Monitoring of Chinese White Dolphins in Southwest Lantau Waters – Fourth Quarterly Report (December 2015 – February 2016)

Submitted to the Environmental Project Office for the HZMB, HKLR, HZMB HKBCF and TM-CLKL – Investigation

Submitted by
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1. Introduction

1.1. In March 2015, Hong Kong Cetacean Research Project (HKCRP) was appointed by the Environmental Project Office for the HZMB Hong Kong Projects to undertake a monitoring study of Chinese White Dolphins in Southwest Lantau (SWL) waters.

1.2. The objectives of the monitoring study are to quantify the abundance and density of Chinese White Dolphins in SWL waters, to identify individuals during the monitoring surveys, and to analyze their range use and movement patterns in Hong Kong and the wider Pearl River Estuary waters.

1.3. The monitoring study will supplement the on-going EM&A monitoring results of the HZMB Hong Kong Projects in North and West Lantau waters, and provide a more complete picture of dolphin usage and movements between different survey areas in western Hong Kong waters.

1.4. The present report is the fourth quarterly progress report under this dolphin monitoring study submitted to the Environmental Project Office, summarizing the results of the survey findings during the quarterly period of December 2015 to February 2016.

2. Monitoring Methodology

2.1. Vessel-based Line-transect Survey

2.1.1. According to the requirement of the technical proposal submitted to the Environmental Project Office, the present dolphin monitoring programme should cover all transect lines

in SWL survey area (see Figure 1) once per month upon instruction. The co-ordinates of all transect lines conducted during the dolphin monitoring survey are shown in Table 1.

Table 1. Co-ordinates of transect lines in SWL survey area (corresponding to transect line layout as shown in Figure 1)

Line #		Northing	Easting		Line #		Northing	Easting
SWL001	1	806180	802510		SWL007	13	807380	808520
	2	804250	802510			14	805600	808520
SWL002	3	806710	803480			15	804400	808520
	4	803450	803480			16	803000	808520
SWL003	5	807270	804500			17	802100	808520
	6	802690	804500			18	800470	808520
SWL004	7	807590	805450		SWL008	19	807380	809550
	8	802295	805450			20	805050	809550
SWL005	9	808490	806500			21	804400	809550
	10	801410	806500			22	800470	809550
SWL006	11	808500	807430		SWL009	23	807380	810550
	12	801250	807430			24	800470	810550
					SWL010	25	809410	811510
						26	801470	811510

2.1.2. The HKCRP 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 19 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2014). For each monitoring vessel survey, a 15-m inboard vessel with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area.

2.1.3. Two experienced observers from HKCRP (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited different transect lines at a constant speed of 13-15 km per hour. The data recorder searched with unaided eyes and filled out the datasheets, while the primary observer searched for dolphins and porpoises continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea

ahead of the vessel, between 270° and 90° (in relation to the bow, which is defined as 0°). One to two additional experienced observer was 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, position (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance traveled in each series (a continuous period of search effort) with the assistance of a handheld GPS (*Garmin eTrex Legend*).

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

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

2.1.7. Survey effort being conducted along the parallel transect lines that were perpendicular to the coastlines (as indicated in Figure 1) was labeled as “primary” survey effort, while the survey effort conducted along the connecting lines between parallel lines as well as the section around the Soko Islands was labeled as “secondary” survey effort. 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 survey team would end effort and approach the group slowly from the side and behind to take photographs of them. Every attempt was made to photograph every dolphin in the group, and even photograph both sides of the dolphins, since the colouration and markings on both sides may not be symmetrical.

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

computer.

2.2.3. All digital images taken in the field were first examined, and those containing potentially identifiable individuals were sorted out. These photographs would then be examined in greater detail, and were carefully compared to the existing Chinese White Dolphin photo-identification catalogue maintained by HKCRP since 1995. For individual dolphins that are not readily identifiable from the catalogue but have distinct features on their bodies, they will be placed in a pool of "potential new individuals", with decision being made at the end of each year on whether any of them should be incorporated into the photo-ID catalogue.

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

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

2.3. Data analysis

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

2.3.2. Encounter rate analysis – Encounter rates of Chinese white dolphins (number of on-effort sightings per 100 km of survey effort (ER(STG)), and total number of dolphins sighted on-effort per 100 km of survey effort (ER(ANI))) were calculated in SWL survey area in relation to the amount of survey effort conducted during each month of monitoring survey. Only data collected under Beaufort 3 or below would be used for encounter rate analysis. Dolphin encounter rates were calculated in two ways: 1) using primary survey effort alone; and 2) using both primary and secondary survey effort collected.

2.3.3. Quantitative grid analysis on habitat use – To conduct quantitative grid analysis of habitat use, positions of on-effort sightings of Chinese White Dolphins collected during the

quarterly impact phase monitoring period were plotted onto 1-km^2 grids in SWL survey area on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS. Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period. For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

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

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

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

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

2.3.5. Line-transect analysis –Density and abundance of Chinese White Dolphins in SWL in

2015 were estimated by line-transect analysis using systematic line-transect data collected under the present study. For the analysis, survey effort in each single survey day was used as the sample. Estimates were calculated from dolphin sightings and effort data collected during conditions of Beaufort 0-3, using line-transect methods. The estimates were made using the computer program DISTANCE Version 6.0, Release 2. The following formulae were used to estimate density, abundance, and their associated coefficient of variation:

$$\hat{D} = \frac{n\,\hat{f}(0)\,\hat{E}(s)}{2\,L\,\hat{g}(0)}$$

$$\hat{N} = \frac{n\,\hat{f}(0)\,\hat{E}(s)\,A}{2\,L\,\hat{g}(0)}$$

$$\widehat{CV} = \sqrt{\frac{\widehat{\mathrm{var}}(n)}{n^2} + \frac{\widehat{\mathrm{var}}[\hat{f}(0)]}{[\hat{f}(0)]^2} + \frac{\widehat{\mathrm{var}}[\hat{E}(s)]}{[\hat{E}(s)]^2} + \frac{\widehat{\mathrm{var}}[\hat{g}(0)]}{[\hat{g}(0)]^2}}$$

where D = density (of individuals),
n = number of on-effort sightings,
f(0) = trackline probability density at zero distance,
E(s) = unbiased estimate of average group size,
L = length of transect lines surveyed on effort,
g(0) = trackline detection probability,
N = abundance,
A = size of the survey area,
CV = coefficient of variation, and
var = variance.

A strategy of selective pooling and stratification was used in order to minimize bias and maximize precision in making the estimates of density and abundance. Distant sightings were truncated to remove outliers and accommodate modeling, and size-bias corrected estimate of group size was calculated by regressing $\log_e$ of group size against distance. Three models (uniform, half-normal and hazard rate) were fitted to the data of perpendicular distances. The model with the lowest values of Akaike's Information Criterion (AIC) was chosen as the best model and used to estimate f(0) and the resulting dolphin density and abundance.

2.3.6. Ranging pattern analysis – Location data of individual dolphins that occurred during the three-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 (utilization distribution) level. If the sample size (number of re-sightings of each individual within the study period) were adequate (i.e. a minimum of 15 re-sightings, Hung 2008), the core areas of individuals at two different levels (50% and 25% UD) were also examined to investigate their range use in greater details. To examine the movement pattern within individual ranges, the locations of re-sightings made in the present quarterly period were visually examined and compared to those made in recent years, in order to determine whether any apparent shift in range use occurs in the present quarterly period.

3. Monitoring Results

3.1. Summary of survey effort and dolphin sightings

3.1.1. During the period of December 2015 to February 2016, three sets of systematic line-transect vessel surveys were conducted on December 14th, January 18th and February 17th to cover all transect lines in SWL survey area once per month. In addition, eight line-transect surveys were also conducted under the AFCD long-term marine mammal monitoring programme in SWL survey area on December 3rd, December 18th, December 30th, January 5th, January 26th, February 4th, February 19th and February 23rd (see Appendix I and Table 2). Such AFCD monitoring survey data were also incorporated into the present study for various analyses.

3.1.2. For the present study alone, a total of 212.13 km of survey effort was collected in SWL survey during this quarter (Table 2), with 98.4% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility) (Appendix I). The total survey effort conducted on primary and secondary lines were 163.84 km and 48.29 km respectively during the three sets of surveys. For the combined monitoring dataset from both the present study and AFCD monitoring study, a total of 429.85 km of survey effort was collected in SWL waters during December 2015 to February 2016.

3.1.3. During the present quarter, 18 groups of 62 Chinese White Dolphins were sighted form the present study's surveys and AFCD monitoring surveys conducted in SWL survey area (Table 2, Appendix II). All dolphin sightings were made during on-effort search.

Eleven of the 18 on-effort sightings were made on primary lines, while the other seven were made on secondary lines.

Table 2. Summary table of survey effort and dolphin sightings collected during the present quarter (i.e. December 2015 – February 2016)

Month	Date	Total Distance (km)	No. of CWD Sighting	No. of Individual
HYD				
December 2015	December 14th	71.00	2	4
January 2016	January 18th	70.26	4	20
February 2016	February 17th	70.87	3	7
	Total	***212.13***	***9***	***31***
AFCD				
December 2015	December 3rd, 18th, 30th	91.53	5	20
January 2016	January 5th, 26th	56.96	2	8
February 2016	February 4th, 19th, 23rd	69.23	2	3
	Total	***217.72***	***9***	***31***

3.1.4. In addition, the Indo-Pacific finless porpoises were also sighted during the present quarter in SWL survey area, with a total of 14 groups of 50 animals sighted (Appendix III).

3.2. Distribution

3.2.1. Distribution of dolphin sightings made during the monitoring surveys from December 2015 to February 2016 is shown in Figure 1. Chinese White Dolphins occurred regularly in Southwest Lantau waters during this quarter, but they were mostly distributed along the stretch of coastline from Fan Lau to Kau Ling Chung, as well as the waters between Shek Pik and Siu A Chau (Figure 1). On the contrary, they have mostly avoided the southern and eastern ends of the survey area as in previous quarters (Figure 1).

3.2.2. The 14 finless porpoise groups were mostly sighted to the south of Tai A Chau, while a few sightings were also made to the east of Soko Islands as well as near Shui Hau Peninsula, away from the main concentration of dolphin occurrence (Figure 1).

3.2.3. Sighting distribution of dolphins in the present quarter (i.e. winter 2015-16) was quite different from the three winter periods of 2012-15 (Figure 2). In previous winter periods, most dolphin groups were sighted in the coastal waters between Fan Lau and Shui Hau Peninsula, but dolphins also occurred near the northern waters of Siu A Chau in the winter of 2015-16. It also appeared that progressively more dolphins were sighted in the past

three winter periods when compared to the winter of 2012-13 (Figure 2).

3.3. Encounter rate

3.3.1. During the present three-month impact phase monitoring period (December 2015 – February 2016), encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data from the primary transect lines under favourable conditions (Beaufort 3 or below) from the SWL survey area are shown in Table 3. The quarterly rates were calculated by pooling the monthly survey effort and on-effort dolphin sightings from the three months during the present quarter, in order to compare to the historical data. To facilitate the comparison with the AFCD long-term monitoring results, the encounter rates were also calculated for the present quarter using both primary and secondary survey effort (Table 3).

3.3.2. Both types of quarterly encounter rates (ER(STG) and ER(ANI)) deduced from the present quarter were also compared with the same quarters deduced from 2013-14 and 2014-15, while the quarterly encounter rates deduced using primary and secondary survey effort combined was compared with the ones deduced from all winter months in the past decade (2005-14) (Table 3).

Table 3. Overall dolphin encounter rates (no. of sightings per 100 km of survey effort) from the present monitoring survey and combined database with AFCD monitoring survey conducted in December 2015 – February 2016 (i.e. winter 2015-16) (primary lines only, as well as both primary lines and secondary lines were used) in Southwest Lantau survey area in comparison to the ones deduced during winter months of 2013-14 and 2014-15, as well as the ones in the past decade (December-February 2005-14)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	Primary Lines Only	Both Primary and Secondary Lines	Primary Lines Only	Both Primary and Secondary Lines
Winter 2015-16	3.74	4.30	16.30	14.82
Winter 2014-15	0.78	0.57	6.22	4.52
Winter 2013-14	9.89	7.63	38.14	27.06
Winter of 2005-14		3.32		10.88

3.3.3. Dolphin encounter rates in the present quarter were higher than the overall period of 2005-14, and were much higher than the ones recorded in winter of 2014-15. But such encounter rates in winter of 2015-16 was much lower than the ones recorded in winter of 2013-14. With no apparent temporal trend in the past few winter periods, the dolphin usage in winter periods in SWL waters should be continuously monitored in order to detect any long-term trend.

3.4. Group size

3.4.1. Group size of Chinese White Dolphins ranged from one to twelve individuals per group in SWL survey area between December 2015 and February 2016. The average dolphin group size for the three-month period was 3.4, which was lower than the one recorded during the 2005-14 period (4.0).

3.4.2. Among the 18 dolphin groups sighted during this quarter, 12 of them were small groups composed of only 1-3 dolphins per group. On the other hand, there were four groups with five or more animals per group, and one large group with twelve animals.

3.4.3. Distribution of dolphins with moderate and large group sizes is shown in Figure 3. These larger groups were mostly sighted near Fan Lau (Figure 3).

3.5. Habitat use

3.5.1. From December 2015 to February 2016, a number of grids recorded dolphin presence in SWL survey area, with high densities of dolphins located near Fan Lau, Kau Ling Chung and between the waters of Shek Pik and Siu A Chau. However, the results should be treated with cautions as the amount of survey effort collected in each grid during the three-month period was fairly low (5-10 units of survey effort for most grids). A more complete picture of dolphin habitat use pattern can be presented when more survey effort for each grid will be collected throughout the impact phase monitoring programme.

3.5.2. When compared with the habitat use pattern recorded during the winter months of 2012-15, high dolphin usage of SWL was more confined nearshore at Fan Lau in 2015-16, while there was higher dolphin occurrence between Shek Pik and Siu A Chau in 2015-16 than in previous winters (Figures 5a and 5b).

3.6. Mother-calf pairs

3.6.1. During the three-month monitoring period, only one unspotted calf (UC) was sighted in SWL waters. The rare occurrence of this mother-calf pair was located near Fan Lau (Figure 6).

3.7. Activities and associations with fishing boats

3.7.1. During the three-month monitoring period, only two dolphin sightings were associated with feeding activities, which were located near Fan Lau and Shek Pik respectively (Figure 7).

3.7.2. Two of the 18 dolphin groups were associated with operating fishing boats (a purse-seiner

and a gill-netter respectively) during the present quarter.

3.8. Abundance estimation

3.8.1. In 2015, the abundance estimate of Chinese white dolphins in SWL survey area was 24 dolphins. The coefficient of variation (CV) is fairly low (24%), and the resulted estimates should be quite reliable.

3.9. Summary of photo-identification works

3.9.1. From December 2015 to February 2016, nearly 2,000 digital photographs of Chinese White Dolphins were taken during the SWL monitoring surveys for the photo-identification work.

