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Occurrences of Indo-Pacific Finless porpoise (*Neophocaena phocaenoides)* off the West Coast of Penang Island, Malaysia

L. Rajamani[1*], N.F. Ali[1], L.H. Rodriguez-Vargas[1, 2] and A. Abd. Rahman[3]

[1]*Centre for Marine and Coastal Studies, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia*

[2]*Inter-American Convention for the Protection and Conservation of Sea Turtles, Leesburg Pike, Falls Church, Virginia 22041-3803, USA*

[3]*School of Humanities, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia*

The Indo-Pacific finless porpoise (*Neophocaena phocaenoides)* occurs in a narrow strip of shallow marine waters less than 50m deep. The finless porpoise although recorded in Malaysia has not been comprehensively studied. The documentation of the occurrence and distribution of finless porpoise in west and north-west Penang was carried out from 2011 to 2019.This included interview surveys every 3 months from December 2012 to December 2013, a collation of published literature and conducting preliminary boat surveys in 2019. A total of 240 structured, individual interviews were done with the local community. Based on the interview surveys, there were 6 sightings (n=6/240, 2.5%) of finless porpoises in 2013. Published data indicated that there were 19 sightings of finless porpoises in 2013 and 3 sightings in 2014. Twenty mortalities of finless porpoises have been recorded. Boat surveys recorded 14 sightings of finless porpoise with an encounter rate of 0.106 sightings per hour. Mean group size was 2.6 ± 0.4 SE. The finless porpoise appears to occur in Teluk Bahang, Pantai Kerachut, Sungai Pinang and Sungai Burung in west Penang. Overall, the data suggests that there is a consistent population where line transect surveys can be done to further elucidate the population status of finless porpoises in Penang.

Keywords: Finless porpoise; Occurrence; Penang; Malaysia

I. INTRODUCTION

The Indo-Pacific finless porpoise (*Neophocaena phocaenoides)* is found mostly in coastal waters including shallow bays, mangrove swamps, river mouths and estuaries (Wang & Reeves, 2017). They are known to occupy a narrow strip of shallow coastal waters which include the northern rim of the Indian and western Pacific Oceans from the Arabian Gulf (Preen, 2004; Collins *et al.*, 2005), the Indian Ocean and Indo-Malay region (Ponnampalam, 2012) to Java, Indonesia as well as northwards to the Taiwan Straits and central Chinese waters (Gao, 1991; Gao & Zhou, 1995). They occur in waters less than 200 metres deep and can be sighted up to 240 km from shore in some areas. Soft or sandy bottoms are often favoured by Indo-Pacific finless porpoise (hereafter referred to as finless porpoise (Jefferson & Hung, 2004). Finless porpoises are small and difficult to study and estimates have only been made in a few areas in the region, such as Hong Kong and Sarawak, Malaysia (Jefferson *et. al.*, 2002; Minton *et al.*, 2013). Finless porpoise numbers were estimated to be 217 (Jefferson *et al.*, 2002) in Hong Kong. Line transects in Sarawak estimated finless porpoises to be 135 individuals (Minton *et al.*, 2013).

Finless porpoises are classified as Vulnerable according to the IUCN Red list of Threatened Species and they are subject to various threats such as incidental entanglement in gill nets and large numbers continue to be killed in many parts of their range (Jefferson *et. al.*, 2002; Wang & Reeves, 2017). In East Malaysia, finless porpoises are caught in “fish stakes” in Sabah (Jaaman *et al.*, 2009) and one individual was found

*Corresponding author’s e-mail: leelarajamani@usm.my

entangled in the line of a crab trap in Sarawak (Wang & Reeves, 2017).

Based on previous literature they have been observed in southern Penang, Langkawi, Perak, Selangor, Melaka, Johor, Pahang and Kedah in Malaysia (Ponnampalam, 2012). Prior to 2012, no research had been conducted on any cetaceans including finless porpoise.

The purpose of this study is to systematically document all the data on finless porpoise (*Neophocaena phocaenoides*) for Penang, from 2011 to 2019 based on interview surveys in 2013, published data in 2018 and boat surveys in 2019. Finless porpoises are facing increasing anthropogenic threats (Wang & Reeves, 2017) and changes to their natural habitat in Penang (Chee *et al.*, 2017). Penang island is a rapidly industrialising island where coastal reclamation and coastal infrastructure development play important roles in its economic development (Chee *et al.*, 2017). Therefore, it is imperative that their status, distribution and relative abundance are studied in greater detail to facilitate future decisions on the conservation and management of this species.

II. MATERIALS AND METHODS

A. Study Area

Penang Island is located in western Peninsular Malaysia (05°08'0" N to 05°35"N) and (100°08'0"E to 100°32'0"E). Penang island covers an area of about 293 km² (Ismail *et al.*, 2002) (Figure 1). Much of the data was collected from north-west Penang and west Penang where besides the finless porpoise, there were also sightings of other inshore cetaceans such as the Irrawaddy and the Indo-Pacific humpback dolphin. (Rajamani *et. al.*, 2018; Rodriguez-Vargas, 2015). This mangrove coastline is approximately 14 km long and is a shallow habitat with freshwater input from six different rivers including Sungai Pinang and Sungai Burung (Rodriguez-Vargas *et al.*, 2019).

B. Interview Surveys

Structured, individual interview surveys were conducted every 3 months from December 2012 to December 2013 in north-west and west Penang. Additional interviews were conducted in April and May 2014 as a replacement for interviews not done in April and May 2013. The areas included Teluk Bahang, Teluk Aling, where the Centre for Marine and Coastal Studies (CEMACS) is located, and Teluk Duyung (Monkey Beach), Sungai Pinang and Sungai Burung.

