TECHNICAL PAPER

BIOSECURITY NEW ZEALAND

Port of Taranaki

Second baseline survey for non-indigenous marine species (Research Project ZBS2000/04

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Executive summary

- This report describes the results of a repeat port baseline survey of the Port of Taranaki undertaken in March 2005. The survey provides a second inventory of native, non indigenous and cryptogenic marine species within the port and compares the biota with the results of an earlier port baseline survey of the Port of Taranaki undertaken in April 2002.

- The survey is part of a nationwide investigation of native and non-native marine biodiversity in 13 international shipping ports and three marinas of first entry for yachts entering New Zealand from overseas.

- To allow a direct comparison between the initial baseline survey and the resurvey of the Port of Taranaki, the survey used the same methodologies, occurred in the same season, and sampled the same sites used in the initial baseline survey. To improve the description of the biota of the port, some additional survey sites were added during the repeat survey.

- Sampling methods used in both surveys were based on protocols developed by the Australian Centre for Research on Introduced Marine Pests (CRIMP) for baseline surveys of non-indigenous species (NIS) in ports. Modifications were made to the CRIMP protocols for use in New Zealand port conditions. These are described in more detail in the body of the report.

- A wide range of sampling techniques was used to collect marine organisms from habitats within the Port of Taranaki. Fouling assemblages were scraped from hard substrata by divers, benthic assemblages were sampled using a sled and benthic grabs, and a gravity corer was used to sample for dinoflagellate cysts. Mobile predators and scavengers were sampled using baited fish, crab, starfish and shrimp traps.

- Sampling effort was distributed in the Port of Taranaki according to priorities identified in the CRIMP protocols, which are designed to maximise the chances of detecting non-indigenous species. Most effort was concentrated on high-risk locations and habitats where non-indigenous species were most likely to be found.

- Organisms collected during the survey were sent to local and international taxonomic experts for identification.

- A total of 267 species or higher taxa were identified in the first survey of the Port of Taranaki in April 2002. They consisted of 178 native species, 14 non-indigenous species, 34 cryptogenic species (those whose geographic origins are uncertain) and 41 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level).

- During the repeat survey, 269 species or higher taxa were recorded, including 180 native species, 13 non-indigenous species, 27 cryptogenic species and 49 species indeterminata. Many species were common to both surveys. Around 54% of the native species, 61% of non-indigenous species, and 48% of cryptogenic species recorded during the repeat survey were also found in the earlier survey.

- The 13 non-indigenous organisms found in the repeat survey of the Port of Taranaki included representatives of 6 major taxonomic groups. The non-indigenous species detected were: (Annelida) *Euchone limnicola*, *Barantolla lepte*; (Bryozoa) *Bugula flabellata*, *Bugula neritina*, *Cryptosula pallasiana*, *Watersipora subtorquata*; (Cnidaria) *Monotheca pulchella*, *Amphisbetia maplestonei*; (Crustacea) *Monocorophium sextonae*; (Mollusca) *Crassostrea gigas*, *Theora lubrica*; (Macroalgae) *Griffithsia crassiuscula*, and *Undaria pinnatifida*. Five of these species - *Euchone limnicola*, *Monotheca pulchella*, *Amphisbetia maplestonei*, *Monocorophium sextonae*, *Undaria pinnatifida* - were not recorded in the earlier baseline survey of the Port of Taranaki. In addition, six non-indigenous species that were present in the first survey - *Bugula stolonifera*, *Tricellaria inopinata*, *Watersipora arcuata*, *Eudendrium capillare*, *Polysiphonia sertularioides* and *Halisarca dujardini* – were not found during the repeat survey.

- Eleven species recorded in the repeat survey of Taranaki had not been described from New Zealand waters prior to the baseline surveys. One of these was an indigenous species (the hydroid *Amphisbetia maplestonei*). The remaining 10 species do not correspond with existing species descriptions from New Zealand or overseas and may be new to science.

- The only species from the Port of Taranaki on the New Zealand register of unwanted organisms is the Asian kelp, *Undaria pinnatifida*. This alga is known to now have a wide distribution in southern and eastern New Zealand, but was recorded for the first time from Taranaki during the repeat baseline survey of this port.

- Most non-indigenous species located in the Port are likely to have been introduced to New Zealand accidentally by international shipping or spread from other locations in New Zealand (including translocation by shipping).

- Approximately 61 % (8 of 13 species) of NIS in the Port of Taranaki are likely to have been introduced in hull fouling assemblages, 8 % (1 species) via ballast water and 31% (four species) could have been introduced by either ballast water or hull fouling vectors.

- The predominance of hull fouling species in the introduced biota of the Port of Taranaki (as opposed to ballast water introductions) is consistent with findings from similar port baseline studies overseas.

Introduction

Introduced (non-indigenous) plants and animals are now recognised as one of the most serious threats to the natural ecology of biological systems worldwide (Wilcove et al. 1998; Mack et al. 2000). Growing international trade and trans-continental travel mean that humans now intentionally and unintentionally transport a wide range of species outside their natural biogeographic ranges to regions where they did not previously occur. A proportion of these species are capable of causing serious harm to native biodiversity, industries and human health. Recent studies suggest that coastal marine environments may be among the most heavily invaded ecosystems, as a consequence of the long history of transport of marine species by international shipping (Carlton and Geller 1993; Grosholz 2002). Ocean-going vessels transport marine species in ballast water, in sea chests and other recesses in the hull structure, and as fouling communities attached to submerged parts of their hulls (Carlton 1985; Carlton 1999; AMOG Consulting 2002; Coutts et al. 2003). These shipping transport mechanisms have enabled hundreds of marine species to spread worldwide and establish populations in shipping ports and coastal environments outside their natural range (Cohen and Carlton 1995; Hewitt et al. 1999; Eldredge and Carlton 2002; Leppakoski et al. 2002).

Like many other coastal nations, New Zealand is just beginning to document the numbers, identity, distribution and impacts of non-indigenous species in its coastal waters. A review of existing records suggested that by 1998, at least 148 marine species had been deliberately or accidentally introduced to New Zealand, with around 90 % of these establishing permanent populations (Cranfield et al. 1998). Since that review, an additional 41 non-indigenous species or suspected non-indigenous species (i.e. Cryptogenic type I – see "Definitions of species categories", in methods section) have been recorded from New Zealand waters. To manage the risk from these and other non-indigenous species, better information is needed on the current diversity and distribution of species present within New Zealand.

BIOLOGICAL BASELINE SURVEYS FOR NON-INDIGENOUS MARINE SPECIES

In 1997, the International Maritime Organisation (IMO) released guidelines for ballast water management (Resolution A868-20) encouraging countries to undertake biological surveys of port environments for potentially harmful non-indigenous aquatic species. As part of its comprehensive five-year Biodiversity Strategy package on conservation, environment, fisheries, and biosecurity released in 2000, the New Zealand Government funded a national series of baseline surveys. These surveys aimed to determine the identity, prevalence and distribution of native, cryptogenic and non-indigenous species (NIS) in New Zealand's major shipping ports and other high risk points of entry for vessels entering New Zealand from overseas. The government department responsible for biosecurity in the marine environment at the time, the New Zealand Ministry of Fisheries (MFish), commissioned NIWA to undertake biological baseline surveys in 13 ports and three marinas that are first ports of entry for vessels entering New Zealand from overseas (Figure 1). Marine biosecurity functions are now vested in MAF Biosecurity New Zealand.

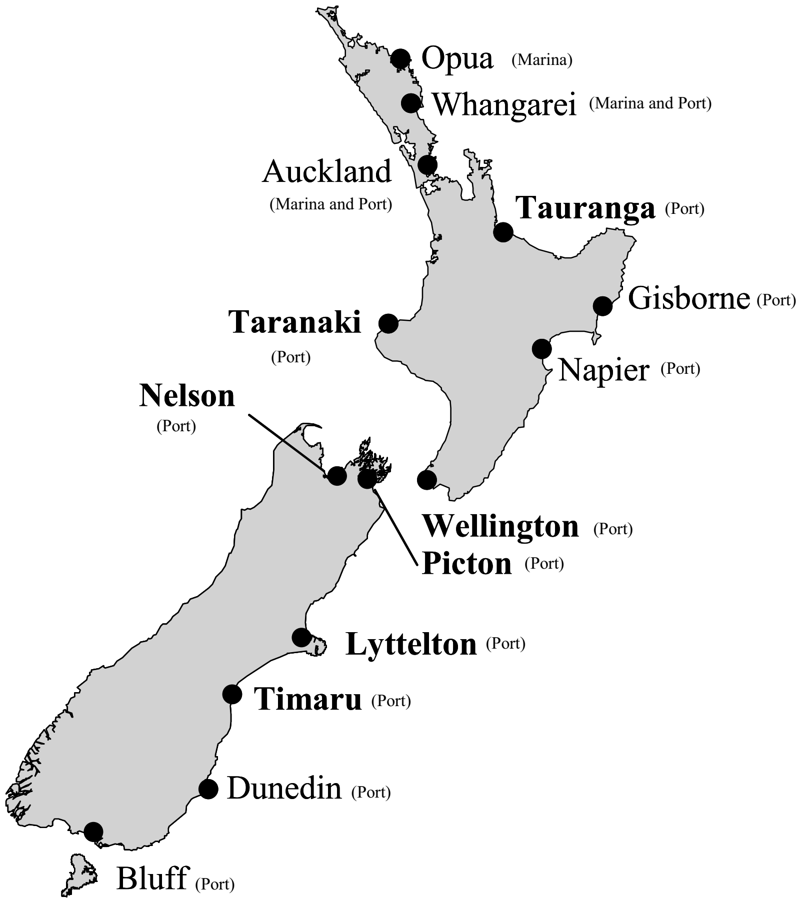

Figure 1: **Commercial shipping ports in New Zealand where baseline non-indigenous species surveys have been conducted. Group 1 ports surveyed in the summer of 2001/2002 and re-surveyed in the summer of 2004/2005 are indicated in bold and Group 2 ports surveyed in the summer of 2002/2003 are indicated in plain font. Marinas were also surveyed for NIS in Auckland, Opua and Whangarei in 2002/2003.**

The New Zealand baseline port surveys were based on protocols developed in Australia by the CSIRO Centre for Research on Introduced Marine Pests (CRIMP) for port surveys of introduced marine species (Hewitt and Martin 1996; Hewitt and Martin 2001). They are best described as "*generalised pest surveys*", as they are broad-based investigations whose primary purpose is to identify and inventory the range of non-indigenous species present in a port (Wittenberg and Cock 2001; Inglis et al. 2003)

The surveys have two stated objectives:

i. To provide a baseline assessment of native, non-indigenous and cryptogenic[1] species, and
ii. To determine the distribution and relative abundance of a limited number of target species in shipping ports and other high risk points of entry for non-indigenous marine species (Hewitt and Martin 2001).

Initial surveys were completed in New Zealand's 13 major shipping ports and 3 marinas of first entry during the summers of 2001/2002 and 2002/2003 (Figure 1). These surveys recorded more than 1300 species; 124 of which were known or suspected to have been

[1] "Cryptogenic:" species are species whose geographic origins are uncertain (Carlton 1996).

introduced to New Zealand. At least 18 of the non-indigenous species were recorded for the first time in New Zealand in the port baseline surveys. In addition, 106 species that are potentially new to science were discovered during the surveys and await more formal taxonomic description.

Worldwide, port surveys based on the CRIMP protocols have been completed in at least 37 Australian ports, at demonstration sites in China, Brasil, the Ukraine, Iran, South Africa, India, Kenya, and the Seychelles Islands, at six sites in the United Kingdom, and are underway at 10 sites in the Mediterranean (Raaymakers 2003). Despite their wide use, there have been few evaluations of the survey methods or survey design to determine their sensitivity for individual unwanted species or to determine the completeness of biodiversity inventories based upon them. Inglis et al. (2003) used a range of biodiversity metrics to evaluate the adequacy of sample effort and distribution during the initial New Zealand survey of the Port of Wellington and compared the results with those from seven Australian port baseline surveys. In general, they concluded that the surveys provided an adequate description of the richness of the assemblage of non-indigenous species present in the ports, but that the total richness of native and cryptogenic species present in the survey area was likely to be under estimated. The authors made a number of recommendations for future surveys that included increasing the sample effort for benthic infauna, maximising dispersion of samples throughout the survey area (rather than allocation based on CRIMP priorities) and modification of survey methods or design components which had high complementarity in species composition. Both Inglis et al. (2003) and a more recent study by Hayes et al. (2005) on the sensitivity of the survey methods concluded that generalised port surveys, such as these, are likely to under-sample species that are very rare or that have restricted distributions within the port environments and, as such, should not be considered surveys for early detection of unwanted species.

Instead, the port surveys are intended to provide a baseline for monitoring the rate of new incursions by non-indigenous marine species in port environments, and to assist international risk profiling of problem species through the sharing of information with other shipping nations (Hewitt and Martin 2001). Despite the large number of ports that have been surveyed using modifications of the CRIMP protocols, no ports have been completely re-surveyed. This means that there has been no empirical determination of the background rate of new arrivals or of the surveys' ability to detect temporal changes in the composition of native and non-indigenous assemblages.

This report describes the results of a second, repeat survey of the Port of Taranaki undertaken in March 2005, approximately 3 years after the initial baseline survey. In the manner of the first survey report (Inglis et al. 2006), we provide an inventory of species recorded during the survey and their biogeographic status as either native, introduced ("non-indigenous") or cryptogenic. Organisms that could not be identified to species level are also listed, as species indeterminata (see "Definitions of species categories", in methods section).

The report is intended as a stand-alone record of the re-survey and, as such, we reiterate background information on the Port of Taranaki, including its history, physical environment, shipping and trading patterns, development and maintenance activities, and biological environment. Where available, this information is updated with new data that have become available in the time between the two surveys.

DESCRIPTION OF THE PORT OF TARANAKI

General features

The Port of Taranaki is centrally located on the west coast of New Zealand's North Island, servicing the city of New Plymouth (39^{o} 03'S. 174^{o} 02.5'E; Figure 1). The Port was established in 1875. In 1881, work began on a breakwater to provide safe anchorage. Since 1881 the port has grown apace with its province, with increasing export/import and coastal trade, as well as with oil exploration-related trade that has occurred in the Taranaki region since the 1960's.

The Port of Taranaki is protected from the open sea by two artificial breakwaters, one of which is also a fully operational berthing facility (Figure 2). The Port entrance is subject to a high frequency of swell conditions (Henwood 1989) but is easily navigable, with an open road-stead and anchorage in 18-22 m of water. There is no bar. The main Port breakwater has had a large impact on sand transport along the coastline, and sand accumulation has to be controlled by regular dredging (Gibb 1983). The harbour floor consists of a broad deep trough that merges with the inner continental margin beyond the harbour entrance (Carter et al. 1981). Harbour sediments are predominantly anaerobic fine sandy muds (Don 1981), becoming mixed sand and gravel near the wharves (Carter et al. 1981). The Port of Taranaki experiences a fairly large tidal range of 1.7 to 3.9 m. The mean oceanic flow is to the northeast adjacent to the Port. Tidal currents are not significant (they do not exceed 0.5 m/s and are typically 0.25 m/s or less) and are mainly wind-induced closer inshore (Gibb 1983).

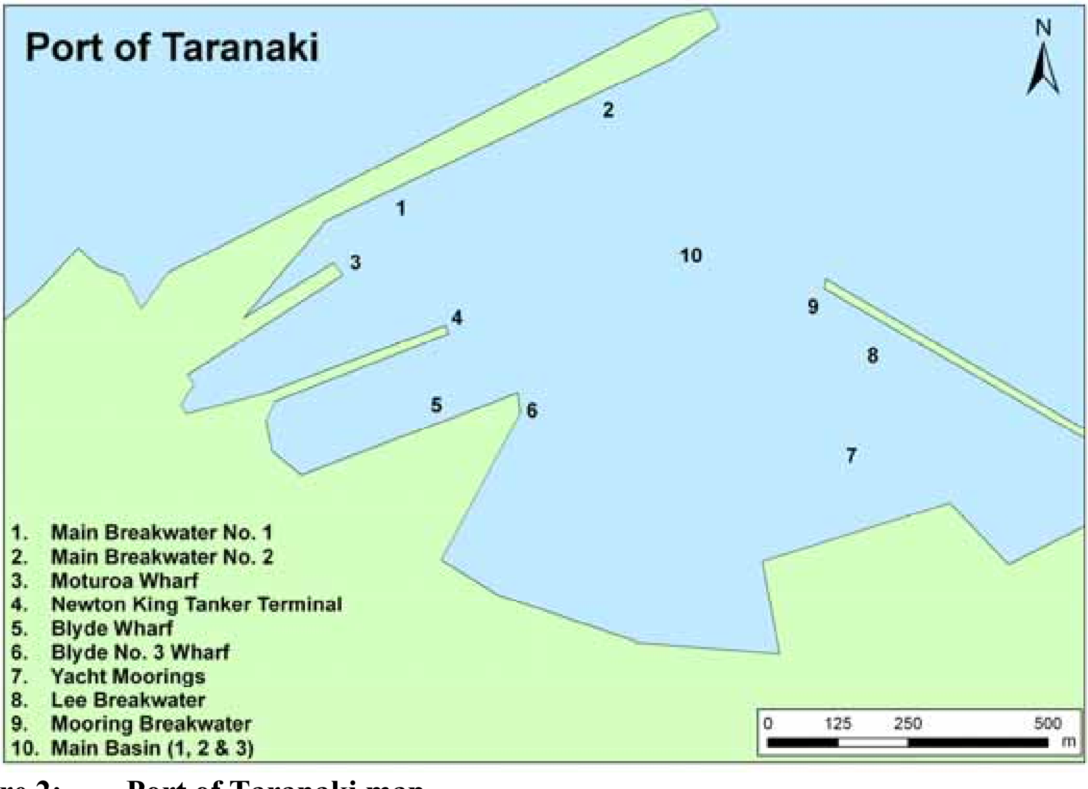

Figure 2: Port of Taranaki map

Port operation, development and maintenance activities

The Port of Taranaki is the only deep-water seaport on New Zealand's western seaboard. Known commercially as Port Taranaki, the port is New Zealand's fifth largest seaport overall and the country's second largest export port in terms of tonnes of freight handled (www.porttaranaki.co.nz). The port has MAF customs clearance, inspection and quarantine facilities.

Port Taranaki currently has nine main berths capable of handling a wide diversity of cargoes and vessels with an official maximum draught of 10 m which may be exceeded by arrangement (www.porttaranaki.co.nz). The inner side of the Main Breakwater terminal primarily handles coastal bulk traders and offshore support vessels, as well as catering for the needs of Taranaki's offshore oil and gas operations and providing berths for fishing vessels. Moturoa Wharf is generally used for dry bulk cargoes. Berths on both sides of the Newton King Tanker Terminal handle a wide range of petrochemical products and bulk liquids including crude oils, liquefied petroleum gas and methanol. The newest development at the Port of Taranaki is the Blyde Terminal, an integrated facility handling containers, general/refrigerated cargoes and catering for vessels that service oil and gas production operations offshore. Berth construction is predominantly concrete deck on concrete or steel piles, although the Main Beakwater is solid concrete. Details of the berthing facilities available are provided in Table 1.

Outside the Port's operational area, on the lee breakwater, there is an 18 to 20 berth marina constructed with steel pontoons and piles. On the southeastern side of the harbour is a 6.5 ha reclamation with areas currently leased by retail and marine services.

Vessels unable to be berthed immediately in the port may anchor outside the port to the west of a line running 197° to the end of the main breakwater, but no closer than 1 nautical mile to any point of land, in approximately 20 m of water. Pilotage is compulsory on vessels over 100 GRT (www.porttaranaki.co.nz).

Within the port, there is on-going maintenance dredging as required, in the area encompassed by the Main Breakwater on the west and the tips of the Blyde Wharf and Lee Breakwater on the east. Maintenance dredging usually occurs every two years, with removal of approximately 350,000 m^3 in this time. Approximately 75 to 80 % of the dredged material is clean fine sand, with the remaining volume consisisting of finer materials such as silts. The spoil is deposited in two sites: one in-shore site with sand for beach renourishment, and one off-shore site approximately 2 km north of the breakwater for mud and silt spoil (marked on nautical chart). The inshore spoil site was first used in March 2004, and again in June 2005 after the second port baseline survey (P. Atkinson, Duffill Watts & King Ltd., pers comm.).

Capital dredging of port areas including the harbour entrance, turning basin and some berths commenced in December 2005 (after the second baseline survey was completed) and is expected to run into the first half of 2007. Operating depths in these areas will be increased upon completion of this work. The total volume expected to be dredged is 863,000 m^3, all of which will be deposited in the offshore spoil ground. Small volumes were also dredged from June to September 2002 (after the first baseline survey); approximately 1,500 m^3 was dredged from Blyde No. 2 wharf, around 2,000 to 3,000 m^3 was dredged from the Newton King Tanker Terminal, and several small shallow areas were also dredged around the harbour. All of this material was deposited in the offshore spoil ground (P. Atkinson, pers comm.).

Other capital works activities have not involved any changes to in-water structures since the first baseline survey in April 2002 (P. Atkinson, pers comm.).

Imports and exports

The total trade volume for Port Taranaki has declined in recent years, from 5.03 million tonnes in the 2002-2003 financial year to 3.48 million tonnes in 2003-2004 and 3.45 million tonnes in 2004-2005 (Westgate Transport Ltd 2004, 2005). This is associated mainly with the decline of the Maui gas field, which accelerated in the 2003-2004 financial year and resulted in large declines in bulk liquid trade tonnages, especially methanol exports (Westgate Transport Ltd 2004). Total exports from Port Taranaki therefore declined from 5.05 million freight tonnes in the 2001-2002 financial year to 2.68 million freight tonnes in the 2004-2005 financial year, whilst total imports showed a net increase over the same period, from 0.59 to 0.77 million freight tonnes (Westgate Transport Ltd 2005). Continuing growth on the Blyde Terminal (container terminal) resulted in the handling of 51,750 TEU[2] in 2004-2005, compared with 48,500 in the previous year and 45,200 in the 2002-2003 year.

We used data from Statistics New Zealand to summarise import and export characteristics for the Port of Taranaki. We summarised total quantities of overseas cargo loaded and unloaded by weight and by value for each financial year between the 2001-2002 year and the 2004-2005 year (Statistics New Zealand 2006b). Also available from Statistics New Zealand (2006a) was a breakdown of cargo value by country of orgin or destination and by commodity for each calendar year; we analysed the data for the period 2002 to 2005 inclusive (ie. the period between the first and second baseline surveys). Note that the import and export data presented below only consider cargo being loaded for, or unloaded from, overseas and does not consider domestic cargo. This is, therefore, likely to sum to a lower amount than the total amount of cargo handled by the port.

Imports

Both the weight and value of overseas cargo unloaded at the Port of Taranaki has increased each year since the 2002 initial baseline survey, with 462,693 tonnes gross weight, valued at $275 million, being unloaded in the year ended June 2005 (Statistics New Zealand 2006b). This represents an increase in weight of almost 30 % and value of almost 53 % compared to the year ending June 2002 (Table 2). Overseas cargo unloaded at the Port of Taranaki accounted for 2 to 3 % by weight and 0.7 to 1 % by value of the total overseas cargo unloaded at New Zealand's seaports (Table 2).

The Port of Taranaki imported cargo in 89 different commodity categories between 2002 and 2005 inclusive (Statistics New Zealand 2006a). The dominant commodities by value imported at the Port of Taranaki during this time were fertilisers (25 %), mineral fuels, oils and products (17 %), dairy produce, bird's eggs, natural honey and other edible animal products (6 %) and aluminium and aluminium articles (6 %; Figure 3). Fertilisers ranked first each year except in 2005, when they ranked second after dairy. Mineral fuels ranked second or third each year. The ranking of third place overall for dairy is due entirely to a large import in 2005; dairy did not rank in the top 10 in other years (Statistics New Zealand 2006a).

The Port of Taranaki received imports from 89 countries of initial origin[3] between 2002 and 2005 inclusive (Statistics New Zealand 2006a). During this time, the Port of Taranaki imported most of its overseas cargo by value from Australia (25 %), the USA (20 %), and Saudi Arabia (8 %; Figure 4). Australia ranked first and the USA second each year except in 2004 when their ranks were reversed. Saudi Arabia ranked third each year (Statistics New Zealand 2006a).

[2] TEU = twenty foot equivalent unit. This is a standard size of container and a common measure of capacity in the container logistics business.

[3] The country of initial origin is not necessarily the country that the ship carrying the commodity was in immediately before arriving at the Port of Taranaki; for ship movements see the section on "Shipping movements and ballast discharge patterns"

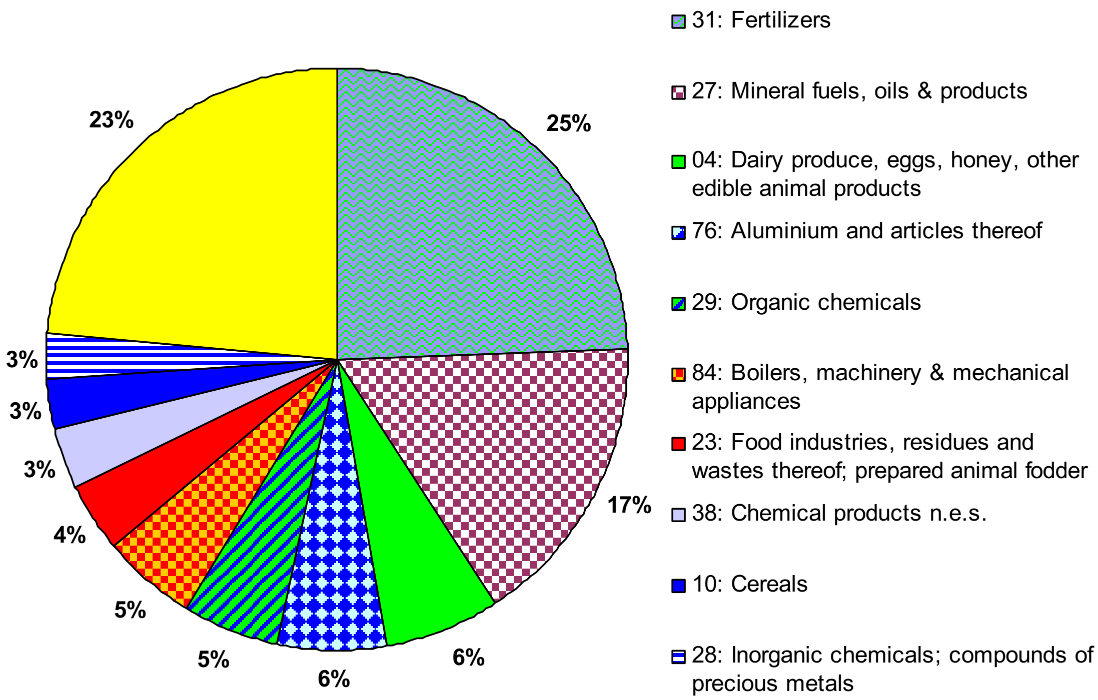

Figure 3: **Top 10 commodities by value unloaded at the Port of Taranaki summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a). Commodity category descriptions have been summarised for brevity; category numbers are provided in the legend and full descriptions are available at Statistics New Zealand (2006a).**

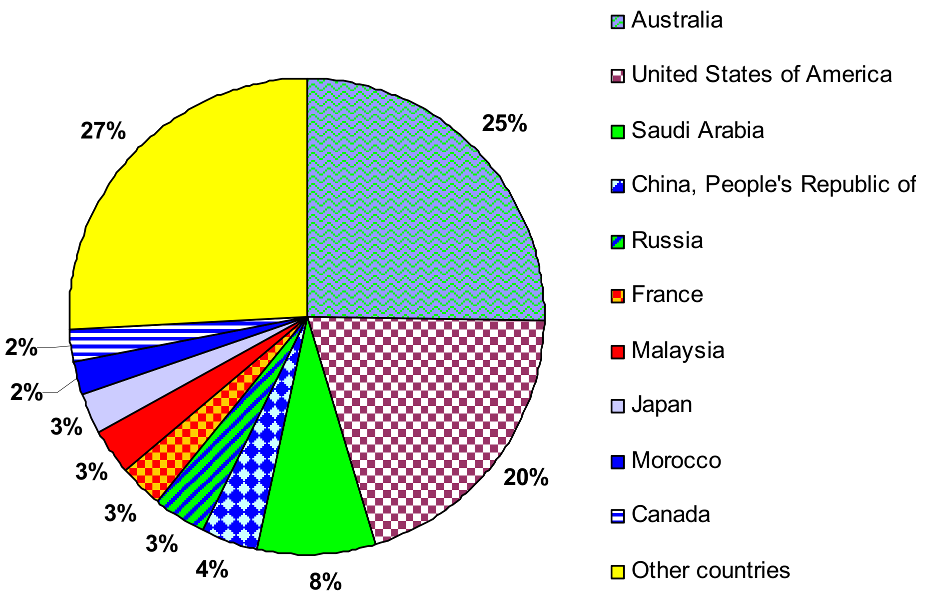

Figure 4: **Top 10 countries of initial origin that cargo was unloaded from at the Port of Taranaki. The data are percentages of the total volume of cargo unloaded in the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).**

Exports

In the year ending June 2005, the Port of Taranaki loaded 1,890,401 tonnes of cargo for export (Statistics New Zealand 2006b). This represented a decline of almost 50 % compared to the year ending June 2002, with most of the downturn occurring in the 2003-2004 financial year (Table 3) when the Maui gas field declined. The value of the cargo loaded for export in the year ending June 2005 was similar to the value in the year ending June 2002, but lower than the year ending June 2003. The proportion of the total overseas cargo by weight loaded at New Zealand's seaports loaded by the Port of Taranaki has dropped from around 15 % in 2002 to less than 9 % in 2005. However, the proportion by value increased slightly, from 6.8 % in 2002 to 7.5 % in 2005, although it reached 8.5 % in the 2002-2003 financial year (Table 3).

The Port of Taranaki exported cargo in 69 different commodity categories between 2002 and 2005 inclusive (Statistics New Zealand 2006a). The dominant commodity categories by value loaded at the Port of Taranaki for export during this time were dairy produce, bird's eggs, natural honey and other edible animal products (35 %), mineral fuels, oils and products (21 %), meat and edible meat offal (13 %), and confidential items (11 %; Figure 5). Dairy produce ranked first and mineral fuels and oils ranked second each year. Confidential items and meat ranked third or fourth each year except in 2002, when meat ranked fifth (Statistics New Zealand 2006a). Log exports have been one of the fastest growing trades in the past five years, and coal, fertilisers and cement volumes also increased strongly in the 2004-2005 year (Westgate Transport Ltd 2005).

The Port of Taranaki loaded cargo for export to 103 countries of final destination[4] between 2002 and 2005 inclusive (Statistics New Zealand 2006a). During this time, the Port of Taranaki exported most of its overseas cargo by value to Australia (19 %), the USA (16 %), Japan (15 %), the Republic of Korea (5 %) and the People's Republic of China (5 %; Figure 6). Australia, the USA and Japan ranked in the top three every year, with Australia ranking first each year except in 2005 when it was outranked by the USA (Statistics New Zealand 2006a).

[4] The country of final destination is not necessarily the country that the ship carrying the commodity goes to immediately after departing from the Port of Taranaki; it is the final destination of the goods. For ship movements see "Shipping movements and ballast discharge patterns"

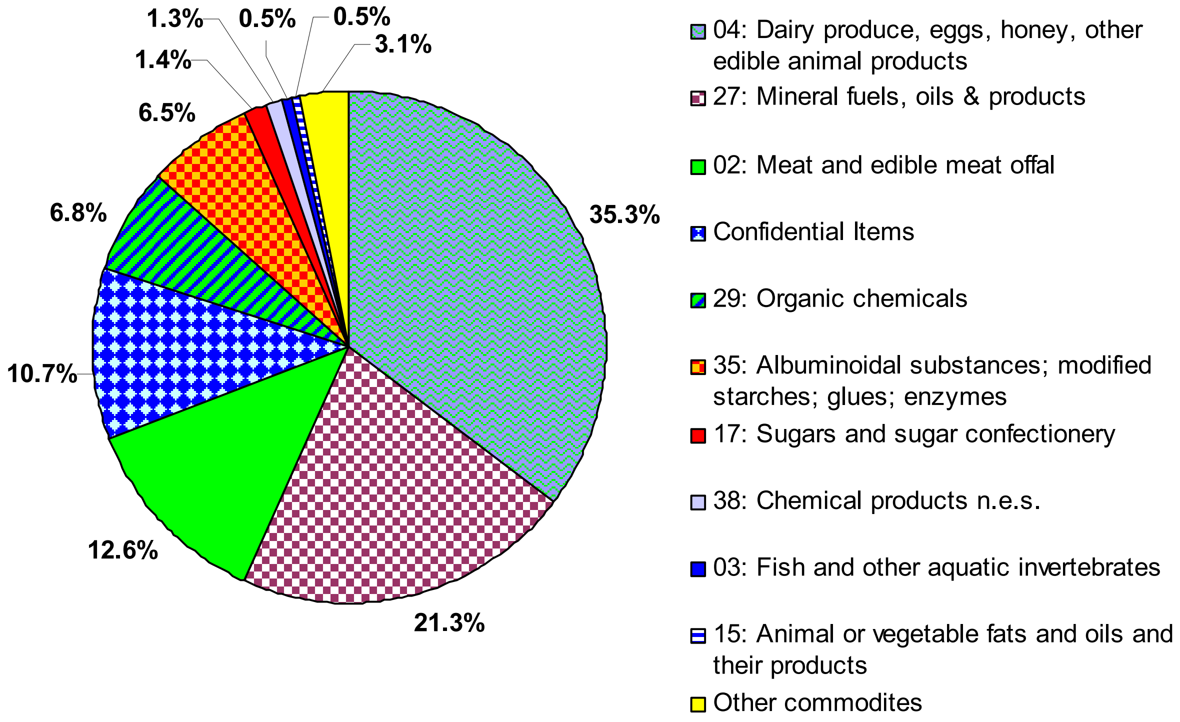

Figure 5: Top 10 commodities by value loaded at the Port of Taranaki summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a). Commodity category descriptions have been summarised for brevity; category numbers are provided in the legend and full descriptions are available at Statistics New Zealand (2006a).

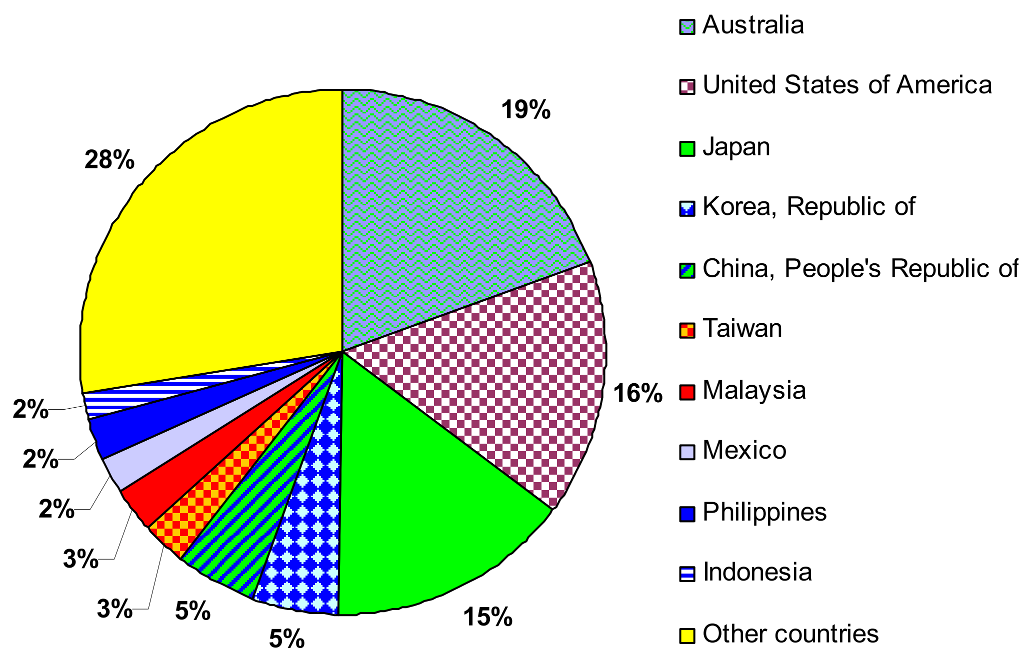

Figure 6: Top 10 countries of final destination that overseas cargo was loaded for at the Port of Taranaki summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).

Shipping movements and ballast discharge patterns

According to Inglis (2001), a total volume of 1,150,570 m^3 of ballast water was discharged in the Port of Taranaki in 1999, with the largest country-of-origin volumes of 507,895 m^3 from Australia, 224,601 m^3 from Japan, 210,589 m^3 from Hong Kong, and 119,926 m^3 unspecified. Since June 2005, vessels have been required to comply with the Import Health Standard for Ships' Ballast Water from All Countries (www.fish.govt.nz/sustainability/biosecurity). No ballast water is allowed to be discharged without the express permission of an MAF (Ministry of Agriculture and Forestry) inspector. To allow discharge, vessels Masters are responsible for providing the inspector with evidence of either: discharging ballast water at sea (200 nautical miles from the nearest land, and at least 200 m depth); demonstrating ballast water is fresh (2.5 ppt sodium chloride) or having the ballast water treated by a MAF approved treatment system.

In the financial years between 2001-2002 and 2004-2005, the largest number of vessel arrivals (domestic and international over 100 GRT) in Port Taranaki occurred in the year ending June 2003 (688 arrivals), while the smallest number of arrivals occurred in the year ending June 2005 (562 arrivals, Westgate Transport Ltd 2005).

To gain a more detailed understanding of international and domestic vessel movements to and from the Port of Taranaki between 2002 and 2005 inclusive, we analysed a database of vessel movements generated and updated by Lloyds Marine Intelligence Unit, called 'SeaSearcher.com'. Drawing on real-time information from a network of Lloyd's agents and other sources around the world, the database contains arrival and departure details of all ocean going merchant vessels larger than 99 gross tonnes for all of the ports in the Group 1 and Group 2 surveys. However, the database does not include movement records for domestic or international ferries plying definitive scheduled routes. Cruise ships, coastal cargo vessels and all other vessels over 99 gross tonnes excluding scheduled ferry services are included in the database.

The database, therefore, gives a good indication of the movements of international and domestic vessels involved in trade, but does not record ferry trips or movements by domestic fishing or recreational vessels. Furthermore, a small number of vessel movement records in the database are incomplete, resulting in those movements being excluded from the analysis. Definitions of geographical area and vessel type categories are given in Appendix 1.

International vessel movements

Based on an analysis of the LMIU 'Seasearcher.com' database there were 612 vessel arrivals to the Port of Taranaki from overseas ports between 2002 and 2005 inclusive (Table 4). These arrived from 40 different countries represented by most regions of the world. The greatest number of overseas arrivals during this period came from the following areas: Australia (230), Pacific Islands (127), Japan (79), and the northwest Pacific (68; Table 4). The previous ports of call for three of the international arrivals were not stated in the database. Vessels arriving from Australia came mostly from ports in Queensland (138 arrivals), New South Wales (33), and Victoria (32; Table 5). The major vessel types arriving from overseas at the Port of Taranaki were tankers (218 arrivals), LPG / LNG carriers (138 arrivals), and container ships and ro/ro vessels (134 arrivals; Table 4).

According to the LMIU 'Seasearcher.com' database, during the same period 818 vessels departed from the Port of Taranaki to 28 different countries, also represented by most regions of the world (but not to the European Atlantic coast; Table 6). The greatest number of departures for overseas went to Australian ports as their next port of call (379 movements) followed by east Asian seas (154), Japan (108), the northwest Pacific (84) and the Pacific Islands (74). The major vessel types departing to overseas ports from the Port of Taranaki were tankers (312 movements), container ships and ro/ro (250), LPG / LNG carriers (117) and general cargo vessels (75; Table 6).

Domestic vessel movements

The LMIU 'Seasearcher.com' database contained movement records for 1,123 vessel arrivals to the Port of Taranaki from New Zealand ports between 2002 and 2005 inclusive. These arrived from 16 different ports in both the North and South Islands (Table 7). The greatest number of domestic arrivals during this period came from Lyttelton (270 arrivals), Nelson (162 arrivals), Dunedin (142 arrivals), and Wellington (131 arrivals). The dominant vessel types arriving from New Zealand ports were LPG / LNG carriers (240 arrivals), container ships and ro/ro's (234), tankers (207), general cargo vessels (206), and bulk / cement carriers (187 arrivals; Table 7).

