SEYCHELLES FISHING AUTHORITY
TECHNICAL REPORT

REPORT ON THE SPINY LOBSTER FISHERY

Summary of Fishing Activity for the 2020-2021 season

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SFA/R&D/085

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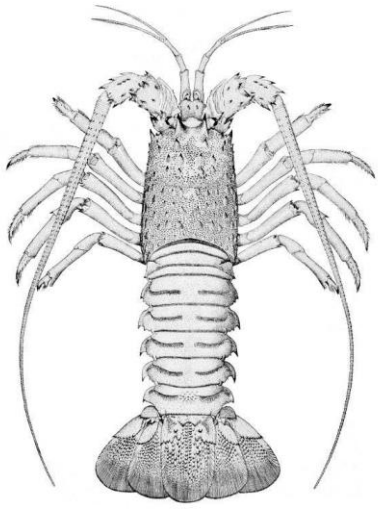

SFA Fisheries Research Section

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All Research staff who participated in the sampling activities, data entry and verification during the lobster fishery season.

All lobster fisherman who participated in the sampling programme for their understanding and cooperation.

Abstract

Spiny lobsters (Palinuridae) are amongst many marine species with great commercial importance for small-scale fisherman. In Seychelles, the spiny lobster fishery has traditionally been managed as a seasonal closure and limited access (license-limited) fishery. The lobster fishing season usually opens for 3 months, but because of low catch and effort as a result of unfavourable weather conditions, the 2020/2021 fishing season was extended by 1 month. This report presents analyses of the fisheries-dependent data collected from the spiny lobster fishery during the 2020/2021 fishing season and makes comparison between previous fishing seasons. To achieve this, data collected from fishers and sampled Catch and Effort logbooks were used. Statistical analyses to compare sizes between the previous seasons for *Panulirus longipes* (Long-legged spiny lobster) and *Panulirus penicillatus* (Pronghorn spiny lobster) were performed. Results for 2020/2021 season showed that snorkelling was the dominant fishing method. An increase in both the total catch (6.14 Metric Tonnes) and number of fishing trips (242 trips) was observed compared to the two previous seasons. In terms of fishing location, Mahé remains the most dominant area for both total catch and number of trips amongst the major fishing sites. Despite an increase in the number of trips, the CPUE showed a slight decrease. For the 2020/21 season, female carapace length (CL) sizes for both *Panulirus penicillatus* and *Panulirus longipes* were larger compared to the previous seasons. In contrast, a decrease in CL was observed in males. Overall, the data analysis for 2020/2021 season indicates that there was a slight decrease in lobster's relative abundance, most probably attributed to lobster fishing season being open for two consecutive fishing seasons. Despite more fishing opportunities being made available through the fishery extension, the CPUE remained lower compared to the previous season, thus indicating possible signs of reduced lobster abundance. The 2021 fisheries independent survey will be conducted during the last quarter of the year to establish the changes in the relative abundance of lobsters.

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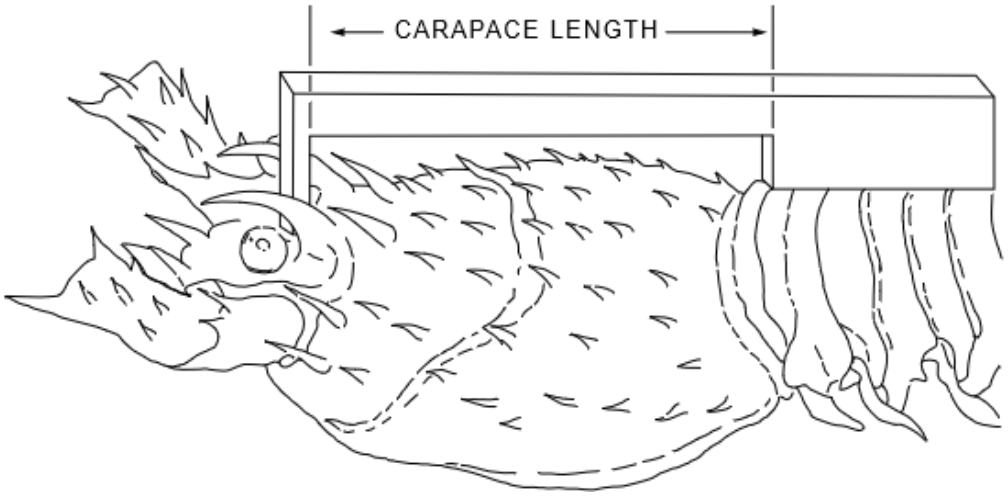

1. Introduction.

The Seychelles artisanal spiny lobster fishery targets shallow water lobster stocks around the main granitic islands (Seychelles Fishing Authority [SFA], 2019). Locally, there are four species harvested, notably, *Panulirus penicillatus*, the Pronghorn spiny lobster (Oliver, 1791); *Panulirus longipes*, the Long-legged spiny lobster (A. Milne Edwards, 1868); *Panulirus versicolor*, the Painted spiny lobster (Latreille, 1804); and *Panulirus ornatus*, the Ornate spiny lobster (Fabricius, 1798) (SFA, 2017). These reef-dwelling species prefer fringing carbonate reefs and granitic reef habitats, constituting of crevices, burrows and coral overhangs (Withy-Allen and Hovel, 2013; Hovel and Lowe, 2007; Holthuis, 1991). Such protective structures provide shelter against multiple ecological factors such as predation, thus maximising survival probabilities (Behringer and Butler, 2010). Since spiny lobsters are mainly nocturnal scavengers, fishing operations are conducted from dusk to dawn (Radhakrishnan et al., 2019; SFA, 2017). Fishers generally utilise small outboard vessels to access various coastal fishing grounds and on average, a fishing trip consists of two to three men fishing for approximately five hours (SFA, 2017). Scuba diving, snorkelling and bamboo traps are the different fishing techniques practiced locally (SFA, 2017). Amongst these, snorkelling or skin diving is the most popular fishing method, whereby fishers use snorkelling gears and underwater flashlight to extract lobsters from the crevices. Scuba diving and bamboo traps fishing methods are used on a lesser extent and account for a small percentage of the catch.

In Seychelles, the spiny lobster fishery is licenced and seasonally managed, whereby fishers are required to apply for licences prior to the opening of the fishing season. Currently, the management regulations implemented for the spiny lobster fishery are as follows:

I. **Restrictions on the number of licences**
II. **Seasonal restrictions (the fishery is typically opened for a 3-month period)**
III. **Minimum size (75 mm carapace length for all species)**
IV. **Prohibition to retain berried females**

Additionally, the licence conditions also specify that logbooks and sale receipts be maintained and submitted. A copy of the new amended licence conditions is listed in **Appendix 1**. The management measures provide a degree of input control. However, there are no output controls (such as Total Allowable Catches (TACs)) in place to limit the total catches.

Since 1992, a monitoring programme for the spiny lobster fishery was established by the SFA (Mees, 1992). From there onwards, reports have been produced at the end of each season outlining several aspects of the fishery including research and management.

The most recent lobster fishing season was opened on the 21st of December 2020 and was scheduled to close on the 20th of March 2021. However, following an analysis of the performance of the fishery, significant declines in effort as a consequence of unfavourable weather conditions was observed, as a result, the fishing season was extended for one more month, closing on the 20th of April 2021. A compliance bond of SCR5000 was maintained to ensure that licence holders submitted their logbooks and sale records at the end of the fishing season. A total of sixteen fishing licences were on offer, of which 13 were from Mahé, 2 from Praslin and 1 from La digue. This report presents an analysis of fisheries-dependent data collected for the spiny lobster fishery during the 2020/2021 fishing season. It also compares the stock indicators, namely, the size structure of lobsters, and the harvest rate between the 2016/2017, 2019/2020 and 2020/2021 fishing seasons.

2. Methodology.

2.1. Sampling procedures.

During the 2020/2021 season data was collected from fishermen operating on Mahé, Praslin and La Digue through three different sources:

a) **Fisher Catch and Effort log (FCEL)**: Each licenced fisherman was given a logbook to record information on their fishing activities (**Appendix 2**). Information collected included information on catch, effort and fishing location.

b) **Sampled Catch and Effort log (SCEL)**: SFA technicians sampled the landed catch directly whenever possible. Information on the species caught, weight and length measures were collected (**Appendix 3**). Interviews were also conducted to determine total effort and fishing location.

c) **Receipt Book:** At the end of the fishing season, receipt books completed by licensed fishermen with sales of lobsters were collected to derive total sales. The fishermen recorded the number and weight of lobsters sold.

2.2. Data analysis.

Information collected from the FCEL and the SCEL were crosschecked to determine the number of lobsters not sampled for each fishing trip. The average weight for each species was derived from the total weight and total number of lobsters (per species) recorded from the SCEL [(a)]. The weight of lobsters not sampled for each fishing trip was estimated by raising the average weight of each species to the total number of that species caught [(b)]. The total catch of lobsters [(c)] for the 2020/2021 season was derived from the sum of weights of lobsters from the SCEL and the total sum of the raised weight of lobsters not sampled (SFA, 2017).

$$a)\ \boldsymbol{Average\ weight} = \sum \boldsymbol{total}\ \frac{\boldsymbol{Weight\ (kg)}}{\boldsymbol{\mathcal{N}^0 of\ Lobster\ (per\ species\ )}}$$

$$b)\ \boldsymbol{Raised\ Weight} = \boldsymbol{average\ weight} * \boldsymbol{\mathcal{N}^0 of\ lobsters\ (per\ species)}$$

$$c)\ \boldsymbol{Catch\ (kg)} = \sum \boldsymbol{of\ weight\ \ sampled\ catch\ effort\ log} + \boldsymbol{raised\ weight\ of\ lobsters\ not\ sampled}$$

The total effort was based on the total number of fishing trips undertaken. The catch per unit effort (CPUE) was calculated from the total catch in kg and the total effort[(e)]. The catch, effort, CPUE and species composition was calculated for the main fishing location groupings.

$$e)\ \boldsymbol{CPUE} = \sum \boldsymbol{total}\ \frac{\boldsymbol{Catch\ (kg)}}{\boldsymbol{Fishing\ Effort\ (\mathcal{N}^0 of\ trips)}}$$

The length frequency (carapace length (CL)) distributions of males and females for the different lobster species sampled in 2020/2021 was compared with distributions of lobsters sampled in the previous seasons (2016/2017 and 2019/2020), using univariate analysis of variance (ANOVA) or Kruskal-Wallis non-parametric tests. Assumptions of the ANOVA model were checked by examining the residual plots for normality of error terms and homogeneity of variances. In addition, homogeneity of variances was verified by running the Fligner-Killeen test. A significance level of α=0.05 was used throughout the analysis.

