Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand

REPORT

The Study of Mud Spiny Lobster (*Panulirus polyphagus*) Distribution and Density in East Johor-South Pahang Waters: Observer on Board Survey 2019

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Introduction

The mud spiny lobsters (*Panulirus polyphagus*) is a prized seafood commodity in Malaysia. Due to its high demand and high price, the related lobster fishery is very active and has thus created high pressure to the lobster's natural resources and the sustainability of the lobster fishery. In an effort to mitigate this decline in lobster resources, a proposal to create a lobster refugia in the East Johor-South Pahang waters is underway and spearheaded by the Department of Fisheries Malaysia. The fisheries refugia the context of the UNEP/GEF South China Sea Project are defined as:

"Spatially and geographically defined, marine or coastal areas in which specific management measures are applied to sustain important species [fisheries resources] during critical stages of their life cycle, for their sustainable use"

Source: *https://fisheries-refugia.org/*

Several scientific surveys were carried out in previous years to determine the resource level and distribution of mud spiny lobsters in the East Johor-South Pahang waters. This information is vital for the determination of the lobster aggregation and spawning site to be designated as a proposed lobster refugia site in Malaysia. Thus, the aim of this survey was the determine the location where high concentration of mud spiny lobsters can be found in the East Johor-South Pahang waters and subsequently a proposed area for the establishment of a lobster refugia in East Johor-South Pahang waters.

Materials and Method

The lobster survey was conducted in the fishing ground in East Johor-South Pahang waters. A total of six sampling trips were carried out onboard four fish trawler vessels (3 zone B vessels and one zone C vessel). The sampling periods were between September to November 2019. For each sampling trip, two DOFM personnel were assigned onboard a fish trawler vessel for the entire duration of the fishing trip (one to two weeks). Their task were to record the landing of lobsters for every haul. Some of the information recorded were location of the fishing operation (GPS coordinates), weight and length of individual lobsters caught and presence of berried lobsters. Standardized forms were prepared for the DOFM personnel to fill. The completed forms were brought back to FRI for analysis. As this study is based on the Observer-On-Board method, the location and duration of each fishing operation was solely at the discretion of the vessel's operator.

The density of the lobsters were calculated using the Swept Area Method as prescribed by FAO (Sparre and Venema,1998).

The swept area, a, was estimated using the following equation:

$a = D * h * x$ ……. (Equation 1)

Where $D = V * t$ …… (Equation 2)

where V is the average speed ($km.hr^{-1}$) of the trawling operation, t is the trawling duration (in hours), h is the length of the trawl net headrope and x is the fraction of the headrope which equal to the width of the path swept by the trawl net (FRI, 2017). In this study, the value of x used was 0.5 (Sparre and Venema, 1998).

Assuming that the weight of the catch of each haul is Cw, then the catch per hour is described as Cw/t. Also, if "a" is the area swept by the trawl net during each operation, then a/t represent the area swept per hour. Therefore, the equation for the weight of catch per unit area is as follow:

$(Cw/t) / (a/t) = Cw/a$ …….. (Equation 3)

Results

A total of 195 hauls were recorded from six fishing trips. The number of hauls for each trip was dependent on specification of individual trawler vessel and the location of their fishing ground. A summary of the fishing trips from the four fish trawler vessels is shown in table 1. The total number of *P. polyphagus* caught during the duration of the entire survey was 49 tails. However, the majority (80%) of the mud spiny lobsters were caught at the fishing ground south of Pulau Aur, Johor.

Table 1: A summary of the fishing trips during the study from September – November 2019

Trip No.	Vessel Reg. Number	No. of Hauls	Fishing Area	No. of Lobsters Caught	Ave. Depth (m)
1	JHF5222T	35	Zone B, P. Sibu to Desaru	3	N.A
2	PAF4623	20	Desaru, P. Seri Buat to P. Tinggi	2	26.9
3	JHF3388T	34	South of P. Aur	12	47.3
4	JHF5222T	38	Zone B, P. Sibu to Desaru	4	N.A
5	JHF3388T	41	South of P. Aur	27	44.2
6	JHF1255T	27	P. Sibu to P. Besar	1	20.1
	Total	**195**		**49**	

* N.A : depth data not available

During the duration of the survey, three berried lobsters (female with eggs) were caught. All three individuals were from the fishing area south of Pulau Aur. The size range of the berried lobsters were from 7.5 – 11.7 cm (CL) or weighted from 470 – 810 gram. The eggs were at the intermediate stage of development (based on the reddish color of the eggs), indicating spawning season for the spiny lobster in the area was still ongoing in October 2019. There were no other berried female lobsters caught elsewhere during the survey.

The distribution and density of mud spiny lobsters in the East Johor-South Pahang waters area are shown in figure 1. Generally, the lobsters can be found in three areas, namely south of Pulau Aur, coastal area of Bandar Penawar and north-east of Pulau Besar. However, large concentration of mud spiny lobsters have been recorded in zone C region south of Pulau Aur. The overall average density of mud spiny lobsters was 0.95 $kg.km^{-2}$ and ranged from 0.31 to 2.62 $kg.km^{-2}$ (table 2). However, the average density of mud spiny lobsters at the south of Pulau Aur area were higher (0.87 and 1.17 $kg.km^{-2}$) than other areas and the chances of catching the lobster species there were higher as well.

