Using new tools to monitor human behaviour in critical dolphin habitat and marine protected areas

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MEEF 2020005
Final Report

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Final Report
December 2022

Submitted to Marine Ecology Enhancement Fund (MEEF)
Project Number MEEF2020005

Southeast Asia Marine Mammal Research (SEAMAR)
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Declaration

Reference Number: MEEF2020005

Project Title: Using new tools to monitor human behaviour in critical dolphin habitat and marine protected areas

Project Leader: Lindsay Porter

I hereby irrevocably declare to the MEEF Management Committee and the Steering Committee of the relevant Funds including the Top-up Fund, that all the dataset and information included in the completion report has been properly referenced, and necessary authorisation has been obtained in respect of information owned by third parties.

Any opinions, findings, conclusions or recommendations expressed in this report do not necessarily reflect the views of the Marine Ecology Enhancement Fund or the Trustee.

I hereby irrevocably declare, warrant and undertake to the MEEF Management Committee and the Steering Committee of the relevant Funds including the Top-up Fund, that I myself, and the Organisation:

1. Do not deal with, and are not in any way associated with, any country or organisation or activity which is or may potentially be relevant to, or targeted by, sanctions administered by the United Nations Security Council, the European Union, Her Majesty's Treasury-United Kingdom, the United States Department of the Treasury's Office of Foreign Assets Control, or the Hong Kong Monetary Authority, or any sanctions law applicable;

2. Have not used any money obtained from the Marine Ecology Enhancement Fund or the related Top-up Fund (and any derived surplus), in any unlawful manner, whether involving bribery, money- laundering, terrorism or infringement of any international or local law; and

3. Have used the funds received (and any derived surplus) solely for the studies or projects which further the MEEF Objectives and have not distributed any portion of such funds (including any derived surplus) to members of the Recipient Organisation or the public.

Signature: ____________________

Lindsay Porter, Project Leader

Date: 01/12/2022

Contents

Executive Summary

In Hong Kong, a ban on commercial trawling came into effect in December 2012. The purpose of the ban was to conserve the fisheries resources in Hong Kong waters and promote the sustainable development of the Hong Kong fisheries industry. Healthy fisheries are critical to marine mammal survival in Hong Kong. Previous studies that included both direct observation and interviews with local fishermen, indicated that illegal trawlers regularly operate in Hong Kong waters at night. As these vessels operate without lights, they are not easily 'seen' but can be detected acoustically by the distinctive underwater sound of the trawl vessel. This project used underwater acoustic monitoring devices, usually deployed to record marine mammals, to monitor vessel activity at night, with the aim of better understanding the extent of any unlawful practises, such as trawling. Both static underwater listening stations and hydrophones deployed from a moving vessel were used to record the underwater soundscape. Data collected from night time surveys towing passive acoustic monitoring (PAM) equipment was used to map the spatial overlap between vessel activities and cetaceans. The use of static PAM devices provided detailed information on both day and night time vessel activities within three of Hong Kong's marine protected areas. The objective of deploying the static devices, and comparing the data collected with environmental variables, was to test the ability of these devices to document the frequency, duration and driving factors of vessel activities in marine park areas.

This study, in its entirety, was conducted between January and October 2021. This report details the period 1 January – 30 June 2021, the data collection phase and a second report, covering the period 1 July – 31 October 2021, details the continuation of the towed PAM surveys and all data analysis (MEEF2020005A).

This study was conducted during the start of the Covid-19 pandemic and, as such, Hong Kong's maritime border was closed. This restriction did not inhibit project fieldwork activities and static acoustic devices were deployed at Yuen Chau, in the South Lantau Marine Park (SLMP), proposed at time of research, now designated; Peaked Hill, in the South West Lantau Marine Park (SWLMP) and; Tai Mo To, in The Brothers Marine Park (TBMP). A total of 65.7 days (1576 hours) of acoustic recordings were collected from the static devices, between February and June 2021.

Night-time vessel surveys, using towed PAM arrays, conducted 783.8 km of survey effort recorded 148 cetacean acoustic events (50 Chinese white dolphin; 98 finless porpoise) and 240 acoustic events attributed to vessels, of which 121 were either definitely, or most likely, conducting unlawful activities (10 active trawlers and 111 unlit, speed boats travelling across the Hong Kong maritime border). Dolphins were detected in Northwest Lantau (NWL), West Lantau (WL), South Lantau (SL) and Southeast Lantau (SEL), including within Sha Chau Lung Kwu Chau Marine Park (SCLKCMP), SWLMP and SLMP. Finless porpoise were detected in SL and SEL, including within SLMP. Illegal trawling activities (usually single trawlers) were documented in SL, SEL and WEL, including within SLMP. Speedboats were encountered in NWL and NEL, including SCLKCMP and TBMP. Trawlers were encountered between February and April, whereas speed boats were encountered throughout the survey period.

Project Title and Brief Description of the Project

Project Title

Using New Tools to Monitor Human Behaviour in Critical Dolphin Habitat and Marine Protected Areas.

Brief Description

In Hong Kong, a ban on commercial trawling came into effect in December 2012. The purpose of the ban was to conserve the fisheries resources in Hong Kong waters and promote the sustainable development of the Hong Kong fisheries industry. Healthy fisheries are critical to the dolphins, and other marine mammals, survival in Hong Kong. Illegal trawlers operate at night without lights so are not easily 'seen' but are readily heard by the distinctive underwater sound of the trawl nets. Acoustic devices usually deployed to detect marine mammals were assessed and modified so as to provide an efficient means of (a) informing management authorities of unlawful activities and (b) mapping the overlap between marine mammals and various vessel activities, particularly illegal activities, such as trawling, which pose risk to dolphins and porpoise from direct injury or death and from impoverishing their prey resources.

Objectives

- Test the feasibility of multiple passive acoustic monitoring devices to document the frequency, duration and driving factors of human activities, particularly illegal trawling events, in critical cetacean habitat and Hong Kong Marine Park Areas.

- Provide a summary report to management authorities with a detailed analysis of human activities in both critical cetacean habitat and Marine Park Areas so that management and enforcement activities can be informed and adapted, if required.

This report details project methodology and a summary of the data gathered from multiple acoustic monitoring devices during the period 1 January – 30 June 2021. A second report details the continued collection of vessel activity and cetacean detection data for the remainder of the entire study period (1 July – 31 October 2021). A detailed analysis of human activities in both critical cetacean habitat and Marine Park areas is also presented in the second report (MEEF2020005A)

Completed Activities Against the Proposed Work Schedule

The project and its activities were conducted between January-June 2021, during which nine (9) activities were scheduled (Table 1).

Activity 1: Towed PAM Surveys
Status: Completed for this period (and continued in July-October 2021)

For methodology, please refer to Appendix 5.

Activity 2: Static PAM Deployment
Status: Complete

For methodology, please refer to Appendix 6.

Activity 3: Visual Mapping of Vessels at Static Sites
Status: Completed for this period (and continued in July-October 2021)

For methodology, please refer to Appendix 6

Activity 4: Data collection for sound propagation model
Status: Completed for this period (and continued in July-October 2021)

For methodology, please refer to Appendix 6.

Activity 5: Data Collection: existing datasets/environment
Status: Complete

See MEEF2020005A report for analysis.

Activity 6: Data Analyses
Status: Complete

See MEEF2020005A report for analysis.

Activity 7: Interim Report
Status: Complete

Activity 8: Discussion Management Authorities
Status: Ongoing

See MEEF2020005A report for documentation.

Activity 9: Final Report
Status: Complete

Results

Static PAM Stations

Between January and June 2021, SoundTraps were deployed at Yuen Chau, Peaked Hill and Tai Mo To for 65.7 days resulting in 1576 hours of acoustic recordings (Table 2). On average, there were 26 days and 630 hours recorded at each PAM station with the exception of Peaked Hill, where a SoundTrap error resulted in only 12.8 days and 307.4 hours being recorded. Analyses of these data are presented in the report of MEEF2020005A.

Acoustic Surveys

Between January and June 2021, 14 surveys were conducted resulting in 783.8 km of survey effort. Surveys were conducted between 17:00 and 04:00 (Figure 1). There were 148 acoustic detections of cetaceans, of which 50 were Chinese white dolphin and 98 were finless porpoise (Table 3). Dolphins were detected in NWL, WL, SL and SEL, including SCLKCMP, SWLMP and SLMP. Finless porpoise were detected in SL and SEL, including SLMP. There were no cetacean detections in Northeast Lantau (NEL), including The Brothers Marine Park (TBMP) (Figure 2; Appendix 7)

There were 240 vessel encounters of which 121 were definitely or likely conducting illegal activities (Appendix 8). Of these, 10 vessels were "definitely" conducting illegal activities, e.g., active trawling (Figure 3a); and 111 that were "likely" conducting illegal activities, e.g., high-powered speed boats travelling at >50 kt into and out of Hong Kong waters, often without navigation lights (Figure 3b). It is noted that it was not possible to identify individual vessels at night, such that a single trawler operating in an area may have been "encountered" multiple times throughout a survey. Trawlers were encountered in WL (n=1), SL (n=6) and SEL (n=3) and only in February, March and April, noting that May to July is the annual fishing moratorium period in the South China Sea, thus all trawlers are confined to port. Speed boats were encountered predominantly in NWL (n = 109), including within SCLKCMP, and on two (2) occasions in NEL, including TBMP (n = 1). Speed boats were almost exclusively encountered alone, though the number of vessels per encounter ranged between 1 to 30 vessels. Speed boats were encountered in every month that NWL was surveyed, i.e., January, March and May.

Evaluation of Project Effectiveness

The **major outcomes** of this project are a) to document vessel behaviour, determine the frequency and location of unlawful activities, such as illegal trawling, and investigate the factors that influence such activities b) provide new insights to authorities on the effectiveness of management actions and c) assess the feasibility of using acoustic tools to assist conservation initiatives.

Objective 1 (as stated in the project proposal). *This objective will be achieved by successfully deploying towed and static acoustic equipment throughout the project period and analysing the collected data. Additional visual observations of vessel traffic around the static acoustic recorders will provide data on vessel size and activity that will inform acoustic models. Recordings of marine mammals will also be logged and mapped. The overlap of marine mammal occurrence and undesirable vessel activities will be summarised and direct risk assessed. On completion and appropriate approvals, the acceptance of a scientific paper in a peer reviewed journal shall be an indicator of this projects academic research value.*

Objective 1 has been achieved by successfully deploying towed and static acoustic equipment throughout the project period and preparing the data for analysis (see MEEF2020005A). Visual observations of vessel traffic around the static acoustics recorders were also collected and prepared for inclusion in the propagation model (see MEEF2020005A). The overlap of cetacean occurrence and undesirable vessel activity indicates that:

- Illegal trawling activities occur predominantly in Hong Kong's southwestern waters, where they overlap directly with both Chinese white dolphin and finless porpoise presence, including within and around SWLMP and SLMP.
- Illegal speed boats are active predominantly in Hong Kong's northwestern waters, where they overlap directly with humpback dolphin presence, including within and around SCLKCMP.

