Appendix H

Post Construction (Operational) Dolphin Monitoring Survey

CONTRACT NO. HY/2012/08
Hong Kong-Zhuhai-Macao Bridge Tuen Mun – Chek Lap Kok Link (Northern Connection Sub-sea Tunnel Section) Post-Construction Dolphin Monitoring

4th Quarterly Progress Report (March-May 2021)
submitted to Dragages – Bouygues Joint Venture & ERM Hong Kong Ltd.

Submitted by
Samuel K.Y. Hung, Ph.D.
Hong Kong Cetacean Research Project

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1. Introduction

1.1. As part of the Hong Kong-Zhuhai-Macao Bridge, the Tuen Mun-Chek Lap Kok Link (TM-CLKL) Northern Connection Sub-sea Tunnel Section (Contract no. HY/2012/08) comprises the sub-sea TBM tunnels (two tubes with cross passages) across the Urmston Road to connect Tuen Area 40 and Hong Kong Boundary Crossing Facilities (HKBCF) of approximately 4 km in length with dual 2-lane carriageway, the tunnels at both the southern landfall and the northern landfall for construction of approach roads to the sub-sea TBM tunnels of approximately 1.5 km in length, as well as the northern landfall reclamation of approximately 16.5 hectares and about 20.km long seawalls. Dragages – Bouygues Joint Venture (hereinafter called the "Contractor") was awarded as the main contractor for the Northern Connection Sub-sea Tunnel Section, and ERM Hong Kong Limited would serve as the Environmental Team to implement the Environmental Monitoring and Audit (EM&A) programme.

1.2. According to the updated EM&A Manual (for TM-CLKL), monthly line-transect vessel surveys for Chinese White Dolphin should be conducted to cover the Northwest (NWL) and Northeast Lantau (NEL) survey areas as in AFCD annual marine mammal monitoring programme. Between 2013 and 2019, as such surveys have already been undertaken by the HKLR03 and HKBCF projects in the survey same areas of NEL and NWL, a combined monitoring approach was recommended by the Highways Department, that the TM-CLKL EM&A project can utilize the monitoring data collected by HKLR03 or HKBCF project to avoid any redundancy in monitoring effort. Such exemption for the dolphin monitoring has ended in September 2019 as the dolphin monitoring works carried out by HKLR03 and HKBCF contract have been completed. Starting in October 2019, TMCLKL08 contract takes over the dolphin monitoring works by conducting the regular vessel-based line-transect surveys during the construction phase. And as the construction works for the TMCLKL08 contract has also been completed in May 2020, the post-construction dolphin monitoring works have subsequently commenced in June 2020.

1.3. Since November 2013, the Director of Hong Kong Cetacean Research Project (HKCRP), Dr. Samuel Hung, has been appointed by ERM Hong Kong Limited as the dolphin specialist for the TMCLKL Northern Connection Sub-sea Tunnel Section EM&A project. He is responsible for the dolphin monitoring study, including the data collection on Chinese White Dolphins during the construction phase (i.e. impact period) as well as the post-construction phase of the TMCLKL project in Northwest Lantau (NWL) and Northeast Lantau (NEL) survey areas. During both phases, the dolphin specialist is responsible to utilize the collected monitoring data in order to examine any potential impacts on the dolphins during and after the TMCLKL construction works.

1.4. This report is the fourth quarterly progress report under the TM-CLKL post-construction phase dolphin monitoring programme submitted to the Contractor, which summarizes the results of the survey findings during the period of March to May 2021.

2. Monitoring Methodology

2.1. Vessel-based Line-transect Survey

2.1.1. According to the requirement of the updated EM&A manual, dolphin monitoring programme should cover all transect lines in NEL and NWL survey areas (see Figure 1) twice per month throughout the entire construction and post-construction monitoring period. The co-ordinates of all transect lines are shown in Table 1.

Table 1 Co-ordinates of transect lines conducted by TMCLKL08 project

Line No.		Easting	Northing		Line No.		Easting	Northing
1	Start Point	804671	815456		13	Start Point	816506	819480
1	End Point	804671	831404		13	End Point	816506	824859
2	Start Point	805476	820800		14	Start Point	817537	820220
2	End Point	805476	826654		14	End Point	817537	824613
3	Start Point	806464	821150		15	Start Point	818568	820735
3	End Point	806464	822911		15	End Point	818568	824433
4	Start Point	807518	821500		16	Start Point	819532	821420
4	End Point	807518	829230		16	End Point	819532	824209
5	Start Point	808504	821850		17	Start Point	820451	822125
5	End Point	808504	828602		17	End Point	820451	823671
6	Start Point	809490	822150		18	Start Point	821504	822371
6	End Point	809490	825352		18	End Point	821504	823761
7	Start Point	810499	822000		19	Start Point	822513	823268
7	End Point	810499	824613		19	End Point	822513	824321

8	Start Point	811508	821123		20	Start Point	823477	823402
8	End Point	811508	824254		20	End Point	823477	824613
9	Start Point	812516	821303		21	Start Point	805476	827081
9	End Point	812516	824254		21	End Point	805476	830562
10	Start Point	813525	821176		22	Start Point	806464	824033
10	End Point	813525	824657		22	End Point	806464	829598
11	Start Point	814556	818853		23	Start Point	814559	821739
11	End Point	814556	820992		23	End Point	814559	824768
12	Start Point	815542	818807		24	Start Point	805476	815900
12	End Point	815542	824882		24	End Point	805476	819100

2.1.2. The TMCLKL08 survey team used standard line-transect methods (Buckland et al. 2001) to conduct the systematic vessel surveys, and followed the same technique of data collection that has been adopted over the last 22 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2020). For each monitoring vessel survey, a 15-m inboard vessel with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area.

2.1.3. Two experienced observers (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited different transect lines at a constant speed of 13-15 km per hour. The data recorder searched with unaided eyes and filled out the datasheets, while the primary observer searched for dolphins and porpoises continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea ahead of the vessel, between 270^{o} and 90^{o} (in relation to the bow, which is defined as 0^{o}). One to two additional experienced observers were available on the boat to work in shift (i.e. rotate every 30 minutes) in order to minimize fatigue of the survey team members. All observers were experienced in small cetacean survey techniques and identifying local cetacean species.

2.1.4. During on-effort survey periods, the survey team recorded effort data including time, positions (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance traveled in each series (a continuous period of search effort) with the assistance of a handheld GPS (*Garmin eTrex Legend*).

2.1.5. Data including time, position and vessel speed were also automatically and continuously logged by handheld GPS throughout the entire survey for subsequent review.

2.1.6. When dolphins were sighted, the survey team would end the survey effort, and immediately record the initial sighting distance and angle of the dolphin group from the survey vessel, as well as the sighting time and position. Then the research vessel was diverted from its course to approach the animals for species identification, group size estimation, assessment of group composition, and behavioural observations. The perpendicular distance (PSD) of the dolphin group to the transect line was later calculated from the initial sighting distance and angle.

2.1.7. Survey effort being conducted along the parallel transect lines that were perpendicular to the coastlines (as indicated in Figure 1) was labeled as "primary" survey effort, while the survey effort conducted along the connecting lines between parallel lines was labeled as "secondary" survey effort. According to HKCRP long-term dolphin monitoring data, encounter rates of Chinese white dolphins deduced from effort and sighting data collected along primary and secondary lines were similar in NEL and NWL survey areas. Therefore, both primary and secondary survey effort were presented as on-effort survey effort in this report.

2.2. Photo-identification Work

2.2.1. When a group of Chinese White Dolphins were sighted during the line-transect survey, the TMCLKL08 survey team would end effort and approach the group slowly from the side and behind to take photographs of them. Every attempt was made to photograph every dolphin in the group, and even photograph both sides of the dolphins, since the colouration and markings on both sides may not be symmetrical.

2.2.2. A professional digital camera (*Canon* EOS 7D model), equipped with long telephoto lenses (100-400 mm zoom), were available on board for researchers to take sharp, close-up photographs of dolphins as they surfaced. The images were shot at the highest available resolution and stored on Compact Flash memory cards for downloading onto a computer.

2.2.3. All digital images taken in the field were first examined, and those containing potentially identifiable individuals were sorted out. These photographs would then be examined in greater detail, and were carefully compared to the existing Chinese White Dolphin photo-identification catalogue maintained by HKCRP since 1995.

2.2.4. Chinese White Dolphins can be identified by their natural markings, such as nicks, cuts, scars and deformities on their dorsal fin and body, and their unique spotting patterns were also used as secondary identifying features (Jefferson 2000).

2.2.5. All photographs of each individual were then compiled and arranged in chronological order, with data including the date and location first identified (initial sighting), re-sightings, associated dolphins, distinctive features, and age classes entered into a computer database.

2.3. Data Analysis

2.3.1. Distribution Analysis – The line-transect survey data was integrated with the Geographic Information System (GIS) in order to visualize and interpret different spatial and temporal patterns of dolphin distribution using sighting positions. Location data of dolphin groups were plotted on map layers of Hong Kong using a desktop GIS (ArcView© 3.1) to examine their distribution patterns in details. The dataset was also stratified into different subsets to examine distribution patterns of dolphin groups with different categories of group sizes, young calves and activities.

2.3.2. Encounter rate analysis – Encounter rates of Chinese white dolphins (number of on-effort sightings per 100 km of survey effort, and total number of dolphins sighted on-effort per 100 km of survey effort) were calculated in NEL and NWL survey areas in relation to the amount of survey effort conducted during each month of monitoring survey. Only data collect under Beaufort 3 or below condition would be used for the encounter rate analyses. Dolphin encounter rates were calculated in two ways for comparisons with the HZMB baseline monitoring results as well as to AFCD long-term marine mammal monitoring results.