3. Fishery extension.

3.1. 2020/2021 Season.

Request to extend the lobster fishery was taken into consideration after lobster licensees claimed that they were unable to operate as normal, due to strong weather conditions. Total catch data analysed from December to February of 2020/2021 season, showed 1553 kg (1.55 MT) of lobsters

were caught as opposed to 4150 kg (4.15 MT) in 2019/2020. This represented a decrease of 63% in total catch landed. As per species composition, *Panulirus penicillatus* 1181 kg (1.18 MT), *Panulirus longipes* 330 kg (0.33 MT), and *Panulirus versicolor* 40 kg (0.04 MT), represented 66%, 48% and 42% decrease respectfully (**Figure 1**). Compared to 2019/2020, this represented only 27% of the total catch, with only 15 days left before the closure of the lobster fishing season. In relation to effort by number of trips, a decrease of 38% was observed (**Figure 2**). Furthermore, when comparing the catch per unit effort data (CPUE) without the fishery extension, 2020/2021 reported a 15% decrease compared to the 2019/2020 season and an increase of 36% compared to the 2016/2017 (**Figure 3**). Based on this scientific data/analysis the fishing season was extended for a period of 1 month.

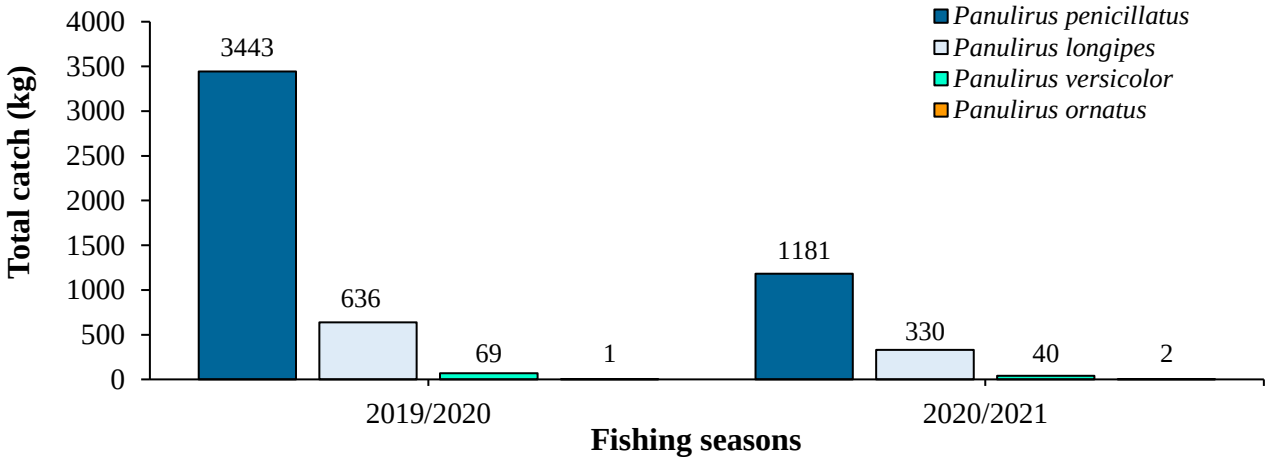

Figure 1: Comparison of total catch (kg) per species from December to February between the recent and previous fishing season. **N.B:** the lobster fishing season was originally open for 3 months (December to March).

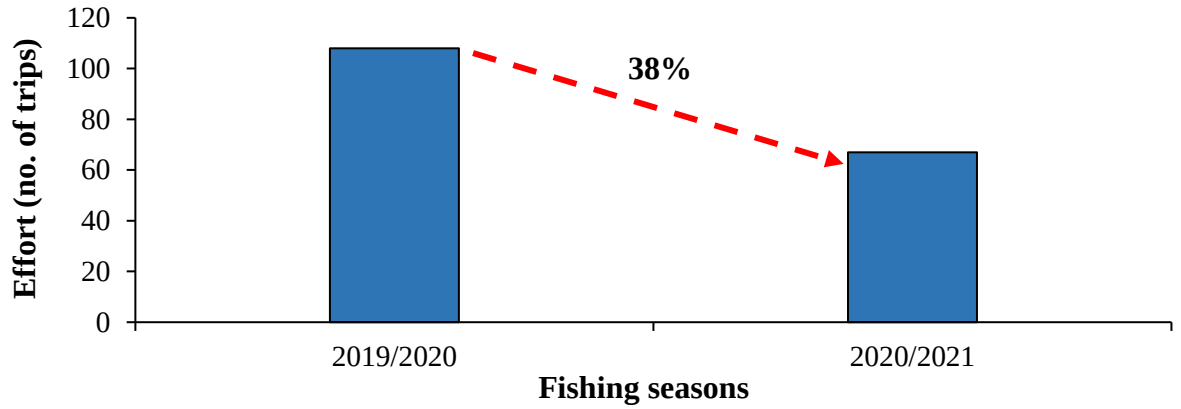

Figure 2: Comparisons of fishing efforts (no. of trips) from December to February between recent and previous fishing seasons. Red dashed arrow highlights the decrease in number of efforts.

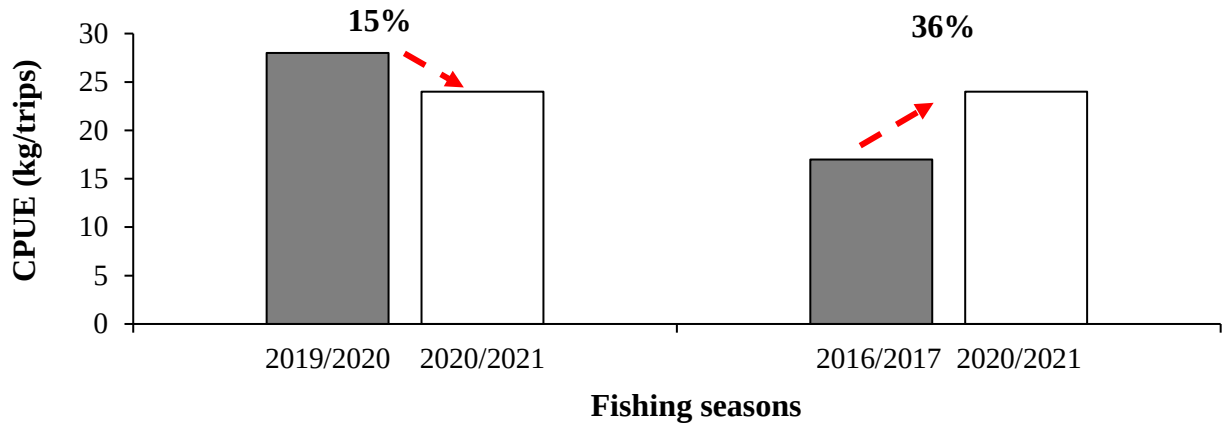

Figure 3: Catch per unit effort (CPUE) (kg/trips) between recent and previous fishing seasons. Red dashed arrow highlights changes observed in the CPUE. **N.B:** fishery extension was excluded in the analysis.

4. Results.

4.1. Catch, effort and catch per unit effort.

For the 2020/2021 lobster fishing season, a total catch of 6.14 Metric Tonnes (MT) was recorded, compared to 5.42 MT in 2019/2020 and 4.12 MT in 2016/2017 season, representing a 13% and 49% increase respectively. The 2020/2021 catch was 41% higher than the historical mean of 4.4 MT (**Figure 4**). The predominant fishing method used to capture lobster was snorkelling which accounted for 94% of the total catch. Scuba diving was the only other fishing method used. **N.B.** The data displayed for the 2020/2021 season, accommodates the 1-month extension period.

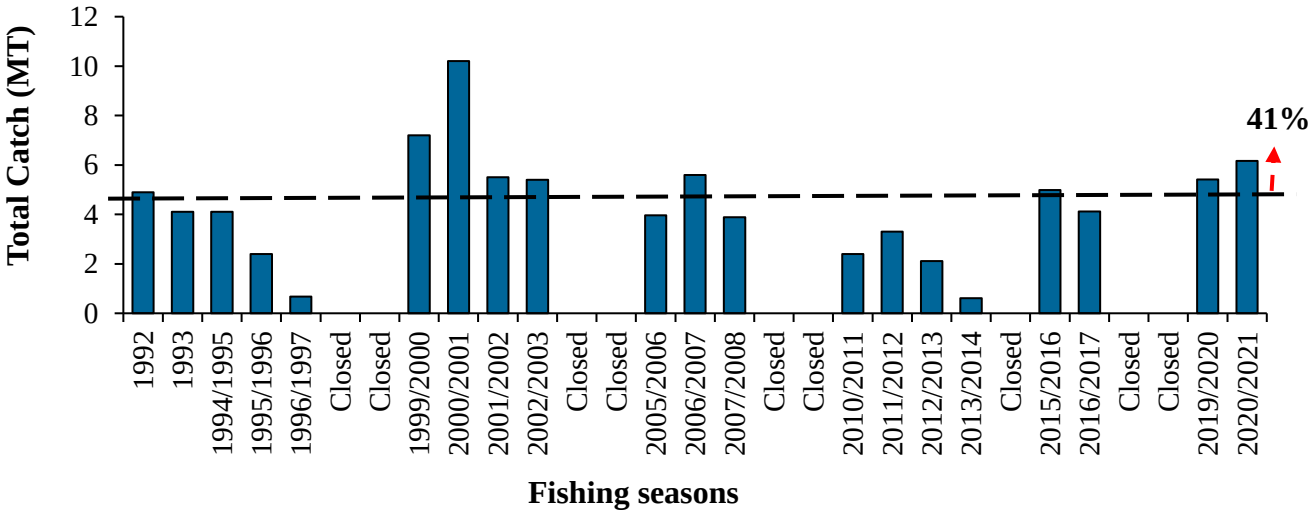

Figure 4: Spiny lobster historical seasonal catch (metric tonnes) from 1992 to 2021. Dashed black line of 4.4 MT indicates mean seasonal catch since the monitoring began in 1992.