During the same period, the LMIU 'Seasearcher.com' database contained movement records for 903 vessel departures from the Port of Taranaki to 16 New Zealand ports in both the North and South Islands. The most domestic movements departed the Port of Taranaki for Lyttelton (216 movements), Wellington (99), Taranaki (ie. closed-loop trips; 79 departures), Napier (76) and Dunedin and Nelson (70 each; Table 8). LPG / LNG carriers dominated the vessel types leaving the Port of Taranaki on domestic voyages (260 movements), followed by bulk / cement carriers (196 movements), general cargo vessels (170 movements), tankers (113), and container ships and ro/ro's (109 movements; Table 8). In 2000, there were 15 registered fishing vessels in the Port of Taranaki (Sinner et al 2000).

Port Taranaki has recently been holding talks with shipping operators over plans to introduce a new inter-island ferry service between New Plymouth and Nelson (www.porttaranaki.co.nz). If initiated, it is expected that the service would initially carry only freight, but could eventually also carry passengers. Such a service would substantially increase the numbers of vessel movements between these two ports.

EXISTING BIOLOGICAL INFORMATION

Several studies have been completed of coastal processes in the Port of Taranaki and the effects of deepening the Port by dredge (see Carter et al. 1981; Gibb 1983; Henwood 1989), but none of these incorporate studies of the ecology of the area. However, the supplement of information from the initial NIWA baseline survey of Taranaki Harbour (Inglis et al. 2006) has made a valuable addition to the biological information available in the area (explained further in the next section). Additionally, a small number of studies relating to the ecology of the Port and harbour environment do exist, but unfortunately we have been unable to source most of these.

Don (1981) examined the benthic communities within the Port and harbour. The study was part of an environmental impact assessment to assess the ecological impact of the Taranaki Harbour Board's proposal to dredge 1.75 million cubic metres of sediment from the harbour, and the disposal of the sediment at an open water site. Twenty-one sublittoral stations were sampled by dredge. Species lists were generated for each station, with a total of 38 species recorded, including the non-indigenous bivalve *Theora lubrica*. The biota was noted to be similar to that recorded in previous studies during the mid-1970s.

Cole and McComb (2000) surveyed the marine fauna off New Plymouth, to the east of Port Taranaki, as part of studies into the potential effects of a proposed nearshore placement site for material dredged from Port Taranaki. They found that the fauna was limited compared to other areas in New Zealand. The only non-indigenous species recorded was the boring sponge *Cliona celata*, found at one kelp forest site at approximately 4 m depth, with a mean abundance of 0.2 per 1 m^2 quadrat. The assemblage of fishes comprised species common in New Zealand. The dominant habitat encountered was coralline pavements with low species richness. They also found several areas of seaweed (*Ecklonia radiata* and *Carpophyllum maschalocarpum*) forest habitat, which is less common in the region. These habitats had higher species richness and abundance, and the report recommended that the spoil placement ground be placed to avoid areas of seaweed forest. The report found that organism abundance generally declined with depth, and abundances were very low below 10 m depth..

Monitoring by drop video camera of the effects of spoil disposal at the inshore site (which has been used since 2004) indicated no effect of the sand placement on the seaweed in the area (Westgate Transport Ltd 2005).

Taylor and MacKenzie (2001) tested the Port of Taranaki for the presence of the toxic blooming dinoflagellate *Gymnodinium catenatum*, and detected both resting cysts (sediment samples) and motile cells (phytoplankton samples).

Taranaki Regional Council and Port Taranaki have agreed to jointly monitor the harbour waters for factors that lie outside the areas covered by resource consents, including invasive species, subtidal and intertidal ecology and sediment and water quality monitoring (Westgate Transport Ltd 2005). However, this has not yet commenced (D. Govier, Taranaki Regional Council, pers comm.).

RESULTS OF THE FIRST BASELINE SURVEY

An initial baseline survey of the Port of Taranaki was completed in April 2002 (Inglis et al. 2006). A total of 270 species or higher taxa were identified. They consisted of 180 native species, 15 non-indigenous species, 20 cryptogenic species (those whose geographic origins are uncertain) and 55 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level). Two non-indigenous species and seven cryptogenic species sampled in the Port of Taranaki were recorded for the first time in New Zealand waters. These were the hydroid *Eudendrium capillare*, the ascidian *Cnemidocarpa* sp., the cryptogenic portunid crab, *Ovalipes elongatus*, an undescribed pycnogonid (*Achelia* sp. nov. A), an amphipod (*Leucothoe* sp. 1), and five species of sponge (*Esperiopsis* n. sp. 1, *Halichondria* n. sp. 4, *Halichondria* n. sp. 1, *Paraesperella* n. sp. 1, *Phorbas* n. sp. 2).

Since the first survey was completed, several species recorded in it have been re-classified as a result of new information or re-examination of specimens during identification of material from the repeat baseline survey. For example, the ascidian *Cnemidocarpa* sp. was subsequently re-identified as a native species (*Cnemidocarpa nisiotus*). The revised summary statistics for the initial baseline survey of the Port of Taranaki following re-classification was a total of 267 species, consisting of 178 native species, 14 non-indigenous species, 34 cryptogenic species and 41 species indeterminata. These revisions have been incorporated into the comparison of data from the two surveys below.

The 14 non-indigenous organisms described from the Port of Taranaki included representatives of six major taxonomic groups. The non-indigenous species detected were *Barantolla lepte* (Annelida); *Bugula flabellata, Bugula neritina, Bugula stolonifera, Cryptosula pallasiana, Tricellaria inopinata, Watersipora arcuata, Watersipora subtorquata* (Bryozoa); *Eudendrium capillare* (Cnidaria); *Crassostrea gigas, Theora lubrica* (Mollusca); *Griffithsia crassiuscula, Polysiphonia sertularioides* (Macroalgae), and *Halisarca dujardini*

(Porifera). None of the non-indigenous organisms collected and described from the Port of Taranaki was on the New Zealand register of unwanted organisms. However, two species included on the ABWMAC list of unwanted marine species in Australia, the Pacific oyster *Crassostrea gigas*, and cysts of the cryptogenic toxic dinoflagellate *Gymnodinium catenatum*, were present in the Port. Approximately 73 % (11 of 14 species) of non-indigenous species recorded in the Port of Taranaki initial baseline survey were likely to have been introduced in hull fouling assemblages, 7 % via ballast water and 20 % could have been introduced by either ballast water or hull fouling vectors.

Methods

SURVEY METHOD DEVELOPMENT

The sampling methods used in this survey were based on the CSIRO Centre for Research on Introduced Marine Pests (CRIMP) protocols developed for baseline port surveys in Australia (Hewitt and Martin 1996; Hewitt and Martin 2001). CRIMP protocols have been adopted as a standard by the International Maritime Organisation's Global Ballast Water Management Programme (GloBallast). Variations of these protocols are being applied to port surveys in many other nations. A group of New Zealand marine scientists reviewed the CRIMP protocols and conducted a workshop in September 2001 to assess their feasibility for surveys in this country (Gust et al. 2001). A number of recommendations for modifications to the protocols ensued from the workshop and were implemented in surveys throughout New Zealand. The modifications were intended to ensure cost effective and efficient collection of baseline species data for New Zealand ports and marinas. The modifications made to the CRIMP protocols and reasons for the changes are summarised in Table 9. Further details are provided in Gust et al. (2001).

Baseline survey protocols are intended to sample a variety of habitats within ports, including epibenthic fouling communities on hard substrata, soft-sediment communities, mobile invertebrates and fishes, and dinoflagellates. Below, we describe the methods and sampling effort used for the second survey of the Port of Taranaki. The survey was undertaken between March 14th and 18th, 2005.

DIVER OBSERVATIONS AND COLLECTIONS ON WHARF PILES

Fouling assemblages were sampled on four pilings at each berth. Selected pilings were separated by 10 – 15 m and comprised two pilings on the outer face of the berth and, where possible, two inner pilings beneath the berth (Gust et al. 2001). On each piling, four quadrats (40 cm x 25 cm) were fixed to the outer surface of the pile at water depths of approximately -0.5 m, -1.5 m, -3.0 m and -7 m. A diver descended slowly down the outer surface of each pile and filmed a vertical transect from approximately high water to the base of the pile, using a digital video camera in an underwater housing. On reaching the sea floor, the diver then ascended slowly and captured high-resolution still images of each quadrat using the photo capture mechanism on the video camera. Because of limited visibility, four overlapping still images, each covering approximately ¼ of the area of the quadrat were taken for each quadrat. A second diver then removed fouling organisms from the piling by scraping the organisms inside each quadrat into a 1-mm mesh collection bag, attached to the base of the quadrat (Figure 7). Once scraping was completed, the sample bag was sealed and returned to the laboratory for processing. The second diver also made a visual search of each piling for potential invasive species and collected samples of large conspicuous organisms not represented in quadrats. Opportunistic visual searches were also made of breakwalls and rock facings within the commercial port area. Divers swam vertical profiles of the structures and collected specimens that could not be identified reliably in the field.

BENTHIC FAUNA

Benthic infauna was sampled using a Shipek grab sampler deployed from a research vessel moored adjacent to the berth (Figure 8), with samples collected from within 5 m of the edge of the berth. The Shipek grab removes a sediment sample of ~3 *l* and covers an area of approximately 0.04 m^2 on the seafloor to a depth of about 10 cm. It is designed to sample unconsolidated sediments ranging from fine muds and sands to hard-packed clays and small cobbles. Because of the strong torsion springs and single, rotating scoop action, the Shipek grab is generally more efficient at retaining samples intact than conventional VanVeen or Smith McIntyre grabs with double jaws (Fenwick *pers obs*). Three grab samples were taken at haphazard locations along each sampled berth. Sediment samples were washed through a 1-mm mesh sieve and animals retained on the sieve were returned to the field laboratory for sorting and preservation.

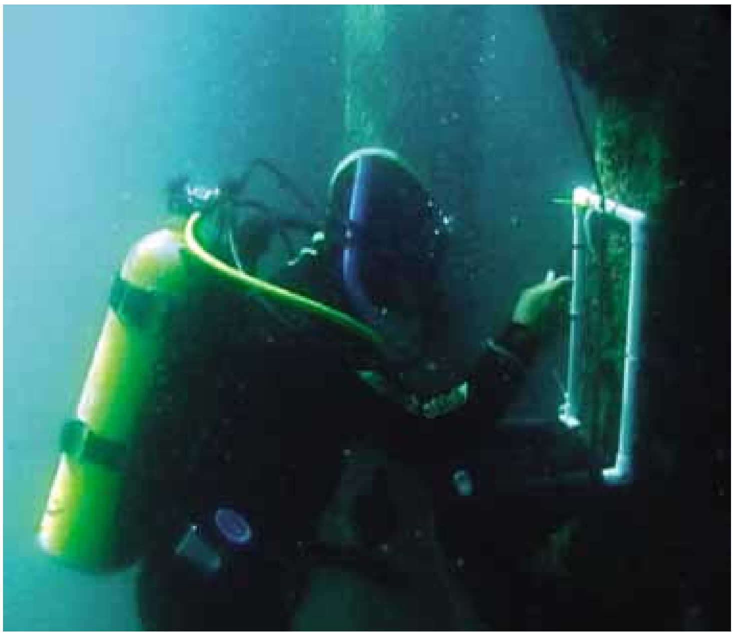

Figure 7: Diver sampling organisms on pier piles.

Figure 8: Shipek grab sampler: releasing benthic sample into bucket

EPIBENTHOS

Larger benthic organisms were sampled using an Ocklemann sled (hereafter referred to as a "sled"). The sled is approximately one meter long with an entrance width of ~0.7 m and height of 0.2 m. A short yoke of heavy chain connects the sled to a tow line (Figure 9). The mouth of the sled partially digs into the sediment and collects organisms in the surface layers to a depth of a few centimetres. Runners on each side of the sled prevent it from sinking completely into the sediment so that shallow burrowing organisms and small, epibenthic fauna pass into the exposed mouth. Sediment and other material that enters the sled is passed through a mesh basket that retains organisms larger than about 2 mm. Sleds were towed for a standard time of two minutes at approximately two knots. During this time, the sled typically traversed between 80 – 100 m of seafloor before being retrieved. Two to three sled tows were completed adjacent to each sampled berth within the port, and the entire contents were sorted.

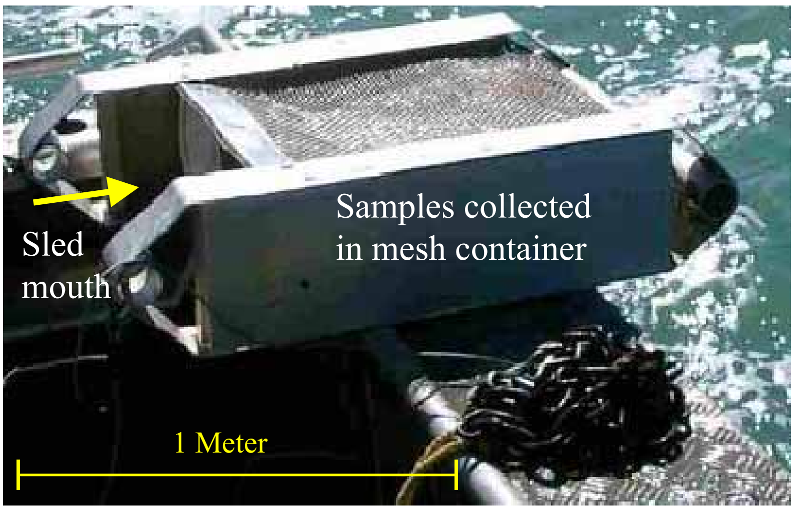

Figure 9: Benthic sled

SEDIMENT SAMPLING FOR CYST-FORMING SPECIES

A TFO gravity corer (hereafter referred to as a “javelin corer”) was used to take small sediment cores for dinoflagellate cysts (Figure 10). The corer consists of a 1.0-m long x 1.5-cm diameter hollow stainless steel shaft with a detachable 0.5-m long head (total length = 1.5 m). Directional fins on the shaft ensure that the javelin travels vertically through the water so that the point of the sampler makes first contact with the seafloor. The detachable tip of the javelin is weighted and tapered to ensure rapid penetration of unconsolidated sediments to a depth of 20 to 30 cm. A thin (1.2 cm diameter) sediment core is retained in a perspex tube within the hollow spearhead. In muddy sediments, the corer preserves the vertical structure of the sediments and fine flocculant material on the sediment surface more effectively than hand-held coring devices (Matsuoka and Fukuyo 2000). The javelin corer is deployed and retrieved from a small research vessel. Cyst sample sites were not constrained to the berths sampled by pile scraping and trapping techniques. Sampling focused on high sedimentation areas within the Port and avoided areas subject to strong tidal flow. On retrieval, the perspex tube was removed from the spearhead and the top 5 cm of sediment retained for analysis. Sediment samples were kept on ice and refrigerated prior to culturing. Culture procedures generally followed those described by Hewitt and Martin (2001).

MOBILE EPIBENTHOS

Benthic scavengers and fishes were sampled using a variety of baited trap designs described below.

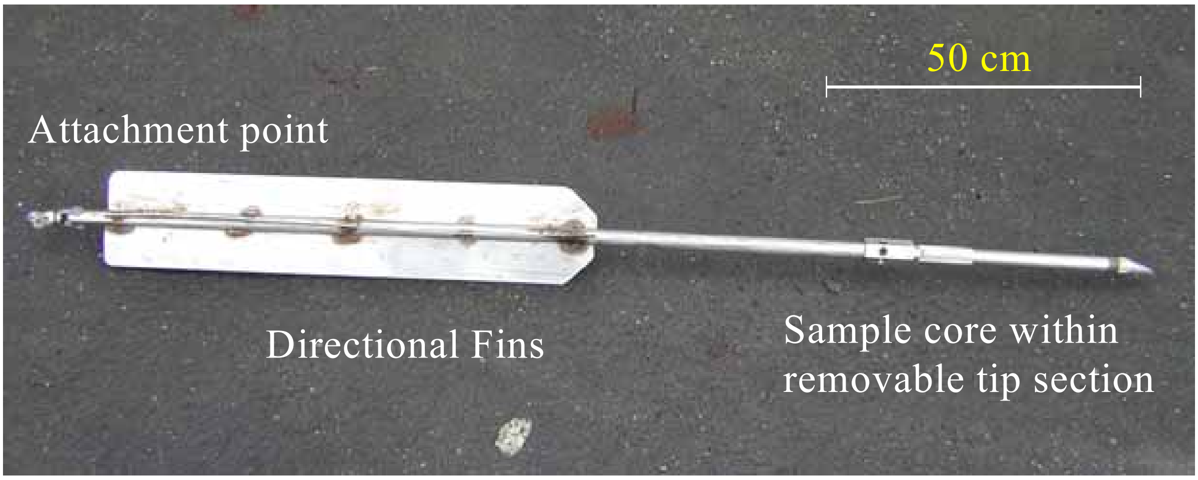

Figure 10: Javelin corer

Opera house fish traps

Opera house fish traps (1.2 m long x 0.8 m wide x 0.6 m high) were used to sample fishes and other bentho-pelagic scavengers (Figure 11). These traps were covered in 1-cm^2 mesh netting and had entrances on each end consisting of 0.25 m long tunnels that tapered in diameter from 40 to 14 cm. The trap was baited with two dead pilchards (*Sardinops neopilchardus*) held in plastic mesh suspended in the centre of the trap. Two trap lines, each containing two opera house traps were set for a period of 1 hour at each site before retrieval. Previous studies have shown opera house traps to be more effective than other types of fish trap and that consistent catches are achieved with soak times of 20 to 50 minutes (Ferrell et al. 1994; Thrush et al. 2002).

Box traps

Fukui-designed box traps (63 cm x 42 cm x 20 cm) with a 1.3 cm mesh netting were used to sample mobile crabs and other small epibenthic scavengers (Figure 11). A central mesh bait holder containing two dead pilchards was secured inside the trap. Organisms attracted to the bait enter the traps through slits in inward sloping panels at each end. Two trap lines, each containing two box traps, were set on the sea floor at each site and left to soak overnight before retrieval.

Starfish traps

Starfish traps designed by Whayman-Holdsworth were used to catch asteroids and other large benthic scavengers (Figure 11). These are circular hoop traps with a basal diameter of 100 cm and an opening on the top of 60 cm diameter. The sides and bottom of the trap are covered with 26-mm mesh and a plastic, screw-top bait holder is secured in the centre of the trap entrance (Andrews et al. 1996). Each trap was baited with two dead pilchards. Two trap lines, each with two starfish traps were set on the sea floor at each site and left to soak overnight before retrieval.

Shrimp traps

Shrimp traps were used to sample small, mobile crustaceans. They consisted of a 15 cm plastic cylinder with a 5-cm diameter screw top lid in which a funnel had been fitted. The funnel had a 20-cm entrance that tapered in diameter to 1 cm. The entrance was covered with 1-cm plastic mesh to prevent larger animals from entering and becoming trapped in the funnel entrance. Each trap was baited with a single dead pilchard. Two trap lines, each containing two scavenger traps, were set on the sea floor at each site and left to soak overnight before retrieval.

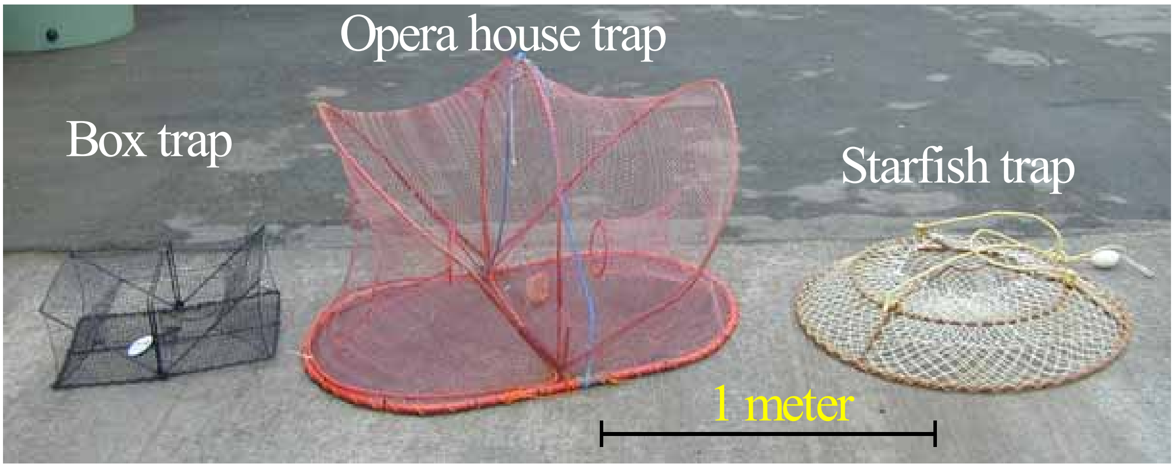

Figure 11: Trap types deployed in the port.

VISUAL SEARCHES

Opportunistic visual searches from above water were conducted at three sites in the port (Blyde Wharf, Breakwater No. 1 and the yacht moorings). Observers searched for non-indigenous organisms fouling breakwalls, pilings, jetties and associated structures.

SAMPLING EFFORT

A summary of sampling effort during second baseline survey of the Port of Taranaki is provided in Table 10, and exact locations of each sample site are provided in Appendix 2. We particularly focused sampling effort on hard substrata within ports (such as pier piles and wharves) where invasive species are likely to be found (Hewitt and Martin 2001), and increased the number of quadrats sampled on each pile relative to the CRIMP protocols, as well as sampling both shaded and unshaded piles. The distribution of effort within ports aimed to maximise spatial coverage and represent the diversity of active berthing sites within the area. Total sampling effort was constrained by the costs of processing and identifying specimens obtained during the survey.

During the initial baseline survey, most sample effort was concentrated around four berths – Blyde Wharf, Breakwater No. 2, Moturoa Wharf and the Newton King Tanker Terminal No. 2 (Figure 2). Additional trap, benthic grab, benthic sled and cyst samples were taken at several other locations throughout the port (Table 10 and Inglis et al. 2006). The four main berths sampled in the first survey were sampled again during the re-survey of the port for all methods, except pile scrape sampling was conducted at Breakwater No. 1 instead of Breakwater No. 2. To improve description of the flora and fauna in the resurvey, we increased sampling effort by adding an additional site (the marina yacht moorings) for all survey techniques, and sampling effort was further increased for benthic grabs, benthic sleds and fish, crab and starfish traps (Table 10).

The spatial distribution of sampling effort for each of the sample methods in the Port of Taranaki is indicated in the following figures: diver pile scrapings (Figure 12), benthic sledding (Figure 13), box, starfish and shrimp trapping (Figure 14), opera house fish trapping (Figure 15), shipek grab sampling (Figure 16), javelin cyst coring (Figure 17) and above-water visual searches (Figure 18).

SORTING AND IDENTIFICATION OF SPECIMENS

Each sample collected in the diver pile scrapings, benthic sleds, box, starfish and shrimp traps, opera house fish traps, shipek grabs and javelin cores was allocated a unique code on waterproof labels and transported to a nearby field laboratory where it was sorted by a team into broad taxonomic groups (e.g. ascidians, barnacles, sponges etc.). These groups were then preserved and individually labelled. Details of the preservation techniques varied for many of the major taxonomic groups collected, and the protocols adopted and preservative solutions used are indicated in

Table 11. Specimens were subsequently sent to over 25 taxonomic experts (Appendix 3) for identification to species or lowest taxonomic unit (LTU). We also sought information from each taxonomist on the known biogeography of each species within New Zealand and overseas. Species lists compiled for each port were compared with the marine species listed on the New Zealand register of unwanted organisms under the Biosecurity Act 1993 (Table 12) and the marine pest list produced by the Australian Ballast Water Management Advisory Council (Table 13).

5 % Formalin solution	10 % Formalin solution	70 % Ethanol solution	80 % Ethanol solution	100 % Ethanol solution
Macroalgae	Ascidiacea (colonial) [1, 2]	Alcyonacea [2]	Ascidiacea (solitary) [1]	Bryozoa
	Asteroidea	Crustacea (small)		
	Brachiopoda	Holothuria [1, 2]		
	Crustacea (large)	Mollusca (with shell)		
	Ctenophora [1]	Mollusca [1, 2] (without shell)		
	Echinoidea	Platyhelminthes [1, 3]		
	Hydrozoa	Porifera [1]		
	Nudibranchia [1]	Zoantharia [1, 2]		
	Ophiuroidea			
	Polychaeta			
	Scleractinia			
	Scyphozoa [1, 2]			
	Vertebrata [1] (pisces)			

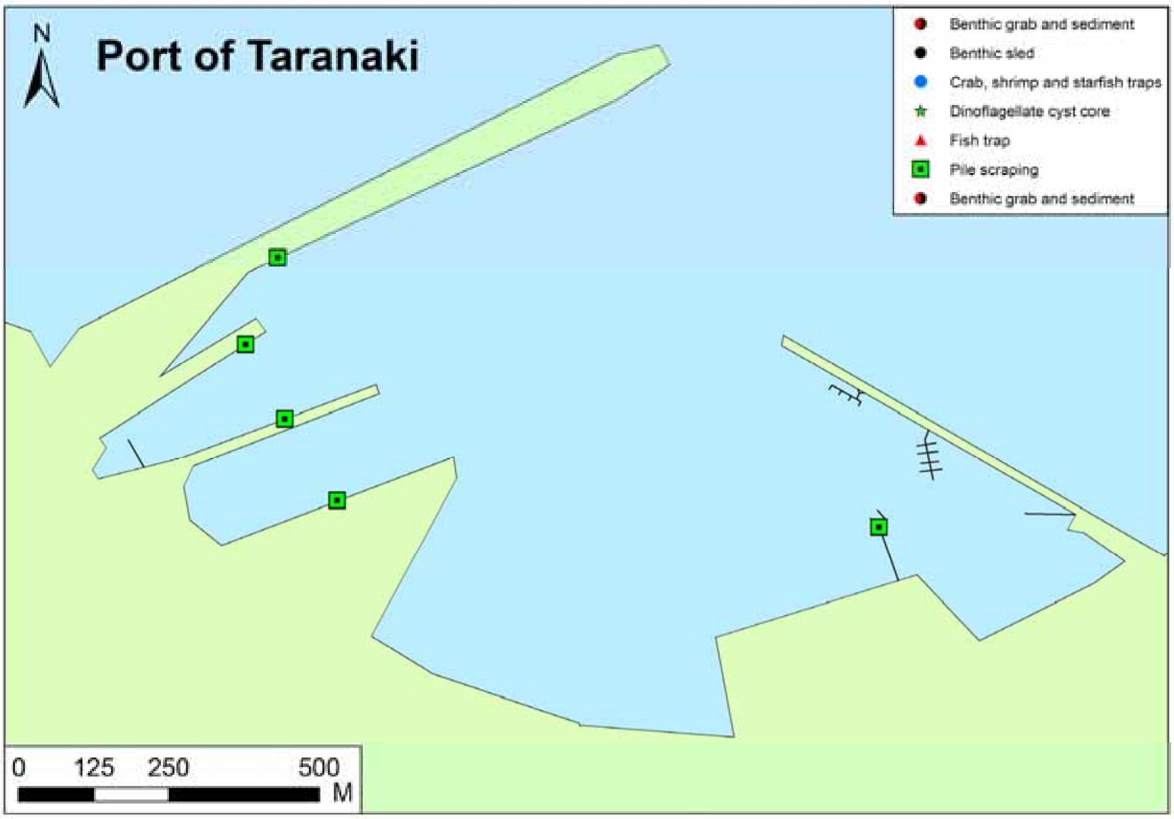

Figure 12: Diver pile scraping sites

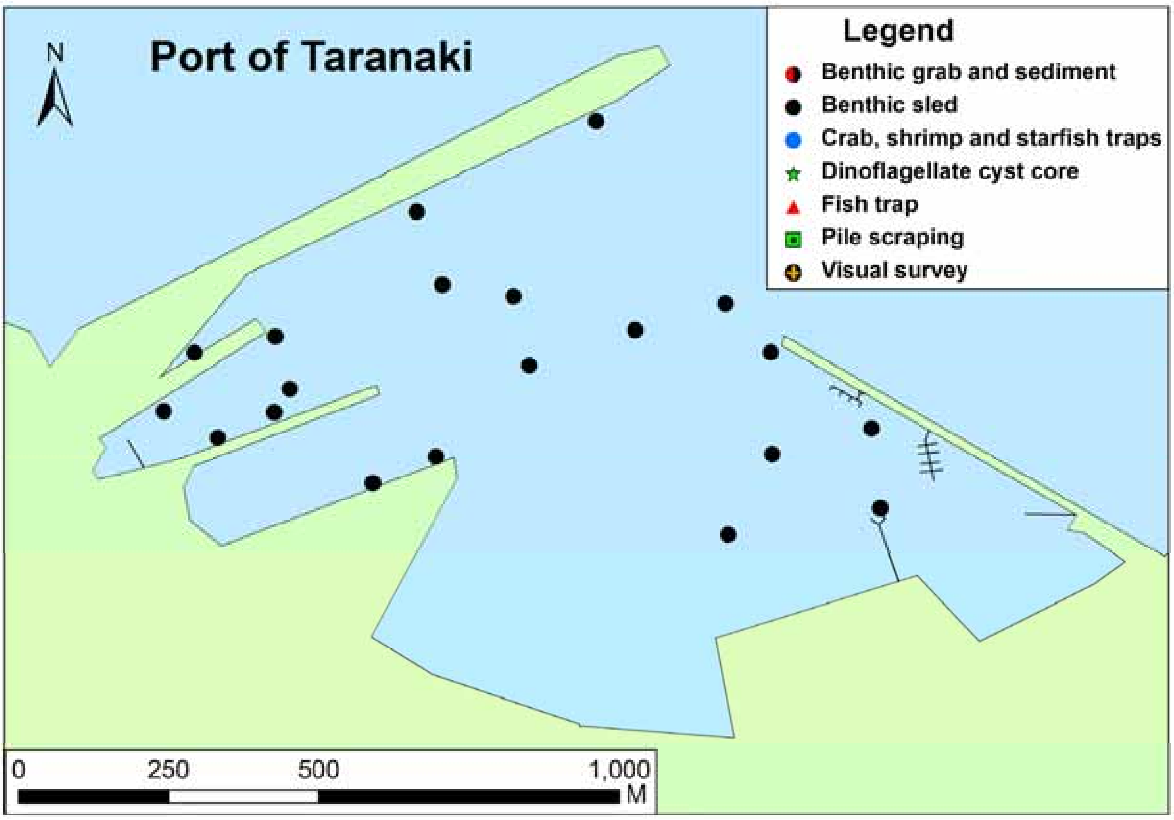

Figure 13: Benthic sled sites

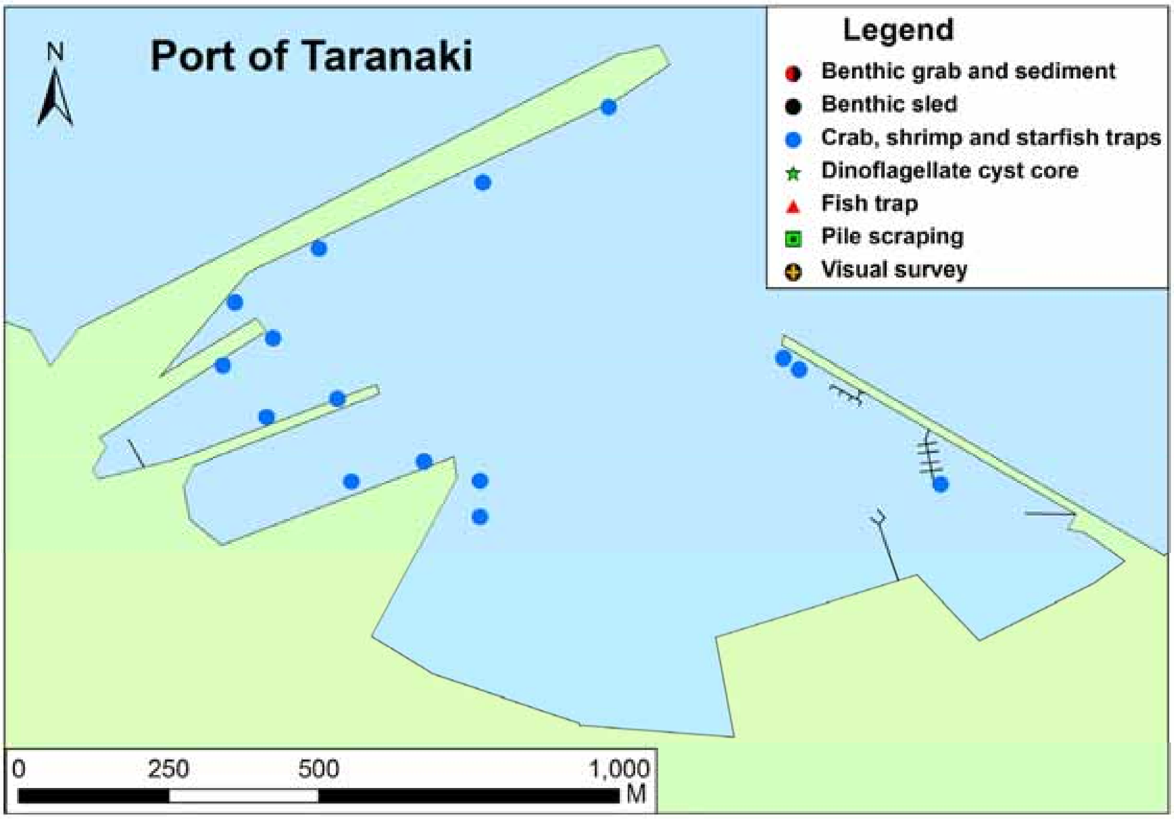

Figure 14: Sites trapped using box (crab), shrimp and starfish traps

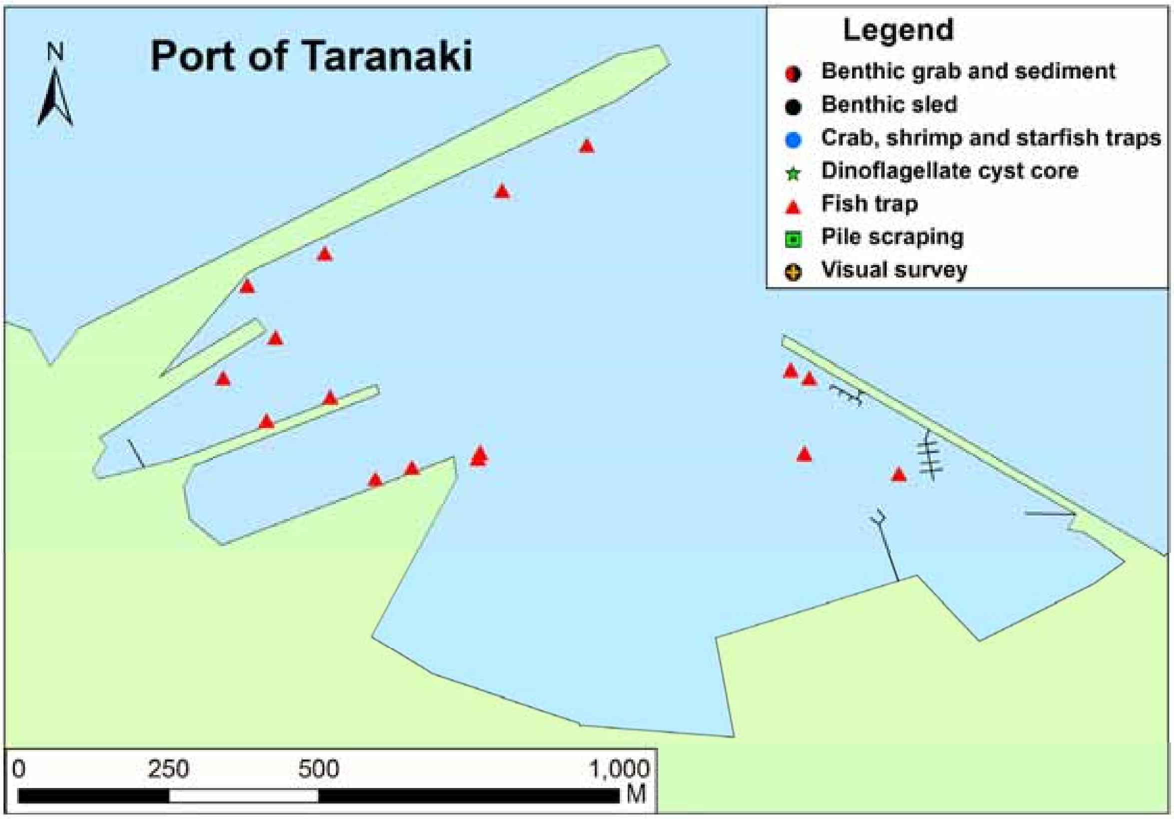

Figure 15: Opera house (fish) trapping sites

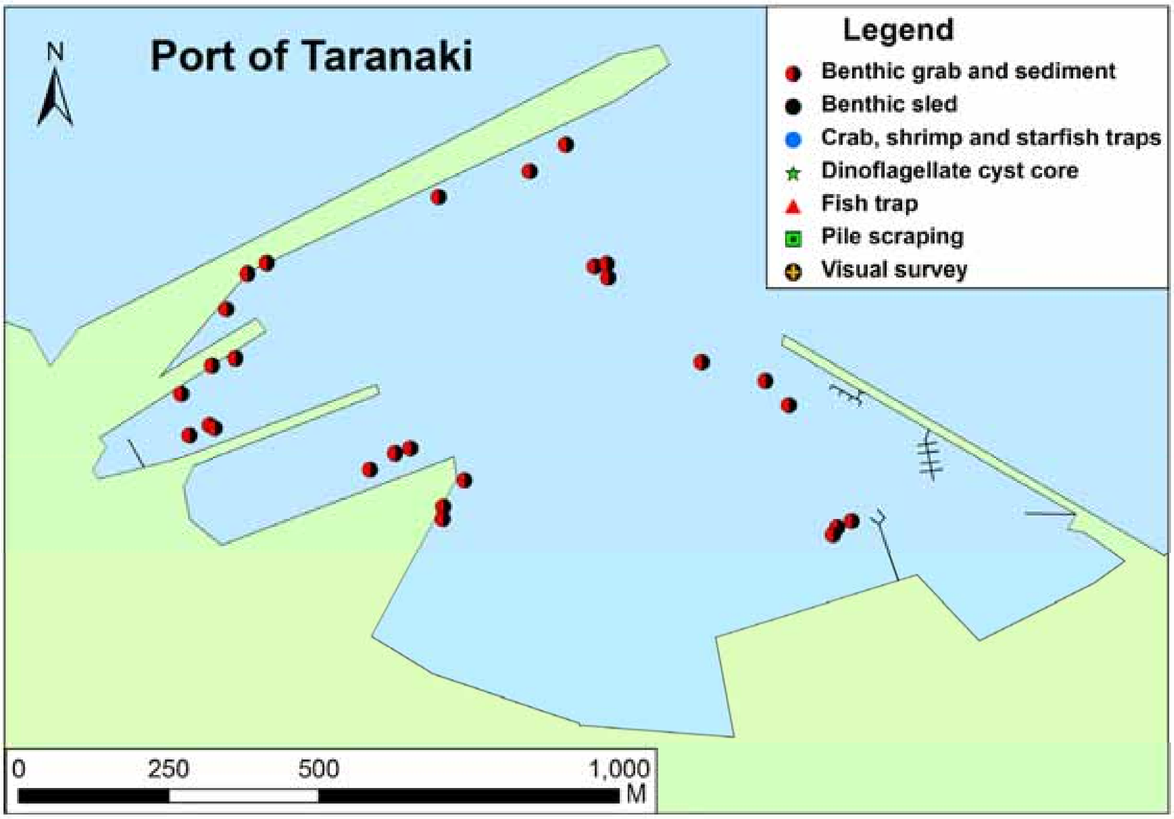

Figure 16: Shipek benthic grab sites

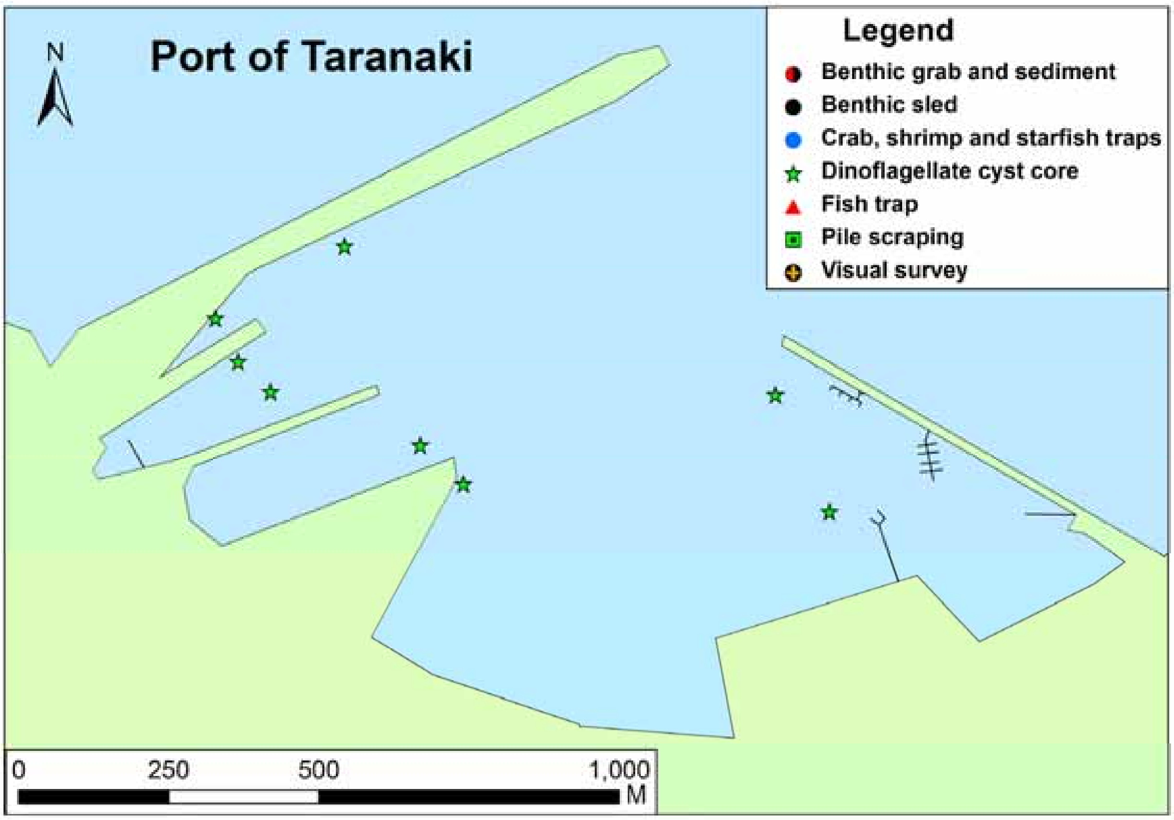

Figure 17: Javelin core sites

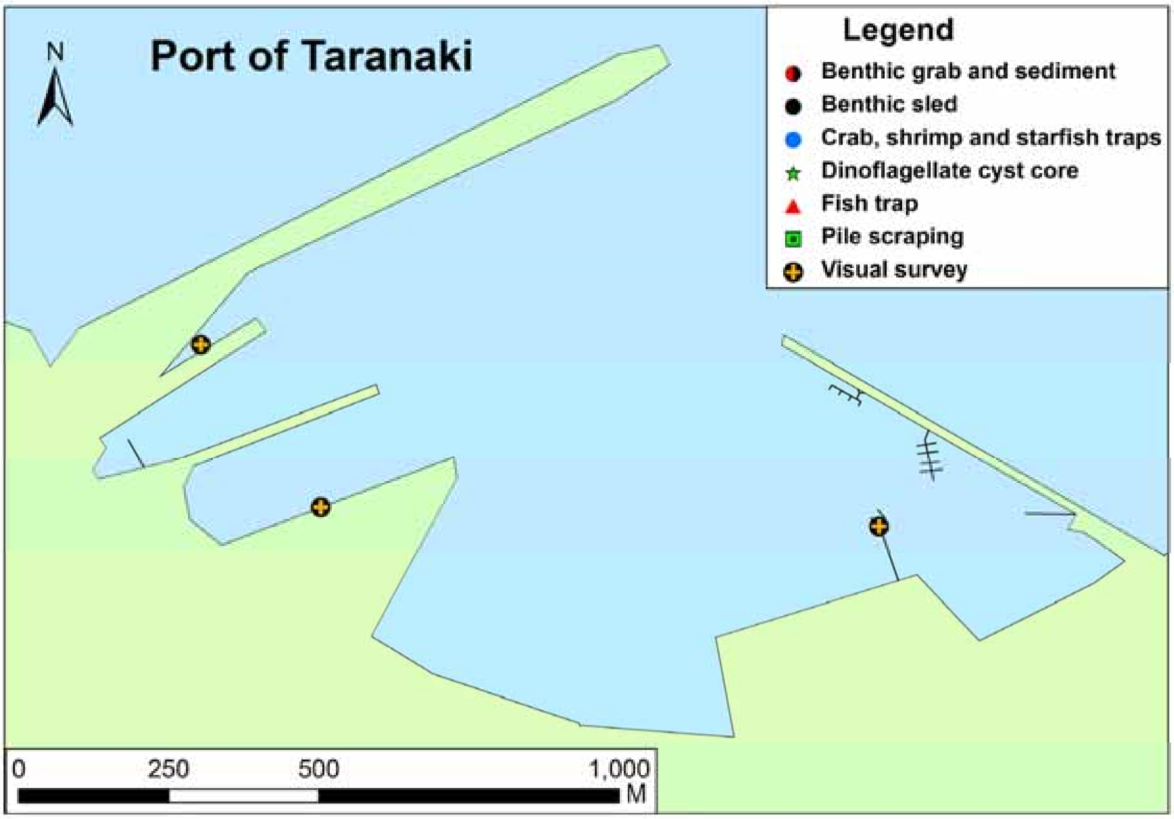

Figure 18: Above-water visual search sites

DEFINITIONS OF SPECIES CATEGORIES

Each species recovered during the survey was classified into one of four categories that reflected its known or suspected geographic origin. To do this we used the experience of taxonomic experts and reviewed published literature and unpublished reports to collate information on the species' biogeography.

