TECHNICAL PAPER

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NEW ZEALAND

Port of Picton

Second baseline survey for non-indigenous marine species (Research Project ZBS2008/04)

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Executive summary

- This report describes the results of a repeat port baseline survey of the Port of Picton undertaken in January 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 Picton undertaken in December 2001.

- 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 Picton, 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 Picton. 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 Picton 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 206 species or higher taxa were identified in the first survey of the Port of Picton in December 2001. They consisted of 145 native species, 7 non-indigenous species, 27 cryptogenic species (those whose geographic origins are uncertain) and 27 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level).

- During the repeat survey, 249 species or higher taxa were recorded, including 167 native species, 11 non-indigenous species, 36 cryptogenic species and 35 species indeterminata. Many species were common to both surveys. Around 54% of the native species, 45% of non-indigenous species, and 50% of cryptogenic species recorded during the repeat survey were also found in the earlier survey.

- The 11 non-indigenous organisms found in the repeat survey of the Port of Picton included representatives of 6 major taxonomic groups. The non-indigenous species detected were: (Annelida), *Spirobranchus polytrema*; (Bryozoa) *Bugula flabellata*, *B. neritina*, *Tricellaria inopinata, Cryptosula pallasiana*, *Watersipora subtorquata*; (Cnidaria) *Eudendrium generale*; (Mollusca) *Theora lubrica*; (Macroalgae) *Griffithsia crassiuscula*, *Undaria pinnatifida*, and (Porifera) *Halisarca dujardini*. Six of these species - *Spirobranchus polytrema*, *Bugula neritina*, *Tricellaria inopinata, Cryptosula pallasiana, Eudendrium generale* and *Theora lubrica* - were not recorded in the earlier baseline survey of the Port of Picton. In addition, two non-indigenous species that were present in the first survey – the annelids *Dipolydora armata* and *Polydora hoplura* – were not found during the repeat survey.

- Ten *s*pecies recorded in the repeat survey were new records for New Zealand waters. These were all newly discovered sponges (*Adocia* new sp. 1, *Chalinula* new sp. 2, *Chondropsis* new sp. 1, *Dactylia* new sp. 1, *Dysidea* new sp. 3, *Haliclona* new sp. 1, *Haliclona* new sp. 4, *Haliclona* new sp. 6, *Haliclona* new sp. 14, and *Mycale (Carmia)* new sp. 3).

- One species recorded from the Port of Picton repeat survey, the Asian kelp *Undaria pinnatifida*, is on the New Zealand register of unwanted organisms. *Undaria pinnatifida* is now widely distributed in southern and eastern New Zealand.

- 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 64% (7 of 11 species) of NIS in the Port of Picton are likely to have been introduced in hull fouling assemblages, 9% (1 species) via ballast water and 27% (3 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 Picton (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.

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).

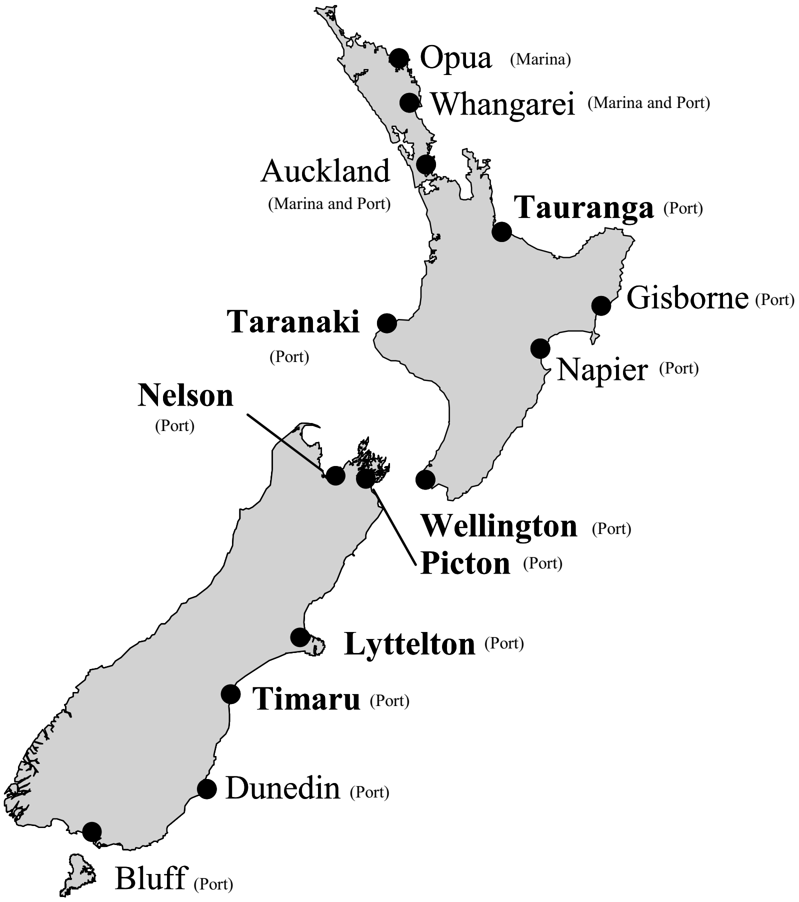

Figure 1: Commercial shipping ports in New Zealand where baseline non-indigenous species surveys have been conducted. Group 1 ports surveyed in the summer of 2001/2002 and re-surveyed in the summer of 2004/2005 are indicated in bold and Group 2 ports surveyed in the summer of 2002/2003 are indicated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

The 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 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.

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

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 which 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 Picton undertaken in January 2005, approximately 3 years after the initial baseline survey. In the manner of the first survey report (Inglis et al. 2006a), 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 Picton, 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 PICTON

General features

The Port of Picton is located at the head of the sheltered Queen Charlotte Sound, on the north-eastern tip of the South Island of New Zealand (14° 17'S, 174° 00'E). The inner part of the Sound is generally over 20 m in depth. The minimum depth in the main channel west of Long Island is 13.4 m, whilst the alternative channel to the east of Long Island has a minimum water depth of 19.2 m. Neap tidal range is 0.6 m and spring tidal range 1.7 m.

Picton was first established as Te-Wera-a-Waitohi by Te Atiawa Māori. When Europeans sailed up Queen Charlotte Sound for the first time they found a well established village which was an important trading point with North Island Māori, with a population of around 200. In December 1844 Francis Dillon Bell, representing the New Zealand Company, and Sir George Grey, the Governor, purchased the site. By 1850 Picton was fully established and had begun servicing the antimony, copper and coal mines in the area as well as gold mining up the Pelorus Valley, although mining had ceased by 1953. As the population and farming increased a number of processing units set up to service the town. Eventually the railway linking Picton to Blenheim and the rest of the country was built. This resulted in Picton becoming the main inter-island travel port for New Zealand (www.marlboroughonline.co.nz) with terminal facilities established at the port in 1962 (www.teara.govt.nz).

Port operation, development and maintenance activities

The head of Picton Harbour is divided into two bays by Kaipupu Point, with the Port of Picton including facilities in both bays (Figure 2). The Port of Picton is currently run by Port Marlborough NZ Ltd (www.portmarlborough.co.nz), established in 1988. It is a relatively small shipping port, but has berths serving both road and rail traffic for the Cook Strait inter-island ferry services. The port also has wharves for water taxis, commercial launches, vessels at anchor, and large visiting recreational vessels.

The main port activity takes place at Picton, situated at the head of the eastern bay where there are a number of finger wharves including three ferry terminal berths and the Waitohi Wharf (Figure 2). Waitohi Wharf is a general-purpose finger wharf providing berths and facilities for overseas and coastal cargo vessels – mainly those involved in coastal trading (salt loading, cement discharge), fishing and those which sail the Cook Strait. The wharf also serves as the berth for passenger cruise ships, accommodating vessels up to 265 m long.

In 2000, the new deep water port facility, Waimahara Wharf, opened in the western bay, Shakespeare Bay (Figure 2). This new development complements the port's existing facilities. The 200 m long Waimahara Wharf is designed as a multi purpose berth for timber, logs and coal with the ability to be expanded northwards if required. With a depth alongside of 15.3 m at low tide the wharf provides deep-water access. The addition of mooring dolphins will allow Panamax vessels to be accommodated. The Waimahara Wharf was not sampled during the first baseline survey (Inglis et al. 2006a) because marine pest surveys at the site were being undertaken by the Cawthron Institute. In response to a request from Biosecurity NZ, survey sites at the Waimahara Wharf were included during the second baseline survey (this report). Construction of another new berth in an area called the Westshore on the western side of Picton Harbour was completed in the second half of 2005 (after the completion of the second baseline survey) to provide berth space for commercial fishing vessels.

Berth construction within the port is predominantly concrete deck on a mixture of steel casing (concrete internally) and precast concrete piles with wooden fendering piles. Further details of the dimensions of each berth, the adjacent draught and the cargo each berth handles are provided in Table 1.

Vessels unable to be berthed immediately in the port may anchor inside the Sound west of Mabel Island (41°16'S, 174°00.7'E) in 25 m of water. Pilotage is compulsory on vessels over 500 GRT unless with Pilot exemption (www.portmarlborough.co.nz).

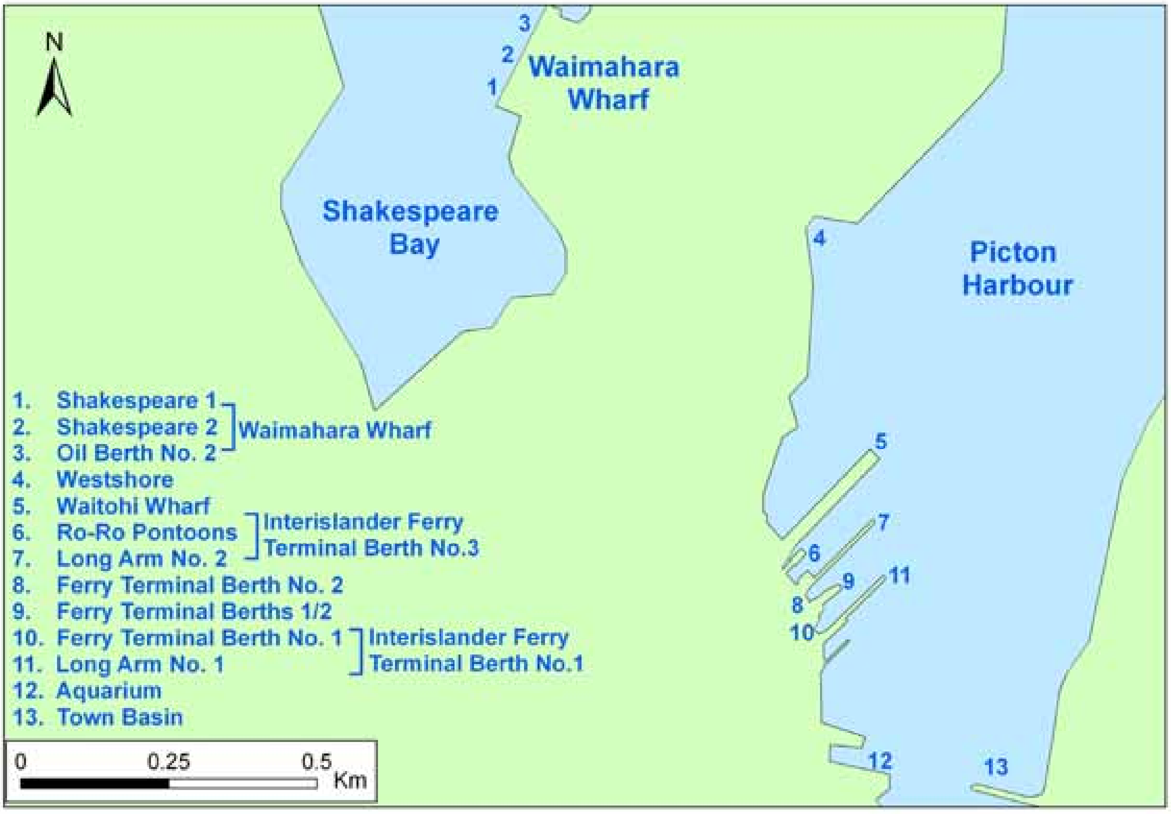

Figure 2: **Port of Picton map**

Within the port, there is no on-going maintenance dredging, and no capital dredging has occurred since the initial baseline survey in December 2001 (R. Boyce, Port Marlborough New Zealand Ltd., pers. comm.). Scouring by vessel thrusters and propellers ensures the berths are kept free from sedimentation (R. Boyce, pers comm.).

Between August and November 2005 (ie. after the second baseline survey had been completed in January 2005), a 30 m long steel sheet pile berth was constructed on the Westshore of Picton Harbour for commercial fishing vessels (Table 1), driven through the existing edge of rock batters. This involved some rearranging of the rock wall but no dredging. Also after the January 2005 survey, a slipway was cut into the northern end of the existing reclamation as part of the construction of boat building premises there. No land reclamation has occurred on the Westshore and no further capital works are currently planned for the Westshore (R. Boyce, pers comm.).

Port Marlborough operates three recreational marinas in the Marlborough Sounds; Picton Marina adjacent to the Port of Picton, Waikawa Marina also within Queen Charlotte Sound and five minutes drive from Picton, and Havelock Marina at the head of Pelorus Sound. The Picton Marina has 232 floating concrete pier/wooden pile berths for vessels 8-35+ m in length (www.portmarlborough.co.nz). An expansion of the Picton Marina has recently been completed, with a breakwater constructed at Shirley Beach between September and December 2000 and the installation of floating jetties completed around mid 2003. This involved a small volume of dredging along the shore line for berths, with the dredged material placed on land behind sheetpiling (R. Boyce, pers. comm.).

Waikawa Marina has 600 floating concrete pier/wooden pile berths for vessels 8-20 m in length, and 70 additional individual lock-up boat sheds (www.portmarlborough.co.nz). There have been no recent capital works conducted at Waikawa Marina.

Imports and exports

The volumes and value of goods imported and exported through the Port of Picton are summarised below. These data describe only cargo being loaded for, or unloaded from, overseas ports and do not include domestic cargo (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).

Imports

The value of cargo unloaded at the Port of Picton was less than one million dollars per year for the financial years ending June 2003 to June 2005 (Statistics New Zealand 2006b). In the calendar years 2002 to 2005 inclusive, the Port of Picton unloaded cargo from overseas to a value of $3,875,199 (Statistics New Zealand 2006a). This consisted mostly of wood and wooden articles (95 %) imported in September 2005, with the remaining 5 % in the commodity category "ships, boats and floating structures", imported in 2003 (Figure 3).

The Port of Picton received imports from just 3 countries of initial origin[2] between 2002 and 2005 inclusive (Statistics New Zealand 2006a). Cargo in the "ships, boats and floating structures" commodities class unloaded in 2003 arrived from the Bahamas, whilst the wood and wooden articles unloaded in 2005 came from the Republic of Korea and India (Figure 4).

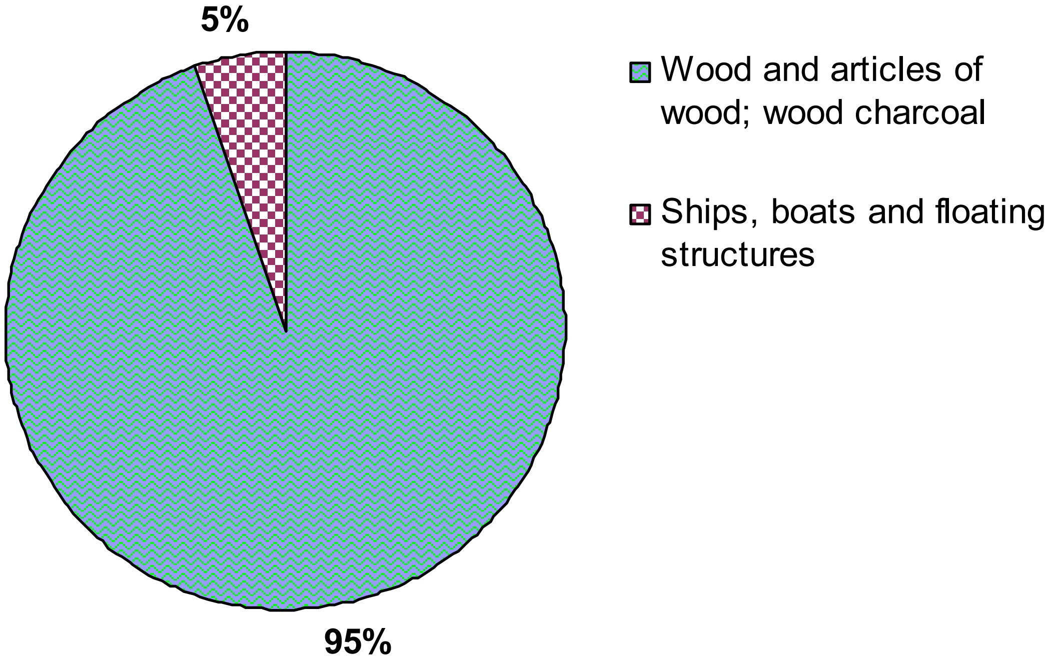

Figure 3: Overseas cargo unloaded at the Port of Picton between January 2002 and December 2005. Percentages represent the proportion by value of each commodity unloaded during this period (data sourced from Statistics New Zealand 2006a).

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[2] 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 Picton; for ship movements see the section on "Shipping movements and ballast discharge patterns".

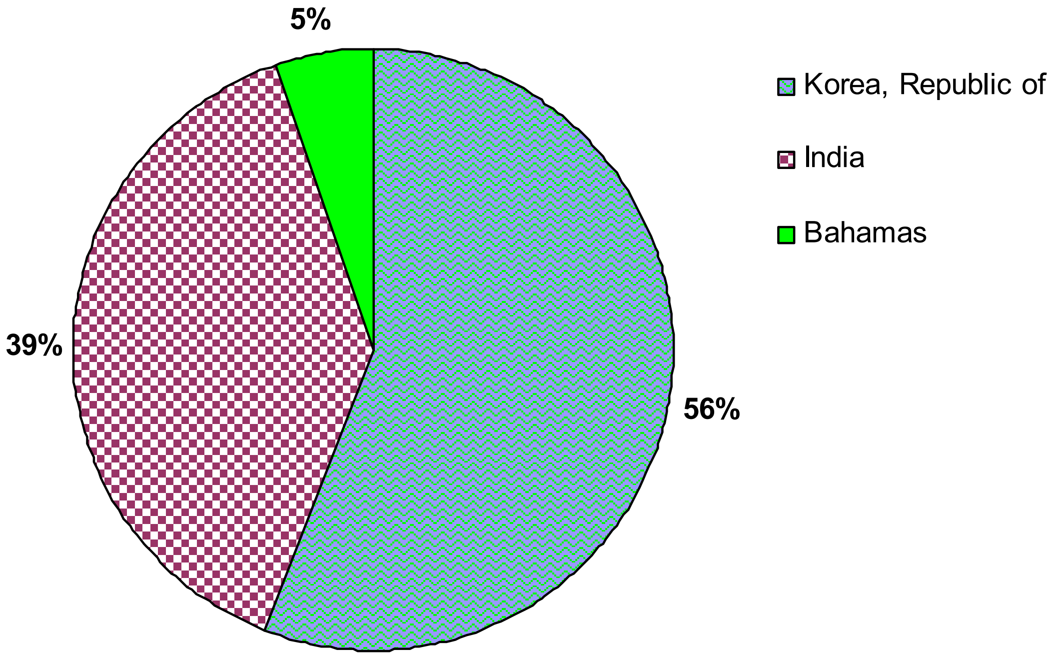

Figure 4: **Countries of initial origin that overseas cargo was unloaded from at the Port of Picton The data are percentages of the total volume of cargo unloaded in the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).**

Exports

The weight of overseas cargo loaded at the Port of Picton increased each financial year between the years ending June 2002 and June 2005 (Statistics New Zealand 2006b). In the year ending June 2005, the Port of Picton loaded 387,295 tonnes of cargo for export, representing a 51.3 % increase compared to the 256,004 tonnes loaded in the 2001-2002 financial year (Table 2). The value of this cargo increased by 14 % during this period, with a value of $33 million in the year ending June 2005. For the financial years ending June 2002 to 2005, overseas cargo loaded at the Port of Picton accounted for 1 to 1.8 % by weight and 0.1 % by value of the total overseas cargo loaded at New Zealand's seaports (Table 2).

The Port of Picton exported cargo in 8 different commodity categories between January 2002 and December 2005 inclusive (Statistics New Zealand 2006a). Wood and wooden articles were by far the dominant commodity category by value, representing 96 % by value of the cargo loaded (Figure 5) and being the only commodity that was loaded for export every year between 2002 and 2005 (Statistics New Zealand 2006a).

The Port of Picton loaded cargo for export to 19 countries of final destination[3] between January 2002 and December 2005 inclusive (Statistics New Zealand 2006a). During this time, the Port of Picton exported most of its overseas cargo by value to the Republic of Korea (74 %), and India (17.5 %; Figure 6). The Republic of Korea ranked first and India second in all years except 2002, when the People's Republic of China ranked second.

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[3] 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 Picton; it is the final destination of the goods. For ship movements see "Shipping movements and ballast discharge patterns".

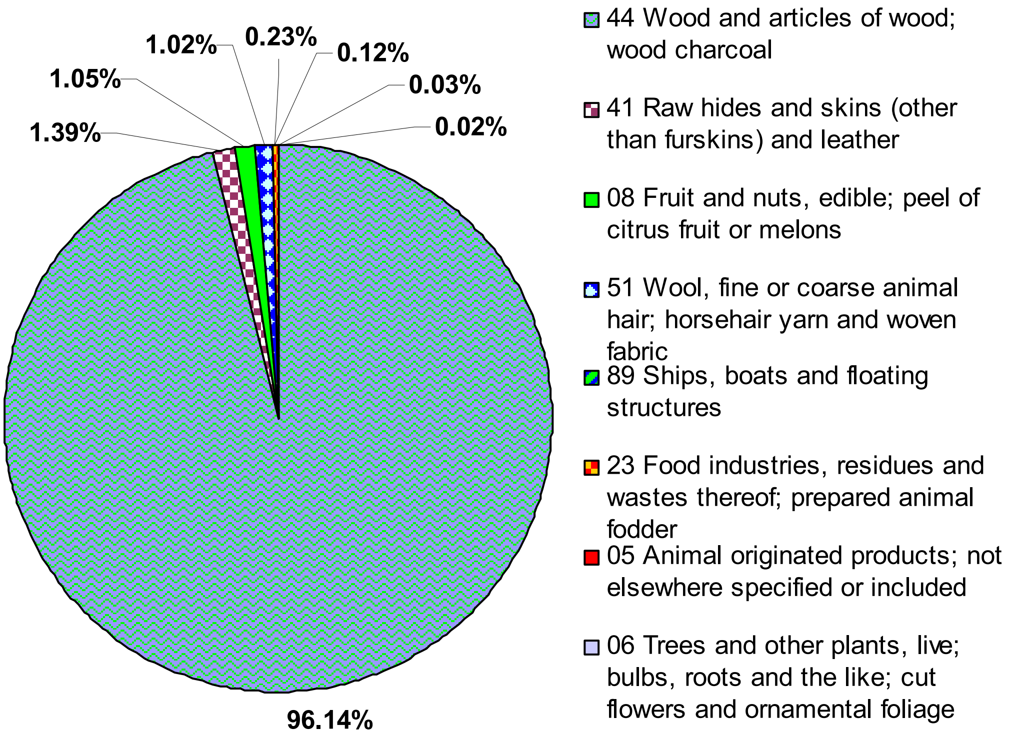

Figure 5: Overseas cargo loaded at the Port of Picton between January 2002 and December 2005. Percentages represent the proportion by value of each commodity loaded during this period (data sourced from Statistics New Zealand 2006a). Commodity category descriptions have been summarised for brevity; category numbers are provided in the legend and full descriptions are available at Statistics New Zealand (2006a).

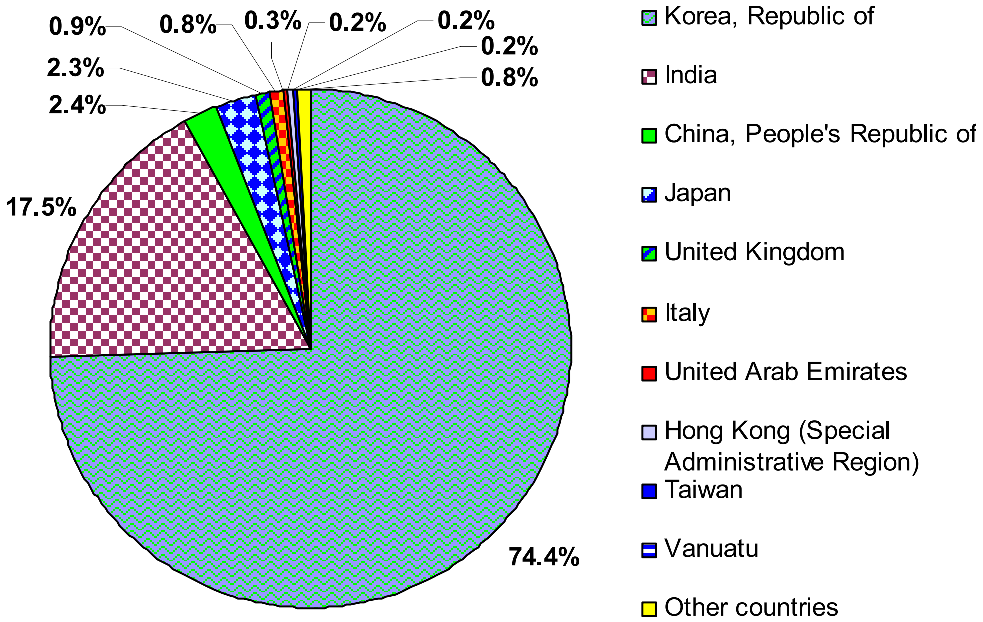

Figure 6: Top 10 countries of final destination that cargo was loaded for at the Port of Picton. The data are percentages of the total cargo loaded at the port for the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).

Shipping movements and ballast discharge patterns

A total volume of 6,956 m^3 of ballast water was discharged in the Port of Picton in 1999, with the largest country-of-origin volumes of 1,618 m^3 from Japan, 154 m^3 from Australia, and 5,184 m^3 unspecified (Inglis 2001). This figure is three orders of magnitude lower than the recorded ballast water discharge into the Port of New Plymouth, and two orders of magnitude lower that the volumes discharged in Lyttelton, Tauranga, Whangarei and Nelson Ports (Inglis 2001), providing an indication of the relatively small scale of commercial shipping operations at the Port of Picton. Since June 2005, vessels have been required to comply with the Import Health Standard for Ships' Ballast Water from All Countries (www.biosecurity.govt.nz/imports/non-organic/standards/ballastwater.htm). 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.

To gain a more detailed understanding of international and domestic vessel movements to and from the Port of Picton between 2002 and 2005 inclusive, we analysed a database of vessel movements generated and updated by Lloyds Marine Intelligence Unit (LMIU), 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. The database does not include movement records for domestic or international ferries plying scheduled routes, small domestic fishing vessels or recreational vessels. Cruise ships, coastal cargo vessels and all other vessels over 99 gross tonnes are included in the database. The database therefore gives a good indication of the movements of international and domestic vessels involved in trade. Definitions of vessel type categories are given in Appendix 1.

International vessel movements

Based on an analysis of the 'Seaseacher.com' database, there were 26 vessel arrivals to the Port of Picton from overseas ports between 2002 and 2005 inclusive. These arrived from 6 different countries (Table 3), with more than half coming from Australia (15 arrivals), and the remainder arriving from China, Korea (both in the northwest Pacific region), Japan, New Caledonia (Pacific Islands), and Aruba (off the South America Atlantic coast). Of the 15 vessels arriving from Australia, 4 came from ports in New South Wales, 4 from Tasmania, 3 from Victoria, 2 from Queensland and 2 from South Australia (Table 4). These were mostly bulk / cement carriers, and this vessel type represented over two-thirds of the total international arrivals (Table 3).

According to the 'Seasearcher.com' database, during the same period 50 vessels departed from the Port of Picton to 7 different countries (Table 5). The greatest number of departures for overseas went to ports in the Republic of Korea (northwest Pacific region) as their next port of call (32 movements) followed by the Republic of Singapore (east Asian seas region; 8 departures), Australia (5), India (central Indian Ocean region; 2 departures), and one each for Japan, China (in the northwest Pacific) and the Philippines (east Asian seas). Forty-seven of the 50 movements were bulk / cement carriers, with the remaining three being passenger / vehicle / livestock carriers (Table 5).