Fishing activities were predominantly around the region of Mahé. The landed catch for 2020/2021 was 2968 kg (2.97 MT; **Figure 5**), representing 48% of the total catch compared to 75% in 2019/2020 and 68% in 2016/2017 seasons. The second most dominant fishing site was Fregate/Recif with a total catch of 1150 kg, followed by 607 kg from North Island and 'Other', accounting for 19% and 10% of the total catch respectively. Minor fishing sites comprised of Praslin Ridge (264 kg), The Sisters/Felicite (244 kg) and La Digue (121 kg) collectively representing 4% of the total catch (**Figure 6**).

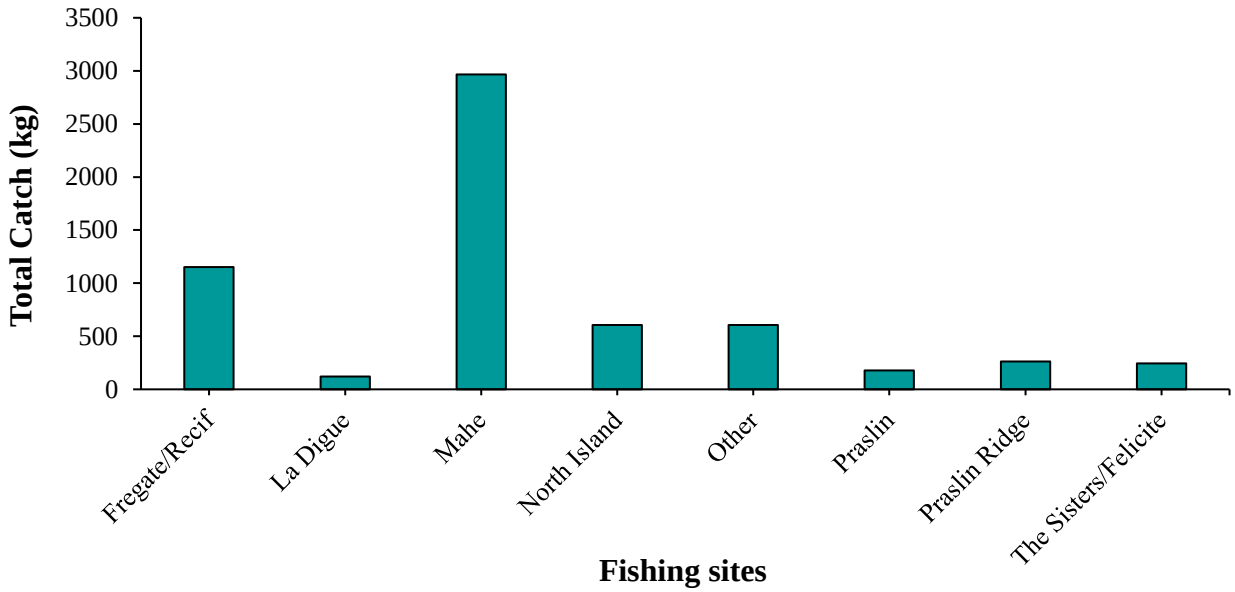

Figure 5: Total Catch (kg) by major fishing location for the 2020/2021 fishing season.

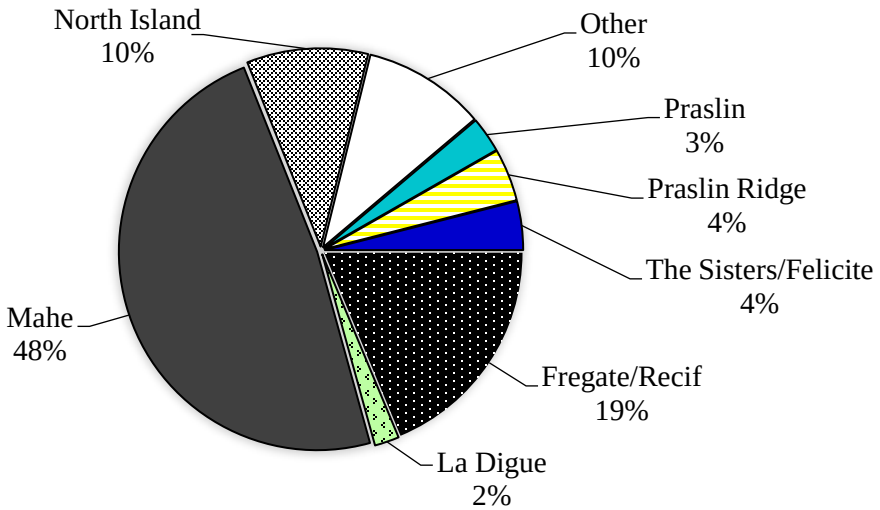

Figure 6: Total catch in percentage by major fishing location for the 2020/2021 fishing season.

A total of 242 (mostly dominated on Mahé (141 trips)) fishing trips were recorded during the 2020/2021 season (**Figure 7**), compared to 196 trips in 2019/2020 and 238 trips in 2016/2017, representing an increase of 23% and 2% respectively (**Figure 8**).

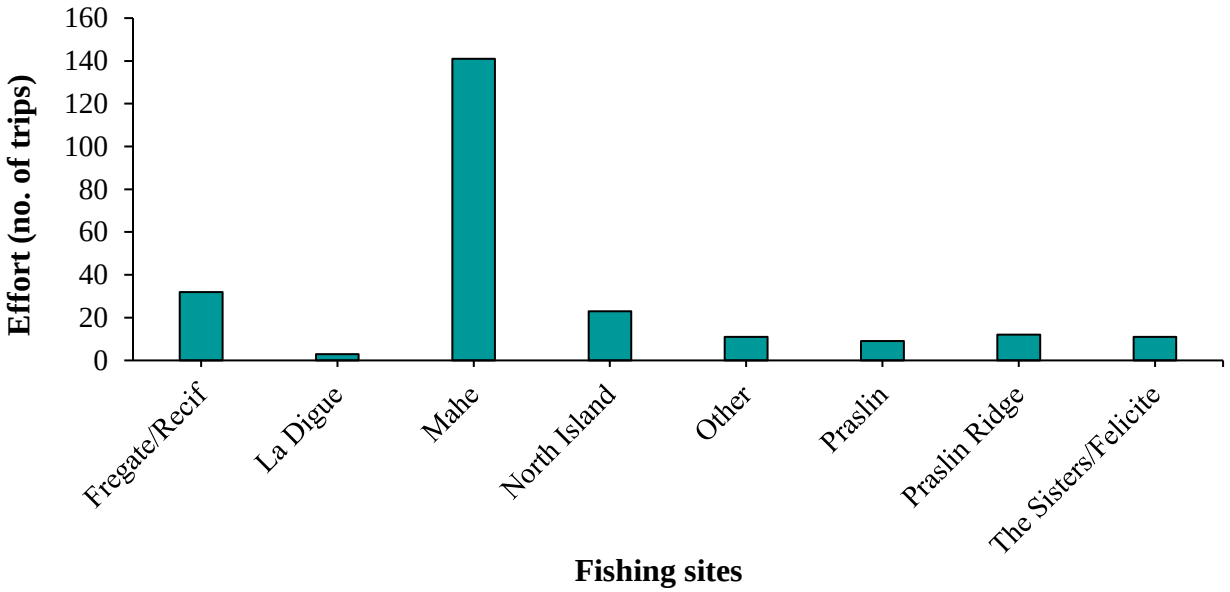

Figure 7: Fishing effort (no. of trips) by major fishing location for the 2020/2021 fishing season.

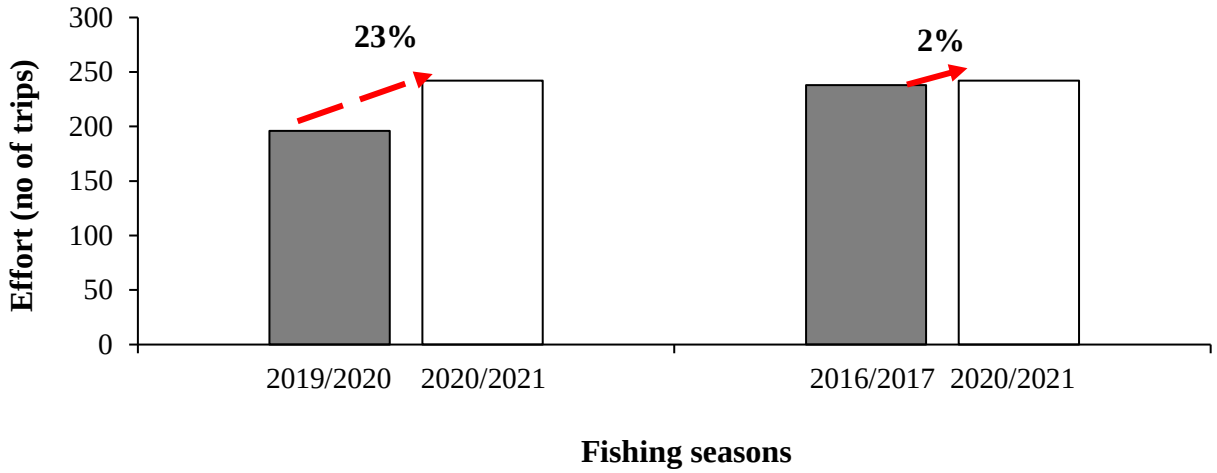

Figure 8: Comparisons of fishing efforts (no. of trips) between the recent and previous fishing seasons. Red dashed arrow highlights the increase in number of efforts.

