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A Report for

PROJECT ORATSIMBA

Participatory Monitoring Programme: Phase III Analysis

Jessica Savage

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2 Introduction and Methods

The participatory lobster fishery monitoring programme monitors both the short and medium-term effects of establishing a Locally Managed Marine Area (LMMA) and associated local management measures, and compliance with national fisheries legislation. Local management measures include periodic No Take Zones (NTZ), and national fisheries legislation includes a 200mm minimum landing size (MLS) and prohibition on landing berried females. The monitoring program was established in 2015 in Sainte Luce and was extended to the neighbouring communities of Elodrato and Itapera in 2018 during Project Oratsimba Phase III.

The participatory monitoring programme consists of two surveys, a landings/effort survey and a catch composition survey, and is carried out by trained community data collectors, for the full methodology see Long 2017. The landings/effort survey collects data on the number of pirogues (wooden dugout canoes), the number of pots deployed, the number of fishers involved, total catch count and weight (kg), price at first point of sale (MGA/kg) and in Itapera, if a snorkel has been used and the number of ground nets deployed. The catch composition survey collects data on individual lobsters landed including species, total length (mm), sex and berried status of females. In all three communities, data was collected from April 2018 to December 2020 inclusive, excluding the annual national closed season for lobster fishing occurring from January to March. In Sainte Luce, this also included both open and closed NTZ periods. In Itapera, the data collector is not stationed directly at the landing site and does not collect data from pirogues which have not caught lobster opposed to in Elodrato and Sainte Luce where pirogues are sampled at random. In Sainte Luce, sampling at the second landing site, the Lodge, was ceased during Phase III as the majority of fisher effort is concentrated from the Manafiafy landing site (referred to as ‘Sainte Luce’ throughout this report) with less than 10 pirogues operating from the Lodge landing site. Additionally, previous data (see Long 2018) suggests no major differences between the landing sites in Sainte Luce other than the number of pirogues operating.

Progress towards fisheries management during Phase III varied between the three communities. In Sainte Luce the LMMA and NTZ remained operational and the *dina* (local customary law) became ratified into national law. In Elodrato the community designed a fisheries *dina* which was locally ratified and the NTZ was closed for the first time during Phase III in May 2021 (2021 data is excluded from this analysis to enable comparison between years). In Itapera, the community rejected the idea of an NTZ due to conflicts within the community between users of different lobster fishing gear (pots vs freediving) and between resident and long-term migrant fishers and an LMMA was not established. This report presents a summary of participatory monitoring programme data collected during Project Oratsimba Phase III from 2018 – 2020 in Elodrato, Itapera and Sainte Luce, building on analysis conducted for 2018 (see Long 2019) and 2015 – 2017 (see Long 2018). Additionally, in Sainte Luce, data from 2015-2017 is included for comparative purposes.

3 Results

3.1 Landings / Effort

A total of 1,340 landings effort surveys were conducted by community data collectors from April 2018 to December 2020 at three landing sites: 451 in Elodrato, 431 in Itapera and 458 in Sainte Luce (Table 1).

3.1.1 Fishing effort

The mean number of pirogues, which includes active and inactive pirogues and pirogues not involved in lobster fishing, provides a broad estimate of fishing effort at each landing site. From 2018-2020, Sainte Luce consistently had the highest number of pirogues and was the largest fishing community in terms of the number of pirogues. Elodrato and Itapera had notably fewer pirogues operating, and the mean number of pirogues decreased from 2018 to 2020. In Sainte Luce, the mean number of pirogues increased overall from 2018 to 2020 although a decrease was observed in 2019. The mean number of pots deployed per pirogue was similar between communities and decreased in all communities from 2018 to 2020 (Table 1).

Table 1. Landings/effort survey sampling occasions mean pirogues present (active and inactive and also including pirogues not involved in lobster fishing) and men lobster pots deployed.

Landing site	Year	Sampling occasions	Pirogues sampled	Mean pirogues present (sd)	Mean pots deployed per pirogue (sd)
Elodrato	2018	148	1,916	35.7 (4.1)	24.4 (7.6)
	2019	148	1,119	34.4 (6.9)	25.0 (12.4)
	2020	155	1,318	26.7 (1.7)	17.9 (2.9)
Itapera ¹	2018	158	1,843	36.4 (3.6)	33.4 (13.9)
	2019	149	1,477	34.4 (7.3)	24.9 (14.0)
	2020	124	1,208	30.9 (1.2)	23.6 (14.5)
Sainte Luce	2018	169	2,450	100.0 (12.0)	23.0 (12.5)
	2019	150	2,406	93.4 (18.6)	21.6 (12.8)
	2020	139	2,264	111.7 (17.7)	21.3 (9.8)
All	2018	475	4,353	172.1	25.9 (12.2)
	2019	447	4,528	162.2	23.2 (13.1)
	2020	418	7,120	169.3	20.9 (10.2)
	Total	1,340	16,001	503.6	23.5(12.1)

¹In Itapera, the data collector is not stationed directly at the landing site and does not collect data from pirogues which have not caught lobster and in addition multiple gear types are deployed including snorkels and ground nets. Caution should be taken when comparing data from Itapera to Elodrato and Sainte Luce.

3.1.2 Comparison of CPUE for Pot Fishing

Catch per unit effort (CPUE) was measured as lobsters boatday⁻¹ (the number of lobsters caught per boat per day) and was standardised to the mean number of pots used in from 2018-2020 for that community. Data from Itapera was not comparable, due to the different gear employed, snorkels and ground nets, and sampling method, only sampling pirogues where lobsters had been caught, and was therefore excluded. In Elodrato and Sainte Luce, CPUE was higher in April for all years which was the first month of the national season for lobster fishing. In Sainte Luce, CPUE was also higher during the first month of NTZ opening. Overall, median CPUE for 2018-2020 was higher in Sainte Luce, 2.7 lobsters boatday⁻¹, compared to Elodrato, 2.3 lobsters boatday⁻¹ (Figure 1).