Domestic vessel movements

The 'Seasearcher.com' database contains movement records for 103 vessel arrivals to the Port of Picton from New Zealand ports between 2002 and 2005 inclusive. These vessels arrived

from 13 different ports in both the North and South Islands (Table 6). The greatest number of domestic arrivals during this period came from Wellington (26 arrivals), Lyttelton (20 arrivals), Nelson (15 arrivals), and Napier (10 arrivals). Bulk / cement carriers were by far the dominant vessel type arriving at the Port of Picton from other New Zealand ports (70 arrivals) followed by passenger / vehicle / livestock carriers (20 arrivals; Table 6).
During the same period, the 'Seasearcher.com' database contained movement records for 77 vessel departures from the Port of Picton to 12 New Zealand ports in both the North and South Islands. The most domestic movements departed the Port of Picton for Wellington (19 movements), Whangarei (13), Napier (11) and Lyttelton (11; Table 7). Similar to the domestic arrivals, vessels departing the Port of Picton on domestic voyages were mostly bulk / cement carriers (42 movements), followed by passenger / vehicle / livestock carriers (22 movements; Table 7).

The data described above do not include scheduled ferry movements, or vessels under 99 gross tonnes including fishing and recreational vessels. The Port of Picton facilitates a significant interisland passenger/freight service involving two companies: The Interisland Line and Strait Shipping. Each year Interislander vessels accommodate over one million passengers, 230,000 domestic vehicles and operate over 5,700 sailings (www.interislander.co.nz), while Strait Shipping runs 1,300 return trips between Picton and Wellington annually (www.strait.co.nz). Just seven movement records for these ferries are included in the 'Seasearcher.com' database, signifying the origination or cancellation of a route for a particular vessel. Many fishing vessels are also registered in the Port of Picton (69 in the year 2000, Sinner et al. 2000).

EXISTING BIOLOGICAL INFORMATION

Existing published biological studies that describe marine communities in Picton Harbour are not plentiful. However, the supplement of information from the initial NIWA baseline survey of Picton Harbour (Inglis et al. 2006a) has made a valuable addition to the biological information available in the area. This is explained further in the next section. In addition, the NIWA Client Report by Inglis et al. (Inglis et al. 2006b) describes marine communties in Picton Harbour, with particular emphasis on surveillance for early detection of unwanted organisims in New Zealand Ports.

Impact assessment studies were conducted for the Shakespeare Bay port development (Duckworth 1987) and the Cawthron Institute has been involved in on-going studies of the flora and fauna of the new port facility in Shakespeare Bay.

A biological inventory of the intertidal communities of Waikawa Bay (in Queen Charlotte Sound five minutes drive northeast of Picton) was produced by Stephenson (1977) for the Marlborough Harbour Board. Of the forty-three species recorded, none were non-indigenous, and only one (the sea anemone *Anthopleura aureoradiata*) was cryptogenic. Species distribution patterns were strongly related to tide and sediment characteristics, but within a given tidal level community structure did not vary greatly between sampling stations. The most abundant animal was the cockle *Chione stutchburyi*, with a maximum recorded density of 2,800 / m^2. The only plant recorded in significant quantity in the study was the eel grass *Zostera muelleri*. Trace metal content in four species of molluscs were analysed and found to be low to moderate.

The invasive kelp *Undaria pinnatifida* was identified in the Marlborough Sounds in 1991, and this area is deemed in the optimal temperature zone for this macroalga (Sinner et al. 2000).

Taylor and MacKenzie (2001) investigated the Port of Picton for the presence of the toxic blooming dinoflagellate *Gymnodinium catenatum*, and did not detect resting cysts (sediment samples) or motile cells (phytoplankton samples).

In February 2002, a team of divers surveyed the hull of the steel barge the ‘Steel Mariner’ for “unwanted exotic organisms”. The barge had been moored west of Kaipupu Point in Shakespeare Bay since late 2001 (Coutts 2002). Six algal species and 70 animal taxa were identified on the hull of the vessel. Amongst the species found were two North Island species that do not occur in the south island, the ribbed slipper limpet *Crepidula costata* and the red alga *Cladhymenia lyalli*, and two potential pest species, the “unwanted introduced” *Undaria pinnatifida* and the colonial ascidian *Didemnum vexillum*, known from dense infestations in Whangamata Harbour (Coromandel Peninsula, North Island), and latterly, Tauranga Harbour (Kott 2002). The surveys estimated 2,923 ± 628 kg of the *D. vexillum* to be present on the barge and another 460 ± 180 kg on the seabed. It was considered that offspring of *D. vexillum* from the barge may still have been confined at that time to an estimated 40 m x 80 m area in 5 to 15 m depth below the barge, due to the limited currents in the area and the fast settling time for *D. vexillum* larvae (Coutts 2002).

Because of concern over the potential impacts of *D. vexillum* on long-line mussel aquaculture, an attempt was made, in August 2003, to eradicate the *D. vexillum* infestation in northern Shakespeare Bay (R. Boyce, Port Marlborough New Zealand Ltd., pers. comm.). Dredge material from along the front edge of Waimahara Wharf and from a stock pile on land was used to cover the infested area of approximately 50 m by 30 m, located approximately 750 m northeast from Waimahara Wharf. Approximately 600 m^3 of dredge material was used. In October 2003, all the piles of Waimahara Wharf were wrapped and the rip rap under the wharf was covered in another attempt to smother the *D. vexillum*. The wraps and covers were removed approximately 8 months later as the *D. vexillum* had re-established itself on the surface of the wraps. Some piles have since become re-infested with *D. vexillum* and colonies have subsequently been found on barges and recreational moorings in Shakespeare Bay and on a salmon farm in East Bay (R. Boyce, pers. comm.).

Marlborough District Council produces a State of the Environment Monitoring Report every five years. The 2003/2004 report notes that sediment samples collected from Picton Harbour by Marlborough District Council in March 2004 showed elevated trace metals in harbour sediments, with levels of mercury, copper, lead and zinc exceeding ANZECC guidelines (Marlborough District Council 2004). Tributyltin (TBT) contamination was found at all sites, with a small area of high contamination around Carey’s Boatyard, to the east of the Port. Sites closest to the shoreline and boatyard slipways had higher levels of pollution-tolerant polychaete worms and copper concentrations were highest in this area. Shellfish from near the boatyard slipway had slightly higher TBT concentrations. The report notes that the contaminants have been present for a long time and to date have resulted in a low level of adverse effects to benthic animals and shellfish, and will continue to be released from the sediments unless the sediments are removed from the site (Marlborough District Council 2004).

RESULTS OF THE FIRST BASELINE SURVEY

An initial baseline survey of the Port of Picton was completed in December 2001 (Inglis et al. 2006a). The report identified a total of 215 species or higher taxa. These consisted of 148 native species, 9 non-indigenous species, 25 cryptogenic species (those whose geographic origins are uncertain) and 33 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level). Fourteen species of marine organisms collected from the Port of Picton had not previously been described from New Zealand waters. One of these, the ascidian *Cnemidocarpa* sp., was thought to be a non-indigenous species. Another was a cryptogenic amphipod (*Meridiolembos* sp. aff. *acherontis*) and the remaining 12 were species of sponge that did not match existing species descriptions and which may have been new to science.

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*), as was the polychaete worm *Dipolydora flava* (re-identified as a native species, *D. dorsomaculata*), the latter because the concept of a widely distributed *D. flava* is now regarded as suspect and the local synonomy (*D. dorsomaculata*) is now considered a distinct species. The revised summary statistics for the Port of Picton following re-classification were a total of 206 species or higher taxa, consisting of 145 native species, 7 non-indigenous species, 27 cryptogenic species and 27 species indeterminata. These revisions have been incorporated into the comparison of data from the two surveys below.

The seven non-indigenous organisms described from the Port of Picton included representatives of four major taxonomic groups. The non-indigenous species detected were: (Annelida): *Dipolydora armata* and *Polydora hoplura* (Bryozoa): *Bugula flabellata* and *Watersipora subtorquata,* (Macroalgae): *Undaria pinnatifida* and *Griffithsia crassiuscula* and (Porifera): *Halisarca dujardini*. The only species on the New Zealand register of unwanted organisms found in the Port of Picton initial baseline survey was the Asian kelp, *Undaria pinnatifida*. This alga is known to now have a wide distribution in southern and eastern New Zealand. Approximately 57 % (four of seven species) of NIS in the Port of Picton were likely to have been introduced in hull fouling assemblages and 43 % (three species) could have been introduced by either ballast water or hull fouling vectors. Ballast water was not attributed as the probable vector for any of the NIS encountered in the Port of Picton.

Methods

SURVEY METHOD DEVELOPMENT

To allow a direct comparison between the initial baseline survey and the resurvey of the Port of Picton, the survey used the same methodologies, occurred in the same season, and sampled the same sites used in the initial baseline survey (as requested by Biosecurity NZ). To improve the description of the biota of the port, some additional survey sites were added during the repeat survey. These are described below.

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 8. 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 Picton baseline survey. The survey was undertaken between January 18th and 22nd, 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.

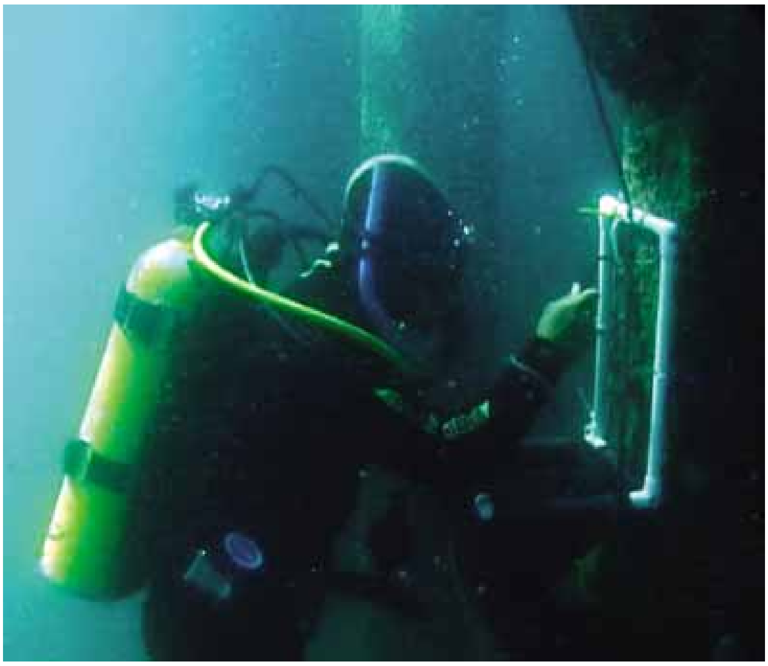

Figure 7: Diver sampling organisms on pier piles.

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.

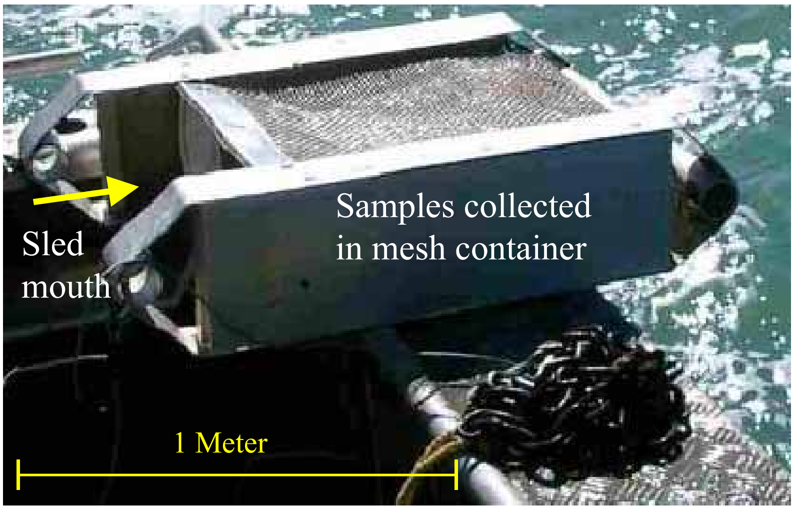

Figure 9: **Benthic sled**

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.

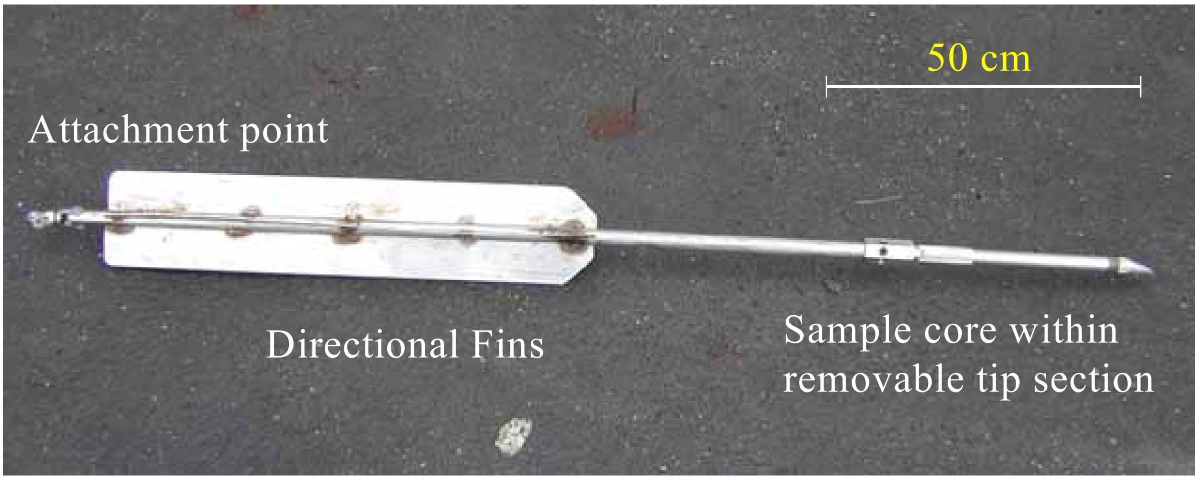

Figure 10: **Javelin corer**

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.

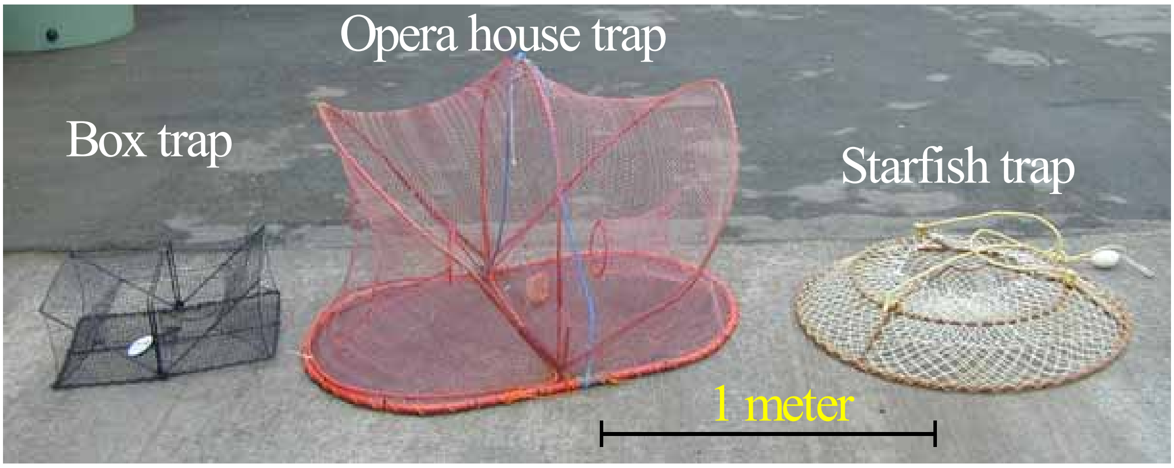

Figure 11: Trap types deployed in the port.

SAMPLING EFFORT

A summary of sampling effort during the second baseline survey of the Port of Picton is provided in Table 9 and exact locations of each sample site are provided in Appendix 2. The distribution of effort 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 three berths – Ferry Terminal Berths 1/2 (reported under the name “Ferry Terminal No. 2” in the initial survey report), Long Arm No. 1 (reported under the name “Ferry Terminal No. 3” in the initial survey report) and Waitohi Wharf (Inglis et al. 2006a). Javelin cores for cyst sampling were taken from six additional sites distributed throughout the port. These same locations (except for the cyst sampling sites) were again sampled during the re-survey of the port. To improve description of the flora and fauna in the resurvey, we increased sampling effort by adding an additional berth (in Shakespeare Bay) for all survey techniques and through the addition of nine additional sites for fish, crab and starfish traps, eight additional sites for shrimp traps, and three additional sites for benthic sleds. This greatly increased the spatial coverage of both Picton Harbour and Shakespeare Bay. Four sites were sampled for dinoflagellate cysts using the javelin corer. Also, during the initial survey of the Port of Picton, the benthic grab was damaged and few grab samples were able to be taken (Inglis et al. 2006a). In the repeat survey, the grab functioned properly and all of the planned survey sites were sampled with this technique.

The spatial distribution of sampling effort for each of the sample methods in the Port of Picton 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) and javelin cyst coring (Figure 17).

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 10. 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 11) and the marine pest list produced by the Australian Ballast Water Management Advisory Council (Table 12).

