ISSN: 1659-7141

SEYCHELLES FISHING AUTHORITY
TECHNICAL REPORT

REPORT ON THE SPINY LOBSTER FISHERY

Lobster Survey Report 2022

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SFA/R&D/088

Lobster Survey Report 2022

©Roger Swainston
Source: anima.net.au/ image ID: IB0418
Species: Panulirus ornatus

SFA Fisheries Research Department

December 2022

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1. Introduction.

The spiny lobster fishery has been conventionally managed by seasonal closures and limited access (license-limited) regulations implemented by the Seychelles Fishing Authority. These regulations have been in force to limit fishers primarily targeting coastal and shallow water stocks, where abundance is limited and easily accessible. In the past, assessments of fisheries dependent data have shown several significant declines in the coastal stocks when too many licenses are allocated or when the fishery remains open for 3 to 4 consecutive seasons. Consequently, the stock status is determined by assessing both fisheries dependent and independent (surveys) data. Results obtained are provided to managers with advice on whether the fishery should be open or remain closed.

The 2021/2022 lobster fishing season was reopened after opening for two consecutive seasons (2019/2020 and 2020/2021 fishing season; **Figure 1**). In October 2022, as part of the Participatory Lobster Monitoring Programme (PLMP) a fisheries independent survey was carried out to assess stock status at 20 sites around Mahé. The aim of this paper is to present the results of the 2022 PLMP survey and to present information on several stock indicators based on the combined data collected from the survey and the 2021-2022 fishing season (**Table 1 & 2**).

Moreover, it provides several recommendations and advice to managers based on both the fishery data and PLMP survey to assist with decision making on whether the 2021-2022 fishing season should be open or remain closed.

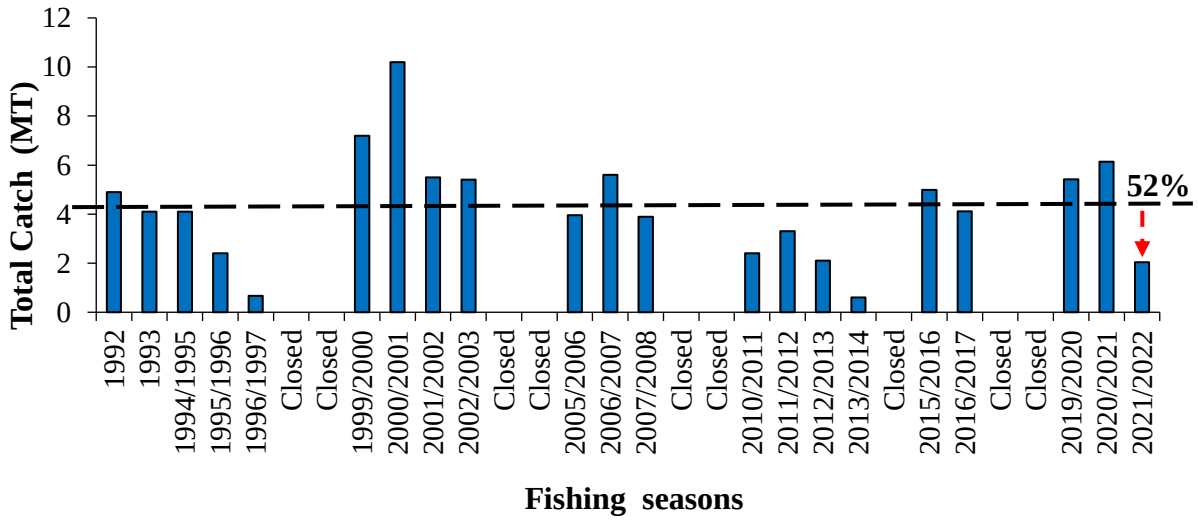

Figure 1: Overview of the catches (Metric Tonnes (MT)) from the lobster fishery from 1992 to 2022. Dashed black line of 4.24 MT indicates mean seasonal catch.

2. Fisheries independent survey (PLMP survey).

2.1. Total catch.

The total catch of lobsters for the 20 sites surveyed is shown in **Figure 2.** In, 2022, 76 kg of lobsters were caught as opposed to 79 kg in 2021, representing a 4% decrease. The catch composition consisted of three species notably *Panulirus penicillatus, Panulirus longipes and Panulirus versicolor. P. penicillatus* remains the dominant species with a total of 41 kg, followed by *P. longipes* 26 kg and *P. versicolor* 9 kg. Compared to 2021, this is an increase of 6% and 51% for *P. penicillatus* and *P. versicolor* respectively, whilst *P. longipes* decreased by 25% (**Figure 2**).

