin'ny mostikera (lay misy ody moka), lamba, harato kely maso latsakin'ny 2 tondro ve ny ato anaty tokatranonareo?
Does your household sell the products of fishing with mosquito nets, lambas, mahampy, nets with mesh size smaller than two fingers or something similar?

2.3.7 Tamin'ny taona lasa,ny 2018, efa nisy fotoana nihinanan'ny vadinao laoky niazo avy any anaty ala: Lamboala, Variky,Fanihy ?
In the past year, 2018, has your household eaten lemur, bats, wild pigs or other animals hunted and caught in the forest?

3.1 Oviana no tena amarotanareo matetika ny vombon'antsantsa amin'ny fotoana ihidian'ilay faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ianareo ve sa ny isokafany?
When it is not allowed to fish for lobster because the no take zone is closed do you sell **shark fins** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

3.2 Oviana ny fotoana tena ivarotanareo vatan'antsantsa matetika amin'ny fotoana ihidian'ny faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ianareo ve sa amin'ny fotoana isokafany?
When it is not allowed to fish for lobster because the no take zone is closed does your household sell **shark meat** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

3.3 Oviana ny ny tena ivarotanareo charbon matetika amin'ny fotoana ihidian'ny faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ianareo ve sa amin'ny fotoana isokafany?
When it is not allowed to fish for lobster because the no take zone is closed does your household sell **charcoal** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

3.4 Oviana ny fotoana tena ivarotanareo kitay matetika amin'ny fotoana ihidian'ny faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ve ianao sa amin'ny fotoana isokafany?
When it is not allowed to fish for lobster because the no take zone is closed does your household sell **firewood** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

3.5 Oviana ny fotoana tena ivarotanareo hazotrano matetika amin'ny fotoana ihidian'ny faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ve ianao sa amin'ny fotoana isokafany?
When it is not allowed to fish for lobster because the no take zone is closed does your household sell **timber (wood for construction)** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

3.6 Oviana ny fotoana tena ivarotanareo vokatra azo amin'ny mostikera (lay misy ody moka), lamba, harato kely maso latsakin'ny 2 tondro   matetika amin'ny fotoana ihidian'ny faritra arovana (limity) satria tsy afaka mamovo na manjono oratsimba ve ianao sa amin'ny fotoana isokafany?
When it is not allowed to fish for lobster because the no take zone is closed does your household sell **mosquito nets, lambas, mahampy, nets with mesh size smaller than two fingers or something similar** more or less compared to when it is allowed to fish for lobster because the no take zone is open?

4.1 Asehoy tsirairay ilay karatra dia apetraho ity fanontaniana ity: "Manana na afaka mahazo an'ity ve ianao"?

Present cards one by one and ask "Does your household currently own or have access to this item?"

Iangavio ilay olona anaovanao fanadihadiana mba hanokana ny karatra eny sy tsia

Get participant to place cards into piles of yes and no.

Yes **Eny**	No **Tsia**	Prefer not to say **Tsy tiana hambara**

A. Plastic bucket : **sihoa**
B. Big cooking pot, size 60 for celebration: **vilany be60marikahanaovana fety, na fivoriam-pianakaviana.**
C. Big cooking pot for rice : **vilagny be fandrahoa vary**
D.Small metal spoon for eating : **sotro**
E. Mahampy mat : **tsihy mahampy**
F. Fleece blanket : **bodofotsy**
G. Metal lobster pot: **vovo langosta vita amin'ny vy**
H. Wooden lobster pot: **vovo langosta vita amin'ny hazo**
I. Life jacket : **sauvetage**
J. Cement floor in house : **tragno vita dallage**
K. Metal roof on house : **tragno vifotsy**
L. Radio : **radio**
M. Latrine : **fivoahana (toilet)**
N. Zebu : **agnomby**
O. Antanosy pirogue : **laka tanosy**
P. Vezo pirogue :**lakam-bezo**
Q. Fibreglass boat with motor: **kanoty**
R. Bicycle: **biskileta**
S. Shoes : **kiraro**
T. Glass cup : **vera**
U. Tin plate : **lasety**
V. Foam mattress: **kidory eponge**
W. Bed : **farafara**
X. Mobile : **telefony**
Y. Motor cycle: **moto**
Z. Television: **tele**
AA. Metal cooking tripod : **toko-vy**
BB. Solar panel : **panneaux solair**
CC. Generator : **group**
DD. Money to visit a doctor: **Vola ho an'ny fahasalamana**
EE. Money to send all school age kids to school: **Vola ikarakarana fianaran-jaza**
FF. Water from a well or tap in the community: **Ranom-bovo na rano pompy eo an-tanana**
GG. Enough money to be able to save money: **Mananan-bola ampy hahaja hitsinjovana vodiandro homerika**