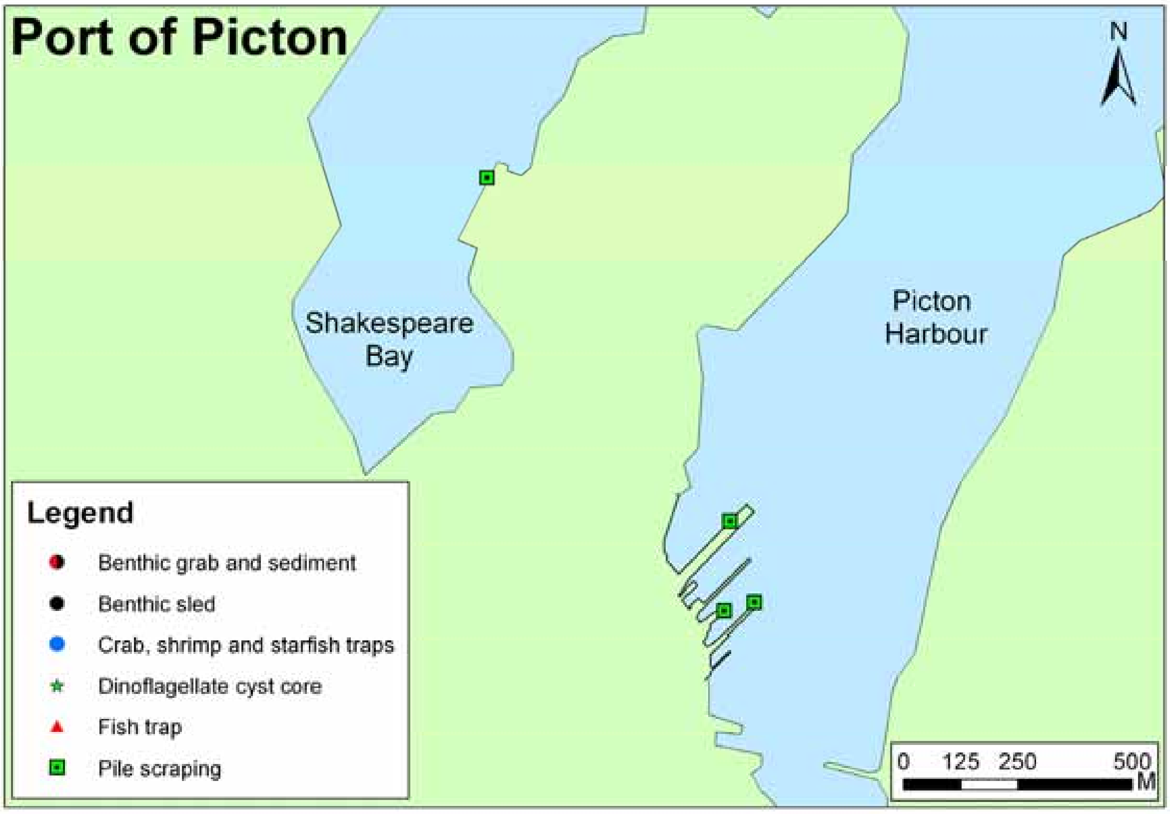

Figure 12: **Diver pile scraping sites**

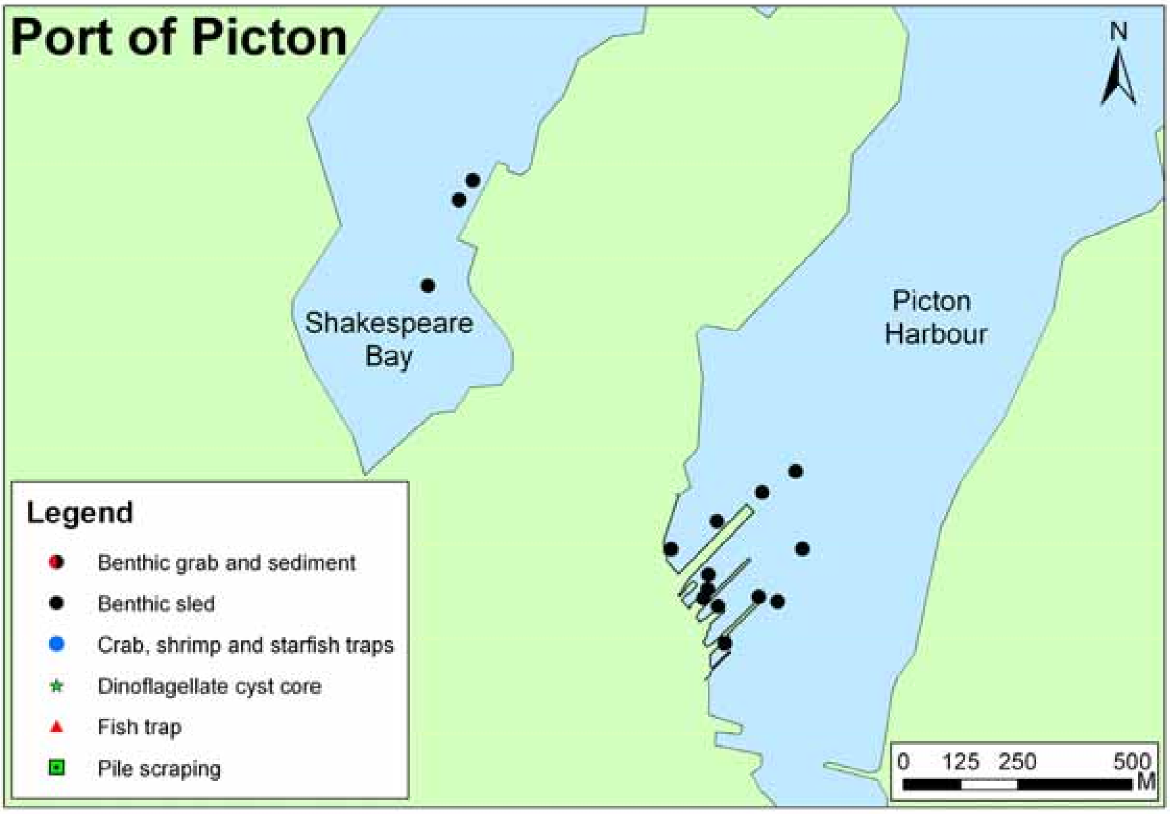

Figure 13: Benthic sled sites

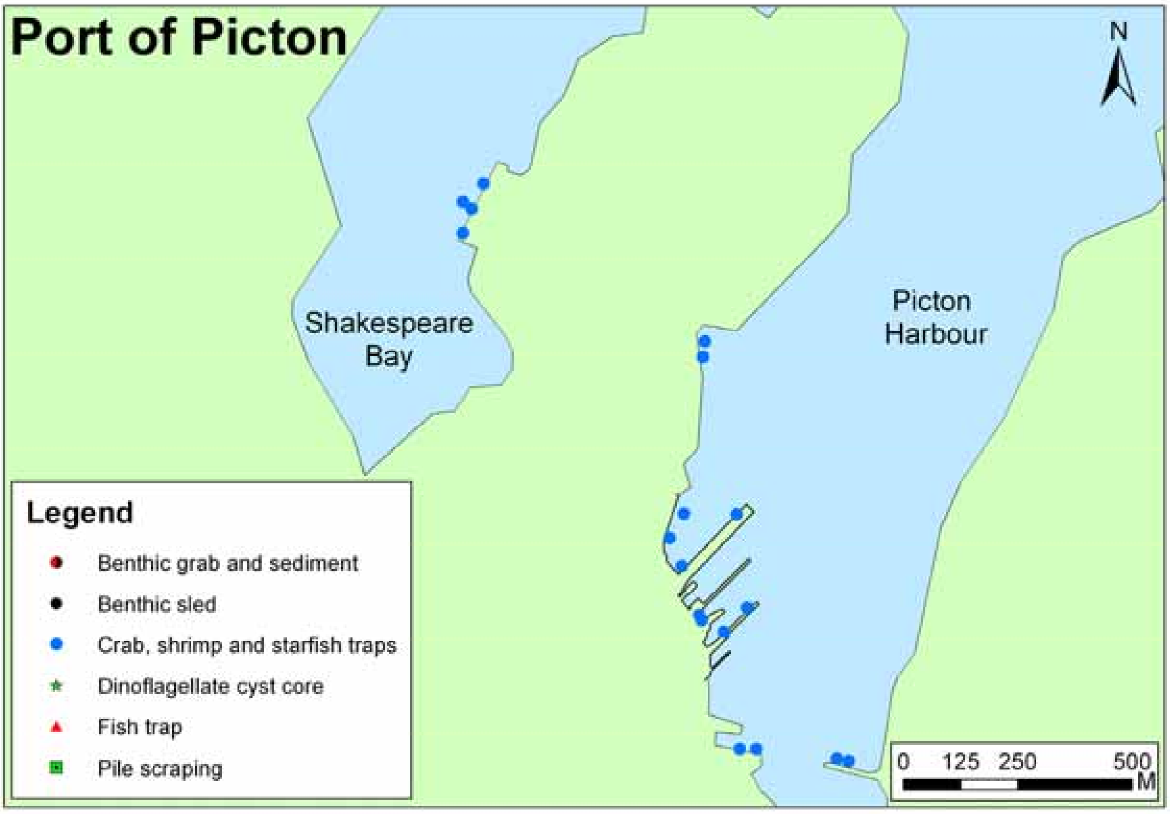

Figure 14: Sites trapped using box (crab), shrimp and starfish traps

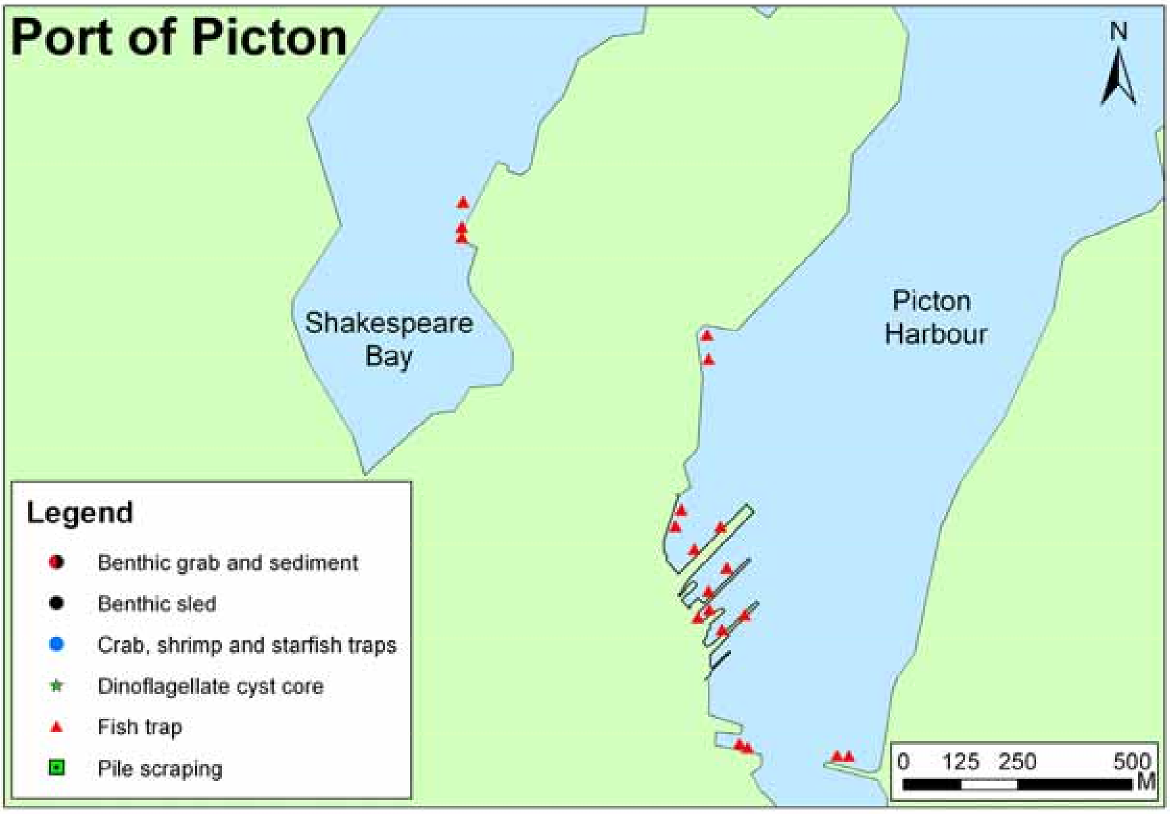

Figure 15: Opera house (fish) trapping sites

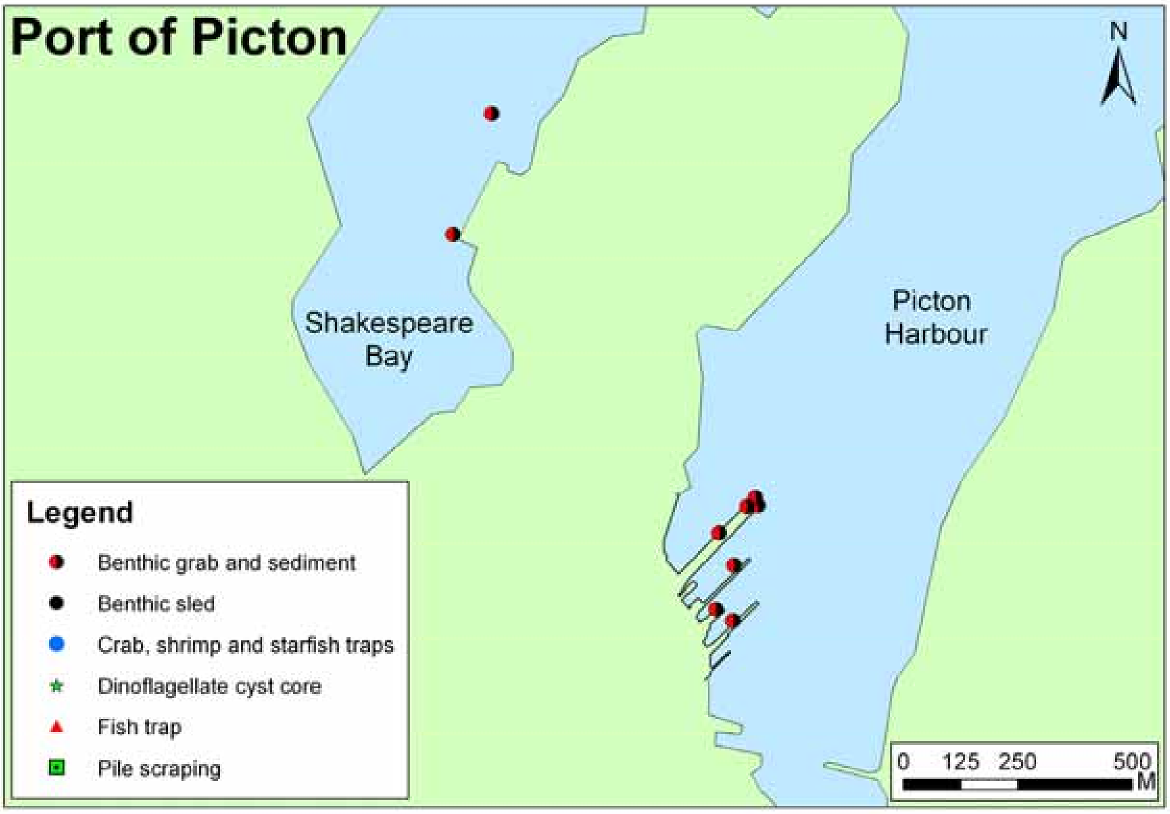

Figure 16: Shipek benthic grab sites

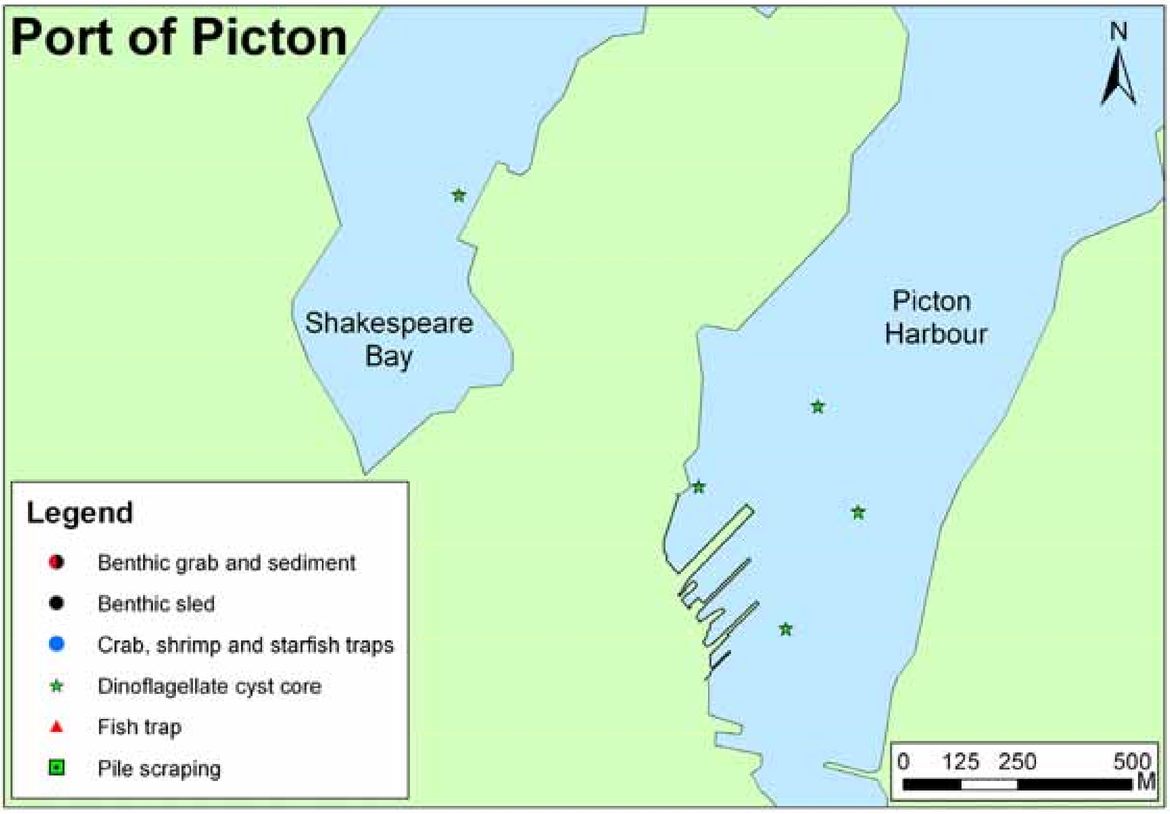

Figure 17: Javelin core sites

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 Picton, completed in December 2001 (Inglis et al. 2006a).

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 Picton.

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). For each similarity index, values range from zero (completely different) to one (identical).

Survey results

A total of 249 species or higher taxa were identified from the re-survey of the Port of Picton. This collection consisted of 167 native (Table 13), 36 cryptogenic (Table 14), and 11 non-indigenous species (Table 15), with the remaining 35 taxa being made up of indeterminate species (Table 16, Figure 18). In comparison, 206 taxa were recorded from the initial survey of the port in December 2001, comprising 145 native species, 27 cryptogenic species, 7 non-indigenous species and 27 species indeterminata.

The biota in the re-survey included a diverse array of organisms from 11 major taxonomic groups (Figure 19). 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.

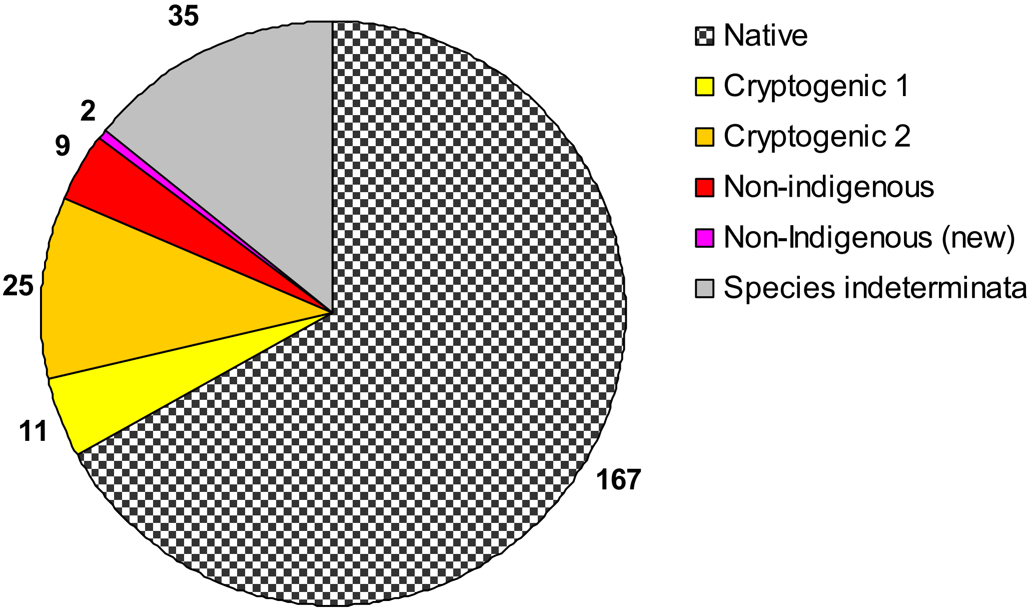

Figure 18: Diversity of marine species sampled in the Port of Picton. Values indicate the number of taxa in each category.

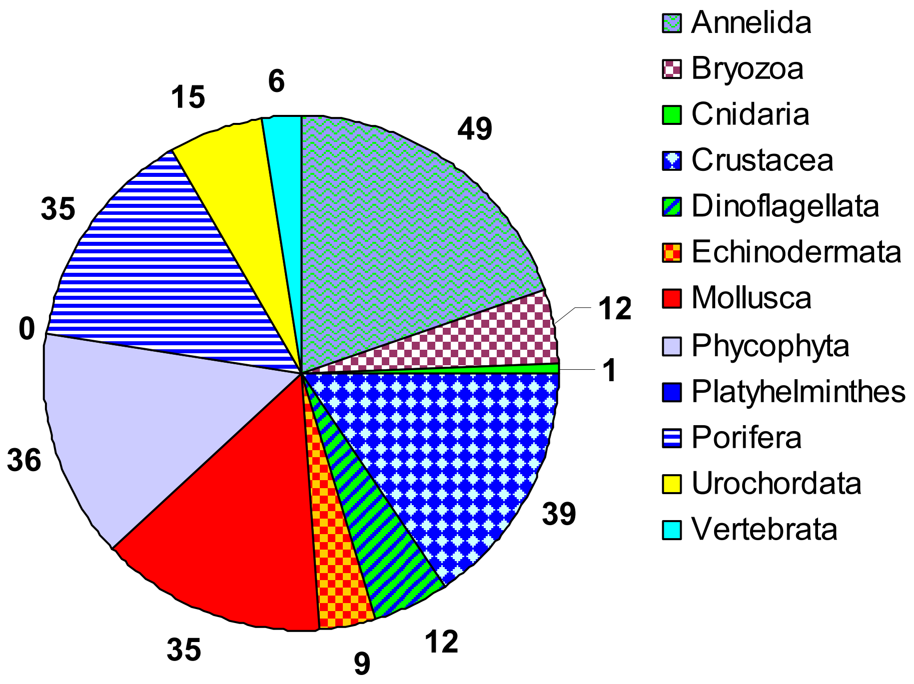

Figure 19: **Major taxonomic groups sampled in the Port of Picton. Values indicate the number of taxa in each of the major taxonomic groups.**

NATIVE SPECIES

The 167 native species recorded during the resurvey of the Port of Picton represented 67 % of all species identified from this location (Table 13) and included diverse assemblages of annelids (37 species), crustaceans (32 species), molluscs (31 species), algae (14 species), porifera (13 species), urochordates (10 species), dinoflagellates (10 species) and echinoderms (9 species). A number of other major taxonomic groups including bryozoans and vertebrates were also sampled from the Port (Table 13).

CRYPTOGENIC SPECIES

Cryptogenic species (*n* = 36) represented 14% of all species or higher taxa identified from the Port. The cryptogenic organisms identified included 11 Category 1 and 25 Category 2 species as defined in "Definitions of species categories" above. These organisms included 8 annelids, 1 bryozoan, 1 crustacean, 2 molluscs, 20 sponges and 4 ascidian species (Table 14). Only one of the Category 1 cryptogenic species (the nudibranch mollusc *Polycera hedgpathi*) was not recorded in the initial baseline survey of the port, whilst 3 of the 13 Category 1 cryptogenic species recorded in the initial baseline survey of the Port of Picton was not found during the re-survey (the bryozoan *Rhyncozoon larreyi,* the hydroid *Plumularia setacea* and the amphipod *Aora typica*). Several of the Category 1 cryptogenic species (e.g the ascidians *Astereocarpa cerea*, *Botrylloides leachii* 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).

Two cryptogenic category 1 species that have recently spread rapidly and which are dominant habitat modifiers are worthy of note. The colonial ascidians *Didemnum vexillum* (Kott 2002) and *Didemnum incanum* were among the cryptogenic Category 1 species recorded in the initial New Zealand port baseline surveys, and one of these species, *D. incanum*, was recorded in the first baseline survey of the Port of Picton. The other species, *D. vexillum,* was first described in 2001 when it formed nuisance growths on ship's hulls, wharf piles and other submerged structures in Whangamata, New Zealand (Kott 2002). It has subsequently been reported from several other port environments including Shakespeare Bay in Picton, Port Nelson and the Bay of Plenty, and a local control programme was trialled in the Marlborough Sounds to prevent its spread to aquaculture sites (Coutts 2002). The detection of *D. vexillum* in New Zealand was followed closely by reports of other nuisance species in this genus from the Atlantic coast of the USA, Mediterranean, North Sea and English Channel, but these now appear to be different species (Kott 2004b). Although the type specimen of *D. vexillum* was described from New Zealand, we have included it in the Cryptogenic 1 category because of uncertainty about its true geographic origins. *Didemnum incanum* is one of the few species of Didemnid that occurs both in Australia and New Zealand (Kott 2004a). Unlike *D. vexillum*, there have been no reports of local proliferation by this species (but see below).

The taxonomy of the Didemnidae is complex. The colonies do not display many distinguishing characters at either species or genus level and are comprised of very small, simplified zooids (Kott 2004a). Six species have been described in New Zealand (Kott 2002) and 241 in Australia (Kott 2004a). Most are recent descriptions and, as a result, there are few experts who can distinguish the species reliably. Specimens of *Didemnum* obtained during the initial port baseline surveys were examined by the world authority on this group, Dr Patricia Kott (Queensland Museum). Because, at the time of writing, we had been unable to secure Dr Kott's services to examine specimens from the repeat-baseline surveys, we have reported these species collectively, as a species group (*Didemnum* sp.; Table 14).

In the first baseline survey of the Port of Picton, *D. incanum* occurred in pile scrapes taken from Ferry Terminal Berths 2 and 3 and unidentified specimens of Didemnidae (specimens that did not fit the morphological charcters for *D. vexillum* or *D. incanum*) were recorded from pile scrape samples taken from Waitohi Wharf and Ferry Terminal Berth No. 2. In the repeat survey of the Port of Picton, species in the *Didemnum* group were recorded in pile scrape samples taken from Waitohi Wharf, Long Arm No. 1 and Shakespeare Bay 2. The divers conducting the pile scrape surveys at Shakespeare Bay 2 also observed that *Didemnum* was carpeting the sea floor at this site.

NON-INDIGENOUS SPECIES

The 11 non-indigenous species (NIS) recorded in the re-survey of the Port of Picton included 1 annelid worm, 5 bryozoans, 1 hydroid, 1 mollusc, 2 phycophytes and 1 poriferan (Table 15). Six species found in the re-survey were not recorded during the initial baseline survey of Picton in December 2001. These were: the polychaete *Spirobranchus polytrema*, the bryozoans *Cryptosula pallasiana, Tricellaria inopinata* and *Bugula neritina,* the hydroid *Eudendrium generale* and the mollusc *Theora lubrica.* Only two NIS recorded in the initial survey (the polychaetes *Polydora hoplura* and *Dipolydora armata*) were not recorded in the re-survey. These two species, both shell-boring worms, are well established in New Zealand and it is likely that these species are still present in the Port of Picton, despite not having been encountered in the repeat survey.

Two of the NIS (the polychaete worm *Spirobranchus polytrema* and the hydroid *Eudendrium generale*) were recorded for the first time during the initial port baseline surveys; *Spirobranchus polytrema* was recorded from the ports of Dunedin, Napier and Wellington and *Eudendrium generale* was recorded from the Port of Napier (see the species descriptions below). Neither species has previously been recorded from the Port of Picton. 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 15.

***Spirobranchus polytrema* (Philippi, 1844)**

No image available.

Spirobranchus polytrema is a serpulid tubeworm most commonly found along the continental shelf, intertidal, rock bottom, and sublittoral habitats, and on the underside of stones around the low water mark (Australian Faunal Directory 2005). Its impacts are unknown. *S. polytrema* is widely distributed, with a recorded distribution from Australia, Lord Howe Island, Solomon Islands, Sri Lanka, Japan, the Indo-west Pacific and the Mediterranean. The type specimen for this species was recorded from the Mediterranean, but there is continued uncertainty over the synonomy of Mediterranean and Indo-Pacific forms of this species complex. During the initial port baseline surveys, *S. polytrema* was recorded from the ports of Wellington, Napier and Dunedin (Table 17). These findings were the first time the species had been recorded in New Zealand (G. Read, NIWA, pers. comm.). During the second baseline surveys of Group 1 ports it was recorded from the ports of Wellington, Picton, Lyttelton and Timaru. In the Port of Picton *S. polytrema* occurred in pile scrape samples from Ferry Terminal Berths 1/2 and the Waitohi Wharf (Figure 20).

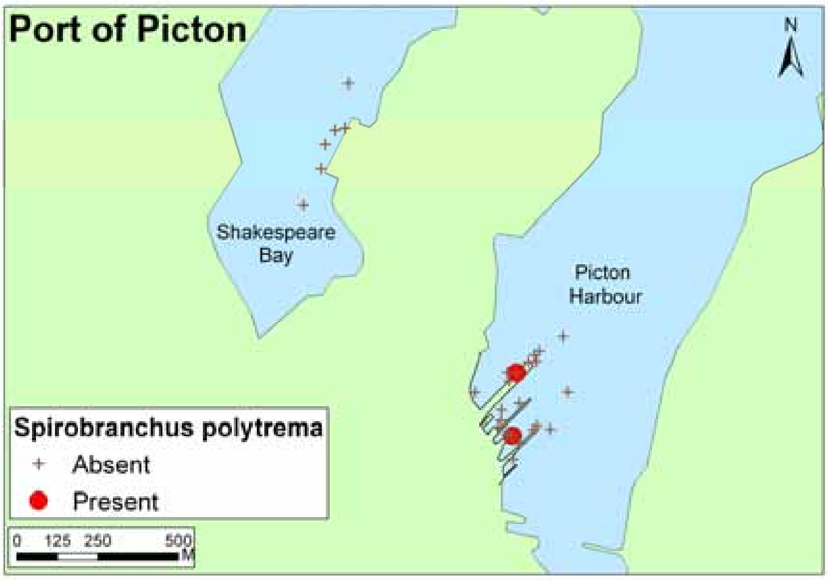

Figure 20: *Spirobranchus polytrema* distribution in the re-survey of the Port of Picton (January 2005).

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 17). In Picton it was recorded from Ferry Terminal 2 (reported as "Ferry Terminal Berths 1/2" in the second survey), Ferry Terminal 3 (reported as "Long Arm No. 1" in the second survey) and Waitohi Wharf (Figure 21). During the second baseline surveys of Group 1 ports *B. flabellata* was recorded from the ports of Tauaranga, Taranaki, Wellington, Picton, Nelson, Lyttelton and Timaru. In the Port of Picton *B. flabellata* occurred in pile scrape samples taken from the Waitohi Wharf, Ferry Terminal Berths 1/2, Long Arm No. 1 and Shakespeare Bay 2. It also occurred in benthic grab samples from Ferry Terminal Berths 1/2 and Waitohi Wharf and in benthic sled samples from Ferry Terminal Berths 1/2, Long Arm No. 1, Shakespeare Bay 2 and Waitohi East, West and End (Figure 22).

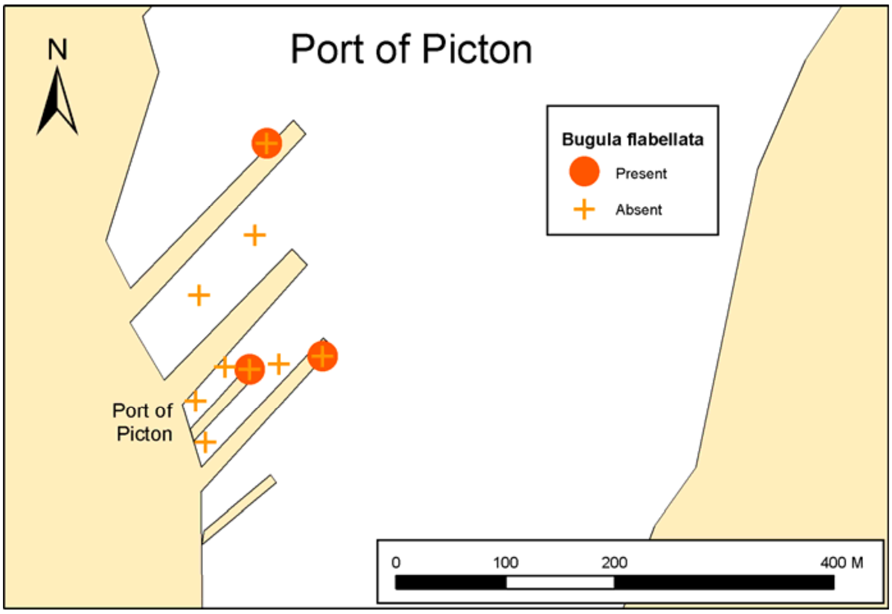

Figure 21: ***Bugula flabellata*** **distribution in the initial baseline survey of the Port of Picton (December 2001).**

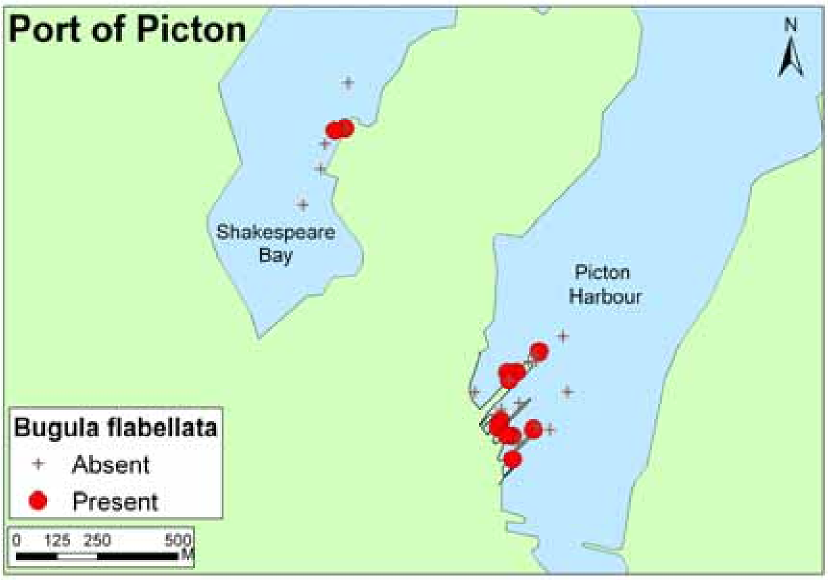

Figure 22: ***Bugula flabellata*** **distribution in the re-survey of the Port of Picton (January 2005).**

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 17). 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 Picton it occurred in pile scrape samples taken from Ferry Terminal Berths 1/2 and Shakespeare Bay 2 and in a benthic sled sample from Ferry Terminal Berths 1/2 (Figure 23).

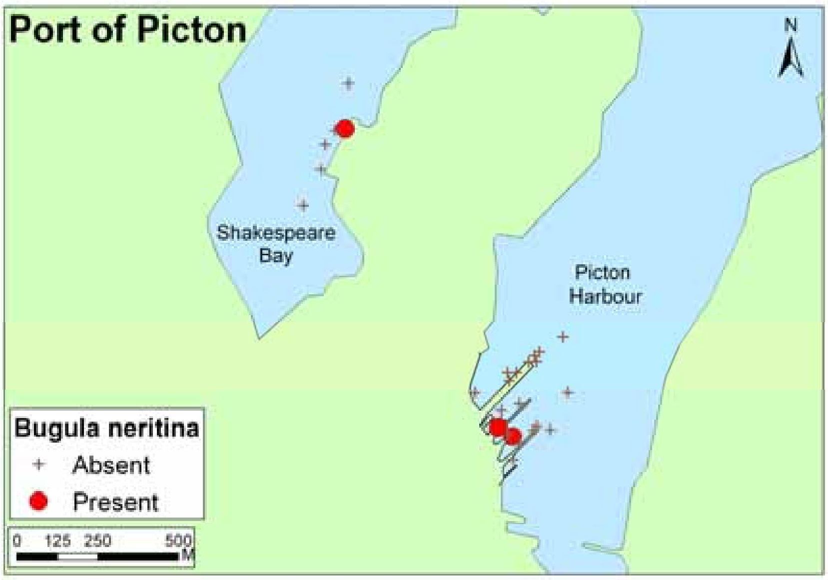

Figure 23: ***Bugula neritina* distribution in the re-survey of the Port of Picton (January 2005).**

Tricellaria inopinata d'Hondt and Occhipinti Ambrogi, 1985

Image: Bock (2004)
Information: Dyrynda et al. (2000), Occhipinti Ambrogi (2000)

Tricellaria inopinata is an erect bryozoan. An assessment of samples and literature from various global regions suggests that Atlantic and Adriatic *T. inopinata* correspond with a morphospecies known to be invasive in New Zealand, and cryptogenic in Pacific North America, Japan and Australia. The morphospecies in question has usually been referred to as *T. occidentalis* (Trask, 1857) and, in at least one instance, as *T. porteri* (MacGillivray, 1889). *Tricellaria inopinata*'s widespread Pacific distribution and the possibility of anthropogenic dispersal there in historical times precludes the more precise identification of its source region. *Tricellaria inopinata* is a prolific fouling species with a high reproductive output. It has documented impacts on the abundance of native bryozoan species; for example, *T. inopinata*'s invasion of the Laguna di Venezia (Italy) resulted in a sharp decline in the abundance of native bryozoans whose populations had been stable prior to *T. inopinata*'s introduction. During the initial port baseline surveys, *T. inopinata* was recorded from Whangarei (Marsden Point), Gisborne, Taranaki and Lyttelton (Table 17). During the second baseline surveys of Group 1 ports it was recorded from the Port of Picton, where it occurred in a pile scrape sample from Shakespeare Bay 2 (Figure 24).

