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

Third Annual Progress Report (November 2015 - October 2016)
submitted to Dragages – Bouygues Joint Venture & ERM Hong Kong Ltd.

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

8 June 2017

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 third annual 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 November 2015 to October 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 of HZMB. The co-ordinates of all transect lines conducted during the HKLR03 dolphin monitoring surveys are shown 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					

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 20 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2015, 2016). 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* or *Steiner* 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.

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. The following analyses were performed utilizing the HKLR03 dolphin monitoring data collected under the present impact phase (the third year of TMCLKL construction; i.e. November 2015 to October 2016). In addition, these analyses were also conducted for the one-year baseline phase (one year before any HZMB construction works have commenced; i.e. February 2011 to January 2012); the one-year transitional phase (one year after the

HZMB construction works (HKBCF and HKLR works) have commenced, but before the commencement of TMCLKL construction works; i.e. November 2012 to October 2013); and the first and second years of TMCLKL construction (i.e. November 2013 to October 2014 & November 2014 to October 2015).

2.3.2. Along with the analyzed results from the baseline and transitional as well as the first and second years of impact phase, results from the third year of impact phase can then be interpreted from the examination of any temporal changes before and during the construction activities of TMCLKL on dolphin usage in North Lantau waters. For the baseline phase, both baseline monitoring data collected under HZMB contract as well as the AFCD long-term dolphin monitoring data were included to increase the sample size in order to match the similar amount of survey effort in transitional and impact phases, both of which only HKLR03 monitoring data were included for the various analyses.

Distribution analysis

2.3.3. 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.

Encounter rate analysis

2.3.4. 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 collected under Beaufort 3 or below condition would be used for the encounter rate analyses. Dolphin encounter rates during the impact phase were calculated in two ways for comparisons with the HZMB baseline and transitional period monitoring results as well as to the AFCD long-term marine mammal monitoring results.

2.3.5. Firstly, for the comparison with the HZMB 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 the 24 events during the present 12-month study period (i.e. 24 sets of line-transect surveys in North Lantau), which was also compared with the ones deduced from the events during the first and second years of impact period as well as the transitional period and baseline period.

2.3.6. Secondly, the encounter rates were also calculated using both primary and secondary survey effort as in AFCD long-term monitoring study. The encounter rate of sightings and dolphins were deduced by diving the total number of on-effort sightings (STG) and total number of dolphins (ANI) by the amount of survey effort for the present 12-month study period.

Quantitative grid analysis on habitat use

2.3.7. 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.

2.3.8. 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).

2.3.9. 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

Behavioural analysis

2.3.10. 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. Sighting distribution 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.

Ranging pattern analysis

2.3.11. Location data of individual dolphins that occurred during the present 12-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 third year of TMCLKL impact phase monitoring (November 2015 to October 2016), a total of 24 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 3,598.07 km of survey effort was collected, with 92.7% 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, 1,373.63 km and 2,224.44 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 2,609.11 km, while the effort on secondary lines was 988.96 km. The survey effort conducted on primary and secondary lines were both considered as on-effort survey data. Summary table of the survey effort is shown in Appendix I.

3.1.4. From the 24 sets of HKLR03 monitoring surveys from November 2015 to October 2016, a total of 45 groups of 168 Chinese White Dolphins were sighted. All except seven dolphin groups were sighted during on-effort search. Among the 38 on-effort sightings, 33 of them were made on primary lines, while the other five dolphin sightings were made on secondary lines.

3.1.5. During this 12-month period, all except one dolphin sighting were made in NWL, and the only rare off-effort sighting made in NEL on June 6th was a lone animal. 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 November 2015 to October 2016 is shown in Figure 1.

3.2.2. Similar to the first and second years of impact phase, the majority of dolphin sightings made during the third year of impact phase were concentrated at the northwestern end of the North Lantau region, mainly to the north of Lung Kwu Chau (Figure 1). Some dolphin groups were also sighted around Lung Kwu Chau and Sha Chau, near Pillar Point and near Shum Wat in NWL, while the lone sighting made in NEL was located in the coastal water between Shum Shui Kok and Yam O (Figure 1).

3.2.3. One dolphin group was sighted adjacent to the northern landfall of TMCLKL construction

site, while none of the dolphin groups were sighted in the vicinity of TMCLKL southern viaduct (Figure 1). Moreover, another sighting was made just to the north of HKBCF, while four sightings were made adjacent to the HKLR09 alignment near Shum Wat (Figure 1).

3.2.4. In general, dolphins appeared to have mostly avoided the construction areas of HZMB works during the present impact phase monitoring period, which was consistent with the dolphin distribution during the first two years of impact phase monitoring.

3.2.5. Dolphin sighting distribution of the present impact phase monitoring period (November 2015 to October 2016) was compared to the ones during the baseline phase (February 2011 to January 2012), the transitional phase (November 2012 to October 2013) and the first and second years of impact phase (November 2013 to October 2014 & November 2014 to October 2015 respectively).

3.2.6. During the present impact phase period in 2015-16, the distribution was largely similar to the previous impact phase period in 2014-15, with dolphins being largely vacated from the NEL survey area and the eastern half of the NWL survey area (Figure 2). This was in stark contrast to their very frequent occurrence around the Brothers Islands, Shum Shui Kok, the waters between Pillar Point and airport platform, and the vicinity of HZMB-associated work sites during the baseline period (Figure 2). Even in the transitional phase, dolphins still utilized these waters in a moderate extent, but such usage has progressively diminished during the three periods of impact phase of TMCLKL construction (Figure 2).

3.2.7. The only area where dolphin occurrence was consistent across the five periods was around the Lung Kwu Chau area, but even so such occurrence there was progressively diminishing in recent years (Figure 2).

3.2.8. Notably, dolphin usage around Lung Kwu Chau reached to a lower point in 2015-16, with only a few dolphin groups sighted at this critical dolphin habitat in the past (Figure 2). Such decline could be related to the recent diversion of high-speed ferry traffic originated from the Airport's Sky Pier, where the ferries have been traversing through the waters to the north of Lung Kwu Chau since late December 2015.

3.3. Encounter rate

3.3.1. During the present 12-month impact phase monitoring period, the average daily encounter rates of Chinese White Dolphins were deduced in NEL and NWL survey areas, and compared to the ones deduced from the baseline, transitional and first year of impact phases (Table 2).

3.3.2. To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present 12-month study period using both primary and secondary survey effort. The encounter rates of sightings (STG) and dolphins (ANI) in NWL were 1.82 sightings and 7.08 dolphins per 100 km of survey effort respectively, while the encounter rates of sightings (STG) and dolphins (ANI) in NEL were both nil with no on-effort sighting being made there in 2015-16.

Table 2. Comparison of average daily dolphin encounter rates from first, second and third years of impact phase, transitional phase and baseline phase monitoring periods (Note: encounter rates deduced from the five periods were calculated based on survey 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)	
	Northeast Lantau	**Northwest Lantau**	**Northeast Lantau**	**Northwest Lantau**
Impact Phase III (2015-16)	0.00	2.10 ± 1.83	0.00	8.54 ± 8.53
Impact Phase II (2014-15)	0.11 ± 0.54	2.54 ± 2.49	0.11 ± 0.54	11.64 ± 14.04
Impact Phase I (2013-14)	0.22 ± 0.74	6.93 ± 4.08	0.76 ± 2.59	26.31 ± 17.56
Transitional Phase (2012-13)	1.70 ± 2.26	7.68 ± 4.36	4.75 ± 7.61	27.51 ± 18.06
Baseline Phase (2011-12)	6.05 ± 5.04	7.75 ± 5.69	19.91 ± 21.30	29.57 ± 26.96

3.3.3. A two-way ANOVA with repeated measures of variance and unequal sample size was conducted to examine whether there were any significant differences in the average encounter rates between the baseline, transitional and the three impact phase periods. The two variables that were examined included the different periods and the two locations (i.e. NEL and NWL).

3.3.4. For the comparison between the different monitoring periods, the p-value for the differences in average dolphin encounter rates of STG and ANI were both 0.000000 and 0.00000 respectively. Even if the alpha value is set at 0.00001, significant differences were detected among the different periods in both dolphin encounter rates of STG and ANI.

3.3.5. In NEL, the dolphin encounter rates (both STG and ANI) in the third year of TMCLKL impact monitoring period were nil, which was a huge contrast to the averages during the baseline phase and transitional phase (Table 2). Such progressive decline has actually existed in this area since the transitional phase (i.e. well before the TMCLKL construction works commenced), with the averages in the transitional phase being much lower than the ones in the baseline phase (reductions of 71.9% for STG and 76.1% respectively). Since then, dolphin occurrence has further diminished to an extremely low level during the first and second years of TMCLKL construction works, and then to complete absence in the third year.

3.3.6. In NWL, the average dolphin encounter rates (STG and ANI) during the present impact phase monitoring period were much lower (reductions of 72.9% and 71.1% respectively) than the ones recorded in the baseline period, indicating a dramatic decline in dolphin usage of this survey area during the third year of TMCLKL impact phase monitoring period (Table 2). Notably, the encounter rates in NWL during the first year of impact

phase (2013-14) were only slightly lower than the baseline period, but such decline has quickly escalated during the second and third years of impact phase, signaling a further widespread of declining usage by the dolphins throughout the entire North Lantau region with no sign of recovery.

3.4. Group size

3.4.1. Group size of Chinese White Dolphins ranged from one to 12 individuals per group in North Lantau region during November 2015 – October 2016. The average dolphin group sizes from the 12-month impact phase monitoring period were compared with the ones deduced from baseline, transitional and first two years of impact phases, as shown in Table 3.

3.4.2. The average dolphin group sizes in the entire North Lantau region as well as in NWL waters during the present impact phase monitoring period were slightly higher than the ones recorded during the baseline and transitional phases, similar to the first year of impact phase, but lower than the second year of impact phase (Table 3). On the other hand, there was only one group of a lone animal found in NEL during the present impact phase monitoring period, and such group size was much lower than the ones during the baseline and transitional phases.

Table 3. Comparison of average dolphin group sizes from the first three years of impact phase, transitional phase and baseline phase monitoring periods (± denotes the standard deviation of the average encounter rates)

	Average Dolphin Group Size		
	Overall	**Northeast Lantau**	**Northwest Lantau**
Impact Phase III (2015-16)	3.73 ± 3.14 (n = 45)	1.00 (n = 1)	3.80 ± 3.14 (n = 44)
Impact Phase II (2014-15)	4.24 ± 3.15 (n = 54)	1.00 (n = 1)	4.30 ± 3.15 (n = 53)
Impact Phase I (2013-14)	3.76 ± 2.57 (n = 136)	5.00 ± 2.71 (n = 4)	3.73 ± 2.57 (n = 132)
Transitional Phase (2012-13)	3.37 ± 2.98 (n = 186)	2.64 ± 2.38 (n = 22)	3.47 ± 3.05 (n = 164)
Baseline Phase (2011-12)	3.32 ± 2.86 (n = 288)	2.80 ± 2.35 (n = 79)	3.52 ± 3.01 (n = 209)

3.4.3. Among the 45 dolphin groups sighted during the impact phase, 29 of them were composed of 1-4 individuals only, while there were only four dolphin groups with more than 10 individuals (Appendix II).

3.4.4. Distribution of dolphins with larger group sizes (i.e. five individuals or more per group) during the present impact phase is shown in Figure 3, with comparison to the ones in the first two years of impact phase, transitional phase and baseline phase. During the impact phase in 2015-16, distribution of the larger dolphin groups were mainly concentrated at the northwestern portion of the North Lantau waters (Figure 3).

3.4.5. Notably, throughout the three impact phases, distribution of these larger groups has been restricted to the northwestern portion of North Lantau region. Such restriction was drastically different from the baseline phase, when the larger dolphin groups were distributed more evenly in NWL waters with many also sighted in NEL waters (Figure 3).

3.5. Habitat use

3.5.1. During the impact phase monitoring period in 2015-16, the most heavily utilized habitat by Chinese White Dolphins was only found around Lung Kwu Chau (Figures 4a and 4b). For the rest of North Lantau region, only a handful of grids to the west of Sha Chau, around Sha Chau, near HKLR09 alignment and near the northern landfall of TMCLKL have recorded low to moderately low dolphin densities (Figures 4a and 4b). Moreover, all grids near the reclamation sites of HKLR03 and HKBCF projects sites did not record any presence of dolphins in the present 12-month impact monitoring period in 2015-16 (Figures 4a and 4b).

3.5.2. When compared with the habitat use patterns during the baseline phase, dolphin usage in NEL has progressively diminished during the transitional phase and the three periods of impact phases (Figure 5). During the baseline period, a number of grids between Siu Mo To and Shum Shui Kok recorded moderately high to high dolphin densities, and most grids in NEL recorded dolphin usage. This was in stark contrast to the complete absence of dolphin in this area during the present impact phase period (Figure 5).

3.5.3. Moreover, dolphin usage of NWL waters also declined dramatically during the present impact phase monitoring period, with the only higher densities occurred right around the Lung Kwu Chau area, in contrast to a more evenly spread usage in NWL during the baseline phase, transitional phase and first year of impact phase monitoring (Figure 5). It appeared that there was a more widespread decline of dolphin usage throughout the North Lantau waters in the second and third years of the impact phase.

3.6. Mother-calf pairs

3.6.1. During the present 12-month impact phase monitoring period, no young calves were sighted at all with their mothers in North Lantau waters. This was drastically different from the regular occurrence of young calves in North Lantau region during the baseline phase, transitional phase and the first year of impact phase monitoring (Figure 6).

3.7. Activities and associations with fishing boats

3.7.1. Five and four dolphin sightings were associated with feeding and socializing activities respectively during the 12-month impact phase monitoring period. The percentage of sightings associated with feeding activities during the present impact phase (11.1%) was higher than the impact phase in 2013-14 (5.9%) and transitional phase (8.6%), but lower than the previous impact phase in 2014-15 (18.5%) and baseline phase (12.8%).

3.7.2. On the contrary, the percentage of socializing activities during the present impact phase monitoring period (8.9%) was higher than the first two years of impact phases (5.5% in 2014-15 and 5.9% in 2013-14), as well as the baseline period (3.8%) and transitional period (6.4%). Notably, only one of the 45 dolphin groups was engaged in traveling

activity, while none of these groups was engaged in resting activity during the present impact phase monitoring period in 2015-16.

3.7.3. Distribution of dolphins engaged in feeding, socializing and traveling activities during the present impact phase monitoring period is shown in Figure 7. The five dolphin groups associated with feeding activities occurred near Lung Kwu Chau and Sha Chau as well as adjacent to HKLR09 alignment near Shum Wat, while the four dolphin groups associated with socializing activities were located to the north of Lung Kwu Chau, near the northern landfall of TMCLKL as well as adjacent to the HKLR09 alignment (Figure 7).

3.7.4. In contrast, during the baseline phase, feeding activities were frequently sighted along the Urmston Road, within the marine park, to the west of airport platform and around the Brothers Islands, while the socializing activities were more scattered throughout the North Lantau region in the same period as well as in the transitional phase (Figure 7). It is apparent that the "hotspots" where dolphins engaged in different activities were considerably different between the baseline, transitional and impact phases.

3.7.5. Notably, none of the 45 dolphin groups sighted during the impact phase monitoring period in 2015-16 was found to be associated with any operating fishing vessel. The extremely rare event of fishing boat association during the three periods of impact phase as well as the transitional phase was quite different from the baseline period with 14 of 288 dolphin groups associated with fishing boats.

3.8. Summary of photo-identification works

3.8.1. During the 12-month impact phase monitoring period in 2015-16, a total of 42 individuals sighted 118 times altogether were identified (see Appendix III). All of these re-sightings were made in NWL, while the lone individual sighted in NEL was not identified.

3.8.2. Nearly two-thirds of the 42 identified individuals were sighted only once or twice, while the rest were sighted more frequently during the 12-month period. For example, seven individuals were sighted more than five to nine times (NL136, NL182, NL202, NL210, NL285, NL286 and NL320), while one individual (NL48) were sighted ten times during the HKLR03 surveys in 2015-16. Their frequent occurrences during the third year of impact phase monitoring indicated strong reliance of NWL waters as their home ranges.

3.8.3. Notably, five recognized females (i.e. NL33, NL104, NL202, NL233 and NL264) were accompanied with their calves during their re-sightings, and all of these calves are older and already in their juvenile stage. For example, the calves of NL264 (i.e. NL288) and NL202 (i.e. NL286) have been accompanying their mothers for over 7-8 years.

3.9. Individual range use

3.9.1. Ranging patterns of the 42 individuals identified during the 12-month impact phase monitoring period in 2015-16 were determined by fixed kernel method, and are shown in Appendix IV.

3.9.2. Almost all identified dolphins sighted within this 12-month period were utilizing their ranges primarily in NWL (with the exception of NL293 and WL243), while 16 of them

have extended their range use to West Lantau waters (e.g. NL104, NL136, NL210, NL302) based on the HKLR09 monitoring data collected concurrently during the same 12-month period. All of these identified dolphins have avoided the NEL waters (Appendix IV), the area where many of them have utilized as their core areas of activities in the past.

3.9.3. Temporal changes in range use of 31 individual dolphins that ranged across different survey areas in North, West and South Lantau waters were examined in details during baseline phase, transitional phase and three periods of impact phases (Appendix V). It is apparent that 17 of them (e.g. CH34, NL33, NL210, NL259) have gradually shifted their range use away from their previously important habitat in NEL in the past few years, and have been completely absent from there in the present impact phase (Appendix V).

3.9.4. Moreover, 20 individual dolphins have gradually diminished their utilization of NWL waters during the TMCLKL impact phases, and at the same time all of them (e.g. NL98, NL261, NL287, NL302) have increased their utilization of WL waters, apparently expanding their range use into West Lantau waters (Appendix V). Six individuals (NL33, NL120, NL123, NL224, NL269 and NL287) have even expanded their range use to Southwest Lantau waters as well during the past two periods of impact phase (Appendix V).

3.9.5. Notably, while some individuals have expanded their range use in WL and diminished their range use in NWL, ten individuals (e.g. NL103, NL264, WL17) have utilized waters of Hong Kong generally less during the past two impact phase periods (Appendix V). This corresponded well with a much lower dolphin encounter rate in NWL in 2014-15 and 2015-16 impact phase periods as examined in Section 3.3.4.

3.9.7. The apparent range shifts of many identified individual dolphins examined above were also documented in Hung (2016), and such shifts could be related to the disturbance of construction activities and other existing threats in the North Lantau region. This should be continuously monitored for the rest of the TMCLKL impact phase monitoring period to determine whether such range shifts are temporary or permanent, and whether the dolphins would continue the North Lantau waters once the HZMB-related construction works have completed.

4. Conclusion

4.1. During the third year of TMCLKL impact phase monitoring of Chinese white dolphins, no adverse impact from the activities of the TMCLKL construction project on the 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 for the rest of the impact phase monitoring period, 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

- 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. 2013. Monitoring of Marine Mammals in Hong Kong waters: final report (2012-13). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 168 pp.

- Hung, S. K. 2014. Monitoring of marine mammals in Hong Kong waters – data collection: final report (2013-14). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government, 231 pp.

- Hung, S. K. 2015. Monitoring of marine mammals in Hong Kong waters – data collection: final report (2014-15). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government, 198 pp.

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

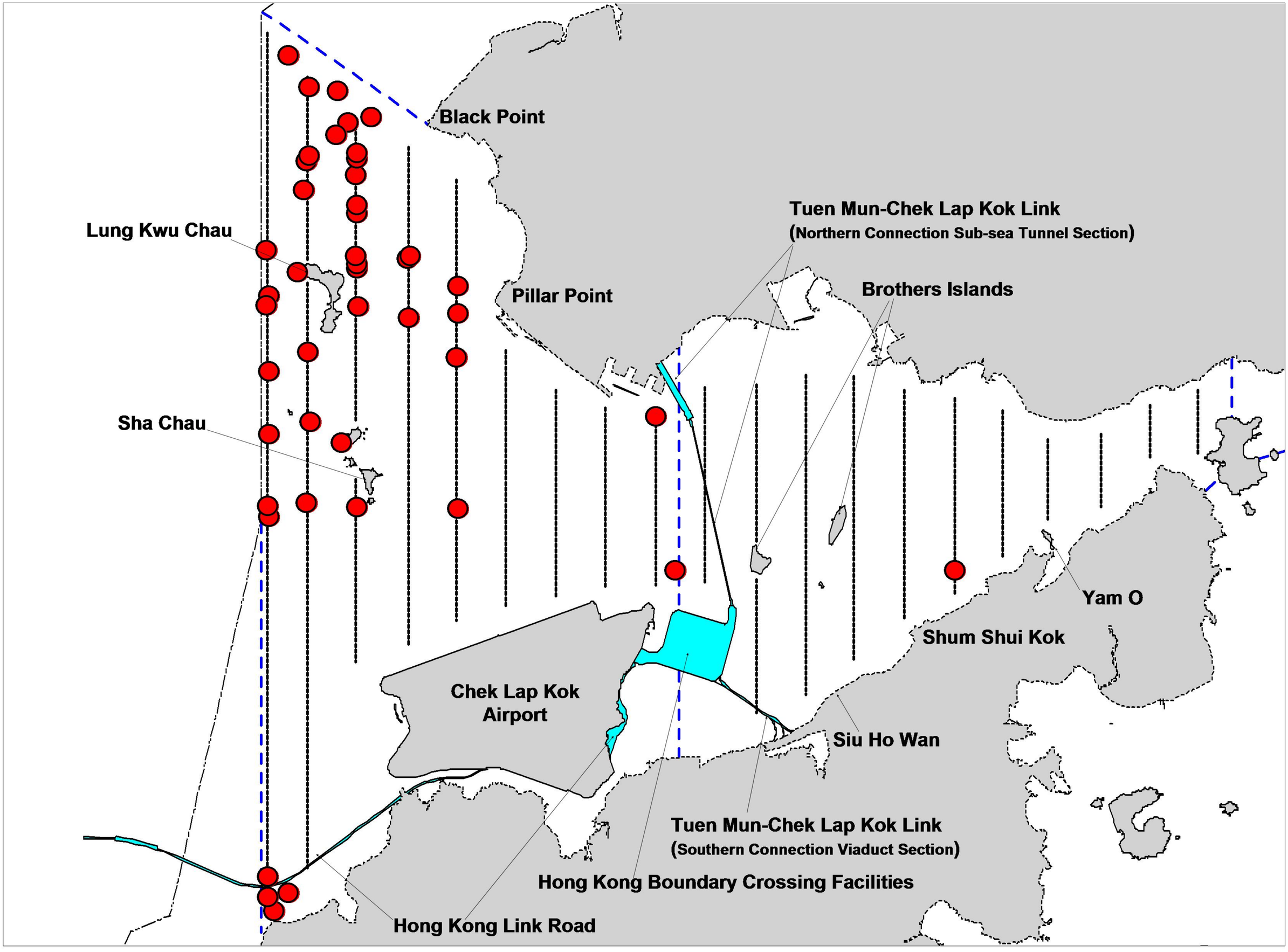


Figure 1. Distribution of Chinese white dolphin sightings in North Lantau region during the third year of TMCLKL construction works (November 2015 to October 2016), utilizing the HKLR03 monitoring data

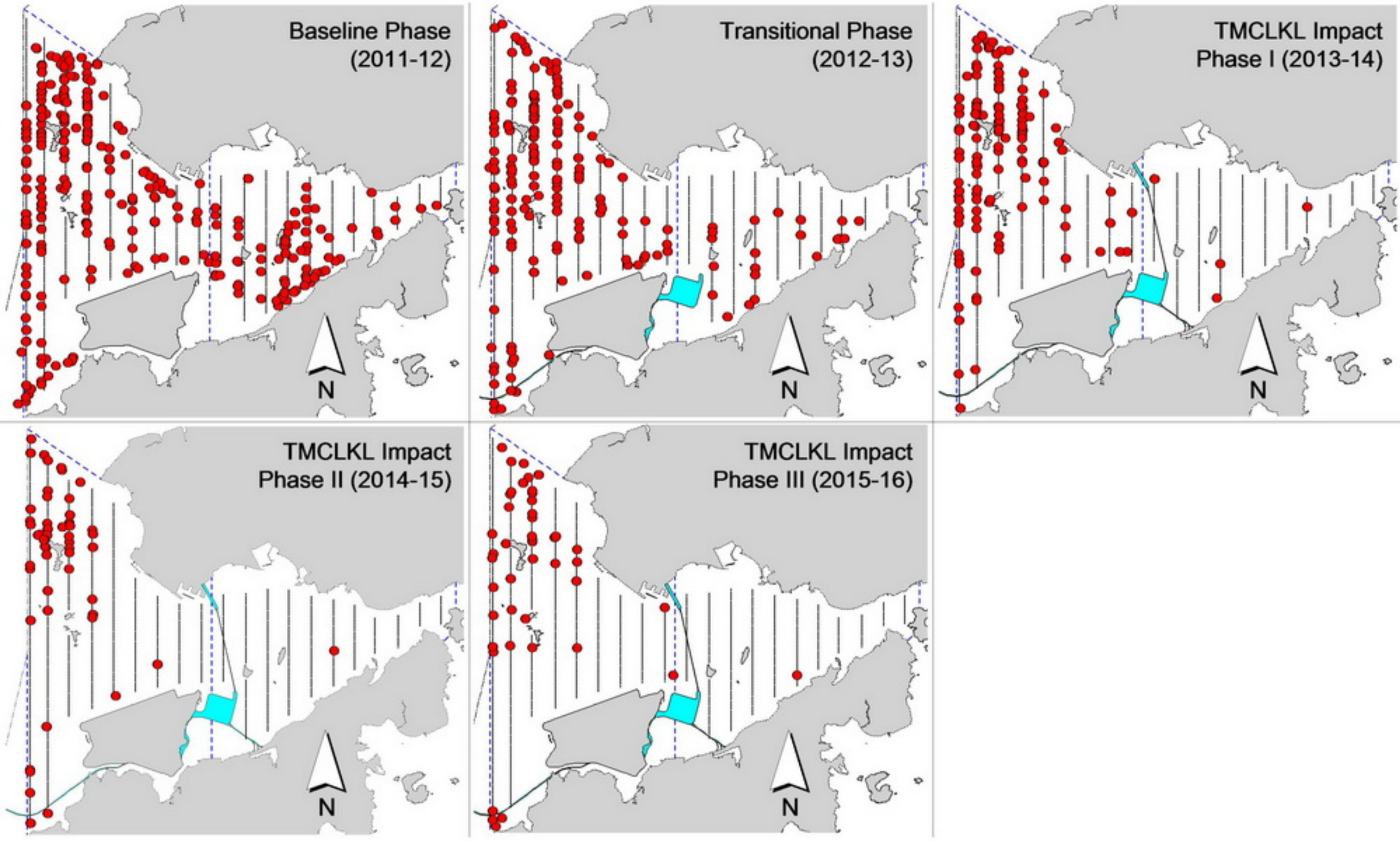
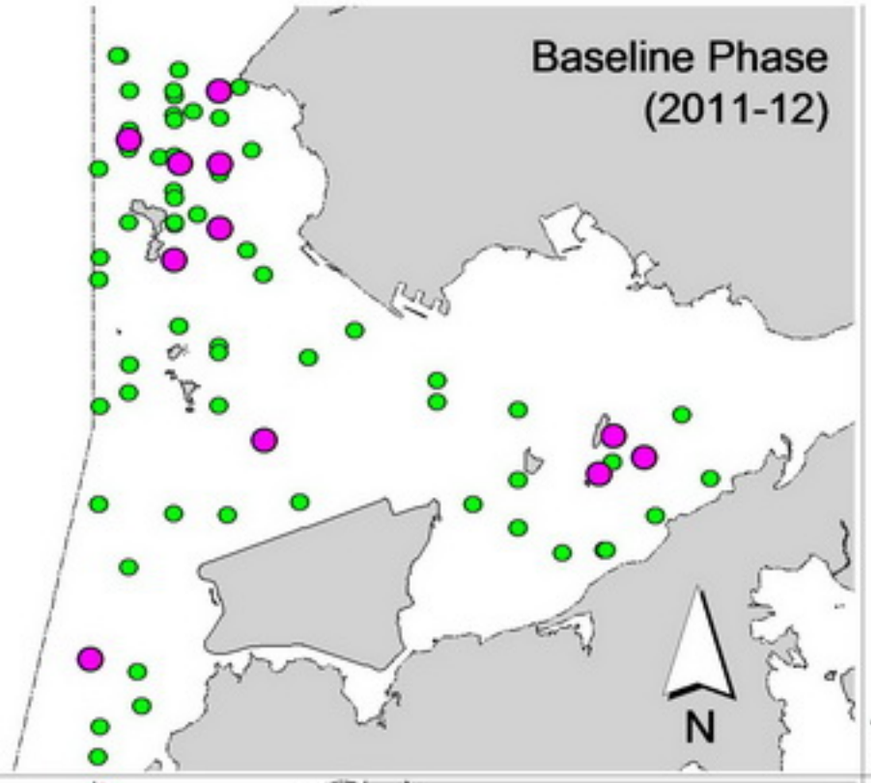
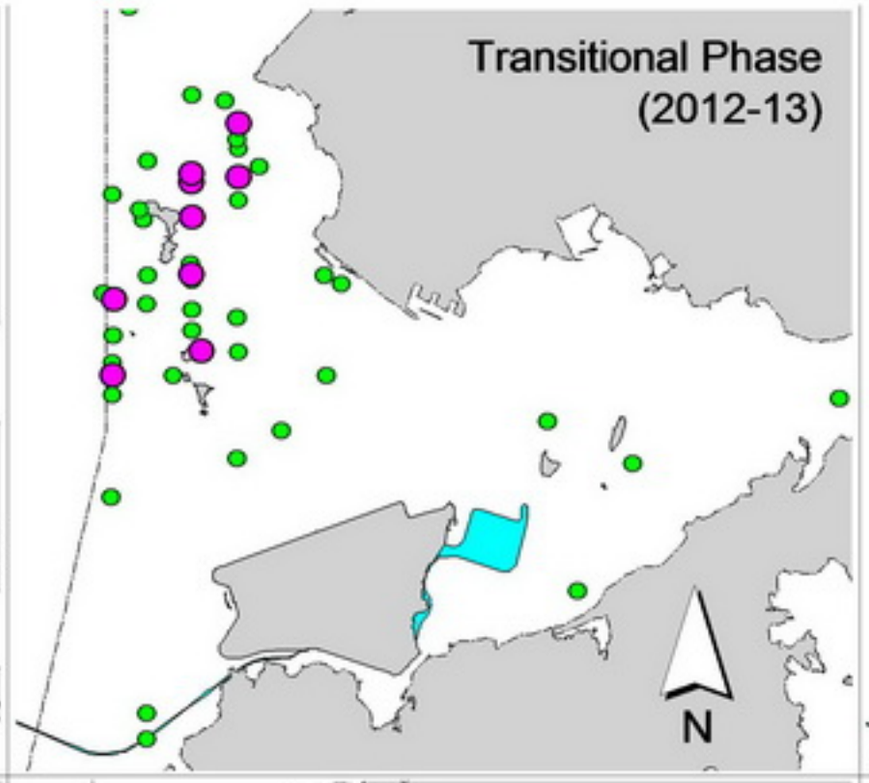
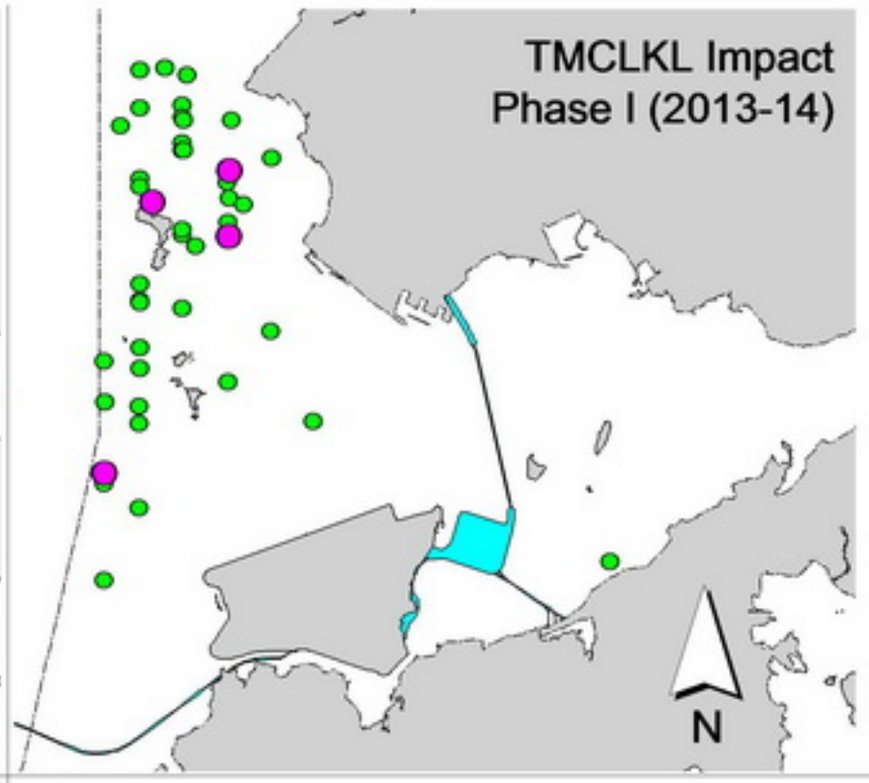
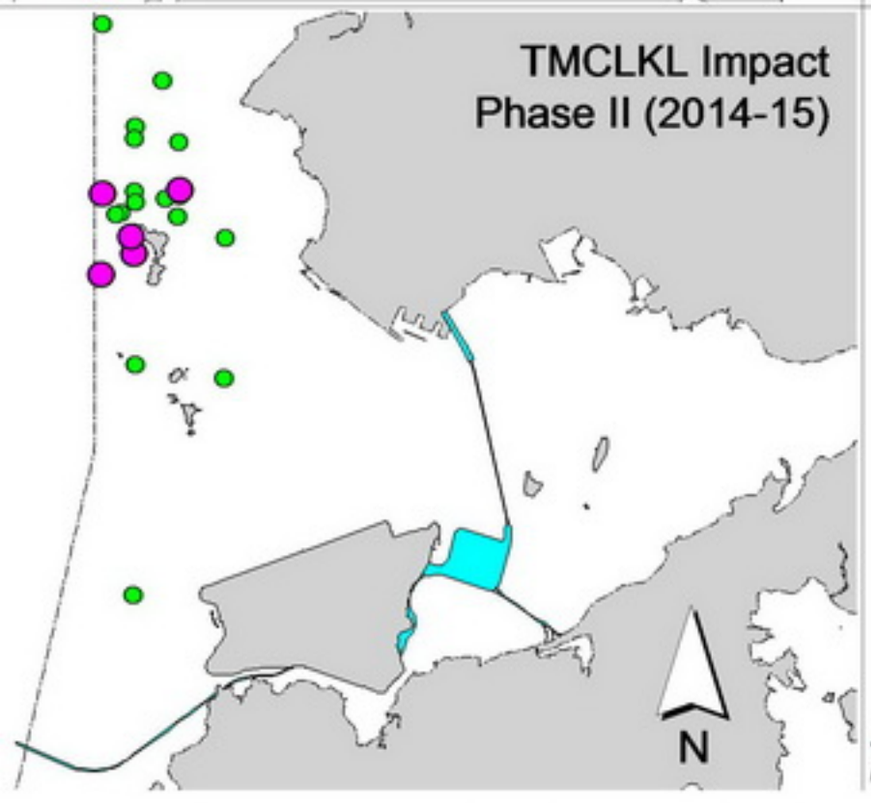


