TECHNICAL PAPER

BIOSECURITY NEW ZEALAND

Port of Timaru

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

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Prepared for MAFBNZ Post Border Directorate
by Graeme Inglis, Nick Gust, Isla Fitridge, Oliver Floerl, Chris Woods, Marie Kospartov, Barbara Hayden, Graham Fenwick

NIWA
Taihoro Nukurangi

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Requests for further copies should be directed to:

Biosecurity Surveillance Group
Post-border Directorate

MAF Biosecurity New Zealand
Pastoral House,
25 The Terrace
P O Box 2526
WELLINGTON

Tel: 04 894 4100
Fax: 04 894 4227

This publication is also available on the MAF Biosecurity New Zealand website at http://www.biosecurity.govt.nz/about-us/our-publications/technical-papers.

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Executive summary

- This report describes the results of a repeat port baseline survey of the Port of Timaru undertaken in November 2004. 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 Timaru undertaken in February 2002.

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

- To allow a direct comparison between the initial baseline survey and the resurvey of the Port of Timaru, the survey used the same methodologies, occurred in the same season and, where possible, 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 Timaru. 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 Timaru 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 275 species or higher taxa were identified in the first survey of the Port of Timaru in February 2002. They consisted of 172 native species, 15 non-indigenous species, 39 cryptogenic species (those whose geographic origins are uncertain) and 49 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level).

- During the repeat survey, 230 species or higher taxa were recorded, including 136 native species, 21 non-indigenous species, 33 cryptogenic species and 40 species indeterminata. Many species were common to both surveys. Around 59% of the native species, 57% of non-indigenous species, and 58% of cryptogenic species recorded during the repeat survey were also found in the earlier survey.

- The 21 non-indigenous organisms found in the repeat survey of the Port of Timaru included representatives of 6 major taxonomic groups. The non-indigenous species detected were: *Euchone limnicola*, *Spirobranchus polytrema*, *Polydora hoplura* (Annelida); *Bugula flabellata*, *B. neritina*, *Cryptosula pallasiana*, *Celleporaria nodulosa*, *Watersipora subtorquata* (Bryozoa); *Monotheca pulchella*, *Amphisbetia maplestonei?*, *Symplectoscyphus subdichotomus*, *Synthecium subventricosum* (Cnidaria); *Caprella mutica*, *Apocorophium acutum*, *Monocorophium acherusicum*, *Jassa marmorata*, *J. slatteryi*, *J. staudei* (Crustacea); *Griffithsia crassiuscula*, *Undaria pinnatifida* (Macroalgae); *Ciona intestinalis* (Urochordata). Nine of these species – *Spirobranchus polytrema*, *Polydora hoplura* (Annelida); *Celleporaria nodulosa* (Bryozoa); *Monotheca pulchella*, *Amphisbetia maplestonei?*, *Symplectoscyphus subdichotomus*, *Synthecium subventricosum* (Cnidaria); *Jassa marmorata*, *J. staudei* (Malacostraca) – were not recorded in the earlier baseline survey of the Port of Timaru. In addition, 3 non-indigenous species that were present in the first survey – *Barantolla lepte* (Annelida), *Cancer gibbosulus* (Crustacea) and *Polysiphonia sublitissima* (Macroalgae) – were not found during the repeat survey.

- 17 species recorded in the repeat survey had not been described from New Zealand waters prior to the baseline surveys. Five of these were non-indigenous species (a polychaete worm, *Spirobranchus polytrema*, a bryozoan, *Celleporaria nodulosa*, a hydroid, *Amphisbetis maplestonei*, and two amphipods, *Caprella mutica* and *Jassa staudei*). The remaining 12 species do not correspond with existing species descriptions from New Zealand or overseas and may be new to science.

- The only species from the Port of Timaru on the New Zealand register of unwanted organisms is the Asian kelp, *Undaria pinnatifida*. This alga is known to now have a wide distribution in southern and eastern New Zealand.

- 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 86 % (18 of 21 species) of NIS in the Port of Timaru are likely to have been introduced in hull fouling assemblages, and 14 % (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 Timaru (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). Transport by shipping has enabled hundreds of marine species to spread worldwide and establish populations in shipping ports and coastal environments outside their natural range (Cohen and Carlton 1995; Hewitt et al. 1999; Eldredge and Carlton 2002; Leppakoski et al. 2002).