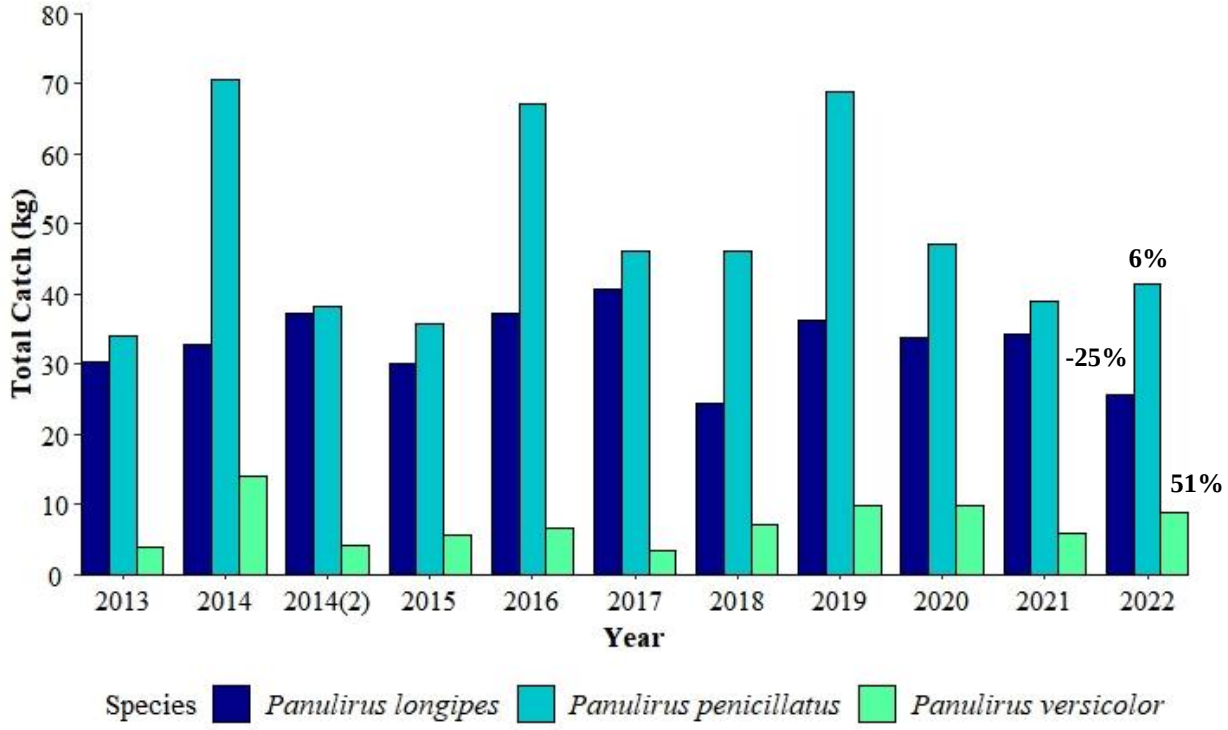

Figure 2: Total catch by species in kilograms for the twenty survey sites from 2013 to 2022.

3. Effort trend indicator.

The average fishing effort and total catch (kg) is shown in **Figure 3**. From 2020 to 2022, a decline in both the effort and total catch can be observed. An increase of 42% for both indicators was reported in 2019. Compared to 2019, 2020 reported a decline of 28% in fishing effort and 20.8% in total lobster caught. Further decline of 5% and 13% was observed for fishing effort and total catch (kg) in 2021. Similarly, in 2022 survey a decline of 12% and 4% was observed in fishing effort and total catch respectively (**Figure 3**).