Figure 2. A comparison on distribution of Chinese white dolphin sightings in North Lantau region during the baseline, transitional and three impact phases of TMCLKL construction works









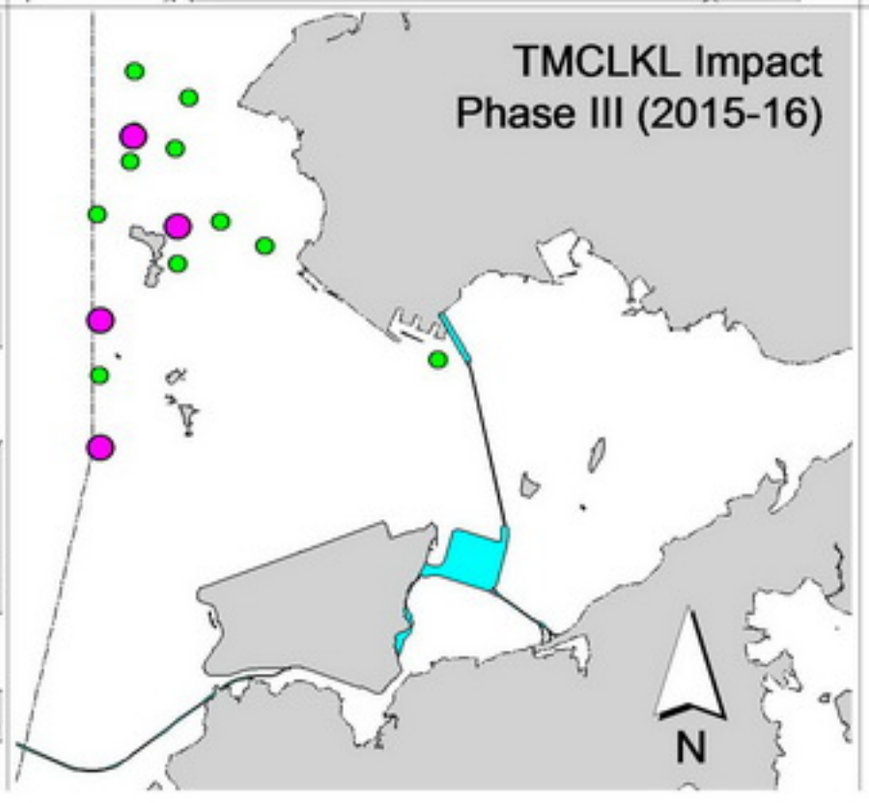


Figure 3. Distribution of dolphins with larger group sizes during different phases of TMCLKL construction works (green dots: group sizes of 5 or more; purple dots: group sizes of 10 or more)

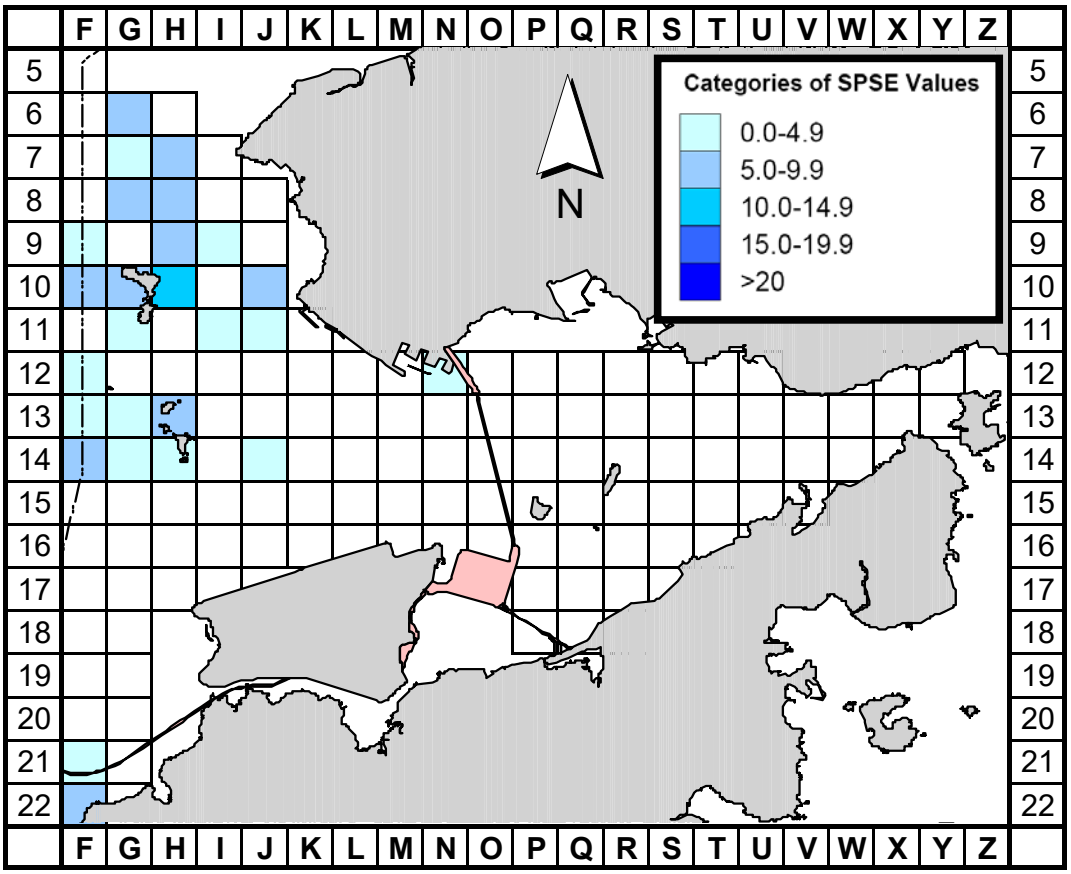


Figure 4a. Sighting density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during HKLR03 impact monitoring period monitoring period (Nov15 - Oct16) (SPSE = no. of on-effort sightings per 100 units of survey effort)

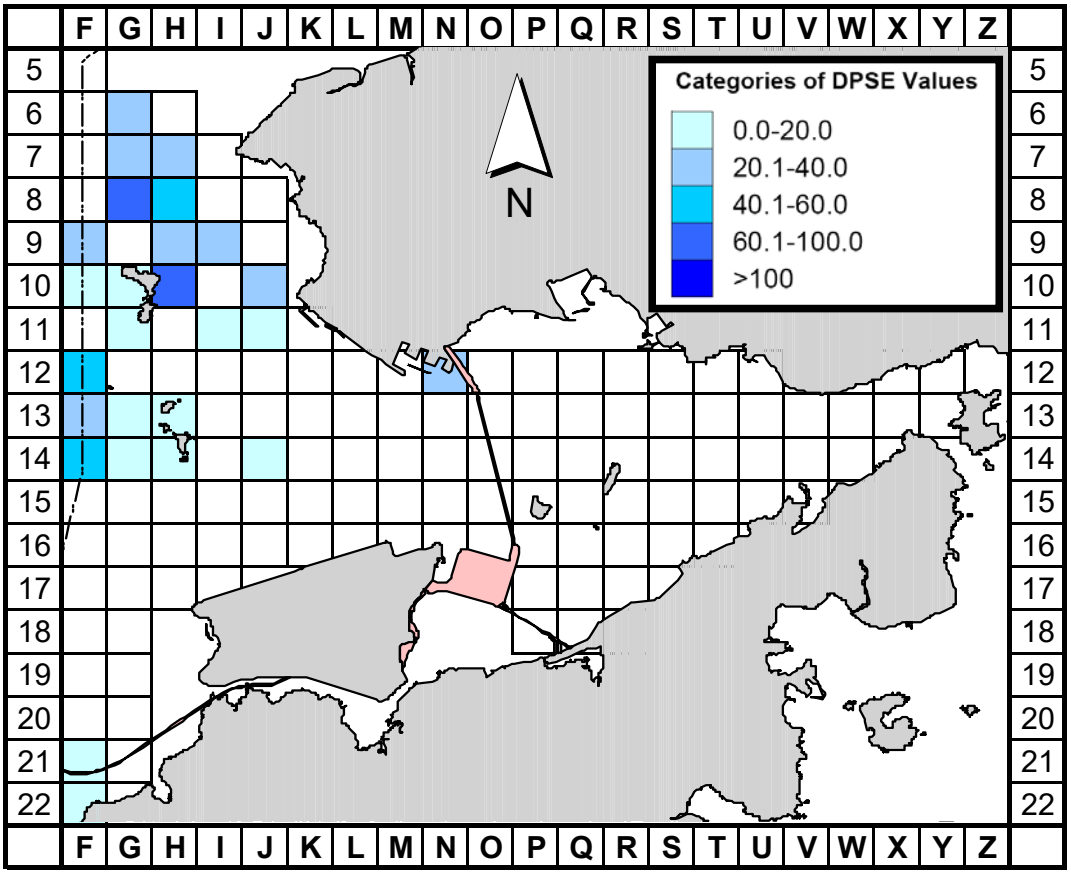


Figure 4b. Density of Chinese white dolphins with corrected survey effort per km^2 in Northeast and Northwest Lantau survey areas, using data collected during HKLR03 impact monitoring period (Nov15 -Oct16) (DPSE = no. of dolphins per 100 units of survey effort)

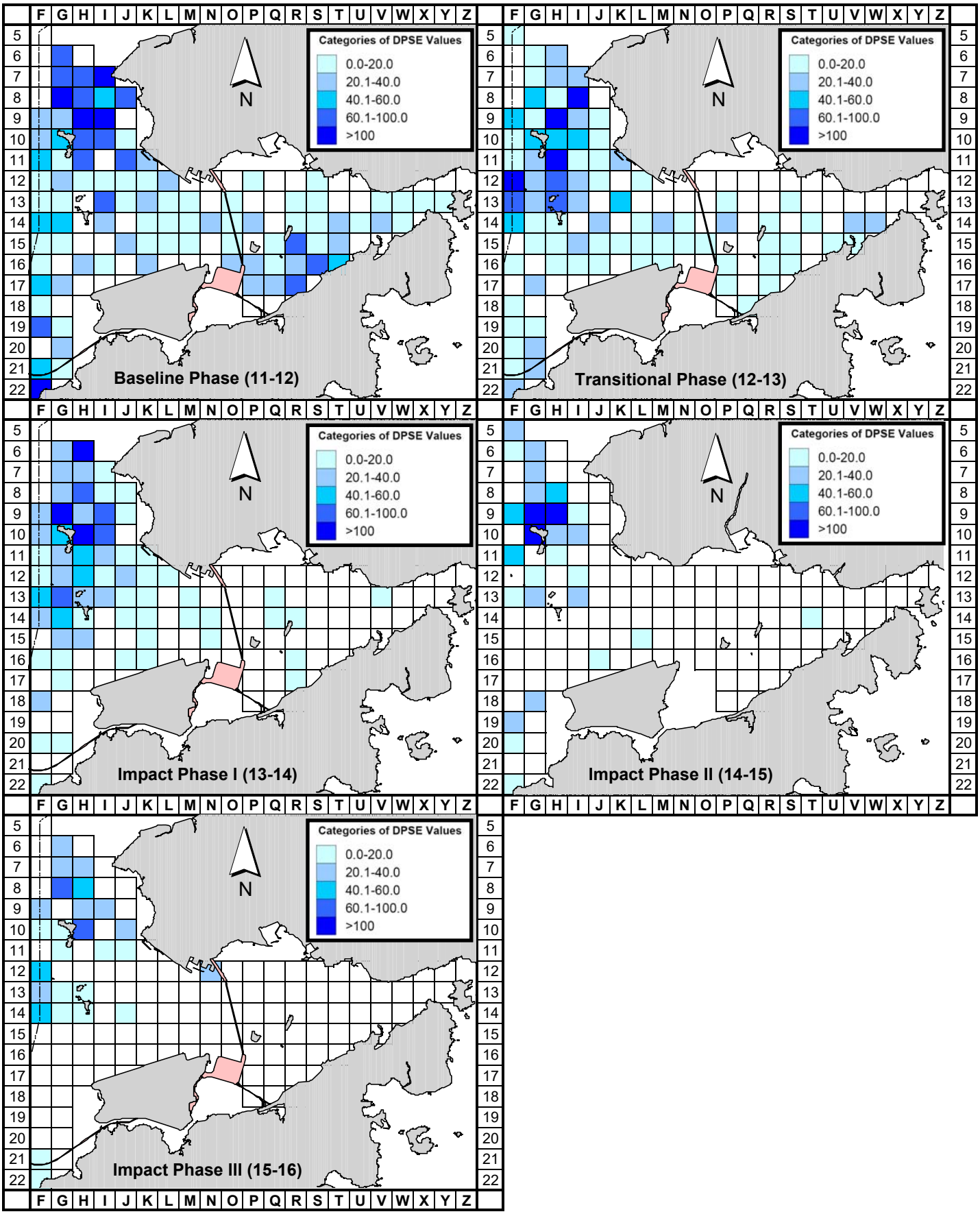


Figure 5. Comparison of density of Chinese white dolphins with corrected survey effort per km^2 in NWL and NEL survey areas between the three impact phases (Nov15-Oct16, Nov14-Oct15 and Nov13-Oct14), transitional phase (Nov12-Oct13) and baseline phase (Feb11-Jan12) monitoring periods (DPSE = no. of dolphins per 100 units of survey effort)

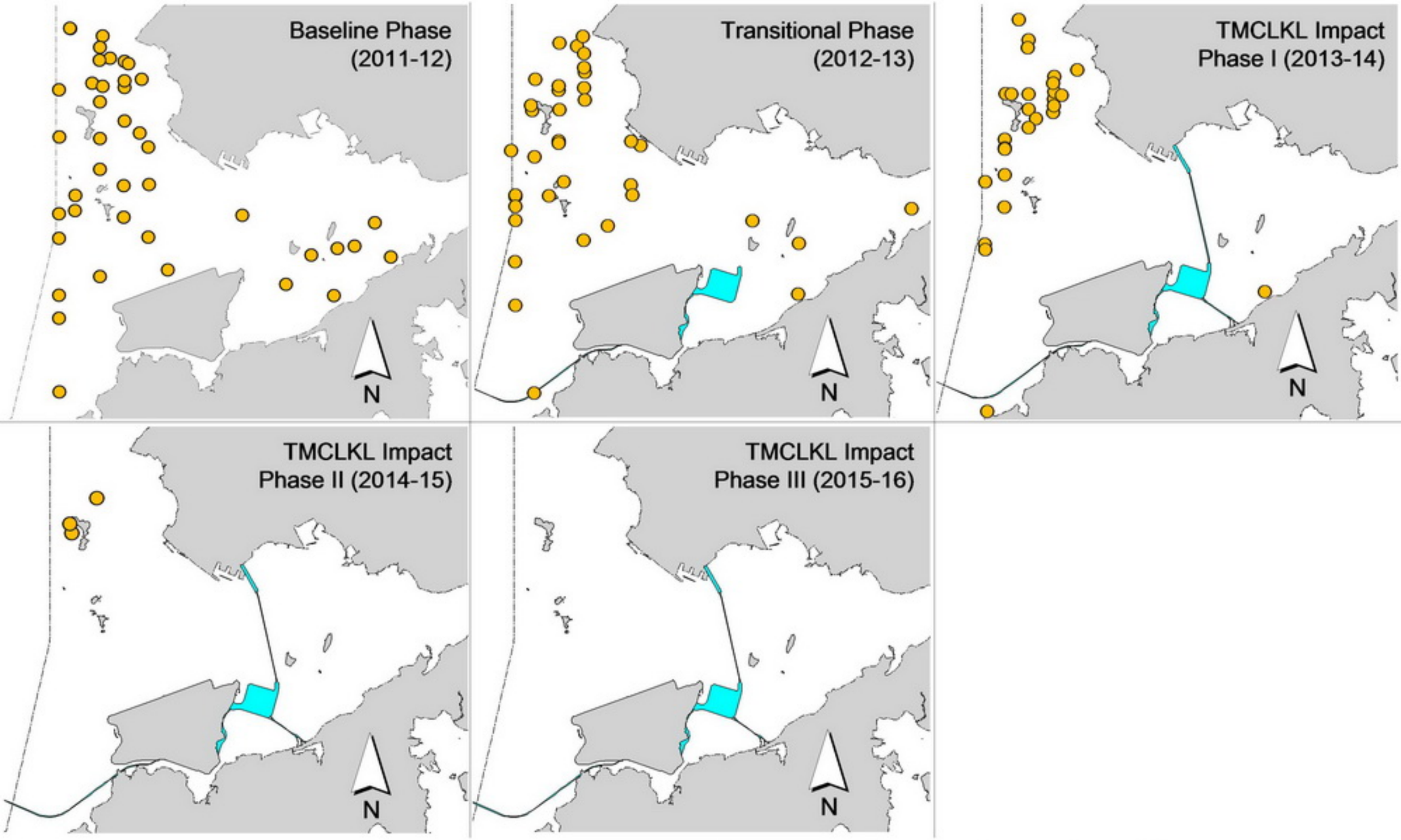


Figure 6. Distribution of young calves of Chinese white dolphins during different phases of TMCLKL construction works

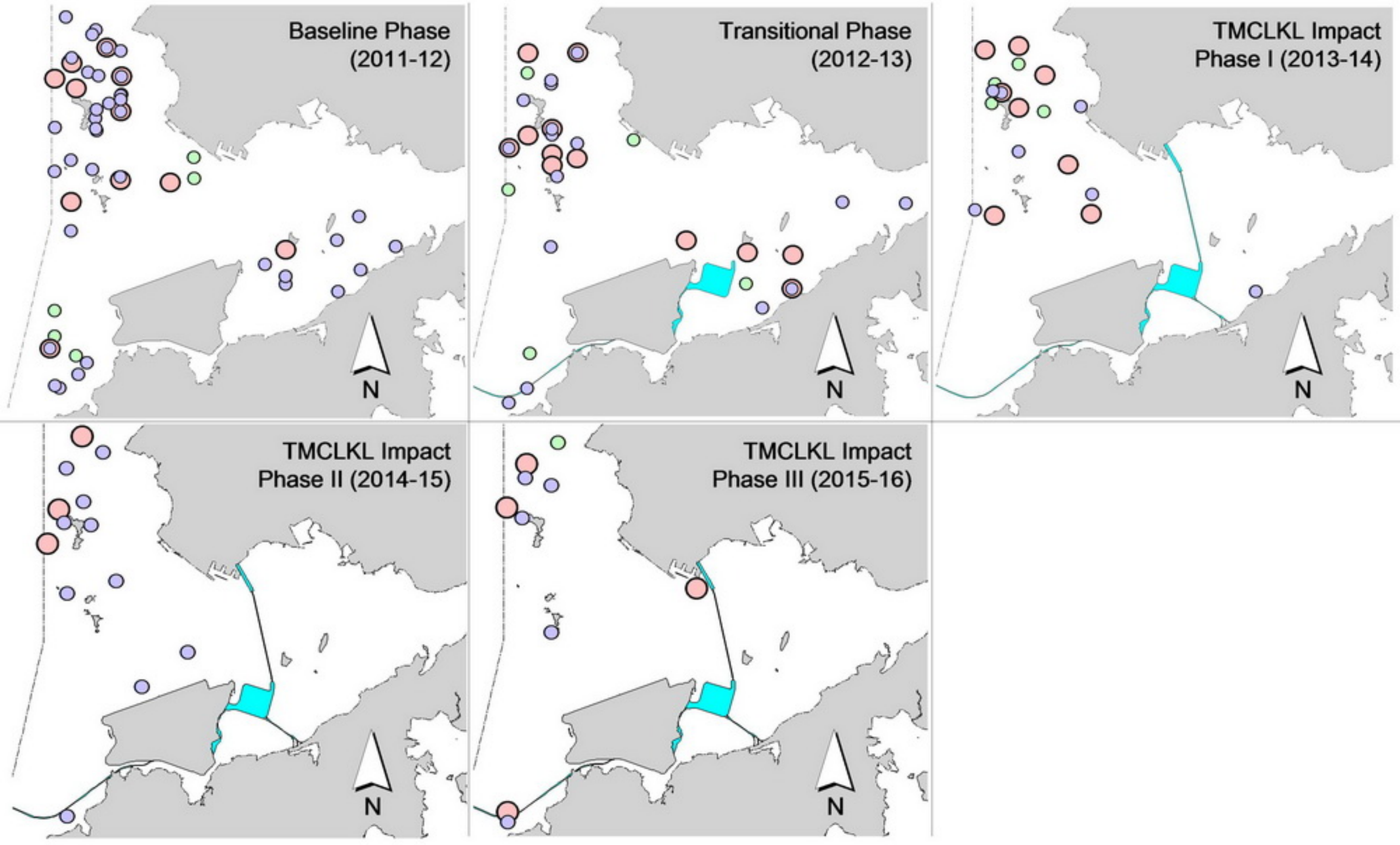


Figure 7. Distribution of dolphins engaged in feeding (purple dots), socializing (pink dots) and traveling (green dots) activities during different phases of TMCLKL construction works

Appendix I. HKLR03 Survey Effort Database (November 2015 - October 201

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
2-Nov-15	NW LANTAU	2	6.50	AUTUMN	STANDARD31516	HKLR	P
2-Nov-15	NW LANTAU	3	27.18	AUTUMN	STANDARD31516	HKLR	P
2-Nov-15	NW LANTAU	4	7.13	AUTUMN	STANDARD31516	HKLR	P
2-Nov-15	NW LANTAU	2	2.30	AUTUMN	STANDARD31516	HKLR	S
2-Nov-15	NW LANTAU	3	7.55	AUTUMN	STANDARD31516	HKLR	S
2-Nov-15	NW LANTAU	4	2.74	AUTUMN	STANDARD31516	HKLR	S
2-Nov-15	NE LANTAU	2	14.92	AUTUMN	STANDARD31516	HKLR	P
2-Nov-15	NE LANTAU	3	1.70	AUTUMN	STANDARD31516	HKLR	P
2-Nov-15	NE LANTAU	2	7.98	AUTUMN	STANDARD31516	HKLR	S
2-Nov-15	NE LANTAU	3	2.40	AUTUMN	STANDARD31516	HKLR	S
6-Nov-15	NW LANTAU	3	18.35	AUTUMN	STANDARD31516	HKLR	P
6-Nov-15	NW LANTAU	4	13.86	AUTUMN	STANDARD31516	HKLR	P
6-Nov-15	NW LANTAU	3	6.79	AUTUMN	STANDARD31516	HKLR	S
6-Nov-15	NE LANTAU	2	5.90	AUTUMN	STANDARD31516	HKLR	P
6-Nov-15	NE LANTAU	3	14.15	AUTUMN	STANDARD31516	HKLR	P
6-Nov-15	NE LANTAU	2	6.70	AUTUMN	STANDARD31516	HKLR	S
6-Nov-15	NE LANTAU	3	3.95	AUTUMN	STANDARD31516	HKLR	S
10-Nov-15	NW LANTAU	2	2.44	AUTUMN	STANDARD31516	HKLR	P
10-Nov-15	NW LANTAU	3	27.80	AUTUMN	STANDARD31516	HKLR	P
10-Nov-15	NW LANTAU	4	0.98	AUTUMN	STANDARD31516	HKLR	P
10-Nov-15	NW LANTAU	2	0.28	AUTUMN	STANDARD31516	HKLR	S
10-Nov-15	NW LANTAU	3	6.23	AUTUMN	STANDARD31516	HKLR	S
10-Nov-15	NW LANTAU	4	1.30	AUTUMN	STANDARD31516	HKLR	S
10-Nov-15	NE LANTAU	2	9.09	AUTUMN	STANDARD31516	HKLR	P
10-Nov-15	NE LANTAU	3	10.38	AUTUMN	STANDARD31516	HKLR	P
10-Nov-15	NE LANTAU	2	8.03	AUTUMN	STANDARD31516	HKLR	S
10-Nov-15	NE LANTAU	3	2.70	AUTUMN	STANDARD31516	HKLR	S
16-Nov-15	NE LANTAU	2	5.26	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NE LANTAU	3	12.22	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NE LANTAU	2	7.72	AUTUMN	STANDARD31516	HKLR	S
16-Nov-15	NE LANTAU	3	2.10	AUTUMN	STANDARD31516	HKLR	S
16-Nov-15	NW LANTAU	2	6.48	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NW LANTAU	3	21.03	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NW LANTAU	4	9.27	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NW LANTAU	5	4.10	AUTUMN	STANDARD31516	HKLR	P
16-Nov-15	NW LANTAU	2	2.53	AUTUMN	STANDARD31516	HKLR	S
16-Nov-15	NW LANTAU	3	7.79	AUTUMN	STANDARD31516	HKLR	S
16-Nov-15	NW LANTAU	4	2.60	AUTUMN	STANDARD31516	HKLR	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

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
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
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

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
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
7-Mar-16	NW LANTAU	1	18.42	SPRING	STANDARD31516	HKLR	P
7-Mar-16	NW LANTAU	2	10.78	SPRING	STANDARD31516	HKLR	P
7-Mar-16	NW LANTAU	3	10.30	SPRING	STANDARD31516	HKLR	P
7-Mar-16	NW LANTAU	1	2.50	SPRING	STANDARD31516	HKLR	S
7-Mar-16	NW LANTAU	2	3.70	SPRING	STANDARD31516	HKLR	S
7-Mar-16	NW LANTAU	3	6.70	SPRING	STANDARD31516	HKLR	S
7-Mar-16	NE LANTAU	2	16.44	SPRING	STANDARD31516	HKLR	P
7-Mar-16	NE LANTAU	2	10.46	SPRING	STANDARD31516	HKLR	S
11-Mar-16	NW LANTAU	2	15.40	SPRING	STANDARD31516	HKLR	P
11-Mar-16	NW LANTAU	3	16.20	SPRING	STANDARD31516	HKLR	P
11-Mar-16	NW LANTAU	2	7.60	SPRING	STANDARD31516	HKLR	S
11-Mar-16	NW LANTAU	3	0.30	SPRING	STANDARD31516	HKLR	S
11-Mar-16	NE LANTAU	1	2.04	SPRING	STANDARD31516	HKLR	P
11-Mar-16	NE LANTAU	2	17.97	SPRING	STANDARD31516	HKLR	P
11-Mar-16	NE LANTAU	1	2.40	SPRING	STANDARD31516	HKLR	S
11-Mar-16	NE LANTAU	2	6.19	SPRING	STANDARD31516	HKLR	S
11-Mar-16	NE LANTAU	3	2.20	SPRING	STANDARD31516	HKLR	S
22-Mar-16	NE LANTAU	2	7.42	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NE LANTAU	3	27.44	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NE LANTAU	4	2.30	SPRING	STANDARD31516	HKLR	P

