Ministry for Primary Industries
Manatū Ahu Matua

Marine high-risk site surveillance

Annual report for all ports and marinas 2012/2013 (Project 12099)

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Executive Summary

The Marine High-Risk Site Surveillance programme of targeted surveillance for marine non-indigenous species (NIS), delivered by the National Institute for Water and Atmospheric Research (NIWA) under contract to the Ministry for Primary Industries (MPI), is designed to detect the presence of a group of five primary and four secondary target non-indigenous or potentially invasive marine animals and plants that MPI have identified as presenting a significant risk of arriving and establishing in New Zealand. It also aims to monitor changes in the distribution of established marine non-indigenous or pest species.

This annual report details the targeted surveillance surveys in the 11 ports and marinas covered by the programme during the periods June - September 2012 (the Winter 2012 round of surveys) and November 2012 - March 2013 (the Summer 2012-2013 round).

Numbers of locations sampled met the target on all surveys. Numbers of specimens sent to the Marine Invasive Taxonomic Service (MITS) per survey ranged from none to 16, and the total numbers of specimens sent were 44 for the Winter 2012 round and 41 for the Summer 2012-2013 round. No primary target species were detected but all four secondary target species were:

- *Eudistoma elongatum* was recorded during the following surveys: Opua (Winter 2012, Summer 2012-2013), Whangarei (Winter 2012, Summer 2012-2013).
- *Musculista senhousia* was recorded during the following surveys: Auckland (Summer 2012-2013), Tauranga (Winter 2012), Whangarei (Winter 2012, Summer 2012-2013).
- *Sabella spallanzanii* was recorded during the following surveys: Auckland (Winter 2012, Summer 2012-2013), Lyttelton (Winter 2012, Summer 2012-2013), Whangarei (Winter 2012 – **range extension**, Summer 2012-2013).
- *Styela clava* was recorded during the following surveys: Auckland (Winter 2012, Summer 2012-2013), Dunedin (Winter 2012, Summer 2012-2013), Lyttelton (Winter 2012, Summer 2012-2013), Nelson (Winter 2012, Summer 2012-2013), Opua (Winter 2012, Summer 2012-2013), Wellington (Summer 2012-2013 – **range extension** but may have come off boat hull), Whangarei (Winter 2012, Summer 2012-2013).

MPI were informed of the range extensions at the time.

Eleven of the specimens sent to MITS from the Winter 2012 survey were NIS, including *Charybdis japonica* (Opua), *Grateloupia* sp. (Nelson), *Metapenaeus bennettae* (Whangarei), *Nassarius burchardi* (Whangarei), *Sabella spallanzanii* (Whangarei), *Styela clava* (Nelson) and *Undaria pinnatifida* (on a vessel in Opua). None of them were new records but *Charybdis* in Opua, *S. spallanzanii* in Whangarei and *Undaria* in Opua represent range extensions and were notified to MPI. *S. spallanzanii* had been detected on four fishing boats moored on Whangarei Wharves, Port Nikau by commercial divers in early April 2012 and, at the request of MPI and Northland Regional Council, additional sampling effort was allocated to this location during the Winter survey. The three specimens collected at this location during the survey were the first to be found on structures (as opposed to vessels) in Whangarei Harbour. During a shore search in Marsden Cove Marina, a single *S. spallanzanii* was recorded from another fishing boat. Additional dives were then done around this vessel and large numbers of *S. spallanzanii* were noted on the hull (two specimens were collected and sent to MITS), but none on the pontoons or other structures.

Twenty of the specimens sent to MITS from the Summer 2012-2013 survey were NIS, including *Grateloupia turuturu* (Lyttelton), *Sabella spallanzanii* (Lyttelton and Whangarei) and *Styela clava* (Wellington). *S. clava* had previously been recorded on the hulls of vessels in Clyde Quay Marina, Wellington (in 2007) but the present record (from Chaffers Marina) represents the first since then and consisted of two individuals found on the seabed. They were not attached to any substratum and may, therefore, have been dislodged from a vessel hull. *S. spallanzanii* was found during diver (five out of six dives) and shore searches (three out of ten searches) in Marsden Cove Marina, Whangarei Harbour, growing on pontoons, breakwalls and pilings. It was also found on five out of ten piles searched by divers at Port Nikau, Whangarei Harbour. The red alga *Schizymenia apoda* was provisionally identified from Dunedin, but confirmation of this identification requires molecular analysis. *S. apoda* was first identified in New Zealand from specimens collected from Wellington Harbour during the Winter 2009 survey, and is now widespread throughout that harbour. The eastern Australian penaeid prawn *Metapenaeus bennettae*, first recorded in the Waitemata Harbour in August 2009 and in Whangarei Harbour in February 2012, appears to be established in both locations.

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Introduction

The Marine High-Risk Site Surveillance programme of targeted surveillance for non-indigenous marine species is part of the Ministry for Primary Industries' (MPI) wider marine biosecurity programme. The targeted surveillance programme, currently delivered by NIWA under contract to MPI, repeats surveillance work developed and undertaken in 2002-2004, 2005-2006 and 2008-present, also by NIWA, at 11 major ports and marinas around the country (Figure 1). The surveillance is designed to detect the presence of a group of non-indigenous and potentially invasive marine flora and fauna that MPI have identified as presenting a significant risk of arriving and establishing in New Zealand. It also aims to allow changes in the distribution of established marine non-indigenous or pest species to be monitored. The majority of marine pests targeted by the surveillance programme are listed on the New Zealand register of Unwanted Organisms under the Biosecurity Act 1993.

This annual report details the targeted surveillance in the 11 ports and marinas covered by the programme in the winter of 2012 and summer of 2012-2013.

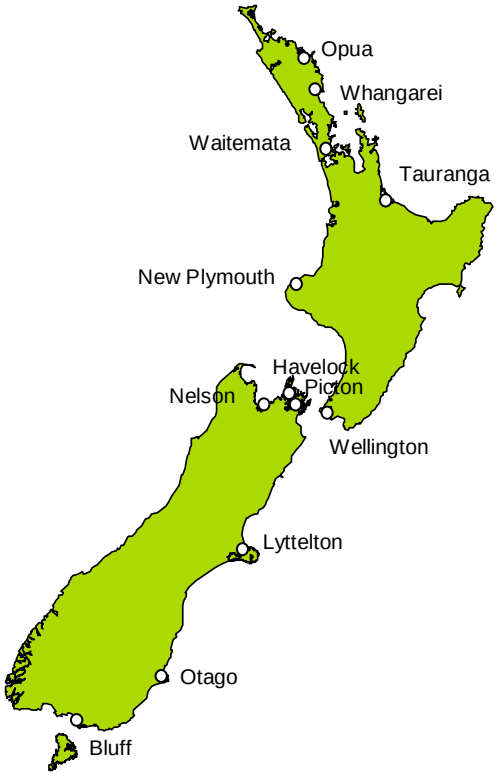

Figure 1 Locations of the 11 ports and marinas covered by the targeted surveillance programme.

OBJECTIVES OF THE MARINE HIGH-RISK SITE SURVEILLANCE PROGRAMME

The primary objective of the targeted surveillance programme is to detect incursions of five primary target marine species (see below).

The secondary objectives were to:

- Detect incursions of non-target non-indigenous or cryptogenic species not previously recorded in New Zealand
- Detect incursions of established non-indigenous or cryptogenic species which are exhibiting invasive characteristics (i.e. range extensions of established organisms)

TARGET SPECIES

MPI has identified five **primary target species** which are listed on the Unwanted Organisms register. These are:

1. the northern Pacific seastar *Asterias amurensis*
2. the European green crab *Carcinus maenas*
3. the green alga *Caulerpa taxifolia*
4. the Chinese mitten crab *Eriocheir sinensis*
5. the Asian clam *Potamocorbula amurensis*

Additionally, four **secondary target organisms**[1] are known to be established in New Zealand's coastal waters. These include:

1. the Australian droplet tunicate *Eudistoma elongatum*
2. the Asian date mussel *Musculista senhousia*
3. the Mediterranean fanworm *Sabella spallanzanii*
4. the clubbed tunicate *Styela clava*

Dates of surveys

The targeted surveillance surveys of the 11 ports and marinas covered by the programme took place during the periods May-September 2012 (the Winter 2012 round of surveys) and November 2012-March 2013 (the Summer 2012-2013 round). Dates for each survey are given in Table 1.

MPI Biosecurity New Zealand: contacts

The targeted marine surveillance programme is administered and funded by MPI's Biosecurity Surveillance Group. Queries relating to this programme should be directed to MPI.

The MPI contact person for all marine surveillance activity is Tim Riding (email tim.riding@mpi.govt.nz). Alternatively, the Biosecurity Surveillance Group Manager can be contacted at the following email address: NZBiosecuritySurveillance@mpi.govt.nz.

The surveillance team: contact person and personnel

The surveillance programme was designed by Graeme Inglis and Don Morrisey at NIWA, and implemented by the NIWA personnel.

[1] *Didemnum* sp. was removed from the list of secondary target species by MPI in December 2008 (email from Brendan Gould, MPIBNZ, to Don Morrisey, NIWA, 12 December 2008).

Table 1 Dates and contact person / field team leader for the Winter 2012 and Summer 2012-2013 surveys.

Port	Dates Winter 2012	Dates Summer 2012-2013
Auckland	30 July – 10 August 2012	12 – 23 November 2012
Bluff	11 – 15 June 2012	5 – 9 November 2012
Dunedin	28 May – 1 June 2012	4 – 8 March 2013
Lyttelton	10 – 14 September 2012	11 – 15 February 2013
Nelson	23 – 27 July 2012	26 – 30 November 2012
New Plymouth	21 – 25 May 2012	18– 22 March 2013
Opua	11 – 15 June 2012	3 – 7 December 2012
Picton / Havelock	13 – 17 August 2012	10 – 14 December 2012
Tauranga	3 – 7 September 2012	21 – 25 January 2013
Wellington	17 – 1 September 2012	18 – 22 February 2013
Whangarei	7 – 11 May 2012	4 – 8 February 2013

Results

SAMPLE COLLECTION

Sampling used a variety of techniques designed to sample a range of habitat types encompassing soft and hard surface habitats such as mud and gravel bottoms, intertidal rocky shores, and artificial structures, including marina pontoons, pilings, moorings, jetties and commercial vessel berths. The sampling techniques used were: crab condo lines, crab box traps, epibenthic sled tows, and diver and shore searches. The habitats and species targeted by each sampling technique are shown in Appendix 1 (appendices are in a separate volume).

Total numbers of locations surveyed in each survey round (Winter 2012 and Summer 2012-2013) in each port are shown in Table 2. Numbers of locations sampled met the target on all surveys. Numbers of locations sampled with each method in each port are shown in Appendix 2, by sampling round. The sample locations for each technique are shown in Appendix 3.

Additional dive searches (target total 45) and shore searches (target total 45) were made during the Winter 2012 and Summer 2012-2013 surveys of Tauranga. These searches formed part of the biosecurity monitoring programme for the response to the grounding of the container ship *Rena* on Astrolabe Reef in October 2011.

Four additional dive searches were made in Marsden Cove Marina, Whangarei during the Winter 2012 survey, in response to the detection of *Sabella spallanzanii* on the hull of a vessel in the marina during a shore search. Another four additional dive searches were made on piles and five extra sled tows were done around Port Nikau, Whangarei Harbour after the recent discovery of *S. spallanzanii* on vessels on the wharf (see under *Sabella spallanzanii*, below). These extra locations were:

- Dives:
    - 15256 – 35° 44.327 S 174° 20.508 E, around an old barge on the Hatea River
    - Extra 15257 – 35° 44.651 S 174° 20.903 E and Extra 15258 – 35° 44.820 S 174° 20.924 E, ship repair area

- Extra 15259 – 35° 45.397 S 174° 20.959 E, Main One at Port Nikau
- Extra 15260 – 35° 45.416 S 174° 20.970 E, under two fishing vessels

- Benthic sleds (as close a practically possible to Main Wharves One and Two at Port Nikau:
  - 15251 – 35° 45.387 S 174° 20.955 E,
  - 15252 – 35° 45.384 S 174° 20.957 E,
  - 15253 – 35° 45.439 S 174° 20.957 E,
  - 15254 – 35° 45.472 S 174° 20.993 E
  - 15255 – 35° 45.414 S 174° 20.997 E

Sample locations for crab box trap lines, epibenthic tows, and diver searches were pre-assigned prior to the survey by using a grid overlaid on the survey area in GIS. Where a pre-allocated sampling point was not accessible at the time the survey was done (for example, because a berth was occupied by a vessel), the sample was moved to a nearby location and the new coordinates recorded on the data sheet (or notepad computer, as appropriate). Field teams also noted any sampling locations that were not appropriate so that these could be removed from the grid of potential sampling locations for future surveys. Such locations included areas where high vessel traffic makes diving too hazardous or deployment of traps impossible, areas that are not suitable for trapping because they dry at low tide, and cable zones and other restricted areas.

Table 2 Summary of target and achieved numbers of locations sampled in each port in each survey.

Location	Sampling round	Target number of locations	Actual number of locations	% of target achieved
Auckland	Winter 2012	486	492	101
	Summer 2012-2013	486	497	102
Bluff	Winter 2012	243	243	100
	Summer 2012-2013	243	243	100
Dunedin	Winter 2012	243	243	100
	Summer 2012-2013	243	243	100
Lyttelton	Winter 2012	243	243	100
	Summer 2012-2013	243	243	100
Nelson	Winter 2012	243	248	102
	Summer 2012-2013	243	243	100
New Plymouth	Winter 2012	243	244	100
	Summer 2012-2013	243	244	100
Opua	Winter 2012	243	252	104
	Summer 2012-2013	243	248	102
Picton / Havelock	Winter 2012	243	242	100
	Summer 2012-2013	243	243	100
Tauranga	Winter 2012	278	284	102
	Summer 2012-2013	278	291	105
Wellington	Winter 2012	243	243	100
	Summer 2012-2013	243	242	100
Whangarei	Winter 2012	243	262	108
	Summer 2012-2013	243	252	104

TARGET SPECIES COLLECTION

Primary target species detected[1]: None

Secondary target species detected[2]:*Eudistoma elongatum*, *Musculista senhousia*, *Sabella spallanzanii* and *Styela clava* were recorded during both rounds of surveys (see below)

[1] *Asterias amurensis*, *Carcinus maenas*, *Caulerpa taxifolia*, *Eriocheir sinensis*, *Potamocorbula amurensis*
[2] *Eudistoma elongatum*, *Musculista senhousia*, *Sabella spallanzanii*, *Styela clava*

- *Eudistoma elongatum* was recorded during the following surveys: Opua (Winter 2012, Summer 2012-2013), Whangarei (Winter 2012, Summer 2012-2013).
- *Musculista senhousia* was recorded during the following surveys: Auckland (Summer 2012-2013), Tauranga (Winter 2012), Whangarei (Winter 2012, Summer 2012-2013).
- *Sabella spallanzanii* was recorded during the following surveys: Auckland (Winter 2012, Summer 2012-2013), Lyttelton (Winter 2012, Summer 2012-2013), Whangarei (Winter 2012 – **range extension**, Summer 2012-2013).
- *Styela clava* was recorded during the following surveys: Auckland (Winter 2012, Summer 2012-2013), Dunedin (Winter 2012, Summer 2012-2013), Lyttelton (Winter 2012, Summer 2012-2013), Nelson (Winter 2012, Summer 2012-2013), Opua (Winter 2012, Summer 2012-2013), Wellington (Summer 2012-2013 – **range extension** but may have come off boat hull: see *Styela clava*, below), Whangarei (Winter 2012, Summer 2012-2013).

NUMBER OF SPECIMENS COLLECTED AND SENT TO MITS

Numbers of specimens sent to MITS per survey ranged from none to 16, and the total numbers of specimens sent were 44 for the Winter 2012 round and 41 for the Summer 2012-2013 round (Table 3 and Table 4).

Eleven of the specimens sent to MITS from the Winter 2012 survey were NIS (Table 5), including *Charybdis japonica* (Opua), *Grateloupia* sp. (Nelson), *Metapenaeus bennettae* (Whangarei), *Nassarius burchardi* (Whangarei), *Sabella spallanzanii* (Whangarei), *Styela clava* (Nelson) and *Undaria pinnatifida* (on a vessel in Opua). None of them were new records but *Charybdis* in Opua, *Sabella* in Whangarei and *Undaria* in Opua represent range extensions and were notified to MPI.

Twenty of the specimens sent to MITS from the Summer 2012-2013 survey were NIS (Table 6), including *Grateloupia turuturu* (Lyttelton), *Sabella spallanzanii* (Lyttelton and Whangarei) and *Styela clava* (Wellington). *S. clava* had previously been recorded on the hulls of vessels in Clyde Quay Marina, Wellington (in 2007) but the present record (from Chaffers Marina) represents the first since then and consisted of two individuals found on the seabed. They were not attached to any substratum and may, therefore, have been dislodged from a vessel hull. *S. spallanzanii* was found during diver (five out of six dives) and shore searches (three out of ten searches) in Marsden Cove Marina, Whangarei Harbour, growing on pontoons, breakwalls and pilings. It was also found on five out of ten piles searched by divers at Port Nikau, Whangarei Harbour. The red alga *Schizymenia apoda* was provisionally identified from Dunedin, but confirmation of this identification requires molecular analysis. *S. apoda* was first identified in New Zealand from specimens collected from Wellington Harbour during the Winter 2009 survey, and is now widespread throughout that harbour. The type locality for *S. apoda* is in South Africa and it has also been recorded from the Azores, China and Korea. The eastern Australian penaeid prawn *Metapenaeus bennettae*, first recorded in the Waitemata Harbour in August 2009 and in Whangarei Harbour in February 2012, appears to be established in both locations.

Table 3 Summary of numbers and types of specimens collected and sent to MITS during the Winter 2012 round of surveys.

Port	Auckland	Bluff	Lyttelton	Nelson	New Plymouth	Opua	Otago	Picton / Havelock	Tauranga	Wellington	Whangarei	Total	% of total
Algae		1		1		1					1	4	9.1
Amphipods												0	0
Ascidians	2				1			2				5	11.4
Barnacles						3						3	6.8
Bivalves						3		2			2	7	15.9
Bryozoans												0	0
Crabs	1			1	1	3					2	8	18.2
Decapods	1								1		3	5	11.4
Echinoderms								2				2	4.5
Fish							1					1	2.3
Gastropods											3	3	6.8
Hydroids												0	0.0
Nudibranchs			1									1	2.3
Sea anemones												0	0
Sponges												0	0
Worms											5	5	11.4
Total	4	1	1	2	2	10	1	6	1	0	16	44	100.0

Table 4 Summary of numbers and types of specimens collected and sent to MITS during the Summer 2012-2013 round of surveys.

Port	Auckland	Bluff	Lyttelton	Nelson	New Plymouth	Opua	Otago	Picton / Havelock	Tauranga	Wellington	Whangarei	Total	% of total
Algae			3				3					6	14.6
Amphipods												0	0
Ascidians					1					8		9	22.0
Barnacles												0	0
Bivalves						1				1		2	4.9
Bryozoans							2			1		3	7.3
Crabs										1	1	2	4.9
Decapods						2					3	5	12.2
Echinoderms												0	0
Fish												0	0
Gastropods												0	0
Hydroids							1	1		2		4	9.8
Nudibranchs												0	0
Sea anemones												0	0
Sponges										1		1	2.4
Worms			5							1	3	9	22.0
Total	0	0	8	0	1	3	6	1	0	15	7	41	100.0

Table 5 Specimens collected and sent to MITS from each port during the Winter 2012 survey (non-indigenous species in bold type).

Taxonomic group	Species	Sample number	MITS code	Date	Location	Method
AUCKLAND						
Decapod	*Upogebia hirtifrons*	AKL15043	70302	3/08/2012	AKL15043	Benthic sled
Crab	*Liocarcinus corrugatus*	AKL15095	70301	6/08/2012	AKL15095	Benthic sled
Ascidian	*Aplidium phortax*	AKL15462	70303	6/08/2012	AKL15462	Shore search
Ascidian	*Didemnum* sp.	AKL15468	70300	6/08/2012	AKL15468	Shore search
BLUFF						
Alga	*Schizoseris griffithsia*	BLU15202	70211	13/06/2012	BLU15202	Diver search
DUNEDIN						
Fish	*Bregmaceros mcclellandii*[2]	DUD15108	70210	29/05/2012	DUD15108	Diver search
LYTTELTON						
Nudibranch	*Tritonia* sp.[3]	LYT15045	70304	12/09/2012	LYT15045	Benthic sled
NELSON						
Crab	*Nectocarcinus antarcticus*	NSN15037	70278	23/07/12	NSN15037	Benthic sled
Alga	*Grateloupia* sp.[4]	NSN15194	70279	23/07/12	NSN15794	Diver search
NEW PLYMOUTH						
Crab	*Liocarcinus corrugatus*	NPL15076	70192	22/05/2012	NPL15076	Benthic sled
Ascidian	*Molgula* sp.[5]	NPL15168	70193	24/05/2012	NPL15168	Crab trap
OPUA						
Bivalve	*Zenatia acinaces*	OPX15003	70202	12/06/2012	OPX15003	Benthic sled
Bivalve	*Maorimactra ordinaria*	OPX15020	70204	12/06/2012	OPX15020	Benthic sled
Crab	*Liocarcinus corrugatus*	OPX15074	70205	12/06/2012	OPX15074	Benthic sled
Bivalve	*Corbula zelandica*	OPX15095	70206	16/06/2012	OPX15095	Benthic sled
Crab	*Pilumnus novaezealandiae*	OPX15097	70203	12/06/2012	OPX15097	Benthic sled
Crab	***Charybdis japonica***	OPX15135	70207	12/06/2012	OPX15135	Crab trap
Barnacle	*Conchoderma aurigatum*	OPX15210	70208	13/06/2012	OPX15210	Diver search
Barnacle	*Conchoderma virgatum*	OPX15210	70219	13/06/2012	OPX15210	Diver search
Barnacle	*Lepas* sp.	OPX15210	70220	13/06/2012	OPX15210	Diver search
Alga	***Undaria pinnatifida***	OPX15236	70209	13/06/2012	OPX15236	Shore search
PICTON						
Ascidian	*Diplosoma listerianum*[1]	PCN15040	70274	14/08/2012	PCN15040	Benthic sled
Echinoderm	*Chiridota nigra*	PCN15057	70275	15/08/2012	PCN15057	Benthic sled
Echinoderm	*Chiridota nigra*	PCN15081	70277	13/08/2012	PCN15081	Benthic sled
Bivalve	*Limnoperna securis*	PCN15197	70276	16/08/2012	PCN15197	Diver search
Ascidian	*Aplidium adamsi*	PCN15208	70273	14/08/2012	PCN15208	Diver search
Bivalve	*Aulacomya maoriana*	PCN15209	70272	14/08/2012	PCN15209	Diver search
TAURANGA						
Decapod	*Alpheus richardsoni*	TRG15124	70311	4/09/2012	TRG15124	Benthic sled
WELLINGTON						
	Unidentifiable organic material	WLG15181	70310	17/09/2012	WLG15181	Diver search
WHANGAREI						
Gastropod	***Nassarius burchardi***	WRE15002	70183	07/05/2012	WRE15002	Benthic sled
Decapod	***Metapenaeus bennettae***	WRE15007	70186	07/05/2012	WRE15007	Benthic sled
Crab	*Liocarcinus corrugatus*	WRE15051	70185	07/05/2012	WRE15051	Crab trap
Crab	*Nepinnotheres atrinocola*	WRE15073	70189	09/05/2012	WRE15073	Benthic sled
Decapod	*Periclimenes yaldwyni*	WRE15076	70187	09/05/2012	WRE15076	Benthic sled
Bivalve	*Pratulum pulchellum*	WRE15078	70182	09/05/2012	WRE15078	Benthic sled
Bivalve	*Solemya parkinsonii*	WRE15078	70190	09/05/2012	WRE15078	Benthic sled
Decapod	*Philocheras australis*	WRE15078	70191	09/05/2012	WRE15078	Benthic sled
Gastropod	***Nassarius burchardi***	WRE15093	70188	11/05/2012	WRE15093	Benthic sled
Alga	Halymeniales	WRE15126	70184	07/05/2012	WRE15126	Benthic sled
Gastropod	*Cominella glandiformis*	WRE15177	70181	09/05/2012	WRE15177	Crab trap
Worm	***Sabella spallanzanii***	WRE15187	70178	10/05/2012	WRE15187	Diver search
Worm	***Sabella spallanzanii***	WRE15190	70177	10/05/2012	WRE15190	Diver search
Worm	***Sabella spallanzanii***	WRE15209	70176	10/05/2012	WRE15209	Diver search
Worm	***Sabella spallanzanii***	WRE15222_Extra	70179	10/05/2012	WRE15222	Diver search

[2] Cryptogenic.
[3] Previously undescribed native species.
[4] Molecular identification required to resolve to species level.
[5] Condition of specimen too poor to allow identification to species.

Taxonomic group	Species	Sample number	MITS code	Date	Location	Method
Worm	*Sabella spallanzanii*	WRE15222_Extra	70180	10/05/2012	WRE15222	Diver search

Table 6 Specimens collected and sent to MITS from each port during the Summer 2012-2013 survey (non-indigenous species in bold type).

Taxonomic group	Species	Sample number	MITS code	Date	Location	Method
AUCKLAND						
None						
BLUFF						
None						
DUNEDIN						
Bryozoan	*Celleporina proximalis*	DUD16034	70559	6/03/2013	DUD16034	Benthic sled
Hydroid	*Amphisbetia fasciculata*	DUD16034	70560	6/03/2013	DUD16034	Benthic sled
Bryozoan	***Bugula flabellata***	DUD16034	70567	6/03/2013	DUD16034	Benthic sled
Alga	***Schizymenia apoda***[6]	DUD16191	70561	7/03/2013	DUD16191	Diver search
Alga	***Schizymenia apoda***[6]	DUD16194	70562	7/03/2013	DUD16194	Diver search
Alga	***Schizymenia apoda***[6]	DUD16195	70563	7/03/2013	DUD16195	Diver search
LYTTELTON						
Worm	*Megalomma suspiciens*	LYT16003	70536	14/02/2013	LYT16003	Benthic sled
Worm	*Ophiodromus angustifrons*	LYT16003	70566	14/02/2013	LYT16003	Benthic sled
Worm	*Sternaspis scutata*	LYT16016	70537	14/02/2013	LYT16016	Benthic sled
Echinoderm	*Heterothyone alba*	LYT16052	70535	13/02/2013	LYT16052	Benthic sled
Alga	***Grateloupia turuturu***[6]	LYT16196	70532	12/02/2013	LYT16196	Diver search
Alga	***Grateloupia turuturu***[6]	LYT16202	70533	12/02/2013	LYT16202	Diver search
Worm	***Sabella spallanzanii***	LYT16202	70534	12/02/2013	LYT16202	Diver search
Alga	***Grateloupia turuturu***[6]	LYT16205	70531	11/02/2013	LYT16205	Diver search
NELSON						
None						
NEW PLYMOUTH						
Ascidian	*Diplosoma listeranum*[1]	NPL16182	70565	19/03/2013	NPL16182	Diver search
OPUA						
Decapod	*Ogyrides delli*	OPX16018	70475	5/12/2012	OPX16018	Benthic sled
Bivalve	*Musculus impactus*	OPX16018	70476	5/12/2012	OPX16018	Benthic sled
Decapod	*Hippolyte bifidirostris*	OPX16018	70491	5/12/2012	OPX16018	Benthic sled
PICTON						
Hydroid	***Ectopleura crocea***	PCN16182	70486	10/12/2012	PCN16182	Diver search
TAURANGA						
None						
WELLINGTON						
Worm	*Aglaophamus verrilli*	WLG16068	70529	20/02/2013	WLG16068	Benthic sled
Ascidian	*Botryllus schlosseri*	WLG16102	70523	21/02/2013	WLG16102	Crab trap
Ascidian	*Didemnum vexillum*	WLG16182	70520	18/02/2013	WLG16182	Diver search
Ascidian	*Didemnum vexillum*	WLG16185	70521	18/02/2013	WLG16185	Diver search
Ascidian	*Didemnum incanum*	WLG16185	70545	18/02/2013	WLG16185	Diver search
Hydroid	***Ectopleura crocea***	WLG16187	70527	20/02/2013	WLG16187	Diver search
Ascidian	*Aplidium adamsi*	WLG16188	70519	20/02/2013	WLG16188	Diver search
Bryozoan	***Watersipora subtorquata***	WLG16188	70528	20/02/2013	WLG16188	Diver search
Crab	*Nepinnotheres atrinicola*	WLG16188	70530	20/02/2013	WLG16188	Diver search
Hydroid	***Ectopleura crocea***	WLG16191	70524	20/02/2013	WLG16191	Diver search
Bivalve	*Musculus impactus*	WLG16191	70525	20/02/2013	WLG16191	Diver search
Sponge	*Dactylia* n. sp. 1	WLG16192	70526	20/02/2013	WLG16192	Diver search
Ascidian	*Botrylloides leachii*	WLG16192	70518	20/02/2013	WLG16192	Diver search
Ascidian	***Styela clava***	WLG16203	70522	18/02/2013	WLG16203	Diver search
Ascidian	*Didemnum vexillum*	WLG16206	70517	19/02/2013	WLG16206	Diver search
WHANGAREI						
Decapod	***Metapenaeus bennettae***	WRE16023	70540	04/02/2013	WRE16023	Benthic sled
Decapod	***Metapenaeus bennettae***	WRE16024	70538	04/02/2013	WRE16024	Benthic sled

[6] Molecular identification required to resolve to species level.

Taxonomic group	Species	Sample number	MITS code	Date	Location	Method
Decapod	*Metapenaeus bennettae*	WRE16036	70541	06/02/2013	WRE16036	Benthic sled
Crab	*Charybdis japonica*	WRE16036	70542	06/02/2013	WRE16036	Benthic sled
Worm	*Sabella spallanzanii*	WRE16191	70544	07/02/2013	WRE16191	Diver search
Worm	*Sabella spallanzanii*	WRE16206	70543	07/02/2013	WRE16206	Diver search
Worm	*Sabella spallanzanii*	WRE16231	70539	05/02/2013	WRE16231	Shore search

DISTRIBUTION OF TARGET AND NON-TARGET SPECIES

Distribution maps were plotted for target species and for non-target species in the following categories: new records for New Zealand; those that have expanded their ranges; and those that currently have a restricted distribution (Appendix 3). The maps show locations where each species was recorded (as red dots) and also locations where it was absent, based on appropriate sampling methods for each species (see Appendix 1). Species plotted (and the sampling methods) are: *Acentrogobius pflaumii* (crab trap, epibenthic sled, diver search); *Charybdis japonica* (epibenthic sled, crab trap, crab condos, diver search, shore search); *Clavelina lepadiformis* (diver search, shore search); *Ectopleura crocea* (diver search); *Eudistoma elongatum* (epibenthic sled, diver search, shore search); *Ficopomatus enigmaticus* (diver search, shore search); *Grateloupia turuturu* (diver search, shore search); *Limaria orientalis* (epibenthic sled); *Metapenaeus bennettae* (epibenthic sled, crab trap, diver search); *Musculista senhousia* (epibenthic sled, crab trap, shore search); *Nassarius burchardi* (epibenthic sled); *Pyromaia tuberculata* (epibenthic sled, crab trap); *Sabella spallanzanii* (epibenthic sled, crab trap, diver search, shore search); *Schizymenia apoda* (epibenthic sled, crab trap, diver search, shore search); *Styela clava* (epibenthic sled, diver search, shore search); *Theora lubrica* (epibenthic sled); and *Undaria pinnatifida* (epibenthic sled, crab trap, diver search, shore search). Records are shown for the Winter 2012 and Summer 2012-2013 surveys.

Secondary target species

Eudistoma elongatum

Eudistoma elongatum was recorded in both surveys of Opua and Whangarei Harbour. Distributions within each harbour were as follows:

- Opua: present at two locations along the coast towards Paihia in the winter survey and two in the marina in the summer survey. It was present at fewer sites within these locations than during previous surveys (for example, during the Winter 2011 and Summer 2011-2012 surveys it was present at 17-18 sites within the marina).
- Whangarei Harbour: as in the 2011-2012 surveys, *Eudistoma* found in the Portland Arm during both surveys, and on Limestone Island in the summer survey. The abundances during the summer survey were the highest seen to date.

Musculista senhousia

Musculista senhousia was recorded in both surveys of Whangarei Harbour, the winter survey of Tauranga Harbour and the summer survey of Auckland Harbour. Distributions within each harbour were as follows:

- Auckland Harbour: recorded at only one site in the upper harbour during the summer survey, reflecting a decrease in the number and distribution of sites where this species has been recorded during recent surveys compared to earlier surveys.
- Tauranga Harbour: as in previous surveys, recorded in the channel south (upstream) of the Tauranga Bridge during the winter survey. Not recorded in the summer survey.

- Whangarei Harbour: as in previous surveys, recorded throughout the harbour, from the Town Basin to Marsden Point, including the Portland Arm and Marsden Cove Marina. In Marsden Cove Marina, *M. senhousia* has invaded the new part of the marina above the lock system.

Sabella spallanzanii

S. spallanzanii was found during both surveys of Auckland, Lyttelton and Whangarei Harbours:

- Auckland Harbour: throughout the port, Orakei, Westhaven, Bayswater and Westpark Marinas, Devonport, the channel between the Harbour Bridge and Kauri Point and in the upper harbour. During the summer survey *S. spallanzanii* was recorded in all of the 60 dive searches, 11 benthic sled and 29 shore search sites. Population densities in the Viaduct Basin were up to 200 per m^2. It was abundant at all locations where it occurred, and several sites had tubes with estimated length in excess of 300 mm.
- Lyttelton Harbour: as in previous surveys, and in stark contrast to Auckland Harbour, only one individual was detected during each of the winter and summer surveys (on pontoons on Z Berth and a pile on the Oil Berth, respectively).
- Whangarei Harbour: a range extension to Whangarei Harbour was detected in early April 2012 by commercial divers inspecting fishing boats brought to Port Nikau from the Waitemata Harbour. During the winter survey, specimens were detected for the first time on wharf structures at this location and also on another fishing vessel berthed in Marsden Cove Marina (see below for details). In the summer survey, *S. spallanzanii* was found at one location in Port Nikau (Main 1) where it was present on five out of ten piles (all specimens were slightly below the normal search depth - circa 6.5 m at low tide). In Marsden Cove Marina divers found specimens on five out of six dives. Individuals were found growing on the breakwalls, pontoons and pilings. Shore searches found worms on three out of ten searches within the marina.

S. spallanzanii was detected by commercial divers in early April 2012 on four fishing vessels brought up from Auckland and moored on Whangarei Wharves at Port Nikau (Figure 2). At the request of MPI and Northland Regional Council the winter survey was brought forward to early May and additional dives were searched around these vessels (Figure 3).

- The western side of the wharf (approx. 45 piles – sites 15207, 15208, 15189, 15209) was surveyed by divers down to 8-9 m. *S. spallanzanii* (one individual) was found on one pile behind a vessel at approximately 8.5 m depth. The specimen was around 40 mm long with a tube width of about 2 mm and collected from site 15209.
- The metal breakwall at the northern end of the wharf was surveyed and no *S. spallanzanii* were found – site 15210.
- *S. spallanzanii* (one individual) was found at site 15190 on the eastern side of the wharf at approximately 10 m depth, the specimen was of a similar size to the sample collected from site 15209.
- The divers then surveyed the fishing wharf at site 15187. A single *S. spallanzanii* was found at the base of one pile at approximately 10 m depth, also of a similar size to that found at site 15209. One specimen was collected but the diver thinks more were seen before visibility became severely reduced while collecting the first specimen.

Note that the visibility was generally poor around this area. Not all piles were searched down to their bases. Site 15209 was resurveyed on 22nd May, when the visibility was better, and no additional *S. spallanzanii* were detected.

These three specimens represent the first records of *S. spallanzanii* on fixed structures (as opposed to vessels) in Whangarei Harbour.

Figure 2 Vessels at the Whangarei Wharves (Port Nikau) (photo: NIWA).

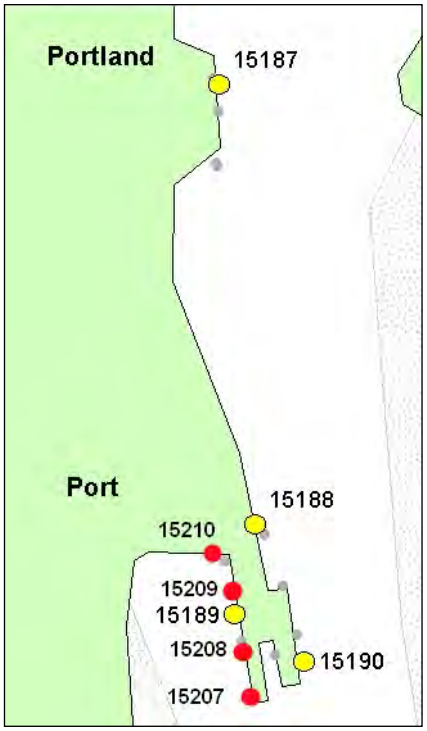

Figure 3 Scheduled (yellow circles) and additional (red circles) dives sites at Whangarei Wharves. *Sabella spallanzanii* was found at sites 15209, 15190 and 15187.

During the winter survey of Whangarei Harbour, a single *Sabella spallanzanii* (approximately 100 mm long) was also detected on a fishing vessel during a shore search at Marsden Cove Marin (berth A47:Figure 4). After this discovery, four additional diver searches were made under the vessel and in the surrounding area. Approximately 20-30 worms per m^2, up to 300 mm long, were found on the vessel (Figure 5). No *S. spallanzanii* were found on the

pontoons or the pilings. Voucher samples of these worms were preserved and sent to MITS (location WRE15222_Extra, in Table 5).

Figure 4 A vessel fouled with Saballa spallanzanii in Marsden Cove (photo: Crispin Middleton, NIWA).

Figure 5 *Sabella spallanzanii* on the hull of a vessel in Whangarei (photo: NIWA).

Styela clava

Styela clava was found during both surveys of Auckland, Dunedin, Lyttelton, Nelson, Opua and Whangarei Harbours and during the summer survey of Wellington Harbour:

- Auckland Harbour: throughout the port, Orakei, Westhaven, Bayswater and Westpark Marinas, Devonport, the channel between the Harbour Bridge and Kauri Point and in the upper harbour (the upper harbour in the summer survey only). During the winter survey *S. clava* was found in 37 of the dive searches, in 10 benthic sleds, and on 23 of the shore searches. Many of the specimens appeared to be in poor condition. During the summer survey it was found in 50 of the dive searches, on 22 benthic sled sites, and on 18 of the shore searches throughout the harbour.
- Dunedin: distribution was similar to that in 2011-2012, with specimens recorded at a single site in the Town Basin in the winter survey and three sites in the same location in summer. All specimens were removed and disposed of to landfill.
- Lyttelton Harbour: at locations throughout the port and, during the summer survey, at Magazine Bay Marina. Unlike the 2011-2012 surveys, none were found along the northern shore west of the port (other than the marina) and it was present at fewer locations in the port (eight and 14 in 2011-2012, seven and two in 2012-2013).
- Nelson: a single specimen was collected from the lay-up berth during the winter survey. A total of 12 specimens of *Styela clava* were found in a widespread distribution around the harbour during the summer survey: in the southwestern portion of the Nelson Haven (one specimen in a sled sample), in the Cut (four specimens found at two shore dives around the entrance to Nelson Haven), on piles along McGlashen Quay (one specimen), the Main Wharf at the southwestern end of Port Nelson (three specimens), in Dixon Basin (one specimen on piles), and in the Nelson Marina (one specimen on a floating pontoon and one specimen on a rock wall). This represents an increased distribution of *S. clava* within Nelson Harbour. All specimens were removed and disposed of to landfill.
- Opua: present at two locations during the winter survey, on the shore north of the marina and the channel east of the marina, and in the marina, north of the marina and at Russell during the summer survey. This represents a reduction in the number of locations recorded from 2011-2012.
- Tauranga: not recorded (a single specimen was recorded during the Summer 2011-2012 survey).
- Wellington: two individuals were collected from the seabed in Chaffers Marina during the summer survey. They were not attached to a substratum and may have been dislodged from the hull of a boat.
- Whangarei Harbour: Marsden Cove Marina (both surveys), Parua Bay (summer survey) and, for the first time, in the middle harbour (Limestone Island Wharf and from a sled sample in the channel off Parua Bay) during the summer survey.

Non-target, non-indigenous species

Acentrogobius pflaumii

Recorded during the winter and summer surveys of Auckland and Whangarei Harbours. In Waitemata Harbour it occurred in the port, Westhaven Marina, Bayswater Marina, Meola Reef, and the northern shore of the harbour upstream of the Harbour Bridge. In contrast to previous surveys, it was not recorded at Opua. In Whangarei it was recorded at a single location in the middle harbour during the winter survey, and a location at Port Nikau and in the Portland Arm in the summer survey.

Charybdis japonica

Recorded during the winter and summer surveys of Auckland and Whangarei Harbours, and the winter survey of Opua, as follows (all specimens were destroyed):

- Auckland: throughout the port, at Devonport, in Orakei, Bayswater, Westhaven and Westpark Marinas, and in the channels in the upper, middle and lower harbour. No

specimens of the native paddle crab, *Ovalipes catharus*, were captured during either survey.
- Whangarei Harbour: around the Town Wharf, Limestone Island, Portland Arm, Parua and Munro Bays and Marsden Cove Marina.
- Opua: collected at a single location near Paihia, representing a range extension.

Clavelina lepadiformis

The known distribution of this species in New Zealand continues to be restricted to Nelson Marina and Dickson Basin, where it was first noted in November 2008. In contrast to previous surveys, when it had become widespread in the marina, it was only recorded at two locations during each of the winter and summer surveys.

Ectopleura crocea

Specimens were collected from Waikawa Marina (Picton) and along Aotea Quay in Wellington Harbour, both during the summer surveys.

Ficopomatus enigmaticus

This species was recorded during both surveys of Whangarei Harbour, where it has been recorded previously. It was present in the Town Basin Marina and, during the summer survey, in the upper harbour and at Port Nikau.

Grateloupia turuturu

Specimens resembling *Grateloupia turuturu* were collected during the Winter 2012 surveys of Whangarei, Bluff and Nelson (marina) and the Summer 2012-2013 survey of Lyttelton, and sent to MITS for identification. It was also recorded but not collected from New Plymouth (winter and summer surveys) and the winter survey of Wellington, where *G. turuturu* has been recorded previously. As previously, the identification of some of the specimens sent to MITS proved to be difficult and a review of the Genera *Grateloupia* and molecular information is required to confirm some of them (Roberta D'Archino, NIWA, pers. comm. to Serena Wilkens, MITS). The current status of these and previously-collected specimens indicates that *G. turuturu* is present in Lyttelton (Table 7), and is also known to occur in Nelson, New Plymouth and Wellington Harbour.

Table 7 Summary of the current status of identifications of specimens resembling *Grateloupia turuturu* collected during the Winter 2012 and Summer 2012-2013 surveys.

MITS ID code	Port	Date	Sample number	Identity	Notes
70184.	Whangarei	7/5/12	WRE15126	Halymeniales	
70211	Bluff	13/3/12	BLU15202	*Schizoseris griffithsia*	Indigenous
70279	Nelson	23/7/11	NSN15194	*Grateloupia* sp.	Molecular identification required to species level – appears different to *G. turuturu*
70532	Lyttelton	12/2/13	LYT16196	*Grateloupia turuturu*	
70533	Lyttelton	12/2/13	LYT16202	*Grateloupia turuturu*	
70531	Lyttelton	11/2/13	LYT16205	*Grateloupia turuturu*	
70531	Lyttelton	11/2/13	LYT16205	*Grateloupia turuturu*	

Limaria orientalis

Recorded in Auckland Harbour during the winter and summer surveys, where it occurs in the main channel in the outer and middle harbours, including the port and Devonport.

Metapenaeus bennettae

First recorded in New Zealand during the Winter 2009 survey of Auckland Harbour (outside Bayswater Marina), *M. bennettae* was recorded at two locations in the upper harbour and in Bayswater Marina during the Winter 2012 survey of Auckland Harbour. In the summer survey it was recorded in the middle harbour, Bayswater Marina and in the port. *M. bennettae* was also recorded at Port Nikau in Whangarei Harbour in February 2012. During the Winter 2012 survey it was recorded below the Town Basin Marina, Port Nikau, Onerahi (on the north shore) and in the channel off Tamaterau. In the summer survey it was only recorded at Port Nikau.

Nassarius burchardi

Verified (by MITS) records of this gastropod were made throughout Whangarei Harbour, from the Town Basin to Marsden Cover Marina during the winter survey. During the summer survey it was recorded in the Town Basin and Port Nikau. This species was originally reported from the Waitemata Harbour in 2009 and was noted (by field teams including members who also take part in the Whangarei surveys) as being present in this harbour during the Winter 2012 and Summer 2012-2013 surveys. No specimens were sent to MITS to confirm the identification, however, and these records have consequently not been mapped.

Pyromaia tuberculata

Recorded in Auckland Harbour during both surveys, Opua (commercial wharf) and Tauranga Harbour (railway bridge) during the summer surveys, and Whangarei Harbour (Marsden Point) during the winter survey. In Auckland Harbour it occurred in the main channel of the upper, middle and outer harbour, Bayswater Marina and the port.

Schizymenia apoda

Recorded in the town basin of Port Otago during the summer survey and provisionally identified (confirmation of this identification requires molecular analysis). *S. apoda* was first identified in New Zealand from specimens collected from Wellington Harbour during the Winter 2009 survey, and is now widespread throughout that harbour (R. d'Archino, NIWA, pers. comm.).

Theora lubrica

This species occurs in soft, muddy sediments throughout Auckland, Lyttelton, Nelson, New Plymouth, Opua, Picton and Havelock, Tauranga, Wellington and Whangarei Harbours.

Undaria pinnatifida

Widespread in Auckland, Bluff, Dunedin, Lyttelton, Nelson, New Plymouth, Picton and Wellington Harbours. Also present in Tauranga Harbour (southern part of the port and Tauranga Bridge Marina). It was recorded on a vessel on a swing-mooring opposite the commercial wharf in Opua during the winter survey, which was the first record in this harbour (MPI were notified of this find the same day).

- Auckland: the port, Viaduct, Westpark and Bayswater Marinas, Devonport and outer harbour.
- Bluff: western side of the harbour, including the port, and Tiwai Wharf.
- Dunedin: throughout the harbour.
- Lyttelton: throughout the harbour.
- Nelson: marina, port and inside the Boulder Bank.
- New Plymouth: throughout the port.
- Picton: throughout the port, Waimahana Wharf (Shakespeare Bay) and Waikawa Marina.

- Tauranga: at the southern end of the port in both surveys and in Tauranga Bridge Marina during the summer survey.
- Wellington: throughout the harbour.

ENVIRONMENTAL DATA COLLECTION

Environmental data were recorded at most survey locations (the principal aim of these records is to develop a database of environmental conditions for each port in the surveillance programme, rather than conditions associated with each individual sample). The following parameters were measured: water depth, salinity, temperature, secchi depth, wind direction and speed, and time of sampling (to allow determination of tidal stage). Wind direction was allocated to one of eight compass directions (north, northeast, east, etc.). It should also be noted that the wind speed measured at a given sampling location (for example, against a sheltered wharf) may not be representative of general conditions prevailing at the time of the survey.

Conclusions

The Winter 2012 and Summer 2012-2013 rounds of marine high-risk site surveillance surveys met the project objectives. The survey location targets were met in all cases and 85 specimens were collected and sent to MITS for identification. No primary target species were detected during the survey but the four secondary target species were all recorded: *Eudistoma elongatum* (Opua and Whangarei); *Musculista senhousia* (Auckland, Tauranga and Whangarei); *Sabella spallanzanii* (Auckland, Lyttelton and Whangarei); and *Styela clava* (Auckland, Dunedin, Lyttelton, Nelson, Opua, Wellington and Whangarei). All of these target species have been recorded at these respective locations during previous surveys apart from *S. spallanzanii* in Whangarei and *S. clava* in Wellington, which represent range extensions (although specimens of *S. clava* were previously found on the hulls of a vessels in Wellington in 2007).

The following non-target, non-indigenous species were also recorded: *Acentrogobius pflaumii*; *Bugula flabellata*; *Charybdis japonica*; *Clavelina lepadiformis*; *Ectopleura crocea*; *Ficopomatus enigmaticus*; *Grateloupia turuturu*; *Limaria orientalis*; *Metapenaeus bennettae*; *Nassarius burchardi*; *Pyromaia tuberculata*; *Schizymenia apoda*; *Theora lubrica*; and *Undaria pinnatifida*.

All *Charybdis* specimens caught in crab traps were measured and euthanized. All *Sabella spallanzanii* found in Lyttelton and Whangarei (other than those on vessels) and all *Styela clava* found in Dunedin, Nelson and Wellington were collected and either preserved and sent to MITS or disposed of to landfill.

Problems encountered:

Problems during sampling

Dive searches along the northern part of the main port in Tauranga were postponed until the week of 19 September due to persistent, strong, westerly winds during the Winter 2012 survey. Heavy vessel traffic and construction work on Sulphur Point Wharf made it necessary to relocate several crab trapping and diving locations in the port. Large amounts of drift alga made recovery of crab traps difficult, as often occurs in this harbour. An additional 15 dive sites and 20 shore searches were done during this survey as part of the biosecurity monitoring component of the Rena Recovery Programme, by agreement among NIWA, MPI and Bay of Plenty Regional Council.

During the Winter 2012 survey of Port Taranaki, methyl bromide gas fumigation was underway adjacent to some inner harbour dive sites and, after contacting the fumigation company, it was decided to move the dive sites because of the risk of exposure to methyl bromide gas.

Management actions taken to reduce problems

Where pre-assigned sampling locations could not be accessed because of, for example, the presence of a vessel on the wharf, the sample was taken as close as possible to the pre-assigned location and GPS coordinates were recorded.

During the Winter 2012 survey of Opua, two vessels were identified as being potential biosecurity risks and were inspected by the divers after consultation with local MPI staff. One vessel had recently arrived from Hawaii and had goose barnacles on its hull (specimens were sent to MITS). The other was a decommissioned fishing vessel from the hull of which *Undaria pinnatifida* was collected and sent to MITS for formal identification (sample SVOPX 15236). The vessel was originally identified as a potential risk from a surface ("shore") search from a boat (location/sample number SVOPX15236) and subsequently searched below the water line as a diver search (location number SVOPX15209), when *Styela clava* was noted but not collected.

Underwater visibility was poor during the Opua summer survey.

Recommendations

Trials of electronic data recording continue but problems of reliability have been encountered. We recommend that the distribution of sampling effort in Opua be continued as proposed in the revised design report, based on SST modelling (Morrisey et al. 2012). This optimisation approach may be applied to other ports in the future, following discussion between NIWA and MPI in May 2013.

Acknowledgements

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Appendix 1. Summary of sampling methods, target species and habitats.

Underlined species have been collected using this method during the present or previous target-species surveillance programmes.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous surveillance in NZ?	Previous surveillance overseas?
Epibenthic sled tows	*Asterias amurensis* *Eudistoma elongatum* *Musculista senhousia* *Potamocorbula amurensis* *Sabella spallanzanii* *Styela clava*	*Acentrogobius pflaumii* *Chaetopterus* sp. *Charybdis japonica* *Didemnum* sp. *Grateloupia turuturu* *Hypnea* sp. *Pyromaia tuberculata* *Theora lubrica*	Subtidal soft sediments. Particular focus on known shellfish beds (for *Asterias*) and areas next to public access (e.g. wharves, boat ramps, marinas, etc. *Caulerpa*, *Sabella*).	Narrow width but 50 m tow length and high replication (100+ per location) enables a reasonably large area to be sampled (ca 2500m^2 per location).	Reliable sample collection including asteroids, infaunal and epifaunal bivalves and polychaetes and macroalgae.	Processing of sled contents can be time consuming.	Feasible on all soft-sediment habitats under reasonable weather conditions. Can be limited by the presence of large amounts of benthic macroalgae or soft mud that fill mouth of sled.	Yes	Yes

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous surveillance in NZ?	Previous surveillance overseas?
Box (crab) traps	*Asterias amurensis* *Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* *Charybdis japonica* *Pyromaia tuberculata*	Adjacent to wharf pilings and other artificial habitats. Intertidal and shallow subtidal rocky shores, breakwalls and saltmarsh. Particular focus on habitats with complex physical structure (e.g. mussel beds, seagrass beds)	Sampled area is dependent on dispersion of bait odour. High replication possible.	Effectively sample other species of crabs (*Ovalipes*, *Macrophthalmus*, *Charybdis*).	Quick to deploy and recover, so high replication possible.	Most locations and weather conditions.	Yes	Yes (Hewitt & Martin 2001, May & Brown, 2001 Thresher et al. 2003, Yamada et al. 2001)
Crab condos	*Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* *Charybdis japonica* *Pyromaia tuberculata*	Intertidal and shallow subtidal banks of rivers. Particular focus on brackish water habitats with complex physical structure (e.g. saltmarsh or fringing vegetation).	High replication possible. Availability of suitable estuarine habitat may limit deployment.	Effectively sample other species of crabs (*Helice*, *Macrophthalmus*). Higher rates of detection of crabs than bated traps in muddy river banks (Veldhuizen 2000).	Quick to deploy and recover, so high replication possible.	High – access problems at some sites (shallow water, deep mud, private land).	Yes	Yes (Veldhuizen 2000)

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous surveillance in NZ?	Previous surveillance overseas?
Shoreline searches	*Carcinus maenas* *Eriocheir sinensis* *Eudistoma elongatum* *Musculista senhousia* *Sabella spallanzanii* *Styela clava*	*Chaetopterus* sp. *Charybdis japonica* *Clavelina lepadiformis* *Didemnum* sp. *Grateloupia turuturu* *Hypnea* sp. *Pyromaia tuberculata*	Sloping sandy shorelines, intertidal rocky reefs and areas where drift material is likely to accumulate. Prevailing winds on preceding days are a useful guide to where material may accumulate.	Wide – can cover long stretches of intertidal habitat quickly.	Used effectively in delimitation studies of *Styela.*	High	High – access to intertidal areas may be limiting.	Yes	Yes
Diver searches	*Asterias amurensis* *Carcinus maenas* *Eudistoma elongatum* *Sabella spallanzanii* *Styela clava*	*Chaetopterus* sp. *Charybdis japonica* *Clavelina lepadiformis* *Didemnum* sp. *Grateloupia turuturu* *Hypnea* sp. *Pyromaia tuberculata*	Wharf piles, marina piles and pontoons and other artificial structures, intertidal and shallow subtidal reefs.	Good – large numbers of piles or lengths of hard substratum can be searched in detail.	Dependent on water clarity and level of biofouling.	Cost effective in reasonable water clarity, can be time-consuming under poor conditions.	Feasibility dependent on water currents, weather, water clarity and safety issues for divers.	Yes	Yes

Hewitt, C.L., Martin, R.B. 2001. Revised protocols for baseline surveys for introduced marine species: survey design, sampling protocols and specimen handling. Technical Report Number 22. Centre for Research on Introduced Marine Pests, CSIRO Marine Research, Hobart, Tasmania. 46 pp.

May, J.T., Brown, L.R. 2001. Chinese mitten crab surveys of San Joaquin River Basin and Suisun Marsh, California, 2000. Open-File Report 01-396 Prepared for the U.S. Geological Survey in Cooperation with the Interagency Ecological Program, Sacramento, California. 25 p.

Thresher, R.E., Proctor, C., Ruiz, G.M., Gurney, R., MacKinnon, C., Walton, W., Rodriguez, L., Bax, N. 2003. Invasion dynamics of the European shore crab, *Carcinus maenas*, in Australia. Marine Biology 142: 867-876.

Veldhuizen, T.C. (2000). Gear type selection for the Chinese Mitten Crab habitat use study. IEP Newsletter 13(1): 10.

Yamada, S.B., A. Kalin, Hunt, C., 2001. Growth and longevity of the European green crab *Carcinus maenas*, in the Pacific Northwest. Proceedings of the Second International Conference on Marine Bioinvasions, New Orleans, USA, 9-11 April, 2001, pp. 158-159.

Appendix 2. Summaries of achieved versus target sample numbers for Winter 2012 and Summer 2012-2013.

AUCKLAND

Sampling method	Target number of locations	Actual number of locations	% of target achieved
ALL AUCKLAND WINTER 2012			
Crab condo lines	16	16	100
Crab (box) trap lines	160	161	101
Epibenthic sled tows	200	200	100
Diver searches	60	60	100
Shore searches	50	55	110
Sample total	486	492	101
WAITEMATA WINTER 2012			
Crab condo lines	8	12	150
Crab (box) trap lines	32	25	78
Epibenthic sled tows	91	90	99
Diver searches	4	1	25
Shore searches	20	18	90
Sample total	155	146	94
PORT OF AUCKLAND WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	28	33	118
Epibenthic sled tows	37	39	105
Diver searches	15	15	100
Shore searches	0	1	
Sample total	80	88	110
VIADUCT/HOBSON WEST WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	13	22	169
Epibenthic sled tows	15	15	100
Diver searches	15	12	80
Shore searches	10	11	110
Sample total	53	60	113
WESTHAVEN WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	11	19	173
Epibenthic sled tows	24	26	108
Diver searches	15	13	87
Shore searches	9	13	144
Sample total	59	71	120
BAYSWATER MARINA WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	13	13	100
Epibenthic sled tows	12	12	100
Diver searches	5	4	80
Shore searches	6	6	100
Sample total	36	35	97
WESTPARK MARINA WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	13	10	77

Sampling method	Target number of locations	Actual number of locations	% of target achieved
Epibenthic sled tows	1	1	100
Diver searches	3	3	100
Shore searches	3	2	67
Sample total	20	16	80
ORAKEI/HOBSON MARINA WINTER 2012			
Crab condo lines	8	4	50
Crab (box) trap lines	10	25	250
Epibenthic sled tows	5	3	60
Diver searches	3	4	133
Shore searches	2	2	100
Sample total	28	38	136
DEVONPORT NAVAL BASE AND PUBLIC WHARF WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	11	11	100
Epibenthic sled tows	12	13	108
Diver searches	6	6	100
Shore searches	0	0	
Sample total	29	30	103
KAURI POINT WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	3	3	100
Epibenthic sled tows	3	0	0
Diver searches	2	2	100
Shore searches		2	
Sample total	8	7	88
ALL AUCKLAND SUMMER 2012-2013			
Crab condo lines	16	14	88
Crab (box) trap lines	160	160	100
Epibenthic sled tows	200	204	102
Diver searches	60	61	102
Shore searches	50	58	116
Sample total	486	497	102
WAITEMATA SUMMER 2012-2013			
Crab condo lines	8	10	125
Crab (box) trap lines	32	25	78
Epibenthic sled tows	91	93	102
Diver searches	4	1	25
Shore searches	20	22	110
Sample total	155	151	97
PORT OF AUCKLAND SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	28	33	118
Epibenthic sled tows	37	37	100
Diver searches	15	16	107
Shore searches		4	
Sample total	80	90	113
VIADUCT/HOBSON WEST SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	13	22	169
Epibenthic sled tows	15	15	100
Diver searches	15	12	80
Shore searches	10	6	60

Sampling method	Target number of locations	Actual number of locations	% of target achieved
Sample total	53	55	104
WESTHAVEN SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	11	19	173
Epibenthic sled tows	24	26	108
Diver searches	15	13	87
Shore searches	9	15	167
Sample total	59	73	124
BAYSWATER MARINA SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	13	13	100
Epibenthic sled tows	12	12	100
Diver searches	5	4	80
Shore searches	6	6	100
Sample total	36	35	97
WESTPARK MARINA SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	13	10	77
Epibenthic sled tows	1	1	100
Diver searches	3	3	100
Shore searches	3	1	33
Sample total	20	15	75
ORAKEI/HOBSON MARINA SUMMER 2012-2013			
Crab condo lines	8	4	50
Crab (box) trap lines	10	24	240
Epibenthic sled tows	5	3	60
Diver searches	3	4	133
Shore searches	2	4	200
Sample total	28	39	139
DEVONPORT NAVAL BASE AND PUBLIC WHARF SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	11	11	100
Epibenthic sled tows	12	15	125
Diver searches	6	6	100
Shore searches	0	0	
Sample total	29	32	110
KAURI POINT SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	3	3	100
Epibenthic sled tows	3	2	67
Diver searches	2	2	100
Shore searches	0	0	
Sample total	8	7	88

BLUFF

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	79	98.75
Epibenthic sled tows	100	100	100
Diver searches	30	31	103.3
Shore searches	25	25	100
Sample total	243	243	100

DUNEDIN

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	78	97.5
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	27	108
Sample total	243	243	100

LYTTELTON

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100

NELSON

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	30	120
Sample total	243	248	102
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100

NEW PLYMOUTH

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	7	87.5
Crab (box) trap lines	80	82	102.5
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	244	100
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	101	101
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	244	100

OPUA

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	105	105
Diver searches	30	30	100
Shore searches	25	29	116
Sample total	243	252	104
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	105	105
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	248	102

PICTON / HAVELOCK

Sampling method	Target number of locations	Actual number of locations	% of target achieved
TOTAL PICTON / HAVELOCK WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	99	99
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	242	100
PICTON / SHAKESPEARE BAY WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	35	35	100
Epibenthic sled tows	60	59	98
Diver searches	15	15	100
Shore searches	9	9	100
Sample total	119	118	99
WAIKAWA WINTER 2012			
Crab condo lines	0	0	
Crab (box) trap lines	20	20	100
Epibenthic sled tows	20	20	100
Diver searches	7	7	100
Shore searches	8	8	100
Sample total	55	55	100
HAVELOCK WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	25	25	100
Epibenthic sled tows	20	20	100
Diver searches	8	8	100
Shore searches	8	8	100
Sample total	69	69	100
TOTAL PICTON / HAVELOCK SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	99	99
Diver searches	30	30	100
Shore searches	25	26	104
Sample total	243	243	100
PICTON / SHAKESPEARE BAY SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	35	35	100
Epibenthic sled tows	60	60	100
Diver searches	15	15	100
Shore searches	9	9	100
Sample total	119	119	100
WAIKAWA SUMMER 2012-2013			
Crab condo lines	0	0	
Crab (box) trap lines	20	20	100
Epibenthic sled tows	20	20	100
Diver searches	7	7	100
Shore searches	8	8	100
Sample total	55	55	100

Sampling method	Target number of locations	Actual number of locations	% of target achieved
HAVELOCK 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	25	25	100
Epibenthic sled tows	20	20	100
Diver searches	8	8	100
Shore searches	8	8	100
Sample total	69	69	100

TAURANGA

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	84	105
Epibenthic sled tows	100	102	102
Diver searches[1]	45	45	100
Shore searches	45	45	100
Sample total	278	284	102
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	81	101
Epibenthic sled tows	100	101	101
Diver searches[1]	45	45	100
Shore searches	45	56	124
Sample total	278	291	105

[1] Additional dive searches (target total 45) and shore searches (target total 45) were made during the Winter 2012 and Summer 2012-2013 surveys as part of the biosecurity monitoring programme for the response to the grounding of the container ship *Rena* on Astrolabe Reef in October 2011.

WELLINGTON

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	243	100
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	79	99
Epibenthic sled tows	100	100	100
Diver searches	30	30	100
Shore searches	25	25	100
Sample total	243	242	100

WHANGAREI

Sampling method	Target number of locations	Actual number of locations	% of target achieved
WINTER 2012			
Crab condo lines	8	8	100
Crab (box) trap lines	80	84	105
Epibenthic sled tows	100	105	105
Diver searches[2]	30	39	130
Shore searches	25	26	104
Sample total	243	262	108
SUMMER 2012-2013			
Crab condo lines	8	8	100
Crab (box) trap lines	80	80	100
Epibenthic sled tows	100	102	102
Diver searches	30	32	107
Shore searches	25	30	120
Sample total	243	252	104

[2] Four additional dive searches were also made in Marsden Cove Marina, Whangarei during the Winter 2012 survey, in response to the detection of *Sabella spallanzanii* on the hull of a vessel in the marina during a shore search. Four additional dive searches were also made on piles in Port Nikau, Whangarei Harbour after the recent discovery of *S. spallanzanii* on vessels on the wharf.

Appendix 3. Maps showing locations sampled in Winter 2012 and Summer 2012-2013.