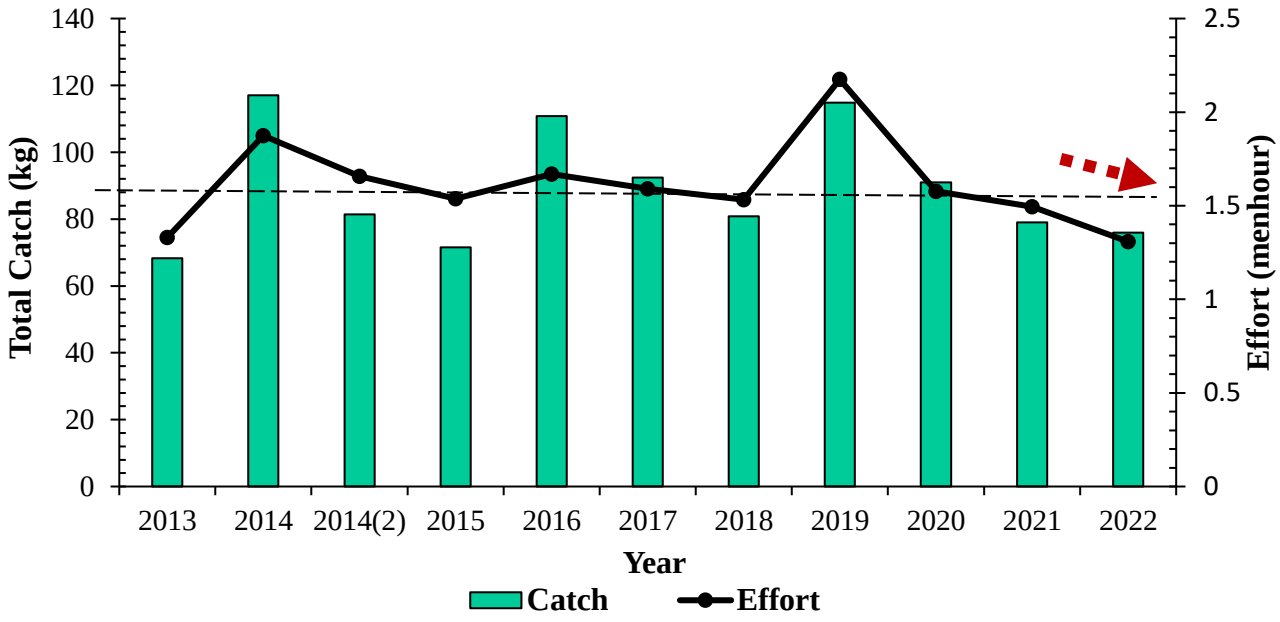

Figure 3: Average fishing effort (menhour) and total catch (kg) from 2013 to 2022. Red arrow highlights decrease in trend. Black dotted line indicates the long-term catch average of 88 kg.

4. Abundance and biomass indicators.

4.1. All lobsters caught.

The average catch per unit effort (CPUE) in kg/menhour and no/menhour[1] from 2013 to 2022 can be observed in **Figure 4**. The CPUE in kg/menhour was higher than most of the previous surveys with an average of 2.95 kg/menhour except for 2016 and 2020 surveys. Whilst the CPUE no/menhour remains lower compared to most previous surveys with an average of 6 lobsters per menhour. The trend in 2017 shows a 25% decline in the CPUE kg/menhour whilst the CPUE no/menhour remained relatively stable. Further declines in CPUE were observed in 2018. In 2019 a 13% increase for both measures of CPUE was recorded. Similarly, in 2020, both measures of CPUE showed an increasing trend of 7.6% (kg/menhour) and 14.6% (no/menhour) respectively. In 2021, a 10% decline was observed in the CPUE in kg/menhour whilst the CPUE in no/menhour increased by 2%. All lobster caught in 2021 consisted of 51% undersized (< 7.5 cm) and 49% legal size (> 7.5cm). In 2022, the CPUE kg/menhour increased by 10% and the CPUE no/menhour decreased by 2%. Compared to 2021, 60% of the total catch were legal size lobsters whereas the remaining 40% were undersize lobsters. This represents an increase of 24% and a decrease of 22% respectively. However, there were no significant

1 menhour = transect time per site multiplied by number of men (2) snorkelling.

difference ($p > 0.05$) observed in CPUE kg/menhour[2] and CPUE no/menhour[3] between previous surveys.