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
22-Mar-16	NE LANTAU	2	5.86	SPRING	STANDARD31516	HKLR	S
22-Mar-16	NE LANTAU	3	8.18	SPRING	STANDARD31516	HKLR	S
22-Mar-16	NE LANTAU	4	0.40	SPRING	STANDARD31516	HKLR	S
22-Mar-16	NW LANTAU	2	3.59	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NW LANTAU	3	9.39	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NW LANTAU	4	8.10	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NW LANTAU	5	2.40	SPRING	STANDARD31516	HKLR	P
22-Mar-16	NW LANTAU	2	1.40	SPRING	STANDARD31516	HKLR	S
22-Mar-16	NW LANTAU	3	5.12	SPRING	STANDARD31516	HKLR	S
23-Mar-16	NW LANTAU	2	27.12	SPRING	STANDARD31516	HKLR	P
23-Mar-16	NW LANTAU	3	22.69	SPRING	STANDARD31516	HKLR	P
23-Mar-16	NW LANTAU	2	4.11	SPRING	STANDARD31516	HKLR	S
23-Mar-16	NW LANTAU	3	5.20	SPRING	STANDARD31516	HKLR	S
5-Apr-16	NW LANTAU	0	0.83	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NW LANTAU	1	5.38	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NW LANTAU	2	21.07	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NW LANTAU	3	13.64	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NW LANTAU	2	3.00	SPRING	STANDARD31516	HKLR	S
5-Apr-16	NW LANTAU	3	10.08	SPRING	STANDARD31516	HKLR	S
5-Apr-16	NE LANTAU	1	1.60	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NE LANTAU	2	15.44	SPRING	STANDARD31516	HKLR	P
5-Apr-16	NE LANTAU	1	2.10	SPRING	STANDARD31516	HKLR	S
5-Apr-16	NE LANTAU	2	8.06	SPRING	STANDARD31516	HKLR	S
12-Apr-16	NE LANTAU	2	3.81	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NE LANTAU	3	13.73	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NE LANTAU	4	2.60	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NE LANTAU	2	4.20	SPRING	STANDARD31516	HKLR	S
12-Apr-16	NE LANTAU	3	6.46	SPRING	STANDARD31516	HKLR	S
12-Apr-16	NW LANTAU	3	4.57	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NW LANTAU	4	25.36	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NW LANTAU	5	1.90	SPRING	STANDARD31516	HKLR	P
12-Apr-16	NW LANTAU	3	5.97	SPRING	STANDARD31516	HKLR	S
12-Apr-16	NW LANTAU	4	2.10	SPRING	STANDARD31516	HKLR	S
15-Apr-16	NW LANTAU	2	5.14	SPRING	STANDARD31516	HKLR	P
15-Apr-16	NW LANTAU	3	20.36	SPRING	STANDARD31516	HKLR	P
15-Apr-16	NW LANTAU	4	6.20	SPRING	STANDARD31516	HKLR	P
15-Apr-16	NW LANTAU	2	3.40	SPRING	STANDARD31516	HKLR	S
15-Apr-16	NW LANTAU	3	3.10	SPRING	STANDARD31516	HKLR	S
15-Apr-16	NW LANTAU	4	1.40	SPRING	STANDARD31516	HKLR	S
15-Apr-16	NE LANTAU	2	14.06	SPRING	STANDARD31516	HKLR	P
15-Apr-16	NE LANTAU	3	6.93	SPRING	STANDARD31516	HKLR	P
15-Apr-16	NE LANTAU	2	7.11	SPRING	STANDARD31516	HKLR	S
15-Apr-16	NE LANTAU	3	2.90	SPRING	STANDARD31516	HKLR	S
19-Apr-16	NE LANTAU	3	10.81	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NE LANTAU	4	6.46	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NE LANTAU	3	10.03	SPRING	STANDARD31516	HKLR	S
19-Apr-16	NW LANTAU	2	6.79	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NW LANTAU	3	15.26	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NW LANTAU	4	9.20	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NW LANTAU	5	9.70	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NW LANTAU	6	1.30	SPRING	STANDARD31516	HKLR	P
19-Apr-16	NW LANTAU	2	3.83	SPRING	STANDARD31516	HKLR	S
19-Apr-16	NW LANTAU	3	3.01	SPRING	STANDARD31516	HKLR	S
19-Apr-16	NW LANTAU	4	6.39	SPRING	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
3-May-16	NE LANTAU	2	15.29	SPRING	STANDARD31516	HKLR	P
3-May-16	NE LANTAU	3	1.40	SPRING	STANDARD31516	HKLR	P
3-May-16	NE LANTAU	2	10.01	SPRING	STANDARD31516	HKLR	S
3-May-16	NW LANTAU	2	16.24	SPRING	STANDARD31516	HKLR	P
3-May-16	NW LANTAU	3	23.50	SPRING	STANDARD31516	HKLR	P
3-May-16	NW LANTAU	2	7.16	SPRING	STANDARD31516	HKLR	S
3-May-16	NW LANTAU	3	5.60	SPRING	STANDARD31516	HKLR	S
12-May-16	NW LANTAU	2	15.26	SPRING	STANDARD31516	HKLR	P
12-May-16	NW LANTAU	3	16.74	SPRING	STANDARD31516	HKLR	P
12-May-16	NW LANTAU	2	7.60	SPRING	STANDARD31516	HKLR	S
12-May-16	NE LANTAU	2	6.52	SPRING	STANDARD31516	HKLR	P
12-May-16	NE LANTAU	3	13.33	SPRING	STANDARD31516	HKLR	P
12-May-16	NE LANTAU	2	4.72	SPRING	STANDARD31516	HKLR	S
12-May-16	NE LANTAU	3	6.69	SPRING	STANDARD31516	HKLR	S
17-May-16	NE LANTAU	2	10.20	SPRING	STANDARD31516	HKLR	P
17-May-16	NE LANTAU	3	9.92	SPRING	STANDARD31516	HKLR	P
17-May-16	NE LANTAU	2	6.30	SPRING	STANDARD31516	HKLR	S
17-May-16	NE LANTAU	3	4.38	SPRING	STANDARD31516	HKLR	S
17-May-16	NW LANTAU	2	2.74	SPRING	STANDARD31516	HKLR	P
17-May-16	NW LANTAU	3	28.07	SPRING	STANDARD31516	HKLR	P
17-May-16	NW LANTAU	4	0.79	SPRING	STANDARD31516	HKLR	P
17-May-16	NW LANTAU	3	7.80	SPRING	STANDARD31516	HKLR	S
26-May-16	NW LANTAU	2	14.13	SPRING	STANDARD31516	HKLR	P
26-May-16	NW LANTAU	3	26.67	SPRING	STANDARD31516	HKLR	P
26-May-16	NW LANTAU	2	7.10	SPRING	STANDARD31516	HKLR	S
26-May-16	NW LANTAU	3	6.00	SPRING	STANDARD31516	HKLR	S
26-May-16	NE LANTAU	2	2.62	SPRING	STANDARD31516	HKLR	P
26-May-16	NE LANTAU	3	14.38	SPRING	STANDARD31516	HKLR	P
26-May-16	NE LANTAU	2	3.70	SPRING	STANDARD31516	HKLR	S
26-May-16	NE LANTAU	3	6.10	SPRING	STANDARD31516	HKLR	S
1-Jun-16	NW LANTAU	3	5.57	SUMMER	STANDARD31516	HKLR	P
1-Jun-16	NW LANTAU	4	24.03	SUMMER	STANDARD31516	HKLR	P
1-Jun-16	NW LANTAU	5	1.80	SUMMER	STANDARD31516	HKLR	P
1-Jun-16	NW LANTAU	3	2.80	SUMMER	STANDARD31516	HKLR	S
1-Jun-16	NW LANTAU	4	5.30	SUMMER	STANDARD31516	HKLR	S
1-Jun-16	NE LANTAU	2	6.91	SUMMER	STANDARD31516	HKLR	P
1-Jun-16	NE LANTAU	3	12.82	SUMMER	STANDARD31516	HKLR	P
1-Jun-16	NE LANTAU	2	8.05	SUMMER	STANDARD31516	HKLR	S
1-Jun-16	NE LANTAU	3	2.52	SUMMER	STANDARD31516	HKLR	S
6-Jun-16	NW LANTAU	1	4.44	SUMMER	STANDARD31516	HKLR	P
6-Jun-16	NW LANTAU	2	30.16	SUMMER	STANDARD31516	HKLR	P
6-Jun-16	NW LANTAU	3	5.59	SUMMER	STANDARD31516	HKLR	P
6-Jun-16	NW LANTAU	2	13.61	SUMMER	STANDARD31516	HKLR	S
6-Jun-16	NE LANTAU	2	15.55	SUMMER	STANDARD31516	HKLR	P
6-Jun-16	NE LANTAU	3	0.80	SUMMER	STANDARD31516	HKLR	P
6-Jun-16	NE LANTAU	2	10.94	SUMMER	STANDARD31516	HKLR	S
13-Jun-16	NW LANTAU	3	28.50	SUMMER	STANDARD31516	HKLR	P
13-Jun-16	NW LANTAU	4	5.40	SUMMER	STANDARD31516	HKLR	P
13-Jun-16	NW LANTAU	3	4.90	SUMMER	STANDARD31516	HKLR	S
13-Jun-16	NW LANTAU	4	4.90	SUMMER	STANDARD31516	HKLR	S
13-Jun-16	NE LANTAU	2	14.58	SUMMER	STANDARD31516	HKLR	P
13-Jun-16	NE LANTAU	3	5.31	SUMMER	STANDARD31516	HKLR	P
13-Jun-16	NE LANTAU	2	6.03	SUMMER	STANDARD31516	HKLR	S
13-Jun-16	NE LANTAU	3	5.18	SUMMER	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
17-Jun-16	NW LANTAU	2	20.32	SUMMER	STANDARD31516	HKLR	P
17-Jun-16	NW LANTAU	3	18.28	SUMMER	STANDARD31516	HKLR	P
17-Jun-16	NW LANTAU	2	3.00	SUMMER	STANDARD31516	HKLR	S
17-Jun-16	NW LANTAU	3	5.50	SUMMER	STANDARD31516	HKLR	S
17-Jun-16	NE LANTAU	2	11.80	SUMMER	STANDARD31516	HKLR	P
17-Jun-16	NE LANTAU	3	5.68	SUMMER	STANDARD31516	HKLR	P
17-Jun-16	NE LANTAU	2	3.32	SUMMER	STANDARD31516	HKLR	S
17-Jun-16	NE LANTAU	3	2.90	SUMMER	STANDARD31516	HKLR	S
5-Jul-16	NW LANTAU	2	4.50	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NW LANTAU	3	29.29	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NW LANTAU	4	6.90	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NW LANTAU	2	2.10	SUMMER	STANDARD31516	HKLR	S
5-Jul-16	NW LANTAU	3	7.30	SUMMER	STANDARD31516	HKLR	S
5-Jul-16	NW LANTAU	4	3.70	SUMMER	STANDARD31516	HKLR	S
5-Jul-16	NE LANTAU	2	2.30	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NE LANTAU	3	13.62	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NE LANTAU	4	0.81	SUMMER	STANDARD31516	HKLR	P
5-Jul-16	NE LANTAU	2	4.30	SUMMER	STANDARD31516	HKLR	S
5-Jul-16	NE LANTAU	3	5.77	SUMMER	STANDARD31516	HKLR	S
12-Jul-16	NW LANTAU	1	4.04	SUMMER	STANDARD31516	HKLR	P
12-Jul-16	NW LANTAU	2	27.40	SUMMER	STANDARD31516	HKLR	P
12-Jul-16	NW LANTAU	1	2.10	SUMMER	STANDARD31516	HKLR	S
12-Jul-16	NW LANTAU	2	6.27	SUMMER	STANDARD31516	HKLR	S
12-Jul-16	NE LANTAU	2	19.99	SUMMER	STANDARD31516	HKLR	P
12-Jul-16	NE LANTAU	2	11.81	SUMMER	STANDARD31516	HKLR	S
18-Jul-16	NW LANTAU	2	4.34	SUMMER	STANDARD31516	HKLR	P
18-Jul-16	NW LANTAU	3	29.06	SUMMER	STANDARD31516	HKLR	P
18-Jul-16	NW LANTAU	4	7.70	SUMMER	STANDARD31516	HKLR	P
18-Jul-16	NW LANTAU	2	2.00	SUMMER	STANDARD31516	HKLR	S
18-Jul-16	NW LANTAU	3	7.60	SUMMER	STANDARD31516	HKLR	S
18-Jul-16	NW LANTAU	4	3.00	SUMMER	STANDARD31516	HKLR	S
18-Jul-16	NE LANTAU	2	15.66	SUMMER	STANDARD31516	HKLR	P
18-Jul-16	NE LANTAU	3	1.06	SUMMER	STANDARD31516	HKLR	P
18-Jul-16	NE LANTAU	2	9.89	SUMMER	STANDARD31516	HKLR	S
27-Jul-16	NE LANTAU	2	18.79	SUMMER	STANDARD31516	HKLR	P
27-Jul-16	NE LANTAU	3	0.70	SUMMER	STANDARD31516	HKLR	P
27-Jul-16	NE LANTAU	2	10.91	SUMMER	STANDARD31516	HKLR	S
27-Jul-16	NW LANTAU	2	19.61	SUMMER	STANDARD31516	HKLR	P
27-Jul-16	NW LANTAU	3	11.30	SUMMER	STANDARD31516	HKLR	P
27-Jul-16	NW LANTAU	4	0.60	SUMMER	STANDARD31516	HKLR	P
27-Jul-16	NW LANTAU	2	6.89	SUMMER	STANDARD31516	HKLR	S
27-Jul-16	NW LANTAU	3	1.20	SUMMER	STANDARD31516	HKLR	S
5-Aug-16	NW LANTAU	1	0.88	SUMMER	STANDARD31516	HKLR	P
5-Aug-16	NW LANTAU	2	39.05	SUMMER	STANDARD31516	HKLR	P
5-Aug-16	NW LANTAU	2	11.73	SUMMER	STANDARD31516	HKLR	S
5-Aug-16	NW LANTAU	3	1.70	SUMMER	STANDARD31516	HKLR	S
5-Aug-16	NE LANTAU	2	16.76	SUMMER	STANDARD31516	HKLR	P
5-Aug-16	NE LANTAU	2	9.74	SUMMER	STANDARD31516	HKLR	S
9-Aug-16	NW LANTAU	1	23.75	SUMMER	STANDARD36826	HKLR	P
9-Aug-16	NW LANTAU	2	7.05	SUMMER	STANDARD36826	HKLR	P
9-Aug-16	NW LANTAU	1	6.40	SUMMER	STANDARD36826	HKLR	S
9-Aug-16	NW LANTAU	2	1.70	SUMMER	STANDARD36826	HKLR	S
9-Aug-16	NE LANTAU	1	1.61	SUMMER	STANDARD36826	HKLR	P
9-Aug-16	NE LANTAU	2	9.89	SUMMER	STANDARD36826	HKLR	P

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
9-Aug-16	NE LANTAU	3	7.85	SUMMER	STANDARD36826	HKLR	P
9-Aug-16	NE LANTAU	2	8.65	SUMMER	STANDARD36826	HKLR	S
9-Aug-16	NE LANTAU	3	2.10	SUMMER	STANDARD36826	HKLR	S
17-Aug-16	NE LANTAU	2	13.69	SUMMER	STANDARD36826	HKLR	P
17-Aug-16	NE LANTAU	3	6.29	SUMMER	STANDARD36826	HKLR	P
17-Aug-16	NE LANTAU	2	10.92	SUMMER	STANDARD36826	HKLR	S
17-Aug-16	NW LANTAU	2	23.13	SUMMER	STANDARD36826	HKLR	P
17-Aug-16	NW LANTAU	3	4.78	SUMMER	STANDARD36826	HKLR	P
17-Aug-16	NW LANTAU	4	2.58	SUMMER	STANDARD36826	HKLR	P
17-Aug-16	NW LANTAU	2	5.31	SUMMER	STANDARD36826	HKLR	S
17-Aug-16	NW LANTAU	3	2.44	SUMMER	STANDARD36826	HKLR	S
17-Aug-16	NW LANTAU	4	0.56	SUMMER	STANDARD36826	HKLR	S
23-Aug-16	NW LANTAU	1	0.94	SUMMER	STANDARD31516	HKLR	P
23-Aug-16	NW LANTAU	2	38.76	SUMMER	STANDARD31516	HKLR	P
23-Aug-16	NW LANTAU	2	13.50	SUMMER	STANDARD31516	HKLR	S
23-Aug-16	NE LANTAU	1	1.00	SUMMER	STANDARD31516	HKLR	P
23-Aug-16	NE LANTAU	2	15.48	SUMMER	STANDARD31516	HKLR	P
23-Aug-16	NE LANTAU	2	9.82	SUMMER	STANDARD31516	HKLR	S
13-Sep-16	NE LANTAU	2	15.97	AUTUMN	STANDARD31516	HKLR	P
13-Sep-16	NE LANTAU	2	10.03	AUTUMN	STANDARD31516	HKLR	S
13-Sep-16	NW LANTAU	2	36.84	AUTUMN	STANDARD31516	HKLR	P
13-Sep-16	NW LANTAU	3	2.60	AUTUMN	STANDARD31516	HKLR	P
13-Sep-16	NW LANTAU	2	15.06	AUTUMN	STANDARD31516	HKLR	S
14-Sep-16	NW LANTAU	3	16.30	AUTUMN	STANDARD36826	HKLR	P
14-Sep-16	NW LANTAU	4	14.20	AUTUMN	STANDARD36826	HKLR	P
14-Sep-16	NW LANTAU	3	2.30	AUTUMN	STANDARD36826	HKLR	S
14-Sep-16	NW LANTAU	4	5.30	AUTUMN	STANDARD36826	HKLR	S
14-Sep-16	NW LANTAU	5	0.50	AUTUMN	STANDARD36826	HKLR	S
14-Sep-16	NE LANTAU	2	2.79	AUTUMN	STANDARD36826	HKLR	P
14-Sep-16	NE LANTAU	3	16.35	AUTUMN	STANDARD36826	HKLR	P
14-Sep-16	NE LANTAU	4	0.76	AUTUMN	STANDARD36826	HKLR	P
14-Sep-16	NE LANTAU	2	2.40	AUTUMN	STANDARD36826	HKLR	S
14-Sep-16	NE LANTAU	3	9.00	AUTUMN	STANDARD36826	HKLR	S
21-Sep-16	NW LANTAU	2	30.13	AUTUMN	STANDARD36826	HKLR	P
21-Sep-16	NW LANTAU	3	9.42	AUTUMN	STANDARD36826	HKLR	P
21-Sep-16	NW LANTAU	2	10.37	AUTUMN	STANDARD36826	HKLR	S
21-Sep-16	NW LANTAU	3	2.31	AUTUMN	STANDARD36826	HKLR	S
21-Sep-16	NE LANTAU	1	1.80	AUTUMN	STANDARD36826	HKLR	P
21-Sep-16	NE LANTAU	2	14.60	AUTUMN	STANDARD36826	HKLR	P
21-Sep-16	NE LANTAU	1	2.10	AUTUMN	STANDARD36826	HKLR	S
21-Sep-16	NE LANTAU	2	8.10	AUTUMN	STANDARD36826	HKLR	S
23-Sep-16	NE LANTAU	2	18.82	AUTUMN	STANDARD36826	HKLR	P
23-Sep-16	NE LANTAU	3	0.81	AUTUMN	STANDARD36826	HKLR	P
23-Sep-16	NE LANTAU	2	10.07	AUTUMN	STANDARD36826	HKLR	S
23-Sep-16	NW LANTAU	2	1.25	AUTUMN	STANDARD36826	HKLR	P
23-Sep-16	NW LANTAU	3	28.81	AUTUMN	STANDARD36826	HKLR	P
23-Sep-16	NW LANTAU	4	0.80	AUTUMN	STANDARD36826	HKLR	P
23-Sep-16	NW LANTAU	3	7.34	AUTUMN	STANDARD36826	HKLR	S
4-Oct-16	NW LANTAU	2	25.94	AUTUMN	STANDARD36826	HKLR	P
4-Oct-16	NW LANTAU	3	5.70	AUTUMN	STANDARD36826	HKLR	P
4-Oct-16	NW LANTAU	2	6.60	AUTUMN	STANDARD36826	HKLR	S
4-Oct-16	NE LANTAU	2	15.22	AUTUMN	STANDARD36826	HKLR	P
4-Oct-16	NE LANTAU	3	4.57	AUTUMN	STANDARD36826	HKLR	P
4-Oct-16	NE LANTAU	2	10.41	AUTUMN	STANDARD36826	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
7-Oct-16	NE LANTAU	2	16.19	AUTUMN	STANDARD36826	HKLR	P
7-Oct-16	NE LANTAU	2	10.71	AUTUMN	STANDARD36826	HKLR	S
7-Oct-16	NW LANTAU	1	4.54	AUTUMN	STANDARD36826	HKLR	P
7-Oct-16	NW LANTAU	2	36.45	AUTUMN	STANDARD36826	HKLR	P
7-Oct-16	NW LANTAU	1	1.03	AUTUMN	STANDARD36826	HKLR	S
7-Oct-16	NW LANTAU	2	11.81	AUTUMN	STANDARD36826	HKLR	S
7-Oct-16	NW LANTAU	3	0.40	AUTUMN	STANDARD36826	HKLR	S
11-Oct-16	NW LANTAU	2	29.01	AUTUMN	STANDARD36826	HKLR	P
11-Oct-16	NW LANTAU	3	10.75	AUTUMN	STANDARD36826	HKLR	P
11-Oct-16	NW LANTAU	2	12.21	AUTUMN	STANDARD36826	HKLR	S
11-Oct-16	NW LANTAU	3	1.40	AUTUMN	STANDARD36826	HKLR	S
11-Oct-16	NE LANTAU	2	15.82	AUTUMN	STANDARD36826	HKLR	P
11-Oct-16	NE LANTAU	3	0.80	AUTUMN	STANDARD36826	HKLR	P
11-Oct-16	NE LANTAU	2	7.48	AUTUMN	STANDARD36826	HKLR	S
11-Oct-16	NE LANTAU	3	2.40	AUTUMN	STANDARD36826	HKLR	S
13-Oct-16	NW LANTAU	2	14.72	AUTUMN	STANDARD36826	HKLR	P
13-Oct-16	NW LANTAU	3	15.81	AUTUMN	STANDARD36826	HKLR	P
13-Oct-16	NW LANTAU	2	3.21	AUTUMN	STANDARD36826	HKLR	S
13-Oct-16	NW LANTAU	3	5.06	AUTUMN	STANDARD36826	HKLR	S
13-Oct-16	NE LANTAU	2	20.06	AUTUMN	STANDARD36826	HKLR	P
13-Oct-16	NE LANTAU	2	11.14	AUTUMN	STANDARD36826	HKLR	S

Appendix II. HKLR03 Chinese White Dolphin Sighting Database (November 2015 - October 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-Nov-15	1	1143	7	NW LANTAU	2	181	ON	HKLR	828699	806450	AUTUMN	NONE	P
6-Nov-15	1	1106	1	NW LANTAU	3	77	ON	HKLR	826830	805262	AUTUMN	NONE	P
10-Nov-15	1	1042	1	NW LANTAU	3	465	ON	HKLR	825312	805475	AUTUMN	NONE	P
16-Nov-15	1	1455	5	NW LANTAU	5	662	ON	HKLR	827241	804645	AUTUMN	NONE	P
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
11-Mar-16	1	1300	1	NW LANTAU	2	ND	OFF	HKLR	821158	812895	SPRING	NONE	
23-Mar-16	1	1338	3	NW LANTAU	2	5	ON	HKLR	828123	806459	SPRING	NONE	P
5-Apr-16	1	1059	8	NW LANTAU	2	454	ON	HKLR	824938	804702	SPRING	NONE	P
19-Apr-16	1	1426	2	NW LANTAU	2	ND	OFF	HKLR	828998	806471	SPRING	NONE	
19-Apr-16	2	1451	2	NW LANTAU	2	ND	OFF	HKLR	829109	806461	SPRING	NONE	
19-Apr-16	3	1504	3	NW LANTAU	2	177	ON	HKLR	829696	806297	SPRING	NONE	P
19-Apr-16	4	1519	3	NW LANTAU	2	465	ON	HKLR	829442	806050	SPRING	NONE	S
6-Jun-16	1	1556	1	NE LANTAU	2	ND	OFF	HKLR	821150	818561	SUMMER	NONE	
5-Jul-16	1	1016	2	NW LANTAU	2	434	ON	HKLR	815337	804661	SUMMER	NONE	P
12-Jul-16	1	1335	1	NW LANTAU	2	531	ON	HKLR	825962	807516	SUMMER	NONE	P
12-Jul-16	2	1446	3	NW LANTAU	2	165	ON	HKLR	822433	805459	SUMMER	NONE	P
18-Jul-16	1	1014	1	NW LANTAU	3	ND	OFF	HKLR	815004	805073	SUMMER	NONE	
5-Aug-16	1	1049	11	NW LANTAU	2	95	ON	HKLR	822169	804686	SUMMER	NONE	P
5-Aug-16	2	1130	7	NW LANTAU	2	415	ON	HKLR	823742	804689	SUMMER	NONE	P

Appendix II. (cont'd)

(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
5-Aug-16	3	1228	2	NW LANTAU	2	119	ON	HKLR	826905	806457	SUMMER	NONE	P
17-Aug-16	1	1353	5	NW LANTAU	2	107	ON	HKLR	827091	807487	SUMMER	NONE	P
17-Aug-16	2	1422	1	NW LANTAU	2	ND	OFF	HKLR	827147	807528	SUMMER	NONE	
21-Sep-16	1	1057	3	NW LANTAU	2	0	ON	HKLR	826211	804642	AUTUMN	NONE	P
21-Sep-16	2	1155	11	NW LANTAU	2	664	ON	HKLR	826983	806467	AUTUMN	NONE	P
21-Sep-16	3	1229	5	NW LANTAU	2	0	ON	HKLR	826185	806496	AUTUMN	NONE	P
21-Sep-16	4	1341	2	NW LANTAU	2	79	ON	HKLR	825218	808472	AUTUMN	NONE	P
4-Oct-16	1	1039	1	NW LANTAU	2	14	ON	HKLR	823995	805534	AUTUMN	NONE	P
4-Oct-16	2	1114	2	NW LANTAU	2	377	ON	HKLR	830283	806082	AUTUMN	NONE	S
7-Oct-16	1	1419	4	NW LANTAU	1	103	ON	HKLR	827149	806447	AUTUMN	NONE	P
7-Oct-16	2	1553	2	NW LANTAU	2	8	ON	HKLR	814927	804671	AUTUMN	NONE	P
11-Oct-16	1	1049	1	NW LANTAU	2	243	ON	HKLR	822391	804655	AUTUMN	NONE	P
13-Oct-16	1	1104	5	NW LANTAU	3	69	ON	HKLR	828391	805399	AUTUMN	NONE	P

Appendix III. Individual dolphins identified during HKLR03 monitoring surveys in November 2015-October 2016

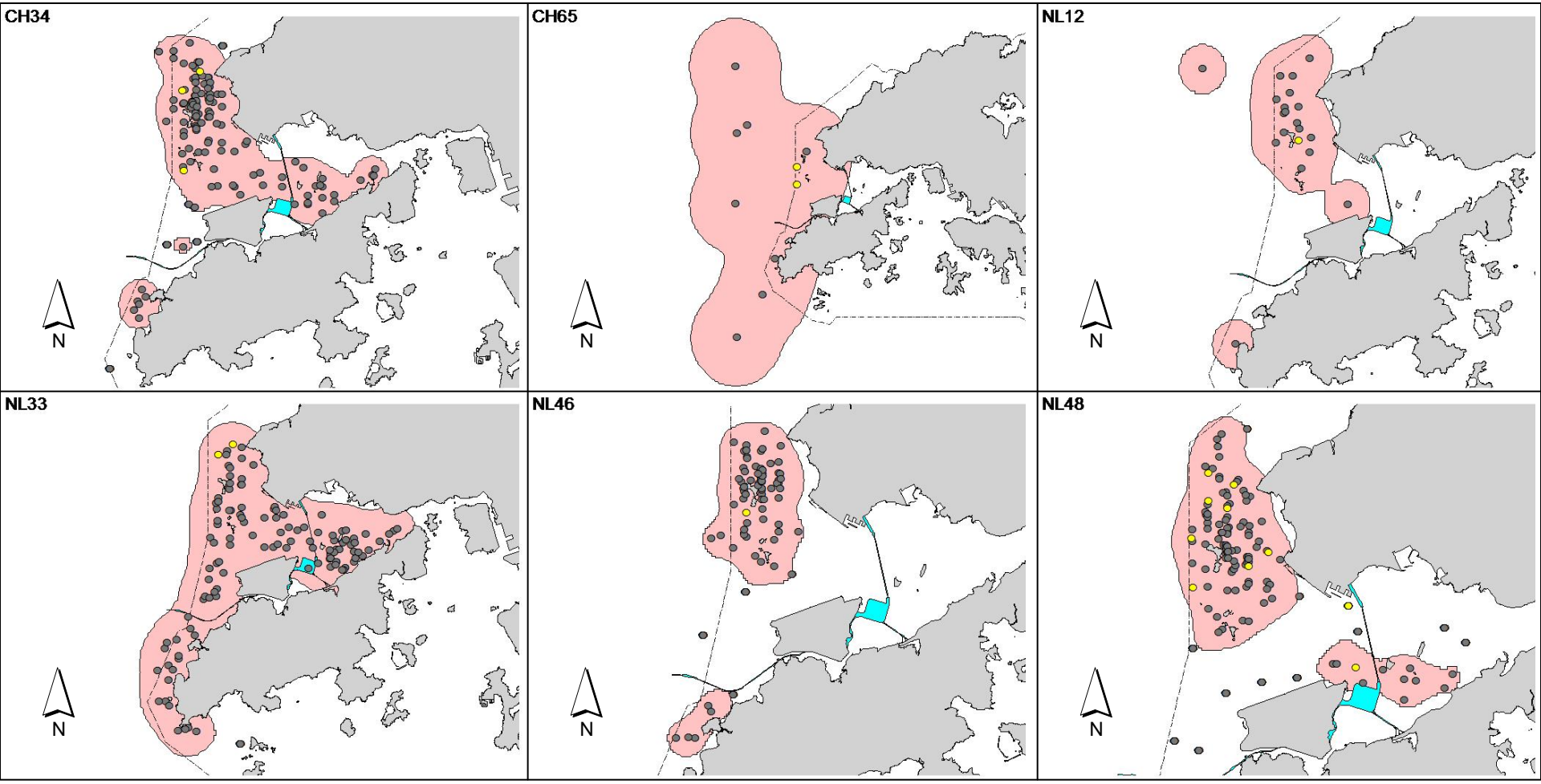
ID#	DATE	STG#	AREA
CH34	09/12/15	1	NW LANTAU
	12/07/16	2	NW LANTAU
	13/10/16	1	NW LANTAU
CH65	05/04/16	1	NW LANTAU
	05/08/16	1	NW LANTAU
NL12	21/09/16	3	NW LANTAU
NL33	07/12/15	1	NW LANTAU
	09/12/15	1	NW LANTAU
NL46	10/11/15	1	NW LANTAU
NL48	02/11/15	1	NW LANTAU
	16/11/15	1	NW LANTAU
	09/12/15	1	NW LANTAU
	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	03/02/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
	11/03/16	1	NW LANTAU
	05/04/16	1	NW LANTAU
	12/07/16	1	NW LANTAU
NL98	02/11/15	1	NW LANTAU
NL103	21/09/16	3	NW LANTAU
NL104	09/12/15	1	NW LANTAU
	15/12/15	3	NW LANTAU
	17/08/16	1	NW LANTAU
	13/10/16	1	NW LANTAU
NL120	05/04/16	1	NW LANTAU
NL123	02/11/15	1	NW LANTAU
	11/01/16	1	NW LANTAU
	23/03/16	1	NW LANTAU
	05/04/16	1	NW LANTAU
NL136	02/11/15	1	NW LANTAU
	09/12/15	1	NW LANTAU
	16/02/16	1	NW LANTAU
	12/07/16	2	NW LANTAU
	21/09/16	3	NW LANTAU
	04/10/16	2	NW LANTAU
NL145	05/04/16	1	NW LANTAU
NL150	17/08/16	1	NW LANTAU

ID#	DATE	STG#	AREA
NL182	02/11/15	1	NW LANTAU
	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	16/02/16	1	NW LANTAU
	12/07/16	2	NW LANTAU
	04/10/16	2	NW LANTAU
NL202	16/11/15	1	NW LANTAU
	07/12/15	1	NW LANTAU
	19/01/16	1	NW LANTAU
	19/04/16	1	NW LANTAU
	05/08/16	3	NW LANTAU
	21/09/16	2	NW LANTAU
	07/10/16	1	NW LANTAU
	13/10/16	1	NW LANTAU
NL210	02/11/15	1	NW LANTAU
	16/11/15	1	NW LANTAU
	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
NL224	05/04/16	1	NW LANTAU
	21/09/16	2	NW LANTAU
NL233	07/12/15	1	NW LANTAU
NL255	05/08/16	1	NW LANTAU
NL259	05/04/16	1	NW LANTAU
	21/09/16	3	NW LANTAU
NL261	15/12/15	2	NW LANTAU
	03/02/16	1	NW LANTAU
	05/04/16	1	NW LANTAU
	21/09/16	2	NW LANTAU
NL264	05/04/16	1	NW LANTAU
	21/09/16	3	NW LANTAU
NL269	09/12/15	1	NW LANTAU
NL272	07/12/15	1	NW LANTAU
	15/12/15	2	NW LANTAU
	21/09/16	2	NW LANTAU
NL280	07/12/15	1	NW LANTAU
	17/08/16	1	NW LANTAU

