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

9th Quarterly Progress Report (December 2015 – February 2016)
submitted to Dragages – Bouygues Joint Venture & ERM Hong Kong Ltd.

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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. However, as such surveys have been undertaken by the HKLR03 and HKBCF projects in the same areas (i.e. NWL and NEL), a combined monitoring approach is 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 will end upon the completion of the dolphin monitoring carried out by HKLR03 contract.

1.3. In 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 TM-CLKL 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) of the TM-CLKL project in Northwest Lantau (NWL) and Northeast Lantau (NEL) survey areas.

1.4. During the construction period of HKLR, the dolphin specialist would be in charge of reviewing and collating information collected by HKLR03 dolphin monitoring programme to examine any potential impacts of TM-CLKL construction works on the dolphins.

1.5. From the monitoring results, any changes in dolphin occurrence within the study area will be examined for possible causes, and appropriate actions and additional mitigation measures will be recommended as necessary.

1.6. This report is the ninth quarterly progress report under the TM-CLKL construction phase dolphin monitoring programme submitted to the Contractor, summarizing the results of the surveys findings during the period of December 2015 to February 2016, utilizing the survey data collected by HKLR03 project.

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 period. The co-ordinates of all transect lines are shown in Table 1. The coordinates of several starting points have been revised due to the obstruction of the permanent structures in association to the construction works of HKLR and the southern viaduct of TM-CLKL, as well as provision of adequate buffer distance from the Airport Restricted Areas. The EPD issued a memo and confirmed that they had no objection on the revised transect lines on 19 August 2015, and the revised coordinates are in red and marked with an asterisk in Table 1.

Table 1 Co-ordinates of transect lines conducted by HKLR03 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	805475	815913*		14	Start Point	817537	820220
2	End Point	805477	826654		14	End Point	817537	824613
3	Start Point	806464	819435		15	Start Point	818568	820735
3	End Point	806464	822911		15	End Point	818568	824433
4	Start Point	807518	819771		16	Start Point	819532	821420
4	End Point	807518	829230		16	End Point	819532	824209
5	Start Point	808504	820220		17	Start Point	820451	822125

5	End Point	808504	828602		17	End Point	820451	823671
6	Start Point	809490	820466		18	Start Point	821504	822371
6	End Point	809490	825352		18	End Point	821504	823761
7	Start Point	810499	820880*		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	820872		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					
12	End Point	815542	824882					

Note: Co-ordinates in red and marked with asterisk are revised co-ordinates of transect line.

2.1.2. The HKLR03 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 16 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2013, 2014). 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° and 90° (in relation to the bow, which is defined as 0°). 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 HKLR03 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 or 60D 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 impact phase 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:

$$SPSE = ((S / E) \times 100) / SA\%$$
$$DPSE = ((D / E) \times 100) / SA\%$$

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 December 2015 to February 2016, six sets of systematic line-transect vessel surveys were conducted under the HKLR03 monitoring works to cover all transect lines in NWL and NEL survey areas twice per month.

3.1.2. From these HKLR03 surveys, a total of 907.45 km of survey effort was collected, with 95.1% 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, 347.07 km and 560.38 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 655.90 km, while the effort on secondary lines was 251.55 km. Survey effort conducted on both primary and secondary lines were considered as on-effort survey data. A summary table of the survey effort is shown in Appendix I.

3.1.4. During the six sets of HKLR03 monitoring surveys in December 2015 to February 2016, a total of 14 groups of 57 Chinese White Dolphins were sighted. All except one dolphin sighting were made during on-effort search, and ten of the thirteen on-effort dolphin sightings were made on primary lines. In this quarterly period, all dolphin groups were sighted in NWL, while none was sighted at all in NEL. A summary table of the dolphin sightings is shown in Appendix II.

3.2. Distribution

3.2.1. Distribution of dolphin sightings made during the HKLR03 monitoring surveys in December 2015 to February 2016 is shown in Figure 1. Dolphin sightings made in the present quarter were mostly located to the north of Lung Kwu Chau, while a few other sightings were also made near Pillar Point and Sha Chau (Figure 1).

3.2.2. Notably, a dolphin sighting was made near the northern landfall of TM-CLKL, but no other sighting was made near the southern viaduct of TM-CLKL or the HKLR03/HKBCF reclamation sites (Figure 1).

3.2.3. Sighting distribution of the present impact phase monitoring period (December 2015 to February 2016) was compared to the one during the baseline monitoring period (September to November 2011). 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).

3.2.4. In NWL survey area, dolphin occurrence was also drastically different between the baseline and impact phase periods. During the present impact monitoring period, much fewer dolphins occurred in this survey area than during the baseline period, when many dolphin groups were frequently sighted between Lung Kwu Chau and Black Point, around Sha Chau, near Pillar Point and to the west of the Chek Lap Kok Airport (Figure 1).

3.2.5. Another comparison in dolphin distribution was made between the four quarterly periods of winter months in 2012-13, 2013-14, 2014-15 and 2015-16 (Figure 2). Among the four winter periods, dolphins were regularly sighted in NEL in 2012-13, but their usage there was dramatically reduced in 2013-14, and the dolphins have completely avoided this area during the winter of 2014-15 and 2015-16 (Figure 2).

3.2.6. On the other hand, dramatic changes in dolphin distribution in NWL waters were also observed in the winter months during the four quarterly periods (Figure 2). In 2012-13 and 2013-14, dolphins still regularly occurred throughout the NWL survey area, with higher concentrations of sightings within Sha Chau and Lung Kwu Chau Marine Park, but they appeared to avoid the waters to the north of the airport in 2013-14 where they

normally occurred in the previous winter. In 2014-15 and 2015-16, dolphin usage in NWL was then dramatically reduced, with most sightings clustered around and to the north of Lung Kwu Chau but rarely sighted elsewhere. Such temporal trend indicated that dolphin usage in the NWL region has progressively diminished in recent years.

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 HKLR03 surveys in NEL and NWL are shown in Table 2. The average encounter rates deduced from the six sets of HKLR03 surveys were also compared with the ones deduced from the baseline monitoring period (September – November 2011) (Table 3).

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 2.32 sightings and 9.11 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.

Table 2. Dolphin encounter rates (sightings per 100 km of survey effort) during December 2015 to February 2016

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 (2 & 7 Dec 2015)	0.00	0.00
	Set 2 (9 & 15 Dec 2015)	0.00	0.00
	Set 3 (8 & 11 Jan 2016)	0.00	0.00
	Set 4 (13 & 19 Jan 2016)	0.00	0.00
	Set 5 (2 & 3 Feb 2016)	0.00	0.00
	Set 6 (16 & 22 Feb 2016)	0.00	0.00
Northwest Lantau	Set 1 (2 & 7 Dec 2015)	4.12	17.84
	Set 2 (9 & 15 Dec 2015)	4.78	11.94
	Set 3 (8 & 11 Jan 2016)	2.79	9.78
	Set 4 (13 & 19 Jan 2016)	1.36	10.90
	Set 5 (2 & 3 Feb 2016)	1.35	6.75
	Set 6 (16 & 22 Feb 2016)	1.44	8.66

Table 3. Comparison of average dolphin encounter rates from impact monitoring period (December 2015 – February 2016) 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)	
	December 2015 - February 2016	**September - November 2011**	**December 2015 - February 2016**	**September - November 2011**
Northeast Lantau	0.0	6.00 ± 5.05	0.0	22.19 ± 26.81
Northwest Lantau	2.64 ± 1.52	9.85 ± 5.85	10.98 ± 3.81	44.66 ± 29.85

Table 4. Comparison of average dolphin encounter rates in Northeast Lantau survey area from all quarters of HKLR03 impact monitoring period 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; the encounter rates in winter months were highlighted in blue; ± 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
December 2012-February 2013 (Impact)	3.14 ± 3.21	6.33 ± 8.64
March-May 2013 (Impact)	0.42 ± 1.03	0.42 ± 1.03
June-August 2013 (Impact)	0.88 ± 1.36	3.91 ± 8.36
September-November 2013 (Impact)	1.01 ± 1.59	3.77 ± 6.49
December 2013-February 2014 (Impact)	0.45 ± 1.10	1.34 ± 3.29
March-May 2014 (Impact)	0.00	0.00
June-August 2014 (Impact)	0.42 ± 1.04	1.69 ± 4.15
September-November 2014 (Impact)	0.00	0.00
December 2014-February 2015 (Impact)	0.00	0.00
March-May 2015 (Impact)	0.00	0.00
June-August 2015 (Impact)	0.44 ± 1.08	0.44 ± 1.08
September-November 2015 (Impact)	0.00	0.00
December 2015-February 2016 (Impact)	0.00	0.00

3.3.3. In NEL, the average dolphin encounter rates (both STG and ANI) in the present three-month impact monitoring period were both zero with no sighting made, and such extremely low occurrence of dolphins in NEL have been consistently recorded in the past

twelve quarters of HKLR03 monitoring (Table 4). This is a serious concern as the dolphin occurrence in NEL in the last eleven quarters (0.0-1.0 for ER(STG) and 0.0-3.9 for ER(ANI)) have been exceptionally low when compared to the baseline period (Table 4). Dolphins have almost vacated from NEL waters since January 2014, with only two groups of five dolphins sighted there since then despite consistent and intensive survey effort being conducted in this survey area

3.3.4. Moreover, the average dolphin encounter rates (STG and ANI) in NWL during the present impact phase monitoring period were also much lower (reductions of 73.2% and 75.4% respectively) than the ones recorded in the 3-month baseline period, indicating a dramatic decline in dolphin usage of this survey area as well during the present impact phase period (Table 5).

3.3.5. Even for the same winter quarters, the dolphin encounter rates in NWL during the winters of 2014-2015 and 2015-16 were much lower than the ones recorded in winters of 2012-13 and 2013-14 (Table 5).

