ENVIRON

Our Ref.: HYDHZMBEEM00_0_0469L.12.doc

6 November 2012

ARUP
Level 5, Festival Walk
80 Tat Chee Avenue
Kowloon Tong, Kowloon

By Fax (2268 3970) and By Post

Attention: Mr. Robert Antony Evans

Dear Sirs,

Re: Agreement No. CE 48/2011 (EP)
Environmental Project Office for the
HZMB Hong Kong Link Road, HZMB Hong Kong Boundary Crossing Facilities, and Tuen Mun-Chek Lap Kok Link – Investigation

Contract No. HY/2011/03 HZMB Hong Kong Link Road
Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (BCF) and Roadlinks between the Proposed HKBCF and Hong Kong International Airport
- Baseline Environmental Monitoring Report Revision 4

Reference is made to the submission of Baseline Environmental Monitoring Report Revision 4 dated 5 November 2012 certified by the ET Leader (ET's ref.: 8954/0056 dated 5 November 2012).

We are pleased to inform you that we have no adverse comments on the Baseline Environmental Monitoring Report (Revision 4 dated 5 November 2012) to be submitted under Condition 4.3 of EP-352/2009/A and condition 5.3 of EP-353-2009/E. We write to verify the captioned submission in accordance with conditions 1.9 and 4.3 of EP-352/2009/A as well as conditions 1.9 and 5.3 of EP-353-2009/E.

Thank you for your kind attention. Please do not hesitate to contact the undersigned or the ENPO Leader Mr. Y H Hui should you have any queries.

Yours sincerely,

Antony Wong
Independent Environmental Checker
Hong Kong Link Road

c.c. HyD – Mr. Matthew Fung (By Fax: 3188 6614)
HyD – Mr. Y K Lam (By Fax: 3188 6614)
ARUP – Mr. Eric Chan (By Fax: 2268 3970)

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5 November 2012
Our Ref: 8954/0056

By Email and Post

China State Construction Engineering (Hong Kong) Ltd.
29/F, China Overseas Building
139 Hennessy Road
Hong Kong

Attention: Mr. Tse Shun Yau

Dear Sirs

CONTRACT NO. HY/2011/03
HONG KONG-ZHUHAI-MACAO BRIDGE HONG KONG LINK ROAD SECTION BETWEEN SCENIC HILL AND HONG KONG BOUNDARY CROSSING FACILITIES (BCF) AND ROADLINKS BETWEEN THE PROPOSED HKBCF AND HONG KONG INTERNATIONAL AIRPORT
– BASELINE MONITORING REPORT (VER. 4)

I refer to the Environmental Permit No. EP-352/2009/A Condition 4.3 and EP-353/2009/E Condition 5.3 requiring the submission of a baseline monitoring report and the comments from EPD. I have reviewed and certified the revised Baseline Monitoring Report.

Yours faithfully
BMT Asia Pacific Limited

Claudine Lee
Environmental Team Leader

路政署
HIGHWAYS DEPARTMENT
港珠澳大橋香港工程管理處
Hong Kong - Zhuhai - Macao Bridge
Hong Kong Project Management Office

Contract No. HY/2011/03

Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road Section between Scenic Hill and Hong Kong Boundary Crossing Facilities

Baseline Environmental Monitoring Report

5 November 2012

Revision 4

Main Contractor

中國建築工程(香港)有限公司
CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LTD.

Designer

ATKINS

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Executive Summary

Prior to the commencement of Contract No. HY/2011/03 Hong Kong Zhuhai-Macao Bridge Hong Kong Link Road – Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract), Highways Department employed environmental specialist under Agreement No. CE35/2011 (EP) and Contract No. HY/2011/02 to carry out baseline environmental monitoring in air quality, noise water quality and ecology (Chinese White Dolphin) to facilitate early commencement of construction of Hong Kong Boundary Crossing Facilities (HKBCF) reclamation works and the Tuen Mum – Chek Lap Kok Link (TM-CLKL) advance Southern Landfall reclamation works under Contract No. HY/2010/02. The baseline environmental monitoring for air quality, noise, water quality and ecology (Chinese White Dolphin) was undertaken between September and November 2011 in accordance with requirements provided in the Environmental Monitoring and Audit (EM&A) Documents for the Hong Kong Link Road (HKLR), HKBCF and TM-CLKL. A Baseline Environmental Monitoring Report (Version C) for Hong Kong-Zhuhai-Macao Bridge Hong Kong Projects – Investigation (hereafter referred to as "BEMR") was prepared to fulfil environmental permit conditions for HKBCF (including TM-CLKL southern landfall) project. The BEMR presented monitoring locations, equipment, period, methodology, results and observations and is available from the website of Agreement No. CE 48/2011 (EP) Environmental Project Office (ENPO) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road, Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities, & Tuen Mun-Chek Lap Kok Link – Investigation:

http://www.hzmbenpo.com/

There are a total of two air quality monitoring stations, one noise monitoring station and thirteen water quality monitoring stations for this Contract No. HY/2011/03. As these environmental monitoring locations were also covered in the BEMR, the baseline monitoring results for these environmental monitoring locations will be adopted for the Contract.

This Baseline Environmental Monitoring Report has been prepared based on baseline mudflat monitoring results and baseline monitoring results presented in the BEMR.

The Action and Limit Levels for air quality, noise, water quality and ecology (Chinese White Dolphin) were developed based on the baseline monitoring results presented in the BEMR.

According to the baseline mudflat monitoring, surveys for horseshoe crabs, seagrass beds, intertidal soft shore communities as well as sedimentation rate monitoring were conducted in September 2012 at the specified mudflat survey areas.

The mudflat monitoring covered water quality monitoring data. Reference was made to the water quality baseline monitoring data of the representative water quality monitoring station (i.e. SR3) as presented in the BEMR. Baseline water quality monitoring in San Tau (monitoring station, SR3) was conducted in October 2011 prior to the construction of the HZMB.

1 Introduction

1.1 Background

1.1.1 The HZMB Hong Kong Link Road (HKLR) serves to connect the Hong Kong-Zhuhai-Macao Bridge (HZMB) Main Bridge at the Hong Kong Special Administrative Region (HKSAR) Boundary and the HZMB Hong Kong Boundary Crossing Facilities (HKBCF) located at the north eastern waters of the Hong Kong International Airport (HKIA).

1.1.2 The HKLR project has been separated into two contracts. They are Contract No. HY/2011/03 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (hereafter referred to as the Contract) and Contract No. HY/2011/09 Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road-Section between HKSAR Boundary and Scenic Hill. The split of environmental monitoring and audit works for these two contracts have been clarified in Environmental Project Office's letter ref.: HYDHZMBEEM00_0_0424L.12 which was sent to Environmental Protection Department on 17 October 2012.

1.1.3 China State Construction Engineering (Hong Kong) Ltd. was awarded by Highways Department as the Contractor to undertake the construction works of Contract No. HY/2011/03.

1.1.4 Prior to the commencement of the Contract, Highways Department employed environmental specialist under Agreement No. CE35/2011 (EP) to carry out baseline environmental monitoring in air quality, noise water quality and ecology (Chinese White Dolphin) to facilitate early commencement of construction of HKBCF reclamation works and the Tuen Mum – Chek Lap Kok Link (TM-CLKL) advance Southern Landfall reclamation works under Contract No. HY/2010/02.

1.1.5 The baseline environmental monitoring was undertaken between September and November 2011 in accordance with requirements in the Environmental Monitoring and Audit (EM&A) Documents for the HKLR, HKBCF and TM-CLKL. A Baseline Environmental Monitoring Report (Version C) dated 8 March 2012 for Hong Kong-Zhuhai-Macao Bridge Hong Kong Projects – Investigation (hereafter referred to as BEMR) was prepared to present monitoring locations, equipment, period, methodology, results and observations and is available from the website of Agreement No. CE 48/2011 (EP) Environmental Project Office (ENPO) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road, Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities, & Tuen Mun-Chek Lap Kok Link – Investigation:

http://www.hzmbenpo.com/

1.1.6 The relevant baseline monitoring results for air quality, noise, water quality and ecology (Chinese White Dolphin) presented in the BEMR have been adopted for this Contract as the baseline monitoring were undertaken prior to the commencement of the Contract and other nearby construction contracts in accordance with the EM&A requirements for the Contract.

1.1.7 This Baseline Environmental Monitoring Report is prepared to document Action and Limit Levels for air quality, noise, water quality, ecology (Chinese White Dolphin) which are extracted from the BEMR and baseline mudflat monitoring results for the Contract. The baseline levels will be used as the basis for compliance check during the impact monitoring for the Contract.

2 Air Quality

2.1 Air Quality Monitoring Stations

2.1.1 There are a total of two air quality monitoring stations for the Contract and they are the same baseline monitoring stations presented in the BEMR. The baseline air quality monitoring was undertaken approximately one year prior to the commencement of the Contract and other nearby construction contracts. Therefore, the baseline monitoring results together with the Action and Limit Levels for these monitoring stations are considered applicable for the Contract. The air quality monitoring stations for the Contract are listed in **Table 2.1** and shown in **Appendix A**.

Table 2.1 Locations of Air Quality Monitoring Stations

Monitoring Stations	Location
AMS 5	Ma Wan Chung Village (Tung Chung)
AMS 6	Dragonair / CNAC (Group) Building (HKIA)

2.2 Monitoring Methodology and Results

2.2.1 The monitoring methodology and results are detailed in the BEMR. The baseline monitoring results provided in Tables 3.4 and 3.5 of the BEMR will be adopted for the Contact as the baseline monitoring stations for the Contract are the same as those presented in the BEMR. A summary of the average 1-hour TSP concentration and 24-hour TSP concentration is provided in **Table 2.2** and **Table 2.3**, respectively.

Table 2.2 Summary of Baseline 1-hour TSP Monitoring Results

Monitoring Station	Average 1-hour TSP Concentration, µg/m^3 (Range)
AMS 5	156.9 (82.2 – 246.6)
AMS 6	169.2 (87.8 – 273.2)

Table 2.3 Summary of Baseline 24-hour TSP Monitoring Results

Monitoring Station	Average 24-hour TSP Concentration, µg/m^3 (Range)
AMS 5	52.9 (25.3 – 74.2)
AMS 6	66.4 (35.2 – 103.5)

2.3 Action and Limit Levels

2.3.1 The Action and Limit Levels for the Contract have been extracted from Tables 3.8 and 3.9 of the BEMR and summarised in **Table 2.4** and **Table 2.5**.

Table 2.4 Action and Limit Levels for 1-hour TSP

Monitoring Station	Action Level, μg/m^3	Limit Level, μg/m^3
AMS 5	352	500
AMS 6	360	

Table 2.5 Action and Limit Levels for 24-hour TSP

Monitoring Station	Action Level, μg/m^3	Limit Level, μg/m^3
AMS 5	164	260
AMS 6	173	

2.4 Event and Action Plan for Air Quality

2.4.1 Should non-compliance of the air quality criteria occur, actions in accordance with the Action Plan in **Table 2.6** shall be carried out.

Table 2.6 Event and Action Plan for Air Quality

Event	Action			
	ET	IEC	SO	Contractor
Exceedance of Action Level for one sample	1. Identify source, investigate the causes of exceedance and propose remedial measures; 2. Inform IEC and SO; 3. Repeat measurement to confirm finding; 4. Increase monitoring frequency to daily.	1. Check monitoring data submitted by ET; 2. Check Contractor's working method.	1. Notify Contractor.	1. Rectify any unacceptable practice; 2. Amend working methods if appropriate.

Event	Action			
	ET	IEC	SO	Contractor
Exceedance of Action Level for two or more consecutive samples	1. Identify source; 2. Inform IEC and SO; 3. Advise the SO on the effectiveness of the proposed remedial measures; 4. Repeat measurements to confirm findings; 5. Increase monitoring frequency to daily; 6. Discuss with IEC and Contractor on remedial actions required; 7. If exceedance continues, arrange meeting with IEC and SO; 8. If exceedance stops, cease additional monitoring.	1. Check monitoring data submitted by ET; 2. Check Contractor's working method; 3. Discuss with ET and Contractor on possible remedial measures; 4. Advise the ET on the effectiveness of the proposed remedial measures; 5. Supervise Implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Ensure remedial measures properly implemented.	1. Submit proposals for remedial to SO within 3 working days of notification; 2. Implement the agreed proposals; 3. Amend proposal if appropriate.
Exceedance of Limit Level for one sample	1. Identify source, investigate the causes of exceedance and propose remedial measures; 2. Inform SO, Contractor and EPD; 3. Repeat measurement to confirm finding; 4. Increase monitoring frequency to daily; 5. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and SO informed of the results.	1. Check monitoring data submitted by ET; 2. Check Contractor's working method; 3. Discuss with ET and Contractor on possible remedial measures; 4. Advise the SO on the effectiveness of the proposed remedial measures; 5. Supervise implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Ensure remedial measures properly implemented.	1. Take immediate action to avoid further exceedance; 2. Submit proposals for remedial actions to IEC within 3 working days of notification; 3. Implement the agreed proposals; 4. Amend proposal if appropriate.

Event	Action			
	ET	IEC	SO	Contractor
Exceedance of Limit Level for two or more consecutive samples	1. Notify IEC, SO, Contractor and EPD; 2. Identify source; 3. Repeat measurement to confirm findings; 4. Increase monitoring frequency to daily; 5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented; 6. Arrange meeting with IEC and SO to discuss the remedial actions to be taken; 7. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and SO informed of the results; 8. If exceedance stops, cease additional monitoring.	1. Discuss amongst SO, ET, and Contractor on the potential remedial actions; 2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the SO accordingly; 3. Supervise the implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. In consultation with the IEC, agree with the Contractor on the remedial measures to be implemented; 4. Ensure remedial measures properly implemented; 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	1. Take immediate action to avoid further exceedance; 2. Submit proposals for remedial actions to IEC within 3 working days of notification; 3. Implement the agreed proposals; 4. Resubmit proposals if problem still not under control; 5. Stop the relevant portion of works as determined by the SO until the exceedance is abated.

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

3 Noise

3.1 Noise Monitoring Stations

3.1.1 There is one noise monitoring stations for the Contract and they are the same baseline monitoring stations presented in the BEMR. The baseline noise monitoring was undertaken approximately one year prior to the commencement of the Contract and other nearby construction contracts. Therefore, the baseline monitoring results together with the Action and Limit Levels for these monitoring stations are considered applicable for the Contract. The noise monitoring stations for the Contract are listed in **Table 3.1** and shown in **Appendix A**.

Table 3.1 Locations of Noise Monitoring Stations

Monitoring Station	Location
NMS 5	Ma Wan Chung Village (Tung Chung)

3.2 Monitoring Methodology and Results

3.2.1 The monitoring methodology and results are detailed in the BEMR. The baseline monitoring results provided in Tables 4.5 – 4.7 of the BEMR will be adopted for the Contact as the baseline monitoring stations for the Contract is the same as those presented in the BEMR. The baseline monitoring results are summarized in **Table 3.2** to **Table 3.4**.

Table 3.2 Summary of Daytime (Normal Weekdays) Noise Monitoring Results

Monitoring Station	Daytime 0700-1900 hrs on normal weekdays Range of Noise Level, dB(A)								
	$L_{eq\ (30\ min)}$			$L_{10\ (5\ min)}$			$L_{90\ (5\ min)}$		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
NMS 5	55.3	63.5	51.0	57.5	74.1	50.8	51.1	61.7	48.3

Table 3.3 Summary of Evening-Time & Daytime (Holiday) Noise Monitoring Results

Monitoring Station	Evening-time 1900-2300 hrs on all days & Daytime 0700-1900 hrs on holidays Range of Noise Level, dB(A)								
	$L_{eq\ (30\ min)}$			$L_{10\ (5\ min)}$			$L_{90\ (5\ min)}$		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min.
NMS 5	55.4	68.2	48.9	58.2	67.8	49.7	51.0	57.5	48.1

Table 3.4 Summary of Night Time Noise Monitoring Results

Monitoring Station	Night-time 2300-0700 hrs on the next day Range of Noise Level, dB (A)								
	$L_{eq\ (30\ min)}$			$L_{10\ (5\ min)}$			$L_{90\ (5\ min)}$		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
NMS 5	53.7	67.5	48.6	55.7	71.5	49.5	50.0	55.0	48.0

3.3 Action and Limit Levels

3.3.1 The Action and Limit Levels for the Contract have been extracted from Table 4.9 of the BEMR and summarised in **Table 3.5**.

Table 3.5 Action Limit Levels for Noise during Construction Period

Monitoring Station	Time Period	Action Level	Limit Level
NMS5	0700-1900 hrs on normal weekdays	When one documented complaint is received	75 dB(A)

Notes:
If works are to be carried during restricted hours, the conditions stipulated in the construction noise permit issued by the Noise Control Authority have to be followed.
(*): Reduce to 65 dB (A) during school examination periods.

3.4 Event and Action Plan for Noise Monitoring

3.4.1 Should non-compliance of the criteria occur, action in accordance with the Event and Action Plan, as provided in **Table 3.6**, shall be carried out.

Table 3.6 Event and Action Plan for Construction Noise

Event	Action			
	ET	IEC	SO	Contractor
Exceedance of Action Level	1. Identify source, investigate the causes of exceedance and propose remedial measures; 2. Notify IEC and Contractor; 3. Report the results of investigation to the IEC, SO and Contractor; 4. Discuss with the Contractor and formulate remedial measures; 5. Increase monitoring frequency to check mitigation effectiveness.	1. Review the analysed results submitted by the ET; 2. Review the proposed remedial measures by the Contractor and advise the SO accordingly; 3. Supervise the implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Require Contractor to propose remedial measures for the analysed noise problem; 4. Ensure remedial measures are properly implemented	1. Submit noise mitigation proposals to IEC; 2. Implement noise mitigation proposals.

4 Water Quality

4.1 Water Quality Monitoring Stations

4.1.1 There are a total of thirteen water quality monitoring stations specified under the ER for the contract. The baseline water quality monitoring was undertaken approximately one year prior to the commencement of the Contract and other nearby construction contracts. Therefore, the baseline monitoring results together with the Action and Limit Levels for these monitoring stations are considered applicable for the Contract. They are listed in **Table 4.1** and shown in **Appendix A**.

Table 4.1 Locations of the Water Quality Monitoring Stations

Monitoring Stations	Description	Coordinates	
		Easting	Northing
IS5	Impact Station (Close to HKLR construction site)	811579	817106
IS(Mf)6	Impact Station (Close to HKLR construction site)	812101	817873
IS7	Impact Station (Close to HKBCF construction site)	812244	818777
IS8	Impact Station (Close to HKBCF construction site)	814251	818412
IS(Mf)9	Impact Station (Close to HKBCF construction site)	813273	818850
IS10	Impact Station (Close to HKBCF construction site)	812577	820670
SR3	Sensitive receivers (San Tau SSSI)	810525	816456
SR4	Sensitive receivers (Tai Ho Inlet)	814760	817867
SR5	Sensitive receivers (Artificial Reef In NE Airport)	811489	820455
SR10A	Sensitive receivers (Ma Wan Fish Culture Zone)	823741	823495
SR10B	Sensitive receivers (Ma Wan Fish Culture Zone)	823686	823213
CS2	Control Station	805849	818780
CS(Mf)5	Control Station	817990	821129

4.2 Monitoring Methodology and Results

4.2.1 The monitoring methodology and results are detailed in the BEMR. The baseline monitoring results provided in the BEMR will be adopted for the Contact as the baseline monitoring stations for the Contract is the same as those presented in the BEMR. Appendices C3 and C4 of the BEMR detail the baseline monitoring results for the Contract.

4.3 Action and Limit Levels

4.3.1 The Action and Limit Levels for the Contract have been extracted from Table 5.6 of the BEMR and summarised in **Table 4.2**.

Table 4.2 Action and Limit Levels for Water Quality

Parameter (unit)	Water Depth	Action Level	Limit Level
Dissolved Oxygen (mg/L) (surface, middle and bottom)	Surface and Middle	5.0	4.2 except 5 for Fish Culture Zone
	Bottom	4.7	3.6
Turbidity (NTU)	Depth average	27.5 or 120% of upstream control station's turbidity at the same tide of the same day	47.0 or 130% of turbidity at the upstream control station at the same tide of same day
Suspended Solid (SS) (mg/L)	Depth average	23.5 or 120% of upstream control station's SS at the same tide of the same day	34.4 or 130% of SS at the upstream control station at the same tide of same day and 10mg/L for Water Services Department Seawater Intakes

Notes:
(1) Depth-averaged is calculated by taking the arithmetic means of reading of all three depths.
(2) For DO, non-compliance of the water quality limit occurs when monitoring result is lower that the limit.
(3) For SS & turbidity non-compliance of the water quality limits occur when monitoring result is higher than the limits.
(4) All the figures given in the table are used for reference only and the EPD may amend the figures whenever it is considered as necessary.
(5) The 1 percentile of baseline data for dissolved oxygen (surface and middle) and dissolved oxygen (bottom) are 4.2mg/L and 3.6mg/L respectively.

4.4 Event and Action Plan for Water Quality Monitoring

4.4.1 Should non-compliance of the criteria occur, action in accordance with the Event and Action Plan, as provided in **Table 4.3**, shall be carried out.

Table 4.3 Event and Action Plan for Water Quality

Event	Action			
	ET Leader	IEC	SO	Contractor
Action level being exceeded by one sampling day	1. Repeat in situ measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IEC, contractor and SO; 4. Check monitoring data, all plant, equipment and Contractor's working methods.	1. Check monitoring data submitted by ET and Contractor's working methods.	1. Confirm receipt of notification of non-compliance in writing; 2. Notify Contractor.	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Amend working methods if appropriate.

Event	Action			
	ET Leader	IEC	SO	Contractor
Action level being exceeded by two or more consecutive sampling days	1. Repeat measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IEC, contractor, SO and EPD; 4. Check monitoring data, all plant, equipment and Contractor's working methods; 5. Discuss mitigation measures with IEC, SO and Contractor; 6. Ensure mitigation measures are implemented; 7. Increase the monitoring frequency to daily until no exceedance of Action level;	1. Check monitoring data submitted by ET and Contractor's working method; 2. Discuss with ET and Contractor on possible remedial actions; 3. Review the proposed mitigation measures submitted by Contractor and advise the SO accordingly; 4. Supervise the implementation of mitigation measures.	1. Discuss with IEC on the proposed mitigation measures; 2. Ensure mitigation measures are properly implemented; 3. Assess the effectiveness of the implemented mitigation measures.	1. Inform the Engineer and confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Check all plant and equipment and consider changes of working methods; 4. Submit proposal of additional mitigation measures to SO within 3 working days of notification and discuss with ET, IEC and SO; 5. Implement the agreed mitigation measures.
Limit level being exceeded by one sampling day	1. Repeat measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IEC, contractor, SO and EPD; 4. Check monitoring data, all plant, equipment and Contractor's working methods; 5. Discuss mitigation measures with IEC, SO and Contractor;	1. Check monitoring data submitted by ET and Contractor's working method; 2. Discuss with ET and Contractor on possible remedial actions; 3. Review the proposed mitigation measures submitted by Contractor and advise the SO accordingly.	1. Confirm receipt of notification of failure in writing; 2. Discuss with IEC, ET and Contractor on the proposed mitigation measures; 3. Request Contractor to review the working methods.	1. Inform the SO and confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Check all plant and equipment and consider changes of working methods; 4. Submit proposal of mitigation measures to SO within 3 working days of notification and discuss with ET, IEC and SO.

Event	Action			
	ET Leader	IEC	SO	Contractor
Limit level being exceeded by two or more consecutive sampling days	1. Repeat measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IEC, contractor, SO and EPD; 4. Check monitoring data, all plant, equipment and Contractor's working methods; 5. Discuss mitigation measures with IEC, SO and Contractor; 6. Ensure mitigation measures are implemented; 7. Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days;	1. Check monitoring data submitted by ET and Contractor's working method; 2. Discuss with ET and Contractor on possible remedial actions; 3. Review the Contractor's mitigation measures whenever necessary to assure their effectiveness and advise the SO accordingly; 4. Supervise the implementation of mitigation measures.	1. Discuss with IEC, ET and Contractor on the proposed mitigation measures; 2. Request Contractor to critically review the working methods; 3. Make agreement on the mitigation measures to be implemented; 4. Ensure mitigation measures are properly implemented; 5. Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the construction activities until no exceedance of Limit level.	1. Take immediate action to avoid further exceedance; 2. Submit proposal of mitigation measures to SO within 3 working days of notification and discuss with ET, IEC and SO; 3. Implement the agreed mitigation measures; 4. Resubmit proposals of mitigation measures if problem still not under control; 5. As directed by the Engineer, to slow down or to stop all or part of the construction activities until no exceedance of Limit level.

5 Ecology

5.1 Monitoring Methodology and Results for Chinese White Dolphins

5.1.1 The monitoring methodology and results are detailed in Section 6 of the BEMR. In total, 112 groups of Chinese White Dolphins, numbering 413 individuals, were observed during the three-month baseline survey. Most were sighted in the West Lantau and Northwest Lantau regions. The detailed monitoring results which were extracted from Appendix D of BEMR are presented in **Appendix C**.

5.2 Event and Action Plan for Dolphin Monitoring

5.2.1 The Event and Action Plan for dolphin monitoring for the Contract have been extracted from Table 6.2 of the BEMR and summarised in **Table 5.2**.

Table 5.2 Event and Action Plan for Dolphin Monitoring

Event	Action*			
	ET	IEC	SO	Contractor
Dolphin numbers and behaviour patterns recorded in the construction and post-construction monitoring are significantly lower than or different from those recorded in the pre-construction monitoring.	Repeat statistical data analysis to confirm findings; Review historical data to ensure differences are as a result of natural variation or previously observed seasonal differences; Identify source(s) of impact; Inform the IEC, SO and Contractor; Check monitoring data; Discuss additional dolphin monitoring and any other measures, with the IEC and Contractor.	Discuss monitoring with the ET and the Contractor; Review proposals for additional monitoring and any other measures submitted by the Contractor and advise the SO accordingly.	Discuss with the IEC additional monitoring requirements and any other measures proposed by the ET; Make agreement on the measures to be implemented	Inform the SO and confirm notification of the non-compliance in writing; Discuss with the ET and the IEC and propose measures to the IEC and the SO; Implement the agreed measures.

Notes:
ET – Environmental Team
IEC – Independent Environmental Checker
SO – Supervising Officer
* Action to be instigated within 1 month of an event

6 Mudflat Monitoring

6.1 Mudflat Ecology Monitoring Methodology

Sampling Zone

6.1.1 There are two survey areas specified under the ER for the Contract, namely Tung Chung Bay and San Tau. Tung Chung Bay survey area is divided into three sampling zones (TC1, TC2 and TC3) and there is one sampling zone at San Tau (ST). Survey of horseshoe crabs, seagrass beds and intertidal communities were conducted in each sampling zone. The

locations of sampling zones are shown in **Figure 6.1**. The pre-construction mudflat ecology monitoring was undertaken between 13 and 23 September 2012.

Horseshoe Crabs

6.1.2 An active search method was adopted for horseshoe crab survey at each sampling zone. The survey was undertaken by 2 specialists each spending 2 to 3 hours at the site subject to the site and tidal conditions for two days. Once a horseshoe crab was found, the species, size and inhabiting substrate, photographic record and respective GPS coordinate were recorded.

Seagrass Beds

6.1.3 An active search method was adopted for seagrass bed survey at each sampling zone. The survey was undertaken by 2 specialists each spending 2 to 3 hours at the site subject to the site and tidal conditions for two days. Once seagrass bed was observed, the species, the estimated area (m^2), photographic record and respective GPS coordinate were recorded.

Intertidal Soft Shore Communities

6.1.4 The sandy shore of San Tau and Tung Chung Bay from the uppermost part of the shore and to the water edge was divided into three tidal zones – upper, middle and lower zones, at each sampling zone, TC1, TC2, TC3 and ST. A 100m transect was laid in each of the three tidal zones for fauna sampling.

6.1.5 At each sampling zone, three 100m horizontal transects will be laid at 2.0m, 1.5m and 1.0m above C.D. Along each transect, ten random quadrats (0.5 m x 0.5m) were placed. In each quadrat, the epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers/coverage percentages were recorded. One core of 10cm diameter x 20cm depth was also collected within each quadrat. The sediments of the cores were sieved with 2mm mesh-size sieve and the biota inside was identified and counted. Species and abundance of biota in both cores and quadrats were reported.

6.2 Mudflat Ecology Monitoring Results

Horseshoe Crabs

6.2.1 There were 1, 9 and 16 individuals of *Tachypleus tridentatus* observed at TC1, TC3 and ST respectively. In addition, grouping of *T. tridentatus* was also observed at TC3 and ST while each group consisted of 2 to 4 individuals of *T. tridentatus*. Survey results are presented in Table 3.1 of **Appendix B**. No individuals of *T. tridentatus* were observed at TC2.

6.2.2 The prosomal width was also measured for each individual of *T. tridentatus*, and the range of prosomal width was from 8.45mm to 59.32mm, which corresponds to an age of 9 months to 8 years old. The survey results have been grouped together for presentation. Summary of prosomal width of horseshoe crab is shown in **Table 6.1**.

Table 6.1 Summary of Prosomal Width of Horseshoe Crab Survey

	TC1	TC2	TC3	ST
No. of individuals	1	N/A	9	16
Mean prosomal width (mm)	28.14	N/A	42.65	24.41
Range of prosomal width (mm)	N/A	N/A	12.67 – 59.32	8.45 – 47.90
Search record (individual hr^{-1} $person^{-1}$)	0.25	N/A	1.50	2.67

Seagrass Beds

6.2.3 Four patches of *Halophila ovalis* were observed at ST while no any patches of *H. ovalis* were observed at the other sampling zones, TC1, TC2 and TC3. The survey results have been

grouped together for presentation. The estimated total area and the mean area of *H. ovalis* as observed at ST were 332.3m^2 and 83.1m^2, respectively. Survey results for seagrass beds are presented in Table 3.3 of **Appendix B**.

Intertidal Soft Shore Communities

6.2.4 A total of 15,188 individuals were recorded. Mollusks were significantly abundant phylum (total individuals of 14,669; relative abundance of 96.6%, density of 489 individual m^{-2}) followed by the second abundant group, arthropod (total individuals of 467; relative abundance of 3.1%, density of 16 individual m^{-2}) at the sampling zones. The summary of the total abundance and total biomass of every phylum is presented in Table 3.5 of **Appendix B**. The complete list of species recorded is shown in Appendix III of **Appendix B**.

6.2.5 In general, molluscs were the most dominant phylum (No. of individuals: 3011-4839; relative abundance of 93.6-98.5%, density of 401-645 individual m^{-2}) followed by the second abundant phylum, arthropods (no. of individuals: 43-201; relative abundance of 1.2-6.0%, density of 6-27 individual m^{-2}). In addition, other phyla were very low in abundance across the four sampling zones (relative abundance of < 1%). The number of individuals and relative abundance (%) of each phylum at every sampling zone were presented in Table 3.6 of **Appendix B**.

6.2.6 For TC1, gastropod *Batillaria multiformis* was the most dominant species (64-65 ind. m^{-2}; relative abundance of 33-61%) at upper and middle tidal zones. Rock oyster *Saccostrea cucullata* (12-43 ind. m^{-2}; relative abundance of 15-22%) was the second abundant species at middle and lower tidal zones. Gastropod *Cerithidea djadjariensis* was the most dominant species (18 ind. m^{-2}; relative abundance of 21%) at lower tidal zone while gastropod *Batillaria multiformis* (12 ind. m^{-2}; relative abundance of 14%) was the third dominant species at lower tidal zone.

6.2.7 For TC2, gastropod *Cerithidea djadjariensis* was the most dominant species at all tidal zones (31-60 ind. m^{-2}; relative abundance of 36-51%). The rock oyster *Saccostrea cucullata* (32 ind. m^{-2}; relative abundance of 19%) was the second abundant species at middle tidal zone.