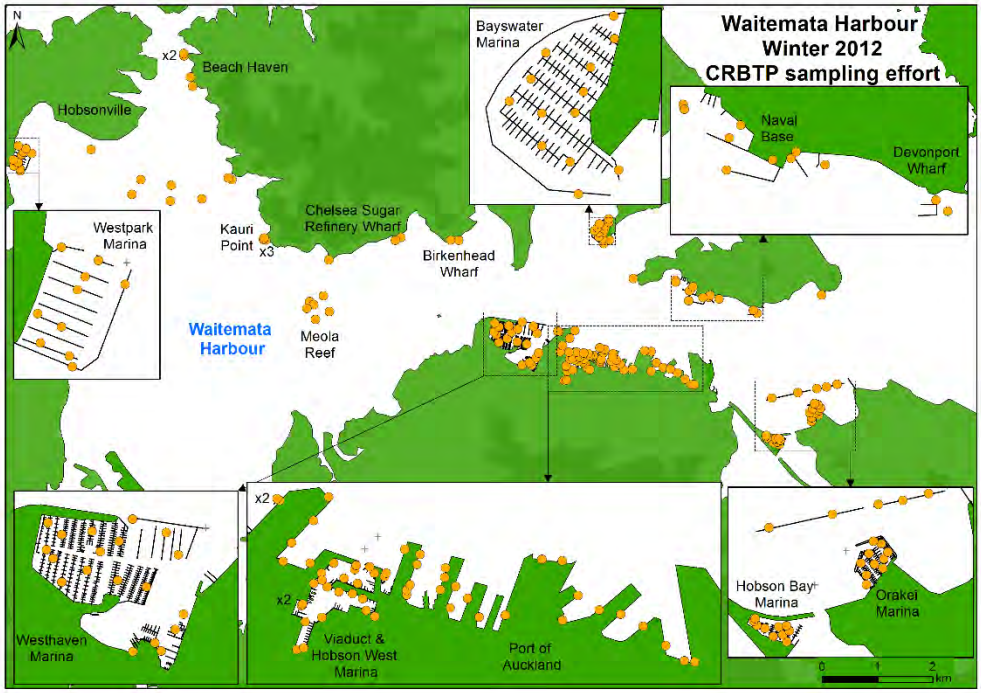
NOTE THAT NUMBERS OF LOCATIONS PLOTTED MAY APPEAR SMALLER THAN THOSE SHOWN IN APPENDIX 2 DUE TO POINTS PLOTTING ON TOP OF EACH OTHER AS A RESULT OF THE SPATIAL RESOLUTION OF THESE MAPS

AUCKLAND (WAITEMATA HARBOUR)

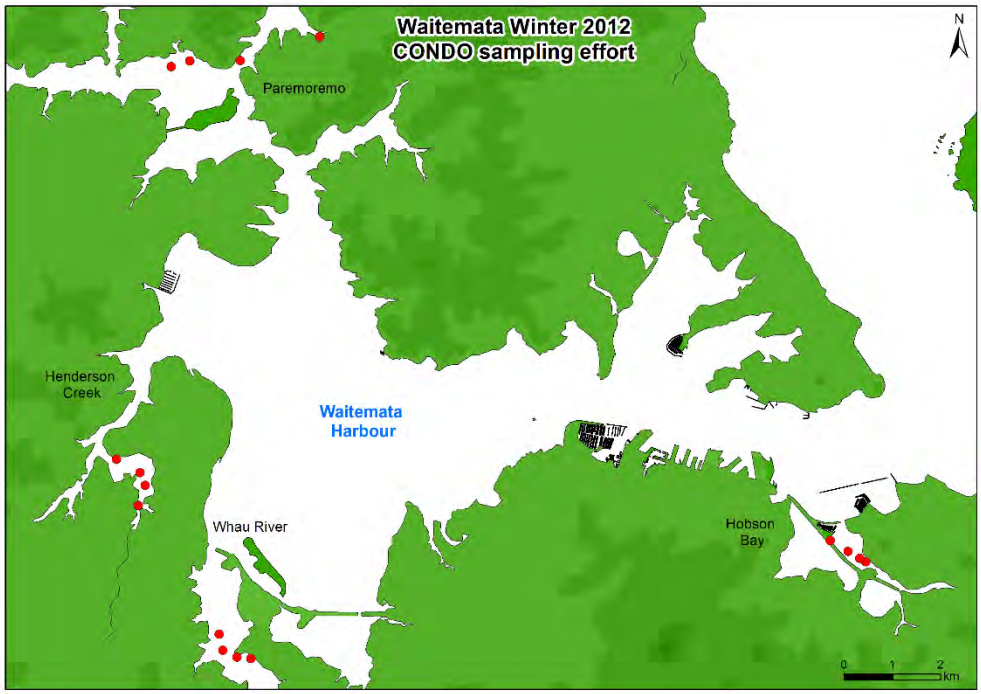
Note: grey crosses indicate navigational markers

Winter 2012

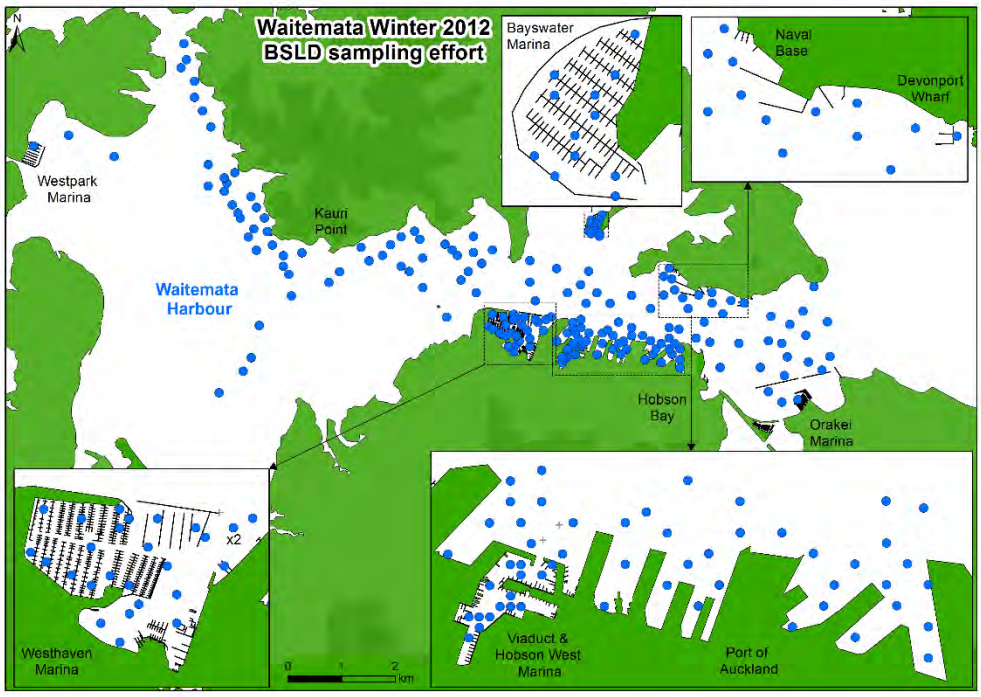
Crab (box) trapping locations



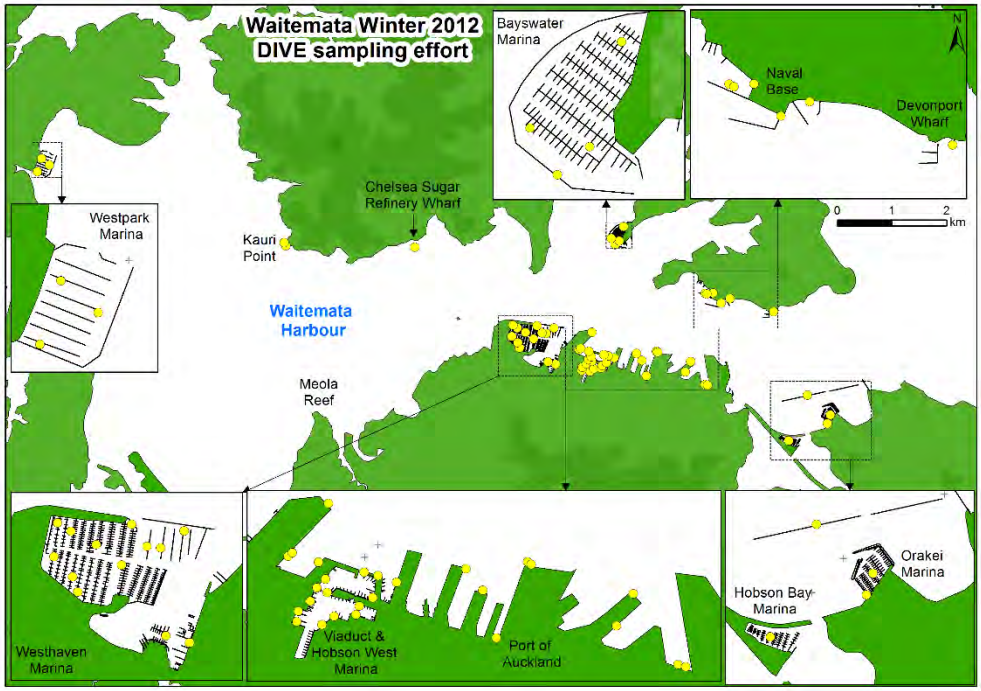
Crab condo locations



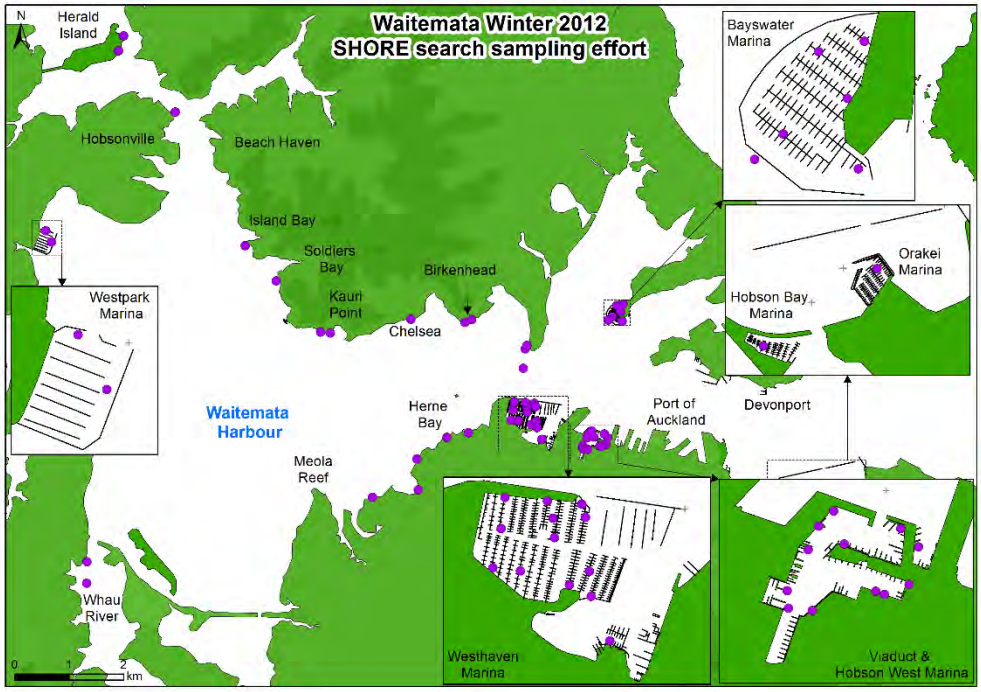
Sledding locations



Dive search locations

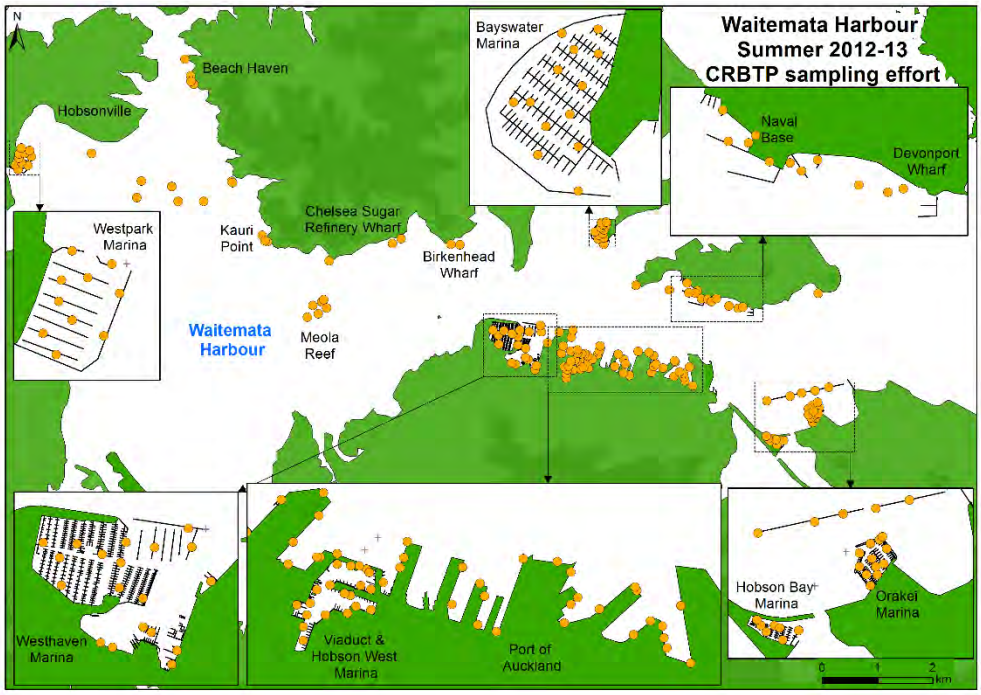


Shore search locations

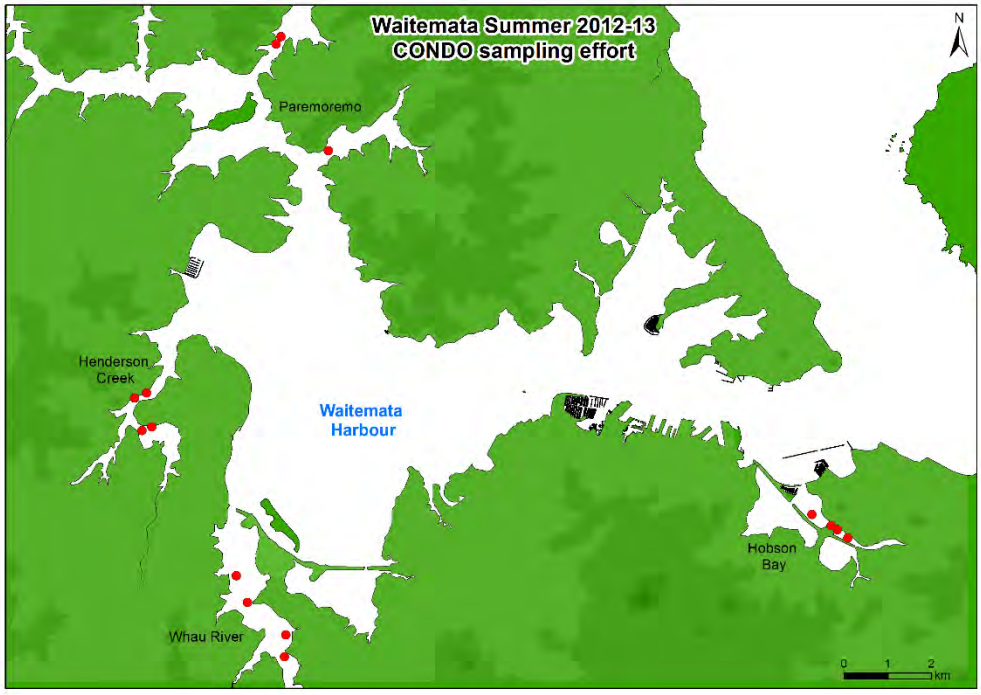


Summer 2012-2013

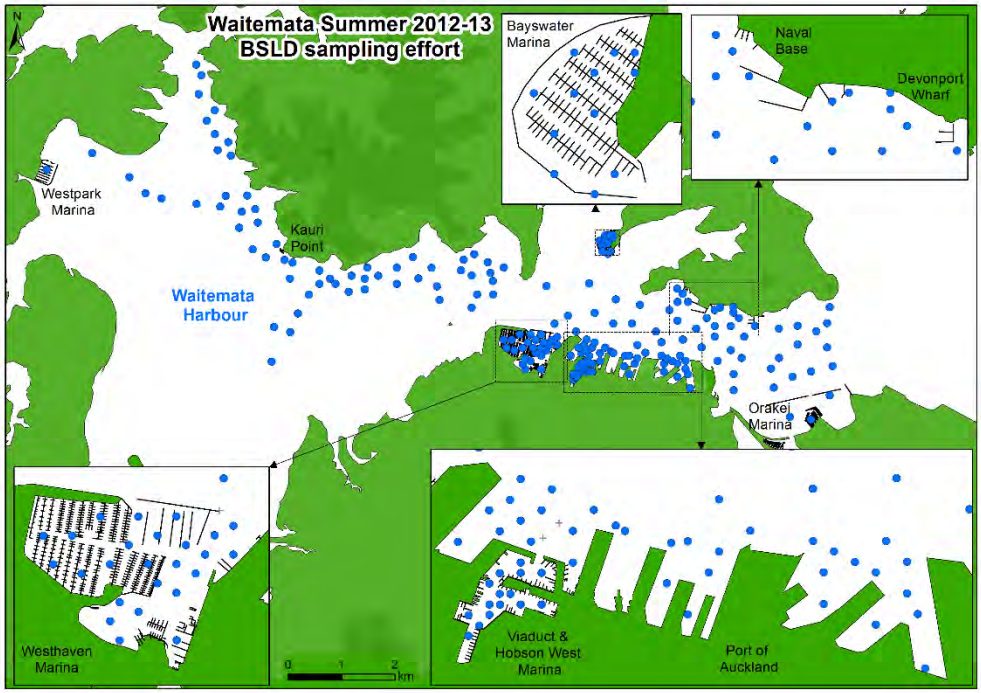
Crab (box) trapping locations



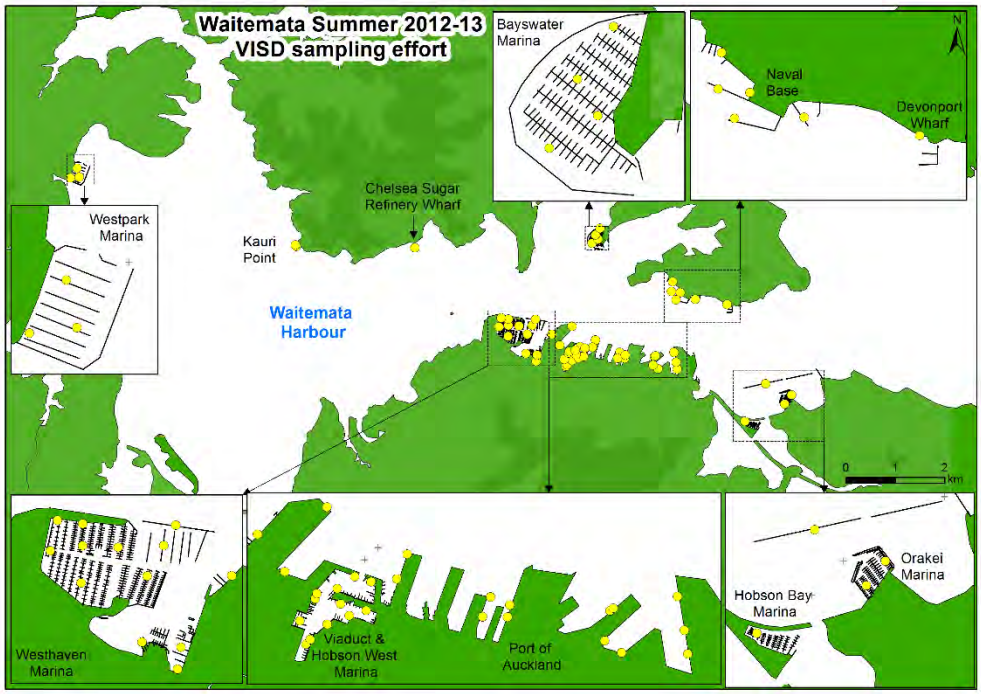
Crab condo locations



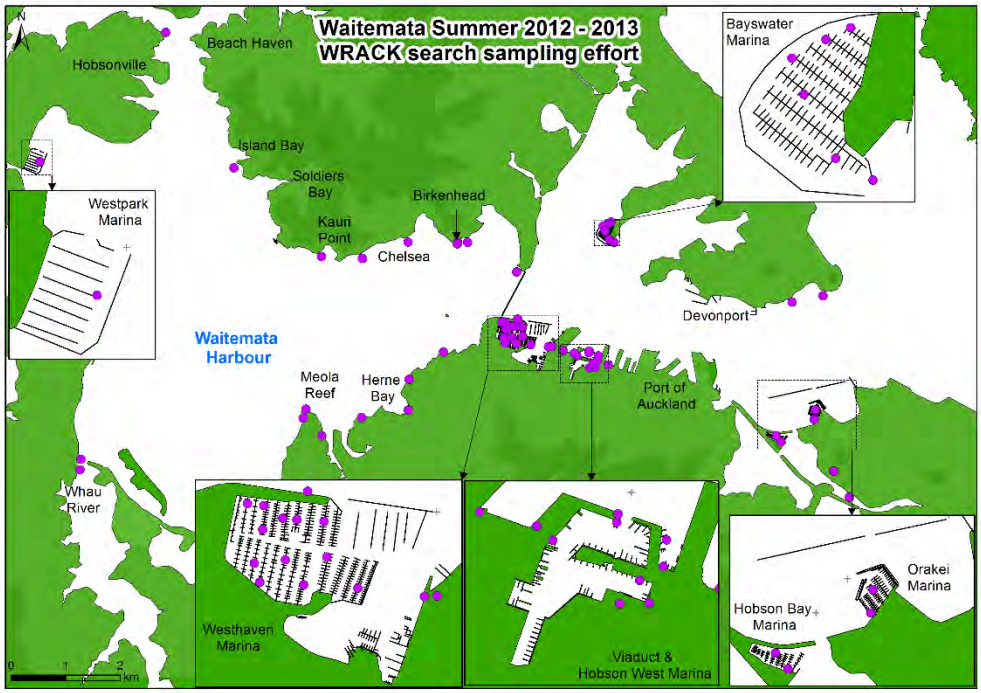
Sledding locations



Dive search locations



Shore search locations

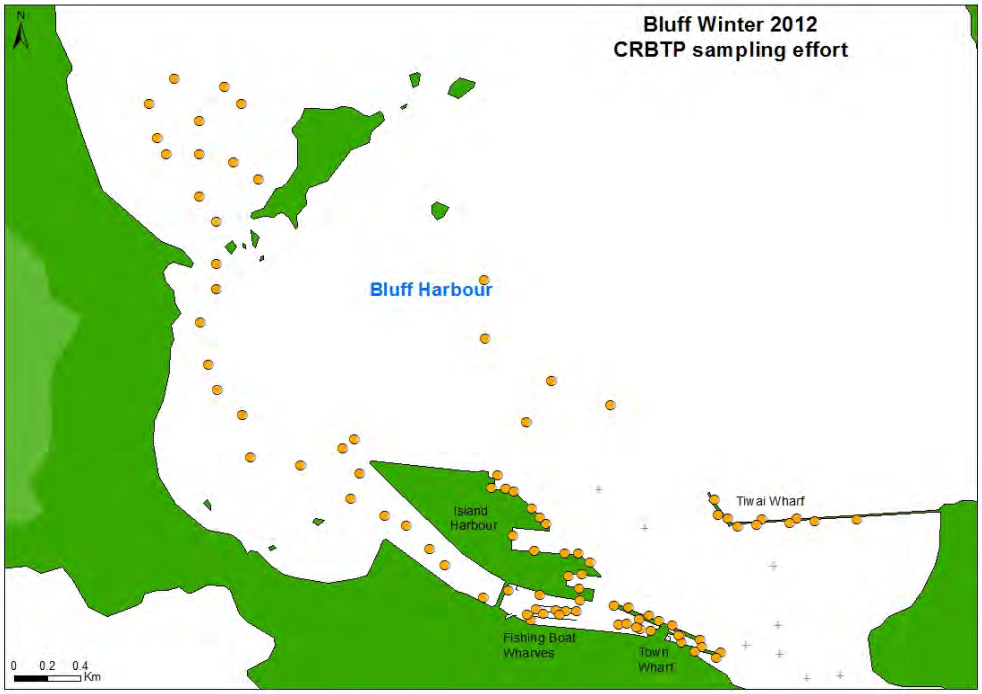


BLUFF HARBOUR

Note: grey crosses indicate navigational markers

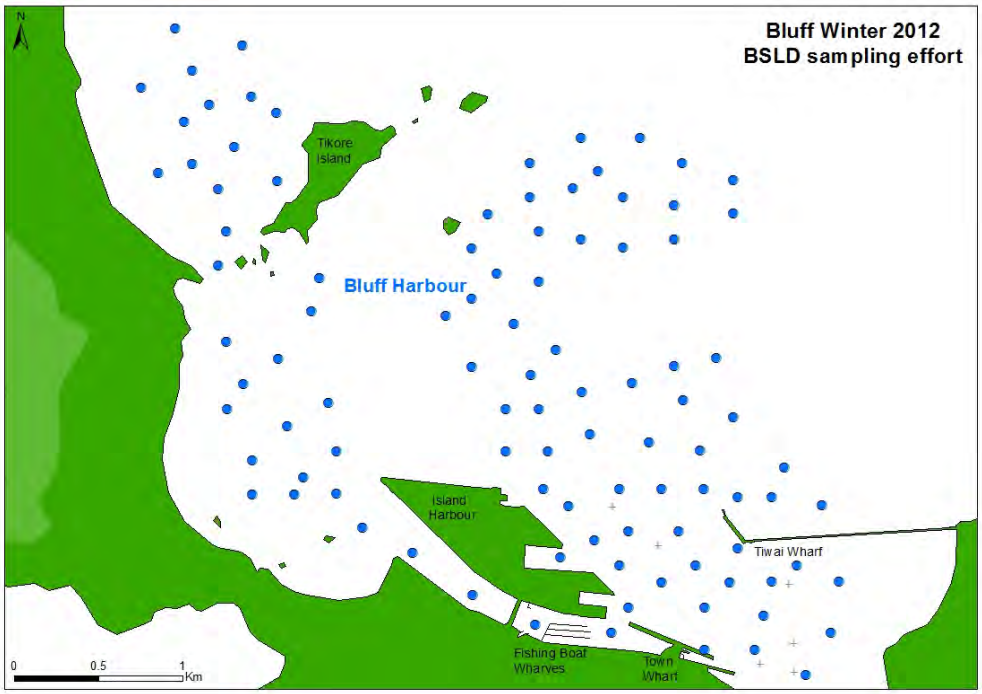
Winter 2012

Crab (box) trapping locations

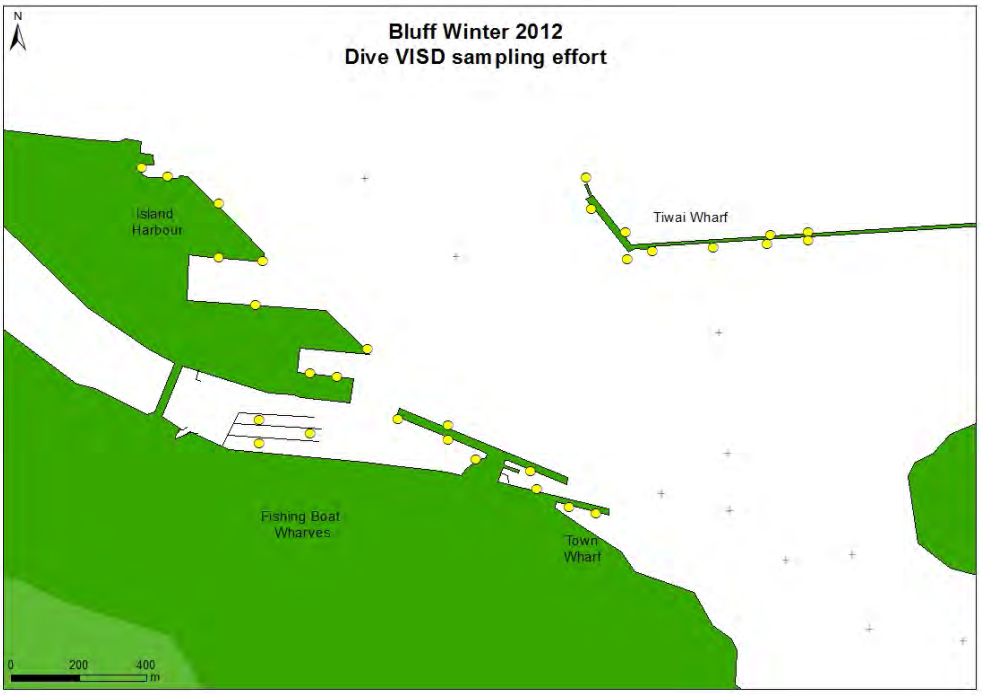


Crab condo locations

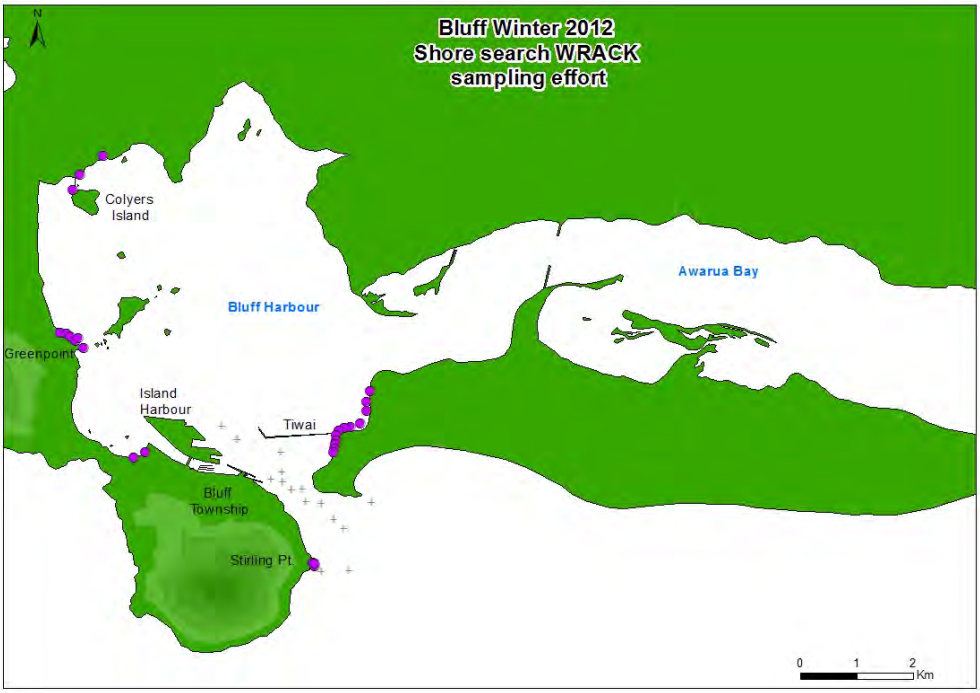
Sledding locations



Dive search locations

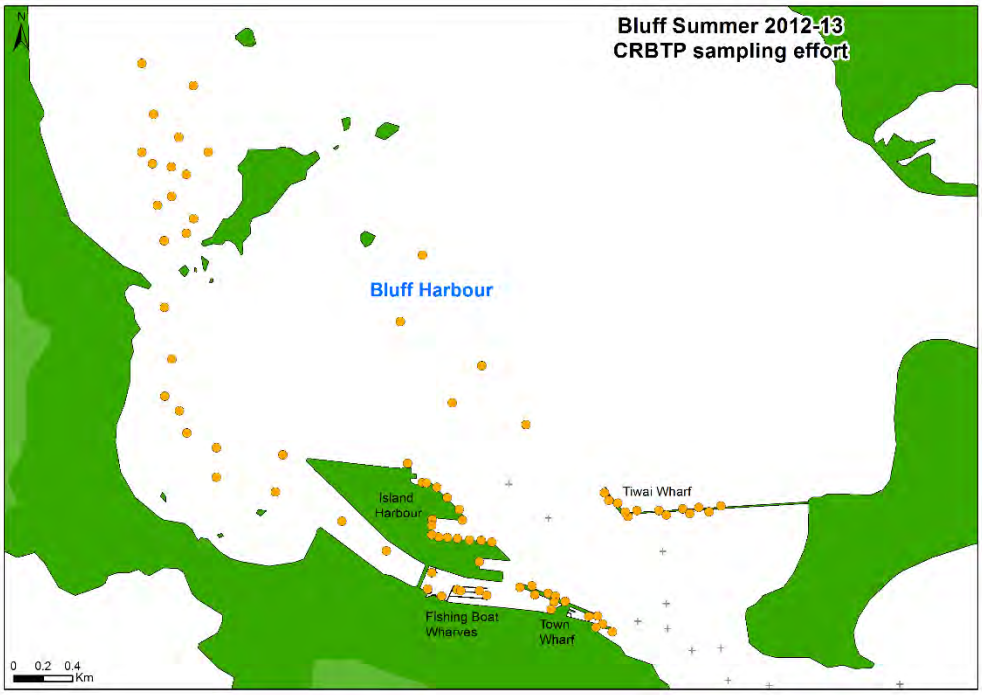


Shore search locations

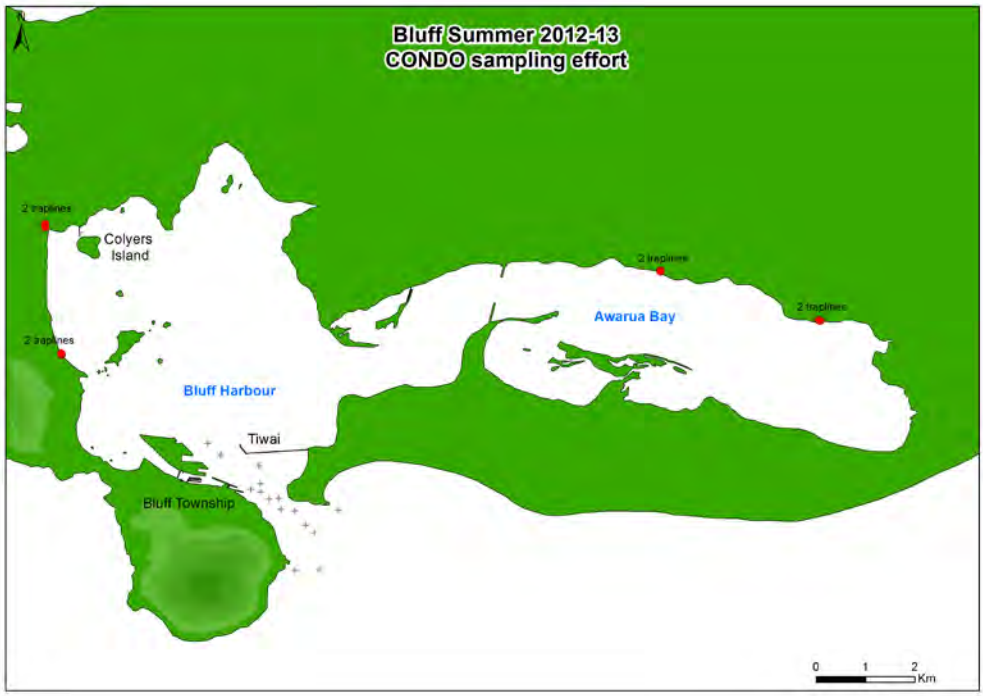


Summer 2012-2013

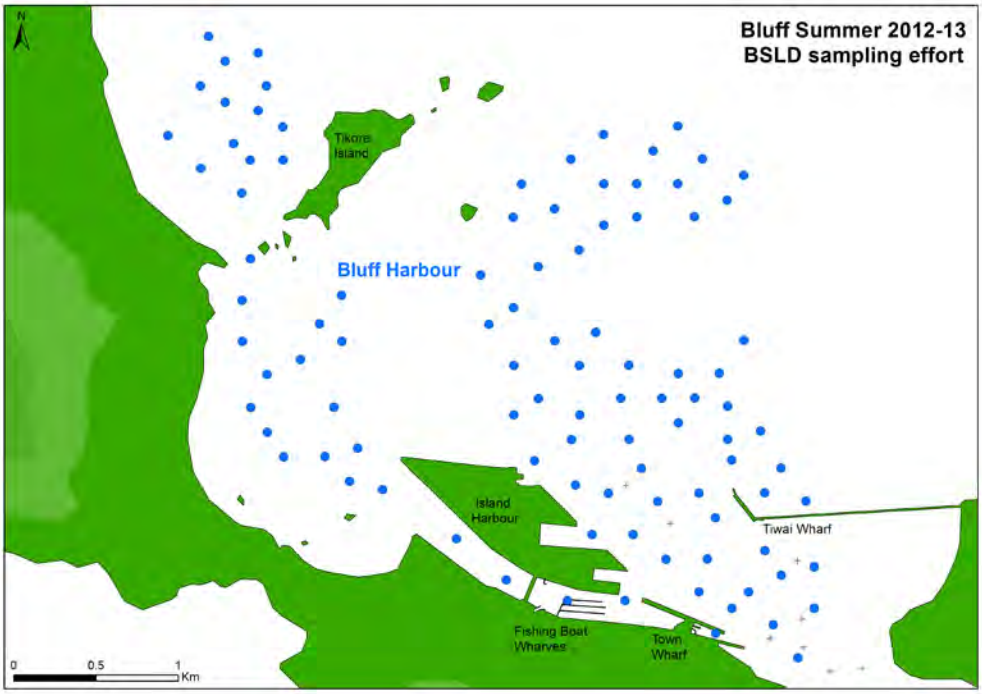
Crab (box) trapping locations



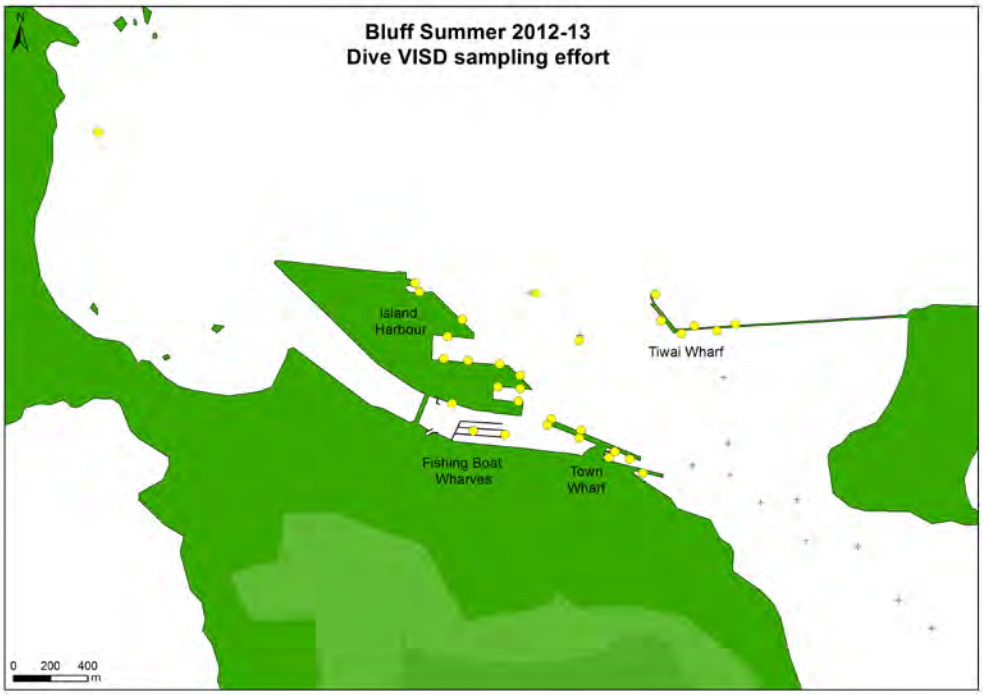
Crab condo locations



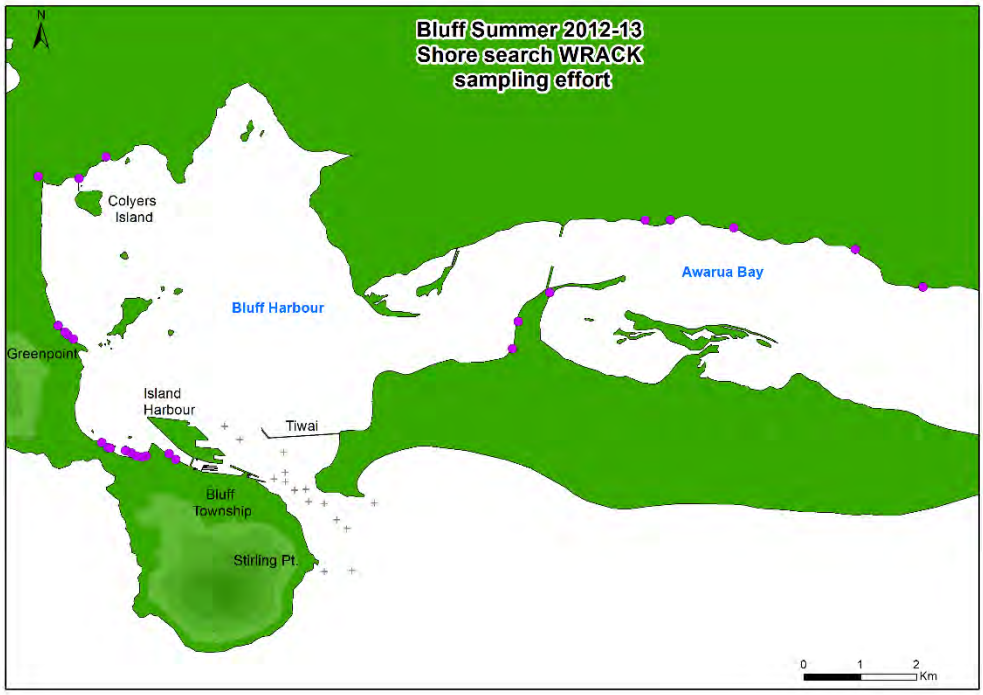
Sledding locations



Dive search locations



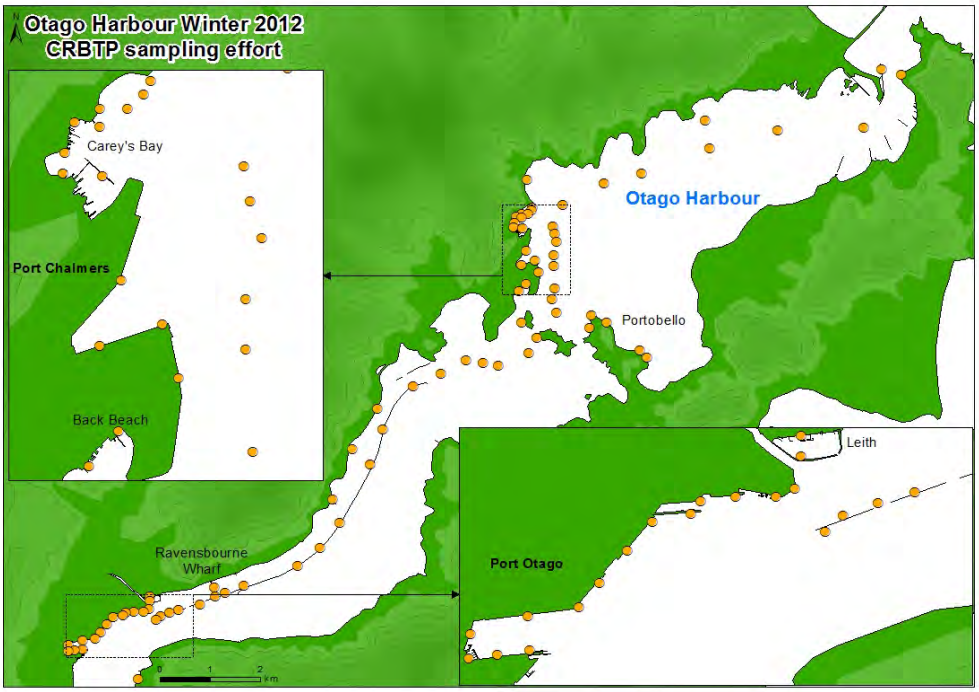
Shore search locations



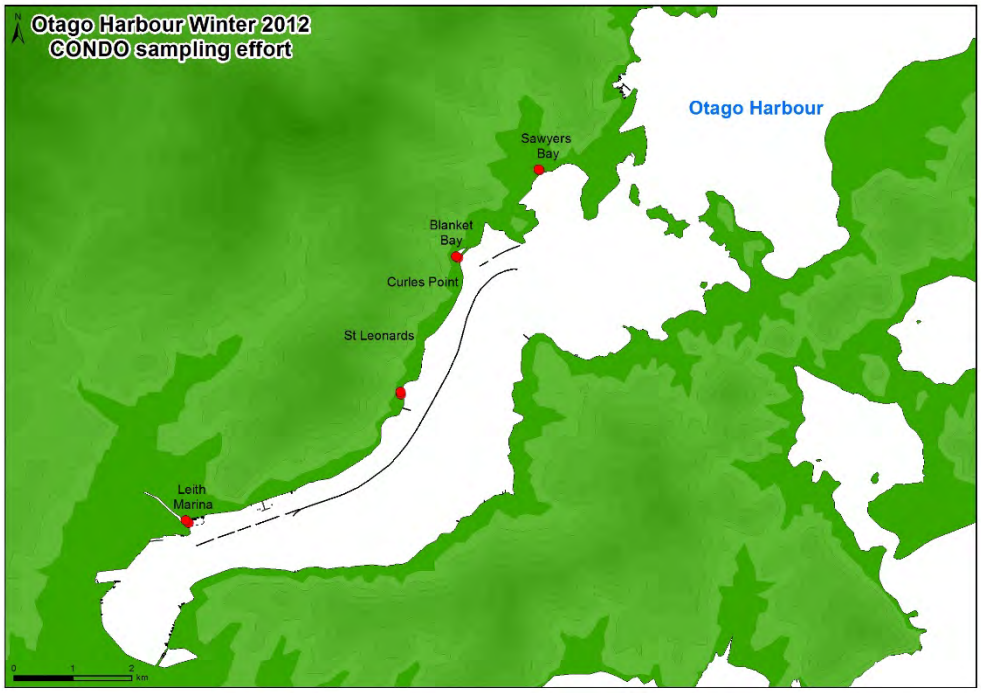
DUNEDIN (OTAGO HARBOUR)