3.9.2. In total, 29 individuals sighted 32 times altogether were identified (see the summary table in Appendix IV and photographs of identified individuals in Appendix V). The majority of identified individuals were sighted only once during the three-month period, with the exception of SL50, SL60 and WL123 sighted twice.

3.9.3. In addition to the photo-identification effort in SWL waters, it should be noted that a set of on-going large-scale surveys has recently been conducted in Lingding Bay (or the eastern section of the Pearl River Estuary, EPRE) by the South China Sea Fisheries Research Institute (SCSFRI), which is commissioned by the Hong Kong-Zhuhai-Macao Bridge Authority (HZMBA). One of the goals of such surveys is to assess any cross-movements of individual dolphins from Hong Kong waters into Mainland waters in light of their dramatic decline in North Lantau waters in recent years. With the permission of HZMBA, such data is made available to this study in order to match photographs of dolphins taken from the EPRE surveys to the catalogue individual dolphins in Hong Kong maintained by HKCRP researchers.

3.9.4. Between September 2015 to January 2016, four sets of EPRE surveys have been conducted in Lingding Bay so far, with a total of 68 groups of 330 dolphins being sighted among North Lingding Bay (NLDB), Central Lingding Bay (CLDB), South Lingding Bay (SLDB) and Macau (MA) survey areas. Over 7,000 photographs were taken during the course of these surveys, and the preliminary photo-identification analysis by HKCRP researchers has already identified 61 individual dolphins being sighted 70 times altogether (Appendix VI).

3.9.5. Among these 61 individuals sighted in Lingding Bay during 2015-16, 13 of them have never or rarely occurred in Hong Kong waters in the past, while the rest have been frequently sighted among different survey areas in Hong Kong waters in the recent past.

Notably, many of these individuals (e.g. NL104, NL123, NL145, NL260, NL264) are year-round residents that regularly occurred in Hong Kong waters in the past, while a few (e.g. NL281 and WL66) have disappeared from Hong Kong waters for more than one to two years. Their range use and cross-boundary movements will be further assessed when the full set of EPRE surveys is completed in the second half of 2016.

3.10. Individual range use in SWL waters

3.10.1. Ranging patterns of the 29 individuals identified during the three-month study period in SWL waters were determined by the fixed kernel method, and their 95% kernel home ranges including their re-sightings during each year of 2012-16 are shown in Appendix VII for examination of any temporal changes in their range use in recent years.

3.10.2. Five of the 29 individuals (NL212, NL260, WL200, WL237 and WL265) were sighted in SWL survey area for the first time during the present quarterly period (Appendix IV). Their ranges were mostly extended from WL into SWL waters, and two of them (WL237 and WL265) were newly identified dolphins added to the photo-identification catalogue just in the past 2-3 years (Appendix VI). On the contrary, the other 25 individuals were re-sighted well within their home ranges including SWL waters during this three-month period (Appendix VI).

3.10.3. Notably, ten individuals (CH38, NL49, NL120, NL212, SL05, WL68, WL123, WL130, WL216 and WL265) sighted in SWL waters during the present quarter were also sighted in WL waters during HKLR09 monitoring surveys in the same quarter. These showed their frequent movements between different survey areas around Lantau Island in this relatively brief period.

3.10.4. With their primary ranges centered in North and West Lantau waters, some individuals showed apparent range shifts or extensions to Southwest Lantau waters in 2015-16. For example, three individual dolphins (NL120, WL46 and WL221) indicated obvious shifts in their range use from NWL to WL and SWL waters. Moreover, many individuals (e.g. NL212, NL260, WL200, SL55, WL232, WL237 and WL265) have extended their ranges from WL waters to SWL waters. It remains to be seen whether some of these individuals have permanently shifted their ranges away from their primary ranges in North and Lantau, or begin to spend more times in SWL waters as part of their ranges.

4. References

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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.

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

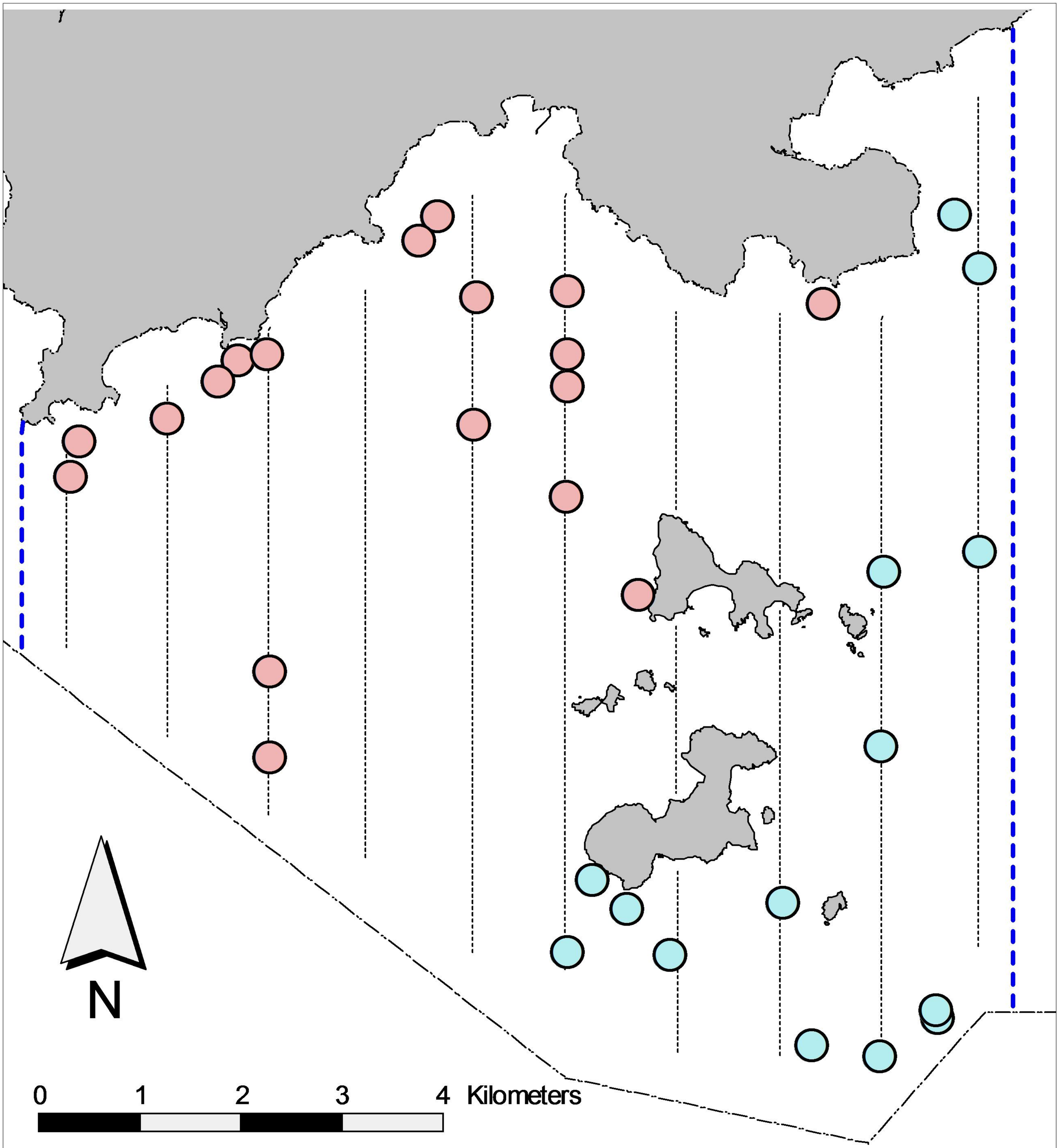


Figure 1. Distribution of marine mammal sightings (pink dots: Chinese White Dolphins; blue dots: Finless Porpoises) during monitoring surveys in Southwest Lantau survey area conducted in December 2015 – February 2016

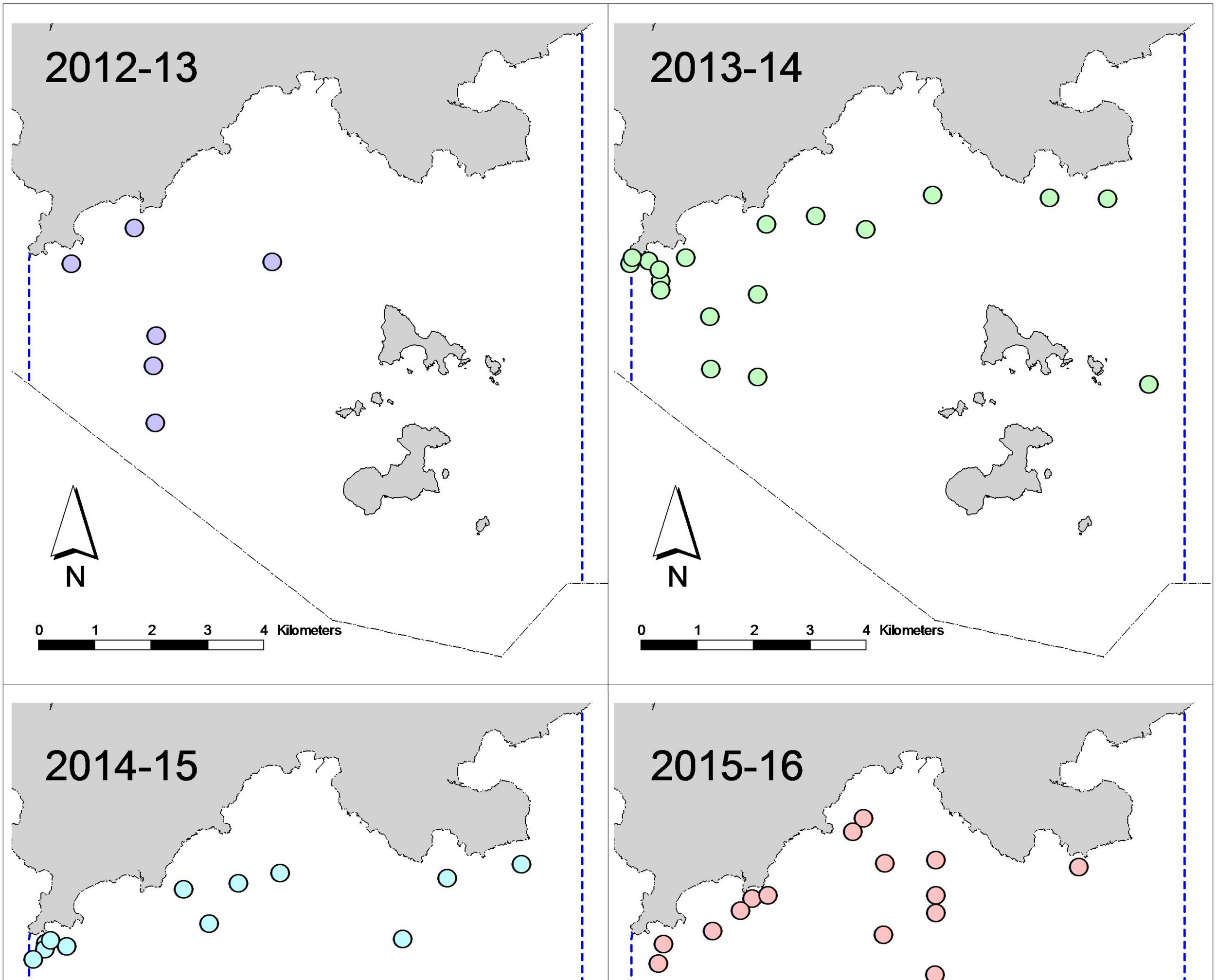


Figure 2. Comparisons on distribution of Chinese White Dolphin sightings in Southwest Lantau survey area during the winter months of 2012-2016

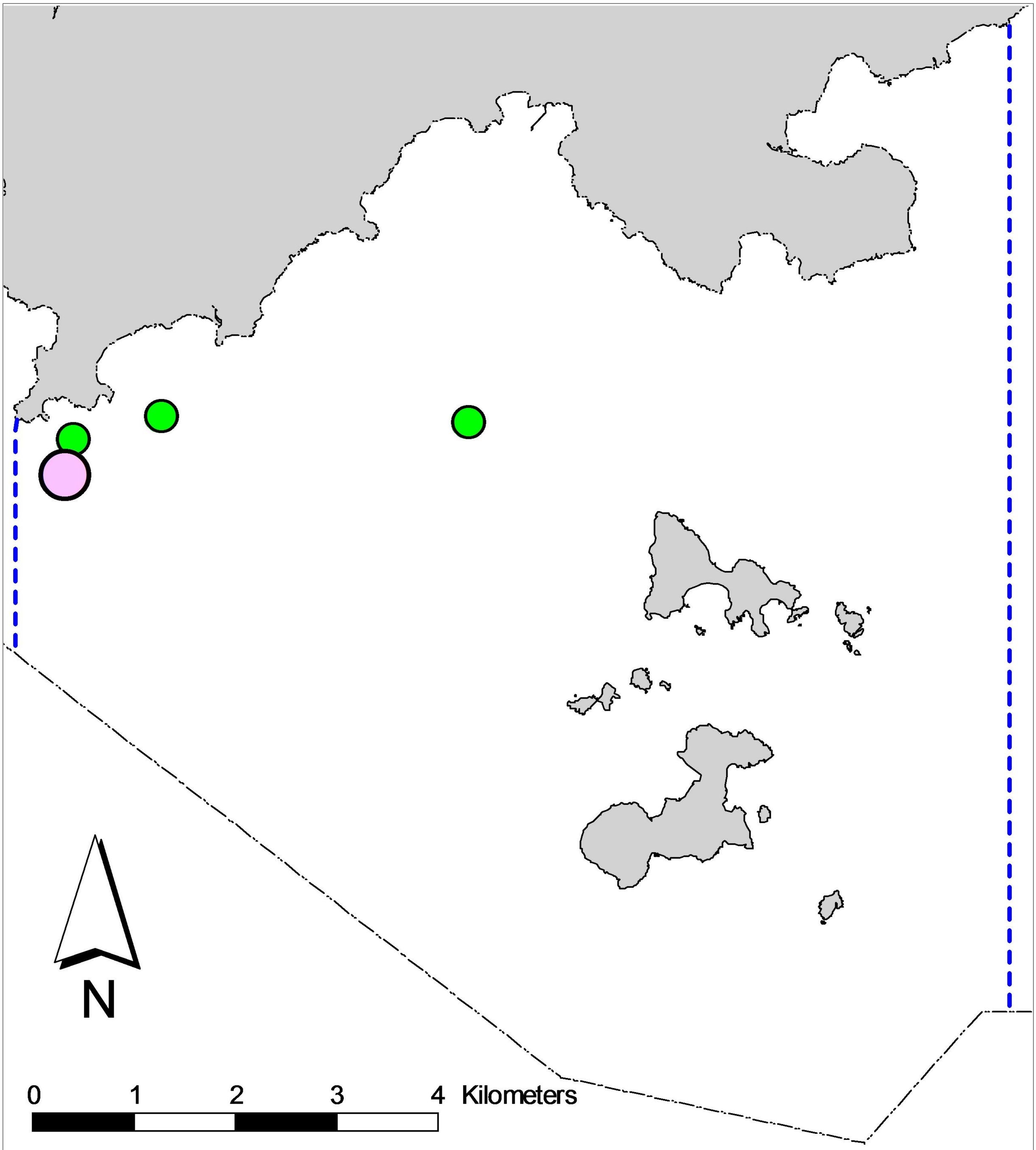


Figure 3. Distribution of Chinese White Dolphins with large group sizes of 5-9 dolphins (green dots) and 10 or more dolphins (purple dots) during SWL monitoring surveys conducted in December 2015 – February 2016