6.2.8 For TC3, gastropod *Cerithidea djadjariensis* (45-83 ind. m^{-2}; relative abundance of 27-47%) and *Batillaria multiformis* (44-61 ind. m^{-2}; relative abundance of 25-36%) were the two most dominant species at upper and middle tidal zones. Rocky oyster *Saccostrea cucullata* (44 ind. m^{-2}; relative abundance of 30%) and gastropod *Monodonta labio* (36 ind. m^{-2}; relative abundance of 24%) were the most dominant species at lower tidal zone.

6.2.9 For ST, the upper tidal zone was dominated by gastropod *Batillaria multiformis* (40 ind. m^{-2}; relative abundance of 26%) and *Nassarius festivus* (32 ind. m^{-2}; relative abundance of 21%). Gastropod *Cerithidea djadjariensis* (35 ind. m^{-2}; relative abundance of 33%) was the first dominant species at middle tidal zone and second dominant species (10 ind. m^{-2}; relative abundance of 20%) at lower tidal zone. At middle tidal zone, the gastropod *Cerithidea cingulata* was the second abundant species (23 ind. m^{-2}; relative abundance of 22%). At lower tidal zone, rocky oyster *Saccostrea cucullata* was the most dominant species (18 ind. m^{-2}; relative abundance of 37%).

6.2.10 There was no consistent pattern of species distribution observed across sampling zones and tidal levels in Tung Chung Wan and San Tau. The species distribution might be determined by the type of substratum. In general, gastropod *Batillaria multiformis*, *Cerithidea djadjariensis* and rocky oyster *Saccostrea cucullata* were the most common occurring species among the four sampling zones. The abundant species (relative abundance >10%) at every sampling zone is presented in Table 3.7 of **Appendix B**.

6.2.11 The mean values of number of species, density, *H'* and *J* at every sampling zone are presented in Table 3.8 of **Appendix B**. There was no obvious difference across the three tidal zones and sampling zones. The number of species ranged 7-12, 5-9, 7-9 and 5-9 spp. 0.25 m^{-2} at TC1, TC2, TC3 and ST respectively. The mean density ranged 340-780, 258-668, 587-705 and 192-612 ind. m^{-2} at TC1, TC2, TC3 and ST respectively. The *H'* ranged 1.06-1.65, 0.93-1.43, 1.04-1.31 and 0.95-1.59 at TC1, TC2, TC3 and ST respectively. The *J* ranged 0.54-0.73, 0.57-0.67, 0.55-0.60 and 0.61-0.73 at TC1, TC2, TC3 and ST respectively. In general, there was no obvious difference of biodiversity among the four sampling zones

based on the mean *H'* and *J* across tidal zones. The values reflected a stable intertidal soft shore community with moderate ecological functions.

6.3 Water Quality Monitoring

6.3.1 The mudflat monitoring covered water quality monitoring data. Reference was made to the water quality baseline monitoring data of the representative water quality monitoring station (i.e. SR3) as in the EM&A Manual. The water quality monitoring location (SR3) is shown in **Appendix A**.

6.3.2 Baseline water quality monitoring in San Tau (monitoring station SR3) was conducted in October 2011 prior to the construction of the HZMB. The monitoring parameters included dissolved oxygen (DO), turbidity and suspended solids (SS).

6.3.3 The baseline monitoring results for SR3 were extracted from the BEMR and summarised below:

Table 6.2 Baseline Water Quality Monitoring Results (Depth Average)

Date	Mid Ebb Tide				Mid Flood Tide			
	DO Saturation (%)	DO (mg/L)	Turbidity (NTU)	SS (mg/L)	DO Saturation (%)	DO (mg/L)	Turbidity (NTU)	SS (mg/L)
6 Oct 2011	87.6	6.0	7.3	15.5	91.1	6.2	9.4	7.6
8 Oct 2011	89.2	6.0	4.6	7.4	95.7	6.4	9.7	12.0
10 Oct 2011	92.1	6.2	6.3	11.0	93.9	6.3	8.5	14.0
12 Oct 2011	100.4	7.2	5.6	6.7	92.8	6.6	7.7	11.5
14 Oct 2011	91.4	6.4	9.1	10.0	88.2	6.2	10.5	16.5
16 Oct 2011	96.9	6.8	14.1	13.0	91.0	6.5	8.5	9.7
18 Oct 2011	85.6	6.5	7.0	16.0	85.3	6.5	9.4	14.5
22 Oct 2011	93.2	7.4	9.2	12.5	92.5	7.3	10.3	18.0
25 Oct 2011	89.8	7.2	8.4	8.3	88.4	7.1	17.8	28.0
27 Oct 2011	94.1	6.4	6.4	31.0	100.7	6.9	19.7	20.5
29 Oct 2011	120.6	8.1	8.1	15.0	106.1	7.3	14.1	22.0
31 Oct 2011	84.1	6.8	6.8	21.0	88.8	7.1	19.0	21.0
Average	93.8	6.8	7.7	14.0	92.9	6.7	12.1	16.3

6.4 Sedimentation Rate Monitoring

Methodology

6.4.1 To avoid disturbance to the mudflat and nuisance to navigation, no fixed marker/monitoring rod was installed at the monitoring stations. A high precision Global Navigation Satellite System (GNSS) real time location fixing system (or equivalent technology) was used to locate the station in the precision of 1mm, which is reasonable under flat mudflat topography with uneven mudflat surface only at micro level. This method has been used on Agricultural Fisheries and Conservation Department's (AFCD) project, namely Baseline Ecological Monitoring Programme for the Mai Po Inner Deep Bay Ramsar Site for measurement of seabed levels.

6.4.2 Measurements were taken directly on the mudflat surface. The Real Time Kinematic GNSS (RTK GNSS) surveying technology was used to measure mudflat surface levels and 3D coordinates of a survey point. The RTK GNSS survey was calibrated against a reference station in the field before and after each survey. The reference station was a survey control

point established by the Lands Department of the HKSAR Government or traditional land surveying methods using professional surveying instruments such as total station, level and/or geodetic global navigation satellite system. The coordinates system was in HK1980 GRID system. The reference control station was surveyed and established by traditional land surveying methods using professional surveying instruments such as total station, level and/or geodetic GNSS. The accuracy was down to mm level and higher than the proposed RTK GNSS cm level so that the reference control station has relatively higher accuracy. As the reference control station has higher accuracy, it was set as true evaluation relative to the RTK GNSS measurement. All position and height correction were adjusted and corrected to the reference control station.

6.4.3 The precision of the measured mudflat surface level reading (vertical precision setting) was within 10 mm (standard deviation) after averaging the valid survey records of the XYZ HK1980 GRID coordinates. Each survey record at each station was computed by averaging at least three measurements that are within the above specified precision setting. Both digital data logging and written records were collected in the field. Field data on station fixing and mudflat surface measurement were recorded.

Monitoring Locations

6.4.4 Four monitoring stations were established based on the site conditions for the sedimentation monitoring and are shown in **Figure 6.1**.

Monitoring Results

6.4.5 The mudflat surface levels at the four established monitoring stations and the corresponding XYZ HK1980 GRID coordinates are presented in **Table 6.3.**

Table 6.3 Measured Mudflat Surface Level Results

Monitoring Station	Easting (m)	Northing (m)	Sedimentation Rate (mPD)	Remarks
S1	810291.160	816678.727	0.950	Soft mudflat
S2	810958.272	815831.531	0.864	Soft mudflat
S3	810716.585	815953.308	1.341	Soft mudflat
S4	811221.433	816151.381	0.931	Soft mudflat

6.5 Event and Action Plan for Mudflat Monitoring

6.5.1 In the event of the impact monitoring results indicating that the density or the distribution pattern of intertidal fauna and seagrass is found to be significant different to the baseline condition (taking into account natural fluctuation in the occurrence and distribution pattern such as due to seasonal change), appropriate actions should be taken and additional mitigation measures should be implemented as necessary. Data should then be re-assessed and the need for any further monitoring should be established. The action plan, as given in **Table 6.4**, should be undertaken within a period of 1 month after a significant difference has been determined.

Table 6.4 Event and Action Plan for Mudflat Monitoring

Event	ET	IEC	SO	Contractor
Density or the distribution pattern of horseshoe crab, seagrass or intertidal soft shore communities recorded in the impact or post-construction monitoring are significantly lower than or different from those recorded in the baseline monitoring.	Review historical data to ensure differences are as a result of natural variation or previously observed seasonal differences; Identify source(s) of impact; Inform the IEC, SO and Contractor; Check monitoring data; Discuss additional monitoring and any other measures, with the IEC and Contractor.	Discuss monitoring with the ET and the Contractor; Review proposals for additional monitoring and any other measures submitted by the Contractor and advise the SO accordingly.	Discuss with the IEC additional monitoring requirements and any other measures proposed by the ET; Make agreement on the measures to be implemented.	Inform the SO and in writing; Discuss with the ET and the IEC and propose measures to the IEC and the ER; Implement the agreed measures.

Notes:
ET – Environmental Team
IEC – Independent Environmental Checker
SO – Supervising Officer

7 Conclusions

7.1.1 The baseline monitoring results for air quality, noise, water quality and ecology (Chinese White Dolphin) undertaken for Agreement No. CE35/2011 (EP) Baseline Environmental monitoring for Hong Kong – Zhuhai – Macao Bridge Hong Kong Projects – Investigation has been adopted for the Contract as the baseline monitoring stations and requirements for the Contract are the same as those presented in the BEMR.

7.1.2 For the water quality monitoring as required for mudflat monitoring, reference was made to the water quality baseline monitoring data of the representative water quality monitoring station (i.e. SR3) as required in the EM&A Manual. Baseline water quality monitoring in San Tau (monitoring station, SR3) was conducted in October 2011 prior to the construction of the HZMB. The monitoring parameters included DO, turbidity and SS.

7.1.3 For horseshoe crab survey under mudflat monitoring, there were 1, 9 and 16 individuals of *Tachypleus tridentatus* as observed at sampling zones, TC1, TC3 and ST, respectively during the survey. Indeed, all horseshoe crabs, *Tachypleus tridentatus*, were in ages of 9 months to 8 years old based on the measurements of their prosomal widths.

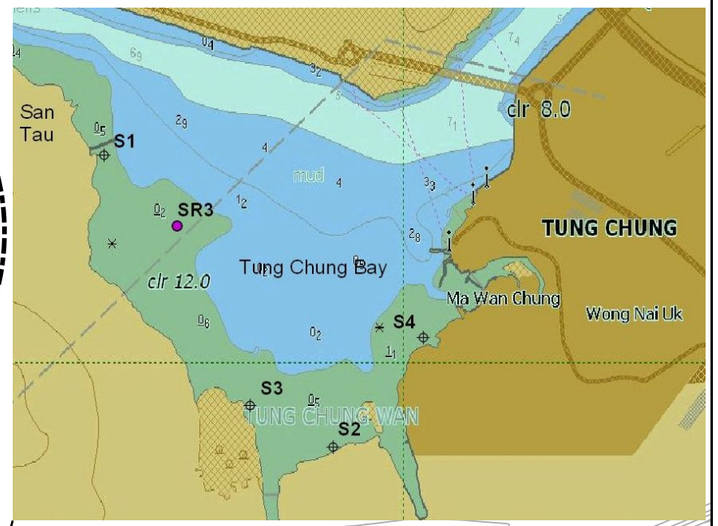
7.1.4 Only one species of seagrass, *Halophila ovalis*, was recorded at one sampling zone, ST during the seagrass beds survey. Four patches of this species of seagrass were observed and their estimated areas were also recorded of which the estimated total area was about 332.3m^2.

7.1.5 For intertidal soft shore communities survey under mudflat monitoring, a total of 15,188 individuals were recorded. Mollusks were significantly abundant phylum (total individuals of 14,669; relative abundance of 96.6%) followed by the second abundant group, arthropod (total individuals of 467; relative abundance of 3.1%) at the sampling zones.

7.1.6 Measurement of the mudflat surface level were conducted at four monitoring stations, S1, S2, S3 and S4, to establish the baseline level prior to the commencement of the construction works. The mudflat sedimentation rate at S1, S2, S3, and S4 were 0.950mPD, 0.864mPD, 1.341mPD and 0.931mPD, respectively.

FIGURES

	EASTING	NORTHING
S1	810291.160	816678.727
S2	810958.272	815831.531
S3	810716.585	815953.308
S4	810291.160	816151.381
SR3	810508	816473



LEGEND:

- WORKS BOUNDARY
- SR3 — WATER QUALITY MONITORING STATION
- SAMPLING ZONE
- S1 — MEASUREMENT POINT SEDIMENTATION RATE

Rev	Description	By	Date

Supervising Officer
ARUP 奧雅納工程顧問 Ove Arup & Partners Hong Kong Limited

Contractor
CSCEC 中國建築工程(香港)有限公司 CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LTD.

Contractor's Designer
ATKINS 阿特金斯

Contract No. and Title:
Contract No. HY/2011/03
Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road -
Section Between Scenic Hill and
Hong Kong Boundary Crossing Facilities

Drawing title
MUDFLAT SURVEY AREAS

Drawing no.		Rev.
FIGURE 6.1		-
Drawn: ACL	Date: 26 SEP 2012	Checked: -	Approved: -
Scale @ A1: 1 : 7500		Status: -	

路政署 HIGHWAYS DEPARTMENT
港珠澳大橋香港工程管理處
Hong Kong - Zhuhai - Macao Bridge
Hong Kong Project Management Office

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APPENDIX A

Environmental Monitoring Stations

Water Monitoring Station

Monitoring Stations	Coordinates	
	Easting	Northing
IS5	811579	817106
IS(Mf)6	812101	817873
IS7	812244	818777
IS8	814251	818412
IS(Mf)9	813273	818850
IS10	812577	820670
SR3	810525	816456
SR4	814760	817867
SR5	811489	820455
SR10A	823741	823495
SR10B	823686	823213
CS2	805849	818780
CS(Mf)5	817990	821129

INSET A

824500 N
822000 N
822500 E
825000 E
827500 E
TSING MA BRIDGE
TSING YI
SR10A
SR10B
MA WAN
LANTAU ISLAND

N
TUEN MUN
INSET A
HKIA
LANTAU ISLAND

KEY PLAN

PROPOSED HONG KONG BOUNDARY CROSSING FACILITIES (HKBCF) (BY OTHERS)
PROPOSED TUEN MUN-CHEK LAP KOK LINK (BY OTHERS)
CS(Mf)5
IS10
SR5
805000 E
815000 E
820000 N
CS2
HONG KONG INTERNATIONAL AIRPORT (HKIA)
IS7
IS(Mf)9
IS8
AMS6
IS(Mf)6
SR4
IS5
AIRPORT CHANNEL
HKSAR BOUNDARY
HZMB MAIN BRIDGE (BY OTHERS)
PROPOSED HKLR
PROPOSED HONG KONG LINK ROAD (HKLR)
SAN SHEK WAN
SHA LO WAN
SR3
TUNG CHUNG
AMS5
NMS5
MUDFLAT SURVEY (SAN TAU)
MUDFLAT SURVEY (TUNG CHUNG BAY)
LANTAU ISLAND
810000 E
815000 N

NOTES

1. EXACT LOCATIONS OF MONITORING STATIONS ARE TO BE DETERMINED ON SITE. THE CONTRACTOR AND ENVIRONMENTAL TEAM (ET) SHALL AGREE WITH THE INDEPENDENT ENVIRONMENTAL CHECKER (IEC) AND ENVIRONMENTAL PROJECT OFFICE (ENPO) AND APPROVED BY THE SUPERVISING OFFICER FOR THE PROPOSED LOCATION OF THE MONITORING STATIONS.
2. THE LOCATION AND EXTENT OF MUDFLAT SURVEY SHOWN ON THIS DRAWING ARE APPROXIMATE ONLY. THE CONTRACTOR AND ET SHALL DETERMINE AND AGREE WITH THE IEC, ENPO AND SUPERVISING OFFICER THE DETAILS OF THE MUDFLAT SURVEY IN ACCORDANCE WITH THE REQUIREMENTS STIPULATED IN THE EIA REPORTS AND EM&A MANUALS.
3. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS STIPULATED IN THE EM&A MANUALS TO CONDUCT THE ENVIRONMENTAL MONITORING AND AUDIT WORKS.

LEGEND

- WORKS BOUNDARY OF CONTRACT HY/2011/03
- IS — IMPACT STATIONS (WATER QUALITY)
- CS — CONTROL/FAR FIELD STATIONS (WATER QUALITY)
- SR — SENSITIVE RECEIVERS STATIONS (WATER QUALITY)
- ST — STATION FOR SENSITIVITY TEST RESULT (WATER QUALITY)
- AMS — MONITORING STATIONS (AIR QUALITY)
- NMS — MONITORING STATIONS (NOISE)
- MUDFLAT ECOLOGICAL SAMPLING LOCATION

Rev	Description	By	Date
A	TENDER ADDENDUM ISSUE	AW	11/11

Consultant
ARUP 奧雅納工程顧問 Ove Arup & Partners Hong Kong Limited

Contract No. and Title:
Contract No. HY/2011/03
Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road -
Section Between Scenic Hill and
Hong Kong Boundary Crossing Facilities

Drawing title
ENVIRONMENTAL MONITORING STATIONS

Drawing			Rev.
			A
Drawn: RY	Date: 11/11	Checked: AW	Approved: SK
Scale: 1:25000 @A1		Status:	

路政署 HIGHWAYS DEPARTMENT
港珠澳大橋香港工程管理處 Hong Kong - Zhuhai - Macao Bridge Hong Kong Project Management Office

Printed by : 10/11/2011
Filename : J:\214487\Record\HY_2011_03\Tender Addendum (2011-11-11)\DGN\E-HY_2011_03-DRG_310-A-00.dgn

APPENDIX B

Intertidal Soft Shore Communities Survey Results

TC1

TC2

TC3

ST

Figure 2.2. *Photographic record of the environment at every sampling zone.*

Table 3.1. *Record of horseshoe crab monitoring at every sampling zone.*

Species	Prosomal width (mm)	Substratum	GPS coordinate		Grouping
TC1 (search hour = 2 hr)					
Tachypleus tridentatus	28.14	S	22º 21.326' N	114º 45.150' E	
TC2 (search hour = 2 hr)					
No record					
TC3 (search hour = 3 hr)					
Tachypleus tridentatus	25.85	S	22º 16.962' N	113º 55.692' E	
T. tridentatus	59.32	S	22º 16.922' N	113º 55.672' E	
T. tridentatus	12.67	S	22º 16.975' N	113º 55.661' E	
T. tridentatus	49.37	S	22º 16.977' N	113º 55.678' E	
T. tridentatus	41.16	M	22º 17.111' N	113º 55.609' E	
T. tridentatus	48.19	S	22º 17.088' N	113º 55.587' E	
T. tridentatus	54.11	M	22º 17.105' N	113º 55.568' E	
T. tridentatus	52.95	M	22º 17.101' N	113º 55.622' E	1
T. tridentatus	40.22	M	22º 17.059' N	113º 55.621' E	1

M = Soft mud; S = Sands

Individuals in a group was given the same grouping number

Table 3.1(Cont'd). *Record of horseshoe crab monitoring at every sampling zone.*

Species	Prosomal width (mm)	Substratum	GPS coordinate		Grouping
ST (search hour = 3 hr)					
Tachypleus tridentatus	15.85	S	22º 16.904' N	113º 56.035' E	
T. tridentatus	35.35	M	22º 16.904' N	113º 56.035' E	
T. tridentatus	43.82	M	22º 17.531' N	113º 55.626' E	
T. tridentatus	8.45	S	22º 17.067' N	113º 55.971' E	
T. tridentatus	26.12	S	22º 17.057' N	113º 55.973' E	
T. tridentatus	30.95	M	22º 17.151' N	113º 55.970' E	2
T. tridentatus	26.77	M	22º 17.151' N	113º 55.970' E	2
T. tridentatus	30.08	M	22º 17.151' N	113º 55.970' E	2
T. tridentatus	47.9	M	22º 17.151' N	113º 55.970' E	2
T. tridentatus	17.99	M	22º 17.531' N	113º 55.626' E	3
T. tridentatus	13.16	M	22º 17.531' N	113º 55.626' E	3
T. tridentatus	15.91	M	22º 17.531' N	113º 55.626' E	3
T. tridentatus	16.39	S	22º 17.067' N	113º 55.964' E	4
T. tridentatus	14.99	S	22º 17.067' N	113º 55.964' E	4
T. tridentatus	16.02	S	22º 17.067' N	113º 55.964' E	4
T. tridentatus	30.8	S	22º 17.066' N	113º 55.964' E	

M = Soft mud; S = Sands

Individuals in a group was given the same grouping number

TC1

TC3

ST

Figure 3.1. *Examples of photographic records of horseshoe crab monitoring*

Table 3.3. *Summary of seagrass beds monitoring at every sampling zone.*

Species	Estimated area (m^2)	GPS coordinate	Estimated percentage cover (%)	Remark
TC1 & TC2 & TC3 (search hour = 3 hr)				
No record				
ST (search hour = 3 hr)				
Halophila ovalis	251.7	22º 17.057' N 113º 55.973' E - 22º 16.948' N 113º 56.031' E	50	A long strand of seagrass bed nearby the seaward side of mangrove area at 2.0m above C.D.
Halophila ovalis	27.0	22º 16.948' N 113º 56.031' E	80	
Halophila ovalis	34.7	22º 17.151' N 113º 55.970' E	70	
Halophila ovalis	18.9	22º 17.067' N 113º 55.971' E	80	
no. of patches	4			
Total area (m^2)	332.3			
Average area (m^2)	83.1			

Figure 3.2. *Examples of photographic records of seagrass beds monitoring at ST*

Table 3.5. *Total abundance, density and total biomass of every phylum*

Phylum	Total Abundance	%	Density (ind. m^{-2})	Number of taxon
Sep 2012				
Mollusca	14669	96.6	489	33
Arthropoda	467	3.1	16	22
Annelida	26	0.2	1	5
Sipuncula	21	0.1	1	2
Chordata	4	0.0	0	2
Nemertea	1	0.0	0	1
Total	15188			

0.0 %: Total abundance of the phylum is less than 0.1% of relative abundance.

0 ind. m^{-2}: Density of the phylum is less than 1 ind. m^{-2}.

Table 3.6. *The number of individuals, relative abundance (percentage) and density of each phylum at every sampling zone.*

Phylum	TC1	%	density (ind. m^{-2})	TC2	%	density (ind. m^{-2})	TC3	%	density (ind. m^{-2})	ST	%	density (ind. m^{-2})
Mollusca	3677	95.4	490	3142	93.6	419	4839	98.5	645	3011	98.3	401
Arthropoda	166	4.3	22	201	6.0	27	57	1.2	8	43	1.4	6
Sipuncula	8	0.2	1	8	0.2	1	5	0.1	1			
Annelida	4	0.1	1	6	0.2	1	10	0.2	1	6	0.2	1
Chordata	1	0.0	0							3	0.1	0
Nemertea							1	0.0	0			
Sub-total	3856			3357			4912			3063		

0.0 %: Total abundance of the phylum is less than 0.1% of relative abundance of the sampling zone.

0 ind. m^{-2}: Density of the phylum is less than 1 ind. m^{-2} of the sampling zone.

Table 3.7. *The abundant species (relative abundance >10%) at every sampling zone.*

Sampling zone TC1	Group	Species	mean density (ind. m^{-2})	relative abundance (%)	cumulative relative abundance (%)
High	G	*Batillaria multiformis*	65	61	61
	G	*Cerithidea cingulata*	16	16	77
	G	*Cerithidea djadjariensis*	11	10	87
Mid	G	*Batillaria multiformis*	64	33	33
	Bi	*Saccostrea cucullata*	43	22	55
	G	*Monodonta labio*	39	20	75
	G	*Cerithidea djadjariensis*	23	12	86
Low	G	*Cerithidea djadjariensis*	18	21	21
	Bi	*Saccostrea cucullata*	12	15	35
	G	*Batillaria multiformis*	12	14	49
	G	*Batillaria zonalis*	11	13	62
	Ba	*Balanus amphitrite*	10	12	75

Ba = Barnacle, Bi = Bivalve, G = Gastropod

Table 3.7(Cont'd). *The abundant species (relative abundance >10%) at every sampling zone.*

Sampling zone TC2	Group	Species	mean density (ind. m^{-2})	relative abundance (%)	cumulative relative abundance (%)
High	G	*Cerithidea djadjariensis*	31	49	49
	G	*Cerithidea cingulata*	14	21	70
	G	*Batillaria multiformis*	8	12	81
	Bi	*Saccostrea cucullata*	7	11	93
Mid	G	*Cerithidea djadjariensis*	60	36	36
	Bi	*Saccostrea cucullata*	32	19	55
	G	*Cerithidea cingulata*	30	18	73
Low	G	*Cerithidea djadjariensis*	54	51	51
	G	*Cerithidea cingulata*	14	13	65
	Bi	*Saccostrea cucullata*	12	12	77

Bi = Bivalve, G = Gastropod

Table 3.7(Cont'd). *The abundant species at every sampling zone.*

Sampling zone TC3	Group	Species	mean density (ind. m^{-2})	relative abundance (%)	cumulative relative abundance (%)
High	G	*Cerithidea djadjariensis*	83	47	47
	G	*Batillaria multiformis*	44	25	72
	G	*Cerithidea cingulata*	33	18	91
Mid	G	*Batillaria multiformis*	61	36	36
	G	*Cerithidea djadjariensis*	45	27	63
	G	*Cerithidea cingulata*	33	20	82
Low	Bi	*Saccostrea cucullata*	44	30	30
	G	*Monodonta labio*	36	24	55
	G	*Batillaria multiformis*	27	18	73
	G	*Cerithidea djadjariensis*	20	13	86

Bi = Bivalve, G = Gastropod

Table 3.7(Cont'd). *The abundant species at every sampling zone.*

Sampling zone ST	Group	Species	mean density (ind. m^{-2})	relative abundance (%)	cumulative relative abundance (%)
High	G	*Batillaria multiformis*	40	26	26
	G	*Nassarius festivus*	32	21	47
	G	*Monodonta labio*	29	19	66
	G	*Cerithidea djadjariensis*	24	15	81
Mid	G	*Cerithidea djadjariensis*	35	33	33
	G	*Cerithidea cingulata*	23	22	55
	Bi	*Saccostrea cucullata*	16	15	70
Low	Bi	*Saccostrea cucullata*	18	37	37
	G	*Cerithidea djadjariensis*	10	20	57
	G	*Batillaria zonalis*	6	12	69

Bi = Bivalve, G = Gastropod

Table 3.8. *Mean values of number of species, density, Shannon-Weaver Diversity Index (H') and Pielou's Species Evenness (J) at every tidal level and sampling zone*

Sampling zone	Tidal level	Mean number of species (spp. 0.25 m-2)	Mean density (ind. m-2)	mean *H'*	mean *H'* across tidal level	mean *J*	mean *J* across tidal level
TC1	**H**	7	422	1.06		0.54	
	M	12	780	1.57	1.43	0.64	0.64
	L	10	340	1.65		0.73	
TC2	**H**	5	258	0.93		0.57	
	M	9	668	1.43	1.25	0.67	0.63
	L	9	416	1.39		0.64	
TC3	**H**	7	705	1.04		0.55	
	M	8	673	1.15	1.17	0.58	0.58
	L	9	587	1.31		0.60	
ST	**H**	8	612	1.37		0.65	
	M	9	421	1.59	1.30	0.73	0.66
	L	5	192	0.95		0.61	

H: 2.0 m above C.D.; M: 1.5 m above C.D.; L: 1.0 m above C.D.