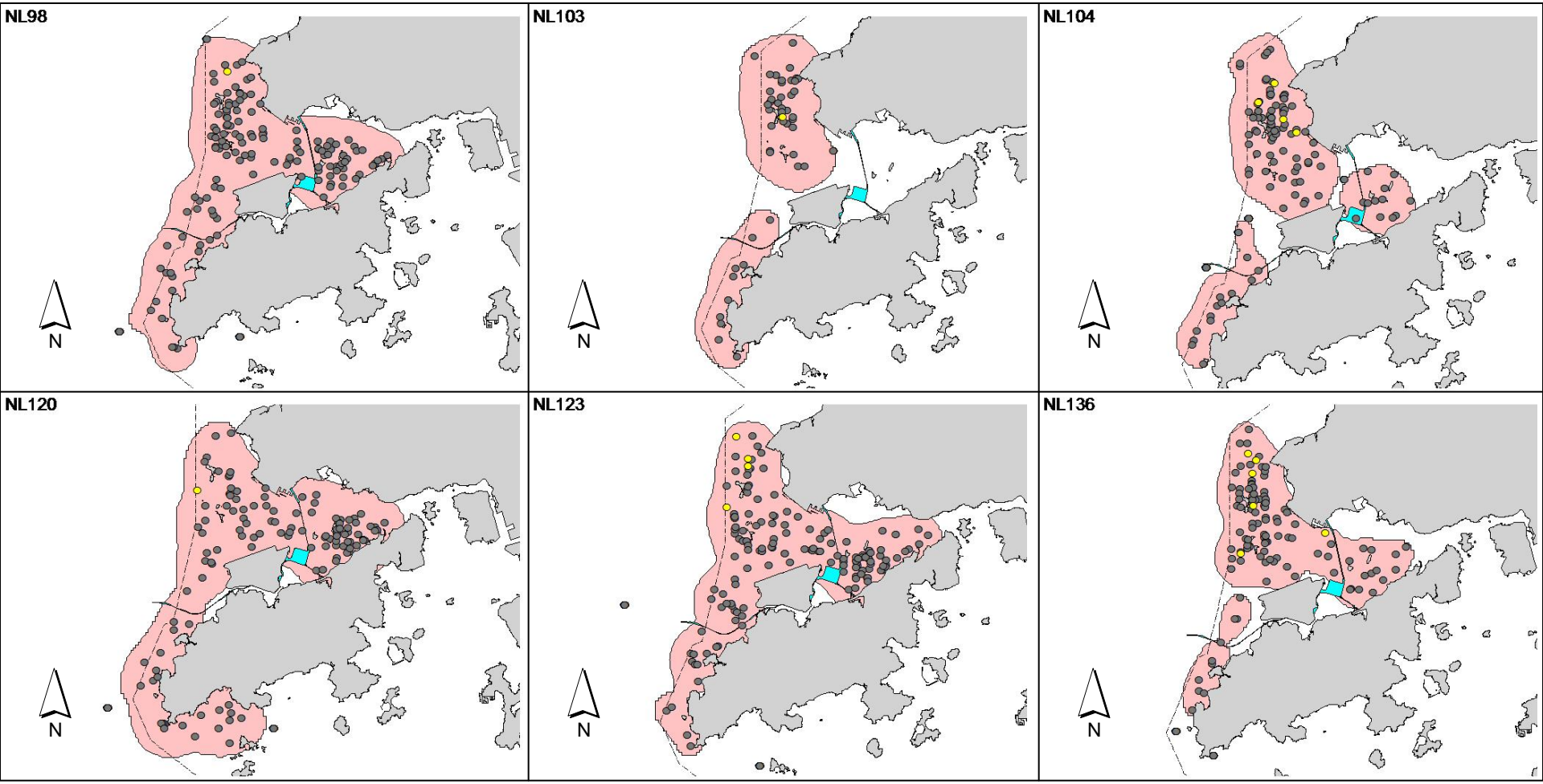
Appendix III. (cont'd)

ID#	DATE	STG#	AREA
NL281	05/08/16	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
	23/03/16	1	NW LANTAU
	05/04/16	1	NW LANTAU
NL286	16/11/15	1	NW LANTAU
	02/12/15	1	NW LANTAU
	02/12/15	2	NW LANTAU
	07/12/15	1	NW LANTAU
	19/04/16	1	NW LANTAU
	05/08/16	3	NW LANTAU
	21/09/16	2	NW LANTAU
	07/10/16	1	NW LANTAU
	13/10/16	1	NW LANTAU
NL287	05/04/16	1	NW LANTAU
NL288	05/04/16	1	NW LANTAU
	21/09/16	3	NW LANTAU
NL293	18/07/16	1	NW LANTAU
NL302	13/01/16	2	NW LANTAU
	05/07/16	1	NW LANTAU
NL307	05/07/16	1	NW LANTAU
	21/09/16	2	NW LANTAU
NL308	19/04/16	3	NW LANTAU
NL319	21/09/16	2	NW LANTAU
NL320	11/01/16	1	NW LANTAU
	19/01/16	1	NW LANTAU
	03/02/16	1	NW LANTAU
	23/03/16	1	NW LANTAU
	21/09/16	2	NW LANTAU
	07/10/16	1	NW LANTAU
NL321	13/10/16	1	NW LANTAU
WL17	16/02/16	1	NW LANTAU
WL243	07/10/16	2	NW LANTAU

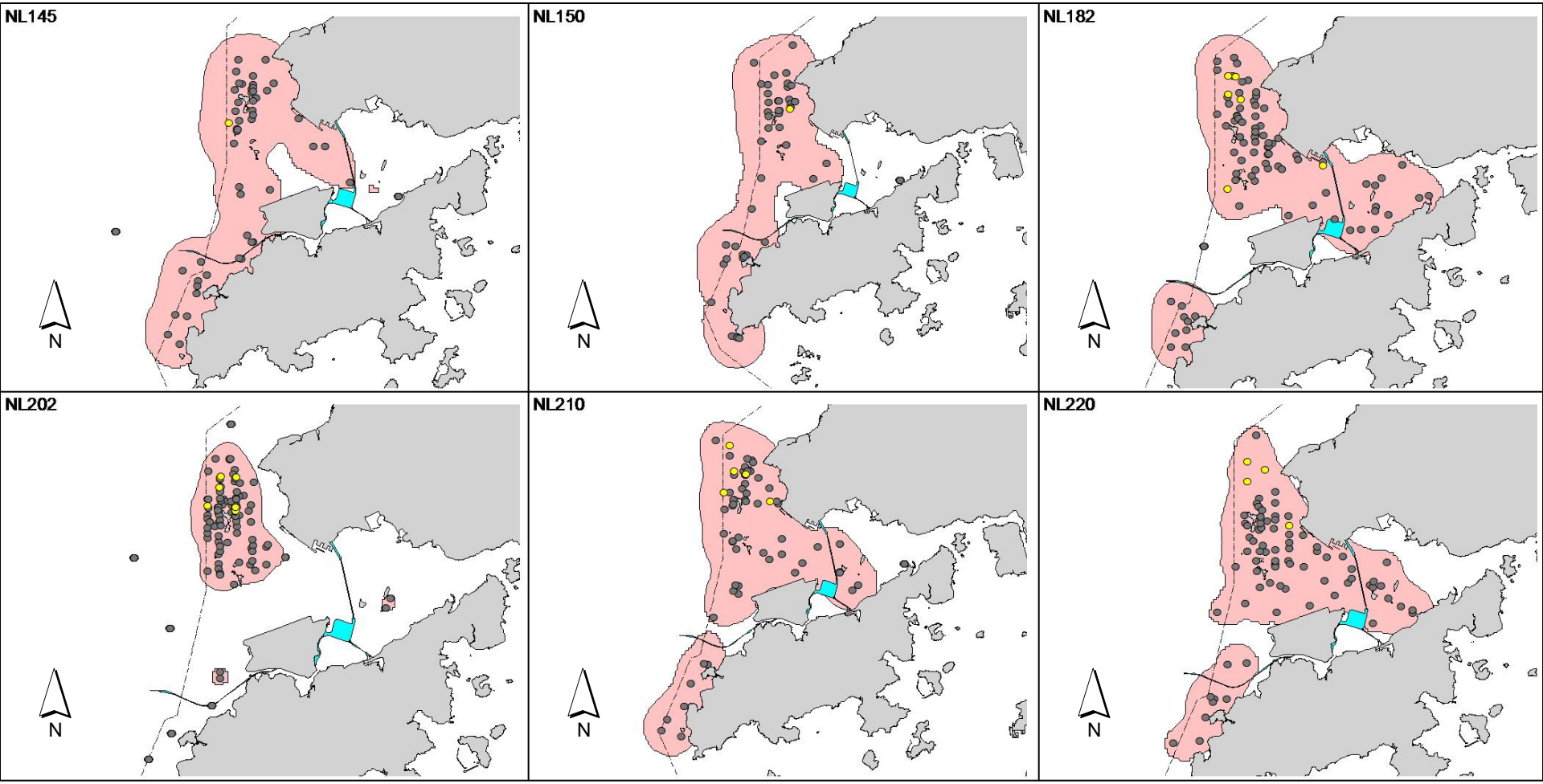
Appendix IV. Ranging patterns (95% kernel ranges) of 42 individual dolphins that were sighted during the third year of TMCLKL construction works, utilizing the HKLR03 and HKLR09 monitoring data
(note: yellow dots indicates sightings made in November 2015 to October 2016)



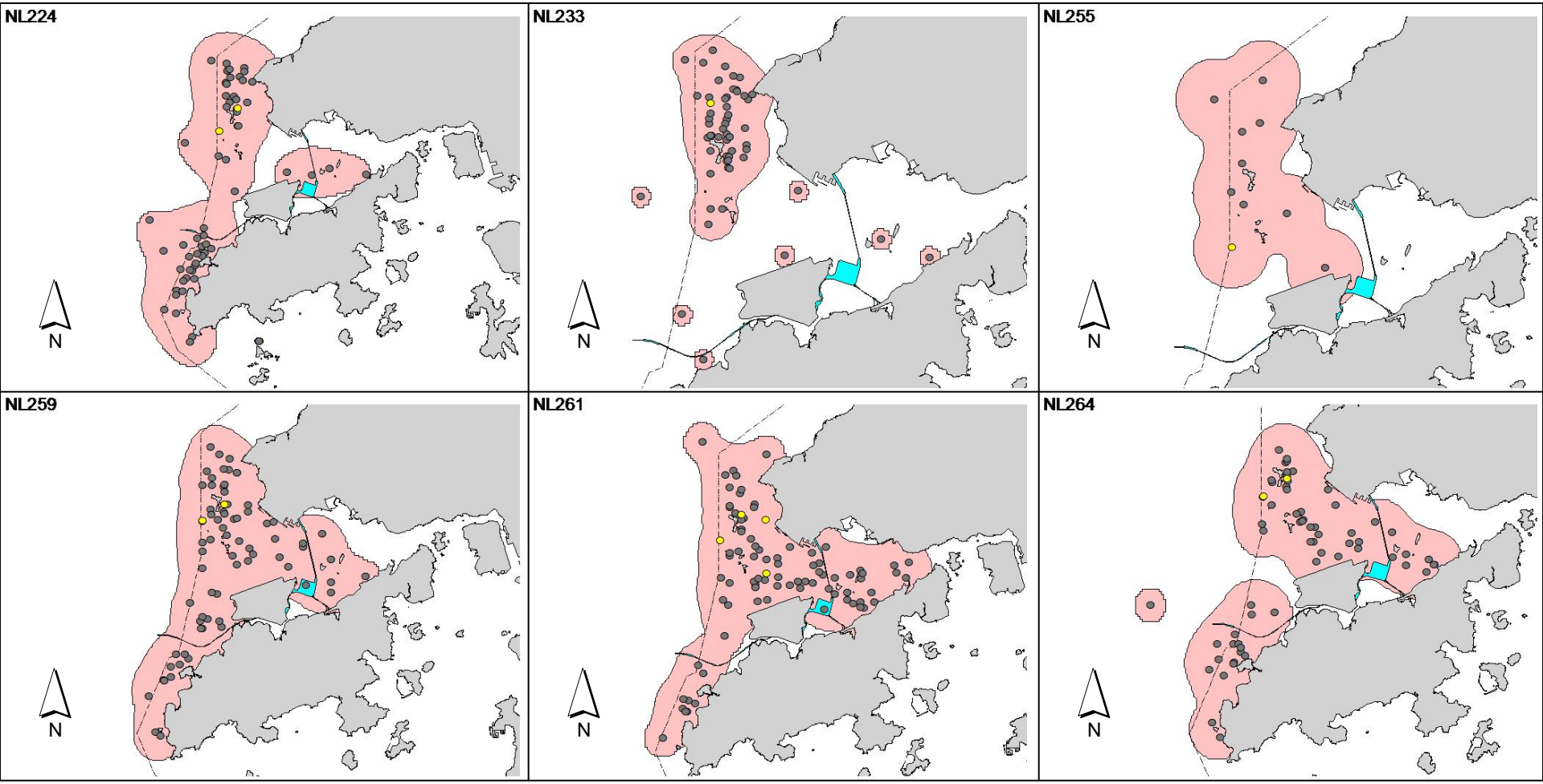
Appendix IV. (cont'd)



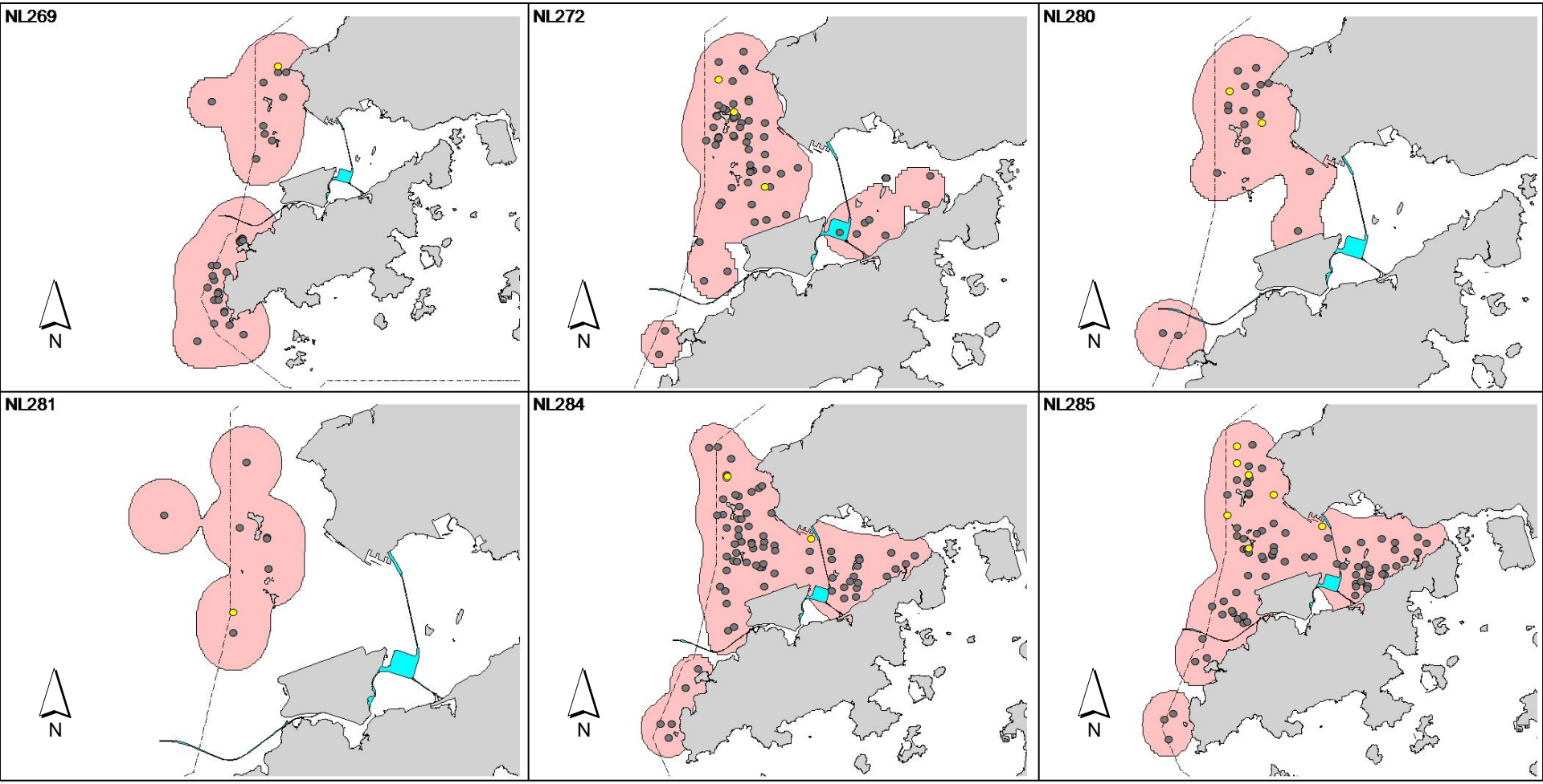
Appendix IV. (cont'd)



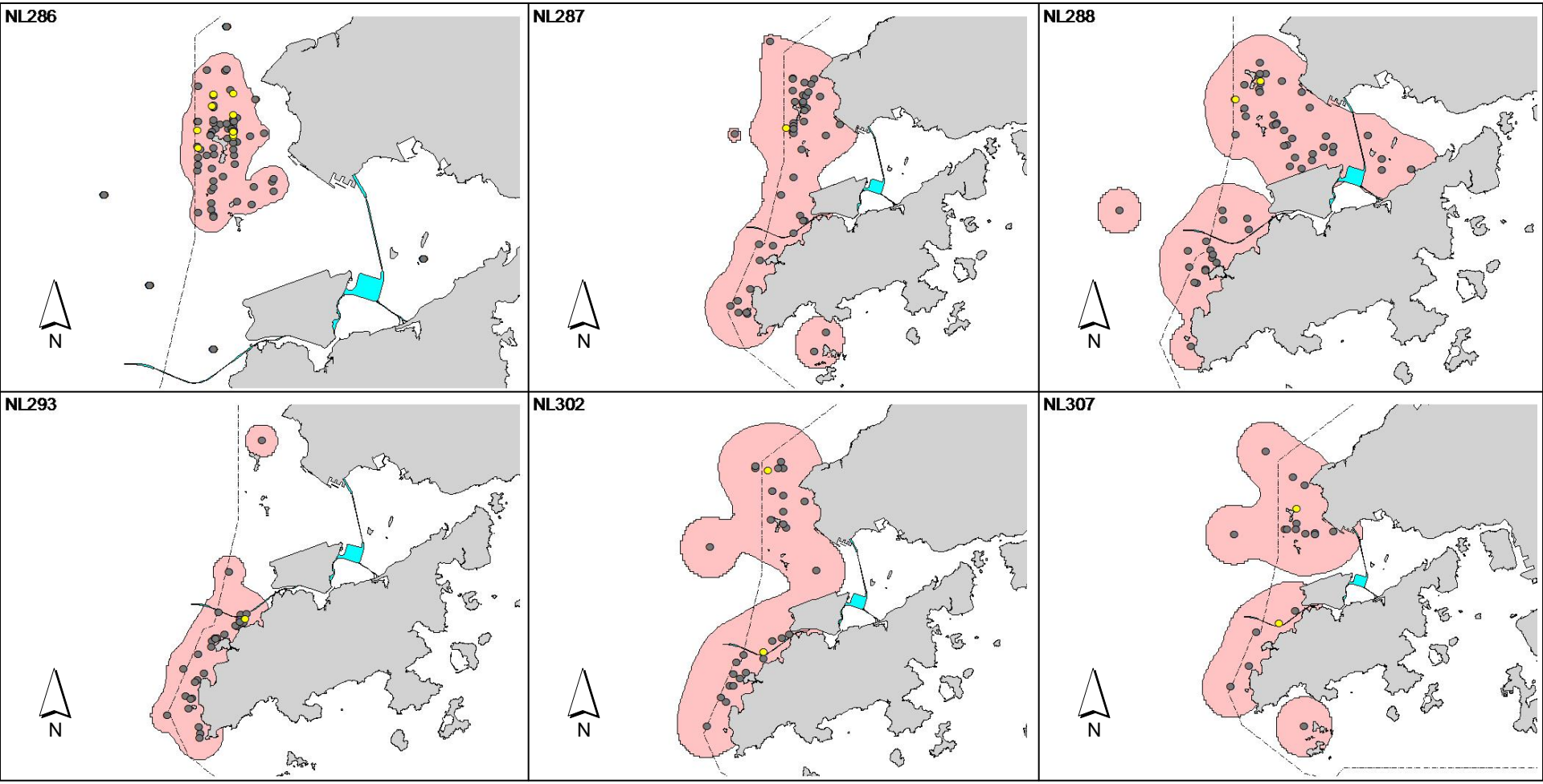
Appendix IV. (cont'd)



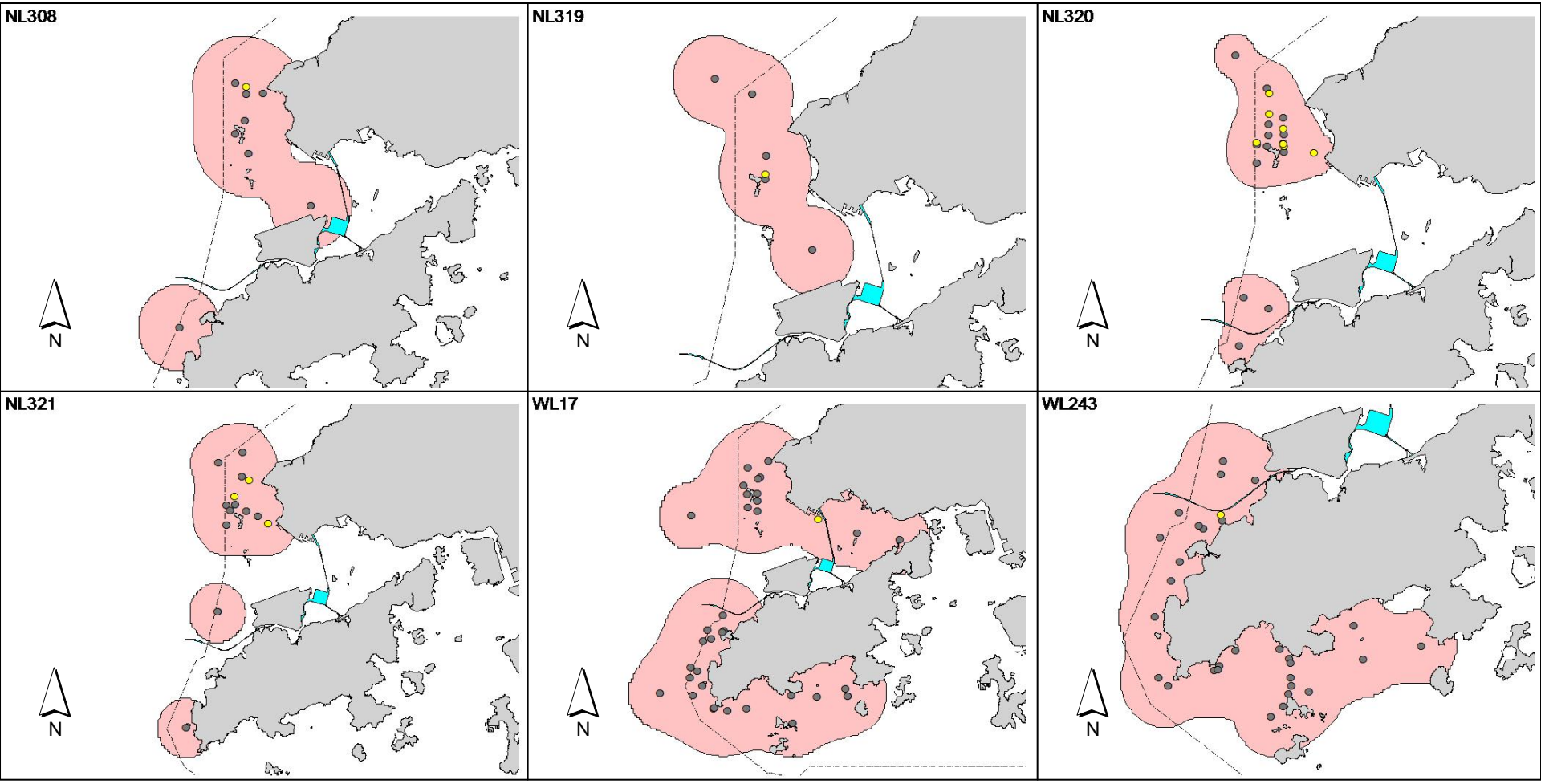
Appendix IV. (cont'd)

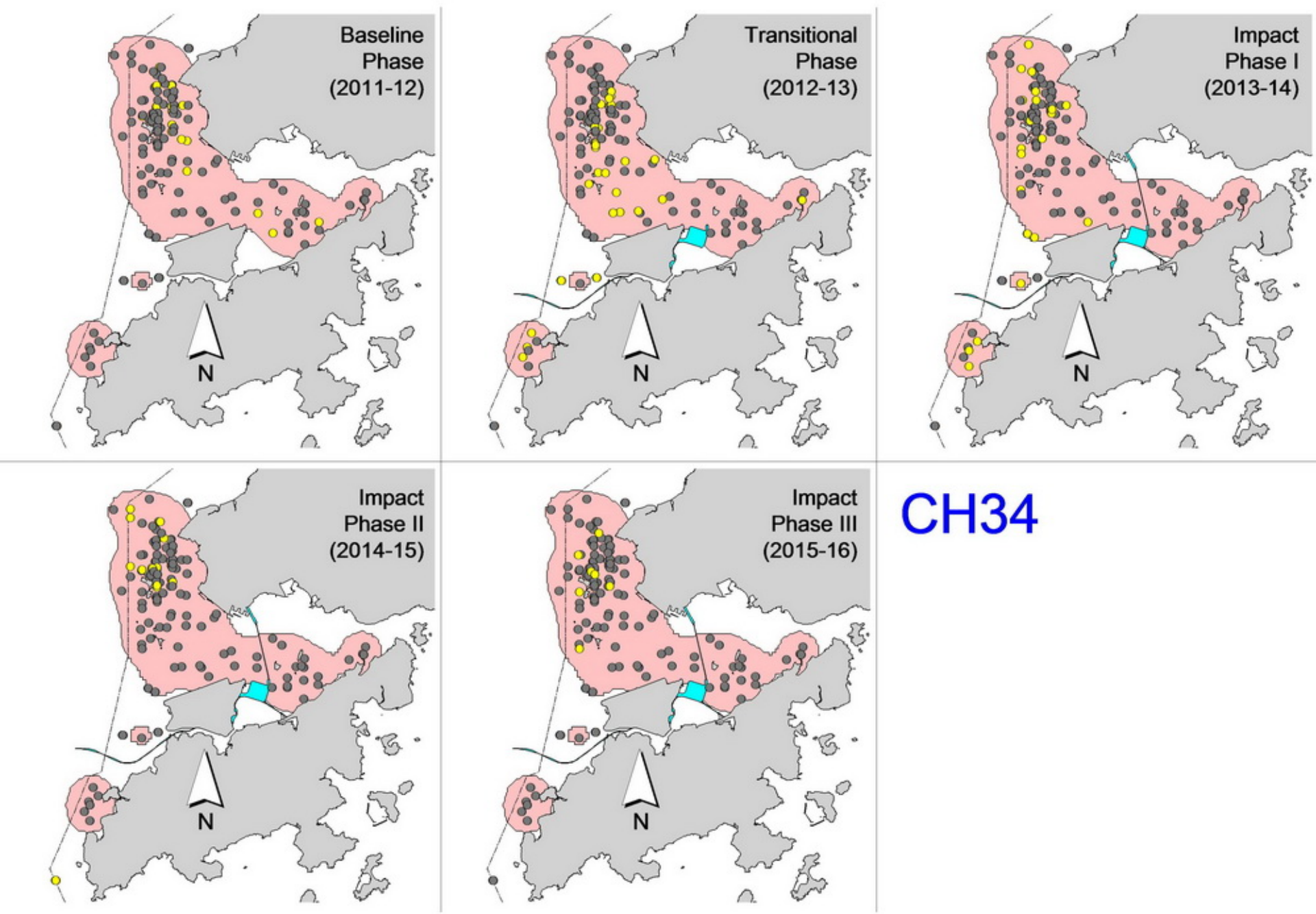


Appendix IV. (cont'd)

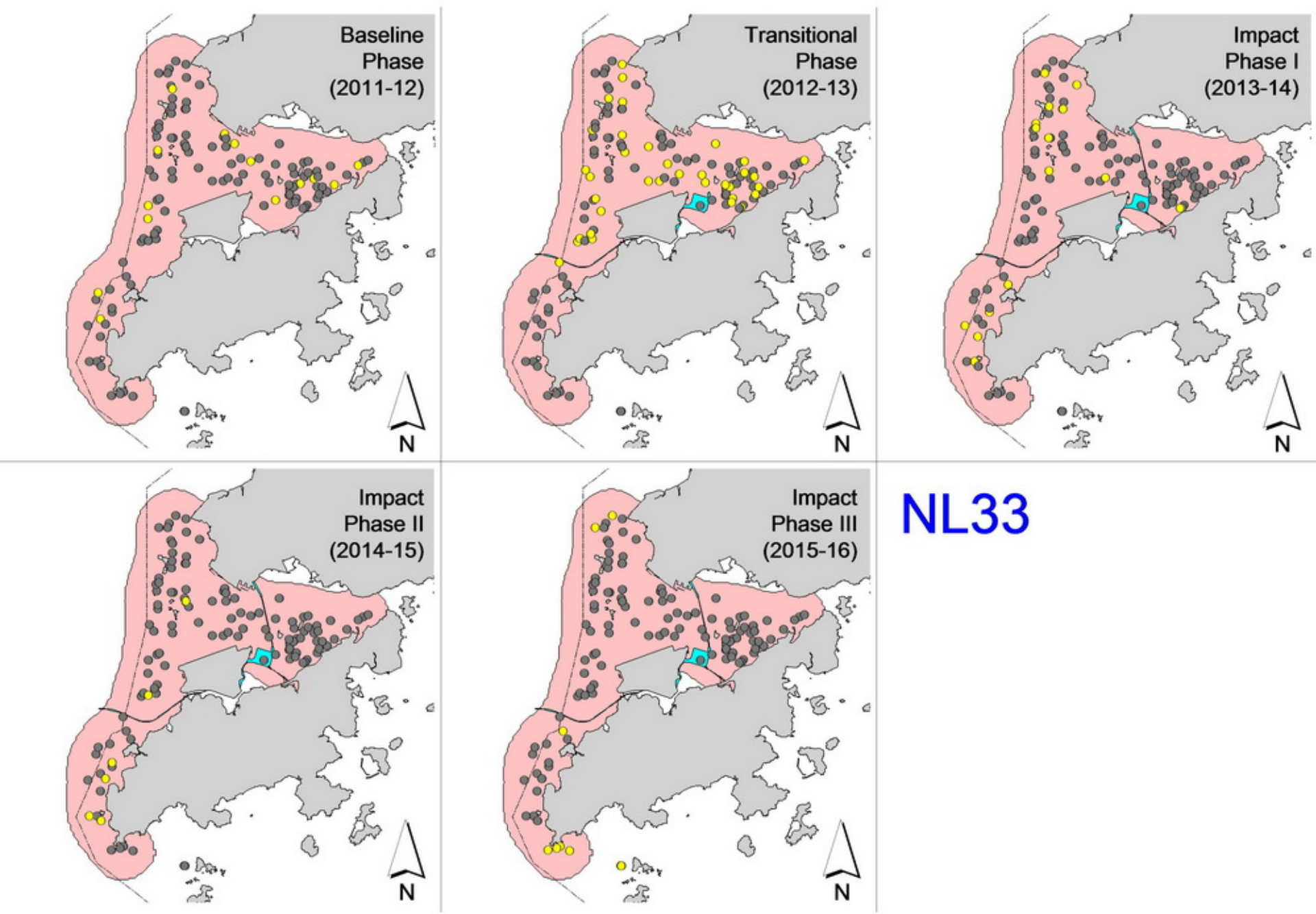


Appendix IV. (cont'd)

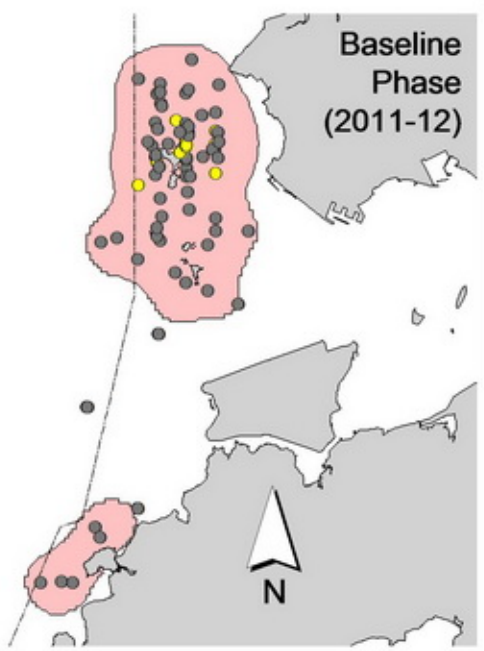


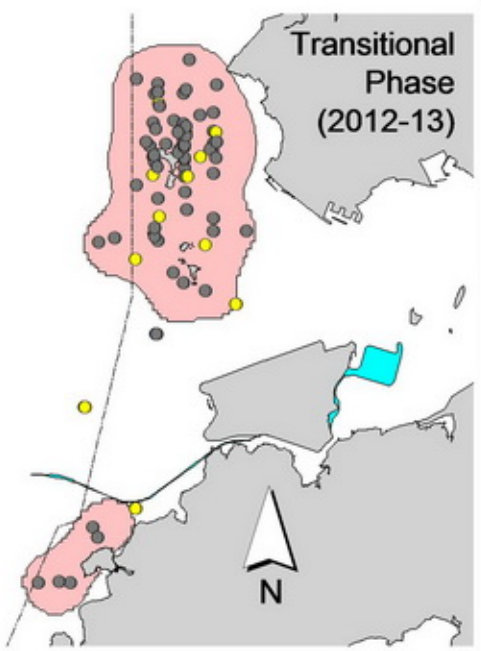


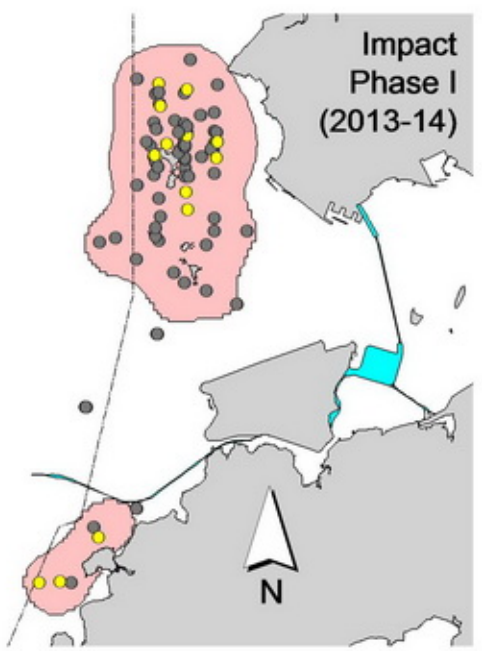
Appendix V. Temporal changes in range use patterns of 31 individual dolphins during baseline, transitional & three impact phases of TMCLKL construction (note: yellow dots indicates sightings made in corresponding period)

