

Marine High Risk Site Surveillance

Annual Synopsis Report for all High Risk Sites 2018–19 (SOW18048)

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Executive Summary

The Marine High Risk Site Surveillance (MHRSS) is a national programme of surveys targeted at the early detection of high-risk marine non-indigenous species (NIS). The primary objective of the MHRSS programme is to detect incursions of new-to-New Zealand non-indigenous organisms listed on the Unwanted Organisms Register in New Zealand ports and marinas previously identified as the highest risk for the introduction and establishment of marine NIS. The programme has two secondary objectives: (i) to detect incursions of marine NIS or cryptogenic organisms not previously recorded in New Zealand, and; (ii) to detect range extensions by marine NIS or cryptogenic organisms that are already established in New Zealand waters. The MHRSS programme is designed to detect the presence of five primary (*Asterias amurensis*, *Carcinus maenas*, *Caulerpa taxifolia*, *Eriocheir sinensis* and *Potamocorbula amurensis*) and four secondary (*Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii* and *Styela clava*) target NIS. Each High Risk Site is surveyed bi-annually (hereafter referred to as the Winter and Summer surveys).

This Annual Synopsis Report details the targeted surveillance surveys at the 11 High Risk Sites during the periods June to September 2018 (the Winter 2018 surveys) and November 2018 to March 2019 (the Summer 2018–19 surveys).

The number of survey locations sampled exceeded the overall MHRSS programme survey targets. A total of 2922 locations (100.7% of target 2903) were surveyed during the Winter 2018 surveys. A total of 2943 locations (101.4% of target 2903) were surveyed during the Summer 2018–19 surveys. No primary target species were detected, but all four secondary target species were detected during both rounds of surveys.

- *Arcuatula senhousia* was detected during the following surveys: Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Eudistoma elongatum* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Sabella spallanzanii* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Summer 2018–19); Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Styela clava* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Winter 2018, Summer 2018–19); Nelson Harbour (Winter 2018, Summer 2018–19); Ōpua Marina/Waikare Inlet (Winter 2018, Summer 2018–19); Otago Harbour (Winter 2018, Summer 2018–19); Picton Harbour (Winter 2018, Summer 2018–19); Tauranga Harbour (Winter 2018, Summer 2018–19); Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).

These secondary target species have previously been detected at the respective High Risk Sites during MHRSS surveys.

The number of specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification ranged from 0 to 16 per survey. The total numbers of specimens sent to MITS were 63 for the Winter 2018 round and 46 for the Summer 2018–19 round.

Twenty-two of the 63 specimens sent to MITS from the Winter 2018 surveys were NIS, including the red alga *Grateloupia turuturu* (Tauranga Harbour), the colonial ascidians *Botrylloides giganteum* (Tauranga Harbour) and *Didemnum vexillum* (Waitematā, Wellington and Whāngārei harbours), the solitary ascidians *Ciona intestinalis* (Wellington Harbour) and *C. savignyi* (Waitematā Harbour), the bryozoans *Amathia chimonidesi* (Wellington Harbour) and *Celleporaria nodulosa* (Tauranga and Waitematā harbours), the fish *Acentrogobius pflaumii* (Nelson Harbour) and the nudibranchs *Polycera fujitai* (Nelson Harbour) and *P. hedgpethi* (Port Taranaki, Nelson and Picton harbours).

- The record of *A. chimonidesi* from Wellington Harbour for the first time represents a detected range extension (previously recorded in Waitematā Harbour).
- The record of *A. pflaumii* from Nelson Harbour for the first time represents a detected range extension (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).
- The record of *P. fujitai* from Nelson Harbour for the first time represents a detected range extension (previously recorded in Waitematā Harbour).
- The record of *P. hedgpethi* from Port Taranaki and Nelson Harbour represent detected range extensions (previously recorded in Ōpua Marina/Waikare Inlet, Lyttelton, Picton, Tauranga and Wellington harbours).

Sixteen of the 46 specimens sent to MITS from the Summer 2018–19 surveys were NIS, including the algae *Grateloupia turuturu* (Nelson Harbour), *Chaetomorpha linum* (Picton Harbour), *Cladophora vagabunda* (Picton Harbour), *Schizymenia apoda* (Otago Harbour) and *Striaria attenuata* (Wellington Harbour), the colonial ascidians *Clavelina lepadiformis* (Wellington Harbour) and *Diplosoma listerianum* (Waitematā Harbour), the bivalve *Magallana gigas* (Lyttelton Harbour/Whakaraupō), the bryozoan *Celleporaria umbonatoidea* (Ōpua Marina/Waikare Inlet), the fish *Acentrogobius pflaumii* (Nelson Harbour) and the hydroids *Ectopleura crocea* (Nelson Harbour), *E. larynx* (Ōpua Marina/Waikare Inlet) and *Pennaria disticha* (Waitematā Harbour).

- The record of *E. crocea* from Nelson Harbour for the first time represents a detected range extension (previously recorded in Bluff, Lyttelton, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).
- The record of *E. larynx* from Ōpua Marina/Waikare Inlet for the first time represents a detected range extension (previously recorded in Nelson, Picton, Tauranga, Waitematā and Whāngārei harbours).

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Introduction

The Marine High Risk Site Surveillance (MHRSS) is a national programme of surveys targeted at the early detection of high-risk marine non-indigenous marine species (NIS) and is part of Biosecurity New Zealand's (BNZ)¹ wider marine biosecurity system. The MHRSS programme, delivered by NIWA under contract to BNZ, repeats targeted surveillance surveys developed and undertaken by NIWA in 2002–06 and 2008–present at 11 major New Zealand ports and marinas deemed to be the highest risk for the introduction and establishment of marine NIS (Figure 1). Repeat surveys by an experienced team, the core of which includes observers who have surveyed the sites on multiple occasions (often for several years), builds capability and increases the likelihood of detecting temporal changes in species' assemblages. Each site is surveyed in winter and summer each year because some organisms have life cycles that prevent macroscopic detection during certain times of the year.

The 11 High Risk Sites^{2,3} for the MHRSS programme are (from north to south):

1. Ōpua Marina/Waikare Inlet (including waters to the south of Brampton Bank);
2. Whāngārei Harbour (Whāngārei-te-rerenga-parāoa);
3. Waitematā Harbour (Auckland; including the Viaduct Basin, Hobson West Marina area, Westhaven Marina, Bayswater Marina, Devonport and Kauri Point/Te Mātā-rae-o-Mana defence areas);
4. Tauranga Harbour (Te Awanui);
5. Port Taranaki (New Plymouth, Ngāmotu);
6. Wellington Harbour (Te Whanganui-a-Tara);
7. Nelson Harbour (including Port Nelson and Waimea Inlet) (within Te Tai-o-Aorere/Tasman Bay);
8. Picton Harbour (including Shakespeare and Waikawa bays, and Havelock Marina);
9. Lyttelton Harbour/Whakaraupō;
10. Otago Harbour; and
11. Bluff Harbour (Awarua).

¹Biosecurity New Zealand is a business unit within the Ministry for Primary Industries

²High Risk Site is the terminology used in the Ministry for Primary Industries Statement of Work for the national Marine High Risk Site Surveillance programme.

³Where appropriate, High Risk Site names follow official names listed in: 1) the New Zealand Gazetteer of place names (<http://www.linz.govt.nz/regulatory/place-names/find-place-name/new-zealand-gazetteer-place-names>); 2) Reed, A.W. (2016, revised by Dowling, P.) *Maori place names: their meanings and origins*, Oratia Books, 152p.; 3) Kā Huru Manu (<http://www.kahurumanu.co.nz/ka-ara-tawhito>); 4) '1000 Māori place names', (<https://nzhistory.govt.nz/culture/maori-language-week/1000-maori-place-names>, Ministry for Culture and Heritage, updated 22-Aug-2017); and 5), and as advised by mana whenua. Otherwise, High Risk Site names follow those listed in the Biosecurity New Zealand's Statement of Work (SOW18048) for the national Marine High Risk Site Surveillance programme.

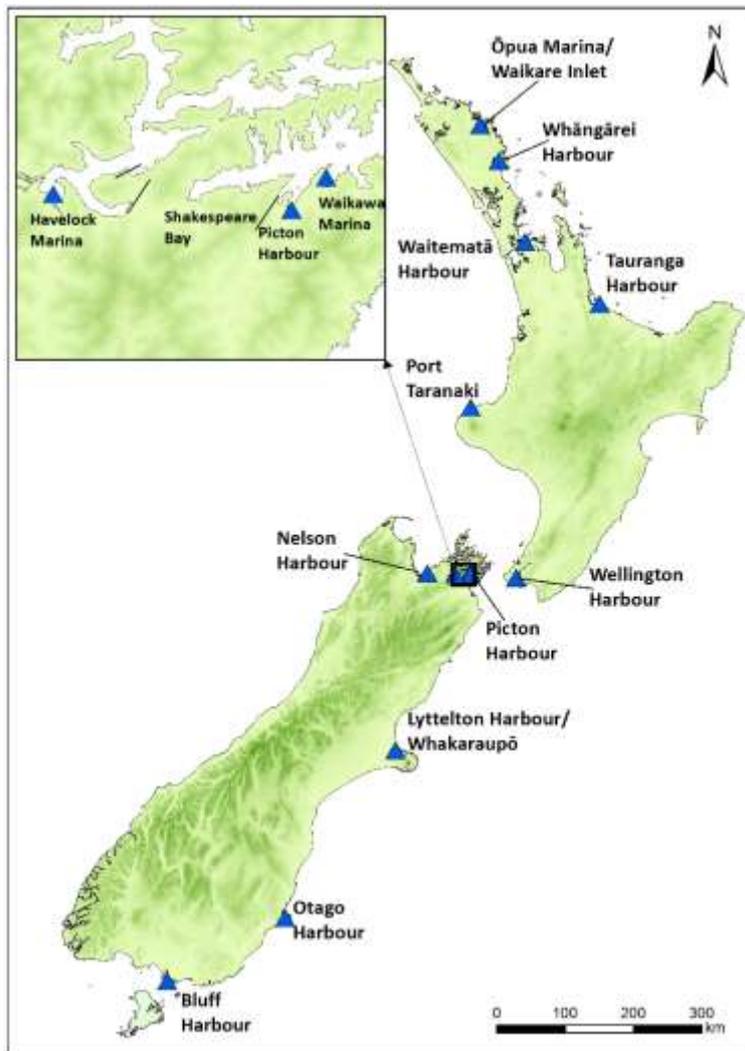


Figure 1: Locations of the 11 High Risk Sites covered by the Marine High Risk Site Surveillance (MHRSS) programme.

Objectives of the Marine High-Risk Site Surveillance programme

The primary objective of the MHRSS programme is:

- To detect incursions of new-to-New Zealand non-indigenous organisms listed on the Unwanted Organisms Register at High Risk Sites throughout New Zealand.

The secondary objectives of the MHRSS programme are:

- To detect incursions of new-to-New Zealand non-indigenous or cryptogenic organisms not listed on the Unwanted Organisms Register at High Risk Sites throughout New Zealand.
- To detect incursions (i.e., range extensions⁴) of established non-indigenous or cryptogenic organisms that exhibit characteristics of Pests and Diseases.

Target species

BNZ has identified five primary target species which are listed on the Unwanted Organisms register.

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 organisms⁵ are known to be established in New Zealand's coastal waters.

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

*Notifiable organism under Biosecurity (Notifiable Organisms) Order 2016
<http://www.legislation.govt.nz/regulation/public/2016/0073/9.0/whole.html>

This Annual Synopsis Report details the targeted surveillance at the 11 High Risk Sites covered by the MHRSS programme in the survey rounds of Winter 2018 and Summer 2018–19.

⁴The term 'range extension' is frequently applied when a NIS is detected at a geographic location where it has not been documented as previously occurring. They represent expansions to the known geographic distribution of a NIS, but do not implicitly equate to actual geographic spread of a NIS. Hence they are referred to in this report as 'detected range extensions'.

⁵*Didemnum* sp. was removed from the list of secondary target species by BNZ in December 2008 (Email from Brendan Gould, BNZ, to Don Morrissey, NIWA, 12 December 2008). *Sabella spallanzanii* was moved from the primary to the secondary list in June 2011 (MAF Statement of Work for Post Border Surveillance Programmes. National Marine High Risk Site Surveillance Programme – 12099 [10 June 2011]).

Summary of Survey Activity/Methods

Dates of Marine High Risk Site Surveillance programme survey activity

The targeted surveillance surveys of the 11 High Risk Sites covered by the MHRSS programme took place during the periods June⁶ to September 2018 (the Winter 2018 round of surveys) and November 2018 to March 2019 (the Summer 2018–19 round of surveys). Dates for each survey are provided in Table 1.

Table 1: Dates for the Winter 2018 and Summer 2018–19 Marine High Risk Site Surveillance (MHRSS) programme surveys.

High Risk Site	Winter 2018 survey	Summer 2018–19 survey
Bluff Harbour	16–20 July 2018	25 February–1 March 2019
Lyttelton Harbour/Whakaraupō	13–17 August 2018	3–7 December 2018
Nelson Harbour	23 July–1 August 2018	11–15 February 2019
Ōpua Marina/Waikare Inlet	2–6 July 2018	12–16 November 2018
Otago Harbour	10–14 September 2018	4–8 March 2019
Picton Harbour	3–7 September 2018	25 February–1 March 2019
Port Taranaki	25–29 June 2018	26–30 November 2018
Tauranga Harbour	23–27 July 2018	17–21 December 2018
Waitematā Harbour	20–31 September 2018	21 January–1 February 2019
Wellington Harbour	6–10 August 2018	10–14 December 2018
Whāngārei Harbour	11–15 July 2018	18–22 March 2019

Marine High Risk Site Surveillance programme survey techniques

Survey sampling for the MHRSS programme uses a variety of techniques designed to sample a range of soft and hard habitat types 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: benthic sled tows; crab condos; crab (box) traps; diver searches; and shore searches. The habitats and species targeted by each sampling technique are detailed in Appendix 1.

A documented process for the selection of sampling methods and allocation of sampling effort for the target species was developed at the start of a previous phase of the MHRSS programme (Inglis et al. 2006a) and includes information on the biology and behaviour of the target organisms, as well as sampling methods used for the same or similar species in other parts of their range. Sample plans for the targeted marine pest surveillance programme were developed using a combination of niche models for the target species and particle dispersion models (to simulate dispersal of propagules from the point of release). The niche models were based on Habitat Suitability Indices derived from expert opinion. Their performance was compared with niche models derived statistically from independent data on the distribution of representative NIS (Inglis et al. 2006b). Sensitivity (efficiency of the survey method), cost-effectiveness, impacts on native species and environments, feasibility and consistency with safe field-working practice were also evaluated in selecting sampling methods. Stochastic Scenario Tree (SST) modelling has also been used to evaluate and optimise confidence of target species detection and identify the resources needed to achieve the required detection outcomes (Morrisey et al. 2012a, b).

⁶The typical winter MHRSS survey period is May–September, but BNZ requested a one-month delay to the start of the winter survey season for budget re-alignment purposes.

Sampling locations for benthic sled tows, crab (box) trap lines and diver searches were pre-allocated prior to each survey by using a grid overlaid on the survey area in a Geographic Information System (GIS). Where a pre-allocated sampling point was not accessible at the time of the survey (e.g., port berth occupied by a vessel, unfavourable weather conditions, port operations underway), the sample was relocated to a nearby suitable location and the new coordinates recorded. Field teams also noted any sampling locations that were not appropriate or were unsafe, so that these could be removed from the grid of potential sampling locations for future surveys. Such locations included areas where high vessel traffic make diving too hazardous, areas that are not suitable for trapping because they are above the low water tide mark or have underwater hazards, seafloor cable zones and other restricted areas.

Specimen identification

All survey samples collected are sorted on-site and taxonomic identities confirmed (where possible) by field team members trained in identification of target species, and who have experience with the biota normally found at each High Risk Site.

Survey specimens to be retained for formal identification include all primary target species, representative samples of secondary target species at locations where they are not currently known to occur (i.e., range extensions) and any suspect organisms whose identities are uncertain. These specimens, preserved in the chemical appropriate to that taxon and with corresponding sampling information (i.e., sample date, location and collection method), are sent to the Marine Invasives Taxonomic Service (MITS) (the centralised, clearinghouse service for taxonomic identification of marine organisms under contract to BNZ) immediately following each survey. Species identities are checked for correct naming via the World Register of Marine Species (WoRMS, <http://www.marinespecies.org/>), which provides an authoritative and comprehensive list of names of marine organisms, including information on synonymy.

Any suspected primary target species, non-indigenous or cryptogenic species not previously recorded in New Zealand and detected range extensions of secondary target species are reported by NIWA to BNZ as soon as practicable (within 48 h), with confirmation as to taxonomic identity provided by MITS to BNZ through their contracted reporting procedure. 'Range extension' and new-to-New Zealand status are checked via the Marine Biosecurity Porthole (www.marinebiosecurity.org.nz).

Environmental data collection

Environmental data were recorded at sampling locations during each survey (the principal aim of these records is to develop a database of environmental conditions for each High Risk Site, rather than conditions associated with each individual sample). The following parameters were measured: water depth; salinity; temperature; water clarity (secchi disk depth); wind direction and speed; time of sampling (to allow determination of tidal stage); and sediment type (for benthic sled sampling).

BNZ Marine High Risk Site Surveillance programme team: contacts

The MHRSS programme is administered and funded by BNZ's Biosecurity Surveillance Group. Queries relating to the MHRSS programme should be directed to BNZ.

The BNZ Operational Liaison for MHRSS surveillance activity is Abraham Growcott, Senior Advisor, Marine Surveillance and Incursion Investigation (tel: 04 894 2433, email: Abraham.Growcott@mpi.govt.nz).

NIWA Marine High Risk Site Surveillance programme survey team: contacts

The MHRSS programme surveys were designed by NIWA and implemented by the NIWA personnel listed in the *Field team list and stakeholder communications log* submitted to BNZ prior to each MHRSS programme survey. The NIWA Project Manager for the MHRSS programme is Dr Chris Woods (tel: 03 343 7820, email: Chris.Woods@niwa.co.nz).

Results

Sample collection

Total numbers of locations surveyed in each MHRSS programme survey round (Winter 2018 and Summer 2018–19) at each High Risk Site are shown in Table 2. Numbers of survey locations sampled at each High Risk Site met, or exceeded the survey targets. A total of 2922 locations (100.7% of target 2903) were surveyed during the Winter 2018 surveys. A total of 2943 locations (101.4% of target 2903) were surveyed during the Summer 2018–19 surveys.

Numbers of locations sampled with each method at each High Risk Site are shown in Appendix 2, by sampling round. The achieved sample locations for each sampling technique at each High Risk Site are shown in Appendix 3, by sampling round.

Table 2: Summary of target and achieved numbers of survey locations sampled at each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site.

High Risk Site	Sampling round	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
Bluff Harbour*	Winter 2018	225	225	100.0
	Summer 2018–19	225	225	100.0
Lyttelton Harbour/Whakaraupō	Winter 2018	243	244	100.4
	Summer 2018–19	243	245	100.8
Nelson Harbour	Winter 2018	243	244	100.4
	Summer 2018–19	243	244	100.4
Ōpua Marina/Waikare Inlet**	Winter 2018	248	254	102.4
	Summer 2018–19	248	262	105.6
Otago Harbour	Winter 2018	243	245	100.8
	Summer 2018–19	243	244	100.4
Picton Harbour	Winter 2018	243	243	100.0
	Summer 2018–19	243	243	100.0
Port Taranaki	Winter 2018	243	244	100.4
	Summer 2018–19	243	245	100.8
Tauranga Harbour	Winter 2018	243	249	102.5
	Summer 2018–19	243	246	101.2
Waitematā Harbour	Winter 2018	486	488	100.4
	Summer 2018–19	486	498	102.5
Wellington Harbour	Winter 2018	243	243	100.0
	Summer 2018–19	243	246	101.2
Whāngārei Harbour	Winter 2018	243	243	100.0
	Summer 2018–19	243	246	101.2
All sites	Winter 2018	2903	2922	100.7
All sites	Summer 2018–19	2903	2943	101.4

* By agreement with BNZ, the total target number of sampling locations in Bluff Harbour has been reduced compared to earlier surveys (from 243 down to 225), due to the presence of a sub-surface oyster farm lease north of Tikore Island which has resulted in the immediate area being inaccessible for safe sampling using crab traps and benthic sled tows. The numbers of crab traps and benthic sled locations have been reduced (from 80 to 68, and from 100 to 84, respectively), but the number of dive locations increased (from 30 to 40), with several of those dives taking place in the oyster farming area.

**By agreement with BNZ, the target number of benthic sled locations increased to 105 following Stochastic Scenario Tree modelling, with increased survey allocation around Hermione Rock (where cruise ships anchor).

Target species collection

Primary target species detected⁷: None.

Secondary target species detected⁸: *Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii* and *Styela clava* were detected during both rounds of surveys (see below).

- *Arcuatula senhousia* was detected during the following surveys: Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Eudistoma elongatum* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Sabella spallanzanii* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Summer 2018–19); Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).
- *Styela clava* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Winter 2018, Summer 2018–19); Nelson Harbour (Winter 2018, Summer 2018–19); Ōpua Marina/Waikare Inlet (Winter 2018, Summer 2018–19); Otago Harbour (Winter 2018, Summer 2018–19); Picton Harbour (Winter 2018, Summer 2018–19); Tauranga Harbour (Winter 2018, Summer 2018–19); Waitematā Harbour (Winter 2018, Summer 2018–19); and Whāngārei Harbour (Winter 2018, Summer 2018–19).

Number of specimens collected and sent to MITS

The number of specimens sent to the MITS for formal identification ranged from 0 to 16 per survey. The total numbers of specimens sent were 63 for the Winter 2018 round of surveys and 46 for the Summer 2018–19 round of surveys (Table 3 and Table 4).

Twenty-two of the 63 specimens sent to MITS from the Winter 2018 surveys were NIS (Table 5), including the red alga *Grateloupia turuturu* (Tauranga Harbour), the colonial ascidians *Botrylloides giganteum* (Tauranga Harbour) and *Didemnum vexillum* (Waitematā, Wellington and Whāngārei harbours), the solitary ascidians *Ciona intestinalis* (Wellington Harbour) and *C. savignyi* (Waitematā Harbour), the bryozoans *Amathia chimonidesi* (Wellington Harbour) and *Celleporaria nodulosa* (Tauranga and Waitematā harbours), the fish *Acentrogobius pflaumii* (Nelson Harbour) and the nudibranchs *Polycera fujitai* (Nelson Harbour) and *P. hedgpethi* (Port Taranaki, Nelson and Picton harbours).

- The record of *A. chimonidesi* from Wellington Harbour represents a detected range extension (previously recorded in Waitematā Harbour).
- The record of *A. pflaumii* from Nelson Harbour represents a detected range extension (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).
- The record of *P. fujitai* from Nelson Harbour represents a detected range extension (previously recorded in Waitematā Harbour).
- The record of *P. hedgpethi* from Port Taranaki and Nelson Harbour represent detected range extensions (previously recorded in Ōpua Marina/Waikare Inlet, Lyttelton, Picton, Tauranga and Wellington harbours⁹).

⁷*Asterias amurensis*, *Carcinus maenas*, *Caulerpa taxifolia*, *Eriocheir sinensis*, *Potamocorbula amurensis*

⁸*Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii*, *Styela clava*

⁹This NIS has also recorded at non-MHRSS locations such as Gisborne Harbour, Waihinu Bay (Pelorus Sound) and Ruakaka Bay (Queen Charlotte Sound).

These detected range extensions were communicated to BNZ through the MITS reporting procedure.

Sixteen of the 46 specimens sent to MITS from the Summer 2018–19 surveys were NIS (Table 6), including the algae *Grateloupia turuturu* (Nelson Harbour), *Chaetomorpha linum* (Picton Harbour), *Cladophora vagabunda* (Picton Harbour), *Schizymenia apoda* (Otago Harbour) and *Striaria attenuata* (Wellington Harbour), the colonial ascidians *Clavelina lepadiformis* (Wellington Harbour) and *Diplosoma listerianum* (Waitematā Harbour), the bivalve *Magallana gigas* (Lyttelton Harbour/Whakaraupō), the bryozoan *Celleporaria umbonatoidea* (Ōpua Marina/Waikare Inlet), the fish *Acentrogobius pflaumii* (Nelson Harbour) and the hydroids *Ectopleura crocea* (Nelson Harbour), *E. larynx* (Ōpua Marina/Waikare Inlet) and *Pennaria disticha* (Waitematā Harbour).

- The record of *E. crocea* from Nelson Harbour represents a detected range extension (previously recorded in Bluff, Lyttelton, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).
- The record of *E. larynx* from Ōpua Marina/Waikare Inlet represents a detected range extension (previously recorded in Nelson, Picton, Tauranga, Waitematā and Whāngārei harbours).

These detected range extensions were communicated to BNZ through the MITS reporting procedure.

Table 3: Summary of numbers and types of specimens collected from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification during the Winter 2018 round of surveys.

Organism type	Bluff Harbour	Lyttelton Harbour/Whakaraupō	Nelson Harbour	Ōpua Marina/Waikare Inlet	Otago Harbour	Picton Harbour	Port Taranaki	Tauranga Harbour	Waitematā Harbour	Wellington Harbour	Whāngārei Harbour	Total	% of total
Algae								1	1	2		4	6.3
Annelid						4						4	6.3
Amphipod												0	0
Anthozoan												0	0
Ascidian		4						3	13	9	1	30	47.6
Barnacle											1	1	1.6
Bivalve												0	0
Bryozoan								1	2	1		4	6.3
Crab			1					4		1		6	9.5
Decapod												0	0
Echinoderm						1		1				2	3.2
Fish			1									1	1.6
Gastropod												0	0
Hydroid								1				1	1.6
Isopod				1								1	1.6
Nudibranch			4		2	1	1					8	12.7
Sponge										1		1	1.6
Scleractinian												0	0
Other												0	0
Total	0	4	6	1	2	6	1	11	16	14	2	63	100

Table 4: Summary of numbers and types of specimens collected from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification during the Summer 2018–19 round of surveys.

Organism type	Bluff Harbour	Lyttelton Harbour/Whakaraupō	Nelson Harbour	Ōpua Marina/Waikare Inlet	Otago Harbour	Picton Harbour	Port Taranaki	Tauranga Harbour	Waitematā Harbour	Wellington Harbour	Whāngārei Harbour	Total	% of total
Algae			3		2	5				1		11	23.9
Annelid												0	0
Amphipod												0	0
Anthozoan									1			1	2.2
Ascidian		1		1		1	1	7	6	2		19	41.3
Barnacle												0	0
Bivalve		1										1	2.2
Bryozoan				2								2	4.3
Crab		1								1		2	4.3
Decapod												0	0
Echinoderm												0	0
Fish			1		1							2	4.3
Gastropod							2					2	4.3
Hydroid			2	1			1		1			5	10.9
Isopod												0	0
Nudibranch												0	0
Sponge										1		1	2.2
Scleractinian												0	0
Other												0	0
Total	0	3	6	4	3	6	4	7	8	5	0	46	100

Table 5: Specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site during the Winter 2018 round of surveys.

Non-indigenous species are in bold type. Specimens are ordered alphabetically by High Risk Site, then by organism type, taxon and (field) sample number. Cryptogenic = cryptogenic species category 1. Species previously recorded from New Zealand whose identity as either native or non-indigenous is ambiguous. Also included in this category are newly described species that have exhibited invasive behaviour in New Zealand, but for which there are no known records outside the New Zealand region; Indeterminate = specimens that could not be reliably identified to genus or species level. This group includes: (1) organisms that were damaged, propagule or juvenile stage, and lacked morphological characteristics necessary for identification; and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow identification to species level. Note: where an organism cannot be identified to genus or species level there may still be certain diagnostic characters present/absent to enable a biosecurity status to be assigned that organism. Species detected range extensions are highlighted in blue.

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Cnemidocarpa nisiotis</i>	Indigenous	LYT27094	74875	Benthic sled
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Cnemidocarpa bicornuta</i>	Indigenous	LYT27094	74883	Benthic sled
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Pyura cancellata</i>	Indigenous	LYT27094	74884	Benthic sled
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Pyura picta</i>	Indigenous	LYT27094	74874	Shore search
Nelson Harbour	Crab	<i>Liocarcinus corrugatus</i>	Indigenous	NSN27105c	74757	Crab trap
Nelson Harbour	Fish	<i>Acentrogobius pflaumii</i>	Non-indigenous	NSN27054	74806	Benthic sled
Nelson Harbour	Nudibranch	<i>Lamellaria cerebroides</i>	Indigenous	NSN27054	74802	Benthic sled
Nelson Harbour	Nudibranch	<i>Polycera hedgpethi</i>	Non-indigenous	NSN27061	74787	Benthic sled
Nelson Harbour	Nudibranch	<i>Polycera hedgpethi</i>	Non-indigenous	NSN27183a	74759	Diver search
Nelson Harbour	Nudibranch	<i>Polycera fujitai</i>	Non-indigenous	NSN27193a	74758	Diver search
Ōpua Marina/Waikare Inlet	Isopod	<i>Cleantis tubicola</i>	Indigenous	OPX27010	74740	Benthic sled
Otago Harbour	Nudibranch	<i>Aphelodoris luctuosa</i>	Indigenous	DUD27045	74892	Benthic sled
Otago Harbour	Nudibranch	<i>Janolus novozealandicus</i>	Indigenous	DUD27192	74891	Diver search
Picton Harbour	Annelid	<i>Acromegalomma suspiciens</i>	Indigenous	PCN27094	74890	Benthic sled
Picton Harbour	Annelid	<i>Acromegalomma suspiciens</i>	Indigenous	PCN27193a	74887	Diver search
Picton Harbour	Annelid	<i>Spirobranchus polytrema</i> complex	Cryptogenic	PCN27195b	74888	Diver search
Picton Harbour	Annelid	<i>Acromegalomma suspiciens</i>	Indigenous	PCN27208b	74885	Diver search
Picton Harbour	Echinoderm	<i>Rynkatorpa uncinata</i>	Indigenous	PCN27183a	74889	Diver search
Picton Harbour	Nudibranch	<i>Polycera hedgpethi</i>	Non-indigenous	PCN27193a	74886	Diver search
Port Taranaki	Nudibranch	<i>Polycera hedgpethi</i>	Non-indigenous	NPL27193a	74728	Diver search

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Tauranga Harbour	Algae	<i>Grateloupia turuturu</i>	Non-indigenous	TRG27231	74751	Shore search
Tauranga Harbour	Ascidian	<i>Botrylloides giganteum</i>	Non-indigenous	TRG27183	74747	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides giganteum</i>	Non-indigenous	TRG27204	74750	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides leachii</i>	Cryptogenic	TRG27206	74746	Diver search
Tauranga Harbour	Bryozoan	<i>Celleporaria nodulosa</i>	Non-indigenous	TRG27202	74749	Diver search
Tauranga Harbour	Crab	Brachyura	Indeterminate ¹⁰	TRG27009	74755	Benthic sled
Tauranga Harbour	Crab	<i>Liocarcinus corrugatus</i>	Indigenous	TRG27015	74753	Benthic sled
Tauranga Harbour	Crab	<i>Liocarcinus corrugatus</i>	Indigenous	TRG27039	74754	Benthic sled
Tauranga Harbour	Crab	<i>Hemiplax hirtipes</i>	Indigenous	TRG27039	74876	Benthic sled
Tauranga Harbour	Echinoderm	<i>Astropecten</i> sp.	Indeterminate	TRG27044	74752	Benthic sled
Tauranga Harbour	Hydroid	<i>Aglaophenia laxa</i>	Indigenous	TRG27205	74748	Diver search
Waitematā Harbour	Algae	<i>Ceramium</i> sp.	Indeterminate	AKL27366	74896	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum</i> sp.	Indeterminate	AKL27305	74895	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum vexillum</i>	Non-indigenous	AKL27400	74897	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum vexillum</i>	Non-indigenous	AKL27400	74898	Diver search
Waitematā Harbour	Ascidian	<i>Ciona savignyi</i>	Non-indigenous	AKL27404	74899	Diver search
Waitematā Harbour	Ascidian	<i>Diplosoma listerianum</i>	Non-indigenous	AKL27406	74910	Diver search
Waitematā Harbour	Ascidian	<i>Diplosoma listerianum</i>	Non-indigenous	AKL27406	74911	Diver search
Waitematā Harbour	Ascidian	<i>Botrylloides magnicoecum</i>	Cryptogenic	AKL27407	74901	Diver search
Waitematā Harbour	Ascidian	<i>Botrylloides magnicoecum</i>	Cryptogenic	AKL27407	74912	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum incanum</i>	Indigenous	AKL27408	74902	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum vexillum</i>	Non-indigenous	AKL27408	74903	Diver search
Waitematā Harbour	Ascidian	<i>Pyura rugata</i>	Indigenous	AKL27408	74906	Diver search
Waitematā Harbour	Ascidian	<i>Botrylloides magnicoecum</i>	Cryptogenic	AKL27408	74907	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum incanum</i>	Indigenous	AKL27408	74908	Diver search

¹⁰ Megalopa stage

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MIT code	Survey method
Waitematā Harbour	Bryozoan	<i>Celleporaria nodulosa</i>	Non-indigenous	AKL27399	74900	Diver search
Waitematā Harbour	Bryozoan	<i>Gregarinidra</i> sp.	Indigenous	AKL27408	74909	Diver search
Wellington Harbour	Algae	<i>Grateloupia stipitata</i>	Indigenous	WLG27187	74866	Diver search
Wellington Harbour	Algae	Rhodophyta ¹¹	Indeterminate	WLG27200	74862	Diver search
Wellington Harbour	Ascidian	<i>Pyura pulla</i>	Indigenous	WLG27190	74864	Diver search
Wellington Harbour	Ascidian	<i>Pyura cancellata</i>	Indigenous	WLG27190	74879	Diver search
Wellington Harbour	Ascidian	<i>Pyura subuculata</i>	Indigenous	WLG27190	74880	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	Non-indigenous	WLG27192	74863	Diver search
Wellington Harbour	Ascidian	<i>Didemnum incanum</i>	Indigenous	WLG27199	74861	Diver search
Wellington Harbour	Ascidian	<i>Clavelina lepadiformis</i>	Non-indigenous	WLG27206	74859	Diver search
Wellington Harbour	Ascidian	<i>Aplidium adamsi</i>	Indigenous	WLG27207	74860	Diver search
Wellington Harbour	Ascidian	<i>Ciona intestinalis</i>	Non-indigenous	WLG27209	74858	Diver search
Wellington Harbour	Ascidian	<i>Molgula mortenseni</i>	Cryptogenic	WLG27209	74878	Diver search
Wellington Harbour	Bryozoan	<i>Amathia chimonidesi</i>	Non-indigenous	WLG27050	74868	Benthic sled
Wellington Harbour	Crab	<i>Ebalia laevis</i>	Indigenous	WLG27009	74867	Benthic sled
Wellington Harbour	Sponge	<i>Haliclona</i> sp.	Indigenous	WLG27196	74865	Diver search
Whāngārei Harbour	Ascidian	<i>Didemnum vexillum</i>	Non-indigenous	WRE27207	74443	Diver search
Whāngārei Harbour	Barnacle	<i>Amphibalanus variegatus</i>	Indigenous	WRE27207	74442	Diver search

¹¹ Genetic sequencing required for further taxonomic elaboration.

Table 6: Specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site during the Summer 2018–19 round of surveys.

Non-indigenous species are in bold type. Specimens are ordered alphabetically by High Risk Site, then by organism type, taxon and (field) sample number. Cryptogenic = cryptogenic species category 1. Species previously recorded from New Zealand whose identity as either native or non-indigenous is ambiguous. Also included in this category are newly described species that have exhibited invasive behaviour in New Zealand, but for which there are no known records outside the New Zealand region; Indeterminate = specimens that could not be reliably identified to genus or species level. This group includes: (1) organisms that were damaged, propagule or juvenile stage, and lacked morphological characteristics necessary for identification; and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow identification to species level. Note: where an organism cannot be identified to genus or species level there may still be certain diagnostic characters present/absent to enable a biosecurity status to be assigned that organism. Species detected range extensions are highlighted in blue.

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Asterocarpa humilis</i>	Cryptogenic	LYT28194	74938	Diver search
Lyttelton Harbour/Whakaraupō	Bivalve	<i>Magallana gigas</i>	Non-indigenous	LYT28221	74939	Shore search
Lyttelton Harbour/Whakaraupō	Crab	<i>Pagurus albidianthus</i>	Indigenous	LYT28033	74940	Benthic sled
Nelson Harbour	Algae	<i>Grateloupia turuturu</i>	Non-indigenous	NSN28220	74966	Shore search
Nelson Harbour	Algae	<i>Codium gracile</i>	Indigenous	NSN28236	74971	Shore search
Nelson Harbour	Algae	<i>Grateloupia turuturu</i>	Non-indigenous	NSN28243	74971	Shore search
Nelson Harbour	Fish	<i>Acentrogobius pflaumii</i>	Non-indigenous	NSN28176	74969	Benthic sled
Nelson Harbour	Hydroid	<i>Ectopleura crocea</i>	Non-indigenous	NSN28194a	74968	Diver search
Nelson Harbour	Hydroid	<i>Ectopleura crocea</i>	Non-indigenous	NSN28201a	74967	Diver search
Ōpua Marina/Waikare Inlet	Ascidian	<i>Aplidium</i> sp.	Indeterminate	OPX28242	74923	Shore search
Ōpua Marina/Waikare Inlet	Bryozoan	<i>Celleporaria umbonatoidea</i>	Non-indigenous	OPX28011	74920	Benthic sled
Ōpua Marina/Waikare Inlet	Bryozoan	<i>Celleporaria umbonatoidea</i>	Non-indigenous	OPX28213	74921	Diver search
Ōpua Marina/Waikare Inlet	Hydroid	<i>Ectopleura larynx</i>	Non-indigenous	OPX28187	74922	Diver search
Otago Harbour	Algae	<i>Schizymenia apoda</i>	Non-Indigenous	DUD28184	74982	Diver search
Otago Harbour	Algae	<i>Rhodoglossum gigartinoides</i>	Indigenous	DUD28188	74983	Diver search
Otago Harbour	Fish	<i>Bovichtus variegatus</i>	Indigenous	DUD28115	74984	Crab trap
Picton Harbour	Algae	<i>Cladophora vagabunda</i>	Non-indigenous	PCN28183a	74974	Diver search
Picton Harbour	Algae	<i>Cladostephus spongiosus</i>	Indigenous	PCN28190b	74977	Diver search
Picton Harbour	Algae	<i>Chaetomorpha linum</i>	Non-indigenous	PCN28194a	74976	Diver search

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Picton Harbour	Algae	Ectocarpaceae ¹²	Indeterminate	PCN28206b	74975	Diver search
Picton Harbour	Algae	<i>Gracilaria chilensis</i>	Indigenous	PCN28212	74979	Crab condo
Picton Harbour	Ascidian	Unidentifiable	Indeterminate	PCN28081	74978	Benthic sled
Port Taranaki	Ascidian	<i>Botrylloides leachii</i>	Cryptogenic	NPL28187	74931	Diver search
Port Taranaki	Gastropod	<i>Potamopyrgus estuarinus</i>	Indigenous	NPL28215	74933	Crab condo
Port Taranaki	Gastropod	Gastropod eggs	Indigenous	NPL28215	74934	Crab condo
Port Taranaki	Hydroid	<i>Ectopleura</i> sp.	Indeterminate	NPL28184	74932	Diver search
Tauranga Harbour	Ascidian	<i>Aplidium nottii</i>	Indigenous	TRG28182	74945	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides leachii</i>	Cryptogenic	TRG28186	74946	Diver search
Tauranga Harbour	Ascidian	<i>Microcosmus squamiger</i>	Cryptogenic	TRG28186	74950	Diver search
Tauranga Harbour	Ascidian	<i>Asterocarpa humilis</i>	Cryptogenic	TRG28186	74951	Diver search
Tauranga Harbour	Ascidian	<i>Metandrocarpa thilenii</i>	Indigenous	TRG28195	74947	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides leachii</i>	Cryptogenic	TRG28203	74948	Diver search
Tauranga Harbour	Ascidian	<i>Styela plicata</i>	Cryptogenic	TRG28230	74949	Shore search
Waitematā Harbour	Anthozoan	<i>Culicia rubeola</i>	Indigenous	AKL28420	74961	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum</i> sp.	Cryptogenic	AKL28370	74955	Diver search
Waitematā Harbour	Ascidian	<i>Polyzoa reticulata</i>	Indigenous	AKL28379	74957	Diver search
Waitematā Harbour	Ascidian	<i>Pyura rugata</i>	Indigenous	AKL28380	74958	Diver search
Waitematā Harbour	Ascidian	<i>Mycale (Carmia) tasmani</i>	Indigenous	AKL28396	74959	Diver search
Waitematā Harbour	Ascidian	<i>Microcosmus squamiger</i>	Cryptogenic	AKL28419	74960	Diver search
Waitematā Harbour	Ascidian	<i>Diplosoma listerianum</i>	Non-indigenous	AKL28420	74962	Diver search
Waitematā Harbour	Hydroid	<i>Pennaria disticha</i>	Non-indigenous	AKL28370	74956	Diver search
Wellington Harbour	Algae	<i>Striaria attenuata</i>	Non-indigenous	WLG28184	74942	Diver search
Wellington Harbour	Ascidian	<i>Clavelina lepadiformis</i>	Non-indigenous	WLG28195	74935	Diver search
Wellington Harbour	Ascidian	<i>Agnezia glaciata</i>	Indigenous	WLG28195	74944	Diver search
Wellington Harbour	Crab	<i>Petrocheles spinosus</i>	Indigenous	WLG28021	74943	Benthic sled

¹² Genetic sequencing required for further taxonomic elaboration.

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Wellington Harbour	Sponge	<i>Haliclona</i> sp.	Cryptogenic	WLG28196	74936	Diver search

Distribution of target and non-target species

Distribution maps were plotted for target and non-target NIS in the following categories¹³: species that have not previously been reported in specific locations (i.e., listed as detected range extensions according to Marine Biosecurity Porthole records); and those that currently have a restricted distribution. The maps show locations where each species was detected and locations where it was absent (Appendix 4), based on appropriate sampling methods for each species (see Appendix 1).

Species plotted (and the survey methods by which they might be collected) are:

Acentrogobius pflaumii (benthic sled, crab trap and diver search); *Amathia chimonidesi* (benthic sled, diver search and shore search); *Amathia verticillata* (benthic sled, diver search and shore search); *Arcuatula senhousia* (benthic sled and diver search); *Arenigobius bifrenatus* (benthic sled, crab trap and diver search); *Ascidiella aspersa* (benthic sled, diver search and shore search); *Botrylloides giganteum* (benthic sled, diver search and shore search); *Caprella mutica* (diver search and shore search); *Celleporaria nodulosa* (benthic sled, diver search and shore search); *Celleporaria umbonatoidea* (benthic sled, diver search and shore search); *Chaetomorpha linum* (benthic sled, diver search and shore search); *Charybdis (Charybdis) japonica* (benthic sled, crab trap, crab condo, diver search and shore search); *Ciona intestinalis* (benthic sled, diver search and shore search); *Ciona savignyi* (benthic sled, diver search and shore search); *Ciona* spp.¹⁴ (benthic sled, diver search and shore search); *Cladophora vagabunda* (benthic sled, diver search and shore search); *Clavelina lepadiformis* (benthic sled, diver search and shore search); *Colpomenia bullosa* (benthic sled, diver search and shore search); *Didemnum vexillum* (benthic sled, diver search and shore search); *Diplosoma listerianum* (benthic sled, diver search and shore search); *Ectopleura crocea* (benthic sled, diver search and shore search); *Ectopleura larynx* (benthic sled, diver search and shore search); *Ectopleura* spp.¹⁵ (benthic sled, diver search and shore search); *Eudistoma elongatum* (benthic sled, diver search and shore search); *Grateloupia turuturu* (benthic sled, diver search and shore search); *Limaria orientalis* (benthic sled); *Metapenaeus bennettiae* (benthic sled, crab condo and crab trap); *Omobranchus anolius* (benthic sled, crab condo, crab trap, diver search and shore search); *Pennaria disticha* (benthic sled, diver search and shore search); *Polyandrocarpa zorritensis* (benthic sled, diver search and shore search); *Polycera fujitai* (diver search and shore search); *Polycera hedgpethi* (diver search and shore search); *Pyromaia tuberculata* (benthic sled and crab trap); *Sabella spallanzanii* (benthic sled, crab trap, diver search and shore search); *Schizymenia apoda* (benthic sled, diver search and shore search); *Striaria attenuata* (benthic sled, diver search and shore search); *Styela clava* (benthic sled, crab trap, diver search and shore search); *Symplegma brakenhielmi* (benthic sled, diver search and shore search); *Theora lubrica* (benthic sled); *Tritia burchardi*¹⁶ (benthic sled, crab trap, crab condo, diver search and shore search); and *Undaria pinnatifida* (benthic sled, crab trap, diver search and shore search). Records are shown for both the Winter 2018 and Summer 2018–19 survey rounds.

¹³ There were no new species records for New Zealand (i.e., new-to-New Zealand species) for the Winter 2018 and Summer 2018–19 survey rounds.

¹⁴ Includes *Ciona intestinalis* and *C. savignyi*. Both are NIS that have been recorded previously in New Zealand. There are no native *Ciona* spp. in New Zealand. Further differentiation as to the extent of the presence of both NIS at MHRSS High Risk Sites is ongoing. Where siphon pigmentation is present, physical differentiation between *C. intestinalis* and *C. savignyi* in the field is possible and has been confirmed via expert formal identification.

¹⁵ Includes *Ectopleura crocea* and *E. larynx*. Both are NIS that have been recorded previously in New Zealand. There are native *Ectopleura* spp. in New Zealand, but their polyp colouration is markedly different, allowing *E. crocea* and *E. larynx* to be differentiated from the natives. Further differentiation as to the extent of the presence of both NIS at MHRSS High Risk Sites is ongoing. Physical differentiation between *E. crocea* and *E. larynx* in the field is problematic and requires formal expert identification.

¹⁶ Formerly known as *Nassarius burchardi*.

Secondary target non-indigenous species

Arcuatula senhousia

Detected (predominantly in benthic sled tows) in Waitemata and Whāngārei Harbour (Figure 2) during both surveys. Distributions within each High Risk Site were as follows:

- Waitemata Harbour: Lucas Creek channel. Recorded at a total of 1 out of 488 (0.2%) sampling locations during the winter survey and at 1 out of 498 (0.2%) sampling locations during the summer survey. This reflects a continued sparse distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Hātea River channel; Matakoho (Limestone Island); Portland Reach; Wellington Reach; Tamaterau Reach; and Marsden Cove Marina. Recorded at a total of 15 out of 243 (6.2%) sampling locations during the winter survey and at 12 out of 246 (4.9%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys, apart from the more limited distribution recorded in the Winter 2014 and Summer 2014–15 survey rounds when there were no detections in the lower harbour or Marsden Cove Marina.



Figure 2: *Arcuatula senhousia* in situ in Marsden Cove Marina, Whāngārei Harbour (left) and ex situ (right, scale bar in mm) (images: C Woods/NIWA).

Eudistoma elongatum

Eudistoma elongatum was detected (predominantly during diver and shore searches) in Ōpua Marina/Waikare Inlet and Whāngārei Harbour (Figure 3) during both surveys. Distributions within each High Risk Site were as follows:

- Ōpua Marina/Waikare Inlet: Russell; Motuarahi Island; Toretore Island; Paihia; Haumi Point; Ōkiato; Tapu Point; Ōpua Wharf; and Ōpua Marina. Recorded at a total of 15 out of 254 (5.9%) sampling locations during the winter survey and at 36 out of 262 (13.7%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Port Nikau; Kaiwaka Point; Matakoho (Limestone Island); Portland Reach; Portland Wharf; Mangapai River channel; Wellington Reach; and Tamaterau Reach. Recorded at a total of 3 out of 243 (1.2%) sampling locations during the winter survey and at 19 out of 246 (7.7%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys for the winter survey, but the summer survey detections indicate an increased distribution and abundance relative to other recent MHRSS surveys despite no detections in the lower harbour.



Figure 3: *Eudistoma elongatum* exposed at low tide at Kaiwaka Point (left) and on a pontoon at Port Nikau, Whāngārei Harbour (image: C Woods/NIWA).

Sabella spallanzanii

Sabella spallanzanii was detected (predominantly during diver and shore searches) in Waitemātā and Whāngārei (Figure 4) harbours during both surveys and the summer survey of Ōpua Marina/Waikare Inlet. Distributions within each High Risk Site were as follows:

- Ōpua Marina/Waikare Inlet: Ōpua Wharf. Recorded at a total of 1 out of 262 (0.4%) sampling locations during the summer survey. The one specimen detected was removed for disposal to landfill. This species was only recently detected at this High Risk Site in July 2018 by contractors inspecting mooring blocks for Northland Regional Council (NRC) and is subject to an ongoing Northland Regional Council (NRC)/BNZ delimitation and removal survey programme.
- Waitemātā Harbour: main channels in upper and lower harbour from Herald Island to harbour entrance; West Park Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Hobson Bay Marina; and Ōrākei Marina. Recorded at a total of 109 out of 488 (22.3%) sampling locations during the winter survey and at 124 out of 498 (24.9%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Town Basin Marina; Kissing Point Marina; Port Nikau; Matakōhe (Limestone Island); Portland Wharf; Parua Bay; McLeod Bay; Marsden Cove Marina; and Marsden Point. Recorded at a total of 25 out of 243 (10.3%) sampling locations during the winter survey and at 32 out of 246 (13.0%) sampling locations during the summer survey. Aside from the first detection in the Town Basin Marina this reflects a similar distribution relative to other recent MHRSS surveys, though abundances of *S. spallanzanii* were noticeably greater at locations such as Kissing Point Marina, Port Nikau and Marsden Cove Marina than in previous surveys. This species was subject to delimitation and removal surveys by NRC until recently, and the increased abundances detected during the summer survey reflect the effects of discontinuation of the NRC survey programme.

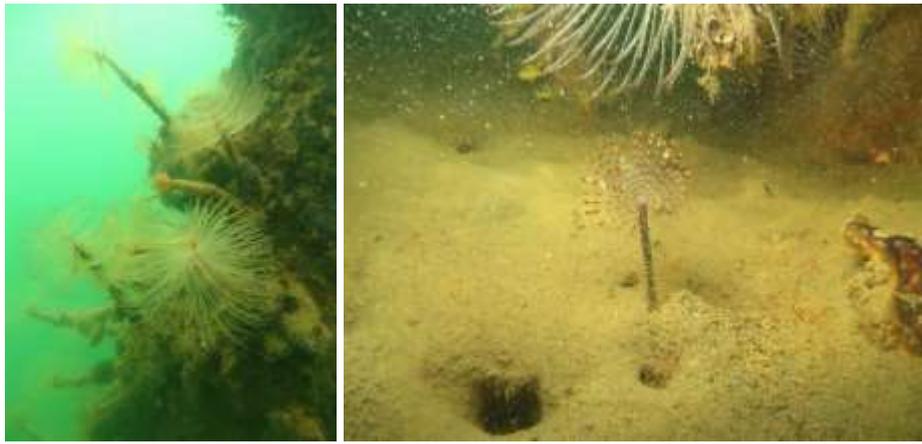


Figure 4: *Sabella spallanzanii* growing on a pontoon pile (left) and a juvenile growing from the benthos at the base of a pontoon pile (right) in Marsden Cove Marina, Whāngārei Harbour (image: C Woods/NIWA).

Styela clava

Styela clava was detected (predominantly during diver and shore searches) in Ōpua Marina/Waikare Inlet, Lyttelton (Figure 5), Nelson, Otago, Picton, Tauranga, Waitematā and Whāngārei harbours during both surveys. Distributions within each High Risk Site were as follows:

- Lyttelton Harbour/Whakaraupō: throughout upper harbour and one location in the lower harbour; Governors Bay; Quail Island; Charteris Bay; Magazine Bay Marina; Port of Lyttelton; Cashin Quay; Diamond Harbour; and Purau Bay. Recorded at a total of 35 out of 244 (14.3%) sampling locations during the winter survey and at 50 out of 245 (20.4%) sampling locations during the summer survey. This generally reflects a similar distribution and abundance relative to other recent MHRSS surveys, though a noticeable increase in recruitment was observed at certain locations along the southwestern margin of the harbour (e.g., Charteris Bay). The completion of a new pontoon marina in the Port of Lyttelton, Te Ana Marina, has also seen an increase in abundance of *S. clava* in the port area.
- Nelson Harbour: Haulashore Island; The Cut; Port Nelson; Slipway Basin; Nelson Marina; and Nelson Haven. Recorded at a total of 24 out of 244 (9.8%) sampling locations during the winter survey and at 28 out of 244 (11.5%) sampling locations during the summer survey. This reflects a somewhat reduced distribution and abundance relative to other recent MHRSS surveys.
- Ōpua Marina/Waikare Inlet: Hermione Rock; Russell; Motuarahi Island; Toretore Island; Ōpua Wharf; and Ōpua Marina. Recorded at a total of 6 out of 254 (2.4%) sampling locations during the winter survey and at 29 out of 262 (11.1%) sampling locations during the summer survey. This reflects a somewhat reduced distribution and abundance relative to other recent MHRSS surveys.
- Otago Harbour: upper harbour margin; Port Otago; Leith Marina; and Ravensbourne Wharf. Recorded at a total of 16 out of 245 (6.5%) sampling locations during the winter survey and at 8 out of 244 (3.3%) sampling locations during the summer survey. This reflects a somewhat reduced distribution and abundance relative to other recent MHRSS surveys.
- Picton Harbour: Waimahara Wharf; Ferry Terminal; and Waikawa Marina. Recorded at a total of 5 out of 243 (2.1%) sampling locations during the winter survey and 1 out of 243 (0.4%) sampling locations during the summer survey. This reflects a similar sparse distribution and abundance relative to other recent MHRSS surveys following its first detection here as a detected range extension during the Winter 2014 survey, and a subsequent delimitation and removal survey in June 2014 commissioned by

Marlborough District Council (MDC) and BNZ and subsequent removal surveys by MDC and the Top of the South Biosecurity Partnership.

- Tauranga Harbour: Port of Tauranga (Sulphur Point). Recorded at a total of 2 out of 249 (0.1%) sampling locations during the winter survey and at 1 out of 246 (0.4%) sampling locations during the summer survey. This reflects a similar sparse distribution and abundance relative to other recent MHRSS surveys. This species has been subject to delimitation and removal surveys by Bay of Plenty Regional Council (BOPRC).
- Waitematā Harbour: upper and lower harbour from Lucas Creek channel to harbour entrance; Kauri Point/Te Mātā-rae-o-Mana; Chelsea Wharf; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina. Recorded at a total of 44 out of 488 (9.0%) sampling locations during the winter survey and at 41 out of 498 (8.2%) sampling locations during the summer survey. This reflects a somewhat reduced distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Marsden Cove Marina. Recorded at a total of 1 out of 243 (0.4%) sampling locations during the winter survey and at 9 out of 246 (3.7%) sampling locations during the summer survey. This reflects a somewhat more restricted distribution, but similar abundance relative to other recent MHRSS surveys. This species has been subject to delimitation and removal surveys by NRC.



Figure 5: *Styela clava* exposed at low tide at Charteris Bay (left), and on pontoons at Te Ana Marina (right), Lyttelton Harbour/Whakaraupō (image: C Woods/NIWA).

Non-target, non-indigenous species

Acentrogobius pflaumii

Detected in Nelson and Waitematā harbours during both surveys and Whāngārei Harbour during the winter survey. The Nelson Harbour detection represents a detected range extension (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).

- Nelson: Port Nelson; and Nelson Marina.
- Waitematā Harbour: Westpark Marina; and Viaduct and Hobson West Marina.
- Whāngārei Harbour: Hātea River channel; and Port Nikau.

Amathia chimonidesi

Detected in Wellington Harbour for the first time during the winter survey at CentrePort near Aotea Quay. This represents a detected range extension (previously recorded in Waitematā Harbour).

Amathia verticillata

Detected in Nelson Harbour during both surveys and Tauranga and Waitematā harbours during the summer survey.

- Nelson Harbour: Port Nelson; Nelson Marina; Boulder Bank; and Nelson Haven.
- Tauranga Harbour: Tauranga Marina; Port of Tauranga; and Tauranga Bridge Marina.
- Waitematā Harbour: Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina.

Arenigobius bifrenatus

Detected in Whāngārei Harbour during both surveys at Town Basin Marina and Kaiwaka Point.

Asciidiella aspersa

Detected in Lyttelton and Otago harbours during both surveys.

- Lyttelton Harbour/Whakaraupō: upper harbour; Governors Bay; Magazine Bay; and Charteris Bay.
- Otago Harbour: upper harbour; Port Otago; Leith Marina; and Portobello Bay.

Botrylloides giganteum

Detected in Tauranga Harbour during the winter survey and Ōpua Marina/Waikare Inlet during the summer survey.

- Ōpua Marina/Waikare Inlet: Ōpua Marina.
- Tauranga Harbour: Port of Tauranga.

Caprella mutica

Detected in Lyttelton Harbour/Whakaraupō during both surveys and Bluff Harbour during the summer survey.

- Bluff Harbour: mooring channel south of Greenpoint.
- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; and Purau Bay.

Celleporaria nodulosa

Detected in Waitematā Harbour during both surveys and Tauranga Harbour during the winter survey.

- Tauranga Harbour: Port of Tauranga; and Tauranga Bridge Marina.
- Waitematā Harbour: Kauri Point/Te Mātā-rae-o-Mana; Chelsea Wharf; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Hobson Bay Marina; and Ōrākei Marina.

Celleporaria umbonatoidea

Detected in Ōpua Marina/Waikare Inlet during the summer survey at Ōpua Wharf and Ōpua Marina.

Chaetomorpha linum

Detected in Picton Harbour during the summer survey at Picton Marina.

Charybdis (Charybdis) japonica

Detected in Waitematā and Whāngārei harbours during both surveys and Tauranga Harbour during the summer survey.

- Tauranga Harbour: Ōmokoroa; Matapihi railway bridge; and Maungatapu Bridge.

- Waitematā Harbour: throughout the upper and lower harbour; Lucas Creek channel; Oruamo/Hellyers Creek; Kauri Point/Te Mātā-rae-o-Mana; Chelsea Wharf; Birkenhead Wharf; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina.
- Whāngārei Harbour: upper and lower harbour; Kissing Point Marina; Port Nikau; Matakōhe (Limestone Island); Portland Reach; McLeod Bay; and Marsden Cove Marina.

Ciona intestinalis

Detected in Lyttelton Harbour/Whakaraupō during both surveys and Nelson, Picton, Waitematā and Wellington harbours during the winter survey.

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; Cashin Quay; and Purau Bay.
- Nelson Harbour: Nelson Port; and Nelson Marina.
- Picton Harbour: water taxi berths; and Picton Marina.
- Waitematā Harbour: Viaduct and Hobson West Marina.
- Wellington Harbour: Seaview Marina.

Ciona savignyi

Detected in Lyttelton and Waitematā harbours during both surveys and Otago and Wellington harbours during the winter survey.

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; and Cashin Quay.
- Otago Harbour: Leith Marina.
- Waitematā Harbour: Westhaven Marina; Viaduct and Hobson West Marina; and Port of Auckland.
- Wellington: Seaview Marina.

Ciona spp.

Detected in Lyttelton, Tauranga and Wellington harbours during both surveys, Waitematā Harbour during the winter survey and Nelson and Picton and harbours during the summer survey.

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; and Cashin Quay.
- Nelson Harbour: Nelson Marina.
- Picton Harbour: Picton Marina.
- Tauranga Harbour: Tauranga Marina.
- Waitematā Harbour: Kauri Point/Te Mātā-rae-o-Mana; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Hobson Bay Marina; and Ōrākei Marina.
- Wellington Harbour: Chaffers Marina; and Seaview Marina.

Cladophora vagabunda

Detected in Picton Harbour during the summer survey at Havelock Marina.

Clavelina lepadiformis

Detected in Nelson, Picton and Wellington harbours during both surveys and Lyttelton Harbour/Whakaraupō Harbour during the winter survey.

- Lyttelton Harbour/Whakaraupō: Purau Bay.
- Nelson Harbour: Nelson Port; and Nelson Marina.

- Picton Harbour: Picton Marina; and Waikawa Marina.
- Wellington Harbour: Chaffers Marina; and Seaview Marina.

Colpomenia bullosa

Detected in Wellington Harbour during the winter survey at Evans Bay (near Greta Point, Cobham Drive shoreline and Shelly Bay).

Didemnum vexillum

Detected in Ōpua Marina/Waikare Inlet, Port Taranaki, Lyttelton, Nelson, Otago, Tauranga, Waitematā, Wellington and Whāngārei harbours during both surveys.

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; Cashin Quay; and Purau Bay.
- Nelson Harbour: Nelson Port; and Nelson Marina.
- Ōpua Marina/Waikare Inlet: near Tahapuke Bay.
- Otago Harbour: Port Otago; Leith Marina; and Ravensbourne Wharf.
- Port Taranaki: Moturoa Wharf; Newton King Tanker Terminal; and Blyde Wharf.
- Tauranga Harbour: Ōmokoroa Beach; Sulphur Point; Tauranga Marina; Port of Tauranga; Tauranga Bridge Marina; and Town Reach.
- Waitematā Harbour: upper and lower harbour from Herald Island to harbour entrance; Kauri Point/Te Mātā-rae-o-Mana; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina.
- Wellington Harbour: Lambton Harbour; Shelly Bay; and Burnham Oil Wharf.
- Whāngārei Harbour: Hātea River channel; Port Nikau; Matakahe (Limestone Island); Portland Reach; Mangapai Rover channel; McLeod Bay; and Marsden Point.

Diplosoma listerianum

Detected in Waitematā Harbour during both surveys at Bayswater Marina and Devonport Naval Base.

Ectopleura crocea

Detected in Nelson Harbour for the first time during the summer survey at Nelson Port. This detection represents a detected range extension (previously recorded in Bluff, Lyttelton, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).

Ectopleura larynx

Detected in Ōpua Marina/Waikare Inlet for the first time during the summer survey at Ōpua Wharf. This detection represents a detected range extension (previously recorded in Nelson, Picton, Tauranga, Waitematā and Whāngārei harbours).

Ectopleura spp.

Detected in Ōpua Marina/Waikare Inlet, Tauranga, Waitematā and Whāngārei harbours during both surveys and Port Taranaki, Nelson and Picton harbours during the summer survey.

- Nelson Harbour: Nelson Port.
- Ōpua Marina/Waikare Inlet: Ōpua Wharf; and Ōpua Marina.
- Picton Harbour: Waikawa Marina.
- Port Taranaki: Moturoa Wharf.
- Tauranga Harbour: Sulphur Point; Tauranga Marina; Port of Tauranga; and Tauranga Bridge Marina.

- Waitematā Harbour: Chelsea Wharf; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; and Devonport Naval Base.
- Whāngārei Harbour: Kissing Point Marina; and Port Nikau.

Grateloupia turuturu

Detected in Tauranga Harbour during the winter survey and Nelson Harbour during the summer survey.

- Nelson Harbour: Best Island (Waimea Inlet); and Nelson Marina.
- Tauranga Harbour: Tauranga Bridge Marina.

Limaria orientalis

Detected in Waitematā Harbour during both surveys and Nelson Harbour during the summer survey.

- Nelson Harbour: near The Cut along Boulder Bank.
- Waitematā Harbour: main channel mid-harbour near Whau River channel; Chelsea Wharf; and Harbour Bridge.

Metapenaeus bennettiae

Detected in Waitematā and Whāngārei harbours during both surveys.

- Waitematā Harbour: upper and lower harbour; Lucas Creek channel; Oruamo/Hellyers Creek channel; Te Wai-o-Pareira/Henderson Creek channel; Westhaven Marina; and near Ōrākei Marina.
- Whāngārei Harbour: Town Basin Marina; Port Nikau; Portland Reach; and Parua Bay.

Omobranchus anolius

Detected in Waitematā Harbour during both surveys and Whāngārei Harbour during the summer survey.

- Waitematā Harbour: Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; and Hobson Bay Marina.
- Whāngārei Harbour: Port Nikau; Portland Wharf; and Matakohe (Limestone Island).

Pennaria disticha

Detected in Waitematā Harbour during the summer survey at Chelsea Wharf, Westhaven Marina and Devonport Naval Base.

Polyandrocarpa zorritensis

Detected in Tauranga Harbour during the summer survey at Tauranga Marina.

Polycera fujitai

Detected in Nelson Harbour for the first time during the winter survey at Main Wharf. This detection represents a detected range extension (previously detected in Waitematā Harbour).

Polycera hedgpethi

Detected in Port Taranaki and Picton Harbour during both surveys, Lyttelton and Nelson harbours during the winter survey and Ōpua Marina/Waikare Inlet and Tauranga Harbour during the summer survey. The Nelson Harbour and Port Taranaki detections represent detected range extensions (previously recorded in Ōpua Marina/Waikare Inlet, Lyttelton, Picton, Tauranga and Wellington harbours).

- Lyttelton Harbour/Whakaraupō: Port of Lyttelton.
- Nelson Harbour: Nelson Marina.
- Ōpua Marina/Waikare Inlet: Ōpua Wharf; and Ōpua Marina.

- Picton Harbour: Waimahara Wharf; and Waikawa Marina.
- Port Taranaki: Moturoa Wharf; Blyde Wharf; and Lee Breakwater
- Tauranga Harbour: Port of Tauranga.

Pyromaia tuberculata

Detected in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours during both surveys and Tauranga Harbour during the winter survey.

- Ōpua Marina/Waikare Inlet: Waitangi; Hermione Rock; Veronica channel; Tapu Point; and Ōpua Wharf.
- Tauranga Harbour: south of Mount Maunganui; Tauranga Bridge Marina; and south of Matapihi railway bridge.
- Waitematā Harbour: harbour end of Te Wai-o-Pareira/Henderson Creek channel through main channels of the harbour to the harbour entrance.
- Whāngārei Harbour: Matakōhe (Limestone Island); Portland Reach; Wellington Reach; and Tamaterau Reach.

Schizymeria apoda

Detected in Otago Harbour during the summer survey at Port Chalmers (Container Terminal).

Striaria attenuata

Detected in Wellington Harbour during the summer survey at Evans Bay Marina.

Symplegma brakenhielmi

Detected in Waitematā Harbour during both surveys and Whāngārei Harbour during the summer survey.

- Waitematā Harbour: main channels in upper and lower harbour from near Soldiers Bay to harbour entrance; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina. As in recent rounds of surveys this species appears to exhibit a marked seasonality at this site, with more frequent detections in summer.
- Whāngārei Harbour: Port Nikau; and Marsden Cove Marina.

Theora lubrica

Detected in Ōpua Marina/Waikare Inlet, Port Taranaki, Lyttelton, Nelson, Picton, Waitematā, Wellington and Whāngārei harbours during both surveys.

- Lyttelton Harbour/Whakaraupō: upper and lower harbour from Governors Bay to Little Port Cooper; Magazine Bay; Port of Lyttelton; Charteris Bay; and Purau Bay.
- Nelson Harbour: Old Entrance; Haulashore Island; The Cut; Port Nelson; and Nelson Marina.
- Ōpua Marina/Waikare Inlet: Hutia Creek channel; Waitangi; Hermione Rock; Kororāreka Bay; Veronica channel; Ōpua Marina; and Waikare Inlet.
- Picton Harbour: Havelock Marina; Port of Picton; near Kaipupu Point; Picton Marina; Waikawa Marina; and Waikawa Bay.
- Port Taranaki: main dredged channel of port area inside of the Main Breakwater; near Blyde Wharf (non-dredged shallows); and Lee Breakwater.
- Waitematā Harbour: upper and lower harbour from Oruamo/Hellyers Creek channel to harbour entrance; Te Wai-o-Pareira/Henderson Creek channel; Whau River channel; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Hobson Bay Marina; Ōrākei Marina; and Ōkahu Bay.

- Wellington Harbour: Lambton Harbour; CentrePort; from Kaiwharawhara past Ngauranga; Evans Bay; Seaview Marina; and Seaview Wharf/Terminal.
- Whāngārei Harbour: Town Basin; Port Nikau; Kaiwaka Point; Matakohe (Limestone Island); Portland Reach; Parua Bay; and Marsden Cove Marina.

Tritia burchardi

Detected in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours during both surveys.

- Ōpua Marina/Waikare Inlet: Hermione Rock; Kororareka Bay; Ōpua Marina; and Kawakawa River channel.
- Waitematā Harbour: upper and lower harbour from Charcoal Bay to harbour entrance; Te Wai-o-Pareira/Henderson Creek channel; Whau River channel; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Wharf; Hobson Bay Marina; Ōrākei Marina; and Ōkahu Bay.
- Whāngārei Harbour: upper and lower harbour; Town Basin; Hātea River channel; Kissing Point Marina; Port Nikau; Matakohe (Limestone Island); Kaiwaka Point; Portland Reach; Parua Bay; and Marsden Cove Marina.

Undaria pinnatifida

Detected in Port Taranaki, Bluff, Lyttelton, Nelson, Otago, Picton, Tauranga, Waitematā and Wellington harbours during both surveys.

- Bluff Harbour: western side of harbour up past Tikore Island; main channel; Island Harbour; Fishing Boat Wharves; Tiwai Wharf; Tiwai; Town Wharf; Argyle Beach; and Stirling Point.
- Lyttelton Harbour/Whakaraupō: upper harbour from Governors Bay to Ripapa Island; Cass Bay; Magazine Bay; Port of Lyttelton; Quail Island; Charteris Bay; Diamond Harbour; and Purau Bay.
- Nelson Harbour: Haulashore Island; The Cut; Main Wharf; Port Nelson; and Nelson Marina. As in previous rounds of surveys this species appears to exhibit a marked seasonality at this site, with more frequent detections in winter and few summer detections due to temperature-related dieback.
- Otago Harbour: upper and lower harbour from Port Otago to Harrington Point; Port Otago; Leith Marina; Ravensbourne Wharf; McAndrews Bay; Raynbirds Bay; Broad Bay; St. Leonards; Back Beach; Port Chalmers; Careys Bay; Deborah Bay; and Ōmate Beach.
- Picton Harbour: Shakespeare Bay; Waimahara Wharf; Port of Picton; Picton Marina; and Waikawa Marina.
- Port Taranaki: Moturoa Wharf; Newton King Tanker Terminal; Blyde Wharf; near the reclamation; and inside the Lee Breakwater.
- Tauranga Harbour: Tauranga Marina; Mount Maunganui swing moorings; Port Tauranga; and Trinity Wharf.
- Waitematā Harbour: upper and lower harbour from Harrier Point to harbour entrance; Beach Haven; Birkenhead Wharf; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina. As in previous rounds of surveys this species appears to exhibit a marked seasonality at this site, with more frequent detections in winter and fewer in summer due to temperature-related dieback.
- Wellington Harbour: throughout the south-western margin of the harbour from Kaiwharawhara to Point Jerningham; CentrePort; Lambton Harbour; Evans Bay; Evans Bay Marina; Miramar Peninsula from Burnham Oil Wharf to Scorching Bay; and Seaview Marina.

Discussion

The Winter 2018 and Summer 2018–19 rounds of MHRSS programme surveys exceeded the overall target numbers of survey sampling locations at the 11 High Risk Sites. Any operational obstacles to planned survey activities encountered were successfully managed, allowing contracted target survey effort to be achieved (see Other section).

No primary target species were detected during the surveys. No new-to-New Zealand species were detected. All four secondary target species were detected during the surveys: *Arcuatula senhousia* (Waitematā and Whāngārei harbours); *Eudistoma elongatum* (Ōpua Marina/Waikare Inlet and Whāngārei Harbour); *Sabella spallanzanii* (Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours); and *Styela clava* (Ōpua Marina/Waikare Inlet, Lyttelton, Nelson, Otago, Picton, Tauranga, Waitematā and Whāngārei harbours). These secondary target species have been recorded at the respective High Risk Sites during previous surveys.

Removal of secondary target species from High Risk Sites during survey activities was implemented where feasible and where population density was low enough that removal would have a possible effect. All *S. spallanzanii* found in Ōpua Marina/Waikare Inlet and Town Basin Marina in Whāngārei Harbour were removed and disposed of to landfill. All *S. clava* found in Picton and Tauranga harbours were also removed and disposed of to landfill.

Non-target NIS of note detected during the MHRSS surveys included the following: *Acentrogobius pflaumii* (detected range extension, Nelson Harbour); *Amathia chimonidesi* (detected range extension, Wellington Harbour); *Amathia verticillata*; *Arenigobius bifrenatus*; *Asciadiella aspersa*; *Botrylloides giganteum*; *Caprella mutica*; *Celleporaria nodulosa*; *Celleporaria umbonatoidea*; *Chaetomorpha linum*; *Charybdis (Charybdis) japonica*; *Ciona intestinalis*; *Ciona savignyi*; *Ciona* spp.; *Cladophora vagabunda*; *Clavelina lepadiformis*; *Colpomenia bullosa*; *Didemnum vexillum*; *Diplosoma listerianum*; *Ectopleura crocea* (detected range extension, Nelson Harbour); *Ectopleura larynx* (detected range extension, Ōpua Marina/Waikare Inlet); *Ectopleura* spp.; *Grateloupia turuturu*; *Limaria orientalis*; *Metapenaeus bennettiae*; *Omobranchus anolius*; *Polyandrocarpa zorritensis*; *Polycera fujitai* (detected range extension, Nelson Harbour); *Polycera hedgpethi* (detected range extensions, Nelson Harbour and Port Taranaki); *Pyromaia tuberculata*; *Schizymenia apoda*; *Striaria attenuata*; *Symplegma brakenhielmi*; *Theora lubrica*; *Tritia burchardi*; and *Undaria pinnatifida*.

Recommendations

- Survey sampling techniques currently employed in the MHRSS programme still reflect international best practice for effective detection of the MHRSS programme primary and secondary target species, and survey results indicate that they are effective at detecting actual and suspect NIS. However, continued evaluation of the effectiveness of alternative or emergent detection tools or techniques is recommended (see item on molecular probes and Remotely Operated Vehicles (ROVs) in the following innovations/efficiencies section).
- The distribution of sampling effort in Ōpua Marina/Waikare Inlet, as proposed in the revised design report (Morrisey et al, 2012a) and based on stochastic scenario tree modelling (Morrisey et al, 2012b), will continue to be used in future rounds of Ōpua surveys. Stochastic scenario trees were also developed for all other MHRSS programme High Risk Sites (Morrisey et al, 2012b) to estimate the detection sensitivity of different strategies for allocating samples, and to explore the optimisation of sample allocation for individual target species and estimate current

levels of sensitivity. This optimisation approach could be applied to other High Risk Sites in the future, pending BNZ decisions on potential review of target sites and species and further discussion with BNZ.

Innovations/efficiencies

In 2018–19, NIWA invested in developing the following innovations and efficiencies to help improve surveillance for marine NIS in New Zealand:

- NIWA led a three-year project, funded through the Ministry for Business, Innovation and Employment’s (MBIE) International Relationships Fund (C01X1527), *Quadrilateral Scientific Collaboration in Marine Biosecurity (NIWA Project MBC16502)*, to develop enduring collaborations with marine biosecurity scientists in the USA, Canada, Australia. The project established an international Working Group to facilitate information exchange and collaboration among the four countries and involves research scientists from 16 international research organisations, including the Smithsonian Environmental Research Centre, Canadian Government Department of Fisheries and Oceans, Australian Government Department of Agriculture and Water Resources, and the Western Australian Department of Primary Industries and Regional Development.

The Working Group was able to mobilise complementary skills and resources from within each of the partner countries to align research in three strategic areas of shared interest: (a) development of more sensitive, cost-efficient tools for surveillance; (b) innovative technologies and tactics for control and eradication; and (c) methods to evaluate social and cultural impacts from invasive marine species, particularly for indigenous communities. Over 50 institutions from across the four countries were engaged directly in one or more of the Research Aims. Direct co-funding and in-kind contributions from the partnering countries totalled over NZ\$1.6 million, approximately four times the initial investment made by MBIE.

The project directly addressed the need for “smarter, more cost-effective tools and strategies for targeted marine surveillance” by greatly increasing our understanding of the stages in the workflows of eDNA-based high-throughput-sequencing (HTS) that can cause errors in marine biosecurity surveillance. A collaborative experiment, that involved 12 laboratories across the partnering countries, revealed surprising sources of variation among laboratories, markers, and library preparation protocols. In identifying these sources of inconsistency, the work provided a sharp focus for future research to standardise workflows and improve methodology. It has also initiated a collaborative approach to developing biosecurity-appropriate Quality Control/Quality Assurance protocols for HTS and to the development of shared DNA sequence libraries. An opinion piece on the potential perils of eDNA HTS technologies for biosecurity surveillance has been submitted to the Policy Forum in *Science*.

The project pioneered a new method of Research & Development innovation for marine biosecurity by running two global innovation challenges using the crowdsourcing platform InnoCentive® (www.innocentive.com). The challenges – on Novel control technologies for marine pests and Treatment of biofouling in vessel box coolers – engaged 377 technological “Problem Solvers” from 42 different countries. Seventy solutions were submitted to the two challenges that involved a wide variety of technologies and approaches. Research strategies have been developed based on four of the best submitted ideas.

International collaborations have been initiated to obtain better understanding of the social and cultural impacts of invasive marine species. This has included review of methods for eliciting social and cultural values and of methods to incorporate them in marine biosecurity risk assessments. Kanohi ki te kanohi (face-to-face) discussions between Māori researchers and kaitiaki and their peers from each of the partner countries have facilitated a unique sharing of collective indigenous knowledge and experiences with marine pests. This indigenous network will be a catalyst for increased participation by iwi, hapū and whānau in marine biosecurity research and management within New Zealand. As an example of this, a four-day wananga on marine biosecurity was hosted by NIWA's Te Kūwaha Group and Manaaki Te Awanui in Tauranga (May 2019). The wananga involved Māori researchers and kaitiaki from around NZ and eight of their peers from Canada (Heiltsuk Nation), Hawaii (Paepae o He`eia), and Australia (Yirrganydji Land and Sea Ranger Program) who gathered to share their experiences of marine pest impacts and their management.

The research has also catalysed new research collaborations among the partnering countries on the management of biofouling on vessels and the application of Remotely Operated Vehicles (ROVs) to marine biosecurity surveillance.

A final meeting of the international Working Group at NIWA's Wellington site was held in May 2019 with an accompanying presentation to New Zealand biosecurity stakeholders on the project.

- NIWA continues to invest co-funding in the Marine Biosecurity Porthole. The Marine Biosecurity Porthole was created in 2010 as a collaboration between BNZ and NIWA to provide greater access to information and data on marine non-indigenous species in New Zealand. The Porthole contains information for over 3,800 native, cryptogenic and non-indigenous marine species with links to over 320,000 individual distribution records. It draws upon data compiled from a range of funded surveys for marine NIS, records reported via the passive surveillance system through MITS and observations of marine NIS made through taxonomic and ecological research undertaken by NIWA. The Porthole includes an interactive mapping application that allows verified observations on the distribution of non-indigenous species within New Zealand to be displayed, identification guides for non-indigenous and native marine species, videos and information on marine pests and their management, and information on marine biosecurity research being undertaken in New Zealand. The Porthole has recently been redesigned to allow easier access to data downloads and information on marine biosecurity research and management.
- As part of its Strategic Science Investment Fund (SSIF)-funded Marine Biosecurity Programme, NIWA continued investment in the development of species-specific molecular markers for a range of key target species (Environmental DNA (eDNA) and RNA (eRNA)). This work was originally done in collaboration with researchers at the Cawthron Institute, and the Universities of Canterbury and Otago with field-trials of qPCR assays for the Mediterranean fanworm (*Sabella spallanzanii*) and clubbed tunicate (*Styela clava*) in Nelson and Waitematā harbours (e.g., Wood et al., in press). In the 2018–19 financial year, we implemented repeat (winter) sampling trials at six MHRSS High Risk sites that have different levels of infestation by the target species to determine the sensitivity and efficacy of the molecular survey method.
- In response to significant Health and Safety hazards to divers posed by certain dangerous marine megafauna and environmental conditions, NIWA invested in the purchase of a New Zealand-manufactured Boxfish ROV which incorporates high resolution (4K) video streaming for high quality video and still imagery and the ability to operate within complex structures such as wharf piles and the undersides of

pontoons. Field trials to prove the efficacy of the ROV's for biosecurity surveillance application and to develop operating and potential sampling protocols are continuing.

Other

Stakeholder engagement, public awareness and media contact

The response from stakeholders contacted prior to the survey to inform them and obtain permission was generally rapid, and aside from restricted access to some site-specific locations at certain times due to port/marina operations and vessel traffic, no overall problems were encountered regarding access to sample locations. Introduction of the Health and Safety at Work Act 2015 (HSWA) has seen port and marina companies increasing their health and safety requirements pertaining to external agencies operating in their jurisdiction. This has resulted in new or upgraded operating area induction processes, varying degree of permitting of survey activities and evidence of appropriate compliance with the HSWA for the MHRSS programme survey field teams.

The identification of known, or potential hazards specific to each High Risk Site is a critical component of our workplace health and safety practice. In addition to our own specific MHRSS programme process of identifying and managing site-specific risks, during the pre-survey stakeholder communications process NIWA FTLs specifically request that the stakeholders identify any known or potential hazards they are aware of that could affect the survey team. Any hazards identified by stakeholders, as well as by the survey team themselves, are to be detailed in the interim post-sampling reports which are sent to BNZ and copied to the NIWA FTLs.

To answer any concern from stakeholders about not being aware of the MHRSS programme surveys, BNZ have provided NIWA with a one-page summary marine pest survey notification poster for wider pre-survey dissemination. For each survey, this one-page summary marine pest survey notification poster was sent to our main stakeholder contacts (e.g., port and marina operators, harbourmaster, regional councils) for them to disseminate to their own stakeholders as appropriate. Copies of these posters were also placed by the survey field teams at strategic points (e.g., boat ramps, marina or boat club noticeboards) at the start of each survey to inform wider stakeholders and the public as to the survey activity.

The reporting of MHRSS programme survey results to stakeholders was conducted via BNZ stakeholder notices following the completion (and identification of any samples collected) of each survey. For the Winter 2018 and Summer 2018–19 survey rounds, extra detection information for target and non-target NIS was provided to BNZ in the NIWA interim post-sampling reports for each survey to facilitate rapid dissemination of detection details by BNZ to stakeholders.

During MHRSS programme surveys, individuals representing various stakeholders with vested interest in survey locations, biosecurity and education activities sometimes accompanied the field teams to observe, and sometimes participate in sampling activities (see Table 7).

Table 7: Stakeholders observing/participating in the Winter 2018 and Summer 2018–19 Marine High Risk Site Surveillance (MHRSS) programme surveys.

High Risk Site	Winter 2018 survey	Summer 2018–19 survey
Bluff Harbour	Environment Southland	
Lyttelton Harbour/Whakaraupō		

Nelson Harbour	Ministry for Primary Industries	
Ōpua Marina/Waikare Inlet	Northland Regional Council	Ministry for Primary Industries
Otago Harbour	Ministry for Primary Industries	
Picton Harbour		
Port Taranaki	New Plymouth Regional Council Port Taranaki	
Tauranga Harbour		
Waitematā Harbour		Auckland Council
Wellington Harbour	Ministry for Primary Industries	Ministry for Primary Industries
Whāngārei Harbour	Northland Regional Council	Northland Regional Council

Using specialised 360-Virtual Reality (VR) video technology, a team from New Zealand Geographic—with funding from Foundation North and NZonAir—has produced VR experiences across six sites from Niue to the Hauraki Gulf. The project is produced in association with WWF, and The Sir Peter Blake Trust who will be visiting schools with high-quality VR headsets and curriculum connected lessons. BNZ and NIWA were approached by NZ Geographic to participate in the Hauraki Gulf segment, with NIWA divers filming their search for NIS during the Summer 2017–18 MHRSS survey of the Waitematā Harbour. The short MHRSS VR segment became available in 2019 for the public and is accessible at: www.nzgeo.com/vr.

During the New Zealand Biosecurity Institute’s National Education and Training Seminar (NETS) in Nelson July 2018, participants could undertake a field trip to the Nelson Marina looking at marine biosecurity threats and actions taken to address them in this significant hub for commercial and recreational vessels. As the Nelson Harbour Winter 2018 survey was occurring at this time, the diver searches for the marina were timed to occur at the same time in order that participants could see first-hand MHRSS survey activities and speak with the NIWA field team.

Casual enquiries from members of the public, port and marina operators, owners or staff were responded to by the field team leader as per the short-term communications policy between BNZ and NIWA.

In collaboration with BNZ, NIWA’s MITS ran one workshop for stakeholder on marine pest identification and sample preservation and transport at Northland Regional Council in Whāngārei (January 2019) and at Auckland Council in Auckland (June 2019), which provided a valuable opportunity to interact with stakeholders and additionally inform them as to MHRSS programme activities and findings. A training workshop was held for representatives of New Zealand Dive and Salvage Ltd and Dive Co. in Wellington on identification of marine pests, MHRSS programme activities and findings, the Craft Risk Management Standards and Department of Conservation vessel inspections (March 2019).

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Appendix 1. Summary of sampling methods, target species and habitats in the Marine High Risk Site Surveillance (MHRSS) programme

Note: underlined species have been collected using this method during the present or previous target-species surveillance programmes in New Zealand.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Benthic sled ¹⁷	<u><i>Arcuatula senhousia</i></u> <i>Asterias amurensis</i> <u><i>Caulerpa taxifolia</i></u> <u><i>Carcinus maenas</i></u> <u><i>Eudistoma elongatum</i></u> <i>Potamocorbula amurensis</i> <u><i>Sabella spallanzanii</i></u> <u><i>Styela clava</i></u>	<u><i>Acentrogobius pflaumii</i></u> <u><i>Chaetopterus</i> sp.</u> <u><i>Charybdis (Charybdis) japonica</i></u> <u><i>Didemnum vexillum</i></u> <i>Grateloupia turuturu</i> <u><i>Metapenaeus bennettiae</i></u> <u><i>Pyromaia tuberculata</i></u> <i>Theora lubrica</i> <u><i>Undaria pinnatifida</i></u>	Subtidal soft sediments. Particular focus on known shellfish beds (for <i>Asterias</i>), shipping channels and areas next to public access (e.g., wharves, boat ramps, marinas, etc. <i>Caulerpa</i> , <i>Sabella</i>).	Narrow width but 100-m tow length and high replication (100+ per location) enables a reasonably large area to be sampled (ca 3500 m ² per location).	Reliable sample collection including asteroids, infaunal and epifaunal bivalves and polychaetes and macroalgae, as well as some crab and fish species.	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, rocky substratum or soft mud that block the mouth of sled.	Yes	Yes

¹⁷ Similar in design to an Ockelmann (1964) detritus-sledge.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Crab (box) traps	<i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Eriocheir sinensis</i>	<i>Acentrogobius pflaumii</i> <u><i>Charybdis</i></u> <u>(<i>Charybdis japonica</i>)</u> <u><i>Metapenaeus bennettiae</i></u> <u><i>Pyromaia tuberculata</i></u> <u><i>Styela clava</i>¹⁸</u>	Adjacent to wharf pilings and other artificial habitats. Intertidal and shallow subtidal rocky shores, Breakwaters 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 samples other species of crabs (e.g., <i>Hemiplax hirtipes</i> , <i>Notomithrax</i> spp., <i>Ovalipes catharus</i> , <i>Metacarcinus novaezelandiae</i>) and echinoderms (e.g., <i>Patiriella regularis</i> , <i>Coscinasterias muricata</i>). Also samples a wide range of fish species. Biofouling species may also be incidentally captured with this method if attached to mobile organisms attracted to the traps (e.g., <i>Styela clava</i> attached to masking crabs)	Quick to deploy and recover, so high replication possible.	Most locations and weather conditions.	Yes	Yes (Hewitt and Martin 2001; May and Brown 2001; Thresher et al 2003; Yamada et al 2005)

¹⁸ Incidentally, as specimens attached to masking crabs (*Notomithrax* spp.) caught in traps.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Crab condos	<i>Carcinus maenas</i> <i>Eriocheir sinensis</i>	<i>Acentrogobius pflaumii</i> <i>Charybdis</i> (<i>Charybdis</i>) <i>japonica</i> <i>Metapenaeus bennettiae</i> <i>Pyromaia tuberculata</i> <i>Tritia burchardi</i>	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 samples other species of crabs (e.g., <i>Austrohelice crassa</i> , <i>Hemigrapsus crenulatus</i> , <i>Hemiplax hirtipes</i>). Higher rates of detection of crabs than baited traps in muddy river banks (Veldhuizen, 2000).	Quick to deploy and recover, so high replication possible.	High – access problems at some locations (shallow water, deep mud, private land).	Yes	Yes (Veldhuizen 2000)

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Diver searches	<i>Arcuatula senhousia</i> <i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Caulerpa taxifolia</i> <i>Eriocheir sinensis</i> <i>Eudistoma elongatum</i> <i>Sabella spallanzanii</i> <i>Styela clava</i>	<u><i>Amathia verticillata</i></u> <u><i>Caprella mutica</i></u> <u><i>Chaetopterus</i> sp.</u> <u><i>Charybdis (Charybdis) japonica</i></u> <u><i>Clavelina lepadiformis</i></u> <u><i>Didemnum</i> sp.</u> <u><i>Grateloupia turuturu</i></u> <i>Hypnea</i> sp. <i>Pyromaia tuberculata</i> <u><i>Undaria pinnatifida</i></u>	Wharf piles and berth walls, marina piles and pontoons and other artificial structures, Breakwaters and riprap, 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

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Shoreline searches	<i>Arcuatula senhousia</i> <i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Caulerpa taxifolia</i> <i>Eriocheris sinensis</i> <i>Eudistoma elongatum</i> <i>Sabella spallanzanii</i> <i>Styela clava</i>	<i>Chaetopterus</i> sp. <i>Charybdis (Charybdis) japonica</i> <i>Clavelina lepadiformis</i> <i>Didemnum</i> sp. <i>Grateloupia turuturu</i> <i>Hypnea</i> sp. <i>Undaria pinnatifida</i>	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 <i>S. clava</i> .	High	High – access to intertidal areas may be limiting.	Yes	Yes

Appendix 2. Summaries of target versus achieved number of sampling locations for Winter 2018 and Summer 2018–19 Marine High Risk Site Surveillance (MHRSS) programme surveys

BLUFF HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	68	68	100.0
Benthic sled tows	84	84	100.0
Diver searches	40	40	100.0
Shore searches	25	25	100.0
Sample total	225	225	100.0
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	68	68	100.0
Benthic sled tows	84	84	100.0
Diver searches	40	40	100.0
Shore searches	25	25	100.0
Sample total	225	225	100.0

LYTTELTON HARBOUR/WHAKARAUPŌ

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	79*	98.8
Benthic sled tows	100	101	101.0
Diver searches	30	31	103.3
Shore searches	25	25	100.0
Sample total	243	244	100.6
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	26	104.0
Sample total	243	245	101.5

*One crab trap line missing

NELSON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	244	100.4
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	25	100
Sample total	243	244	100.4

ŌPUA MARINA/WAIKARE INLET

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	105	110	104.8
Diver searches	30	30	100.0
Shore searches	25	26	104.0
Sample total	248	254	102.4
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	105	116	110.5
Diver searches	30	30	100.0
Shore searches	25	28	112.0
Sample total	248	262	105.6

OTAGO HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	26	104.0
Sample total	243	245	100.8
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	244	100.4

PICTON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0

PORT TARANAKI

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	7*	87.5
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	27	108.0
Sample total	243	244	100.4
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	26	104.0
Sample total	243	245	100.8

*One condo line stolen

TAURANGA HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	85	106.3
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	26	104.0
Sample total	243	249	102.5
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	28	112.0
Sample total	243	246	101.2

WAITEMATĀ HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	16	16	100.0
Crab (box) trap lines	160	160	100.0
Benthic sled tows	200	200	100.0
Diver searches	60	60	100.0
Shore searches	50	52	104.0
Sample total	486	488	100.4
SUMMER 2018–19			
Crab condo lines	16	16	100.0
Crab (box) trap lines	160	160	100.0
Benthic sled tows	200	201	100.5
Diver searches	60	60	100.0
Shore searches	50	61	122.0
Sample total	486	498	102.5

WELLINGTON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	31	103.3
Shore searches	25	26	104.0
Sample total	243	246	101.2

WHĀNGĀREI HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2018			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0
SUMMER 2018–19			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	28	112.0
Sample total	243	246	101.2

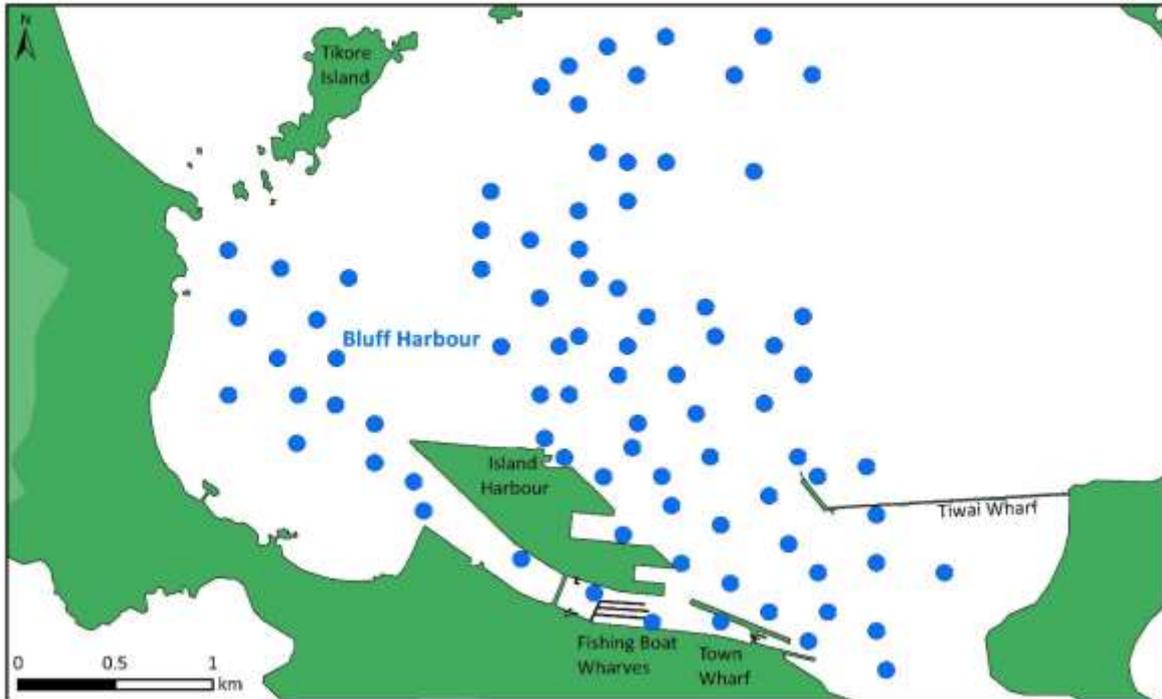
Appendix 3. Maps showing locations sampled in Winter 2018 and Summer 2018–19 Marine High Risk Site Surveillance (MHRSS) programme surveys

Note: 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 the maps.