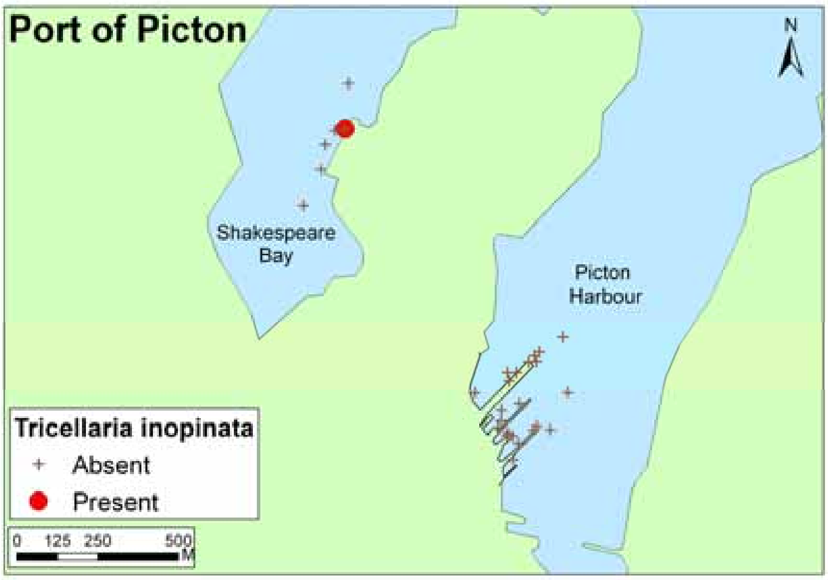

Figure 24: ***Tricellaria inopinata*** **distribution in the re-survey of the Port of Picton (January 2005).**

Cryptosula pallasiana (Moll, 1803)

Image and information: NIMPIS (2002c)

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 last 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 17). 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 Picton it occurred in a pile scrape sample taken from Ferry Terminal Berths 1/2 (Figure 25).

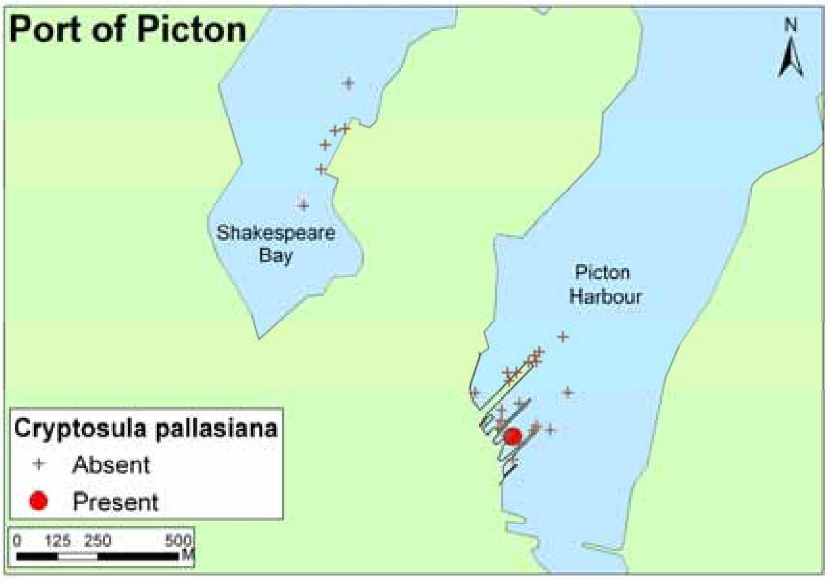

Figure 25: ***Cryptosula pallasiana* distribution in the re-survey of the Port of Picton (January 2005).**

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

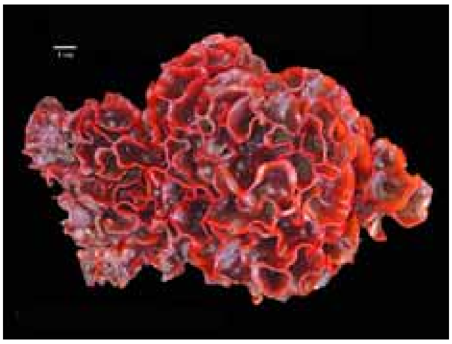

Image: Cohen (2005)
Information: Gordon and Matawari (1992)

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 17). In Picton it was recorded from Ferry Terminal 2 (recorded in the second survey as “Ferry Terminal Berths 1/2”) and Ferry Terminal 3 (recorded in the second survey as “Long Arm No. 1”; Figure 26). 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 Picton it occurred in pile scrape samples taken from Ferry Terminal Berths 1/2, Long Arm No. 1 and Shakespeare Bay 2, in benthic sled samples from Waitohi West and in a benthic grab sample taken near Ferry Terminal Berths 1/2 (Figure 27).

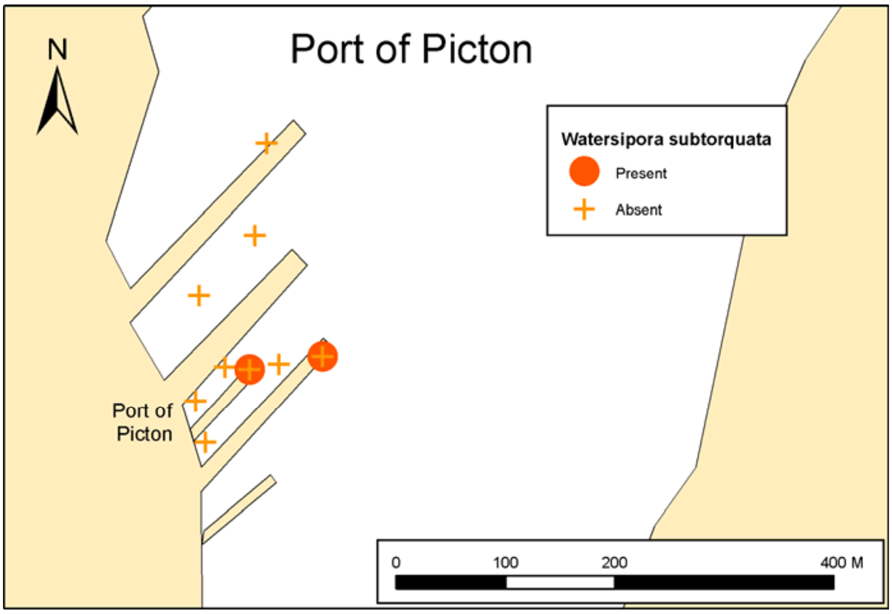

Figure 26: ***Watersipora subtorquata* distribution in the initial baseline survey of the Port of Picton (December 2001).**

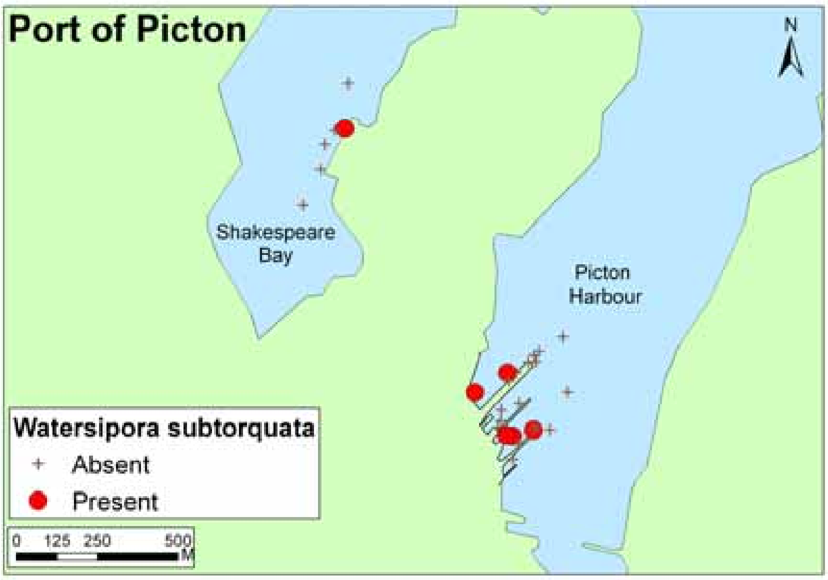

Figure 27: ***Watersipora subtorquata* distribution in the re-survey of the Port of Picton (January 2005).**

Eudendrium generale Lendenfeld, 1885

No image available

Eudendrium generale is a small hydroid from the family Eudendriidae. It forms bushy, erect colonies, 2-30 cm high. *Eudendrium generale* typically occurs in the deep ocean or sheltered waters, often attached to calcareous bryozoa or rocks (Southcott and Thomas 1982). The type specimen was described from southern Australia, but it has also recently been reported from the Antarctic (Puce et al. 2002). During the initial port baseline surveys, *E. generale* was recorded only from the Port of Napier, and the specimens obtained were the first known records of this species in New Zealand. During the second baseline surveys of Group 1 ports

E. generale was recorded from the ports of Wellington and Picton (Table 17). In the Port of Picton it occurred in a pile scrape sample taken from Long Arm No. 1 (Figure 28).

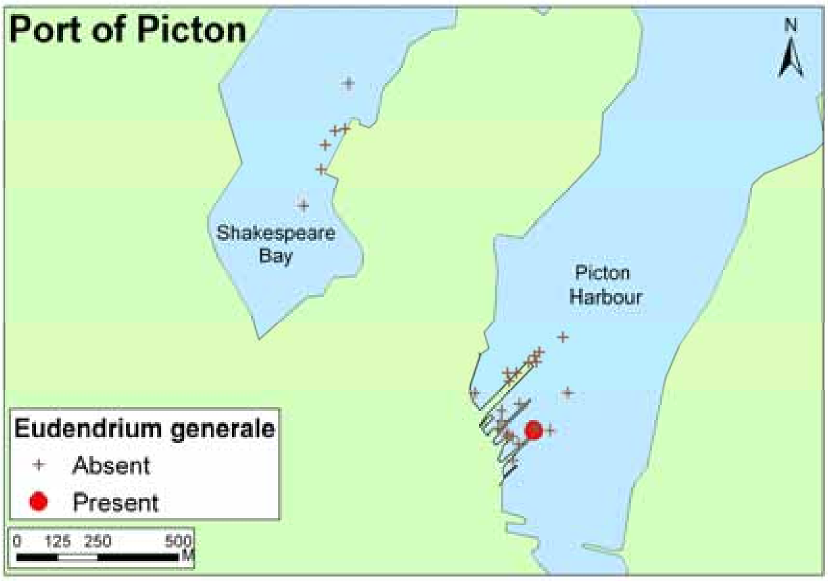

Figure 28: ***Eudendrium generale*** **distribution in the re-survey of the Port of Picton (January 2005).**

Theora lubrica Gould, 1861

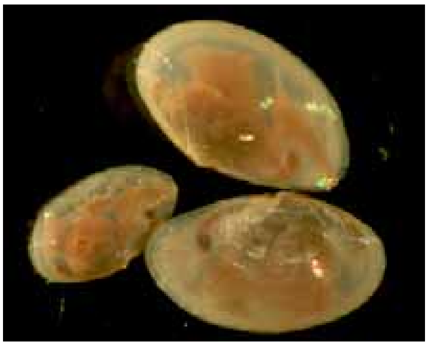

Image and information: NIMPIS (2002d)

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 (Cranfield et al. 1998). 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 17). 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 Picton *Theora lubrica* occurred in a benthic sled sample taken from Waitohi West and a benthic grab sample taken from Long Arm No. 1 (Figure 29).

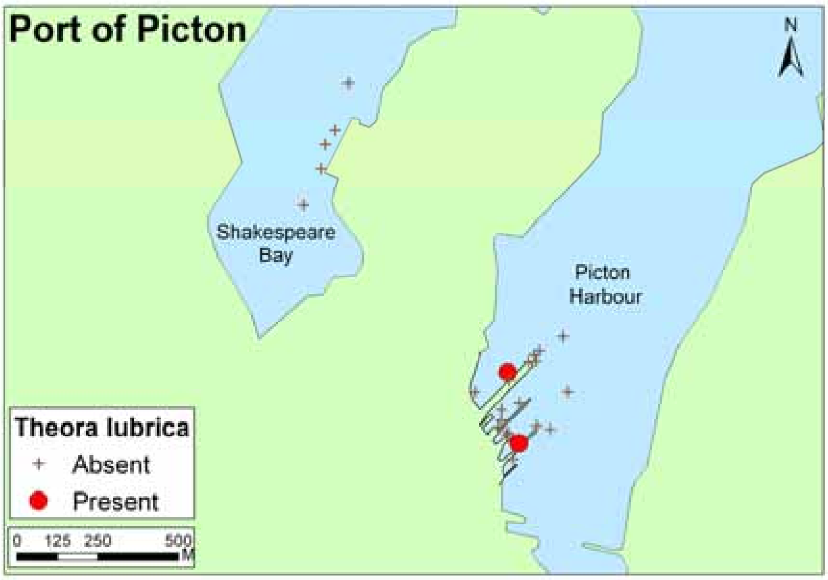

Figure 29: ***Theora lubrica* distribution in the re-survey of the Port of Picton (January 2005).**

Griffithsia crassiuscula C.Agardh 1824

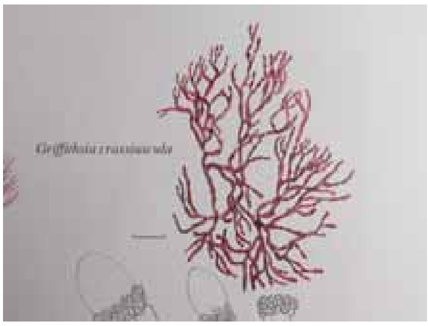

Image and information: Adams (1994)

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 17). In Picton it was recorded from Waitohi Wharf (Figure 30). 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 Picton, it occurred in pile scrape samples taken from Waitohi Wharf and in benthic sled samples from Waitohi End and Waitohi West (Figure 31).

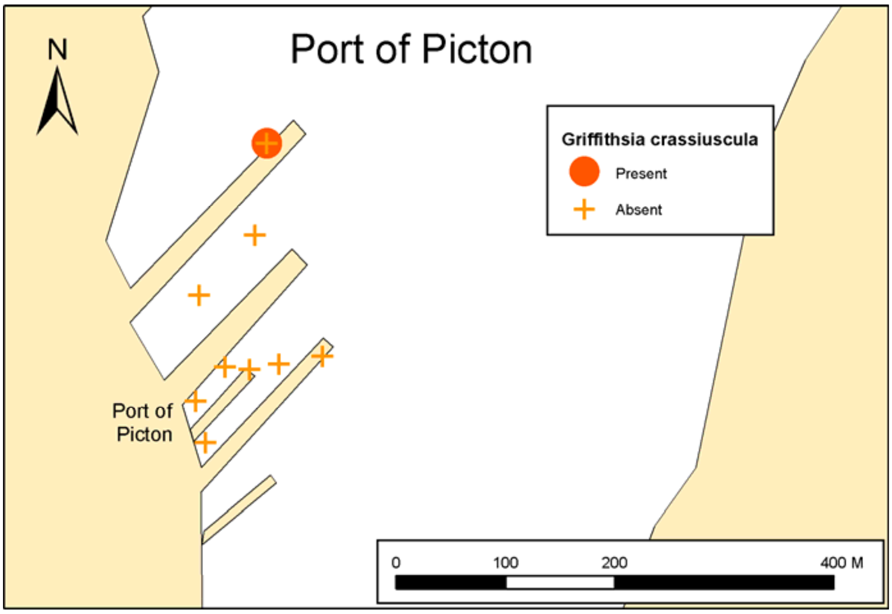

Figure 30: *Griffithsia crassiuscula* **distribution in the initial baseline survey of the Port of Picton (December 2001).**

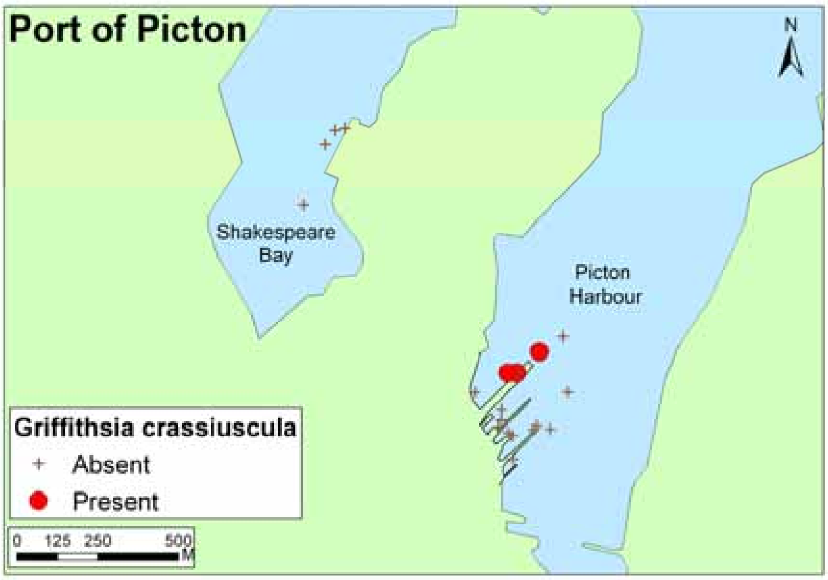

Figure 31: *Griffithsia crassiuscula* **distribution in the re-survey of the Port of Picton (January 2005).**

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

Image: NIMPIS (2002e)
Information: Fletcher and Farrell (1999), NIMPIS (2002e)

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 17). In Picton it was recorded from Ferry Terminal 2 (recorded in the second survey as “Ferry Terminal Berths 1/2”), Ferry Terminal 3 (recorded in the second survey as “Long Arm No. 1”) and Waitohi Wharf (Figure 32). 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 Picton, *U. pinnatifida* occurred on wharf pilings from Ferry Terminal Berths 1/2, Long Arm No. 1 and Waitohi Wharf, in a benthic sled sample from Waitohi End and in a benthic grab sample from Shakespeare Bay 2 (Figure 33).

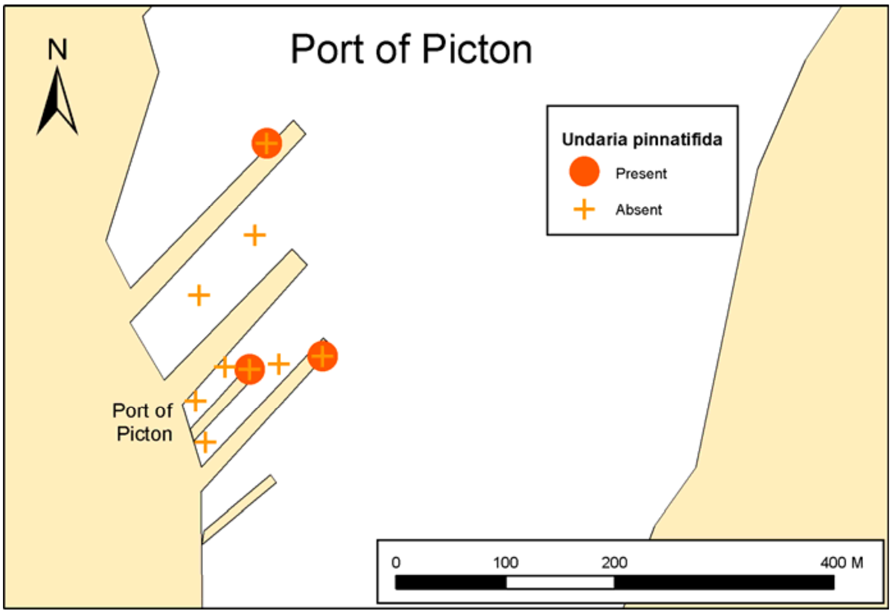

Figure 32: ***Undaria pinnatifida*** **distribution in the initial baseline survey of the Port of Picton (December 2001).**

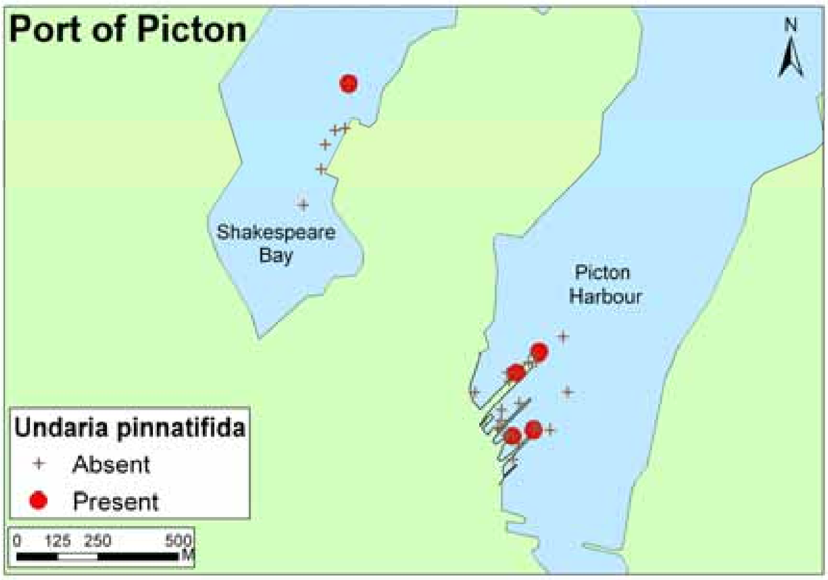

Figure 33: ***Undaria pinnatifida*** **distribution in the re-survey of the Port of Picton (January 2005).**

Halisarca dujardini Johnston, 1842

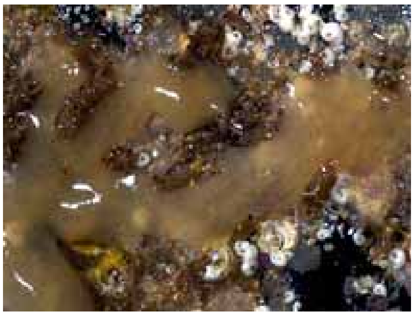

Image and information: Picton and Morrow (2005)

Halisarca dujardini is an encrusting cold-water sponge that grows in yellowish, greyish or creamy fawn coloured slimy sheets to 4 cm x 5 cm. It occurs from the shallow subtidal to a depth of 450 m. *H. dujardini* grows on small stones, under overhangs, in fissures, in empty shells, on crab carapaces and at the base of gorgonians and *Laminaria* algae. It has no known impacts. It is a cosmopolitan species with a wide distribution that includes the Arctic and Antarctic, the Subantarctic Islands, Australia, New Zealand, Chile, England, the Atlantic and the Mediterranean. During the initial port baseline surveys *H. dujardini* was recorded from the ports of Auckland, Taranaki, Wellington, Picton, Dunedin and Bluff (Table 17). In Picton it was recorded from Ferry Terminal 2 (recorded in the second survey as "Ferry Terminal Berths 1/2") and Waitohi Wharf (Figure 34). During the second baseline surveys of Group 1 ports it was recorded from the ports of Picton and Lyttelton. In the Port of Picton it was collected in pile scrape samples taken from Ferry Terminal Berths 1/2 and Waitohi Wharf and in a benthic sled sample from Waitohi West (Figure 35).

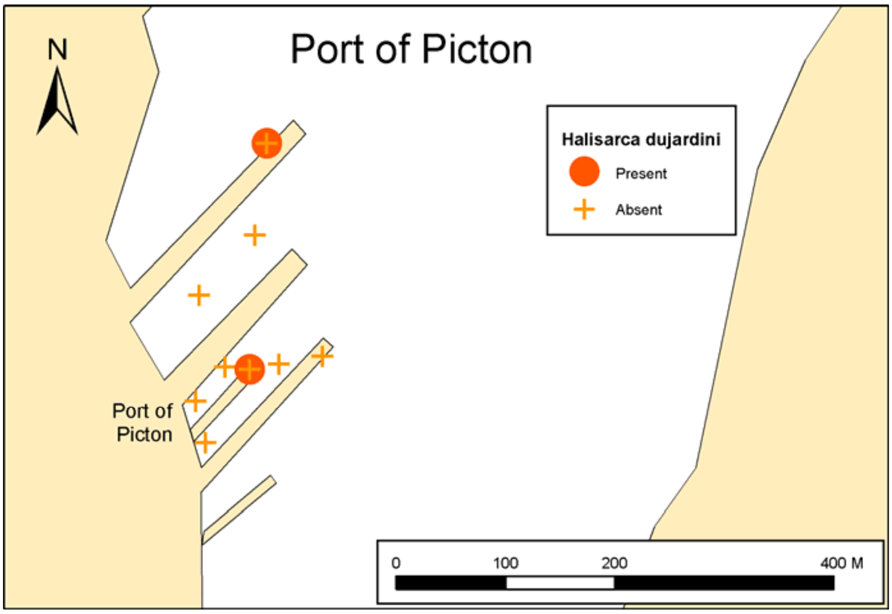

Figure 34: ***Halisarca dujardini*** **distribution in the initial baseline survey of the Port of Picton (December 2001).**

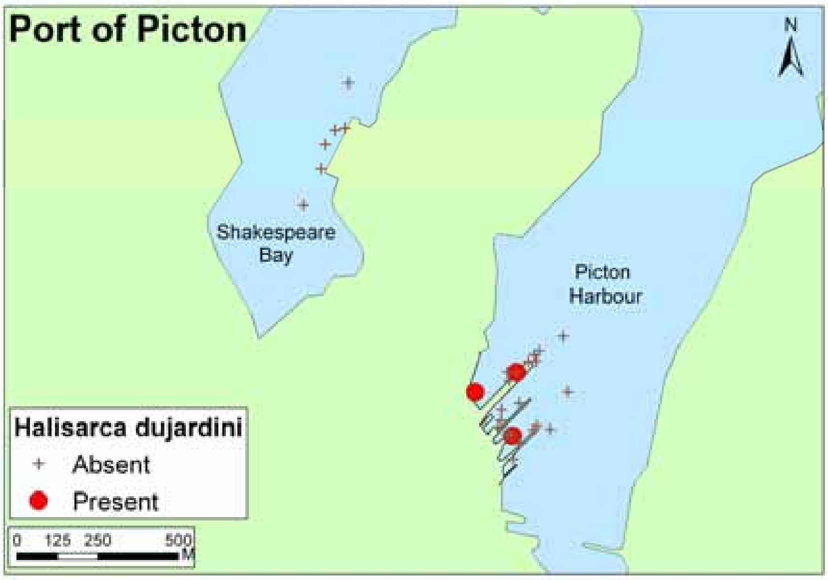

Figure 35: ***Halisarca dujardini*** **distribution in the re-survey of the Port of Picton (January 2005).**

SPECIES INDETERMINATA

Thirty-five organisms from the Port of Picton repeat survey were classified as species indeterminata. If each of these organisms is considered a species of unresolved identity, then together they represent 14% of all species collected from this survey (Figure 18). Species indeterminata from the Port of Picton included 3 annelid worms, 1 bryozoan, 6 crustaceans, 2 dinoflagellates, 1 mollusc, 20 algae, 1 sponge and 1 ascidian (Table 16).

NOTIFIABLE AND UNWANTED SPECIES

One species recorded from the Port of Picton, the Asian seaweed *Undaria pinnatifida,* is currently listed on the New Zealand Register of Unwanted Organisms (Table 11). None of the species listed on the ABWMAC Australian list of marine pest species was recorded from the re-survey of the Port of Picton (Table 12).

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 MAF Biosecurity New Zealand. Seven of the 53 Australian priority domestic pests are present in the Port of Picton. These are listed in descending order of the impact potential ranking attributed to them by Hayes et al. (2004): *Bugula neritina*, *Bugula flabellata*, *Undaria pinnatifida*, *Watersipora subtorquata*, *Halisarca dujardini*, *Theora lubrica* and *Cryptosula pallasiana*. None of the 37 priority international pests identified by Hayes et al. (2004) was present in the Port of Picton.

PREVIOUSLY UNDESCRIBED SPECIES IN NEW ZEALAND

Ten species recorded from the re-survey of the Port of Picton are new records from New Zealand waters. These were all sponges that do not fit existing species descriptions (*Adocia* new sp. 1, *Chalinula* new sp. 2, *Chondropsis* new sp. 1, *Dactylia* new sp. 1, *Dysidea* new sp. 3, *Haliclona* new sp. 1, *Haliclona* new sp. 4, *Haliclona* new sp. 6, *Haliclona* new sp. 14, and *Mycale (Carmia)* new sp. 3). A further 11 species from the re-survey of the Port of Picton were described for the first time during the initial port baseline surveys. These were the non-indigenous polychaete *Spirobranchus polytrema,* the non-indigenous hydroid *Eudendrium generale,* the native sponges *Callyspongia stellata* and *Tedania diversiraphidiophora,* the cryptogenic category 1 sponge *Chondropsis kirkii* and the cryptogenic category 2 sponges *Adocia* new sp. 2, *Dysidea* new sp. 1, *Esperiopsis* new sp. 1, *Euryspongia* new sp. 1, *Halichondria* new sp. 1 and *Paraesperella* new sp. 1 (*macrosigma*). Eight of these species were recorded during the earlier port baseline survey of the Port of Picton. The other three – *Eudendrium generale, Spirobranchus polytrema* and *Paraesperella* new sp. 1 (*macrosigma*) - are new records for Picton.

