

Capco 青山發電有限公司
Castle Peak Power Co. Ltd.

 **港燈**
HK Electric

 **HKLTL**

Hong Kong Offshore LNG Terminal Project

Review Report on Finless Porpoise Peak Occurrence Season

8 May 2020

Project No.: 0505354

Document details	
Document title	Hong Kong Offshore LNG Terminal Project
Document subtitle	Review Report on Finless Porpoise Peak Occurrence Season
Project No.	0505354
Date	8 May 2020
Version	0
Author	SH
Client Name	Castle Peak Power Company Limited

Document history

	Revision	Author	Reviewed by	ERM approval to issue		Comments
				Name	Date	
	0	SH	JN	JN	08/05/2020	N/A

Signature Page

8 May 2020

Hong Kong Offshore LNG Terminal Project

Review Report on Finless Porpoise Peak Occurrence Season



Dr Jasmine Ng
Partner

ERM-Hong Kong, Limited
2507, 25/F One Harbourfront
18 Tak Fung Street
Hung Hom
Kowloon
Hong Kong

© Copyright 2020 by ERM Worldwide Group Ltd and / or its affiliates ("ERM").
All rights reserved. No part of this work may be reproduced or transmitted in any form,
or by any means, without the prior written permission of ERM.



**Hong Kong Offshore LNG Terminal - Works associated with the double berth
jetty at LNG Terminal
Environmental Certification Sheet
FEP-01/558/2018**

Reference Document/Plan

Document/ Plan to be Certified/ Verified:	Review Report on Finless Porpoise Peak Occurrence Season
Date of Report:	8 May 2020
Date received by ET:	8 May 2020
Date received by IEC:	

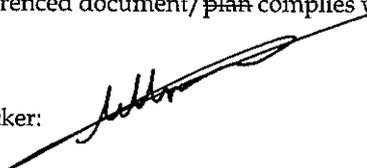
Reference EP Requirement

EP Condition:	Condition No. 2.9 of FEP-01/558/2018
Content:	<i>Review Report on Finless Porpoise Peak Occurrence Season</i>
<p>The Permit Holder shall review the relevant information and published data, including the long-term marine mammal monitoring programme of the Agriculture, Fisheries and Conservation Department (AFCD), to ascertain the peak occurrence season of Finless Porpoise, with a view to avoiding underwater piling works for jetty construction during the peak occurrence season of the Finless Porpoise. The Permit Holder shall, no later than 1 month before the commencement of construction of the Project, submit 3 hard copies and 1 electronic copy of a review report on the peak occurrence season of Finless Porpoise to the Director for approval. Prior to the submission to the Director, the Permit Holder shall seek agreement from the AFCD on the review findings of the peak occurrence season of Finless Porpoise.</p>	

ET Certification

I hereby certify that the above referenced document/ plan complies with the above referenced condition of FEP-01/558/2018.	
Mr Raymond Chow, Environmental Team Leader:	 Date: 8 May 2020

IEC Verification

I hereby verify that the above referenced document/ plan complies with the above referenced condition of FEP-01/558/2018.	
Mr Arthur Lo, Independent Environmental Checker:	 Date: 21 May 2020

CONTENTS

1. INTRODUCTION	1
1.1 Background	1
1.2 Purpose of the Review Report on Finless Porpoise Peak Occurrence Season	1
1.3 Structure of the Review Report on Finless Porpoise Peak Occurrence Season	2
2. REVIEW BACKGROUND	3
2.1 Past Knowledge on Finless Porpoise Seasonal Occurrence	3
2.2 Examination of Finless Porpoise Seasonal Occurrence in the EIA Study	3
3. REVIEW APPROACH AND METHODOLOGY	5
3.1 Quantitative Grid Analysis on Habitat Use	5
3.2 Passive Acoustic Monitoring Data Analysis	6
4. REVIEW RESULTS	7
4.1 Quantitative Grid Analysis on Habitat Use	7
4.2 Passive Acoustic Monitoring Data Analysis	11
5. REVIEW CONCLUSIONS	12

Annexes

Annex A	References Cited
---------	------------------

List of Figures

Figure 2.1	Underwater PAM Deployment Location during the EIA Study
Figure 4.1	Spatial patterns on monthly variations in sighting densities of porpoises (SPSE values) in South Lantau waters, utilizing AFCD long-term marine mammal monitoring data collected between April 2009 and March 2019 (red square: four grids surrounding the LNG Terminal site)
Figure 4.2	Spatial patterns on monthly variations in porpoise densities (DPSE values) in South Lantau waters, utilizing AFCD long-term marine mammal monitoring data collected between April 2009 and March 2019 (red square: four grids surrounding the LNG Terminal site)
Figure 4.3	Temporal variations in monthly averages of SPSE values (top) and DPSE values (bottom) of finless porpoises at: 1) entire South Lantau region (137 grids), 2) SEL survey area (68 grids)
Figure 4.4	Temporal variations in monthly averages of daily total DPM of finless porpoises at two PAM deployment locations (i.e. Locations 2 and 3) in the vicinity of the LNG Terminal site in 2017

1. INTRODUCTION

1.1 Background

To support the increased use of natural gas in Hong Kong from 2020 onwards, CLP Power Hong Kong Limited (CLP) and The Hongkong Electric Co., Ltd. (HK Electric) have identified that the development of an offshore liquefied natural gas (LNG) receiving terminal in Hong Kong using Floating Storage and Regasification Unit (FSRU) technology ('the Project') presents a viable additional gas supply option that will provide energy security through access to competitive gas supplies from world markets. The Project will involve the construction and operation of an offshore LNG import facility to be located in the southern waters of Hong Kong, a double berth jetty, and subsea pipelines that connect to the gas receiving stations (GRS) at the Black Point Power Station (BPPS) and the Lamma Power Station (LPS).

