Dragages -China Harbour-VSL JV

Contract HY/2011/09

Hong Kong-Zhuhai-Macao Bridge

Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill

Dolphin Acoustic Behaviour Monitoring Construction Phase Report

November 2014
(Version 2.0)

Certified By ____________________

Dr. H.F. Chan
Environmental Team Leader

REMARKS:

The information supplied and contained within this report is, to the best of our knowledge, correct at the time of printing.

CINOTECH accepts no responsibility for changes made to this report by third parties

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EXECUTIVE SUMMARY

1. This Dolphin Acoustic Behaviour Monitoring Construction Phase Report is prepared by Cinotech Consultants Ltd. for the project "Contract No. HY/2011/09 – Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill" (hereinafter called the "Contract"). This report documents the findings of Dolphin Acoustic Behaviour Monitoring conducted in March, April and July 2013.

Dolphin Acoustic Behaviour Monitoring Impact Phase Monitoring Progress

2. A summary of the monitoring activities in the reporting period is listed in **Table I** below:

Table I Summary Table for Monitoring Activities in the Reporting Month

Parameter(s)	Date(s)
* Dolphin Acoustic Behaviour Monitoring	With Bored Piling Activities: 18th, 19th, 20th, 21st, 22nd, 23rd, 25th, 27th, 28th and 29th March 2013 1st, 2nd, 3rd, 5th, 7th, 8th, 10th and 11th April 2013 9th, 11th, 12th, 15th, 16th, 17th, 18th, 22nd, 23rd, 24th, 25th and 26th July 2013

Remark: *Dolphin-related monitoring was conducted in the reporting period. According to the EM&A Manual for HKLR, the dolphin-related monitoring was conducted during the bored piling activities (e.g. installation of permanent casting for bored piling activities) which presented in **Appendix A**.

Breaches of Action and Limit Levels

3. Summary of the exceedances of the Dolphin Acoustic Behaviour Monitoring is tabulated in **Table II**.

Table II Summary of Exceedances of Dolphin Acoustic Behaviour Monitoring

	Average clicks per minute (± s.d.)	Average whistles per minute (± s.d.)
Group Size		
1 dolphins	**Limit**	**Limit**
2-5 dolphins		**Limit**
6-9 dolphins		Action
10+ dolphins		
Behavioural State		
Feeding	Action	**Limit**
Milling		**Limit**
Socializing	Action	Action
Traveling	**Limit**	Action
Resting		
Time of day		
09:00-10:59	**Limit**	**Limit**
11:00-12:59	Action	
13:00-14:59	**Limit**	**Limit**
15:00-16:59	Action	**Limit**

Remark: Highlighted in yellow means significant differences between the values recorded in impact and baseline monitoring periods

4. The details of the methodology, locations and results can be referred to Dolphin Acoustic Behaviour Monitoring Impact Phase Monitoring Report prepared by Dolphin Specialist in **Appendix C**.

1 INTRODUCTION

Background

1.1 The proposed Hong Kong - Zhuhai - Macao Bridge Hong Kong Link Road (HKLR) is 12km long connecting the Hong Kong-Zhuhai-Macao Bridge (HZMB) at the HKSAR Boundary with the Hong Kong Boundary Crossing Facilities (HKBCF) situated at the north eastern waters of the Hong Kong International Airport, opening a new and direct connection route between Hong Kong, Macao and the Western Pearl River Delta.

1.2 The HKLR comprises a 9.4km long viaduct section from the HKSAR boundary to Scenic Hill on the Airport Island; a 1km tunnel section to the reclamation formed along the east coast of the Airport Island and a 1.6km long at-grade road section on the reclamation connecting to the HKBCF. The tunnel section of HKLR will pass under Scenic Hill, Airport Road and Airport Railway to minimize the environmental and visual impacts to Tung Chung residents.

1.3 An application (No ESB-110/2003) for an Environmental Impact Assessment (EIA) Study Brief under Section 5(1) of the Environmental Impact Assessment Ordinance (EIAO) was submitted by Highways Department (the Project Proponent) on 8 October 2003 with a Project Profile (No. No. PP-201/2003) for the Hong Kong - Zhuhai - Macao Bridge Hong Kong Section and North Lantau Highway Connection. The Hong Kong - Zhuhai - Macao Bridge Hong Kong Section and North Lantau Highway Connection has subsequently been renamed as HKLR. EPD issued an EIA Study Brief (No: ESB-110/2003) in November 2003 to the Project Proponent to carry out an EIA study.

1.4 An EIA Study (Reg. No. AEIAR-144/2009) has been undertaken to provide information on nature and extent of environmental impacts arising from the construction and operation of HKLR. The Environmental Permit was issued on 4 November 2009 (Permit No. EP-352/2009). Pursuant to Section 13 of the EIAO, the Director of Environmental Protection amends the Environmental Permit (No. EP-352/2009) based on the Application No. VEP-339/2011 and the environmental Permit (Permit No. EP-352/2009/A) was issued on 9 November 2011 for HKLR to the Highways Department as the Permit Holder. Subsequently, the Director of Environmental Protection amends the Environmental Permits (No. EP-352/2009/A and EP-352/2009/B) based on the Application No. VEP-409/2013 and VEP-411/2013 respectively. The environmental Permit (Permit No. EP-352/2009/C) was then issued on 5 September 2013.

1.5 **Figure 1a-d** shows the layout of the Contract and the scope of the Contract works comprises the following major items:

- a dual 3-lane carriageway in the form of viaduct from the HKSAR boundary (connecting with the HZMB Main Bridge) to the Scenic Hill (connecting with the tunnel under separate Contract No. HY/2011/03), of approximately 9.4km in length with a hard shoulder for each bound of carriageway and a utilities trough on the outer edge of each bound of viaducts;

- a grade-separated turnaround facility located near San Shek Wan, composed of sliproads in the form of viaduct with single-lane carriageway bifurcated from the HKLR mainline with an elevated junction above the mainline;
- provision of ancillary facilities including, but not limited to, meteorological enhancement measures including the provisioning of anemometers and modification of the wind profiler station at hillside of Sha Lo Wan, provisioning of a compensatory marine radar, and provisioning of security systems; and
- associated civil, structural, geotechnical, marine, environmental protection, landscaping, drainage and highways electrical and mechanical (E&M) works, street lightings, traffic aids and sign gantries, marine navigational aids, ship impact protection system, water mains and fire hydrants, lightning protection system, structural health monitoring and maintenance management system (SHM&MMS), supervisory control and data acquisition (SCADA) system, as well as operation and maintenance provisions of viaducts, provisioning of facilities for installation of traffic control and surveillance system (TCSS), provisioning of facilities for installation of telecommunication cables/equipments and reprovisioning works of affected existing facilities/utilities.

1.6 The commencement date of the construction works for Contract No. HY/2011/09 is on 22nd February 2014.

1.7 This Dolphin Acoustic Behaviou Monitoring Impact Phase Monitoring Report is prepared by Cinotech to fulfill the impact monitoring requirements according to the EM&A Documents including the Proposal for Dolphin Acoustic Behaviour Monitoring dated 31 January 2013 for HKLR.

2 DOLPHIN ACOUSTIC BEHAVIOUR MONITORING

Monitoring Requirements

2.1 According to EM&A Manual Section 10.3.4, acoustic behavior and movement of Chinese White Dolphin near the bored piling sites should be monitored during bridge construction.

Monitoring Location

2.2 The dedicated acoustic surveys with calibrated hydrophone deployment were conducted in the western side of Lantau Island during the construction phase. The research vessel followed a predefined route for systematic search effort in West Lantau waters to cover the HKLR alignment in Northwest and West Lantau waters (in particular the area near the first three bored piling sites), where dolphins will be potentially disturbed by the bored piling works.

2.3 The EARs were deployed at two locations: 1) near the bridge alignment (N22°17.222, E113°53.016), about 500 m from the first three bored piling sites (P48, P50 & P52 - Site B2), and 2) at a less disturbed site away from the bridge alignment as control site, off Fan Lau (N22°11.827, 113°50.648; Site B1). EAR B2 was in water depth 4 m, and EAR B1 in 7 m. The location of Site B1 and B2 are shown in **Figure 2.**

Monitoring Frequency

2.4 Thirty days of monitoring during bored piling activities were carried out during the construction phase.

Monitoring Day

2.5 In March 2013, a total of 23 days of acoustic monitoring surveys were conducted between March 6th and 30th 2013. A total of 8 days and 2 days of acoustic monitoring surveys were conducted during the bored piling activities for P48 and P52 respectively.

2.6 In April 2013, a total of 8 days of acoustic monitoring surveys were conducted on the 1st, 2nd, 3rd, 5th, 7th, 8th, 10th and 11th April 2013, when bored piling activities were concurrently conducted at Piers 48 and 52.

2.7 In July 2013, a total of 12 days of acoustic monitoring surveys were conducted on the 9th, 11th, 12th, 15th, 16th, 17th, 18th, 22nd, 23rd, 24th, 25th and 26th, when bored piling activities were concurrently conducted.

2.8 The dolphin acoustic behaviour monitoring schedule is shown in **Appendix B**.

Monitoring Results

2.9 A total of 30 days of acoustic monitoring surveys were conducted in March, April and July 2013, when bored piling activities were concurrently conducted. During those dates, 2,751.8 km of survey effort were conducted to search for dolphins in the western and northwestern waters of Lantau. A total of 91 groups, numbering 301 dolphins, were sighted during these surveys. In addition, 67 sound samples of recordings were taken from the surveys. Moreover, the EARs were deployed at Fan Lau (site B1) and near the bridge alignment (Site B2).

2.10 Detailed monitoring methodology and results can be found in **Appendix C**.

2.11 According to the Dolphin Acoustic Behaviour Monitoring Impact Phase Monitoring Report prepared by Dolphin Specialist as shown in **Appendix C**, summary of the dolphin acoustic behavior monitoring results is shown in **Table 2.1**.

Table 2.1. Values of the two response variables of dolphin acoustic behaviour collected by calibrated hydrophone (average clicks and whistles per minutes) by size of group, behavioural state and time of day during baseline and impact monitoring periods. (The numerical values highlighted in blue indicated that the values recorded in impact monitoring period have triggered the Action Level (20% higher or lower than the baseline period), while the ones highlighted in red indicated a triggering of Limit Level (40% higher or lower than the baseline period). Only the cells highlighted in yellow have found significant differences between the values recorded in impact and baseline monitoring periods, while no significant difference was found in other comparisons even though some have triggered the Action or Limit Level.)

		Average clicks per minute (± s.d.)	Average whistles per minute (± s.d.)
Group Size			
1 dolphins	Baseline	62.19 ± 77.73 (n=21)	0.21 ± 1.49 (n=19)
	Impact	119.11 ± 201.67 (n=11)	0.13 ± 0.30 (n=11)
2-5 dolphins	Baseline	54.03 ± 179.32 (n=82)	0.56 ± 1.70 (n=126)
	Impact	54.17 ± 95.45 (n=46)	0.09 ± 0.20 (n=46)
6-9 dolphins	Baseline	118.00 ± 310.31 (n=23)	1.58 ± 4.63 (n=38)
	Impact	106.06 ± 199.58 (n=26)	0.97 ± 1.99 (n=26)
10+ dolphins	Baseline	289.33 ± 140.58 (n=20)	2.74 ± 1.99 (n=36)
	Impact	n/a	n/a
Behavioural State			
Feeding	Baseline	30.95 ± 69.90 (n=16)	0.62 ± 1.33 (n=29)
	Impact	19.30 ± 29.62 (n=11)	0.16 ± 0.26 (n=11)
Milling	Baseline	71.29 ± 205.44 (n=90)	0.66 ± 1.85 (n=139)
	Impact	80.09 ± 136.86 (n=54)	0.18 ± 0.60 (n=54)
Socializing	Baseline	287.48 ± 326.22 (n=20)	3.78 ± 4.14 (n=26)
	Impact	213.12 ± 309.71 (n=7)	2.48 ± 3.16 (n=7)
Traveling	Baseline	13.16 ± 208.94 (n=11)	0.25 ± 1.48 (n=12)
	Impact	52.34 ± 32.53 (n=7)	0.17 ± 0.29 (n=7)
Resting	Baseline	0.10 ± 70.35 (n=2)	0.13 ± 1.43 (n=6)
	Impact	n/a	n/a
Time of day			
09:00-10:59	Baseline	38.14 ± 69.90 (n=15)	0.70 ± 1.33 (n=29)
	Impact	74.39 ± 124.79 (n=31)	0.32 ± 0.75 (n=31)
11:00-12:59	Baseline	79.97 ± 144.51 (n=68)	0.68 ± 1.86 (n=94)

	Impact	110.73 ± 218.62 (n=26)	0.66 ± 1.78 (n=26)
13:00-14:59	Baseline	159.41 ± 303.43 (n=44)	1.74 ± 3.80 (n=62)
	Impact	43.35 ± 72.50 (n=17)	0.03 ± 0.08 (n=17)
15:00-16:59	Baseline	65.40 ± 140.58 (n=17)	1.16 ± 1.99 (n=36)
	Impact	49.90 ± 69.04 (n=12)	0.42 ± 1.20 (n=12)

Event and Action Plan

2.12 The detailed Event and Action Plan is presented in **Table 2.3**.

Table 2.3 Event and Action Plan on Dolphin Acoustic Behaviour

EVENT	ACTION			
	ET Leader	**IEC**	**SO**	**Contractor**
Action Level With the numerical values presented in Table 1, when any of the response variable for dolphin acoustic behaviour recorded in the construction phase monitoring is **20% lower or higher** than that recorded in the baseline monitoring, or when there is a shift of **3 hours or more** in peak occurrence at B2 Site (i.e. 00:00 – 01:00), the action level should be triggered	1. Repeat statistical data analysis to confirm findings; 2. Review all available and relevant data to ascertain if differences are as a result of natural variation or seasonal differences; 3. Identify source(s) of impact; 4. Inform the IEC, SO and Contractor; 5. Check monitoring data; 6. Carry out audit to ensure all dolphin protective measures are implemented fully and additional measures be proposed if necessary	1. Check monitoring data submitted by ET and Contractor; 2. Discuss monitoring with the ET and the Contractor;	1. Discuss with the IEC the repeat monitoring and any other measures proposed by the ET; 2. Make agreement on measures to be implemented.	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose measures to the IEC and the SO; 3. Implement the agreed measures.
Limit Level With the numerical values presented in Table 1, when any of the response variable for dolphin acoustic behaviour recorded in the construction phase monitoring is **40% lower or higher** than that recorded in the baseline monitoring, or when there	1. Repeat statistical data analysis to confirm findings; 2. Review all available and relevant data to ascertain if differences are as a result of natural variation or seasonal differences; 3. Identify source(s) of impact; 4. Inform the IEC, SO and Contractor;	1. Check monitoring data submitted by ET and Contractor; 2. Discuss monitoring with the ET and the Contractor;	1. Discuss with the IEC the repeat monitoring and any other measures proposed by the ET; 2. Make	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose

is a shift of **6 hours or more** in peak occurrence at B2 Site (i.e. 00:00 – 01:00), the limit level should be triggered	5. Check monitoring data; 6. Carry out audit to ensure all dolphin protective measures are implemented fully and additional measures be proposed if necessary 7. Discuss additional dolphin monitoring and any other potential mitigation measures (e.g. consider to temporarily stop relevant portion of construction activity) with the IEC and Contractor.	3. Review proposals for additional monitoring and any other measures submitted by the Contractor and advise ER accordingly.	agreement on measures to be implemented.	measures to the IEC and the SO; 3. Implement the agreed measures.

Abbreviations: ET – Environmental Team, IEC – Independent Environmental Checker, SO – Supervising Officer

2.13 Detailed monitoring methodology and results can be found in **Appendix C**.

2.14 According to **Table 2.1**, there were four Action Level (AL) exceedances and four Limit Level (LL) exceedances in the clicking rates, while there were three AL exceedances and seven LL exceedances in the whistling rates. However, only significant differences were found in both the whistling and clicking rates recorded in the afternoon time period between 13:00 and 14:59.

2.15 As the Environmental Team of the Contract, all the monitoring data and statistical data analysis as presented in **Appendix C** have been checked and reviewed according to **Table 2.3**.

2.16 No direct evidence that the exceedances were due to the bored piling activities under the Contract according to the Dolphin Acoustic Behaviour Monitoring Impact Phase Monitoring Report in **Appendix C**:

- The majority of the exceedances are not statistically significant due to small sample size;
- Different type of vessels recorded during baseline and construction may contribute the significant different values of response variables between baseline and construction phases;
- Natural seasonal variation including the addition of strong seasonal fish chorusing, and that other than anthropogenic influences may cause the different dolphins' acoustic behaviour between baseline and construction phase dolphin monitoring;
- The change in peak occurrence does not only occur at the site of impact (Site B2) but also at the control site (Site B1);
- The decrease in number of sightings was also mainly occurred in Zone 1 and Zone 3 which were away from the construction site of the Contract according to Figure 9a and

9b in **Appendix C**;

- Significant increases in the ambient noise levels measured at both sites B1 and B2 during the construction phase which may affect the dolphins' acoustic behaviour.

Implementation Status of Environmental Mitigation Measures

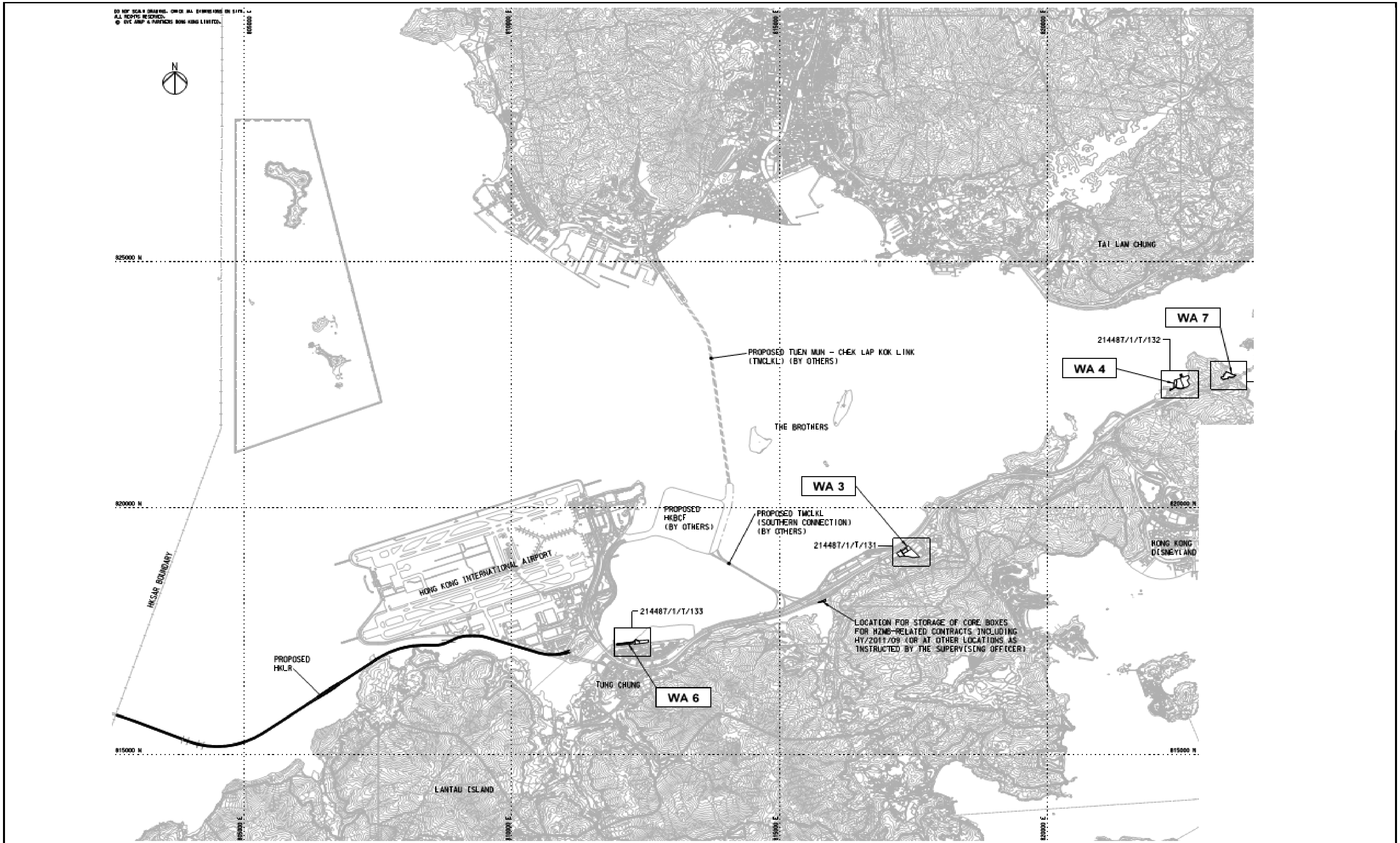
2.17 In order to minimize impact on dolphins' acoustic behaviour, dolphin protection measures as described below were properly implemented during the marine works for the Contract:

- Regular marine travel route for marine vessels were implemented properly in accordance with the submitted plan and relevant records were kept properly.

- Acoustic decoupling measures for the stationary equipment (generators, winch generators and air compressors) mounted on boards were adopted according to the approved Acoustic Decoupling Measures Plan, EP Condition 3.7 and EM&A Manual, Section 10.2.18.

- Dolphin exclusion zone and dolphin watching plan according to EM&A Manual, Section 10.2.12 and 10.2.17 respectively.

FIGURE(S)



Title	Scale	Proposal No.
Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill Site Layout Plan (WA3, WA4, WA6 and WA7)	N.T.S	MA12014
	Date	**Figure**
	Feb-13	1a

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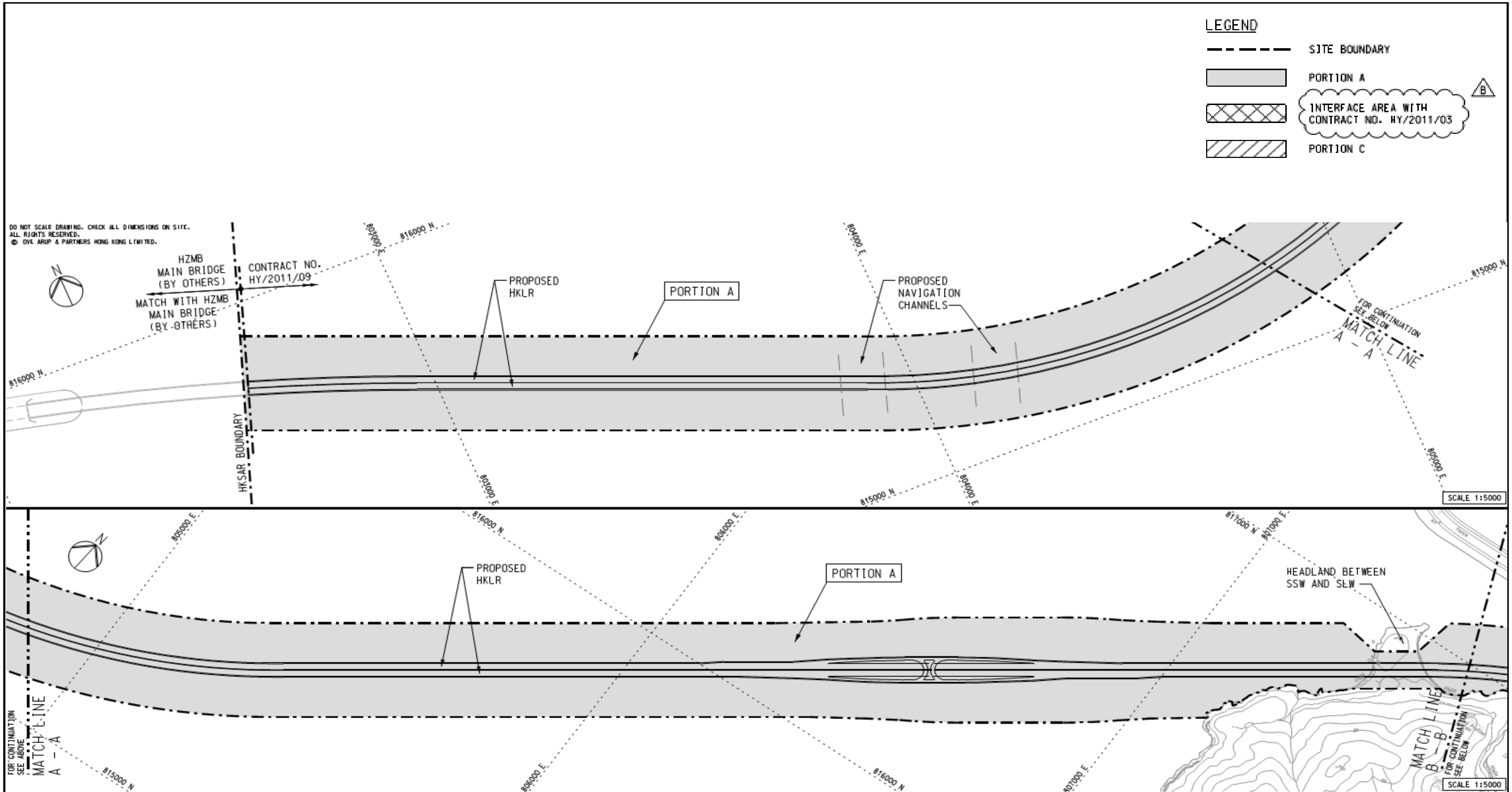
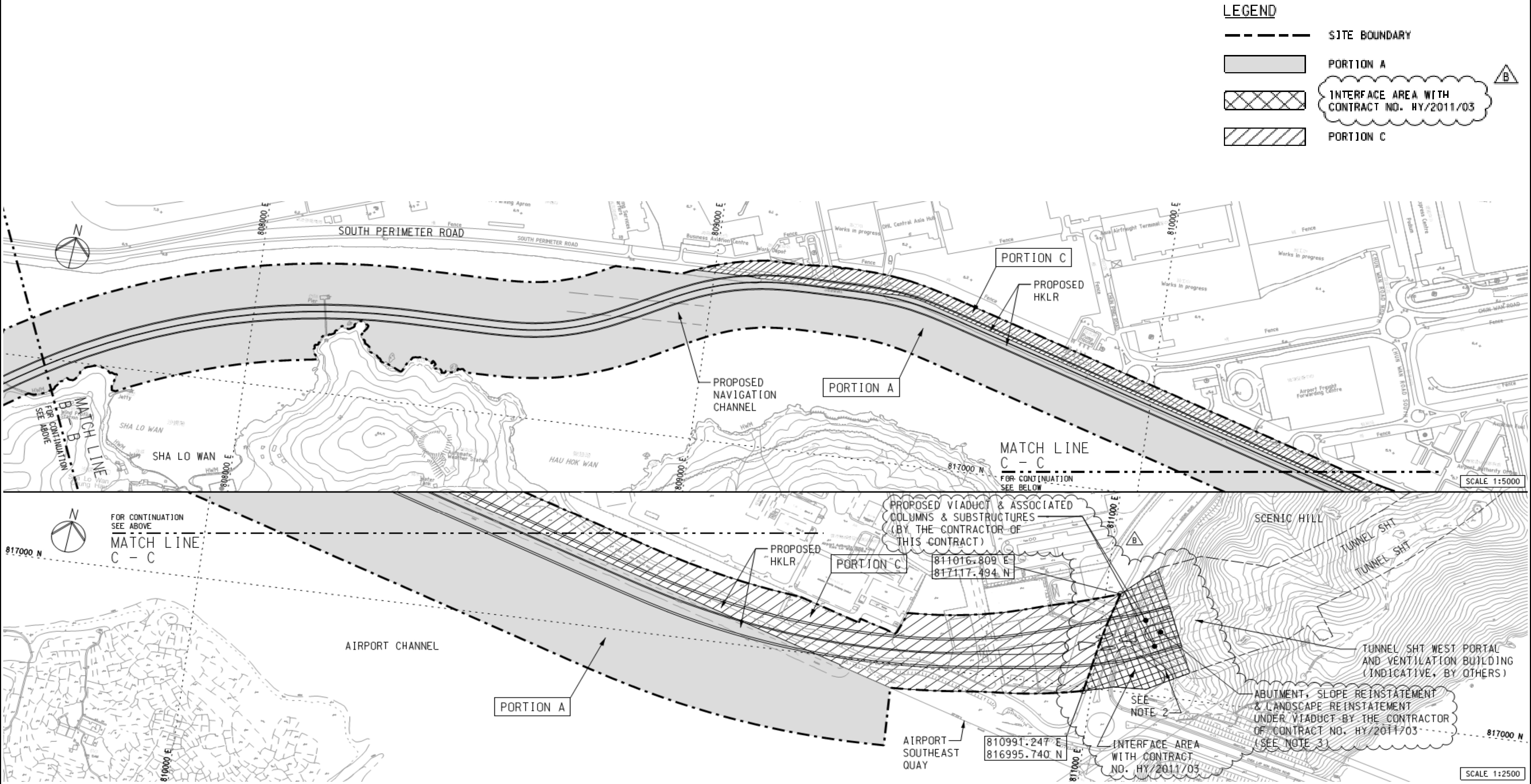
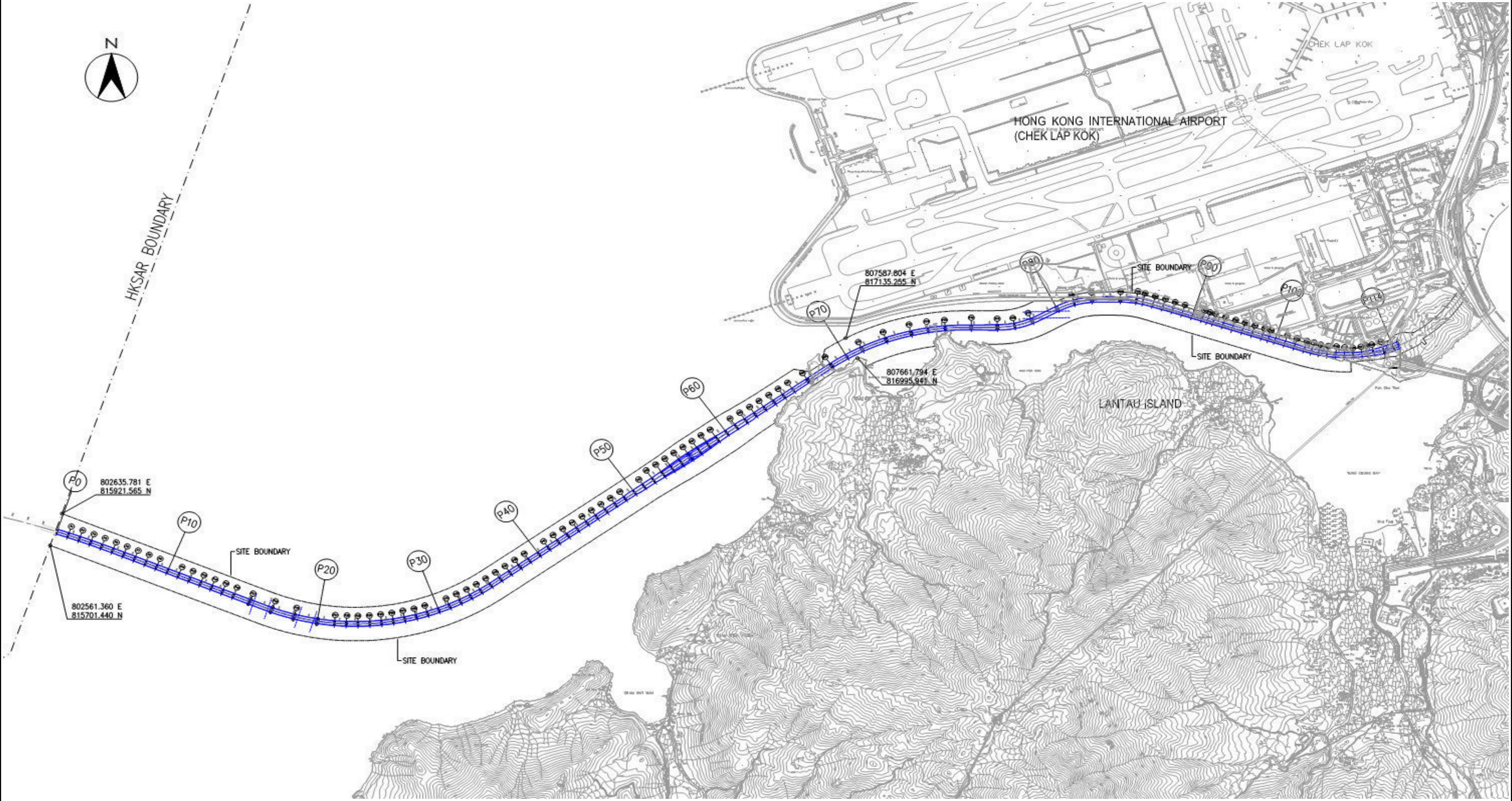


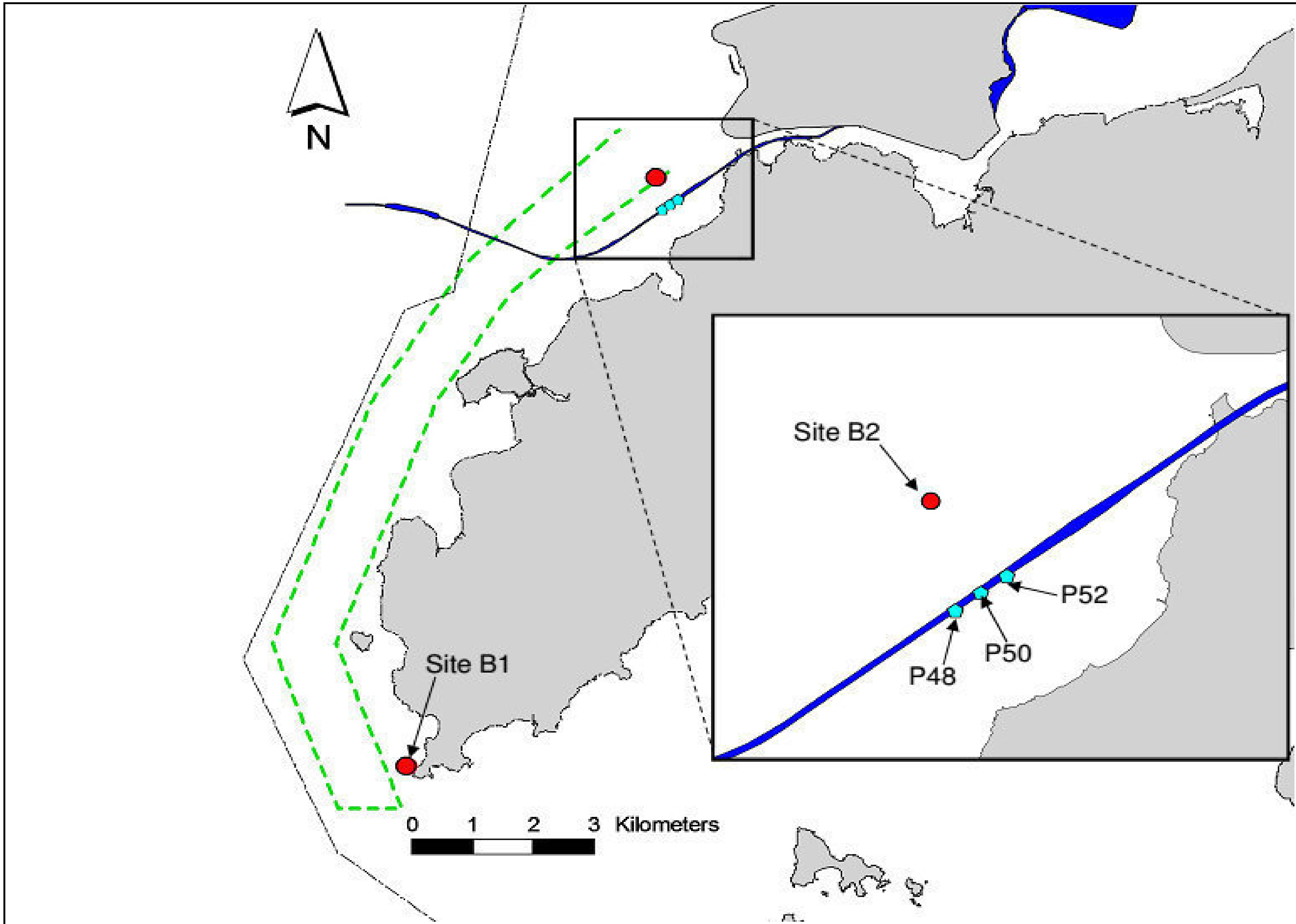
Title	Scale	Proposal No.	
Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill Site Layout Plan (Portion A)	N.T.S	MA12014	CINOTECH
	Date: May-13	Figure: 1b	



Title	Scale	Proposal No.	
Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill Site Layout Plan (Portion A and C)	N.T.S	MA12014	CINOTECH
	Date: May-13	Figure: 1c	



Title			
Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill Site Layout Plan (Pier(s) Site)	Scale N.T.S	Proposa No. MA12014	CINOTECH
	Date Feb-13	Figure 1d	



Title	Scale	Project
Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill Locations of Two EARs Deployed near Fan Lau (site B1) and Bored Piling Site (site B2)	N.T.S	No. MA12014
	Date Aug-14	Figure 2

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APPENDIX A
SUMMARY OF BORED PILING ACTIVITIES

Bored Piling Activities in March 2013

Date	Location	Bored Piling Activities
18-Mar-13	P48	Commencement of inserting permanent casting for bored pile no. P48-R3
19-Mar-13	P48	Installation of permanent casting for bored pile no. P48-R3
20-Mar-13	P48	Installation of permanent casing for bored pile no. P48-R2 & P48-L2
	P52	Commencement of installing permanent casting of bored pile no. P52-R3
21-Mar-13	P48	Installation of permanent casting for bored pile no. P48-L1, P48-R1 & P48-L3
	P52	Installation of permanent casing for bored pile no. P52-R3
22-Mar-13	P48	Installation of permanent casing for bored pile in progress, extend casing to P48-L2 & P48-R1
	P52	Installation of permanent casing for bored pile no. P52-R4
23-Mar-13	P48	Installation of permanent casting for bored pile no. P48-R1, P48-L1 & P48-L3
	P52	Installation of permanent casting for bored pile no. P52-R2 & P52-R4
25-Mar-13	P48	Installation of permanent casting for bored pile no. P48-R1, P48-R2, P48-R3, P48-L1 P48-L2 & P48-L3
	P52	Installation of permanent casting for bored pile no. P52-R1
27-Mar-13	P52	Installation of permanent casting for bored pile no. P52-R1 & P52-L2
28-Mar-13	P52	Installation of permanent casting for bored pile no. P52-L1
29-Mar-13	P48	Adjust permanent casing for bored pile no. P48-L2 & P48-R1
	P52	Installation of permanent casting for bored pile no. P52-L1, P52-L2, P52-L3 & P52-L4

Bored Piling Activities in April 2013

Date	Location	Bored Piling Activities
1-Apr-13	Pier 52	Installation of permanent casing for bored pile no. P52-L3 & P52-L4.
2-Apr-13	Pier 52	Installation of permanent casing for bored pile.
3-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile no. P52-R1, P52-R2, P52-R3, P52-R4, P52-L1, P52-L2, P52-L3 & P52-L4.
4-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
5-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
6-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
7-Apr-13	Pier 52	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
8-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile in progress.
9-Apr-13	Pier 48	Set up for bored pile excavation at P48-L1.
	Pier 52	Excavation for bored pile in progress.
10-Apr-13	Pier 48	Commencement of bored pile excavation at P48-L1.
	Pier 52	Excavation at P52-R2.
11-Apr-13	Pier 48	Bored pile excavation at P48-L1 in progress.
12-Apr-13	Pier 48	Bored pile excavation at P48-L1 in progress.
13-Apr-13	Pier 48	Bored pile excavation at P48-L1 in progress.
	Pier 52	Set up RCD for bored pile excavation at P52-R4.
15-Apr-13	Pier 48	Bored pile excavation at P48-L1 completed & excavation at P48-R1 commenced.
	Pier 50	Preparation work for install RCD to permanent casing of bored pile.
	Pier 52	Commenced drilling for bored pile no. P52-R4 by RCD.
16-Apr-13	Pier 48	Bored pile excavation at P48-R1 in progress.
	Pier 50	Preparation work for install RCD to permanent casing of bored pile.
	Pier 52	Drilling for bored pile no. P52-R4 by RCD. Excavation for bored pile no. P52-L3 & L4 by grab.
night	Pier 52	Drilling for bored pile no. P52-R4 by RCD. Shifting of RCD from bored pile P52-R4 to P52-R3.
17-Apr-13	Pier 48	Bored pile excavation at P48-R1 in progress.
	Pier 50	Commenced excavation for bored pile no. P50-L4 by grab.
	Pier 52	Drilling for bored pile no. P52-R3 by RCD.
night	Pier 52	Drilling for bored pile no. P52-R3 by RCD.
18-Apr-13	Pier 48	Bored pile excavation at P48-R1 in progress.
	Pier 50	Excavation for bored pile P50-L2 by grab.
night	Pier 50	Drilling for bored pile no. P50-L2 by RCD.
	Pier 52	Drilling for bored pile no. P52-R3 by RCD.
night	Pier 52	Drilling for bored pile no. P52-R1 & R3 by RCD. 2 nos. of RCDs delivery on site.
19-Apr-13	Pier 48	Bored pile excavation at P48-R1 in progress.
	Pier 50	Drilling for bored pile P50-L2 by RCD.
night	Pier 50	Drilling for bored pile no. P50-L2 by RCD. Excavation for bored pile at P50-L3 by grab.
	Pier 52	Drilling for bored pile no. P52-R3 by RCD finish.
night	Pier 52	Preparation work for installation of RCD to P52-L4.
20-Apr-13	Pier 50	Drilling for bored pile P50-L2 by RCD. Excavation for bored pile P50-L4 by grab.
night	Pier 50	Drilling for bored pile P50-L3 by RCD. Excavation for bored pile P50-L1 by grab.
	Pier 52	Shifting of RCD from bored pile P52-R3 to P52-R1. Drilling for bored pile no. P52-R1 & L4 by RCD.
night	Pier 52	Drilling for bored pile no. P52-R1 & L4 by RCD.
21-Apr-13	Pier 50	Excavation for bored pile P50-L2 by RCD.
	Pier 52	Drilling for bored pile P52-R4 & P52-L4 by RCD.
22-Apr-13	Pier 50	Drilling for bored pile P50-L4 by RCD. Shifting RCD from bored pile P50-L4 to P50-L2.
night	Pier 50	Drilling for bored pile P50-L4 by RCD.
	Pier 52	Drilling for bored pile P52-R1 & P52-L4 by RCD.
night	Pier 52	Drilling for bored pile P52-R1 & P52-L4 by RCD.
23-Apr-13	Pier 48	Installation of rebar cage for bored pile no. P48-L1.
night	Pier 50	Drilling for bored pile P50-L2 by RCD.
	Pier 52	Drilling for bored pile P52-R1 & P52-L4 by RCD.

night	Pier 52	Drilling for bored pile P52-R1 by RCD finish. Air-lifting & install cage for P52-R3.
24-Apr-13	Pier 0	Installation permanent casings for bored pile P0-R2.
	Pier 48	Concreting for bored pile P48-L1.
	Pier 50	Drilling for bored pile P50-L2 by RCD.
night	Pier 50	Drilling for bored pile P50-L2 by RCD.
	Pier 52	Drilling for bored pile P52-L4 by RCD. Install steel cage for P52-R3.
night	Pier 52	Install steel cage for P52-R3.
25-Apr-13	Pier 0	Installation permanent casings for bored pile P0-R3, P0-L1 & P0-L2.
	Pier 48	Air-lifting for bored pile P48-R1.
night	Pier 48	Installation of bottom cage for P48-R1.
	Pier 50	Drilling for bored pile P50-L2 by RCD.
night	Pier 50	Drilling for bored pile P50-L2 by RCD finish.
	Pier 52	Concreting for bored pile P52-R3.
night	Pier 52	Drilling for bored pile P52-L4.
26-Apr-13	Pier 48	Installation of rebar cage (2nd & top) for P48-R1.
night	Pier 48	Installation of rebar cage for P48-R1. Preparation works for concreting of P48-R1.
	Pier 50	Drilling for bored pile P50-L4 by RCD.
night	Pier 50	Air-lifting for bored pile P50-L2.
	Pier 52	Install steel cage for P52-R3.
night	Pier 52	Install steel cage for P52-R1. Drilling for bored pile P52-L2.
27-Apr-13	Pier 48	Salvage rebar cage at P48-R1.
night	Pier 48	Salvage rebar cage at P48-R1.
	Pier 50	Install steel cage for bored pile P50-L2.
night	Pier 50	Drilling for bored pile P50-L4 by RCD.
	Pier 52	Drilling for bored pile P52-L2 by RCD.
night	Pier 52	Splicing permanent casing bored pile P52-L4.
28-Apr-13	Pier 0	Excavation of bored pile P0-L1.
	Pier 50	Drilling for bored pile P50-L4 by RCD finish. Install steel cage for bored pile P50-L2.
night	Pier 50	Install steel cage for bored pile P50-L2.
	Pier 52	Drilling for bored pile P52-L2 by RCD. Install steel cage for bored pile P52-R1.
night	Pier 52	Splicing permanent casing bored pile P52-L2.
29-Apr-13	Pier 0	Excavation of bored pile P0-L1.
	Pier 48	Salvage rebar cage at P48-R1.
night	Pier 48	Air-lifting for bored pile P48-R1.
	Pier 50	Install steel cage for bored pile P50-L2.
night	Pier 50	Set up for final air-lifting for bored pile P50-L2.
	Pier 52	Drilling for bored pile P52-L4 by RCD. Concreting to bored pile P52-R1.
night	Pier 52	Drilling for bored pile P52-L4 by RCD.
30-Apr-13	Pier 0	Excavation of bored pile P0-L1.
	Pier 48	Air-lifting for bored pile P48-R1.
night	Pier 48	Install steel cage for bored pile P48-R1.
	Pier 50	Concreting for bored pile P50-L2.
night	Pier 50	Air-lifting for bored pile P50-L4.
	Pier 52	Drilling for bored pile P52-L2 by RCD finish. Drilling for bored pile P52-R4 by RCD.
night	Pier 52	Drilling for bored pile P52-R4 by RCD.