CYST-FORMING SPECIES

Cysts of 10 native species of dinoflagellate (Table 13) and two dinoflagellate species indeterminata (Table 16) were collected during this survey. Two of these species have been associated with marine biotoxins. *Lingulodinium polyedrum* can form blooms known as "red tides" which have been associated with fish and shellfish mortality events (Faust and Gulledge 2002). The presence of a paralytic shellfish poison (PSP) toxin, saxitoxin, has also been reported in water samples taken during a bloom of *L. polyedrum* (Bruno 1990, in Faust and Gulledge 2002). However, it is not listed as a marine biotoxin by either of the recent reviews of the non-commercial marine biotoxin monitoring programme in New Zealand (Hay et al. 2000; New Zealand Food Safety Authority 2003). *Protoceratium reticulatum* has been reported to produce Yessotoxins (Satake et al. 1997; Satake et al. 1999), which may cause Diarrhetic Shellfish Poisoning (New Zealand Food Safety Authority 2003). None of the other species recorded are known to produce toxins (Hay et al. 2000; Faust and Gulledge 2002; New Zealand Food Safety Authority 2003).

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

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 Lyttelton are presented in Figure 36a. Curves for the native species assemblage exhibited similar rates of species accumulation relative to sampling effort in each survey, with slightly greater density of species in the initial survey. As a result, slightly fewer species were observed overall in the repeat survey despite a 34% increase in sample effort (Survey 1, $S_{\max} = 120$ species, $n_{\max} = 47$ samples; Survey 2, $S_{\max} = 116$ species, $n_{\max} = 63$ samples; Table 18). Mean estimates of the total species richness in the first survey continued to increase with sample size at about the same rate as the rarefaction curve and did not plateau or converge with observed richness, indicating a high proportion of unsampled species in the assemblage. In the second survey, the estimated richness increased only slowly with survey effort and approached an asymptote at around 150 species (Figure 36a). At the observed rate of accrual of species in the second survey, however, at least a further 50 pile scrape samples would be needed to attain the total estimated richness (i.e. a 79% increase in effort). Thirty-five percent and 29 % of the native species observed in each survey, respectively, occurred in just a single sample (Table 18). The large number of uniques had a strong influence on the estimated number of unsampled species in the assemblage, which varied between 46% in the first survey (ie. 55 unsampled species out of 120 observed) and 31% in the re-survey (ie. 36 unsampled species of 116 observed; Figure 36a).

Despite the correspondence between the rarefaction curves for the two surveys, the observed species composition in each survey was quite different. Only 75 species (47% of the total number) were recorded in both surveys (Table 18). Again, this reflects the large number of comparatively rare species in the assemblage, with non-detection of many of these probably accounting for much of the difference observed between the two surveys. For example, the classic Jaccard and Sorenson measures of compositional similarity indicate low-to-moderate similarity between the assemblages recorded in the initial and repeat baseline surveys of Picton (0.466 and 0.636, respectively). In contrast, the new Chao similarity indices, which adjust for the effects of non-detection of rare species, suggest much closer resemblance of the two samples (Chao bias-adjusted Jaccard = 0.833; Chao bias-adjusted Sorenson = 0.909; Table 18).

Cryptogenic category 2 species

Rarefaction curves for cryptogenic category 2 species showed contrasting patterns of species accumulation in the two surveys (Figure 36b). In the initial baseline survey, both the mean number of observed species and the estimated richness approached an asymptote after ~30 pile scrape samples had been taken. The two curves converged at a total richness of between 14 to 15 species, indicating a relatively complete inventory (Figure 36b). Species density was slightly greater in the repeat survey, with 5 additional species observed, on average, for the same level of sample effort (Survey 1, $S_{n=47} = 14$ species; Survey 2, $S_{n=47} = 19.4$ species). The sample from the second survey also had a much larger proportion of “unique” species (species that occur in just one sample) than the initial baseline survey (Table 18). A consequence of this was that the rarefaction curve continued to increase with sample size, as more uniques were added to the sample, and did not reach an asymptote. The richness estimator for the second survey also increased steeply after ~45 samples (Figure 36b). Because the Chao estimators are calculated using the ratio of the number of "uniques" and "duplicates" (species that occurred in just two samples), this instability can occur when there are few, or no, duplicates relative to uniques. For example, in the second baseline survey, only 3 duplicates and 10 unique species were recorded, 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. In these circumstances, the estimate is likely to be unreliable. It is unclear what caused the differences in species density and estimated species richness between surveys, but they may be associated with temporal variation in the abundance of species within the assemblage or immigration of new species into it.

There was comparatively high turn-over in cryptogenic category 2 species composition between the two surveys. Just 8 of the 28 species in this category (29%) recorded from the Port of Picton were common to both surveys (Table 18). This is reflected in comparatively low similarity between the assemblages, even when adjustment is made for undetected rare species (Chao bias-adjusted Jaccard = 0.341; Chao bias-adjusted Sorenson = 0.509; Table 18).

Non-indigenous and cryptogenic category 1 species

The re-survey of the Port of Picton recorded a similar number of non-indigenous and cryptogenic category 1 species ($S_{\max} = 21$ species) to the initial baseline survey ($S_{\max} = 20$ species). Only a single extra species was recorded, despite a 34% increase in the number of samples taken (Table 18). In the initial survey, the observed species density in this group continued to increase with sample size and did not reach an asymptote or converge with the estimate of total richness, which stabilised at around 28 species (Figure 36c). In contrast, curves for both the observed species density and the estimated richness in the second survey appeared to plateau and converge after 40 quadrat samples at between 21 (observed species number) and 22 species (estimated richness), although there was some instability in the outer bound of the richness estimate (Figure 36c). The modest difference between the observed and estimated richness in this survey suggests a relatively complete inventory with a small proportion of uniques (19%) and, therefore, few undetected species (Table 18). Over half (58%) of the species observed occurred in both surveys (Table 18). As a result, the compositional similarity of the two assemblages was relatively high, once undetected species had been adjusted for (Chao bias-adjusted Jaccard = 0.924; Chao bias-adjusted Sorenson = 0.961; Table 18).

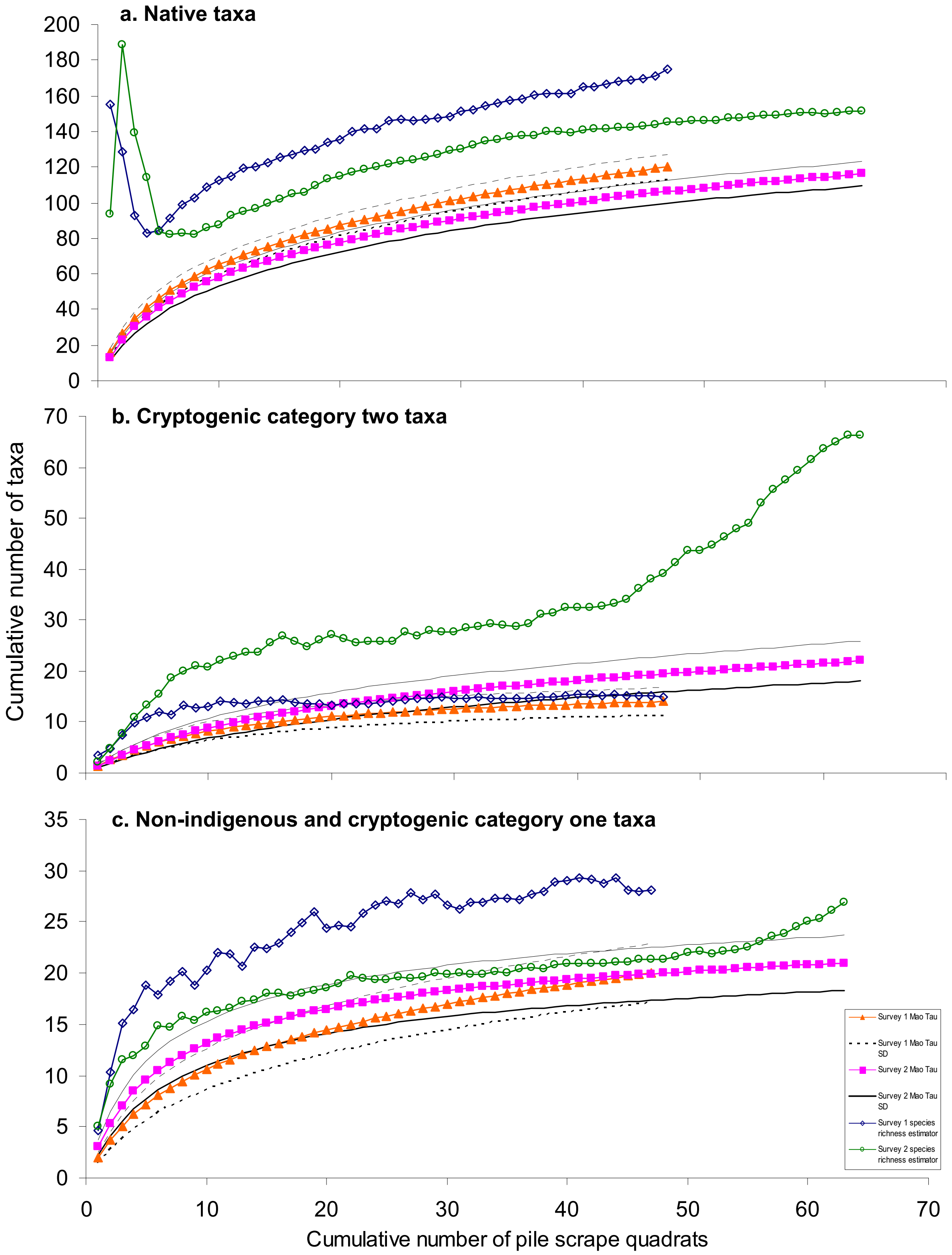

Figure 36: **Rarefaction curves (Mao Tau) for native (top), cryptogenic category two (middle) and non-indigenous and cryptogenic category one (bottom) taxa from pile scrape quadrats for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 classic formula was used for native and NIS & C1 taxa in the first survey and for C2 taxa in the second survey, whilst the Chao 2 bias-corrected formula was used for C2 taxa in the first survey and NIS & C1 taxa in the second survey, and the ICE formula was used for native taxa in the second survey.**

Benthic sled samples

Native species

Survey effort for the benthic sled samples was more than doubled in the repeat baseline survey to improve description of the epibenthic fauna of the port (Table 18). In the initial survey, samples taken using this method were dominated by uniques (79% of species), resulting in a comparatively large and unstable estimate of total species richness (Figure 37). To some extent, this is a function of the small sample size, since a single sled sample represented 17% of the total survey effort in the initial survey. Despite the increased sample effort in the second survey the trajectory of the rarefaction curve was relatively flat, indicating slow accumulation of species with additional samples. At the rate indicated in Figure 37a, at least a further doubling of survey effort (i.e. >30 sled samples) would be needed to capture the estimated species richness of the assemblage, which had largely stabilised at 86 species. Only 9 of the 59 species recorded in the benthic sled samples (15%) were recorded in both surveys; again reflecting the small sample size in the initial survey. The high proportions of unique species in each survey (79% and 64%, respectively) suggest a large number of undetected species and, consequently, although similarity measures for the observed assemblages in the two surveys were quite low (Classic Jaccard index = 0.153, Classic Sorenson index = 0.265), the similarity of the estimated assemblages was relatively high, reflecting the large number of potentially undetected species (Chao bias-adjusted Jaccard = 0.973; Chao bias-adjusted Sorenson = 0.986; Table 18).

Cryptogenic category 2 species

Nine cryptogenic category 2 species were recorded in the benthic sled samples. Most of these (7 of 9 species) were recorded during the repeat survey (Table 18). The low diversity of species in this group and high proportion of uniques (all of the species in the first survey and all but one of the species in the second survey each occurred in just a single sample) meant that the rate of accumulation in the samples was slow and did not approach an asymptote in either survey (Figure 37b). Similarly, the estimate of total richness in the assemblage continued to increase as more samples were added and remained at approximately twice the number of observed species in each survey, despite greater sample effort in the second survey (Figure 37b). The slow rate of accumulation suggests that survey effort would need to more than double again to achieve a more complete inventory of category 2 species using this survey method. Only one of the three cryptogenic category 2 species recovered during the initial survey occurred in the repeat survey (Table 18), despite the rate of species accumulation being the same in both surveys. As a result, similarity between the sampled assemblages (Classic Jaccard index = 0.111, Classic Sorenson index = 0.200) and estimated assemblages was low (Chao bias-adjusted Jaccard = 0.149; Chao bias-adjusted Sorenson = 0.26; Table 18).

Non-indigenous and cryptogenic category 1 species

Rarefaction curves for the combined non-indigenous and cryptogenic category 1 species in each survey are presented in Figure 37c. The overall density of species in this grouping was much greater in the second survey with, on average, more than 3 times as many species recovered for the same number of samples (Survey 1, $S_{\max}$ = 2 species, $n_{\max}$ = 6 samples; Survey 2, $S_{n=6}$ = 6.5 species; Figure 37c). Twelve species were recovered in total, with most of these (11 species) being recorded in the second survey. The proportion of unique species was quite low in the sample from the second survey (46%; Table 18) and, as a result, the mean observed number of species ($S_{\max}$ = 11 species) approached the estimated total richness of the assemblage (Chao2 estimate = 13.3 species), suggesting relatively few unsampled species. Despite this, similarity between the two sampled assemblages (Jaccard index = 0.083, Classic Sorenson index = 0.154) and the two estimated assemblages was low (Chao bias-

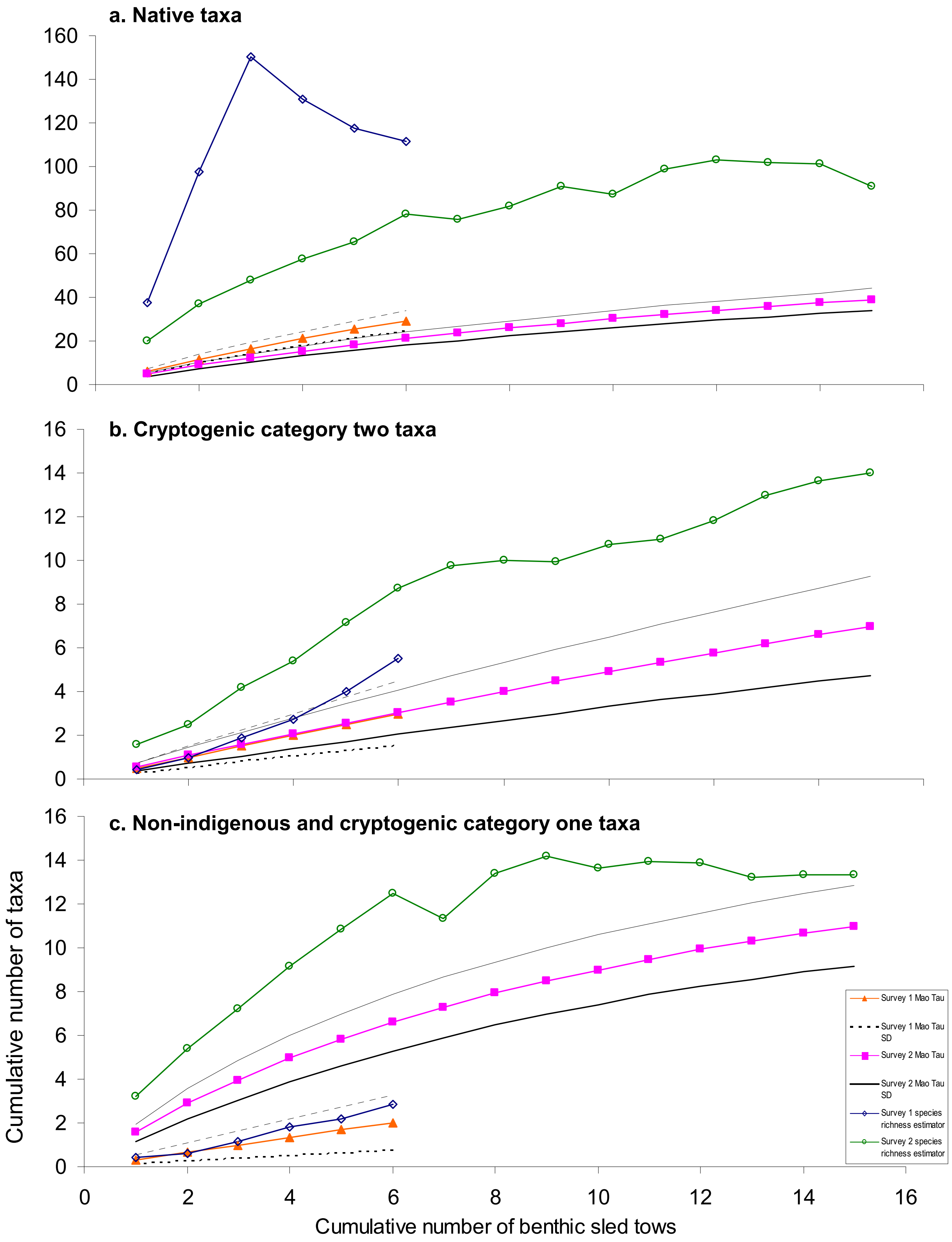

Figure 37: Rarefaction curves (Mao Tau) for native (top), cryptogenic category two (middle) and non-indigenous and cryptogenic category one (bottom) taxa from benthic sled tows for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 bias corrected formula was used in all instances except for native taxa, where the ICE formula was used for the first survey and the Chao 2 classic formula was used for the second survey.

adjusted Jaccard = 0.156; Chao bias-adjusted Sorenson = 0.27; Table 18), presumably because of the very small number of species recorded in the first survey and, therefore, the small overlap in species composition.

Benthic grab samples

Damage to the benthic grab during transit to the site for the first survey of Picton meant that no samples could be taken with this method during the initial baseline survey in December 2001. Twenty-one grab samples were taken in total during the second survey in January 2005. These contained a total of 42 native, 6 cryptogenic category 2 and 6 non-indigenous and cryptogenic category 1 species (Table 18). The combined rarefaction curve for these three groups increased steeply with sample size and did not approach an asymptote (Figure 38). The sample contained a large proportion of uniques (83% of those recorded, Table 18), but the estimate of total richness in the assemblage was relatively stable and reached an asymptote at around 90 species after a sample size of 7 grabs had been taken (Figure 38). At the mean rate of species accumulation observed in the survey, an additional 20 or more grab samples would be needed to approach the number of species indicated by the richness estimate.

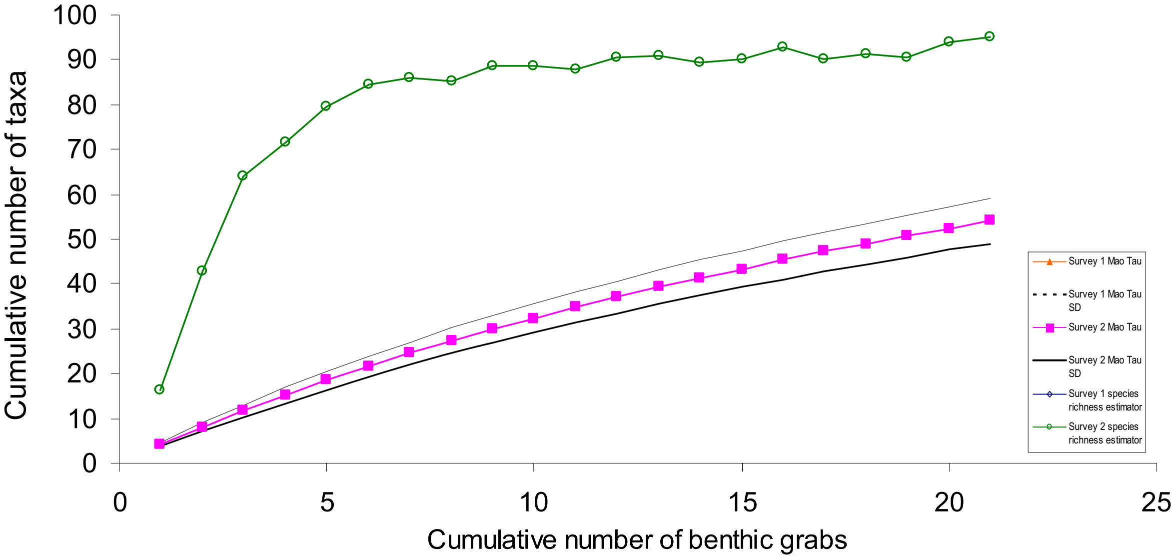

Figure 38: **Rarefaction curves (Mao Tau) for native, cryptogenic and non-indigenous taxa combined from benthic grabs for the second survey (full squares, ± SD (solid lines)). The Chao 2 bias-corrected species richness estimator is also shown (empty circles). No data are available for the first survey due to damage to the grab sampler.**

Crab trap samples

Samples obtained using baited crab traps were characterised by relatively few species (Figure 39; Table 18). This was a feature of all of the passive trapping techniques (see below). In total, 11 species were observed in the crab traps, over both surveys. All were native species. Almost equal numbers of species were observed in each survey, despite twice as many samples being taken in the second survey (Table 18). Nevertheless, the observed species density in the first survey was within the 95% confidence interval for the rarefaction curve of the second survey, suggesting similar overall rates of accumulation (Figure 39). The proportion of uniques in the sample from the second survey was comparatively low (29%) and, as a result, there was good correspondence between the observed number of species (S_{max}

= 7 species, $n_{\max}$ = 36 samples) and the estimated richness of the assemblage (Chao2 estimate = 7.2 species; Figure 39). Similarity between the two sampled (Jaccard index = 0.182, Classic Sorenson index = 0.308) and estimated assemblages (Chao bias-adjusted Jaccard = 0.495; Chao bias-adjusted Sorenson = 0.662; Table 18), however, was low-to-moderate, reflecting both the small number of species shared between the two surveys (2 species) and the small estimated number of unsampled species.

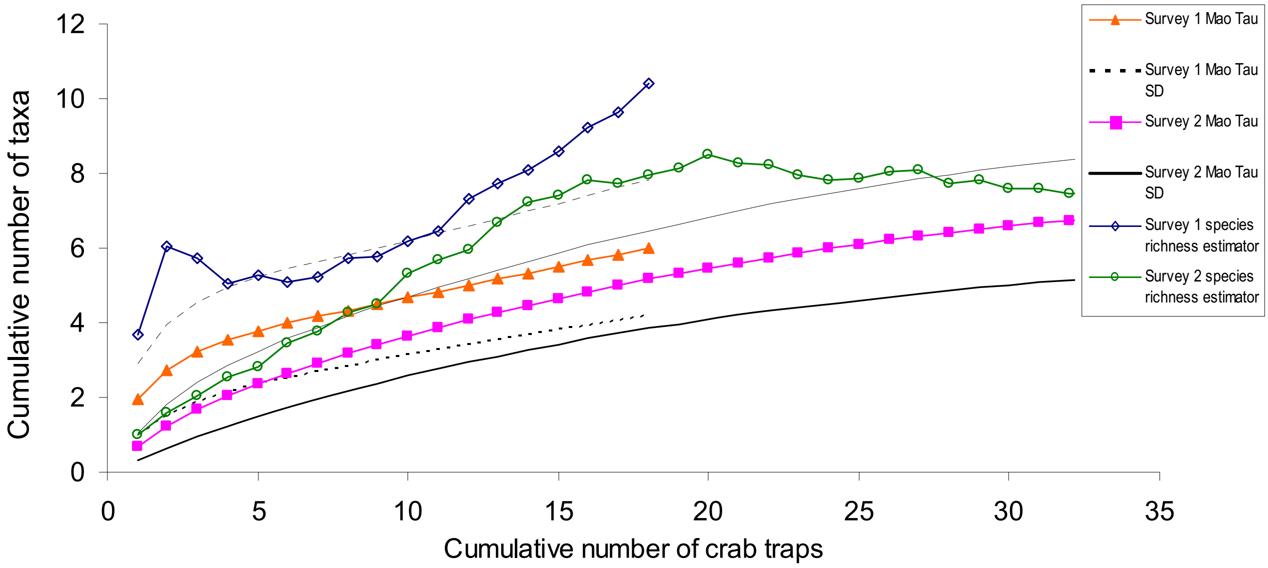

Figure 39: **Rarefaction curves (Mao Tau) for native taxa from crab traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No cryptogenic or non-indigenous taxa were encountered during either survey. Species richness estimators are also shown for the first survey (empty diamonds, ICE formula) and second survey (empty circles, Chao 2 bias-corrected formula).**

Fish trap samples

Only 10 species were captured in the fish traps, all of which were native (Table 18). Twice as many species ($S_{\max}$ = 8 species, $n_{\max}$ = 40 samples) were recorded in the repeat survey as in the initial survey ($S_{\max}$ = 4 species, $n_{\max}$ = 16 samples, but, again, this was attributable mostly to the larger number of samples taken in the repeat survey. The mean rarefaction curve for the repeat survey was within the bounds of the standard deviations for that of the earlier survey (Figure 40). Neither rarefaction curve approached an asymptote. Similarly, estimates of total richness in each survey continued to increase as more samples were taken and did not converge with the observed species density (Figure 40). In both surveys, comparatively large proportions of the observed sample were comprised of uniques (75% and 50%, respectively). The correspondingaly large estimated numbers of unsampled species meant that, although similarity was comparatively low between the sampled assemblages (Jaccard index = 0.200, Classic Sorenson index = 0.333), with just two species shared between the two surveys, the estimated assemblages were considered to be highly similar (Chao bias-adjusted Jaccard = 0.756; Chao bias-adjusted Sorenson = 0.861).

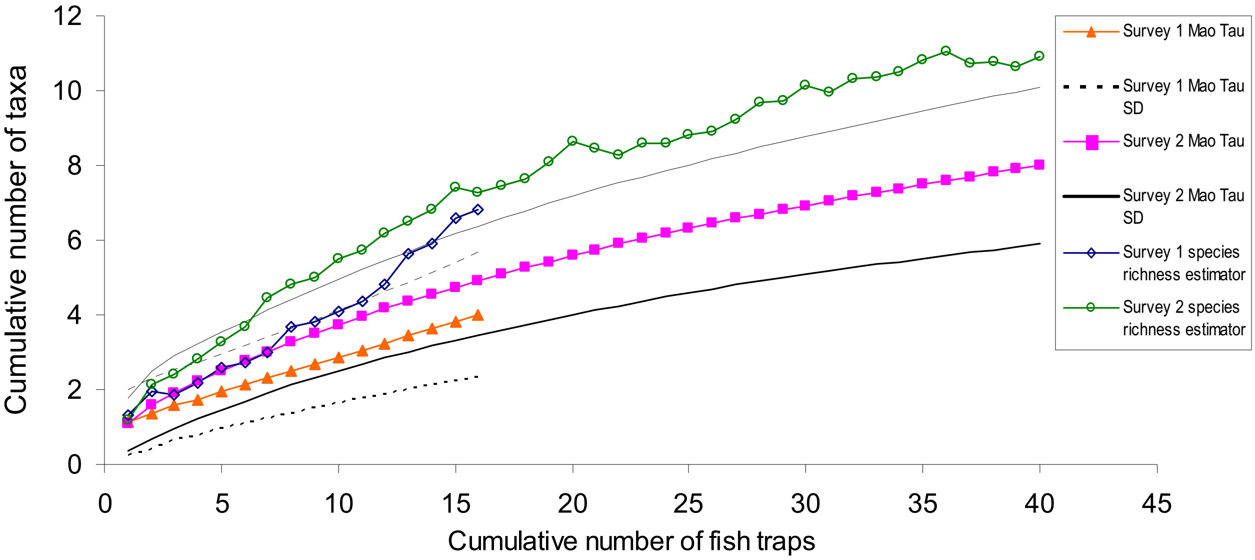

Figure 40: **Rarefaction curves (Mao Tau) for native taxa from fish traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No cryptogenic or non-indigenous taxa were encountered in either survey. Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 classic formula) and second survey (empty circles, Chao 2 bias-corrected formula).**

Starfish trap samples

Only 9 species were captured in the starfish traps (Table 18). Most of these (7 of nine species) were recorded in the initial baseline survey. Indeed, the density of species was much greater in the earlier survey. Despite a 50% increase in sample number in the second survey, less than half the number of species was observed (Table 18). In the second survey, the rarefaction curve reached an asymptote of 3 species and converged with estimated richness after an average of 15 trap samples were taken (Figure 41). In contrast, the rarefaction curve from the first survey did not plateau, but did converge with the richness estimate at around 7 species, indicating a relatively complete inventory. The small estimated numbers of unsampled species and the relatively distinct species compositions observed in the two surveys meant that indices of similarity were comparatively low for both the sampled (Jaccard index = 0.111, Classic Sorenson index = 0.200) and estimated (Chao bias-adjusted Jaccard = 0.221; Chao bias-adjusted Sorenson = 0.361) assemblages (Table 18).