The Environmental Impact Assessment (EIA) Report for the Project was submitted to the Environmental Protection Department (EPD) of the HKSAR Government in May 2018. The EIA Report (EIAO Register No. AEIAR-218/2018) was approved by EPD and the associated Environmental Permit (EP) (EP-558/2018) was issued in October 2018. The Project Proponent has undergone application of Further Environmental Permit (FEP) on 24 December 2019 to demarcate the works under the responsibility of different parties, namely the double berth jetty at LNG Terminal under the Hong Kong LNG Terminal Limited (HKLTL) (FEP-01/558/2018), the subsea gas pipeline for the BPPS and the associated GRS in the BPPS under Castle Peak Power Company Limited (CAPCO) (FEP-03/558/2018) and the subsea gas pipeline for the LPS and the associated GRS in the LPS under HK Electric (FEP-02/558/2018) issued on 17 January 2020. CLP has surrendered the EP under EP-558/2018 on 5 March 2020.

In accordance with Condition 2.9 of the FEP of the LNG Terminal (FEP-01/558/2018):

FEP No. FEP-01/558/2018, Condition 2.9:

"The Permit Holder shall review the relevant information and published data, including the long-term marine mammal monitoring programme of the Agriculture, Fisheries and Conservation Department (AFCD), to ascertain the peak occurrence season of Finless Porpoise, with a view to avoiding underwater piling works for jetty construction during the peak occurrence season of the Finless Porpoise. The Permit Holder shall, no later than 1 month before the commencement of construction of the Project, submit 3 hard copies and 1 electronic copy of a review report on the peak occurrence season of Finless Porpoise to the Director for approval. Prior to the submission to the Director, the Permit Holder shall seek agreement from the AFCD on the review findings of the peak occurrence season of Finless Porpoise."

A review on the peak occurrence season of Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) has been conducted.

1.2 Purpose of the Review Report on Finless Porpoise Peak Occurrence Season

As stated in FEP-01/558/2018 Condition 2.9, the purpose of the Review Report on Finless Porpoise Peak Occurrence Season is to provide a review of available relevant information and published data, including the AFCD long-term marine mammal monitoring programme, to ascertain the peak occurrence season of finless porpoise. This Review Report assessed and evaluated relevant historical data on the species to ascertain its peak occurrence season in South Lantau waters, and more specifically in the vicinity of the jetty construction site at the LNG Terminal.

1.3 Structure of the Review Report on Finless Porpoise Peak Occurrence Season

Following this introductory section, the remainder of this Review Report is organized as follows:

- Section 2 presents the background of this review;
- Section 3 introduces the approach and methodology for this review;
- Section 4 summarizes the results of this review; and
- Section 5 provides the conclusions of this review.

2. REVIEW BACKGROUND

2.1 Past Knowledge on Finless Porpoise Seasonal Occurrence

Past studies have demonstrated that seasonal variation in distribution is evident for finless porpoises in Hong Kong (Jefferson and Braulik 1999; Jefferson et al. 2002; Hung 2005). The porpoises were reported to be more commonly sighted in southern waters (i.e. waters off South Lantau and Lamma) during winter (December-February) and spring (March-May), while in summer (June-August) and autumn (September-November) they occurred more often in eastern waters (Jefferson et al. 2002; Hung 2005).

The main driving force for such seasonal variation in porpoise distribution was thought to be related to the seasonal patterns of freshwater outflow from the Pearl River, which may in turn affect the distribution of their corresponding prey resources. In addition, competition for prey resources with Chinese White Dolphins (*Sousa chinensis*) during summer and autumn months (especially in South Lantau waters), as well as the reproductive cycle of porpoises, may also be attributable to such seasonal variations in porpoise distribution (Jefferson et al. 2002; Hung 2005).

Furthermore, abundance estimates of finless porpoises were calculated based on vessel and helicopter line-transect surveys, coupled with acoustic detection data from a towed porpoise click detector (POD). The porpoise abundance in Hong Kong ranged from 44 porpoises in autumn to 152 porpoises in spring (Jefferson et al. 2002), indicating a good portion of animals is outside of Hong Kong in autumn months.

2.2 Examination of Finless Porpoise Seasonal Occurrence in the EIA Study

Utilizing the more updated porpoise survey data from 2007-2017, the review conducted during the EIA Study of this Project indicated that although porpoises occurred in South Lantau waters year-round, their occurrence was higher in winter and spring months (December to May), when their distribution was more widespread in both Southwest Lantau (SWL) and Southeast Lantau (SEL) survey areas. On the other hand, they occurred in much smaller extent in these waters during summer and autumn months (June to November), when their occurrences were largely confined to the waters between Shek Kwu Chau and the Soko Islands but were quite rare in the inshore waters of South Lantau.