Bored Piling Activities at P0, P48, P50 & P52 conducted in July 2013

Date	Location	Bored Piling Activities
8-Jul-13	Pier 0	P0-R1 Bored pile excavation works by BG40.
	Night	P0-R1 Excavation works reached Founding Level by BG40.
		P0-L3 Excavation works by BG40.
	Pier 50	Excavation for bored pile P50-R2 by RCD.
		Splicing of permanent casing to bored pile P50-R3.
	Night	Set up RCD to bored pile P50-R1.
	Pier 52	Set up RCD to bored pile P52-L4.
		Excavation for bored pile P52-L1 by RCD.
	Night	Set up RCD to bored pile P52-L4.
		Excavation for bored pile P52-L1 by RCD.
9-Jul-13	Pier 0	P0-R1 Air-lifting & preparation work for Koden test.
	Night	Tidy up and maintenance drilling bit.
	Pier 50	Excavation for bored pile P50-R1 by RCD.
		Set up RCD to bored pile P50-R3.
	Night	Excavation for bored pile P50-R1 by RCD.
		Set up RCD to bored pile P50-R3.
	Pier 52	Set up RCD and excavation for bored pile P52-R4.
	Night	Installation of steel cage for bored pile P52-L4.
10-Jul-13	Pier 0	P0-R1 Remedial works
	Night	Tidy up and maintenance drilling bit.
	Pier 50	Excavation for bored pile P50-R4 by RCD.
	Night	Excavation for bored pile P50-R4 by RCD.
	Pier 52	Concreting to bored pile P52-L4.
	Night	Excavation for bored pile P52-R4 by RCD.
		Shifting of RCD from bored pile P52-R4 to P52-R2.
		Concreting to bored pile P52-L4.
11-Jul-13	Pier 0	P0-R1 placing concrete for Remedial works.
	Night	P0-R1 placing concrete for Remedial works.
		Tidy up and maintenance work.
	Pier 50	Excavation for bored pile P50-R4 by RCD.
		Splicing of permanent casing to bored pile P50-R2.
	Night	Excavation for bored pile P50-L1 by RCD.
	Pier 52	Air-lifting, Koden test and installation of steel cage for bored pile P52-R4.
	Night	Installation of steel cage for bored pile P52-R4.
12-Jul-13	Pier 0	P0-R1 Remedial works
	Night	Tidy up and maintenance work.
	Pier 50	Excavation for bored pile P50-L1 by RCD.
	Night	Excavation for bored pile P50-L1 by RCD.
	Pier 52	Installation of steel cage and concreting to bored pile P52-R4.
	Night	Concreting to bored pile P52-R4.
		Excavation for bored pile P52-L1 by RCD.
13-Jul-13	Pier 0	Tidy up & maintenance on CP1 platform.
	Night	P0-L3 excavation works by BG40.
	Pier 50	Installation of steel cage for bored pile P50-R4.
	Night	No site activity.
	Pier 52	Excavation for bored pile P52-L1 by RCD.
	Night	Excavation for bored pile P52-R2 by RCD.
14-Jul-13	Pier 0	No site activity on Sunday.
	Night	No site activity on Sunday.
	Pier 50	Installation of steel cage for bored pile P50-R4.
	Night	Installation of steel cage for bored pile P50-R4.
	Pier 52	No site activity on Sunday.
	Night	No site activity on Sunday.

Bored Piling Activities at P0, P48, P50 & P52 conducted in July 2013

Date	Location	Bored Piling Activities
15-Jul-13	Pier 0	P0-R1 excavation works by BG40.
	Night	P0-R1 excavation works by BG40.
	Pier 50	Installation of steel cage and concreting to bored pile P50-R4.
	Night	Concreting to bored pile P50-R4.
		General cleaning and tidying on barge.
	Pier 52	Excavation for bored pile P52-R2 by RCD.
	Night	Installation of steel cage for bored pile P52-L1.
16-Jul-13	Pier 0	P0-L3 excavation works by BG40.
		P0-R1 placing concrete for Remedial works.
	Night	Tidy up and maintenance drilling bit.
	Pier 50	Installation of steel cage for bored pile P50-L1.
		Set up RCD to bored pile P50-R1.
	Night	Installation of steel cage for bored pile P50-L1.
	Pier 52	Installation of steel cage and concreting to bored pile P52-L1.
	Night	Concreting to bored pile P52-L1.
		Set up RCD to bored pile P52-R2.
17-Jul-13	Pier 0	P0-L3 excavation works by BG40.
		P0-R1 Re-excavation works for infill concrete by BG40.
	Night	P0-R1 Re-excavation works for infill concrete by BG40.
	Pier 50	Installation of steel cage for bored pile P50-L1.
	Night	Installation of steel cage and tremie pipe for concreting for bored pile P50-L1.
	Pier 52	Set up RCD to bored pile P52-L3.
	Night	Preparation work of installation of steel cage for bored pile P52-R2.
18-Jul-13	Pier 0	P0-R1 Re-excavation works for infill concrete by BG40.
	Night	P0-R1 Re-excavation works for infill concrete by BG40.
	Pier 50	Concreting to bored pile P50-L1.
	Night	No site activity.
	Pier 52	Set up RCD to bored pile P52-L3.
		Installation of rebar cage for bored pile P50-R2.
	Night	Air-lifting for bored pile P52-L3.
		Installation of rebar cage for bored pile P52-R2.
19-Jul-13	Pier 0	P0-R1 Re-excavation works for infill concrete by BG40.
	Night	P0-R1 Re-excavation works for infill concrete by BG40.
	Pier 50	Excavation for bored pile P50-R1 and P50-R3 by RCD.
	Night	Excavation for bored pile P50-L3 by RCD.
	Pier 52	Installation of rebar cage for bored pile P52-R2 and P52-L3.
	Night	Installation of rebar cage for bored pile P52-R2 and P52-L3.
22-Jul-13	Pier 0	P0-R1 Re-excavation works for infill concrete by BG40.
	Night	P0-R1 Re-excavation works for infill concrete by BG40.
	Pier 50	Excavation for bored pile P50-R1 by RCD.
		Installation of rebar cage and concreting to bored pile P50-L3.
	Night	Excavation for bored pile P50-R1 by RCD.
		Concreting to bored pile R50-L3.
	Pier 52	Preparation work for removal of Jacket Platform (LHS and RHS).
	Night	No site activity.
23-Jul-13	Pier 0	P0-R1 Re-excavation works for infill concrete by BG40.
		P0-L3 Excavation works by BG40.
	Night	P0-L3 Excavation works by BG40.
	Pier 50	Excavation for bored pile P50-R1 by RCD.
	Night	Excavation for bored pile P50-R1 by RCD.
	Pier 52	Preparation work for removal of Jacket Platform (LHS and RHS).
	Night	No site activity.

Bored Piling Activities at P0, P48, P50 & P52 conducted in July 2013

Date	Location	Bored Piling Activities
24-Jul-13	Pier 0	P0-R1 Re-excavation works by BG40.
	Night	P0-R1 Exchange bentonite.
	Pier 50	Excavation for bored pile P50-R3 by RCD.
	Night	Excavation for bored pile P50-R3 by RCD.
	Pier 52	Preparation work for removal of Jacket Platform (LHS and RHS).
	Night	No site activity.
25-Jul-13	Pier 0	P0-R1 air-lifting.
	Night	P0-R1 Exchange bentonite.
	Pier 50	Excavation for bored pile P50-R3 by RCD.
		Installation of rebar cage to bored pile P50-R1.
	Night	Installation of rebar cage to bored pile P50-R1.
	Pier 52	Removal of pin piles of Jacket Platform (LHS and RHS).
		No site activity.
26-Jul-13	Pier 0	P0-R1 air-lifting.
	Night	P0-R1 installation works of steel cage.
	Pier 50	Excavation for bored pile P50-R2 by RCD.
		Installation of rebar cage to bored pile P50-R1.
	Night	Excavation for bored pile P50-R3 by RCD.
		Installation of rebar cage to bored pile P50-R1.
	Pier 52	Removal of pin piles of Jacket Platform (LHS and RHS).
		No site activity.
29-Jul-13	Pier 0	P0-R1 installation works of steel cage.
	Night	P0-R1 installation works of steel cage.
	Pier 48	P48-L3 Excavation work by BG40.
	Night	No site activity.
	Pier 50	Splicing of permanent casing and set up RCD for bored pile P50-R3.
	Night	Excavation for bored pile P50-R3 by RCD.

APPENDIX B
DOLPHIN ACOUSTIC BEHAVIOUR
MONITORING SCHEDULES

Contract HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill
Dolphin Acoustic Behaviour Monitoring in March 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1-Mar	2-Mar
3-Mar	4-Mar	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar
10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar
17-Mar	18-Mar	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar
	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring
24-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar
	*Dolphin Behaviour Monitoring		*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	
31-Mar						

Remarks: * Dolphin-related monitoring was conducted during the bored piling activitie

Contract HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill
Dolphin Acoustic Behaviour Monitoring in April 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr
	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring		*Dolphin Behaviour Monitoring	
7-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr
*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring		*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring		
14-Apr	15-Apr	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr
21-Apr	22-Apr	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr
28-Apr	29-Apr	30-Apr				

Remarks: * Dolphin-related monitoring was conducted during the bored piling activitie

Contract HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill

Dolphin Acoustic Behaviour Monitoring in July 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul
7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul
		*Dolphin Behaviour Monitoring		*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	
14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul
	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring		
21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul
	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	*Dolphin Behaviour Monitoring	
28-Jul	29-Jul	30-Jul	31-Jul			

Remarks: * Dolphin-related monitoring was conducted during the bored piling activitie

APPENDIX C
DOLPHIN ACOUSTIC BEHAVIOUR MONITORING IMPACT PHASE MONITORING REPORT PREPARED BY DOLPHIN SPECIALIST

CONTRACT HY/2011/09
Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill on Dolphin Acoustic Behaviour Monitoring Construction Phase Report

Prepared by Professor Bernd Würsig, Dr. Marc Lammers, Dr. Lisa Munger and Dr. Samuel Hung, Hong Kong Cetacean Research Project (HKCRP)

9 September 2014

1. INTRODUCTION

The Hong Kong Link Road (HKLR) comprises a 9.4 km long viaduct section from the HKSAR boundary to Scenic Hill on the Airport Island; a 1-km tunnel section to the reclamation formed along the east coast of the Airport Island, and a 1.6-km long at-grade road section on the reclamation connecting to the Hong Kong Boundary Crossing Facilities (HKBCF). Dragages – China Harbour – VSL JV (hereinafter called the "Contractor") was awarded as the main contractor of "Contract No. HY/2011/09 – Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill".

According to the HKLR EM&A Manual, a number of environmental monitoring and audit works related to Chinese White Dolphins (a.k.a. Indo-Pacific humpback dolphins, *Sousa chinensis*) shall be conducted during baseline, construction and post-construction phases, including dolphin acoustic behaviour monitoring in relation to bored piling activities. Such monitoring is being undertaken by qualified dolphin specialists who have sufficient (at least 5-10 years) relevant post-graduate experience and publication in the respective aspects. Approval of the specialists responsible for the dolphin acoustic behaviour monitoring was sought from AFCD and EPD, and Drs. Bernd Würsig, Marc Lammers, and Lisa Munger were selected and approved.

This dolphin acoustic behaviour monitoring assessment compares the results obtained during an initial baseline phase study conducted between January 15 and February 22, 2013, with results obtained during a construction-phase study conducted between March 7 and April 30, 2013 and also July 8-14, 2013.

2. METHODS AND MATERIALS

2.1. Overall Objective and Research Scheme

For the present dolphin acoustic behaviour monitoring study, the primary objective was to investigate dolphin acoustic behaviour and movement at and near bored piling sites during the baseline and construction phases. Overall, parameters such as the presence of dolphin acoustic signaling, durations of periods of acoustic activity, relative occurrence of different kinds of signals per unit time and shifts in the time of day of acoustic activity were quantified. Other factors were also measured during both the baseline phase and the construction phase, in order to compare the two phases to understand whether any observed differences in acoustic behaviour of dolphins may represent a reaction to the bored piling works, or are an artifact of other factors.

To achieve this primary goal, several approaches in acoustic data collection were adopted by the team of experienced bio-acoustician and dolphin behavioural researchers, including the local research team of the HK Cetacean Research Project (HKCRP). The primary approach was to conduct dedicated acoustic surveys of focal follows of Chinese White Dolphins in West Lantau with sound recordings from a calibrated hydrophone deployed from a research vessel, and their movements near the bored piling site were also monitored during focal follow sessions for both the baseline and construction phases. These recordings were used to establish the acoustic behaviour (e.g. rate of sound production, types of sounds) of dolphins and its relation to visually determined group sizes, behaviours (e.g. foraging, socializing, traveling, milling) and covariates such as the time of day and the occurrence of nearby vessels. Types, distances, and behaviours of vessels were determined from the recording vessel using a laser rangefinder.

A complementary approach for the acoustic data collection was to deploy two ecological acoustic recorders (EARs), one near the bored piling site and the other at a control site for passive acoustic monitoring. The EARs are bottom-moored, autonomous acoustic recording systems that are used to monitor ambient sounds on a programmable duty cycle (see detailed specifications of EAR in Lammers et al. 2008 and Appendix I for hydrophone specifications). They were programmed to record with a bandwidth from 20 Hz to 32 kHz, with a duty cycle of 20%, at 1 min. recording for every 5 min. total time.

2.2. Monitoring Location

The dedicated acoustic surveys with calibrated hydrophone deployment were conducted mostly along the west coast of Lantau Island during both the baseline and construction phases. During the baseline phase, the research vessel followed a predefined route for systematic search effort in West Lantau waters to cover the HKLR alignment in Northwest and West Lantau waters (in particular the area near the first three bored piling sites) (Figure 1), where dolphins will be potentially disturbed by the bored piling works. The baseline phase acoustic surveys also covered parts of Northwest and Southwest Lantau waters where dolphins were likely to be encountered for dolphin acoustic data collection (e.g. Sha Chau, Lung Kwu Chau, Black Point, Fan Lau, Kau Ling Chung). For the construction phase, more intensive search effort was conducted along and in the vicinity of the HKLR alignment (i.e. at the juncture of West and Northwest Lantau survey areas), in order to maximize the opportunity to collect dolphin sounds within the potential region of disturbance from construction works of the first three bored piling sites.

The EARs were deployed at two locations: 1) near the bridge alignment (N22°17.222', E113°53.016'; Site B2), which was 550m, 510m and 520 m away from the first three bored piling sites (i.e. P48, P50 and P52) respectively, and 2) at a less disturbed site away from the bridge alignment as control site, off Fan Lau (N22°11.827', 113°50.648'; Site B1) (Figure 1). EAR at site B2 was in water depth of 4m, and EAR at site B1 in 7m.

2.3. Monitoring Methodology

2.3.1. Acoustic survey using calibrated hydrophone

During dedicated acoustic surveys, the survey team of two (an experienced sound operator and another HKCRP research assistant) conducted a systematic search for dolphins within the study area on a predefined route. The survey protocol to search for dolphins was similar to the line-transect survey methodology adopted in the vessel survey under the HKLR09 EM&A programme. For each survey, a 15 m inboard vessel with an open upper deck was used to make observations from the flying bridge area, at a visual height of 4-5 m above water surface. Two observers searched with unaided eyes and 7 x 50 marine binoculars ahead of the vessel (between 270° and 90° in relation to the bow, which is defined as 0°). The survey team recorded effort data including time, position (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance travelled in each series (a continuous period of search effort) with the assistance of a handheld GPS.

When dolphins were sighted, the survey team ended the search effort, and the research vessel was diverted from its course to slowly approach the animals for group size estimation, assessment of group composition, and behavioural observations in the initial 5-10 minutes. The calibrated hydrophone was then deployed 3 to 7 m below the sea surface by 2 m long spar buoy from the stern of the research vessel, with vessel engine noise off and the vessel drifting. Broadband dolphin recordings were made with a Cetacean Research Technology spot-calibrated hydrophone (model: CR1; sensitivity: -197.46 dB, re. 1 V/μPa; usable frequency response listed as 0.05 Hz-68 kHz +3/-12 dB connected to a 1 MΩ input impedance; linear frequency range: 0.2-48 kHz ± 3 dB) (see Appendix II for specifications and calibration report). The spar buoy acted to prevent excessive hydrophone movement from wave and boat motion. The recordings were streamed into a digital memory field recorder (model: Fostex FR-2; frequency response: 20 Hz-80kHz ±3 dB) with a pre-amplified signal conditioner (model: PC200-ICP; precision gain: x0.1-x100; frequency range: >100 kHz; system response: 1 Hz-100 kHz ± 3 dB; 192 kHz sample rate) to prevent overloading and minimize cable noise. The recordings were then stored on a 4 GB Compact Flash Card, and downloaded for further analysis. The above acoustic data collection setup has been used in the long-term monitoring study on Chinese White Dolphins in Hong Kong since April 2010 (Sims et al. 2011, 2012; also see Hung 2012).

During hydrophone deployment, the date, start and end times, hydrophone and water depths, Beaufort sea state, survey area, locations, ICP gain, event, and notes were taken for each recording in five-minute intervals. Within each corresponding five-minute interval, observers also noted variables including the dolphin group size, group composition and their general behaviour during the 5-minute period (i.e. feeding, socializing, travelling, resting, milling and any aerial activity). The number of vessels that passed within 500 m of the dolphin group were recorded during the same 5-minute interval, with special notes on close approaches by vessels within 100 m of dolphins, including the time of closest approach and any behavioural reaction noted. Distances of vessels were gathered by hand-held laser rangefinder (*Bushnell* Yardage Pro 800; maximum range of detection for most objects: 720 metres; ranging accuracy ± 2 metres under most circumstances). Also, notes were made on the approximate distance (i.e. 0-250m, 250-500m, >500 m) of the dolphin group to the hydrophone during the 5-minute interval. Notably, positions of dolphin group were recorded continuously during the entire focal follow session to examine their movement in detail, especially when they occurred in the vicinity of the HKLR alignment (in particular the area near the first three bored piling sites).

2.3.2. Passive acoustic monitoring using EARs

Two EARs were deployed at two sites in West Lantau, one near the bored piling site and another at the control site off Fan Lau, as mentioned above. The EARs were deployed and recovered by a professional dive team from Oceanway Corporation

Limited. During each deployment, the EAR serial number, as well as the time and date of deployment were recorded. Moreover, the GPS position, water depth and type of substrate at the deployment location were also recorded.

The EARs were programmed to record on a 20% duty cycle (1 min "on" for every 5 min). Recording was from approximately 20 Hz at the low end to 32 kHz at the high end, which effectively covers a major part of the acoustic channel of the Chinese White Dolphins (Sims et al. 2011). Data from the EARs were downloaded onto a computer hard disk at the conclusion of the baseline phase of the project on February 22, 2013, and the EARs were then re-deployed at the same location, concurrently with bored piling operations, between February 26 and April 8, 2013, between April 14 and May 22, 2013 and between July 5 and August 19, 2013.

2.4. Data Analysis

2.4.1. Calibrated hydrophone data

To evaluate if dolphin acoustic behaviour varies between baseline and construction phases, a number of parameters were examined during both phases for comparison. For the calibrated hydrophone data, the parameters considered include the duration of acoustic encounters of dolphins and the rates of their whistling and click production (echolocation and burst pulses) per 5 min recording time bin. The rates of sound production as a function of dolphin group size, behavioural state, location, distance to nearest vessel, Beaufort sea state and the time of day were also examined.

For the comparison of response variables between baseline and construction phases, each 5 min recording time bin was treated as a sample point, providing a measure of the rate of whistling (whistles/min) and click production (clicks/min). The rate of whistling was quantified for each time period by visually and aurally examining individual recordings and logging the presence of signals using the program Raven Pro 1.5^{TM}. The analyst scanned spectrograms of each file in either a 60-second display window (browsing mode) or a 10-second display window (verification mode). Click production (echolocation and burst pulses) was quantified using a custom-written click detector program in MATLAB^{TM} R2011b. Recording periods when the dolphins were more than 500 m away or when they were on the bow of the research vessel were excluded from consideration.

To investigate signal production as a function of dolphin group size, the whistling and clicking rates were binned by group size as follows: 1 individual dolphin, 2-5 dolphins, 6-9 dolphins, and 10+ dolphins. The whistling and clicking rates were also stratified by the behavioural categories of milling, traveling, socializing, feeding and resting. Signal production by time of day was investigated by grouping the number of sightings and rates of whistling and clicking occurring in four two-hour periods of data collection (09:00-10:59, 11:00-12:59, 13:00-14:59 and 15:00-16:59). Signal production was also investigated as a function of distance to the nearest vessel binned into six categories (0-99 m, 100-199 m, 200-299 m, 400-499 m, 500+ m), as well as the Beaufort sea state (measured on a scale from 0 to 12). Finally, to examine sound production by location, the GPS coordinates of the first recording for each sighting were plotted using Google Earth™, and these were divided into three zones based on proximity to the construction area. The recordings were then grouped by zone.

2.4.2 EARs data

The data from EARs were analyzed by visually and aurally examining individual recordings. The presence of clicks and/or whistles was used to establish the presence of dolphins near the EAR. The analyst scanned spectrograms of each file using a 10-second display window. Dolphin sounds were confirmed visually and aurally by playing back at reduced speed (usually to ½ original speed, and in some cases ¼ speed).

The occurrence of dolphin signals was used to examine temporal trends in dolphin presence and activity level, and to provide a basis for comparison between the baseline and construction phases. The number and duration of dolphin encounters was established for each day. Here an encounter is defined as a period of recordings containing dolphin signals in which the interval between detected signals is less than 30 minutes. For example, two recordings with detections separated by 25 minutes would be treated as part of the same encounter, while two recordings with detections separated 40 minutes would be treated as two separate encounters. In addition, the overall patterns in acoustic behaviour (not per individual dolphin) were also established, and baseline and construction phases were compared to detect any changes in temporal patterns (e.g. from mostly calling at night, to mostly during the day, or vice versa) and/or changes in the average duration of acoustic presence at the EAR locations .

3. RESULTS AND ANALYSES

3.1. Summary of Acoustic Monitoring Effort

Thirty days of acoustic monitoring surveys were conducted between 15 January and 22 February 2013 for the baseline phase and 43 days of construction phase surveys were conducted between 6 March and 11 April 2013 and between 9 July and 26 July 2013 (see Appendix III for detailed monitoring schedule and Appendix IV for bored piling work schedule). To respond to the EP Condition 3.1, the JV decided to temporarily suspend the bored piling works at the west of Airport Island during the period of May and June, as these two months represent the peak of calving season of Chinese White Dolphins in Hong Kong. Therefore, no acoustic surveys were conducted during these two months, and the construction phase monitoring surveys resumed in July 2013.

During the baseline period, 1,885 km of survey effort were conducted to search for dolphins in the western and northwestern waters of Lantau. A total of 196 groups, numbering 694 dolphins, were sighted during these surveys, and 238 sound samples were taken from some of these dolphin groups. During the construction phase, 2,751.8 km of survey effort were conducted and a total of 91 groups, numbering 301 dolphins were sighted (Appendix V), and 67 sound samples were obtained (Appendix VI).

3.2. Calibrated hydrophone recordings

3.2.1 Baseline phase results

A total of 212 five-minute recordings were made between 22 January and 22 February 2013. Recordings made on 21 January were excluded from the analysis because they were deemed exceedingly noisy and the signal to noise ratio was not comparable to the rest of the data. Figure 2a shows the number of recording minutes summed for each day, as well as the number of sightings per day. There was a general decreasing trend, with fewer sightings (mean = 3.0, S.D. = 1.4) and minutes recorded (mean = 28.5, S.D. = 16.1) during the second half of the data collection period (4-22 February) than during the first half (22 January to 3 February; mean number of sightings = 4.3, S.D. = 2.1; mean number of minutes recorded = 50.0, S.D. = 18.9). The cause or significance of this trend, if any, is not presently clear.

Whistling rates were determined for all recordings (n = 212). Clicking rates were also calculated for all recordings except for some or all recordings made on 26-29 January, 1-2 February and 13-16 February (a total of 73 recording periods excluded) due to the presence of high frequency electronic noise in the recordings originating from an unknown extraneous source. This noise precluded the detection of clicks due to the frequency range affected, but the rate of whistling could still be established. A total of 139 recordings were analyzed for click rate. Figure 3a shows the averaged daily rate of click and whistle production recorded. The daily rates varied considerably, with some days containing more whistles than clicks and vise versa. The average daily whistling rate over the entire baseline period was 1.0 whistles/minute (S.D. = 0.99), and the average daily clicking rate over the entire baseline period was 86.4 clicks/minute (S.D. = 90.8).

The variability of whistling and clicking rates was examined as a function of group size, behavioural state, time of day, distance to the nearest vessel, Beaufort sea state and location within the study area. Figure 4a shows the rate of both click and whistle production as a function of group size. Both the rate of whistling and click production generally increased with group size. In Figure 5a the rate of signaling is represented in relation to the dolphins' observed behavioural state during the recording period. Milling was the most common behavioural state noted. However, the rate of both whistle and click production was greatest when the animals were observed socializing.

The greatest number of recordings (reflected by the number of whistle recordings, as some recordings with clicks were excluded due to high noise) were made during the 11:00-12:59 time period (n = 94), followed by the 13:00-14:59 period (n = 62), the 15:00-16:59 period (n = 36) and lastly the 9:00-10:59 period (n = 29) (Figure 6a). The highest rates of both whistling and clicking occurred in the afternoon period from 13:00 to 14:59. Notably, the daily monitoring effort has been held consistent throughout the entire monitoring period. However, the recording effort was largely depended upon the time of dolphin occurrence and whether they were available for recording. Therefore, no bias was introduced in the monitoring and recording effort throughout the day, which may be related to the observed asymmetry in peak rates of whistling and clicking during the day.

A total of 134 recordings were made with vessels transiting nearby. Of these, 22 were with vessels between 0 and 99 m at the closest approach, 36 were between 100 and 199 m, 20 were between 200 and 299 m, 8 between 300 and 399 m, 5 between 400 and 499 m, and 43 were 500 m or further away. The highest rate of whistling and clicking occurred with vessels transiting between 300 and 399 m (Figure 7a). However, the sample size of this distance bin is small and the variability is high, so no firm conclusions should yet be drawn about the effects of vessel distance on signaling rate from these data.

Recordings were collected in Beaufort sea states (BSS) ranging from 0 to 5. There were 9 recordings made in BSS 0, 40 recordings in BSS 1, 145 recordings in BSS 2, 19 recordings in BSS 3, 2 recordings in BSS 4, and 6 recordings in BSS 5. Whistling rates were lowest during BSS 1 and clicking rates were lowest during BSS 2 (Figure 8a). However, the variability and difference in sample sizes between the BSS bins suggest that differences are likely due to unequal sample sizes rather than changes in the dolphin's acoustic behaviour.

The location of each recording and the division of the study area into three zones are shown in Figure 9a. Zone 2 includes the construction area, while Zones 1 and 3 are north and south of the construction area, respectively. The greatest number of recordings was made in Zone 3 (n = 97), followed by Zone 2 (n = 65) and the fewest were made in Zone 1 (n = 59). The rates of whistling and clicking were comparable between Zones 2 and 3 (Figure 10a). However, in Zone 1, considerably more whistles and fewer clicks were recorded. This difference must be considered with some caution, however, as fewer recordings suitable for click analysis were available from Zone 1 (n = 26) than from Zone 2 (n = 41) and Zone 3 (n = 81).

3.2.2 Construction phase results

A total of 34 five-minute recordings were made from 7 March to 2 April 2013, and 52 recordings were made from 9 to 26 July 2013. Figure 2b shows the number of recording minutes summed for each day, as well as the number of sightings per day.

Whistling and clicking rates were determined for all recordings (n = 86). Figure 3b shows the averaged daily rate of click and whistle production recorded. The average daily whistling rate over the entire construction period was 0.18 whistles/minute (S.D. = 0.30) and the average daily clicking rate over the entire construction period was 51.9 clicks/minute (S.D. = 61.3). The daily rates differed significantly between the March/April and July recording periods. During March/April the average daily whistling and clicking rates were 0.1 whistles/min (S.D. = 0.23) and 12.5 clicks/min (S.D. = 24.9), while in July they were 0.27 whistles/min (S.D. = 0.34) and 94.6 clicks/min (S.D. = 60.8) (Whistles: Mann-Whitney U Test, $Z = 1.958$, $p = 0.04$; Clicks: Mann-Whitney U Test, $Z = 3.698$, $p < 0.001$.) (Table 3).

As in the baseline phase, the variability of whistling and clicking rates was examined as a function of group size, behavioural state, time of day, distance to the nearest vessel, Beaufort sea state and location within the study area. Figure 4b shows the rate of both click and whistle production as a function of group size. The whistling rate was low (~ 0.1 whistles/minute) for groups of 5 or fewer animals (including single animals), and greatest (~ 1.0 whistles/minute) for groups of 6-9 animals, while the clicking rate was variable. In Figure 5b the rate of signaling is represented in relation to the dolphins' observed behavioural state during the recording period. As during the baseline phase, milling was the most common behavioural state noted. However, the rate of both whistle and click production was greatest when the animals were observed socializing.

The greatest number of recordings were made during the 9:00-10:59 time period (n = 31), followed by the 11:00-12:59 period (n = 26), the 13:00-14:59 period (n = 17) and lastly the 15:00-16:59 period (n = 12) (Figure 6b). The highest rates of both whistling and clicking occurred in the midday period from 11:00 to 12:59.

A total of 55 recordings were made with vessels transiting nearby. Of these, 7 were with vessels between 0 and 99 m at the closest approach, 16 were between 100 and 199 m, 9 were between 200 and 299 m, 10 between 300 and 399 m, 5 between 400 and 499 m, and 8 were 500 m or further away. The highest rate of whistling and clicking occurred with vessels transiting at a distance of 500 m or greater (Figure 7b).

Recordings were collected in Beaufort sea states (BSS) ranging from 0 to 4. There were 16 recordings made in BSS 1, 62 recordings in BSS 2, 7 recordings in BSS 3, and 1 recording in BSS 4. Both whistling and clicking rates were highest during BSS 2 (Figure 8b). However, the variability and difference in sample sizes between the BSS bins suggest that differences could be due to unequal sample sizes rather than changes in the dolphin's acoustic behaviour.

Figure 9b shows the location of each recording session and the study zone in which it occurred. The majority of recordings were made in Zone 2 (n = 80), followed by Zone 1 (n = 6) and no recordings were made in Zone 3. The rates of whistling and clicking were higher in Zone 1 than Zone 2 (Figure 10b). This is consistent with baseline phase results, in which whistling rates were greater in Zone 1 than in Zone 2 or 3. However, the low sample size in Zone 1 and lack of recording in zone 3 reflect an intentional concentration of search/recording effort in Zone 2 rather than zone-specific differences in the dolphin's acoustic behaviour, and preclude any statistical comparisons based on zone.

3.2.3 Baseline and construction phase comparison of hydrophone data

More than twice the total number of recordings were made during the baseline phase (n = 212) as during the construction phase (n = 86), reflecting a significantly lower sighting rate during the latter period (Mann-Whitney U Test, $Z = 3.443$, $p <$

0.001) (Table 3). The daily summed length of recordings obtained was also lower during the construction phase (Figure 11). However, the average dolphin group sizes between the baseline and construction phases were 4.6 (S.D. = 3.7) and 4.0 (S.D. = 2.1), respectively, which was not significantly different (Mann-Whitney U Test, $Z = 0.084$, $p = 0.933$) (Table 3).

Comparisons of whistling and clicking rates were made, respectively, between the baseline and construction phases as a function of behavioural state (Figure 12) and group size (Figure 13). The largest deviation from baseline levels was in the clicking rates of dolphin groups with only one individual (Figure 13b), but the difference was not statistically significant (Mann-Whitney U Test, $Z = 1.869$, $p = 0.061$) (Table 3). The next largest deviation was in the whistling rate of dolphin groups with 2-5 animals (Figure 13a), but this difference was also not significant (Mann-Whitney U Test, $Z = 1.427$, $p = 0.154$) (Table 3). Otherwise, no other notable differences are present.

Similar comparisons for whistling and clicking rates were also made as a function of distance to the nearest vessel (Figure 14) and the time of day (Figure 15). A notable difference is seen in the clicking rate with the nearest vessel 300-399 m away, which was much lower during the construction phase (Figure 14b). However, this difference was not significant (Mann-Whitney U Test, $Z = 0.796$, $p = 0.426$) (Table 3) and was largely due to small sample sizes (n =5 and n =10) and two outliers in the baseline phase data. Another notable difference is seen in both the whistling and clicking rates recorded in the afternoon time period between 13:00 and 14:59 (Figures 15a & 15b). In both cases, significantly lower rates were observed during the construction phase (Mann-Whitney U Test, $Z = 3.564$, $p < 0.001$ and $Z = 5.035$, $p < 0.001$, respectively) (Table 3). It should also be noted that the sample sizes for this time bin were more than twice as large during the baseline phase, again reflecting significantly lower sighting rates during the construction phase relative to the baseline phase.

Lastly, Figures 16a and 16b show the averaged daily whistling and clicking rates for both phases of the study. The daily whistling rate was significantly lower during the construction phase than during the baseline phase (Mann-Whitney U Test, $Z = 4.432$, $p < 0.001$) (Figure 16a, Table 3). The averaged daily clicking rates were lower during the March/April period of the construction phase, but were higher again in July (Figure 16b). As a result, there was no significant difference in the overall averaged daily clicking rates between the two phases (Mann-Whitney U Test, $Z = 1.599$, $p = 0.11$) (Table 3). However, a comparison between the baseline phase and the data collected from 7 March to 2 April of the construction phase reveals that clicking rates were significantly lower during the latter period (Mann-Whitney U Test, $Z = 3.316$, $p < 0.001$) (Table 3).

3.3. EAR data

3.3.1 Baseline phase EAR results

The EAR at Fan Lau (Site B1) was deployed between 4 and 22 February for a total of 19 days. It yielded 5,236 one min recordings totaling 87 hours of data. The EAR at the bridge alignment site (site B2) was also deployed between 4 and 22 February for 19 days and recorded 5,225 one min files. Due to a disk drive corruption issue that was since resolved, the baseline phase report included only partial data from B2, but results from all 5,225 one-min files are presented here.

3.3.1.1 Site B1 - Fan Lau (Baseline phase)

Dolphin signals were detected on all 19 days of the EAR deployment at this site. Figure 17a shows the percentage of files for each day (288 recordings per day) that contained dolphin signals. Daily dolphin acoustic activity was variable, with between ~2% and 60% of recordings (calculated only for days with 24 hours of data) containing dolphin signals any given day. Figure 18a shows the number of dolphin encounters (as defined in section 2.4.2) and the average duration of encounters for each day of the deployment period. There were an average of 6.4 encounters per day (S.D. = 3.2) at site B1, which lasted an average of 49.7 min (S.D. = 46.1).

Figure 19a shows the occurrence of dolphin acoustic signals in EAR recordings at site B1 as a function of the hour of the day. Nearly all detections were of dolphin clicks. Only two detections were made of dolphin whistles, one in hour 2 and the other in hour 15 (Figure 19a). The most likely explanation for the low number of whistle detections is that high levels of ambient and anthropogenic noise in the frequency bands associated with whistles (4-12 kHz) characterize the site (see below). Therefore, dolphins either do not produce many whistles in this area or they were not detected in analyses due to masking, or both.

Approximately 47% of detections occurred during the nighttime period between 19:00 and 6:59 and 53% occurred during the day between 7:00 and 18:59. However, there was a distinct peak in acoustic activity in the dawn and early morning hours and a low period in the afternoon between 13:00 and 16:00.

Figure 20a shows the root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly at site B1. The noise level was approximately equivalent across the frequency bands between 0-16 kHz. The SPLs in these frequency bands were high (between 100 and 110 dB re 1 μPa RMS) and were primarily driven by the activity of snapping shrimp and noise from vessel traffic.