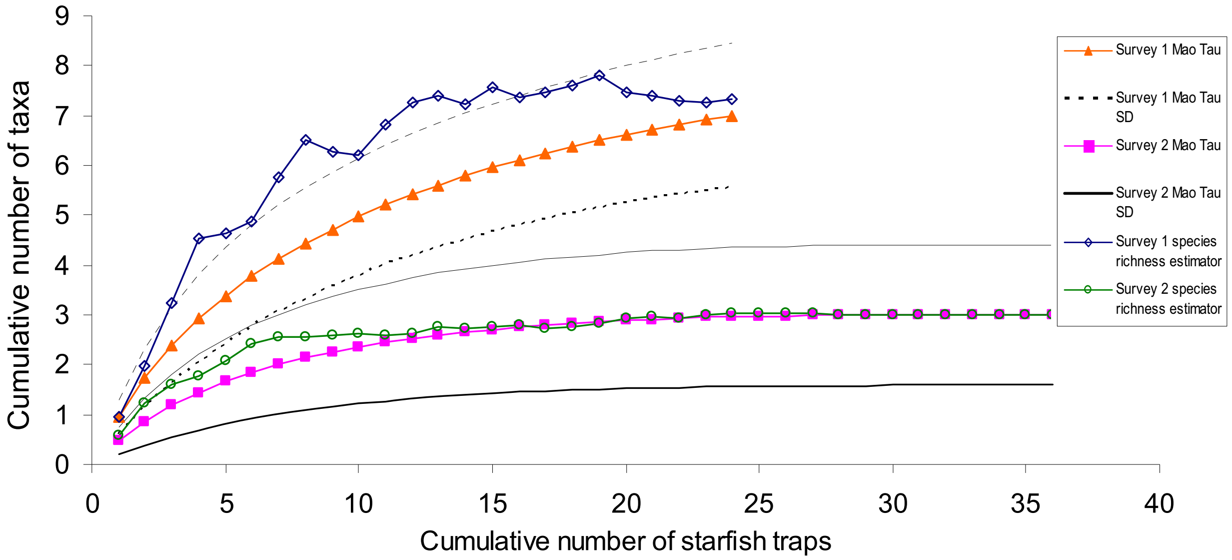

Figure 41: **Rarefaction curves (Mao Tau) for native taxa from starfish traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No alien or cryptogenic taxa were encountered in either survey. Chao 2 bias-corrected species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles).**

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

The non-indigenous species located in the Port of Picton are thought to have arrived in New Zealand via international shipping. They may have reached the Port of Picton directly from overseas or through domestic spread (natural and/or anthropogenic) from other New Zealand ports. Table 15 indicates the possible vectors for the introduction of each NIS recorded from the Port of Picton 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 11 NIS (9%) probably arrived via ballast water, 7 species (67%) were most likely to be associated with hull fouling, and 3 species (27%) could have arrived via either of these mechanisms.

Assessment of the risk of new introductions to the port

Many non-indigenous species introduced to New Zealand ports by shipping do not survive to 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).

The Port of Picton receives comparatively little international commercial shipping compared with other New Zealand ports. Between 2002 and 2005, there were only 26 vessel arrivals from overseas to the Port of Picton recorded in the "SeaSearcher.com" database. The majority of these came from Australia (15) and the northwest Pacific (China and Korea, 6 arrivals; Table 3). Most trade vessels arriving in Picton from overseas are, therefore, coming from ports in other temperate regions that have coastal environments similar to New Zealand's. Bulk carriers comprised the greatest proportion of vessel types arriving at Picton from overseas (18 of the 26 arrivals). Empty vessels of these types carry the largest volumes of ballast water and may, therefore, be more likely to carry invasive species that can be transported in ballast water. In the Port of Picton these vessels came from Australia (9 arrivals), the northwest Pacific (6), Japan (2) and the Pacific Islands (one arrival; Table 3). Six of the remaining eight vessel arrivals were passenger/ vehicle/ livestock carriers, which typically discharge relatively small volumes of ballast water. Smaller, slower moving vessels such as barges, tugs and fishing boats, tend to carry a greater density of fouling organisms than faster cargo vessels. In the Port of Picton, only two vessels of this type were recorded as arriving in Picton (from Australia) between 2002 and 2005 (Table 3).

Based on shipping patterns at the Port of Picton and similarities in coastal environments, shipping from southern Australia, China, Korea, and Japan present a low, but on-going risk of introduction of new NIS to the Port of Picton. Thirteen of the 15 vessel arrivals from Australia recorded in the 'Seasearcher.com' data came from southern Australia. 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 in southern Australia (*Carcinus maenas*, *Asterias amurensis*, *Undaria pinnatifida*, *Sabella spallanzanii*, *Caulerpa taxifolia*, and *Styela clava*). The native range of other two species – *Eriocheir sinensis* and *Potamocorbula amurensis* – is the northwestern Pacific, including China and Japan.

The small number of international arrivals suggests that the overall risk of introductions directly from overseas ports would be relatively low, and is probably lower than the risk of non-indigenous species being translocated to the Port of Picton from other ports in New Zealand. The Port of Picton is connected directly to the ports of Wellington and Nelson by regular coastal shipping and between 2002 and 2005 received 103 arrivals of commercial shipping vessels from a total of 13 New Zealand ports (Table 6). The LMIU "SeaSearcher.com" database recorded the majority of vessels arriving in Picton from other New Zealand ports between 2002 and 2005 as arriving mostly from Wellington (26 arrivals), Lyttelton (20 arrivals), Nelson (15 arrivals), Napier (10 arrivals), Tauranga (8 arrivals), Whangarei (8 arrivals) and Timaru (5 arrivals), and the majority of these are bulk carriers (Table 6). These ports (particularly Lyttelton and Timaru) have many non-indigenous species that have not been recorded in Picton, including the unwanted ascidian *Styela clava* (recorded in Lyttelton, the Hauraki Gulf and Tutukaka marina). However, due to its fouling nature, the risk of translocating *Styela clava* is greatest for slow-moving vessels, which comprised only 2 of the 20 arrivals to Picton from Lyttelton between 2002 and 2005 recorded by the LMIU "SeaSearcher.com" database (Table 6). Picton is a gateway to the South Island, particularly from Wellington, and other slow-moving vessels such as barges, yachts and pleasure craft arriving from the North Island may, therefore, present an increased risk of introduction of non-indigenous species to Picton.

In 2005, *S. clava* was found on the hull of a launch that had recently arrived in Waikawa Marina, Picton, from Viaduct Harbour, Auckland, where *S. clava* is well-established. The launch was removed from the water and cleaned of all fouling. A subsequent search of the surrounding marina did not find any additional specimens (Morrisey 2005). Nevertheless, this incident does highlight the potential for continuing transportation of unwanted species into Picton from other New Zealand locations.

Assessment of translocation risk for introduced species found in the port

Between 2002 and 2005, vessels departing from the Port of Picton travelled to 12 ports throughout New Zealand. Wellington, Whangarei, Napier, Lyttelton, Nelson and Tauranga were the next ports of call for the most domestic vessel movements from Picton (Table 7). Although all of the non-indigenous species found in the re-survey of the Port of Picton have been recorded in other locations throughout New Zealand (Table 17), they were not detected in all of the other ports surveyed. There is, therefore, a risk that species established in the Port of Picton could be spread to other New Zealand locations.

Of particular note is the one species present in Picton that is on the New Zealand Register of Unwanted Species: the invasive alga *Undaria pinnatifida*. *U. pinnatifida* has been present in New Zealand since at least 1987 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, Gulf Harbour marina and Tauranga Port). Until recently, it was absent from the Ports of Taranaki (New Plymouth) and Tauranga. Mature sporophytes were discovered in the Port of Taranaki during the repeat baseline port survey there in March 2005. Some isolated sporophytes have also been discovered independently on rocky reefs near the Port of Tauranga (Environment Bay of Plenty, pers. comm.), but the alga does not appear to be established in the port itself. A small number of vessels travel between Picton and the Port of Tauranga and, even less frequently, to ports north of Auckland where *U. pinnatifida* has not yet become established. There is, therefore, a small risk that it could be spread to these locations by shipping from Picton.

Because it is a fouling organism, the risk of translocating *U. pinnatifida* is highest for slow-moving vessels, such as yachts and barges, and vessels that have long residence times in port. In the Port of Picton, cargo and bulk (including fuel) carriers, recreational craft, and seasonal fishing vessels that are laid up for significant periods of time pose a particular risk for the spread of this species. Such vessels also pose a significant risk of translocation of colonial ascidians in the genus *Didemnum* (classed as cryptogenic category 1 in this report due to uncertainty of their geographic origins). Two species of *Didemnum* that exhibit invasive behaviour have been recorded from the Port of Picton: *D. incanum* (in the initial survey, Inglis et al. 2006a) and *D. vexillum* (on a barge moored in Shakespeare Bay, Coutts 2002). During the re-survey of the Port of Picton, colonies of *Didemnum* were observed carpeting the seafloor near the wharf at Shakespeare Bay. Elsewhere in New Zealand, *Didemnum vexillum* has been reported only from Nelson, Tarakohe, Whangamata (Coromandel Peninsula) and the Bay of Plenty, and there is, therefore, a risk that it and other *Didemnum* species could be transported by shipping to other ports where it is not already established. *Didemnum vexillum* has the potential to be a significant fouling pest of aquaculture. It may be spread as fouling on poorly maintained commercial or recreational vessels, on fouled ropes and buoys, or other submerged marine structures.

One other non-indigenous species recorded from the repeat survey of Picton, the hydroid *Eudendrium generale,* has a relatively restricted distribution nationwide (Table 17) and could, therefore, be spread from Picton to other locations. Information on the ecology of this species is limited, but it is not known to have potential for significant impacts.

Management of existing non-indigenous species in the port

All except three of the NIS detected in this survey appear to be well established in the port. However, the hydroid *Eudendrium generale* and the bryozoans *Tricellaria inopinata* and *Cryptosula pallasiana* were each recorded from only one site in this survey (Table 17). None of these were recorded from the initial survey of the Port of Picton and thus may not be well established in Picton. However, based on survey results, the bryozoans appear present in several other New Zealand ports. In contrast, *E. generale* has only been recorded from two other New Zealand ports (Napier and Wellington).

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 Picton. 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 be directed toward mitigating the spread of species established in the port to locations where they do not presently occur.

Prevention of new introductions

Interception of unwanted species transported by shipping is best achieved offshore, through control and treatment of ships destined for Picton 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 to 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 Picton recorded 249 species or higher taxa, including 167 native species, 11 non-indigenous species, 36 cryptogenic species and 35 species indeterminata. Although many species also occurred in the initial, December 2001 baseline survey of the port, the degree of overlap was not high. Around 46% of the native species, 55% of non-indigenous species, and 50% of cryptogenic species recorded during the repeat survey were not found in the earlier survey. This is not simply attributable to the 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, all of the non-indigenous species except *Undaria pinnatifida* were found in four or fewer samples. Whilst the increased sampling effort in the second survey recorded six non-indigenous species that were not found in the first survey, it did not markedly improve the rate of recovery of the six species recorded infrequently in the first survey. Two of these six (*Griffithsia crassiuscula* and *Halisarca dujardini*) were detected in only five samples in the repeat survey and two of them (the polychaetes *Polydora hoplura* and *Dipolydora armata*) were not recorded in the second survey. Furthermore, of the 6 non-indigenous species that were detected in the second survey but not the first, 3 (50%) were present in just a single sample (*Tricellaria inopinata, Cryptosula pallasiana* and *Eudendrium generale*), and all six were present in five or fewer samples. 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 the non-indigenous annelids *Dipolydora armata* and *Polydora hoplura* in the second survey could be explained either by sampling error or local extinction since the initial baseline survey.

In each case, additional information can be used to address this problem. Three of the non-indigenous species recorded only in the second survey – *Bugula neritina, Cryptosula* *pallasiana* and *Theora lubrica* – have been present in New Zealand for more than 30 years (>100 years in the case of *C. pallasiana*) and have either been recorded previously from Picton Harbour (*B. neritina, C. pallasiana*) or are known from nearby areas (*T. lubrica*) (Gordon and Mawatari 1992; Cranfield et al. 1998). Each of these species was present in fewer than 5 samples in the second survey. It seems likely, therefore, that they were present in Picton during the first survey, albeit at small densities, and were not detected by the survey because of their rarity. Similarly, *Tricellaria inopinata* has a cosmopolitan distribution, has been recorded from elsewhere in the South Island (in Lyttelton Harbour, Gordon and Mawatari 1992), and is likely to have been present but undetected during the initial survey of Picton. The two non-indigenous species detected in the first but not the repeat survey, *Dipolydora armata* and *Polydora hoplura,* are also well-established in New Zealand and known from locations near Picton (Marlborough Sounds and Wellington Harbour, Read 1975; Cranfield et al. 1998) and are likely to have been present in Picton despite not being encountered in the re-survey. The remaining two species - *Spirobranchus polytrema* and *Eudendrium generale* – were new records for New Zealand in the initial baseline surveys, have relatively limited national distributions and are new records for Picton in the repeat survey. Although the evidence is only circumstantial, these two species are the most likely to represent recent incursions.

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 around 35% of native species recorded in each survey also occurred in just a single sample. 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 Picton.

Berth	Berth No.	Purpose	Construction	Length of berth (m)	Maximum draught (m)	Maximum beam (m)
Inter-island ferry terminal	1	Vehicle-carrying high speed ferries	Concrete deck/wood and steel casing piles + wooden pile fendering	120	7.5	26
	2	Road and rail-carrying conventional ferries	Concrete dec/steel casing piles + wooden pile fendering	160	7.5	22
	3	Vehicle-carrying conventional vessels	Concrete dec/steel casing piles + wooden pile fendering	140	7.5	16
Waitohi Wharf	East	General-purpose finger wharf, cargo berths, overseas and coastal vessels, Cook Strait roll on-roll off vessels, fishing vessels	Concrete deck/concrete piles + wooden pile fendering	210	10.3	32
	West		Concrete deck/steel casing piles + wooden pile fendering	210	10.3	32
Waimahara Wharf (Shakespeare Bay)		Multi-purpose berth for timber, logs and coal	Concrete deck/concrete piles + rubber strung timber fendering	200	15.3	No limit
West shore		Commercial fishing vessels	Steel sheet pile on rock wall	30	2.5	No limit

Table 2: Weight and value of overseas cargo loaded at the Port of Picton 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^2) ($million)	% value change from previous year	Proportion by weight of all NZ Seaports	Proportion by value of all NZ Seaports
2002	256,004		29		1.0	0.1
2003	282,079	10.2	27	-6.9	1.1	0.1
2004	329,790	16.9	29	7.4	1.5	0.1
2005^P	387,295	17.4	33	13.8	1.8	0.1
Change from 2002 to 2005	131,291	51.3	4	13.8		

[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 3: Number of vessel arrivals from overseas ports to the Port of Picton by each general vessel type and country of previous port of call, between 2002 and 2005 inclusive (data from LMIU “SeaSearcher.com” database)

Country (and geographic 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 (including chemical / oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Australia (Australia)	9						3	1	1				1	15
Republic of Korea (northwest Pacific)	3													3
People's Republic of China (northwest Pacific)	3													3
Japan (Japan)	2													2
New Caledonia (Pacific Islands)	1						1							2
Aruba (South America Atlantic coast)							1							1
Total	18						5	1	1				1	26

Table 4: Number of vessel arrivals from Australia to the Port of Picton by each general vessel type and previous 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
New South Wales	1						2	1						4
Tasmania	2						1		1					4
Victoria	3													3
Queensland	2													2
South Australia	1												1	2
Total	9						3	1	1				1	15

Table 5: **Number of vessel departures from the Port of Picton to overseas ports, by each general vessel type and country of next port of call, between 2002 and 2005 inclusive (data from LMIU "SeaSearcher.com" database)**

Country (and geographic area) of next port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG	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
Republic of Korea (northwest Pacific)	32													32
Republic of Singapore (east Asian seas)	8													8
Australia (Australia)	2						3							5
India (Central Indian Ocean)	2													2
Japan (Japan)	1													1
People's Republic of China (northwest Pacific)	1													1
Philippines (east Asian seas)	1													1
Total	47						3							50

Table 6: Number of vessel arrivals from New Zealand ports to the Port of Picton 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
Wellington	13						8	1	4					26
Lyttelton	9						9	1					1	20
Nelson	8						1					6		15
Napier	10													10
Tauranga	8													8
Whangarei	8													8
Timaru	5													5
Auckland	2						1							3
Bluff	2													2
Westport	2													2
Gisborne	2													2
Dunedin	1													1
Stewart Is.							1							1
Total	70						20	2	4			6	1	103

Table 7: Number of vessel departures from the Port of Picton 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
Wellington	7						7	1	4					19
Whangarei	13													13
Napier	8						3							11
Lyttelton	4						7							11
Nelson							1	1				6	1	9
Tauranga	3						2							5
Gisborne	3													3
Westport	2													2
Auckland							1							1
Onehunga	1													1
Dunedin							1							1
Bluff	1													1
Total	42	0	0	0	0	0	22	2	4	0	0	6	1	77

Table 8: 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 9: Summary of sampling effort in the Port of Picton. 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 wharf 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
Picton Harbour																				
Town Basin		4		4		4		4												
Aquarium		4		4		1		4												
Ferry Terminal No.1 Berth		4		4		2		4												4
Ferry Terminal No.2 Berth		4		4		4		4												
Ferry Terminal Berths 1/2#	6		4		8		8			3	2	2	16	16	16	16	4	4		
Long Arm No. 1*	6		4		5		8			3	2	4	16	15	16	15	4	4		
Long Arm No.2										3										
Ro-Ro Pontoon				4																
Site 1																			1	
Site 2																			1	
Site 3																			1	
Site 4																			1	

	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 wharf 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
Site 5																			1	
Site 6																			1	
Waitohi Wharf (East)												2								
Waitohi Wharf (End)										3		2								2
Waitohi Wharf (West)		4		4				4				2								2
Waitohi Wharf	6	4	8	4	8	4	8	4		3	2		15	16	15	16	4	4		
Westshore		4		4		3		4												
Shakespeare Bay (Waimahara Wharf)																				
Shakespeare Bay 1		4		4		4		4		3										
Shakespeare Bay 2		2		4		4		2		3		3		16		16		4		2
Oil Berth No. 2		2				2		2												
Total	18	36	16	40	21	28	24	36	0	21	6	15	47	63	47	63	12	16	6	10

Recorded as Ferry Terminal No.2 in the first survey
* Recorded as Ferry Terminal No.3 in the first survey

Table 10: 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 11: 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 12: Marine pest species listed on the Australian Ballast Water Management Advisory Council's (ABWMAC) schedule of non-indigenous pest species.

Major taxonomic group	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 13: Native species recorded from the Port of Picton in the first (T1) and second (T2) surveys.

Major taxonomic group, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Eunicida	Dorvilleidae	*Dorvillea australiensis*	1	1
Polychaeta	Eunicida	Dorvilleidae	*Schistomeringos loveni*	1	1
Polychaeta	Eunicida	Eunicidae	*Eunice australis*	0	1
Polychaeta	Eunicida	Eunicidae	*Eunice laticeps*	0	1
Polychaeta	Eunicida	Eunicidae	*Lysidice ninetta*	1	0
Polychaeta	Eunicida	Lumbrineridae	*Abyssoninoe galatheae*	0	1
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sphaerocephala*	1	1
Polychaeta	Phyllodocida	Glyceridae	*Glycera benhami*	0	1
Polychaeta	Phyllodocida	Goniadidae	*Glycinde trifida*	0	1
Polychaeta	Phyllodocida	Nereididae	*Neanthes cricognatha*	1	0
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	*Platynereis Platynereis_australis_group*	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia capensis*	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Nereiphylla cf. castanea*	0	1
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe macrolepidota*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidastheniella comma*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus banksi*	1	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus fiordlandica*	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	Syllidae	*Haplosyllis spongicola*	1	1
Polychaeta	Phyllodocida	Syllidae	*Trypanosyllis zebra*	1	1
Polychaeta	Sabellida	Sabellidae	*Megalomma suspiciens*	1	1
Polychaeta	Sabellida	Serpulidae	*Galeolaria hystrix*	1	1
Polychaeta	Sabellida	Serpulidae	*Neovermilia sphaeropomatus*	0	1
Polychaeta	Sabellida	Serpulidae	*Romanchella perrieri*	1	1
Polychaeta	Sabellida	Serpulidae	*Spirobranchus cariniferus*	1	0
Polychaeta	Scolecida	Opheliidae	*Armandia maculata*	0	1
Polychaeta	Scolecida	Orbiniidae	*Scoloplos cylindrifer*	1	0
Polychaeta	Scolecida	Scalibregmatidae	*Hyboscolex longiseta*	0	1
Polychaeta	Spionida	Spionidae	*Dipolydora dorsomaculata*	1	0
Polychaeta	Spionida	Spionidae	*Prionospio multicristata*	0	1
Polychaeta	Terebellida	Acrocirridae	*Acrocirrus trisectus*	1	1

Major taxonomic group, Class	**Order**	**Family**	**Genus and species**	**T1***	**T2***
Polychaeta	Terebellida	Cirratulidae	*Timarete anchylochaetus*	1	0
Polychaeta	Terebellida	Flabelligeridae	*Flabelligera affinis*	1	1
Polychaeta	Terebellida	Flabelligeridae	*Pherusa parmata*	1	1
Polychaeta	Terebellida	Terebellidae	*Nicolea armilla*	1	1
Polychaeta	Terebellida	Terebellidae	*Pista pegma*	0	1
Polychaeta	Terebellida	Terebellidae	*Pseudopista rostrata*	1	1
Polychaeta	Terebellida	Terebellidae	*Streblosoma toddae*	1	1
Polychaeta	Terebellida	Terebellidae	*Thelepus extensus*	1	0
Bryozoa					
Gymnolaemata	Cheilostomata	Aeteidae	*Aetea australis*	0	1
Gymnolaemata	Cheilostomata	Beaniidae	*Beania discodermiae*	1	0
Gymnolaemata	Cheilostomata	Beaniidae	*Beania new sp. [whitten]*	1	0
Gymnolaemata	Cheilostomata	Beaniidae	*Beania sp.*	0	1
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora mucronifera*	1	0
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora rostrata*	0	1
Gymnolaemata	Cheilostomata	Buffonellodidae	*Aimulosia marsupium*	1	0
Gymnolaemata	Cheilostomata	Calloporidae	*Valdemunitella valdemunita*	1	1
Gymnolaemata	Cheilostomata	Eurystomellidae	*Eurystomella foraminigera*	1	1
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella delta*	1	0
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella tongima*	1	0
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina new sp. [Leigh]*	1	0
Gymnolaemata	Cheilostomata	Microporellidae	*Microporella agonistes*	1	0
Gymnolaemata	Cheilostomata	Smittinidae	*Smittina rosacea*	1	0
Gymnolaemata	Cheilostomata	Smittinidae	*Smittina torques*	1	0
Stenolaemata	Cyclostomata	Tubuliporidae	*Tubulipora cf. connata*	1	0
Cnidaria					
Hydrozoa	Hydroida	Sertulariidae	*Sertularella robusta*	1	0
Crustacea					
Cirripedia	Thoracica	Balanidae	*Austrominius modestus*	1	1
Cirripedia	Thoracica	Balanidae	*Notomegabalanus decorus*	0	1
Cirripedia	Thoracica	Chthamalidae	*Chaemosipho columna*	0	1
Malacostraca	Amphipoda	Aoridae	*Haplocheira barbimana*	1	1
Malacostraca	Amphipoda	Dexaminidae	*Paradexamine pacifica*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe trailli*	1	1
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia akaroica*	0	1
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia hansoni*	1	0
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia vesca*	1	1

Major taxonomic group, Class	Order	Family	Genus and species	T1*	T2*
Malacostraca	Amphipoda	Melitidae	*Ceradocus chiltoni*	0	1
Malacostraca	Amphipoda	Melitidae	*Melita inaequistylis*	1	1
Malacostraca	Amphipoda	Phtisicidae	*Caprellina longicollis*	1	0
Malacostraca	Anomura	Paguridae	*Pagurus novizealandiae*	0	1
Malacostraca	Anomura	Paguridae	*Pagurus traversi*	1	1
Malacostraca	Anomura	Porcellanidae	*Petrolisthes elongatus*	1	1
Malacostraca	Anomura	Porcellanidae	*Petrolisthes novaezelandiae*	1	1
Malacostraca	Brachyura	Cancridae	*Metacarcinus novaezelandiae*	1	0
Malacostraca	Brachyura	Hymenosomatidae	*Elamena producta*	0	1
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus innominatus*	1	1
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus varius*	1	1
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*	1	1
Malacostraca	Brachyura	Ocypodidae	*Macrophthalmus hirtipes*	0	1
Malacostraca	Brachyura	Pinnotheridae	*Pinnotheres novaezelandiae*	0	1
Malacostraca	Brachyura	Xanthidae	*Pilumnus lumpinus*	1	1
Malacostraca	Caridea	Crangonidae	*Pontophilus australis*	0	1
Malacostraca	Caridea	Crangonidae	*Pontophilus hamiltoni*	1	0
Malacostraca	Caridea	Hippolytidae	*Hippolyte bifidirostris*	1	1
Malacostraca	Caridea	Palemonidae	*Periclimenes yaldwyni*	0	1
Malacostraca	Isopoda	Cirolanidae	*Cirolana quechso*	0	1
Malacostraca	Isopoda	Cirolanidae	*Natatolana rossi*	1	0
Malacostraca	Isopoda	Cirolanidae	*Natatolana* sp. nov.	0	1
Malacostraca	Isopoda	Cymothoidae	*Ceratothoa imbricata*	0	1
Malacostraca	Isopoda	Sphaeromatidae	*Pseudosphaeroma campbellensis*	0	1
Echinodermata					
Asteroidea	Forcipulata	Asteriidae	*Allostichaster insignis*	1	1
Asteroidea	Forcipulata	Asteriidae	*Coscinasterias muricata*	0	1
Asteroidea	Valvatida	Asterinidae	*Meridiastra mortenseni*	0	1
Asteroidea	Valvatida	Asterinidae	*Patiriella regularis*	1	1
Echinoidea	Echinoida	Echinometridae	*Evechinus chloroticus*	0	1
Echinoidea	Temnopleuroida	Temnopleuridae	*Pseudechinus albocinctus*	1	0
Holothuroidea	Apodid	Chiridotidae	*Chirodota nigra*	0	1
Holothuroidea	Aspidochirotida	Stichopodidae	*Stichopus mollis*	1	1
Holothuroidea	Molpadiida	Caudinidae	*Paracaudina chilensis*	0	1