The same review also examined the spatial patterns of porpoise densities through quantitative grid analysis on their habitat use. The areas with high porpoise densities during winter and spring months were to the south of Tai A Chau, to the west and southwest of Shek Kwu Chau, the offshore waters between Shek Kwu Chau and Tai A Chau, and to the south of Cheung Chau. In comparison, much fewer grids have recorded porpoise usage during summer and autumn months, which were concentrated to the south and southeast of Tai A Chau, to the southwest of Shek Kwu Chau, and at the offshore waters between the Soko Islands and Shek Kwu Chau.

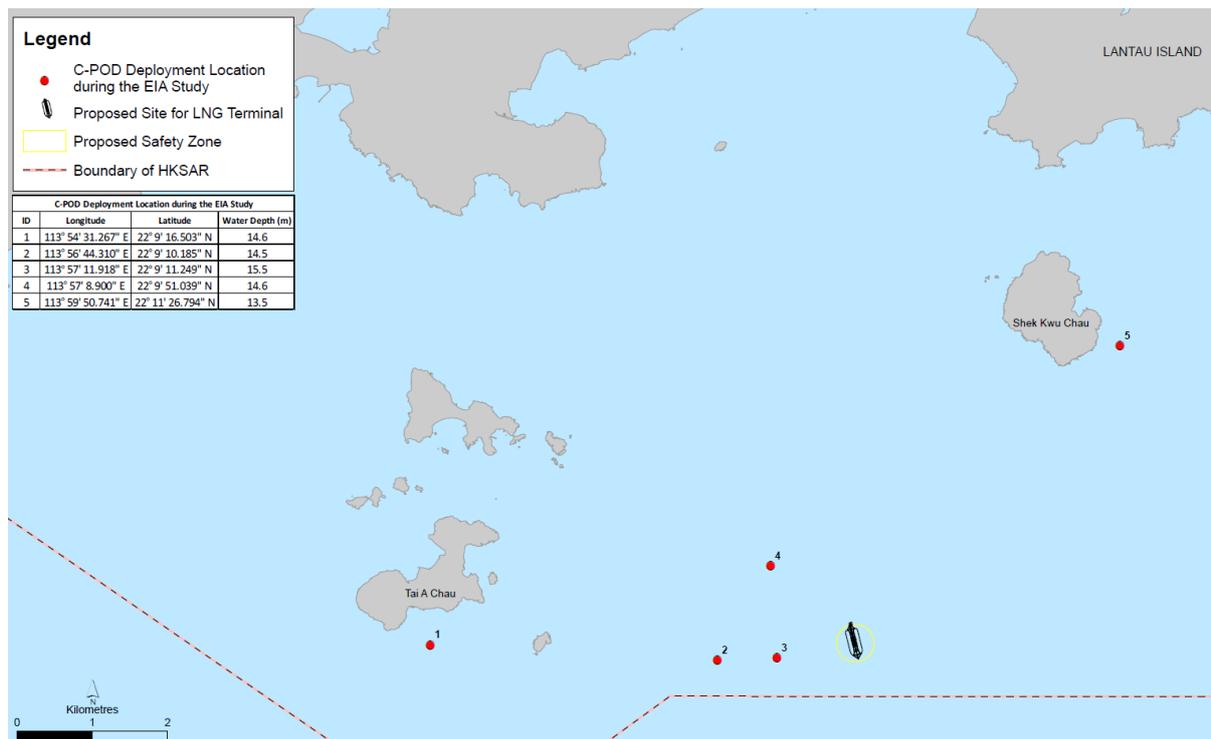
From the baseline marine mammal surveys conducted during the EIA Study, the line-transect vessel survey data collected between June 2016 and May 2017 (inclusive) showed that porpoise sightings were evenly spread between the waters of Soko Islands and Shek Kwu Chau in South Lantau waters as well as the inshore waters during winter and spring months (December to May). However, their distribution was largely confined to the offshore waters to the east of Tai A Chau during summer months (June to August), and the porpoises occurred much less frequently in autumn months (September to November), mainly to the southwest of Shek Kwu Chau and at the offshore waters near the southern territorial boundary.

In the EIA Study, several C-POD units were deployed for the passive acoustic monitoring of finless porpoises in the vicinity of the proposed LNG Terminal site. At one deployment location in the vicinity of the LNG Terminal (i.e. West of HKOLNG, namely Location 2, *Figure 2.1*), May and June 2017 recorded the highest activity months for porpoises in terms of total Detection Positive Minute (DPM).

The second week of June 2017 recorded the highest total DPM, followed by the third week of February 2017.

Overall, from the PAM data, even though porpoise activities dropped noticeably in May and June at the Tai A Chau (namely Location 1), and in June at the Shek Kwu Chau (namely Location 5), such activity remained at similar levels at the West of LNG Terminal in May and June (Figure 2.1). The PAM survey data is consistent with the marine mammal shipboard survey conducted for the EIA Study. This is noteworthy for this Review, as past pattern on porpoise occurrence based on vessel survey data would only consider the winter and spring months (i.e. December through May) as the peak of porpoise occurrence in South Lantau waters, while the EIA Study data suggested that their occurrence remained at similar levels in May and June at the LNG Terminal site.