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

BIOLOGICAL BASELINE SURVEYS FOR NON-INDIGENOUS MARINE SPECIES

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

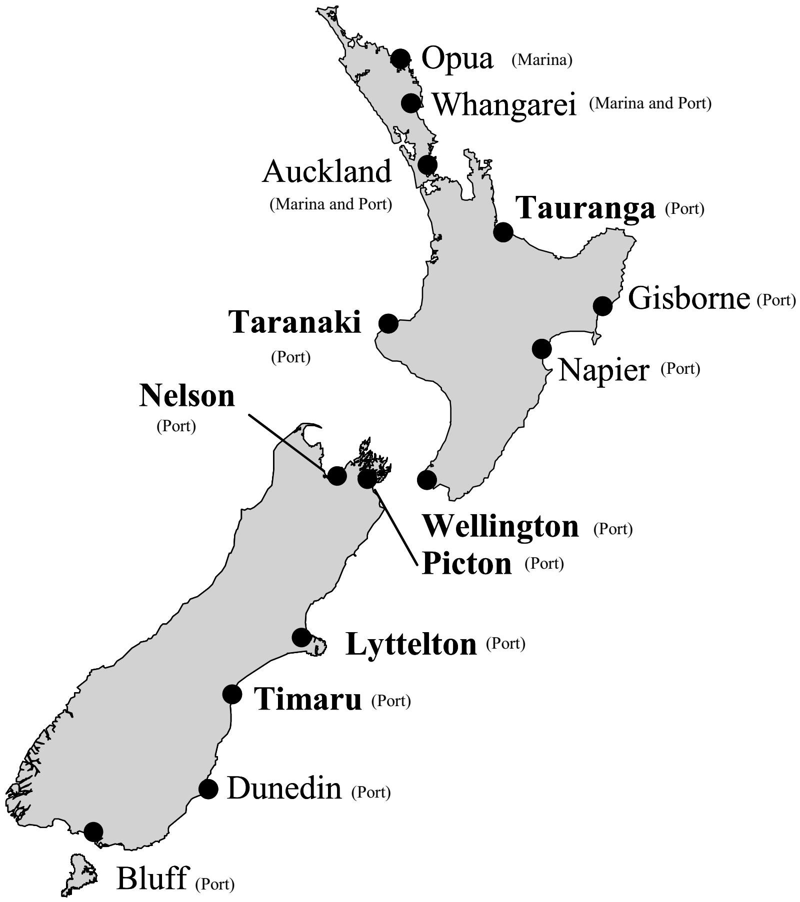


Figure 1: Commercial shipping ports in New Zealand where baseline non-indigenous species surveys have been conducted. Group 1 ports surveyed in the summer of 2001/2002 and re-surveyed in the summer of 2004/2005 are indicated in bold and Group 2 ports surveyed in the summer of 2002/2003 are indicated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

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

The surveys have two stated objectives:

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

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

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

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

Worldwide, port surveys based on the CRIMP protocols have been completed in at least 37 Australian ports, at demonstration sites in China, Brasil, the Ukraine, Iran, South Africa, India, Kenya, and the Seychelles Islands, at six sites in the United Kingdom, and are underway at 10 sites in the Mediterranean (Raaymakers 2003). Despite their wide use, there have been few evaluations of the survey methods or survey design to determine their sensitivity for individual unwanted species or to determine the completeness of biodiversity inventories based upon them. Inglis et al. (2003) used a range of biodiversity metrics to evaluate the adequacy of sample effort and distribution during the initial New Zealand survey of the Port of Wellington and compared the results with those from seven Australian port baseline surveys. In general, they concluded that the surveys provided an adequate description of the richness of the assemblage of non-indigenous species present in the ports, but that the total richness of native and cryptogenic species present in the survey area was likely to be under estimated. The authors made a number of recommendations for future surveys that included increasing the sample effort for benthic infauna, maximising dispersion of samples throughout the survey area (rather than allocation based on CRIMP priorities) and modification of survey methods or design components which had high complementarity in species composition. Both Inglis et al. (2003) and a more recent study by Hayes et al. (2005) on the sensitivity of the survey methods concluded that generalised port surveys, such as these, are likely to under-sample species that are very rare or 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 Timaru undertaken in November 2004, approximately 3 years after the initial baseline survey. In the manner of the first survey (Inglis et al. 2006) we provide an inventory of species recorded during the survey and their biogeographic status as either native, introduced ("non-indigenous") or cryptogenic. Organisms that could not be identified to species level are also listed as species indeterminata (see "Definitions of species categories", in methods section).