Winter 2012

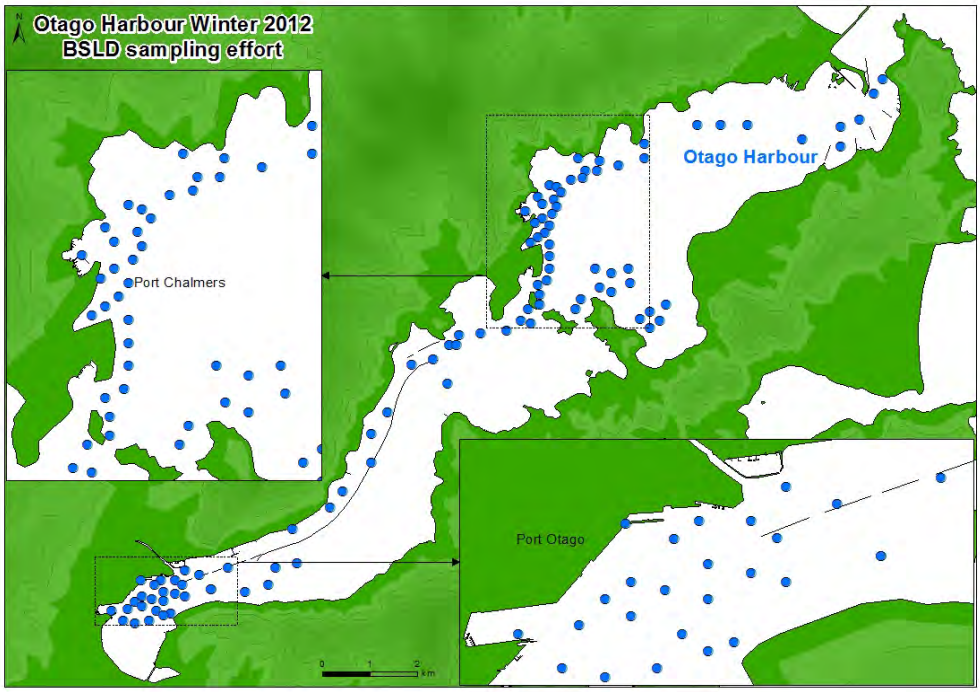
Crab (box) trapping locations



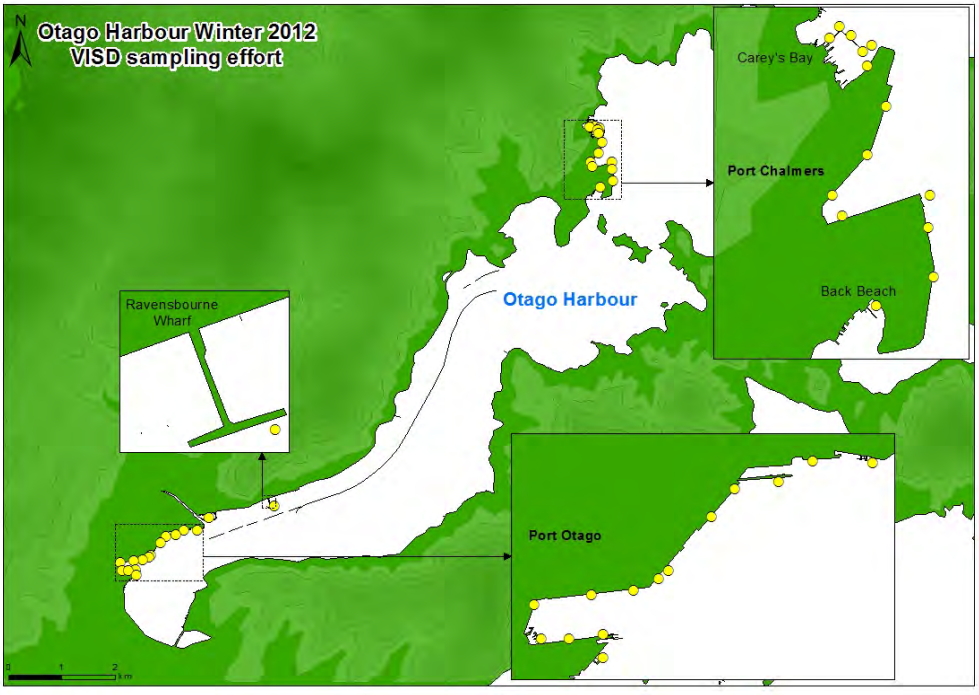
Crab condo locations



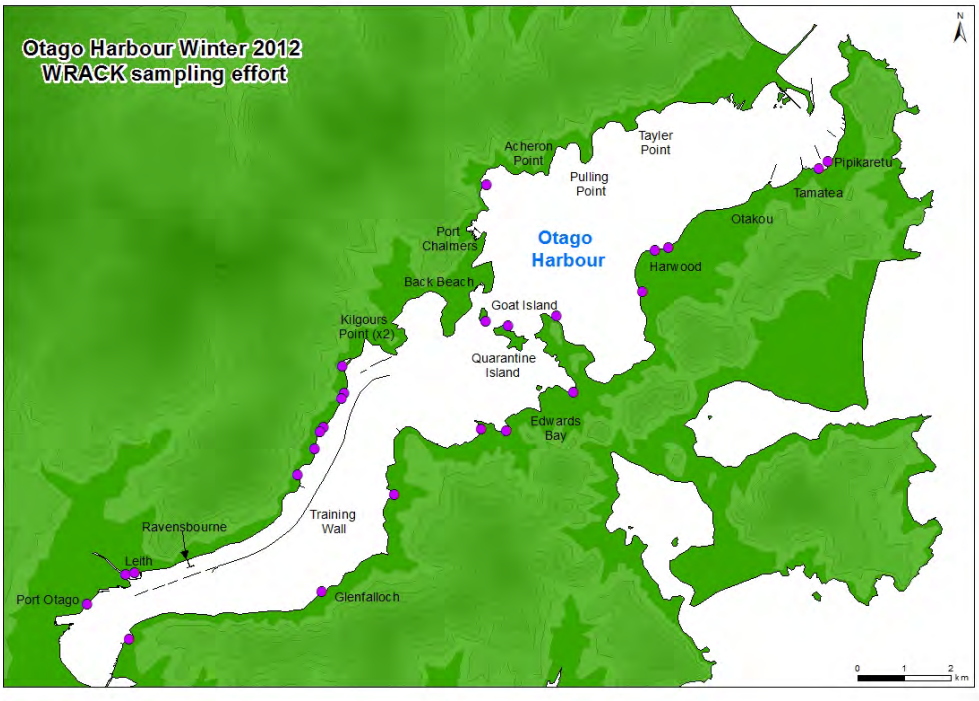
Sledding locations



Dive search locations

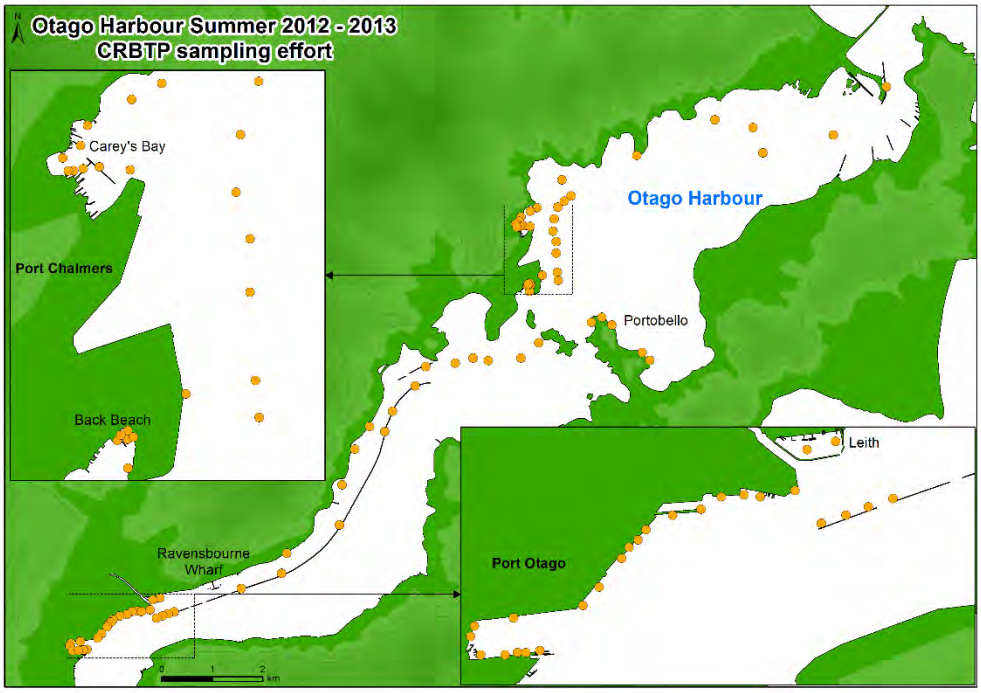


Shore search locations

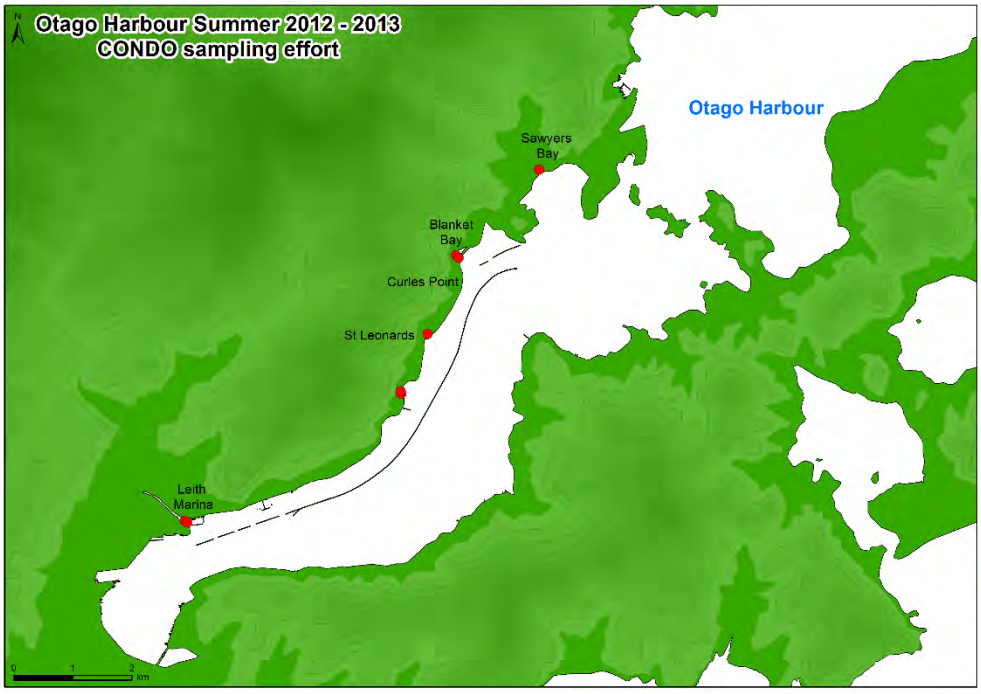


Summer 2012-2013

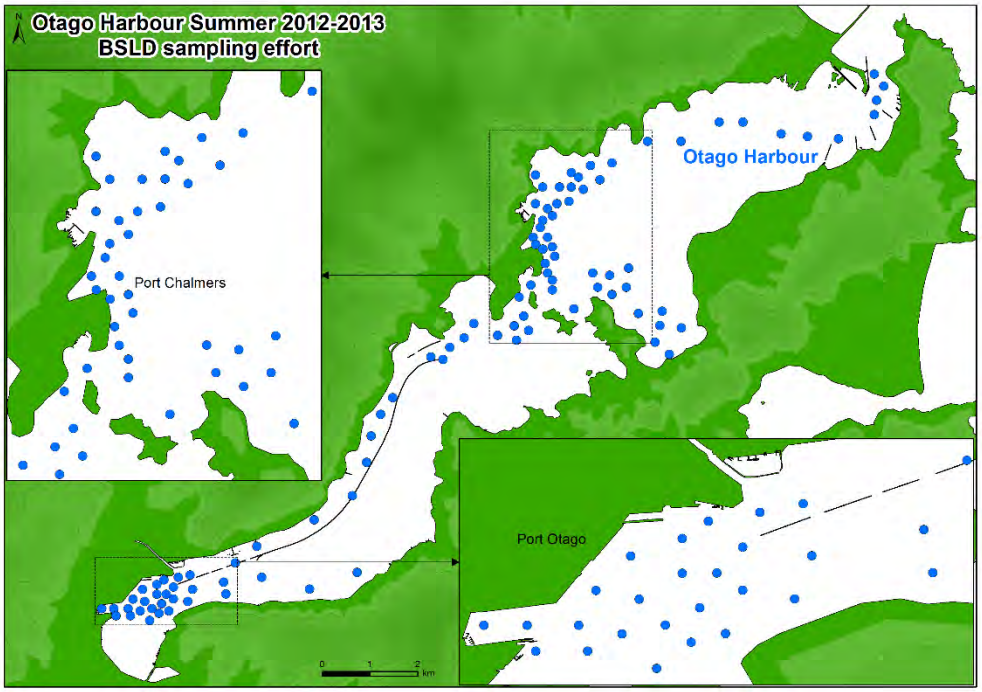
Crab (box) trapping locations



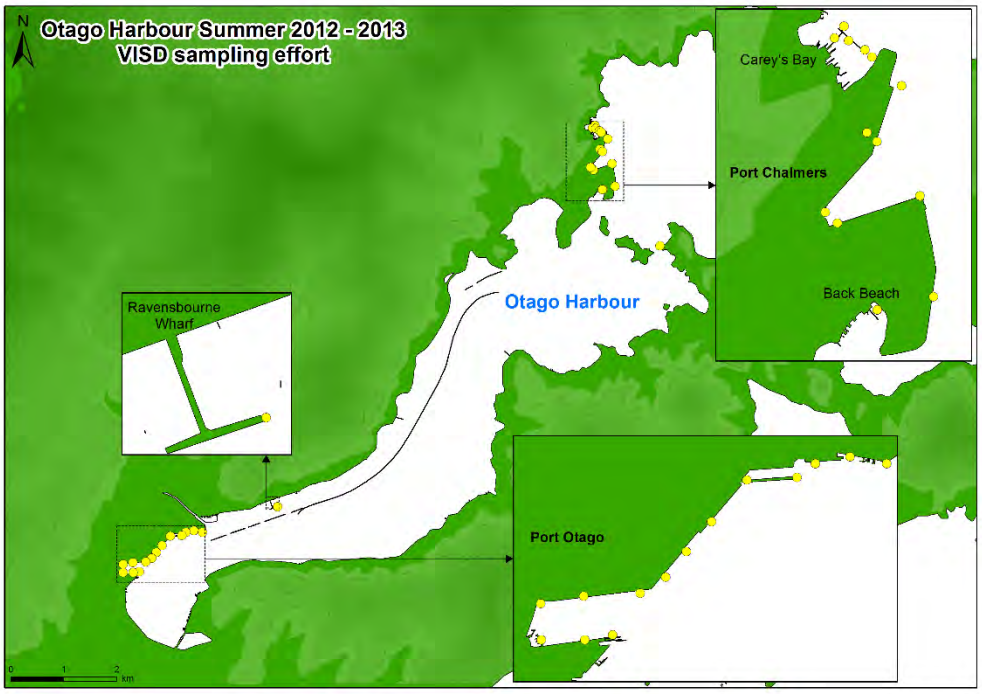
Crab condo locations



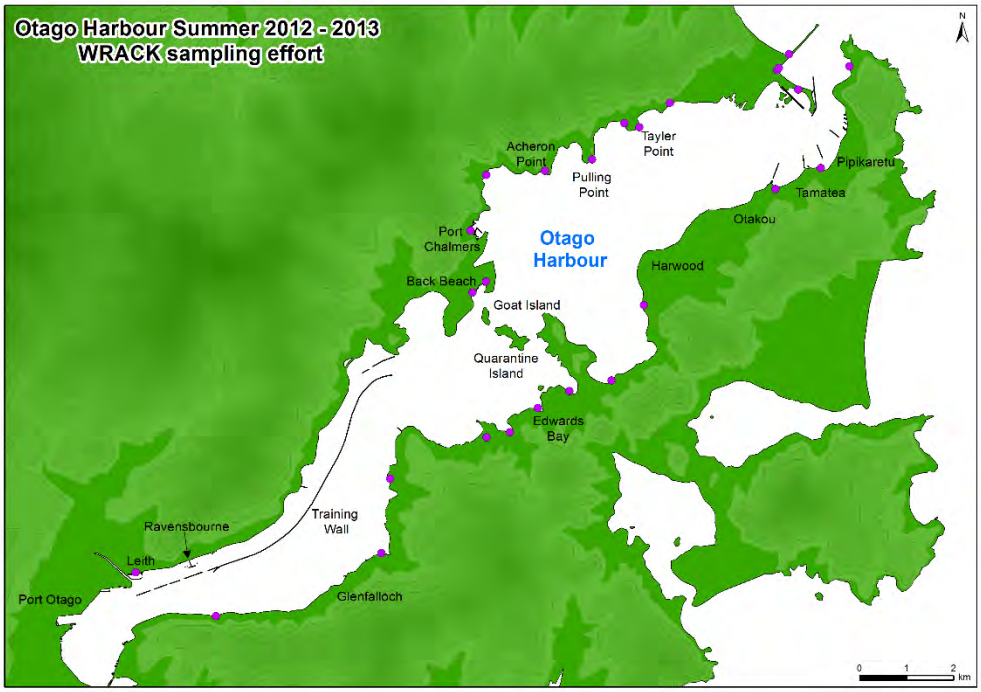
Sledding locations



Dive search locations



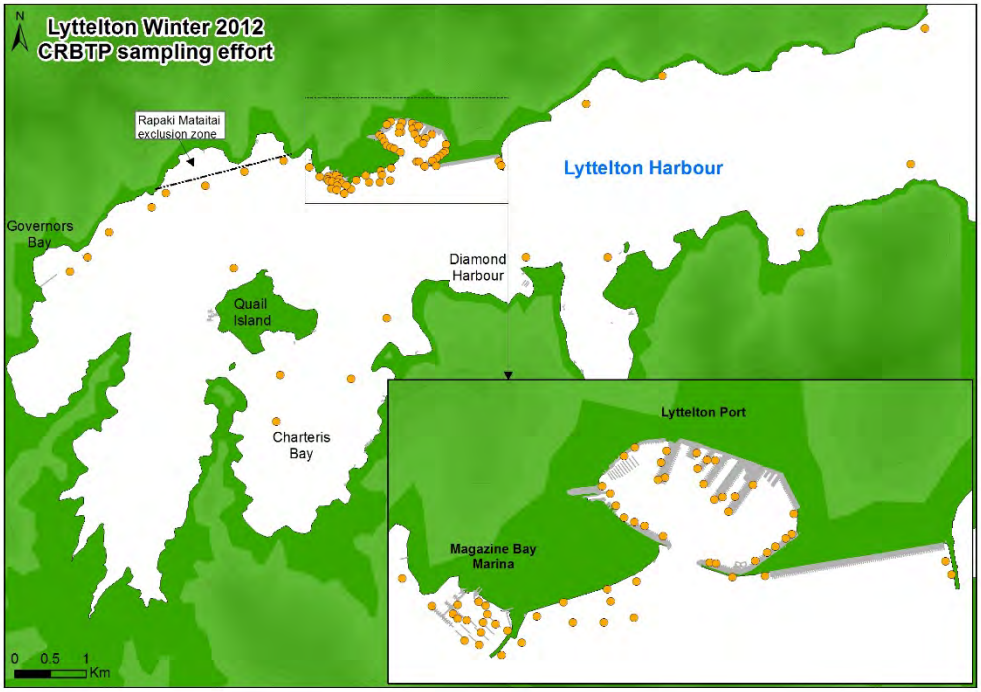
Shore search locations



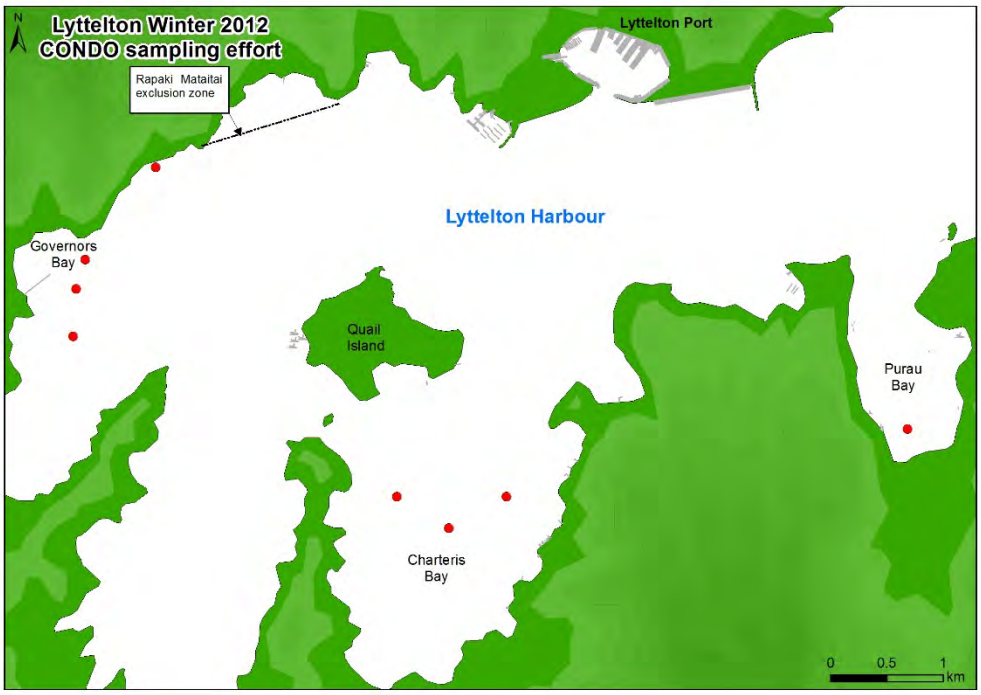
LYTTELTON HARBOUR

Winter 2012

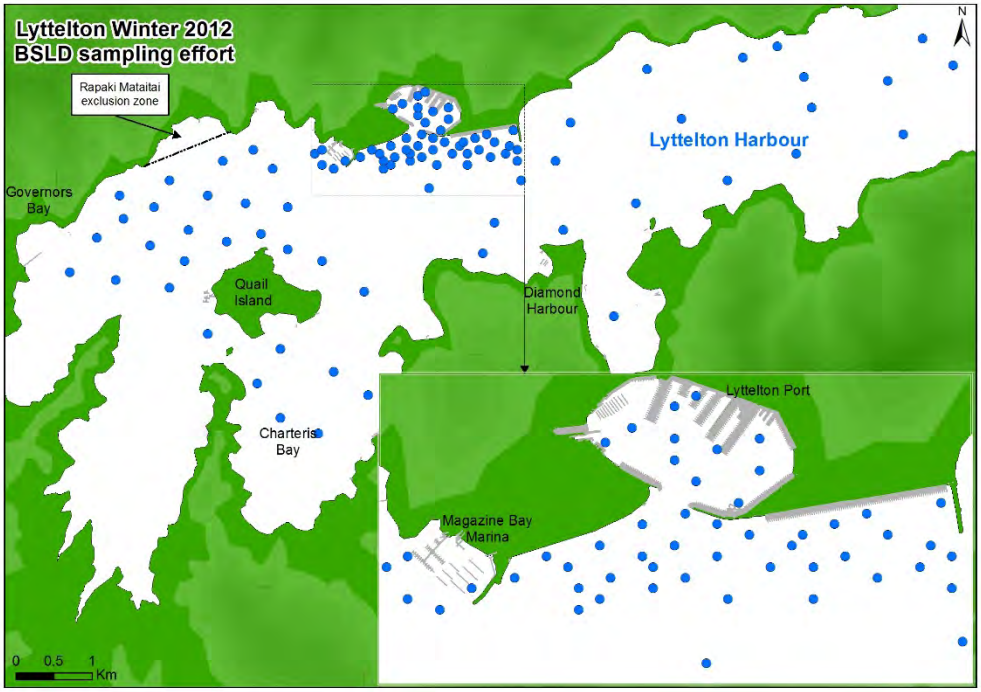
Crab (box) trapping locations



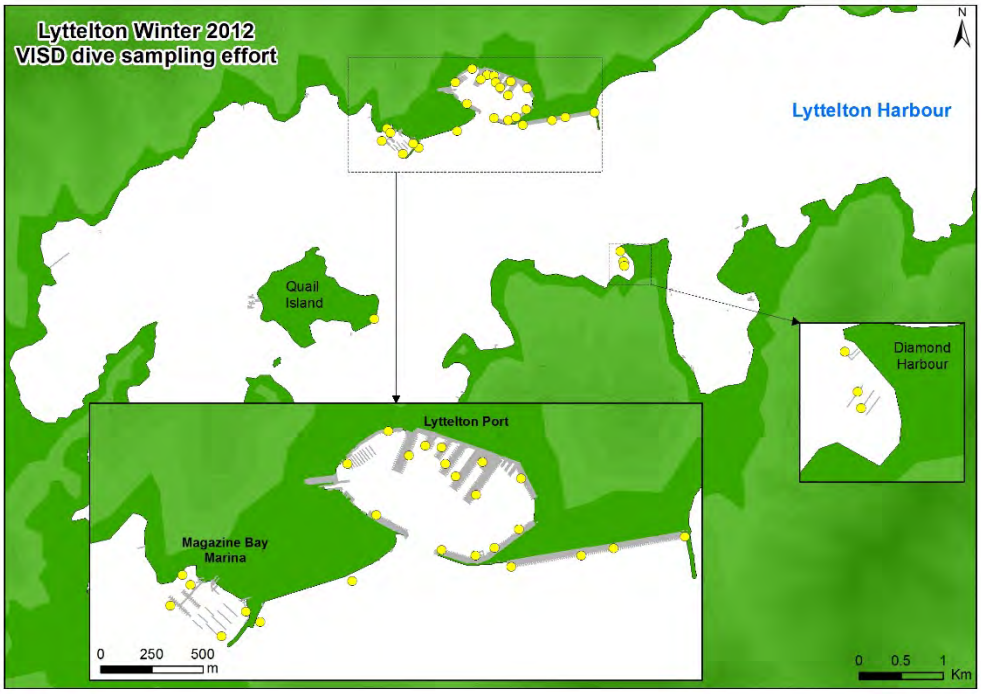
Crab condo locations



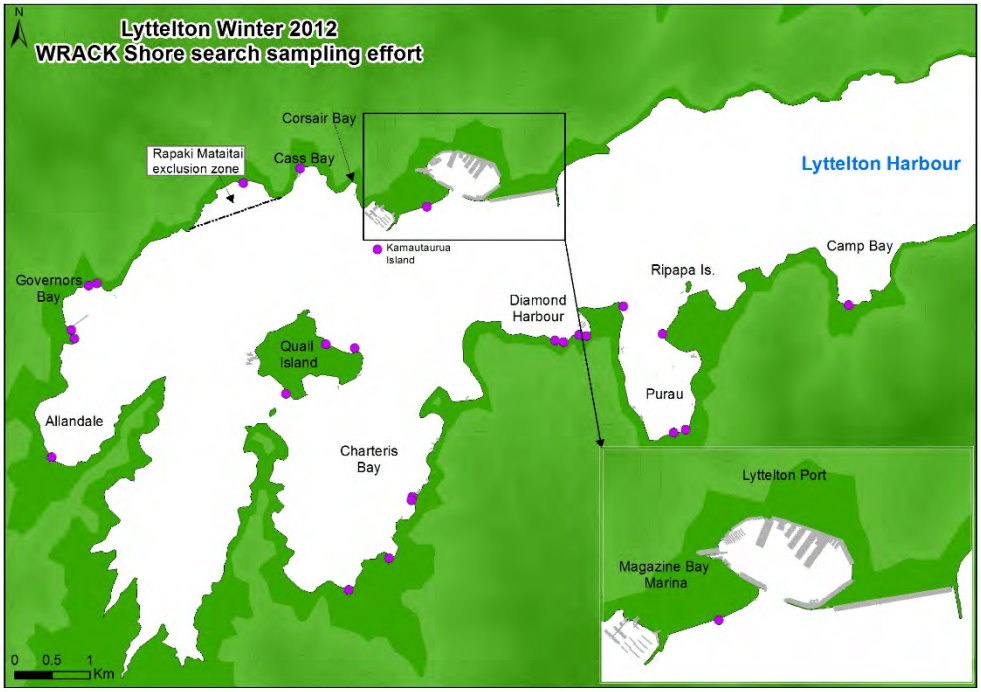
Sledding locations



Dive search locations

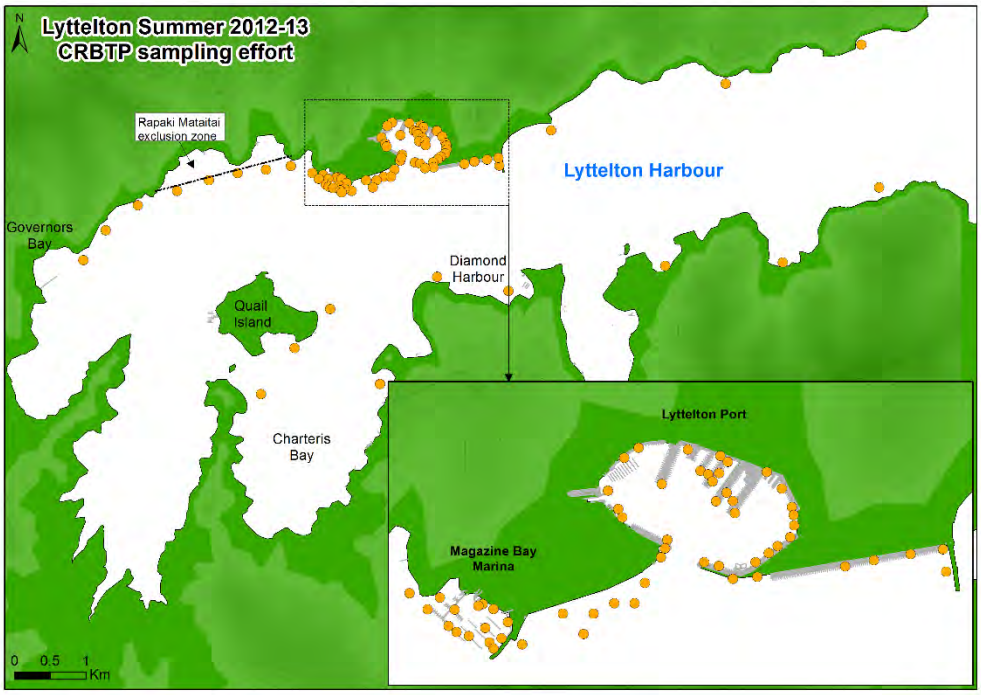


Shore search locations

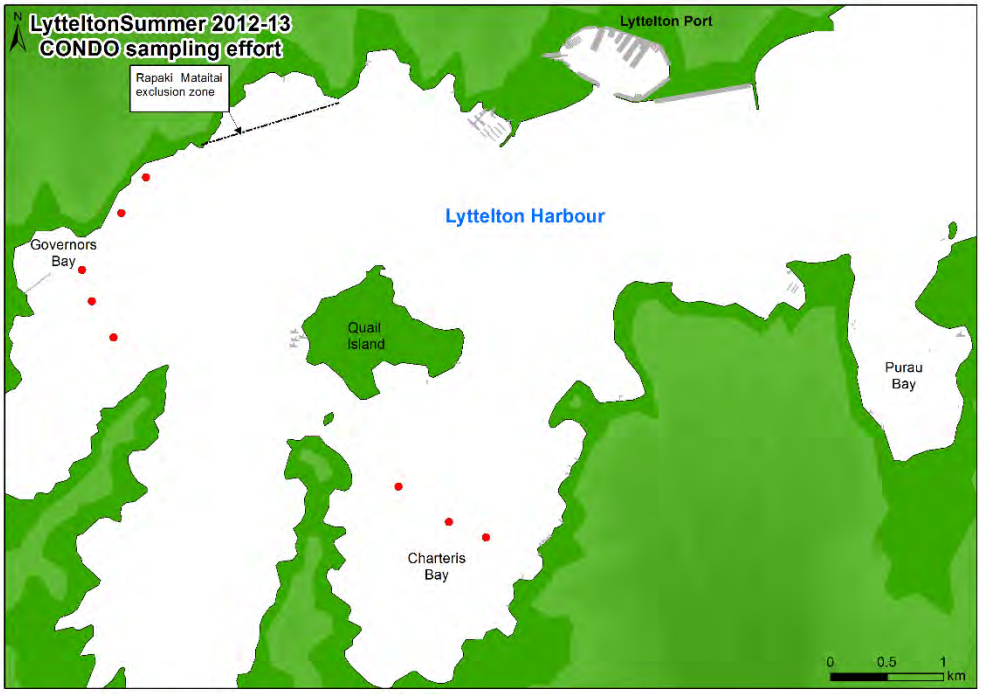


Summer 2012-2013

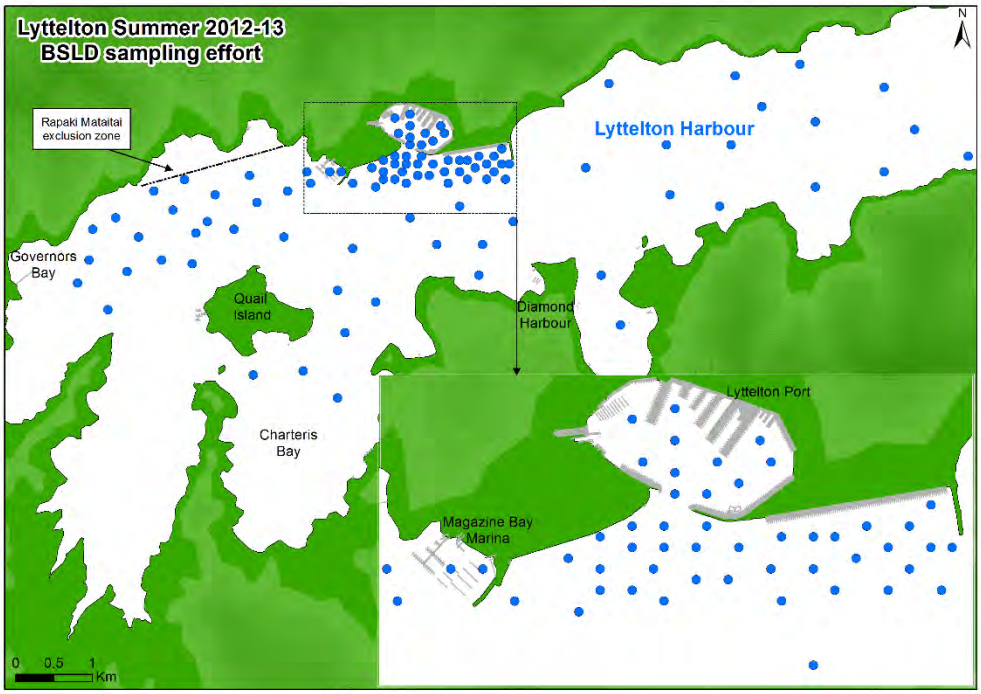
Crab (box) trapping locations



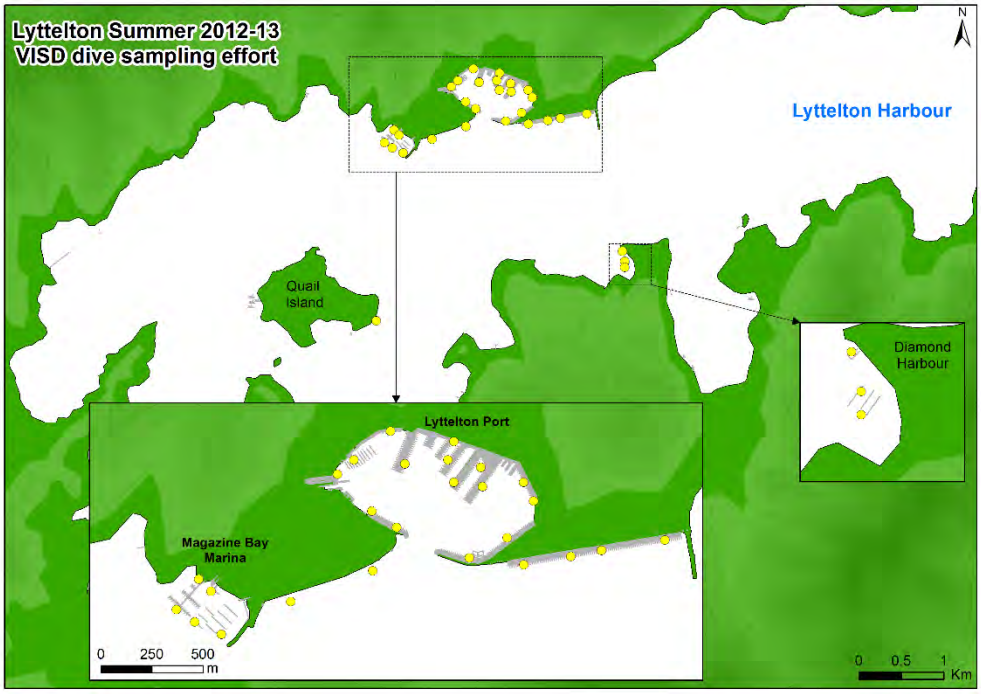
Crab condo locations



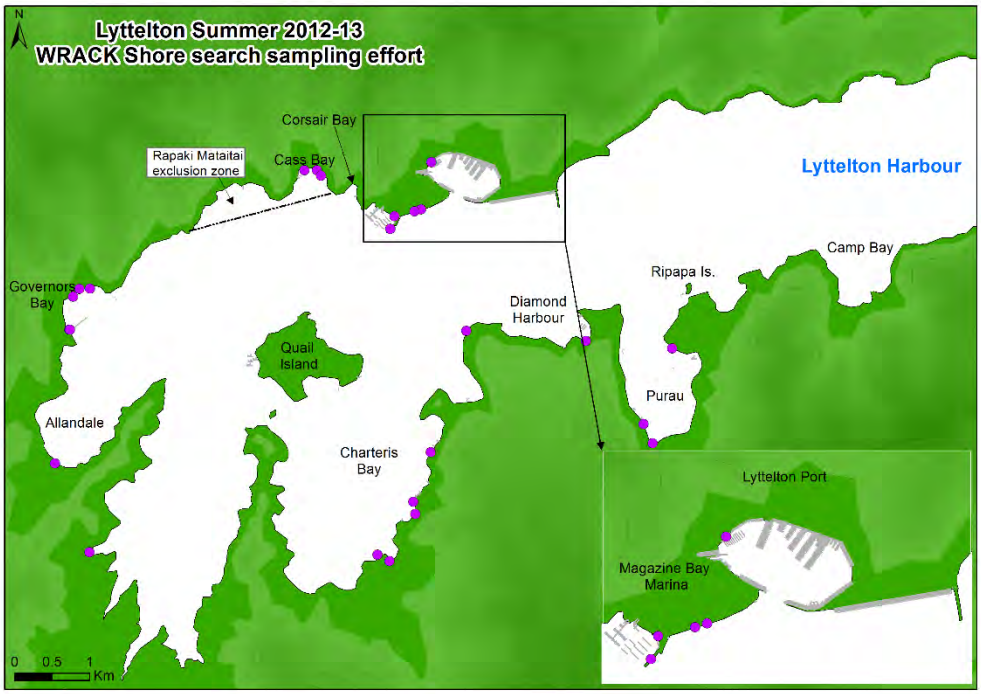
Sledding locations



Dive search locations



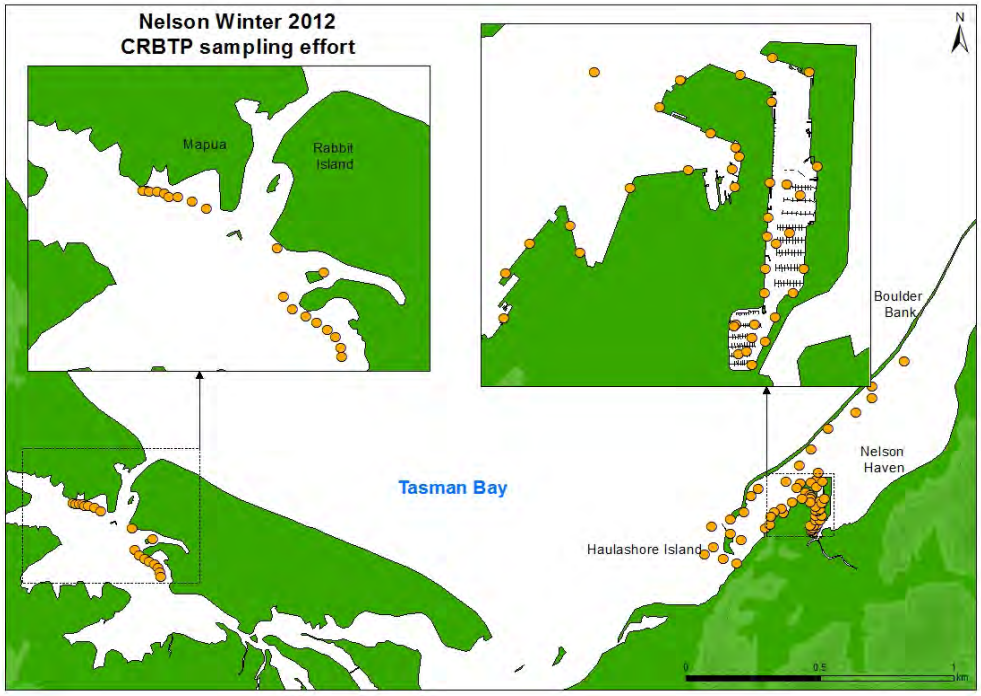
Shore search locations



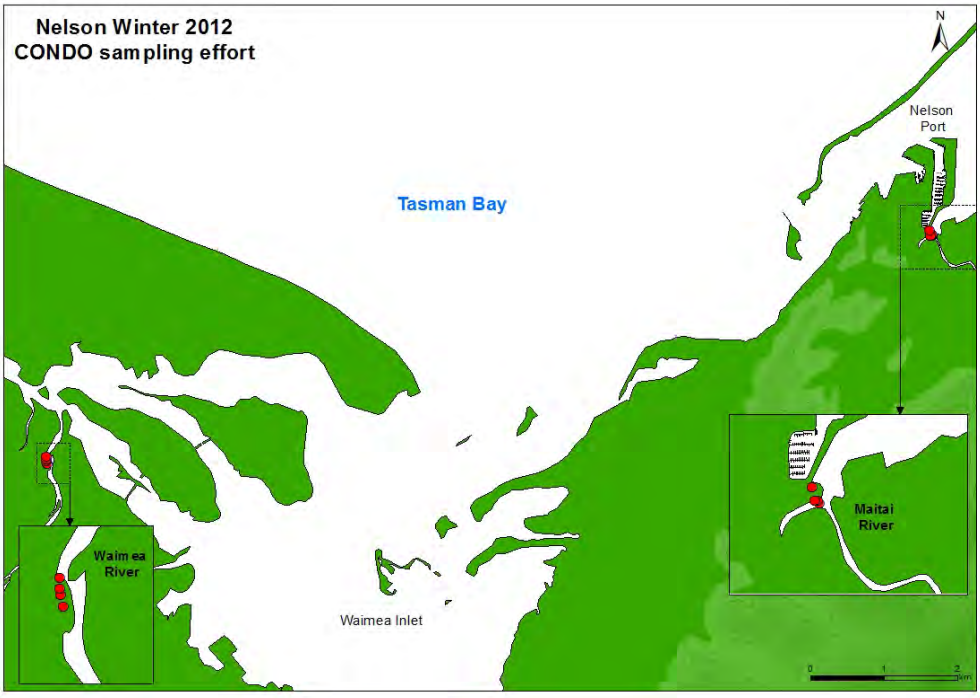
NELSON

Winter 2012

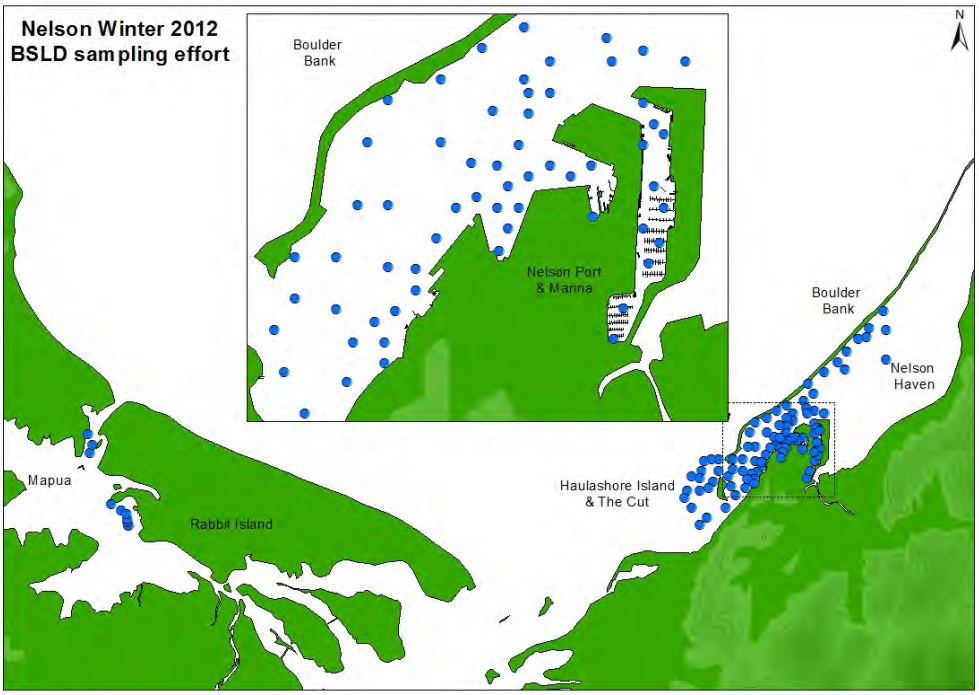
Crab (box) trapping locations



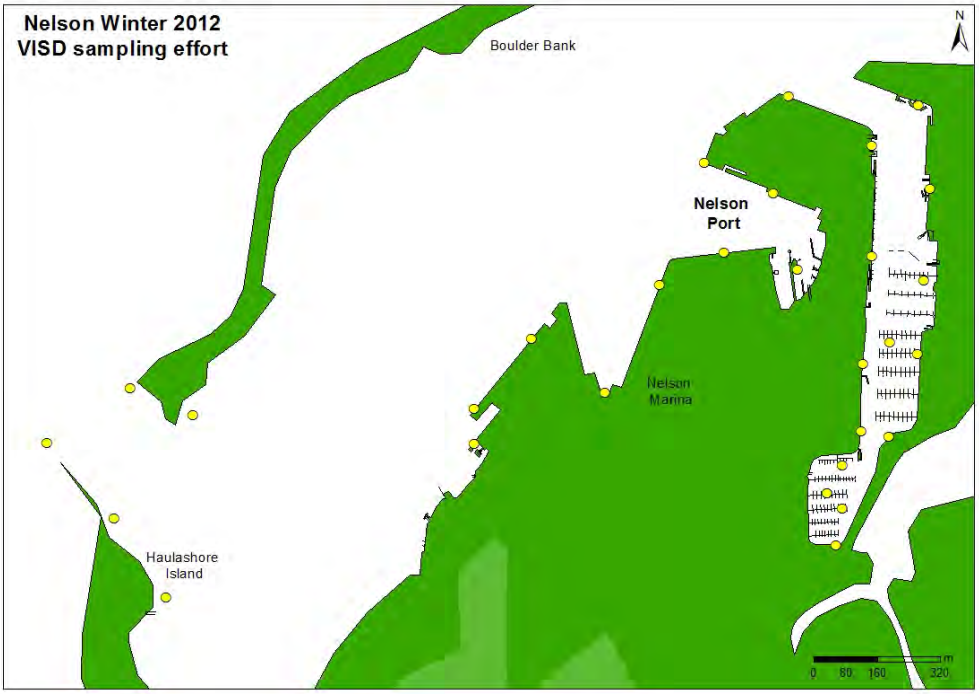
Crab condo locations



Sledding locations



Dive search locations



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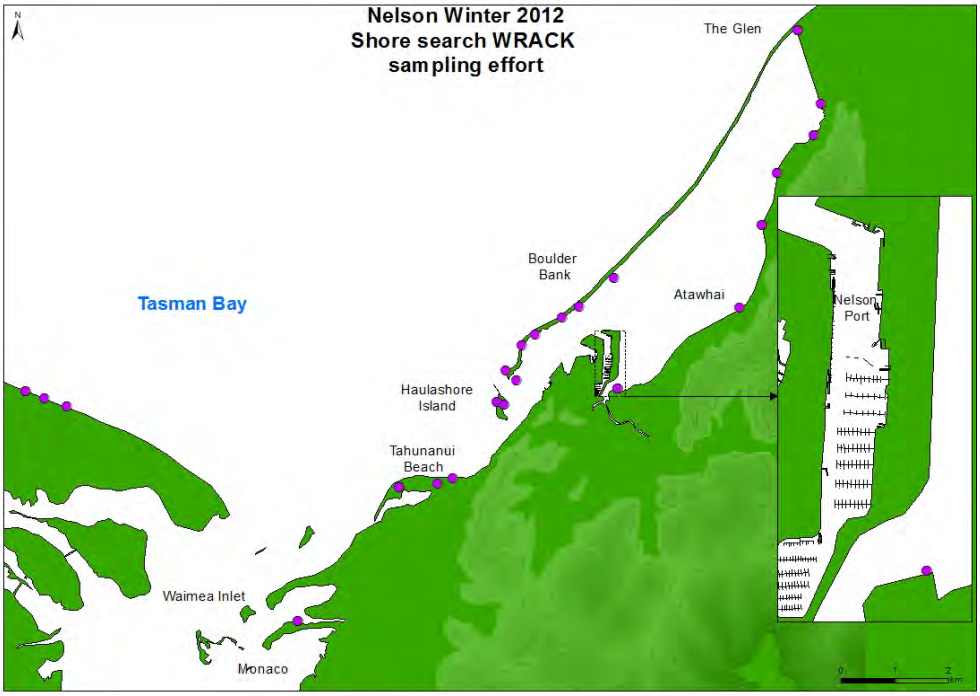
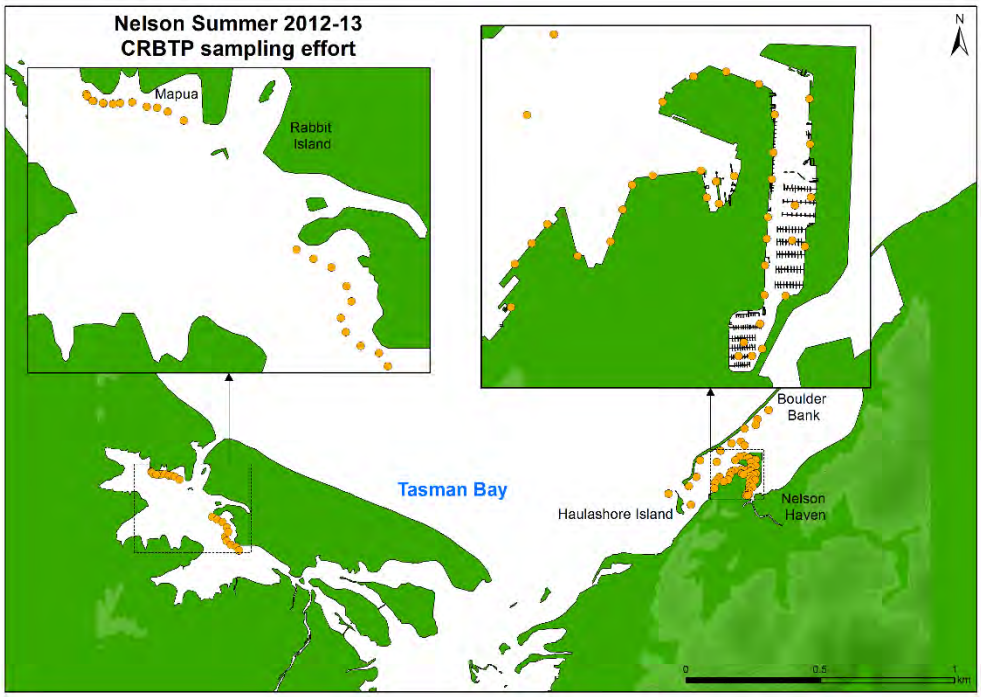
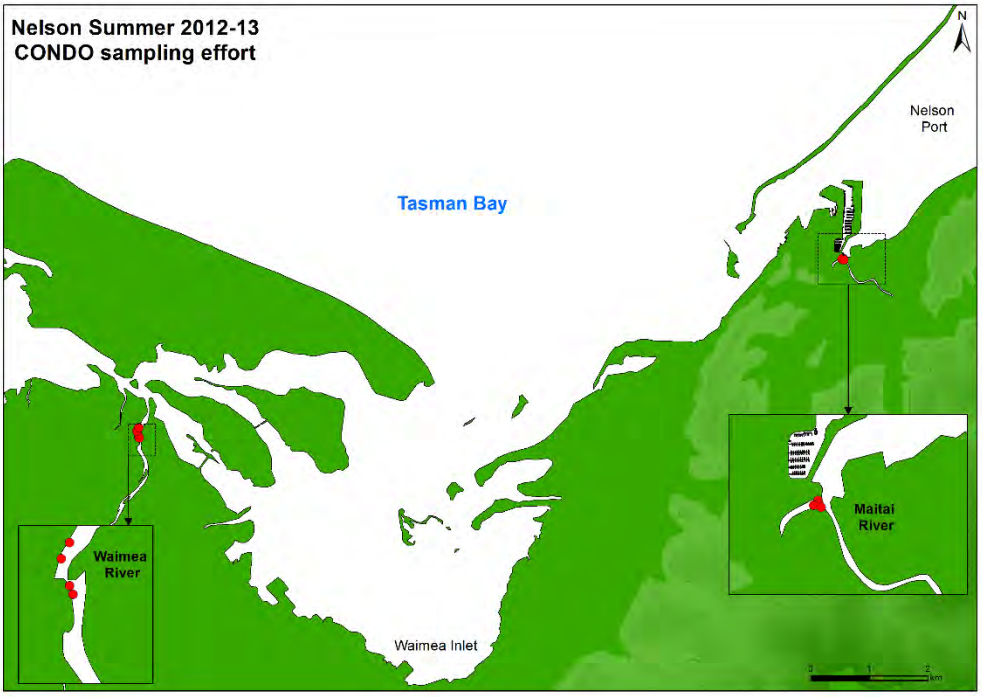


Summer 2012-2013

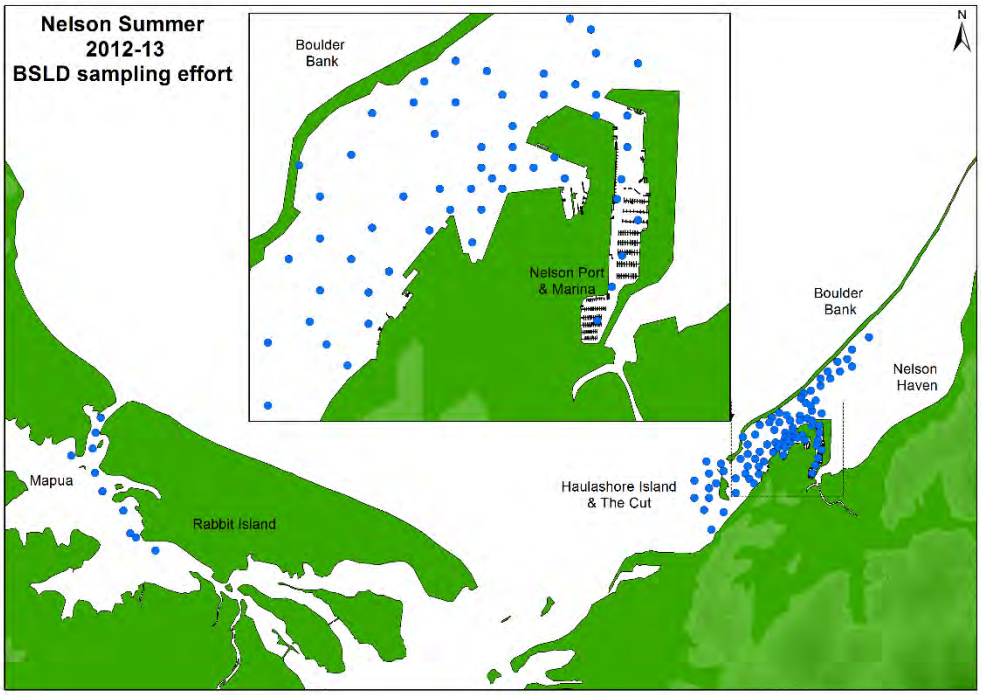
Crab (box) trapping locations



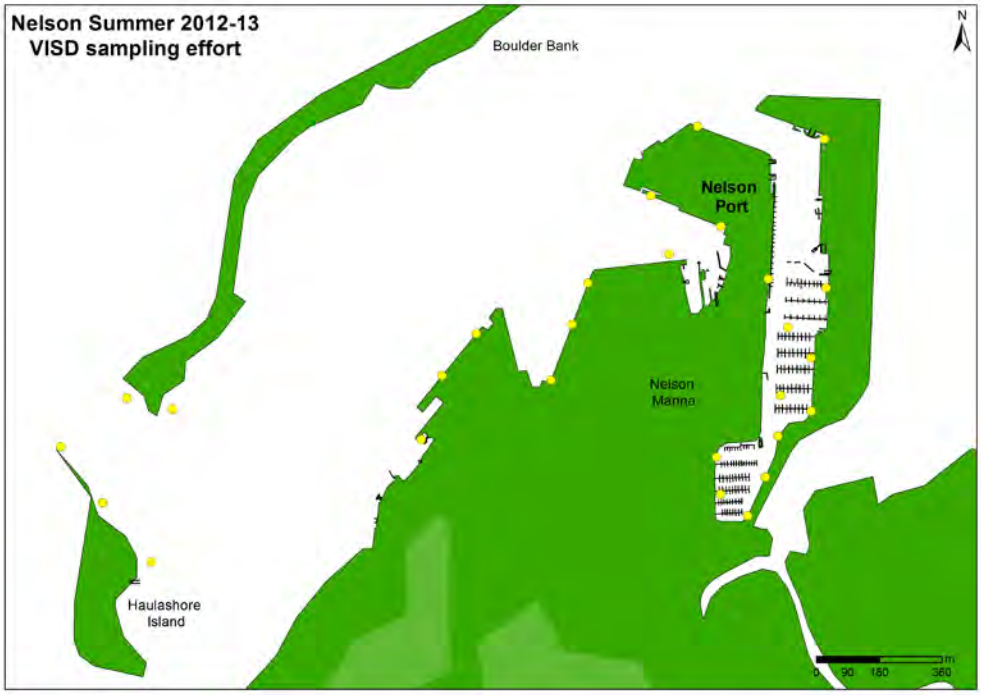
Crab condo locations



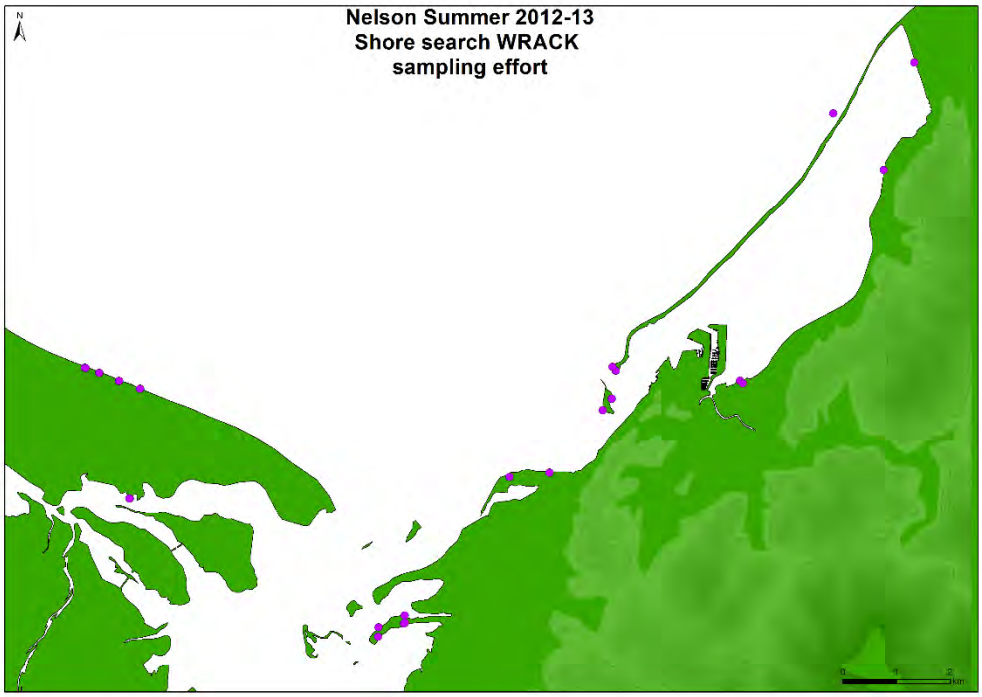
Sledding locations



Dive search locations



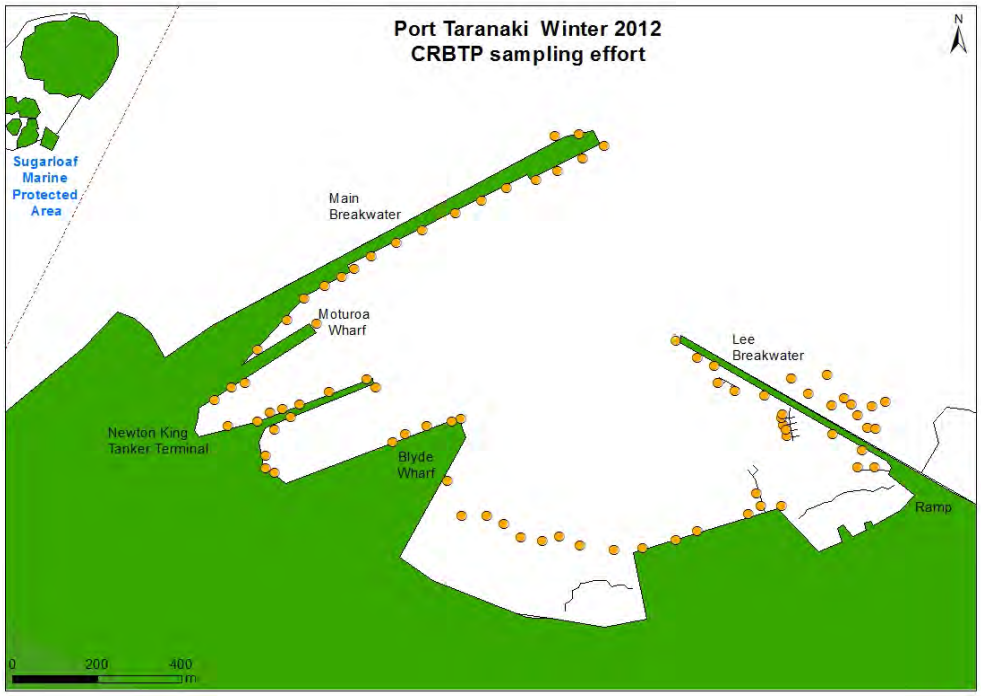
Shore search locations



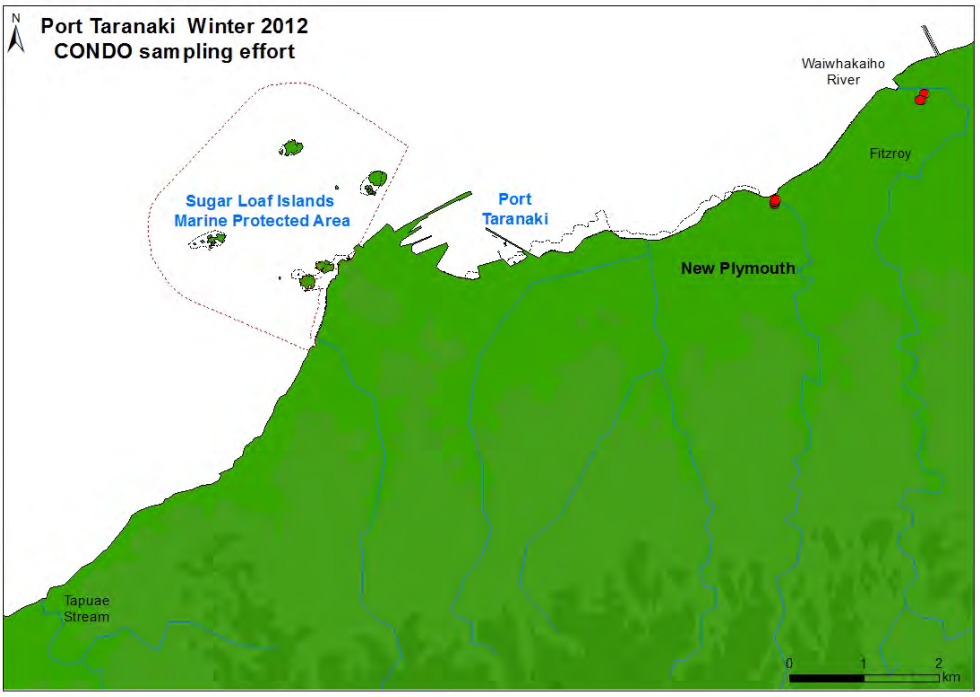
NEW PLYMOUTH

Winter 2012

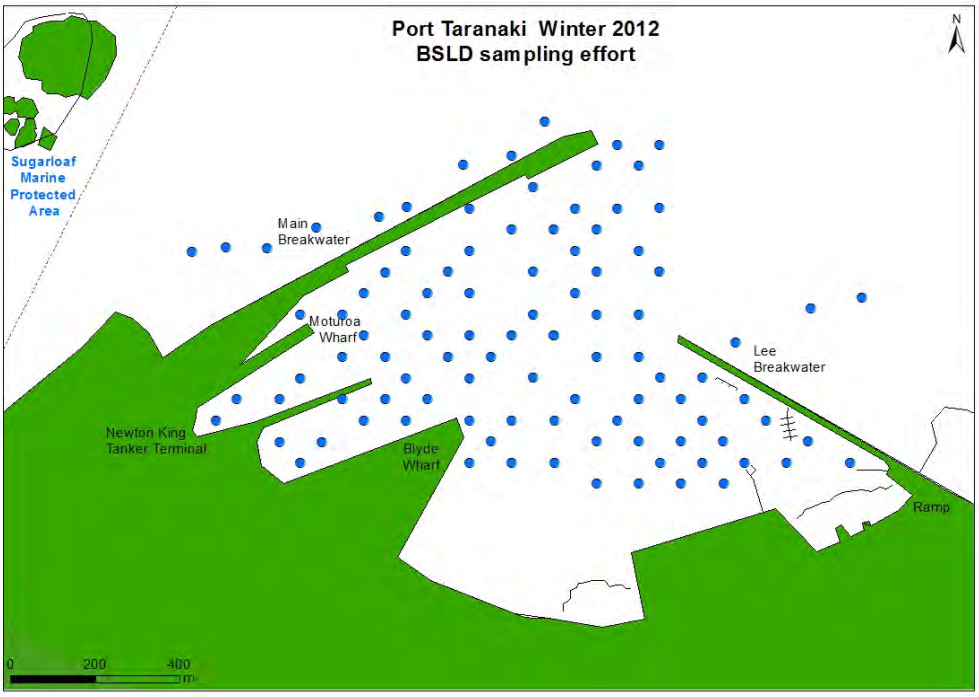
Crab (box) trapping locations



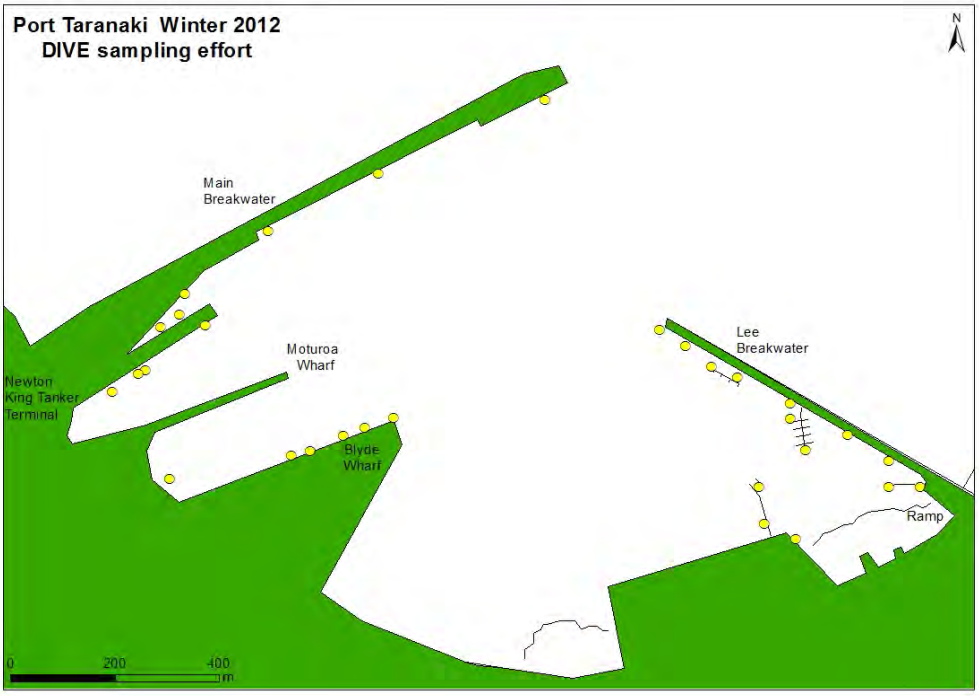
Crab condo locations



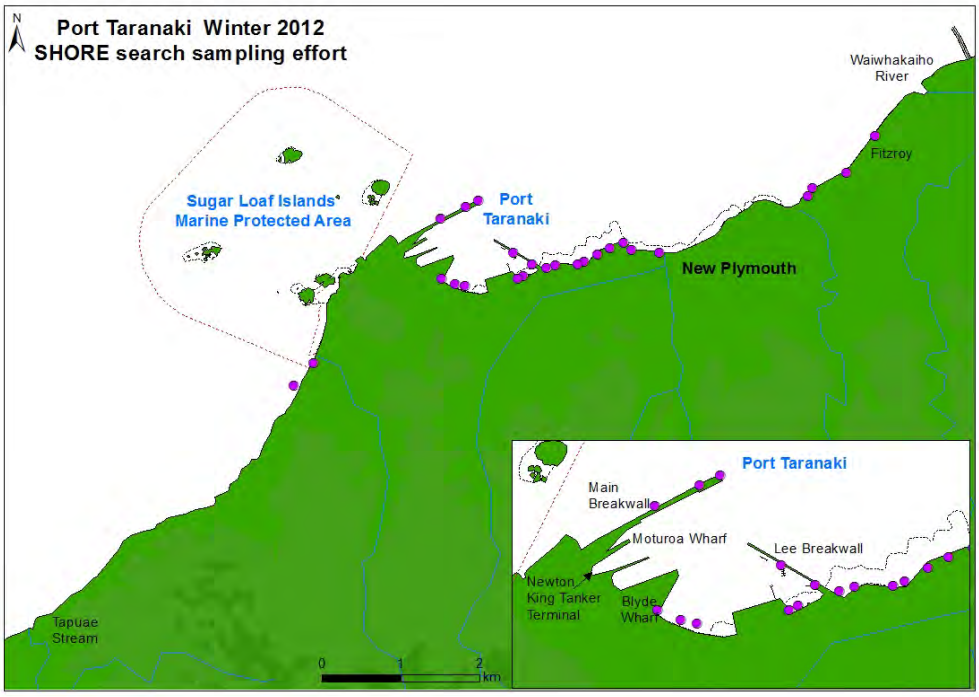
Sledding locations



Dive search locations

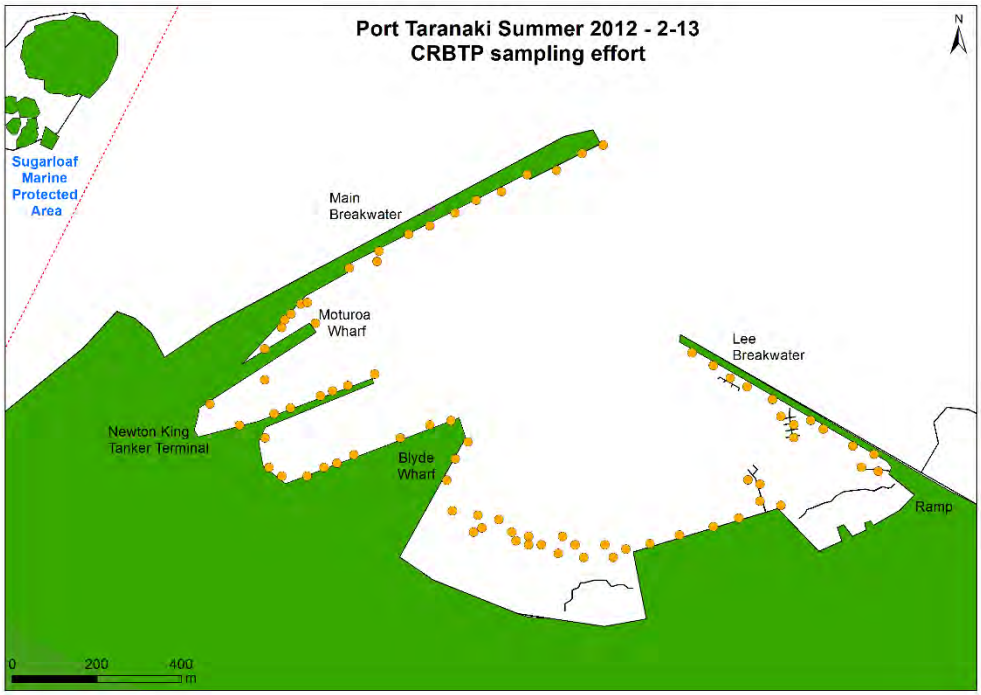


Shore search locations

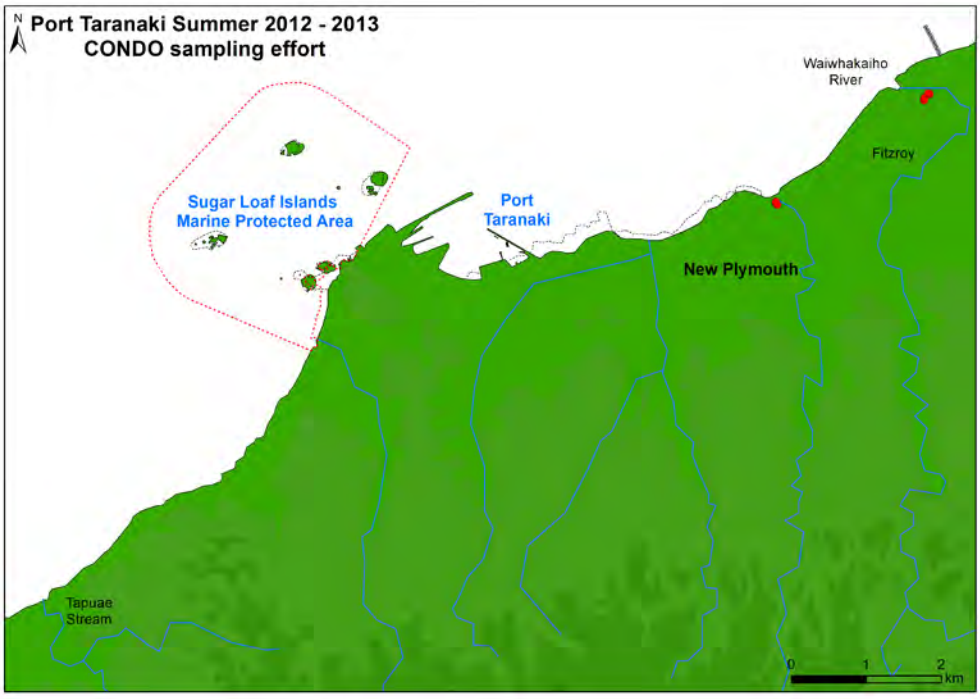


Summer 2012-2013

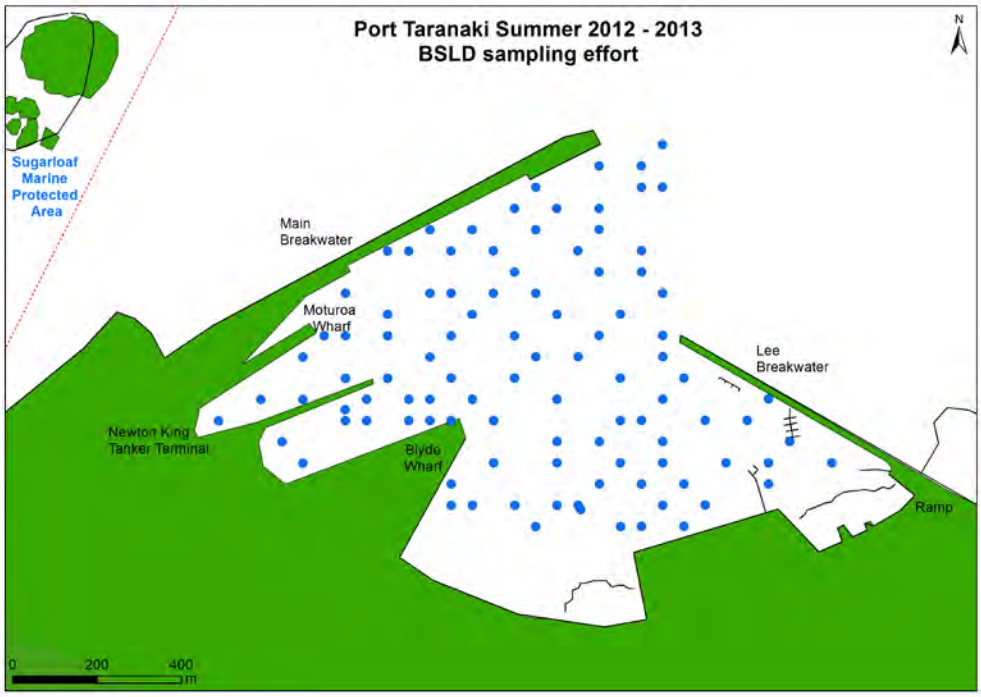
Crab (box) trapping locations



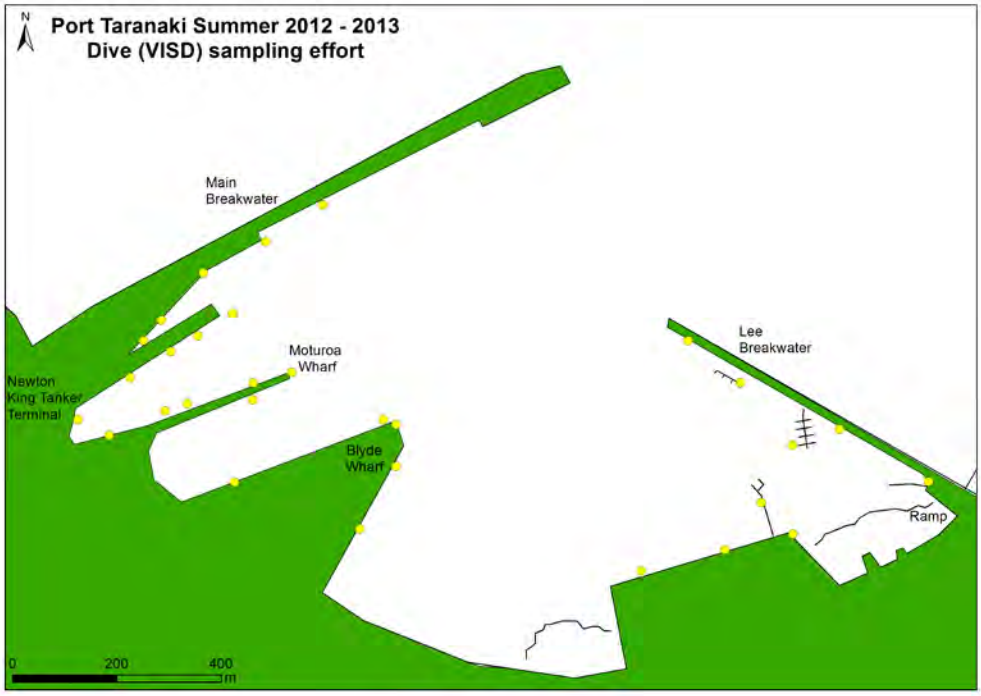
Crab condo locations



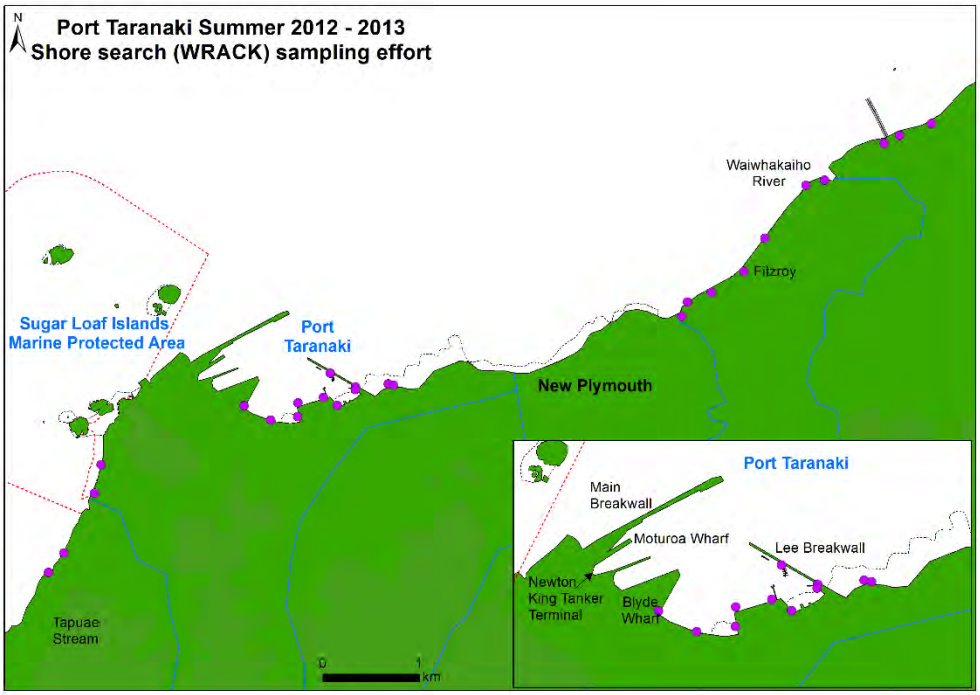
Sledding locations



Dive search locations



Shore search locations

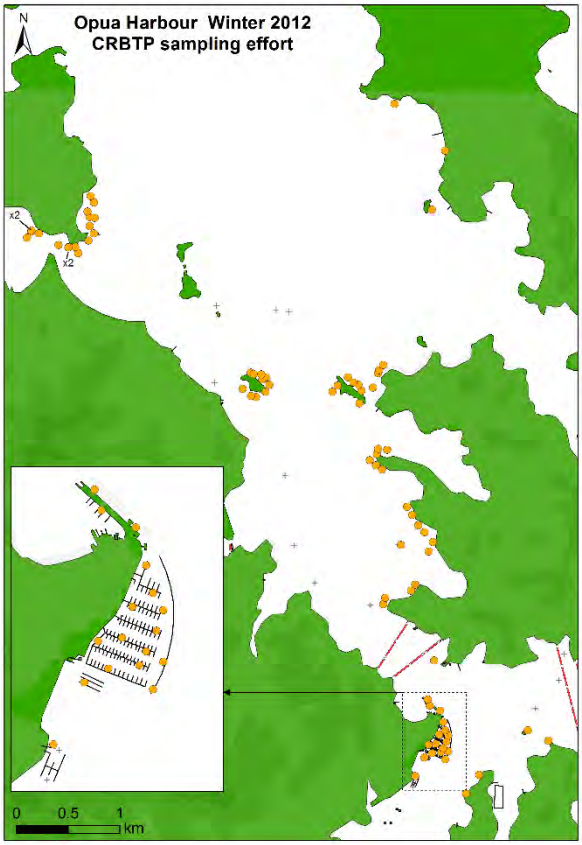


OPUA

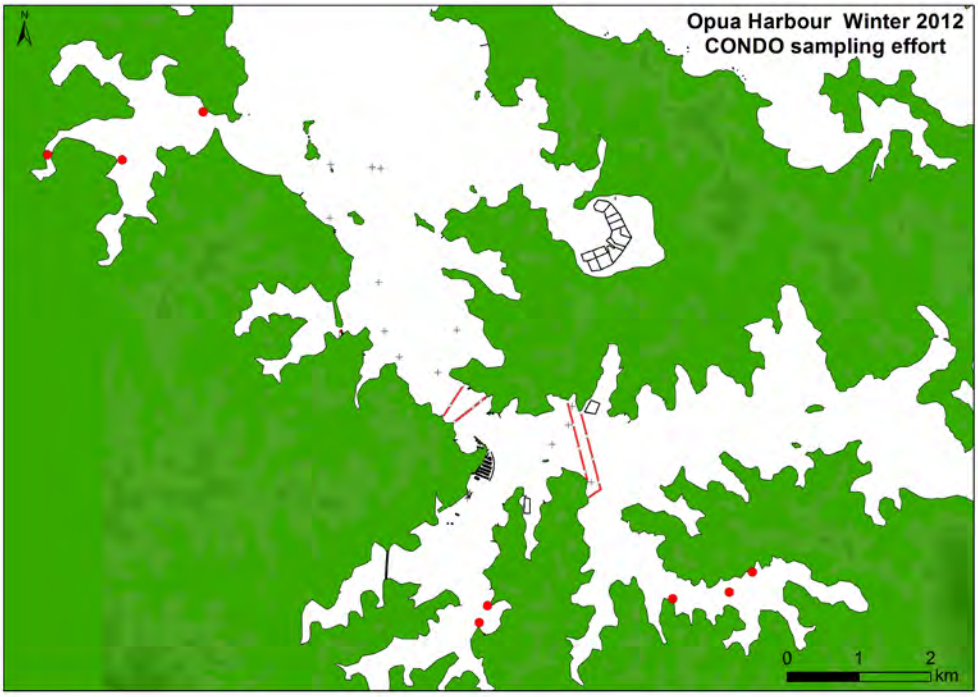
Note: grey crosses indicate navigational markers