Figure 2.1 Underwater PAM Deployment Location during the EIA Study



3. REVIEW APPROACH AND METHODOLOGY

Whilst seasonal variation in porpoise occurrence was evident from past studies, it should be noted that such examination on seasonal occurrence was based on the arbitrary differentiation of the four solar seasons (i.e. the three-month intervals of spring, summer, autumn and winter), which lacks the finer resolution to examine temporal changes in porpoise occurrence at the tail-ends of each solar season.

In this Review Report, the monthly variations in porpoise occurrence have been examined instead, with the aim to ascertain the peak months of porpoise occurrence in South Lantau waters and more specifically in the vicinity of the LNG Terminal site. Such detailed examination on monthly occurrence would facilitate a better management of potential impacts on finless porpoise from jetty construction, such that mitigation measures including the avoidance of underwater piling works for jetty construction would be implemented during the peak occurrence months of the species.

To examine the monthly variation in porpoise occurrence for the reassessment of previous knowledge on peak months of porpoise occurrences, a review on the past decade of long-term porpoise monitoring data is conducted by using a combined approach with the incorporation of both vessel-based survey data (through quantitative grid analysis on habitat use) and passive acoustic monitoring data. The details of the analyses using these two types of monitoring data are provided below.

3.1 Quantitative Grid Analysis on Habitat Use

To examine porpoise occurrence in South Lantau waters and in the vicinity of the LNG Terminal site, the quantitative grid analysis of habitat use (see Hung 2008) was conducted among the 1-km² grids within the Southeast Lantau (SEL) and Southwest Lantau (SWL) survey areas with their occurrences in the past decade (i.e. April 2009 to March 2019).

For the grid analysis, SPSE (sighting density) and DPSE (porpoise density) values were deduced for evaluation on level of porpoise usage. First, positions of on-effort porpoise sightings from April 2009 to March 2019 were retrieved from the long-term AFCD marine mammal monitoring data (see vessel-based monitoring survey methodology in Hung 2019), and plotted onto 137 grids (1 km x 1 km each) among SEL and SWL survey areas, including the four grids surrounding the LNG Terminal site.

Sighting density grids and porpoise density grids were then normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid had been surveyed during 2009-19. With the amount of survey effort calculated for each grid, the sighting density and porpoise density of each grid were normalized (i.e. divided by the unit of survey effort).

The newly derived unit for sighting density was termed SPSE, representing the number of on-effort sightings per 100 units of survey effort. In addition, the derived unit for actual porpoise density was termed DPSE, representing the number of dolphins/porpoise per 100 units of survey effort.

To examine the monthly occurrences of porpoises among the 1-km² in South Lantau waters and more specifically around the LNG Terminal site for this review, the number of on-effort sightings and units of survey effort from the 10-year dataset were further stratified into the 12 calendar months to calculate the monthly SPSE and DPSE values for each grid.

Furthermore, for the examination of the monthly variation in porpoise usage encompassing a suite of grids over the entire South Lantau area (137 grids in SEL and SWL survey areas combined), and the SEL survey area only (68 grids) where the LNG Terminal site is located, the number of on-effort porpoise sightings and unit of survey effort were pooled together from those grids to calculate sighting and porpoise densities as a whole at the two spatial scales (i.e. entire South Lantau area and SEL survey area).

3.2 Passive Acoustic Monitoring Data Analysis

As supplementary information to the line-transect vessel monitoring study findings, the passive acoustic monitoring study conducted during the EIA Study at the LNG Terminal site could provide further information on porpoise occurrences for the examination of monthly variations of such occurrence. PAM data, in terms of detection positive minutes (DPMs), were assessed as the parameter for porpoise occurrences. The DPM was chosen to calculate the total number of minutes where at least one click train was detected within a one-minute period, in order to measure the amount of time porpoises spent in an area. Using DPM could eliminate the possibility of counting individual click trains produced by more than one porpoise, as the number of animals detected is unknown. The DPM is also very useful for detecting the temporal pattern of porpoise occurrences in order to determine the level of habitat utilization by the porpoises at the deployment locations in different months of the year.

The EIA Study reported the PAM data from the C-POD units deployed in the vicinity of the LNG Terminal (i.e. West of HKOLNG, namely Location 2), from 204 logged days during the period of 6 January 2017 to 30 June 2017. Subsequent to the completion of the EIA Study, further data were retrieved from C-POD units once thought to be lost. This included PAM data from Location 2 collected from 7 June 2017 to 27 July 2017, and from a location closer to the LNG Terminal (namely Location 3) collected from 6 January 2017 to 27 July 2017. These data were also analysed and evaluated in this review.

4. REVIEW RESULTS

4.1 Quantitative Grid Analysis on Habitat Use

The spatial patterns of porpoise habitat use (i.e. sighting densities (SPSE) and porpoise densities (DPSE)) derived from the quantitative grid analysis are examined for the entire South Lantau region (including both SEL and SWL survey area; 137 grids in total) as well as the LNG Terminal site (four grids in total) for each month of the year (*Figures 4.1 and 4.2*).