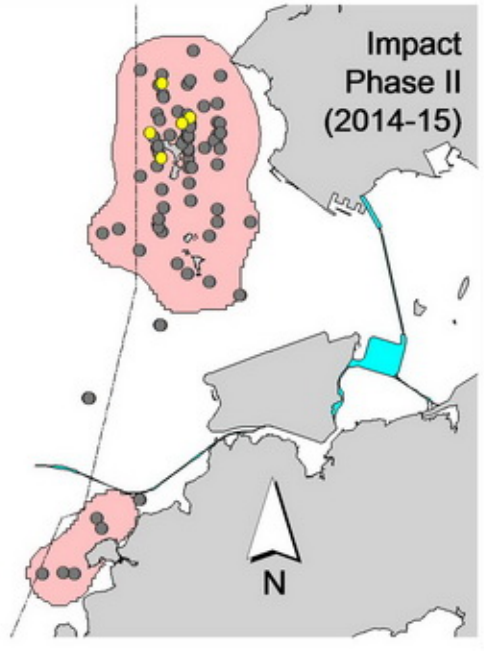


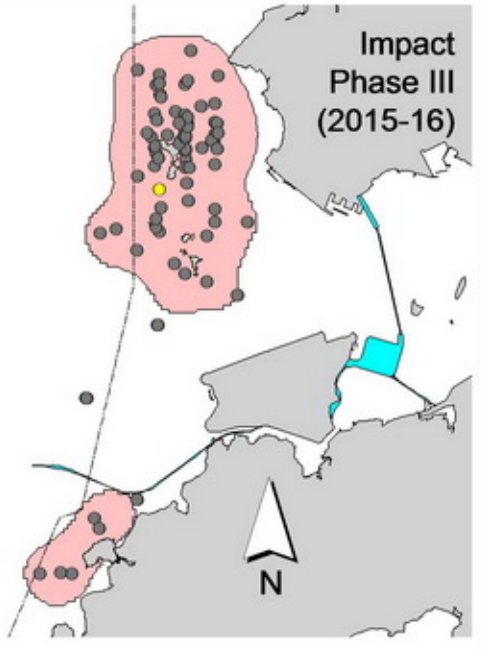
Appendix V. (cont'd)





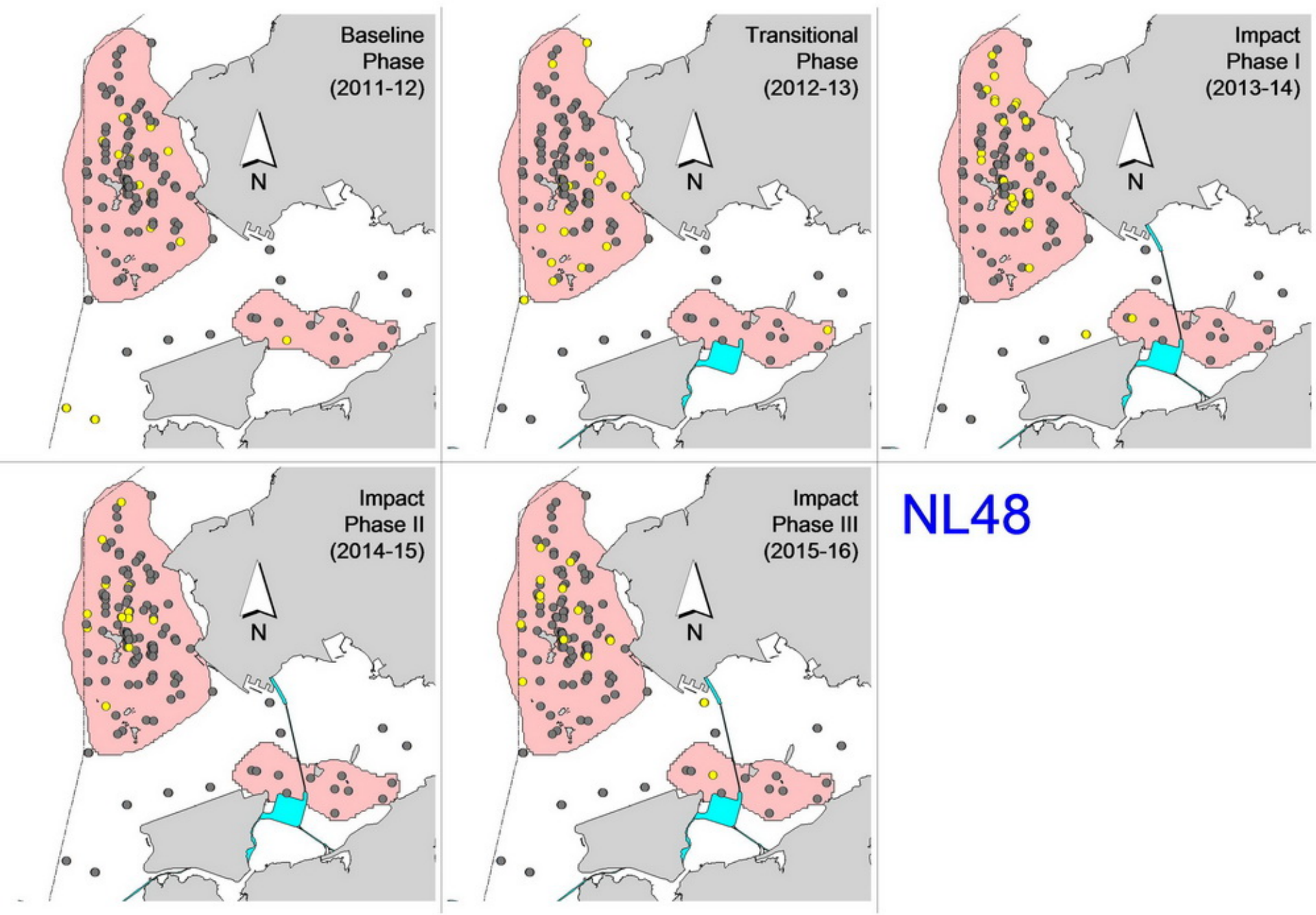




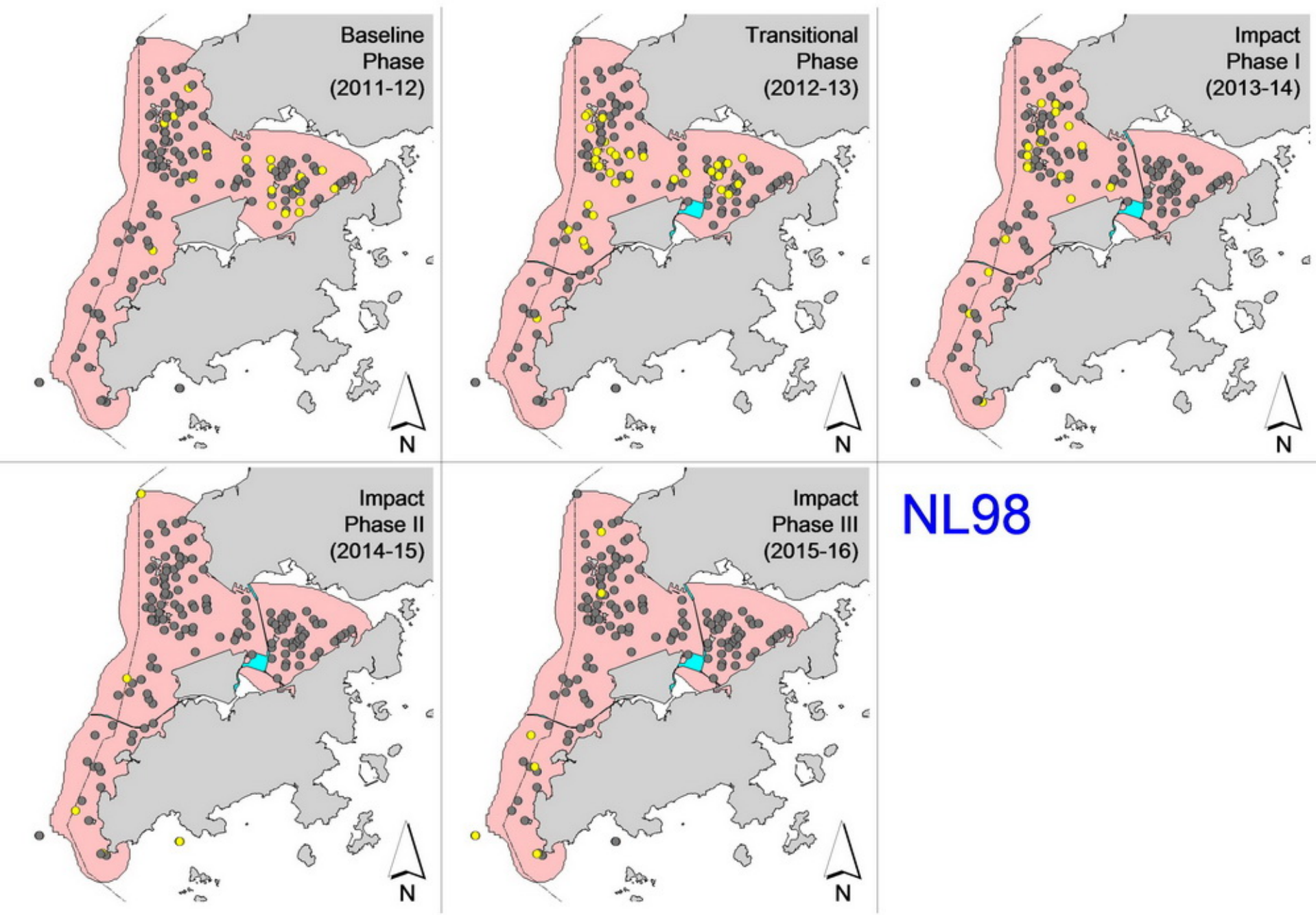


NL46

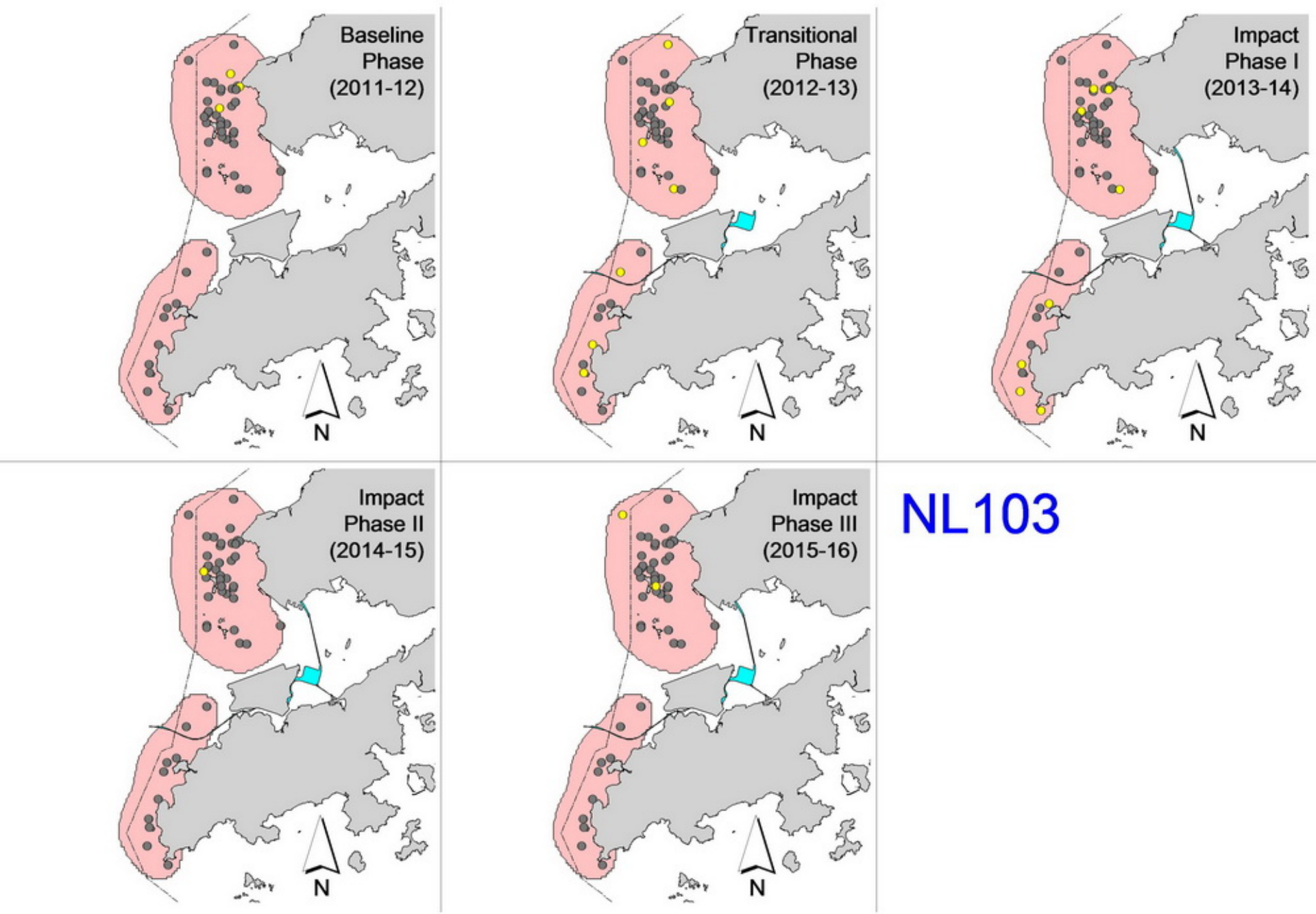
Appendix V. (cont'd)



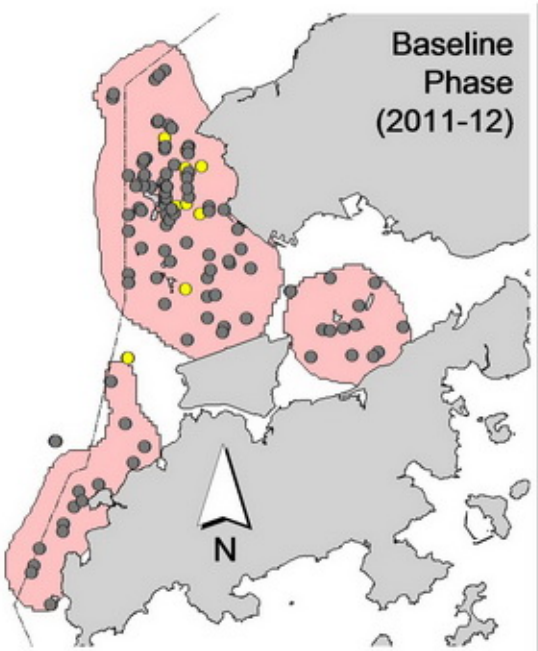
Appendix V. (cont'd)

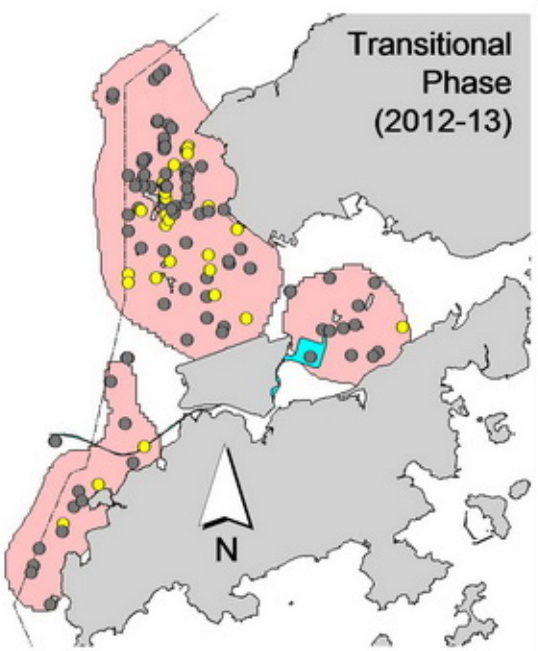


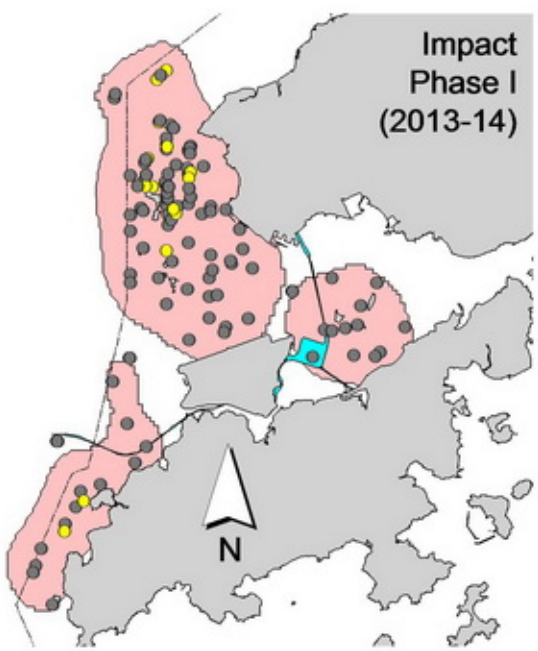
Appendix V. (cont'd)

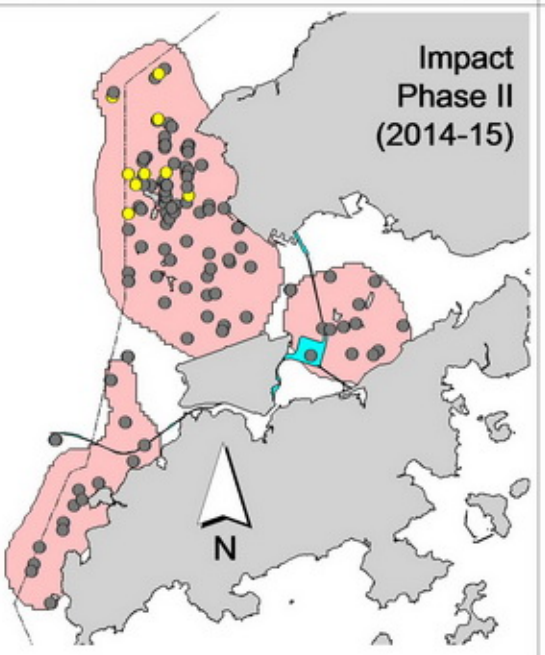


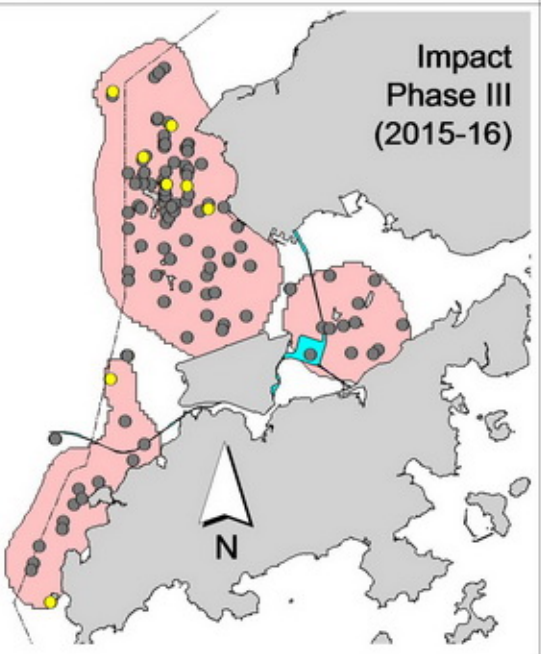
Appendix V. (cont'd)





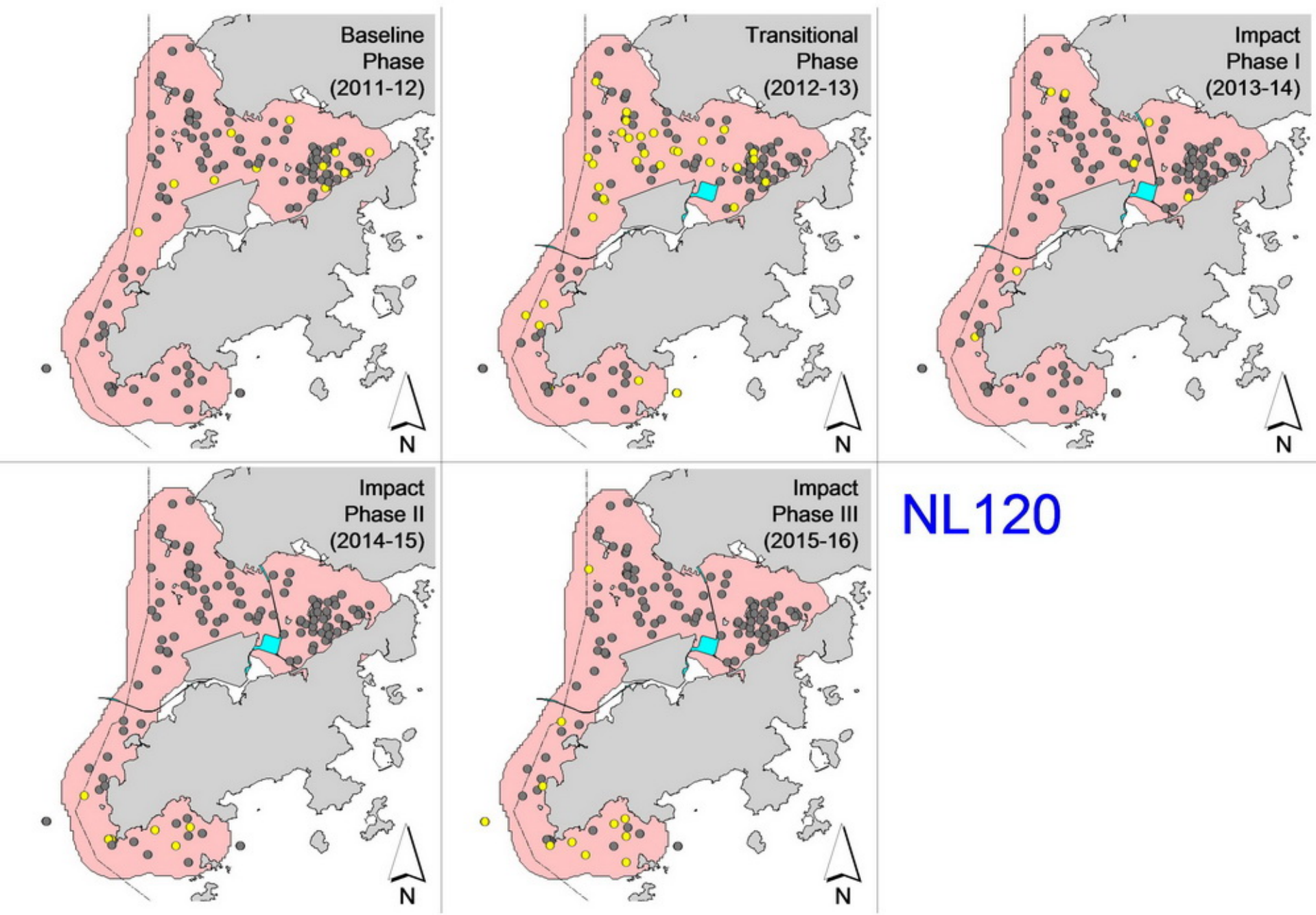




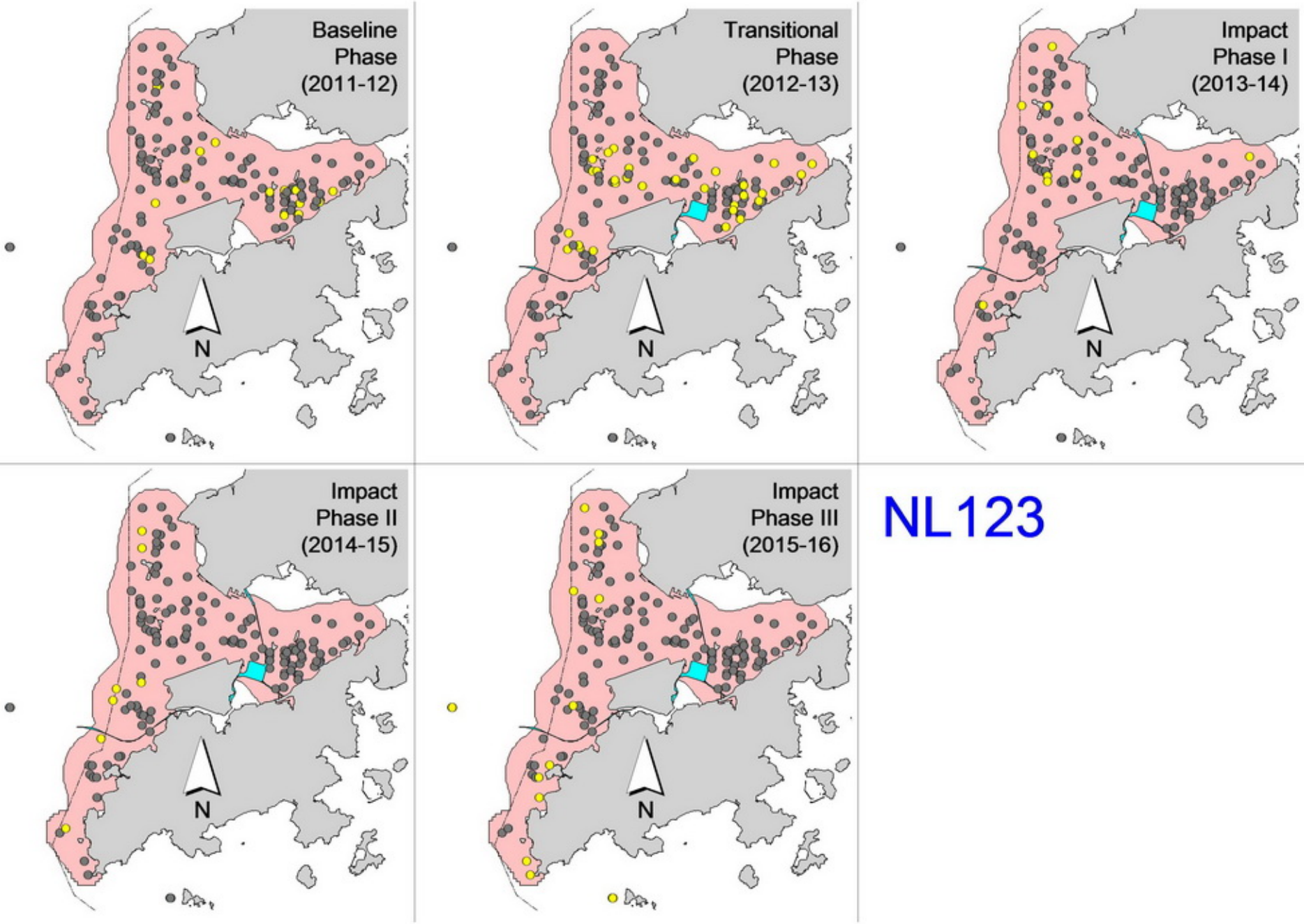


NL104

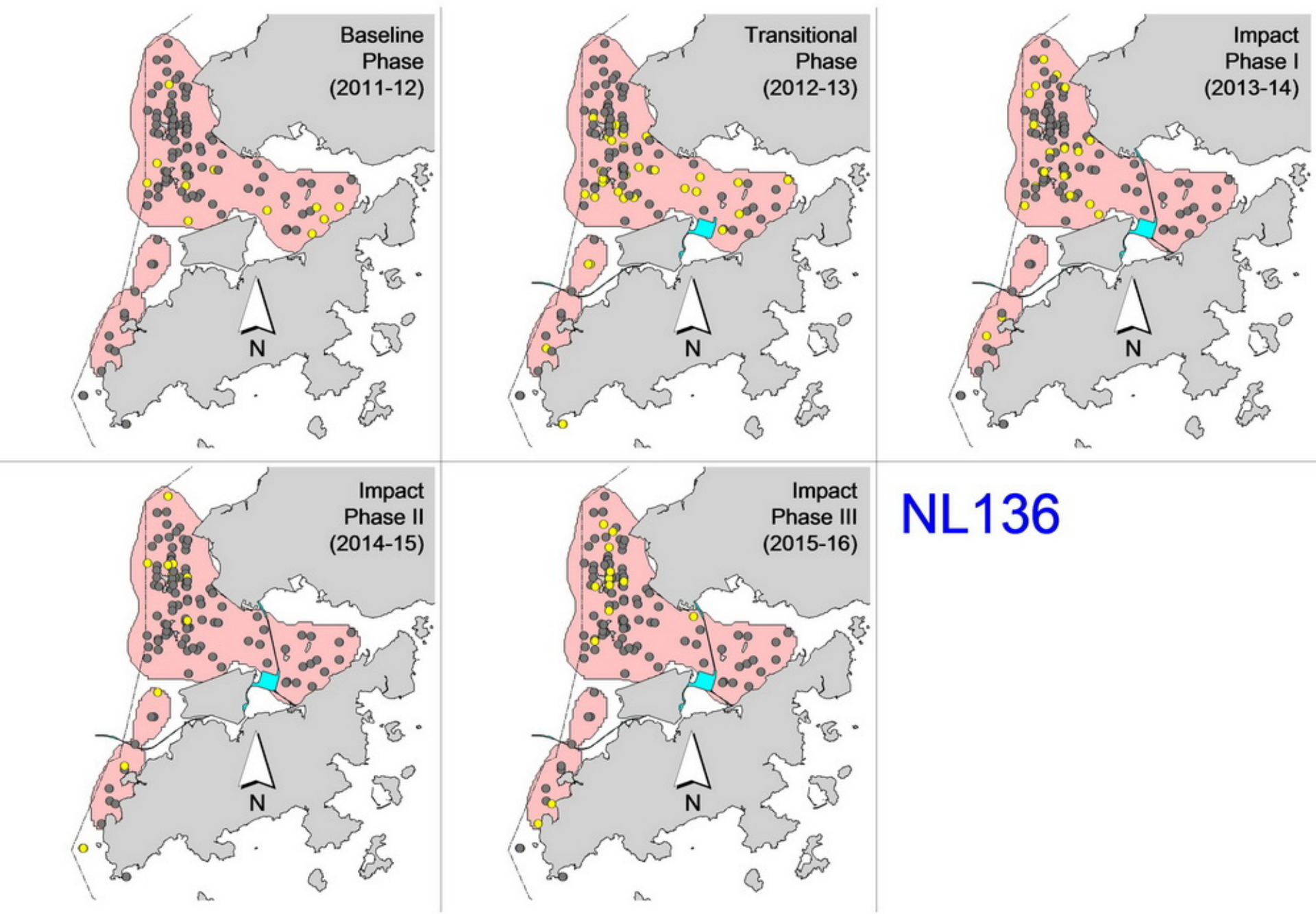
Appendix V. (cont'd)