Bluff Harbour

Winter 2018

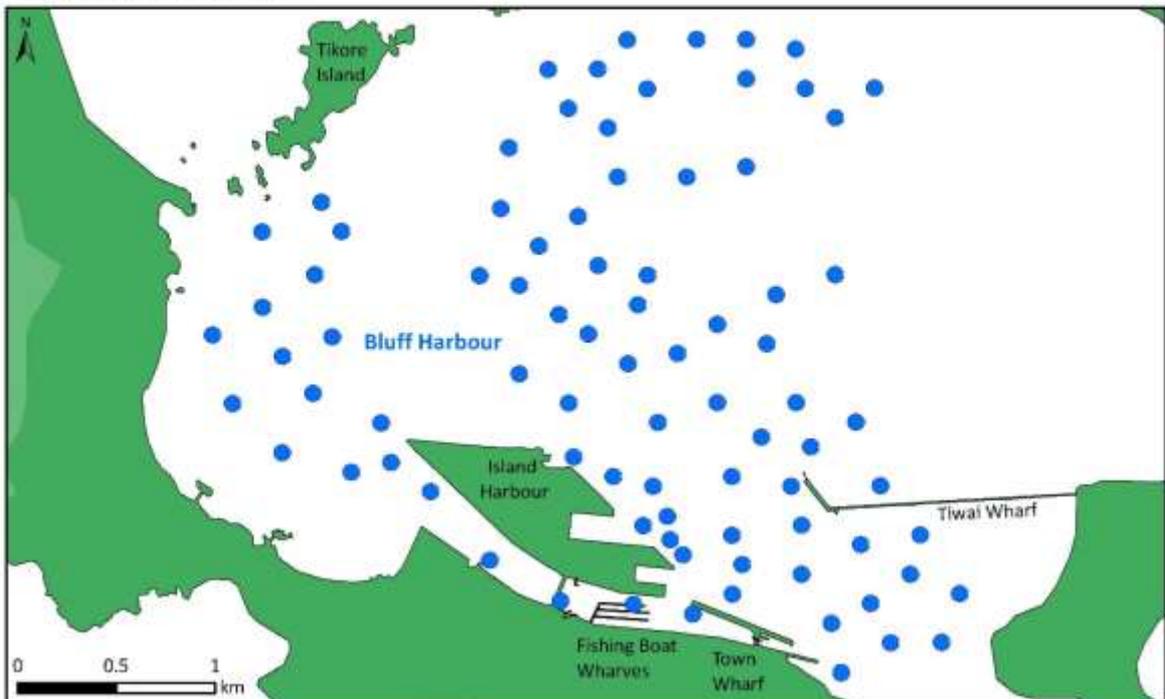
Benthic sled (BSLD) locations



Bluff Harbour

Summer 2018-19

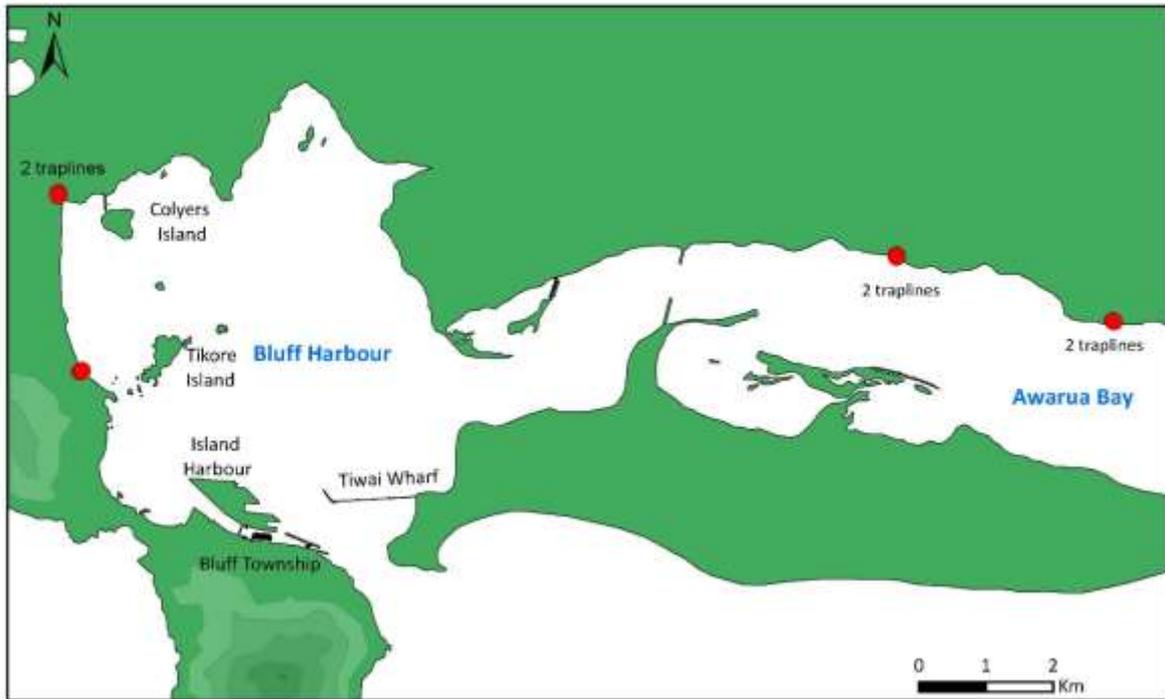
Benthic sled (BSLD) locations



Bluff Harbour

Winter 2018

Crab condo (CONDO) locations



Bluff Harbour

Summer 2018-19

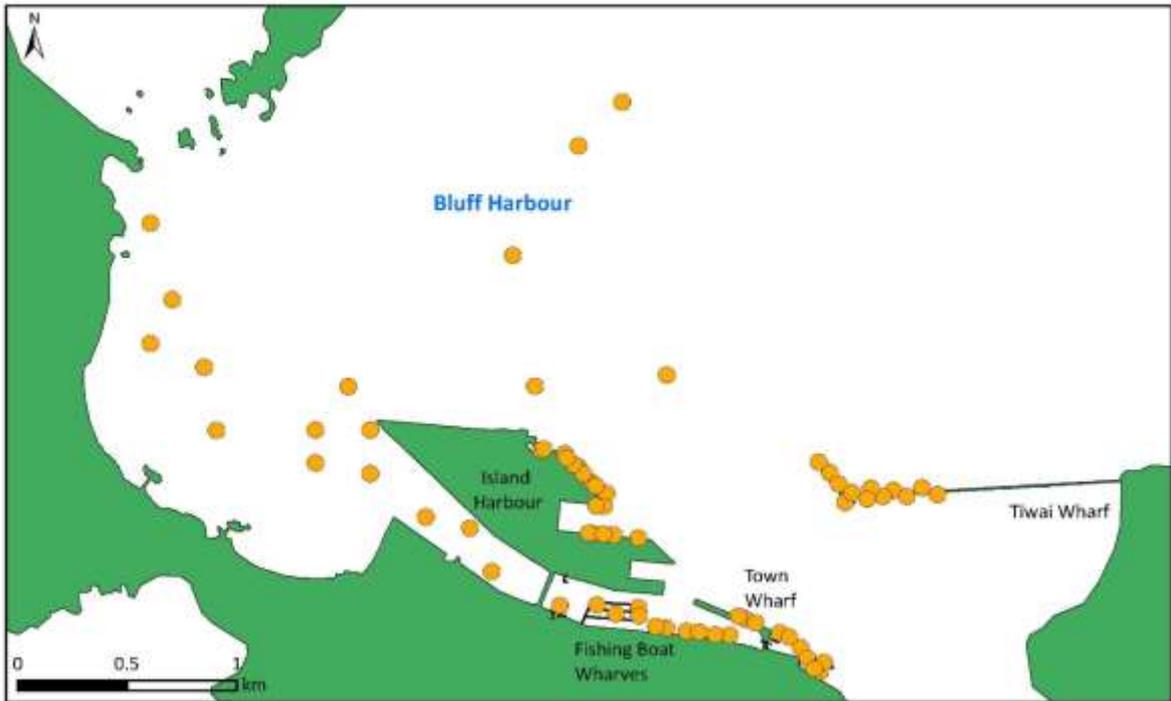
Crab condo (CONDO) locations



Bluff Harbour

Winter 2018

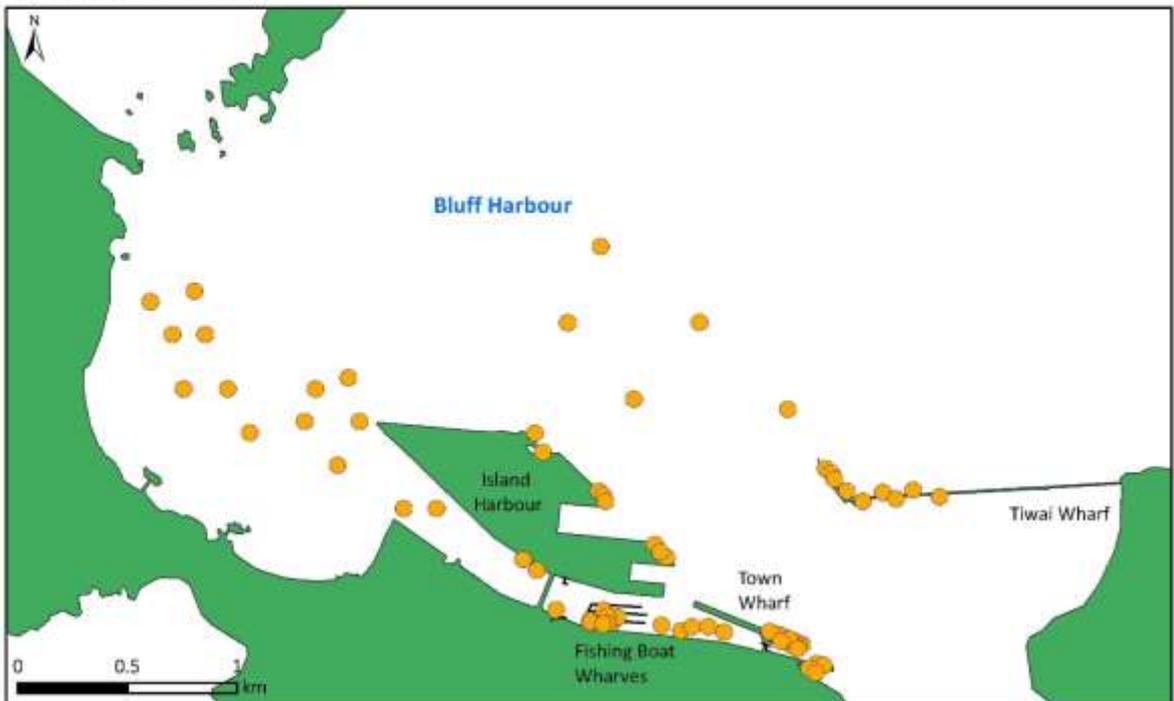
Crab trap (CRBTP) locations



Bluff Harbour

Summer 2018-19

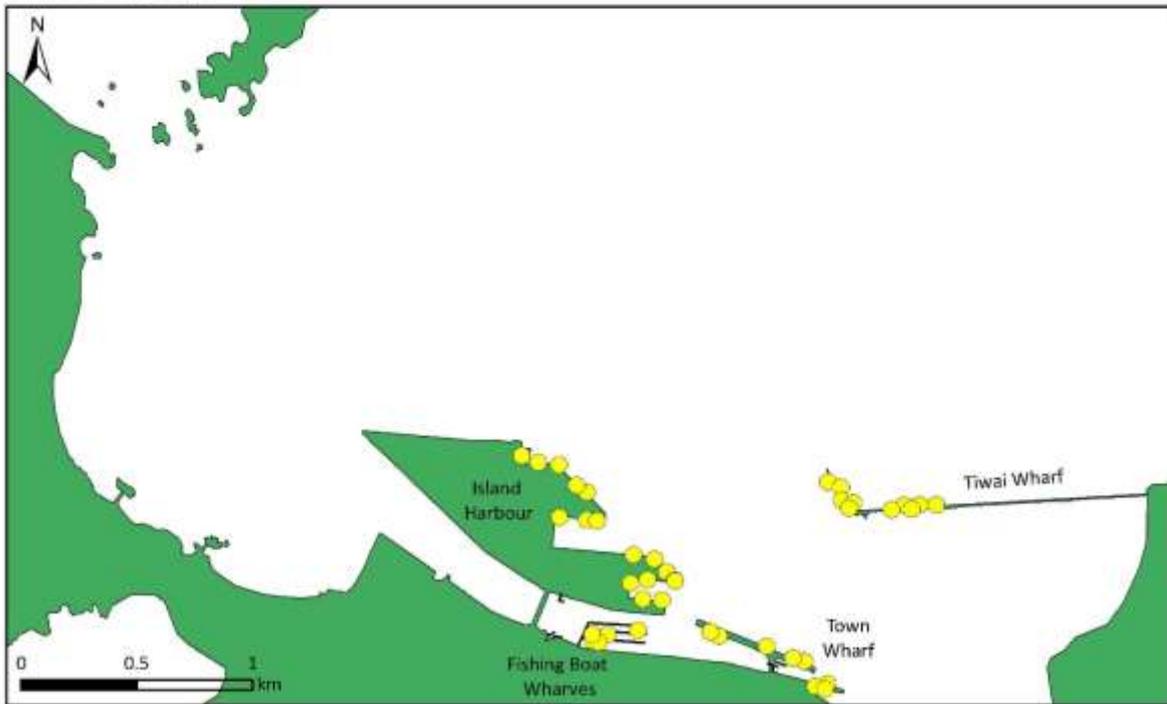
Crab trap (CRBTP) locations



Bluff Harbour

Winter 2018

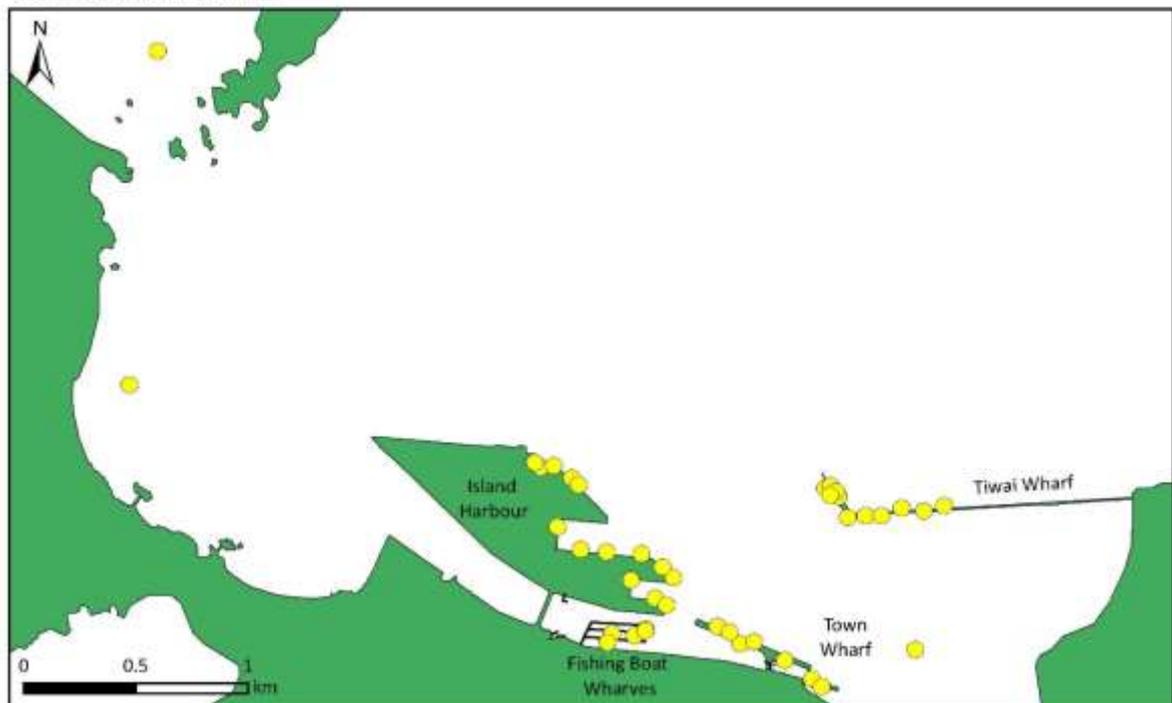
Diver search (VISD) locations



Bluff Harbour

Summer 2018-19

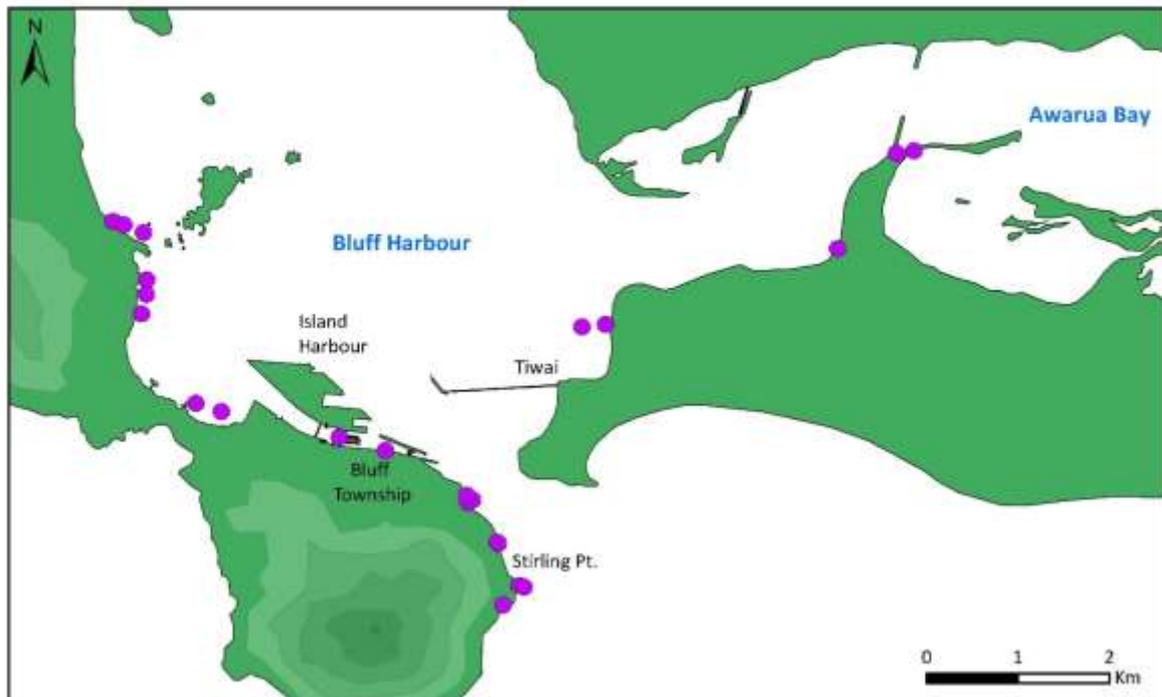
Diver search (VISD) locations



Bluff Harbour

Winter 2018

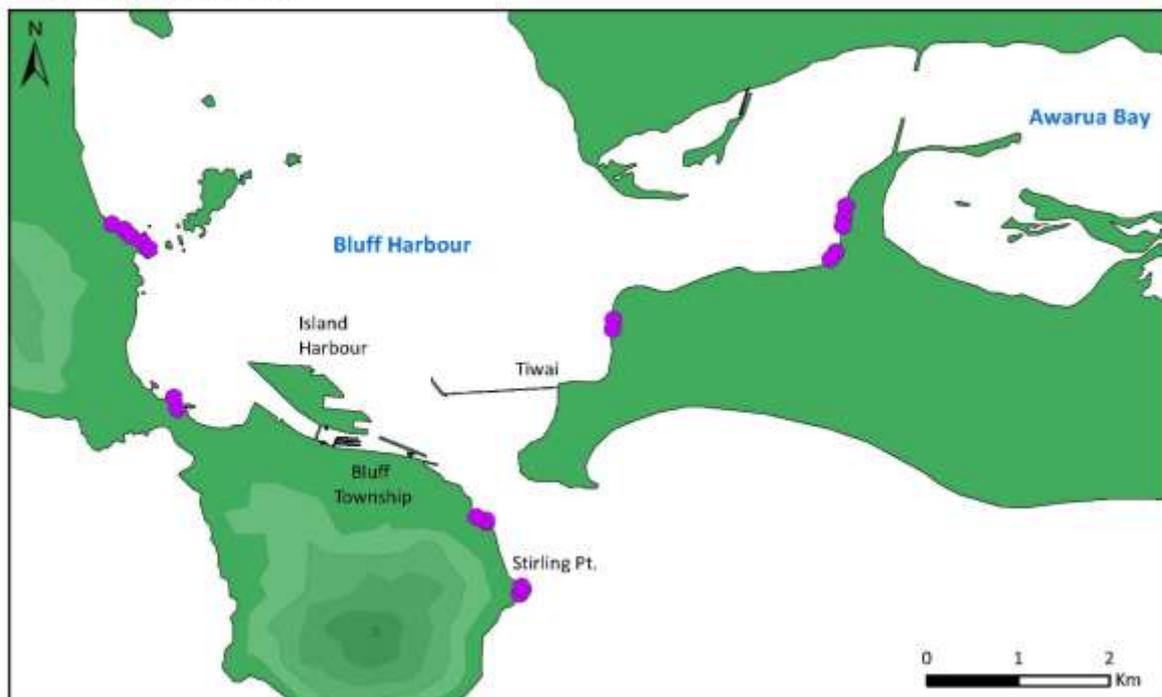
Shore search (WRACK) locations



Bluff Harbour

Summer 2018-19

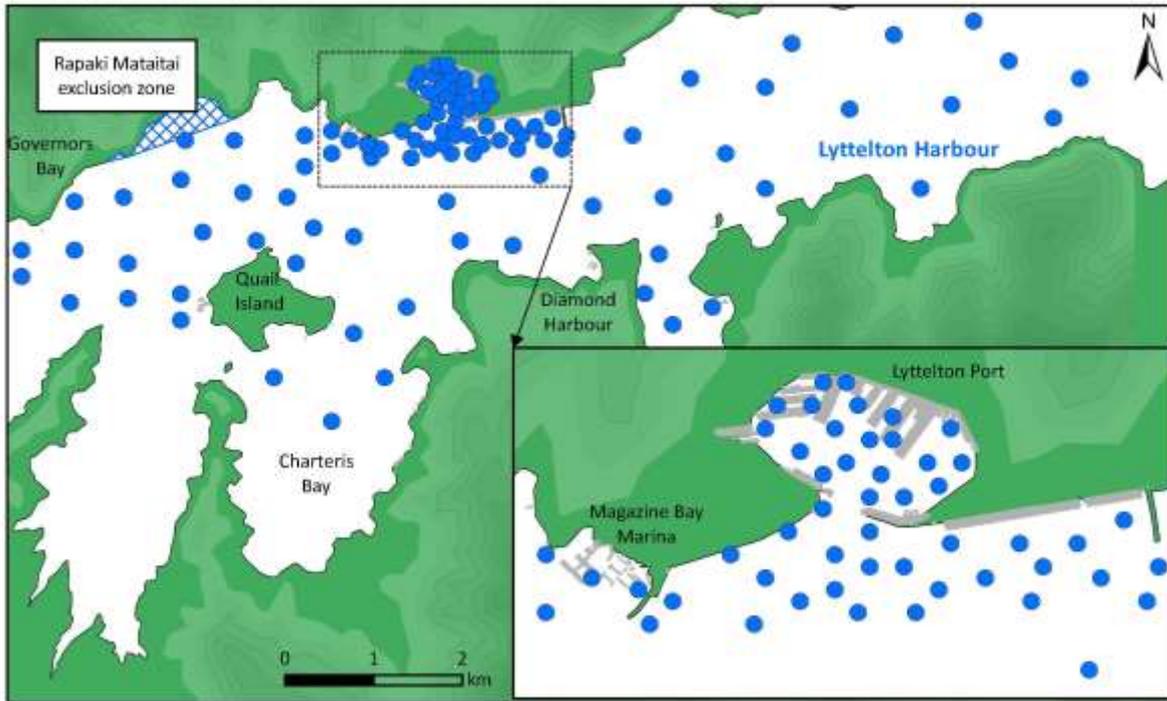
Shore search (WRACK) locations



Lyttelton Harbour/ Whakaraupō

Winter 2018

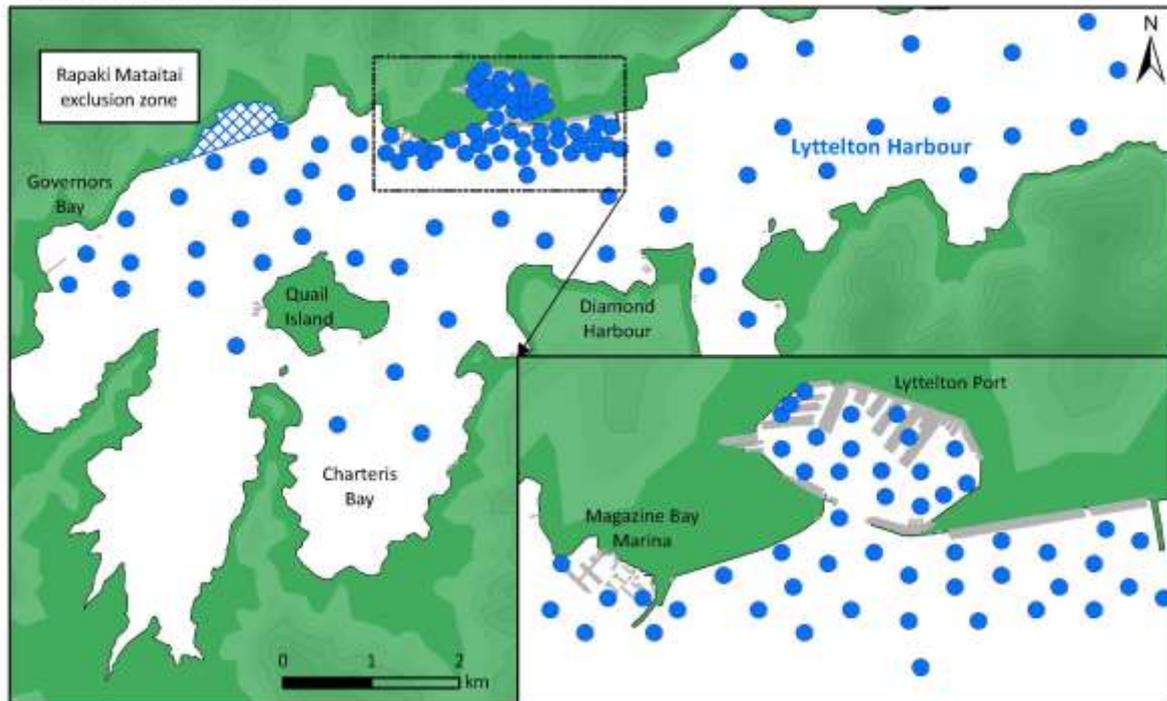
Benthic sled (BSLD) locations



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

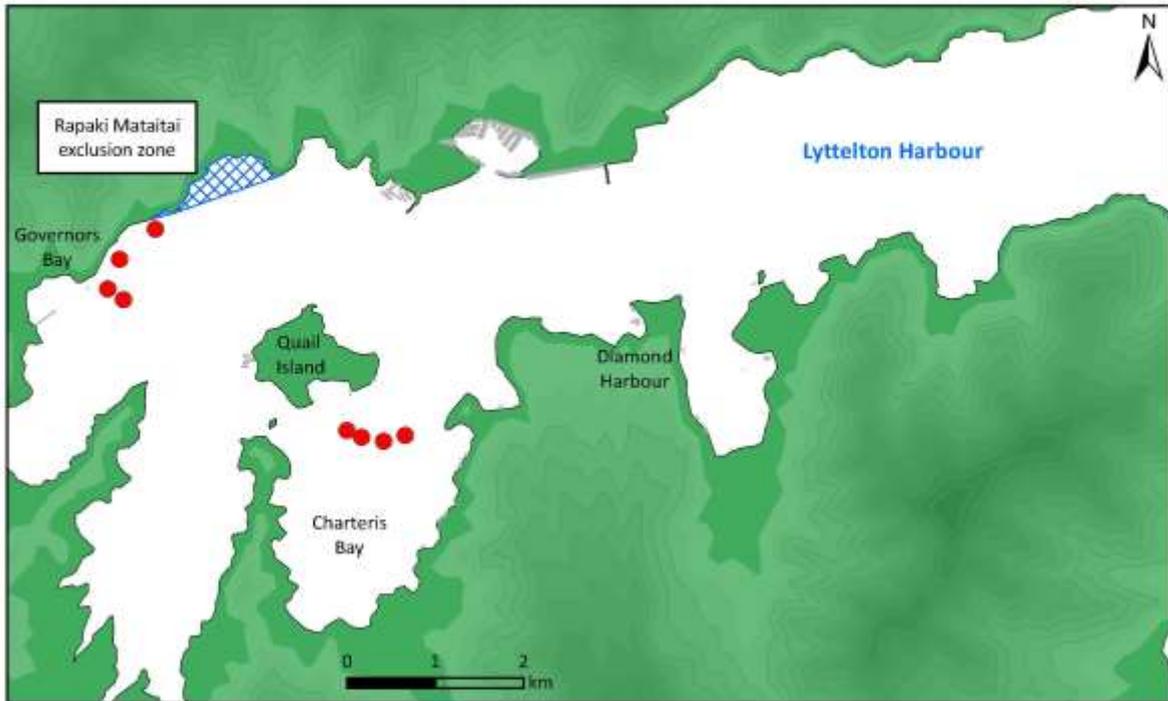
Benthic sled (BSLD) locations



Lyttelton Harbour/ Whakaraupō

Winter 2018

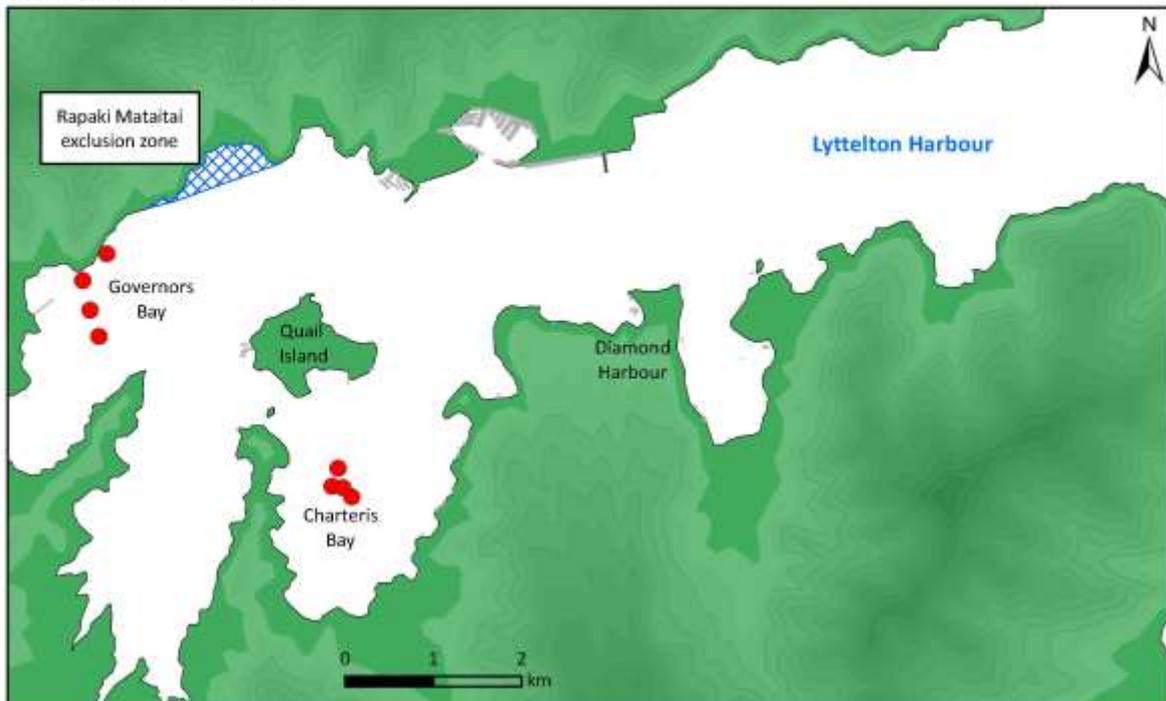
Crab condo (CONDO) locations



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

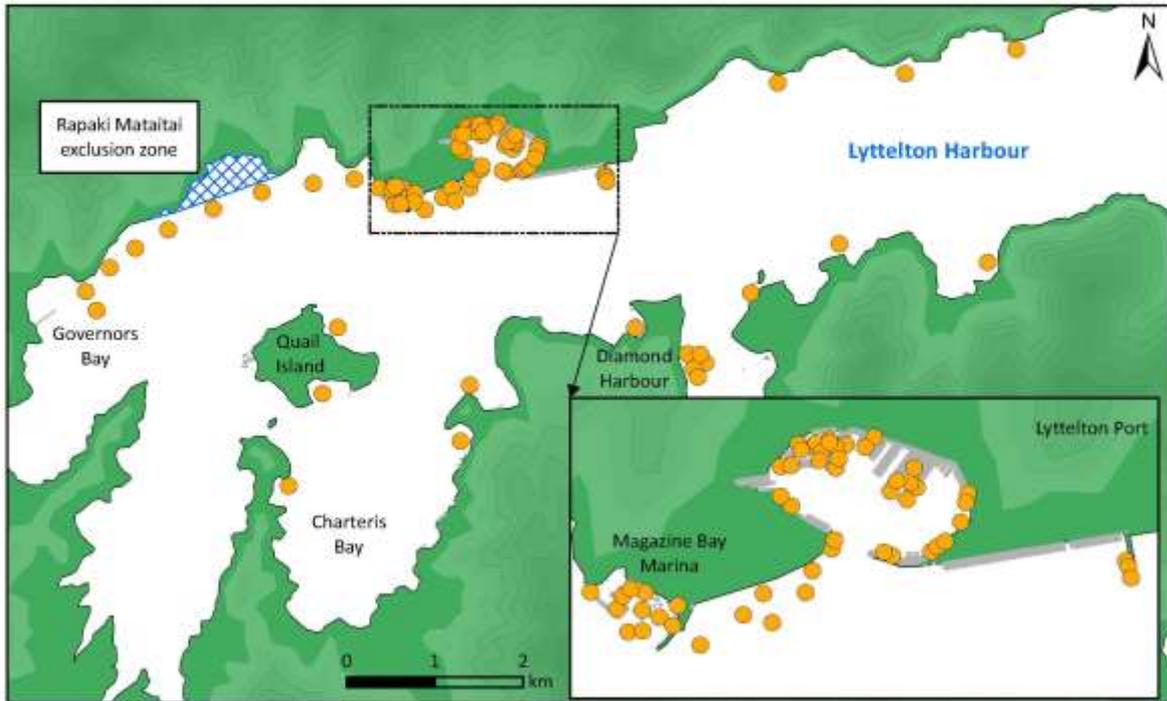
Crab condo (CONDO) locations



Lyttelton Harbour/ Whakaraupō

Winter 2018

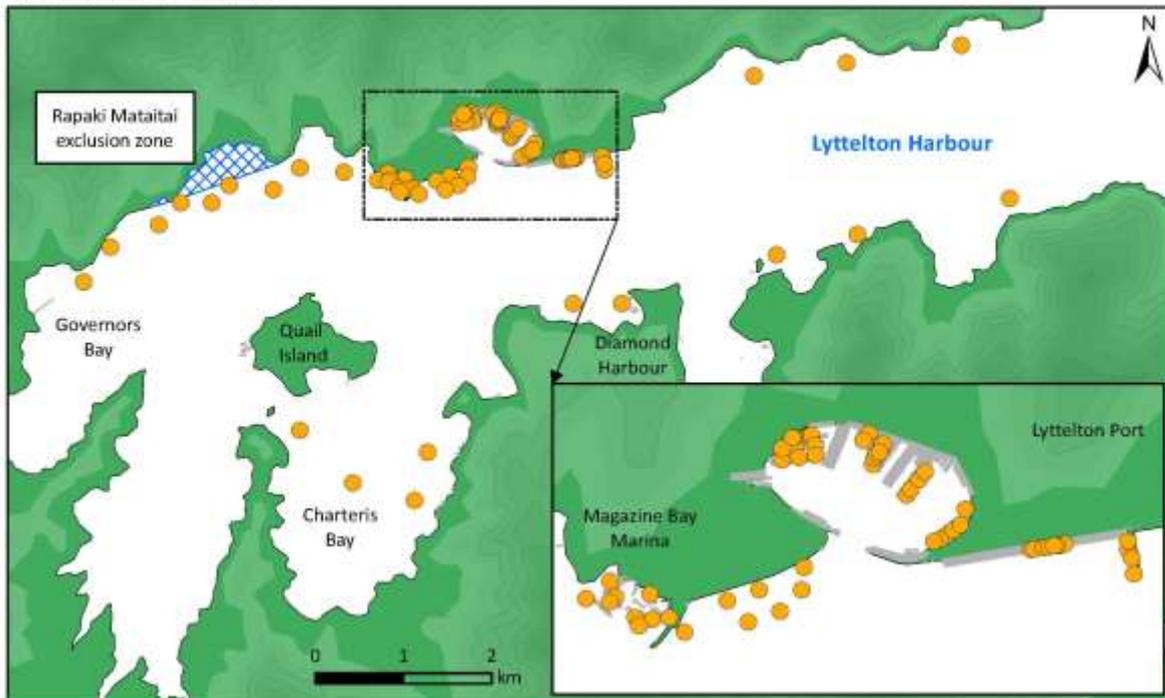
Crab trap (CRBTP) locations



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

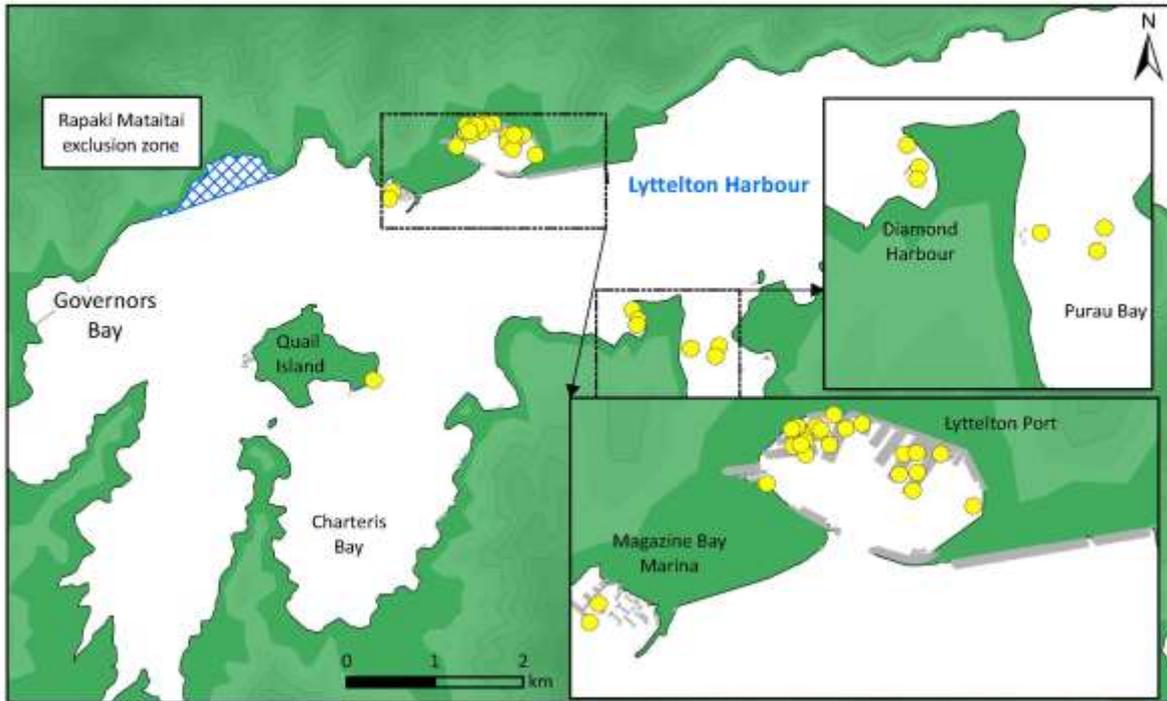
Crab trap (CRBTP) locations



Lyttelton Harbour/ Whakaraupō

Winter 2018

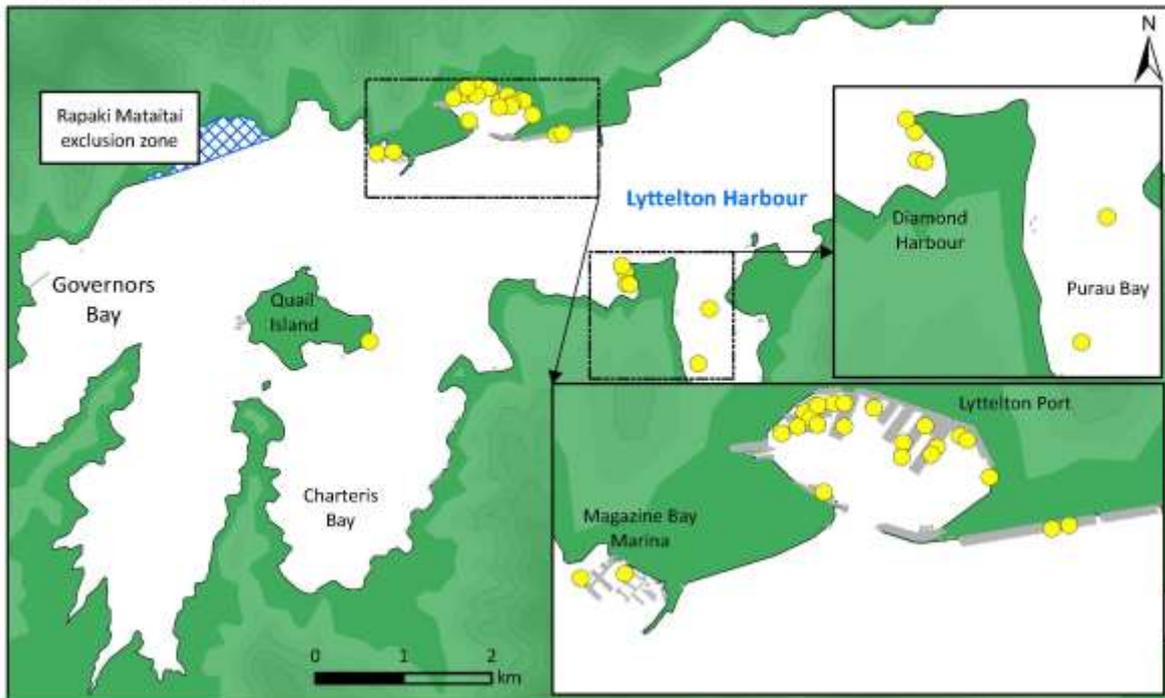
Diver search (VISD) locations



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

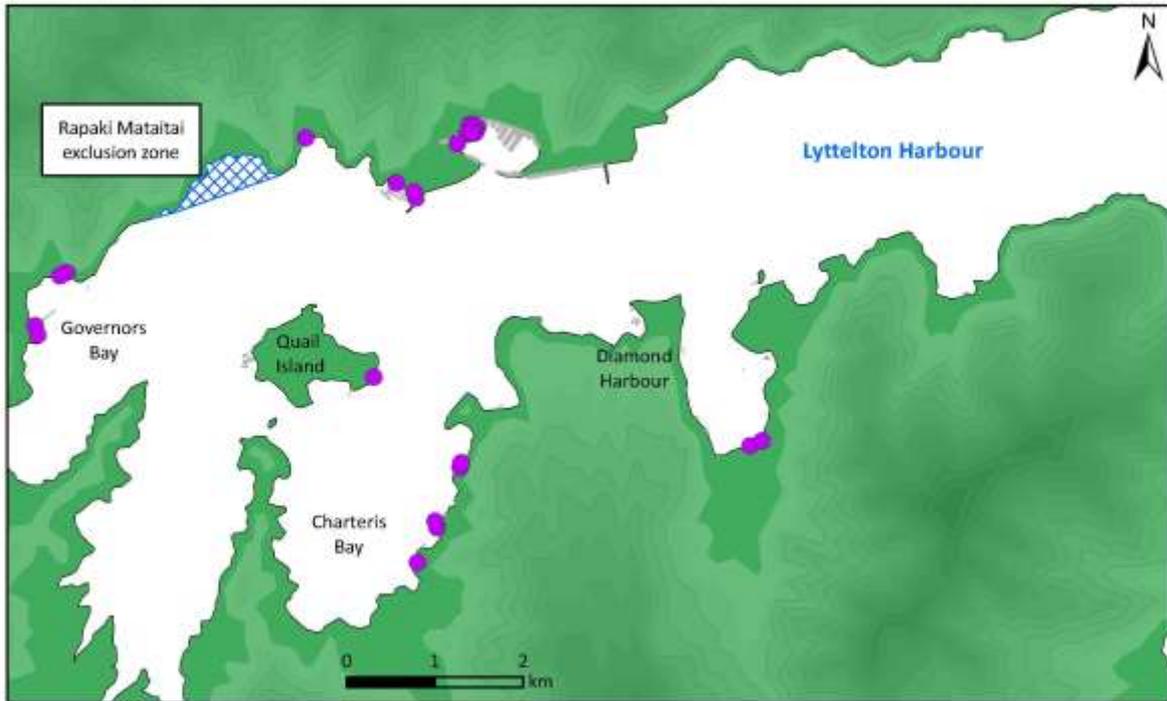
Diver search (VISD) locations



Lyttelton Harbour/ Whakaraupō

Winter 2018

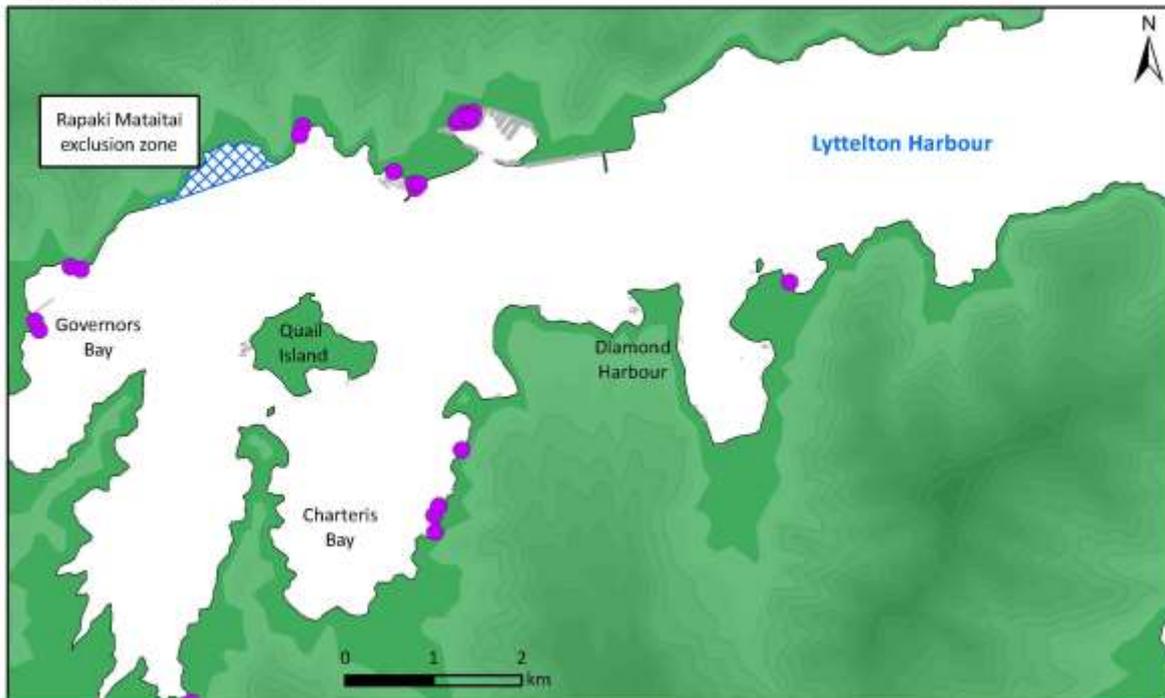
Shore search (WRACK) locations



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

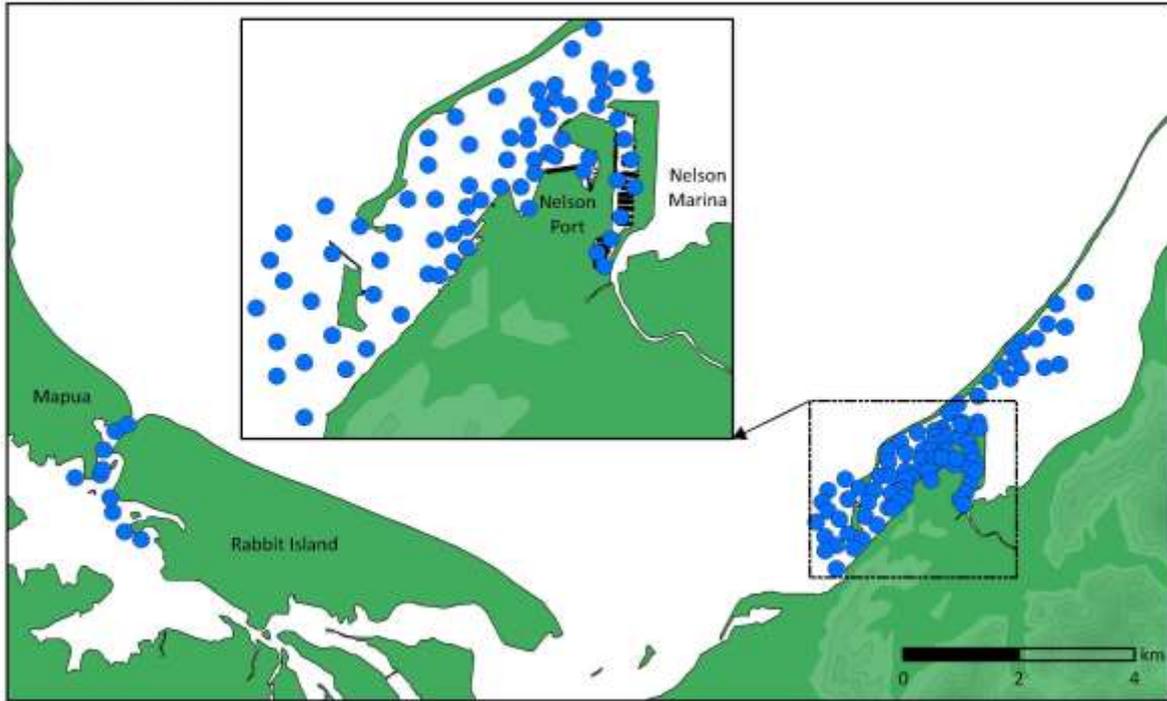
Shore search (WRACK) locations



Nelson Harbour and Waimea Inlet

Winter 2018

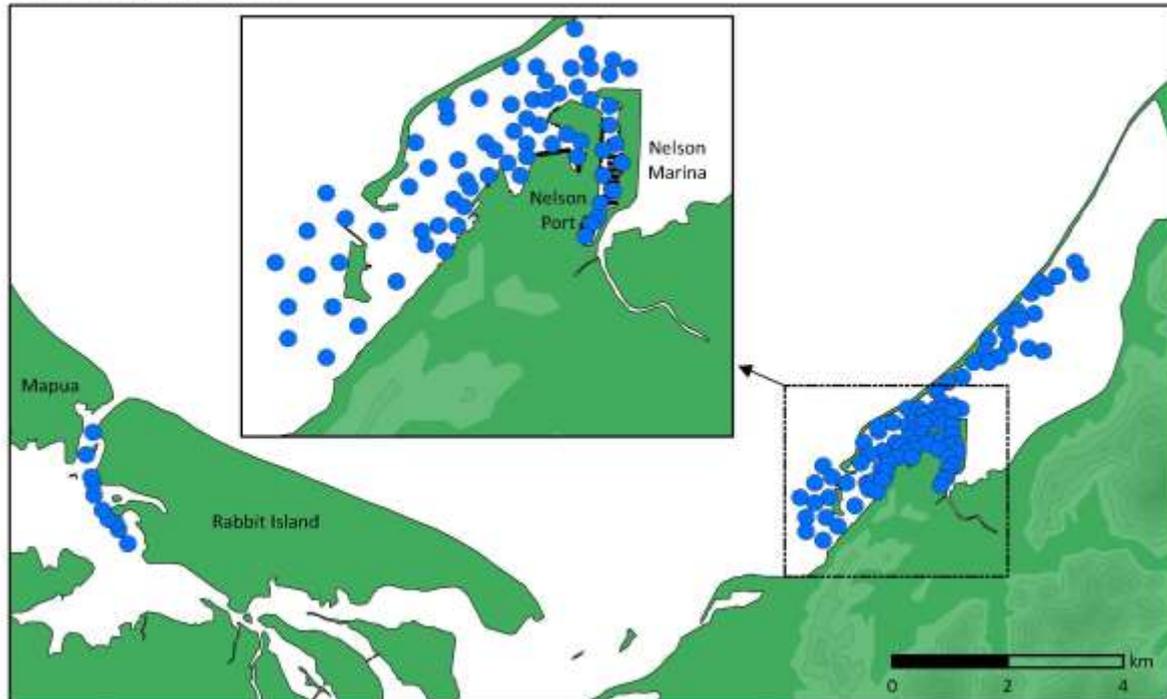
Benthic sled (BSLD) locations



Nelson Harbour and Waimea Inlet

Summer 2018-19

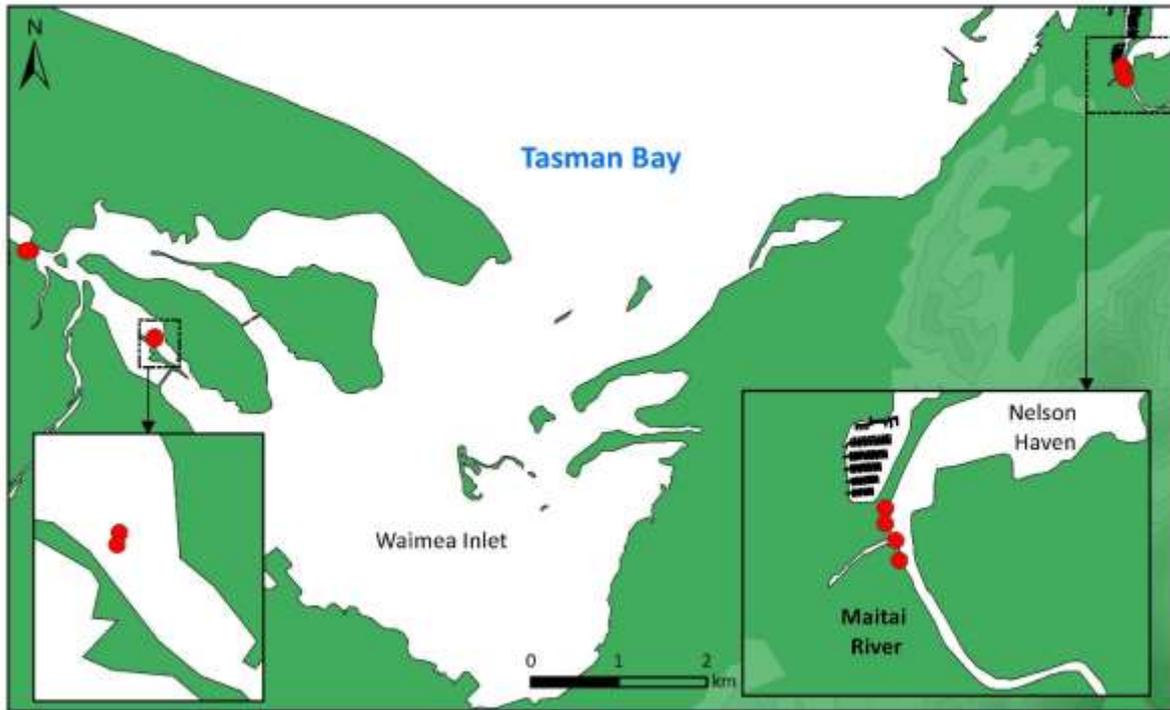
Benthic sled (BSLD) locations



Nelson Harbour and Waimea Inlet

Winter 2018

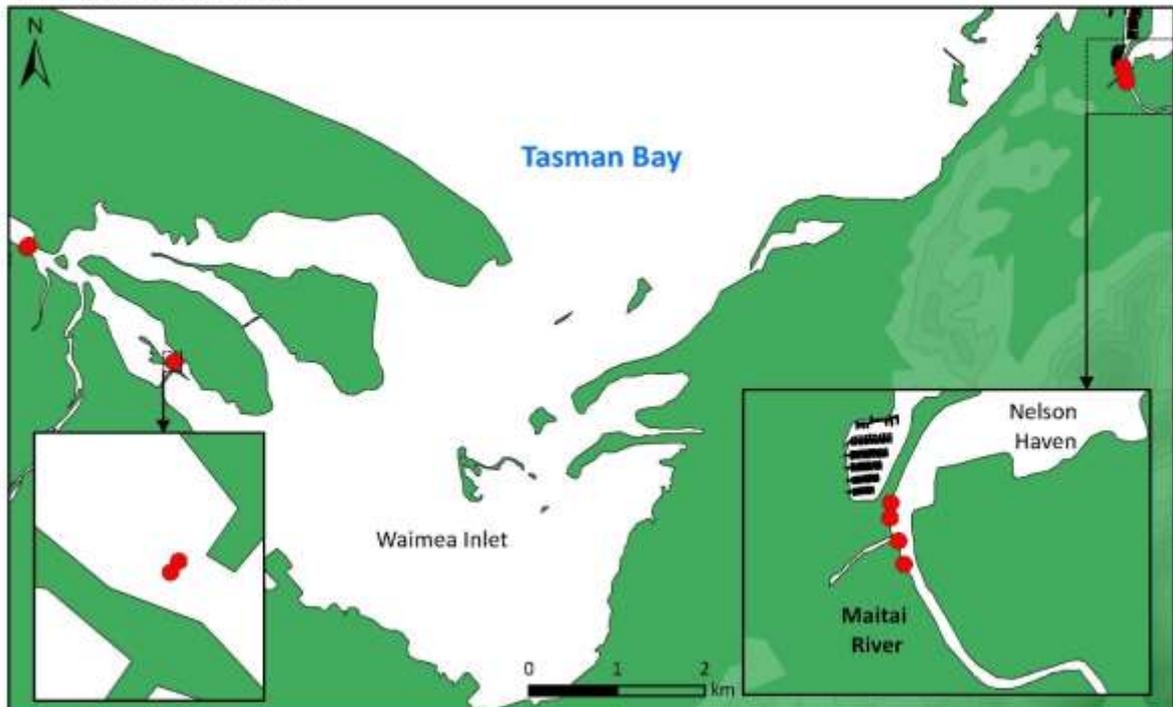
Crab condo (CONDO) locations



Nelson Harbour and Waimea Inlet

Summer 2018-19

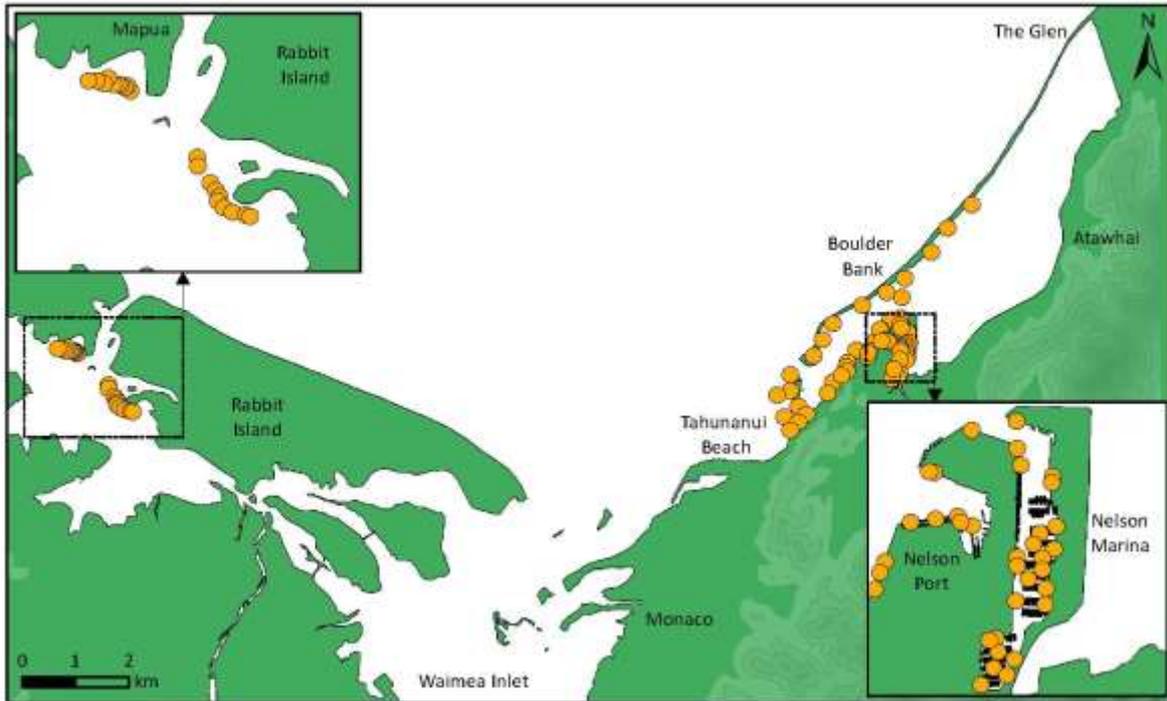
Crab condo (CONDO) locations



Nelson Harbour and Waimea Inlet

Winter 2018

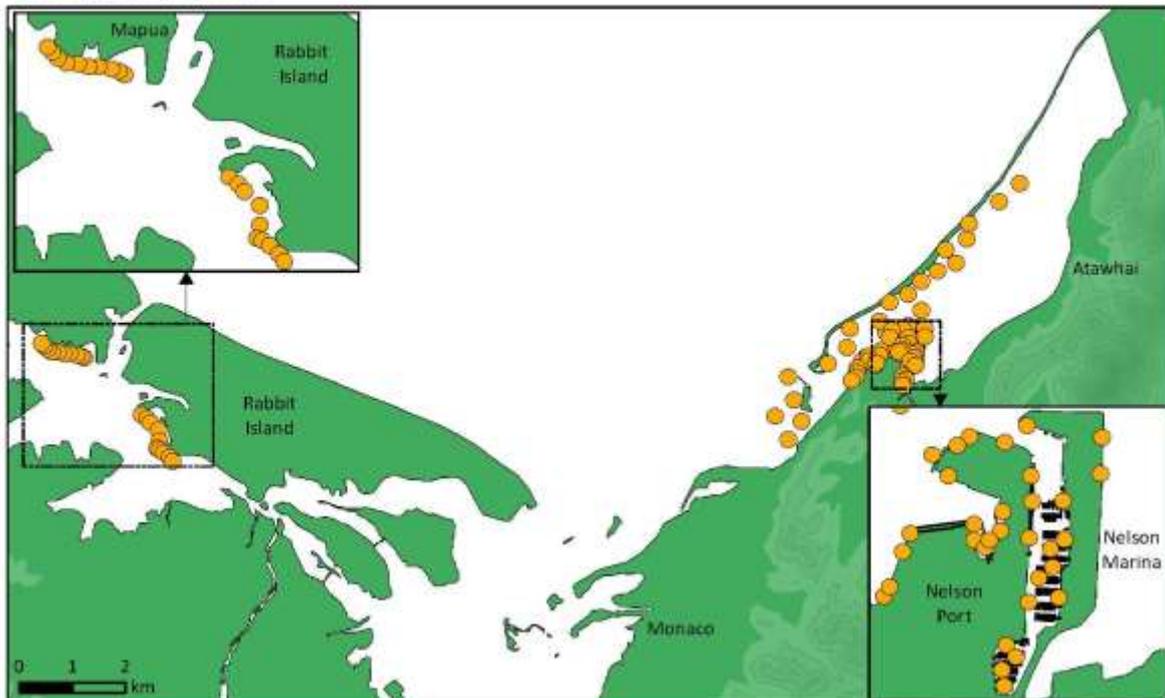
Crab trap (CRBTP) locations



Nelson Harbour and Waimea Inlet

Summer 2018-19

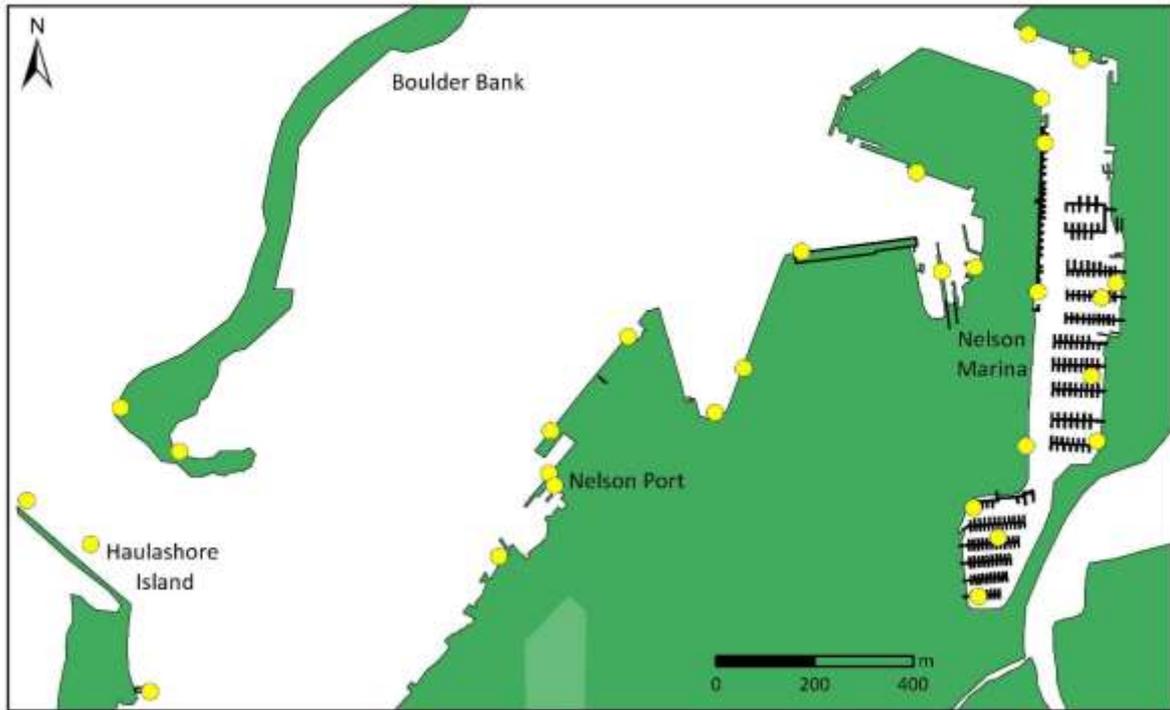
Crab trap (CRBTP) locations



Nelson Harbour and Waimea Inlet

Winter 2018

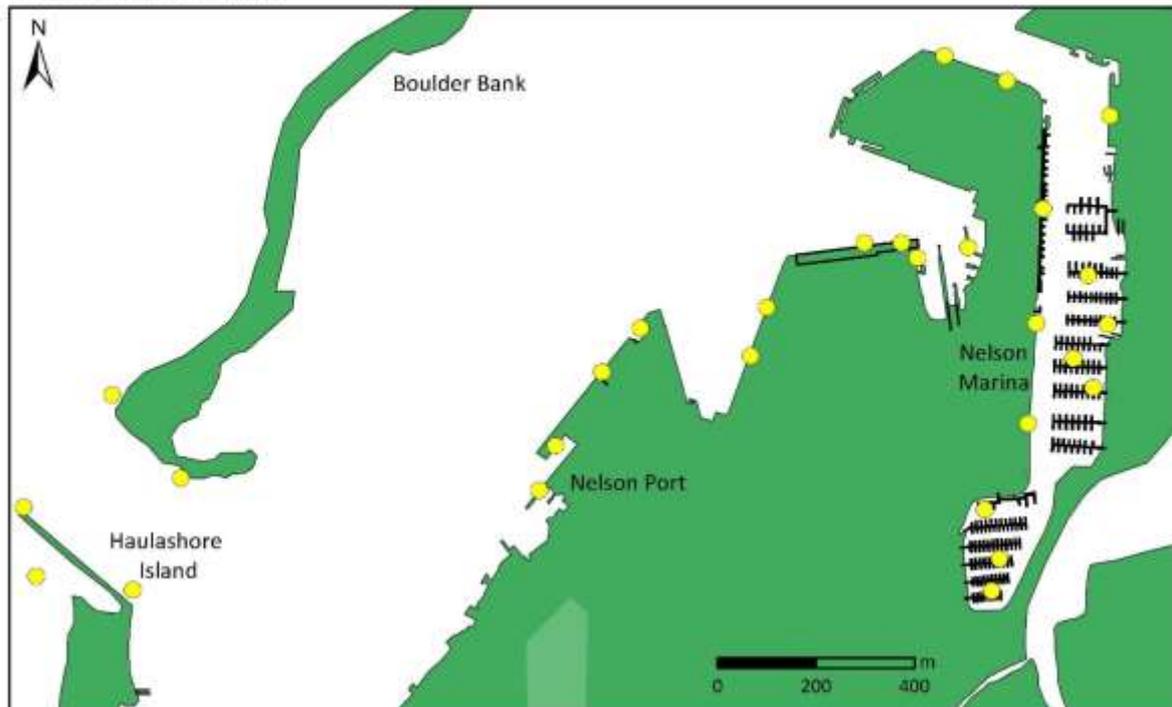
Diver search (VISD) locations



Nelson Harbour and Waimea Inlet

Summer 2018-19

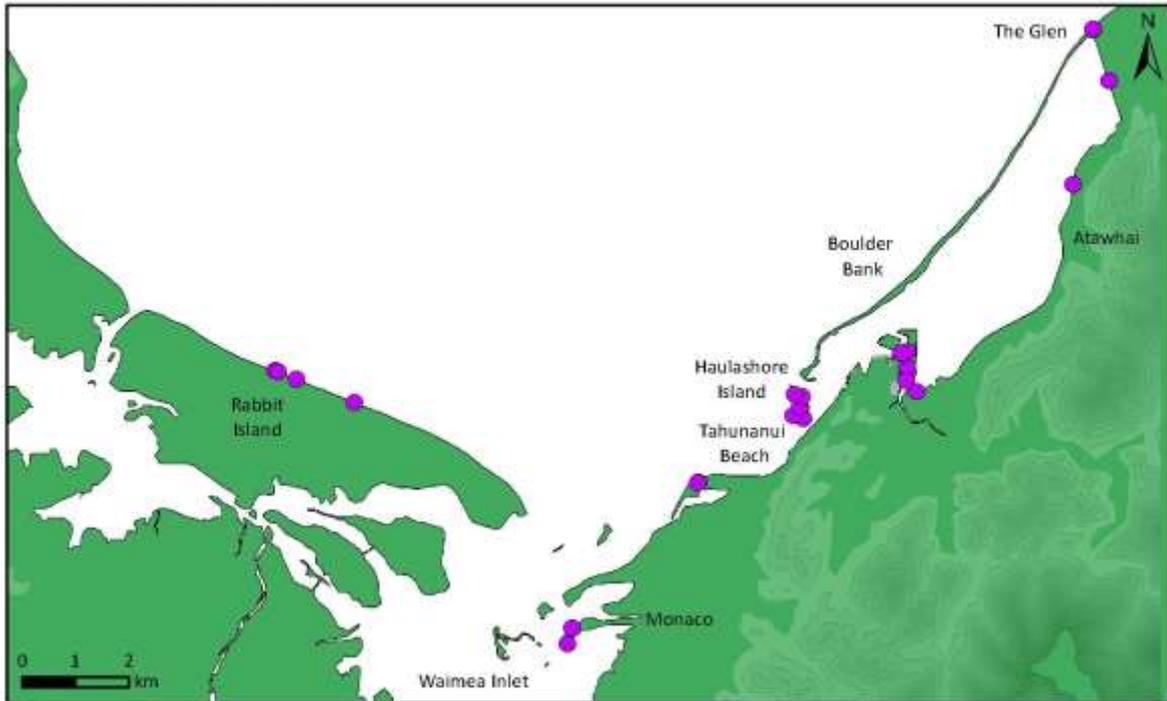
Diver search (VISD) locations



Nelson Harbour and Waimea Inlet

Winter 2018

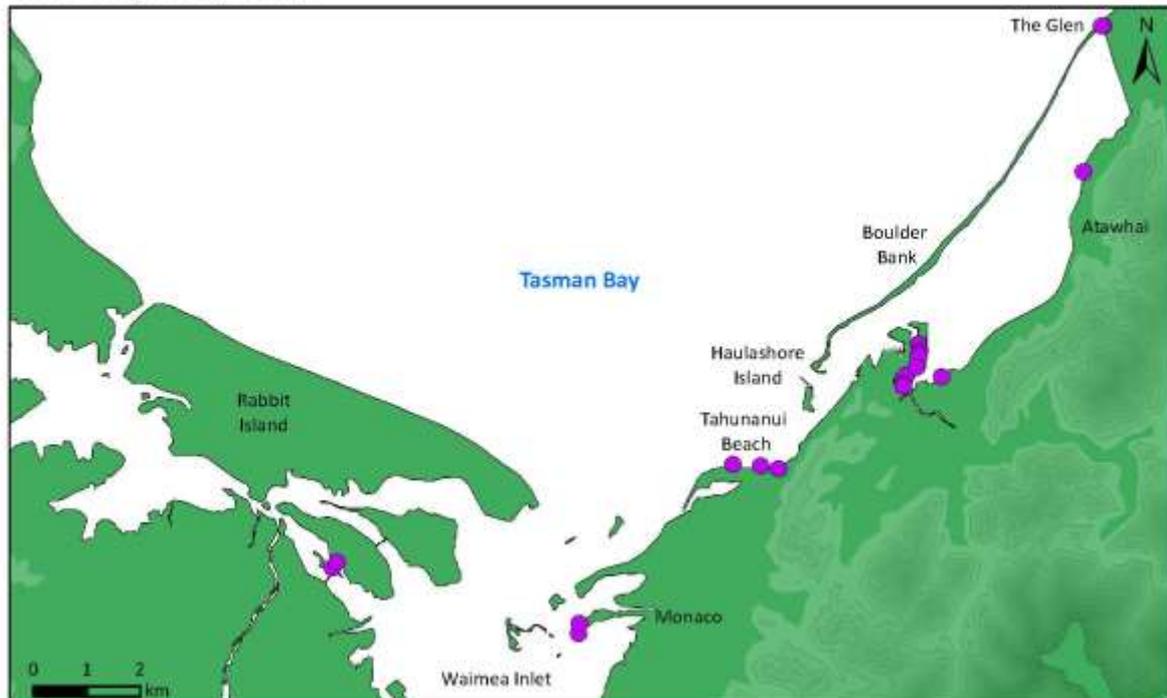
Shore search (WRACK) locations



Nelson Harbour and Waimea Inlet

Summer 2018-19

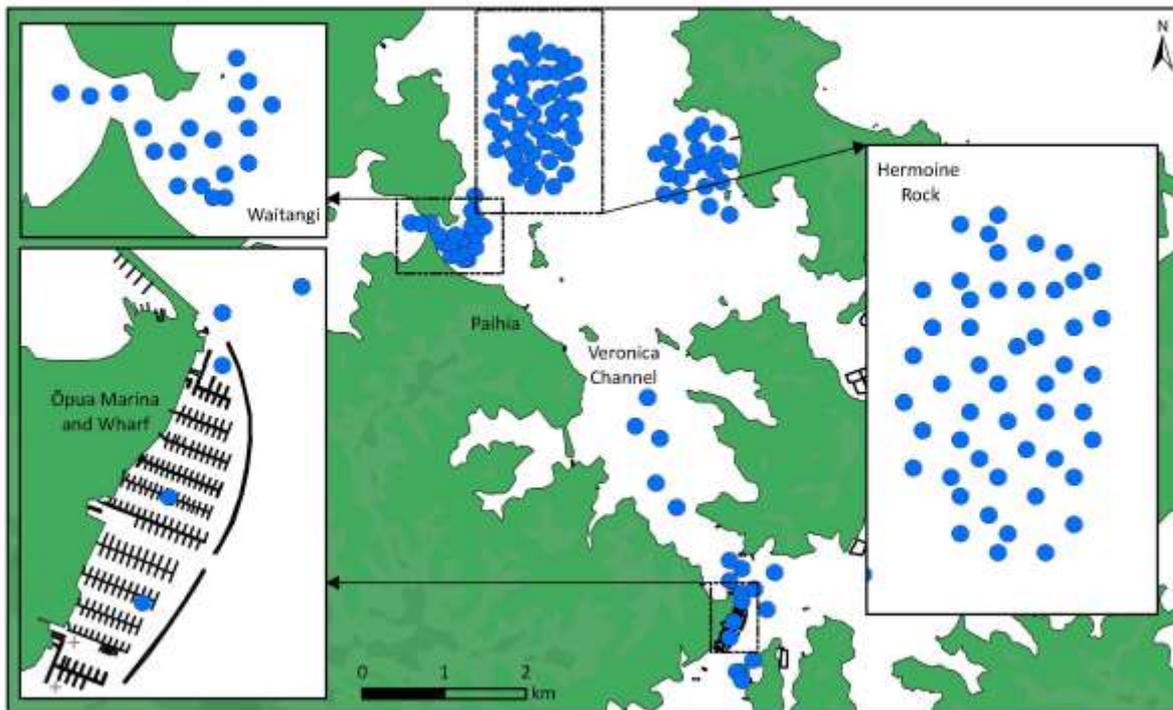
Shore search (WRACK) locations



Ōpua Marina and Waikare Inlet

Winter 2018

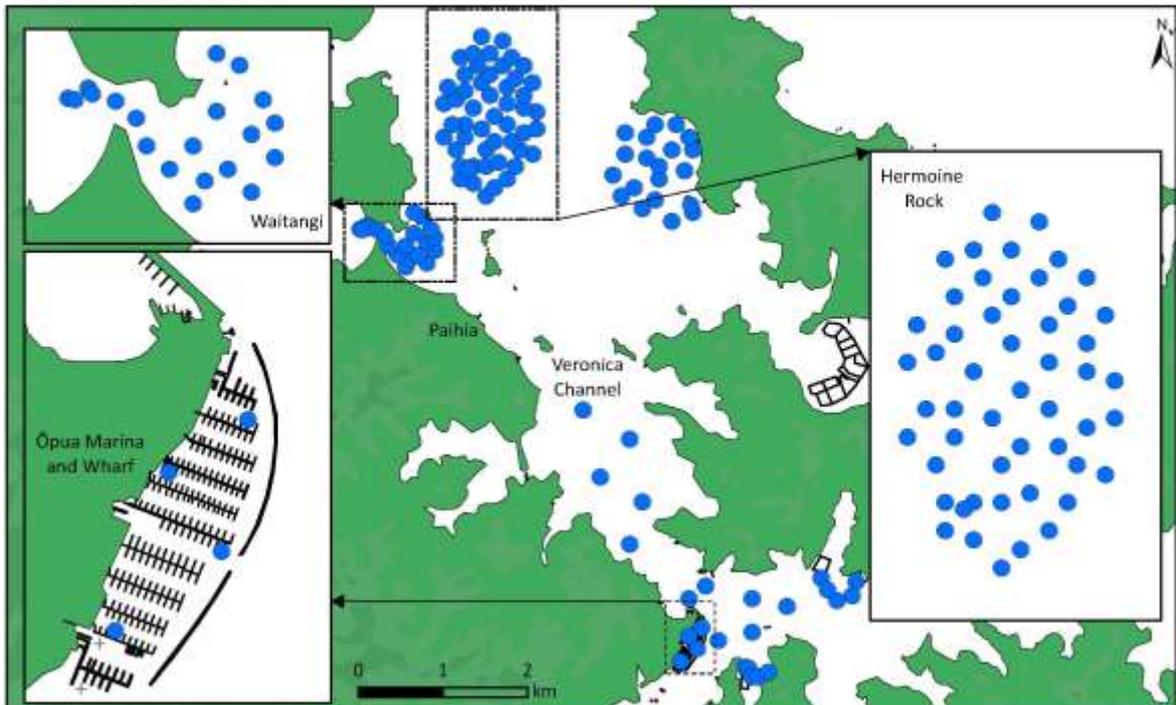
Benthic sled (BSLD) locations



Ōpua Marina and Waikare Inlet

Summer 2018-19

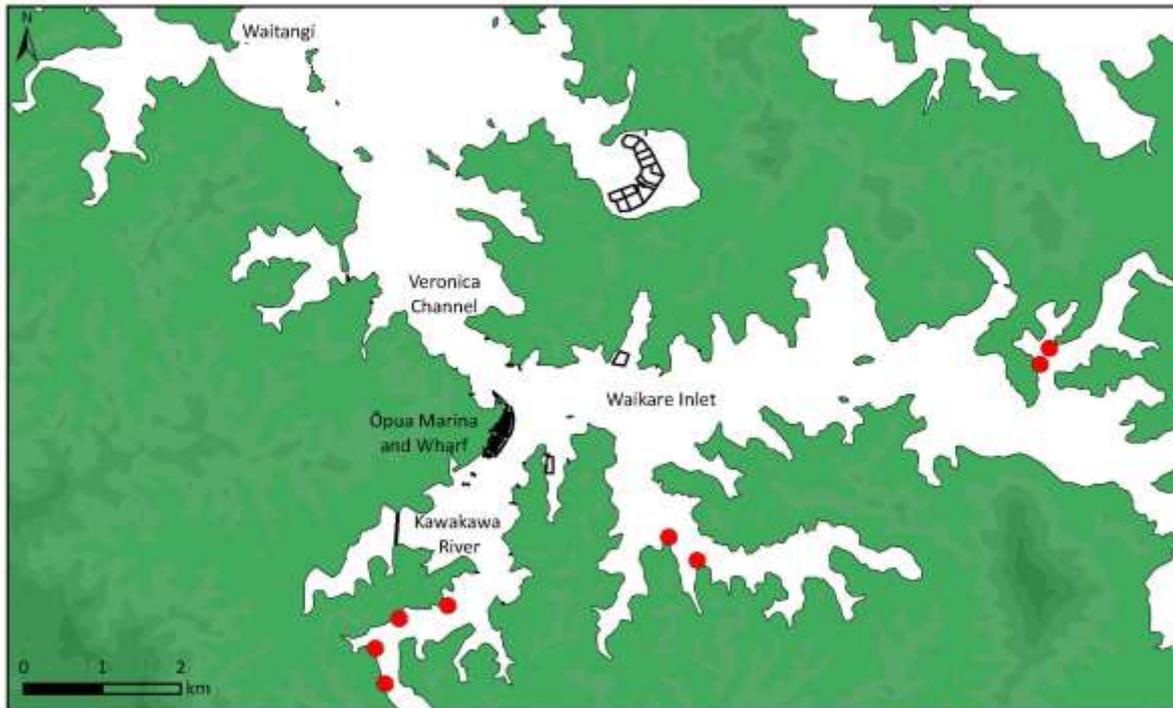
Benthic sled (BSLD) locations



Ōpua Marina and Waikare Inlet

Winter 2018

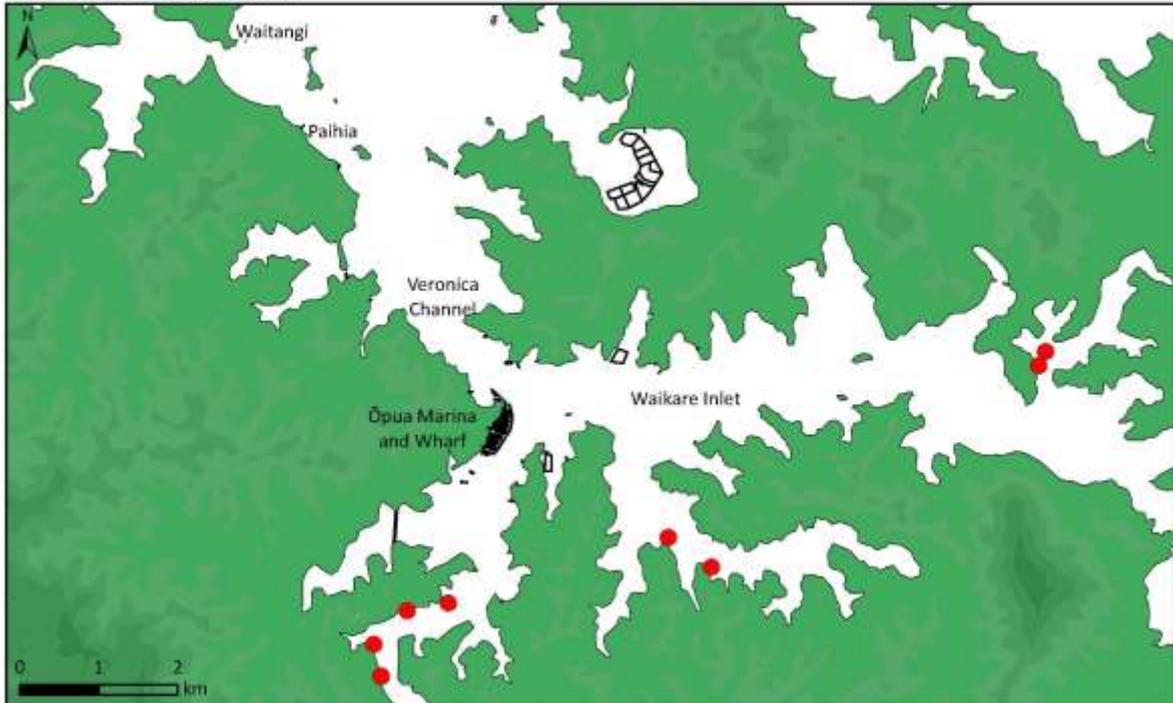
Crab condo (CONDO) locations



Ōpua Marina and Waikare Inlet

Summer 2018-19

Crab condo (CONDO) locations



Ōpua Marina and Waikare Inlet

Winter 2018

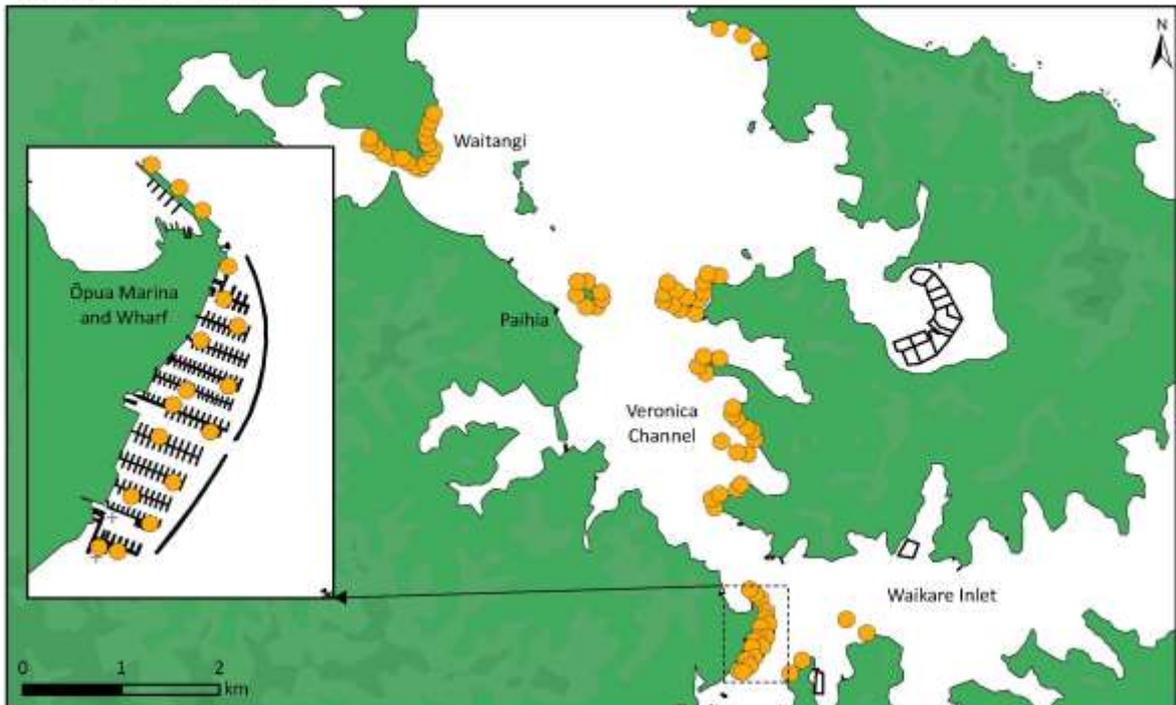
Crab trap (CRBTP) locations



Ōpua Marina and Waikare Inlet

Summer 2018-19

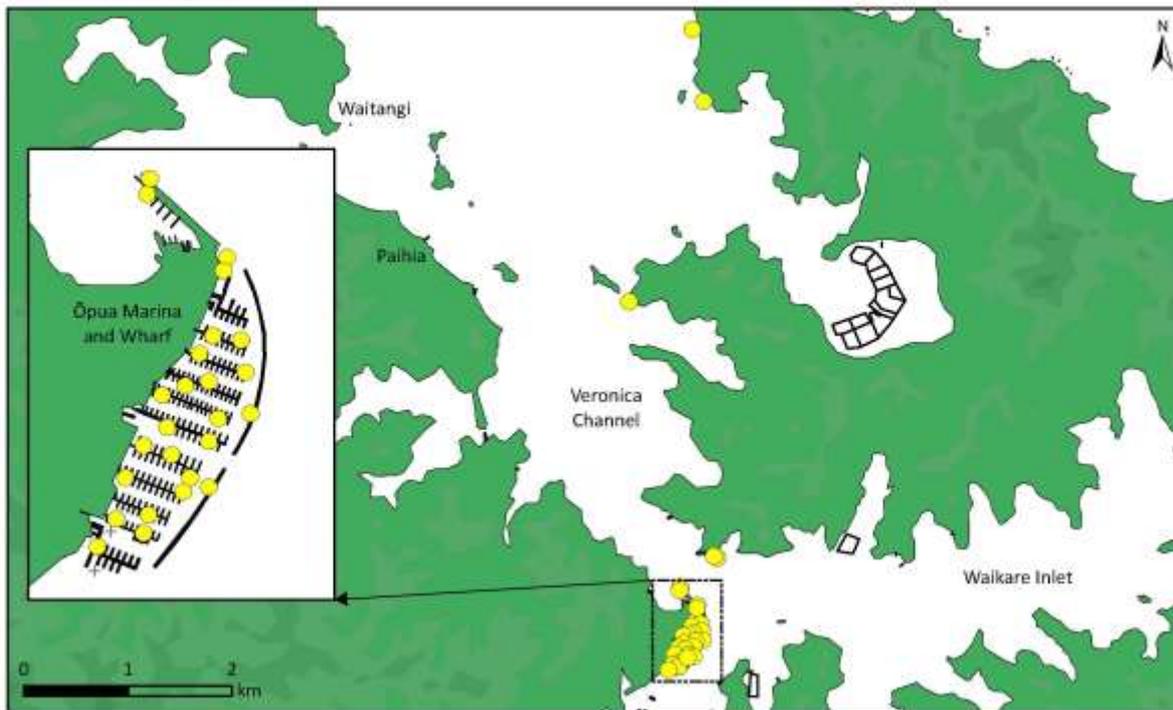
Crab trap (CRBTP) locations



Ōpua Marina and Waikare Inlet

Winter 2018

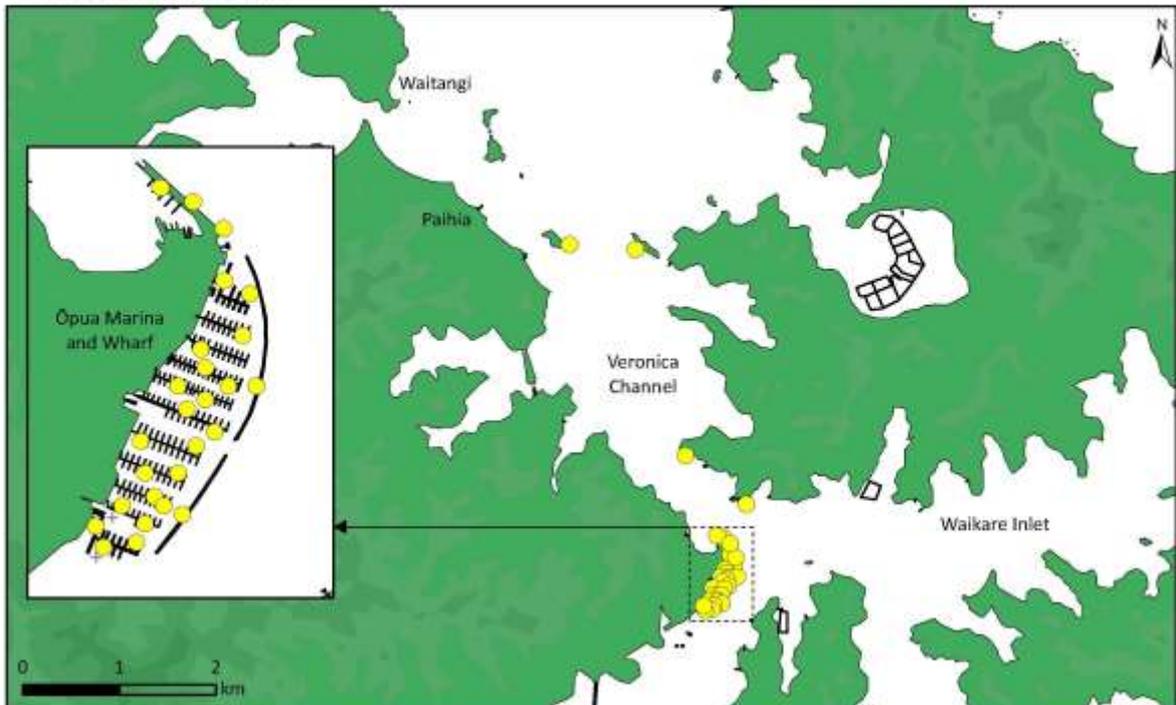
Diver search (VISD) locations



Ōpua Marina and Waikare Inlet

Summer 2018-19

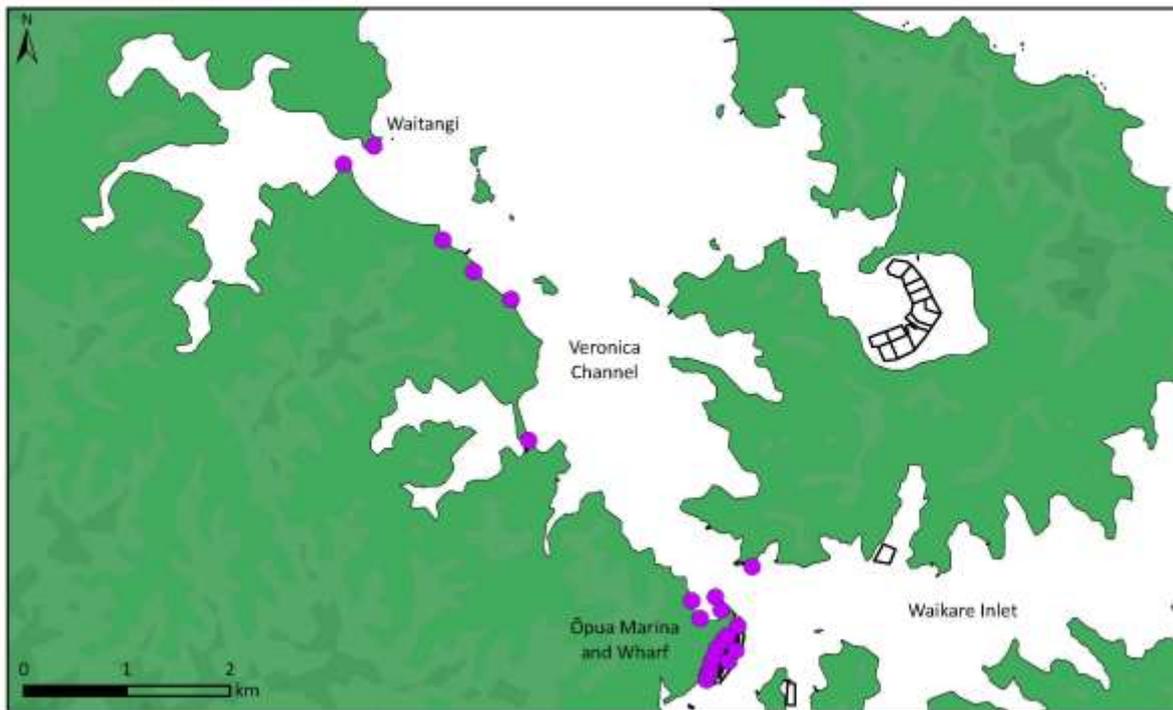
Diver search (VISD) locations



Ōpua Marina and Waikare Inlet

Winter 2018

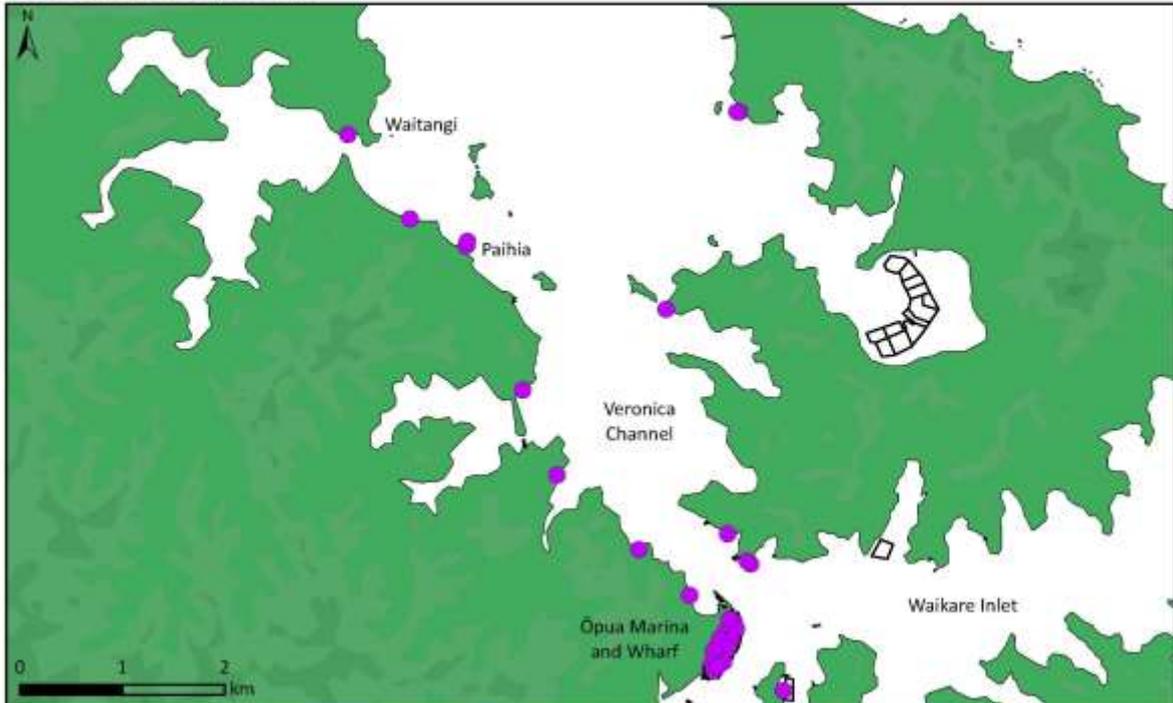
Shore search (WRACK) locations



Ōpua Marina and Waikare Inlet

Summer 2018-19

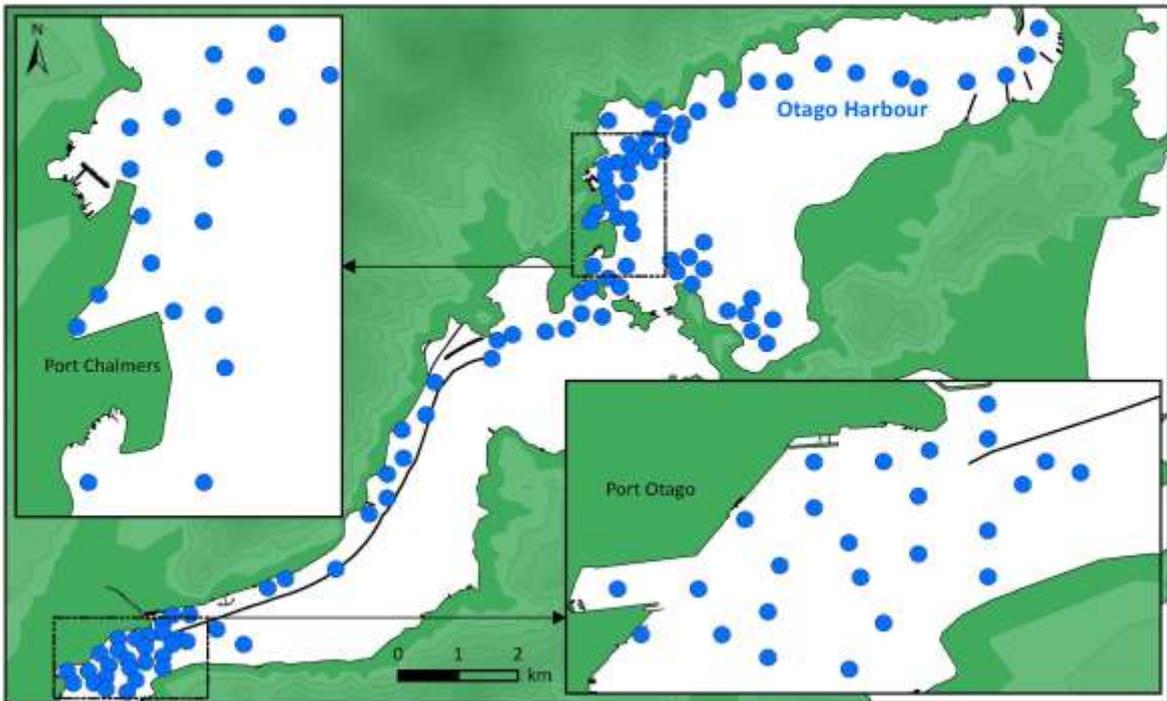
Shore search (WRACK) locations



Otago Harbour

Winter 2018

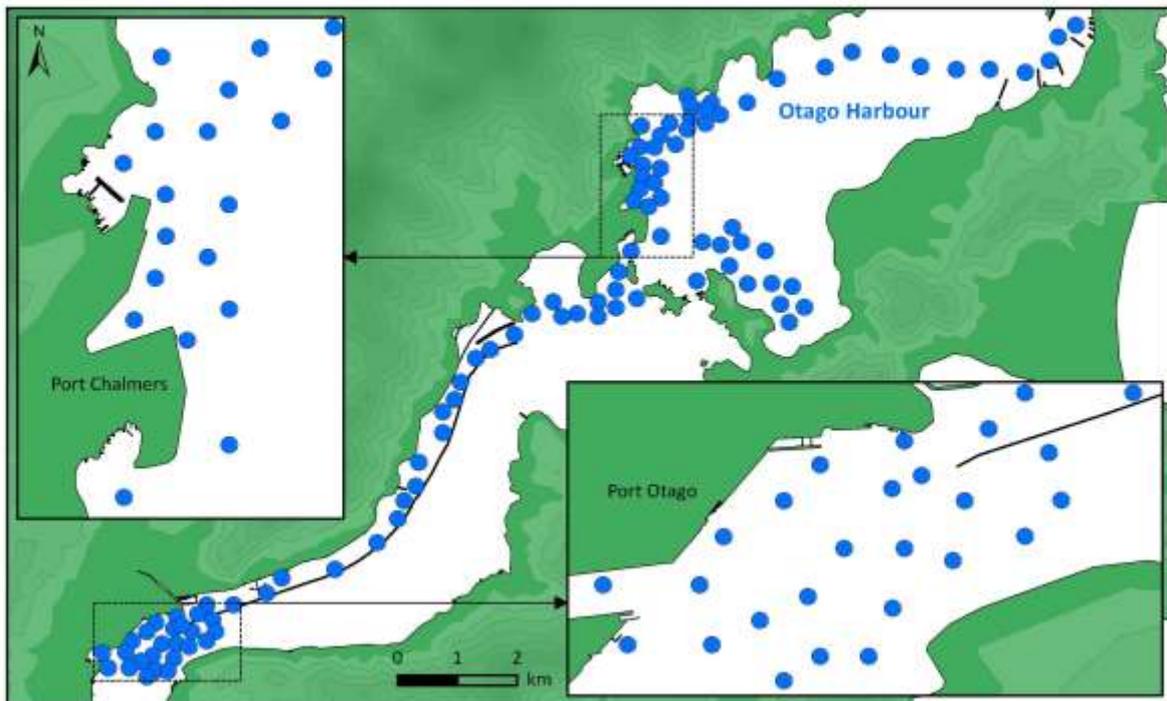
Benthic sled (BSLD) locations



Otago Harbour

Summer 2018-19

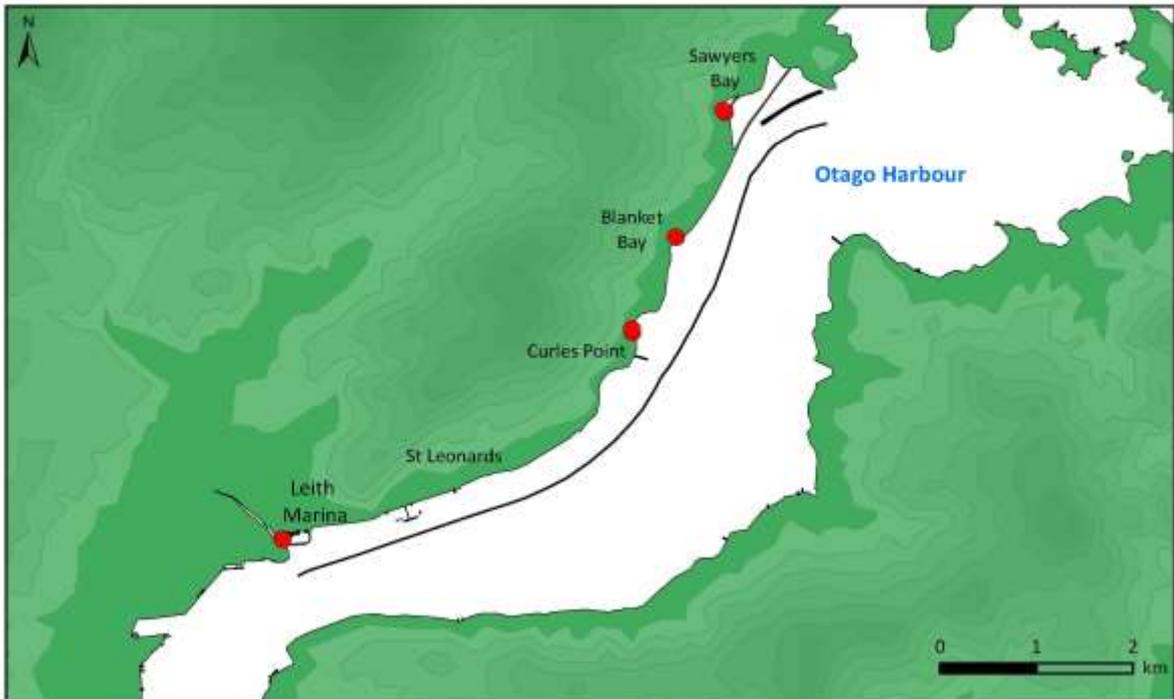
Benthic sled (BSLD) locations



Otago Harbour

Winter 2018

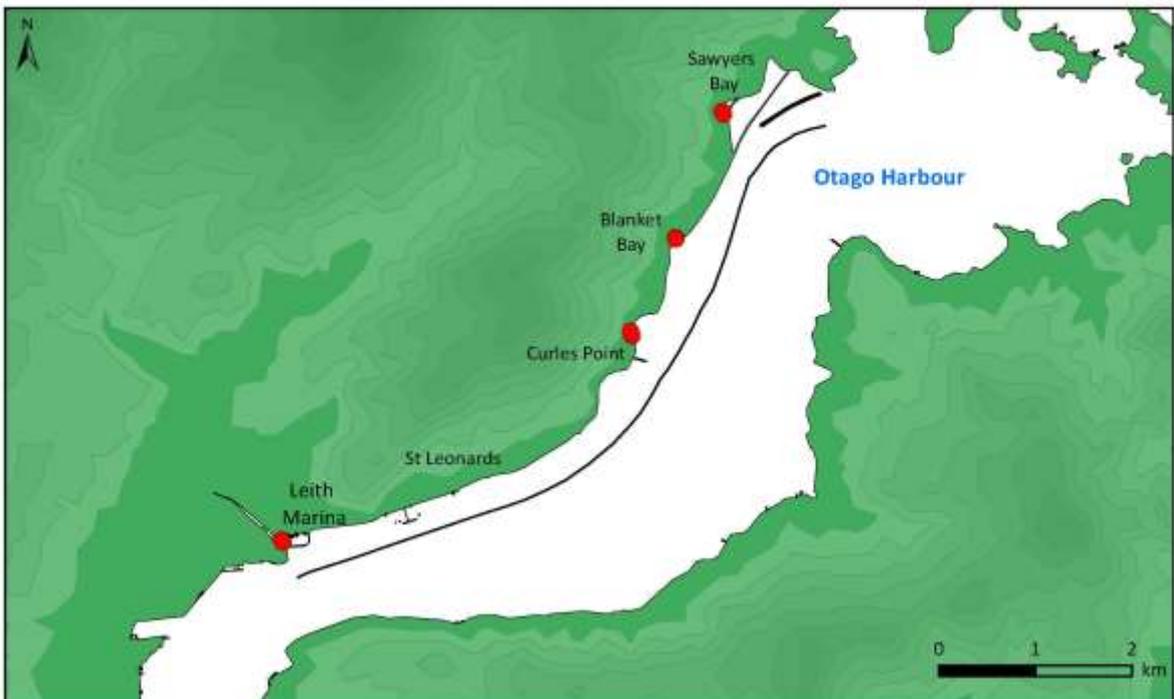
Crab condo (CONDO) locations



Otago Harbour

Summer 2018-19

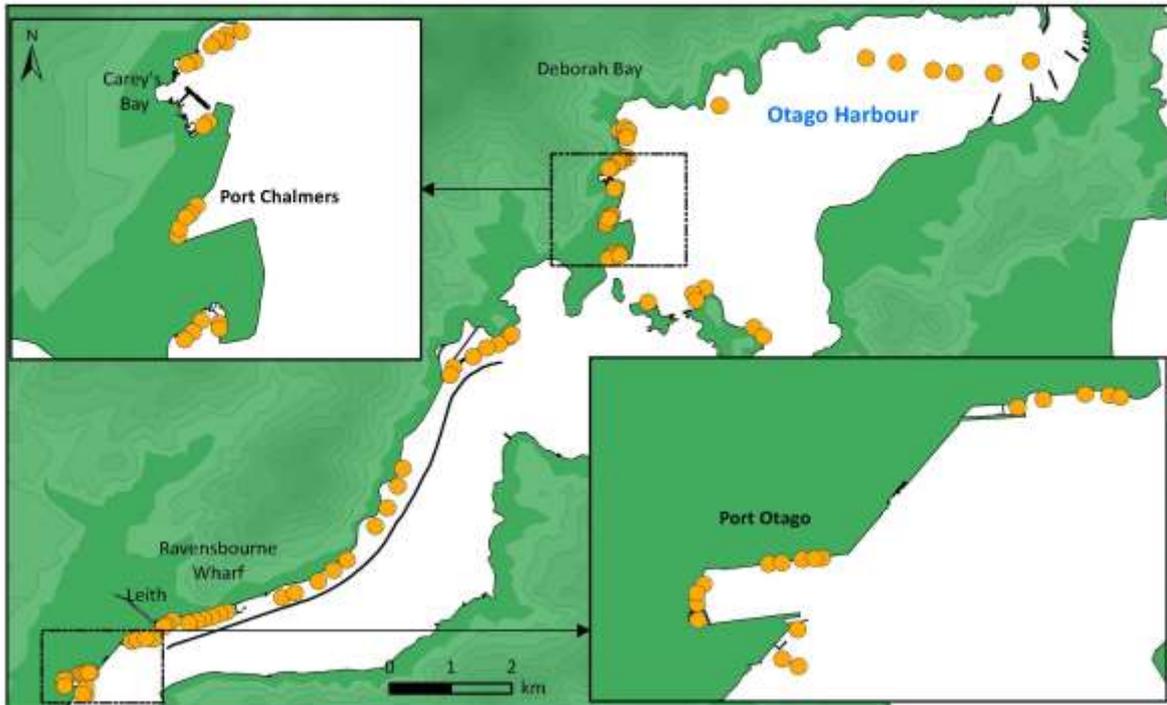
Crab condo (CONDO) locations



Otago Harbour

Winter 2018

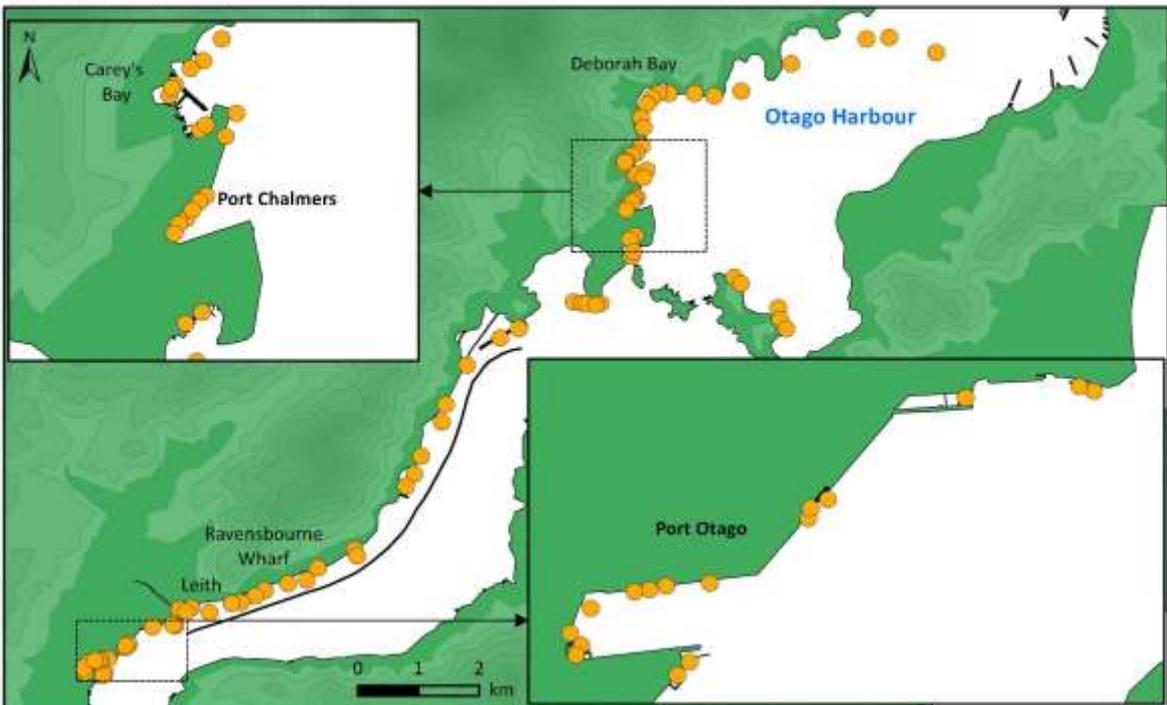
Crab trap (CRBTP) locations



Otago Harbour

Summer 2018-19

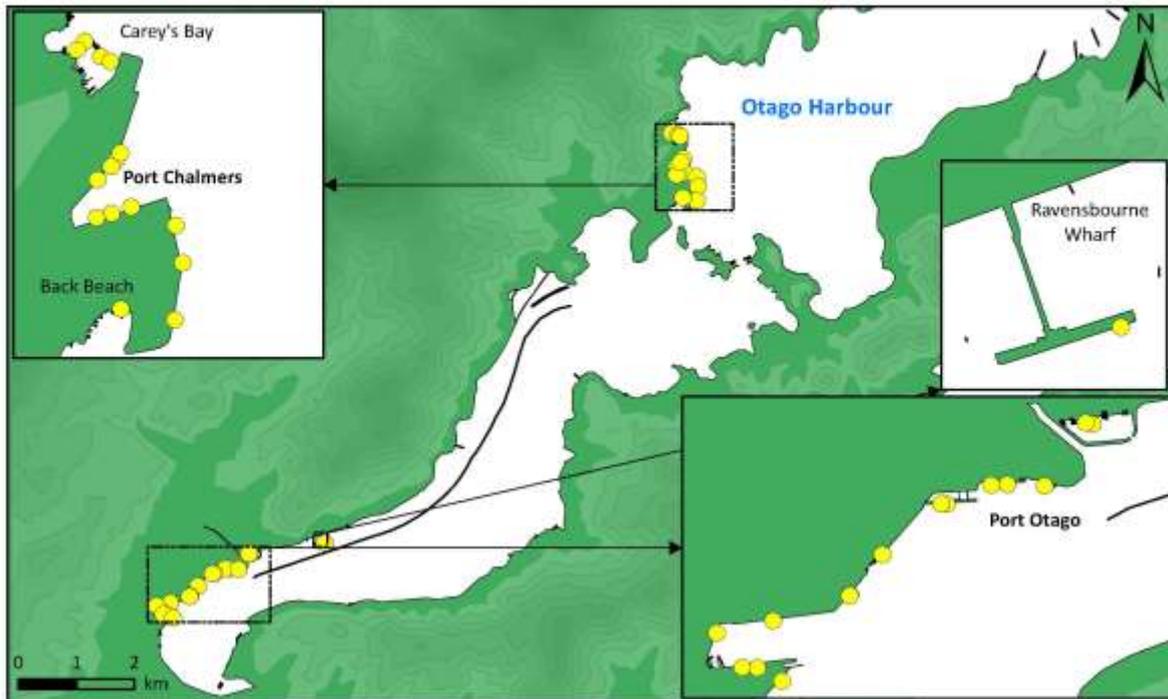
Crab trap (CRBTP) locations



Otago Harbour

Winter 2018

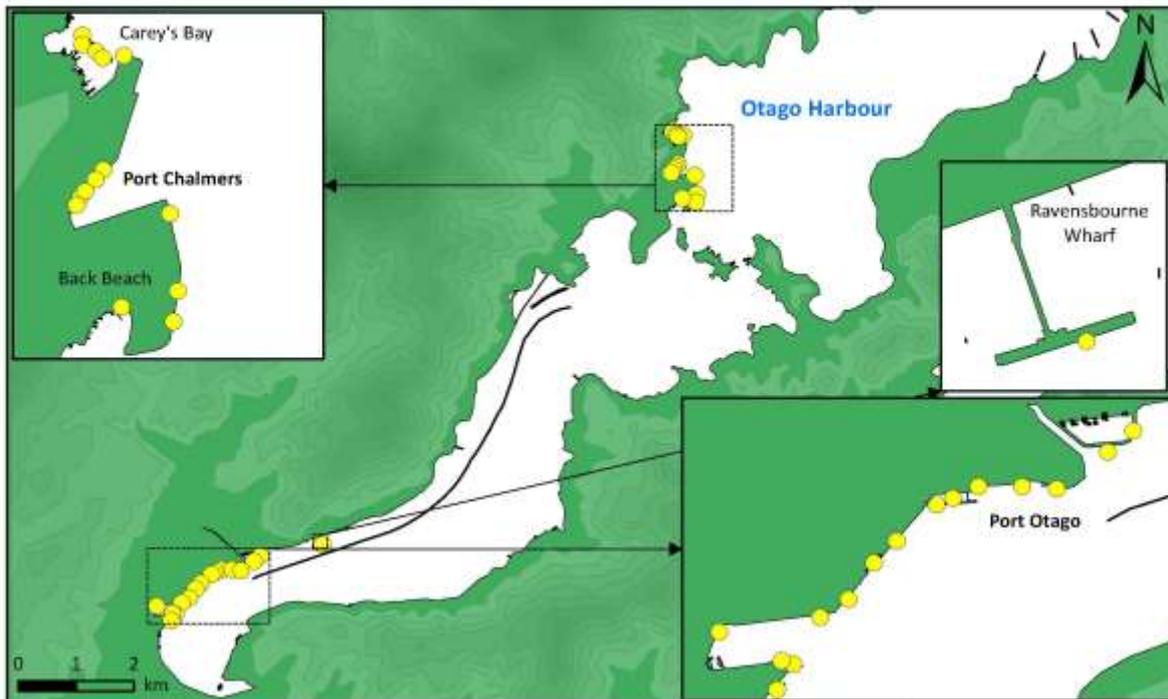
Visual dive (VISD) locations



Otago Harbour

Summer 2018-19

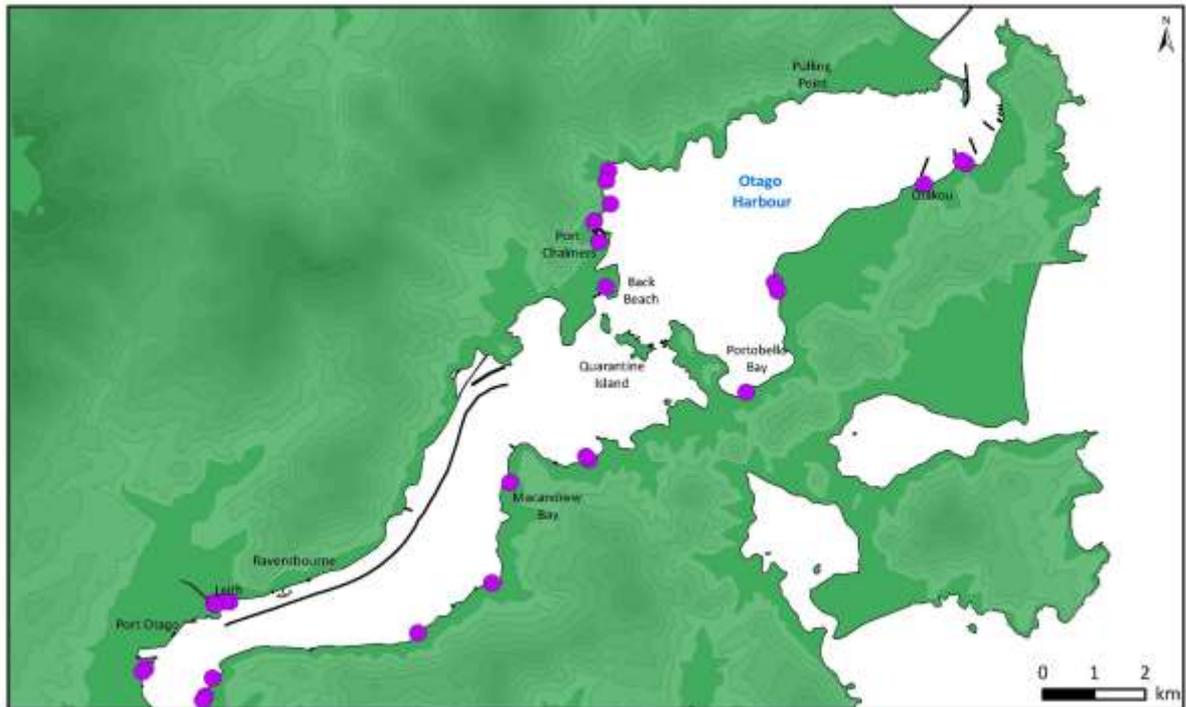
Visual dive (VISD) locations



Otago Harbour

Winter 2018

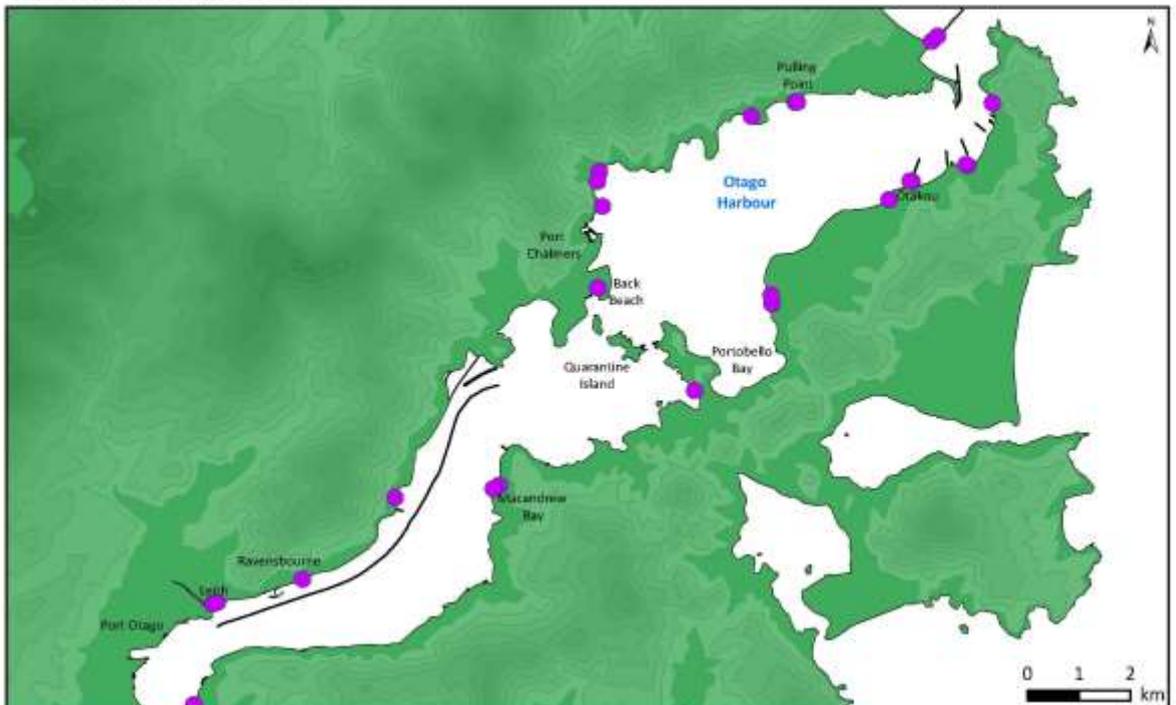
Shore search (WRACK) locations



Otago Harbour

Summer 2018-19

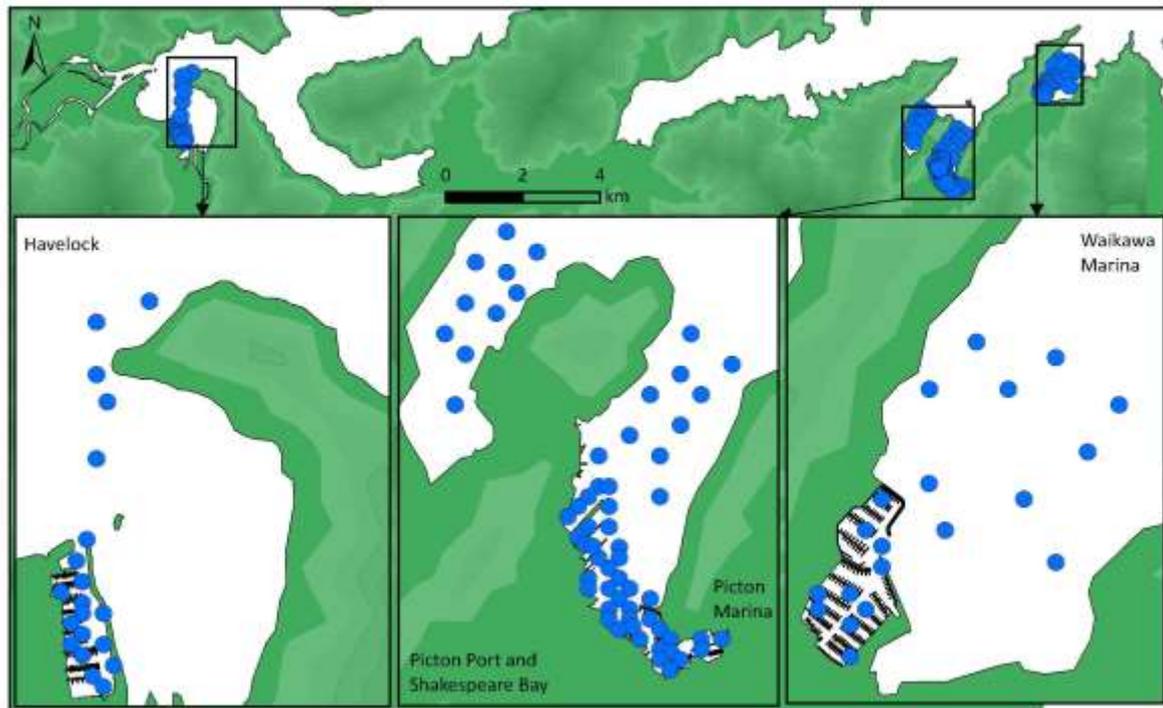
Shore search (WRACK) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