For the entire South Lantau region, porpoise usage began to increase starting in December and January (but mainly at the offshore waters between Tai A Chau and Shek Kwu Chau), then reached the highest level from February through May, with the high density grids mainly distributed to the south and east of Tai A Chau, near Shek Kwu Chau, and the waters between Tai A Chau and Shek Kwu Chau (*Figures 4.1 and 4.2*).

Thereafter, there was a decline in porpoise usage in South Lantau waters starting in June, and then to the lowest level in July. There appeared to be resurgence in porpoise usage at the offshore waters to the south and east of Tai A Chau in August and September to a moderate level, while such usage remained at a lower level between October and December (*Figures 4.1 and 4.2*).

However, such spatial patterns on porpoise densities were slightly different at the four grids surrounding the LNG Terminal site. At these four grids, porpoise usage remained relatively high from January through June, and then dropped markedly from July through December (*Figures 4.1 and 4.2*). In other words, even though porpoise usage started to decline in June for the South Lantau region, such usage remained to be of similar levels in May and June **in the vicinity of the LNG Terminal site**.

Besides the qualitative examination on spatial patterns on porpoise habitat use across different months of the year, the monthly SPSE and DPSE values were calculated collectively across the grids at two spatial scales: 1) the entire South Lantau region as a whole; and 2) SEL survey area. For the entire South Lantau region or the SEL survey area alone, the SPSE and DPSE values were at the highest levels between February and April, and then steadily dropped from May to the lowest level in July (*Figure 4.3*). At these two spatial scales, porpoise occurrence remained low between July and December.

From the quantitative grid analysis on porpoise habitat use utilizing vessel-based porpoise monitoring data from April 2009 to March 2019, it appeared that the period with peak months of porpoise occurrences in South Lantau waters was between December and May. Such peak months appeared to be from January to June **at the LNG Terminal site**.

Figure 4.1 Spatial patterns on monthly variations in sighting densities of porpoises (SPSE values) in South Lantau waters, utilizing AFCD long-term marine mammal monitoring data collected between April 2009 and March 2019 (red square: four grids surrounding the LNG Terminal site)