Appendix III *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 High tidal level (2.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
A	Amphipoda spp.											1										1
Ba	*Balanus amphitrite*	1																				1
Bi	*Cyclina sinesis*	1																				1
Bi	*Dosinia japonica*		1																			1
Bi	*Geloina erosa*									1					1							2
Bi	*Saccostrea cucullata*	3		4		8				1				2		1		3		1		23
Bi	*Xenostrobus atrata*					1																1
C	*Hemigrapsus penicillatus*	1						1								3	1	2				8
C	*Nanosesarma minutum*																			1		1
C	*Uca lactea*																	1				1
G	*Batillaria multiformis*	33	2	14	19	147		55		56		24		62	40	73	32	39	31	18	1	646
G	*Batillaria zonalis*	2													2							4
G	*Cerithidea cingulata*	72	12	2		3						1		28		20	1	24	1			164
G	*Cerithidea djadjariensis*	12		8	2	7		8		9		3		18		7		29	1	3		107
G	*Cerithidea rhizophorarum*											16										16
G	*Echinolittorina radiata*									2												2
G	*Littoraia melanostoma*	1						1				7										9
G	*Monodonta labio*	7				20		1		2		2		5		4		8		1		50
G	*Nassarius festivus*											1										1
G	*Nerita polita*	2												5				5		1		13
G	*Planaxis sulcatus*															1						1

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 High tidal level (2.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ol	Marine oligochaete spp.																2					2
Sp	*Sipunculus nudus*											1										1
																					Total	1056

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*									1		1										2
Bi	*Anodontia stearnsiana*																		1			1
Bi	*Barbatia signata*							5				2										7
Bi	*Barbatia virescens*	5		2		6						4		7		1		1				26
Bi	*Cyclina sinesis*																	1				1
Bi	*Geloina erosa*	1																				1
Bi	*Ruditapes philippinarum*																	1				1
Bi	*Saccostrea cucullata*	91		33		38		54		29		67		66		11		6		35		430
Bi	*Xenostrobus atrata*	1										2		1								4
C	*Hemigrapsus penicillatus*	1		1				2		1				13		1				5		24
C	*Nanosesarma minutum*											1										1
F	*Omobranchus fasciolatoceps*							1														1
G	*Batillaria multiformis*	85	12	59		33	5	79		72		44		106		84		9	1	46		635
G	*Batillaria zonalis*													1								1
G	*Cellana toreuma*	4		3		2		4				5		2		1				3		24
G	*Cerithidea cingulata*	1		4		2	1	5		5		1				1		1		71		92
G	*Cerithidea djadjariensis*	5		18		26		21		13		20		12		6		82	2	22		227
G	*Cerithidea rhizophorarum*	4				2						1				1						8
G	*Lepidozona* sp.											1										1
G	*Lunella coronata*			2		2		4		1		5		3				1		4		22
G	*Monodonta labio*	81	2	30		37		5		42		36		96		34		7		21		391

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	C	sub-total
G	*Nassarius festivus*	1		1																			2
G	*Nerita polita*	2		8				5		4						2				1			22
G	*Patelloida pygmaea*													1									1
G	*Patelloida saccharina*															1							1
G	*Planaxis sulcatus*	5		4								1											10
Hc	*Pagurus dubius*					3		3															6
Sp	*Sipunculus nudus*	1	1	1										2				1		1			7
																						Total	1949

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 Low tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*	14		1						4		4				48				33		104
Bi	*Anodontia stearnsiana*												3				3					6
Bi	*Barbatia virescens*																	4		6		10
Bi	*Caecella chinensis*								1								1					2
Bi	*Cyclina sinesis*	1										2										3
Bi	*Ruditapes philippinarum*																	1		2		3
Bi	*Saccostrea cucullata*	27		1				2				7		5		26		34		22		124
Bi	*Xenostrobus atrata*											1						1				2
C	*Hemigrapsus penicillatus*																	6		2		8
C	*Macrophthalmus erato*			1		1																2
C	*Nanosesarma minutum*																	4		1		5
C	*Uca lactea*					1																1
G	*Batillaria multiformis*	3		3				11	2	10	1	5	4	48	3	2		7		20		119
G	*Batillaria zonalis*	15		12	1	15	1	23		17		5	6	4		10				1		110
G	*Cellana toreuma*																	1		3		4
G	*Cerithidea cingulata*	19		9		1		2				9	3	1								44
G	*Cerithidea djadjariensis*	25	1	50	7	5		7	1	9	1	20	4	39	1			7				177
G	*Lepidozona* sp.																			1		1
G	*Lunella coronata*	4		2						1		10		8		3	1	8		18		55
G	*Monodonta labio*	3						1		1				1		1		12		18		37
G	*Nassarius festivus*							3		2			1	1				3		7		17

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 1 Low tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
G	*Nerita polita*	4										3		1				2		1		11
G	*Patelloida saccharina*																	1				1
G	*Thais clavigera*																	1		1		2
Hc	*Clibanarius* sp.																	1				1
P	Maldanidae spp.						1				1											2

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 2 High tidal level (2.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C		sub-total
Ba	*Balanus amphitrite*	3				1						1		1									6
Bi	*Cyclina sinesis*			1												1							2
Bi	*Saccostrea cucullata*	11				34		25		2													72
C	*Hemigrapsus penicillatus*							2										3		3			8
C	*Nanosesarma minutum*																			1			1
C	*Perisesarma bidens*																			1			1
C	*Philyra carinata*					1																	1
C	*Uca lactea*														1								1
G	*Batillaria multiformis*					73							1						1				75
G	*Batillaria zonalis*	6		1				1								2							10
G	*Cerithidea cingulata*	16		23		62		25		1	1	7				1							136
G	*Cerithidea djadjariensis*	35		48	1	29	1	34		29	1	33		50		36		1	13			3	314
G	*Cerithidea rhizophorarum*																	1		1			2
G	*Lunella coronata*	3				1																	4
G	*Monodonta labio*							6															6
G	*Nerita polita*					1																	1
G	*Terebralia sulcata*											4											4
P	Maldanidae spp.												1										1
																						Total	645

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 2 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*							3				11				39		71		10		134
Bi	*Barbatia signata*			4																	1	5
Bi	*Barbatia virescens*	6		4																		10
Bi	*Cyclina sinesis*						1											1	1		1	4
Bi	*Geloina erosa*	1																				1
Bi	*Ruditapes philippinarum*																4					4
Bi	*Saccostrea cucullata*					31		7				55		82		33		62		45		315
C	*Epixanthus* sp.	2																				2
C	*Hemigrapsus penicillatus*	3		3				1												6		13
C	*Nanosesarma minutum*			1														1				2
C	*Portunus* sp.														1							1
C	*Uca lactea*							1						1			2					4
G	*Batillaria multiformis*	43	1	20	1	11		7	2		1	6		5			1				2	100
G	*Batillaria zonalis*	5				12	2			9		7										35
G	*Cerithidea cingulata*	58	2		1	75		52	5	2	3	27		38		16		18		4	3	304
G	*Cerithidea djadjariensis*	65	1	1		62		64		44	1	72	1	92	1	40		99		54		597
G	*Lunella coronata*	7		8		2		2		2		1								2		24
G	*Monodonta labio*	5		72		4		5		2												88
G	*Nassarius festivus*	6																				6
G	*Nerita polita*	2		4						1												7
G	*Terebralia sulcata*															1		8				9

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 2 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Hc	*Pagurus dubius*	1																				1
Ol	Marine oligochaete spp.																			1		1
P	Maldanidae spp.											1										1
Sp	*Sipunculus nudus*									3												3
																					Total	1671

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 2 Low tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*			11				2								2						15
Bi	*Barbatia signata*											1							1			2
Bi	*Barbatia virescens*													1		5			1			7
Bi	*Cyclina sinesis*													1						1		2
Bi	*Geloina erosa*																1					1
Bi	*Ruditapes philippinarum*								1		1	1		2							3	8
Bi	*Saccostrea cucullata*	2		15		36		42		18								10				123
Bi	*Xenostrobus atrata*											2										2
C	*Hemigrapsus penicillatus*							2				1				4						7
C	*Nanosesarma minutum*													2				1				3
C	*Uca vocans*			1																		1
G	*Batillaria multiformis*	2		4				6	3	4	2	1	13	1			7	3	4		1	51
G	*Batillaria zonalis*	4		7	1	2	1	3	4	1		4	6	3		4		8	2		3	53
G	*Cerithidea cingulata*	50	1					6		55		3				7	4	1	5	8		140
G	*Cerithidea djadjariensis*	50	4	3		18	5	57	2	87		57	5	12		63		58	62	51	2	536
G	*Lunella coronata*					1		2				6		7		2		11	2			31
G	*Monodonta labio*					2		11				4		5				7	2			31
G	*Nassarius festivus*			1				7				5		1				3	1			18
G	*Nerita polita*													1				1				2
P	Maldanidae spp.						1							1								2

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 2 Low tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C		sub-total
P	Nereididae spp.			1																			1
Sp	*Sipunculus nudus*										1	1		1					2				5
																						Total	1041

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 High tidal level (2.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*					2																2
Bi	*Barbatia virescens*							1														1
Bi	*Cyclina sinesis*	1								1							1					3
Bi	*Geloina erosa*																		1			1
Bi	*Ruditapes philippinarum*		1								2				1							4
Bi	*Saccostrea cucullata*	1		2		1		72		6		8										90
C	*Hemigrapsus penicillatus*					2																2
C	*Perisesarma bidens*							1														1
C	*Philyra carinata*			1																		1
C	*Uca borealis*														1							1
C	*Uca lactea*										1			1						1		3
G	*Batillaria multiformis*	1		2				3		30		55		67	2	59	8	33		180		440
G	*Batillaria zonalis*			4		2				22												28
G	*Cerithidea cingulata*	63	1	14		3		15		29		81		22			1	44		52		325
G	*Cerithidea djadjariensis*	89	1	82		56		77		125	1	41		72		130		120	1	36		831
G	*Cerithidea rhizophorarum*							2														2
G	*Lunella coronata*			2		1		2														5
G	*Monodonta labio*					4						4										8
G	*Nerita polita*					2		1				1				1						5
G	*Planaxis sulcatus*							4														4
G	*Terebralia sulcata*					1																1

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 High tidal level (2.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	C	sub-total
Hc	*Clibanarius* sp.							1															1
HSc	*Tachypleus tridentatus*																	1					1
Ne	Nemertea spp.																			1			1
P	Maldanidae spp.									2													2
																						Total	1763

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*	1										3										4
Bi	*Barbatia signata*						1															1
Bi	*Caecella chinensis*															1						1
Bi	*Cyclina sinesis*					1			3					1								5
Bi	*Ruditapes philippinarum*						2															2
Bi	*Saccostrea cucullata*	1		35				3				8		1				15				63
Bi	*Xenostrobus atrata*			1																		1
C	*Hemigrapsus penicillatus*			6		1																7
C	*Nanosesarma minutum*			2																		2
C	*Uca lactea*					1						1										2
G	*Batillaria multiformis*	18		158	93	4	36		4	1		23		1		57	2	98	40	67	7	609
G	*Batillaria zonalis*	60		6	2	25	1	3		8		2		2								109
G	*Cerithidea cingulata*	19		7	2	45	5	18	5	16	1	21		46	4	3		51	9	75	2	329
G	*Cerithidea djadjariensis*	49		23	5	60	3	99	6		2	57		73	2	5		21	1	43		449
G	*Cerithidea rhizophorarum*									50						1						51
G	*Lunella coronata*	1		1														1		1		4
G	*Monodonta labio*			18												2		2		3		25
G	*Nassarius festivus*			1				1														2
G	*Nerita polita*	3		4														4				11
P	Maldanidae spp.										3											3

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	C	sub-total
Sp	*Siphonosoma cumanense*																1						1
Sp	*Sipunculus nudus*																1						1
																						Total	1682

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 Low tidal level (1.0 m above C.D.)

Gp	Taxon	1 Q	C	2 Q	C	3 Q	C	4 Q	C	5 Q	C	6 Q	C	7 Q	C	8 Q	C	9 Q	C	10 Q	C	sub-total
Ba	*Balanus amphitrite*			1						1								1				3
Bi	*Barbatia signata*	1																				1
Bi	*Barbatia virescens*	1																				1
Bi	*Ruditapes philippinarum*											1										1
Bi	*Saccostrea cucullata*	89		116		65		31		12				18		26		77		7		441
C	*Hemigrapsus penicillatus*	1						1		6		4			1	1		2				16
C	*Nanosesarma minutum*	5																				5
C	*Perisesarma fasciata*												1	1								2
C	*Thalamita crenata*														1							1
C	*Uca lactea*															1						1
G	*Batillaria multiformis*	1				6	8	20		50		42	4	25		78		19	3	13		269
G	*Batillaria zonalis*						2		1			3								7		13
G	*Cellana toreuma*									1								3				4
G	*Cerithidea cingulata*			2		7	1		2					12		20		31	2	29		106
G	*Cerithidea djadjariensis*			18		2	1			3		2		25		47		35	2	63		198
G	*Cerithidea rhizophorarum*															1		2				3
G	*Littoraia melanostoma*	2										4										6
G	*Lunella coronata*	5												1				1		2		9
G	*Monodonta labio*	84						32		63		75	21	32		22		29	1			359
G	*Nassarius festivus*													1								1
G	*Nassarius semiplicatus*								1													1

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone TC 3 Low tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	C	sub-total
G	*Nerita polita*	1						1		1		6		1				3		2			15
G	*Thais clavigera*	1																					1
Hc	*Pagurus dubius*											2											2
Ol	Marine oligochaete spp.												1										1
P	Maldanidae spp.					2									1								3
P	Polynoidae spp.	1																					1
Sp	*Siphonosoma cumanense*																	1					1
Sp	*Sipunculus nudus*	1																1					2
																						Total	1467

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone ST High tidal level (2.0 m above C.D.)

Gp	Taxon	1 Q	1 C	2 Q	2 C	3 Q	3 C	4 Q	4 C	5 Q	5 C	6 Q	6 C	7 Q	7 C	8 Q	8 C	9 Q	9 C	10 Q	10 C	sub-total
Bi	*Barbatia signata*											1										1
Bi	*Caecella chinensis*	1																				1
Bi	*Saccostrea cucullata*	11		6		6						36		5		9		10		18		101
Bi	*Xenostrobus atrata*	2																				2
C	*Hemigrapsus penicillatus*			3								1							1	3		8
C	*Nanosesarma minutum*					1		1		1									1			4
F	*Periophthalmus cantonensis*											1										1
G	*Batillaria multiformis*	72		55		8		34		26		76		92						36		399
G	*Cellana toreuma*											2		14		13		25		15		69
G	*Cerithidea cingulata*											19		16				7		1		43
G	*Cerithidea djadjariensis*	18		22		38		29		13		68		32		3		4		8		235
G	*Cerithidea rhizophorarum*	2				1		1														4
G	*Clithon oualaniensis*			1																		1
G	*Littoraria ardouiniana*									1												1
G	*Lunella coronata*											6		4		3		11		6		30
G	*Monodonta labio*	4		75		38		13		31		16		14		10		26		65	1	293
G	*Nassarius festivus*	1		6				3				4		20		142		139				315
G	*Nerita polita*	4		3		2				1		3		2		2		2				19
G	*Planaxis sulcatus*	2				1																3

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone ST Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*													1								1
Bi	*Barbatia virescens*									1												1
Bi	*Dosinia japonica*		2																			2
Bi	*Ruditapes philippinarum*									2												2
Bi	*Saccostrea cucullata*	22		33		17		14		25		7		6		3		27		2		156
Bi	*Xenostrobus atrata*		1																			1
C	*Charybdis* sp.		1																			1
C	*Hemigrapsus penicillatus*									6												6
C	*Macrophthalmus* sp.																			1		1
C	*Nanosesarma minutum*							1		2												3
C	*Perisesarma fasciata*									1												1
F	*Periophthalmus cantonensis*							1										1				2
G	*Batillaria multiformis*			2		12	5	5		40							2	1				67
G	*Batillaria zonalis*	2	2	4	1	6		4	1					1				1				22
G	*Cellana toreuma*					1				7								1				9
G	*Cerithidea cingulata*	29	3	25	5	16		45	2	33		31		13		10		10		9		231
G	*Cerithidea djadjariensis*	35	4	46	3	46	2	30	2	22		27		48		33		28	1	25		352
G	*Cerithidea rhizophorarum*	5	2	18	1	14		5								5				1		51
G	*Lunella coronata*	1		4				6		5		1		1				2		3		23
G	*Monodonta labio*	3		1				2		27												33
G	*Nassarius festivus*	7	1	6	1	8	1	20	1	2		11		1				7		11		77

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone ST Mid tidal level (1.5 m above C.D.)

		1		2		3		4		5		6		7		8		9		10			
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	C	sub-total
G	*Nerita polita*					1				2		1											4
G	*Patelloida saccharina*									4													4
G	*Turritella terebra*															1							1
P	Goniadidae spp.														1		1						2
																						Total	1053

Appendix III (Cont'd) *List of recorded fauna at every sampling zone*

Sep 2012 Sampling zone ST Mid tidal level (1.0 m above C.D.)

		1		2		3		4		5		6		7		8		9		10		
Gp	Taxon	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	Q	C	sub-total
Ba	*Balanus amphitrite*	3										11				1						15
Bi	*Anomalocardia squamosa*							1														1
Bi	*Barbatia signata*																	2				2
Bi	*Barbatia virescens*																			2	1	3
Bi	*Saccostrea cucullata*	68										2				69		12		26		177
C	*Nanosesarma minutum*															1						1
G	*Batillaria multiformis*				1									1		1				1		4
G	*Batillaria zonalis*	3	1	7	3	31		9		3				1								58
G	*Cellana toreuma*																			2		2
G	*Cerithidea cingulata*						1					9		15								25
G	*Cerithidea djadjariensis*							1				35	4	35		19				3		97
G	*Cerithidea rhizophorarum*													2								2
G	*Lepidozona* sp.																	1		3		4
G	*Lunella coronata*	3										1				10		7		10		31
G	*Monodonta labio*															1		11		7		19
G	*Nassarius festivus*	14										6		1		7				3		31
G	*Nerita polita*																			2		2
P	Maldanidae spp.					2	1						1									4
S	*Alpheus distinguendus*						1															1
S	*Oratosquilla kempi*									1												1
																					Total	480

APPENDIX C

Draft Final Report on Baseline Chinese White Dolphin Monitoring for Hong Kong – Zhuhai – Macao Bridge Hong Kong Projects

Contract No. HY/2011/02
Baseline Chinese White Dolphin Monitoring for Hong Kong-Zhuhai-Macao Bridge Hong Kong Projects

Draft Final Report on Baseline Monitoring (September - November 2011)
submitted to the
Hong Kong-Zhuhai-Macao Bridge Hong Kong Project Management Office,
Highways Department


NL24 with newborn calf © HKCRP

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

15 November 2011

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1. INTRODUCTION

In 2009, the Hong Kong-Zhuhai-Macao Bridge (HZMB) received official approval to be built by the Governments of the Hong Kong Special Administrative Region, Guangdong Province and the Macao Special Administrative Region. The Main Bridge will be jointly funded by all three Governments. Each Government will be responsible for constructing its own boundary crossing facility and link road to connect to the Main Bridge. In Hong Kong, there are three projects associated with the HZMB construction, namely the Hong Kong Link Road (HKLR) Project, the Hong Kong Boundary Crossing Facilities (HKBCF) Project, and the Tuen Mun-Chek Lap Kok Link (TM-CLKL) Project. According to the EM&A Manuals and EPs of the HZMB Projects in Hong Kong (i.e. HKBCF, HKLR and TM-CLKL), baseline dolphin monitoring is required to be carried out three months prior to the commencement of the HKBCF reclamation contract.

To comply with the requirements of the EM&A Manuals and EPS of the HZMB Projects in Hong Kong, the present monitoring study aims to collect data on Chinese White Dolphins (a.k.a. Indo-Pacific humpback dolphin, *Sousa chinensis*) during the pre-construction phase (i.e. baseline dolphin monitoring) in Northeast Lantau (NEL), Northwest Lantau (NWL) and West Lantau (WL) survey areas. This report is the draft final report submitted to the Highways Department, summarizing the results of the survey findings during the entire baseline monitoring period (i.e. September to November 2011).

2. OBJECTIVES AND METHODOLOGY

2.1. Objectives of the Present Study

Several objectives were set for this baseline monitoring study of Chinese White Dolphins for the study area in North and West Lantau waters, in association with the construction works of HZMB Projects. The first objective was to assess the spatial and temporal patterns of distribution and habitat use of Chinese White Dolphins during the pre-construction phase of HZMB Projects in great details. This objective was achieved through collection of research data on dolphins by conducting line-transect vessel surveys in NWL, NEL and WL survey areas.

The second objective was to identify individual Chinese White Dolphins by their natural marks, which was achieved by taking high-quality photographs of dolphins for photo-identification analysis. Photographs of identified individuals were compiled and added to the photo-identification catalogue.

The third objective was to analyze the monitoring data from the present baseline study for better understanding of the various aspects of local dolphin population in relation to the construction works of HZMB Projects. This objective was achieved by conducting various data analyses, including distribution analysis, encounter rate analysis, behavioural analysis and quantitative grid analysis to assess the spatial and temporal patterns of distribution and habitat use of local dolphins based on systematic line-transect survey data, and ranging pattern analysis to study individual movement based on photo-identification data.

2.2. Line-transect Vessel Surveys

The survey team used standard line-transect methods (Buckland et al. 2001) to conduct regular vessel surveys, and followed the same technique of data collection that has been adopted in the last 16 years of marine mammal monitoring surveys in Hong Kong (Hung 2010, 2011; Jefferson 2000). The territorial water of Hong Kong Special Administrative Region was divided into twelve survey areas, and line-transect surveys were conducted in NWL, NEL and WL areas (see transect line layout in Figure 1).

During each vessel survey, a 15-m inboard vessel (*Standard* 31516) with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area. 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 continuously through 7 x 35 *Brunton* marine binoculars. Both observers searched the sea ahead of the vessel, between 270^{o} and 90^{o} (in relation to the bow, which is defined as 0^{o}). Two to three 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. Beforehand they had participated in rigorous at-sea training program provided by the PI.

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 H*). When dolphins were sighted, the survey team would end the survey effort, and immediately recorded 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. The line-transect data collected during the present study were compatible with the long-term databases maintained by Hong Kong Cetacean Research Project (HKCRP) in a way that it can be analyzed by established computer programmes (e.g. all recent versions of DISTANCE programme including version 6.0, ArcView© GIS programme) for examination of population status including trends in abundance, distribution and habitat use of Chinese White Dolphins.

2.3. Photo-identification

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 (Jefferson 2000). Two professional digital cameras (*Canon* EOS 7-D, 60-D models), each 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.

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 details, and were carefully compared to over 700 identified dolphins in the PRE Chinese White Dolphin photo-identification catalogue managed by the HKCRP researchers. 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). 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. Any new individuals were given a new identification number, and their data were also added to the catalogue, along with text descriptions including age class, gender, any nickname or unique markings.

2.4. Data Analyses

2.4.1. Distribution pattern 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.

2.4.2. Encounter rate analysis

Since the line-transect survey effort was uneven among different survey areas and across different years, the encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort) were calculated in each survey area in relation to the amount of survey effort conducted during the baseline monitoring period, which was also compared to the ones calculated from previous years of monitoring data to examine temporal trend. The encounter rate could be used as an indicator to determine areas of importance to dolphins within the study area.

2.4.3. 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 3-month baseline monitoring period were plotted onto 1-km^2 grids among NWL, NEL and WL survey areas on GIS. Sighting densities (number of on-effort sightings per km^2) and dolphin densities (total number of dolphins from on-effort sightings per km^2) were then calculated for each 1 km by 1 km grid with the aid of GIS. Sighting density grids and dolphin density grids were then further normalized with the amount of survey effort conducted within each grid. The total amount of survey effort spent on each grid was calculated by examining the survey coverage on each line-transect survey to determine how many times the grid was surveyed during the study period.

For example, when the survey boat traversed through a specific grid 50 times, 50 units of survey effort were counted for that grid. With the amount of survey effort calculated for each grid, the sighting density and dolphin density of each grid were then normalized (i.e. divided by the unit of survey effort).

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

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

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

where S = total number of on-effort sightings

D = total number of dolphins from on-effort sightings

E = total number of units of survey effort

SA% = percentage of sea area

2.4.4. 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.

2.4.5. Ranging pattern analysis

Location data of individual dolphins that occurred during the 3-month baseline 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, created by the Alaska Biological Science Centre, USGS (Hooge and Eichenlaub 1997), 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. RESULTS AND DISCUSSIONS

3.1. Summary of survey effort and dolphin sightings

From September to November 2011, a total of 14 line-transect vessel surveys were conducted in NWL, NEL and WL survey areas (Appendix I). Among these surveys, 966 km of survey effort was collected, with 95% of these effort conducted under favourable sea conditions (Beaufort 3 or below with good visibility). The high percentage of survey effort conducted under favourable sea conditions is critical to the success of the dolphin data collection programme in Hong Kong, as only such data can be used in various analyses such as the examination of encounter rates, habitat use and estimation of density and abundance. The details of the survey effort data collected during the baseline monitoring are shown in Appendix II.

During the 3-month study period, 112 groups of Chinese White Dolphins, numbering 413 individuals, were sighted from the vessel surveys (Appendix III). Among them, 91 groups were sighted during on-effort line-transect vessel surveys, while the others were sighted during off-effort search. Most sightings were made in WL (46 groups) and NWL (49 groups), comprising 84.8% of the total (Figure 1). In addition, 17 dolphin groups were also sighted in NEL throughout the 3-month study period (Figure 1).

3.2. Distribution

Dolphin sightings were unevenly distributed throughout the three survey areas of NWL, NEL and WL during the study period. In North Lantau region, concentration of these sightings were found around Lung Kwu Chau, near Black Point, Pillar Point and Shum Shui Kok, but the dolphins generally avoided the waters to the north of the Chek Lap Kok airport as well as the northern and eastern portions of NEL survey area (Figure 2). On the contrary, dolphins occurred evenly throughout the WL survey area, but slightly more sightings were made near Kai Kung Shan, Fan Lau and the offshore waters between Tai O Peninsula and Kai Kung Shan (Figure 3).

Throughout the baseline monitoring period, dolphins occurred regularly in the

vicinity of the future alignments of HKLR and TM-CLKL as well as the reclamation site of HKBCF, but not in high concentration (Figures 2-3). Their occurrence around these future construction sites in association with HZMB Projects should be continuously monitored to determine whether there will be any change in dolphin distribution and habitat use around these work areas during the construction period.

3.3. Encounter rate

To calculate encounter rates of Chinese White Dolphins, only data collected in Beaufort 0-3 conditions was included in the analysis (see Hung 2011). During the baseline monitoring period, the combined dolphin encounter rate of NWL, NEL and WL was 10.8 sightings per 100 km. This was much higher than the ones in previous years from 2008-2010, but was slightly lower than the one in 2007 recorded during AFCD marine mammal monitoring programme (Figure 4a).

Among the three survey areas, the dolphin encounter rate was the highest in WL (20.4 sightings per 100 km), which was much higher than the ones in NWL (9.3) and NEL (5.4) (Figure 4b). The prominent usage of WL during the same three-month period (September to November) was also consistent throughout the past five years (Figure 4b), providing solid evidence that this stretch of coastal waters presents the most important habitat for Chinese White Dolphins in Hong Kong. Moreover, dolphin usage among all three survey areas during this three-month period also followed similar temporal trends, with encounter rates dropping from the highest in 2007 to the lowest in 2010, but increasing to a higher level in 2011 (Figure 4b). In fact, dolphin encounter rate in NEL reached the highest in 2011 during the five-year period.

3.4. Group size

Group sizes of dolphins during the baseline monitoring period ranged from singles to 18 animals, with an overall mean of 3.7 ± 3.1 (SD) animals per group. Among the three survey areas, their mean group sizes were similar across NEL, NWL and WL survey areas (3.2-3.9 dolphins per group). Moreover, the mean dolphin group size during the 3-month study period was very similar to the one recorded during the 2010-11 AFCD monitoring period (Hung 2011).

Most dolphin groups sighted during the 3-month period tended to be small, with 48.2% of the groups composed of 1-2 animals, and 72.3% of the groups with fewer

than five animals. On the other hand, 31 groups had 5 or more animals, and only five groups had 10 or more animals. These larger aggregations of dolphins were mostly found near Sha Chau and between Lung Kwu Chau and Black Point in NWL; around the Brothers Islands in NEL; and between Tai O Peninsula and Peaked Hill in WL (Figure 5). Notably, several large dolphin groups could be found near the alignments of HKLR and TM-CLKL as well as the reclamation site of HKBCF (Figure 5). Since large dolphin aggregations in certain locations may imply rich fishery resources and good feeding opportunities for dolphins, dolphin occurrence in these important feeding habitats should be closely monitored throughout the construction period to determine whether the construction works in association with the HZMB Projects would affect the feeding opportunities of the dolphins.

3.5. Habitat use

From September to November 2011, the most heavily utilized habitats by Chinese White Dolphins included the waters around Lung Kwu Chau and Shau Chau, near Pillar Point and Black Point, and along the Urmston Road in NWL; around the Brothers Islands and near Shum Shui Kok in NEL; and around Tai O Peninsula, near Kai Kung Shan, Peaked Hill and Fan Lau in WL (Figures 6-7). These important dolphin habitats during the baseline monitoring period coincided well with the results from the previous AFCD monitoring periods (e.g. Hung 2010, 2011), further confirming the importance of these habitats to Chinese White Dolphins in Hong Kong.

Notably, several grids along the alignments of HKLR (Grids E21, F21 & G20) and TM-CLKL (Grids O14-15) as well as near the reclamation site of HKBCF (Grid P17) recorded moderate to high dolphin densities (Figures 6-7). Although the impending construction works in association with HZMB Projects are not situated at the most important dolphin habitats in Hong Kong (e.g. Lung Kwu Chau, Tai O Peninsula to Fan Lau, the Brothers Islands), these works will still be in the vicinity of these sensitive habitats, and dolphin usage should therefore be carefully monitored during the entire construction period to observe any significant changes incurred.

3.6. Mother-calf pairs

During the 3-month baseline monitoring period, a total of 14 unspotted calves (UC) and 14 unspotted juveniles (UJ) were sighted among the three survey areas. These young calves comprised 6.8% of all animals sighted. The young calves were

regularly sighted in the WL and NWL survey areas, but only twice in the NEL survey area. Concentration of these sightings with mother-calf pairs could be found near Tai O Peninsula and Black Point (Figure 8). Several sightings with mother-calf pairs were also located near the alignments of HKLR and TM-CLKL. As the young calves need to maintain close acoustic contact with their mothers in order to survive (Van Parijs and Corkeron 2001), they are more susceptible to acoustic disturbances from underwater construction activities, and their activities around the works area should be carefully monitored throughout the entire construction period.

3.7. Activities and associations with fishing boats

During the baseline monitoring period, 13 and 6 dolphin sightings were associated with feeding and socializing activities respectively, comprising of 11.6% and 5.4% of the total dolphin sightings. Only two dolphin groups were engaged in traveling activities near Pillar Point and to the west of the airport (Figure 9). Dolphin sightings associated with feeding activities were mostly found near Kai Kung Shan and Tai O in WL, and near Lung Kwu Chau in NWL (Figure 9). On the other hand, sightings associated with socializing activities were more scattered around the marine park area in NWL and the central portion of WL (Figure 9). Notably, several sightings associated with feeding activities were observed along and near the alignments of HKLR and TM-CLKL, and around the reclamation site of HKBCF (Figure 9).

Only six dolphin groups were found to be associated with operating fishing boats, comprising of 5.4% of all dolphin groups. These sightings included three dolphin groups associated with pair trawlers, two with hang trawlers and one with shrimp trawler. The location of these fishing boat-associated sightings were scattered throughout the three survey areas, with no apparent concentration (Figure 10). Only two of these sightings were found in the vicinity of the future work sites of HZMB Projects (Figure 10).

3.8. Photo-identification work and individual range use

From September to November 2011, over 5,000 digital photographs of Chinese White Dolphins were taken during the baseline monitoring surveys for the photo-identification work. In total, 96 individuals sighted 182 times altogether were identified (Table 1). The majority of these re-sightings were made in NWL and WL, comprising 53.2% and 31.9% of the total respectively. In addition, 27 re-sightings

were also made in NEL, or about half of the total number of dolphins sighted there during the 3-month study period. Most of the identified individuals were sighted only once or twice, with some notable exceptions though. For example, two individuals (CH34 and NL104) were sighted seven times, and WL04 were sighted five times during the study period. In addition, six individuals were sighted four times, while 15 other individuals were also sighted three times during the baseline monitoring period. Repeated sightings of these individuals during the relatively short study period indicated their frequent use of Hong Kong waters during the baseline monitoring study period.

Ranging patterns of the 96 individuals identified during the baseline monitoring surveys were determined by fixed kernel method, and are shown in Appendix IV. Notably, the majority of these individuals ranged extensively across NEL, NWL and WL survey areas, and many of their ranges overlapped with the alignments of HKLR and TM-CLKL as well as the reclamation site of HKBCF during the baseline monitoring period (Appendix IV). In particular, some individuals (e.g. NL136, NL246, NL264, WL05) were sighted in both NEL and NWL survey areas, while others (e.g. NL258, WL04, WL116, WL137) were sighted in both NWL and WL survey areas during the three-month period (Appendix IV). Several individuals were even sighted across all three areas within the relatively short study period (e.g. NL33, NL123, NL226) (Appendix IV). Their frequent movements across these three survey areas will make them more susceptible to the potential disturbance arisen from the construction activities in association with the HZMB Projects, as the HKLR will be constructed at the boundary of NWL and WL survey areas, while the HKBCF and TM-CLKL will be constructed at the boundary of NWL and NEL survey areas. Recent research on social structure analysis also indicated that there are two social clusters in Hong Kong, with their overall 95% UD ranges overlapped at the waters where the HKLR will be constructed (Dungan 2011; Hung 2011). Consequently, individual movement patterns and habitat use should be closely monitored in the vicinity of the work sites of HKLR, TM-CLKL and HKBCF during and after the construction period, to determine whether individual dolphins will be affected by these construction works.

More importantly, many individuals that were sighted during the baseline monitoring period were year-round residents (e.g. EL01, NL98, NL139, WL25), and some were even accompanied by young calves (e.g. NL24, NL33, NL104, NL123). In fact, these were also the individuals being sighted multiple times during the 3-month baseline monitoring period, showing their strong reliance of Hong Kong

waters. Special attention should be paid to the range use of these year-round residents, as their continuous reliance of these three survey areas during and after the HZMB construction period can become an important indicator to determine whether the local dolphins will be affected by various construction works of HZMB Projects.