By fishing location, the highest CPUEs were recorded at La Digue, 'Other' and Fregate/Recif with a catch rate of 60, 51 and 36 kg/trip respectively. Catch rate around North Island was 26 kg/trip whilst The sisters/Felicite and Praslin Ridge recorded 22 kg/trip each (**Figure 9**).

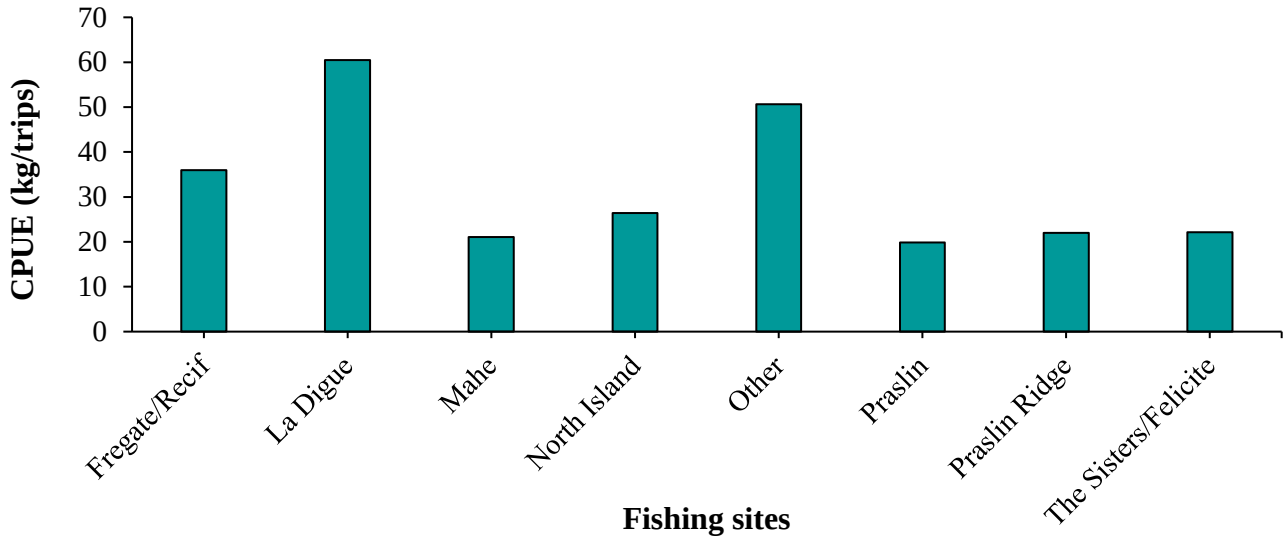

Figure 9: Catch per unit effort (CPUE) (kg/trip) for the 2020/2021 season at the major fishing locations.

The overall CPUE for the 2020/2021 season was 25 kg/trip compared to 28 and 17 kg/trip in the 2019/2020 and 2016/2017 seasons respectively (**Figure 10**). This represents a decline of 8% compared to the 2019/2020 season and an increase of 47% compared to the 2016/2017 season. In 2020/2021 the CPUE was 35% higher than the historical mean of 18.9 MT.

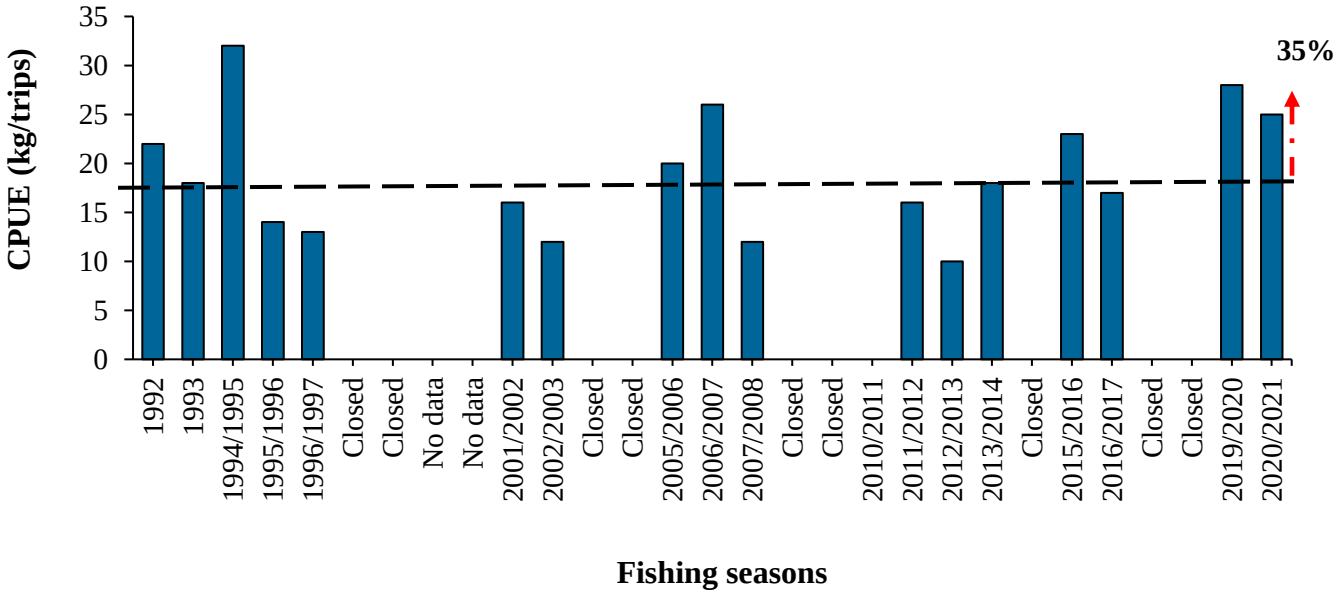

Figure 10: Seasonal CPUE (kg/trip) for open seasons of the lobster fishery between 1992 and 2021. The red dashed line highlights the CPUE increase from the historical mean of 18.9 MT represented by the dashed black line. **N.B.** Due to unavailable data for 2 open seasons and underreporting for 2010/2011 season, the CPUE was not calculated.

4.2. Species catch composition.

The catch composition for the main targeted species was dominated by *P. penicillatus*. A total of 4849 kg (4.84 MT) of *P. penicillatus* was caught compared to 4535 (4.53 MT) in 2019/2020 and 3200 kg (3.20 MT) in 2016/2017. *P. longipes* remained the second most dominant species, accounting for 1031 kg of the catch compared to 806 kg and 798 kg caught in 2019/2020 and 2016/2017 respectively. *P. versicolor* remained the third dominant species comprising of 253 kg compared to 78 kg and 118 kg caught in 2019/2020 and 2016/2017. As for the rarest species, *P. ornatus* comprised of only 8 kg compared to 2 kg and 4 kg caught in 2019/2020 and 2016/2017 (**Figure 11**).

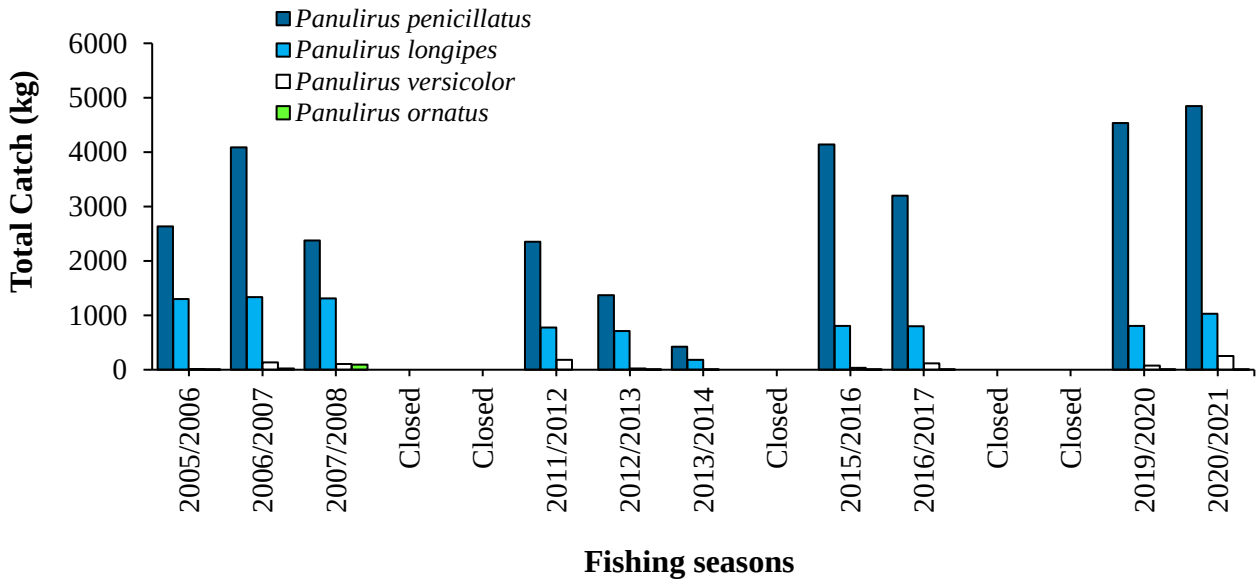

Figure 11: Species catch (kg) composition over the 15-year period from 2005/2006 to 2020/2021.