Objective 2 (as stated in the project proposal). *This objective will be achieved by reporting to management authorities, detailing the acoustic modelling, vessel location and behaviour, and the factors that influence vessel occurrence, will allow the feasibility of this method as a potential monitoring and management tool to be assessed. The evaluation of results and recommendations for future use by the appropriate management authorities shall be an indicator of this works conservation management value.*

Objective 2 will be achieved in full once this study completes (see MEEF2020005A). This objective has been achieved in part as during the survey work, incidents of illegal activity were provided to law enforcement agencies.

Summary and Way Forward

This project was catalysed by a previously funded MEEF project that logged several vessel activities in marine parks, and other areas, that were likely illegal and could potentially negatively impact both dolphins and porpoise. The use of towed array PAM surveys, during a project that focused on night-time activities of dolphins and finless porpoise, had identified trawling activity, by its characteristic underwater signature, noting that trawling has been banned in Hong Kong waters for more than a decade. The means to investigate these clandestine activities in more detail, relied on novel sound modelling propagation techniques that had only just been pioneered for the Great Barrier Reef Marine Park, Australia. This project therefore, had two data collection components, the towed array surveys that were conducted throughout Lantau waters and static PAM stations, that were located in marine park areas. The towed array surveys recorded 121 vessels (50.4% of all vessels detected) conducting, or highly likely to be conducting, illegal activities. Detections of active trawlers were made predominantly in SL waters, including within the SLMP, but occurred only in some months. Notably there was no trawling activity detected during the annual fishing moratorium in the South China Sea (May-June). Speed boats, believed to be involved in cross-border trafficking of goods, were detected in NWL and NEL, including within SCLKCMP and TBMP. These vessels were encountered throughout the study period. The towed array PAM surveys provided acoustic data on dolphins, porpoise and vessel activity from throughout the Lantau habitat, at night, and highlighted areas of overlap in SL (trawlers and porpoise) and NWL (high-speed small vessels). Marine Park monitoring via the deployment of static acoustic monitoring devices will provide a detailed picture of marine park use over 24 hour periods. Analysis of marine park monitoring data will be presented in MEEF2020005A.

The deployment of the static PAM stations was completed with ease and no equipment loss, although an error in a device setting resulted in less data being recorded than anticipated at one station. Night time towed PAM surveys were conducted with a minimal team and completed successfully. These acoustic tools could, therefore, provide a low cost means to monitor activities and marine mammals in marine protected areas in the long term. Data from such monitoring may assist management authorities to assess different patrol strategies and, if some illegal activities are recorded in the more remote waters of Hong Kong, will provide detailed vessel activity data upon which authorities can act.

This project was conducted at a time when illegal activities in Hong Kong waters were perceived to be escalating and real-time information on observed activities was provided to the authorities by the project proponents. In this way, this project has already contributed to the larger effort to reduce illegal activities in Hong Kong waters.

Tables

Table 1. Timeline of completed activities (January – June 2021).

Item	Activities	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21
1	Towed PAM Surveys						
2	Static PAM Deployment						
3	Visual Mapping of Vessels at Static Sites						
4	Data Collection: Sound propagation model						
5	Data Collection: existing datasets/environment						
6	Data Analyses						
7	Interim Report						
8	Discussion Management Authorities						
9	Final Report						

Table 2. Summary of static PAM station effort (February – June 2021).

Site	Marine Park	Deployment Date	Retrieval Date	Recording Hours	Recording Days
Yuen Chau	SLMP	2021-02-02	2021-03-01	637.4	26.6
Peaked Hill	SWLMP	2021-03-25	2021-04-07	307.4	12.8
Tai Mo To	TBMP	2021-05-26	2021-06-21	631.2	26.3
Total				**1576.0**	**65.7**

Table 3. Summary of acoustic survey effort and acoustic events by survey area (January – June 2021).

Month	Surveys	NEL			NWL			SEL			SL			WL		
		Effort (km)	Acoustic Events		Effort (km)	Acoustic Events		Effort (km)	Acoustic Events		Effort (km)	Acoustic Events		Effort (km)	Acoustic Events	
			CWD	FP		CWD	FP		CWD	FP		CWD	FP		CWD	FP
January	4	27.7	0	0	72.8	7	0	35.7	0	17	65.2	8	10	25.6	6	0
February	2	0.0	0	0	0.0	0	0	35.7	0	14	66.2	3	17	0.0	0	0
March	2	27.4	0	0	70.7	1	0	0.0	0	0	3.9	0	0	24.9	5	0
April	2	0.0	0	0	0.0	0	0	35.4	0	11	67.7	0	17	0.0	0	0
May	2	26.1	0	0	72.1	0	0	0.0	0	0	4.0	1	0	26.0	3	0
June	2	0.0	0	0	0.0	0	0	33.2	2	4	63.5	14	8	0.0	0	0
July	2	26.7	0	0	71.8	3	0	0.0	0	0	3.7	1	0	25.2	5	0
August	2	0.0	0	0	0.0	0	0	32.8	0	3	62.1	6	18	0.0	0	0
September	2	28.3	0	0	70.5	4	0	0.0	0	0	6.4	1	0	26.3	5	0
October	2	0.0	0	0	0.0	0	0	33.4	0	3	62.9	0	10	0.0	0	0
Total	**22**	**136.1**	**0**	**0**	**358.0**	**15**	**0**	**206.2**	**2**	**52**	**405.7**	**34**	**80**	**128.0**	**24**	**0**

Figures

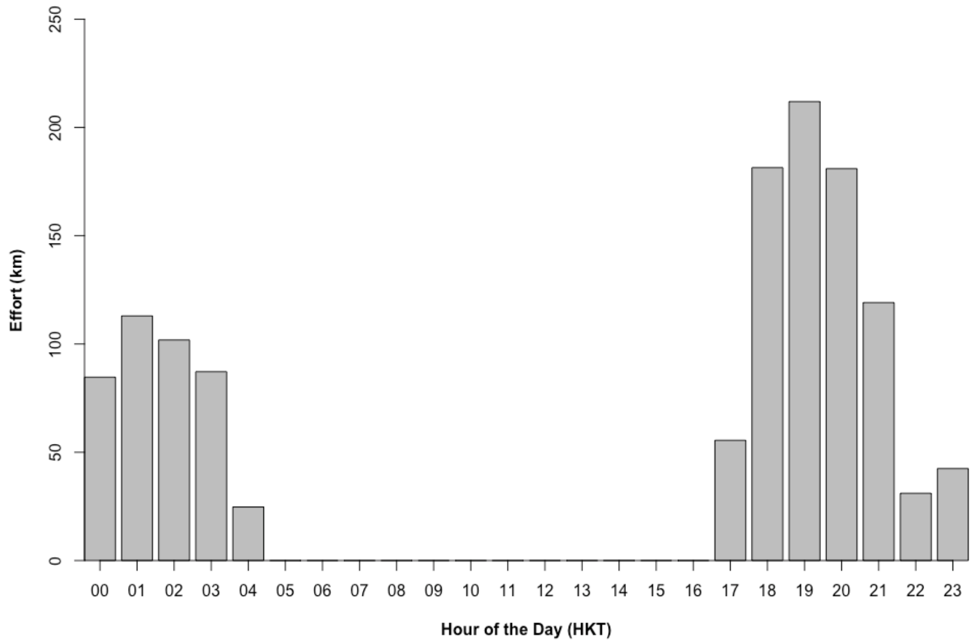

Figure 1. Summary of acoustic survey effort (km) by survey area.

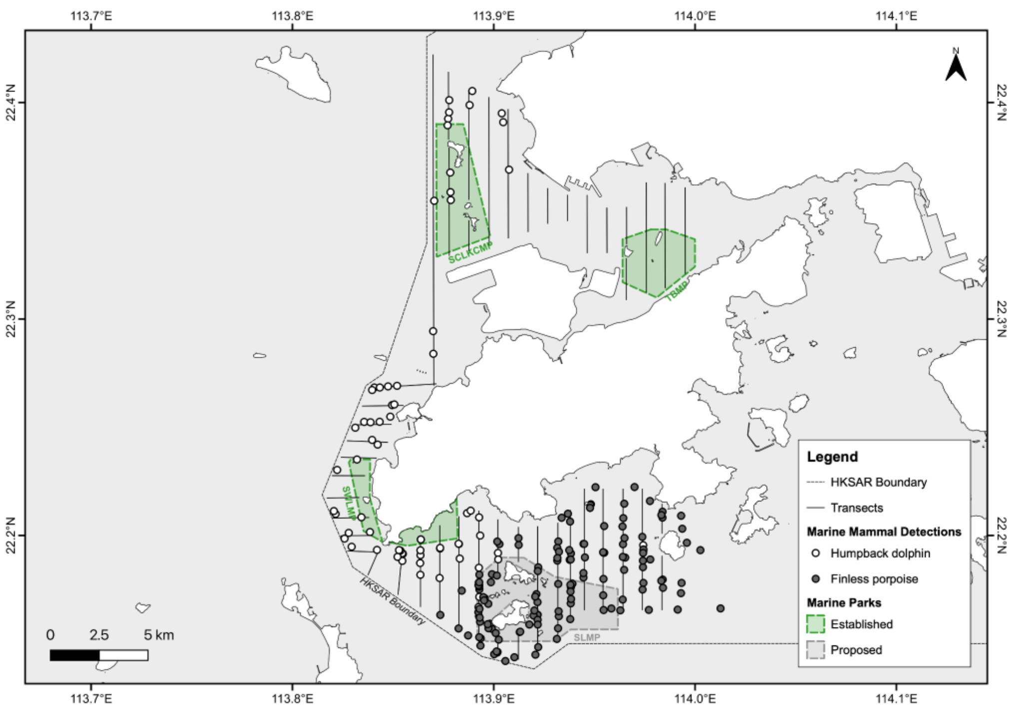

Figure 2. Indo-Pacific humpback dolphin (*Sousa chinensis*) and Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) acoustic events detected during acoustic surveys.