Major taxonomic group, Class	**Order**	**Family**	**Genus and species**	**T1***	**T2***
Ophiuroidea	Ophiurida	Amphiuridae	*Amphipholis squamata*	1	1
Mollusca					
Bivalvia	Myoida	Hiatellidae	*Hiatella arctica*	1	1
Bivalvia	Mytiloida	Mytilidae	*Aulacomya atra maoriana*	1	1
Bivalvia	Mytiloida	Mytilidae	*Modiolarca impacta*	1	1
Bivalvia	Mytiloida	Mytilidae	*Modiolus areolatus*	0	1
Bivalvia	Mytiloida	Mytilidae	*Perna canaliculus*	1	1
Bivalvia	Mytiloida	Mytilidae	*Xenostrobus pulex*	0	1
Bivalvia	Nuculoida	Nuculidae	*Nucula hartvigiana*	1	1
Bivalvia	Ostreoida	Ostreidae	*Ostrea chilensis*	1	1
Bivalvia	Pterioida	Anomiidae	*Pododesmus zelandicus*	1	1
Bivalvia	Pterioida	Pectinidae	*Talochlamys zelandiae*	1	1
Bivalvia	Veneroida	Kelliidae	*Kellia cycladiformis*	1	1
Bivalvia	Veneroida	Lasaeidae	*Borniola reniformis*	1	1
Bivalvia	Veneroida	Semelidae	*Leptomya retiaria*	0	1
Bivalvia	Veneroida	Tellinidae	*Macomona liliana*	0	1
Bivalvia	Veneroida	Veneridae	*Austrovenus stutchburyi*	0	1
Bivalvia	Veneroida	Veneridae	*Dosina zelandica*	0	1
Bivalvia	Veneroida	Veneridae	*Irus reflexus*	0	1
Bivalvia	Veneroida	Veneridae	*Ruditapes largillierti*	1	0
Cephalopoda	Octopoda	Octopodidae	*Octopus maorum*	1	0
Gastropoda	Caenogastropoda	Turritellidae	*Maoricolpus roseus*	1	1
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella novaezelandiae*	1	0
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella tenuis*	1	0
Gastropoda	Neogastropoda	Buccinidae	*Buccinulum linea*	0	1
Gastropoda	Neogastropoda	Buccinidae	*Buccinulum vittatum*	1	1
Gastropoda	Neogastropoda	Buccinidae	*Cominella adspersa*	1	0
Gastropoda	Neogastropoda	Muricidae	*Xymene pusillus*	1	0
Gastropoda	Notaspidea	Pleurobranchidae	*Pleurobranchaea maculata*	0	1
Gastropoda	Nudibranchia	Chromodorididae	*Chromodoris aureomarginata*	0	1
Gastropoda	Nudibranchia	Dendrodorididae	*Dendrodoris citrina*	1	0
Gastropoda	Nudibranchia	Dorididae	*Doriopsis flabellifera*	0	1
Gastropoda	Nudibranchia	Dorididae	*Rostanga muscula*	0	1
Gastropoda	Patellogastropoda	Lottiidae	*Asteracmea suteri*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus artizona*	0	1
Gastropoda	Vetigastropoda	Trochidae	*Trochus tiaratus*	1	1
Gastropoda	Vetigastropoda	Trochidae	*Trochus viridus*	1	1
Gastropoda	Vetigastropoda	Turbinidae	*Turbo smaragdus*	1	1
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus porosus*	1	1

Major taxonomic group, Class	Order	Family	Genus and species	T1*	T2*
Polyplacophora	Ischnochitonina	Chitonidae	*Rhyssoplax aerea*	1	1
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton pelliserpentis*	1	0
Polyplacophora	Lepidopleurina	Leptochitonidae	*Leptochiton inquinatus*	0	1
Macroalgae					
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnionella adnata*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium apiculatum*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium rubrum*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Acrosorium venulosum*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Apoglossum montagneanum*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Erythroglossum undulatissimum*	1	0
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena variolosa*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Myriogramme denticulata*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Phycodrys quercifolia*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris dichotoma*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris griffithsia*	1	0
Florideophyceae	Gelidiales	Gelidiaceae	*Pterocladiella capillacea*	0	1
Florideophyceae	Gigartinales	Cystocloniaceae	*Craspedocarpus erosus*	1	1
Florideophyceae	Gigartinales	Kallymeniaceae	*Callophyllis depressa*	1	0
Florideophyceae	Gigartinales	Phyllophoraceae	*Stenogramme interrupta*	0	1
Florideophyceae	Halymeniales	Halymeniaceae	*Grateloupia urvilleana*	0	1
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria umbellata*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia leptophylla*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia linearis*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia novazelandica*	0	1
Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia velutina*	1	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum sinclairii*	1	0
Porifera					
Demospongiae	Dictyoceratida	Dysideidae	*Euryspongia cf. arenaria*	1	0
Demospongiae	Halichondrida	Halichondriidae	*Halichondria punctata*	0	1
Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. bathami*	0	1
Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia stellata*	1	1
Demospongiae	Haplosclerida	Chalinidae	*Adocia cf. parietalioides*	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona cf. isodictyale*	1	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona cf. punctata*	1	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona glabra*	1	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona maxima*	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona stelliderma*	0	1
Demospongiae	Poecilosclerida	Hymedesmiidae	*Hymedesmia microstrongyla*	0	1

Major taxonomic group, Class	Order	Family	Genus and species	T1*	T2*
Demospongiae	Poecilosclerida	Hymedesmiidae	*Phorbas fulva*	0	1
Demospongiae	Poecilosclerida	Microcionidae	*Clathria (Microciona) coccinea*	1	0
Demospongiae	Poecilosclerida	Microcionidae	*Clathria (Microciona) dendyi*	0	1
Demospongiae	Poecilosclerida	Tedaniidae	*Tedania diversiraphidiophora*	1	1
Dinophyta					
Dinophyceae	Gymnodiniales	Polykrikaceae	*Polykrikos schwartzii*	0	1
Dinophyceae	Peridinales	Gonyaulacaceae	*Gonyaulax grindleyi*	1	1
Dinophyceae	Peridinales	Gonyaulacaceae	*Gonyaulax scrippsae*	0	1
Dinophyceae	Peridinales	Gonyaulacaceae	*Gonyaulax spinifera*	1	1
Dinophyceae	Peridinales	Gonyaulacaceae	*Protoceratium reticulatum*	0	1
Dinophyceae	Peridinales	Peridiniaceae	*Lingulodinium polyedrum*	1	1
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium conicum*	1	1
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium leonis*	0	1
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium oblongum*	0	1
Dinophyceae	Peridinales	Peridiniaceae	*Scrippsiella trochoidea*	1	1
Urochordata					
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula mortenseni*	1	1
Ascidiacea	Stolidobranchia	Polyzoinae	*Polyzoa opuntia*	1	0
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura cancellata*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura carnea*	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura picta*	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	Pyuridae	*Pyura trita*	1	0
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa coerulea*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa bicornuta*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa nisiotus*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa regalis*	1	0
Vertebrata					
Actinopterygii	Anguilliformes	Anguillidae	*Anguilla dieffenbachii*	1	0
Actinopterygii	Gadiformes	Moridae	*Pseudophycis bachus*	1	0
Actinopterygii	Mugiliformes	Mugilidae	*Aldrichetta forsteri*	0	1
Actinopterygii	Mugiliformes	Mugilidae	*Parapercis colias*	0	1
Actinopterygii	Perciformes	Carangidae	*Pseudocarynx dentex*	0	1
Actinopterygii	Perciformes	Cheilodactylidae	*Nemadactylus macropterus*	0	1
Actinopterygii	Perciformes	Gobiesocidae	*Trachelochismus melobesia*	1	0

Major taxonomic group, Class	**Order**	**Family**	**Genus and species**	**T1***	**T2***
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*	1	1
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus fuscus*	1	0
Actinopterygii	Perciformes	Sparidae	*Pagrus auratus*	0	1
Actinopterygii	Perciformes	Trypterigiidae	*Forsterygion lapillum*	1	0
Actinopterygii	Perciformes	Trypterigiidae	*Grahamina capito*	1	0
Actinopterygii	Perciformes	Trypterigiidae	*Grahamina gymnota*	1	0

* 1 = Present, 0 = Absent

Table 14: Cryptogenic marine species recorded from the Port of Picton 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 group, Class	Order	Family	Genus and species	Status	T1*	T2*
Annelida						
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris Lumbrineris-01 [Glasby unpub]*	C2	0	1
Polychaeta	Phyllodocida	Nereididae	*Neanthes Neanthes-A*	C2	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia Eulalia-NIWA-2*	C2	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia Eulalia-NIWA-3-stripey*	C2	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Pirakia Pirakia-A*	C2	1	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus Lepidonotus-A*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Autolytin-unknown sp. A*	C2	0	1
Polychaeta	Phyllodocida	Syllidae	*Eusyllis Eusyllis-B*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Eusyllis Eusyllis-D*	C2	1	0
Polychaeta	Sabellida	Serpulidae	*Serpula Serpula-C*	C2	1	0
Polychaeta	Sabellida	Serpulidae	*Serpula Serpula-D*	C2	1	0
Polychaeta	Spionida	Spionidae	*Paraprionospio Paraprionospio-A [pinnata]*	C2	0	1
Polychaeta	Terebellida	Terebellidae	*Terebella Terebella-B*	C2	1	1
Bryozoa						
Gymnolaemata	Cheilostomata	Phidoloporidae	*Rhynchozoon larreyi*	C1	1	0
Gymnolaemata	Cheilostomata	Scrupariidae	*Scruparia ambigua*	C1	1	1
Cnidaria						
Hydrozoa	Hydroida	Plumulariidae	*Plumularia setacea*	C1	1	0
Crustacea						
Malacostraca	Amphipoda	Aoridae	*Aora typica*	C1	1	0
Malacostraca	Amphipoda	Corophiidae	*Meridiolembos sp. aff. acherontis*	C2	1	0
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia sp. Aff. P. vesca*	C2	0	1
Mollusca						
Bivalvia	Mytiloida	Mytilidae	*Mytilus galloprovincialis*	C1	1	1
Gastropoda	Nudibranchia	Polyceridae	*Polycera hedgpathi*	C1	0	1
Porifera						

Major taxonomic group, Class	**Order**	**Family**	**Genus and species**	**Status**	**T1***	**T2***
Demospongiae	Dictyoceratida	Dysideidae	*Dysidea new sp. 1*	C2	1	1
Demospongiae	Dictyoceratida	Dysideidae	*Dysidea new sp. 3*	C2	0	1
Demospongiae	Dictyoceratida	Dysideidae	*Euryspongia new sp. 1*	C2	1	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 1*	C2	1	1
Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia diffusa*	C1	1	1
Demospongiae	Haplosclerida	Callyspongiidae	*Dactylia new sp. 1*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Adocia new sp. 1*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Adocia new sp. 2*	C2	1	1
Demospongiae	Haplosclerida	Chalinidae	*Chalinula new sp. 2*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 1*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 4*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 6*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 14*	C2	0	1
Demospongiae	Poecilosclerida	Acarnidae	*Iophon proximum*	C1	1	1
Demospongiae	Poecilosclerida	Chondropsidae	*Chondropsis kirkii*	C1	1	1
Demospongiae	Poecilosclerida	Chondropsidae	*Chondropsis new sp. 1*	C2	0	1
Demospongiae	Poecilosclerida	Crellidae	*Crella (Pytheas) incrustans*	C1	1	1
Demospongiae	Poecilosclerida	Esperiopsidae	*Esperiopsis new sp. 1*	C2	1	1
Demospongiae	Poecilosclerida	Mycalidae	*Mycale (Carmia) new sp. 3*	C2	0	1
Demospongiae	Poecilosclerida	Mycalidae	*Paraesperella new sp. 1 (macrosigma)*	C2	0	1
Urochordata						
Ascidiacea	Aplousobranchia	Didemnidae	*Didemnum* sp. grp *(D.vexillum, D. incanum,* and other *Didemnum* sp.*)*	C1	1	1[#]
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella eumyota*	C1	1	1
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes leachii*	C1	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa cerea*	C1	1	1

* 1 = Present, 0 = Absent

[#] Because of the complex taxonomy of this genus, *Didemnum* specimens from the second survey could not be identified to species level, but are reported here collectively as a species group “*Didemnum* sp.”

Table 15: Non-indigenous marine species recorded from the Port of Picton 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 group, Class	Order	Family	Genus and species	T1*	T2*	Probable means of introduction	Date of introduction or detection (d)
Annelida							
Polychaeta	Sabellida	Serpulidae	*Spirobranchus polytrema* ***(NR)***	0	1	H	Nov 2001[d]
Polychaeta	Spionida	Spionidae	*Dipolydora armata*	1	0	H	~1900
Polychaeta	Spionida	Spionidae	*Polydora hoplura*	1	0	H	Unknown[1]
Bryozoa							
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula flabellata*	1	1	H	Pre-1949
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula neritina*	0	1	H	1949
Gymnolaemata	Cheilostomata	Candidae	*Tricellaria inopinata*	0	1	H	Pre-1964
Gymnolaemata	Cheilostomata	Cryptosulidae	*Cryptosula pallasiana*	0	1	H	1890s
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora subtorquata*	1	1	H or B	Pre-1982
Cnidaria							
Hydrozoa	Hydroida	Eudendriidae	*Eudendrium generale*	0	1	H[2]	Jan 2003[d]
Mollusca							
Bivalvia	Veneroida	Semelidae	*Theora lubrica*	0	1	B	1971
Macroalgae							
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia crassiuscula*	1	1	H	Pre-1954
Phaeophyceae	Laminariales	Alariaceae	*Undaria pinnatifida*	1	1	H or B	Pre-1987
Porifera							
Demospongiae	Halisarcida	Halisarcidae	*Halisarca dujardini*	1	1	H or B	Pre-1973

[1] Date of introduction currently unknown but species had been encountered in New Zealand prior to the present survey.

[2] Based on Cranfield et al's (1998) estimation for a congeneric species *Eudendrium ritchiei*.

* 1 = Present, 0 = Absent

Table 16: Species indeterminata recorded from the Port of Picton 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 group, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Phyllodocida	Nereididae	*Nereididae indet*	1	0
Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodocidae Indet*	0	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidastheniella Indet*	1	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotinae Indet*	1	0
Polychaeta	Phyllodocida	Polynoidae	*Polynoidae indet*	1	0
Polychaeta	Sabellida	Sabellidae	*Sabellidae Indet*	0	1
Polychaeta	Sabellida	Serpulidae	*Spirorbinae Indet*	1	0
Polychaeta	Spionida	Spionidae	*Boccardia Indet*	1	0
Polychaeta	Spionida	Spionidae	*Spionidae Indet*	0	1
Polychaeta	Terebellida	Terebellidae	*Terebellidae Indet*	1	0
Bryozoa					
			Unidentified Bryozoa	0	1
Gymnolaemata	Cheilostomata	Aeteidae	*Aetea ?australis*	1	0
Cnidaria					
Anthozoa	Actiniaria		*Acontiaria sp.*	1	0
Anthozoa	Actiniaria	Diadumenidae	*Diadumene sp.*	1	0
Crustacea					
Malacostraca	Amphipoda	Aoridae	*Aoridae sp.*	0	1
Malacostraca	Amphipoda	Corophiidae	*Meridiolembos sp.*	1	0
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis indet.*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Paraleucothoe sp. A*	0	1
Malacostraca	Anomura	Paguridae	*Pagurus sp.*	0	1
Malacostraca	Brachyura	Majidae	*Notomithrax sp.*	0	1
Malacostraca	Mysidacea		*Unidentified Mysidacea*	0	1
Mollusca					
Gastropoda	Neogastropoda	Buccinidae	*Cominella sp.*	0	1
Macroalgae					
			Unidentified Phycophyta	0	1
Florideophyceae			*Unidentified Rhodophyceae*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia sp.*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Unidentified Delesseriaceae*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena affinis?*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena sp.*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Phycodrys sp.*	1	0

Major taxonomic group, Class	Order	Family	Genus and species	T1*	T2*
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris sp.*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia sp.*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sp.*	1	1
Florideophyceae	Corallinales	Corallinaceae	*Unidentified Corallinaceae*	0	1
Florideophyceae	Corallinales	Corallinaceae	*Melobesia? sp.*	1	0
Florideophyceae	Gigartinales	Kallymeniaceae	*Callophyllis sp.*	1	1
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria sp.*	0	1
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria umbellata?*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia aff. dichotoma*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia linearis?*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia sp.*	1	1
Phaeophyceae			*Unidentified Phaeophyceae*	1	0
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Ectocarpoid sp.*	0	1
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum sp.*	0	1
Ulvophyceae	Bryopsidales	Codiaceae	*Codium sp.*	0	1
Ulvophyceae	Cladophorales	Cladophoraceae	*Cladophora sp.*	1	1
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha sp.*	0	1
Ulvophyceae	Ulvales	Ulvaceae	*Ulva sp.*	1	1
Platyhelminthes					
Turbellaria	Polycladida		*Unidentified Polycladida*	1	0
Porifera					
			Unidentified Porifera	0	1
Dinophyta					
Dinophyceae	Gymnodiniales	Polykrikaceae	*Pheopolykrikos sp.*	0	1
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium sp.*	1	1
Urochordata					
Ascidiacea	Aplousobranchia	Didemnidae	*Unidentified Didemnidae*	0	1
Vertebrata					
Actinopterygii	Perciformes	Gobiesocidae	*Unidentified Gobiesocidae*	1	0
Actinopterygii	Perciformes	Trypterigiidae	*Forsterygion sp. post larva*	1	0

* 1 = Present, 0 = Absent

Table 17: Non-indigenous marine organisms recorded from the Port of Picton 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 Picton	Locations detected in the Port of Picton*		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
Annelida				
Spirobranchus polytrema	Pile scrape		Ferry Terminal Berths1/2, Waitohi Wharf (See Figure 20)	Dunedin, Lyttelton, Napier, Timaru, Wellington
Dipolydora armata	Pile scrape	Ferry Terminal 3		Wellington
Polydora hoplura	Pile scrape	Ferry Terminal 3		Dunedin, Lyttelton, Nelson, Tauranga, Timaru, Wellington, Whangarei
Bryozoa				
Bugula flabellata	Benthic grab, benthic sled, pile scrape, pile visual	Ferry Terminal 2, Ferry Terminal 3, Waitohi Wharf (See Figure 21)	Ferry Terminal Berths 1/2, Long Arm No.1, Shakespeare Bay 2, Waitohi Wharf, Waitohi East, Waitohi End, Waitohi West (See Figure 22)	Auckland, Bluff, Dunedin, Lyttelton, Napier, Nelson, New Plymouth, Opua, Tauranga, Timaru, Wellington, Whangarei
Bugula neritina	Benthic sled, pile scrape		Ferry Terminal Berths 1/2, Shakespeare Bay 2 (See Figure 23)	Auckland, Dunedin, Gisborne, Lyttelton, Napier, New Plymouth, Opua, Tauranga, Timaru, Whangarei
Tricellaria inopinata	Pile scrape		Shakespeare Bay 2 (See Figure 24)	Gisborne, Lyttelton, New Plymouth, Whangarei
Cryptosula pallasiana	Pile scrape		Ferry Terminal Berths 1/2 (See Figure 25)	Dunedin, Gisborne, Lyttelton, Nelson, New Plymouth, Timaru, Wellington, Whangarei
Watersipora subtorquata	Pile scrape, benthic grab, benthic sled	Ferry Terminal 2, Ferry Terminal 3 (See Figure 26)	Ferry Terminal Berths 1/2, Long Arm No.1, Shakespeare Bay 2, Waitohi West (See Figure 27)	Auckland, Bluff, Dunedin, Gisborne, Lyttelton, Napier, Nelson, New Plymouth, Opua, Tauranga, Timaru, Wellington, Whangarei

Genus & species	Capture techniques in the Port of Picton	Locations detected in the Port of Picton*		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
Cnidaria				
Eudendrium generale	Pile scrape		Long Arm No.1 (See Figure 28)	Napier, Wellington
Mollusca				
Theora lubrica	Benthic grab, benthic sled		Long Arm No.1, Waitohi West (See Figure 29)	Auckland, Gisborne, Lyttelton, Napier, Nelson, New Plymouth, Opua Wellington, Whangarei
Macroalgae				
Griffithsia crassiuscula	Pile scrape, benthic sled	Waitohi Wharf (See Figure 30)	Waitohi Wharf, Waitohi End, Waitohi West (See Figure 31)	Bluff, Lyttelton, New Plymouth, Timaru, Wellington
Undaria pinnatifida	Pile scrape, benthic grab, benthic sled	Ferry Terminal 2, Ferry Terminal 3, Waitohi Wharf (See Figure 32)	Ferry Terminal Berths 1/2, Long Arm No.1, Shakespeare Bay 2, Waitohi Wharf, Waitohi End (See Figure 33)	Dunedin, Gisborne, Lyttelton, Napier, Nelson, New Plymouth, Timaru, Wellington,
Porifera				
Halisarca dujardini	Pile scrape, benthic sled	Ferry Terminal 2, Waitohi Wharf (See Figure 34)	Ferry Terminal Berths 1/2, Waitohi West, Waitohi Wharf (See Figure 35)	Auckland, Bluff, Dunedin, Lyttelton, New Plymouth, Wellington

* NB. Some site names differed between the first and second surveys. The site names “Ferry Terminal Berths 1/2” and “Long Arm No. 1” used in the second survey were recorded in the first survey as “Ferry Terminal 2” and “Ferry Terminal 3”, respectively.

Table 18: Summary statistics for taxon assemblages collected in the Port of Picton 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	47	63	120	116	75 (47%)	45	41	42 (35%)	34 (29%)	94.529	0.466	0.636	0.833	0.909
C2	47	63	14	22	8 (29%)	6	14	3 (21%)	10 (45%)	8.61	0.286	0.444	0.341	0.509
NIS & C1	47	63	20	21	15 (58%)	5	6	7 (35%)	4 (19%)	15.766	0.577	0.732	0.924	0.961
Benthic sleds														
Native	6	15	29	39	9 (15%)	20	30	23 (79%)	25 (64%)	55.5	0.153	0.265	0.973	0.986
C2	6	15	3	7	1 (11%)	2	6	3 (100%)	6 (86%)	1.25	0.111	0.2	0.149	0.26
NIS & C1	6	15	2	11	1 (8%)	1	10	2 (100%)	5 (46%)	1	0.083	0.154	0.156	0.27
Benthic grabs														
Native	0	21	N/A*	42	0 (0%)	N/A*	42	N/A*	25 (60%)	Unable to conduct similarity analysis because no samples taken in first survey				
C2	0	21	N/A*	6	0 (0%)	N/A*	6	N/A*	4 (67%)					
NIS & C1	0	21	N/A*	6	0 (0%)	N/A*	6	N/A*	5 (83%)					
Native, C2, NIS & C1 taxa combined	0	21	N/A*	54	0 (0%)	N/A*	54	N/A*	34 (63%)					
Crab traps														

	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
Native	18	36	6	7	2 (18%)	4	5	3 (50%)	2 (29%)	0	0.182	0.308	0.495	0.662
C2	18	36	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	18	36	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
Fish traps														
Native	16	40	4	8	2 (20%)	2	6	3 (75%)	4 (50%)	2	0.2	0.333	0.756	0.861
C2	16	40	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	16	40	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
Starfish traps														
Native	24	36	7	3	1 (11%)	6	2	2 (29%)	0 (0%)	1	0.111	0.2	0.221	0.361
C2	24	36	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	24	36	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				

* No benthic grab collections obtained due to damage to the grab sampler at the start of the first survey.

Appendices

Appendix 1: Definitions of vessel types used in analyses of the LMIU 'SeaSearcher.com' database

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

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
	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
	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

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	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
	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

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
	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 Picton second baseline survey (NZGD49)

Site	Easting	Northing	Survey Method*	Number of sample units
Aquarium	2594275	5990582	CRBTP	1
Aquarium	2594275	5990582	CRBTP	1
Aquarium	2594311	5990582	CRBTP	2
Aquarium	2594274	5990594	FSHTP	2
Aquarium	2594292	5990585	FSHTP	2
Aquarium	2594311	5990582	SHRTP	1
Aquarium	2594275	5990582	STFTP	2
Aquarium	2594311	5990582	STFTP	2
Ferry Terminal Berths 1/2	2594223	5990887	BGRB	3
Ferry Terminal Berths 1/2	2594196	5990911	BSLD	1
Ferry Terminal Berths 1/2	2594228	5990894	BSLD	1
Ferry Terminal Berths 1/2	2594241	5990885	PSC	20
Long Arm No1	2594260	5990862	BGRB	3
Long Arm No1	2594242	5990812	BSLD	1
Long Arm No1	2594316	5990914	BSLD	1
Long Arm No1	2594358	5990904	BSLD	1
Long Arm No1	2594412	5991020	BSLD	1
Long Arm No1	2594306	5990903	PSC	15
Long Arm No2	2594262	5990984	BGRB	3
No 1 Berth	2594240	5990838	CRBTP	2
No 1 Berth	2594291	5990892	CRBTP	2
No 1 Berth	2594376	5990844	CYST	2
No 1 Berth	2594534	5991101	CYST	2
No 1 Berth	2594236	5990843	FSHTP	2
No 1 Berth	2594285	5990876	FSHTP	2
No 1 Berth	2594291	5990892	SHRTP	2
No 1 Berth	2594240	5990838	STFTP	2
No 1 Berth	2594291	5990892	STFTP	2
No 2 Berth	2594186	5990876	CRBTP	2
No 2 Berth	2594191	5990864	CRBTP	2
No 2 Berth	2594183	5990870	FSHTP	2
No 2 Berth	2594208	5990887	FSHTP	2
No 2 Berth	2594186	5990876	SHRTP	2
No 2 Berth	2594191	5990864	SHRTP	2

Site	**Easting**	**Northing**	**Survey Method***	**Number of sample units**
No 2 Berth	2594186	5990876	STFTP	2
No 2 Berth	2594191	5990864	STFTP	2
Oil Berth #2	2593714	5991820	CRBTP	2
Oil Berth #2	2593714	5991820	SHRTP	2
Oil Berth #2	2593714	5991820	STFTP	2
Ro-Ro Pontoon	2594206	5990928	FSHTP	2
Ro-Ro Pontoon	2594246	5990978	FSHTP	2
Shakespeare Bay 1	2593648	5991709	BGRB	3
Shakespeare Bay 1	2593670	5991712	CRBTP	2
Shakespeare Bay 1	2593689	5991765	CRBTP	2
Shakespeare Bay 1	2593667	5991702	FSHTP	2
Shakespeare Bay 1	2593667	5991725	FSHTP	2
Shakespeare Bay 1	2593670	5991712	SHRTP	2
Shakespeare Bay 1	2593689	5991765	SHRTP	2
Shakespeare Bay 1	2593670	5991712	STFTP	2
Shakespeare Bay 1	2593689	5991765	STFTP	2
Shakespeare Bay 2	2593733	5991973	BGRB	3
Shakespeare Bay 2	2593593	5991596	BSLD	1
Shakespeare Bay 2	2593661	5991784	BSLD	1
Shakespeare Bay 2	2593691	5991827	BSLD	1
Shakespeare Bay 2	2593670	5991780	CRBTP	2
Shakespeare Bay 2	2593661	5991794	CYST	2
Shakespeare Bay 2	2593670	5991780	FSHTP	4
Shakespeare Bay 2	2593722	5991833	PSC	16
Shakespeare Bay 2	2593670	5991780	SHRTP	4
Shakespeare Bay 2	2593670	5991780	STFTP	2
Town Basin	2594487	5990561	CRBTP	2
Town Basin	2594513	5990556	CRBTP	2
Town Basin	2594487	5990568	FSHTP	2
Town Basin	2594513	5990567	FSHTP	2
Town Basin	2594487	5990561	SHRTP	2
Town Basin	2594513	5990556	SHRTP	2
Town Basin	2594487	5990561	STFTP	2
Town Basin	2594513	5990556	STFTP	2
Waitohi East	2594205	5990931	BSLD	1
Waitohi East	2594206	5990963	BSLD	1
Waitohi End	2594291	5991113	BGRB	1

Site	Easting	Northing	Survey Method*	Number of sample units
Waitohi End	2594309	5991133	BGRB	1
Waitohi End	2594315	5991115	BGRB	1
Waitohi End	2594324	5991144	BSLD	1
Waitohi End	2594397	5991190	BSLD	1
Waitohi End	2594446	5991332	CYST	2
Waitohi West	2594125	5991019	BSLD	1
Waitohi West	2594225	5991081	BSLD	1
Waitohi West	2594122	5991044	CRBTP	2
Waitohi West	2594153	5991097	CRBTP	2
Waitohi West	2594185	5991157	CYST	2
Waitohi West	2594134	5991070	FSHTP	2
Waitohi West	2594147	5991106	FSHTP	2
Waitohi West	2594122	5991044	STFTP	2
Waitohi West	2594153	5991097	STFTP	2
Waitohi Wharf	2594230	5991055	BGRB	3
Waitohi Wharf	2594148	5990983	CRBTP	2
Waitohi Wharf	2594268	5991096	CRBTP	2
Waitohi Wharf	2594175	5991020	FSHTP	2
Waitohi Wharf	2594233	5991070	FSHTP	2
Waitohi Wharf	2594253	5991081	PSC	17
Waitohi Wharf	2594148	5990983	SHRTP	2
Waitohi Wharf	2594268	5991096	SHRTP	2
Waitohi Wharf	2594148	5990983	STFTP	2
Waitohi Wharf	2594268	5991096	STFTP	2
Westshore	2594194	5991440	CRBTP	2
Westshore	2594199	5991474	CRBTP	2
Westshore	2594203	5991489	FSHTP	2
Westshore	2594206	5991436	FSHTP	2
Westshore	2594194	5991440	SHRTP	1
Westshore	2594199	5991474	SHRTP	2
Westshore	2594194	5991440	STFTP	2
Westshore	2594199	5991474	STFTP	2

*Survey methods: PSC = pile scrape quadrats and diver observations on pilings, BSLD = benthic sled, BGRB = benthic grab, CYST = dinoflagellate cyst core, CRBTP = crab trap, FSHTP = fish trap, STFTP = starfish trap, SHRTP = shrimp trap.