The report is intended as a stand-alone record of the re-survey and, as such, we reiterate background information on the Port of Timaru, 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 TIMARU

General features

The Port of Timaru is on the central east coast of New Zealand's South Island (Figure 2), south of Caroline Bay (44° 25'S. 171° 15'E). It is an artificial harbour, protected by two man-made concrete breakwaters. Vessels of up to 228 m in length and up to 10.9 m draft regularly use the Port due to its wide, deep approach channel and the sheltered inner harbour environment. The approach channel is 1.5 nautical miles long (www.primeport.co.nz).

The first Māori to settle in the district appear to have inhabited the caves and rock overhangs in the limestone country of the Opihi and Opuha River gorges, and were followed by the Rapuwai and Ngāti Māmoe. In 1837 Joseph Price, established a shore station at Patiti (Jacks) Point, with a subsidiary station at Whalers Creek. In 1853 the Canterbury Provincial Government defined the town boundaries and residents began to arrive. Progress was slow and by 1874 the population was still less than 2,000, chiefly because of the difficulties of access. Port facilities were non-existent and ships were moored out in the open roadstead. Wrecks were frequent. A landing service was initiated by the Provincial Government in 1864 and in 1870 a local authority, the Timaru and Gladstone Board of Works, completed a groyne which was the first step in the development of harbour works. A harbour board was formed in 1877 and a 300-ft breakwater begun in the following year. By 1881 it had been extended in stages to 2,000 ft. The eastern extension, which makes the harbour safe in all weathers, was begun in 1900 and finished in 1906 (Hassall 1955). The Port of Timaru handled 273,076 tons in 1964, the major exports being frozen meat, timber, wool, and manufactured goods (www.teara.govt.nz).

The coastal zone in the vicinity of Timaru harbour is a high-energy environment with large northward-directed fluxes of a wide range of sediment sizes. Sediment transport past the Port occurs in two different but closely related systems. The harbour was formed from part of an extensive gravel beach ecosystem that runs along the South Canterbury coastline (Thrush 1986). These gravel beaches are highly mobile and are generally biologically impoverished due to storm driven wave action and turbidity, which influences the structure of benthic communities (Thrush 1986).

Figure 2: Caroline Bay and Timaru coast map

Port operation, development and maintenance activities

The Port of Timaru is currently New Zealand's second largest fishing port and is run by PrimePort Timaru (www.primeport.co.nz). The Port incorporates seven main terminals of varying depths and lengths (Figure 3 and Table 1). The largest of these is the North Mole Container Terminal, which at 460 m length is capable of handling a wide variety of cargo such as containers, fertiliser, woodchips and livestock. The other terminals range from 100 to 220 m in length and handle reefer exports, logs, bulk chemicals, diesel bunkers, grains and fish imports/exports (Table 1). Berth construction is a mixture of concrete and wood decking on predominantly Australian hardwood piles.

Vessels unable to be berthed immediately in the port may anchor outside the port, 1.5 nautical miles southeast of the Fairway beacon (44°24.2'S, 171°19.2'E). Pilotage is compulsory on vessels over 500 GRT or in excess of 44 m in length (Roger Dunn, PrimePort Timaru, pers. comm.).