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Table 1. Individual dolphins identified during HYD-HZMB baseline dolphin monitoring surveys in September-November 2011

ID#	DATE	STG#	AREA
CH34	06/10/11	6	NW LANTAU
	28/10/11	5	NW LANTAU
	01/11/11	6	NE LANTAU
	01/11/11	8	NE LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	6	NW LANTAU
	07/11/11	2	NW LANTAU
CH40	17/10/11	2	W LANTAU
	17/10/11	8	W LANTAU
CH98	02/11/11	13	NW LANTAU
CH108	02/11/11	3	W LANTAU
	02/11/11	8	W LANTAU
CH153	28/10/11	3	NW LANTAU
CH157	02/11/11	3	W LANTAU
EL01	01/11/11	9	NE LANTAU
	02/11/11	14	NW LANTAU
NL11	02/11/11	12	NW LANTAU
	07/11/11	2	NW LANTAU
NL12	02/11/11	12	NW LANTAU
NL24	10/10/11	2	NW LANTAU
	05/11/11	5	NW LANTAU
	05/11/11	8	NW LANTAU
	06/11/11	2	NE LANTAU
NL33	23/09/11	10	NW LANTAU
	01/11/11	8	NE LANTAU
	05/11/11	2	NW LANTAU
	07/11/11	5	NW LANTAU
NL37	16/09/11	4	NW LANTAU
NL46	28/10/11	4	NW LANTAU
NL48	16/09/11	5	NW LANTAU
	02/11/11	14	NW LANTAU
	07/11/11	2	NW LANTAU
NL75	16/09/11	3	NW LANTAU
	16/09/11	7	NW LANTAU
	01/11/11	9	NE LANTAU
NL80	02/11/11	12	NW LANTAU
NL93	05/11/11	6	NW LANTAU
	07/11/11	4	NW LANTAU
NL98	06/10/11	2	NE LANTAU
	01/11/11	8	NE LANTAU
	06/11/11	2	NE LANTAU
	07/11/11	2	NW LANTAU

ID#	DATE	STG#	AREA
NL104	16/09/11	7	NW LANTAU
	23/09/11	10	NW LANTAU
	28/10/11	5	NW LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	6	NW LANTAU
	05/11/11	8	NW LANTAU
	07/11/11	2	NW LANTAU
NL118	16/09/11	7	NW LANTAU
NL120	10/10/11	2	NW LANTAU
	06/11/11	4	NE LANTAU
NL123	06/10/11	4	NW LANTAU
	10/10/11	2	NW LANTAU
	06/11/11	2	NE LANTAU
NL136	16/09/11	7	NW LANTAU
	10/10/11	3	NE LANTAU
	28/10/11	1	NW LANTAU
	28/10/11	3	NW LANTAU
NL139	16/09/11	7	NW LANTAU
	10/10/11	3	NE LANTAU
	01/11/11	9	NE LANTAU
NL165	02/11/11	14	NW LANTAU
	05/11/11	8	NW LANTAU
NL170	06/10/11	1	NE LANTAU
NL176	01/11/11	6	NE LANTAU
	01/11/11	8	NE LANTAU
	06/11/11	4	NE LANTAU
NL179	16/09/11	7	NW LANTAU
	06/11/11	2	NE LANTAU
NL188	28/10/11	3	NW LANTAU
	01/11/11	2	NW LANTAU
	07/11/11	5	NW LANTAU
NL191	07/09/11	1	NW LANTAU
NL202	28/10/11	3	NW LANTAU
	07/11/11	4	NW LANTAU
NL206	17/10/11	6	W LANTAU
NL210	07/09/11	1	NW LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	7	NW LANTAU
	07/11/11	5	NW LANTAU
NL214	28/10/11	5	NW LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	6	NW LANTAU
NL220	10/10/11	3	NE LANTAU
NL224	28/10/11	4	NW LANTAU
NL226	17/10/11	2	W LANTAU
	05/11/11	2	NW LANTAU

Table 1. (cont'd)

ID#	DATE	STG#	AREA
NL230	17/10/11	4	W LANTAU
	02/11/11	12	NW LANTAU
NL233	16/09/11	3	NW LANTAU
	06/10/11	4	NW LANTAU
	28/10/11	4	NW LANTAU
NL241	16/09/11	7	NW LANTAU
	02/11/11	12	NW LANTAU
	07/11/11	2	NW LANTAU
NL242	10/10/11	2	NW LANTAU
NL244	05/09/11	3	W LANTAU
	01/11/11	5	NW LANTAU
	01/11/11	8	NE LANTAU
NL246	16/09/11	7	NW LANTAU
	06/11/11	2	NE LANTAU
NL256	02/11/11	12	NW LANTAU
NL258	05/09/11	3	W LANTAU
	16/09/11	5	NW LANTAU
NL259	07/11/11	5	NW LANTAU
NL260	07/11/11	5	NW LANTAU
NL261	01/11/11	9	NE LANTAU
NL264	23/09/11	11	NW LANTAU
	06/10/11	2	NE LANTAU
	06/11/11	3	NE LANTAU
NL269	02/11/11	12	NW LANTAU
NL272	16/09/11	7	NW LANTAU
	28/10/11	4	NW LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	8	NW LANTAU
NL275	23/09/11	9	W LANTAU
NL278	02/11/11	12	NW LANTAU
NL279	02/11/11	12	NW LANTAU
SL40	23/09/11	4	W LANTAU
SL42	02/11/11	13	NW LANTAU
SL43	28/10/11	4	NW LANTAU
SL48	23/09/11	7	W LANTAU
	17/10/11	3	W LANTAU
	02/11/11	8	W LANTAU
WL04	16/09/11	6	NW LANTAU
	10/10/11	2	NW LANTAU
	17/10/11	1	W LANTAU
	02/11/11	14	NW LANTAU
	05/11/11	5	NW LANTAU
WL05	01/11/11	6	NE LANTAU
	01/11/11	8	NE LANTAU
WL11	07/11/11	5	NW LANTAU
WL25	16/09/11	1	NW LANTAU
	23/09/11	9	W LANTAU
	17/10/11	4	W LANTAU

ID#	DATE	STG#	AREA
WL28	23/09/11	9	W LANTAU
WL42	05/09/11	1	W LANTAU
	02/11/11	6	W LANTAU
WL47	17/10/11	2	W LANTAU
WL48	23/09/11	9	W LANTAU
WL61	17/10/11	4	W LANTAU
WL62	23/09/11	6	W LANTAU
	17/10/11	2	W LANTAU
WL66	07/11/11	8	W LANTAU
WL68	05/09/11	1	W LANTAU
	05/09/11	2	W LANTAU
WL72	23/09/11	4	W LANTAU
	02/11/11	3	W LANTAU
	02/11/11	8	W LANTAU
WL87	23/09/11	6	W LANTAU
WL88	16/09/11	1	NW LANTAU
	02/11/11	6	W LANTAU
WL111	02/11/11	14	NW LANTAU
WL116	16/09/11	4	NW LANTAU
WL118	02/11/11	3	W LANTAU
	02/11/11	8	W LANTAU
WL123	02/11/11	8	W LANTAU
WL124	02/11/11	12	NW LANTAU
WL128	02/11/11	10	W LANTAU
	07/11/11	9	W LANTAU
WL131	23/09/11	6	W LANTAU
	02/11/11	3	W LANTAU
	02/11/11	8	W LANTAU
WL132	23/09/11	6	W LANTAU
WL137	02/11/11	8	W LANTAU
WL138	02/11/11	8	W LANTAU
WL144	02/11/11	4	W LANTAU
WL145	05/09/11	5	W LANTAU
WL146	17/10/11	2	W LANTAU
WL153	07/11/11	8	W LANTAU
WL156	23/09/11	9	W LANTAU
	28/10/11	3	NW LANTAU
WL157	23/09/11	9	W LANTAU
WL158	23/09/11	9	W LANTAU
WL162	16/09/11	3	NW LANTAU
WL163	02/11/11	4	W LANTAU
	07/11/11	9	W LANTAU
WL165	17/10/11	6	W LANTAU
WL167	17/10/11	2	W LANTAU
WL170	07/11/11	11	W LANTAU
WL171	28/10/11	8	W LANTAU

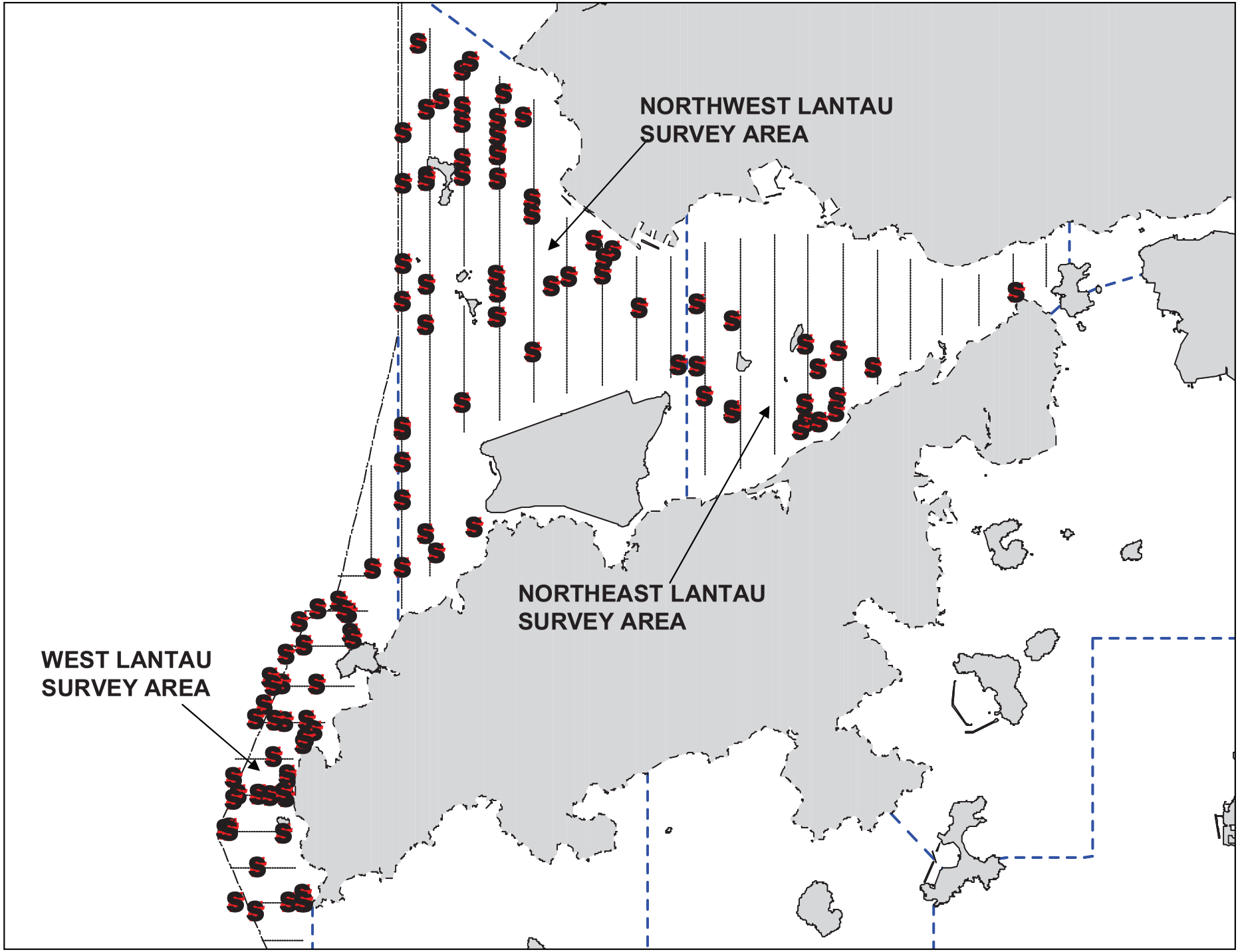


Figure 1. Distribution of Chinese white dolphin sighting during HYD-HZMB baseline monitoring surveys (September – November 2011)

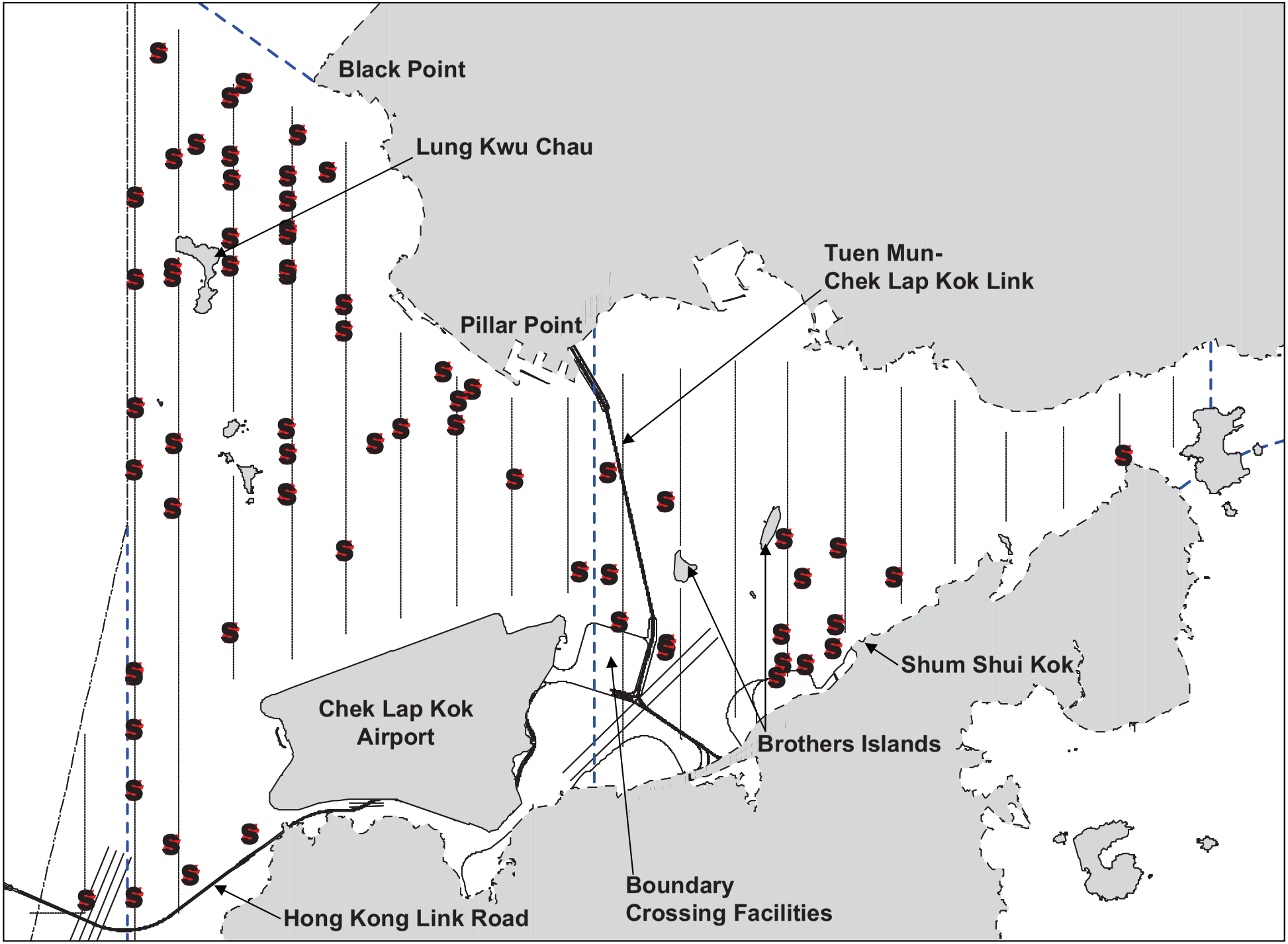


Figure 2. Distribution of Chinese white dolphin sighting in Northwest and Northeast Lantau during HYD-HZMB baseline monitoring surveys (September – November 2011)

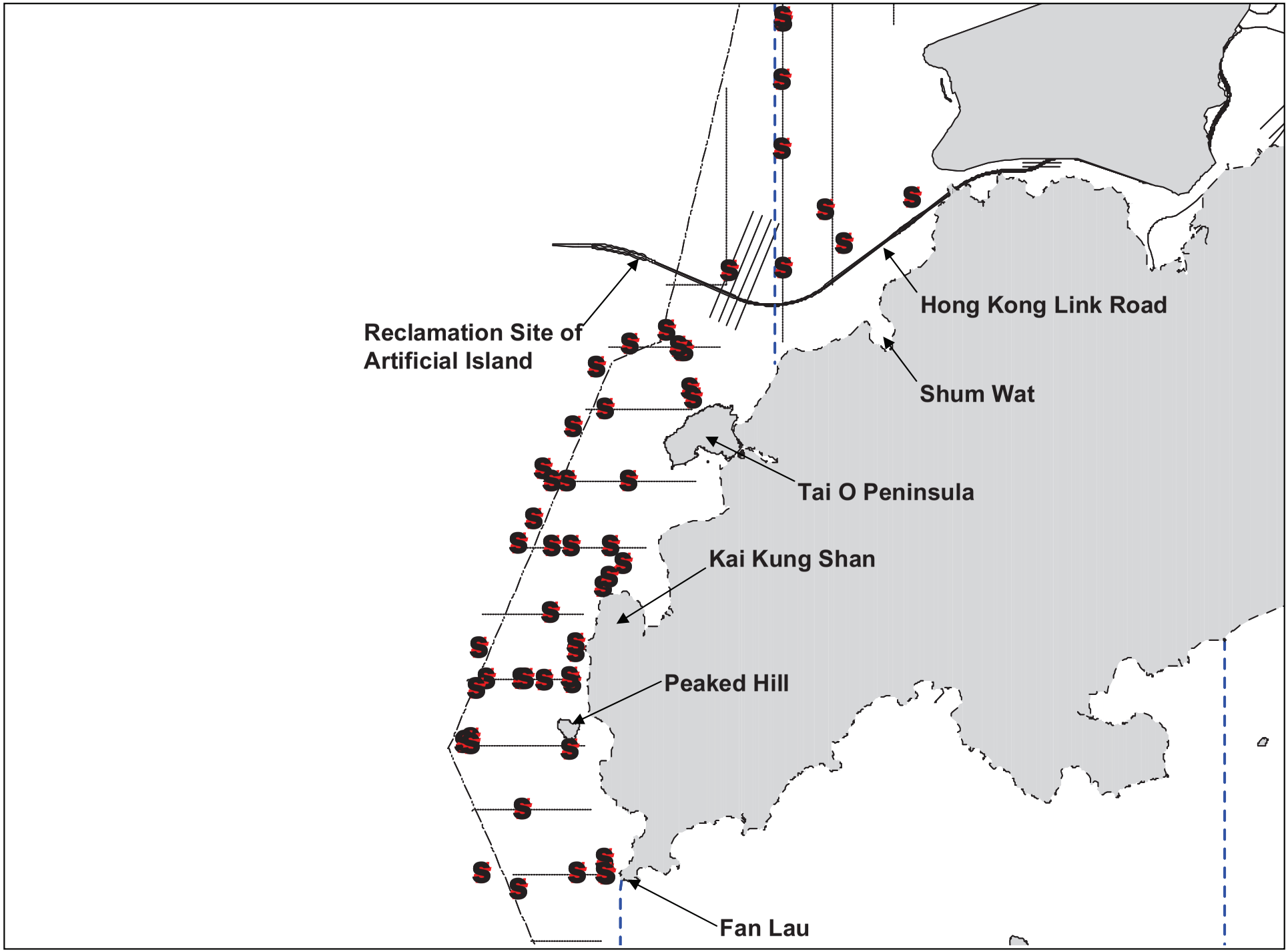


Figure 3. Distribution of Chinese white dolphin sighting in West Lantau during HYD-HZMB baseline monitoring surveys (September – November 2011)

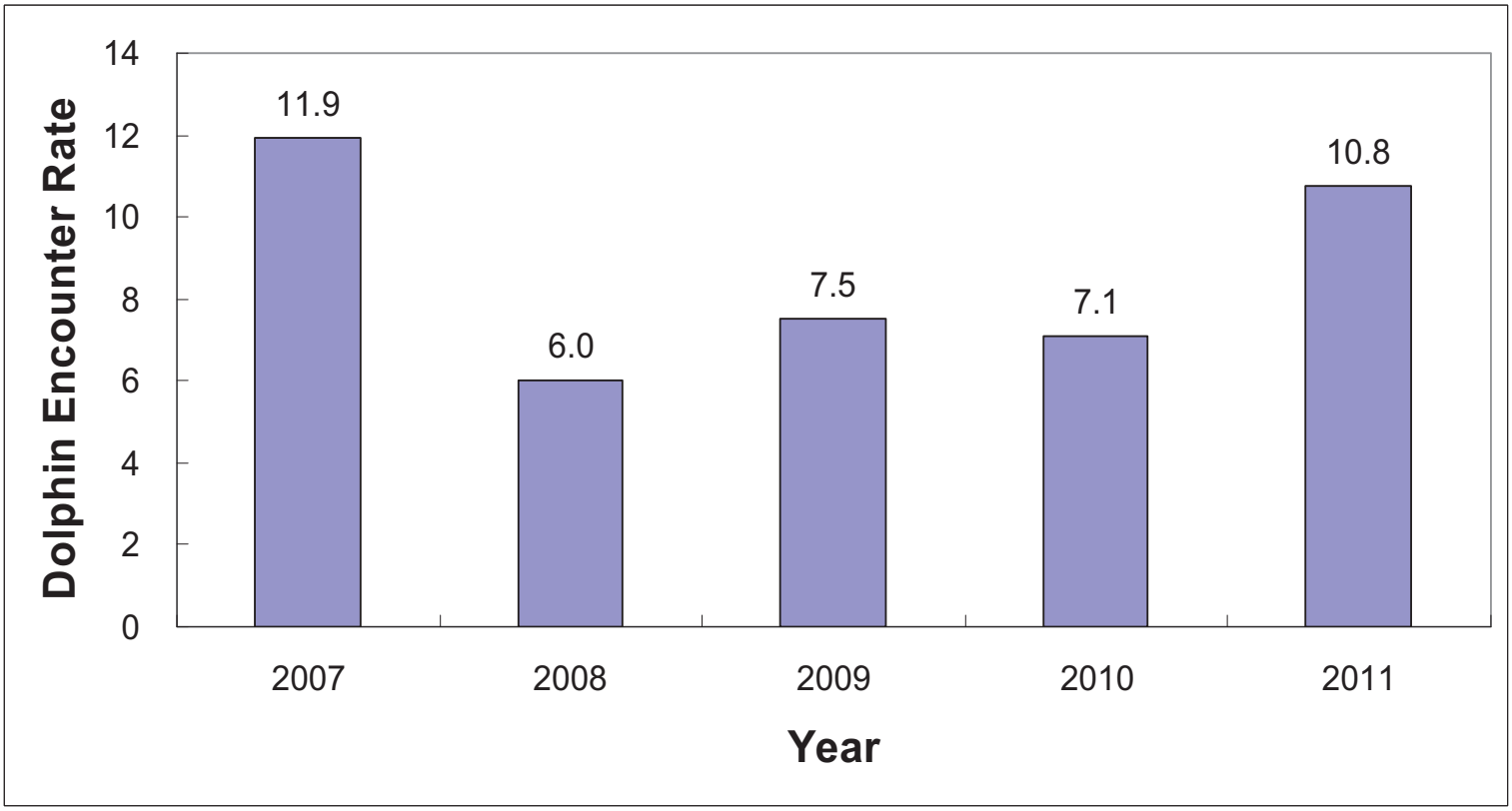


Figure 4a. Temporal trend of encounter rate of Chinese white dolphins (combined from Northwest, Northeast and West Lantau survey areas) during the same 3-month period of September to November from 2007-2011

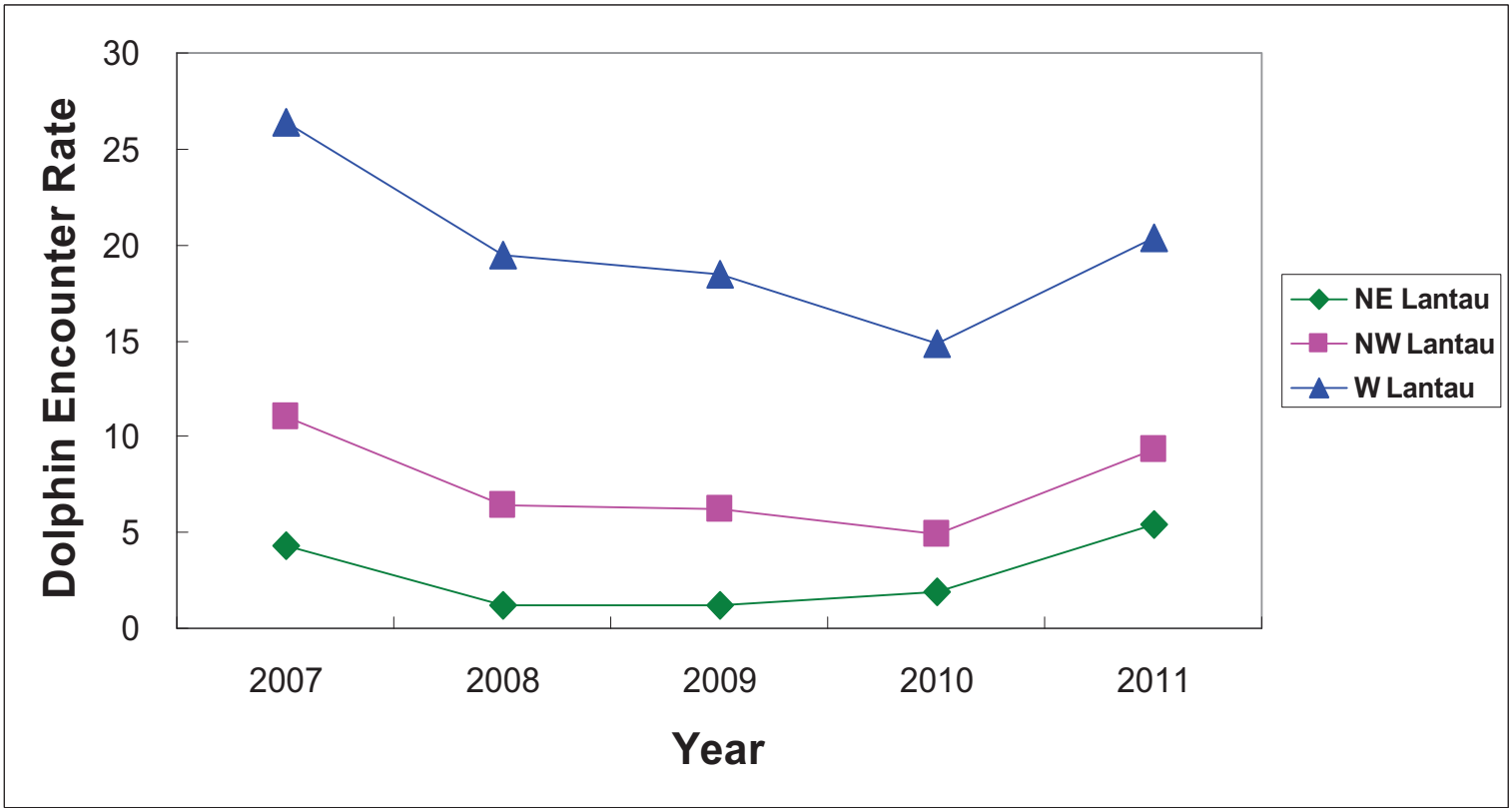


Figure 4b. Temporal trend of encounter rate of Chinese white dolphins in each of the three survey areas during the same 3-month period of September to November from 2007-2011

Figure 5. Distribution of Chinese white dolphins with larger group sizes during HZMB baseline monitoring surveys (green dots: group sizes of 5 or more; purple dots: group sizes of 10 or more)

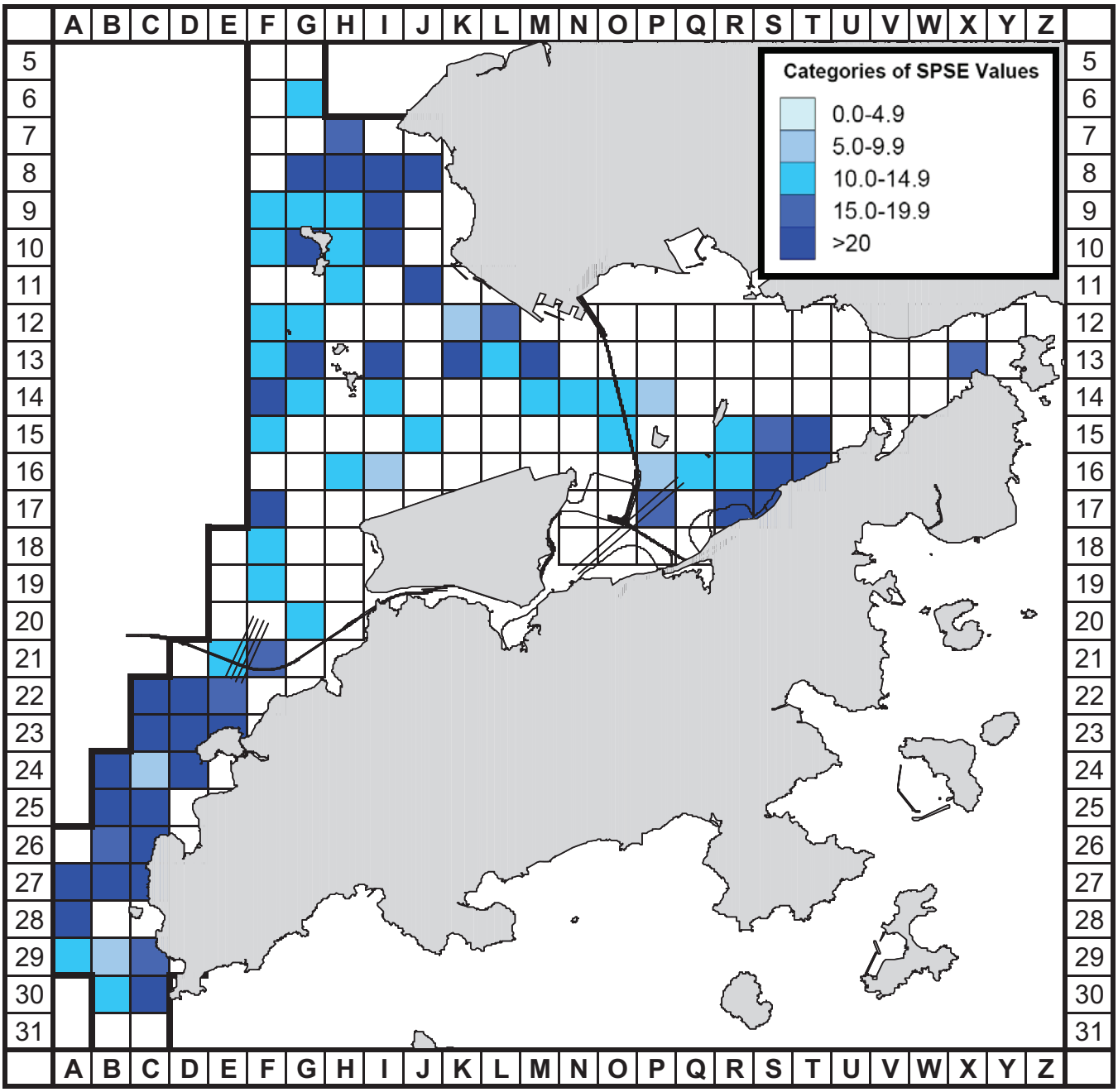


Figure 6. Sighting density of Chinese white dolphins with corrected survey effort per km^2 in Northwest, Northeast and West Lantau survey areas, using data collected during HZMB baseline monitoring period (September to November 2011) (SPSE = no. of on-effort sightings per 100 units of survey effort)

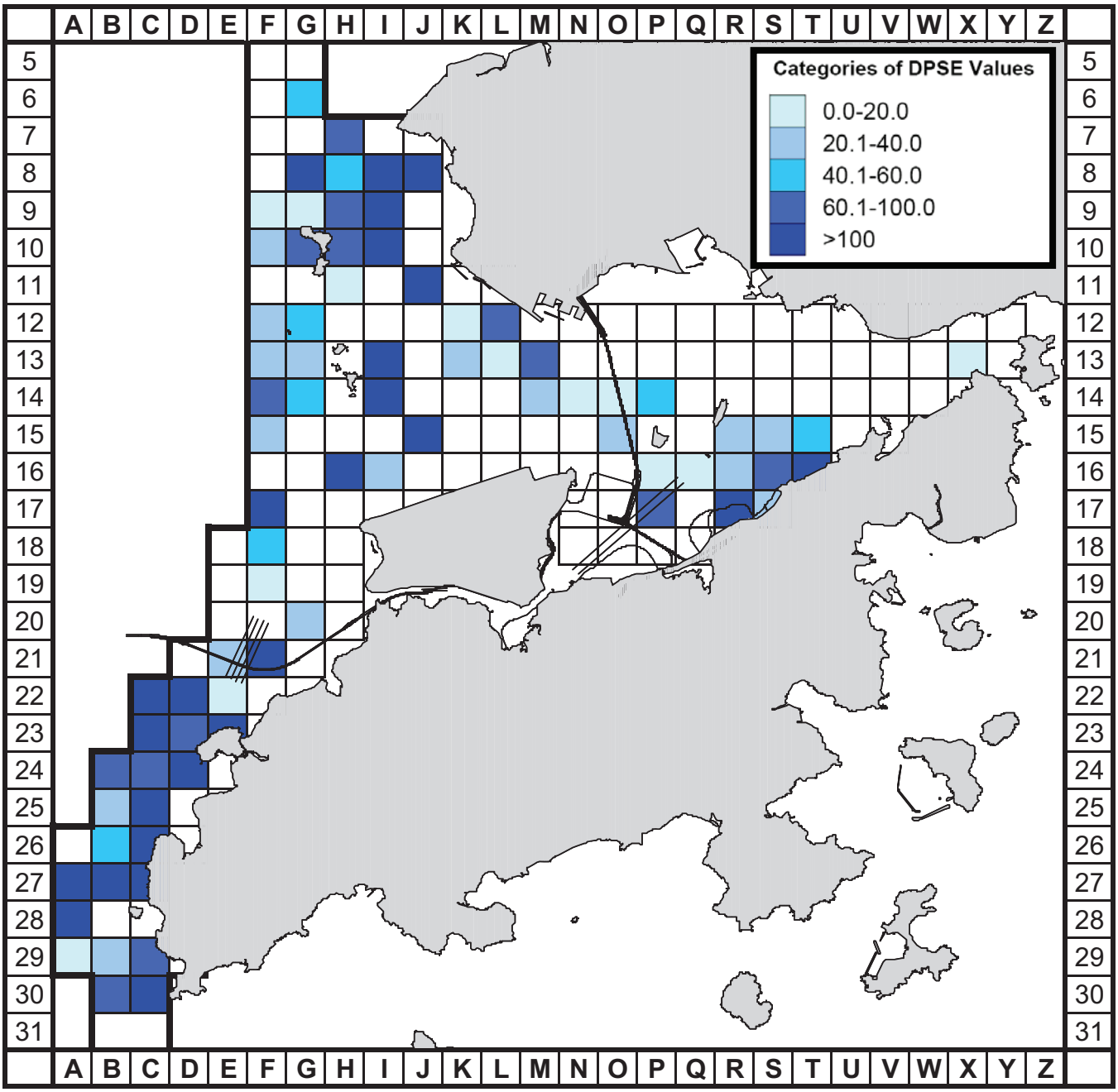


Figure 7. Density of Chinese white dolphins with corrected survey effort per km^2 in Northwest, Northeast and West Lantau survey areas, using data collected during HZMB baseline monitoring period (September to November 2011) (DPSE = no. of dolphins per 100 units of survey effort)