Patterns of species distribution and diversity in the oceans are complex and still poorly understood (Warwick 1996). Worldwide, many species still remain undescribed or undiscovered and their biogeography is incomplete. These gaps in global marine taxonomy and biogeography make it difficult to reliably determine the true range and origin of many species. The four categories we used reflect this uncertainty. Species that were not demonstrably native or non-indigenous were classified as "cryptogenic" (sensu Carlton 1996). Cryptogenesis can arise because the species was spread globally by humans before scientific descriptions of marine flora and fauna began in earnest (i.e. historical introductions). Alternatively the species may have been discovered relatively recently and there is insufficient biogeographic information to determine its native range. We have used two categories of cryptogenesis to distinguish these different sources of uncertainty. In addition, a fifth category ("species indeterminata") was used for specimens that could not be identified to species-level. Formal definitions for each category are given below.

Native species

Native species have occurred within the New Zealand biogeographical region historically and have not been introduced to coastal waters by human mediated transport.

Non-indigenous species (NIS)

Non-indigenous species (NIS) are known or suspected to have been introduced to New Zealand as a result of human activities. They were determined using a series of questions posed as a guide by Chapman and Carlton (1991; 1994); as exemplified by Cranfield et al. (1998).

1. Has the species suddenly appeared locally where it has not been found before?
2. Has the species spread subsequently?
3. Is the species' distribution associated with human mechanisms of dispersal?
4. Is the species associated with, or dependent on, other non-indigenous species?
5. Is the species prevalent in, or restricted to, new or artificial environments?
6. Is the species' distribution restricted compared to natives?

The worldwide distribution of the species was tested by a further three criteria:

7. Does the species have a disjunctive worldwide distribution?
8. Are dispersal mechanisms of the species inadequate to reach New Zealand, and is passive dispersal in ocean currents unlikely to bridge ocean gaps to reach New Zealand?
9. Is the species isolated from the genetically and morphologically most similar species elsewhere in the world?

In this report we distinguish two categories of NIS. "NIS" refers to non-indigenous species previously recorded from New Zealand waters, and "NIS (new)" refers to non-indigenous species first discovered in New Zealand waters during this project.

Cryptogenic species Category 1

Species previously recorded from New Zealand whose identity as either native or non-indigenous is ambiguous. In many cases this status may have resulted from their spread around the world in the era of sailing vessels prior to scientific survey (Chapman and Carlton 1991; Carlton 1992), such that it is no longer possible to determine their original native distribution. Also included in this category are newly described species that exhibited invasive behaviour in New Zealand (Criteria 1 and 2 above), but for which there are no known records outside the New Zealand region.

Cryptogenic species Category 2

Species that have recently been discovered but for which there is insufficient systematic or biogeographic information to determine whether New Zealand lies within their native range. This category includes previously undescribed species that are new to New Zealand and/or science.

Species indeterminata

Specimens that could not be reliably identified to species level. This group includes: (1) organisms that were damaged or juvenile 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.

DATA ANALYSIS

Comparison with the initial baseline survey

Several approaches were used to compare the results of the current survey with the earlier baseline survey of the Port of Taranaki, completed in 2002 (Inglis et al. 2006).

Summary statistics were compiled on the total number of species and major taxonomic groups found in each survey and on the numbers of species in each biogeographic category (i.e. native, non-indigenous, etc) recovered by each survey method. Several taxa (Order Tanaidacea (tanaids), Class Scyphozoa (jellyfish), Phylum Platyhelminthes (flatworms) and Class Anthozoa (sea anemones)) were specifically excluded from analyses as, at the time the reports were prepared, we had been unable to secure identification of specimens from the resurvey.

While these summary data give the numbers of species actually observed in each survey they do not, by themselves, provide a robust basis for comparison, since they do not account for differences in sample effort between the surveys, variation in the relative abundance of species at the time of each survey (for a discussion of these issues, see Gotelli and Colwell 2001), or the actual species composition of the recorded assemblages. The latter is important if port surveys are to be used to estimate and monitor the rate of new incursions by non-indigenous species.

In any single survey, the number of species observed will always be less than the actual number present at the site. This is because a proportion of species remain undetected due to bias in the survey methods, local rarity, or insufficient sampling effort. A basic tenet of sampling biological assemblages is that the number of species observed will increase as more samples are taken, but that the rate at which new species are added to the survey tends to decline and gradually approaches an asymptote that represents the total species richness of the assemblage (Colwell and Coddington 1994). In very diverse assemblages, however, where a large proportion of the species are rare, this asymptote is not reached, even when very large numbers of samples are taken. In these circumstances, comparisons between surveys are complicated by the large number of species that remain undetected in each survey. This issue has received considerable attention in recent literature and new statistical methods have been developed to allow better comparisons among surveys (Gotelli and Colwell 2001; Colwell et al. 2004; Chao et al. 2005). We use several of these new techniques – sample-based rarefaction curves (Colwell et al. 2004), non-parametric species richness estimators (Colwell and Coddington 1994), and bias-adjusted similarity indices (Chao et al. 2005) - to compare results from the two surveys of the Port of Taranaki.

Sample-based rarefaction curves

Sample-based rarefaction curves depict the number of species that would be expected in a given number of samples (*n*) taken from the survey area, where $n_{(max)}$ is the total number of samples taken in the field survey. The shape of the curves and the number of species expected for a given *n* can be used as the basis for comparing the surveys and evaluating the benefit of reducing or increasing sample effort in subsequent surveys (Gotelli and Colwell 2001). For each baseline survey we computed separate sample-based rarefaction curves (Gotelli and Colwell 2001) for each survey method. The curves were computed from the presence or absence of each recorded species in each sample unit (i.e. replicated incidence data) using the analytical formula developed by Colwell et al. (2004) (the Mau Tau index) and the software *EstimateS* (Colwell 2005).

Separate curves were computed for each of six methods: pile scraping, benthic sleds, benthic grabs, crab traps, fish traps and starfish traps. The remaining methods did not usually recover enough taxa to allow meaningful analyses. For pile scrapes, only quadrat samples were used; specimens collected on qualitative visual searches of piles were not included. Since the purpose of the port surveys is primarily inventory of non-indigenous species, we generated separate curves for native species, cryptogenic category 2 species, and the combined species pool of non-indigenous and cryptogenic category 1 taxa, where there were sufficient numbers of taxa to produce meaningful curves (arbitrarily set at > 8 taxa per category). This was possible for pile scrapes and benthic sleds; for the other survey methods, all taxa (excluding species indeterminata) were pooled in order to have sufficient numbers of taxa.

Note that, by generating rarefaction curves we are assuming that the samples can reasonably be considered a random sample from the same universe (Gotelli and Colwell 2001). Strictly, this does not represent the way that sample units were allocated in the survey. For example, quadrat samples were taken from fixed depths on inner and outer pilings at each berth, rather than distributed randomly throughout the ‘universe’ of pilings in the port. Previously, we showed that there is greater dissimilarity between assemblages in these strata than between replicates taken within each stratum, although the difference is marginal (range of average similarity between strata = 22%-30% and between samples = 25%-35 %, Inglis et al. 2003). This stratification is an example of the common tension in biodiversity surveys between optimising the complementarity of samples (i.e. reducing overlap or redundancy in successive samples so that the greatest number of species is included) and adequate description of diversity within a particular stratum (Colwell and Coddington 1994). In practice, no strategy for sampling biodiversity is completely random or unbiased. The effect of the stratification is likely to be an increase in the heterogeneity of the samples, equivalent to increasing the patchiness of species distribution across quadrats. This is likely to mean slower initial rate of accumulation of new species and slower accumulation of rare species (Chazdon et al. 1998). Because the same survey strategy was used in both port surveys, this systematic bias should not unduly affect comparisons between the two surveys. Furthermore, preliminary trials, where we pooled quadrat samples to form more homogenous units (e.g. piles or berths as the sample unit) and compared the curves to total randomisation of the smallest unit (quadrats), had little effect on the rate of accumulation (Inglis et al. 2003).

Estimates of total species richness

Estimates of total species richness (or more appropriately total "species density") in each survey were calculated using the Chao 2 estimator. This is a non-parametric estimate of the true number of species in an assemblage that is calculated using the numbers of rare species (those that occur in just one or two sample units) in the sample (Colwell and Coddington 1994). That is, it estimates the total number of species present, including the proportion that was present, but not detected by the survey ("unseen" species). As recommended by Chao (in Colwell 2005), we used the bias-corrected Chao 2 formula, except when the CV > 0.5, in which case the estimates were recalculated using the Chao 2 classic formula, and the higher of the Chao 2 classic and the ICE (Incidence-based Coverage Estimator) was reported.

Plots of the relationship between the species richness estimates and sample size were compared with the sample-based rarefaction curve for each combination of survey, method, and species category. Convergence of the observed (the rarefaction curve) and estimated (Chao 2 or ICE curve) species richness provides evidence of a relatively thorough inventory (Longino et al. 2002).

Similarity analyses

A range of indices is available to measure the compositional similarity of samples from biological assemblages using presence-absence data (Koleff et al. 2003). Many of these are based on the relative proportions of species that are common to both samples ("shared species") or which occur in only a single sample. The classic indices typically perform poorly for species rich assemblages and are sensitive to sample size, since they do not account for the detection probabilities of rare ("unseen") species. Chao et al. (2005) have recently developed new indices based on the classic Jaccard and Sorenson similarity measures that incorporate the effects of unseen species. We used the routines in EstimateS (Colwell 2005) to compare samples from the two surveys using the new Chao estimators, but also report the classic Jaccard and Sorenson measures. Separate comparisons were done for each combination of survey method and species category where there were sufficient taxa (see above).

Survey results

A total of 269 species or higher taxa were identified from the Taranaki Port survey. This collection consisted of 180 native (Table 14), 27 cryptogenic (Table 15), 13 non-indigenous species (Table 16) and 49 species indeterminata (Table 17, Figure 19). By comparison, 267 taxa were recorded from the initial survey of the port, comprising 178 native, 34 cryptogenic, 14 non-indigenous species and 41 species indeterminata.

The biota included a diverse array of organisms from 12 major taxonomic groups (Figure 20). For general descriptions of the main groups of organisms (major taxonomic groups) encountered during this study refer to Appendix 4, and for detailed species lists collected using each method refer to Appendix 6.

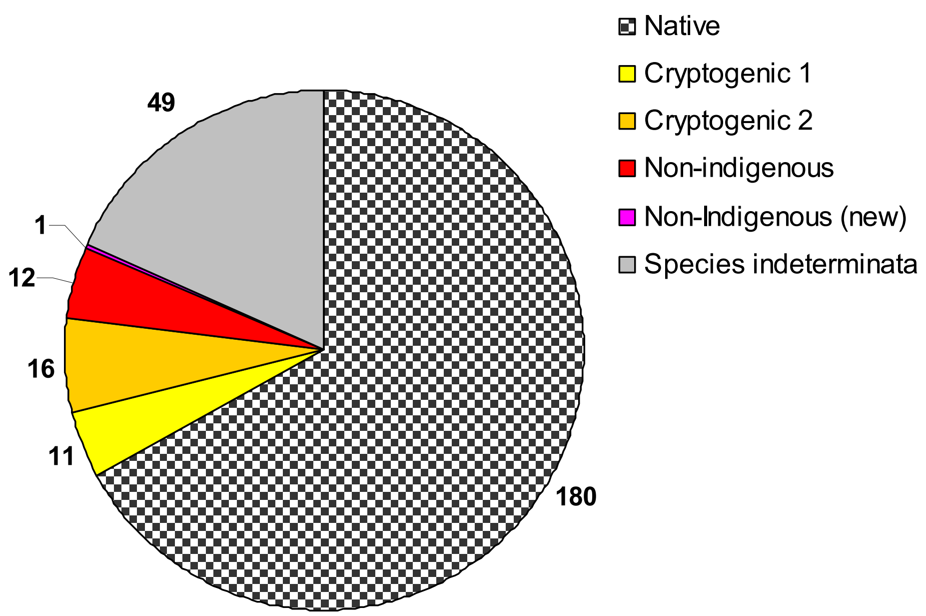

Figure 19: **Diversity of marine species sampled in the Port of Taranaki. Values indicate the number of taxa in each category**

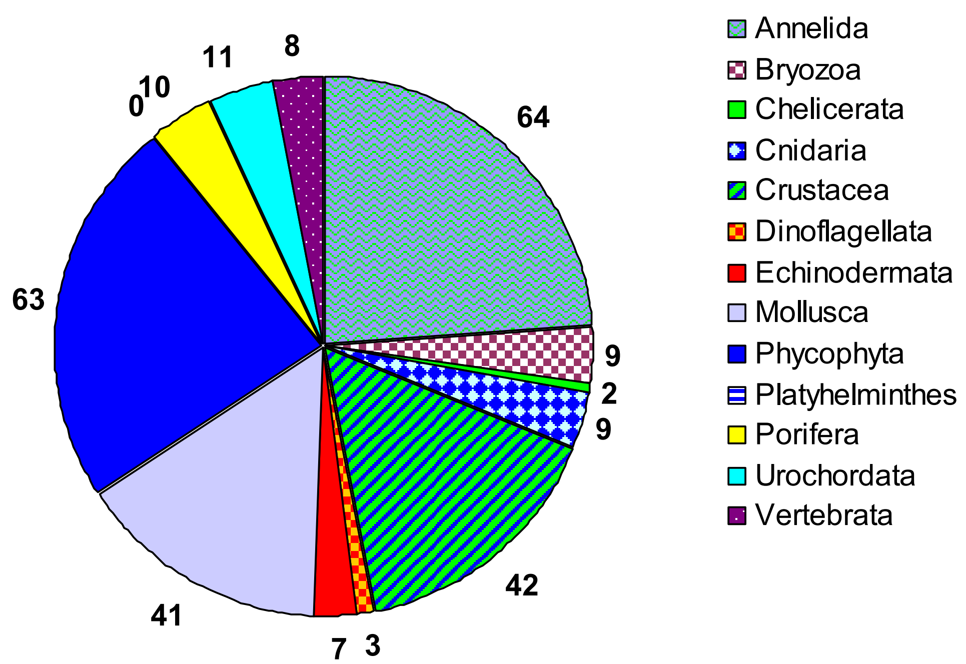

Figure 20: **Major taxonomic groups sampled in the Port of Taranaki. Values indicate the number of taxa in each of the major taxonomic groups.**

NATIVE SPECIES

The 180 native species recorded during the resurvey of the Port of Taranaki represented 67 % of all species identified from this location (Table 14) and included annelids (41 species), algae (36 species), crustaceans (32 species), molluscs (35 species), bryozoans (4 species), porifera (5 species), urochordates (8 species), vertebrates (7 species), echinoderms (7 species), dinoflagellates (1 species) and cnidarians (4 species; Table 14).

CRYPTOGENIC SPECIES

Twenty-seven cryptogenic species were recorded in the repeat survey of the Port of Taranaki, representing 10 % of all species or higher taxa identified from the Port. The cryptogenic organisms identified included 11 Category 1 and 16 Category 2 species as defined in "Definitions of species categories" above. These organisms included 10 annelids, 1 chelicerate, 2 cnidarians, 5 crustaceans, 1 dinoflagellate, 5 porifera, and 3 ascidian species (Table 15). Five of the Category 1 cryptogenic species (the polychaetes *Capitella capitata* and *Heteromastus filiformis,* the hydroid *Clytia hemisphaerica,* the amphipod *Aora typica* and the ascidian *Microcosmus squamiger*) were not recorded in the initial baseline survey of the port. Six of the 13 Category 1 species recorded in the initial baseline survey of the Port of Taranaki were not found during the re-survey (the bryozoan *Scruparia ambigua*, the crab *Plagusia chabrus,* and the ascidians *Diplosoma listerianum, Botryllioides leachii, Microcosmus australis* and *Styela plicata*). Several of the Category 1 cryptogenic species (the ascidians *Astereocarpa cerea* and *Corella eumyota*) have been present in New Zealand for more than 100 years but have distributions outside New Zealand that suggest non-native origins (Cranfield et al. 1998).

NON-INDIGENOUS SPECIES

Thirteen non-indigenous species (NIS) were recorded in the re-survey of the Port of Taranaki, representing 4.8% of all taxa recorded from this location (Table 16). They included 2 annelid worms, 4 bryozoans, 2 cnidarians, 1 crustacean, 2 molluscs and 2 phycophytes. By comparison, 14 NIS were found during the initial April 2002 survey. Five species (the polychaetes *Euchone limnicola,* the hydroids *Amphisbetia maplestonei* and *Monotheca pulchella*, the amphipod *Monocorophium sextonae* and the algae *Undaria pinnatifida*) found in the re-survey were not recorded during the initial survey. Six NIS recorded in the initial survey (the bryozoans *Bugula stolonifera, Tricellaria inopinata* and *Watersipora arcuata,* the hydroid *Eudendrium capillare,* the alga *Polysiphonia sertularioides* and the sponge *Halisarca dujardini*) were not recorded in the re-survey. One of the NIS (the hydroid *Amphisbetia maplestonei*) is new to New Zealand. It was recorded for the first time during re-surveys of the ports of Taranaki and Timaru. A list of Chapman and Carlton's (1994) criteria (see "Definitions of species categories", above) that were met by the non-indigenous species sampled in this survey is given in Appendix 5.

Below we summarise available information on the biology of each of these species, providing images where available, and indicate what is known about their distribution, habitat preferences and impacts. This information was sourced from published literature, the taxonomists listed in Appendix 3 and from regional databases on non-indigenous marine species in Australia (National Introduced Marine Pest Information System, Hewitt et al. 2002) and the USA (National Exotic Marine and Estuarine Species Information System, Fofonoff et al. 2003). Distribution maps for each NIS in the port are composites of multiple replicate samples. Where overlayed presence and absence symbols occur on the map, this indicates the NIS was found in at least one, but not all replicates at that GPS location. NIS are presented below by major taxonomic groups in the same order as Table 16.

***Euchone limnicola* Reish, 1959**

Image and information: NIMPIS (2002e)

Euchone limnicola is a sedentary worm, growing to 12 mm in length. The absence of a membranous flap over the anal depression is only seen in *E. limnicola* and is therefore used to distinguish this species from other *Euchone* species. A crown, comprised of 7 pairs of feeding appendages, is seen above the sediment, with the body of the worm in a tube below. *Euchone limnicola* is native to the USA west coast and has been introduced to Australia and New Zealand. It burrows into soft sediments, secreting a mucous layer to enable it to build firm burrow walls. It has been found subtidally to 24 m in Port Phillip Bay, Australia. *Euchone limnicola* establishes dense populations within the sediments, possibly competing with native species for food and space. The process of tube building consolidates the sediments, thereby altering the habitat for other organisms. During the initial port baseline surveys, *E. limnicola* was recorded from the ports of Gisborne and Timaru. During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki and Timaru (Table 18). In the Port of Taranaki *E. limnicola* occurred in benthic sled samples taken from Breakwater No. 1, Main Basin 1 and 2, Moturoa Wharf and the Newton King Tanker Terminal No. 2. It also occurred in benthic grab samples from Breakwater No. 1 and 2 (Figure 21).

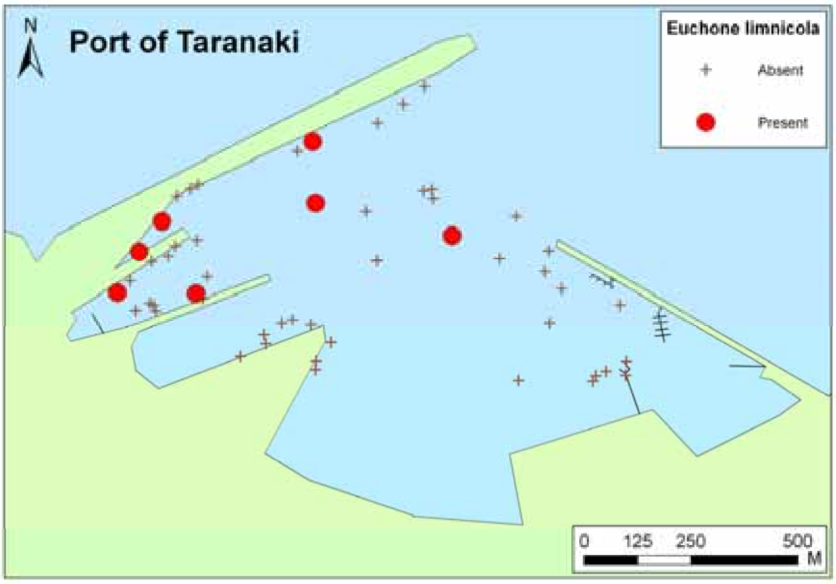

Figure 21: ***Euchone limnicola* distribution distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

***Barantolla lepte* (Hutchings, 1974)**
No image available.

Barantolla lepte is a small polychaete worm in the family Capitellidae. It is found predominantly in estuarine sublittoral muds and weed beds. The type specimen for this species was described from New South Wales, Australia. It is also known to occur in Victoria and Tasmania (Australian Faunal Directory 2005). The first New Zealand record of *B. lepte* was from the Port of Timaru in 1998 (G. read, NIWA, pers. comm.). During the initial baseline port surveys, it was recorded from the ports of Timaru, Napier and Taranaki (Table 18). In the Port of Taranaki, it occurred in benthic grab samples taken near the Moturoa Wharf (Figure 22). During the second baseline surveys of Group 1 ports *B. lepte* was recorded only from the Port of Taranaki, where it occurred in benthic grab samples from Breakwater No. 1, the Lee Breakwater, Newton King Tanker Terminal No. 2 and the yacht moorings (Figure 23).

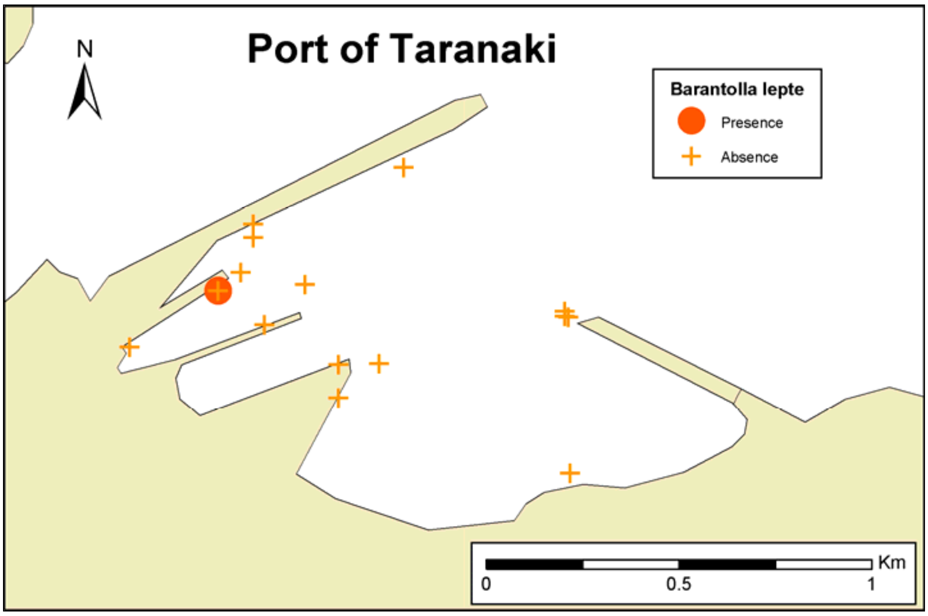

Figure 22: *Barantolla lepte* distribution in the initial baseline survey of the Port of Taranaki (April 2002).

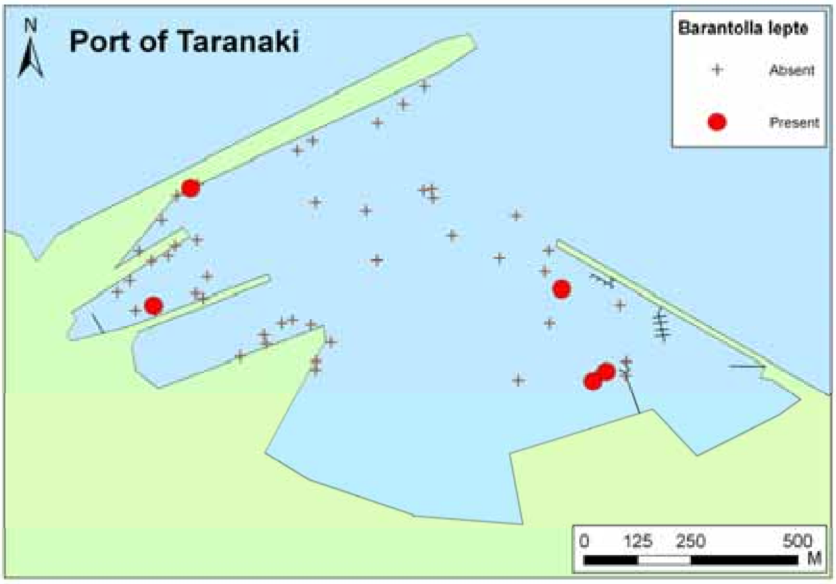

Figure 23: *Barantolla lepte* distribution in the repeat baseline survey of the Port of Taranaki (March 2005).

***Bugula flabellata* (Thompson in Gray, 1848)**

Image and information: NIMPIS (2002a)

Bugula flabellata is an erect bryozoan with broad, flat branches. It is a colonial organism and consists of numerous ‘zooids’ connected to one another. It is pale pink and can grow to about 4 cm high and attaches to hard surfaces such as rocks, pilings and pontoons or the shells of other marine organisms. It is often found growing with other erect bryozoan species such as *B. neritina* (see below) or growing on encrusting bryozoans. Vertical, shaded, sub-littoral rock surfaces also form substrata for this species. It has been recorded down to 35 m. *Bugula flabellata* is native to the British Isles and North Sea and has been introduced to Chile, Florida and the Caribbean and the northern east and west coasts of the USA, as well as Australia and New Zealand. It is cryptogenic on the Atlantic coasts of Spain, Portugal and France. *Bugula flabellata* is a major fouling bryozoan in ports and harbours, particularly on vessel hulls, pilings and pontoons and has also been reported from offshore oil platforms. *Bugula flabellata* has been present in New Zealand since at least 1949 and is present in most New Zealand ports. There have been no recorded impacts from *B. flabellata.* During the initial port baseline surveys it was recorded from Opua marina, Whangarei (Marsden Point and Whangarei Port), and the ports of Auckland, Tauranga, Napier, Taranaki, Wellington, Picton, Nelson, Lyttelton, Timaru, Dunedin and Bluff (Table 18). In the Port of Taranaki, *B. flabellata* occurred in benthic sled and pile scrape samples taken from near Blyde, Breakwater No. 1, Moturoa and Newton King Tanker Terminal Wharves (Figure 24). During the second baseline surveys of Group 1 ports it was recorded from the ports of Tauranga, Taranaki, Wellington, Picton, Nelson, Lyttelton and Timaru. In the Port of Taranaki *B. flabellata* occurred in pile scrape samples taken from the Blyde and Moturoa wharves, Breakwater No. 1 and the Newton King Tanker Terminal No. 2 (Figure 25).

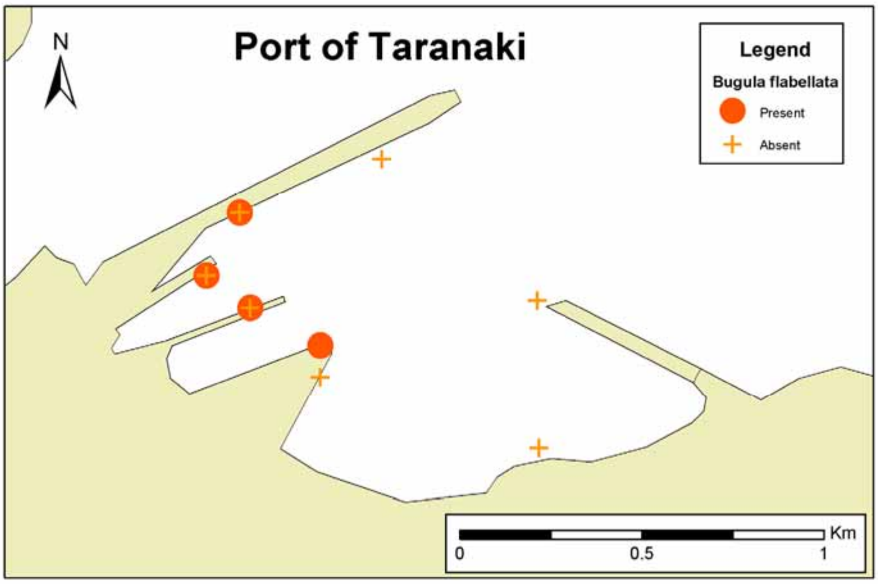

Figure 24: ***Bugula flabellata* distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

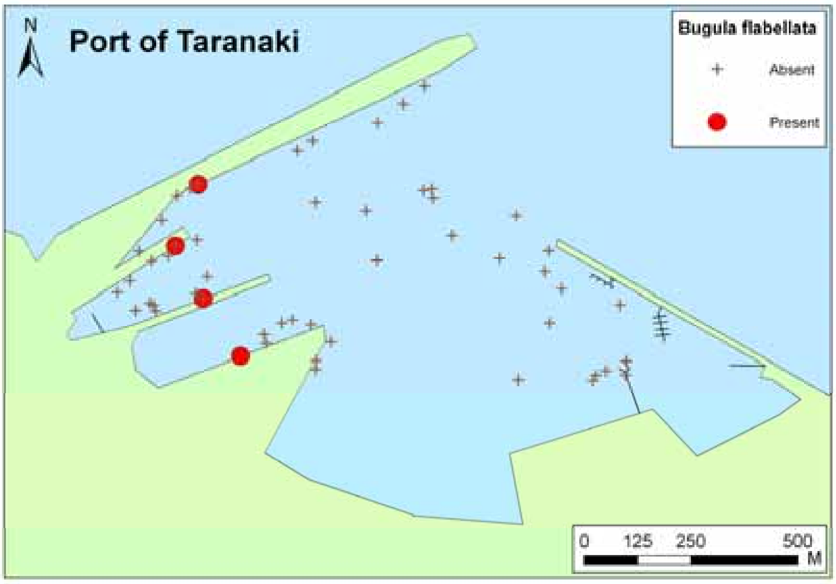

Figure 25: ***Bugula flabellata*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Bugula neritina **(Linnaeus, 1758)**

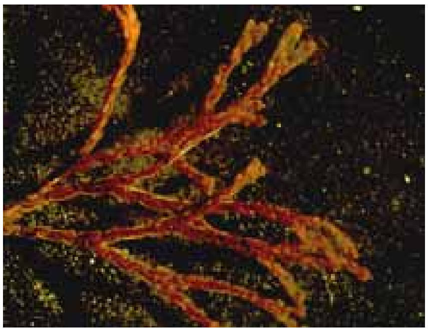

Image and information: NIMPIS (2002b)

Bugula neritina is an erect, bushy, red-purple-brown bryozoan. Branching is dichotomous (in series of two) and zooids alternate in two rows on the branches. Unlike all other species of *Bugula*, *B. neritina* has no avicularia (defensive structures) or spines, but there is a single pointed tip on the outer corner of zooids. Ovicells (reproductive structures) are large, globular and white. They often appear in such high numbers that they resemble small snails or beads. *Bugula neritina* is native to the Mediterranean Sea. It has been introduced to most of North America, Hawaii, India, the Japanese and China Seas, Australia and New Zealand. It is cryptogenic in the British Isles. *Bugula neritina* is one of the most abundant bryozoans in ports and harbours and an important member of the fouling community. The species colonises any available substratum and can form extensive monospecific growths. It grows well on pier piles, vessel hulls, buoys and similar submerged surfaces. It even grows heavily in ships' intake pipes and condenser chambers. In North America, *B. neritina* occurs on rocky reefs and seagrass leaves. In Australia, it occurs primarily on artificial substrata. *B. neritina* occurs in all New Zealand ports (Gordon & Matawari 1992). During the initial port baseline surveys it was recorded from the Opua and Gulf Harbour marinas, Whangarei Harbour (Marsden Point, Whangarei Port and Town Basin marina), and the ports of Tauranga, Taranaki, Napier, Gisborne, Lyttelton, Timaru and Dunedin (Table 18). In the Port of Taranaki this species occurred in samples taken from Blyde Wharf, Breakwater No. 1, Moturoa Wharf, Newton King Tanker Terminal and the Lee Breakwater (Figure 26). In the second baseline surveys of Group 1 ports it was recorded from the ports of Tauranga, Taranaki, Picton, Lyttelton and

Timaru. In the Port of Taranaki it occurred in pile scrape samples taken from Blyde Wharf, Breakwater No. 1 and Moturoa Wharf, in benthic sled samples from Main Basin No. 3 and Mutoroa Wharf, and in benthic grab samples from near Blyde Wharf No. 3 and Newton King Tanker Terminal No. 2 (Figure 27).