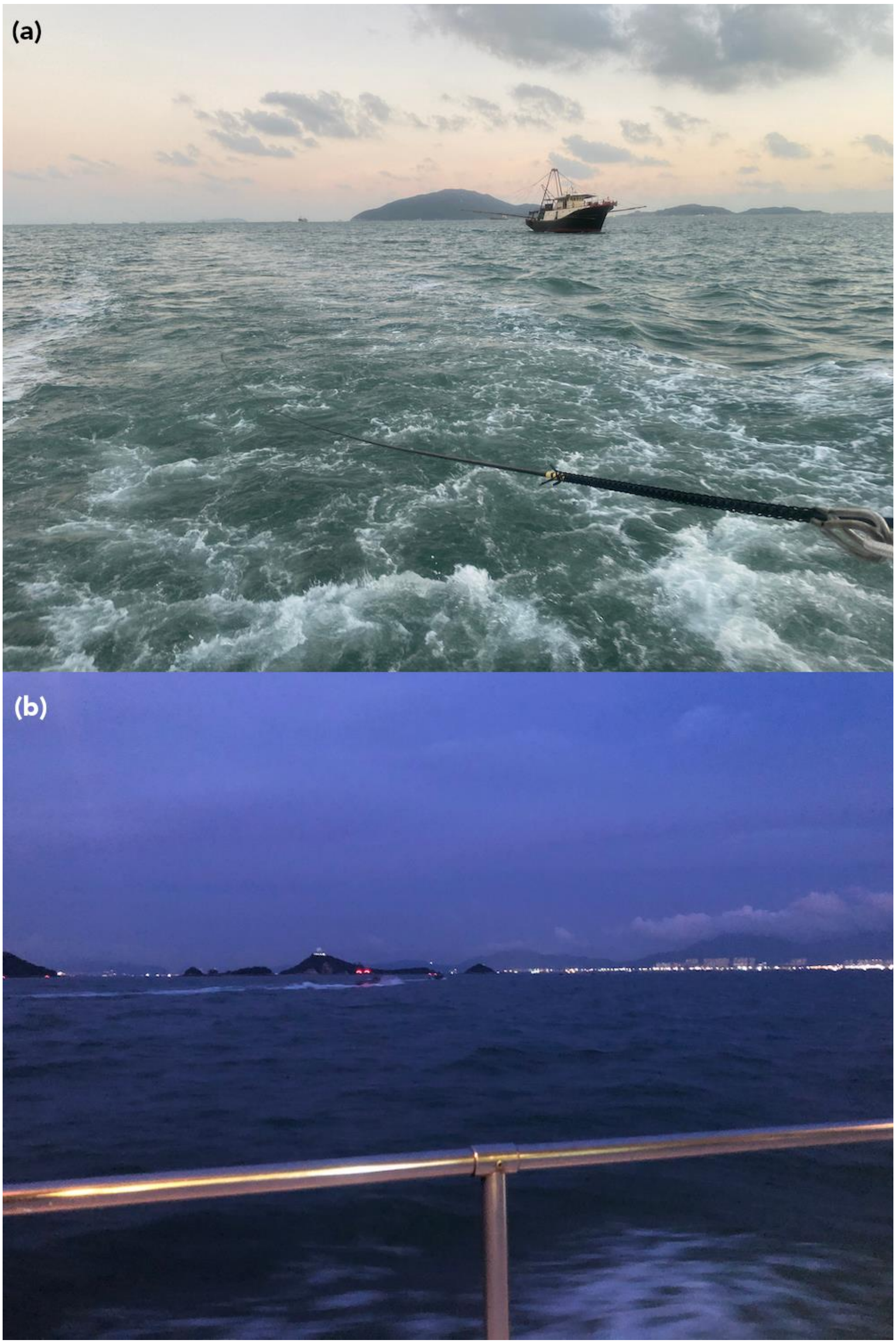

Figure 3. Examples of vessels definitely conducting illegal activities, such as **(a)** active trawlers, and likely conducting illegal activities, such as **(b)** high-powered speed boats.

Appendices

Appendix I: Audit Report MEEF2020005 (January – June 2021)

Audited statement of accounts are not disclosed due to confidentiality reasons.

Appendix 2. Project assets.

List of project assets are not disclosed due to confidentiality reasons.

Appendix 3. Staff attendance record.

Staff attendance record are not disclosed due to confidentiality reasons.

Appendix 4. Recruitment record for all project staff employed under the project enclosed as an appendix to the completion report in accordance with the recruitment plan.

Recruitment record are not disclosed due to confidentiality reasons.

Appendix 5. Methods for *Activity 1: Towed PAM Surveys*.

Study Area

The study area encompassed the waters adjacent to the Third Runway System (3RS), as well as The Brothers Marine Park (TBMP), Sha Chau and Lung Kwu Chau Marine Park (SCLKCMP), South West Lantau Marine Park (SWLMP) and South Lantau Marine Park (SLMP) (Figure 1).

Data Collection

Night-time acoustic data were collected using monthly line transect surveys across the known range of Chinese white dolphins (CWD) around Lantau Island (Figure 2), as identified in the AFCD Marine Mammal Monitoring Programme Report (AFCD 2020). During surveys, a cabled hydrophone array was towed 80 m behind a research vessel travelling at 9 knots (Figure 3). The arrays were custom-built, consisted of two elements, and had a frequency response of 20 Hz to 200 kHz with ± 10 dB sensitivity. Two different array configurations were used: (1) a liner-cast array (*Seiche*, United Kingdom) and (2) a linear oil-filled array (*Vanishing Point Marine*, United Kingdom). Analogue acoustic signals were passed through a 100 Hz high-pass filter and converted into a digital signal at a sampling rate of 500 kHz using a data acquisition (DAQ) card. Two custom-built DAQ cards were used: (1) SAIL (*SA Instrumentation*, United Kingdom) and (2) National Instrument USB 6251 (*National Instruments*, United States). The digitized output was sent to a laptop running Windows 7 for signal processing recording and display using PAMGuard 1.15 software (Gillespie et al. 2008). GPS (Digital Yacht GPS 150 DualNav Sensor; Aadhaar Globalsat BU 353 S4 G Star IV GPS Receiver) and AIS (Digital Yacht AIS100 PRO Dual Channel AIS Receiver) units were connected to PAMGuard via the laptop, permitting the simultaneous recording of acoustic, GPS and AIS data.

Where possible, all hardware was powered by 12 V DC batteries to reduce electrical noise in the acoustic system. When hardware had to be powered by a ship-board generator, a cable was placed in the water to ground the acoustic system. Two different research vessels were used for surveys: (1) a 21.9 m twin-engine motor yacht and (2) a 17.5 m single-engine motor yacht. Various combinations of research vessels cabled hydrophone arrays and DAQ cards were used throughout the study period, which are detailed in Table 1. Surveys were conducted by two PAM operators (excluding the research vessel captain and crew) working in 1-hour shifts to monitor the cabled hydrophone array, listen to the acoustic output and input relevant survey data into PAMGuard (Figure 4). Upon hearing engine noise on the hydrophone, the PAM operator would confirm (to the best of their ability) the number and approximate location of the vessel relative to the research vessel. These vessel "encounters" were then classified into six categories: *Cargo*, *Construction*, *Fishing*, *Government*, *Passenger*, *Pleasure* and *Other* (Table 2). For *Fishing* vessels, activity was also noted, specifically whether they were transiting or fishing. To ensure equal coverage over a 12-hour night cycle, surveys were conducted between 17:00-22:00 or 22:00-04:00.

Data Processing and Analysis

Acoustic recordings from towed hydrophone array surveys were processed and analysed using PAMGuard. Recordings were reviewed continuously for the presence of dolphin vocalisations, specifically echolocation clicks and whistles. The first stage of processing involved identifying individual clicks and whistles using automated detectors in PAMGuard. For clicks, the Click Detector in PAMGuard was configured to trigger on any transient signal with energy rising more than 10 dB above background noise. Transient signals were classified as potential dolphin clicks if they had a peak frequency between 20-50 kHz, 50-70 kHz, 70-110 kHz or 28-130 kHz; or as potential porpoise clicks if they had a peak frequency between 100-150 kHz and total energy in the peak was ≥ 6 dB higher than the 40-90 kHz and 170-210 kHz bands. Potential clicks identified by the detector were then manually reviewed by an analyst for spectral and temporal features, such as peak frequency, frequency range and interclick interval (ICI) specific to CWD and finless porpoise to confirm species presence. To assist with this review, click classifiers were used with different peaked frequencies: 30-50 kHz, 50-70 kHz and 70-110 kHz for CWD; and 100-155 kHz for finless porpoise. A positive CWD click detection required a minimum of one click train (i.e. four successive clicks) that met three criteria: (1) a peak frequency of 20-40 or 60-80 kHz; (2) a frequency range of 10.7 kHz to 200 kHz; and (3) an ICI of 10-145 ms (Goold and Jefferson 2004; Li et al. 2012; Sims et al. 2011; Berg Soto et al. 2014; Fang et al. 2015) (Figure 5). A positive finless porpoise click detection required a minimum of one click that met three criteria: (1) a peak frequency of 130-140 kHz; (2) a frequency range of 110-160 kHz (Goold and Jefferson 2002); and (3) a clear sinusoidal waveform that was smoothly enveloped (Figure 6). For whistles, the Whistle and Moan detector in PAMGuard was configured to trigger potential whistles using a set of parameters (Table 3). Potential whistles were reviewed visually by inspecting spectrogram contours (Figure 7). Where necessary, whistles were also reviewed aurally by playing back at original speed. A positive CWD whistle detection required a whistle contour that had a constant frequency and an upsweep, downsweep, convex, concave, multiple or “chirp” shape, as described by Ruxton (2002). Once identified, individual clicks and whistles were grouped into an acoustic event, which was defined as all confirmed vocalisations occurring within a time window of 60 seconds. Vocalisations separated by more than this time window were assumed to be from separate individuals or groups.

Both acoustic events and vessel “encounters” were paired with GPS using their respective date-time stamps in R 4.0.3. (R Core Team 2020) and mapped using QGIS 3.16. (QGIS Development Team 2020).

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Tables

Table 1. Summary of research vessel, hydrophone array and DAQ card combinations used throughout the study period (January – June 2021).

Survey Date	Survey Start (UTC)	Survey End (UTC)	Hydrophone	DAQ	Sampling Rate	Survey Area	Research Vesse
2021-01-15	2021-01-15 10:46:44	2021-01-15 13:54:57	Seiche SM2073	NI	500	WL,NWL	Twin Engine
2021-01-21	2021-01-21 09:19:39	2021-01-21 13:47:53	Vanishing Point Serial Stere	SAIL	500	SL	Single Engine
2021-01-22	2021-01-22 09:15:50	2021-01-22 12:37:32	Vanishing Point Serial Stere	SAIL	500	SL,SEL	Single Engine
2021-01-27	2021-01-27 09:54:49	2021-01-27 14:19:09	Seiche SM2073	NI	500	NWL,NEL	Twin Engine
2021-02-22	2021-02-22 16:16:08	2021-02-22 20:08:16	Vanishing Point Serial Stere	SAIL	500	SL	Single Engine
2021-02-25	2021-02-25 15:40:34	2021-02-25 19:23:00	Vanishing Point Serial Stere	SAIL	500	SL,SEL	Single Engine
2021-03-01	2021-03-01 14:49:24	2021-03-01 18:15:24	Seiche SM2073	NI	500	SL,WL,NWL	Twin Engine
2021-03-04	2021-03-04 15:40:18	2021-03-04 19:52:38	Seiche SM2073	NI	500	NWL,NEL	Twin Engine
2021-04-12	2021-04-12 16:31:11	2021-04-12 20:31:27	Vanishing Point Serial Stere	SAIL	500	SL	Single Engine
2021-04-13	2021-04-13 16:42:21	2021-04-13 20:20:38	Vanishing Point Serial Stere	SAIL	500	SL,SEL	Single Engine
2021-05-04	2021-05-04 10:04:19	2021-05-04 12:03:01	Seiche SM2073	NI	500	SL,WL	Twin Engine
2021-05-13	2021-05-13 10:45:05	2021-05-13 16:48:50	Seiche SM2073	NI	500	NWL,NEL	Twin Engine
2021-06-02	2021-06-02 10:05:02	2021-06-02 13:56:30	Vanishing Point Serial Stere	SAIL	500	SL	Single Engine
2021-06-03	2021-06-03 09:35:47	2021-06-03 13:10:35	Vanishing Point Serial Stere	SAIL	500	SL,SEL	Single Engine

Table 2. Categories and types of vessels.