Table 5. Comparison of average dolphin encounter rates in Northwest Lantau survey area from all quarters of impact monitoring period 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; encounter rates in winter months were highlighted in blue; ± 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
December 2012-February 2013 (Impact)	8.36 ± 5.03	35.90 ± 23.10
March-May 2013 (Impact)	7.75 ± 3.96	24.23 ± 18.05
June-August 2013 (Impact)	6.56 ± 3.68	27.00 ± 18.71
September-November 2013 (Impact)	8.04 ± 1.10	32.48 ± 26.51
December 2013-February 2014 (Impact)	8.21 ± 2.21	32.58 ± 11.21
March-May 2014 (Impact)	6.51 ± 3.34	19.14 ± 7.19
June-August 2014 (Impact)	4.74 ± 3.84	17.52 ± 15.12
September-November 2014 (Impact)	5.10 ± 4.40	20.52 ± 15.10
December 2014-February 2015 (Impact)	2.91 ± 2.69	11.27 ± 15.19
March-May 2015 (Impact)	0.47 ± 0.73	2.36 ± 4.07
June-August 2015 (Impact)	2.53 ± 3.20	9.21 ± 11.57
September-November 2015 (Impact)	3.94 ± 1.57	21.05 ± 17.19
December 2015-February 2016 (Impact)	2.64 ± 1.52	10.98 ± 3.81

3.3.6. After a slight rebound in encounter rates in NWL in the previous quarter, dolphin occurrence has dropped noticeably once again in the present quarter back to a low level (especially for ER(ANI)) (Table 5). Such temporal trend should be closely monitored in the upcoming monitoring quarters.

3.3.7. As discussed recently in Hung (2015), the dramatic decline in dolphin usage of NEL waters in the past few years (including the declines in abundance, encounter rate and habitat use in NEL, as well as shifts of individual core areas and ranges away from NEL waters) was possibly related to the HZMB construction works that were commenced since 2012. It appeared that such noticeable decline has already extended to NWL waters progressively in the past two years.

3.3.8. 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 impact monitoring periods. The two variables that were examined included the two periods (baseline and impact phases) and two locations (NEL and NWL).

3.3.9. For the comparison between the baseline period and the present quarter (thirteenth quarter of the HKLR03 impact phase being assessed), the p-values for the differences in average dolphin encounter rates of STG and ANI were 0.0043 and 0.0275 respectively. If the alpha value is set at 0.05, significant differences were detected between the baseline and present quarters in both the average dolphin encounter rates of STG and ANI.

3.3.10. For the comparison between the baseline period and the cumulative quarters in impact phase (i.e. first thirteen quarters of the HKLR03 impact phase being assessed), the p-values for the differences in average dolphin encounter rates of STG and ANI were 0.00004 and 0.00001 respectively. Even if the alpha value is set at 0.00005, significant differences were still detected in both the average dolphin encounter rates of STG and ANI (i.e. between the two periods and the locations).

3.3.11. As indicated in both dolphin distribution patterns and encounter rates, dolphin usage has been significantly reduced in both NEL and NWL survey areas during the present quarterly period, and such low occurrence of dolphins has also been consistently documented in previous quarters. This raises serious concern, as the timing of the decline in dolphin usage in North Lantau waters coincided well with the construction schedule of the HZMB-related projects (Hung 2015).

3.3.12. To ensure the continuous usage of North Lantau waters by the dolphins, every possible measure should be implemented by the contractors and relevant authorities of HZMB-related works to minimize all disturbances to the dolphins.

3.4. Group size

3.4.1. Group size of Chinese White Dolphins ranged from one to ten individuals per group in North Lantau region during December 2015 to February 2016. 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 impact monitoring period (December 2015 – February 2016) and baseline monitoring period (September – November 2011) (Note: ± denotes the standard deviation of the average group size)

	Average Dolphin Group Size	
	December 2015 – February 2016	**September – November 2011**
Overall	4.07 ± 3.22 (n = 14)	3.72 ± 3.13 (n = 66)
Northeast Lantau	N/A	3.18 ± 2.16 (n = 17)
Northwest Lantau	4.07 ± 3.22 (n = 14)	3.92 ± 3.40 (n = 49)

3.4.2. The average dolphin group size in NWL waters during December 2015 to February 2016 was slightly higher than the ones recorded during the three-month baseline period (Table 6). Eight of the 14 groups were composed of 1-3 individuals only, while three other groups were moderate in sizes with 5-6 individuals per group. Moreover, three large dolphin groups with 8-10 individuals each were sighted during the present quarterly period.

3.4.3. Distribution of dolphins with larger group sizes (five individuals or more per group and ten individuals per group) during the present quarter is shown in Figure 3, with comparison to the one in baseline period. During the winter months of 2015-16, distribution of these moderately large groups of dolphins were located to the north of Lung Kwu Chau, near Pillar Point and near the northern landfall of TM-CLKL (Figure 3). This distribution pattern was very different from the baseline period, when the larger dolphin groups were more evenly distributed in NWL waters with a few more sighted in NEL waters (Figure 3).

3.5. Habitat use

3.5.1. From December 2015 to February 2016, the areas being heavily utilized by Chinese White Dolphins was to the north of Lung Kwu Chau, near Pillar Point and near the northern landfall of TM-CLKL in the North Lantau region (Figures 4a and 4b). All grids near southern viaduct of TM-CLKL, HKLR03/HKBCF reclamation sites as well as HKLR09 alignment did not record any presence of dolphins during on-effort search in the present quarterly period, but one grid (N12) overlapped with the northern landfall of TM-CLKL recorded moderately high dolphin densities (Figure 4b).

3.5.2. It should be emphasized though 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. A more complete picture of dolphin habitat use pattern should be examined when more survey effort for each grid will be collected throughout the impact phase monitoring programme.

3.5.3. When compared with the habitat use patterns during the baseline period, dolphin usage in NEL and NWL has dramatically diminished in both areas during the present impact 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 impact phase period (Figure 5).

3.5.4. The density patterns were also very different in NWL between the baseline and impact phase monitoring periods, with higher 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. In contrast, mainly the waters to the north of Lung Kwu Chau recorded high densities of dolphins during the present impact phase period (Figure 5).

3.6. Mother-calf pairs

3.6.1. During the present quarterly period, neither unspotted calf nor unspotted juvenile was sighted with any female in the North Lantau region.

3.6.2. The absence of young calves in the present quarter was in stark contrast to their regular occurrence in North Lantau waters during the baseline period. This should be of a serious concern, and the occurrence of young calves in North Lantau waters should be closely monitored in the upcoming quarters.

3.7. Activities and associations with fishing boats

3.7.1. One of the 14 dolphin groups were engaged in feeding activity, while two other dolphin groups were engaged in socializing activities. None of the dolphin groups were engaged in traveling or milling/resting activity during the three-month study period.

3.7.2. The percentage of sightings associated with feeding activities (7.1%) was much lower than the one recorded during the baseline period (11.6%), while the one associated with socializing activities (14.2%) during the present impact phase period was much higher than the one from the baseline period (5.4%). However, it should be noted the sample sizes on total numbers of dolphin sightings during the present quarter (14 dolphin groups) was much lower than the baseline period (66 dolphin groups).

3.7.3. Distribution of dolphins engaged in various activities during the present three-month period is shown in Figure 6. The only dolphin group engaged in feeding activity was sighted near Sha Chau, while the two groups engaged in socializing activities were located to the north of Lung Kwu Chau and near the northern landfall of TMCLKL.

3.7.4. When compared to the baseline period, distribution of various dolphin activities during the present impact phase monitoring period was drastically different with a much more restricted area of occurrences of these activities (Figure 6).

3.7.5. As consistently recorded in the past monitoring quarters, none of the 14 dolphin groups was found to be associated with any operating fishing vessel in North Lantau waters during the present impact phase period.

3.8. Summary of photo-identification works

3.8.1. From December 2015 to February 2016, over 1,500 digital photographs of Chinese White

Dolphins were taken during the HKLR03 impact phase monitoring surveys for the photo-identification work.

3.8.2. In total, 21 individuals sighted 48 times altogether were identified (see summary table in Appendix III and photographs of identified individuals in Appendix IV). All of these re-sightings were made in NWL.

3.8.3. The majority of identified individuals were sighted only once or twice during the three-month period, with the exception of six individuals (NL182, NL210, NL220, NL284, NL286 and NL320) being 3-4 times and another two individuals (NL48 and NL285) being sighted 5 times in the present quarter.

3.8.4. For the first time since such comparison has been made, none of the 21 individuals sighted during HKLR03 monitoring surveys was sighted in West Lantau waters during the HKLR09 monitoring surveys in the same quarter. The restricted movements of individuals between North and West Lantau waters should be continuously monitored to determine whether the presence of HKLR09 alignments has affected such movements.

3.9. Individual range use

3.9.1. Ranging patterns of the 21 individuals identified during the three-month study 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. Moreover, none of the 21 individuals have extended their range use to WL or SWL waters during the present quarter, which was very different from the previous quarters when frequent individual movements between the North and West Lantau waters were observed. In the upcoming quarters, individual range use and movements should be continuously monitored to examine whether there has been any significant change in individual range use, which could possibly be related to the HZMB-related construction works or the physical presence of the bridge structures (see Hung 2015).

4. Conclusion

4.1. During this quarter of dolphin monitoring, no adverse impact from the activities of the TMCLKL construction project on Chinese White Dolphins was noticeable from general observations.

4.2. Although the dolphins infrequently occurred along the alignment of TMCLKL northern connection sub-sea tunnel section in the past and during the baseline monitoring period, it is apparent that dolphin usage has been significantly reduced in NEL, and many

individuals have shifted away from the important habitat around the Brothers Islands.