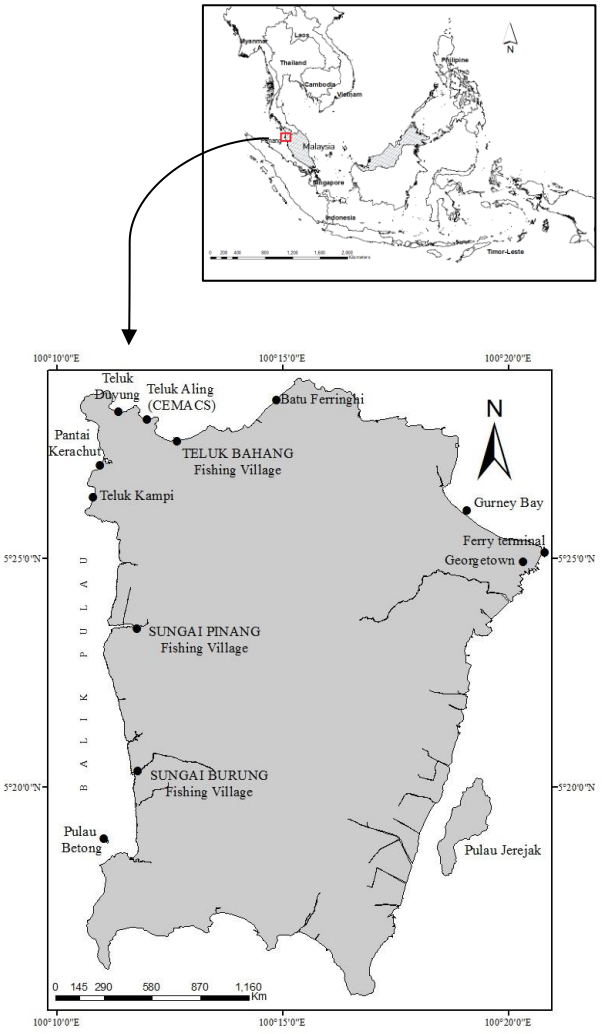

Figure 1. Map of Penang showing the study site in relation to south-east Asia

In December 2012, a pilot survey was carried out to determine the feasibility of conducting a monitoring programme in the designated areas. This survey allowed a first approach with the community, also learning about their schedules and availability to be interviewed, and to identify key informants. Interviews were first conducted every month but it was logistically challenging and caused interviewee fatigue.

It was then decided that interview surveys would be conducted every three months over four main periods namely January to March, April to June, July to September, and

October to December in 2013. The main Teluk Bahang jetty was visited along with three fishing villages of Teluk Bahang, Sungai Pinang and Sungai Burung where fishermen, tourist operators and other members of the local community known to use the sea were interviewed. The same informants were interviewed every time, whenever they were available. Information offered during the times when surveys were not conducted was also noted.

During the interview, information was collected on the species of marine mammals sighted, and its status (i.e. stranded, floating, swimming), date, time, location, behaviour, the activity of the interviewee, and the presence of boats. To obtain information on the proximity of the animals during the encounter, the interviewees were asked to estimate the distance from their position to the animals. Due to logistic constraints between April and June of 2013 the number of interviews were less in comparison with the other periods of the year. Assuming no differences in results (the results are affected by temporal change) between years, additional interviews were carried out in April and May 2014 as a replacement for less effort in April to June of 2013. As a way to detect replicates in the information provided by the interviewees, a comparison of reports was carried out to find if different informants were reporting the same groups of cetaceans on the same date and at a similar hour.

C. Published Data

The authors reviewed any published data and also included it in the compilation of occurrence of finless porpoise. Especially relevant was data from Rajamani *et al.* (2018). Sightings from boat surveys done in 2013 and 2014 were documented (Rajamani *et al.*, 2018). Stranding incidents and opportunistic sightings were also documented (Rajamani *et al.*, 2018).

D. Boat Surveys

Boat surveys were conducted from February 2019 to December 2019 except for the months of March and October. They were carried out around Sungai Pinang/West Penang from February to December 2019, using a 7.62 m (16 hp) fibreglass boat. These surveys were primarily for the observance and photo-identification of Irrawaddy dolphins, however other species were also recorded when observed. Line transects were used in an area the size of 17.3 km x 6 km which is approximately 103.8 km^2. A block survey with 4 transects 17.3 km long and 2 km apart from the shore to the outer continental shelf was developed (Figure 2). The survey pathway was traversed (usually needing 5 days) every month using a search speed of 8-10 knots/hour. Two observers alternated between the naked eyes and binoculars Bushnell® 7x50, to confirm potential sightings every 20 minutes. Observers were trained to estimate distances to a dolphin from the boat using a Nikon® Laser range finder to aid them in estimating distances from dolphins correctly.

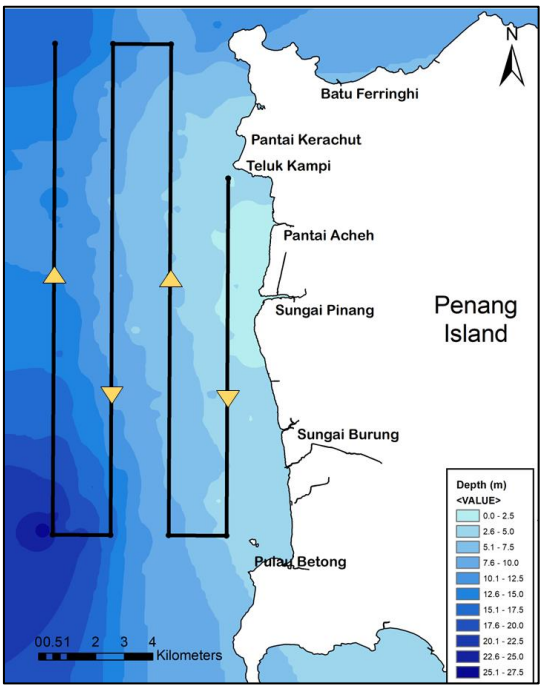

Figure 2. Map of west coast of Penang showing the block survey on west Penang

1. Recording sightings

The observance of cetaceans will be defined as a sighting. A group of dolphins was defined as all the dolphins within a 100m radius of each other and engaged in similar activities (Irvine *et. al.*, 1981; Wells *et. al.*, 1987; Lusseau *et al.*, 2006). A sighting never lasted less than 15 minutes, which was the minimum time given for an animal or a group to re-appear after its last detection. When animals were detected, estimates of low, high and best size of the group were recorded discriminating between adults (approximately 1.7 m length), and calves (less than 1m) (Jefferson *et al.*, 2011).

The sighting form also included other information such as the date, observer, Global Position System (GPS) waypoint, location, species, time of the encounter, group size, distance to animal, behaviour and response of the animals to the boat. The type and distance of the boats present in the area within 1 km radius was recorded in this form as well.

2. Environmental parameters

Every 20 minutes, a YSI multiprobe was used to measure sea surface temperature (°C) and salinity (PSU), a Hach® 2100P meter for turbidity (NTU), and a HawkEye® handheld depth sounder to record the depth (m) in the current geographical position shown in the GPS Garmin Montana 650. Information collected included the date, observers, the event recorded (i.e. water quality measurement, sighting, other event), time in hours, waypoint in the GPS, the trip or distance covered, the height of the wave, the visibility, and the number of fishing boats in a 500 m radius at the time of the measurement. The visibility was defined as the observer's estimate of the distance (in kilometres) at which an object or animal could be detected if present (Barlow *et al.*, 2001), and classified as poor (P) when the estimate was less than 1 km away, medium (M), when less than 4 km away, and good (G) when the estimate was further than 4 km. Surveys were carried out under the weather permitting conditions at Beaufort ≤3.