Category	Type
Cargo	Container
	Dry Carrier
	Fish Carrier
	Liquid Carrier
Construction	Crane Barge
	Dredger
	Dumb Lighter
	Flat-top Barge
	Hopper Barge
	Pilot Boat
	Pelican Barge
	Tug
Fishing	Pair Trawler
	Stern Trawler
	Shrimp Trawler
	Hang Trawler
	Long liner
	Purse seiner
	Cage trapper
	P4
Government	AFCD
	Customs and Excise
	Marine Police
Passenger	
Pleasure	Junk
	Motorised Yacht
	Sailing Yacht
Other	

Table 3. PAMGuard Whistle and Moan detector parameters.

Maximum Frequency	Connection Type	Minimum Length	Minimum Total Size	Crossing / Joining	Maximum Cross Length	Median Filter Length	Subtraction Constant	Threshold
24 kHz	8 sides and diagonals	10 slices	20 pixels	Re-link	5 slices	61	0.02	8 dB

Figures

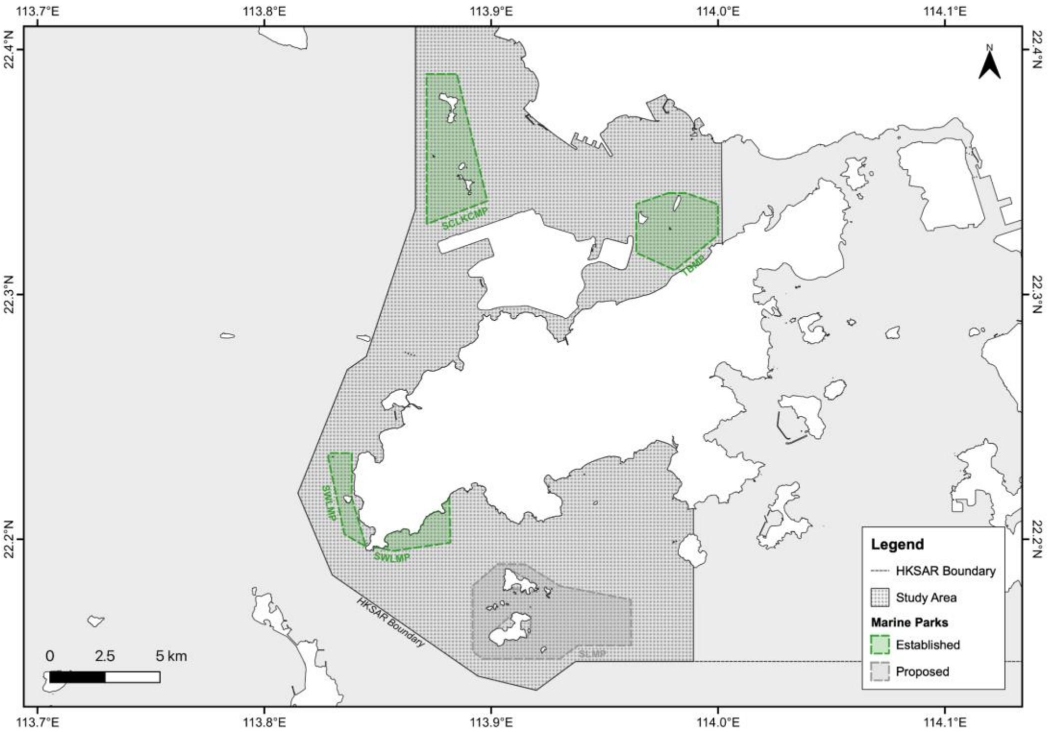

Figure 1. The study area encompassing The Brothers Marine Park (TBMP), Sha Chau and Lung Kwu Chau Marine Park (SCLKCMP), Southwest Lantau (SWLMP) and South Lantau Marine Park (SLMP).

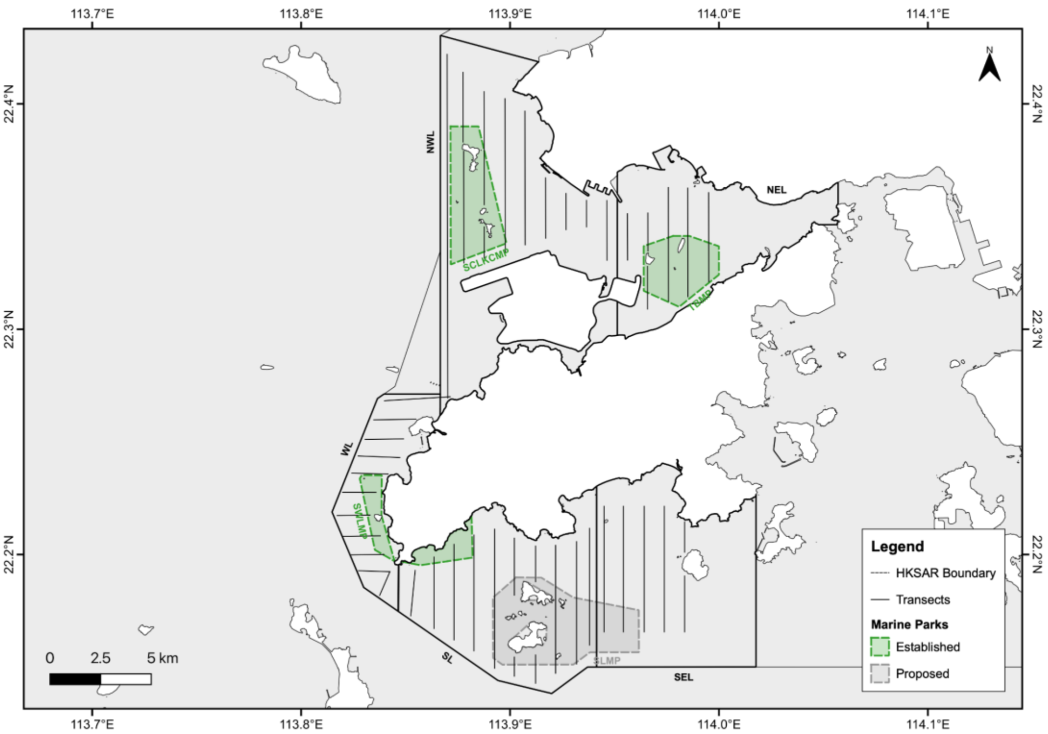

Figure 2. Line transects and survey areas (NEL, NWL, WL, SL, and SEL) for acoustic surveys.

Figure 3. The cabled hydrophone array (*Seiche*, United Kingdom) being deployed from the research vessel near the Soko Islands. An active illegal trawler operating in Hong Kong waters can be seen in the background.

Figure 4. A PAM operator monitoring the cabled hydrophone array, listening to the acoustic output and inputting relevant survey data into PAMGuard.

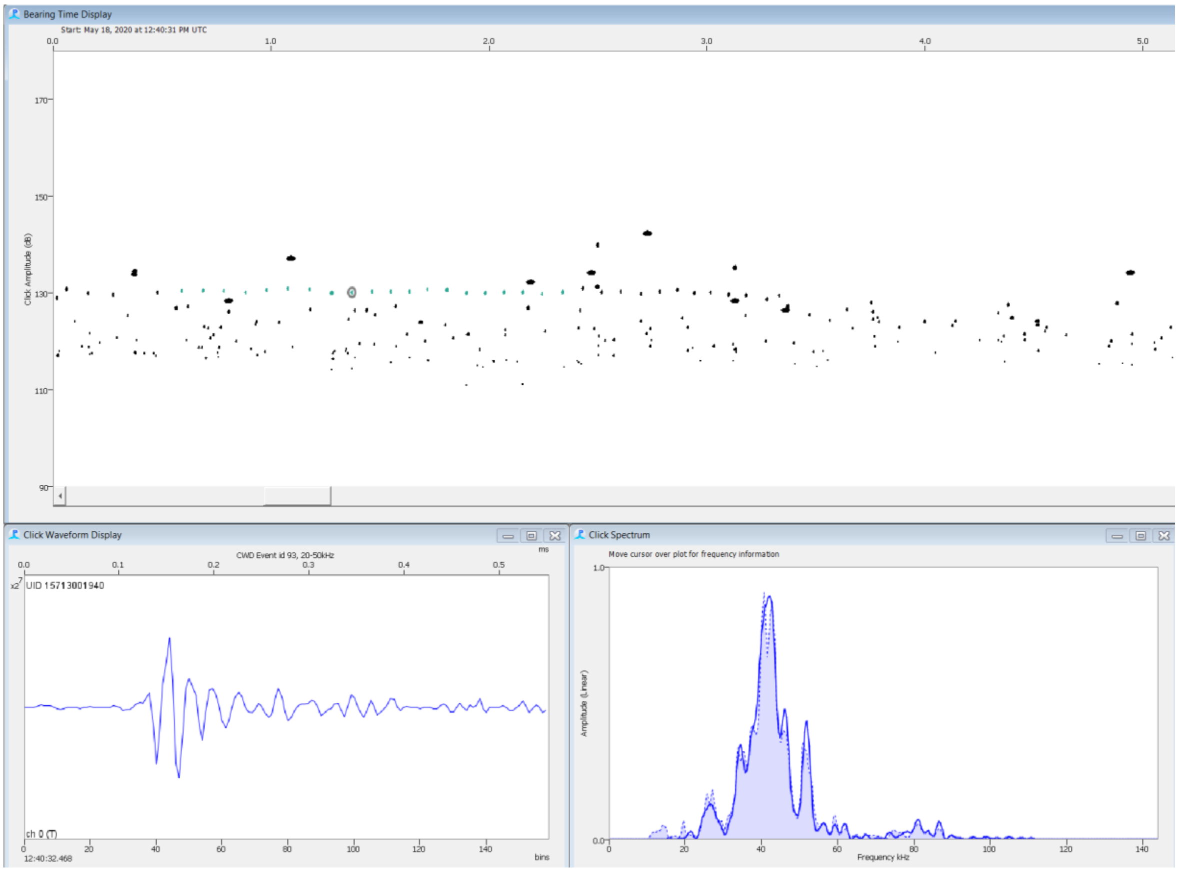

Figure 5. A typical CWD click (*Sousa chinensis*) identified in PAMGuard.