Firstly, for the comparison with the HZMB baseline monitoring results, the encounter rates were calculated using primary survey effort alone. The average encounter rate of sightings (STG) and average encounter rate of dolphins (ANI) were deduced based on the encounter rates from six events during the present quarter (i.e. six sets of line-transect surveys in North Lantau), which was also compared with the one deduced from the six events during the baseline period (i.e. six sets of line-transect surveys in North Lantau).

Secondly, the encounter rates were calculated using both primary and secondary survey effort collected under Beaufort 3 or below condition as in AFCD long-term monitoring study. The encounter rate of sightings and dolphins were deduced by dividing the total number of on-effort sightings (STG) and total number of dolphins (ANI) by the amount of survey effort for the present quarterly period.

2.3.3. Quantitative grid analysis on habitat use – To conduct quantitative grid analysis of habitat use, positions of on-effort sightings of Chinese White Dolphins collected during the quarterly monitoring period were plotted onto 1-km^2 grids among NWL and NEL survey areas on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS.

Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period. For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

The newly-derived unit for sighting density was termed SPSE, representing the number of on-effort **s**ightings **p**er 100 units of **s**urvey **e**ffort. In addition, the derived unit for actual dolphin density was termed DPSE, representing the number of **d**olphins **p**er 100 units of **s**urvey **e**ffort. Among the 1-km^2 grids that were partially covered by land, the percentage of sea area was calculated using GIS tools, and their SPSE and DPSE values were adjusted accordingly. The following formulae were used to estimate SPSE and DPSE in each 1-km^2 grid within the study area:

SPSE = ((S / E) x 100) / SA%
DPSE = ((D / E) x 100) / SA%

where S = total number of on-effort sightings
D = total number of dolphins from on-effort sightings
E = total number of units of survey effort
SA% = percentage of sea area

2.3.4. Behavioural analysis – When dolphins were sighted during vessel surveys, their behaviour was observed. Different activities were categorized (i.e. feeding, socializing, traveling, and milling/resting) and recorded on sighting datasheets. This data was then input into a separate database with sighting information, which can be used to determine the distribution of behavioural data with a desktop GIS. Distribution of sightings of dolphins engaged in different activities and behaviours would then be plotted on GIS and carefully examined to identify important areas for different activities of the dolphins.

2.3.5. Ranging pattern analysis – Location data of individual dolphins that occurred during the 3-month impact phase monitoring period were obtained from the dolphin sighting database and photo-identification catalogue. To deduce home ranges for individual dolphins using the fixed kernel methods, the program Animal Movement Analyst Extension, was loaded as an extension with ArcView© 3.1 along with another extension Spatial Analyst 2.0. Using the fixed kernel method, the program calculated kernel density estimates based on all sighting positions, and provided an active interface to display kernel density plots. The kernel estimator then calculated and displayed the overall ranging area at 95% UD level.

3. Monitoring Results

3.1. Summary of survey effort and dolphin sightings

3.1.1. During the period of March to May 2021, six sets of systematic line-transect vessel surveys were conducted under the TMCLKL08 post-construction dolphin monitoring works to cover all transect lines in NWL and NEL survey areas twice per month.

3.1.2. From these TMCLKL08 surveys, a total of 764.33 km of survey effort was collected, with 100% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility). Among the two areas, 279.60 km and 484.73 km of survey effort were conducted in NEL and NWL survey areas respectively.

3.1.3. The total survey effort conducted on primary lines was 565.74 km, while the effort on secondary lines was 198.59 km. Survey effort conducted on both primary and secondary lines were considered to be on-effort survey data. A summary table of the survey effort is shown in Appendix I.

3.1.4. During the six sets of TMCLKL08 monitoring surveys conducted between March and May 2021, a total of four groups of 12 Chinese White Dolphins were sighted. All

dolphin sightings were made on primary lines during on-effort search in this quarter. A summary table of dolphin sightings is shown in Appendix II.

3.1.5. In this quarterly period, all four dolphin groups were sighted in NWL, and no dolphin was sighted at all in NEL. In fact, since August 2014, only two sightings of two lone dolphins were made respectively in NEL during the HKLR03/TMCLKL08 monitoring surveys, and none was sighted there since June 2016.

3.2. Distribution

3.2.1. Distribution of dolphin sightings made during the TMCLKL08 monitoring surveys from March to May 2021 is shown in Figure 1. Among the four dolphin sightings, two were made within the Urmston Road section between Lung Kwu Chau and Lung Kwu Tan, while the other two occurred at the southwestern corner of NWL survey area, or just to the north of Shum Wat near the HKLR09 alignment (Figure 1). As consistently recorded in previous monitoring quarters in recent years, the dolphins were completely absent from the central and eastern portions of North Lantau waters (Figure 1).

3.2.2. Notably, all dolphin sightings made during this quarterly period were located far away from the TMCLKL alignment as well as the HKBCF and HKLR03 reclamation sites (Figure 1). However, two sightings were made just 1-2 km to the north of the HKLR09 alignment as mentioned above.

3.2.3. Sighting distribution of dolphins during the present post-construction monitoring period was drastically different from the one during the baseline monitoring period (Figure 1). In the present quarter, dolphins have disappeared from the NEL region, which was in stark contrast to their frequent occurrence around the Brothers Islands, near Shum Shui Kok and in the vicinity of HKBCF reclamation site during the baseline period (Figure 1). The nearly complete abandonment of NEL region by the dolphins has been consistently recorded in the past seven years of HKLR03/TMCLKL08 dolphin monitoring, which has resulted in zero to extremely low encounter rates in this area.

3.2.4. In NWL survey area, dolphin occurrences were also drastically different between the baseline and the present post-construction monitoring periods. During the present quarter, the dolphin sightings were confined to the western portion of the North Lantau region, which was in contrary to their frequent occurrences throughout the area during the baseline period (Figure 1). Furthermore, dolphins were completely absent around Lung Kwu Chau during the present quarter, where dolphins occurred regularly during the baseline period (Figure 1).

3.2.5. Another comparison in dolphin distribution was made between six quarterly periods of spring months in 2016-21 (Figure 2). With the exception of one sighting made near HKBCF in spring 2016, almost all dolphin sightings made throughout the past spring periods were at the western end of the North Lantau region (Figure 2). Moreover, dolphins were completely absent from the Sha Chau and Lung Kwu Chau Marine Park in the recent two spring periods in 2020 and 2021, where they occurred regularly in the past. Notably, the dolphins were consistently absent from the NEL survey area throughout the six spring periods.

3.3. Encounter rate

3.3.1. During the present quarterly period, the encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data from the primary transect lines under favourable conditions (Beaufort 3 or below) for each set of the TMCLKL08 surveys in NEL and NWL are shown in Table 2. The average encounter rates deduced from the six sets of surveys were also compared with the ones deduced from the baseline monitoring period (September-November 2011) (Table 3).

Table 2. Dolphin encounter rates (sightings per 100 km of survey effort) during March-May 2021

SURVEY AREA	DOLPHIN MONITORING DATES	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	Primary Lines Only
Northeast Lantau	Set 1 (3 & 8 Mar 2021)	0.00	0.00
	Set 2 (17 & 25 Mar 2021)	0.00	0.00
	Set 3 (8 & 22 Apr 2021)	0.00	0.00
	Set 4 (27 & 29 Apr 2021)	0.00	0.00
	Set 5 (3 & 11 May 2021)	0.00	0.00
	Set 6 (25 & 26 May 2021)	0.00	0.00
Northwest Lantau	Set 1 (3 & 8 Mar 2021)	3.31	8.28
	Set 2 (17 & 25 Mar 2021)	1.65	3.30
	Set 3 (8 & 22 Apr 2021)	0.00	0.00
	Set 4 (27 & 29 Apr 2021)	0.00	0.00
	Set 5 (3 & 11 May 2021)	1.81	9.06
	Set 6 (25 & 26 May 2021)	0.00	0.00

Table 3. Comparison of average dolphin encounter rates from the present post-construction monitoring period (March-May 2021) and baseline monitoring period (September-November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	March – May 2021	September – November 2011	March – May 2021	September – November 2011
Northeast Lantau	0.0	6.00 ± 5.05	0.0	22.19 ± 26.81
Northwest Lantau	1.13 ± 1.37	9.85 ± 5.85	3.44 ± 4.26	44.66 ± 29.85

3.3.2. To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present quarter using both primary and secondary survey effort. The encounter rates of sightings (STG) and dolphins (ANI) in NWL were 0.83 sightings and 2.48 dolphins per 100 km of survey effort respectively, while the encounter rates of sightings (STG) and dolphins (ANI) in NEL were both nil for this quarter.

3.3.3 In NEL, the average dolphin encounter rates (both STG and ANI) in the present quarterly post-construction monitoring period were both zero with no on-effort sighting being made, and such complete absence of dolphins in NEL have been consistently recorded during the same spring quarters throughout the HKLR03/TMCLKL08 dolphin monitoring in the past seven consecutive years (Table 4).