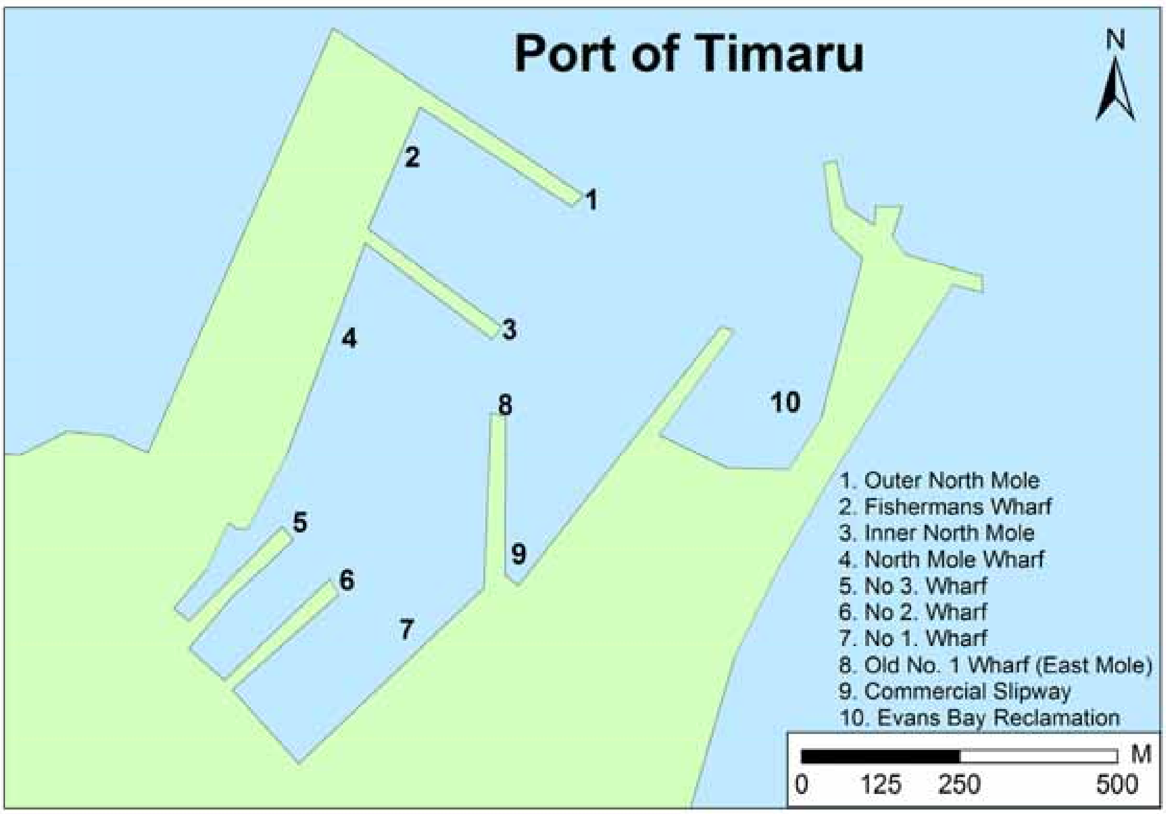


Figure 3: Port of Timaru map

Maintenance dredging is conducted when necessary, and may occur from one to three times per year. Approximately 160,000 m^3 of spoil is removed per year (Peter Hunter, Hunter Hydrographic Services, pers. comm.). PrimePort Timaru has an inshore spoil ground (Spoil Ground C) approximately 1 km off Washdyke Beach, at typically 6.0 m depth, and an offshore spoil ground (Spoil Ground A) where all clays are deposited, 3 km offshore and typically 11 m deep. Spoil Ground A is also a general foul weather ground for when site conditions do not lend to placing spoil in the shallow site.

The Port conducted a major capital works campaign in 2002/2003, with capital dredging of around 271,000 m^3 to increase the entrance channel depth to approximately 11 m and the basin to approximately 10.3 m depth below chart datum (P. Hunter, pers. comm.). This total consisted of 64,000 m^3 dredged by the backhoe dredger "Heron" between November 2002 and February 2003 from the basin (24,400 m^3), the inner entrance channel (24,500 m^3) and the North Mole berth pocket (15,100 m^3, mostly clay). The remaining 207,000 m^3 was dredged as part of a larger campaign by the dredger "Pelican", virtually all from the entrance channel. Of the 64,000 m^3 dredged by the "Heron", approximately 51,400 m^3 was deposited in Spoil Ground A, approximately 1,770 m^3 was deposited in Spoil Ground C, and the remaining approximately 11,000 m^3 (consisting of sands, gravels and silts) was deposited in the Evans Bay reclamation area on the south side of the port (P. Hunter, pers. comm.).

In the latter half of 2002 the outer 250 m of the North Mole berth was sheet piled and the dredging of the berth pocket (as detailed above) resulted in an increased depth at that end of the berth to 11.5 m (P. Hunter, pers. comm.).