3. Analysis

Water parameter values such depth, tide height, salinity, turbidity and temperature were compared during the presence and absence of finless porpoise and were statistically tested using one-way ANOVA to see if there was any significant difference between these values.

III. RESULTS AND DISCUSSION

A. Interview Surveys

A total of 240 interviews were carried out during the community based monitoring programme. Interviews were conducted in Teluk Bahang, CEMACS, Teluk Duyung (Monkey Beach and the remaining in west Penang (Sungai Pinang, Sungai Burung and Teluk Kampi). Only information relevant to finless porpoise is presented as other species of dolphins and otters were also investigated.

Interviewees included fishermen (n=127/240; 53%), tourist operators (n=58/240; 24.2%) and other people of the community (n=49/240; 20.4%), including CEMACS staff and students who reported sightings of aquatic mammals. The majority of the fishermen (22%) and tourist operators (38%) have experience in their respective field of between 11 and 20 years (Figure 3), and in the case of the fishermen the second majority of them (14%) have been fishing for more than 30 years, followed by 11% who have been fishing for 21-30 years.

Most of the interviewees were fishing (37%) when they sighted cetaceans, (Figure 4) others were taking tourists in their boats (21%) or travelling through the area (7%). Most of the sightings on the shoreline (33%), e.g., jetty, beach, rocky and river shores, corresponded to otters (26%) but also included cetaceans (7%). In a few occasions (3%) the information on the activity was not provided.

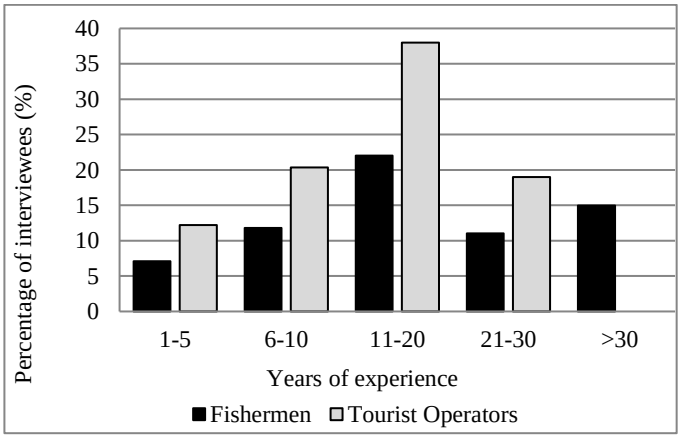

Figure 3. Years of experience of fishermen and tourist operators interviewed throughout the aquatic mammal monitoring programme in Penang (December 2012 – December 2013).

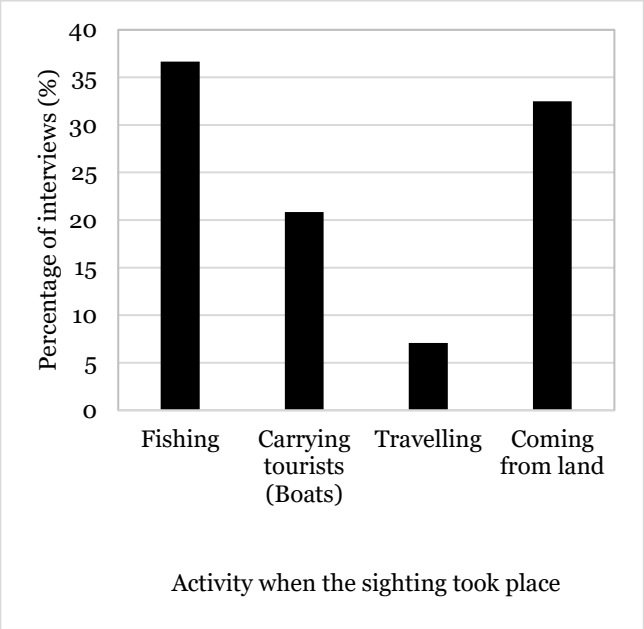

Figure 4. Activity of interviewees when sightings of aquatic mammals took place throughout the monitoring programme (December 2012 – December 2013).

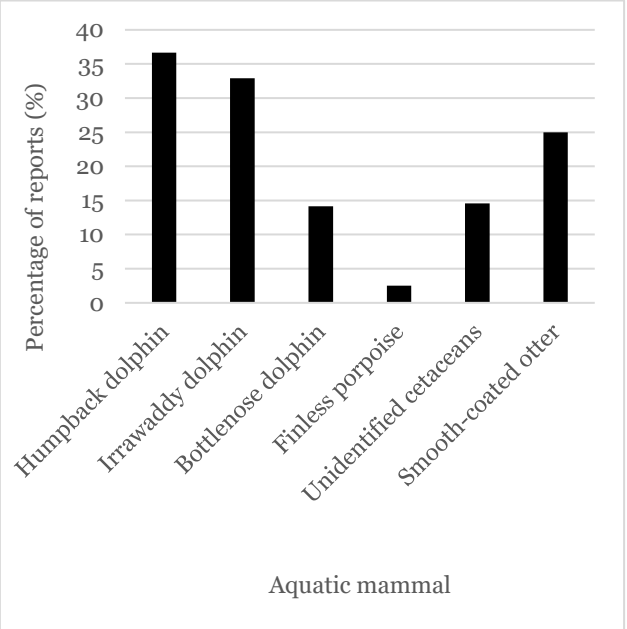

Figure 5. Percentage of reports per species provided by the local community interviewed in Teluk Bahang, Sungai Pinang and Sungai Burung between December 2012 and December 2013, and April and May 2014.

B. Occurrence, Distribution and Status of Aquatic Mammals

According to the information provided by the interviewees there were 279 reports of sightings of aquatic mammals in north-west and west Penang during the period of the study, including 50 sightings of otters and 229 sightings of cetaceans. In addition, 22 sightings (12 of cetaceans, and 10 of otters) which were reported to be in months or years prior to the research, were classified as historical information. Based on the number of interviews (n=240), the Humpback dolphin (37%) and the Irrawaddy dolphin (33%) were the species of cetaceans mostly reported, followed by the smooth-coated otters (25%). Bottlenose dolphins (14%) and Finless porpoises (2%) were reported in smaller numbers, and 15% of the reports involved cetaceans that could not be identified by the informant.