3.3.1.2. Site B2 - Bridge Alignment Area (Baseline phase)

Dolphin signals were detected on all 19 days of EAR data recovered. Figure 21a shows the percentage of files for each day (288 recordings per day) that contained dolphin signals. Daily dolphin acoustic activity was variable, with between ~1% and 17% or recordings (calculated only for days with 24 hours of data) containing dolphin signals any given day. Figure 22a shows the number of dolphin encounters (as defined in section 2.4.2) and the average duration of encounters for each day of the deployment period. There were an average of 4.1 encounters per day (S.D. = 2.3) at site B2, which lasted and average of 22.1 min (S.D. = 13.5).

Figure 23a shows the occurrence of dolphin acoustic signals in EAR recordings as a function of the hour of the day. Although the majority of detections at site B2 were also of clicks, considerably more whistles were detected at this site than at site B1. In addition, there was a strong diel trend in the occurrence of detections, with 89.5% occurring during the nighttime period between 19:00 and 6:59.

Figure 24a shows the root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly at site B2. Noise levels were within 3-5 dB re 1 μPa across all frequency bands between 0-32 kHz. However, SPLs overall were much lower (by about 8-12 dB re 1 μPa RMS) at B2 than at B1 due to considerably less snapping shrimp activity and less noise from vessel traffic (B2 octave band noise levels ranged between approximately 90-100 dB and fullband ranged from 100-105 dB, whereas B1 octave bands ranged from 95-110 dB and fullband ranged from 105-115 dB (Figure 20a)).

3.3.2 Construction phase EAR results

The EAR at Fan Lau (Site B1) was deployed from 25 February to 8 April, 17 April to 22 May, and 5 July to 19 August 2013 for a total of 125 days. It yielded a total of 33,936 one-minute recordings totaling 565.6 hours of data. The EAR at the bridge alignment site (site B2) was deployed from 25 February to 8 April, 17 April to 11 May, and 5 July to 19 August 2013 for a total of 114 days. It yielded a total of 32,312 one-minute recordings totaling 538.5 hours of data. The deployments were discontinuous due to one or more of the following factors: 1) scheduling and sea conditions for SCUBA diving logistics team, 2) CWD calving season, resulting in suspension of bored piling works west of Lantau island and therefore a hiatus in EAR deployment from mid-May through June, and 3) timing EAR deployments to coincide with construction activities and adapting to changes in construction schedule with short notice. Analysis of 30 days of EAR data was planned for the construction phase in the methodology proposal, and this analysis included the periods between 1 to 9 April, 17 to 30 April and 8 to 14 July, which were selected because they overlapped with intensive bored piling activities near site B2. These were the periods analyzed for both EAR sites (B1 and B2). For each site, 8,640 one-minute recordings totaling 144 hours of data were analyzed.

3.3.2.1 Site B1 - Fan Lau (Construction phase)

Dolphin signals were detected on all 30 days of the EAR data analyzed for this site. Figure 17b shows the percentage of files for each day (288 recordings per day) that contained dolphin signals. Daily dolphin acoustic activity varied between ~1% and 15% of recordings containing dolphin signals any given day (calculated only for days with 24 hours of data). Figure 18b shows the number of dolphin encounters (as defined in section 2.4.2) and the average duration of encounters for each of the 30 deployment days analyzed. There were an average of 4.2 encounters per day (S.D. = 2.0) at site B1, which lasted an average of 16.6 min (S.D. = 13.0).

Figure 19b shows the occurrence of dolphin acoustic signals in EAR recordings at site B1 as a function of the hour of the day. As during the baseline phase, nearly all detections were of dolphin clicks. Only a single detection was made of dolphin whistles during hour 14. Approximately 27.7% of detections occurred during the nighttime period between 19:00 and 6:59 and 72.3% occurred during the day between 7:00 and 18:59.

Figure 20b shows the RMS SPLs in 1-octave bands and full bandwidth averaged hourly at site B1. The noise level was approximately equivalent across the frequency bands between 0-16 kHz. The SPLs in these frequency bands varied between 100 and 130 dB re 1 μPa RMS) and were driven by the activity of snapping shrimp, noise from vessel traffic and a diel evening biological chorus most likely originating from one or more species of fish and/or crustaceans. The species identity of these fish/crustacean is not presently known. Figure 25a shows a plot of RMS SPLs averaged hourly over the 24-hour day for the period between 17-30 April from site B1 that illustrates the temporal nature of this chorus. An 8-12 dB re 1 μPa increase can be observed in the 0-2 and 2-4 kHz octave bands from approximately 15h to 23h.

3.3.2.2. Site B2 - Bridge Alignment Area (Construction phase)

Dolphin signals were detected on 22 days of 30 days of EAR data analyzed during the construction phase. Figure 21b shows the percentage of files for each day (288 recordings per day) that contained dolphin signals. Daily dolphin acoustic activity was low with between 0% and 6% or recordings (calculated only for days with 24 hours of data) containing dolphin signals any given day. Figure 22b shows the number of dolphin encounters (as defined in section 2.4.2) and the average duration of encounters for each day of the deployment period. There were an average of 1.5 encounters per day (S.D. = 1.5) at site B2, which lasted and average of 8.1 min (S.D. = 9.0).

Figure 23b shows the occurrence of dolphin acoustic signals in EAR recordings as a function of the hour of the day. Nearly all detections were of dolphin click trains. Only two detections were made of dolphin whistles in hours 11 and 13. A diel trend persisted, with 74.7% occurring during the nighttime period between 19:00 and 6:59, but nocturnal activity occurred almost entirely before midnight.

Figure 24b RMS SPLs in 1-octave bands and full bandwidth averaged hourly at site B2. As at B1 (construction phase) the noise level was approximately equivalent across the frequency bands between 0-16 kHz. The SPLs in these frequency bands varied between 90 and 130 dB re 1 μPa RMS) and were driven by the activity of snapping shrimp, noise from vessel traffic and industrial activities related to bridge construction, and the same diel evening biological chorus present also observed at site B1 during the same time period.

Figure 25b shows a plot of RMS SPLs averaged hourly over the 24-hour day for the period between 17-30 April from site B2 that illustrates the temporal nature of this chorus. A 15-18 dB re 1 μPa increase in ambient noise levels can be observed in the fullband and 0-2 kHz frequency band between approximately 07:00 and 16:00. The increase in the 0-2 kHz band begins at approximately 08:00 as a result of higher vessel engine noise. Thus, it appears that the major work-day component that begins at about 08:00 is due to construction activities, but that the fish chorusing also contributes greatly to the afternoon and into evening component of these lower frequency sounds.

3.3.3 Baseline and construction phase comparison of EAR data

Substantial differences were present between the EAR data obtained during the baseline and construction phases at both monitoring sites. Figures 26a and 26b show the daily percentage of recordings with dolphin signals present during both phases of the study at B1 and B2, respectively. Significantly fewer files contained dolphin detections during the construction phase at both B1 (Mann-Whitney U Test, Z = 4.309, p < 0.001) (Figure 26a) and B2 (Mann-Whitney U Test, Z = 4.155, p < 0.001) (Figure 26b). Similarly, the numbers of encounters (as defined in section 2.4.2) were fewer at both sites during the construction phase (B1: baseline phase = Mann-Whitney U Test, Z = 2.452, p = 0.014; B2: Mann-Whitney U Test, Z = 3.919, p < 0.001), as were the encounter durations (B1: baseline mean = 49.7 min (S.D. = 46.1), construction mean = 16.6 min (S.D. = 13.0), Mann-Whitney U Test, Z = 3.611, p < 0.001; B2: baseline mean = 22.1 min (S.D. = 13.5), construction mean = 8.1 min (S.D. = 9.0), Mann-Whitney U Test, Z = 3.817, p < 0.001) (Table 4).

The occurrence of recordings with dolphin click was lower during the construction phase at both sites. At site B1, 17.8% of baseline phase recordings contained clicks, while only 3.75% of recordings had clicks during the construction phase, a 4.75-fold decrease. At site B2, 5.65% of baseline phase recordings contained clicks, while only 1.08% of recordings had clicks during the construction phase, a 5.23-fold decrease. Similarly, the occurrence of recordings with dolphin whistles was lower during the construction phase at both sites. At site B1, 0.04% of recordings contained whistles during the baseline phase and 0.01% during the construction phase, a 4-fold decrease. At site B2, the occurrence of recordings with dolphin whistles was 1.05% during the re-construction phase and only 0.02% during the construction phase, representing a 52.5-fold decrease.

Figures 27a and 27b show the number of hourly detections made during each phase at sites B1 and B2, respectively. At site B1 there was a shift from a largely nocturnal pattern of presence/activity to a diurnal pattern. At site B2 there was a substantial reduction in the presence/activity of dolphins between midnight and 8:00 (which was the peak period during the baseline phase) but no shift to daytime presence/activity occurred. At both sites, the observed changes were statistically significant (B1: Wilcoxon Matched Pairs Test, T = 12.5, p < 0.001); B2: Wilcoxon Matched Pairs Test, T = 17.5, p < 0.001) (Table 4).

Finally, there were significant increases in the ambient noise levels measured at both sites B1 and B2 during the construction phase (B1: Two-sample T-test, T = 27.1, p < 0.001; B2: Two-sample T-test, T = 27.7, p < 0.001) (Table 4). At site B1, the average full-band RMS SPL measured was 109.8 dB re 1 μPa (S.D. = 2.6) during the baseline phase and 114.7 dB re 1 μPa (S.D. = 3.45) during the construction phase. At site B2, the average full-band RMS SPL measured was 101.2 dB re 1 μPa (S.D. = 2.98) during the baseline phase and 110.8 dB re 1 μPa (S.D. = 7.18) during the construction phase.

4. DISCUSSION

4.1. Calibrated hydrophone data

The data obtained during this study by vessel-based calibrated hydrophone, concurrent with group size and behavioural observations of Chinese White Dolphins, greatly expands our knowledge of click and whistle sound production in Hong Kong waters from that presented by Sims et al. (2011). We first discuss sound variables per baseline acoustic monitoring (January-February 2013), to introduce as little anthropogenic bias as possible, with the realization that much other than bridge construction activity such as ferry traffic, cargo ships, tourism boats, police patrols, fishing vessels, and others, traverse the west and northwest Hong Kong waters (to be addressed below).

Overall, the general rise in occurrence of number of whistles and clicks from a group size of 1, to 2-5, to 6-9, to +10 dolphins is to be expected, as more dolphins are likely to be echolocating and communicating than when there are only a few or one. These amounts of sound production however are at the same time variable by behaviour, with vastly more clicking and whistling occurring during socializing than at other times of feeding, milling, traveling, or resting. As well, there was an overall rise in both sounds during early afternoon hours of 13:00-15:00 than in the morning, mid-day, or later afternoon, and this rise may be due to a combination of factors such as larger group sizes and/or more social than other activity in early afternoon. Such differences in diurnality have been described for other dolphins, often with different times of higher activity levels than here, such as in Hawaiian spinner dolphins (*Stenella longirostris*) resting during much of the day and becoming highly social and much more vocal later in the afternoon, in their case before they go offshore to feed at night (Würsig et al. 1994; Brownlee and Norris 1994).

The Beaufort Sea State (BSS), which is known to have increased basic background noise as it rises, largely due to increased surface wave action (Wenz 1962), does not have a marked or consistent effect on average number of clicks or whistles produced per time. This lack of effect on vocalization rate by wave-induced background noise might indicate that most recordings were made of animals echolocating and communicating over short spans of space, such as less than 100 m or so distances, and therefore within their own group, not for greater distances between groups. We present one caveat – as we did not have precise measurements of distances and directions of dolphins relative to the hydrophone, we do not have calibrated production levels (“loudness”) of sounds produced, and it is possible that such levels increased during increases in background noise. Interestingly, average numbers of clicks and whistles were higher for vessels at distances 300-399 m than at closer and further distances. It is possible that when vessels are very close, dolphins lower communication due to a disturbed (which could be "fright") response, increase their vocalization rate to help overcome noise effects by the vessel at the greater distance, and are simply not affected much at 400 m and greater.

The occurrence of animals in the construction zone area (Zone 2) was substantially lower during the construction phase, despite more search effort being focused in this zone during the construction phase. The reason for this difference is not clear and could be due to variety of factors, both related and unrelated to construction activities (e.g. seasonal variation in distribution, a prey-related shift in behavioural pattern). Yet, despite fewer encounters being made per day and overall during the construction phase, the average group size did not change significantly between phases. In other words, fewer groups occurred in the construction area, but group sizes remained relatively constant. During the baseline phase it was established that a positive correlation exists between acoustic activity and group size. Therefore, it is noteworthy that the average whistling rate was significantly lower during the construction phase. It suggests that the dolphins that did occur in the area shifted behavioural patterns, perhaps engaging in less social signaling than during the baseline phase.

Also of note is the finding that lone animal pods had higher click production rates during the construction phase, although this trend was not statistically significant between phases. Individual animals lack the protective benefits of a group, so a higher click production rate suggests greater vigilance by those animals (Herzing 1996). This could be indicative of a higher level of alertness in response to construction activities in the area.

Averaged daily click rates were not significantly different overall between baseline and construction phases. However, there was a significant decrease in both the clicking and whistling rates recorded during the 13 days of monitoring in March/early April, which coincided with the beginning of construction activities. In other species of odontocetes (e.g. beluga whales), reduced or suppressed acoustic activity for periods of days or weeks is indicative of a stress response (Castellote and Fossa 2006). Therefore, it may be that the lower acoustic activity in March represented an initial stress reaction by dolphins in the area during the start of construction activities, and that by July the animals had become habituated, returning acoustic activity levels back to baseline levels, at least with respect to click production. The fact that whistling rates did not return to baseline levels suggests that a more sustained behavioural shift may have occurred as a result of construction activities, perhaps resulting in dolphins spending less time socializing (therefore producing fewer whistles) in favour of foraging more (therefore producing more clicks). The theodolite tracking portion of this study also indicated a higher amount of foraging during construction than baseline phases, and it is unknown whether this was a reaction to construction, to other (such as food availability) factors, or a combination. This observation agrees with the click production rate increase.

A significant decrease in both whistling and clicking rate was observed during the construction phase in the afternoon time period between 13:00 and 14:59. It is unclear what caused this difference. However, interestingly, this period coincided with a rather sharp increase in ambient noise levels in the 0-2 kHz band recorded on the EAR at site B2 (Bridge Alignment Area) (Figure 25b). Daytime noise levels at site B2 were primarily contributed by anthropogenic activities, including those tied to construction, so it is possible that the reduced afternoon whistling and clicking rates occurred in response to this noise level increase. Overall, whistle rates were much lower during times when vessels were present, broadly across vessel distances from the dolphin group under investigation, indicating that that this lack of response to vessels (strong especially in the baseline phase vessel distance of 300-399 m category) may also be because construction activity "swamped out" any potential reaction to vessel noise. This assessment is made with caution, as sample sizes for the construction phase were lower than for baseline phase.

4.2. EAR data

As mentioned elsewhere, the stationary passive acoustic monitoring by Ecological Acoustic Recorders (EARs) is able to give calibrated overall ambient noise measurements at each site, and at the same time identify the number of click and whistle sounds made by dolphins, day and night and during inclement weather, often while vessel or shore-based observations (and vessel-based dipping hydrophone capability) are not possible. Recent analyses of data from a separate CWD project in Hong Kong waters indicates that dolphin sounds are recorded by EARs up to about 1 km distance, at times a bit more (Würsig, personal observation).

Sound pressure levels at the Fan Lau control site were approximately 3-7 dB re 1 μPa higher than levels measured concurrently at four other locations near the Hong Kong International Airport as part of a separate study, and approximately equivalent to levels measured near Sha Chau during an earlier study (Würsig and Greene 2002). They were also considerably higher in the "0-2 kHz" (which is actually about 20 Hz to 2 kHz) band than the about 96 dB re 1 μPa level of lower frequency shipping noise (at 125 Hz) measured in the Strait of Georgia, Canada (Merchant et al. 2012). While the latter is not directly comparable to the present data, it is instructive to consider the effects of low frequency “background” shipping noise of the Canadian study to that caused largely by high speed ferries at close distance. Individual high speed ferries of Hong Kong have sounds at about 115 dB re 1 μPa in broadband fashion from about 100 Hz to 10 kHz at about 400 m distance, and about 120 dB re 1 μPa (again, broadband from 100 Hz to 10 kHz) at 166 m distance, from the same hydrophone recording system as used for this study (Sims et al. 2012).

Dolphin acoustic activity/presence was higher at the control site (B1) during both phases of the study. During the construction phase, dolphin acoustic activity/presence was lower at both locations. This suggests that the changes observed at site B2 were, at least in part, driven by seasonal factors (e.g. fewer dolphins off west and northwest Lantau in April-July, differences in movement and/or acoustic behaviour, etc.). The reduction in both the number of encounters (as defined in section 2.4.2) and the encounter duration during the construction phase suggests that fewer or smaller groups occurred at both locations and that these spent less time signaling within range of the EAR. This observation is consistent with similar results obtained with the dipping hydrophone recordings, and similar to the lowered sighting rates of dolphin groups as made from shore-based theodolite tracking works as part of this bored piling monitoring programme.

Notably, dolphin detections were nearly absent at site B2 during the first week of April. This low level of occurrence was not observed at site B1 during either phase of the study nor at site B2 during the baseline phase and is therefore anomalous. This observation is consistent, however, with the low levels of acoustic activity observed on the dipping hydrophone data during March and thus may be further evidence of a stress response during the initial weeks following the start of construction in mid-March. Interestingly, acoustic activity levels increased during the third week of April, perhaps marking the start of the dolphin’s habituation to construction activities.

The diel acoustic activity of dolphins changed at both locations between the baseline and construction phases. However, the change was not uniform. At site B1 the shift was towards more daytime presence/activity, whereas at B2 nighttime acoustic activity between midnight and 8:00 nearly disappeared, despite having been the period of highest activity during the baseline phase. The reasons for these shifts are unclear. An examination of the ambient noise levels reveals that at both locations levels increased substantially during the construction phase as a result of the evening biological chorus and, at site B2, due to daytime anthropogenic noise. However, no clear correlation (either positive or negative) with dolphin acoustic activity/presence is apparent. In other words, periods of high or low dolphin detections did not coincide with the maxima or minima in ambient noise levels. Therefore, it may be concluded that non-acoustic factors (e.g. a shift in prey species availability, altered movement patterns, etc.) were involved in driving the observed changes.

Lastly, it should be noted that an alternative explanation for the observations described is that site B1 was not a true ‘control’ site. If a sufficiently strong behavioural response to construction activities took place, it may be that the effects were observed as far away as site B1. There is presently no evidence to support or refute this scenario, but it should be kept in mind. An analysis of data from other EAR recorders deployed around Hong Kong around the same time frame could shed additional light on this issue, when those data become publicly available for further investigation.

5. CONCLUSION & EVENT AND ACTION PLAN

There were fewer EAR-derived CWD sound events during than before the construction phase directly off the B2 EAR, Bridge Alignment Area. This agrees with fewer sightings and focal follows from shore at the same time. An elevated noise level especially in frequency bands at and below 8 kHz in daytime was linked in part to construction phase noise (and in the afternoon, due to very loud chorusing by some species of fish or fishes during the construction phase, mainly at and below 2 kHz). Concomitantly, there was a reduction in overall numbers of sounds, and in social whistling sounds especially during the initial phase of construction, the latter as determined by dipping hydrophone. It is therefore likely that the differences in occurrence and sound patterns were at least in part due to the construction activities, but it is also recognized that seasonality changed, including the addition of strong seasonal fish chorusing, and that other than anthropogenic influences may also have been of importance.

For the implementation of Event and Action Plan, the values of two response variables (clicking and whistling rates) as a function of the size of dolphin group, their behavioural state and time of day deduced from the calibrated hydrophone data are calculated for both baseline and impact monitoring periods, and are compared in Table 1. According to the Event and Action Plan shown in Table 2, all response variables described above are taken in to account, and departures of any of these variables between baseline and construction phases with a 20% difference will trigger the Action Level under the EAP. If a 40% difference in any of these variables between baseline and construction phases is detected, then the Limit Level under the EAP should be triggered and immediate action will be required.

All variables that have triggered the Action and Limit Levels are highlighted in Table 1, and statistical analyses are performed to confirm whether significant differences have been detected. In total, there were four Action Level (AL) exceedances and four Limit Level (LL) exceedances in the clicking rates, while there were three AL exceedances and seven LL exceedances in the whistling rates. However, as described in Section 3.2.3., the only significant differences were found in both the whistling and clicking rates recorded in the afternoon time period between 13:00 and 14:59, that significant lower rates were observed during the construction phase. It should be cautioned though, that the sample sizes for these comparisons were more than twice as large during the baseline phase. Notably, even though a number of variables have triggered the Action and Limit Levels with large differences observed between the baseline and impact monitoring phases, no significant differences were found due to small sample sizes recorded in the impact monitoring period.

Another aspect of the Event and Action Plan is to examine the change of 24-hour pattern of dolphin acoustic activity, and the response variable for the EAR data would be the hours in peak occurrence at the two sites: 0:00-01:00 at Site B2 (Bridge Alignment Area) and 06:00-07:00 at Site B1 (Fan Lau). If a shift of 3 hours or more in peak occurrence at Site B2, the Action Level should be triggered. If a shift of 6 hours or more in peak occurrence at Site B2 occurs, the Limit Level should be triggered. However, if there is a shift in peak occurrence in both Site B2 (00:00-01:00) and Site B1 (06:00-07:00), the action or limit level should not be triggered, as the change in peak occurrence does not only occur at the site of impact (Site B2) but also at the control site (Site B1), and the changes in peak occurrences of dolphins at both sites may not be directly to the HKLR09 construction works.

In examination of the EAR data collected during impact monitoring period, the peak occurrence of dolphins occurred at 20:00-21:00 at Site B2, and there was a shift of four hours from the peak occurrence during the baseline period (i.e. 0:00-01:00). However, the peak occurrence of dolphins at Site B1 also experienced a shift of eight hours from 06:00-07:00 in baseline period to 14:00-15:00 in impact monitoring period. Therefore, no triggering of the Action and Event Plan would be needed as both the impact and control sites experienced changes in peak occurrence of dolphins, which may not be directly related to the HKLR09 construction works.

Nevertheless, it should be noted that significantly fewer detections and lower occurrence of recordings with dolphin clicks and whistles were found in the EAR data during the impact phase, and a significant shift of dolphin acoustic activity also occurred at both sites, to coincide with the significant increase in ambient noise at both sites during construction phase. Therefore, it is still possible that the construction activities of HKLR09 may have caused an adverse impact to alter the acoustic behaviours of dolphins.

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Table 1. Values of the two response variables of dolphin acoustic behaviour collected by calibrated hydrophone (average clicks and whistles per minutes) by size of group, behavioural state and time of day during baseline and impact monitoring periods.

(The numerical values highlighted in blue indicated that the values recorded in impact monitoring period have triggered the Action Level (20% higher or lower than the baseline period), while the ones highlighted in red indicated a triggering of Limit Level (40% higher or lower than the baseline period). Only the cells highlighted in yellow have found significant differences between the values recorded in impact and baseline monitoring periods, while no significant difference was found in other comparisons even though some have triggered the Action or Limit Level.)

		Average clicks per minute (± s.d.)	Average whistles per minute (± s.d.)
Group Size			
1 dolphins	Baseline	62.19 ± 77.73 (n=21)	0.21 ± 1.49 (n=19)
	Impact	119.11 ± 201.67 (n=11)	0.13 ± 0.30 (n=11)
2-5 dolphins	Baseline	54.03 ± 179.32 (n=82)	0.56 ± 1.70 (n=126)
	Impact	54.17 ± 95.45 (n=46)	0.09 ± 0.20 (n=46)
6-9 dolphins	Baseline	118.00 ± 310.31 (n=23)	1.58 ± 4.63 (n=38)
	Impact	106.06 ± 199.58 (n=26)	0.97 ± 1.99 (n=26)
10+ dolphins	Baseline	289.33 ± 140.58 (n=20)	2.74 ± 1.99 (n=36)
	Impact	n/a	n/a
Behavioural State			
Feeding	Baseline	30.95 ± 69.90 (n=16)	0.62 ± 1.33 (n=29)
	Impact	19.30 ± 29.62 (n=11)	0.16 ± 0.26 (n=11)
Milling	Baseline	71.29 ± 205.44 (n=90)	0.66 ± 1.85 (n=139)
	Impact	80.09 ± 136.86 (n=54)	0.18 ± 0.60 (n=54)
Socializing	Baseline	287.48 ± 326.22 (n=20)	3.78 ± 4.14 (n=26)
	Impact	213.12 ± 309.71 (n=7)	2.48 ± 3.16 (n=7)
Traveling	Baseline	13.16 ± 208.94 (n=11)	0.25 ± 1.48 (n=12)
	Impact	52.34 ± 32.53 (n=7)	0.17 ± 0.29 (n=7)
Resting	Baseline	0.10 ± 70.35 (n=2)	0.13 ± 1.43 (n=6)
	Impact	n/a	n/a
Time of day			
09:00-10:59	Baseline	38.14 ± 69.90 (n=15)	0.70 ± 1.33 (n=29)
	Impact	74.39 ± 124.79 (n=31)	0.32 ± 0.75 (n=31)
11:00-12:59	Baseline	79.97 ± 144.51 (n=68)	0.68 ± 1.86 (n=94)
	Impact	110.73 ± 218.62 (n=26)	0.66 ± 1.78 (n=26)
13:00-14:59	Baseline	159.41 ± 303.43 (n=44)	1.74 ± 3.80 (n=62)
	Impact	43.35 ± 72.50 (n=17)	0.03 ± 0.08 (n=17)
15:00-16:59	Baseline	65.40 ± 140.58 (n=17)	1.16 ± 1.99 (n=36)
	Impact	49.90 ± 69.04 (n=12)	0.42 ± 1.20 (n=12)

Table 2. Event and Action Plan on Dolphin Acoustic Behaviour

EVENT	ACTION			
	ET Leader	**IEC**	**SO**	**Contractor**
Action Level With the numerical values presented in Table 1, when any of the response variable for dolphin acoustic behaviour recorded in the construction phase monitoring is **20% lower or higher** than that recorded in the baseline monitoring, or when there is a shift of **3 hours or more** in peak occurrence at B2 Site (i.e. 00:00 – 01:00), the action level should be triggered	1. Repeat statistical data analysis to confirm findings; 2. Review all available and relevant data to ascertain if differences are as a result of natural variation or seasonal differences; 3. Identify source(s) of impact; 4. Inform the IEC, SO and Contractor; 5. Check monitoring data; 6. Carry out audit to ensure all dolphin protective measures are implemented fully and additional measures be proposed if necessary	1. Check monitoring data submitted by ET and Contractor; 2. Discuss monitoring with the ET and the Contractor;	1. Discuss with the IEC the repeat monitoring and any other measures proposed by the ET; 2. Make agreement on measures to be implemented.	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose measures to the IEC and the SO; 3. Implement the agreed measures.
Limit Level With the numerical values presented in Table 1, when any of the response variable for dolphin acoustic behaviour recorded in the construction phase monitoring is **40% lower or higher** than that recorded in the baseline monitoring, or when there is a shift of **6 hours or more** in peak occurrence at B2 Site (i.e. 00:00 – 01:00), the limit level should be triggered	1. Repeat statistical data analysis to confirm findings; 2. Review all available and relevant data to ascertain if differences are as a result of natural variation or seasonal differences; 3. Identify source(s) of impact; 4. Inform the IEC, SO and Contractor; 5. Check monitoring data; 6. Carry out audit to ensure all dolphin protective measures are implemented fully and additional measures be proposed if necessary 7. Discuss additional dolphin monitoring and any other potential mitigation measures (e.g. consider to temporarily stop relevant portion of construction activity) with the IEC and Contractor.	1. Check monitoring data submitted by ET and Contractor; 2. Discuss monitoring with the ET and the Contractor; 3. Review proposals for additional monitoring and any other measures submitted by the Contractor and advise ER accordingly.	1. Discuss with the IEC the repeat monitoring and any other measures proposed by the ET; 2. Make agreement on measures to be implemented.	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Discuss with the ET and the IEC and propose measures to the IEC and the SO; 3. Implement the agreed measures.

Abbreviations: ET – Environmental Team, IEC – Independent Environmental Checker, SO – Supervising Office

Table 3. Summary of statistical comparisons of baseline and construction phases for vessel-based calibrated hydrophone recordings.

Parameter (units)	Time Periods compared	Mean (SD)	N	Test, statistic	P-value
averaged daily whistle rate (whistles/minute)	Construction (Mar-Apr)	0.1 (0.23)	13	Mann-Whitney U Test, Z = 1.958	0.04
	Construction (July)	0.27 (0.34)	12		
averaged daily click rate (clicks/minute)	Construction (Mar-Apr)	12.5 (24.9)	13	Mann-Whitney U Test, Z = 3.698	< 0.001
	Construction (July)	94.6 (60.8)	12		
Encounter rate (sightings/day)	Baseline	3.63 (1.84)	27	Mann-Whitney U Test, Z = 3.443	< 0.001
	Construction (entire)	2.04 (1.14)	25		
Group size (no. of animals)	Baseline	4.6 (3.7)	114	Mann-Whitney U Test, Z = 0.084	0.933
	Construction (entire)	4.0 (2.1)	62		
click rate (clicks/minute), group size = 1	Baseline	62.19 (77.73)	19	Mann-Whitney U Test, Z = 1.869	0.061
	Construction (entire)	119.11 (201.67)	11		
Whistle rate (whistles/minute), group size = 2-5	Baseline	0.56 (1.7)	126	Mann-Whitney U Test, Z = 1.427	0.154
	Construction (entire)	0.09 (0.20)	46		
click rate (clicks/min), dist. to nearest vessel = 300-399 m	Baseline	342.25 (527.43)	5	Mann-Whitney U Test, Z = 0.796	0.426
	Construction (entire)	13.40 (19.06)	10		
whistle rate (whistles/minute), 13:00-14:59	Baseline	1.74 (3.8)	62	Mann-Whitney U Test, Z = 3.564	< 0.001
	Construction (entire)	0.03 (0.08)	17		
click rate (clicks/minute), 13:00-14:59	Baseline	159.41 (303.43)	44	Mann-Whitney U Test, Z = 5.035	< 0.001
	Construction (entire)	43.35 (72.50)	17		
averaged daily whistle rates (whistles/minute)	Baseline	1.00 (0.99)	27	Mann-Whitney U Test, Z = 4.432	< 0.001
	Construction (entire)	0.18 (0.30)	25		
averaged daily click rates (clicks/minute)	Baseline	86.4 (90.8)	20	Mann-Whitney U Test, Z = 1.599	0.11
	Construction (entire)	51.9 (61.3)	25		
averaged daily click rates	Baseline	86.4 (90.8)	20	Mann-Whitney U Test, Z = 3.316	0.001
	Construction (Mar-Apr)	12.5 (24.9)	13		

Table 4. Statistical comparisons of baseline and construction phases for EAR recordings.

Parameter	Time Periods compared	Mean (SD)	N	Test, statistic	P-value
B1 daily # of files with dolphins	Baseline	49.1 (42.2)	19	Mann-Whitney U Test, Z = 4.309	< 0.001
	Construction (entire)	10.8 (9.6)	30		
B2 daily # of files with dolphins	Baseline	16.8 (15.2)	19	Mann-Whitney U Test, Z = 4.155	< 0.001
	Construction (entire)	3.1 (4.5)	30		
B1 daily number of encounters	Baseline	6.4 (3.2)	19	Mann-Whitney U Test, Z = 2.452	0.014
	Construction (entire)	4.2 (2.0)	30		
B2 daily number of encounters	Baseline	4.1 (2.3)	19	Mann-Whitney U Test, Z = 3.919	< 0.001
	Construction (entire)	1.5 (1.5)	30		
B1 encounter duration	Baseline	49.7 (46.1)	19	Mann-Whitney U Test, Z = 3.611	< 0.001
	Construction (entire)	16.6 (13.0)	30		
B2 encounter duration	Baseline	22.1 (13.5)	19	Mann-Whitney U Test, Z = 3.817	< 0.001
	Construction (entire)	8.1 (9.0)	30		
B1 detections by hour of day	Baseline	38.3 (17.4)	24	Wilcoxon Matched Pairs Test, T = 12.5	< 0.001
	Construction (entire)	13.5 (8.9)	24		
B2 detections by hour of day	Baseline	14.6 (13.5)	24	Wilcoxon Matched Pairs Test, T = 17.5	< 0.001
	Construction (entire)	4.0 (4.7)	24		
B1 average full-band RMS sound pressure level hourly mean	Baseline	109.8 (2.60)	430	Two-sample T-test, T = 27.1	< 0.001
	Construction (entire)	114.7 (3.45)	710		
B2 average full-band RMS sound pressure level hourly mean	Baseline	101.2 (2.98)	185	Two-sample T-test, T = 27.7	< 0.001
	Construction (entire)	110.8 (7.18	694		

Appendix I: The Ecological Acoustic Recorder's hydrophone specifications

SENSOR Sensor Technology Limited

SQ26 Seismic & Towed Array Hydrophone **HYDROPHONES**

FEATURES
- Low cost
- Rugged
- Good depth capability

APPLICATIONS
- General-purpose research
- Towed arrays

OVERVIEW

The SQ26 is a general-purpose low-cost hydrophone. It has good sensitivity, wide bandwidth and good stability. Custom configurations of these hydrophones are also available. For additional data on frequency response or outline drawings, please call our technical support.

All parameters measured after hydrophones have been subjected to pressures of 200 bar. The polyurethane-encapsulated hydrophone will withstand continuous immersion in isoparaffinic hydrocarbon fluids and sea water.

SPECIFICATIONS

Voltage sensitivity:	-193.5 ± 1.0 dBV re 1 μPa @ 20 °C, 20 V/bar
Charge sensitivity:	24 nC/bar
Capacitance:	1.4 nF ± 10 % @ 20 °C
Capacitance variation with temperature:	0.33% increase per °C
Capacitance variation with depth:	7% loss per 1,000 m (3,300 ft)
Operating depth:	down to 2,000 m
Frequency response:	flat from 1 Hz to 28,000 Hz
Acceleration sensitivity:	< 0.2 mbar/g when properly mounted
Diameter:	28.7 mm (1.13")
Length:	30.5 mm (1.20") max.
Mass:	16 grams (0.56 oz)
Electrical leads:	two red and black stranded, 28AWG 15 cm (6") long, Hytrel-insulated leads
Electrical insulation:	> 500 M Ohms
Water blocked leads:	Yes
	Also available with integral shield in a low noise configuration (SQ26-01)

ISO 9001:2000 REGISTERED

Established in 1983

20 Stewart Rd, Collingwood, ON, Canada L9Y 4K1
Tel: (705) 444-1440 Fax: (705) 444-6787
www.sensortech.ca techsupport@sensortech.ca

Appendix II: The calibrated hydrophone specifications and calibration record. The CR1 hydrophone of the left column below was used for these data. The Sensor Technology calibration report highlights the CR1 (serial Number CR1-12161-04) used for this report.

CETACEAN RESEARCH TECHNOLOGY

HYDROPHONE SPECIFICATIONS

Model Number	CR1	CR2	CR3
Linear Frequency Range (±3dB) [kHz]	0.0002† – 48	0.002† – 28	0.0004† – 77
Useable Frequency Range (+3/-12dB) [kHz]	0.00005† – 68	0.0004† – 60	0.0001† – 240
Sensitivity [dB, re 1V/μPa]	-198‡	-214	-210‡
SPL Equiv. Noise at 1kHz [dB, re 1μPa/√Hz]	38 (< *Sea State Zero*)	68	57
Maximum Operating Depth [m]	100	460	250
Operating Temperature Range [ºC]	-25 to 60‡	-40 to 70	-40 to 90‡
Capacitance [nF]	10	0.82	4.0
Dimensions [mm]	73L x 32 dia.	56L x 14 dia.	50L x 18 dia.
Coaxial Cable Length [m]	15	10	15
Directionality	Omni below 10kHz	Omni below 10kHz	Omnidirectional
Base Price [US dollars]	Please contact us	crtinfo [at] cetaceanresearch dot com	206-297-1310

† Requires a preamplifier with 100MΩ input impedance, such as VP2000. If a preamplifier with 1MΩ input impedance is used, such as PC200, then the low frequency -3dB point will be increased by a factor of 100 (e.g. 2Hz instead of 0.02Hz). ‡ Hydrophone is spot calibrated at the factory; calibration is guaranteed between -5C and 30C. Calibrated frequency response measurements can be performed for an additional fee.

Appendix II (cont'd)

SENSOR TECHNOLOGY LTD

TEST REPORT

Page 1 of 1

Work Order # **12161**
Date **31-Aug-12**

Tested in air at 46Hz

Part # **CR1 with 15m cable**

Serial #	Sensitivity (dB)	Capacitance	Dissipation (%)
✓ CR1-12161-01	-197.27	10.5	1.63
CR1-12161-02	-197.58	10.41	1.596
✓ CR1-12161-03	-197.22	10.37	1.563 *
CR1-12161-04	-197.46	10.44	1.158
✓ CR1-12161-05	-197.59	10.45	1.848
CR1-12161-06	-197.78	10.34	1.339
CR1-12161-07	-197.03	10.28	1.482
✓ CR1-12161-08	-197.44	10.39	1.515 *
CR1-12161-09	-197.63	10.41	1.007
✓ CR1-12161-10	-197.53	10.42	1.351 *
✓ CR1-12161-11	-197.43	10.43	1.705 *

* Cables cut to 4m.
Decrease capacitance by 0.7nF
Increase sensitivity by 0.6dB

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Appendix III. Construction Phase Monitoring on Acoustic Monitoring in relation to HKLR bored-piling works

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1-Mar	*2-Mar*
					EAR deployed no bored piling work	EAR deployed no bored piling work
3-Mar	*4-Mar*	*5-Mar*	*6-Mar*	*7-Mar*	*8-Mar*	*9-Mar*
EAR deployed no bored piling work	EAR deployed no bored piling work	EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work
10-Mar	*11-Mar*	*12-Mar*	*13-Mar*	*14-Mar*	*15-Mar*	*16-Mar*
EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed no bored piling work
17-Mar	*18-Mar*	*19-Mar*	*20-Mar*	*21-Mar*	*22-Mar*	*23-Mar*
Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed bored piling site monitored: P48	Acoustic Survey; EAR deployed bored piling site monitored: P48	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52
24-Mar	*25-Mar*	*26-Mar*	*27-Mar*	*28-Mar*	*29-Mar*	*30-Mar*
Acoustic Survey; EAR deployed no bored piling work	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	EAR deployed no bored piling work	Acoustic Survey; EAR deployed bored piling site monitored: P52	Acoustic Survey; EAR deployed bored piling site monitored: P52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	Acoustic Survey; EAR deployed no bored piling work

Appendix III. (cont'd)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31-Mar	*1-Apr*	*2-Apr*	*3-Apr*	*4-Apr*	*5-Apr*	*6-Apr*
EAR deployed no bored piling work	Acoustic Survey; EAR deployed bored piling site monitored: P52	Acoustic Survey; EAR deployed bored piling site monitored: P52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	bored piling site monitored: P48/52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	bored piling site monitored: P48/52
7-Apr	*8-Apr*	*9-Apr*	*10-Apr*	*11-Apr*	*12-Apr*	*13-Apr*
Acoustic Survey; EAR deployed bored piling site monitored: P52	Acoustic Survey; EAR deployed bored piling site monitored: P48/52	bored piling site monitored: P48/52	Acoustic Survey bored piling site monitored: P48/52	Acoustic Survey bored piling site monitored: P48	bored piling site monitored: P48	bored piling site monitored: P48/52
14-Apr	*15-Apr*	*16-Apr*	*17-Apr*	*18-Apr*	*19-Apr*	*20-Apr*
no bored piling work	bored piling site monitored: P48/50/52	bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P50/52
21-Apr	*22-Apr*	*23-Apr*	*24-Apr*	*25-Apr*	*26-Apr*	*27-Apr*
EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52
28-Apr	*29-Apr*	*30-Apr*				
EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P48/50/52	EAR deployed bored piling site monitored: P48/50/52				

Appendix III. (cont'd)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1-Jul	*2-Jul*	*3-Jul*	*4-Jul*	*5-Jul*	*6-Jul*
	no bored piling work	no bored piling work	no bored piling work	no bored piling work	EAR deployed no bored piling work	EAR deployed no bored piling work
7-Jul	*8-Jul*	*9-Jul*	*10-Jul*	*11-Jul*	*12-Jul*	*13-Jul*
EAR deployed no bored piling work	EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P50/52
14-Jul	*15-Jul*	*16-Jul*	*17-Jul*	*18-Jul*	*19-Jul*	*20-Jul*
EAR deployed bored piling site monitored: P50	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P50/52	EAR deployed no bored piling work
21-Jul	*22-Jul*	*23-Jul*	*24-Jul*	*25-Jul*	*26-Jul*	*27-Jul*
EAR deployed no bored piling work	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	Acoustic Survey; EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P50/52
28-Jul	*29-Jul*					
EAR deployed bored piling site monitored: P50/52	EAR deployed bored piling site monitored: P48/50					

Appendix IV. Bored Piling Activities at P48, P50 & P52 conducted in March-July 2013

Date	Location	Day/Night	Bored Piling Activities
18-Mar-13	P48	Day	Commencement of inserting permanent casting for bored pile no. P48-R3
19-Mar-13	P48	Day	Installation of permanent casting for bored pile no. P48-R3
20-Mar-13	P48	Day	Installation of permanent casing for bored pile no. P48-R2 & P48-L2
	P52	Day	Commencement of installing permanent casting of bored pile no. P52-R3
21-Mar-13	P48	Day	Installation of permanent casting for bored pile no. P48-L1, P48-R1 & P48-L3
	P52	Day	Installation of permanent casing for bored pile no. P52-R3
22-Mar-13	P48	Day	Installation of permanent casing for bored pile in progress, extend casing to P48-L2 & P48-R1
	P52	Day	Installation of permanent casing for bored pile no. P52-R4
23-Mar-13	P48	Day	Installation of permanent casting for bored pile no. P48-R1, P48-L1 & P48-L3
	P52	Day	Installation of permanent casting for bored pile no. P52-R2 & P52-R4
25-Mar-13	P48	Day	Installation of permanent casting for bored pile no. P48-R1, P48-R2, P48-R3, P48-L1 P48-L2 & P48-L3
	P52	Day	Installation of permanent casting for bored pile no. P52-R1
27-Mar-13	P52	Day	Installation of permanent casting for bored pile no. P52-R1 & P52-L2
28-Mar-13	P52	Day	Installation of permanent casting for bored pile no. P52-L1
29-Mar-13	P48	Day	Adjust permanent casing for bored pile no. P48-L2 & P48-R1
	P52	Day	Installation of permanent casting for bored pile no. P52-L1, P52-L2, P52-L3 & P52-L4
1-Apr-13	P52	Day	Installation of permanent casing for bored pile no. P52-L3 & P52-L4.
2-Apr-13	P52	Day	Installation of permanent casing for bored pile.
3-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile no. P52-R1, P52-R2, P52-R3, P52-R4, P52-L1, P52-L2, P52-L3 & P52-L4.
4-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
5-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
6-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
7-Apr-13	P52	Day	Excavation for bored pile no. P52-R2 and P52-R3 in progress.
8-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile in progress.
9-Apr-13	P48	Day	Set up for bored pile excavation at P48-L1.
	P52	Day	Excavation for bored pile in progress.
10-Apr-13	P48	Day	Commencement of bored pile excavation at P48-L1.
	P52	Day	Excavation at P52-R2.
11-Apr-13	P48	Day	Bored pile excavation at P48-L1 in progress.
12-Apr-13	P48	Day	Bored pile excavation at P48-L1 in progress.
13-Apr-13	P48	Day	Bored pile excavation at P48-L1 in progress.
	P52	Day	Set up RCD for bored pile excavation at P52-R4.