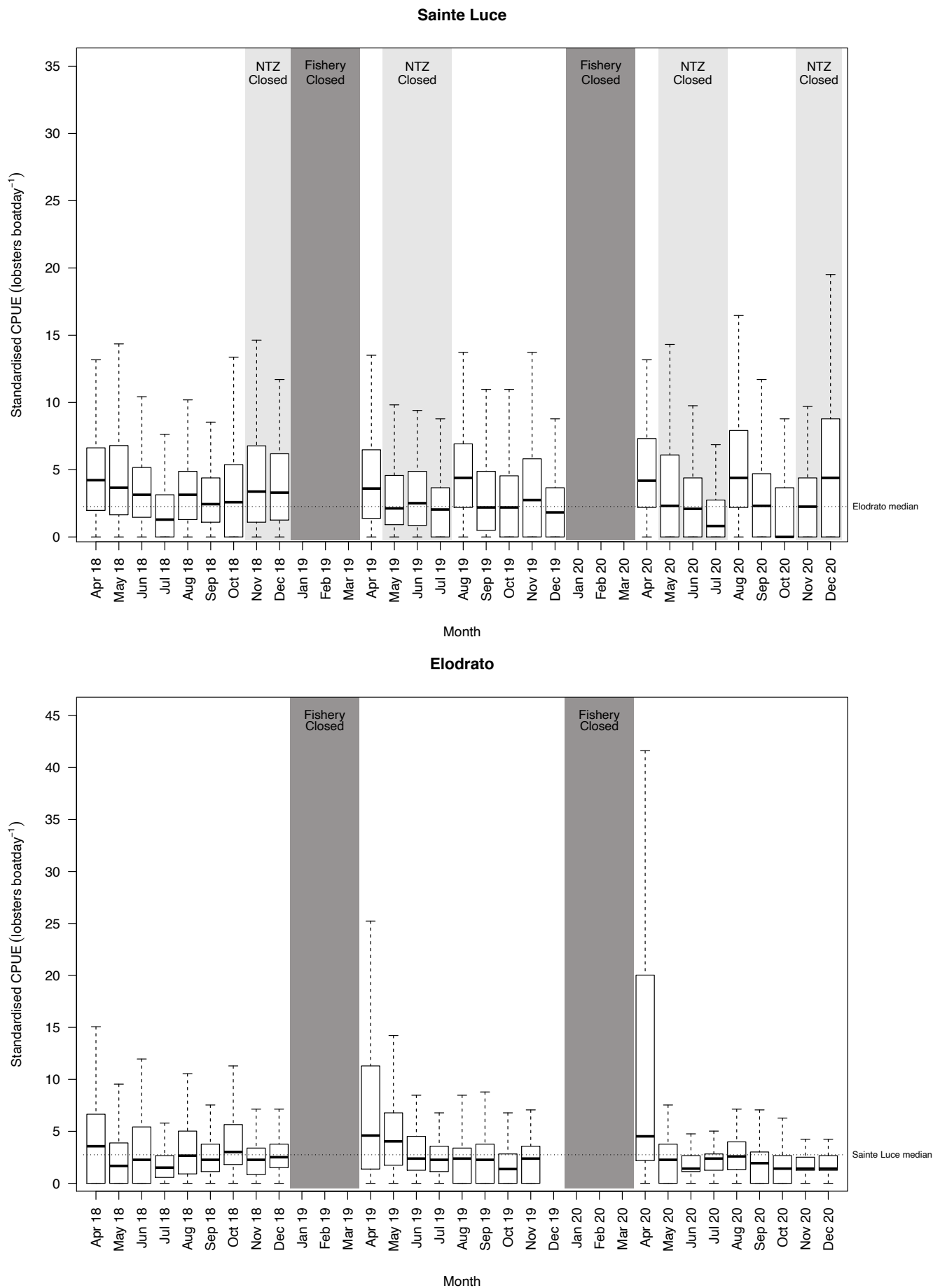


Figure 1. Standardised CPUE (lobsters boatday⁻¹) in Sainte Luce (n=x) and Elodrato (n=x) by month, excluding outliers. CPUE was standardised to the mean number of pots deployed in that community from 2018-2020.

3.1.3 Comparison of CPUE between NTZ Periods

To compare CPUE (lobsters boatday⁻¹) between periods of NTZ closures and openings in Sainte Luce since the NTZ became operational in 2015, CPUE was standardised to the mean number of pots used from 2015-2020. With the exception of 2018, CPUE varied between NTZ status across all years and was higher during NTZ openings compared to closures. In 2018, CPUE was approximately the same for both NTZ openings and closures. Overall, for 2015-2020 combined, median CPUE was slightly higher during NTZ openings, 3.0, compared to NTZ closures, 2.1 (Figure 2).

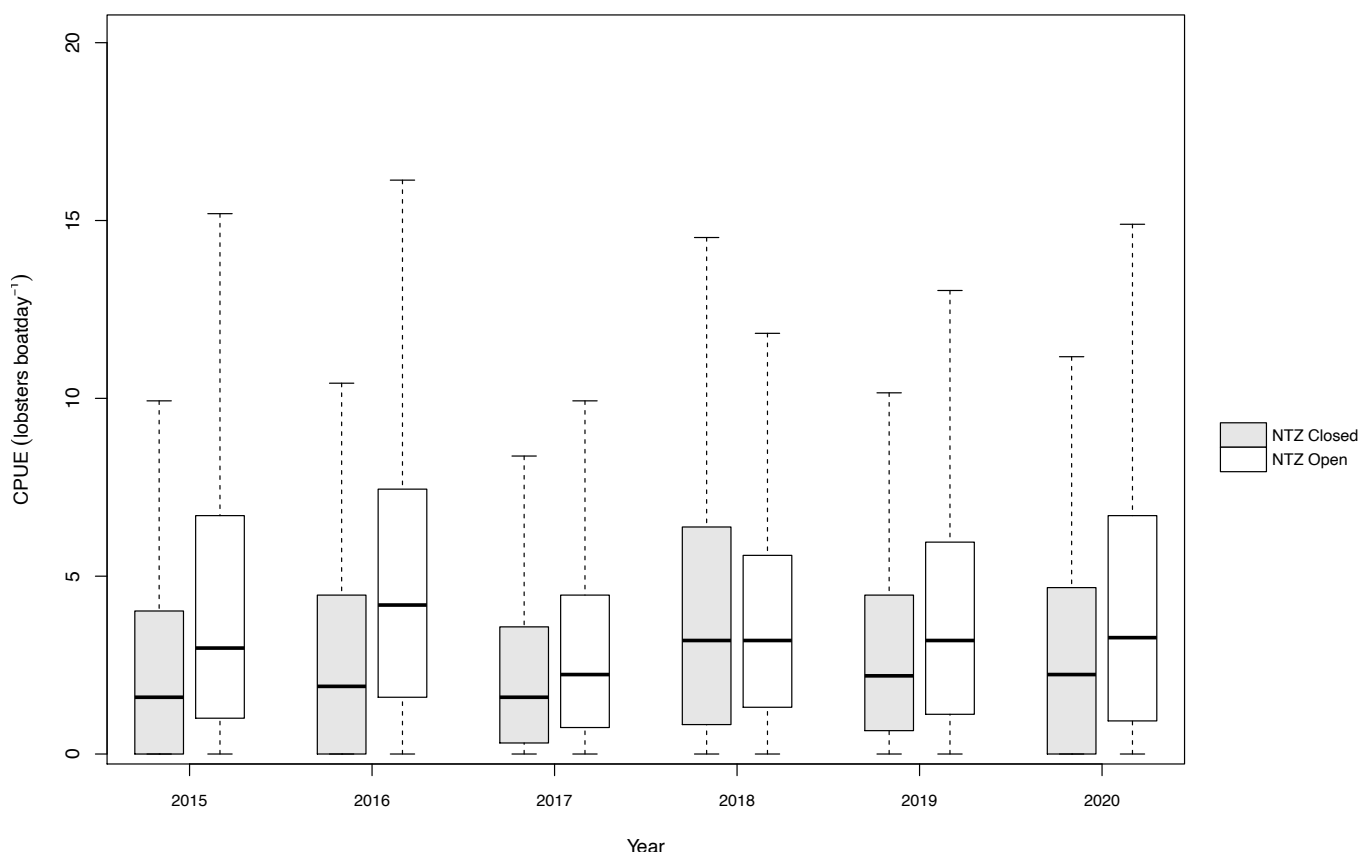


Figure 2. Standardised CPUE (lobsters boatday⁻¹) in Sainte Luce disaggregated by year and by NTZ status from 2015 – 2020 (n=14,147), excluding outliers. Where CPUE was standardised to the mean number of pots deployed in that community from 2015-2020

3.1.4 Comparison of CPUE between all communities

To broadly compare CPUE between all three communities, taking into account the difference in sampling and gear in Itapera, CPUE was calculated as kg lobster boatday⁻¹ and was compared for occasions only where lobsters were caught. This does however overinflate CPUE. CPUE did not vary greatly between the communities and from 2018-2020 Elodrato consistently had the lowest and Sainte Luce had the highest CPUE (Figure 3)