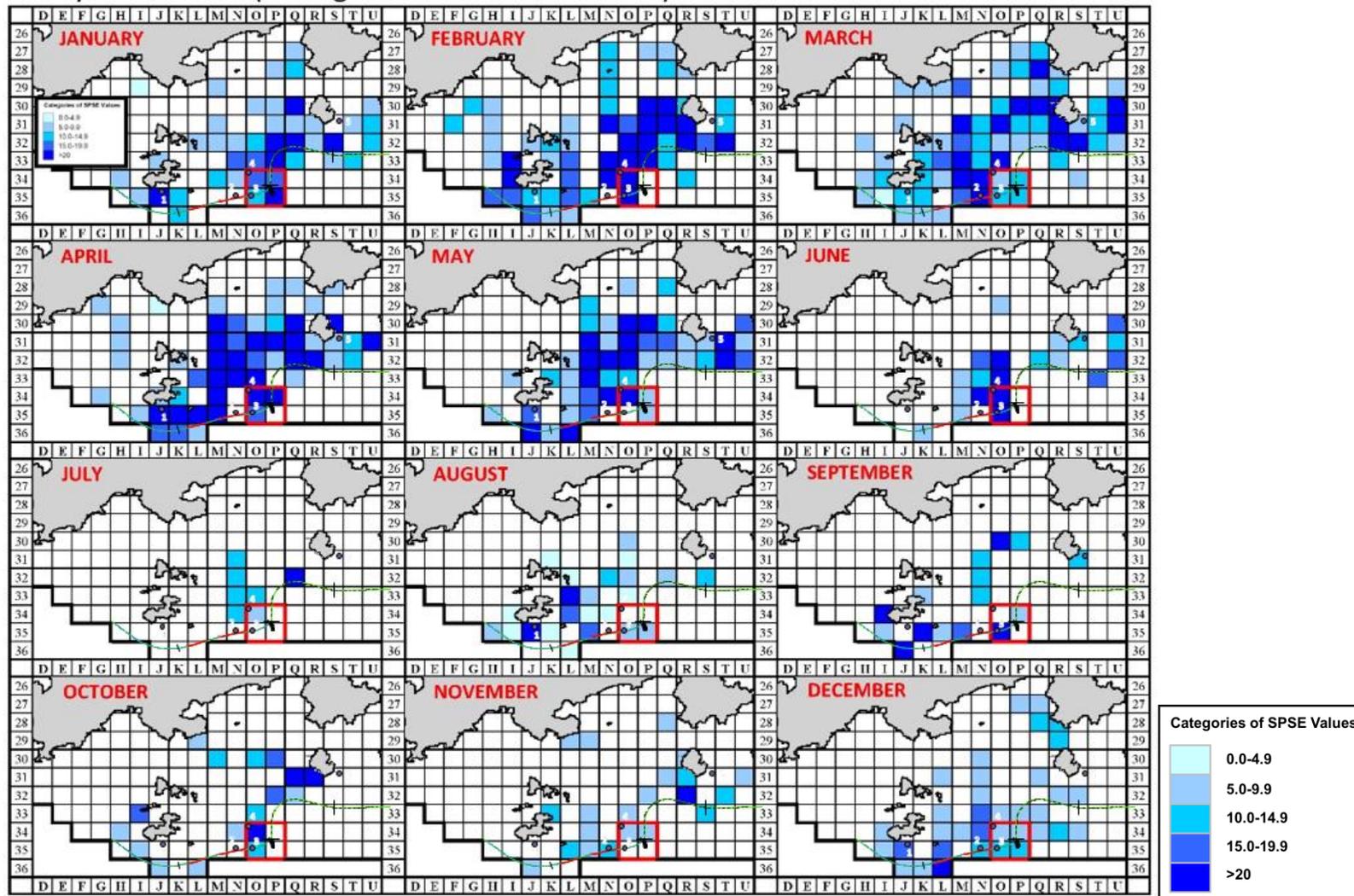


Figure 4.2 Spatial patterns on monthly variations in porpoise densities (DPSE values) in South Lantau waters, utilizing AFCD long-term marine mammal monitoring data collected between April 2009 and March 2019 (red square: four grids surrounding the LNG Terminal site)