Reports of sightings were limited to the areas frequented by fishermen and tourist operators. Reports of Indo-Pacific Humpback dolphins were most frequent in all locations of north-west Penang, however this trend changed towards the west where the reports of Irrawaddy dolphins were more. Although reports of Bottlenose dolphins were uncommon in other locations, Sungai Burung showed the highest frequency (n=12) of these animals. Reports of finless porpoise were the least common but more frequent in the north west of Penang (Figure 5).

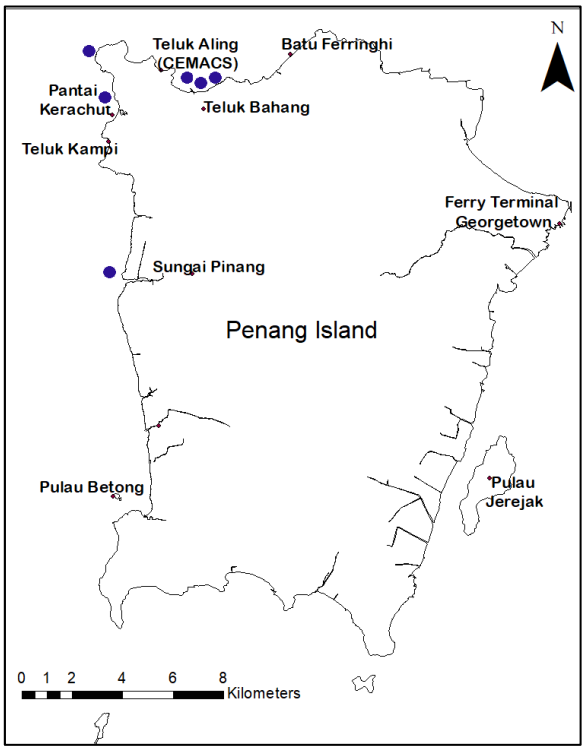

Figure 6. Map of Penang showing the occurrences made by Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) during the interviews from December 2012 to December 2013 and April and May 2014.

There were 6 sightings of finless porpoise (Table 1, Figure 5). (No sightings of finless porpoise were made in 2014 during the replacement surveys). Most of the observations were made during the late evening when the observers were fishing (Table 1). Based on interview surveys the number of animals seen ranged from 1 to 7 with a mean group size of 2.8± 0.9. On one occasion one finless porpoise was found dead and floating while the observer was fishing (Table 1).

C. Published Data

Previous studies indicate there have been 20 sightings of finless porpoise since 2011 (Rajamani *et al.*, 2018) (Table 2). Most of the sightings have been in the region of west Penang, Sungai Pinang and Pantai Kerachut which were observed by seasoned key informants who worked or lived in the areas mentioned (Rajamani *et al.*, 2018). The groups of dolphins ranged from 1 to 6 individuals with a mean group size of 3.7 (Rajamani *et al.*, 2018).

Table 1. Indo-Pacific finless porpoise (*Neophocaena phocaenoides)* sightings based on interview surveys conducted in 2013 with communities in Teluk Bahang, Sungai Pinang and Sungai Burung.

Date of Interview	Date of Sighting	Time of day sighted	No of animals	Location	Activity of porpoise	Activity of observer
14/02/2013	19/02/2013	Night	1	4.8 km from Teluk Bahang	No activity(dead)	Fishing
07/09/2013	10/06/2013	00.00	3	Teluk Bahang	Travelling	Fishing
17/11/2013	16/11/2013	21.00	7	Sungai Pinang	Travelling	Fishing
27/12/2013	26/12/2013	18.00	3	Pantai Kerachut	Travelling	Fishing
25/04/2014	05/03/2014	12.40	1	Batu Buaya, Mukahead	Travelling	Taking tourists
25/04/2014	25/04/2014	8.00	2	Teluk Bahang	Porpoise jumped out of the water	Fishing

Table 2. Key Informant Sightings Records of finless porpoise from Penang, Malaysia based on published data (Rajamani *et al.*, 2018)

No.	Date	Location	Group size	Observer	Photo (Yes/No)
1.	11/12/2011	Pantai Kerachut	1	Pak Atan	No
2.	25/9/2013	West Region Penang	7	Luz Helena	Yes
3.	25/9/2013	West Region Penang	2	Luz Helena	No
4.	25/9/2013	West Region Penang	4	Luz Helena	Yes
5.	30/9/2013	West Region Penang	1	Luz Helena	No
6.	30/9/2013	West Region Penang	4	Luz Helena	Yes
7.	30/9/2013	West Region Penang	4	Luz Helena	Yes
8.	30/9/2013	West Region Penang	4	Luz Helena	Yes
9.	13/11/2013	West Region Penang	6	Luz Helena	Yes
10.	14/11/2013	West Region Penang	1	Luz Helena, Pak Rahman	No
11.	14/11/2013	West Region Penang	6	Pak Rahman	Yes
12.	14/11/2013	West Region Penang	6	Pak Rahman	No
13.	15/11/2013	Sungai Pinang	6	Luz Helena, Pak Rahman	Yes
14.	15/11/2013	West Region Penang	2	Pak Rahman	Yes
15.	15/11/2013	West Region Penang	4	Pak Rahman	Yes
16.	15/11/2013	West Region Penang	3	Pak Rahman	Yes
17.	15/11/2013	West Region Penang	5	Pak Rahman	Yes
18.	15/11/2013	West Region Penang	1	Pak Rahman	Yes
19.	16/11/2013	West Region Penang	5	Pak Rahman	Yes
20.	16/11/2013	West Region Penang	2	Luz Helena, Pak Rahman	Yes

Finless porpoise mortalities have also been widely reported since 2011 to 2019 amounting to a total of 20 known mortalities (Rajamani *et al.*, 2018, unpublished data, Leela Rajamani) (Table 3). Key areas where they were reported include Batu Ferringhi, Teluk Bahang, Teluk Aling, and Sungai Pinang. There has been entanglement in nets recorded in 4 cases in from 2013 to 2014 (Rajamani *et al.*, 2018, unpublished data, Leela Rajamani) (Table 3). Drift nets were the type of nets finless porpoise were caught in three cases (Rajamani *et al.*, 2018) (Table 3).