There is an ongoing project to move beach (pea shingle/gravel) material from South Beach to the Evans Bay reclamation area. Several coldstores were built in 2002, and a large dairy dry goods store was completed in January 2004, but these additions did not involve in-water works (P. Hunter, pers. comm.).

Imports and exports

PrimePort Timaru exchanged 1.2 million tonnes of cargo across the Timaru wharves in 2004 and 1.24 million tonnes in 2005 (PrimePort Timaru Ltd 2005). Of this, non-containerised cargo handled in 2005 was the equivalent of 671,000 tonnes, up by 20,000 tonnes compared to the previous year. Container volumes were 55,300 TEU[2] in the 2004 financial year and decreased in the 2005 financial year to 53,600 TEU, mainly due to the reduction in empty container movements into Timaru for servicing and distribution (www.primeport.co.nz; PrimePort Timaru Ltd 2005). As New Zealand's second largest fishing port, the principal users of the Port of Timaru are fishing vessels and the main imports and exports are seafood (www.primeport.co.nz; PrimePort Timaru Ltd 2005).

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

Imports

Both the weight and value of overseas cargo unloaded at the Port of Timaru increased each year since the 2002 initial baseline survey, with 336,612 tonnes gross weight, valued at $362 million, being unloaded in the year ended June 2005 (Statistics New Zealand 2006b). This represents an increase in weight of 43 % and in value of 112 % compared to the year ending June 2002 (Table 2). Overseas cargo unloaded at the Port of Timaru accounted for less than 2 % by weight and around 1 % by value of the total overseas cargo unloaded at New Zealand's seaports (Table 2).

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

The Port of Timaru imported cargo in 94 different commodity categories between 2002 and 2005 inclusive (Statistics New Zealand 2006a). The dominant commodities by value imported at the Port of Timaru during this time were boilers, machinery and mechanical appliances (17 %), fertilisers (12 %), iron and steel (11 %), vehicles (9 %), and mineral fuels, oils, waxes and bituminous substances (8 %; Figure 4). The first four commodities ranked in the top four each year from 2002 to 2005, with boilers and machinery ranking first each year except except 2003, when it ranked second.

The Port of Timaru received imports from 101 countries of initial origin[3] between 2002 and 2005 inclusive (Statistics New Zealand 2006a). During this time, the Port of Timaru imported most of its overseas cargo by value from Japan (25 %), the Republic of Korea (15 %), the People's Republic of China (7 %), and Germany (6 %; Figure 5). Japan ranked first every year. Korea and China ranked third or fourth each year, except in 2002 when China ranked ninth. Germany ranked in the top five each year except in 2002, and Saudi Arabia and the United Kingdom ranked in the top ten each year (Statistics New Zealand 2006a).