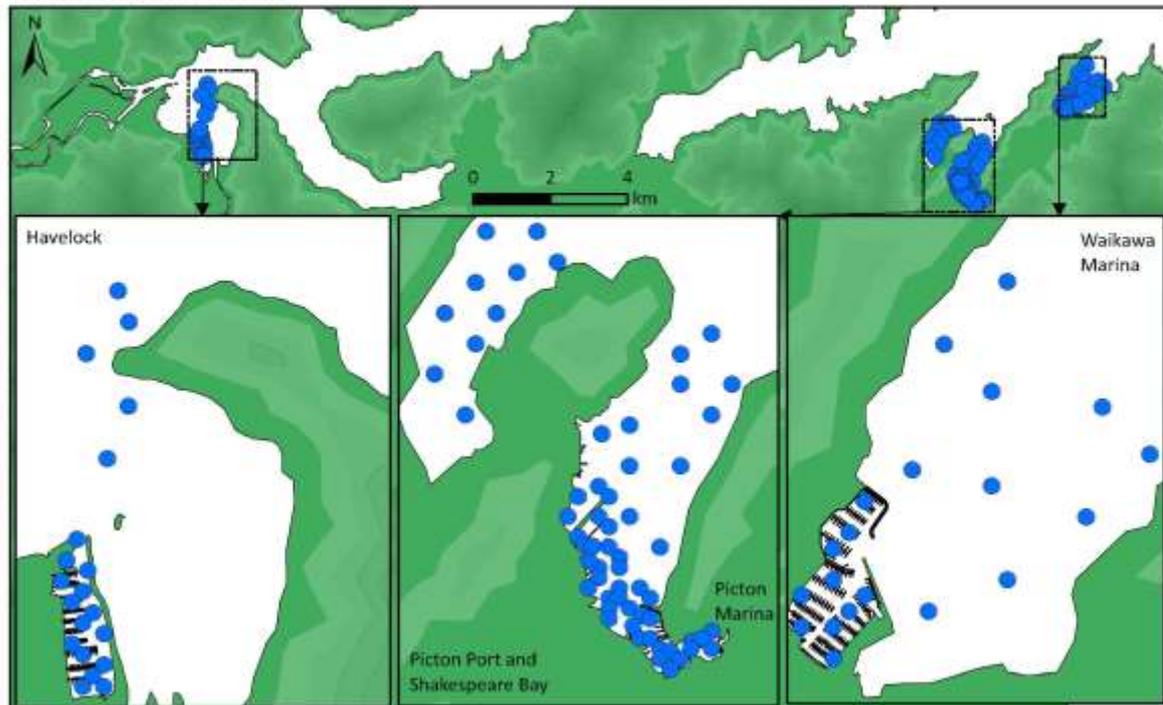
Benthic sled (BSLD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

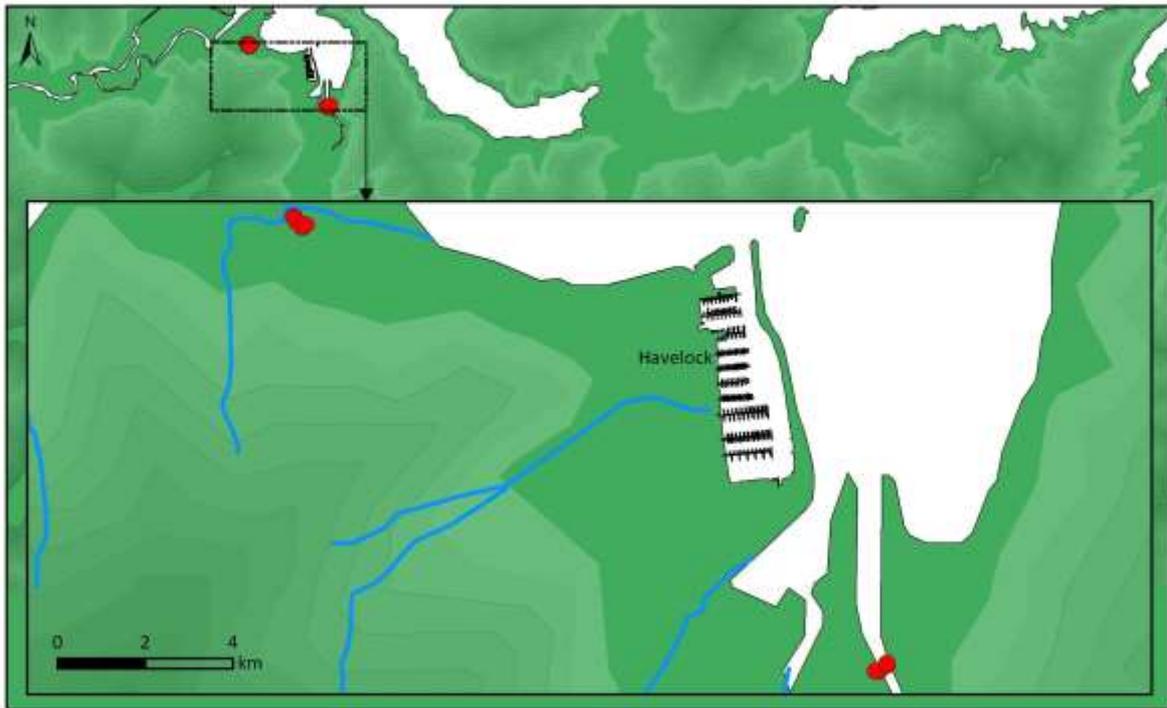
Benthic sled (BSLD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

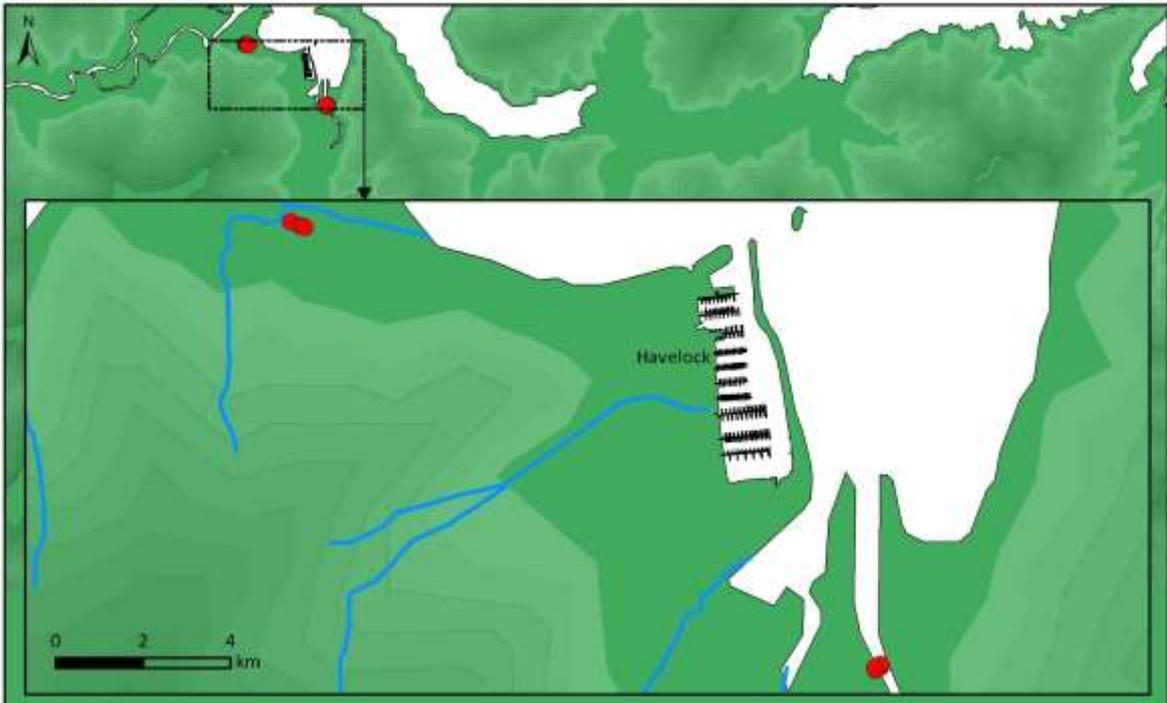
Crab condo (CONDO) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

Crab condo (CONDO) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

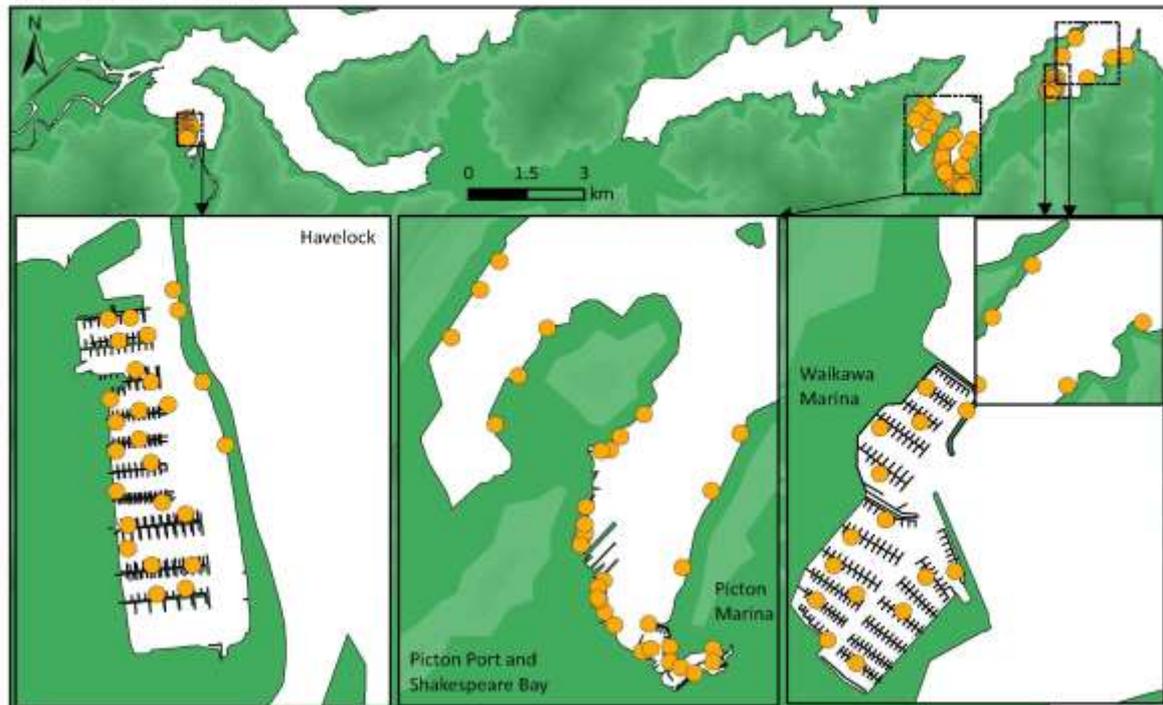
Crab trap (CRBTP) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

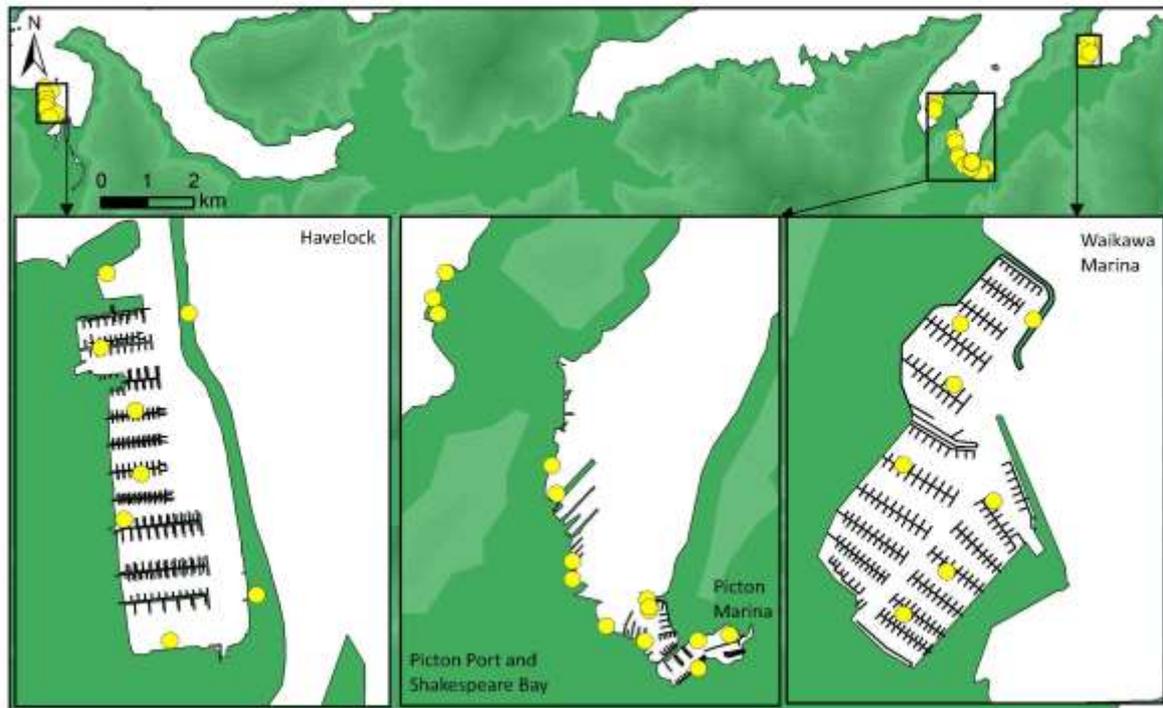
Crab trap (CRBTP) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

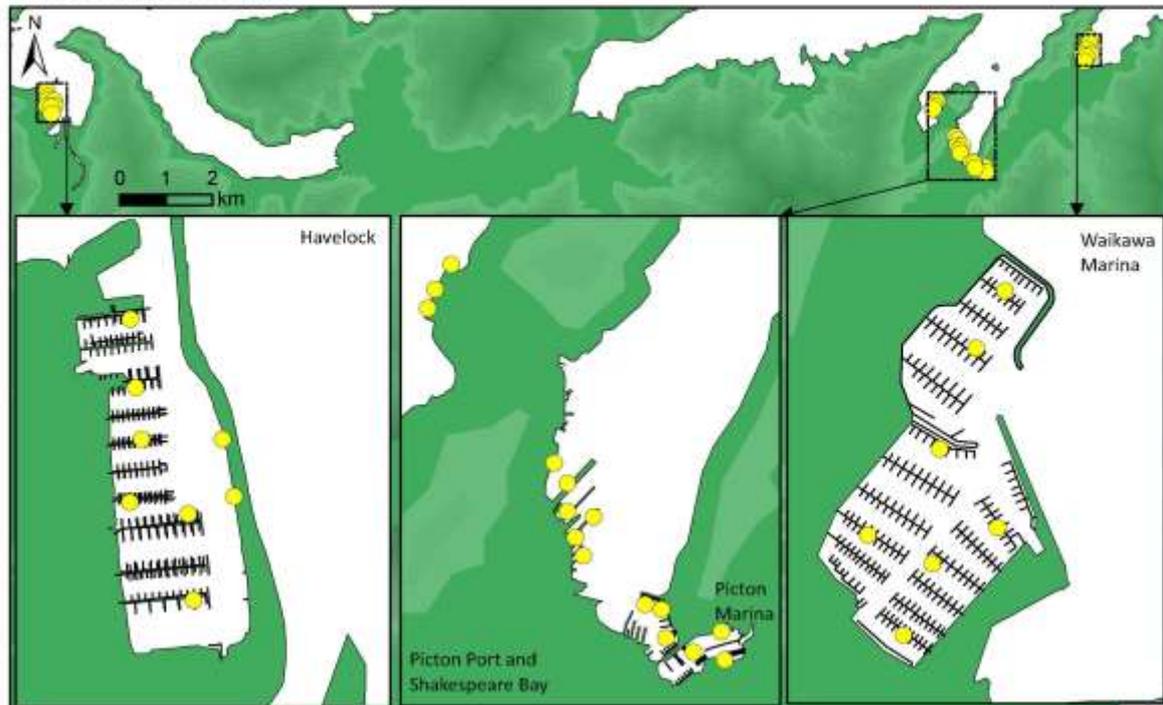
Diver search (VISD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

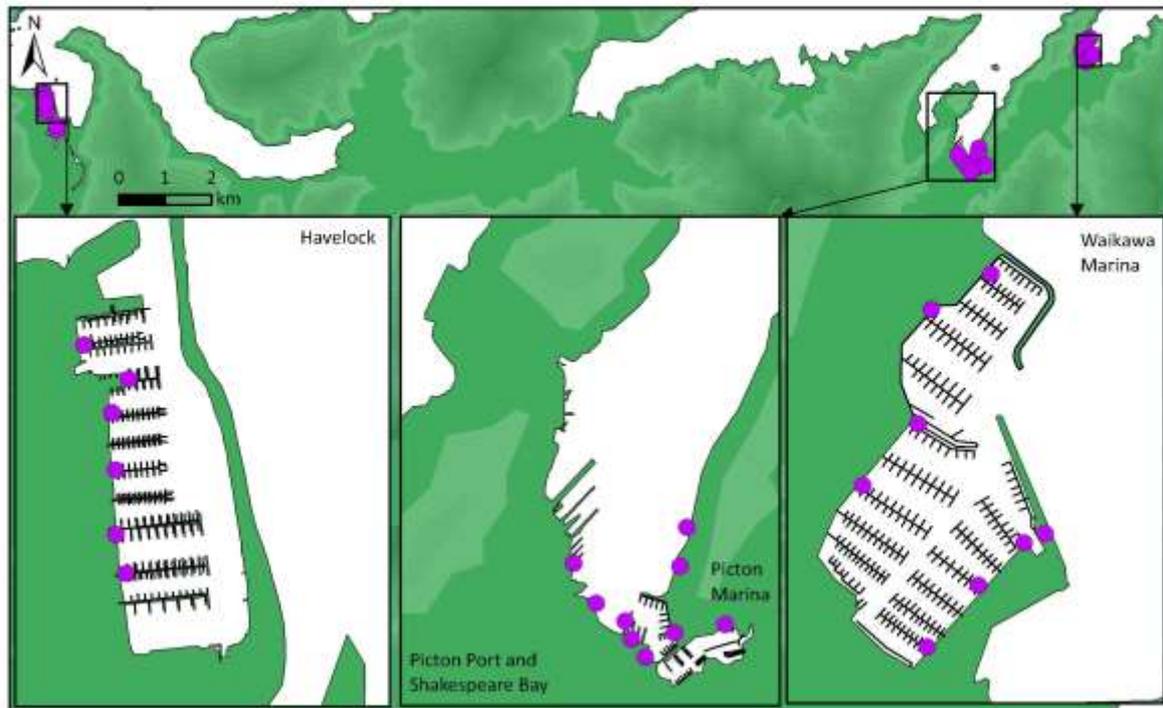
Diver search (VISD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

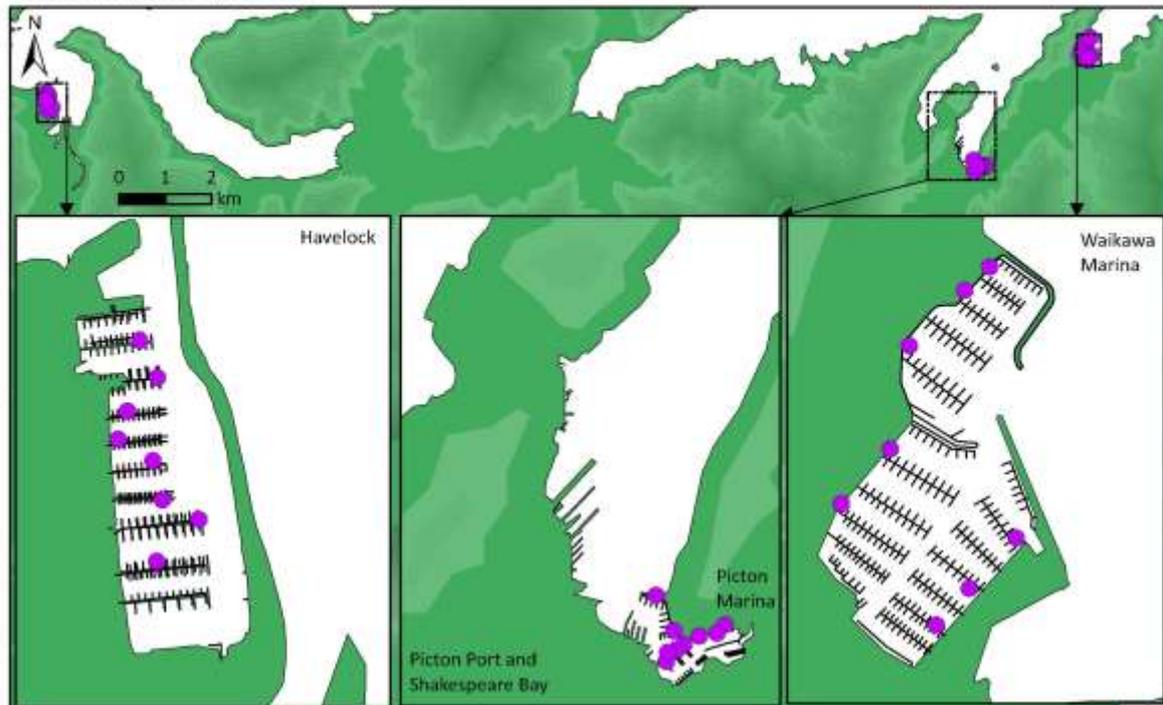
Shore search (WRACK) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

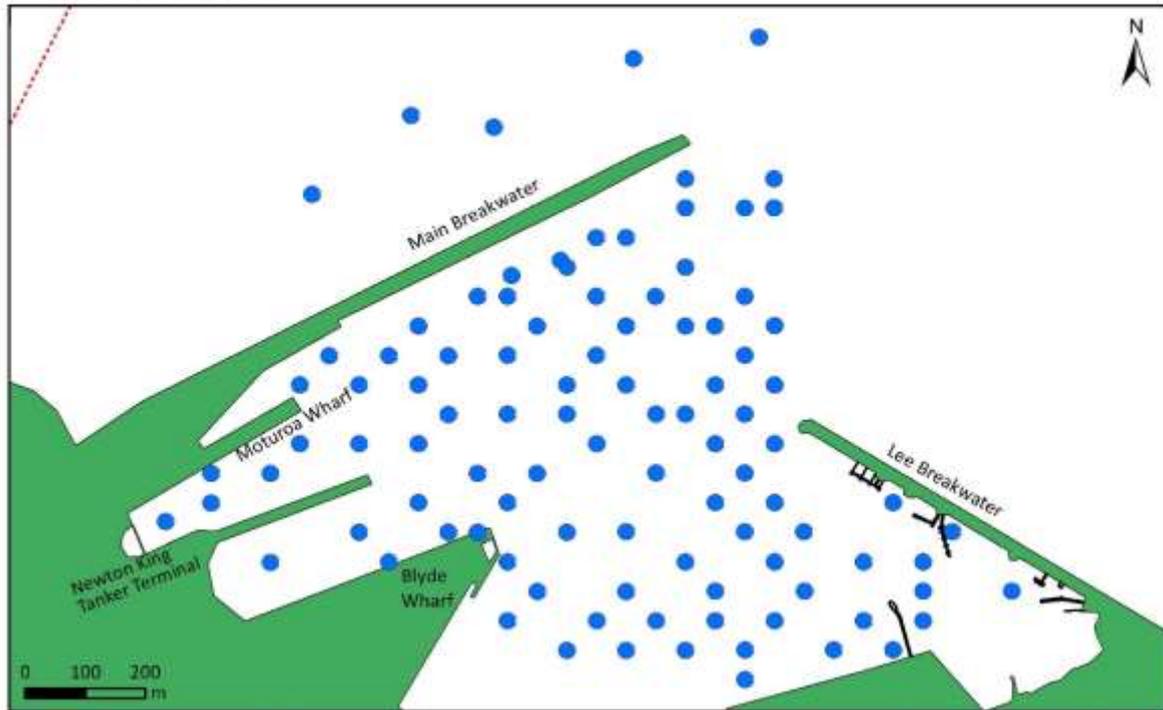
Shore search (WRACK) locations



Port Taranaki

Winter 2018

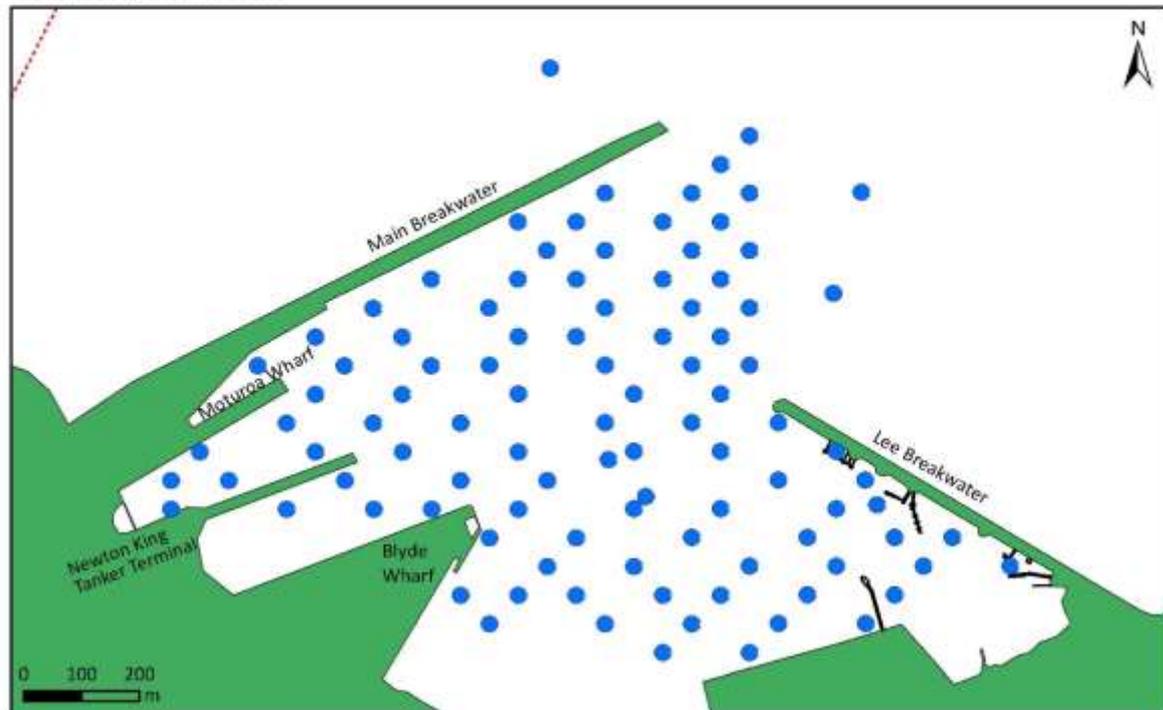
Benthic sled (BSLD) locations



Port Taranaki

Summer 2018-19

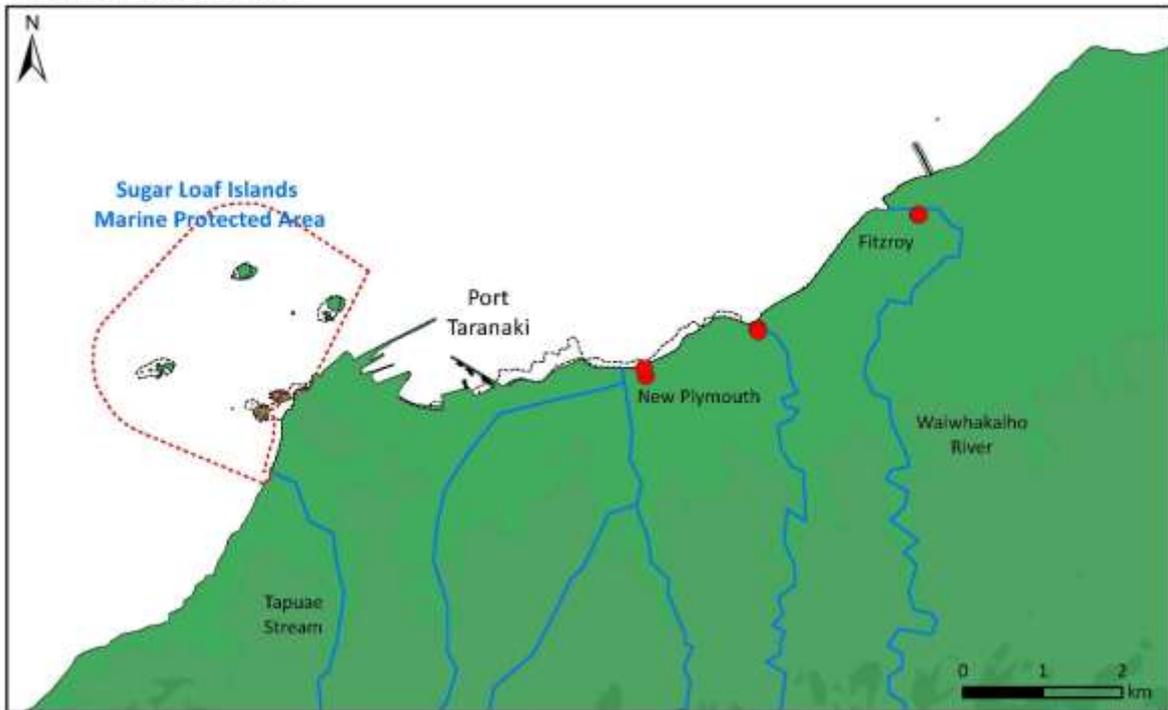
Benthic sled (BSLD) locations



Port Taranaki

Winter 2018

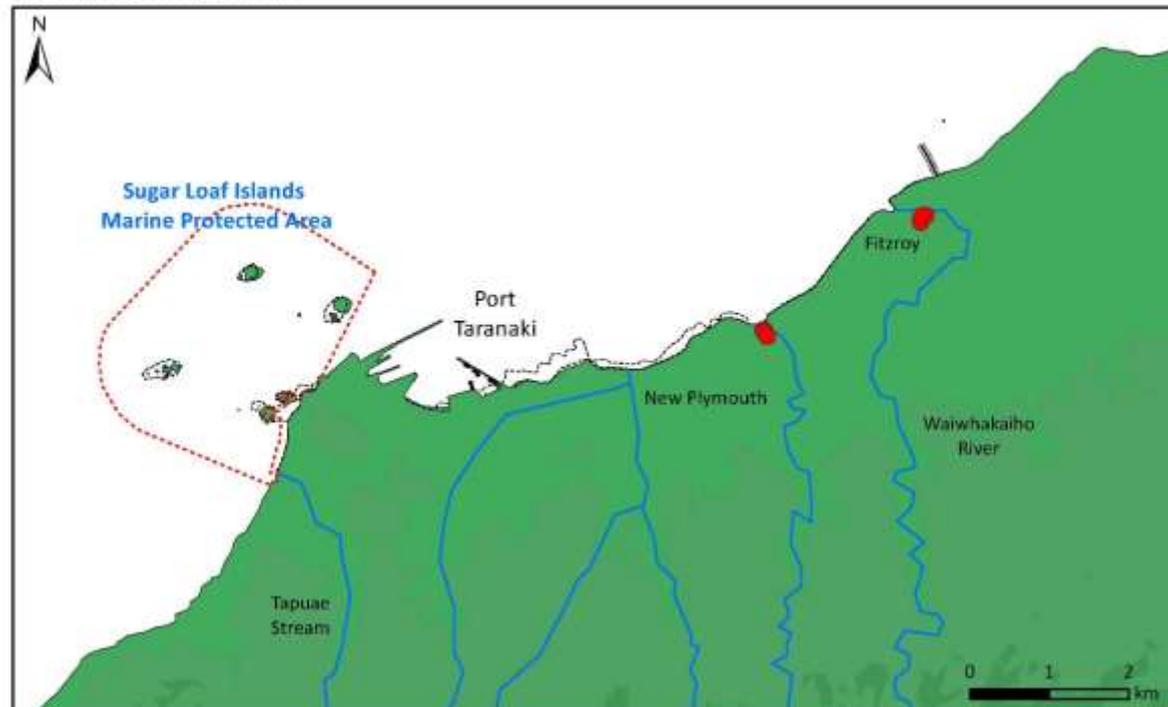
Crab condo (CONDO) locations



Port Taranaki

Summer 2018-19

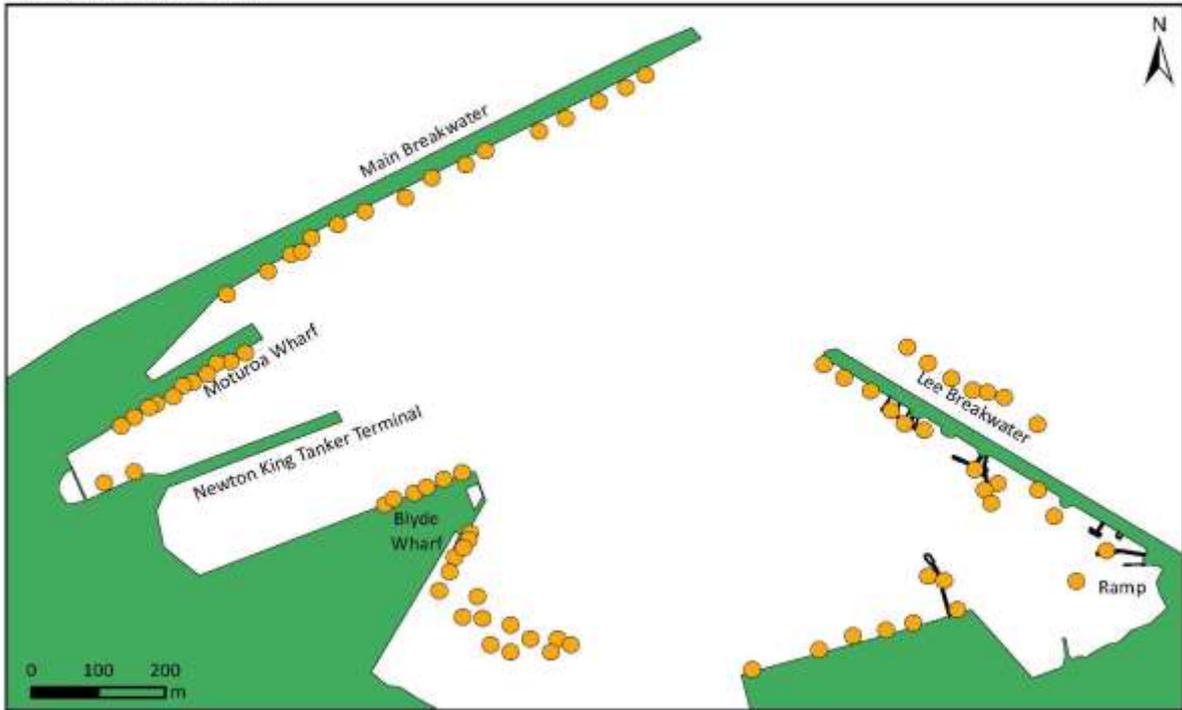
Crab condo (CONDO) locations



Port Taranaki

Winter 2018

Crab trap (CRBTP) locations



Port Taranaki

Summer 2018-19

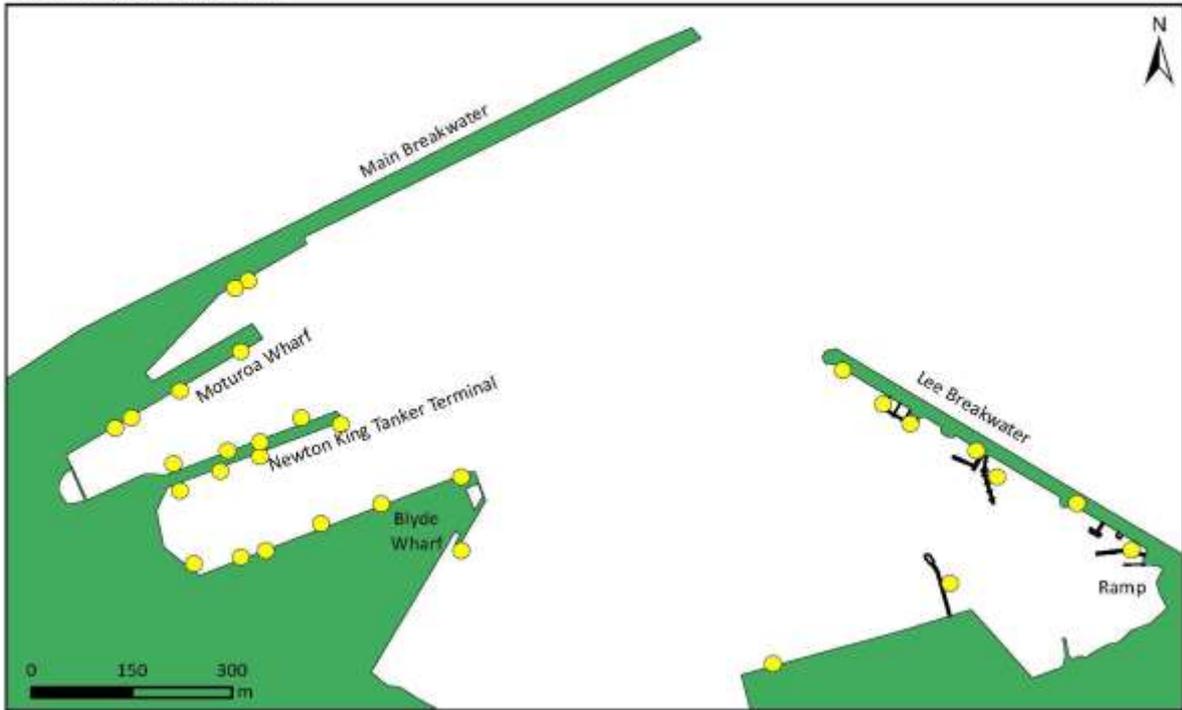
Crab trap (CRBTP) locations



Port Taranaki

Winter 2018

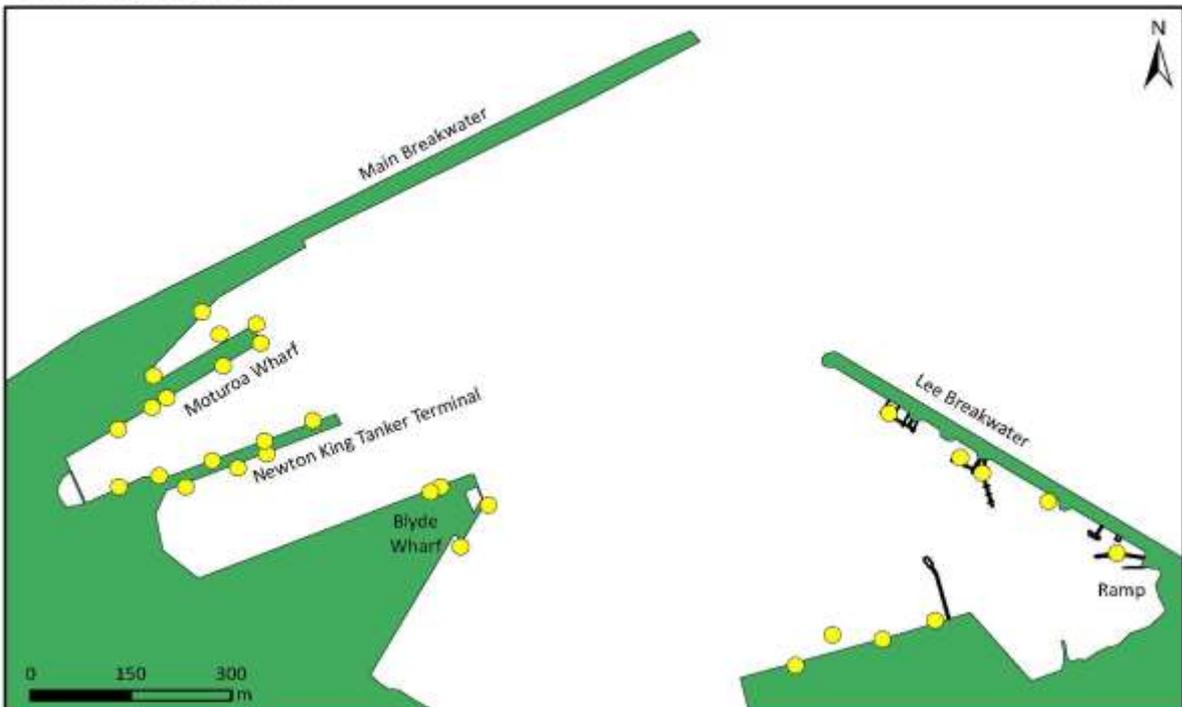
Diver search (VISD) locations



Port Taranaki

Summer 2018-19

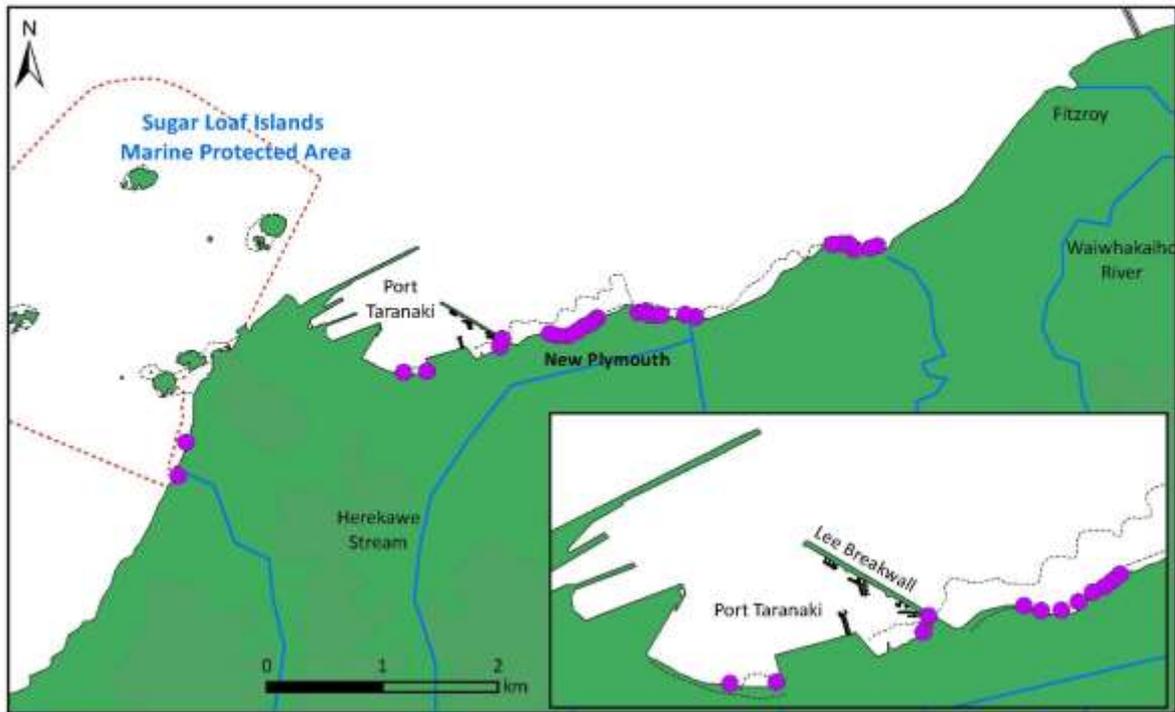
Diver search (VISD) locations



Port Taranaki

Winter 2018

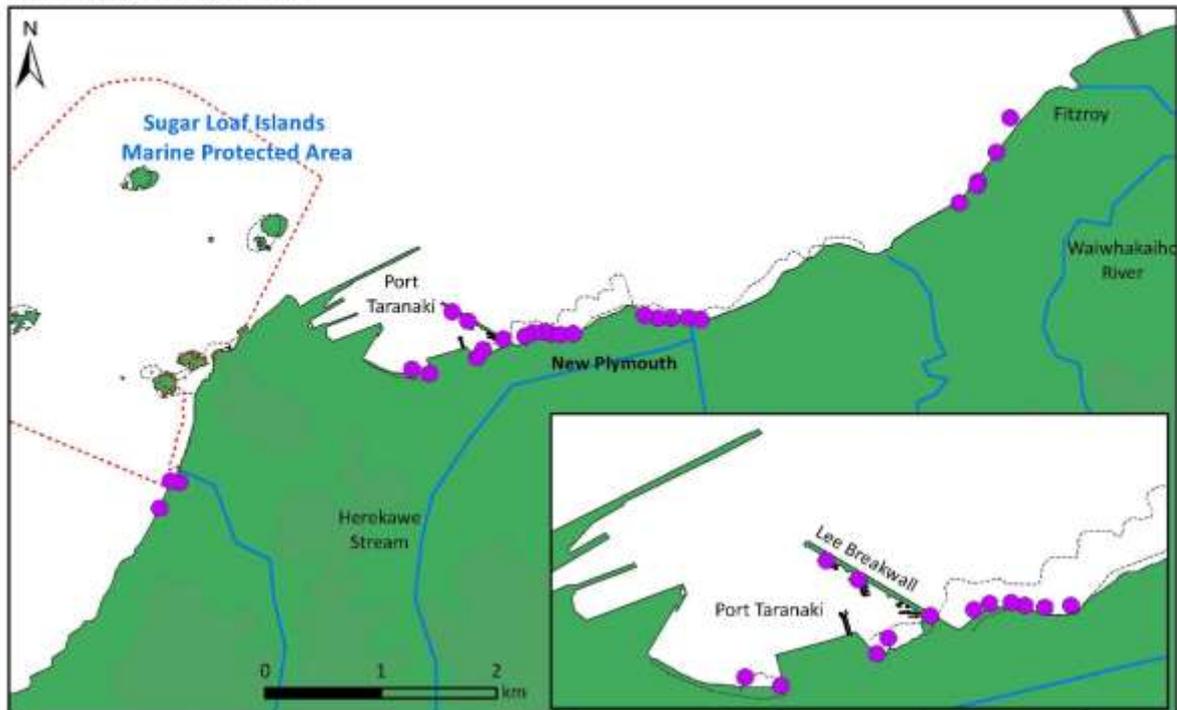
Shore search (WRACK) locations



Port Taranaki

Summer 2018-19

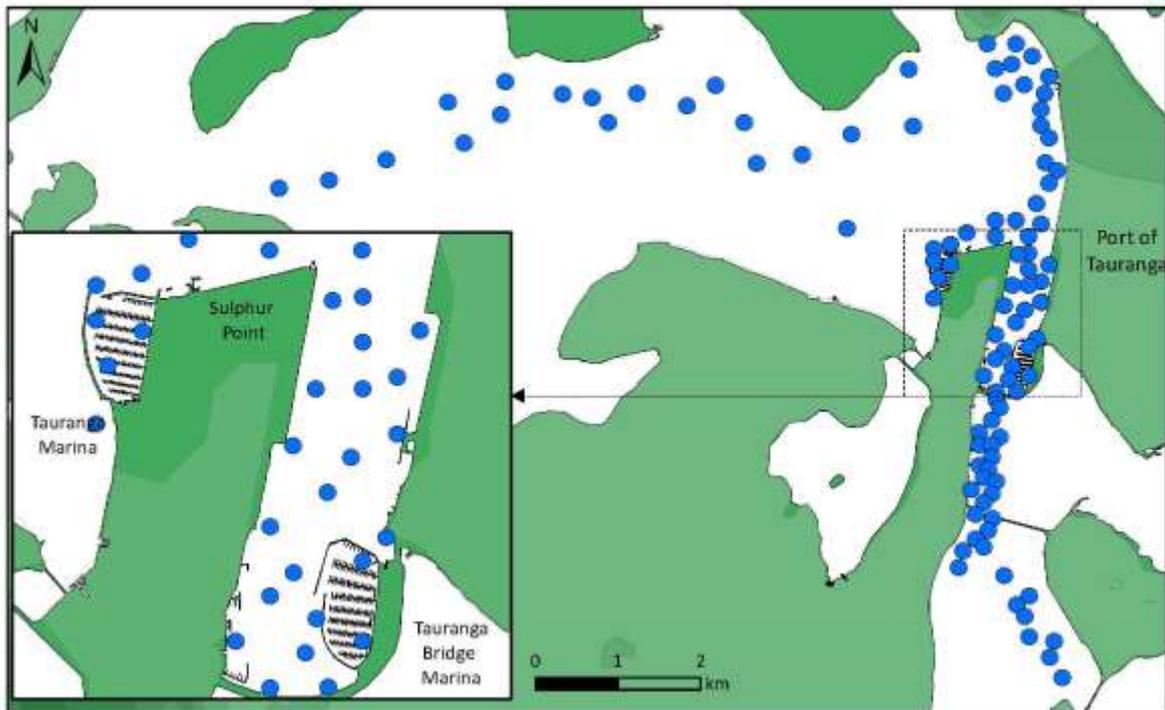
Shore search (WRACK) locations



Tauranga Harbour

Winter 2018

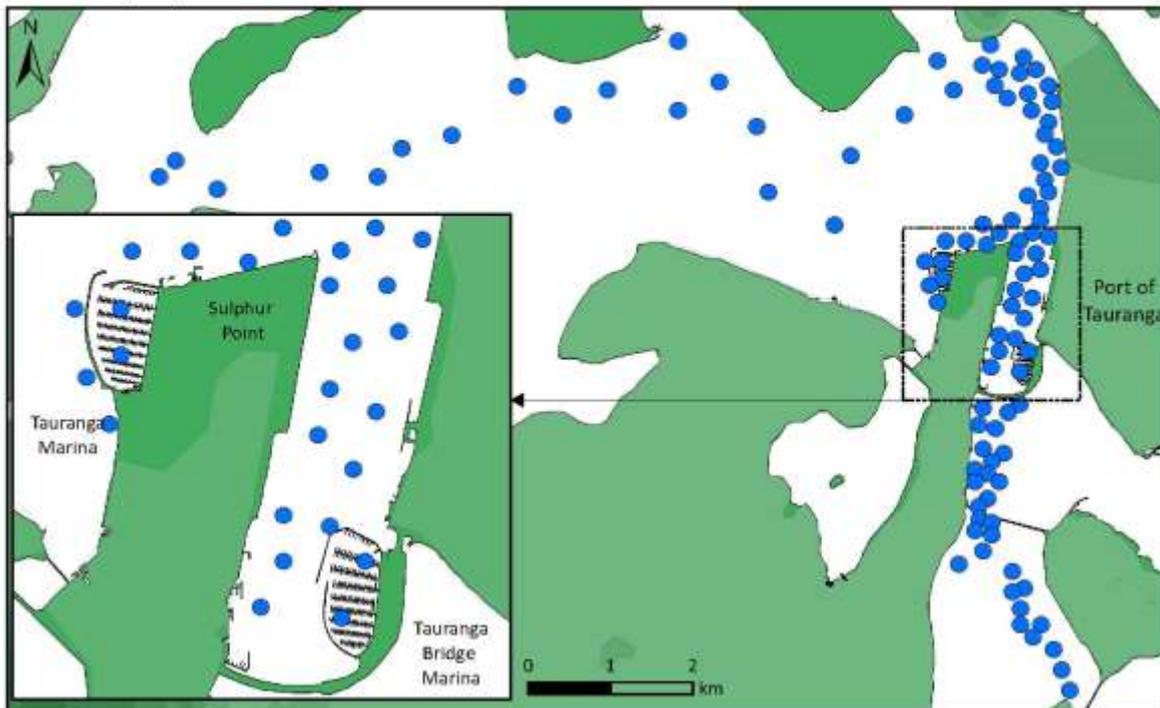
Benthic sled (BSLD) locations



Tauranga Harbour

Summer 2018-19

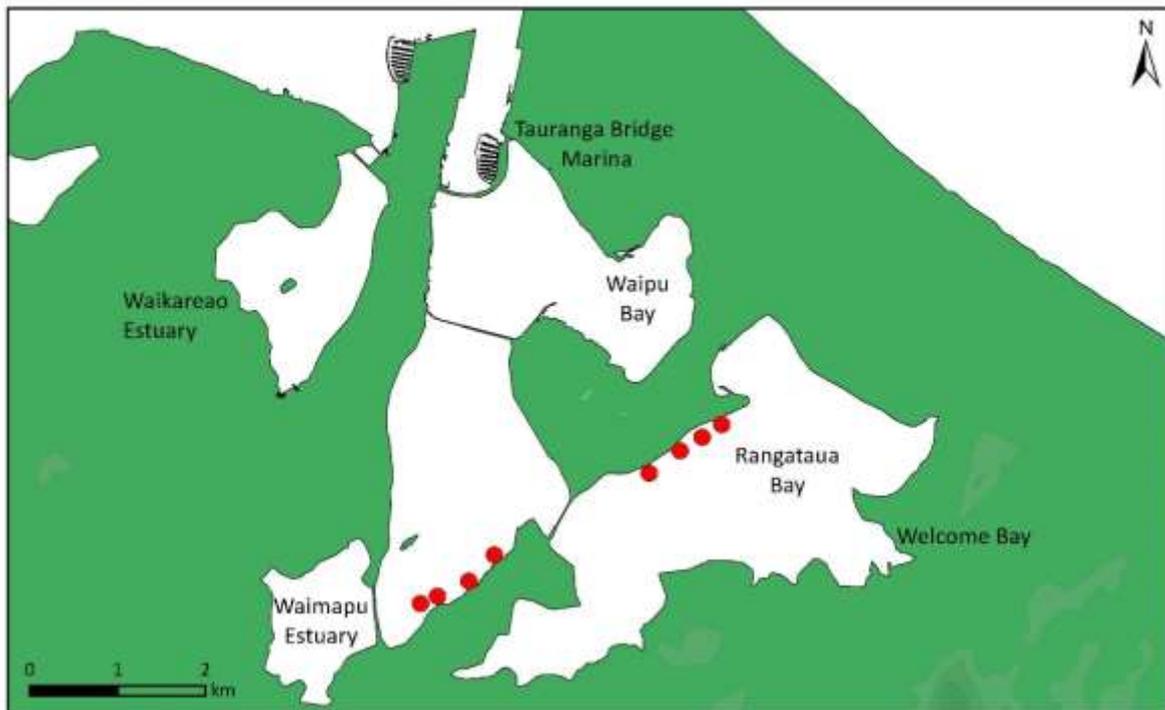
Benthic sled (BSLD) locations



Tauranga Harbour

Winter 2018

Crab condo (CONDO) locations



Tauranga Harbour

Summer 2018-19

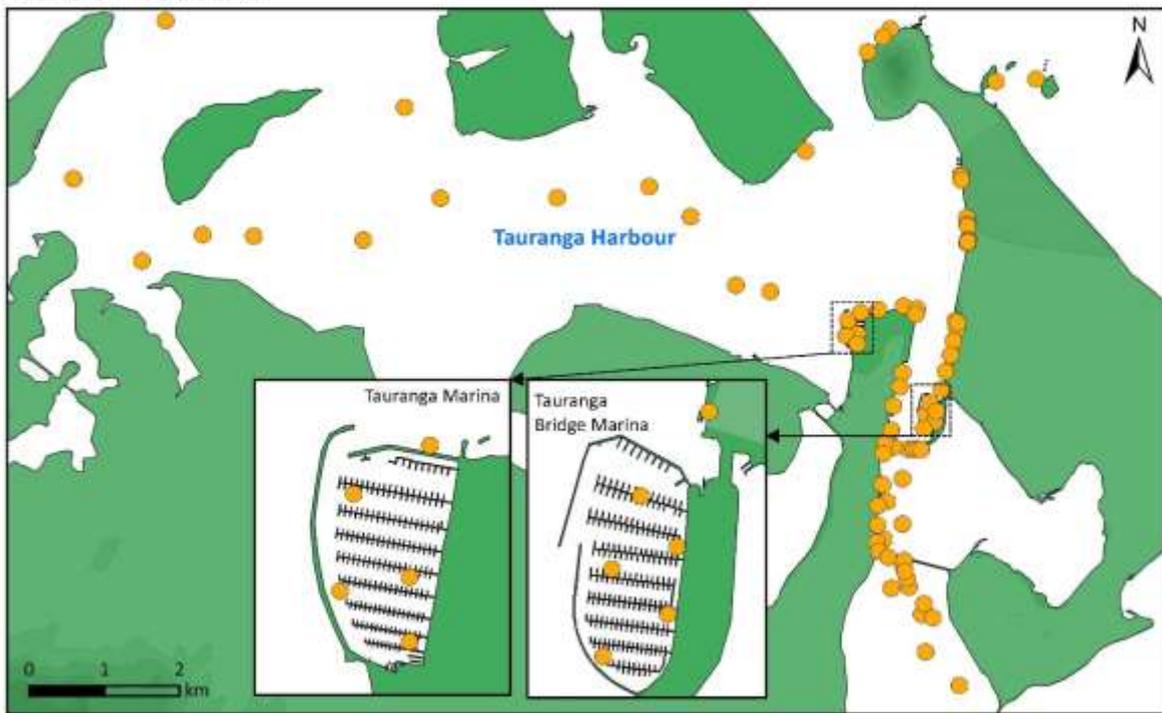
Crab condo (CONDO) locations



Tauranga Harbour

Winter 2018

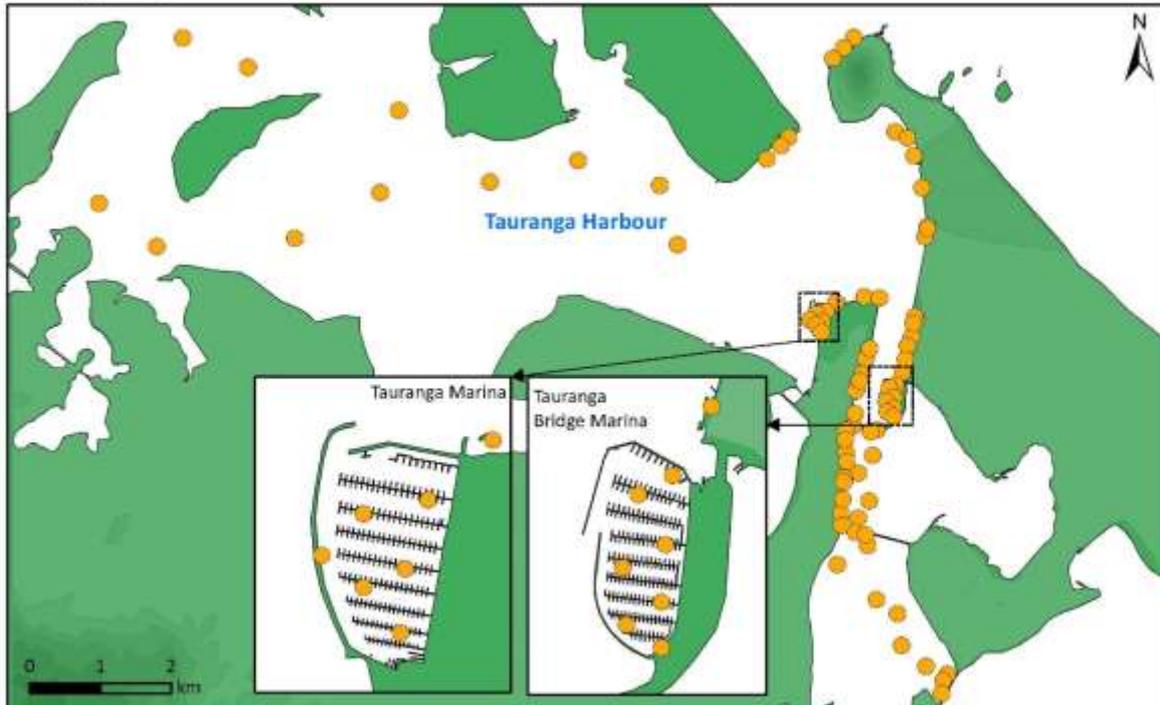
Crab trap (CRBTP) locations



Tauranga Harbour

Summer 2018-19

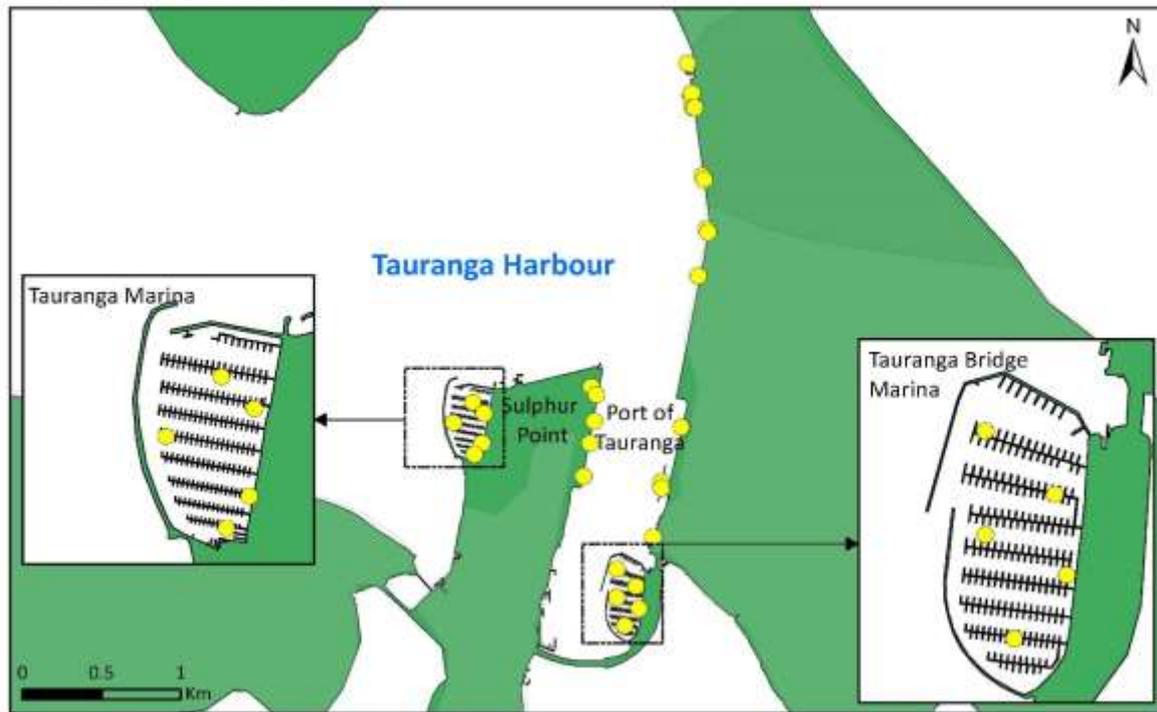
Crab trap (CRBTP) locations



Tauranga Harbour

Winter 2018

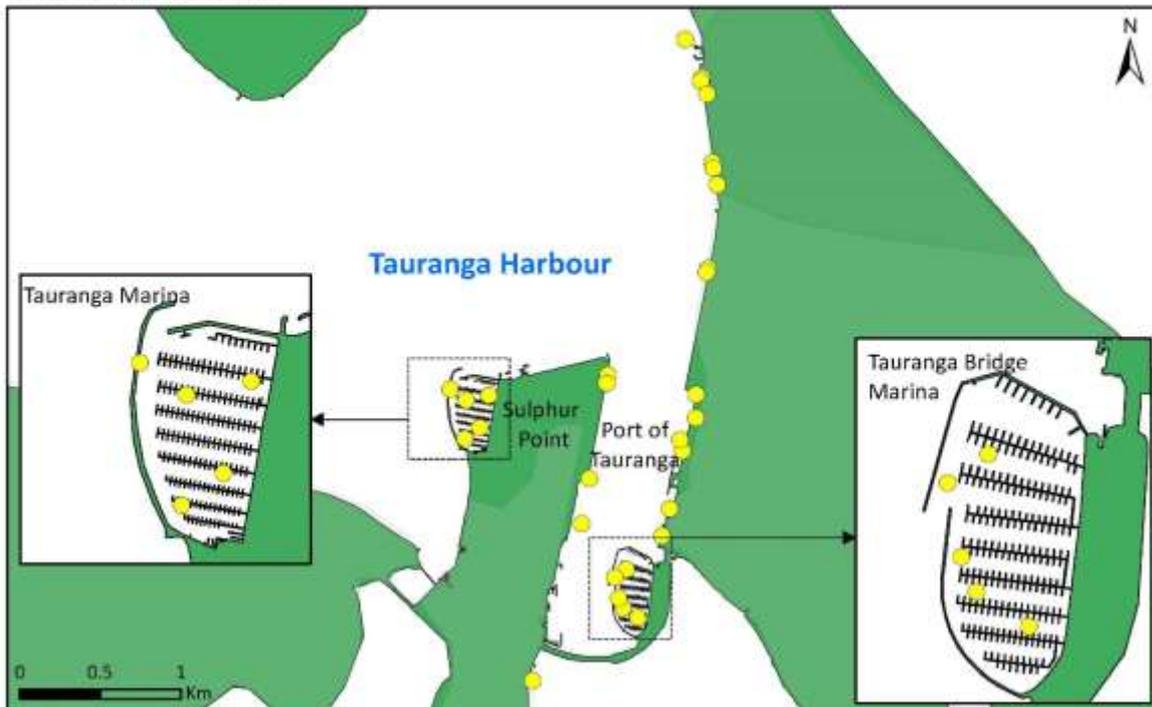
Diver search (VISD) locations



Tauranga Harbour

Summer 2018-19

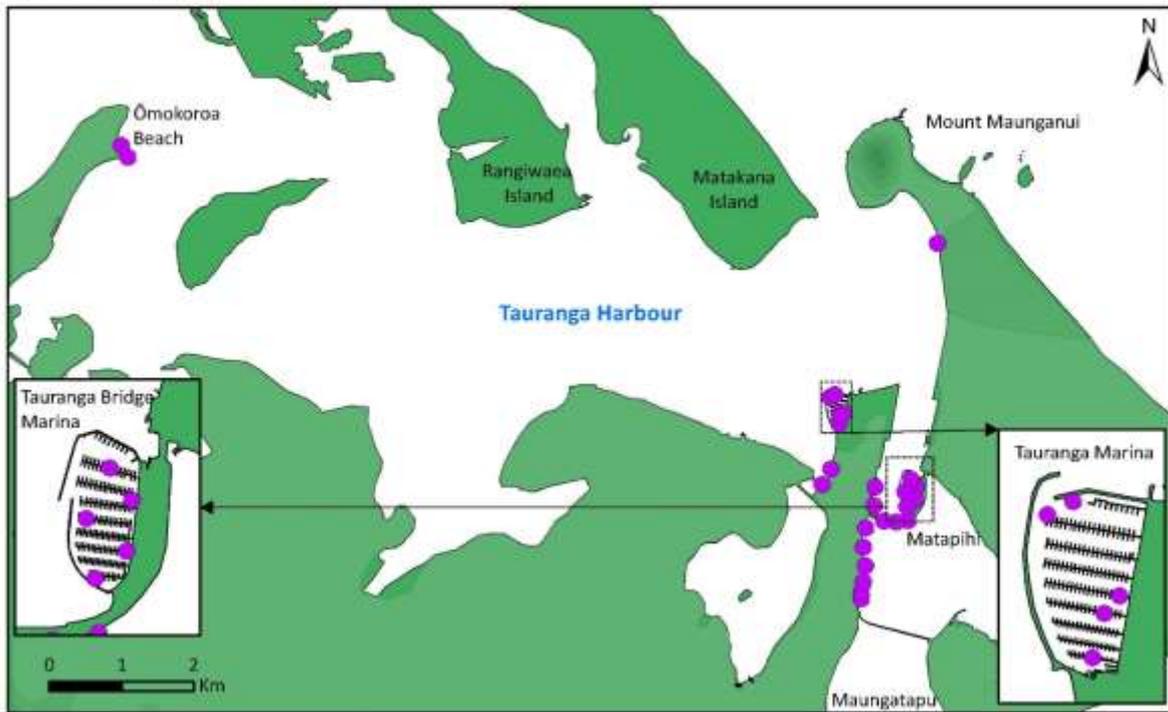
Diver search (VISD) locations



Tauranga Harbour

Winter 2018

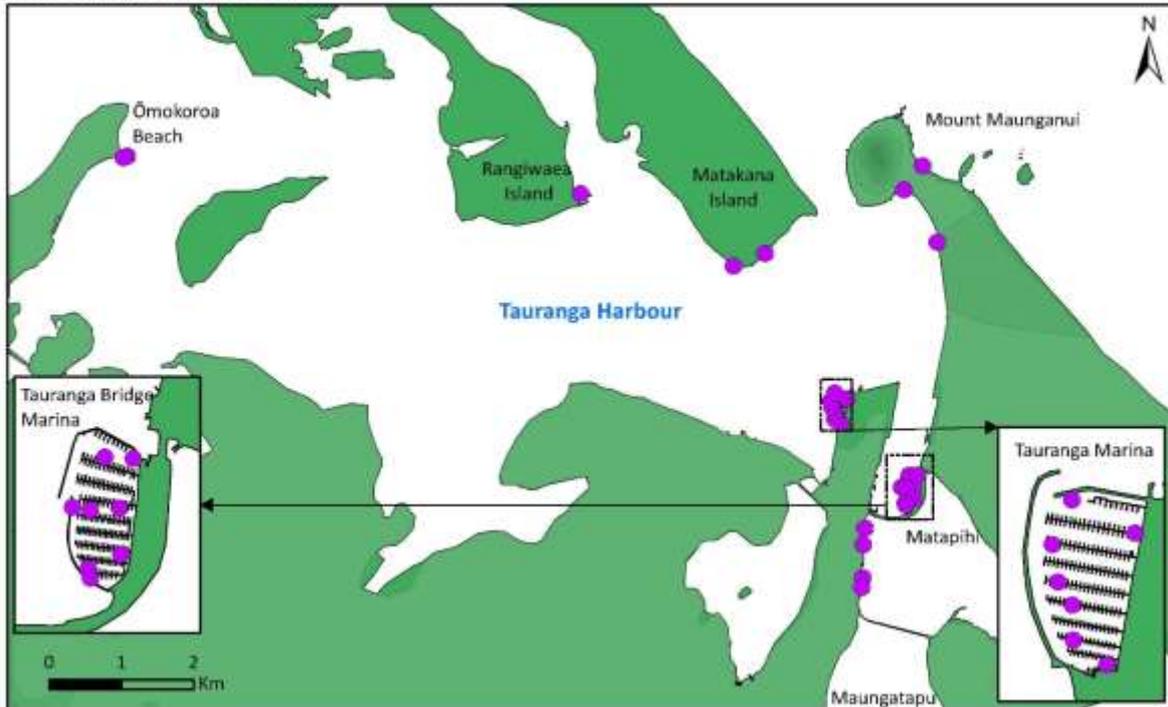
Shore search (WRACK) locations



Tauranga Harbour

Summer 2018-19

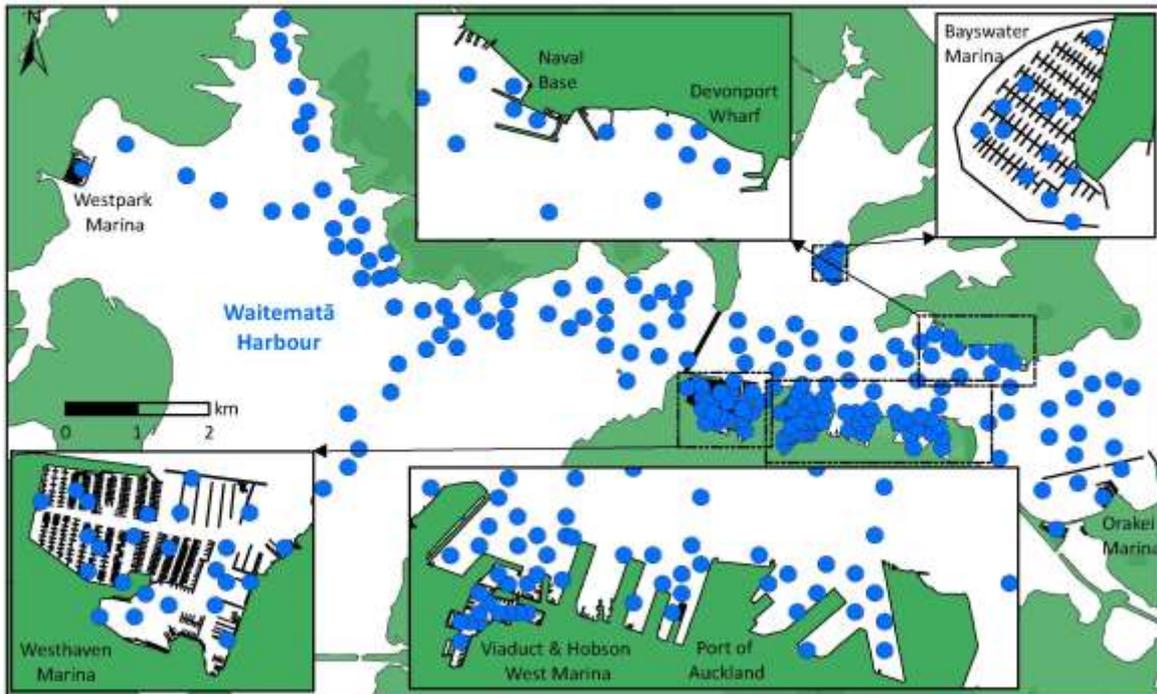
Shore search (WRACK) locations



Waitematā Harbour

Winter 2018

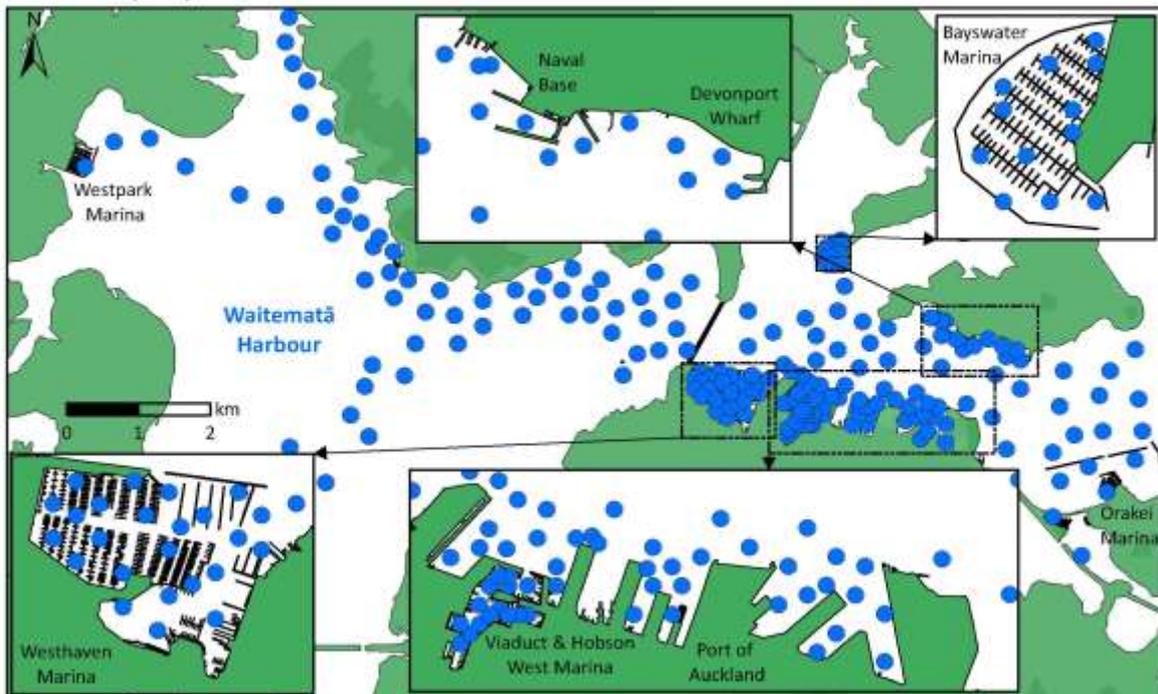
Benthic sled (BSLD) locations



Waitematā Harbour

Summer 2018-19

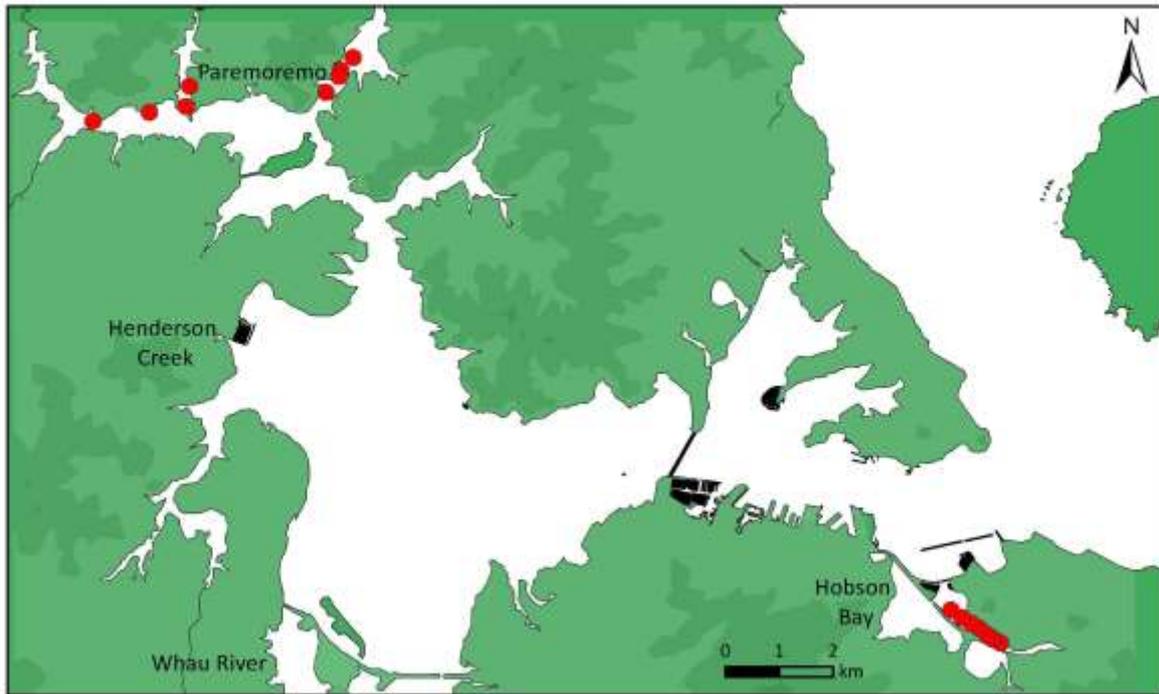
Benthic sled (BSLD) locations



Waitematā Harbour

Winter 2018

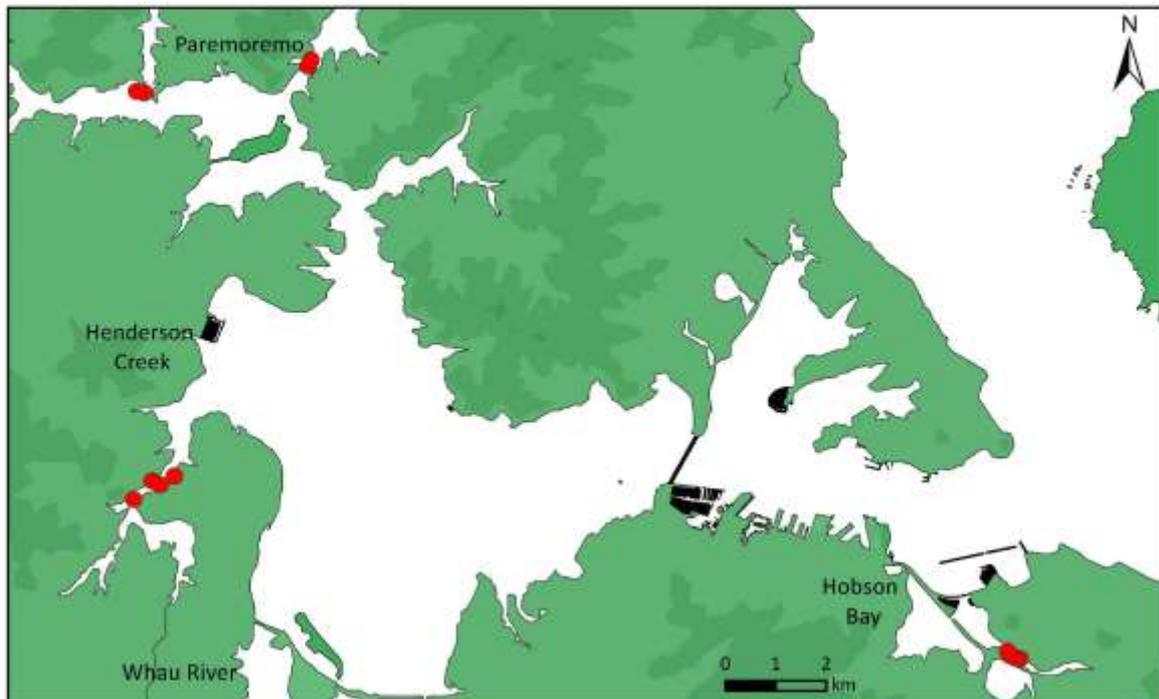
Crab condo (CONDO) locations



Waitematā Harbour

Summer 2018-19

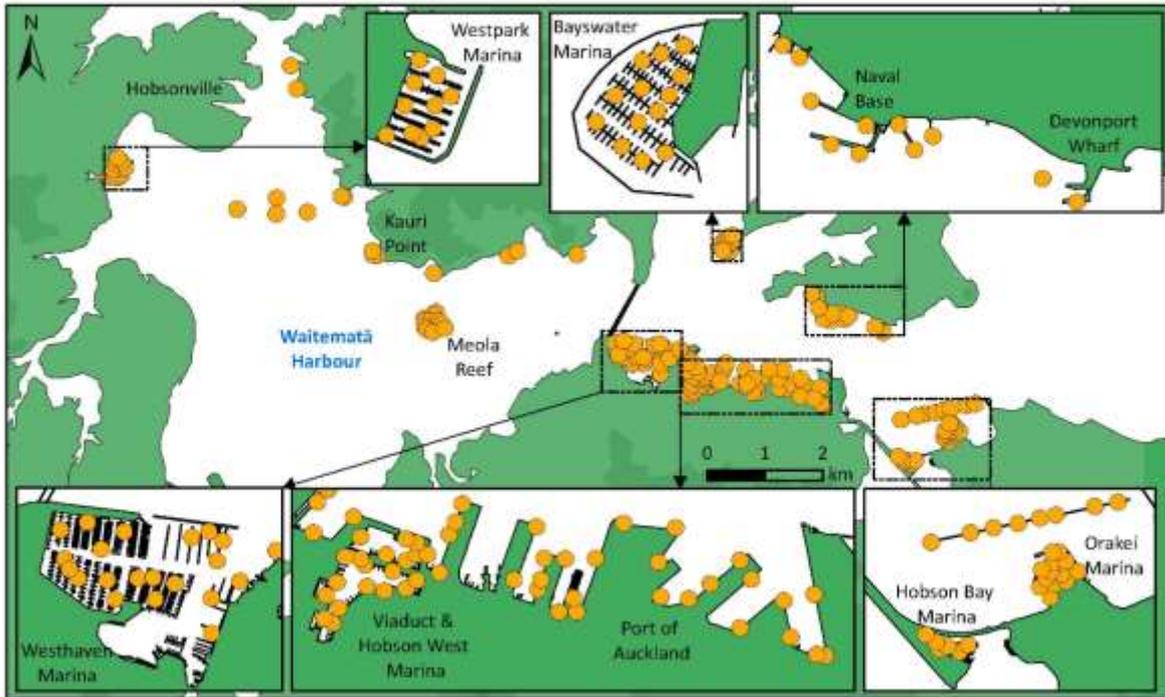
Crab condo (CONDO) locations



Waitematā Harbour

Winter 2018

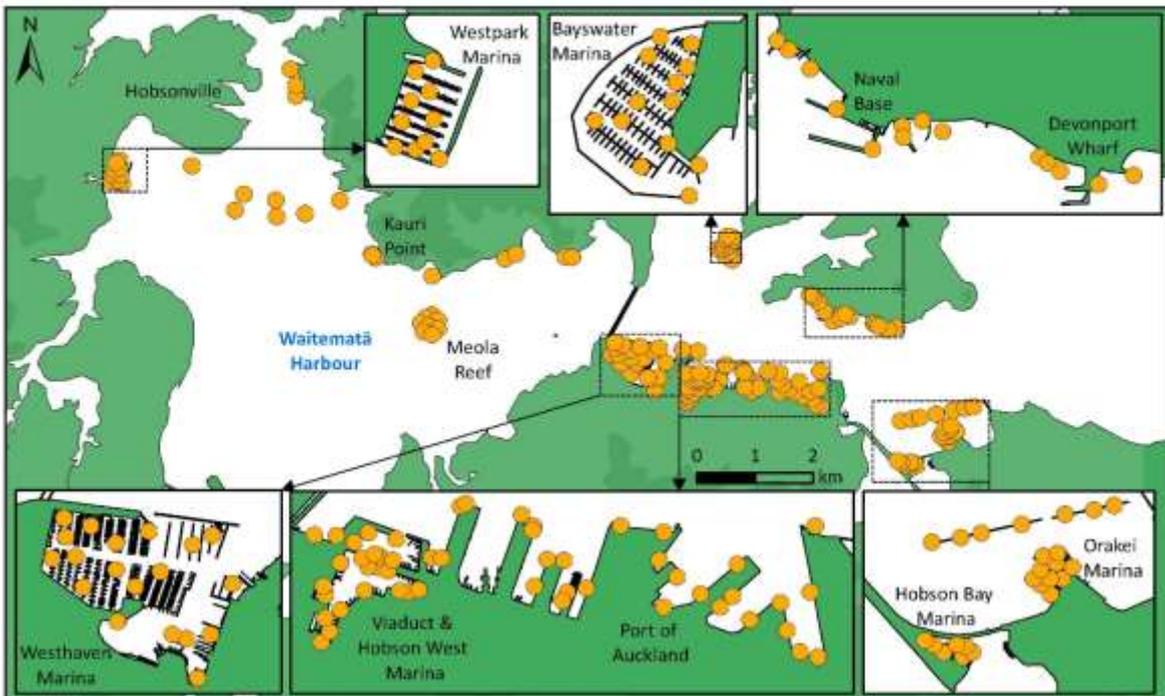
Crab (box) trap (CRBTP) locations



Waitematā Harbour

Summer 2018-19

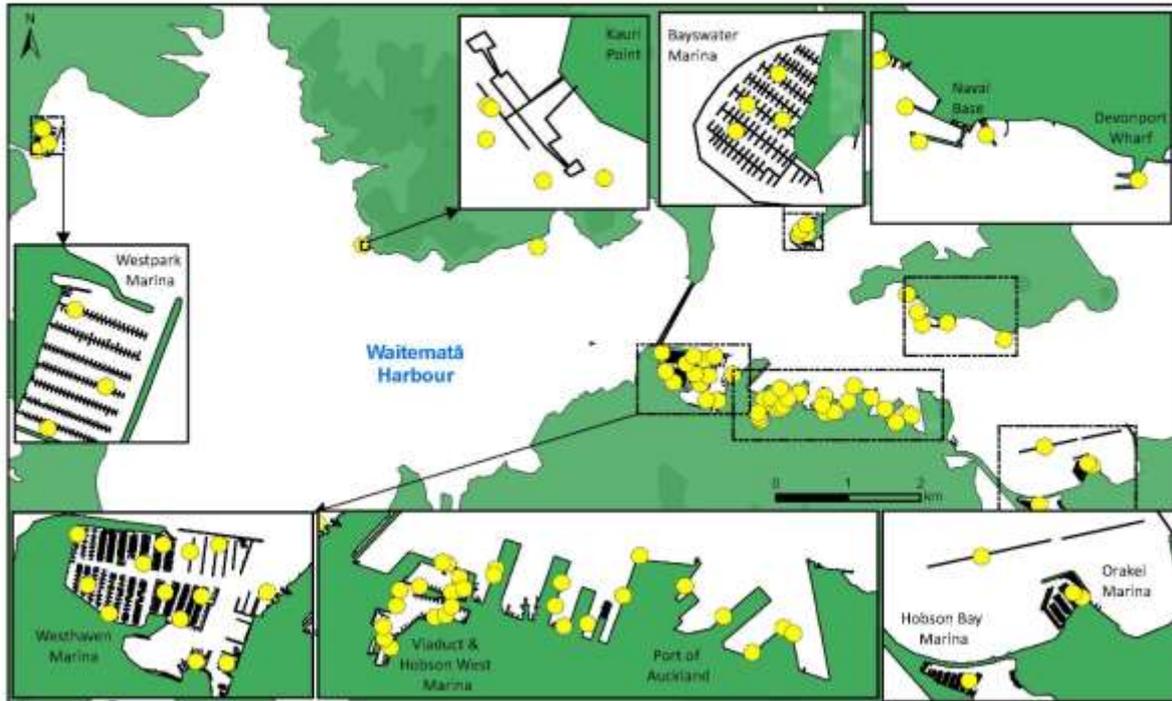
Crab (box) trap (CRBTP) locations



Waitematā Harbour

Winter 2018

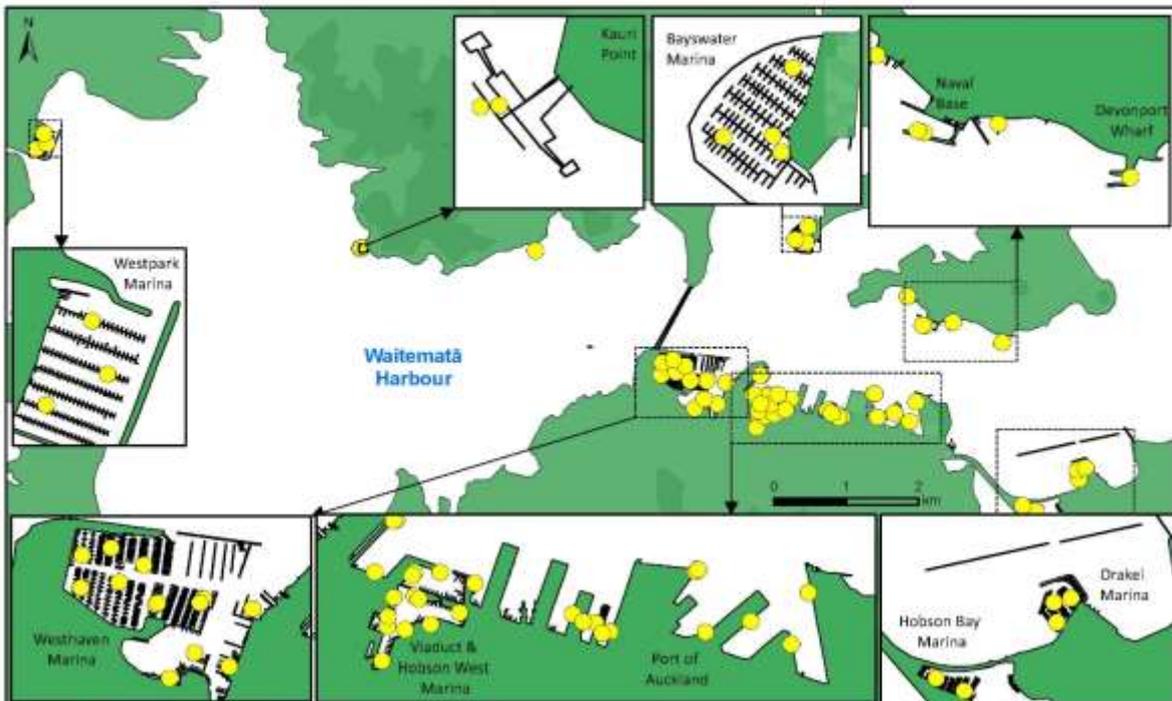
Diver search (VISD) locations



Waitematā Harbour

Summer 2018-19

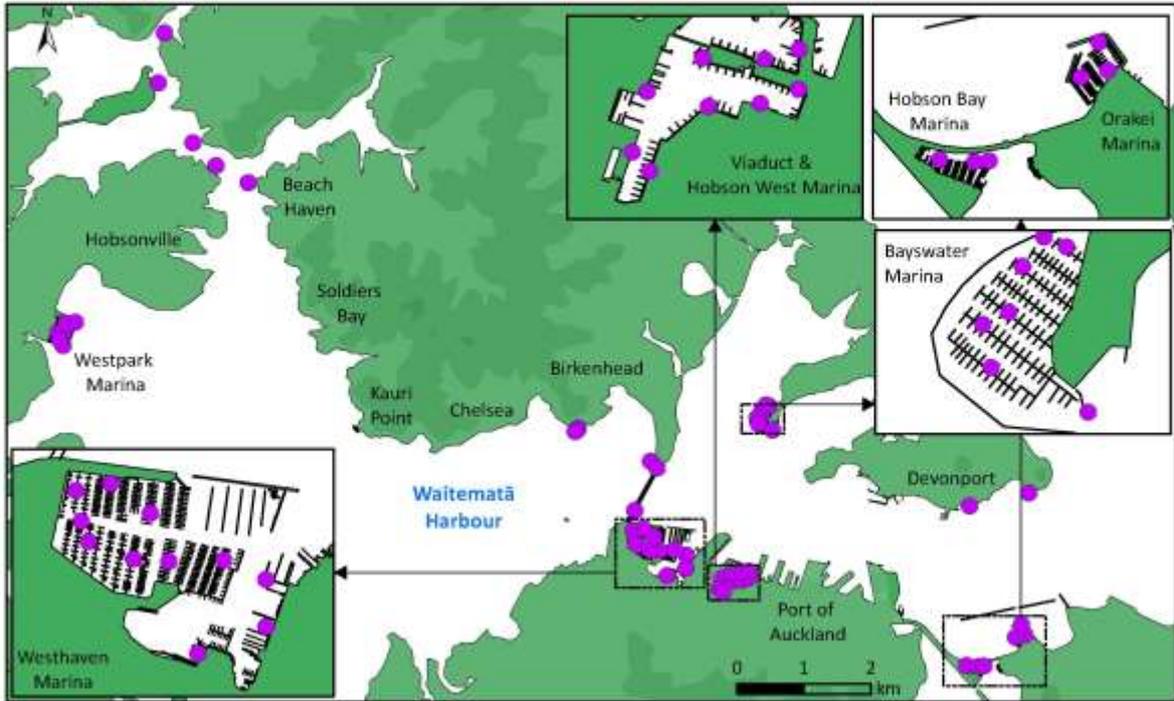
Diver search (VISD) locations



Waitematā Harbour

Winter 2018

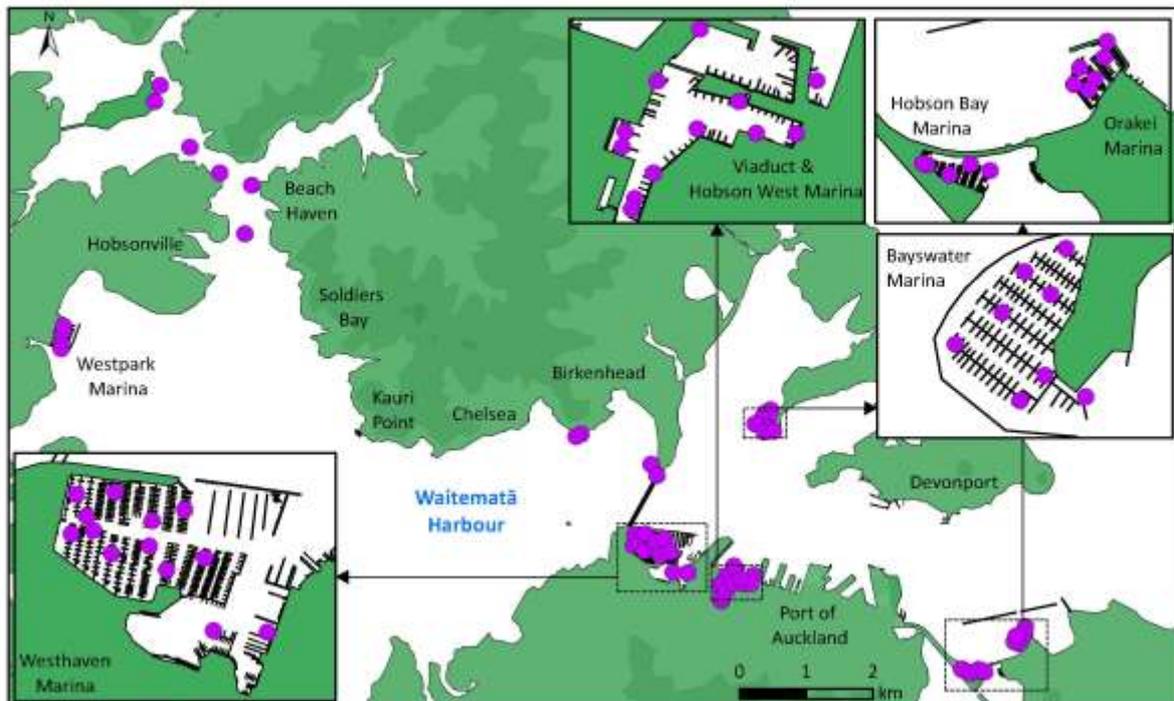
Shore search (WRACK) locations



Waitematā Harbour

Summer 2018-19

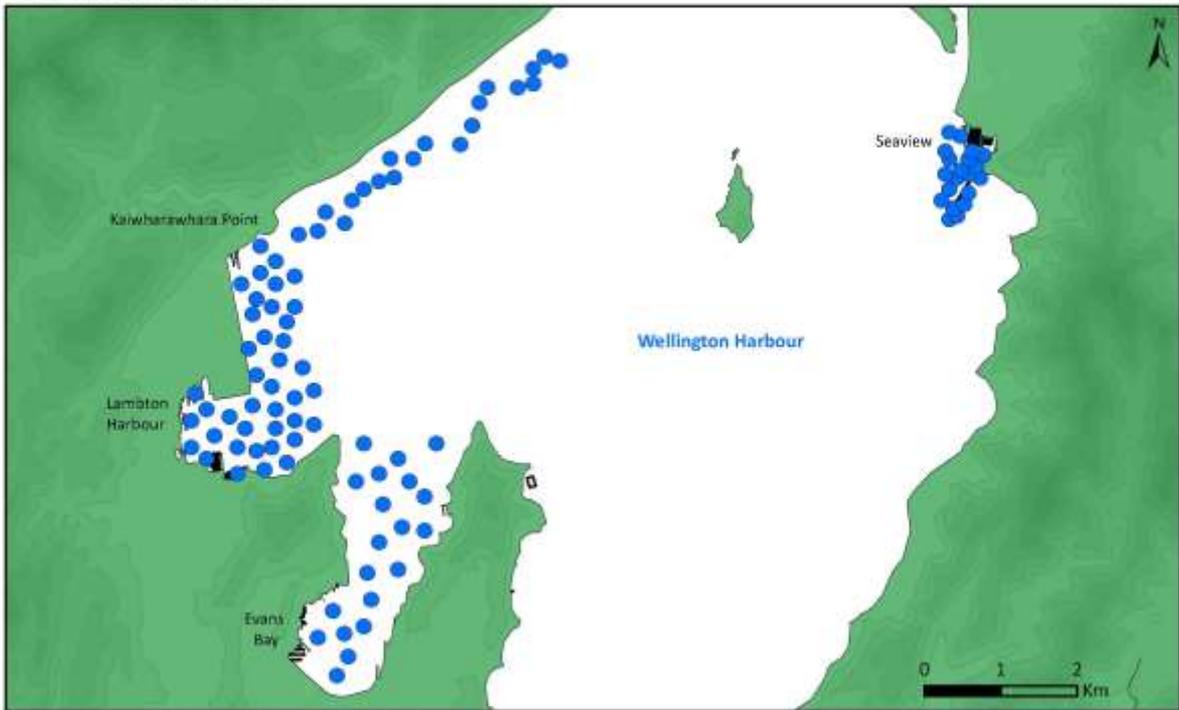
Shore search (WRACK) locations



Wellington Harbour

Winter 2018

Benthic sled (BSLD) locations



Wellington Harbour

Summer 2018-19

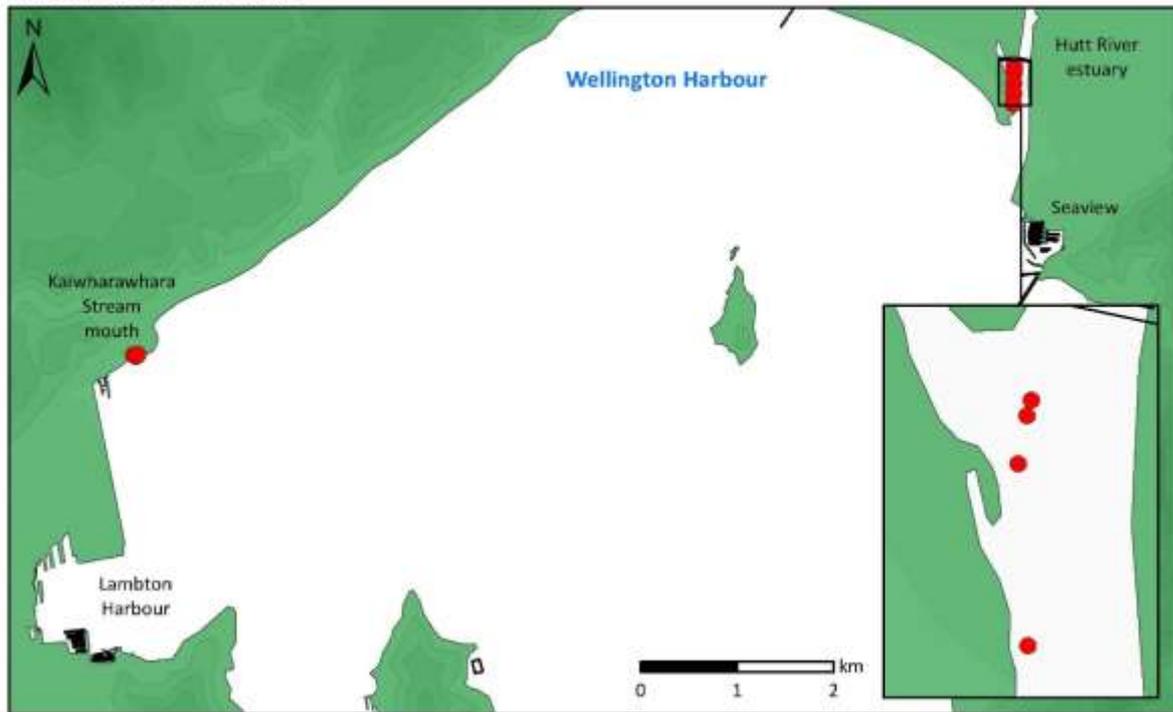
Benthic sled (BSLD) locations



Wellington Harbour

Winter 2018

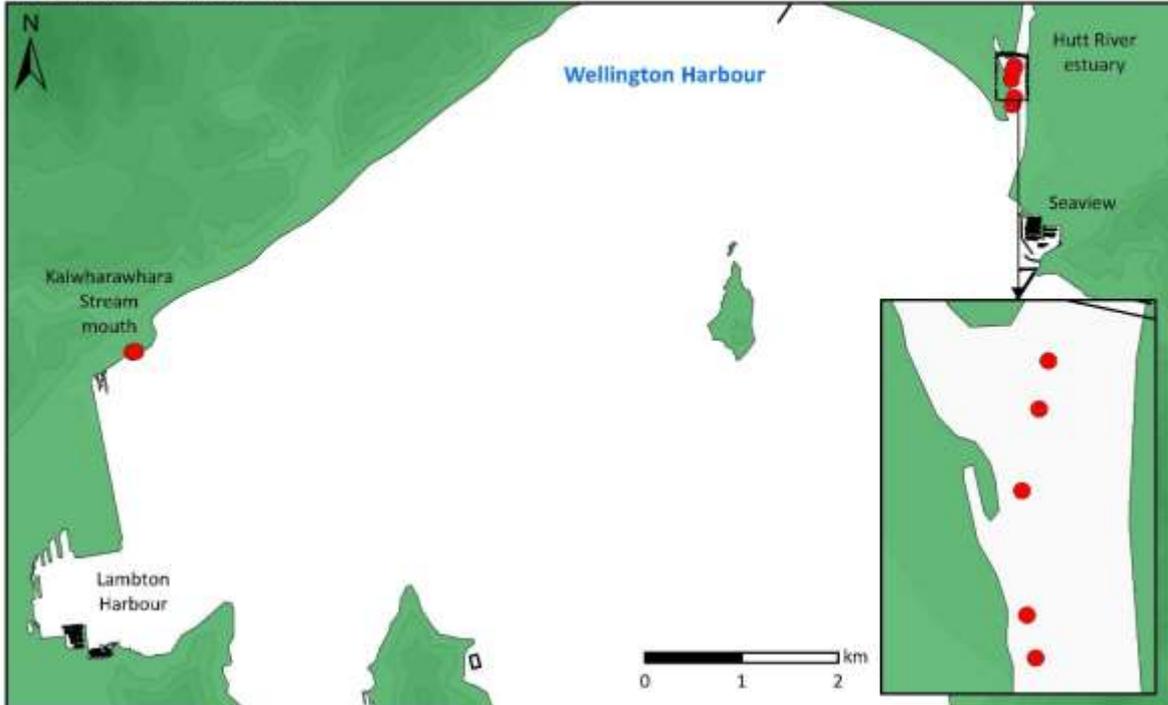
Crab condo (CONDO) locations



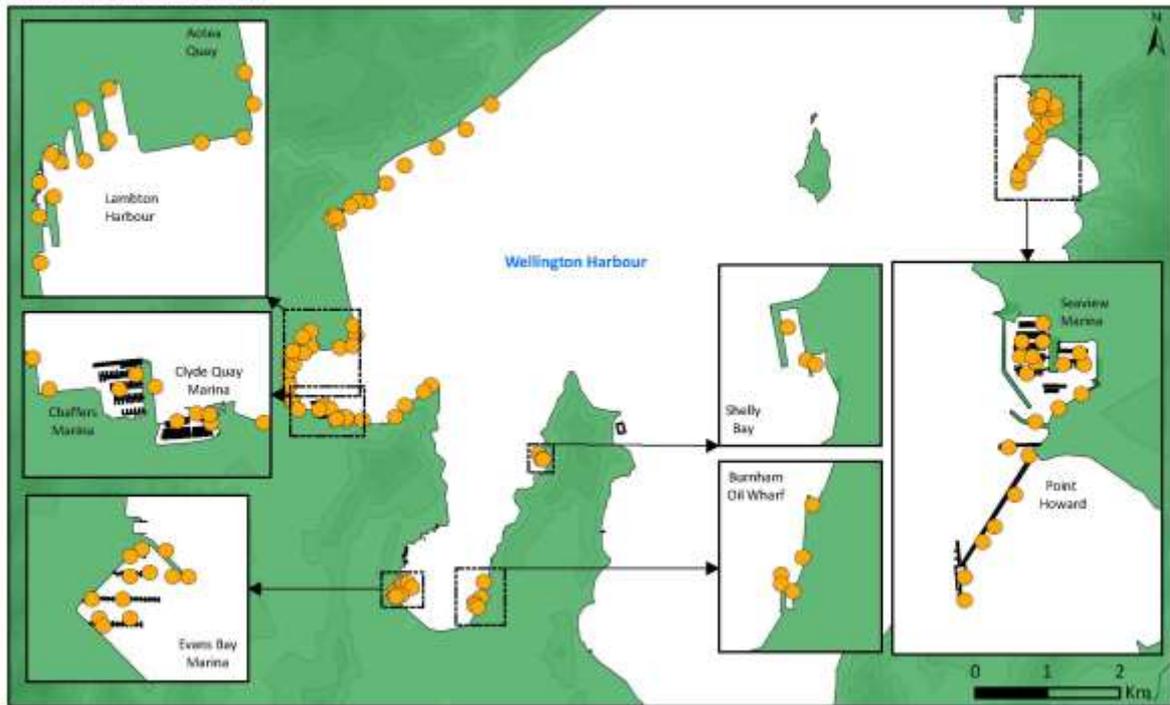
Wellington Harbour

Summer 2018-19

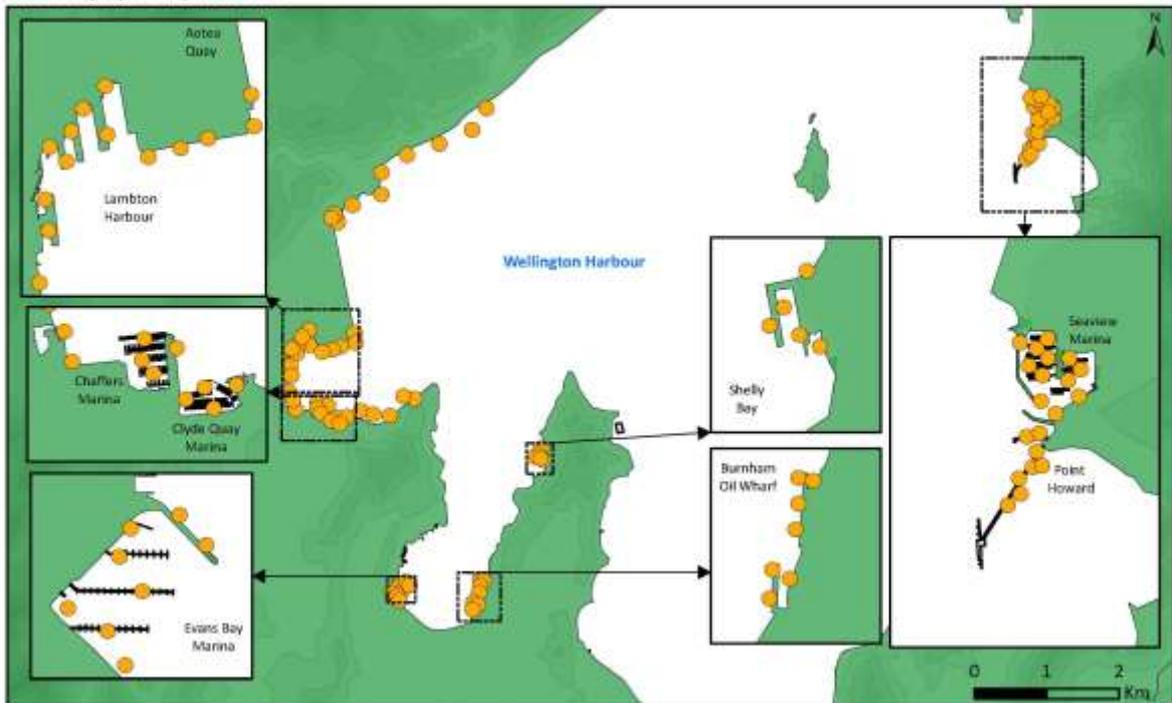
Crab condo (CONDO) locations



Wellington Harbour
 Winter 2018
 Crab traps (CRBTP) locations



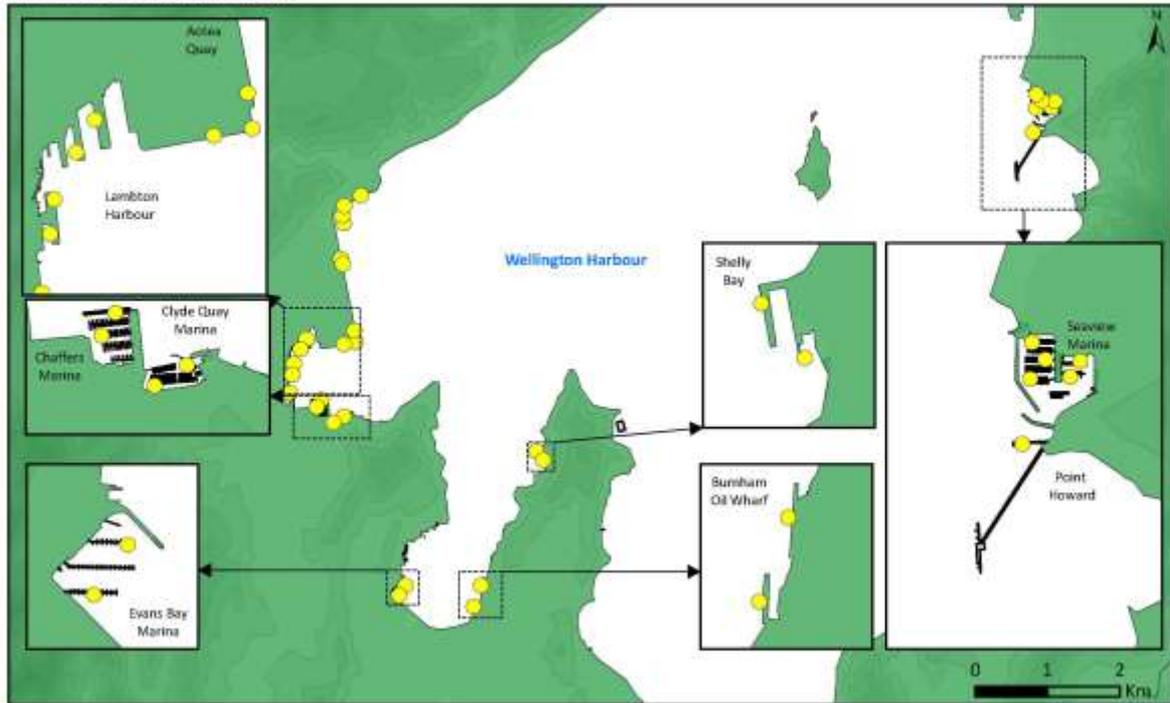
Wellington Harbour
 Summer 2018-19
 Crab traps (CRBTP) locations