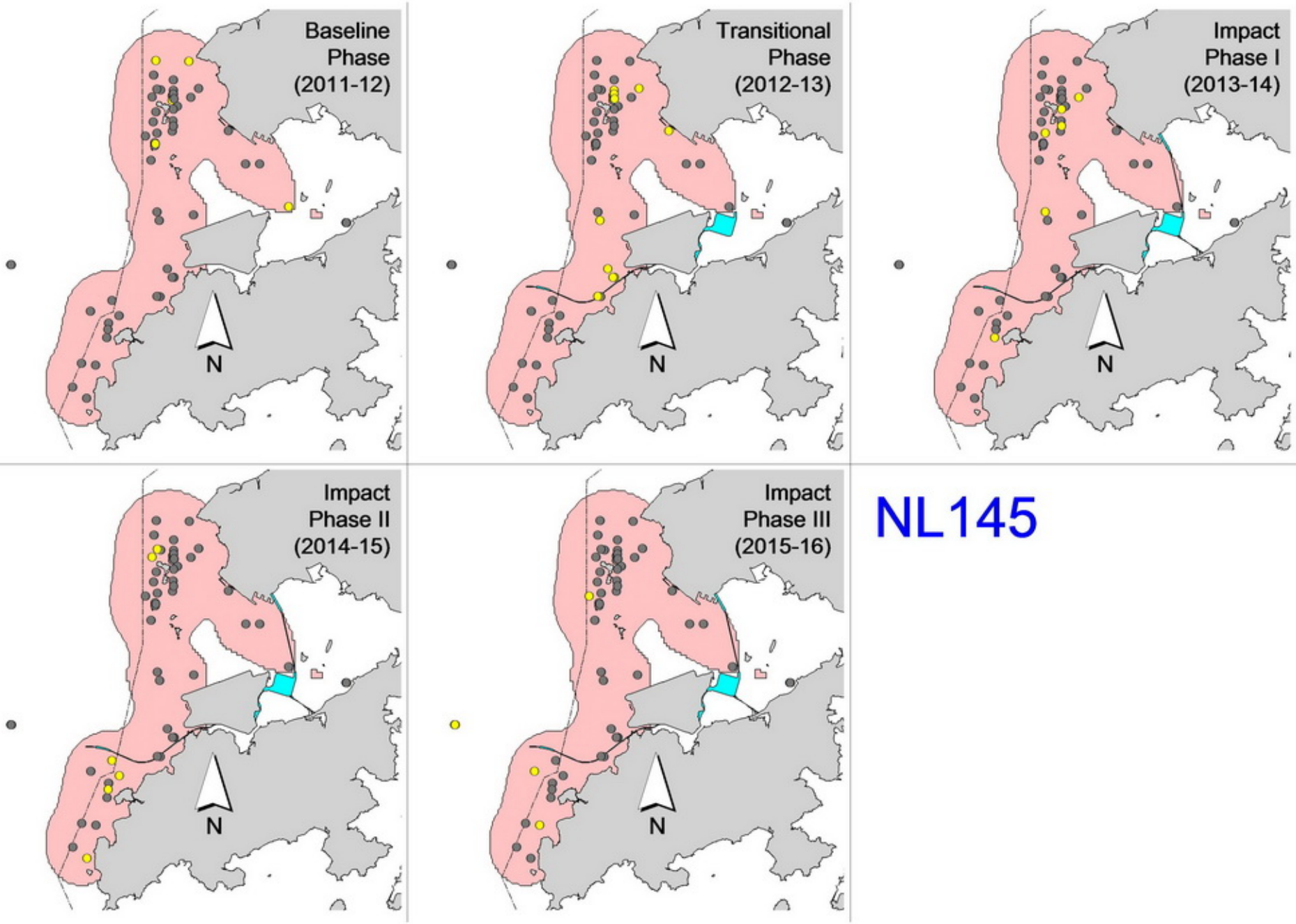
Appendix V. (cont'd)



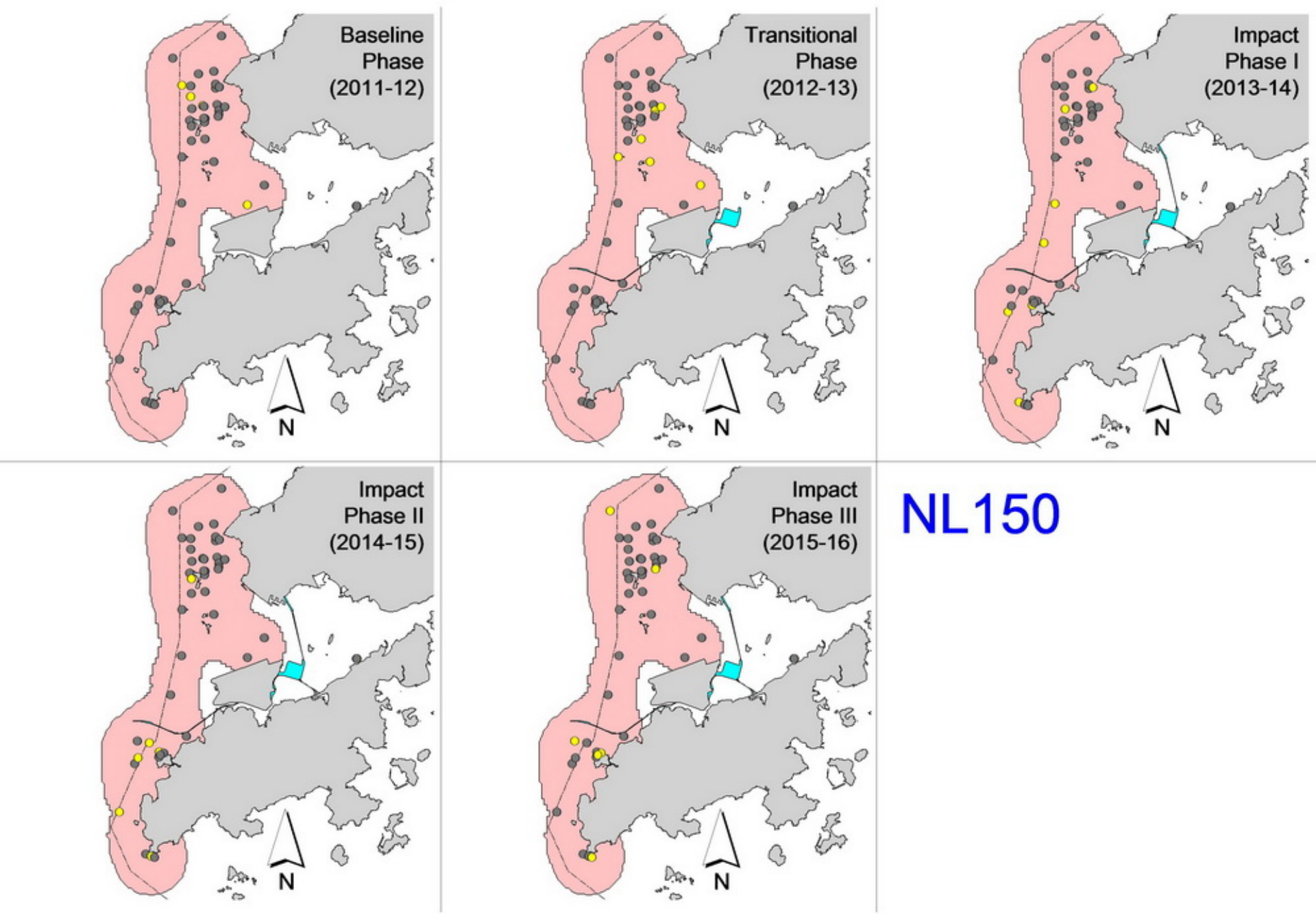
Appendix V. (cont'd)



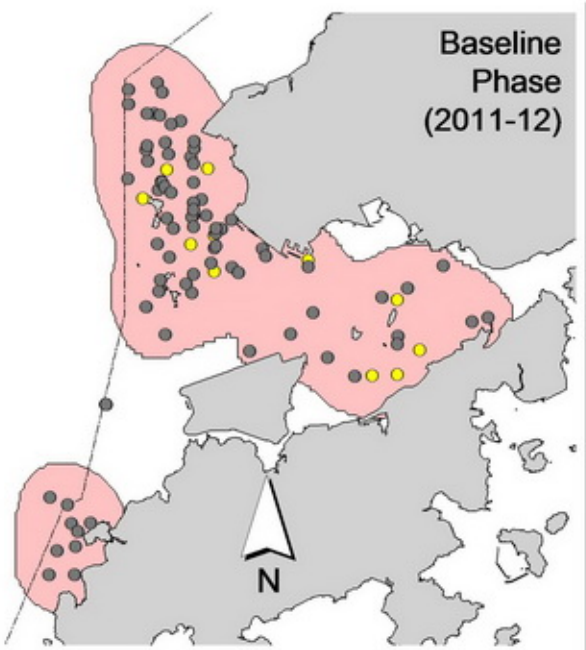
Appendix V. (cont'd)

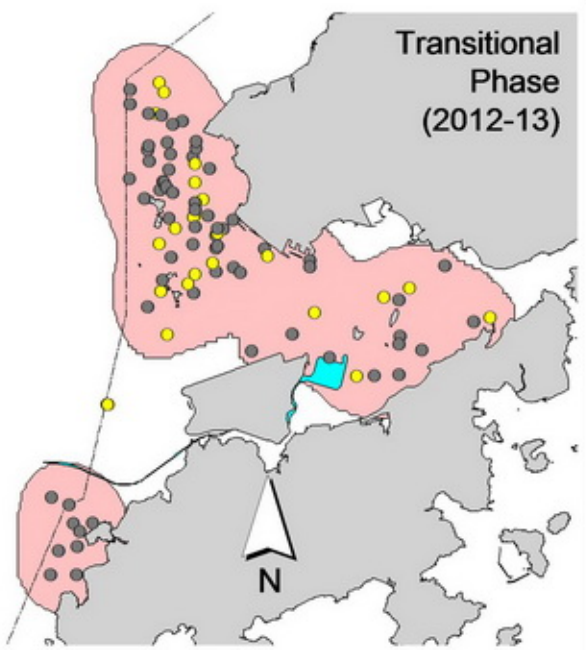


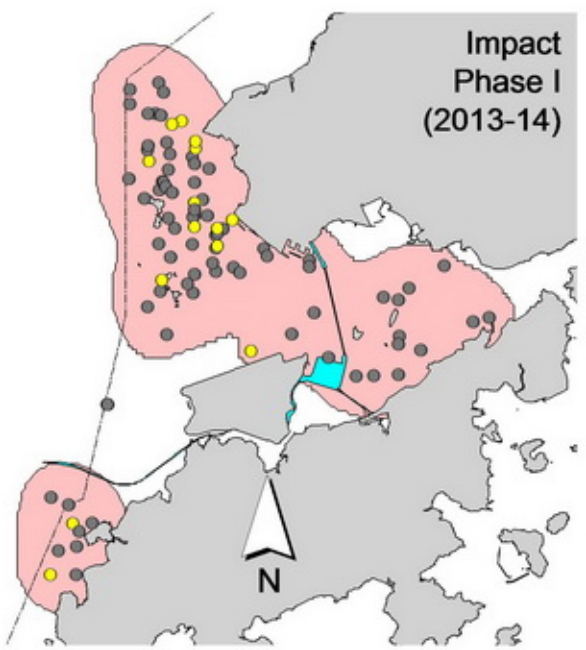
Appendix V. (cont'd)

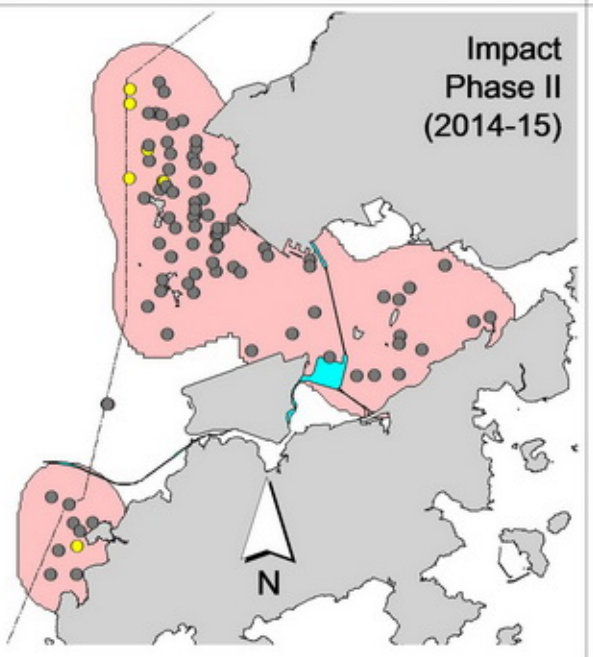


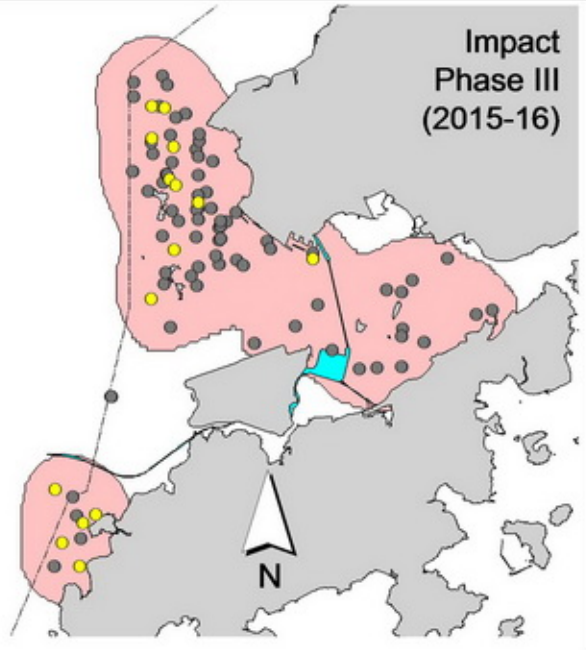
Appendix V. (cont'd)





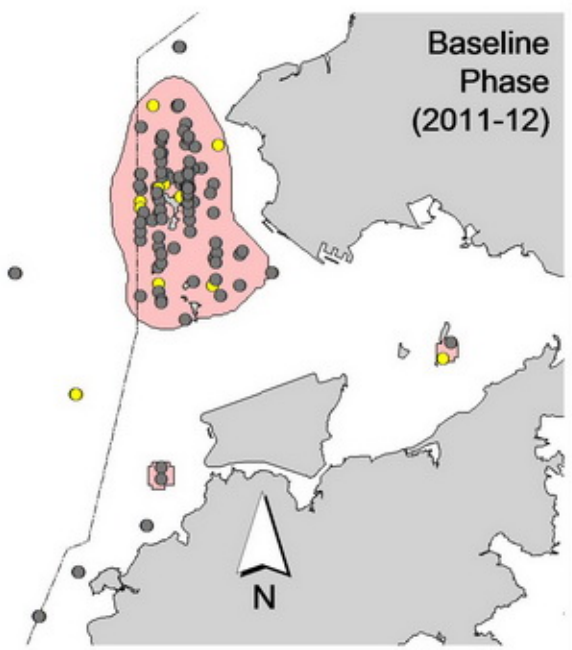


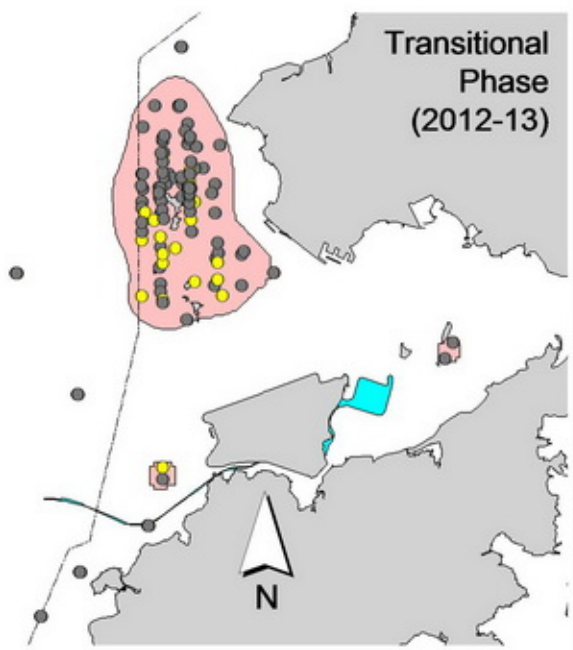


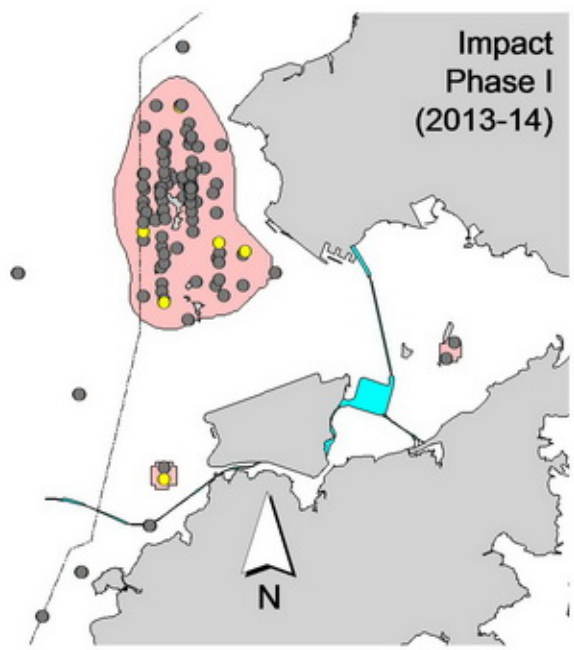


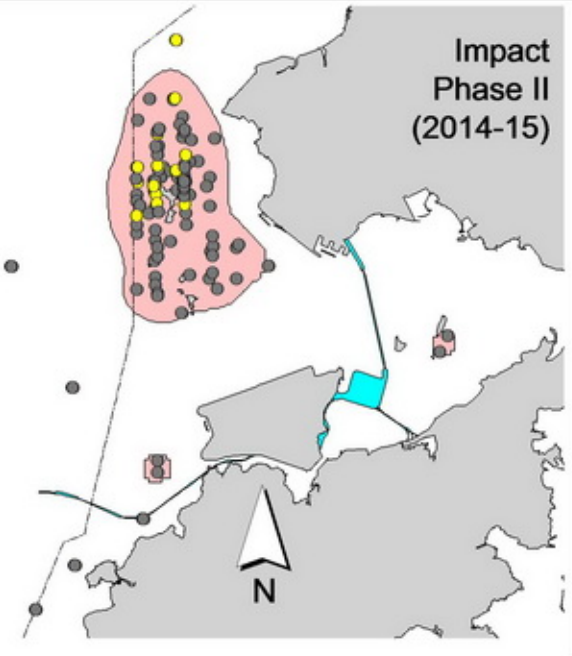
NL182

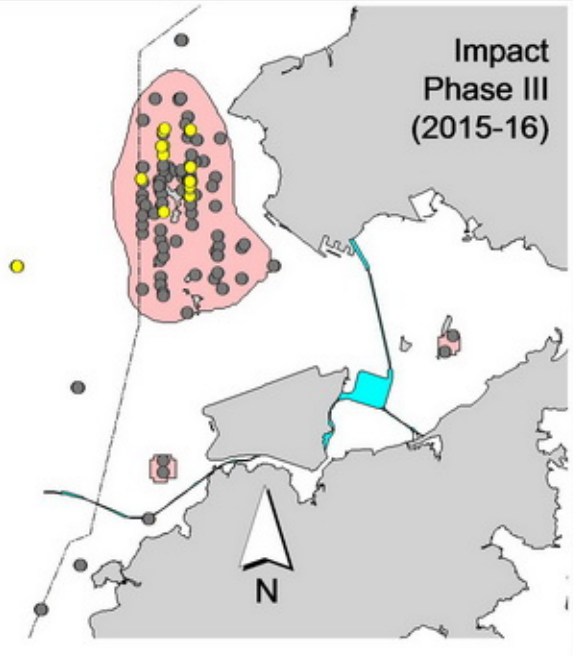
Appendix V. (cont'd)





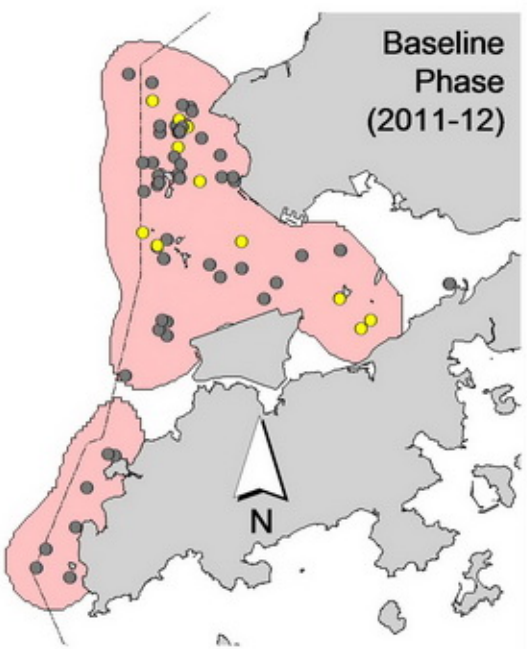


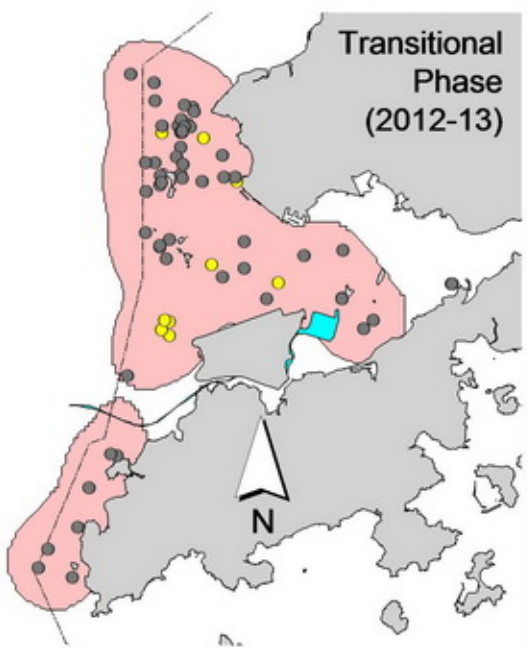


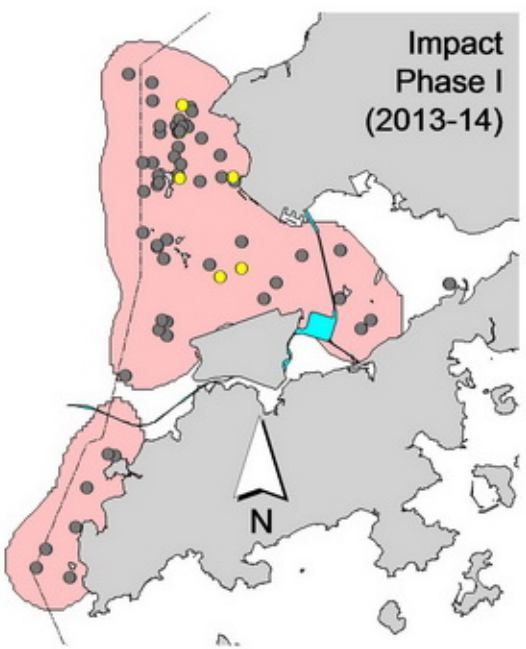


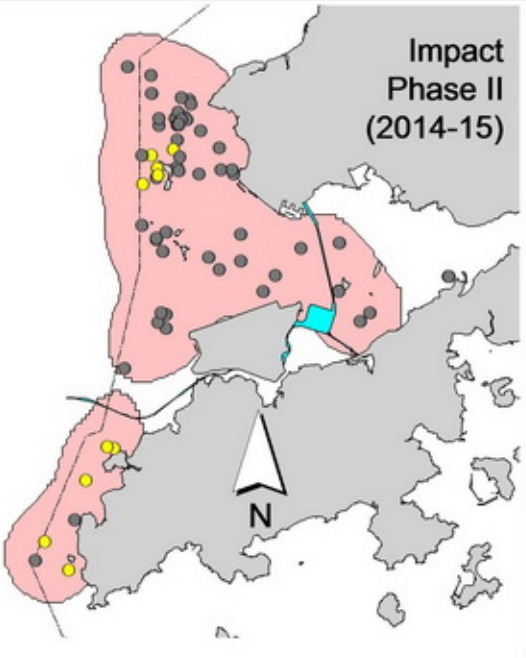
NL202

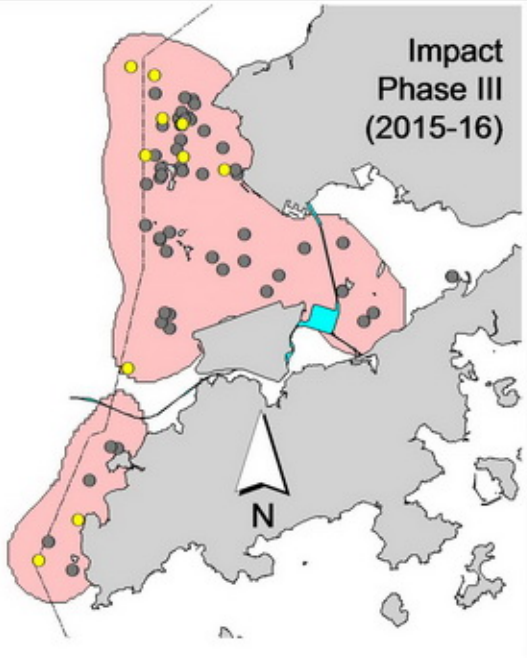
Appendix V. (cont'd)





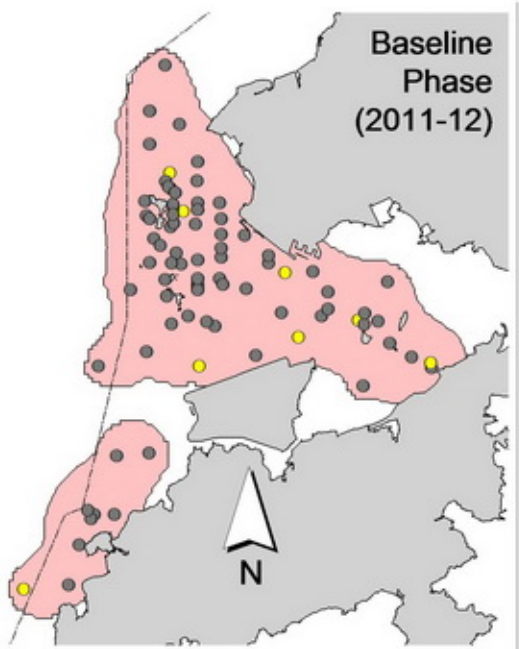


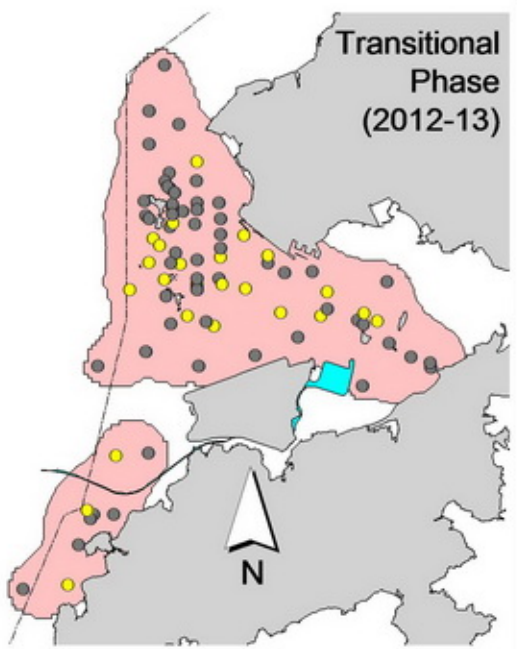


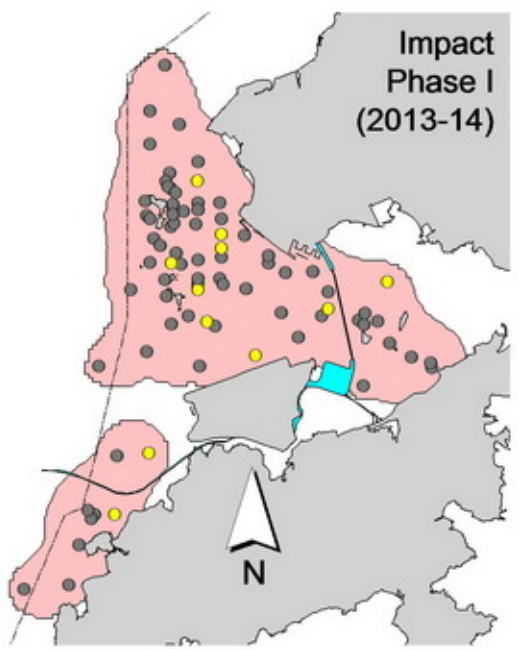


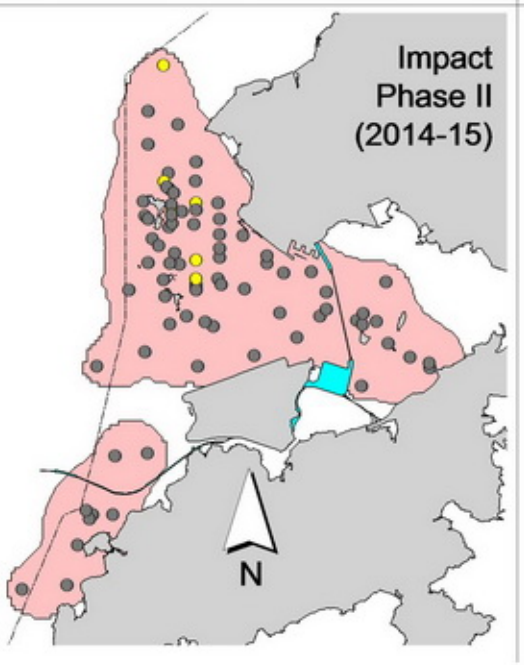
NL210

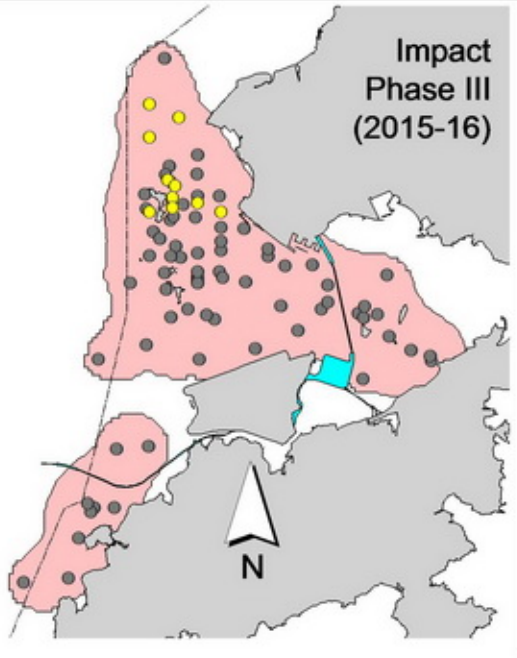
Appendix V. (cont'd)