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

Major taxonomic group	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 Picton 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 Picton 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 group and Species	C1	C2	C3	C4	C5	C6	C7	C8	C9
Annelida									
Spirobranchus polytrema	+		+		+			+	
Bryozoa									
Bugula flabellata	+	+	+		+	+	+	+	+
Bugula neritina	+				+	+	+	+	+
Tricellaria inopinata	+	+	+		+	+		+	+
Cryptosula pallasiana	+	+	+		+	+	+	+	+
Watersipora subtorquata	+	+	+		+	+	+	+	+
Cnidaria									
Eudendrium generale	+		+		+	+		+	
Mollusca									
Theora lubrica	+	+			+	+	+	+	+
Macroalgae									
Griffithsia crassiuscula	+	+				+		+	+
Undaria pinnatifida	+	+	+		+	+	+	+	+
Porifera									
Halisarca dujardini	+		+	+		+	+	+	+

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 scrapings (replicates 1 to 4) and diver observations on wharf pilings (replicates labelled “0”).

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

						Site code	Ferry Terminal 1/2																				Long Arm No1															Shakespeare Bay 2																Waitohi Wharf																
						Pile replicate	1										2										1							2								1								2								1								2								
						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	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	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	3	4	1	2	3	4	0	1	2	3	4	1	2	3	4
Annelida	Polychaeta	Eunicida	Dorvilleidae	Dorvillea	australiensis	N	0	0	1	0	0		0	0	1	0		0	0	1	1		0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	0	1	1
Annelida	Polychaeta	Eunicida	Dorvilleidae	Schistomeringos	loveni	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	0	0	0	0	0	0	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	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
Annelida	Polychaeta	Eunicida	Eunicidae	Eunice	laticeps	N	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
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	Lumbrineris-01 [Glasby	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	0	0	0	0	0	0	0	0	1	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	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
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	benhami	N	0	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	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
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	kerguelensis	N	0	0	1	1	1		0	0	1	1		1	1	0	1		0	1	1	1	1	1	1	0	1	1	0	0	1	1	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	1	0	1	1	1	1
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	Neanthes-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	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
Annelida	Polychaeta	Phyllodocida	Nereididae	Nereis	falcaria	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	amblyodonta	N	0	0	0	0	0		0	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	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
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	camiguinoides	N	0	0	0	0	0		1	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	1	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	capensis	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	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	1	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	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
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Nereiphylla	cf. castanea	N	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	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Phyllodocidae	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Pirakia	Pirakia-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	1	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	1	1	1	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Harmothoe	macrolepidota	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	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	Polynoidae	Lepidastheniella	comma	N	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	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	fiordlandica	N	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	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
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	jacksoni	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	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
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	polychromus	N	0	0	1	0	0		0	1	1	1		1	1	0	1		0	1	1	1	1	0	0	0	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	1	1	0	1	1	1	0	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Ophiodromus	angustifrons	N	0	0	0	0	0		0	0	1	1		0	1	0	1		0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1
Annelida	Polychaeta	Phyllodocida	Syllidae	Autolytin-unknown	sp. A	C2	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
Annelida	Polychaeta	Phyllodocida	Syllidae	Haplosyllis	spongicola	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Trypanosyllis	zebra	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	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
Annelida	Polychaeta	Sabellida	Sabellidae	Megalomma	suspiciens	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	1	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	1	0
Annelida	Polychaeta	Sabellida	Sabellidae	Sabellidae	Indet	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1		1	0	1	0		0	0	0	0		0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0
Annelida	Polychaeta	Sabellida	Serpulidae	Neovermilia	sphaeropomatus	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	0	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
Annelida	Polychaeta	Sabellida	Serpulidae	Romanchella	perrieri	N	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	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Serpulidae	Spirobranchus	polytrema	A	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	1	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Scalibregmatidae	Hyboscolex	longiseta	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Acrocirridae	Acrocirrus	trisectus	N	0	0	0	1	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	1	1	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	1	1	0
Annelida	Polychaeta	Terebellida	Flabelligeridae	Flabelligera	affinis	N	0	0	0	1	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	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0
Annelida	Polychaeta	Terebellida	Flabelligeridae	Pherusa	parmata	N	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
Annelida	Polychaeta	Terebellida	Terebellidae	Nicolea	armilla	N	0	0	0	1	0		0	0	1	1		1	1	0	0		0	0	1	0	0	1	1	0	1	1	0	0	1	1	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1
Annelida	Polychaeta	Terebellida	Terebellidae	Pseudopista	rostrata	N	0	0	0	1	0		0	0	1	1		0	0	0	0		0	0	1	1	0	1	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	1	1
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	1	0	0	0	0	1	0	0	1	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Terebella	Terebella-B	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	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	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	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	Aeteidae	Aetea	australis	N	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	0
Ectoprocta	Gymnolaemata	Cheilostomata	Beaniidae	Beania	sp.	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	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	1	1	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bitectiporidae	Bitectipora	rostrata	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
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	0	0	1	0	0		1	1	0	0		0	1	0	0		0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	A	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	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Calloporidae	Valdemunitella	valdemunita	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
Ectoprocta	Gymnolaemata	Cheilostomata	Candidae	Tricellaria	inopinata	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
Ectoprocta	Gymnolaemata	Cheilostomata	Cryptosulidae	Cryptosula	pallasiana	A	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
Ectoprocta	Gymnolaemata	Cheilostomata	Eurystomellidae	Eurystomella	foraminigera	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
Ectoprocta	Gymnolaemata	Cheilostomata	Scrupariidae	Scruparia	ambigua	C1	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	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	0	0	0	0	0		1	0	0	0		1	0	0	1		1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Eudendriidae	Eudendrium	generale	A	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
Arthropoda	Cirripedia	Thoracica	Balanidae	Austrominius	modestus	N	0	0	0	0	0		1	0	0	0		1	0	0	0		0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Balanidae	Notomegabalanus	decorus	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	0	0	0	0	0	0	0	0	0	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	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
Arthropoda	Malacostraca	Amphipoda	Aoridae	Aoridae	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	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
Arthropoda	Malacostraca	Amphipoda	Aoridae	Haplocheira	barbimana	N	0	0	0	0	0		0	1	0	0		0	0	0	0		0	0	0	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Paradexamine	pacifica	N	0	0	0	0	0		0	1	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	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
Arthropoda	Malacostraca	Amphipoda	Isaeidae	Gammaropsis	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	1	0	0	0
Arthropoda	Malacostraca	Amphipoda	Leucothoidae	Leucothoe	trailli	N	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	sp. Aff. P. vesca	C2	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
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	vesca	N	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	1	0
Arthropoda	Malacostraca	Amphipoda	Melitidae	Melita	inaequistylis	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	0	0	0	0	0	0	0	0	0	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	Pagurus	traversi	N	0	0	0	0	0		0	0	0	1		0	0	0	0		0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	1	1	1	0	0	1	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	elongatus	N	0	1	1	1	0		0	0	1	1		0	1	0	0		0	0	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	1	0	1	1	1	1	1	0	1	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	novaezelandiae	N	0	0	0	0	1		0	0	1	1		0	0	0	1		0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Elamena	producta	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
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	innominatus	N	0	1	1	0	0		0	0	1	0		0	0	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	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	varius	N	0	0	0	0	0		0	0	0	0		0	0	1	1		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Neohymenicus	pubescens	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	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	minor	N	0	0	0	1	1		0	0	1	1		0	0	0	0		0	0	1	1	1	0	1	0	0	1	0	0	1	0	1	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	1	1	1	0	1	1	1	0	1	1	0	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	0	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

*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	Ferry Terminal 1/2																				Long Arm No1															Shakespeare Bay 2																Waitohi Wharf																
						Pile replicate	1										2										1							2								1								2								1								2								
						Pile position	IN					OUT					IN					OUT					IN			OUT				IN				OUT				IN				OUT				IN				OUT				IN				OUT				IN					OUT			
Arthropoda	Malacostraca	Brachyura	Pinnotheridae	Pinnotheres	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	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
Arthropoda	Malacostraca	Brachyura	Xanthidae	Pilumnus	lumpinus	N	0	0	0	0	0		0	0	1	1		0	0	0	0		0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	1	1	1	1	0	1	0
Arthropoda	Malacostraca	Isopoda	Cymothoidae	Ceratothoa	imbricata	N	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
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Pseudosphaeroma	campbellensis	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	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
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Allostichaster	insignis	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	1	1	0	0	1	1
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	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
Echinodermata	Asteroidea	Valvatida	Asterinidae	Meridiastra	mortenseni	N	0	0	0	0	0		0	0	0	0		1	0	1	1		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	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	1
Echinodermata	Echinoidea	Echinoida	Echinometridae	Evechinus	chloroticus	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	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	1	1	0	0	0	1
Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	Amphipholis	squamata	N	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	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
Mollusca	Bivalvia	Myoida	Hiatellidae	Hiatella	arctica	N	0	0	1	1	0		0	0	1	1		0	1	0	0		0	0	1	1	1	1	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	1	1	0	1	0	1	1	0	0	1	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya	atra maoriana	N	0	1	1	1	1		1	1	1	1		1	1	1	1		0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Modiolarca	impacta	N	0	0	0	1	0		0	1	1	1		0	1	0	0		0	0	0	0	0	0	1	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	1	1	1	1	0	1	1	0	0	1	0	1	1	0	1	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Modiolus	areolatus	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	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	C1	0	1	1	0	0		1	0	1	1		1	1	0	0		0	1	1	0	0	1	1	1	1	0	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Perna	canaliculus	N	0	1	0	0	0		0	1	1	0		0	1	0	0		0	1	0	1	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	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Xenostrobus	pulex	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	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
Mollusca	Bivalvia	Ostreoida	Ostreidae	Ostrea	chilensis	N	0	0	0	1	1		0	0	1	1		1	0	1	0		0	1	0	1	0	1	1	0	0	1	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	1	1	0	1	1	1	1	1	0	0	1	1	0	0	1	0	1
Mollusca	Bivalvia	Pterioida	Anomiidae	Pododesmus	zelandicus	N	0	0	0	1	1		0	0	0	1		0	1	0	0		0	0	1	1	1	1	0	0	0	1	0	0	0	0	1	0	0	1	1	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	1	1	1	1	1	0	0	1
Mollusca	Bivalvia	Pterioida	Pectinidae	Talochlamys	zelandiae	N	0	0	0	1	0		0	0	0	1		0	1	0	0		0	0	1	1	0	1	1	0	0	1	0	0	0	0	1	0	0	0	1	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	0	0	1	0	1	1	1
Mollusca	Bivalvia	Veneroida	Kelliidae	Kellia	cycladiformis	N	0	0	0	0	0		0	0	0	1		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	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	1	1
Mollusca	Bivalvia	Veneroida	Lasaeidae	Borniola	reniformis	N	0	0	0	0	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	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
Mollusca	Bivalvia	Veneroida	Semelidae	Leptomya	retiaria	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
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	N	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	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	Neogastropoda	Buccinidae	Buccinulum	vittatum	N	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	1	0	0	0	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	0	1	1	0	1	0	0	0	1
Mollusca	Gastropoda	Notaspidea	Pleurobranchidae	Pleurobranchaea	maculata	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Nudibranchia	Chromodorididae	Chromodoris	aureomarginata	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
Mollusca	Gastropoda	Nudibranchia	Polyceridae	Polycera	hedgpathi	C1	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
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	viridus	N	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	0	0	0	0	0	0	0	0	0	0	0	0	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	Polyplacophora	Acanthochitonina	Acanthochitonidae	Cryptoconchus	porosus	N	0	0	0	0	0		0	1	1	0		0	0	0	0		0	1	0	0	0	1	1	0	0	1	0	0	1	1	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	1	0	0	1	0	1	1	0	1	0	0	1	1
Algae (Unidentified)						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	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnionella	adnata	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	0	0	0	0	0	0	0	0	0	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	apiculatum	N	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	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	1	1	1	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	rubrum	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	1	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	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
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	0	0	1	0		0	0	1	0		0	0	0	0		0	1	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	0	0	0	0	1		1	0	0	0		0	0	0	0		0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	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	0	0	0	0	1	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Acrosorium	venulosum	N	0	0	0	0	0		0	0	0	1		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	1	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	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	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	affinis?	SI	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
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	variolosa	N	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	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	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	1	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Phycodrys	quercifolia	N	0	0	0	1	0		0	0	0	0		0	1	0	0		0	0	1	1	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	1	1	1	0	1	1	1	1	0	1	1	1	1	1	0	1	1
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	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	1	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	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	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	Rhodomelaceae	Polysiphonia	sp.	SI	0	0	0	0	0		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	0	0	0	0	0	0	0	0	0	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	Corallinales	Corallinaceae			SI	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	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Gelidiales	Gelidiaceae	Pterocladiella	capillacea	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Gigartinales	Cystocloniaceae	Craspedocarpus	erosus	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	0	0	0	0	0	0	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	Gigartinales	Kallymeniaceae	Callophyllis	sp.	SI	0	0	1	1	1		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	1	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
Rhodophyta	Florideophyceae	Gigartinales	Phyllophoraceae	Stenogramme	interrupta	N	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	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	Rhodymeniales	Lomentariaceae	Lomentaria	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	0	0	0	0	0	0	0	0	0	0	0	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	Rhodymeniales	Lomentariaceae	Lomentaria	umbellata?	SI	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	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	1	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	novazelandica	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	0	0	0	0	0	0	0	0	0	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	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	1	0	1		1	0	0	0		0	0	0	1		1	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	1	0
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Ectocarpoid	sp.	SI	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
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	1	0	0	0	0	1	1	1	0	0	1	0	1	0	0	1	1	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	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	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	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
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	sp.	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Enteromorpha	sp.	SI	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	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	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	0	0	0		0	1	0	0		0	0	0	0		0	0	1	0	0	0	0	0	1	1	1	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	1	1	0	0
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Dysidea	new sp. 1	C2	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	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	Dictyoceratida	Dysideidae	Dysidea	new sp. 3	C2	0	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	0	1	0	0	1	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	1
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Euryspongia	new sp. 1	C2	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	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
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 1	C2	0	0	1	0	0		1	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	0	0	0	0	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	punctata	N	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Halisarcida	Halisarcidae	Halisarca	dujardini	A	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongiae	Haplosclerida	Callyspongiidae	Callyspongia	cf. bathami	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Callyspongiidae	Callyspongia	diffusa	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	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	1	1
Porifera	Demospongiae	Haplosclerida	Callyspongiidae	Callyspongia	stellata	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	1	0	0	1	1	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	1	0	0	0	1	1
Porifera	Demospongiae	Haplosclerida	Callyspongiidae	Dactylia	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	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Porifera	Demospongiae	Haplosclerida	Chalinidae	Adocia	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	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
Porifera	Demospongiae	Haplosclerida	Chalinidae	Adocia	new sp. 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	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

*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	Ferry Terminal 1/2																				Long Arm No1															Shakespeare Bay 2																Waitohi Wharf																
						Pile replicate	1										2										1							2								1								2								1								2								
						Pile position	IN					OUT					IN					OUT					IN			OUT				IN				OUT				IN				OUT				IN				OUT				IN				OUT				IN					OUT			
Porifera	Demospongiae	Haplosclerida	Chalinidae	Chalinula	new sp. 2	C2	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	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	1	1	0	0	1	0	1	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	cf. isodictyale	N	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	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	cf. punctata	N	0	1	0	0	0		1	0	0	1		1	1	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	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	glabra	N	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	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	Haplosclerida	Chalinidae	Haliclona	new sp. 1	C2	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
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 14	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	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 6	C2	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	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
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	stelliderma	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	1	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Acarnidae	Iophon	proximum	C1	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	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
Porifera	Demospongiae	Poecilosclerida	Chondropsidae	Chondropsis	kirkii	C1	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	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	1	0	0	0	0	0	0	1	1
Porifera	Demospongiae	Poecilosclerida	Chondropsidae	Chondropsis	new sp. 1	C2	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
Porifera	Demospongiae	Poecilosclerida	Crellidae	Crella (Pytheas)	incrustans	C1	0	0	0	0	0		0	0	1	1		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	0	0	1	0	0	0	0	0	1	0	0	1	1
Porifera	Demospongiae	Poecilosclerida	Esperiopsidae	Esperiopsis	new sp. 1	C2	0	0	0	0	0		0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Porifera	Demospongiae	Poecilosclerida	Hymedesmiidae	Hymedesmia	microstrongyla	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	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	1	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Microcionidae	Clathria (Microciona)	dendyi	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Mycalidae	Mycale (Carmia)	new sp. 3	C2	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Mycalidae	Paraesperella	new sp. 1 (macrosigma	C2	0	0	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	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	1	0	1	0	0	0	1	1	0	1
Porifera	Demospongiae	Poecilosclerida	Tedaniidae	Tedania	diversiraphidiophora	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	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Porifera					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	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
Chordata	Ascidiacea	Aplousobranchia	Didemnidae			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	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Didemnidae	Didemnum	sp.	C1	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	1	0	1	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	1	0	0
Chordata	Ascidiacea	Phlebobranchia	Rhodosomatidae	Corella	eumyota	C1	0	0	0	1	0		0	1	1	1		0	0	0	0		0	0	1	0	1	1	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	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	1	1	1	1	1	1
Chordata	Ascidiacea	Stolidobranchia	Botryllinae	Botrylliodes	leachii	C1	0	0	0	0	1		0	0	1	1		1	1	1	0		1	1	1	0	1	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	1	0	0	1	0	1	1	1	1	0	0	0	1
Chordata	Ascidiacea	Stolidobranchia	Molgulidae	Molgula	mortenseni	N	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	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	cancellata	N	0	0	0	0	0		0	0	0	1		0	0	0	1		0	0	1	1	0	1	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	0	0	1	1	0	0	1	1	0	1	0	1	1	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	carnea	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	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
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	pulla	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	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	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	rugata	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	0	0	0	0	0	0	0	0	0	0	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
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	subuculata	N	0	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	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
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	cerea	C1	0	0	0	0	1		0	1	1	1		0	1	0	0		0	1	1	1	0	1	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	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	coerulea	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	1	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	bicornuta	N	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	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	0	0	1	1	1		0	1	1	1		1	1	0	1		0	1	0	1	1	1	1	0	1	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	0	1	1	1	1	0	0	1	1	0	1	0	1	0	1	1	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 6b. Results from the benthic grab samples.

Appendix 6b. Results from the benthic grab samples.

						Site code	Ferry Terminal 1/2			Long Arm No1			Long Arm No2			Shakespeare Bay 1			Shakespeare Bay 2			Waitohi End			Waitohi Wharf		
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**
Annelida	Polychaeta	Eunicida	Dorvilleidae	Schistomeringos	loveni	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Eunicida	Lumbrineridae	Abyssoninoe	galatheae	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Goniadidae	Glycinde	trifida	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	0	0	0	1	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	1	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	Eulalia-NIWA-3-stripey	C2	0	0	0	0	0	0	0	0	0	0	0	0	1	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	1	0	0	0	0	0	0
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	1	0	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Spionida	Spionidae	Prionospio	multicristata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Spionida	Spionidae	Spionidae	Indet	SI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Pista	pegma	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ectoprocta	Gymnolaemata	Cheilostomata	Scrupariidae	Scruparia	ambigua	C1	0	0	1	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	Liljeborgia	akaroica	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Melitidae	Ceradocus	chiltoni	N	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	traversi	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	elongatus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	innominatus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	varius	N	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1
Arthropoda	Malacostraca	Brachyura	Ocypodidae	Macrophthalmus	hirtipes	N	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Caridea	Palemonidae	Periclimenes	yaldwyni	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	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	Meridiastra	mortenseni	N	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Echinodermata	Holothuroidea	Apodid	Chiridotidae	Chirodota	nigra	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Echinodermata	Holothuroidea	Molpadiida	Caudinidae	Paracaudina	chilensis	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya	atra maoriana	N	1	0	0	0	0	0	0	1	0	0	0	0	1	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	0	0	1	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	C1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	hartvigiana	N	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Mollusca	Bivalvia	Pterioida	Anomiidae	Pododesmus	zelandicus	N	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	Theora	lubrica	A	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Tellinidae	Macomona	liliana	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Veneridae	Dosina	zelandica	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Turritellidae	Maoricolpus	roseus	N	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	Buccinulum	linea	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Buccinulum	vittatum	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Notaspidea	Pleurobranchidae	Pleurobranchaea	maculata	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Nudibranchia	Dorididae	Doriopsis	flabellifera	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	tiaratus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Mollusca	Polyplacophora	Ischnochitonina	Chitonidae	Rhyssoplax	aerea	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Polyplacophora	Lepidopleurina	Leptochitonidae	Leptochiton	inquinatus	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Algae (Unidentified)						SI	0	0	0	0	0	0	0	0	0	0	0	1	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	1	0	1	0	0	0	0	1	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	variolosa	N	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Phycodrys	quercifolia	N	0	0	0	0	0	0	0	0	0	0	1	0	1	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	1	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae			SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	aff. dichotoma	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	linearis?	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Dysidea	new sp. 3	C2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Chalinula	new sp. 2	C2	1	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	maxima	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Mycalidae	Paraesperella	new sp. 1 (macrosigma)	C2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Didemnidae			SI	1	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	cancellata	N	0	0	0	0	0	0	0	1	0	0	0	0	1	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	1	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	0	0	0	1	0	0	0	0	0	0	0	0	1	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	Ferry Terminal 1		Long Arm No1				Shakespeare Bay 2			Waitohi East		Waitohi End		Waitohi West	
phylum	**class**	**order**	**family**	**genus**	**species**	***class_code**	**1**	**2**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**1**	**2**
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	capensis	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	1	0	1	0	0	0	0	0	1	1	0	1	0	1	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Scrupariidae	Scruparia	ambigua	C1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	elongatus	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	novaezelandiae	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	innominatus	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Halicarcinus	varius	N	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	minor	N	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	ursus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Caridea	Crangonidae	Pontophilus	australis	N	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Caridea	Hippolytidae	Hippolyte	bifidirostris	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Mysidacea		Mysidacea	sp.	SI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Allostichaster	insignis	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Meridiastra	mortenseni	N	1	0	1	1	0	0	0	0	0	1	0	0	0	0	1
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	1	1	0	0	1	1	0	1	0	0	0	0	1
Echinodermata	Echinoidea	Echinoida	Echinometridae	Evechinus	chloroticus	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Apodid	Chiridotidae	Chirodota	nigra	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	N	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya	atra maoriana	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	C1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Nuculoida	Nuculidae	Nucula	hartvigiana	N	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0
Mollusca	Bivalvia	Ostreoida	Ostreidae	Ostrea	chilensis	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Semelidae	Theora	lubrica	A	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Bivalvia	Veneroida	Veneridae	Austrovenus	stutchburyi	N	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Caenogastropoda	Turritellidae	Maoricolpus	roseus	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Notaspidea	Pleurobranchidae	Pleurobranchaea	maculata	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Nudibranchia	Dorididae	Rostanga	muscula	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Micrelenchus	artizona	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	tiaratus	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mollusca	Polyplacophora	Acanthochitonina	Acanthochitonidae	Cryptoconchus	porosus	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	crassiuscula	A	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Apoglossum	montagneanum	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	sp.	SI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	variolosa	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Myriogramme	denticulata	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Phycodrys	quercifolia	N	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Schizoseris	dichotoma	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	SI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Halymeniales	Halymeniaceae	Grateloupia	urvilleana	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0
Ochrophyta	Phaeophyceae	Fucales	Sargassaceae	Carpophyllum	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Dysidea	new sp. 3	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Euryspongia	new sp. 1	C2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 1	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	punctata	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Porifera	Demospongiae	Halisarcida	Halisarcidae	Halisarca	dujardini	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongiae	Haplosclerida	Callyspongiidae	Callyspongia	stellata	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 14	C2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 4	C2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 6	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Acarnidae	Iophon	proximum	C1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Crellidae	Crella (Pytheas)	incrustans	C1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Hymedesmiidae	Phorbas	fulva	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Poecilosclerida	Mycalidae	Paraesperella	new sp. 1 (macrosigma)	C2	1	0	1	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	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	picta	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	1	1	1	1	0	0	0	0	0	1	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 6d. Results from the dinoflagellate cyst core samples.

Appendic 6d. Results from the dinoflagellate cyst samples.

							No 1 Berth				**Shakespeare Bay 2**		**Waitohi End**		**Waitohi West**	
phylum	**class**	**order**	**family**	**genus**	**species**	**class_code**	1	2	3	4	1	2	1	2	1	2
Dinophyta	Dinophyceae	Gymnodiniales	Polykrikaceae	Pheopolykrikos	sp.	SI	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Gymnodiniales	Polykrikaceae	Polykrikos	schwartzii	N	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Gonyaulax	grindleyi	N	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Gonyaulax	scrippsae	N	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Gonyaulax	spinifera	N	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Protoceratium	reticulatum	N	0	0	1	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Lingulodinium	polyedrum	N	0	0	0	0	1	0	0	1	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	conicum	N	1	0	0	0	1	0	0	0	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	leonis	N	0	0	1	0	0	0	0	1	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	oblongum	N	0	0	0	0	0	0	0	1	0	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	sp.	SI	1	0	1	0	1	0	0	0	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Scrippsiella	trochoidea	N	1	0	1	0	0	0	0	1	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.

Appendix 6e. Results from the fish trap samples.

Appendix 6e. Results from the fish trap samples.

						Site code	Aquarium				No 1 Berth				No 2 Berth				Ro-Ro Pontoon				Shakespeare Bay 1				Shakespeare Bay 2				Town Basin				Waitohi West				Waitohi Wharf				Westshore			
						Trap line	1		2		1		2		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**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	sp.	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	0	0	0	0	0	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	0	0	0	0	0	0	0	1	1	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Mugiliformes	Mugilidae	Aldrichetta	forsteri	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	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Mugiliformes	Mugilidae	Parapercis	colias	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
Vertebrata	Actinopterygii	Perciformes	Carangidae	Pseudocarynx	dentex	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
Vertebrata	Actinopterygii	Perciformes	Cheilodactylidae	Nemadactylus	macropterus	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
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Vertebrata	Actinopterygii	Perciformes	Sparidae	Pagrus	auratus	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	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 6f. Results from the crab trap samples.

Appendix 6f. Results from the crab trap samples.

						Site code	
						Trap line	
phylum	**class**	**order**	**family**	**genus**	**species**	***class_code**	**2**
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	sp.	SI	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	peronii	N	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	sp.	SI	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	N	0
Mollusca	Gastropoda	Caenogastropoda	Turritellidae	Maoricolpus	roseus	N	0
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Turbo	smaragdus	N	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	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	**Aquarium**				**No 1 Berth**				**No 2 Berth**				**Oil Berth #2**		**Shakespeare Bay 1**				**Shakespeare Bay 2**		**Town Basin**				**Waitohi West**				**Waitohi Wharf**				**Westshore**			
						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**	**1**	**2**	**1**	**2**
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	sp.	SI	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	1
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	sp.	SI	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	0	0	0	0	0	0	0	1	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	1	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	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	1	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	Aquarium	No 1 Berth		No 2 Berth				Oil Berth #2		Shakespeare Bay 1				Shakespeare Bay 2				Town Basin				Waitohi Wharf				Westshore	
						Trap line	2	2		1		2		2		1		2		1		2		1		2		1		2		1	2
phylum	class	order	family	genus	species	*class_code	1	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	1
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Cirolana	quechso	N	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
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	rossi	N	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	sp. nov.	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

*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 6h. Results from the starfish trap samples.

						Site code	
						Trap line	
phylum	**class**	**order**	**family**	**genus**	**species**	***class_code**	**2**
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Cirolana	quechso	N	0
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	rossi	N	0
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	sp. nov.	N	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.

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 two that were 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. It was recorded in the repeat survey of Picton from Waitohi Wharf. The other amphipod, *Meridiolembos* sp., appears to be different to the other species in this genus, but as the genus is endemic to New Zealand, it can be safely regarded as a native species that is a new record for New Zealand. This taxon was recorded from the first baseline survey of the Port of Picton but not in the re-survey.

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