Appendix IV. (cont'd)

Date	Location	Day/Night	Bored Piling Activities
15-Apr-13	P48	Day	Bored pile excavation at P48-L1 completed & excavation at P48-R1 commenced.
	P50	Day	Preparation work for install RCD to permanent casing of bored pile.
	P52	Day	Commenced drilling for bored pile no. P52-R4 by RCD.
16-Apr-13	P48	Day	Bored pile excavation at P48-R1 in progress.
	P50	Day	Preparation work for install RCD to permanent casing of bored pile.
	P52	Day	Drilling for bored pile no. P52-R4 by RCD. Excavation for bored pile no. P52-L3 & L4 by grab.
		Night	Drilling for bored pile no. P52-R4 by RCD. Shifting of RCD from bored pile P52-R4 to P52-R3.
17-Apr-13	P48	Day	Bored pile excavation at P48-R1 in progress.
	P50	Day	Commenced excavation for bored pile no. P50-L4 by grab.
	P52	Day	Drilling for bored pile no. P52-R3 by RCD.
		Night	Drilling for bored pile no. P52-R3 by RCD.
18-Apr-13	P48	Day	Bored pile excavation at P48-R1 in progress.
	P50	Day	Excavation for bored pile P50-L2 by grab.
		Night	Drilling for bored pile no. P50-L2 by RCD.
	P52	Day	Drilling for bored pile no. P52-R3 by RCD.
		Night	Drilling for bored pile no. P52-R1 & R3 by RCD. 2 nos. of RCDs delivery on site.
19-Apr-13	P48	Day	Bored pile excavation at P48-R1 in progress.
	P50	Day	Drilling for bored pile P50-L2 by RCD.
		Night	Drilling for bored pile no. P50-L2 by RCD. Excavation for bored pile at P50-L3 by grab.
	P52	Day	Drilling for bored pile no. P52-R3 by RCD finish.
		Night	Preparation work for installation of RCD to P52-L4.
20-Apr-13	P50	Day	Drilling for bored pile P50-L2 by RCD. Excavation for bored pile P50-L4 by grab.
		Night	Drilling for bored pile P50-L3 by RCD. Excavation for bored pile P50-L1 by grab.
	P52	Day	Shifting of RCD from bored pile P52-R3 to P52-R1. Drilling for bored pile no. P52-R1 & L4 by RCD.
		Night	Drilling for bored pile no. P52-R1 & L4 by RCD.
21-Apr-13	P50	Day	Excavation for bored pile P50-L2 by RCD.
	P52	Day	Drilling for bored pile P52-R4 & P52-L4 by RCD.
22-Apr-13	P50	Day	Drilling for bored pile P50-L4 by RCD. Shifting RCD from bored pile P50-L4 to P50-L2.
		Night	Drilling for bored pile P50-L4 by RCD.
	P52	Day	Drilling for bored pile P52-R1 & P52-L4 by RCD.
		Night	Drilling for bored pile P52-R1 & P52-L4 by RCD.
23-Apr-13	P48	Day	Installation of rebar cage for bored pile no. P48-L1.
	P50	Night	Drilling for bored pile P50-L2 by RCD.
	P52	Day	Drilling for bored pile P52-R1 & P52-L4 by RCD.
		Night	Drilling for bored pile P52-R1 by RCD finish. Air-lifting & install cage for P52-R3.

Appendix IV. (cont'd)

Date	Location	Day/Night	Bored Piling Activities
24-Apr-13	P48	Day	Concreting for bored pile P48-L1.
	P50	Day	Drilling for bored pile P50-L2 by RCD.
		Night	Drilling for bored pile P50-L2 by RCD.
	P52	Day	Drilling for bored pile P52-L4 by RCD. Install steel cage for P52-R3.
		Night	Install steel cage for P52-R3.
25-Apr-13	P48	Day	Air-lifting for bored pile P48-R1.
		Night	Installation of bottom cage for P48-R1.
	P50	Day	Drilling for bored pile P50-L2 by RCD.
		Night	Drilling for bored pile P50-L2 by RCD finish.
	P52	Day	Concreting for bored pile P52-R3.
		Night	Drilling for bored pile P52-L4.
26-Apr-13	P48	Day	Installation of rebar cage (2nd & top) for P48-R1.
		Night	Installation of rebar cage for P48-R1. Preparation works for concreting of P48-R1.
	P50	Day	Drilling for bored pile P50-L4 by RCD.
		Night	Air-lifting for bored pile P50-L2.
	P52	Day	Install steel cage for P52-R3.
		Night	Install steel cage for P52-R1. Drilling for bored pile P52-L2.
27-Apr-13	P48	Day	Salvage rebar cage at P48-R1.
		Night	Salvage rebar cage at P48-R1.
	P50	Day	Install steel cage for bored pile P50-L2.
		Night	Drilling for bored pile P50-L4 by RCD.
	P52	Day	Drilling for bored pile P52-L2 by RCD.
		Night	Splicing permanent casing bored pile P52-L4.
28-Apr-13	P50	Day	Drilling for bored pile P50-L4 by RCD finish. Install steel cage for bored pile P50-L2.
		Night	Install steel cage for bored pile P50-L2.
	P52	Day	Drilling for bored pile P52-L2 by RCD. Install steel cage for bored pile P52-R1.
		Night	Splicing permanent casing bored pile P52-L2.
29-Apr-13	P48	Day	Salvage rebar cage at P48-R1.
		Night	Air-lifting for bored pile P48-R1.
	P50	Day	Install steel cage for bored pile P50-L2.
		Night	Set up for final air-lifting for bored pile P50-L2.
	P52	Day	Drilling for bored pile P52-L4 by RCD. Concreting to bored pile P52-R1.
		Night	Drilling for bored pile P52-L4 by RCD.

Appendix IV. (cont'd)

Date	Location	Day/Night	Bored Piling Activities
30-Apr-13	P48	Day	Air-lifting for bored pile P48-R1.
		Night	Install steel cage for bored pile P48-R1.
	P50	Day	Concreting for bored pile P50-L2.
		Night	Air-lifting for bored pile P50-L4.
	P52	Day	Drilling for bored pile P52-L2 by RCD finish. Drilling for bored pile P52-R4 by RCD.
		Night	Drilling for bored pile P52-R4 by RCD.
8-Jul-13	P50	Day	Excavation for bored pile P50-R2 by RCD. Splicing of permanent casing to bored pile P50-R3.
		Night	Set up RCD to bored pile P50-R1.
	P52	Day	Set up RCD to bored pile P52-L4. Excavation for bored pile P52-L1 by RCD.
		Night	Set up RCD to bored pile P52-L4. Excavation for bored pile P52-L1 by RCD.
9-Jul-13	P50	Day	Excavation for bored pile P50-R1 by RCD. Set up RCD to bored pile P50-R3.
		Night	Excavation for bored pile P50-R1 by RCD. Set up RCD to bored pile P50-R3.
	P52	Day	Set up RCD and excavation for bored pile P52-R4.
		Night	Installation of steel cage for bored pile P52-L4.
10-Jul-13	P50	Day	Excavation for bored pile P50-R4 by RCD.
		Night	Excavation for bored pile P50-R4 by RCD.
	P52	Day	Concreting to bored pile P52-L4.
		Night	Excavation for bored pile P52-R4 by RCD. Shifting of RCD from bored pile P52-R4 to P52-R2. Concreting to bored pile P52-L4.
11-Jul-13	P50	Day	Excavation for bored pile P50-R4 by RCD. Splicing of permanent casing to bored pile P50-R2.
		Night	Excavation for bored pile P50-L1 by RCD.
	P52	Day	Air-lifting, Koden test and installation of steel cage for bored pile P52-R4.
		Night	Installation of steel cage for bored pile P52-R4.
12-Jul-13	P50	Day	Excavation for bored pile P50-L1 by RCD.
		Night	Excavation for bored pile P50-L1 by RCD.
	P52	Day	Installation of steel cage and concreting to bored pile P52-R4.
		Night	Concreting to bored pile P52-R4. Excavation for bored pile P52-L1 by RCD.
13-Jul-13	P50	Day	Installation of steel cage for bored pile P50-R4.
	P52	Day	Excavation for bored pile P52-L1 by RCD.
		Night	Excavation for bored pile P52-R2 by RCD.
14-Jul-13	P50	Day	Installation of steel cage for bored pile P50-R4.
		Night	Installation of steel cage for bored pile P50-R4.
15-Jul-13	P50	Day	Installation of steel cage and concreting to bored pile P50-R4.
		Night	Concreting to bored pile P50-R4. General cleaning and tidying on barge.
	P52	Day	Excavation for bored pile P52-R2 by RCD.
		Night	Installation of steel cage for bored pile P52-L1.

Appendix IV. (cont'd)

Date	Location	Day/Night	Bored Piling Activities
16-Jul-13	P50	Day	Installation of steel cage for bored pile P50-L1. Set up RCD to bored pile P50-R1.
		Night	Installation of steel cage for bored pile P50-L1.
	P52	Day	Installation of steel cage and concreting to bored pile P52-L1.
		Night	Concreting to bored pile P52-L1. Set up RCD to bored pile P52-R2.
17-Jul-13	P50	Day	Installation of steel cage for bored pile P50-L1.
		Night	Installation of steel cage and tremie pipe for concreting for bored pile P50-L1.
	P52	Day	Set up RCD to bored pile P52-L3.
		Night	Preparation work of installation of steel cage for bored pile P52-R2.
18-Jul-13	P50	Day	Concreting to bored pile P50-L1.
		Night	No site activity.
	P52	Day	Set up RCD to bored pile P52-L3. Installation of rebar cage for bored pile P50-R2.
		Night	Air-lifting for bored pile P52-L3. Installation of rebar cage for bored pile P52-R2.
19-Jul-13	P50	Day	Excavation for bored pile P50-R1 and P50-R3 by RCD.
		Night	Excavation for bored pile P50-L3 by RCD.
	P52	Day	Installation of rebar cage for bored pile P52-R2 and P52-L3.
		Night	Installation of rebar cage for bored pile P52-R2 and P52-L3.
22-Jul-13	P50	Day	Excavation for bored pile P50-R1 by RCD. Installation of rebar cage and concreting to bored pile P50-L3.
		Night	Excavation for bored pile P50-R1 by RCD. Concreting to bored pile R50-L3.
	P52	Day	Preparation work for removal of Jacket Platform (LHS and RHS).
23-Jul-13	P50	Day	Excavation for bored pile P50-R1 by RCD.
		Night	Excavation for bored pile P50-R1 by RCD.
	P52	Day	Preparation work for removal of Jacket Platform (LHS and RHS).
24-Jul-13	P50	Day	Excavation for bored pile P50-R3 by RCD.
		Night	Excavation for bored pile P50-R3 by RCD.
	P52	Day	Preparation work for removal of Jacket Platform (LHS and RHS).
25-Jul-13	P50	Day	Excavation for bored pile P50-R3 by RCD. Installation of rebar cage to bored pile P50-R1.
		Night	Installation of rebar cage to bored pile P50-R1.
	P52	Day	Removal of pin piles of Jacket Platform (LHS and RHS).
26-Jul-13	P50	Day	Excavation for bored pile P50-R2 by RCD. Installation of rebar cage to bored pile P50-R1.
		Night	Excavation for bored pile P50-R3 by RCD. Installation of rebar cage to bored pile P50-R1.
	P52	Day	Removal of pin piles of Jacket Platform (LHS and RHS).
29-Jul-13	P48	Day	P48-L3 Excavation work by BG40.
	P50	Day	Splicing of permanent casing and set up RCD for bored pile P50-R3.
		Night	Excavation for bored pile P50-R3 by RCD.

Appendix V. Database for acoustic focal follow during construction phase monitoring

Date	Area	Stg#	File#	Hp Depth	Water Depth	ICP Gain	HPF	Time	Latitude	Longitude	Beau	Dolphin Grp Sz
18-Mar-13	NW LANTAU	1	7	4.0	6.9	x10	N	11:28	22.3330	113.8740	1	4
18-Mar-13	W LANTAU	4	8	7.0	13.0	x10	N	13:54	22.2572	113.8364	2	2
19-Mar-13	W LANTAU	2	3	7.0	10.3	x10	N	11:20	22.2761	113.8500	3	3
20-Mar-13	NW LANTAU	1	6	4.0	5.6	x10	N	11:18	22.3328	113.8798	2	3
22-Mar-13	NW LANTAU	1	7	4.0	7.1	x10	N	12:12	22.2934	113.8739	3	6
22-Mar-13	NW LANTAU	1	8	4.0	7.1	x10	N	12:19	22.2927	113.8731	3	6
22-Mar-13	NW LANTAU	1	9	4.0	7.1	x10	N	12:24	22.2920	113.8721	3	6
22-Mar-13	W LANTAU	2	10	7.0	13.5	x10	N	13:42	22.2548	113.8467	2	4
22-Mar-13	W LANTAU	2	11	7.0	13.5	x10	N	13:45	22.2549	113.8473	2	4
22-Mar-13	W LANTAU	2	12	7.0	14.2	x10	N	14:07	22.2593	113.8501	2	4
22-Mar-13	NW LANTAU	3	14	7.0	15.6	x10	N	15:26	22.2981	113.8769	2	9
24-Mar-13	NW LANTAU	1	9	4.0	6.9	x10	N	14:30	22.2943	113.8751	1	1
29-Mar-13	NW LANTAU	1	4	7.0	8.3	x10	N	10:33	22.3046	113.8760	2	1
2-Apr-13	W LANTAU	1	6	7.0	8.5	x10	N	12:01	22.2877	113.8698	2	1
2-Apr-13	W LANTAU	1	7	7.0	8.5	x10	N	12:06	22.2884	113.8700	2	1
9-Jul-13	W LANTAU	2	1	7.0	7.0	x10	N	9:40	22.2742	113.8758	2	2
9-Jul-13	W LANTAU	2	2	7.0	9.8	x10	N	9:59	22.2701	113.8694	2	2
9-Jul-13	W LANTAU	3	3	7.0	7.3	x10	N	10:14	22.2656	113.8630	2	2
9-Jul-13	W LANTAU	3	4	4.0	6.7	x10	N	10:25	22.2635	113.8613	2	1
9-Jul-13	W LANTAU	4	5	7.0	11.9	x10	N	10:41	22.2602	113.8518	2	1
9-Jul-13	W LANTAU	4	6	7.0	12.9	x10	N	10:46	22.2591	113.8504	2	9
9-Jul-13	W LANTAU	4	7	7.0	13.4	x10	N	10:51	22.2584	113.8495	2	9
9-Jul-13	W LANTAU	4	8	7.0	13.6	x10	N	10:57	22.2572	113.8484	2	6
9-Jul-13	W LANTAU	5	9	7.0	12.4	x10	N	11:49	22.2675	113.8519	2	6
9-Jul-13	W LANTAU	5	10	7.0	12.9	x10	N	11:55	22.2668	113.8516	2	4
11-Jul-13	W LANTAU	1	16	4.0	6.9	x10	N	9:43	22.2832	113.8781	2	7
11-Jul-13	W LANTAU	1	17	4.0	7.2	x10	N	9:56	22.2815	113.8759	2	4
11-Jul-13	W LANTAU	2	19	4.0	7.2	x10	N	10:23	22.2908	113.8794	1	6
11-Jul-13	W LANTAU	2	20	4.0	7.2	x10	N	10:29	22.2918	113.8800	1	6
11-Jul-13	W LANTAU	3	1	7.0	8.5	x10	N	11:45	22.3135	113.8666	1	6
11-Jul-13	W LANTAU	3	2	7.0	8.0	x10	N	12:08	22.3165	113.8696	2	6
11-Jul-13	W LANTAU	3	3	7.0	8.0	x10	N	12:13	22.3165	113.8696	2	6
11-Jul-13	W LANTAU	3	4	7.0	8.0	x10	N	12:19	22.3162	113.8693	2	6
11-Jul-13	W LANTAU	4	5	7.0	15.0	x10	N	14:03	22.2585	113.8479	3	4
11-Jul-13	W LANTAU	5	6	7.0	12.2	x10	N	14:51	22.2590	113.8501	3	7
11-Jul-13	W LANTAU	5	7	7.0	8.6	x10	N	14:58	22.2559	113.8492	3	7
12-Jul-13	W LANTAU	1	1	4.0	6.9	x10	N	9:43	22.2916	113.8817	2	6
12-Jul-13	W LANTAU	1	2	4.0	7.2	x10	N	9:53	22.2911	113.8807	2	6
12-Jul-13	W LANTAU	1	3	4.0	7.3	x10	N	10:11	22.2924	113.8801	2	3
12-Jul-13	W LANTAU	1	4	4.0	7.3	x10	N	10:17	22.2925	113.8800	2	3
12-Jul-13	W LANTAU	5	5	7.0	8.3	x10	N	10:42	22.2723	113.8686	1	3
12-Jul-13	W LANTAU	9	7	7.0	9.5	x10	N	11:42	22.2703	113.8698	1	6
12-Jul-13	W LANTAU	11	8	7.0	10.1	x10	N	12:09	22.2772	113.8566	1	2
15-Jul-13	W LANTAU	1	7	7.0	8.6	x10	N	12:33	22.2607	113.8543	2	3
15-Jul-13	W LANTAU	1	8	7.0	8.6	x10	N	12:38	22.2614	113.8554	2	1
15-Jul-13	W LANTAU	2	10	7.0	8.5	x10	N	14:00	22.2709	113.8702	2	1
15-Jul-13	W LANTAU	3	11	7.0	12.3	x10	N	15:35	22.3140	113.8858	2	3
16-Jul-13	W LANTAU	1	8	7.0	8.4	x10	N	15:32	22.2945	113.8613	1	7
16-Jul-13	W LANTAU	1	9	7.0	8.4	x10	N	15:45	22.2982	113.8553	1	7
17-Jul-13	W LANTAU	1	1	7.0	8.9	x10	N	10:00	22.2554	113.8498	2	2
18-Jul-13	W LANTAU	1	7	7.0	12.0	x10	N	12:49	22.2599	113.8506	2	2
22-Jul-13	W LANTAU	4	2	7.0	10.4	x10	N	11:04	22.2575	113.8507	2	5
22-Jul-13	W LANTAU	5	9	4.0	6.7	x10	N	15:27	22.3049	113.8657	2	3
23-Jul-13	W LANTAU	4	7	7.0	10.9	x10	N	13:30	22.2628	113.8541	2	6
23-Jul-13	W LANTAU	4	8	7.0	10.9	x10	N	13:35	22.2610	113.8518	2	4
23-Jul-13	W LANTAU	4	9	7.0	13.5	x10	N	13:41	22.2580	113.8487	2	4

Appendix V. (cont'd)

Date	Area	Stg#	File#	Hp Depth	Water Depth	ICP Gain	HPF	Time	Latitude	Longitude	Beau	Dolphin Grp Sz
24-Jul-13	W LANTAU	1	1	7.0	15.8	x10	N	10:13	22.2606	113.8487	2	5
24-Jul-13	W LANTAU	1	2	7.0	14.5	x10	N	10:18	22.2606	113.8474	2	5
24-Jul-13	W LANTAU	1	3	7.0	11.0	x10	N	10:36	22.2506	113.8459	2	5
24-Jul-13	W LANTAU	2	4	7.0	9.7	x10	N	11:09	22.2698	113.8691	1	1
24-Jul-13	W LANTAU	2	6	7.0	9.3	x10	N	11:49	22.2685	113.8693	2	1
24-Jul-13	W LANTAU	3	12	4.0	7.2	x10	N	15:49	22.2684	113.8686	2	1
25-Jul-13	W LANTAU	2	7	7.0	8.9	x10	N	12:37	22.2619	113.8573	2	3
25-Jul-13	W LANTAU	2	8	7.0	14.7	x10	N	13:13	22.2609	113.8504	2	3
25-Jul-13	W LANTAU	3	9	7.0	9.1	x10	N	13:33	22.2695	113.8690	2	1
26-Jul-13	W LANTAU	1	1	4.0	6.3	x10	N	10:05	22.2688	113.8679	2	4
26-Jul-13	W LANTAU	1	2	7.0	9.2	x10	N	10:28	22.2625	113.8574	2	4

Appendix VI. Sighting records of Chinese White Dolphins during construction phase acoustic monitoring

DATE	STG #	TIME	HRD SZ	AREA	BEAU	TYPE	LATITUDE	LONGITUDE	SEASON	BOAT ASSOC.	RECORDING
7-Mar-13	1	1434	4	W LANTAU	1	HKLR-A	22.2921	113.8497	SPRING	NONE	Y
8-Mar-13	1	1025	2	NW LANTAU	1	HKLR-A	22.3243	113.8754	SPRING	NONE	Y
8-Mar-13	2	1052	8	NW LANTAU	1	HKLR-A	22.3371	113.8708	SPRING	HANG	Y
9-Mar-13	1	1158	2	NW LANTAU	3	HKLR-A	22.3007	113.8587	SPRING	NONE	N
11-Mar-13	1	1258	4	W LANTAU	2	HKLR-A	22.2633	113.8465	SPRING	HANG	Y
11-Mar-13	2	1438	3	NW LANTAU	3	HKLR-A	22.3180	113.8629	SPRING	NONE	Y
12-Mar-13	1	1028	2	W LANTAU	2	HKLR-A	22.2605	113.8537	SPRING	NONE	Y
13-Mar-13	1	1006	5	W LANTAU	2	HKLR-A	22.2850	113.8838	SPRING	NONE	Y
13-Mar-13	2	1148	5	W LANTAU	2	HKLR-A	22.2677	113.8467	SPRING	NONE	Y
13-Mar-13	3	1553	3	W LANTAU	3	HKLR-A	22.2846	113.8642	SPRING	NONE	Y
15-Mar-13	1	1007	1	W LANTAU	2	HKLR-A	22.2662	113.8639	SPRING	NONE	N
15-Mar-13	2	1026	2	W LANTAU	1	HKLR-A	22.2531	113.8455	SPRING	HANG	N
15-Mar-13	3	1104	1	W LANTAU	2	HKLR-A	22.2400	113.8296	SPRING	NONE	N
15-Mar-13	4	1522	5	NW LANTAU	2	HKLR-A	22.3275	113.8681	SPRING	NONE	Y
15-Mar-13	5	1550	7	NW LANTAU	2	HKLR-A	22.3090	113.8660	SPRING	NONE	Y
17-Mar-13	1	1008	5	W LANTAU	2	HKLR-A	22.2620	113.8574	SPRING	NONE	Y
17-Mar-13	2	1042	4	W LANTAU	2	HKLR-A	22.2572	113.8504	SPRING	NONE	N
17-Mar-13	3	1106	4	W LANTAU	2	HKLR-A	22.2637	113.8522	SPRING	NONE	Y
17-Mar-13	4	1123	2	W LANTAU	2	HKLR-A	22.2679	113.8686	SPRING	NONE	N
18-Mar-13	1	1117	4	NW LANTAU	1	HKLR-A	22.3330	113.8742	SPRING	NONE	Y
18-Mar-13	2	1244	1	NW LANTAU	0	HKLR-A	22.3135	113.8591	SPRING	NONE	N
18-Mar-13	3	1326	1	W LANTAU	2	HKLR-A	22.2516	113.8437	SPRING	HANG	N
18-Mar-13	4	1340	2	W LANTAU	2	HKLR-A	22.2477	113.8337	SPRING	HANG	Y
18-Mar-13	5	1615	1	NW LANTAU	2	HKLR-A	22.2887	113.8902	SPRING	NONE	N
19-Mar-13	1	1026	1	W LANTAU	3	HKLR-A	22.2531	113.8455	SPRING	NONE	N
19-Mar-13	2	1110	3	W LANTAU	2	HKLR-A	22.2695	113.8560	SPRING	HANG	Y
20-Mar-13	1	1110	3	NW LANTAU	2	HKLR-A	22.3314	113.8796	SPRING	NONE	Y
20-Mar-13	2	1151	1	NW LANTAU	2	HKLR-A	22.2807	113.8770	SPRING	NONE	N
20-Mar-13	3	1219	1	NW LANTAU	2	HKLR-A	22.3020	113.8684	SPRING	NONE	N
22-Mar-13	1	1201	7	NW LANTAU	3	HKLR-A	22.2933	113.8665	SPRING	NONE	Y
22-Mar-13	2	1331	4	W LANTAU	2	HKLR-A	22.2526	113.8429	SPRING	NONE	Y
22-Mar-13	3	1519	12	NW LANTAU	2	HKLR-A	22.2943	113.8747	SPRING	NONE	Y

Appendix VI. (cont'd)

DATE	STG #	TIME	HRD SZ	AREA	BEAU	TYPE	LATITUDE	LONGITUDE	SEASON	BOAT ASSOC.	RECORDING
24-Mar-13	1	1421	1	NW LANTAU	0	HKLR-A	22.2931	113.8775	SPRING	NONE	Y
24-Mar-13	2	1443	3	W LANTAU	1	HKLR-A	22.2989	113.8611	SPRING	NONE	N
24-Mar-13	3	1448	1	NW LANTAU	1	HKLR-A	22.3046	113.8611	SPRING	NONE	N
24-Mar-13	4	1509	1	NW LANTAU	1	HKLR-A	22.2908	113.8813	SPRING	NONE	N
28-Mar-13	1	1444	4	NW LANTAU	2	HKLR-A	22.2945	113.8732	SPRING	NONE	N
29-Mar-13	1	1032	1	NW LANTAU	2	HKLR-A	22.3052	113.8764	SPRING	NONE	Y
29-Mar-13	2	1039	1	W LANTAU	2	HKLR-A	22.3130	113.8769	SPRING	NONE	N
29-Mar-13	3	1245	1	W LANTAU	2	HKLR-A	22.2777	113.8558	SPRING	NONE	N
29-Mar-13	4	1447	1	NW LANTAU	2	HKLR-A	22.2923	113.8722	SPRING	NONE	N
2-Apr-13	1	1154	1	W LANTAU	2	HKLR-A	22.2868	113.8699	SPRING	GILLNET	Y
7-Apr-13	1	1211	1	NW LANTAU	2	HKLR-A	22.3205	113.8692	SPRING	NONE	N
7-Apr-13	2	1223	2	NW LANTAU	2	HKLR-A	22.3282	113.8696	SPRING	NONE	N
7-Apr-13	3	1502	3	NW LANTAU	2	HKLR-A	22.3035	113.8528	SPRING	NONE	N
9-Jul-13	1	0919	2	NW LANTAU	2	HKLR-A	22.2903	113.8930	SUMMER	NONE	N
9-Jul-13	2	0934	4	NW LANTAU	2	HKLR-A	22.2775	113.8749	SUMMER	GILLNET	Y
9-Jul-13	3	1011	2	W LANTAU	2	HKLR-A	22.2682	113.8670	SUMMER	NONE	Y
9-Jul-13	4	1034	12	W LANTAU	2	HKLR-A	22.2613	113.8543	SUMMER	NONE	Y
9-Jul-13	5	1139	6	W LANTAU	2	HKLR-A	22.2678	113.8547	SUMMER	NONE	Y
9-Jul-13	6	1530	2	NW LANTAU	4	HKLR-A	22.3150	113.8657	SUMMER	NONE	N
11-Jul-13	1	0929	7	NW LANTAU	2	HKLR-A	22.2882	113.8878	SUMMER	NONE	Y
11-Jul-13	2	1020	6	NW LANTAU	1	HKLR-A	22.2897	113.8809	SUMMER	NONE	Y
11-Jul-13	3	1134	6	NW LANTAU	2	HKLR-A	22.3142	113.8726	SUMMER	NONE	Y
11-Jul-13	4	1352	4	W LANTAU	3	HKLR-A	22.2573	113.8507	SUMMER	NONE	Y
11-Jul-13	5	1425	7	W LANTAU	3	HKLR-A	22.2585	113.8496	SUMMER	NONE	Y
12-Jul-13	1	0927	6	NW LANTAU	1	HKLR-A	22.2881	113.8868	SUMMER	NONE	Y
12-Jul-13	2	0931	1	NW LANTAU	1	HKLR-A	22.2822	113.8802	SUMMER	NONE	N
12-Jul-13	3	0932	1	NW LANTAU	1	HKLR-A	22.2816	113.8787	SUMMER	NONE	N
12-Jul-13	4	0934	2	NW LANTAU	1	HKLR-A	22.2856	113.8800	SUMMER	NONE	N
12-Jul-13	5	1029	5	NW LANTAU	2	HKLR-A	22.2839	113.8741	SUMMER	NONE	Y
12-Jul-13	6	1056	2	W LANTAU	1	HKLR-A	22.2686	113.8651	SUMMER	NONE	N
12-Jul-13	7	1127	1	W LANTAU	1	HKLR-A	22.2608	113.8509	SUMMER	NONE	N
12-Jul-13	8	1133	1	W LANTAU	1	HKLR-A	22.2618	113.8570	SUMMER	NONE	N

Appendix VI. (cont'd)

DATE	STG #	TIME	HRD SZ	AREA	BEAU	TYPE	LATITUDE	LONGITUDE	SEASON	BOAT ASSOC.	RECORDING
12-Jul-13	9	1137	6	W LANTAU	1	HKLR-A	22.2652	113.8654	SUMMER	NONE	N
12-Jul-13	10	1151	1	W LANTAU	1	HKLR-A	22.2687	113.8608	SUMMER	NONE	N
12-Jul-13	11	1202	2	W LANTAU	1	HKLR-A	22.2776	113.8567	SUMMER	NONE	Y
15-Jul-13	1	1218	3	W LANTAU	2	HKLR-A	22.2636	113.8590	SUMMER	NONE	Y
15-Jul-13	2	1350	1	W LANTAU	2	HKLR-A	22.2686	113.8679	SUMMER	NONE	Y
15-Jul-13	3	1526	3	NW LANTAU	2	HKLR-A	22.3152	113.8770	SUMMER	NONE	Y
16-Jul-13	1	1518	7	W LANTAU	1	HKLR-A	22.2839	113.8564	SUMMER	NONE	Y
17-Jul-13	1	0949	2	W LANTAU	2	HKLR-A	22.2562	113.8502	SUMMER	NONE	Y
17-Jul-13	2	1539	1	W LANTAU	2	HKLR-A	22.2677	113.8677	SUMMER	NONE	N
18-Jul-13	1	1246	2	W LANTAU	1	HKLR-A	22.2596	113.8492	SUMMER	NONE	Y
22-Jul-13	1	0938	2	W LANTAU	2	HKLR-A	22.2699	113.8716	SUMMER	NONE	N
22-Jul-13	2	0951	7	W LANTAU	2	HKLR-A	22.2646	113.8605	SUMMER	NONE	N
22-Jul-13	3	1009	2	W LANTAU	2	HKLR-A	22.2588	113.8500	SUMMER	NONE	N
22-Jul-13	4	1050	8	W LANTAU	2	HKLR-A	22.2585	113.8515	SUMMER	NONE	Y
22-Jul-13	5	1520	3	NW LANTAU	2	HKLR-A	22.3091	113.8700	SUMMER	NONE	Y
23-Jul-13	1	1009	2	NW LANTAU	2	HKLR-A	22.3082	113.8759	SUMMER	NONE	N
23-Jul-13	2	1148	2	W LANTAU	2	HKLR-A	22.2707	113.8729	SUMMER	NONE	N
23-Jul-13	3	1223	1	NW LANTAU	3	HKLR-A	22.3072	113.8679	SUMMER	NONE	N
23-Jul-13	4	1318	12	W LANTAU	2	HKLR-A	22.2608	113.8548	SUMMER	NONE	Y
24-Jul-13	1	0954	10	W LANTAU	2	HKLR-A	22.2600	113.8529	SUMMER	GILLNET	Y
24-Jul-13	2	1137	1	NW LANTAU	2	HKLR-A	22.2769	113.8753	SUMMER	NONE	Y
24-Jul-13	3	1540	1	W LANTAU	2	HKLR-A	22.2690	113.8667	SUMMER	NONE	Y
25-Jul-13	1	1055	1	NW LANTAU	3	HKLR-A	22.2957	113.8728	SUMMER	NONE	N
25-Jul-13	2	1223	6	W LANTAU	2	HKLR-A	22.2629	113.8587	SUMMER	NONE	Y
25-Jul-13	3	1331	1	W LANTAU	2	HKLR-A	22.2684	113.8688	SUMMER	NONE	Y
26-Jul-13	1	0945	5	NW LANTAU	1	HKLR-A	22.2709	113.8737	SUMMER	NONE	Y
26-Jul-13	2	1041	1	W LANTAU	2	HKLR-A	22.2598	113.8525	SUMMER	NONE	N

APPENDIX VII. Raw data for histogram bar plots.

Data for Figure 2. The summed length of recordings in minutes made for each day of observational effort during the baseline and construction phase monitoring.

Date	Length of recording (min)
22-Jan	56.83
23-Jan	25.00
24-Jan	53.52
25-Jan	22.83
26-Jan	42.33
27-Jan	38.87
28-Jan	55.90
29-Jan	87.73
30-Jan	32.73
31-Jan	58.27
1-Feb	78.85
2-Feb	52.92
3-Feb	44.60
4-Feb	20.12
5-Feb	39.58
6-Feb	34.63
8-Feb	35.05
13-Feb	67.50
14-Feb	15.00
15-Feb	32.80
16-Feb	28.67
17-Feb	46.75
18-Feb	20.00
19-Feb	14.98
20-Feb	13.98
21-Feb	25.00
22-Feb	5.00

Date	Length of recording (min)
7-Mar	5.00
8-Mar	13.00
11-Mar	11.27
12-Mar	10.00
13-Mar	10.00
15-Mar	25.00
17-Mar	20.00
18-Mar	8.00
19-Mar	4.05
20-Mar	5.00
22-Mar	41.25
24-Mar	5.00
2-Apr	10.00
9-Jul	51.63
11-Jul	53.48
12-Jul	35.08
15-Jul	15.70
16-Jul	9.00
17-Jul	5.00
18-Jul	5.00
22-Jul	10.00
23-Jul	15.15
24-Jul	28.15
25-Jul	14.03
26-Jul	10.00

APPENDIX VII (cont'd)

Data for Figure 3. The average number of clicks and whistles per minute of recording detected for each day of observational effort. SD = standard deviation, W = whistles, C = clicks

Date	Average whistles/min	SD W	Average clicks/min	SD C
22-Jan	2.95	3.95	120.83	126.48
23-Jan	1	1.92	140.28	214.1
24-Jan	0.07	0.16	34.97	62.68
25-Jan	0.5	0.59	0.94	2.11
26-Jan	0.27	0.46	NA	NA
27-Jan	0.82	1.47	NA	NA
28-Jan	0.19	0.38	NA	NA
29-Jan	1.18	1.89	352.14	368.43
30-Jan	1.17	1.8	193.56	325.1
31-Jan	0.13	0.4	1.69	4.64
1-Feb	0.72	1.76	60.54	90.38
2-Feb	0.15	0.37	196.94	102.3
3-Feb	0.43	1.03	0.79	0.81
4-Feb	1.9	2.55	62.82	67.87
5-Feb	0.36	0.67	79.41	172.06
6-Feb	0.26	0.44	30.81	36.73
8-Feb	3.77	6.4	21.8	38.46
13-Feb	3.23	5.4	NA	NA
14-Feb	0.6	0.87	NA	NA
15-Feb	1.04	1.74	NA	NA
16-Feb	1	2.08	NA	NA
17-Feb	1.68	3.88	189.37	367.85
18-Feb	0	NA	22.19	37.31
19-Feb	1.2	1.59	68.46	109.44
20-Feb	1.74	2.2	111.76	87.23
21-Feb	0.28	0.63	35.98	56.6
22-Feb	0.4	NA	2.2	NA
7-Mar	0.00	na	0.00	na
8-Mar	0.00	0.00	0.13	0.12
11-Mar	0.00	0.00	1.26	0.93
12-Mar	0.00	0.00	3.60	3.96
13-Mar	0.10	0.14	13.70	19.37
15-Mar	0.04	0.09	85.20	92.29
17-Mar	0.35	0.70	42.65	48.51
18-Mar	0.00	0.00	0.83	1.18
19-Mar	0.00	na	1.73	na
20-Mar	0.00	na	0.00	na
22-Mar	0.80	1.59	13.21	30.42
24-Mar	0.00	na	0.00	na
2-Apr	0.00	0.00	0.20	0.28
9-Jul	0.46	0.43	154.56	212.01
11-Jul	1.16	2.65	159.84	260.27
12-Jul	0.60	1.50	71.29	104.06
15-Jul	0.22	0.29	28.84	21.95
16-Jul	0.00	0.00	35.76	50.01
17-Jul	0.20	na	29.65	na
18-Jul	0.00	na	27.85	na
22-Jul	0.00	0.00	46.78	63.05
23-Jul	0.07	0.11	98.03	54.62
24-Jul	0.30	0.41	146.75	236.59
25-Jul	0.08	0.14	161.44	254.16
26-Jul	0.10	0.14	174.10	236.30

APPENDIX VII (cont'd)

Data for figure 4. Average number of whistles per minute and clicks per minute as a function of dolphin group size. SD = standard deviation, W = whistles, C = clicks

BASELINE PHASE

Group Size	Average whistles/min	SD W	Average clicks/min	SD C
1	0.21	1.49	62.19	77.73
2-6	0.56	1.7	54.03	179.32
6-9	1.58	4.63	117.99	310.31
10+	2.74	1.99	289.32	140.58

CONSTRUCTION PHASE

Group Size	Average whistles/min	SD W	Average clicks/min	SD C
1	0.13	0.30	119.11	201.67
2-5	0.09	0.20	54.17	95.45
6-9	0.97	1.99	106.06	199.58

Data for Figure 5. Average number of whistles per minute and clicks per minute as a function of dolphin behavioural state. SD = standard deviation, W = whistles, C = clicks

BASELINE PHASE

Behavioural State	Average whistles/min	SD W	Average clicks/min	SD C
Feeding	0.62	1.33	30.95	69.9
Milling	0.66	1.85	71.29	205.44
Socializing	3.78	4.14	287.48	326.22
Traveling	0.25	1.48	13.16	208.94
Resting	0.13	1.43	0.1	70.35

CONSTRUCTION PHASE

Behavioural State	Average whistles/min	SD W	Average clicks/min	SD C
Feeding	0.16	0.26	19.30	29.62
Milling	0.18	0.60	80.09	136.86
Socializing	2.48	3.16	213.12	309.71
Traveling	0.17	0.29	32.53	52.34
Resting	0.00	na	0.00	na

APPENDIX VII (cont'd)

Data for Figure 6. Average number of whistles per minute and clicks per minute as a function of the time of day.