Wellington Harbour

Winter 2018

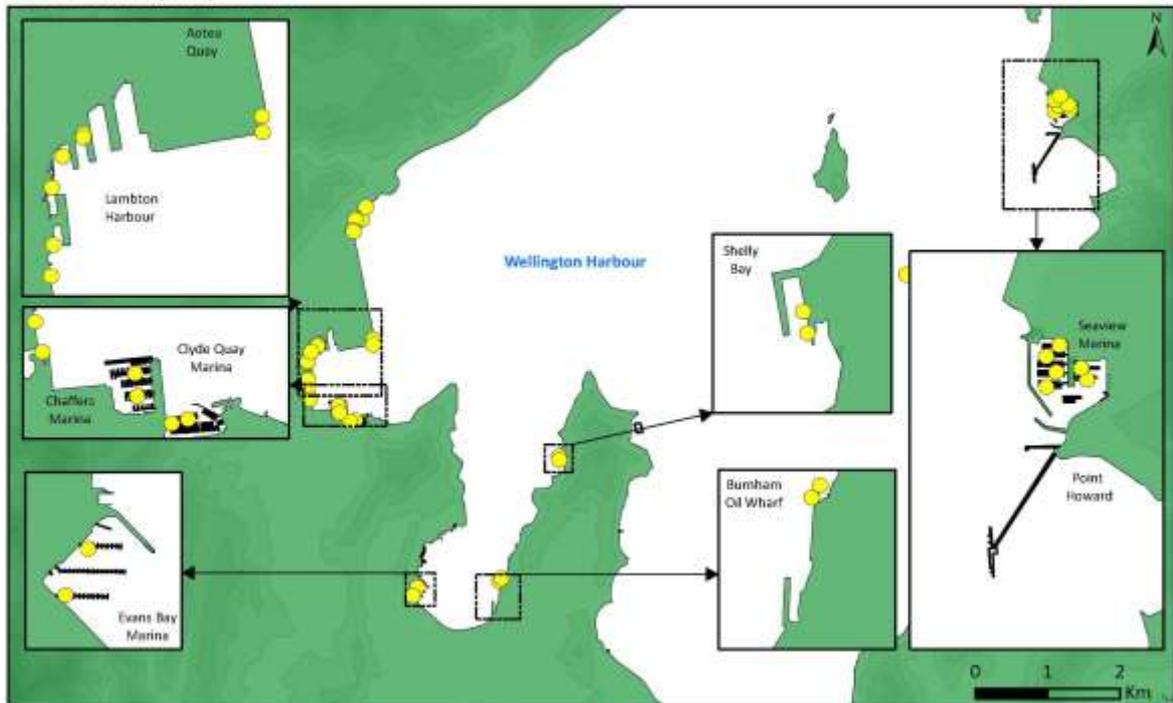
Diver searches (VISD) locations



Wellington Harbour

Summer 2018-19

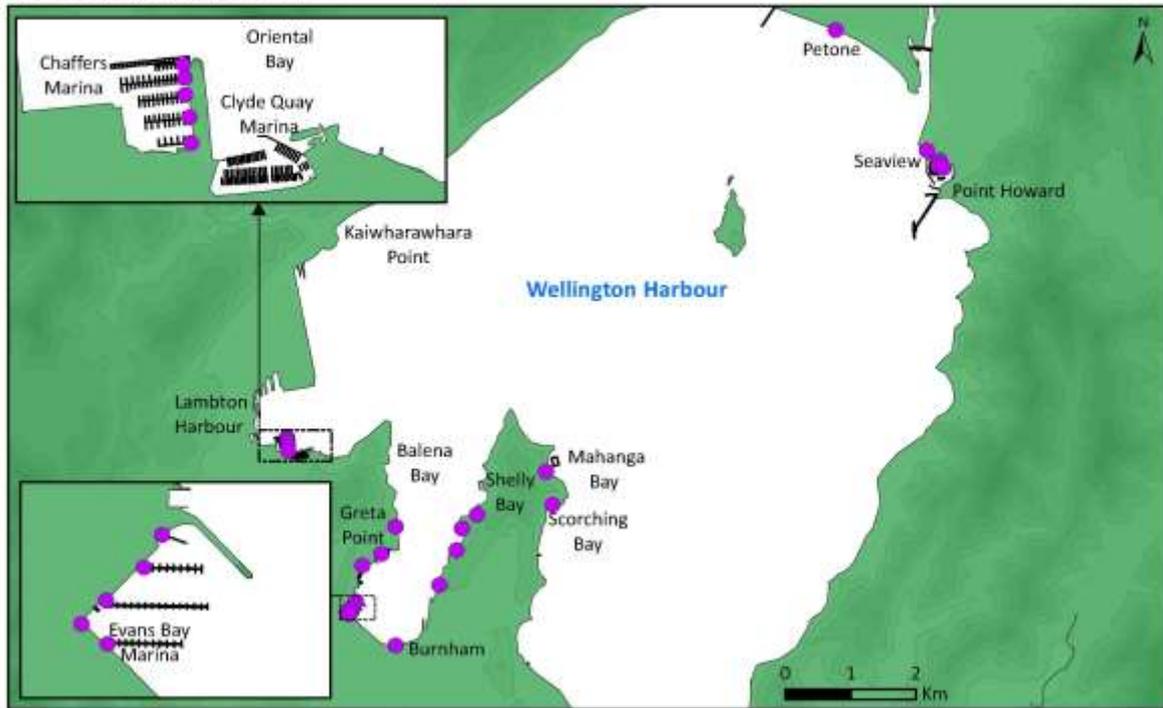
Diver searches (VISD) locations



Wellington Harbour

Winter 2018

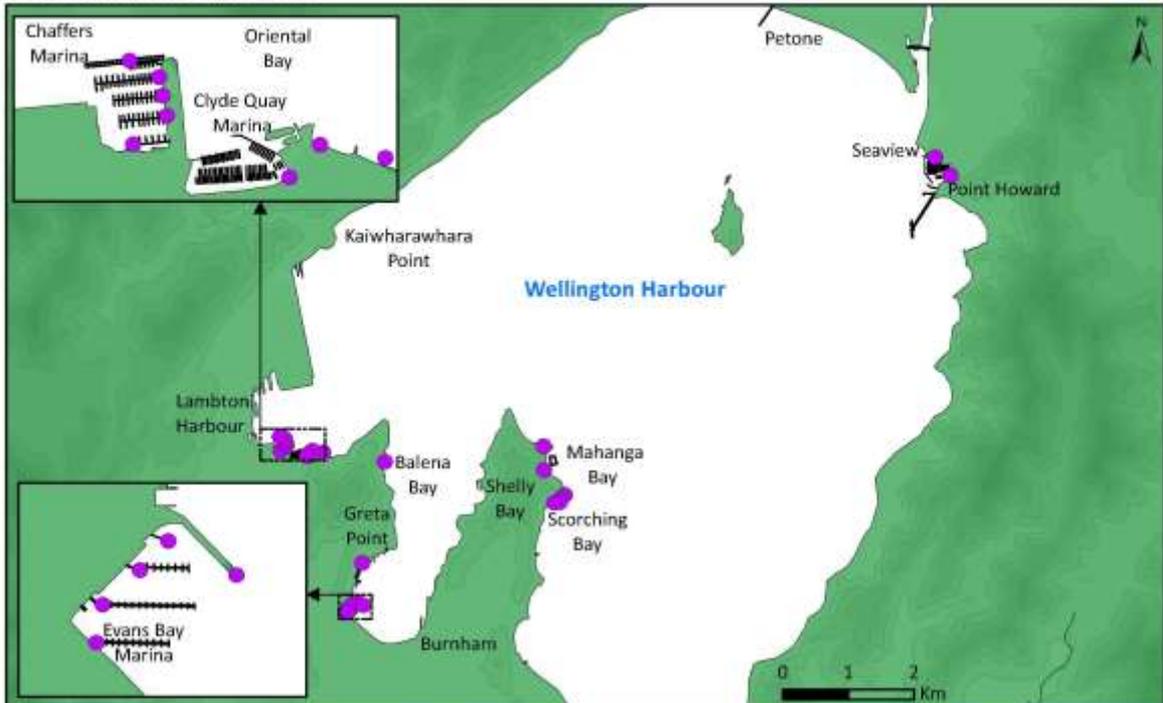
Shore search (WRACK) locations



Wellington Harbour

Summer 2018-19

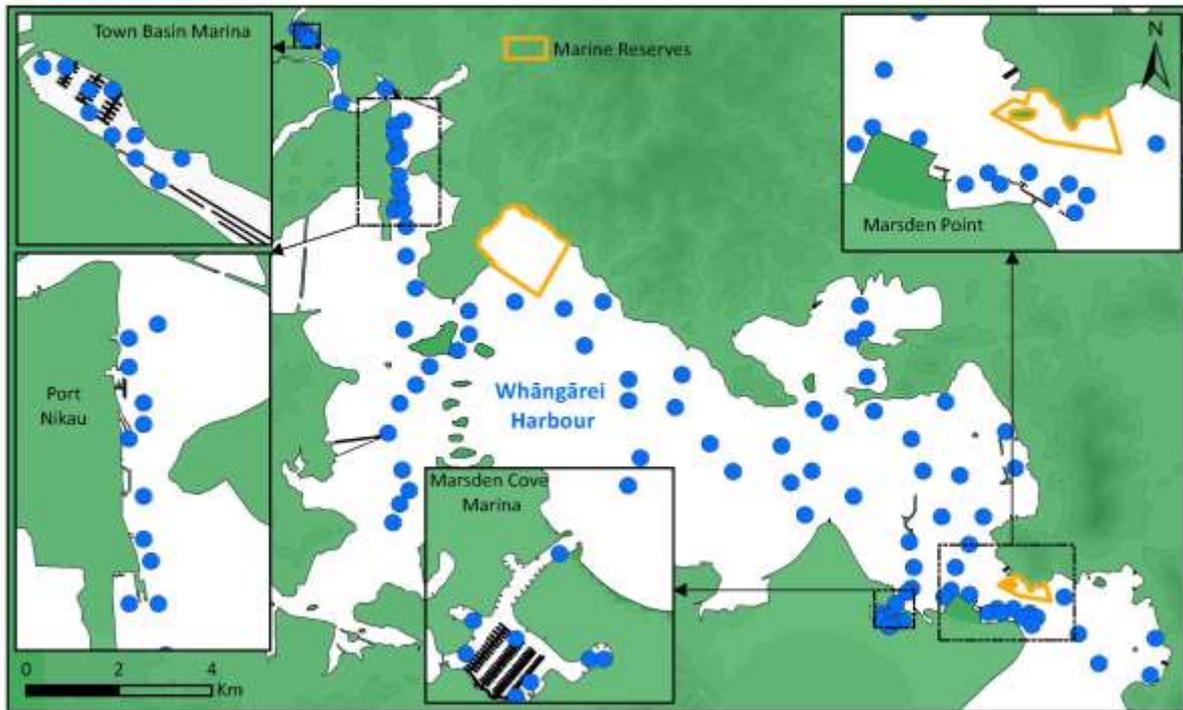
Shore search (WRACK) locations



Whāngārei Harbour

Winter 2018

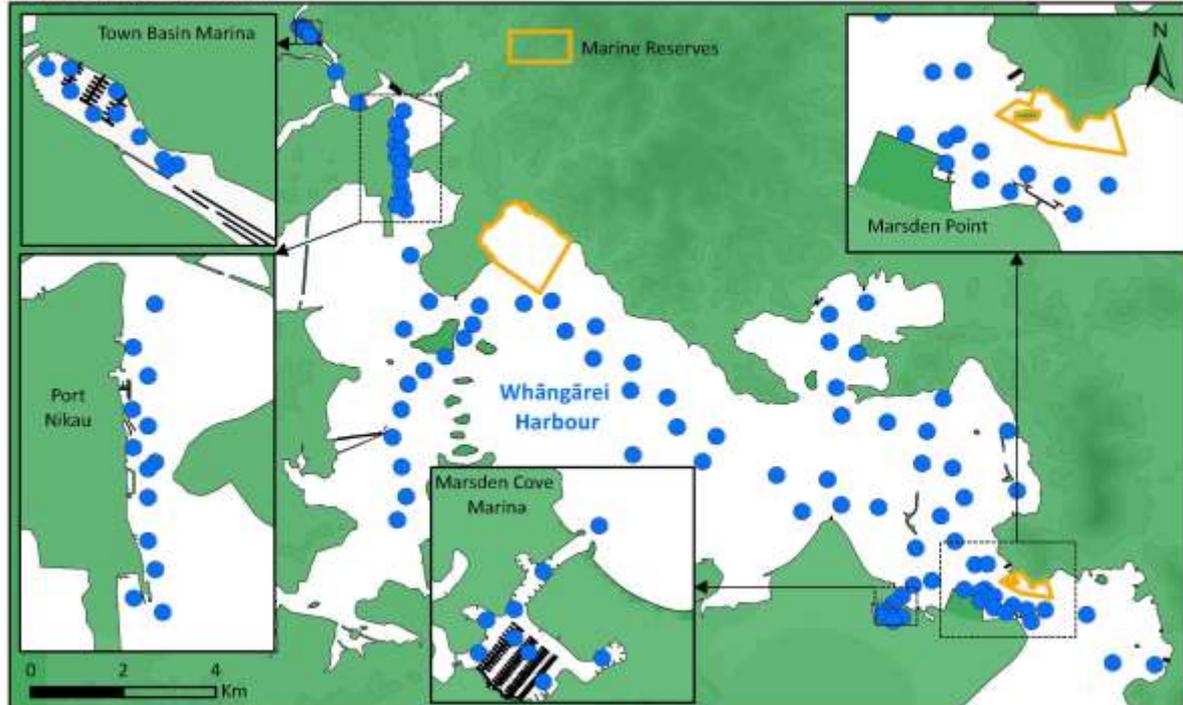
Benthic sled (BSLD) locations



Whāngārei Harbour

Summer 2018-19

Benthic sled (BSLD) locations



Whāngārei Harbour

Winter 2018

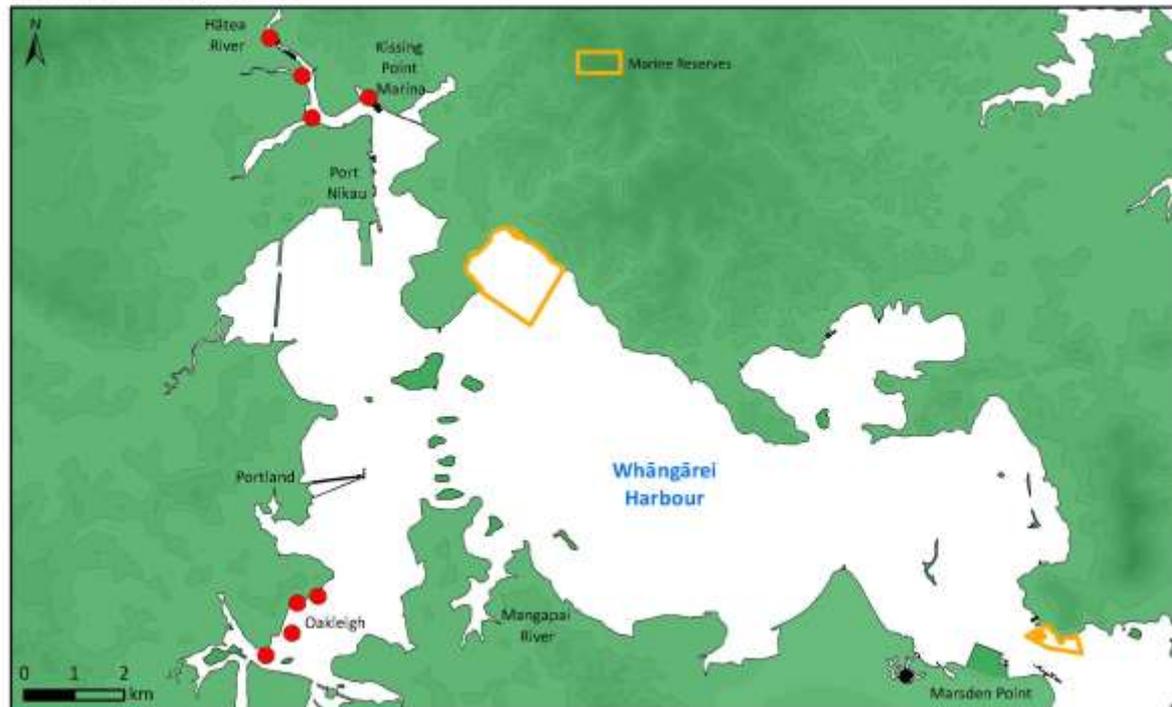
Crab condo (CONDO) locations



Whāngārei Harbour

Summer 2018-19

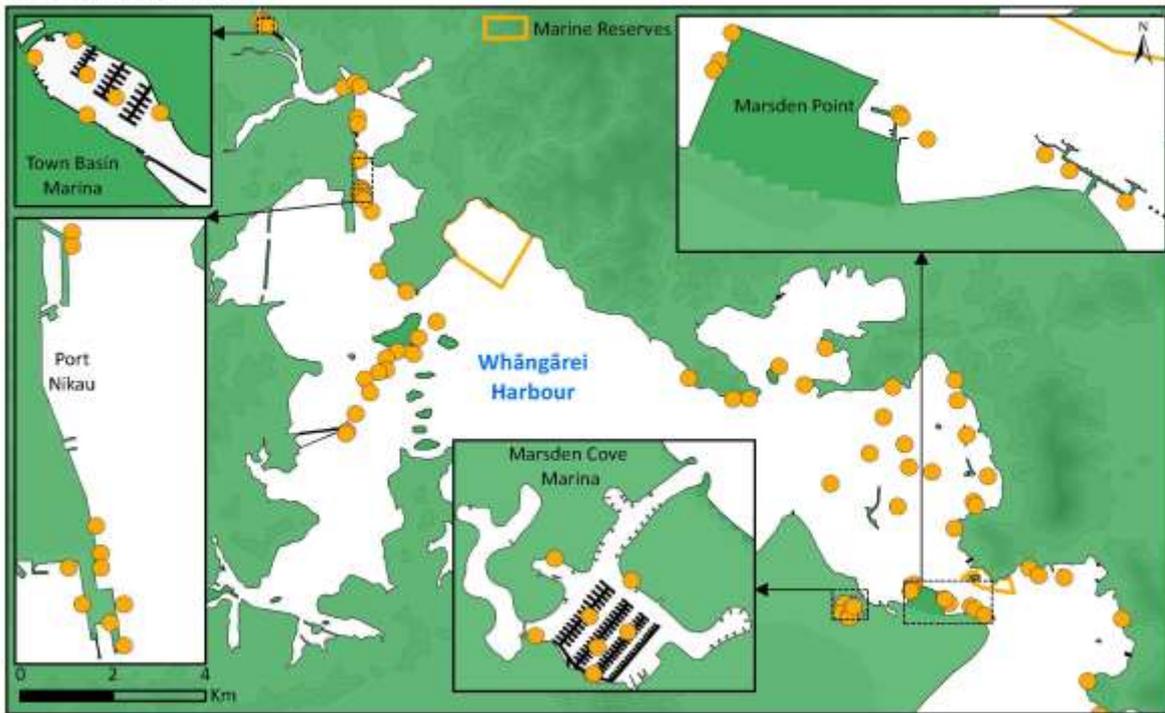
Crab condo (CONDO) locations



Whāngārei Harbour

Winter 2018

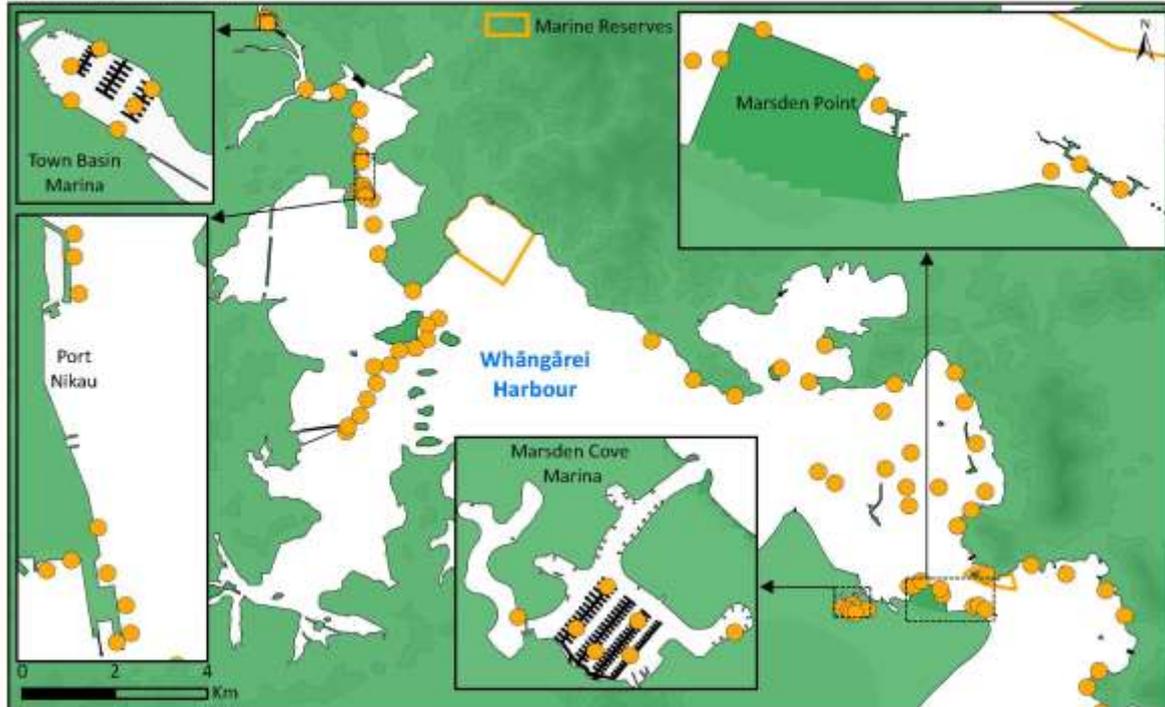
Crab trap (CRBTP) locations



Whāngārei Harbour

Summer 2018-19

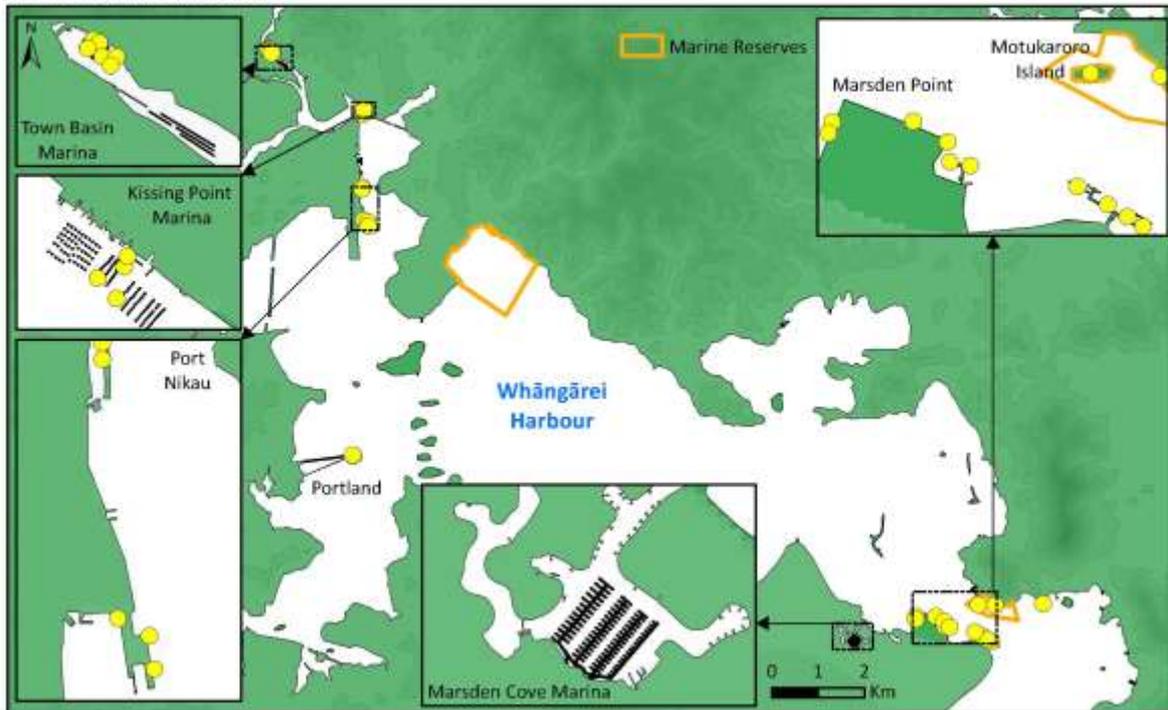
Crab trap (CRBTP) locations



Whāngārei Harbour

Winter 2018

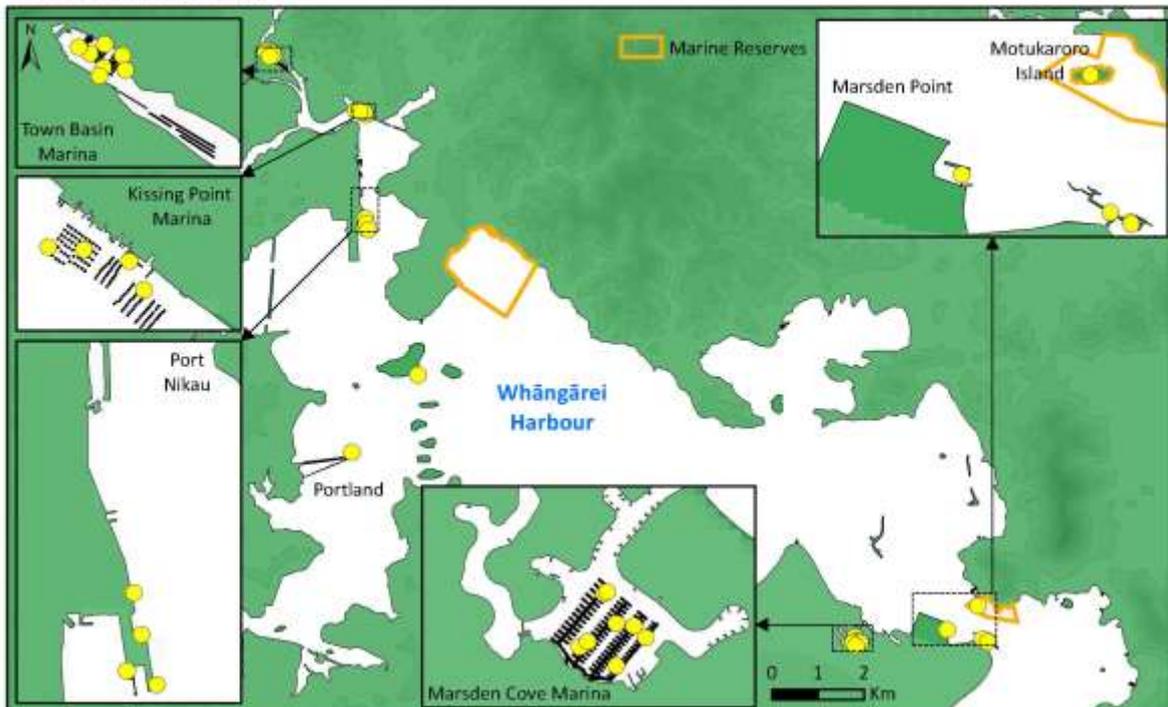
Diver search (VISD) locations



Whāngārei Harbour

Summer 2018-19

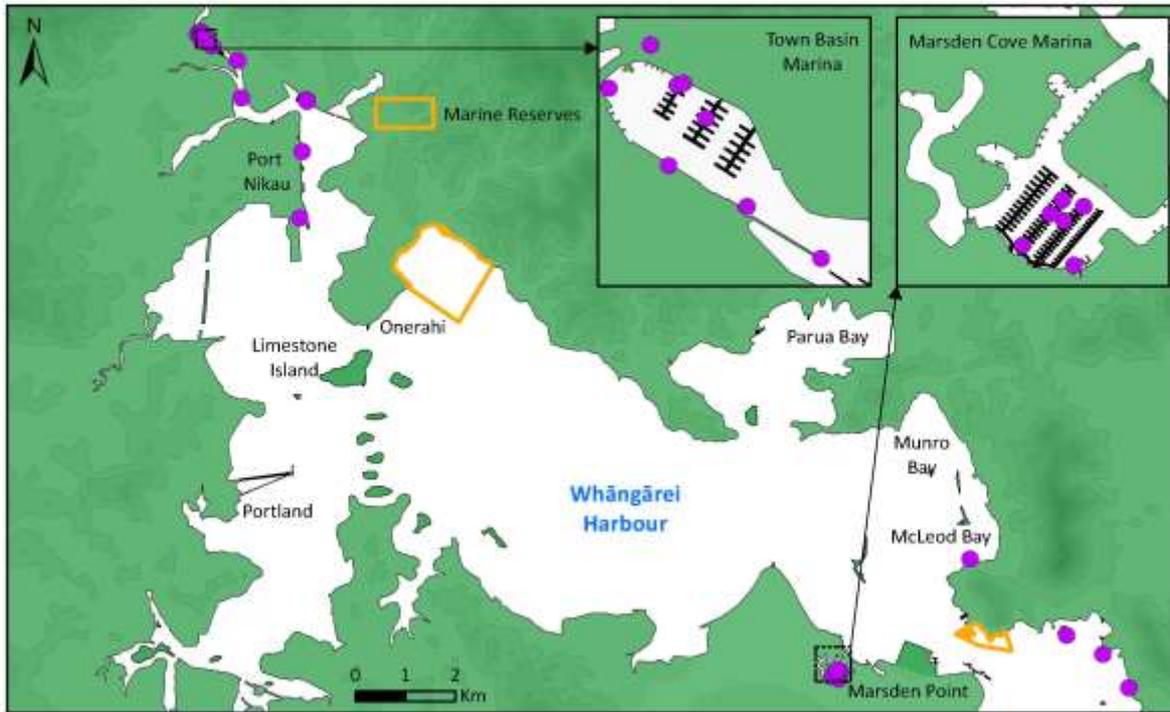
Diver search (VISD) locations



Whāngārei Harbour

Winter 2018

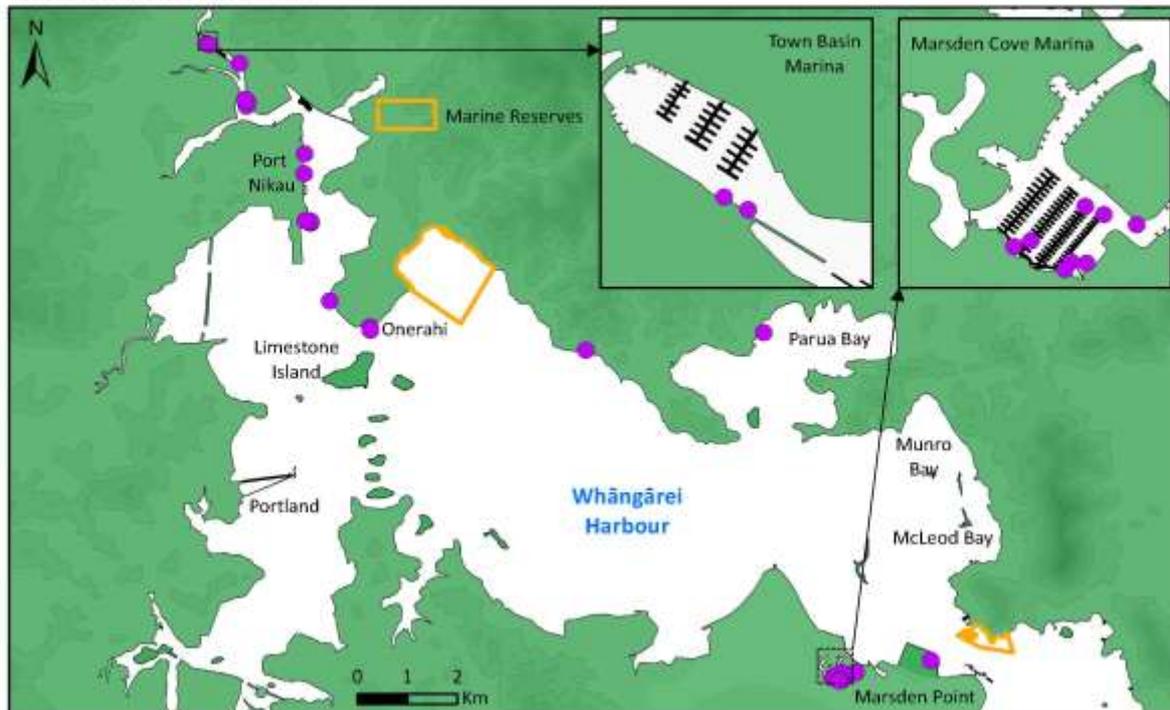
Shore search (WRACK) locations



Whāngārei Harbour

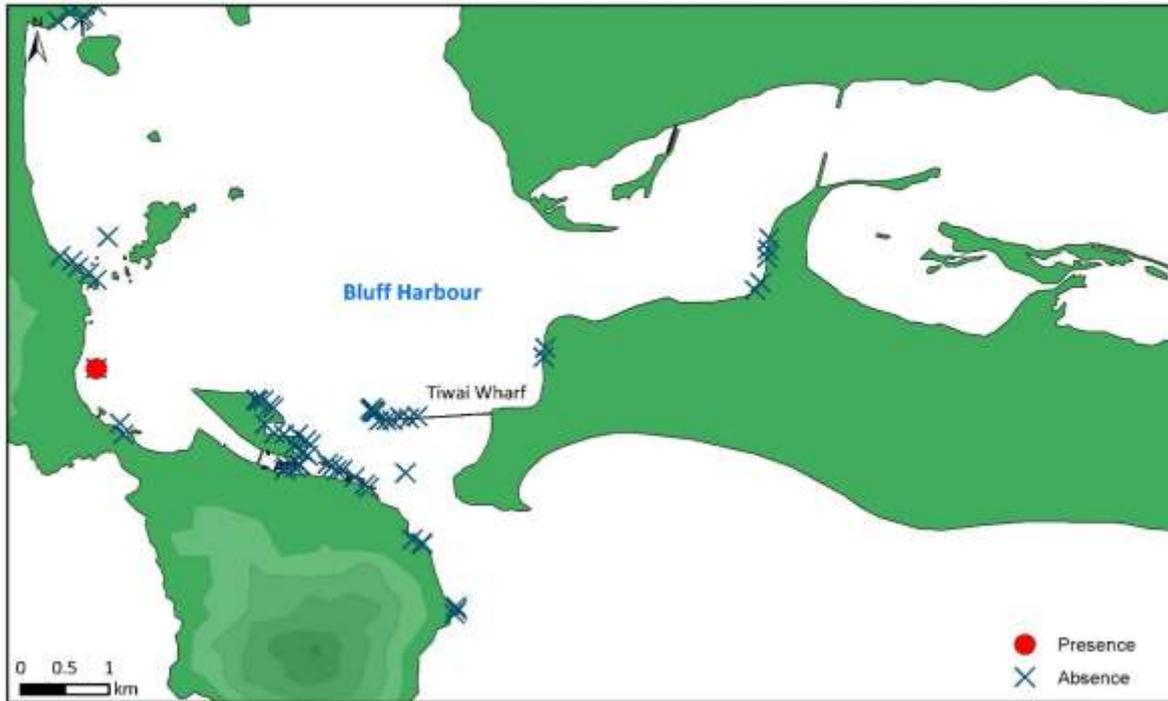
Summer 2018-19

Shore search (WRACK) locations

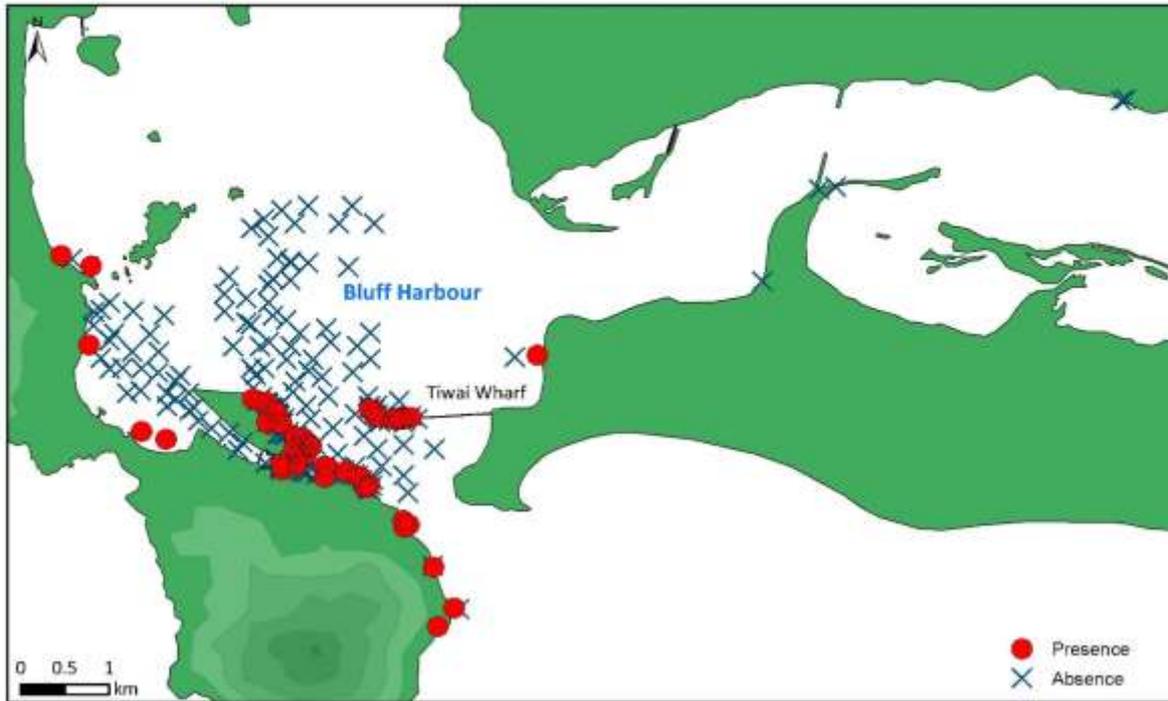


Appendix 4. Distribution maps for target and selected non-target non-indigenous species detected during Winter 2018 and Summer 2018–19 Marine High Risk Site Surveillance (MHRSS) programme surveys

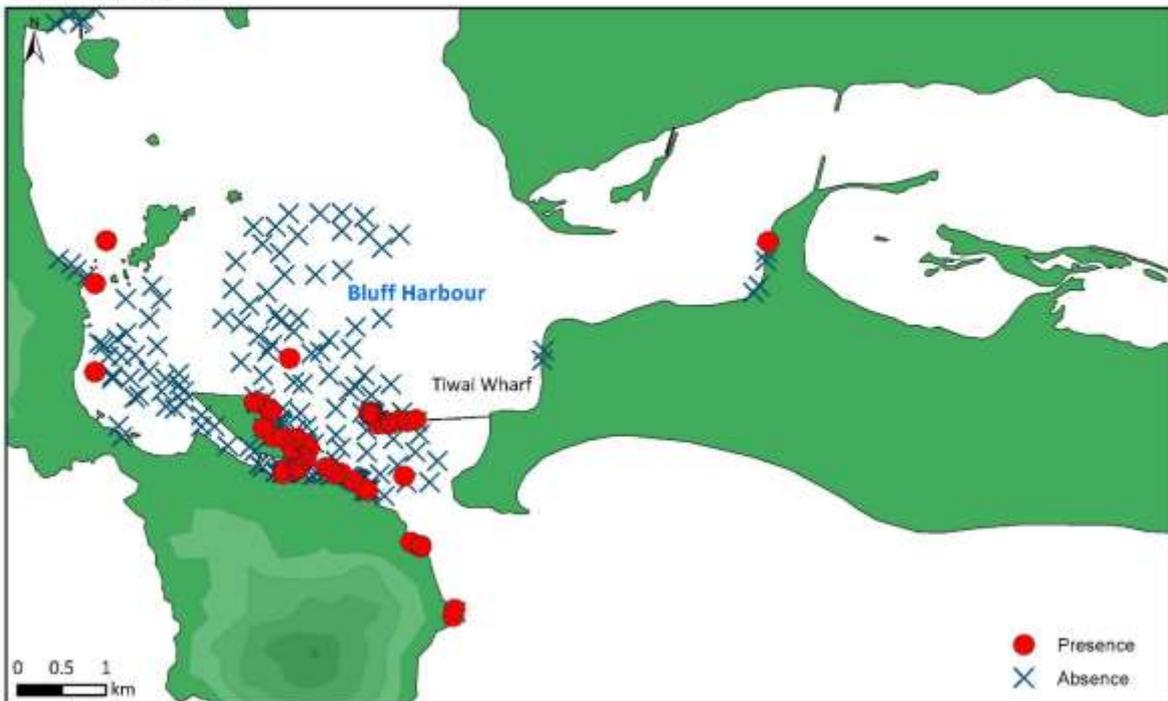
Bluff Harbour
Summer 2018-19
Caprella mutica



Bluff Harbour
Winter 2018
Undaria pinnatifida



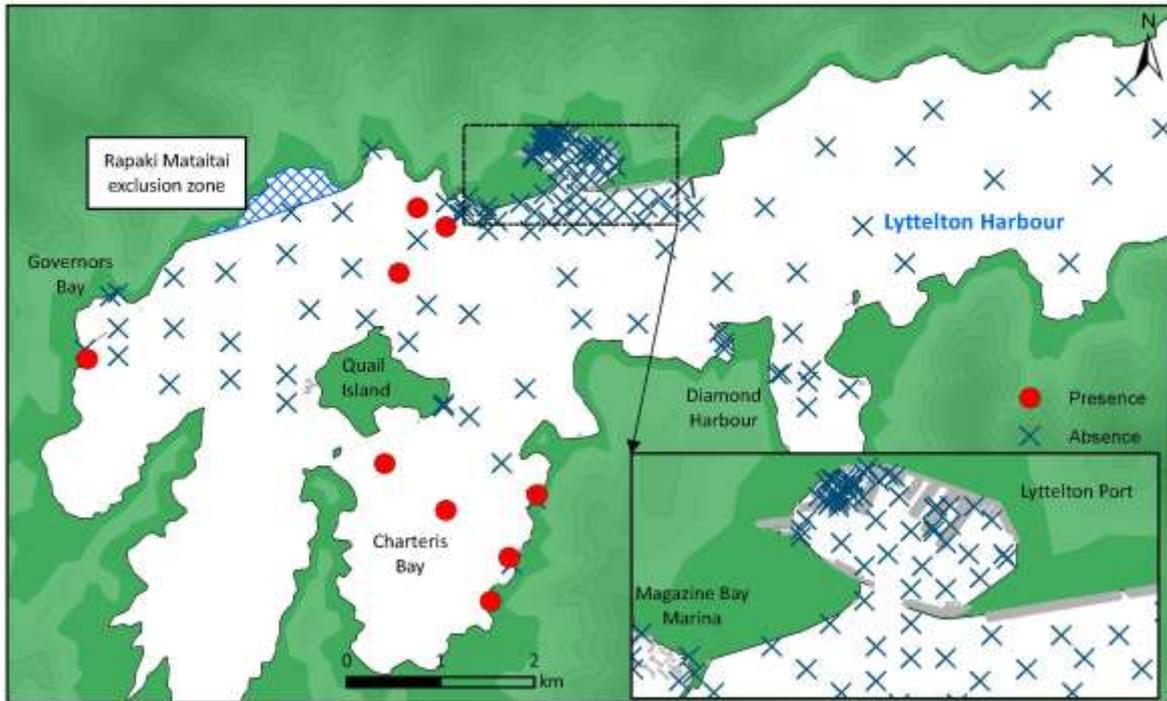
Bluff Harbour
Summer 2018-19
Undaria pinnatifida



Lyttelton Harbour/ Whakaraupō

Winter 2018

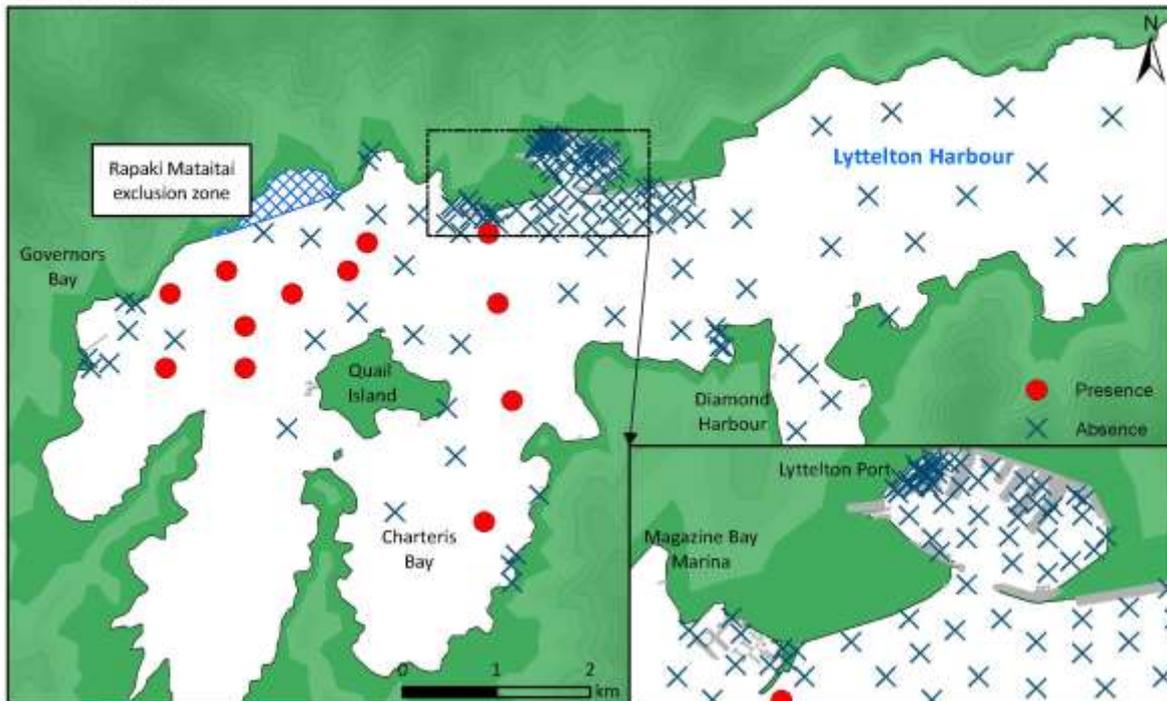
Ascidella aspersa



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

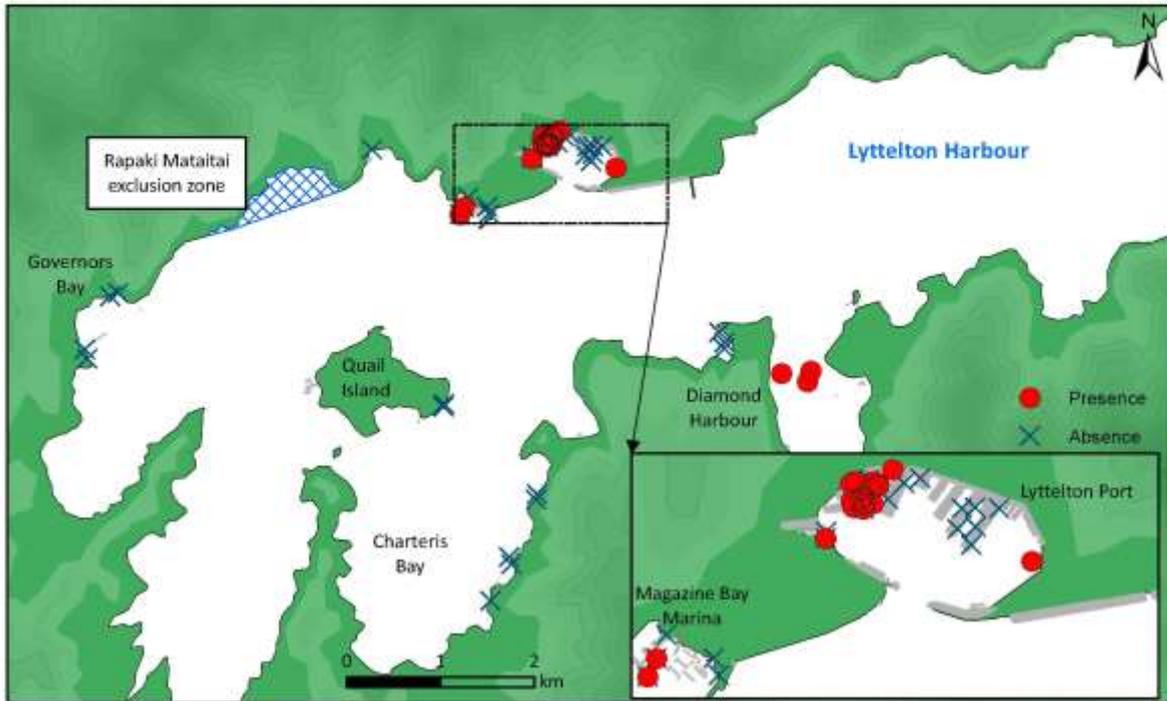
Ascidella aspersa



Lyttelton Harbour/ Whakaraupō

Winter 2018

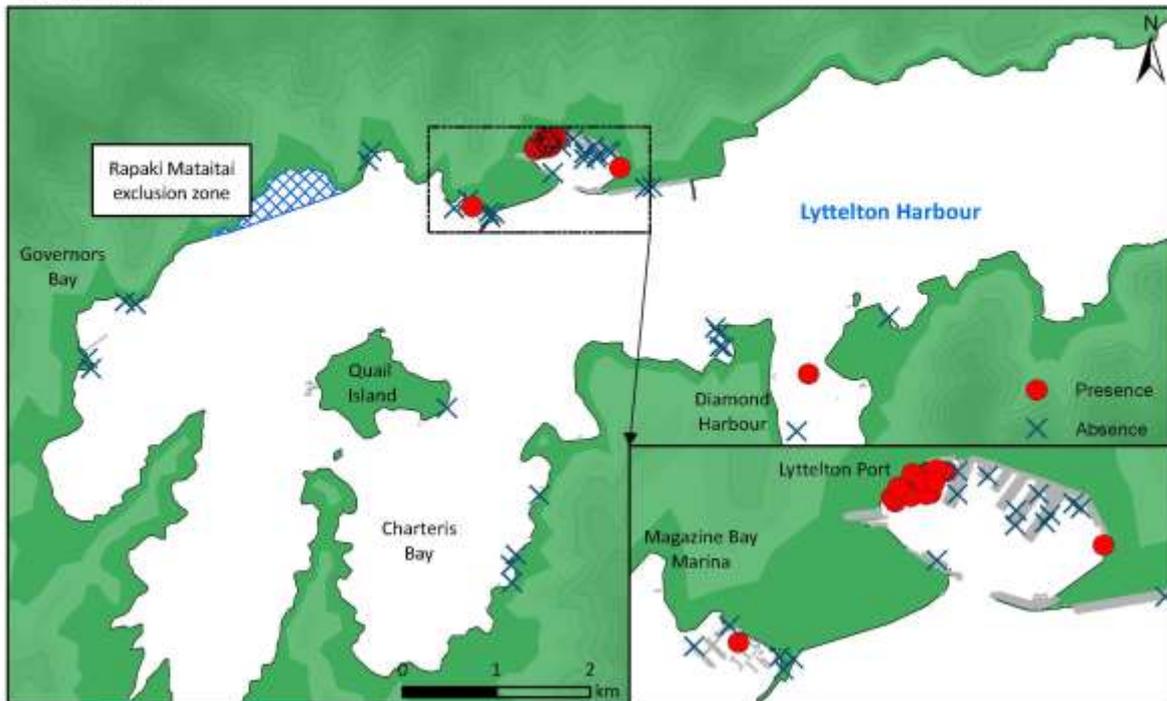
Caprella mutica



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

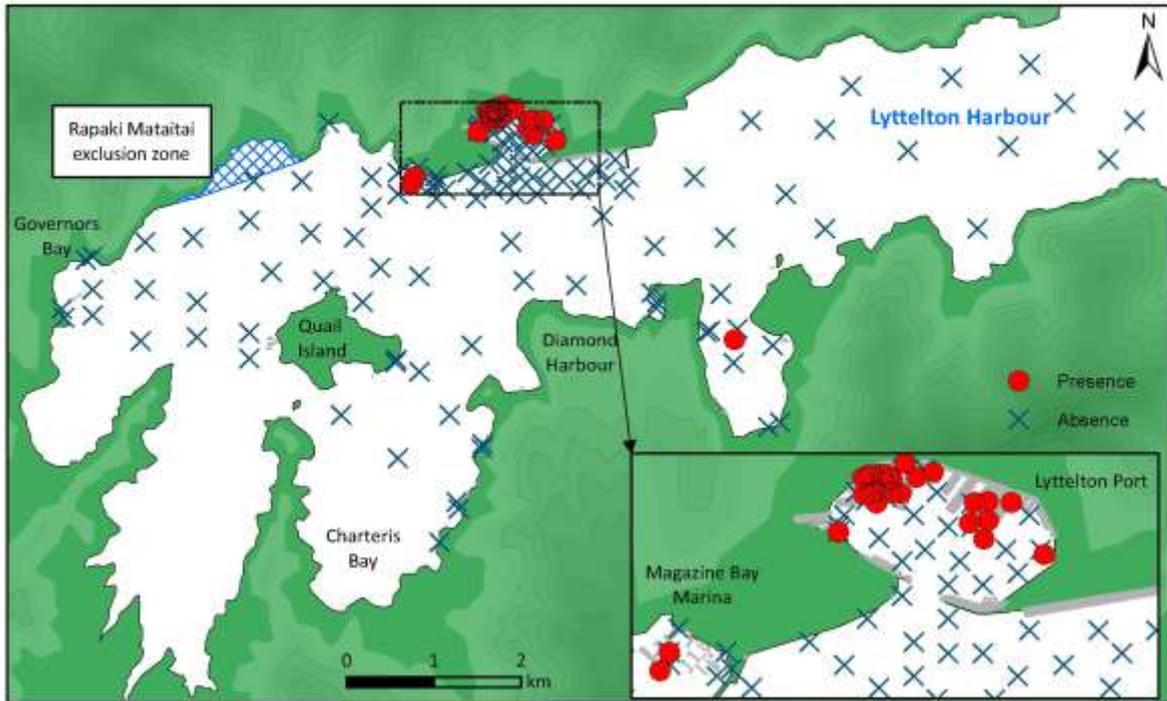
Caprella mutica



Lyttelton Harbour/ Whakaraupō

Winter 2018

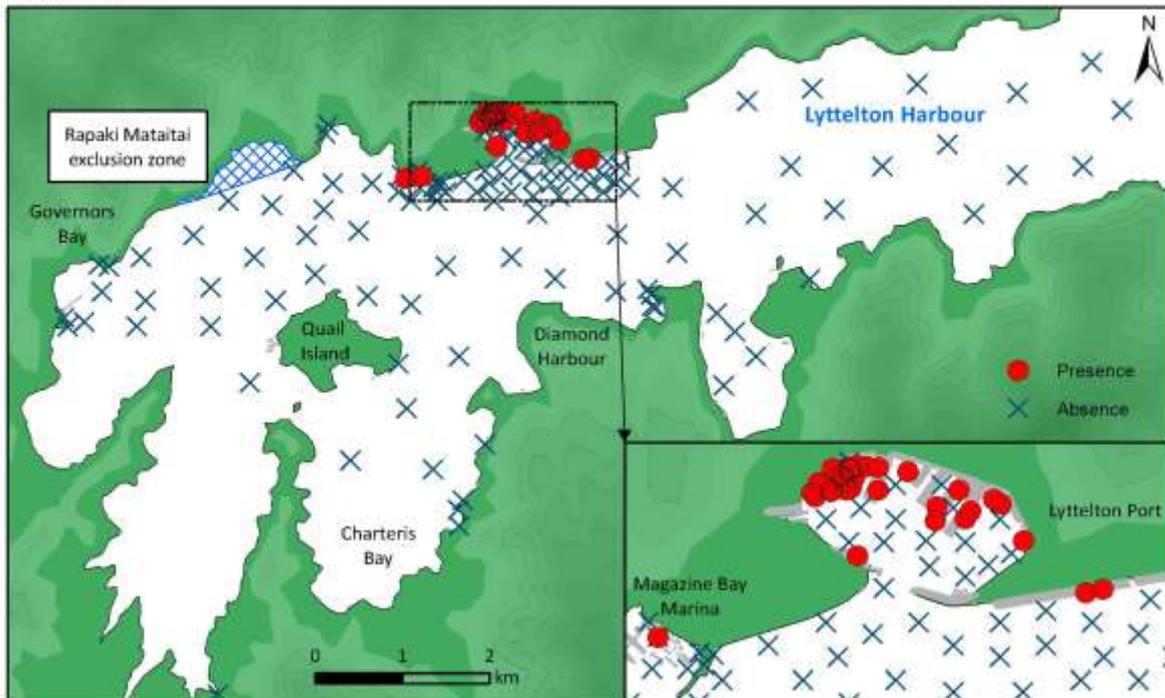
Ciona intestinalis



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

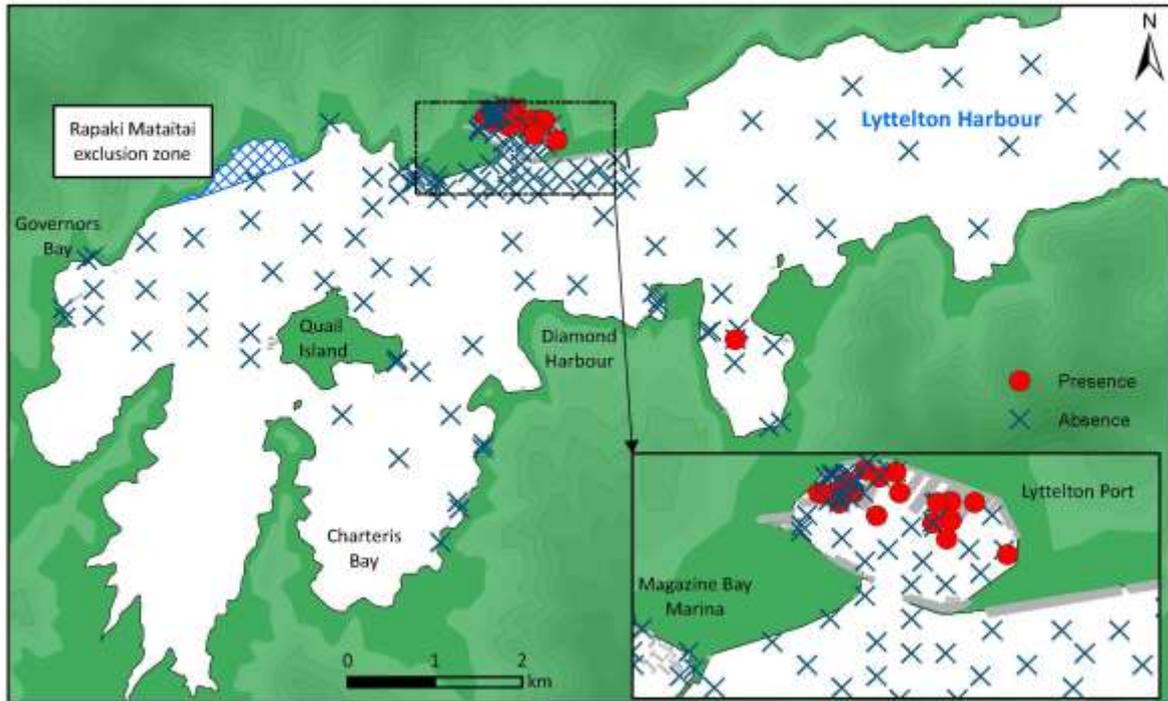
Ciona intestinalis



Lyttelton Harbour/ Whakaraupō

Winter 2018

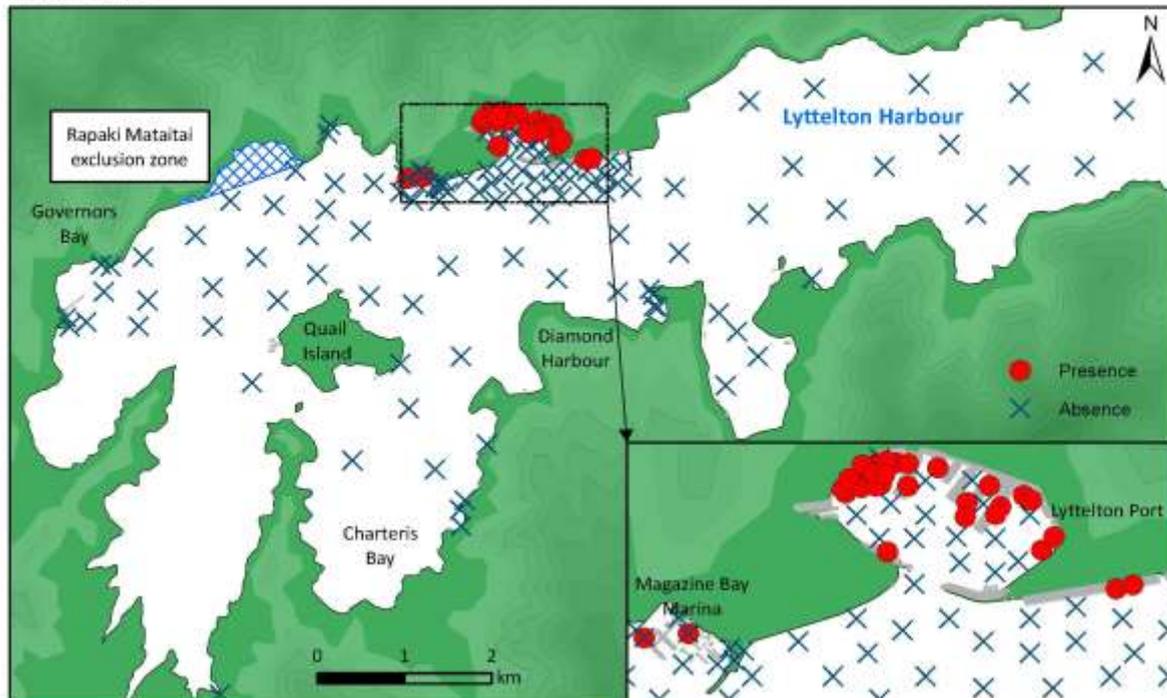
Ciona savignyi



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

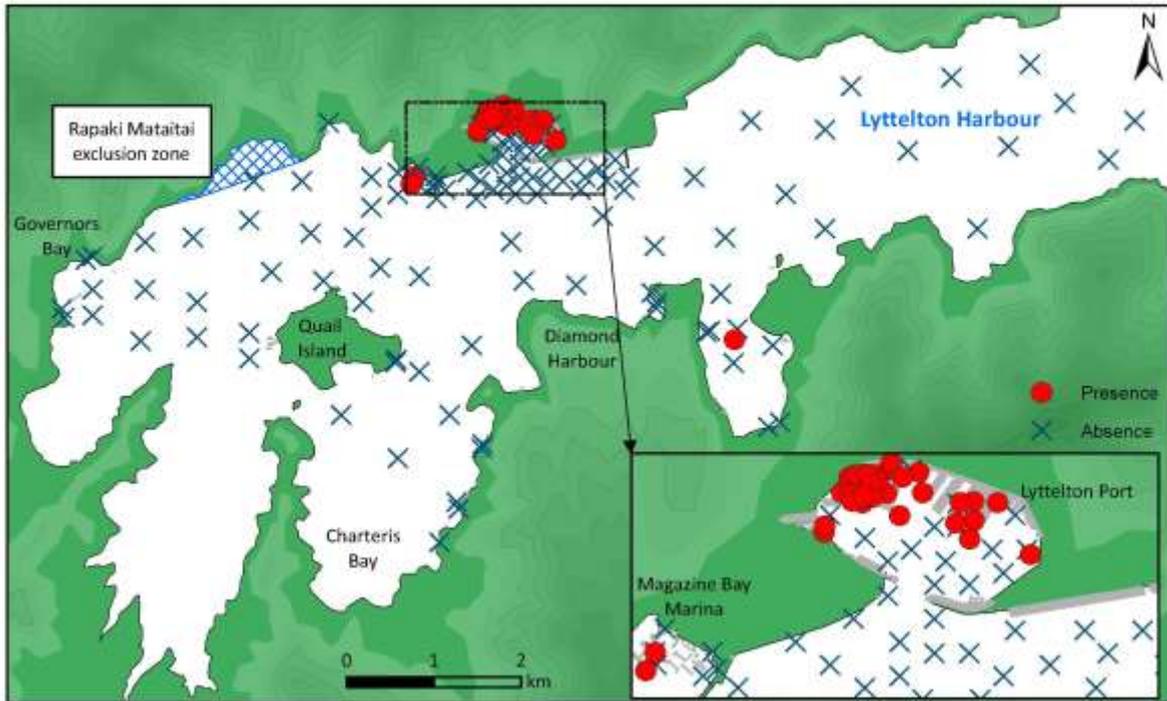
Ciona savignyi



Lyttelton Harbour/ Whakaraupō

Winter 2018

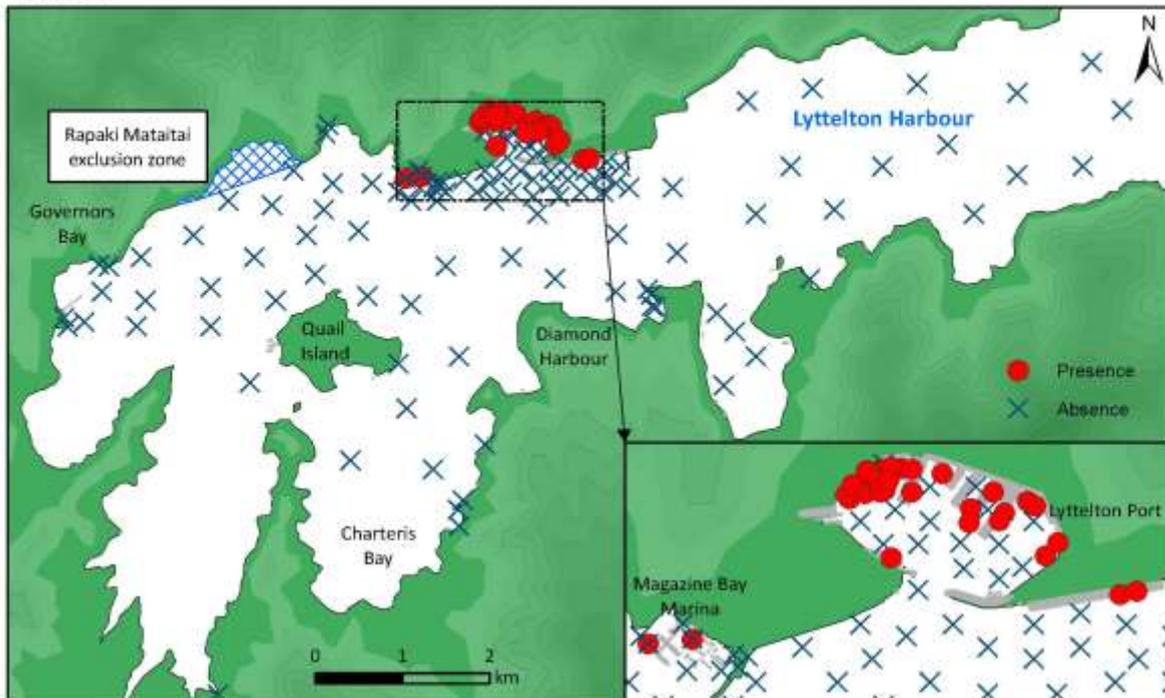
Ciona spp.



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

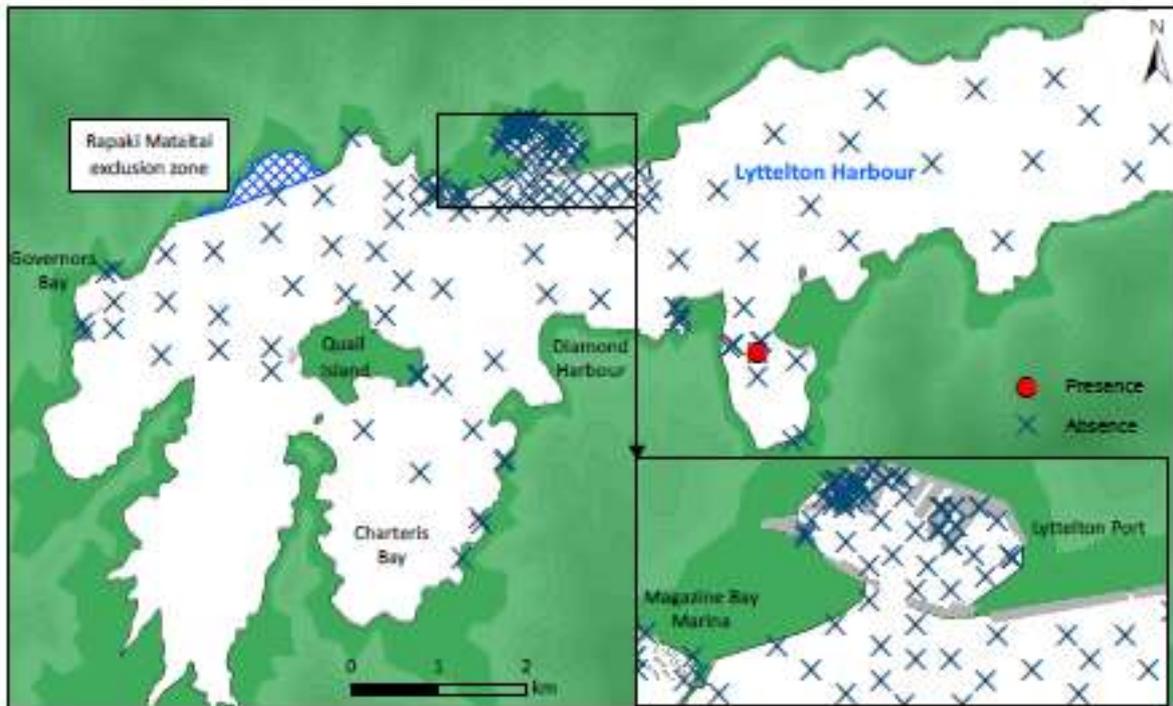
Ciona spp.



Lyttelton Harbour/ Whakaraupō

Winter 2018

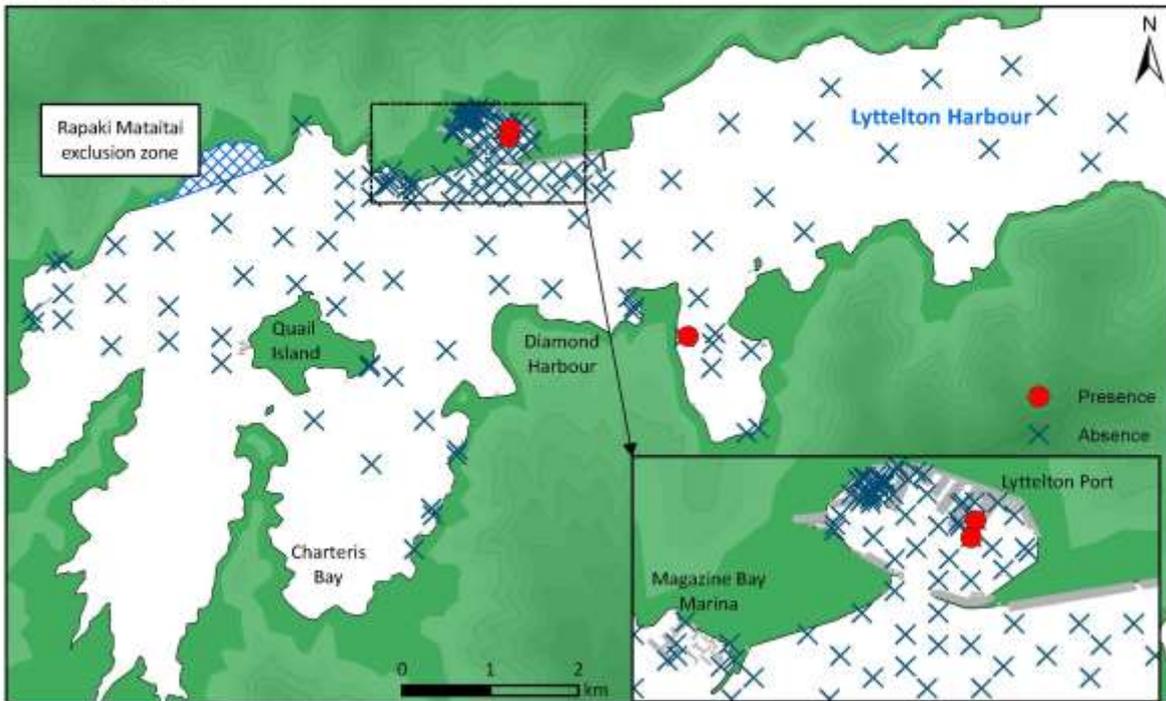
Clavelina lepadiformis



Lyttelton Harbour/ Whakaraupō

Winter 2018

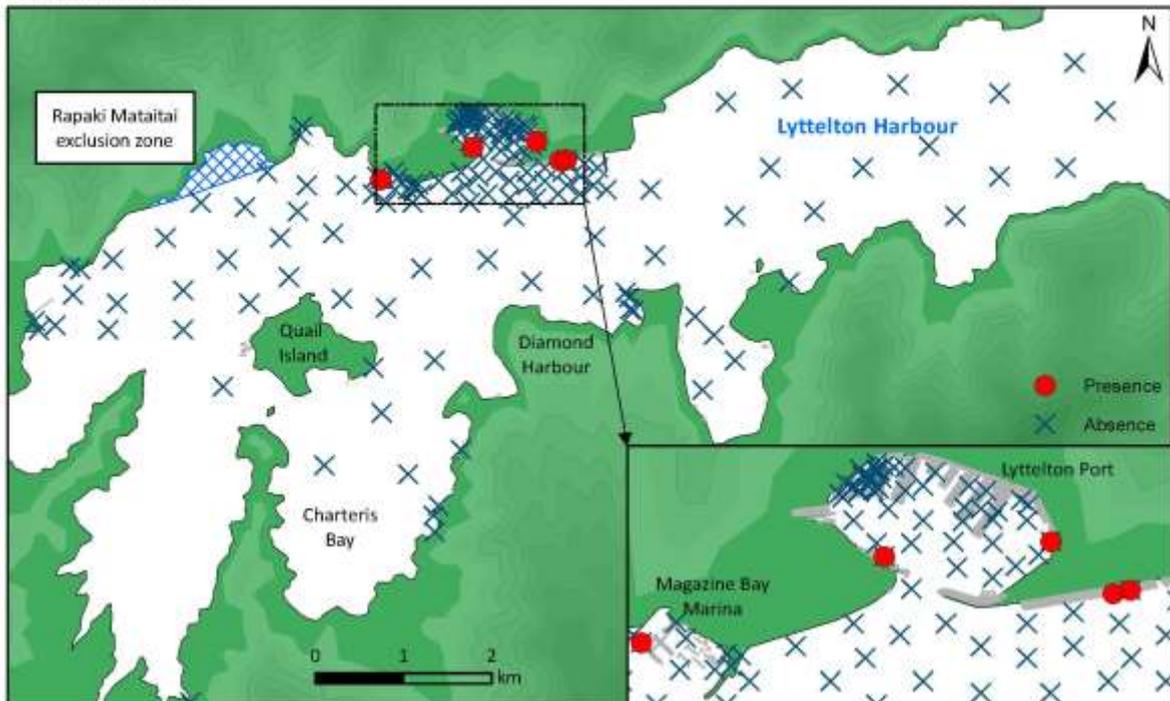
Didemnum vexillum



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

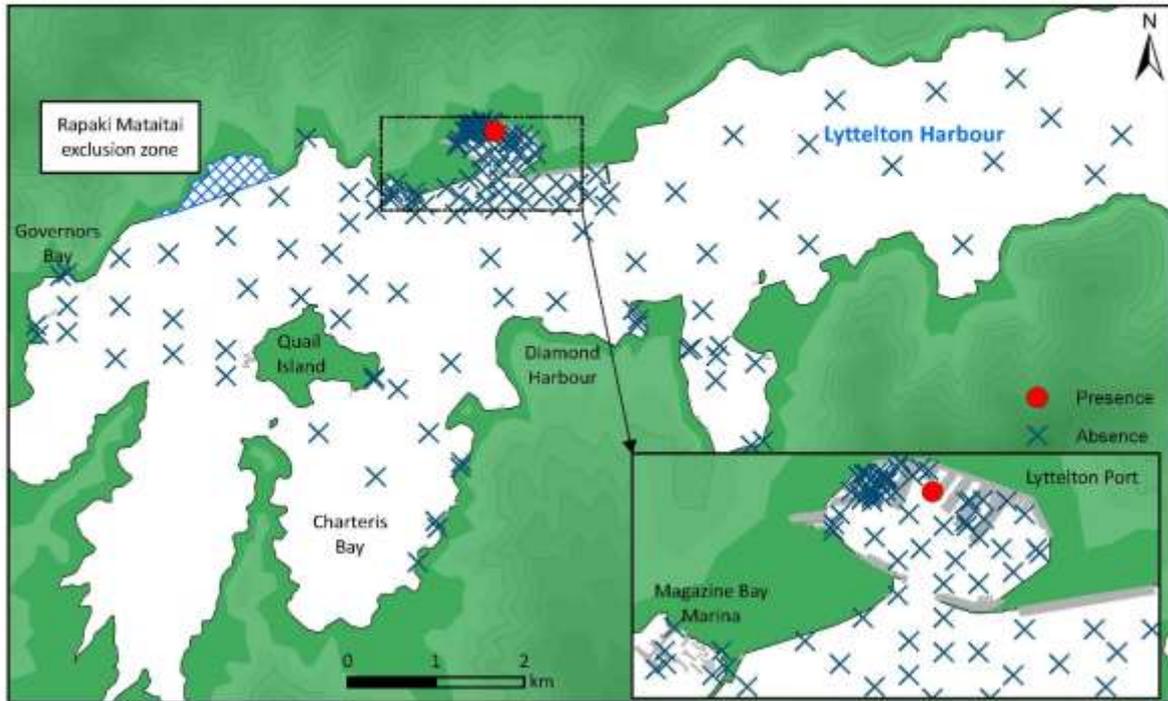
Didemnum vexillum



Lyttelton Harbour/ Whakaraupō

Winter 2018

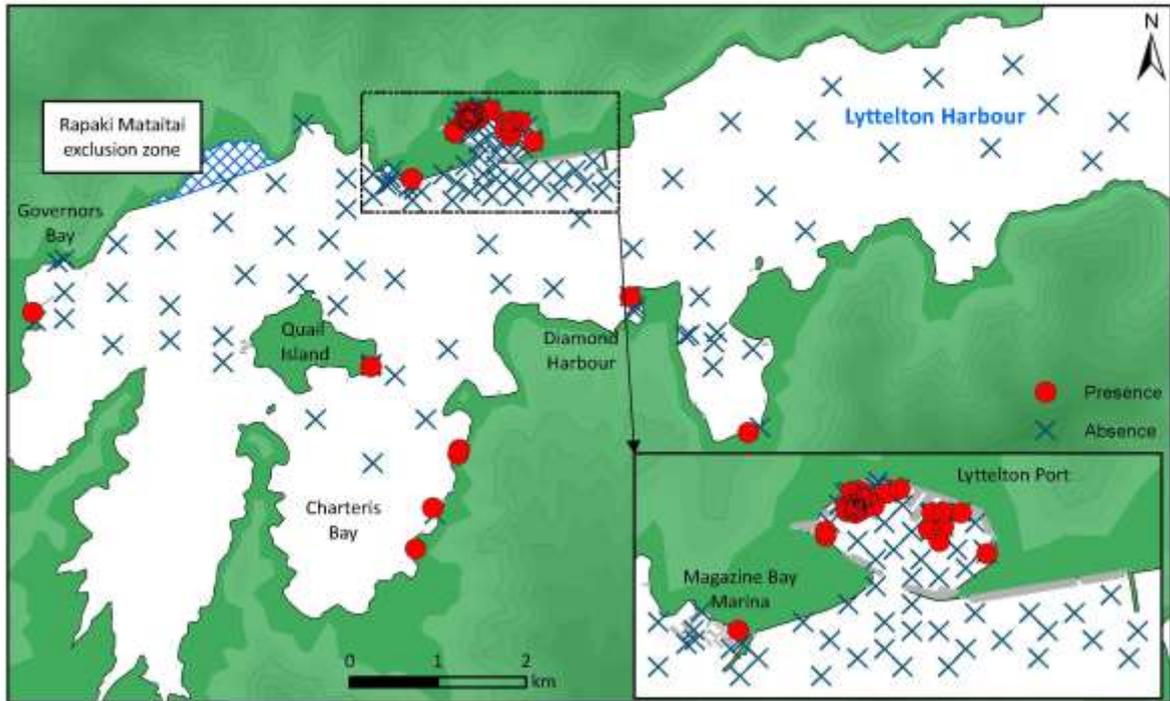
Polycera hedgpethi



Lyttelton Harbour/ Whakaraupō

Winter 2018

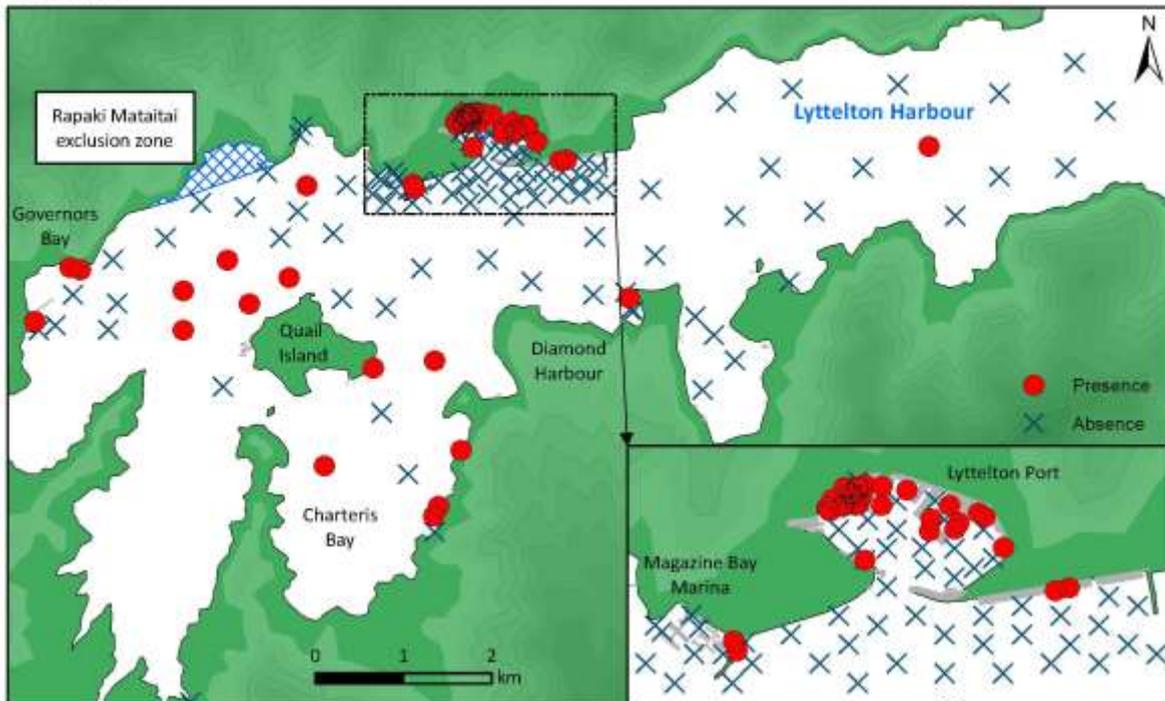
Styela clava



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

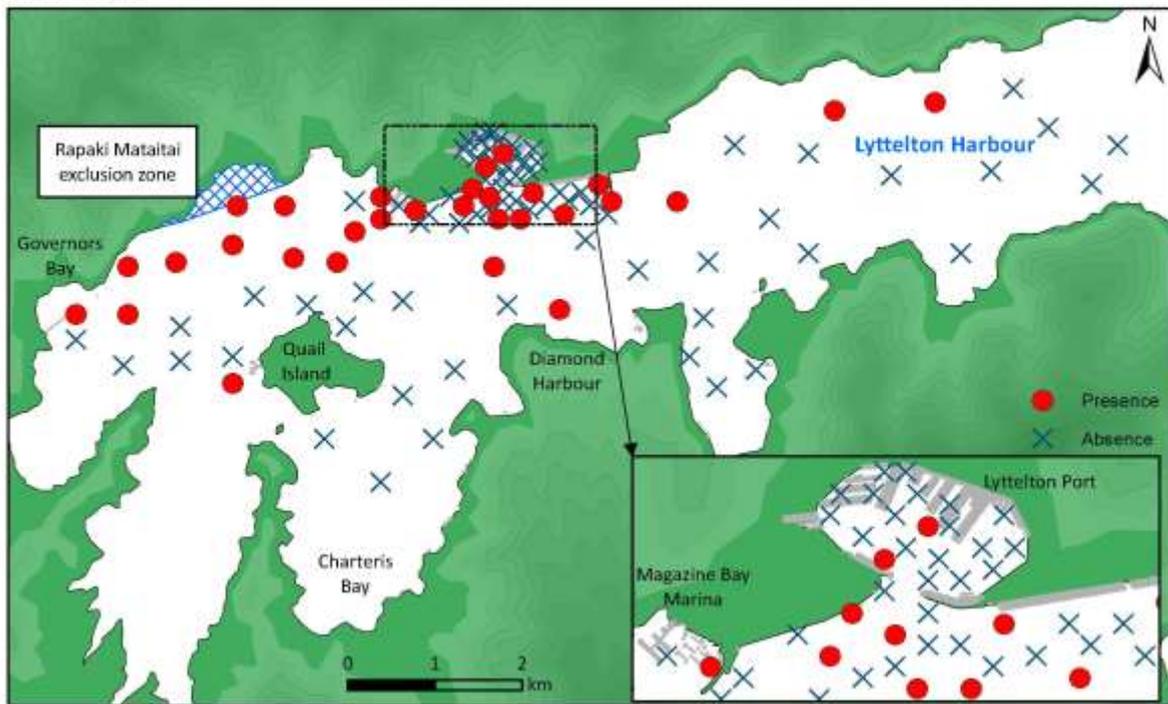
Styela clava



Lyttelton Harbour/ Whakaraupō

Winter 2018

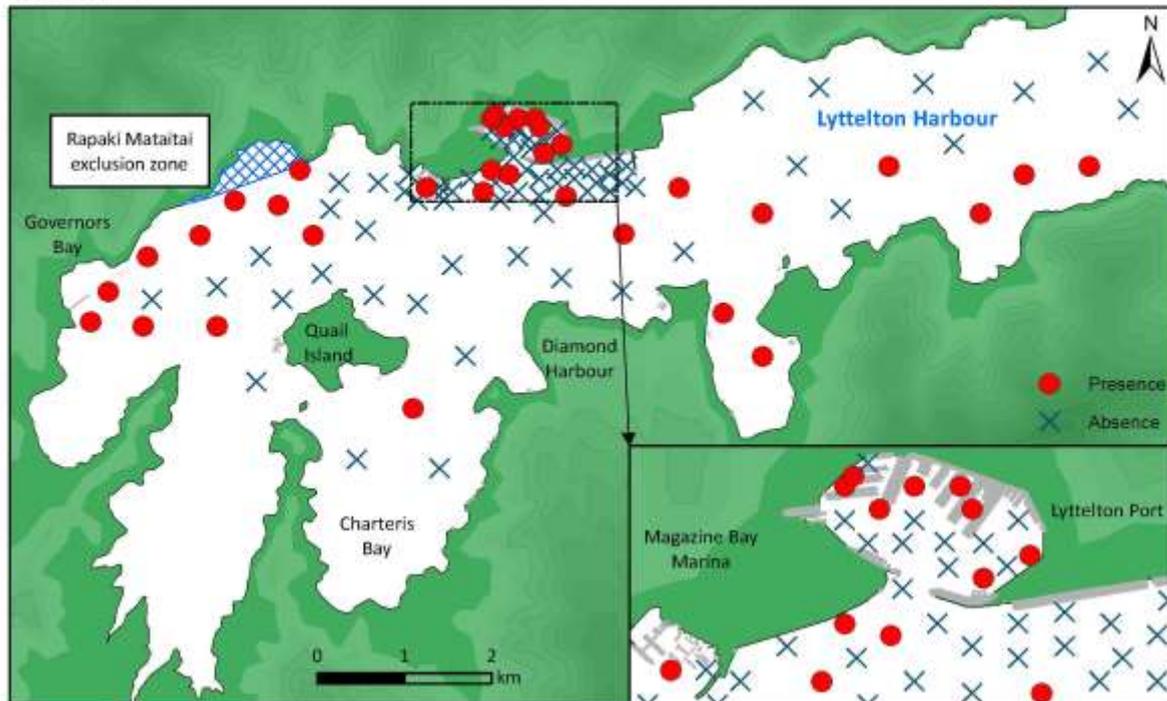
Theora lubrica



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

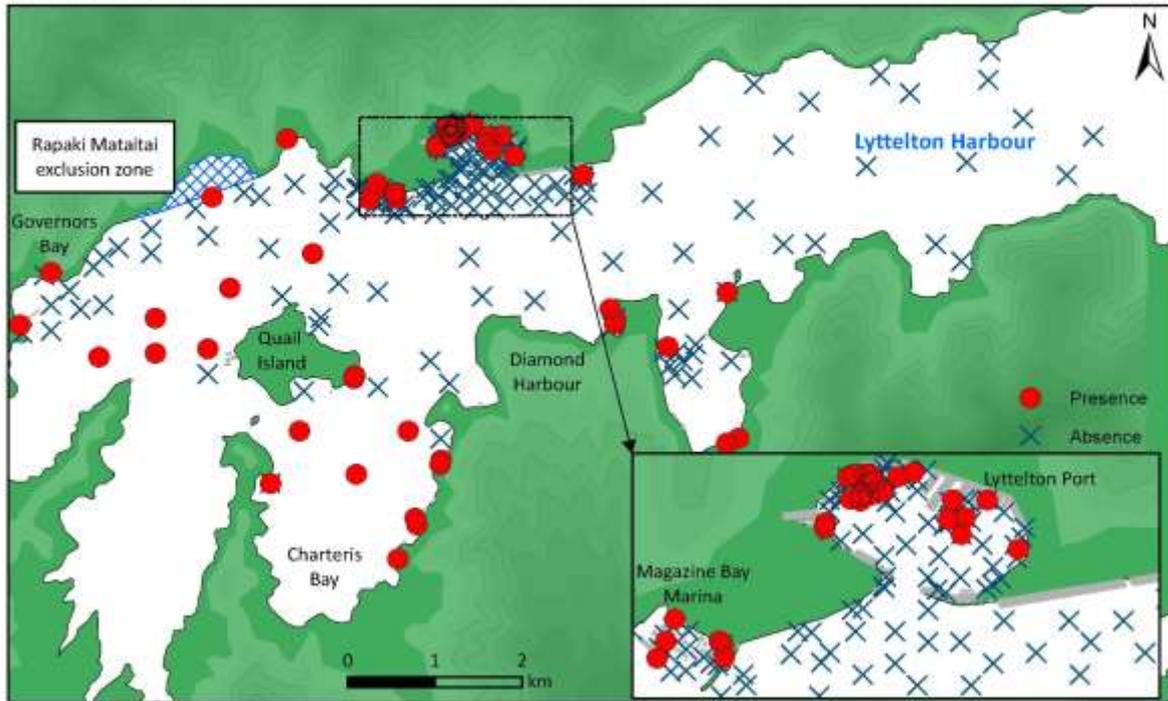
Theora lubrica



Lyttelton Harbour/ Whakaraupō

Winter 2018

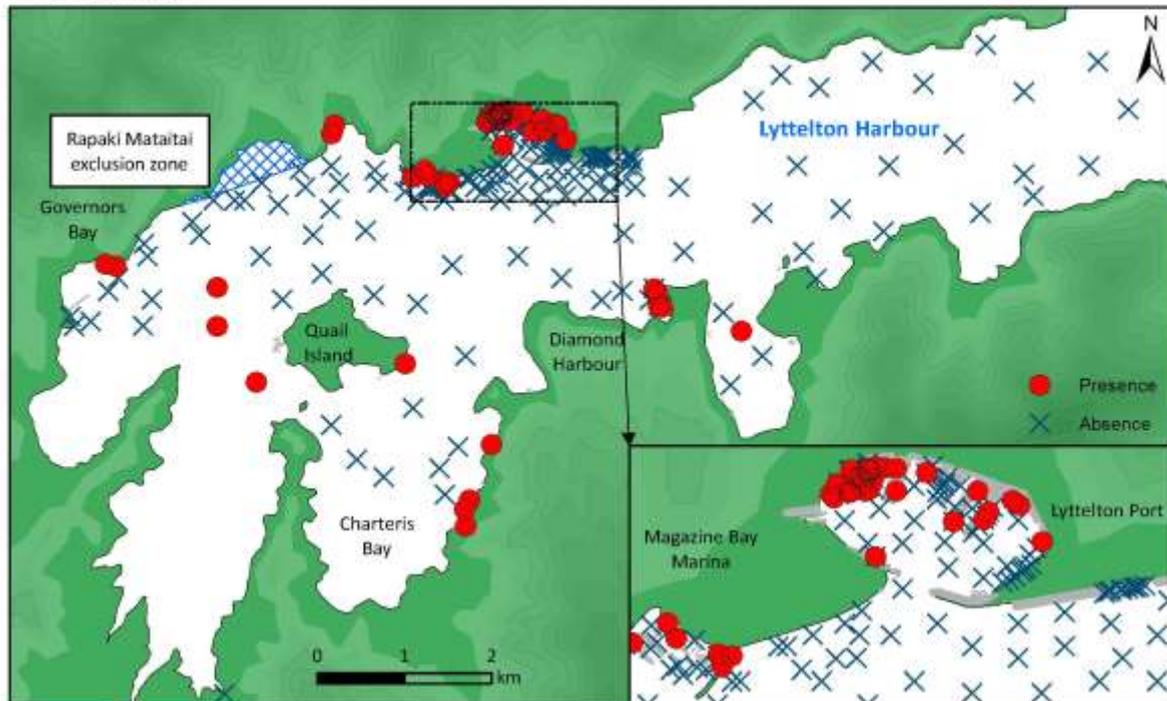
Undaria pinnatifida



Lyttelton Harbour/ Whakaraupō

Summer 2018-19

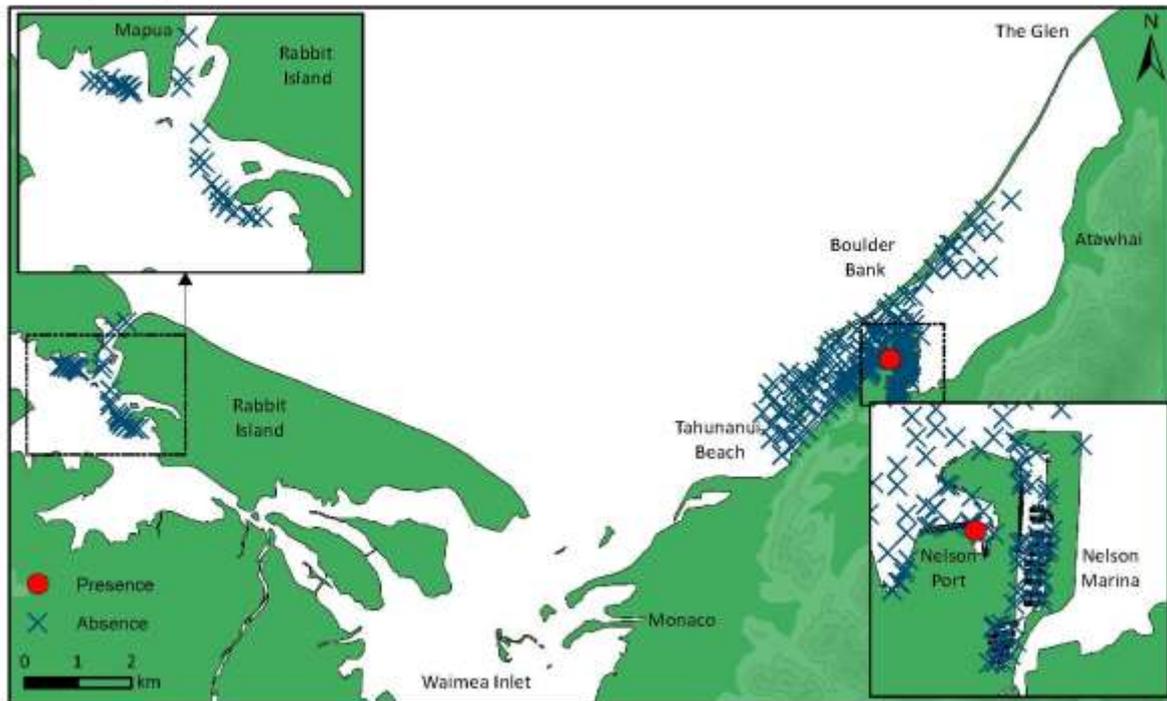
Undaria pinnatifida



Nelson Harbour and Waimea Inlet

Winter 2018

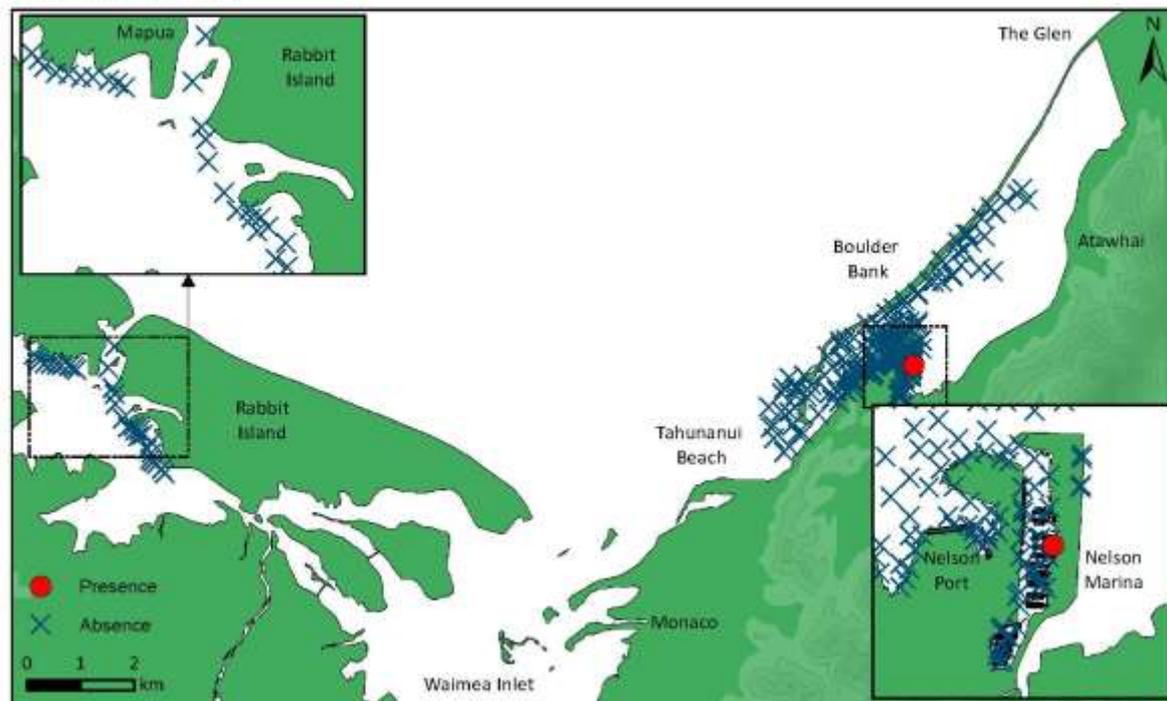
Acentrogobius pflaumii



Nelson Harbour and Waimea Inlet

Summer 2018-19

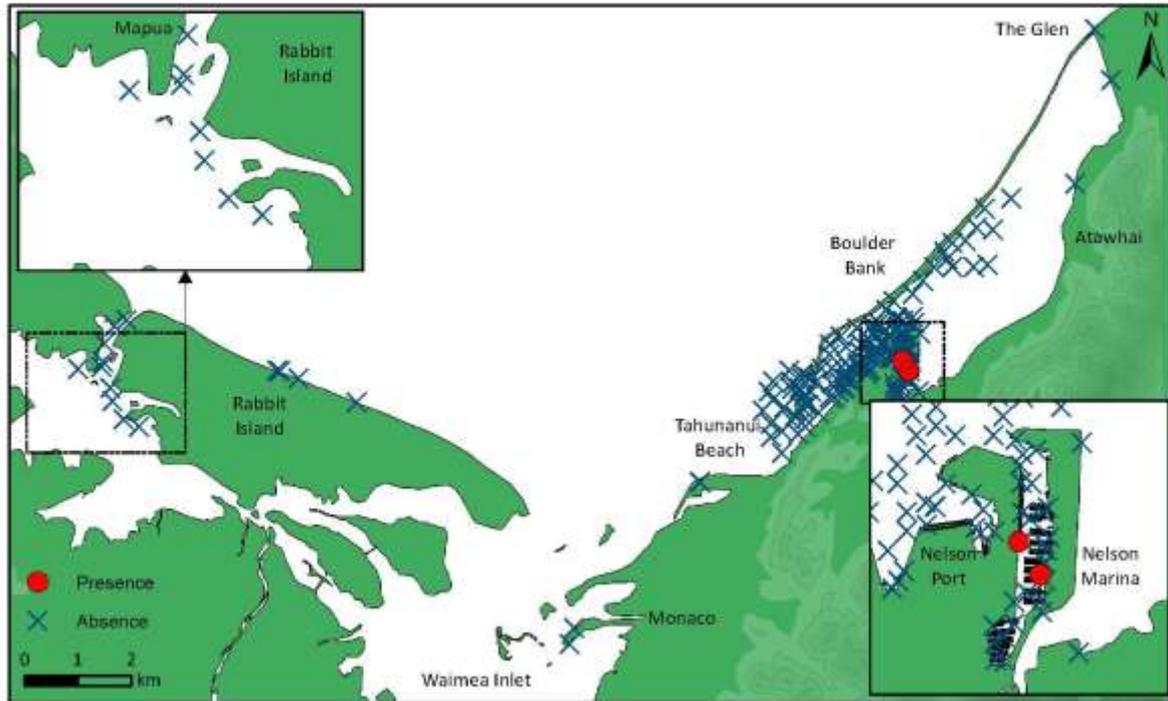
Acentrogobius pflaumii



Nelson Harbour and Waimea Inlet

Winter 2018

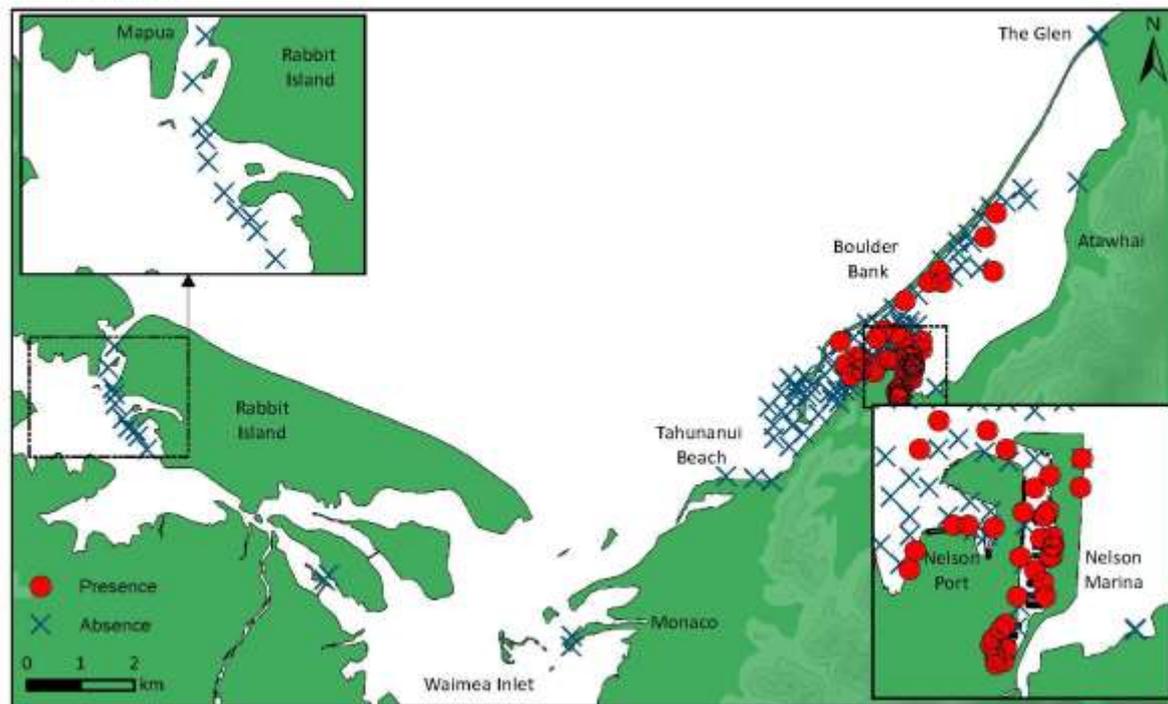
Amathia verticillata



Nelson Harbour and Waimea Inlet

Summer 2018-19

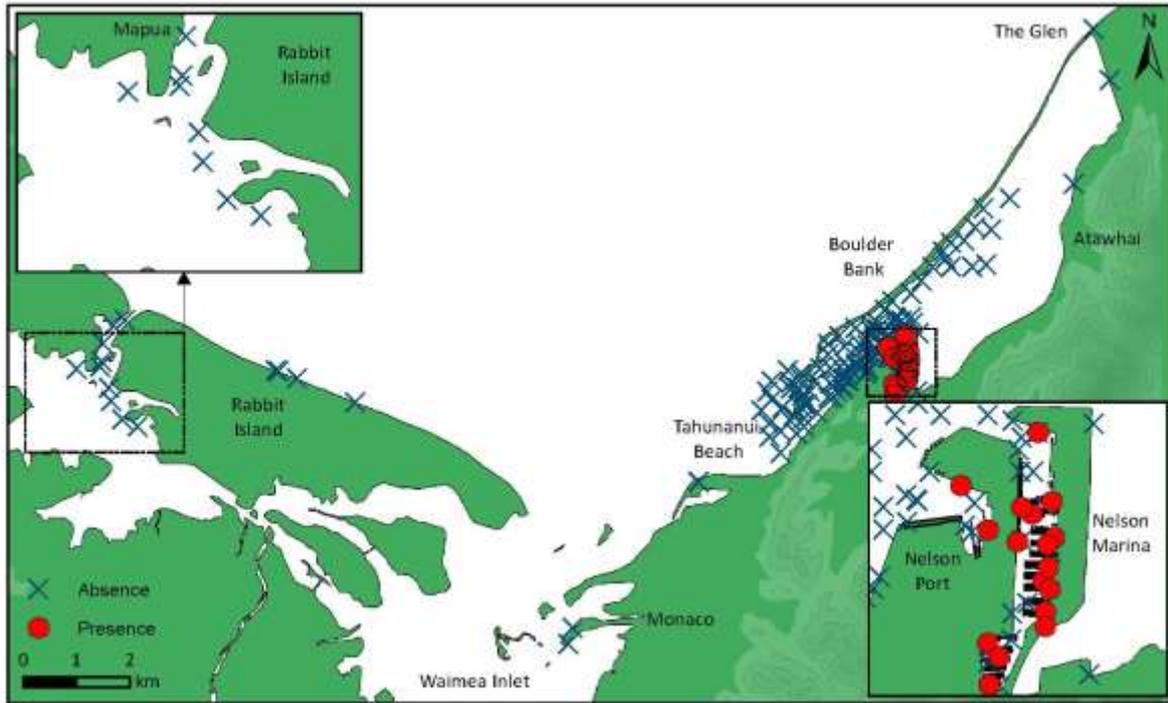
Amathia verticillata



Nelson Harbour and Waimea Inlet

Winter 2018

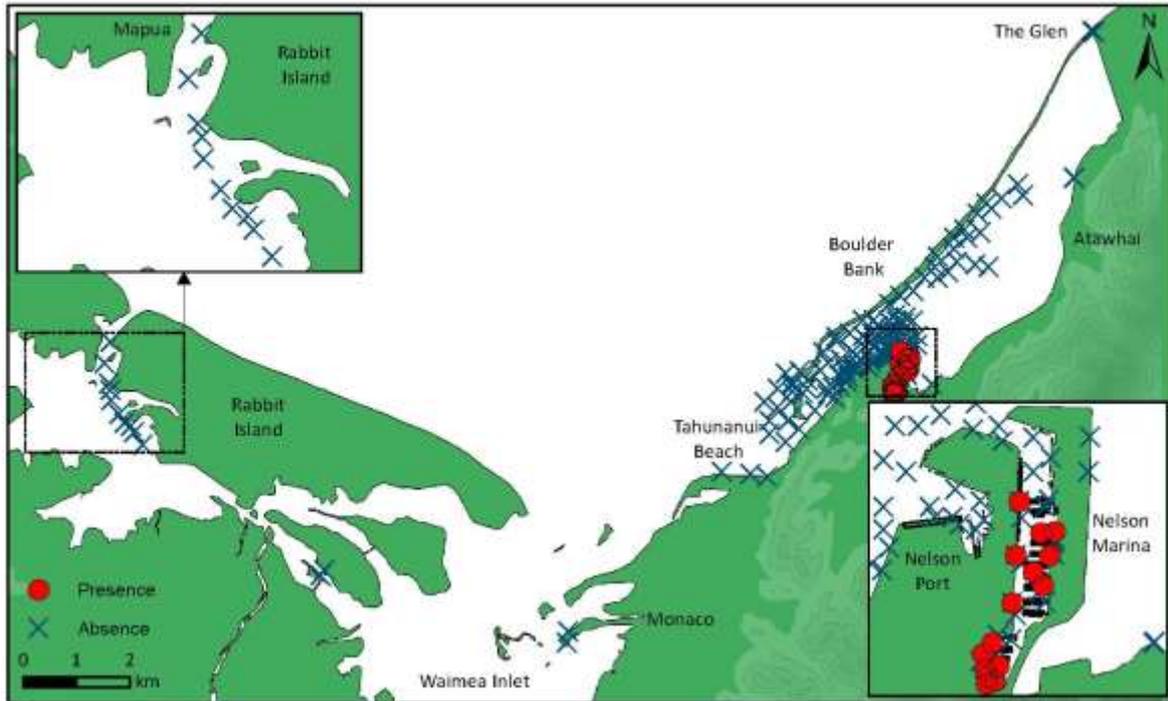
Ciona intestinalis



Nelson Harbour and Waimea Inlet

Summer 2018-19

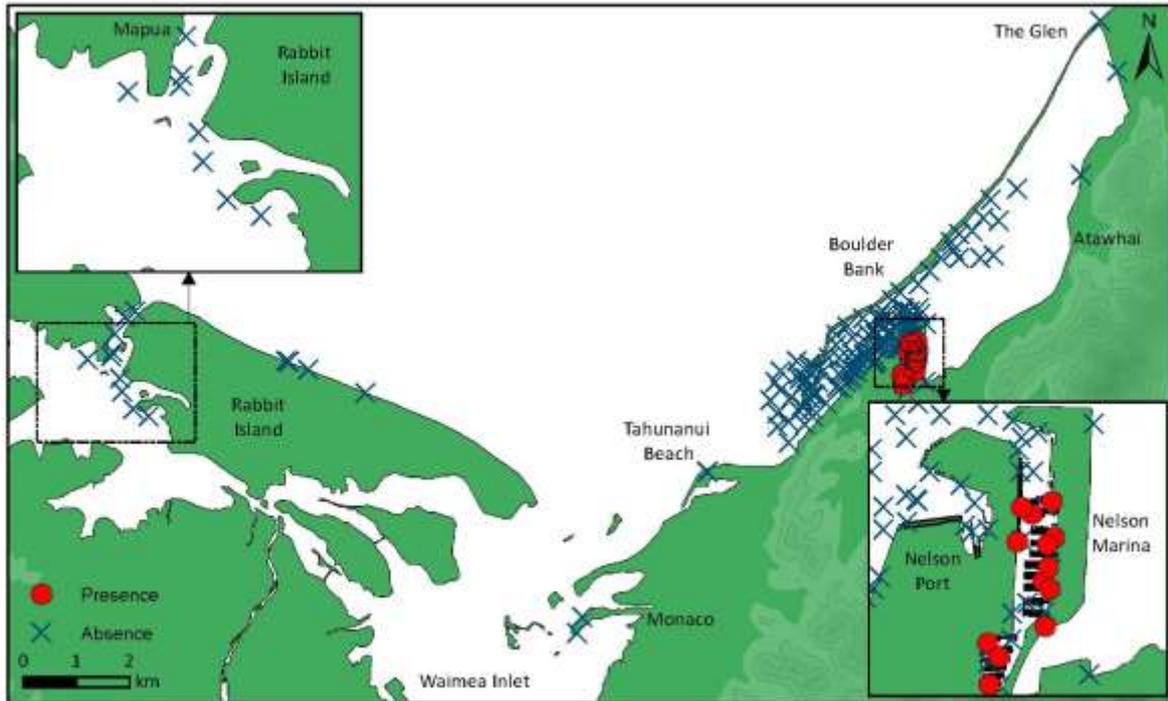
Ciona spp.