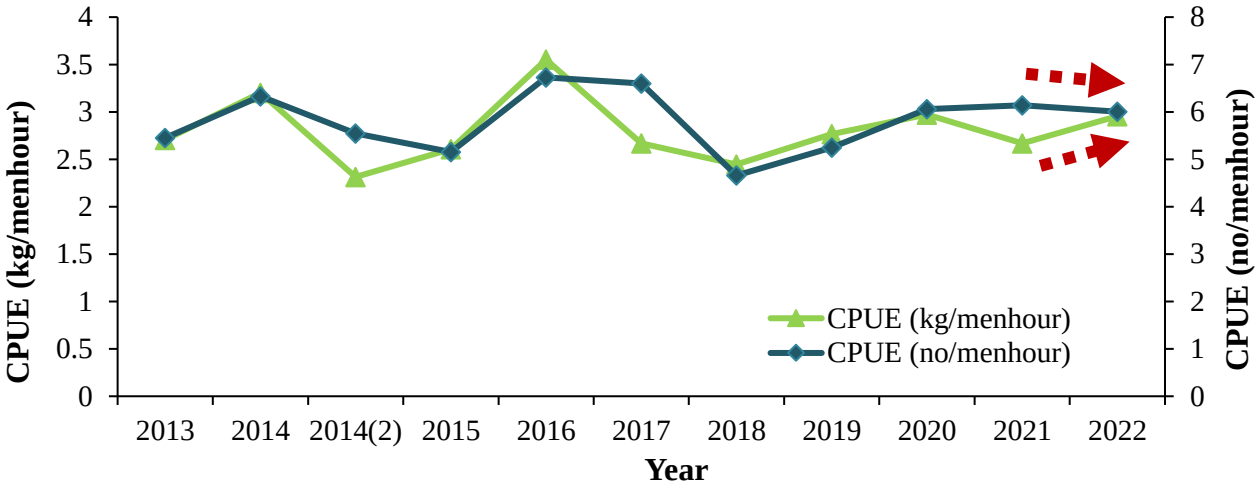

Figure 4: Average catch per unit effort at survey sites in kilogram/menhour and numbers/menhour for all lobsters caught from 2013 to 2022. Red arrow highlights the change in trends.

4.2. Legal sized lobsters (>7.5 cm Carapace Length).

The average CPUE for legal sized lobsters caught varies over the survey periods (**Figure 5**). The CPUE in kg/menhour was higher than most of the previous surveys with an average of 2.42 kg/menhour of lobsters except for 2016 and 2020 surveys. Whilst CPUE in no/menhour was also higher compared to most previous surveys except for 2016 (same average) with an average of 3.68 no/menhour of lobsters caught. The trend in 2017, shows a decline of 39% (kg/menhour) and 31% (no/menhour) in both measures of CPUE. However, in 2018 both measures of CPUE presented an increase of 16% (kg/menhour) and 5% (no/menhour) compared to 2017. Further increase in both CPUE was observed in 2019. A 13.2% and 8.4% increase for kg/menhour and no/menhour respectively, was recorded in 2020. In 2021, a 21% and 7% decline in both measure of CPUE respectively were recorded. As opposed to 2021, the 2022 survey observed a 24% and 20% increase in both measures of CPUE for legal size lobsters. However, there were no significant difference ($p > 0.05$) observed in CPUE kg/menhour[4] and CPUE no/menhour[5] between previous surveys.

2 ANOVA: F (10) = 0.739, $p > 0.05$

3 ANOVA: F (10) = 0.593, $p > 0.05$

4 ANOVA: F (10) = 1.182, $p > 0.05$

5 ANOVA: F (10) = 0.961, $p > 0.05$

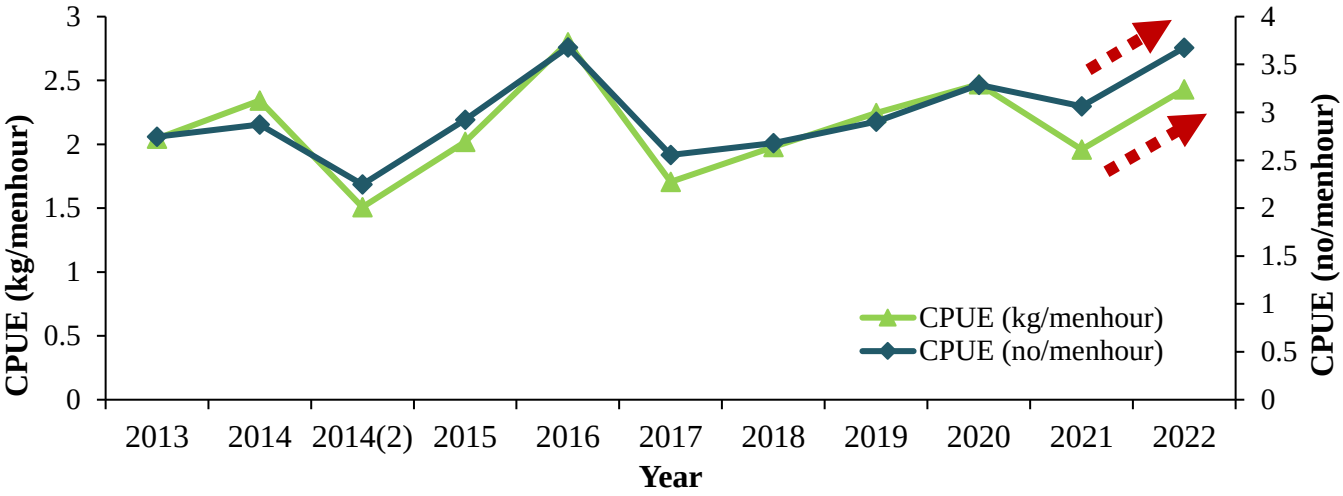

Figure 5: Average catch per unit effort for legal sized lobsters caught from 2013 to 2022. Red arrow highlights the decrease in trend.