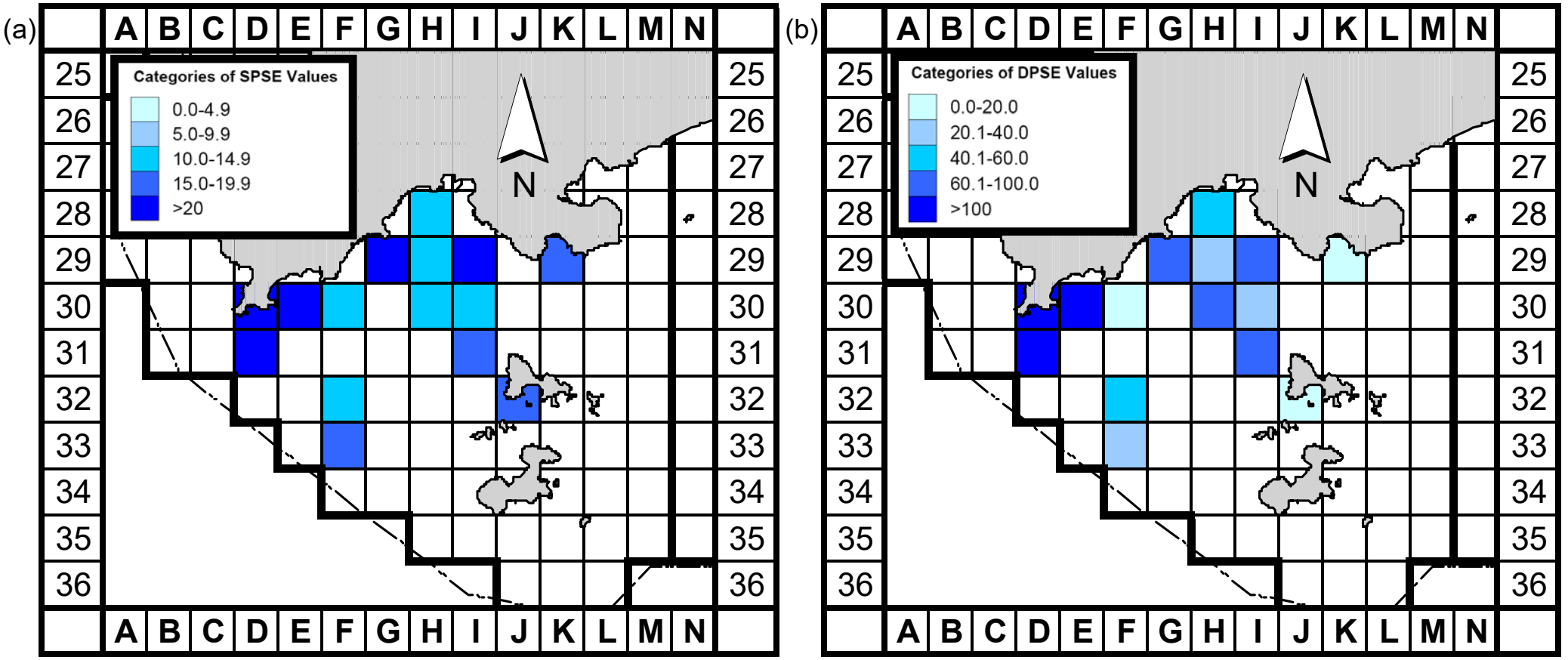
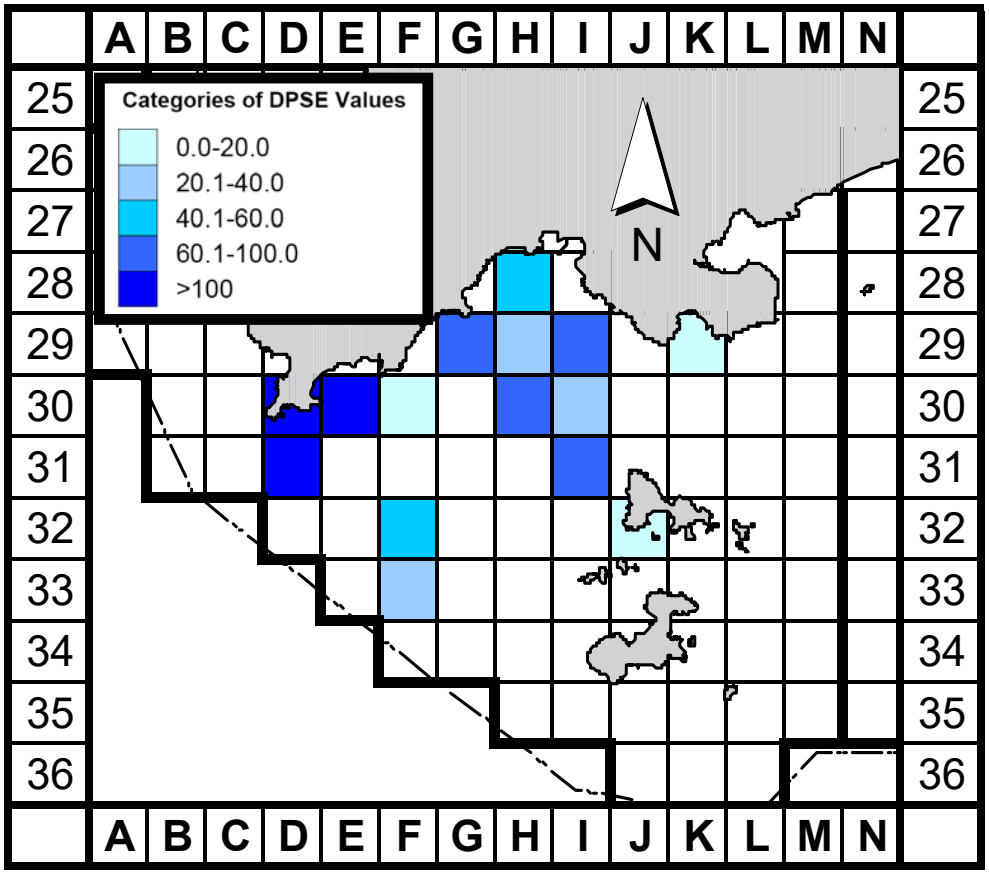


Figure 4a. Sighting density of Chinese white dolphins with corrected survey effort per km^2 in Southwest Lantau survey area during winter months (December-February) of 2015-16 (SPSE = no. of on-effort sightings per 100 units of survey effort)

Figure 4b. Density of Chinese white dolphins with corrected survey effort per km^2 in Southwest Lantau survey area during winter months (December-February) of 2015-16 (DPSE = no. of dolphins per 100 units of survey effort)

(a)



(b)

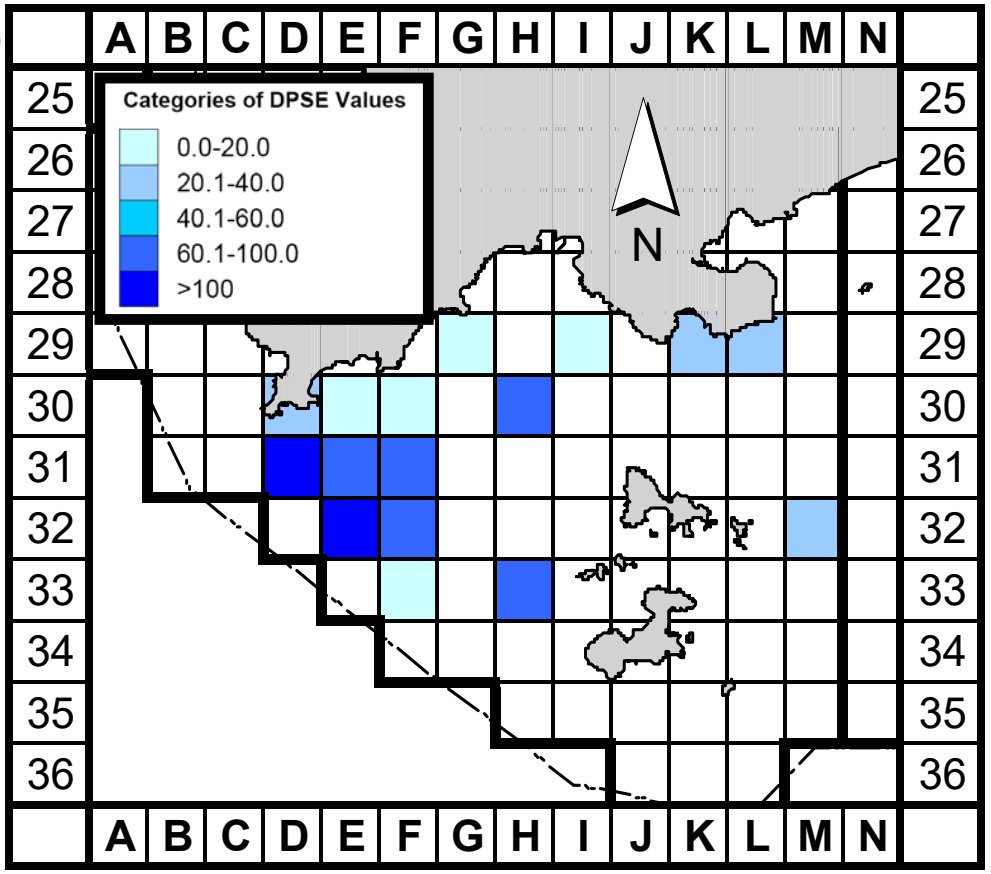


Figure 5a. Density of Chinese white dolphins with corrected survey effort per km^2 in Southwest Lantau survey area during winter months (December-February) of 2015-16 (DPSE = no. of dolphins per 100 units of survey effort)

Figure 5b. Density of Chinese white dolphins with corrected survey effort per km^2 in Southwest Lantau survey area during winter months (December to February) of 2012-2015 (DPSE = no. of dolphins per 100 units of survey effort)

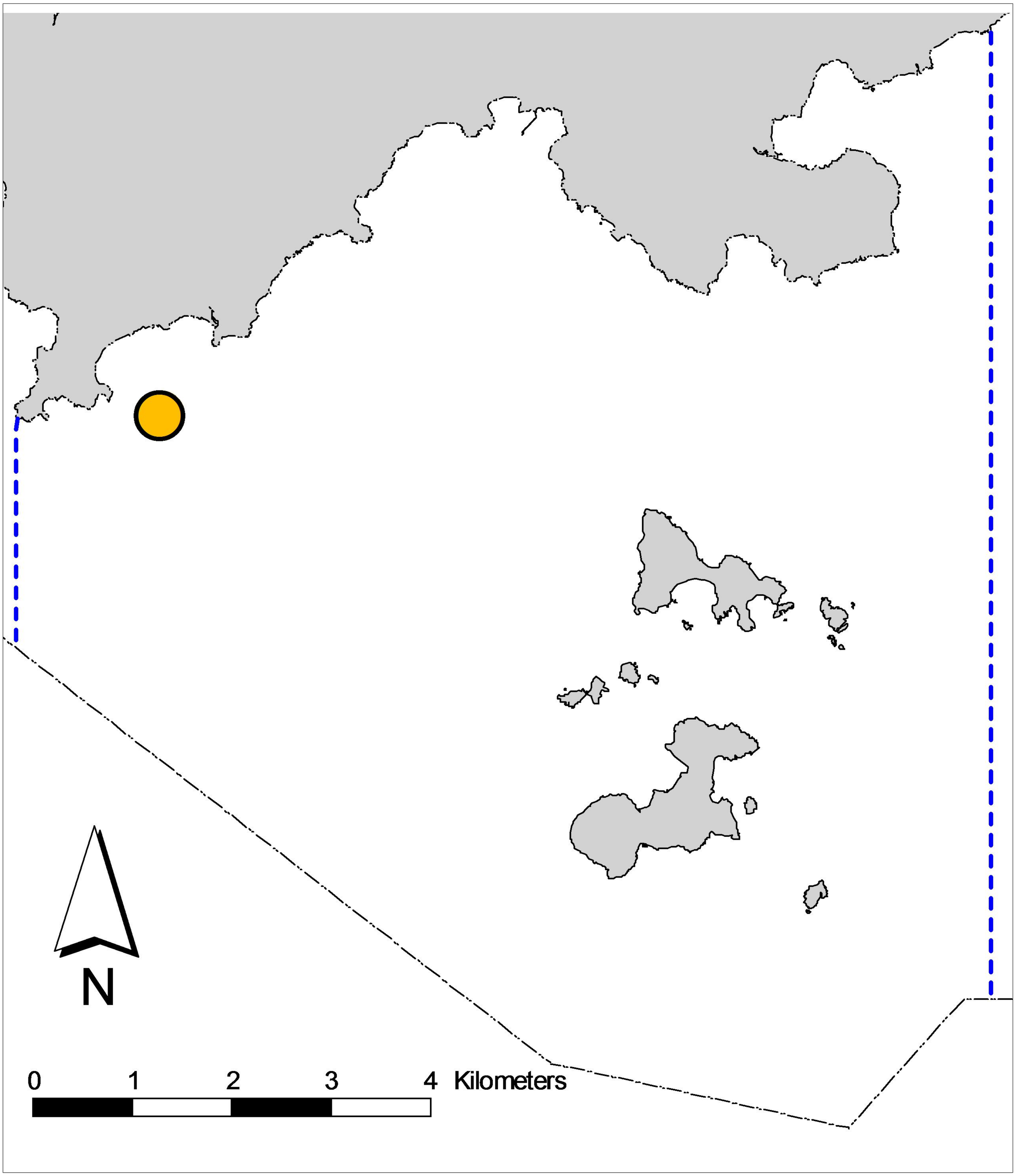


Figure 6. Distribution of young calf of Chinese White Dolphin during SWL monitoring surveys conducted in December 2015 – February 2016