Nelson Harbour and Waimea Inlet

Winter 2018

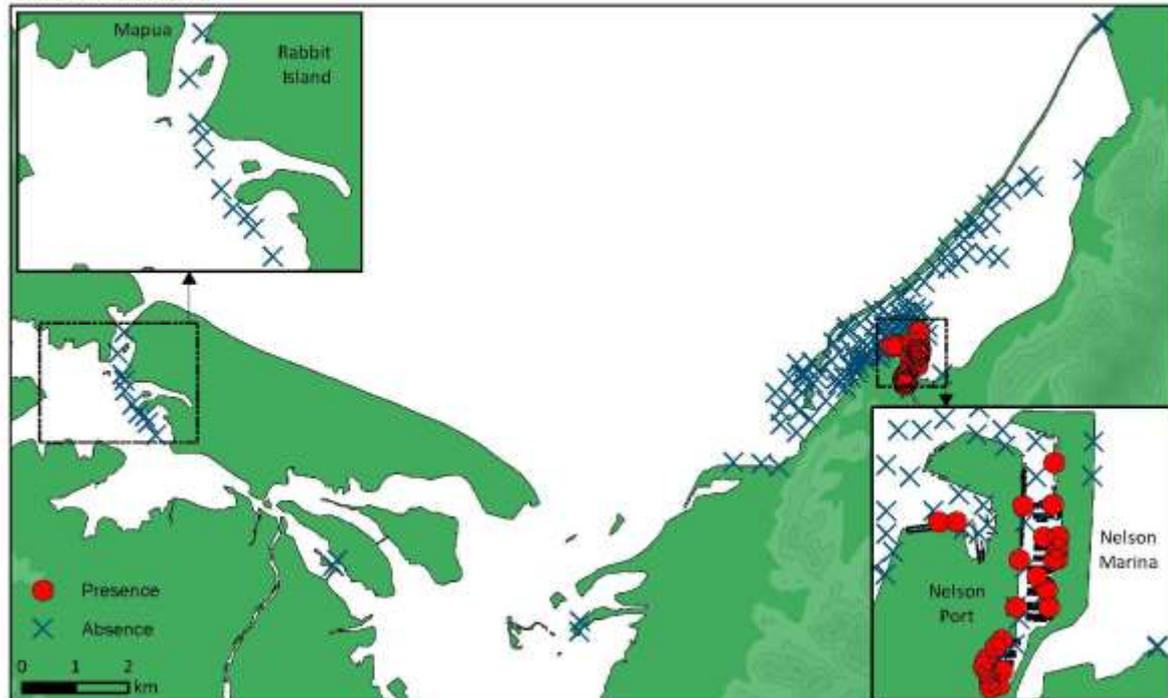
Clavelina lepadiformis



Nelson Harbour and Waimea Inlet

Summer 2018-19

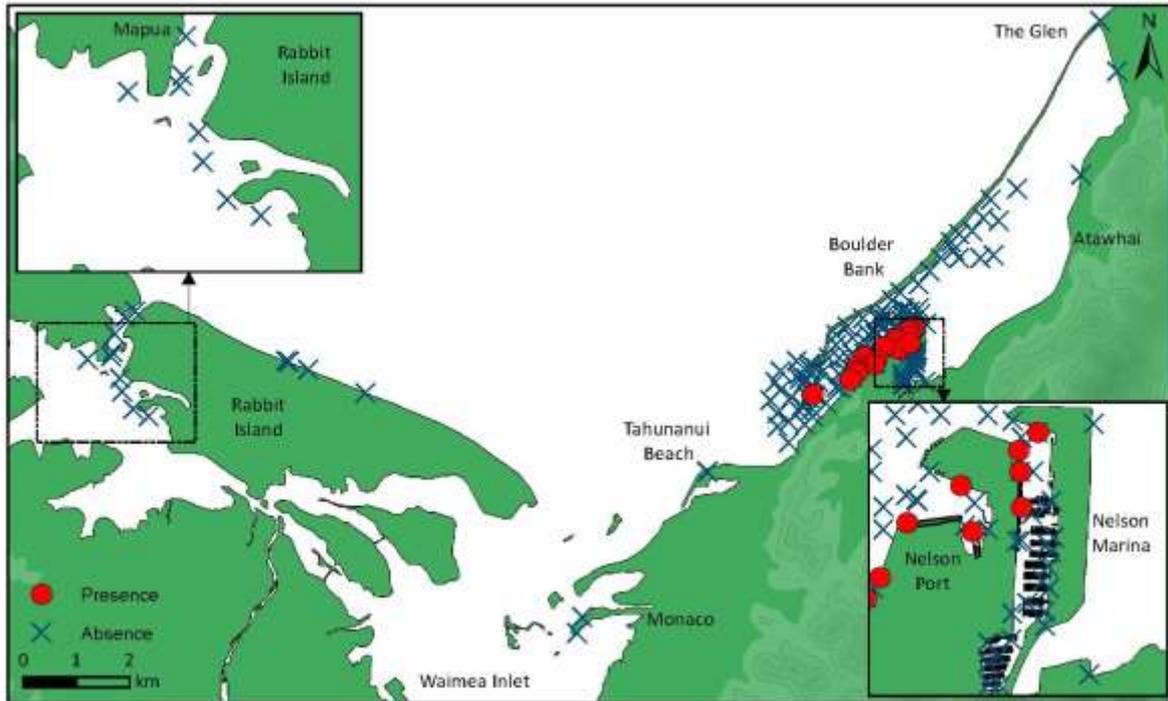
Clavelina lepadiformis



Nelson Harbour and Waimea Inlet

Winter 2018

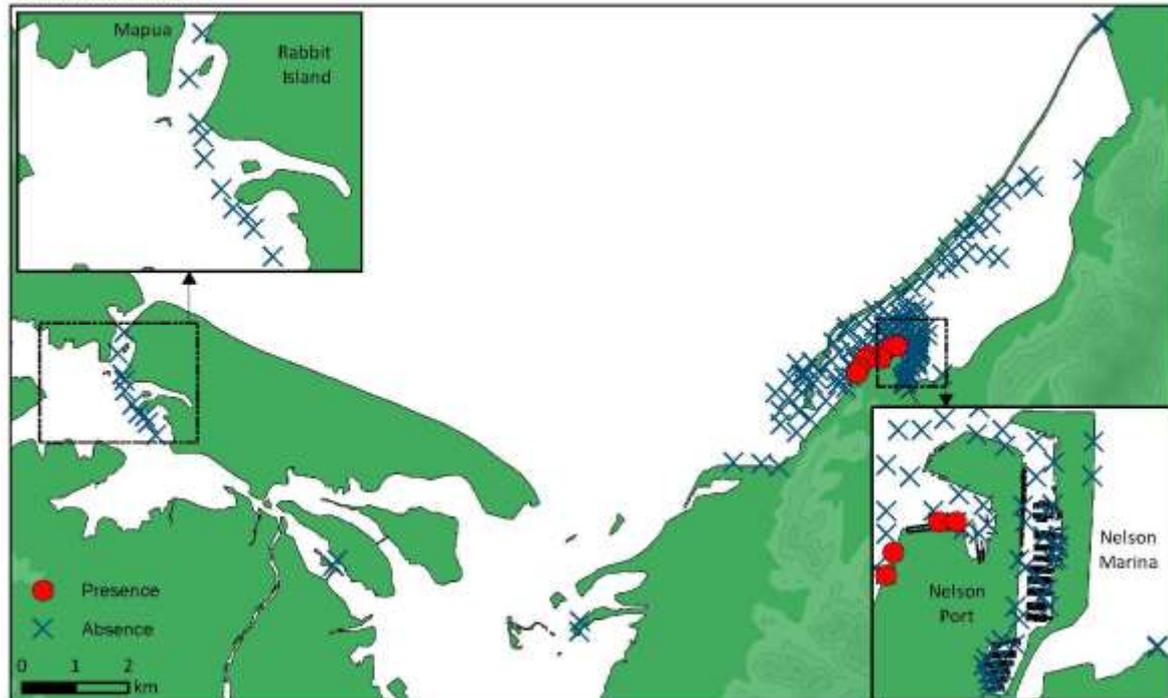
Didemnum vexillum



Nelson Harbour and Waimea Inlet

Summer 2018-19

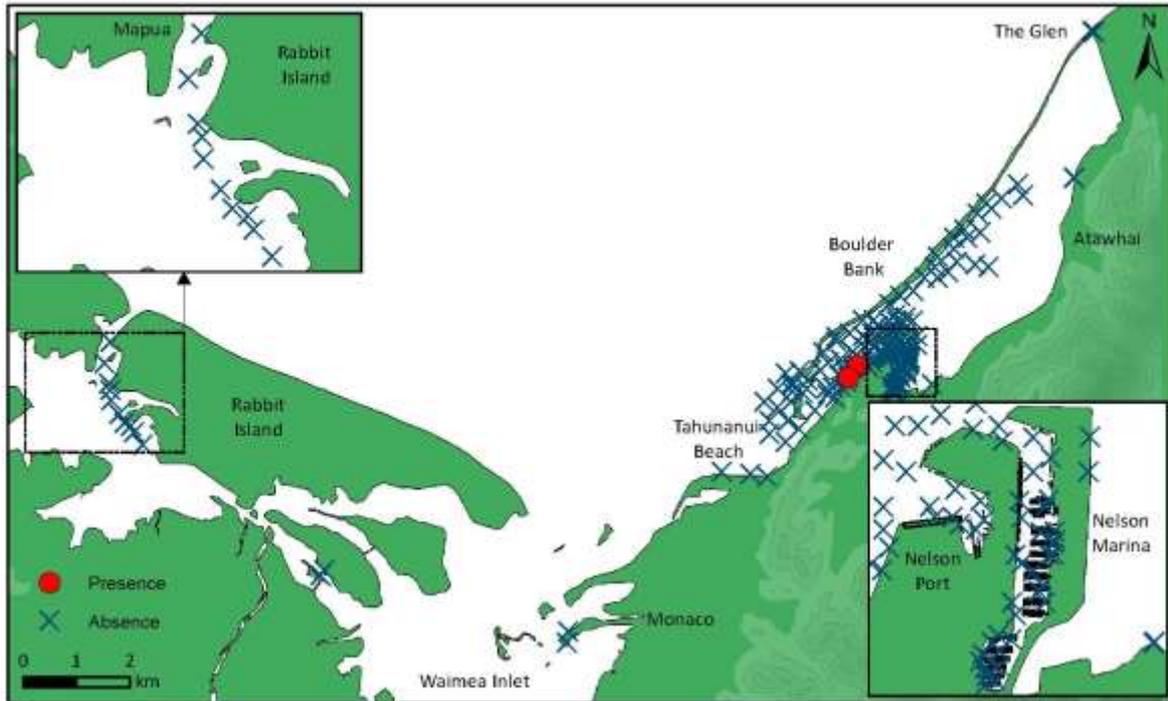
Didemnum vexillum



Nelson Harbour and Waimea Inlet

Summer 2018-19

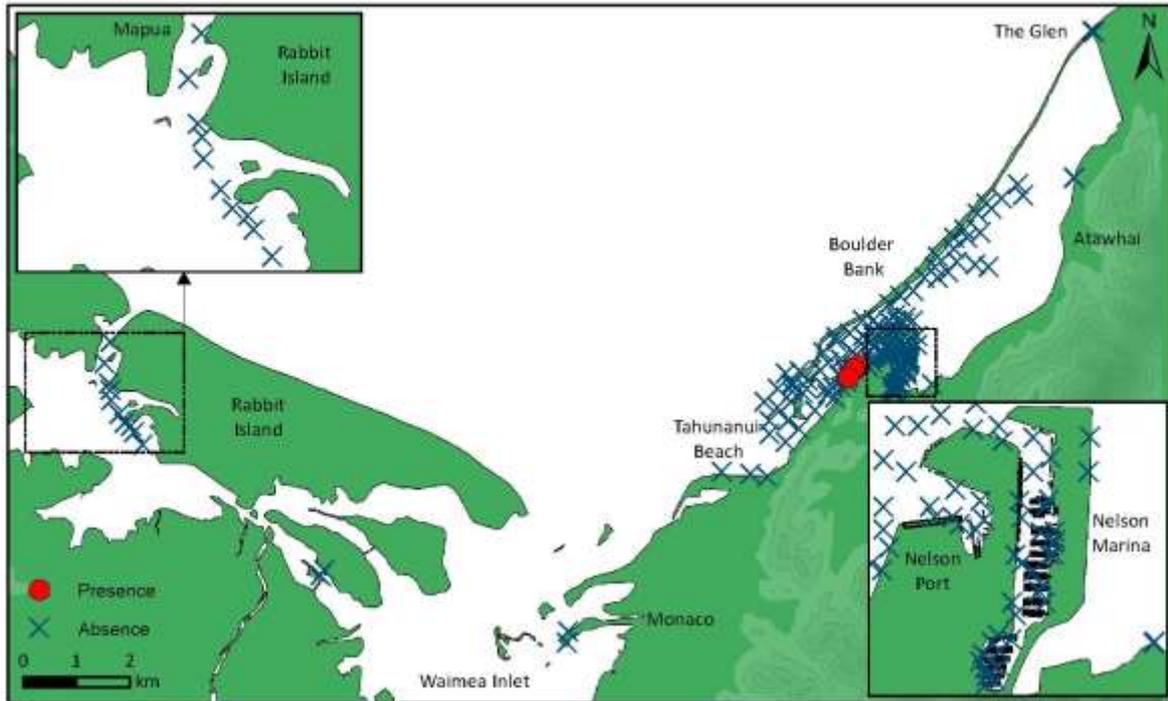
Ectopleura crocea



Nelson Harbour and Waimea Inlet

Summer 2018-19

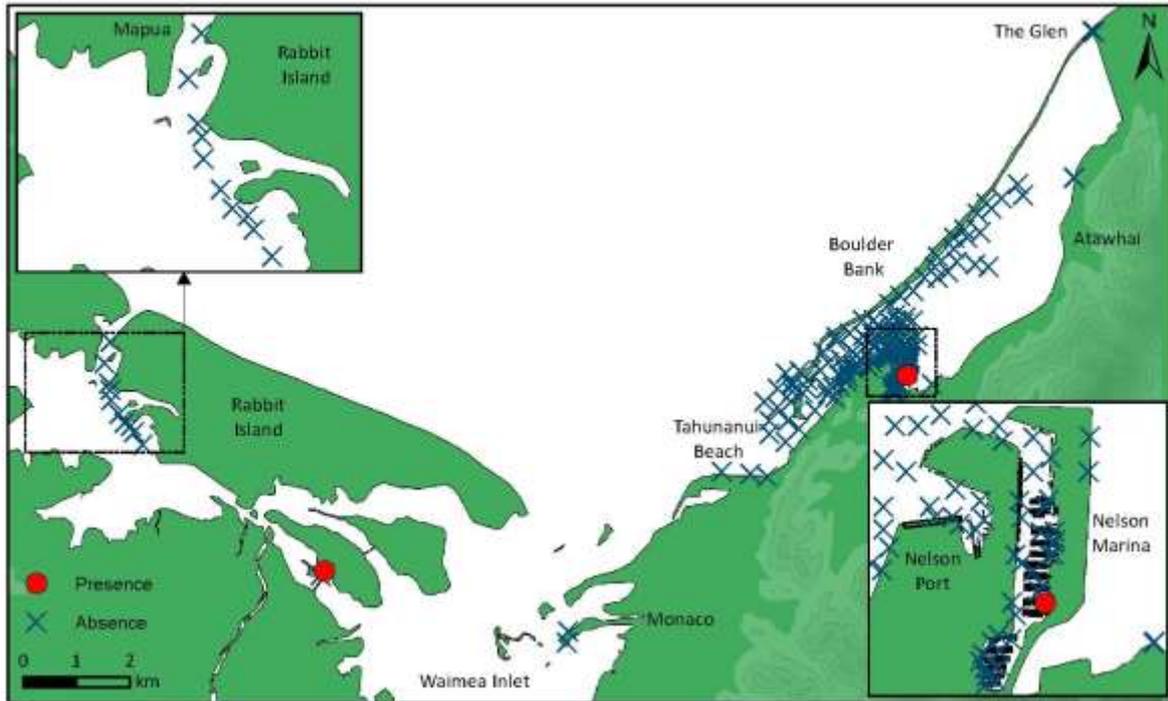
Ectopleura spp.



Nelson Harbour and Waimea Inlet

Summer 2018-19

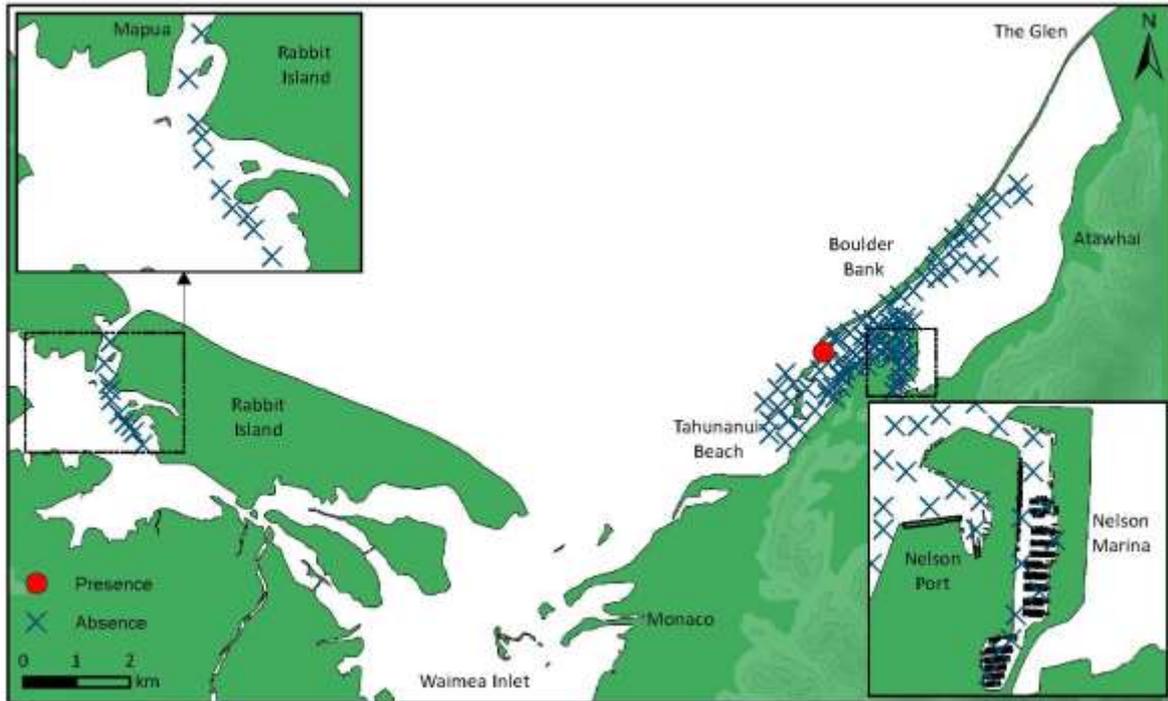
Groteloupia turuturu



Nelson Harbour and Waimea Inlet

Summer 2018-19

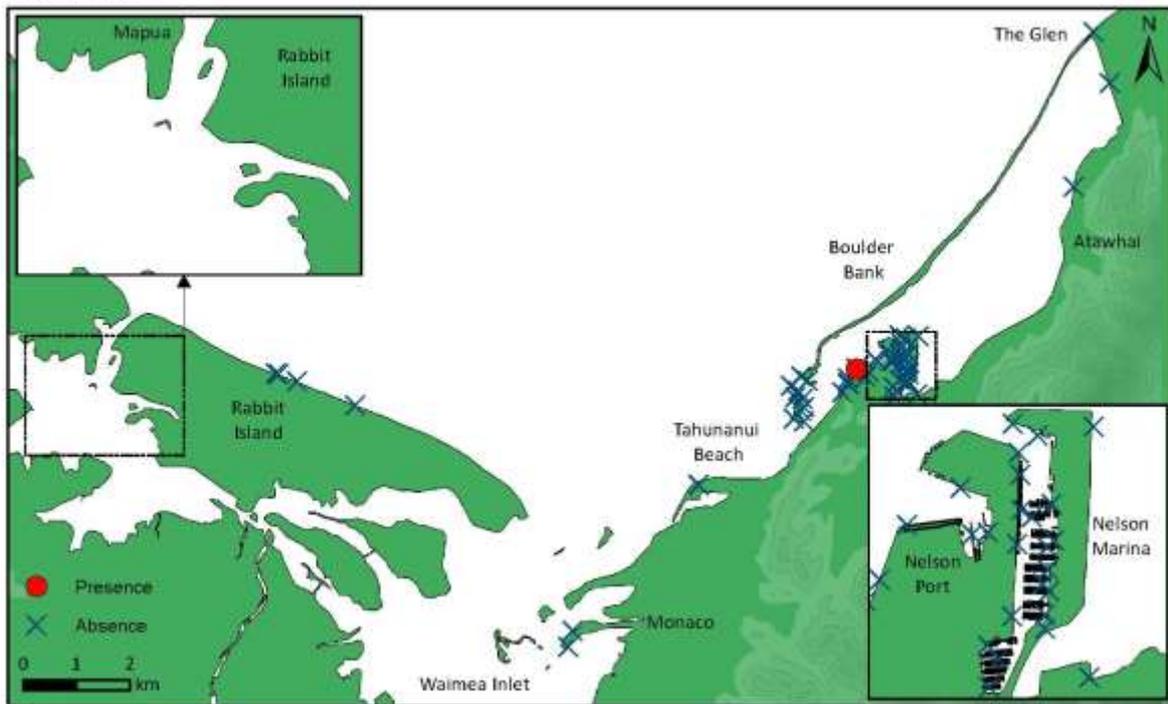
Limaria orientalis



Nelson Harbour and Waimea Inlet

Winter 2018

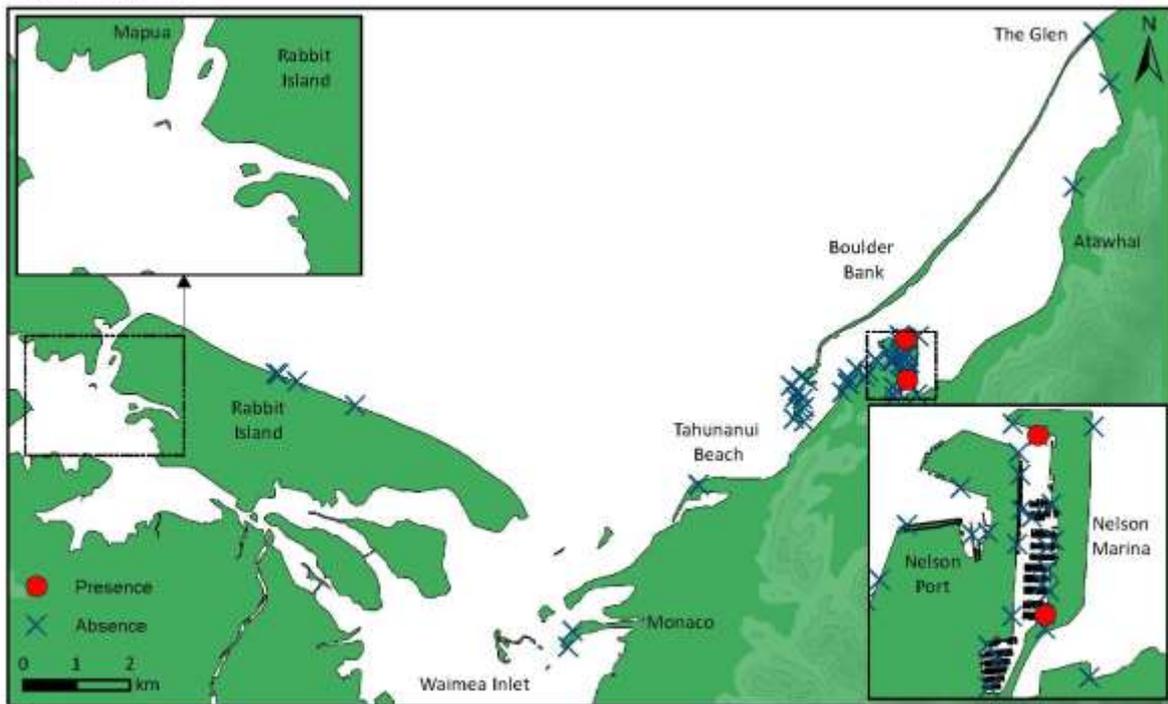
Polycera fujitai



Nelson Harbour and Waimea Inlet

Winter 2018

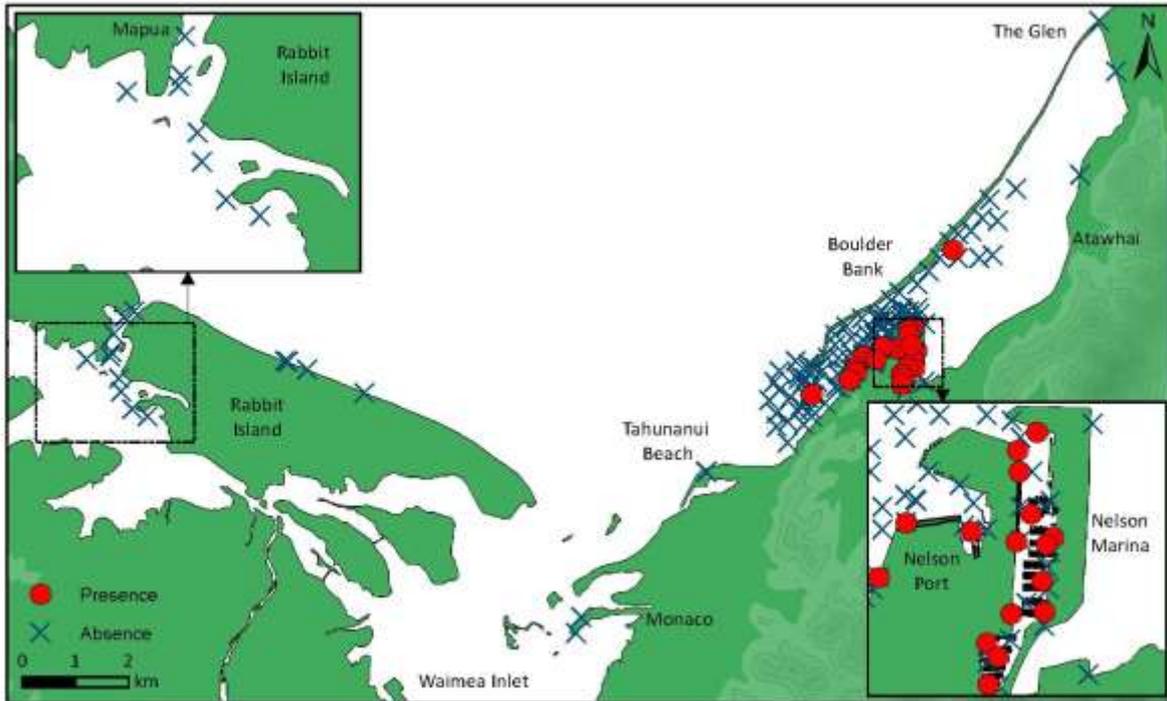
Polycera hedgpethi



Nelson Harbour and Waimea Inlet

Winter 2018

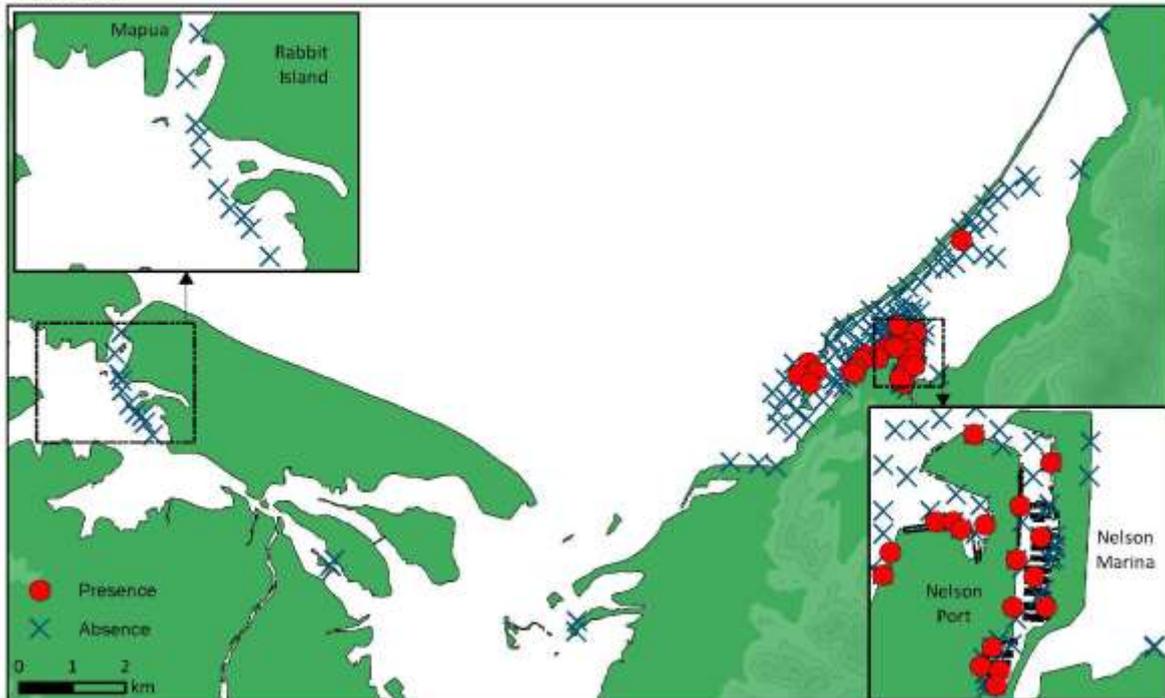
Styela clava



Nelson Harbour and Waimea Inlet

Summer 2018-19

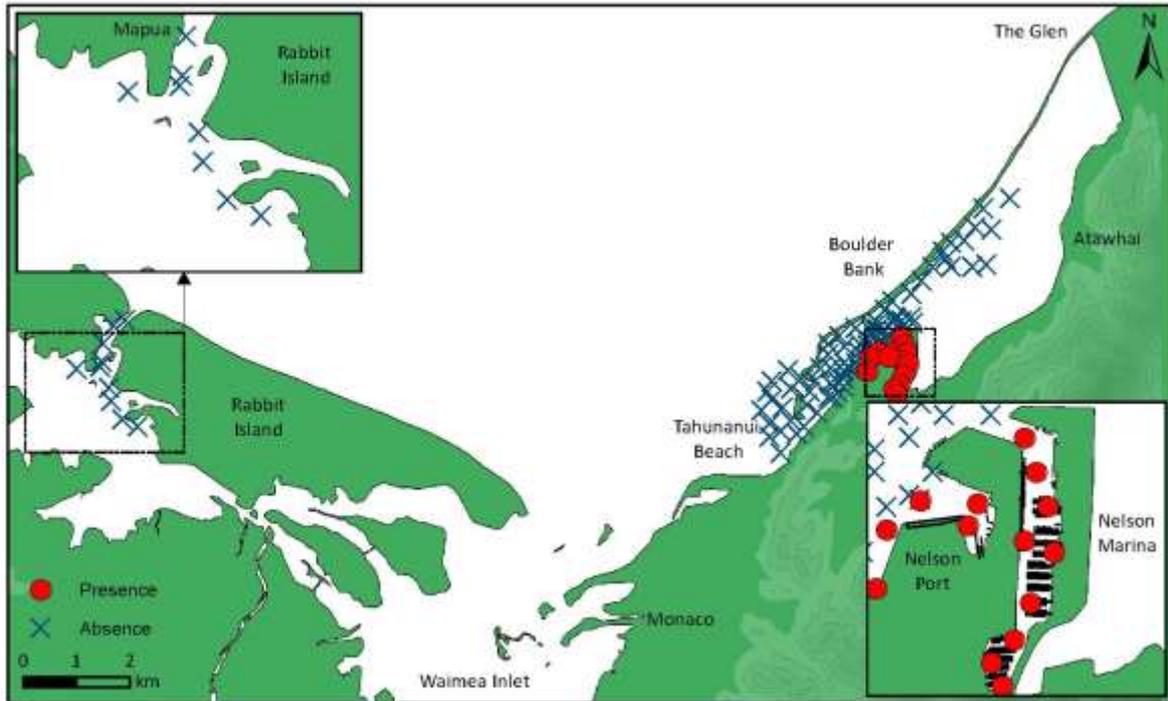
Styela clava



Nelson Harbour and Waimea Inlet

Winter 2018

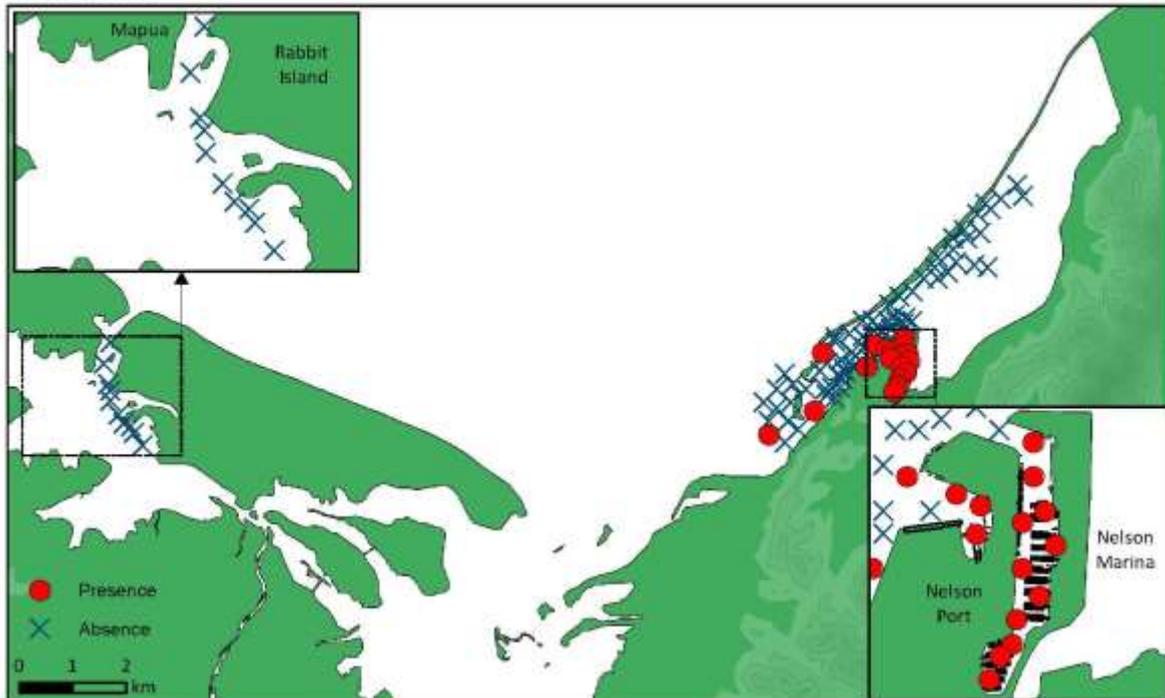
Theora lubrica



Nelson Harbour and Waimea Inlet

Summer 2018-19

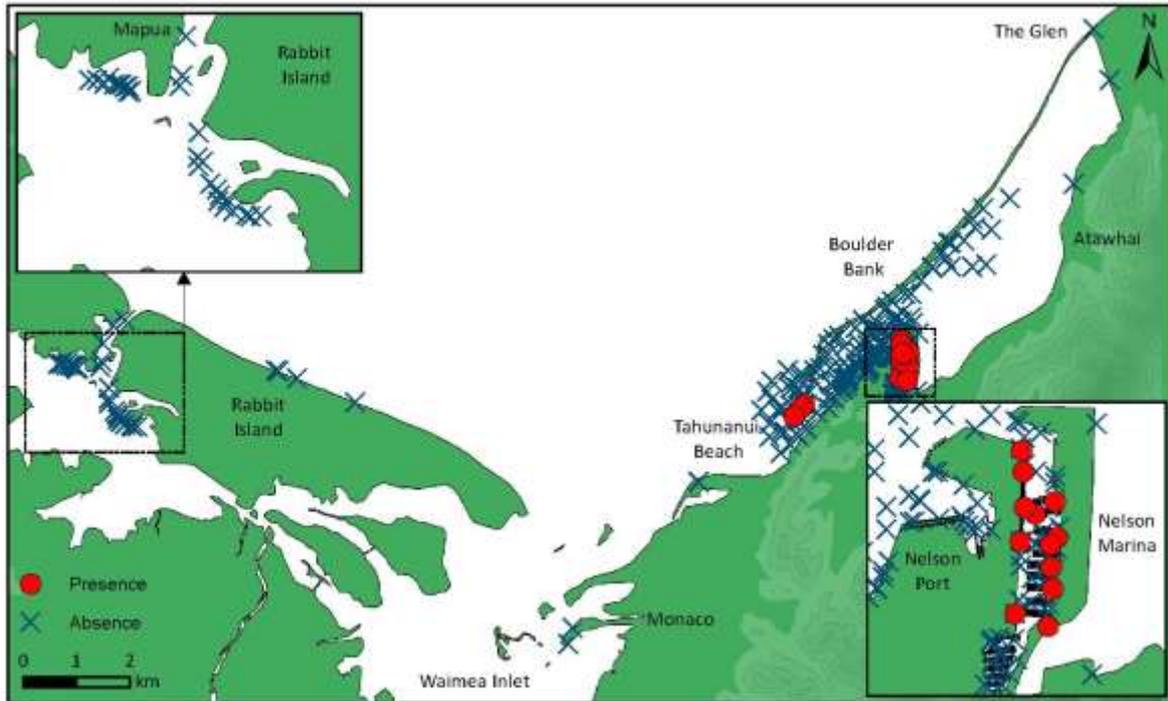
Theora lubrica



Nelson Harbour and Waimea Inlet

Winter 2018

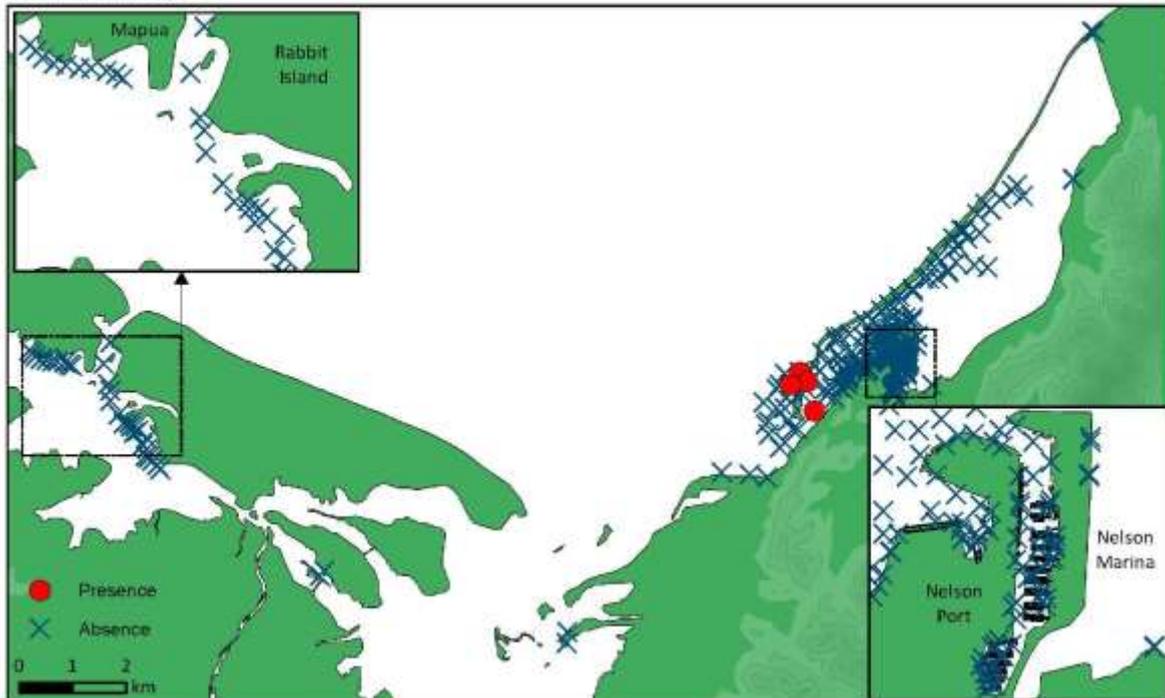
Undaria pinnatifida



Nelson Harbour and Waimea Inlet

Summer 2018-19

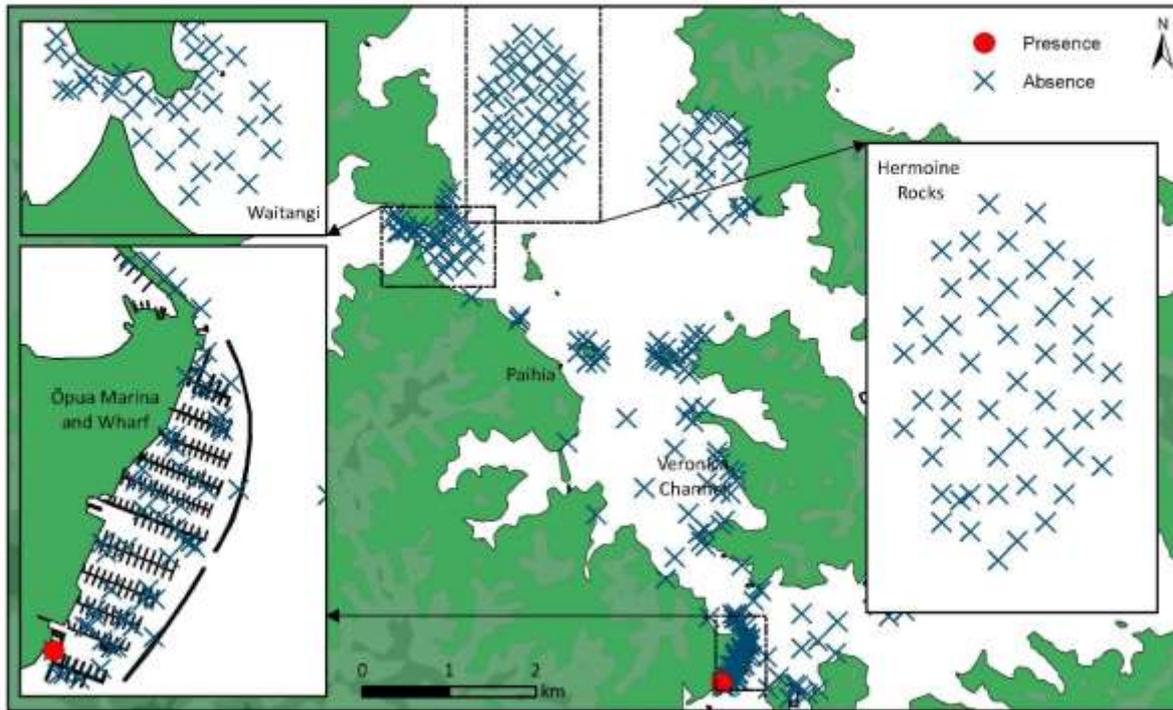
Undaria pinnatifida



Ōpua Marina and Waikare Inlet

Summer 2018-19

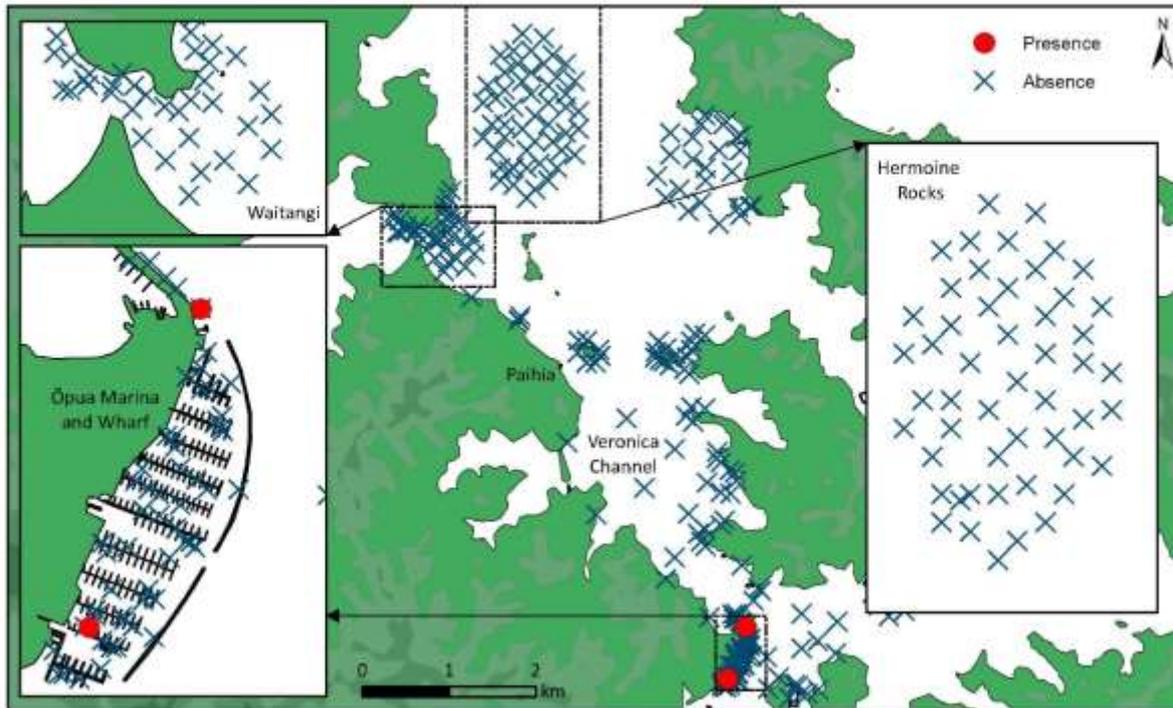
Botrylloides giganteum



Ōpua Marina and Waikare Inlet

Summer 2018-19

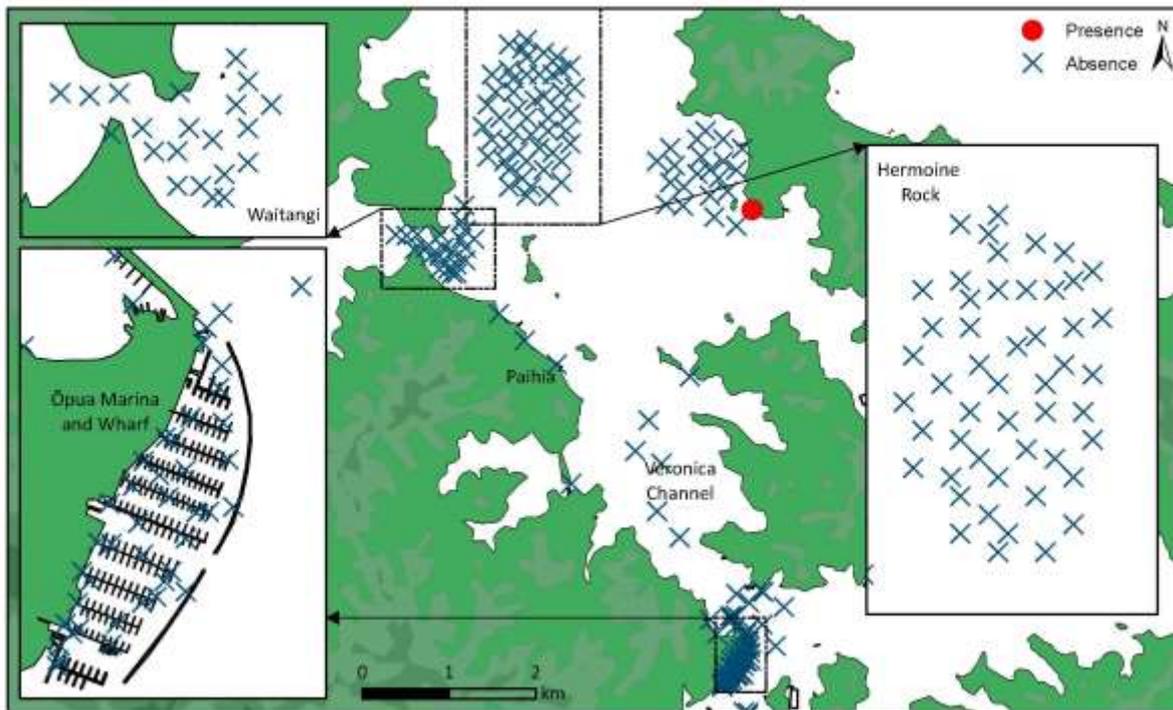
Celleporaria umbonatoidea



Ōpua Marina and Waikare Inlet

Winter 2018

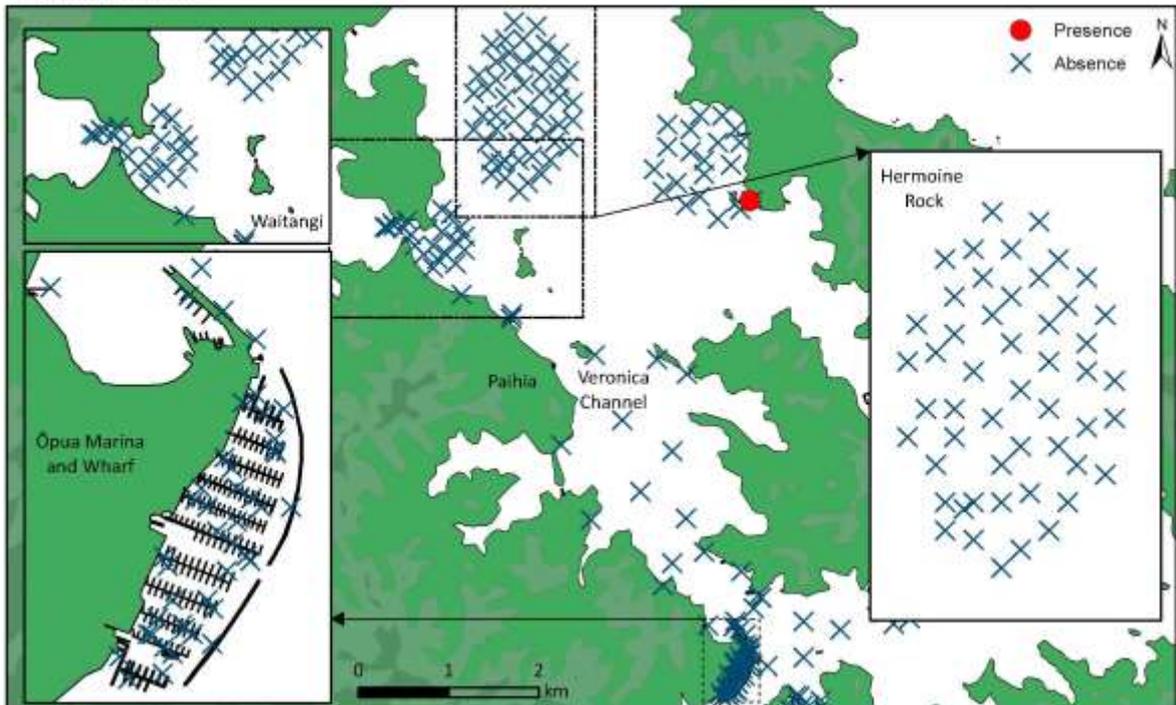
Didemnum vexillum



Ōpua Marina and Waikare Inlet

Summer 2018-19

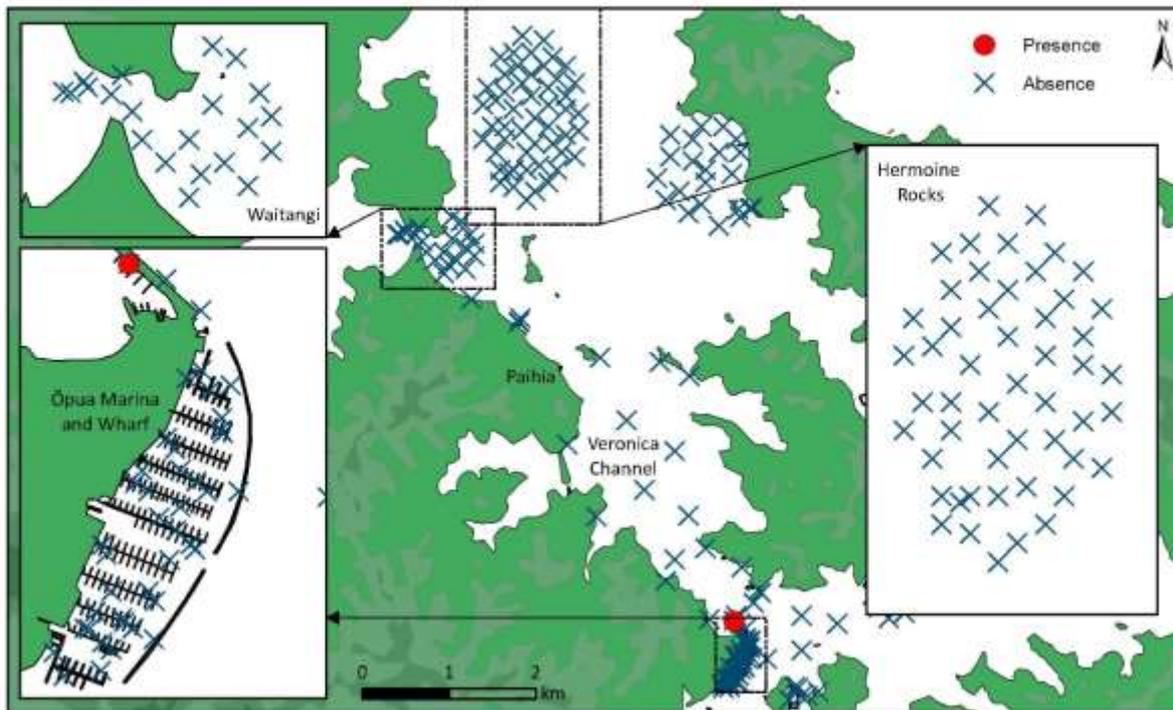
Didemnum vexillum



Ōpua Marina and Waikare Inlet

Summer 2018-19

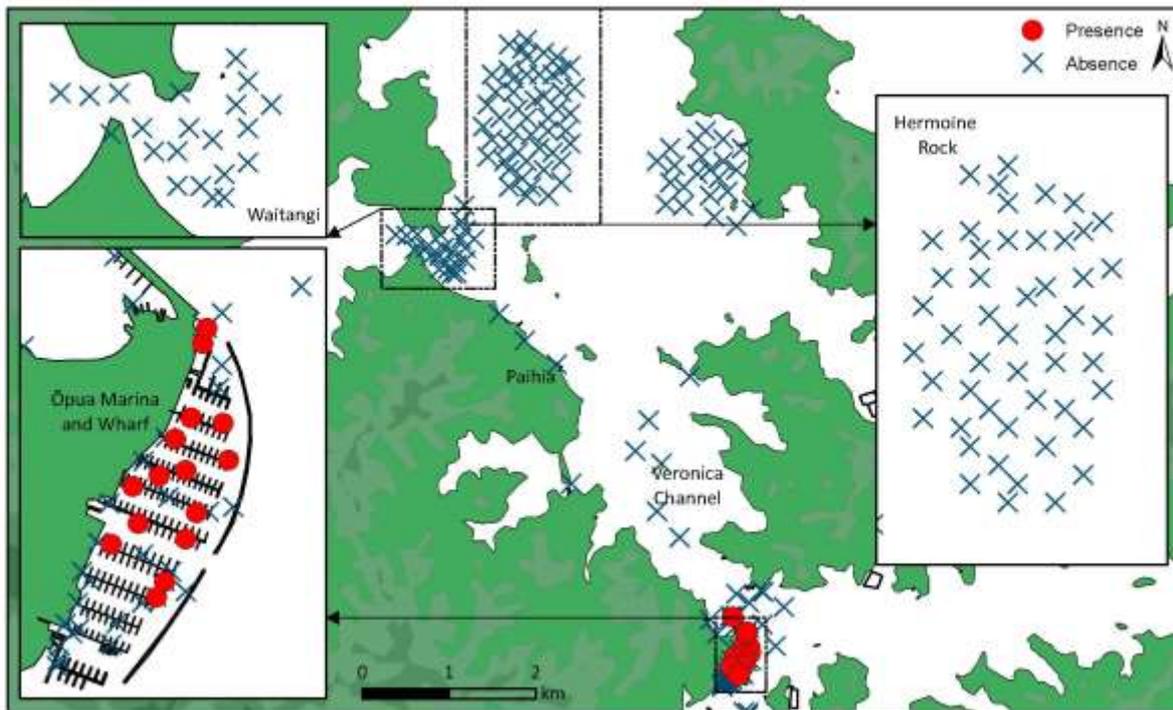
Ectopleura larynx



Ōpua Marina and Waikare Inlet

Winter 2019

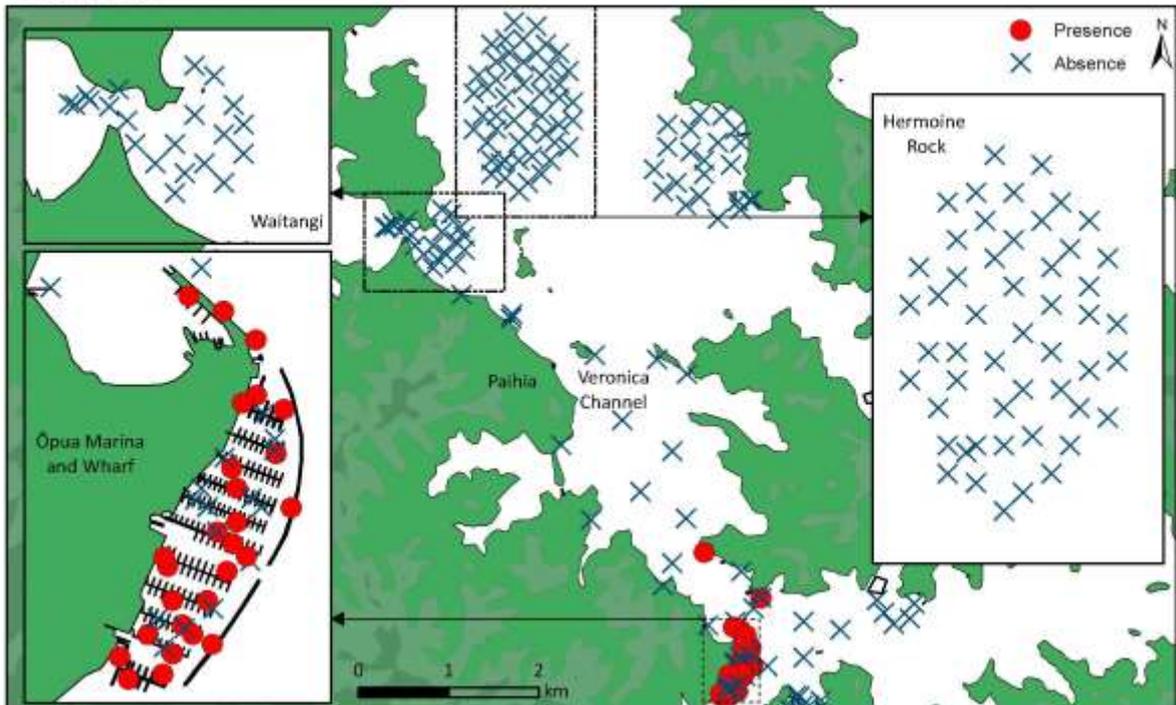
Ectopleura spp.



Ōpua Marina and Waikare Inlet

Summer 2018-19

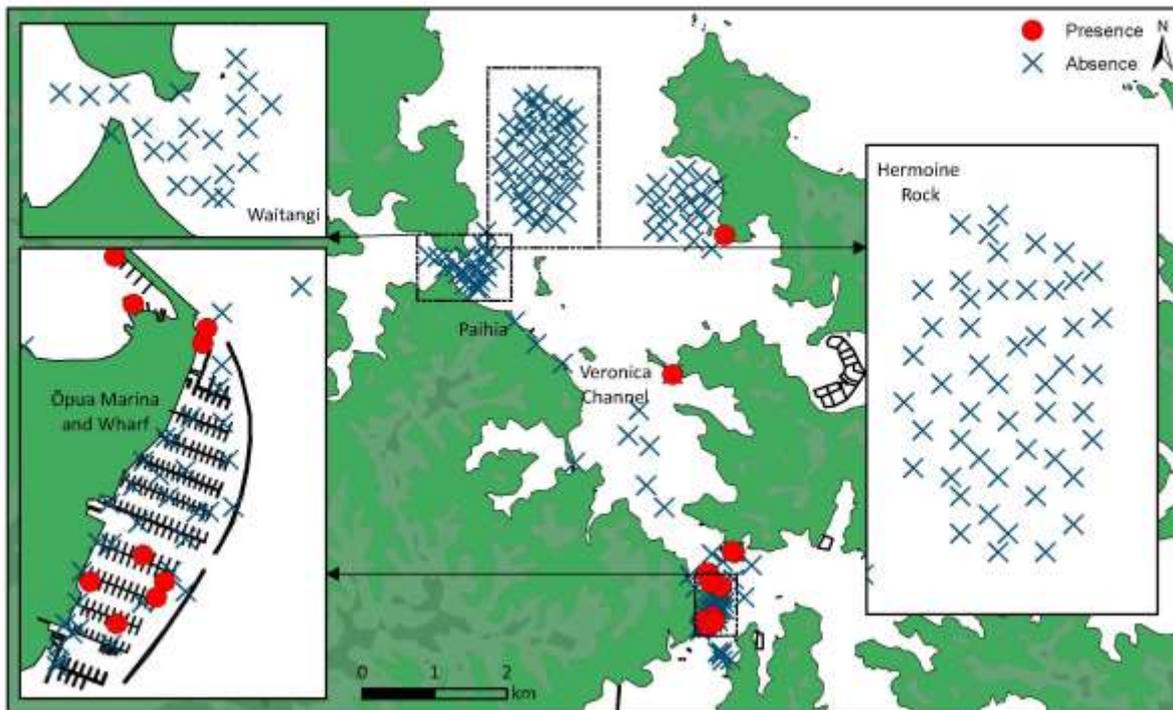
Ectopleura spp.



Ōpua Marina and Waikare Inlet

Winter 2018

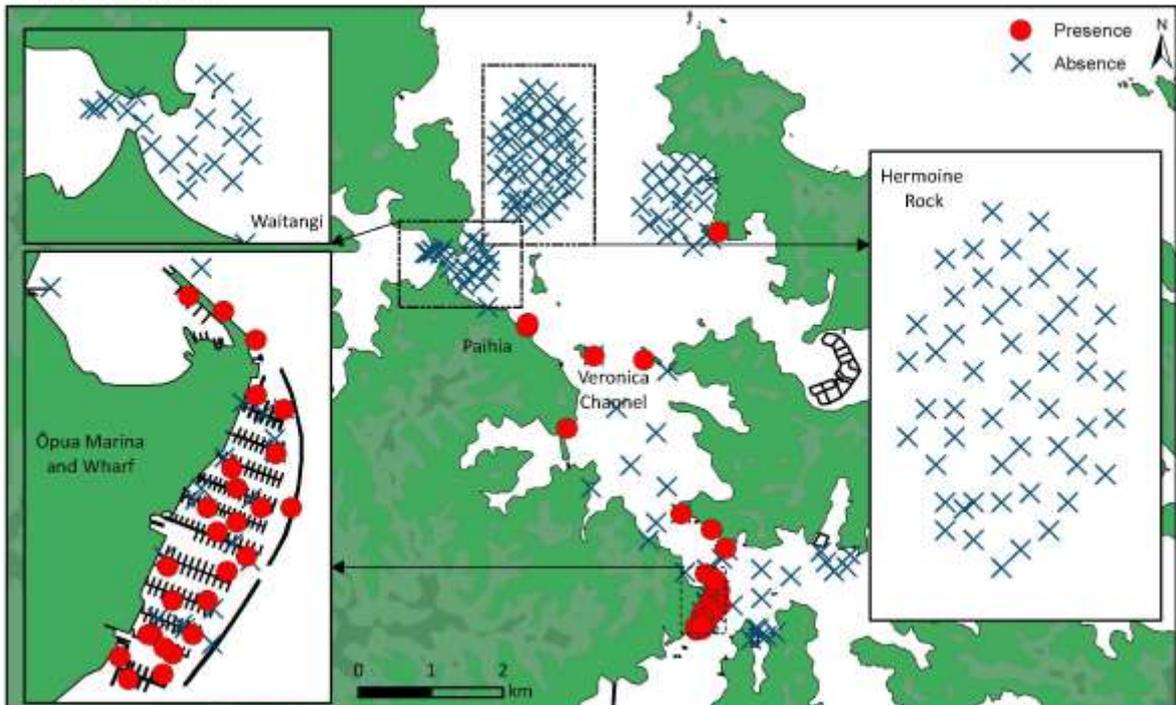
Eudistoma elongatum



Ōpua Marina and Waikare Inlet

Summer 2018-19

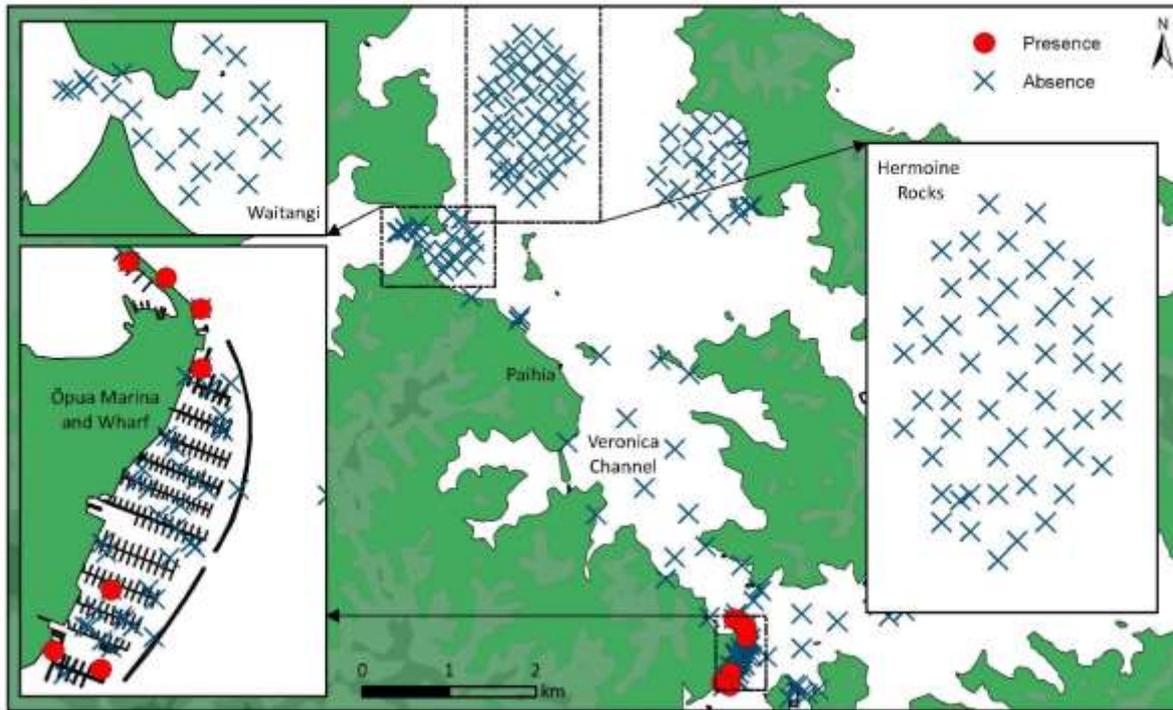
Eudistoma elongatum



Ōpua Marina and Waikare Inlet

Summer 2018-19

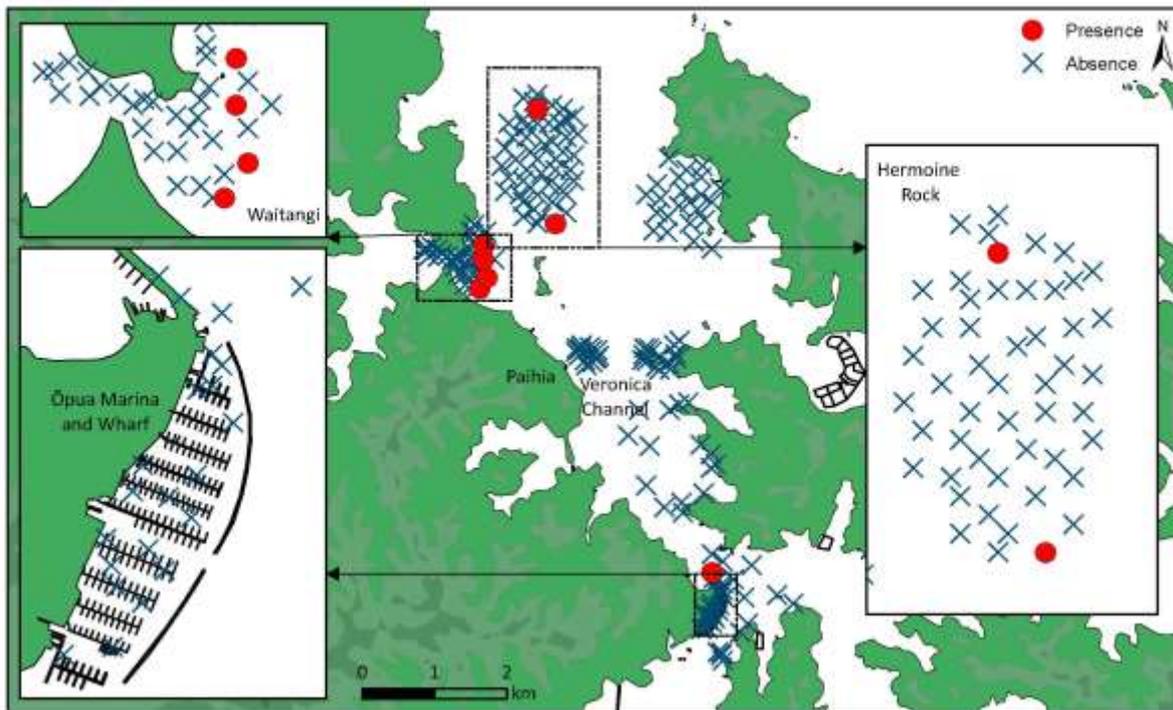
Polycera hedgpethi



Ōpua Marina and Waikare Inlet

Winter 2018

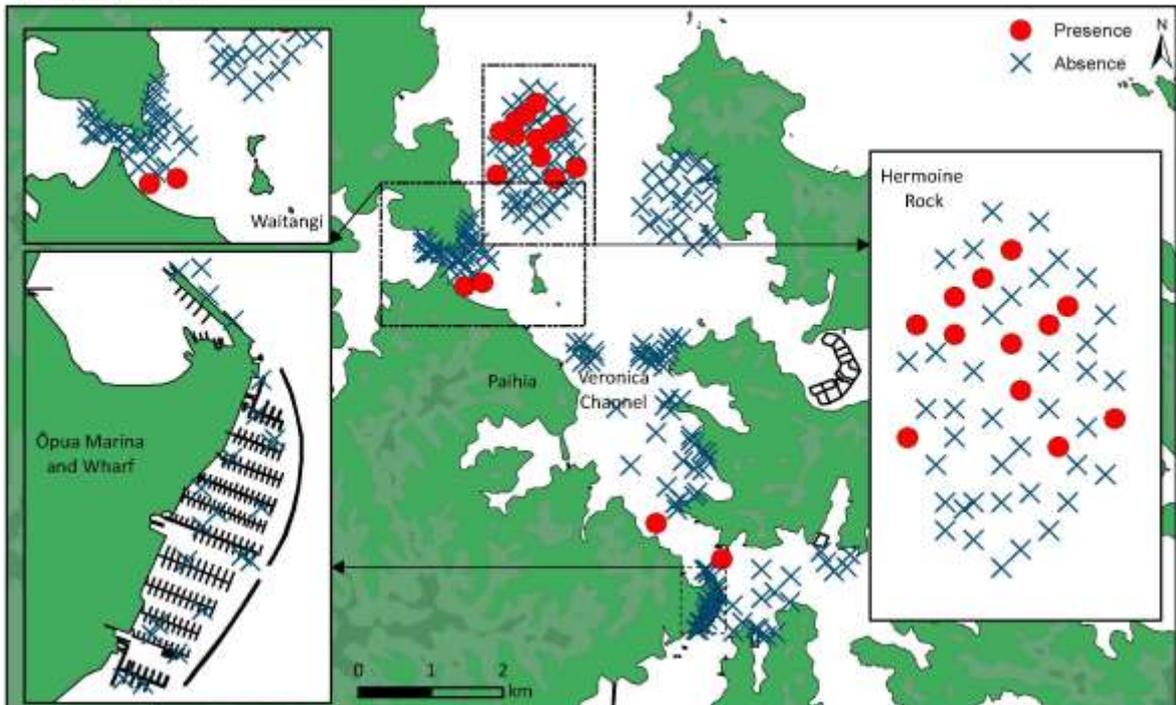
Pyromaia tuberculata



Ōpua Marina and Waikare Inlet

Summer 2018-19

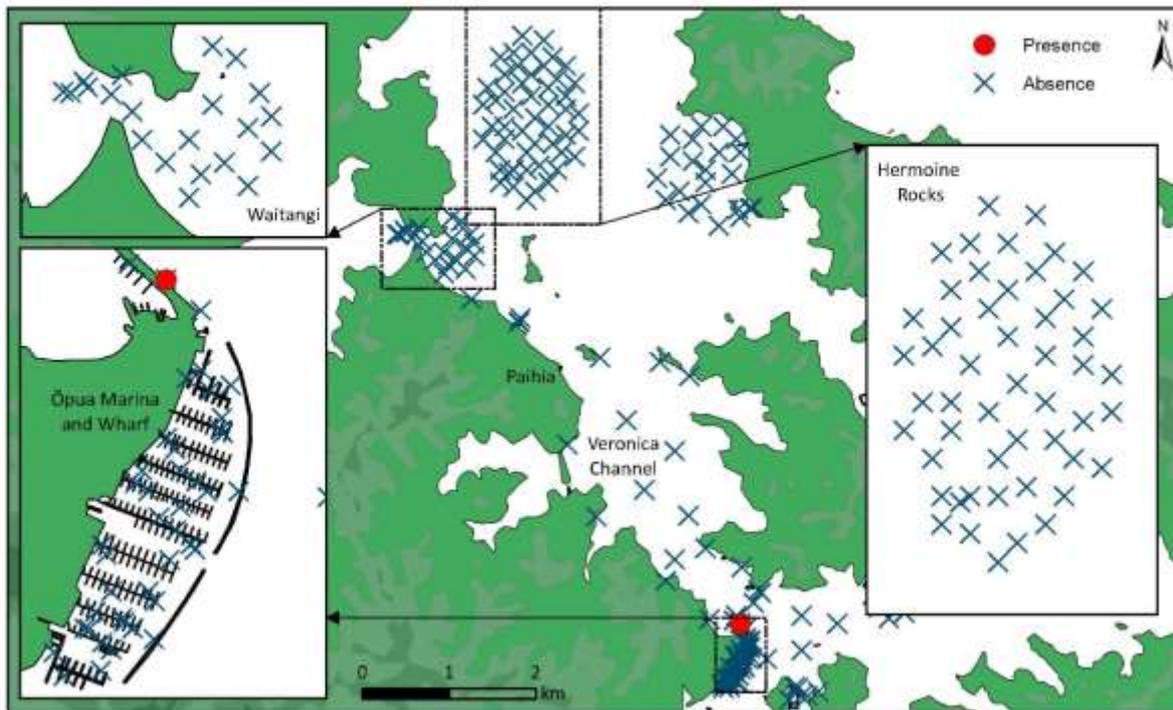
Pyromaia tuberculata



Ōpua Marina and Waikare Inlet

Summer 2018-19

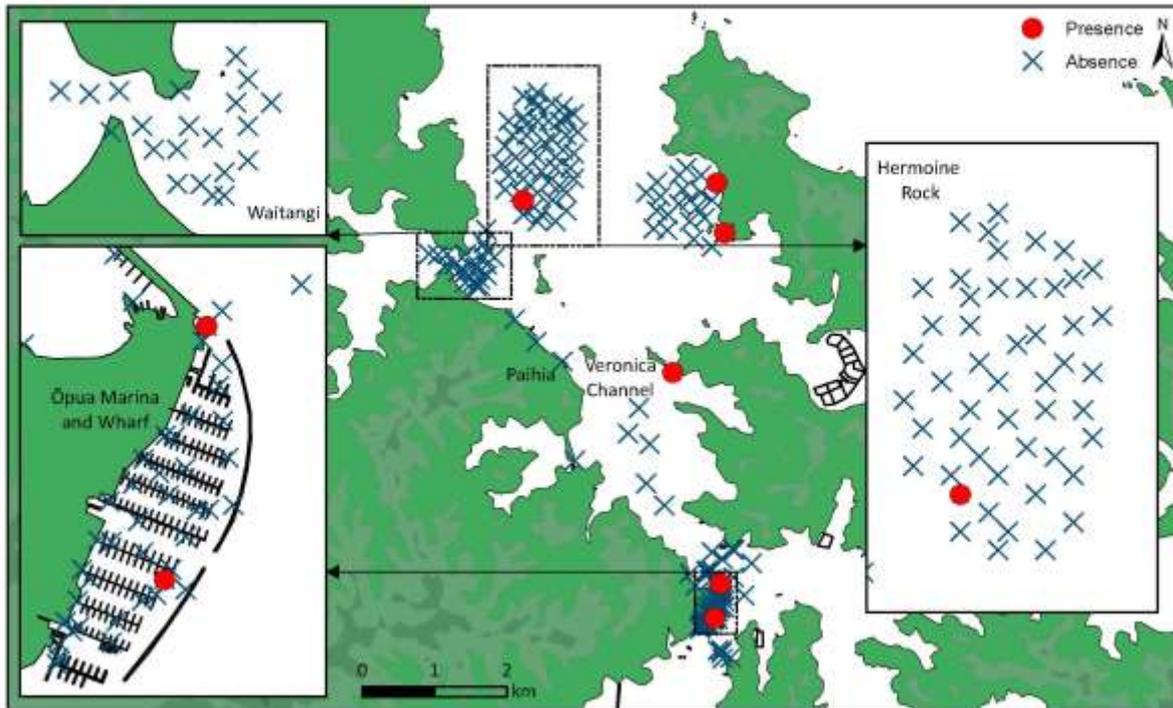
Sabella spallanzanii



Ōpua Marina and Waikare Inlet

Winter 2018

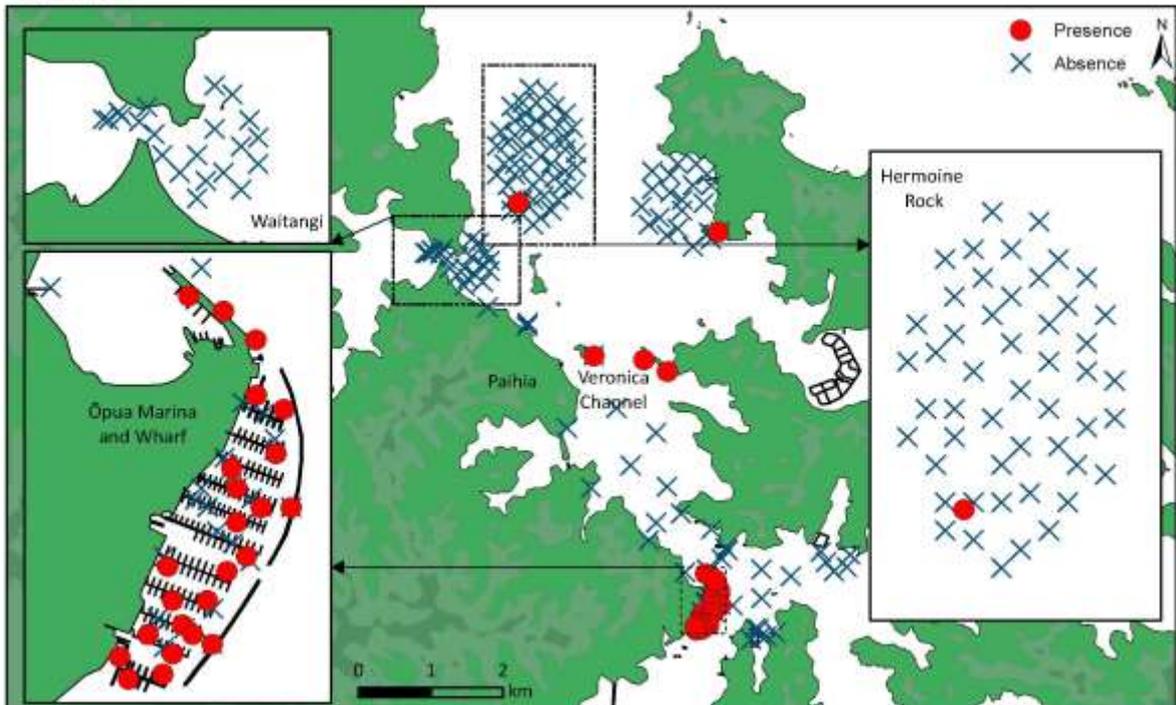
Styela clava



Ōpua Marina and Waikare Inlet

Summer 2018-19

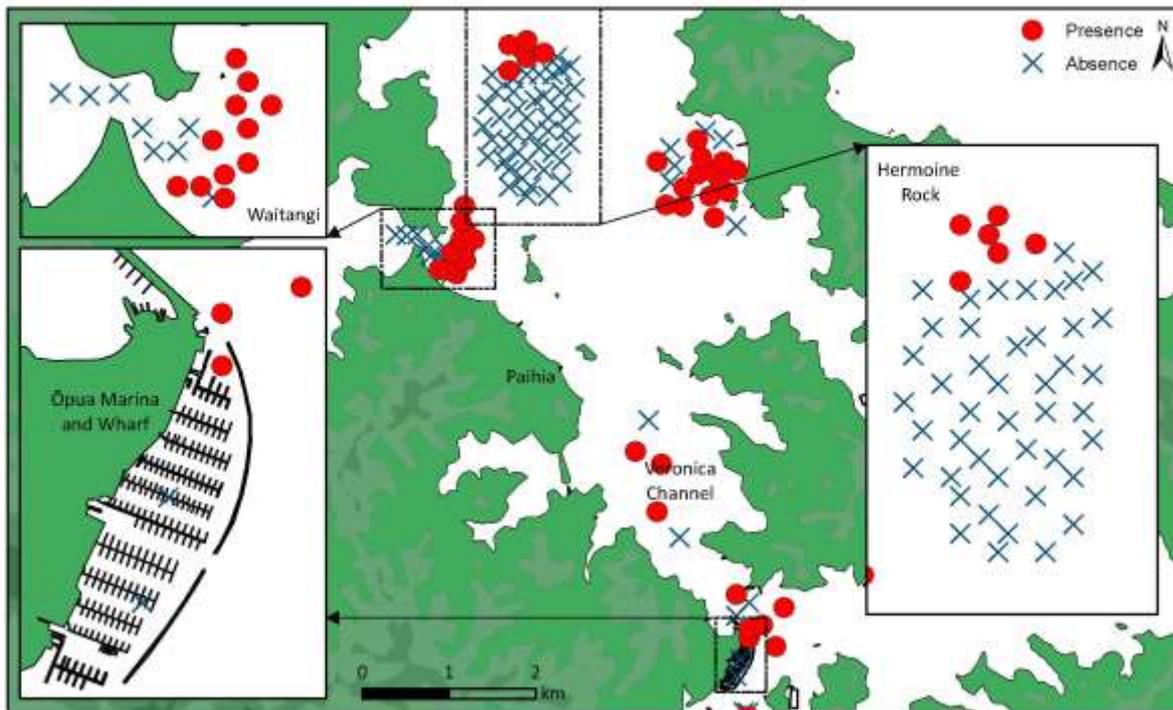
Styela clava



Ōpua Marina and Waikare Inlet

Winter 2018

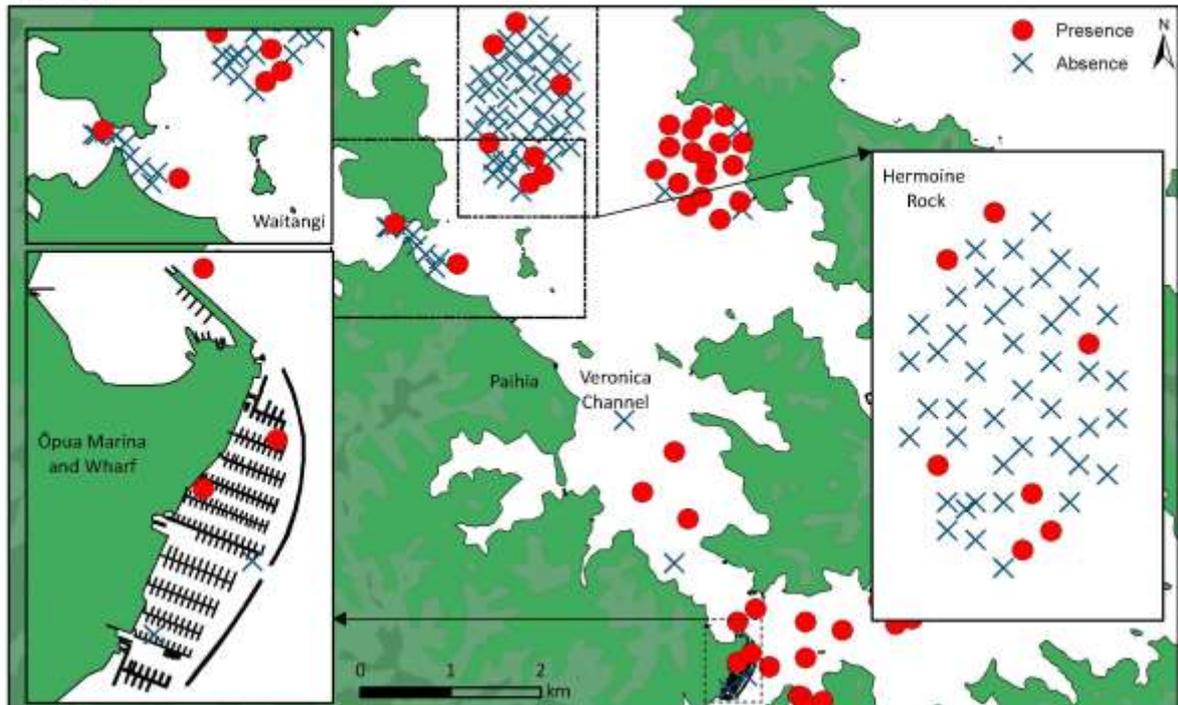
Theora lubrica



Ōpua Marina and Waikare Inlet

Summer 2018-19

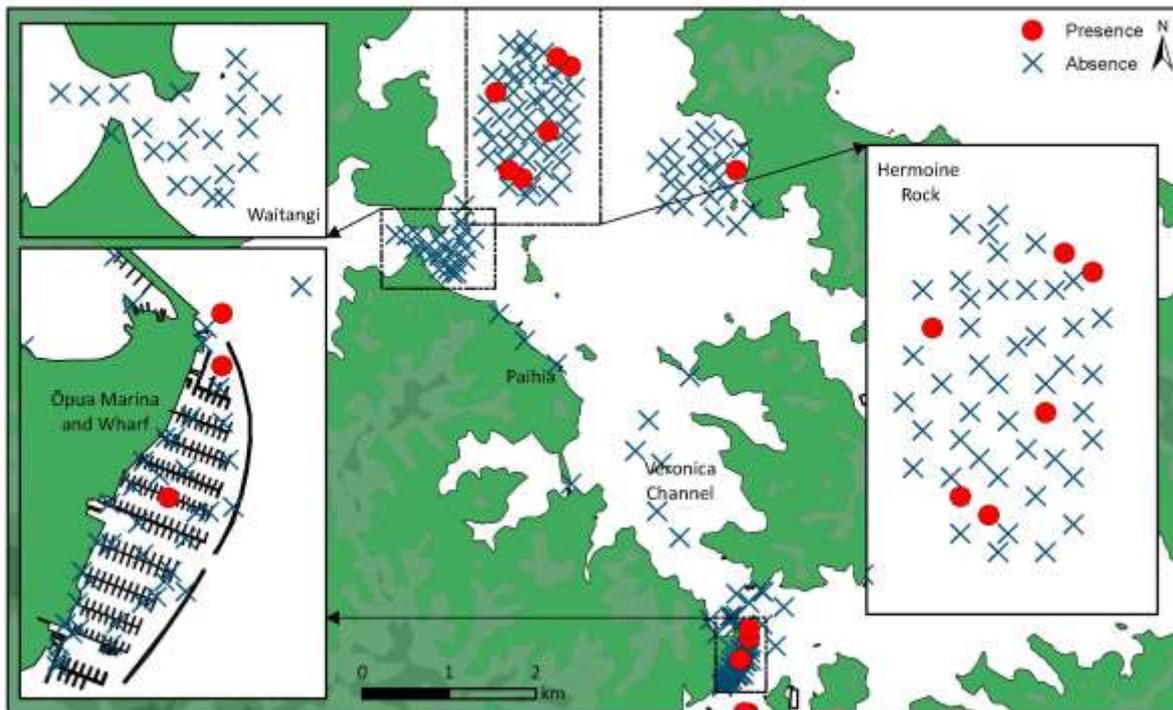
Theora lubrica



Ōpua Marina and Waikare Inlet

Winter 2018

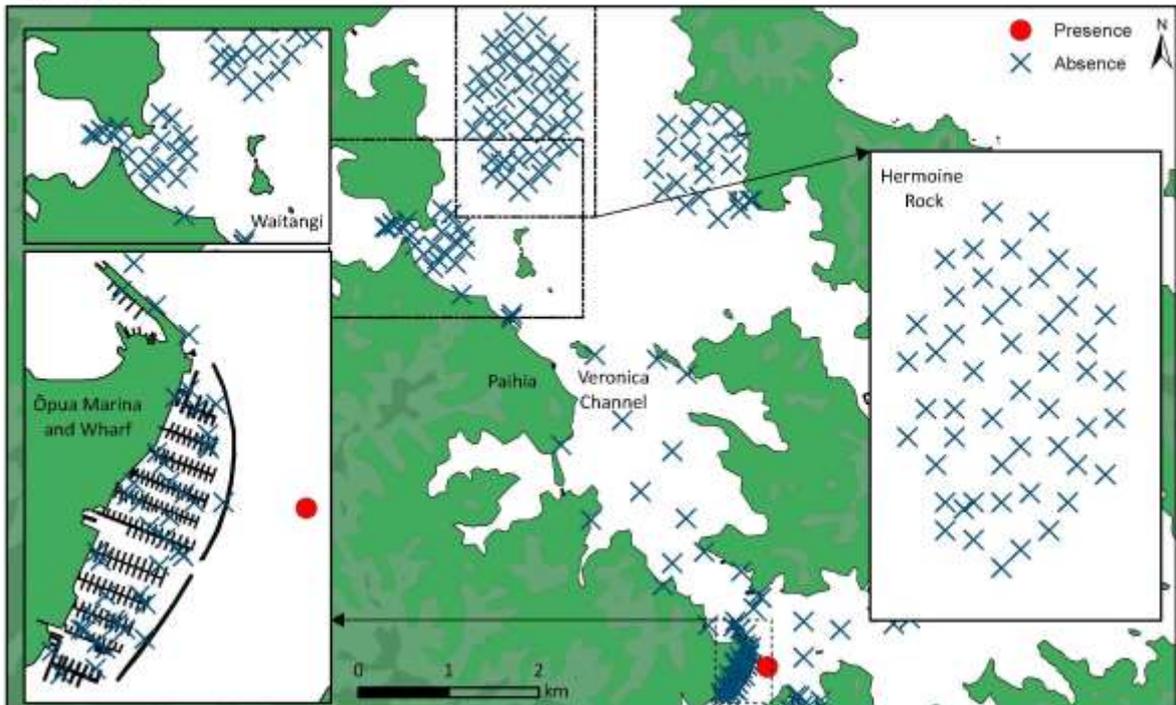
Tritia burchardi



Ōpua Marina and Waikare Inlet

Summer 2018-19

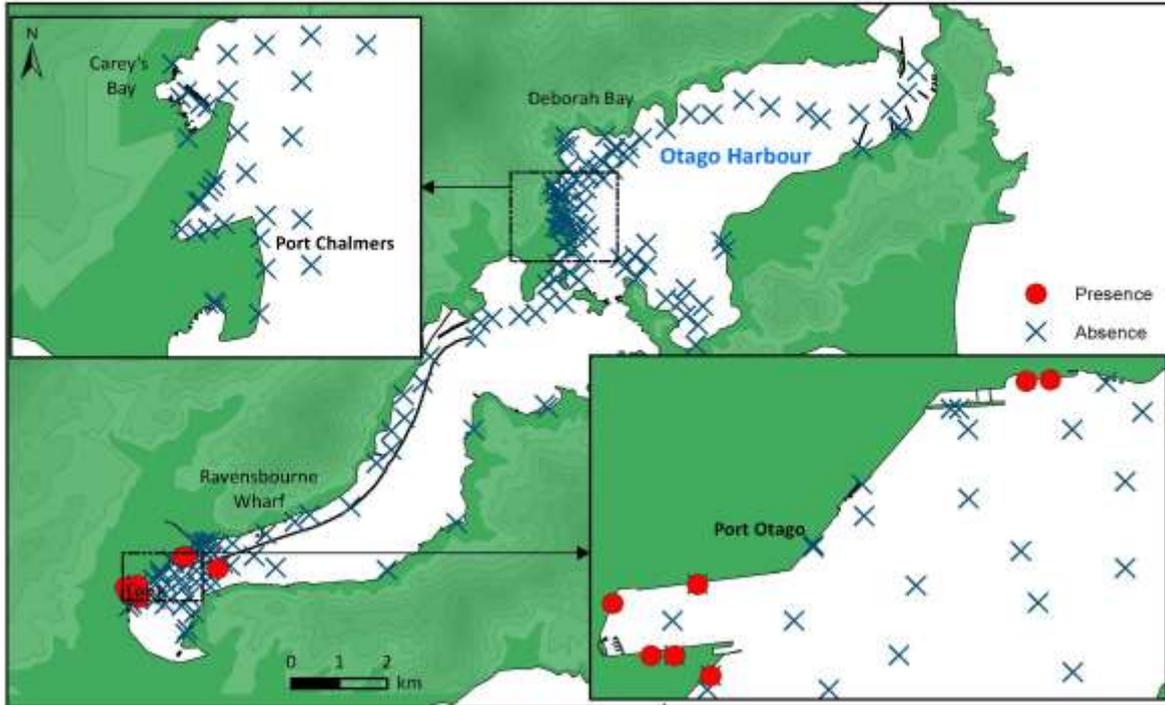
Tritia burchardi



Otago Harbour

Winter 2018

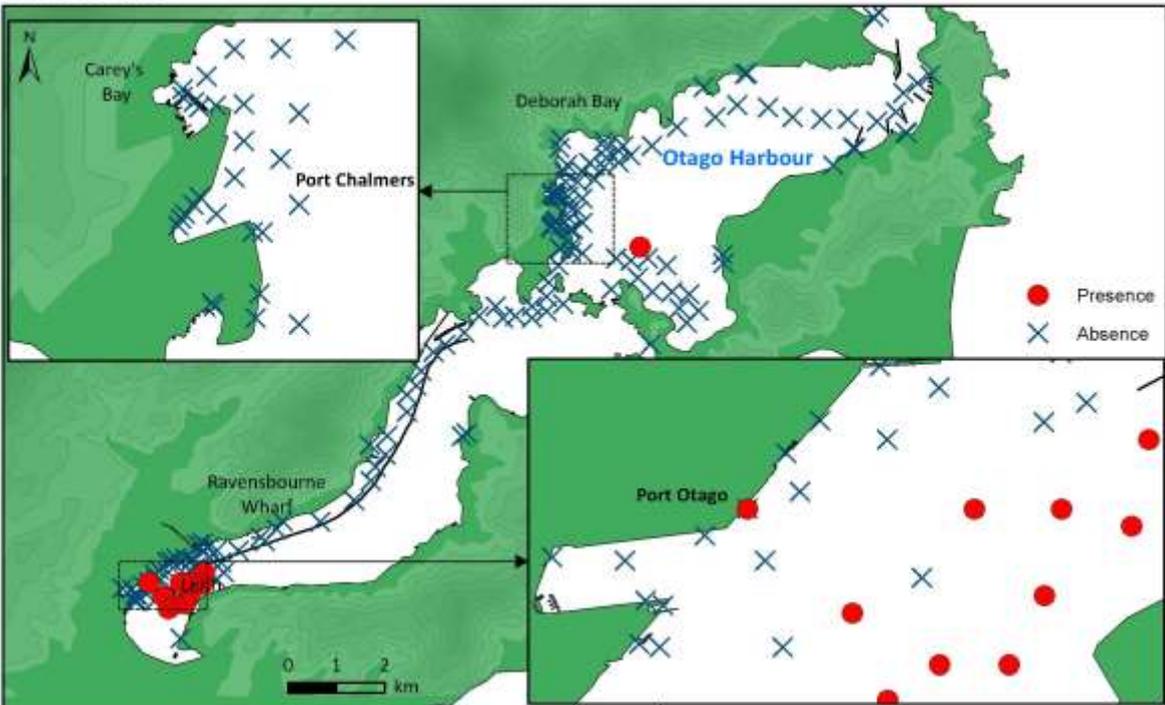
Ascidella aspersa



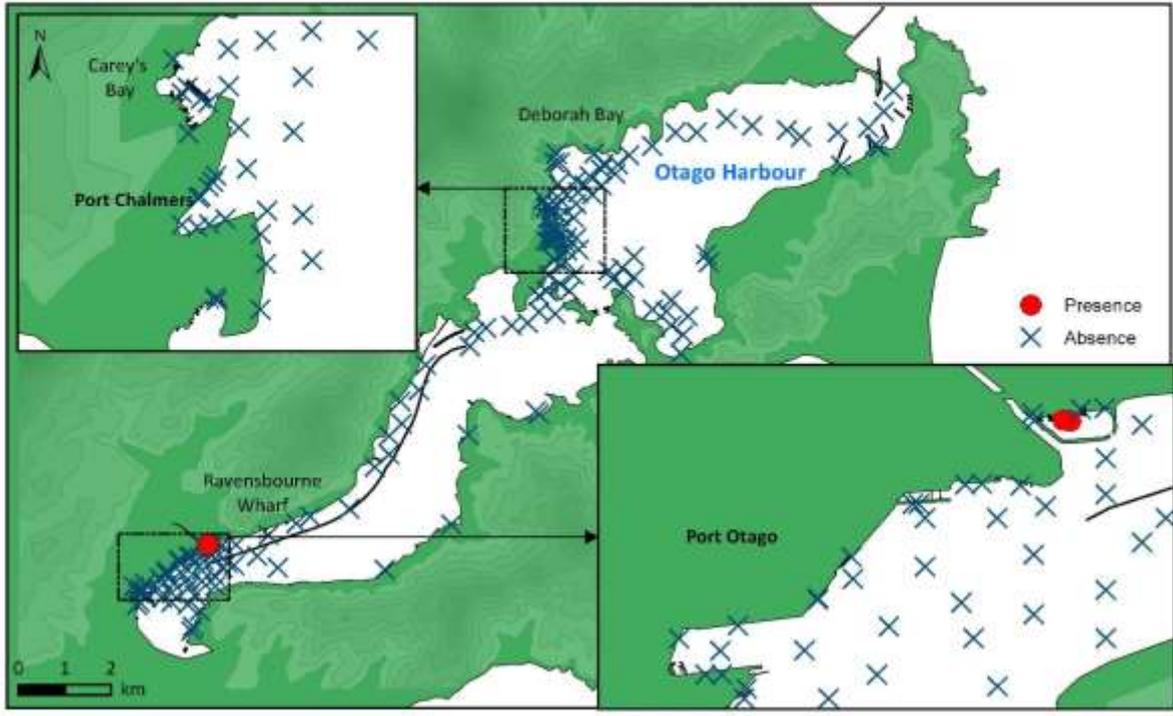
Otago Harbour

Summer 2018-19

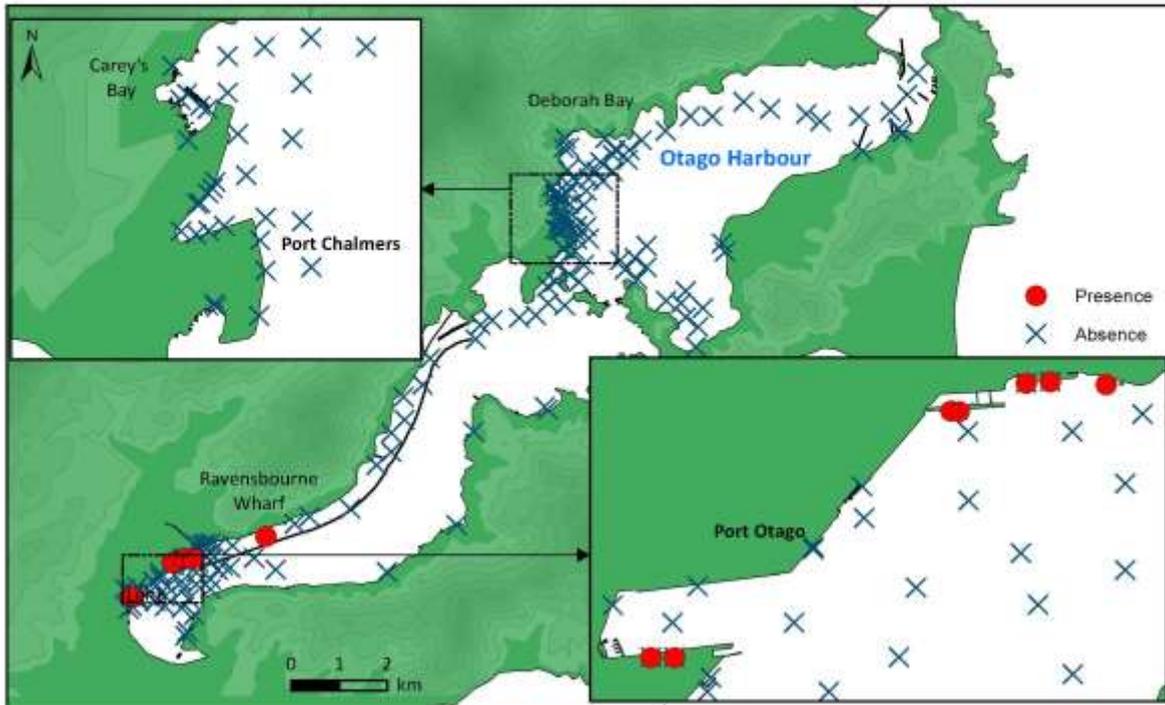
Ascidella aspersa



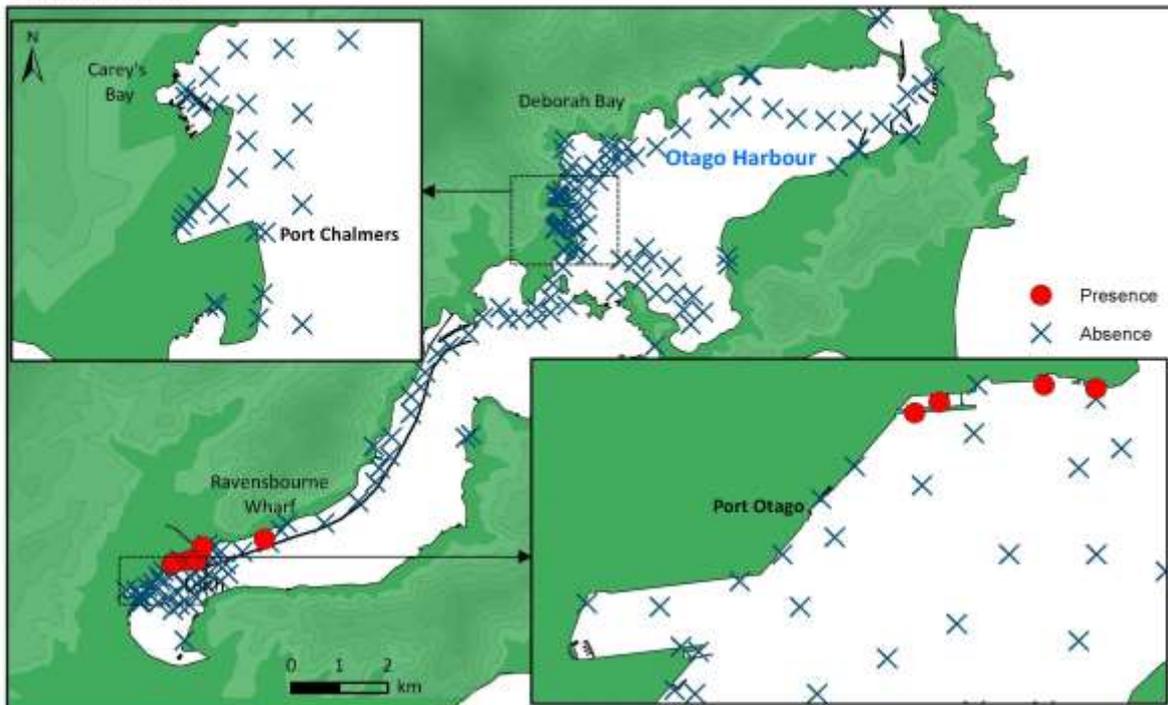
Otago Harbour
Winter 2018
Ciona savignyi



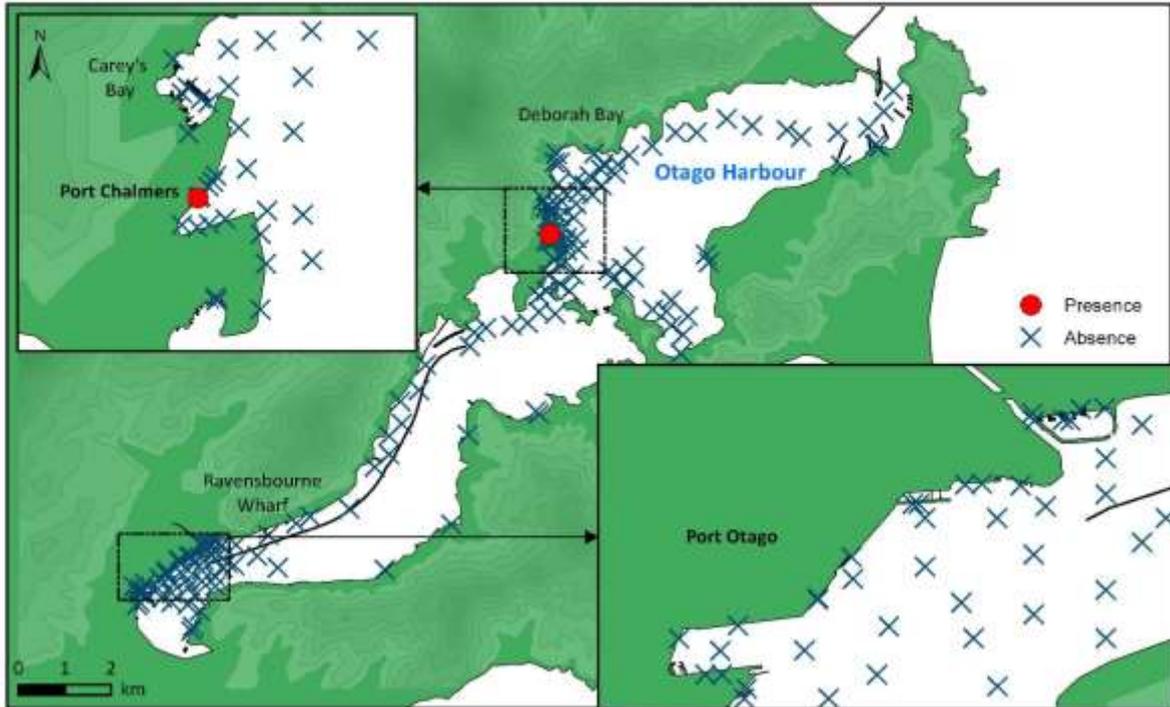
Otago Harbour
 Winter 2018
Didemnum vexillum