4.2 Asehoy indray ilay karatra ary aza ovaina ny filaharany ka apetraho ity fanontaniana ity: "Ilain'ny isan-tokantrano amin'ny fiainany andavanandro ve io hany ka na iza na iza dia tsy maintsy manana azy?

Present cards again in same order and ask ""Is this item in your view a basic necessity that every family in the community should have and no family should have to do without?"

Iangavio ny olona anaovanao fanadihadiana mba hanokana ny karatra eny sy ny tsia.
Get participant to place cards into piles of yes and no.

Yes	No	Prefer not to say
Eny	Tsia	Tsy tiana hambara

4.3 Hanotaniako anao ny laharan'ireo zavatra noresahinao teo aloha
I am now going to ask you the numbers of the items that you previously said you own.

5.1 Manjono oratsimba (mamovo) ve ianao?
Are you yourself a lobster fisher?

Yes	No	Prefer not to say
Eny	Tsia	Tsy tiana hambara

5.2 Firy ny olona manjono oratsimba (mamovo) ao anaty tokantranonareo tamin'ny 2018?
How many people in your household have fished for lobster in 2018?

6. Anontaniana ny isa-tokantrano rehetra anatin'izany ny tokantrano tsy misy mpanjono ireto fanontaniana manaraka ireto.

Following questions to be asked to **all households** including non-fishing.

6.1. Azo atao ve ny mamovo na manjono oratsimba amin'ny volana Janoary, Febroary, Martsa?

Is fishing for lobsters allowed in January, February and March?

6.2 Azo atao ve ny mitondra oratsimba na langouste tahaka an'ity ny habeny?

If a lobster exactly like this was caught is It allowed to take it back to shore?

6.3 Azo atao ve ny mampiasa harato latsakin'ny 2 tondro?

Is fishing with nets or materials with a mesh size smaller than two fingers allowed?

> **Asehoy azy ny tondronao 2 raha toa ka tsy mazava aminy ny fanazavanao**
> If confusion, hold up and show two fingers to participant

6.4 Azo atao ve ny mitondra oratsimba na langouste tena mitovy amin'ity ny habeny?

If a lobster exactly like this was caught is It allowed to take it back to shore?

7.1 Azo atao ve ny mampiasa fiataovam-panjonoana hafa ankoatra ny vovo ao anaty faritra arovana na limity?

Is fishing with fishing gear other than lobster pots in the no take zone allowed?

7.2 Azo atao ve ny mamitana ao anatin'ny faritra arovana na limity amin'ny Mey 2019?

In may 2019 is it allowed to fish in the no take zone?

7.3 Azo atao ve ny mampiasa masque sy

Is fishing with a mask and snorkel allowed in Sainte Luce?

8. Taloha ve imano iba fa nandray anjary amin'ny fanapahakevitra mahakasika ilay faritra arovana na limity?

In the past have you been involved in making decisions about the no take zone?