Three lobster species constituted the catch landed from Mahé with *P. penicillatus* being the most dominant species with 2212 kg (2.21 MT) whereas *P. longipes* remained the dominant species caught on Praslin, representing 95 kg of the catch (**Figure 12**).

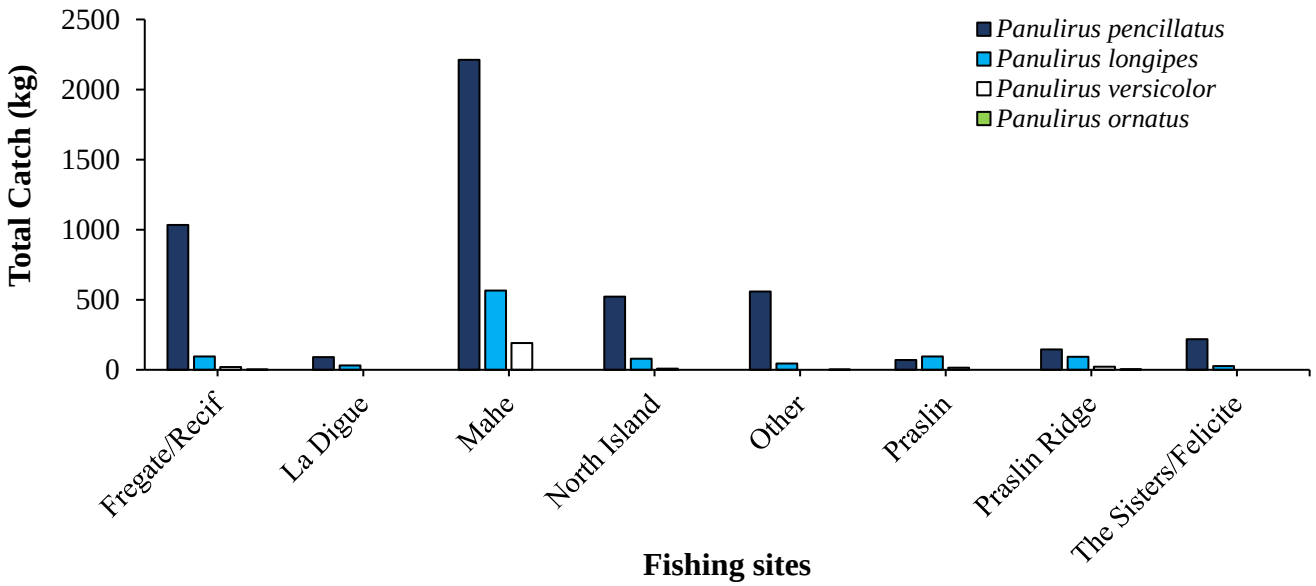

Figure 12: Species compositions of spiny lobster catch from the main fishing locations during the 2020/2021 fishing season.

4.3. Size frequency distribution.

A total of 6298 spiny lobsters were sampled for carapace length (CL), and sexed during the 2020/2021 season compared to 5618 in 2019/2020 and 3697 in 2016/2017. This represents a sampling coverage of about 87% of fishing activities for the 2020/2021 season. In contrast, in 2019/2020 and 2016/2017 the sampling coverage was 94% and 86% respectively. **N.B.** No sampling was conducted on Praslin and La digue as pre-scheduled sampling strategy, due to COVID restrictions. On average, males dominated females in the samples with a ratio of 1:1.1 (**Table 1**).

Table 1: Size frequency sampled per species for the last 3 open season.

Season	Species	F	M	Total
2016/2017	*P. pencillatus*	1140	1527	2667
	P. longipes	373	604	977
	P. versicolor	20	31	51
	P. ornatus	1	1	2
2019/2020	*P. pencillatus*	1660	2782	4442
	P. longipes	386	711	1097
	P. versicolor	33	44	77
	P. ornatus	2		2
2020/2021	*P. pencillatus*	2346	2401	4747
	P. longipes	574	774	1348
	P. versicolor	128	73	201
	P. ornatus		2	2

Note: M=males, F=females

4.3.1. *Panulirus penicillatus*.

The relative size frequency distributions of males and females *P. penicillatus* sampled over the last three fishing seasons are shown in **Figure 13**. The relative strength of larger size classes (8-9 cm CL) for males increased and for females (7.5-10.5 cm CL) decreased in 2020/2021 compared to previous two seasons.

4.3.1.1. Females.

Female *P. penicillatus* sampled during the 2020/2021 season had CL ranging from 6.8 to 13.8 cm, with a mode of 10.2 cm, and a median of 9.3 cm. For the 2019/2020 season, females CL ranged from 6.3 to 13.5 cm, with a mode of 8.6 cm, and a median of 8.9 cm. Whilst in 2016/2017 season, females CL ranged from 6.0 to 14.8 cm, with a mode at 9 cm, and a median of 8.9 cm (**Figure 14**). The CL average size was 9. 4 cm in 2020/2021 and 9.1 cm for the two previous fishing seasons (**Figure 15**). There was a significant difference ($p < 0.05$) amongst the females CL average size between the three fishing seasons [1]. Females sampled in 2020/2021 was larger compared to 2019/2020 and 2016/2017 (**Figure 15** and **Table: 2 Appendix 4**). During the 2020/2021 season, 1.2% of females were undersized (< 7.5 cm) whilst in 2019/2020 and 2016/2017, the proportion was 1.4% and 11% respectively.

4.3.1.2. Males.

Males *P. penicillatus* sampled during the 2020/2021 season had CL ranging from 6.5 to 17 cm, with a mode at 8.4 cm, and a median of 10.9 cm. For the 2019/2020 season, males CL sampled ranged from 7.1 to 16.7 cm, with a mode at 10.6 cm, and a median of 11.8 cm. Whilst in 2016/2017 season, males CL sampled ranged from 5 to 19.6 cm, with a mode of 9.7 cm, and a median of 11 cm. (**Figure 14**). The CL average size was 11.2 cm in 2020/2021, 11.6 cm in 2019/2020 and 11.1 cm in 2016/2017 (**Figure 15**). There was a significant difference ($p < 0.05$) amongst the males CL average size between the three fishing seasons [2]. Males CL sampled in 2020/2021 was smaller compared to 2019/2020 (**Figure 15** and **Table: 3 Appendix 4**). During the 20120/2021 season, 0.6% of males were undersized (< 7.5 cm), whilst in 2019/2020 and 2016/2017, the proportion was 0.4% and 3.3% respectively.

[1] Kruskal-Wallis test: ($\chi^2_{(2)} = 44.679, p < 0.05$)
[2] Kruskal-Wallis test: ($\chi^2_{(2)} = 44.679, p < 0.05$)

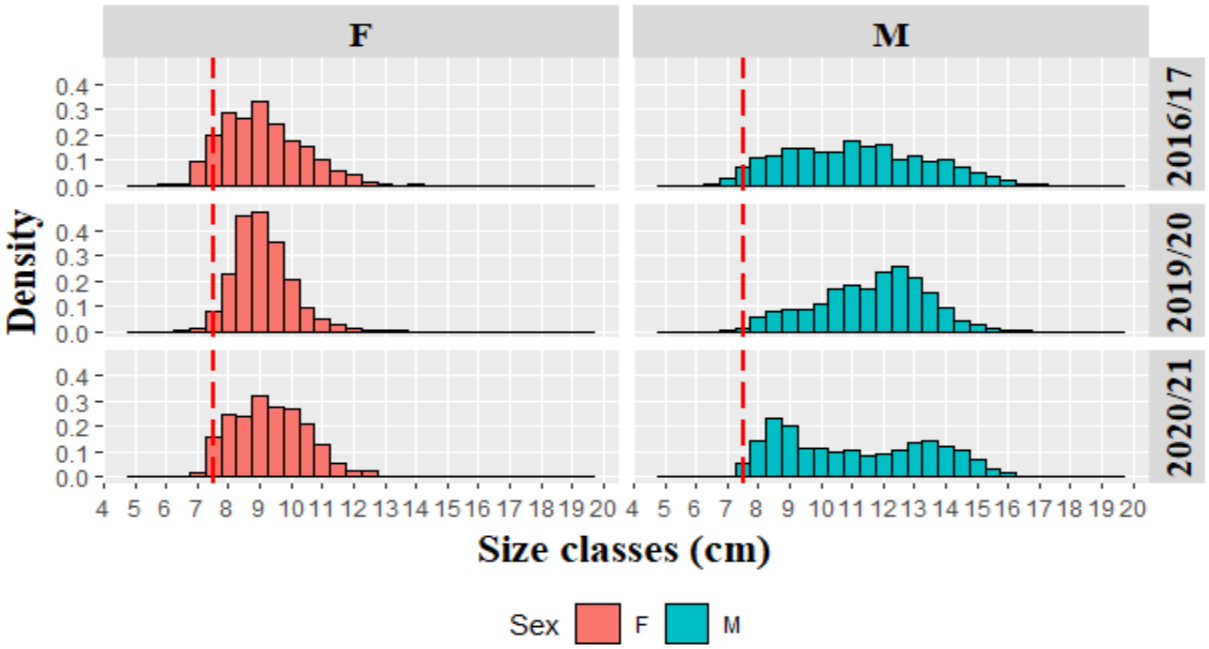

Figure 13: Size frequency distribution of female and male *P. penicillatus* over the last 3 open seasons. Density represents the proportion of counts of each size class. The minimum size limit of 7.5 cm (CL) is highlighted by the dashed redline.