4.3. It is critical to monitor the dolphin usage in North Lantau region in the upcoming quarters, to determine whether the dolphins are continuously affected by the various construction activities in relation to the HZMB-related works, and whether suitable mitigation measure can be applied to revert the situation.

5. References

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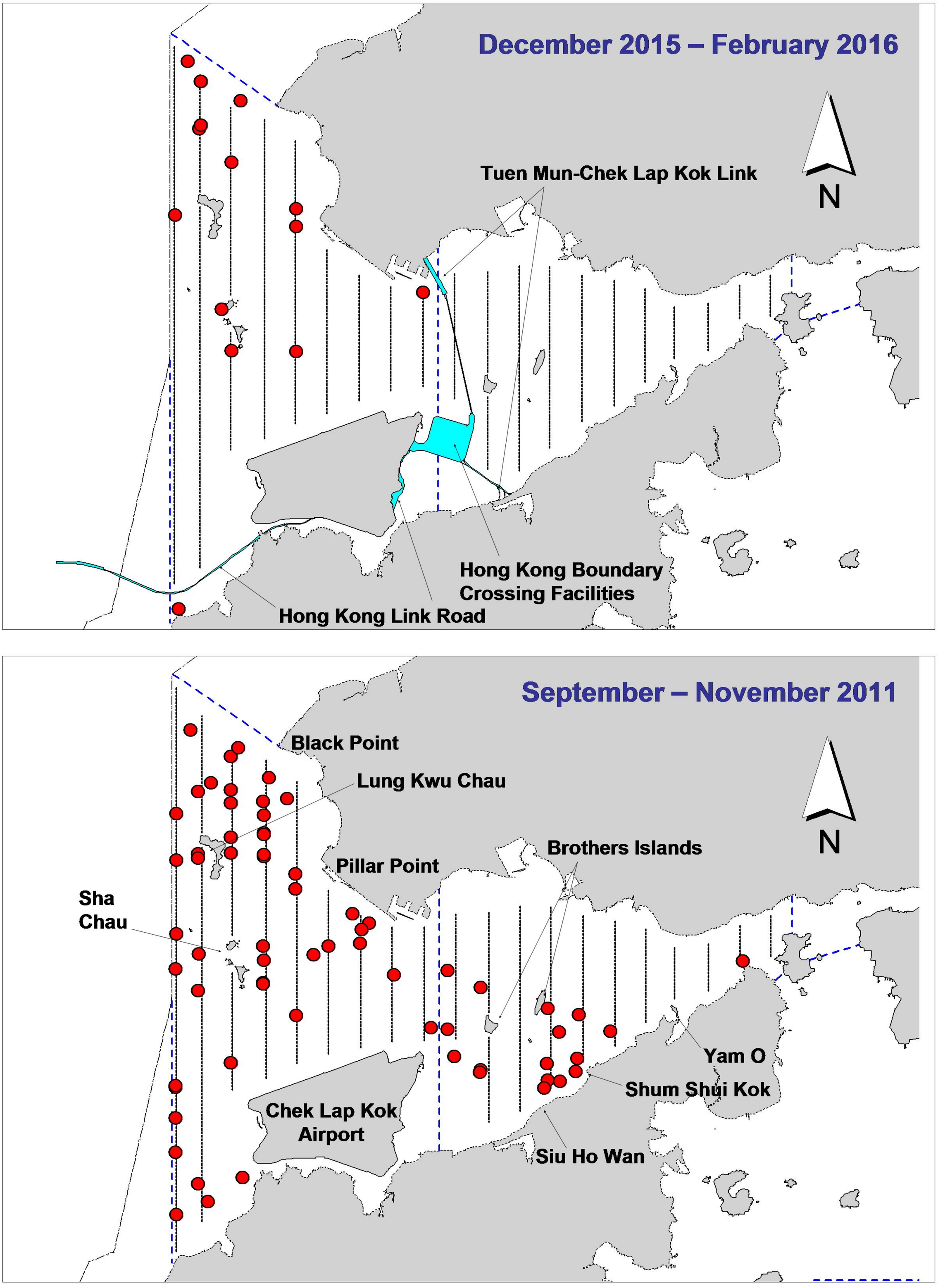


Figure 1. Distribution of Chinese white dolphin sighting in Northwest and Northeast Lantau during HKLR03 impact phase (top) and baseline monitoring surveys (bottom)

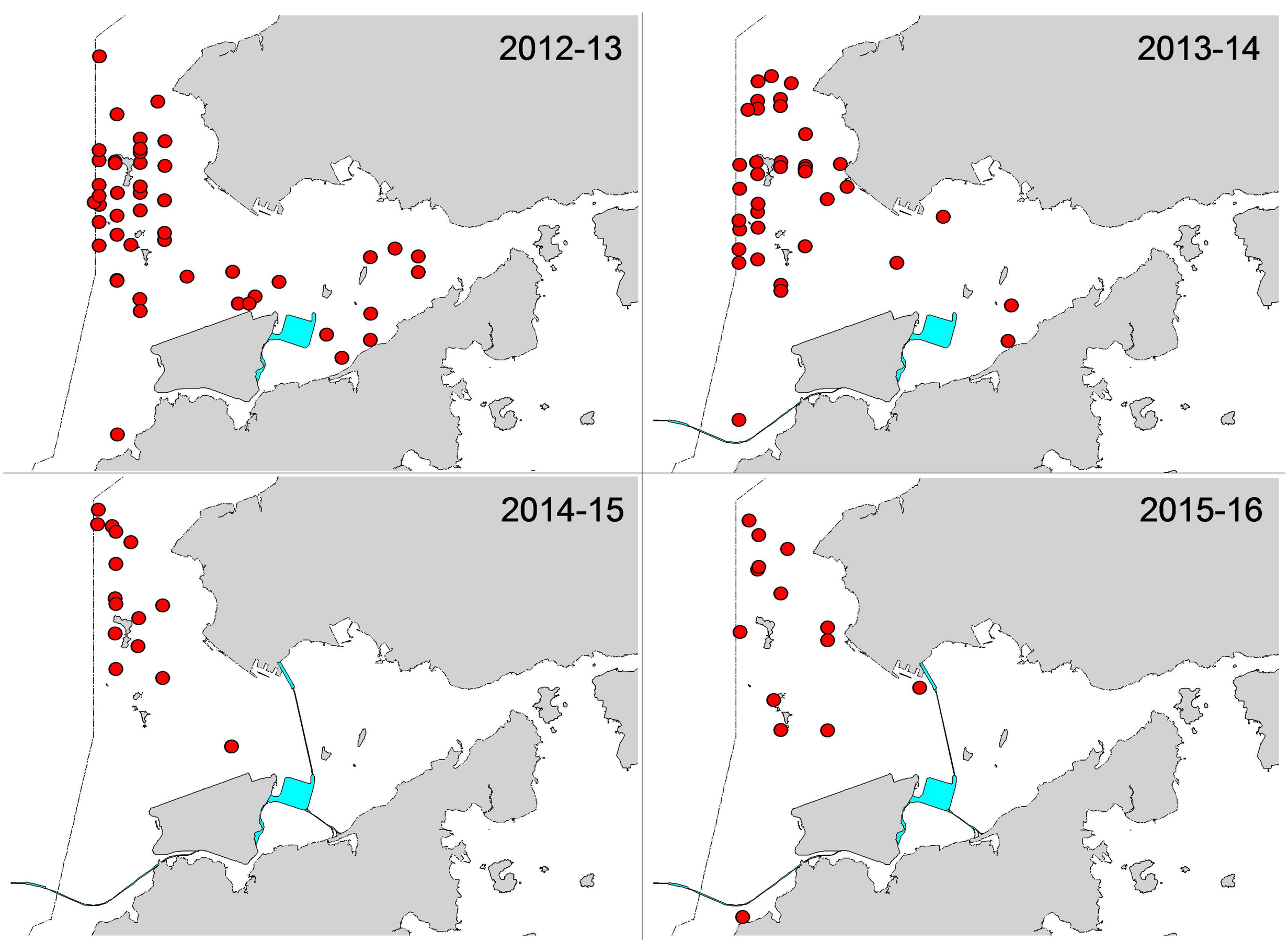


Figure 2. Distribution of Chinese white dolphin sightings in Northwest and Northeast Lantau during the same winter quarters (December - February) of HKLR03 impact phase in 2013-16