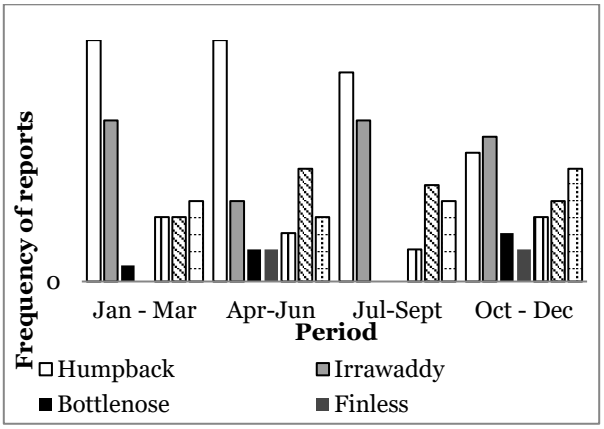

Figure 7. Group size per species of aquatic mammals reported by the local community from north west and west Penang

D. Boat Surveys

Since February 2019, a total of 23 surveys (36 days) have been conducted during the months of February, April, May, June, July, August, September, November and December 2019. These 23 surveys amounted to 131 hours and 56 minutes and 7 hours was spent on photo-identification. A total of 46 minutes was spent on off-effort sightings. A total of 1767 km of survey effort was conducted with a daily mean of 40.2 km ± 3.03 SE.

From February 2013 to December 2013 there were 14 sightings of the finless porpoise (Table 4). Most of these sightings have been between Sungai Pinang and Teluk Kampi in west Penang from between 0.71 km and 7.06 km (see Figure 8). Off-effort sightings of finless porpoise were also observed on three occasions in Teluk Kampi, Pantai Mas and Teluk Ketapung also in west Penang (Appendix 1). Encounter rate (sighting per hour) was 0.106 and 0.008 (sighting per km). Sighting rate per day was 0.389.

Table 3. Finless porpoise mortalities in West and North Penang, Malaysia

No.	Date	Location	No. of individuals	Type of death	Observer/ Source	Sex/ Length (m)	Source
1.	14/1/2011	Teluk Duyung	1	Stranded	FDM	Calf	Rajamani *et al.* (2018)
2.	10/12/2011	Teluk Aling	1	Stranded	FDM	Calf	Rajamani *et al.* (2018)
3.	11/12/2011	Pantai Kerachut	1	Stranded	FDM	Adult	Rajamani *et al.* (2018)
4.	12/2/2012	Kuala Sungai Burung	1	Stranded	FDM	Adult	Rajamani *et al.* (2018)
5.	28/3/2012	Pulau Kendi	1	Stranded	FDM	Adult	Rajamani *et al.* (2018)
6.	7/12/2012	Pulau Kendi	1	Stranded	FDM	Adult	Rajamani *et al.* (2018)
7.	8/2/2013	Teluk Bahang	1	Entangled	LH	N/A	Rajamani *et al.* (2018)
8.	23/2/2013	Teluk Aling (CEMACS)	1	Entangled in drift net	A	1.24	Rajamani *et al.* (2018)

9.	7/3/2013	Teluk Aling (CEMACS)	1	Entangled in drift net	A	0.76	Rajamani *et al.* (2018)
10.	14/5/2013	Kendi Island	1	Entangled in drift net	WM	N/A	Rajamani *et al.* (2018)
11.	19/7/2013	Green Hall – Batu Ferringhi	1	Entangled in drift net	Anonymous	N/A	Rajamani *et al.* (2018)
12.	27/12/2013	Teluk Bahang	1	Entangled	LH	<100	Rajamani *et al.* (2018)
13.	1/1/2014	Teluk Aling	1	Unknown	LH	Male/ 0.97	Rajamani *et al.* (2018)
14.	9/1/2014	Teluk Bahang	1	Entangled	LH	Male/ 0.99	Rajamani *et al.* (2018)
15.	10/1/2015	Teluk Bahang (near police station)	1	Stranded	TF	N/A	Rajamani *et al.* (2018)
16.	28/01/2015	Tanjung Bunga (behind Flamingo hotel)	1	Stranded	TF	N/A	Rajamani *et al.* (2018)
17.	1/2/2018	Teluk Aling CEMACS	2 (Mother and calf)	Stranded	NZ	70cm, 1.2	Rajamani *et al.* (2018)
18.	19/02/2019	Sungai Pinang	1	Floating	LR	1.0	Rajamani *et al.* (2018)
19.	15/04/2019	Sungai Pinang	1	Floating	LR	1.2	Rajamani *et al.* (2018)
20.	4/12/2019	Teluk Aling, CEMACS	1	Stranded	LR	N/A	Rajamani *et al.* (2018)

N.B. FDM-Fisheries Department, Malaysia, LH - Luz Helena, TF - Teviot Fairservis, A - Anip,WM - W.Mohizan, LR - Leela Rajamani, N - Norlaila Zanuri

Table 4. Finless porpoise sightings (18/2/2019- 13/12/2019) from dedicated boat surveys

No.	**Date**	**Latitude**	**Longitude**	**Location**	**Species**	**Group Size**	**Predominant behaviour**
1.	15/4/2019	N 05.42717	E 100.13329	Sungai Pinang	Finless porpoise	6	Undetermined
2.	17/4/2019	N 05.428451	E 100.153909	Teluk Kampi	Finless porpoise	3	Avoidance behaviour
3.	13/5/2019	N 05.43484	E 100.133235	Pantai Acheh	Finless porpoise	2	Undetermined behaviour
4.	15/5/2019	N 05.478173	E 100.171638	Muka Head	Finless porpoise	3	Feeding
5.	28/6/2019	N 05.354576	E 100.146322	Sungai Pinang	Finless porpoise	3	Travelling
6.	23/7/2019	N 05.318598	E 100.156852	Pulau Betong	Irrawaddy/ Finless porpoise	4	Travelling

7.	20/8/2019	N 05.403882	E 100.176422	Pantai Acheh	Finless porpoise	3	Resting
8	26/8/2019	N 05.383413	E 100.120959	Sungai Pinang	Finless porpoise	1	Undetermined
9.	27/8/2019	N 05.426329	E100.176175	Pantai Emas	Finless porpoise	4	Undetermined
10.	12/9/2019	N 05.407914	E100.176107	Pantai Acheh	Finless porpoise	1	Travelling
11.	12/9/2019	N 05.386287	E100.178129	Sungai Pinang	Finless porpoise	4	Milling
12.	19/11/2019	N 05.399531	E100.155511	Sungai Pinang	Finless porpoise	2	Avoidance behaviour
13.	19/11/2019	N 05.436692	E100.124434	Pantai Acheh	Finless porpoise	2 (mother + calf)	Playing and socialising
14.	12/12/2019	N 05.387464	E100.141179	Sungai Pinang	Finless porpoise	1	Avoidance behaviour

Mean group size of finless porpoise was observed to be 2.6 ± 0.4. Minimum group size was observed to be 1 and maximum group size was observed to be 6. The total number of groups encountered was 10 groups and 4 individuals totalling 36 individuals (see Figure 8).