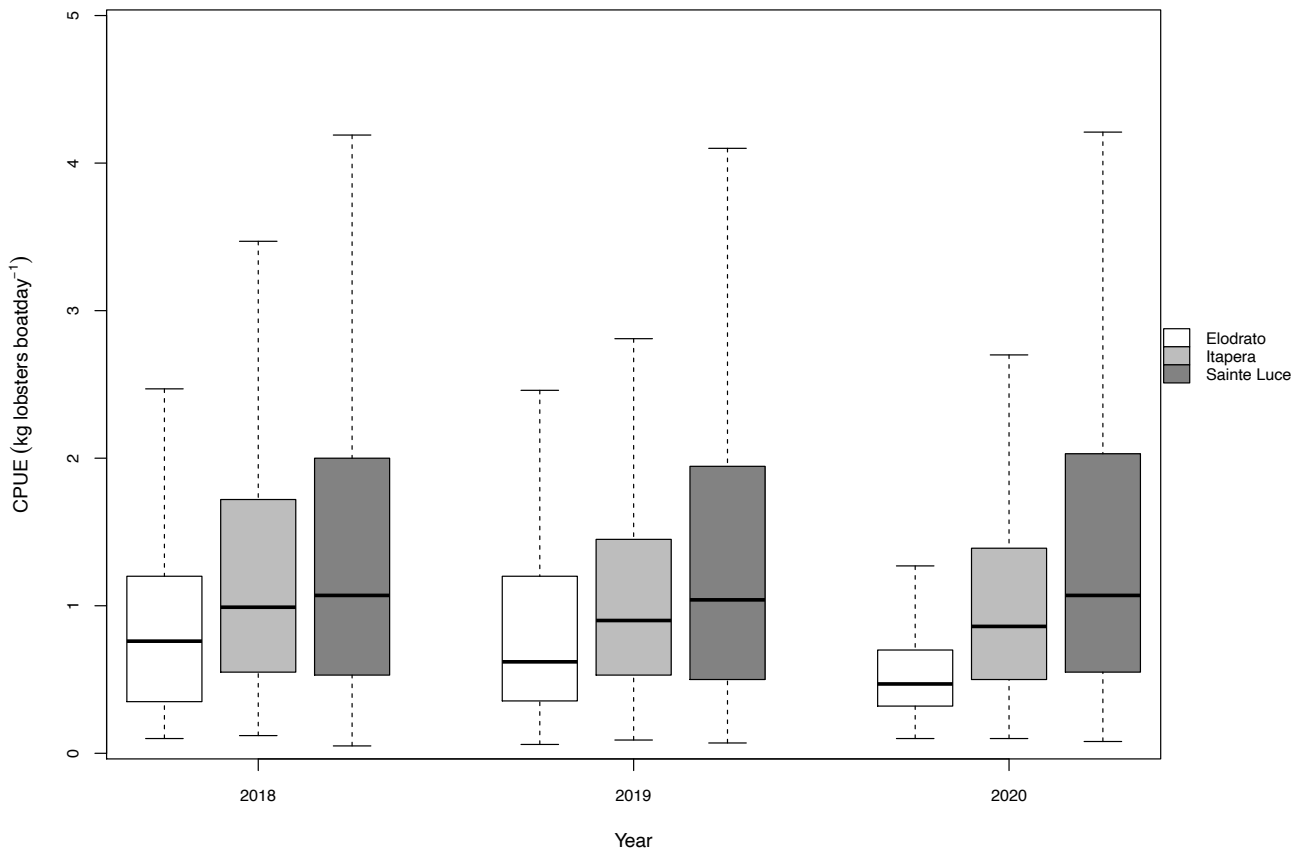


Figure 3. Figure 4. Standardised CPUE (kg lobsters boatday⁻¹) for pot fishing disaggregated by community from 2018-2020 (n=x). CPUE was not standardised to account for the difference in methodology and fish gear deployed in Itapera.

3.1.5 Price at First Point of Sale

The mean price at first point of sale for lobsters throughout Phase III varied between communities and between months within communities. The highest mean price was observed in November 2018 in Itapera, although the exact reason for this is unknown, it is likely due to an increase in demand for lobsters for export markets before the national closed season for lobster fishing (Figure 5). From 2018-2020 (n=13,069), mean price at first point of sale was MGA19,360/kg $\pm$ 1,988 in Itapera, MGA22,490/kg $\pm$ 5,480 in Elodrato and MGA21,121/kg $\pm$ 3,162 in Sainte Luce. In Sainte Luce (n=5,913) from 2018-2020, mean price at first point of sale was slightly higher during NTZ openings, MGA 21,596/kg $\pm$ 3,335, compared to during NTZ closures, MGA 20,177/kg $\pm$ 2,961.

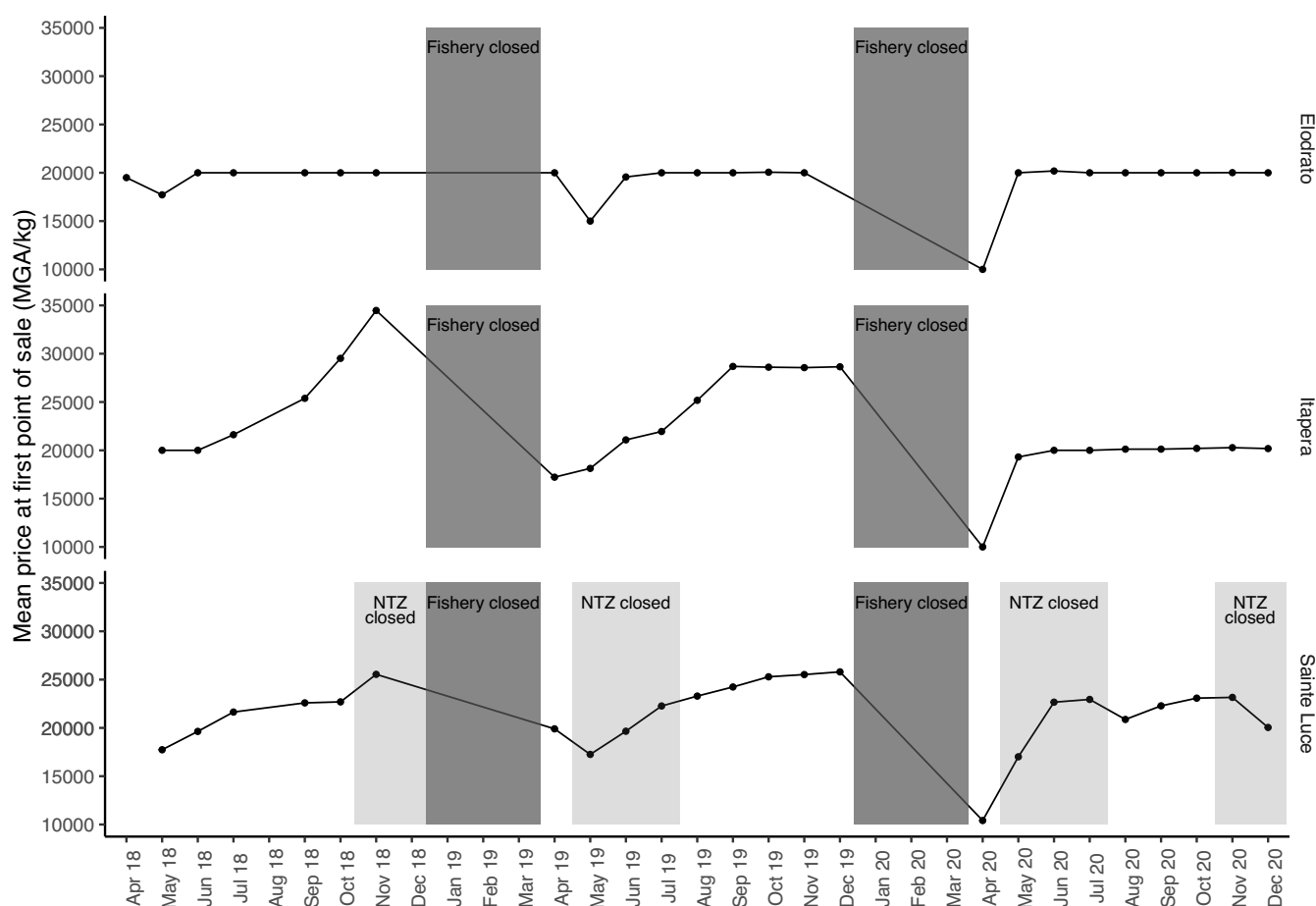


Figure 5. Mean monthly price at first point of sale (MGA/kg) disaggregated by community from 2018-2020 (n=13,069).

3.1.6 Price at First Point of Sale During NTZ Openings (Sainte Luce)

To monitor changes in price at the first point of sale during NTZ openings in Sainte Luce over Phase III, price at baseline and endline was compared. Baseline data was from May 2018 – October 2018 (excluding August 2018 where data was missing) during the first Phase III NTZ opening period and endline data was from August 2020 to October 2020 during the final Phase III NTZ opening period. Mean price at first point of sale during NTZ openings at baseline was MGA20,357/kg (n=1,195) and at endline was MGA21,632/kg (n=1,203) which was an increase of 6.3%.

3.1.7 Fishing Income

Median daily income from lobster fishing also varied between communities and between months within communities. In Elodrato, fishing income was typically lower but more stable compared to the other two communities. In Itapera, fishing income was highest in October 2018 despite the highest catch price at first point of sale observed in November 2018 (Figure 5). In Sainte Luce, fisher income was temporarily higher in August 2018 and August 2020 following NTZ openings (Figure 6). From 2018-2020 (n=13,069), median daily fishing income was MGA 2,000 in Elodrato, MGA 6,510 in Itapera and MGA 4,356 in Sainte Luce. In Sainte Luce (n=5,913) from 2018-2020, median fishing income was higher during NTZ openings, MGA 4,987, compared to during NTZ closures, MGA 3,400.