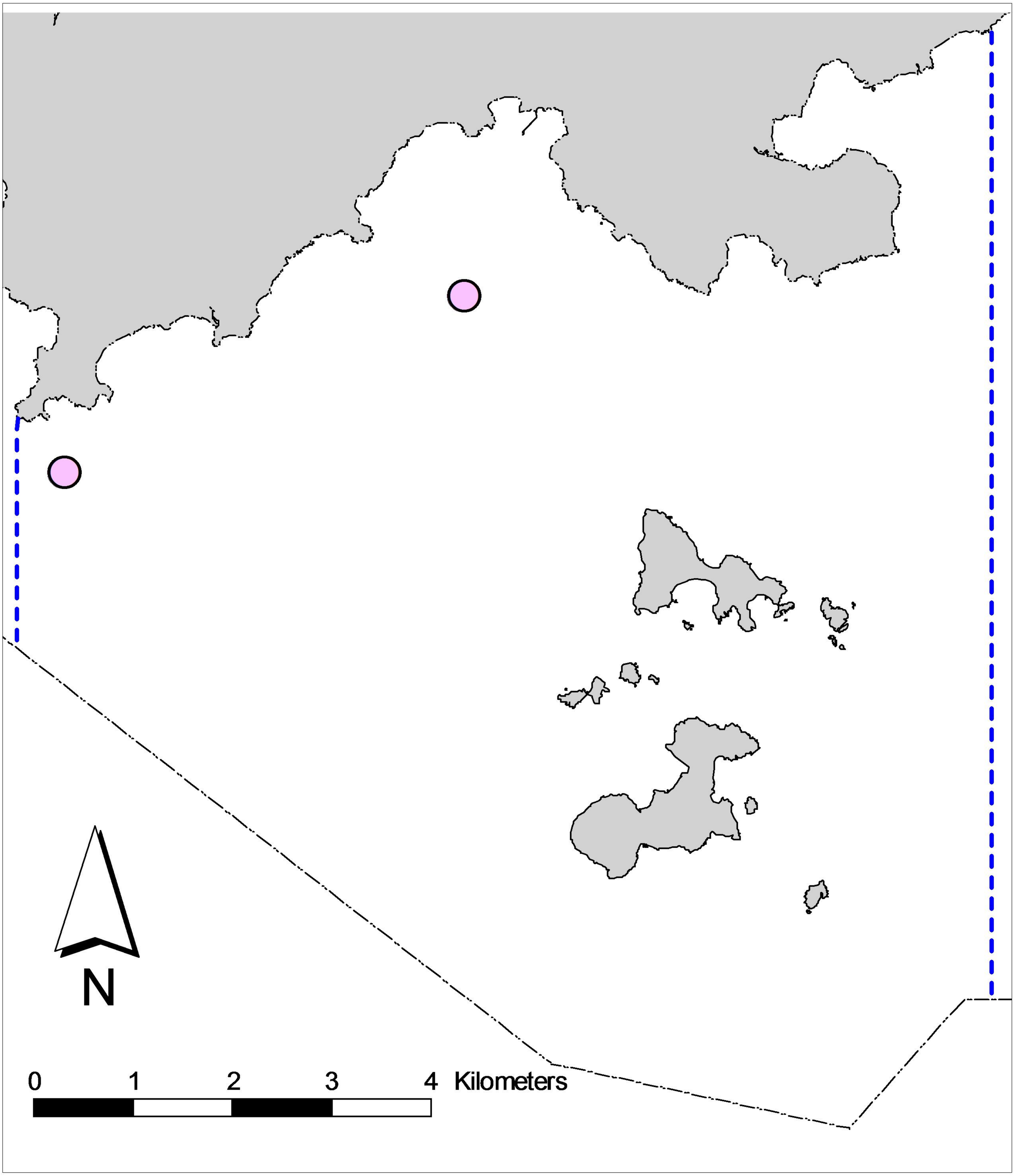


Figure 7. Distribution of Chinese White Dolphins engaged in feeding activities (purple dots) during SWL monitoring surveys conducted in December 2015 – February 2016

Appendix I. Survey Effort Database in SWL Survey Area (Dec. 2015 - Feb. 2016)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
3-Dec-15	SW LANTAU	2	16.37	WINTER	STANDARD31516	HKCRP	P
3-Dec-15	SW LANTAU	3	0.88	WINTER	STANDARD31516	HKCRP	P
3-Dec-15	SW LANTAU	2	4.24	WINTER	STANDARD31516	HKCRP	S
3-Dec-15	SW LANTAU	3	3.29	WINTER	STANDARD31516	HKCRP	S
14-Dec-15	SW LANTAU	2	7.25	WINTER	STANDARD31516	HYD-HZMB	P
14-Dec-15	SW LANTAU	3	45.32	WINTER	STANDARD31516	HYD-HZMB	P
14-Dec-15	SW LANTAU	4	2.74	WINTER	STANDARD31516	HYD-HZMB	P
14-Dec-15	SW LANTAU	2	5.08	WINTER	STANDARD31516	HYD-HZMB	S
14-Dec-15	SW LANTAU	3	10.01	WINTER	STANDARD31516	HYD-HZMB	S
14-Dec-15	SW LANTAU	4	0.60	WINTER	STANDARD31516	HYD-HZMB	S
18-Dec-15	SW LANTAU	2	14.40	WINTER	STANDARD31516	HKCRP	P
18-Dec-15	SW LANTAU	3	6.59	WINTER	STANDARD31516	HKCRP	P
18-Dec-15	SW LANTAU	2	6.92	WINTER	STANDARD31516	HKCRP	S
18-Dec-15	SW LANTAU	3	4.54	WINTER	STANDARD31516	HKCRP	S
30-Dec-15	SW LANTAU	1	2.10	WINTER	STANDARD31516	HKCRP	P
30-Dec-15	SW LANTAU	2	20.56	WINTER	STANDARD31516	HKCRP	P
30-Dec-15	SW LANTAU	2	10.26	WINTER	STANDARD31516	HKCRP	S
30-Dec-15	SW LANTAU	3	1.38	WINTER	STANDARD31516	HKCRP	S
5-Jan-16	SW LANTAU	2	15.16	WINTER	STANDARD31516	HKCRP	P
5-Jan-16	SW LANTAU	3	5.70	WINTER	STANDARD31516	HKCRP	S
18-Jan-16	SW LANTAU	1	11.39	WINTER	STANDARD31516	HYD-HZMB	P
18-Jan-16	SW LANTAU	2	39.91	WINTER	STANDARD31516	HYD-HZMB	P
18-Jan-16	SW LANTAU	3	2.20	WINTER	STANDARD31516	HYD-HZMB	P
18-Jan-16	SW LANTAU	1	5.00	WINTER	STANDARD31516	HYD-HZMB	S
18-Jan-16	SW LANTAU	2	10.68	WINTER	STANDARD31516	HYD-HZMB	S
18-Jan-16	SW LANTAU	3	1.08	WINTER	STANDARD31516	HYD-HZMB	S
26-Jan-16	SW LANTAU	2	6.24	WINTER	STANDARD31516	HKCRP	P
26-Jan-16	SW LANTAU	3	15.68	WINTER	STANDARD31516	HKCRP	P
26-Jan-16	SW LANTAU	2	1.97	WINTER	STANDARD31516	HKCRP	S
26-Jan-16	SW LANTAU	3	12.21	WINTER	STANDARD31516	HKCRP	S
4-Feb-16	SW LANTAU	1	3.20	WINTER	STANDARD31516	HKCRP	P
4-Feb-16	SW LANTAU	2	6.30	WINTER	STANDARD31516	HKCRP	P
4-Feb-16	SW LANTAU	3	2.52	WINTER	STANDARD31516	HKCRP	P
4-Feb-16	SW LANTAU	1	1.10	WINTER	STANDARD31516	HKCRP	S
4-Feb-16	SW LANTAU	2	3.48	WINTER	STANDARD31516	HKCRP	S
4-Feb-16	SW LANTAU	3	4.77	WINTER	STANDARD31516	HKCRP	S
17-Feb-16	SW LANTAU	1	5.61	WINTER	STANDARD31516	HYD-HZMB	P
17-Feb-16	SW LANTAU	2	47.11	WINTER	STANDARD31516	HYD-HZMB	P
17-Feb-16	SW LANTAU	3	2.31	WINTER	STANDARD31516	HYD-HZMB	P
17-Feb-16	SW LANTAU	1	2.24	WINTER	STANDARD31516	HYD-HZMB	S
17-Feb-16	SW LANTAU	2	12.48	WINTER	STANDARD31516	HYD-HZMB	S
17-Feb-16	SW LANTAU	3	1.12	WINTER	STANDARD31516	HYD-HZMB	S
19-Feb-16	SW LANTAU	2	7.00	WINTER	STANDARD31516	HKCRP	P
19-Feb-16	SW LANTAU	3	8.67	WINTER	STANDARD31516	HKCRP	P
19-Feb-16	SW LANTAU	2	7.30	WINTER	STANDARD31516	HKCRP	S
19-Feb-16	SW LANTAU	3	2.33	WINTER	STANDARD31516	HKCRP	S
23-Feb-16	SW LANTAU	1	6.58	WINTER	STANDARD31516	HKCRP	P
23-Feb-16	SW LANTAU	3	1.10	WINTER	STANDARD31516	HKCRP	P
23-Feb-16	SW LANTAU	4	5.10	WINTER	STANDARD31516	HKCRP	P
23-Feb-16	SW LANTAU	2	2.05	WINTER	STANDARD31516	HKCRP	S
23-Feb-16	SW LANTAU	3	4.73	WINTER	STANDARD31516	HKCRP	S
23-Feb-16	SW LANTAU	4	3.00	WINTER	STANDARD31516	HKCRP	S

Appendix II. Chinese White Dolphin Sighting Database in SWL Survey Area (December 2015 - February 2016)

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

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.	P/S
03-Dec-15	1	1326	8	SW LANTAU	2	361	ON	HKCRP	806414	803467	WINTER	NONE	P
14-Dec-15	1	1242	2	SW LANTAU	3	88	ON	HYD-HZMB	807537	806522	WINTER	PURSE-SEINE	P
14-Dec-15	2	1352	2	SW LANTAU	3	18	ON	HYD-HZMB	806705	807428	WINTER	NONE	P
18-Dec-15	2	1352	1	SW LANTAU	2	138	ON	HKCRP	804766	808136	WINTER	NONE	S
18-Dec-15	3	1431	5	SW LANTAU	3	112	ON	HKCRP	806352	806499	WINTER	NONE	P
18-Dec-15	4	1525	2	SW LANTAU	2	263	ON	HKCRP	803244	804481	WINTER	NONE	P
18-Dec-15	5	1536	4	SW LANTAU	2	207	ON	HKCRP	804042	804483	WINTER	NONE	P
05-Jan-16	5	1518	3	SW LANTAU	2	135	ON	HKCRP	807004	807428	WINTER	NONE	P
18-Jan-16	1	1059	12	SW LANTAU	2	132	ON	HYD-HZMB	805862	802507	WINTER	NONE	P
18-Jan-16	2	1149	1	SW LANTAU	1	169	ON	HYD-HZMB	806944	804169	WINTER	NONE	S
18-Jan-16	3	1232	3	SW LANTAU	2	402	ON	HYD-HZMB	808291	806142	WINTER	NONE	P
18-Jan-16	4	1353	4	SW LANTAU	1	120	ON	HYD-HZMB	805675	807415	WINTER	NONE	P
26-Jan-16	4	1122	5	SW LANTAU	3	305	ON	HKCRP	806194	802590	WINTER	NONE	S
04-Feb-16	3	1354	1	SW LANTAU	2	173	ON	HKCRP	806756	803963	WINTER	NONE	S
04-Feb-16	4	1357	2	SW LANTAU	2	212	ON	HKCRP	807010	804458	WINTER	GILLNET	S
17-Feb-16	1	1220	3	SW LANTAU	2	134	ON	HYD-HZMB	808070	805956	WINTER	NONE	S
17-Feb-16	2	1336	3	SW LANTAU	2	202	ON	HYD-HZMB	807591	807429	WINTER	NONE	P
17-Feb-16	3	1509	1	SW LANTAU	2	458	ON	HYD-HZMB	807475	809966	WINTER	NONE	S

Appendix III. Finless Porpoise Sighting Database in SWL Survey Area (December 2015 - February 2016)

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

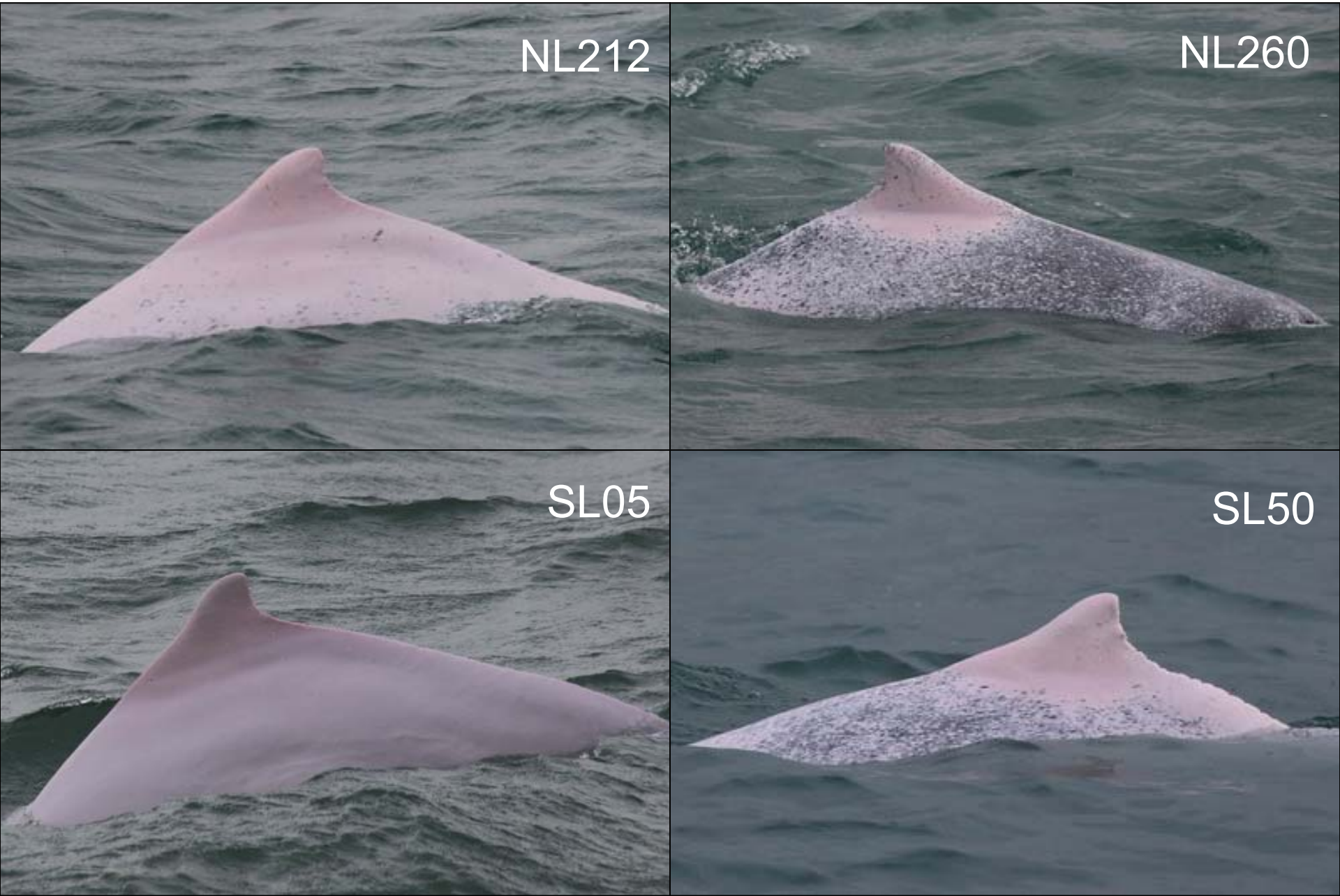
DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	P/S
03-Dec-15	2	1450	4	SW LANTAU	2	278	ON	HKCRP	801434	807428	WINTER	P
03-Dec-15	3	1501	2	SW LANTAU	2	421	ON	HKCRP	801399	808439	WINTER	S
14-Dec-15	3	1444	2	SW LANTAU	3	157	ON	HYD-HZMB	802109	807667	WINTER	S
14-Dec-15	4	1609	1	SW LANTAU	3	10	ON	HYD-HZMB	800818	811089	WINTER	S
18-Dec-15	1	1331	8	SW LANTAU	2	269	ON	HKCRP	801831	808017	WINTER	S
05-Jan-16	2	1357	4	SW LANTAU	2	100	ON	HKCRP	805170	811498	WINTER	P
05-Jan-16	3	1426	1	SW LANTAU	2	224	ON	HKCRP	800555	809840	WINTER	S
05-Jan-16	4	1436	2	SW LANTAU	2	70	ON	HKCRP	801884	809554	WINTER	P
18-Jan-16	5	1635	4	SW LANTAU	2	47	ON	HYD-HZMB	807805	811503	WINTER	P
17-Feb-16	4	1546	1	SW LANTAU	1	249	ON	HYD-HZMB	800885	811069	WINTER	S
23-Feb-16	10	1338	3	SW LANTAU	1	ND	OFF	HKCRP	808304	811266	WINTER	
23-Feb-16	11	1353	14	SW LANTAU	1	167	ON	HKCRP	804972	810560	WINTER	P
23-Feb-16	12	1403	2	SW LANTAU	1	39	ON	HKCRP	803355	810536	WINTER	P
23-Feb-16	13	1418	2	SW LANTAU	2	ND	OFF	HKCRP	800465	810521	WINTER	