Otago Harbour
 Summer 2018-19
Didemnum vexillum



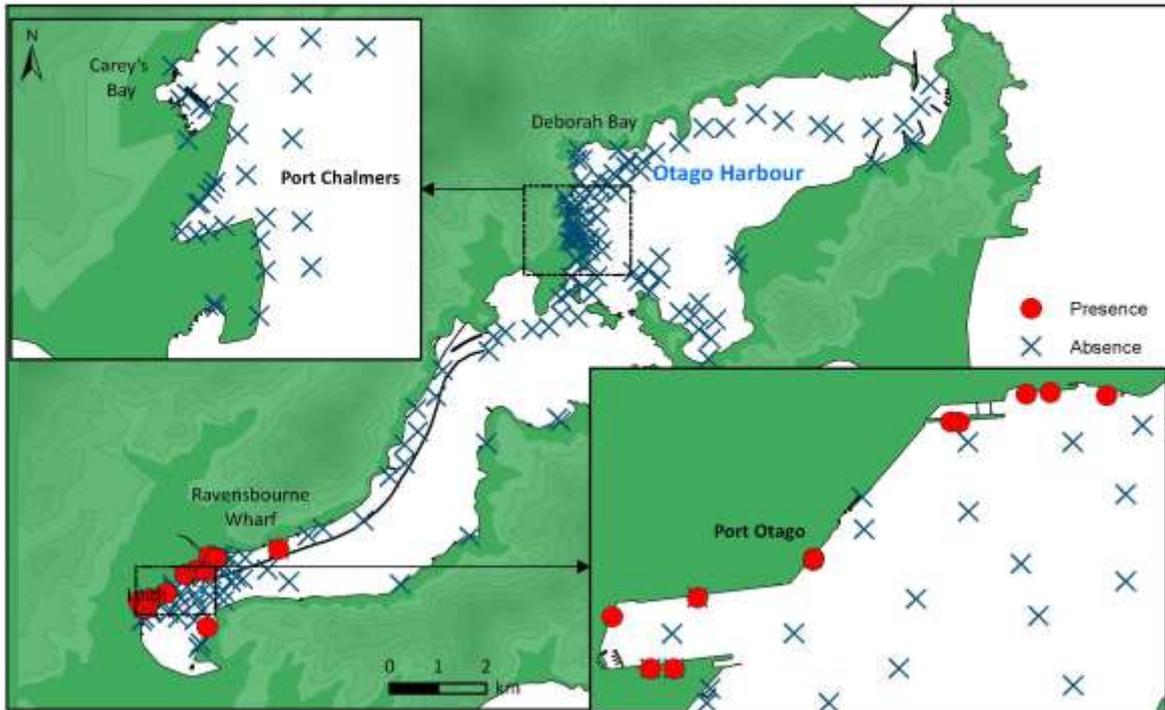
Otago Harbour
Summer 2018-19
Schizymenia apoda



Otago Harbour

Winter 2018

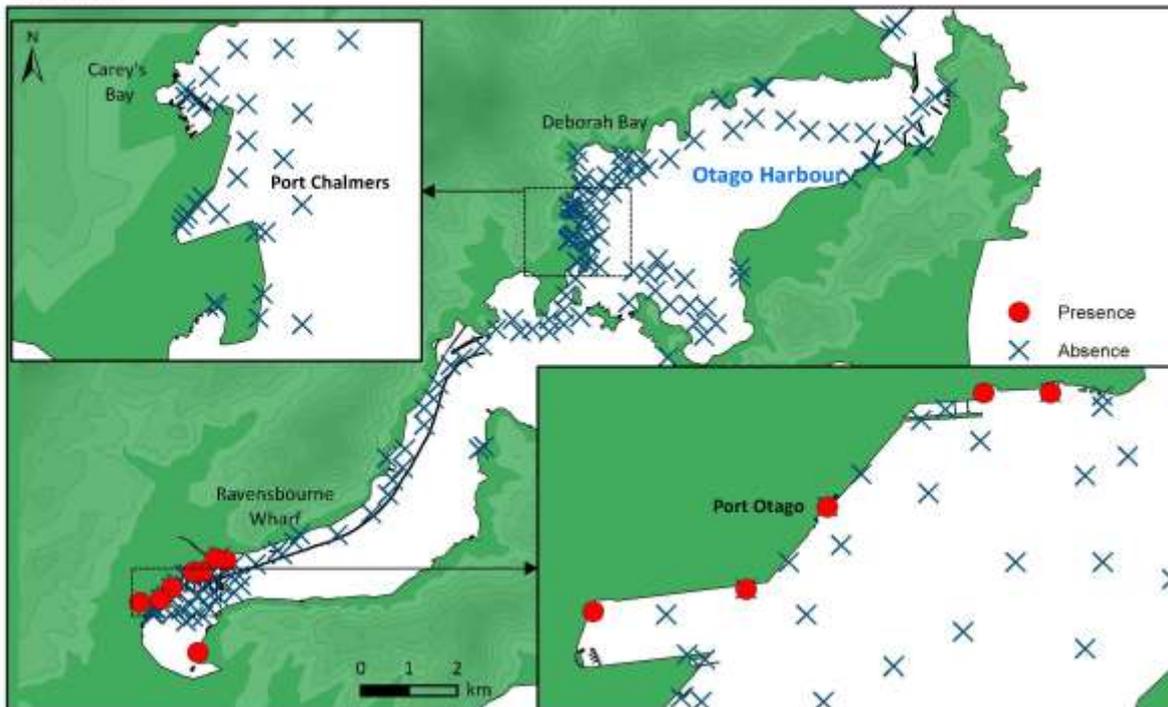
Styela clava



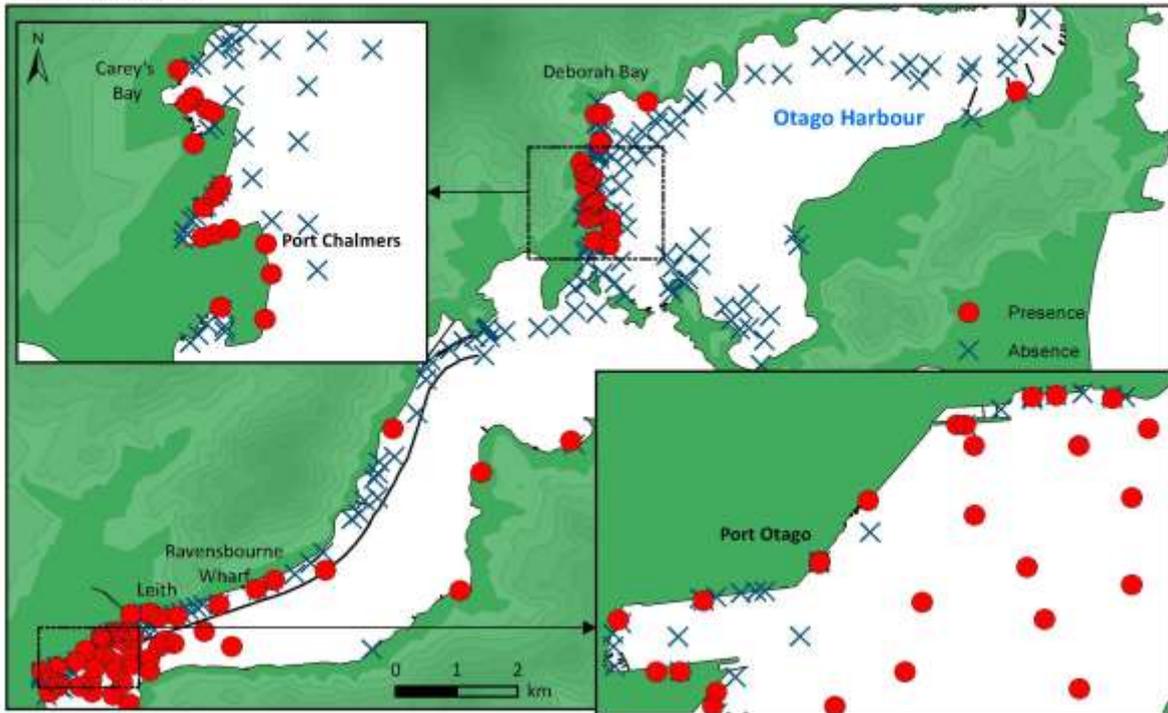
Otago Harbour

Summer 2018-19

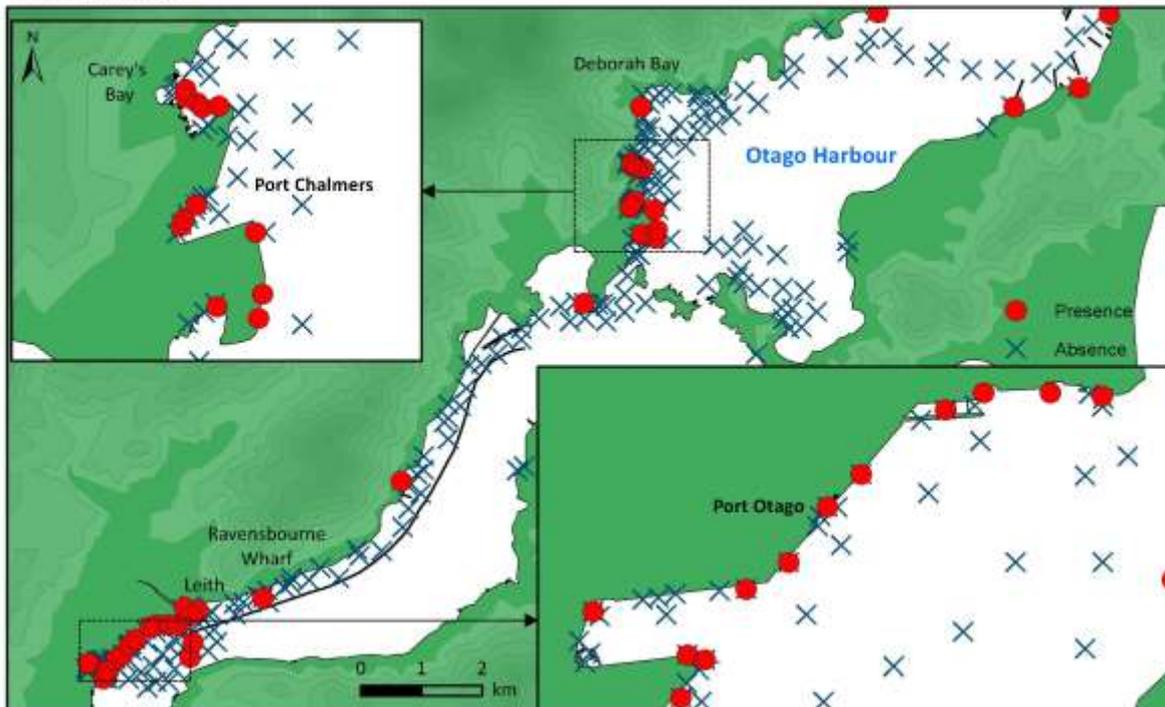
Styela clava



Otago Harbour
Winter 2018
Undaria pinnatifida



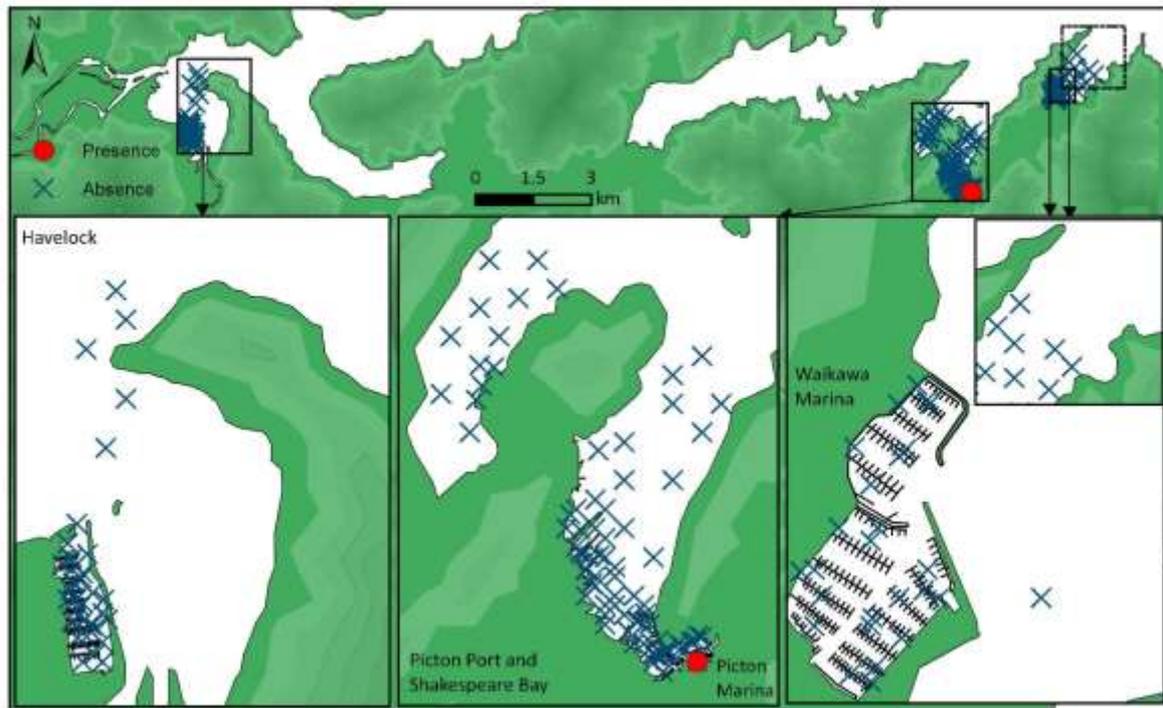
Otago Harbour
Summer 2018-19
Undaria pinnatifida



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

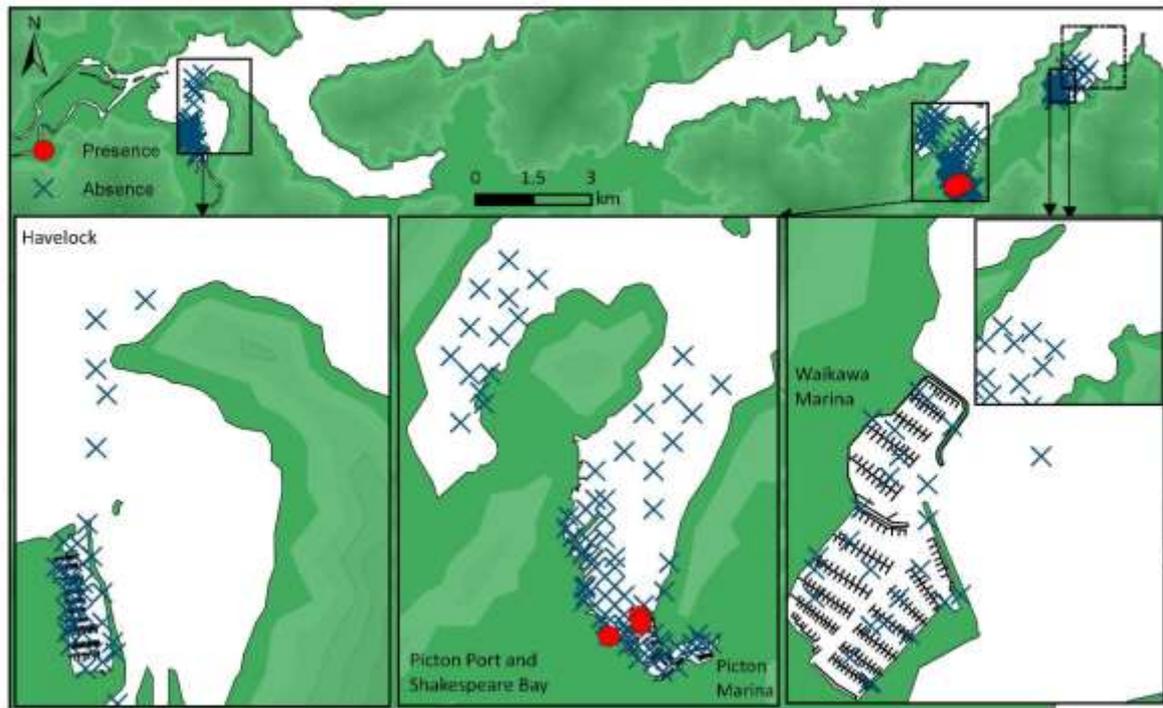
Chaetomorpha linum



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

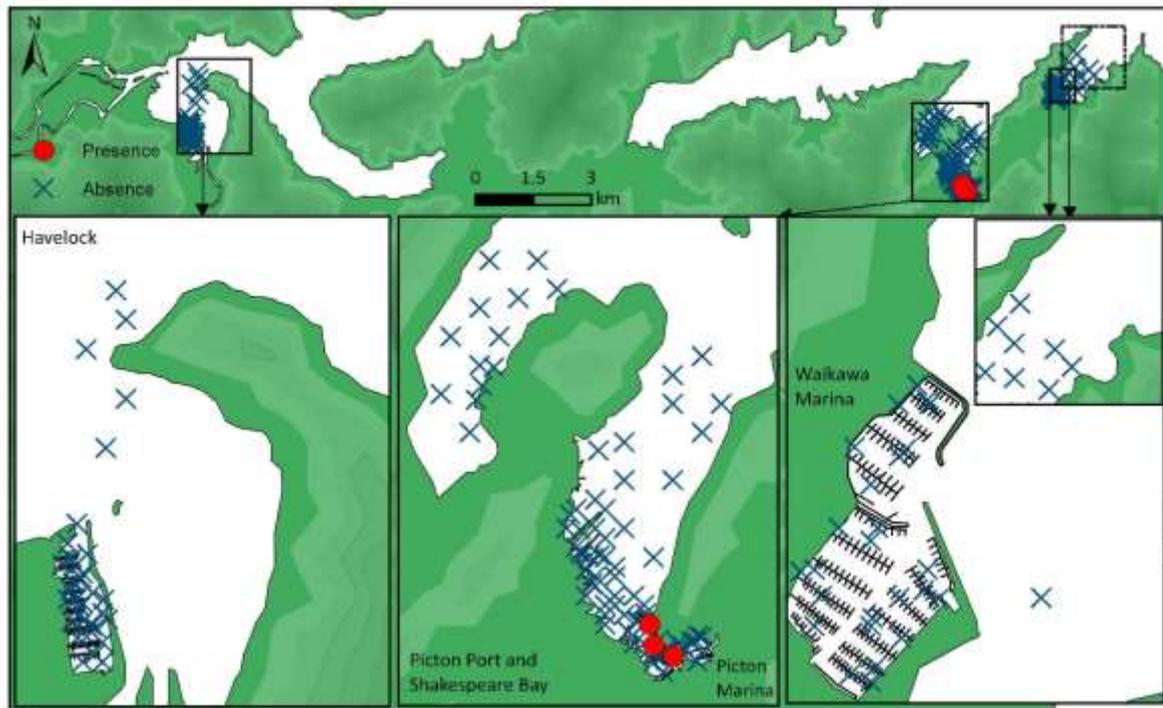
Ciona intestinalis



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

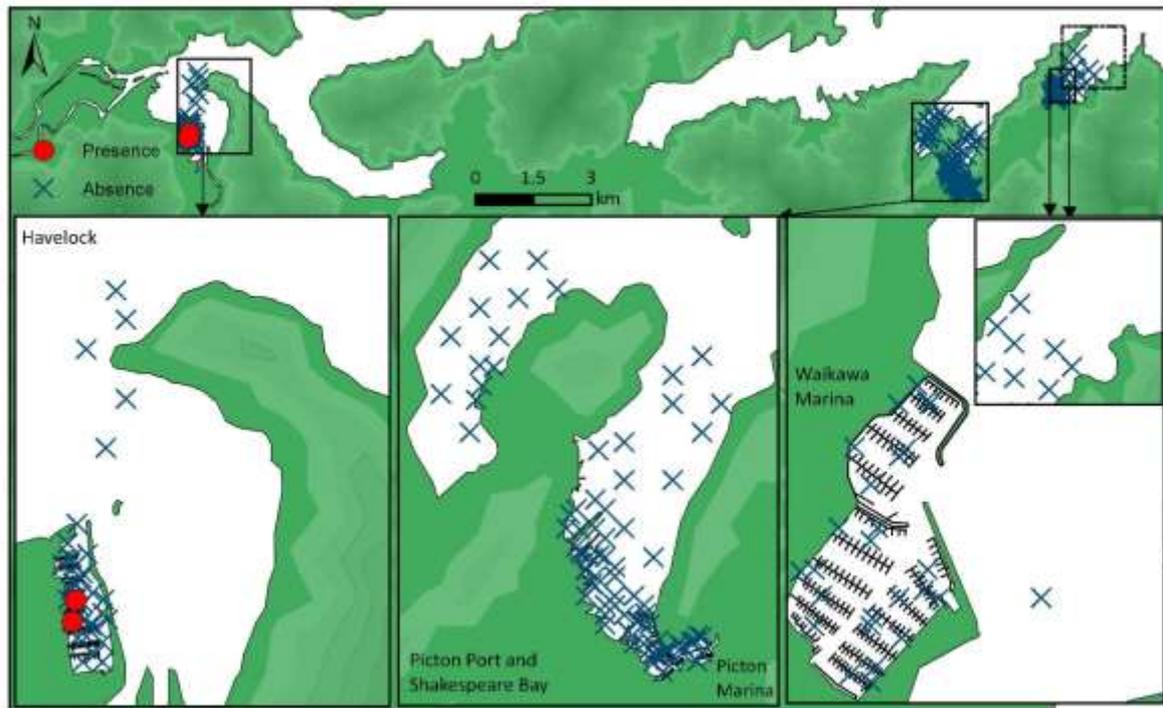
Ciona spp.



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

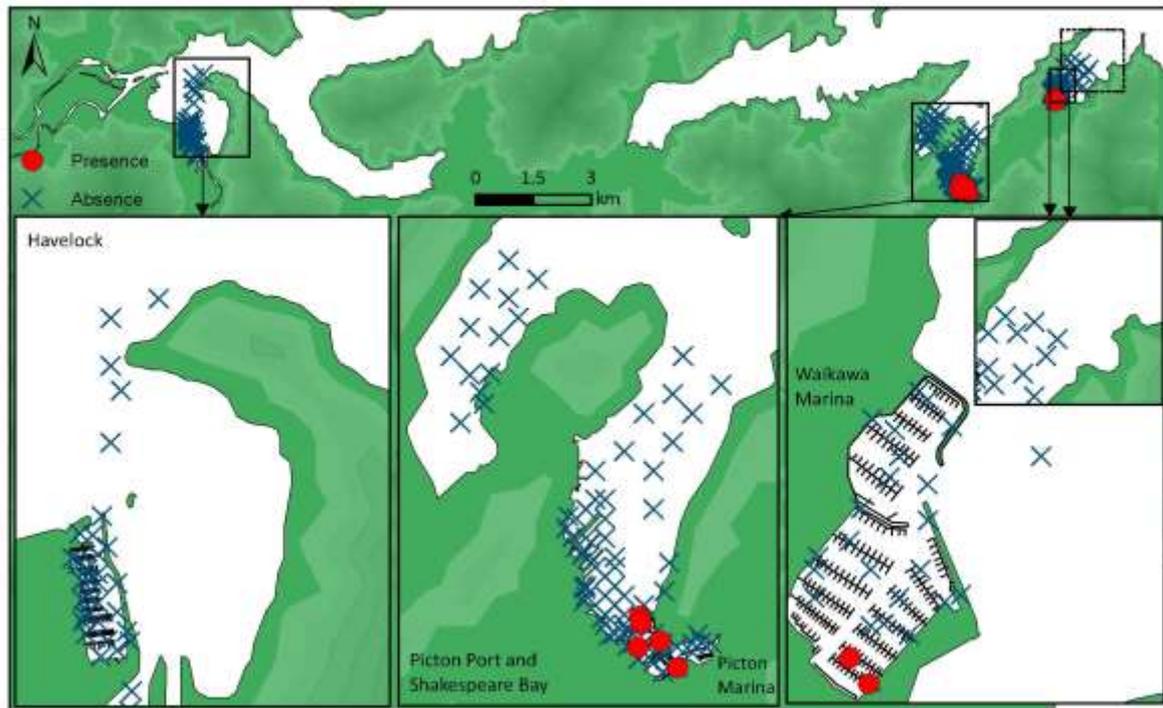
Cladophora vagabunda



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

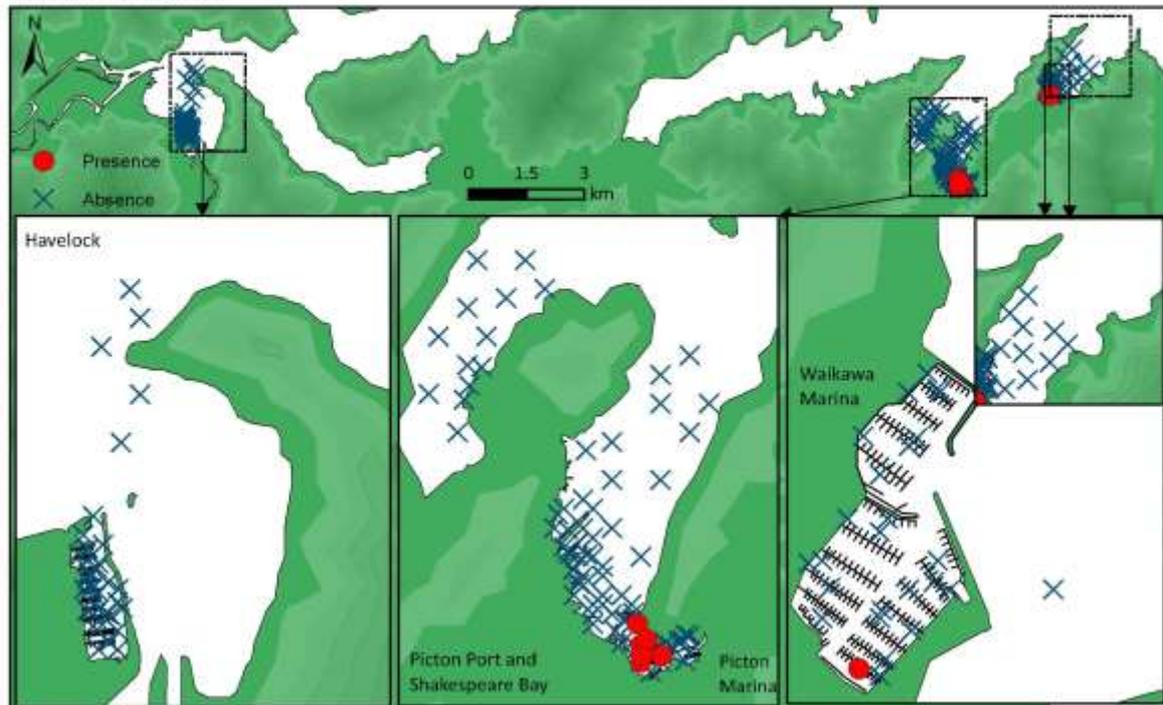
Clavelina lepadiformis



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

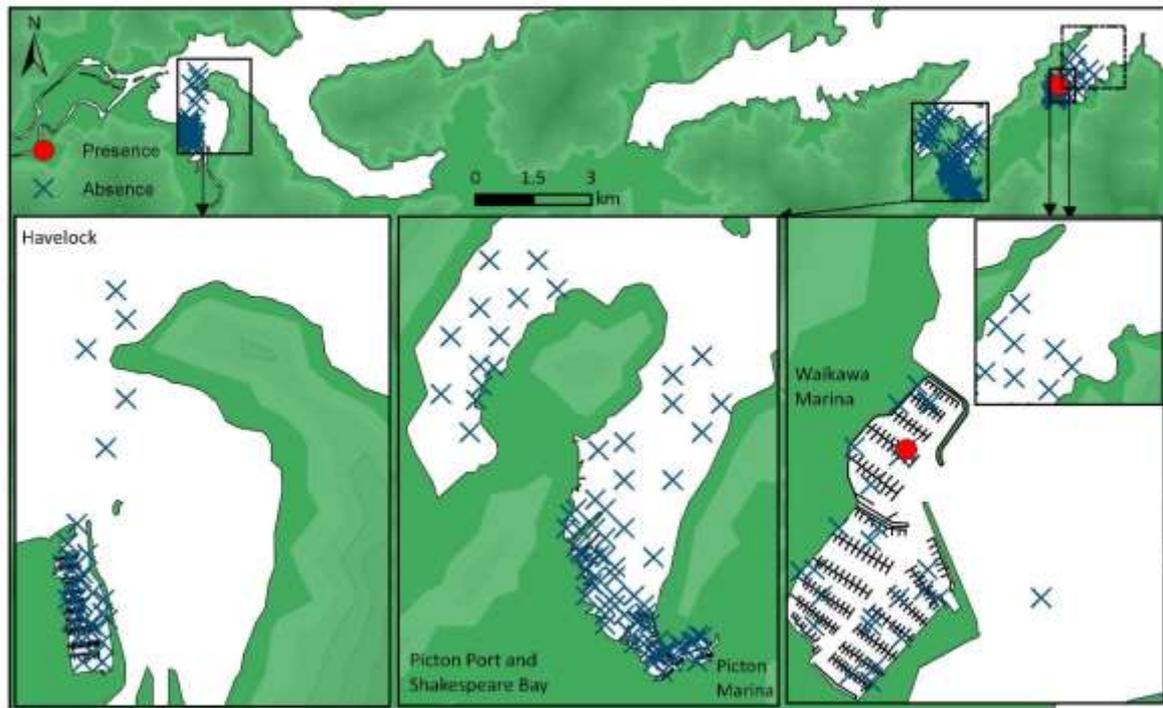
Clavelina lepadiformis



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

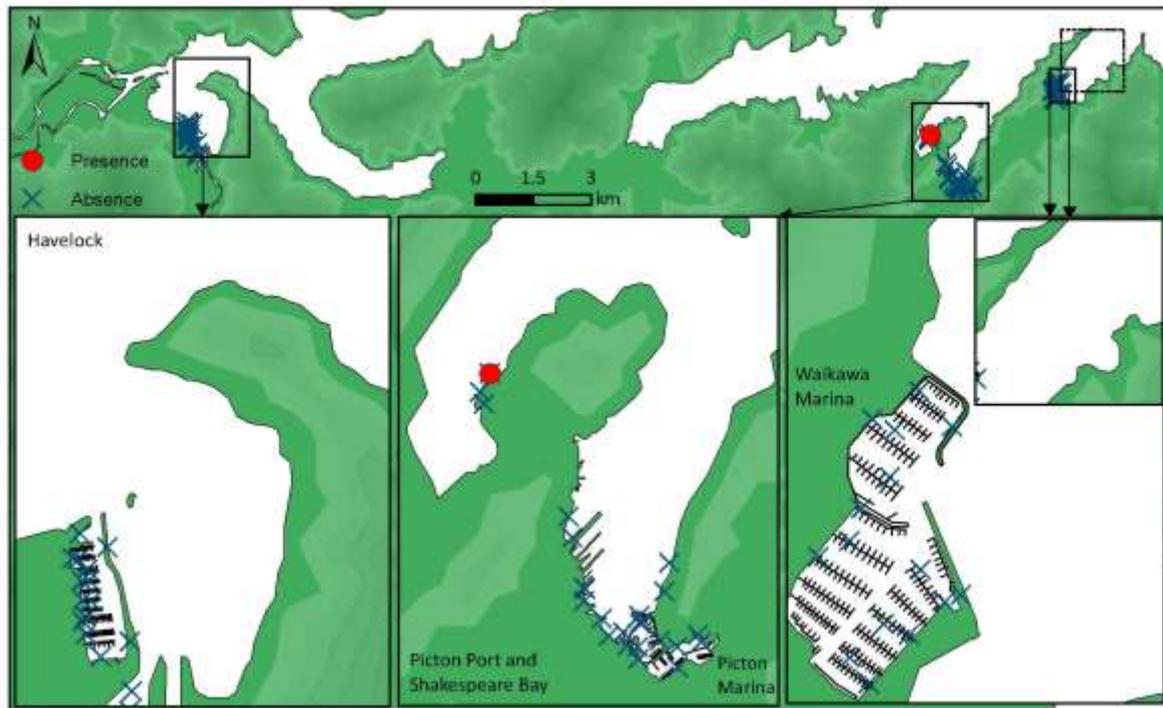
Ectopleura spp.



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

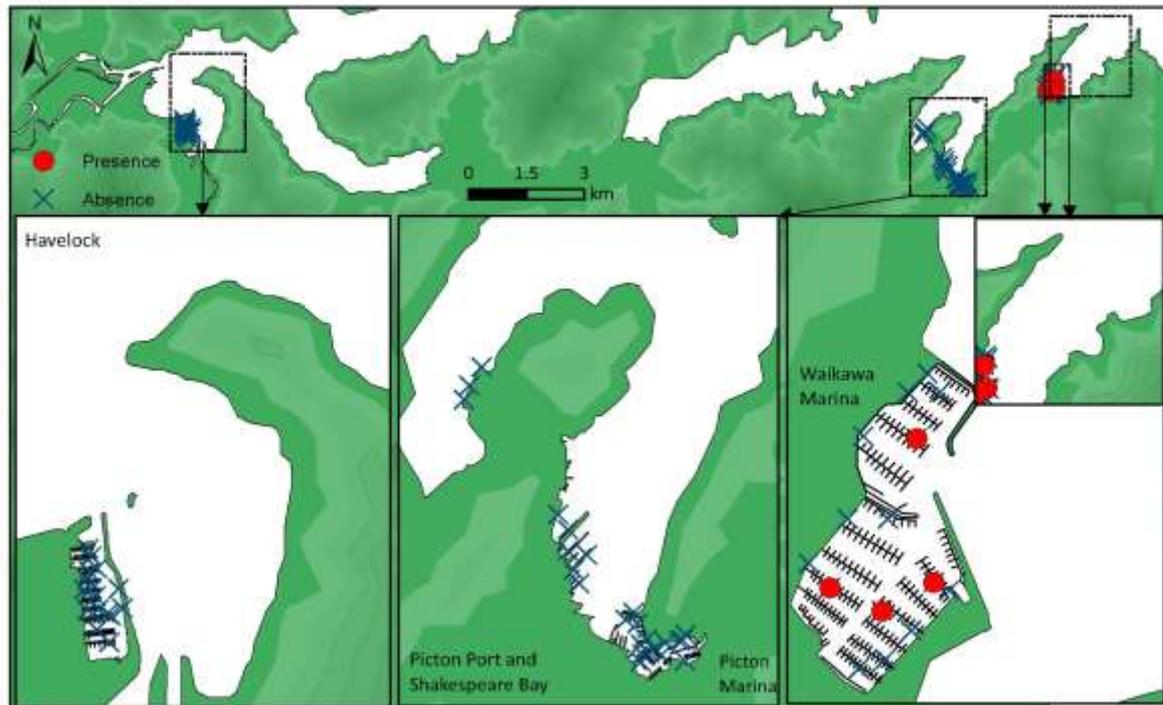
Polycera hedgpethi



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

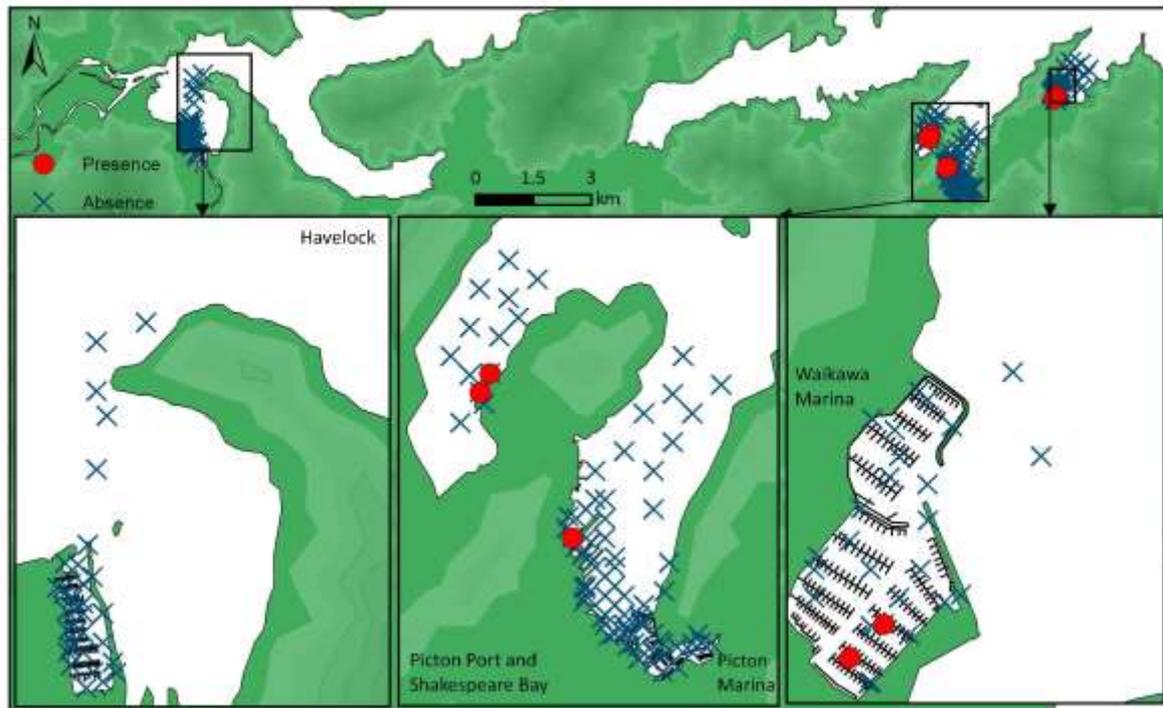
Polycera hedgpethi



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

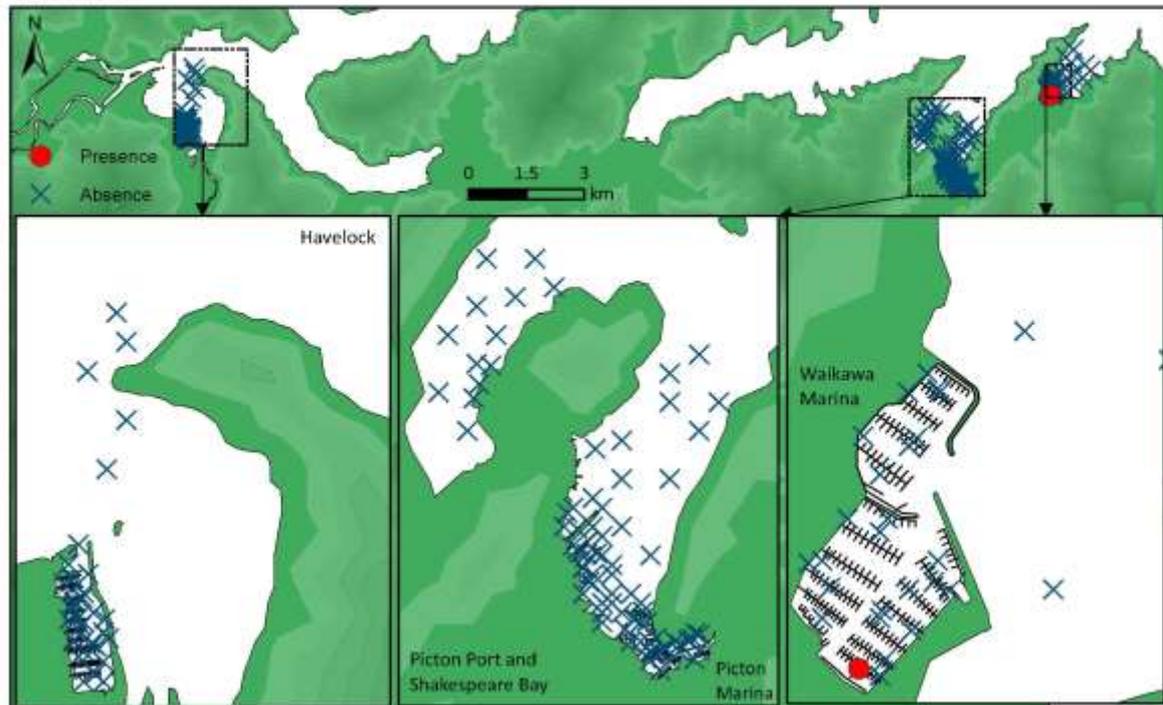
Styela clava



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

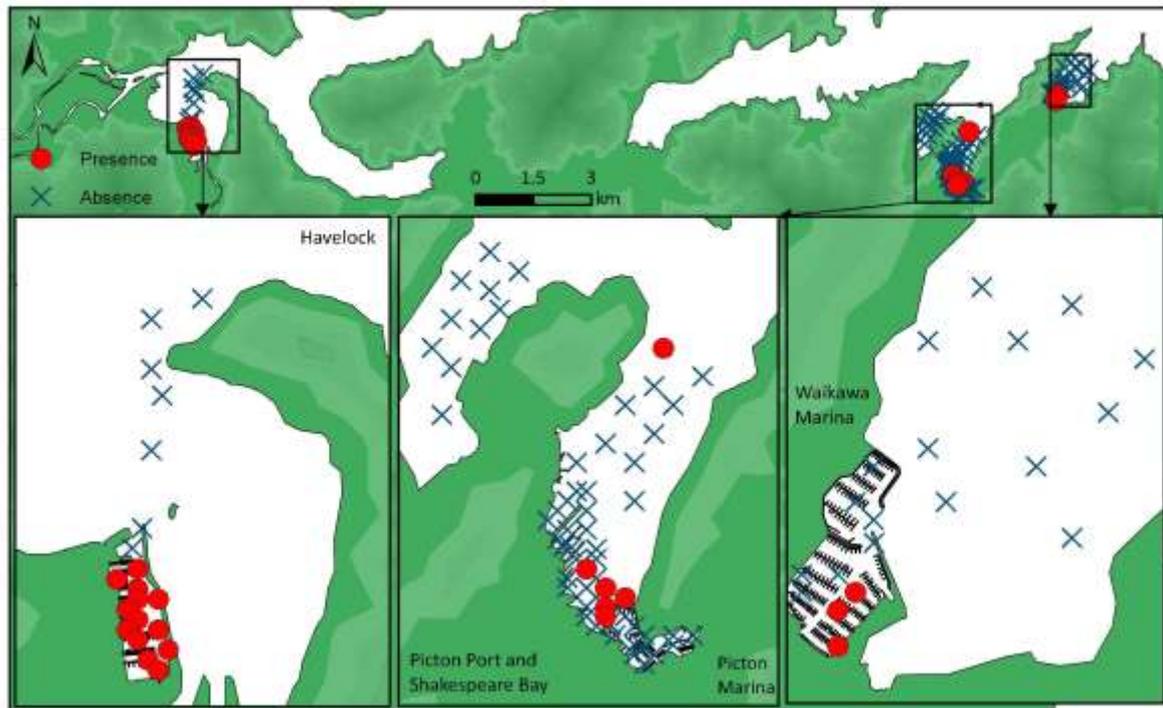
Styela clava



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

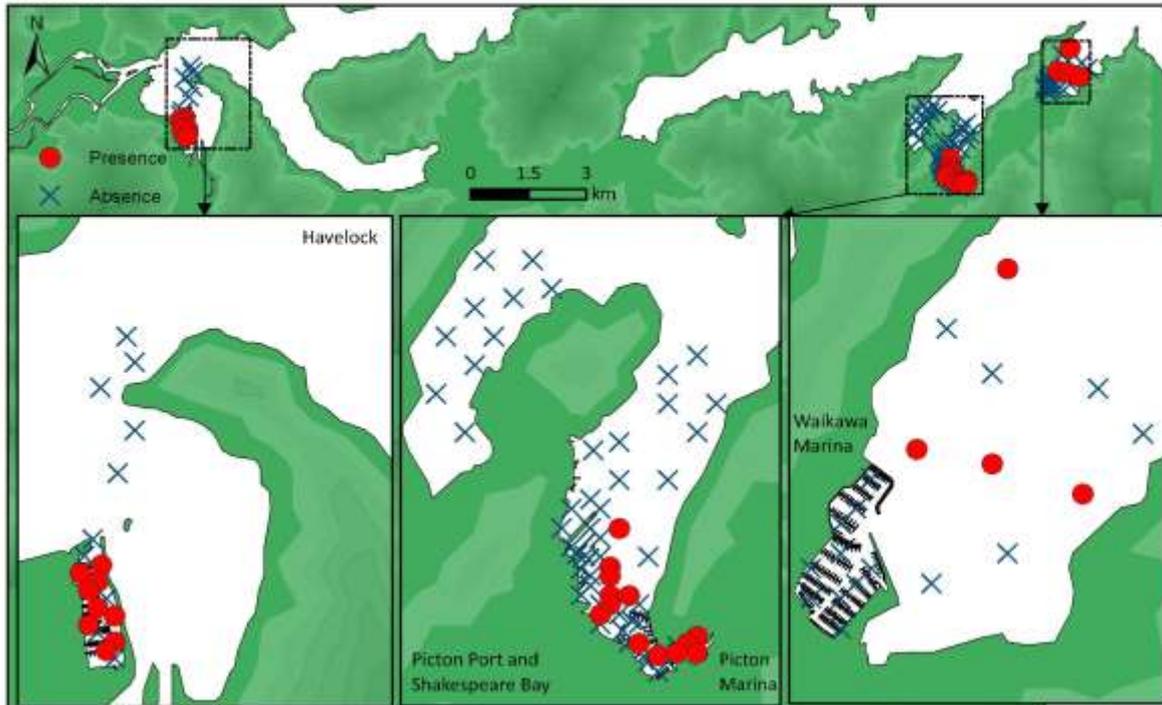
Theora lubrica



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

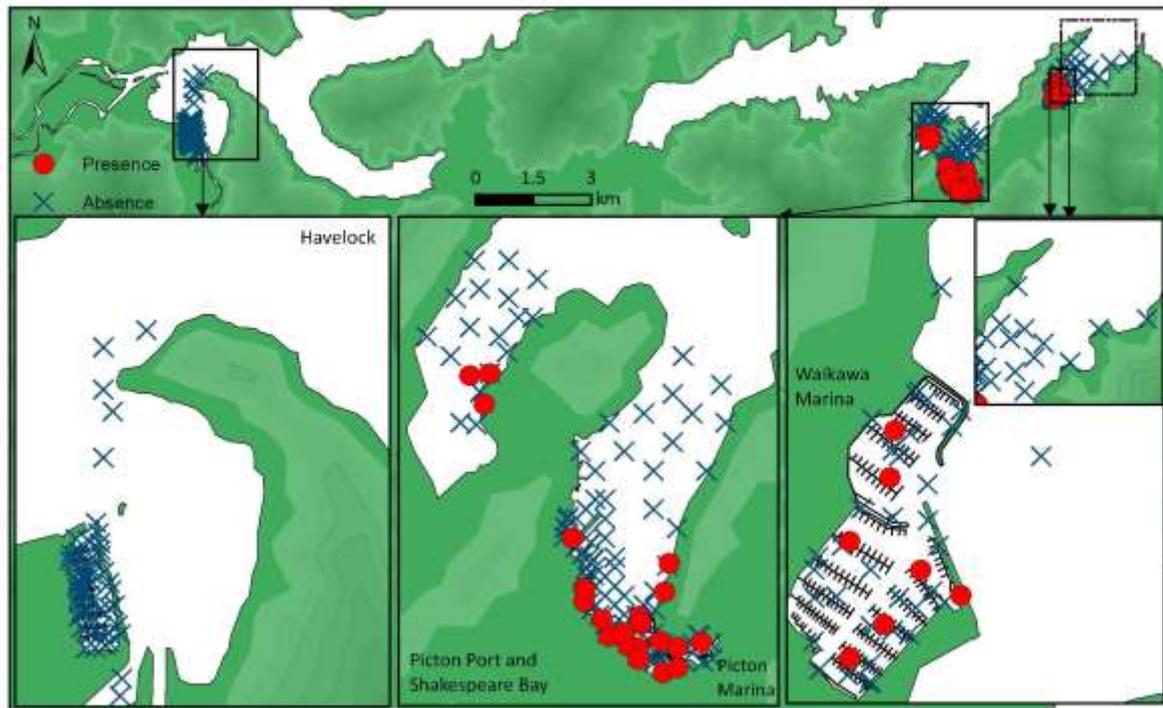
Theora lubrica



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2018

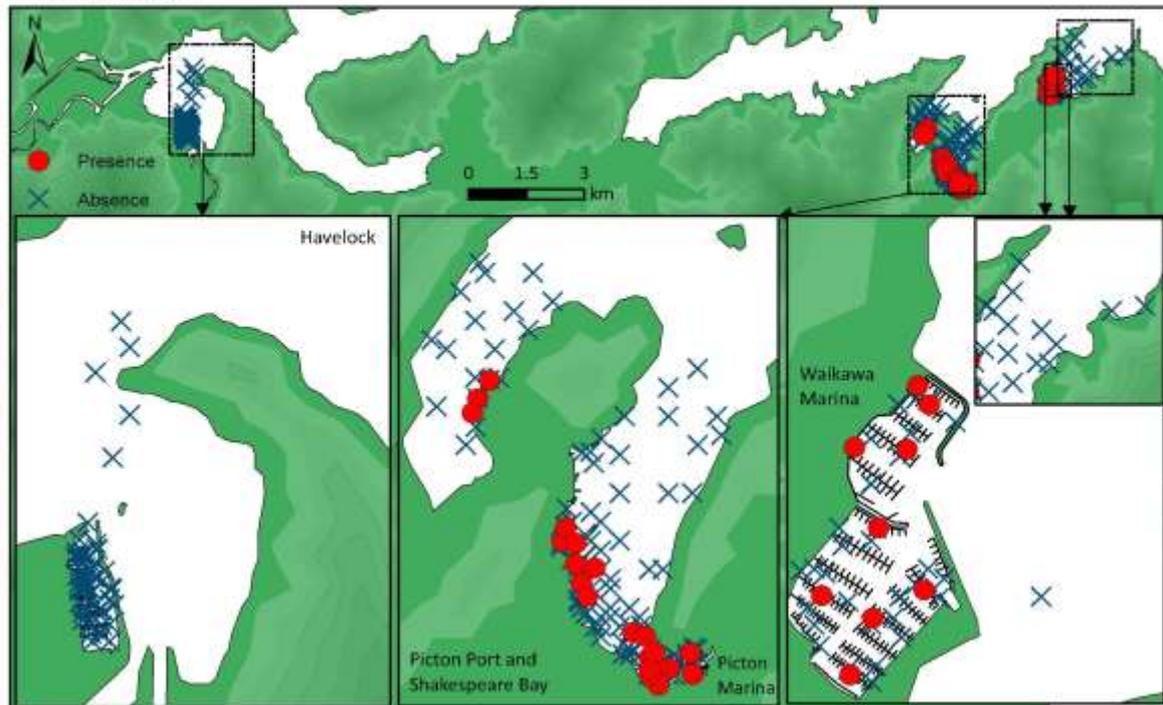
Undaria pinnatifida



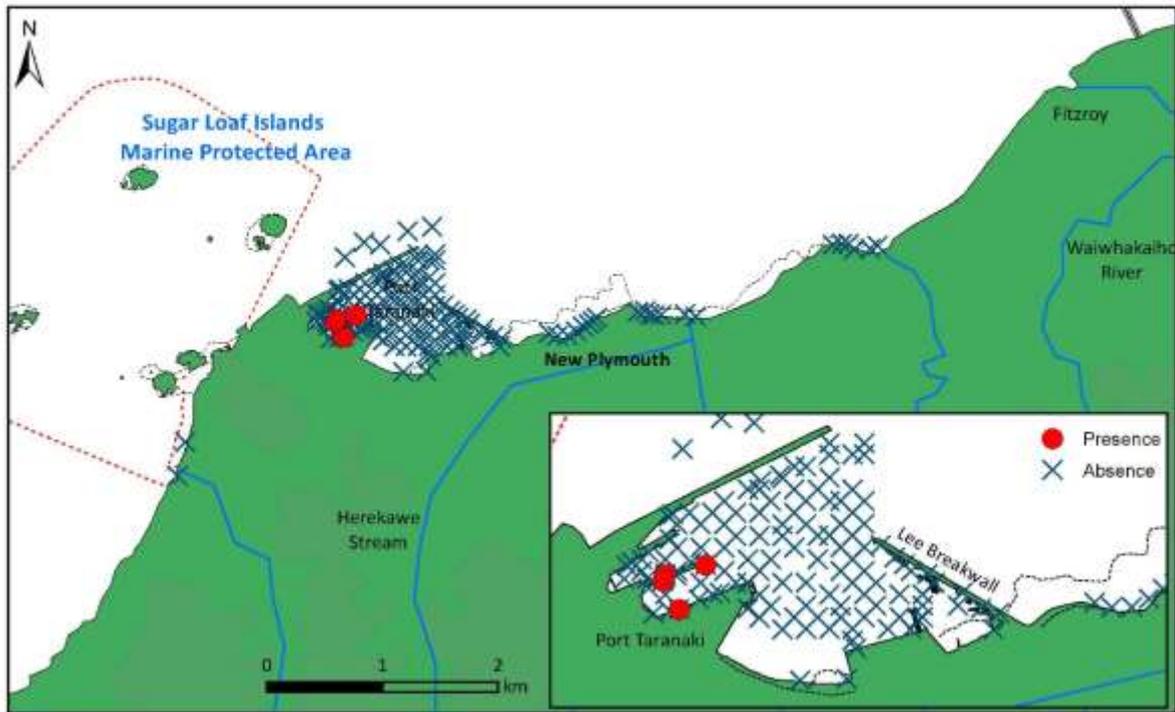
Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2018-19

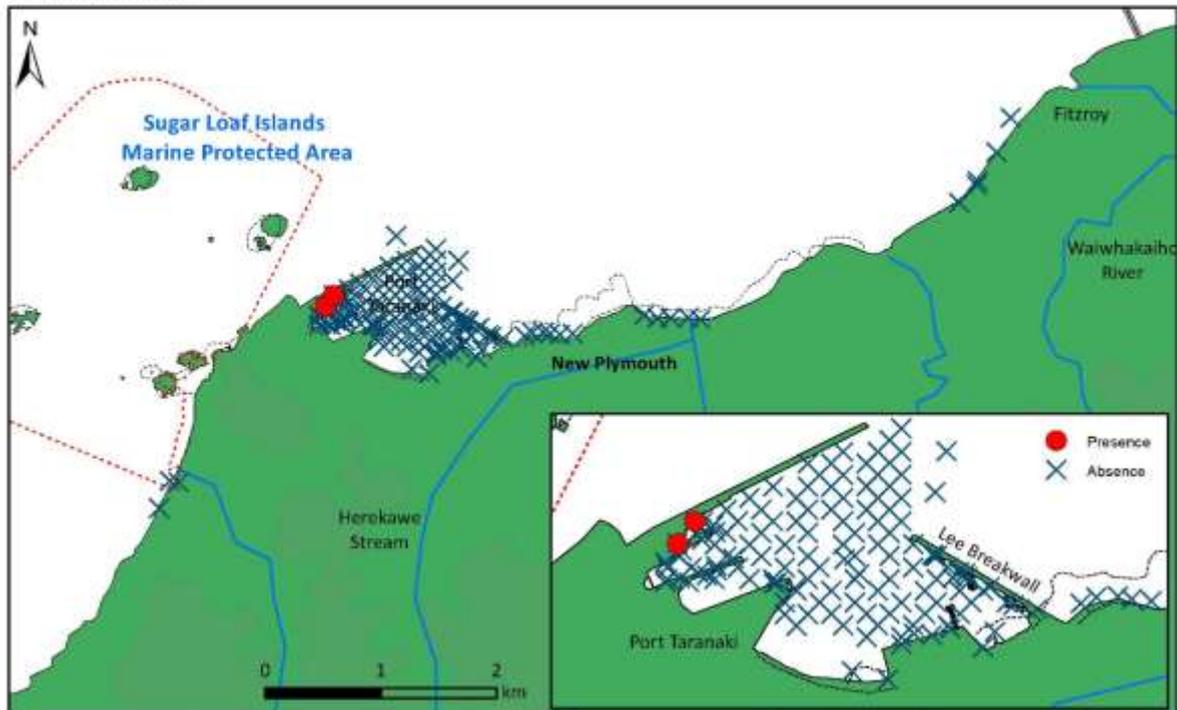
Undaria pinnatifida



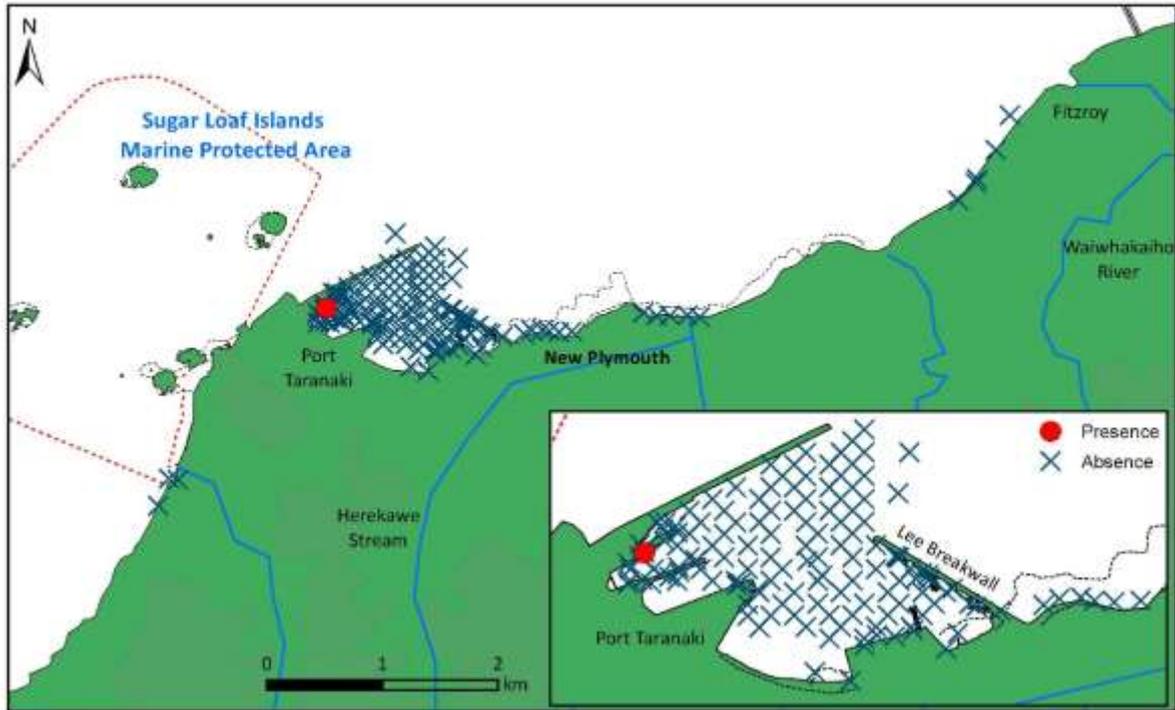
Port Taranaki
Winter 2018
Didemnum vexillum



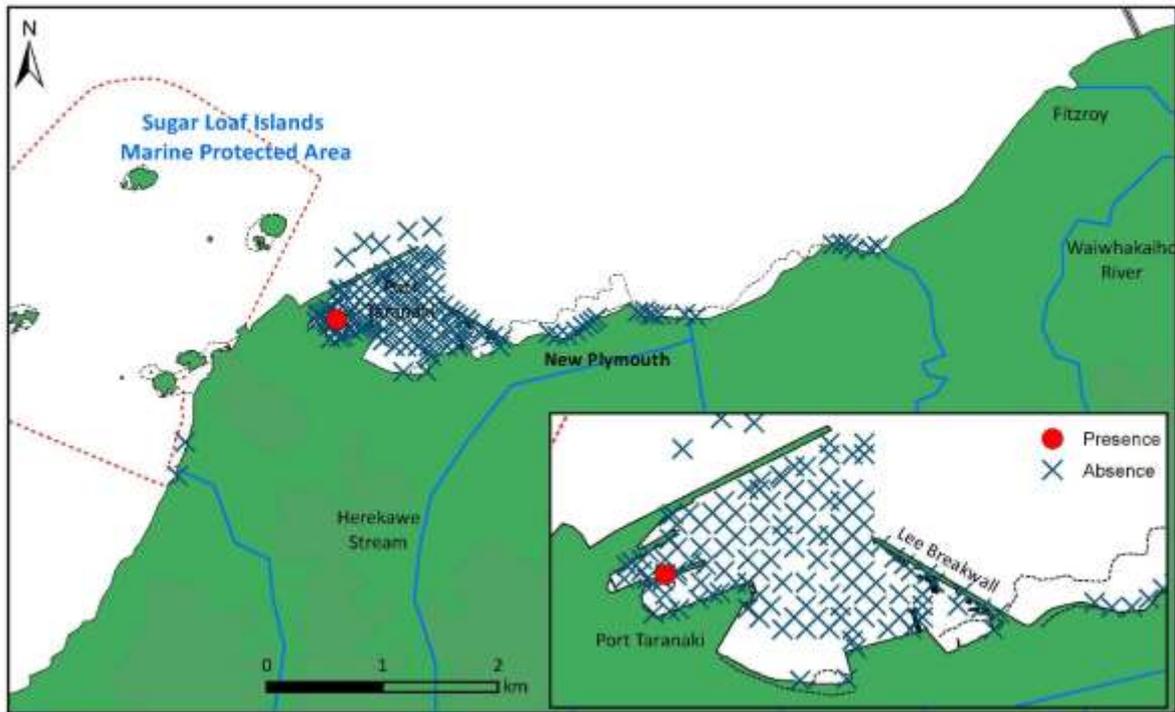
Port Taranaki
Summer 2018-19
Didemnum vexillum



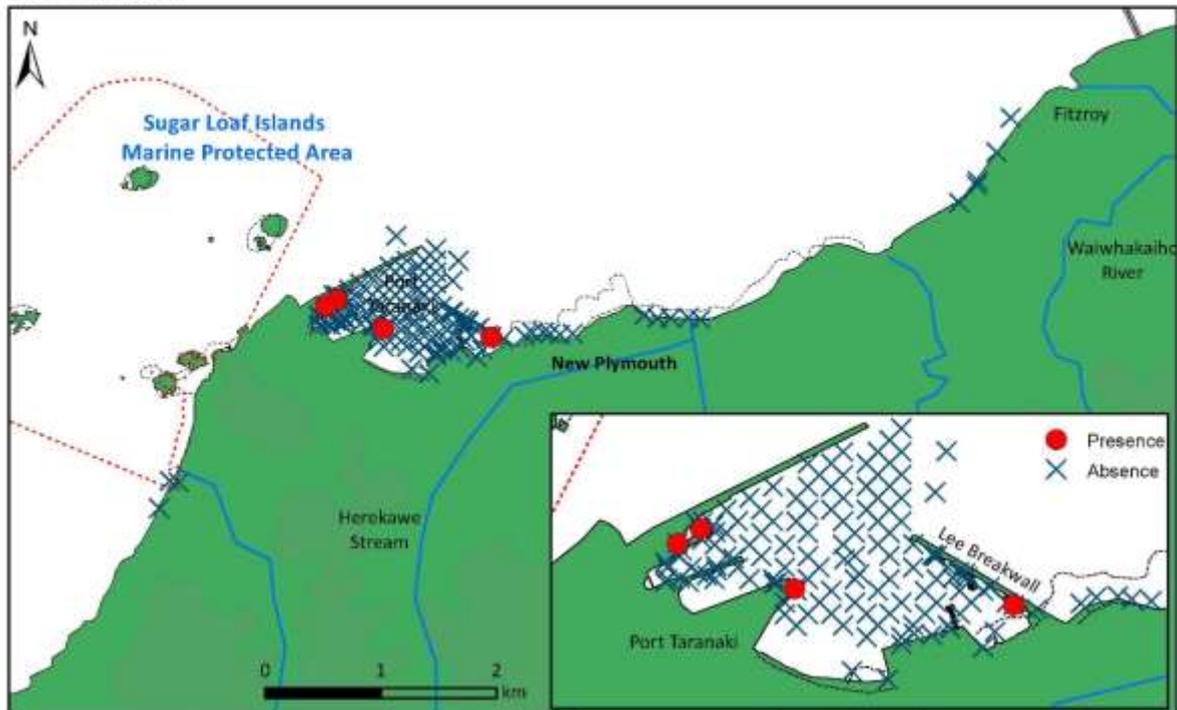
Port Taranaki
Summer 2018-19
Ectopleura spp.



Port Taranaki
 Winter 2018
Polycera hedgpethi



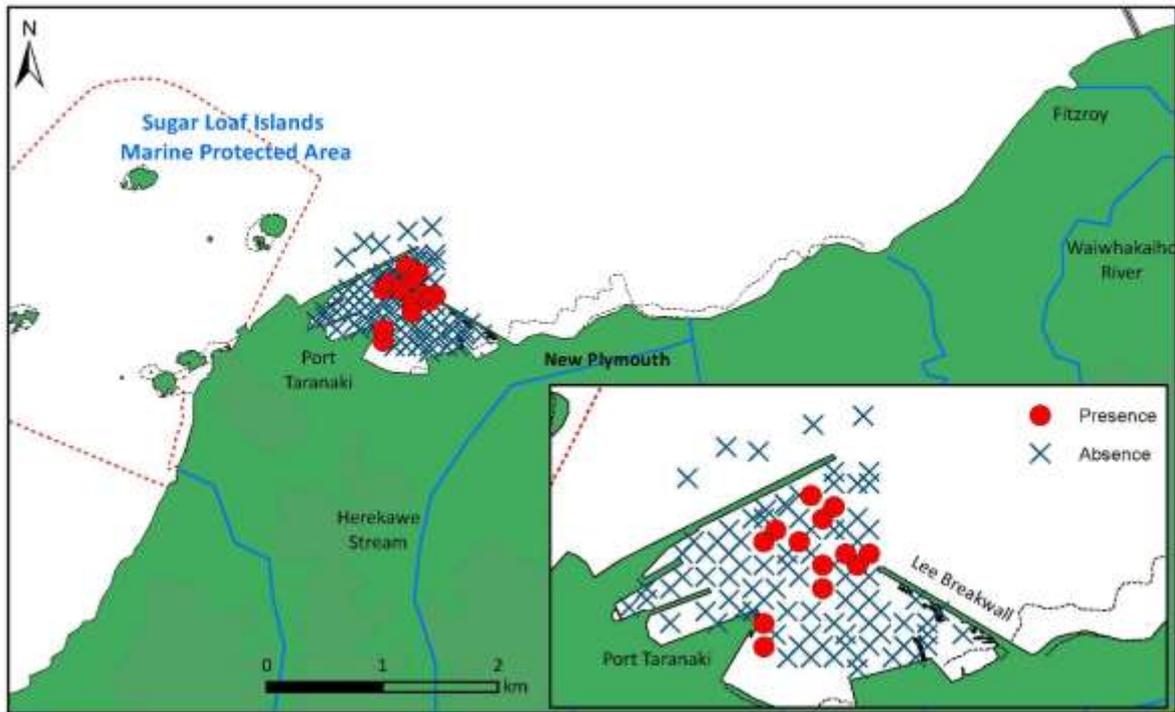
Port Taranaki
 Summer 2018-19
Polycera hedgpethi



Port Taranaki

Winter 2018

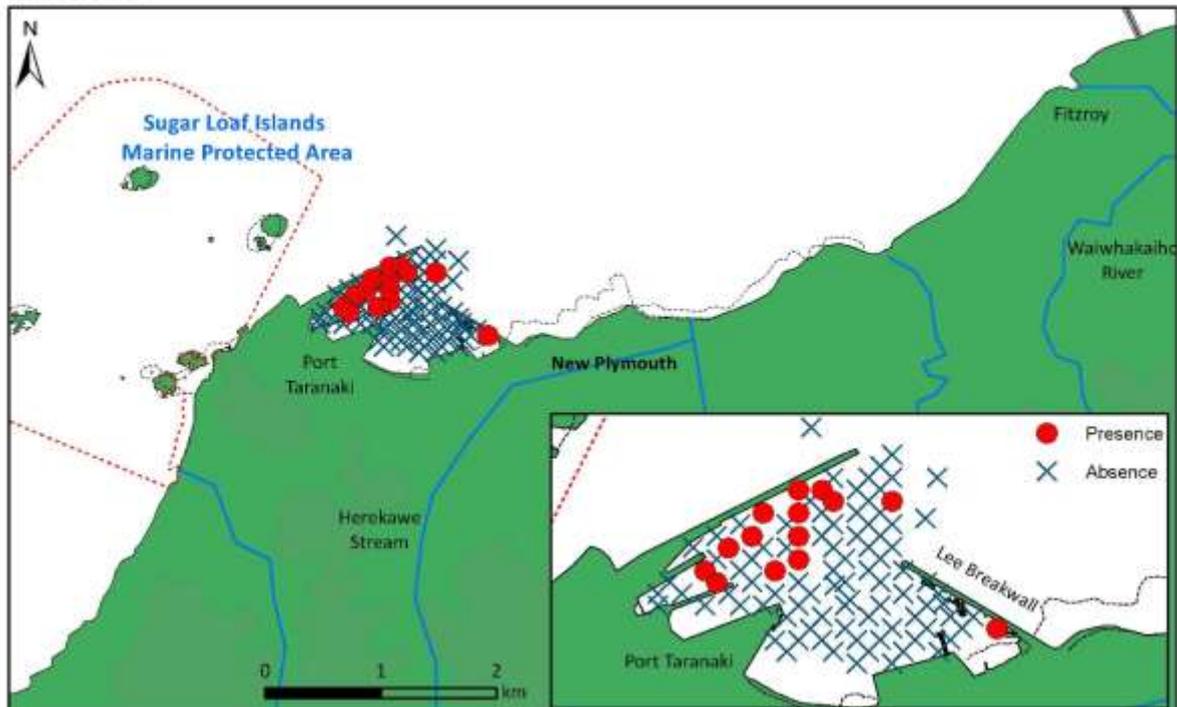
Theora lubrica



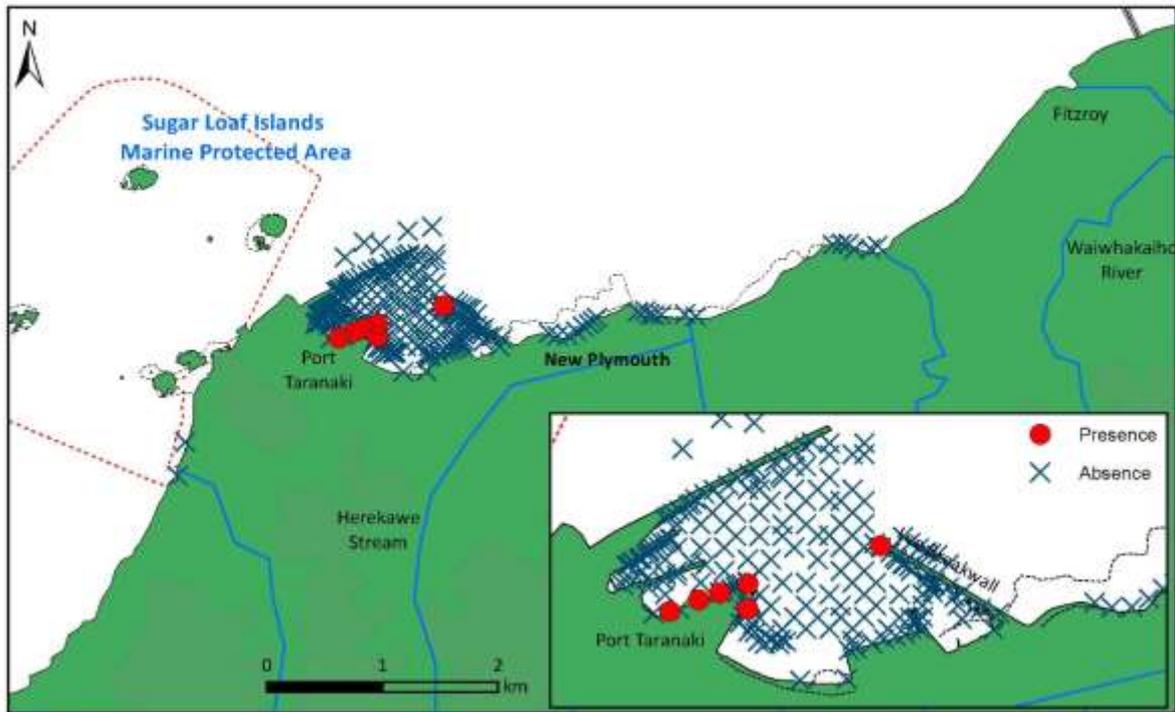
Port Taranaki

Summer 2018-19

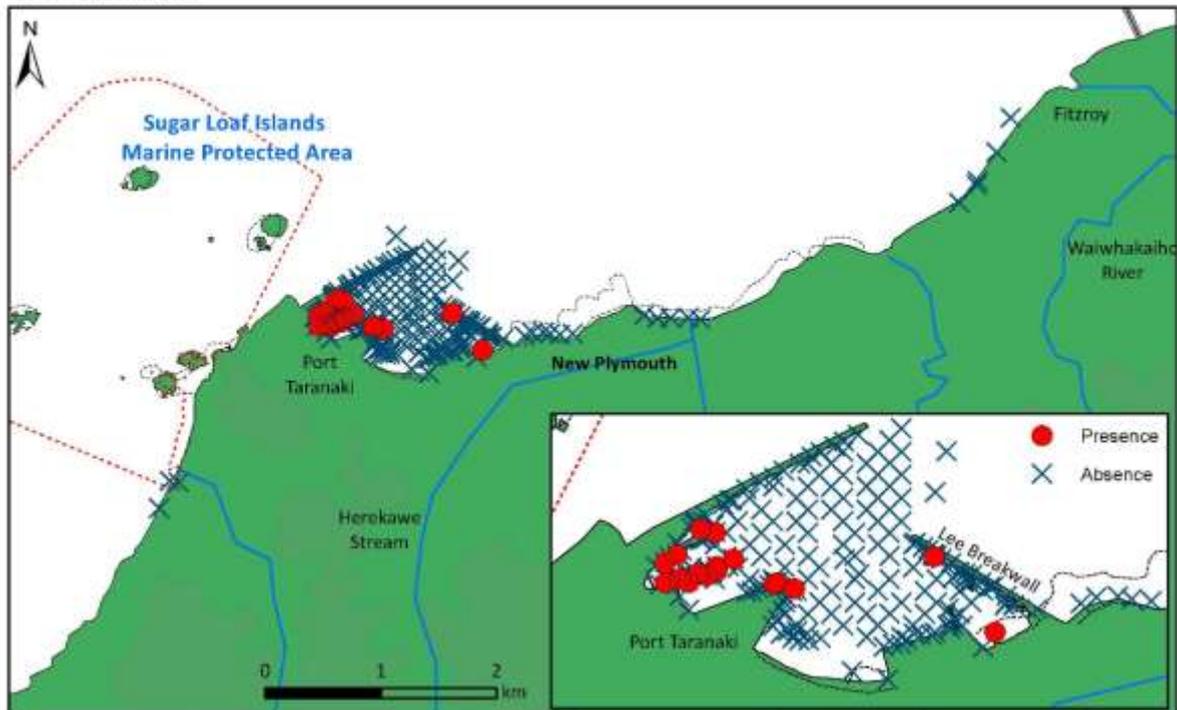
Theora lubrica



Port Taranaki
 Winter 2018
Undaria pinnatifida



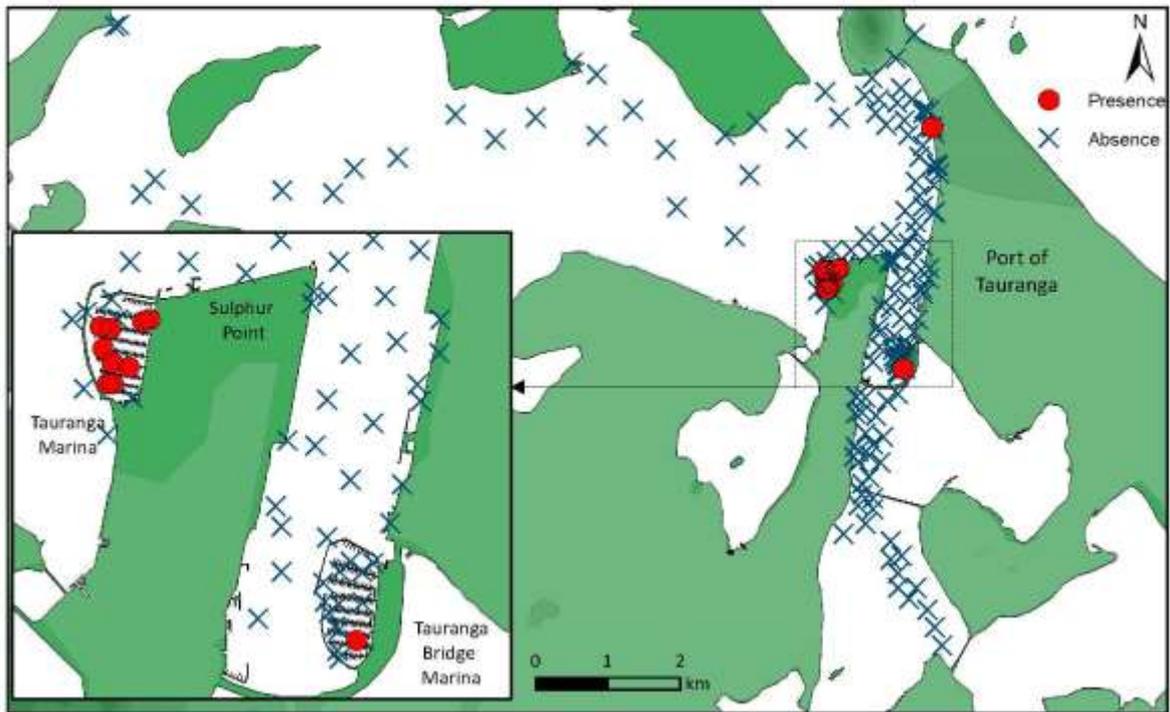
Port Taranaki
 Summer 2018-19
Undaria pinnatifida



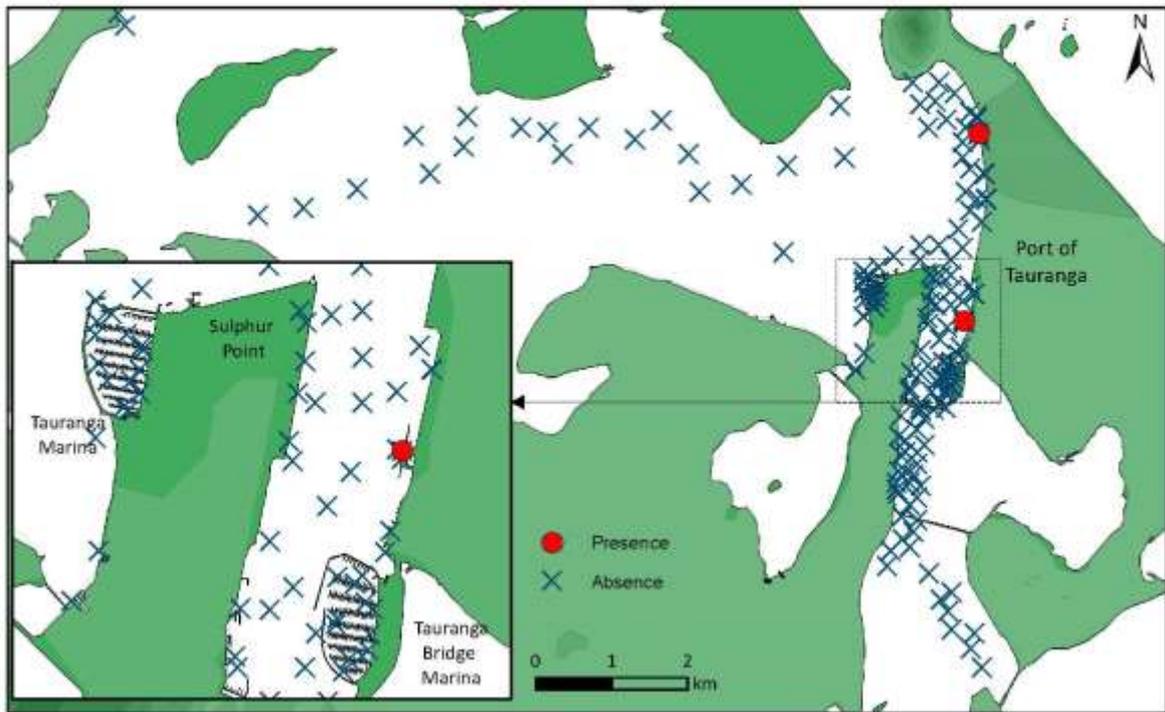
Tauranga Harbour

Summer 2018-19

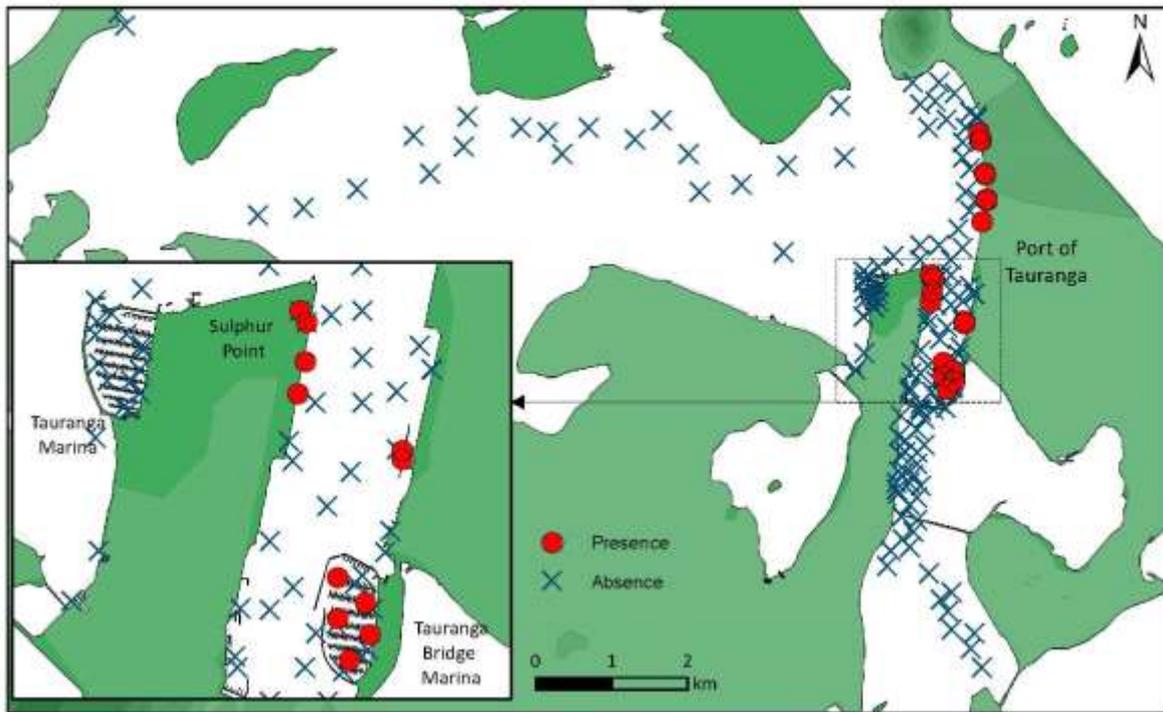
Amathia verticillata



Tauranga Harbour
Winter 2018
Botrylloides giganteum



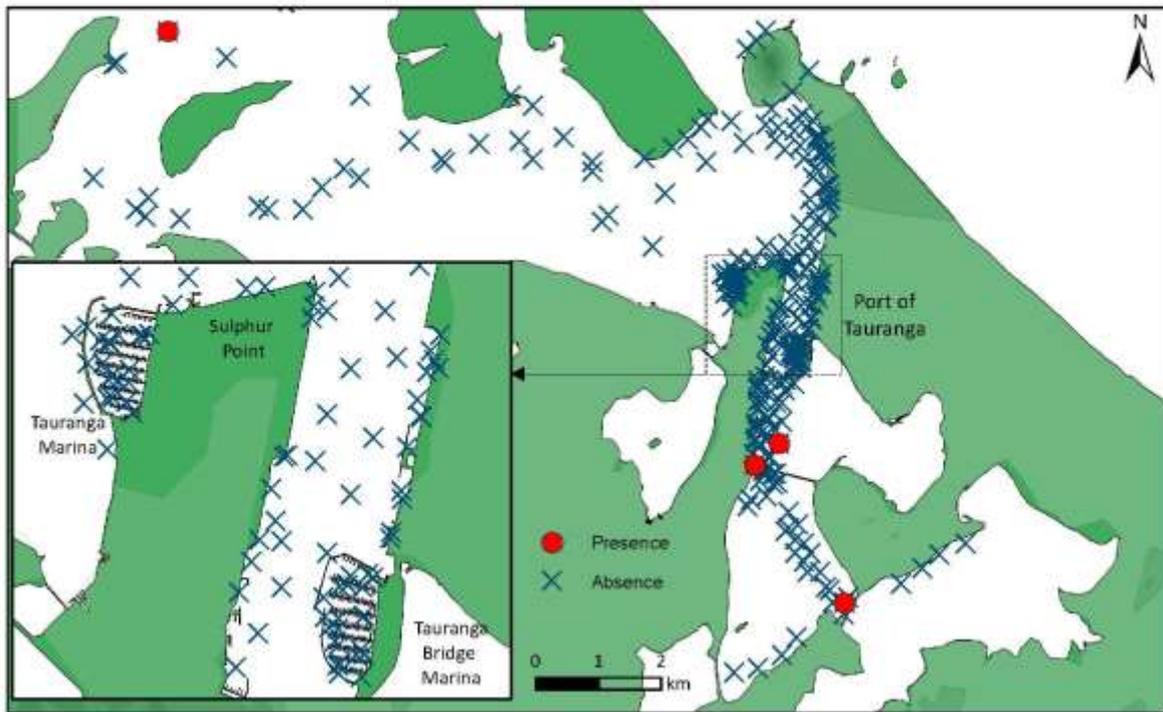
Tauranga Harbour
Winter 2018
Celleporaria nodulosa



Tauranga Harbour

Summer 2018-19

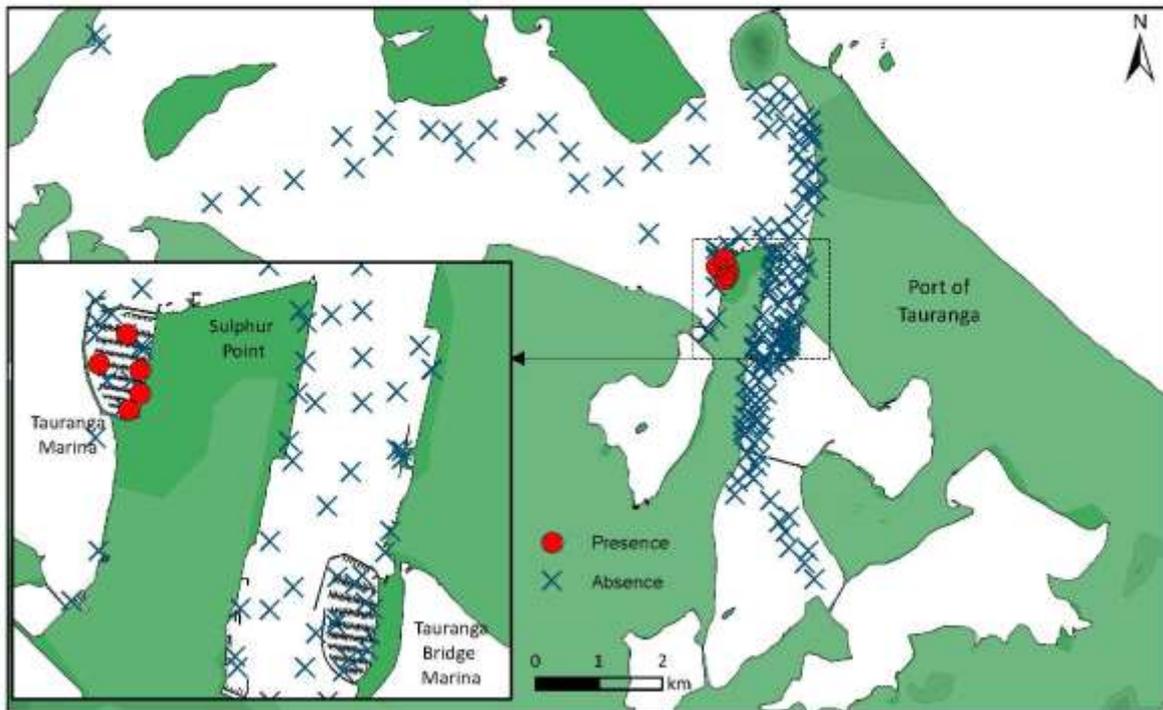
Charybdis (Charybdis) japonica



Tauranga Harbour

Winter 2018

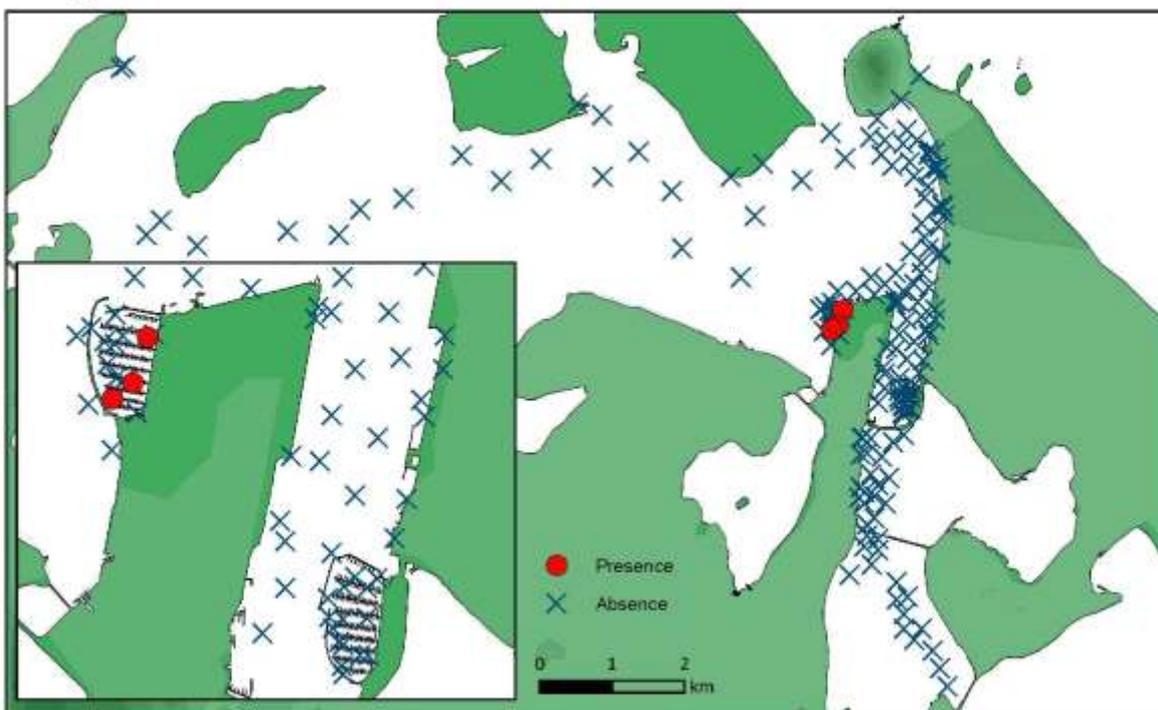
Ciona spp.



Tauranga Harbour

Summer 2018-19

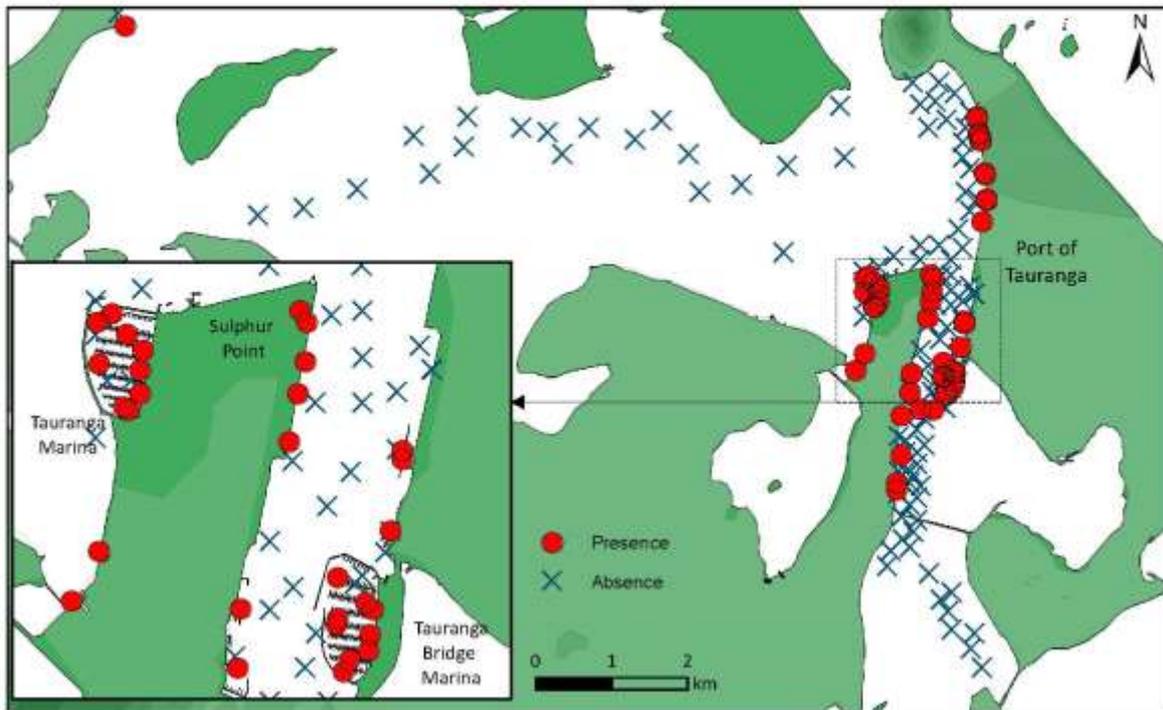
Ciona spp.



Tauranga Harbour

Winter 2018

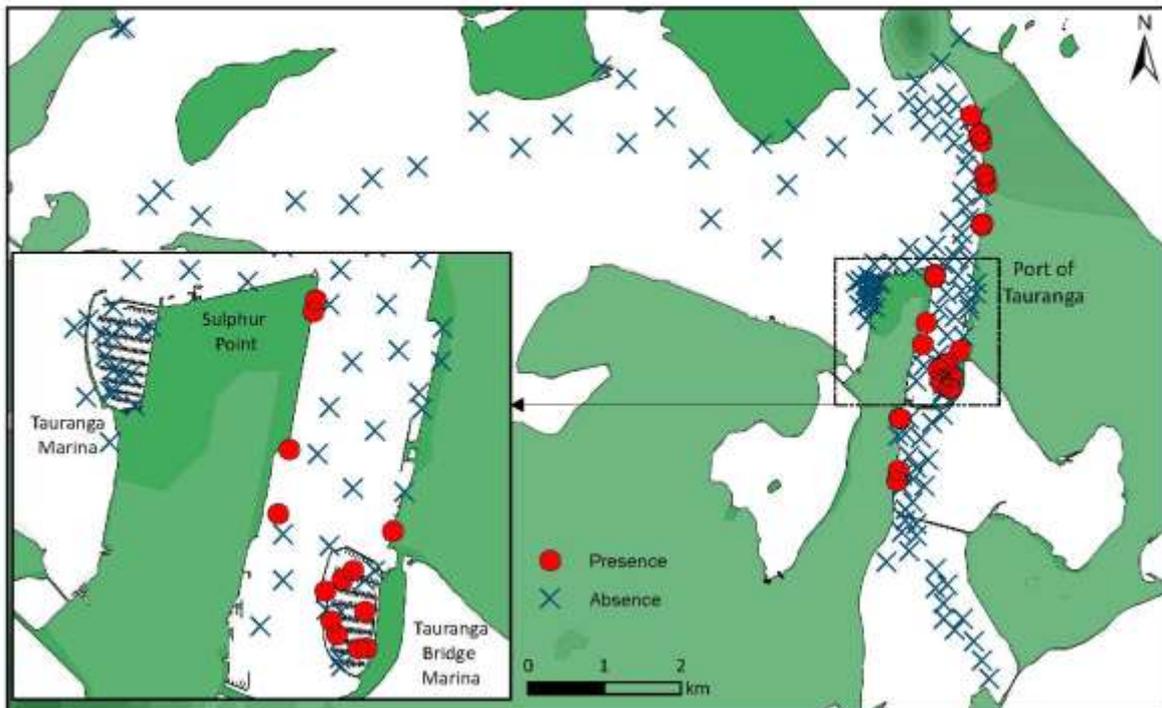
Didemnum vexillum



Tauranga Harbour

Summer 2018-19

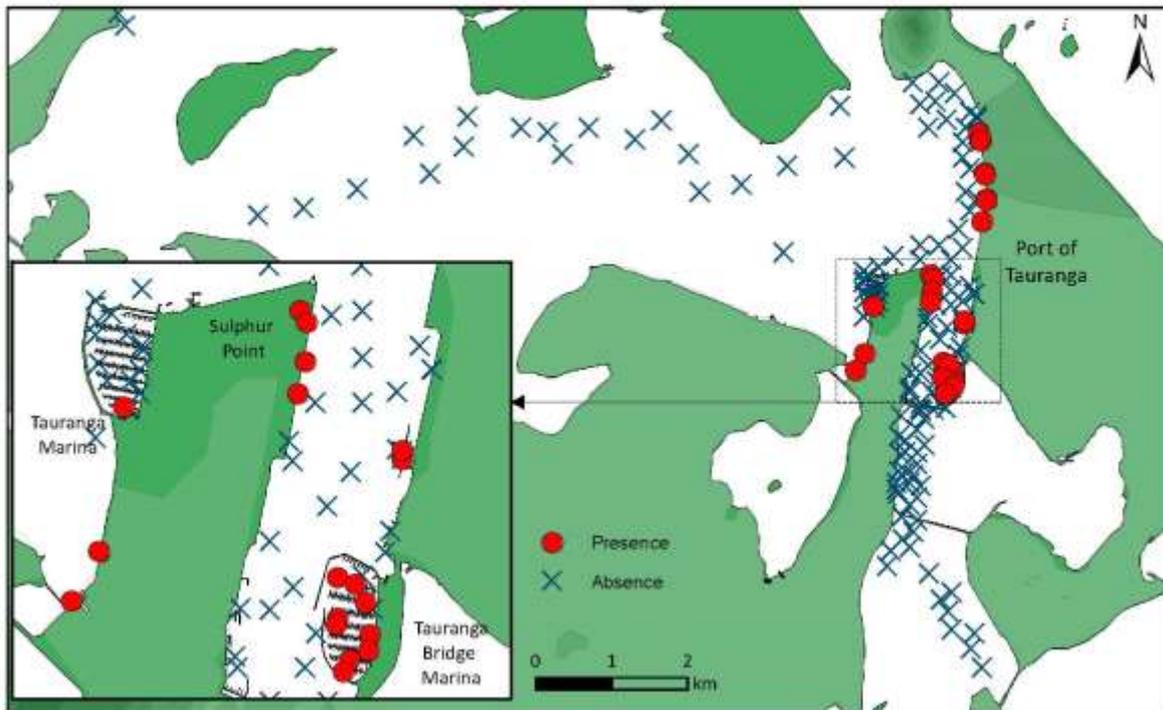
Didemnum vexillum



Tauranga Harbour

Winter 2018

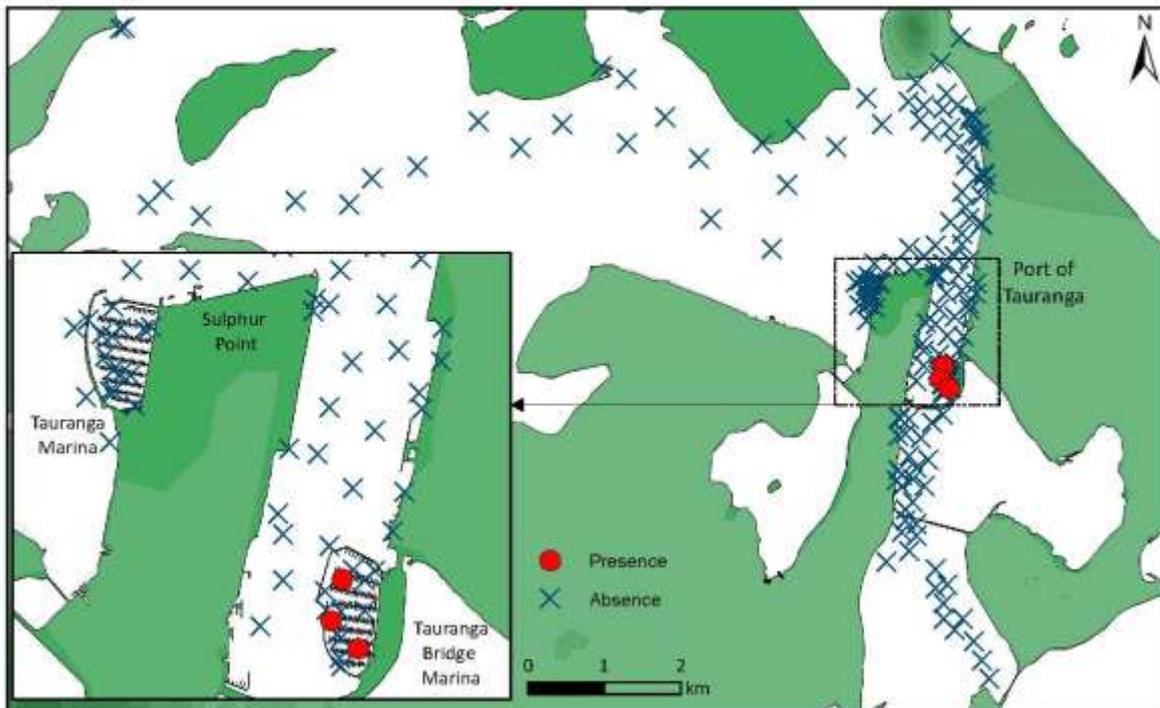
Ectopleura spp.



Tauranga Harbour

Summer 2018-19

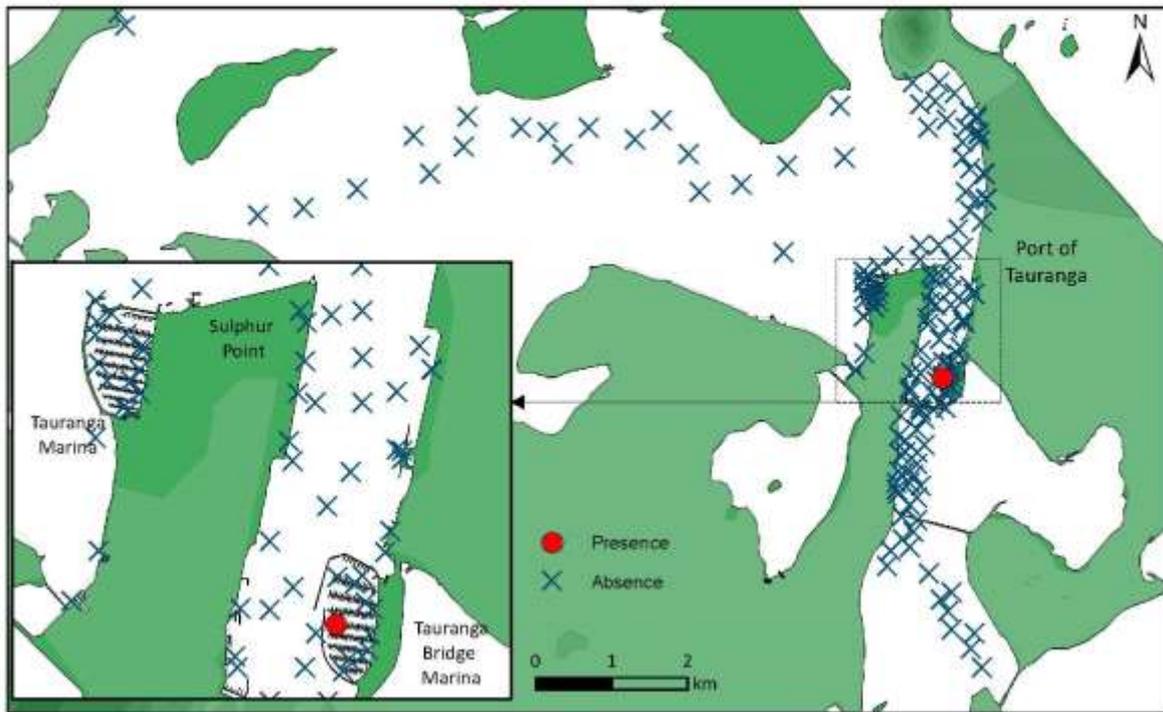
Ectopleura spp.