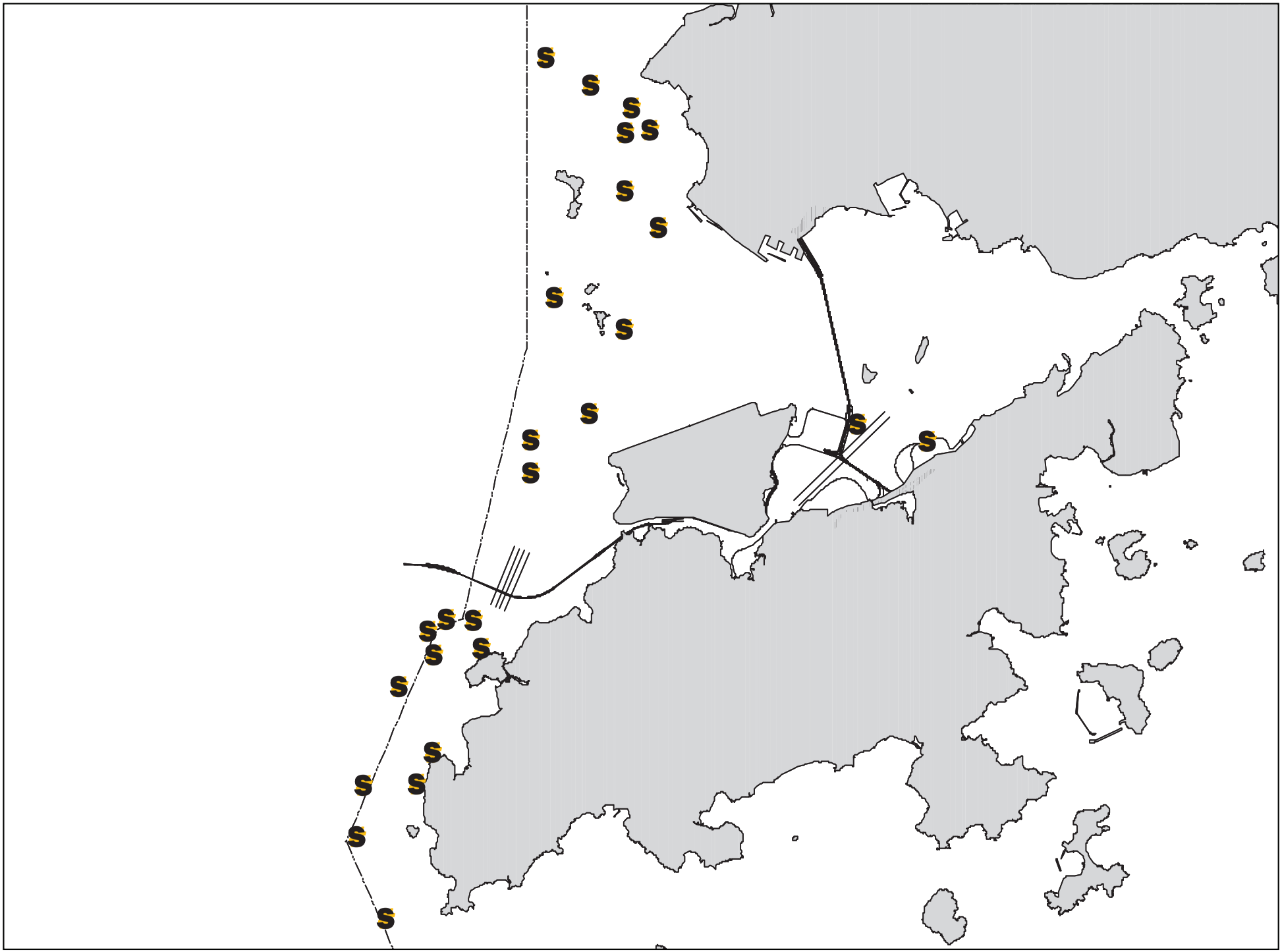


Figure 8. Distribution of young calves of Chinese white dolphins during HZMB baseline monitoring surveys

Figure 9. Distribution of Chinese white dolphins engaged in feeding (blue dots), socializing (pink dots) and traveling (green dots) activities during HZMB baseline monitoring surveys

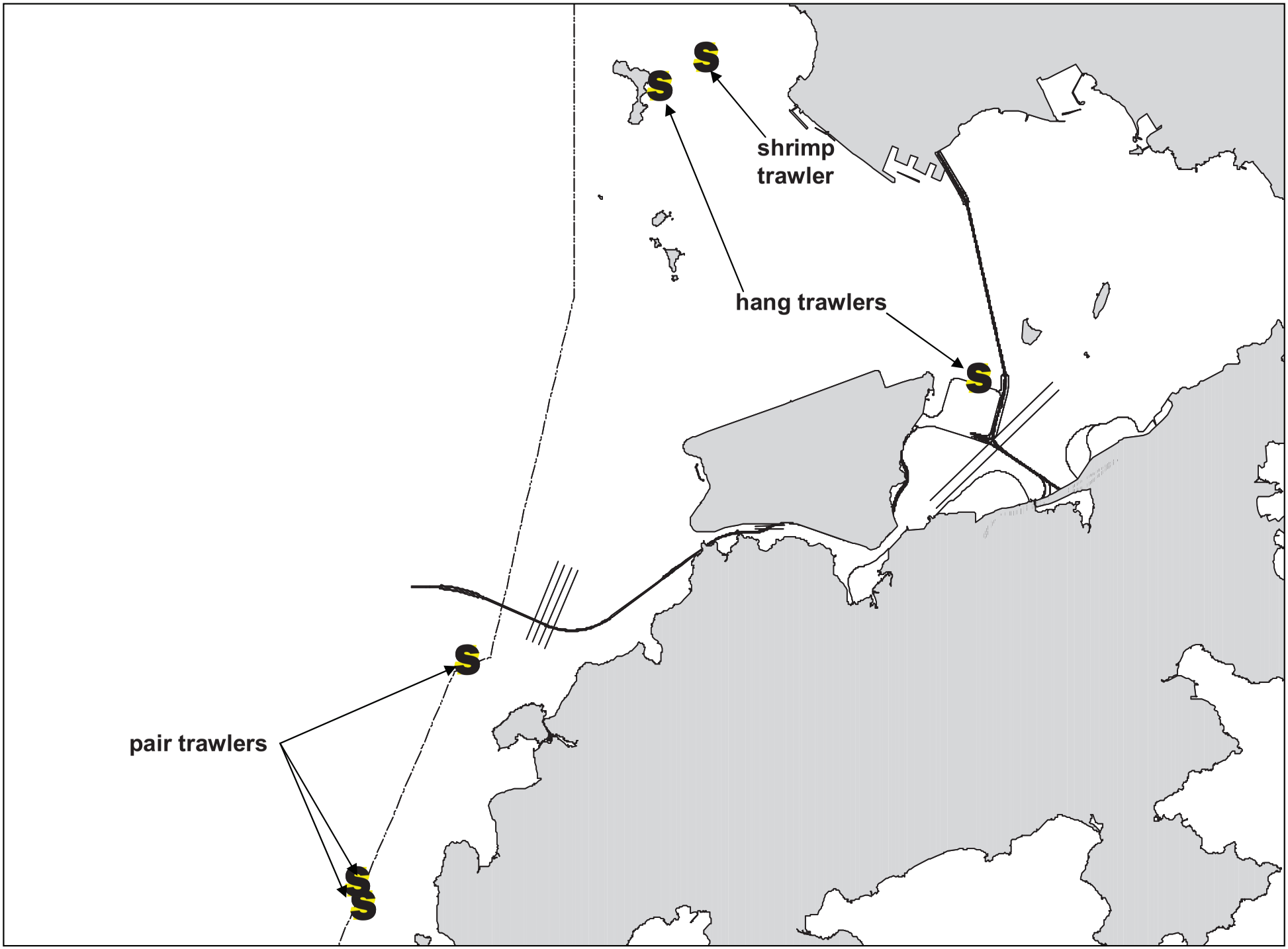


Figure 10. Distribution of dolphin sightings associated with fishing boats during HZMB baseline monitoring surveys

Appendix I. HYD-HZMB Survey Schedule and Details (September-November 2011)

DATE	AREA	SURVEY TIME	# SURVEY HOURS	SEASON	TYPE
5-Sep-11	W LANTAU + NW LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
7-Sep-11	NW LANTAU + NE LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
16-Sep-11	NW LANTAU + NE LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
23-Sep-11	W LANTAU + NW LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
6-Oct-11	NE LANTAU + NW LANTAU	09:00 - 18:00	9.0	AUTUMN	HYD-HZMB
10-Oct-11	NW LANTAU + NE LANTAU	09:30 - 17:00	7.5	AUTUMN	HYD-HZMB
13-Oct-11	NE LANTAU	14:00 - 17:00	3.0	AUTUMN	HYD-HZMB
17-Oct-11	W LANTAU + NW LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
28-Oct-11	NW LANTAU + W LANTAU	09:30 - 17:30	8.0	AUTUMN	HYD-HZMB
1-Nov-11	NW LANTAU + NE LANTAU	09:30 - 18:00	8.5	AUTUMN	HYD-HZMB
2-Nov-11	W LANTAU + NW LANTAU	09:00 - 17:30	8.5	AUTUMN	HYD-HZMB
5-Nov-11	NW LANTAU + NE LANTAU	09:30 - 18:30	9.0	AUTUMN	HYD-HZMB
6-Nov-11	NE LANTAU	14:00 - 17:30	3.5	AUTUMN	HYD-HZMB
7-Nov-11	NW LANTAU + W LANTAU	09:00 - 17:30	8.5	AUTUMN	HYD-HZMB

Appendix II. HYD-HZMB Survey Effort Database (September-November 2011)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
5-Sep-11	W LANTAU	2	8.3	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Sep-11	W LANTAU	3	12.0	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Sep-11	W LANTAU	2	11.1	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Sep-11	W LANTAU	3	7.6	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Sep-11	NW LANTAU	2	10.7	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Sep-11	NW LANTAU	3	28.0	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Sep-11	NW LANTAU	2	4.4	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Sep-11	NW LANTAU	3	2.1	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Sep-11	NW LANTAU	2	14.1	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Sep-11	NW LANTAU	3	19.4	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Sep-11	NW LANTAU	4	3.6	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Sep-11	NW LANTAU	2	1.9	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Sep-11	NW LANTAU	3	10.3	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Sep-11	NW LANTAU	4	0.7	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Sep-11	NE LANTAU	2	8.2	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Sep-11	NE LANTAU	3	21.7	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Sep-11	NE LANTAU	2	7.9	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Sep-11	NE LANTAU	3	3.1	AUTUMN	STANDARD31516	HYD-HZMB	S
16-Sep-11	NW LANTAU	1	2.9	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NW LANTAU	2	27.5	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NW LANTAU	3	6.3	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NW LANTAU	1	0.8	AUTUMN	STANDARD31516	HYD-HZMB	S
16-Sep-11	NW LANTAU	2	5.1	AUTUMN	STANDARD31516	HYD-HZMB	S
16-Sep-11	NW LANTAU	3	0.9	AUTUMN	STANDARD31516	HYD-HZMB	S
16-Sep-11	NE LANTAU	2	4.1	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NE LANTAU	3	22.8	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NE LANTAU	4	2.4	AUTUMN	STANDARD31516	HYD-HZMB	P
16-Sep-11	NE LANTAU	2	6.7	AUTUMN	STANDARD31516	HYD-HZMB	S
16-Sep-11	NE LANTAU	3	3.9	AUTUMN	STANDARD31516	HYD-HZMB	S
23-Sep-11	W LANTAU	2	9.0	AUTUMN	STANDARD31516	HYD-HZMB	P
23-Sep-11	W LANTAU	3	12.0	AUTUMN	STANDARD31516	HYD-HZMB	P
23-Sep-11	W LANTAU	2	11.7	AUTUMN	STANDARD31516	HYD-HZMB	S
23-Sep-11	W LANTAU	3	7.2	AUTUMN	STANDARD31516	HYD-HZMB	S
23-Sep-11	NW LANTAU	2	9.7	AUTUMN	STANDARD31516	HYD-HZMB	P
23-Sep-11	NW LANTAU	3	7.9	AUTUMN	STANDARD31516	HYD-HZMB	P
23-Sep-11	NW LANTAU	2	5.2	AUTUMN	STANDARD31516	HYD-HZMB	S
23-Sep-11	NW LANTAU	3	4.0	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Oct-11	NE LANTAU	0	1.6	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Oct-11	NE LANTAU	1	13.5	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Oct-11	NE LANTAU	2	18.0	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Oct-11	NE LANTAU	1	5.3	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Oct-11	NE LANTAU	2	4.9	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Oct-11	NW LANTAU	1	0.9	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Oct-11	NW LANTAU	2	21.7	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Oct-11	NW LANTAU	1	12.7	AUTUMN	STANDARD31516	HYD-HZMB	S
10-Oct-11	NW LANTAU	2	16.7	AUTUMN	STANDARD31516	HYD-HZMB	P
10-Oct-11	NW LANTAU	3	17.9	AUTUMN	STANDARD31516	HYD-HZMB	P
10-Oct-11	NW LANTAU	2	11.8	AUTUMN	STANDARD31516	HYD-HZMB	S
10-Oct-11	NW LANTAU	3	2.2	AUTUMN	STANDARD31516	HYD-HZMB	S
10-Oct-11	NE LANTAU	2	6.8	AUTUMN	STANDARD31516	HYD-HZMB	P
10-Oct-11	NE LANTAU	3	10.2	AUTUMN	STANDARD31516	HYD-HZMB	P
10-Oct-11	NE LANTAU	4	1.3	AUTUMN	STANDARD31516	HYD-HZMB	P
10-Oct-11	NE LANTAU	2	2.1	AUTUMN	STANDARD31516	HYD-HZMB	S
10-Oct-11	NE LANTAU	3	2.1	AUTUMN	STANDARD31516	HYD-HZMB	S
13-Oct-11	NE LANTAU	2	15.0	AUTUMN	STANDARD31516	HYD-HZMB	P
13-Oct-11	NE LANTAU	3	1.8	AUTUMN	STANDARD31516	HYD-HZMB	P
13-Oct-11	NE LANTAU	2	10.3	AUTUMN	STANDARD31516	HYD-HZMB	S
13-Oct-11	NE LANTAU	3	1.0	AUTUMN	STANDARD31516	HYD-HZMB	S
17-Oct-11	W LANTAU	2	5.2	AUTUMN	STANDARD31516	HYD-HZMB	P
17-Oct-11	W LANTAU	3	10.3	AUTUMN	STANDARD31516	HYD-HZMB	P
17-Oct-11	W LANTAU	4	3.6	AUTUMN	STANDARD31516	HYD-HZMB	P

Appendix II. (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-Oct-11	W LANTAU	2	3.5	AUTUMN	STANDARD31516	HYD-HZMB	S
17-Oct-11	W LANTAU	3	10.1	AUTUMN	STANDARD31516	HYD-HZMB	S
17-Oct-11	W LANTAU	4	5.2	AUTUMN	STANDARD31516	HYD-HZMB	S
17-Oct-11	NW LANTAU	2	24.9	AUTUMN	STANDARD31516	HYD-HZMB	P
17-Oct-11	NW LANTAU	3	2.6	AUTUMN	STANDARD31516	HYD-HZMB	P
17-Oct-11	NW LANTAU	2	4.5	AUTUMN	STANDARD31516	HYD-HZMB	S
17-Oct-11	NW LANTAU	3	2.1	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	NW LANTAU	1	1.5	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	NW LANTAU	2	9.3	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	NW LANTAU	3	20.9	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	NW LANTAU	1	3.9	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	NW LANTAU	2	2.5	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	NW LANTAU	3	0.9	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	W LANTAU	2	1.3	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	W LANTAU	3	14.9	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	W LANTAU	4	0.9	AUTUMN	STANDARD31516	HYD-HZMB	P
28-Oct-11	W LANTAU	2	1.1	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	W LANTAU	3	12.1	AUTUMN	STANDARD31516	HYD-HZMB	S
28-Oct-11	W LANTAU	4	3.6	AUTUMN	STANDARD31516	HYD-HZMB	S
1-Nov-11	NW LANTAU	1	2.4	AUTUMN	STANDARD31516	HYD-HZMB	P
1-Nov-11	NW LANTAU	2	21.1	AUTUMN	STANDARD31516	HYD-HZMB	P
1-Nov-11	NW LANTAU	3	7.9	AUTUMN	STANDARD31516	HYD-HZMB	P
1-Nov-11	NW LANTAU	1	1.8	AUTUMN	STANDARD31516	HYD-HZMB	S
1-Nov-11	NW LANTAU	2	6.1	AUTUMN	STANDARD31516	HYD-HZMB	S
1-Nov-11	NW LANTAU	3	2.1	AUTUMN	STANDARD31516	HYD-HZMB	S
1-Nov-11	NE LANTAU	2	21.8	AUTUMN	STANDARD31516	HYD-HZMB	P
1-Nov-11	NE LANTAU	2	9.9	AUTUMN	STANDARD31516	HYD-HZMB	S
2-Nov-11	W LANTAU	2	9.0	AUTUMN	STANDARD31516	HYD-HZMB	P
2-Nov-11	W LANTAU	3	6.6	AUTUMN	STANDARD31516	HYD-HZMB	P
2-Nov-11	W LANTAU	4	3.2	AUTUMN	STANDARD31516	HYD-HZMB	P
2-Nov-11	W LANTAU	2	12.1	AUTUMN	STANDARD31516	HYD-HZMB	S
2-Nov-11	W LANTAU	3	7.8	AUTUMN	STANDARD31516	HYD-HZMB	S
2-Nov-11	NW LANTAU	2	17.9	AUTUMN	STANDARD31516	HYD-HZMB	P
2-Nov-11	NW LANTAU	3	4.0	AUTUMN	STANDARD31516	HYD-HZMB	P
2-Nov-11	NW LANTAU	2	7.2	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Nov-11	NW LANTAU	0	2.2	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Nov-11	NW LANTAU	1	10.6	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Nov-11	NW LANTAU	2	19.4	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Nov-11	NW LANTAU	1	3.0	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Nov-11	NW LANTAU	2	4.5	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Nov-11	NE LANTAU	1	1.2	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Nov-11	NE LANTAU	2	15.2	AUTUMN	STANDARD31516	HYD-HZMB	P
5-Nov-11	NE LANTAU	1	1.2	AUTUMN	STANDARD31516	HYD-HZMB	S
5-Nov-11	NE LANTAU	2	8.2	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Nov-11	NE LANTAU	3	10.2	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Nov-11	NE LANTAU	4	3.5	AUTUMN	STANDARD31516	HYD-HZMB	P
6-Nov-11	NE LANTAU	2	4.3	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Nov-11	NE LANTAU	3	7.2	AUTUMN	STANDARD31516	HYD-HZMB	S
6-Nov-11	NE LANTAU	4	1.2	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NW LANTAU	2	14.6	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NW LANTAU	3	16.0	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NW LANTAU	4	7.6	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NW LANTAU	2	3.6	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NW LANTAU	3	3.3	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NW LANTAU	4	0.8	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NE LANTAU	2	0.6	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NE LANTAU	3	13.9	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NE LANTAU	4	5.1	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NE LANTAU	5	0.2	AUTUMN	STANDARD31516	HYD-HZMB	P
7-Nov-11	NE LANTAU	2	4.3	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NE LANTAU	3	9.0	AUTUMN	STANDARD31516	HYD-HZMB	S
7-Nov-11	NE LANTAU	4	6.1	AUTUMN	STANDARD31516	HYD-HZMB	S

Appendix III. HYD-HZMB Chinese White Dolphin Sighting Database (September-November 2011)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Associa

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.
05-Sep-11	1	1111	2	W LANTAU	3	ND	OFF	HYD-HZMB	811890	800623	AUTUMN	NONE
05-Sep-11	2	1143	2	W LANTAU	2	230	ON	HYD-HZMB	809851	801299	AUTUMN	NONE
05-Sep-11	3	1155	4	W LANTAU	2	44	ON	HYD-HZMB	809434	799865	AUTUMN	PAIR
05-Sep-11	4	1244	6	W LANTAU	2	179	ON	HYD-HZMB	806232	800373	AUTUMN	NONE
05-Sep-11	5	1324	8	W LANTAU	2	883	ON	HYD-HZMB	809910	799722	AUTUMN	PAIR
07-Sep-11	1	1055	2	NW LANTAU	2	349	ON	HYD-HZMB	824052	804669	AUTUMN	NONE
07-Sep-11	2	1657	1	NE LANTAU	2	179	ON	HYD-HZMB	821661	817387	AUTUMN	NONE
16-Sep-11	1	1001	6	NW LANTAU	2	ND	OFF	HYD-HZMB	816088	805652	AUTUMN	NONE
16-Sep-11	2	1013	2	NW LANTAU	2	330	ON	HYD-HZMB	816609	805334	AUTUMN	NONE
16-Sep-11	3	1038	4	NW LANTAU	2	87	ON	HYD-HZMB	822356	805335	AUTUMN	NONE
16-Sep-11	4	1102	2	NW LANTAU	1	59	ON	HYD-HZMB	826431	805354	AUTUMN	NONE
16-Sep-11	5	1144	3	NW LANTAU	2	157	ON	HYD-HZMB	826350	807424	AUTUMN	NONE
16-Sep-11	6	1204	1	NW LANTAU	2	4	ON	HYD-HZMB	823271	807428	AUTUMN	NONE
16-Sep-11	7	1210	9	NW LANTAU	2	73	ON	HYD-HZMB	822585	807406	AUTUMN	NONE
16-Sep-11	8	1350	1	NW LANTAU	2	ND	OFF	HYD-HZMB	824384	810767	AUTUMN	NONE
16-Sep-11	9	1406	3	NW LANTAU	2	295	ON	HYD-HZMB	822843	811548	AUTUMN	NONE
23-Sep-11	1	1104	1	W LANTAU	3	ND	OFF	HYD-HZMB	813867	803153	AUTUMN	NONE
23-Sep-11	2	1115	2	W LANTAU	3	130	ON	HYD-HZMB	813284	801266	AUTUMN	NONE
23-Sep-11	3	1126	2	W LANTAU	2	7	ON	HYD-HZMB	811503	800365	AUTUMN	NONE
23-Sep-11	4	1149	5	W LANTAU	2	176	ON	HYD-HZMB	809973	801299	AUTUMN	NONE
23-Sep-11	5	1211	1	W LANTAU	2	ND	OFF	HYD-HZMB	809444	800411	AUTUMN	NONE
23-Sep-11	6	1222	4	W LANTAU	2	21	ON	HYD-HZMB	808526	799605	AUTUMN	NONE
23-Sep-11	7	1247	2	W LANTAU	2	351	ON	HYD-HZMB	806462	801797	AUTUMN	NONE
23-Sep-11	8	1315	1	W LANTAU	3	433	ON	HYD-HZMB	806474	801322	AUTUMN	NONE
23-Sep-11	9	1417	9	W LANTAU	2	125	ON	HYD-HZMB	812465	801150	AUTUMN	NONE
23-Sep-11	10	1517	4	NW LANTAU	3	26	ON	HYD-HZMB	819489	804649	AUTUMN	NONE
23-Sep-11	11	1538	2	NW LANTAU	3	137	ON	HYD-HZMB	823011	804646	AUTUMN	NONE
23-Sep-11	12	1608	1	NW LANTAU	2	776	ON	HYD-HZMB	828568	805770	AUTUMN	NONE
6-Oct-11	1	1040	1	NE LANTAU	2	633	ON	HYD-HZMB	823250	822571	AUTUMN	NONE
6-Oct-11	2	1306	5	NE LANTAU	2	57	ON	HYD-HZMB	822462	814277	AUTUMN	NONE
6-Oct-11	3	1455	2	NW LANTAU	1	236	ON	HYD-HZMB	823764	810478	AUTUMN	NONE

Appendix III. (cont'd)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Associa

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.
6-Oct-11	4	1500	6	NW LANTAU	2	151	ON	HYD-HZMB	824185	810520	AUTUMN	NONE
6-Oct-11	5	1517	2	NW LANTAU	2	96	ON	HYD-HZMB	824672	810243	AUTUMN	NONE
6-Oct-11	6	1552	1	NW LANTAU	2	ND	OFF	HYD-HZMB	825827	808442	AUTUMN	NONE
6-Oct-11	7	1615	1	NW LANTAU	2	ND	OFF	HYD-HZMB	821630	808455	AUTUMN	NONE
10-Oct-11	1	1009	3	NW LANTAU	3	183	ON	HYD-HZMB	815702	804652	AUTUMN	NONE
10-Oct-11	2	1207	9	NW LANTAU	3	382	ON	HYD-HZMB	820228	806382	AUTUMN	NONE
10-Oct-11	3	1629	3	NE LANTAU	2	167	ON	HYD-HZMB	820354	817344	AUTUMN	NONE
13-Oct-11	3	1459	2	NE LANTAU	2	42	ON	HYD-HZMB	820015	814284	AUTUMN	NONE
17-Oct-11	1	1014	6	W LANTAU	3	275	ON	HYD-HZMB	814765	802774	AUTUMN	NONE
17-Oct-11	2	1023	10	W LANTAU	3	216	ON	HYD-HZMB	814545	802165	AUTUMN	PAIR
17-Oct-11	3	1045	3	W LANTAU	3	505	ON	HYD-HZMB	812654	800769	AUTUMN	NONE
17-Oct-11	4	1116	5	W LANTAU	3	606	ON	HYD-HZMB	810461	800888	AUTUMN	NONE
17-Oct-11	5	1131	2	W LANTAU	4	ND	OFF	HYD-HZMB	809301	799700	AUTUMN	NONE
17-Oct-11	6	1136	3	W LANTAU	3	ND	OFF	HYD-HZMB	808460	799481	AUTUMN	NONE
17-Oct-11	7	1243	1	W LANTAU	3	104	ON	HYD-HZMB	809432	800473	AUTUMN	NONE
17-Oct-11	8	1324	5	W LANTAU	2	142	ON	HYD-HZMB	814203	801628	AUTUMN	NONE
17-Oct-11	9	1402	1	W LANTAU	2	328	ON	HYD-HZMB	814443	803020	AUTUMN	NONE
17-Oct-11	10	1548	1	NW LANTAU	2	583	ON	HYD-HZMB	827080	807435	AUTUMN	SHRIMP
17-Oct-11	11	1609	1	NW LANTAU	2	ND	OFF	HYD-HZMB	822562	807416	AUTUMN	NONE
28-Oct-11	1	0953	1	NW LANTAU	2	662	ON	HYD-HZMB	823699	809479	AUTUMN	NONE
28-Oct-11	2	1004	1	NW LANTAU	2	ND	OFF	HYD-HZMB	823445	809004	AUTUMN	NONE
28-Oct-11	3	1044	8	NW LANTAU	3	0	ON	HYD-HZMB	823703	807398	AUTUMN	NONE
28-Oct-11	4	1117	7	NW LANTAU	3	160	ON	HYD-HZMB	827579	807426	AUTUMN	NONE
28-Oct-11	5	1129	4	NW LANTAU	3	93	ON	HYD-HZMB	828022	807416	AUTUMN	NONE
28-Oct-11	6	1412	2	W LANTAU	3	27	ON	HYD-HZMB	811457	801220	AUTUMN	NONE
28-Oct-11	7	1418	3	W LANTAU	3	235	ON	HYD-HZMB	811467	801859	AUTUMN	NONE
28-Oct-11	8	1518	4	W LANTAU	3	64	ON	HYD-HZMB	808482	799512	AUTUMN	NONE
1-Nov-11	1	0952	2	NW LANTAU	2	ND	OFF	HYD-HZMB	816794	806746	AUTUMN	NONE
1-Nov-11	2	1021	4	NW LANTAU	2	161	ON	HYD-HZMB	819534	804649	AUTUMN	NONE
1-Nov-11	3	1135	2	NW LANTAU	1	524	ON	HYD-HZMB	828356	806387	AUTUMN	NONE
1-Nov-11	4	1153	1	NW LANTAU	2	ND	OFF	HYD-HZMB	826950	806395	AUTUMN	NONE

Appendix III. (cont'd)

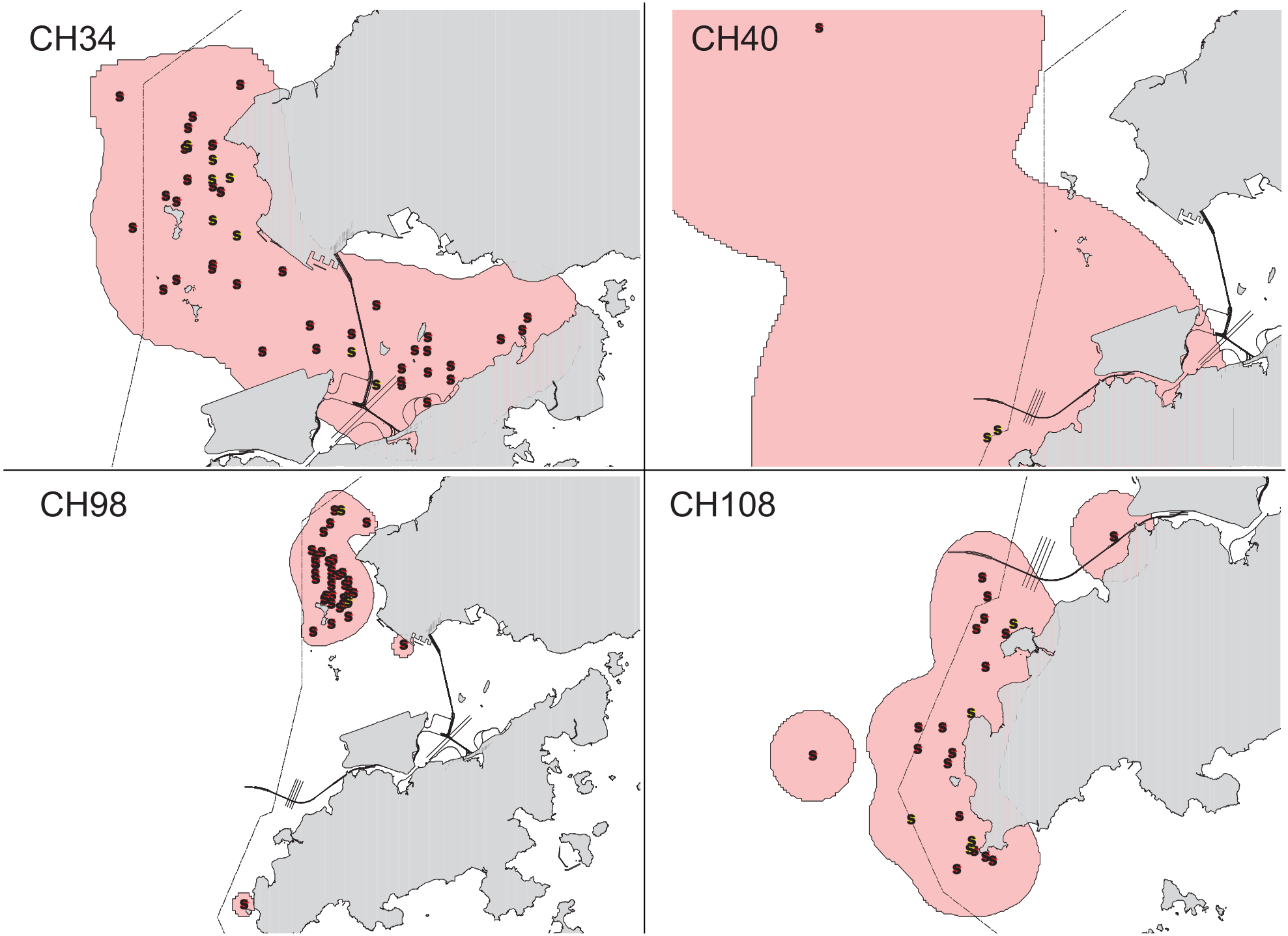
(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Associa