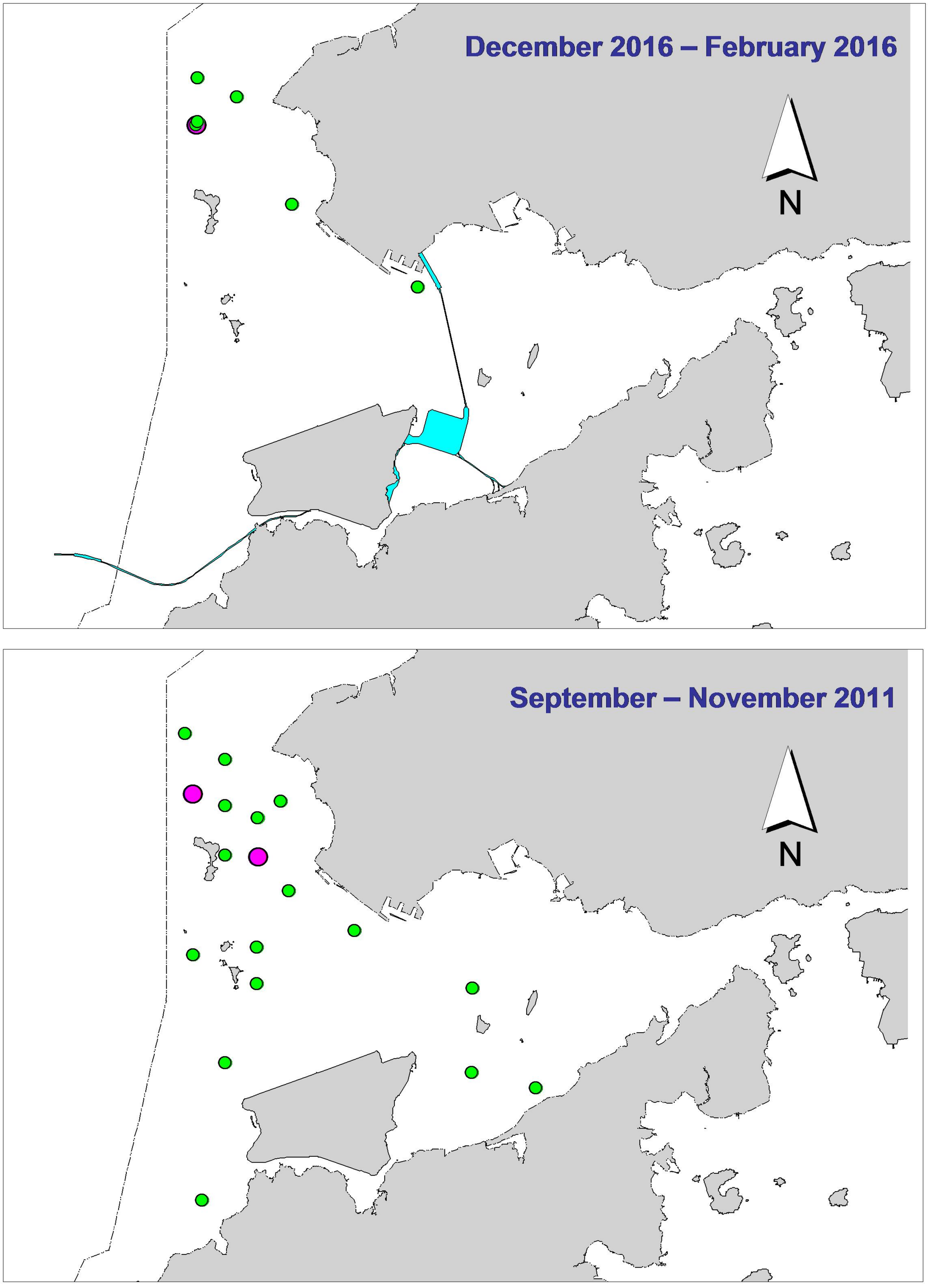


Figure 3. Distribution of Chinese white dolphins with larger group sizes during HKLR03 impact phase (top) and baseline monitoring surveys (bottom) (green dots: group sizes of 5 or more; purple dots: group sizes of 10 or more)

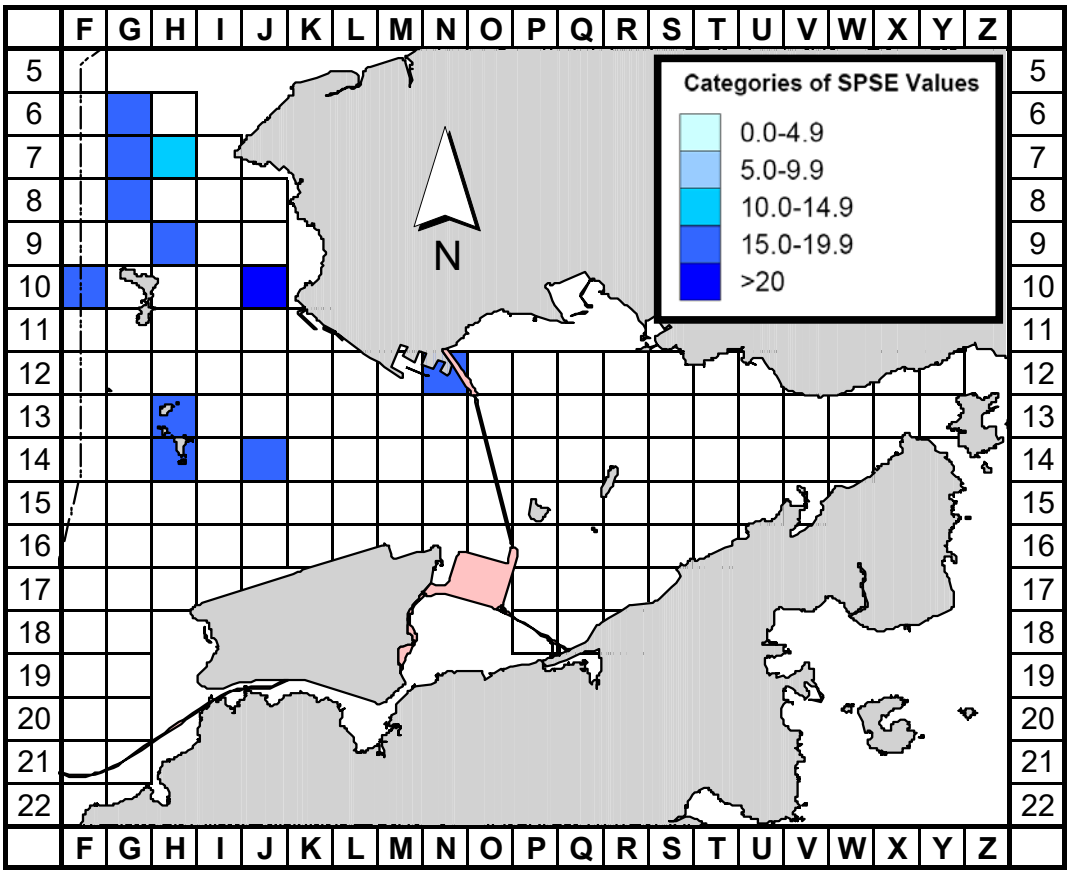


Figure 4a. Sighting density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during HKLR03 impact monitoring period monitoring period (Dec15-Feb16) (SPSE = no. of on-effort sightings per 100 units of survey effort)

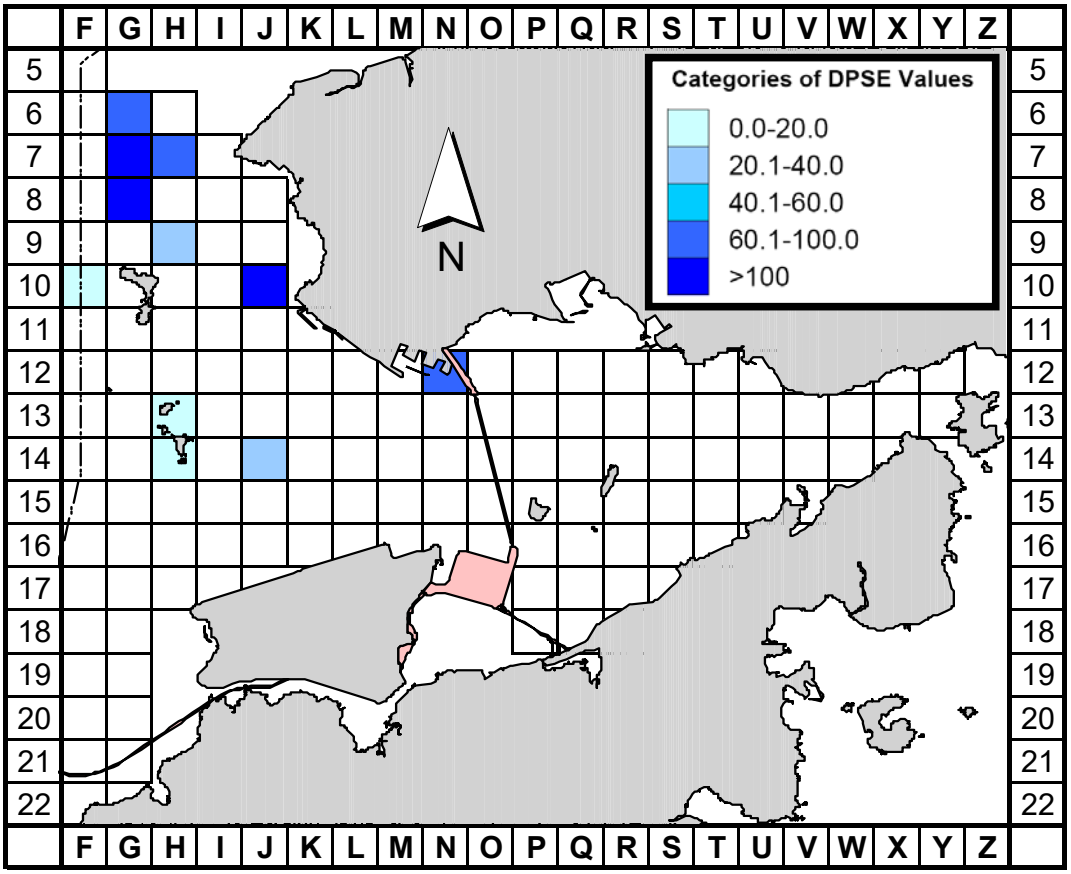


Figure 4b. Density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during HKLR03 impact monitoring period (Dec15-Feb16) (DPSE = no. of dolphins per 100 units of survey effort)