Winter 2012

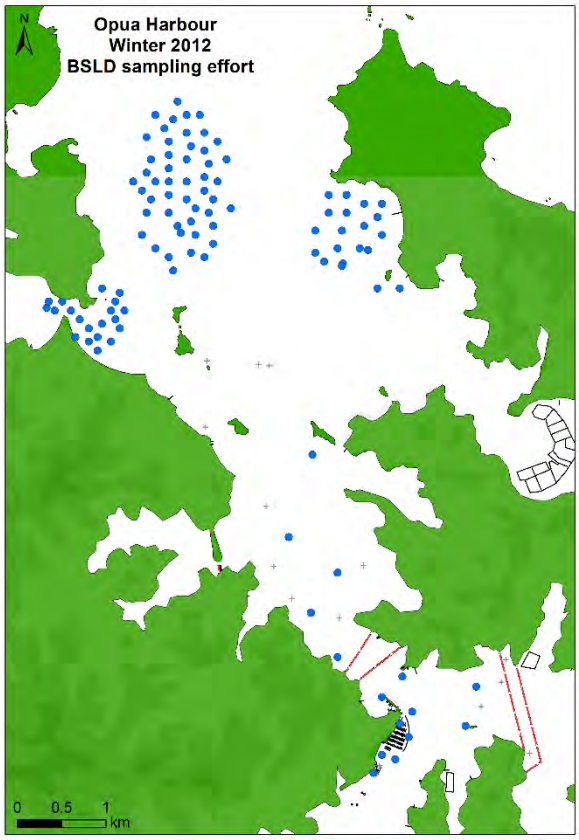
Crab (box) trapping locations



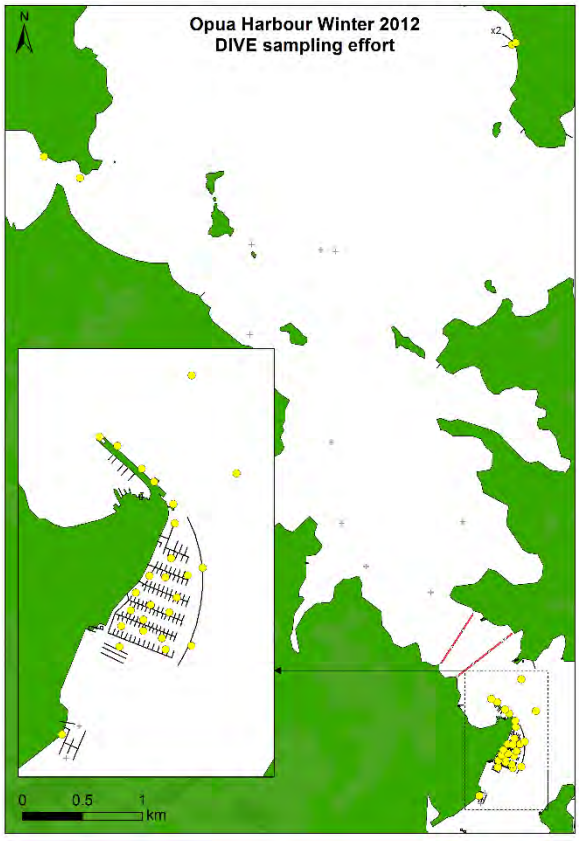
Crab condo locations



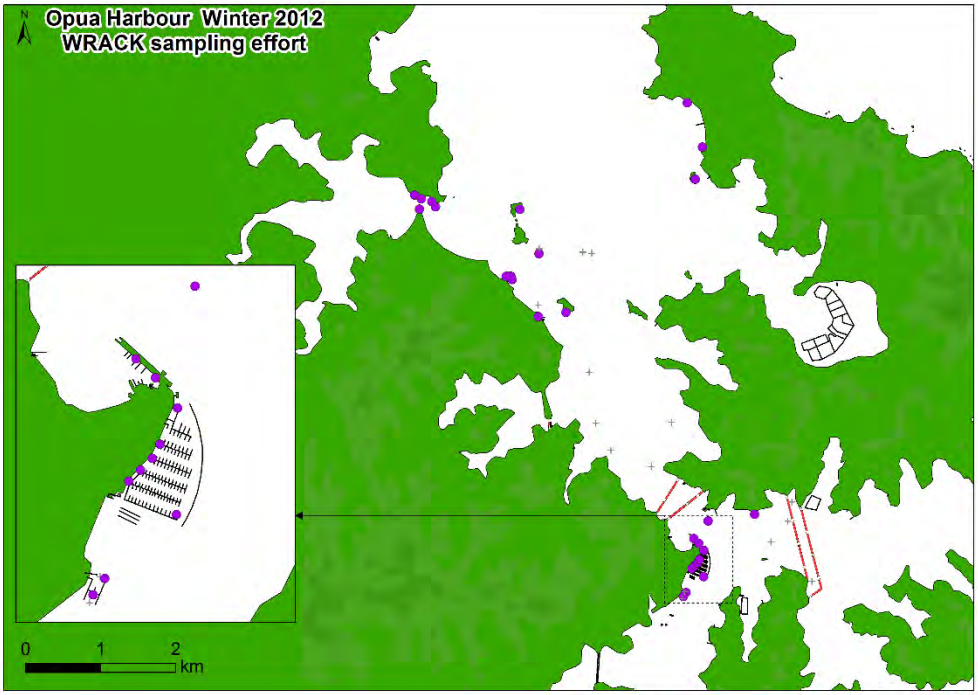
Sledding locations



Dive search locations

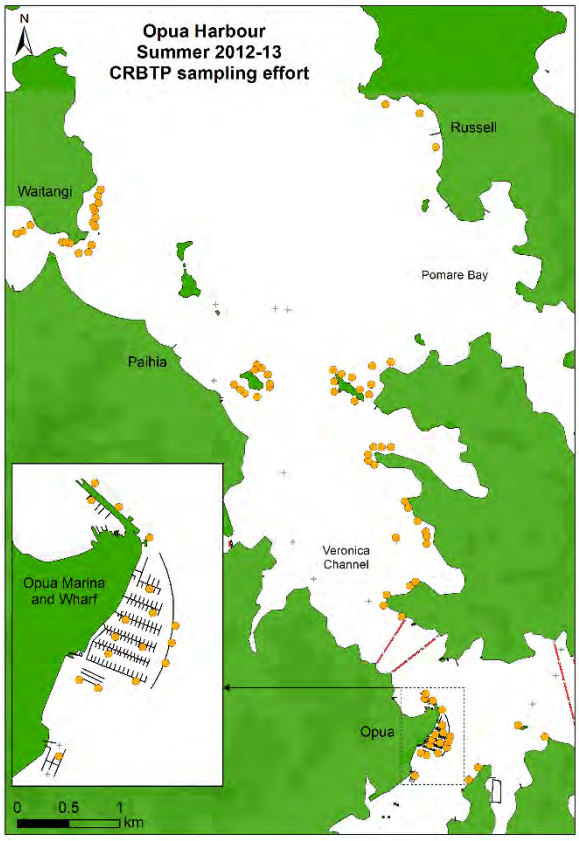


Shore search locations

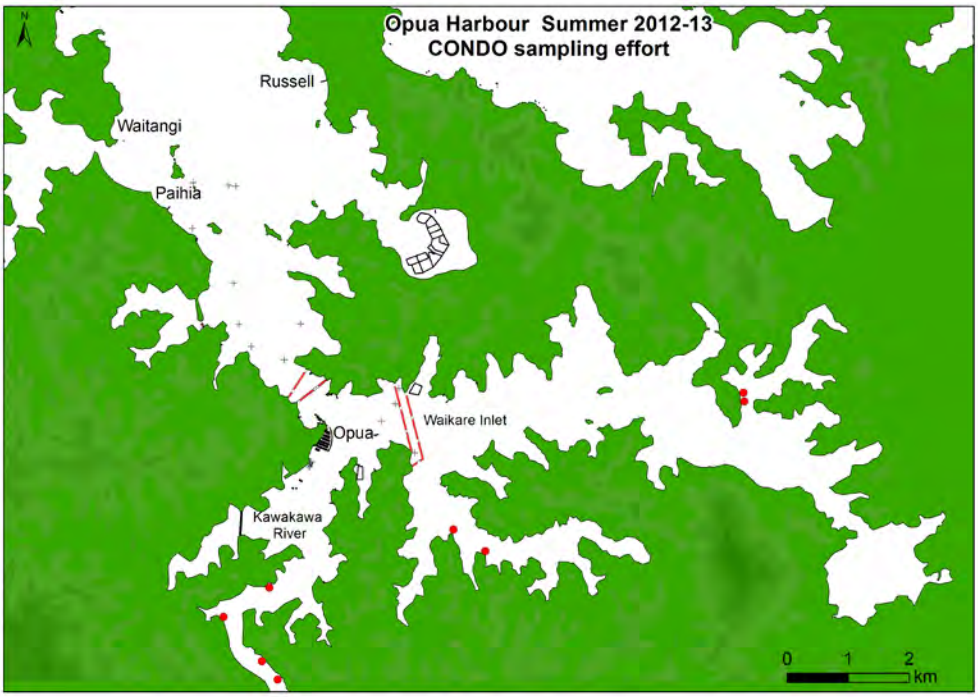


Summer 2012-2013

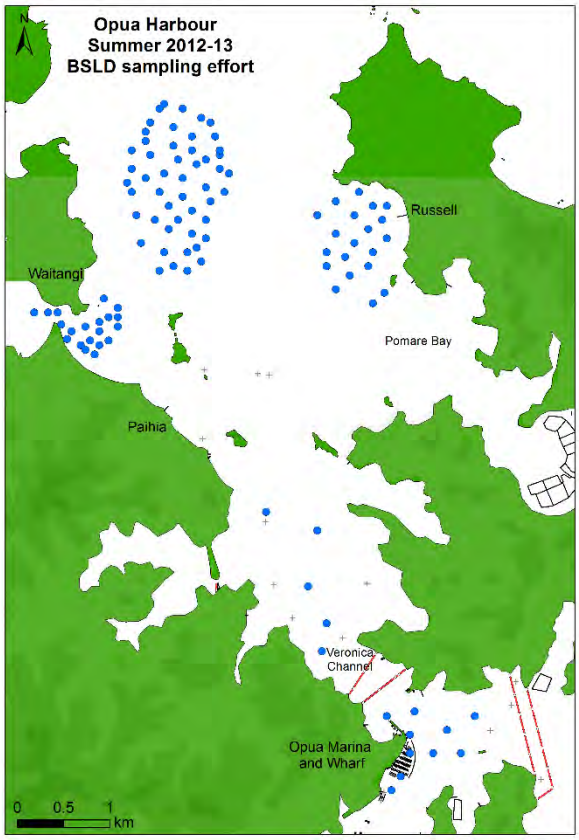
Crab (box) trapping locations



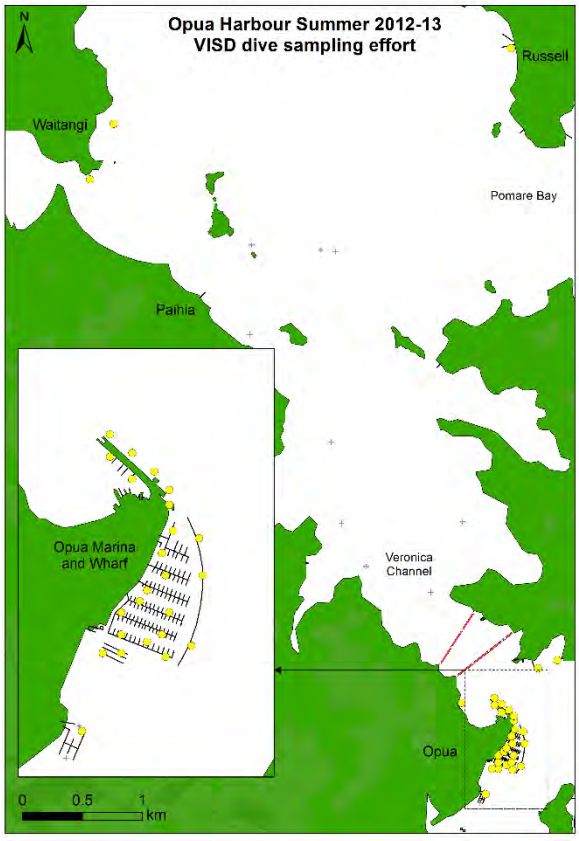
Crab condo locations



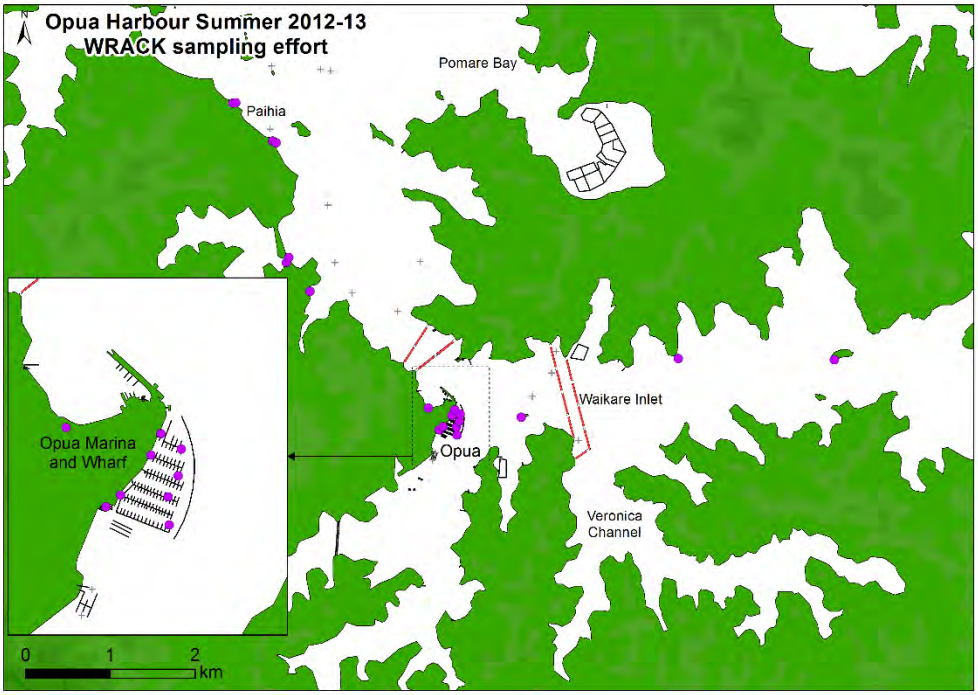
Sledding locations



Dive search locations



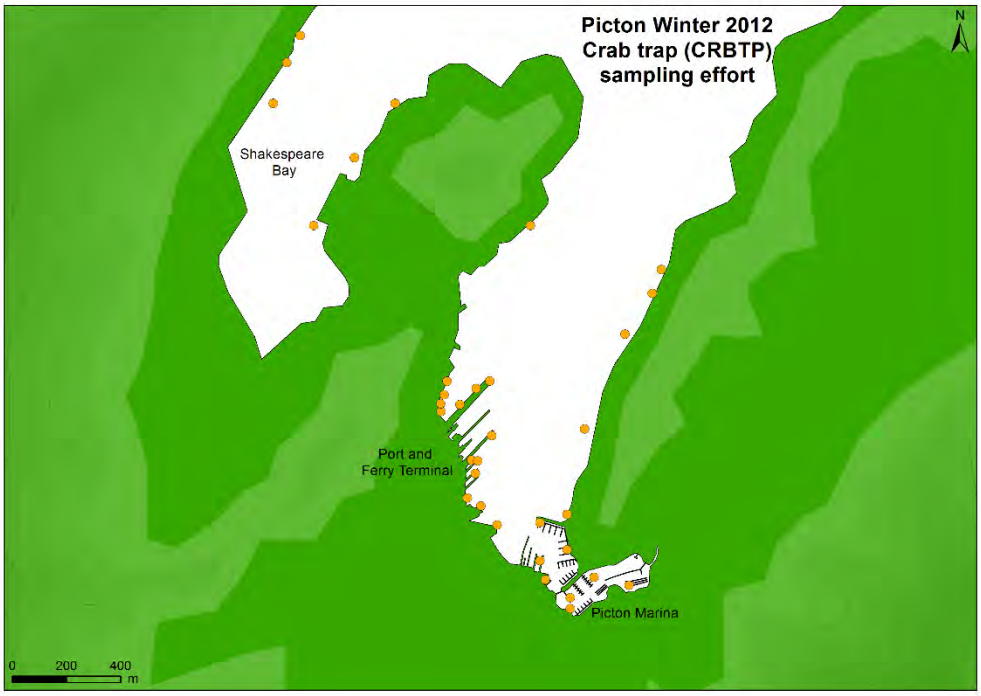
Shore search locations



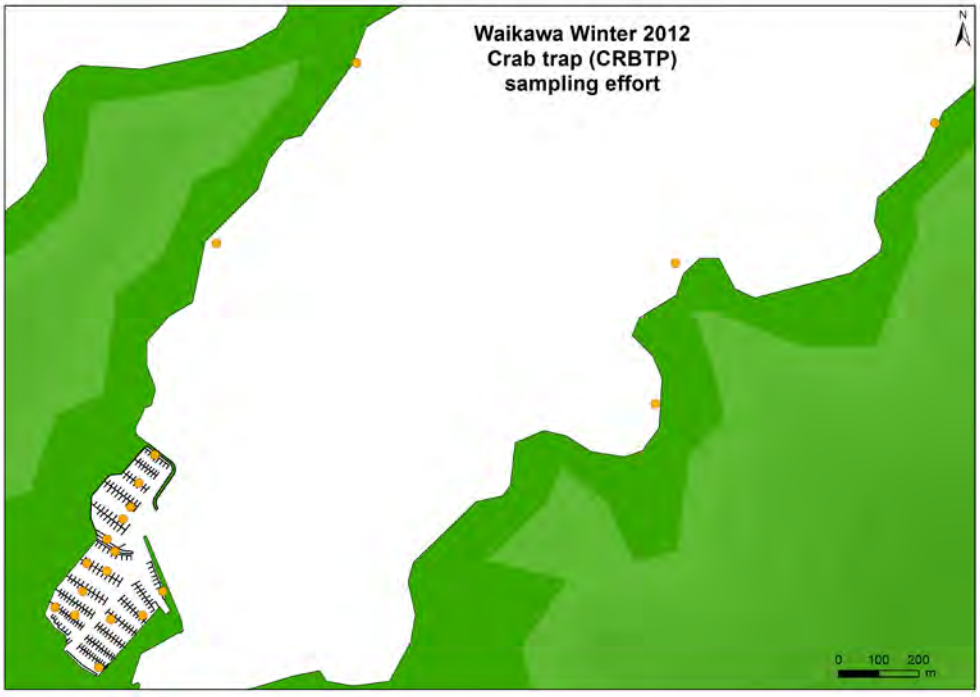
PICTON / HAVELOCK

Winter 2012

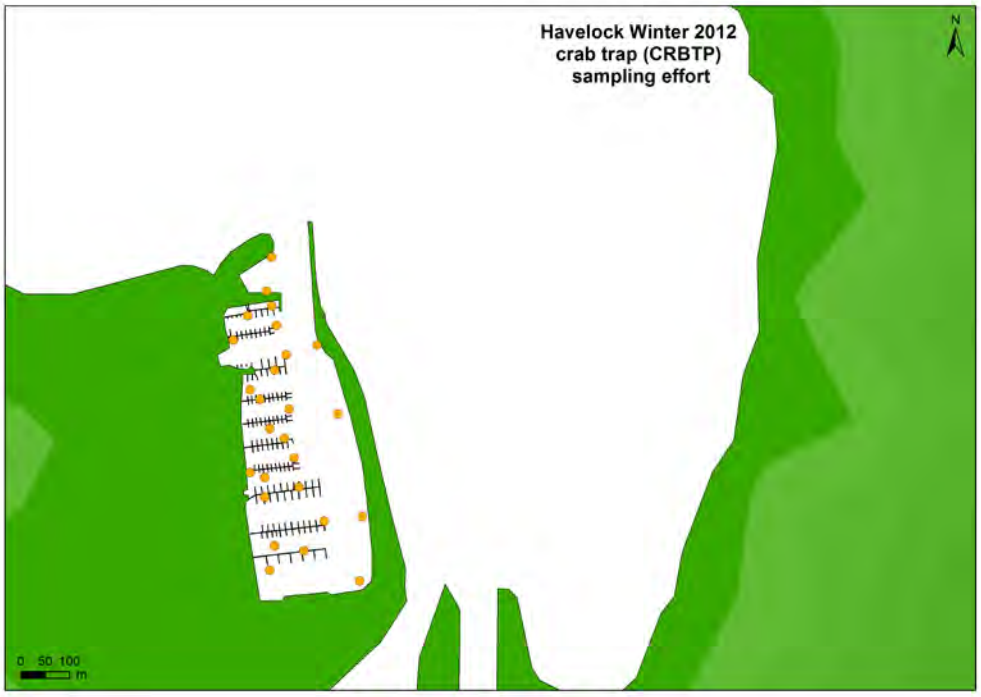
Crab (box) trapping locations (Picton Harbour)



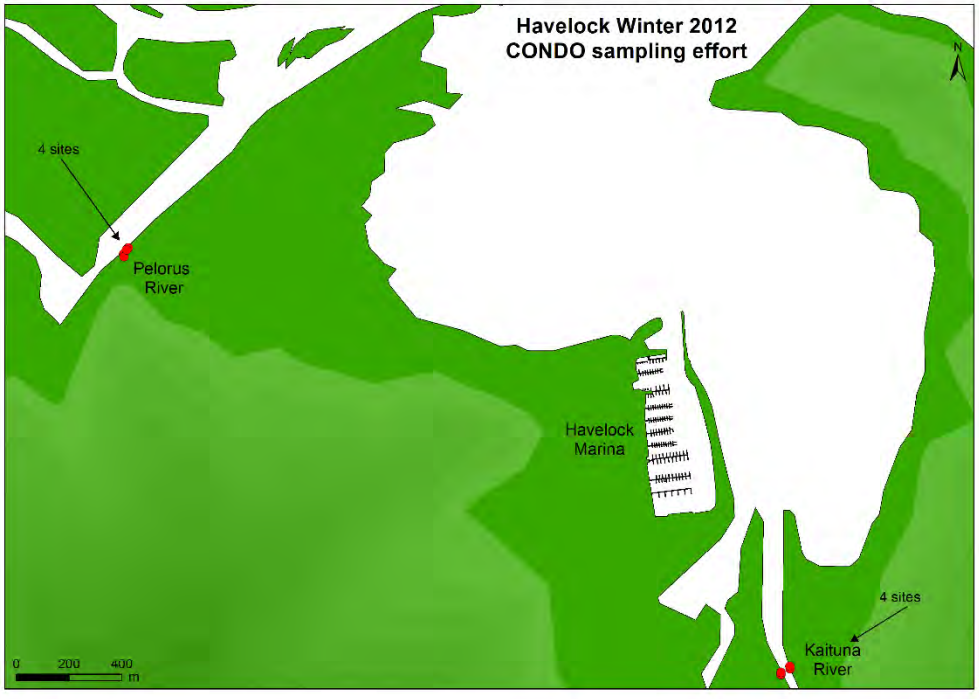
Crab (box) trapping locations (Waikawa Marina)



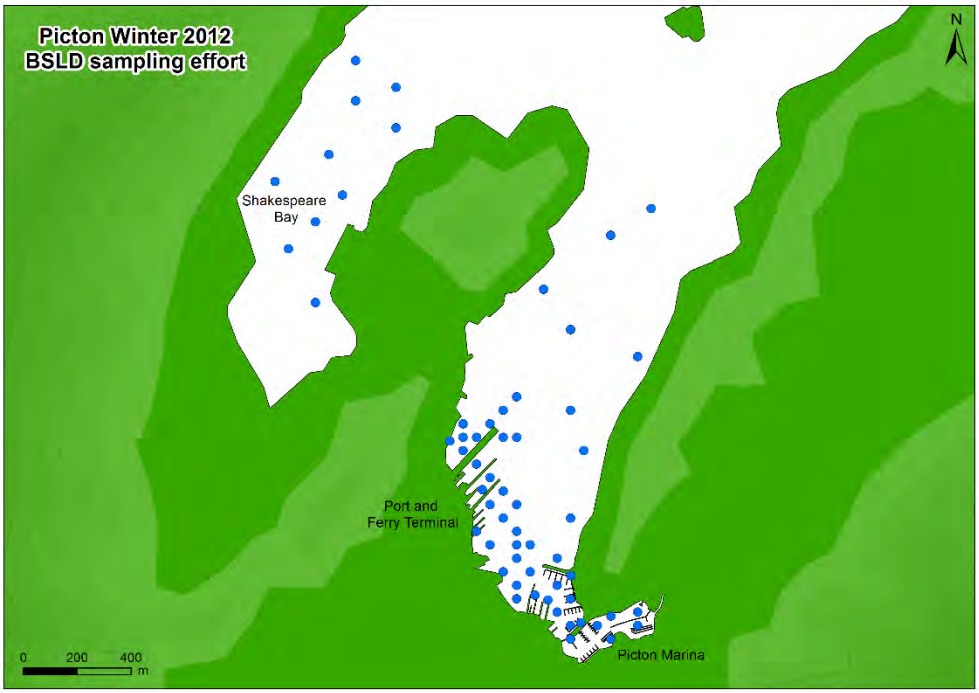
Crab (box) trapping locations (Havelock Harbour)



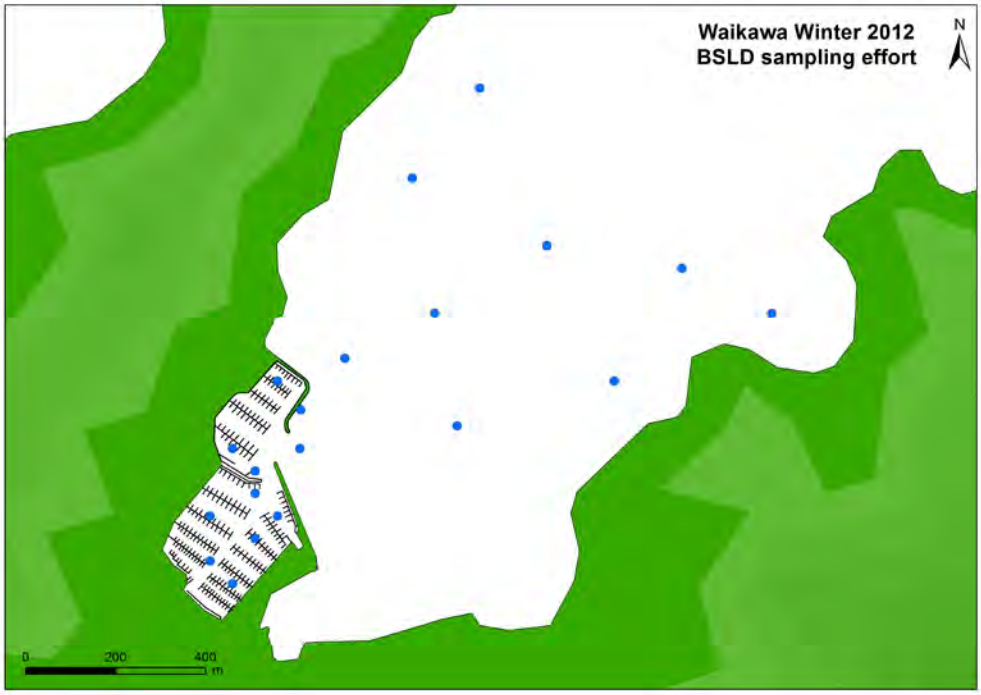
Crab condo locations (Havelock Harbour)



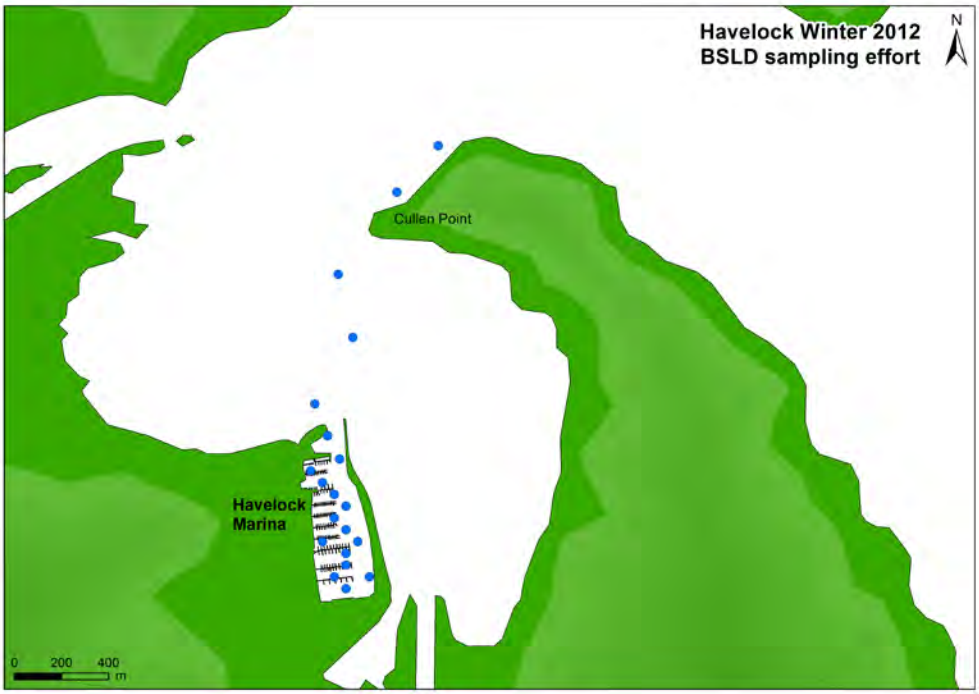
Sledding locations (Picton Harbour)



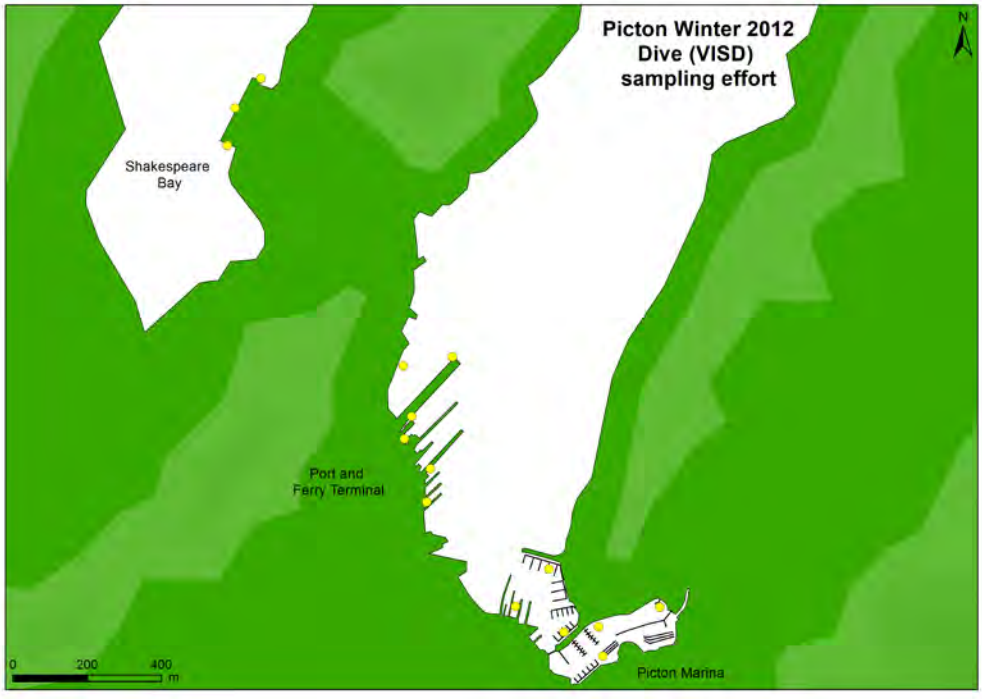
Sledding locations (Waikawa Marina)



Sledding locations (Havelock Marina)



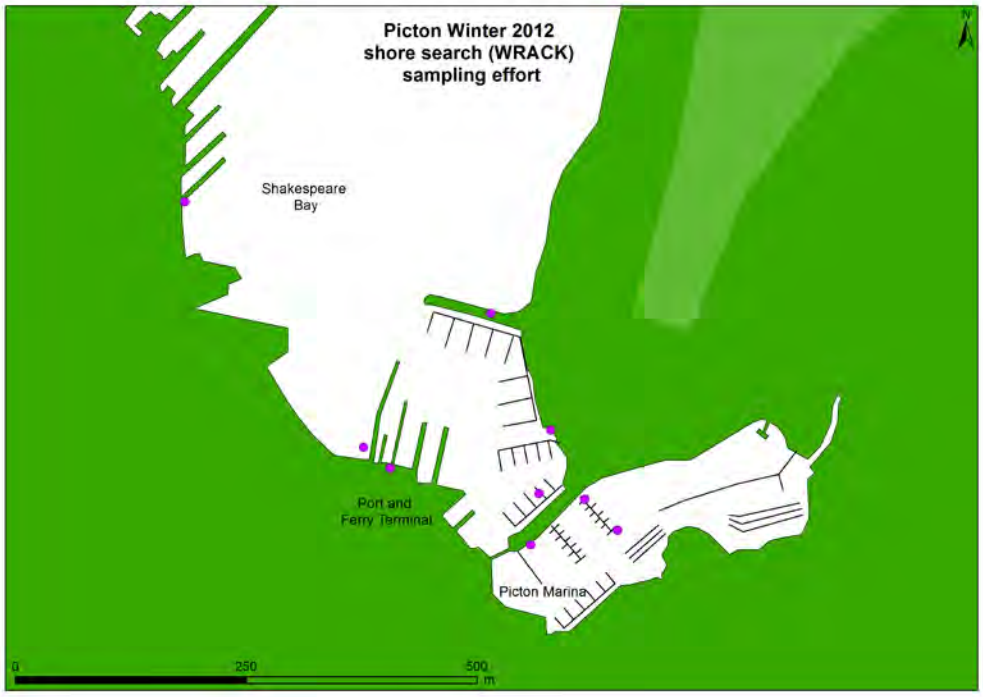
Dive search locations (Picton Harbour)



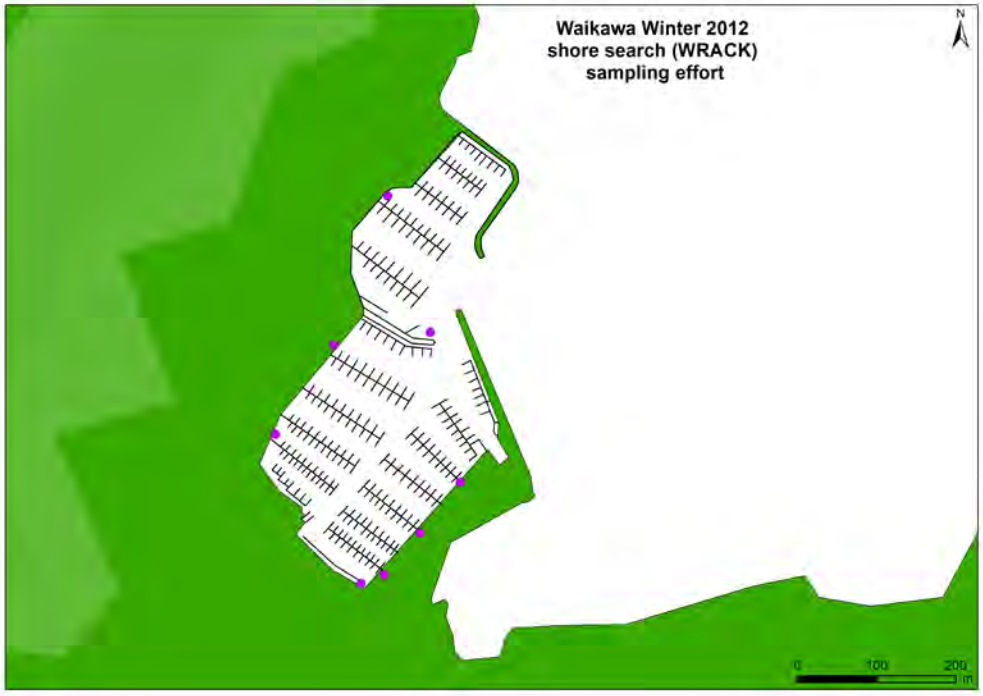
Dive search locations (Waikawa Marina)

Dive search locations (Havelock Harbour)

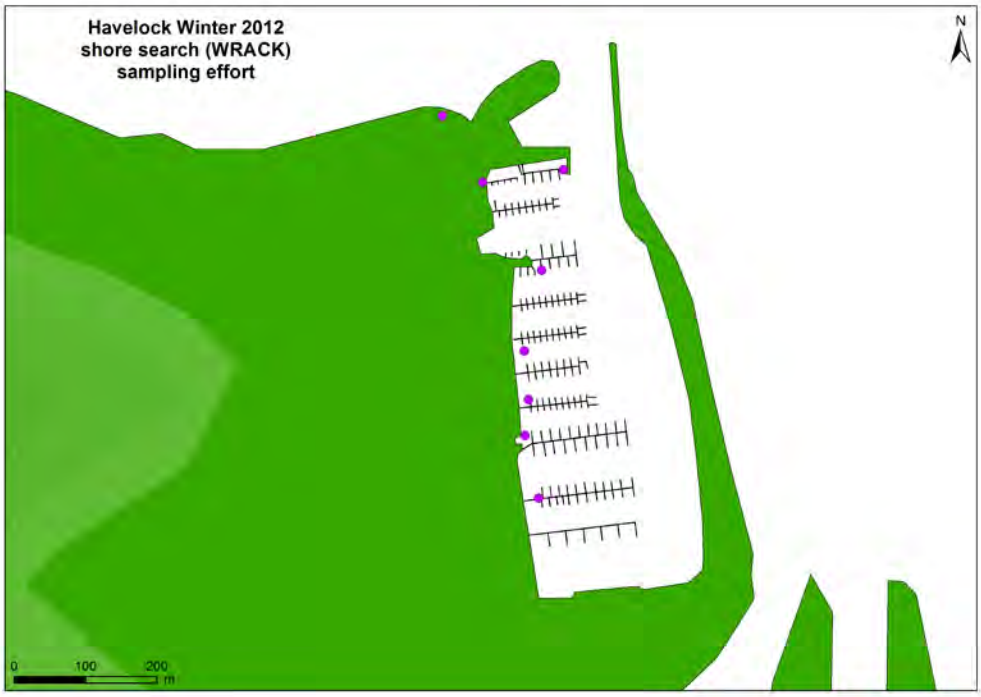
Shore search locations (Picton Harbour)



Shore search locations (Waikawa Marina)

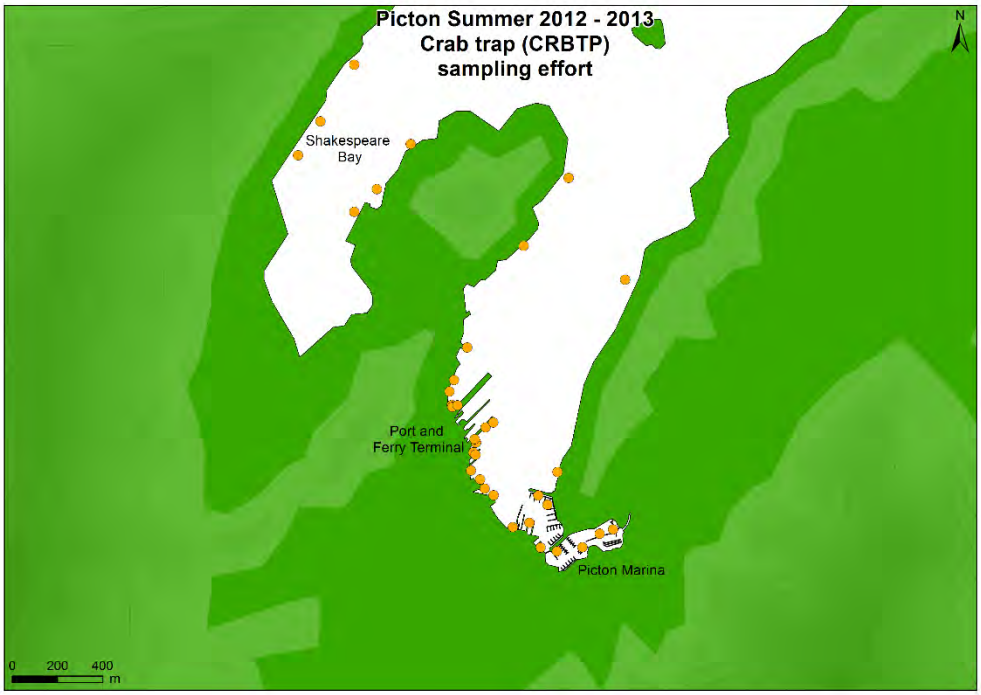


Shore search locations (Havelock Harbour)

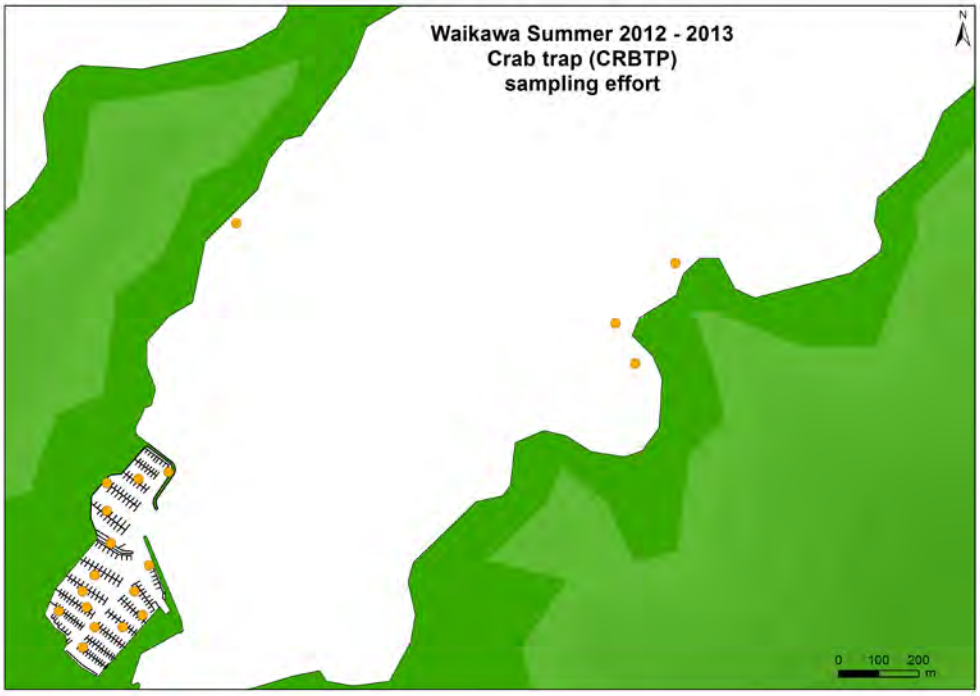


Summer 2012-2013

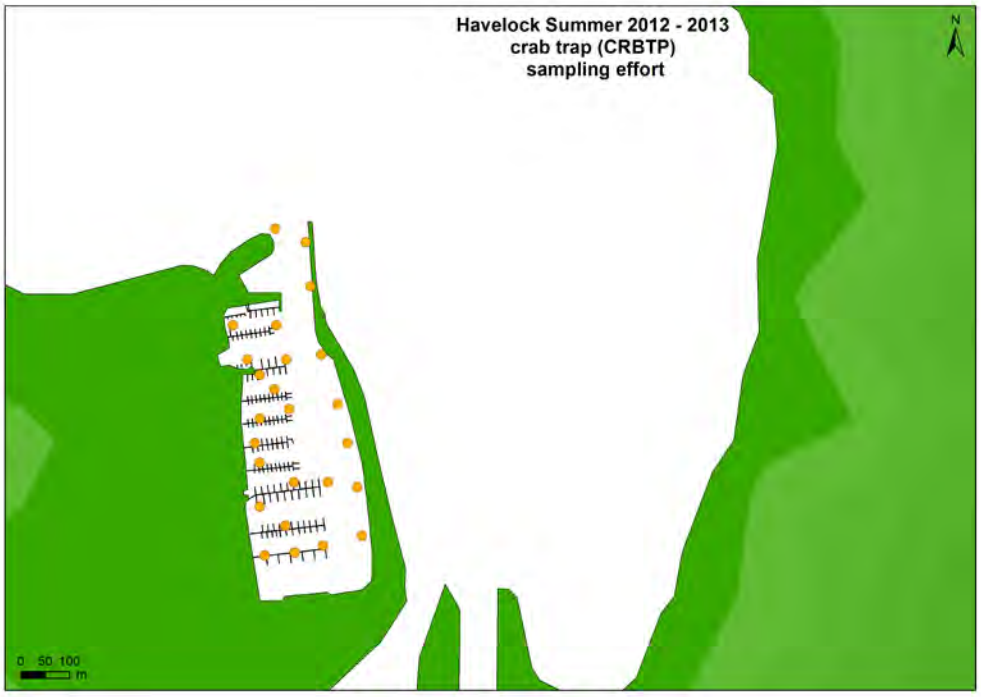
Crab (box) trapping locations (Picton Harbour)



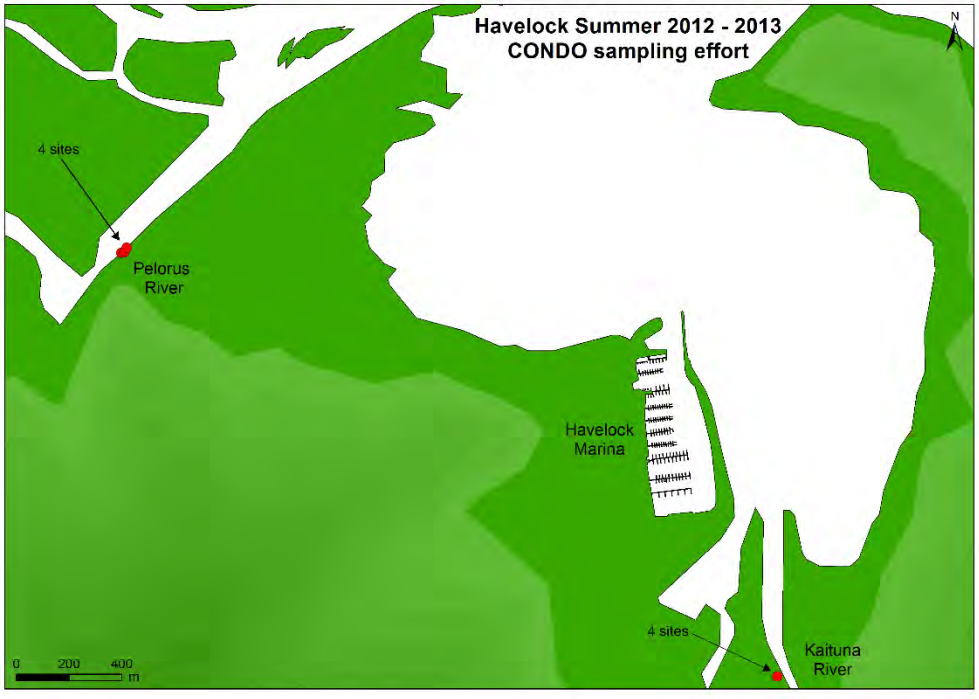
Crab (box) trapping locations (Waikawa Marina)



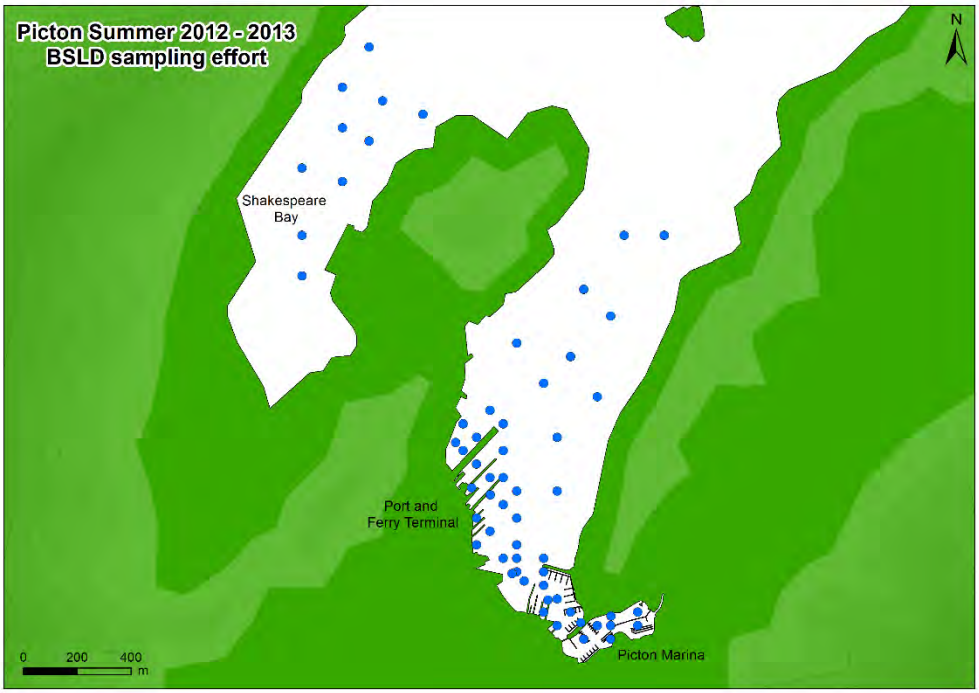
Crab (box) trapping locations (Havelock Harbour)



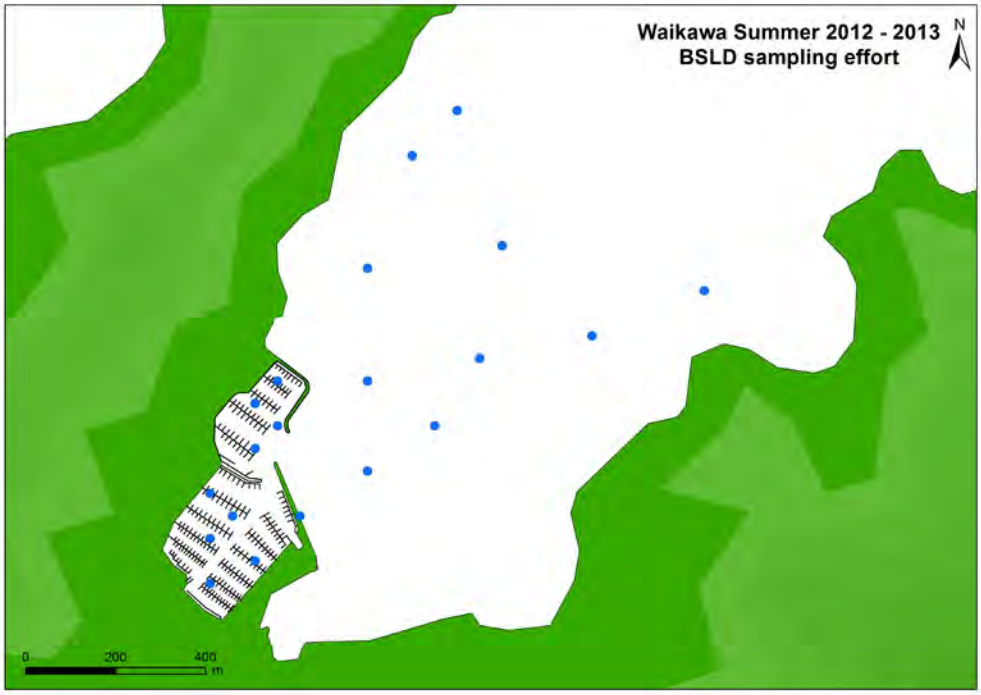
Crab condo locations (Havelock Harbour)



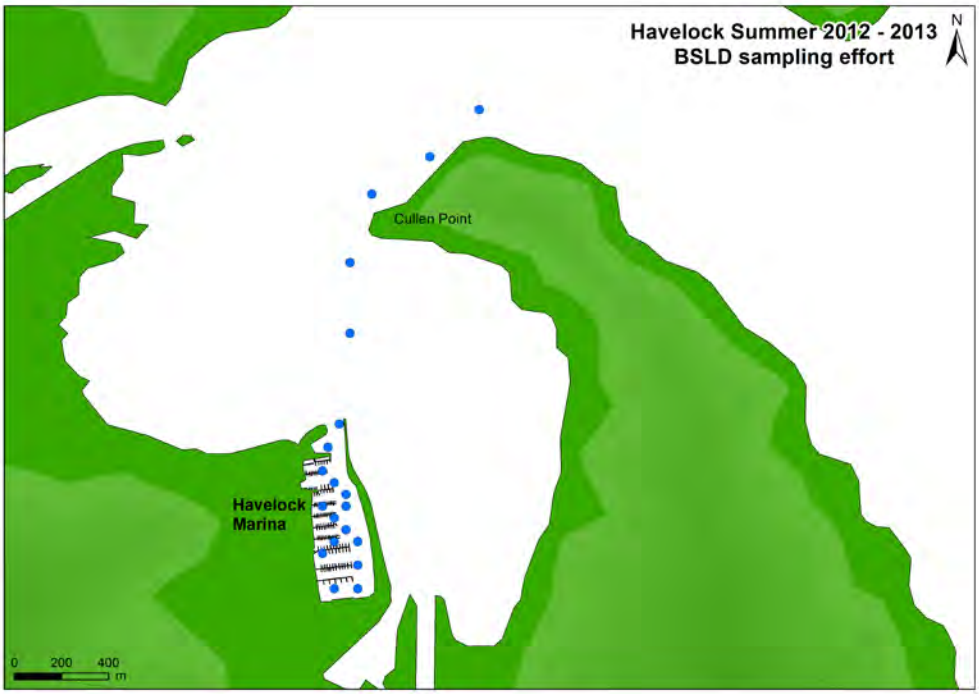
Sledding locations (Picton Harbour)



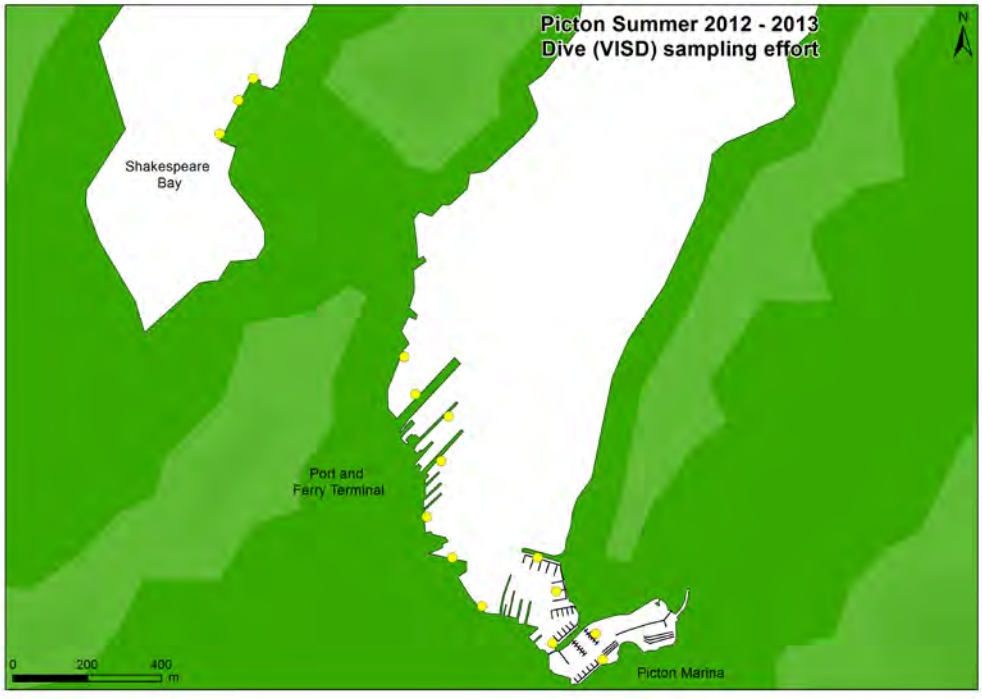
Sledding locations (Waikawa Marina)



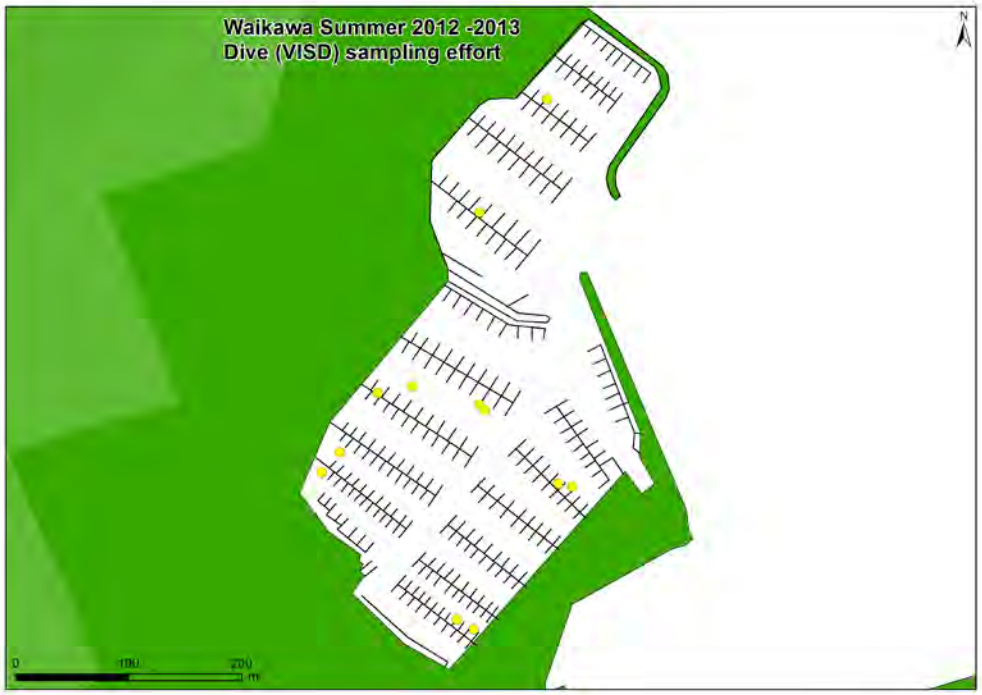
Sledding locations (Havelock Marina)



Dive search locations (Picton Harbour)



Dive search locations (Waikawa Marina)

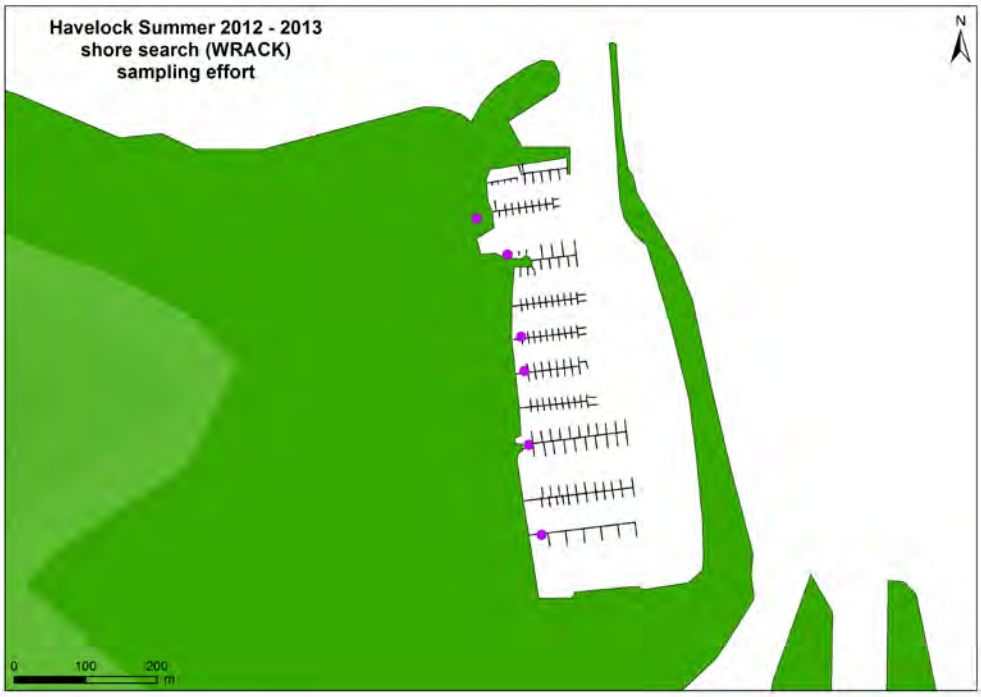


Dive search locations (Havelock Harbour)

Shore search locations (Picton Harbour)

Shore search locations (Waikawa Marina)

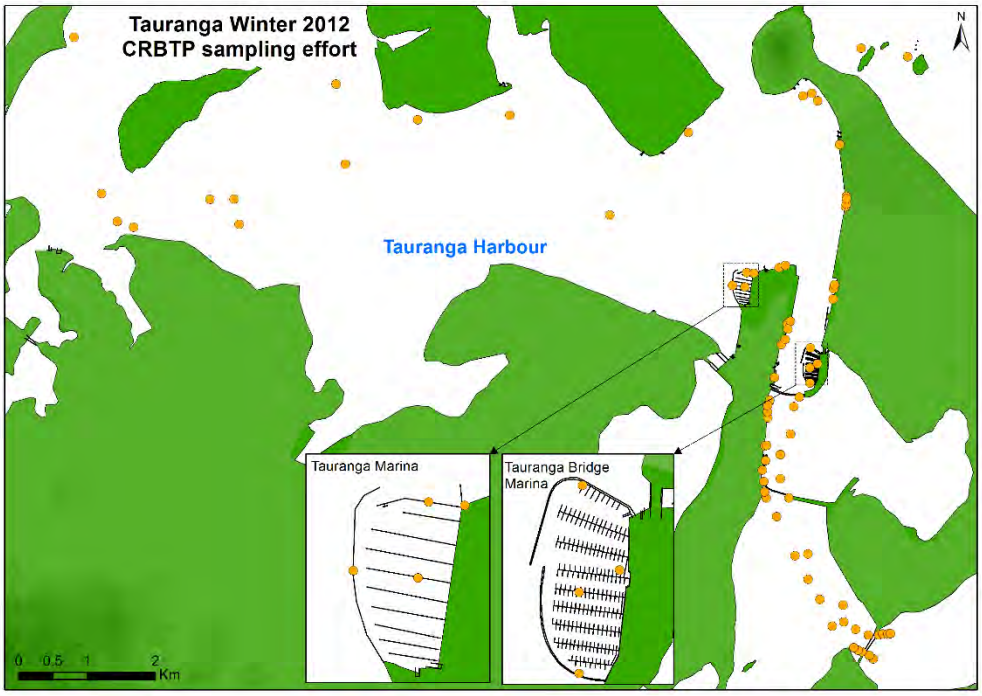
Shore search locations (Havelock Harbour)