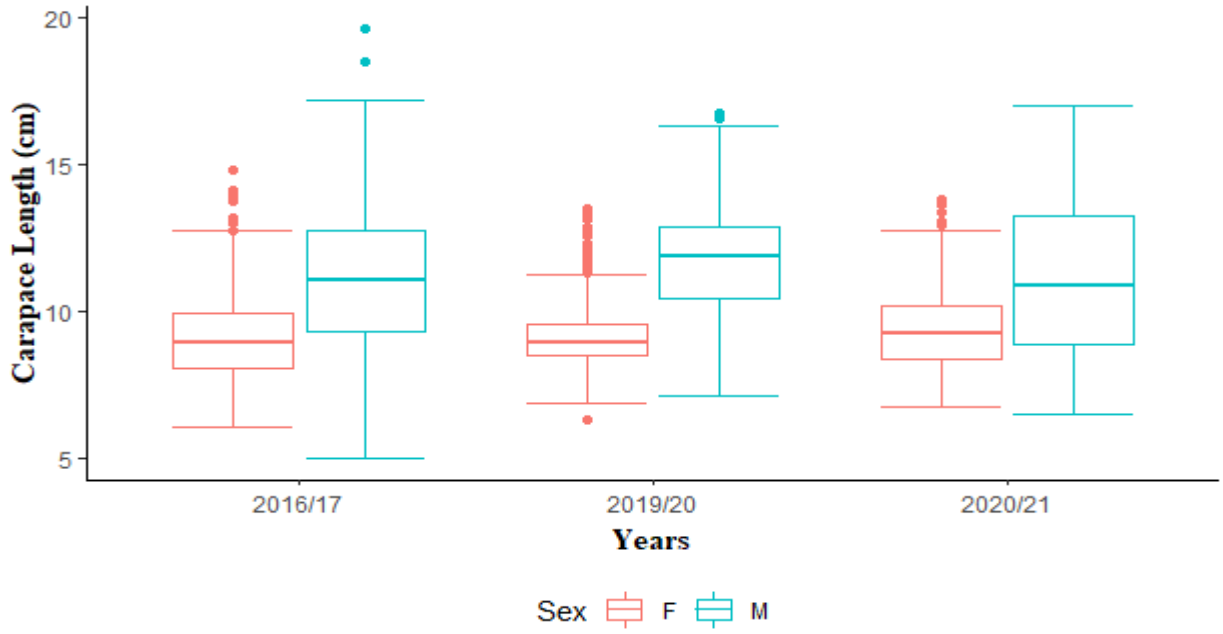

Figure 14: Box plot of the size distribution of female and male *P. penicillatus* for the three fishing seasons.

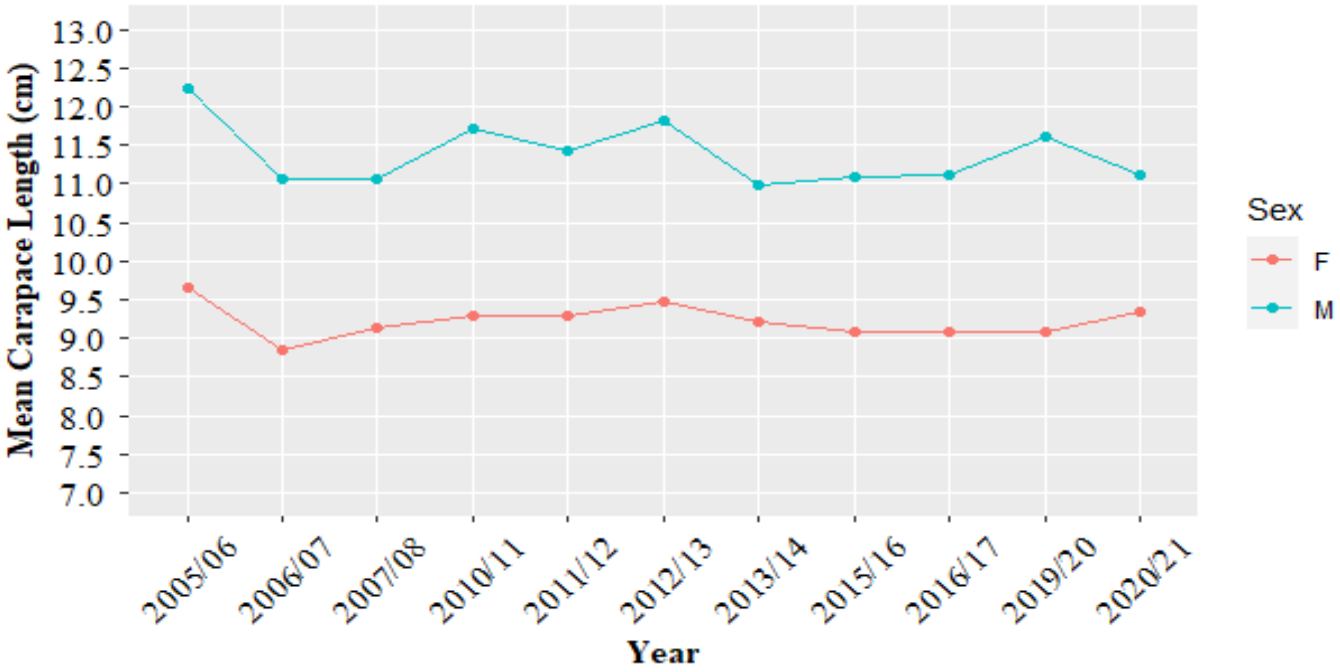

Figure 15: Average sizes of *P. penicillatus* caught during the fishing season between sexes (M = males and F= females) from 2005 to 2021.

4.3.2. *Panulirus longipes*.

The relative size frequency distributions of males and females *P. longipes* sampled over the last three fishing seasons are shown in **Figure 16**. The relative strength of the larger size classes (8-9 cm CL) for males and (8-8.5 cm CL) for females increased in 2020/2021 compared to previous two seasons.

4.3.2.1. Females.

Female *P. longipes* sampled during the 2020/2021 season had CL ranging from 6.2 to 9.4 cm, with a mode at 7.8 cm, and a median of 7.9 cm. For the 2019/2020 season, female CL ranging from 6.0 to 9.9 cm, with a mode at 7.7, and a median of 7.8 cm. Whilst in 2016/2017, females CL ranged from 6.0 to 11.7 cm, with a mode at 6.9 cm, and a median of 7.6 cm (**Figure 17**). The CL average size was 8.0 cm in 2020/2021, 7.9 cm in 2019/2020 and 7.7 cm in 2016/2017 (**Figure 18**). There was a significant difference ($p < 0.05$) amongst the females CL average size between the three fishing seasons [3]. Female CL sampled in 2020/2021 was larger compared to 2016/2017 (**Figure**

[3] Kruskal-Wallis test: ($\chi^2_{(2)} = 44.679, p < 0.05$)

18 and **Table: 4 Appendix 4**). During the 2020/2021 season, 8% of females were undersized (below 7.5 cm) whilst in 2019/2020 and 2016/2017, the proportion was 22% and 42% respectively.

4.3.2.2. Males.

Male *P. longipes* sampled during the 2020/2021 season had CL ranging from 6.4 to 10.7 cm, with a mode at 8.8 cm and a median of 8.7 cm. For the 2019/2020 season, males CL sampled ranged from 6 to 11.5 cm, with a mode at 9.6 cm and a median of 8.8 cm. Whilst in 2016/2017, males CL sampled ranged from 5.6 to 11.5 cm, with a mode at 8.1 cm and a median of 8.5 cm (**Figure 17**). The CL average size was 8.7 cm in 2020/2021, 8.8 cm in 2019/2020 and 8.5 cm in 2016/2017 (**Figure 18**). Males CL sampled in 2020/2021 were significantly different ($p < 0.05$) compared to 2019/2020 and 2016/2017 [4] (**Figure 18** and **Table: 5 Appendix 4**). During the 20120/2021 season, 2.3% of males were undersized (below 7.5 cm), whilst in 2019/2020 and 2016/2017, the proportion was 7% and 12% respectively.

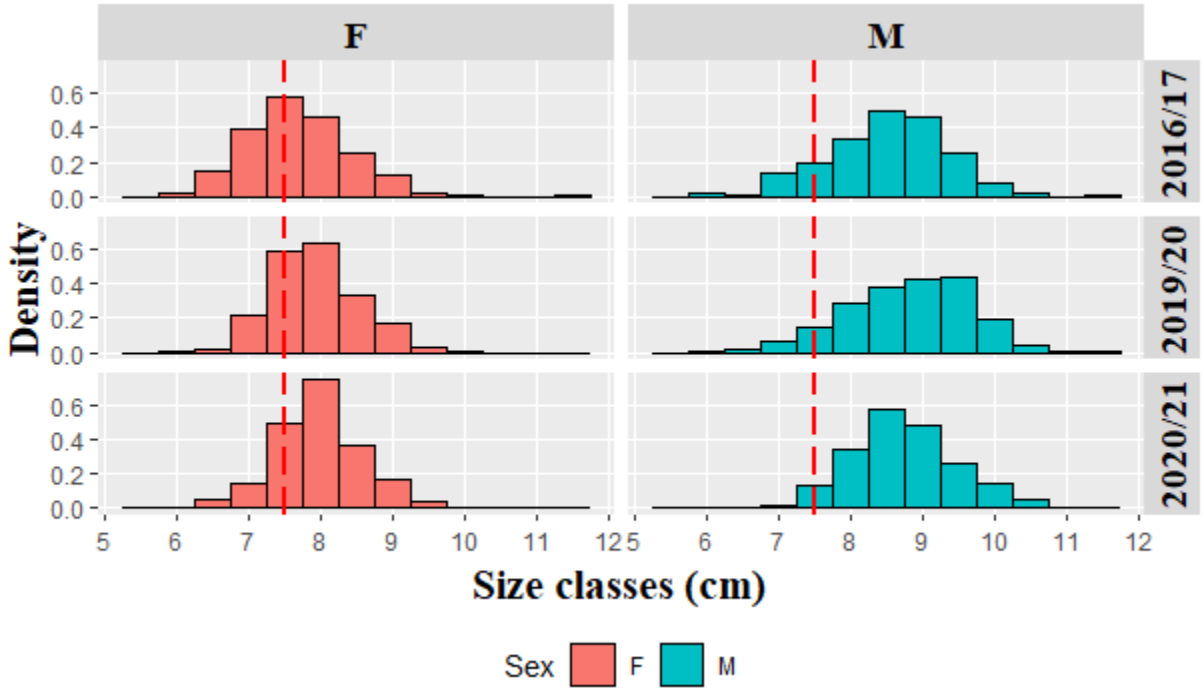

Figure 16: Size frequency distribution of female and male *P. longipes* over the last 3 open seasons. Density represents proportion of counts in each size classes whilst the minimum size limit of 7.5 cm is illustrated by the dashed redline.