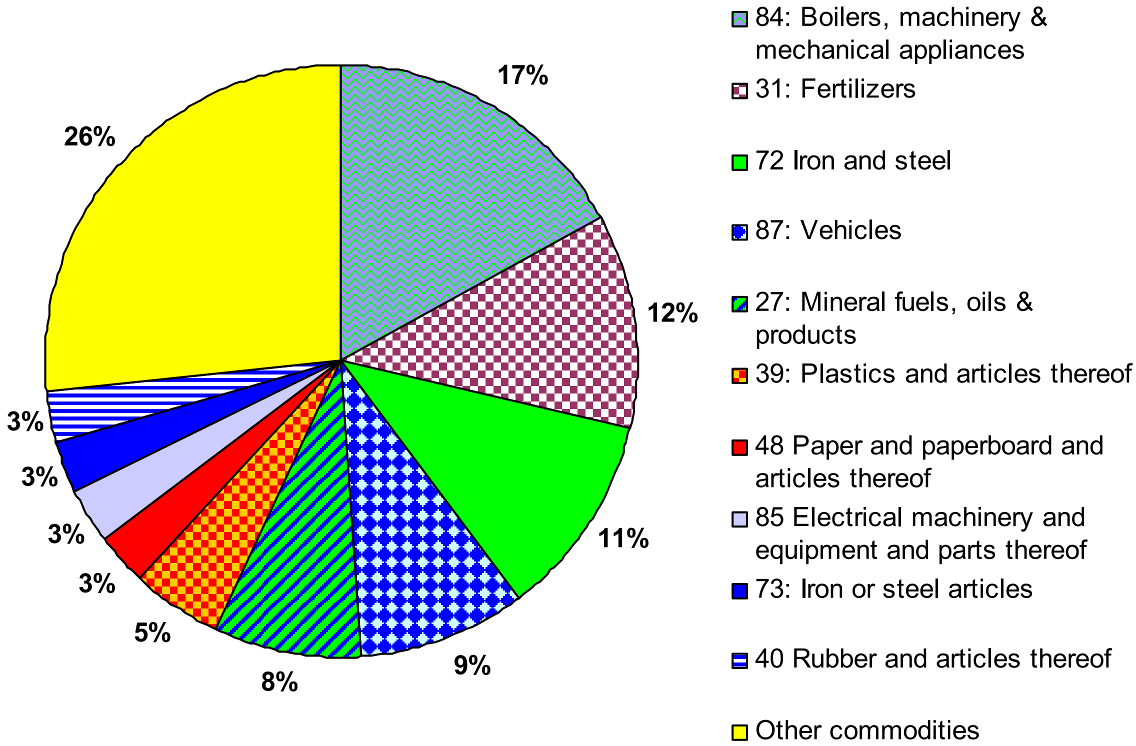


Figure 4: Top 10 commodities by value unloaded at the Port of Timaru summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a). Commodity category descriptions have been summarised for brevity; category numbers are provided in the legend and full descriptions are available at Statistics New Zealand (2006a).

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

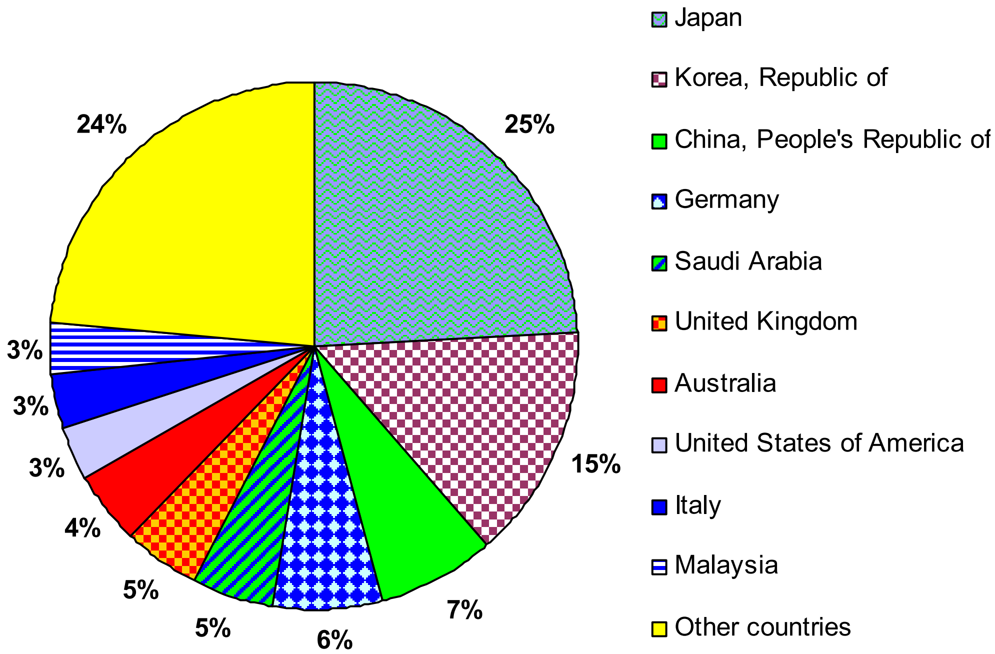


Figure 5: Top 10 countries of initial origin that cargo was unloaded from at the Port of Timaru. The data are percentages of the total volume of cargo unloaded in the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).

Exports

In the financial year ending June 2005, the Port of Timaru loaded 401,664 tonnes of cargo for export (Statistics New Zealand 2006b). This represented an almost 64 % increase by weight compared to the financial year ending June 2002, with 57 % of the increase occurring between the financial years ending 2002 and 2003 (Table 3). The value of this cargo increased by 68 % since the year ending June 2002, with a value of $1,021 million in the year ending June 2005. For the financial years ending June 2002 to 2005, overseas cargo loaded at the Port of Timaru accounted for around 1-2 % by weight and around 2-4 % by value of the total overseas cargo loaded at New Zealand's seaports (Table 3).