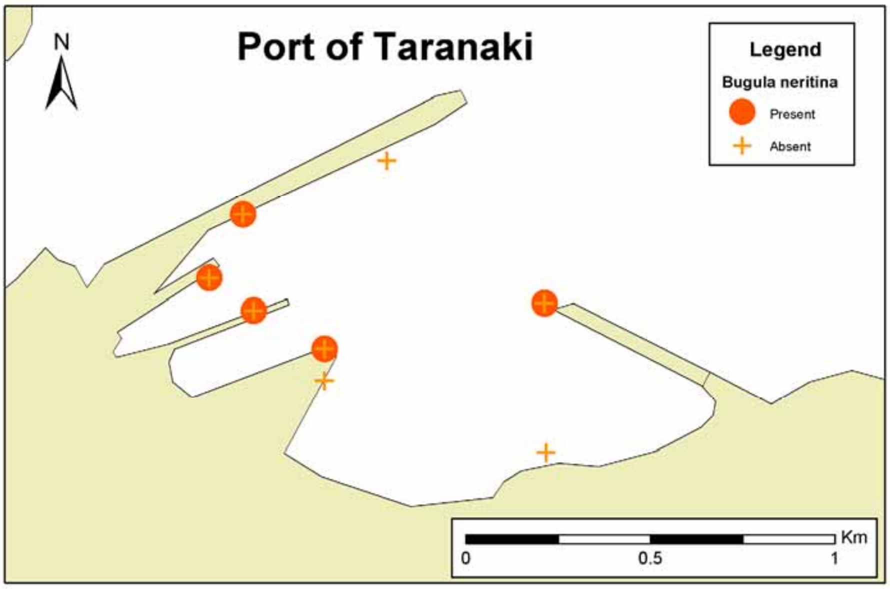

Figure 26: ***Bugula neritina* distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

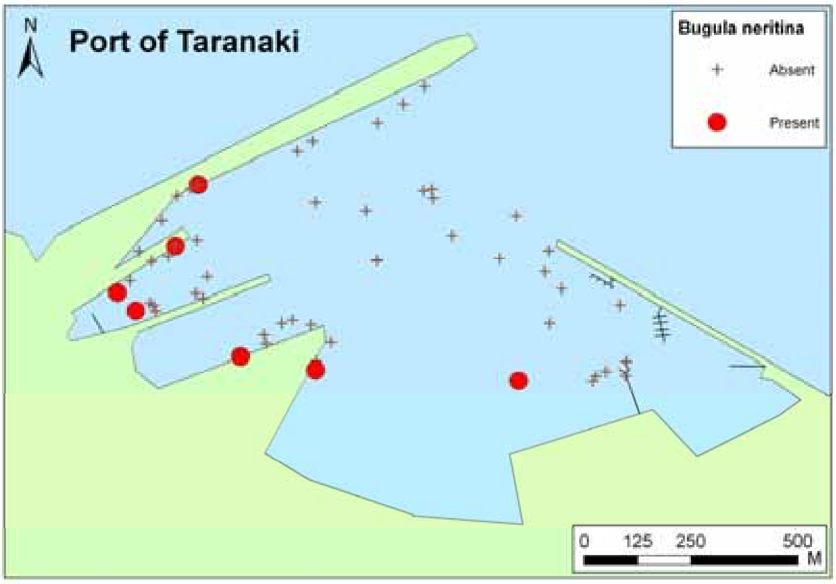

Figure 27: ***Bugula neritina* distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

***Cryptosula pallasiana* (Moll, 1803)**

Image and information: NIMPIS (2002d)

Cryptosula pallasiana is an encrusting bryozoan, white-pink with orange crusts. The colonies sometimes rise into frills towards the edges. Zooids are hexagonal in shape, measuring on average 0.8 mm in length and 0.4 mm in width. The frontal surface of the zooid is heavily calcified, and has large pores set into it. Colonies may sometimes appear to have a beaded surface due to zooids having a suboral umbo (ridge). The aperture is bell shaped, and occasionally sub-oral avicularia (defensive structures) are present. There are no ovicells (reproductive structures) or spines present on the colony. *Cryptosula pallasiana* is native to Florida, the east coast of Mexico and the northeast Atlantic. It has been introduced to the northwest coast of the USA, the Japanese Sea, Australia and New Zealand. It is cryptogenic in the Mediterranean. *Cryptosula pallasiana* is a common fouling organism on a wide variety of substrata. Typical habitats include seagrasses, drift algae, oyster reef, artificial structures such as piers and breakwaters, man-made debris, rock, shells, ascidians, glass and vessel hulls. It has been reported from depths of up to 35 m. There have been no recorded impacts of *Cryptosula pallasiana* throughout its introduced range. However, in the USA, it has been noted as one of the most competitive fouling organisms in ports and harbours it occurs in. Within Australia, colonies generally do not reach a large size or cover large areas of substrata.

C. pallasiana has been known in New Zealand waters since at least the 1890's (Gordon and Mawatari 1992) and has been recorded from all New Zealand ports (Cranfield et al. 1998). During the initial port baseline surveys it was recorded from Whangarei (Marsden Point), Taranaki, Gisborne, Wellington, Nelson, Lyttelton, Timaru and Dunedin (Table 18). In the Port of Taranaki it was recorded in pile scrape samples taken from Blyde Wharf, Moturoa Wharf and the Newton King Tanker Terminal (Figure 28). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki, Wellington, Picton, Nelson, Lyttelton and Timaru. In the Port of Taranaki it occurred in pile scrape samples taken from Moturoa Wharf and Breakwater No. 1 and also in a benthic sled sample from Breakwater No. 1 (Figure 29).

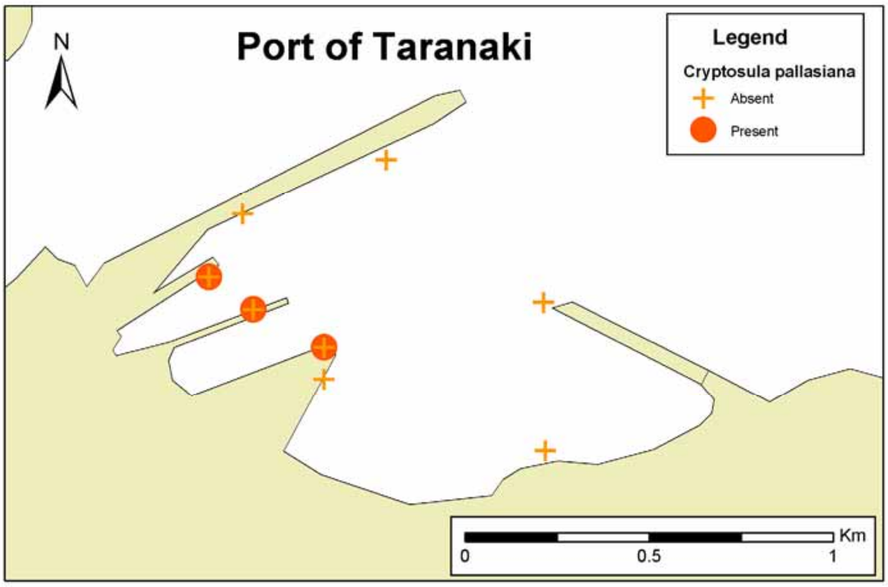

Figure 28: ***Cryptosula pallasiana*** **distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

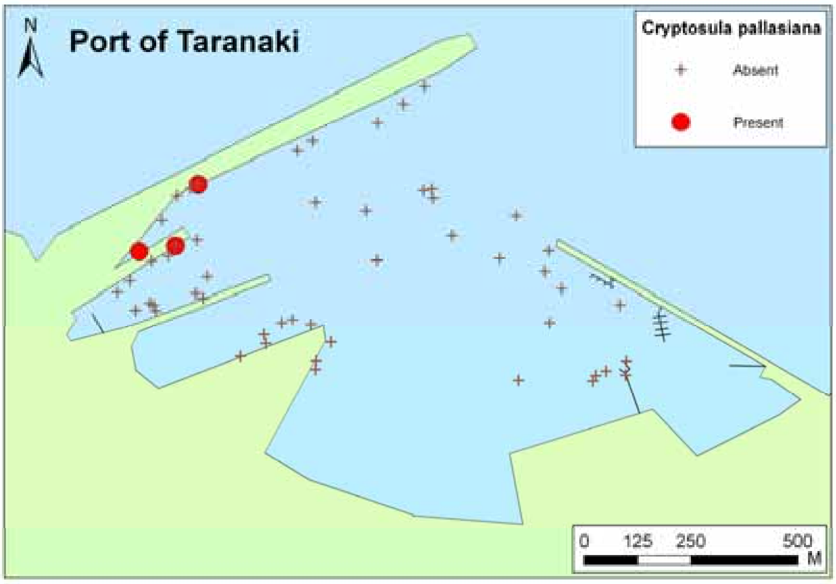

Figure 29: ***Cryptosula pallasiana*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

***Watersipora subtorquata* (d'Orbigny, 1852)**

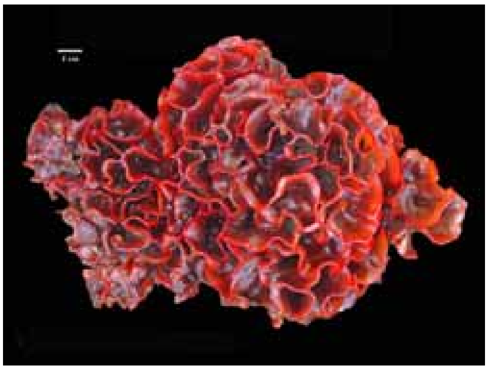

Image: Cohen (2005)
Information: Gordon and Matawari (1992)

Watersipora subtorquata is a loosely encrusting bryozoan capable of forming single or multiple layer colonies. The colonies are usually dark red-brown, with a black centre and a thin, bright red margin. The operculum is dark, with a darker mushroom shaped area centrally. *W. subtorquata* has no spines, avicularia or ovicells. The native range of the species is unknown, but is thought to include the wider Caribbean and South Atlantic. The type specimen was described from Rio de Janeiro, Brazil. It also occurs in the northwest Pacific, Torres Strait and northeastern and southern Australia.

Watersipora subtorquata is a common marine fouling species in ports and harbours. It occurs on vessel hulls, pilings and pontoons. This species can also be found attached to rocks and seaweeds. They form substantial colonies on these surfaces, typically around the low water mark. *W. subtorquata* is also an abundant fouling organism and is resistant to a range of antifouling toxins. It can therefore spread rapidly on vessel hulls and provide an area for other species to settle onto which can adversely impact on vessel maintenance and speed, as fouling assemblages can build up on the hull.

Watersipora subtorquata has been present in New Zealand since at least 1982 and is now present in most ports from Opua to Bluff. During the initial port baseline surveys, it was recorded from the Opua and Gulf Harbour marinas, Whangarei Harbour (Marsden Point and Whangarei Port) and the ports of Tauranga, Gisborne, Napier, Taranaki, Wellington, Picton, Nelson, Lyttelton, Timaru, Dunedin and Bluff (Table 18). In the Port of Taranaki it occurred in samples taken from Blyde Wharf, Moturoa Wharf, Newton King Tanker Terminal and the southern end of Breakwater No. 2 (Figure 30). During the second baseline surveys of Group 1 ports *W. subtorquata* was recorded from the ports of Tauranga, Taranaki, Wellington, Picton, Nelson, Lyttelton and Timaru. In the Port of Taranaki it occurred in pile scrape samples taken from Blyde Wharf, Breakwater No. 1, Moturoa Wharf, Newton King Tanker Terminal No. 2 and the yacht moorings. It was also observed in a visual survey of the yacht moorings (Figure 31).

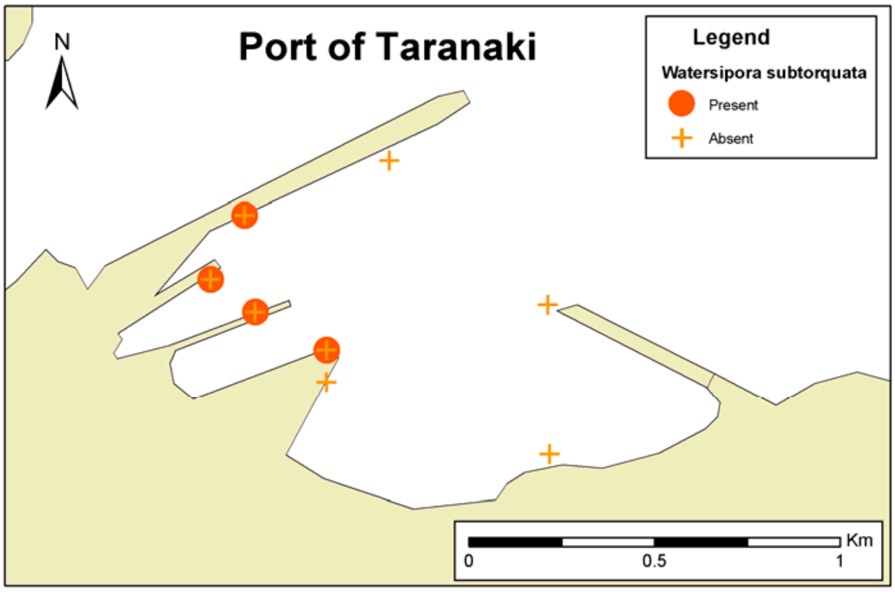

Figure 30: ***Watersipora subtorquata*** **distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

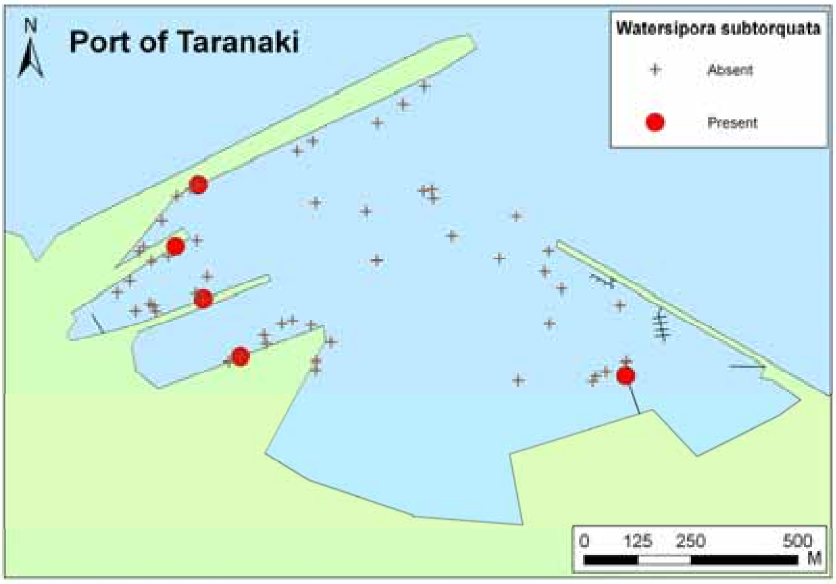

Figure 31: ***Watersipora subtorquata*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Monotheca pulchella **(Bale, 1882)**

No image available.

Monotheca pulchella is a hydroid in the family Plumulariidae. Its forms fine, flexible, monosiphonic, occasionally branched colonies 10 to 15 mm high, rising from tubular stolons (Vervoort and Watson 2003). It attaches to algae, bryozoans and other hydroids. The type locality is Queenscliff, Victoria, Australia. Its distribution is in temperate and subtropical parts of eastern and western Atlantic (including the Mediterranean), South Africa, and southern Australia (Vervoort and Watson 2003). It was first recorded in New Zealand from Bluff in 1928 (see Vervoort and Watson 2003). *Monotheca pulchella* was not recorded during the initial port baseline surveys. During the second baseline surveys of Group 1 ports it was recorded from the ports of Tauranga, Taranaki, Wellington, Lyttelton and Timaru (Table 18). None of these records are extensions to the known range of the species in New Zealand. In the Port of Taranaki, *M. pulchella* occurred in a pile scrape sample from the Newton King Tanker Terminal No. 2 (Figure 32).

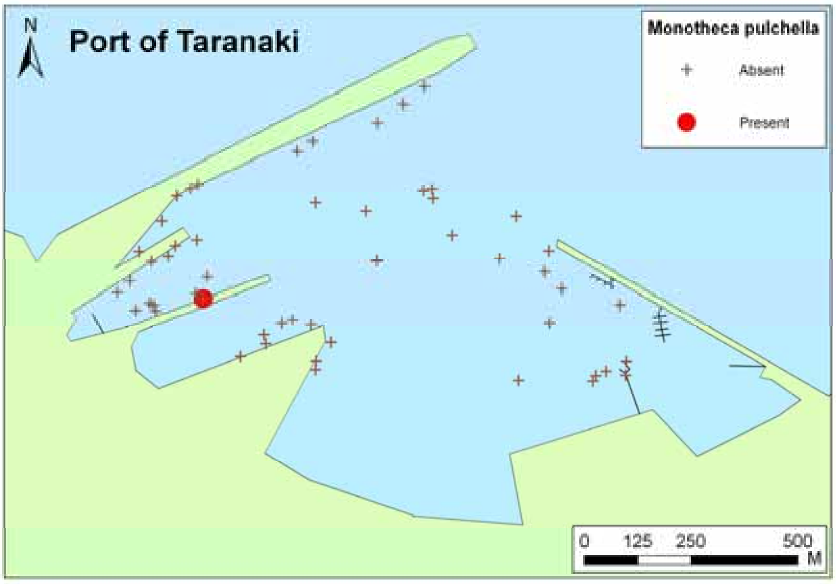

Figure 32: *Monotheca pulchella* distribution in the repeat baseline survey of the Port of Taranaki (March 2005).

***Amphisbetia maplestonei* (Allman, 1863)**
No image available.

This hydroid is part of an Australian - New Zealand *Amphisbetia* species group that are difficult to distinguish apart unless fertile (J. Watson, Hydrozoan Research Laboratory, pers. comm.). *A. maplestonei* has been recorded from southern Australia and it almost certainly occurs in New Zealand (J. Watson, pers. comm.). However, there are no New Zealand records other than those from the current round of port baseline surveys. In Australia it occurs in temperate waters. Stems are up to 5 cm, plumose, flexuous, with a brownish colour. It often occurs among holdfasts of algae and likes fairly clear water conditions (J. Watson, pers. comm.). *Amphisbetia maplestonei* was not recorded during the initial baseline surveys of Group 1 and Group 2 ports. During the second baseline surveys of Group 1 ports it was recorded from the ports of Timaru (an uncertain identification) and Taranaki (Table 18). In the Port of Taranaki it occurred in a benthic sled sample from Blyde Wharf (Figure 33).

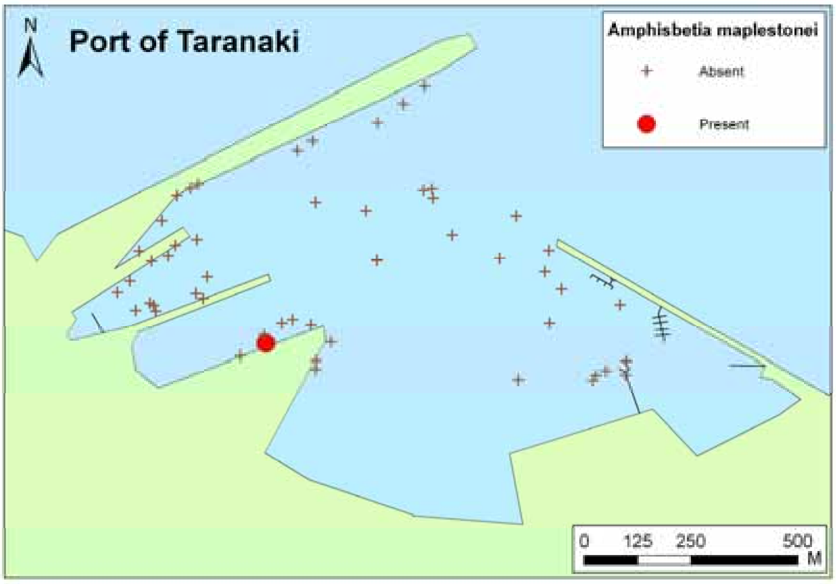

Figure 33: ***Amphisbetia maplestonei*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Monocorophium sextonae **(Crawford, 1937)**

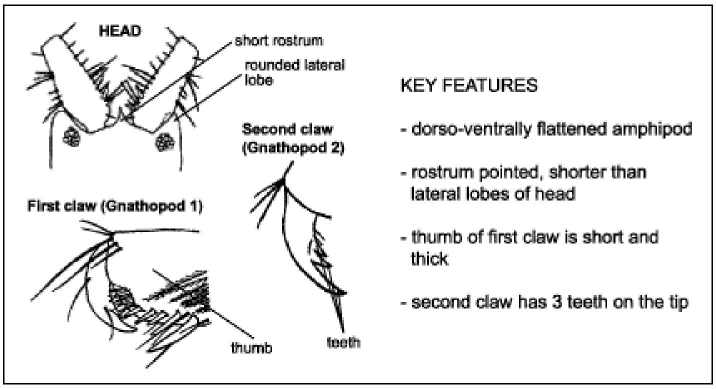

Diagram adapted from Myers 1982, Bousfield & Hoover 1997

Image and information: NIMPIS (2002f)

Monocorophium sextonae is a flat-looking amphipod that is whitish grey, with two dark bars across each segment, antennae and head. It lives amongst assemblages of marine invertebrates and plants or in soft-bottom habitats, and feeds by grazing on bacteria on sediment particles or on organic matter suspended in the water column. The exact native range of *M. sextonae* is unknown, although it is cryptogenic to the northeast Atlantic and Mediterranean and has been introduced to New Zealand and Australia. It builds mud tubes on fouling species such as hydroids, sponges, algae and kelp holdfasts in the subtidal zone from just above low water mark to ~50 m depth. It is tolerant of slow flowing water and large quantities of inorganic material and fouls surfaces such as harbour pylons, rafts and buoys by building mud tubes. It can reach high abundances on sediments or where silt and detritus accumulate among fouling communities. *M. sextonae* has been present in New Zealand since at least 1921 and is known from Lyttelton and Dunedin (Cranfield et al. 1998). During the initial port baseline surveys, *M. sextonae* was recorded only from the Port of Lyttelton (Table 18). During the second baseline surveys of Group 1 ports it was again recorded from the Port of Lyttelton and was also recorded from the Port of Taranaki, which appears to be a range extension for this species in New Zealand (Hurley 1954). In the Port of Taranaki it occurred in pile scrape samples taken from Blyde and Moturoa wharves (Figure 34).

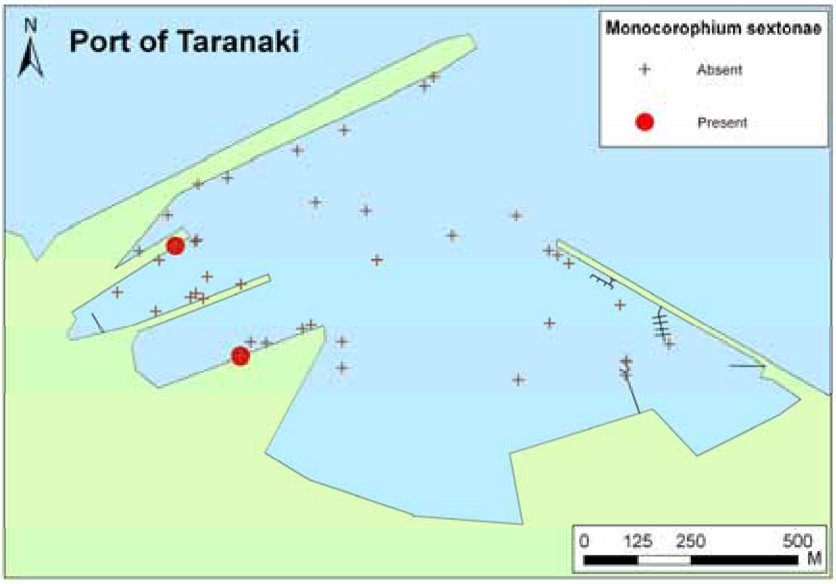

Figure 34: ***Monocorophium sextonae*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Crassostrea gigas **(Thunberg, 1793)**

Image and information: NIMPIS (2002c)

The Pacific oyster, *Crassostrea gigas*, is an important aquaculture species throughout the world, including New Zealand. It has a white elongated shell, with an average size of 150-200 mm. The two valves are solid, but unequal in size and shape. The left valve is slightly convex and the right valve is quite deep and cup shaped. One valve is usually entirely cemented to the substratum. The shells are sculpted with large, irregular, rounded, radial folds.

Crassostrea gigas is native to the Japan and China Seas and the northwest Pacific. It has been introduced to the west coast of both North and South America, the West African coast, the northeast Atlantic, the Mediterranean, Australia, New Zealand, Polynesia and Micronesia. It is cryptogenic in Alaska. *Crassostrea gigas* will attach to almost any hard surface in sheltered waters. Whilst they usually attach to rocks, the oysters can also be found in muddy or sandy areas. Oysters will also settle on adult oysters of the same or other species. They prefer sheltered waters in estuaries where they are found in the intertidal and shallow subtidal zones, to a depth of about 3 m. *Crassostrea gigas* settles in dense aggregations in the intertidal zone, resulting in the limitation of food and space available for other intertidal species.

C. gigas has been present in New Zealand since the early 1960s. Little is known about the impacts of this species in New Zealand, but it is now a dominant structural component of fouling assemblages and intertidal shorelines in northern harbours of New Zealand and the upper South Island. *C. gigas* is now the basis of New Zealand's oyster aquaculture industry, having displaced the native rock oyster, *Saccostrea glomerata*. During the initial port baseline surveys *C. gigas* was recorded from the Opua and Gulf Harbour marinas, Whangarei Harbour (Whangarei Port and Town Basin marina), and the ports of Auckland, Taranaki, Nelson and Dunedin (Table 18). In the Port of Taranaki, *C. gigas* occurred in samples taken from Moturoa Wharf and the Newton King Tanker Terminal (Figure 35). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki and Nelson. In the Port of Taranaki it occurred in a pile scrape sample taken from Moturoa Wharf (Figure 36).

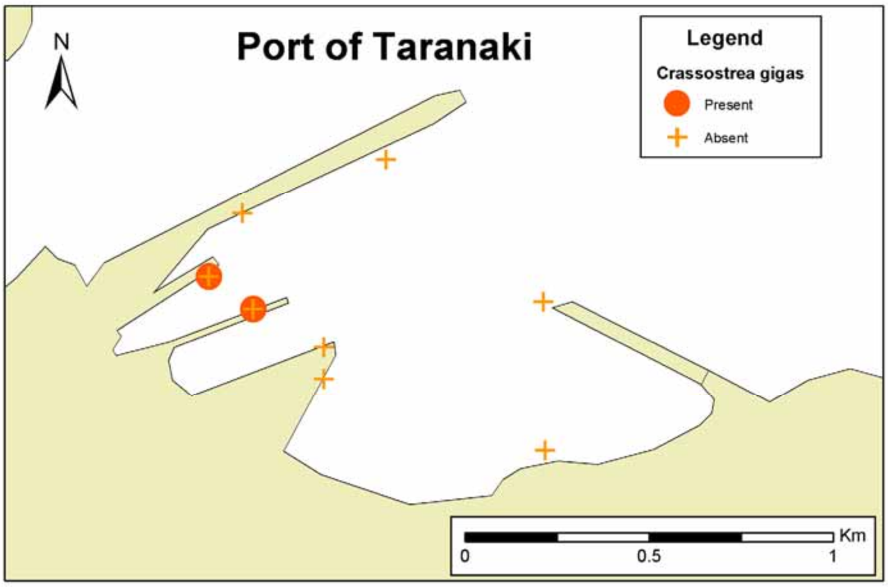

Figure 35: ***Crassostrea gigas* distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

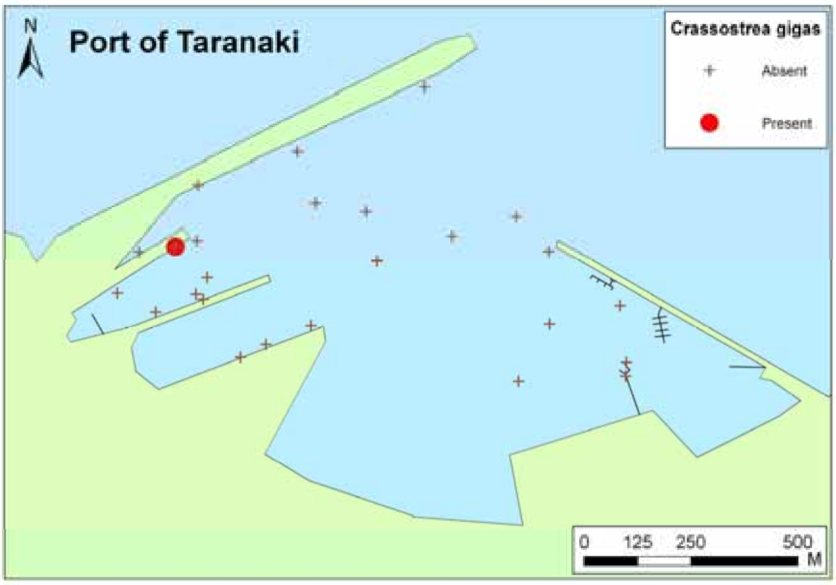

Figure 36: ***Crassostrea gigas* distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Theora lubrica **Gould, 1861**

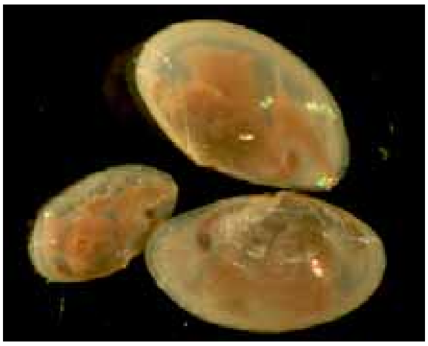

Image and information: NIMPIS (2002g)

Theora lubrica is a small bivalve with an almost transparent shell. The shell is very thin, elongated and has fine concentric ridges. *T. lubrica* grows to about 15 mm in size, and is characterised by a fine elongate rib extending obliquely across the internal surface of the shell. *Theora lubrica* is native to the Japanese and China Seas. It has been introduced to the west coast of the USA, Australia and New Zealand. *Theora lubrica* typically lives in muddy sediments from the low tide mark to 50 m, however it has been found at 100 m. In many localities, *T. lubrica* is an indicator species for eutrophic and anoxic areas. *T. lubrica* has been present in New Zealand since at least 1971. It occurs in estuaries of the northeast coast of the North Island, including the Bay of Islands, Whangarei Harbour, Waitemata Harbour, Wellington and Pelorus Sound. During the initial port baseline surveys, it was recorded from Opua marina, Whangarei port and marina, Gulf Harbour marina, and the ports of Auckland, Gisborne, Napier, Taranaki, Wellington, Nelson, and Lyttelton (Table 18). In the Port of Taranaki *T. lubrica* occurred in samples taken near Blyde Wharf, Breakwaters 1 & 2, Moturoa Wharf, Lee Breakwater and the Newton King Tanker Terminal (Figure 37). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki, Wellington, Picton, Nelson and Lyttelton. In the Port of Taranaki *Theora lubrica* occurred in benthic sled samples taken from Blyde Wharf, Breakwater No. 1, Moturoa Wharf, Newton King Tanker Terminal No. 2 and Main Basin sites 1, 2 and 3. It also occurred in benthic grab samples taken from Blyde Wharf, Blyde Wharf No. 3, Breakwater No. 1, Newton King Tanker Terminal No. 2 and the Main Basin (Figure 38).

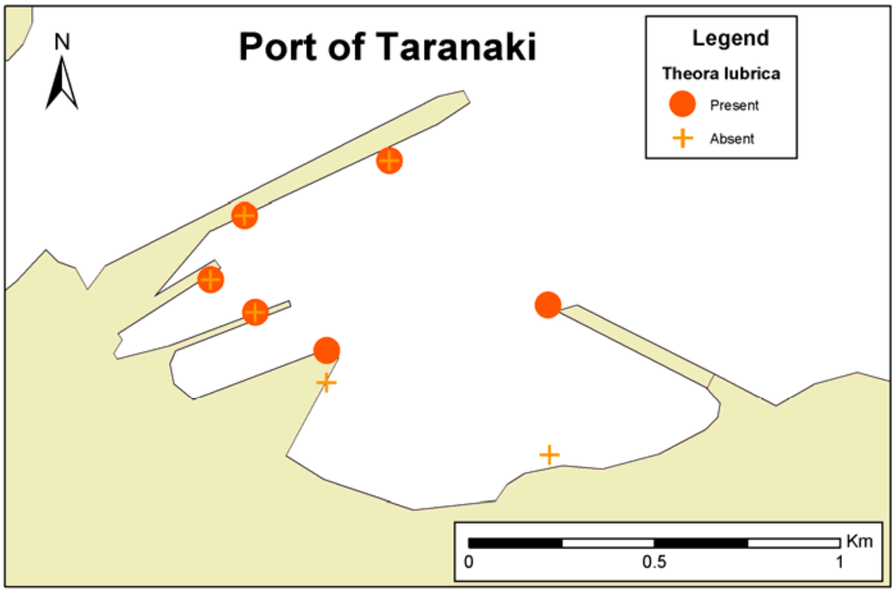

Figure 37: ***Theora lubrica*** **distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

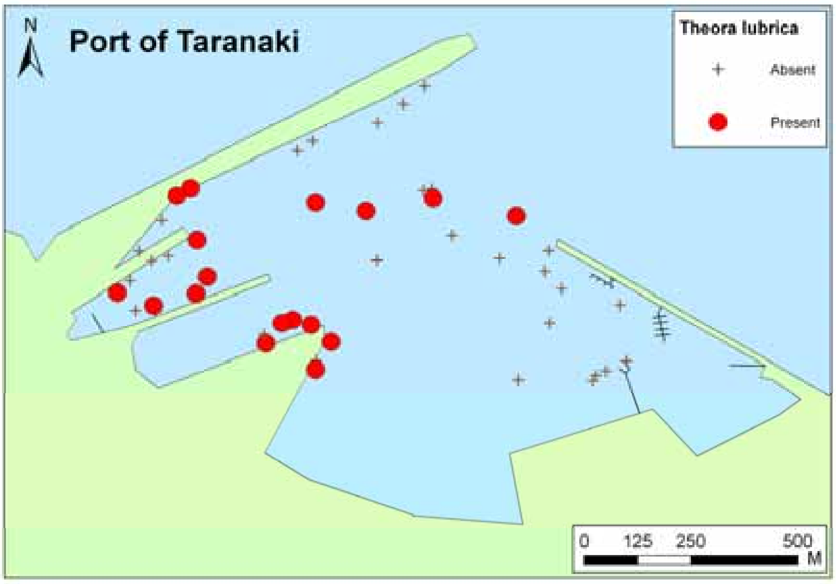

Figure 38: ***Theora lubrica*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

Griffithsia crassiuscula C.Agardh 1824

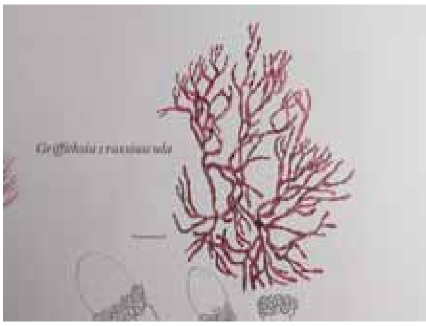

Image and information: Adams (1994)

Griffithsia crassiuscula is a small filamentous red alga. Plants are up to 10 cm high, dichotomously branched, with holdfasts of copious rhizoids. This species is bright rosy red to pink and of a turgid texture. Its native origin is thought to be southern Australia. *Griffithsia crassiuscula* is found subtidally and is mainly epiphytic on other algae and shells, but can also be found on rocks and pebbles. It has no known impacts. During the initial port baseline surveys, *G. crassiuscula* was recorded from the ports of Taranaki (an extension of its known range), Wellington, Picton, Lyttelton, Timaru and Bluff (Table 18). In the Port of Taranaki this species occurred in samples taken from the Newton King Tanker Terminal and the southern end of Breakwater No. 2 (Figure 39). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki, Wellingon, Picton, Lyttelton and Timaru. In the Port of Taranaki, it occurred in pile scrape samples taken from Moturoa Wharf and the Newton King Tanker Terminal No. 2 (Figure 40).

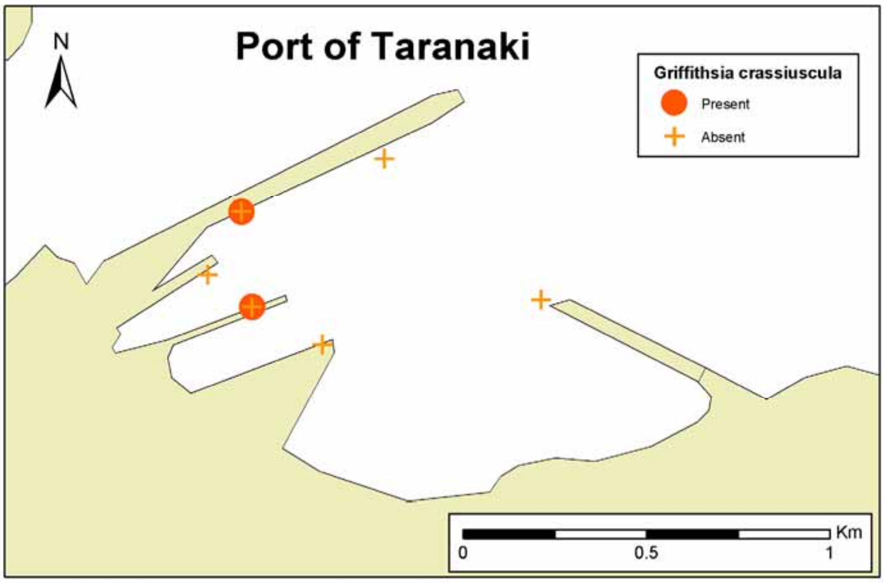

Figure 39: ***Griffithsia crassiuscula*** **distribution in the initial baseline survey of the Port of Taranaki (April 2002).**

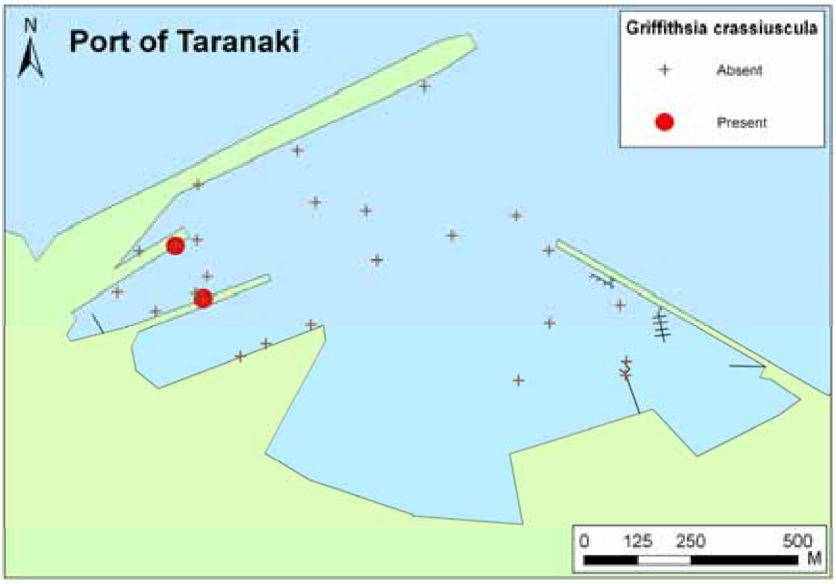

Figure 40: ***Griffithsia crassiuscula*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

***Undaria pinnatifida* (Harvey) Suringar, 1873**

Image and information: NIMPIS (2002h); Fletcher and Farrell (1999)

Undaria pinnatifida is a brown seaweed that can reach an overall length of 1-3 metres. It is an annual species with two separate life stages; it has a large, “macroscopic” stage, usually present through the late winter to early summer months, and small, “microscopic” stage, present during the colder months. The macroscopic stage is golden-brown in colour, with a lighter coloured stipe with leaf-like extensions at the beginning of the blade and develops a distinctive convoluted structure called the “sporophyll” at the base during the reproductive season. It is this sporophyll that makes *U. pinnatifida* easily distinguishable from native New Zealand kelp species such as *Ecklonia radiata.* It is native to the Japan Sea and the northwest Pacific coasts of Japan and Korea and has been introduced to the Mediterranean and Atlantic coasts of France, Spain and Italy, the south coast of England, southern California, Argentina parts of the coastline of Tasmania and Victoria (Australia), and New Zealand. It is cryptogenic on the coast of China.

Undaria pinnatifida is an opportunistic alga that has the ability to rapidly colonise disturbed or new surfaces. It grows from the intertidal zone down to the subtidal zone to a depth of 15-20 metres, particularly in sheltered reef areas subject to oceanic influence. It does not tend to become established successfully in areas with high wave action, exposure and abundant local vegetation. *U. pinnatifida* is highly invasive, grows rapidly and has the potential to overgrow and exclude native algal species. The effects on the marine communities it invades are not yet well understood, although its presence may alter the food resources of herbivores that would normally consume native species. In areas of Tasmania (Australia) it has become very common, growing in large numbers in areas where sea urchins have depleted stocks of native algae. It can also become a problem for marine farms by increasing labour costs due to fouling problems.

Undaria pinnatifida is known to occur in a range of ports and marinas throughout eastern New Zealand, from Gisborne to Stewart Island. During the initial port baseline surveys, it was recorded from the ports of Gisborne, Napier, Wellington, Picton, Lyttelton, Timaru and Dunedin (Table 18). During the second baseline surveys of Group 1 ports *U. pinnatifida* was recorded from the ports of Taranaki, Wellington, Picton, Nelson, Lyttelton, Waitemata Harbour, Auckland, Tauranga Harbour and Timaru. In the Port of Taranaki, *U. pinnatifida* was observed in a visual survey of the yacht moorings (Figure 41).