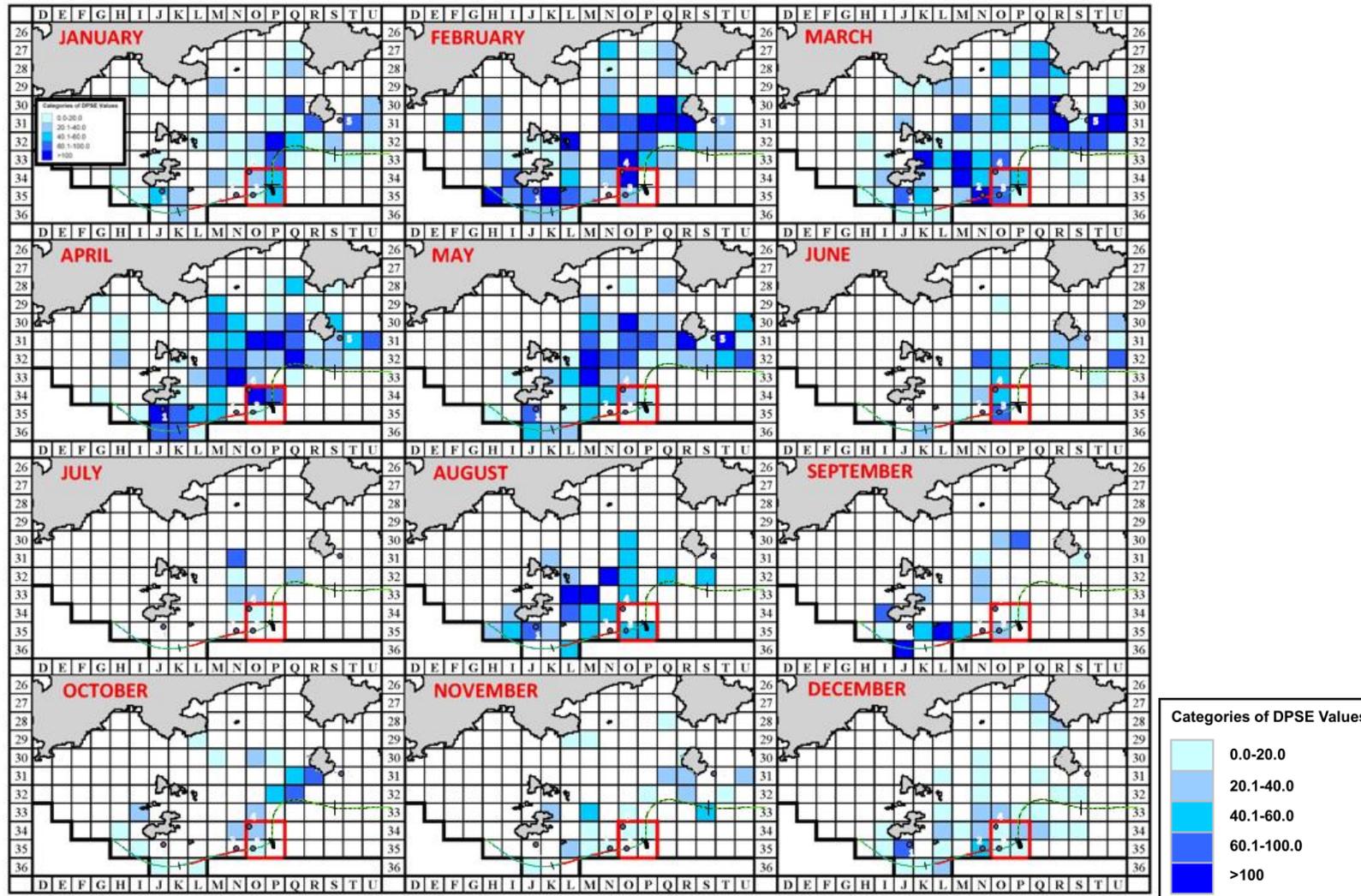
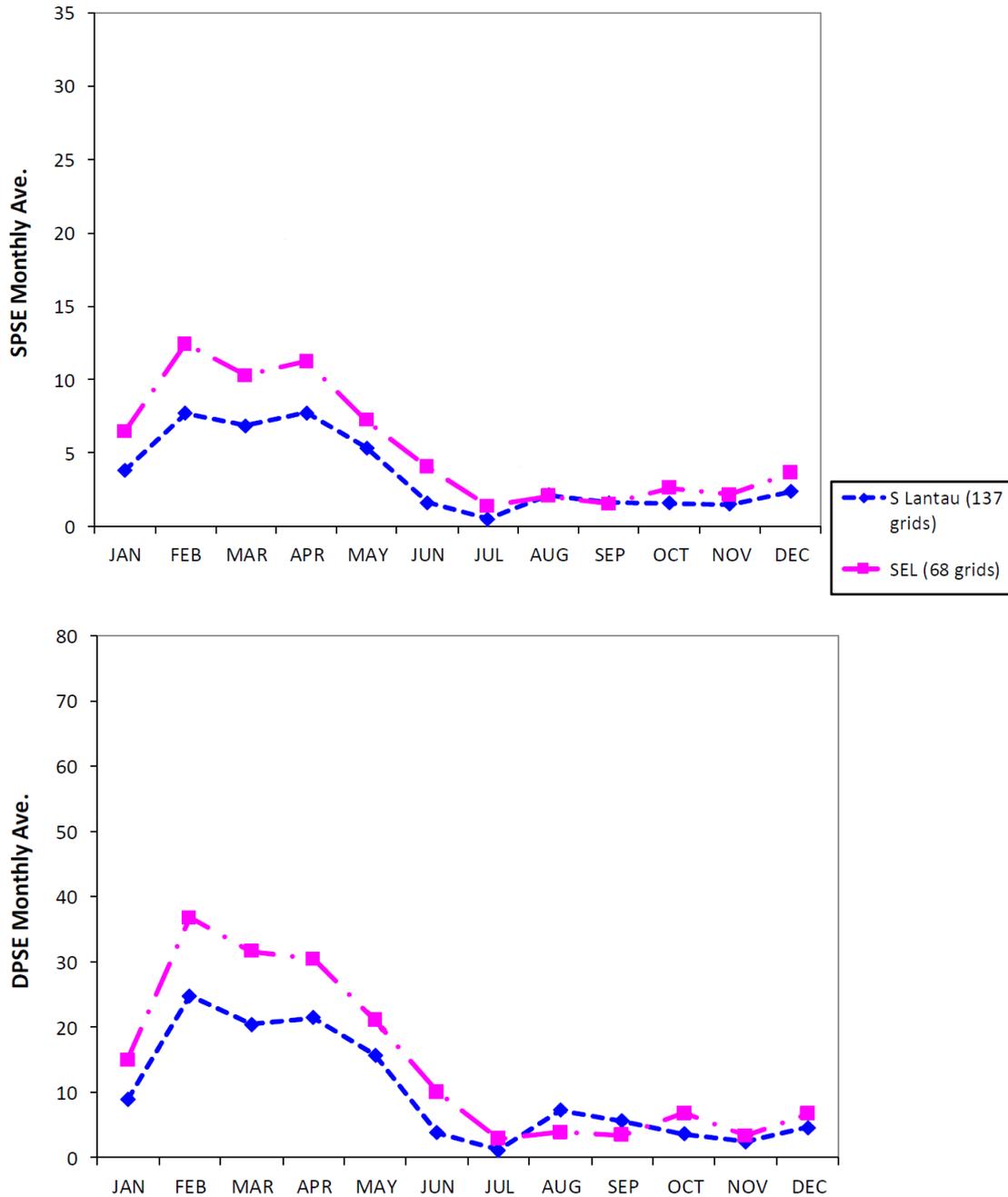


Figure 4.3 Temporal variations in monthly averages of SPSE values (top) and DPSE values (bottom of finless porpoises at: 1) entire South Lantau region (137 grids), 2) SEL survey area (68 grids)