BASELINE PHASE

Time of observation	Average whistles/min	SD W	Average clicks/min	SD C
9:00-10:59	0.7	1.33	38.14	69.9
11:00-12:59	0.68	1.86	79.97	144.51
13:00-14:59	1.74	3.8	159.41	303.43
15:00-16:59	1.16	1.99	65.4	140.58

CONSTRUCTION PHASE

Time of observation	Average whistles/min	SD W	Average clicks/min	SD C
9:00-10:59	0.32	0.75	74.39	124.79
11:00-12:59	0.66	1.78	110.73	218.62
13:00-14:59	0.03	0.08	43.35	72.50
15:00-16:59	0.42	1.20	49.90	69.04

Data for Figure 7. Average number of clicks/min and whistles/min recorded as a function of the distance to the nearest vessel.

BASELINE PHASE

Distance to nearest boat	Average whistles/min	SD W	Average clicks/min	SD C
0-99m	0.69	1.41	109.34	237.67
100-199m	0.71	1.98	47.53	95.3
200-299m	0.49	4.37	32.39	48.5
300-399m	1.54	4.37	342.25	527.43
400-499m	0.09	0.12	54.69	
500+	0.93	2.31	86.7	195.44

CONSTRUCTION PHASE

Distance to nearest boat	Average whistles/min	SD W	Average clicks/min	SD C
0-99m	0.24	0.52	114.03	176.62
100-199m	0.02	0.07	63.67	76.62
200-299m	0.13	0.25	55.46	55.86
300-399m	0.40	1.26	13.40	19.06
400-499m	0.16	0.26	44.79	62.55
500+	0.65	1.61	168.47	299.89

APPENDIX VII (cont'd)

Data for Figure 8. Average number of clicks/min and whistles/min recorded as a function of the Beaufort Sea State.

BASELINE PHASE

Beaufort Sea State	Average whistles/min	SD W	Average clicks/min	SD C
0	1.84	4.08	188.22	388.37
1	0.84	1.64	210.35	318.08
2	0.97	2.66	50.11	99.13
3	1.6	2.82	134.3	228.1
4	2.04	1.48	89.75	124.19
5	1.37	1.89	72.98	99.15

CONSTRUCTION PHASE

Beaufort Sea State	Average whistles/min	SD W	Average clicks/min	SD C
1	0.08	0.26	18.79	43.12
2	0.48	1.34	94.09	168.57
3	0.20	0.53	52.36	95.20
4	0.00	na	0.00	na

Data for Figure 10. Average number of whistles per minute and clicks per minute recorded in each zone of the study area.

BASELINE PHASE

Zone	Average whistles/min	SD W	Average clicks/min	SD C
1	1.34	1.26	32.81	80.1
2	0.88	2.09	116.06	164.71
3	1	3.27	110.48	271.04

CONSTRUCTION PHASE

Zone	Average whistles/min	SD W	Average clicks/min	SD C
1	2.20	3.36	223.67	341.49
2	0.24	0.70	64.37	119.83
3	0.00	na	0.00	na

APPENDIX VII (cont'd)

Data for Figure 17. Histogram of the percentage of EAR recordings with dolphin detections made at site B1 (Fan Lau) during each day for the deployment period (Note: February 4 and 24 did not have a full day of recordings)

Date	# of files	% files per day
4-Feb	16	13%
5-Feb	84	29%
6-Feb	83	29%
7-Feb	26	9%
8-Feb	94	33%
9-Feb	45	16%
10-Feb	20	7%
11-Feb	22	8%
12-Feb	11	4%
13-Feb	5	2%
14-Feb	16	6%
15-Feb	39	14%
16-Feb	45	16%
17-Feb	43	15%
18-Feb	42	15%
19-Feb	81	28%
20-Feb	172	60%
21-Feb	86	30%
22-Feb	2	1%
1-Apr	11	4%
2-Apr	21	7%
3-Apr	26	9%
4-Apr	43	15%
5-Apr	11	4%
6-Apr	26	9%
7-Apr	20	7%
8-Apr	13	5%
9-Apr	7	2%
17-Apr	9	3%
18-Apr	1	0%
19-Apr	9	3%
20-Apr	8	3%
21-Apr	8	3%
22-Apr	11	4%
23-Apr	11	4%
24-Apr	3	1%
25-Apr	5	2%
26-Apr	3	1%
27-Apr	5	2%
28-Apr	7	2%
29-Apr	7	2%
30-Apr	6	2%
8-Jul	2	1%
9-Jul	1	0%
10-Jul	4	1%
11-Jul	3	1%
12-Jul	4	1%
13-Jul	12	4%
14-Jul	28	10%

APPENDIX VII (cont'd)

Data for Figure 18. The number of dolphin encounters and the average encounter duration recorded on the EAR at site B1 (Fan Lau).

Date	# of encounters	Average encounter duration	Std Dev
4-Feb	3	48.33	27.54
5-Feb	8	65	69.69
6-Feb	4	117.5	121.83
7-Feb	10	11	15.6
8-Feb	9	76.11	64.41
9-Feb	9	44.38	52.27
10-Feb	5	18	17.89
11-Feb	4	27.5	41.73
12-Feb	3	30	39.05
13-Feb	5	5	0
14-Feb	3	35	51.96
15-Feb	5	48	45.77
16-Feb	8	46.88	55.61
17-Feb	10	24.44	28.99
18-Feb	9	31.67	40.23
19-Feb	13	40	73.71
20-Feb	5	204	253.39
21-Feb	8	66.25	82.32
22-Feb	1	5	0
1-Apr	6	13.33	18.07
2-Apr	4	43.75	48.71
3-Apr	5	32.00	49.95
4-Apr	4	58.75	64.73
5-Apr	4	18.75	18.87
6-Apr	6	34.17	51.03
7-Apr	7	24.29	33.72
8-Apr	6	16.67	18.07
9-Apr	3	21.67	17.56
17-Apr	3	21.67	28.87
18-Apr	1	5.00	na
19-Apr	6	10.00	8.37
20-Apr	5	14.00	10.84
21-Apr	5	9.00	6.52
22-Apr	6	6.67	2.58
23-Apr	5	16.00	12.94
24-Apr	3	5.00	0.00
25-Apr	3	5.00	0.00
26-Apr	3	5.00	0.00
27-Apr	2	7.50	3.54
28-Apr	3	20.00	25.98
29-Apr	2	32.50	3.54
30-Apr	3	11.67	7.64
8-Jul	2	5.00	0.00
9-Jul	1	5.00	na
10-Jul	3	11.67	11.55
11-Jul	3	5.00	0.00
12-Jul	4	5.00	0.00
13-Jul	7	12.14	9.51
14-Jul	10	22.00	19.32

APPENDIX VII (cont'd)

Data for Figure 19. Detections of dolphin signals at site B1 (Fan Lau) as a function of the hour of the day

BASELINE PHASE

Hour	Clicks	Whistles
0	33	0
1	21	1
2	33	1
3	49	0
4	43	0
5	58	0
6	57	2
7	77	1
8	62	0
9	61	0
10	46	0
11	38	0
12	20	0
13	15	0
14	18	0
15	12	0
16	15	1
17	42	0
18	33	0
19	25	0
20	30	0
21	33	0
22	40	0
23	49	1

CONSTRUCTION PHASE

Hour	Clicks	Whistles
0	8	0
1	6	0
2	1	0
3	4	0
4	10	0
5	6	0
6	8	0
7	22	0
8	16	0
9	10	0
10	13	0
11	21	0
12	23	0
13	11	0
14	31	1
15	23	0
16	10	0
17	24	0
18	30	0
19	22	0
20	10	0
21	5	0
22	4	0
23	6	0

APPENDIX VII (cont'd)

Data for Figure 21. Histogram of the percentage of EAR recordings at site B2 (Bridge Alignment Area), with dolphin detections made during each day for the deployment period recovered (Note: February 4 and 16 did not have a full day of recordings).

Date	# Files	% files/day
4-Feb	1	0.35%
5-Feb	26	9.03%
6-Feb	49	17.01%
7-Feb	41	14.24%
8-Feb	43	14.93%
9-Feb	31	10.76%
10-Feb	29	10.07%
11-Feb	7	2.43%
12-Feb	4	1.39%
13-Feb	15	5.21%
14-Feb	1	0.35%
14-Feb	16	5.56%
15-Feb	12	4.17%
16-Feb	8	2.78%
17-Feb	6	2.08%
18-Feb	14	4.86%
19-Feb	4	1.39%
20-Feb	9	3.13%
21-Feb	1	0.35%
22-Feb	3	1.04%
1-Apr	0	0%
2-Apr	0	0%
3-Apr	0	0%
4-Apr	0	0%
5-Apr	1	0%
6-Apr	1	0%
7-Apr	4	1%
8-Apr	2	1%
9-Apr	1	0%
17-Apr	4	1%
18-Apr	1	0%
19-Apr	0	0%
20-Apr	10	3%
21-Apr	4	1%
22-Apr	4	1%
23-Apr	16	6%
24-Apr	13	5%
25-Apr	2	1%
26-Apr	4	1%
27-Apr	1	0%
28-Apr	1	0%
29-Apr	1	0%
30-Apr	0	0%
8-Jul	16	6%
9-Jul	2	1%
10-Jul	3	1%
11-Jul	0	0%
12-Jul	2	1%
13-Jul	0	0%
14-Jul	1	0%

APPENDIX VII (cont'd)

Data for Figure 22. The number of dolphin encounters and the average encounter duration recorded on the EAR at site B2 (Bridge Alignment Area).

Date	# of enounters	Avg. encounter duration	Std Dev
4-Feb	1	5.00	0.00
5-Feb	6	31.67	41.79
6-Feb	8	36.25	59.39
7-Feb	6	39.17	49.24
8-Feb	8	32.50	38.54
9-Feb	4	57.50	105.00
10-Feb	7	28.57	22.31
11-Feb	3	16.67	20.21
12-Feb	2	17.50	17.68
13-Feb	7	11.43	11.80
14-Feb	5	25.00	28.28
15-Feb	4	13.75	10.31
16-Feb	3	15.00	10.00
17-Feb	2	12.50	10.61
18-Feb	3	31.67	16.07
19-Feb	2	10.00	7.07
20-Feb	3	16.67	16.07
21-Feb	1	5.00	0.00
22-Feb	2	15.00	14.14
1-Apr	0	0.00	na
2-Apr	0	0.00	na
3-Apr	0	0.00	na
4-Apr	0	0.00	na
5-Apr	1	5.00	na
6-Apr	1	5.00	na
7-Apr	1	15.00	na
8-Apr	2	5.00	0.00
9-Apr	1	5.00	na
17-Apr	2	20.00	21.21
18-Apr	1	5.00	na
19-Apr	0	0.00	na
20-Apr	4	23.75	22.50
21-Apr	4	5.00	0.00
22-Apr	2	5.00	0.00
23-Apr	3	38.33	36.86
24-Apr	6	17.50	19.94
25-Apr	1	8.33	5.77
26-Apr	3	8.33	5.77
27-Apr	1	5.00	na
28-Apr	1	5.00	na
29-Apr	1	5.00	na
30-Apr	0	0.00	na
8-Jul	4	18.75	16.01
9-Jul	2	5.00	0.00
10-Jul	1	20.00	na
11-Jul	0	0.00	na
12-Jul	2	12.50	10.61
13-Jul	0	0.00	na
14-Jul	1	5.00	na

APPENDIX VII (cont'd)

Data for Figure 23. Detections of dolphin signals at site B2 (Bridge Alignment Area) as a function of the hour of the day

BASELINE PHASE

Hour	Clicks	Whistles
0	39	7
1	22	1
2	32	5
3	15	3
4	25	5
5	8	2
6	17	4
7	10	2
8	4	3
9	0	0
10	0	0
11	0	0
12	2	1
13	1	0
14	2	2
15	0	0
16	0	0
17	0	0
18	1	0
19	25	1
20	24	3
21	22	7
22	20	5
23	15	4

CONSTRUCTION PHASE

Hour	Clicks	Whistles
0	4	0
1	2	0
2	0	0
3	2	0
4	3	0
5	1	0
6	1	0
7	3	0
8	2	0
9	0	0
10	0	0
11	4	1
12	5	0
13	4	1
14	0	0
15	1	0
16	1	0
17	1	0
18	1	0
19	11	0
20	20	0
21	9	0
22	10	0
23	8	0

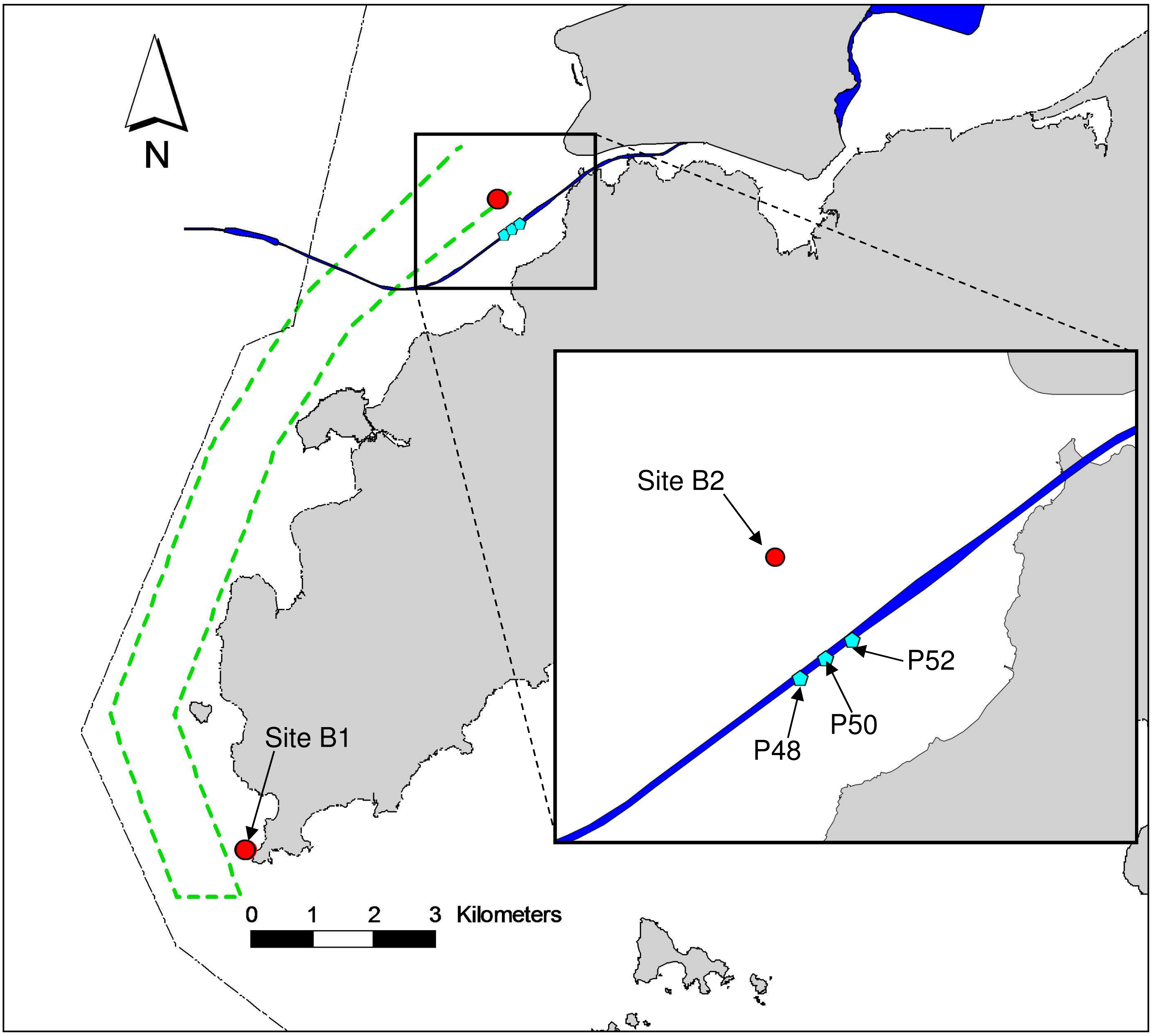


Figure 1. Predefined route for systematic effort (green dotted line) in West Lantau for HKLR acoustic monitoring surveys, with the locations of two EARs deployed near Fan Lau (site B1) and bored piling site (site B2), and the three bored piling pier sites (P48, P50 and P52) being monitored by the EARs.

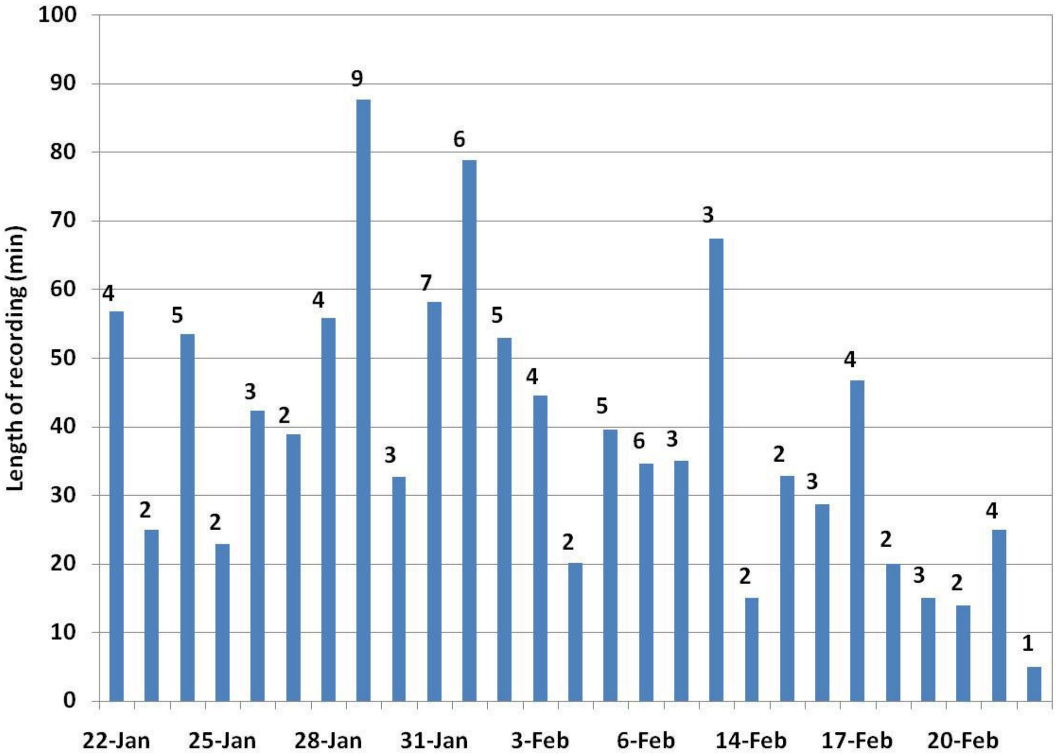


Figure 2a. The summed length of hydrophone recordings in minutes made for each day of observational effort during the **baseline acoustic monitoring** in January-February 2013. The values above each column represent the number of sightings per day.

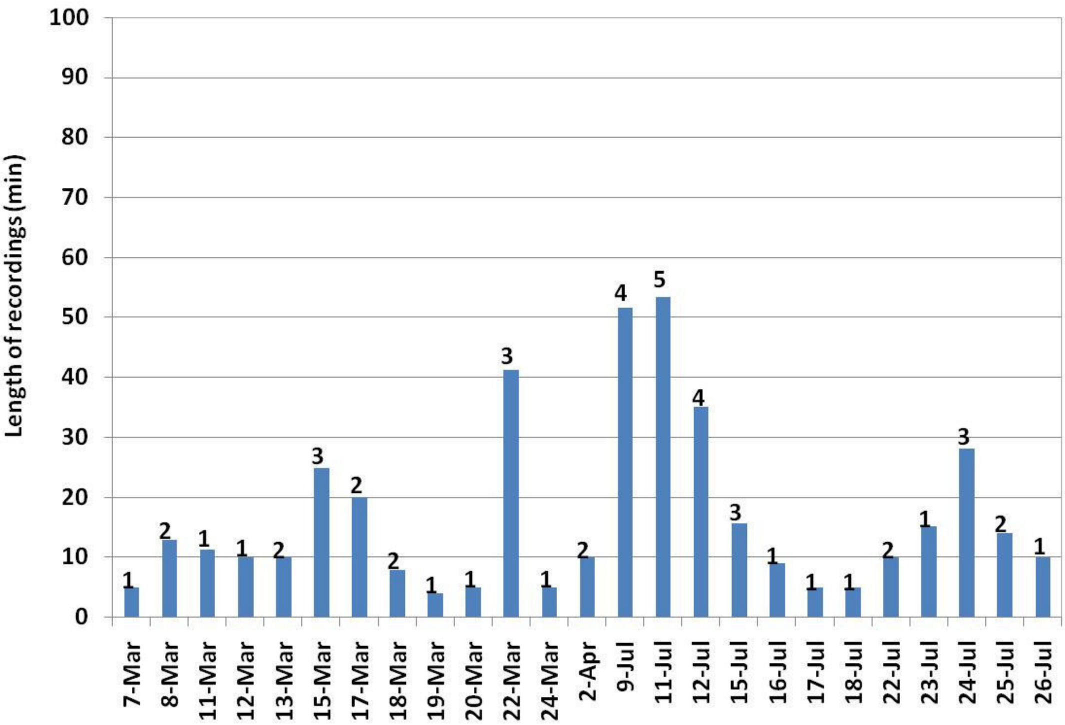


Figure 2b. The summed length of hydrophone recordings in minutes made for each day of observational effort during the **construction phase acoustic monitoring** periods. The values above each column represent the number of sightings per day.

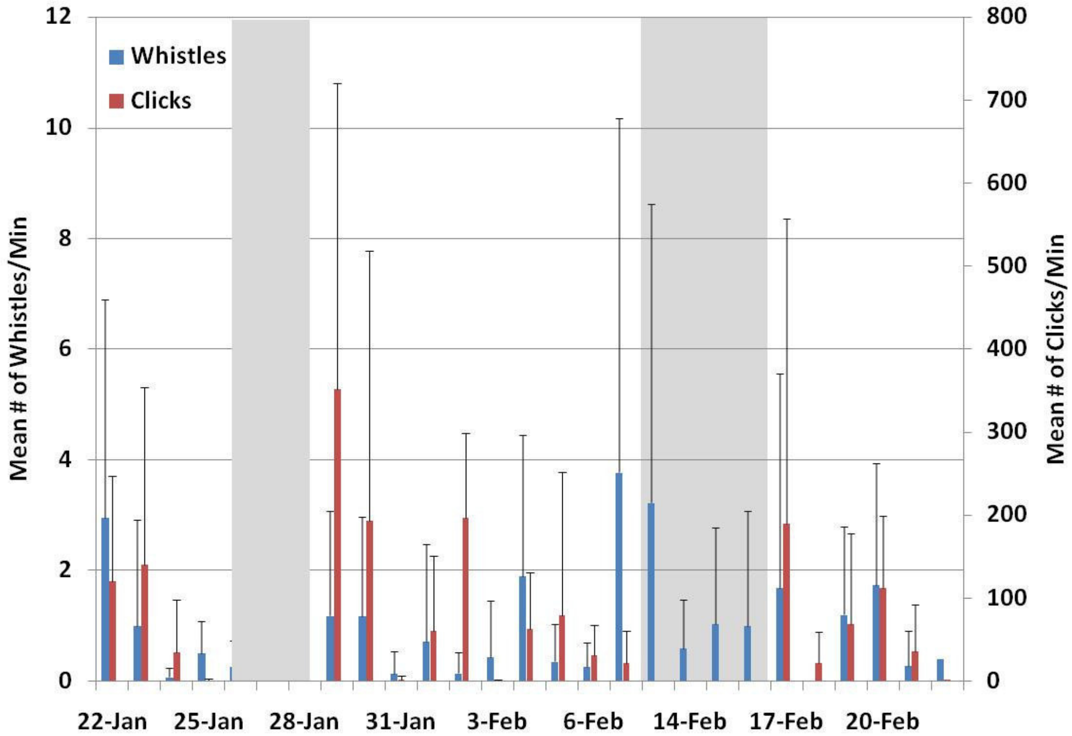


Figure 3a. The mean number of clicks and whistles per minute of hydrophone recording detected for each day of observational effort during the **baseline phase**. Shaded areas represent days with recordings that had high-frequency noise interference and therefore could not be analyzed for clicks. Errors bars represent one standard deviation. Sample sizes are shown in Figure 2a.

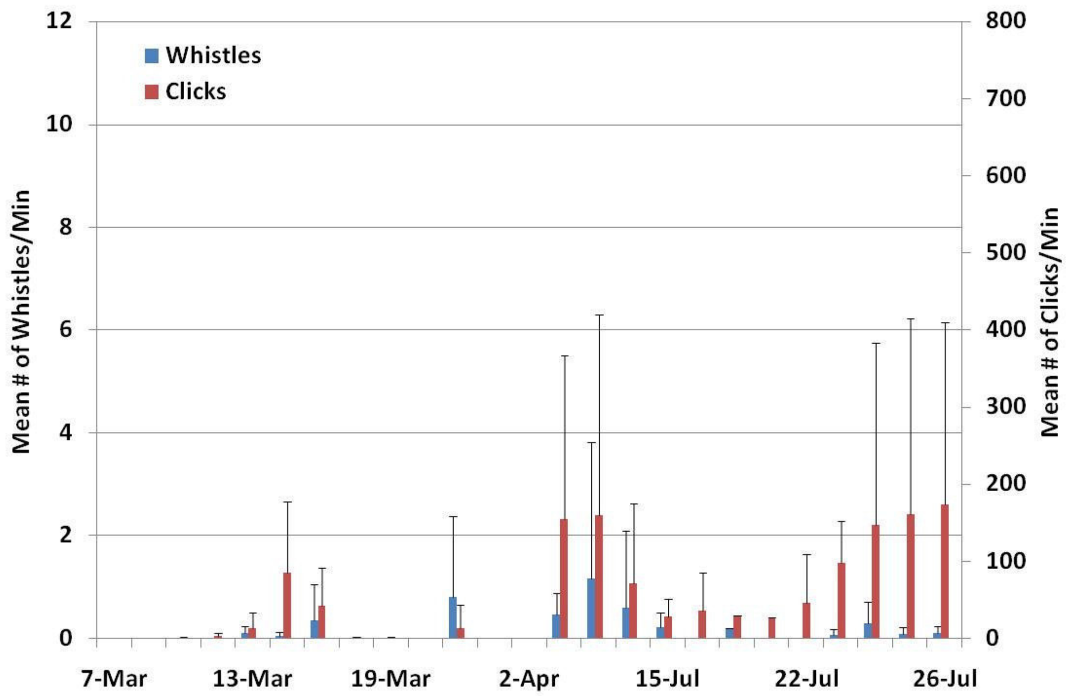


Figure 3b. The mean number of clicks and whistles per minute of hydrophone recording detected for each day of observational effort during the **construction phase**. Errors bars represent one standard deviation. Sample sizes are shown in Figure 2b.

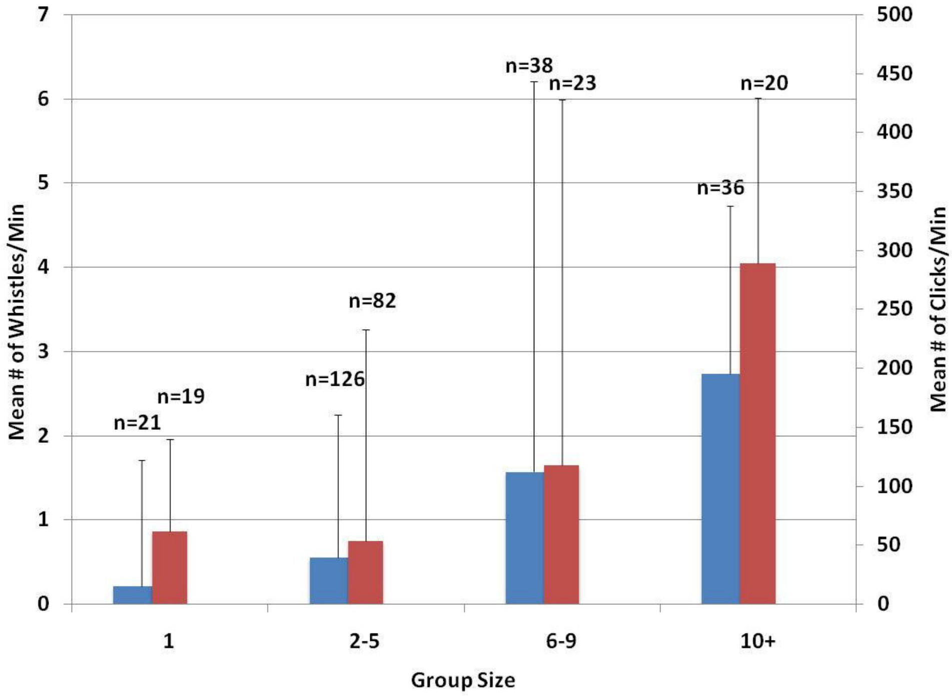


Figure 4a. Mean number of whistles per minute and clicks per minute as a function of dolphin group size measured during the **baseline phase**. Error bars represent one standard deviation.

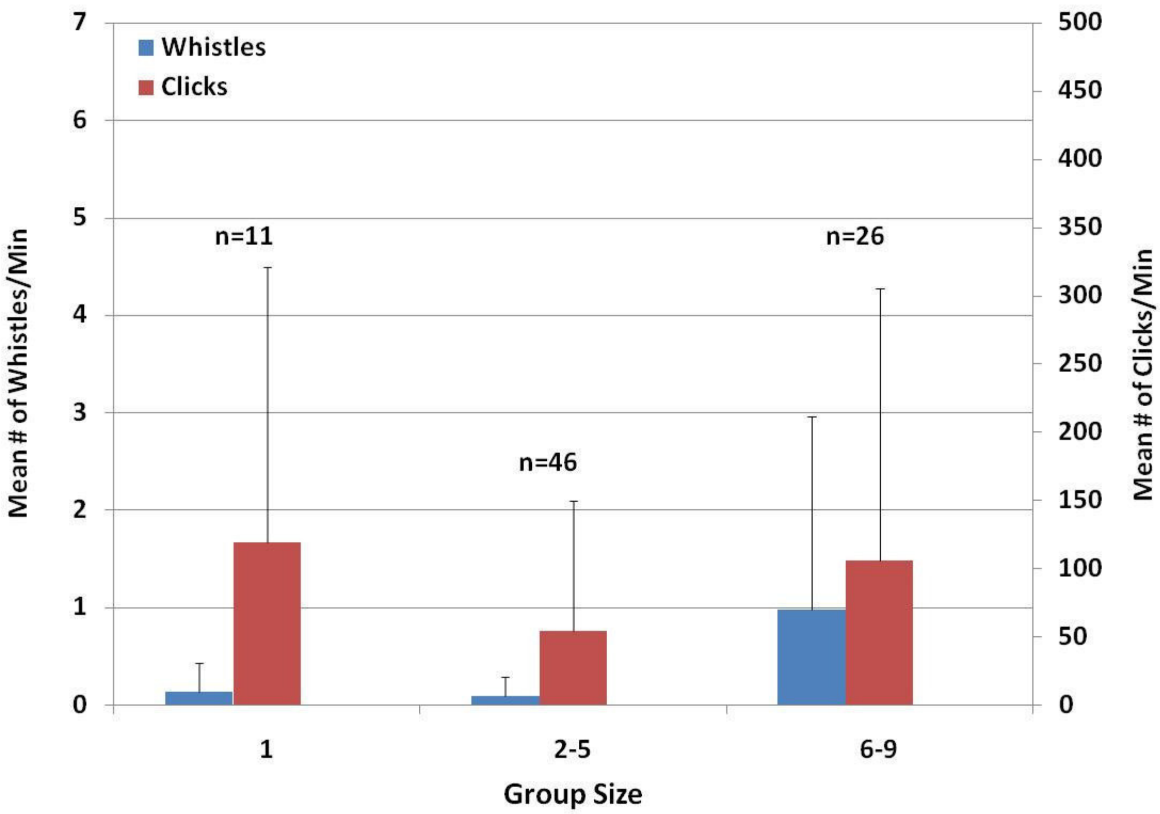


Figure 4b. Mean number of whistles per minute and clicks per minute as a function of dolphin group size measured during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

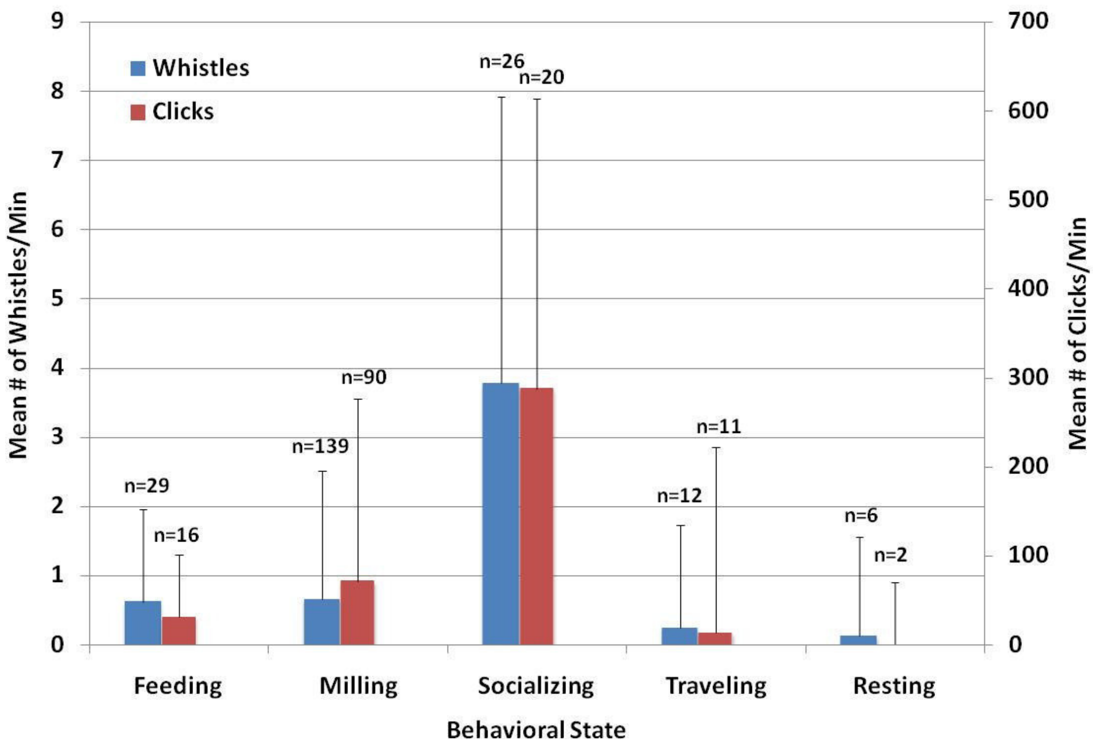


Figure 5a. Mean number of whistles per minute and clicks per minute as a function of dolphin behavioural state measured during the **baseline phase**. Error bars represent one standard deviation.

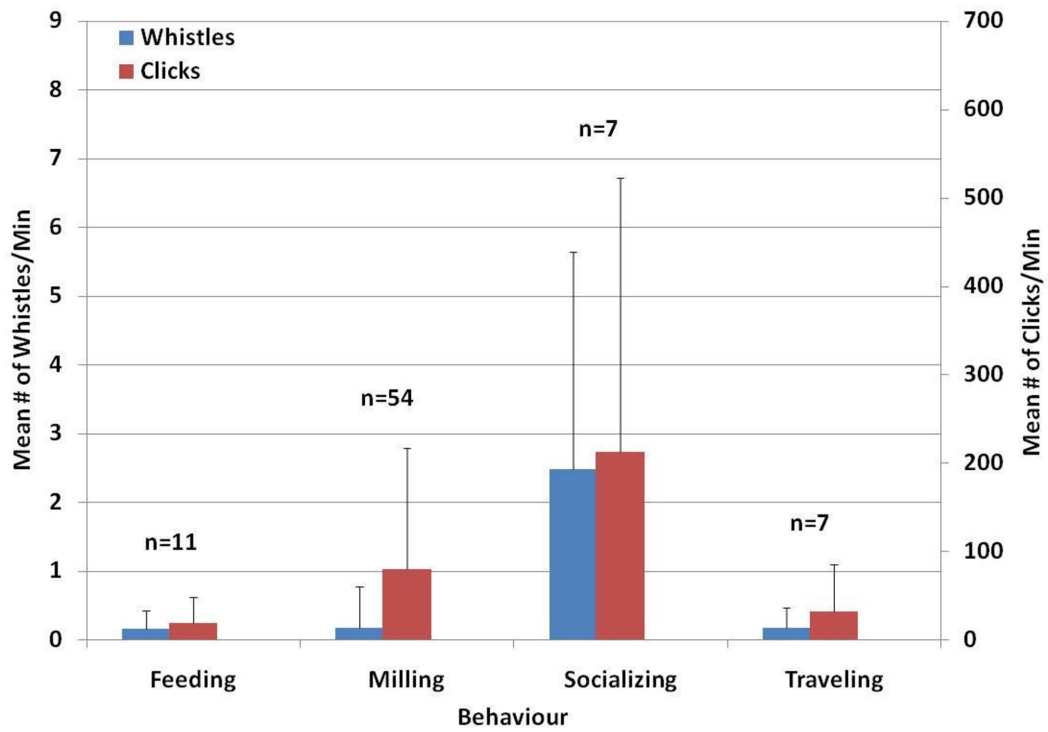


Figure 5b. Mean number of whistles per minute and clicks per minute as a function of dolphin behavioural state during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

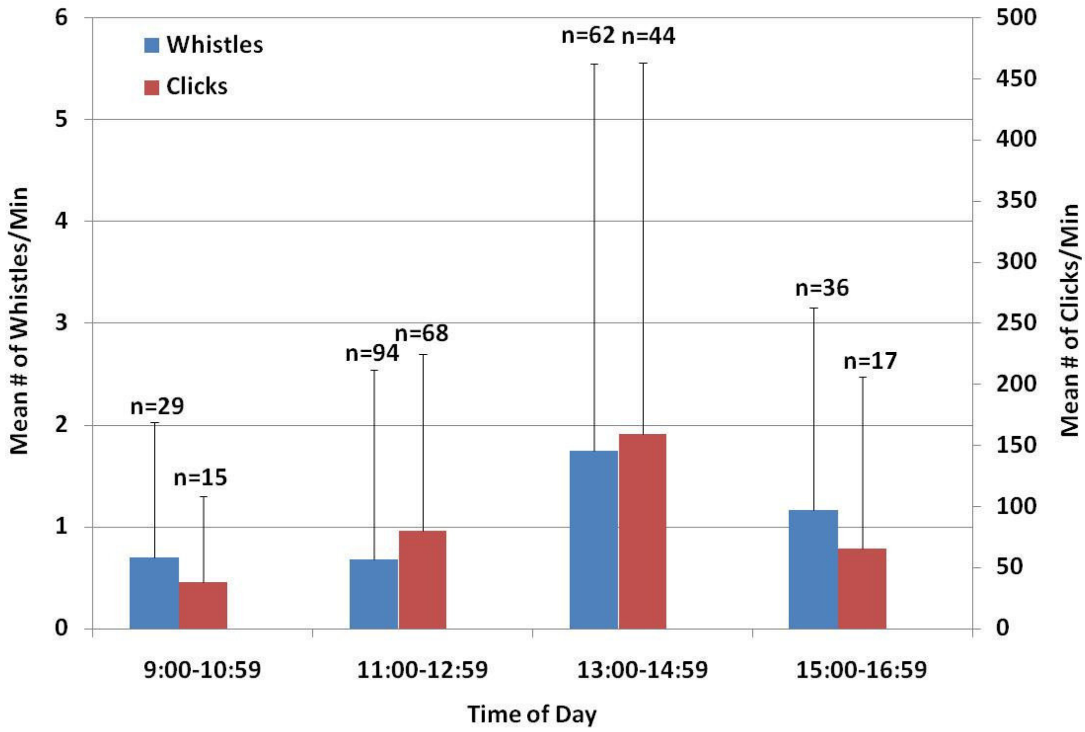


Figure 6a. Mean number of whistles per minute and clicks per minute as a function of the time of day measured during the **baseline phase**. Error bars represent one standard deviation.