This was the first record of *Undaria pinnatifida* from the west coast of New Zealand. Following its detection by NIWA in March 2005 (this report), the Taranaki Regional Council and the Department of Conservation undertook surveys in July and August 2005 to further determine the extent of the species in the harbour (Govier 2005). A large number of mature adult plants were found on the floating pontoons at the reclamation known as “Gilligans Island” (to the east of the Lee Breakwater) and also in the Port Taranaki marina (on the inside of the Lee Breakwater). The number of plants found at Gilligan’s Island in July had tripled since the NIWA March surveys, and plants had grown to around 1.5 m long. In August 2005, an attempt was made in conjunction with MAF Biosecurity New Zealand to eradicate *U. pinnatifida* from the harbour (see "Management of existing non-indigenous species in the port", below). Monitoring is continuing in order to evaluate the success of the eradication trial and the extent of *U. pinnatifida* in the harbour.

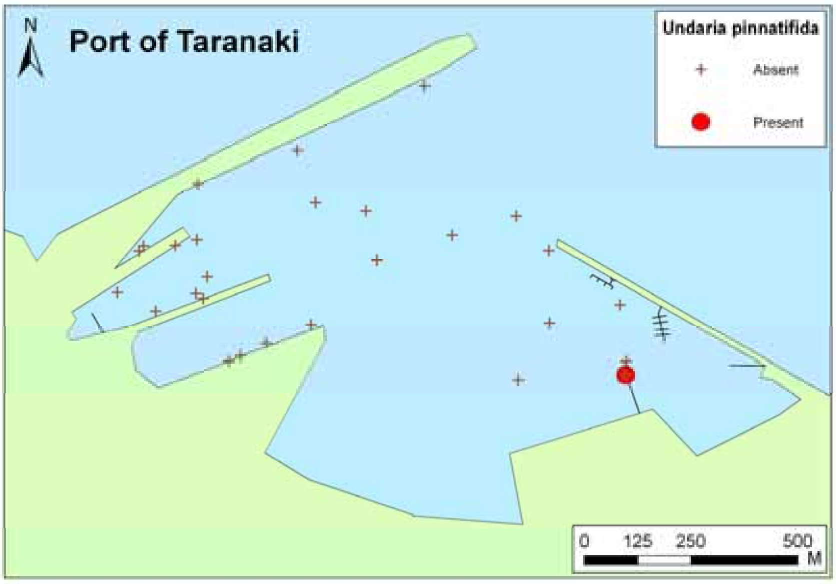

Figure 41: ***Undaria pinnatifida*** **distribution in the repeat baseline survey of the Port of Taranaki (March 2005).**

SPECIES INDETERMINATA

Forty-nine organisms from the Port of Taranaki were classified as species indeterminata. If each of these organisms is considered a species of unresolved identity, then together they represent 18.2 % of all species collected from this survey (Figure 19). Species indeterminata from the Port of Taranaki included specimens or fragments of 25 phycophytes, 1 bryozoan, 11 annelids, 1 cnidarian, 4 crustaceans, 4 molluscs, 1 chelicerate, 1 dinoflagellate, and 1 fish (Table 17).

NOTIFIABLE AND UNWANTED SPECIES

Of the non-indigenous species identified from the Port of Taranaki, only the Asian seaweed, *Undaria pinnatifida*, is currently listed as an unwanted species on either the New Zealand register of unwanted organisms (Table 12). The Pacific oyster, *Crassostrea gigas*, and cysts of the toxic dinoflagellate, *Gymnodinium catenatum*, were also recorded from the Port of Taranaki. Both species are listed on the ABWMAC Australian list of marine pest species (Table 13).

Australia has recently prepared an expanded list of priority marine pests that includes 53 non-indigenous species that have already established in Australia and 37 potential pests that have not yet reached its shores (Hayes et al. 2004). A similar watch list for New Zealand is currently being prepared by Biosecurity NZ. Eight of the 53 Australian priority domestic pests were recorded during the second baseline survey of the Port of Taranaki and a further 3 priority species were recorded in the initial baseline survey. These are listed in descending order of the impact potential ranking attributed to them by Hayes et al. (2004): *Gymnodinium catenatum*, *Crassostrea gigas*, *Bugula neritina*, *Bugula flabellata*, *Undaria pinnatifida*, *Watersipora subtorquata*, *Halisarca dujardini*, *Watersipora arcuta*, *Theora lubrica,* *Cryptosula pallasiana* and *Euchone limnicola*. None of the 37 priority international pests identified by Hayes et al. (2004) were recorded during this survey.

PREVIOUSLY UNDESCRIBED SPECIES IN NEW ZEALAND

Three species recorded from the re-survey of the Port of Taranaki are new records from New Zealand waters: the non-indigenous hydroid *Amphisbetia maplestonei* (Table 16; also recorded during the recent Port of Timaru re-survey), and the cryptogenic category two sponges *Haliclona* new sp. 4 (also recorded during the recent re-survey of the Ports of Lyttelton, Tauranga and Picton) and *Halichondria* new sp. 4 (Table 15). A further eight species from the present survey were recorded in New Zealand for the first time during the initial port baseline surveys. These were the pycnogonid *Tanystylum* sp. B, the amphipod *Leucothoe sp*. 1, the portunid crab *Ovalipes elongates*, the dinoflagellate *Gymnodinium catenatum,* the ascidian *Microcosmus squamiger* and three species of sponge (*Esperiopsis* new sp. 1, *Euryspongia* cf. *arenaria* and *Halichondria* new sp. 1). Three of these species - *Tanystylum* sp. B, *Euryspongia* cf. *arenaria* and *Microcosmus squamiger* – represent new records for Taranaki. The remainder were recorded during the earlier port baseline survey of the Port of Taranaki.

CYST-FORMING SPECIES

Cysts of three species of dinoflagellate were collected during this survey. These included 1 native species (Table 14), one cryptogenic species (*Gymnodinium catenatum*; cryptogenic category 1, Table 15), and one indeterminate species (Table 17). Motile forms of *Gymnodinium catenatum* are known to produce toxins that cause Paralytic Shellfish Poisoning (PSP, see also Hay et al. 2000; New Zealand Food Safety Authority 2003). Blooms can cause problems for aquaculture and recreational harvesting of shellfish and are a significant public health hazard.

COMPARISON OF RESULTS FROM THE INITIAL AND REPEAT BASELINE SURVEYS OF THE PORT OF TARANAKI

Pile scrape samples

Native species

Rarefaction curves and estimates of total species richness in pile scrape samples taken from the two baseline surveys of the Port of Taranaki are presented in Figure 42a. Curves for the native species assemblage exhibited similar rates of species accumulation in each survey, with a slightly larger density of species in the initial baseline survey. For an equivalent level of survey effort (n = 60 pile scrape samples), around 10 more species were recorded, on average, in the initial baseline survey. A consequence was that, despite slightly greater total survey effort in the repeat survey (n_{max} = 70 samples, S_{max} = 88 species), fewer native species were recorded than in the initial survey (n_{max} = 60 samples, S_{max} = 93 species; Table 19). This pattern was repeated for cryptogenic and non-indigenous species (see below). Neither rarefaction curve reached an asymptote nor converged with the estimated total richness. Estimates of total richness in the assemblages were similar (~122 species) and relatively stable in each survey, but again, did not reach an asymptote in either survey (Figure 42a). In each case, the estimated richness was between 32% (initial survey) to 37% (repeat survey) higher than the observed richness and increased at approximately the same rate as more samples were added. ‘Uniques’ (species that occurred in only a single sample) comprised very similar proportions of the sampled assemblage in each survey (32% of the observed assemblage in the first survey and 35% in the second survey; Table 19).

Only 55 of the 126 native species (44%) recorded in pile scrape samples from the Port of Taranaki occurred in both surveys (Table 19). This reflected the number of comparatively rare species in the assemblage, with non-detection of many of these accounting for much of the difference observed between the two surveys. For example, the classic Jaccard (0.437) and Sorenson (0.608) measures of compositional similarity indicated only moderate similarity between the assemblages recorded in the initial and repeat baseline surveys of the Port of Taranaki (Table 19). The new Chao similarity indices, however, which adjust for the effects of non-detection of rare species, suggest much closer resemblance of the two samples (Chao bias-adjusted Jaccard = 0.823; Chao bias-adjusted Sorenson = 0.903; Table 19).

Cryptogenic category 2 species

A total of 23 cryptogenic category 2 species were observed in the pile scrape samples over the two baseline surveys. Average per sample densities of these species were much greater in the initial survey than in the repeat survey (Figure 42b), with 3 more species observed, despite a greater number of samples in the repeat survey (Survey 1, S_{max} = 16 species; Survey 2, S_{max} = 13 species; Table 19). Rarefaction curves for neither survey reached an asymptote, with that from the first survey increasing more steeply with sample size than the curve for the repeat survey (Figure 42b). In each survey, uniques accounted for more than half of the species recorded (Table 19). A consequence was that estimates of total richness remained between 32% (Repeat survey) and 55% (First survey) higher than the observed richness, suggesting comparatively large numbers of undetected species in this category (Figure 42b).

Compositional similarity between samples from the two surveys was relatively low. Only 6 of the 23 cryptogenic category 2 species (26%) were common to both surveys, resulting in low-to-moderate similarity indices, even when potentially undetected species were taken into account (Chao bias-adjusted Jaccard = 0.54; Chao bias-adjusted Sorenson = 0.701; Table 19).

Non-indigenous and cryptogenic category 1 species

Slightly more non-indigenous and cryptogenic category 1 species were detected in the pile-scrape samples in the first survey ($S_{\max}$ = 19 species) than in the second survey ($S_{\max}$ = 14 species; Table 19), but fewer than half of the species were common to both surveys (9 of 24 species in total; Table 19). The Chao bias-adjusted Jaccard (0.673) and Chao bias-adjusted Sorenson (0.804) indices pointed to moderately to strongly similar species compositions in the two assemblages, reflecting, perhaps, the comparatively small proportions of unique species in each survey (Table 19). Sample-based rarefaction curves for the two surveys exhibited different patterns of species accumulation, with a greater density of species and steeper rate of increase of the curve in the first survey (Figure 42c). The estimate of total richness for the first survey continued to increase as more samples were added and did not plateau or converge with the observed (Mean Chao 2 bias-corrected richness = 23.9 species; Figure 42c). In the second survey, however, the richness estimator reached an asymptote at around 16 species and began to converge with the observed species richness ($S_{\max}$ = 14 species), indicating a relatively complete inventory (Figure 42c).

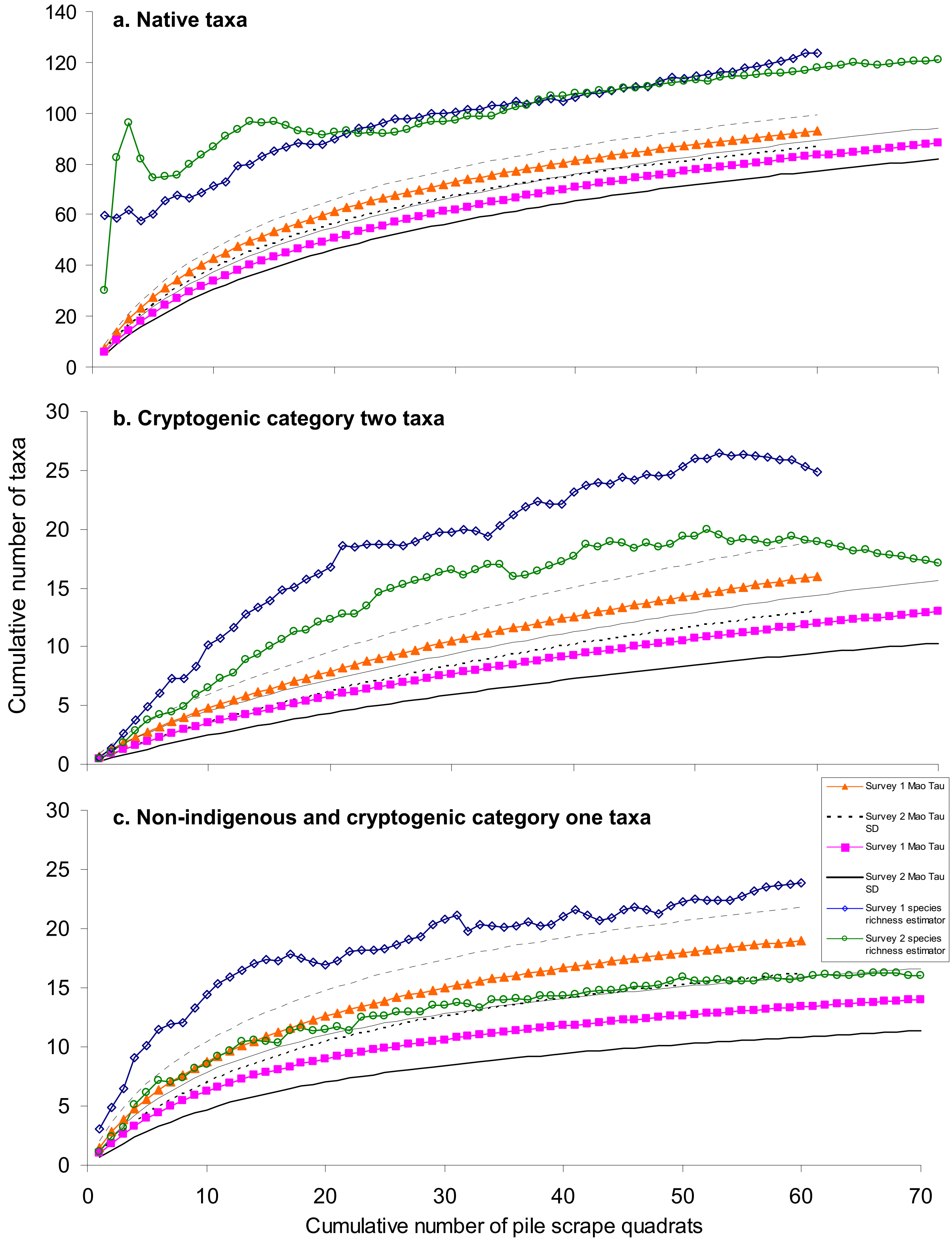

Figure 42: Rarefaction curves (Mao Tau) for native (top), cryptogenic category two (middle) and non-indigenous and cryptogenic category one (bottom) taxa from pile scrape quadrats for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 bias-corrected formula was used in all cases except for native taxa in the second survey, where the ICE formula was used.

Benthic sled samples

Native species

One hundred-and-one native species were recorded in total from benthic sled samples taken during the two baseline surveys of the Port of Taranaki. Although considerably more species were observed in the second survey from this sample method (S_{max} = 75 species), this was largely a result of greater sample effort (n = 20 sled tows *cf* n = 12 sled tows in the initial survey). Rarefaction curves for each survey exhibited similar rates of species accumulation with sample size, with only slightly greater species density in the repeat survey (Figure 43a). Very similar mean numbers of species were observed in each survey when sample effort was standardised (Survey 1, $S_{n=12}$ = 48 species; Survey 2, $S_{n=12}$ = 55 species). Neither curve approached an asymptote, but continued to increase as more samples were added. Estimates of total richness in the assemblage showed contrasting patterns of change in each survey as sample size increased (Figure 43a). In the first survey, the richness estimator was unstable and increased sharply to a maximum of 184 species, or 3.8 x the observed number of species. In the second survey, the richness estimator stabilised at ~136 species, but was still substantially larger than the observed richness in the survey (S_{max} = 75 species; Table 19). The large proportion of uniques in each survey is an indication of the extremely patchy distributions of species sampled by the benthic sled. Less than ¼ of the species sampled using this method occurred in both surveys (Table 19). As a result, both the sampled (Classic Jaccard Index = 0.218, Classic Sorenson Index = 0.358) and estimated species assemblages in each survey had low-to-moderate similarity (Chao bias-adjusted Jaccard = 0.631; Chao bias-adjusted Sorenson = 0.774; Table 19).

Cryptogenic category 2 species

Only 4 cryptogenic category 2 species were recovered with the benthic sled in the two surveys; too few for meaningful statistical comparison (Table 19).

Non-indigenous and cryptogenic category 1 species

Sixteen non-indigenous and cryptogenic category 1 species were found in the benthic sled samples, with identical numbers of species recorded from each survey (S_{max} = 10 species; Table 19), despite almost twice the sample effort in the second survey (Figure 43b). Neither rarefaction curve reached an asymptote. The number of species observed in the surveys accounted for between 36% (initial baseline survey) and 71% (repeat survey) of the estimated richness of the assemblage. This difference was related to the increase in survey effort in the second survey. Almost equal numbers of unique species were recorded in each survey (Table 19), but these were averaged over a greater number of benthic sled samples in the second survey, producing a more stable estimate of total richness in the assemblage (Figure 43b). Despite this, only 4 of the 16 species in this category recovered by the benthic sleds occurred in both surveys. As a result, there was only moderate overlap between the observed (Classic Jaccard Index = 0.250, Classic Sorenson Index = 0.400) and estimated (Chao bias-adjusted Jaccard = 0.493; Chao bias-adjusted Sorenson = 0.661; Table 19) species composition in each survey.

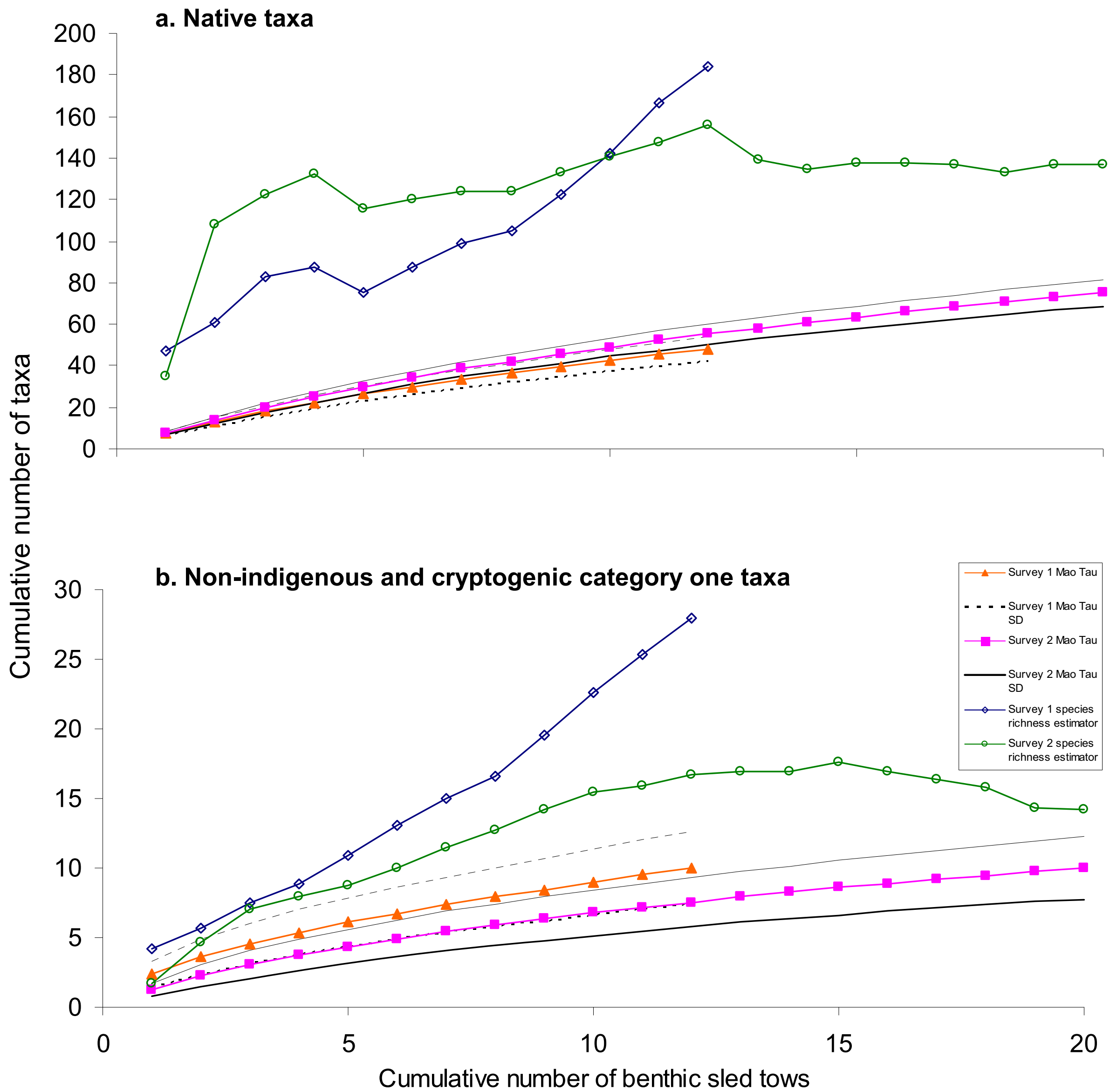

Figure 43: Rarefaction curves (Mao Tau) for native (top) and non-indigenous and cryptogenic category one (bottom) taxa from benthic sled tows for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators (Chao 2 classic formula) are also shown for the first survey (empty diamonds) and second survey (empty circles).

Benthic grab samples

Too few cryptogenic category 2 (4 species) and non-indigenous and cryptogenic category 1 species (5 species) were recorded in the benthic grab samples for separate analysis. Instead, comparisons were made using the pooled data for all species (Table 19). In total, 70 species occurred in benthic grab samples from the two surveys. Fourteen of these species (20%) were common to both surveys. Many of the species recorded in the first survey (30 of 38 species) each occurred in just a single benthic grab sample (Table 19). As a result, the estimate of total richness in the assemblage for this survey was unstable and increased sharply after 15 grabs samples (Figure 44). Because the Chao estimators of richness in the assemblage are calculated using the ratio of the number of species that occur in just one ("uniques") and two samples ("duplicates"), this instability can occur when there are few, or no, duplicates relative to uniques. In the first baseline survey, for example, only 1 duplicate was recorded from the benthic grabs, meaning that, as sample size increased, the mean number of unique species added continued to increase, while the mean number of duplicates declined, leading to a steeply increasing richness estimate (Figure 44). In these circumstances, the estimate is likely to be unreliable. This pattern of prevalence indicates highly patchy distributions of the benthic assemblage sampled by the grab and comparatively large numbers of unsampled species. Nevertheless, the density of species observed in each survey was roughly similar, with almost equal numbers of species observed when sample effort was standardised (Survey 1, $S_{n=21}$ = 38 species; Survey 2, $S_{n=21}$ = 41 species). Data from the second baseline survey produced a more stable estimate of the richness of the assemblage at around 62 species (i.e. ~1.3 x the observed number; Figure 44). The limited overlap in assemblages sampled by the two surveys and large proportions of uniques in the sample from the first survey, meant relatively low similarity in the observed (Classic Jaccard Index = 0. 200, Classic Sorenson Index = 0.333) and moderate similarity in the estimated species composition (Chao bias-adjusted Jaccard = 0.586; Chao bias-adjusted Sorenson = 0.739) in each survey (Table 19).

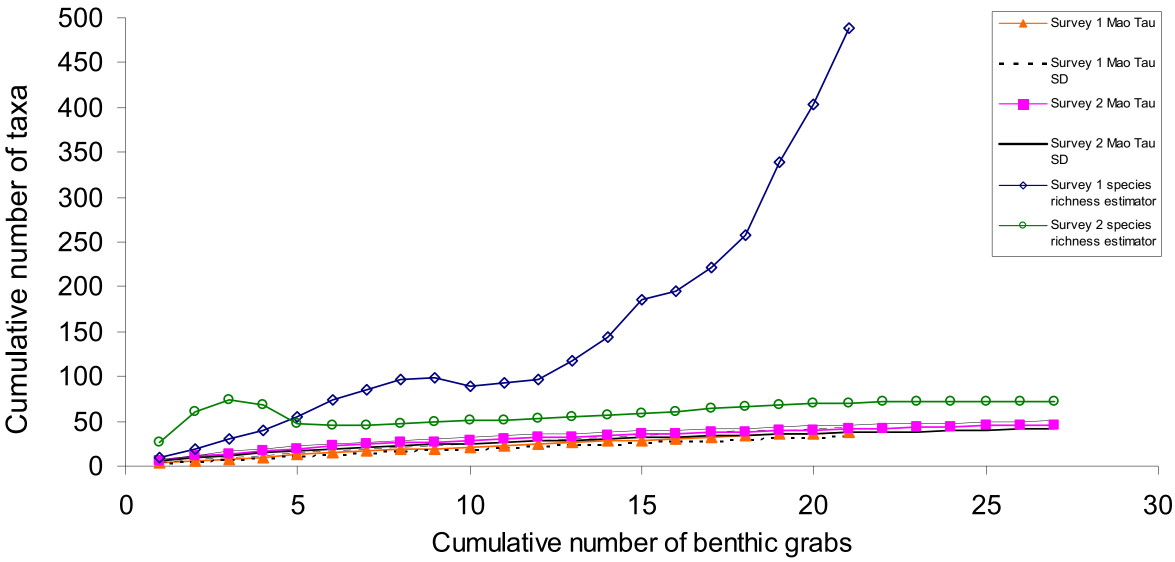

Figure 44: Rarefaction curves (Mao Tau) for native, cryptogenic and non-indigenous taxa combined from benthic grabs for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 classic formula was used for the first survey and the ICE formula for the second survey.

Crab trap samples

Rarefaction curves and richness estimates for samples taken from the crab traps are depicted in Figure 45. Only 1 cryptogenic category 1 species and no cryptogenic category 2 or non-indigenous species were recorded in the crab trap samples in either survey. Analyses were, therefore, completed for the pooled species assemblage obtained in each survey (Table 19). Similar total numbers of species were observed in the crab traps in each survey, despite greater sample effort in the second survey (Table 19). The rarefaction curve for the first baseline survey plateaued at between 12 to 13 species and converged with the richness estimate (Chao 2 bias-corrected estimate = 14 species), indicating a relatively complete inventory of species susceptible to this sample method. In contrast, the rate of species accumulation in the second survey continued to increase with sample size (albeit slowly) and the total number of observed species (S_{max} = 12) was considerably smaller than the estimated richness (Chao 2 bias-corrected estimate = 52.5 species). Again, the instability in the richness estimate appears to be the result of the relatively small number of duplicates (1 species) in the sample, relative to uniques (9 species).

Seven species (39% of the total) were common to both surveys. While there was only low-to-moderate similarity in species composition between the assemblages observed in each survey (Classic Jaccard Index = 0.389, Classic Sorenson Index = 0.560), the large estimates of the numbers of undetected species in each survey meant that the total assemblage (observed + unseen species) had high similarity (Chao bias-adjusted Jaccard = 0.838; Chao bias-adjusted Sorenson = 0.912; Table 19).

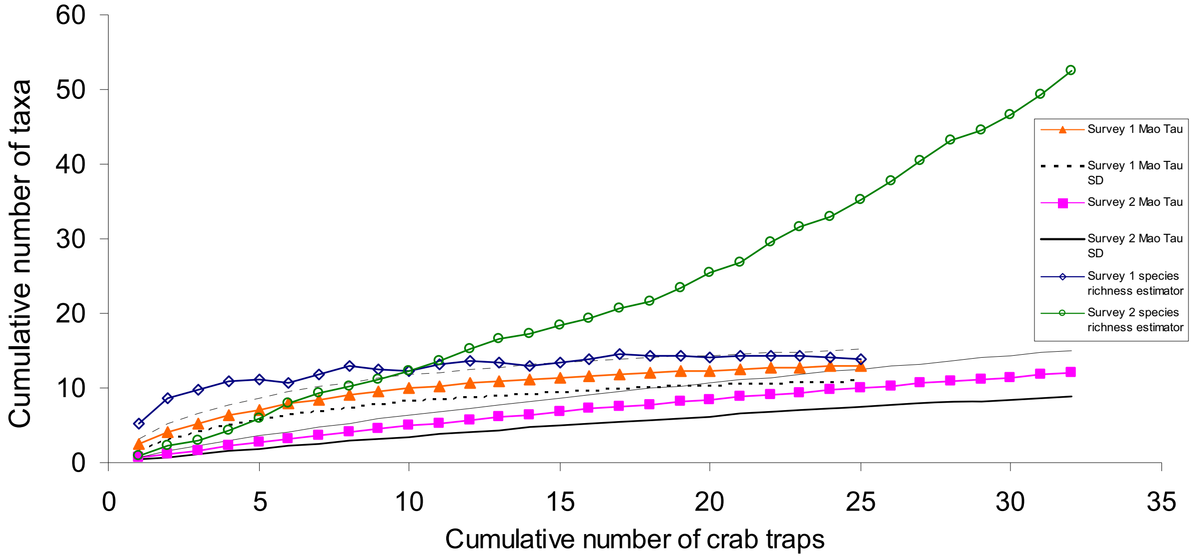

Figure 45: Rarefaction curves (Mao Tau) for native and cryptogenic taxa combined, from crab traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No non-indigenous taxa were encountered in either survey. Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 bias-corrected formula) and second survey (empty circles, Chao 2 classic formula).

Fish trap samples

Rarefaction curves and richness estimates for samples taken from the fish (Opera House) traps are depicted in Figure 46. No cryptogenic or non-indigenous species were recorded in the fish trap samples in either survey, so analyses are limited to native species (Table 19). The density of observed species was slightly greater in the initial baseline survey with, on average, 2 more species being recorded for equivelent survey effort (Survey 1, $S_{n=24}$ = 8 species; Survey 2, $S_{n=24}$ = 6 species). A consequence was that almost identical numbers of species were observed in each survey, despite greater overall sample effort in the repeat survey (Table 19). In both surveys, the rarefaction curves and their associated richness estimates did not reach an asymptote, but continued to increase slowly as more samples were taken (Figure 46). The rates of species accumulation were very slow, with fewer than 2 additional species being added for each additional ten traps that were set (Figure 46). Estimates of total richness were between 36% (Survey 1) and 83% (Survey 2) greater than the observed number of species in each survey, reflecting the large proportion of uniques recorded (Table 19). At the slow rate of species accumulation observed in the surveys, a further 15 and 25 fish traps, respectively, would need to be sampled to capture the total richness in each sampled assemblage. Similarity indices calculated for the two assemblages indicated only low-to-moderate similarity in the estimated species composition (Chao bias-adjusted Jaccard = 0.480; Chao bias-adjusted Sorenson = 0.648; Table 19).

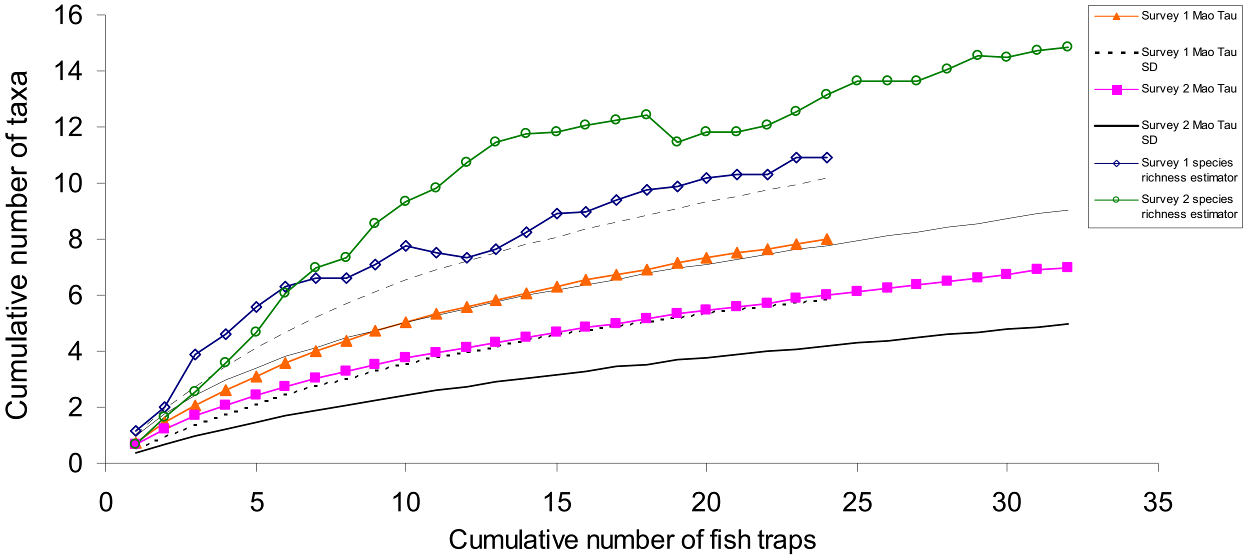

Figure 46: Rarefaction curves (Mao Tau) for native taxa from fish traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No non-indigenous or cryptogenic taxa were encountered. Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 bias-corrected formula) and second survey (empty circles, ICE formula).

Starfish trap samples

No cryptogenic category 2 or non-indigenous species were recorded in samples from the starfish traps in either survey (Table 19). Comparisons between the surveys were, therefore, made using the pooled data for native species and cryptogenic category 1 species. In total, 12 species were recorded from the two surveys using this sample method; all but one were native species. Approximately equal numbers of species (8 and 9 species, respectively) were recovered in each survey, with just under half (42%) of these being common to both surveys (Table 19). Rarefaction curves for the two surveys depict very similar rates of species accumulation with sample size (Figure 47). On average, fewer than 2 additional species were added to the inventory for every 10 starfish traps that were set. In the first survey the observed number of species (S_{max} = 8 species) converged with the richness estimate (Chao 2 bias-corrected estimate = 8.72 species) after 24 traps had been sampled (Figure 47), indicating a relatively complete inventory. In the second survey, however, the richness estimate did not reach an asymptote, but increased at a greater rate than the rarefaction curve as more samples were added (Figure 47). This instability is attributable to a higher proportion of uniques in the sample (Table 19) and just a single duplicate species (3 duplicates were present in the initial survey). Nevertheless, the estimated similarity between assemblages sampled by the first and second surveys was comparatively high (Chao bias-adjusted Jaccard = 0.700; Chao bias-adjusted Sorenson = 0.824; Table 19).

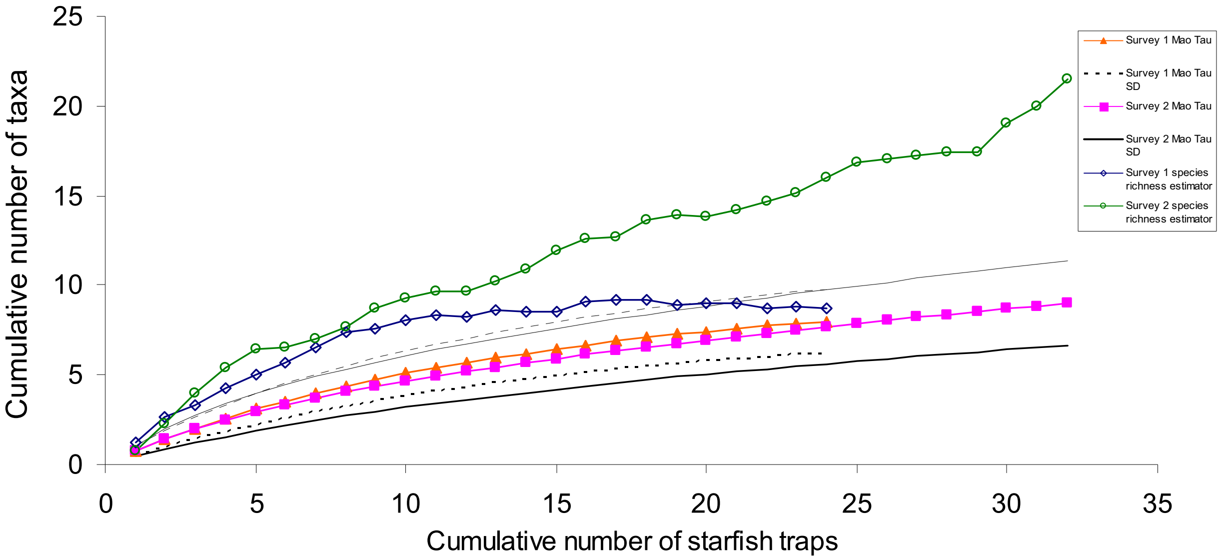

Figure 47: Rarefaction curves (Mao Tau) for native and cryptogenic category one taxa from starfish traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No non-indigenous or cryptogenic category two taxa were encountered in either survey. Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 bias-corrected formula) and second survey (empty circles, Chao 2 classic formula).

POSSIBLE VECTORS FOR THE INTRODUCTION OF NON-INDIGENOUS SPECIES TO THE PORT

The non-indigenous species located in the Port of Taranaki are thought to have arrived in New Zealand via international shipping. They may have reached the port directly from overseas or through domestic spread (natural and/or anthropogenic) from other New Zealand ports. Table 16 indicates the possible vectors for the introduction of each NIS recorded from the Port of Taranaki during the baseline port surveys. Likely vectors of introduction are largely derived from Cranfield et al. (1998) and expert opinion. They suggest that only 1 of the 19 NIS (5 %) probably arrived via ballast water, 13 species (68 %) were most likely to be associated with hull fouling, and 5 species (27 %) could have arrived via either of these mechanisms. Other potential vectors include the domestic and international movement of organisms in dredge hoppers and domestic relocation of fouled maritime equipment (e.g. ropes, pontoons, buoys, etc).

Assessment of the risk of new introductions to the port

Many of the non-indigenous species introduced to New Zealand ports by shipping do not establish self-sustaining local populations. Those that do often come from coastlines that have similar marine environments to New Zealand. For example, approximately 80% of the marine NIS known to be present within New Zealand are native to temperate coastlines of Europe, the northwest Pacific, and southern Australia (Cranfield et al. 1998).

Between 2002 and 2005, there were 612 vessel arrivals from overseas to the Port of Taranaki recorded in the LMIU 'SeaSearcher.com' database (Table 4). The greatest number of these came from Queensland (138) and other parts of Australia (92), followed by the Pacific Islands (127), Japan (79), northwest Pacific (68), and east Asian seas (29; Table 4). Approximately half of this trade is with ports from other temperate regions that have coastal environments similar to New Zealand's (for example, southern Australia, Japan and the northwest Pacific). Vessels arriving from tropical areas with coastal environments strongly dissimilar to New Zealand's (e.g. the Pacific Islands and east Asian seas) may present less of a risk.

Bulk carriers and tankers that arrive empty carry the largest volumes of ballast water. In the Port of Taranaki these came predominantly from Australia (114 visits), the Pacific Islands (115), Japan (73) and the northwest Pacific (66; Table 4). The Port of Taranaki has a high trade volume of bulk cargoes relative to other ports in New Zealand, ranking second largest with regard to export volume (freight tonnes handled, Statistics New Zealand 2004). This is reflected in the relatively high volume of ballast that is discharged in the Port of Taranaki. In 1999 the Port of Taranaki received the highest volume of reported ballast water discharged, with a total volume of 1,150,570 m^3 of ballast water discharged into the Port (Inglis 2001). This was derived from a variety of sources, including 507,895 m^3 from Australia, 224,601 m^3 from Japan, 210,589 m^3 from Hong Kong, and 119,926 m^3 from unspecified source countires. Shipping from these regions presents an on-going risk of introduction of new NIS to the Port of Taranaki.

Smaller, slower moving vessels, such as barges and fishing boats, tend to carry a greater density of fouling organisms than faster cargo vessels. There were only 12 visits to the Port of Taranaki by these vessels recorded in the 'Seasearcher.com' database, with the greatest number (6) arriving from Australia (Table 4).

Shipping from southern Australia, Japan and the northwest Pacific (predominantly China, Korea, Russia and Taiwan) present the greatest risk of introducing new non-indigenous species to the Port of Taranaki. These countries have similar temperate marine environments to New Zealand, and are among the largest sources of vessel visits to Taranaki, including visits by vessel types that carry large volumes of ballast water. Because of the relatively short transit time, shipping originating in southern Australia (particularly Victoria and Tasmania) carries, perhaps, the greatest overall risk. Furthermore, six of the eight marine pests on the New Zealand Register of Unwanted Organisms are already present there (*Carcinus maenas*, *Asterias amurensis*, *Undaria pinnatifida*, *Sabella spallanzanii*, *Caulerpa taxifolia*, and *Styela clava*). The native range of the other two species – *Eriocheir sinensis* and *Potamocorbula amurensis* – is the northwestern Pacific, including China and Japan.