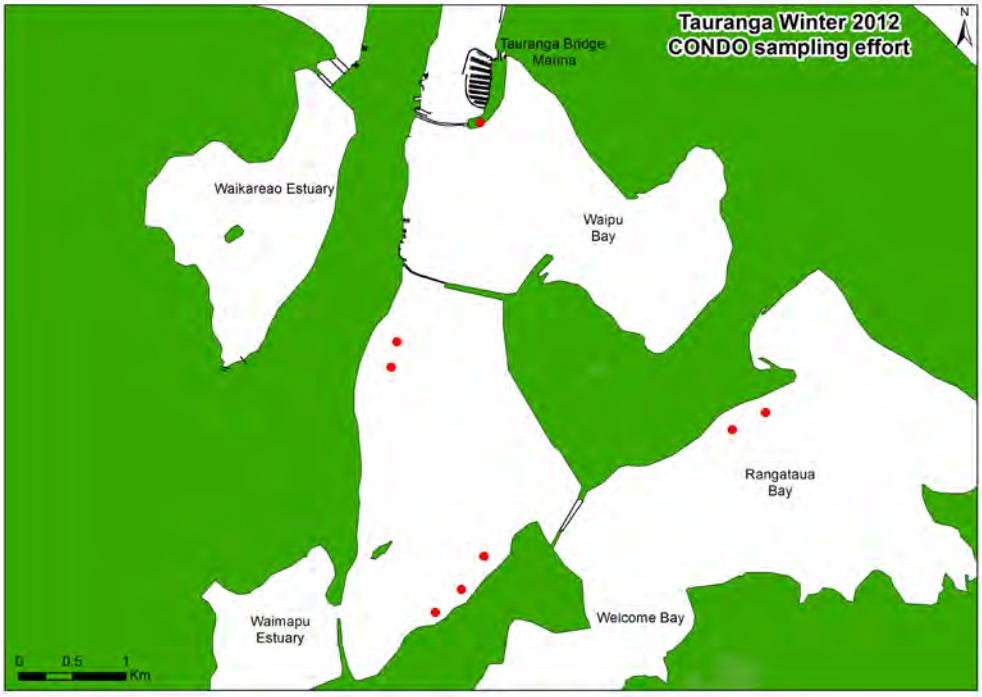
TAURANGA HARBOUR

Winter 2012

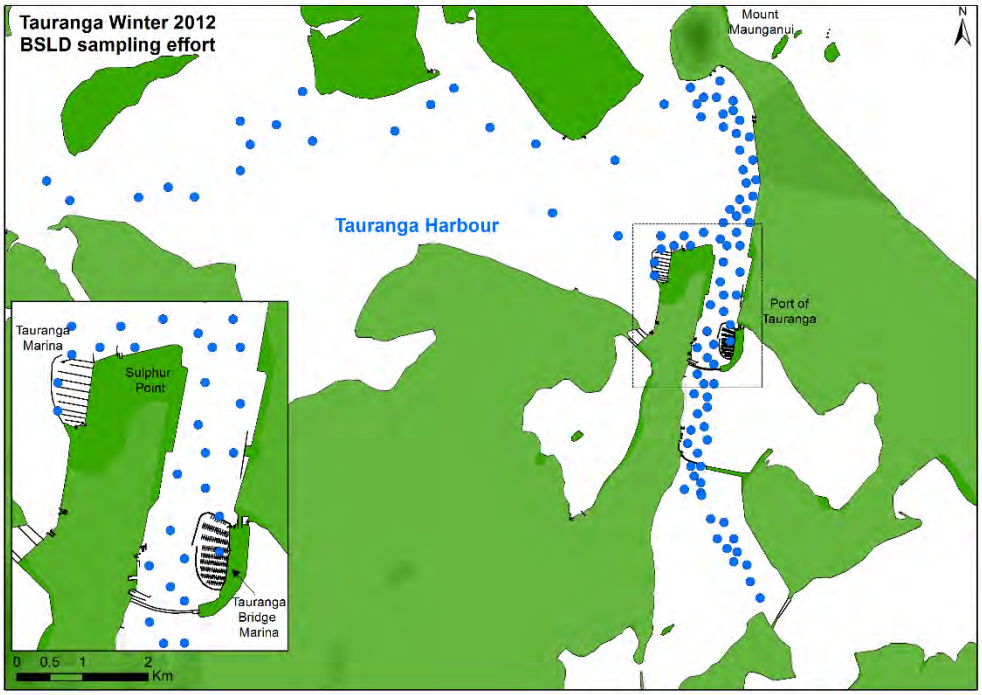
Crab (box) trapping locations



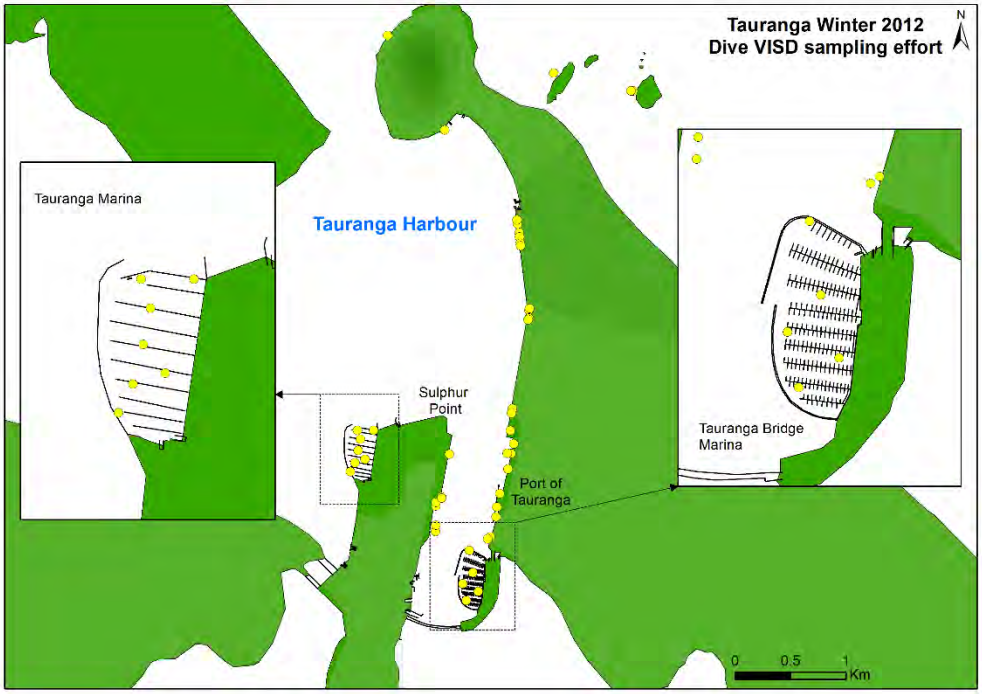
Crab condo locations



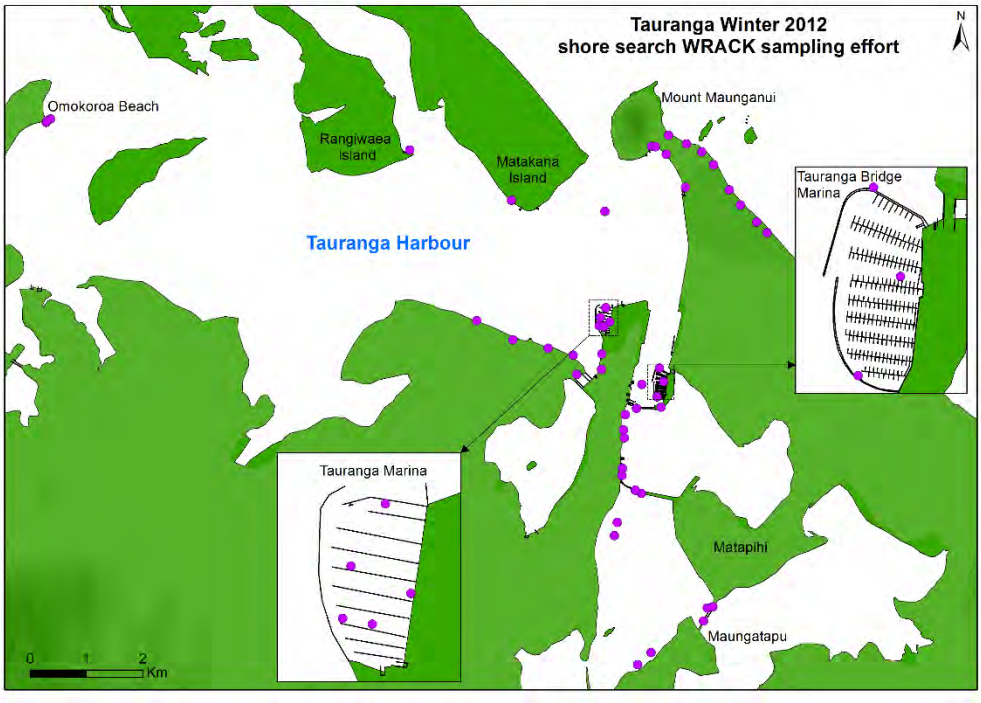
Sledding locations



Dive search locations

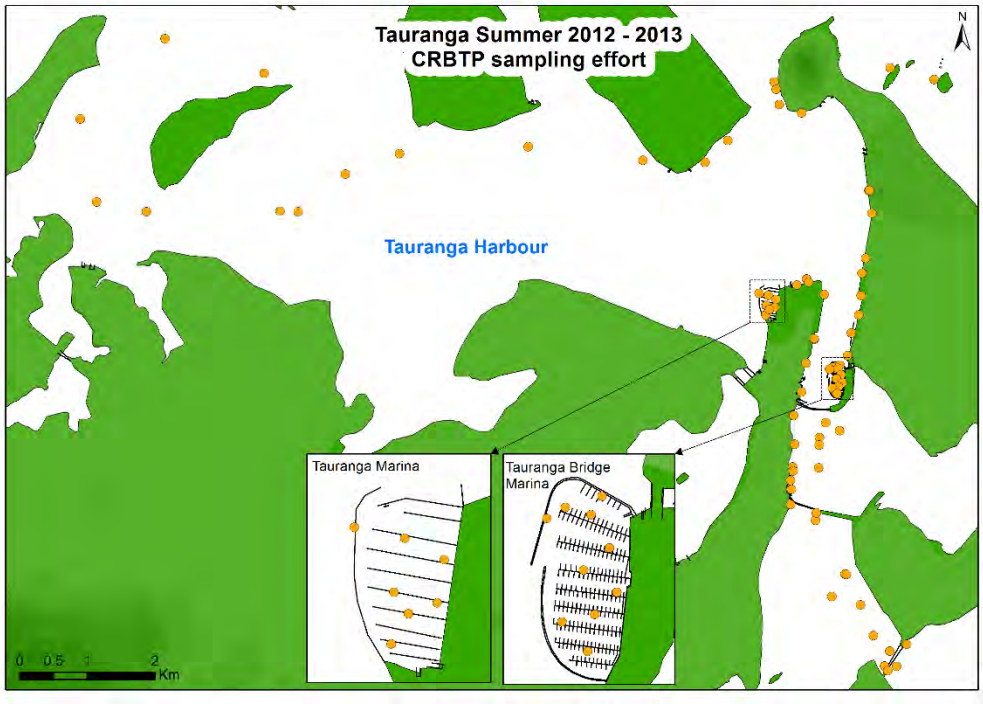


Shore search locations



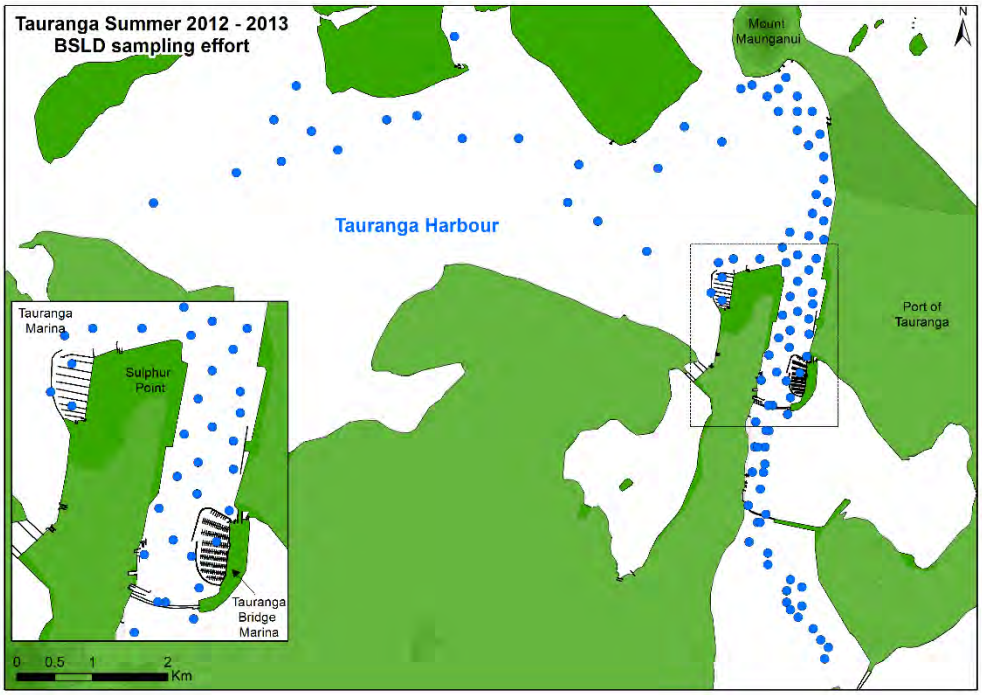
Summer 2012-2013

Crab (box) trapping locations

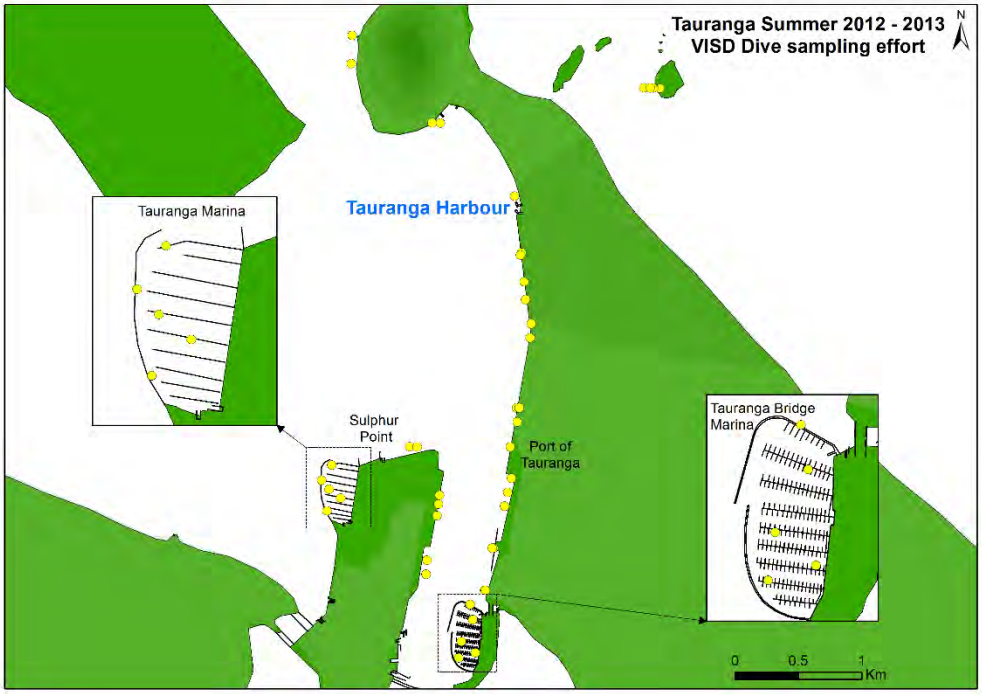


Crab condo locations

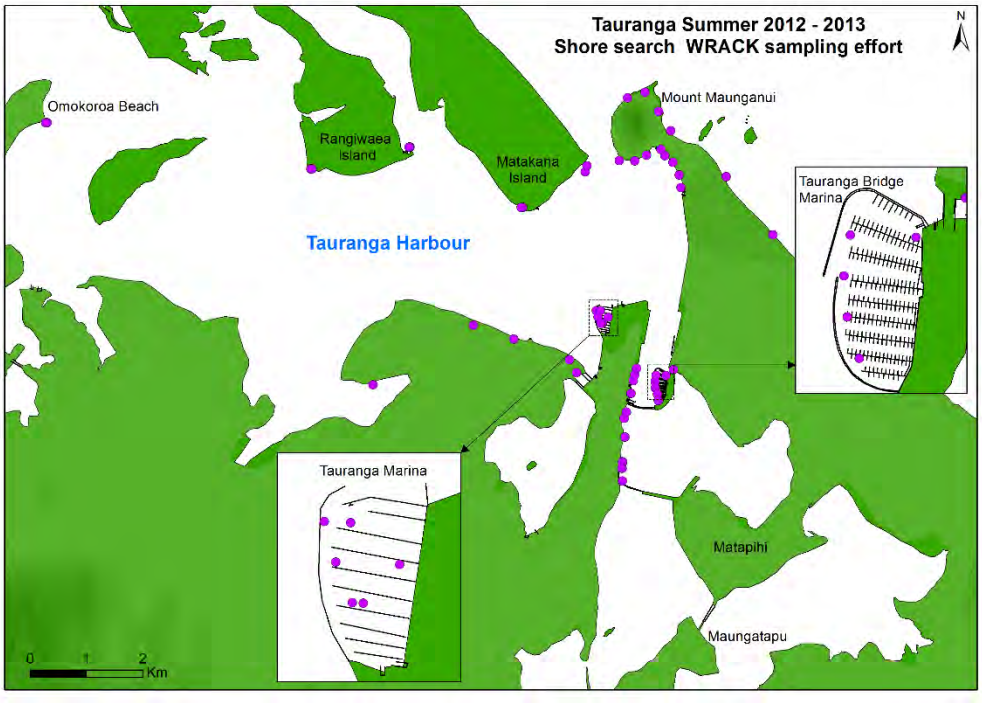
Sledding locations



Dive search locations



Shore search locations

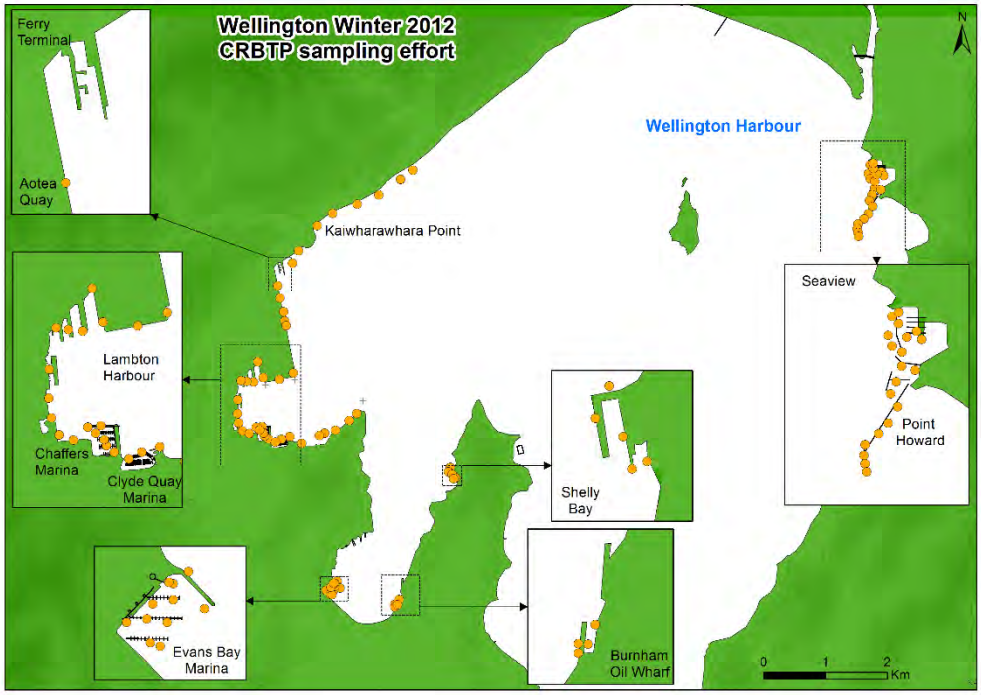


WELLINGTON HARBOUR

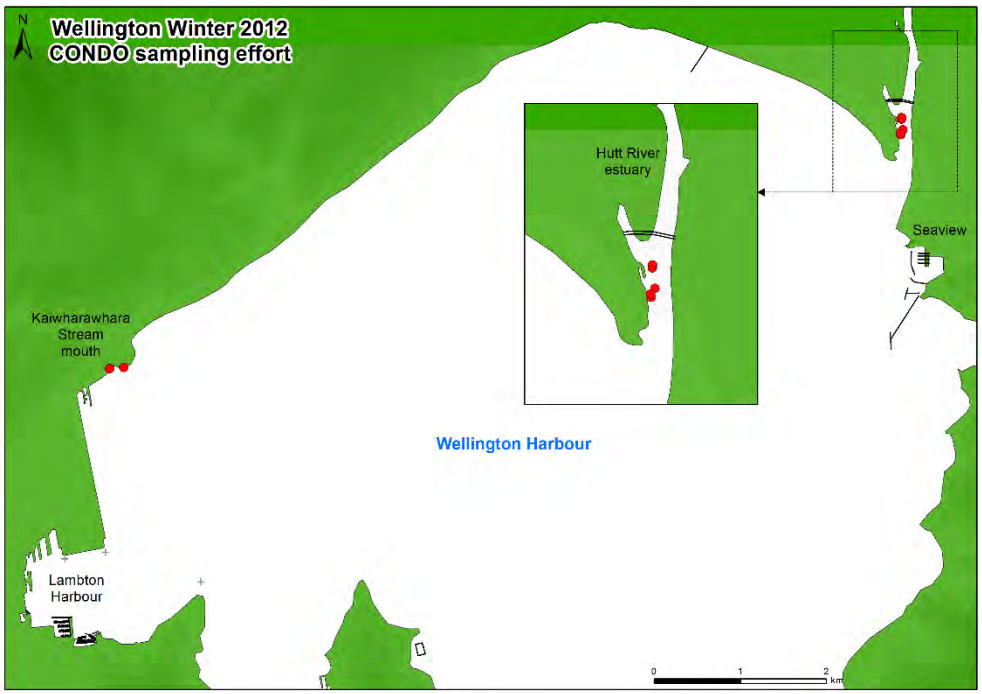
Note: grey crosses indicate navigational markers

Winter 2012

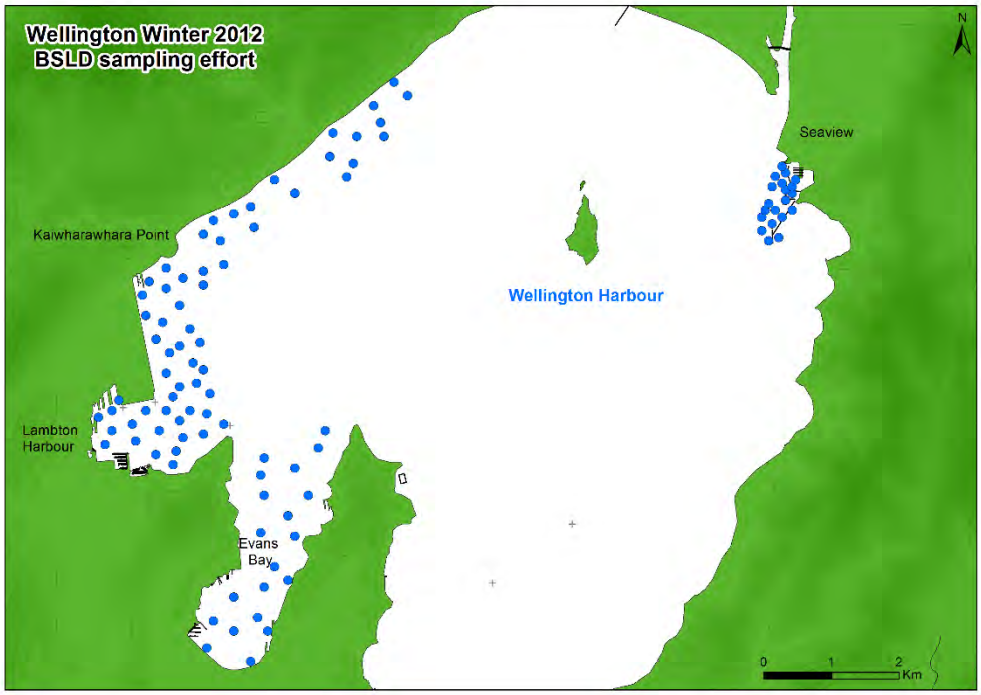
Crab (box) trapping locations



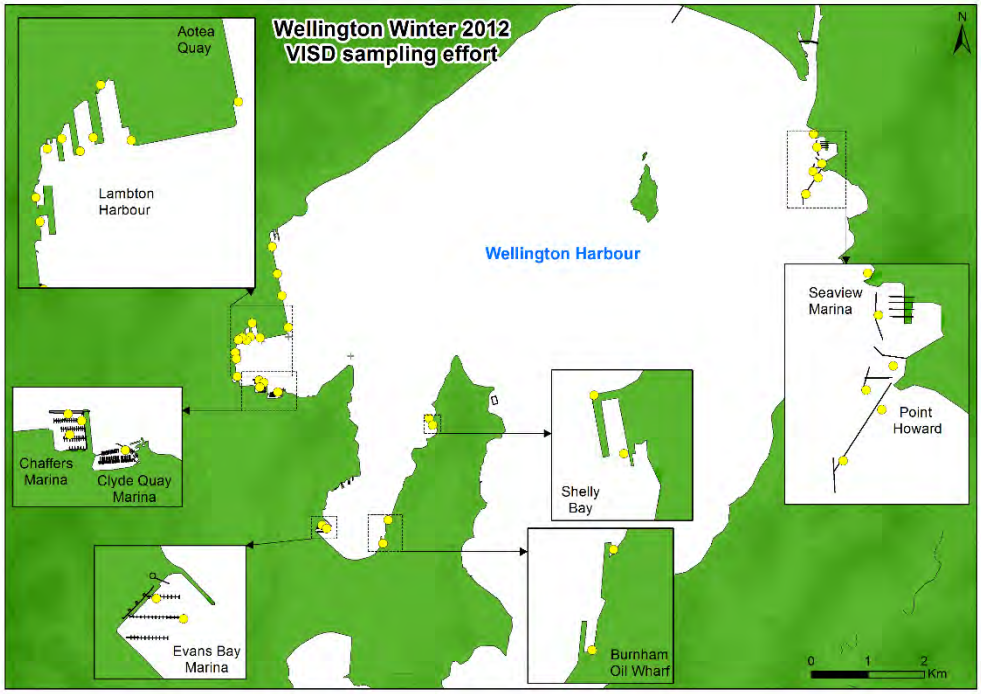
Crab condo locations



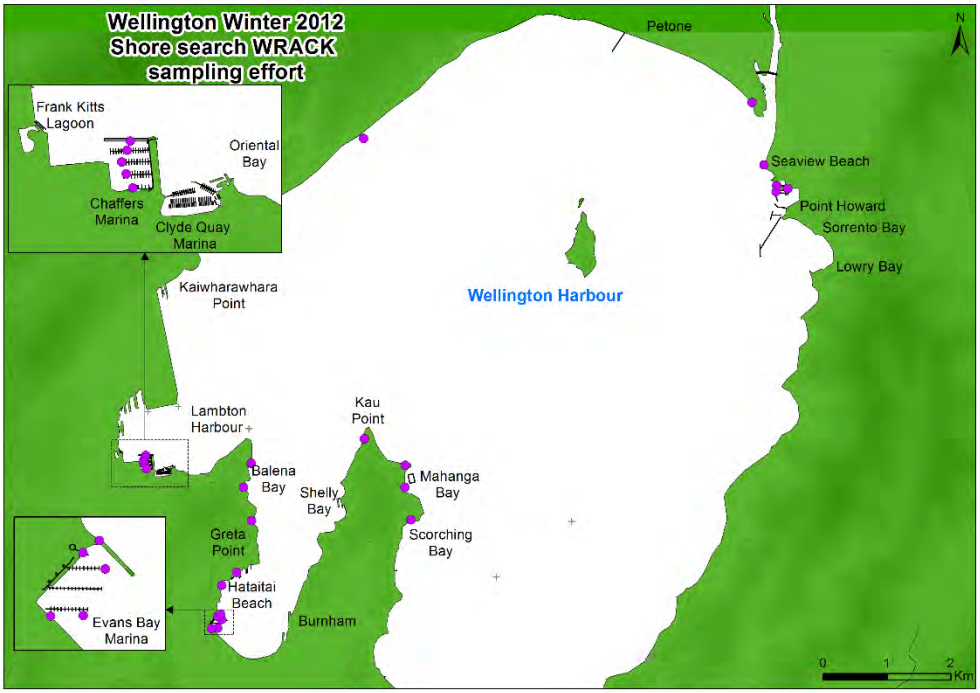
Sledding locations



Dive search locations

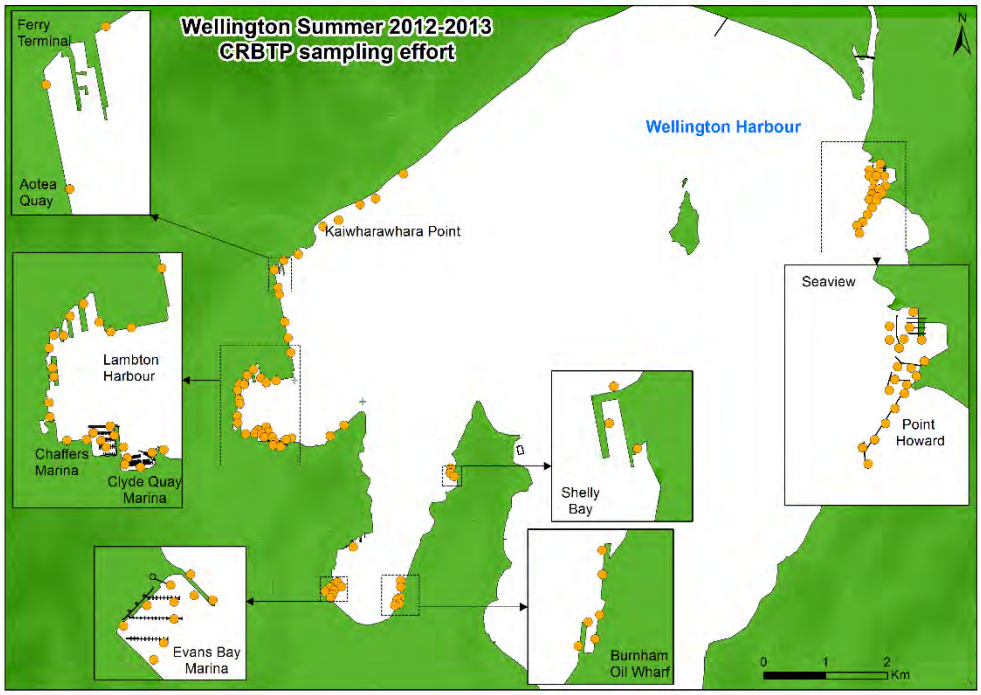


Shore search locations

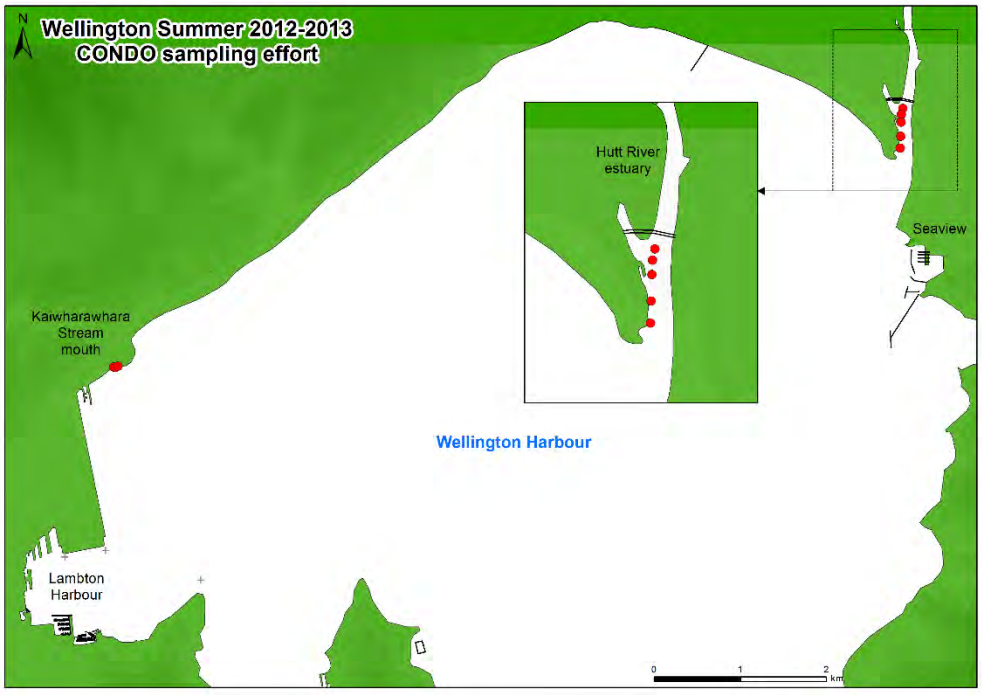


Summer 2012-2013

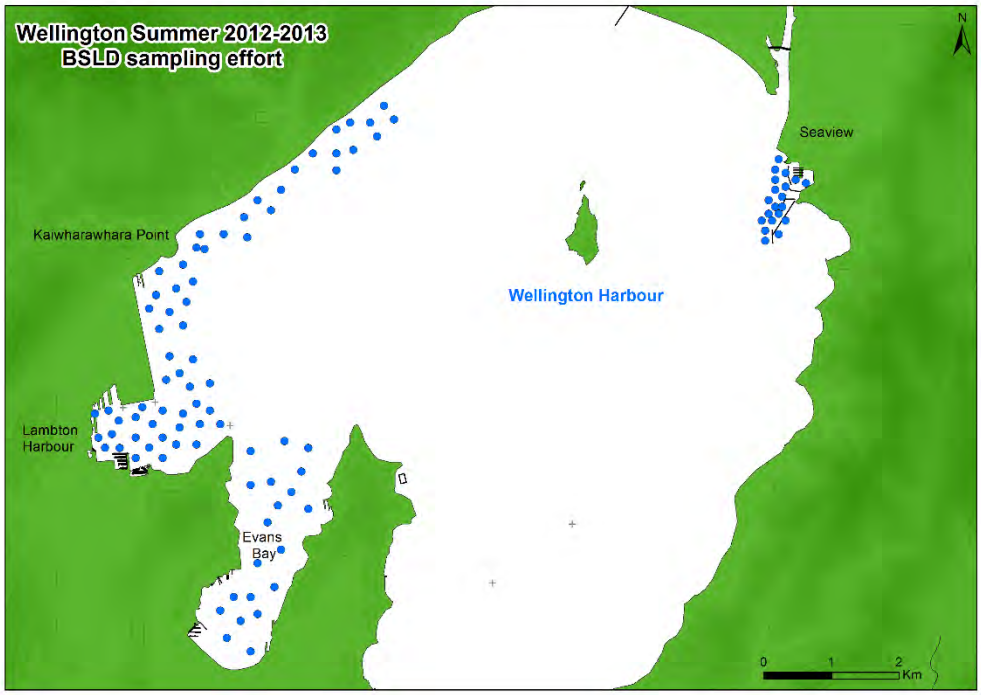
Crab (box) trapping locations



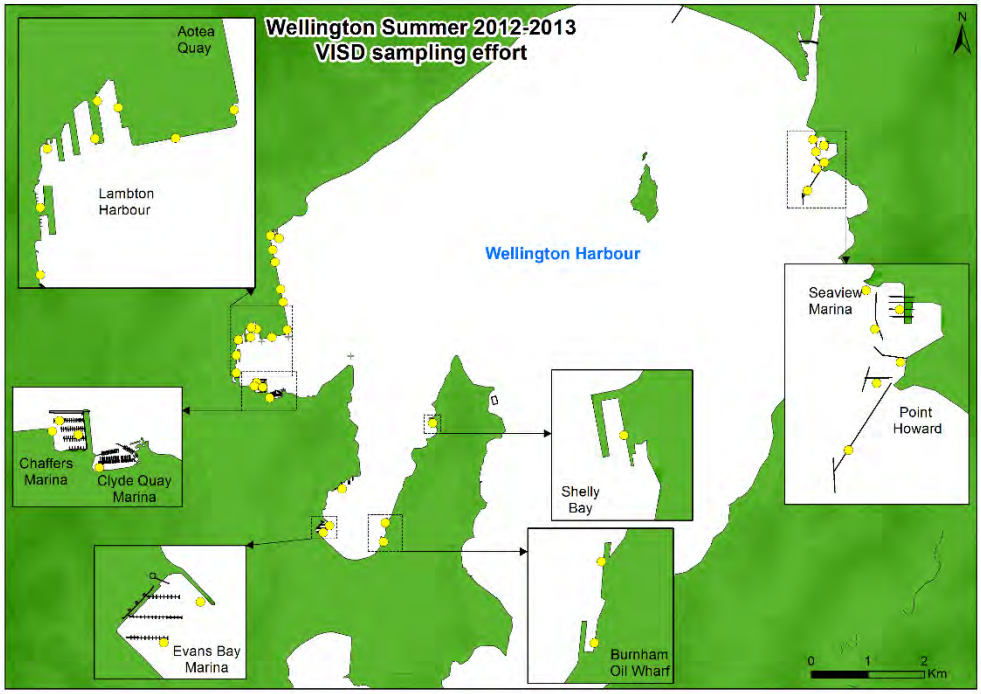
Crab condo locations



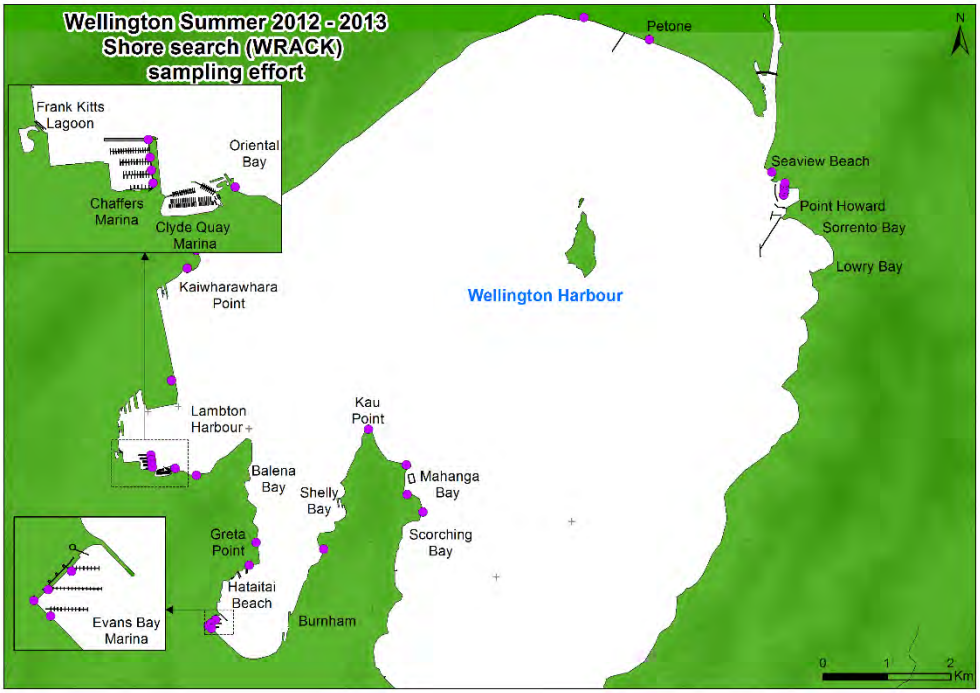
Sledding locations



Dive search locations



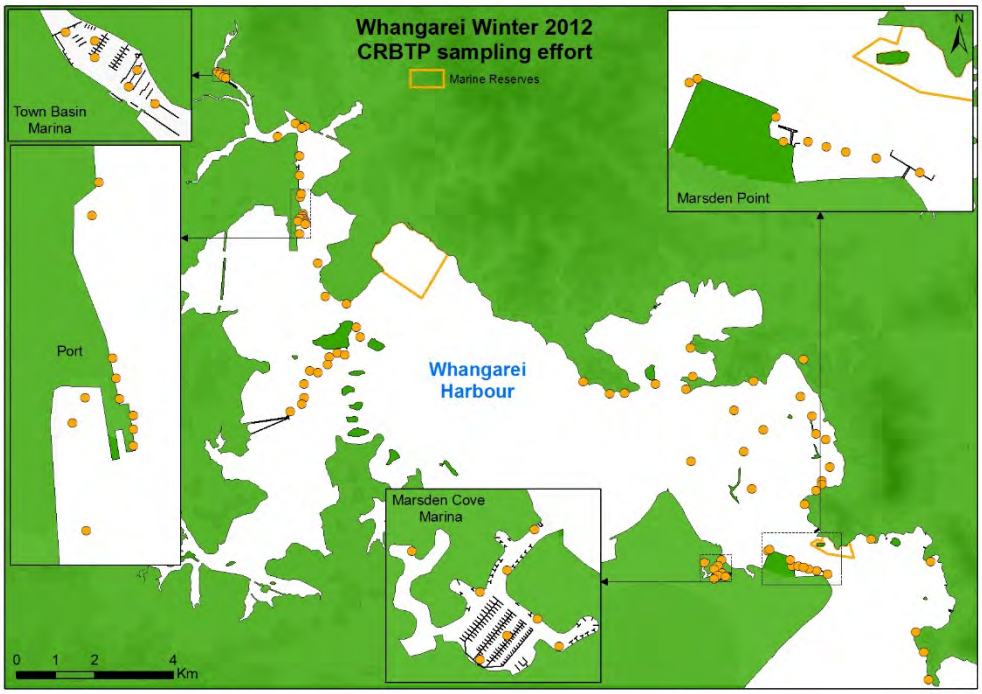
Shore search locations



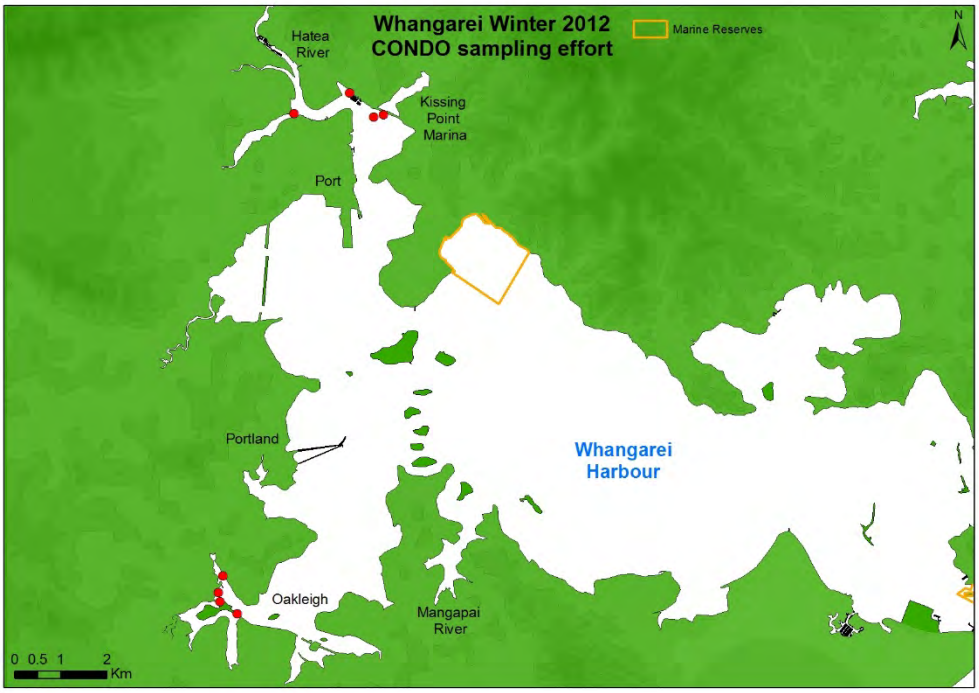
WHANGAREI HARBOUR

Winter 2012

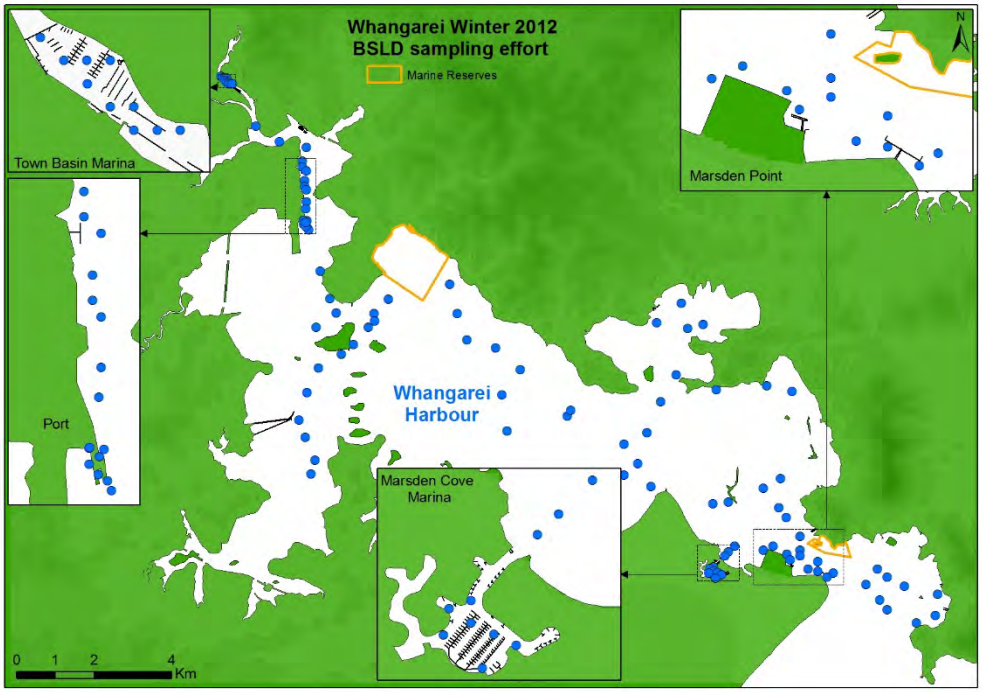
Crab (box) trapping locations



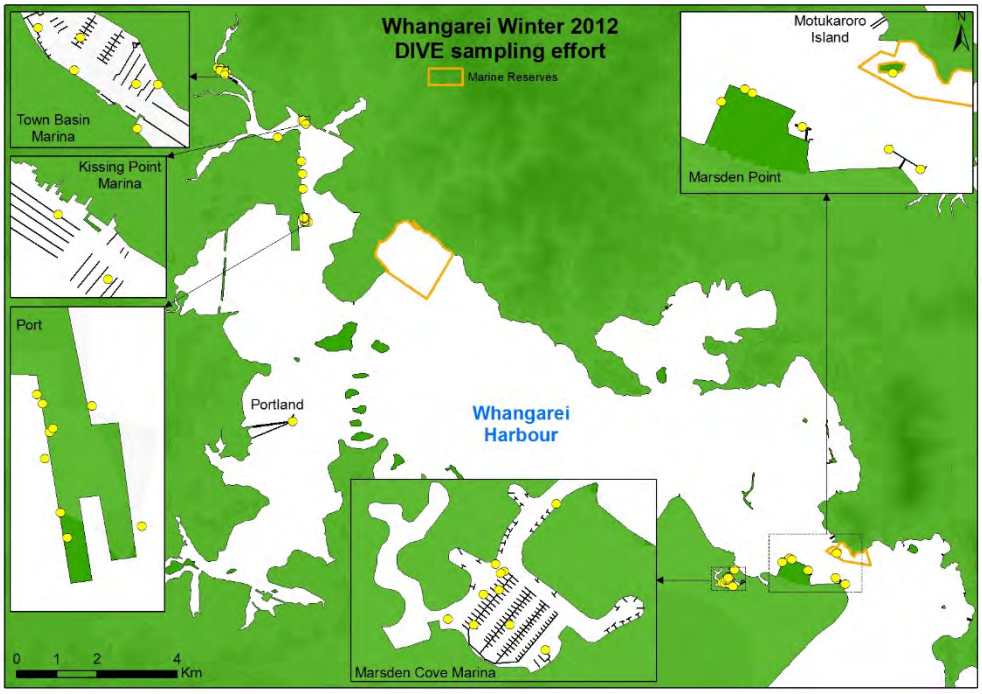
Crab condo locations



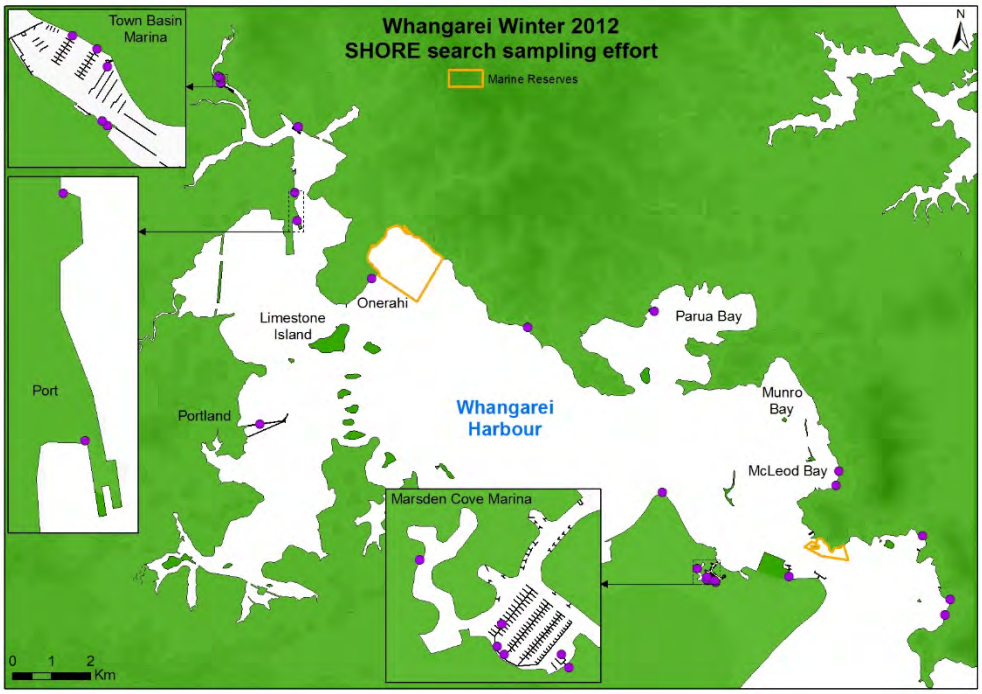
Sledding locations



Dive search locations

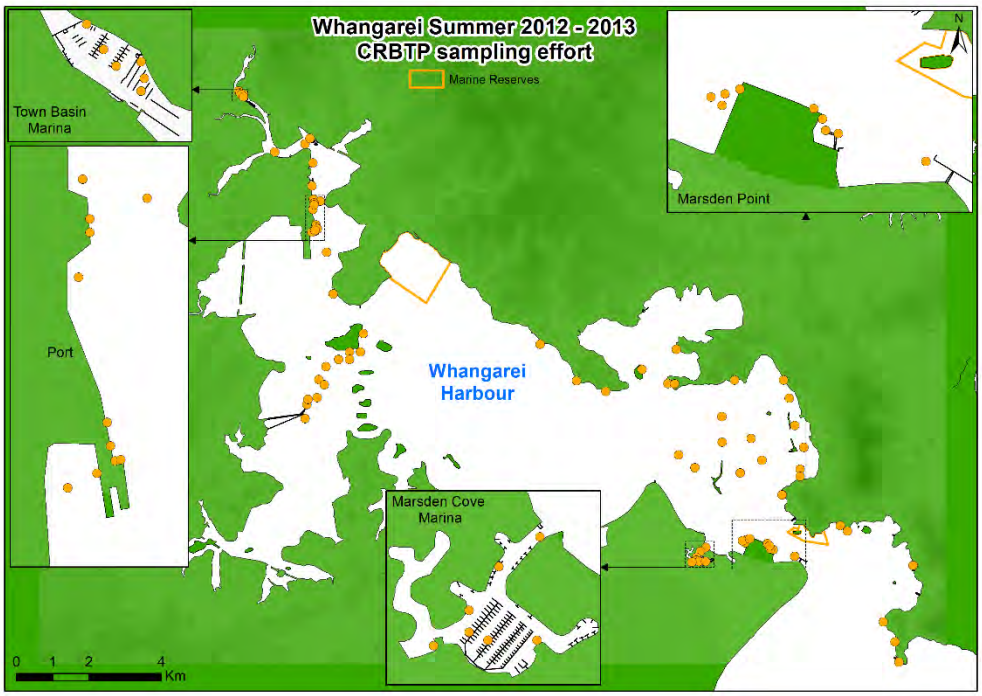


Shore search locations

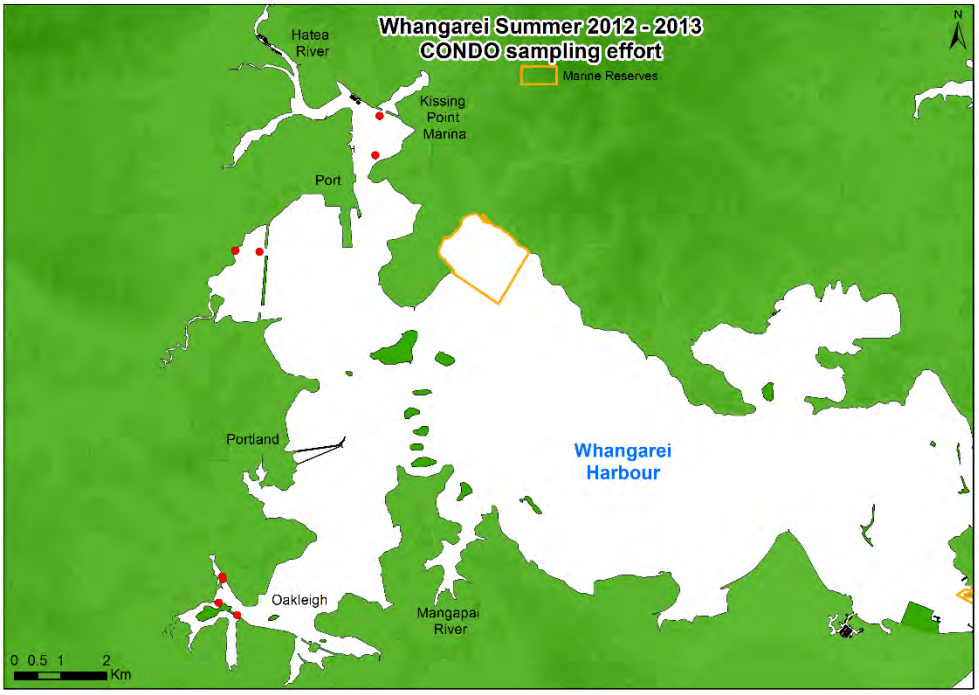


Summer 2012-2013

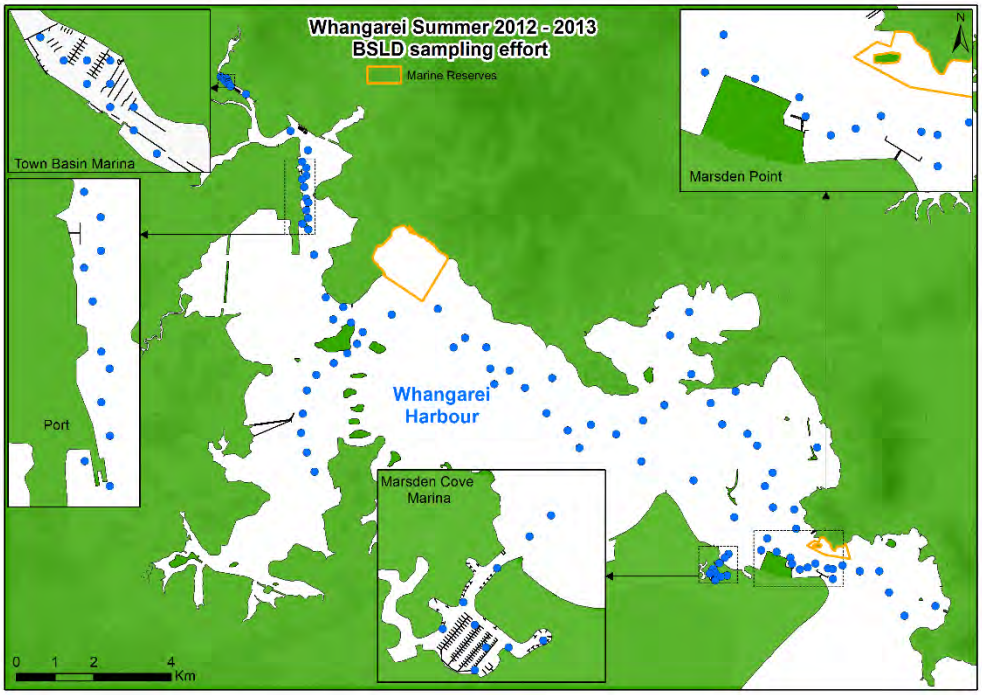
Crab (box) trapping locations



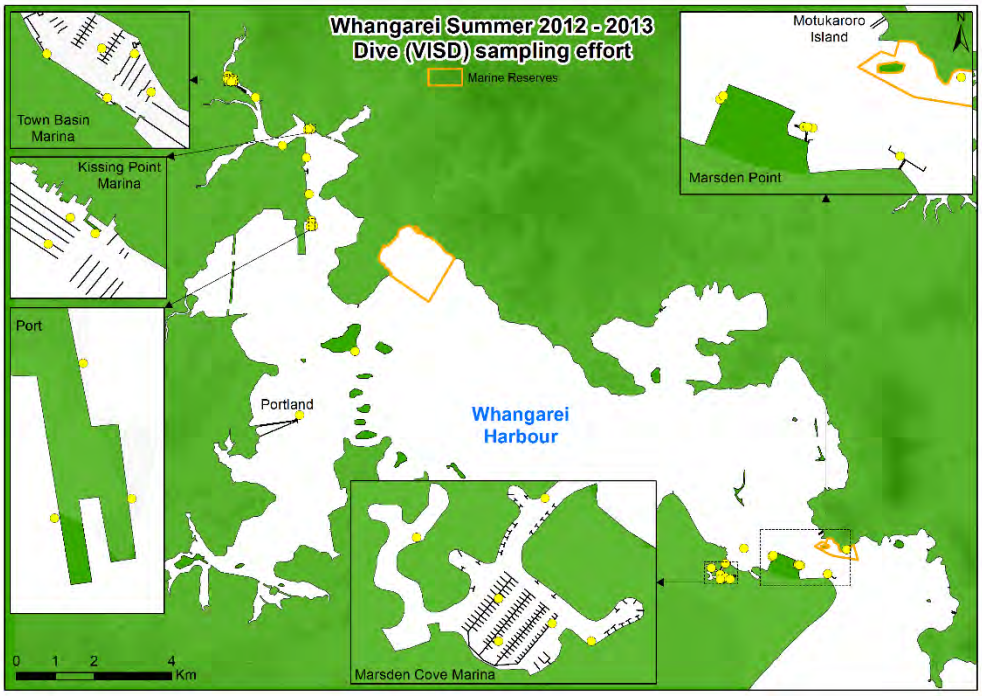
Crab condo locations



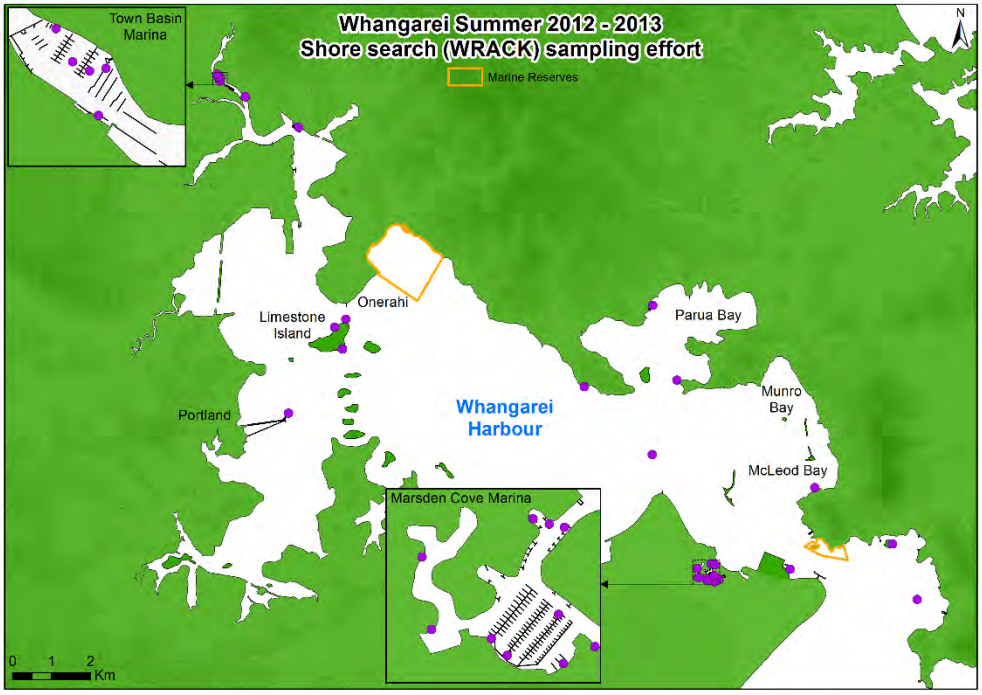
Sledding locations



Dive search locations



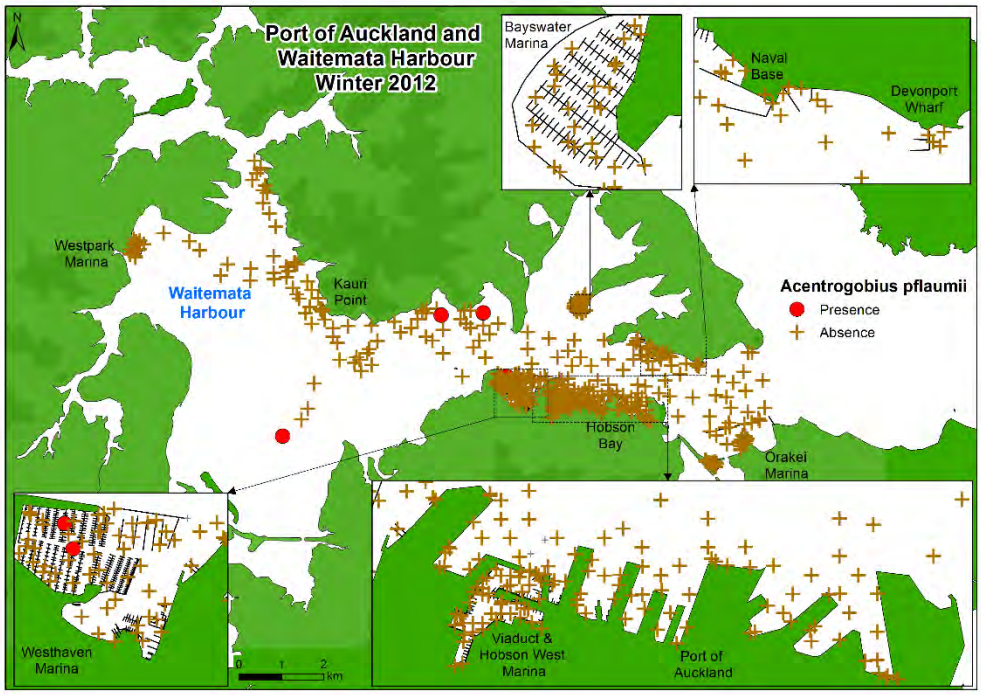
Shore search locations



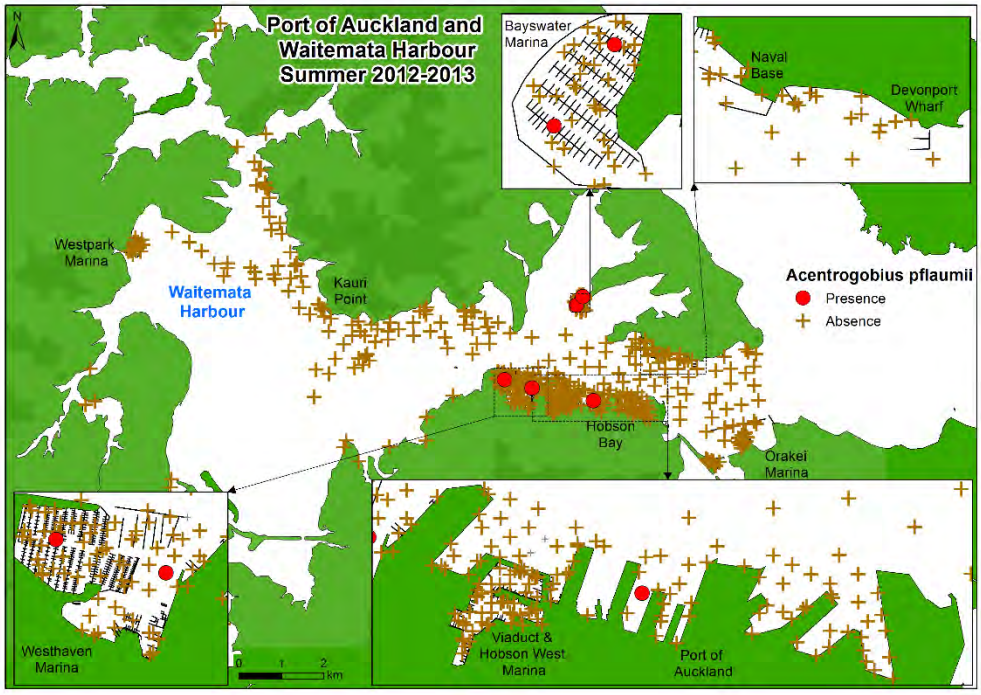
Appendix 3. Distribution maps for target and selected non-target species in Winter 2012 and Summer 2012-2013.