The Port of Timaru exported cargo in 62 different commodity categories between 2002 and 2005 inclusive (Statistics New Zealand 2006a). The dominant commodity categories by value loaded at the Port of Timaru for export during this time were dairy produce, bird's eggs, natural honey and other edible animal products (48 %), meat and edible meat offal (19 %), fish, crustaceans, molluscs and other aquatic invertebrates (10 %) and wool and animal hair (6 %; Figure 6). The same 5 commodities ranked in the top 5 each year, and in the same order each year as the total for 2002 to 2005 combined. PrimePort Timaru (2005) reported their major exports in the 2004-2005 financial year as seafood, grain, bulk chemicals, livestock, vegetables, and MDF forestry products. Timaru is the major South Island export port for bulk tallow (PrimePort Timaru Ltd 2005).

The Port of Timaru loaded cargo for export to 144 countries of final destination[4] between 2002 and 2005 inclusive (Statistics New Zealand 2006a). During this time, the Port of Timaru exported most of its overseas cargo by value to the People's Republic of China (13 %), the USA (12 %), Japan (6 %), and the United Kingdom (5 %; Figure 7). China ranked first and

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

the USA second in all years except 2002, when their ranks were reversed (Statistics New Zealand 2006a).

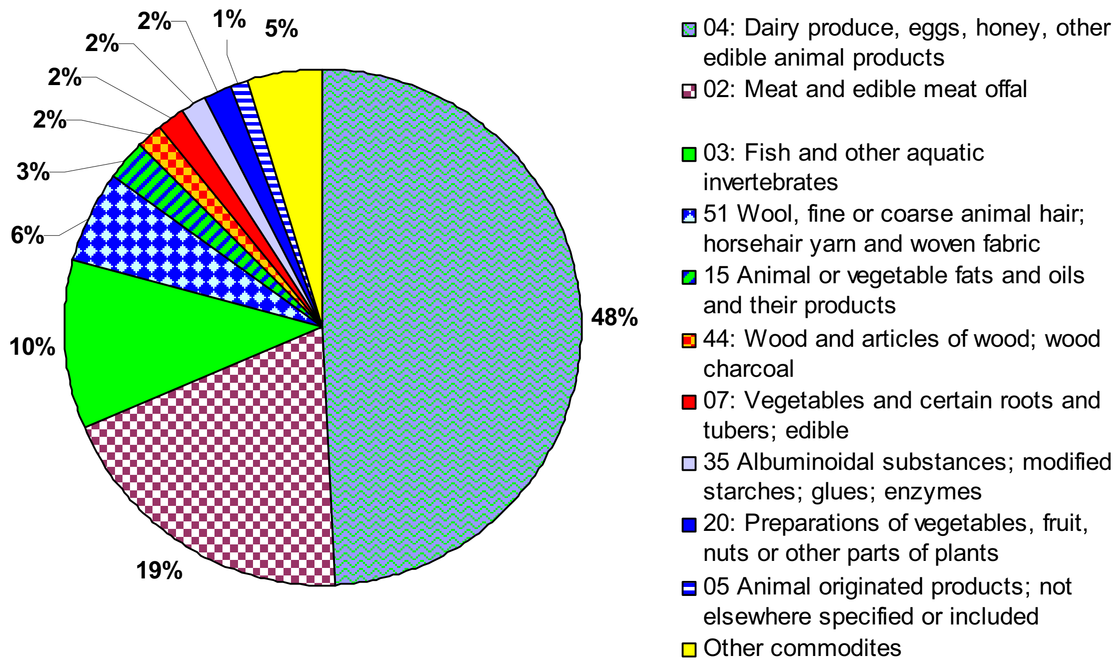


Figure 6: **Top 10 commodities by value loaded at the Port of Timaru summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a). Commodity category descriptions have been summarised for brevity; category numbers are provided in the legend and full descriptions are available at Statistics New Zealand (2006a).**