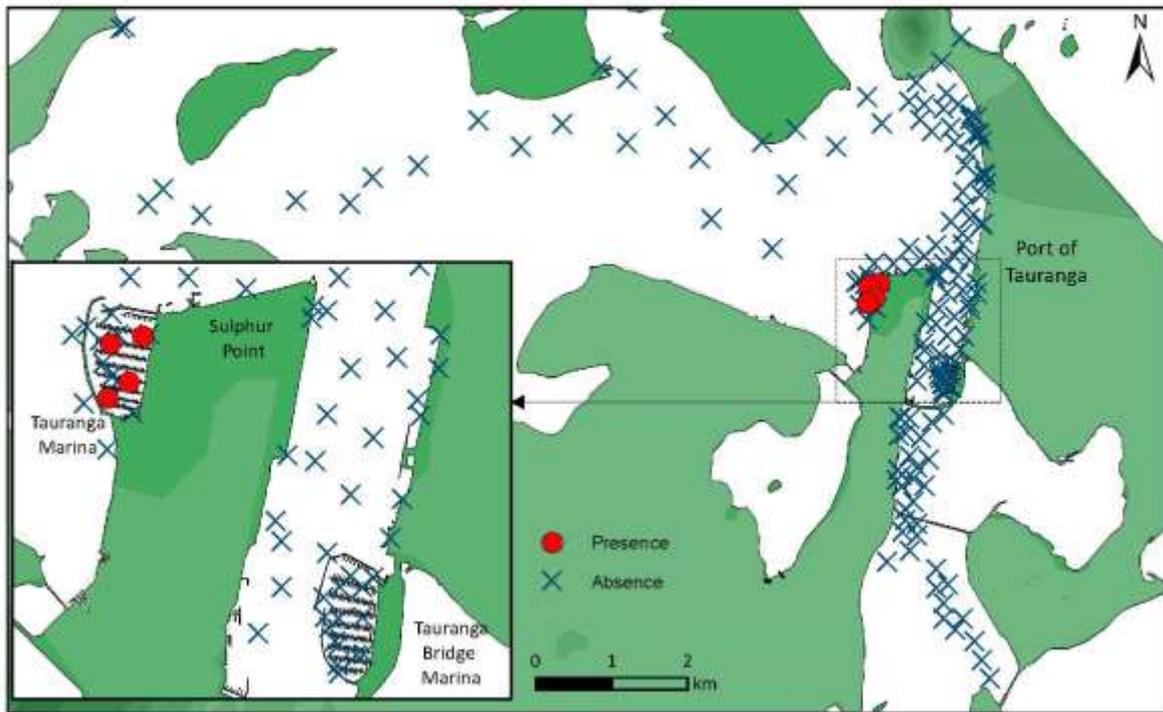
Tauranga Harbour

Winter 2018

Grateloupia turuturu



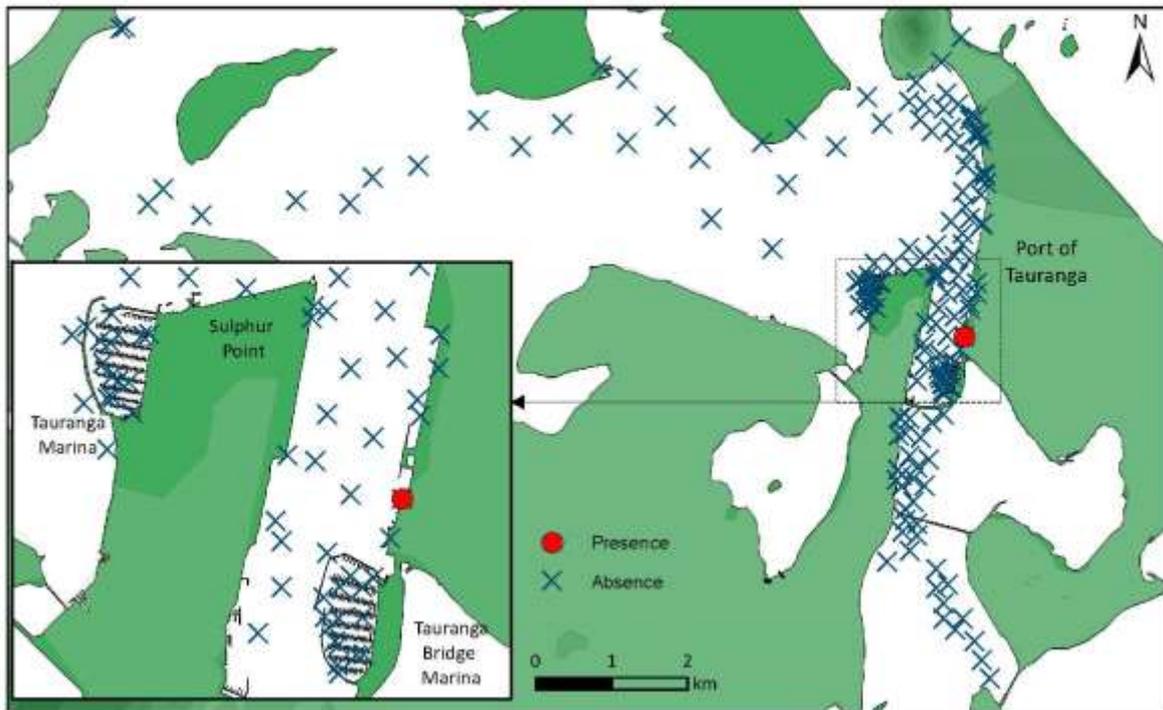
Tauranga Harbour
Summer 2018-19
Polyandrocarpa zorritensis



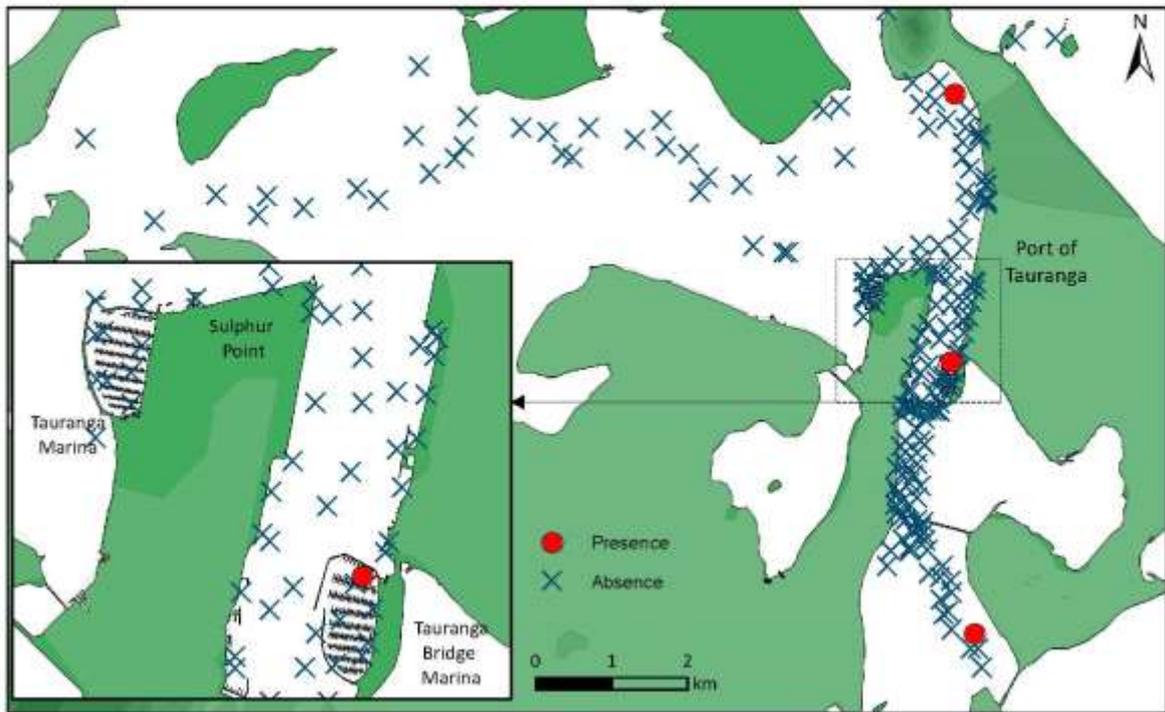
Tauranga Harbour

Summer 2018-19

Polycera hedgpethi



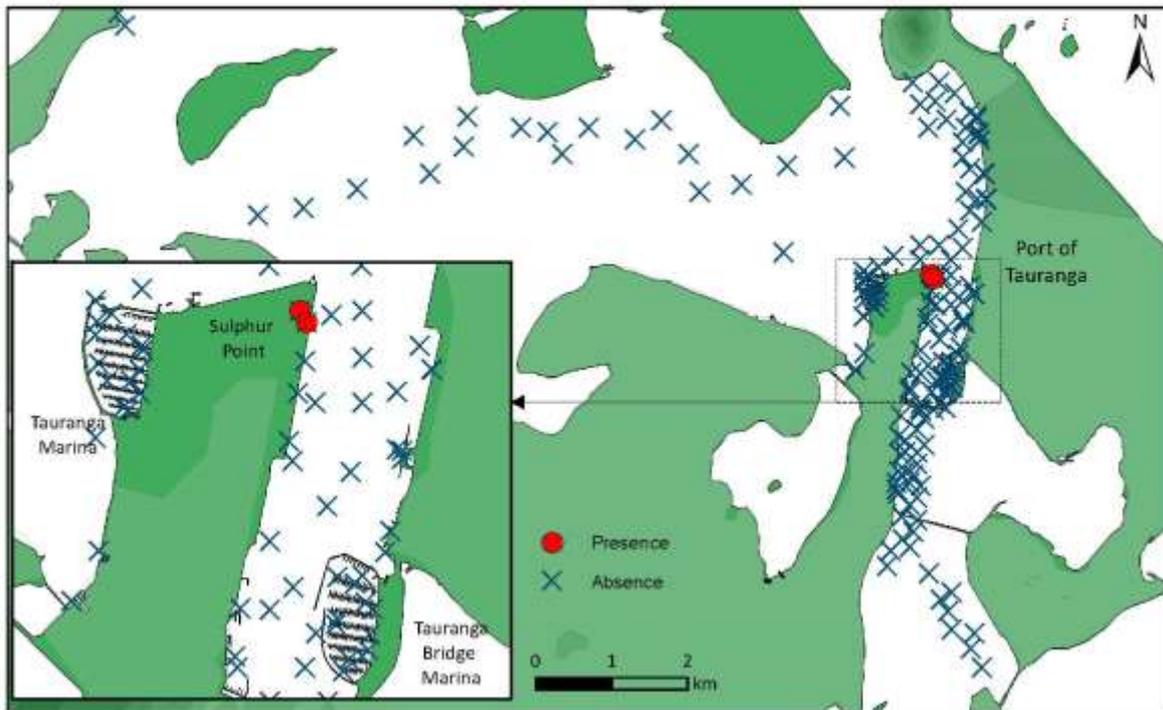
Tauranga Harbour
Winter 2018
Pyromaia tuberculata



Tauranga Harbour

Winter 2018

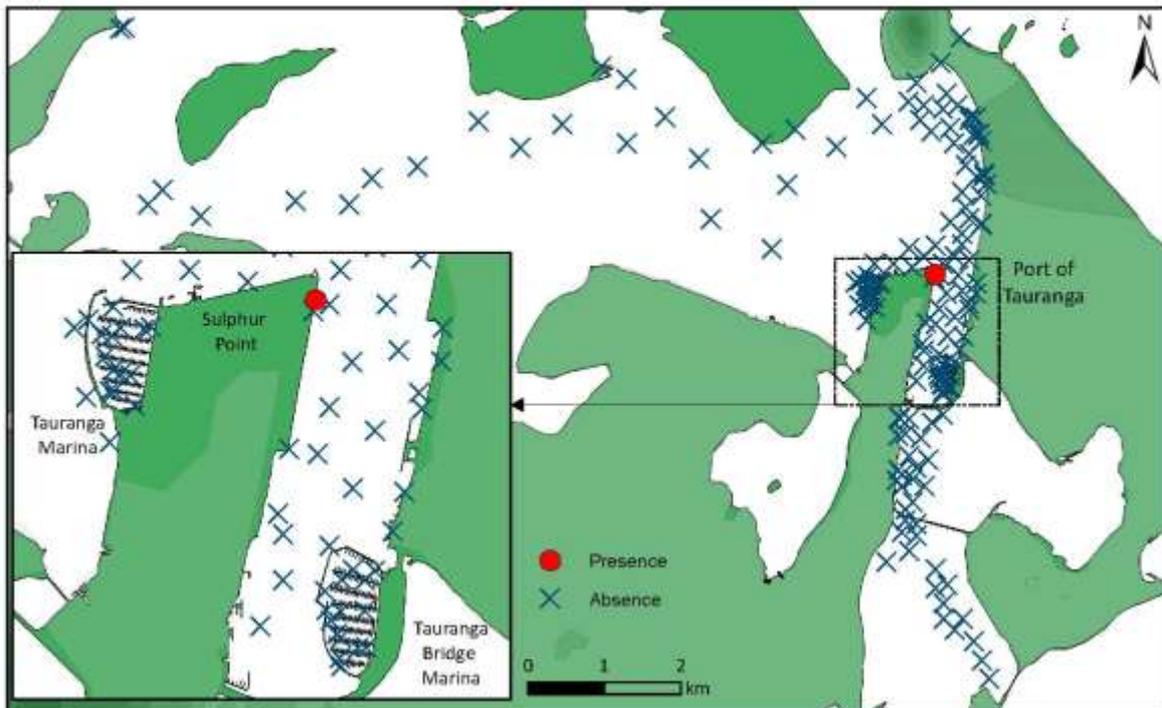
Styela clava



Tauranga Harbour

Summer 2018-19

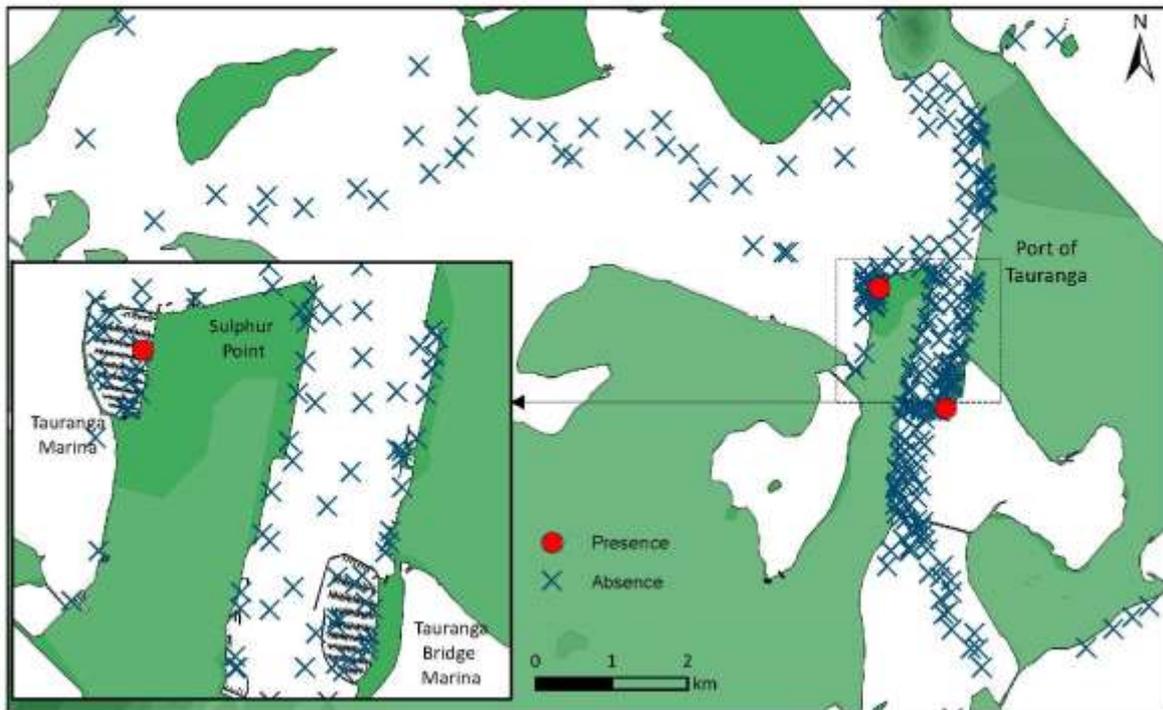
Styela clava



Tauranga Harbour

Winter 2018

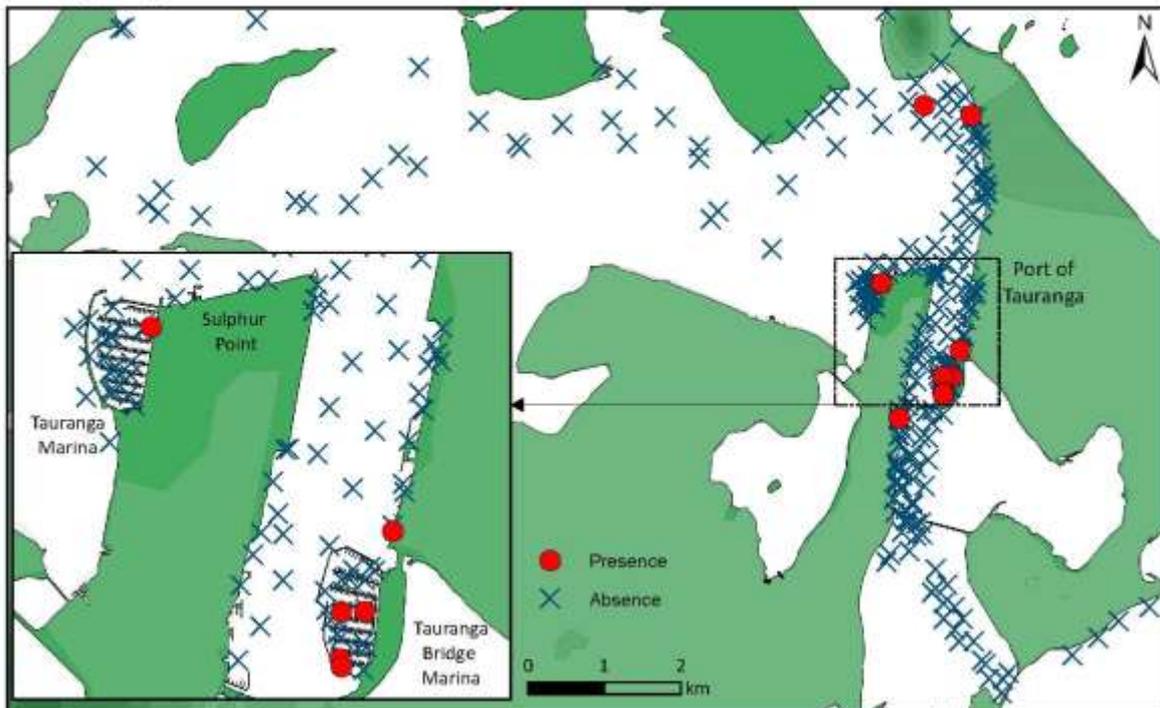
Undaria pinnatifida



Tauranga Harbour

Summer 2018-19

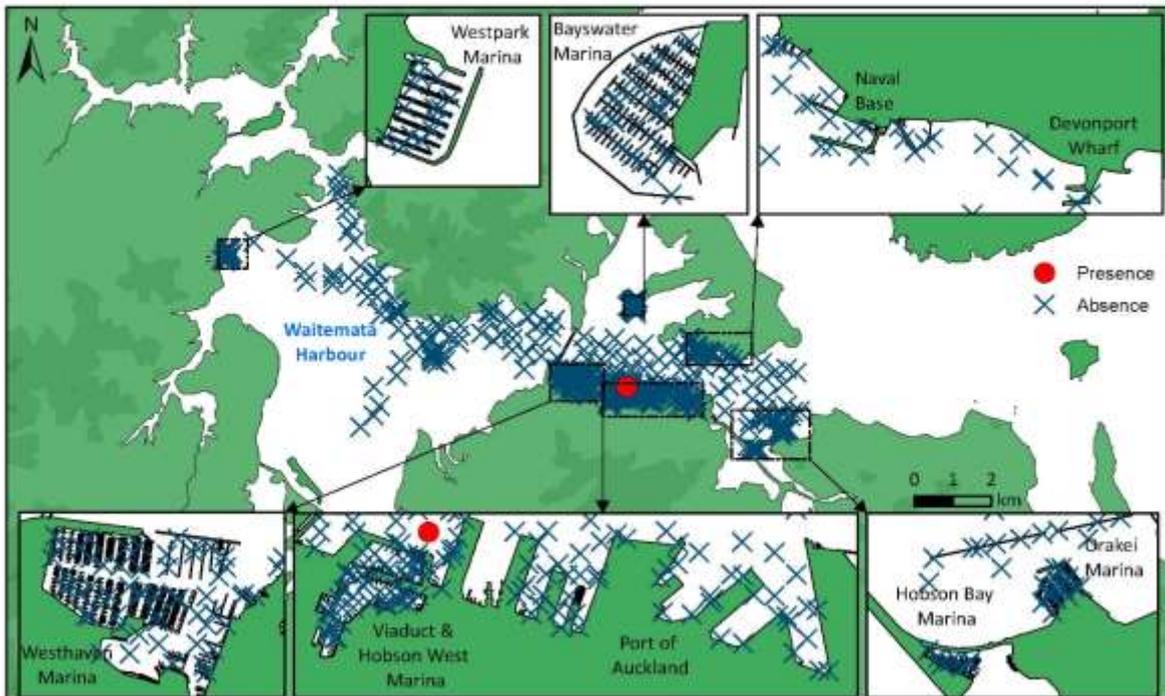
Undaria pinnatifida



Waitematā Harbour

Winter 2018

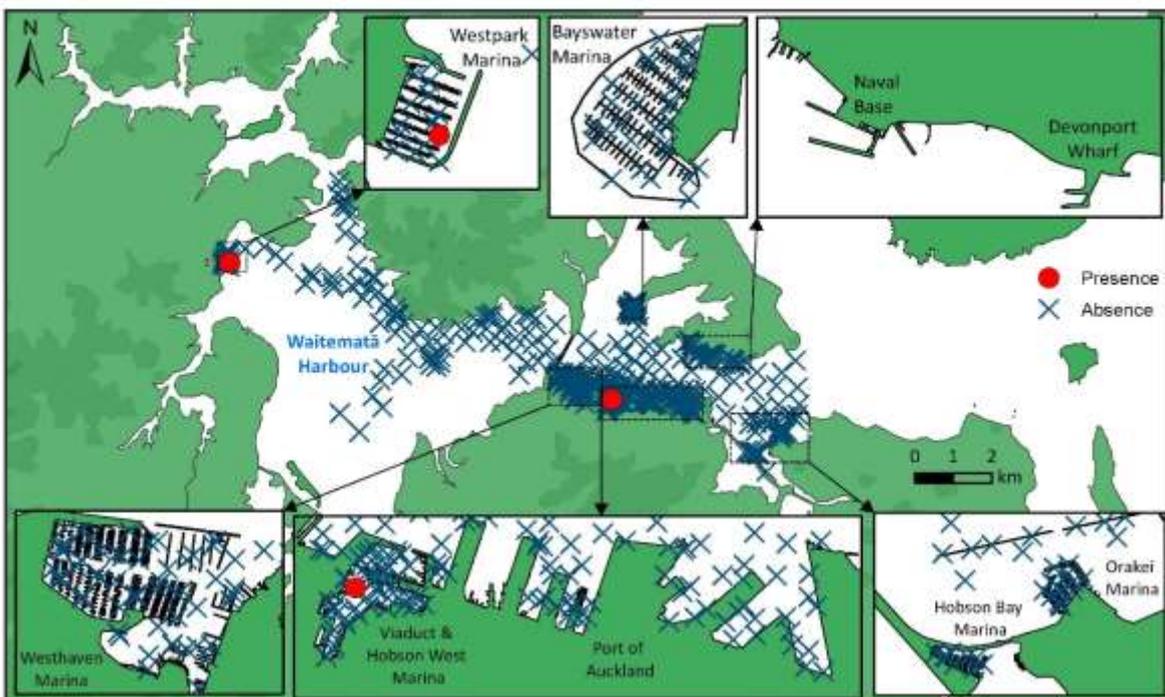
Acentrogobius pflaumii



Waitematā Harbour

Summer 2018-19

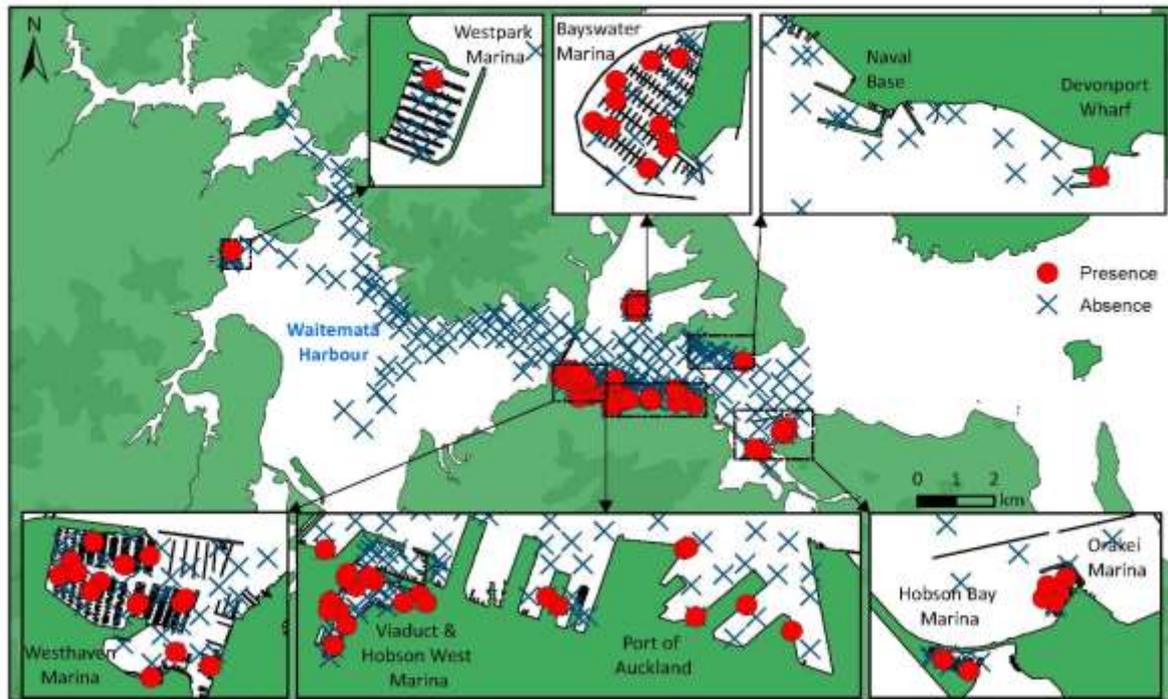
Acentrogobius pflaumii



Waitematā Harbour

Summer 2018-19

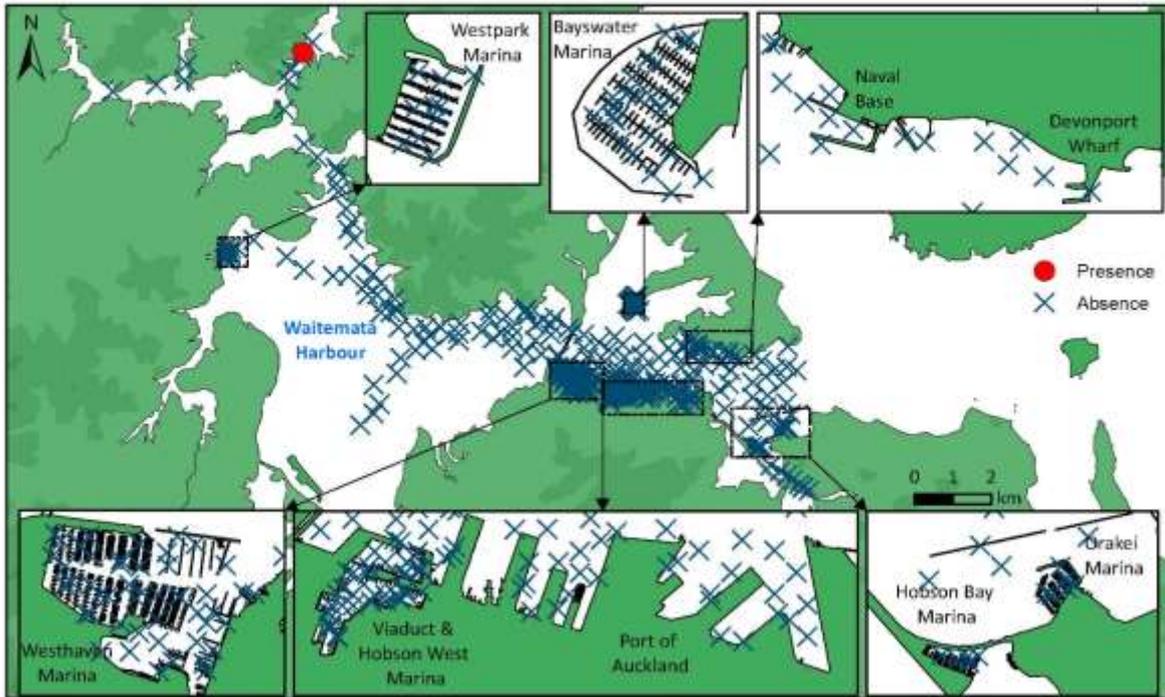
Amathia verticillata



Waitematā Harbour

Winter 2018

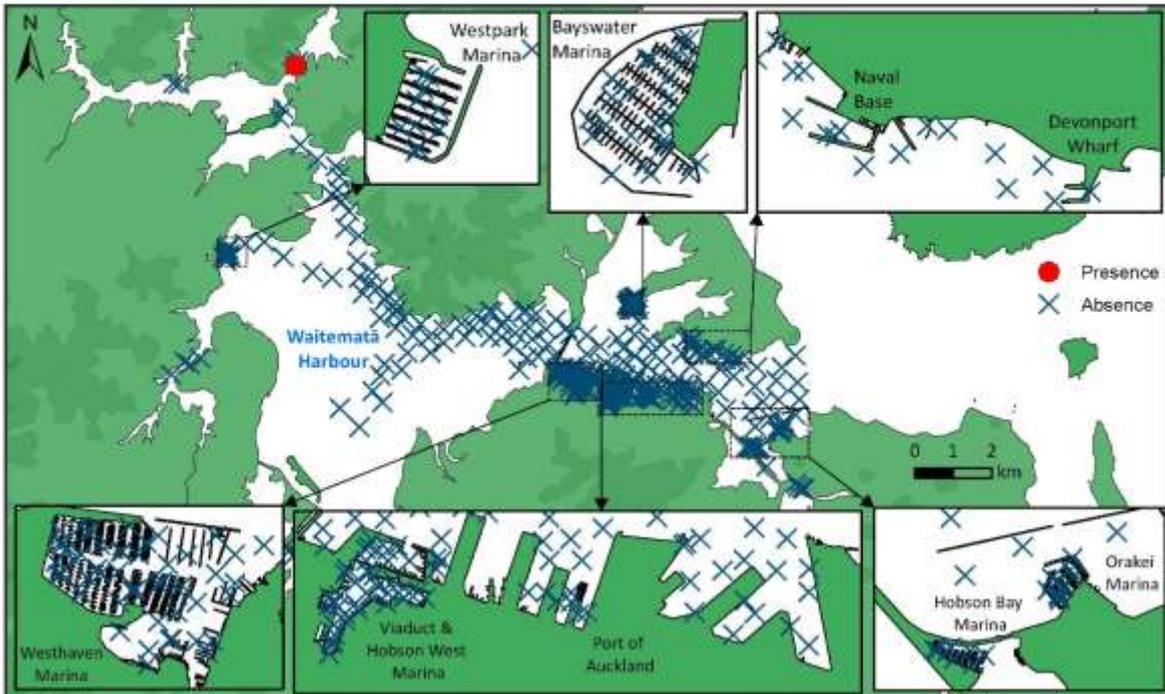
Arcuatula senhousia



Waitematā Harbour

Summer 2018-19

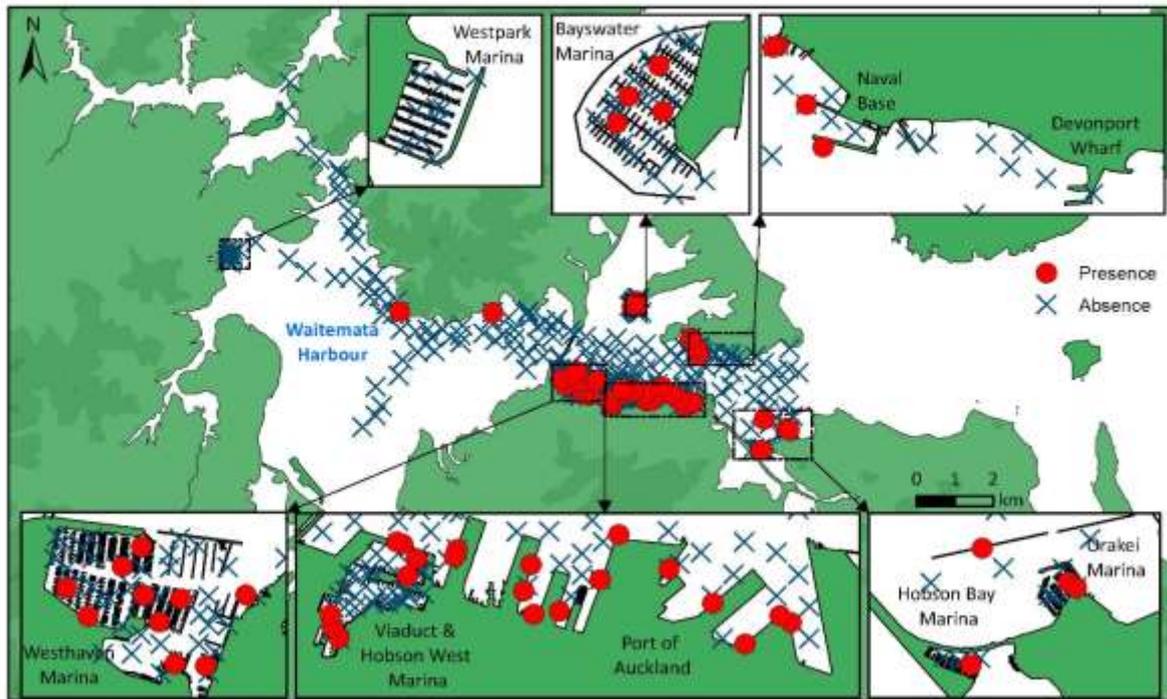
Arcuatula senhousia



Waitematā Harbour

Winter 2018

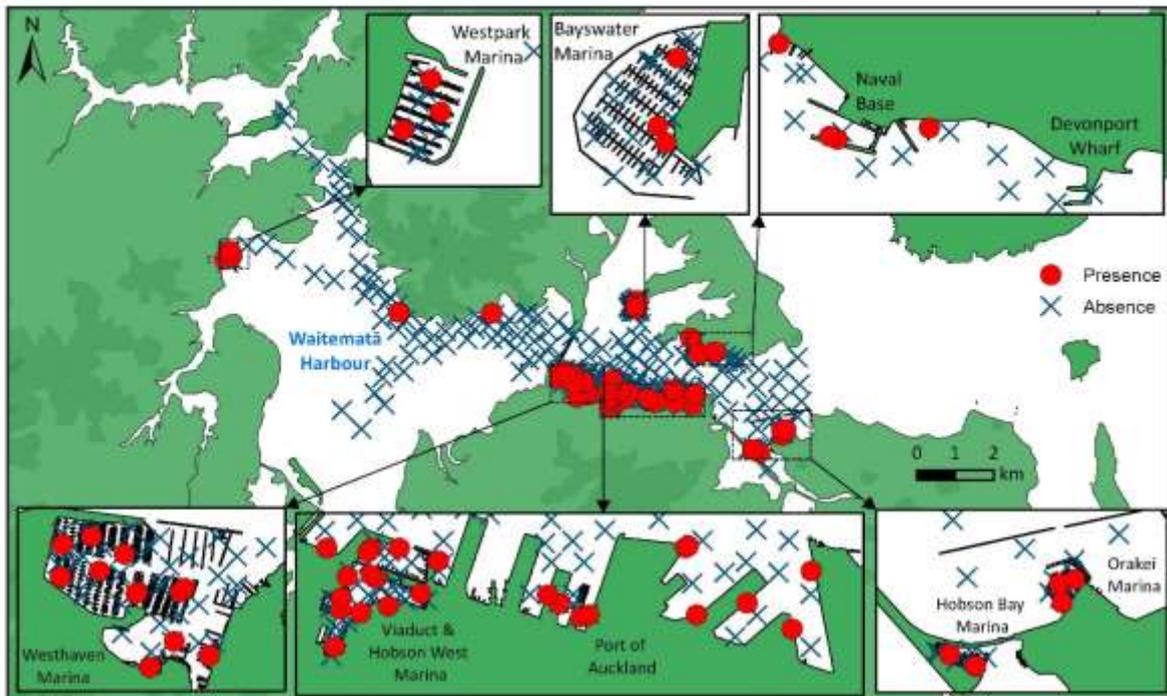
Celleporaria nodulosa



Waitematā Harbour

Summer 2018-19

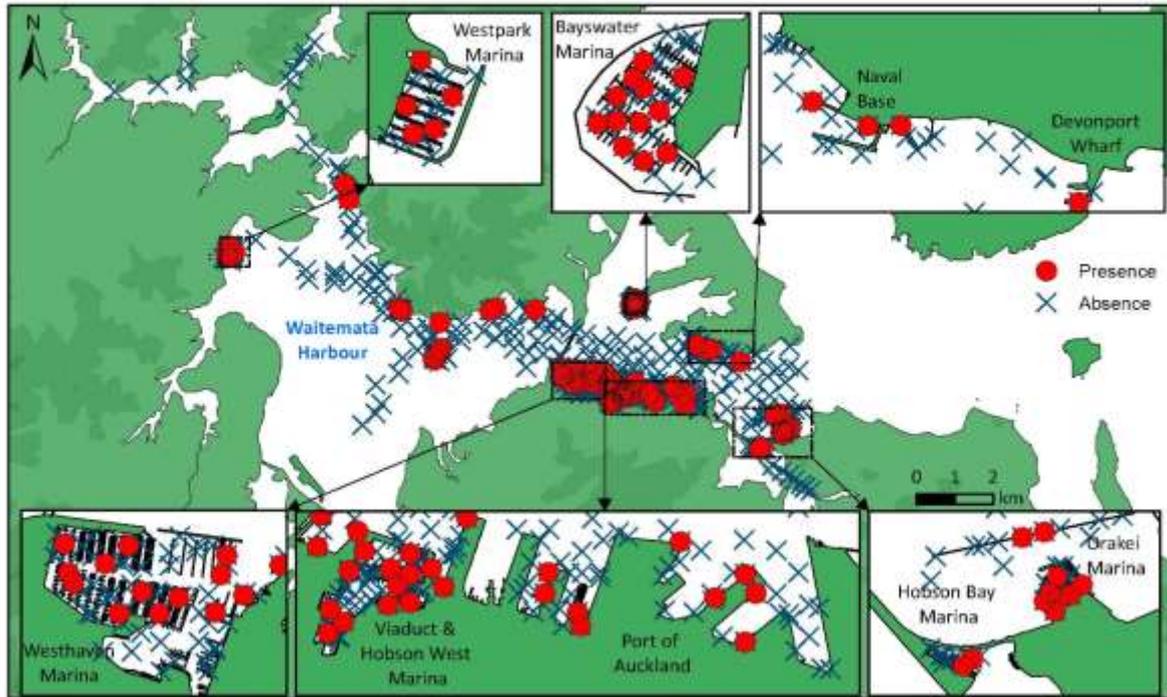
Celleporaria nodulosa



Waitematā Harbour

Winter 2018

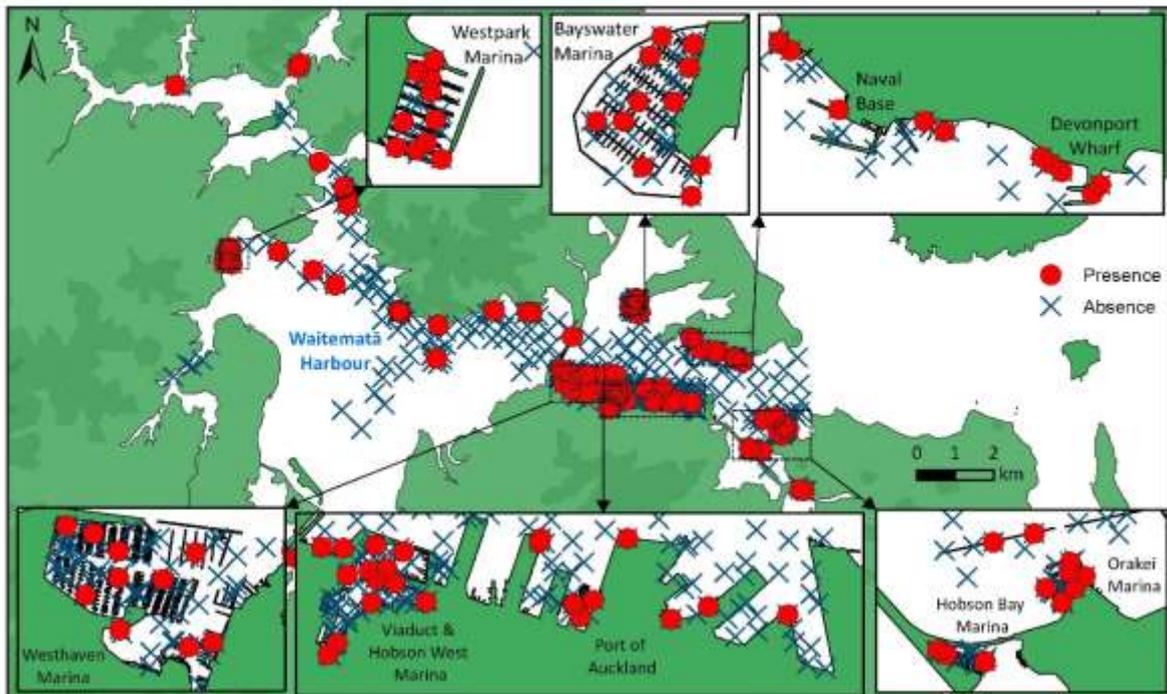
Charydis (Charybdis) japonica



Waitematā Harbour

Summer 2018-19

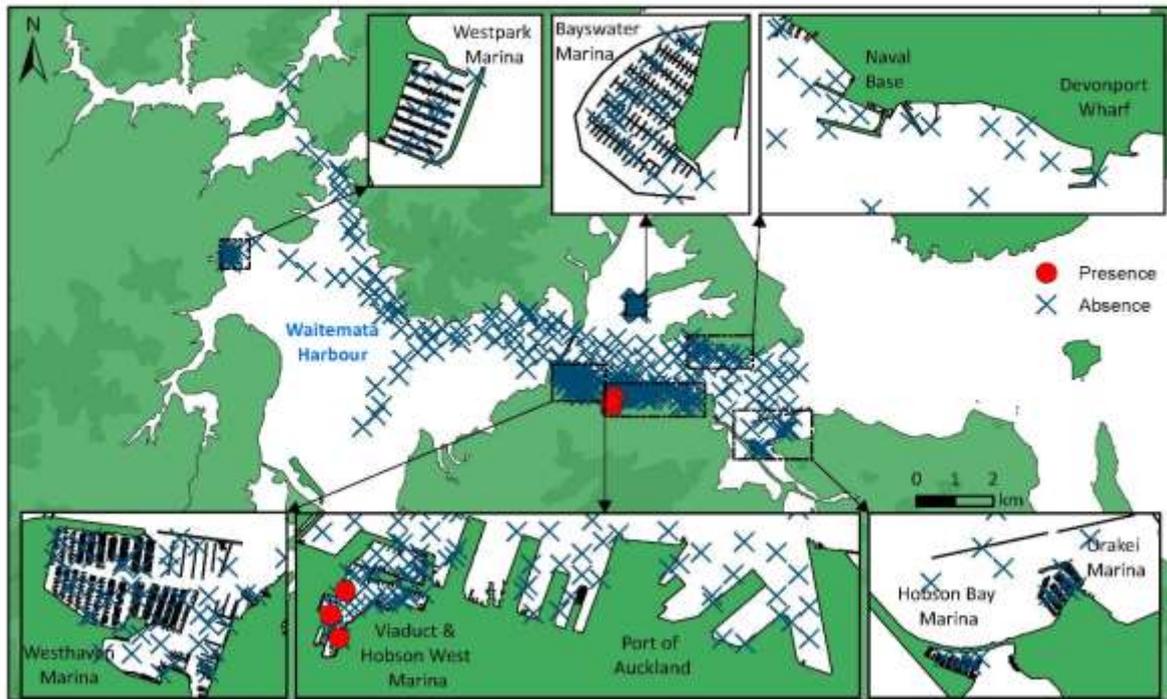
Charydis (Charybdis) japonica



Waitematā Harbour

Winter 2018

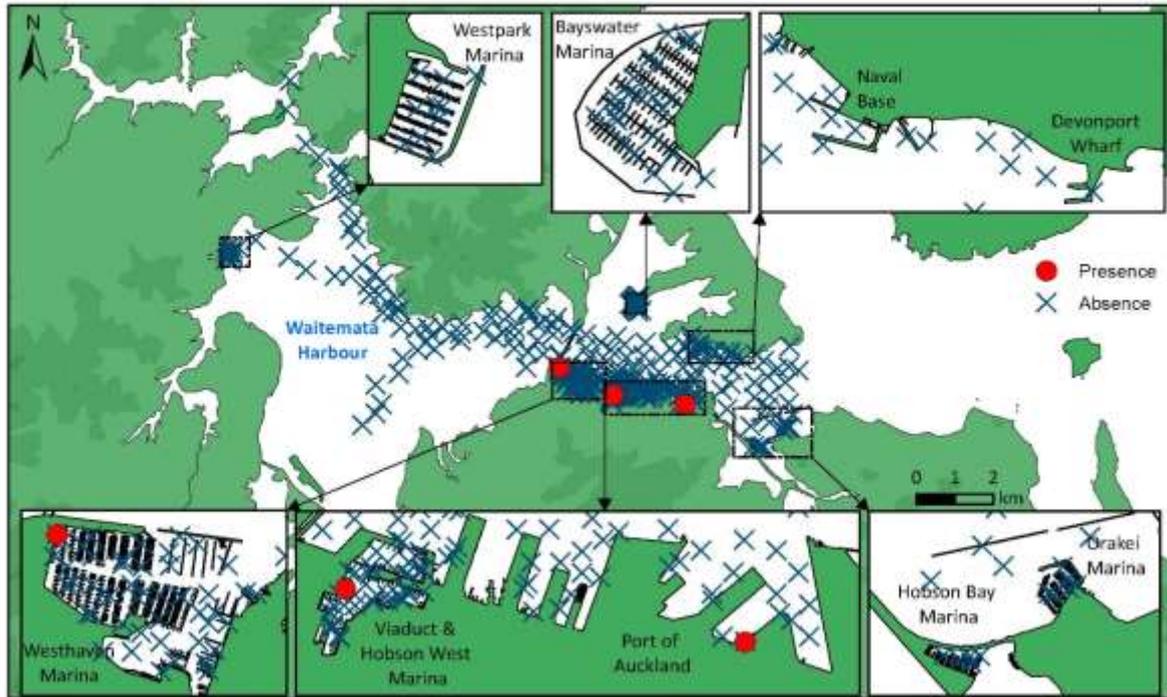
Ciona intestinalis



Waitematā Harbour

Winter 2018

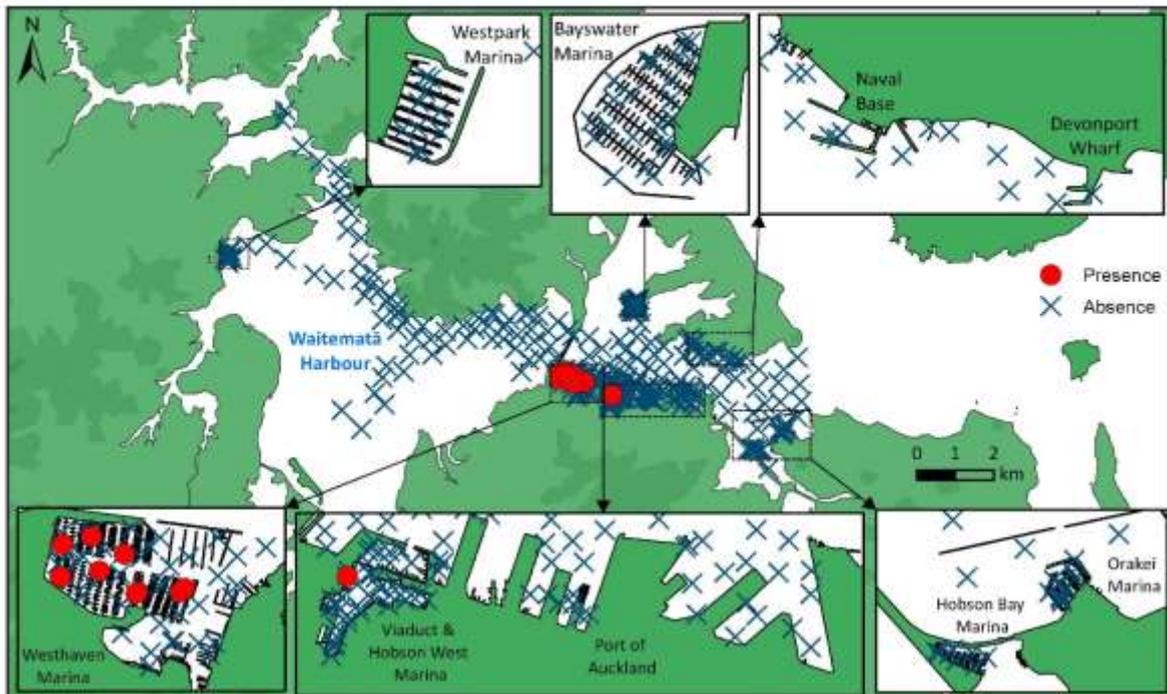
Ciona savignyi



Waitematā Harbour

Summer 2018-19

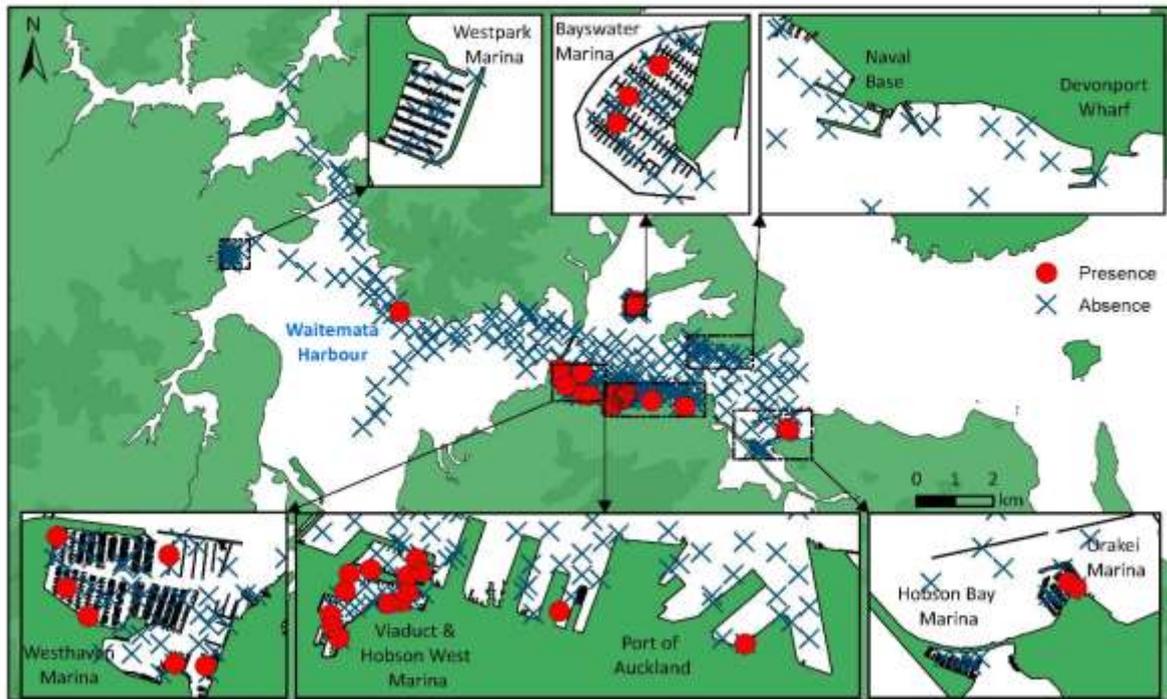
Ciona savignyi



Waitematā Harbour

Winter 2018

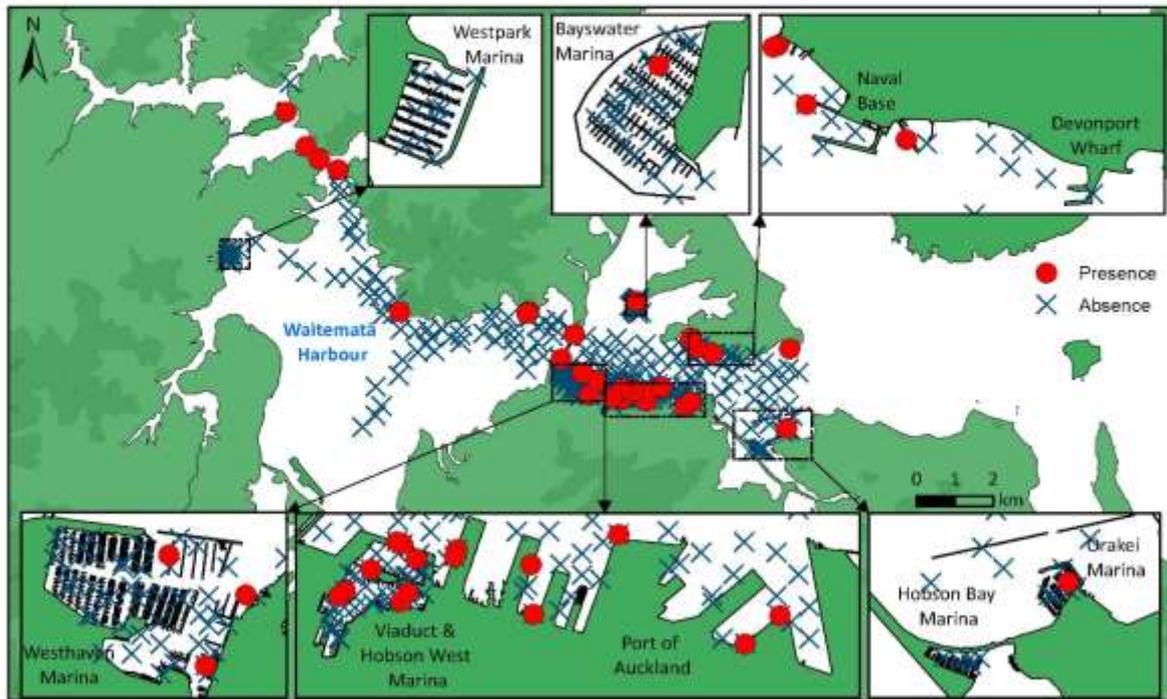
Ciona spp.



Waitematā Harbour

Winter 2018

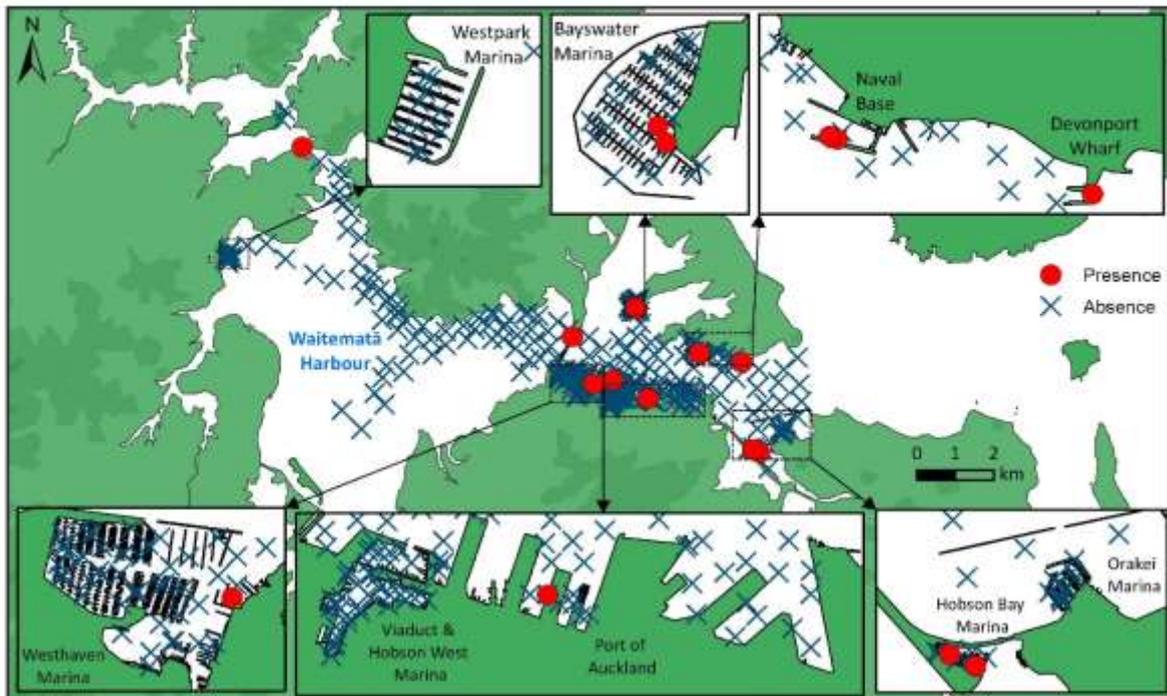
Didemnum vexillum



Waitematā Harbour

Summer 2018-19

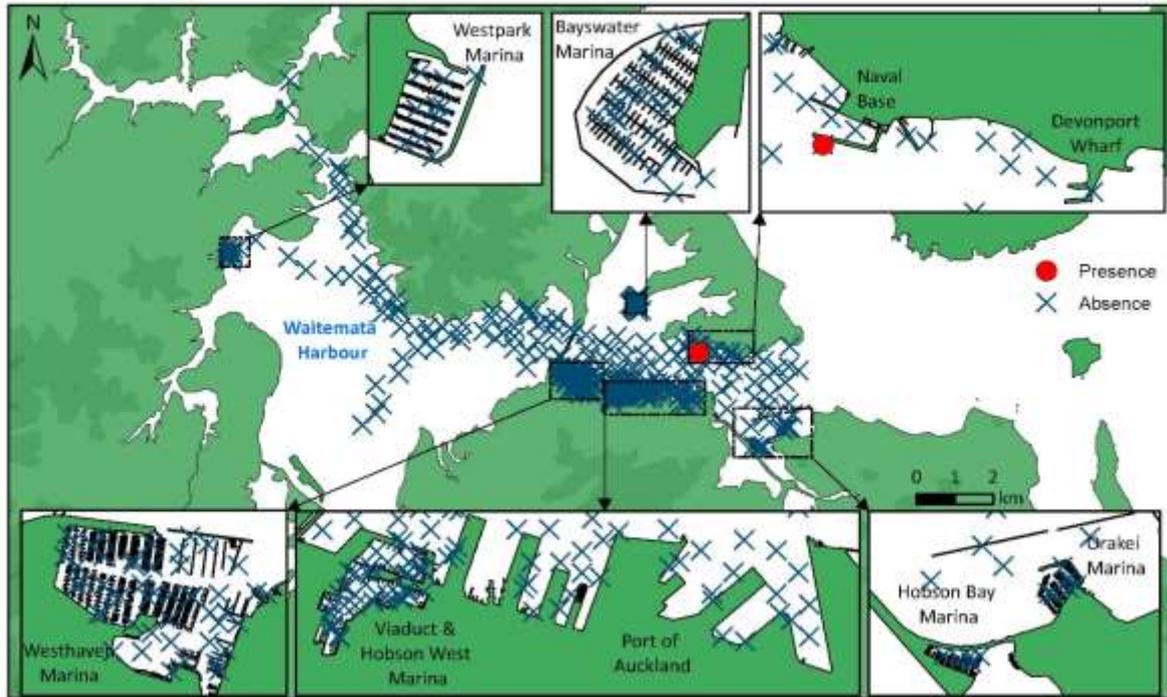
Didemnum vexillum



Waitematā Harbour

Winter 2018

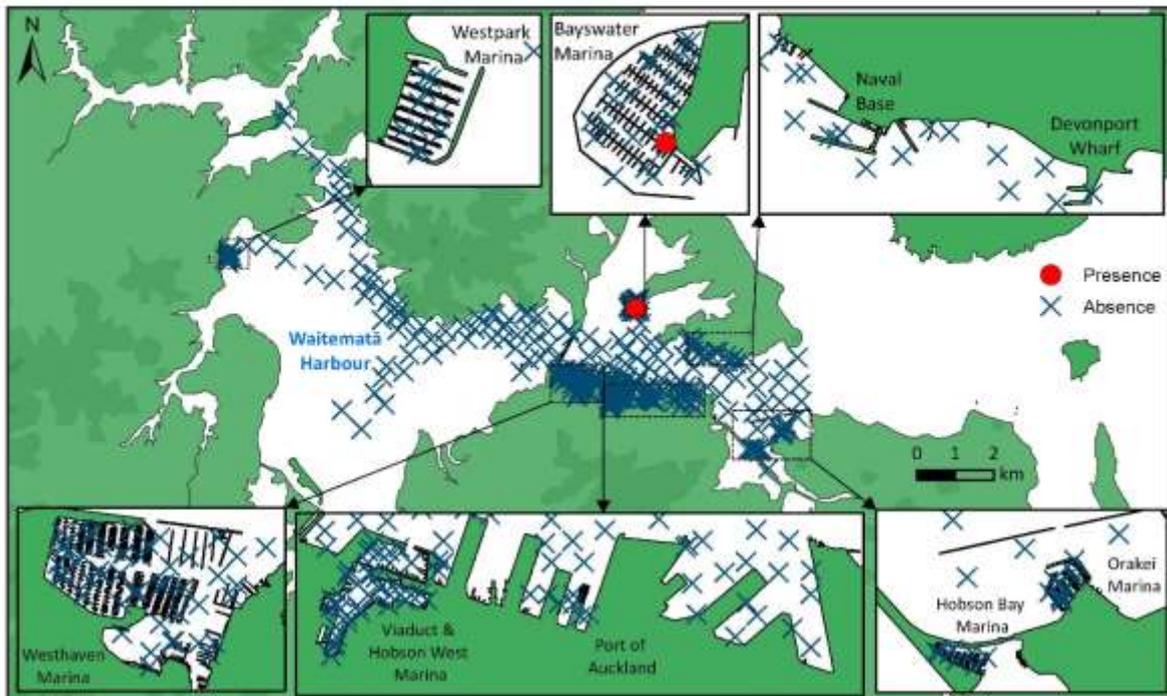
Diplosoma listerianum



Waitematā Harbour

Summer 2018-19

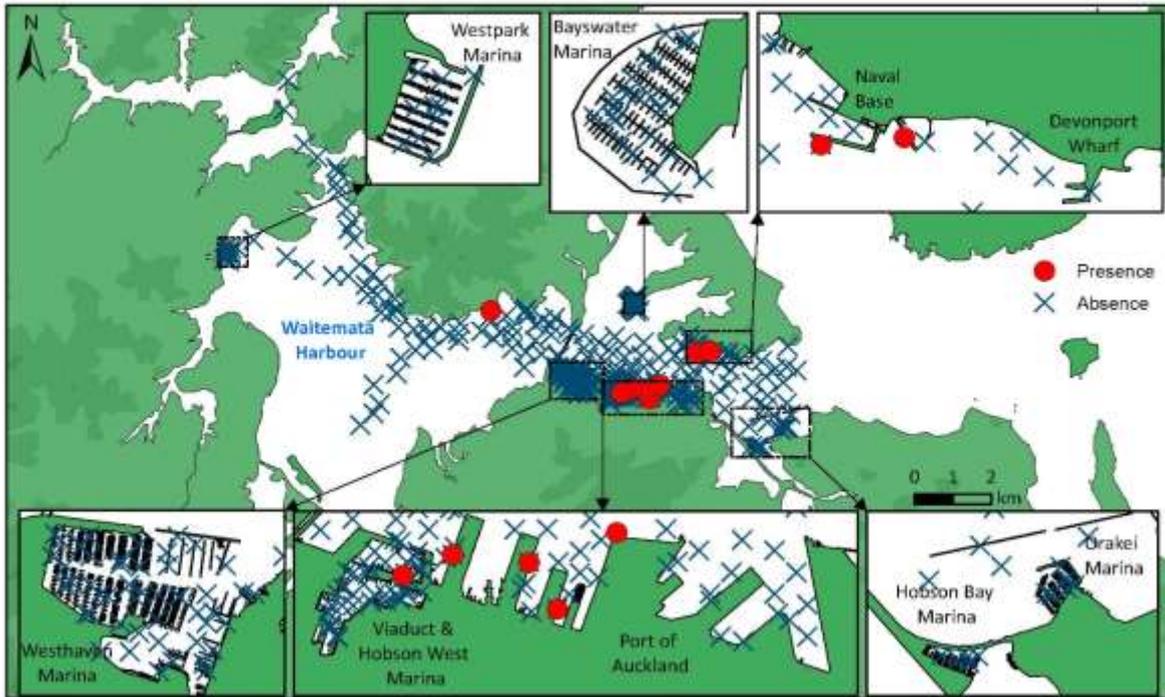
Diplosoma listerianum



Waitematā Harbour

Winter 2018

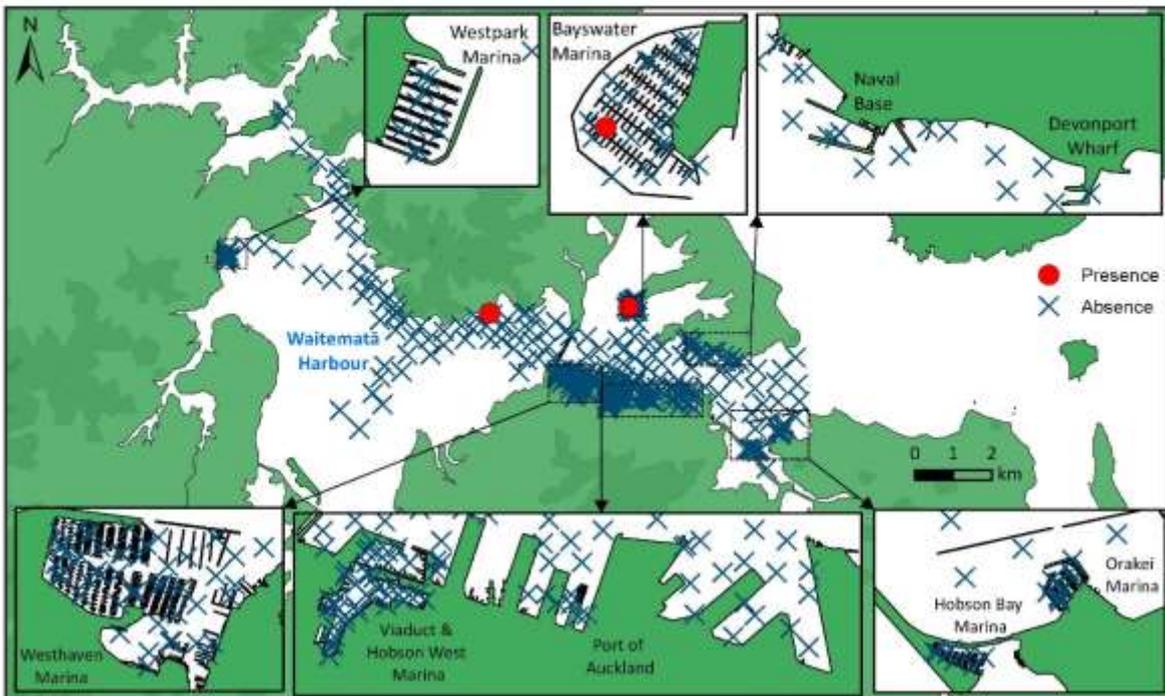
Ectopleura spp.



Waitematā Harbour

Summer 2018-19

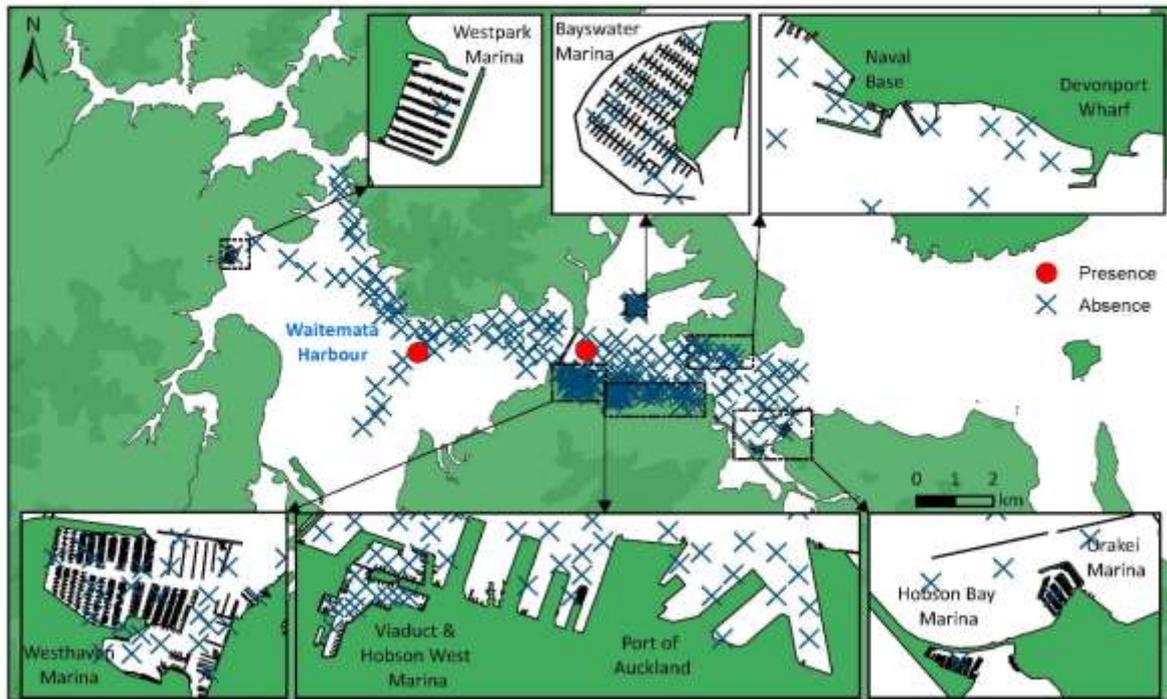
Ectopleura spp.



Waitematā Harbour

Winter 2018

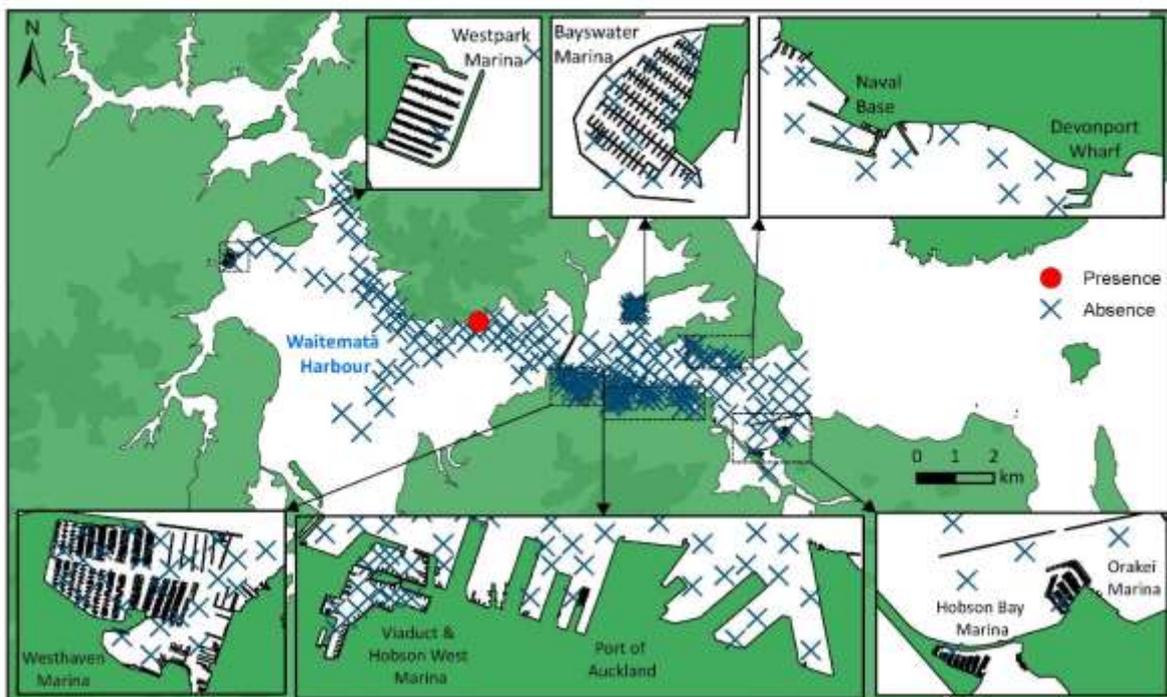
Limaria orientalis



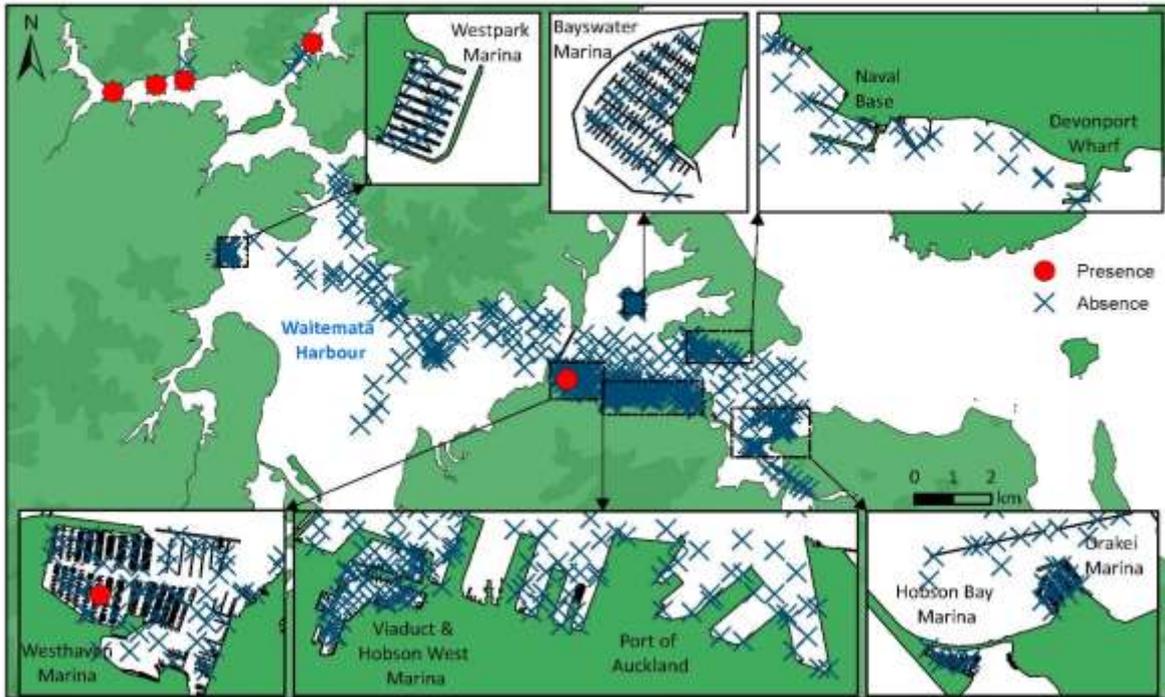
Waitematā Harbour

Summer 2018-19

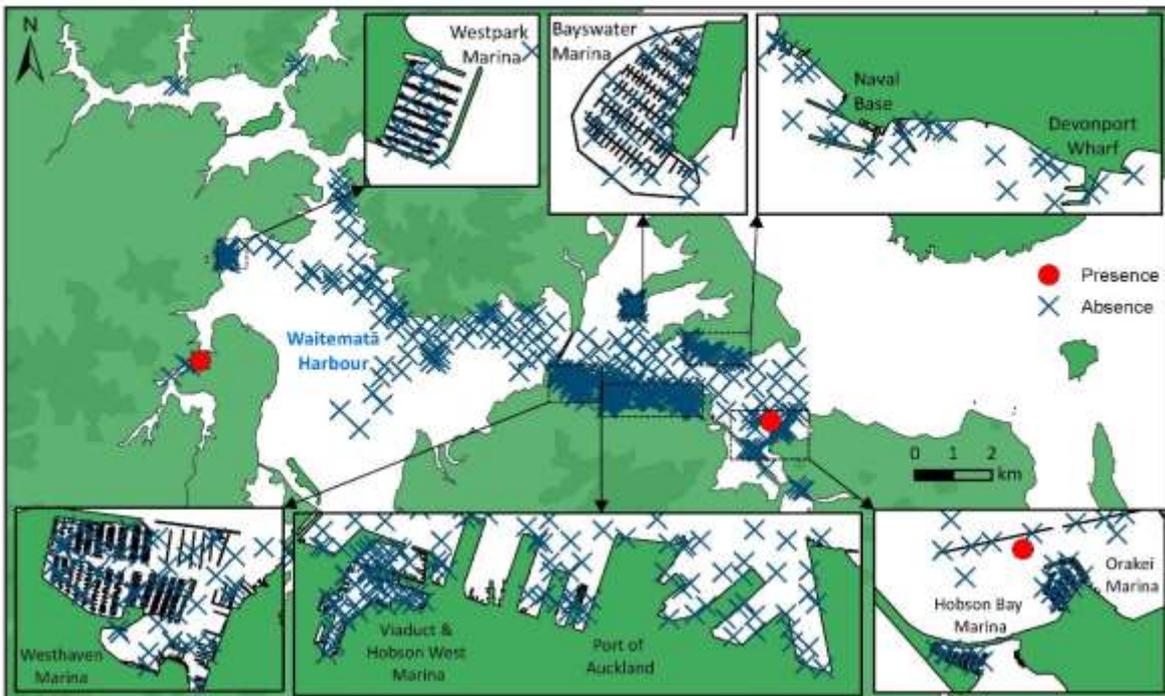
Limaria orientalis



Waitematā Harbour
 Winter 2018
Metapenaeus bennettiae



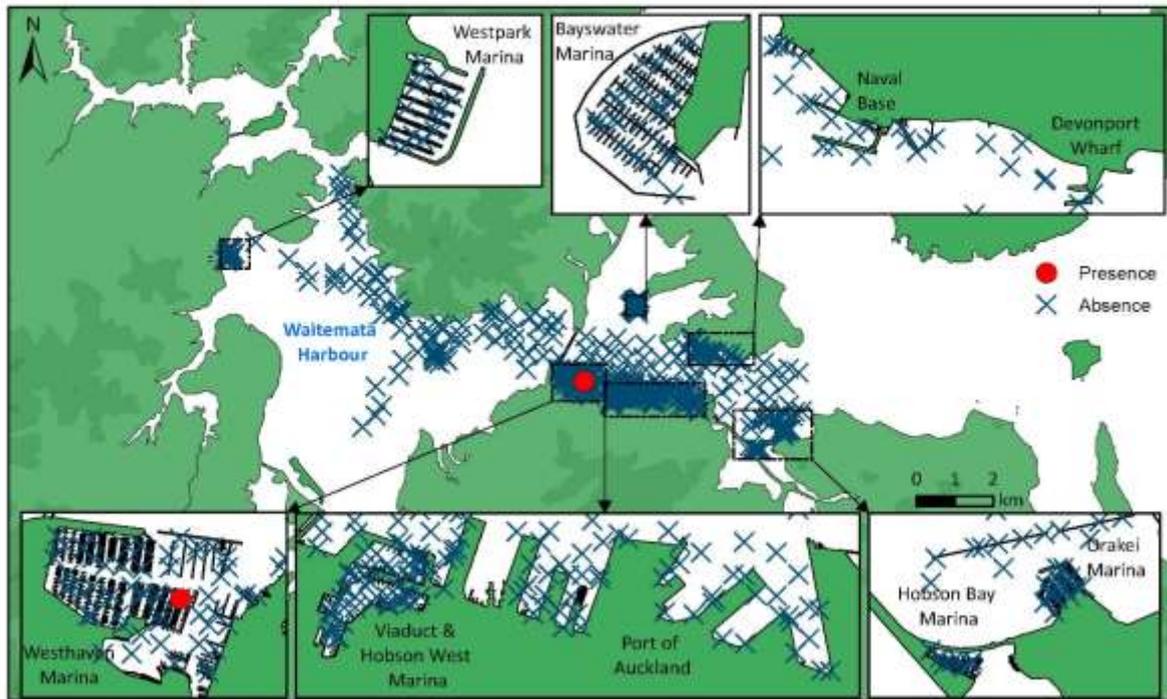
Waitematā Harbour
 Summer 2018-19
Metapenaeus bennettiae



Waitematā Harbour

Winter 2018

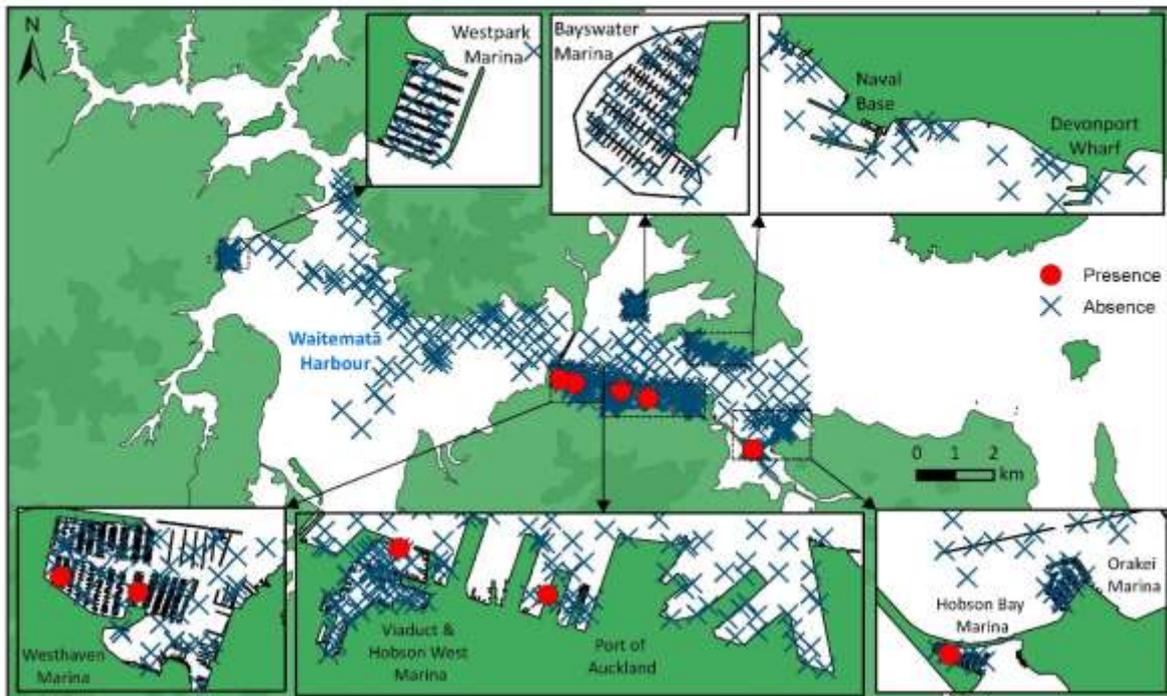
Omobranchus anolius



Waitematā Harbour

Summer 2018-19

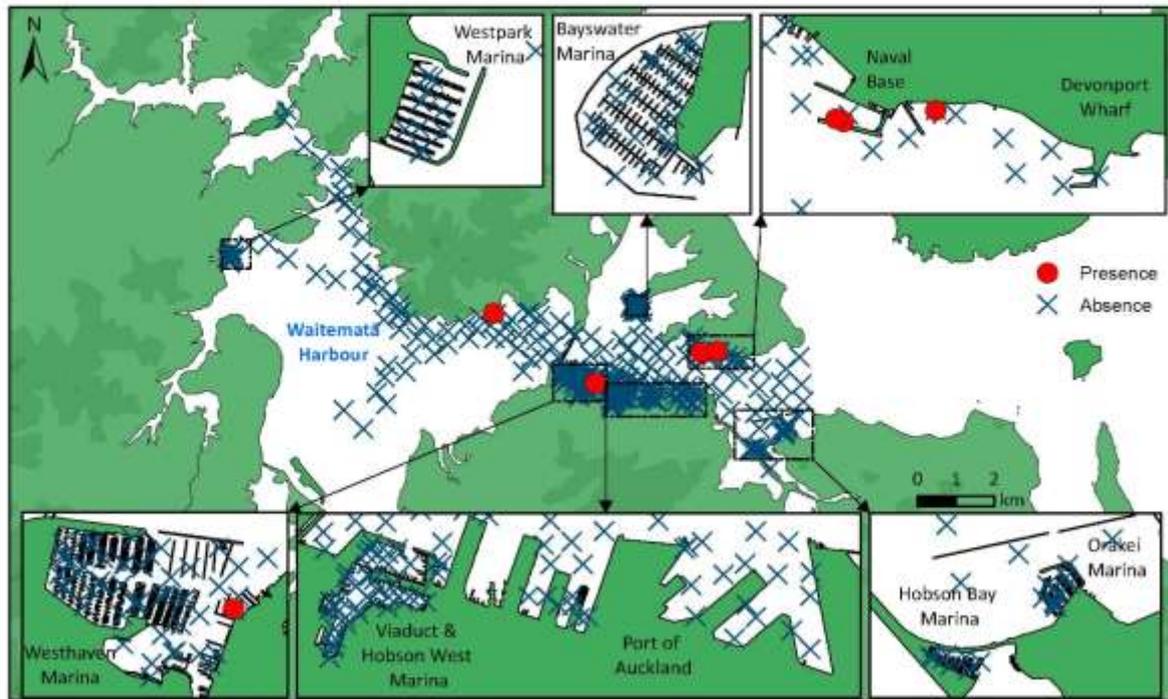
Omobranchus anolius



Waitematā Harbour

Summer 2018-19

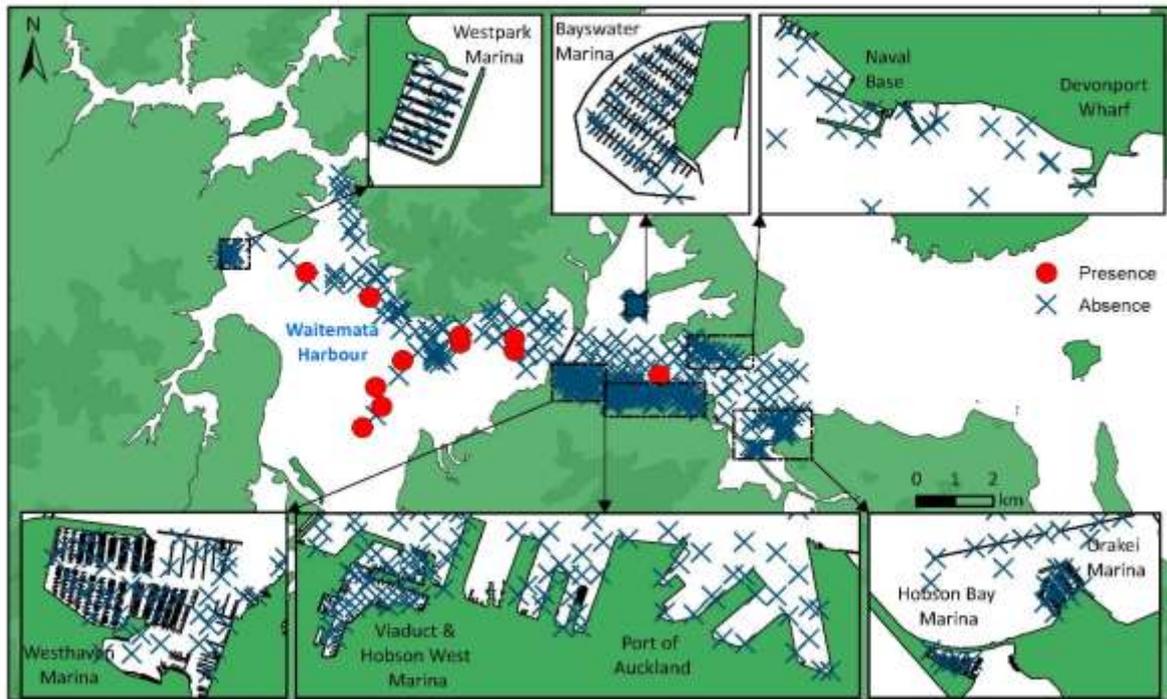
Pennaria disticha



Waitematā Harbour

Winter 2018

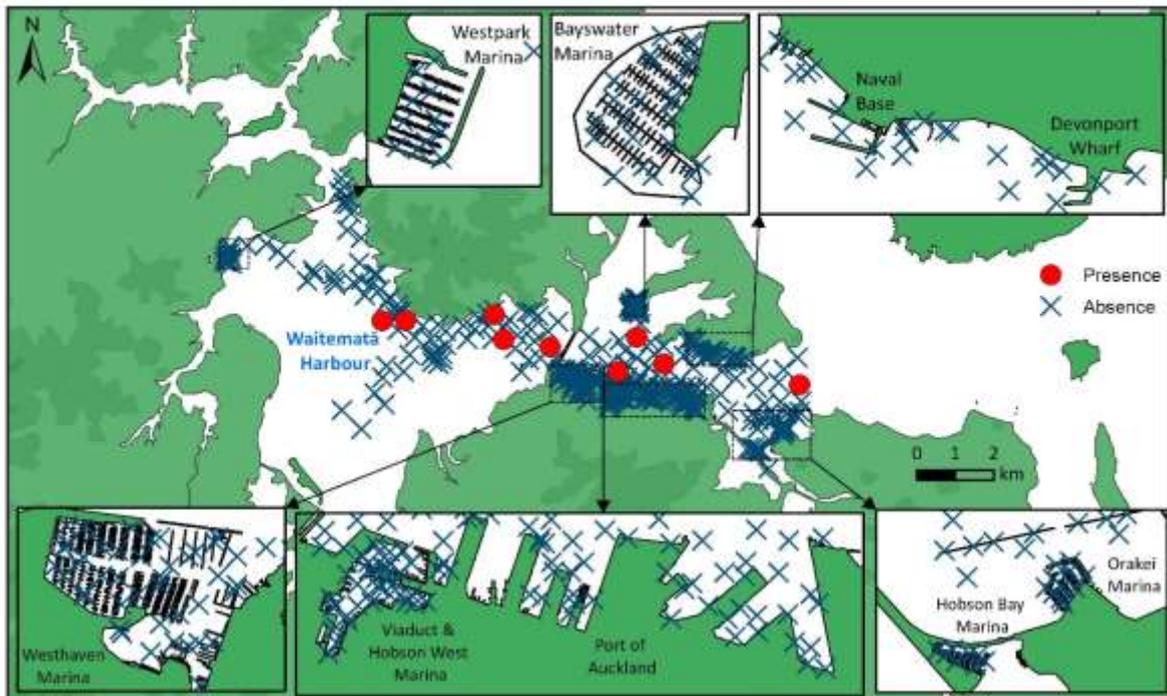
Pyromia tuberculata



Waitematā Harbour

Summer 2018-19

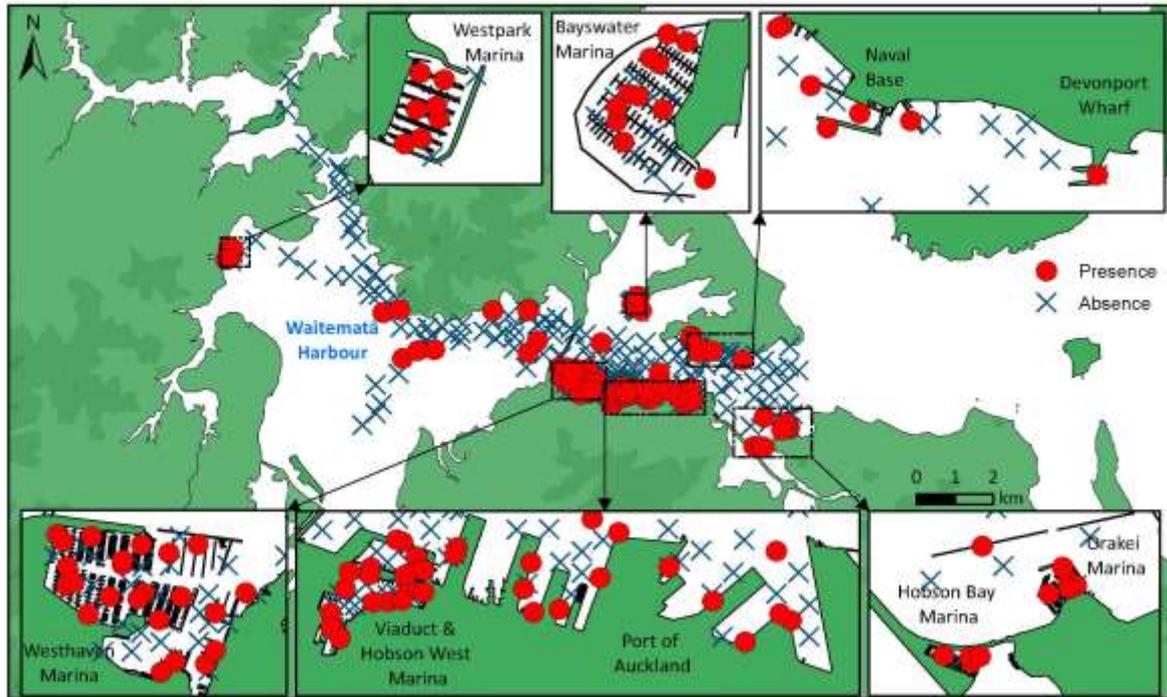
Pyromia tuberculata



Waitematā Harbour

Winter 2018

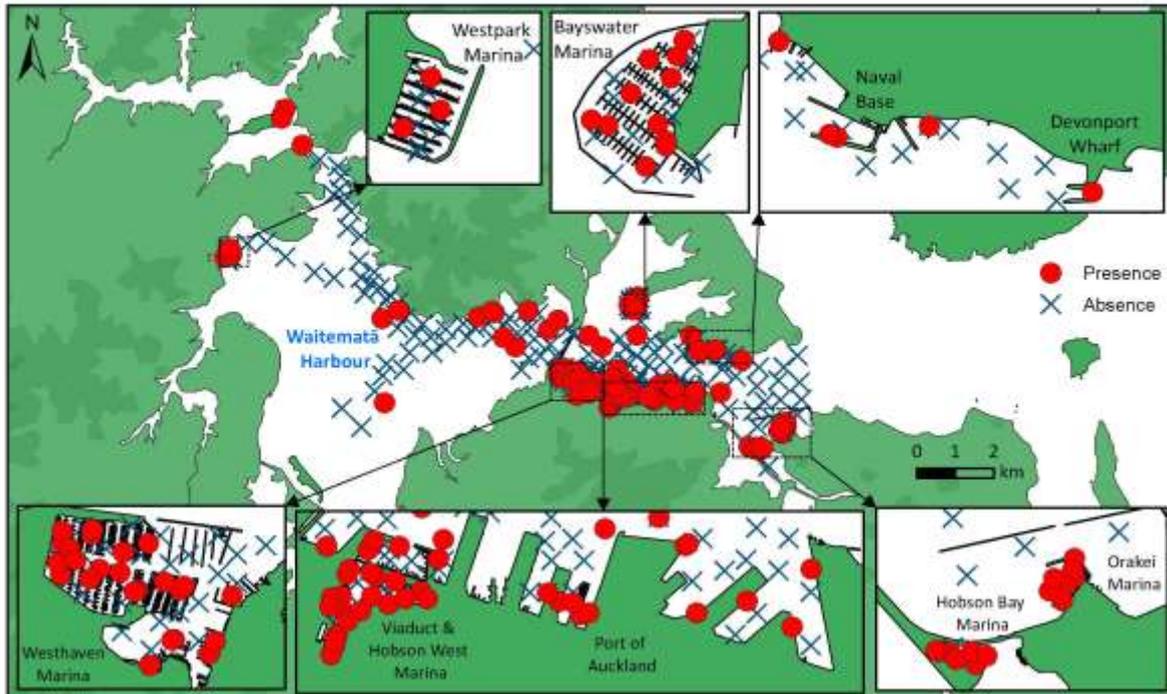
Sabella spallanzanii



Waitematā Harbour

Summer 2018-19

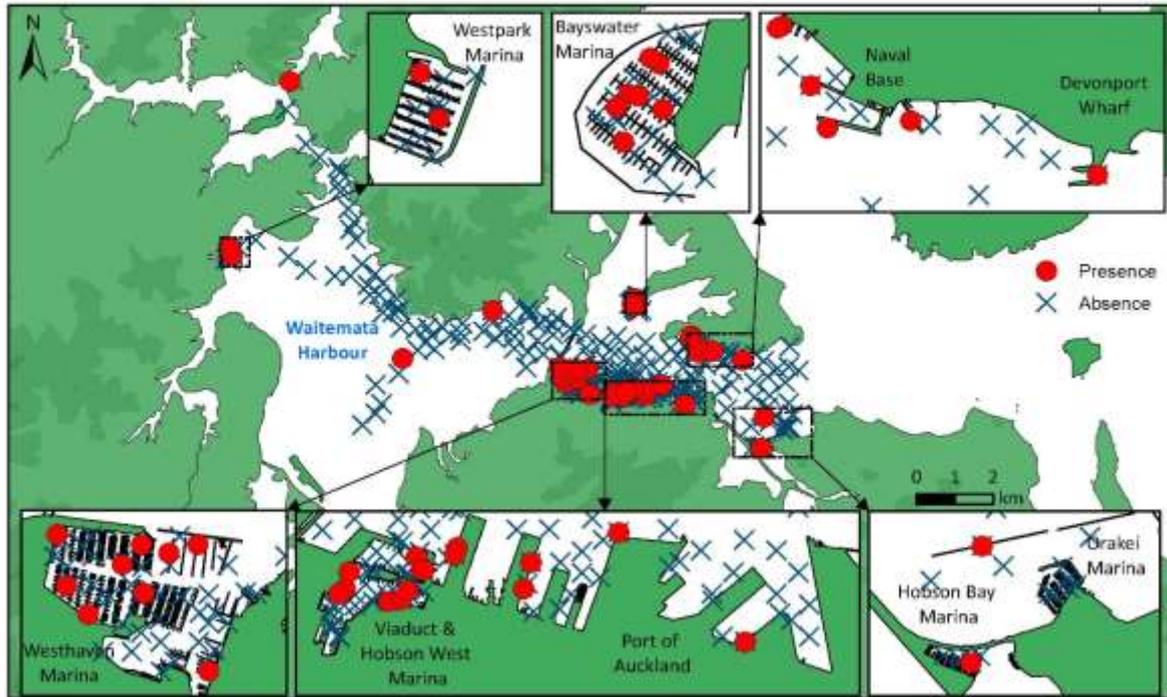
Sabella spallanzanii



Waitematā Harbour

Winter 2018

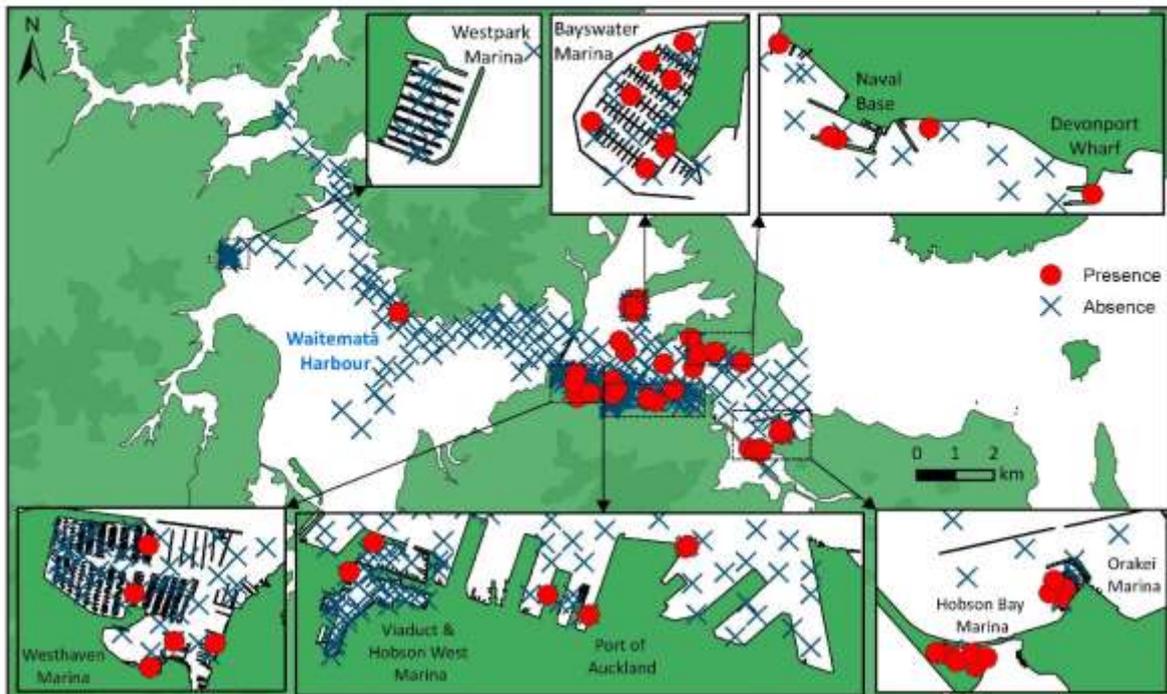
Styela clava



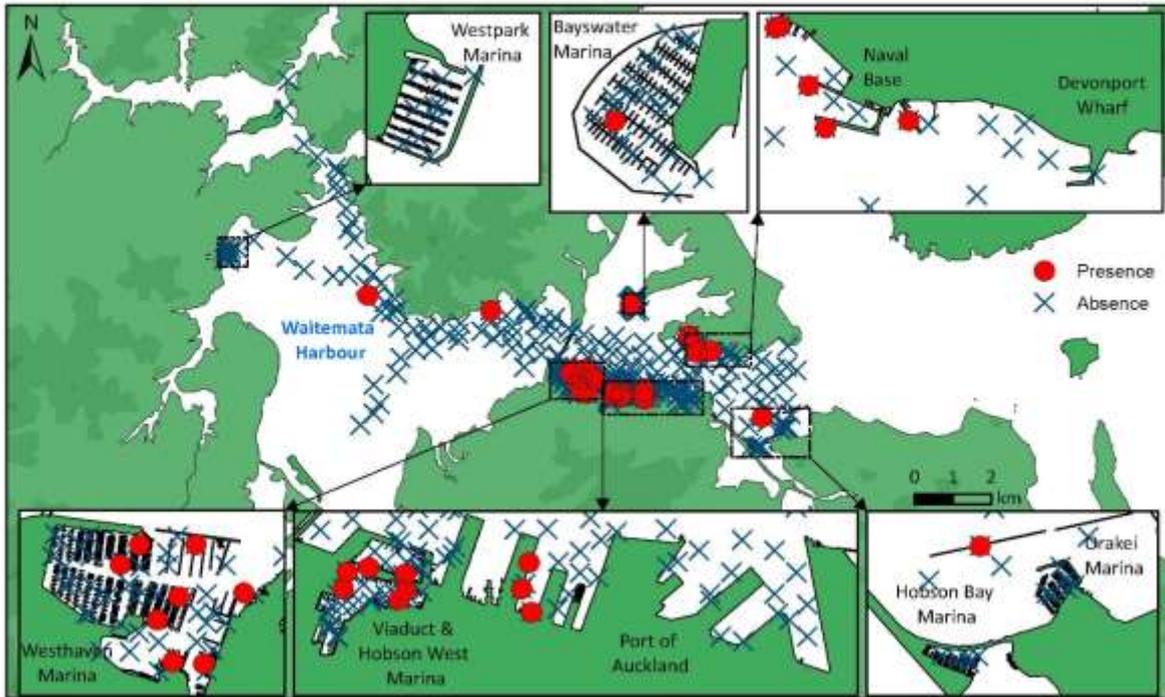
Waitematā Harbour

Summer 2018-19

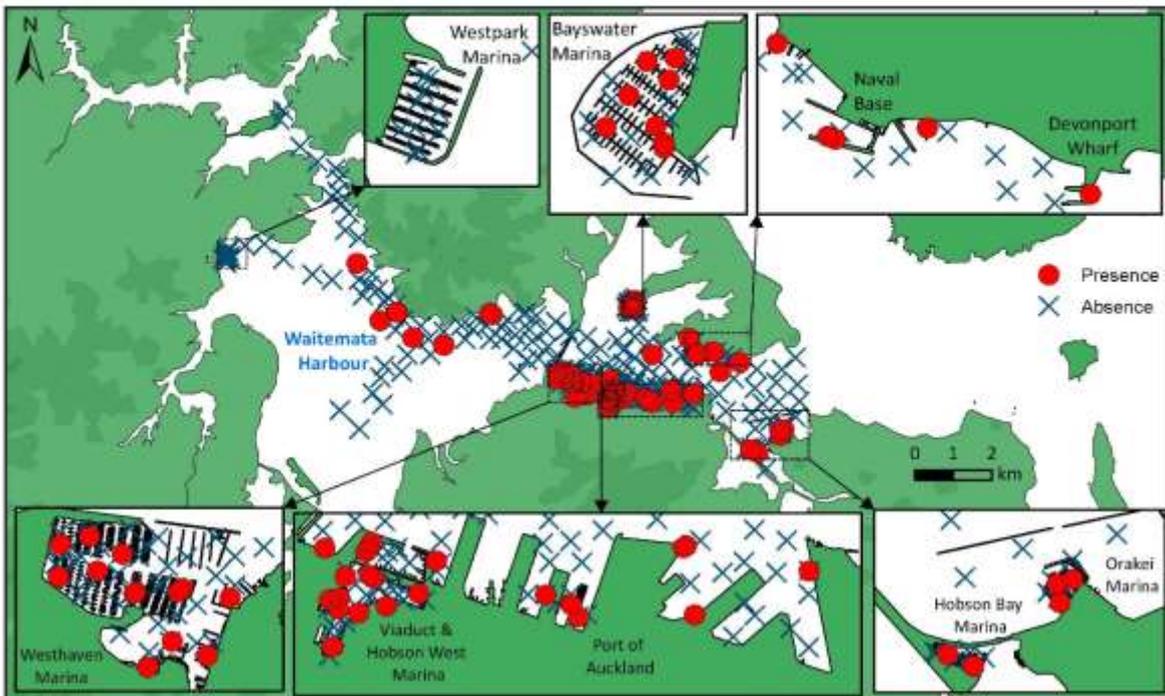
Styela clava



Waitematā Harbour
 Winter 2018
Symplesma brakenhielmi



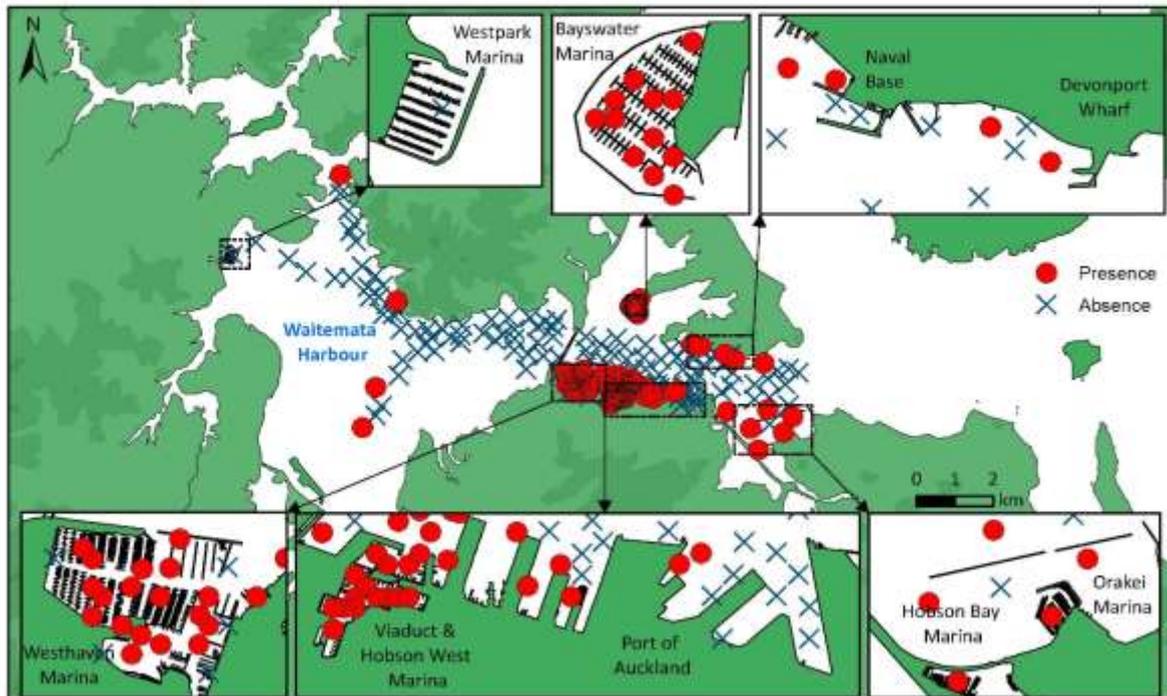
Waitematā Harbour
 Summer 2018-19
Symplesma brakenhielmi



Waitematā Harbour

Winter 2018

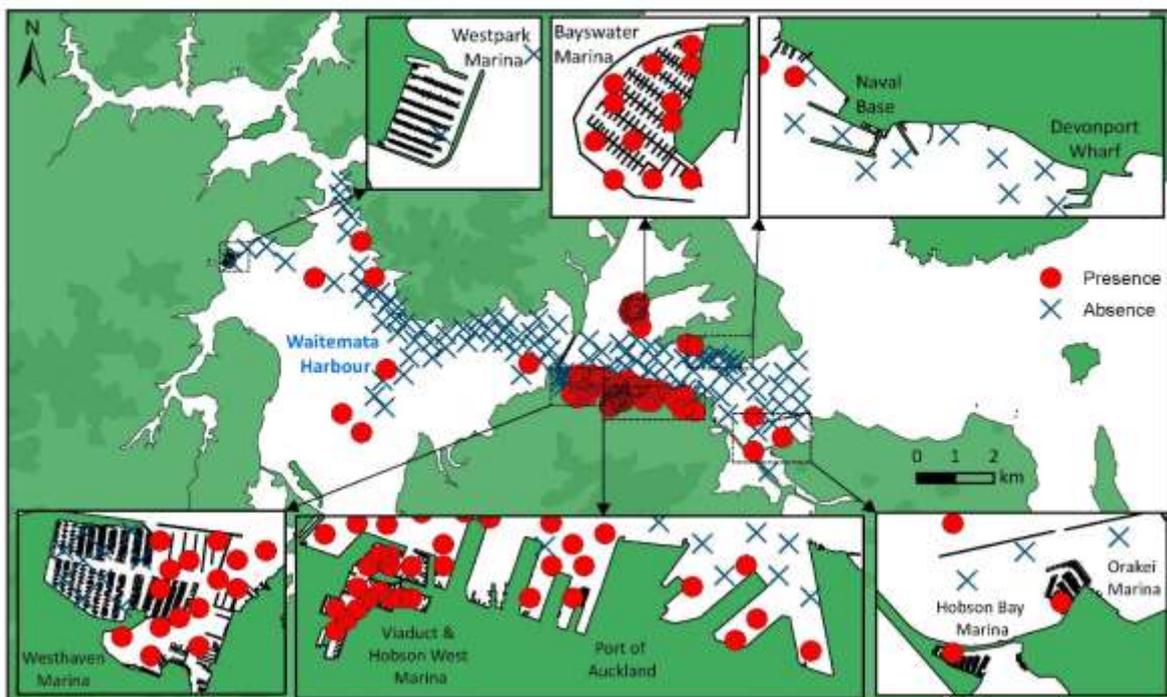
Theora lubrica



Waitematā Harbour

Summer 2018-19

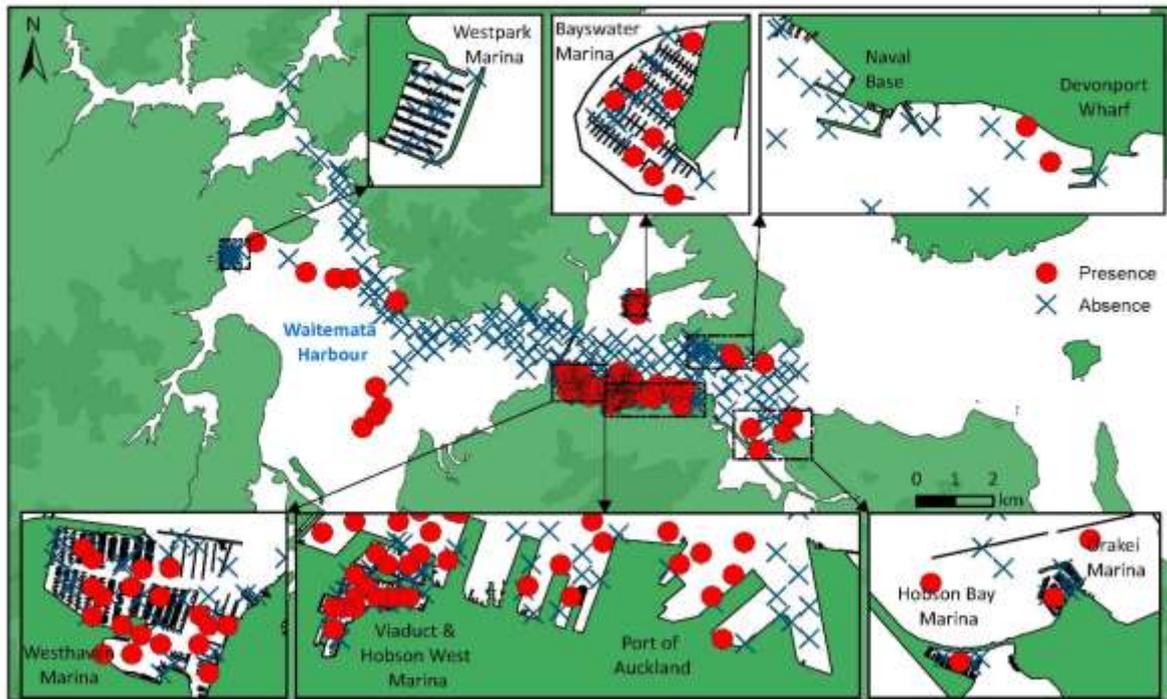
Theora lubrica



Waitematā Harbour

Winter 2018

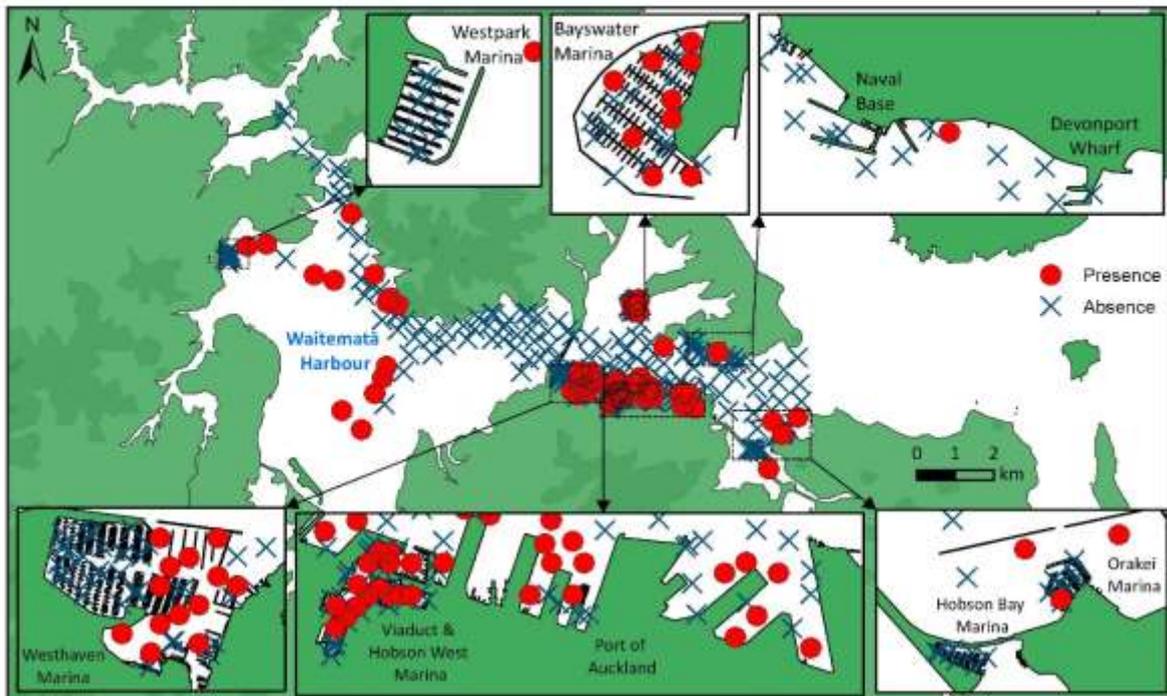
Tritia burchardi



Waitematā Harbour

Summer 2018-19

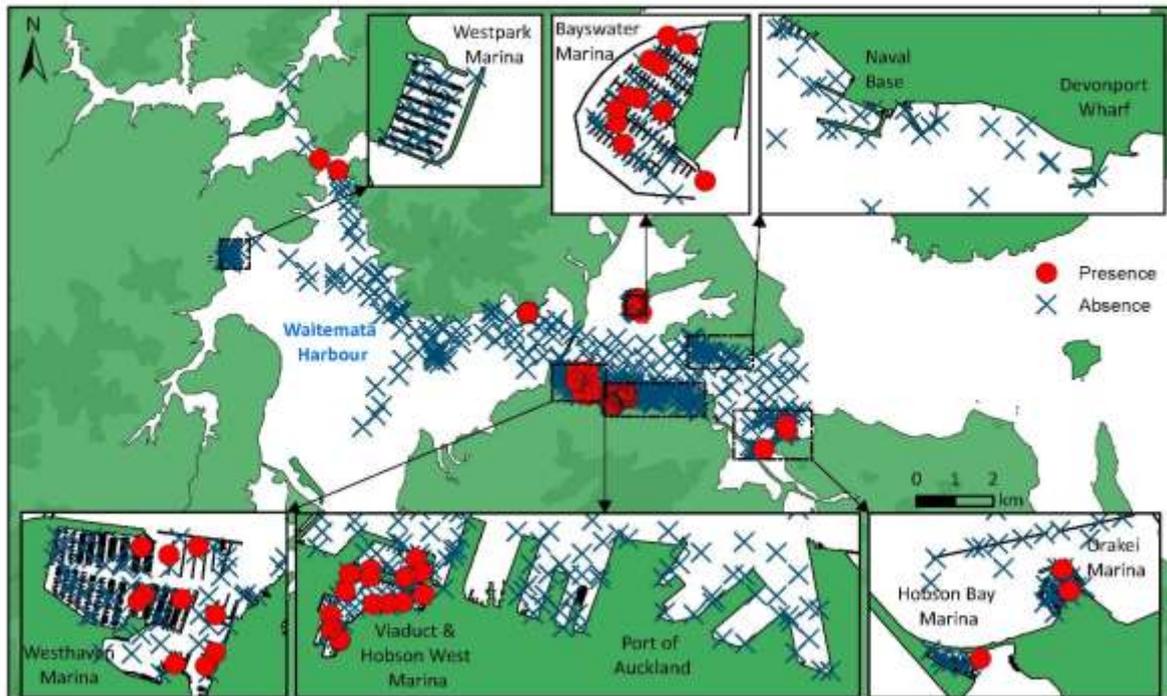
Tritia burchardi



Waitematā Harbour

Winter 2018

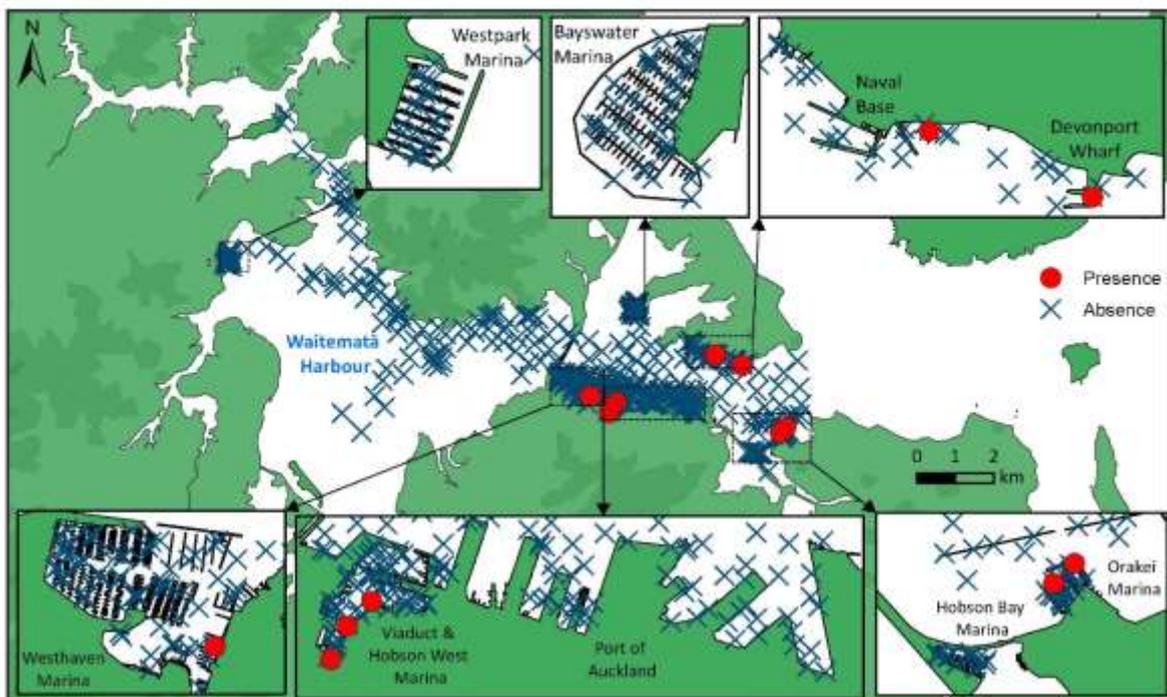
Undaria pinnatifida



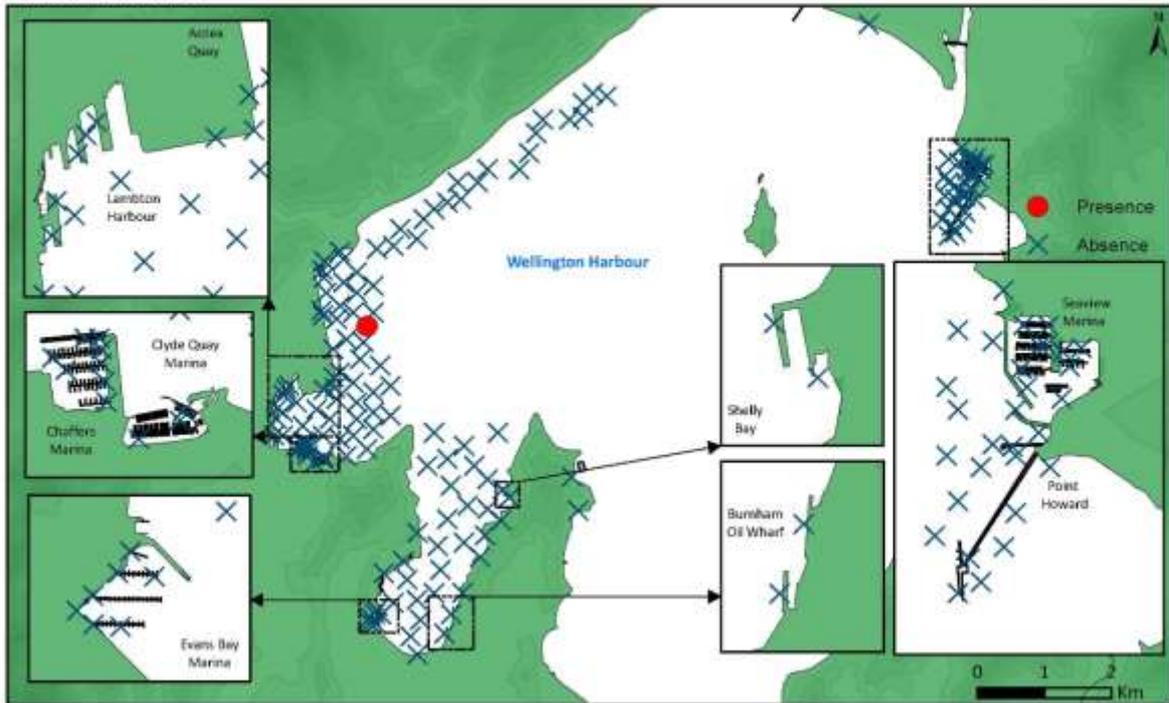
Waitematā Harbour

Summer 2018-19

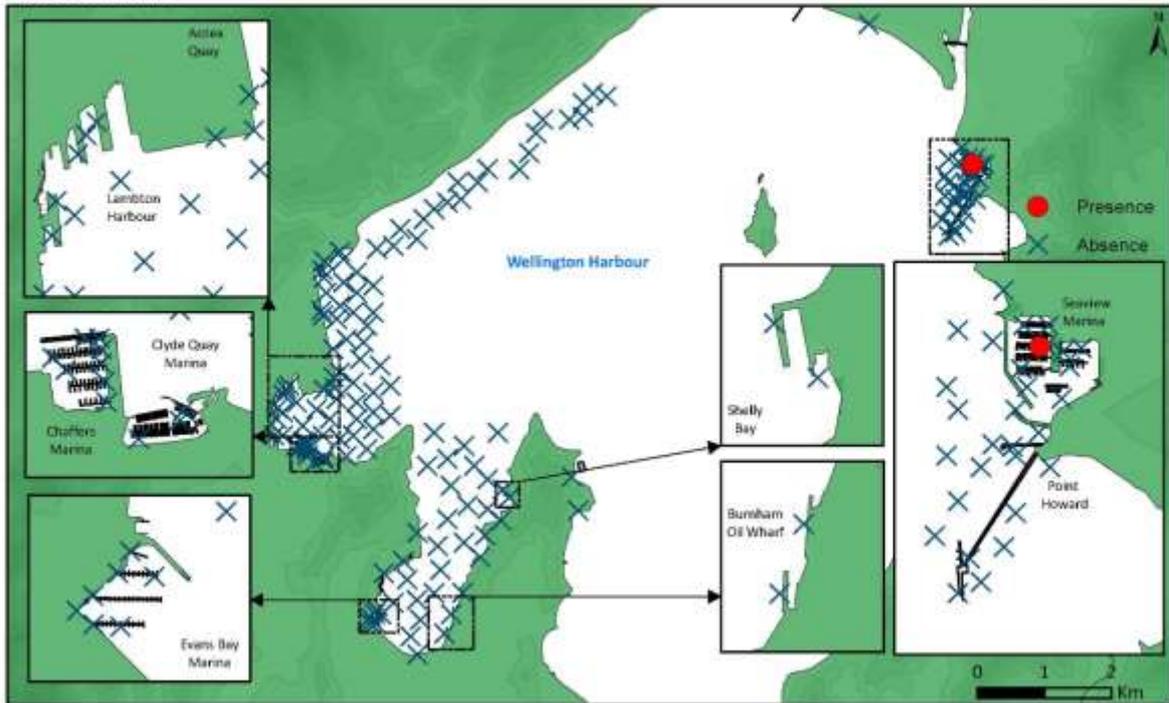
Undaria pinnatifida



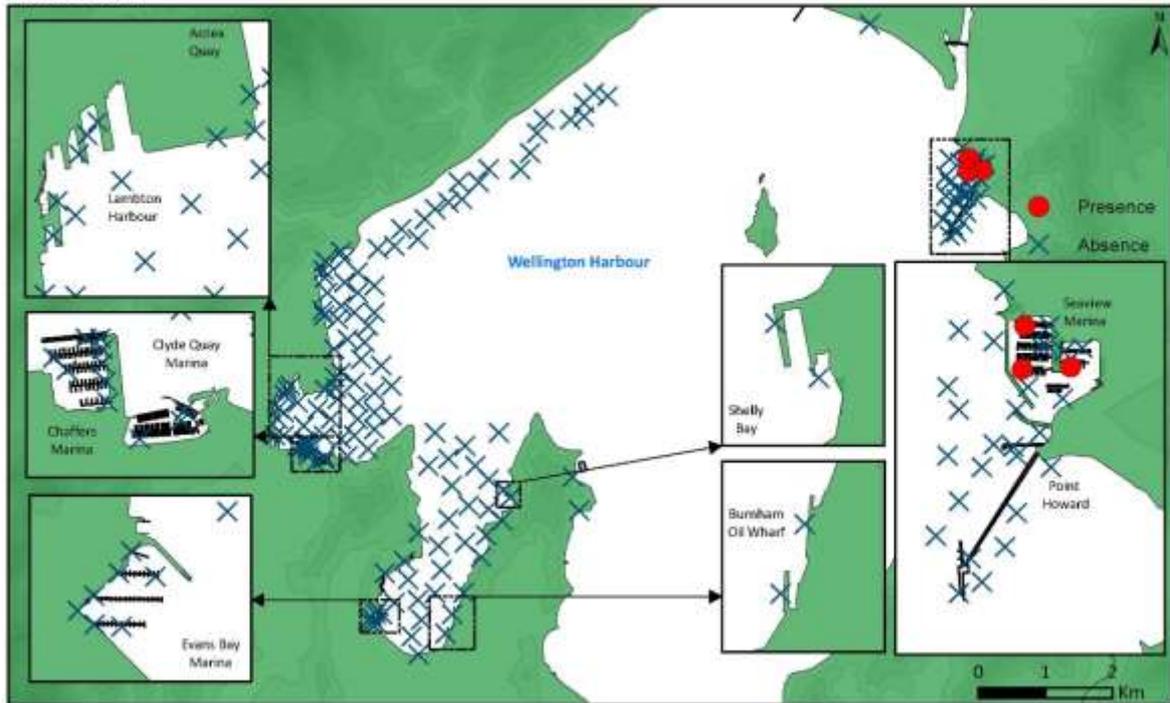
Wellington Harbour
Winter 2018
Amathia chimonides



Wellington Harbour
Winter 2018
Ciona intestinalis



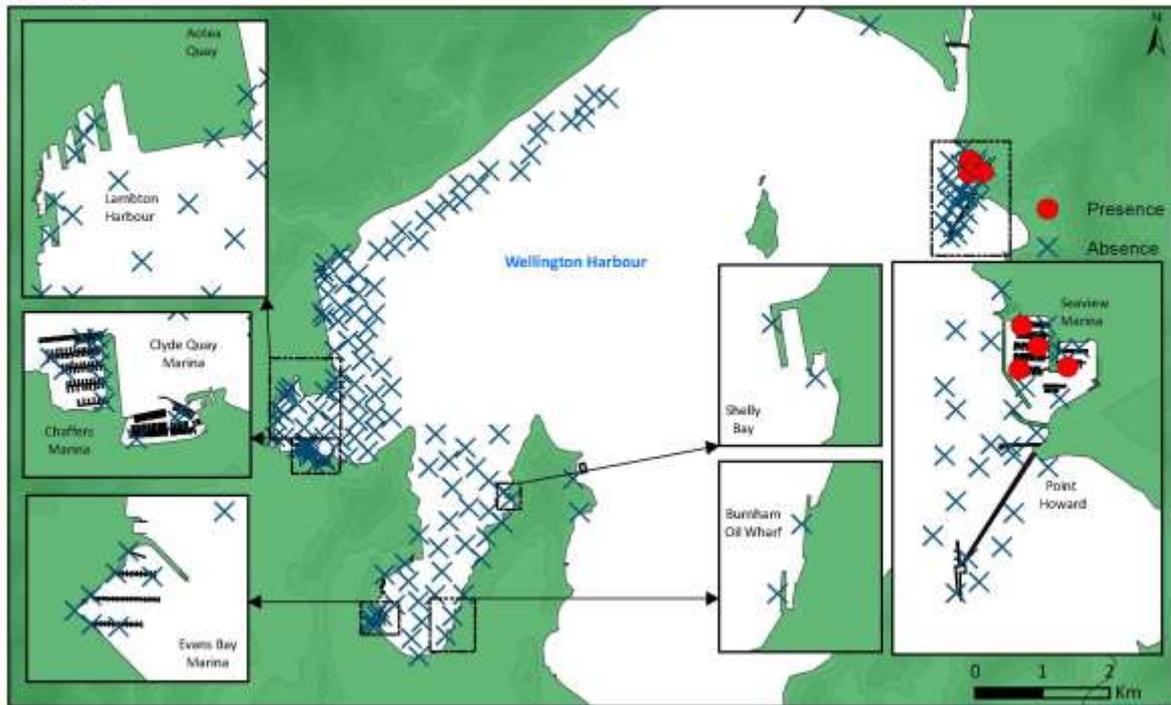
Wellington Harbour
Winter 2018
Ciona savignyi



Wellington Harbour

Winter 2018

Ciona spp.