ACENTROGOBIUS PFLAUMII

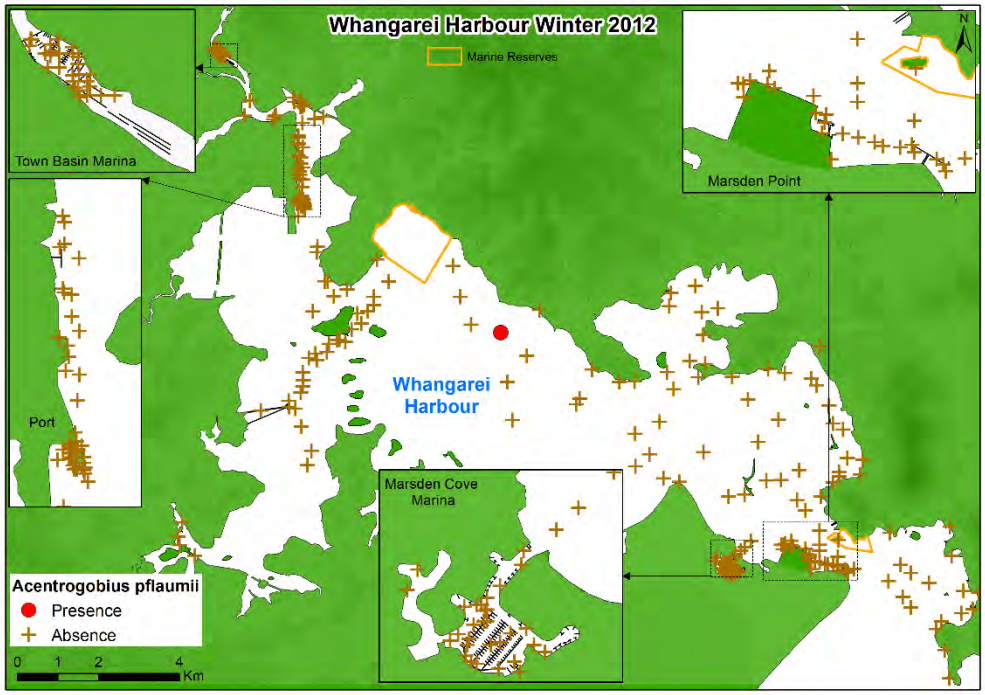
Auckland (Waitemata Harbour) Winter 2012



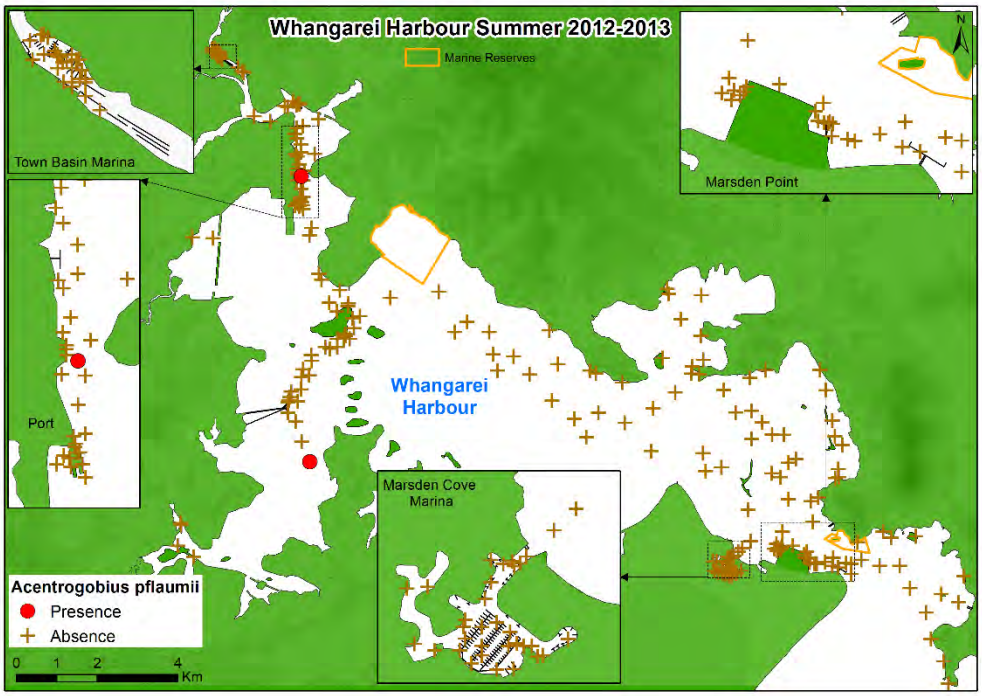
Auckland (Waitemata Harbour) Summer 2012-2013



Whangarei Harbour Winter 2012

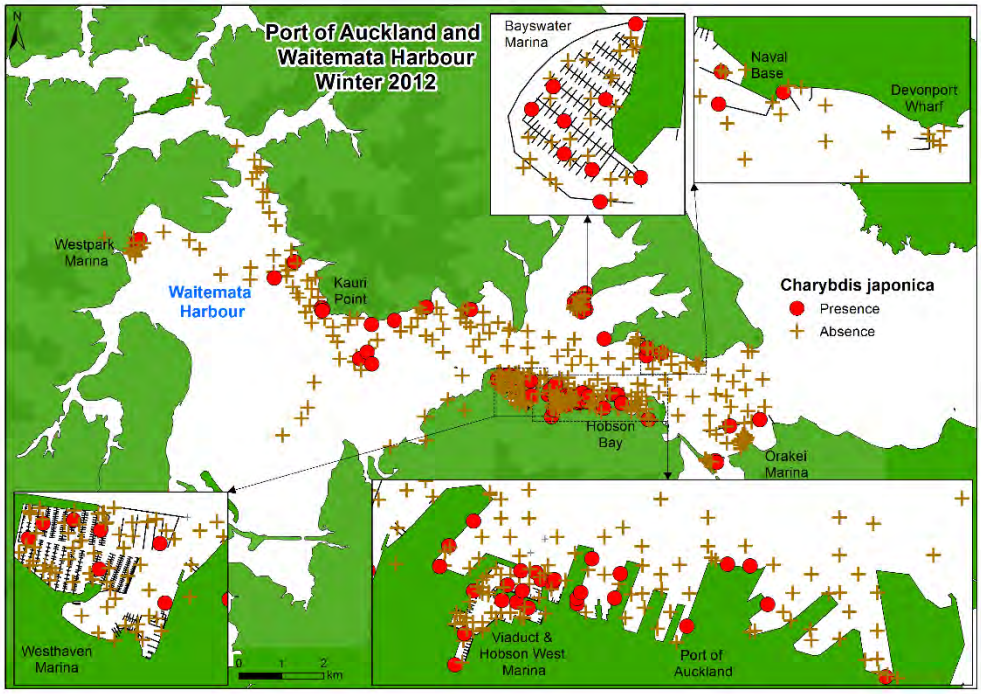


Whangarei Harbour Summer 2012-2013

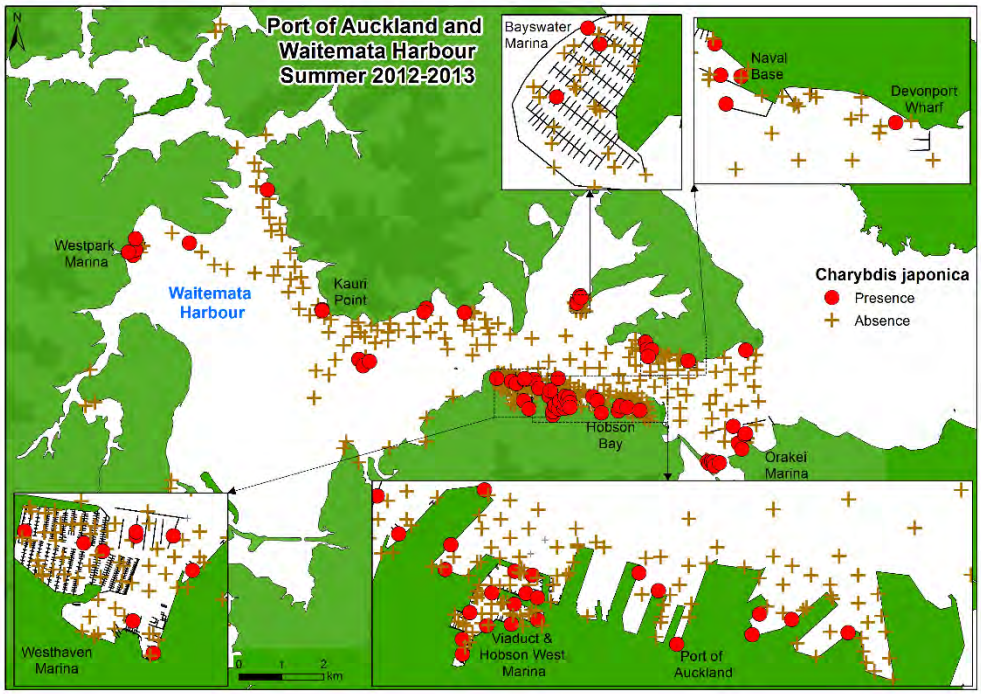


CHARYBDIS JAPONICA

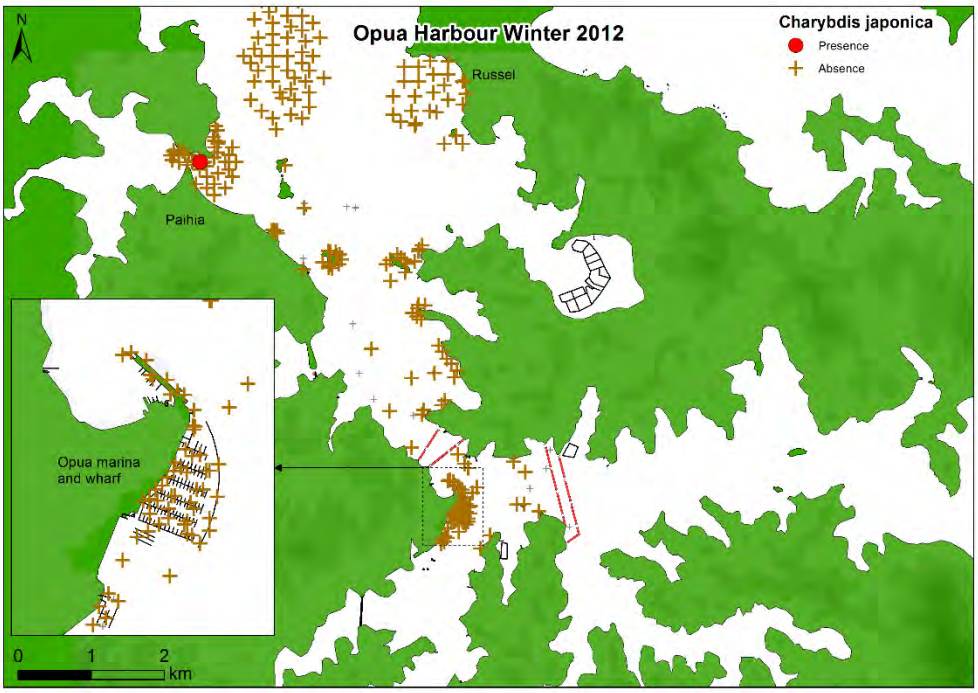
Auckland (Waitemata Harbour) Winter 2012



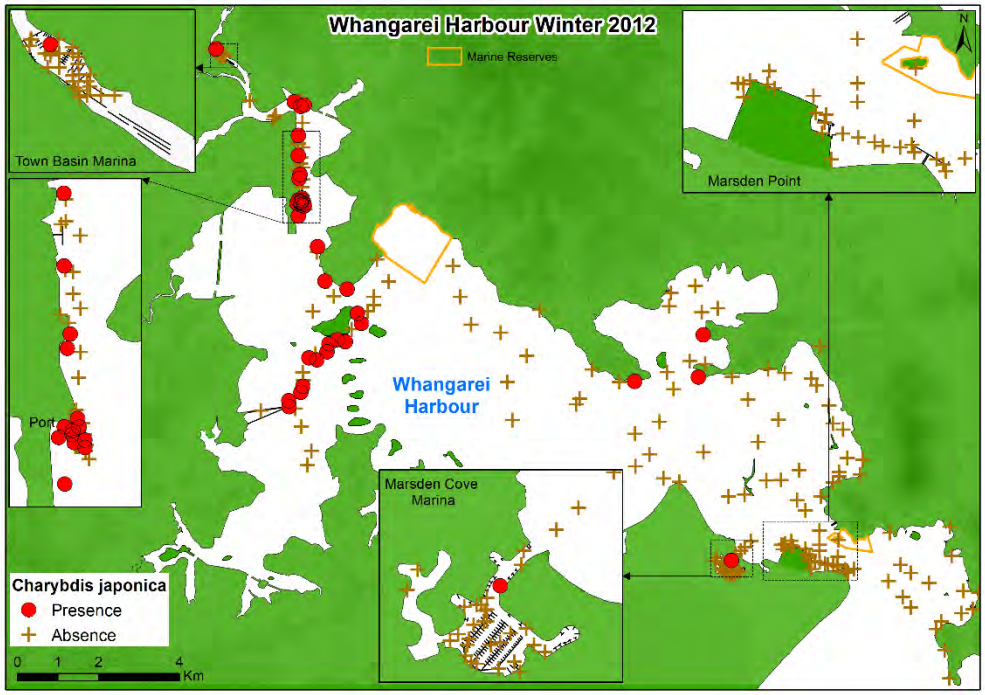
Auckland (Waitemata Harbour) Summer 2012-2013



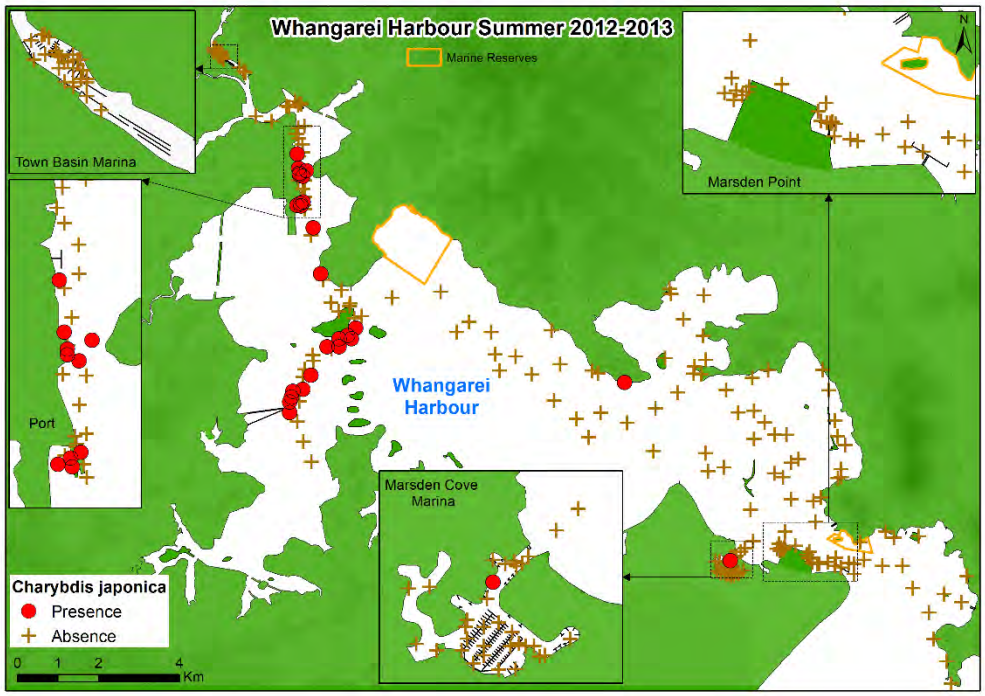
Opua Winter 2012



Whangarei Harbour Winter 2012

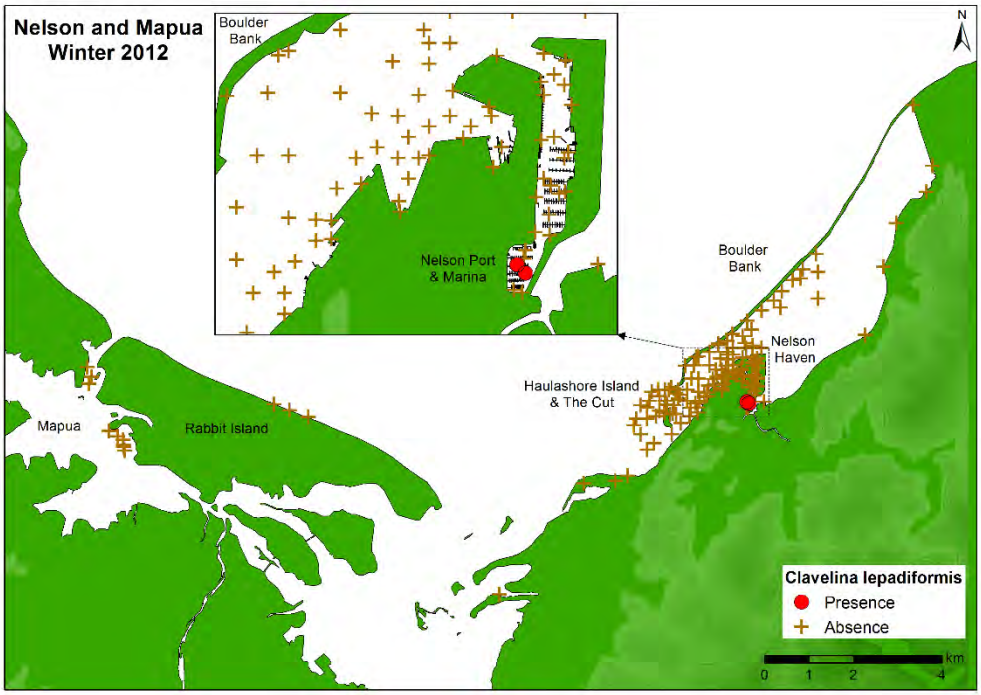


Whangarei Harbour Summer 2012-2013

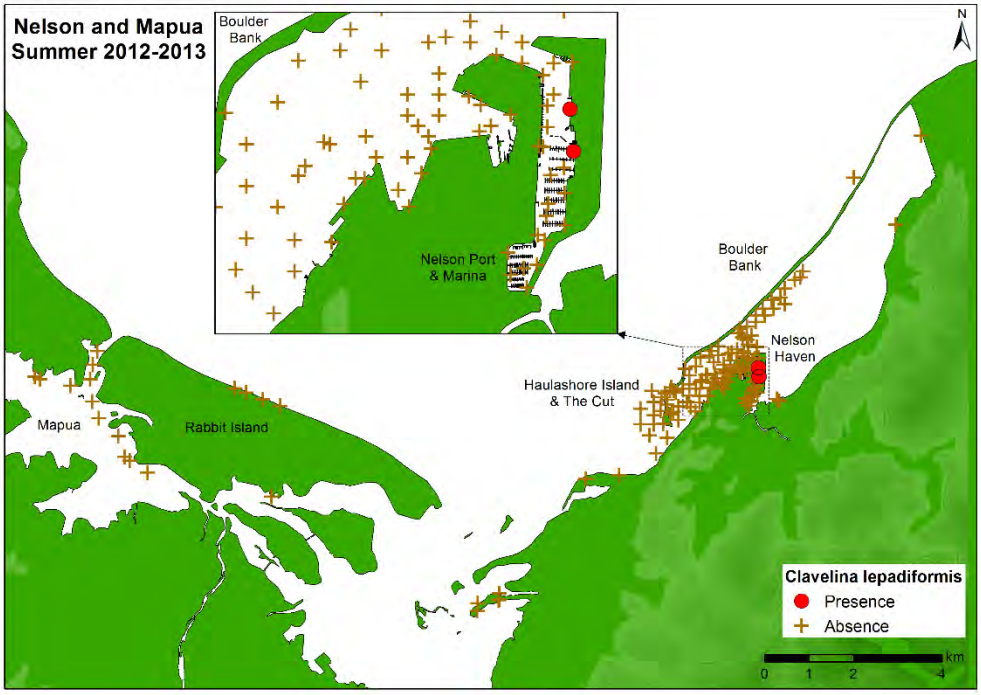


CLAVELINA LEPADIFORMIS

Nelson Winter 2012

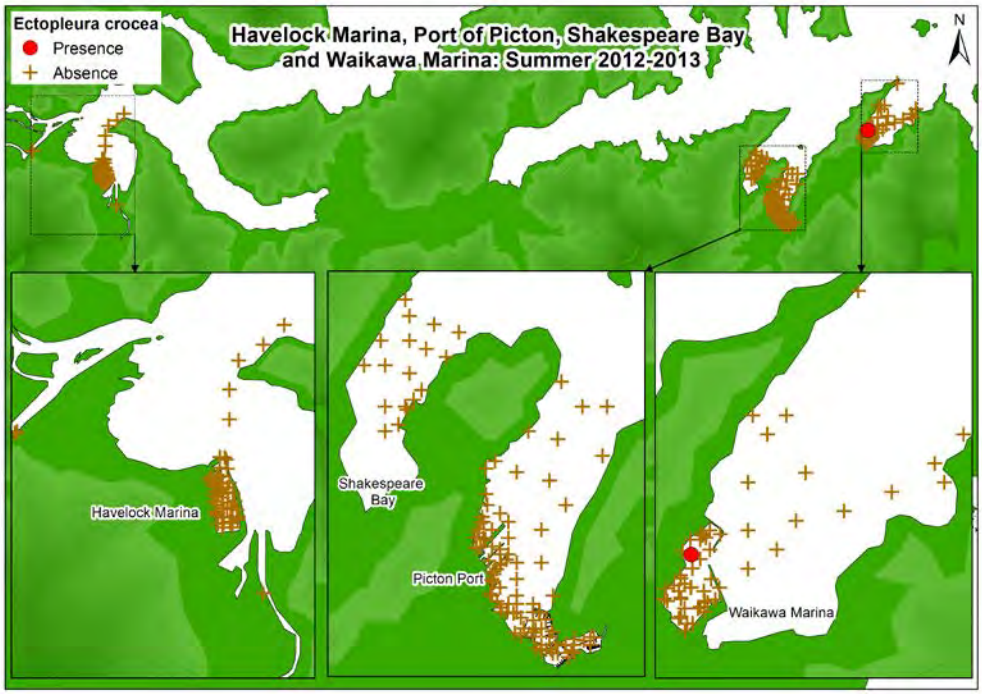


Nelson Summer 2012-2013

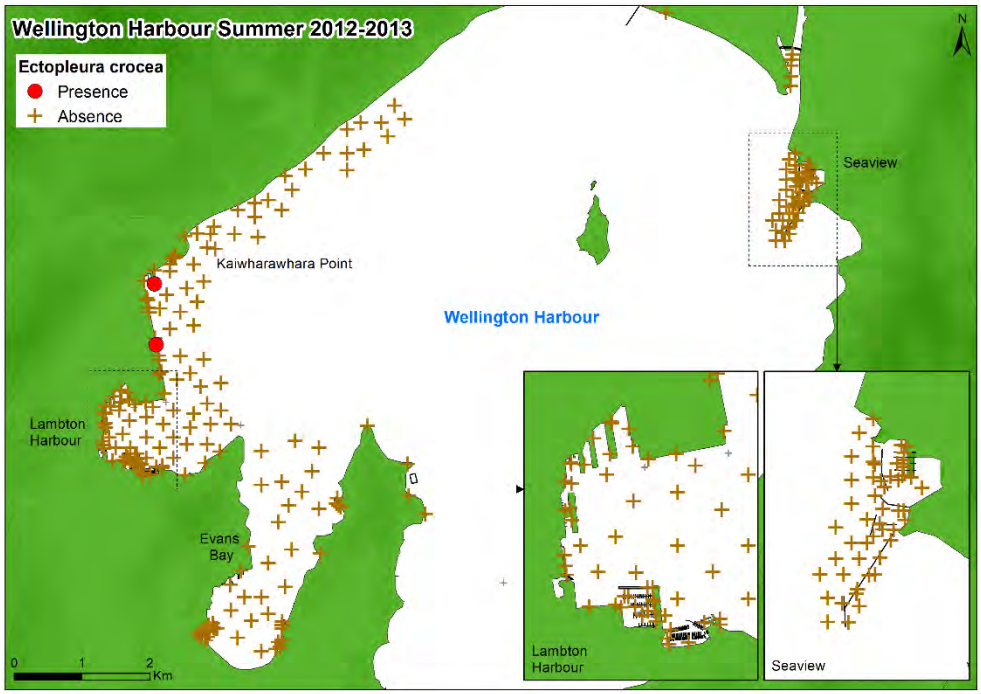


ECTOPLEURA CROCEA

Picton / Havelock Summer 2012-2013

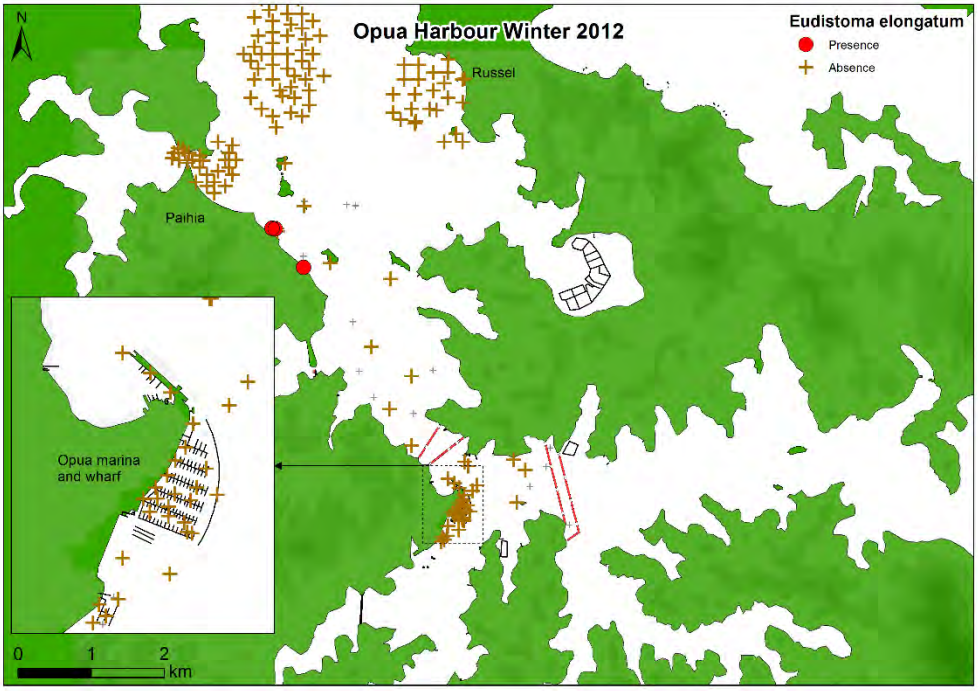


Wellington Harbour Summer 2012-2013

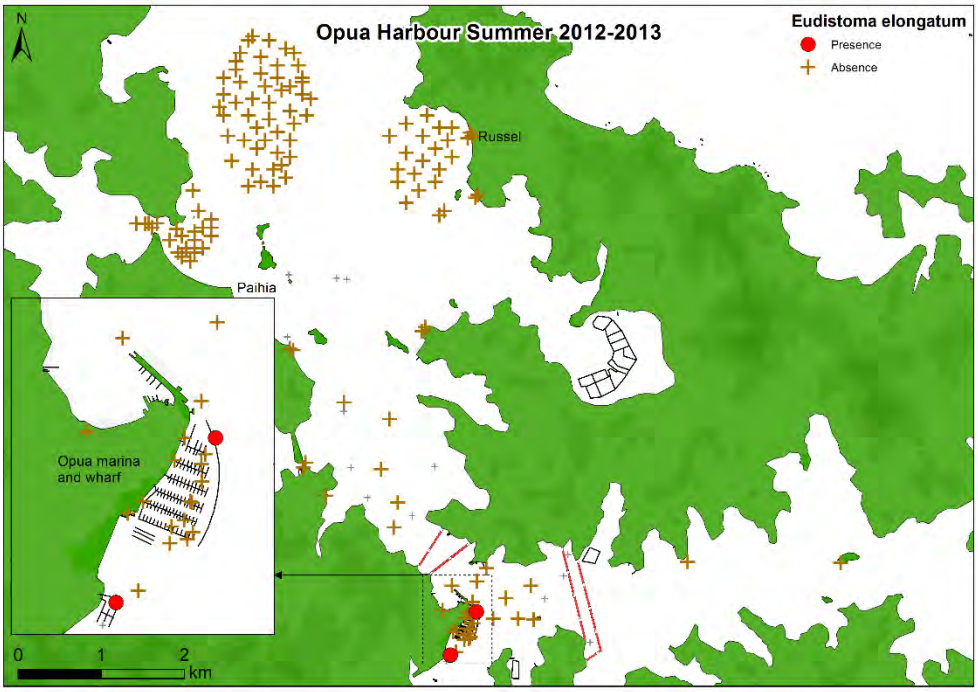


EUDISTOMA ELONGATUM

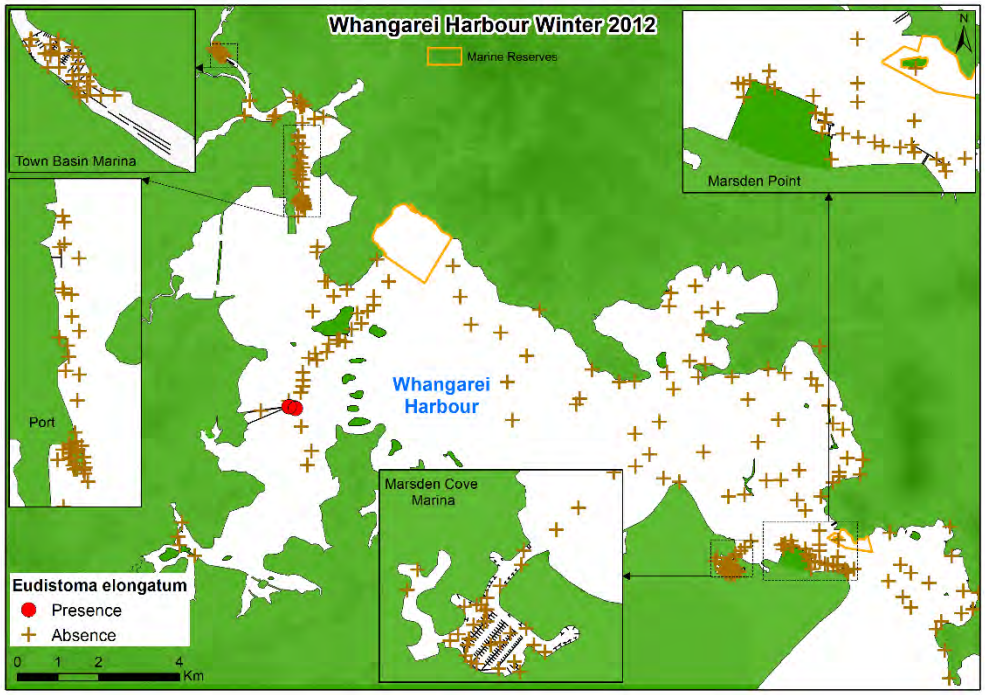
Opua Winter 2012



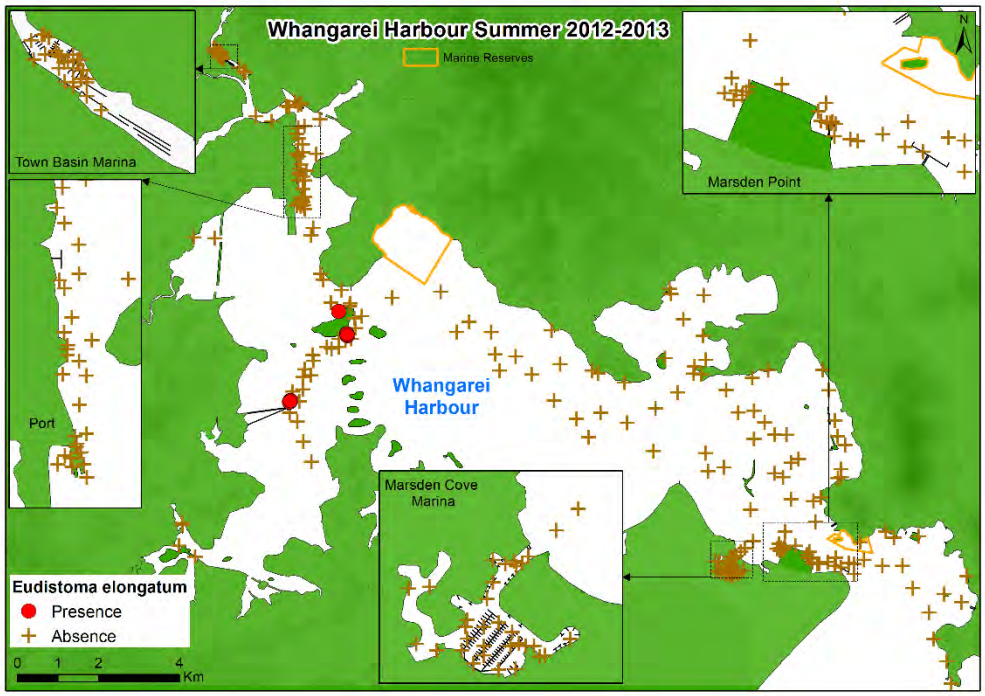
Opua Summer 2012-2013



Whangarei Harbour Winter 2012

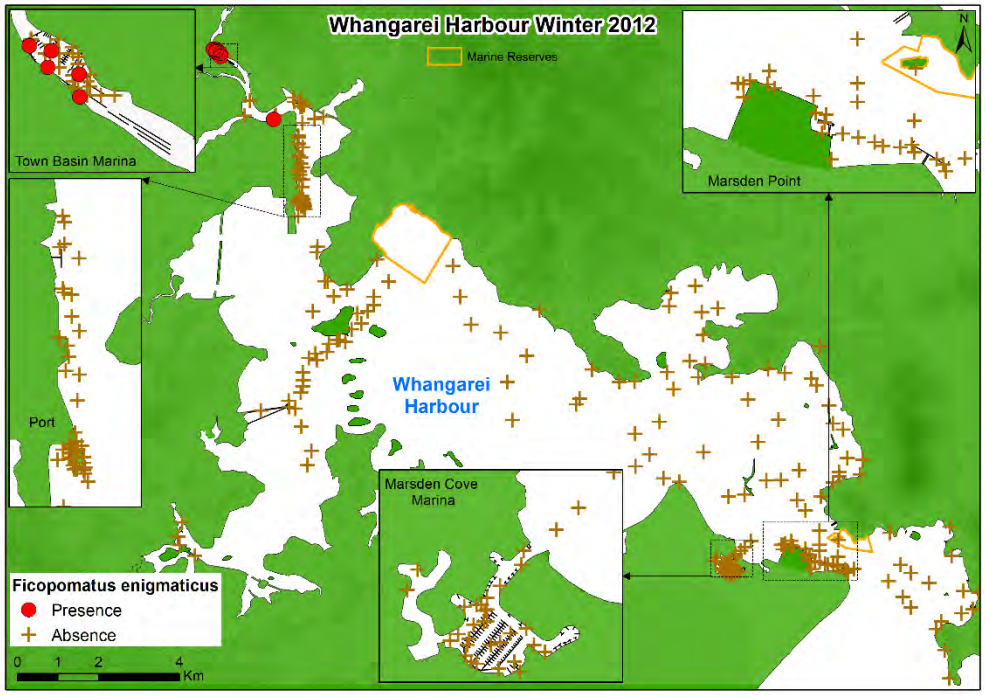


Whangarei Harbour Summer 2012-2013

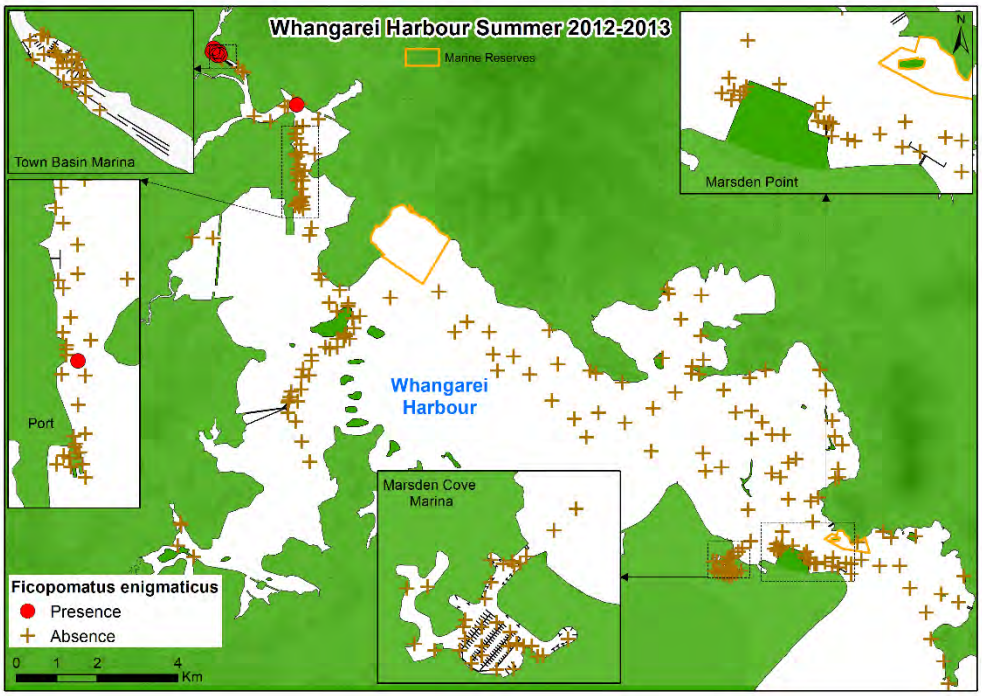


FICOPOMATUS ENIGMATICUS

Whangarei Harbour Winter 2012

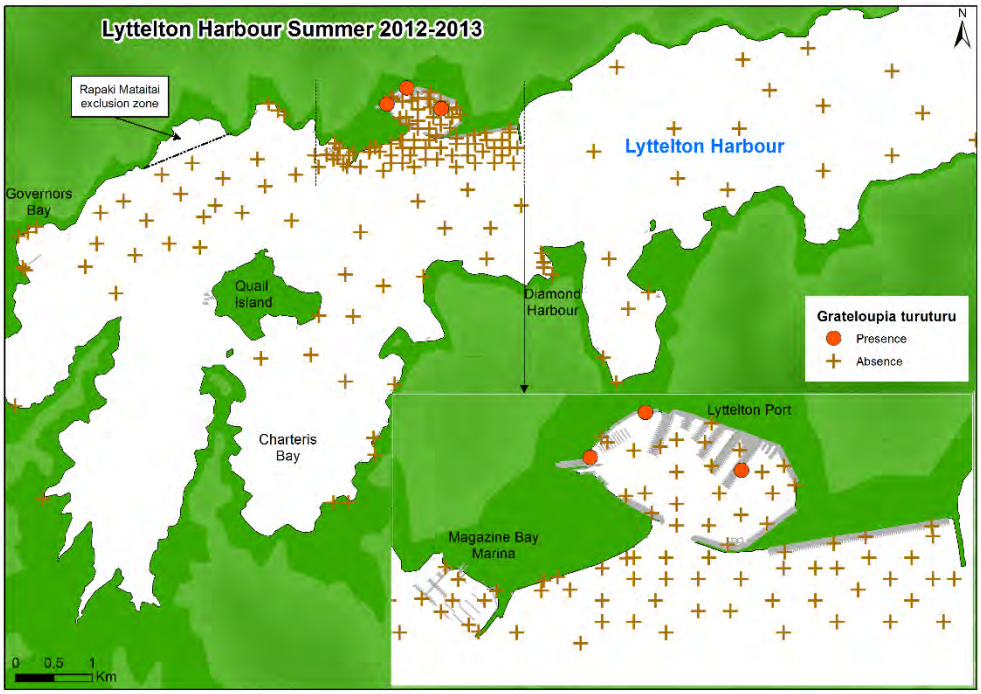


Whangarei Harbour Summer 2012-2013

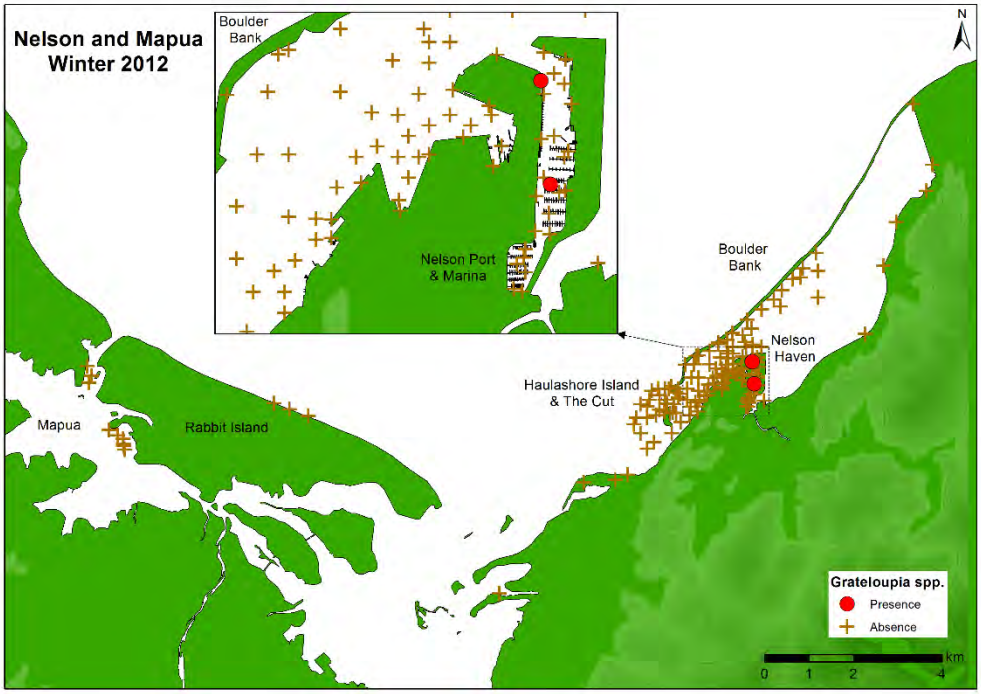


GRATELOUPIA TURUTURU / GRATELOUPIA SP.

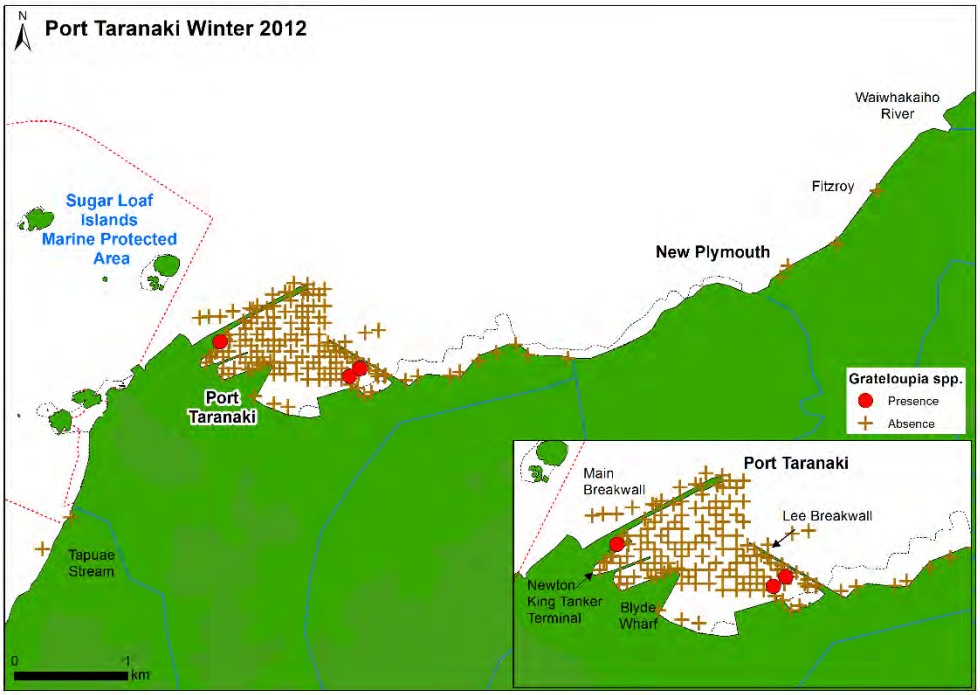
Lyttelton Harbour Summer 2012-2013



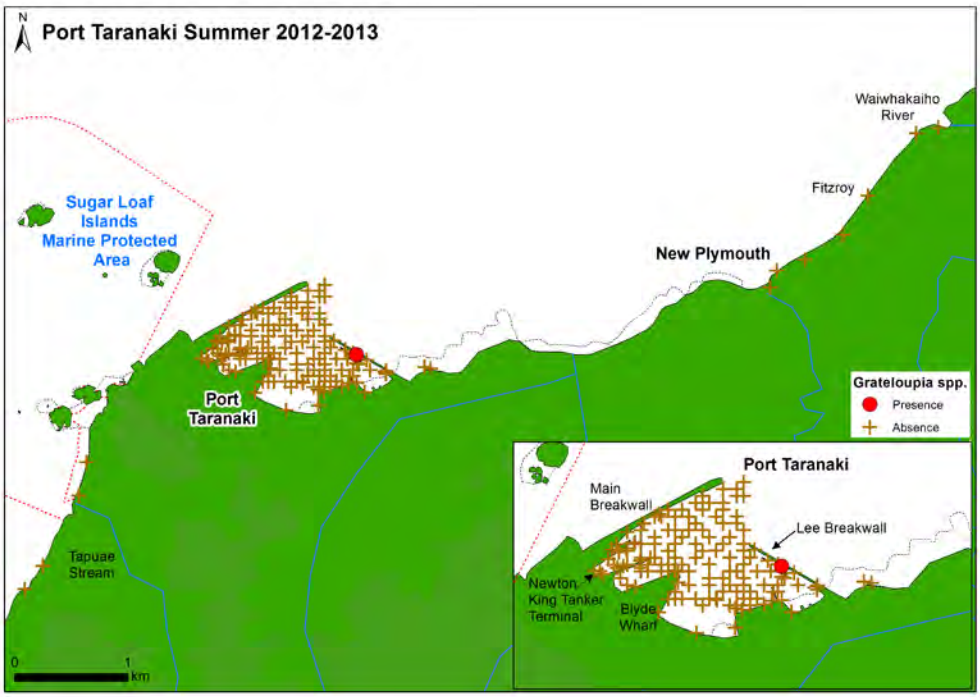
Nelson Winter 2012



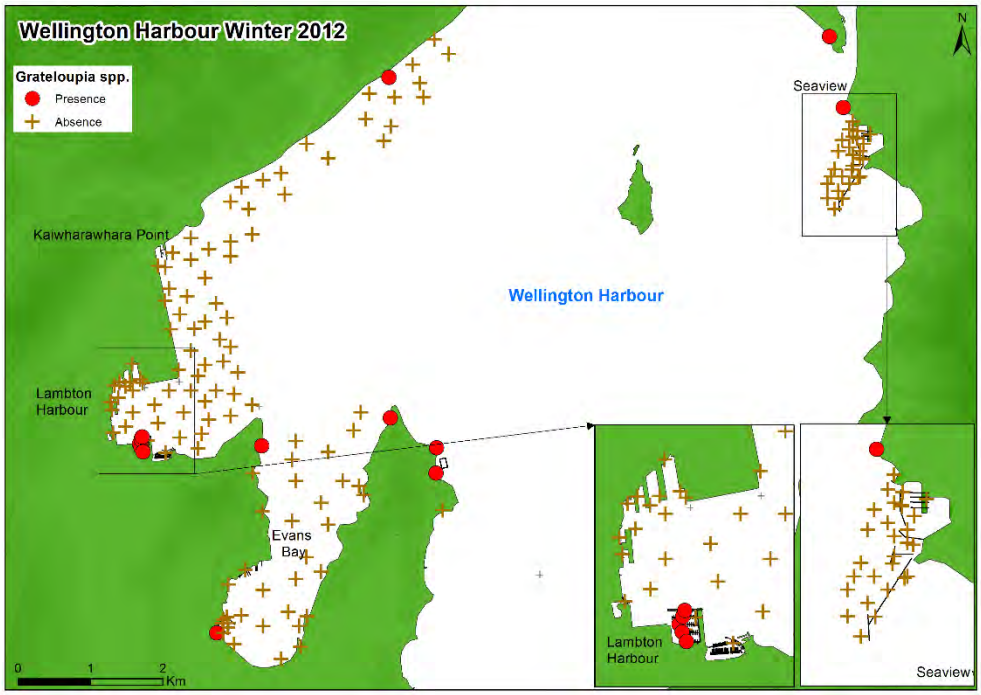
New Plymouth Winter 2012



New Plymouth Summer 2012-2013

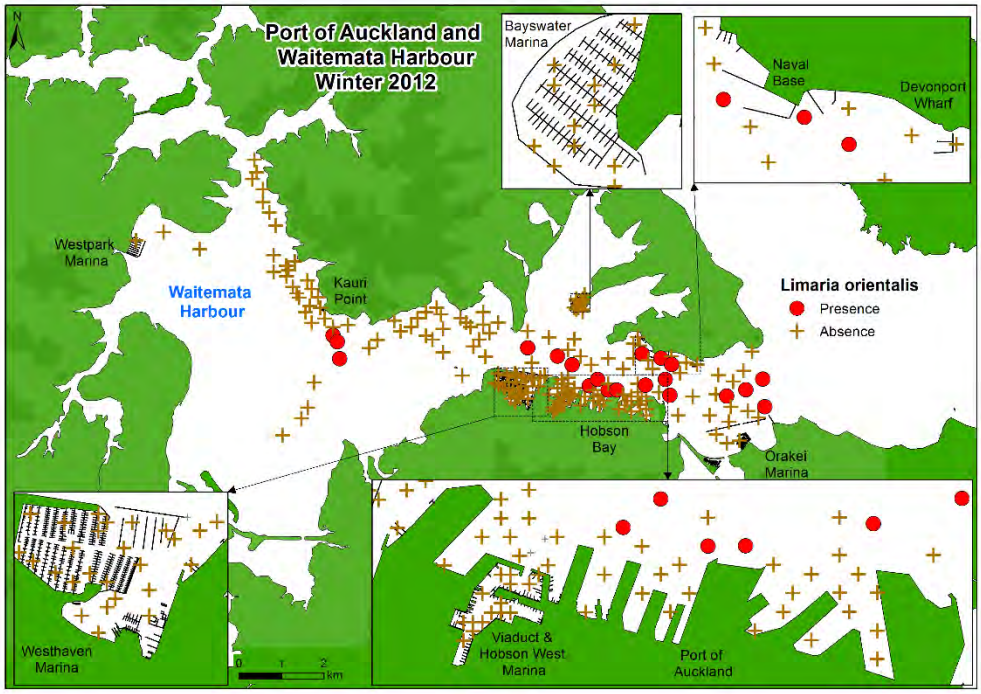


Wellington Harbour Winter 2012

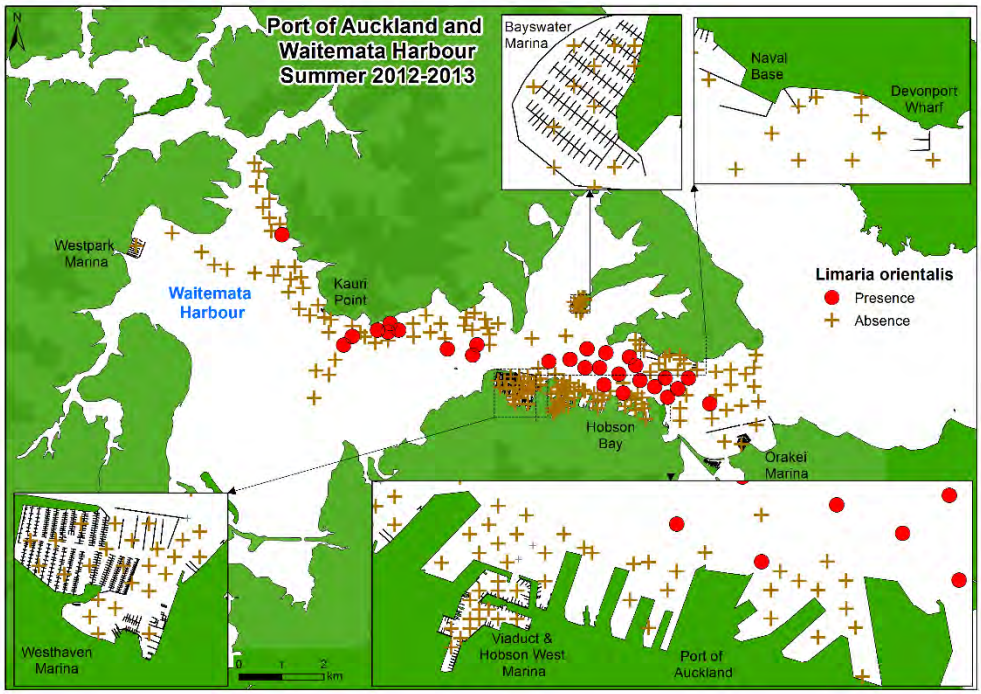


LIMARIA ORIENTALIS

Auckland (Waitemata Harbour) Winter 2012

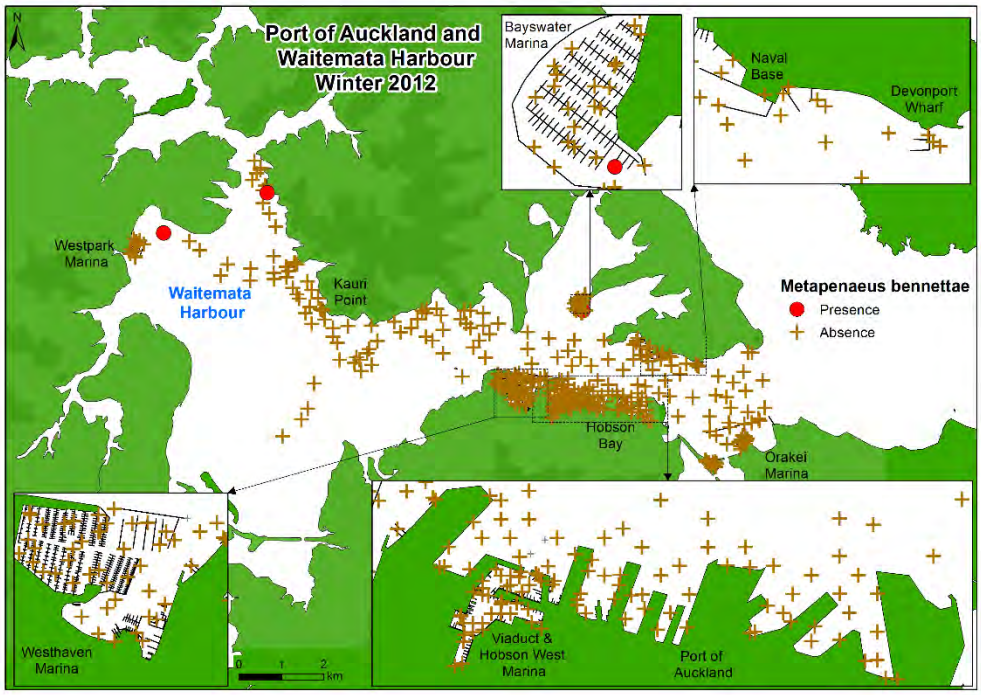


Auckland (Waitemata Harbour) Summer 2012-2013

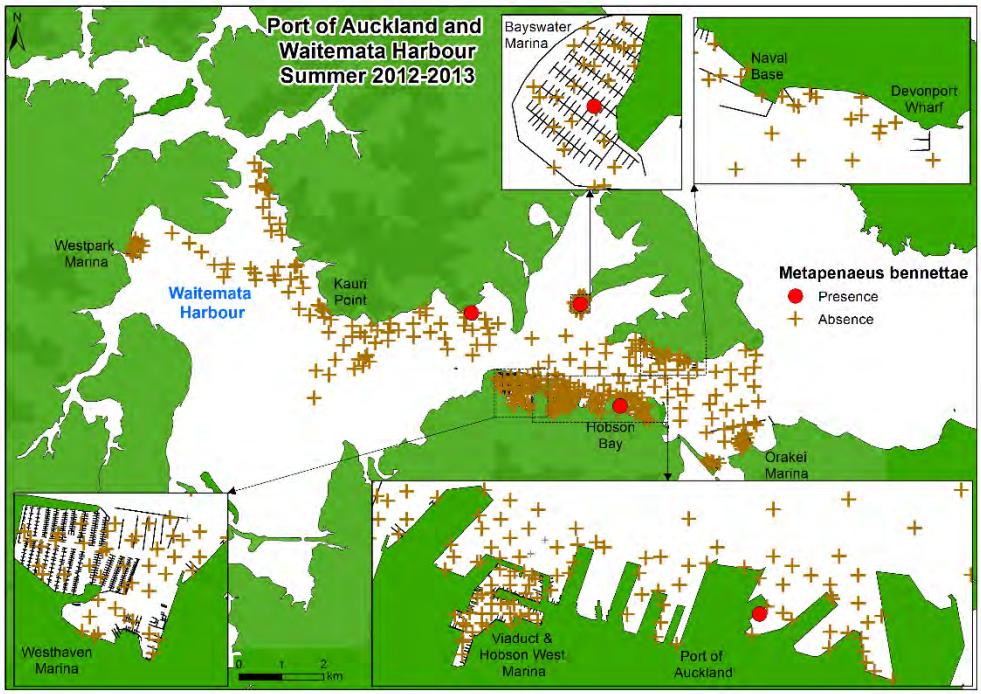


METAPENAEUS BENNETTAE

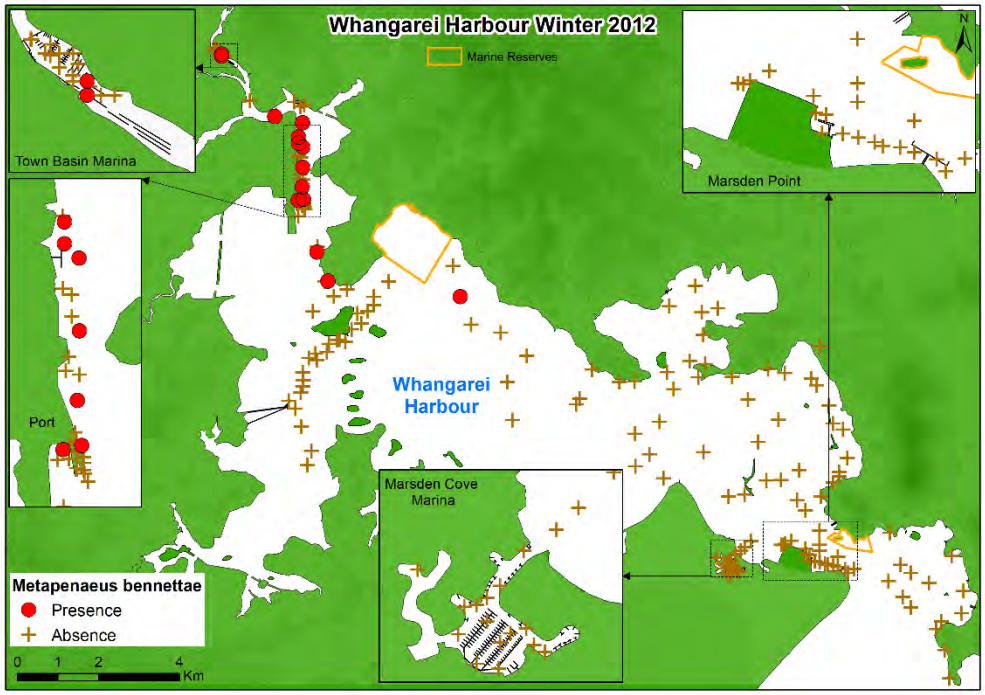
Auckland (Waitemata Harbour) Winter 2012



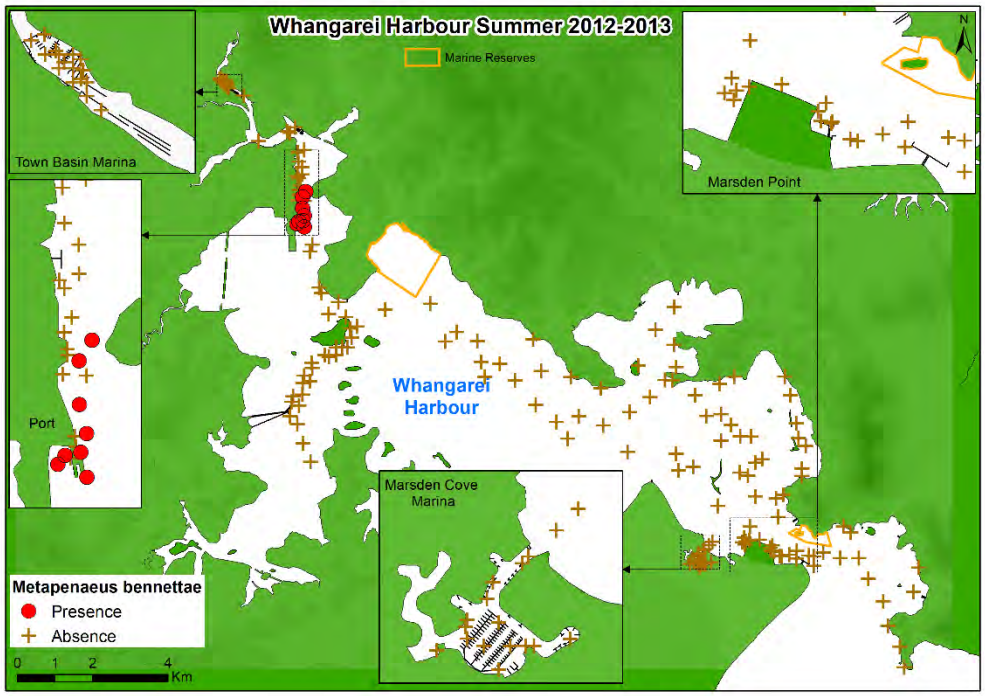
Auckland (Waitemata Harbour) Summer 2012-2013



Whangarei Harbour Winter 2012

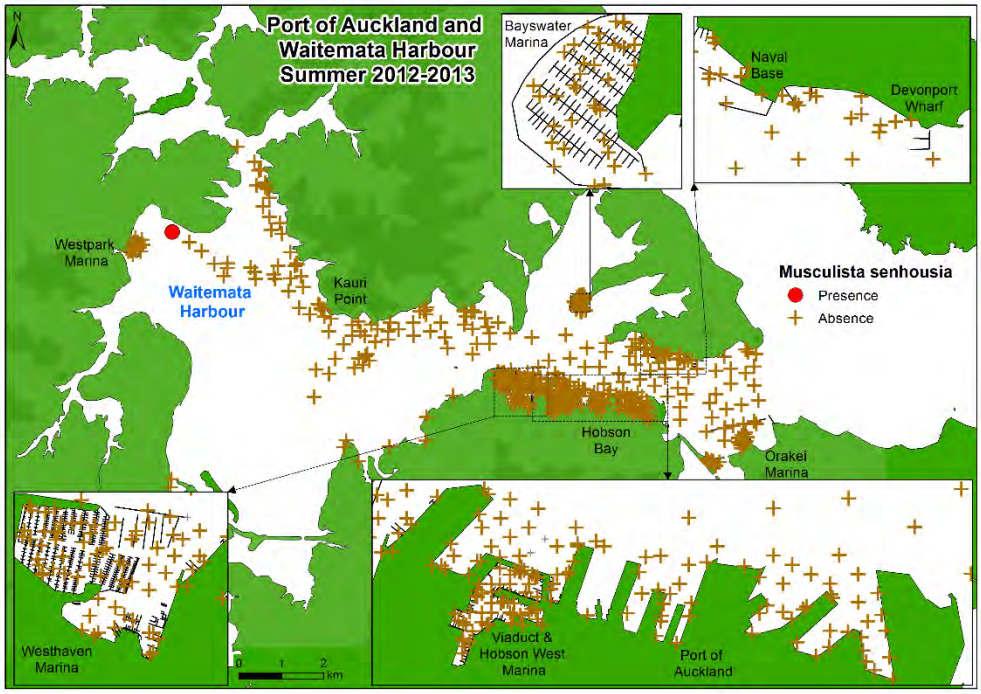


Whangarei Harbour Summer 2012-2013

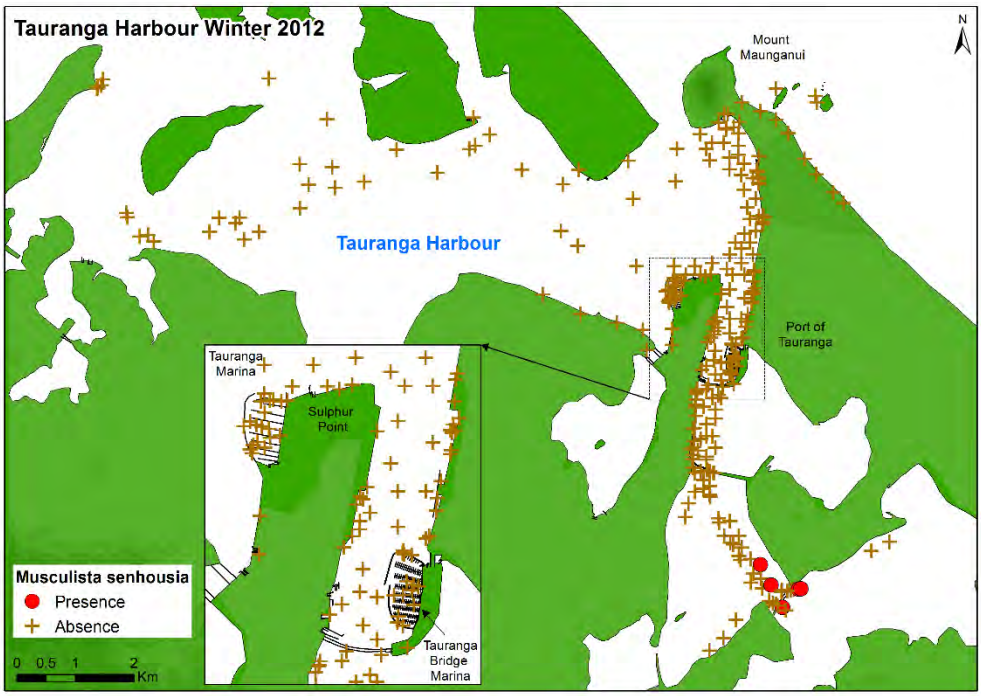


MUSCULISTA SENHOUSIA

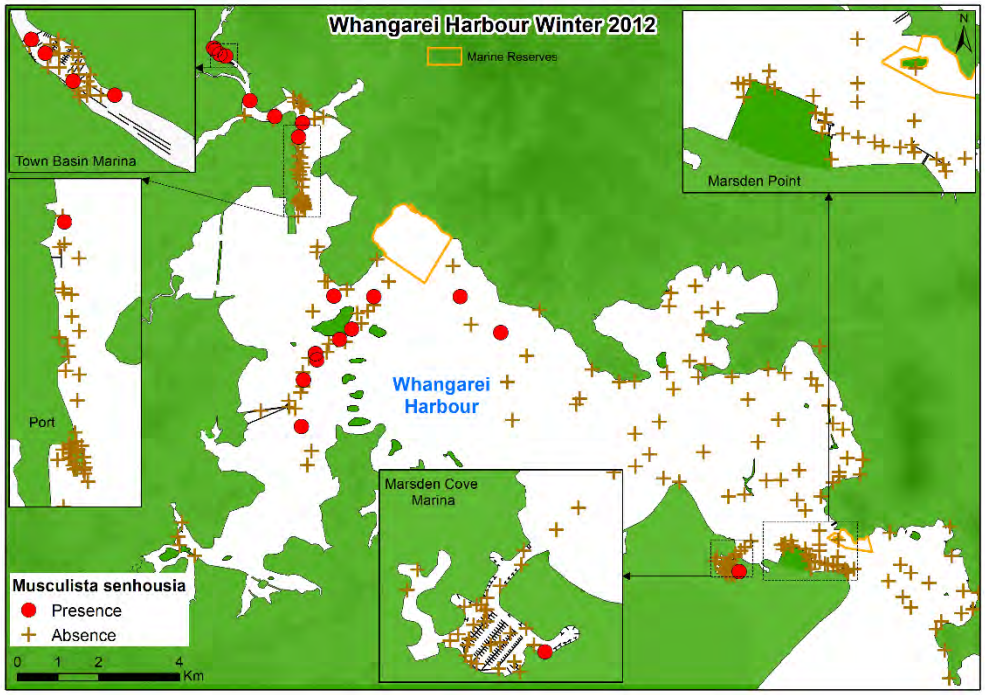
Auckland (Waitemata Harbour) Summer 2012-2013



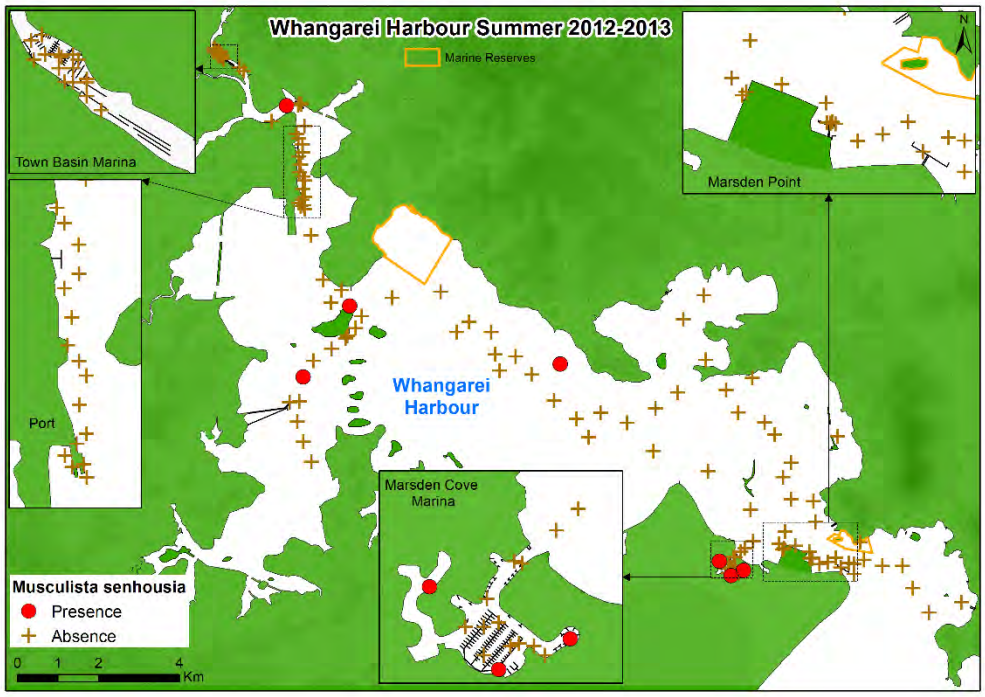
Tauranga Harbour Winter 2012



Whangarei Harbour Winter 2012

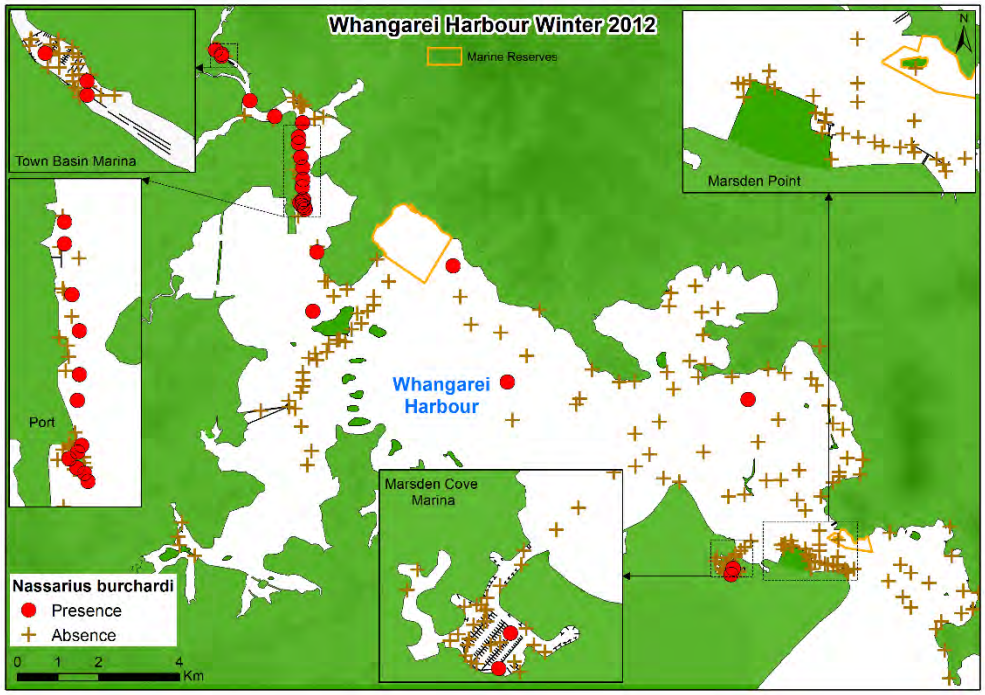


Whangarei Harbour Summer 2012-2013

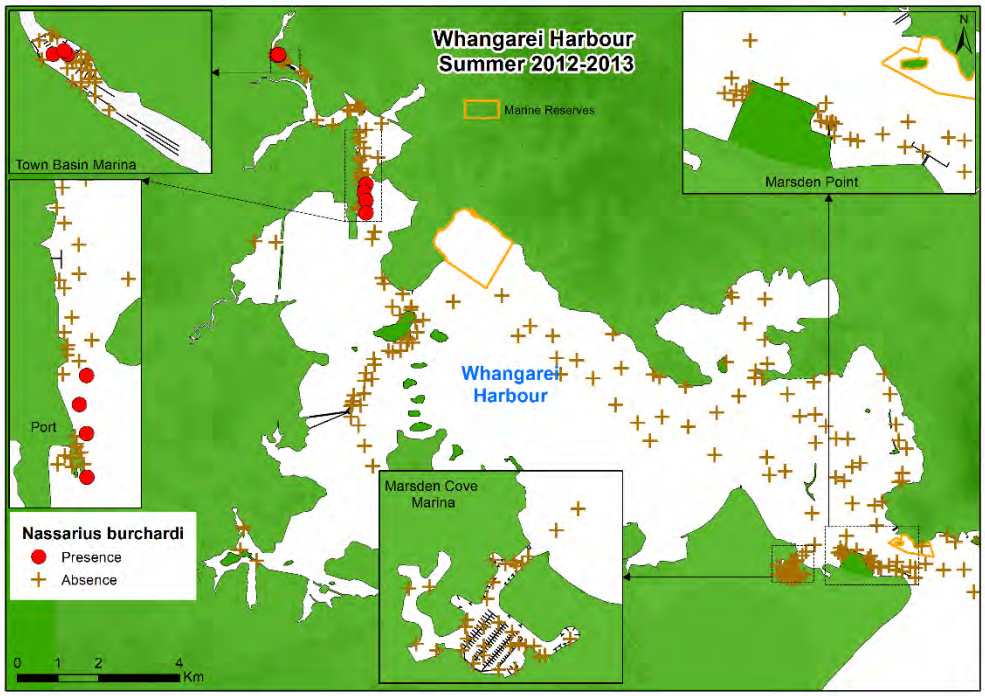


NASSARIUS BURCHARDI

Whangarei Harbour Winter 2012

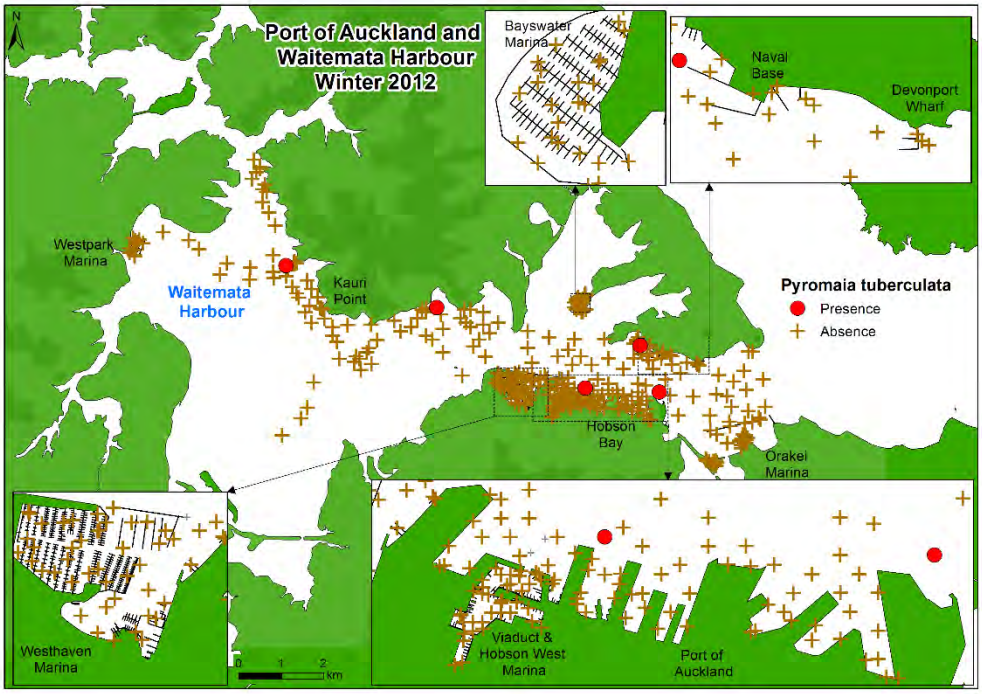


Whangarei Harbour Summer 2012-2013

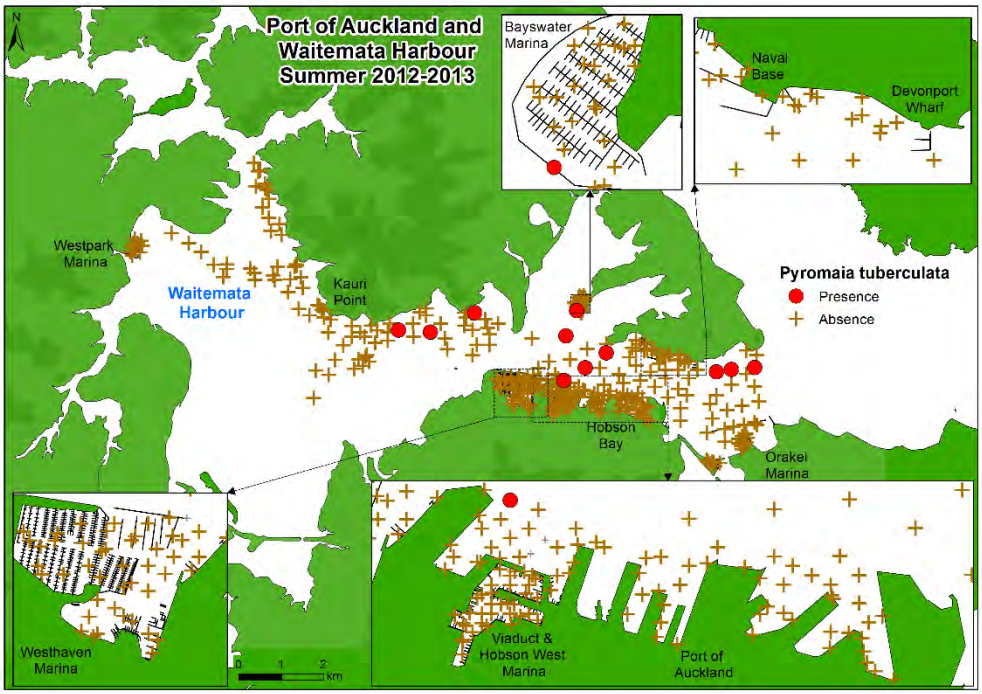


PYROMAIA TUBERCULATA

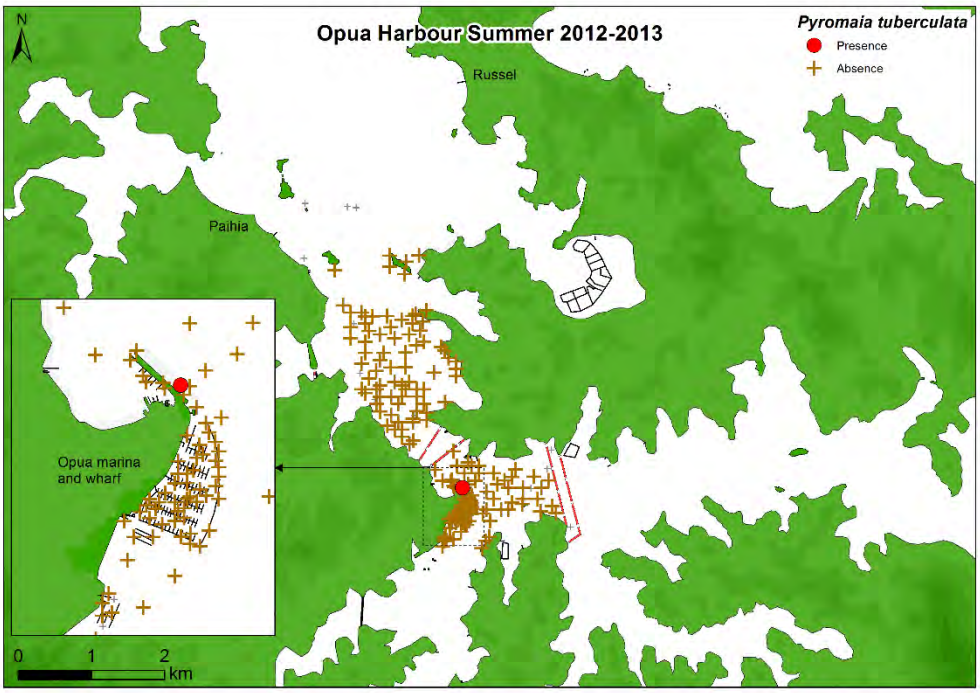
Auckland (Waitemata Harbour) Winter 2012