[4] Kruskal-Wallis test: ($\chi^2_{(2)} = 47.562, p < 0.05$)

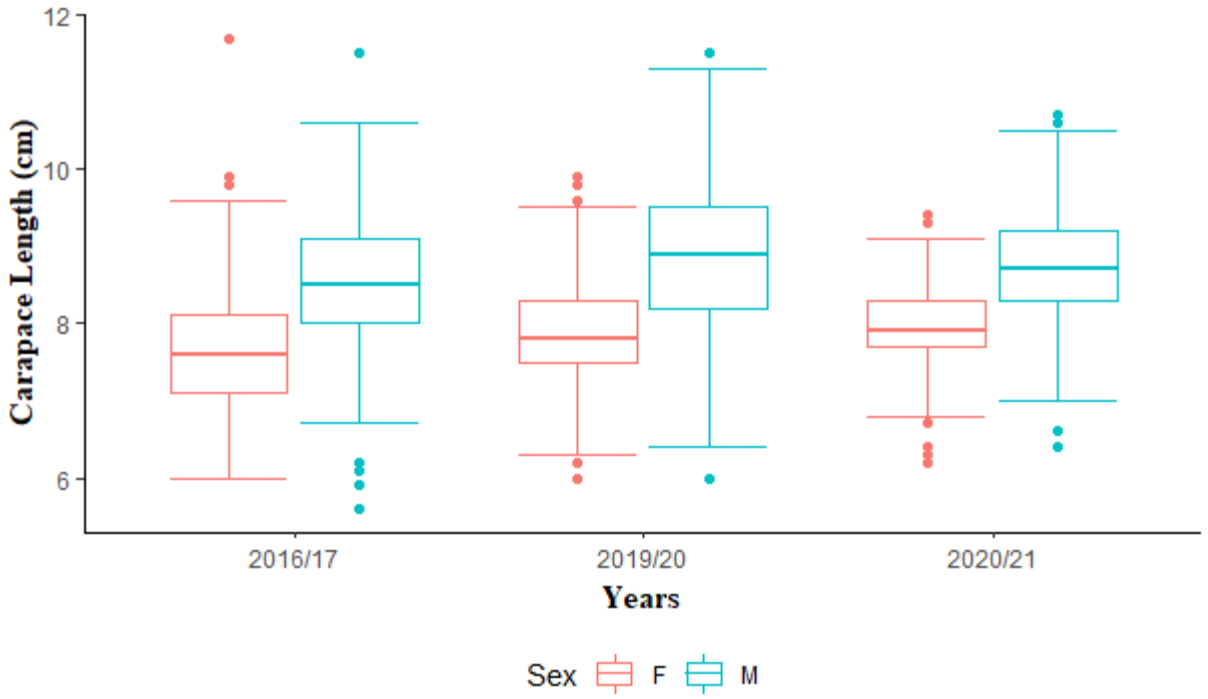

Figure 17: Box plot of the size distribution of female and male *P. longipes* for the three fishing seasons.

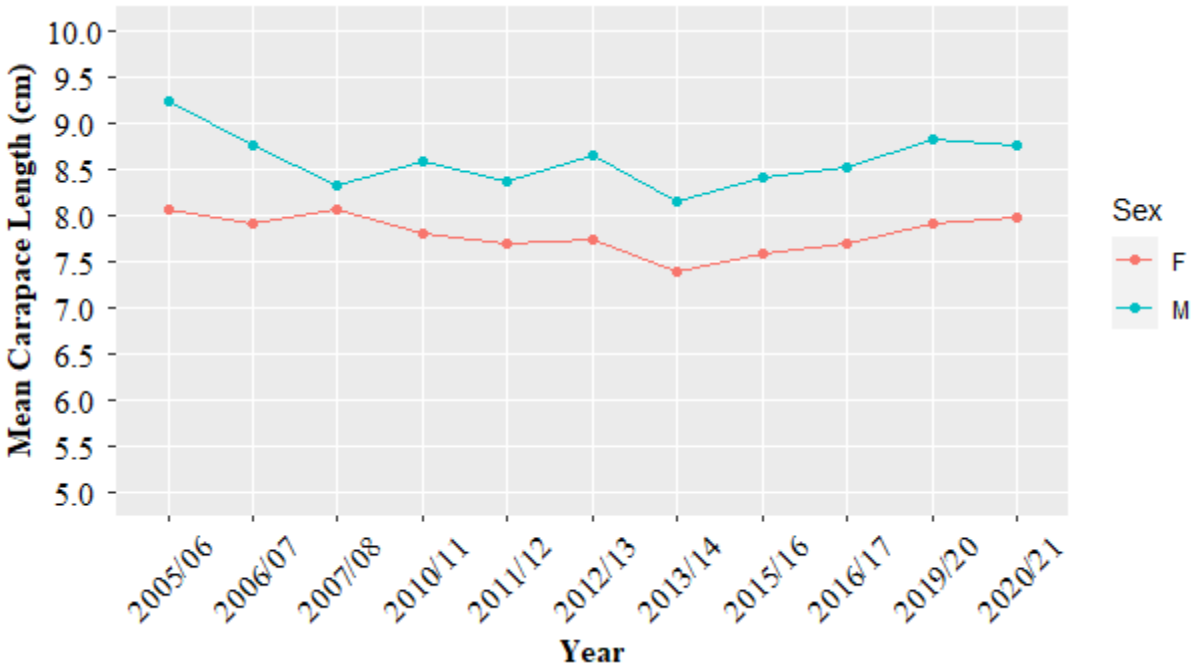

Figure 18: Average sizes of *P. longipes* caught during the fishing season between sexes (M = males and F= females) from 2005 to 2021.

5. Discussion.

The 2020/2021 lobster fishing season was opened for a period of three months and was extended for 1 month after scientific data showed decreased catch rate compared to 2019/2020 season. The Research Section is responsible for the collection of biological information, and this season we managed to carry out an effective sampling programme despite challenges experienced due to COVID-19. The licensed lobster fishery is relatively well regulated compared to most other artisanal fisheries in Seychelles. Limited access, combined with seasonal restrictions has provided a fairly effective management tool.

The 2020/2021 season reported an increase in both the total catch and number of fishing trips compared to the two previous seasons. The total catch was higher than catches reported in the past few opening seasons. This may be attributed to the extension of the fishing season and allocation of all 16 licenses, compared to 2019/2020 and 2016/2017 which may have contributed to the increase in total catch. However, this does not necessarily mean the local stock is not under pressure. Lobster fishing was dominant around Mahé but as opposed to the previous two seasons a decrease of 27% and 20% was observed respectively. This decline could be attributed to the capability of lobster fishers to visit other distant fishing locations other than Mahé. With illegal fishing being a major issue, lobster licensees may have also been encouraged to visit other fishing locations more frequently compared to previous fishing seasons, perhaps contributing to the decline in catch around Mahé.

As the measure of CPUE provides an indication of the stock abundance, in 2020/2021 fishing season it was above the historical mean. Despite this, a slight decrease was noticed when compared to the 2019/2020 fishing season. Although remaining over the historical mean, the decline could imply the stock is experiencing fishing pressure to some degree. It must also be noted that the lobster fishery has been opened for two consecutive fishing seasons. Due to the continued fishing pressure, it is likely that the stock is unable to reproduce or mature faster to replenish individuals taken by the fishery. When compared with CPUE from 2016/2017 fishing season, 2020/2021 was the highest, most certainly due to the 2-year closures (2017/2018 and 2018/2019), allowing the lobster stock to increase in abundance. As for CPUE per fishing location, La Digue recorded the highest value, indicating that lobster biomass is higher. However, it is difficult to say with certainty

this is the case given the low uptake of licenses (1 licensee) and low fishing effort (2 trips) around the particular island.

Panulirus penicillatus once again dominated the total catch. Emmerson, (2017) and Pitcher, (1993) have discovered that *P. penicillatus* is the most common species in several parts of tropical Eastern Africa and throughout south Pacific islands. This dominance could be due to various factors such as having a faster growth rate (Chauvet and Coutures, 2001; Radhakrishnan et al., 2019) or reduction in intraspecific competition (Porobic et al, 2019). Catch could also be dependent on fishing grounds, as there are habitat specificities and depth variation between each species (Pitcher, 1993). As a result, higher wave impacted fishing sites are being targeted by fishers as *P. penicillatus* abundance is specific to this habitat type (Radhakrishnan et al., 2019; Pitcher, 1993). Alternately, it can be assumed that the minimum size restriction can impose a selective effect on lobster species caught. Since *P. longipes* is a slow growing and smaller species than *P. penicillatus*, fishers are reluctant to exploit this species (Radhakrishnan et al., 2019; Chauvet and Farman, 1994). It should be noted that fishers have expressed concerns to re-evaluate the legal minimum size limit of 7.5 cm for *P. longipes* to accommodate this.