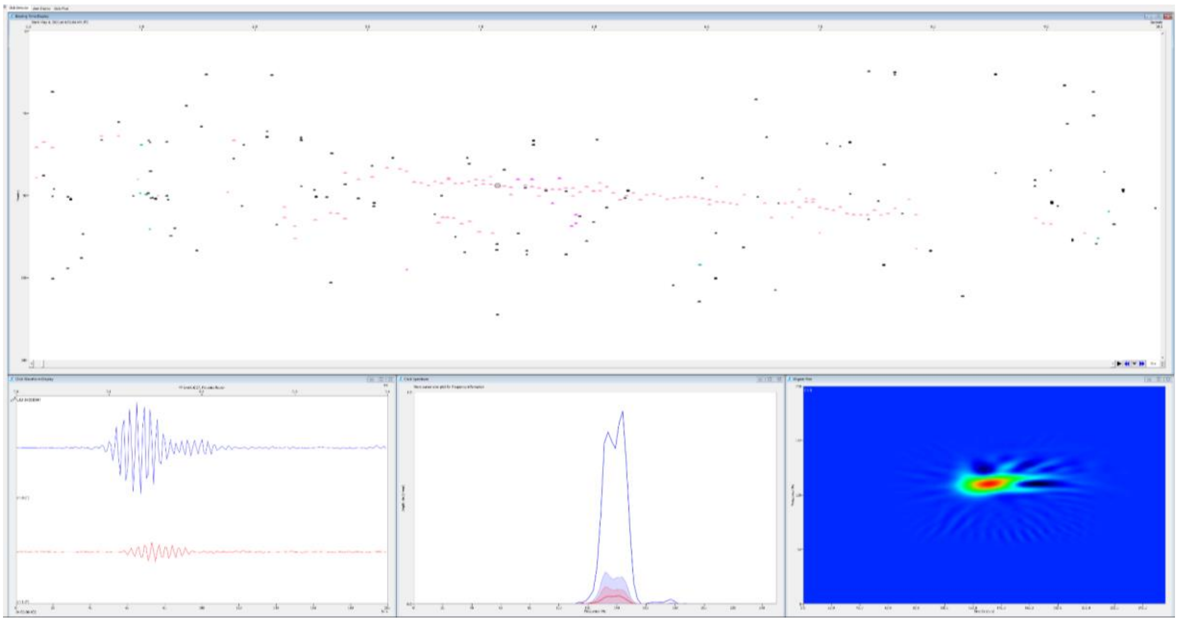

Figure 6. A typical Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) click identified in PAMGuard.

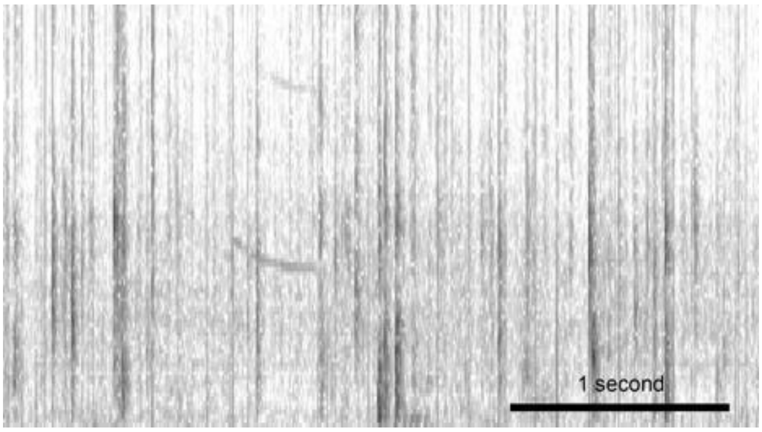

Figure 7. Spectrogram of a typical CWD (*Sousa chinensis*) whistle contour.

Appendix 6. Methods for *Activities 2, 3 and 4: Static PAM Deployment and Visual Mapping*.

Data Collection

To investigate vessel presence within marine parks in Hong Kong waters, three PAM stations were established at Tai Mo To (Coordinates: 22.334133, 113.971083; Depth: 7 m) within TMBP; Peaked Hill (Coordinates: 22.219117, 113.836317; Depth: 6 m) within SWLMP; and Yuen Chau (Coordinates: 22.1727, 113.905283; Depth: 5 m) within SLMP (Figure 1). Each PAM station consisted of a 15 cm deep, 50 kg circular concrete platform with a 30 cm iron beam that permitted the attachment of archival underwater acoustic recorders (SoundTrap ST300 HF, *Ocean Instruments*, New Zealand) by divers (Figure 2). Each SoundTrap consisted of a calibrated, omnidirectional cylindrical hydrophone, preamplifier and digital recorder, which were set to record continuously at a sampling rate of 48 kHz, providing an effective recording bandwidth of 20 Hz to 24 kHz. Because these settings permitted a maximum recording duration of 13 days, two SoundTraps were deployed together (with the first SoundTrap triggered to start recording immediately and the second SoundTrap 13 days after the deployment date) to ensure a minimum of 21 days' coverage at each PAM station.

During deployment, SoundTraps at each PAM station were calibrated to permit transmission loss modelling as described in Kline et al. (2020). A rigid-hulled inflatable boat (RHIB) motored, at a constant speed of 10 kt, in three circles and an "X" centered on the PAM station (Figure 3), deviating where necessary to avoid nearby islands. The radii of the three circles were 250 m, 500 m and 1000 m, respectively. Two different RHIBs were used for the calibration: *Hato* (a 6.5 m RHIB with a single Suzuki 140 hp 4-stroke engine) at the Peaked Hill PAM station; and *Seawolf* (a 4.8 m RHIB with a single Mercury 60 hp 4-stroke engine) at the Yuen Chau and Tai Mo To PAM stations. A handheld GPS (Garmin GPSMAP 78S, *Garmin*, United States) was used to record timestamped calibration tracks, which provided known distances of the RHIB to the SoundTrap.

During the period that the static PAM station was active, surveys of the area using Unmanned Aerial Vehicles (UAV) or 'drones', were conducted so that the different types of vessels using the area could be visually recorded. Upon retrieval of the PAM device, the underwater noise associated with that particular vessel class was used to inform the propagation model. Visual mapping was conducted in February 2021 at Yuen Chau and four (4) different vessel types were recorded (Table 1; Figure 4)

References

Kline, L.R., DeAngelis, A.I., McBride, C., Rodgers, G.G., Rowell, T.J., Smith, J., Stanley, J.A., Read, A.D. and Van Parijs, S. M. (2020) Sleuthing with sound: Understanding vessel activity in marine protected areas using passive acoustic monitoring. Marine Policy 120: 104138.

Figures

Figure 1. Static PAM stations established in The Brothers Marine Park (TBMP) at Tai Mo To, Southwest Lantau Marine Park (SWLMP) at Peaked Hill and South Lantau Marine Park (SLMP) at Yuen Chau.

Figure 2. A diver preparing to deploy at SoundTrap ST300 HF (*Ocean Instruments*, New Zealand) at the Peaked Hill static PAM station in Southwest Lantau Marine Park (SWLMP).

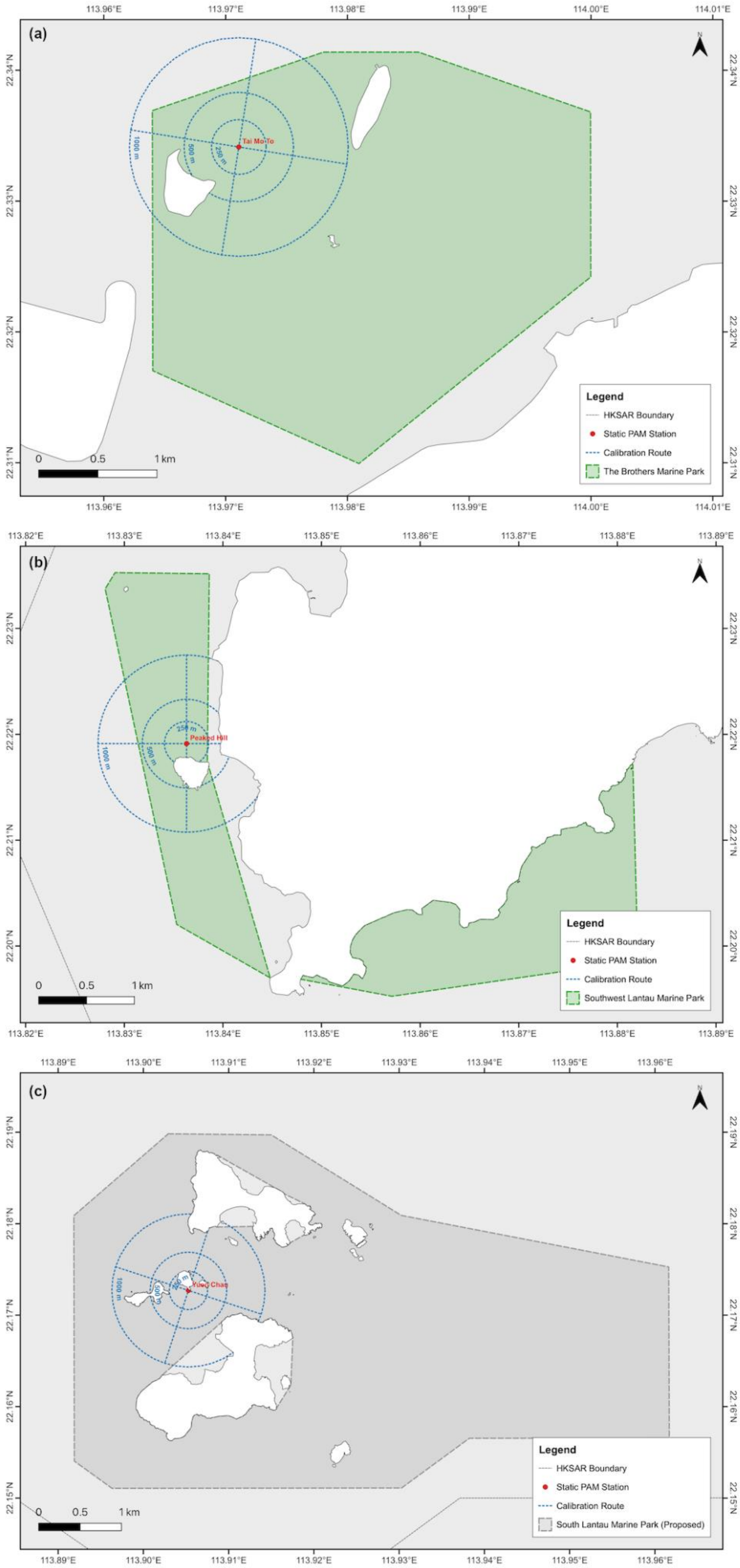

Figure 3. Calibration tracks of the **(a)** Tai Mo To, **(b)** Peaked Hill and **(c)** Yuen Chau static PAM stations.