Table 4. Comparison of average dolphin encounter rates in Northeast Lantau survey area from the same spring quarters of HKLR03/TMCLKL08 impact and post-construction monitoring periods since 2013 and the baseline monitoring period (September-November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	6.00 ± 5.05	22.19 ± 26.81
March-May 2013 (Impact)	0.42 ± 1.03	0.42 ± 1.03
March-May 2014 (Impact)	0.00	0.00
March-May 2015 (Impact)	0.00	0.00
March-May 2016 (Impact)	0.00	0.00
March-May 2017 (Impact)	0.00	0.00
March-May 2018 (Impact)	0.00	0.00
March-May 2019 (Impact)	0.00	0.00
March-May 2020 (Impact)	0.00	0.00
March-May 2021 (Post-Construction)	0.00	0.00

3.3.4. On the other hand, the average dolphin encounter rates (STG and ANI) in NWL during the present quarterly period were only small fractions of the ones recorded during the three-month baseline period (with reductions of 88.5% and 92.3% respectively), indicating a dramatic decline in dolphin usage of this survey area during the present quarterly period as compared to the baseline period in 2011 (Table 5).

3.3.5. When comparing to the past eight spring quarters in 2013-20, both quarterly counter rates in STG and ANI have been consistently low since 2015, besides a small rebound occurred in spring 2018 (Table 5). The dramatic drop in dolphin occurrence in NWL after the spring period in 2015 raises serious concerns, and the temporal trend would need to be closely monitoring in upcoming quarters when all construction activities of HZMB works

have been completed.

Table 5. Comparison of average dolphin encounter rates in Northwest Lantau survey area from the same spring quarters of HKLR03/TMCLKL08 impact and post-construction monitoring periods since 2013 and the baseline monitoring period (September November 2011) (Note: encounter rates deduced from the baseline monitoring period have been recalculated based only on survey effort and on-effort sighting data made along the primary transect lines under favourable conditions; ± denotes the standard deviation of the average encounter rates)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
September-November 2011 (Baseline)	9.85 ± 5.85	44.66 ± 29.85
March-May 2013 (Impact)	7.75 ± 3.96	24.23 ± 18.05
March-May 2014 (Impact)	6.51 ± 3.34	19.14 ± 7.19
March-May 2015 (Impact)	0.47 ± 0.73	2.36 ± 4.07
March-May 2016 (Impact)	0.98 ± 1.10	4.78 ± 6.85
March-May 2017 (Impact)	0.93 ± 1.03	5.25 ± 9.53
March-May 2018 (Impact)	2.88 ± 4.81	11.12 ± 22.46
March-May 2019 (Impact)	1.13 ± 1.39	2.54 ± 3.00
March-May 2020 (Impact)	0.56 ± 0.86	0.56 ± 0.86
March-May 2021 (Post-Construction)	1.13 ± 1.37	3.44 ± 4.26

3.3.6. A two-way ANOVA with repeated measures and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline and HKLR03/TMCLKL08 monitoring periods. The two variables that were examined included the two periods (baseline and impact/post-construction phases) and two locations (NEL and NWL).

3.3.7. For the comparison between the baseline period and the present quarter (the fourth quarter of the TMCLKL08 post-construction monitoring period being assessed), the p-values for the differences in average dolphin encounter rates of STG and ANI were 0.0122 and 0.0425 respectively. If the alpha value is set at 0.05, significant differences were detected between the baseline period and present quarter in both the average dolphin encounter rates of STG and ANI.

3.3.8. For the comparison between the baseline period and the cumulative quarters of the HKLR03/TMCLKL08 monitoring period (i.e. the 34 quarters of the impact and post-construction phases being assessed), the p-values for the differences in average dolphin encounter rates of STG and ANI were both 0.000000. Even if the alpha value is set at 0.00001, significant differences were still detected in both the average dolphin encounter rates of STG and ANI (i.e. between the cumulative periods and the locations).

3.3.9. As indicated in both dolphin distribution patterns and encounter rates, dolphin usage has

been significantly and dramatically reduced in both NEL and NWL survey areas during the present quarterly period, and such low occurrence of dolphins has also been consistently documented throughout the HKLR03/TMCLKL08 monitoring period.

3.3.10. Even though all marine works associated with the HZMB construction have already been completed, and the Brothers Marine Park has been established as a compensation measure for the permanent habitat loss in association with the HZMB reclamation works since late 2016, apparently there has been no sign of recovery of dolphin usage in North Lantau waters at all, while such usage has diminished to a very low level.

3.4. Group size

3.4.1. Group size of the four Chinese White Dolphin sightings ranged from two to five animals per group in the North Lantau region during March to May 2021. The average dolphin group sizes from these three months were compared with the ones deduced from the baseline period in September to November 2011, as shown in Table 6.

Table 6. Comparison of average dolphin group sizes from the present post-construction monitoring period (March – May 2021) and baseline monitoring period (September – November 2011) (Note: ± denotes the standard deviation of the average group size)

	Average Dolphin Group Size	
	March – May 2021	**September – November 2011**
Overall	3.00 ± 1.41 (n = 4)	3.72 ± 3.13 (n = 66)
Northeast Lantau	---	3.18 ± 2.16 (n = 17)
Northwest Lantau	3.00 ± 1.41 (n = 4)	3.92 ± 3.40 (n = 49)

3.4.2. The average dolphin group size in NWL waters during the present quarter was lower than the one recorded during the three-month baseline period, but it should also be noted that the sample size of four dolphin groups in the present quarter was only a tiny fraction of the 66 dolphin groups sighted during the baseline period (Table 6).

3.4.3. Notably, three of the four dolphin groups were small with only 2-3 individuals per group, while there was one medium-sized group of dolphins with five animals (Appendix II). This larger group was sighted within the Urmston Road between Lung Kwu Chau and Lung Kwu Tan in NWL survey area (Figure 3). This is in stark contrast to the baseline period when the larger groups were frequently sighted and evenly distributed throughout NWL waters, with a few also sighted in NEL waters (Figure 3).

3.5. Habitat use

3.5.1. From March to May 2021, only three grids in North Lantau waters recorded dolphin occurrences, and all of them were located at the western portion of the NWL survey area (Figures 4a and 4b). Two grids near Pillar Point and to the north of Shum Wat (near HKLR09 alignment) recorded higher dolphin densities, while the grid near Black Point had lower dolphin density. Notably, all grids near TMCLKL alignment did not record any presence of dolphins at all during on-effort search in the present quarterly period (Figures 4a and 4b).

3.5.2. It should be emphasized that the amount of survey effort collected in each grid during the three-month period was fairly low (6-12 units of survey effort for most grids), and therefore the habitat use pattern derived from the three-month dataset should be treated with caution.

3.5.3. When compared with the habitat use patterns during the baseline period, dolphin usage in NEL and NWL has drastically diminished in both areas during the present post-construction monitoring period (Figure 5). During the baseline period, many grids between Siu Mo To and Shum Shui Kok in NEL recorded moderately high to high dolphin densities, which was in stark contrast to the complete absence of dolphins there during the present quarter (Figure 5).

3.5.4. The density patterns were also very different in NWL between the baseline and present post-construction monitoring periods, with high dolphin usage throughout the area, especially around Sha Chau, near Black Point, to the west of the airport, as well as between Pillar Point and airport platform during the baseline period. On the contrary, the grids with dolphin occurrences were all distributed at the western portion of the NWL survey area with only a handful of grids recording higher dolphin densities during the present quarter (Figure 5).

3.6. Mother-calf pairs

3.6.1. During the present quarterly period, only one unspotted juvenile was sighted with its mother near Pillar Point (Figure 6). In fact, this is the first young calf sighted in NWL since the winter quarter of 2019-20.

3.6.2. It should be noted that the rare occurrence of young calves in the present quarter as well as in recent years of HKLR03/TMCLKL08 monitoring was very different from their regular occurrence in North Lantau waters during the baseline period (Figure 6).

3.7. Activities and associations with fishing boats

3.7.1. From March to May 2021, none of the four dolphin groups was engaged in any activities. Furthermore, none of them were not associated with any operating fishing vessel either during this post-construction monitoring period.

3.8. Summary of photo-identification works

3.8.1. About 500 digital photographs of Chinese White Dolphins were taken during the present post-construction monitoring period for the photo-identification work. In total, eight individuals sighted nine times were identified (see summary table in Appendix III and photographs of identified individuals in Appendix IV).

3.8.2. All of these re-sightings were made in NWL. With the exception of one individual (NL182) being re-sighted twice, the rest of the individuals were only re-sighted once during the quarterly monitoring period (Appendix III).

3.9. Individual range use

3.9.1. Ranging patterns of the eight individuals identified during the present quarterly period

were determined by fixed kernel method, and are shown in Appendix V.

3.9.2. All identified dolphins sighted in the present quarter were utilizing NWL waters only, but have completely avoided NEL waters where many of them have utilized as their core areas in the past (Appendix V). This is in contrary to the extensive movements between NEL and NWL survey areas observed in the earlier impact monitoring quarters as well as the baseline period.

3.9.3. Notably, five of the individuals have primarily centered their range use in North Lantau waters in the past, and were still re-sighted within their normal ranges during this quarterly period. On the contrary, three other individuals (WL79, WL179 and WL294) which have their primary ranges in West Lantau waters but have extended to NWL waters during the present quarterly period (Appendix V).

4. References

- Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, London.

- Hung, S. K. 2020. Monitoring of marine mammals in Hong Kong waters – data collection: final report (2019-20). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government, 138 pp.

- Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144:1-65.