Appendix IV. Individual dolphins identified during SWL monitoring surveys in December 2015 - February 2016

ID#	DATE	STG#	TYPE
CH38	18/12/15	5	HKCRP
NL49	18/01/16	1	HYD-HZMB
NL120	14/12/15	1	HYD-HZMB
NL165	18/01/16	1	HYD-HZMB
NL212	18/01/16	1	HYD-HZMB
NL260	18/01/16	1	HYD-HZMB
SL05	03/12/15	1	HKCRP
SL50	18/12/15	4	HKCRP
	05/01/16	5	HKCRP
SL55	03/12/15	1	HKCRP
SL60	17/02/16	1	HYD-HZMB
	17/02/16	2	HYD-HZMB
WL15	05/01/16	5	HKCRP
WL29	03/12/15	1	HKCRP
WL46	18/01/16	1	HYD-HZMB
WL62	14/12/15	1	HYD-HZMB
WL68	04/02/16	4	HKCRP
WL69	17/02/16	1	HYD-HZMB
WL91	18/12/15	3	HKCRP
WL123	17/02/16	1	HYD-HZMB
	17/02/16	2	HYD-HZMB
WL129	03/12/15	1	HKCRP
WL130	26/01/16	4	HKCRP
WL199	18/01/16	1	HYD-HZMB
WL200	26/01/16	4	HKCRP
WL210	03/12/15	1	HKCRP
WL216	18/01/16	1	HYD-HZMB
WL221	14/12/15	1	HYD-HZMB
WL232	05/01/16	5	HKCRP
WL235	18/12/15	3	HKCRP
WL237	18/01/16	1	HYD-HZMB
WL265	26/01/16	4	HKCRP

Appendix V. Twenty-nine individual dolphins that were identified in Southwest Lantau survey area during December 2015 – February 2016

Appendix V. (cont'd)



Appendix V. (cont'd)

Appendix V. (cont'd)


WL91


WL123


WL129


WL130

Appendix V. (cont'd)


WL221
WL232
WL235
WL237

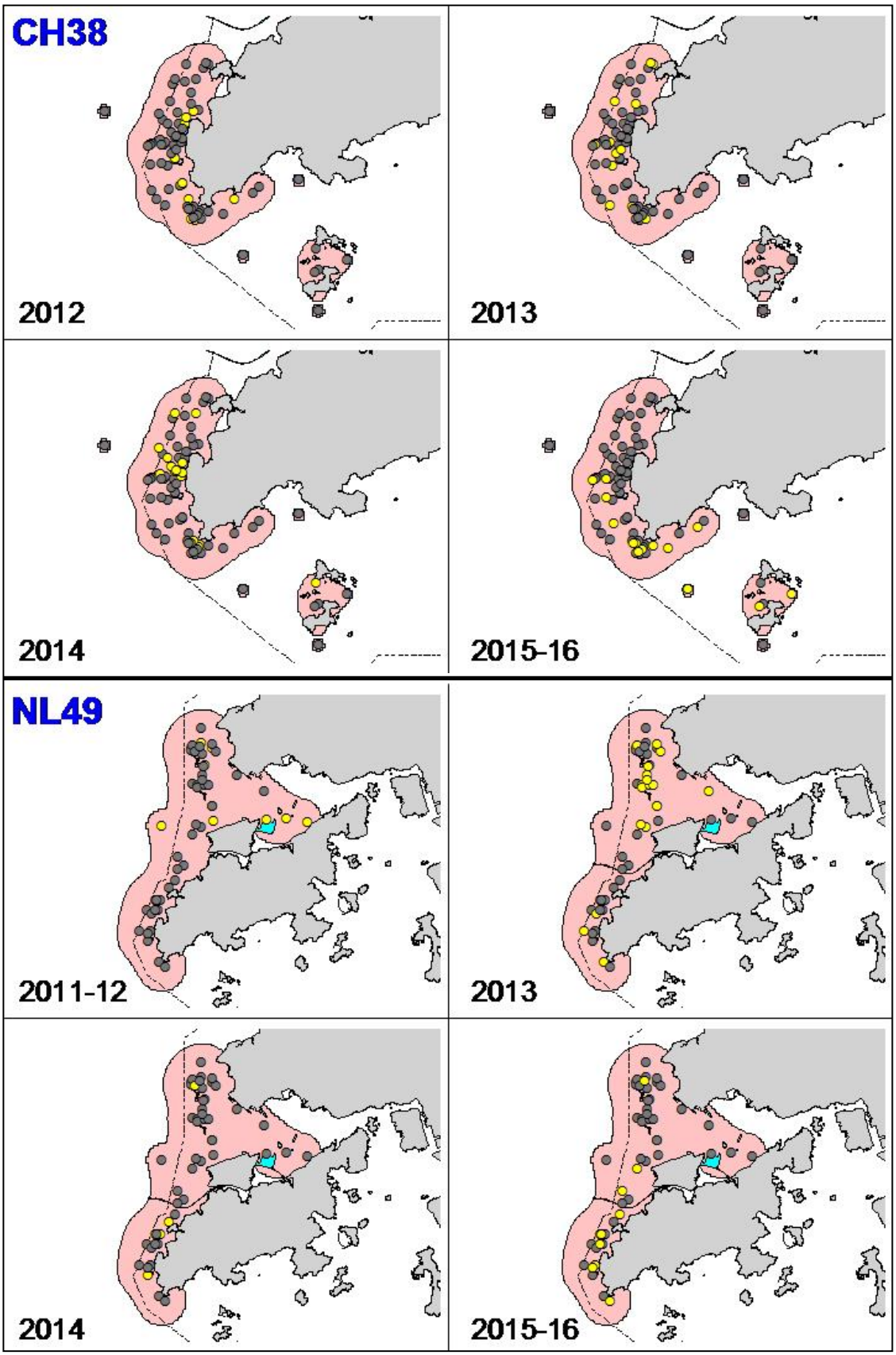
Appendix V. (cont'd)

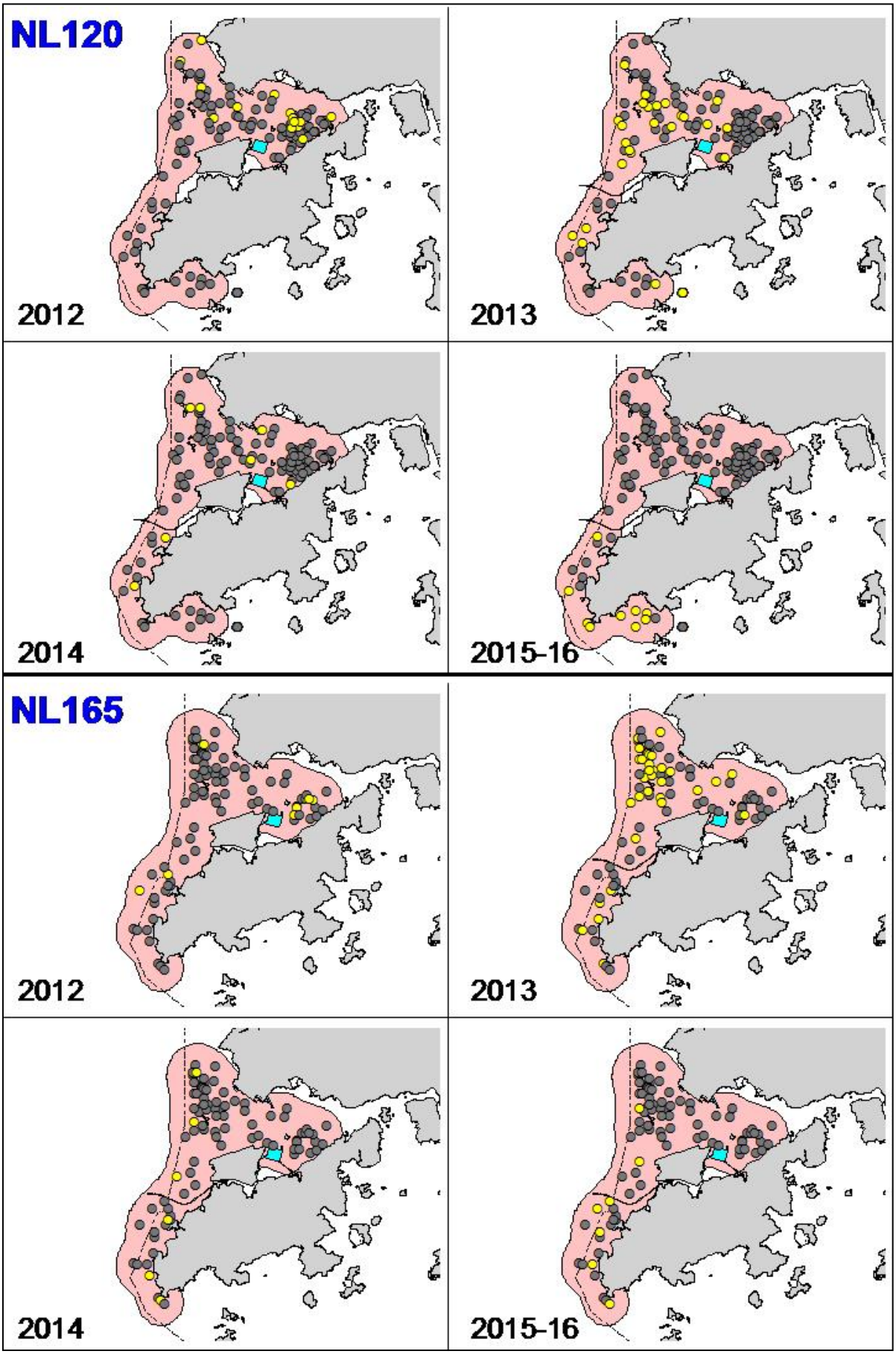
Appendix VI. Individual dolphins identified in Lingding Bay during monitoring surveys conducted in the eastern section of the Pearl River Estuary during September 2015 to January 2016 by the South China Sea Fisheries Research Institute (courtesy of the Hong Kong-Zhuhai-Macao Bridge Authority for providing the data)

ID#	DATE	STG#	AREA
CH27	02/01/16	3	NLDB
CH38	05/01/16	1	SLDB
CH84	23/10/15	3	CLDB
CH113	03/01/16	3	CLDB
CH165	23/09/15	3	MA
CH174	23/10/15	1	CLDB
CH182	23/09/15	3	MA
CH189	02/01/16	2	NLDB
CH195	23/09/15	2	MA
CH198	06/01/16	6	MA
CH205	08/12/15	5	CLDB
CH206	10/12/15	1	SLDB
CH210	22/09/15	4	MA
CH213	24/10/15	5	SLDB
EL01	22/09/15	2	SLDB
MA44	11/12/15	1	MA
NL37	04/01/16	2	SLDB
NL80	20/09/15	3	CLDB
NL104	23/10/15	4	CLDB
NL123	04/01/16	2	SLDB
NL145	04/01/16	2	SLDB
NL236	04/01/16	2	SLDB
NL260	04/01/16	2	SLDB
NL264	04/01/16	2	SLDB
NL279	08/12/15	2	CLDB
	02/01/16	2	NLDB
NL281	20/09/15	3	CLDB
NL287	03/01/16	4	CLDB
NL288	04/01/16	2	SLDB
NL295	04/01/16	2	SLDB
NL296	04/01/16	2	SLDB
NL301	20/09/15	3	CLDB
NL302	23/10/15	2	CLDB
	03/01/16	4	CLDB
NL303	20/09/15	3	CLDB
	04/01/16	2	SLDB
NL304	22/09/15	2	SLDB
NL307	03/01/16	4	CLDB