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.
1-Nov-11	5	1156	5	NW LANTAU	2	161	ON	HYD-HZMB	826473	806394	AUTUMN	HANG
1-Nov-11	6	1405	4	NE LANTAU	2	350	ON	HYD-HZMB	821213	813245	AUTUMN	NONE
1-Nov-11	7	1416	1	NE LANTAU	2	ND	OFF	HYD-HZMB	820404	813440	AUTUMN	HANG
1-Nov-11	8	1505	8	NE LANTAU	2	277	ON	HYD-HZMB	819926	814273	AUTUMN	NONE
1-Nov-11	9	1612	4	NE LANTAU	2	159	ON	HYD-HZMB	819702	816406	AUTUMN	NONE
2-Nov-11	1	0957	2	W LANTAU	2	564	ON	HYD-HZMB	815660	803796	AUTUMN	NONE
2-Nov-11	2	1021	1	W LANTAU	2	29	ON	HYD-HZMB	814454	803072	AUTUMN	NONE
2-Nov-11	3	1026	10	W LANTAU	2	561	ON	HYD-HZMB	813723	803204	AUTUMN	NONE
2-Nov-11	4	1044	4	W LANTAU	2	316	ON	HYD-HZMB	813560	801782	AUTUMN	NONE
2-Nov-11	5	1114	1	W LANTAU	3	746	ON	HYD-HZMB	809386	801246	AUTUMN	NONE
2-Nov-11	6	1120	8	W LANTAU	3	112	ON	HYD-HZMB	809409	800793	AUTUMN	NONE
2-Nov-11	7	1144	1	W LANTAU	2	92	ON	HYD-HZMB	808449	799615	AUTUMN	NONE
2-Nov-11	8	1301	14	W LANTAU	2	303	ON	HYD-HZMB	810847	801745	AUTUMN	NONE
2-Nov-11	9	1343	4	W LANTAU	2	259	ON	HYD-HZMB	812455	800903	AUTUMN	NONE
2-Nov-11	10	1403	6	W LANTAU	2	243	ON	HYD-HZMB	814510	802959	AUTUMN	NONE
2-Nov-11	11	1501	2	NW LANTAU	2	30	ON	HYD-HZMB	826309	805353	AUTUMN	NONE
2-Nov-11	12	1513	18	NW LANTAU	2	282	ON	HYD-HZMB	828303	805357	AUTUMN	NONE
2-Nov-11	13	1555	3	NW LANTAU	2	262	ON	HYD-HZMB	827025	807425	AUTUMN	NONE
2-Nov-11	14	1601	12	NW LANTAU	2	263	ON	HYD-HZMB	826405	807424	AUTUMN	NONE
5-Nov-11	1	1018	1	NW LANTAU	2	204	ON	HYD-HZMB	817540	804645	AUTUMN	NONE
5-Nov-11	2	1025	4	NW LANTAU	2	220	ON	HYD-HZMB	818581	804647	AUTUMN	NONE
5-Nov-11	3	1110	2	NW LANTAU	2	220	ON	HYD-HZMB	826255	804663	AUTUMN	NONE
5-Nov-11	4	1121	1	NW LANTAU	2	534	ON	HYD-HZMB	827651	804666	AUTUMN	NONE
5-Nov-11	5	1138	6	NW LANTAU	1	453	ON	HYD-HZMB	830119	805104	AUTUMN	NONE
5-Nov-11	6	1153	7	NW LANTAU	1	248	ON	HYD-HZMB	829353	806389	AUTUMN	NONE
5-Nov-11	7	1208	5	NW LANTAU	1	21	ON	HYD-HZMB	827946	806397	AUTUMN	NONE
5-Nov-11	8	1321	8	NW LANTAU	2	312	ON	HYD-HZMB	825384	808431	AUTUMN	NONE
5-Nov-11	9	1516	4	NE LANTAU	1	195	ON	HYD-HZMB	820189	816376	AUTUMN	NONE
5-Nov-11	10	1524	3	NE LANTAU	2	ND	OFF	HYD-HZMB	821141	816768	AUTUMN	NONE
5-Nov-11	11	1537	2	NE LANTAU	1	136	ON	HYD-HZMB	821828	816409	AUTUMN	NONE
5-Nov-11	12	1614	2	NE LANTAU	2	193	ON	HYD-HZMB	821172	818396	AUTUMN	NONE

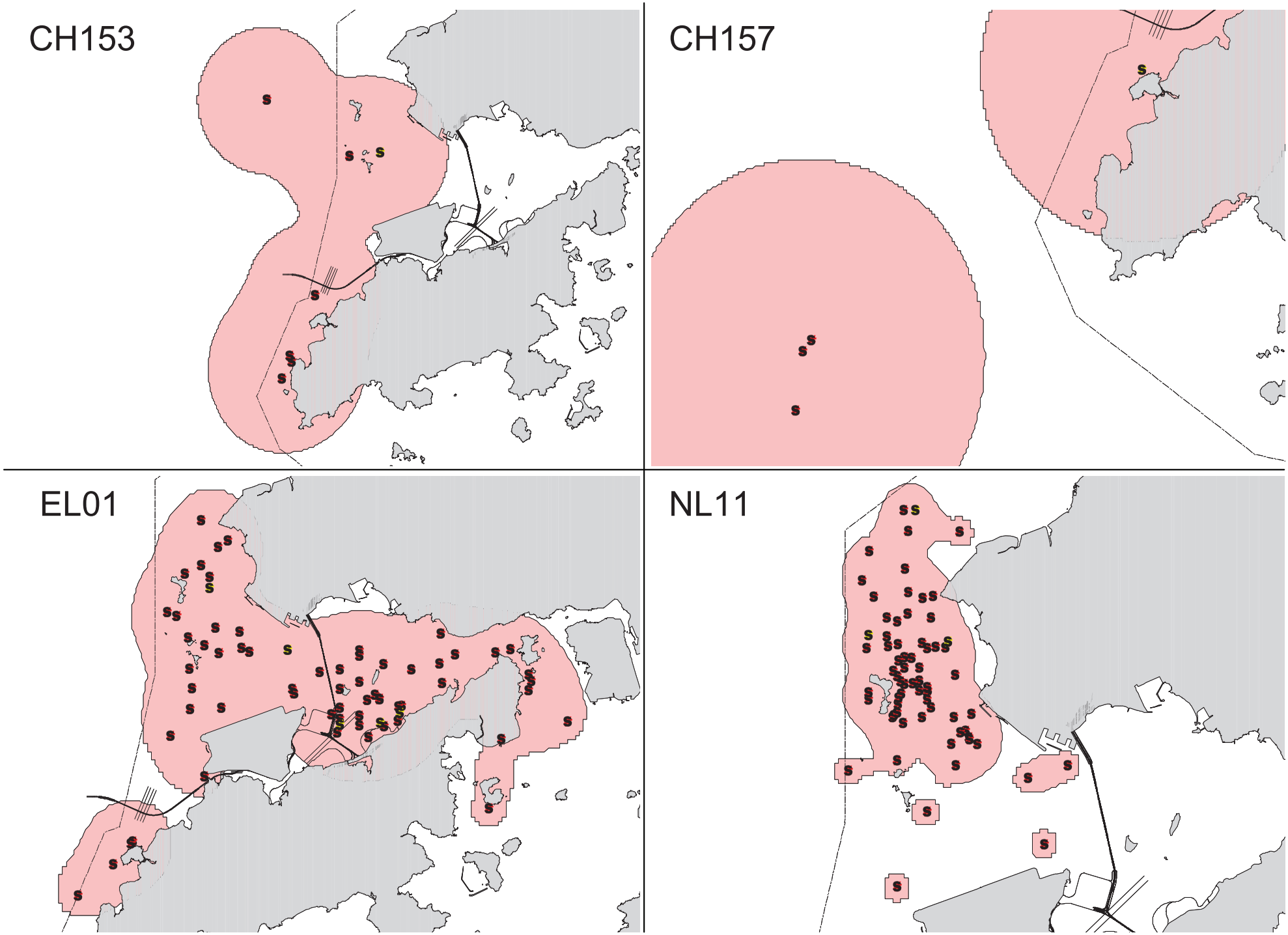
Appendix III. (cont'd)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; BOAT ASSOC. = Fishing Boat Associa

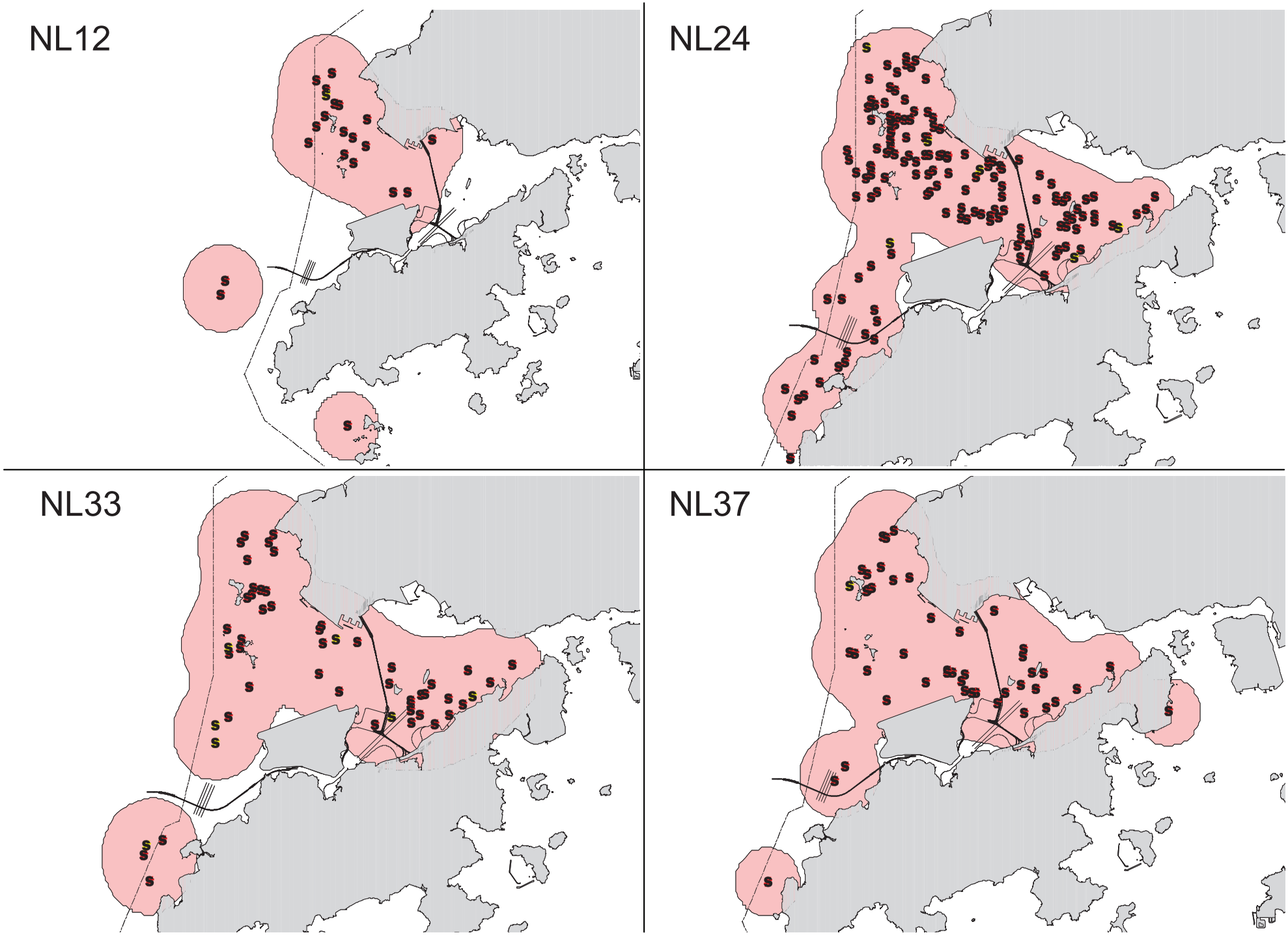
DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.
6-Nov-11	1	1447	2	NE LANTAU	4	92	ON	HYD-HZMB	822951	813237	AUTUMN	NONE
6-Nov-11	2	1543	8	NE LANTAU	3	44	ON	HYD-HZMB	819459	816292	AUTUMN	NONE
6-Nov-11	3	1605	2	NE LANTAU	2	163	ON	HYD-HZMB	819668	816808	AUTUMN	NONE
6-Nov-11	4	1611	2	NE LANTAU	2	18	ON	HYD-HZMB	819956	817303	AUTUMN	NONE
7-Nov-11	1	0922	1	NW LANTAU	2	ND	OFF	HYD-HZMB	821258	812720	AUTUMN	NONE
7-Nov-11	2	1116	8	NW LANTAU	2	790	ON	HYD-HZMB	828087	808158	AUTUMN	NONE
7-Nov-11	3	1136	4	NW LANTAU	2	59	ON	HYD-HZMB	828708	807603	AUTUMN	NONE
7-Nov-11	4	1146	3	NW LANTAU	2	160	ON	HYD-HZMB	829607	806637	AUTUMN	NONE
7-Nov-11	5	1226	6	NW LANTAU	3	ND	OFF	HYD-HZMB	823463	805358	AUTUMN	NONE
7-Nov-11	6	1411	1	W LANTAU	3	245	ON	HYD-HZMB	811458	800921	AUTUMN	NONE
7-Nov-11	7	1421	1	W LANTAU	2	ND	OFF	HYD-HZMB	811189	802075	AUTUMN	NONE
7-Nov-11	8	1424	5	W LANTAU	2	52	ON	HYD-HZMB	810991	801838	AUTUMN	NONE
7-Nov-11	9	1436	4	W LANTAU	3	68	ON	HYD-HZMB	809464	801195	AUTUMN	NONE
7-Nov-11	10	1507	3	W LANTAU	2	48	ON	HYD-HZMB	807450	800438	AUTUMN	NONE
7-Nov-11	11	1518	3	W LANTAU	2	105	ON	HYD-HZMB	806694	801756	AUTUMN	NONE
7-Nov-11	12	1537	2	W LANTAU	3	ND	OFF	HYD-HZMB	806488	799775	AUTUMN	NONE
7-Nov-11	13	1545	1	W LANTAU	3	49	ON	HYD-HZMB	806484	801755	AUTUMN	NONE
7-Nov-11	14	1554	1	W LANTAU	2	ND	OFF	HYD-HZMB	808368	801193	AUTUMN	NONE
7-Nov-11	15	1625	1	W LANTAU	3	ND	OFF	HYD-HZMB	812463	802150	AUTUMN	NONE



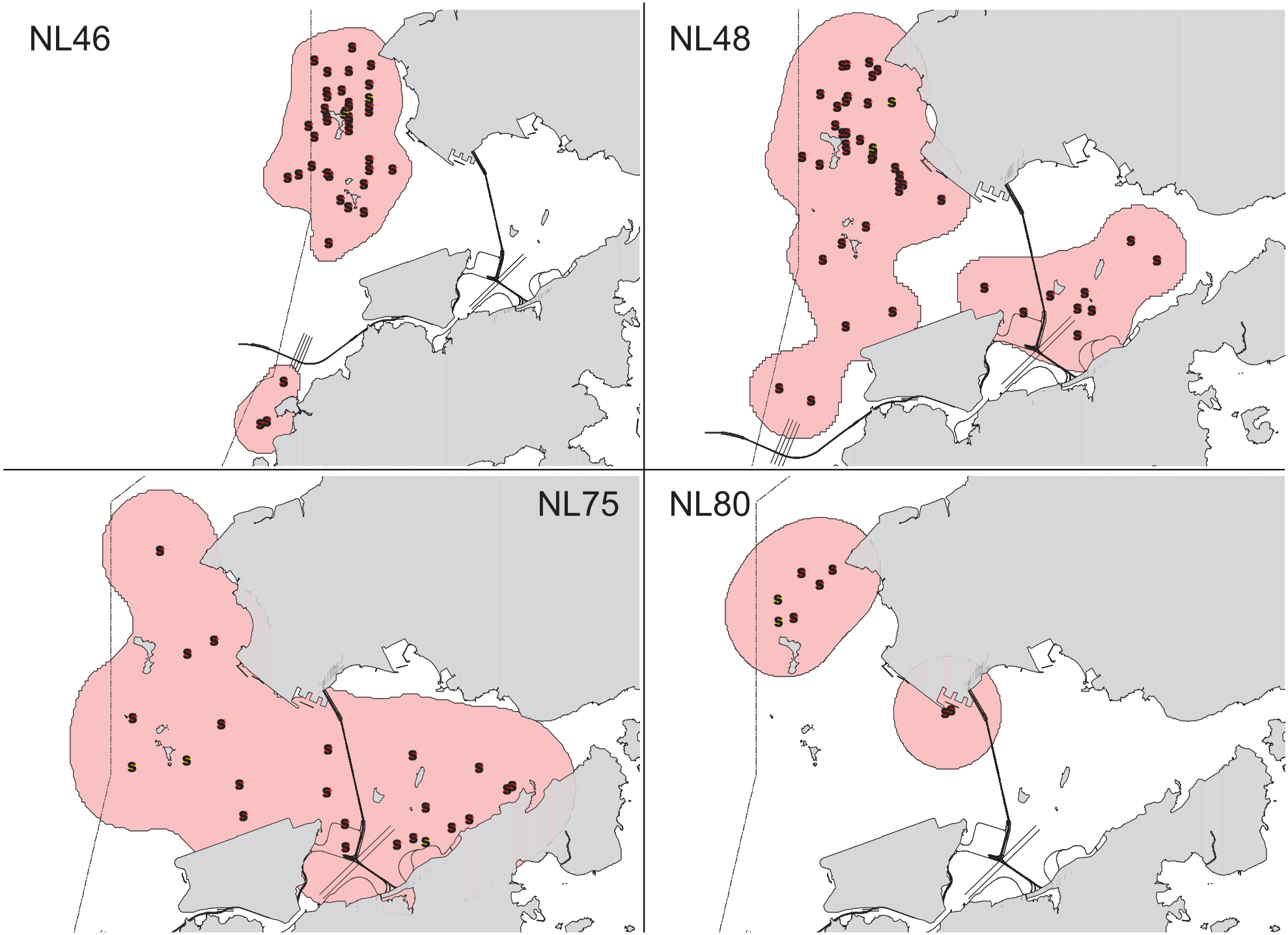
Appendix IV. Ranging patterns (95% kernel ranges) of 96 individual dolphins that were identified during HYD-HZMB baseline monitoring surveys (yellow dots: sightings made during September to November 2011)



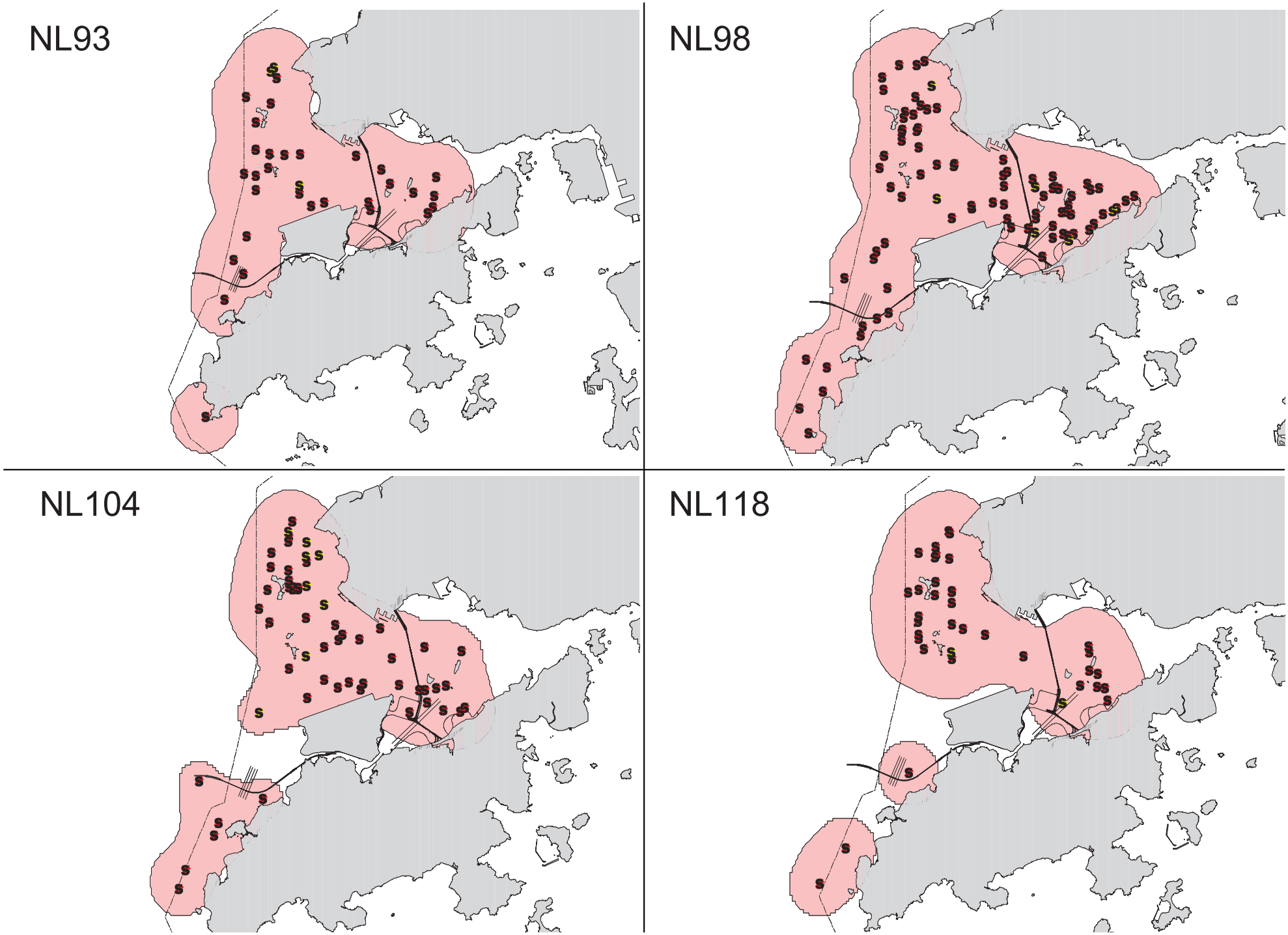
Appendix IV. (cont'd)



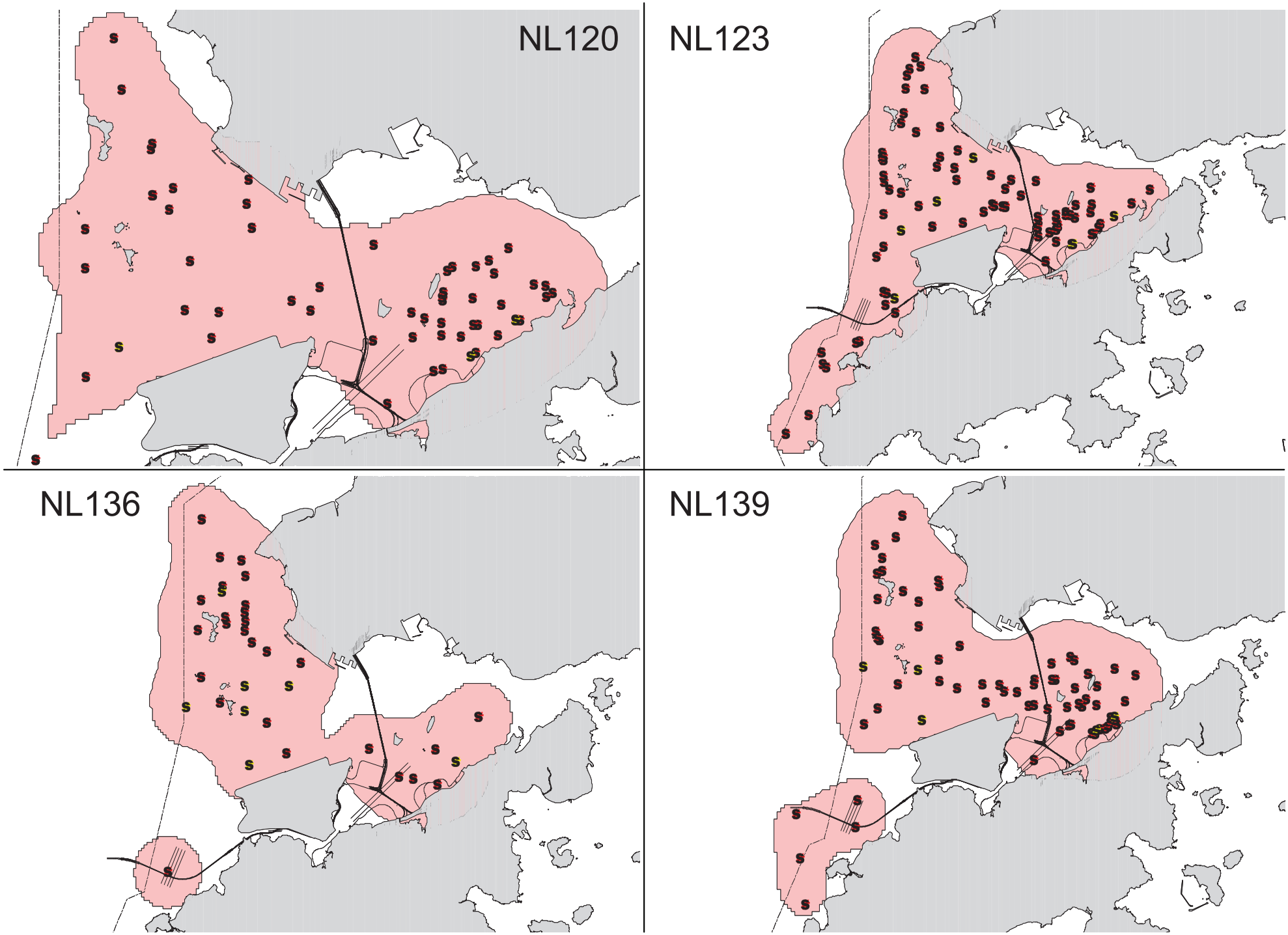
Appendix IV. (cont'd)



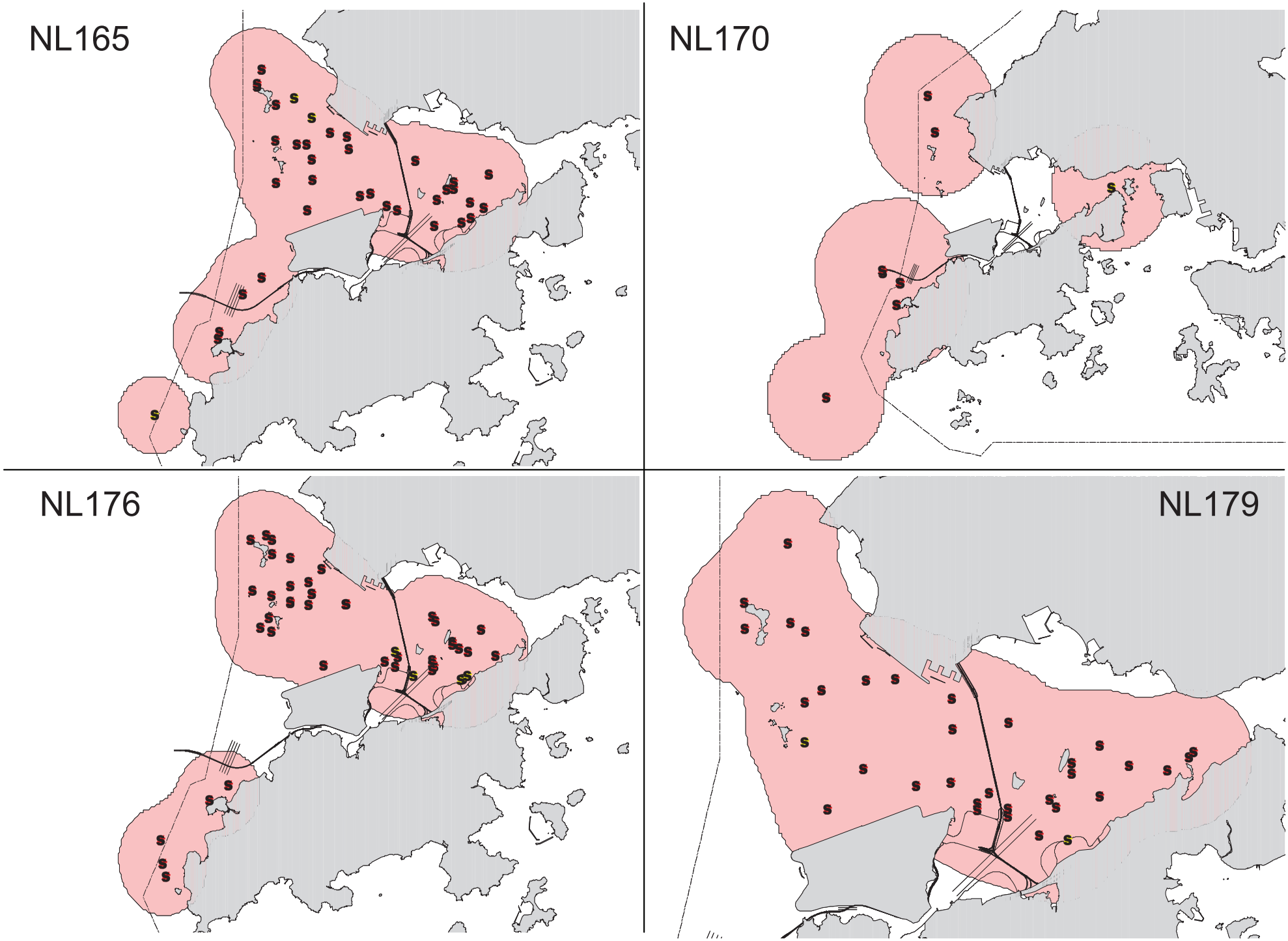
Appendix IV. (cont'd)