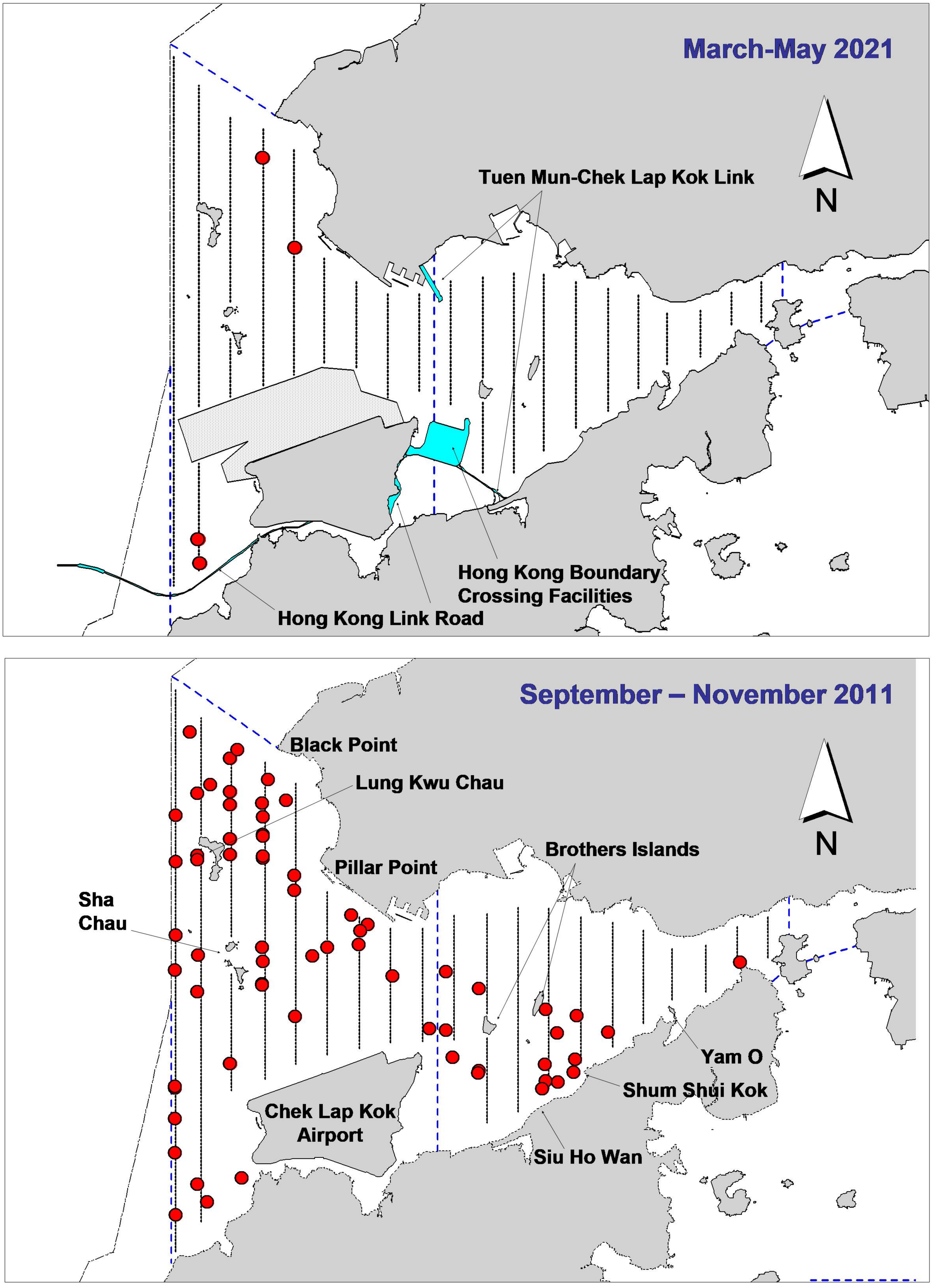


Figure 1. Distribution of Chinese white dolphin sighting in Northwest and Northeast Lantau during the present TMCLKL08 monitoring period (top) and baseline monitoring surveys (bottom)

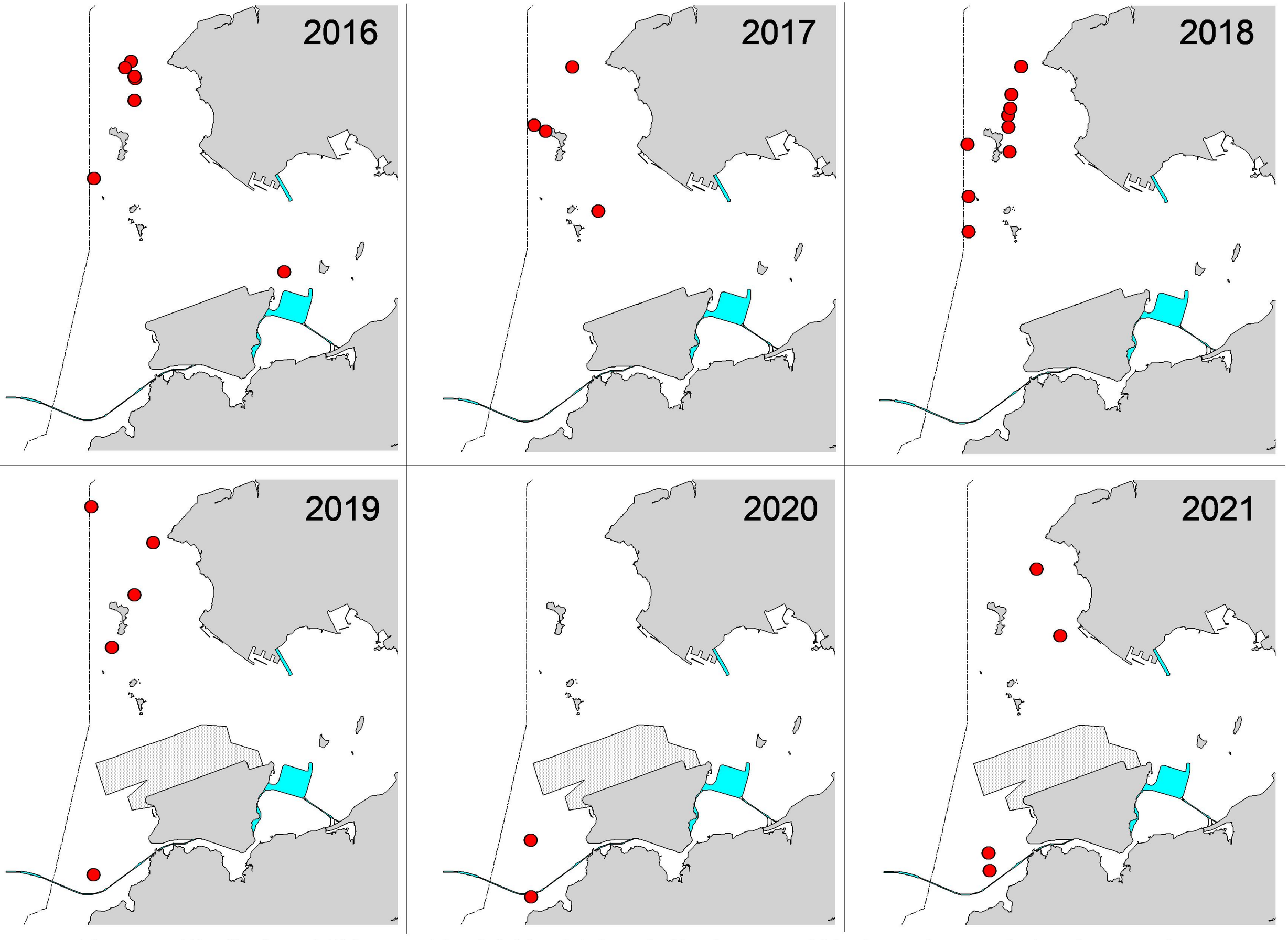


Figure 2. Distribution of Chinese white dolphin sightings in Northwest and Northeast Lantau during the past six spring quarters (March-May) of HKLR03/TMCLKL08 monitoring in 2016-21