Assessment of translocation risk for introduced species found in the port

Between 2002 and 2005, vessels departing from the Port of Taranaki travelled to 16 ports throughout New Zealand. Lyttelton, Wellington, Napier, Dunedin and Nelson were the next ports of call for the most domestic vessel movements from Taranaki (Table 8). Although many of the non-indigenous species found in the re-survey of the Port of Taranaki have been recorded in other locations throughout New Zealand (Table 18), they were not detected in all of the other ports surveyed.. There is, therefore, a risk that species established in the Port of Taranaki could be spread to other New Zealand locations.

Two species present in the Port of Taranaki are of particular note for other locations in New Zealand. The invasive alga, *Undaria pinnatifida*, is on the New Zealand Register of Unwanted Species and has spread through shipping and other vectors to 11 of the 16 ports and marinas surveyed during the baseline surveys (the exceptions being Opua, Whangarei Port and marina and Gulf Harbour marina). All of the known infestations are currently on the east coast of New Zealand and the top of the South Island (Nelson, Picton). This survey provided the first record of *U. pinnatifida* on the west coast of New Zealand. Its presence in the Port of Taranaki could provide a new source location for spread of the alga to other west coast locations, including sensitive areas like the nearby Sugar Loaf Islands Marine Protected Area. According to the 'Seasearcher.com' database the Port of Taranaki has regular shipping connections with the ports of Westport (44 vessels departing Taranaki in 2002-2005), Onehunga (23 vessels) and, to a lesser extent, Greymouth (8 vessels; Table 8). The large densities of *U. pinnatifida* within the marina at the Port of Taranaki suggest that it may have been transported into the port by fouled smaller vessels (e.g. coastal fishing vessels and recreational craft). Although an attempt has been made to eradicate the local population of *U. pinnatifida* in the Port of Taranaki (see "Management of existing non-indigenous species in the port", below), there is a continuing risk that it could be spread to other locations and re-introduced to the port from established populations in Lyttelton, Wellington, Napier, Dunedin and Nelson, which have frequent shipping links with the port. The risk of translocation of *U. pinnatifida* is greatest for slow-moving vessels, such as yachts and barges, and vessels that have long residence times in port. In the Port of Taranaki, recreational craft and fishing vessels that are laid up for significant periods of time pose a particular risk for the spread of these species.

Cysts of the dinoflagellate *Gymnodinium catenatum* were also reported from the Port of Taranaki. *G. catenatum* produces saxitoxins and gonyautoxins that can cause Paralytic Shellfish Poisoning (PSP) and it is, therefore, a threat to shellfish aquaculture. A bloom of *G. catenatum* between May 2000 and February 2001 contaminated shellfish with PSP toxins around the coast of the North Island, but there have been few PSP events recorded from the Marlborough Sounds and further south in New Zealand (New Zealand Food Safety Authority 2003). There is potential, therefore, for shipping and other vectors to spread *G. catenatum* to shellfish producing and harvesting areas where it has not yet been recorded. In a risk profiling study of marine pests in Australia, *G. catenatum* was considered to have high invasion potential and to be one of the ten most damaging species based on actual (or potential) human health, economic and environmental impacts (invasion potential, Hayes et al. 2004).

Several other non-indigenous species that are present in the Port of Taranaki have relatively restricted distributions within New Zealand and could be spread to other ports and marinas. These include the polychaete worms *Euchone limnicola* and *Barantolla lepte*, the Pacific oyster *Crassostrea gigas*, and the hydroids *Monotheca pulchella* and *Amphisbetia maplestonei* (Table 18). Only limited information is available about potential impacts of the hydroid species. Based on current information the impacts of *Monotheca pulchella* are likely to be no more than minor. However, whilst the impacts of *Amphisbetia maplestonei* in New Zealand are unknown, a related hydroid, the native species *A. bispinosa*, commonly fouls the shells of cultured Greenshell mussels (*Perna canaliculus*). Heavy growths of *A. bispinosa* on marine farms in the Coromandel and Firth of Thames have increased the costs of cleaning and harvesting and may negatively affect mussel production. It is possible that *A. maplestonei* could have similar impacts, although this has not yet been recorded. The other three species can potentially modify benthic habitats, where they occur in large densities. *C. gigas*, in particular, has caused significant changes to natural ecosystems where it has invaded native environments in New Zealand and overseas (Wolff and Reise 2002). Hayes et al. (2004) ranked its impact potential as fifth out of 53 potential pest species in Australian waters. Although *C. gigas* is now widespread in northern New Zealand, it is still absent from southern ports where it could potentially survive.

Management of existing non-indigenous species in the port

Many of the NIS detected in this survey appear to be well established in the port. Three species, which are new records from the port, occurred in just a single site and may have a limited local distribution. These were the hydroids *Amphisbetia maplestonei* and *Monotheca pulchella*, and the alga *Undaria pinnatifida*. Efforts to control or eradicate marine pests should be undertaken only where such a programme can be shown to have significant benefits to New Zealand's natural environments, economy, or cultural or spiritual values. As noted above, the potential impacts of the non-indigenous hydroids on New Zealand's core environmental values are unknown. For most marine NIS, eradication by physical removal or chemical treatment is not yet a cost-effective option. Local population controls are unlikely to be effective for species that are widespread in the Port of Taranaki. They may be worth considering for the more restricted species noted above, but a more detailed delimitation survey is needed for these species to determine their current distribution and abundance more accurately before any control measures are considered.

It is recommended that management activity of existing non-indigenous species should be directed toward preventing spread of potentially harmful species established in the port to locations where they do not presently occur. NIWA notified MAF Biosecurity New Zealand of the presence of *Undaria pinnatifida* in the Port of Taranaki as soon as it was detected (in March 2005). An attempt was subsequently (in August 2005) made by Taranaki Regional Council, the Department of Conservation and MAF Biosecurity New Zealand to eradicate it from the harbour. All parts of the plants on the ropes and collars attached to the pontoons were removed (approximately 60 kg of *U. pinnatifida*; D. Govier, Taranaki Regional Council, pers comm.). Piles were wrapped in black durable plastic from the seafloor up to the low tide mark in an attempt to smother the plants. The trial reportedly worked well within the harbour, and when the wrapping was removed in late 2005 there were no live plants remaining, and the piles had not been recolonised by *U. pinnatifida* (D. Govier, pers comm.). However, the infestation was more widespread than originally realised and monthly dives are ongoing to remove the adult plants and try to control the population, which now seems to be growing mostly on buoys, collars and moorings. A yacht heavily fouled with *U. pinnatifida* was discovered on the outskirts of the marina moorings after the eradication trial. The yacht was removed from the water for cleaning, due to the large number of sporophytes present. The yacht had been in Port Taranaki marina for several years prior to the discovery of *U. pinnatifida* on its hull. Most of the *U. pinnatifida* plants are believed to have now been removed from the harbour and the infestation appears to be slowing down (D. Govier, pers comm.). Monitoring is continuing to evaluate the success of the eradication trial and the extent of *U. pinnatifida* in the harbour.

Prevention of new introductions

Interception of unwanted species transported by shipping is best achieved offshore, through control and treatment of ships destined for the Port of Taranaki from high-risk locations elsewhere in New Zealand or overseas. Under the Biosecurity Act (1993), the New Zealand Government has developed an Import Health Standard for ballast water that requires large ships to exchange foreign coastal ballast water with oceanic water prior to entering New Zealand, unless exempted on safety grounds. This procedure ("ballast exchange") does not remove all risk, but does reduce the abundance and diversity of coastal species that may be discharged with ballast. Ballast exchange requirements do not currently apply to ballast water that is uptaken domestically. Globally, shipping nations are moving toward implementing the International Convention for the Control and Management of Ships Ballast Water & Sediments that was recently adopted by the International Maritime Organisation (IMO). By

2016 all merchant vessels will be required to meet discharge standards for ballast water that are stipulated within the agreement.

Options are currently lacking, however, for effective in-situ treatment of biofouling and sea-chests. MAF Biosecurity New Zealand has recently embarked on a national survey of hull fouling on vessels entering New Zealand from overseas. The study will characterise risks from this pathway (including high risk source regions and vessel types) and identify predictors of risk that may be used to manage problem vessels. Shipping companies and vessel owners can reduce the risk of transporting NIS in hull fouling or sea chests through regular maintenance and antifouling of their vessels. Until effective risk mitigation options are developed, it is recommended that local authorities and port companies assess the risk of activities such as in-water cleaning of vessel hulls and sea-chests. These activities can increase the likelihood of non-indigenous fouling species being released and potentially becoming established within the port. They should be discouraged where the risk is considered unacceptable. Slow moving barges or vessels that are laid up in overseas ports for long periods before travelling to New Zealand can carry large densities of non-indigenous marine organisms with them. Cleaning and maintenance of these vessels should be encouraged by port authorities and shipping companies prior to their departure for New Zealand waters.

Studies of historical patterns of invasion have suggested that changes in trade routes can herald an influx of new NIS from regions that have not traditionally had major shipping links with the country or port (Carlton 1987; Hayden et al. in review). The growing number of baseline port surveys internationally and an associated increase in published literature on marine NIS means that information is becoming available that will allow more robust risk assessments to be carried out for new shipping routes. We recommend that port companies consider undertaking such assessments for their ports when new import or export markets are forecast to develop. The assessment would allow potential problem species to be identified and appropriate management and monitoring requirements to be put in place.

Conclusions and recommendations

The national biological baseline surveys have significantly increased our understanding of the identity, prevalence and distribution of introduced and native species in New Zealand's shipping ports. They represent a first step towards a comprehensive assessment of the risks posed to native coastal marine ecosystems from non-indigenous marine species. Although measures are being taken by the New Zealand government to reduce the rate of new incursions, foreign species are likely to continue to be introduced into New Zealand waters by shipping. There is a need for continued monitoring of non-indigenous marine species in port environments to allow for (1) early detection and control of harmful or potentially harmful non-indigenous species, (2) to provide on-going evaluation of the efficacy of management activities, and (3) to allow trading partners to be notified of species that may be potentially harmful.

The repeat survey of the Port of Taranaki recorded 269 species or higher taxa, including 13 non-indigenous species. Although many species also occurred in the initial, April 2002 baseline survey of the port, the degree of overlap was not high. Around 46% of the native species, 39 % of non-indigenous species, and 52 % of cryptogenic species recorded during the repeat survey were not found in the earlier survey. This is not simply attributable to greater sampling effort in the second survey. The species assemblage in each survey was characterised by high diversity, a comparatively large proportion of uncommon species, and patchy local distributions that are typical of marine biota. As a consequence, the estimated numbers of undetected species were comparatively high. In the initial baseline survey, for example, 3 of the 14 non-indigenous species (21%) were each found in five or fewer samples (Table 18). Several species found in that survey, notably *Barantolla lepte* and *Theora lubrica*, were more prevalent in the repeat survey, possibly as a result of greater sampling effort. Others (*Bugula stolonifera*, *Tricellaria inopinata*, *Watersipora arcuata*, *Eudendrium capillare*, *Polysiphonia sertularioides*, and *Halisarca dujardini*), however, were not detected at all. Of the 5 non-indigenous species that were found only in the second survey, 3 were recorded at just a single site (*Monotheca pulchella, Amphisbetia maplestonei* and *Undaria pinnatifida*). This makes it difficult to determine if the new records in the second survey represent incursions that occurred after the first survey or, rather, are species that were present, but undetected during the first survey due to their sparse densities or distribution. Similarly, the absence of *B. stolonifera*, *T. inopinata*, *W. arcuata*, *E. capillare*, *P. sertularioides*, and *Halisarca dujardini* in the second survey could be explained either by sampling error or local extinction since the initial baseline survey.

In some cases, additional information can be used to address this problem. For example, although *Monotheca pulchella* was not recorded in the initial survey of the Port of Taranaki, it has been present in New Zealand for more than 70 years and is known to occur in the region (Vervoort and Watson 2003). It seems likely, therefore, that it was present, but undetected in the port during the first survey. The other four non-indigenous species that were detected only in the repeat survey (*Amphisbetia maplestonei*, *Monocorophium sextonae*, *Euchone limnicola*, and *Undaria pinnatifida*) appear to be new range records. Although the evidence is only circumstantial, these species are the most likely to represent recent incursions.

Similarly, 5 of the 6 non-indigenous species that were only recorded in the initial baseline survey (*Bugula stolonifera*, *Tricellaria inopinata*, *Watersipora arcuata*, *Polysiphonia sertularioides*, and *Halisarca dujardini*) have been present in New Zealand for at least 30 years, are widely distributed and/or have been recorded previously in surveys from this region, suggesting that they were likely to be present, but because they are locally rare, or seasonally abundant, were undetected during the repeat survey. The exception – *Eudendrium capillare* – was a new record for the Port of Taranaki. In the initial baseline survey it occurred in only 3 samples. It is possible that this population has not persisted or, more likely, it was not detected in the re-survey because of its local rarity.

As several recent analyses have shown, the large area of habitat available for marine organisms within shipping ports and the logistic difficulties of sampling in these environments mean that detection probabilities are likely to be comparatively low for species with low prevalence, even when species-specific survey methods are used (Inglis 2003; Inglis et al. 2003; Hayes et al. 2005; Gust et al. 2006; Inglis et al. in press). In generalised pest surveys, such as the baseline port surveys, this problem is compounded by the high cost of identifying all specimens (native and non-indigenous) which constrains the total number of samples that can be taken (Inglis 2003). A consequence is that a high proportion of comparatively rare species will remain undetected by any single survey. This problem is not limited to non-indigenous species, as more than one third of native species recorded in the pile scrape samples from the Port of Taranaki also occurred in just a single sample (35 % of native species in each survey). Nor is it unique to marine assemblages. These results reflect the spatial and temporal variability that are features of marine biological assemblages (Morrisey et al. 1992a, b) and the difficulties that are involved in characterising diversity within hyper-diverse assemblages (Gray 2000; Gotelli and Colwell 2001; Longino et al. 2002).

Nevertheless, the baseline surveys continue to reveal new records of non-indigenous species in New Zealand ports and, with repetition, the cumulative number of undetected species should decline over time. This type of sequential analysis of occupancy and detection probability requires a series of three (or more) surveys, which should allow more accurate estimates of the rate of new incursions and extinctions (MacKenzie et al. 2004). Hewitt and Martin (2001) recommend repeating the baseline surveys on a regular basis to ensure they remain current. It may also be prudent to repeat at least components of a survey over a shorter time frame to achieve better estimates of occupancy without the confounding effects of temporal variation and new incursions.

This survey, alone, cannot determine the threat to New Zealand's native ecosystems that is presented by the non-indigenous species encountered in this port. It does, however, provide a starting point for further investigations of the distribution, abundance and ecology of the species described within it. Non-indigenous marine species can have a range of adverse impacts through interactions with native organisms. These include competition with native species, predator-prey interactions, hybridisation, parasitism or toxicity and modification of the physical environment (Ruiz et al. 1999; Ricciardi 2001). Assessing the impact of a NIS in a given location ideally requires information on a range of factors, including the mechanism of their impact and their local abundance and distribution (Parker et al. 1999). To predict or quantify their impacts over larger areas or longer time scales requires additional information on the species' seasonality, population size and mechanisms of dispersal (Mack et al. 2000).

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Tables

Table 1: Berthage facilities in the Port of Taranaki

Berth	Berth No.	Purpose	Construction	Length of Berth (m)	Max. Draft (m)
Main Breakwater (Breakwater No.1)	Inner #1	Support facilities for offshore oil and gas operations, and smaller berth areas nearby for fishing vessels	Solid concrete	78	6
(Breakwater No.2)	Inner # 2	Multipurpose, coastal bulk traders, offshore support vessels	Solid concrete	150	6
Moturoa Wharf	1	Dry bulk cargoes	Concrete deck/concrete piles	99	6
	2	Dry bulk cargoes	Concrete deck/concrete piles	196	9.8
	3	Dry bulk cargoes	Concrete deck/concrete piles	75	5.5
Newton King Tanker Terminal		Petrochemical products and bulk liquids	Concrete deck/steel piles	211	10
Blyde Terminal (Blyde Wharf No.3)	1	Containers, general/refrigerated cargoes	Concrete deck/steel piles + steel sheet pile wall	225	10.0
	2	Containers, general/refrigerated cargoes	Concrete deck/steel piles + steel sheet pile wall	225	11.2
	3	Oil and gas production vessels	Concrete deck/steel piles + steel sheet pile wall	78	6.5

Table 2: Weight and value of overseas cargo unloaded at the Port of Taranaki between the 2001-2002 and 2004-2005 financial years (data from Statistics New Zealand (2006b))

Year ended June	Gross weight (tonnes)	% weight change from previous year	Value (CIF[1]) ($million)	% value change from previous year	Proportion by weight of all NZ Seaports	Proportion by value of all NZ Seaports
2002	356,358		180		2.3	0.7
2003	442,071	24.1	187	3.9	2.8	0.8
2004	450,479	1.9	222	18.7	2.6	0.9
2005 [P]	462,693	2.7	275	23.9	2.4	1.0
Change from 2002 to 2005	106,335	29.8	95	52.8		

[1] CIF: Cost including insurance and freight

[P] Provisional statistics – at the time of access, data for the final two months of the 2005 year were provisional

Table 3: Weight and value of overseas cargo loaded at the Port of Taranaki between the 2001-2002 and 2004-2005 financial years (data from Statistics New Zealand (2006b))

Year ended June	Gross weight (tonnes)	% weight change from previous year	Value (FOB[1]) ($million)	% value change from previous year	Proportion by weight of all NZ Seaports	Proportion by value of all NZ Seaports
2002	3,726,284		1,914		15.2	6.8
2003	3,236,740	-13.1	2,148	12.2	12.8	8.5
2004	2,034,146	-37.2	1,792	-16.6	9.0	7.0
2005 [P]	1,890,401	-7.1	1,966	9.7	8.7	7.5
Change from 2002 to 2005	-1,835,883	-49.3	52	2.7		

[1] FOB: Free on board

[P] Provisional statistics – at the time of access, data for the final two months of the 2005 year were provisional

Table 4: Number of vessel arrivals from overseas to the Port of Taranaki by each general vessel type and previous geographical area, between 2002 and 2005 inclusive (data from LMIU "SeaSearcher.com" database)

Geographical area of previous port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger/ vehicle/ livestock	Other (inc pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (inc chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Australia	12			1	4	27	1	5		4	75	94	7	230
Pacific Islands	1			2	8	109					5		2	127
Japan	5				6						68			79
Northwest Pacific	14							1			52	1		68
East Asian eas	4				4	2	2	2		2	12		1	29
Central America inc Mexico to Panama												25		25
West coast North America inc USA, Canada & Alaska	4				1						4	3		12
Gulf States	5				4						1			10
U.S, Atlantic coast including part of Canada					7							3		10
Caribbean Islands												7		7
North African coast	4													4
Unknown (not stated in database)								1				1	1	3
South America Atlantic coast	1				1									2
Gulf of Mexico					1						1			2
South America Pacific coast					1									1
North European Atlantic coast					1									1
Central Indian Ocean	1													1
Spain / Portugal inc Atlantic Islands	1													1
Total	52	0	0	3	38	138	3	9	0	6	218	134	11	612

Table 5: Number of vessel arrivals to the Port of Taranaki from Australia by each general vessel type and Australian state, between 2002 and 2005 inclusive (data from LMIU "SeaSearcher.com" database)

Australian state of previous port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG / LNG	Passenger/ vehicle/ livestock	Other (inc pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (inc chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Queensland	3					14					30	88	3	138
New South Wales	2				1	2		2			20	5	1	33
Victoria	1				3	5		2		3	15	1	2	32
Tasmania						6					4			10
Western Australia	2						1	1			4			8
South Australia	4			1							2		1	8
Northern Territory										1				1
Total	12			1	4	27	1	5		4	75	94	7	230

Table 6: Number of vessel departures from the Port of Taranaki to overseas ports, by each general vessel type and next geographical area, between 2002 and 2005 inclusive data from LMIU “SeaSearcher.com” database)

Geographical area ofnext port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger/ vehicle/ livestock	Other (inc pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (inc chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Australia	14			1	25	44		3		2	113	172	5	379
East Asian seas	12				37	3		1		1	21	77	2	154
Japan	2										106			108
Northwest Pacific	13					1	3				67			84
Pacific Islands	1			1	2	68				1			1	74
U.S, Atlantic coast including part of Canada					9									9
Gulf of Mexico											3			3
Central America inc Mexico to Panama												1		1
South America Pacific coast								1						1
Central Indian Ocean						1								1
West coast North America inc USA, Canada & Alaska					1									1
South America Atlantic coast											1			1
Gulf States											1			1
Scandinavia inc Baltic, Greenland, Iceland etc					1									1
Total	42	0	0	2	75	117	3	5	0	4	312	250	8	818

Table 7: Number of vessel arrivals from New Zealand ports to the Port of Taranaki by each general vessel type and previous port, between 2002 and 2005 inclusive data from LMIU "SeaSearcher.com" database)

Previous port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger / vehicle/ livestock	Other (includes pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (including chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Lyttelton	20		1	1	62	137					44	5		270
Nelson	21			1	20	2					16	100	2	162
Dunedin	7				5	49					4	77		142
Wellington	31				45	1					48	6		131
Auckland	22				28	9					18	9	1	87
Timaru	9				2			1			36	35		83
New Plymouth	3					39		19		7	9		2	79
Westport	32							2					2	36
Napier	11				8						9	2		30
Whangarei	4				22						3			29
Tauranga	2				13						13			28
Onehunga	21					3		1						25
Bluff	3									1	7			11
Greymouth								2					4	6
Tarakohe					1			1					1	3
Gisborne	1													1
Total	187	0	1	2	206	240	0	26	0	8	207	234	12	1123

Table 8: Number of vessel departures from the Port of Taranaki to New Zealand ports by each general vessel type and next port of call, between 2002 and 2005 inclusive data from LMIU "SeaSearcher.com" database)

Next port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger / vehicle/ livestock	Other (includes pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (including chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Lyttelton	26		1	1	5	145		1			34	3		216
Wellington	15				23	4				1	4	52		99
New Plymouth	3					39		19		7	9		2	79
Napier	11				53						7	5		76
Dunedin	11				1	57					1			70
Nelson	19				34	2					9	2	4	70
Whangarei	16				32						17	2		67
Timaru	2				2						17	39		60
Auckland	22			1	4	9					4	4		44
Westport	38							4					2	44
Tauranga	11				13						5	2		31
Onehunga	15				1	4		1					2	23
Bluff	5				2						6			13
Greymouth								3					5	8
Gisborne	2													2
Tarakohe								1						1
Total	196	0	1	2	170	260	0	29	0	8	113	109	15	903

Table 9: Comparison of survey methods used in this study with the CRIMP protocols (Hewitt and Martin 2001), indicating modifications made to the protocols following recommendations from a workshop of New Zealand scientists. Full details of the workshop recommendations can be found in Gust et al. (2001).

	CRIMP Protocol		NIWA Method		
Taxa sampled	**Survey method**	**Sample procedure**	**Survey method**	**Sample procedure**	**Notes**
Dinoflagellate cysts	Small hand core	Cores taken by divers from locations where sediment deposition occurs	TFO Gravity core ("javelin" core)	Cores taken from locations where sediment deposition occurs	Use of the javelin core eliminated the need to expose divers to unnecessary hazards (poor visibility, snags, boat movements, repetitive dives > 10 m). It is a method recommended by the WESTPAC/IOC Harmful Algal Bloom project for dinoflagellate cyst collection (Matsuoka and Fukuyo 2000)
Benthic infauna	Large core	3 cores close to (0 m) and 3 cores away (50 m) from each berth	Shipek benthic grab	3 cores within 10 m of each sampled berth and at sites in the port basin	Use of the benthic grab eliminated need to expose divers to unnecessary hazards (poor visibility, snags, boat movements, repetitive dives > 10 m).
Dinoflagellates	20µm plankton net	Horizontal and vertical net tows	Not sampled	Not sampled	Plankton assemblages spatially and temporally variable, time-consuming and difficult to identify to species. Workshop recommended using resources to sample other taxa more comprehensively
Zooplankton and/ phytoplankton	100 µm plankton net	Vertical net tow	Not sampled	Not sampled	Plankton assemblages spatially and temporally variable, time-consuming and difficult to identify to species. Workshop recommended using resources to sample other taxa more comprehensively
Crab/shrimp	Baited traps	3 traps of each kind left overnight at each site	Baited traps	4 traps (2 line x 2 traps) of each kind left overnight at each site	
Macrobiota	Qualitative visual survey	Visual searches of wharves & breakwaters for target species	Qualitative visual survey	Visual searches of wharves & breakwaters for target species	

	CRIMP Protocol		NIWA Method		
Taxa sampled	**Survey method**	**Sample procedure**	**Survey method**	**Sample procedure**	**Notes**
Sedentary / encrusting biota	Quadrat scraping	0.10 m^2 quadrats sampled at -0.5 m, -3.0 m and -7.0 m on 3 outer piles per berth	Quadrat scraping	0.10 m^2 quadrats sampled at -0.5 m, -1.5 m, -3.0 m and -7 m on 2 inner and 2 outer piles per berth	Workshop recommended extra quadrat in high diversity algal zone (-1.5 m) and to sample inner pilings for shade tolerant species
Sedentary / encrusting biota	Video / photo transect	Video transect of pile/rockwall facing. Still images taken of the three 0.10 m^2 quadrats	Video / photo transect	Video transect of pile/rockwall facing. Still images taken of the four 0.10 m^2 quadrats	
Mobile epifauna	Beam trawl or benthic sled	1 x 100 m or timed trawl at each site	Benthic sled	2 x 100 m (or 2 min.) tows at each site	
Fish	Poison station	Divers & snorkelers collect fish from poison stations	Opera house fish traps	4 traps (2 lines x 2 traps) left for min. 1 hr at each site	Poor capture rates anticipated from poison stations because of low visibility in NZ ports. Some poisons also an OS&H risk to personnel and may require resource consent.
Fish/mobile epifauna	Beach seine	25 m seine haul on sand or mud flat sites	Opera house fish traps / Whayman Holdsworth starfish traps	4 traps (2 lines x 2 traps) of left at each site (Whayman Holdworth starfish traps left overnight)	Few NZ ports have suitable intertidal areas to beach seine.

Table 10: Summary of sampling effort in the Port of Taranaki. Exact geographic locations of survey sites are provided in Appendix 2.

	Sampling method and survey (T1 = first survey; T2 = second survey)																			
	Crab traps		**Fish traps**		**Shrimp traps**		**Starfish traps**		**Benthic grabs**		**Benthic sleds**		**Pile scrape quadrats**		**Photo stills and video**		**Qualitative visual searches (on pilings)**		**Javelin cores (for cysts)**	
Site name	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
New Plymouth Port																				
Blyde Wharf *	4	4	4	4	4	2	4	4	3	3	2	2	16	16	16	16	4	4	2	2
Blyde Wharf No.3		4		4		2		4		3										2
Boat ramp																	1			
Breakwater No.1		4		4		2		4	3	3	2	2		14		13		4	2	2
Breakwater No.2	4	4	4	4	4	4	4	4	3	3	2	2	13		13		4		2	2
Lee Breakwater	4		4		4		4		3	3	2	2							2	2
Main Basin										3										
Main Basin 1												2								
Main Basin 2												2								
Main Basin 3												2								
Mid channel																			2	
Mooring Breakwater		4		4		2		4												
Moturoa Wharf#	5	4	4	4	4	2	4	4	3	3	2	2	15	16	15	16	4	4	2	2
Moturoa Wharf Pontoon																	1			
Newton King Tanker Terminal	4	4	4	4	4	2	4	4	3	3	2	2	16	16	16	16	4	4	2	2
Pilot Boat hull																	1			
Marina																				
Reclamation Area (Marina)	4		4		4		4		3											
Yacht Moorings		4		4		2		4		3		2		9		9		4		2
Total	25	32	24	32	24	18	24	32	21	27	12	20	60	71	60	70	19	20	14	16

* Recorded as Blyde Wharf No. 1 & No.2 in the first survey
# Recorded as Moturoa Wharf No.2 in the first survey

Table 11: Preservatives used for the major taxonomic groups of organisms collected during the port survey. [1] indicates photographs were taken before preservation, [2] indicates they were relaxed in menthol prior to preservation and [3] indicates a formalin fix was carried out before final preservation took place.

5 % Formalin solution	10 % Formalin solution	70 % Ethanol solution	80 % Ethanol solution	100 % Ethanol solution
Macroalgae	Ascidiacea (colonial) [1, 2]	Alcyonacea [2]	Ascidiacea (solitary) [1]	Bryozoa
	Asteroidea	Crustacea (small)		
	Brachiopoda	Holothuria [1, 2]		
	Crustacea (large)	Mollusca (with shell)		
	Ctenophora [1]	Mollusca [1, 2] (without shell)		
	Echinoidea	Platyhelminthes [1, 3]		
	Hydrozoa	Porifera [1]		
	Nudibranchia [1]	Zoantharia [1, 2]		
	Ophiuroidea			
	Polychaeta			
	Scleractinia			
	Scyphozoa [1, 2]			
	Vertebrata [1] (pisces)			

NB: Changes since the first survey:
Ascidians now considered separately as colonial and solitary species, and preserved in different solutions. The solitary species are no longer relaxed prior to preservation and the strength of preservative for these species has been increased. The colonials are now preserved in formalin as opposed to ethanol.
The Bryozoa are now initially preserved in 100% ethanol, then air dried at a later date prior to identification.
Platyhelminthes are now fixed in formalin, rather than relaxed, before preservation in ethanol.

Table 12: Marine pest species listed on the New Zealand register of Unwanted Organisms under the Biosecurity Act 1993.

Phylum	Class	Order	Genus and Species
Annelida	Polychaeta	Sabellida	*Sabella spallanzanii*
Arthropoda	Malacostraca	Decapoda	*Carcinus maenas*
Arthropoda	Malacostraca	Decapoda	*Eriocheir sinensis*
Echinodermata	Asteroidea	Forcipulatida	*Asterias amurensis*
Mollusca	Bivalvia	Myoida	*Potamocorbula amurensis*
Chlorophyta	Ulvophyceae	Caulerpales	*Caulerpa taxifolia*
Ochrophyta	Phaeophyceae	Laminariales	*Undaria pinnatifida*
Chordata	Ascidiacea	Pleurogona	*Styela clava*[1]

[1]*Styela clava* was added to the list of unwanted organisms in 2005, following its discovery in Auckland Harbour

Table 13: Marine pest species listed on the Australian Ballast Water Management Advisory Council's (ABWMAC) schedule of non-indigenous pest species.

Major taxonomic groups	Class/Order	Genus and Species
Annelida	Polychaeta	*Sabella spallanzanii*
Arthropoda	Decapoda	*Carcinus maenas*
Echinodermata	Asteroidea	*Asterias amurensis*
Mollusca	Bivalvia	*Corbula gibba*
Mollusca	Bivalvia	*Crassostrea gigas*
Mollusca	Bivalvia	*Musculista senhousia*
Macroalgae	Dinophyceae	*Alexandrium catenella*
Macroalgae	Dinophyceae	*Alexandrium minutum*
Macroalgae	Dinophyceae	*Alexandrium tamarense*
Macroalgae	Dinophyceae	*Gymnodinium catenatum*

Table 14: Native species recorded from the Port of Taranaki in the first (T1) and second (T2) surveys.

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Eunicida	Dorvilleidae	*Dorvillea australiensis*	0	1
Polychaeta	Eunicida	Dorvilleidae	*Schistomeringos loveni*	1	0
Polychaeta	Eunicida	Eunicidae	*Eunice australis*	1	1
Polychaeta	Eunicida	Lumbrineridae	*Lumbricalus aotearoae*	1	1
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sphaerocephala*	1	1
Polychaeta	Eunicida	Onuphidae	*Diopatra akarana*	1	0
Polychaeta	Eunicida	Onuphidae	*Onuphis aucklandensis*	1	1
Polychaeta	Phyllodocida	Glyceridae	*Glycera lamelliformis*	1	1
Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus macroura*	0	1
Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus verrilli*	1	1
Polychaeta	Phyllodocida	Nereididae	*Neanthes kerguelensis*	1	1
Polychaeta	Phyllodocida	Nereididae	*Nereis falcaria*	1	1
Polychaeta	Phyllodocida	Nereididae	*Perinereis amblyodonta*	1	1
Polychaeta	Phyllodocida	Nereididae	*Perinereis camiguinoides*	1	1
Polychaeta	Phyllodocida	Nereididae	*Perinereis pseudocamiguina*	1	1
Polychaeta	Phyllodocida	Nereididae	*Phyllodoce longipes*	0	1
Polychaeta	Phyllodocida	Nereididae	*Platynereis Platynereis_australis_group*	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia capensis*	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia microphylla*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus jacksoni*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus polychromus*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Ophiodromus angustifrons*	1	1
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis laevis*	1	1
Polychaeta	Phyllodocida	Sigalionidae	*Pelogenia antipoda*	1	0
Polychaeta	Phyllodocida	Sigalionidae	*Sigalion oviger*	0	1
Polychaeta	Phyllodocida	Sigalionidae	*Sthenelais novaezealandiae*	0	1
Polychaeta	Phyllodocida	Syllidae	*Clavisyllis alternata*	1	0
Polychaeta	Phyllodocida	Syllidae	*Odontosyllis polycera*	1	0
Polychaeta	Phyllodocida	Syllidae	*Trypanosyllis gigantea*	1	0
Polychaeta	Sabellida	Sabellidae	*Megalomma suspiciens*	1	1
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla laciniosa*	1	1
Polychaeta	Sabellida	Serpulidae	*Galeolaria hystrix*	1	1
Polychaeta	Sabellida	Serpulidae	*Neovermilia sphaeropomatus*	1	1
Polychaeta	Sabellida	Serpulidae	*Spirobranchus cariniferus*	1	0
Polychaeta	Scolecida	Arenicolidae	*Abarenicola affinis*	0	1
Polychaeta	Scolecida	Cossuridae	*Cossura consimilis*	0	1
Polychaeta	Scolecida	Opheliidae	*Armandia maculata*	1	1
Polychaeta	Scolecida	Orbiniidae	*Scoloplos simplex*	1	0
Polychaeta	Scolecida	Orbiniidae	*Scoloplos (Scoloplos) simplex*	0	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Polychaeta	Spionida	Spionidae	*Boccardia acus*	0	1
Polychaeta	Spionida	Spionidae	*Boccardia syrtis*	0	1
Polychaeta	Spionida	Spionidae	*Prionospio aucklandica*	1	1
Polychaeta	Spionida	Spionidae	*Prionospio multicristata*	1	0
Polychaeta	Terebellida	Acrocirridae	*Acrocirrus trisectus*	1	0
Polychaeta	Terebellida	Cirratulidae	*Dodecaceria berkeleyi*	0	1
Polychaeta	Terebellida	Cirratulidae	*Timarete anchylochaetus*	0	1
Polychaeta	Terebellida	Flabelligeridae	*Pherusa parmata*	1	1
Polychaeta	Terebellida	Pectinariidae	*Pectinaria australis*	1	1
Polychaeta	Terebellida	Terebellidae	*Neoleprea papilla*	1	0
Polychaeta	Terebellida	Terebellidae	*Pseudopista rostrata*	0	1
Polychaeta	Terebellida	Terebellidae	*Streblosoma toddae*	1	1
Polychaeta	Terebellida	Trichobranchidae	*Terebellides narribri*	0	1
Bryozoa					
Gymnolaemata	Cheilostomata	Beaniidae	*Beania plurispinosa*	1	1
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora rostrata*	0	1
Gymnolaemata	Cheilostomata	Bugulidae	*Bicellariella ciliata*	1	0
Gymnolaemata	Cheilostomata	Calloporidae	*Crassimarginatella papulifera*	1	0
Gymnolaemata	Cheilostomata	Romancheinidae	*Escharoides angela*	1	1
Gymnolaemata	Cheilostomata	Smittinidae	*Parasmittina delicatula*	1	0
Gymnolaemata	Cheilostomata	Steginoporellidae	*Steginoporella magnifica*	1	1
Chelicerata					
Pycnogonida	Pantopoda	Ammotheidae	*Achelia assimilis*	1	0
Pycnogonida	Pantopoda	Callipallenidae	*Pallenopsis obliqua*	1	0
Cnidaria					
Hydrozoa	Hydroida	Campanulariidae	*Obelia geniculata*	0	1
Hydrozoa	Hydroida	Haleciidae	*Halecium beanii*	1	1
Hydrozoa	Hydroida	Plumulariidae	*Aglaophenia acanthocarpa*	0	1
Hydrozoa	Hydroida	Sertulariidae	*Stereotheca elongata*	0	1
Crustacea					
Cirripedia	Thoracica	Balanidae	*Austrominius modestus*	1	1
Cirripedia	Thoracica	Balanidae	*Notobalanus vestitus*	1	0
Cirripedia	Thoracica	Balanidae	*Notomegabalanus decorus*	1	1
Cirripedia	Thoracica	Chthamalidae	*Chaemosipho columna*	1	1
Cirripedia	Thoracica	Pachylasmidae	*Epopella plicata*	1	1
Malacostraca	Amphipoda	Aoridae	*Haplocheira barbimana*	1	1
Malacostraca	Amphipoda	Dexaminidae	*Paradexamine pacifica*	1	0
Malacostraca	Amphipoda	Hyalidae	*Allorchestes novizealandiae*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe trailli*	1	0
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia akaroica*	1	0
Malacostraca	Amphipoda	Lysianassidae	*Orchomene aahu*	0	1
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia vesca*	0	1
Malacostraca	Amphipoda	Oedicerotidae	*Carolobatea novae-*	0	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
			zealandiae		
Malacostraca	Amphipoda	Phoxocephalidae	*Torridoharpinia hurleyi*	1	1
Malacostraca	Anomura	Diogenidae	*Paguristes pilosus*	0	1
Malacostraca	Anomura	Diogenidae	*Paguristes setosus*	0	1
Malacostraca	Anomura	Paguridae	*Lophopagurus (A.) cristatus*	0	1
Malacostraca	Anomura	Paguridae	*Lophopagurus (Australeremus) kirkii*	0	1
Malacostraca	Anomura	Paguridae	*Pagurixus kermadecensis*	0	1
Malacostraca	Anomura	Paguridae	*Pagurus novizealandiae*	1	1
Malacostraca	Anomura	Paguridae	*Pagurus traversi*	1	1
Malacostraca	Anomura	Porcellanidae	*Petrolisthes novaezelandiae*	1	1
Malacostraca	Brachyura	Cancridae	*Metacarcinus novaezelandiae*	1	0
Malacostraca	Brachyura	Grapsidae	*Leptograpsus variegatus*	1	0
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus cookii*	1	1
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus varius*	1	0
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus whitei*	0	1
Malacostraca	Brachyura	Hymenosomatidae	*Hymenosoma depressum*	1	0
Malacostraca	Brachyura	Hymenosomatidae	*Neohymenicus pubescens*	1	1
Malacostraca	Brachyura	Majidae	*Notomithrax minor*	1	1
Malacostraca	Brachyura	Majidae	*Notomithrax peronii*	0	1
Malacostraca	Brachyura	Majidae	*Notomithrax ursus*	0	1
Malacostraca	Brachyura	Ocypodidae	*Macrophthalmus hirtipes*	1	1
Malacostraca	Brachyura	Pinnotheridae	*Pinnotheres atrinocola*	1	0
Malacostraca	Brachyura	Pinnotheridae	*Pinnotheres novaezelandiae*	1	0
Malacostraca	Brachyura	Portunidae	*Ovalipes catharus*	1	1
Malacostraca	Caridea	Crangonidae	*Pontophilus australis*	1	1
Malacostraca	Caridea	Palemonidae	*Palaemon affinis*	1	0
Malacostraca	Isopoda	Cirolanidae	*Natatolana rossi*	0	1
Malacostraca	Isopoda	Cymothoidae	*Nerocila orbignyi*	0	1
Malacostraca	Isopoda	Holognathiidae	*Cleantis tubicola*	1	1
Malacostraca	Isopoda	Idoteidae	*Euidotea durvillei*	0	1
Malacostraca	Ogyrididae	Ogyrididae	*Ogyrides delli*	0	1
Echinodermata					
Asteroidea	Forcipulata	Asteriidae	*Allostichaster polyplax*	1	0
Asteroidea	Forcipulata	Asteriidae	*Coscinasterias muricata*	0	1
Asteroidea	Forcipulata	Asteriidae	*Stichaster australis*	1	1
Asteroidea	Valvatida	Asterinidae	*Meridiastra mortenseni*	0	1
Asteroidea	Valvatida	Asterinidae	*Patiriella regularis*	1	1
Echinoidea	Spatangoida	Loveniidae	*Echinocardium cordatum*	1	1
Holothuroidea	Aspidochirotida	Stichopodidae	*Stichopus mollis*	1	1
Ophiuroidea	Ophiurida	Ophiactidae	*Ophiactis resiliens*	1	0
Ophiuroidea	Ophiurida	Ophionereididae	*Ophionereis fasciata*	0	1
Mollusca					