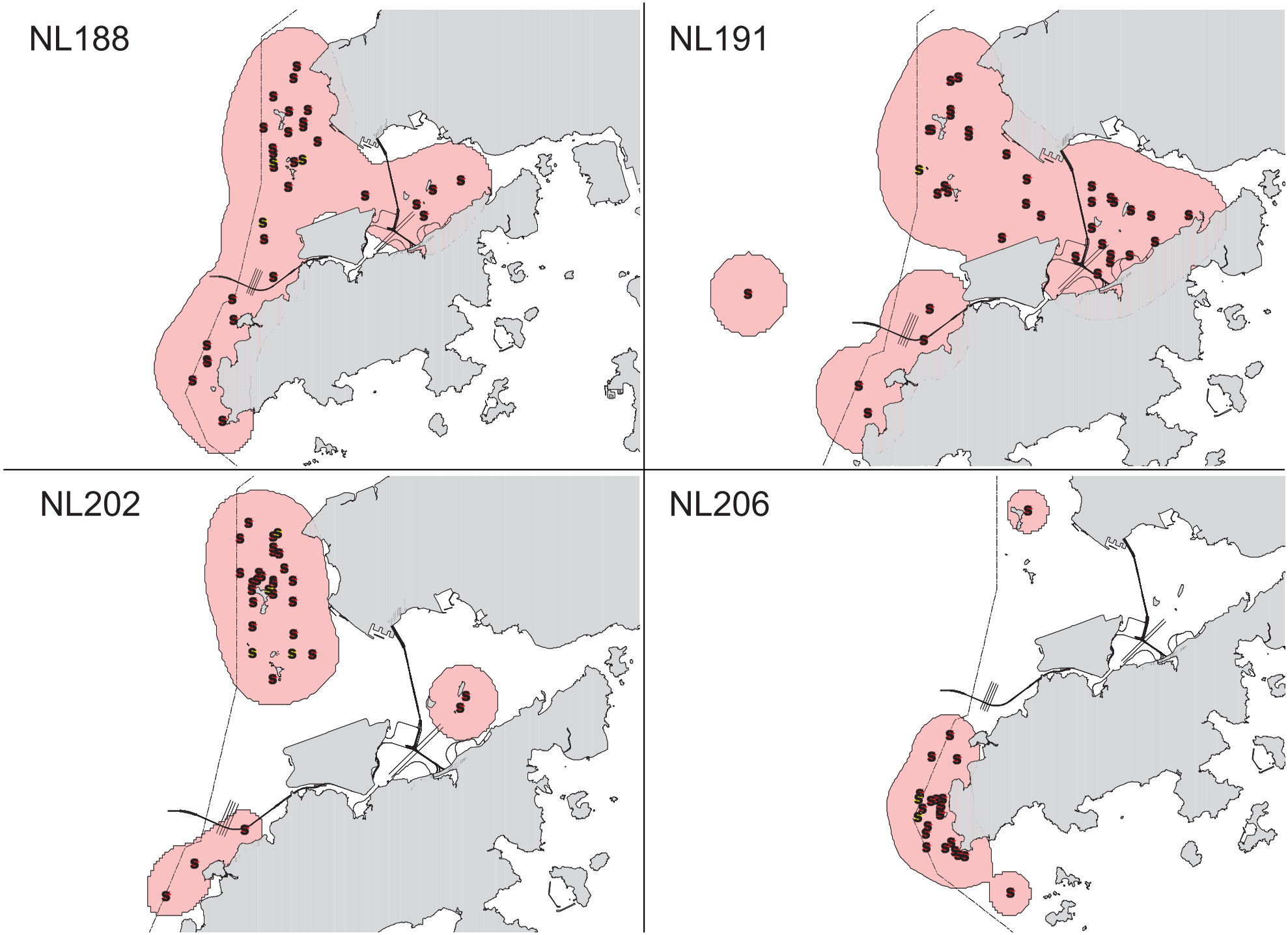
Appendix IV. (cont'd)



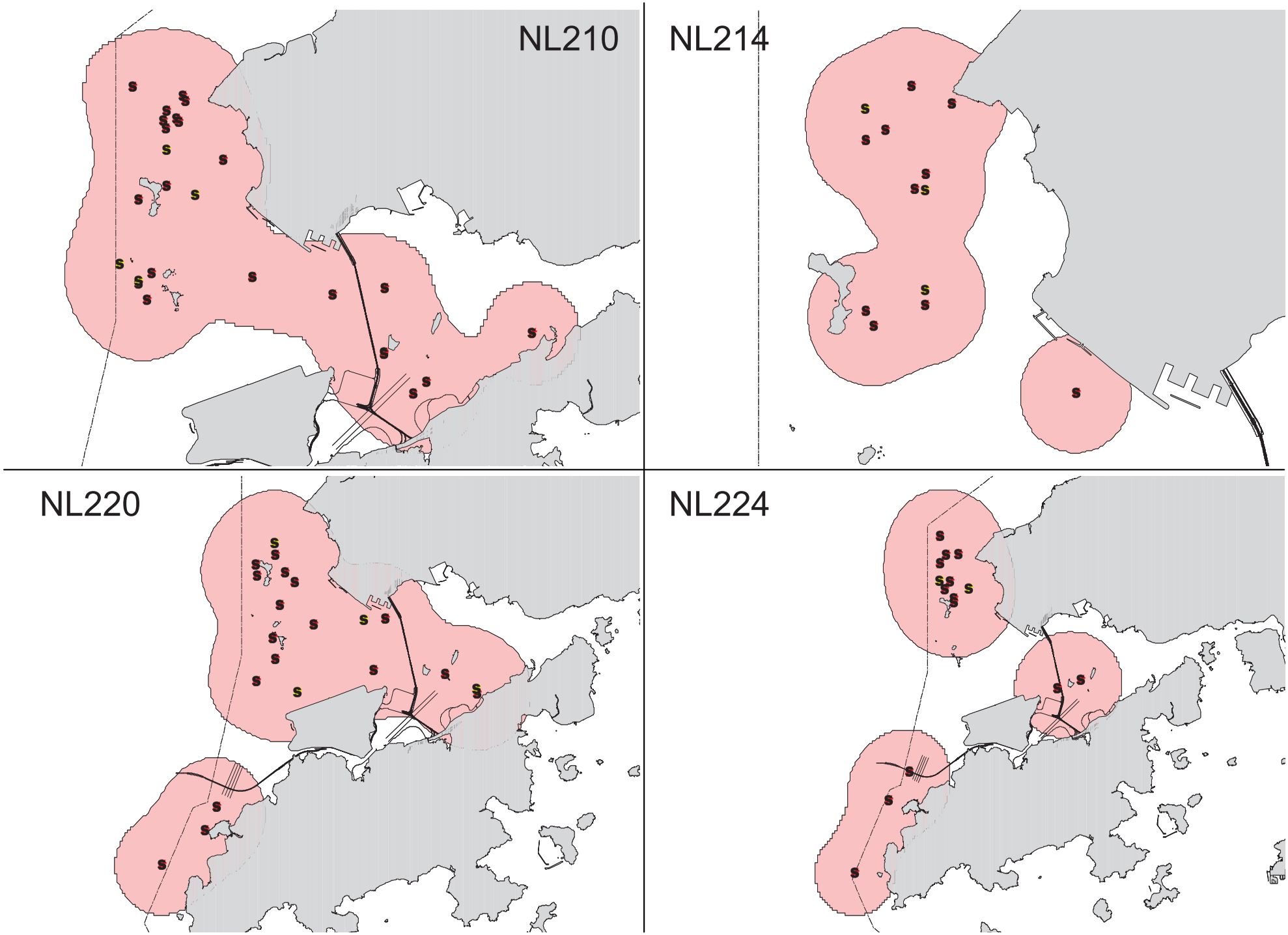
Appendix IV. (cont'd)



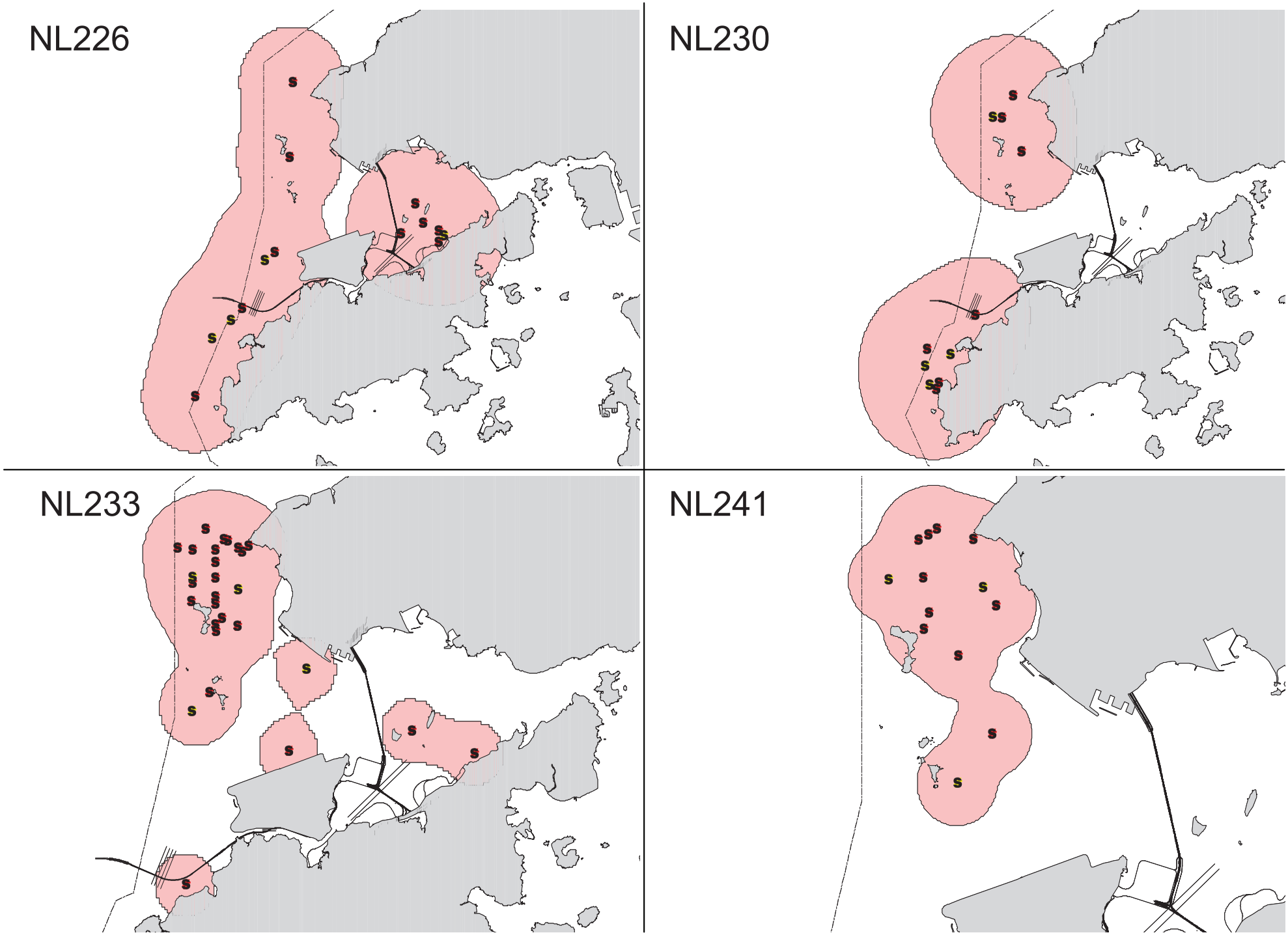
Appendix IV. (cont'd)



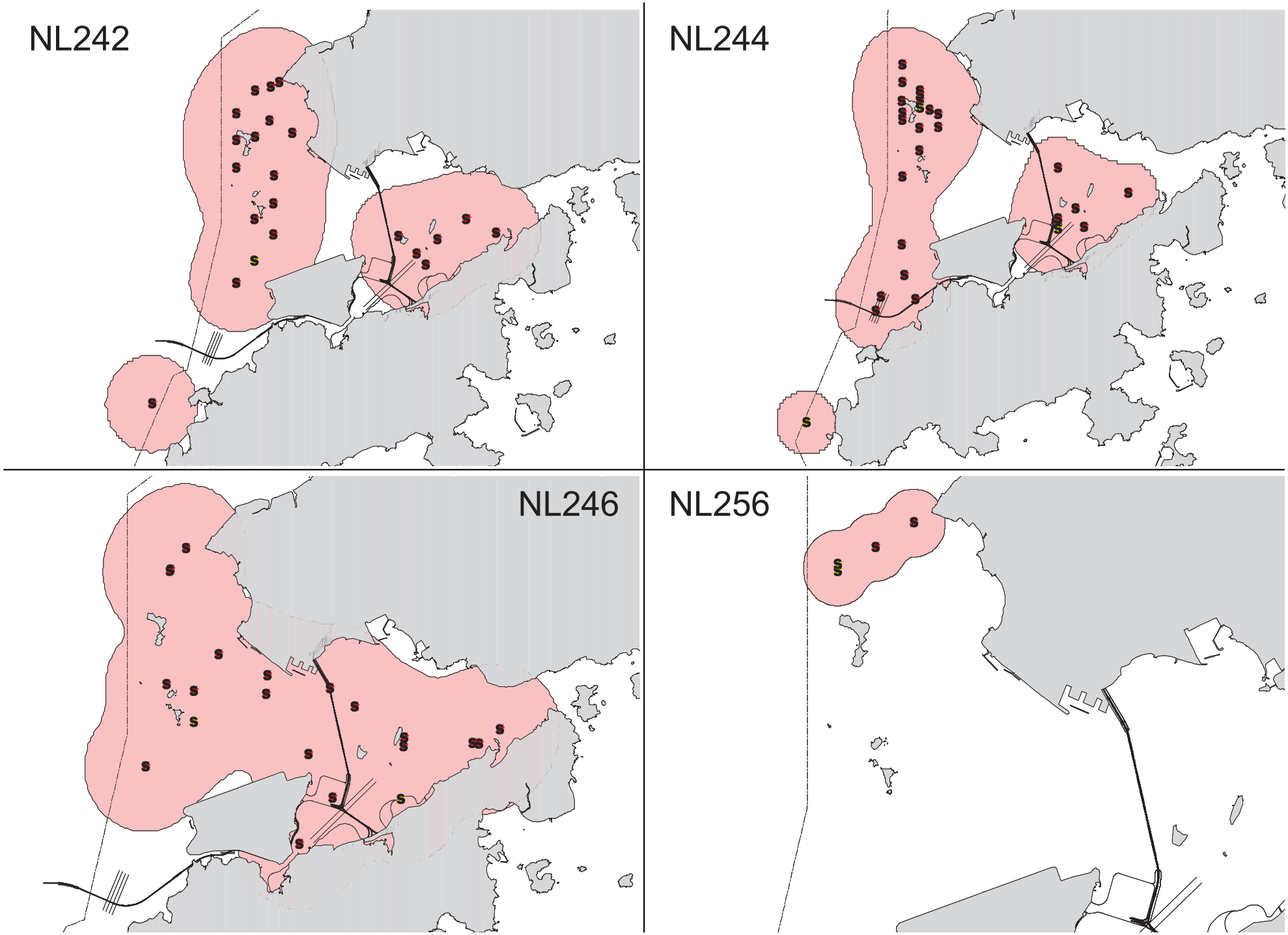
Appendix IV. (cont'd)



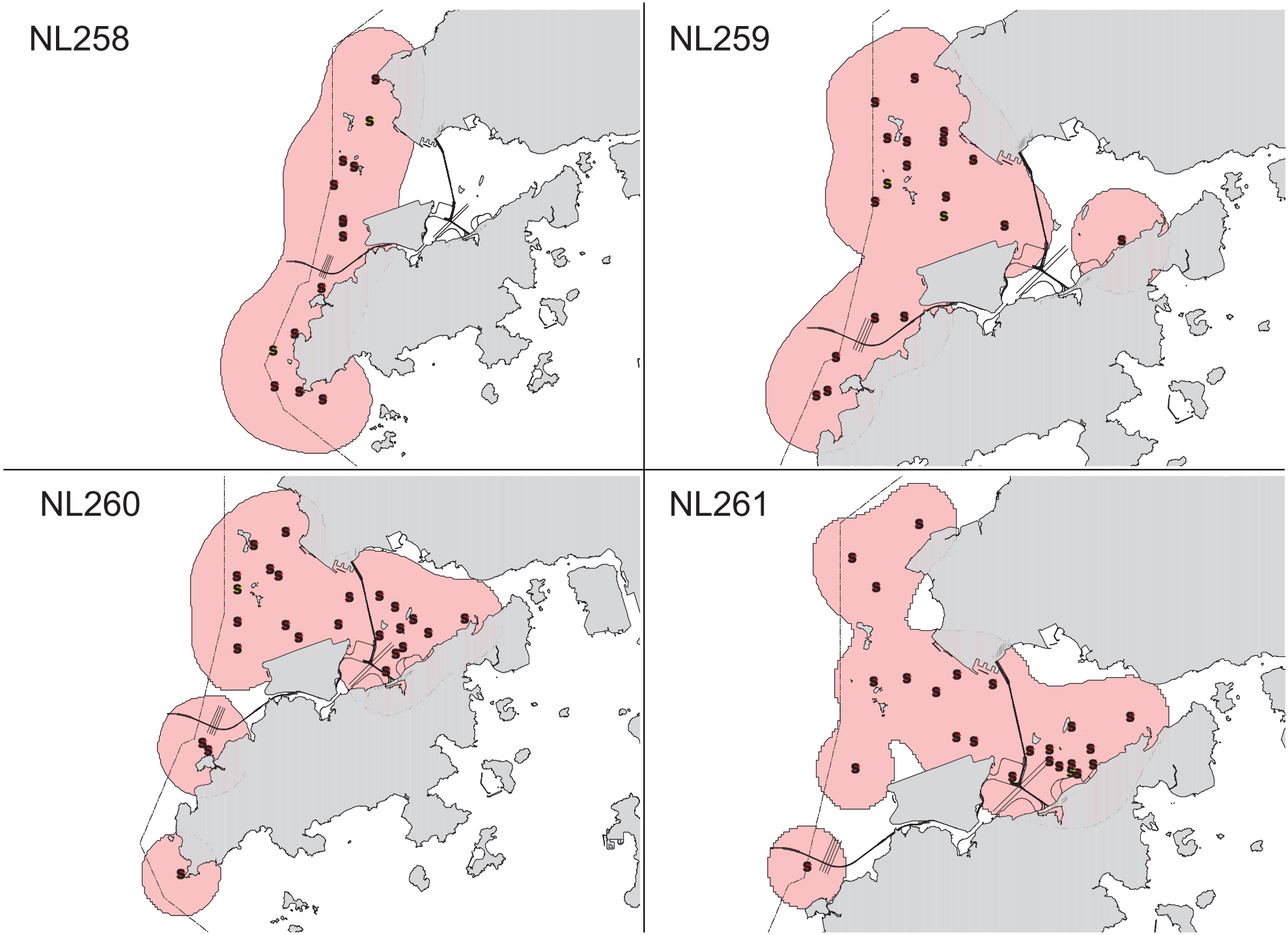
Appendix IV. (cont'd)



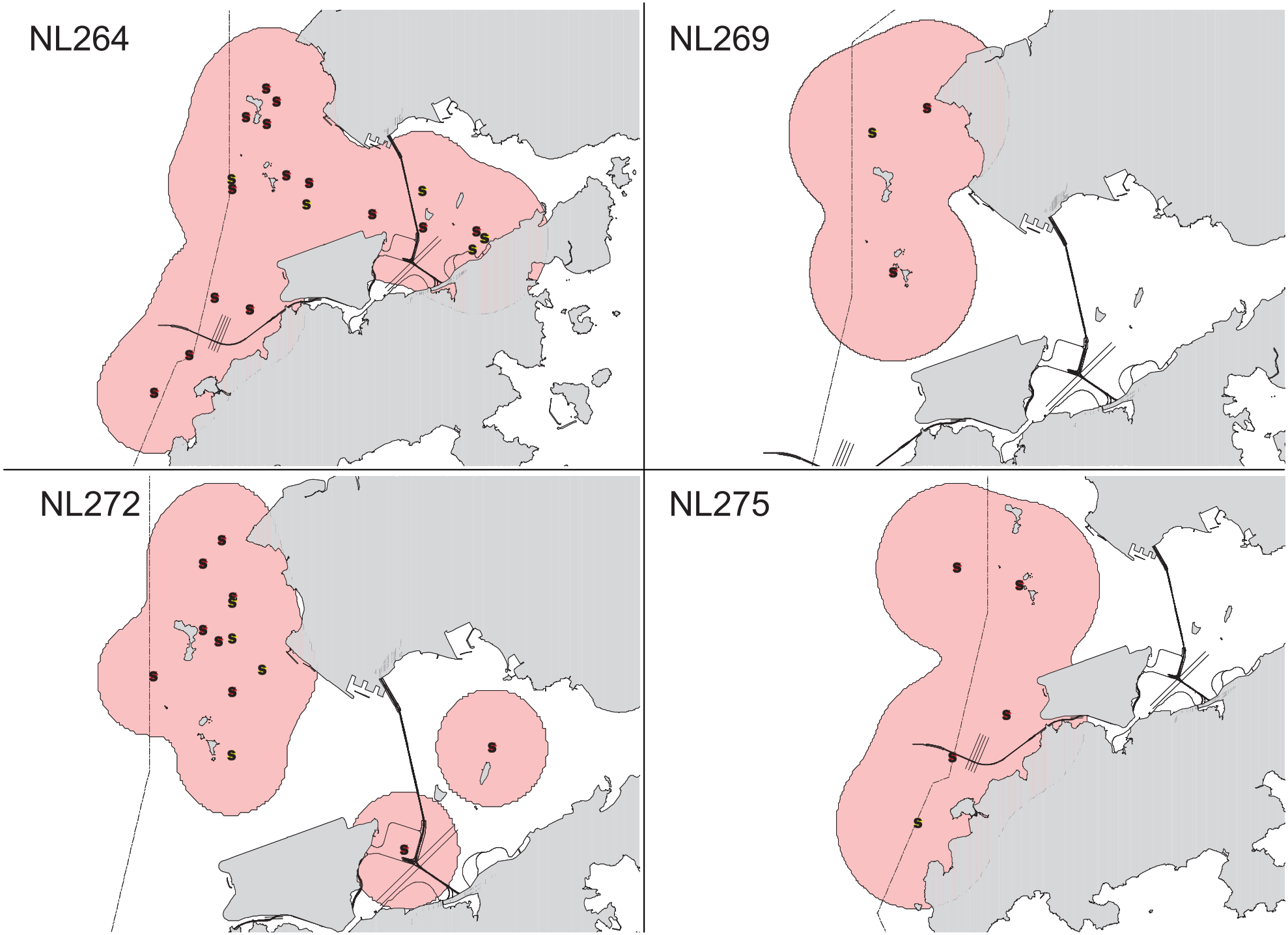
Appendix IV. (cont'd)



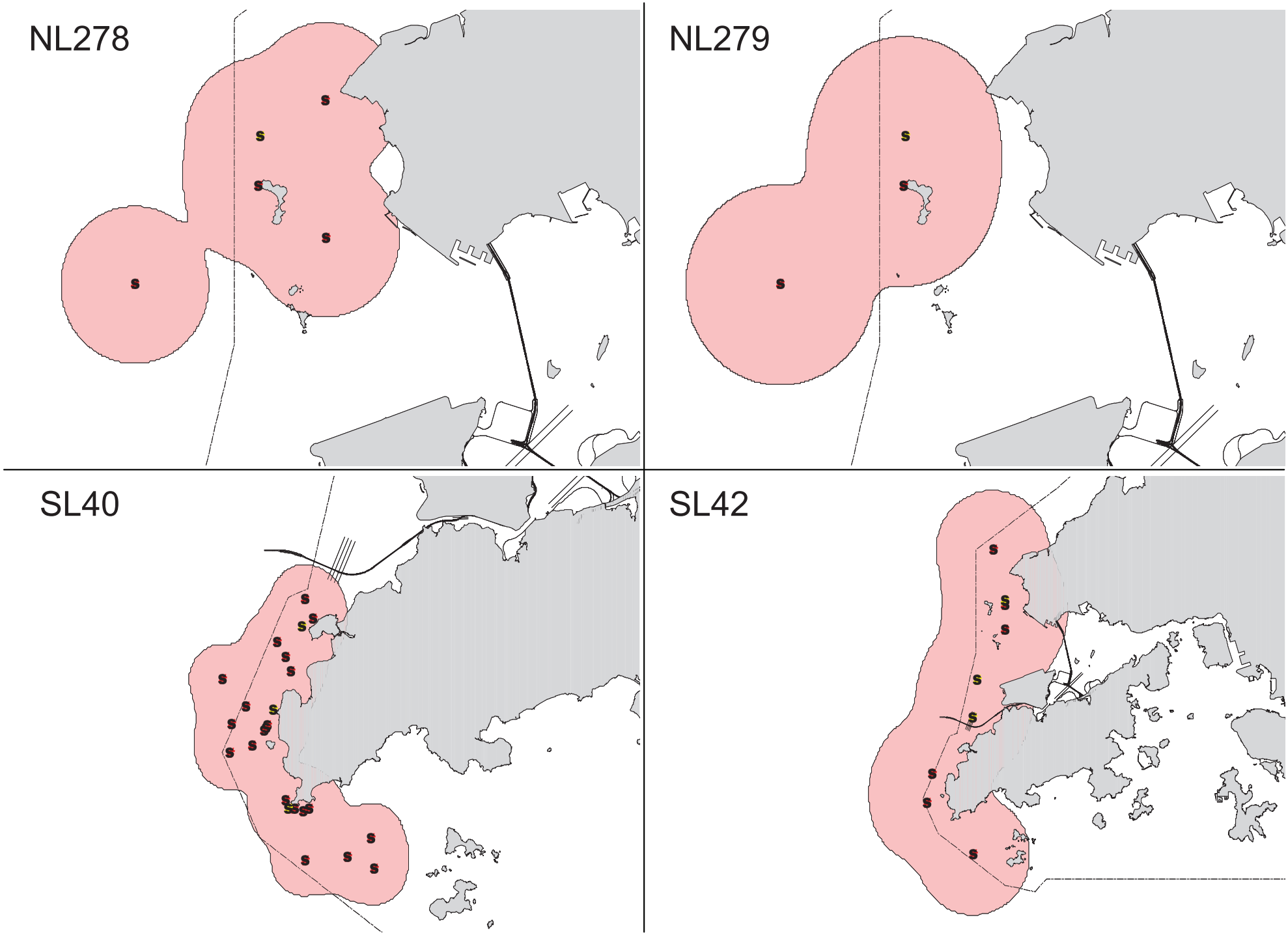
Appendix IV. (cont'd)



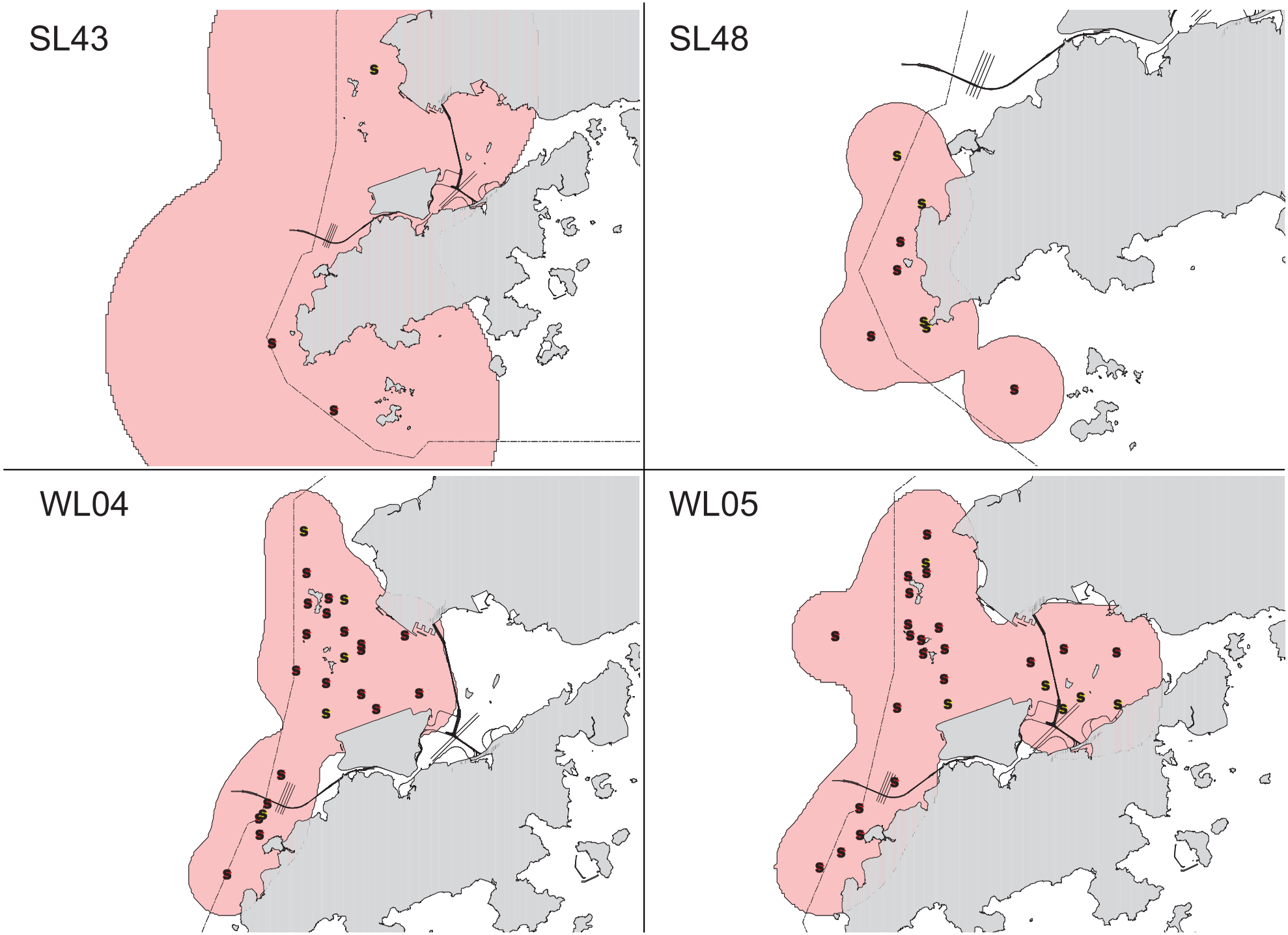
Appendix IV. (cont'd)



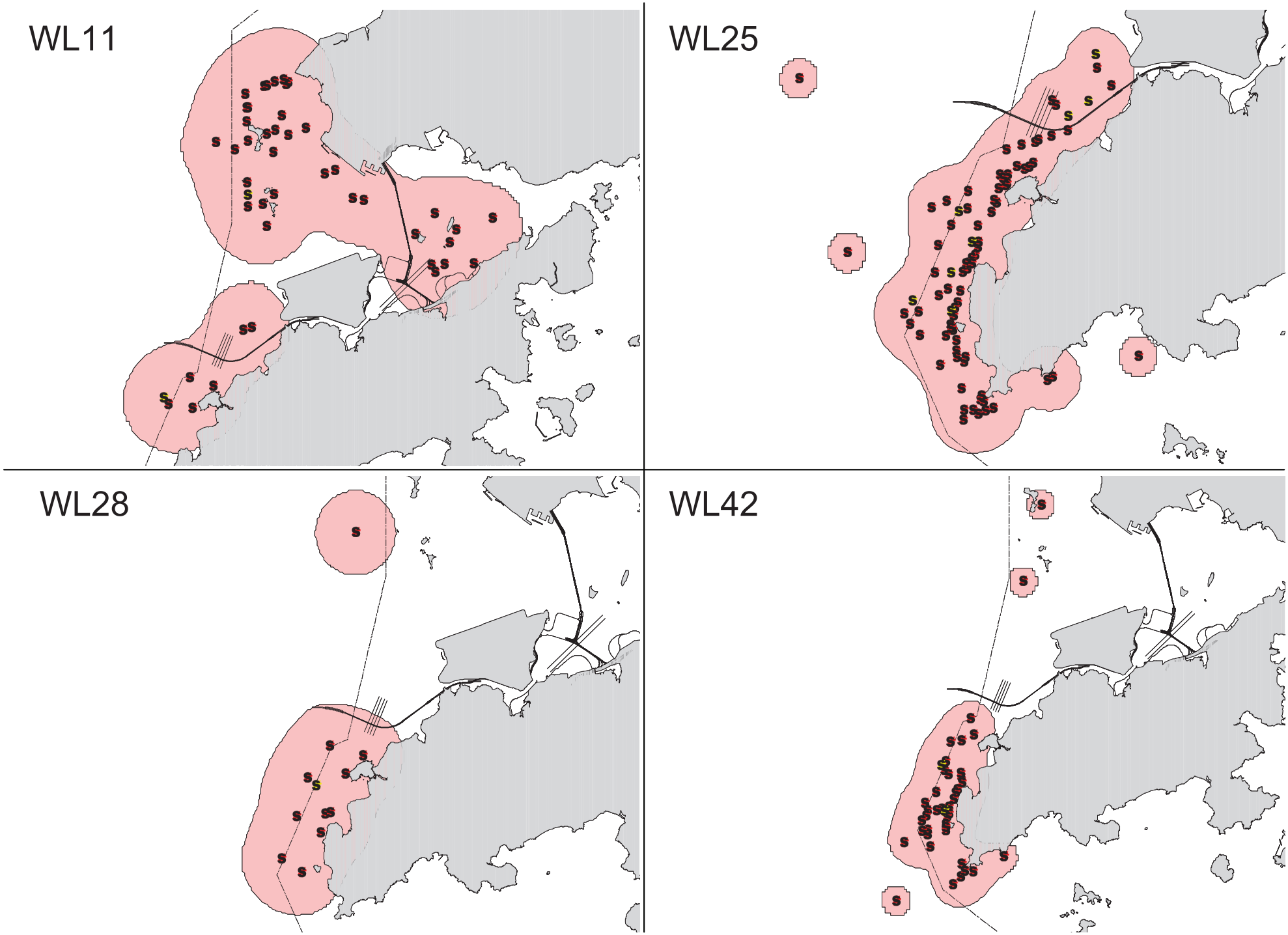
Appendix IV. (cont'd)