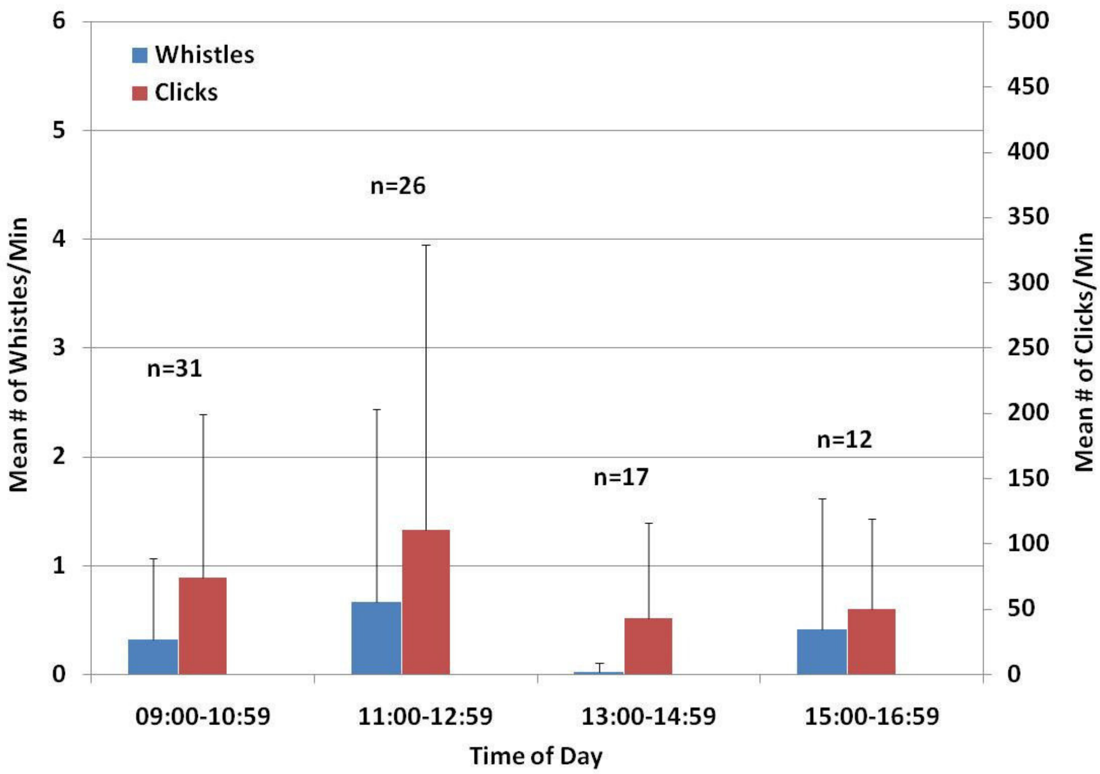


Figure 6b. Mean number of whistles per minute and clicks per minute as a function of the time of day measured during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

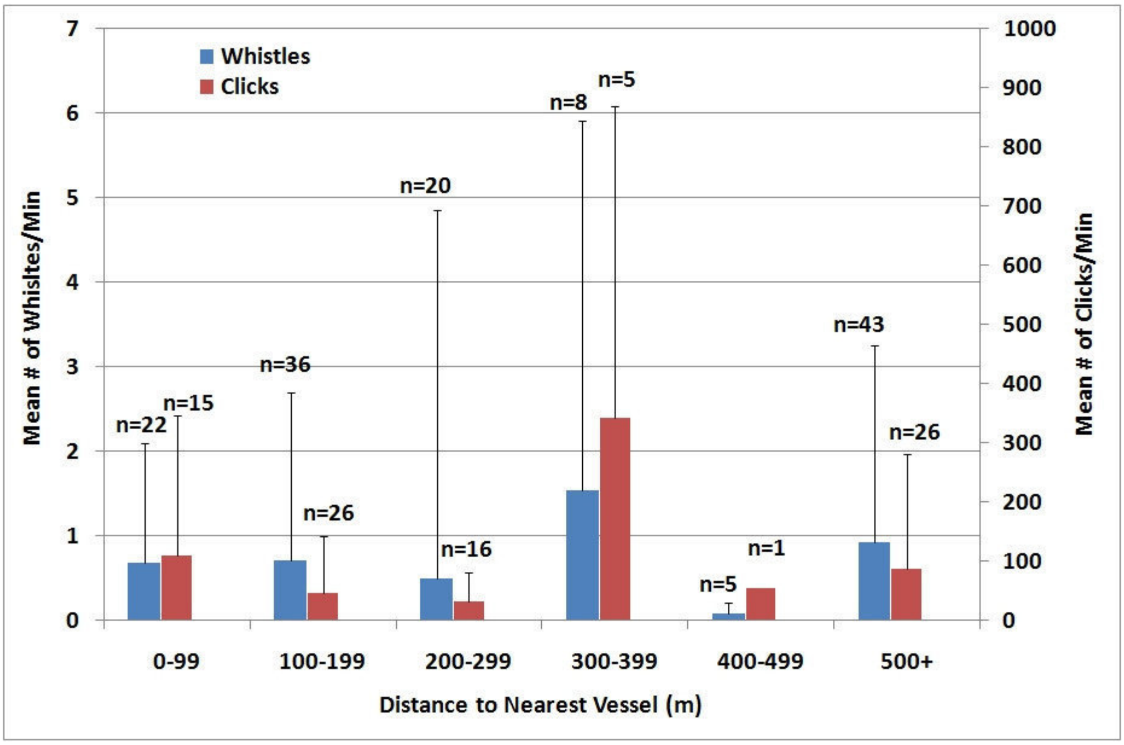


Figure 7a. Mean number of clicks/min and whistles/min recorded as a function of the distance to the nearest vessel measured during the **baseline phase**. Error bars represent one standard deviation.

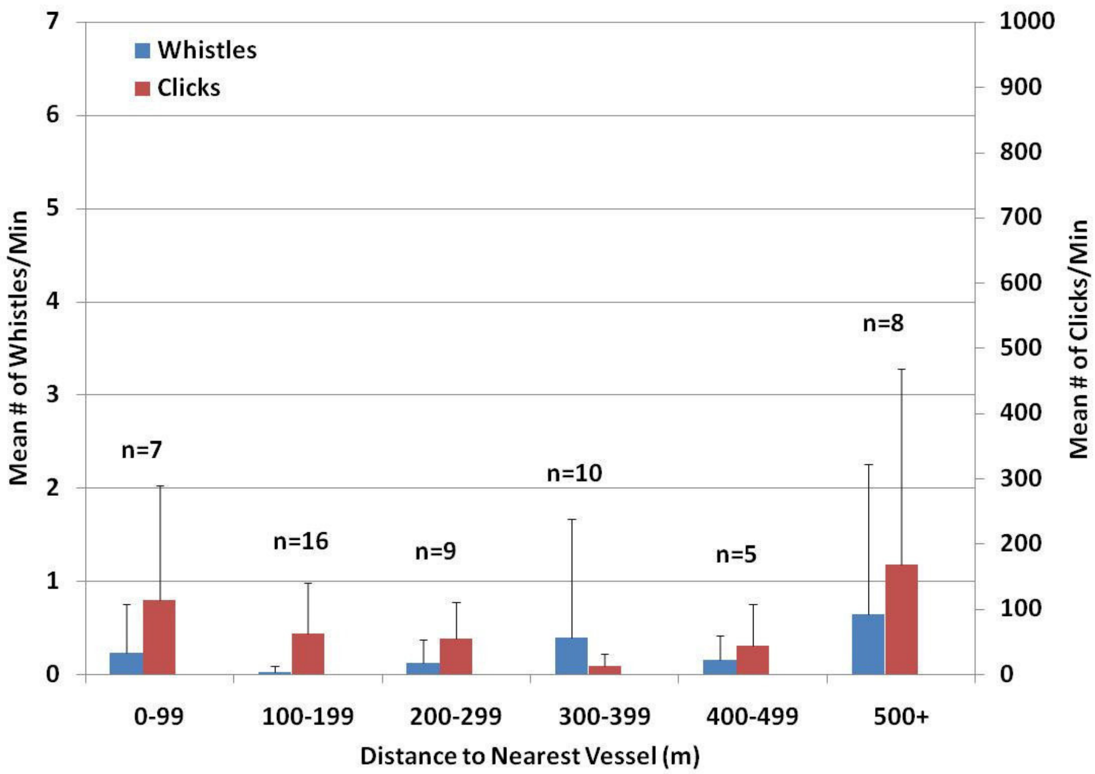


Figure 7b. Mean number of clicks/min and whistles/min recorded as a function of the distance to the nearest vessel measured during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

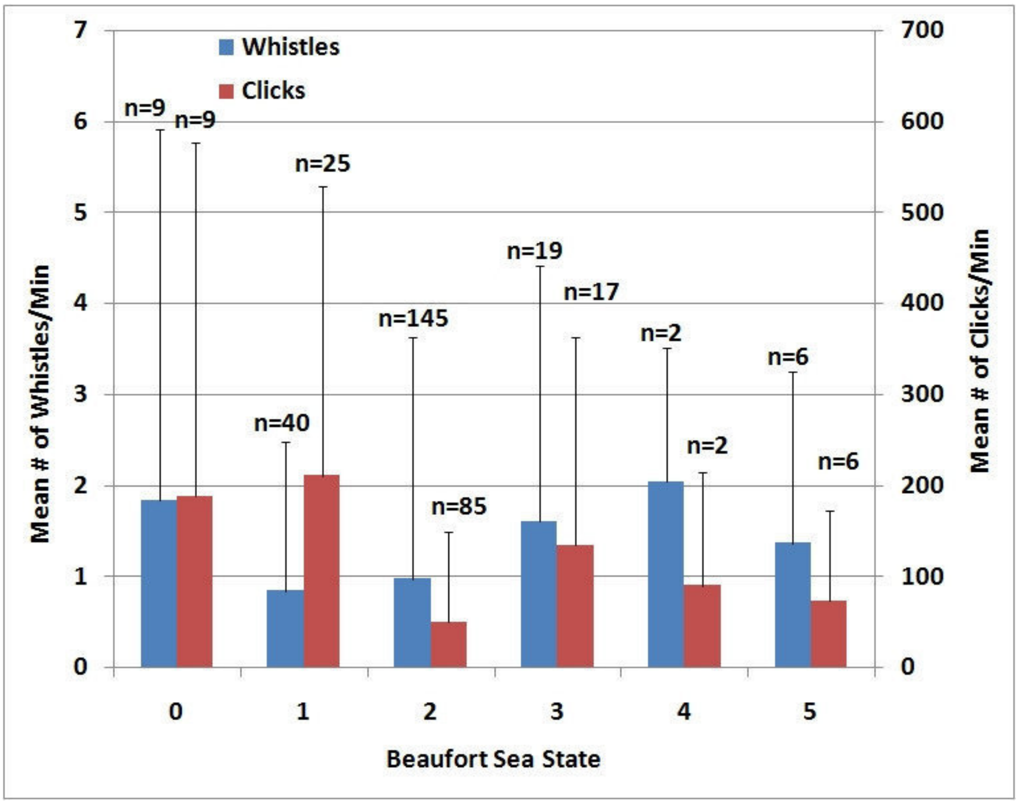


Figure 8a. Mean number of clicks/min and whistles/min recorded as a function of the Beaufort Sea State during the **baseline phase**. Error bars represent one standard deviation.

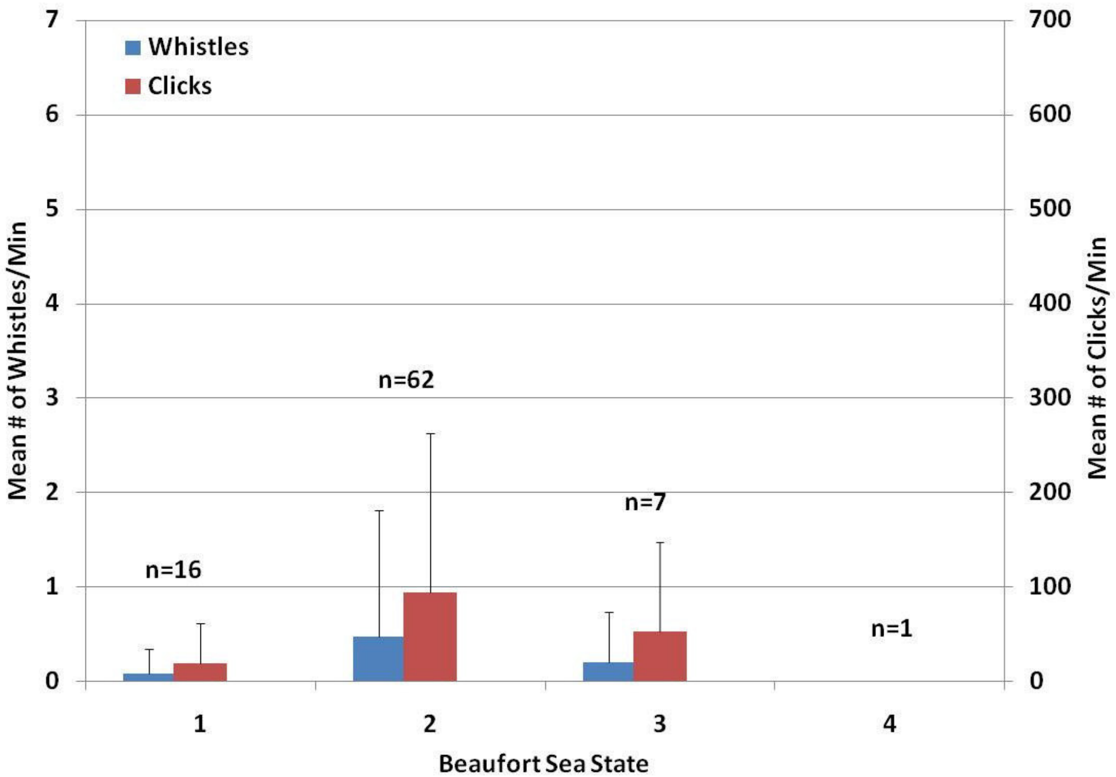


Figure 8b. Mean number of clicks/min and whistles/min recorded as a function of the Beaufort Sea State during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

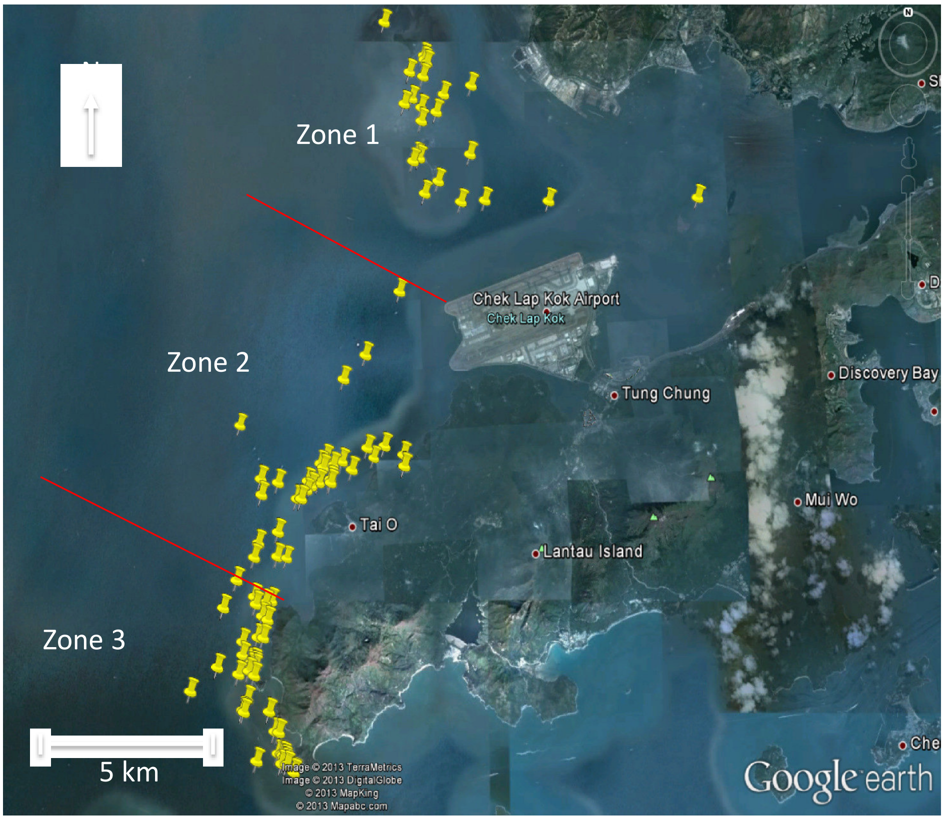


Figure 9a. The location of the first recordings made for each sighting for each day of the **baseline phase** observational effort. Place marks represent GPS coordinates. The solid lines designate the boundaries of three zones. Map generated in Google Earth 7.0.3.8542.

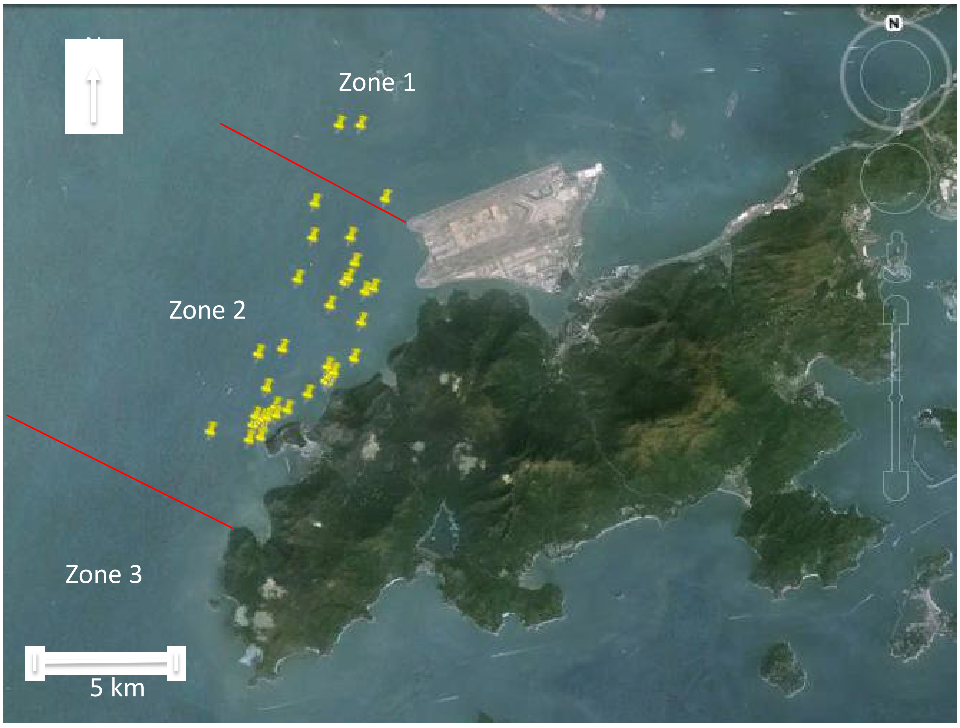


Figure 9b. The location of the first recordings made for each sighting for each day of the **construction phase** observational effort. Place marks represent GPS coordinates. The solid lines designate the boundaries of three zones. Map generated in Google Earth 7.0.3.8542.

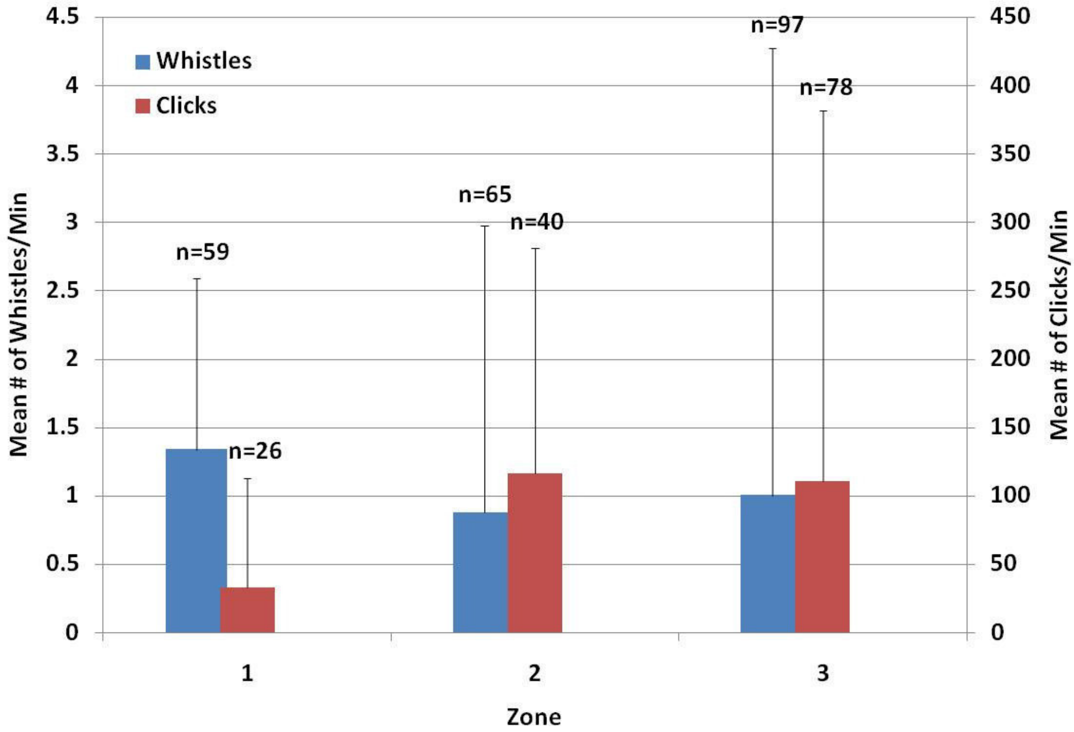


Figure 10a. Mean number of whistles per minute and clicks per minute recorded in each zone of the study area during the **baseline phase**. Error bars represent one standard deviation.

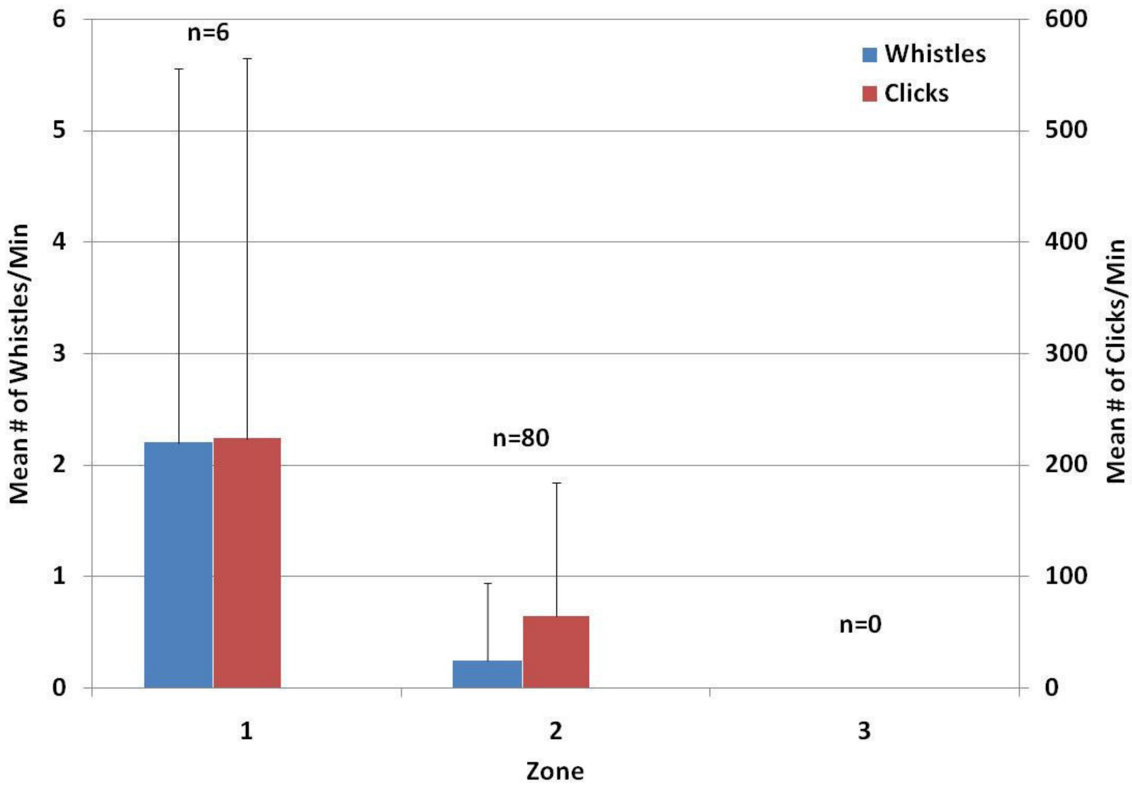


Figure 10b. Mean number of whistles per minute and clicks per minute recorded in each zone of the study area during the **construction phase**. Number of recordings (n) within each category given above. Error bars represent one standard deviation.

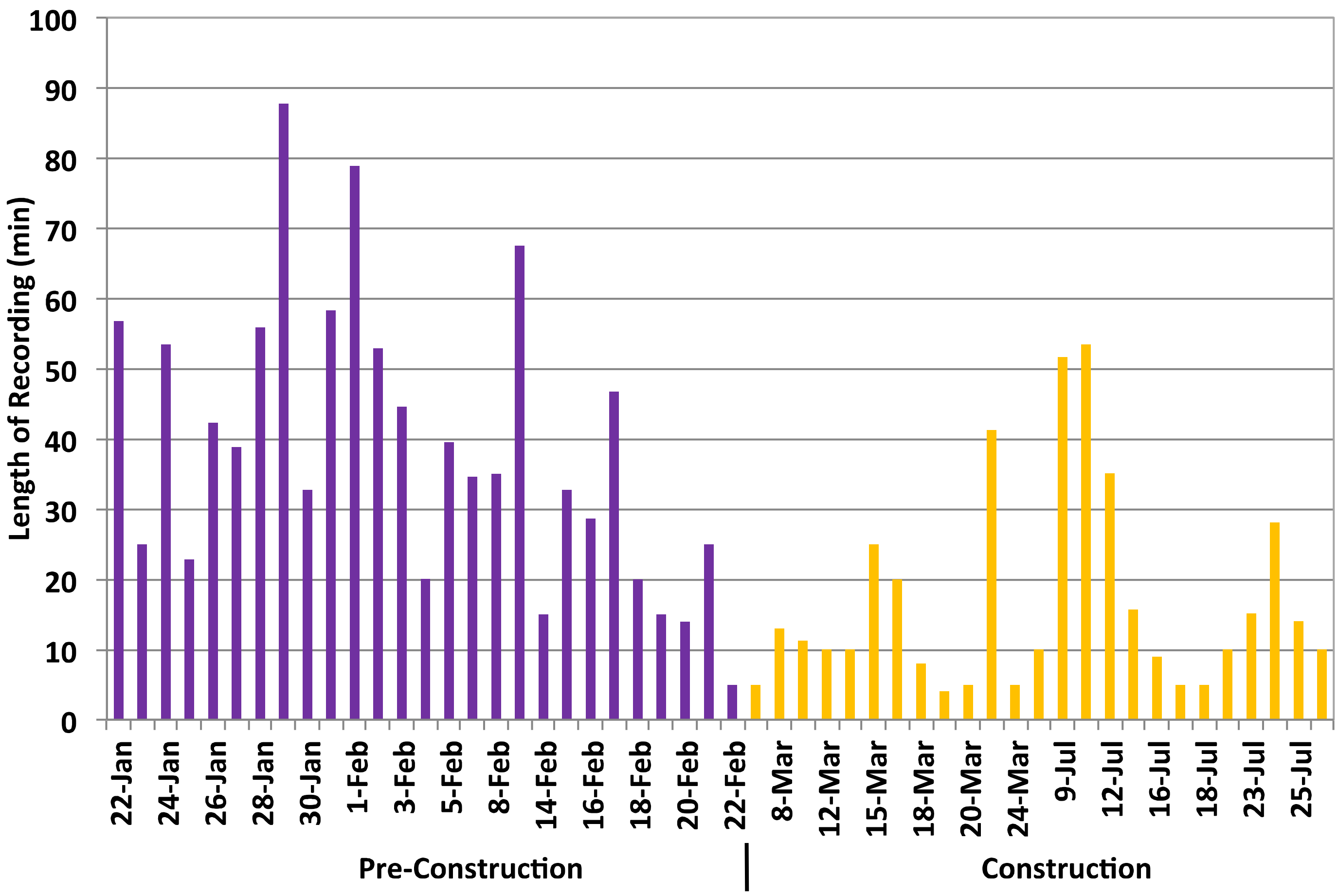


Figure 11. The daily summed length of recordings obtained during the two phases of the study. Sample sizes for **Baseline (i.e. Pre-construction)** are shown in Figure 2a and those for **Construction** are shown in Figure 2b.

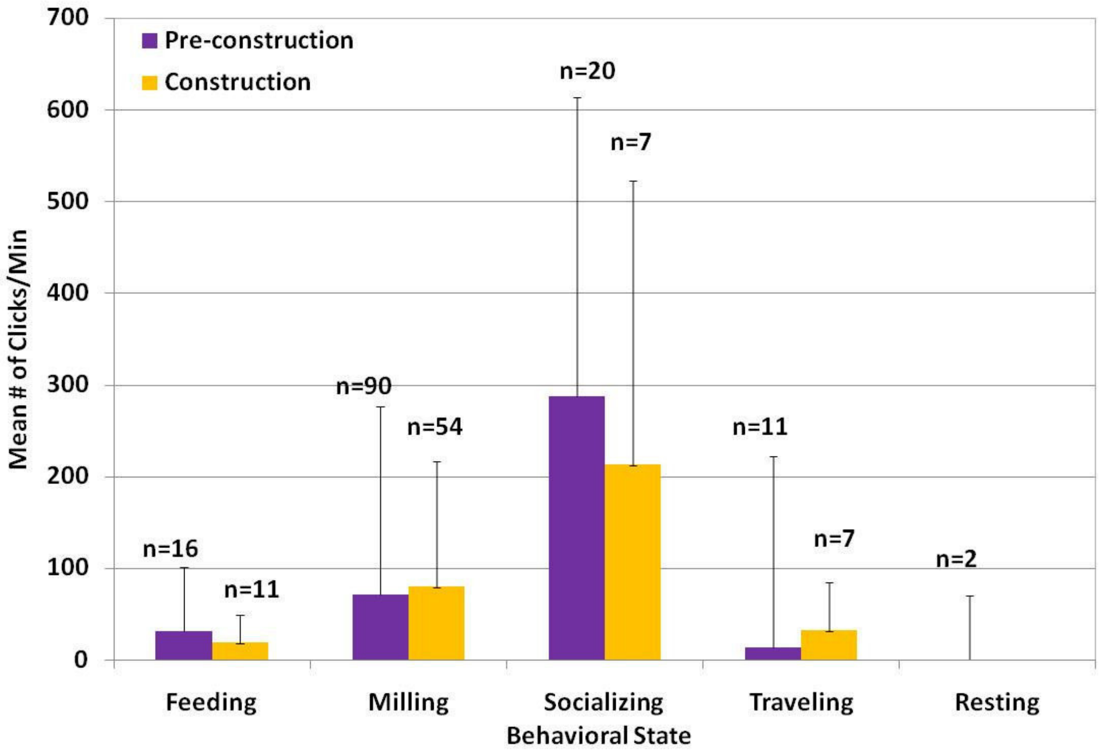


Figure 12a. A comparison of mean **clicking rates** recorded during the baseline (pre-construction) and construction phases as a function of behavioral state. Error bars represent one standard deviation.

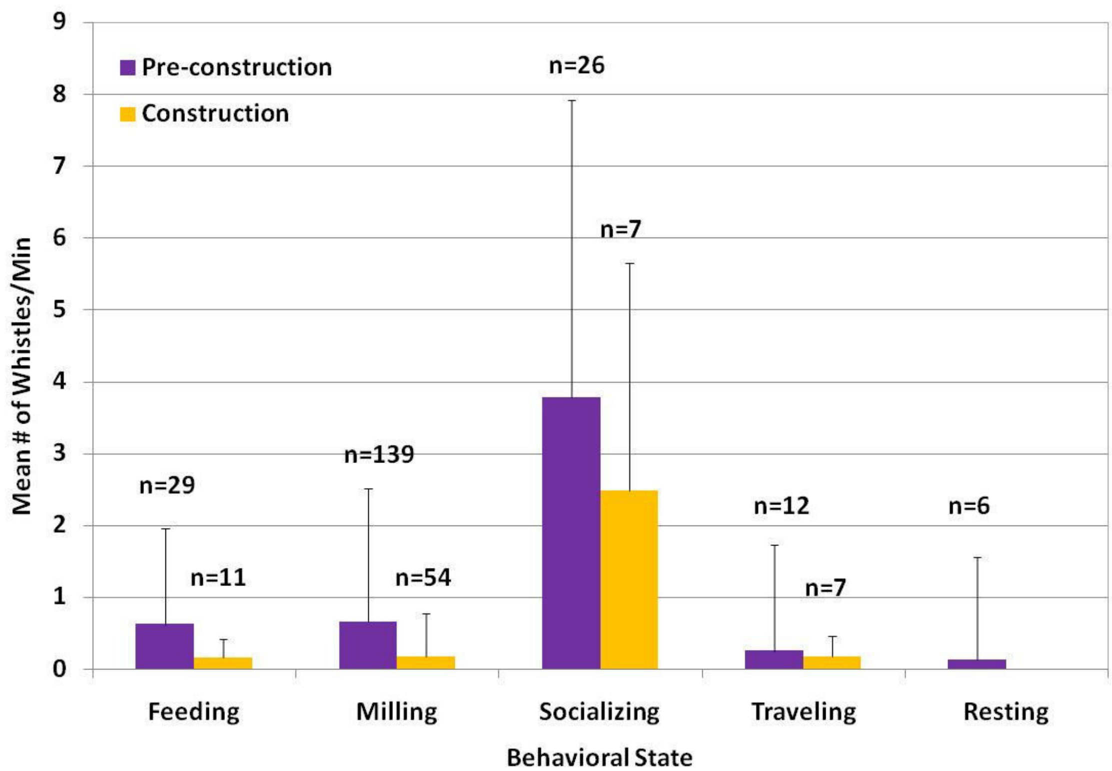


Figure 12b. A comparison of mean **whistling rates** recorded during the baseline (pre-construction) and construction phases as a function of behavioral state. Error bars represent one standard deviation.

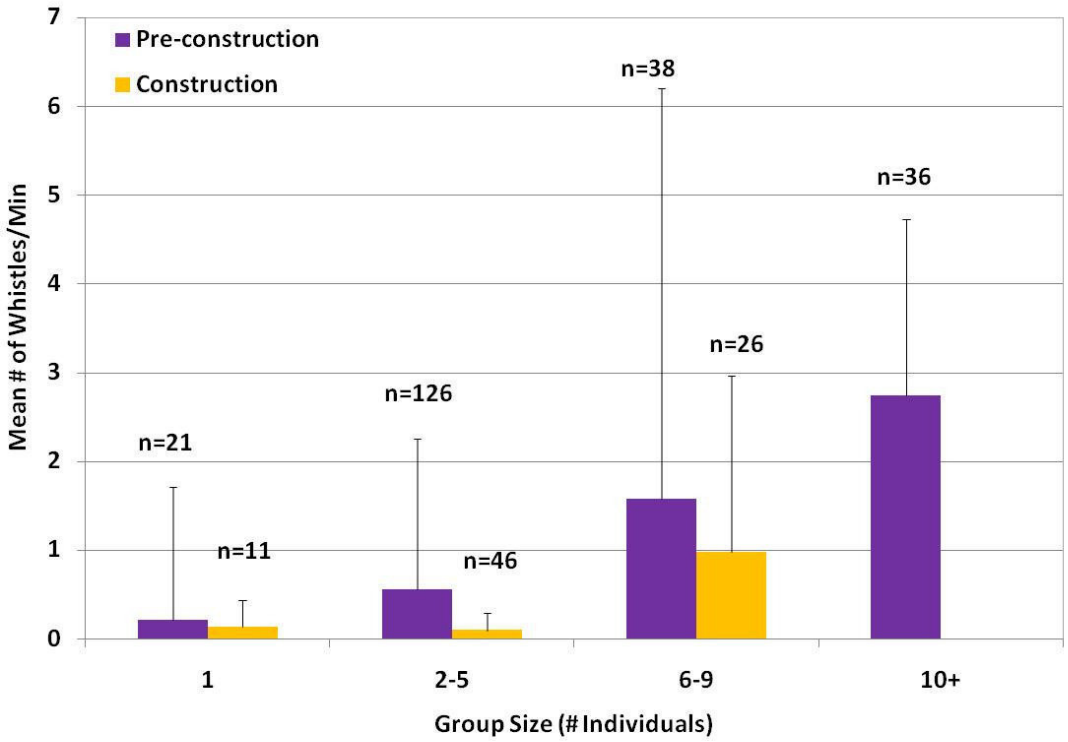


Figure 13a. A comparison of mean **whistling rates** between the baseline and construction phases as a function of group size. Note: no groups of 10+ animals were recorded during the construction phase. Error bars represent one standard deviation.

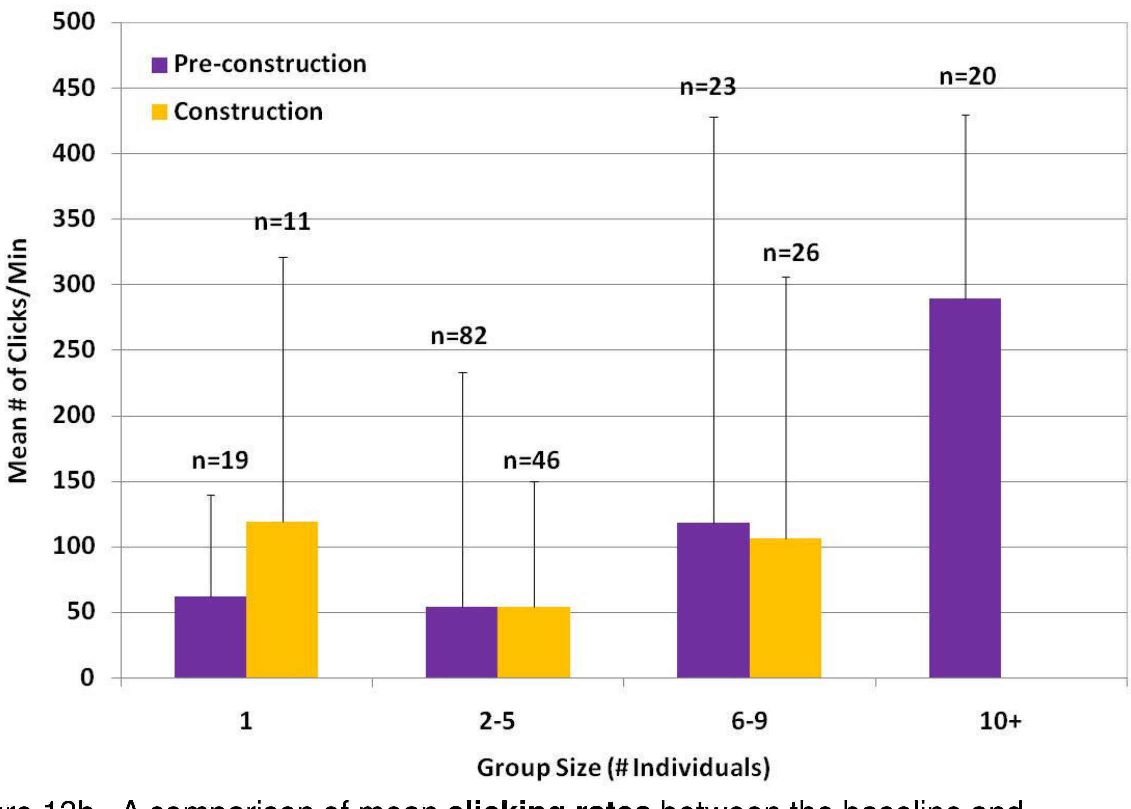


Figure 13b. A comparison of mean **clicking rates** between the baseline and construction phases as a function of group size. Note: no groups of 10+ animals were recorded during the construction phase. Error bars represent one standard deviation.

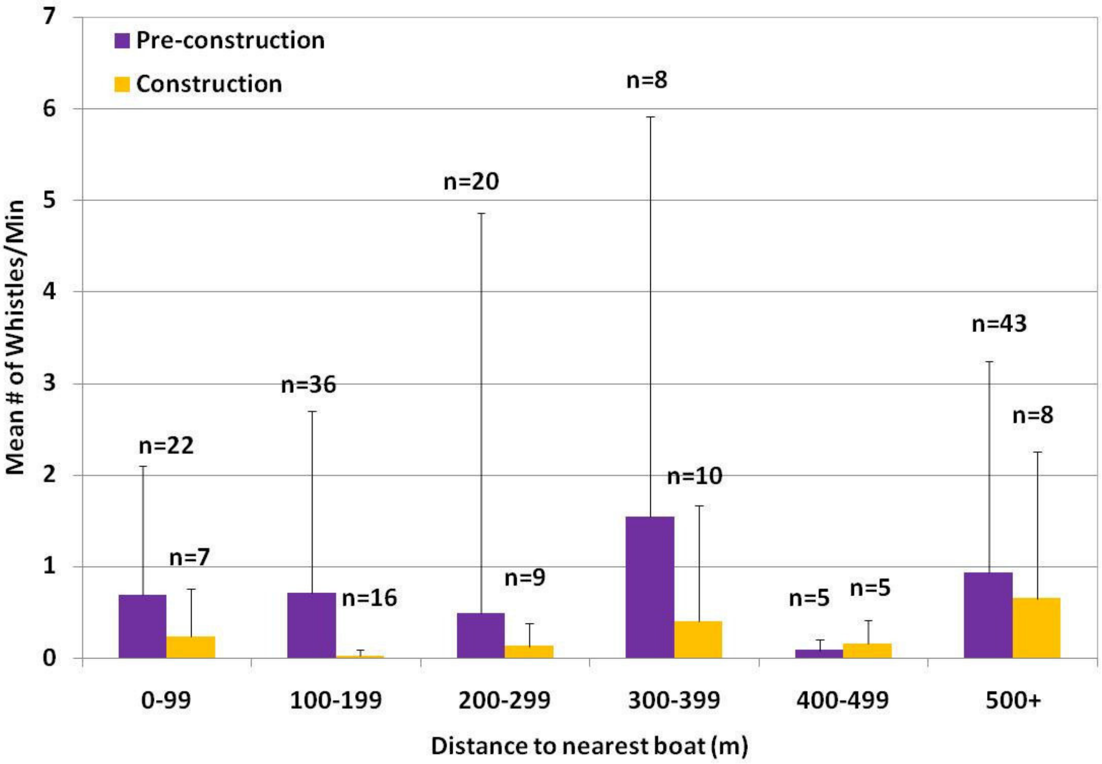


Figure 14a. A comparison of mean **whistling rates** between the baseline and construction phases as a function of distance to the nearest vessel. Error bars represent one standard deviation.