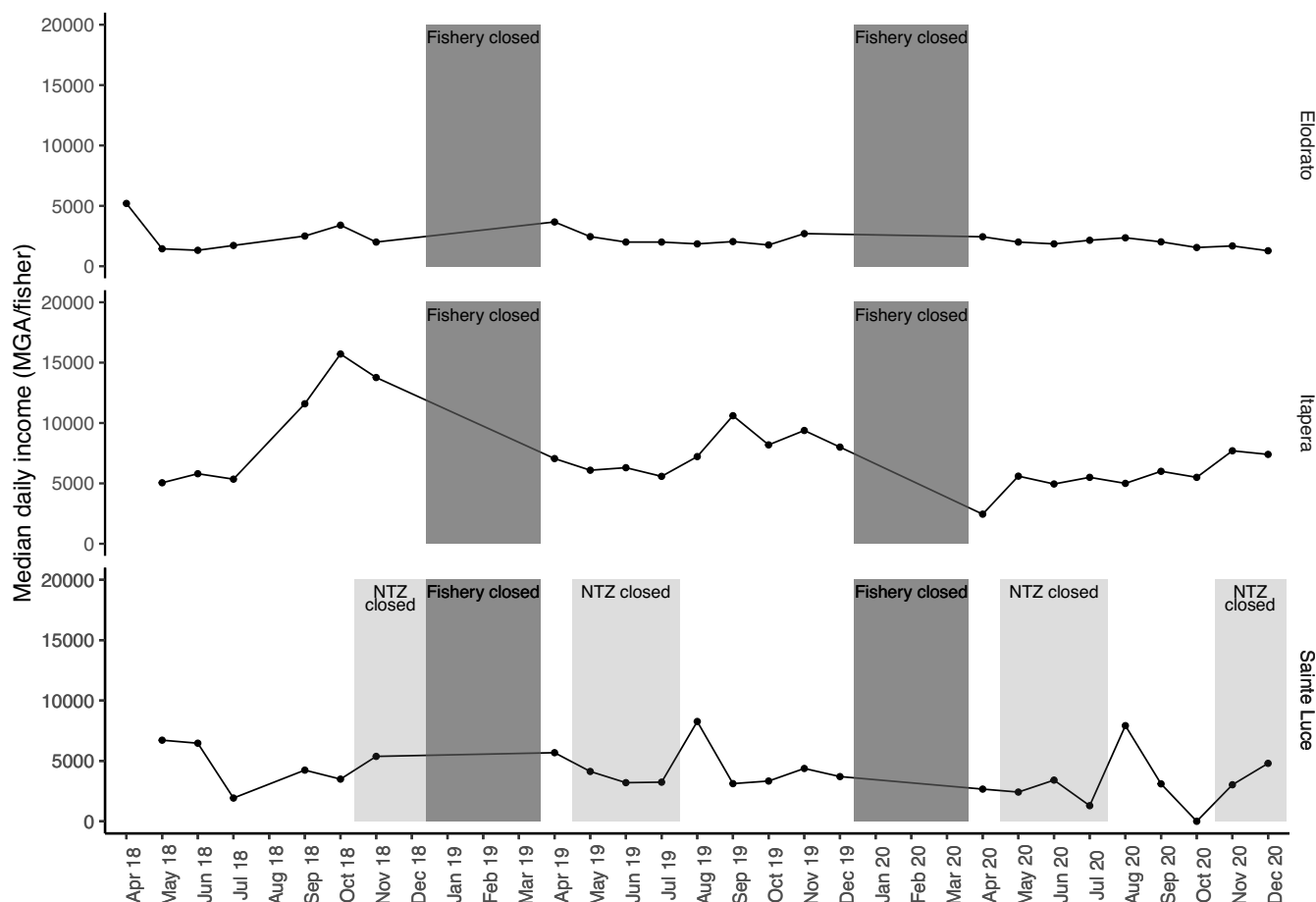


Figure 6. Figure 7. Median daily income (MGA/fisher) disaggregated by community from 2018-2020 (n=13,060).

3.1.8 Fisher Income During NTZ Openings (Sainte Luce)

To monitor changes in daily income from lobster fishing over Phase III, income from baseline to endline was compared. Baseline data was from May 2018 – October 2018 (excluding August 2018 where data was missing) during the first Phase III NTZ opening period and endline data was from August 2020 to October 2020 during the final Phase III NTZ opening period. Median daily fisher income during NTZ openings at baseline was MGA 4,590 (n=1,195) and at endline was MGA 5,400 (n=1,193), an increase of 17.6%.

3.2 Catch Composition

A total of 27,265 lobsters were sampled by community data collectors from April 2018 to December 2020 at three landing sites: 4,984 in Elodrato, 12,883 in Itapera and 9,308 in Sainte Luce (Table 2).

Table 2. Catch composition survey sampling occasions.

Landing site	Year	Lobsters sampled
Elodrato	2018	1,603
	2019	1,492
	2020	1,889
Itapera ¹	2018	4,390
	2019	4,955
	2020	3,538
Sainte Luce	2018	4,992
	2019	2,475
	2020	1,841
All	2018	10,985
	2019	8,922
	2020	7,628
	Total	27,265

3.2.1 Species Composition

A total of seven lobster species targeted in the fishery were previously identified, comprising of four spiny lobster species of a single genus (*Panulirus homarus*, *Panulirus longipes*, *Panulirus Ornatus* and *Panulirus pencillatus*) and three slipper lobster species from three genera (*Arctides regalis* (provisional identification), *Parribus antarticus* and *Scyllarides squammosus*) (see Long 2017). *P. homarus* and *P. longipes* were the most commonly caught species overall as observed previously (Long 2017). Catch species composition varied between communities but was similar within communities between years. In Elodrato and Sainte Luce *P. homarus* was the most commonly landed species whereas in Itapera this was *P. longipes* (Figure 8). Species composition in Sainte Luce between 2018 to 2020 was similar to that observed from 2015 to 2017 (Long 2018).

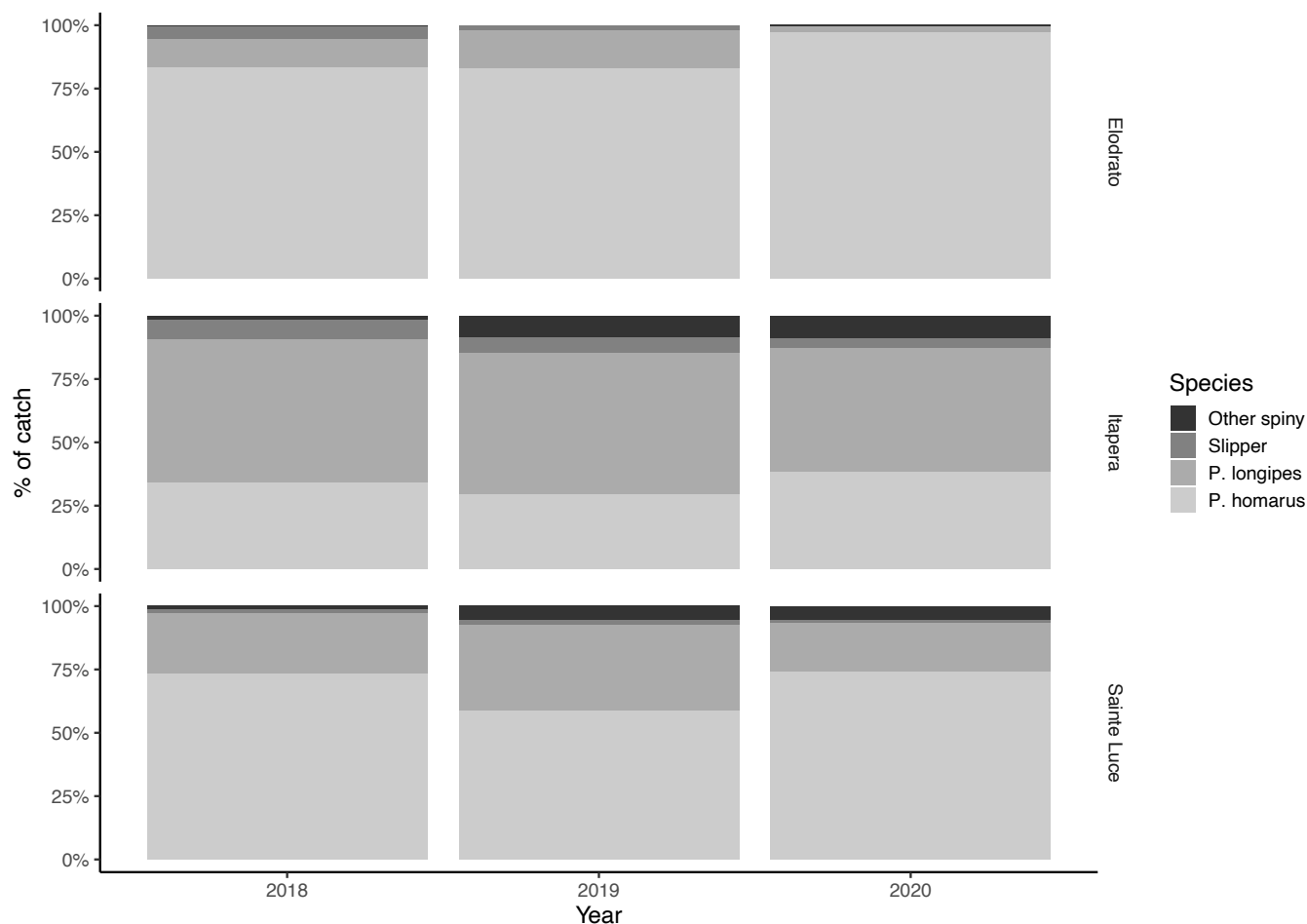
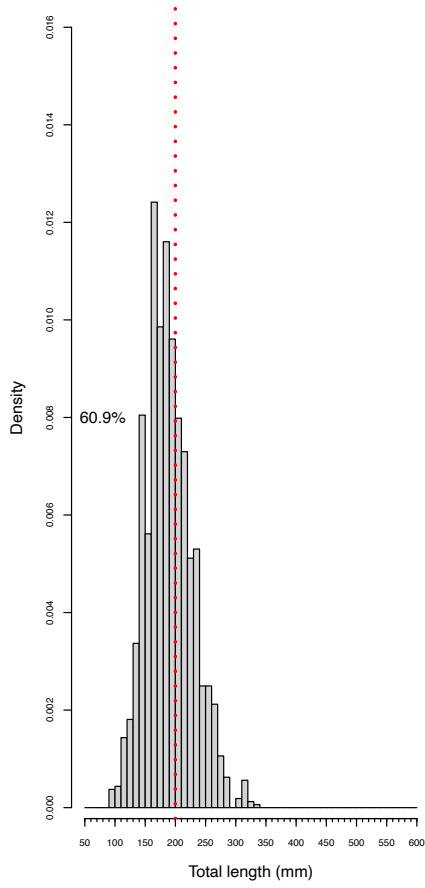