5. Length based indicators.

A total of 158 spiny lobsters were sampled for carapace length (CL) and sexed during the 2022 survey as opposed to 183 in 2021. Amongst the samples, 63 individuals were undersize (< 7.5 cm) whilst 95 individuals were legal size and above (> 7.5 cm). Twenty seven percent (27%) of lobsters were berried females of which *P. longipes* and *P. penicillatus* dominated with 13%, followed by 1% *P. versicolor*. The smallest berried female reported with a carapace length of 5.6 cm weighing 0.187 kg (*P. longipes*) whereas the largest berried female was 11.1 cm weighing 0.974 kg (*P. penicillatus*). Compared to the previous survey, females dominated males with a ratio of 1:0.8.

5.1. *P. penicillatus.*

The average sizes of *P. penicillatus* caught during the surveys are shown in **Figure 6**. In 2018 females and males showed an increased average carapace length of 1.3 cm and 1.5 cm respectively. Further increase in the average carapace length of 0.3 cm and 0.8 cm for both females and males were observed respectively in 2019. In 2020, the average carapace length showed a decrease of 0.7 cm in males whilst that of females remains relatively stable. A decrease in average carapace length of 0.6 cm (7% **Table 1**) in females and 1.3 cm (12% **Table 1**) in males was observed in 2021. In contrast, in 2022 both females and males average carapace length increased by 0.4 cm (4.3% **Table 1**) and 0.3 cm (3.3% **Table 1**) respectively. However, there was no significant difference ($p > 0.05$) between the females and males average carapace length between the last three fishing seasons (**Table 3 and Table 4 Appendix 1**).

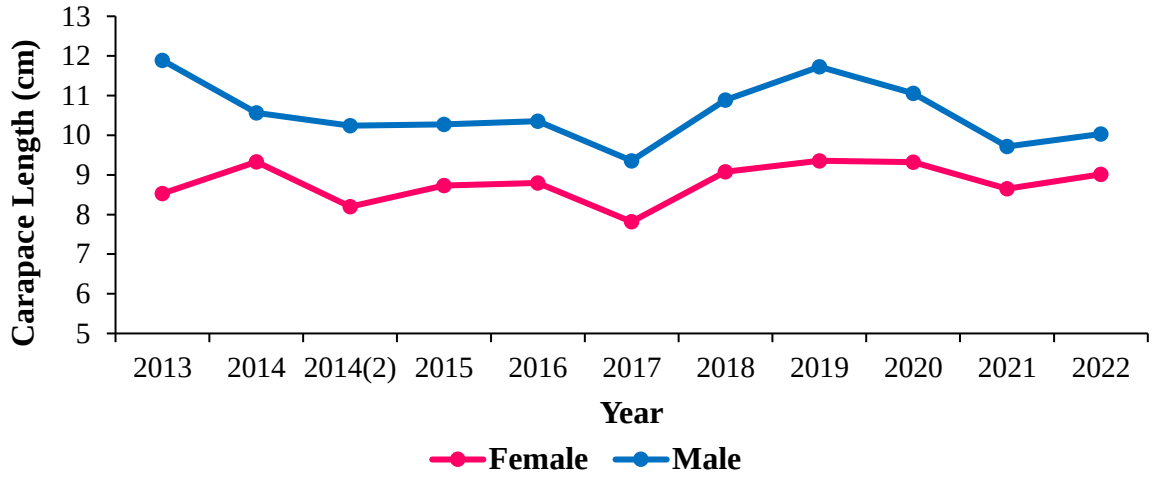

Figure 6: Average carapace sizes of *P. penicillatus* caught during the surveys between sexes from 2013 to 2022.

5.2. *P. longipes.*

In 2018, the average carapace length of males remained stable whilst that of females increased by 0.4 cm. The average carapace length increased by 0.2 cm in males and by 0.4 cm in females in 2019. Further increase was observed in average carapace length of males by 0.3 cm, whilst that of females remained relatively stable. A decrease in average carapace length of 0.3 cm (5%) in females and 0.5 cm (6%) in males was observed in 2021. In contrast, in 2022 males average carapace length increased by 0.3 cm (5% **Table 1**) whilst females remains relatively stable (**Figure 7**). However, there was no significance difference ($p > 0.05$) amongst the females and males average carapace length between the last three fishing seasons (**Table 5 and Table 6 Appendix 1**).