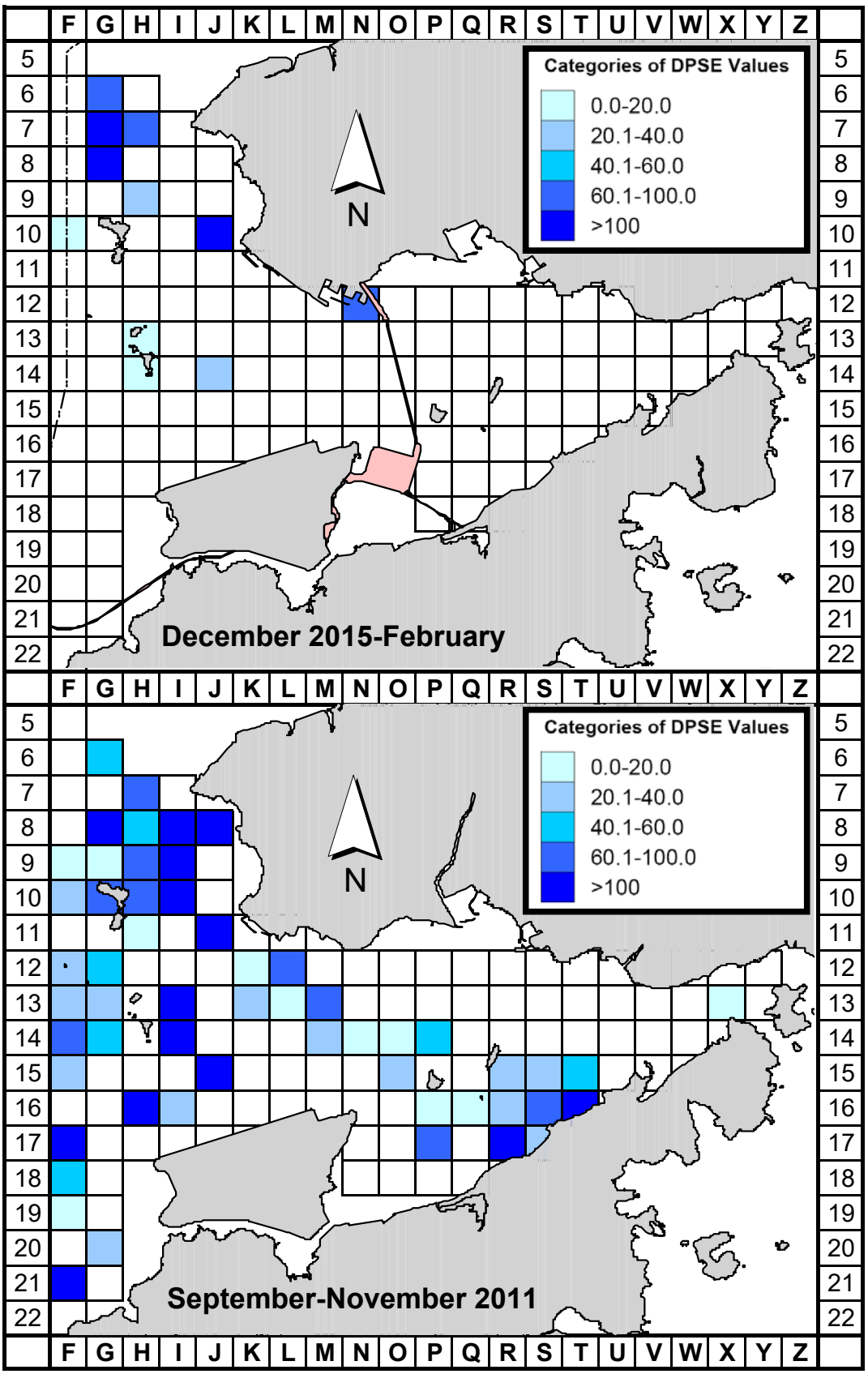


Figure 5. Comparison of density of Chinese white dolphins with corrected survey effort per km^2 in Northwest and Northeast Lantau survey area between the impact monitoring period December 2015-February 2016) and baseline monitoring period (September-November 2011)
(DPSE = no. of dolphins per 100 units of survey effort)

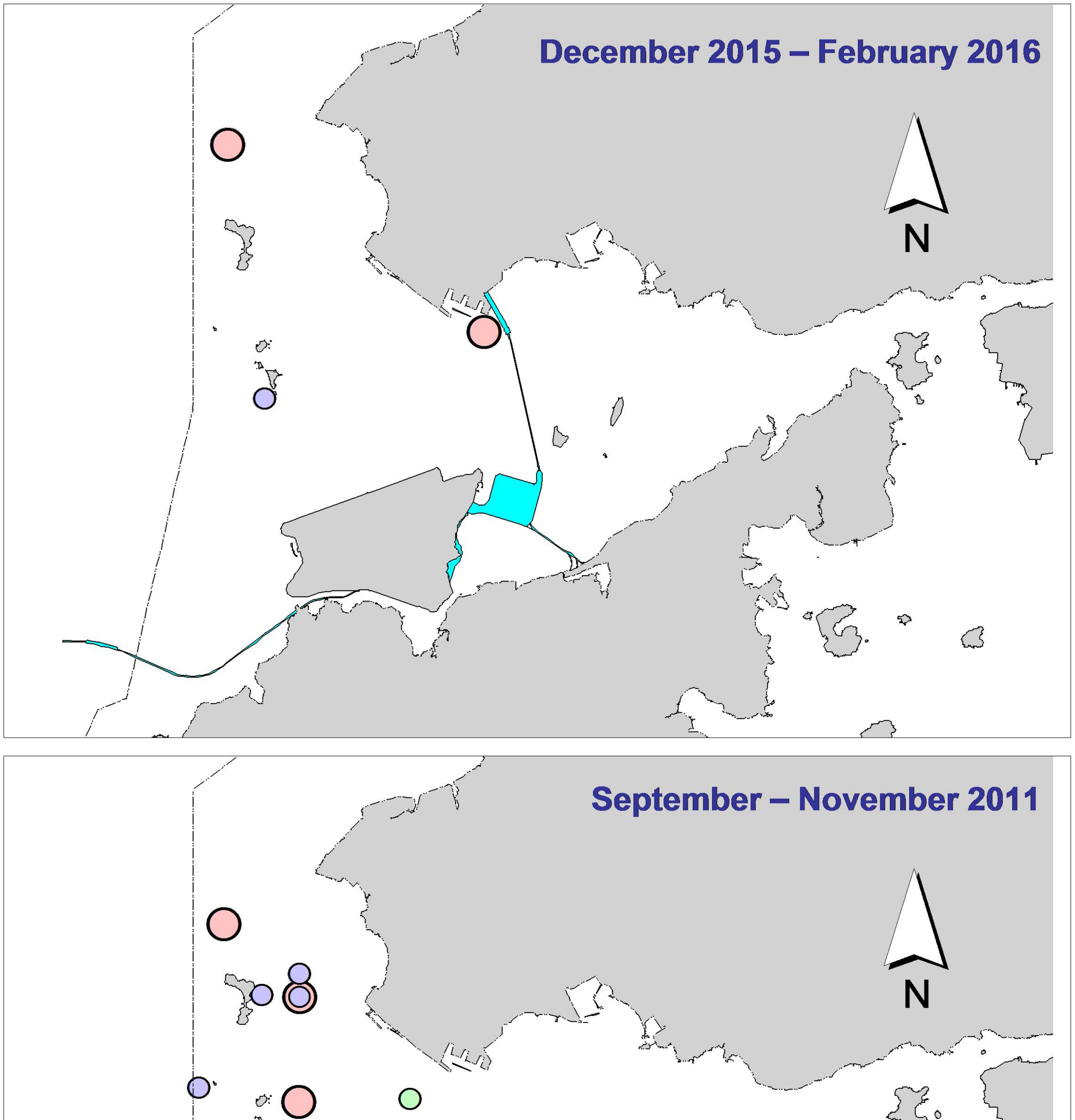


Figure 6. Distribution of Chinese white dolphins engaged in feeding (purple dots), socializing (pink dots) and traveling (green dots) activities during HKLR03 impact phase (top) and baseline monitoring surveys (bottom)