Figure 8. Species composition of catch landed between 2018 and 2020 disaggregated by landing site (n=27,175). Where; Other spiny consisted of *P. ornatus* and *P. penicillatus* and Slipper consisted of *A. regalis* (provisional identification), *P. antarcticus* and *S. squammosus*.

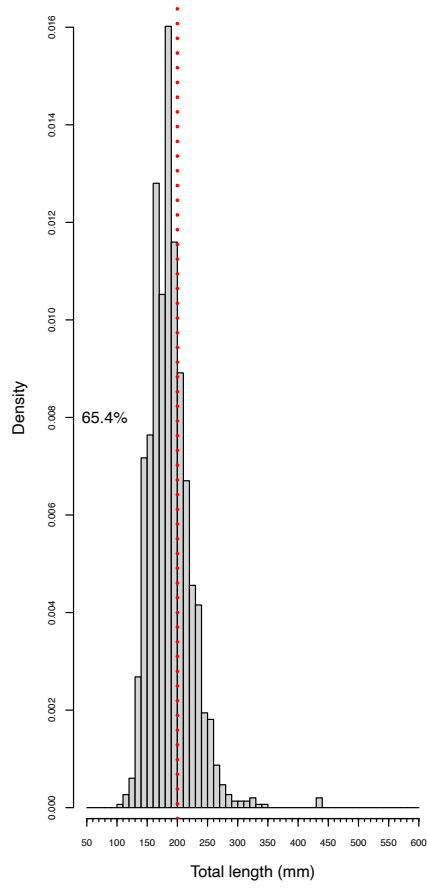
3.2.2 Minimum Landing Size Compliance

Size class distribution of sampled lobsters was similar between communities and within communities between years. Across all three years, Elodrato consistently had the highest percentage of catch below the 200mm MLS, and thus the lowest levels of compliance with the MLS, and Itapera consistently had the lowest percentage of catch below the . However, lobsters less than 14cm were inconsistently sampled and therefore non-compliance with the MLS is underestimated (Figure 9).