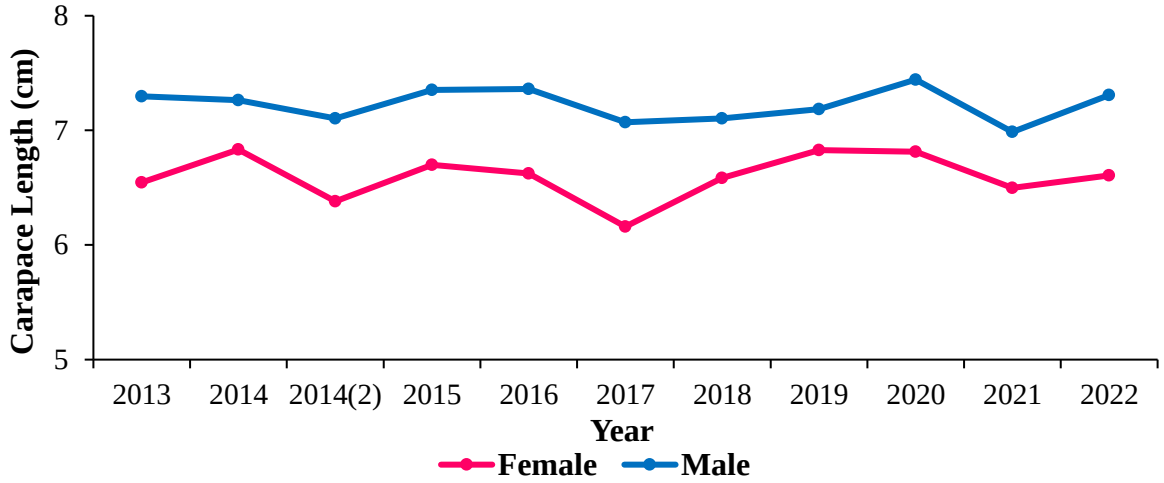

Figure 7: Average carapace sizes of *P. longipes* caught during the surveys between sexes from 2013 to 2022.

6. Lobster stock status indicators

Table 1. Summary output for lobster survey 2022.

Fishery independent indicators	2021 Survey	2022 Survey	Comments
Catch (compared to long-term average)	**79 kg**	**76 kg**	Catch for 2022 was lower than the long-term average of 88 kg compared to the previous years (**Figure 3**).
Catch (compared to previous survey)	**13% decrease**	**4% decrease**	Catch further decreased in 2022 survey (**Figure 2**).
Effort (compared to previous season)	**5% decrease**	**12% decrease**	Effort (menhour) decreased by 12% between 2022 and 2021 survey (**Figure 3**).
CPUE kg/menhour (all lobsters compared to previous survey)	**10% decrease**	**11% increase**	CPUE increased for all lobster caught in 2022 compared to the 2021 survey. However, the increase was not statistically significant (**Figure 4**).
CPUE kg/menhour (legal size lobsters compared to previous survey)	**21% decrease**	**24% increase**	CPUE increased for legal size lobster caught in 2022 compared to the 2021 survey. However, the increase was not statistically significant (**Figure 5**).
CPUE no/menhour (all lobsters compared to previous survey)	**2% increase**	**2% decrease**	CPUE decreased slightly for all lobster caught between 2022 and 2021 surveys. However, the decrease was not statistically significant (**Figure 4**).
CPUE no/menhour (legal size lobsters compared to previous survey)	**7% decrease**	**20% increase**	CPUE increase for legal size lobster caught in 2022 compared to 2021 survey. However, the increase was not statistically significant (**Figure 5**).
Mean size *P. penicillatus* M (compared to previous season)	**12% decrease**	**3.3% increase**	Male increased in size between 2022 and 2021 surveys. However, the increase was not statistically significant (**Figure 6**).
Mean size *P. penicillatus* F (compared to previous season)	**7% decrease**	**4.3% increase**	Female increased in size between 2022 and 2021 surveys. However, the increase was not statistically significant (**Figure 6**).
Mean size *P. longipes* M (compared to previous season)	**6% decrease**	**5% increase**	Male increased in size for the 2022 survey compared to the 2021 survey. However, the increase was not statistically significant (**Figure 7**)**.**
Mean size *P. longipes* F (compared to previous season)	**5% decrease**	**2% increase**	Female increased in size between 2021 and 2020 surveys. However, the increase was not statistically significant (**Figure 7**).

key		Indicator shows negative trend or comparison		Indicator shows positive trend or comparison		Indicator shows a stable trend

Table 2. Summary output for lobster fishing season 2021/2022.