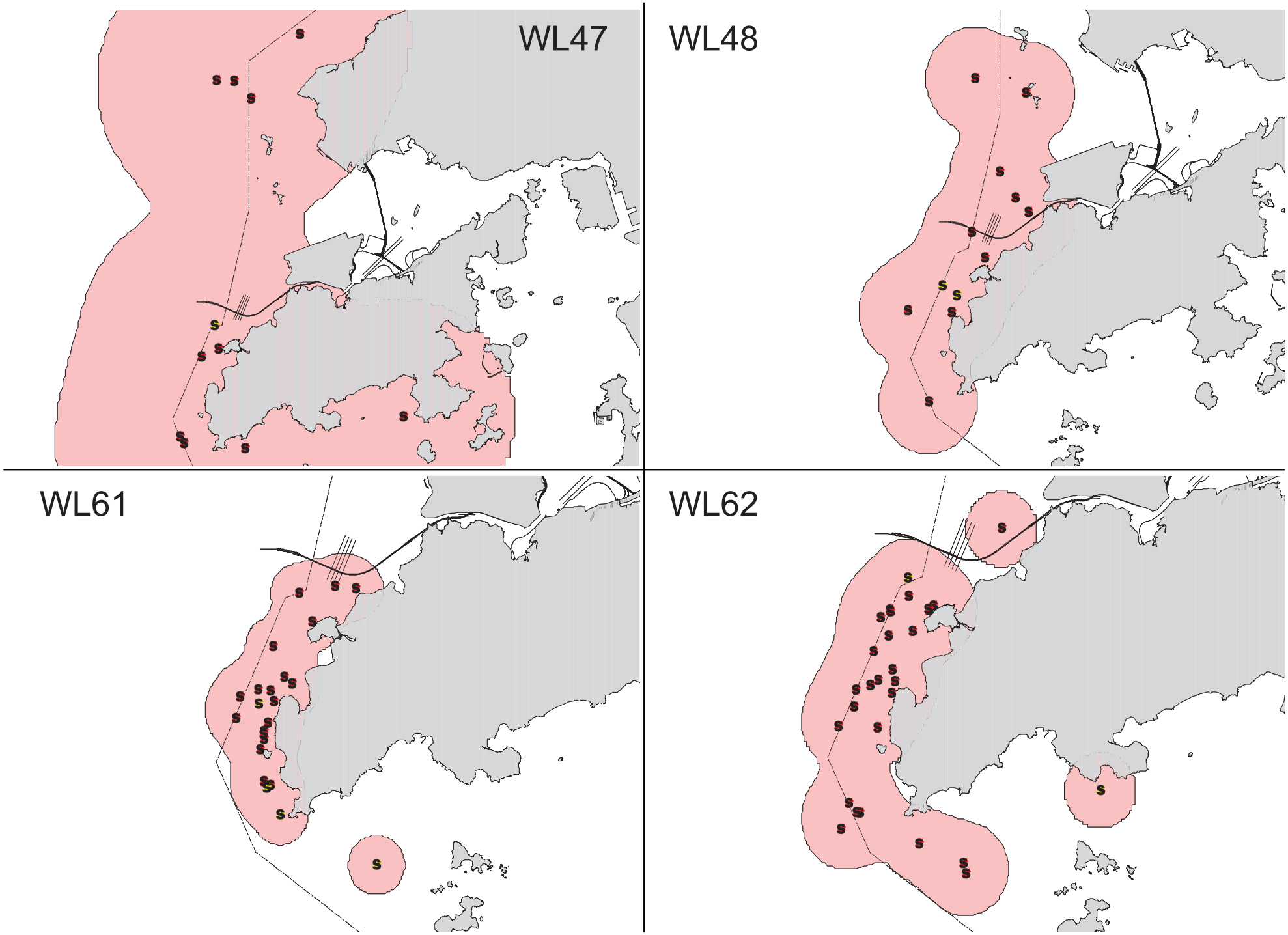
Appendix IV. (cont'd)



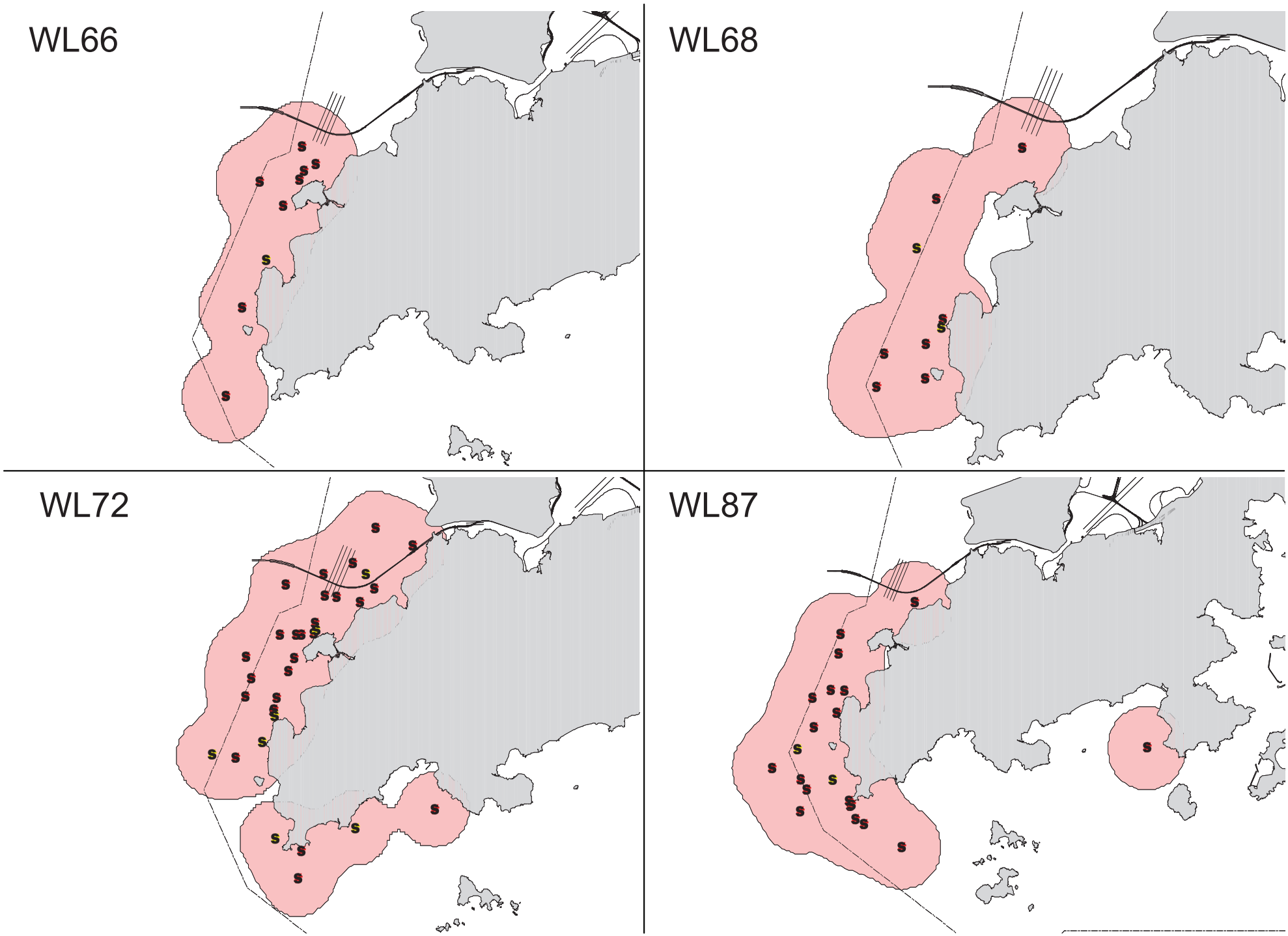
Appendix IV. (cont'd)



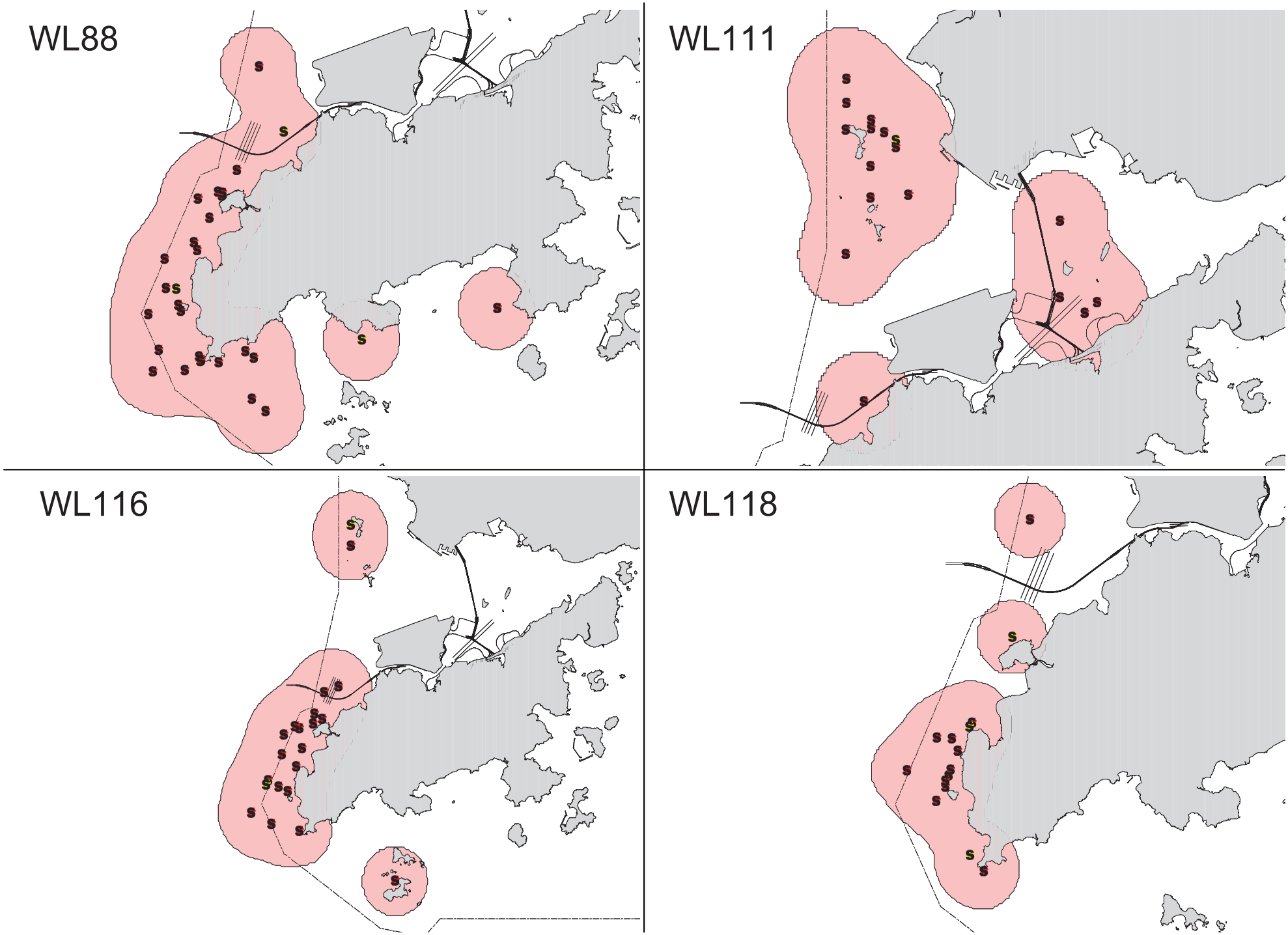
Appendix IV. (cont'd)



Appendix IV. (cont'd)



Appendix IV. (cont'd)



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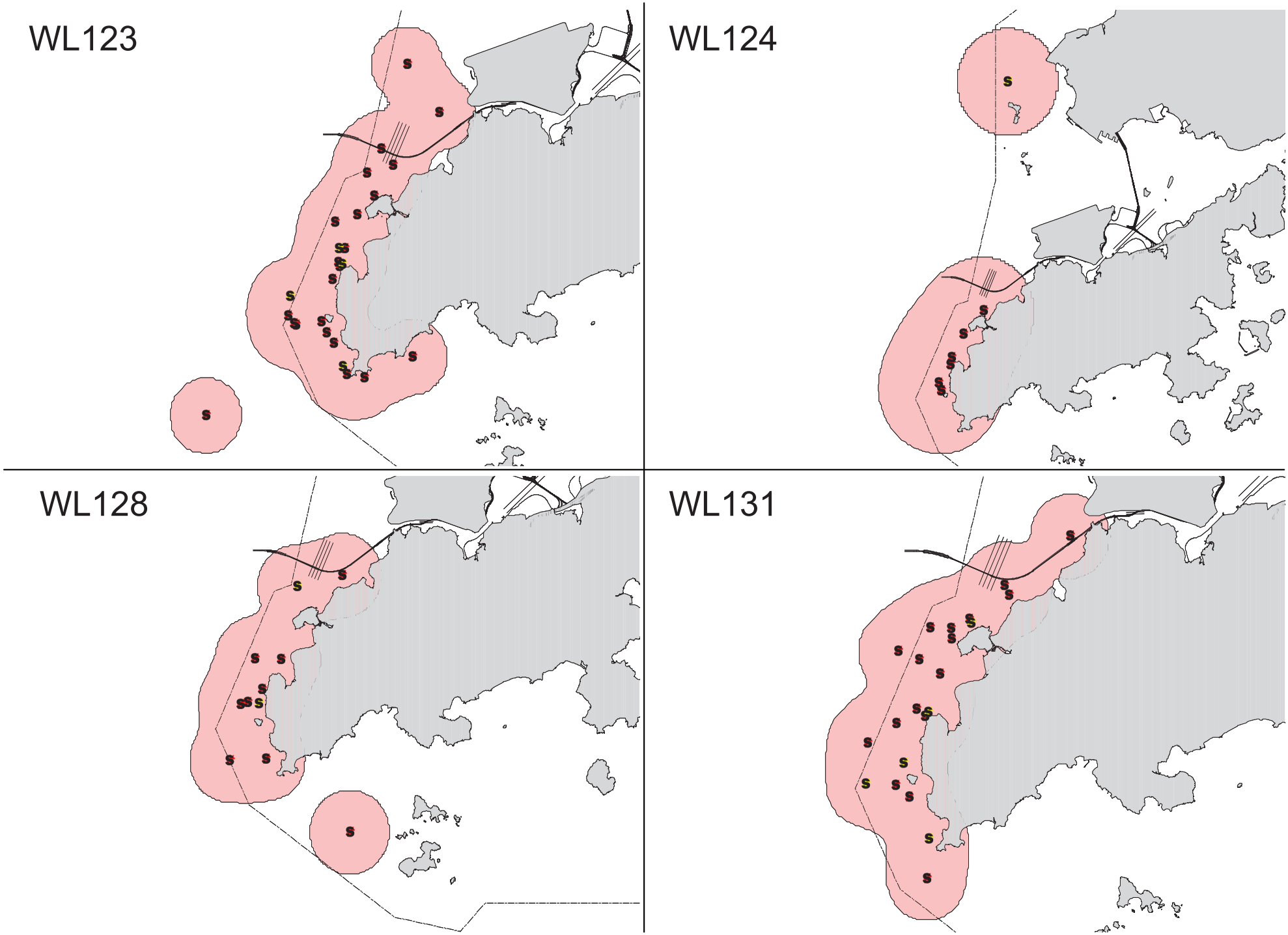

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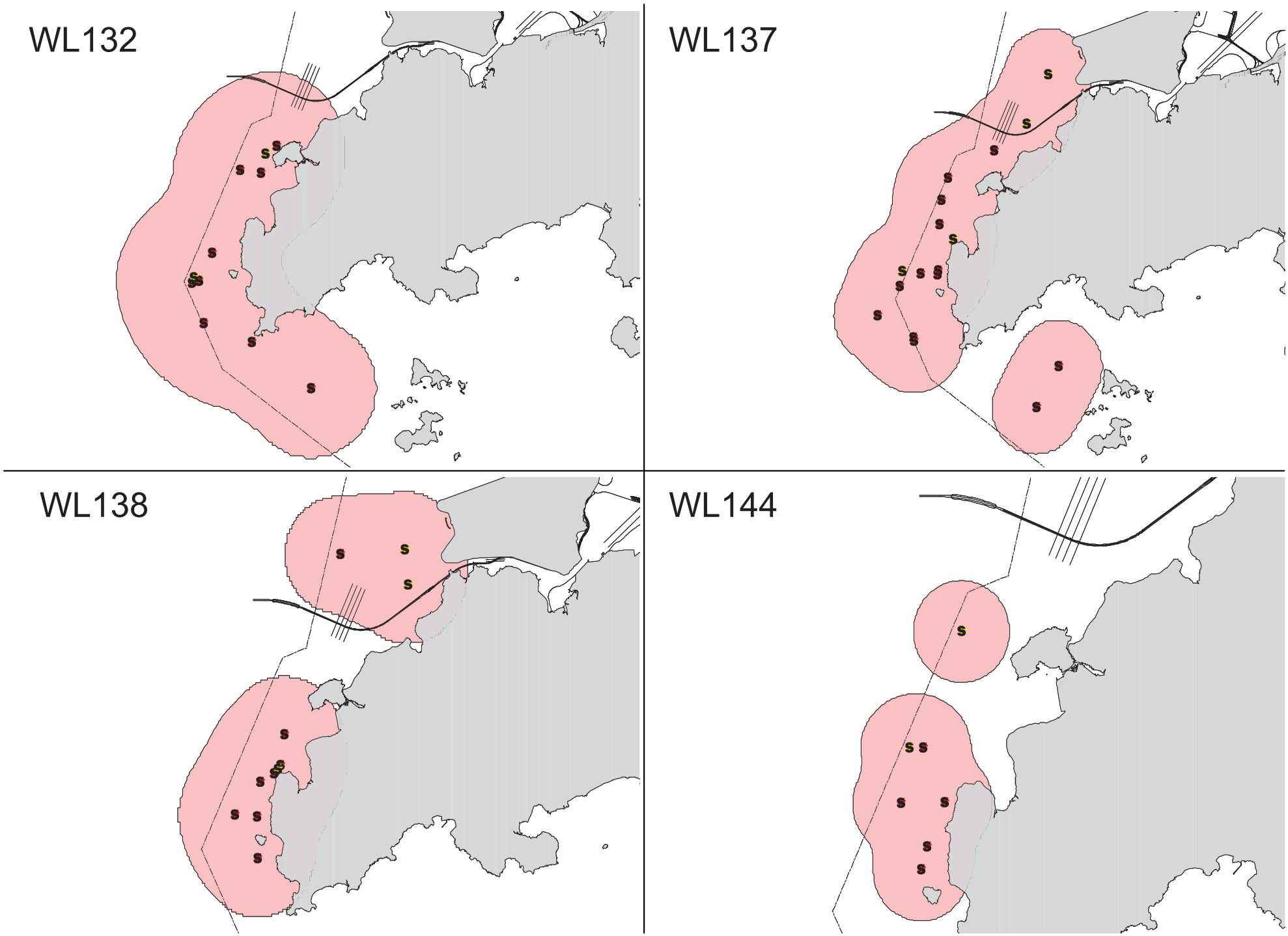

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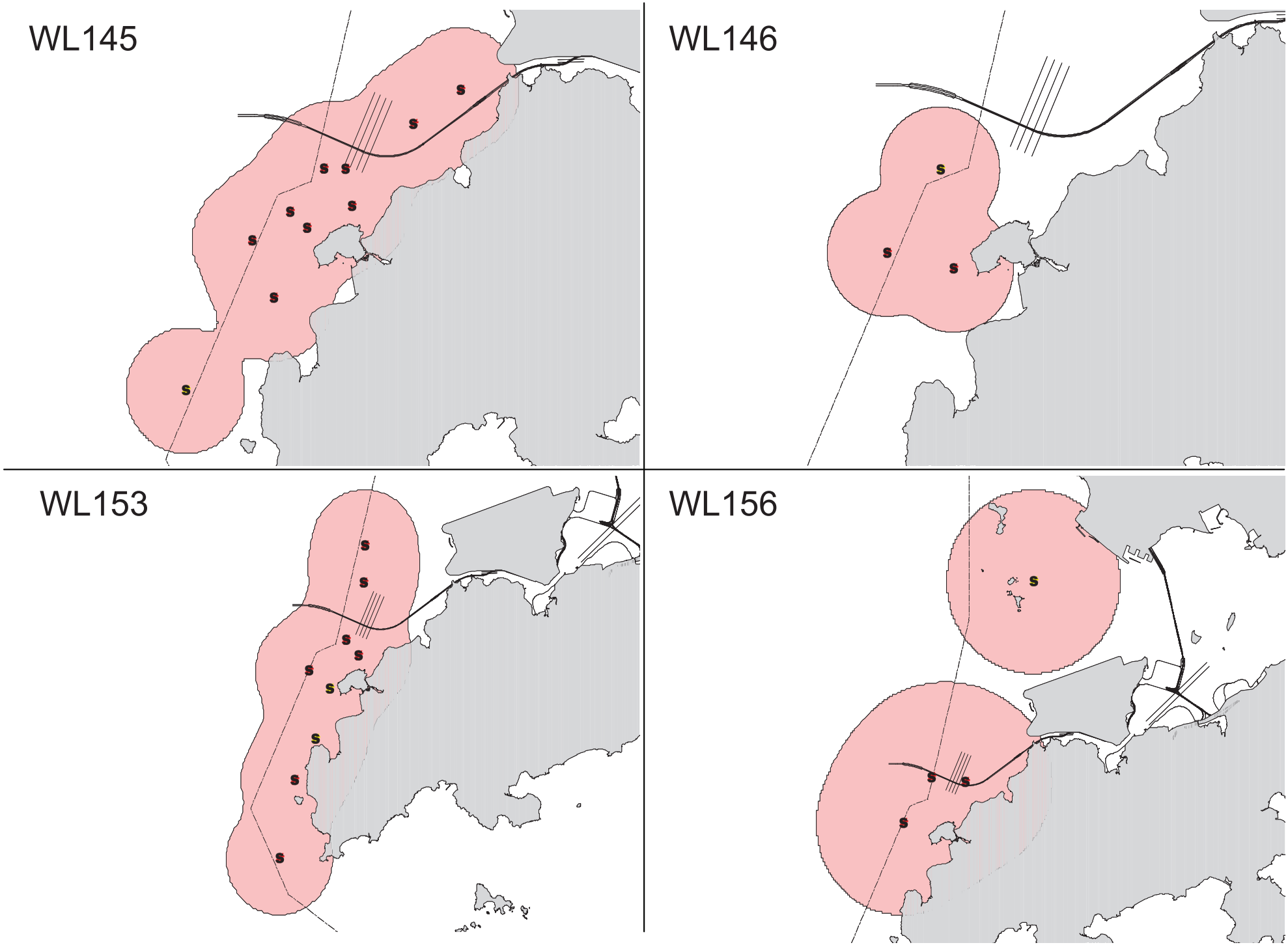

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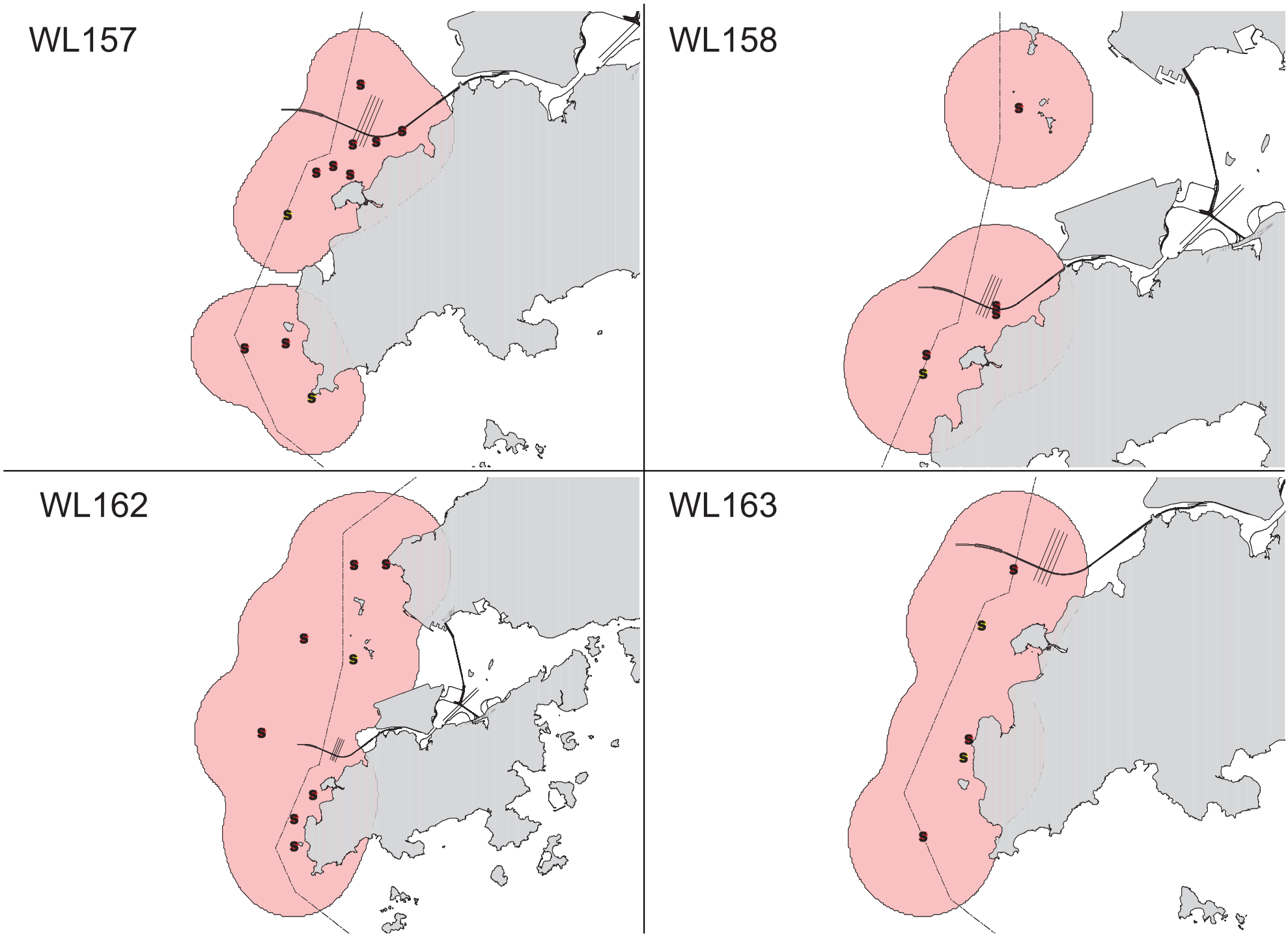

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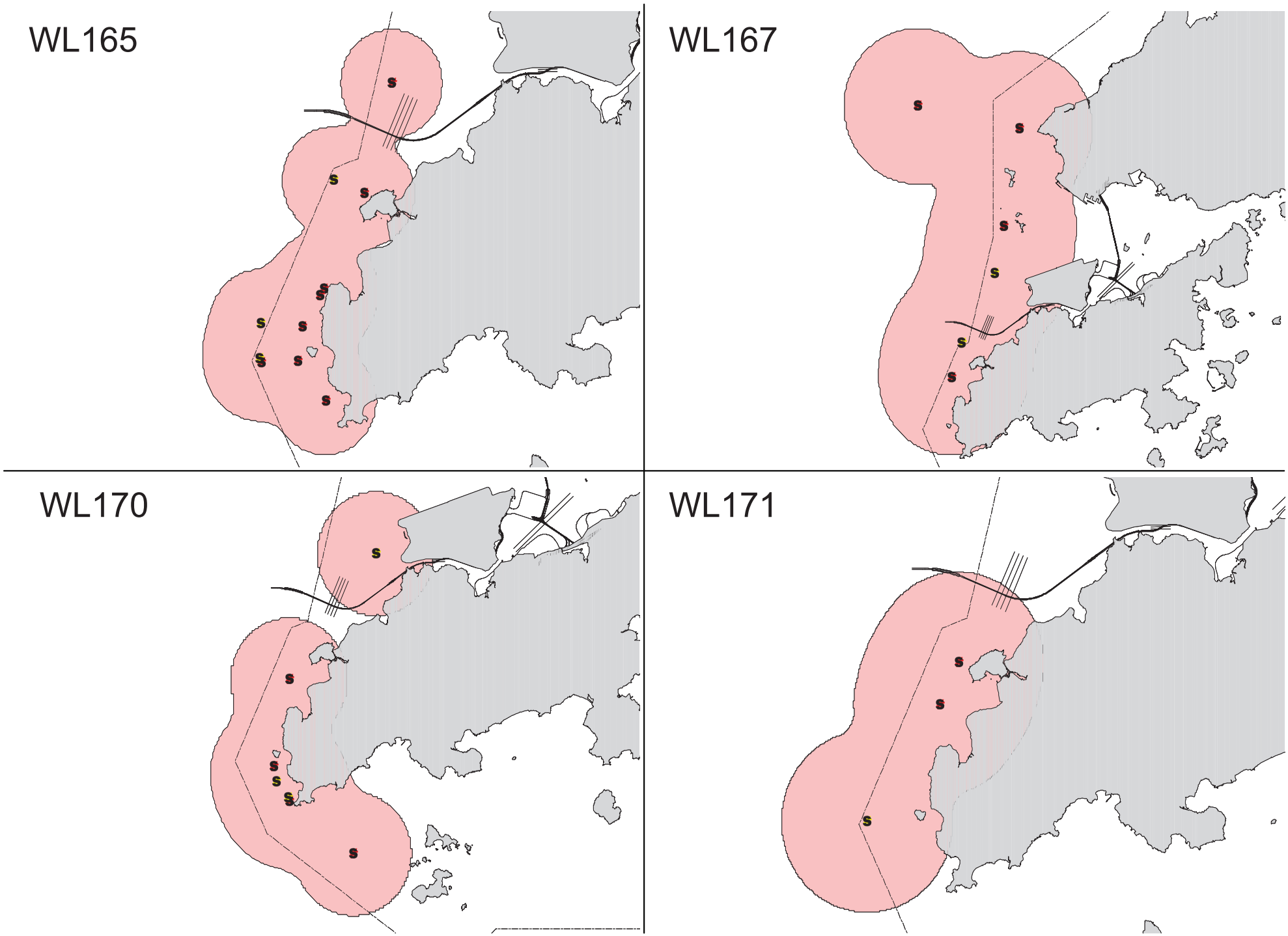

Appendix IV. (cont'd)