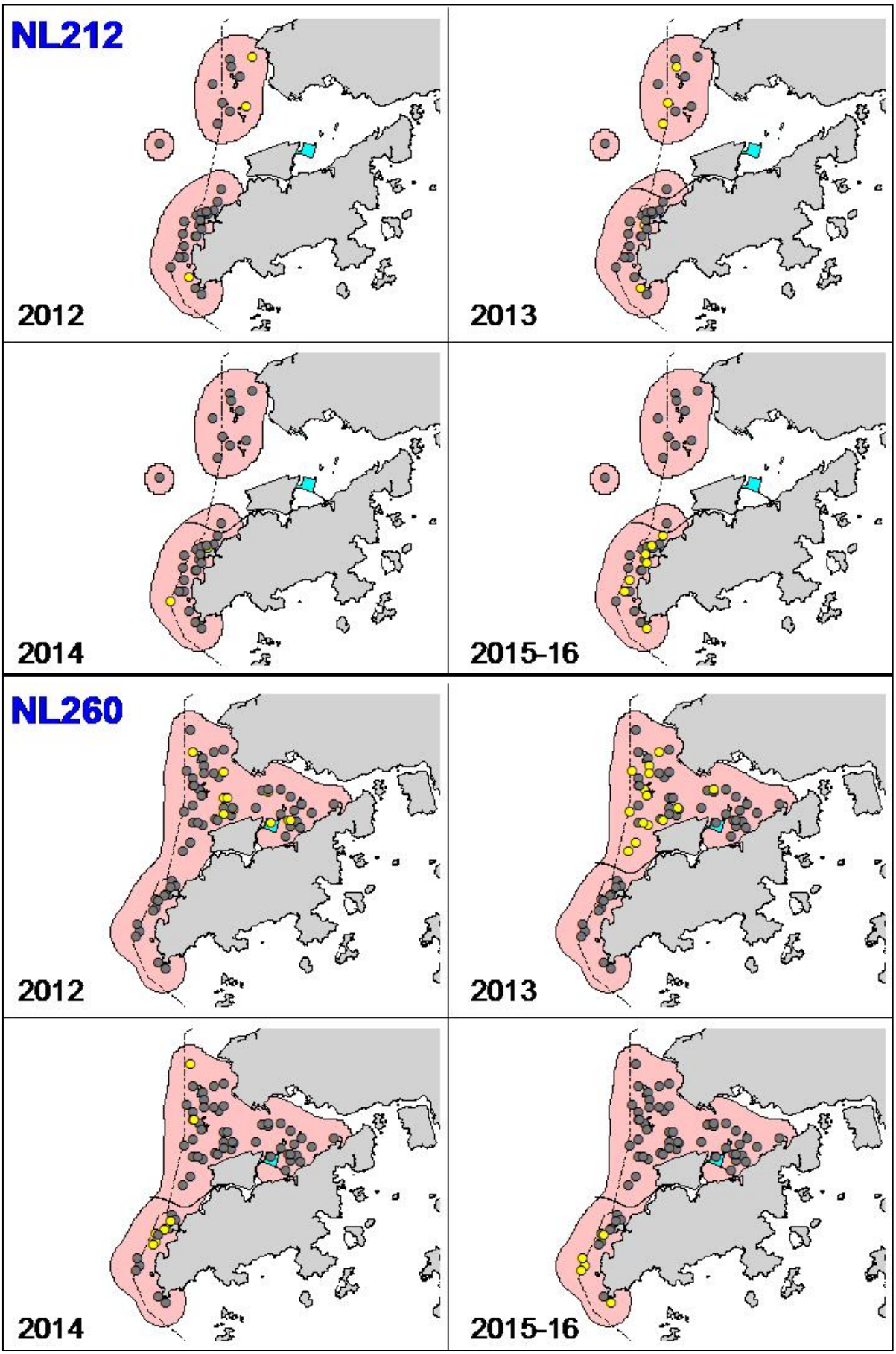
ID#	DATE	STG#	AREA
SL05	05/01/16	1	SLDB
WL05	04/01/16	2	SLDB
WL17	03/01/16	4	CLDB
WL21	23/10/15	3	CLDB
	03/01/16	3	CLDB
WL28	22/09/15	2	SLDB
WL42	05/01/16	1	SLDB
WL44	05/01/16	1	SLDB
WL66	23/10/15	3	CLDB
	24/10/15	5	SLDB
	03/01/16	3	CLDB
WL94	05/01/16	1	SLDB
WL114	10/12/15	1	SLDB
	05/01/16	1	SLDB
WL116	10/12/15	1	SLDB
WL118	04/01/16	3	SLDB
WL124	03/01/16	4	CLDB
WL128	10/12/15	1	SLDB
WL129	10/12/15	1	SLDB
WL131	05/01/16	1	SLDB
WL193	03/01/16	4	CLDB
WL216	23/10/15	3	CLDB
WL226	03/01/16	4	CLDB
WL236	10/12/15	1	SLDB
WL237	10/12/15	1	SLDB
WL249	08/12/15	3	CLDB
	04/01/16	1	CLDB
WL256	23/10/15	3	CLDB
	03/01/16	3	CLDB
WL260	05/01/16	1	SLDB
WL262	05/01/16	1	SLDB
WL265	22/09/15	2	SLDB

Appendix VII. Ranging patterns (95% kernel ranges) of 29 individual dolphins that were sighted in Southwest Lantau survey area during December 2015 – February 2016 (note: yellow dots indicates sightings made in the respective years of 2012-16)

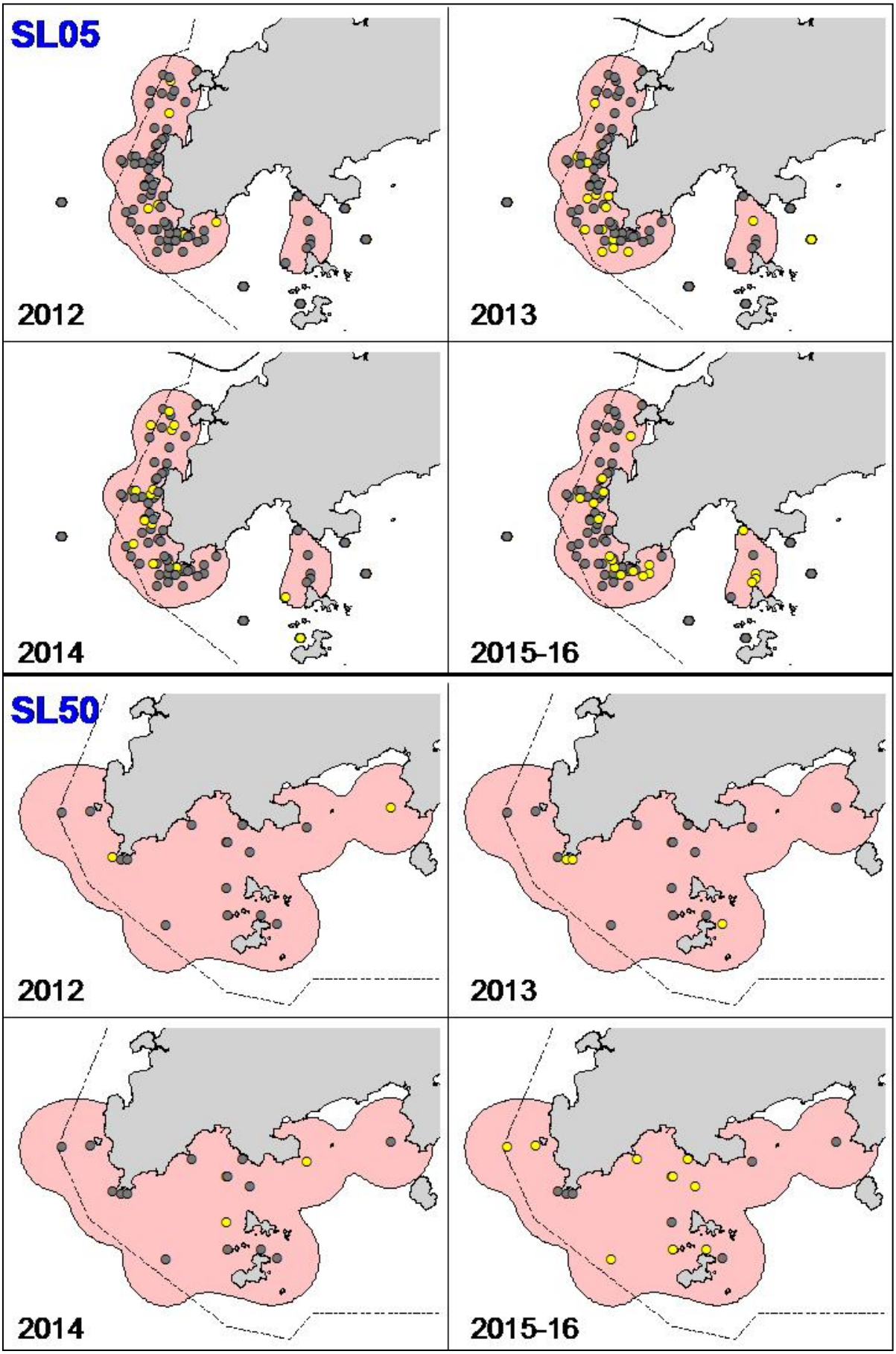


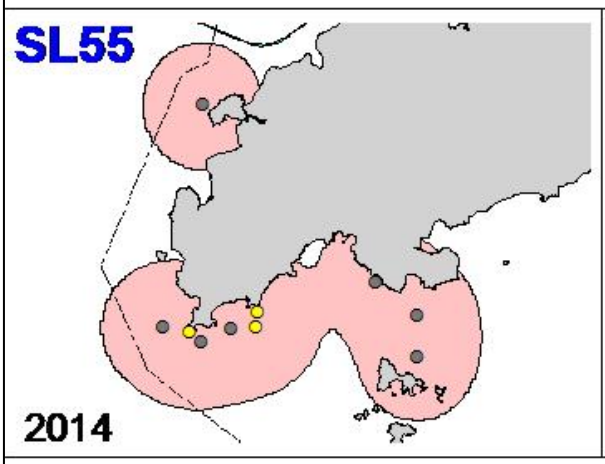

NL120
2012
2013
2014
2015-16
NL165
2012
2013
2014
2015-16

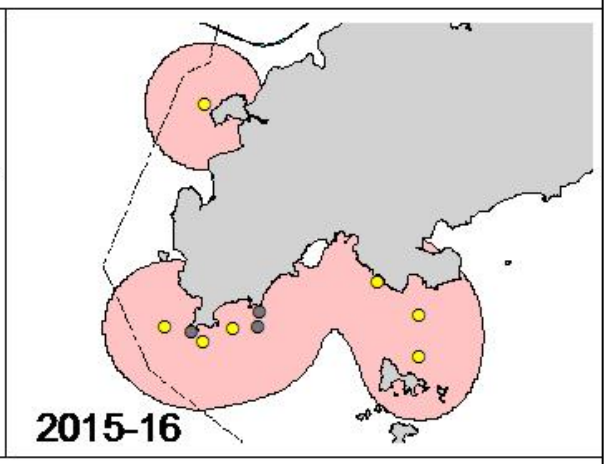
Appendix VII. (cont'd)

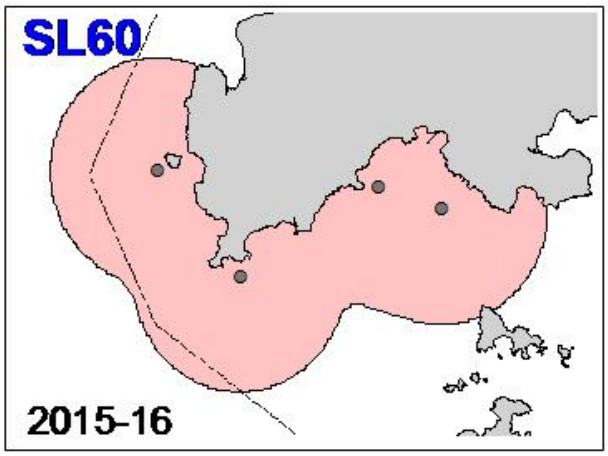


Appendix VII. (cont'd)