Appendix I. HKLR03 Survey Effort Database (Dec. 2015 - Feb. 2016)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
2-Dec-15	NW LANTAU	2	34.36	WINTER	STANDARD31516	HKLR	P
2-Dec-15	NW LANTAU	3	6.71	WINTER	STANDARD31516	HKLR	P
2-Dec-15	NW LANTAU	2	12.06	WINTER	STANDARD31516	HKLR	S
2-Dec-15	NW LANTAU	3	0.90	WINTER	STANDARD31516	HKLR	S
2-Dec-15	NE LANTAU	1	0.77	WINTER	STANDARD31516	HKLR	P
2-Dec-15	NE LANTAU	2	15.53	WINTER	STANDARD31516	HKLR	P
2-Dec-15	NE LANTAU	2	10.30	WINTER	STANDARD31516	HKLR	S
7-Dec-15	NE LANTAU	2	18.39	WINTER	STANDARD31516	HKLR	P
7-Dec-15	NE LANTAU	3	1.75	WINTER	STANDARD31516	HKLR	P
7-Dec-15	NE LANTAU	2	9.11	WINTER	STANDARD31516	HKLR	S
7-Dec-15	NE LANTAU	3	1.35	WINTER	STANDARD31516	HKLR	S
7-Dec-15	NW LANTAU	2	3.22	WINTER	STANDARD31516	HKLR	P
7-Dec-15	NW LANTAU	3	28.58	WINTER	STANDARD31516	HKLR	P
7-Dec-15	NW LANTAU	2	0.27	WINTER	STANDARD31516	HKLR	S
7-Dec-15	NW LANTAU	3	7.53	WINTER	STANDARD31516	HKLR	S
9-Dec-15	NW LANTAU	2	1.20	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NW LANTAU	3	13.30	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NW LANTAU	4	14.71	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NW LANTAU	5	2.69	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NW LANTAU	2	1.10	WINTER	STANDARD31516	HKLR	S
9-Dec-15	NW LANTAU	3	1.84	WINTER	STANDARD31516	HKLR	S
9-Dec-15	NW LANTAU	4	4.72	WINTER	STANDARD31516	HKLR	S
9-Dec-15	NE LANTAU	2	12.20	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NE LANTAU	3	7.10	WINTER	STANDARD31516	HKLR	P
9-Dec-15	NE LANTAU	2	8.50	WINTER	STANDARD31516	HKLR	S
9-Dec-15	NE LANTAU	3	2.30	WINTER	STANDARD31516	HKLR	S
15-Dec-15	NW LANTAU	2	10.12	WINTER	STANDARD31516	HKLR	P
15-Dec-15	NW LANTAU	3	17.24	WINTER	STANDARD31516	HKLR	P
15-Dec-15	NW LANTAU	4	13.57	WINTER	STANDARD31516	HKLR	P
15-Dec-15	NW LANTAU	2	2.83	WINTER	STANDARD31516	HKLR	S
15-Dec-15	NW LANTAU	3	10.47	WINTER	STANDARD31516	HKLR	S
15-Dec-15	NE LANTAU	2	15.04	WINTER	STANDARD31516	HKLR	P
15-Dec-15	NE LANTAU	3	1.60	WINTER	STANDARD31516	HKLR	P
15-Dec-15	NE LANTAU	2	10.16	WINTER	STANDARD31516	HKLR	S
8-Jan-16	NW LANTAU	2	25.03	WINTER	STANDARD31516	HKLR	P
8-Jan-16	NW LANTAU	3	15.46	WINTER	STANDARD31516	HKLR	P
8-Jan-16	NW LANTAU	2	10.60	WINTER	STANDARD31516	HKLR	S
8-Jan-16	NW LANTAU	3	2.21	WINTER	STANDARD31516	HKLR	S
8-Jan-16	NE LANTAU	2	16.39	WINTER	STANDARD31516	HKLR	P
8-Jan-16	NE LANTAU	2	8.31	WINTER	STANDARD31516	HKLR	S
8-Jan-16	NE LANTAU	3	2.10	WINTER	STANDARD31516	HKLR	S
11-Jan-16	NE LANTAU	1	1.97	WINTER	STANDARD31516	HKLR	P
11-Jan-16	NE LANTAU	2	15.21	WINTER	STANDARD31516	HKLR	P
11-Jan-16	NE LANTAU	3	2.72	WINTER	STANDARD31516	HKLR	P
11-Jan-16	NE LANTAU	2	11.00	WINTER	STANDARD31516	HKLR	S
11-Jan-16	NE LANTAU	3	1.30	WINTER	STANDARD31516	HKLR	S
11-Jan-16	NW LANTAU	2	11.76	WINTER	STANDARD31516	HKLR	P
11-Jan-16	NW LANTAU	3	19.32	WINTER	STANDARD31516	HKLR	P
11-Jan-16	NW LANTAU	2	4.82	WINTER	STANDARD31516	HKLR	S
11-Jan-16	NW LANTAU	3	1.00	WINTER	STANDARD31516	HKLR	S
11-Jan-16	NW LANTAU	4	2.10	WINTER	STANDARD31516	HKLR	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
13-Jan-16	NE LANTAU	1	1.00	WINTER	STANDARD31516	HKLR	P
13-Jan-16	NE LANTAU	2	15.93	WINTER	STANDARD31516	HKLR	P
13-Jan-16	NE LANTAU	2	9.63	WINTER	STANDARD31516	HKLR	S
13-Jan-16	NE LANTAU	3	0.64	WINTER	STANDARD31516	HKLR	S
13-Jan-16	NW LANTAU	2	26.61	WINTER	STANDARD31516	HKLR	P
13-Jan-16	NW LANTAU	3	15.03	WINTER	STANDARD31516	HKLR	P
13-Jan-16	NW LANTAU	2	5.05	WINTER	STANDARD31516	HKLR	S
13-Jan-16	NW LANTAU	3	6.87	WINTER	STANDARD31516	HKLR	S
19-Jan-16	NW LANTAU	2	22.73	WINTER	STANDARD31516	HKLR	P
19-Jan-16	NW LANTAU	3	9.01	WINTER	STANDARD31516	HKLR	P
19-Jan-16	NW LANTAU	2	6.16	WINTER	STANDARD31516	HKLR	S
19-Jan-16	NW LANTAU	3	1.50	WINTER	STANDARD31516	HKLR	S
19-Jan-16	NE LANTAU	1	0.90	WINTER	STANDARD31516	HKLR	P
19-Jan-16	NE LANTAU	2	16.70	WINTER	STANDARD31516	HKLR	P
19-Jan-16	NE LANTAU	3	2.29	WINTER	STANDARD31516	HKLR	P
19-Jan-16	NE LANTAU	1	2.30	WINTER	STANDARD31516	HKLR	S
19-Jan-16	NE LANTAU	2	8.41	WINTER	STANDARD31516	HKLR	S
2-Feb-16	NE LANTAU	2	20.46	WINTER	STANDARD31516	HKLR	P
2-Feb-16	NE LANTAU	2	6.05	WINTER	STANDARD31516	HKLR	S
2-Feb-16	NE LANTAU	3	4.59	WINTER	STANDARD31516	HKLR	S
2-Feb-16	NW LANTAU	2	6.80	WINTER	STANDARD31516	HKLR	P
2-Feb-16	NW LANTAU	3	26.28	WINTER	STANDARD31516	HKLR	P
2-Feb-16	NW LANTAU	2	2.32	WINTER	STANDARD31516	HKLR	S
2-Feb-16	NW LANTAU	3	4.50	WINTER	STANDARD31516	HKLR	S
3-Feb-16	NW LANTAU	2	21.30	WINTER	STANDARD31516	HKLR	P
3-Feb-16	NW LANTAU	3	19.74	WINTER	STANDARD31516	HKLR	P
3-Feb-16	NW LANTAU	2	10.82	WINTER	STANDARD31516	HKLR	S
3-Feb-16	NW LANTAU	3	2.24	WINTER	STANDARD31516	HKLR	S
3-Feb-16	NE LANTAU	1	1.82	WINTER	STANDARD31516	HKLR	P
3-Feb-16	NE LANTAU	2	14.48	WINTER	STANDARD31516	HKLR	P
3-Feb-16	NE LANTAU	1	2.49	WINTER	STANDARD31516	HKLR	S
3-Feb-16	NE LANTAU	2	8.08	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NW LANTAU	2	6.05	WINTER	STANDARD31516	HKLR	P
16-Feb-16	NW LANTAU	3	31.35	WINTER	STANDARD31516	HKLR	P
16-Feb-16	NW LANTAU	4	3.00	WINTER	STANDARD31516	HKLR	P
16-Feb-16	NW LANTAU	2	5.70	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NW LANTAU	3	4.80	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NW LANTAU	4	3.10	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NE LANTAU	1	1.10	WINTER	STANDARD31516	HKLR	P
16-Feb-16	NE LANTAU	2	15.25	WINTER	STANDARD31516	HKLR	P
16-Feb-16	NE LANTAU	1	1.40	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NE LANTAU	2	8.16	WINTER	STANDARD31516	HKLR	S
16-Feb-16	NE LANTAU	3	1.09	WINTER	STANDARD31516	HKLR	S
22-Feb-16	NE LANTAU	2	20.26	WINTER	STANDARD31516	HKLR	P
22-Feb-16	NE LANTAU	2	9.08	WINTER	STANDARD31516	HKLR	S
22-Feb-16	NE LANTAU	3	1.86	WINTER	STANDARD31516	HKLR	S
22-Feb-16	NW LANTAU	2	14.88	WINTER	STANDARD31516	HKLR	P
22-Feb-16	NW LANTAU	3	16.99	WINTER	STANDARD31516	HKLR	P
22-Feb-16	NW LANTAU	2	2.43	WINTER	STANDARD31516	HKLR	S
22-Feb-16	NW LANTAU	3	5.10	WINTER	STANDARD31516	HKLR	S
22-Feb-16	NW LANTAU	4	0.30	WINTER	STANDARD31516	HKLR	S

Appendix II. HKLR03 Chinese White Dolphin Sighting Database (December 2015-February 2016)

(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
2-Dec-15	1	1058	1	NW LANTAU	2	477	ON	HKLR	826399	804684	WINTER	NONE	P
2-Dec-15	2	1149	2	NW LANTAU	2	257	ON	HKLR	827946	806459	WINTER	NONE	P
7-Dec-15	1	1449	10	NW LANTAU	3	553	ON	HKLR	828945	805462	WINTER	NONE	P
9-Dec-15	1	1209	9	NW LANTAU	4	126	ON	HKLR	829795	806761	WINTER	NONE	S
15-Dec-15	1	1015	1	NW LANTAU	2	ND	OFF	HKLR	814683	804794	WINTER	NONE	
15-Dec-15	2	1303	2	NW LANTAU	2	169	ON	HKLR	822328	808518	WINTER	NONE	P
15-Dec-15	3	1329	3	NW LANTAU	3	236	ON	HKLR	826060	808504	WINTER	NONE	P
8-Jan-16	1	1209	1	NW LANTAU	2	591	ON	HKLR	822365	806458	WINTER	NONE	P
11-Jan-16	1	1303	6	NW LANTAU	3	140	ON	HKLR	830351	805495	WINTER	NONE	P
13-Jan-16	1	1355	1	NW LANTAU	3	54	ON	HKLR	823584	806162	WINTER	NONE	S
13-Jan-16	2	1458	2	NW LANTAU	2	83	ON	HKLR	830961	805085	WINTER	NONE	S
19-Jan-16	1	1112	8	NW LANTAU	3	332	ON	HKLR	829044	805503	WINTER	NONE	P
3-Feb-16	1	1318	5	NW LANTAU	3	28	ON	HKLR	826580	808505	WINTER	NONE	P
16-Feb-16	1	1414	6	NW LANTAU	3	145	ON	HKLR	824082	812518	WINTER	NONE	P