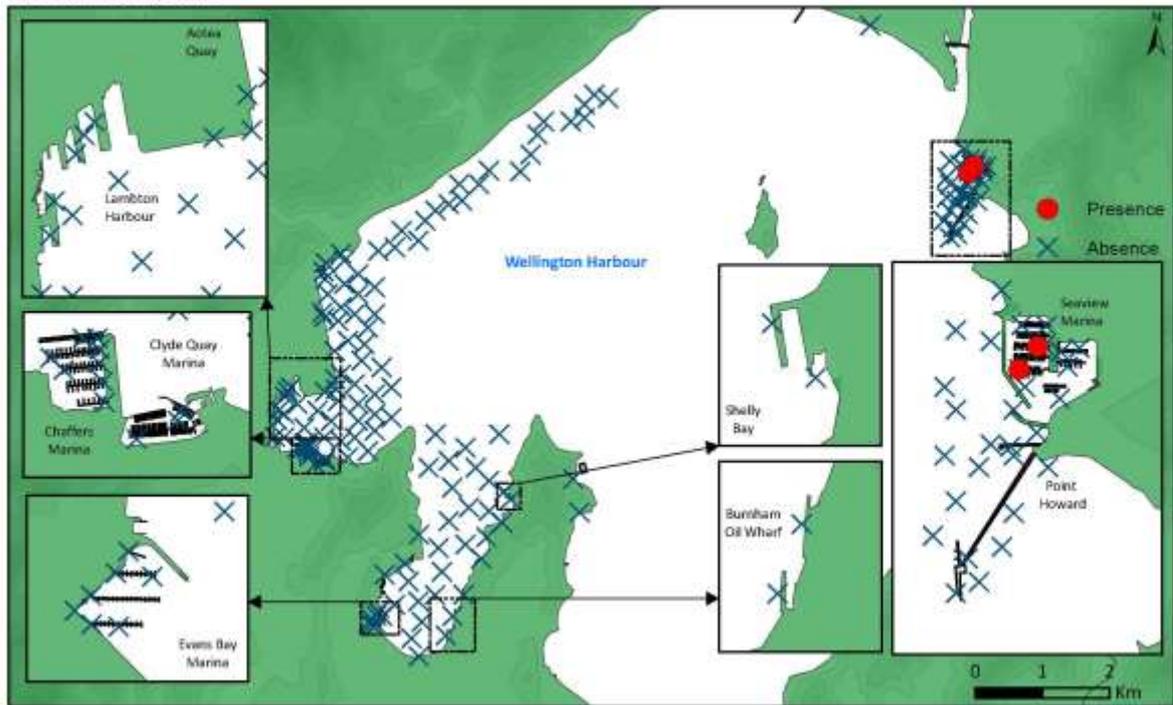
Wellington Harbour

Summer 2018-19

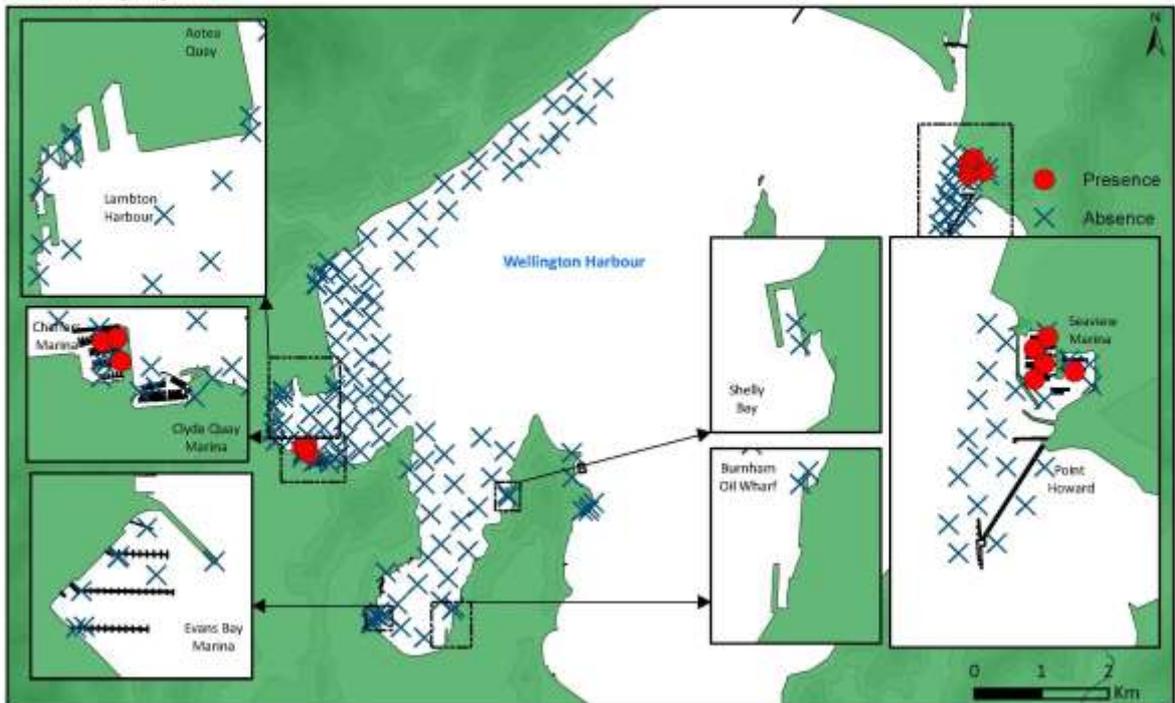
Ciona spp.



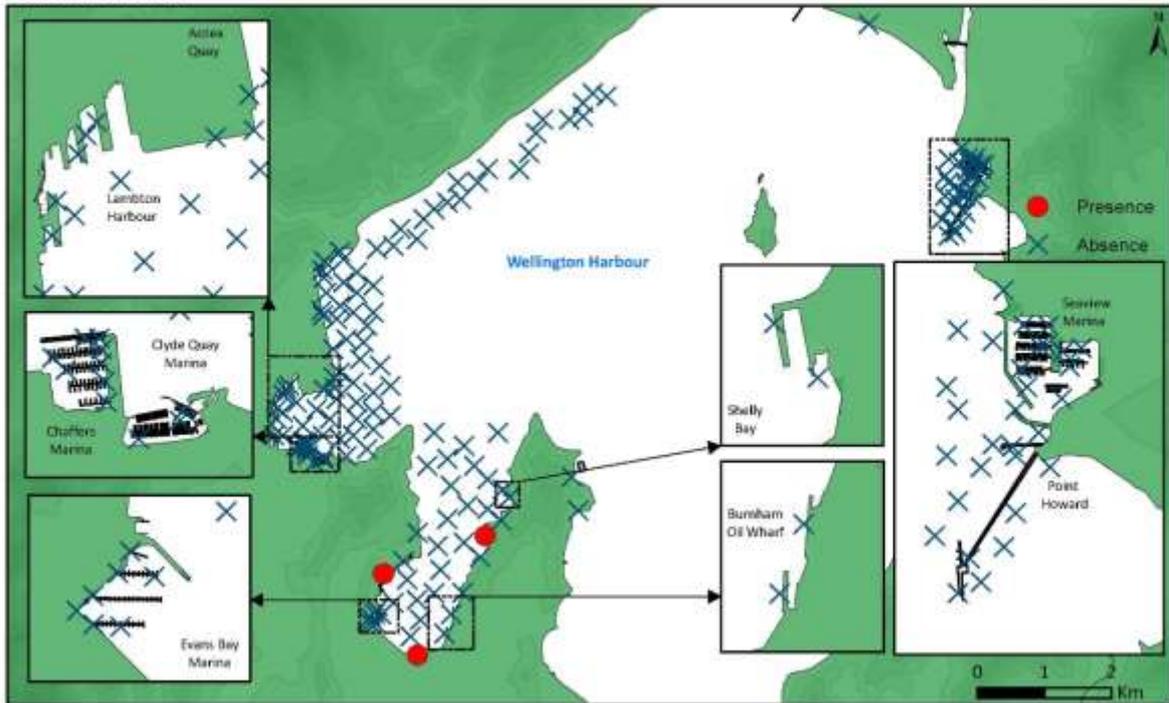
Wellington Harbour
 Winter 2018
Clavelina lepadiformis



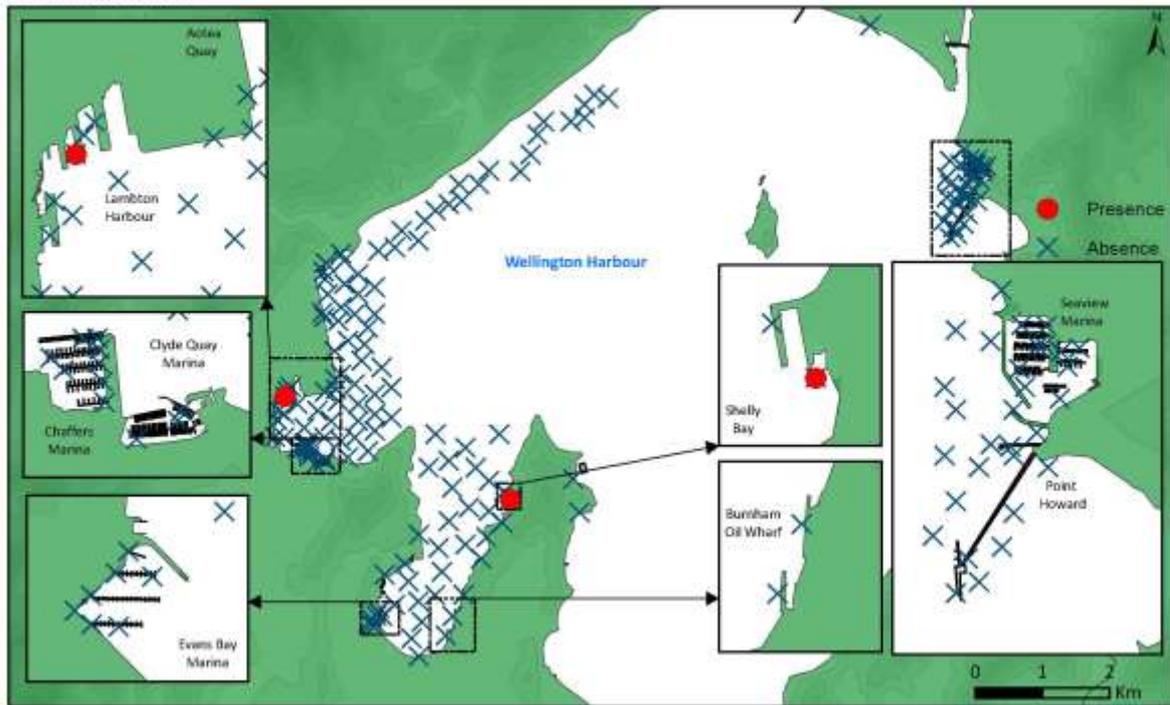
Wellington Harbour
 Summer 2018-19
Clavelina lepadiformis



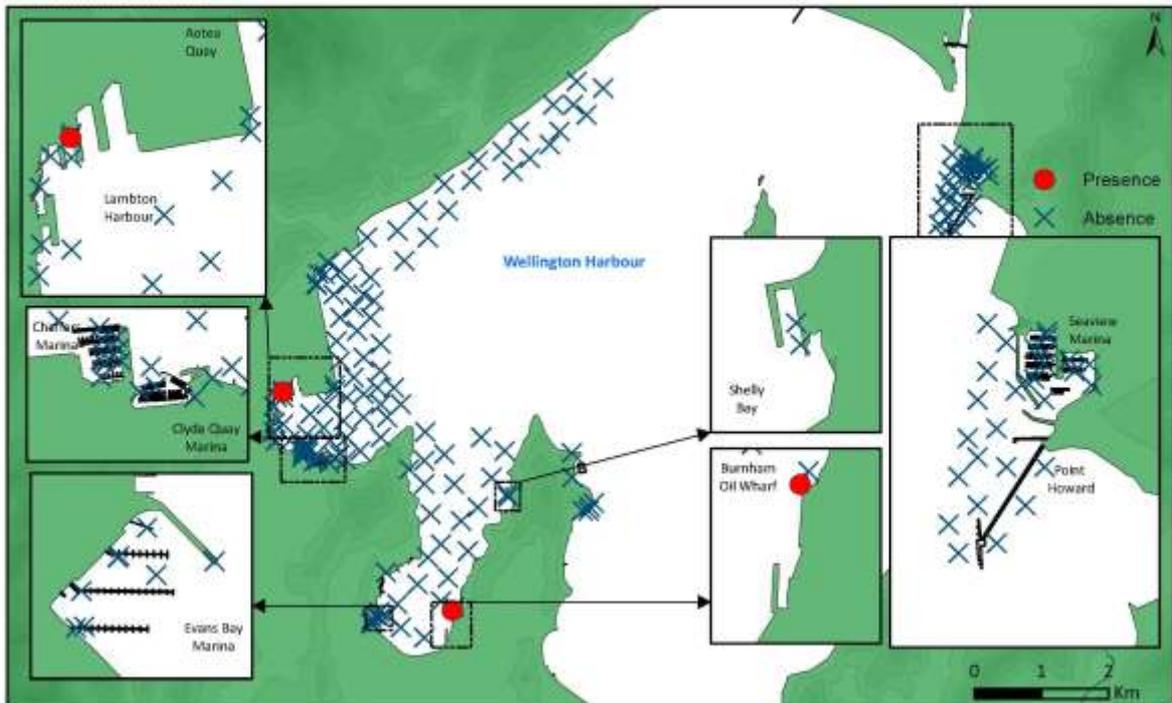
Wellington Harbour
Winter 2018
Colpomenia bullosa



Wellington Harbour
 Winter 2018
Didemnum vexillum



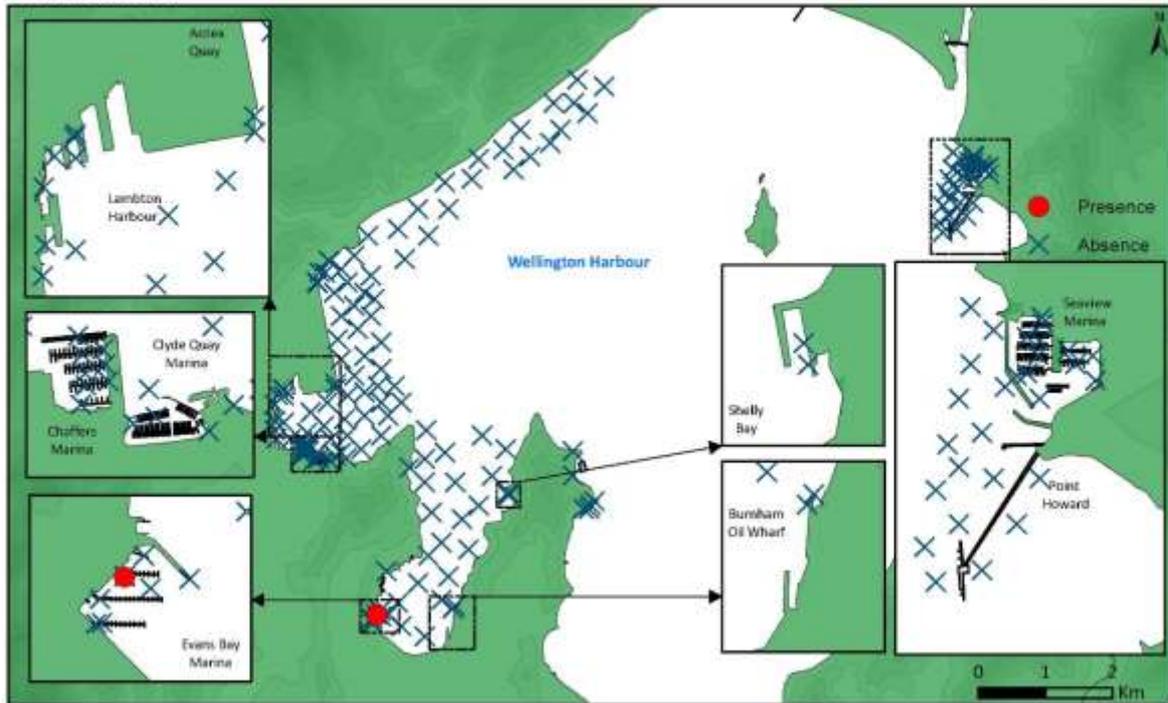
Wellington Harbour
 Summer 2018-19
Didemnum vexillum



Wellington Harbour

Summer 2018-19

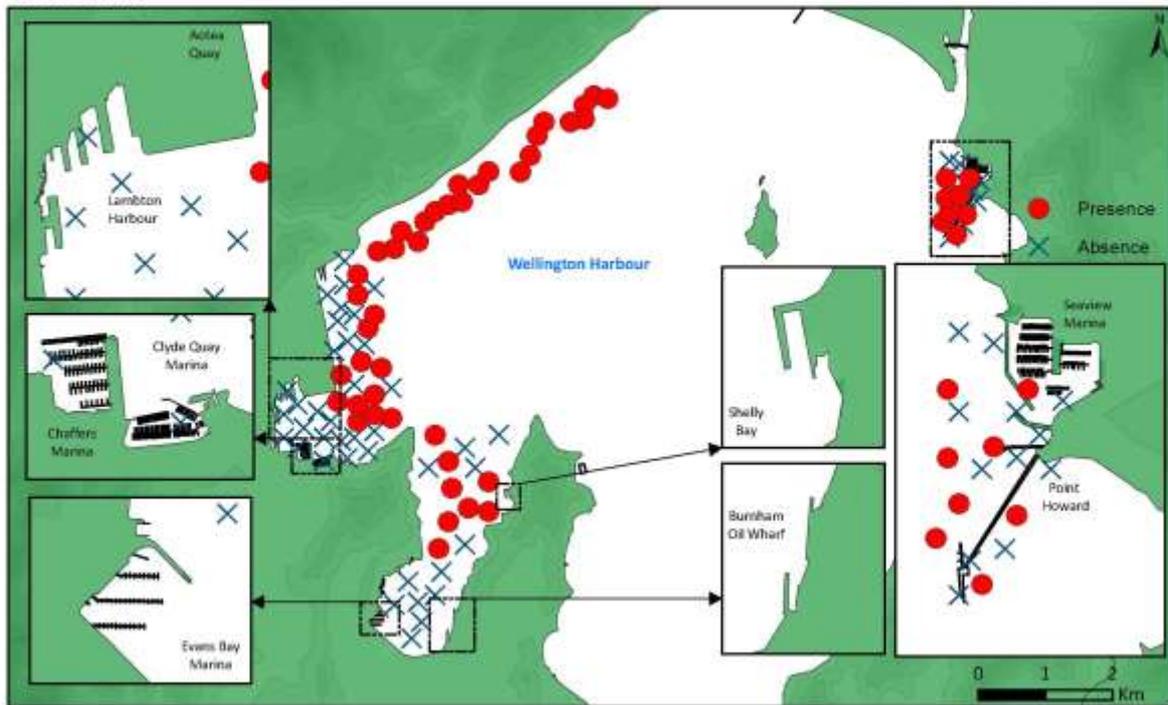
Striaria attenuata



Wellington Harbour

Winter 2018

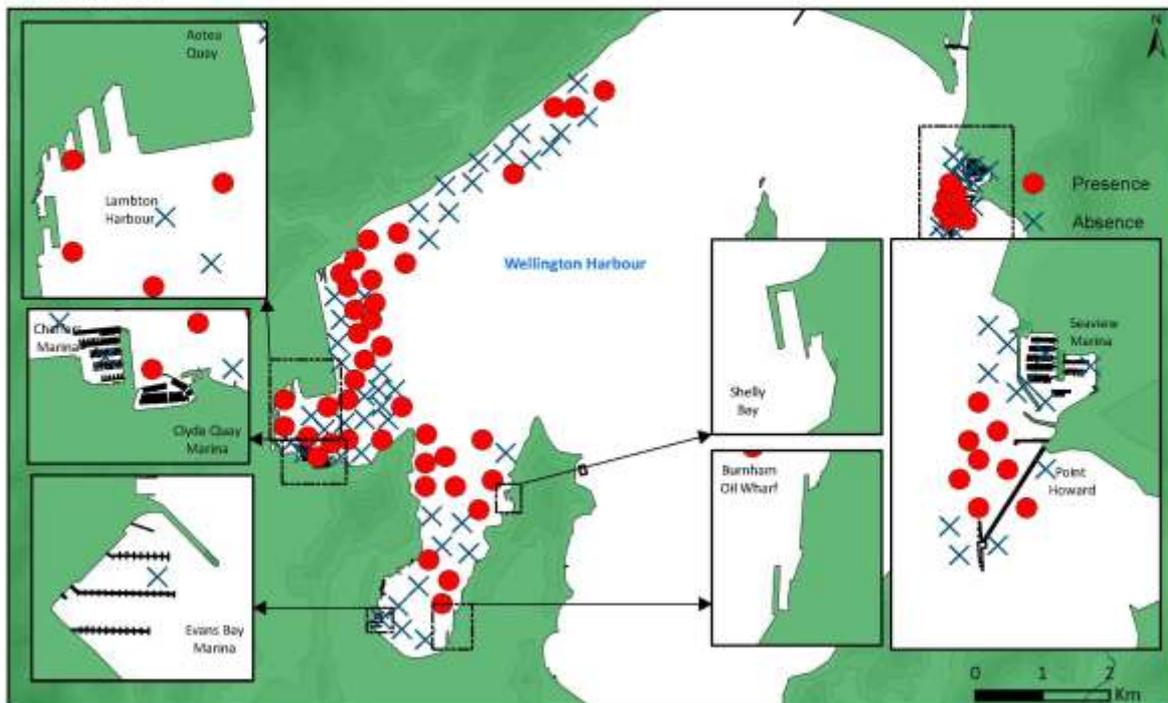
Theora lubrica



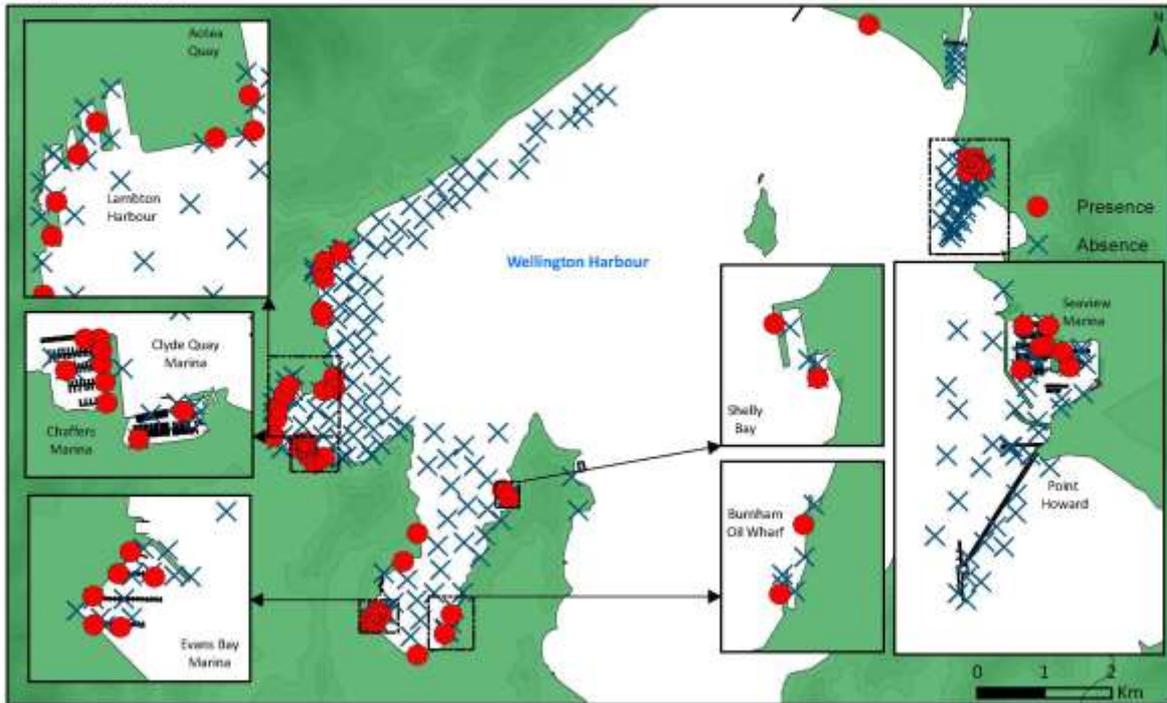
Wellington Harbour

Summer 2018-19

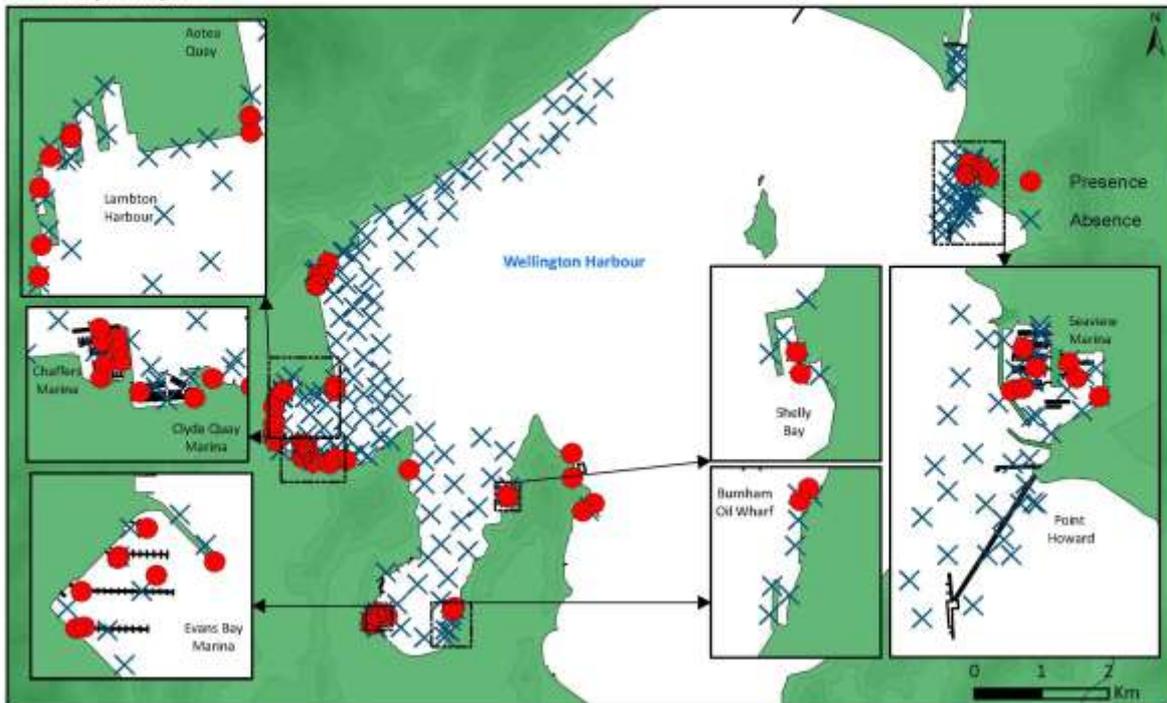
Theora lubrica



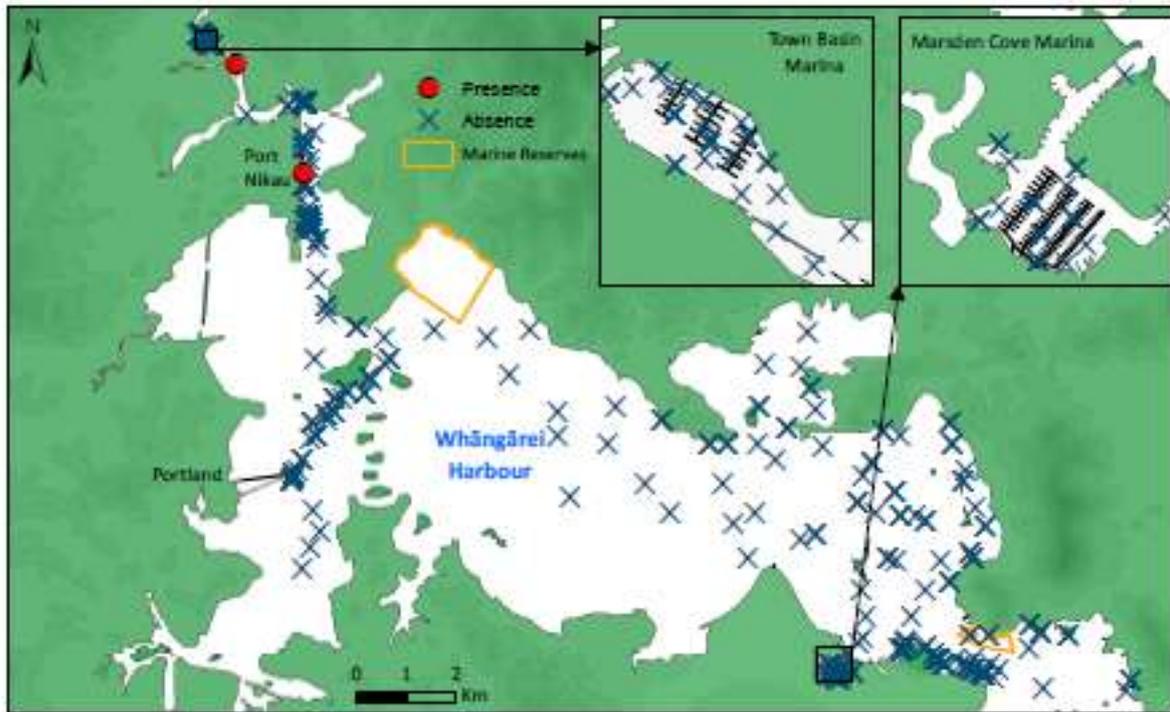
Wellington Harbour
 Winter 2018
Undaria pinnatifida



Wellington Harbour
 Summer 2018-19
Undaria pinnatifida



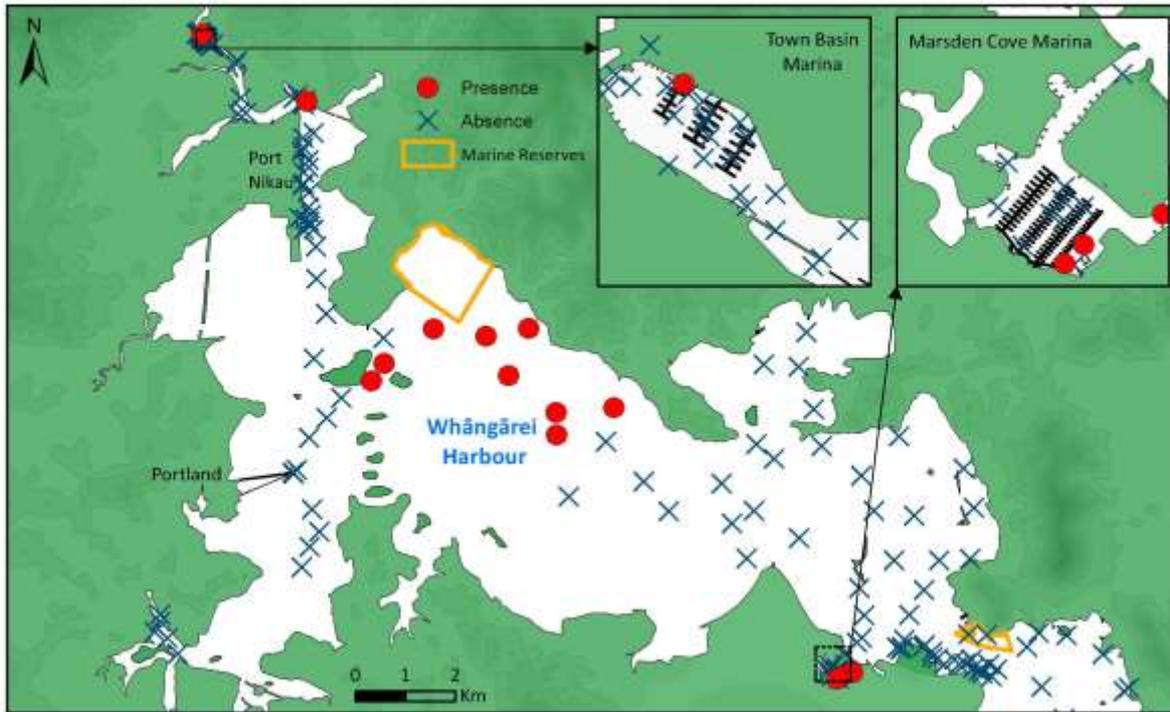
Whāngārei Harbour
Winter 2018
Acentrogobius pflaumi



Whāngārei Harbour

Winter 2018

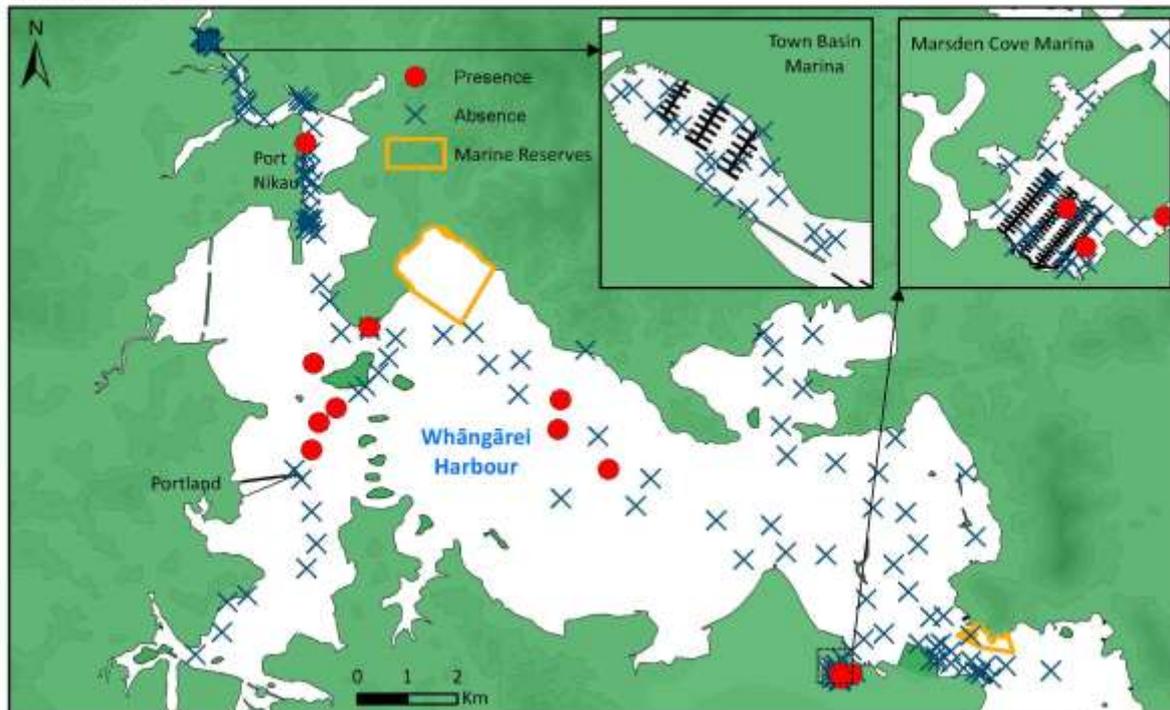
Arcuatula senhousia



Whāngārei Harbour

Summer 2018-19

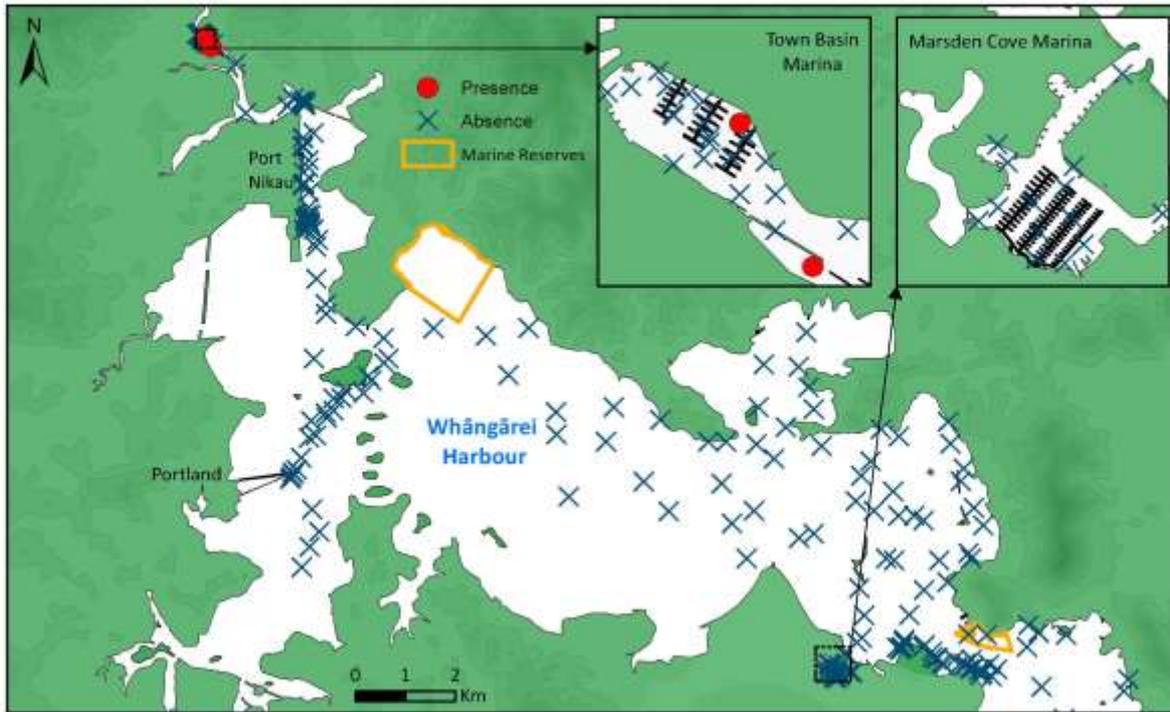
Arcuatula senhousia



Whāngārei Harbour

Winter 2018

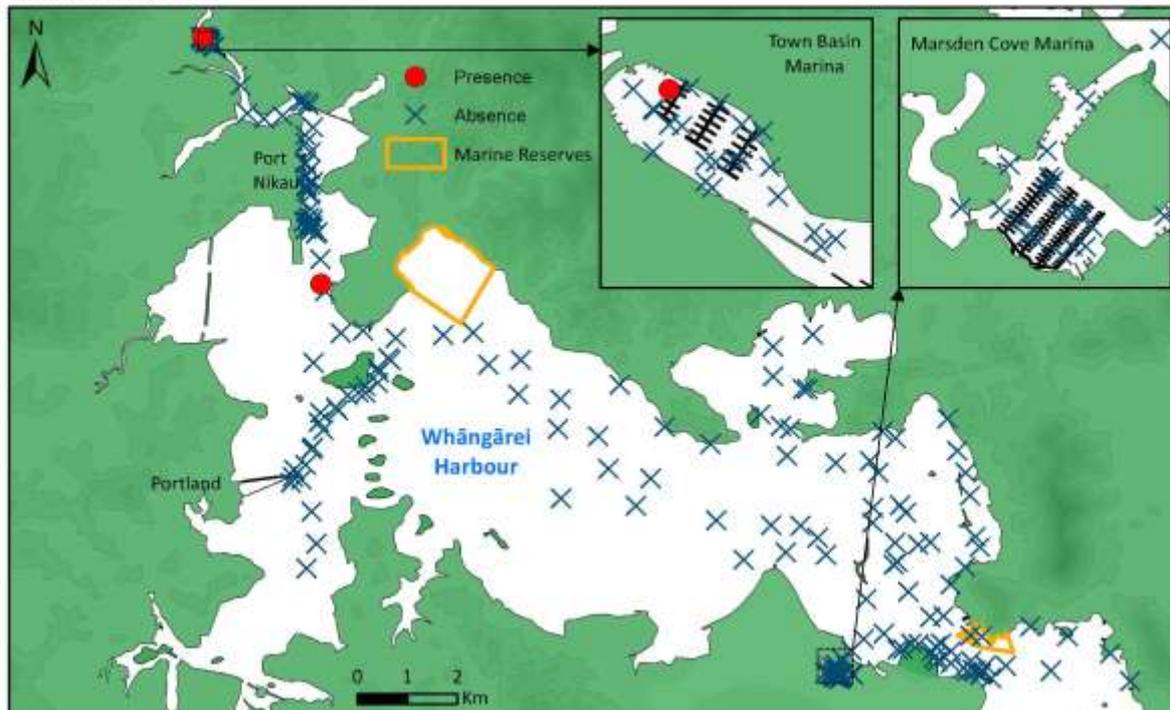
Arenigobius bifrenatus



Whāngārei Harbour

Summer 2018-19

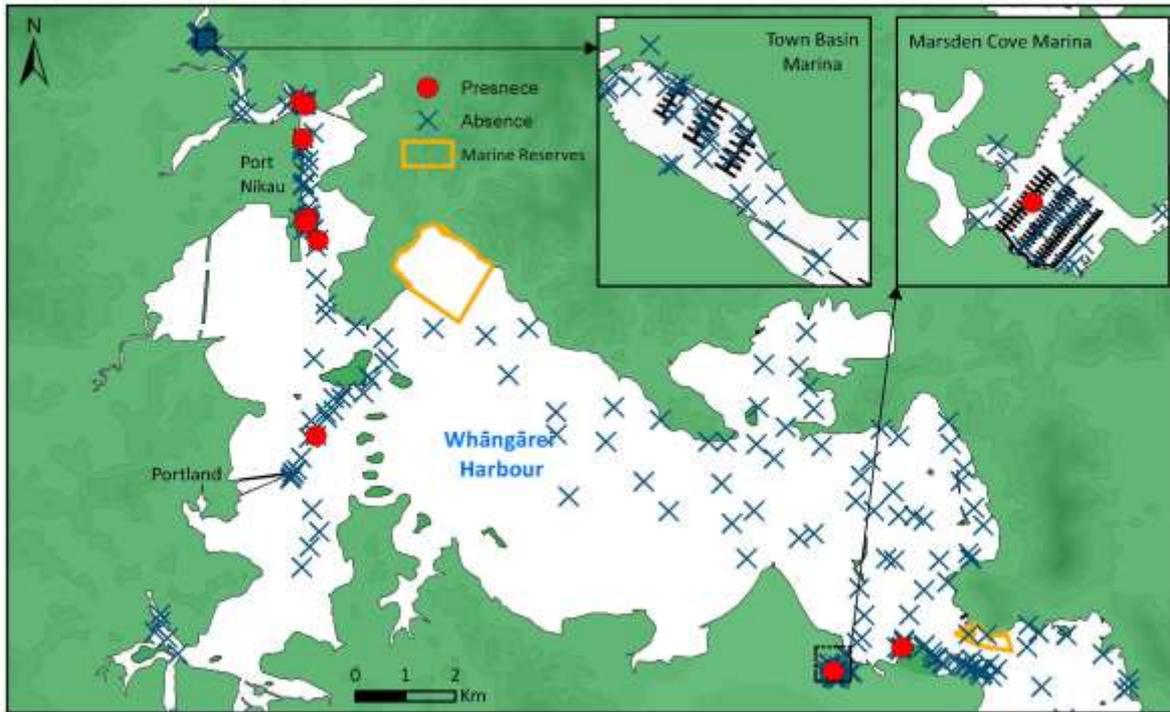
Arenigobius bifrenatus



Whāngārei Harbour

Winter 2018

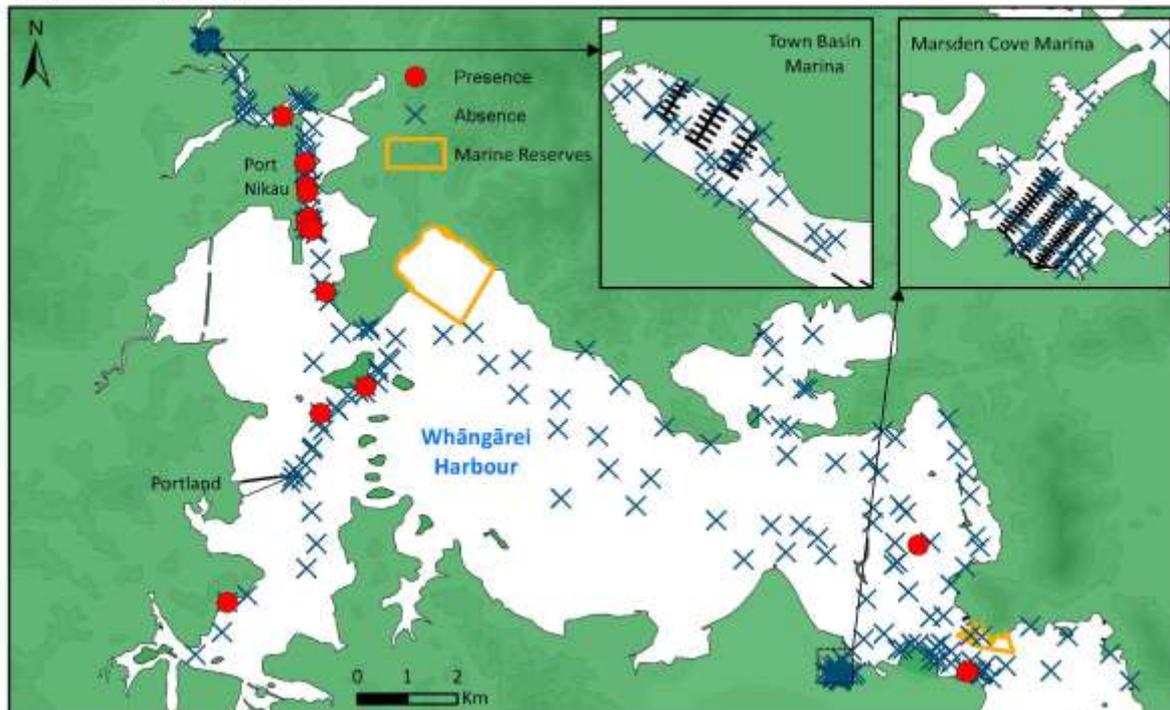
Charybdis (Charybdis) japonica



Whāngārei Harbour

Summer 2018-19

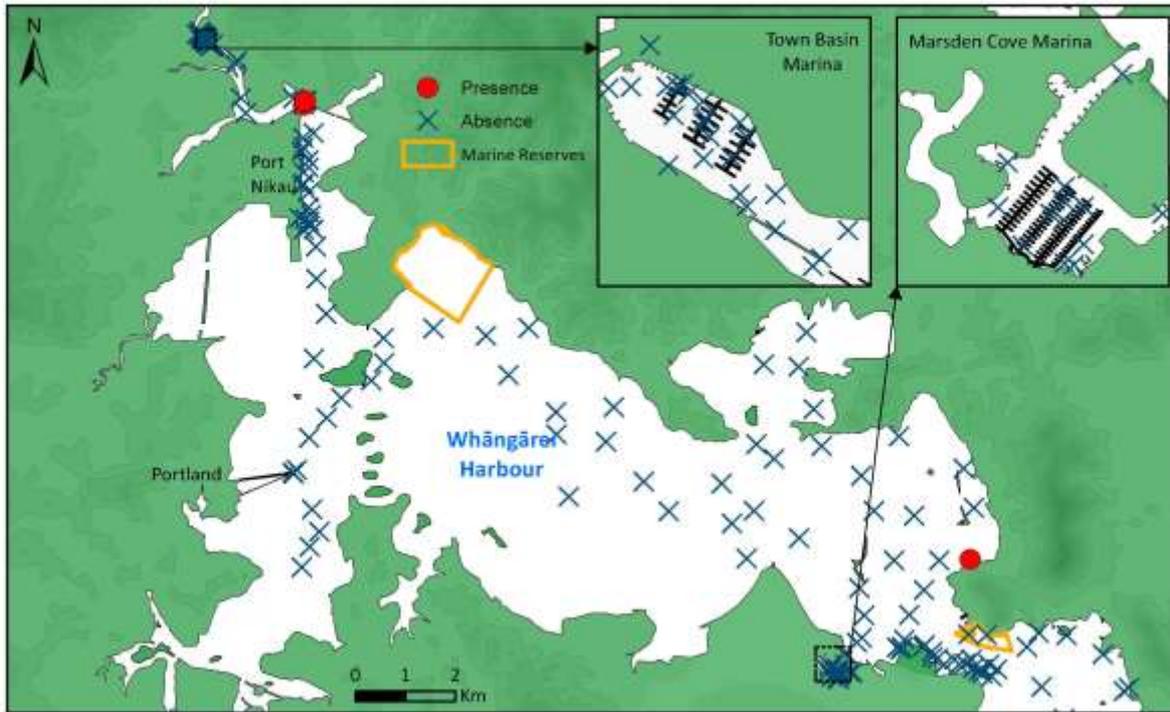
Charybdis (Charybdis) japonica



Whāngārei Harbour

Winter 2018

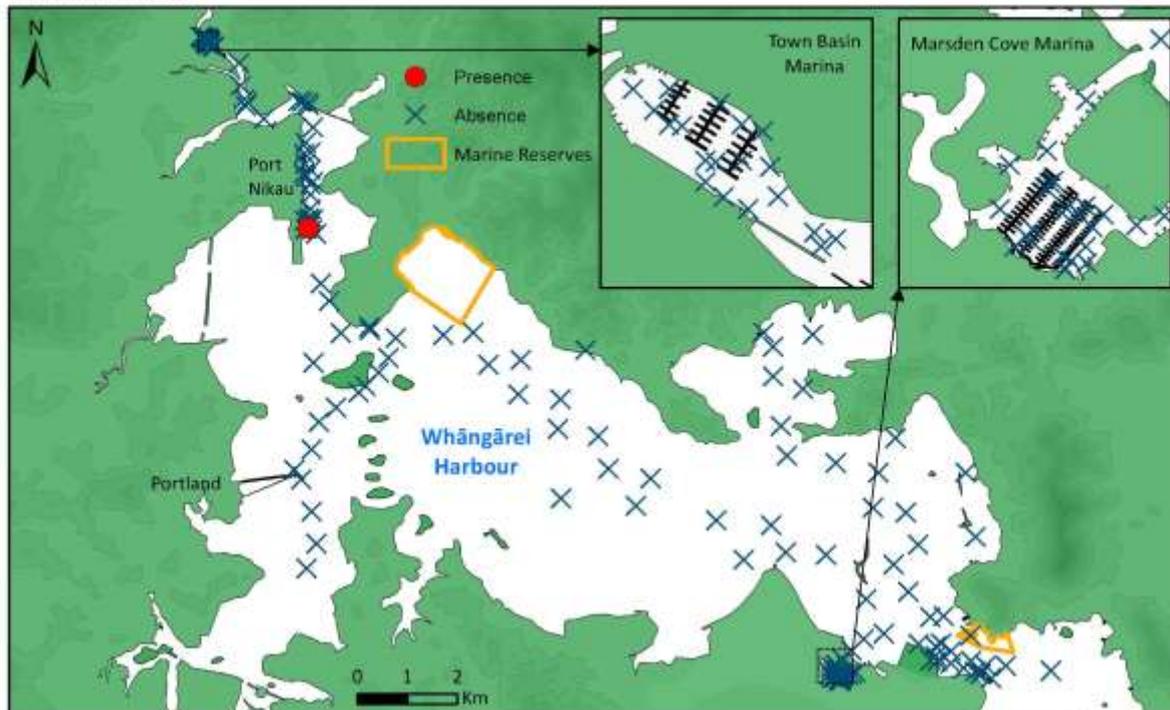
Didemnum vexillum



Whāngārei Harbour

Summer 2018-19

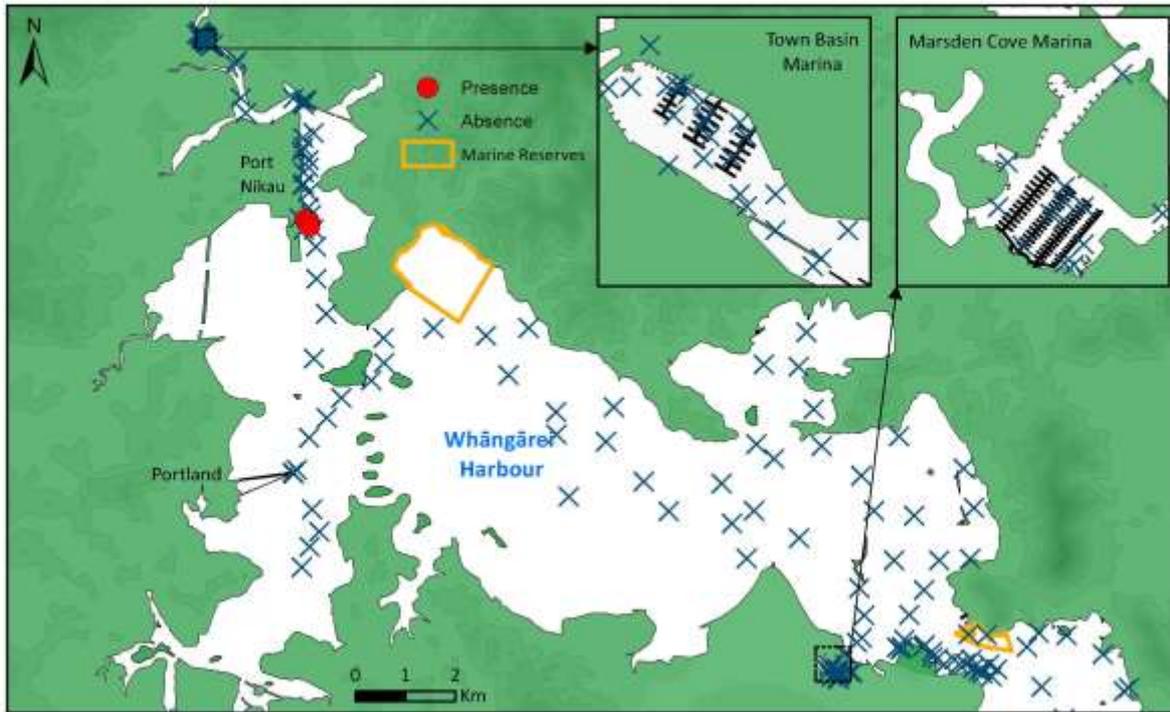
Didemnum vexillum



Whāngārei Harbour

Winter 2018

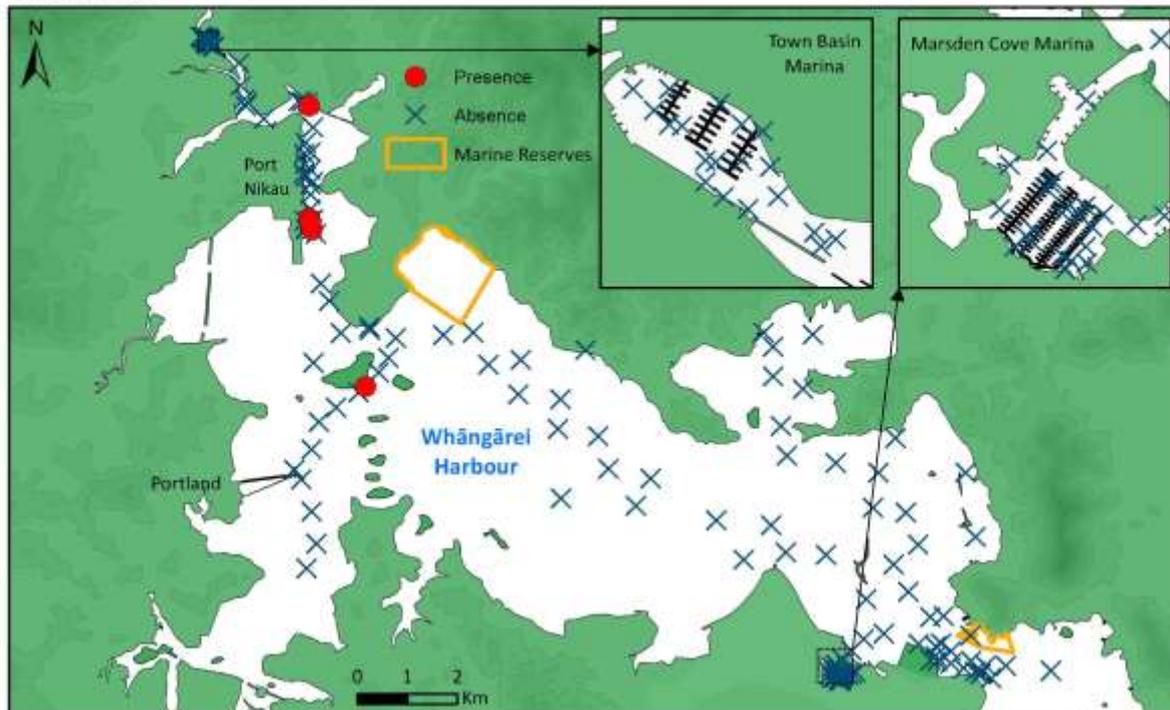
Ectopleura spp.



Whāngārei Harbour

Summer 2018-19

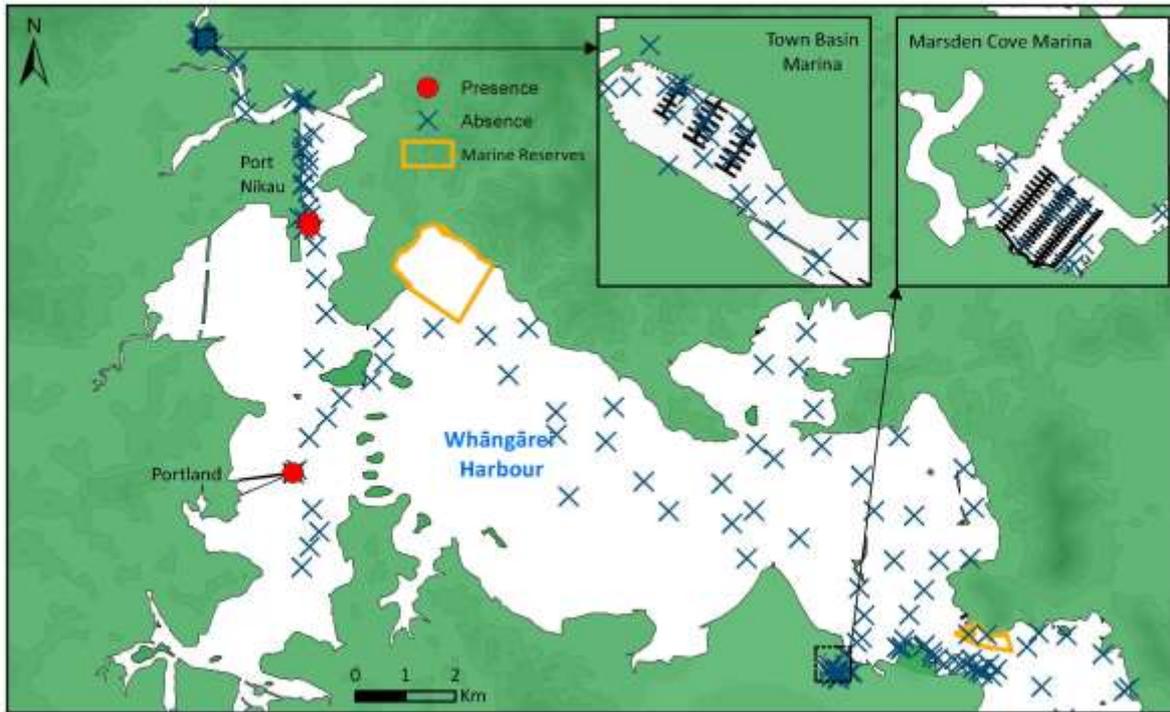
Ectopleura spp.



Whāngārei Harbour

Winter 2018

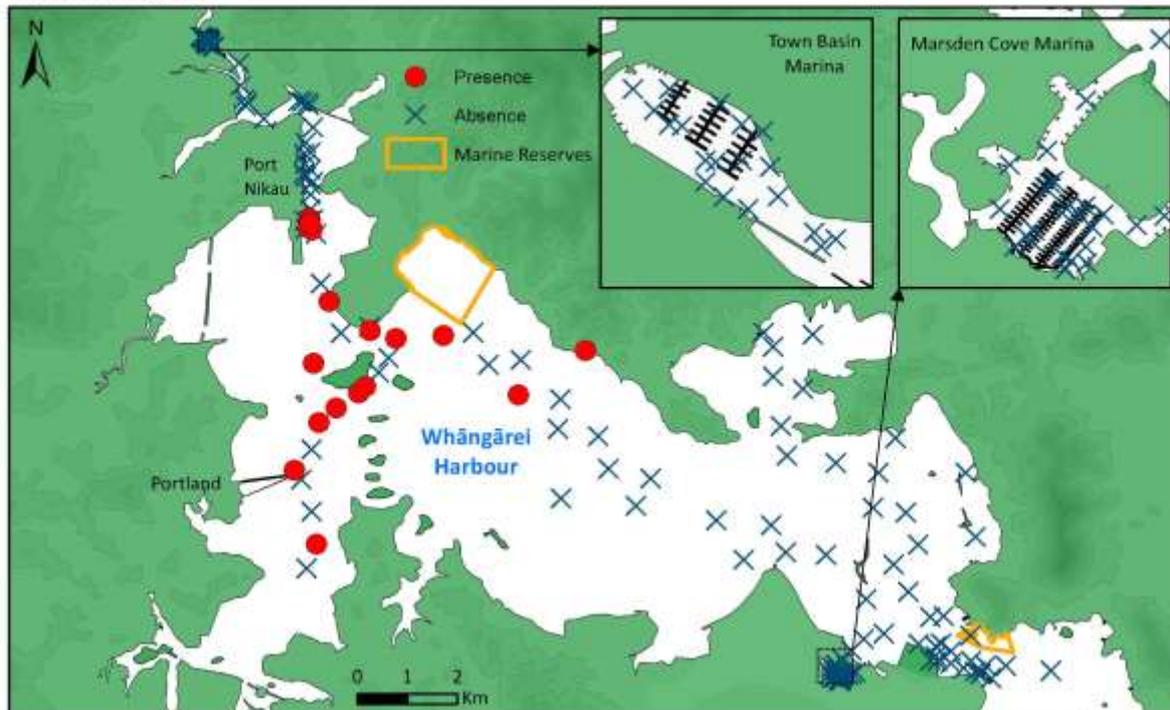
Eudistoma elongatum



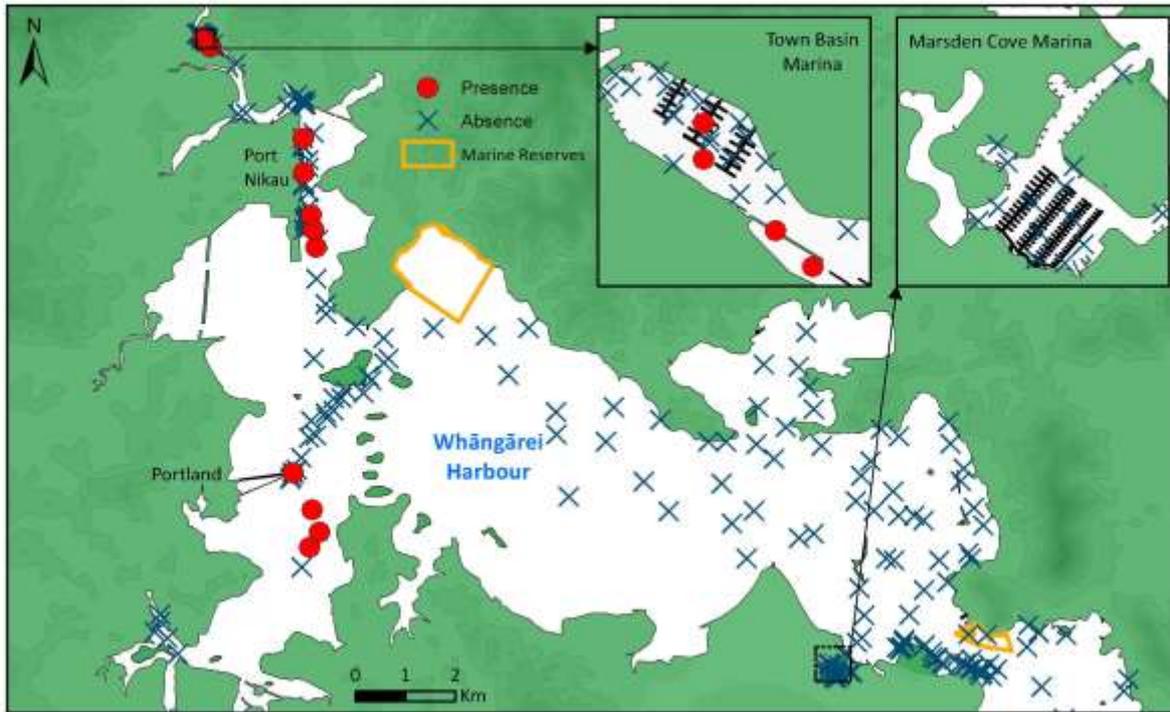
Whāngārei Harbour

Summer 2018-19

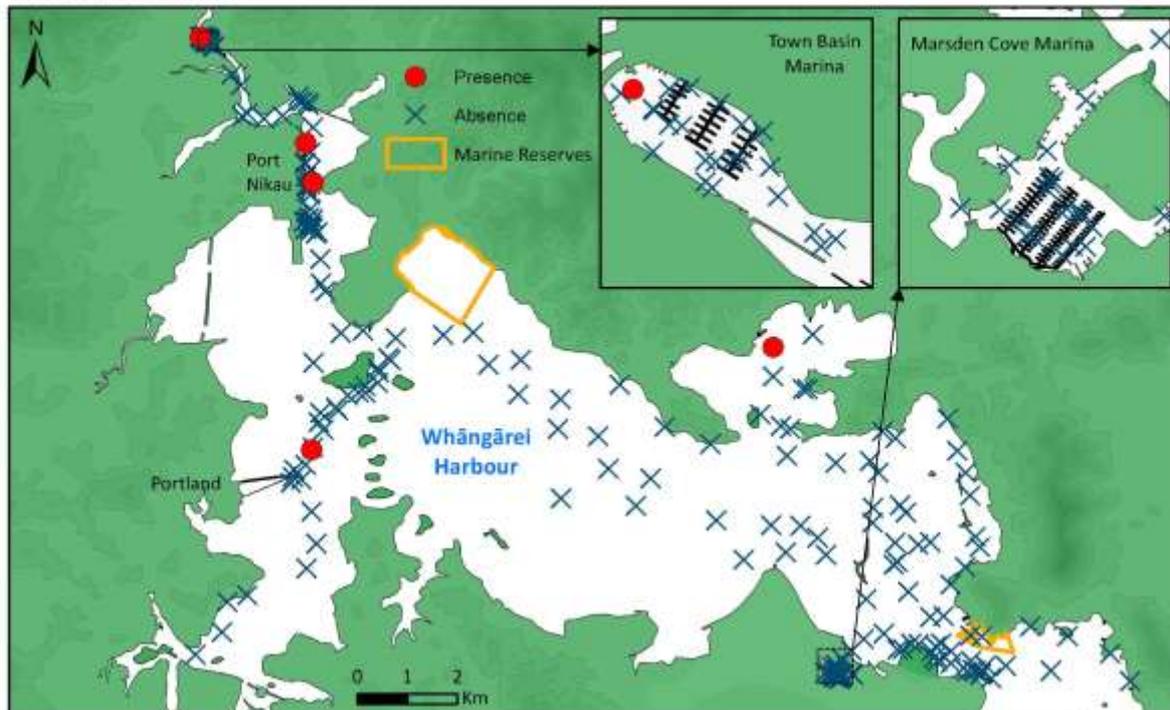
Eudistoma elongatum



Whāngārei Harbour
Winter 2018
Metapenaeus bennettiae



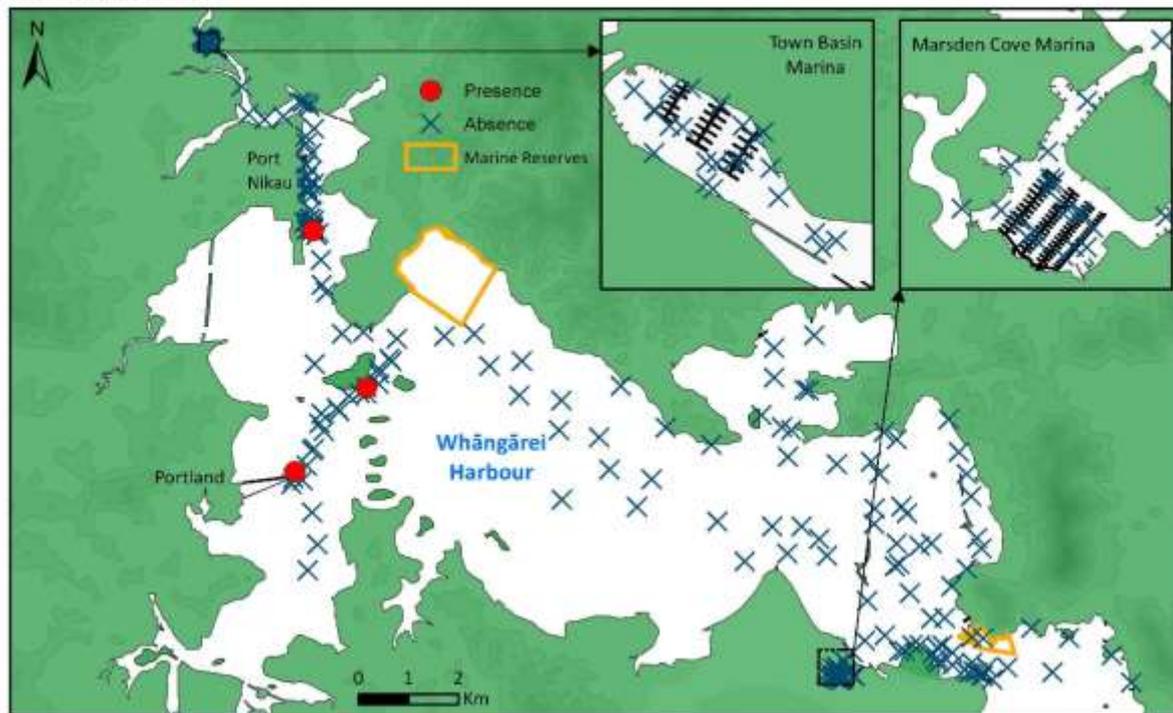
Whāngārei Harbour
Summer 2018-19
Metapenaeus bennettiae



Whāngārei Harbour

Summer 2018-19

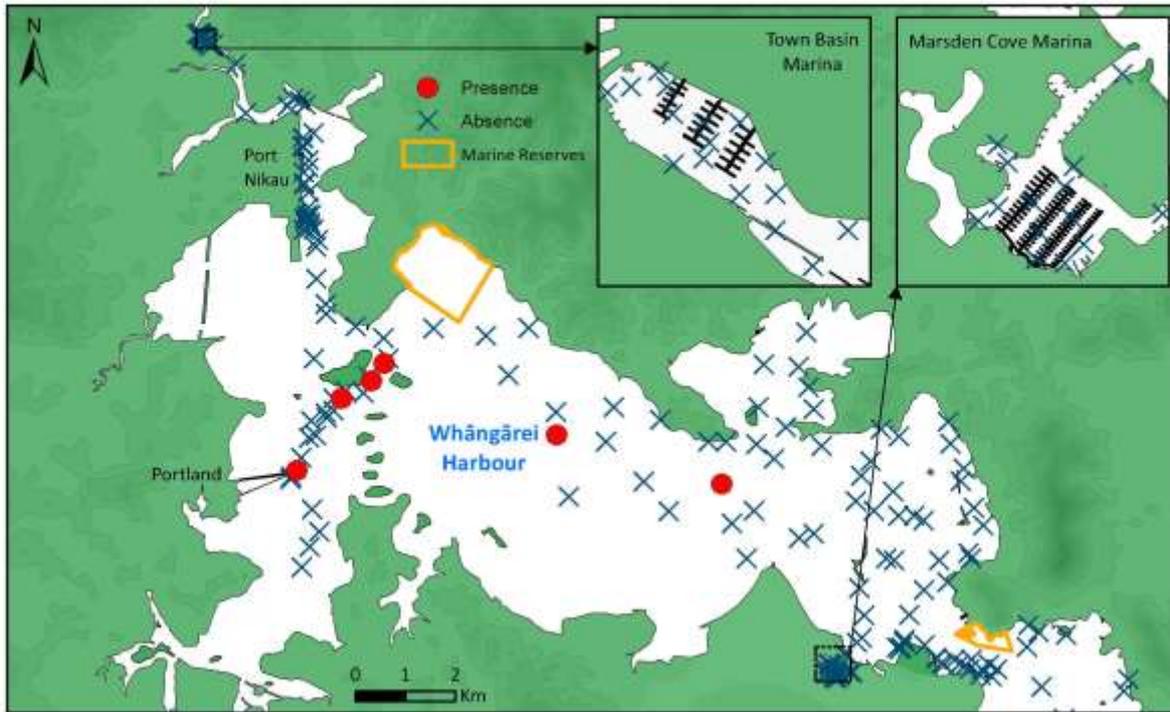
Omobranchus anolius



Whāngārei Harbour

Winter 2018

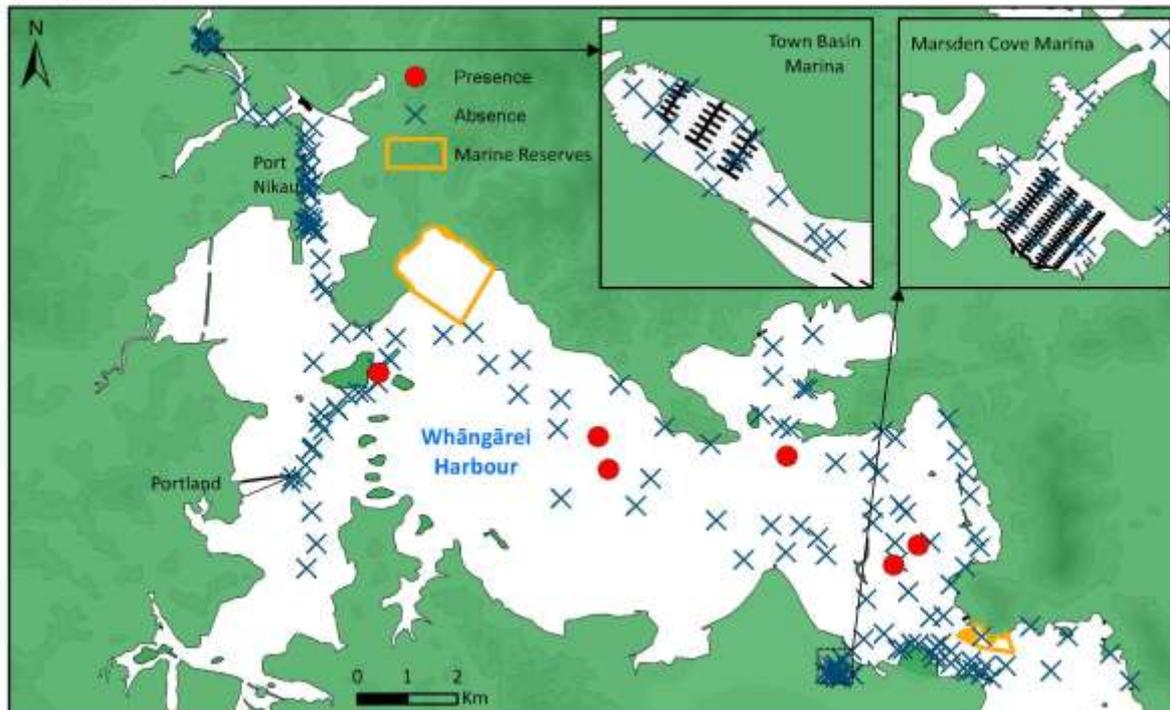
Pyromaia tuberculata



Whāngārei Harbour

Summer 2018-19

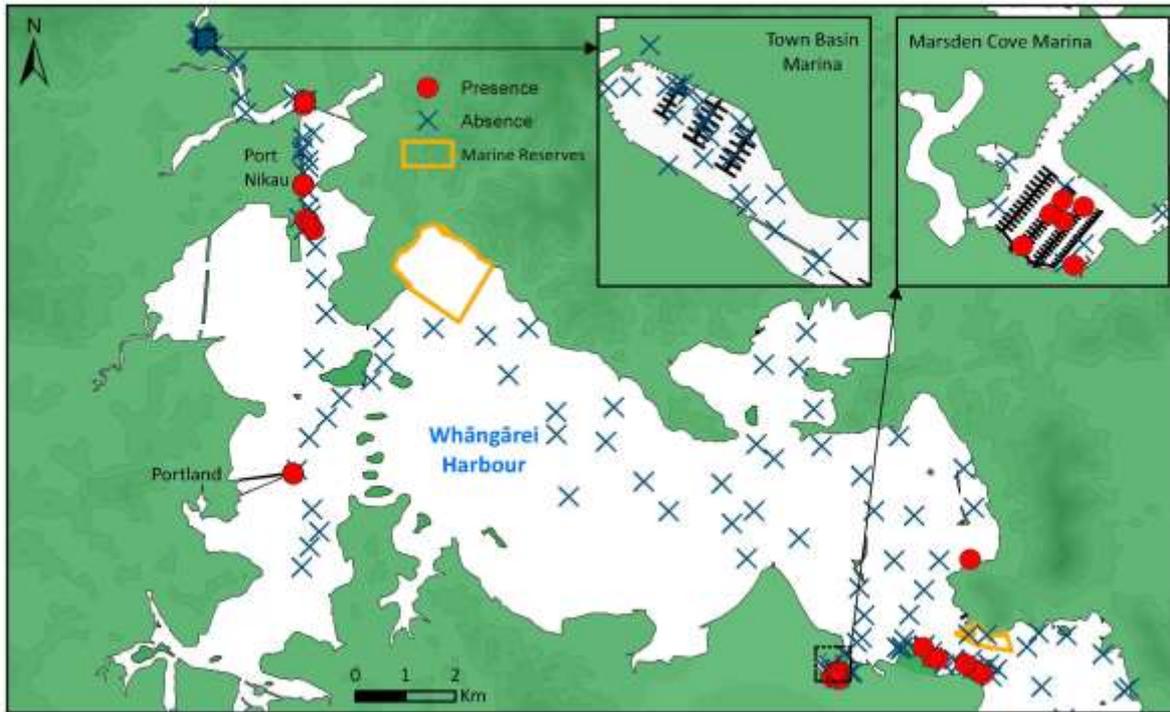
Pyromaia tuberculata



Whāngārei Harbour

Winter 2018

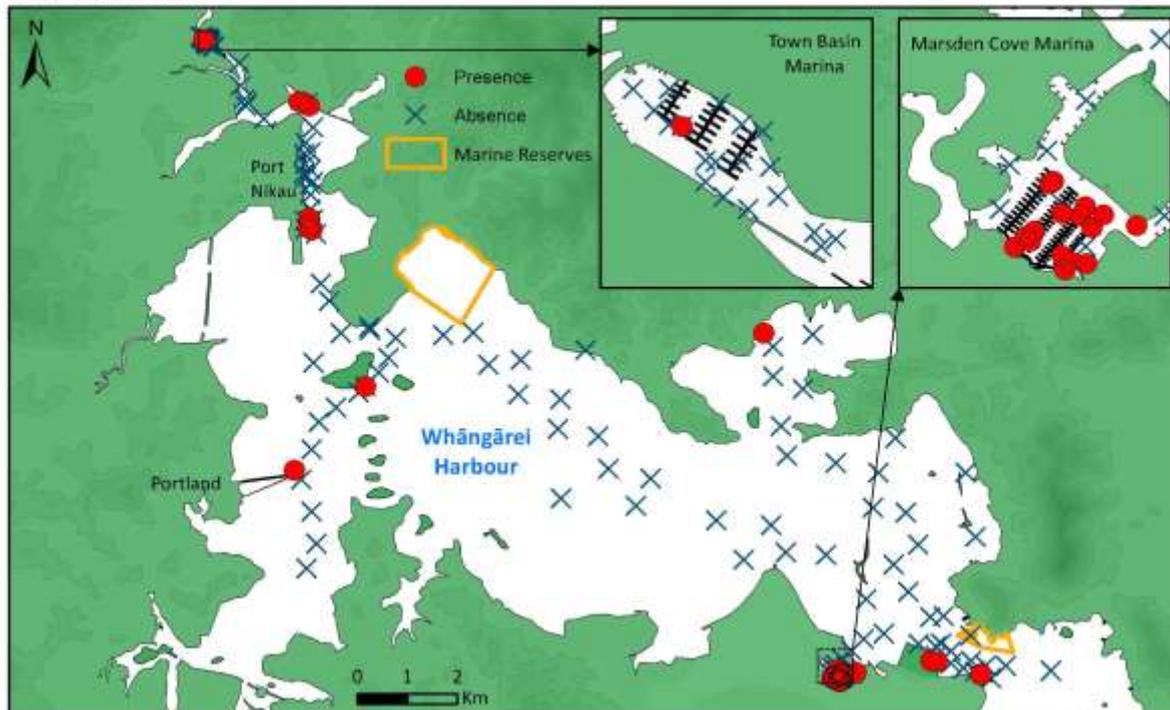
Sabella spallanzanii



Whāngārei Harbour

Summer 2018-19

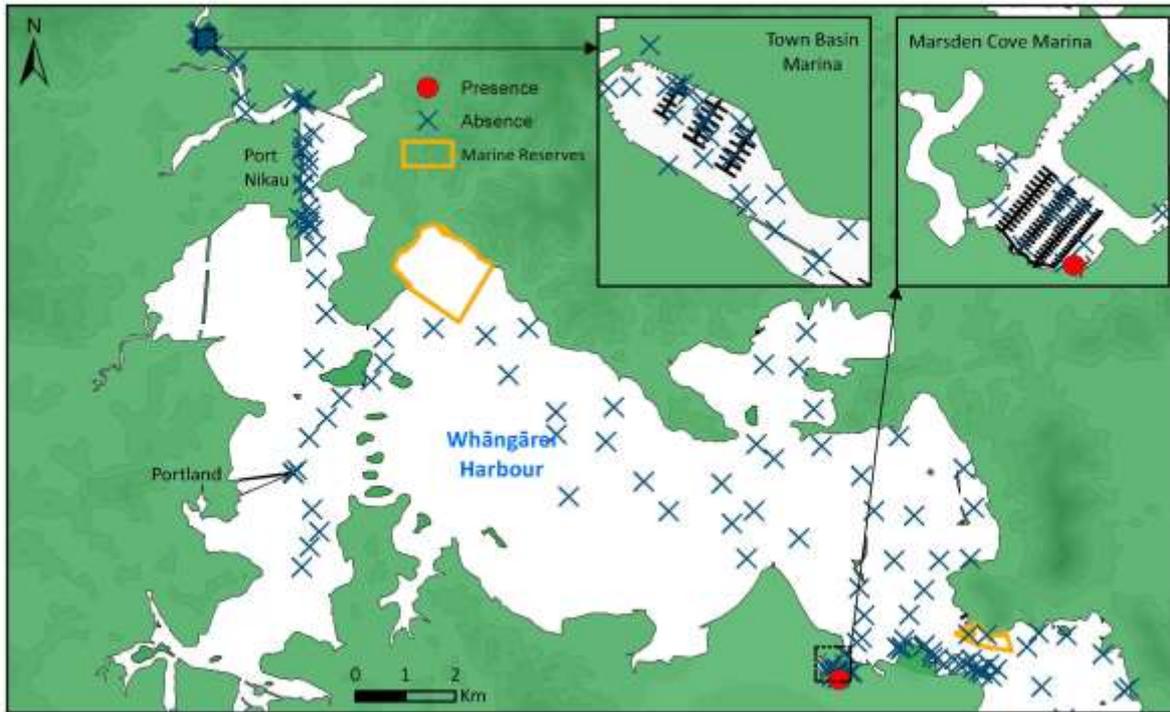
Sabella spallanzanii



Whāngārei Harbour

Winter 2018

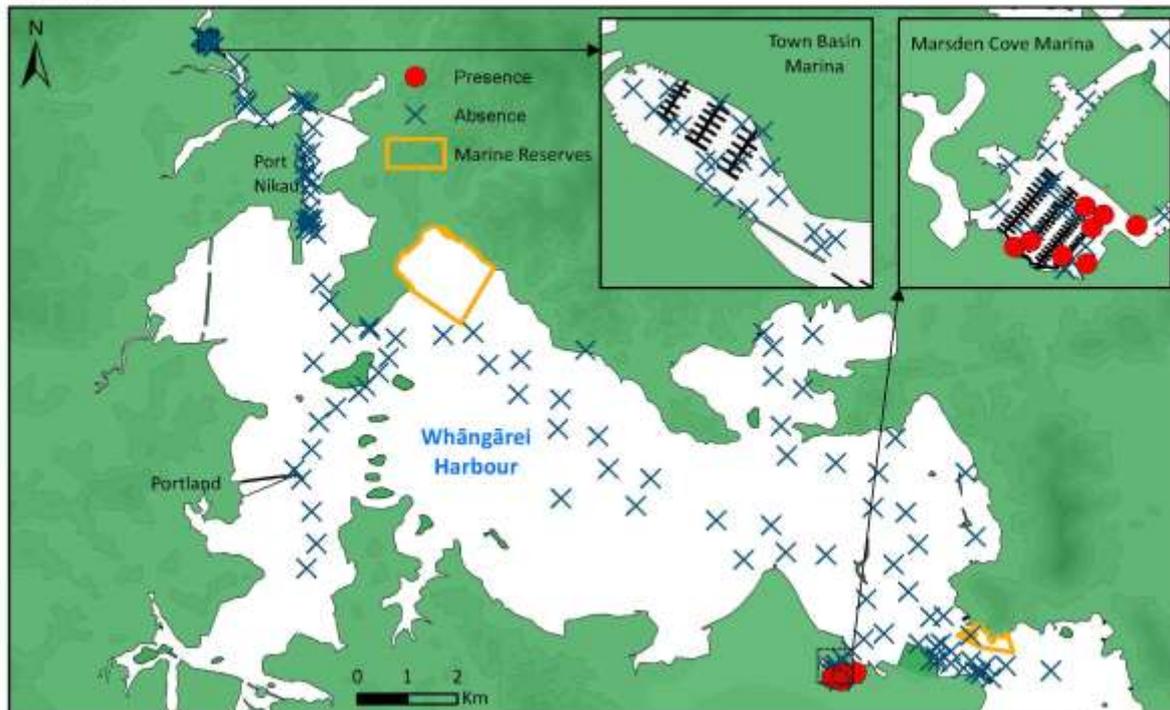
Styela clava



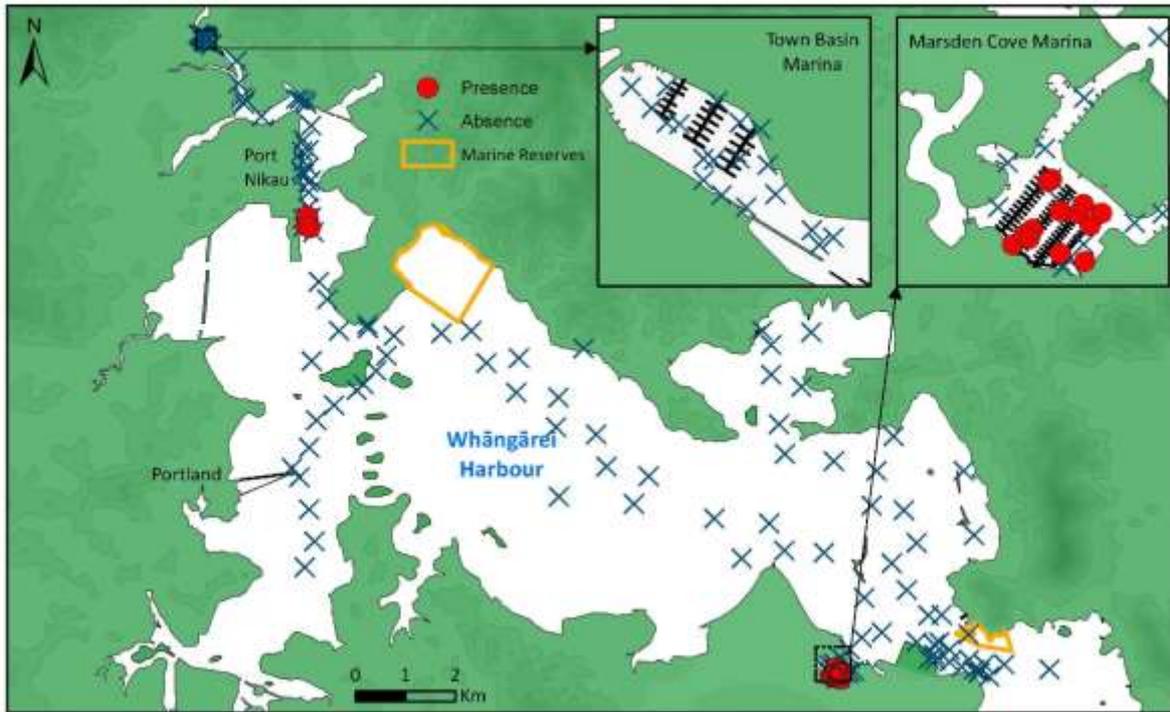
Whāngārei Harbour

Summer 2018-19

Styela clava



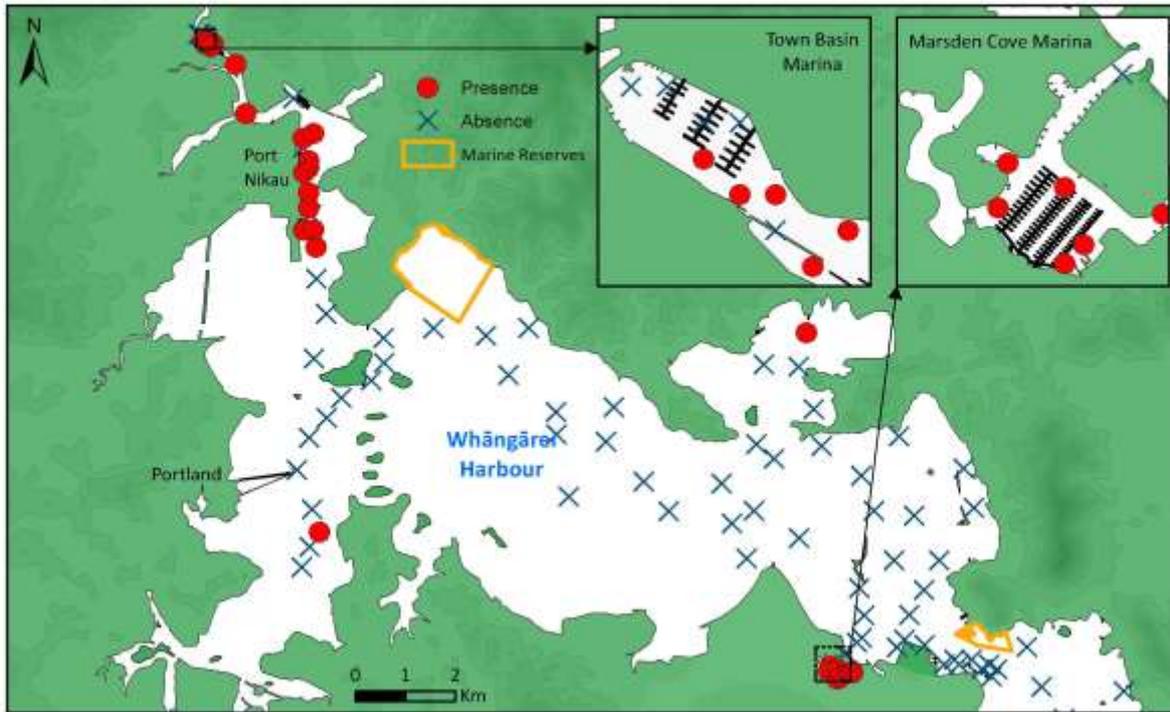
Whāngārei Harbour
Summer 2018-19
Symplegma brakenhielmi



Whāngārei Harbour

Winter 2018

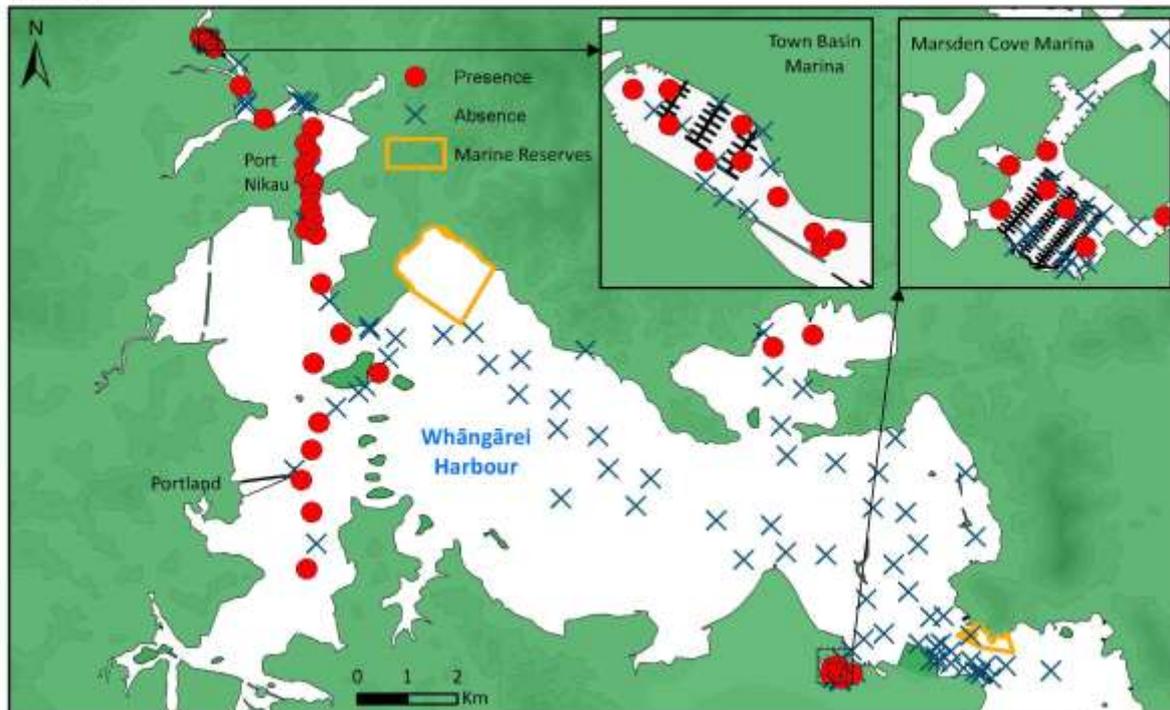
Theora lubrica



Whāngārei Harbour

Summer 2018-19

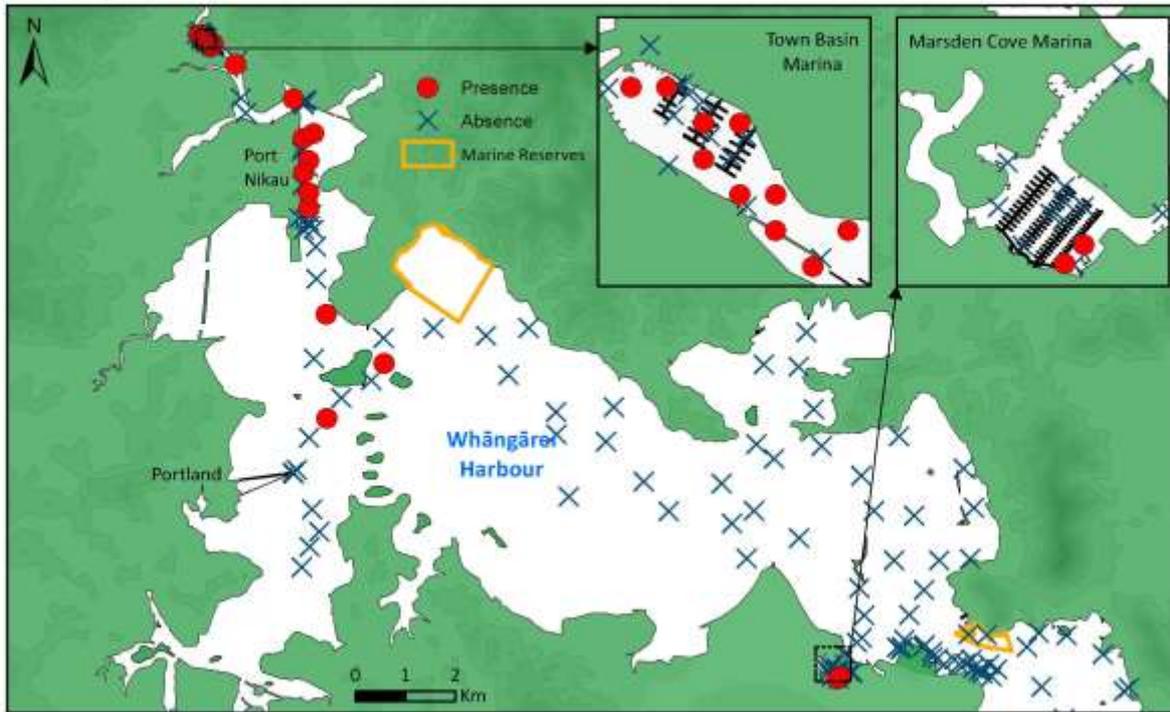
Theora lubrica



Whāngārei Harbour

Winter 2018

Tritia burchardi



Whāngārei Harbour

Summer 2018-19

Tritia burchardi