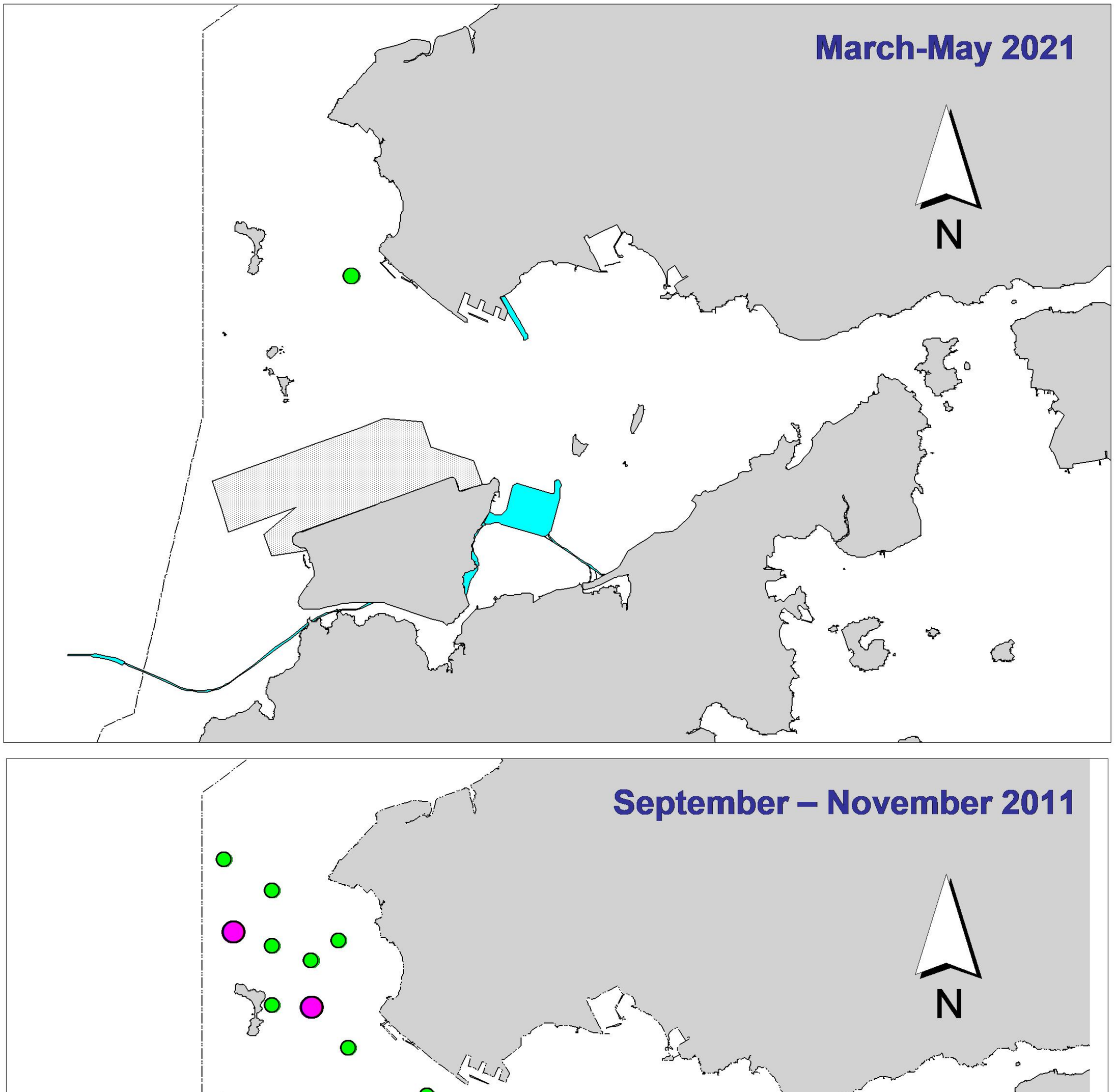


Figure 3. Distribution of Chinese white dolphins with larger group sizes during the present TMCLKL08 monitoring period (top) and baseline monitoring surveys (bottom) (green dots: group sizes of 5 or more; purple dots: group sizes of 10 or more)

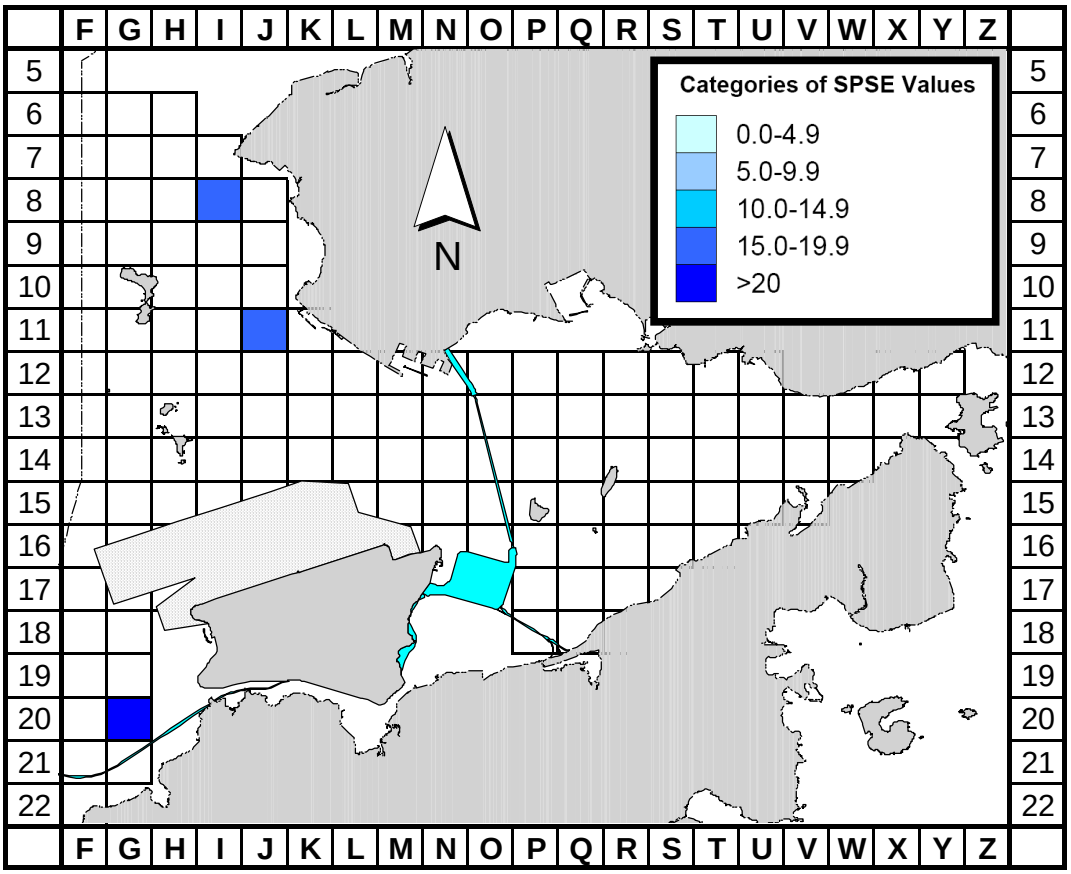


Figure 4a. Sighting density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during present TMCLKL08 monitoring period (March-May 2021) (SPSE = no. of on-effort sightings per 100 units of survey effort)

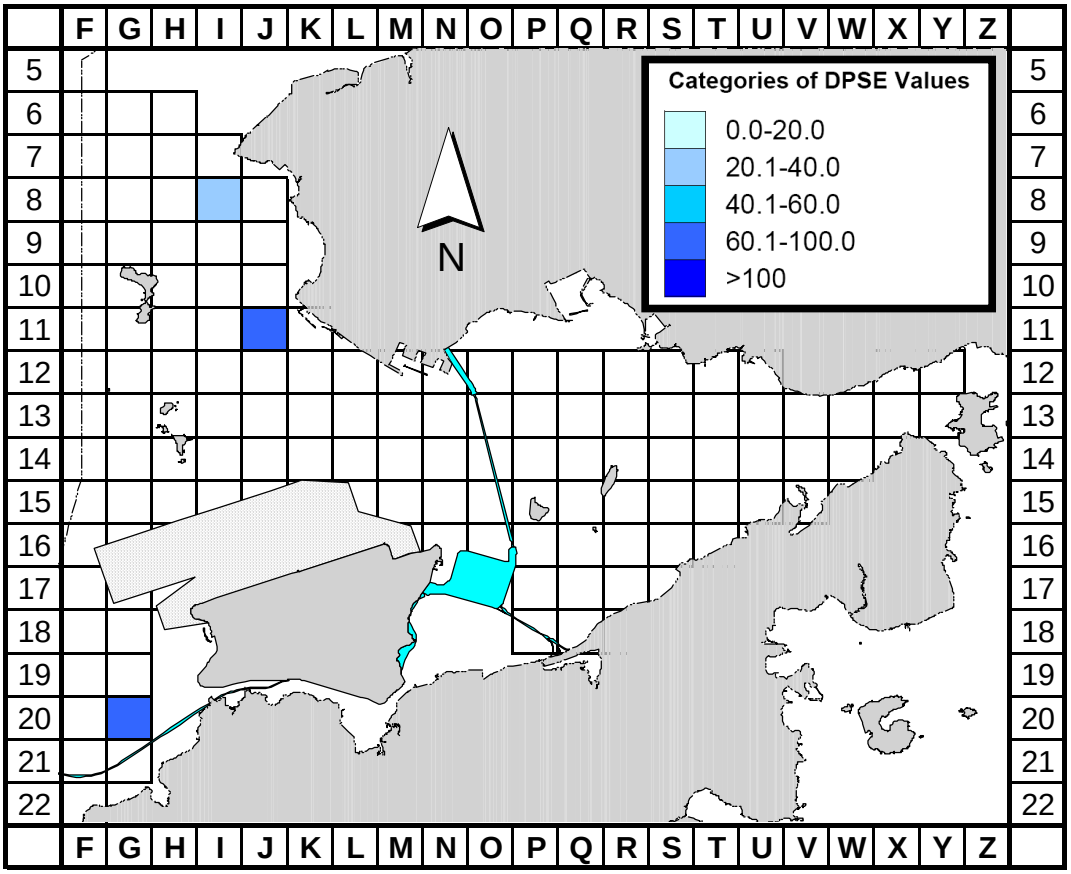


Figure 4b. Density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during present TMCLKL08 monitoring period (March-May 2021) (DPSE = no. of dolphins per 100 units of survey effort)