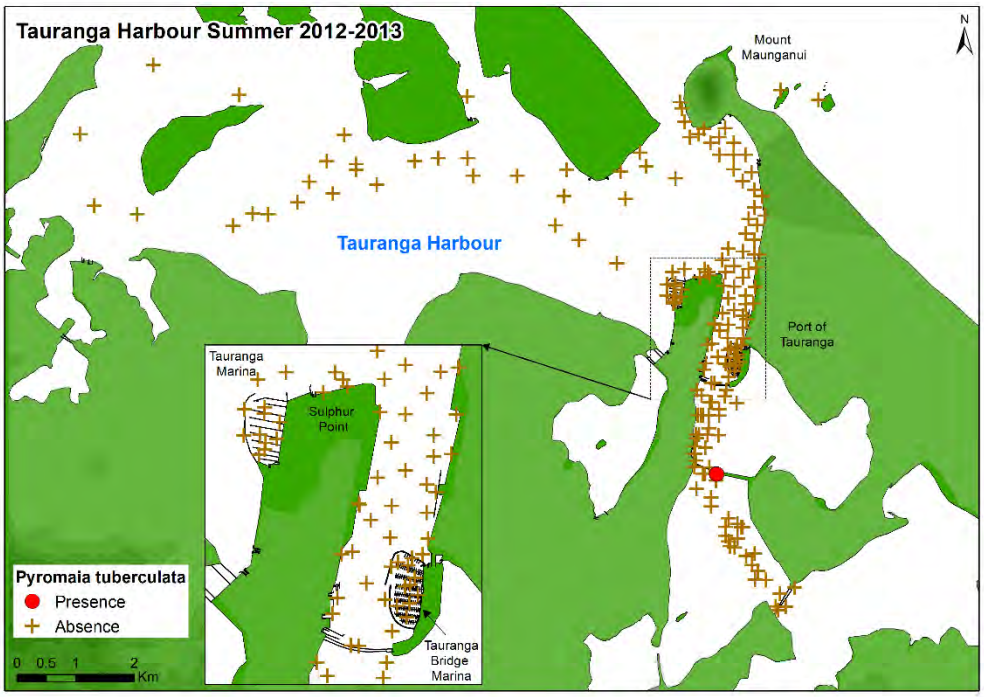
Auckland (Waitemata Harbour) Summer 2012-2013



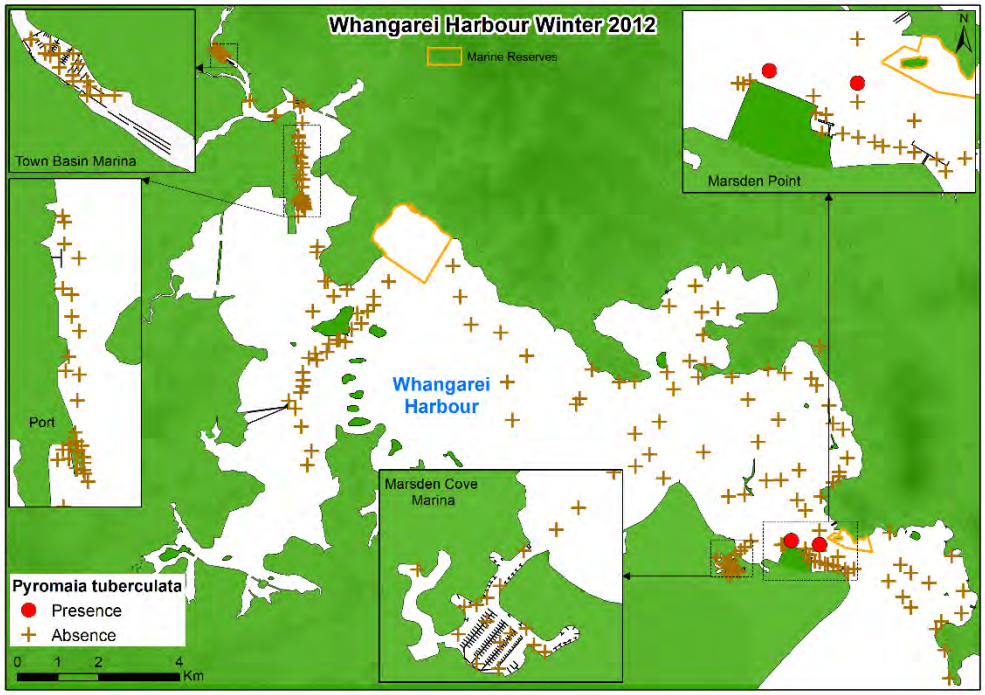
Opua Summer 2012-2013



Tauranga Harbour Summer 2012-2013

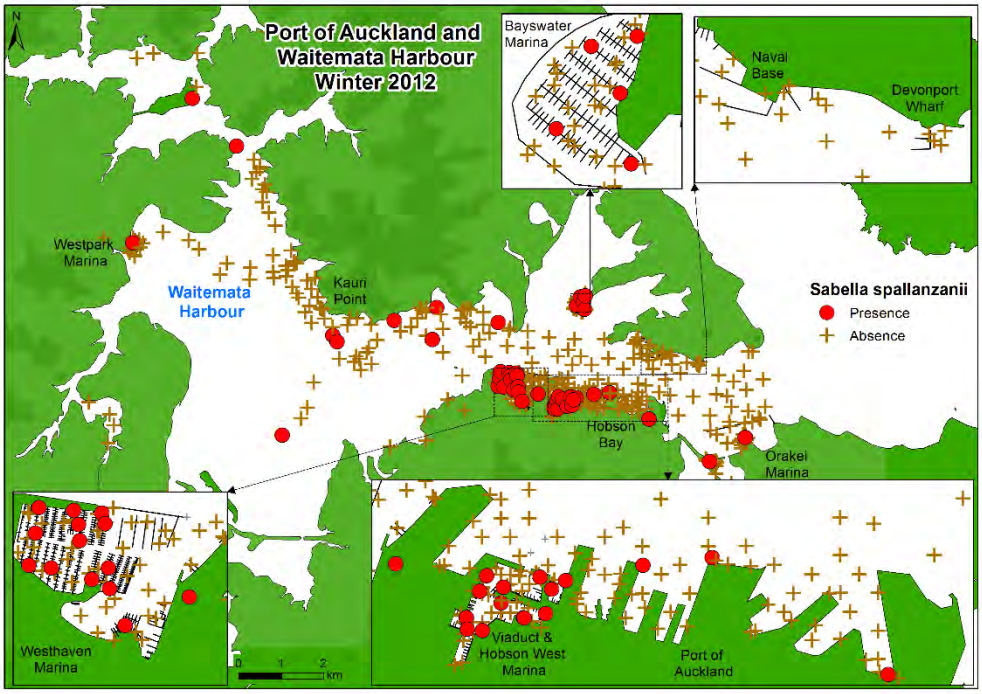


Whangarei Harbour Winter 2012

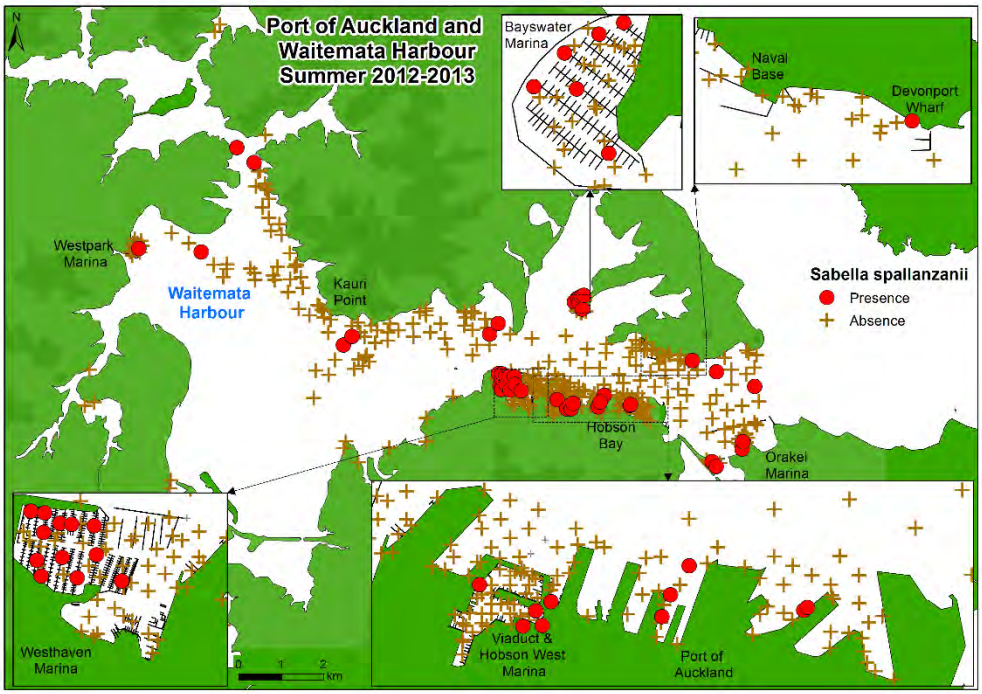


SABELLA SPALLANZANII

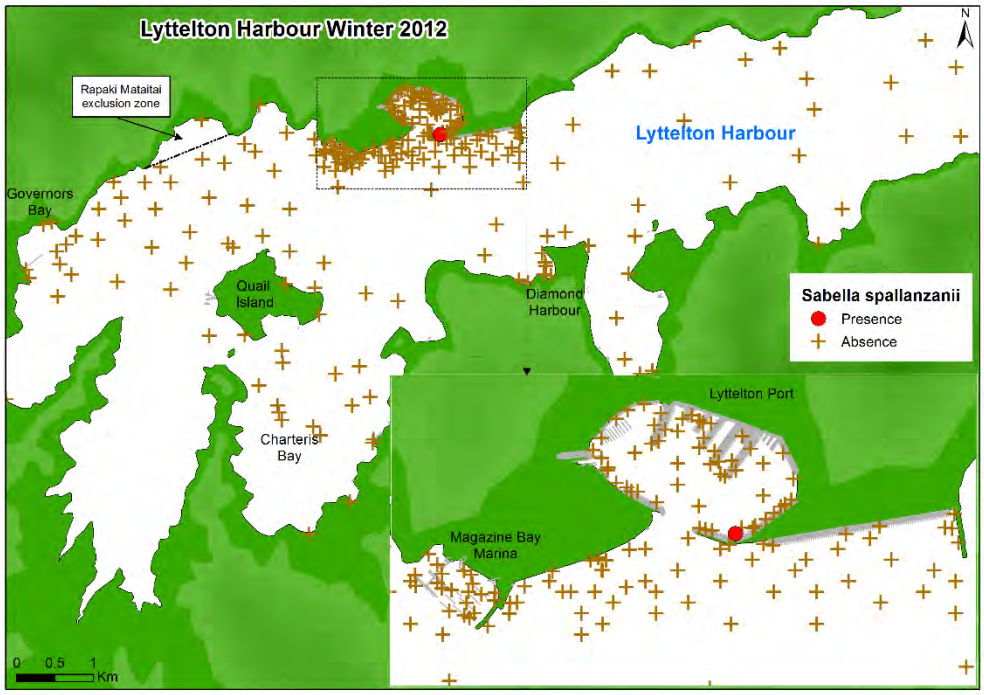
Auckland (Waitemata Harbour) Winter 2012



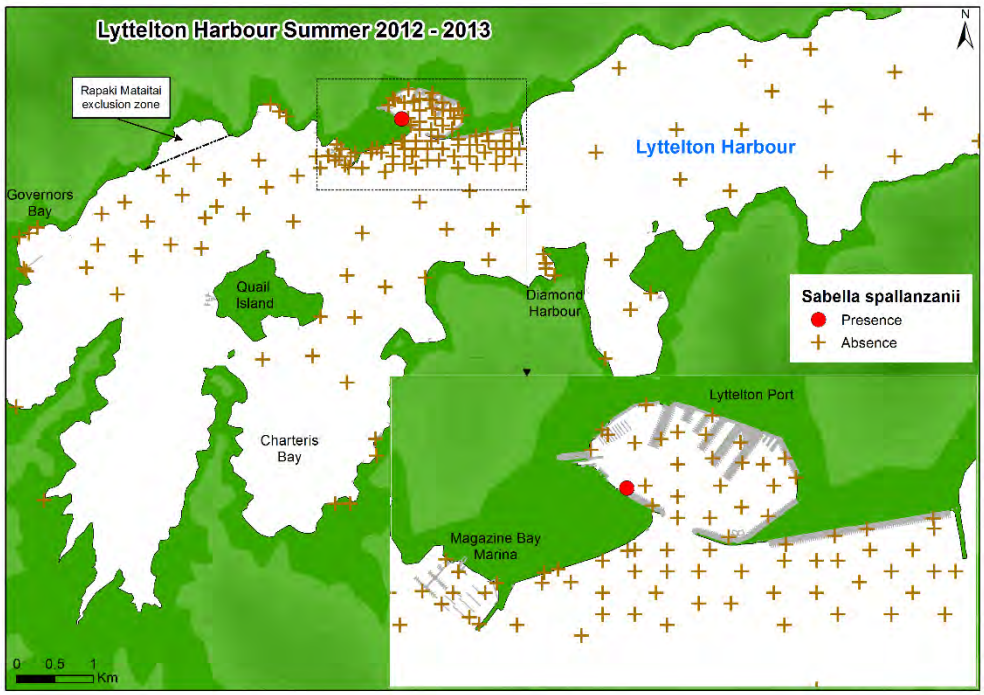
Auckland (Waitemata Harbour) Summer 2012-2013



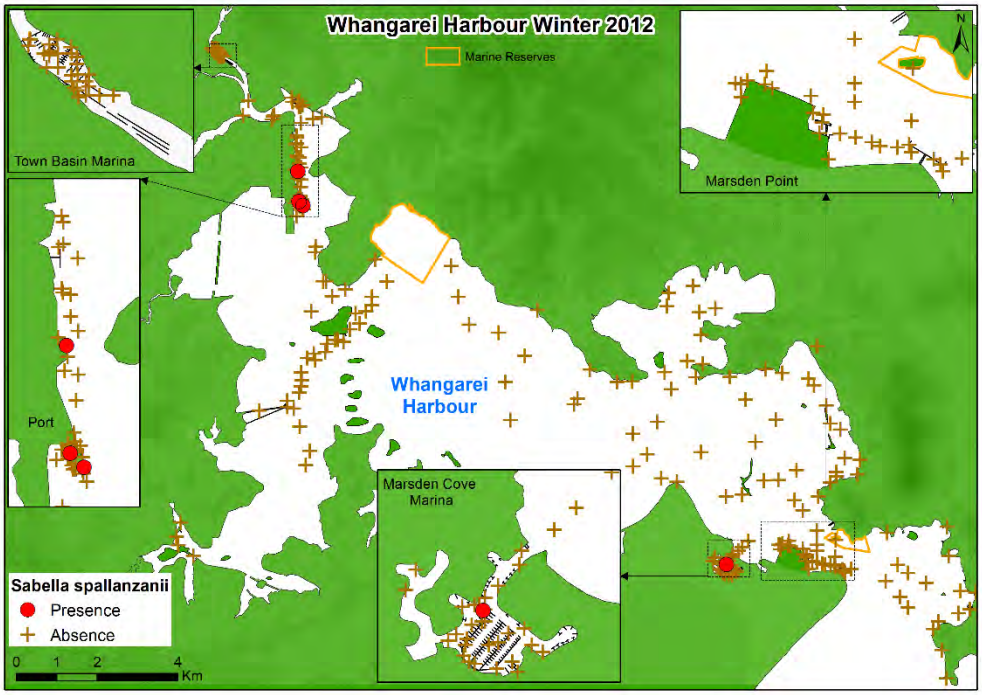
Lyttelton Harbour Winter 2012



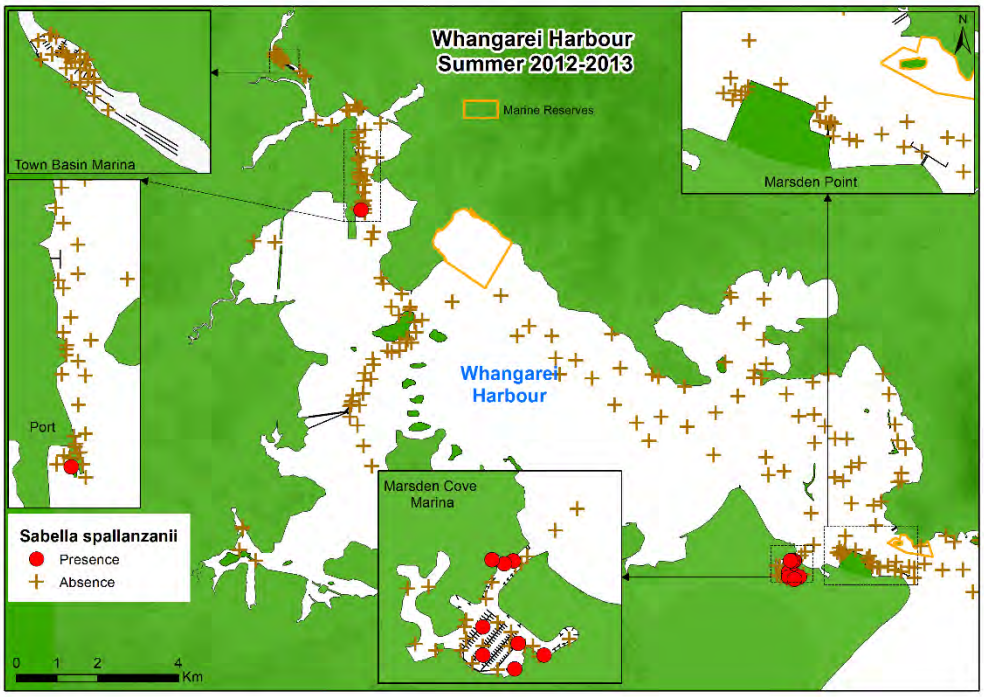
Lyttelton Harbour Summer 2012-2013



Whangarei Harbour Winter 2012

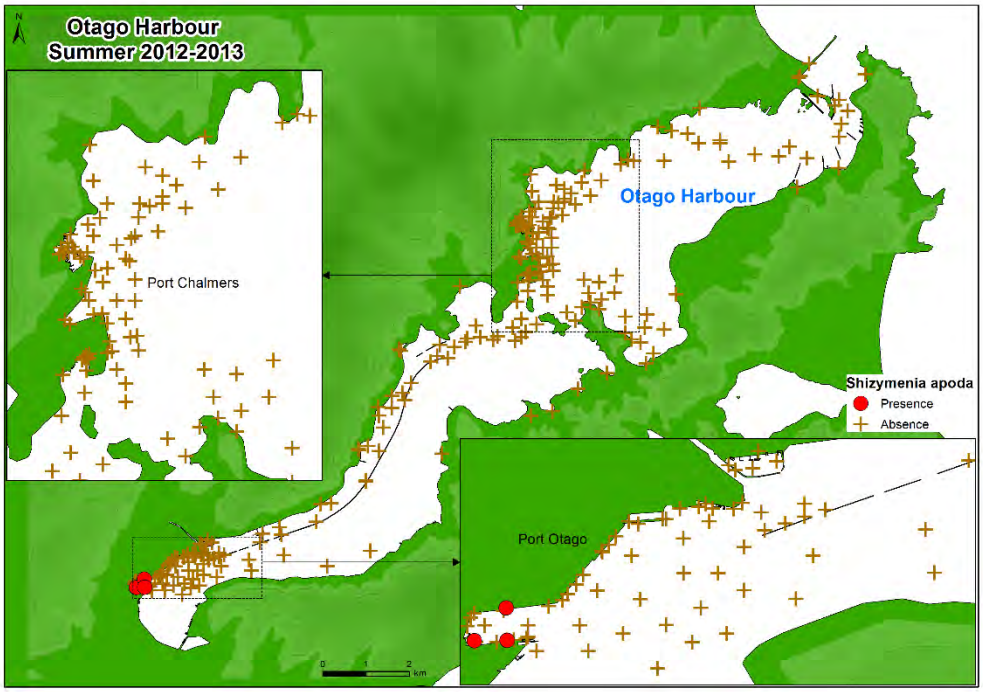


Whangarei Harbour Summer 2012-2013



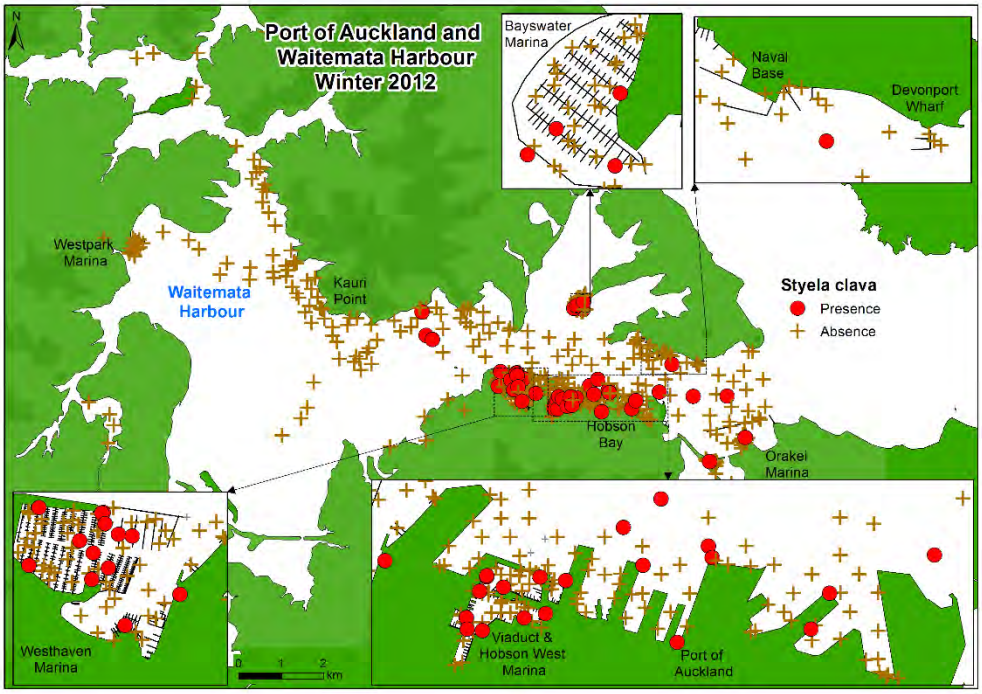
SCHIZYMENIA APODA

Dunedin (Otago Harbour) Summer 2012-2013

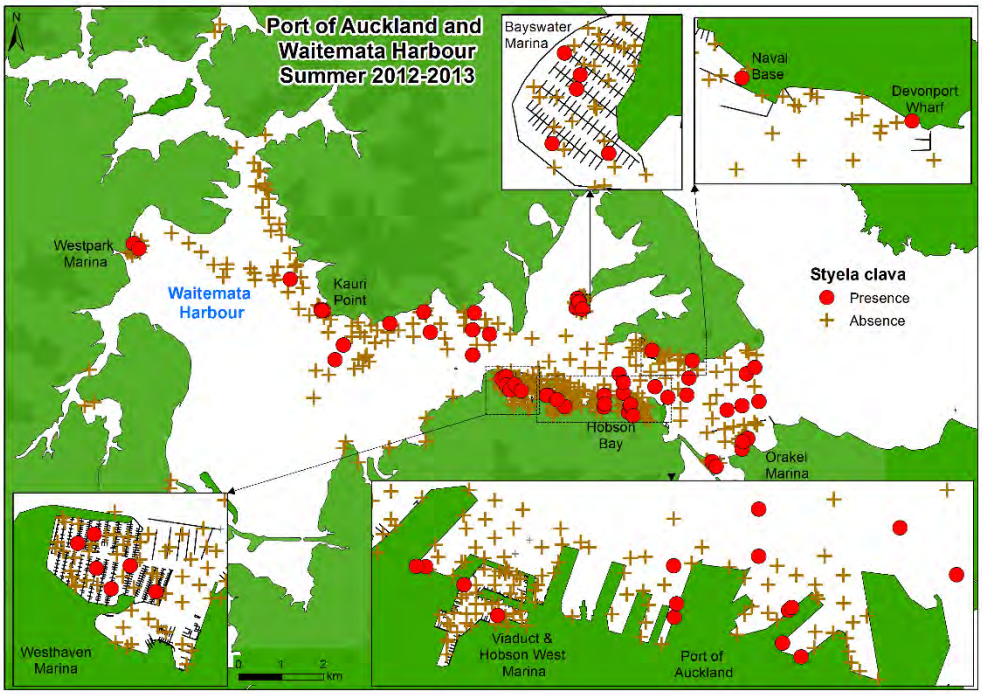


STYELA CLAVA

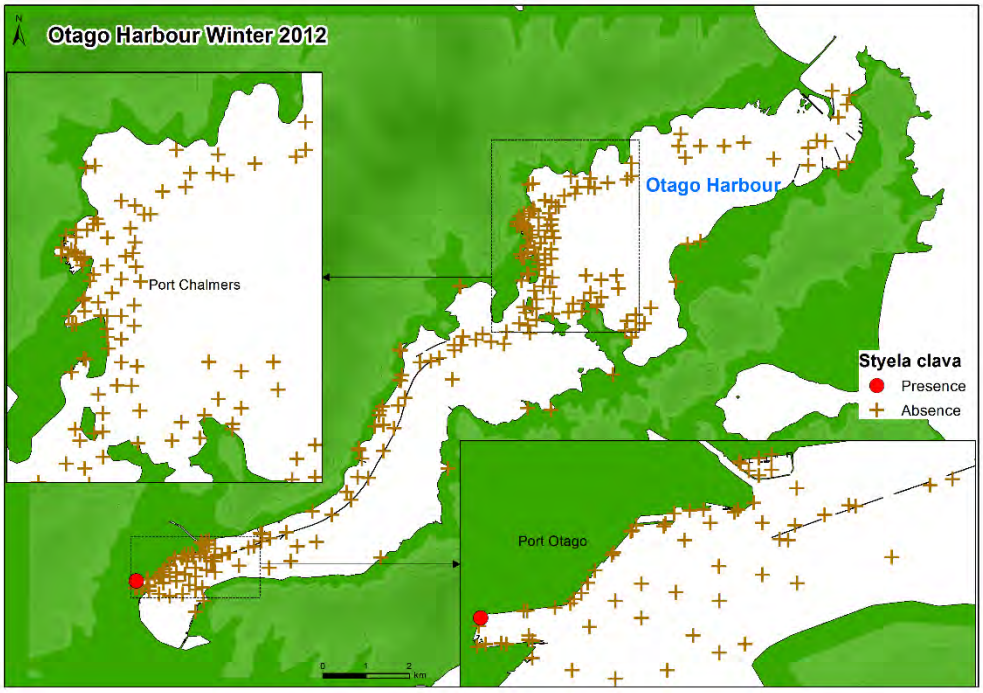
Auckland (Waitemata Harbour) Winter 2012



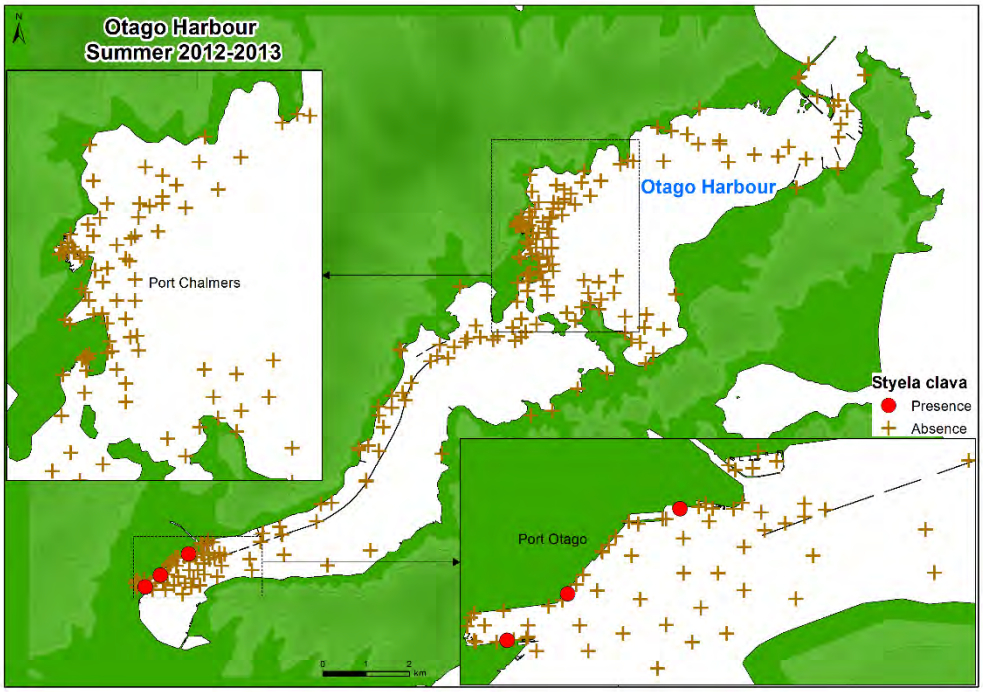
Auckland (Waitemata Harbour) Summer 2012-2013



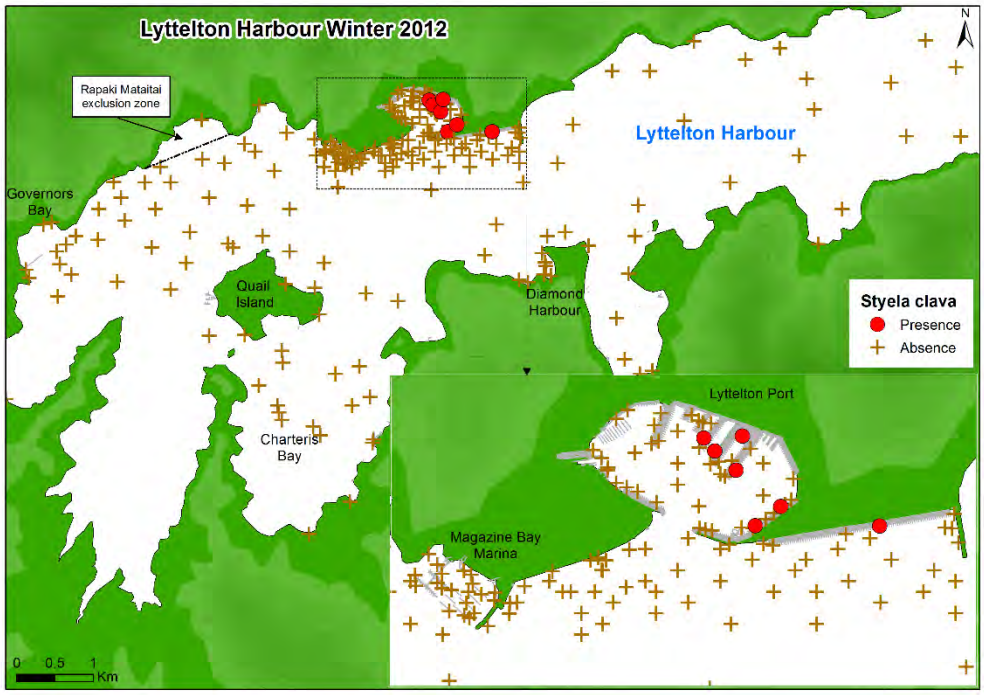
Dunedin (Otago Harbour) Winter 2012



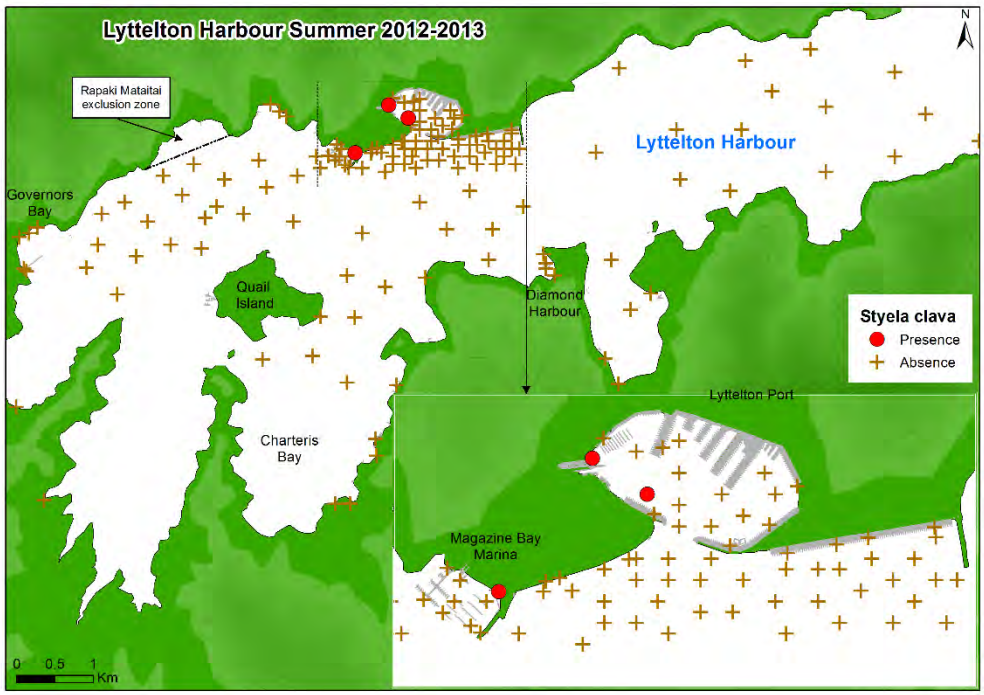
Dunedin (Otago Harbour) Summer 2012-2013



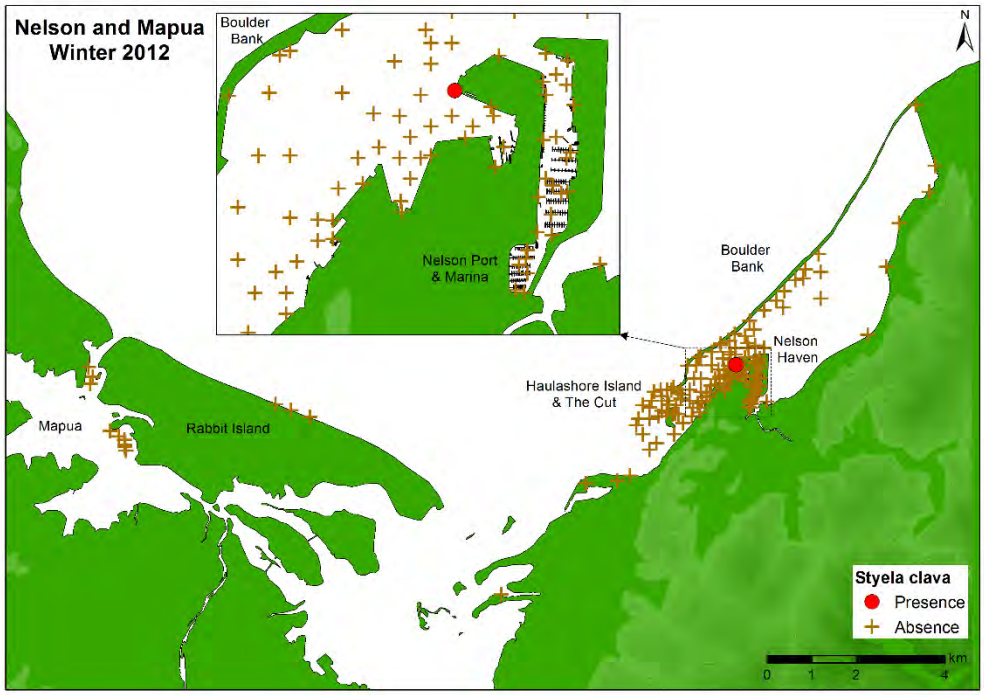
Lyttelton Harbour Winter 2012



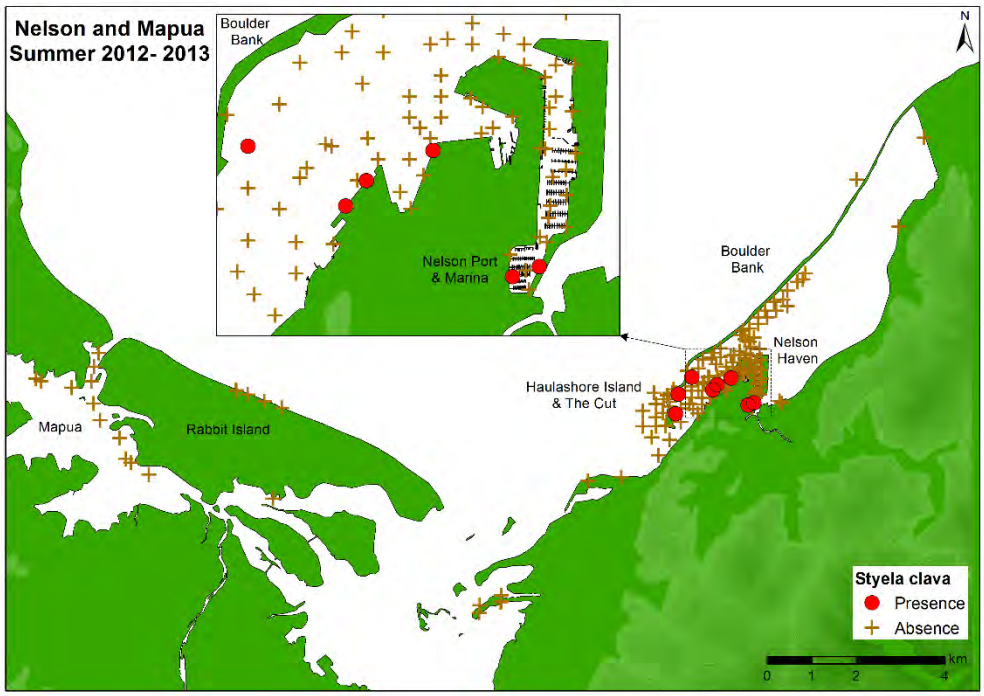
Lyttelton Harbour Summer 2012-2013



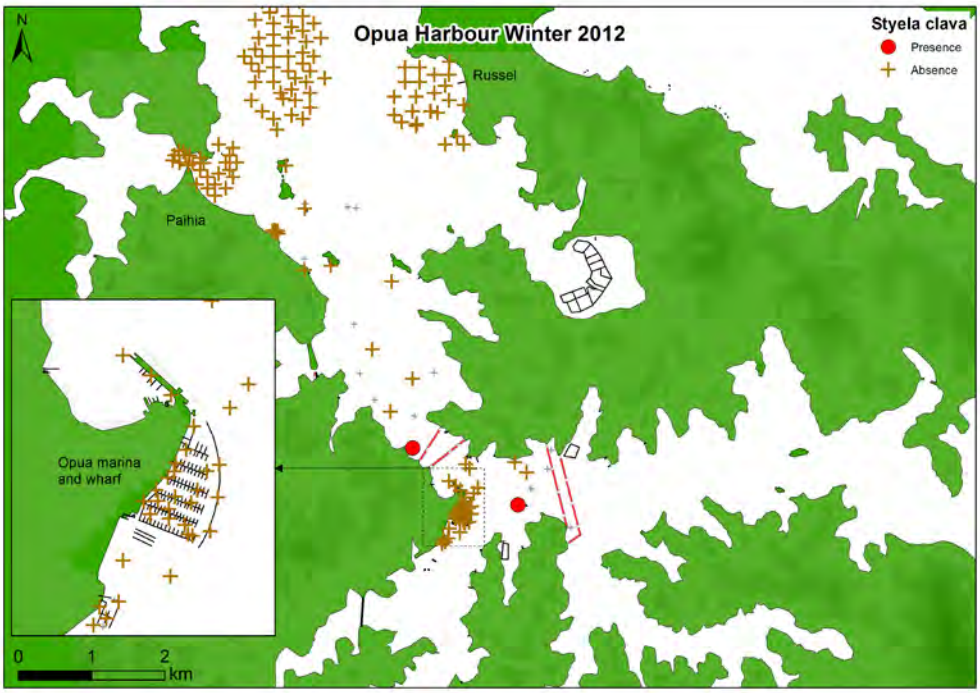
Nelson Winter 2012



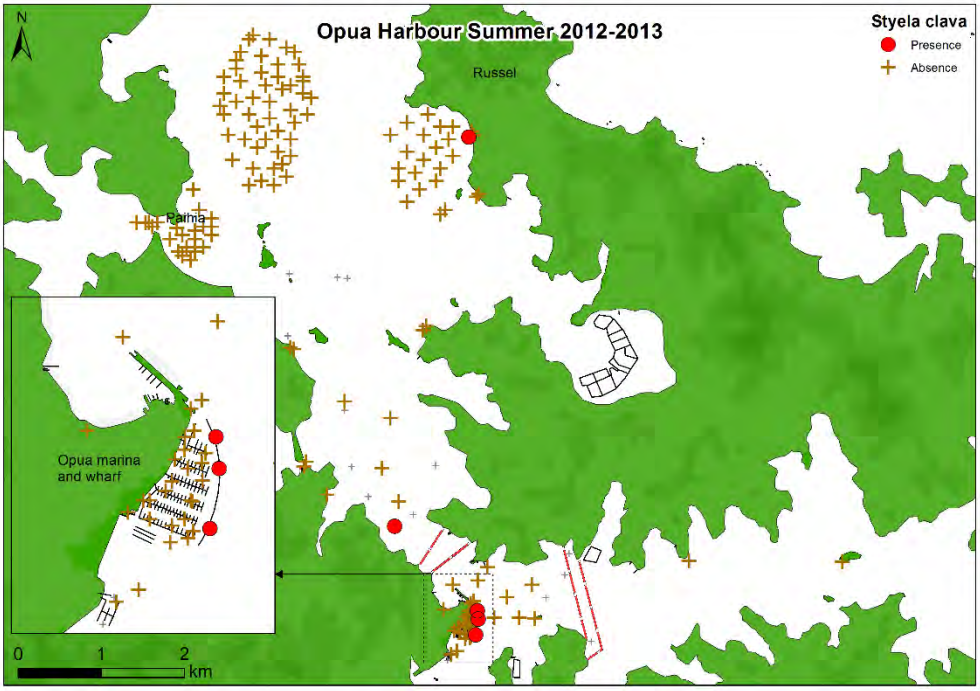
Nelson Summer 2012-2013



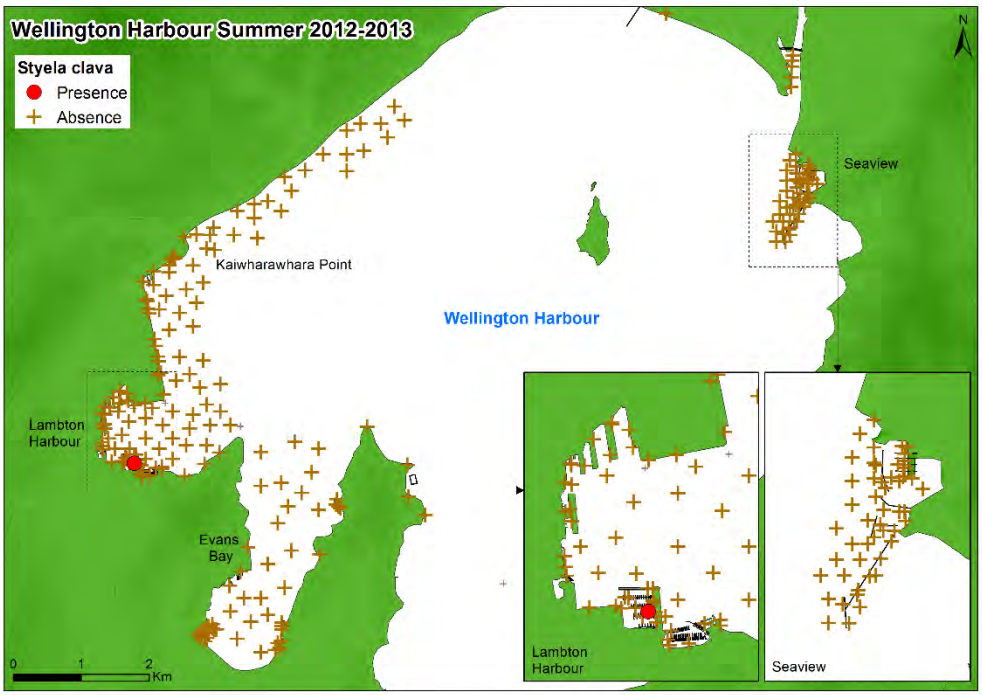
Opua Winter 2012



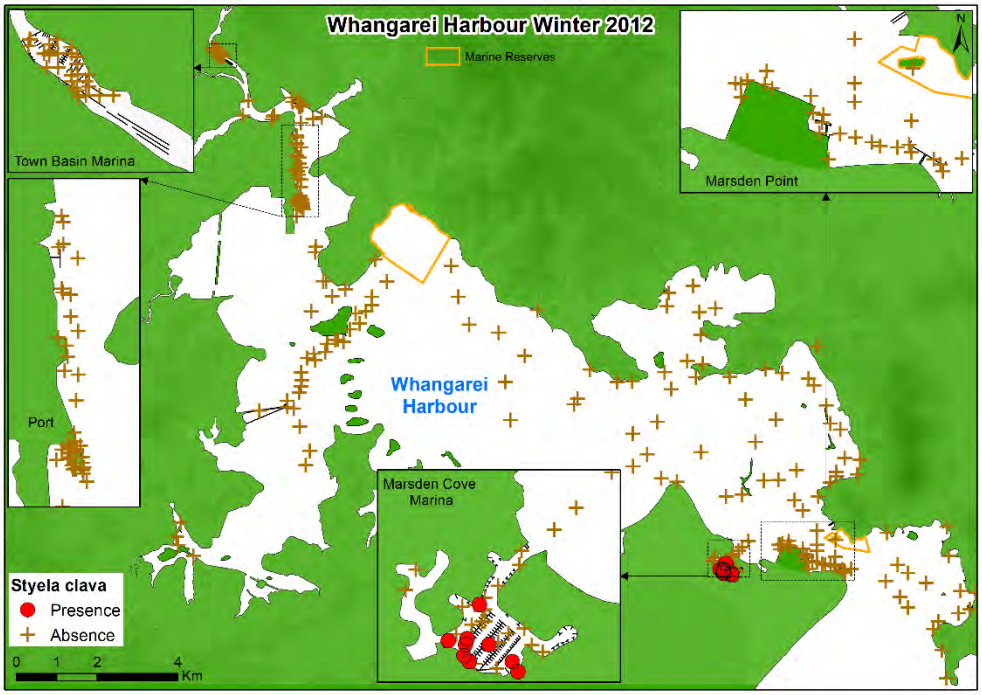
Opua Summer 2012-2013



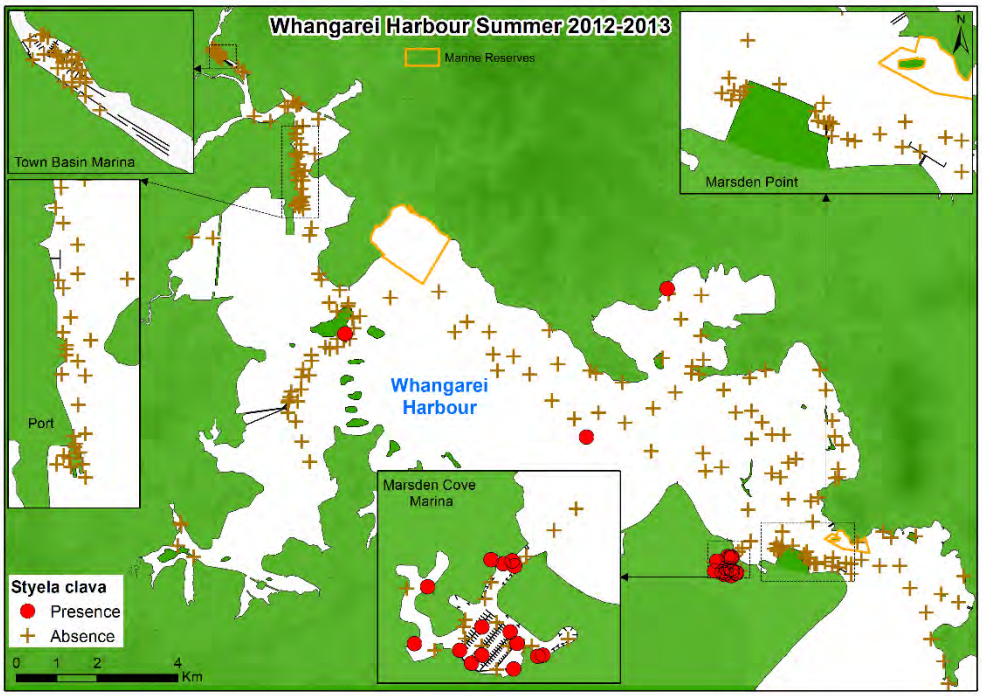
Wellington Harbour Summer 2012-2013



Whangarei Harbour Winter 2012

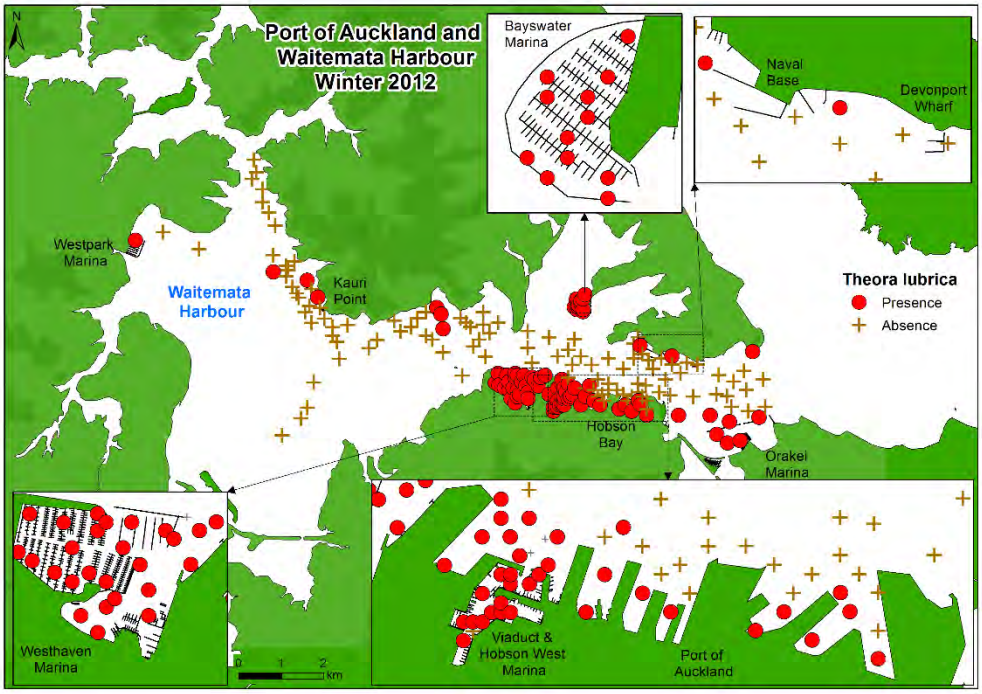


Whangarei Harbour Summer 2012-2013

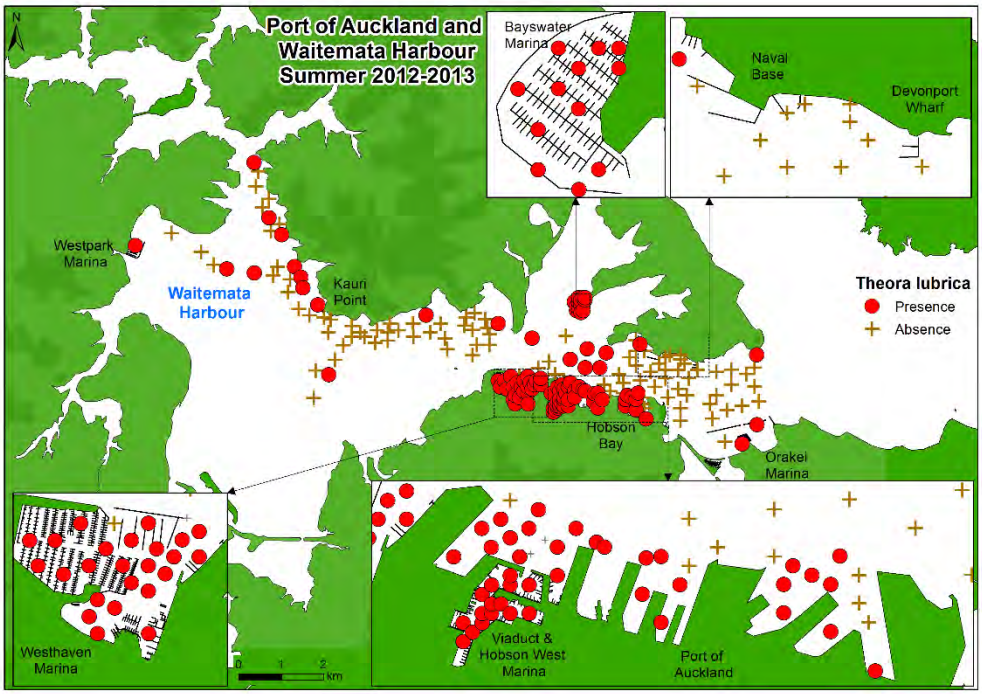


THEORA LUBRICA

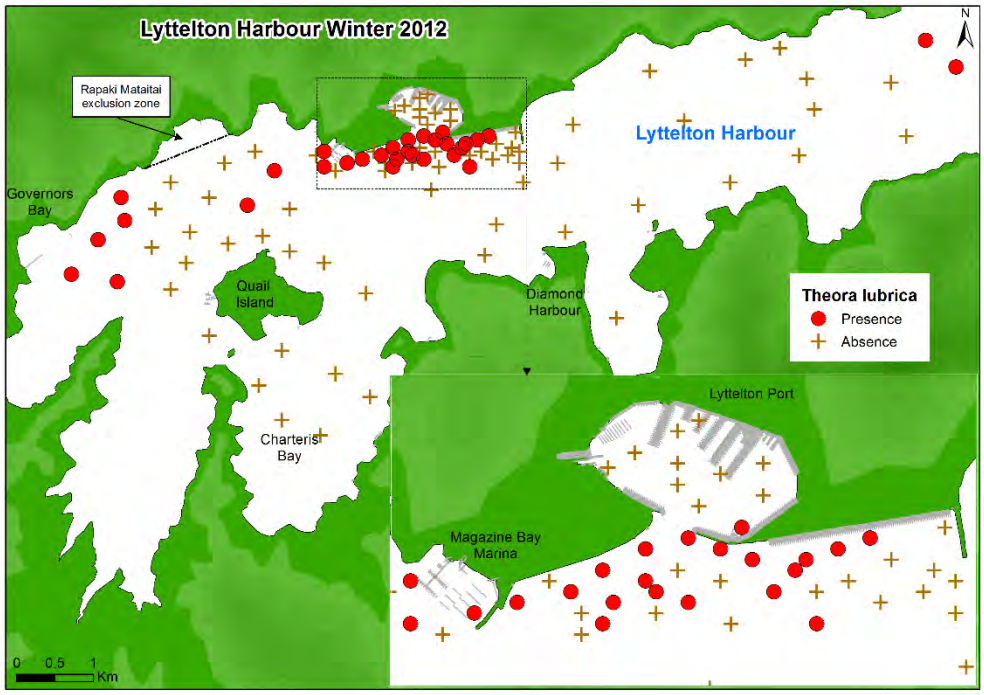
Auckland (Waitemata Harbour) Winter 2012



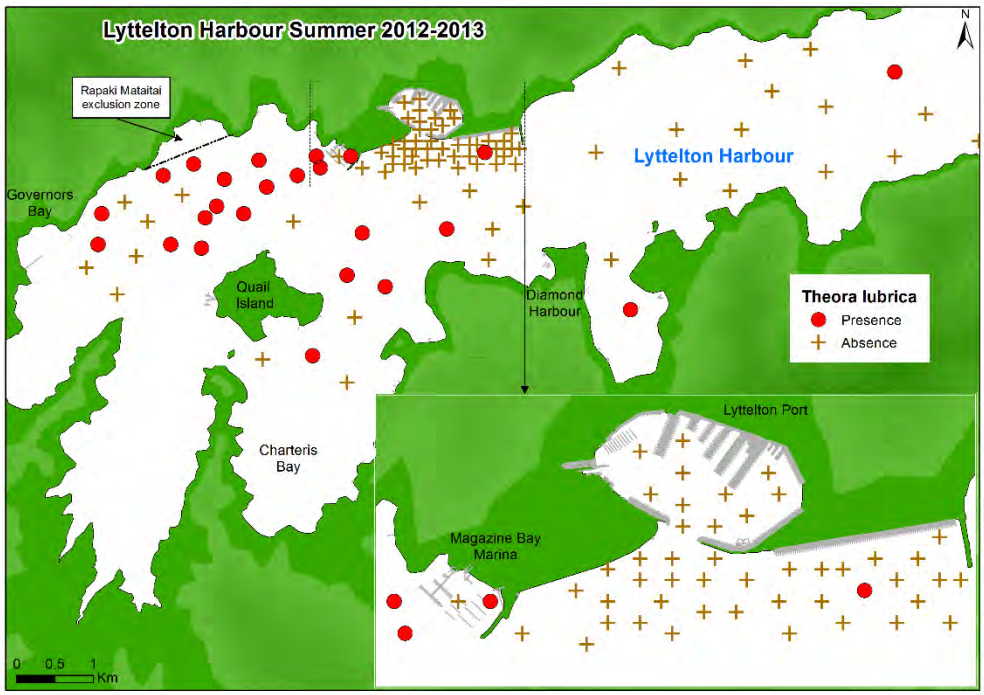
Auckland (Waitemata Harbour) Summer 2012-2013