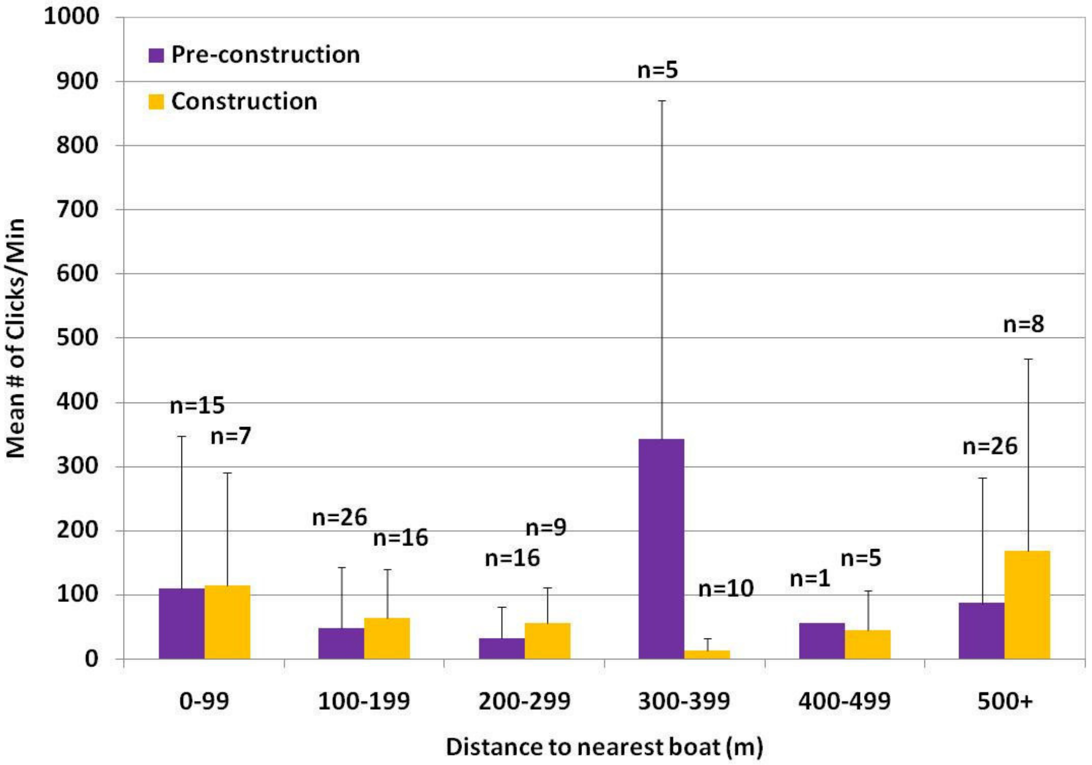


Figure 14b. A comparison of mean **clicking rates** between the baseline and construction phases as a function of distance to the nearest vessel. Error bars represent one standard deviation.

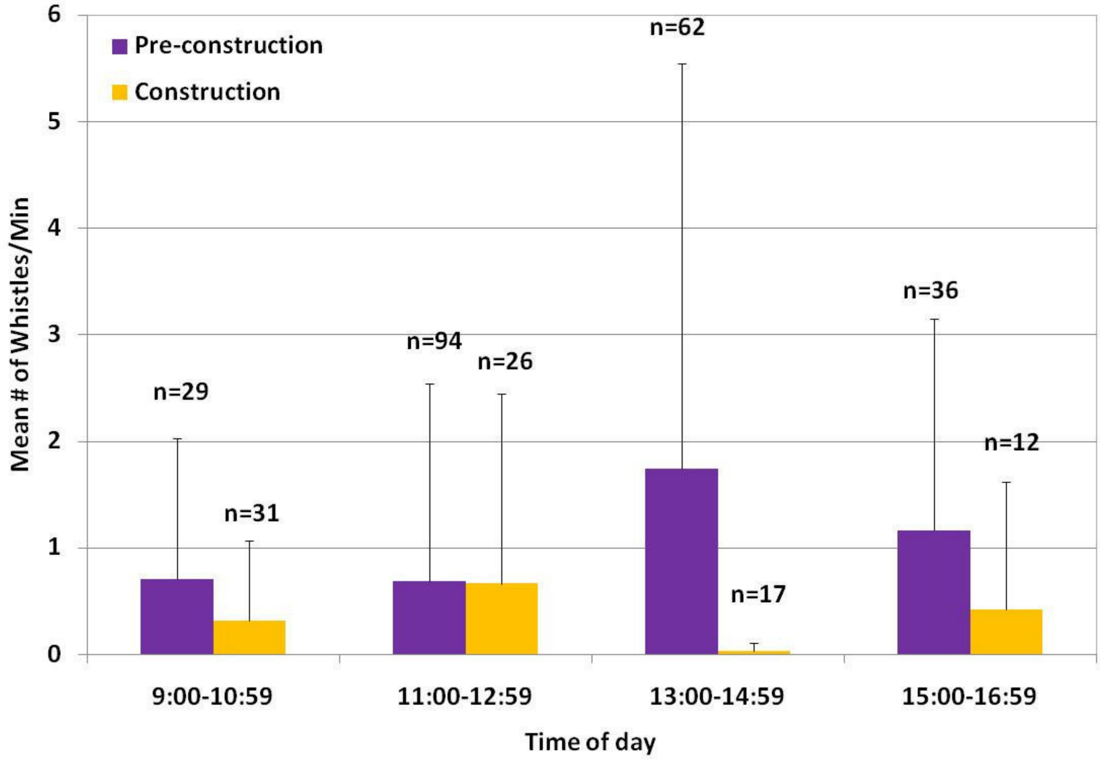


Figure 15a. A comparison of mean **whistling rates** between the baseline and construction phases as a function of distance to the time of day. Error bars represent one standard deviation.

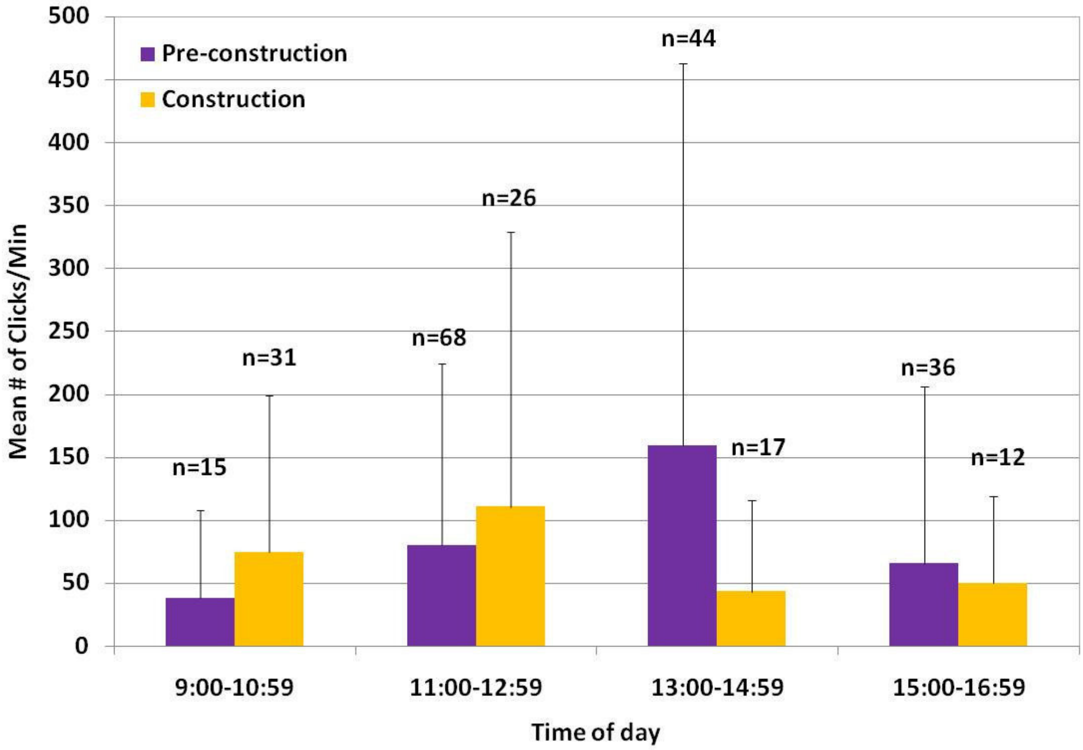


Figure 15b. A comparison of mean **clicking rates** between the baseline and construction phases as a function of distance to the time of day. Error bars represent one standard deviation.

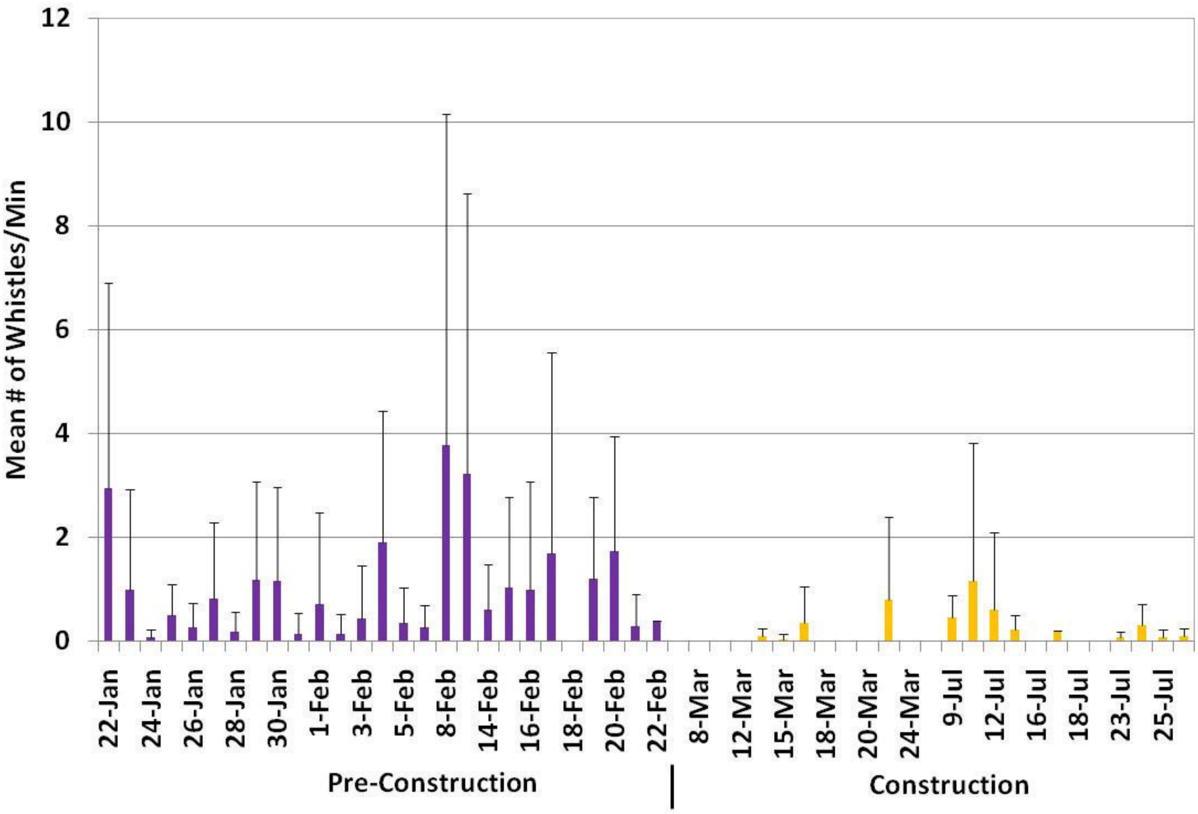


Figure 16a. Mean daily **whistling rates** for the baseline and construction phases of the study. Error bars represent one standard deviation. Sample sizes for **baseline** are shown in Figure 2a and those for **Construction** are shown in Figure 2b.

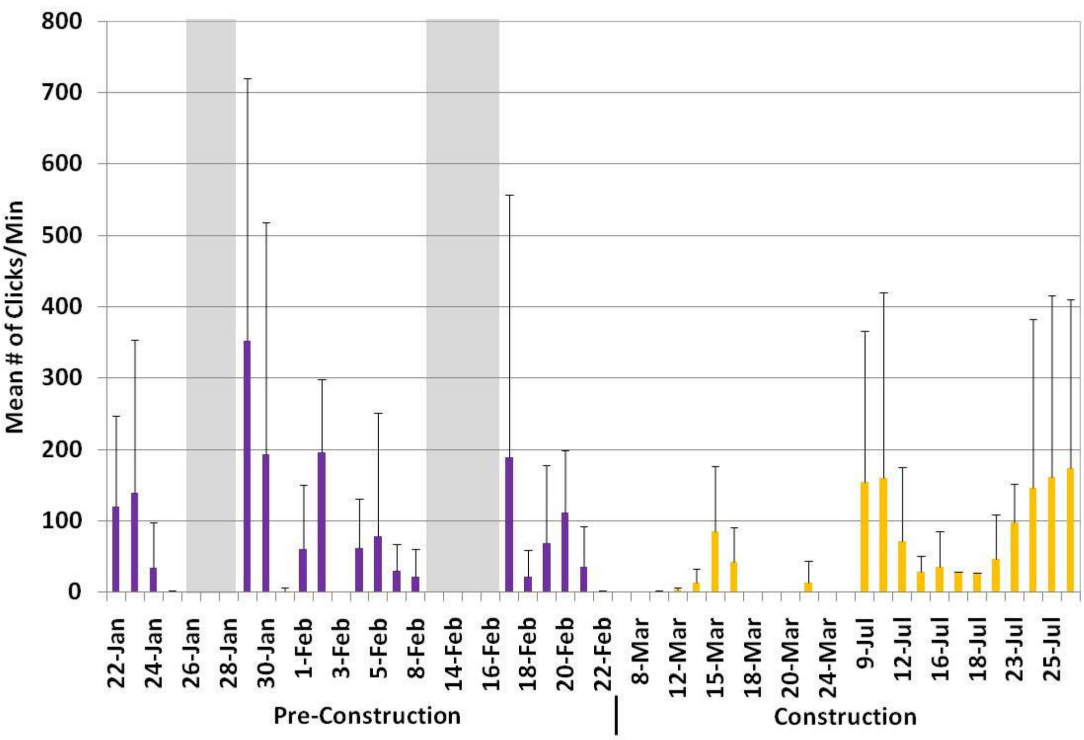


Figure 16b. Mean daily **clicking rates** for the baseline and construction phases of the study. Shaded areas represent days with recordings that had high-frequency noise interference and therefore could not be analyzed for clicks. Error bars represent one standard deviation. Sample sizes for **baseline** are shown in Figure 2a and those for **Construction** are shown in Figure 2b.

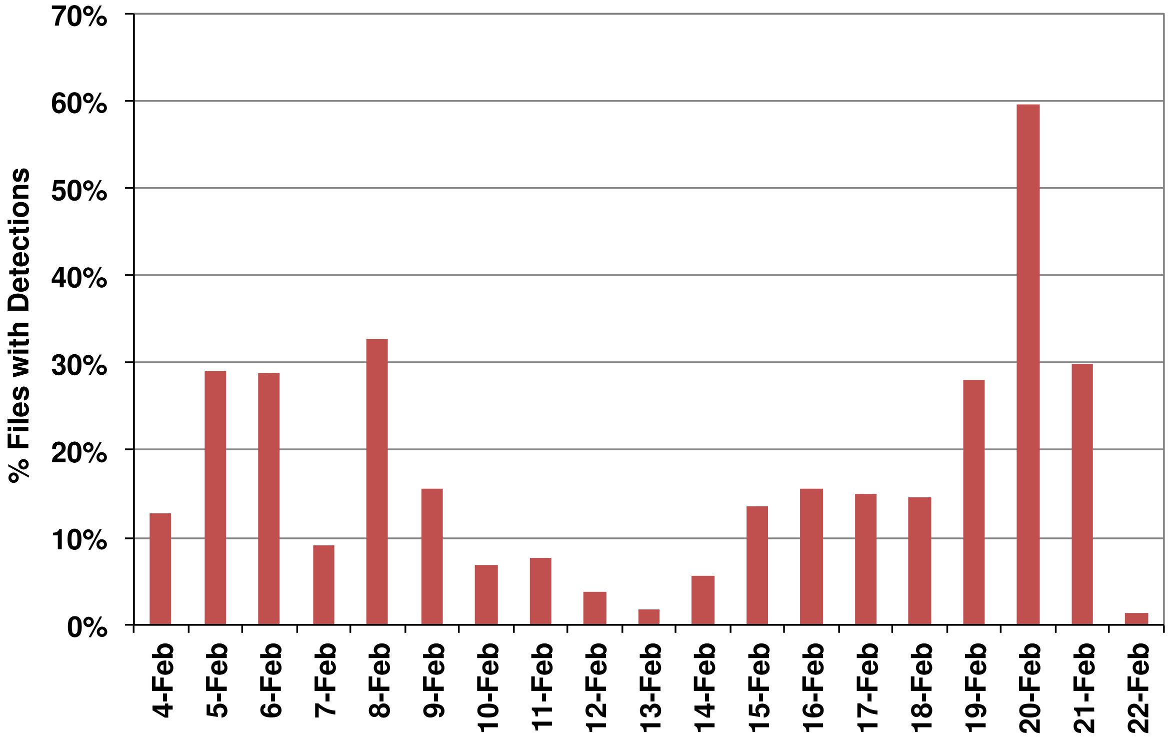


Figure 17a. Histogram of the percentage of EAR recordings with dolphin detections made at site B1 (Fan Lau) during each day of deployment during the **baseline period** (Note: February 4 and 22 did not have a full day of recordings)

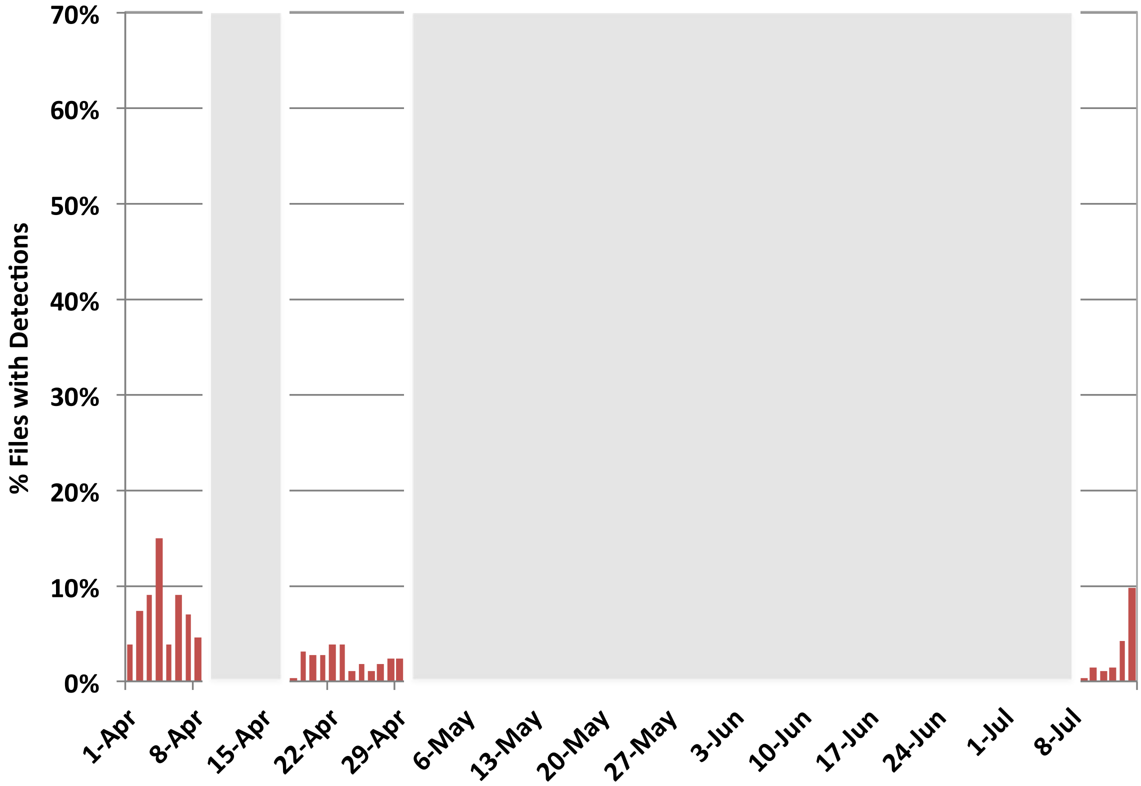


Figure 17b. The percentage of files for each day during the **construction phase** that contained dolphin signals at site B1 (Fan Lau). Shaded areas represent periods when either no data were obtained or for which the data recorded were not analyzed for inclusion in this report.

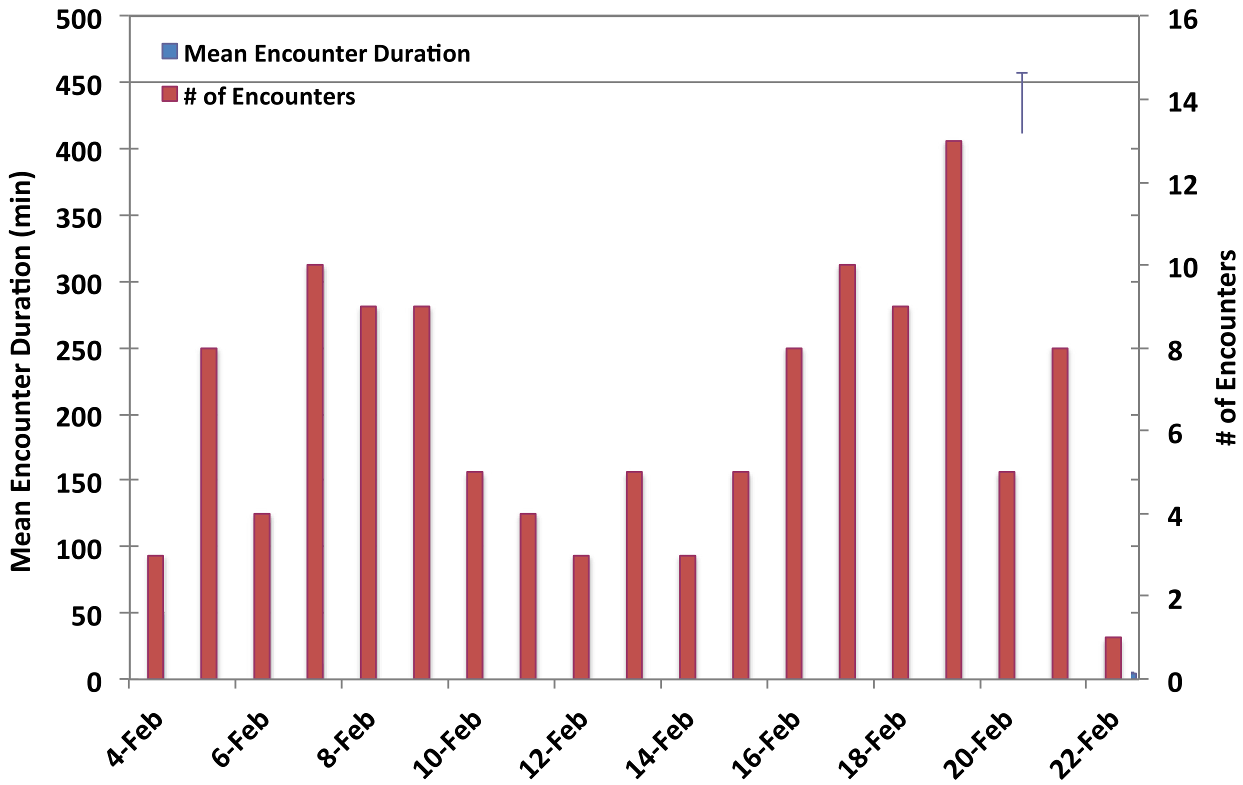


Figure 18a. The number of dolphin encounters and the average encounter duration for each day recorded on the EAR at site B1 (Fan Lau) during the **baseline period**. Error bars represent one standard deviation.

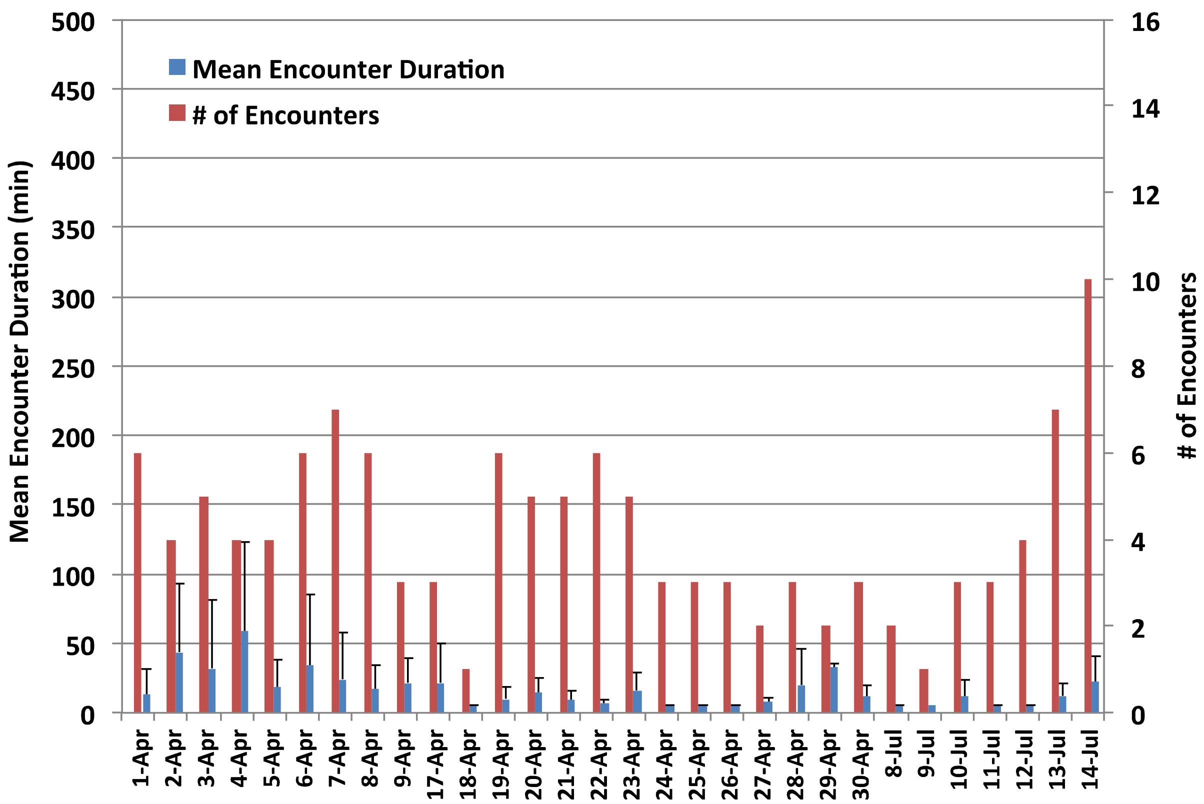


Figure 18b. The number of dolphin encounters and the average encounter duration for each day recorded on the EAR at site B1 (Fan Lau) during the **construction period**. Error bars represent one standard deviation.

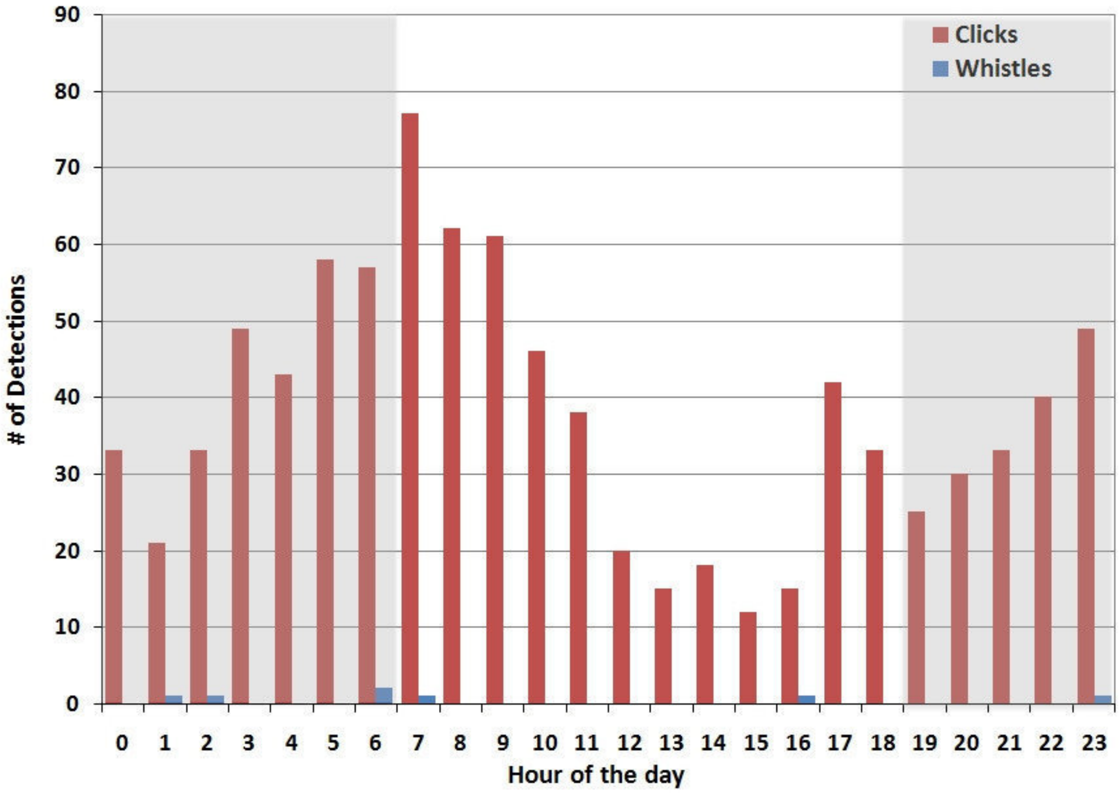


Figure 19a. Detections of dolphin signals at site B1 (Fan Lau) during the **baseline period** as a function of the hour of the day. Values are the total number of detections in each hour across the entire monitoring period.

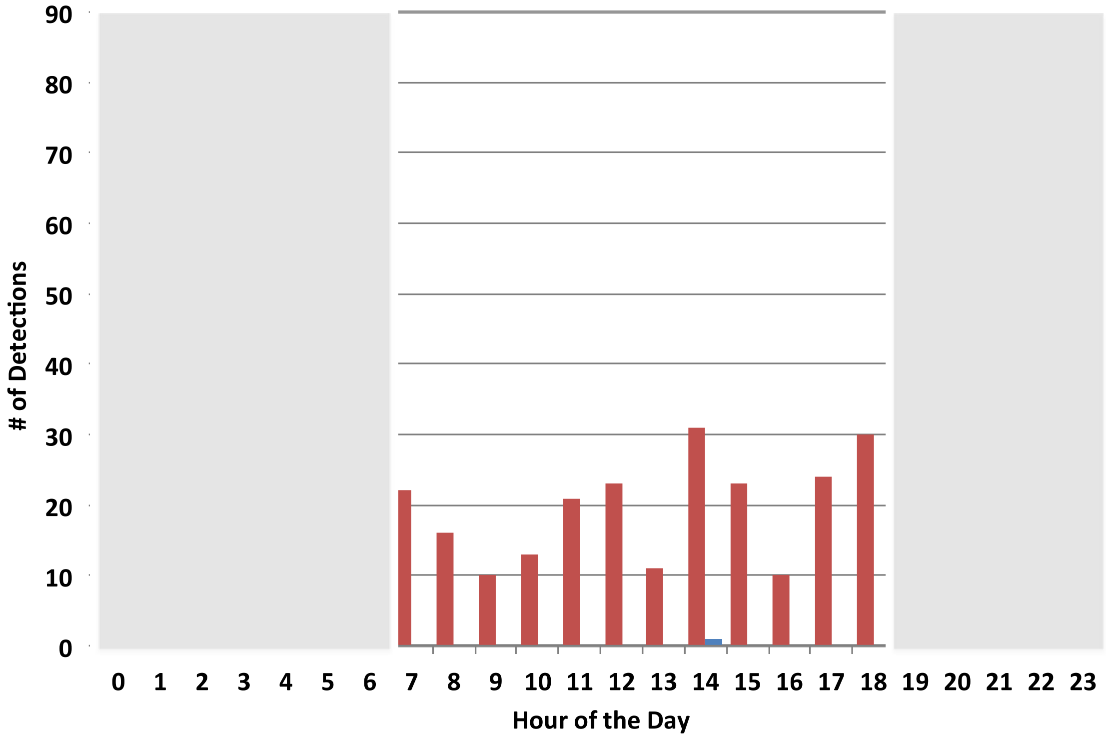


Figure 19b. Detections of dolphin signals at site B1 (Fan Lau) during the **construction period** as a function of the hour of the day. Values are the total number of detections in each hour across the entire monitoring period.

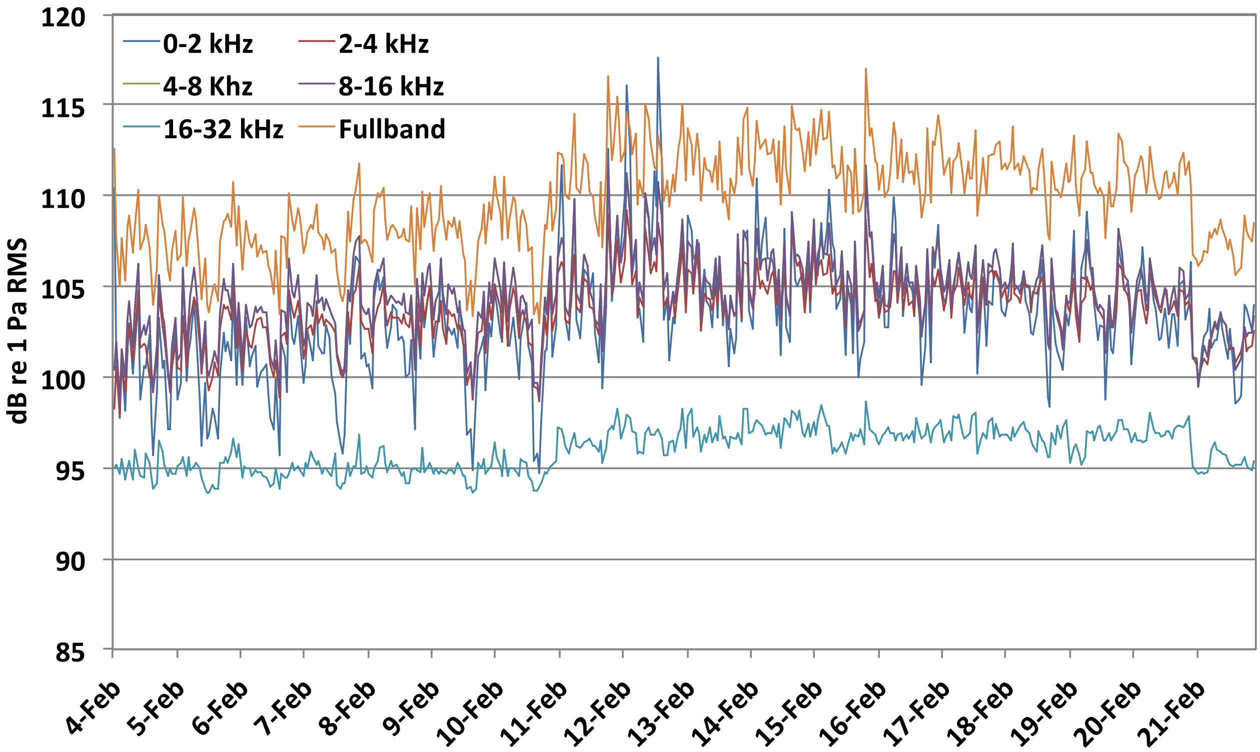


Figure 20a. Root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly over the **baseline deployment period** at site B1 (Fan Lau).

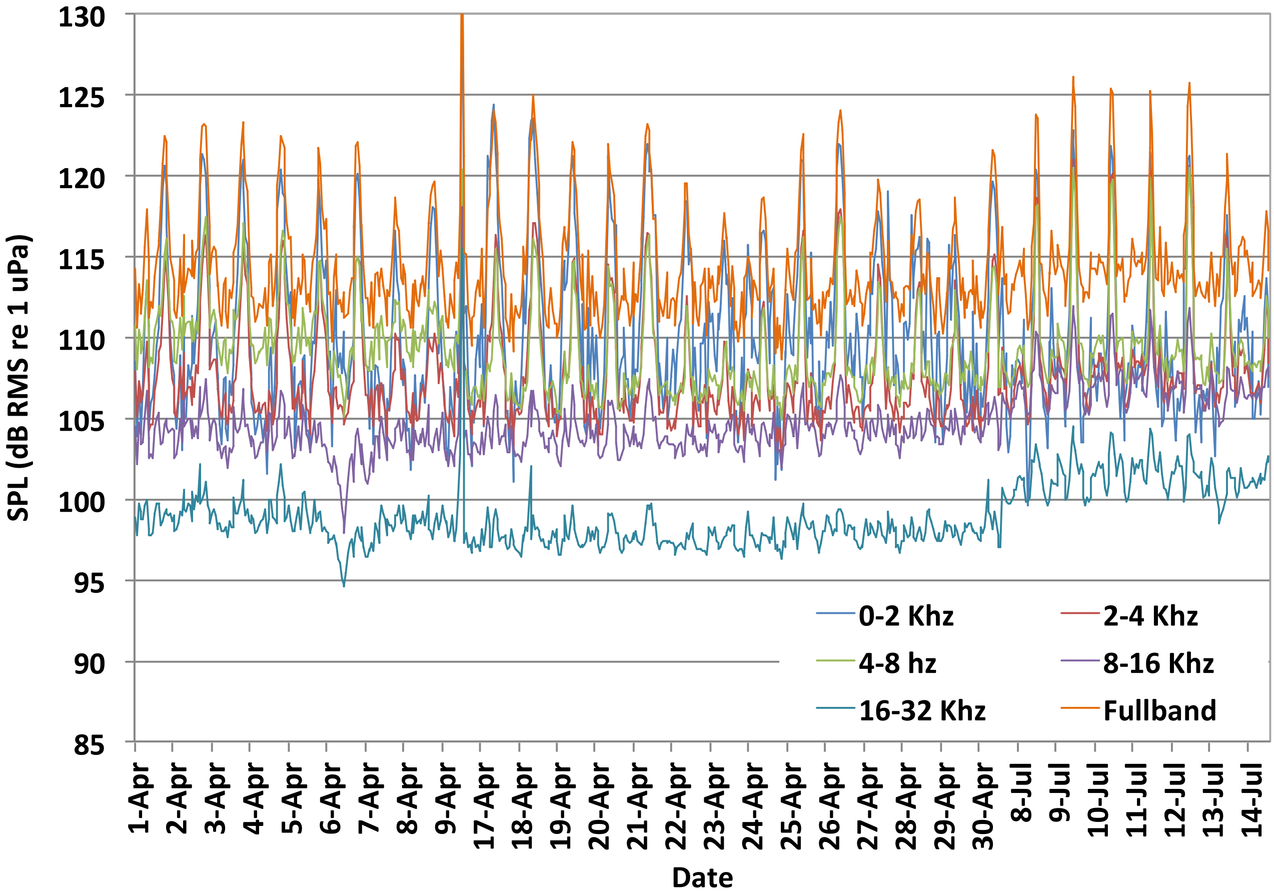
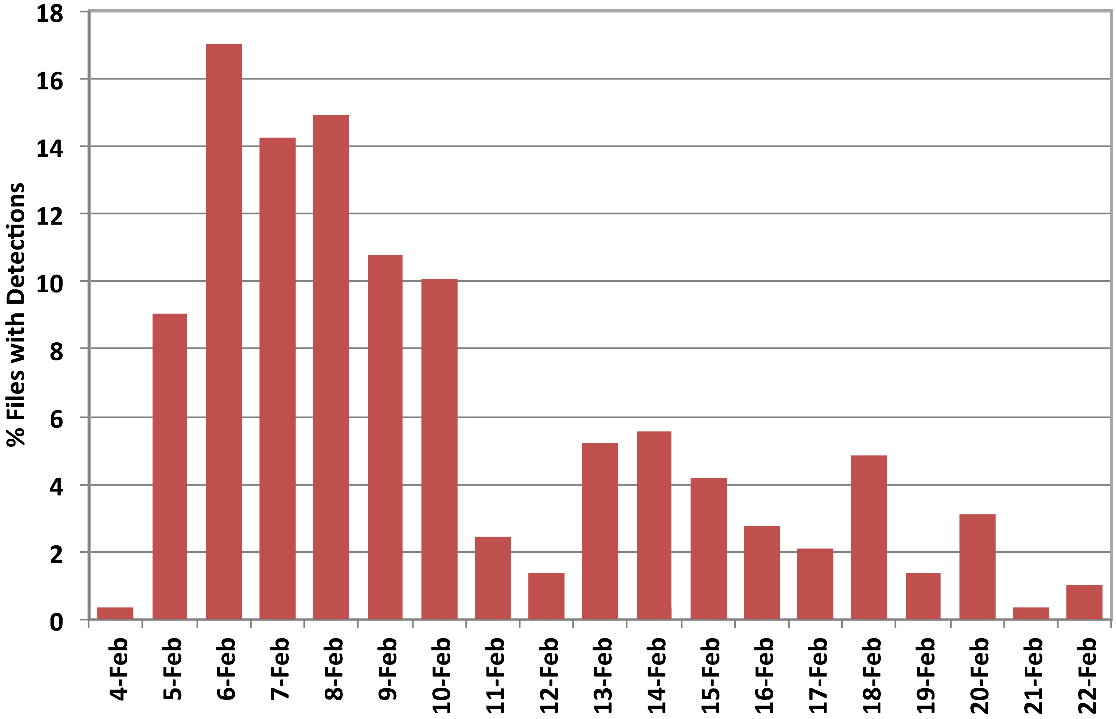


Figure 20b. Root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly over the **construction deployment period** at site B1 (Fan Lau).