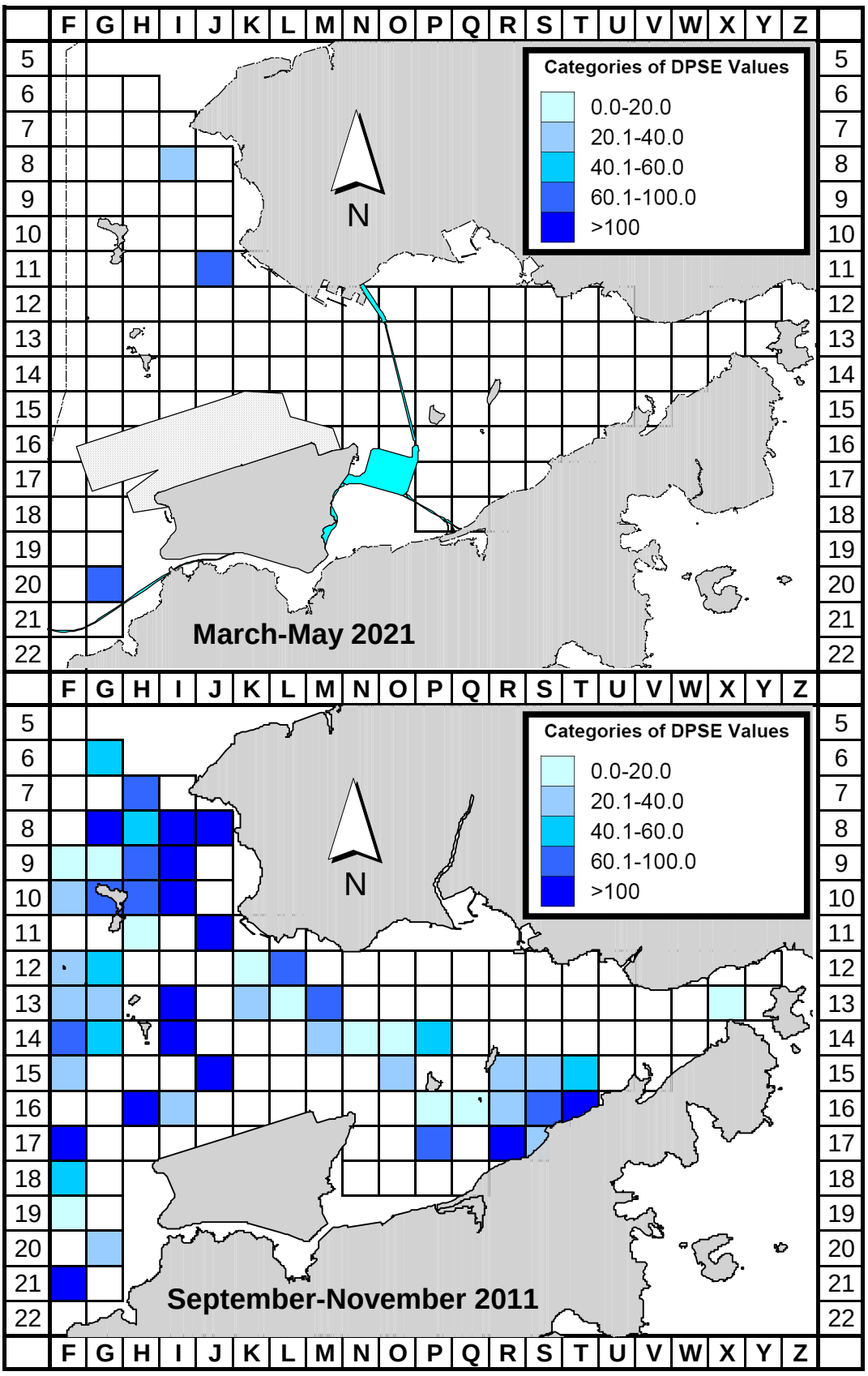


Figure 5. Comparison of density of Chinese white dolphins with corrected survey effort per km^2 in Northwest and Northeast Lantau survey area between present TMCLKL08 monitoring period (March-May 2021) and baseline monitoring period (September-November 2011)
(DPSE = no. of dolphins per 100 units of survey effort)

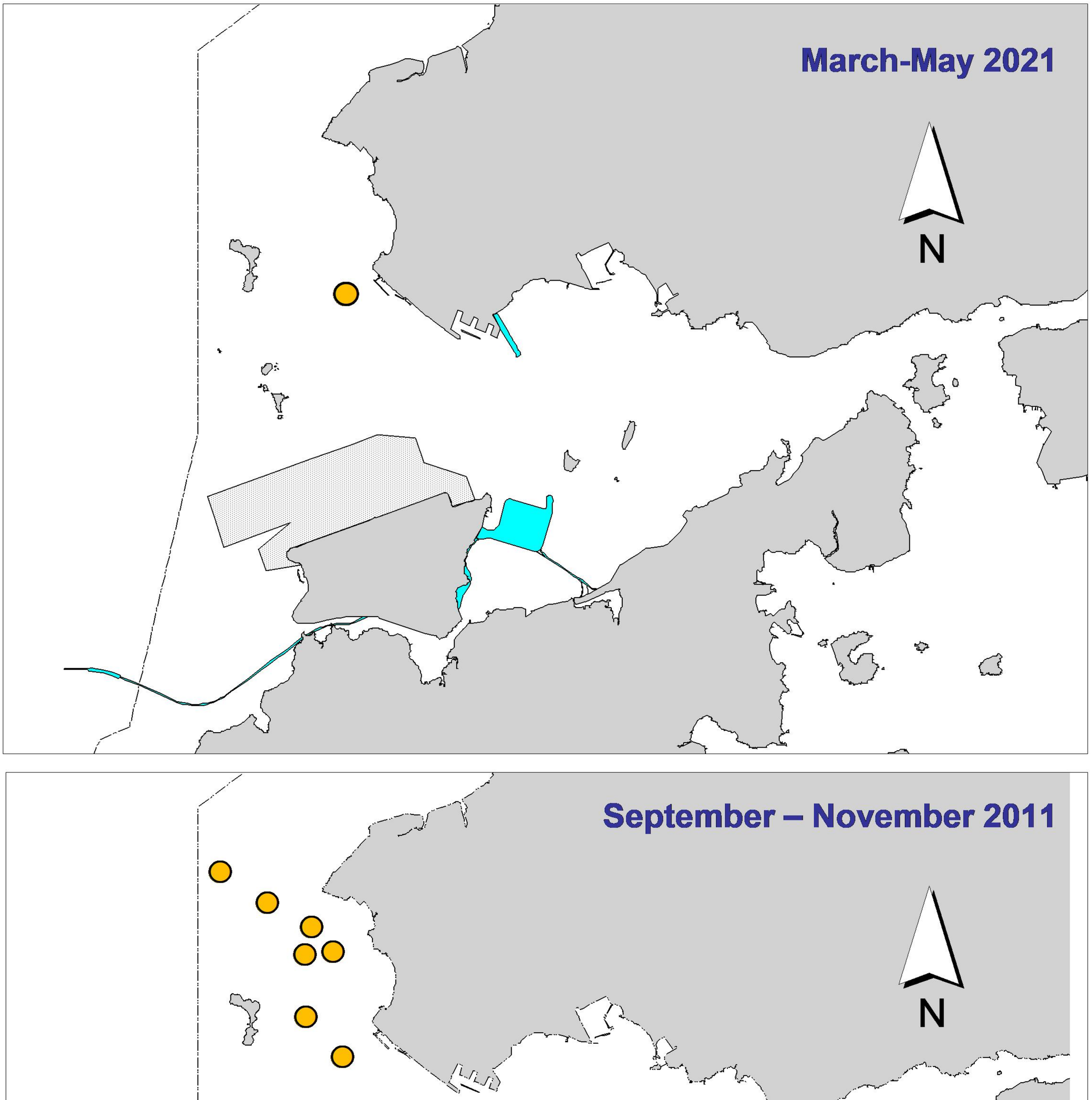


Figure 6. Distribution of young calves of Chinese white dolphins during the present TMCLKL08 monitoring period (top) and baseline monitoring surveys (bottom)

Appendix I. TMCLKL08 Survey Effort Database (March-May 2021)

(Abbreviations: BEAU = Beaufort Sea State; P = Primary Line Effort; S = Secondary Line Effort)