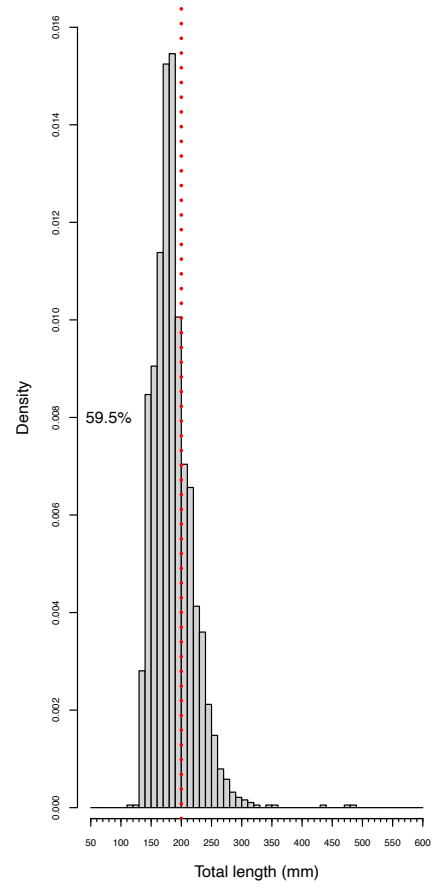
2018



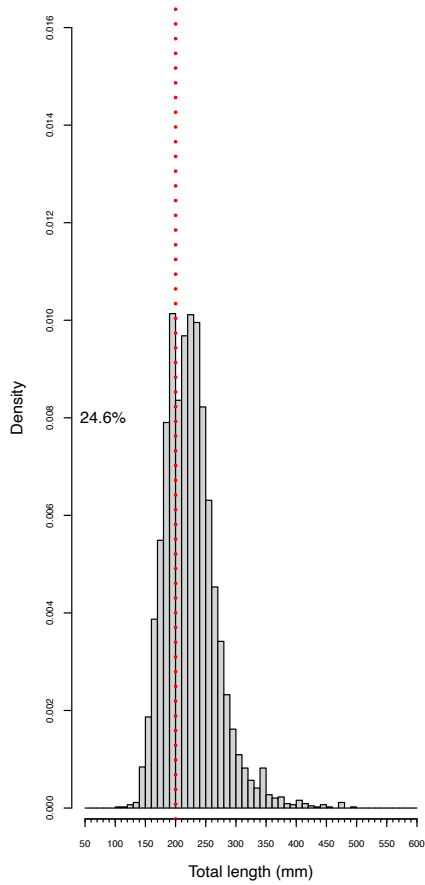
Elodrato
2019



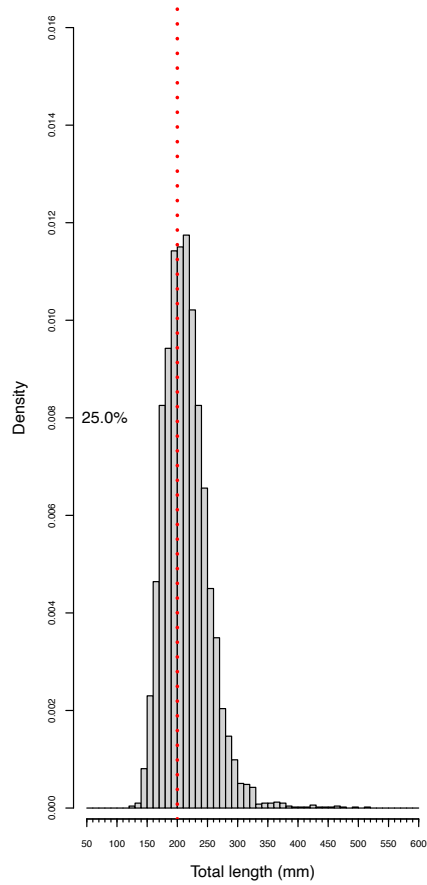
2020



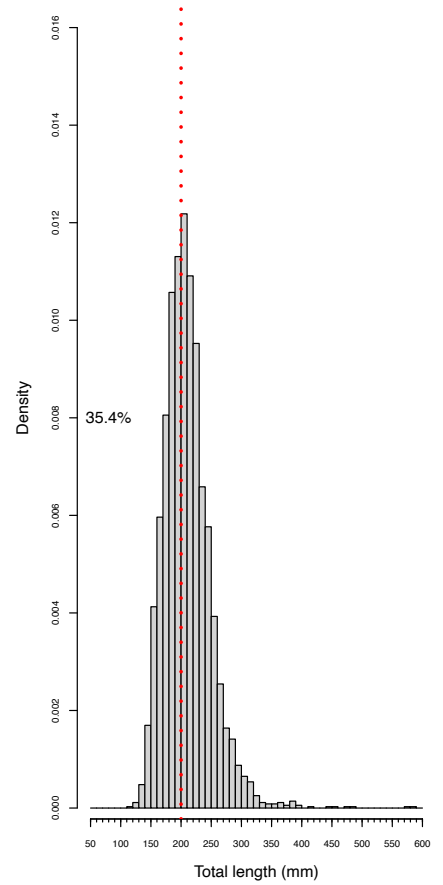
2018



Itapera
2019



2020



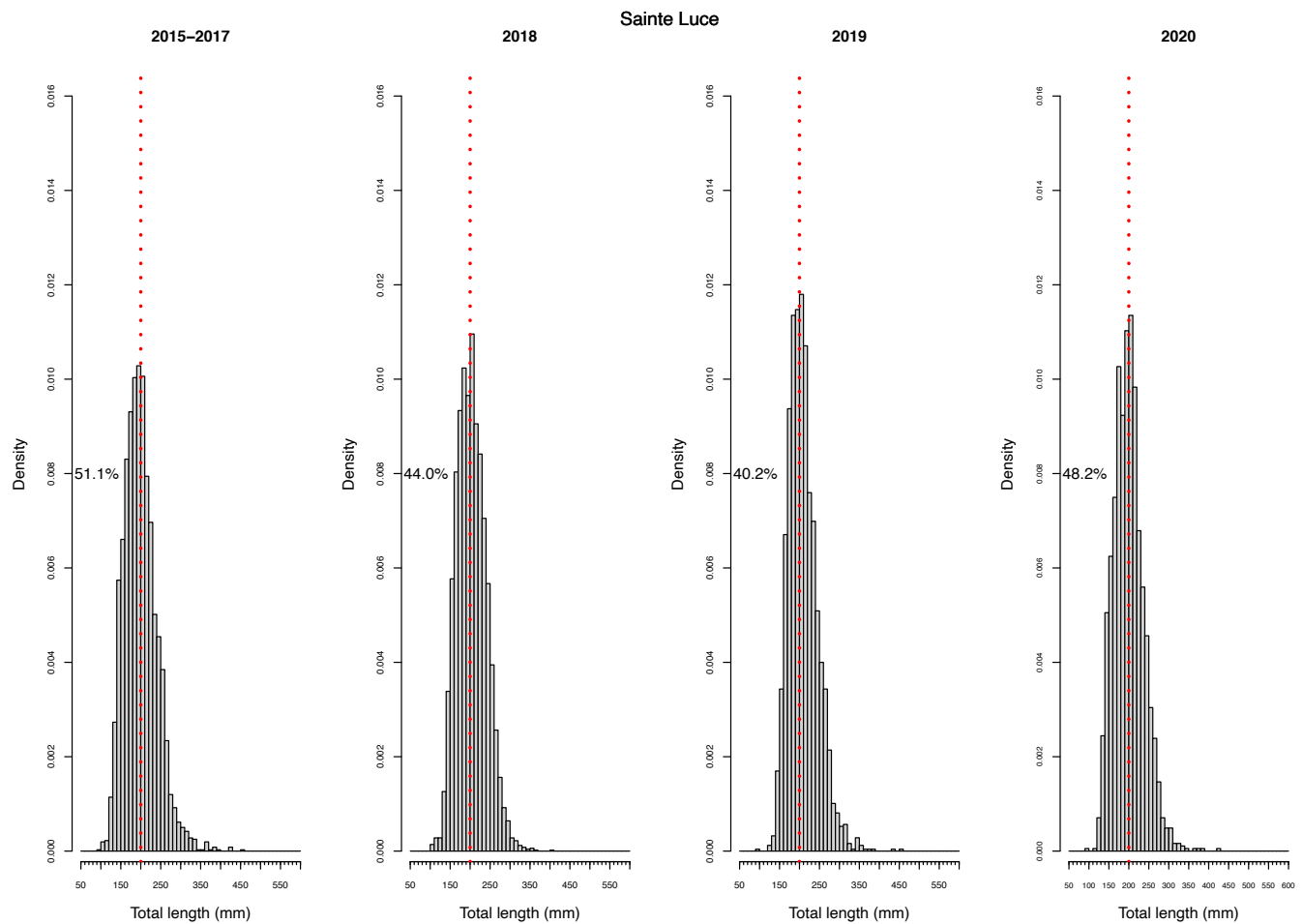


Figure 9. Size class distribution of all species of lobster combined sampled between 2018 and 2020 disaggregated by landing site compared to the 200mm MLS (red dashed line) (n=27,157). The percentage of lobsters below the MLS is shown. Lobsters less than 14cm were inconsistently sampled.

The proportion of undersized lobsters varied between months in all three communities, but no distinct seasonality was evident in any community (

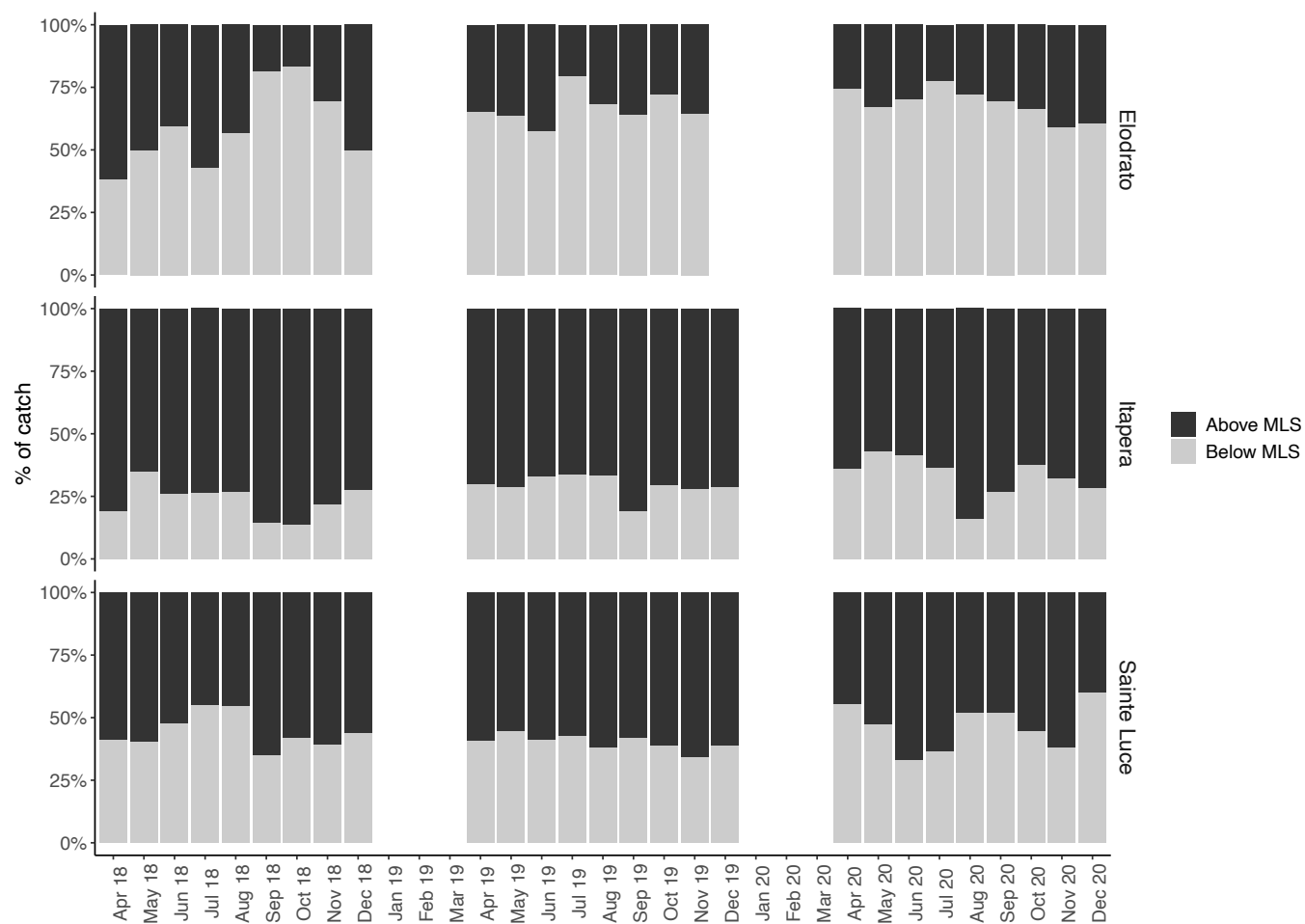


Figure 10).