One mother and calf pair were seen on the 12th of September, 2019 and on the 19th of November 2019. In the November sighting, playing and socializing behaviour was observed between the mother and calf whereby the calf was observed doing a backward somersault. One interesting social activity observed was when two groups of cetaceans were swimming together in an encounter on 23rd of July 2019 near to Pulau Betong, where one group consisted of two Irrawaddy dolphins and another group consisting of one Irrawaddy dolphin and one finless porpoise. Initially, these two pairs of cetaceans were milling separately towards the port and starboard (left and right) sides of the boat, then they swam to form one group in the front of the boat. After that, the group headed south towards Pulau Betong island together before they dived (see Figure 1).

1. Behaviour and response to boats

Finless porpoise were observed to have undetermined behaviour (28.6%, n=4/14 sightings), travelling (21.4, n=3/14), resting (7.1%, n=1/14), milling (7.1%, n= 1/14), feeding (7.1%, n=1/14) playing and socializing behaviour (7.1%, n= 1/14) (Figure 9). Undetermined behaviour mostly occurred when the animals were observed to surface once and then were not seen again.

The finless porpoise mostly did not have any response to the boats (92.9%, n=13/14). Avoidance behaviour was observed in three instances (21.4%, n= 3/14). Distances observed from the sampling boat were 0-50 m (21.4%, n=3/14), 51-100 m (42.9%, n=6/14), 101-150 m (21.4%, n= 3/14) and 301-350 m (14.3%, n= 2/14).

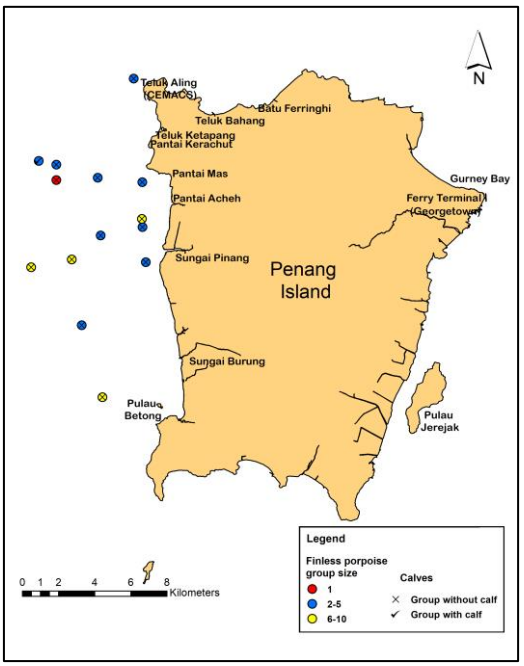

Figure 8. Distribution of Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) showing the groups with calves during the on effort survey

2. Porpoise habitat

Mean water depth was 7.61 ± 1.08(SE) when there were finless porpoise sightings (Table 5). In comparison mean water depth when there were no sightings was 7.96 ± 0.25 (SE) (Table 5). Tide height measured overall seemed to be increasing and not decreasing. The tide level (m) was estimated from the Tide Table for Penang (National Hydrographic Centre, 2019). The mean sea level (MSL) in Penang as defined by the Malaysia National Hydrographic Centre is 1.68 m (National Hydrography Centre, 2019). All the values above the MSL were recorded as high tide, whereas all those equal or below the MSL were recorded as low tide. Mean tide height recorded was 1.71 ± 0.12 (SE) during finless porpoise sightings. In comparison when porpoises were not sighted tide height was recorded to be 1.75 ± 0.03 m (Table 5).

Mean salinity was 29.96 ± 0.14 (SE) for finless porpoise. This was close to the mean salinity of 30.04 ± 0.04 (SE) when porpoises were not sighted. The mean turbidity reading was 13.92 ± 4.32 (SE) for finless porpoise. Mean Turbidity when porpoises were not present was 11.56 ± 1.08 (SE) (Table 5).

All average temperature readings for both presence and absence of finless porpoise were almost similar, as shown in Table 5.

No significant difference in water parameters such as depth, tide height, salinity was detected ($p>0.05$) when compared to the absence and presence of the finless porpoise indicating that the absence and presence of finless porpoise is not dependent on these physical water parameters (see Supplementary material, Appendix 2).

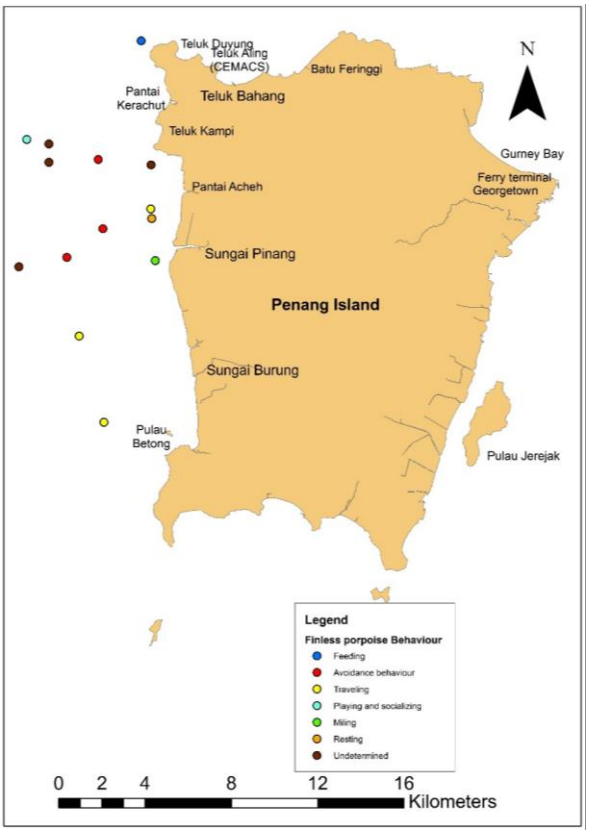

Figure 9. Behaviour exhibited by the finless porpoise (*Neophocaena phocaenoides*) west Penang

The cumulative data presented since 2011 indicates a consistent population in west Penang. Most of the occurrences have been in north west Penang from Sungai Pinang, Pantai Kerachut to Teluk Aling and Teluk Bahang. This trend is exhibited in both the interview surveys, previous surveys and current surveys in 2019.

The habitat that it is found in represents the ideal habitat for it to survive which is characteristic of estuarine and mangrove habitats (Wang & Reeves, 2017).

Table 5. Information on environmental parameters during the presence and absence of Indo-pacific finless porpoise (*Neophocaena phocaenoides*) during surveys from February until December 2019.