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
3-Mar-21	NW LANTAU	2	17.29	SPRING	STANDARD36826	TMCLKL	P
3-Mar-21	NW LANTAU	3	10.70	SPRING	STANDARD36826	TMCLKL	P
3-Mar-21	NW LANTAU	2	6.60	SPRING	STANDARD36826	TMCLKL	S
3-Mar-21	NW LANTAU	3	4.75	SPRING	STANDARD36826	TMCLKL	S
3-Mar-21	NE LANTAU	2	32.08	SPRING	STANDARD36826	TMCLKL	P
3-Mar-21	NE LANTAU	3	3.05	SPRING	STANDARD36826	TMCLKL	P
3-Mar-21	NE LANTAU	2	11.87	SPRING	STANDARD36826	TMCLKL	S
3-Mar-21	NE LANTAU	3	1.00	SPRING	STANDARD36826	TMCLKL	S
8-Mar-21	NW LANTAU	2	7.06	SPRING	STANDARD36826	TMCLKL	P
8-Mar-21	NW LANTAU	3	25.36	SPRING	STANDARD36826	TMCLKL	P
8-Mar-21	NW LANTAU	2	2.86	SPRING	STANDARD36826	TMCLKL	S
8-Mar-21	NW LANTAU	3	5.32	SPRING	STANDARD36826	TMCLKL	S
17-Mar-21	NW LANTAU	1	9.65	SPRING	STANDARD36826	TMCLKL	P
17-Mar-21	NW LANTAU	2	18.44	SPRING	STANDARD36826	TMCLKL	P
17-Mar-21	NW LANTAU	1	3.10	SPRING	STANDARD36826	TMCLKL	S
17-Mar-21	NW LANTAU	2	7.99	SPRING	STANDARD36826	TMCLKL	S
17-Mar-21	NE LANTAU	1	3.50	SPRING	STANDARD36826	TMCLKL	P
17-Mar-21	NE LANTAU	2	31.93	SPRING	STANDARD36826	TMCLKL	P
17-Mar-21	NE LANTAU	1	2.00	SPRING	STANDARD36826	TMCLKL	S
17-Mar-21	NE LANTAU	2	9.37	SPRING	STANDARD36826	TMCLKL	S
25-Mar-21	NW LANTAU	2	6.30	SPRING	STANDARD36826	TMCLKL	P
25-Mar-21	NW LANTAU	3	26.28	SPRING	STANDARD36826	TMCLKL	P
25-Mar-21	NW LANTAU	2	5.92	SPRING	STANDARD36826	TMCLKL	S
25-Mar-21	NW LANTAU	3	4.90	SPRING	STANDARD36826	TMCLKL	S
8-Apr-21	NW LANTAU	2	25.85	SPRING	STANDARD36826	TMCLKL	P
8-Apr-21	NW LANTAU	3	6.95	SPRING	STANDARD36826	TMCLKL	P
8-Apr-21	NW LANTAU	2	10.80	SPRING	STANDARD36826	TMCLKL	S
8-Apr-21	NE LANTAU	2	34.14	SPRING	STANDARD36826	TMCLKL	P
8-Apr-21	NE LANTAU	2	11.56	SPRING	STANDARD36826	TMCLKL	S
22-Apr-21	NW LANTAU	1	5.79	SPRING	STANDARD36826	TMCLKL	P
22-Apr-21	NW LANTAU	2	26.60	SPRING	STANDARD36826	TMCLKL	P
22-Apr-21	NW LANTAU	2	11.11	SPRING	STANDARD36826	TMCLKL	S
27-Apr-21	NW LANTAU	2	15.81	SPRING	STANDARD36826	TMCLKL	P
27-Apr-21	NW LANTAU	3	12.76	SPRING	STANDARD36826	TMCLKL	P
27-Apr-21	NW LANTAU	2	8.23	SPRING	STANDARD36826	TMCLKL	S
27-Apr-21	NW LANTAU	3	3.00	SPRING	STANDARD36826	TMCLKL	S
27-Apr-21	NE LANTAU	2	5.30	SPRING	STANDARD36826	TMCLKL	P
27-Apr-21	NE LANTAU	3	31.17	SPRING	STANDARD36826	TMCLKL	P
27-Apr-21	NE LANTAU	2	3.70	SPRING	STANDARD36826	TMCLKL	S
27-Apr-21	NE LANTAU	3	8.43	SPRING	STANDARD36826	TMCLKL	S
29-Apr-21	NW LANTAU	2	16.60	SPRING	STANDARD36826	TMCLKL	P
29-Apr-21	NW LANTAU	3	11.22	SPRING	STANDARD36826	TMCLKL	P
29-Apr-21	NW LANTAU	2	7.08	SPRING	STANDARD36826	TMCLKL	S
29-Apr-21	NW LANTAU	3	1.40	SPRING	STANDARD36826	TMCLKL	S
3-May-21	NW LANTAU	3	26.45	SPRING	STANDARD36826	TMCLKL	P
3-May-21	NW LANTAU	2	1.10	SPRING	STANDARD36826	TMCLKL	S
3-May-21	NW LANTAU	3	11.85	SPRING	STANDARD36826	TMCLKL	S
3-May-21	NE LANTAU	2	15.62	SPRING	STANDARD36826	TMCLKL	P
3-May-21	NE LANTAU	3	18.05	SPRING	STANDARD36826	TMCLKL	P
3-May-21	NE LANTAU	2	4.70	SPRING	STANDARD36826	TMCLKL	S
3-May-21	NE LANTAU	3	7.33	SPRING	STANDARD36826	TMCLKL	S

Appendix I. (cont'd)

(Abbreviations: BEAU = Beaufort Sea State; P = Primary Line Effort; S = Secondary Line Effort)

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
11-May-21	NW LANTAU	2	2.72	SPRING	STANDARD36826	TMCLKL	P
11-May-21	NW LANTAU	3	25.99	SPRING	STANDARD36826	TMCLKL	P
11-May-21	NW LANTAU	2	4.46	SPRING	STANDARD36826	TMCLKL	S
11-May-21	NW LANTAU	3	6.24	SPRING	STANDARD36826	TMCLKL	S
25-May-21	NW LANTAU	1	2.78	SPRING	STANDARD36826	TMCLKL	P
25-May-21	NW LANTAU	2	26.32	SPRING	STANDARD36826	TMCLKL	P
25-May-21	NW LANTAU	2	7.40	SPRING	STANDARD36826	TMCLKL	S
26-May-21	NW LANTAU	1	1.60	SPRING	STANDARD138716	TMCLKL	P
26-May-21	NW LANTAU	2	30.69	SPRING	STANDARD138716	TMCLKL	P
26-May-21	NW LANTAU	1	4.80	SPRING	STANDARD138716	TMCLKL	S
26-May-21	NW LANTAU	2	6.61	SPRING	STANDARD138716	TMCLKL	S
26-May-21	NE LANTAU	1	11.39	SPRING	STANDARD138716	TMCLKL	P
26-May-21	NE LANTAU	2	14.50	SPRING	STANDARD138716	TMCLKL	P
26-May-21	NE LANTAU	3	5.80	SPRING	STANDARD138716	TMCLKL	P
26-May-21	NE LANTAU	1	3.51	SPRING	STANDARD138716	TMCLKL	S
26-May-21	NE LANTAU	2	8.00	SPRING	STANDARD138716	TMCLKL	S
26-May-21	NE LANTAU	3	1.60	SPRING	STANDARD138716	TMCLKL	S

Appendix II. TMCLKL08 Chinese White Dolphin Sighting Database (March-May 2021)

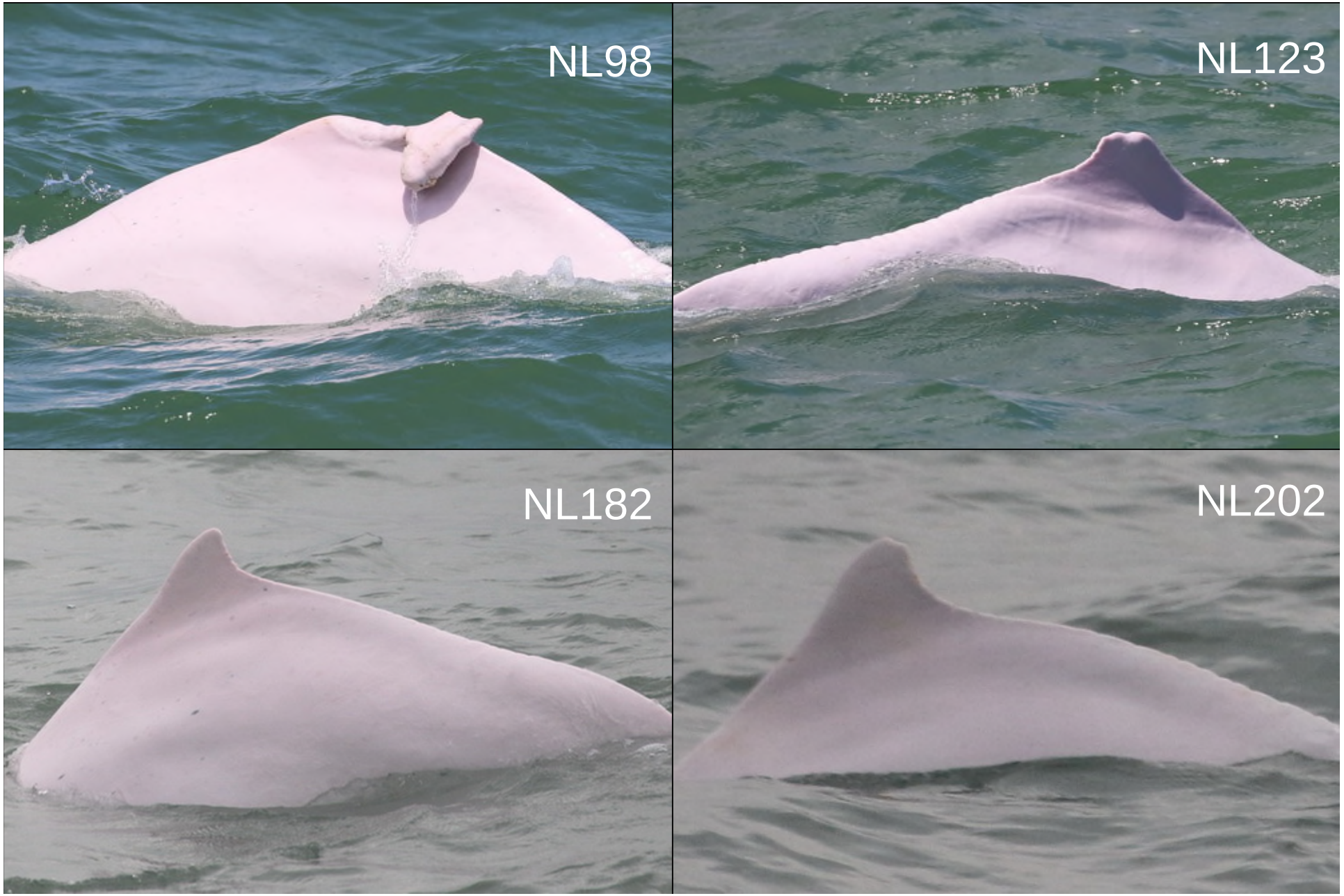
(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Association; P/S: Sighting Made on Primary/Secondary Lines)