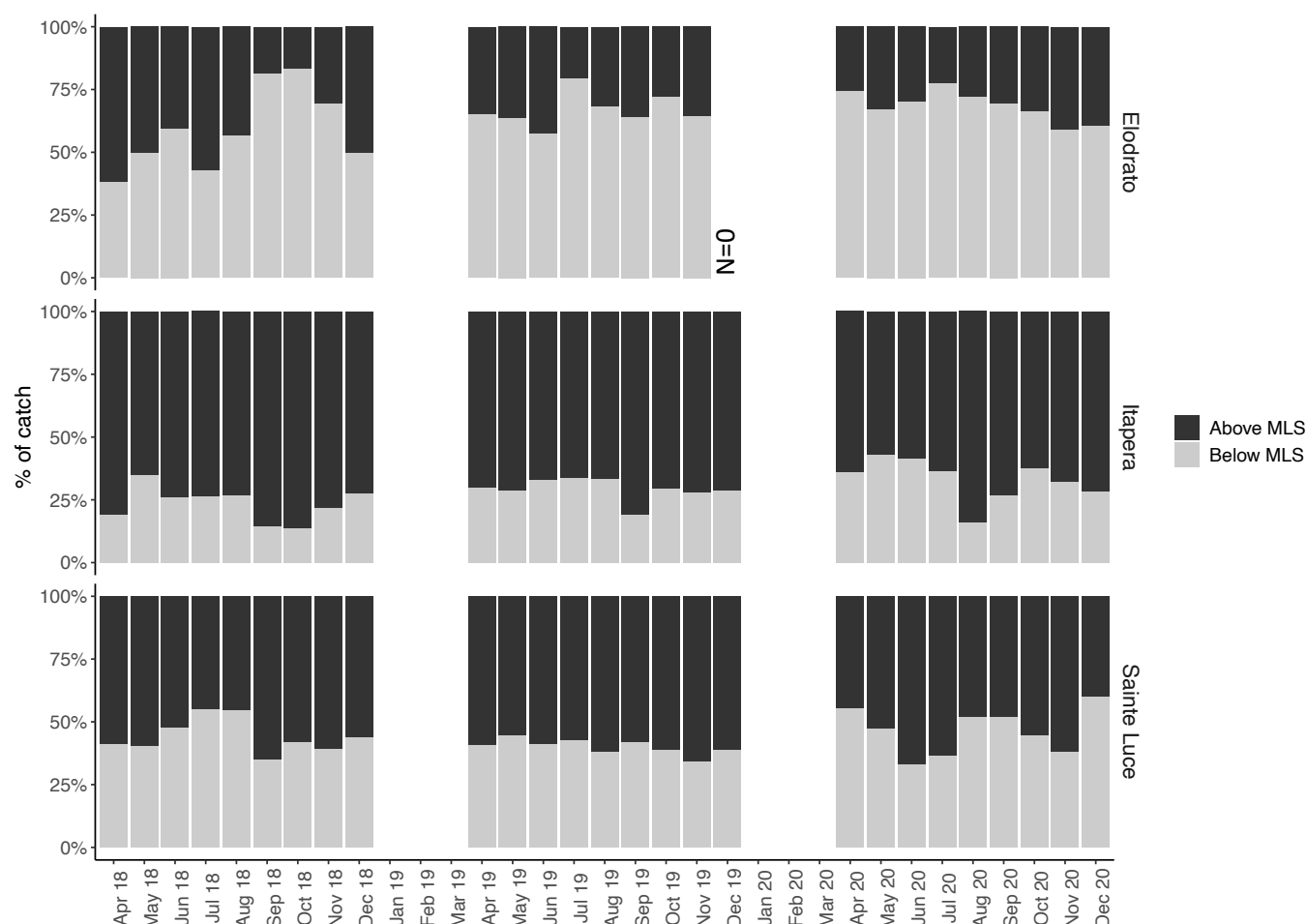


Figure 10. Lobsters (all species combined) sampled in relation to the 20cm MLS by monthly from April 2018 to December 2020 disaggregated by landing site (n=27,157). Lobsters less than 14cm were inconsistently sampled and therefore non-compliance with the MLS was underestimated.

To assess changes in compliance with the MLS during Project Oratsimba Phase III, total length was truncated at 140mm due to inconsistent sampling below 140mm. In Sainte Luce baseline data was aggregated from 2015-2017 and in Elodrato and Itapera baseline data was from 2018. From baseline to endline catch below the MLS, increased by 17.6 % in Elodrato and 43.0% in Itapera but decreased by 4.5% in Sainte Luce (Table 3).

Table 3. Percentage of lobster catch (all species) below the 20cm MLS disaggregated by landing site at baseline (2018 in Elodrato and Itapera and 2015-2017 aggregated in Sainte Luce) and endline (2020) with total length truncated at 140mm as lobsters below 140mm were inconsistently sampled (n=16,562).

	Elodrato	Itapera	Sainte Luce
Baseline ¹	58.6	24.5	49.3
Endline	68.8	35.1	47.0
Percentage change from baseline to endline	17.6	43.0	-4.5

In Sainte Luce, between 2018 – 2020, catch below the MLS was similar between periods of NTZ closures and openings but in 2015-2017 was higher during NTZ openings (Figure 11).

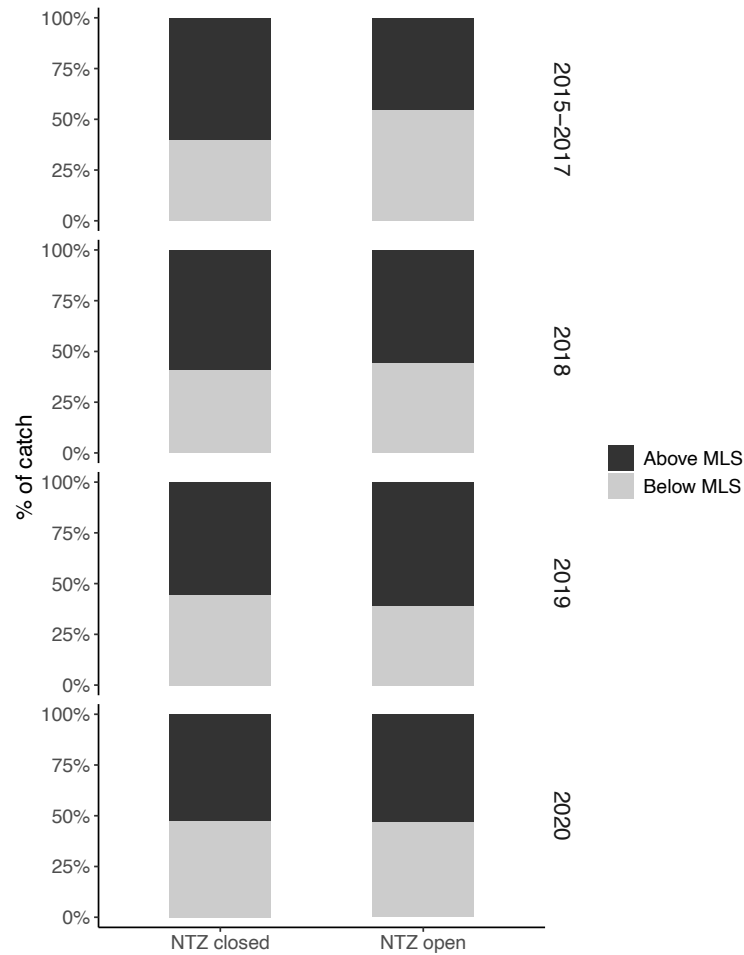


Figure 11. Lobsters (all species combined) sampled in relation to the 200mm MLS during NTZ closures and openings disaggregated by year (n=12,651). Total length was truncated at 140 mm as lobsters less than 140mm were inconsistently sampled.

3.2.3 Compliance with Prohibition on Landing Berried Lobsters

The data demonstrates seasonal variation in reproduction and suggests that the peak months for berried females are from October through to December (Figure 12). This is in line with previous research which also suggested that the peak continues in January and February (Long 2017, 2018). Although from 2018-2020 data was not collected from January to March due to the national closed season for lobster fishing.