	Finless porpoise		**Absence of cetaceans**	
	Mean ± SE	**Range**	**Mean ± SE**	**Range**
Water Depth (m)	7.61 ± 1.08	2.2 – 14.4	7.96 ± 0.25	0.8 – 26.9
Tide height (m)	1.71 ± 0.12	1.00 – 2.50	1.75 ± 0.03	0.0 – 2.8
Salinity(ppt)	29.96 ± 0.14	28.87 – 31.00	30.04 ± 0.04	28.65 –39.98
Turbidity (NTU)	13.92 ± 4.32	2.35 – 53.00	11.56 ± 1.08	0.43 – 179.0
Temperature (°C)	30.47 ± 0.19	29.0 – 31.8	30.6 ± 0.04	28.8 – 33.0

Since 2011 there have been 20 mortalities recorded with 7 confirmed cases of entanglement (Table 2). Because they are small. They have limited strength to break free once entangled and are very vulnerable to incidental mortality (Jefferson & Curry, 1994). Fishing effort with gear to catch finless porpoise accidentally (including gill nets, trawls, stow nets and seines) is intense in many areas where the species occurs in areas of its range (Wang & Reeves, 2017) including Penang. Regional declines and local extirpation in this species has been attributed to a combination of fishing pressure, coastal development, pollution and heavy vessel traffic (Reeves *et. al.*, 1997; Collins *et. al.*, 2005; Braulik *et al.*, 2010). Therefore, it is important that detailed necropsies for finless porpoises be done in future cases of mortalities.

The behaviour of finless porpoises was also recorded although they were often very difficult to observe at some instances they would be seen gliding just below the water surface. Finless porpoises have been seen travelling, resting, milling and feeding. In November 2019, they were observed playing and socialising for the first time by the research team. Socialising and playing has rarely been recorded in previous studies. However, a lot of the time they were seen surfacing only once and then were not seen again. Finless porpoise are known to have deep dives (≥ 2.7m) and shorter dives (< 2.7 m) (Akumatsu *et al.*, 2002). Their horizontal travel distances are also longer than other oceanic relative species (e.g. harbour porpoises, *Phocoena phocoena*) (Akamatsu *et al.*, 2002) which is probably the reason why they were not seen again. Very few studies have been done on the behaviour of finless porpoise thus making the current results not comparable to previous studies.

The interaction between a finless porpoise and Irrawaddy dolphin reported to be swimming together appears to be a first record of such of an interaction between two different cetacean species within west Penang Island. However, interactions between finless porpoise and other species have been reported. In Hong Kong inter-specific interactions have been observed between Humpback dolphins and finless porpoises (Parsons, 1998).

III. CONCLUSION

There is a presence of Indo-Pacific finless porpoise (*Neophocaena phocaenoides)* in western Penang through the evidence of interview surveys, boat surveys as well as previous studies. This population is vulnerable to threats such as entanglement in fishing nets. Further investigation in the form of necropsy studies on dead finless porpoises would be useful to determine the cause of death of these animals. This preliminary account of the finless porpoise behaviour serves as a starting point to understand the habitat use of this species as well provide insights to other finless porpoise populations in its range. It is hoped that further research especially line transects on finless porpoise will continue especially for the learning of their relative abundance, and population density so that informed decisions can be made on the conservation of this Vulnerable species.

IV. ACKNOWLEDGEMENTS

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SUPPLEMENTARY MATERIAL

Appendix 1. Off-effort dolphin sightings obtained during the field days from Feb until December, 2019.

No.	Date	Latitude	Longitude	Location	Species	Group size	Predominant behaviour
1.	22-07-2019	N 05.469839	E100.149889	Teluk Kampi	Finless porpoise	2	Undetermined
2.	27-08-2019	N 05.432283	E 100.170069	Pantai Emas	Finless porpoise	3	Undetermined Behaviour
3.	16-12-2019	N 05.4635	E 100.1725	Teluk Ketapang	Finless porpoise	4	Milling

Appendix 2. Total number of interviews carried out per period during the monitoring programme, including the pilot survey conducted in 2012.

Period	Months (2013)	No. Interviews	Percentage (%)
1	January – March	54	23
2	April – June*	46	19
3	July - September	51	21
4	October - December	58	24
Pilot survey	December 2012	31	13
Total		**240**	100

***Including additional interviews conducted in April and May 2014**

Appendix 3. Statistical analysis using One-way ANOVA to determine whether the presence of finless porpoise is determined by environmental parameters such as water depth, tide height, salinity, turbidity and temperature.

Group Statistics

	Abs_Pres	N	Mean	Std. Deviation	Std. Error Mean
Tide_height	Absence of dolphins	321	1.7533	.57841	.03228
	Presence Finless Porpoise	14	1.7143	.46427	.12408
Depth	Absence of dolphins	321	7.9601	4.39252	.24517
	Presence Finless Porpoise	14	7.6143	4.04567	1.08125
Temperature	Absence of dolphins	321	30.577	.7482	.0418
	Presence Finless Porpoise	14	30.471	.6922	.1850
Salinity	Absence of dolphins	321	30.0376	.71085	.03968
	Presence Finless Porpoise	14	29.9564	.50619	.13528
Turbidity	Absence of dolphins	254	11.5580	17.21720	1.08030
	Presence Finless Porpoise	12	13.9158	14.95616	4.31747

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Depth	Between Groups	1.645	1	1.645	.086	.770
	Within Groups	6376.752	333	19.149		
	Total	6378.397	334			
Temperature	Between Groups	.170	1	.170	.308	.579
	Within Groups	183.745	334	.550		
	Total	183.914	335			
Salinity	Between Groups	.025	1	.025	.125	.724
	Within Groups	66.632	334	.199		
	Total	66.657	335			
Turbidity	Between Groups	66.673	1	66.673	.227	.634
	Within Groups	77080.765	263	293.083		
	Total	77147.438	264			

APPENDIX A. Interview survey forms.