Fishery dependent indicators	2020/2021 Season*	2021/2022 Season†	Comments
Catch (compared to long-term average)	**6140 kg**	**2050 kg**	Catch was lower in 2021/2022 fishing seasons compared to the long-term average of 4.24 MT (SFA, 2022a; **Figure 1)**.
Catch (compared to previous season)	**13% increase**	**67% decrease**	Catch decrease was observed between 2021/2022 and 2020/2021 fishing seasons (SFA, 2022a; **Figure 1)**.
Effort (compared to previous season)	**23% increase**	**57% decrease**	Effort (no. of fishing trips) decrease by 57% between 2021/2022 and 2020/2021 fishing season (SFA, 2022a; **Figure 5**).
CPUE (all gears compared to long-term average)	**35% increase**	**5% increase**	CPUE for all gears increased from the long-term mean = 18.9 kg/trip (SFA, 2022a; **Figure 6**).
CPUE (all gears compared to previous season)	**8% decrease**	**22% decrease**	CPUE for all gears decreased during the 2021/2022 compared to the 2020/2021 fishing season.
CPUE (snorkelling) (compared to previous season)	**10% decrease**	**80% decrease**	CPUE for snorkelling fishing technique decreased in 2021/2022 compared to the 2020/2021 fishing season.
CPUE (scuba‡) (compared to previous season)		**83% decrease**	CPUE for scuba fishing technique decreased in 2021/2022 compared to the 2020/2021 fishing season.
Mean size *P. penicillatus* M (compared to previous season)	**4.3% decrease**	**2.4% decrease**	Male size in 2021/2022 was significantly smaller than in the 2020/2021 fishing season. **Test result: Kruskal-Wallis test: (χ 2 (2) = 23658, p < 0.05 (**SFA, 2022a; **Figure 12**).
Mean size *P. penicillatus* F (compared to previous season)	**3% increase**	**0.01% increase**	Female size remains constant between the 2021/2022 and 2020/2021 fishing seasons (SFA, 2022a; **Figure 12**)
Mean size *P. longipes* M (compared to previous season)	**0.9% decrease**	**24% increase**	Male size decreased in 2021/2022. However, it was not statistically significant between the previous fishing season (SFA, 2022a; **Figure 15**).
Mean size *P. longipes* F (compared to previous season)	**0.7% increase**	**17% decrease**	Female size increased in 2021/2022. However, it was not statistically significant between the previous fishing season (SFA, 2022a; **Figure 15**).

key		Indicator shows negative trend or comparison		Indicator shows positive trend or comparison		Indicator shows a stable trend

* **The 2020/2021 fishing season was extended for another 1 month thus contributing to the increase in the total catch (SFA, 2021).**

† **The 2021/2022 fishing season was open for 2 months only (SFA,2022a).**

‡ **Snorkelling and Scuba were the two methods used and were done separately in 2021/2022 compared to the 2020/2021 fishing season were Scuba was combined alongside Snorkeling.**

7. Conclusion.

The 2022 PLMP survey, indicates that the overall catch of lobsters have decreased compared to previous years. The CPUE data in kg/menhour suggests the biomass of all lobster caught has increased while a slight decline was observed in the relative abundance. This indicates that there are larger lobsters within the stock, however they are fewer in numbers compared to the two previous surveys. These changes were not statistically significant.

Furthermore, an increasing trend was also observed in the relative abundance and biomass of legal-size lobsters (more than 7.5 cm carapace length). The CPUE kg/menhour and no/menhour, shows that on average 2.42 kilograms and 3.68 number of lobsters per menhour were caught, which is an increase compared to other survey years. This can potentially suggest that there are more, and larger legal size lobsters in the fishable stock. However, one noticeable indicator during the 2022 survey was the lower numbers of undersize lobsters sampled compared to legal size lobsters. This suggests if not enough recovery time is given for the legal-size lobsters to spawn at least once or more, it will not be beneficial for future fishing seasons (2023/2024). **As larger lobsters have greater spawning potential (Bertelsen and Matthews 2001, Fanning et al., 2011), if legal size lobsters are permitted to attain a larger size, the future spawning stock will improve thus increase the fishable population for the next season (2023/2024 fishing season)** (Bertelsen and Matthews 2001, Fanning et al., 2011).