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Bivalvia	Arcoida	Arcidae	*Barbatia novaezelandiae*	1	1
Bivalvia	Myoida	Hiatellidae	*Hiatella arctica*	1	1
Bivalvia	Mytiloida	Mytilidae	*Modiolarca impacta*	1	1
Bivalvia	Mytiloida	Mytilidae	*Perna canaliculus*	1	1
Bivalvia	Mytiloida	Mytilidae	*Xenostrobus pulex*	1	1
Bivalvia	Nuculoida	Nuculidae	*Nucula hartvigiana*	1	1
Bivalvia	Nuculoida	Nuculidae	*Nucula nitidula*	1	1
Bivalvia	Pterioida	Anomiidae	*Pododesmus zelandicus*	1	1
Bivalvia	Solemyoida	Solemyidae	*Solemya parkinsonii*	1	0
Bivalvia	Veneroida	Cardiidae	*Pratulum pulchellum*	0	1
Bivalvia	Veneroida	Kelliidae	*Kellia cycladiformis*	0	1
Bivalvia	Veneroida	Lasaeidae	*Arthritica bifurca*	0	1
Bivalvia	Veneroida	Lucinidae	*Divaricella huttoniana*	0	1
Bivalvia	Veneroida	Mactridae	*Maorimactra ordinaria*	0	1
Bivalvia	Veneroida	Mactridae	*Scalpomactra scalpellum*	0	1
Bivalvia	Veneroida	Semelidae	*Leptomya retiaria*	1	1
Bivalvia	Veneroida	Tellinidae	*Macomona liliana*	0	1
Bivalvia	Veneroida	Tellinidae	*Tellinota edgari*	0	1
Bivalvia	Veneroida	Veneridae	*Irus reflexus*	1	1
Bivalvia	Veneroida	Veneridae	*Tawera spissa*	1	1
Gastropoda	Basommatophora	Siphonariidae	*Siphonaria australis*	1	1
Gastropoda	Cephalaspidea	Acteonidae	*Acteon cratericulatus*	0	1
Gastropoda	Cephalaspidea	Aglajidae	*Philinopsis taronga*	0	1
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella novaezelandiae*	1	1
Gastropoda	Littorinimorpha	Littorinidae	*Austrolittorina antipodum*	1	0
Gastropoda	Littorinimorpha	Littorinidae	*Risellopsis varia*	1	1
Gastropoda	Littorinimorpha	Naticidae	*Tanea zelandica*	1	1
Gastropoda	Littorinimorpha	Ranellidae	*Cabestana spengleri*	1	0
Gastropoda	Neogastropoda	Buccinidae	*Austrofusus glans*	1	1
Gastropoda	Neogastropoda	Buccinidae	*Cominella adspersa*	1	1
Gastropoda	Neogastropoda	Muricidae	*Dicithais orbita*	1	0
Gastropoda	Neogastropoda	Muricidae	*Xymene pusillus*	0	1
Gastropoda	Neogastropoda	Muricidae	*Xymene traversi*	1	1
Gastropoda	Neogastropoda	Turridae	*Phenatoma rosea*	1	0
Gastropoda	Neotaenioglossa	Velutinidae	*Lamellaria ophione*	1	0
Gastropoda	Notaspidea	Pleurobranchidae	*Pleurobranchaea maculata*	1	0
Gastropoda	Nudibranchia	Dendrodorididae	*Dendrodoris citrina*	1	0
Gastropoda	Nudibranchia	Dorididae	*Archidoris wellingtonensis*	1	0
Gastropoda	Patellogastropoda	Lottiidae	*Notoacmea helmsi*	1	0
Gastropoda	Patellogastropoda	Lottiidae	*Notoacmea parviconoidea*	1	0
Gastropoda	Patellogastropoda	Lottiidae	*Patelloida corticata*	1	1
Gastropoda	Patellogastropoda	Nacellidae	*Cellana ornata*	1	0
Gastropoda	Patellogastropoda	Nacellidae	*Cellana radians*	1	0

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Gastropoda	Patellogastropoda	Nacellidae	*Cellana stellifera*	1	0
Gastropoda	Vetigastropoda	Calliostomatidae	*Calliostoma punctulatum*	1	0
Gastropoda	Vetigastropoda	Calliostomatidae	*Calliostoma tigris*	1	0
Gastropoda	Vetigastropoda	Fissurellidae	*Scutus breviculus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Cantharidella tesselata*	0	1
Gastropoda	Vetigastropoda	Trochidae	*Cantharidus purpureus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus sanguineus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus tenebrosus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Trochus viridus*	1	0
Gastropoda	Vetigastropoda	Turbinidae	*Cookia sulcata*	1	1
Gastropoda	Vetigastropoda	Turbinidae	*Turbo smaragdus*	1	1
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Acanthochitona zelandica*	0	1
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus porosus*	1	1
Polyplacophora	Ischnochitonidae	Ischnochitonidae	*Eudoxochiton nobilis*	1	0
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton pelliserpentis*	1	0
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton sinclairi*	1	0
Polyplacophora	Ischnochitonina	Mopaliidae	*Plaxiphora caelata*	1	0
Macroalgae					
Florideophyceae	Balliales	Balliaceae	*Ballia callitricha*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Anotrichium crinitum*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnion pectinatum*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnionella adnata*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Centroceras clavulatum*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium aff apiculatum*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium flaccidum*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Microcladia novae-zelandiae*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Pterothamnion confusum*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Pterothamnion simile*	1	1
Florideophyceae	Ceramiales	Dasyaceae	*Dasya subtilis*	1	0
Florideophyceae	Ceramiales	Dasyaceae	*Heterosiphonia concinna*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Acrosorium decumbens*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Acrosorium venulosum*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Apoglossum montagneanum*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Caloglossa leprieurii*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena variolosa*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Myriogramme denticulata*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris dichotoma*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Aphanocladia delicatula*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia harveyi*	1	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia moritziana*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Dasyclonium harveyanum*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Dasyclonium incisum*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Dipterosiphonia*	0	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
			heteroclada		
Florideophyceae	Ceramiales	Rhodomelaceae	*Echinothamnion hystrix*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Lophurella hookeriana*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia strictissima*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Pterosiphonia pennata*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Stictosiphonia hookeri*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Symphyocladia marchantioides*	0	1
Florideophyceae	Corallinales	Corallinaceae	*Corallina officinalis*	1	0
Florideophyceae	Corallinales	Corallinaceae	*Haliptilon roseum*	1	1
Florideophyceae	Gelidiales	Gelidiaceae	*Pterocladiella capillacea*	1	1
Florideophyceae	Gigartinales	Gigartinaceae	*Chondracanthus chapmanii*	1	0
Florideophyceae	Gigartinales	Phyllophoraceae	*Gymnogongrus furcatus*	0	1
Florideophyceae	Gracilariales	Gracilariaceae	*Gracilaria truncata*	1	0
Florideophyceae	Halymeniales	Halymeniaceae	*Cryptonemia latissima*	1	0
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium angustum*	1	1
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium cirrhosum*	0	1
Florideophyceae	Rhodymeniales	Faucheaceae	*Gloiocladia saccata*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia foliifera*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia leptophylla*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia novazelandica*	0	1
Florideophyceae	Stylonematales	Stylonemataceae	*Stylonema alsidii*	0	1
Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia velutina*	1	1
Phaeophyceae	Dictyotales	Dictyotaceae	*Dictyota papenfussii*	1	0
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Endarachne binghamiae*	1	0
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora retroflexa*	1	0
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora torulosa*	1	0
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum flexuosum*	0	1
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum maschalocarpum*	1	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum sinclairii*	1	0
Phaeophyceae	Laminariales	Alariaceae	*Ecklonia radiata*	0	1
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha compressa*	1	0
Porifera					
Calcarea	Leucosolenida	Sycettidae	*Sycon cf. ornatum*	1	0
Demospongiae	Dictyoceratida	Dysideidae	*Euryspongia cf. arenaria*	0	1
Demospongiae	Haplosclerida	Chalinidae	*Adocia cf. parietalioides*	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona glabra*	1	1
Demospongiae	Poecilosclerida	Desmacellidae	*Biemna rhabderemioides*	1	1
Demospongiae	Poecilosclerida	Hymedesmiidae	*Phorbas fulva*	1	1
Dinophyta					
Dinophyceae	Peridinales	Gonyaulacaceae	*Gonyaulax grindleyi*	1	0
Dinophyceae	Peridinales	Peridiniaceae	*Scrippsiella trochoidea*	1	1
Urochordata					
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula mortenseni*	1	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura cancellata*	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura carnea*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura pulla*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura rugata*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura subuculata*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa bicornuta*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa nisiotus*	1	1
Vertebrata					
Actinopterygii	Anguilliformes	Congridae	*Conger wilsoni*	1	1
Actinopterygii	Gadiformes	Moridae	*Lotella rhacinum*	1	1
Actinopterygii	Gadiformes	Moridae	*Pseudophycis barbata*	0	1
Actinopterygii	Gadiformes	Moridae	*Pseudophycis breviuscula*	1	0
Actinopterygii	Gasterosteiformes	Syngnathidae	*Hippocampus abdominalis*	1	1
Actinopterygii	Perciformes	Arripidae	*Arripis trutta*	1	1
Actinopterygii	Perciformes	Carangidae	*Pseudocarynx dentex*	1	0
Actinopterygii	Perciformes	Carangidae	*Trachurus novaezelandiae*	1	0
Actinopterygii	Perciformes	Cheilodactylidae	*Nemadactylus macropterus*	1	0
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*	1	1
Actinopterygii	Perciformes	Labridae	*Notolabrus fucicola*	1	0
Actinopterygii	Perciformes	Sparidae	*Pagrus auratus*	0	1

* 1 = Present, 0 = Absent

Table 15: Cryptogenic marine species recorded from the Port of Taranaki in the first (T1) and second (T2) surveys. Category 1 cryptogenic species (C1); Category 2 cryptogenic species (C2). Refer to "Definitions of species categories" for definitions.

Major taxonomic groups, Class	Order	Family	Genus and species	Status	T1*	T2*
Annelida						
Polychaeta	Eunicida	Lumbrineridae	*Eranno Eranno-A*	C2	1	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis Perinereis-A*	C2	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia Eulalia-NIWA-2*	C2	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eumida Eumida-B*	C2	1	0
Polychaeta	Phyllodocida	Phyllodocidae	*Eumida Eumida-C*	C2	1	0
Polychaeta	Phyllodocida	Phyllodocidae	*Pirakia Pirakia-A*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Autolytin-unknown sp. A*	C2	1	1
Polychaeta	Phyllodocida	Syllidae	*Eusyllin-unknown Eusyllin-unknown-A*	C2	0	1
Polychaeta	Phyllodocida	Syllidae	*Eusyllis Eusyllis-A*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Eusyllis Eusyllis-B*	C2	1	1
Polychaeta	Phyllodocida	Syllidae	*Syllis Syllis-A*	C2	1	1
Polychaeta	Phyllodocida	Syllidae	*Typosyllis Typosyllis-A*	C2	1	0
Polychaeta	Sabellida	Sabellidae	*Branchiomma Branchiomma-B*	C2	1	0
Polychaeta	Sabellida	Serpulidae	*Serpula Serpula-C*	C2	0	1
Polychaeta	Scolecida	Capitellidae	*Capitella capitata*	C1	0	1
Polychaeta	Scolecida	Capitellidae	*Heteromastus filiformis*	C1	0	1
Polychaeta	Spionida	Spionidae	*Paraprionospio Paraprionospio-A [pinnata]*	C2	0	1
Polychaeta	Spionida	Spionidae	*Scolelepis Scolelepis-A*	C2	1	0
Polychaeta	Terebellida	Ampharetidae	*Amphicteis Amphicteis-A*	C2	1	0
Bryozoa						
Gymnolaemata	Cheilostomata	Scrupariidae	*Scruparia ambigua*	C1	1	0
Chelicerata						
Pycnogonida	Pantopoda	Ammotheidae	*Achelia sp. nov. A*	C2	1	0
Pycnogonida	Pantopoda	Ammotheidae	*Tanystylum sp. B*	C2	0	1
Cnidaria						
Anthozoa	Corallimorpharia	Corallimorphidae	*Corynactis australis*	C1	1	?[5]

[5] Not determined at the time of reporting, as specimens of Anthozoa had not been identified.

Major taxonomic groups, Class	Order	Family	Genus and species	Status	T1*	T2*
Hydrozoa	Hydroida	Campanulariidae	*Clytia hemisphaerica*	C1	0	1
Hydrozoa	Hydroida	Plumulariidae	*Plumularia setacea*	C1	1	1
Crustacea						
Malacostraca	Amphipoda	Aoridae	*Aora typica*	C1	0	1
Malacostraca	Amphipoda	Dexaminidae	*Paradexamine sp. A*	C2	0	1
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis sp. 1*	C2	1	0
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe sp. 1*	C2	1	1
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia sp.*	C2	1	0
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia sp. aff. P. stephenseni*	C2	0	1
Malacostraca	Brachyura	Grapsidae	*Plagusia chabrus*	C1	1	0
Malacostraca	Brachyura	Portunidae	*Ovalipes elongatus*	C1	1	1
Porifera						
Demospongiae	Hadromerida	Suberitidae	*Pseudosuberites sulcatus*	C1	1	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 1*	C2	1	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 4*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 4*	C2	0	1
Demospongiae	Poecilosclerida	Esperiopsidae	*Esperiopsis new sp. 1*	C2	1	1
Demospongiae	Poecilosclerida	Hymedesmiidae	*Phorbas new sp. 2*	C2	1	0
Demospongiae	Poecilosclerida	Mycalidae	*Paraesperella new sp. 1 (macrosigma)*	C2	1	0
Dinophyta						
Dinophyceae	Gymnodiniales	Gymnodiniaceae	*Gymnodinium catenatum*	C1	1	1
Urochordata						
Ascidiacea	Aplousobranchia	Didemnidae	*Diplosoma listerianum*	C1	1	0
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella eumyota*	C1	1	1
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes leachii*	C1	1	0
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus australis*	C1	1	0
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus squamiger*	C1	0	1
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa cerea*	C1	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Styela plicata*	C1	1	0

* 1 = Present, 0 = Absent

Table 16: Non-indigenous marine species recorded from the Port of Taranaki during the first survey (T1) and second survey (T2). Likely vectors of introduction are largely derived from Cranfield et al. (1998), where H = Hull fouling and B = Ballast water transport. Novel NIS not listed in Cranfield et al. (1998) or previously encountered by taxonomic experts in New Zealand waters are marked as New Records (NR). For these species and others for which information is scarce, we provide dates of first detection rather than probable dates of introduction.

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*	Probable means of introduction	Date of introduction or detection (d)
Annelida							
Polychaeta	Sabellida	Sabellidae	*Euchone limnicola*	0	1	H or B	Unknown[1]
Polychaeta	Scolecida	Capitellidae	*Barantolla lepte*	1	1	H or B	Unknown[1]
Bryozoa							
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula flabellata*	1	1	H	Pre-1949
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula neritina*	1	1	H	1949
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula stolonifera*	1	0	H	1962
Gymnolaemata	Cheilostomata	Candidae	*Tricellaria inopinata*	1	0	H	Pre-1964
Gymnolaemata	Cheilostomata	Cryptosulidae	*Cryptosula pallasiana*	1	1	H	1890s
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora arcuata*	1	0	H	Pre-1957
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora subtorquata*	1	1	H or B	Pre-1982
Cnidaria							
Hydrozoa	Hydroida	Eudendriidae	*Eudendrium capillare* ***(NR)***	1	0	H	Nov 2001[d]

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*	Probable means of introduction	Date of introduction or detection (d)
Hydrozoa	Hydroida	Plumulariidae	*Monotheca pulchella*	0	1	H	1928
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia maplestonei* ***(NR)***	0	1	H	Dec 2004[d]
Crustacea							
Malacostraca	Amphipoda	Corophiidae	*Monocorophium sextonae*	0	1	H	Pre-1921
Mollusca							
Bivalvia	Ostreoida	Ostreidae	*Crassostrea gigas*	1	1	H	1961
Bivalvia	Veneroida	Semelidae	*Theora lubrica*	1	1	B	1971
Macroalgae							
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia crassiuscula*	1	1	H	Pre-1954
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sertularioides*	1	0	H	Pre-1938
Phaeophyceae	Laminariales	Alariaceae	*Undaria pinnatifida*	0	1	H or B	Pre-1987
Porifera							
Demospongiae	Halisarcida	Halisarcidae	*Halisarca dujardini*	1	0	H or B	Pre-1973

[1] Date of introduction currently unknown but species had been encountered in New Zealand prior to the present survey.
* 1 = Present, 0 = Absent

Table 17: Species indeterminata recorded from the Port of Taranaki in the first (T1) and second (T2) surveys. This group includes: (1) organisms that were damaged or juvenile and lacked crucial morphological characteristics, and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow positive identification to species level.

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris Indet*	0	1
Polychaeta	Eunicida	Onuphidae	*Onuphidae Indet*	1	0
Polychaeta	Phyllodocida	Nereididae	*Nereididae indet*	1	0
Polychaeta	Phyllodocida	Nereididae	*Nereis Indet*	1	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis sp_indet*	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodocidae Indet*	1	0
Polychaeta	Phyllodocida	Syllidae	*Eusyllin-unknown Indet*	1	0
Polychaeta	Phyllodocida	Syllidae	*Syllidae Indet*	1	1
Polychaeta	Phyllodocida	Syllidae	*Typosyllis sp_undet*	0	1
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla Indet*	1	0
Polychaeta	Sabellida	Sabellidae	*Sabellidae Indet*	0	1
Polychaeta	Sabellida	Serpulidae	*Serpula Indet*	1	0
Polychaeta	Sabellida	Serpulidae	*Serpulidae Indet*	1	0
Polychaeta	Scolecida	Maldanidae	*Unknown sp_undet*	0	1
Polychaeta	Scolecida	Orbiniidae	*Orbiniidae Indet*	0	1
Polychaeta	Spionida	Magelonidae	*Unknown sp_undet*	0	1
Polychaeta	Terebellida	Pectinariidae	*Unknown sp_undet*	0	1
Polychaeta	Terebellida	Terebellidae	*Terebellidae Indet*	1	1
Polychaeta	Terebellida	Trichobranchidae	*Unknown sp_undet*	0	1
Bryozoa					
			Unidentified Bryozoa	0	1
Chelicerata					
Pycnogonida			*Unidentified Pycnogonida*	0	1
Cnidaria					
Anthozoa	Actiniaria		*Actiniaria sp.*	1	0
Anthozoa	Corallimorpharia	Corallimorphidae	*Corynactis sp.*	1	0
Hydrozoa	Hydroida	Tubulariidae	*Ectopleura multicirrata?*	0	1
Crustacea					
Malacostraca	Amphipoda		*Unidentified Amphipoda*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Paraleucothoe sp. A*	0	1
Malacostraca	Anomura	Paguridae	*Pagurus sp.*	0	1
Malacostraca	Brachyura		*Brachyuran megalopa*	1	0
Malacostraca	Brachyura	Majidae	*Notomithrax sp.*	0	1
Malacostraca	Isopoda	Cymothoidae	*?genus sp*	1	0
Malacostraca	Isopoda	Sphaeromatidae	*Pseudosphaeroma sp.*	1	0
Mollusca					
Bivalvia	Nuculoida	Nuculidae	*Linucula sp.*	1	0
Bivalvia	Nuculoida	Nuculidae	*Nucula sp.*	0	1
Gastropoda	Neogastropoda	Buccinidae	*Cominella sp.*	0	1
Gastropoda	Neogastropoda	Turridae	*Neoguraleus sp.*	1	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Polyplacophora	Ischnochitonina	Chitonidae	*Chitonidae sp.*	0	1
Macroalgae					
			Unidentified Phycophyta	1	1
Bangiophyceae	Erythropeltidales	Erythrothrichiaceae	*Erythrotrichia sp.*	1	0
Florideophyceae			*Unidentified Rhodophyceae*	1	1
Florideophyceae	Acrochaetiales	Acrochaetiaceae	*Audouinella sp.*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Anotrichium?*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnion sp.*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Callithamnion sp.*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramiaceae sp.*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium sp.*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia sp.*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Pterothamnion sp.*	1	1
Florideophyceae	Ceramiales	Dasyaceae	*Dasya sp.*	1	0
Florideophyceae	Ceramiales	Delesseriaceae	*Unidentified Delesseriaceae*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Apoglossum? sp.*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Erythroglossum sp.*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Hypoglossum sp.*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia sp.*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Lophurella sp.*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sp.*	1	1
Florideophyceae	Corallinales	Corallinaceae	*Jania sp.*	0	1
Florideophyceae	Gigartinales	Gigartinaceae	*Gigartina sp.*	1	0
Florideophyceae	Halymeniales	Halymeniaceae	*Halymenia sp.*	1	0
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria sp.*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia sp.*	1	1
Phaeophyceae	Dictyotales		*Dictyotales sp.*	0	1
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum sp.*	0	1
Phaeophyceae	Sphacelariales	Sphacelariaceae	*Sphacelaria sp.*	0	1
Phaeophyceae	Sphacelariales	Stypocaulaceae	*Halopteris sp.*	1	1
Ulvophyceae			*Unidentified Ulvophyceae*	1	0
Ulvophyceae	Bryopsidales	Bryopsidaceae	*Derbesia sp.*	1	0
Ulvophyceae	Cladophorales	Cladophoraceae	*Cladophora sp.*	1	1
Ulvophyceae	Cladophorales	Cladophoraceae	*Rhizoclonium sp.*	0	1
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha sp.*	1	1
Ulvophyceae	Ulvales	Ulvaceae	*Ulva sp.*	1	1
Platyhelminthes					
Turbellaria	Polycladida		*Unidentified Polycladida*	1	0
Dinophyta					
Dinophyceae	Gymnodiniales	Polykrikaceae	*Pheopolykrikos sp.*	1	0
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium sp.*	0	1
Vertebrata					
Actinopterygii	Perciformes	Tripterygiidae	*Tripterygiidae sp.*	0	1

* 1 = Present, 0 = Absent

Table 18: Non-indigenous marine organisms recorded from the Port of Taranaki survey and the techniques used to capture each species. Species distributions throughout the port and in other ports and marinas around New Zealand are indicated.

Genus & species	Capture techniques in the Port of Taranaki	Locations detected in the Port of Taranaki		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
Annelida				
Euchone limnicola	Benthic grab, benthic sled		Breakwater No.1, Breakwater No. 2, Main basin 1, Main Basin 2, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 21)	Gisborne, Timaru
Barantolla lepte	Benthic grab	Moturoa Wharf (See Figure 22)	Breakwater No.1, Lee Breakwater No.1, Newton King Tanker Terminal No.2, Yacht Moorings (See Figure 23)	Napier, Timaru
Bryozoa				
Bugula flabellata	Benthic sled, pile scrape,	Blyde Wharf, Breakwater No.2, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 24)	Blyde Wharf, Breakwater No.1, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 25)	Auckland, Bluff, Dunedin, Lyttelton, Napier, Nelson, Opua, Picton, Tauranga, Timaru, Wellington, Whangarei
Bugula neritina	Bentic sled, benthic grab, pile scrape	Blyde Wharf, Breakwater No.2, Lee Breakwater No.1, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 27)	Blyde Wharf, Breakwater No.1, Newton King Tanker Terminal No.2, Main Basin 3, Moturoa Wharf (See Figure 27)	Auckland, Dunedin, Gisborne, Lyttelton, Napier, Opua, Picton, Tauranga, Timaru, Whangarei
Bugula stolonifera	Pile scrape	Moturoa Wharf		Whangarei
Tricellaria inopinata	Benthic sled	Lee Breakwall No.1		Gisborne, Lyttelton, Picton, Whangarei
Cryptosula pallasiana	Pile scrape, benthic sled	Blyde Wharf, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 28)	Breakwater No.1, Moturoa Wharf (See Figure 29)	Dunedin, Gisborne, Lyttelton, Nelson, Picton, Timaru, Wellington, Whangarei
Watersipora arcuata	Pile scrape	Blyde Wharf, Moturoa Wharf, Newton		

Genus & species	Capture techniques in the Port of Taranaki	Locations detected in the Port of Taranaki		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
		King Tanker Terminal No.2		
Watersipora subtorquata	Benthic sled, pile scrape, visual	Blyde Wharf, Breakwater No.2, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 30)	Blyde Wharf, Breakwater No.1, Moturoa Wharf, Newton King Tanker Terminal No.2, Yacht Moorings (See Figure 31)	Auckland, Bluff, Dunedin, Gisborne, Lyttelton, Napier, Nelson, Opua, Picton, Tauranga, Timaru, Wellington, Whangarei
Cnidaria				
Eudendrium capillare	Pile scrape	Moturoa Wharf, Newton King Tanker Terminal No.2		Tauranga, Wellington
Monotheca pulchella	Pile scrape		Newton King Tanker Terminal No.2 (See Figure 32)	Lyttelton, Tauranga, Timaru, Wellington
Amphisbetia maplestonei	Benthic sled		Blyde Wharf (See Figure 33)	Timaru
Crustacea				
Monocorophium sextonae	Pile scrape		Blyde Wharf, Moturoa Wharf (See Figure 34)	Lyttelton
Mollusca				
Crassostrea gigas	Pile scrape, pile visual	Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 35)	Moturoa Wharf (See Figure 36)	Auckland, Dunedin, Nelson, Opua, Whangarei
Theora lubrica	Benthic grab, benthic sled	Blyde Wharf, Breakwater No.1, Breakwater No.2, Lee Breakwater No.1, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 37)	Blyde Wharf, Breakwater No.1, Main Basin, Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 38)	Auckland, Gisborne, Lyttelton, Napier, Nelson, Opua, Picton, Wellington, Whangarei
Macroalgae				
Griffithsia crassiuscula	Pile scrape	Breakwater No.2, Newton King Tanker Terminal No.2 (See Figure	Moturoa Wharf, Newton King Tanker Terminal No.2 (See Figure 40)	Bluff, Lyttelton, Picton, Timaru, Wellington

Genus & species	Capture techniques in the Port of Taranaki	Locations detected in the Port of Taranaki		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
		39)		
Polysiphonia sertularioides	Visual	Boat ramp, Reclamation area (Marina)		Opua marina
Undaria pinnatifida	Visual		Yacht moorings (See Figure 41)	Dunedin, Gisborne, Lyttelton, Napier, Nelson, Picton, Timaru, Wellington
Porifera				
Halisarca dujardini	Pile scrape	Newton King Tanker Terminal No.2		Auckland, Wellington, Picton, Dunedin, Bluff

Table 19: Summary statistics for taxon assemblages collected in the Port of Taranaki using six different methods, and similarity indices comparing assemblages between the first and second survey. See "Definitions of species categories" for definitions of Native, C1 and C2 (cryptogenic category 1 and 2) and NIS (non-indigenous species) taxa.

	No. of samples in first survey	No. of samples in second survey	No. of taxa in first survey	No. of taxa in second survey	No. (%) of taxa shared between surveys	No. of taxa in first survey only	No. of taxa in second survey only	No. (%) of taxa in only one sample in first survey	No. (%) of taxa in only one sample in second survey	Chao Shared Esimated	Jaccard Classic	Sorensen Classic	Chao-Jaccard-Est Incidence-based	Chao-Sorensen-Est Incidence-based
Pile scrape quadrats														
Native	60	70	93	88	55 (44%)	38	33	30 (32%)	31 (35%)	73.907	0.437	0.608	0.823	0.903
C2	60	70	16	13	6 (26%)	10	7	9 (56%)	7 (54%)	8.16	0.261	0.414	0.54	0.701
NIS & C1	60	70	19	14	9 (38%)	10	5	6 (32%)	4 (29%)	9.877	0.375	0.545	0.673	0.804
Benthic sleds														
Native	12	20	48	75	22 (22%)	26	53	33 (69%)	43 (57%)	52.422	0.218	0.358	0.631	0.774
C2	12	20	1	3	0 (0%)	1	3	0 (0%)	2 (67%)	Not enough taxa encountered for meaningful analysis				
NIS & C1	12	20	10	10	4 (25%)	6	6	6 (60%)	5 (50%)	6.757	0.25	0.4	0.493	0.661
Benthic grabs														
Native	21	27	33	40	12 (20%)	21	28	26 (79%)	18 (45%)	See analysis for all taxa combined				
C2	21	27	3	1	0 (0%)	3	1	3 (100%)	0 (0%)	Not enough taxa encountered for meaningful analysis				
NIS & C1	21	27	2	5	2 (40%)	0	3	1 (50%)	1 (20%)	Not enough taxa encountered for meaningful analysis				
Native, C2, NIS & C1	21	27	38	46	14	24	32	30 (79%)	19 (41%)	29.648	0.2	0.333	0.586	0.739

	No. of samples in first survey	No. of samples in second survey	No. of taxa in first survey	No. of taxa in second survey	No. (%) of taxa shared between surveys	No. of taxa in first survey only	No. of taxa in second survey only	No. (%) of taxa in only one sample in first survey	No. (%) of taxa in only one sample in second survey	Chao Shared Esimated	Jaccard Classic	Sorensen Classic	Chao-Jaccard-Est Incidence-based	Chao-Sorensen-Est Incidence-based
taxa combined					(20%)									
Crab traps														
Native	25	32	12	12	7 (41%)	5	5	3 (25%)	9 (75%)	See analysis for all taxa combined				
Cryptogenic 2	25	32	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
C1 (No NIS were encountered)	25	32	1	0	0 (0%)	1	0	0 (0%)	0 (0%)	Not enough taxa encountered for meaningful analysis				
Native, C2, and C1 taxa combined	25	32	13	12	7 (39%)	6	5	3 (23%)	9 (75%)	11.196	0.389	0.56	0.838	0.912
Fish traps														
Native	24	32	8	7	3 (25%)	5	4	4 (50%)	4 (57%)	6.417	0.25	0.4	0.48	0.648
C2	24	32	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	24	32	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
Starfish traps														
Native	24	32	7	9	5 (45%)	2	4	2 (29%)	5 (56%)	See analysis for all taxa combined				
Cryptogenic 2	24	32	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
C1 (No NIS were encountered)	24	32	1	0	0 (0%)	1	0	1 (100%)	0 (0%)	Not enough taxa encountered for meaningful analysis				
Native and C1 taxa combined	24	32	8	9	5 (42%)	3	4	3 (38%)	5 (56%)	5.202	0.417	0.588	0.7	0.824

Appendices

Appendix 1: Definitions of vessel types and geographical areas used in Analyses of the LMIU 'SeaSearcher.com' shipping movements database

A. Groupings of countries into geographical areas. A country may be included in more than one geographical area category if different parts of that country are considered (by LMIU) to belong to different geographical areas (for example, Canada occurs in the NE Canada and Great Lakes area and in the West Coast North America area). Only countries that occur in the database are listed in the table below.

Geographical area	Countries/locations included
Africa Atlantic coast	Angola
	The Congo
	Nigeria
Antarctica (includes Southern Ocean)	Antarctica
	Australia (Macquarie Island)
Australia	Australia (general)
	Australia (VIC)
	Australia (QLD)
	Australia (NSW)
	Australia (TAS)
	Australia (WA)
	Australia (NT)
	Australia (SA)
Black Sea coast	Russian Federation
Caribbean Islands	Bahamas
	Cuba
	Jamaica
	Puerto Rico
Central America inc Mexico to Panama	Costa Rica
	El Salvador
	Guatemala
	Mexico
	Panama
Central Indian Ocean	Bangladesh
	India
	Pakistan
	Sri Lanka
East Asian seas	Indonesia
	Malaysia
	Philippines
	Republic of Singapore
	Sultanate of Brunei
	Thailand

Geographical area	Countries/locations included
Eastern Mediterranean inc Cyprus, Turkey	Turkey
European Mediterranean coast	France
	Gibraltar
	Italy
	Malta
	Spain
Gulf of Mexico	United States of America
Gulf States	Iran
	Kuwait
	Saudi Arabia
	State of Qatar
	Sultanate of Oman
	United Arab Emirates
Japan	Japan
N.E. Canada and Great Lakes	Canada
New Zealand	New Zealand
Northwest Pacific	People's Republic of China
	Republic of Korea
	Russian Federation
	Taiwan
	Vietnam
North African coast	Algeria
	Arab Republic of Egypt
	Morocco
	Spain
	Tunisia
	Western Sahara
North European Atlantic coast	Belgium
	France
	Germany
	Netherlands
Pacific Islands	American Samoa
	Cook Islands
	Fiji
	French Polynesia
	Guam
	Independent State of Samoa
	Kiribati
	Marshall Islands
	New Caledonia
	Niue Island
	Norfolk Island
	Northern Marianas

Geographical area	Countries/locations included
	Papua New Guinea
	Pitcairn Islands
	Solomon Islands
	Tokelau Islands
	Tonga
	Tuvalu
	Vanuatu
	Wallis & Futuna
Red Sea coast inc up to the Persian Gulf	Arab Republic of Egypt
	Saudi Arabia
	Sudan
	Yemeni Republic
Scandinavia inc Baltic, Greenland, Iceland etc	Denmark
	Norway
	Poland
	Russian Federation
South & East African coasts	Heard & McDonald Islands
	Kenya
	Mauritius
	Mozambique
	Republic of Djibouti
	Republic of Namibia
	Reunion
	South Africa
South America Atlantic coast	Argentina
	Aruba
	Brazil
	Colombia
	Falkland Islands
	Netherlands Antilles
	Uruguay
	Venezuela
South America Pacific coast	Chile
	Ecuador
	Peru
Spain / Portugal inc Atlantic Islands	Canary Islands
	Portugal
	Spain
U.S, Atlantic coast including part of Canada	United States of America
United Kingdom inc Eire	United Kingdom
West coast North America inc USA, Canada & Alaska	Canada
	United States of America

B. Groupings of vessel sub-types according to LMIU definitions.

Vessel type definition in this report	General type as listed in LMIU database	Sub type code from LMIU database	Definition of sub type in LMIU database
Bulk/ cement carrier	B	BU	bulk
	B	CB	bulk/c.c.
	B	CE	cement
	B	OR	ore
	B	WC	wood-chip
Bulk/ oil carrier	C	BO	bulk/oil
	C	OO	ore/oil
Dredge	D	BD	bucket dredger
	D	CH	cutter suction hopper dredger
	D	CS	cutter suction dredger
	D	DR	dredger
	D	GD	grab dredger
	D	GH	grab hopper dredger
	D	HD	hopper dredger
	D	SD	suction dredger
	D	SH	suction hopper dredger
	D	SS	sand suction dredger
	D	TD	trailing suction dredger
	D	TS	trailing suction hopper dredger
Fishing	F	FC	fish carrier
	F	FF	fish factory
	F	FP	fishery protection
	F	FS	fishing
	F	TR	trawler
	F	WF	whale factory
	F	WH	whaler
General cargo	G	CT	cargo/training
	G	GC	general cargo
	G	PC	part c.c.
	G	RF	ref
LPG / LNG	L	FP	floating production
	L	FS	floating storage
	L	NG	Lng
	L	NP	Lng/Lpg
	L	PG	Lpg
Passenger/ vehicle/ livestock	M	LV	livestock
	M	PR	passenger
	M	VE	vehicle
Other (includes pontoons, barges, mining & supply ships, etc)	O	BA	barge
	O	BS	buoy ship/supply
	O	BY	buoy ship
	O	CL	cable
	O	CP	cable pontoon
	O	CS	crane ship
	O	CX	crane barge
	O	DE	depot ship

Vessel type definition in this report	General type as listed in LMIU database	Sub type code from LMIU database	Definition of sub type in LMIU database
	O	DS	diving support
	O	ES	exhibition ship
	O	FL	floating crane
	O	FY	ferry
	O	HB	hopper barge
	O	HF	hydrofoil
	O	HL	semi-sub HL vessel
	O	HS	hospital ship
	O	HT	semi-sub HL/tank
	O	IB	icebreaker
	O	IF	icebreaker/ferry
	O	IS	icebreaker/supply
	O	IT	icebreaker/tender
	O	LC	landing craft
	O	LT	lighthouse tender
	O	MN	mining ship
	O	MS	mission ship
	O	MT	maintenance
	O	OS	offshore safety
	O	PA	patrol ship
	O	PC	pollution control vessel
	O	PD	paddle
	O	PI	pilot ship
	O	PL	pipe layer
	O	PO	pontoon
	O	PP	pipe carrier
	O	RD	radio ship
	O	RN	ro/ro pontoon
	O	RP	repair ship
	O	RX	repair barge
	O	SB	storage barge
	O	SC	sludge carrier
	O	SP	semi-sub pontoon
	O	SS	storage ship
	O	SU	support
	O	SV	salvage
	O	SY	supply
	O	SZ	standby safety vessel
	O	TB	tank barge
	O	TC	tank cleaning ship
	O	TN	tender
	O	TR	training
	O	WA	waste ship
	O	WO	work ship
	O	YT	yacht
Passenger ro/ro	P	RR	passenger ro/ro
Research	R	HR	hydrographic research
	R	MR	meteorological research
	R	OR	oceanographic research
	R	RB	research/buoy ship

Vessel type definition in this report	General type as listed in LMIU database	Sub type code from LMIU database	Definition of sub type in LMIU database
	R	RE	research
	R	RS	research/supply ship
	R	SR	seismographic research
Tanker (including chemical/ oil / ashphalt etc)	T	AC	acid tanker
	T	AS	asphalt tanker
	T	BK	bunkering tanker
	T	CH	chem.tank
	T	CO	chemical/oil carrier
	T	CR	crude oil tanker
	T	EO	edible oil tanker
	T	FJ	fruit juice tanker
	T	FO	fish oil tanker
	T	FP	floating production
	T	FS	floating storage
	T	MO	molasses tanker
	T	NA	naval auxiliary
	T	PD	product tanker
	T	TA	non specific tanker
	T	WN	wine tank
	T	WT	water tanker
Container/ unitised carrier and ro/ro	U	BC	barge carrier/c.c.
	U	BG	barge carrier
	U	CC	c.c. container/unitised carrier
	U	CR	c.c.ref
	U	RC	ro/ro/c.c.
	U	RR	ro/ro
Tug	X	AA	anchor handling salvage tug
	X	AF	anchor handling firefighting tug/supply
	X	AG	anchor handling firefighting tug
	X	AH	anchor handling tug/supply
	X	AT	anchor handling tug
	X	CT	catamaran tug
	X	FF	firefighting tug
	X	FS	firefighting tug/supply
	X	FT	firefighting tractor tug
	X	PT	pusher tug
	X	ST	salvage tug
	X	TG	tug
	X	TI	tug/icebreaker
	X	TP	tug/pilot ship
	X	TR	tractor tug
	X	TS	tug/supply
	X	TT	tug/tender
	X	TX	tug/support

Appendix 2. Geographic locations of sample sites in the Port of Taranaki second baseline survey (NZGD49)