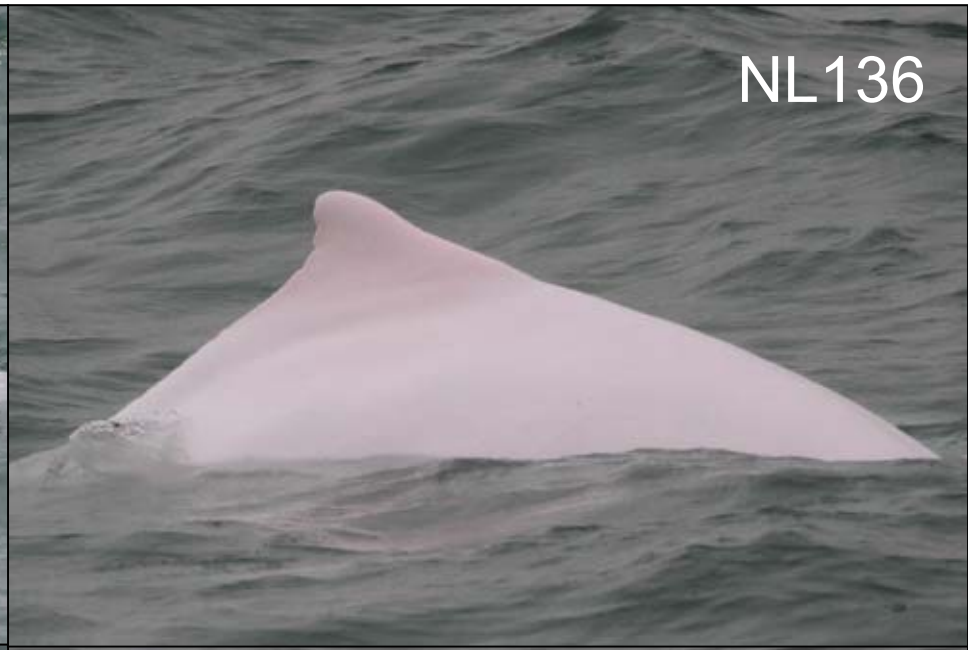
Appendix III. Individual dolphins identified during HKLR03 monitoring surveys in December 2015 - February 2016

ID#	DATE	STG#	AREA
CH34	09/12/15	1	NW LANTAU
NL33	07/12/15	1	NW LANTAU
	09/12/15	1	NW LANTAU
NL48	09/12/15	1	NW LANTAU
	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	03/02/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
NL104	09/12/15	1	NW LANTAU
	15/12/15	3	NW LANTAU
NL123	11/01/16	1	NW LANTAU
NL136	09/12/15	1	NW LANTAU
	16/02/16	1	NW LANTAU
NL182	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
NL202	07/12/15	1	NW LANTAU
	19/01/16	1	NW LANTAU
NL210	07/12/15	1	NW LANTAU
	13/01/16	2	NW LANTAU
	03/02/16	1	NW LANTAU
NL220	09/12/15	1	NW LANTAU
	15/12/15	3	NW LANTAU
	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU

ID#	DATE	STG#	AREA
NL233	07/12/15	1	NW LANTAU
NL261	15/12/15	2	NW LANTAU
	03/02/16	1	NW LANTAU
NL269	09/12/15	1	NW LANTAU
NL272	07/12/15	1	NW LANTAU
	15/12/15	2	NW LANTAU
NL280	07/12/15	1	NW LANTAU
NL284	07/12/15	1	NW LANTAU
	19/01/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
NL285	08/01/16	1	NW LANTAU
	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	03/02/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
NL286	02/12/15	1	NW LANTAU
	02/12/15	2	NW LANTAU
	07/12/15	1	NW LANTAU
NL302	13/01/16	2	NW LANTAU
NL320	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	03/02/16	1	NW LANTAU
WL17	16/02/16	1	NW LANTAU

Appendix IV. Twenty-one individual dolphins that were identified during December 2015 – February 2016 under HKLR03 impact phase monitoring surveys

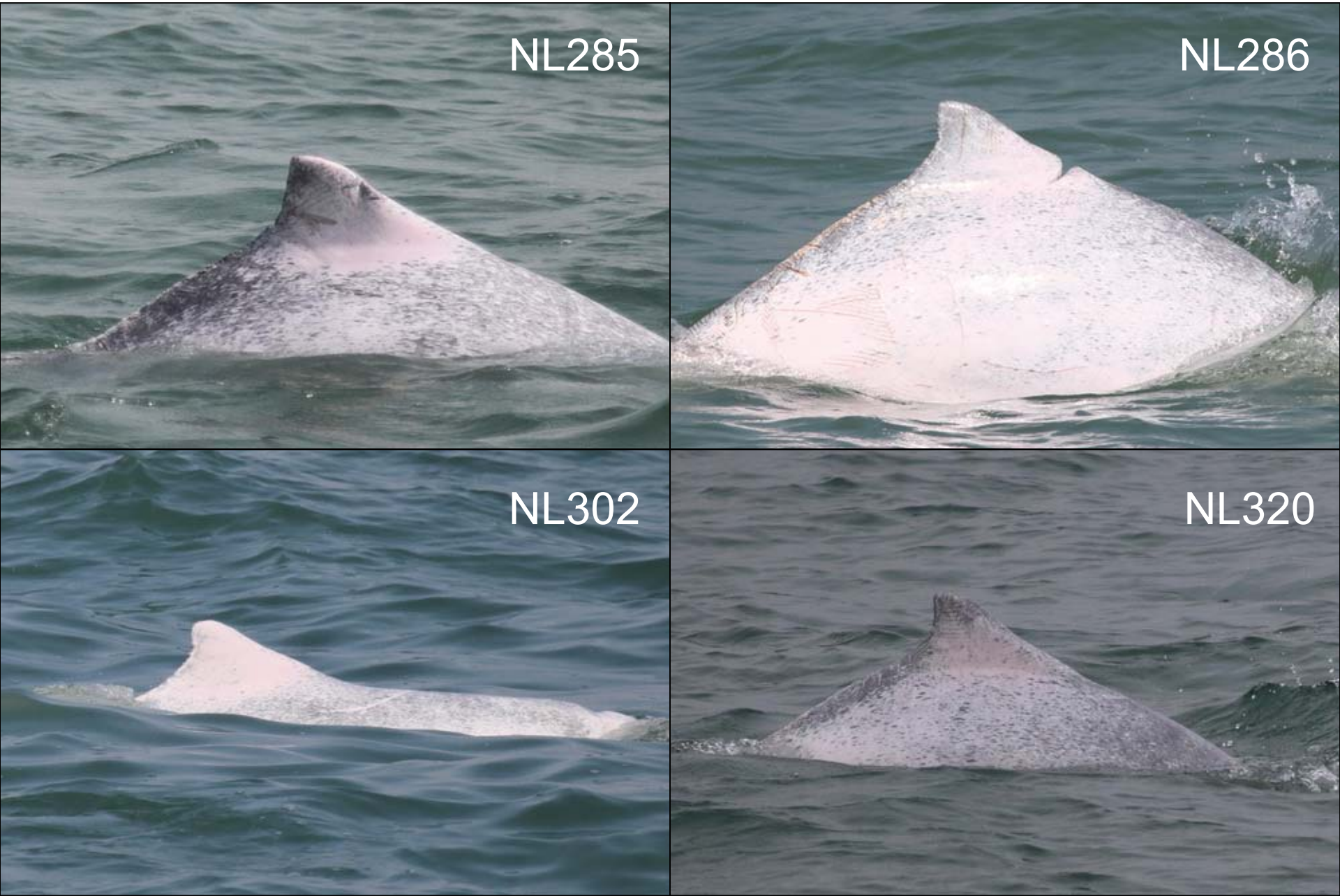
Appendix IV. (cont'd)



Appendix IV. (cont'd)

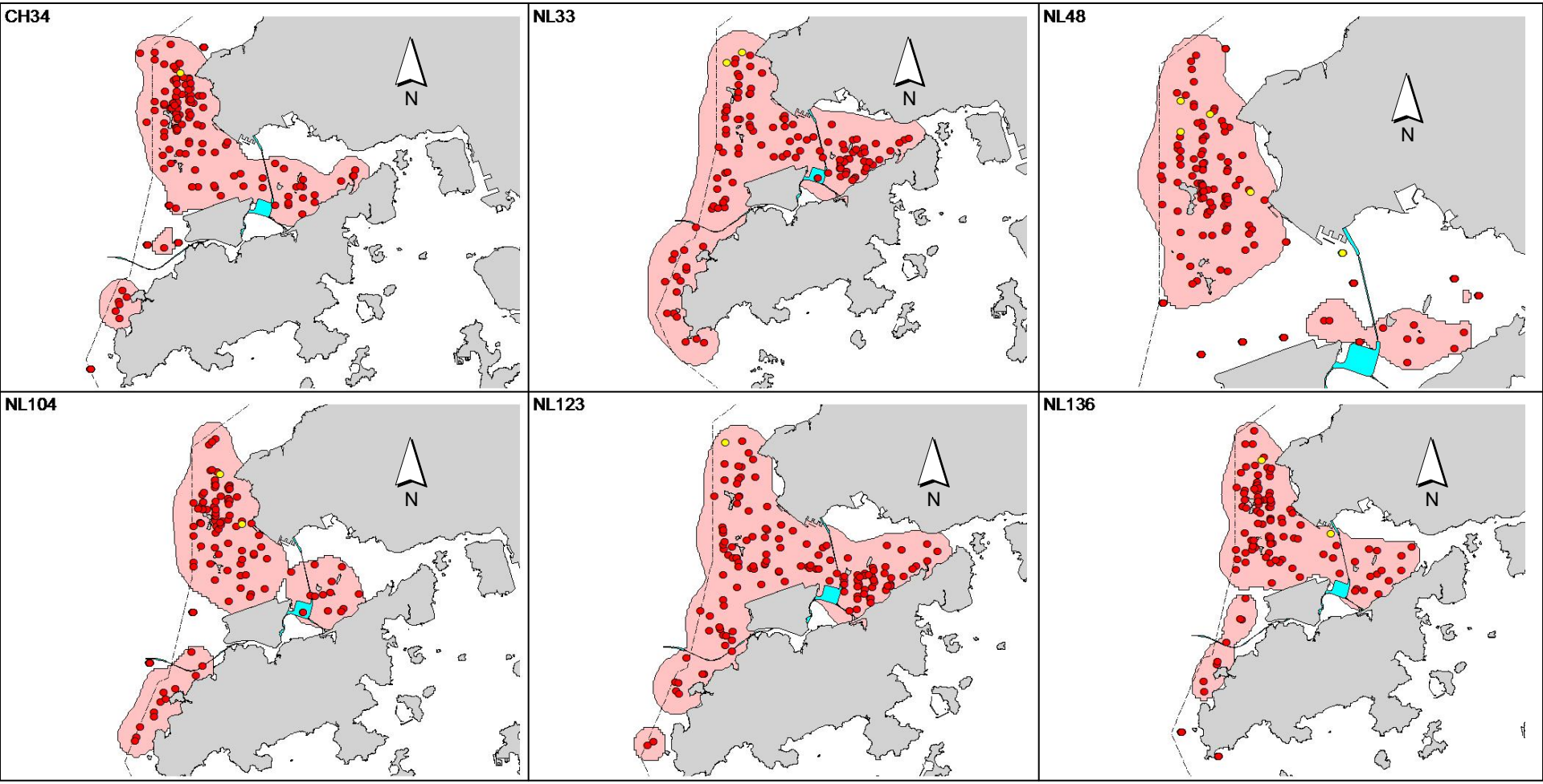
Appendix IV. (cont'd)