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.	P/S
3-Mar-21	1	1011	3	NW LANTAU	3	404	ON	TMCLKL	816830	805427	SPRING	NONE	P
3-Mar-21	2	1151	2	NW LANTAU	2	121	ON	TMCLKL	828365	807489	SPRING	NONE	P
17-Mar-21	1	1016	2	NW LANTAU	1	786	ON	TMCLKL	816121	805487	SPRING	NONE	P
11-May-21	1	1046	5	NW LANTAU	3	191	ON	TMCLKL	825639	808524	SPRING	NONE	P

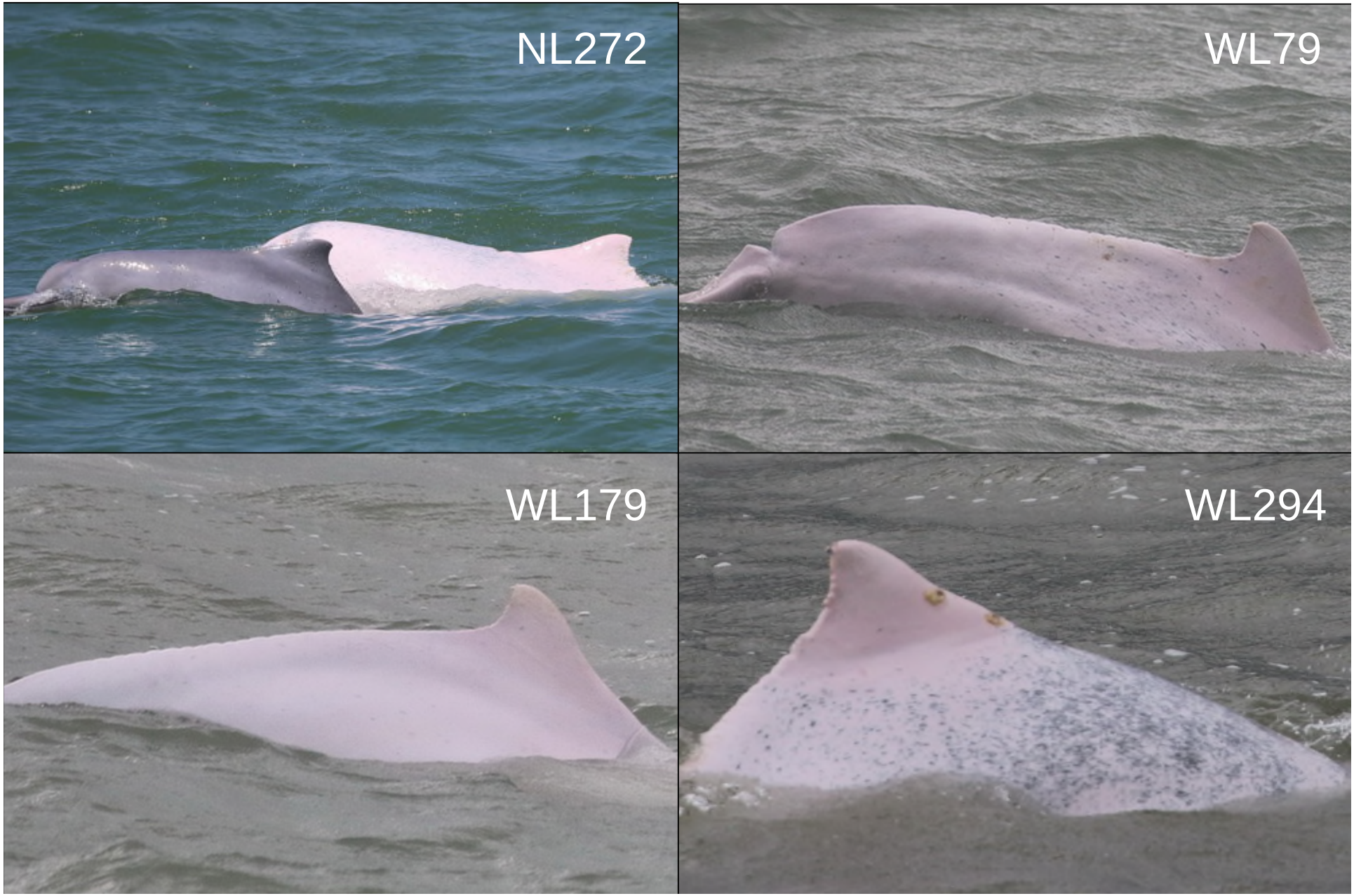
Appendix III. Individual dolphins identified during TMCLKL08 monitoring surveys in March-May 2021

ID#	DATE	STG#	AREA
NL98	11/05/21	1	NW LANTAU
NL123	11/05/21	1	NW LANTAU
NL182	03/03/21	2	NW LANTAU
	11/05/21	1	NW LANTAU
NL202	03/03/21	2	NW LANTAU
NL272	11/05/21	1	NW LANTAU
WL79	03/03/21	1	NW LANTAU
WL179	03/03/21	1	NW LANTAU
WL294	03/03/21	1	NW LANTAU

Appendix IV. Eight individual dolphins that were identified between March and May 2021 during the TMCLKL08 monitoring surveys

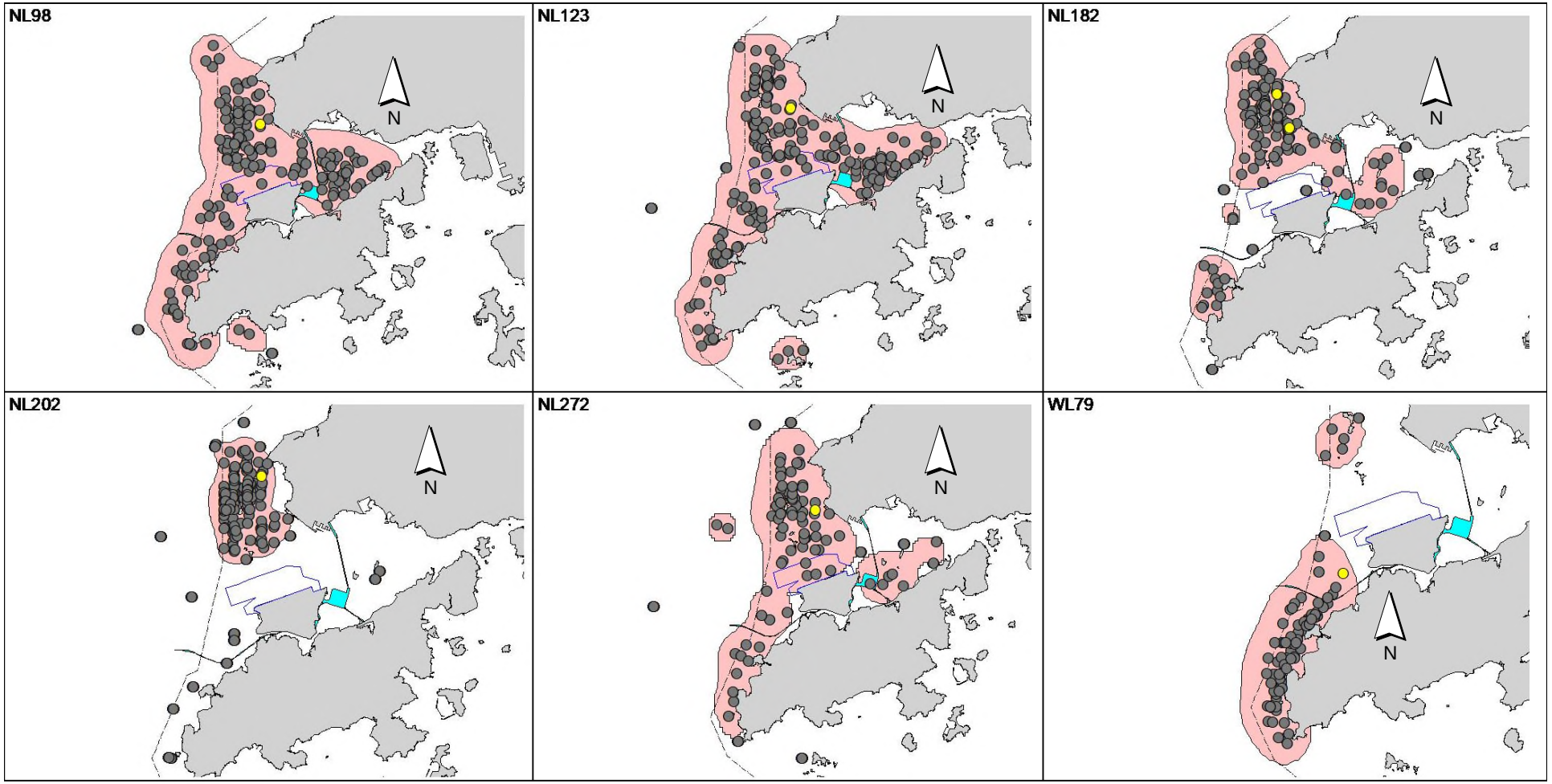


Appendix IV. (cont'd)



Appendix V. Ranging patterns (95% kernel ranges) of eight individual dolphins that were sighted during the present TMCLKL08 monitoring period

(note: yellow dots indicate sightings made in March-May 2021 during TMCLKL08 monitoring surveys)



Appendix V. (cont'd)