Site	Easting	Northing	Survey Method	No. of sample units
Blyde Wharf	2599779	6238155	BGRB	1
Blyde Wharf	2599821	6238182	BGRB	1
Blyde Wharf	2599846	6238190	BGRB	1
Blyde Wharf	2599784	6238134	BSLD	1
Blyde Wharf	2599889	6238178	BSLD	1
Blyde Wharf	2599869	6238169	CRBTP	1
Blyde Wharf	2599748	6238136	CRBTP	1
Blyde Wharf	2599748	6238136	CRBTP	1
Blyde Wharf	2599869	6238169	CRBTP	1
Blyde Wharf	2599862	6238197	CYST	2
Blyde Wharf	2599849	6238160	FSHTP	1
Blyde Wharf	2599788	6238141	FSHTP	1
Blyde Wharf	2599788	6238141	FSHTP	1
Blyde Wharf	2599849	6238160	FSHTP	1
Blyde Wharf	2599724	6238104	PSC	16
Blyde Wharf	2599748	6238136	SHRTP	1
Blyde Wharf	2599869	6238169	SHRTP	1
Blyde Wharf	2599748	6238136	STFTP	2
Blyde Wharf	2599869	6238169	STFTP	2
Blyde Wharf	2599697	6238092	VISS	1
Blyde Wharf, No.3	2599900	6238073	BGRB	1
Blyde Wharf, No.3	2599901	6238093	BGRB	1
Blyde Wharf, No.3	2599936	6238137	BGRB	1
Blyde Wharf, No.3	2599962	6238077	CRBTP	1
Blyde Wharf, No.3	2599962	6238077	CRBTP	1
Blyde Wharf, No.3	2599962	6238137	CRBTP	1
Blyde Wharf, No.3	2599962	6238137	CRBTP	1
Blyde Wharf, No.3	2599934	6238132	CYST	2
Blyde Wharf, No.3	2599959	6238175	FSHTP	1
Blyde Wharf, No.3	2599962	6238184	FSHTP	1
Blyde Wharf, No.3	2599962	6238184	FSHTP	1
Blyde Wharf, No.3	2599959	6238175	FSHTP	1
Blyde Wharf, No.3	2599962	6238077	SHRTP	1
Blyde Wharf, No.3	2599962	6238137	SHRTP	1
Blyde Wharf, No.3	2599962	6238077	STFTP	2
Blyde Wharf, No.3	2599962	6238137	STFTP	2
Breakwater No.1	2599540	6238422	BGRB	1
Breakwater No.1	2599575	6238481	BGRB	1
Breakwater No.1	2599607	6238499	BGRB	1
Breakwater No.1	2599487	6238351	BSLD	1
Breakwater No.1	2599646	6238291	BSLD	1
Breakwater No.1	2599554	6238434	CRBTP	1
Breakwater No.1	2599554	6238434	CRBTP	1
Breakwater No.1	2599694	6238523	CRBTP	1
Breakwater No.1	2599694	6238523	CRBTP	1
Breakwater No.1	2599521	6238408	CYST	2
Breakwater No.1	2599575	6238463	FSHTP	1
Breakwater No.1	2599575	6238463	FSHTP	1

Breakwater No.1	2599704	6238517	FSHTP	1
Breakwater No.1	2599704	6238517	FSHTP	1
Breakwater No.1	2599625	6238508	PSC	13
Breakwater No.1	2599554	6238434	SHRTP	1
Breakwater No.1	2599694	6238523	SHRTP	1
Breakwater No.1	2599554	6238434	STFTP	2
Breakwater No.1	2599694	6238523	STFTP	2
Breakwater No.1	2599497	6238363	VISS	1
Breakwater No.2	2599893	6238609	BGRB	1
Breakwater No.2	2600045	6238652	BGRB	1
Breakwater No.2	2600105	6238697	BGRB	1
Breakwater No.2	2599857	6238586	BSLD	1
Breakwater No.2	2600155	6238737	BSLD	1
Breakwater No.2	2600176	6238759	CRBTP	1
Breakwater No.2	2599967	6238634	CRBTP	1
Breakwater No.2	2599967	6238634	CRBTP	1
Breakwater No.2	2600176	6238759	CRBTP	1
Breakwater No.2	2599736	6238528	CYST	2
Breakwater No.2	2600140	6238697	FSHTP	1
Breakwater No.2	2599999	6238621	FSHTP	1
Breakwater No.2	2599999	6238621	FSHTP	1
Breakwater No.2	2600140	6238697	FSHTP	1
Breakwater No.2	2599967	6238634	SHRTP	2
Breakwater No.2	2600176	6238759	SHRTP	2
Breakwater No.2	2599967	6238634	STFTP	2
Breakwater No.2	2600176	6238759	STFTP	2
Lee Breakwater No. 1	2600331	6238334	BGRB	1
Lee Breakwater No. 1	2600437	6238303	BGRB	1
Lee Breakwater No. 1	2600476	6238262	BGRB	1
Lee Breakwater No. 1	2600446	6238352	BSLD	1
Lee Breakwater No. 1	2600613	6238225	BSLD	1
Lee Breakwater No. 1	2600453	6238281	CYST	2
Main Basin	2600153	6238493	BGRB	1
Main Basin	2600173	6238497	BGRB	1
Main Basin	2600175	6238475	BGRB	1
Main Basin 1	2600018	6238445	BSLD	1
Main Basin 1	2600220	6238389	BSLD	1
Main Basin 2	2599900	6238465	BSLD	1
Main Basin 2	2600044	6238330	BSLD	1
Main Basin 3	2600370	6238433	BSLD	1
Main Basin 3	2600375	6238048	BSLD	1
Mooring Breakwater	2600467	6238341	CRBTP	2
Mooring Breakwater	2600493	6238322	CRBTP	2
Mooring Breakwater	2600510	6238309	FSHTP	1
Mooring Breakwater	2600479	6238322	FSHTP	2
Mooring Breakwater	2600510	6238309	FSHTP	1
Mooring Breakwater	2600467	6238341	SHRTP	1
Mooring Breakwater	2600493	6238322	SHRTP	1
Mooring Breakwater	2600467	6238341	STFTP	1
Mooring Breakwater	2600493	6238322	STFTP	1
Mooring Breakwater	2600493	6238322	STFTP	1
Mooring Breakwater	2600467	6238341	STFTP	1
Moturoa Wharf	2599465	6238281	BGRB	1

Moturoa Wharf	2599516	6238328	BGRB	1
Moturoa Wharf	2599555	6238340	BGRB	1
Moturoa Wharf	2599436	6238254	BSLD	1
Moturoa Wharf	2599622	6238378	BSLD	1
Moturoa Wharf	2599534	6238329	CRBTP	1
Moturoa Wharf	2599618	6238374	CRBTP	1
Moturoa Wharf	2599534	6238329	CRBTP	1
Moturoa Wharf	2599618	6238374	CRBTP	1
Moturoa Wharf	2599559	6238336	CYST	2
Moturoa Wharf	2599535	6238309	FSHTP	1
Moturoa Wharf	2599622	6238376	FSHTP	1
Moturoa Wharf	2599535	6238309	FSHTP	1
Moturoa Wharf	2599622	6238376	FSHTP	1
Moturoa Wharf	2599572	6238364	PSC	16
Moturoa Wharf	2599534	6238329	SHRTP	1
Moturoa Wharf	2599618	6238374	SHRTP	1
Moturoa Wharf	2599534	6238329	STFTP	2
Moturoa Wharf	2599618	6238374	STFTP	2
Newton King Tanker Terminal, No.2	2599512	6238229	BGRB	1
Newton King Tanker Terminal, No.2	2599521	6238224	BGRB	1
Newton King Tanker Terminal, No.2	2599479	6238212	BGRB	1
Newton King Tanker Terminal, No.2	2599526	6238210	BSLD	1
Newton King Tanker Terminal, No.2	2599620	6238252	BSLD	1
Newton King Tanker Terminal, No.2	2599725	6238273	CRBTP	1
Newton King Tanker Terminal, No.2	2599607	6238243	CRBTP	2
Newton King Tanker Terminal, No.2	2599725	6238273	CRBTP	1
Newton King Tanker Terminal, No.2	2599613	6238286	CYST	2
Newton King Tanker Terminal, No.2	2599713	6238277	FSHTP	1
Newton King Tanker Terminal, No.2	2599607	6238237	FSHTP	1
Newton King Tanker Terminal, No.2	2599607	6238237	FSHTP	1
Newton King Tanker Terminal, No.2	2599713	6238277	FSHTP	1
Newton King Tanker Terminal, No.2	2599637	6238240	PSC	16
Newton King Tanker Terminal, No.2	2599607	6238243	SHRTP	1
Newton King Tanker Terminal, No.2	2599725	6238273	SHRTP	1
Newton King Tanker Terminal, No.2	2599607	6238243	STFTP	1
Newton King Tanker Terminal, No.2	2599607	6238243	STFTP	1
Newton King Tanker Terminal, No.2	2599725	6238273	STFTP	2
Yacht Moorings	2600580	6238069	BGRB	1
Yacht Moorings	2600549	6238046	BGRB	1

Yacht Moorings	2600556	6238059	BGRB	1
Yacht Moorings	2600448	6238182	BSLD	1
Yacht Moorings	2600628	6238092	BSLD	1
Yacht Moorings	2600728	6238131	CRBTP	4
Yacht Moorings	2600543	6238086	CYST	2
Yacht Moorings	2600502	6238183	FSHTP	2
Yacht Moorings	2600659	6238149	FSHTP	1
Yacht Moorings	2600659	6238149	FSHTP	1
Yacht Moorings	2600626	6238060	PSC	9
Yacht Moorings	2600728	6238131	SHRTP	2
Yacht Moorings	2600728	6238131	STFTP	1
Yacht Moorings	2600728	6238131	STFTP	3
Yacht Moorings	2600626	6238060	VISS	1

*Survey methods: PSC = pile scrape, BSLD = benthic sled, BGRB = benthic grab, CYST = dinoflagellate cyst core, CRBTP = crab trap, FSHTP = fish trap, STFTP = starfish trap, SHRTP = shrimp trap, VISS = qualitative above-water visual surveys

Appendix 3: Specialists engaged to identify specimens obtained from the New Zealand port surveys

Major taxonomic groups	Class	Specialist Survey 1 samples	Specialist Survey 2 samples	Institution
Annelida	Polychaeta	Geoff Read[1], Jeff Forman[1]	Geoff Read[1], Jeff Forman[1]	[1]NIWA Greta Point
Bryozoa	Gymnolaemata	Dennis Gordon[1]	Dennis Gordon[1]	[1]NIWA Greta Point
Chelicerata	Pycnogonida	David Staples[2]	David Staples[2]	[2]Melbourne Museum, Victoria, Australia
Cnidaria	Anthozoa	Adorian Ardelean[3]	No specialist available as yet	[3]West University of Timisoara, Timisoara, 1900, Romania
Cnidaria	Hydrozoa	Jan Watson[4]	Jan Watson[4]	[4]Hydrozoan Research Laboratory, Clifton Springs, Victoria, Australia
Crustacea	Amphipoda	Graham Fenwick[5]	Graham Fenwick[5]	[5]NIWA Christchurch
Crustacea	Cirripedia	Graham Fenwick[5], Isla Fitridge[5] John Buckeridge[6]	Isla Fitridge[5]	[5]NIWA Christchurch and [6]Auckland University of Technology
Crustacea	Decapoda	Colin McLay[7] Graham Fenwick[5], Nick Gust[5]	Colin McLay[7]	[7]University of Canterbury and [5]NIWA Christchurch
Crustacea	Isopoda	Niel Bruce[1]	Niel Bruce[1]	[1]NIWA Greta Point
Crustacea	Mysidacea	Fukuoka Kouki[8]	Niel Bruce[1]	[1]NIWA Greta Point and [8]National Science Museum, Tokyo
Echinodermata	Asteroidea	Don McKnight[1]	Niki Davey[9]	[1]NIWA Greta Point and [9]NIWA Nelson
Echinodermata	Echinoidea	Don McKnight[1]	Niki Davey[9]	[1]NIWA Greta Point and [9]NIWA Nelson
Echinodermata	Holothuroidea	Niki Davey[9]	Niki Davey[9]	[9]NIWA Nelson
Echinodermata	Ophiuroidea	Don McKnight[1], Helen Rottman[1]	Niki Davey[9]	[1]NIWA Greta Point and [9]NIWA Nelson
Echiura	Echiuroidea	Geoff Read[1]	Geoff Read[1]	[1]NIWA Greta Point
Mollusca	Bivalvia. Cephalopoda, Gastropoda, Polyplacophora	Bruce Marshall[10]	Bruce Marshall[10]	[10]Museum of NZ Te Papa Tongarewa
Nemertea	Anopla, Enopla	Geoff Read[1]	Geoff Read[1]	[1]NIWA Greta Point
Macroalgae	Phaeophyceae, Rhodophyceae, Ulvophyceae	Wendy Nelson[1], Kate Neill[1]	Wendy Nelson[1], Kate Neill[1]	[1]NIWA Greta Point
Platyhelminthes	Turbellaria	Sean Handley[9]	Sean Handley[9]	[9]NIWA Nelson
Porifera	Demospongiae, Calcarea	Michelle Kelly-Shanks[11]	Michelle Kelly-Shanks[11]	[11]NIWA Auckland
Priapula	Priapulidae	Geoff Read[1]	Geoff Read[1]	[1]NIWA Greta Point
Dinophyta	Dinophyceae	Hoe Chang[1], Rob Stewart[1]	Hoe Chang[1], Rob Stewart[1]	[1]NIWA Greta Point
Urochordata	Ascidiacea	Mike Page[e], Anna Bradley[e] Patricia Kott[12]	Mike Page[9], Anna Bradley[9]	[9]NIWA Nelson and [12]Queensland Museum
Vertebrata	Osteichthyes	Clive Roberts[10], Andrew Stewart[10]	Clive Roberts[10], Andrew Stewart[10]	[10]Museum of NZ Te Papa Tongarewa

Appendix 4: Generic descriptions of representative groups of the main marine phyla collected during sampling

Phylum Annelida
Polychaetes: The polychaetes are the largest group of marine worms and are closely related to the earthworms and leeches found on land. Polychaetes are widely distributed in the marine environment and are commonly found under stones and rocks, buried in the sediment or attached to submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species. All polychaete worms have visible legs or bristles. Many species live in tubes secreted by the body or assembled from debris and sediments, while others are free-living. Depending on species, polychaetes feed by filtering small food particles from the water or by preying upon smaller creatures.

Phylum Arthropoda
The Arthropoda is a very large group of organisms, with well-known members including crustaceans, insects and spiders.
Crustaceans: The crustaceans (including Classes Malacostra, Cirripedia and other smaller classes) represent one of the sea's most diverse groups of organisms, including shrimps, crabs, lobsters, amphipods, tanaids and several other groups. Most crustaceans are motile (capable of movement) although there are also a variety of sessile species (e.g. barnacles). All crustaceans are protected by an external carapace, and most can be recognised by having two pairs of antennae.
Pycnogonids: The pycnogonids, or sea spiders, are closely related to land spiders. They are commonly encountered living among sponges, hydroids and bryozoans on the seafloor. They range in size from a few mm to many cm and superficially resemble spiders found on land.

Phyla Chlorophyta, Rhodophyta and Ochrophyta
Macroalgae: Marine macroalgae are highly diverse and are grouped under several phyla. The green algae are in Phylum Chlorophyta; red algae are in Phylum Rhodophyta, and the brown algae are in Phylum Ochrophyta. Whilst the green and red algae fall under Kingdom Plantae, the brown algae (Phylum Ochrophyta) are grouped in the Kingdom Chromista. Despite their disparate systematics, red, green and brown algae perform many similar ecological functions. Large macroalgae were sampled that live attached to submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species.

Phylum Chordata
Ascidiacea: Ascidians are sometimes referred to as 'sea squirts' or 'tunicates'. Adult ascidians are sessile (permanently attached to the substrate) organisms that live on submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species. Ascidians can occur as individuals (solitary ascidians) or merged together into colonies (colonial ascidians). They are soft-bodied and have a rubbery or jelly-like outer coating (test). They feed by pumping water into the body through an inhalant siphon. Inside the body, food particles are filtered out of the water, which is then expelled through an exhalant siphon. Ascidians reproduce via swimming larvae (ascidian tadpoles) that retain a notochord, which explains why these animals are included in the Phylum Chordata along with vertebrates.
Actinopterygii: The Class Actinopterygii refers to the ray-finned fishes. This is an extremely diverse group. Approximately 200 families of fish are represented in New Zealand waters ranging from tropical and subtropical groups in the north to subantarctic groups in the south. They can be classified ecologically according to depth habitat preferences; for example, fish that live on or near the sea floor are considered demersal while those living in the upper water column are termed pelagics.
Elasmobranchii: The Class Elasmobranchii are one of two classes of cartilaginous fishes, including sharks, skates and rays.

Phylum Cnidaria
Anthozoa: The Class Anthozoa includes the true corals, sea anemones and sea pens.

Hydrozoa: The Class Hydrozoa includes hydroids, fire corals and many medusae. Of these, only hydroids were recorded in the port surveys. Hydroids can easily be mistaken for erect and branching bryozoans. They are also sessile organisms that live attached to submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species. All hydroids are colonial, with individual colonies consisting of hundreds of individual 'polyps'. Like bryozoans, they feed by filtering small food particles from the water column.
Scyphozoa: Scyphozoans are the true jellyfish.

Phylum Dinophyta
Dinoflagellates: Dinoflagellates are a large group of unicellular algae that live in the water column or within the sediments. About half of all dinoflagellates are capable of photosynthesis and some are symbionts, living inside organisms such as jellyfish and corals. Some dinoflagellates are phosphorescent and can be responsible for the phosphorescence visible at night in the sea. The phenomenon known as red tide occurs when the rapid reproduction of certain dinoflagellate species results in large brownish red algal blooms. Some dinoflagellates are highly toxic and can kill fish and shellfish, or poison humans that eat these infected organisms.

Phylum Echinodermata
Echinoderms: This phylum contains a range of predominantly motile organisms – sea stars, brittle stars, sea urchins, sea cucumbers, sand dollars, feather stars and sea lilies. Echinoderms feed by filtering small food particles from the water column or by extracting food particles from sediment grains or rock surfaces.

Phylum Ectoprocta
Bryozoans: This group of organisms is also referred to as 'moss animals' or 'lace corals'. Bryozoans are sessile and live attached to submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species. They are all colonial, with individual colonies consisting of hundreds of individual 'zooids'. Bryozoans can have encrusting growth forms that are sheet-like and approximately 1 mm thick, or can form erect or branching structures several centimetres high. Bryozoans feed by filtering small food particles from the water column, and colonies grow by producing additional zooids.

Phylum Magnoliophyta
Seagrasses: The Magnoliophyta are the flowering plants, or angiosperms. Most of these are terrestrial, but the Magnoliophyta also include marine representatives – the seagrasses. The only Mangnoliophyte encountered in the port surveys was the seagrass *Zostera*.

Phylum Mollusca
Molluscs: The molluscs are a highly diverse group of marine animals characterised by the presence of an external or internal shell. This phyla includes the bivalves (organisms with hinged shells e.g. mussels, oysters, etc), gastropods (marine snails, e.g. winkles, limpets, topshells), chitons, sea slugs and sea hares, as well as the cephalopods (squid, cuttlefish and octopus).

Phylum Porifera
Sponges: Sponges are very simple colonial organisms that live attached to submerged natural and artificial surfaces including rocks, pilings, ropes and the shells or carapaces of other species. They vary greatly in colour and shape, and include sheet-like encrusting forms, branching forms and tubular forms. Sponge surfaces have thousands of small pores to through which water is drawn into the colony, where small food particles are filtered out before the water is again expelled through one or several other holes.

Appendix 5: Criteria for assigning non-indigenous status to species sampled from the Port of Taranaki in the second survey.

List of Chapman and Carlton's (1994) nine criteria (C1 – C9) for assigning non-indigenous species status that were met by the non-indigenous species sampled in the Port of Taranaki in the second survey. Criteria that apply to each species are indicated by (+). Cranfield et al's (1998) analysis was used for species previously known from New Zealand waters. For non-indigenous species that were first detected during the present study, criteria were assigned using advice from the taxonomists that identified them. Refer to footnote for a full description of C1 – C9.

Major taxonomic groups and Species	C1	C2	C3	C4	C5	C6	C7	C8	C9
Annelida									
Euchone limnicola	+		+		+	+	+	+	
Barantolla lepte	+		+					+	
Bryozoa									
Bugula flabellata	+	+	+		+	+	+	+	+
Bugula neritina	+				+	+	+	+	+
Cryptosula pallasiana	+	+	+		+	+	+	+	+
Watersipora subtorquata	+	+	+		+	+	+	+	+
Cnidaria									
Monotheca pulchella	+		+		+		+	+	
Amphisbetia maplestonei	+		+		+		+	+	
Crustacea									
Monocorophium sextonae			+		+	+	+	+	+
Mollusca									
Crassostrea gigas	+	+	+			+	+	+	+
Theora lubrica	+	+			+	+	+	+	+
Macroalgae									
Griffithsia crassiuscula	+	+				+		+	+
Undaria pinnatifida	+	+	+		+	+	+	+	+

Criterion 1: Has the species suddenly appeared locally where it has not been found before?

Criterion 2: Has the species spread subsequently?

Criterion 3: Is the species' distribution associated with human mechanisms of dispersal?

Criterion 4: Is the species associated with, or dependent on, other introduced species?

Criterion 5: Is the species prevalent in, or restricted to, new or artificial environments?

Criterion 6: Is the species' distribution restricted compared to natives?

Criterion 7: Does the species have a disjunct worldwide distribution?

Criterion 8: Are dispersal mechanisms of the species inadequate to reach New Zealand, and is passive dispersal in ocean currents unlikely to bridge ocean gaps to reach New Zealand?

Criterion 9: Is the species isolated from the genetically and morphologically most similar species elsewhere in the world?

Appendix 6a. Results from the pile scraping quadrats

Appendix 6a. Results from the diver collections and pile scrapings.

						Site code	Blyde Wharf																Breakwater No_1													Moturoa Wharf																Newton King Tanker Terminal, No_2																Yacht Moorings								
						Pile replicate	1								2								1						2							1								2								1								2								1			2		3		4	
						Pile position	IN				OUT				IN				OUT				IN			OUT			IN				OUT			IN				OUT				IN				OUT				IN				OUT				IN				OUT												
phylum	class	order	family	genus	species	*class_code	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	1	2	3	1	2	3	4	1	2	3	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	4	1	2	1	2	1	2
Annelida	Polychaeta	Eunicida	Dorvilleidae	Dorvillea	australiensis	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Eunicida	Eunicidae	Eunice	australis	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	sphaerocephala	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	kerguelensis	N	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Nereis	falcaria	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	amblyodonta	N	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	camiguinoides	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	Perinereis-A	C2	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	pseudocamiguina	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	sp_indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	capensis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	Eulalia-NIWA-2	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	microphylla	N	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	jacksoni	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	polychromus	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Annelida	Polychaeta	Phyllodocida	Polynoidae	Ophiodromus	angustifrons	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Autolytin-unknown	sp. A	C2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Eusyllin-unknown	Eusyllin-unknown-A	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Syllidae	Indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Syllis	Syllis-A	C2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Typosyllis	sp_undet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Megalomma	suspiciens	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Pseudopotamilla	laciniosa	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Sabellidae	Indet	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Serpulidae	Galeolaria	hystrix	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
Annelida	Polychaeta	Sabellida	Serpulidae	Neovermilia	sphaeropomatus	N	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Serpulidae	Serpula	Serpula-C	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionida	Magelonidae	Unknown	sp_undet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Terebellida	Cirratulidae	Dodecaceria	berkeleyi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Terebellida	Cirratulidae	Timarete	anchylochaetus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Flabelligeridae	Pherusa	parmata	N	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Pseudopista	rostrata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Streblosoma	toddae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Terebellidae	Indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta						SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Beaniidae	Beania	plurispinosa	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bitectiporidae	Bitectipora	rostrata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	A	0	0	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Cryptosulidae	Cryptosula	pallasiana	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Romancheinidae	Escharoides	angela	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Steginoporellidae	Steginoporella	magnifica	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	1
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Clytia	hemisphaerica	C1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Obelia	geniculata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Haleciidae	Halecium	beanii	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Monotheca	pulchella	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Balanidae	Austrominius	modestus	N	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0
Arthropoda	Cirripedia	Thoracica	Balanidae	Notomegabalanus	decorus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Chthamalidae	Chaemosipho	columna	N	1	1	1	0	1	1	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	0	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	1	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Pachylasmidae	Epopella	plicata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Aoridae	Aora	typica	C1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Aoridae	Haplocheira	barbimana	N	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Corophiidae	Monocorophium	sextonae	A	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Paradexamine	sp. A	C2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Leucothoidae	Leucothoe	sp. 1	C2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Leucothoidae	Paraleucothoe	sp. A	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Orchomene	aahu	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	sp. aff. P. stephenseni	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	vesca	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Diogenidae	Paguristes	setosus	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurixus	kermadecensis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	traversi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	cookii	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	minor	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Arcoida	Arcidae	Barbatia	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Myoida	Hiatellidae	Hiatella	arctica	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Modiolarca	impacta	N	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Perna	canaliculus	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Xenostrobus	pulex	N	1	1	0	0	1	1	1	1	1	1	0	0	0	1	0	1	1	0	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	0	1	0	1	1
Mollusca	Bivalvia	Ostreoida	Ostreidae	Crassostrea	gigas	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Pterioida	Anomiidae	Pododesmus	zelandicus	N	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Kelliidae	Kellia	cycladiformis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Semelidae	Leptomya	retiaria	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Basommatophora	Siphonariidae	Siphonaria	australis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Littorinimorpha	Calyptraeidae	Sigapatella	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Littorinimorpha	Littorinidae	Risellopsis	varia	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	traversi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6a. Results from the diver collections and pile scrapings.

						Site code	Blyde Wharf																Breakwater No_1													Moturoa Wharf																Newton King Tanker Terminal, No_2																Yacht Moorings								
						Pile replicate	1								2								1						2							1								2								1								2								1			2		3		4	
						Pile position	IN				OUT				IN				OUT				IN			OUT			IN			OUT				IN				OUT				IN				OUT				IN				OUT				IN				OUT												
Mollusca	Gastropoda	Patellogastropoda	Lottiidae	Patelloida	corticata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Cookia	sulcata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Turbo	smaragdus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Mollusca	Polyplacophora	Acanthochitonina	Acanthochitonidae	Acanthochitona	zelandica	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Acanthochitonina	Acanthochitonidae	Cryptoconchus	porosus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (Unidentified)						SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Anotrichium	crinitum	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Anotrichium?		SI	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnionella	adnata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Callithamnion	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	flaccidum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	crassiuscula	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Pterothamnion	confusum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Pterothamnion	sp.	SI	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Apoglossum	montagneanum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Apoglossum?	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Erythroglossum	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Myriogramme	denticulata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Schizoseris	dichotoma	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	harveyi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	moritziana	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	SI	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	strictissima	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	foliifera	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	novazelandica	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Dictyotales				SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Ecklonia	radiata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Rhizoclonium	sp.	SI	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Enteromorpha	sp.	SI	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Euryspongia	cf. arenaria	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Hadromerida	Suberitidae	Pseudosuberites	sulcatus	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 1	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 4	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Adocia	cf. parietalioides	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	glabra	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 4	C2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Desmacellidae	Biemna	rhabderemioides	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Esperiopsidae	Esperiopsis	new sp. 1	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Hymedesmiidae	Phorbas	fulva	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Phlebobranchia	Rhodosomatidae	Corella	eumyota	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Molgulidae	Molgula	mortenseni	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Microcosmus	squamiger	C1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	cancellata	N	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	carnea	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	pulla	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	rugata	N	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	subuculata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	cerea	C1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	bicornuta	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	0	0	1	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6b. Results from the benthic grab samples.

Appendix 6b. Results from the benthic grab samples.

						Site code	Blyde Wharf			Blyde Wharf, No_3			Breakwater No_1			Breakwater No_2			Lee Breakwater No_ 1			Main Basin			Moturoa Wharf			Newton King Tanker Terminal, No_2			Yacht Moorings		
phylum	class	order	family	genus	species	*class_code	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbricalus	aotearoae	N	1	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	Indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Eunicida	Onuphidae	Onuphis	aucklandensis	N	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	lamelliformis	N	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	1	0
Annelida	Polychaeta	Phyllodocida	Nephtyidae	Aglaophamus	macroura	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nephtyidae	Aglaophamus	verrilli	N	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Labiosthenolepis	laevis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Sigalion	oviger	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Sthenelais	novaezealandiae	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Euchone	limnicola	A	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Arenicolidae	Abarenicola	affinis	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Capitellidae	Barantolla	lepte	A	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1
Annelida	Polychaeta	Scolecida	Capitellidae	Heteromastus	filiformis	C1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Cossuridae	Cossura	consimilis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Maldanidae	Unknown	sp_undet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Annelida	Polychaeta	Scolecida	Orbiniidae	Orbiniidae	Indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Scolecida	Orbiniidae	Scoloplos (Scoloplos)	simplex	N	0	0	0	1	1	0	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	1	1	1	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Boccardia	syrtis	N	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Paraprionospio	Paraprionospio-A [pinnata]	C2	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Spionida	Spionidae	Prionospio	aucklandica	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Terebellida	Pectinariidae	Pectinaria	australis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Trichobranchidae	Terebellides	narribri	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Trichobranchidae	Unknown	sp_undet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	A	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Stereotheca	elongata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	Carolobatea	novae-zealandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	Torridoharpinia	hurleyi	N	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Ocypodidae	Macrophthalmus	hirtipes	N	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Ogyrididae	Ogyrididae	Ogyrides	delli	N	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Echinodermata	Echinoidea	Spatangoida	Loveniidae	Echinocardium	cordatum	N	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
Echinodermata	Ophiuroidea	Ophiurida	Ophionereididae	Ophionereis	fasciata	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	hartvigiana	N	0	1	0	0	1	1	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	nitidula	N	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	sp.	SI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Cardiidae	Pratulum	pulchellum	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Lasaeidae	Arthritica	bifurca	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Lucinidae	Divaricella	huttoniana	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mollusca	Bivalvia	Veneroida	Semelidae	Leptomya	retiaria	N	0	1	0	1	1	1	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1
Mollusca	Bivalvia	Veneroida	Semelidae	Theora	lubrica	A	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Mollusca	Bivalvia	Veneroida	Tellinidae	Macomona	liliana	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Tellinidae	Tellinota	edgari	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Bivalvia	Veneroida	Veneridae	Tawera	spissa	N	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Gastropoda	Cephalaspidea	Acteonidae	Acteon	cratericulatus	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Littorinimorpha	Naticidae	Tanea	zelandica	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae					SI	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnionella	adnata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	flaccidum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Pterothamnion	simile	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Dasyclonium	incisum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Lophurella	hookeriana	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species.

Appendix 6c. Results from the benthic sled samples.

Appendix 6c. Results from the benthic sled samples.

						Site code	Blyde Wharf		Breakwater No_1		Breakwater No_2		Lee Breakwater No_1		Main Basin 1		Main Basin 2		Main Basin 3		Moturoa Wharf		Newton King Tanker Terminal, No_2		Yacht Moorings	
phylum	class	order	family	genus	species	*class_code	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	sphaerocephala	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Phyllodocida	Nephtyidae	Aglaophamus	verrilli	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	Perinereis-A	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Phyllodoce	longipes	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	capensis	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Ophiodromus	angustifrons	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Sthenelais	novaezealandiae	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Syllidae	Eusyllis	Eusyllis-B	C2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Euchone	limnicola	A	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0
Annelida	Polychaeta	Scolecida	Capitellidae	Capitella	capitata	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Orbiniidae	Scoloplos (Scoloplos)	simplex	N	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Boccardia	acus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Terebellida	Pectinariidae	Pectinaria	australis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Annelida	Polychaeta	Terebellida	Pectinariidae	Unknown	sp_undet	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Arthropoda	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	A	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Arthropoda	Gymnolaemata	Cheilostomata	Cryptosulidae	Cryptosula	pallasiana	A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Pycnogonida					SI	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	1	0
Arthropoda	Pycnogonida	Pantopoda	Ammotheidae	Tanystylum	sp. B	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Aglaophenia	acanthocarpa	N	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Plumularia	setacea	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Amphisbetia	maplestonei	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda				SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda	Hyalidae	Allorchestes	novizealandiae	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Diogenidae	Paguristes	pilosus	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Diogenidae	Paguristes	setosus	N	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Lophopagurus (A.)	cristatus	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Lophopagurus (Australeremus)	kirkii	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	traversi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	cookii	N	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	whitei	N	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Neohymenicus	pubescens	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	minor	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	ursus	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Ocypodidae	Macrophthalmus	hirtipes	N	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0
Arthropoda	Malacostraca	Brachyura	Portunidae	Ovalipes	elongatus	C1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Caridea	Crangonidae	Pontophilus	australis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Isopoda	Holognathiidae	Cleantis	tubicola	N	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Arthropoda	Malacostraca	Isopoda	Idoteidae	Euidotea	durvillei	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Arthropoda	Malacostraca	Ogyrididae	Ogyrididae	Ogyrides	delli	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Stichaster	australis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Echinodermata	Echinoidea	Spatangoida	Loveniidae	Echinocardium	cordatum	N	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Xenostrobus	pulex	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	hartvigiana	N	0	0	1	1	1	0	0	1	0	0	1	0	1	0	1	0	0	0	1	1
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	nitidula	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	sp.	SI	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Cardiidae	Pratulum	pulchellum	N	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Mactridae	Maorimactra	ordinaria	N	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Bivalvia	Veneroida	Mactridae	Scalpomactra	scalpellum	N	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Semelidae	Leptomya	retiaria	N	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Semelidae	Theora	lubrica	A	1	1	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	1	0	0
Mollusca	Bivalvia	Veneroida	Veneridae	Tawera	spissa	N	1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Cephalaspidea	Acteonidae	Acteon	cratericulatus	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Cephalaspidea	Aglajidae	Philinopsis	taronga	N	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	adspersa	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	pusillus	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	traversi	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Neogastropoda	Turridae	Neoguraleus	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Cantharidella	tesselata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Algae (Unidentified)						SI	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae					SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Balliales	Balliaceae	Ballia	callitricha	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnion	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Callithamnion	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Centroceras	clavulatum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramiaceae	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	flaccidum	N	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Pterothamnion	confusum	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Dasyaceae	Heterosiphonia	concinna	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Acrosorium	decumbens	N	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Acrosorium	venulosum	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Caloglossa	leprieurii	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	variolosa	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Aphanocladia	delicatula	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Dasyclonium	harveyanum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Dasyclonium	incisum	N	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Dipterosiphonia	heteroclada	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Echinothamnion	hystrix	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Lophurella	hookeriana	N	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Lophurella	sp.	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	strictissima	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Symphyocladia	marchantioides	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Haliptilon	roseum	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Jania	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Gelidiales	Gelidiaceae	Pterocladiella	capillacea	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Gigartinales	Phyllophoraceae	Gymnogongrus	furcatus	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	angustum	N	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	cirrhosum	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Ochrophyta	Phaeophyceae	Cutleriales	Cutleriaceae	Microzonia	velutina	N	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Fucales	Sargassaceae	Carpophyllum	flexuosum	N	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Fucales	Sargassaceae	Carpophyllum	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Ecklonia	radiata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Sphacelariales	Sphacelariaceae	Sphacelaria	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Sphacelariales	Stypocaulaceae	Halopteris	sp.	SI	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Hymedesmiidae	Phorbas	fulva	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chordata	Ascidiacea	Phlebobranchia	Rhodosomatidae	Corella	eumyota	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	cancellata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	subuculata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	cerea	C1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

*class_code: A = non-indigenous (highlighted by shading)., C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6d. Results from the dinoflagellate cyst core samples.

Appendic 6d. Results from the dinoflagellate cyst samples.

							Blyde Wharf		Blyde Wharf, No_3		Breakwater No_1		Breakwater No_2		Lee Breakwater No_ 1		Moturoa Wharf		Newton King Tanker Terminal, No_2		Yacht M
phylum	**class**	**order**	**family**	**genus**	**species**	**class_code**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**
Dinophyta	Dinophyceae	Gymnodiniales	Gymnodiniaceae	Gymnodinium	catenatum	C1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	sp.	SI	1	0	1	0	0	1	1	0	0	0	0	0	0	0	1
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Scrippsiella	trochoidea	N	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	adspersa	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

*class_code: A = nonindigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendic 6d. Results from the dinoflagellate cyst samples.

							oorings
phylum	**class**	**order**	**family**	**genus**	**species**	**class_code**	**2**
Dinophyta	Dinophyceae	Gymnodiniales	Gymnodiniaceae	Gymnodinium	catenatum	C1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	sp.	SI	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Scrippsiella	trochoidea	N	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	adspersa	N	0

*class_code: A = nonindigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6e. Results from the fish trap samples.

Appendix 6e. Results from the fish trap samples.

						Site code	Blyde Wharf				Blyde Wharf, No_3				Breakwater No_1				Breakwater No_2				Mooring Breakwater				Moturoa Wharf				King Tanker Termina				Yacht Moorings			
						Trap line	1		2		1		2		1		2		1		2		1		2		1		2		1		2		1		2	
phylum	**class**	**order**	**family**	**genus**	**species**	***class_code**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Cnidaria	Hydrozoa	Hydroida	Tubulariidae	Ectopleura	multicirrata?	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Arthropoda	Malacostraca	Brachyura	Portunidae	Ovalipes	catharus	N	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Vertebrata	Actinopterygii	Anguilliformes	Congridae	Conger	wilsoni	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Perciformes	Arripidae	Arripis	trutta	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0
Vertebrata	Actinopterygii	Perciformes	Sparidae	Pagrus	auratus	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Vertebrata	Actinopterygii	Perciformes	Tripterygiidae	Tripterygiidae	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6f. Results from the crab trap samples.

Appendix 6f. Results from the crab trap samples.

						Site code	Blyde Wharf				Blyde Wharf, No_3				Breakwater No_1				Breakwater No_2				Mooring Breakwater				Moturoa Wharf				Newton King Tanker Terminal, No_2				Yacht Moorings			
						Trap line	1		2		1		2		1		2		1		2		1		2		1		2		1		2		1		2	
phylum	class	order	family	genus	species	*class_code	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	sp.	SI	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	peronii	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Portunidae	Ovalipes	catharus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Isopoda	Cymothoidae	Nerocila	orbignyi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	adspersa	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	sp.	SI	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	1	0	0	0
Vertebrata	Actinopterygii	Gadiformes	Moridae	Lotella	rhacinum	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Gadiformes	Moridae	Pseudophycis	barbata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Gasterosteiformes	Syngnathidae	Hippocampus	abdominalis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6g. Results from the starfish trap samples.

Appendix 6g. Results from the starfish trap samples.

						Site code	Blyde Wharf				Blyde Wharf, No_3				Breakwater No_1				Breakwater No_2				Mooring Breakwater				Moturoa Wharf				Newton King Tanker Terminal, No_2				Yacht Moorings			
						Trap line	1		2		1		2		1		2		1		2		1		2		1		2		1		2		1		2	
phylum	class	order	family	genus	species	*class_code	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	sp.	SI	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Portunidae	Ovalipes	catharus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Meridiastra	mortenseni	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	adspersa	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	sp.	SI	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	1	0	0
Mollusca	Polyplacophora	Acanthochitonina	Acanthochitonidae	Cryptoconchus	porosus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Mollusca	Polyplacophora	Ischnochitonina	Chitonidae			SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Gasterosteiformes	Syngnathidae	Hippocampus	abdominalis	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic cateogry 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6h. Results from the shrimp trap samples.

Appendix 6h. Results from the starfish trap samples.

						Site code	Blyde Wharf		Blyde Wharf, No_3		Breakwater No_1		Breakwater No_2				Mooring Breakwater		Moturoa Wharf		ton King Tanker Terminal,		Yacht Moorings	
						Trap line	1	2	1	2	1	2	1		2		1	2	1	2	1	2	1	2
phylum	class	order	family	genus	species	*class_code	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	rossi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Appendix 6i. Results from the above-water visual searches.

Appendix 6i. Results from the opportunistic visual surveys.

phylum	class	order	family	genus	species	*class_code	Blyde Wharf	Breakwater No_1	Yacht Moorings
Bryozoa	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	0	0	1
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	traversi	N	0	0	1
Arthropoda	Malacostraca	Brachyura	Hymenosomatida	Halicarcinus	cookii	N	0	0	1
Rhodophyta	Florideophyceae	Acrochaetiales	Acrochaetiaceae	Audouinella	sp.	SI	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnionella	adnata	N	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	flaccidum	N	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	sp.	SI	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	SI	0	0	1
Rhodophyta	Florideophyceae	Stylonematales	Stylonemataceae	Stylonema	alsidii	N	0	0	1
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	0	0	1

*class_code: A = non-indigenous (highlighted by shading), C1 = cryptogenic category 1, C2 = cryptogenic category 2, N = native, SI = indeterminate species. See text for details.

Addendum

Recent revision by one of the authors (G.F.) of the status of amphipods identified in this survey has lead to a change in status of one that was classed as species indeterminata in this report. *Paraleucothoe* sp. A should instead be considered cryptogenic category two, on the basis that only one other species of *Paraleucothoe* has been described world-wide (from Australia) and *Paraleucothoe* sp. A does not match its description. *Paraleucothoe* sp. A has not previously been recorded in New Zealand. In the second survey of the Port of Taranaki it occurred in pile scrape samples from the Newton King Tanker Terminal No. 2.

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