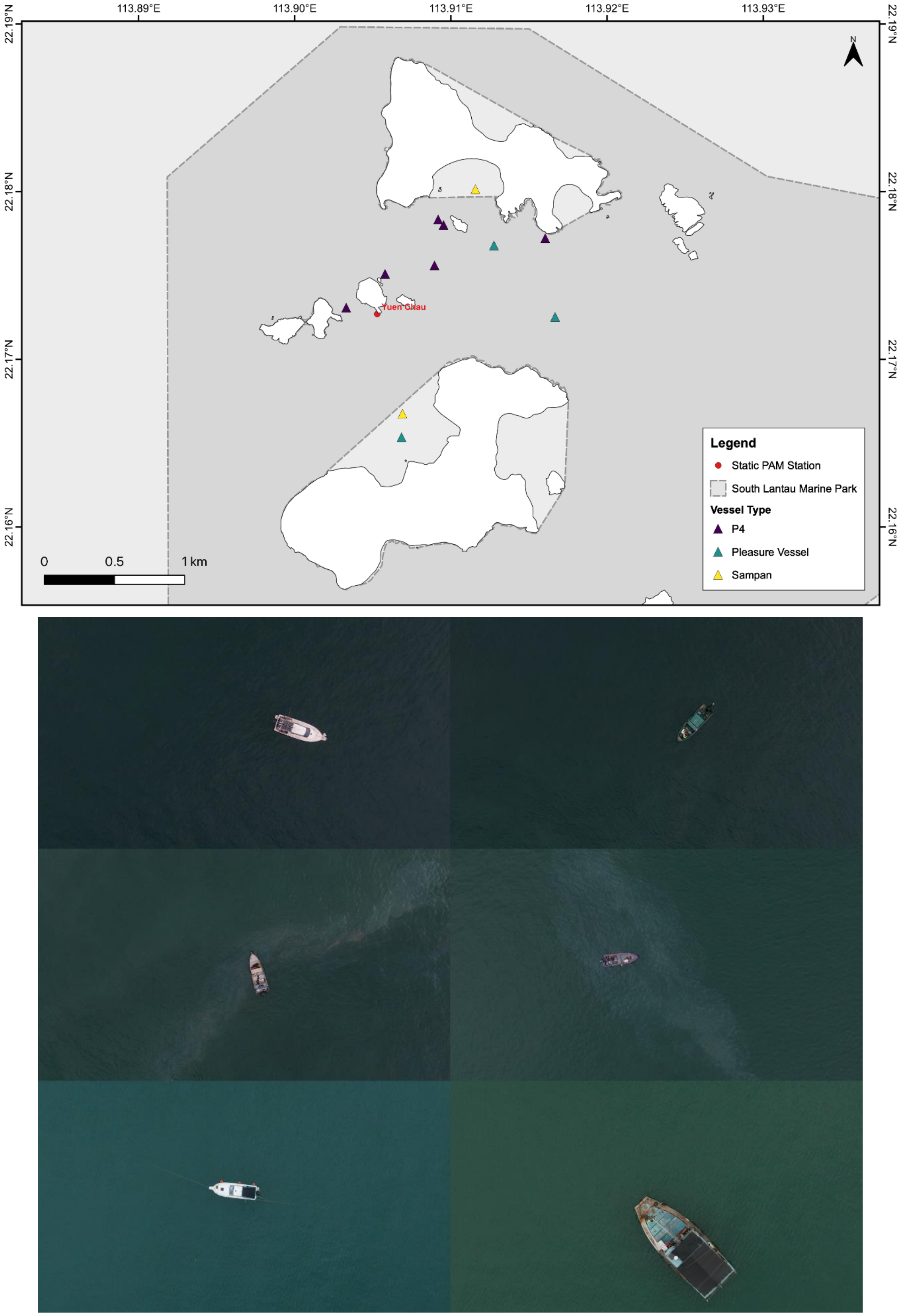

Figure 4. Vessels recorded during visual monitoring surveys, using UAV, at Yuen Chau, February 2021

Tables

Table 1. Vessel types and associated activity recorded during UAV surveys, Yuen Chau, 26 February 2021

DateTime_Local	Latitude	Longitude	AbsoluteAltitude	RelativeAltitude	FocalLength	VesselType	Behaviour
2021-02-26 12:13:20	22.172265	113.90556	98.97	89.9	8.6	RHIB	Stationary
2021-02-26 12:14:38	22.166755	113.90690	99.57	90.2	8.6	Fishing Vessel	Anchored
2021-02-26 12:15:24	22.165353	113.90684	98.54	90.1	8.6	Pleasure Vessel	Anchored
2021-02-26 12:17:36	22.173084	113.90330	99.34	90.3	8.6	P4	Anchored
2021-02-26 12:18:34	22.175097	113.90579	100.65	89.9	8.6	P4	Idling
2021-02-26 12:19:34	22.175605	113.90895	100.83	90	8.6	P4	Idling
2021-02-26 12:20:44	22.176792	113.91276	99.57	89.9	8.6	Pleasure Vessel	Idling
2021-02-26 12:21:38	22.177220	113.91604	98.18	89.9	8.6	P4	Idling
2021-02-26 12:22:46	22.180145	113.91157	98.03	89.9	8.6	Fishing Vessel	Anchored
2021-02-26 12:23:48	22.178344	113.90919	96.91	90.1	8.6	P4	Anchored
2021-02-26 12:24:06	22.178015	113.90953	97.39	90.1	8.6	P4	Idling
2021-02-26 12:30:00	22.172532	113.91667	99.05	90.4	4.386	Pleasure Vessel	Drifting

Appendix 7. Indo-Pacific humpback dolphin (*Sousa chinensis*) and Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) acoustic events from acoustic surveys (January – June 2021).

Event ID	Event Start (UTC)	Event End (UTC)	Latitude	Longitude	Survey Area	Species
1	2021-01-15 11:05:57	2021-01-15 11:06:11	22.20158	113.839	WL	CWD
2	2021-01-15 11:09:20	2021-01-15 11:09:43	22.2084	113.834	WL	CWD
3	2021-01-15 11:54:22	2021-01-15 11:54:22	22.2549	113.849	WL	CWD
4	2021-01-15 11:56:35	2021-01-15 11:59:13	22.26024	113.85	WL	CWD
5	2021-01-15 12:05:23	2021-01-15 12:05:24	22.26836	113.841	WL	CWD
6	2021-01-15 12:06:27	2021-01-15 12:08:30	22.26838	113.843	WL	CWD
7	2021-01-15 12:20:03	2021-01-15 12:22:30	22.28396	113.87	NWL	CWD
8	2021-01-15 12:23:48	2021-01-15 12:25:24	22.29441	113.87	NWL	CWD
9	2021-01-15 13:37:39	2021-01-15 13:39:04	22.36766	113.878	NWL	CWD
10	2021-01-15 13:41:38	2021-01-15 13:42:20	22.35859	113.879	NWL	CWD
11	2021-01-15 13:43:21	2021-01-15 13:43:21	22.35497	113.879	NWL	CWD
12	2021-01-21 09:20:14	2021-01-21 09:20:35	22.19153	113.855	SL	CWD
13	2021-01-21 09:22:00	2021-01-21 09:22:10	22.18824	113.855	SL	CWD
14	2021-01-21 09:44:36	2021-01-21 09:49:31	22.18182	113.864	SL	CWD
15	2021-01-21 09:49:10	2021-01-21 09:49:31	22.1909	113.864	SL	CWD
16	2021-01-21 10:52:07	2021-01-21 10:52:08	22.21029	113.887	SL	CWD
17	2021-01-21 10:53:08	2021-01-21 10:53:08	22.21145	113.889	SL	CWD
18	2021-01-21 10:56:16	2021-01-21 10:56:17	22.20835	113.893	SL	CWD
19	2021-01-21 11:00:40	2021-01-21 11:02:25	22.19995	113.893	SL	CWD
20	2021-01-21 11:18:44	2021-01-21 11:25:23	22.16454	113.892	SL	FP
21	2021-01-21 11:34:48	2021-01-21 11:36:19	22.15681	113.899	SL	FP
22	2021-01-21 11:41:11	2021-01-21 11:43:49	22.1684	113.897	SL	FP
23	2021-01-21 12:24:58	2021-01-21 12:43:31	22.17284	113.921	SL	FP
24	2021-01-21 12:44:46	2021-01-21 12:52:32	22.14487	113.921	SL	FP
25	2021-01-21 12:54:27	2021-01-21 13:02:06	22.16336	113.922	SL	FP
26	2021-01-22 09:16:41	2021-01-22 09:18:07	22.16131	113.938	SL	FP
27	2021-01-22 09:24:30	2021-01-22 09:29:00	22.17608	113.938	SL	FP
28	2021-01-22 09:31:17	2021-01-22 09:38:39	22.18874	113.938	SL	FP
29	2021-01-22 09:40:57	2021-01-22 09:42:15	22.20642	113.938	SL	FP
30	2021-01-22 09:55:09	2021-01-22 09:58:55	22.1961	113.945	SEL	FP
31	2021-01-22 10:03:07	2021-01-22 10:08:17	22.18055	113.945	SEL	FP
32	2021-01-22 10:16:10	2021-01-22 10:18:11	22.16552	113.955	SEL	FP
33	2021-01-22 10:19:51	2021-01-22 10:22:45	22.17233	113.954	SEL	FP
34	2021-01-22 10:23:54	2021-01-22 10:28:34	22.17991	113.955	SEL	FP
35	2021-01-22 10:30:20	2021-01-22 10:35:13	22.19206	113.954	SEL	FP
36	2021-01-22 11:10:12	2021-01-22 11:18:02	22.18977	113.965	SEL	FP
37	2021-01-22 11:33:41	2021-01-22 11:45:58	22.17807	113.974	SEL	FP
38	2021-01-22 12:04:42	2021-01-22 12:07:52	22.21592	113.978	SEL	FP
39	2021-01-22 12:10:56	2021-01-22 12:10:57	22.20823	113.984	SEL	FP
40	2021-01-22 12:23:38	2021-01-22 12:34:51	22.18891	113.978	SEL	FP
41	2021-01-22 12:41:54	2021-01-22 12:44:51	22.16572	113.991	SEL	FP
42	2021-01-22 12:49:32	2021-01-22 12:53:18	22.17805	113.993	SEL	FP