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SURVEY NO.___ NAME OF INTERVIEWER_____

DATE_____ LOCATION (e.g.*Village*)_____

DEMOGRAPHIC INFORMATION (<u>FIRST TIME Interviewees only)</u>

1. NAME _____

2. AGE: ☐ <18 ☐ 19-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ >60

3. GENDER: MALE ☐ FEMALE ☐

4. ACTIVITY: ☐ FISHERMAN ☐ TOURIST OPERATOR ☐ OTHER _____

5. HOW MANY YEARS HAVE YOU PRACTICED YOUR ACTIVITY?

1 -5 6 – 1 11 – 20 21 – 30 >30

<u>QUESTIONNAIRE</u>

VALIDATION QUESTIONS (Question 6 and 7, will be asked only once every three months)

6. What is the main difference between these animals? (*<u>Images of the animals will be shown</u>*)

DOLPHIN	FISH	OTTER

7. What is the life period (in years) of an Indo-Pacific Humpback Dolphin?

☐ 1 – 20

☐ 21 – 40

☐ > 40

☐ Don’t know

8. Have you seen any of these during the last month? (show them pictures)

A. ☐ Otter Where: _____

B. When? (Approximate Date) _____

C. What time was it? (Approximate Hour)_____

D. ☐ Whale Where: _____

B. When? (Approximate Date) _____

C. What time was it? (Approximate Hour)_____

E. ☐ Dolphin Where: _____

B. When? (Approximate Date) _____

C. What time was it? (Approximate Hour)_____

9. If it was a dolphin, which species you think it was? (*Images of the different species will be shown*)

☐ Indo-Pacific humpback dolphin

☐ Irrawaddy dolphin

☐ Bottlenose dolphin

☐ Other

10. What was the colour of the animal?

☐ White ☐ Pink ☐ Light grey ☐ Grey ☐ Black ☐ Spotted

11. How many animals did you see?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6-10 ☐ 11-20 ☐ >20

12. How far were you from the animals?

____ mts

13. Was the animal(s) dead or alive?

☐ Alive (*Go to question 16*)

☐ Dead

Where_____

When_____

14. What was the animal condition?

☐ Highly decomposed

☐ Very fresh

☐ Scarce and Scratches

Other_____

15. How do you think it died?

☐ Naturally

☐ Entangled (If yes, answer the question below)

a. What type of fishing gear was involved?

☐ Trawl nets

☐ Drift nets

☐ Gill nets

☐ Purse Seine

☐ Drop Nets

☐ Old Nets

Other_____

☐ Boat collision

☐ Other_____

Proceed to question 17

16. What were the animals doing?

☐ Travelling

☐ Feeding

☐ Jumping

☐ Playing

☐ Bow-riding

Other:_____

17. What were you doing?

☐ Fishing

☐ Carrying tourists

☐ Travelling

Other:_____

18. What time do you usually fish?

☐ Morning

☐ Afternoon

☐ Evening

☐ Night

19. Were there other boats around?

☐ Fishing

☐ Carrying tourists

☐ Trawling

☐ Passing by

☐ There were no boats

THANK YOU VERY MUCH FOR YOUR COOPERATION

SOAL SELIDIK No.___ NAMA PENEMUDUGA_____

TARIKH_____ LOKASI (*Contoh: Kampung*)_____

UNIVERSITI SAINS MALAYSIA

Centre for Marine and Coastal Studies

MAKLUMAT DEMOGRAFI (Untuk peserta kali pertama sahaja)

1.NAMA_____

2.UMUR: <18 19-30 31-40 41-50 51-60 >60

3.JANTINA: LELAKI ☐ PEREMPUAN ☐

4.AKTIVITI: PERIKANAN ☐ OPERASI PELANCONGAN ☐ LAIN-LAIN ☐

SILA JELASKAN?_____

KAJIAN SOAL SELIDIK

5. BERAPA TAHUN PENGLIBATAN DALAM AKTIVITI ANDA?

1 -5	6 – 10	11 – 20	21 – 30	>30
☐	☐	☐	☐	☐

PENGESAHAN SOALAN (Soalan 6 dan 7 akan ditanya setiap tiga bulan sahaja)

6. Apakah perbezaan utama antara haiwan berikut? (Gambar haiwan akan ditunjuk)

IKAN LUMBA-LUMBA	IKAN	MEMARANG

7. Berapakah tempoh hayat (tahun) seekor Ikan Lumba-lumba Indo Pacific Humpback?

☐ 1 – 20 tahun

☐ 21 – 40 tahun

☐ > 40 tahun

☐ Tidak tahu

8. Pernahkah anda nampak haiwan-haiwan berikut pada bulan yang lepas?

A. ☐ Memerang Di Mana: _____(*Papar peta Penang*)

B. Bila? (Tarikh) _____

C. Masa? (Jam)_____

D. ☐ Ikan paus Mana: _____(*Untuk papar peta Penang*)

B. Bila? (Tarikh) _____

C. Masa? (Jam)_____

E. ☐ Ikan lumba-lumba Mana: _____ (*Untuk papar peta Penang*)

B. Bila? (Tarikh) _____

C. Masa? (Jam)_____

9. Kalau ianya adalah ikan lumba-lumba, pada pendapat anda apakah speciesnya? (*Imej spesies yang berbeza akan ditunjukkan*)

☐ Ikan lumba-lumba Ind.-Pacific humpback

☐ Ikan lumba-lumba Irrawaddy

☐ Ikan lumba-lumba Bottlenose

☐ Lain-lain

10. Apa warna haiwan?

Putih ☐ Merah jambu ☐ Kelabu mudah ☐ Kelabu ☐ Hitam ☐ Titik ☐

11. Berapakah bilangan haiwan yang dilihat?

1 2 3 4 5 6-10 11-20 >20

12. Berapa jauh kamu dari dolfin? ____mts

13. Bagaimanakah keadaan haiwan

☐ Hidup (*Sambung ke soalan 16*)

☐ Mati

14. Keadaan mayat?

☐ Ruput

☐ Segar

☐ Parut

Lain-lain_____

15. Sebab kematian (pendapat)?

☐ Semulajadi

☐ Tertangkap (jawab soalan di bawah)

a. Apakah jenis pukat yang digunakan?

☐ Pukat tunda

☐ Pukat hanyut

☐ Pukat Insang

☐ Pukat Jerut

☐ Pukat Mati

Lain-lain_____

☐ Perlanggaran bot

☐ Lain-lain_____

<u>Sambung ke soalan 17</u>

16. Apakah yang sedang dilakukan oleh haiwan tersebut?

☐ Bersiar-siar

☐ Makan

☐ Lompat

☐ Main

☐ Berenang di tepi bot

Lain-lain:_____

17. Apakah aktiviti anda?

☐ Menangkap ikan

☐ Membawa pelancong

☐ Bersiar-siar

Lain-lain:_____

18. Berapa masa kamu memancing?

☐ Pagi

☐ Tengah hari

☐ Petang

☐ Malam

19. Aktiviti bot di sekeliling anda?

☐ Menangkap ikan

☐ Membawa pelancong

☐ Membawa pukat tunda

☐ Melalui tempat itu

☐ Tidak bot

TERIMA KASIH ATAS KERJASAMA ANDA