Changes in the average size for both *P. penicillatus* and *P. longipes* was observed over the last three fishing seasons. Females were larger whereas the males were significantly smaller during 2020/2021 compared to 2019/2020 and 2016/2017 fishing season. It can be assumed that more females are being released most probably influenced by the licence regulation (i.e., release of berried females), thus allowing them to attain larger size. Smaller males could indicate that larger individuals could have already been exploited by the fishery in the previous open season. Since the proportion of males are higher each fishing season compared to females, fishers could be targeting more males. Magallón-Gayón et al., (2011) study reported that *Panulirus guttatus* (the Caribbean spiny lobster) females prefers to breed with larger males, most probably because of the greater reproductive success. It could also be assumed that with larger males being limited, it would take longer for smaller males to assert the reproductive role of a larger individual (Briones-Fourzán, et al., 2015). Since fishing pressure tends to disproportionally remove larger individuals primarily male lobsters, this may change ratio between sexes and scale down average size (Evans et al., 1996; Wynne and Côté, 2007; Briones-Fourzán, et al., 2015), thus the stock can be assumed to be under pressure. Additionally, the catch of undersized lobster has declined considerably in

2020/2021 compared to 2019/2020 and 2016/2017 fishing seasons. This could potentially be due to the improved monitoring efforts and increased awareness by fishers themselves.

Although efforts were made to improve monitoring, control and surveillance (MCS), reports of illegal fishing have been brought forth on multiple occasions by licensed fishers. It is imperative that an extensive and effective monitoring plan is enforced. This will ensure compliance from licensed and unlicensed lobster fishers during open and closed season and mitigate stock exhaustion.

The accuracy of the data presented in this report is highly dependent on the reliability and cooperation received from the licensed fishers. Generally, despite logbooks being submitted, several issues regarding data reporting were identified. These included inconsistency in recording (1) fishing date, (2) effort number and (3) under reporting of total catch per trip.

Overall, data collected during the 2020/2021 season indicates that there was a slight decrease in lobster's relative abundance (CPUE), most probably attributed to lobster fishery being open for two consecutive seasons. Despite more fishing opportunities being made available through the extension, the CPUE remained lower compared to the previous season, thus showing signs of reduced lobster abundance. This will be confirmed following the upcoming 2021 fisheries independent survey (PLMP) which will be compared with historical data ranging from 2013 to 2021. This process will effectively allow us to determine the status of the lobster stocks, and relay appropriate feedback to Fisheries Management. Fisheries Management will then make a decision to either open or halt the 2021/2022 fishing season.

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7. List of Appendices.

Appendix 1

Lobster fishery licence terms and condition during open season.

Conditions of this license

1. A COMPLIANCE BOND OF SR5000 WILL BE PAID TO SFA AS A DEPOSIT PRIOR TO ISSUANCE OF THE LICENCE. THE SFA SHALL WITHHOLD THE COMPLIANCE BOND IN THE EVENT OF SUSPECTED NON-COMPLIANCE TO THESE CONDITIONS, THE FISHERIES REGULATIONS AND THE FISHERIES ACT.
2. THE LICENSEE SHOULD FILL IN THE LOGBOOK CORRECTLY, WITH A MARGIN OF ERROR OF +/-10 UNITS AND SHALL SUBMIT TO THE SFA FORTNIGHTLY, FOR THE LENGTH OF THE FISHING SEASON. ALL COMPLETED LOGBOOKS SHALL BE SUBMITTED TO THE SFA WITHIN ONE WEEK AFTER CLOSURE OF THE LOBSTER FISHING SEASON.
3. THE HOLDER OF THE LICENCE SHALL NOT AT ANY TIME FISH FOR, CATCH, OR KILL HOMARD IN A PROTECTED AREA.
4. THE HOLDER OF THE LICENCE SHALL NOT FISH FOR, CATCH OR KILL HOMARD WHICH IS LESS THAN 7.5 CM IN LENGTH MEASURED FROM THE EYE SOCKET ALONG A LINE PARALEL TO THE CENTRE LINE OF THE BODY SHELL (CARAPACE) OF THE HOMARD.
5. THE HOLDER OF THE LICENCE SHALL NOT FISH, CATCH, KILL, SELL OR BE IN POSSESSION OF A HOMARD IN THE BERRIED STATE.
6. THE HOLDER OF THE LICENCE SHALL PROVIDE ACCESS TO THE SFA FISHERIES RESEARCH TECHNICIANS TO ALL CATCHES, AND PROVIDE ALL REASONABLE ASSISTANCE IN THE COLLECTION OF ALL FISHERIES RELATED DATA (i.e. INFORMATION RELATING TO FISHING LOCATION etc..)
7. THE HOLDER OF THE LICENSE SHALL COMPLETE AND PROVIDE A SALES RECEIPT FOR ALL SALE OF LOBSTERS. THE HOLDER OF THE LICENSE SHALL PROVIDE THE SFA WITH A COPY OF THE RECEIPT BOOK AT THE CLOSURE OF THE LOBSTER SEASON.
8. THE HOLDER OF THE LICENSE SHALL NOTIFY THE SFA OF THE NAME OF THE VESSEL(IF APPLICABLE) THAT IS BEING USED FOR THE PURPOSES OF LOBSTER FISHING, AS WELL AS THE FOLLLOWING DETAILS OF THE CREW ONBOARD
    a. NAME AND SURNAME
    b. NATIONAL IDENTIFICATION NUMBER
9. IT SHALL BE THE RESPONSIBILITY OF THE LICENSE HOLDER TO INFORM THE SFA ON ANY CHANGES THEREOF.
10. THE LICENSE HOLDER SHALL SUBMIT A COLOR PICTURE OF FISHING VESSEL BEING NOTIFIED FOR THIS PURPOSE.
11. THE HOLDER OF THE LICENSE SHALL NOTIFY THE SFA PRIOR TO THE COMENCEMENT OF ANY FISHING TRIP, ON 2811280.
12. ALL CREW MEMBERS SHALL CARRY THEIR NATIONAL IDENTIFICATION CARD DURING FISHING TRIPS. THE NATIONAL IDENTIFICATION CARD MUST BE PRODUCED AT THE REQUEST OF AN AUTHORIZED FISHERY OFFICER, OR ANY MEMBER OF A LAW ENFORCEMENT AGENCY.

Appendix 2

Fishers Catch and Effort Logbook (FCEL).

Lobster Catch and Effort Logbook												
SFA No. :												
Date:			Name:				Landing Sites:					
Scuba & Snorkeling												
Fishing Site			Fishing Site			Fishing Site			Fishing Site			
Scuba ☐	Snorkeling ☐		Scuba ☐	Snorkeling ☐		Scuba ☐	Snorkeling ☐		Scuba ☐	Snorkeling ☐		
Time in			Time in			Time in			Time in			
Time out			Time out			Time out			Time out			
No. fishers			No. fishers			No. fishers			No. fishers			
Bottom Type			Bottom Type			Bottom Type			Bottom Type			
Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	
Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	
Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	
Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	
Trap												
Fishing Site			Fishing Site			Fishing Site			Fishing Site			
Time set			Time set			Time set			Time set			
Time Haul			Time Haul			Time Haul			Time Haul			
No. Traps			No. Traps			No. Traps			No. Traps			
Bottom Type			Bottom Type			Bottom Type			Bottom Type			
Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	Oumar Rouz	No:	Kg:	
Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	Oumar Ver	No:	Kg:	
Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	Grosse Tete	No:	Kg:	
Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	Porcelaine	No:	Kg:	
Remark:												

Appendix 3

Sampling Catch and Effort Logbook (SCEL).

Lobster data collection form

Date..... **Licensee Name** ..... **License No**.....

Landing site..... **Fishing Location** .....

Fishing Method ..... **No. Men/Trap** .....

Time in..... **Time out**..... **Substrate type** .....

	Species	Sex	CL (mm)	Weight (g)	Eggs	Tar spot	Setae hair	Tag no.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Comments .....

Measurer..... **Recorder**.....

Appendix 4

Pairwise comparison between fishing seasons.

Table 2: Pairwise comparisons between average carapace length of *Panulirus penicillatus* females caught in 2020/2021, 2019/2020 and 2016/2017 fishing seasons. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2016/2017 - 2019/2020	2.657013e-01	**ns**
2016/20217 - 2020/2021	2.752545e-09	***p* < 0.05**
2019/2020 - 2020/2021	5.720330e-08	***p* < 0.05**

Significance level at 0.05. ns; nonsignificant difference.

Table 3: Pairwise comparisons between average carapace length of *Panulirus penicillatus* males caught in 2020/2021, 2019/2020 and 2016/2017 fishing seasons. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2016/2017 - 2019/2020	8.014709e-15	***p* < 0.05**
2016/20217 - 2020/2021	1.000000e+00	**ns**
2019/2020 - 2020/2021	7.138716e-17	***p* < 0.05**

Significance level at 0.05. ns; nonsignificant difference.

Table 4: Pairwise comparisons between average carapace length of *Panulirus longipes* females caught in 2020/2021, 2019/2020 and 2016/2017 fishing seasons. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2016/2017 - 2019/2020	1.377615e-06	***p* < 0.05**
2016/20217 - 2020/2021	3.257150e-09	***p* < 0.05**
2019/2020 - 2020/2021	1.191557e-01	**ns**

Significance level at 0.05. ns; nonsignificant difference.

Table 5: Pairwise comparisons between average carapace length of *Panulirus longipes* males caught in 2020/2021, 2019/2020 and 2016/2017 fishing seasons. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2016/2017 - 2019/2020	2.084659e-11	***p* < 0.05**
2016/20217 - 2020/2021	3.532657e-05	***p* < 0.05**
2019/2020 - 2020/2021	1.919090e-02	***p* < 0.05**

Significance level at 0.05. ns; nonsignificant different.