Appendix IV. (cont'd)

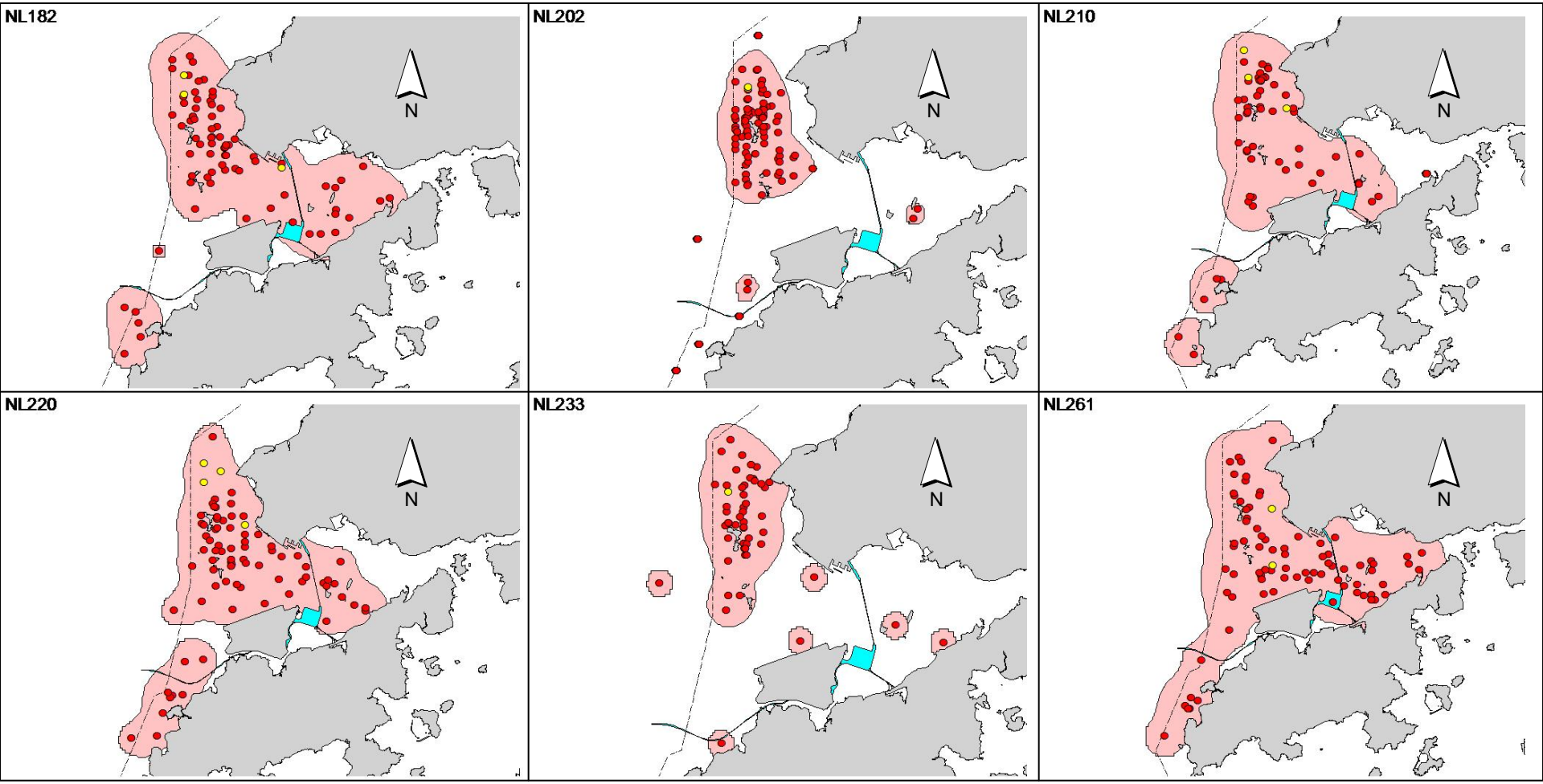


Appendix IV. (cont'd)

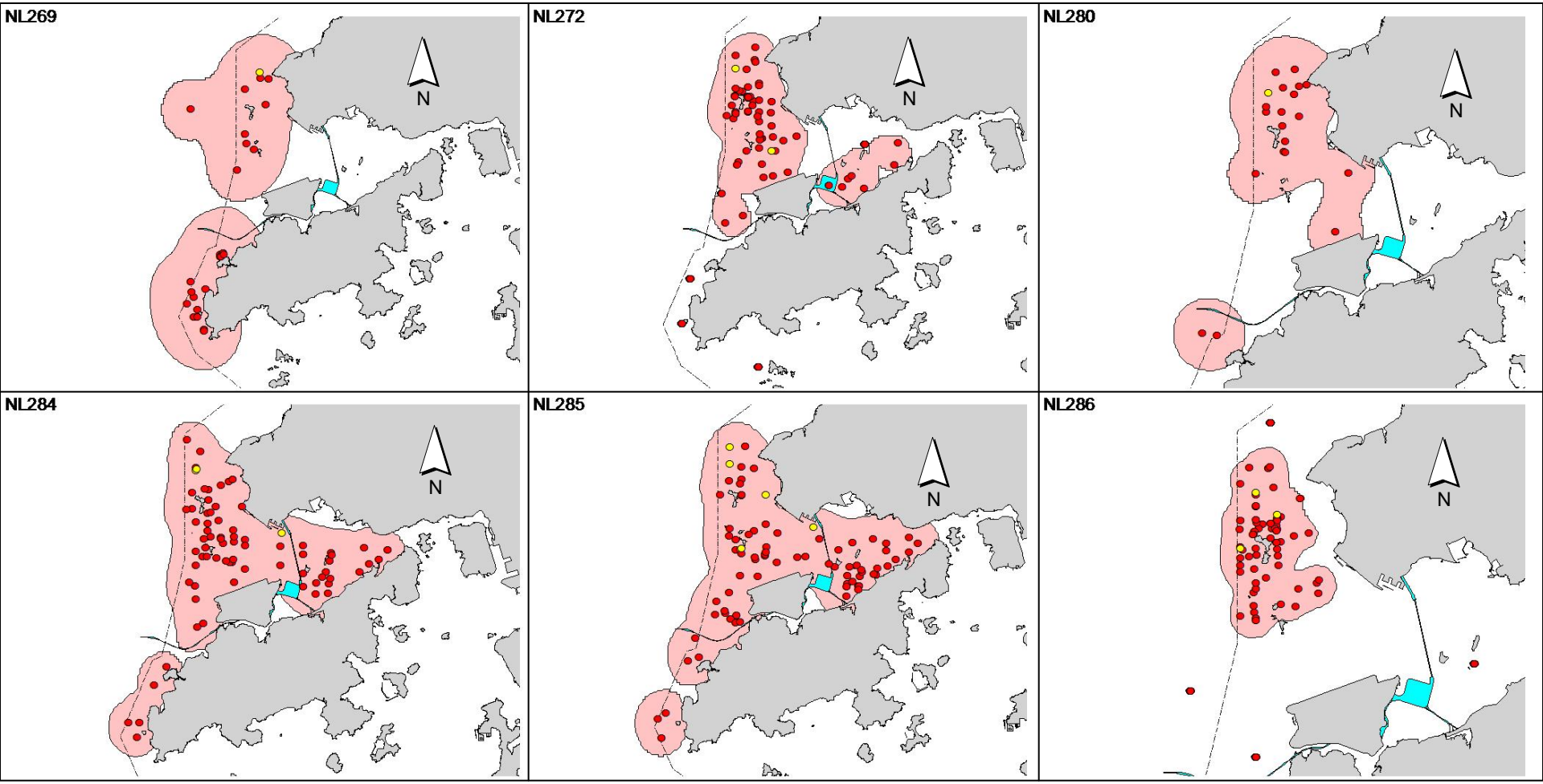
Appendix V. Ranging patterns (95% kernel ranges) of 21 individual dolphins that were sighted during HKLR03 impact phase monitoring period (note: yellow dots indicates sightings made in December 2015 – February 2016)



Appendix V. (cont'd)



Appendix V. (cont'd)



Appendix V. (cont'd)