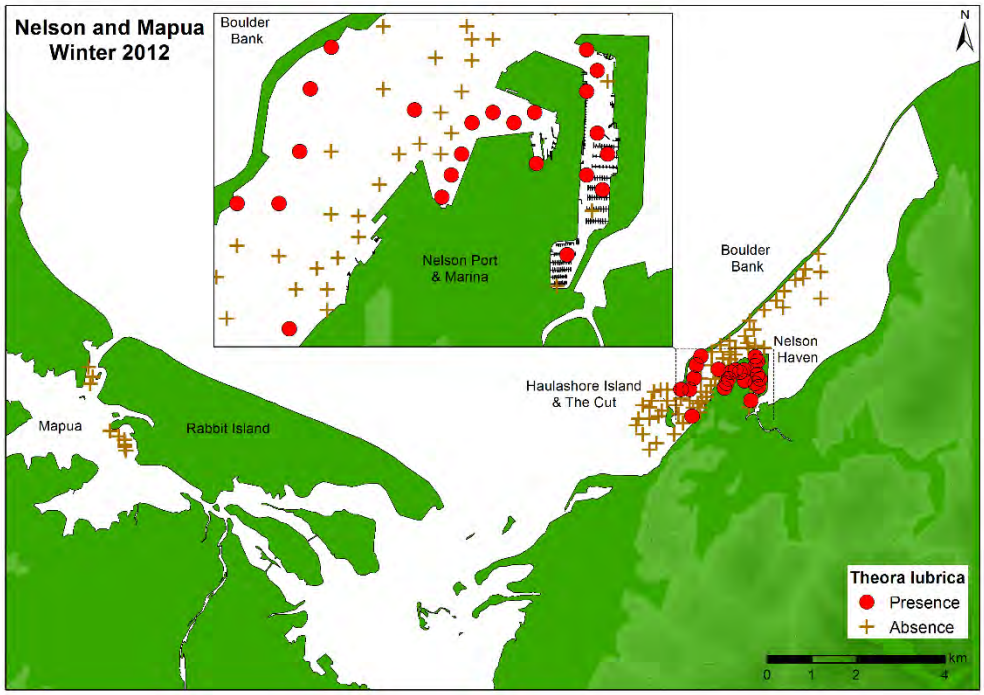
Lyttelton Harbour Winter 2012



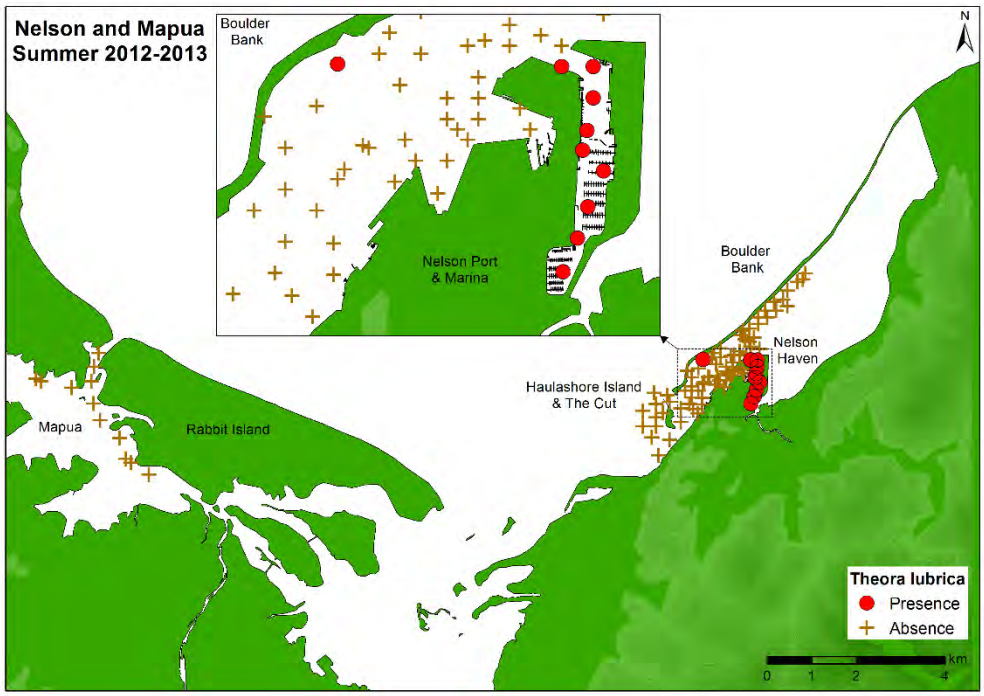
Lyttelton Harbour Summer 2012-2013



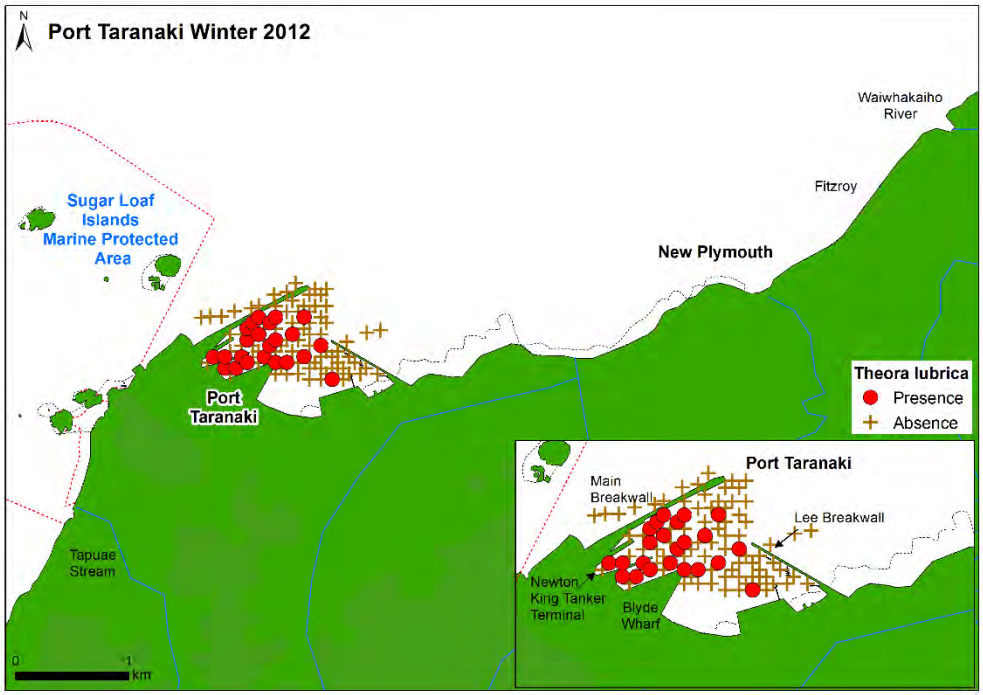
Nelson Winter 2012



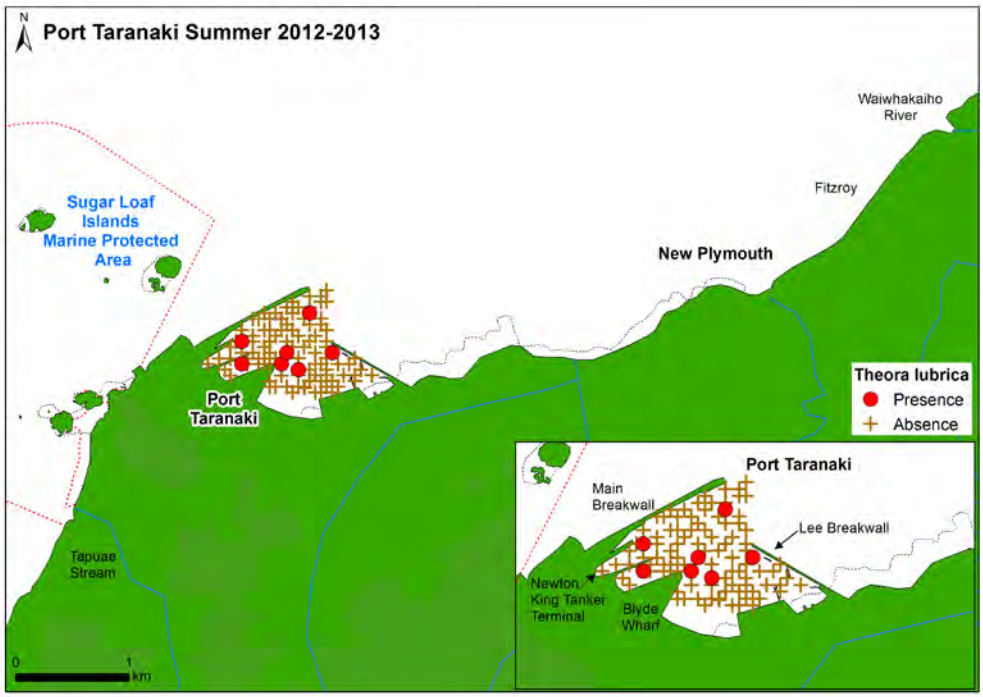
Nelson Summer 2012-2013



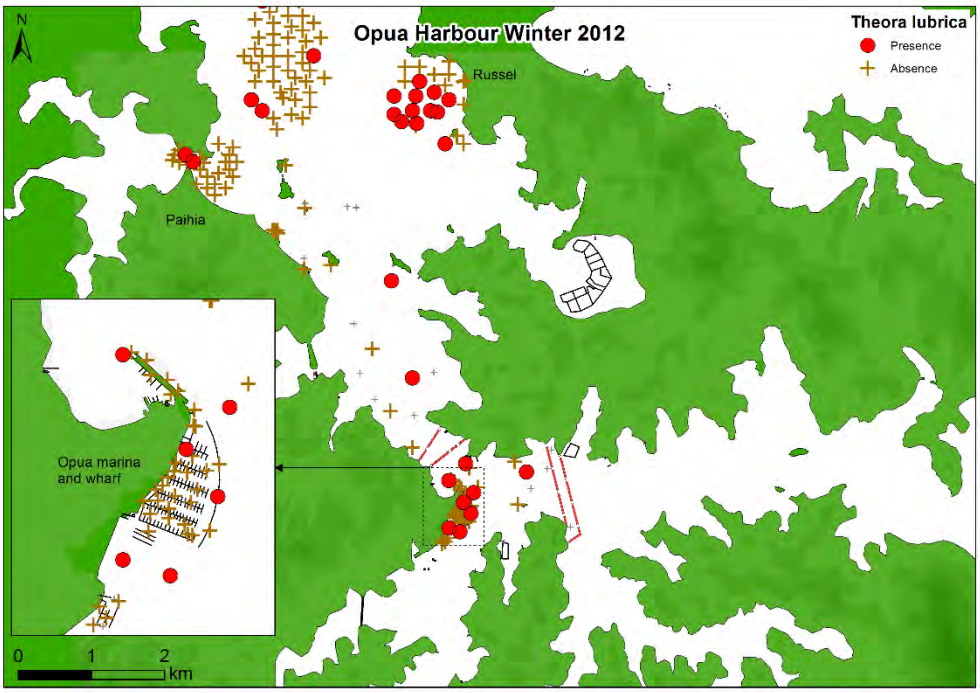
New Plymouth Winter 2012



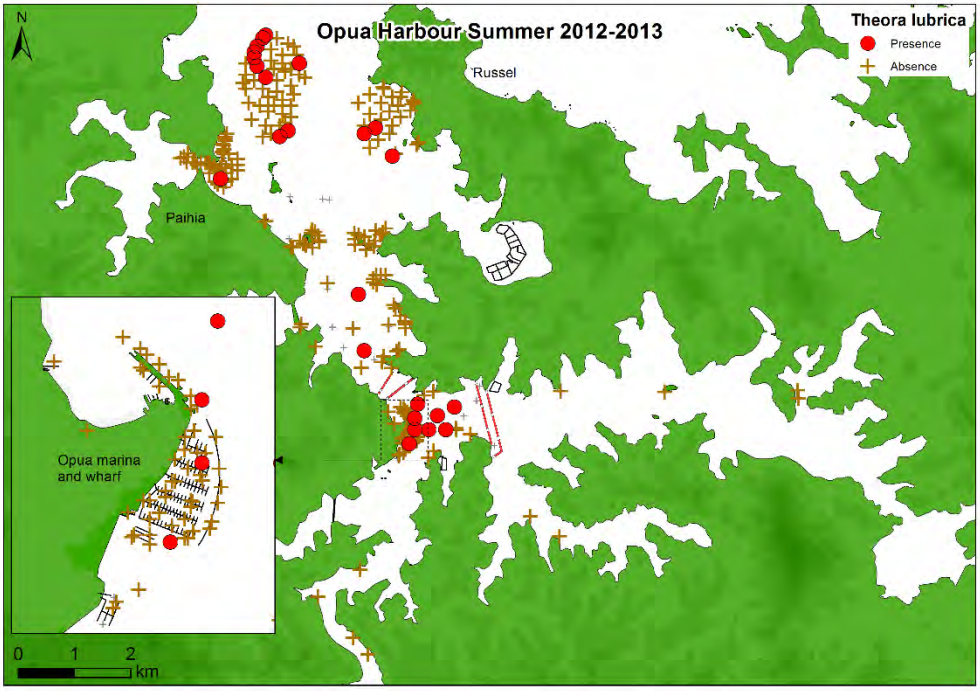
New Plymouth Summer 2012-2013



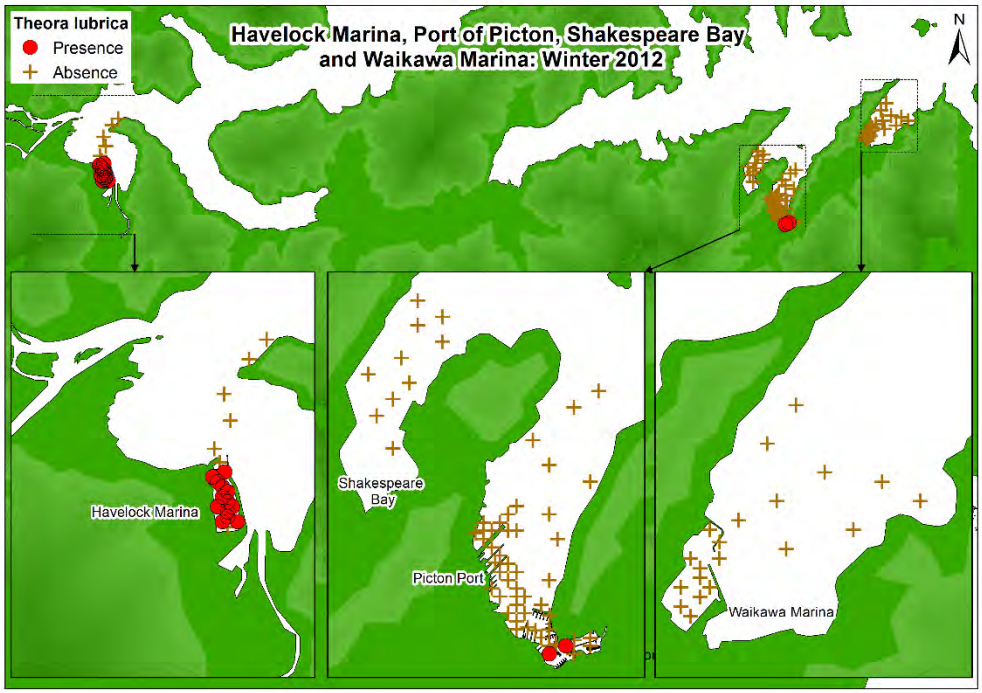
Opua Winter 2012



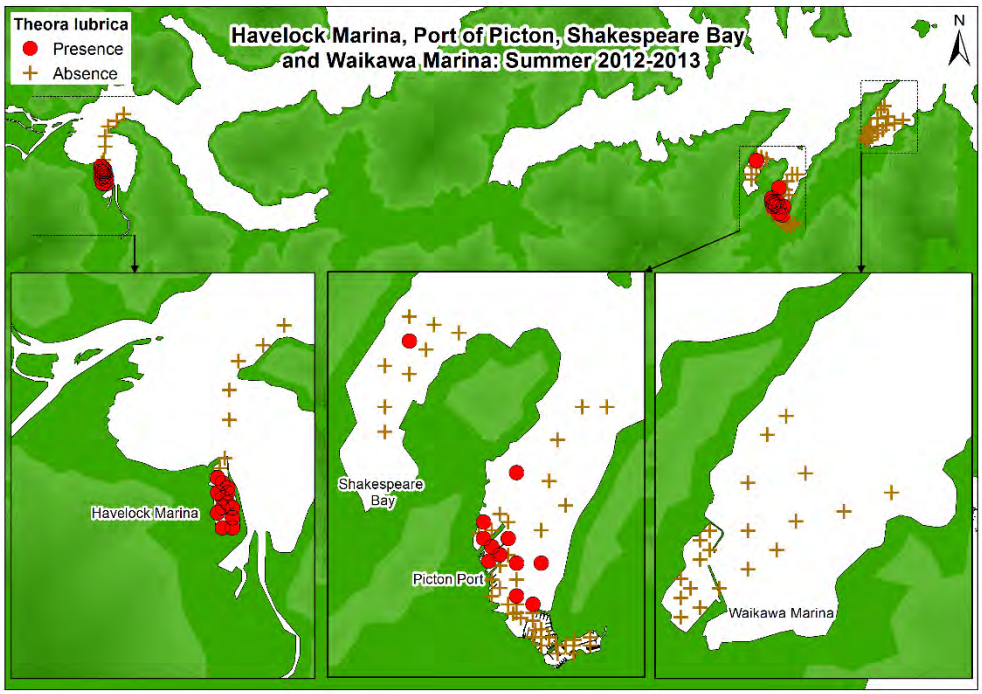
Opua Summer 2012-2013



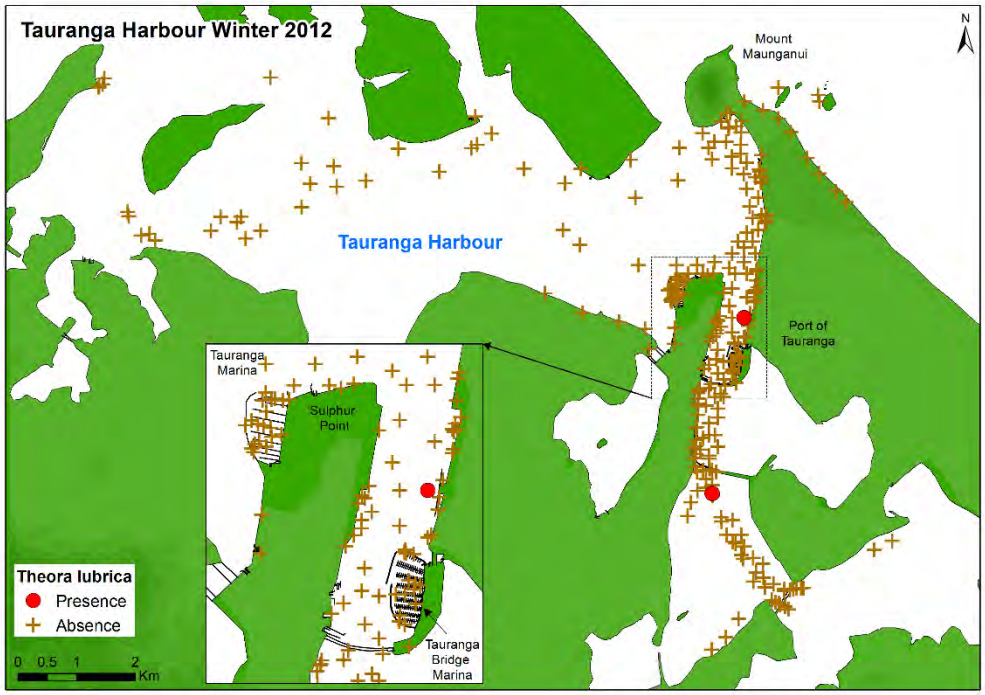
Picton / Havelock Winter 2012



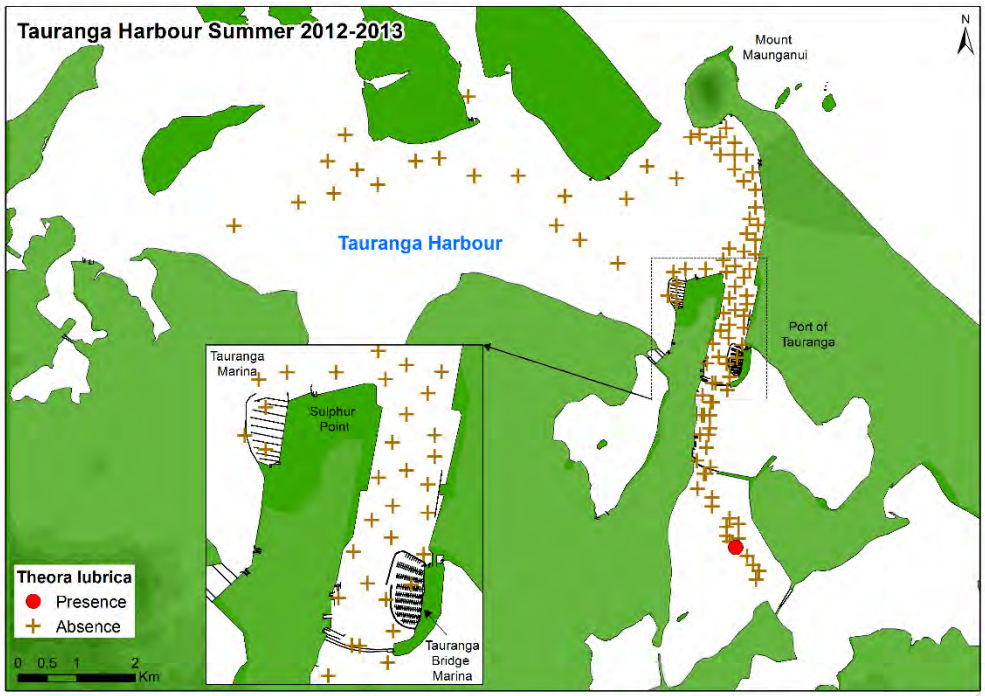
Picton / Havelock Summer 2012-2013



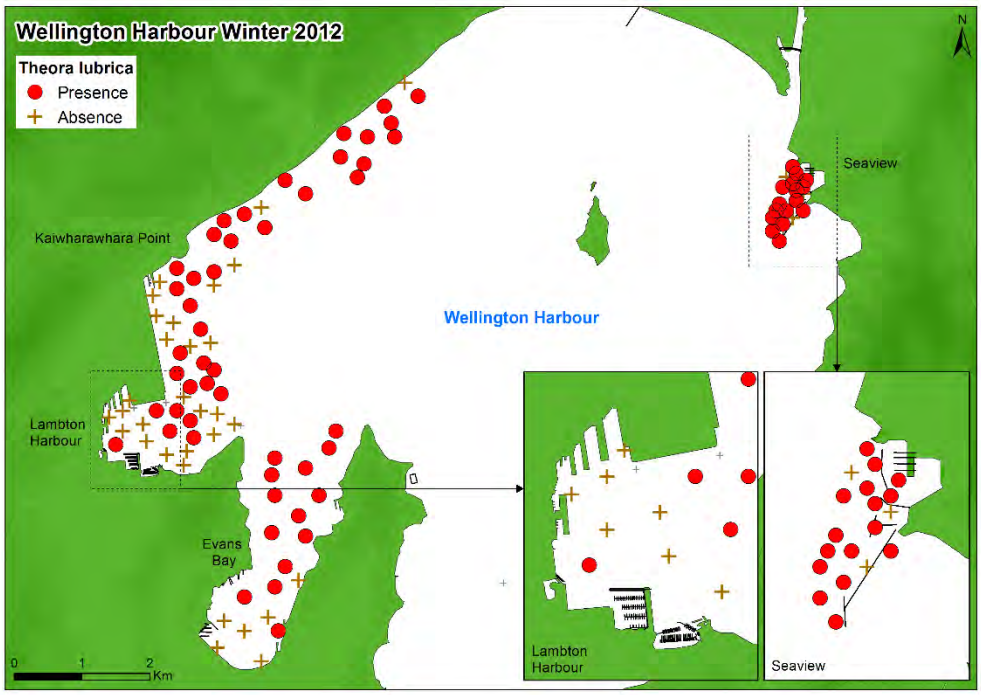
Tauranga Harbour Winter 2012



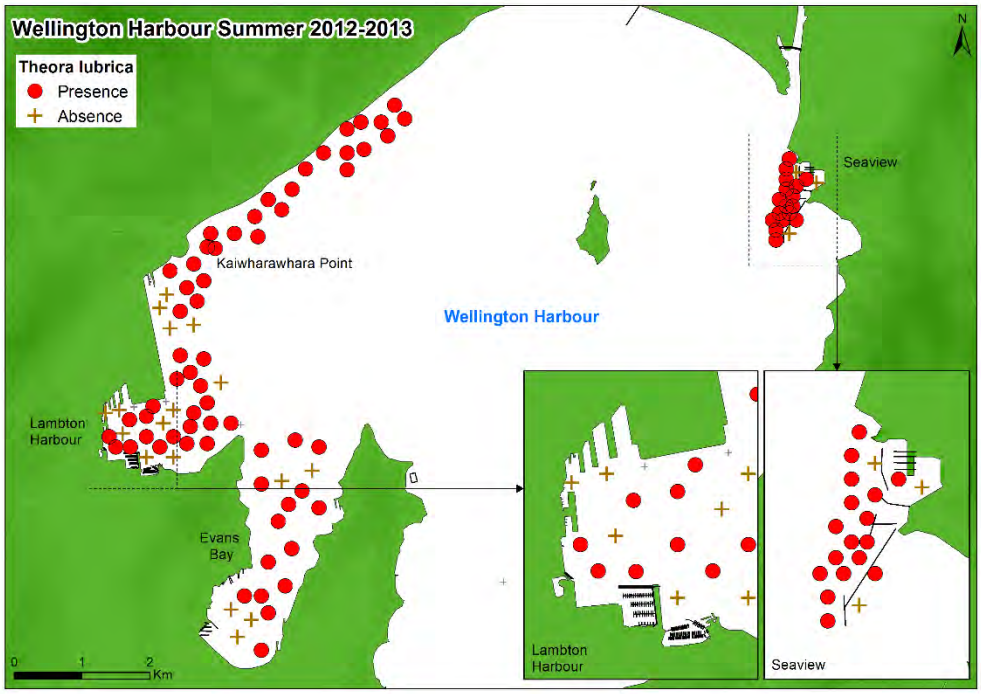
Tauranga Harbour Summer 2012-2013



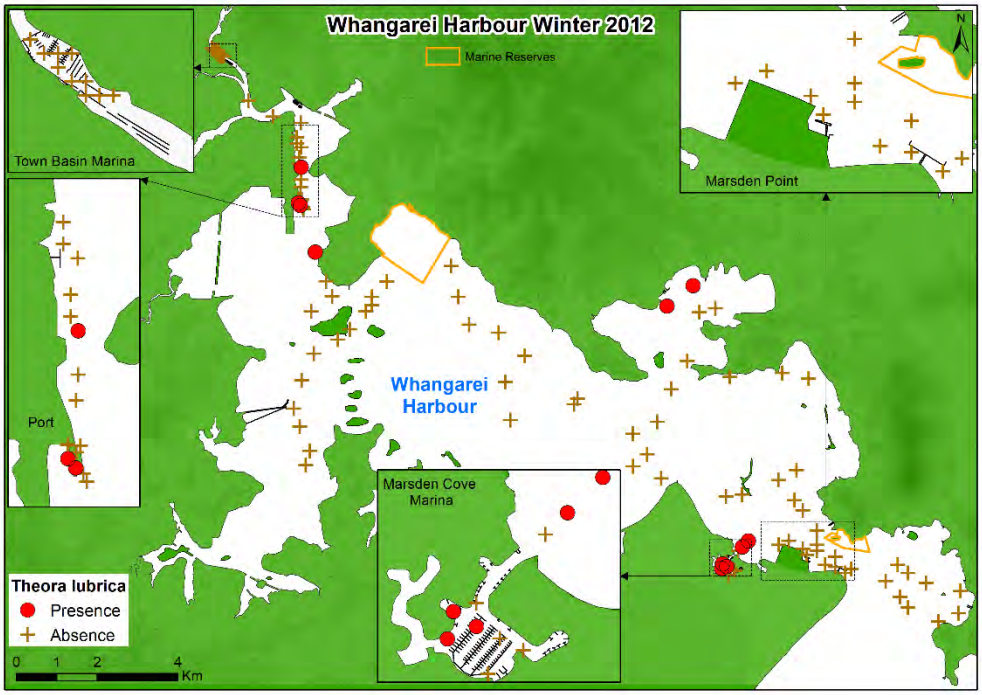
Wellington Harbour Winter 2012



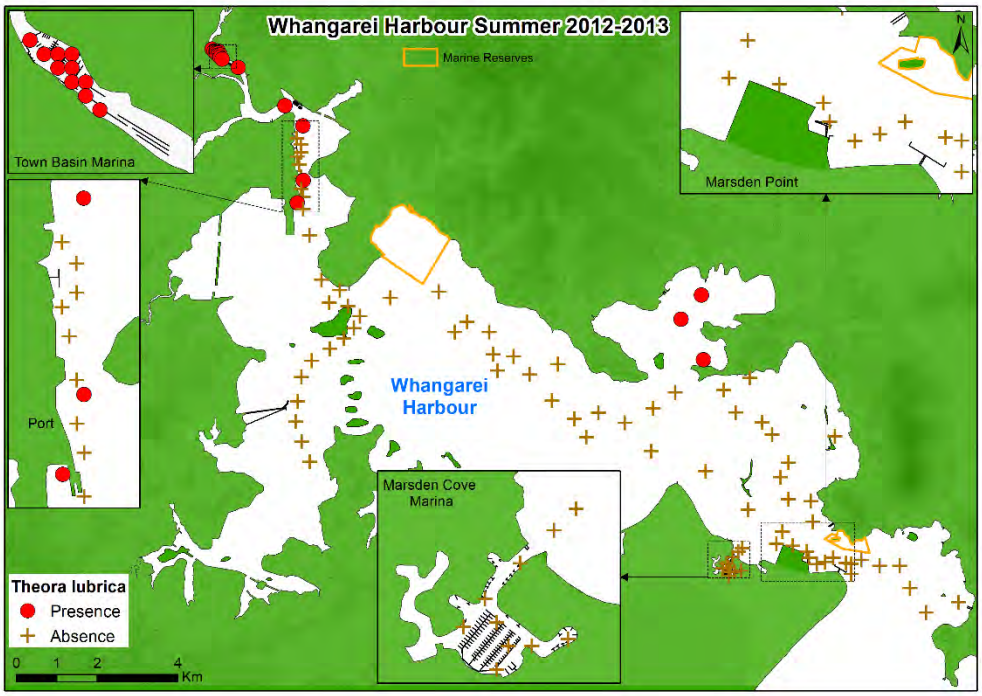
Wellington Harbour Summer 2012-2013



Whangarei Harbour Winter 2012

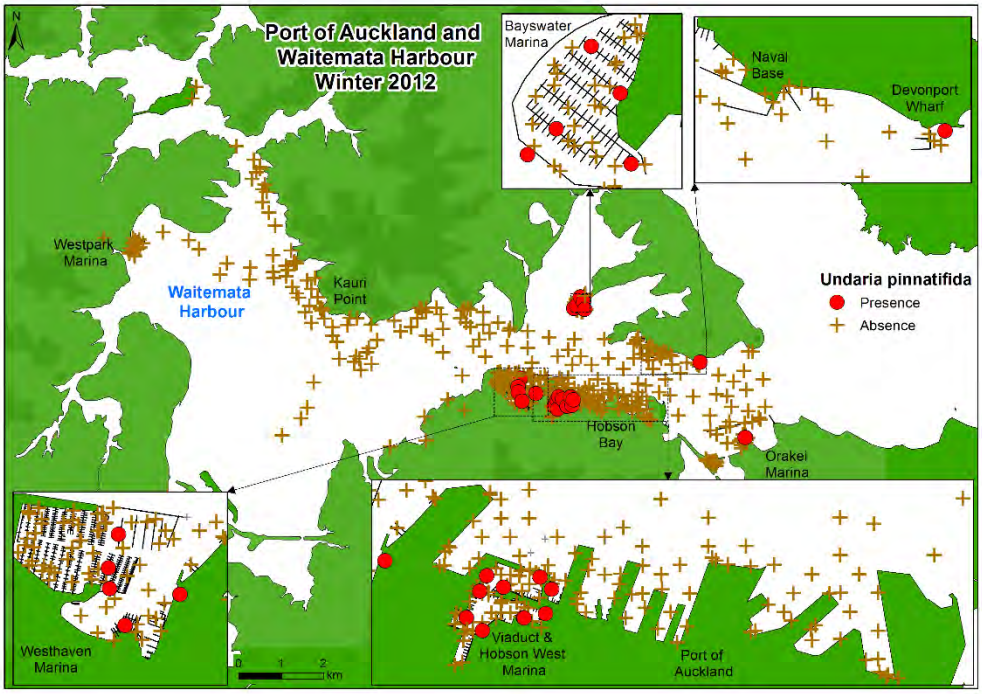


Whangarei Harbour Summer 2012-2013

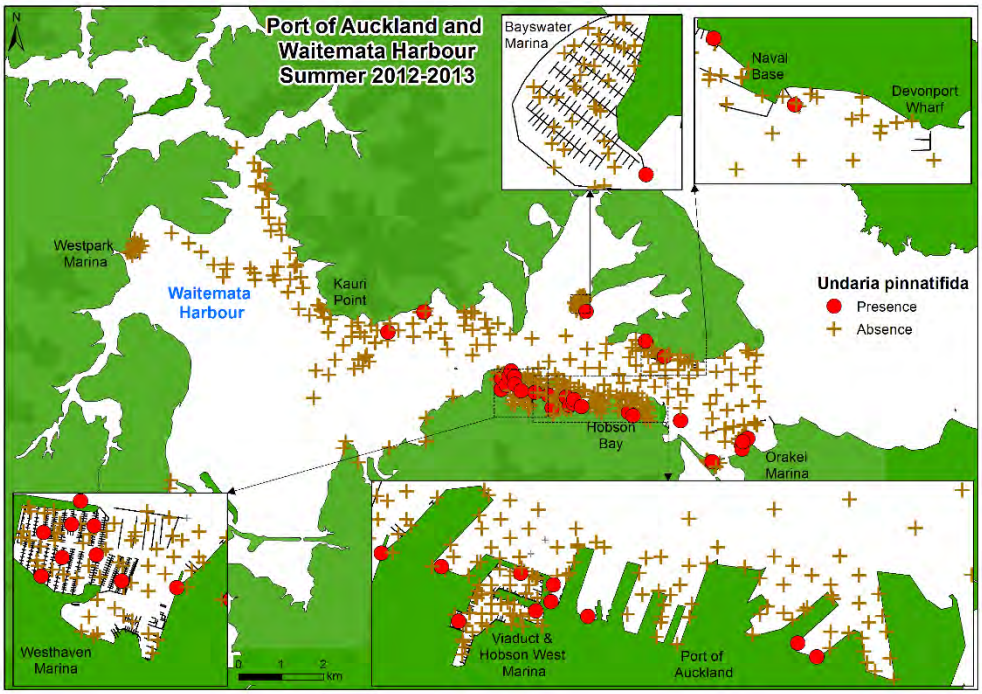


UNDARIA PINNATIFIDA

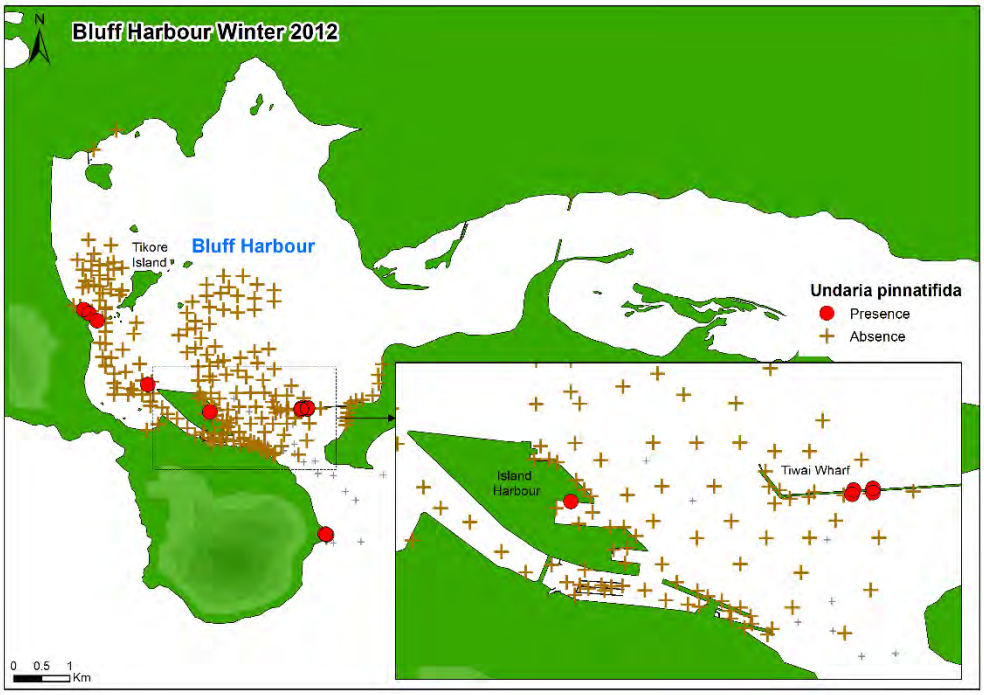
Auckland (Waitemata Harbour) Winter 2012



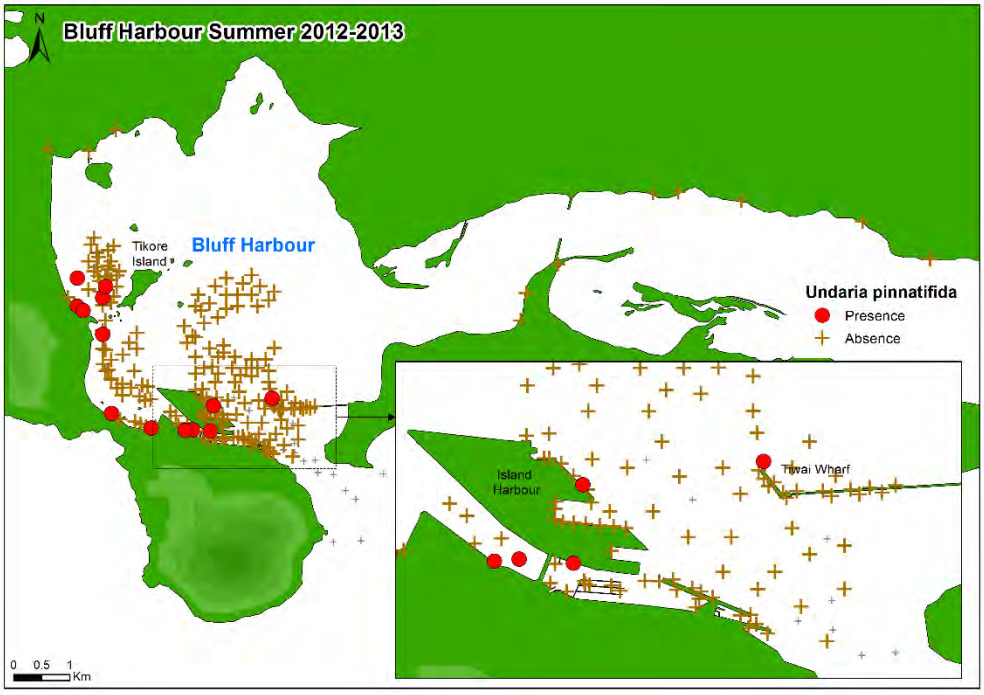
Auckland (Waitemata Harbour) Summer 2012-2013



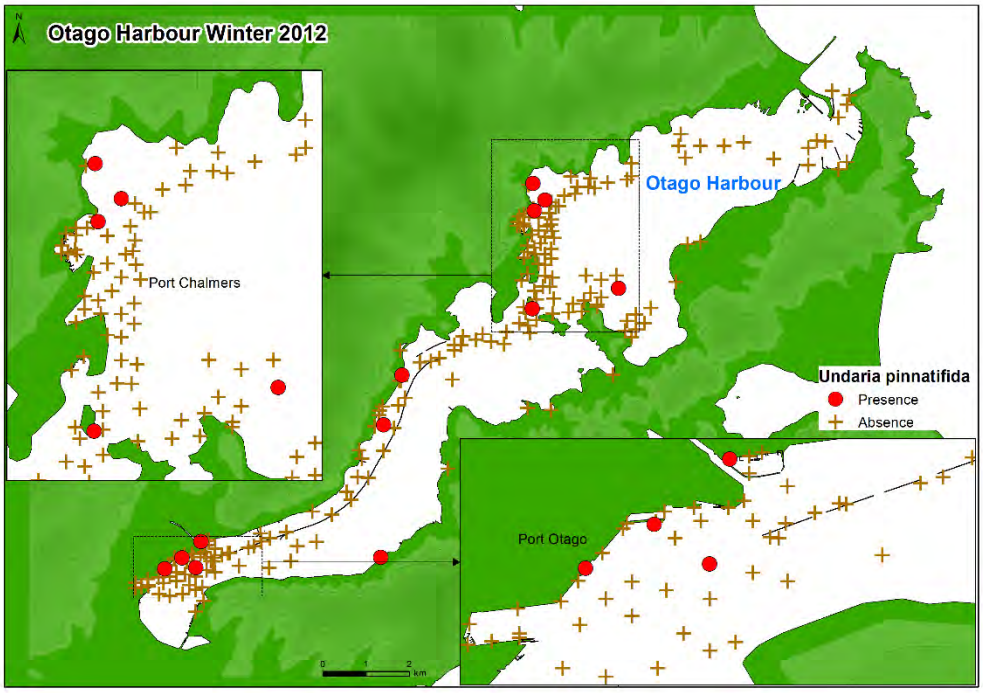
Bluff Harbour Winter 2012



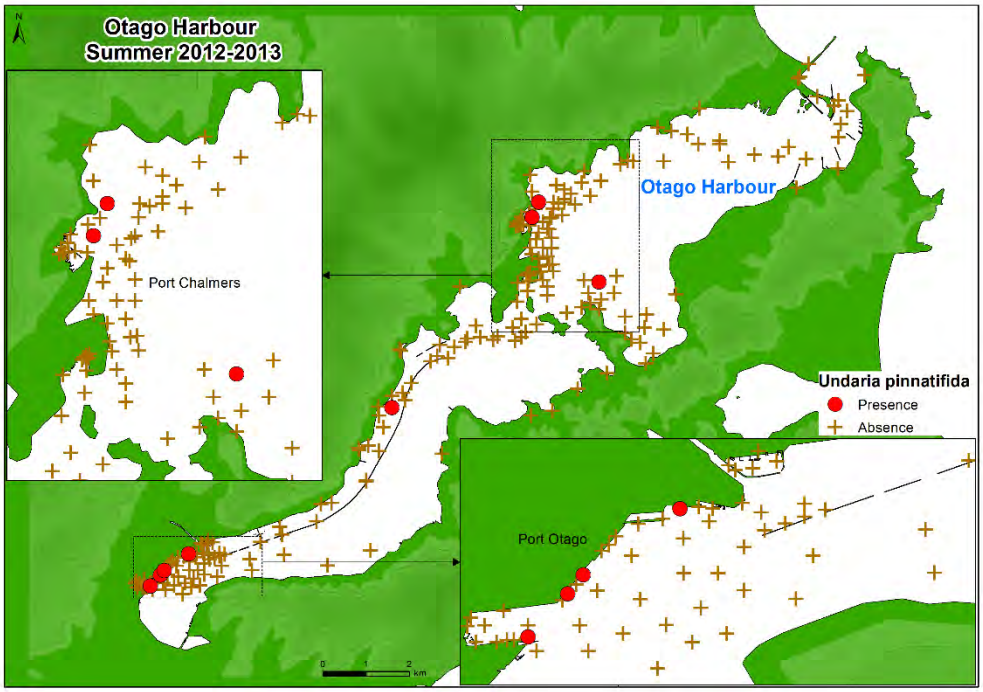
Bluff Harbour Summer 2012-2013



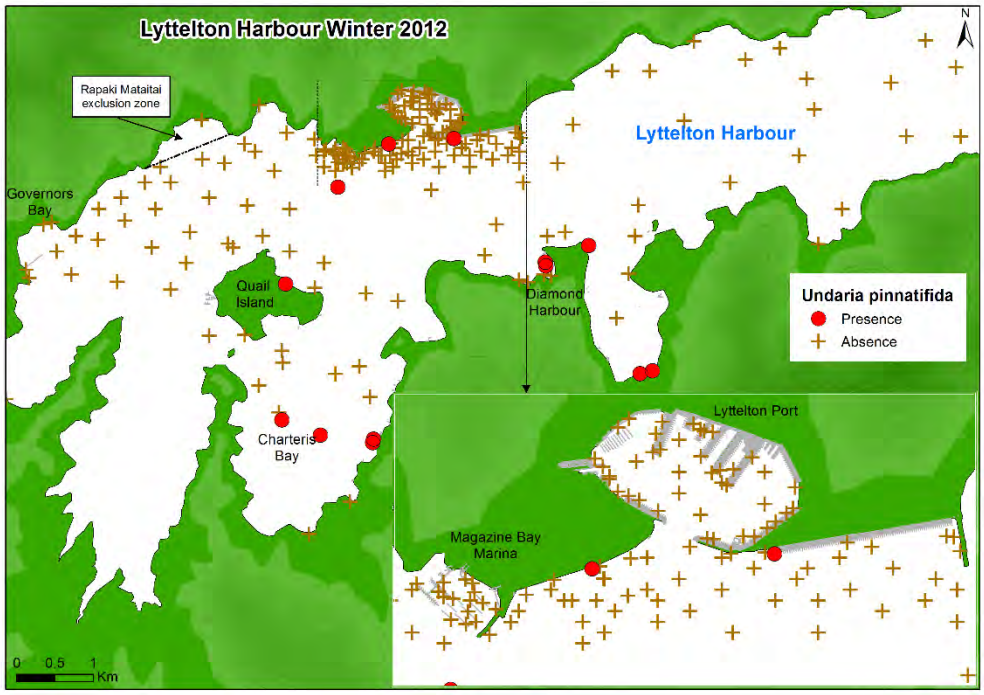
Dunedin (Otago Harbour) Winter 2012



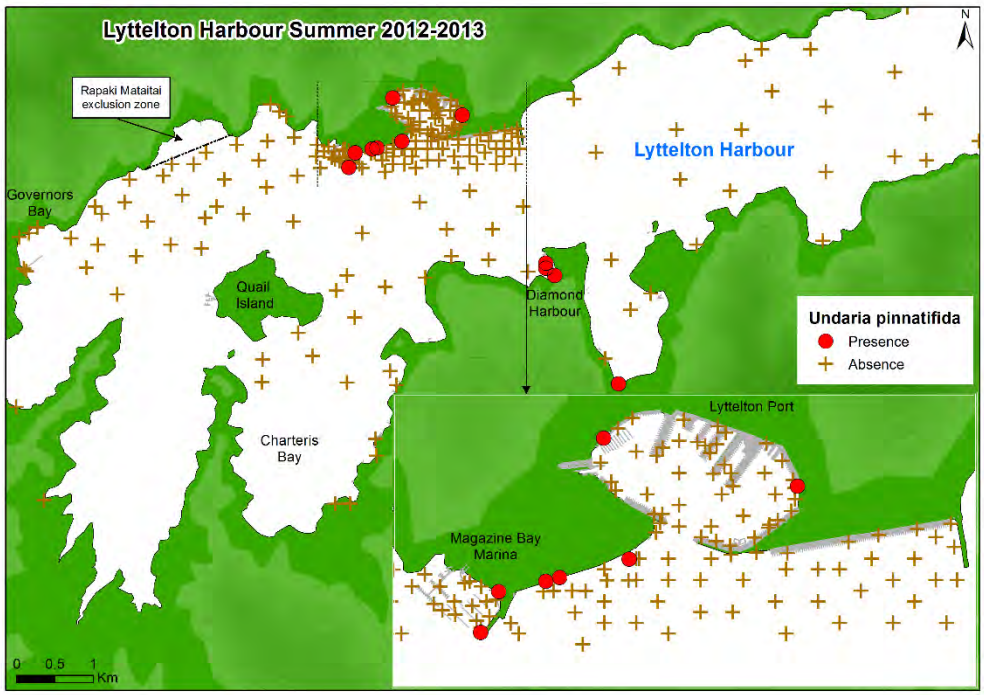
Dunedin (Otago Harbour) Summer 2012-2013



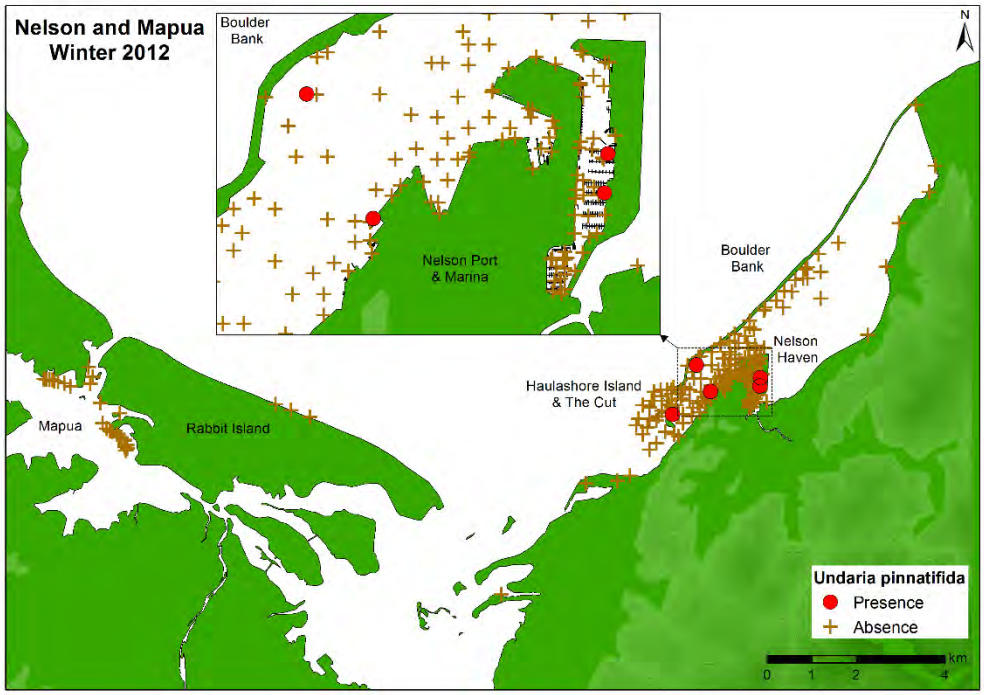
Lyttelton Harbour Winter 2012



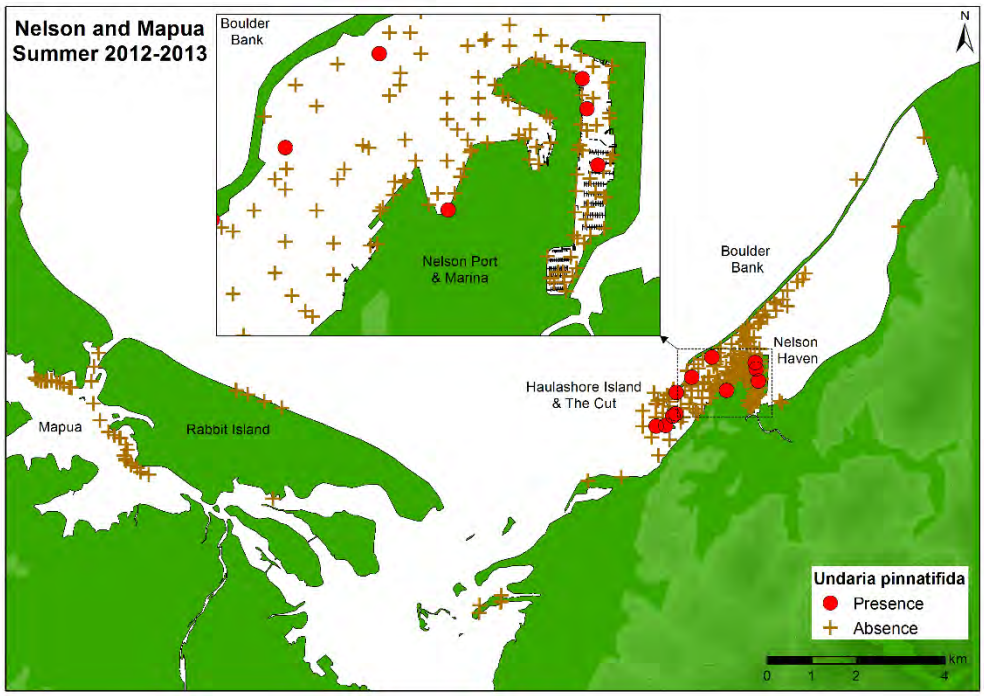
Lyttelton Harbour Summer 2012-2013



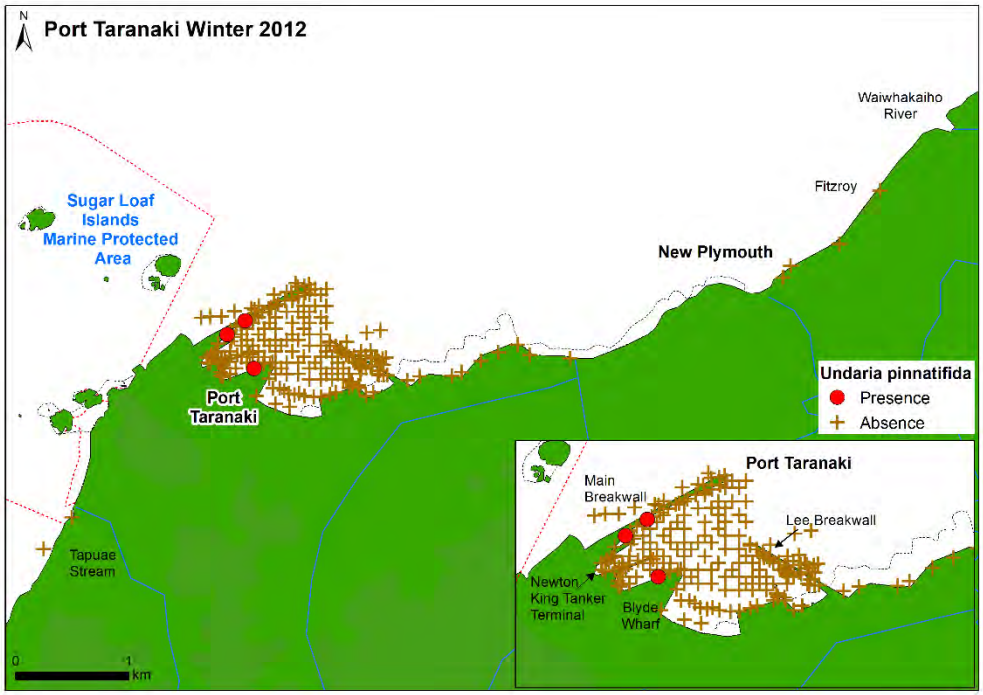
Nelson Winter 2012



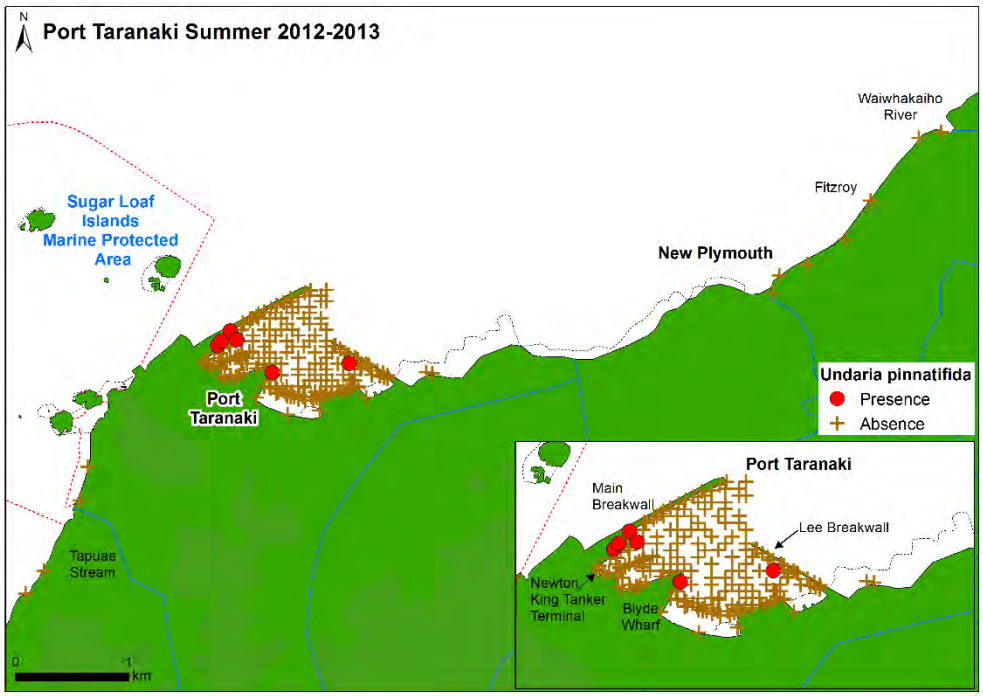
Nelson Summer 2012-2013



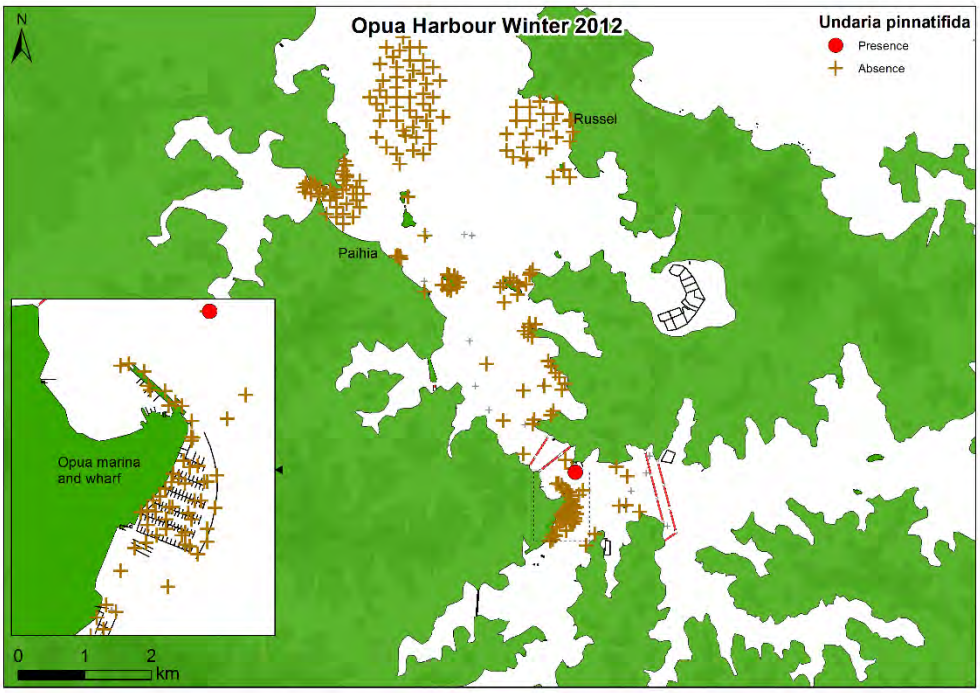
New Plymouth Winter 2012



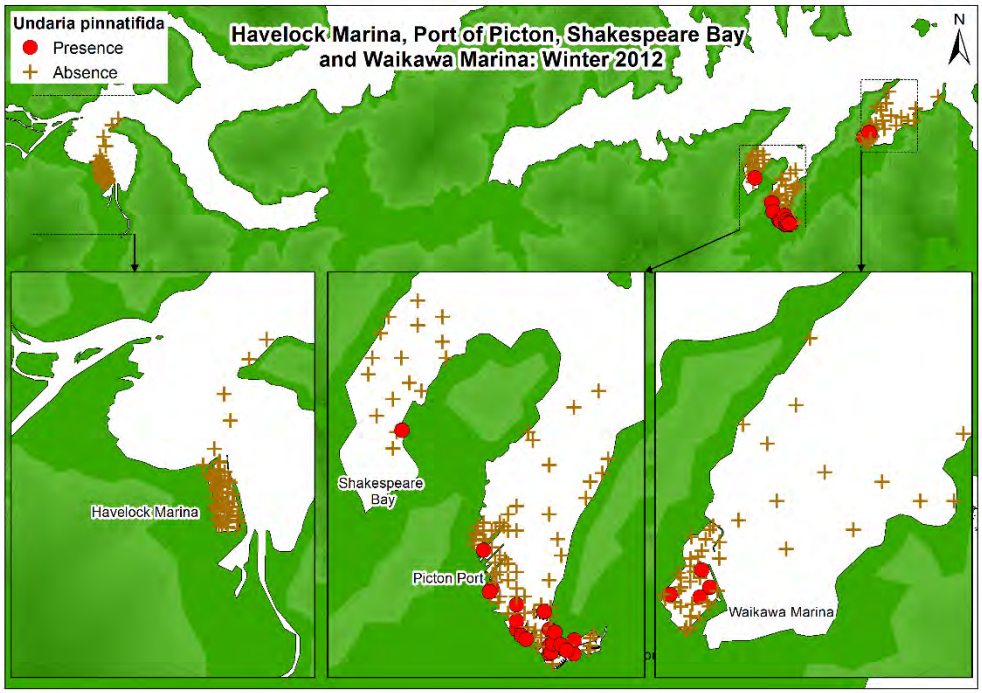
New Plymouth Summer 2012-2013



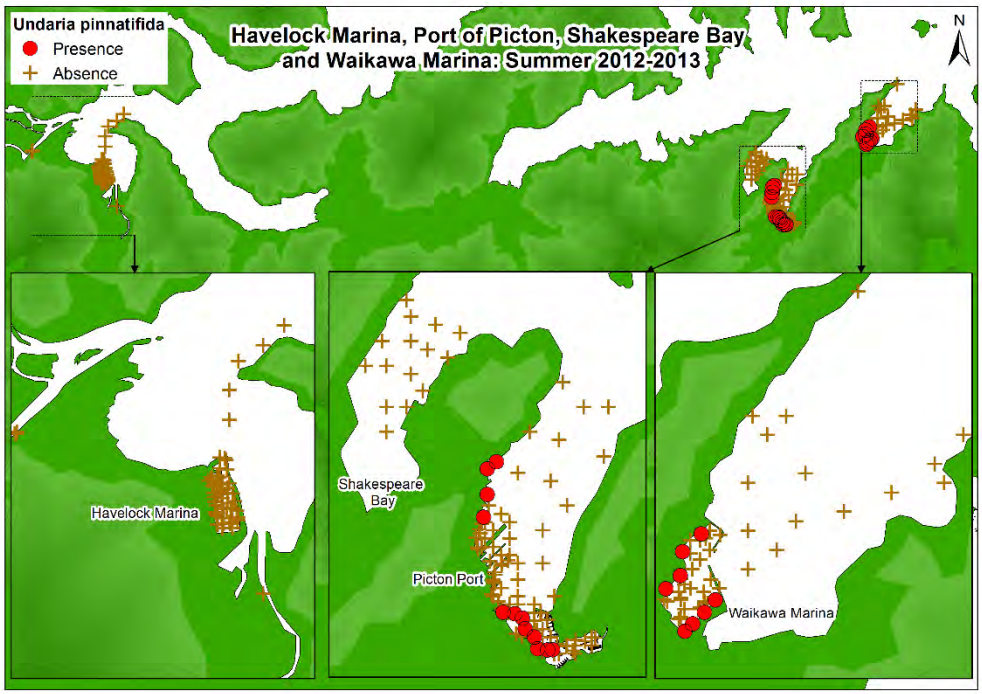
Opua Winter 2012



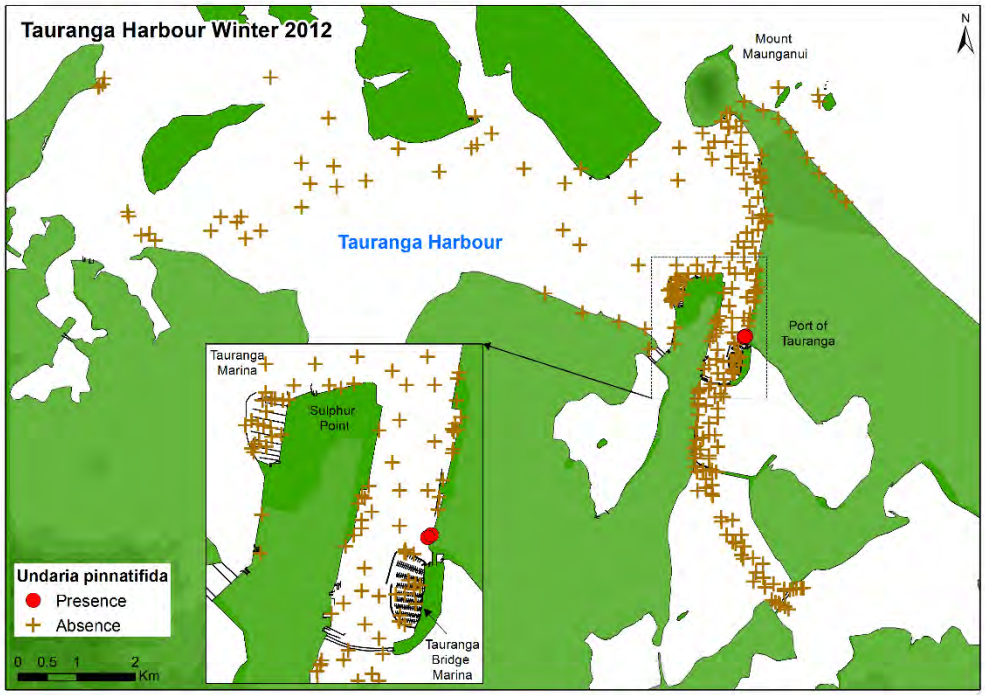
Picton / Havelock Winter 2012



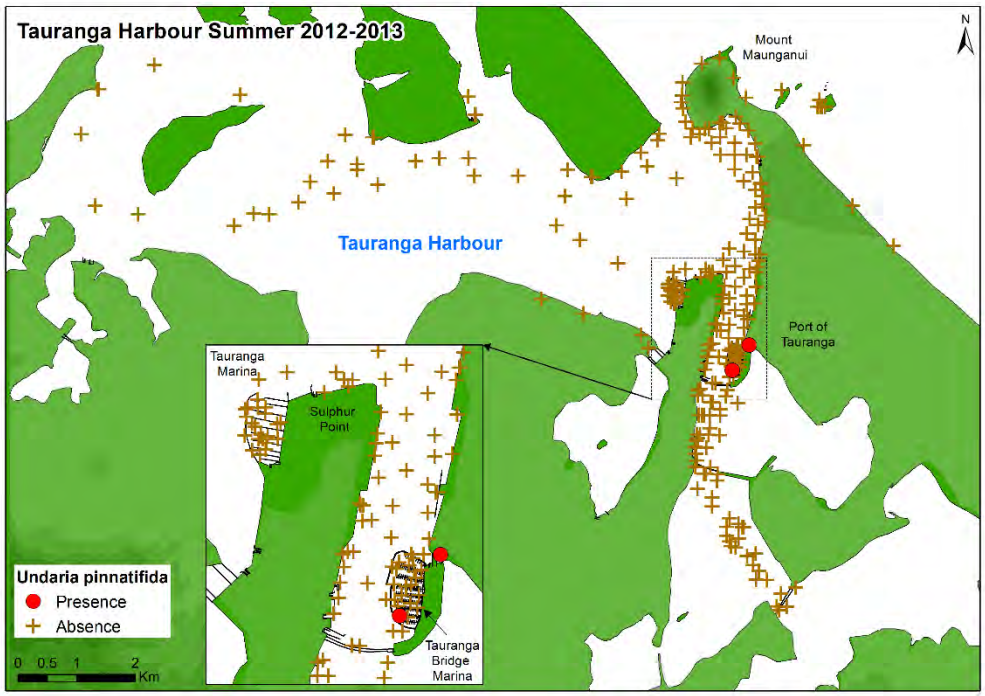
Picton / Havelock Summer 2012-2013



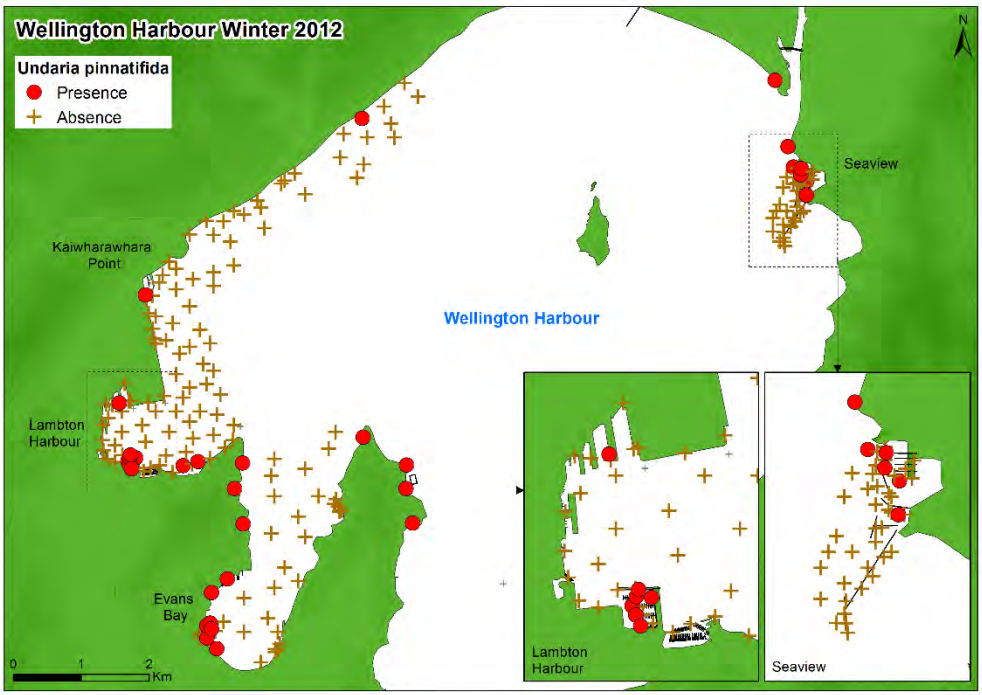
Tauranga Harbour Winter 2012



Tauranga Harbour Summer 2012-2013



Wellington Harbour Winter 2012



Wellington Harbour Summer 2012-2013