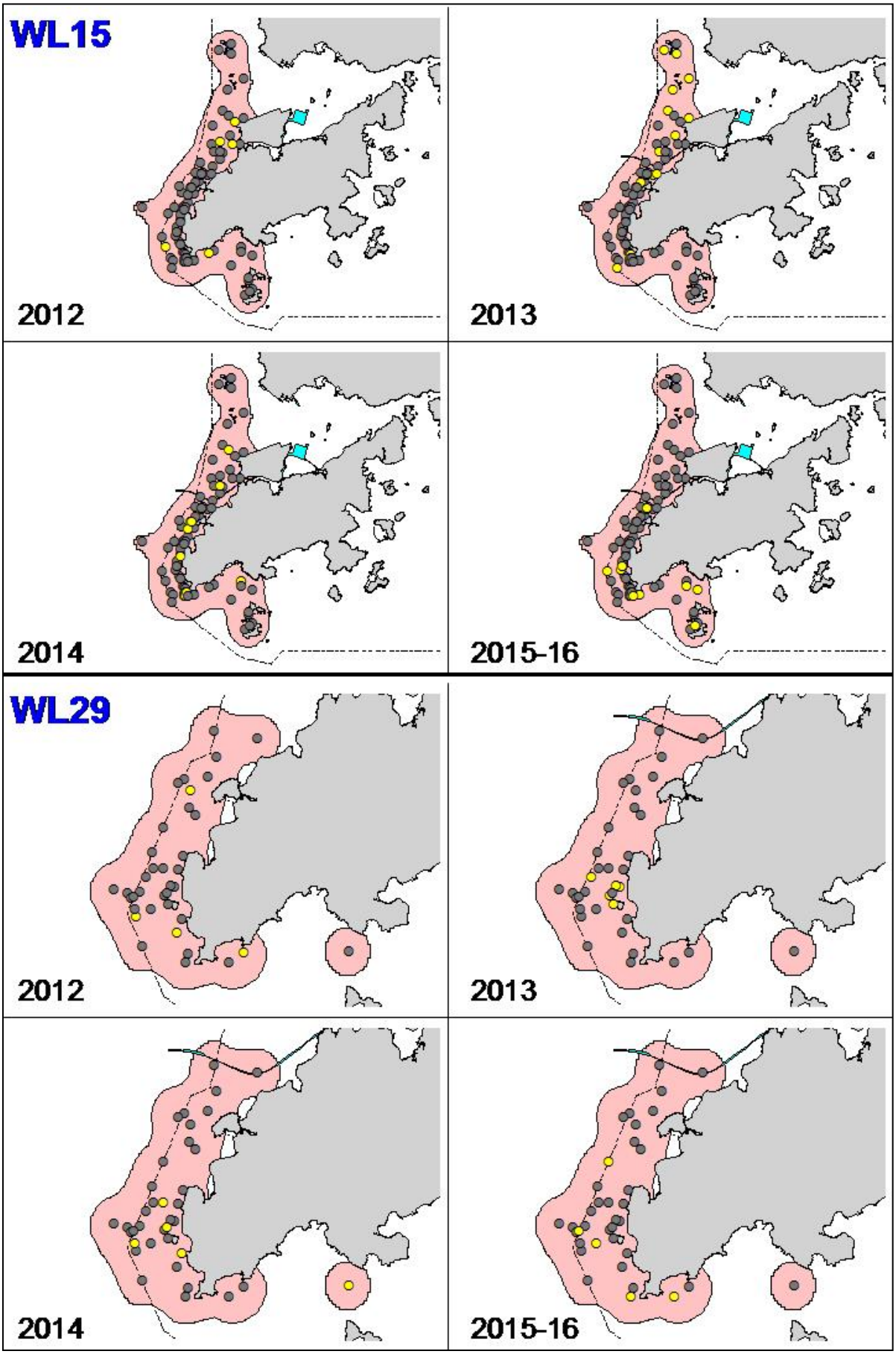



SL55
2014

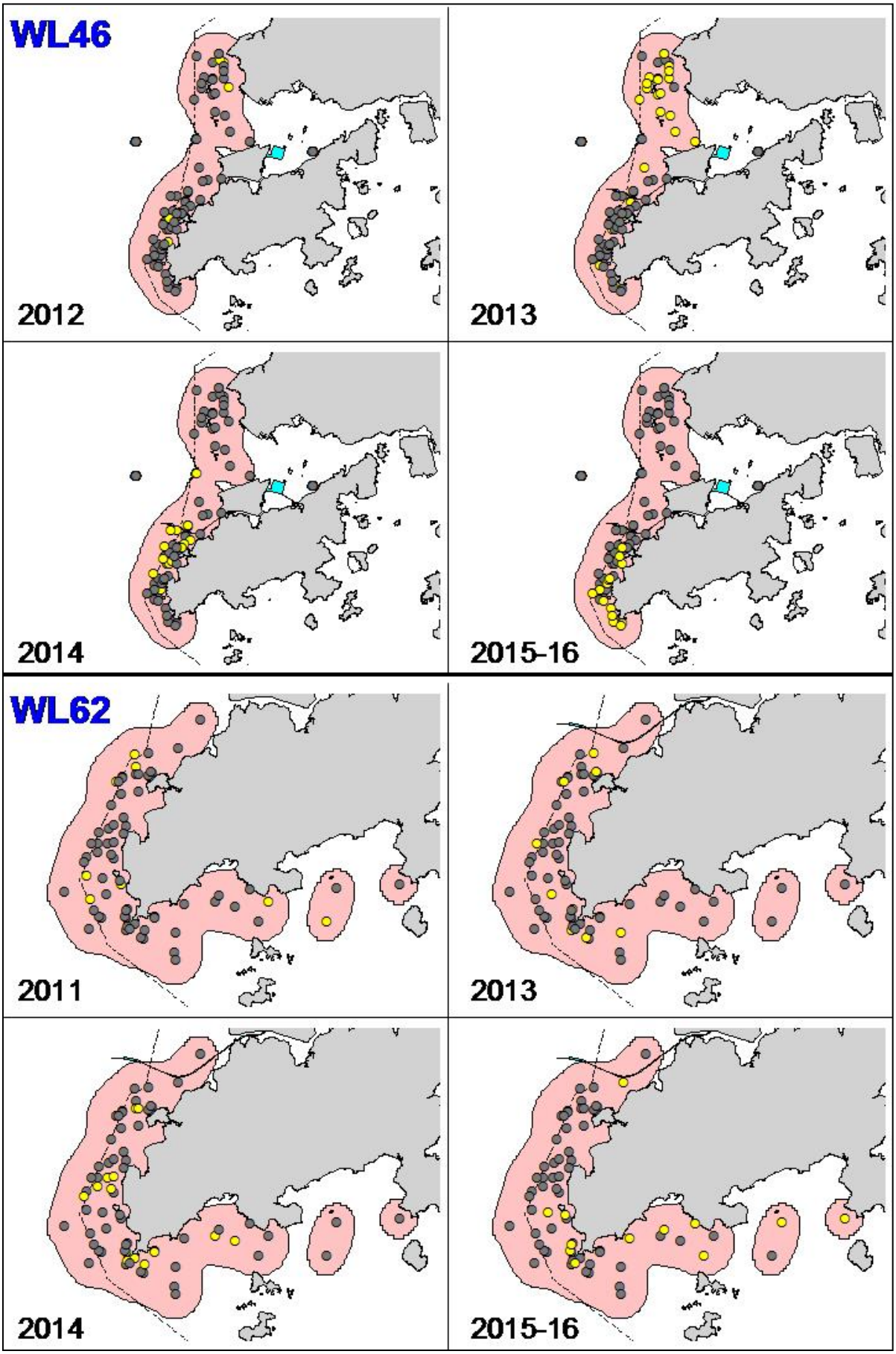

2015-16


SL60
2015-16

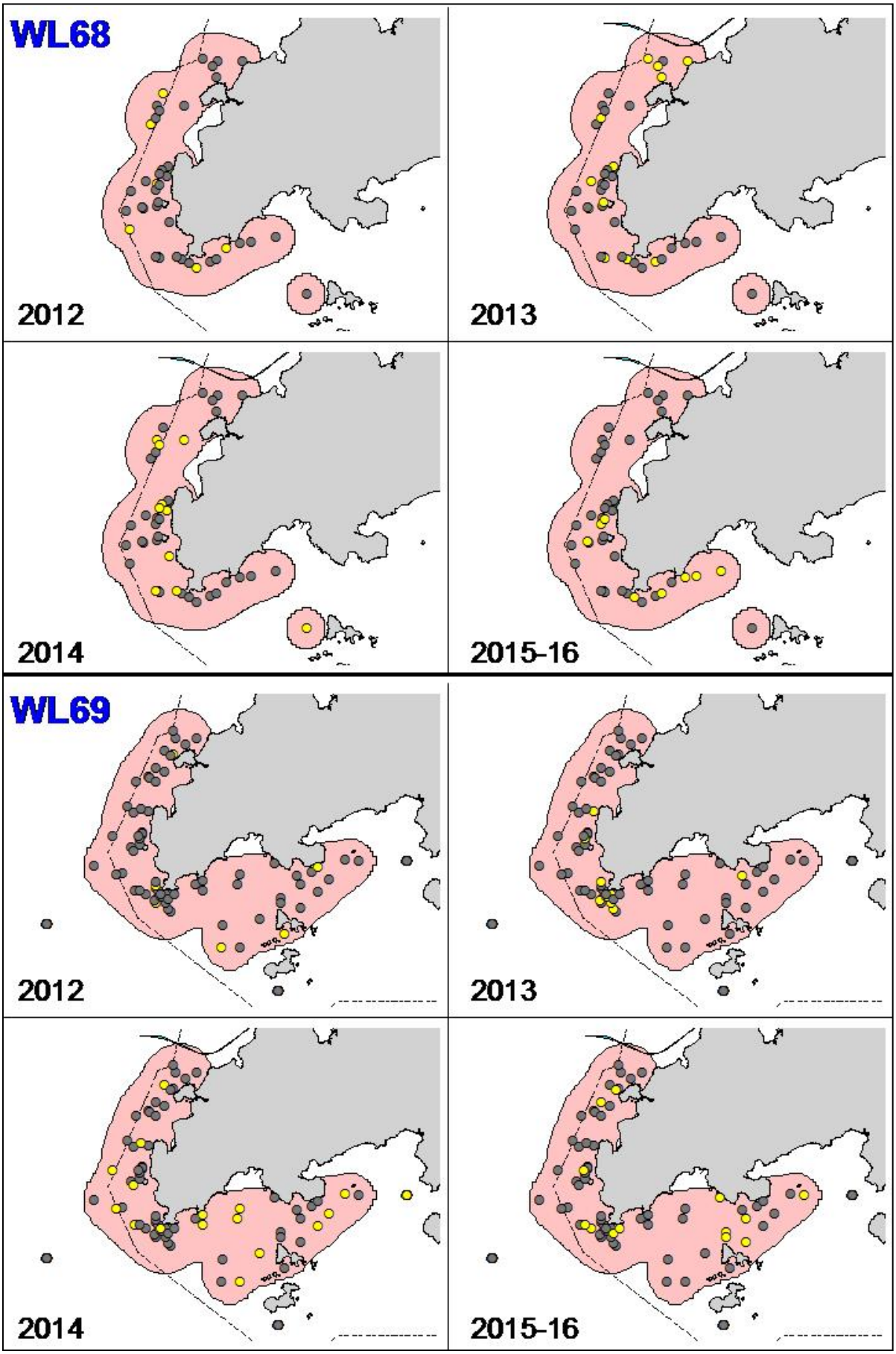
Appendix VII. (cont'd)



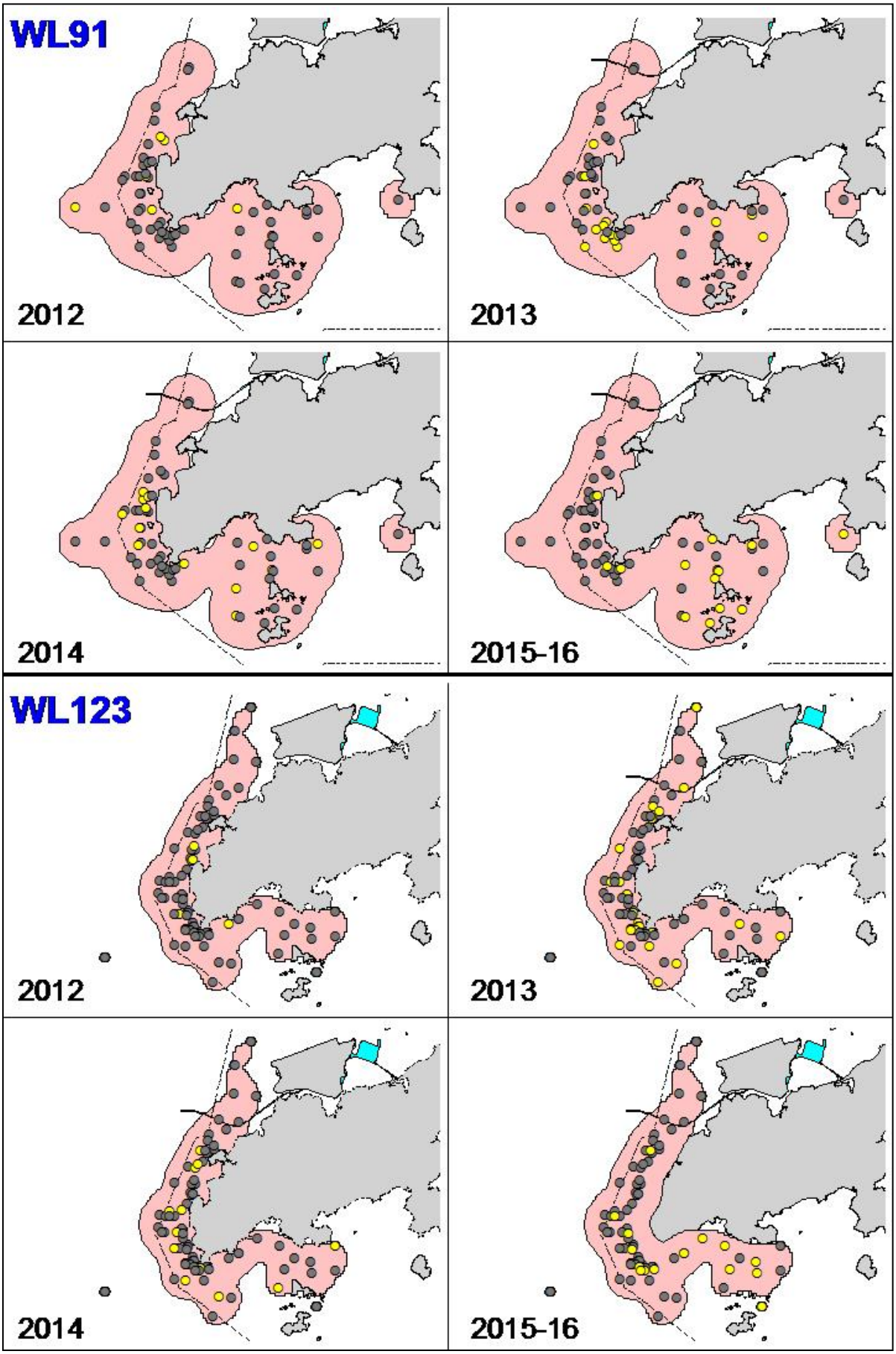
Appendix VII. (cont'd)



Appendix VII. (cont'd)



Appendix VII. (cont'd)



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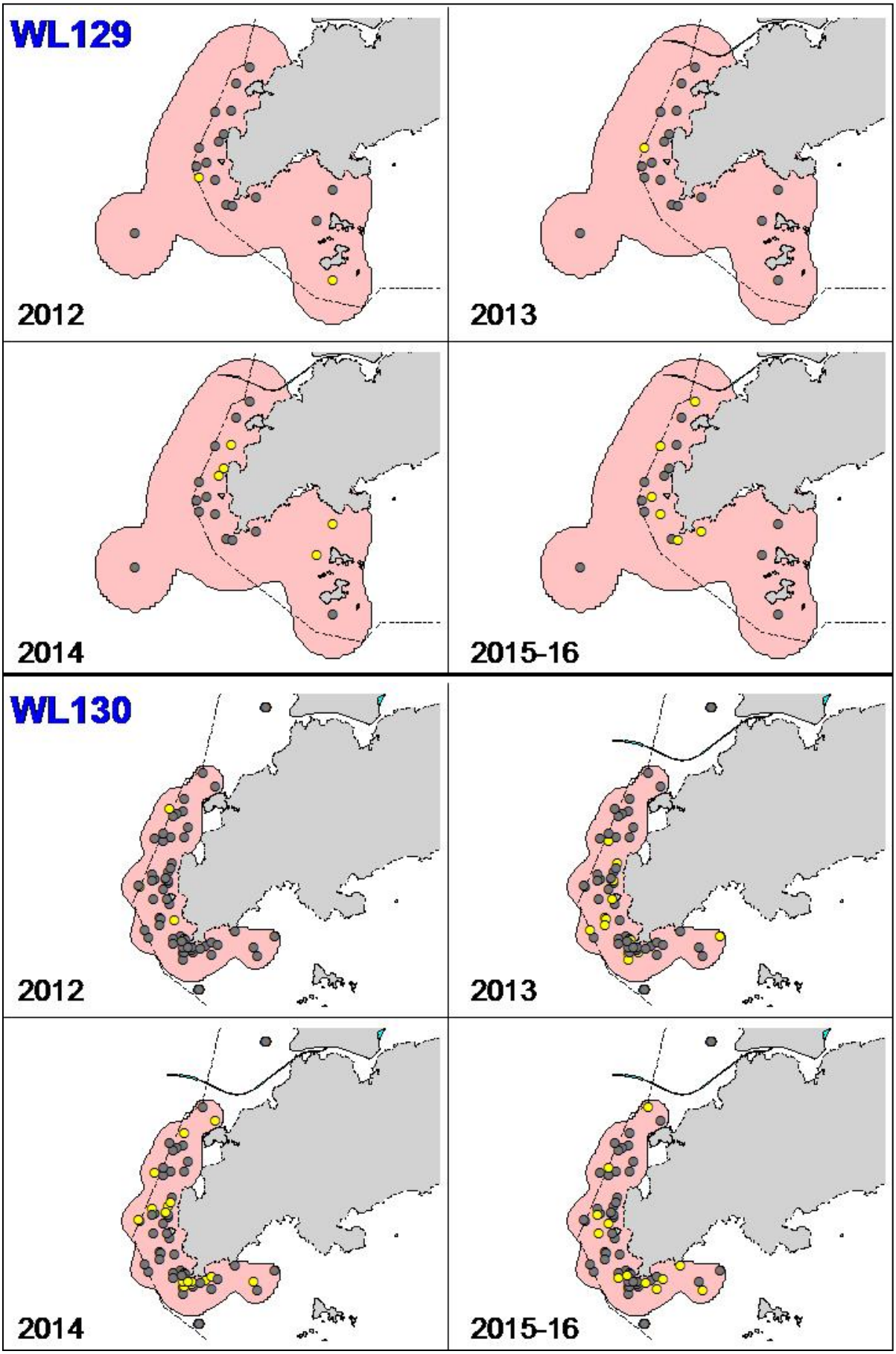