The 2021/2022 fishing season total catch remains below the historical catch mean by 52%. Similarly, the CPUE which is a measure of the relative abundance of lobsters had declined by 22% from the previous season. The decline may potentially be because of the continued fishing pressure, considering that the lobster fishery has been opened for three consecutive years. It is worth mentioning that the fishery was opened for a period of two months following the decline in various stock indicators observed during the 2021 fishery-independent survey.

Despite the increase in fishing effort in 2021/2022 fishing season, less lobsters were caught per fishing trip due to the potential decline in abundance. Furthermore, declines in CPUE suggests the relative abundance of lobsters has decreased. The decline is likely driven by a decline in lobster abundance and not by a decline in fishing effort (SFA, 2022b).

In addition, fishing effort measured in menhour for 2022 survey, shows a slight decrease in all lobsters caught despite an increase in the legal size observed. However, both changes were not

statistically significant. This may suggest the stock could potentially experience fishing pressure to some extent since the catch is slightly lower than the previous survey.

As for the size indicators, an increase in average size for both *P. penicillatus* and *P. longipes* was observed, however this increase is not statistically significant when compared with average size in 2021 survey. In relation to the size indicators from the 2021/2022 fishing season, a slight decrease in the average size for *P. penicillatus* (Male) was observed whereas *P. penicillatus* (Female) and *P. longipes* (Female and Male) increased in average size. This implies the average size of both species have remain consistent between the survey and fishing seasons.

The changes observed across some indicators was not statistically significant, therefore stock projection appears to be stable to some extent. However, it is worth mentioning that the fishery has been open for 3 consecutive seasons, in the past, assessments of fisheries dependent data have shown several significant declines in the coastal stocks when the fishery remained open for 3 to 4 consecutive seasons. The CPUE trend for the 2019/2020, 2020/2021 and 2021/2022 fishing season has been continuously declining therefore indicating that caution should be taken when considering the opening of another consecutive season, as this may potentially lead to a continual decline in lobster stocks. Additionally, as the 2021/2022 fishing season indicate fishing effort was higher compared to the previous fishing seasons (2019/2020,2020/2021) and the catch was considerably lower. Thus, it is likely that the stock is unable to reproduce or mature faster to replenish individuals taken by both the fishery and illegal fishing.

8. Recommendations.

Based on the analysis of the fisheries dependent and independent information collected, the Research Department proposes the following recommendations with regards to the lobster fishery:

- **It is recommended that the fishery remains closed for 2022-2023 season to allow legal size lobsters to boost the future spawning potential.**
- **It is recommended that the annual PLMP survey is carried out in 2024 to continuously evaluate and monitor the status of lobster stock. To note a lobster stock assessment survey is planned for 2023 hence the PLMP survey will not be undertaken.**
- **It is recommended that monitoring, control, and surveillance is strengthened to discourage illegal fishing activities during the closed fishing season.**

- **It is recommended that an education and awareness campaign is set up to educate the public on the regulations of this fishery.**

9. Reference list.

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Appendix 1

Pairwise comparison between survey.

Table 3: Pairwise comparisons between average carapace length of *Panulirus penicillatus* females caught in 2022, 2021 and 2020 PLMP survey. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2021 - 2020	0.7369721	**ns**
2022-2020	0.9987202	**ns**
2022-2021	0.9907842	**ns**

Significance level at 0.05. ns; nonsignificant difference.

Table 4: Pairwise comparisons between average carapace length of *Panulirus penicillatus* males caught in 2022, 2021 and 2020 PLMP survey. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2021 - 2020	1.0000000000	**ns**
2022-2020	1.0000000000	**ns**
2022-2021	1.0000000000	**ns**

Significance level at 0.05. ns; nonsignificant difference.

Table 5: Pairwise comparisons between average carapace length of *Panulirus longipes* females caught in 2022, 2021 and 2020 PLMP survey. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2021 - 2020	0.9278160	**ns**
2022-2020	0.9980662	**ns**
2022-2021	0.9999945	**ns**

Significance level at 0.05. ns; nonsignificant difference.

Table 6: Pairwise comparisons between average carapace length of *Panulirus longipes* males caught in 2022, 2021 and 2020 PLMP survey. P values adjusted with the Bonferroni method.

Comparison Groups	P value	Significance level
2021 - 2020	0.8779644	**ns**
2022-2020	0.9999981	**ns**
2022-2021	0.9933794	**ns**

Significance level at 0.05. ns; nonsignificant different.