Discussion

The results from this survey have indicated a high concentration of mud spiny lobsters in the zone C fishing ground south of Pulau Aur, Johor. This area has a higher density of lobsters, has spawning females and can be further focused as the proposed site for the lobster refugia site (figure 1). The exact size and location of the lobster refugia will require further discussions with various stakeholders as the area is a fishing ground for zone C trawler vessels (table 3).

However, during the survey at the south of Pulau Aur, we have also recorded multiple sightings of illegal pair-trawling activities. Many of these vessels are known to be operated by foreign fishermen and this issue should be taken up during the stakeholders meetings and discussions. The effect of illegal fishing activities such as pair-trawling can have a big impact on the local fish resources and the proposed refugia area.

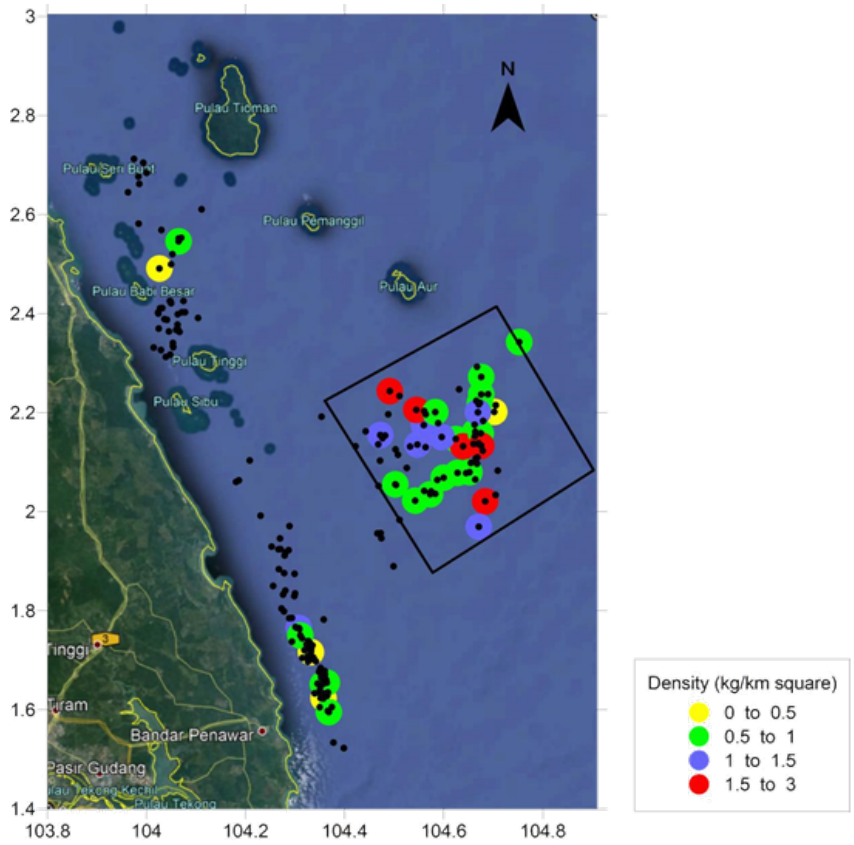

Figure 1: The density of *P. polyphagus* lobster (kg.km^{-2}) from the Observer-On-Board surveys conducted during the September – November 2019 period. The sampling stations are indicated by the black dots while the area with the presence of lobsters are colored according to the their density ranges (refer to legend). The proposed area of focus for the lobster refugia is indicated by the black box.

Table 2: Average density (kg.km^{-2}) and range of density of *P. polyphagus* lobster for each trip during the survey

Trip No.	Vessel Reg. Number	Average	Min	Max
			(kg.km^{-2})	
1	JHF5222T	0.73	0.43	1.02
2	PAF4623	0.81	0.76	0.85
3	JHF3388T	0.87	0.46	1.57
4	JHF5222T	0.59	0.31	0.73
5	JHF3388T	1.17	0.53	2.62
6	JHF1255T	0.40	0.40	0.40
	Overall	**0.95**	**0.31**	**2.62**

Table 3: The coordinates for the proposed site for the lobster refugia at south of Pulau Aur, Johor

Position	Latitude	Longitude
Point 1	2° 13.555'	104° 21.612'
Point 2	2° 24.877'	104° 42.381'
Point 3	2° 5.123'	104° 54.249'
Point 4	1° 52.318'	104° 35.042'

Conclusion

A total of 195 hauls were recorded from six fishing trips. The total number of *P. polyphagus* caught during the duration of the entire survey was 49 tails. However, the majority (80%) of the mud spiny lobsters were caught at the fishing ground south of Pulau Aur, Johor. The average density of mud spiny lobsters at the south of Pulau Aur area were higher (0.87 - 1.17 $kg.km^{-2}$). This area can be further focused as the proposed site for the lobster refugia but the exact size and location of the lobster refugia will require further discussions with various stakeholders.

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Figure 2: Lobster caught at the south of Pulau Aur waters (on third trip onboard JHF3388T)

Figure 3: Lobster caught at the south of Pulau Aur waters (on fifth trip onboard JHF3388T)

Figure 4: Lobster caught at the Pulau Sibu to Desaru waters (on forth trip onboard JHF5222T)

Figure 5: Lobster caught second trip onboard PAF4623