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Area), with dolphin detections made during each day for the **baseline deployment period** (Note: February 4 and 22 did not have a full day of recordings).

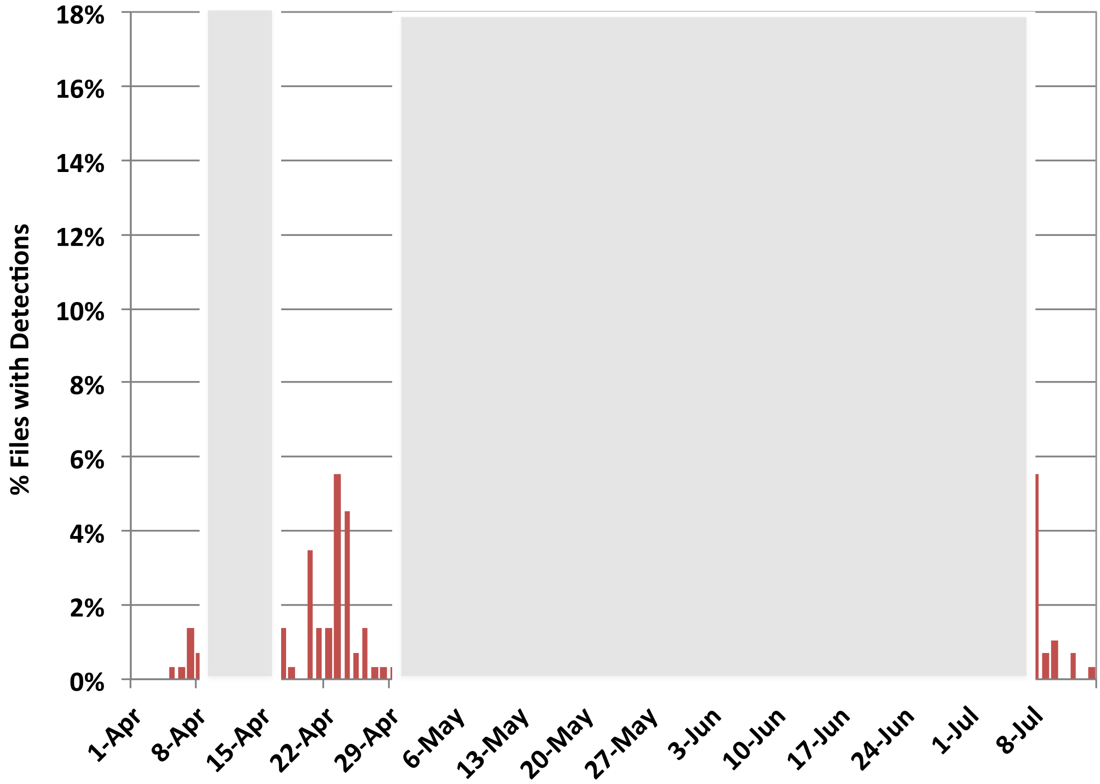

Figure 21b. The percentage of files for each day during the **construction phase** that contained dolphin signals at site B2 (Bridge Alignment Area). Shaded areas represent periods when either no data were obtained or for which the data recorded were not analyzed for inclusion in this report.

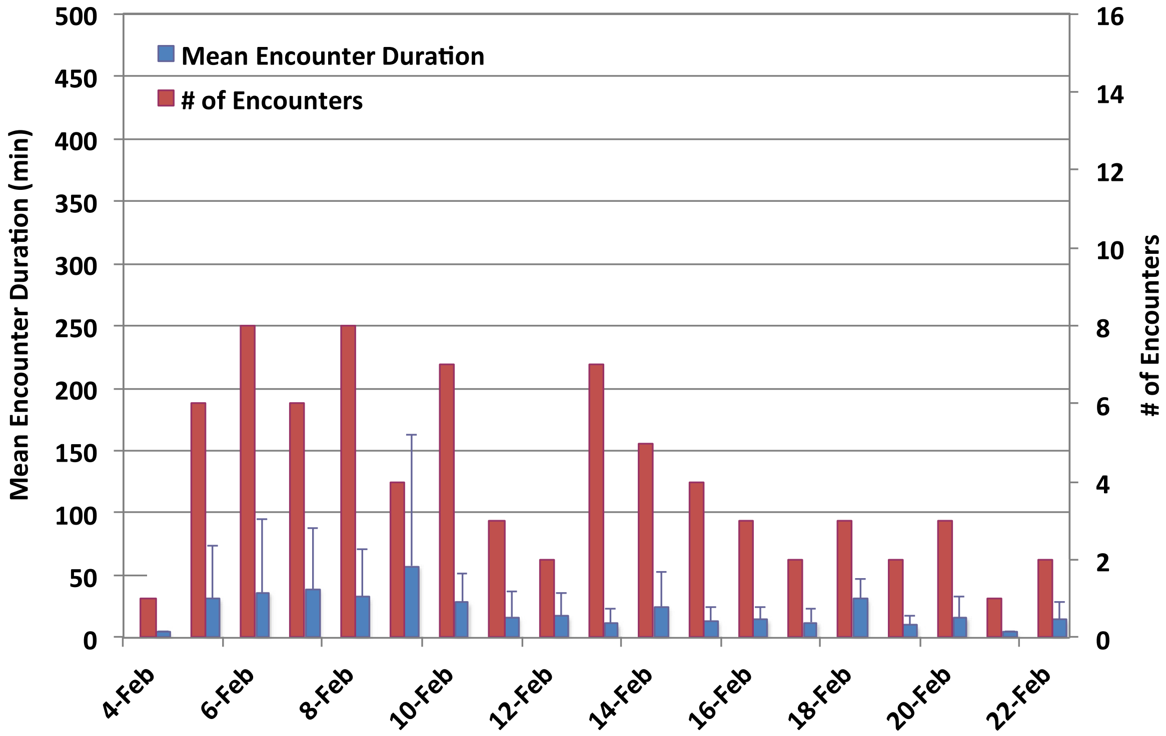

Figure 22a. The number of dolphin encounters and the mean encounter duration for each day recorded on the EAR at site B2 (Bridge Alignment Area) during the **baseline period**. Error bars represent one standard deviation.

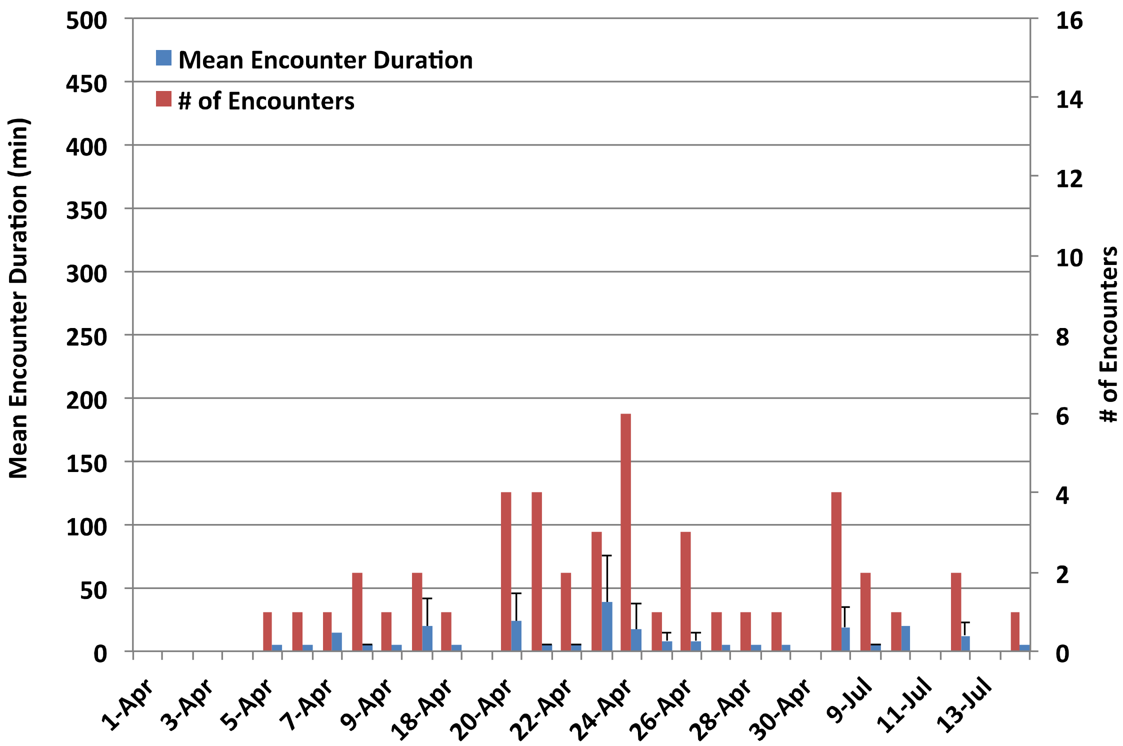

Figure 22b. The number of dolphin encounters and the mean encounter duration for each day recorded on the EAR at site B2 (Bridge Alignment Area) during the **construction** period. Error bars represent one standard deviation.

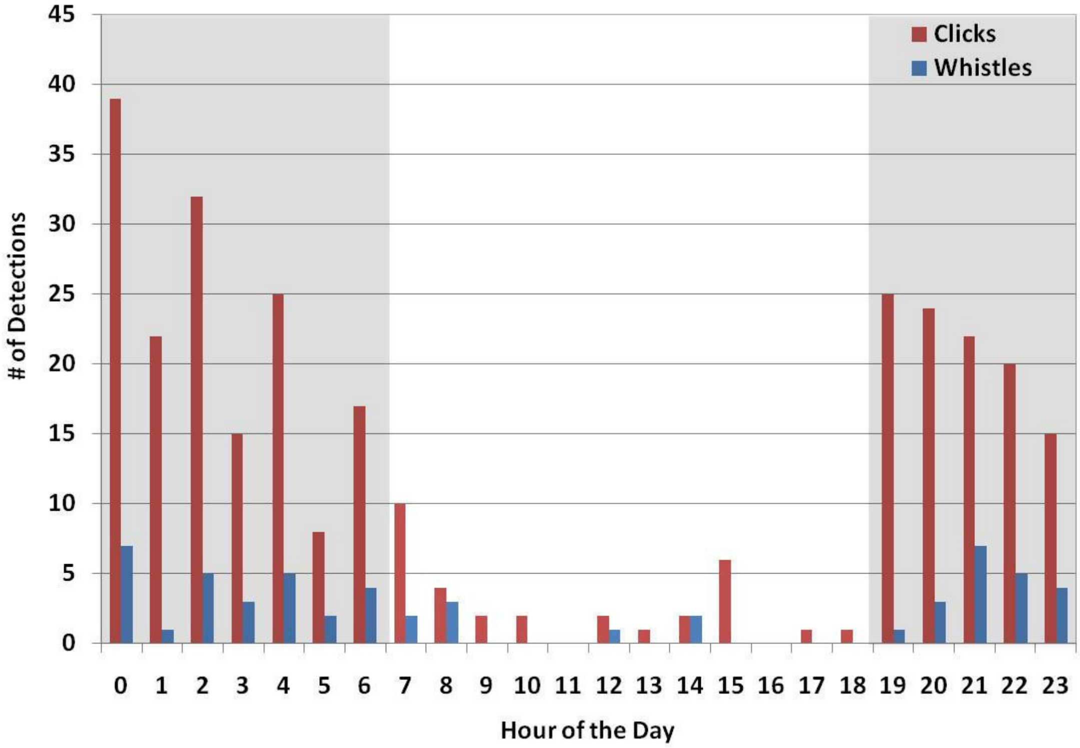

Figure 23a. Detections of dolphin signals at site B2 (Bridge Alignment Area) during the **baseline period** as a function of the hour of the day. Values are the total number of detections in each hour across the entire monitoring period.

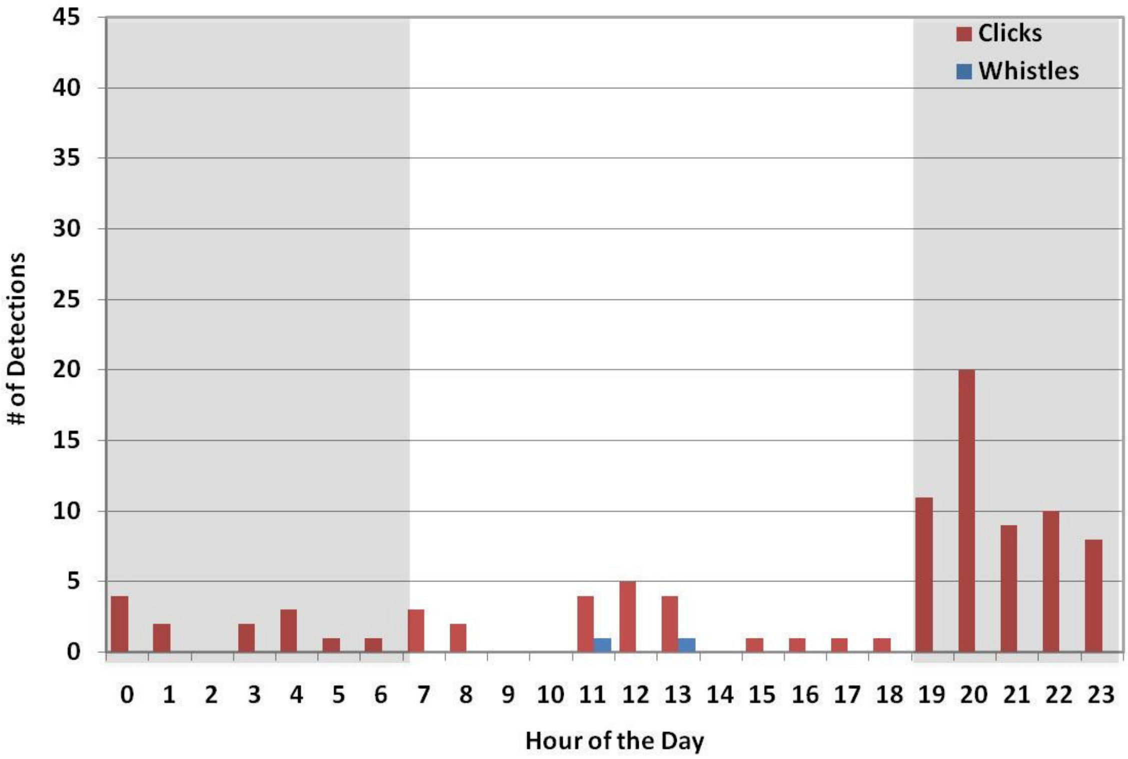

Figure 23b. Detections of dolphin signals at site B2 (Bridge Alignment Area) during the construction period as a function of the hour of the day. Values are the total number of detections in each hour across the entire monitoring period.

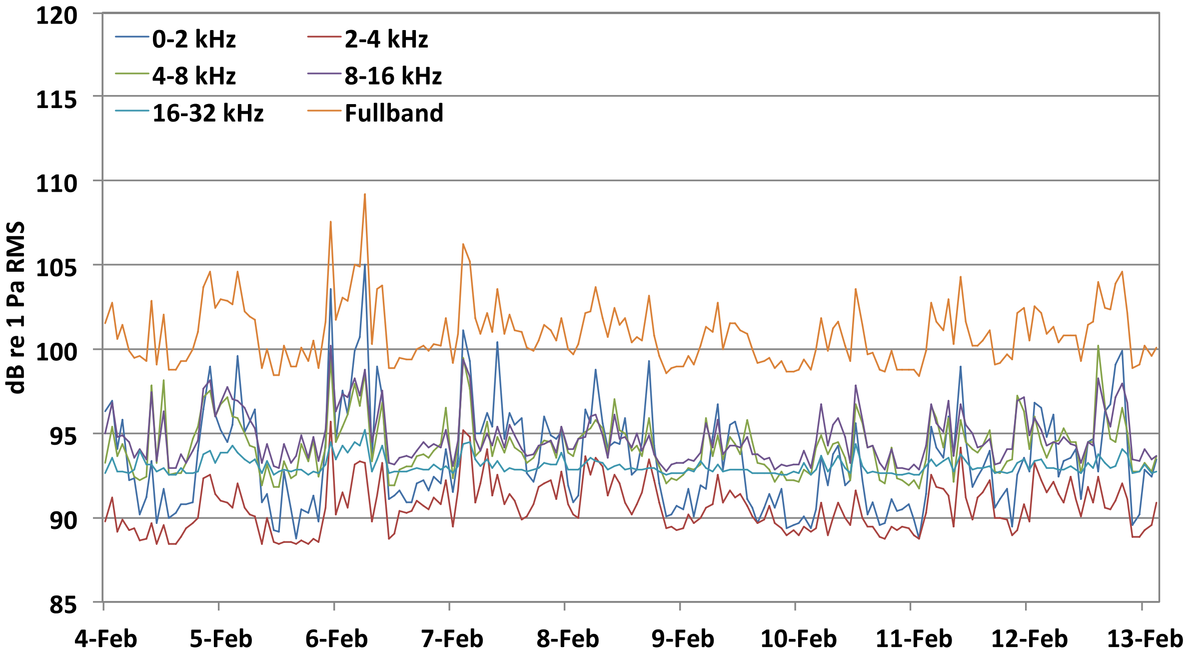

Figure 24a. Root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly over the **baseline deployment period** at site B2 (Bridge Alignment Area).

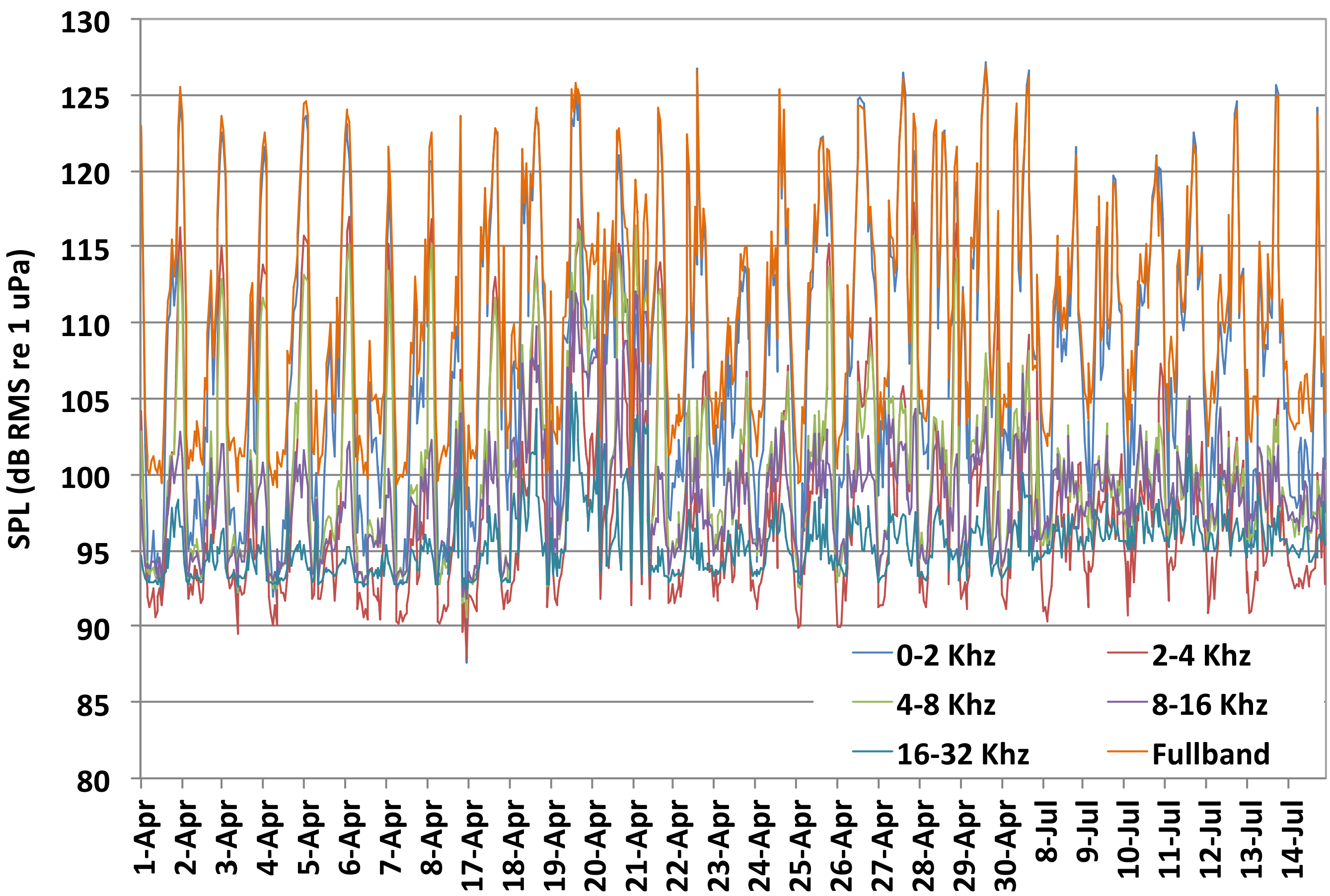

Figure 24b. Root-mean-square (RMS) sound pressure level (SPL) in 1-octave bands and full bandwidth averaged hourly over the **construction deployment period** at site B2 (Bridge Alignment Area).

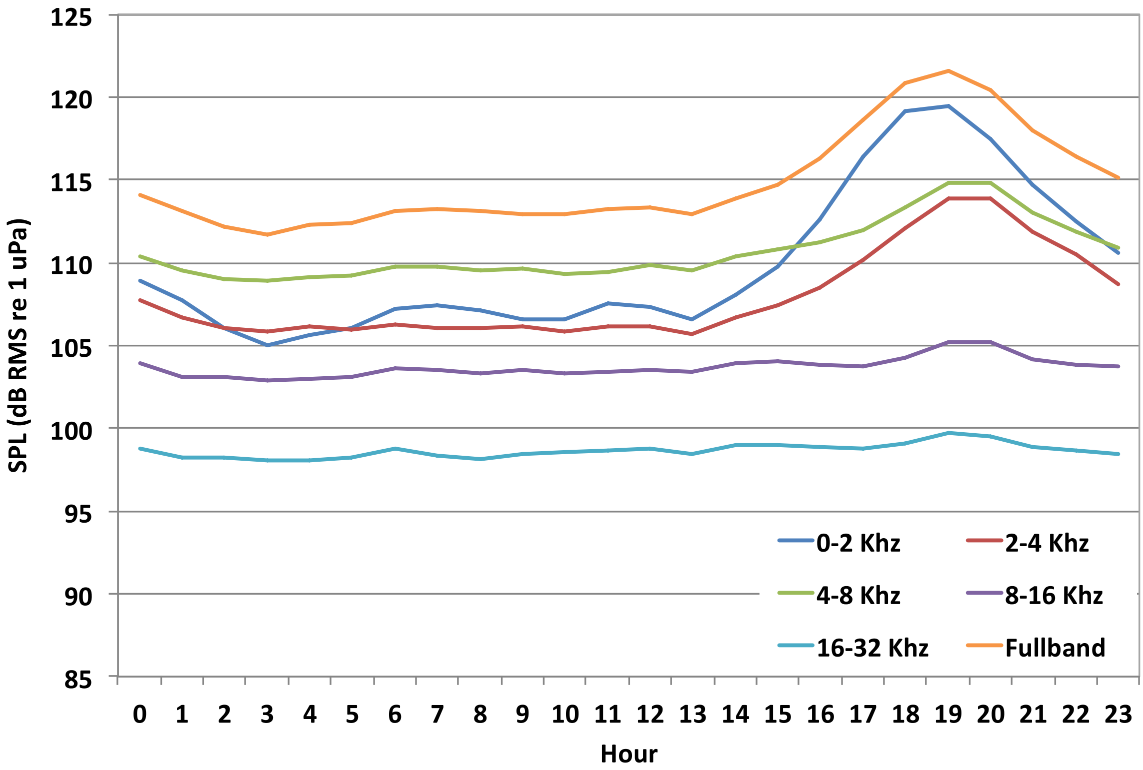

Figure 25a. Root-mean-square (RMS) sound pressure level (SPL) averaged hourly over the 24-hour day for the period between 17-30 April, 2013 (construction phase) from site B1 (Fan Lau).

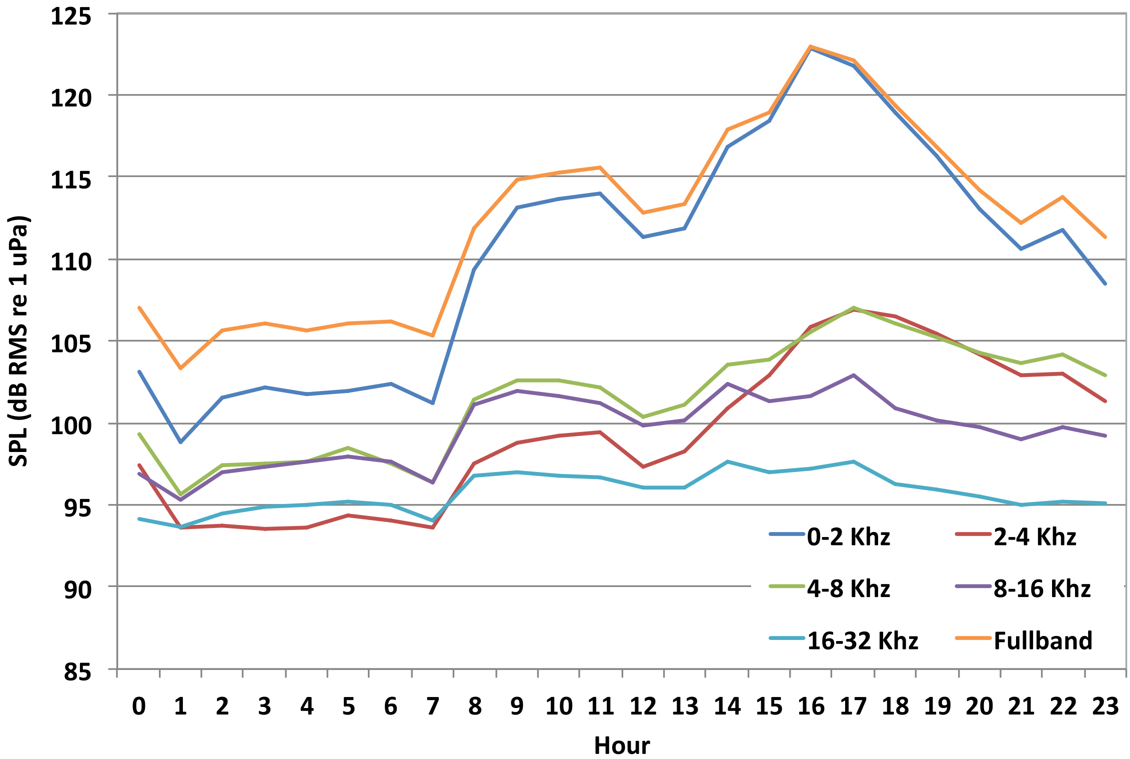

Figure 25b. Root-mean-square (RMS) sound pressure level (SPL) averaged hourly over the 24-hour day for the period between 17-30 April, 2013 (construction phase) from site B2 (Bridge Alignment Area).

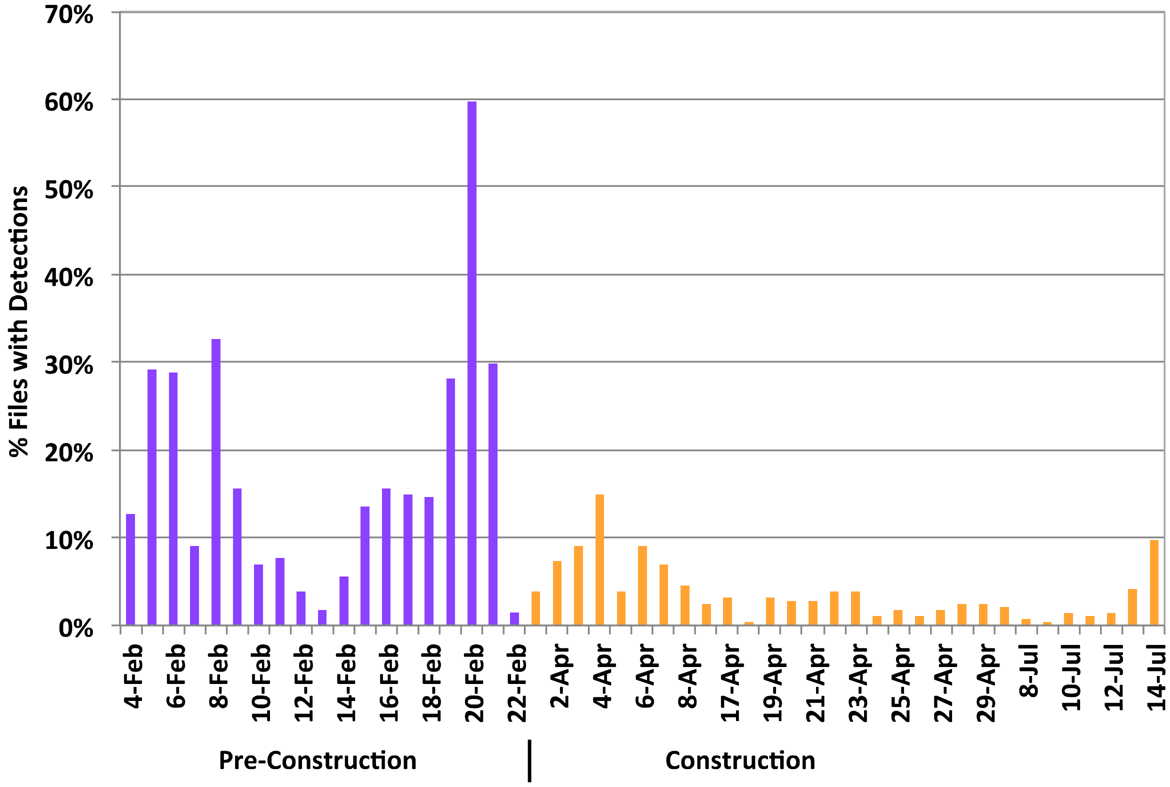

Figure 26a. The percentage of files for each day that contained dolphin signals at **site B1 (Fan Lau)** for the baseline and construction phases of the study.

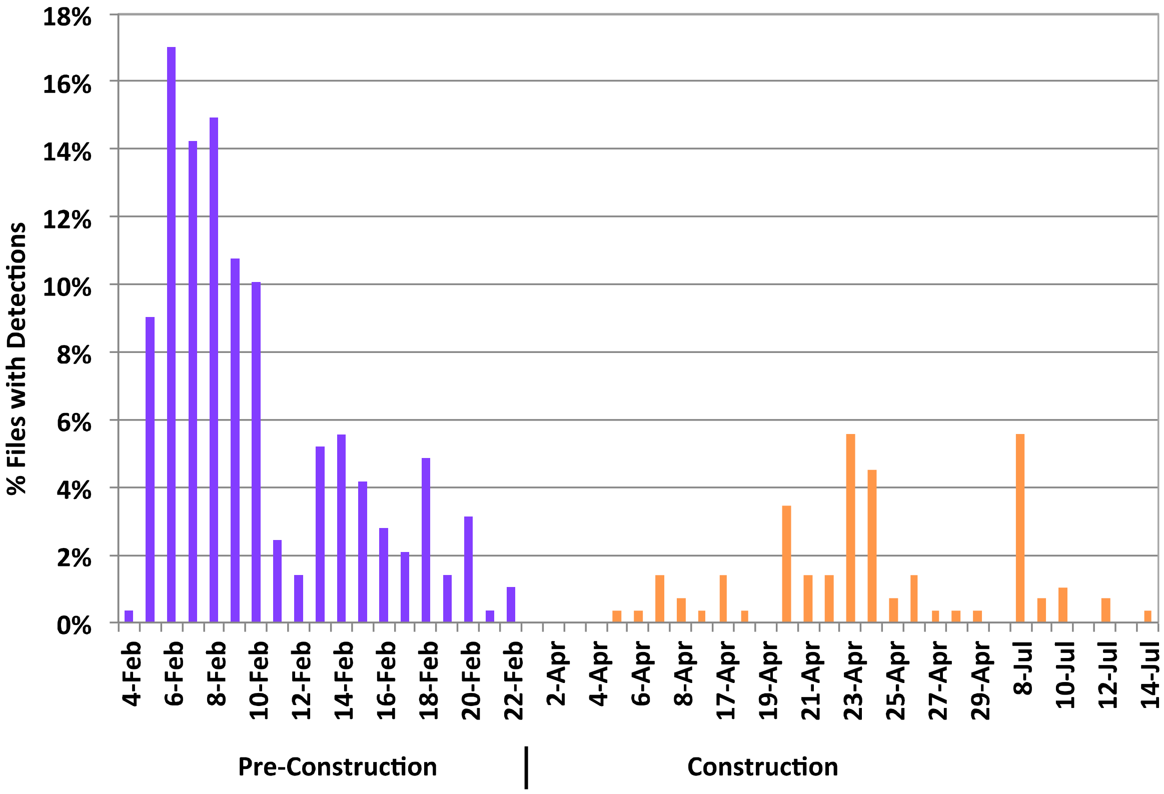

Figure 26b. The percentage of files for each day that contained dolphin signals at **site B2 (Bridge Alignment Area)** for the baseline and construction phases of the study.

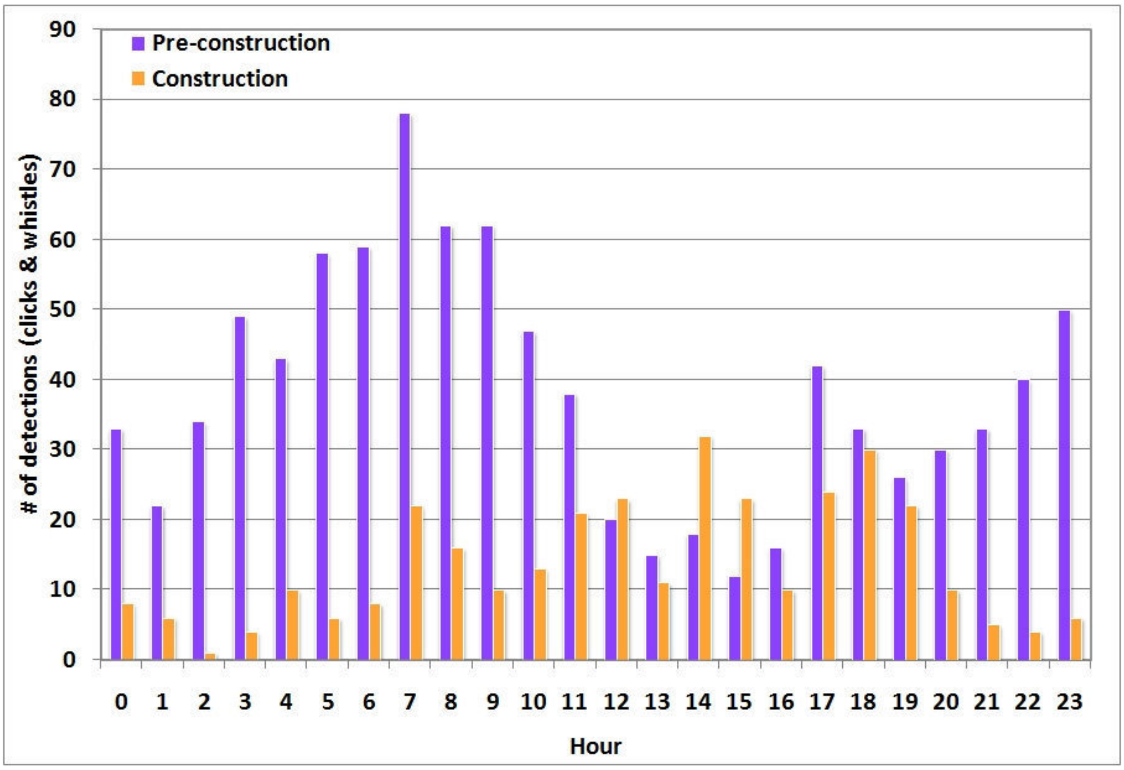

Figure 27a. Detections of dolphin signals at **site B1 (Fan Lau)** as a function of the hour of the day during the baseline and construction periods. Values are the total number of detections in each hour across the entire monitoring period.

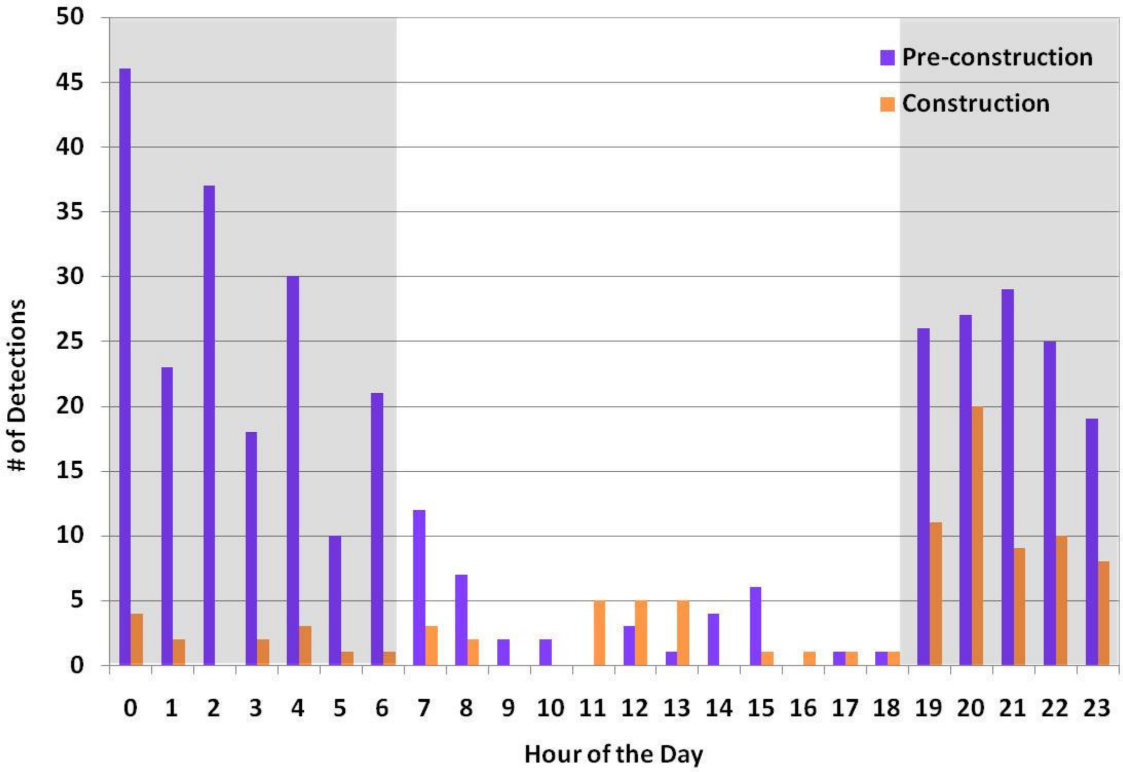

Figure 27b. Detections of dolphin signals at **site B2 (Bridge Alignment Area)** as a function of the hour of the day during the baseline and construction periods. Values are the total number of detections in each hour across the entire monitoring period.