Yes	To some extent	No	Prefer not to say
Eny	Amin'ny lafiny iray	Tsia	Tsy te-hamaly

8.1 Inona avy ny antony tsy fandraisanao anjara?
What were your reasons for not being involved?

Not a lobster fisher myself **Tsy mpamovo na mpanjono oratsimba ny tenako**
Gender **lahy sy vavy**
No one in my family fishes for lobster
Illiterate **tsy mahay taratasy**
Don't want to **tsy tehanao**
Don't have the time **tsy manam-potoa**
Community status **Sata mifehy ny fiarahamonina**
Don't have enough knowledge **tsy ampy fahalalana**
Don't know how to get involved **tsy mahafantatra ny fandraisan'anjara**
Discouraged by riaky committee **kivy amin'ny komity riaky**
Discouraged by SEED staff **kivy amin'ny zavatra ataon'ny SEED**
Discouraged by community leaders **Kivy amin'ny mpitarika eo amin'ny fiarahamonina**
Other (please specify) **hafa (farito tsara)**
Don't know **tsy fantatra**

9.Te handy ankara bebe kokoa amin'ny fanapahakevitra mahakasika ny faritra arovana na limite ve imano amin'ny manaraka?

Would you like to become more involved in making decisions about the fishing gear rules in the future?

Yes	To some extent	No	Prefer not to say
Eny	Amin'ny lafiny iray	Tsia	Tsy te-hamaly

9.1 Inona ny antony tsy itiavanao handray anjara bebe kokoa aminy?
What are your reasons for not wanting to be more involved?

Tapitra ny fanadihadiana. Isaory ny olona niresahanao noho ny fahafoizany fotoana.
End of survey. Thank participant for their time.

Appendix B – Basic Necessity Item Ownership

Table 18. Household (%) basic necessity item ownership by community (n=553).

	Target communities			Control communities		
	Elodrato	Itapera	Sainte Luce	Ambanihazo	Antsotso	Baie d'Italy
Metal spoon	98.9	98.6	99.0	100.0	99.0	100.0
Cooking pot for rice	98.9	100.0	98.0	100.0	100.0	97.1
Tin plate	98.9	100.0	99.0	100.0	96.9	98.0
Metal cooking tripod	93.7	93.2	99.0	98.8	100.0	84.3
Mahampy mat, hand woven reed mat	97.9	97.3	99.0	98.8	99.0	97.1
Plastic bucket	96.8	94.6	98.0	96.3	99.0	78.4
Water from a well or tap in the community	42.1	91.9	81.4	11.0	40.8	99.0
Money to send all school age kids to school	18.9	12.2	13.7	35.4	34.7	13.8
Money to visit a doctor	26.3	24.3	16.7	17.1	26.5	5.9
Enough money to be able to save money	25.3	24.3	16.7	22.0	25.5	2.94
Shoes	91.6	90.5	95.1	95.1	92.9	91.2
Lobster pot (wooden)	51.6	79.7	73.5	63.4	81.6	83.3
Fleece blanket	88.4	81.1	88.2	91.5	89.8	38.2
Antanosy pirogue, wooden dugout canoe	13.7	16.2	40.2	37.8	19.4	36.3
Zebu, dry adapted indicine cattle	50.5	20.3	29.4	75.6	54.1	43.1
Glass cup	67.4	40.5	74.5	76.8	75.5	29.4
Bed	71.6	60.8	78.4	73.2	60.2	30.4
Lobster pot (metal)	10.5	10.8	8.8	31.7	22.4	8.8
Latrine	1.0	0.00	4.9	0.0	1.0	0.0
Large cooking pot for celebrations	28.4	12.2	24.5	23.2	20.4	15.7
Life jacket	7.4	10.8	63.7	11.0	14.3	14.7
Radio	42.1	39.2	47.1	36.6	27.6	18.6

Appendix C – Poverty Index Model

The Poverty Index of households was modelled employing lobster fishing status (categorical, 2 levels) and community (categorical, 6 levels) as explanatory variables. The full model included both explanatory variables and the interaction between them. Stepwise model simplification was conducted using F tests to determine the significance of dropped terms to produce a minimum adequate model (MAM), where Poverty Index was determined by the effect of lobster fishing status and the effect of community.

Fishing households were significantly wealthier ($F_{1,446}$=39.9, $p<0.001$). Poverty index also varies significantly between communities ($F_{5,446}$=15.1, $p<0.001$), a post hoc Tukey test showed this was because Baie d'Italy is significantly ($p<0.01$) poorer than all other communities. The Poverty Index of the other 5 communities did not differ significantly ($p>0.05$).