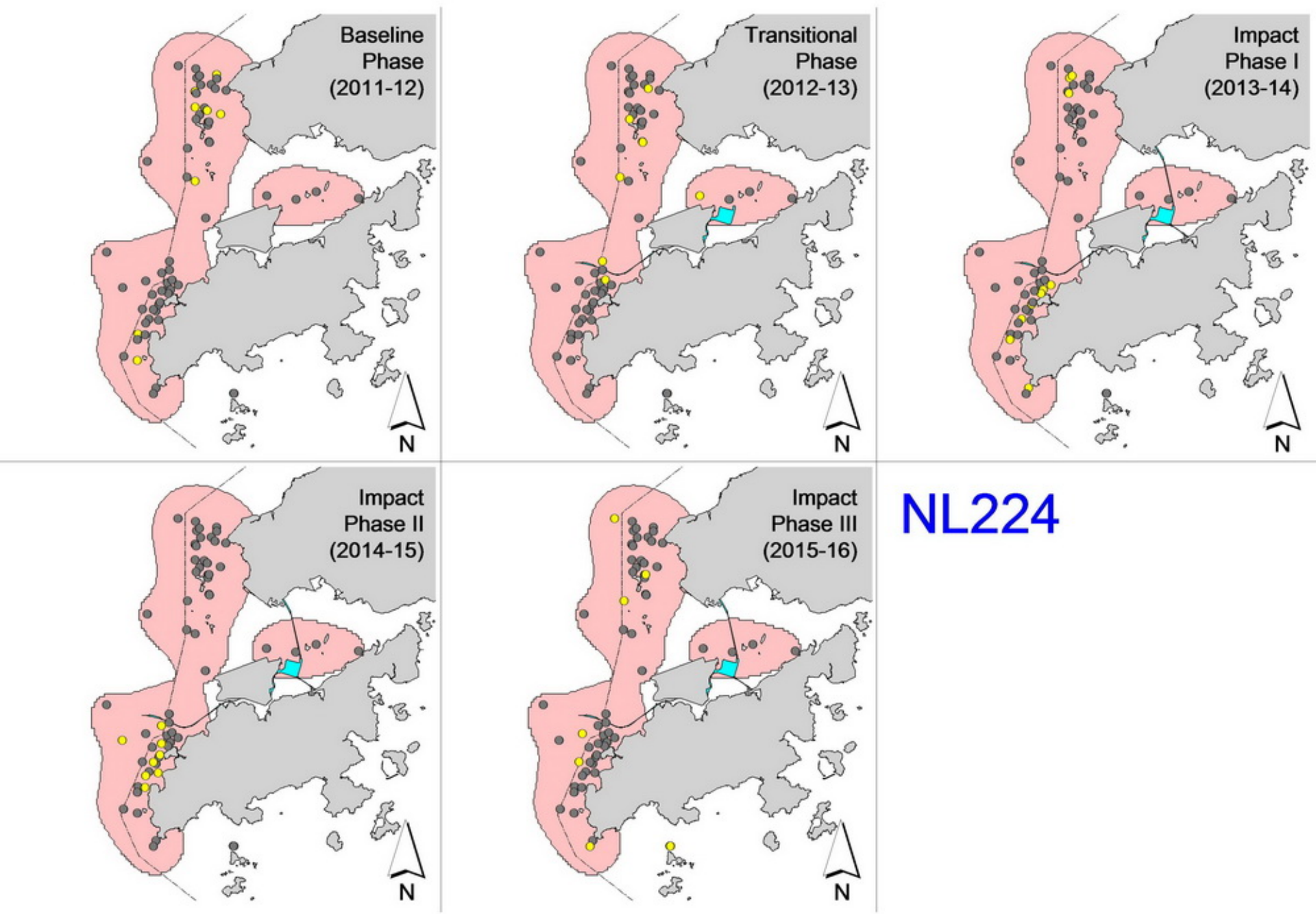




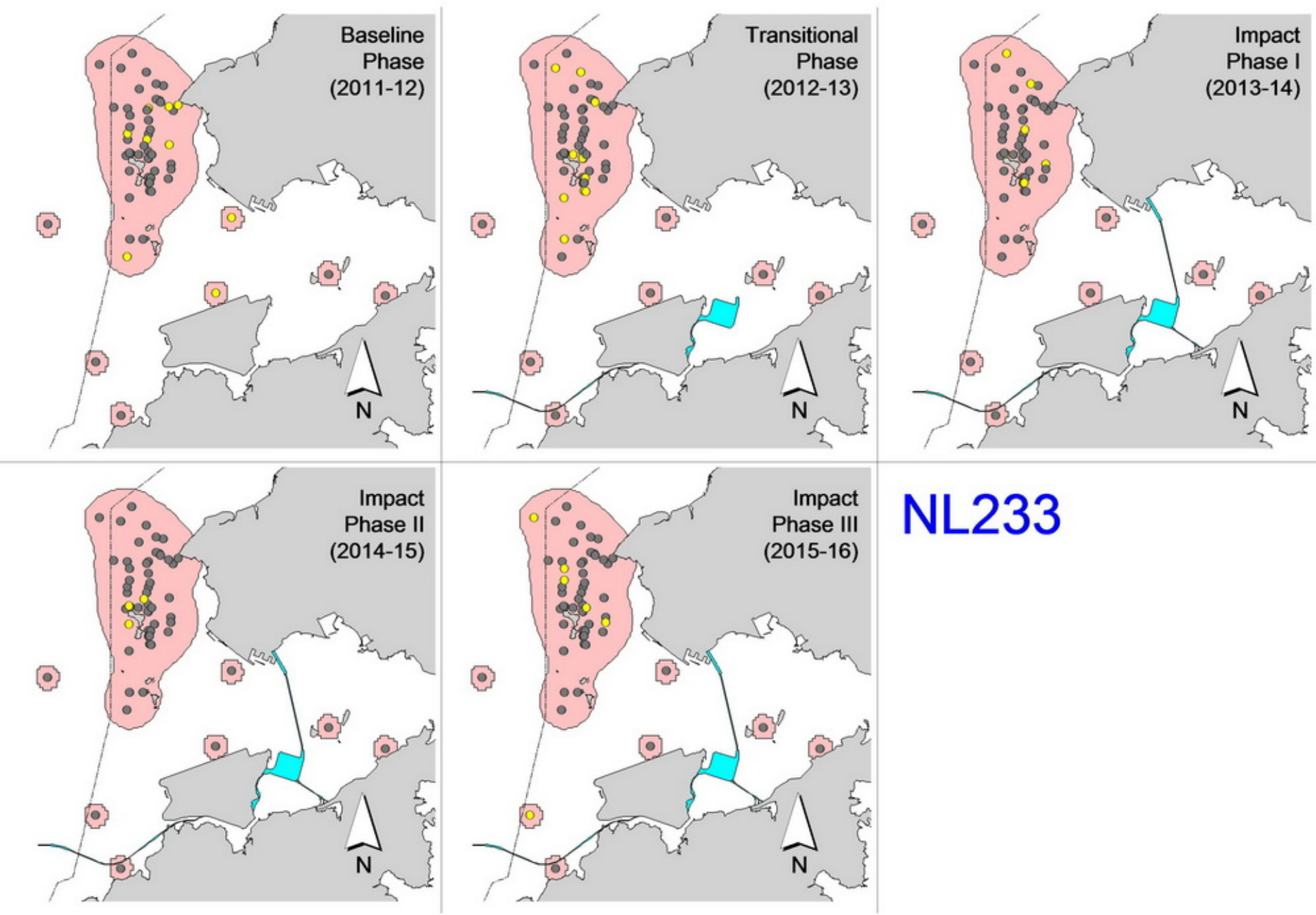


NL220

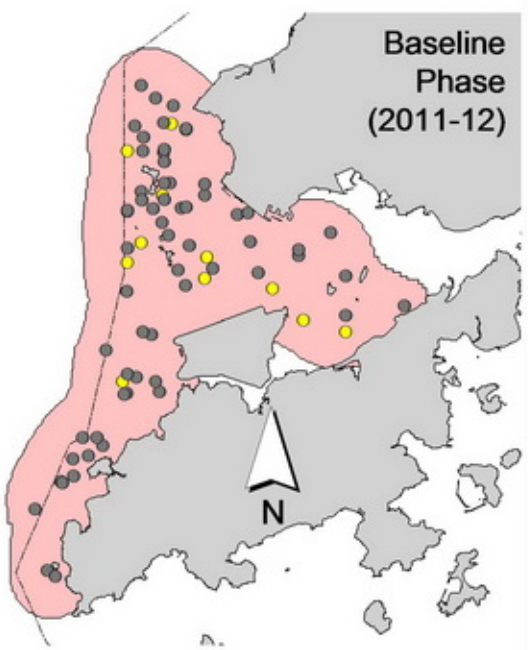
Appendix V. (cont'd)

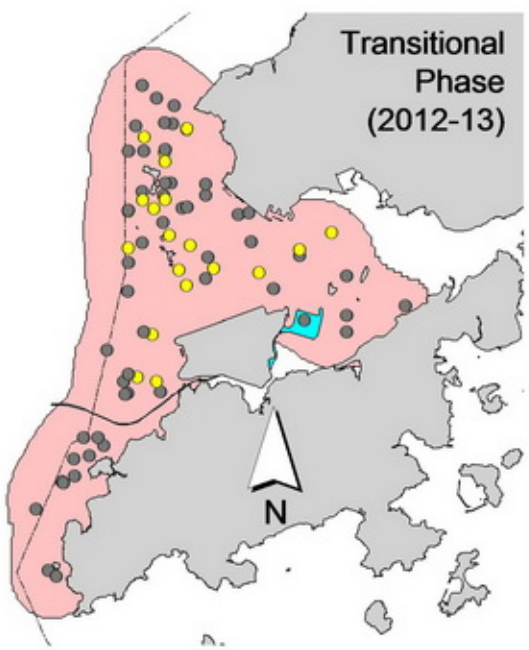


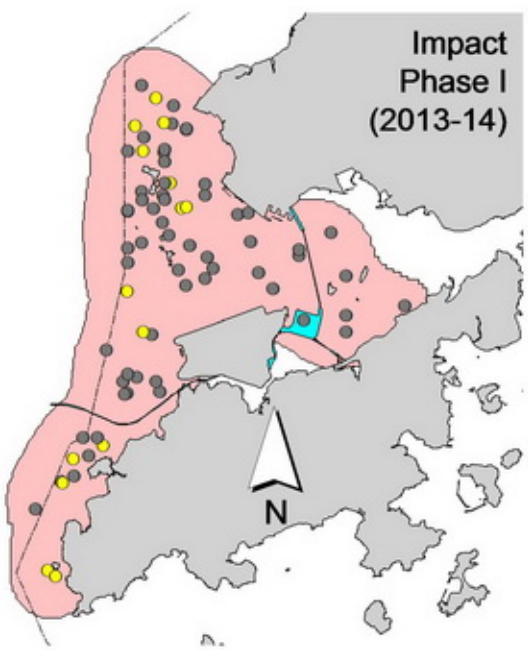
Appendix V. (cont'd)

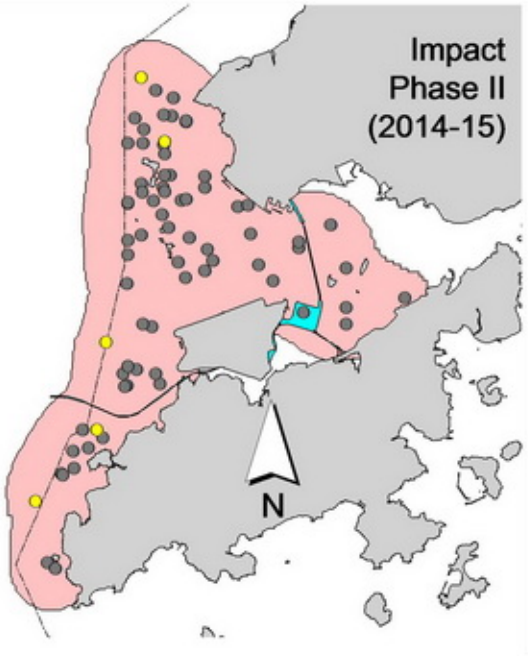


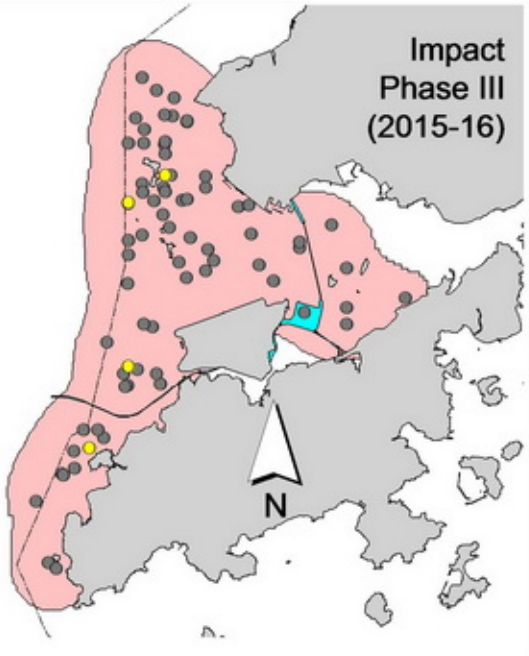
Appendix V. (cont'd)





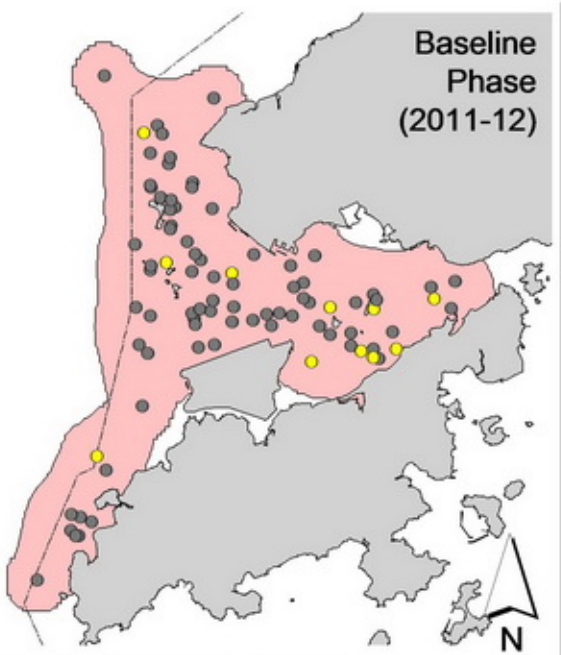


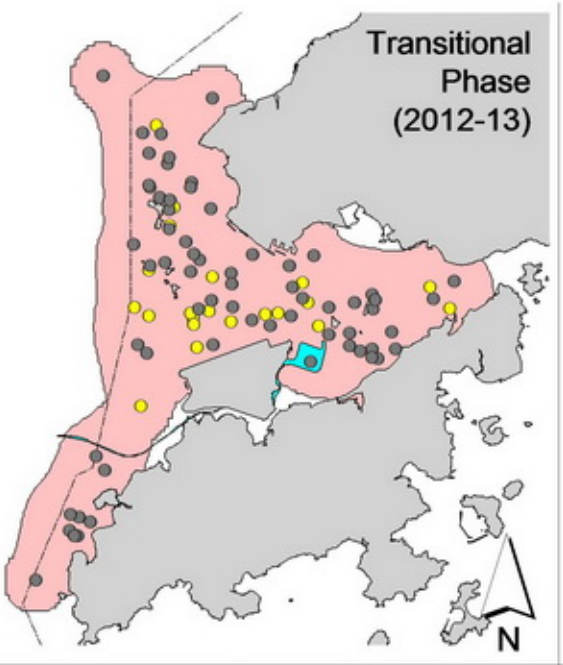


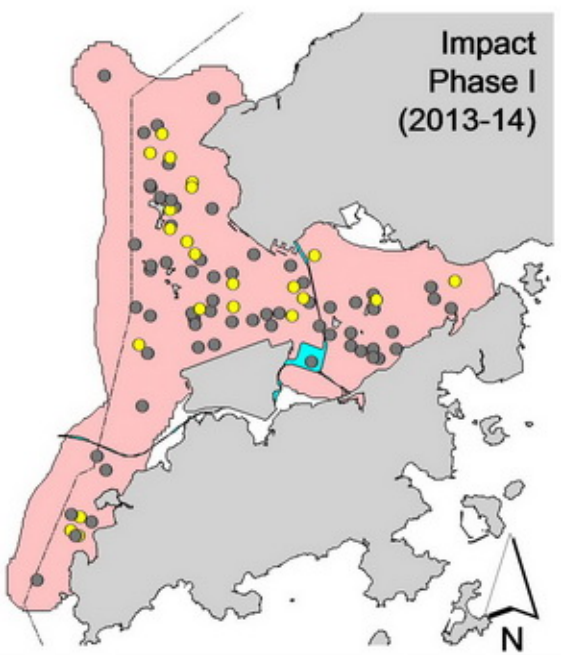


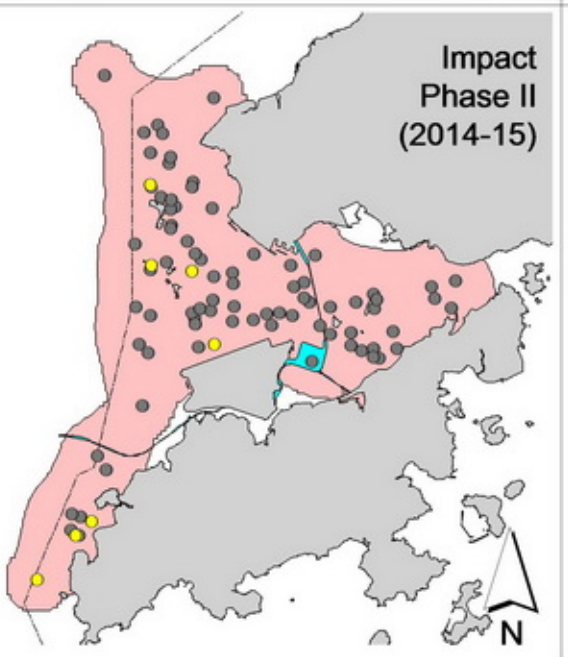
NL259

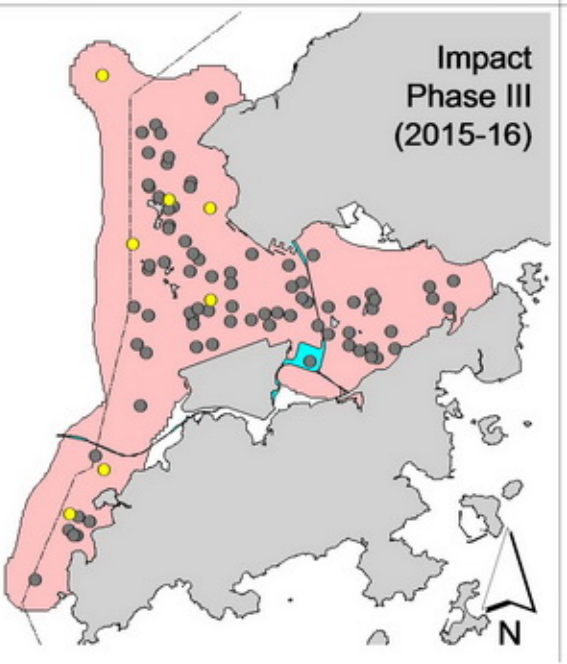
Appendix V. (cont'd)





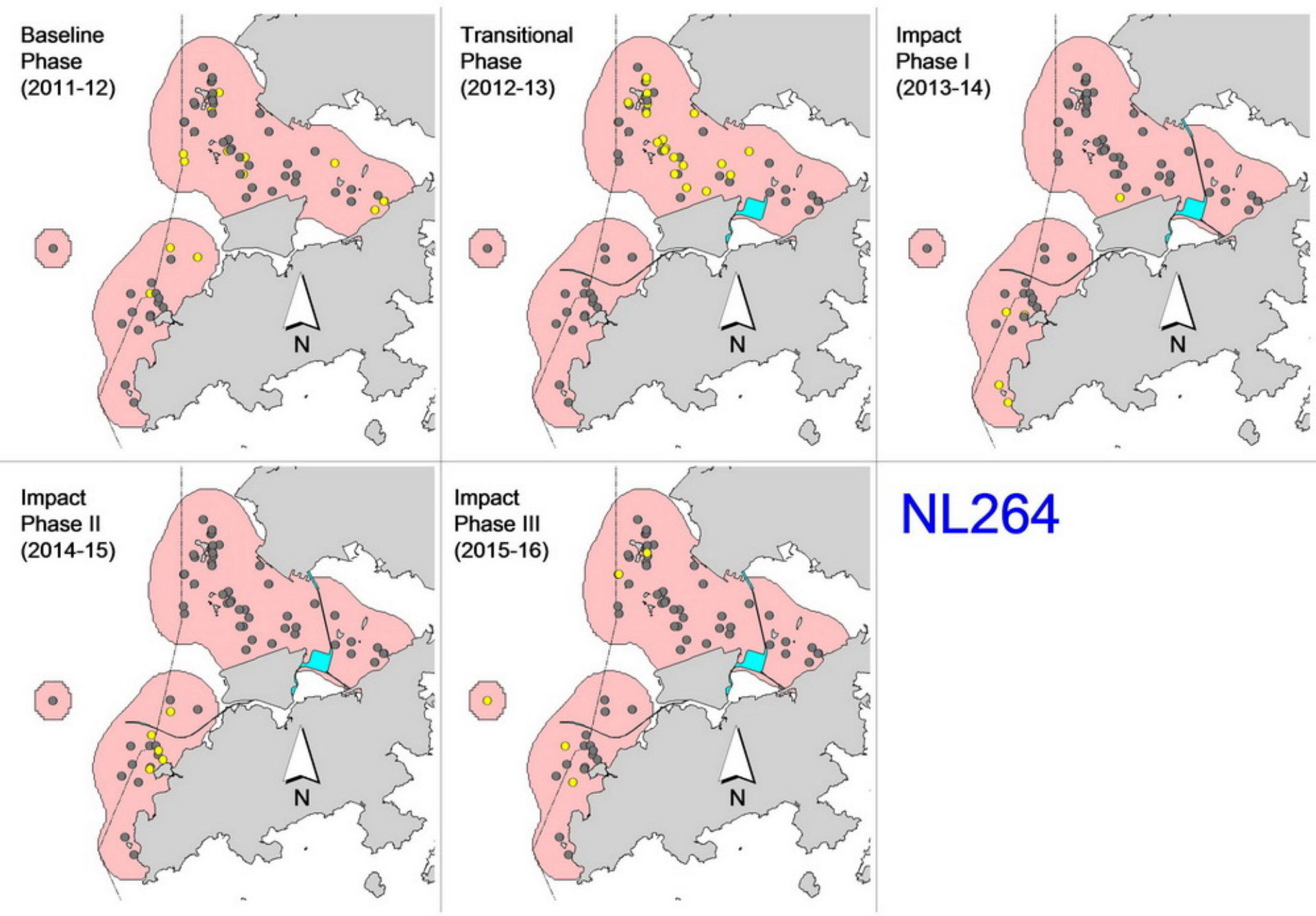




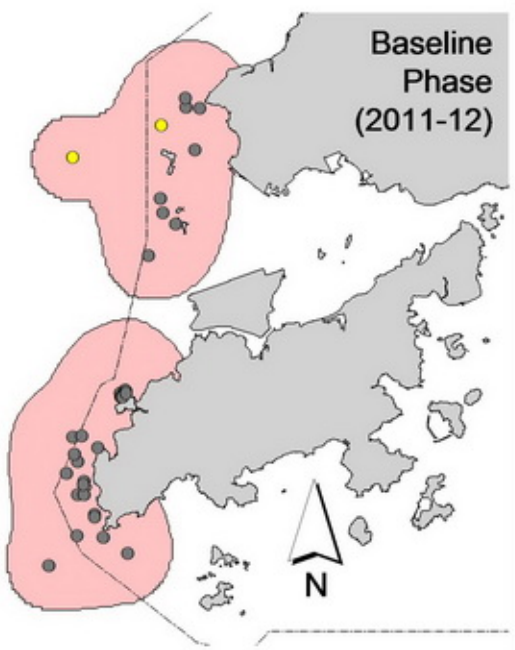


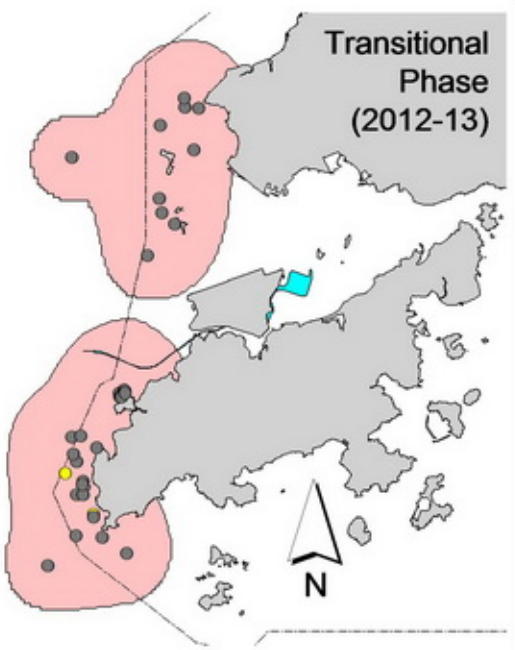
NL261

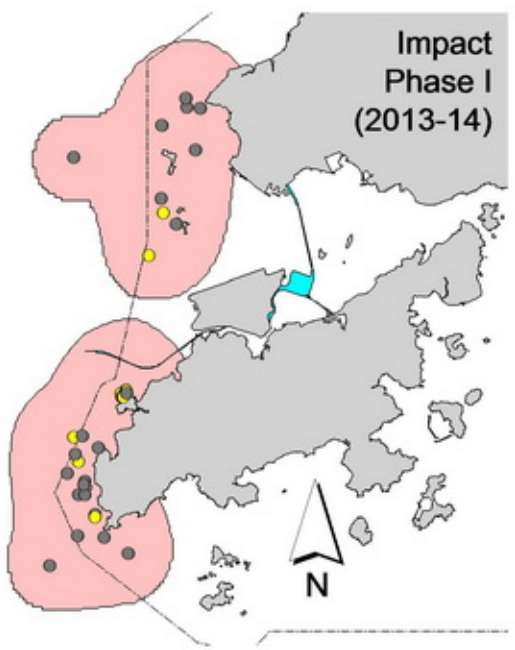
Appendix V. (cont'd)

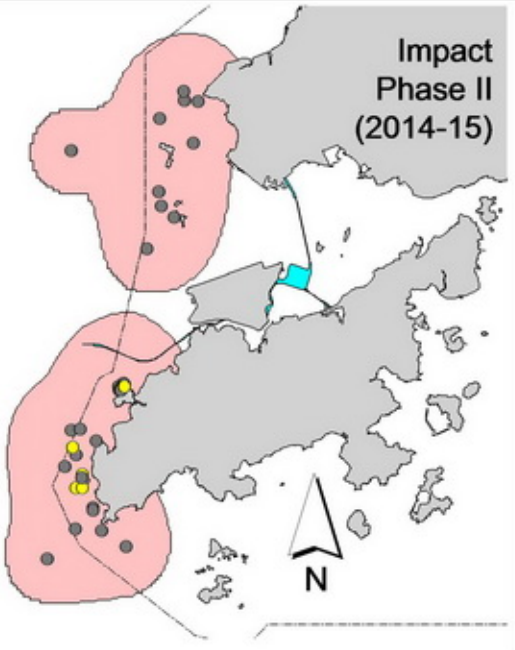


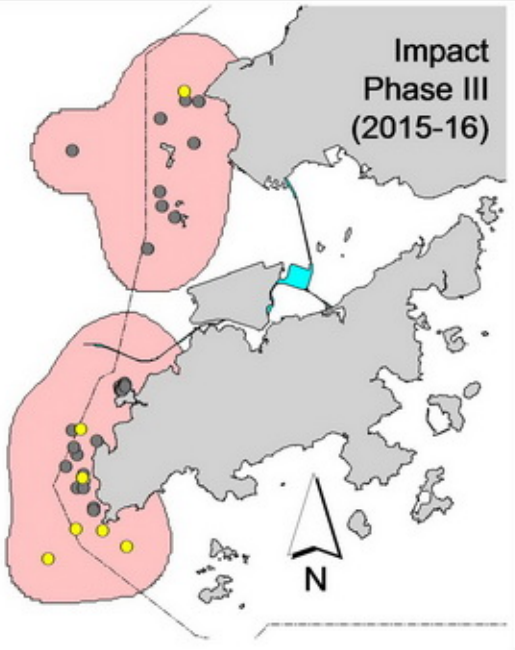
Appendix V. (cont'd)