43	2021-01-22 13:00:42	2021-01-22 13:04:47	22.19662	113.996	SEL	FP
44	2021-01-22 13:08:06	2021-01-22 13:09:14	22.20911	113.993	SEL	FP
45	2021-01-22 13:24:39	2021-01-22 13:30:10	22.19321	114.003	SEL	FP
46	2021-01-22 13:49:33	2021-01-22 14:13:17	22.16626	114.013	SEL	FP
47	2021-01-27 11:22:11	2021-01-27 11:22:12	22.39091	113.905	NWL	CWD
48	2021-01-27 11:23:31	2021-01-27 11:28:18	22.395	113.904	NWL	CWD
49	2021-02-22 16:16:17	2021-02-22 16:21:21	22.19177	113.855	SL	CWD
50	2021-02-22 16:44:39	2021-02-22 16:46:52	22.19314	113.864	SL	CWD
51	2021-02-22 17:17:08	2021-02-22 17:22:08	22.157	113.883	SL	FP
52	2021-02-22 18:01:59	2021-02-22 18:11:39	22.18507	113.893	SL	CWD
53	2021-02-22 18:14:17	2021-02-22 18:20:16	22.16007	113.893	SL	FP
54	2021-02-22 18:23:02	2021-02-22 18:26:07	22.14508	113.9	SL	FP
55	2021-02-22 18:27:11	2021-02-22 18:28:36	22.15183	113.902	SL	FP
56	2021-02-22 18:31:46	2021-02-22 18:37:54	22.1592	113.898	SL	FP
57	2021-02-22 18:43:48	2021-02-22 18:47:23	22.18209	113.899	SL	FP
58	2021-02-22 18:51:08	2021-02-22 19:15:45	22.196	113.903	SL	FP
59	2021-02-22 19:29:31	2021-02-22 19:31:31	22.15534	113.913	SL	FP
60	2021-02-22 19:40:52	2021-02-22 19:46:13	22.1484	113.922	SL	FP
61	2021-02-22 19:59:22	2021-02-22 20:05:44	22.18529	113.922	SL	FP
62	2021-02-25 15:46:02	2021-02-25 15:55:02	22.16264	113.932	SL	FP
63	2021-02-25 15:59:37	2021-02-25 16:02:32	22.18838	113.932	SL	FP
64	2021-02-25 16:04:11	2021-02-25 16:07:55	22.19722	113.932	SL	FP
65	2021-02-25 16:09:44	2021-02-25 16:19:15	22.20818	113.934	SL	FP
66	2021-02-25 16:23:40	2021-02-25 16:24:44	22.19169	113.938	SL	FP
67	2021-02-25 16:30:12	2021-02-25 16:31:58	22.1777	113.939	SL	FP
68	2021-02-25 16:34:35	2021-02-25 16:47:44	22.1686	113.938	SL	FP
69	2021-02-25 16:56:30	2021-02-25 16:58:43	22.18986	113.945	SEL	FP
70	2021-02-25 16:59:49	2021-02-25 17:02:33	22.19608	113.945	SEL	FP
71	2021-02-25 17:09:31	2021-02-25 17:11:22	22.21444	113.948	SEL	FP
72	2021-02-25 17:13:37	2021-02-25 17:15:20	22.22231	113.951	SEL	FP
73	2021-02-25 17:31:12	2021-02-25 17:45:24	22.19202	113.955	SEL	FP
74	2021-02-25 17:58:11	2021-02-25 17:58:14	22.1841	113.965	SEL	FP
75	2021-02-25 18:04:29	2021-02-25 18:07:59	22.19594	113.964	SEL	FP
76	2021-02-25 18:10:48	2021-02-25 18:11:12	22.20801	113.964	SEL	FP
77	2021-02-25 18:38:20	2021-02-25 18:39:43	22.19353	113.974	SEL	FP
78	2021-02-25 18:42:10	2021-02-25 18:45:08	22.18533	113.974	SEL	FP
79	2021-02-25 19:03:59	2021-02-25 19:05:49	22.1796	113.984	SEL	FP
80	2021-02-25 19:22:36	2021-02-25 19:23:26	22.21098	113.984	SEL	FP
81	2021-02-25 19:30:55	2021-02-25 19:38:30	22.20311	113.994	SEL	FP
82	2021-02-25 19:45:46	2021-02-25 19:51:22	22.17332	113.993	SEL	FP
83	2021-03-01 15:56:16	2021-03-01 15:56:32	22.24198	113.842	WL	CWD
84	2021-03-01 15:58:01	2021-03-01 15:59:12	22.24415	113.84	WL	CWD
85	2021-03-01 16:04:38	2021-03-01 16:05:39	22.2498	113.831	WL	CWD
86	2021-03-01 16:06:48	2021-03-01 16:06:53	22.25247	113.836	WL	CWD
87	2021-03-01 16:08:10	2021-03-01 16:08:11	22.25231	113.839	WL	CWD
88	2021-03-04 16:08:05	2021-03-04 16:13:27	22.39881	113.888	NWL	CWD
89	2021-04-12 17:06:49	2021-04-12 17:06:51	22.16325	113.873	SL	FP
90	2021-04-12 17:52:49	2021-04-12 17:59:50	22.17448	113.884	SL	FP
91	2021-04-12 18:07:39	2021-04-12 18:12:19	22.15244	113.894	SL	FP

92	2021-04-12 18:15:44	2021-04-12 18:17:26	22.16606	113.893	SL	FP
93	2021-04-12 18:21:45	2021-04-12 18:21:45	22.17696	113.893	SL	FP
94	2021-04-12 18:24:21	2021-04-12 18:35:24	22.18188	113.893	SL	FP
95	2021-04-12 18:51:13	2021-04-12 18:55:24	22.19719	113.902	SL	FP
96	2021-04-12 18:59:17	2021-04-12 19:01:43	22.18146	113.902	SL	FP
97	2021-04-12 19:05:27	2021-04-12 19:11:06	22.17147	113.895	SL	FP
98	2021-04-12 19:12:11	2021-04-12 19:17:32	22.15709	113.897	SL	FP
99	2021-04-12 19:20:26	2021-04-12 19:32:34	22.14195	113.906	SL	FP
100	2021-04-12 19:33:40	2021-04-12 19:35:17	22.15882	113.918	SL	FP
101	2021-04-12 19:36:31	2021-04-12 19:52:06	22.16379	113.92	SL	FP
102	2021-04-12 19:55:13	2021-04-12 20:13:49	22.19562	113.912	SL	FP
103	2021-04-12 20:23:20	2021-04-12 20:36:08	22.16328	113.922	SL	FP
104	2021-04-13 16:42:42	2021-04-13 16:44:13	22.15215	113.931	SL	FP
105	2021-04-13 17:03:50	2021-04-13 17:42:29	22.19426	113.932	SL	FP
106	2021-04-13 17:52:30	2021-04-13 17:55:07	22.18261	113.945	SEL	FP
107	2021-04-13 18:08:19	2021-04-13 18:22:18	22.214	113.948	SEL	FP
108	2021-04-13 18:24:55	2021-04-13 18:31:46	22.20433	113.955	SEL	FP
109	2021-04-13 18:49:02	2021-04-13 18:58:25	22.16538	113.963	SEL	FP
110	2021-04-13 19:09:15	2021-04-13 19:09:15	22.20414	113.964	SEL	FP
111	2021-04-13 19:14:31	2021-04-13 19:15:47	22.21468	113.965	SEL	FP
112	2021-04-13 19:21:10	2021-04-13 19:25:10	22.22238	113.97	SEL	FP
113	2021-04-13 19:37:06	2021-04-13 19:41:42	22.1919	113.974	SEL	FP
114	2021-04-13 19:51:32	2021-04-13 19:53:52	22.16558	113.977	SEL	FP
115	2021-04-13 19:59:34	2021-04-13 20:03:01	22.1758	113.984	SEL	FP
116	2021-04-13 20:19:52	2021-04-13 20:21:45	22.20943	113.983	SEL	FP
117	2021-05-04 10:06:21	2021-05-04 10:52:23	22.19011	113.852	SL	CWD
118	2021-05-04 10:30:31	2021-05-04 10:30:32	22.19477	113.829	WL	CWD
119	2021-05-04 10:35:48	2021-05-04 10:35:49	22.20117	113.828	WL	CWD
120	2021-05-04 10:51:34	2021-05-04 10:51:35	22.20993	113.821	WL	CWD
121	2021-06-02 09:56:42	2021-06-02 09:57:56	22.19814	113.864	SL	CWD
122	2021-06-02 10:00:36	2021-06-02 10:00:36	22.19814	113.864	SL	CWD
123	2021-06-02 10:01:49	2021-06-02 10:04:17	22.19814	113.864	SL	CWD
124	2021-06-02 10:43:37	2021-06-02 10:46:20	22.19397	113.873	SL	CWD
125	2021-06-02 11:00:39	2021-06-02 11:00:39	22.19606	113.883	SL	CWD
126	2021-06-02 11:04:10	2021-06-02 11:04:12	22.1893	113.883	SL	CWD
127	2021-06-02 11:34:00	2021-06-02 11:37:59	22.16258	113.893	SL	CWD
128	2021-06-02 11:39:04	2021-06-02 11:40:53	22.17161	113.893	SL	CWD
129	2021-06-02 11:41:02	2021-06-02 11:41:03	22.17507	113.893	SL	FP
130	2021-06-02 11:41:08	2021-06-02 11:41:24	22.17524	113.893	SL	CWD
131	2021-06-02 11:41:46	2021-06-02 11:41:46	22.17633	113.893	SL	FP
132	2021-06-02 11:41:54	2021-06-02 11:42:52	22.17654	113.893	SL	CWD
133	2021-06-02 11:42:52	2021-06-02 11:42:53	22.17819	113.893	SL	FP
134	2021-06-02 11:42:53	2021-06-02 11:46:04	22.17822	113.893	SL	CWD
135	2021-06-02 12:14:28	2021-06-02 12:16:00	22.19193	113.902	SL	CWD
136	2021-06-02 12:16:01	2021-06-02 12:17:34	22.18893	113.902	SL	CWD
137	2021-06-02 12:40:29	2021-06-02 12:40:32	22.14583	113.902	SL	CWD
138	2021-06-02 13:36:11	2021-06-02 13:37:14	22.18352	113.922	SL	FP
139	2021-06-02 13:44:03	2021-06-02 13:45:40	22.16916	113.922	SL	FP
140	2021-06-03 09:48:21	2021-06-03 09:52:25	22.17759	113.932	SL	FP

141	2021-06-03 09:55:55	2021-06-03 09:56:05	22.19248	113.932	SL	FP
142	2021-06-03 10:17:21	2021-06-03 10:20:20	22.19322	113.938	SL	FP
143	2021-06-03 11:02:48	2021-06-03 11:03:20	22.21274	113.948	SEL	FP
144	2021-06-03 11:20:46	2021-06-03 11:30:09	22.19225	113.954	SEL	FP
145	2021-06-03 11:56:09	2021-06-03 12:00:37	22.1988	113.965	SEL	FP
146	2021-06-03 12:24:56	2021-06-03 12:24:57	22.19549	113.974	SEL	CWD
147	2021-06-03 12:26:23	2021-06-03 12:26:26	22.1928	113.974	SEL	CWD
148	2021-06-03 12:51:07	2021-06-03 12:53:06	22.17904	113.983	SEL	FP

Appendix 8. Encounters with high-powered speed boat sand active trawlers during acoustic surveys (January - June 2021).