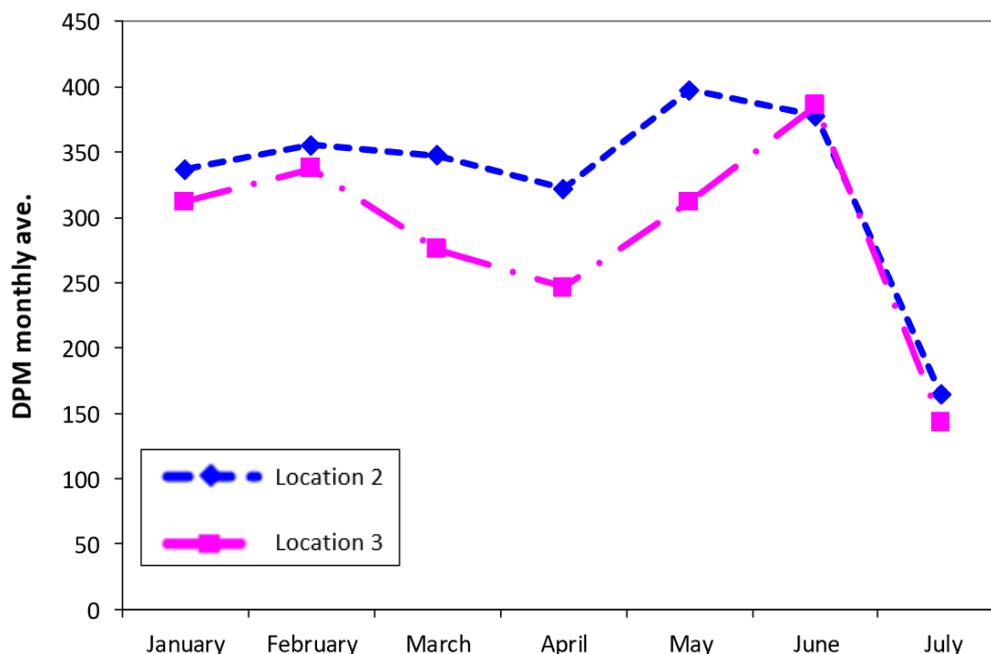
4.2 Passive Acoustic Monitoring Data Analysis

As the PAM data can provide more details on porpoise occurrence at specific site for extended period of time over day and night, such data collected in the vicinity of the LNG Terminal site during the EIA Study were further examined for the monthly occurrence of porpoises at this site.

Continuous PAM data was only available between 6 January 2017 and 27 July 2017 from the two deployment locations in the vicinity of the LNG Terminal (i.e. Locations 2 and 3, *Figure 2.1*). Monthly averages of the seven-month period (i.e. January through July) were calculated from the daily total of DPMs at the two deployment locations, for the examination of monthly variations in porpoise occurrences.

The PAM study results suggested that porpoise occurrences remained at a similar level between January and June, which reached the highest level in May and June at Location 2 and in June at Location 3, before a marked decline in July (*Figure 4.4*). Unfortunately, PAM data from other months of the year at these two locations were not available, but it is evident that **in the vicinity of the LNG Terminal site**, the peak months of porpoise occurrence would be between January and June, followed by a much lower level of porpoise occurrence in July which marked the beginning of the non-peak months of porpoise occurrence.

Figure 4.4 Temporal variations in monthly averages of daily total DPM of finless porpoises at two PAM deployment locations (i.e. Locations 2 and 3) in the vicinity of the LNG Terminal site in 2017



When considering the different sets of porpoise monitoring data, the PAM data can offer more data on porpoise occurrence than the vessel-based monitoring data, as the PAM data could provide details on their presence 24 hours a day continuously while the vessel-based data can only provide a snap-shot of their occurrence restricted to daylight hours. Another important consideration is the diel pattern on porpoise occurrence noted from the EIA Study, which was distinct across all deployment locations in South Lantau waters, with a considerable increase in activity in late hours at night and very early hours in the morning. These acoustic detections were outside of the daylight hours when visual surveys could not possibly take place, which provided important data to supplement the review on porpoise habitat use in the vicinity of the LNG Terminal site.

5. REVIEW CONCLUSIONS

In the past, the winter and spring months (i.e. December-May) have been defined as the peak season of porpoise occurrence in the South Lantau region based on the differentiation of the four solar seasons.

In this Review Report, finless porpoise monitoring data from vessel based survey from April 2009 to March 2019 and passive acoustic monitoring from January to July 2017 at two deployment locations have been reviewed. Both sets of data have been examined for monthly variation, which offers analyses with a more in-depth and finer resolution than previously analysed. A further examination on monthly variations in porpoise occurrences suggested that the period between January and June appears to be the peak months of porpoise occurrences for the waters **in the vicinity of the LNG Terminal site**, which is supported by both vessel-based line-transect survey data as well as the passive acoustic monitoring data.

Therefore, for the implementation of specific mitigation measures to avoid underwater piling works for jetty construction during the peak occurrence season of the Finless Porpoise, the peak months of porpoise occurrence (i.e. January-June) should be considered in order to provide suitable protection to the porpoises within and around the jetty construction site.

ANNEX A

REFERENCES CITED

- Hung, S. K. 2005. Monitoring of finless porpoise (*Neophocaena phocaenoides*) in Hong Kong waters: final report (2003-05). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 95 pp.
- Hung, S. K. 2008. Habitat use of Indo-Pacific humpback dolphins (*Sousa chinensis*) in Hong Kong. Ph.D. dissertation. University of Hong Kong, Hong Kong, 266 pp.
- Hung, S. K. 2019. Monitoring of Marine Mammals in Hong Kong waters: final report (2018-19). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 140 pp.
- Jefferson, T. A. and Braulik, G. T. 1999. Preliminary report on the ecology of the finless porpoise in Hong Kong waters. IBI Reports 9: 41-54.
- Jefferson, T. A., Hung, S. K., Law, L., Torey, M. and Tregenza, N. 2002. Distribution and abundance of finless porpoises in Hong Kong and adjacent waters of China. Raffles Bulletin of Zoology, Supplement 10:43-55.