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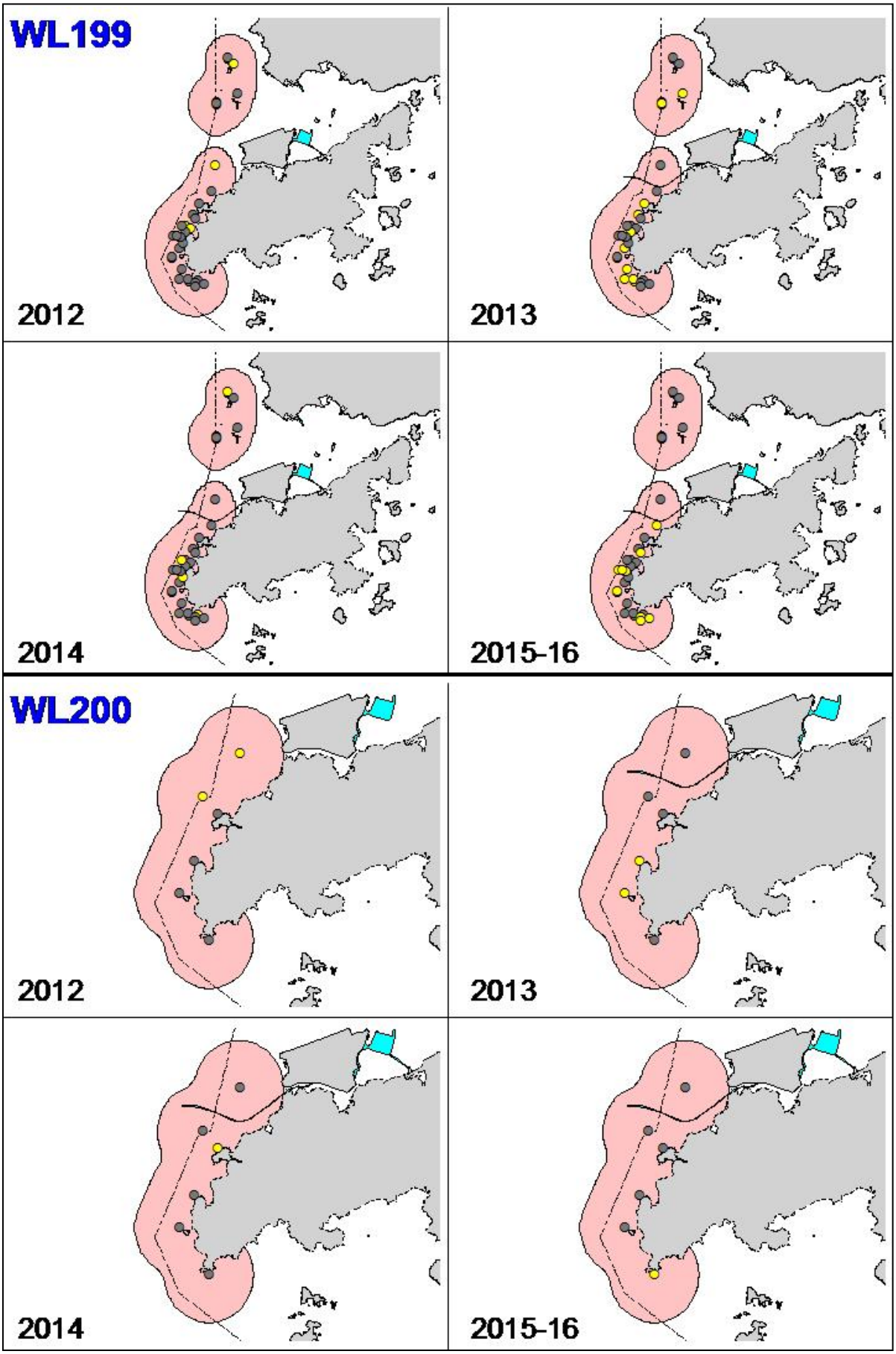
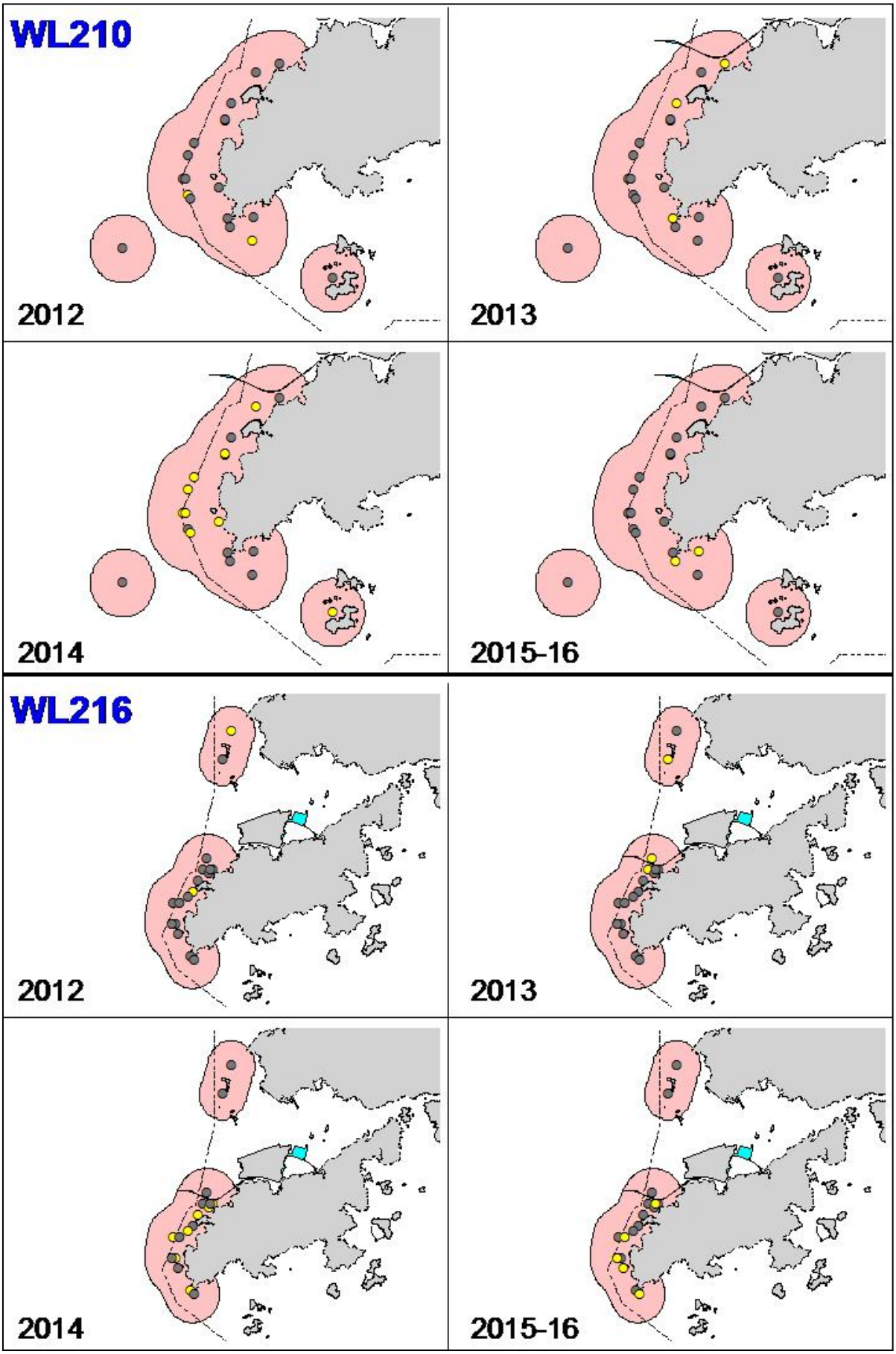
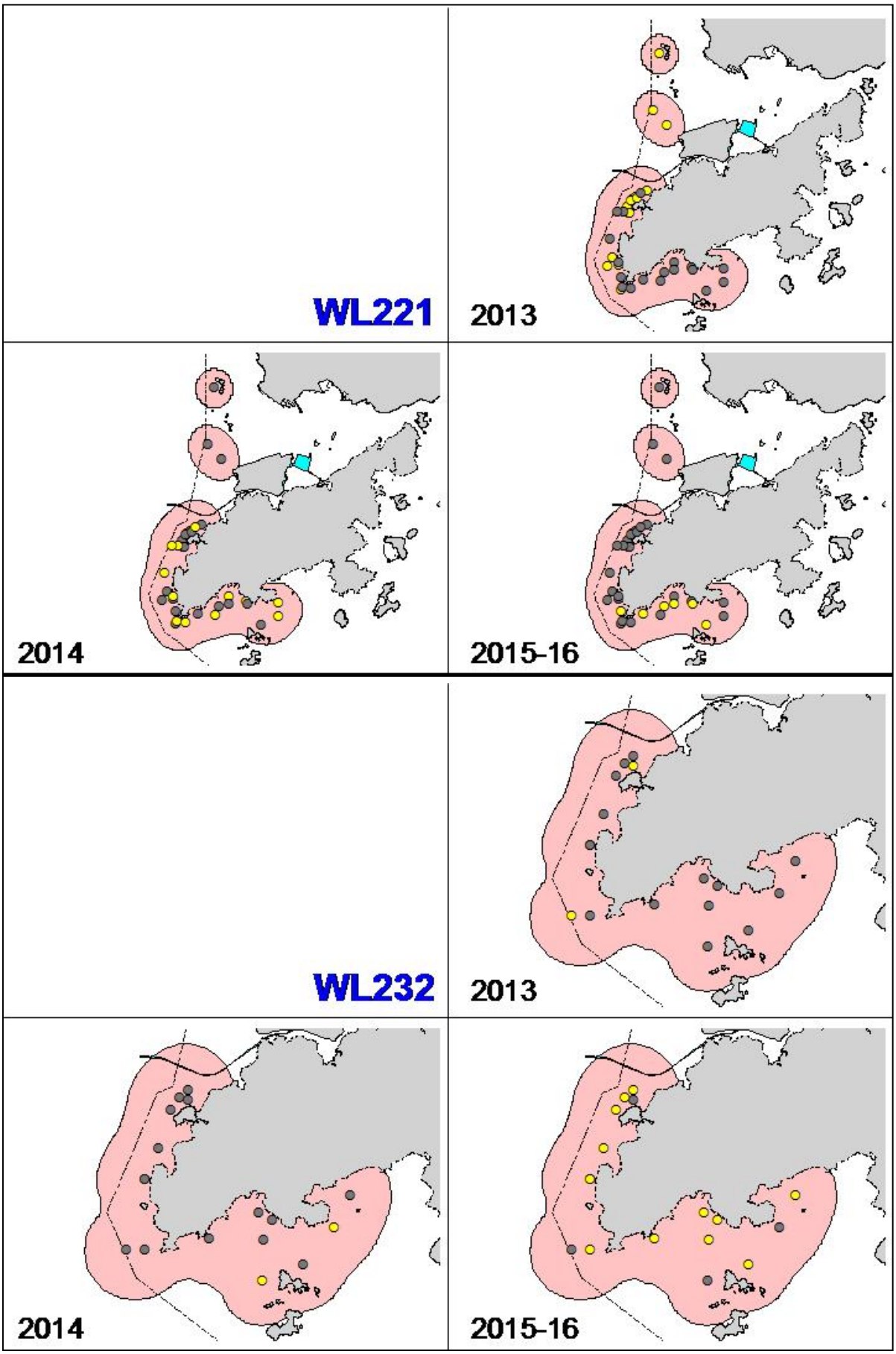


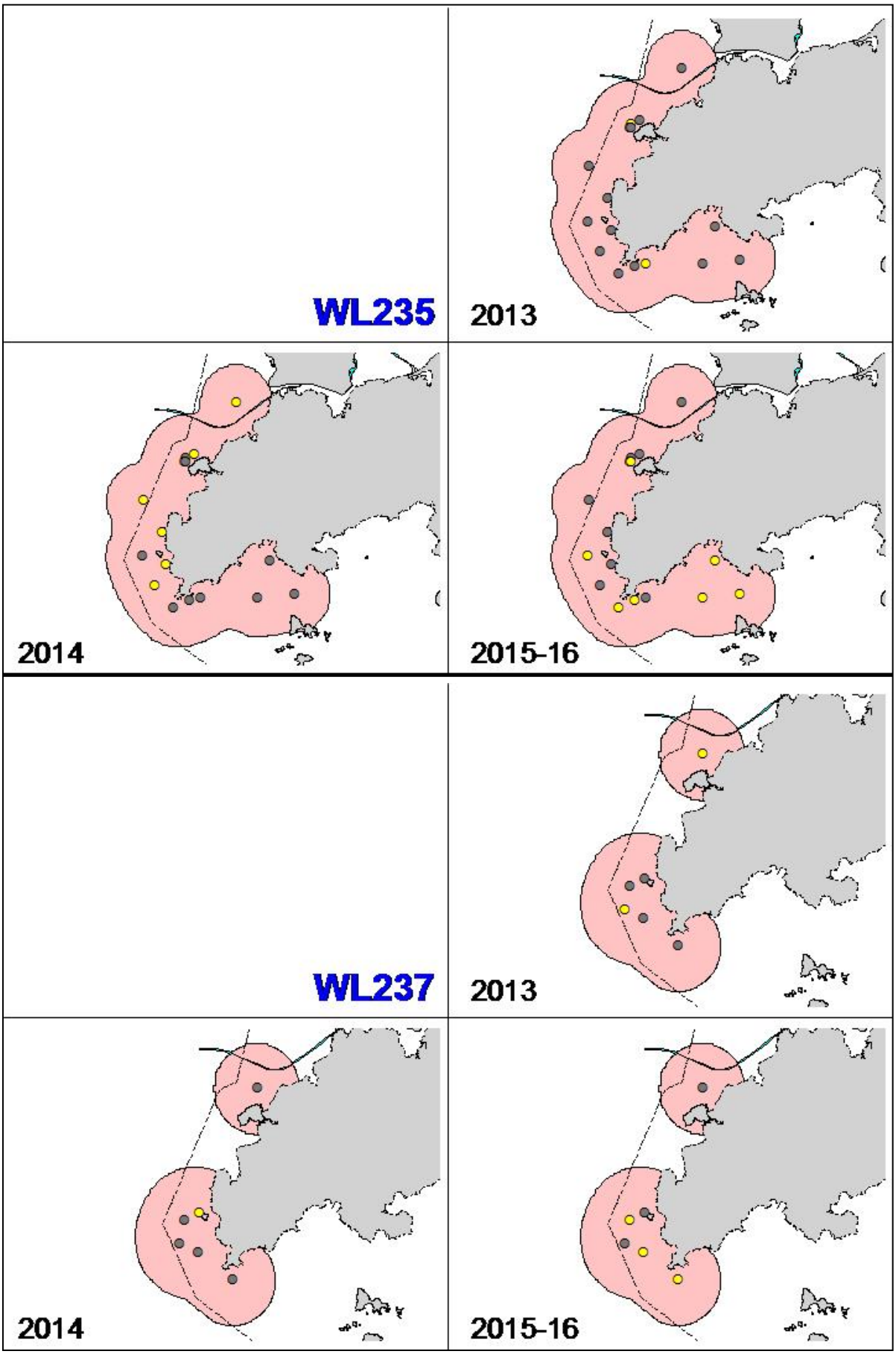
Appendix VII. (cont'd)



Appendix VII. (cont'd)



Appendix VII. (cont'd)



Appendix VII. (cont'd)