Encounter ID	Encounter UTC	Category	Type	Count	Latitude	Longitude	Survey Area
1	2021-01-15 12:34:36	Other	High-powered speedboat	1	22.32355	113.8698	NWL
2	2021-01-15 12:45:22	Other	High-powered speedboat	1	22.35362	113.8705	NWL
3	2021-01-15 12:48:36	Other	High-powered speedboat	2	22.36221	113.8715	NWL
4	2021-01-15 12:53:27	Other	High-powered speedboat	1	22.37607	113.8695	NWL
5	2021-01-15 12:57:20	Other	High-powered speedboat	1	22.38712	113.8693	NWL
6	2021-01-15 12:59:24	Other	High-powered speedboat	1	22.39288	113.8695	NWL
7	2021-01-15 13:00:43	Other	High-powered speedboat	1	22.39663	113.8697	NWL
8	2021-01-15 13:07:59	Other	High-powered speedboat	1	22.41669	113.8696	NWL
9	2021-01-15 13:08:49	Other	High-powered speedboat	1	22.41948	113.8694	NWL
10	2021-01-15 13:10:39	Other	High-powered speedboat	1	22.42165	113.8714	NWL
11	2021-01-15 13:11:29	Other	High-powered speedboat	1	22.42049	113.8725	NWL
12	2021-01-15 13:11:54	Other	High-powered speedboat	1	22.41961	113.8732	NWL
13	2021-01-15 13:13:13	Other	High-powered speedboat	1	22.41742	113.8749	NWL
14	2021-01-15 13:13:21	Other	High-powered speedboat	2	22.41727	113.8750	NWL
15	2021-01-15 13:16:58	Other	High-powered speedboat	3	22.41050	113.8775	NWL
16	2021-01-15 13:18:12	Other	High-powered speedboat	1	22.40827	113.8776	NWL
17	2021-01-15 13:19:29	Other	High-powered speedboat	5	22.40553	113.8778	NWL
18	2021-01-15 13:21:07	Other	High-powered speedboat	1	22.40222	113.8777	NWL
19	2021-01-15 13:22:45	Other	High-powered speedboat	1	22.39838	113.8777	NWL
20	2021-01-15 13:23:28	Other	High-powered speedboat	1	22.39684	113.8777	NWL
21	2021-01-15 13:24:31	Other	High-powered speedboat	1	22.39480	113.8776	NWL
22	2021-01-15 13:33:38	Other	High-powered speedboat	1	22.37606	113.8757	NWL
23	2021-01-15 13:36:56	Other	High-powered speedboat	1	22.36927	113.8782	NWL
24	2021-01-15 13:42:31	Other	High-powered speedboat	1	22.35674	113.8786	NWL
25	2021-01-15 13:53:13	Other	High-powered speedboat	1	22.33287	113.8783	NWL
26	2021-01-27 10:05:14	Other	High-powered speedboat	1	22.35628	113.8878	NWL
27	2021-01-27 10:06:21	Other	High-powered speedboat	1	22.35913	113.8879	NWL
28	2021-01-27 10:07:14	Other	High-powered speedboat	1	22.36150	113.8877	NWL
29	2021-01-27 10:11:58	Other	High-powered speedboat	1	22.37422	113.8872	NWL
30	2021-01-27 10:13:50	Other	High-powered speedboat	1	22.37936	113.8872	NWL

31	2021-01-27 10:21:59	Other	High-powered speedboat	2	22.40193	113.8865	NWL
32	2021-01-27 10:33:29	Other	High-powered speedboat	1	22.38862	113.8985	NWL
33	2021-01-27 10:38:29	Other	High-powered speedboat	1	22.37773	113.8976	NWL
34	2021-01-27 10:40:37	Other	High-powered speedboat	6	22.37326	113.8976	NWL
35	2021-01-27 10:42:01	Other	High-powered speedboat	2	22.36993	113.8975	NWL
36	2021-01-27 11:05:03	Other	High-powered speedboat	1	22.34688	113.9081	NWL
37	2021-01-27 11:05:15	Other	High-powered speedboat	1	22.34730	113.9080	NWL
38	2021-01-27 11:06:15	Other	High-powered speedboat	1	22.34993	113.9078	NWL
39	2021-01-27 11:06:27	Other	High-powered speedboat	1	22.35088	113.9077	NWL
40	2021-01-27 11:07:14	Other	High-powered speedboat	1	22.35248	113.9075	NWL
41	2021-01-27 11:15:02	Other	High-powered speedboat	2	22.37069	113.9069	NWL
42	2021-01-27 11:15:27	Other	High-powered speedboat	1	22.37211	113.9068	NWL
43	2021-01-27 11:16:31	Other	High-powered speedboat	1	22.37502	113.9067	NWL
44	2021-01-27 11:17:38	Other	High-powered speedboat	1	22.37803	113.9066	NWL
45	2021-01-27 11:18:46	Other	High-powered speedboat	1	22.38099	113.9059	NWL
46	2021-01-27 11:18:54	Other	High-powered speedboat	1	22.38188	113.9056	NWL
47	2021-01-27 11:29:20	Other	High-powered speedboat	2	22.38492	113.9085	NWL
48	2021-01-27 11:33:01	Other	High-powered speedboat	1	22.37672	113.9118	NWL
49	2021-01-27 11:33:14	Other	High-powered speedboat	2	22.37638	113.9120	NWL
50	2021-01-27 11:39:43	Other	High-powered speedboat	1	22.36307	113.9164	NWL
51	2021-01-27 11:50:16	Other	High-powered speedboat	1	22.35811	113.9161	NWL
52	2021-01-27 11:50:42	Other	High-powered speedboat	1	22.35683	113.9163	NWL
53	2021-01-27 11:53:51	Other	High-powered speedboat	1	22.34965	113.9166	NWL
54	2021-01-27 11:56:09	Other	High-powered speedboat	1	22.34449	113.9168	NWL
55	2021-01-27 11:59:23	Other	High-powered speedboat	1	22.34271	113.9240	NWL
56	2021-01-27 12:00:33	Other	High-powered speedboat	2	22.34514	113.9250	NWL
57	2021-01-27 13:19:32	Other	High-powered speedboat	1	22.36064	113.9746	NEL
58	2021-02-22 18:41:26	Fishing	Trawler	1	22.17797	113.8967	SL
59	2021-02-25 16:19:11	Fishing	Trawler	1	22.19927	113.9416	SL
60	2021-02-25 17:32:19	Fishing	Trawler	1	22.18998	113.9544	SEL
61	2021-02-25 18:21:07	Fishing	Trawler	1	22.22665	113.9672	SEL
62	2021-02-25 18:41:34	Fishing	Trawler	1	22.18670	113.9741	SEL
63	2021-03-01 16:27:16	Fishing	Trawler	1	22.26978	113.8520	WL
64	2021-03-01 17:34:56	Other	High-powered speedboat	1	22.40698	113.8696	NWL

65	2021-03-04 15:58:05	Other	High-powered speedboat	2	22.37113	113.8881	NWL
66	2021-03-04 16:05:48	Other	High-powered speedboat	1	22.39215	113.8879	NWL
67	2021-03-04 16:06:03	Other	High-powered speedboat	1	22.39269	113.8879	NWL
68	2021-03-04 16:16:21	Other	High-powered speedboat	1	22.39835	113.8964	NWL
69	2021-03-04 16:16:37	Other	High-powered speedboat	1	22.39742	113.8965	NWL
70	2021-03-04 16:17:33	Other	High-powered speedboat	1	22.39579	113.8965	NWL
71	2021-03-04 16:21:36	Other	High-powered speedboat	1	22.38687	113.8969	NWL
72	2021-03-04 16:30:00	Other	High-powered speedboat	1	22.36779	113.8977	NWL
73	2021-03-04 16:30:19	Other	High-powered speedboat	1	22.36669	113.8977	NWL
74	2021-03-04 16:30:31	Other	High-powered speedboat	1	22.36629	113.8977	NWL
75	2021-03-04 16:30:47	Other	High-powered speedboat	1	22.36577	113.8977	NWL
76	2021-03-04 17:33:34	Other	High-powered speedboat	1	22.34263	113.9244	NWL
77	2021-03-04 17:34:02	Other	High-powered speedboat	1	22.34259	113.9255	NWL
78	2021-03-04 17:50:41	Other	High-powered speedboat	3	22.34329	113.9369	NWL
79	2021-03-04 18:08:44	Other	High-powered speedboat	1	22.35448	113.9457	NWL
80	2021-03-04 18:09:25	Other	High-powered speedboat	1	22.35558	113.9461	NWL
81	2021-03-04 18:28:53	Other	High-powered speedboat	1	22.32090	113.9645	NEL
82	2021-04-12 16:57:09	Fishing	Trawler	1	22.17818	113.8622	SL
83	2021-04-12 17:15:52	Fishing	Trawler	1	22.17894	113.8734	SL
84	2021-04-12 17:20:27	Fishing	Trawler	1	22.18751	113.8730	SL
85	2021-04-13 17:35:06	Fishing	Trawler	1	22.16814	113.9378	SL
86	2021-05-13 11:16:48	Other	High-powered speedboat	1	22.34748	113.8700	NWL
87	2021-05-13 11:17:11	Other	High-powered speedboat	1	22.34863	113.8699	NWL
88	2021-05-13 11:20:17	Other	High-powered speedboat	30	22.35589	113.8700	NWL
89	2021-05-13 11:22:39	Other	High-powered speedboat	3	22.36211	113.8703	NWL
90	2021-05-13 11:25:05	Other	High-powered speedboat	1	22.36850	113.8701	NWL
91	2021-05-13 11:31:07	Other	High-powered speedboat	1	22.38285	113.8698	NWL
92	2021-05-13 11:33:28	Other	High-powered speedboat	1	22.38842	113.8697	NWL
93	2021-05-13 11:33:39	Other	High-powered speedboat	6	22.38874	113.8697	NWL
94	2021-05-13 11:35:02	Other	High-powered speedboat	1	22.39199	113.8699	NWL
95	2021-05-13 11:37:20	Other	High-powered speedboat	1	22.39770	113.8698	NWL
96	2021-05-13 11:37:27	Other	High-powered speedboat	1	22.39790	113.8698	NWL
97	2021-05-13 11:38:56	Other	High-powered speedboat	1	22.40204	113.8698	NWL
98	2021-05-13 11:39:24	Other	High-powered speedboat	1	22.40298	113.8699	NWL

99	2021-05-13 11:40:05	Other	High-powered speedboat	1	22.40493	113.8699	NWL
100	2021-05-13 11:40:16	Other	High-powered speedboat	1	22.40531	113.8698	NWL
101	2021-05-13 11:40:22	Other	High-powered speedboat	1	22.40553	113.8698	NWL
102	2021-05-13 11:41:07	Other	High-powered speedboat	1	22.40760	113.8699	NWL
103	2021-05-13 12:01:06	Other	High-powered speedboat	1	22.39157	113.8772	NWL
104	2021-05-13 13:00:39	Other	High-powered speedboat	1	22.39791	113.8868	NWL
105	2021-05-13 13:13:45	Other	High-powered speedboat	6	22.38829	113.8974	NWL
106	2021-05-13 13:17:34	Other	High-powered speedboat	1	22.37977	113.8975	NWL
107	2021-05-13 13:18:05	Other	High-powered speedboat	2	22.37888	113.8974	NWL
108	2021-05-13 13:19:32	Other	High-powered speedboat	1	22.37553	113.8973	NWL
109	2021-05-13 13:25:13	Other	High-powered speedboat	1	22.36259	113.8978	NWL
110	2021-05-13 13:41:25	Other	High-powered speedboat	1	22.34105	113.9074	NWL
111	2021-05-13 13:44:11	Other	High-powered speedboat	1	22.34824	113.9074	NWL
112	2021-05-13 13:47:50	Other	High-powered speedboat	1	22.35813	113.9074	NWL
113	2021-05-13 13:47:55	Other	High-powered speedboat	1	22.35835	113.9074	NWL
114	2021-05-13 13:48:02	Other	High-powered speedboat	1	22.35862	113.9074	NWL
115	2021-05-13 13:48:42	Other	High-powered speedboat	1	22.36011	113.9071	NWL
116	2021-05-13 13:48:46	Other	High-powered speedboat	1	22.36024	113.9071	NWL
117	2021-05-13 13:48:53	Other	High-powered speedboat	1	22.36051	113.9070	NWL
118	2021-05-13 13:52:29	Other	High-powered speedboat	2	22.37041	113.9069	NWL
119	2021-05-13 13:53:00	Other	High-powered speedboat	2	22.37168	113.9069	NWL
120	2021-05-13 13:54:34	Other	High-powered speedboat	1	22.37610	113.9070	NWL
121	2021-05-13 13:54:39	Other	High-powered speedboat	1	22.37629	113.9071	NWL