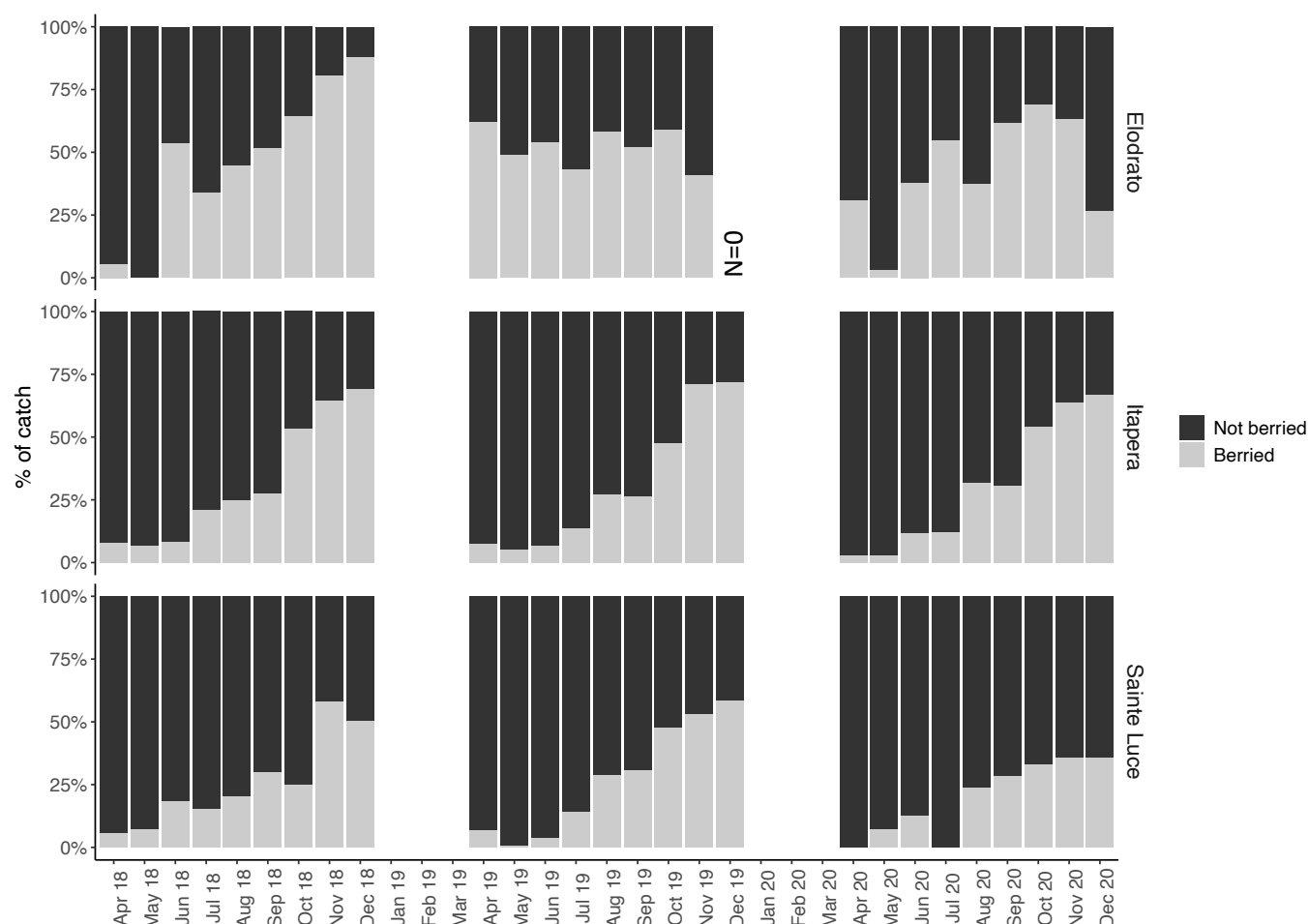


Figure 12. Female lobsters (all species combined) sampled monthly from April 2018 to December 2020 disaggregated by landing site (n=13,073).

From baseline (2018 for Elodrato and Itapera, and 2015-2017 aggregated for Sainte Luce) to endline (2020), the proportion of berried females landed sampled, and thus non-compliance with the prohibition on landing berried females, decreased by 25.6% in Elodrato, remained approximately constant in Itapera and increased by 31.7% in Sainte Luce (Table 4).

Table 4. Percentage of female lobster catch berried (all species) disaggregated by landing site at baseline (2018 for Elodrato and Itapera and 2015-2017 aggregated for Sainte Luce) and endline (2020) (n=8,030).

	Elodrato	Itapera	Sainte Luce
Baseline	59.8	28.8	20.2
Endline	44.5	28.6	26.6
Percentage change from baseline to endline	-25.6	-0.7	31.7

4 Discussion

The data presented in this report presents a summary of data collected during Project Oratsimba Phase III from 2018 – 2020 in Elodrato, Itapera and Sainte Luce. Additionally, in Sainte Luce, data from 2015-2017 was presented for comparison. This report can also serve as a baseline to monitor future changes in fishing effort and catch.

4.1 Fishing Effort

The mean number of pirogues can be used as an approximation for total fishing effort. It is unknown why the mean has decreased in Elodrato and Itapera, but increased in Sainte Luce. The number of pirogues should be continued to be monitored as no legal barriers to entering the fishery exist and fishing effort could therefore increase largely uninhibited, exacerbating overexploitation and stock decline (Sabatini et al. 2007).

4.2 CPUE

CPUE was higher for Sainte Luce compared to Elodrato which was not unexpected as Sainte Luce is described as the regional centre of lobster fishing. CPUE in both communities was higher in April, the first month of the national season for lobster fishing and can likely be attributed to concentration of fishing effort temporally following the national closed season for lobster fishing. In Sainte Luce, CPUE was higher for all years except for 2018 during NTZ openings compared to closures. This can likely be attributed to the concentration of fishing effort, both temporally and spatially, in a productive area of fishing ground (see Long 2017). Short term impacts observed in Sainte Luce following NTZ closures, including increased catch and income, are powerful catalysts for LMMA replication (Long 2017) and community compliance with closures. Durations of future NTZ closures will need to be sufficient in order for these impacts to be observed in Sainte Luce and replicated in Elodrato and elsewhere.

4.3 Price at First Point of Sale and Income

Price at first point of sale and fisher income varied between communities and within communities between months. In April 2020 in all three communities, lobster price was temporarily significantly reduced and was the lowest observed during Phase III, this was due to the impacts of COVID 19 on the fisheries (Savage 2020a), which hit Madagascar in March 2020. Fishing income in all three communities was below the purchasing power parity \$1.90 international poverty line. In Sainte Luce increases in price at first point of sale and fisher income during NTZ openings increased from baseline to endline. In real terms, the increase in median daily fisher income of MGA810 MGA, or 18.6% of median daily income from 2018 – 2020, equates to approximately one cup of rice and is unlikely to increase long-term financial resilience or decrease poverty levels in lobster fishing households. Increases in price at first point of sale and resultant increases in income will need to increase to ensure the lobster fishery remains economically viable. It is also questionable as to whether increases in income will be sufficient to maintain long-term motivation for community-based fisheries management.

4.4 Species Composition

The most commonly caught species remained *P. homarus* and *P. longipes* although the species composition varied between communities. The differences in species composition between communities, may be indicative of the existence of preferred habitat of the two species. Size class distribution did not vary greatly between communities. Despite this, this provides further evidence to suggest communities are targeting the same regional stock. This demonstrates the need for management of the stocks at a regional level through coordinated management efforts at the local level.

4.5 MLS Compliance

MLS compliance was low throughout Project Oratsimba Phase III, although MLS compliance was underestimated due to the inconsistent sampling of lobsters small than 14cm. For lobsters less than 14cm, sampling was inconsistent as fishers hide these lobsters from community data collectors. This, combined with high community knowledge of the MLS (see Savage 2021), suggests that fishers are aware that lobsters they do not offer for sampling are undersized. High rates of removal of undersized and immature lobsters are of conservation concern and could affect recruitment to the regional stock.

4.6 Berried Lobsters

This study provided further evidence of seasonal variation and reproduction and further suggests that the peak months for berried females occurs from October to February. The national closed season for lobster fishing, occurring annually provides protection for berried lobsters some months of the peak season. In Sainte Luce, temporal designs of NTZ closures somewhat complement this. NTZ closures in November and December also provide protection during the peak however the NTZ is also closed from May to July when few females are berried. As with the MLS, evidence suggests that community knowledge of the prohibition on berried lobsters is

high (see Savage 2021) as does anecdotal evidence of fishers removing eggs before trade. High rates of removal of berried females is of conservation concern.

4.7 Improving Compliance with National Fisheries Legislation

Economic necessity and high levels of poverty (see Savage 2020) combined with export market demand, through intermediaries purchasing illegal undersized and berried lobsters, continues to drive non-compliance with the MLS and prohibition on landing berried lobsters. This is further compounded by the lack of state capacity for enforcement. Provision of supplementary livelihoods and leveraging the value chain to transfer greater economic benefits to fishers will be key in improving compliance with national fisheries legislation in the future

5 Acknowledgements

A special thanks must go to the fishers who voluntarily participated and to the community data collectors for their dedication to collecting this data. Thanks must also go to Stephen D. Long and Michael Darling for database support provided. This study was funded by the Darwin Initiative.

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