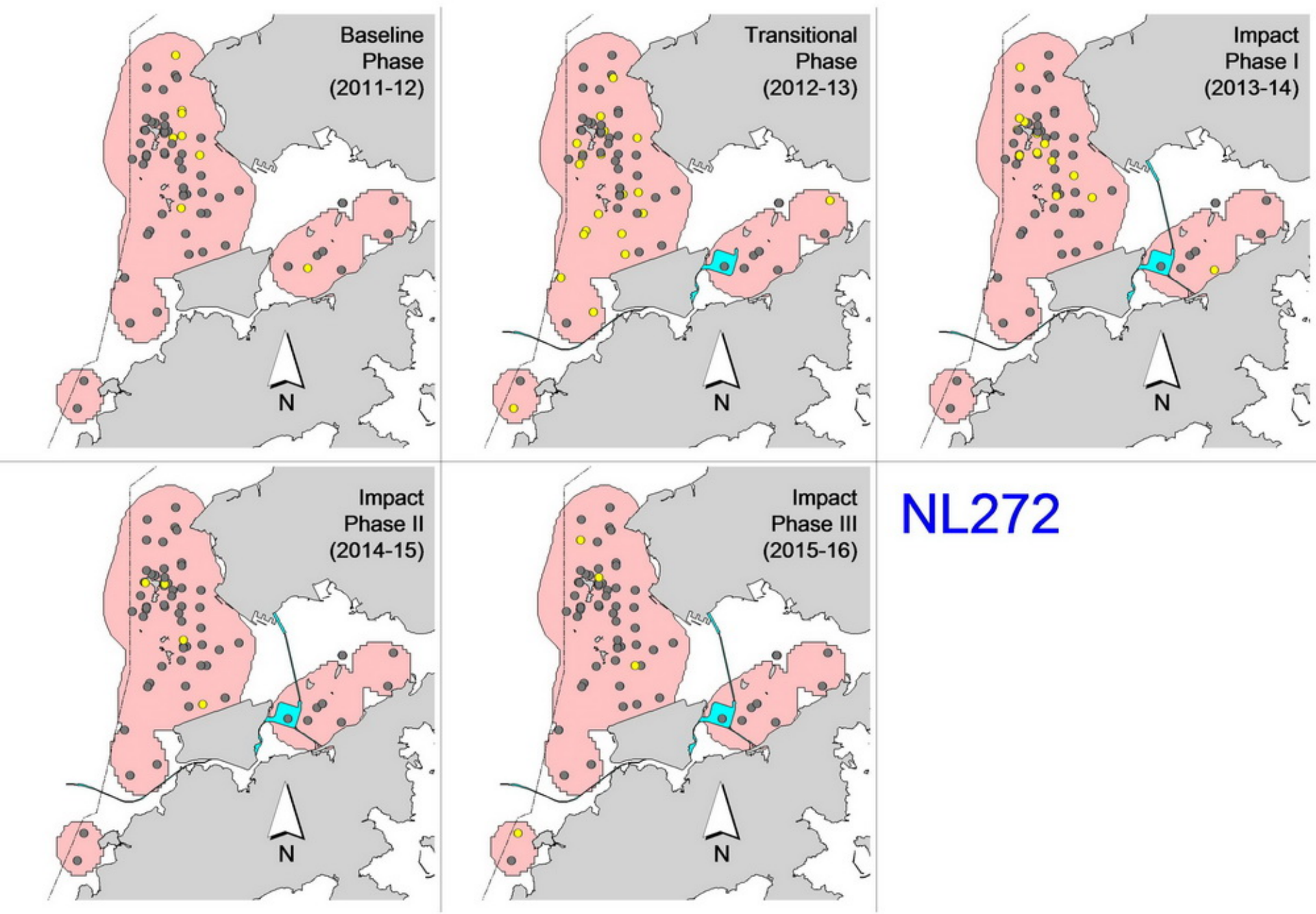




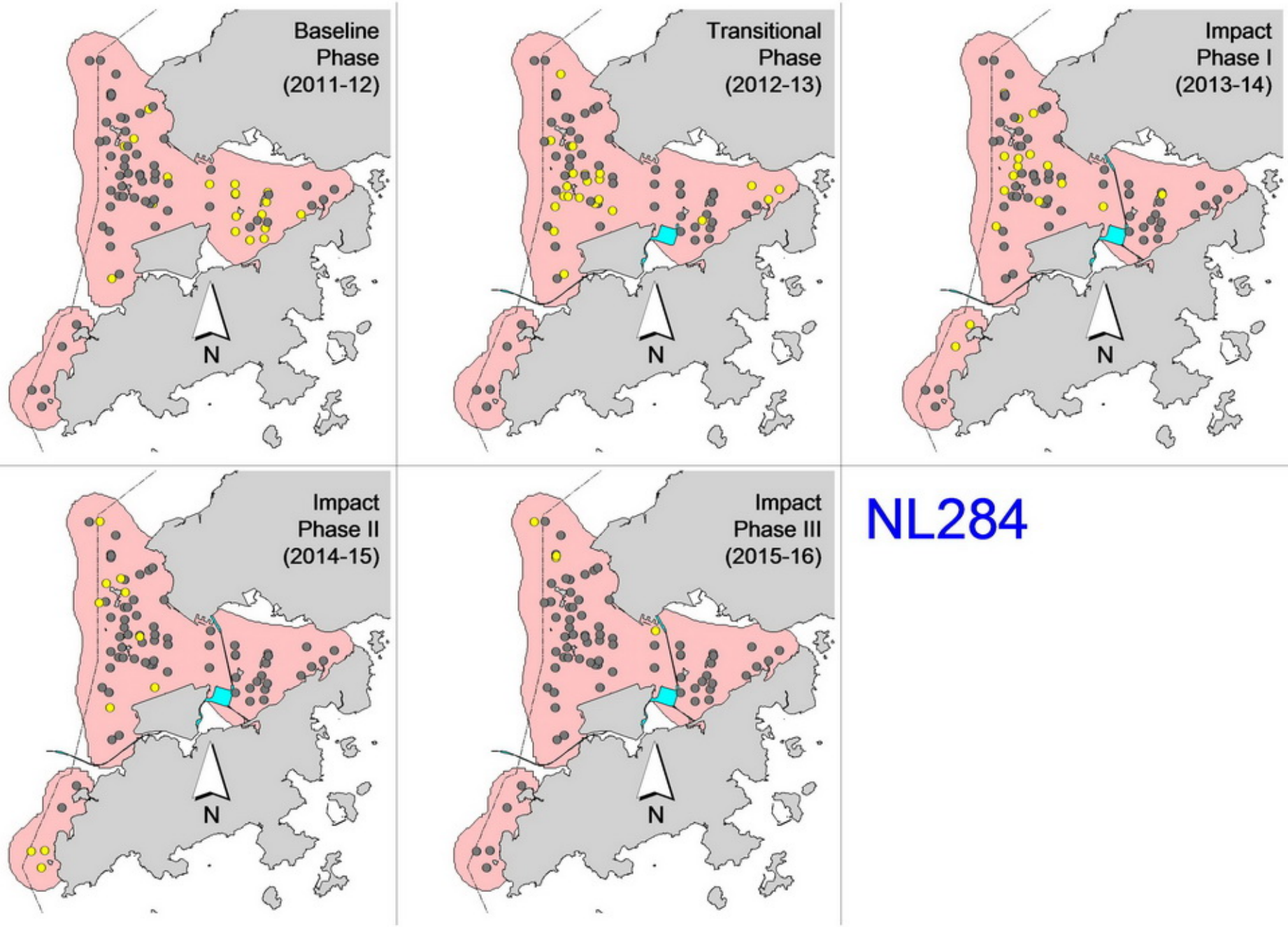


NL269

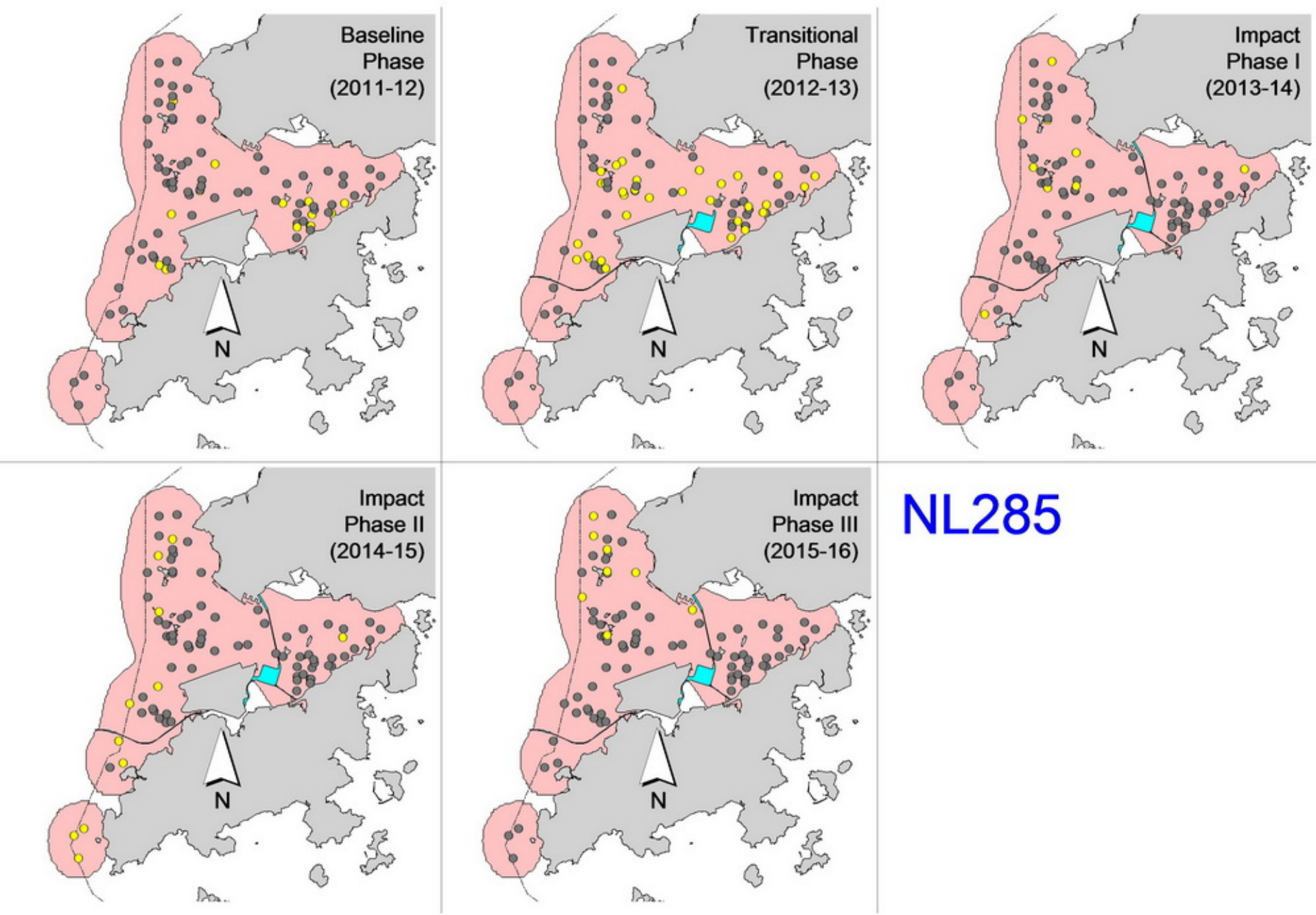
Appendix V. (cont'd)



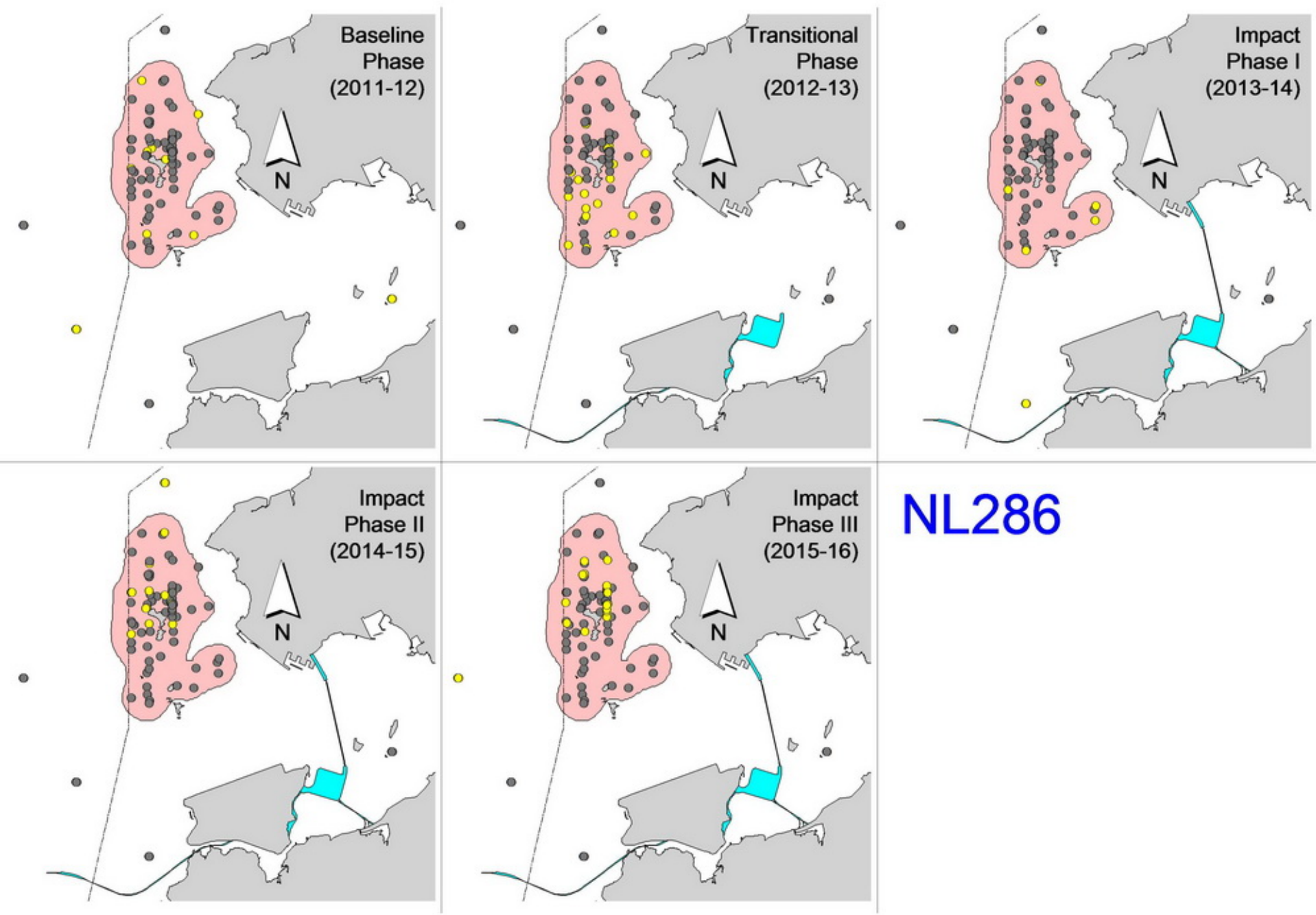
Appendix V. (cont'd)



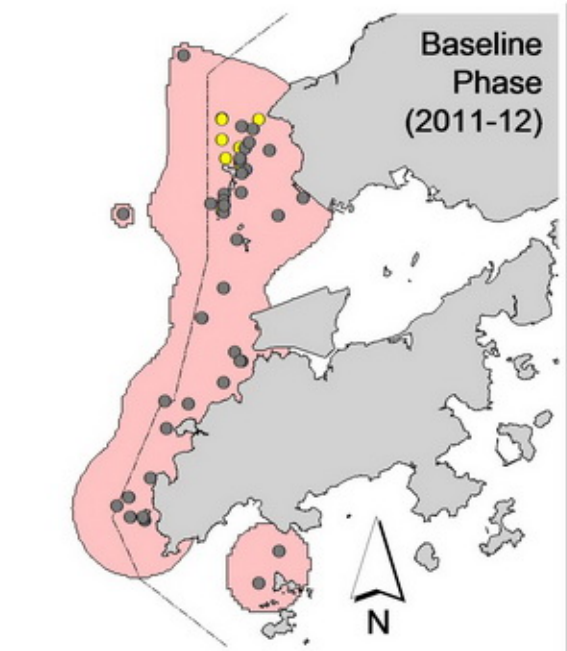
Appendix V. (cont'd)

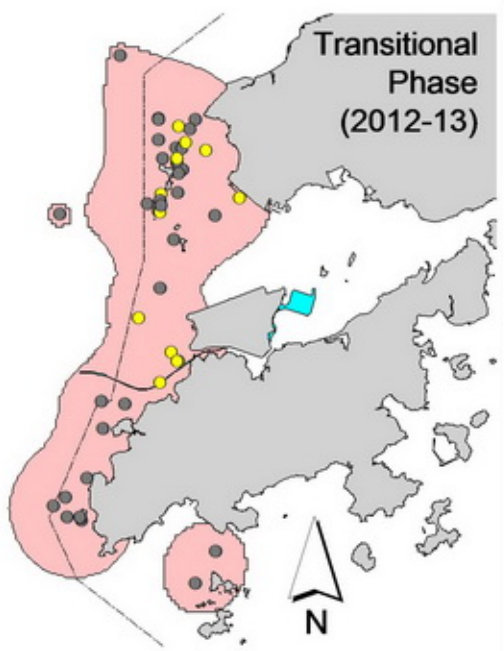


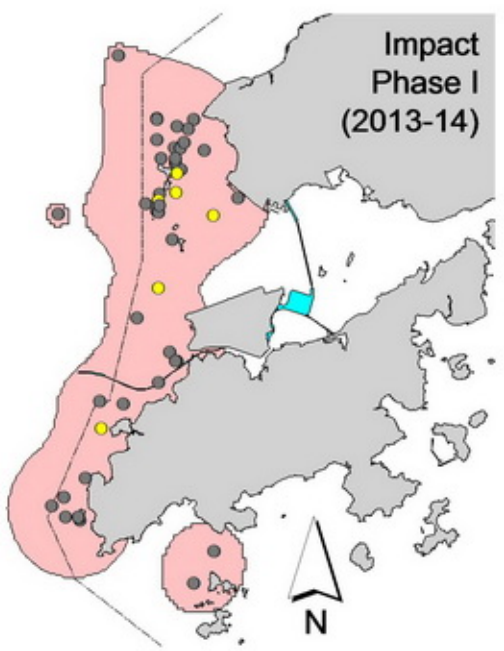
Appendix V. (cont'd)

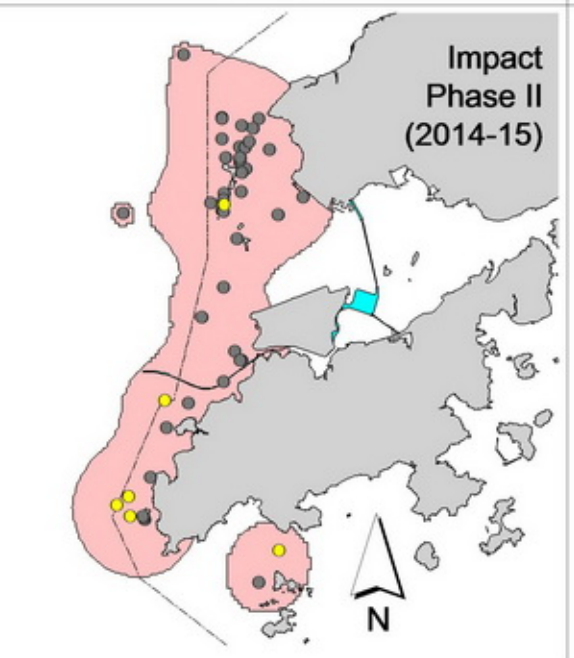


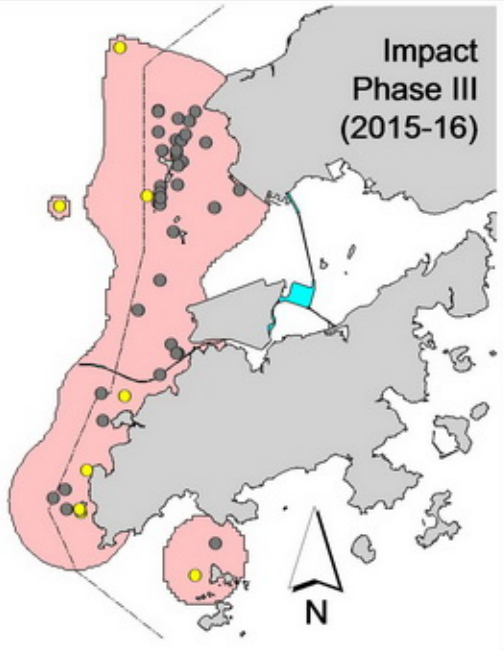
Appendix V. (cont'd)





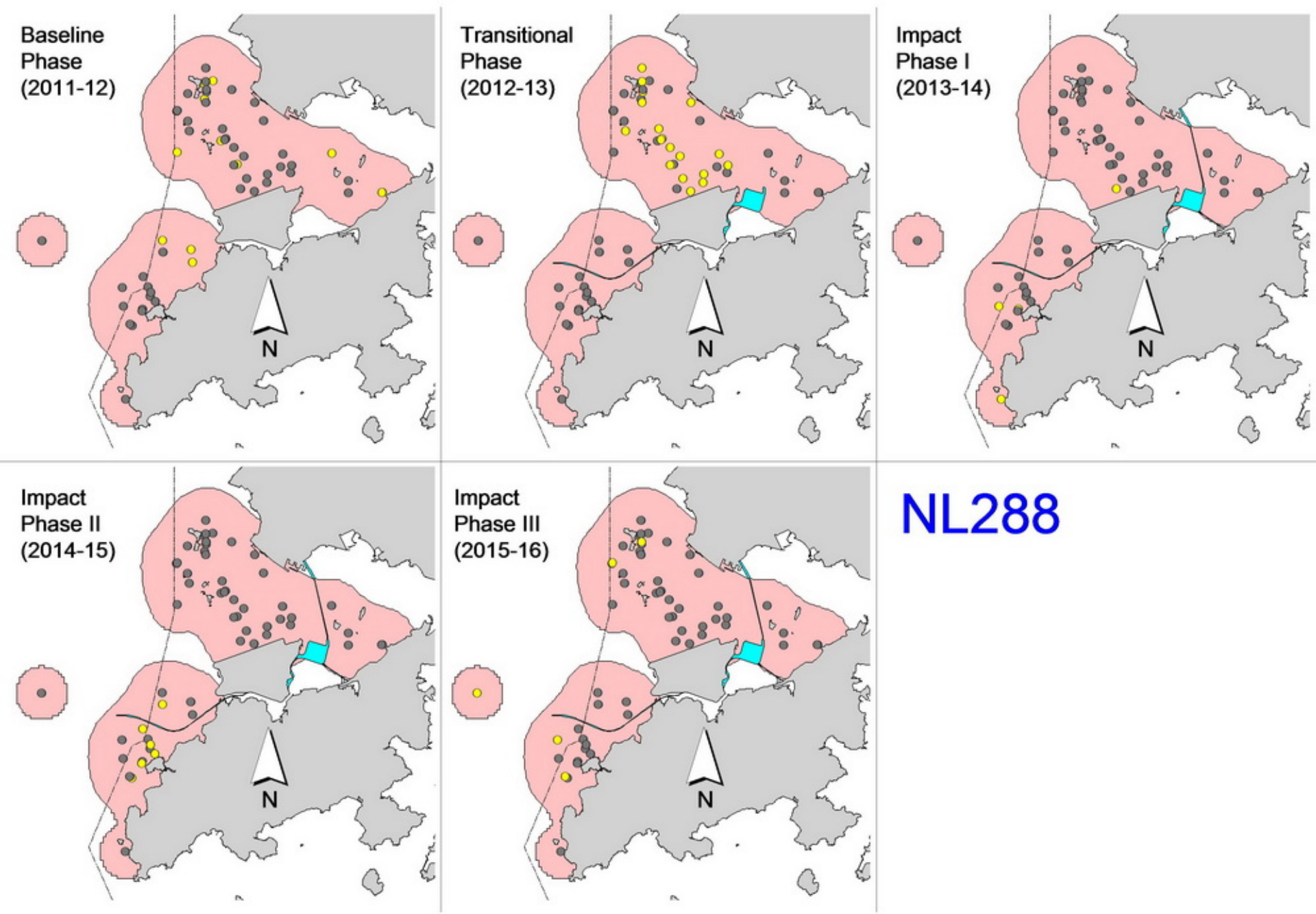




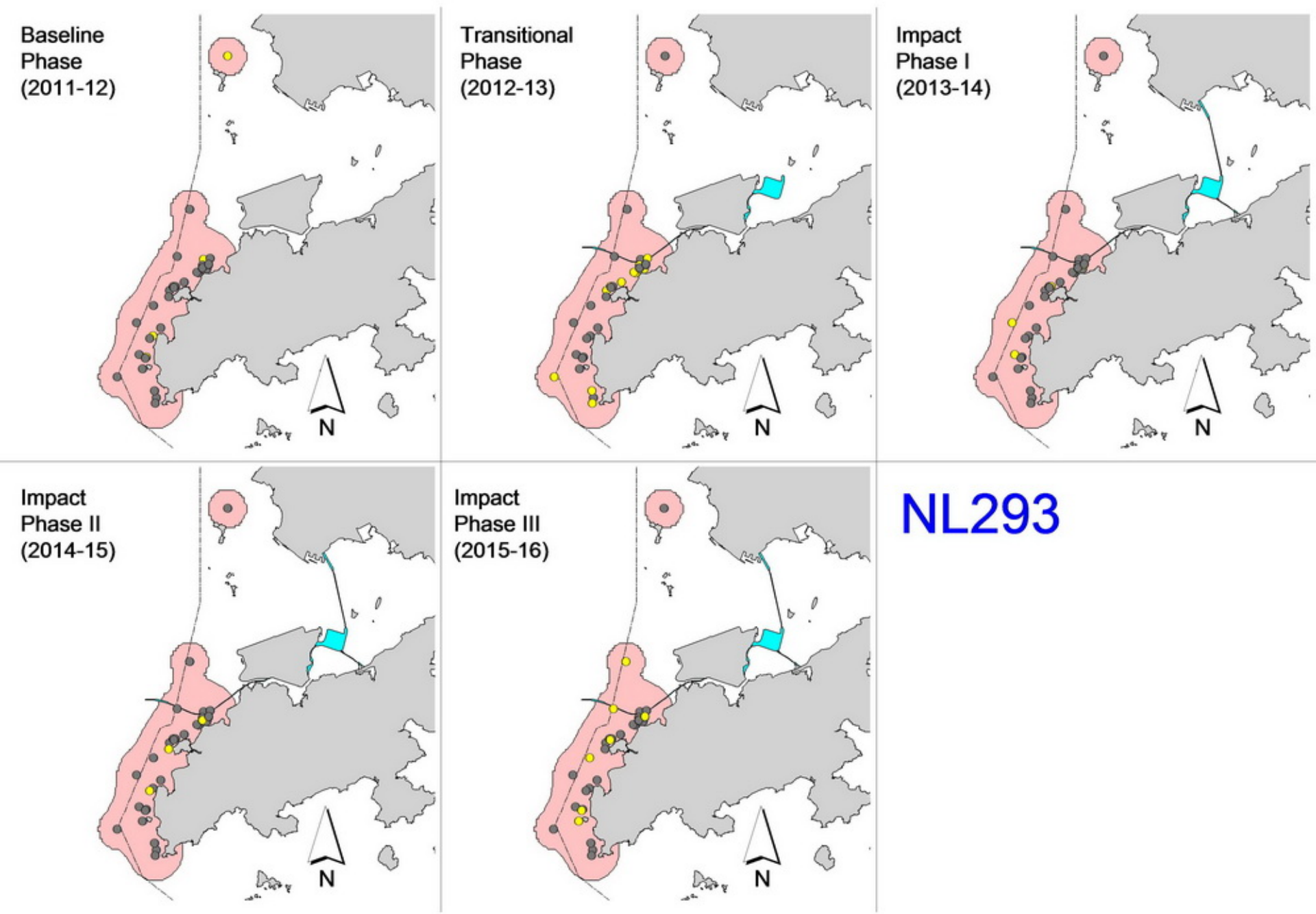


NL287

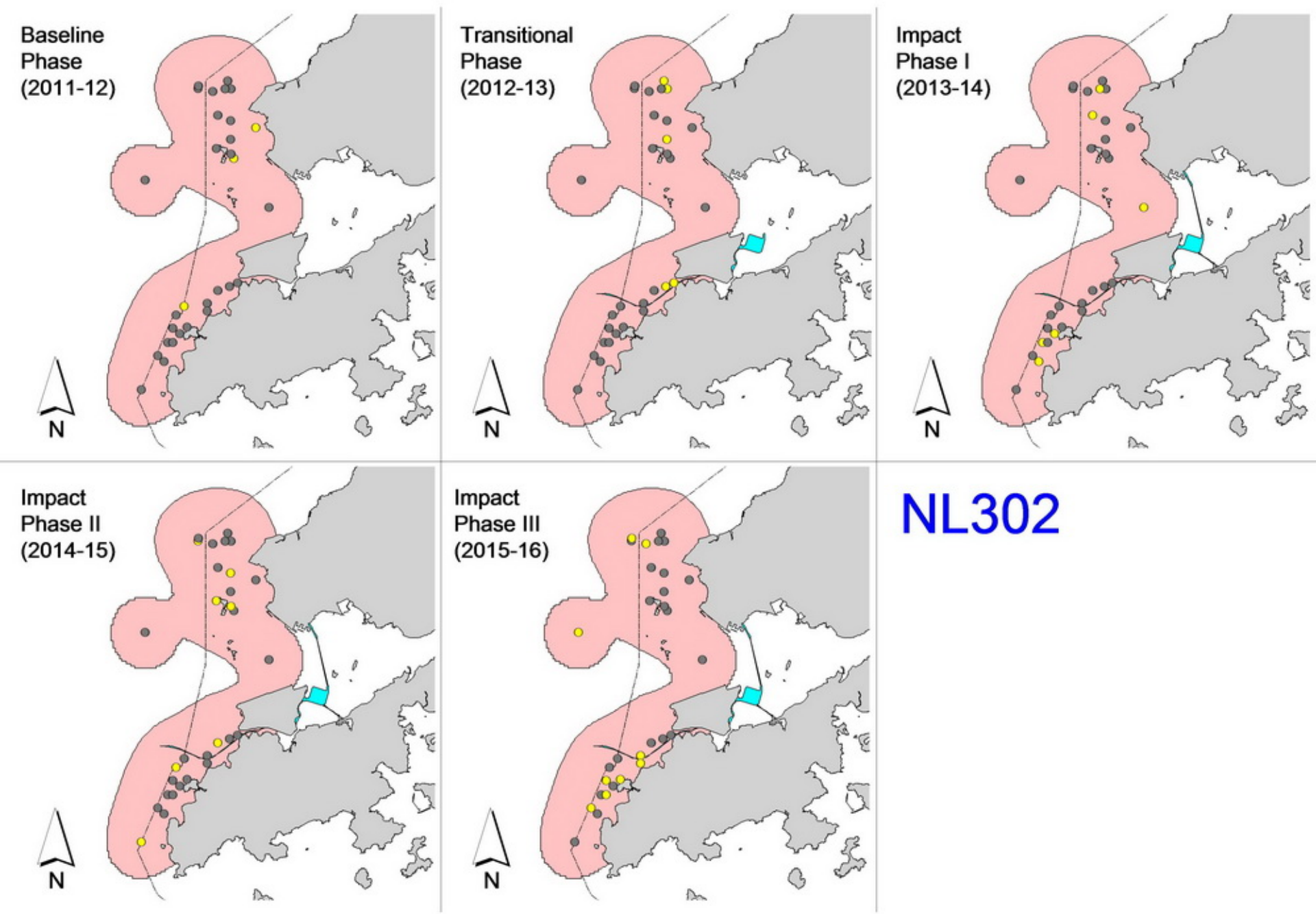
Appendix V. (cont'd)



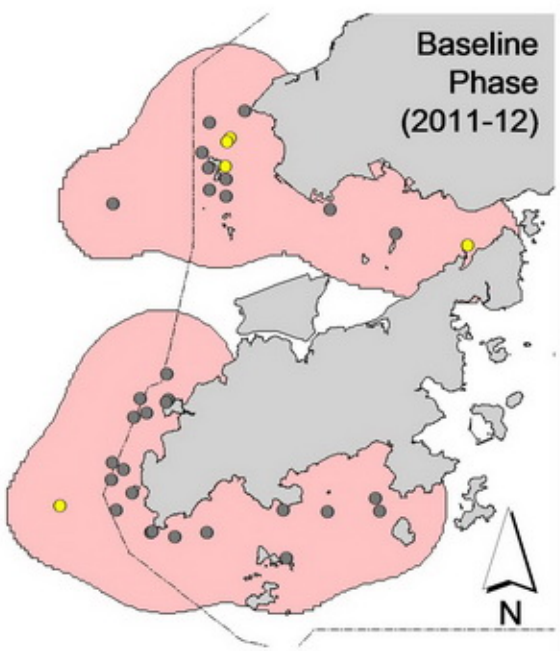
Appendix V. (cont'd)

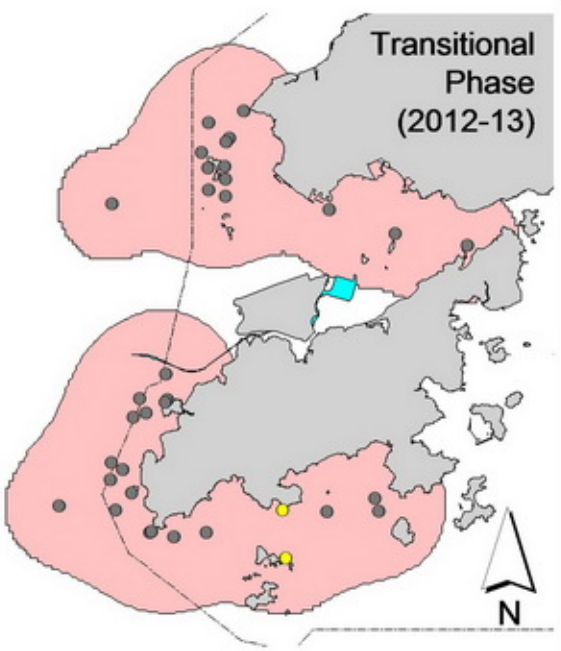


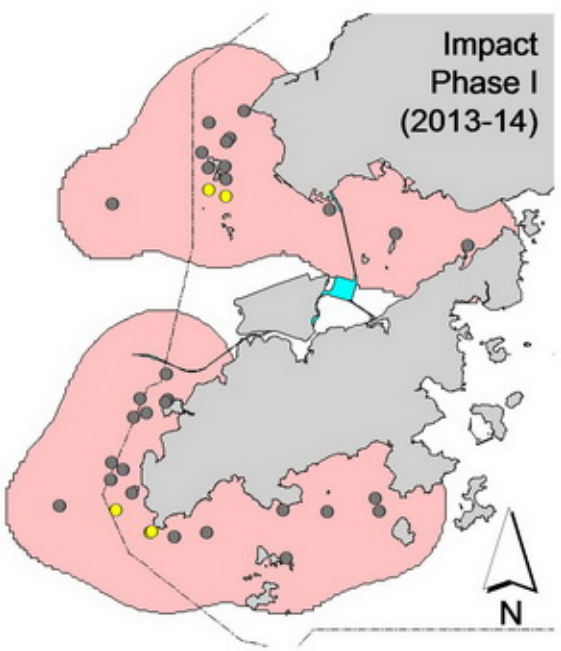
Appendix V. (cont'd)

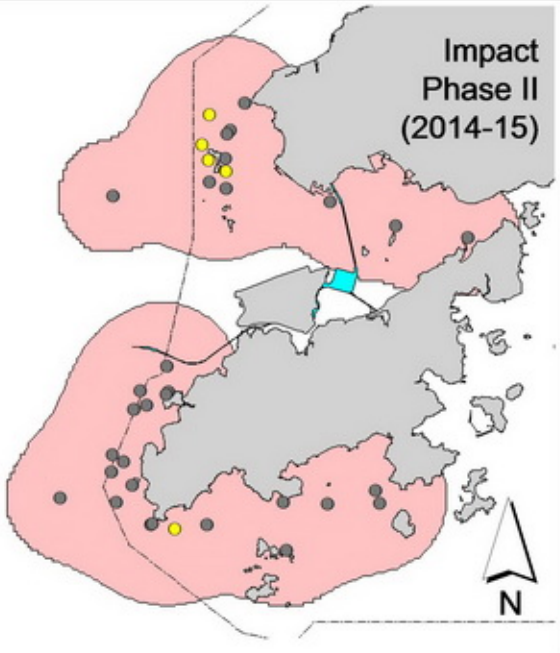


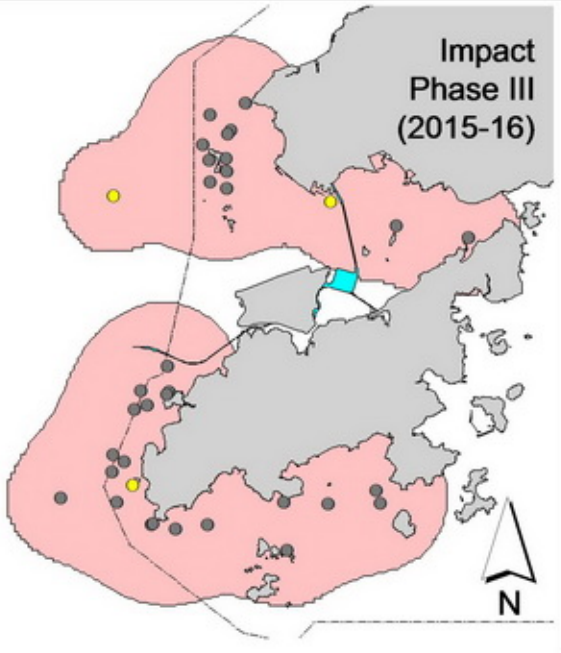
Appendix V. (cont'd)











WL17

Appendix V. (cont'd)