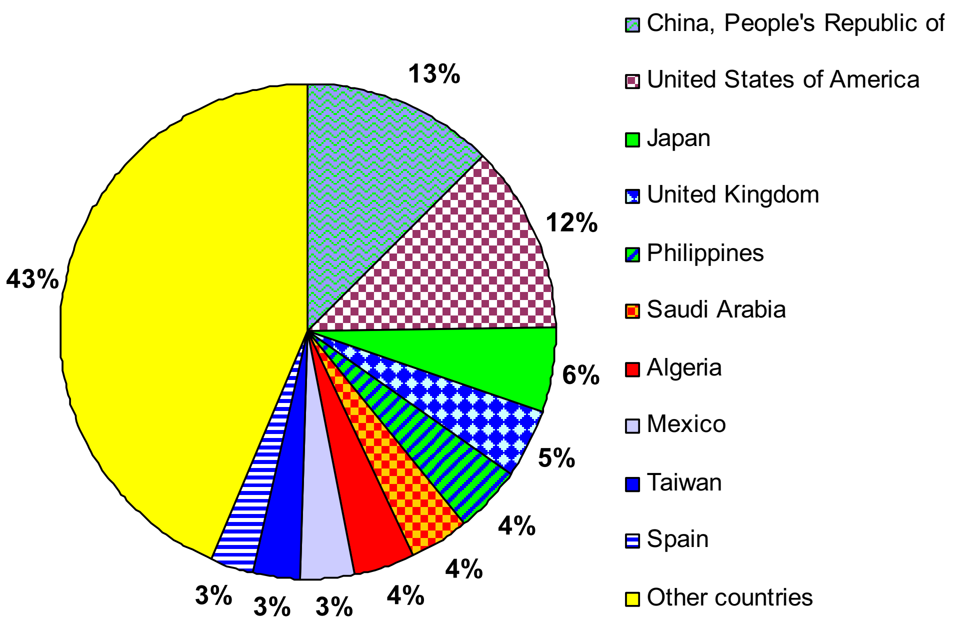


Figure 7: **Top 10 countries of final destination that the Port of Timaru loaded overseas cargo for summed over the period January 2002 to December 2005 inclusive (data sourced from Statistics New Zealand 2006a).**

Shipping movements and ballast discharge patterns

A total volume of 3,885 m^3 of ballast water was discharged in the Port of Timaru in 1999 (Inglis 2001), with the largest country-of-origin volumes of 3,012 m^3 from South Korea, 177 m^3 from Australia, and 696 m^3 unspecified. Since June 2005, vessels have been required to comply with the Import Health Standard for Ships' Ballast Water from All Countries (www.fish.govt.nz/sustainability/biosecurity). No ballast water is allowed to be discharged without the express permission of an MAF (Ministry of Agriculture and Forestry) inspector. To allow discharge, vessels Masters are responsible for providing the inspector with evidence of either: discharging ballast water at sea (200 nautical miles from the nearest land, and at least 200m depth); demonstrating ballast water is fresh (2.5 ppt sodium chloride) or having the ballast water treated by a MAF approved treatment system.

Since 2000, the number of ship visits peaked in the 2002-2003 financial year with over 400 visits (PrimePort Timaru Ltd 2005). PrimePort Timaru recorded 391 ship visits in the 2004 financial year (www.primeport.co.nz) and 373 in the 2005 financial year (PrimePort Timaru Ltd 2005). Fishing vessels registered in the Port of Timaru numbered 30 in the year 2000 (Sinner et al. 2000).

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

The database, therefore, gives a good indication of the movements of international and domestic vessels involved in trade, but ferry trips are not recorded, nor are trips by small domestic fishing vessels or recreational vessels. Furthermore, a small number of vessel movement records in the database are incomplete, resulting in those movements being excluded from the analysis. As a result, the database is unlikely to include every movement that occurred at the port and therefore total movement numbers would be lower than those actually recorded by the port. Definitions of geographical area and vessel type categories are given in Appendix 1.

International vessel movements

Based on an analysis of the LMIU database, there were 105 vessel arrivals to the Port of Timaru from overseas ports between 2002 and 2005 inclusive (Table 4). These arrived from 20 different countries represented by parts of the Pacific, Asia, the Middle East, the Americas and Europe. The greatest number of overseas arrivals during this period came from the following areas: Australia (45 arrivals), east Asian seas (18), the northwest Pacific (12), areas not stated in the database (9), and the Gulf States (6; Table 4). Vessels arriving from Australia came mostly from ports in Queensland (15 arrivals), Victoria (11) and New South Wales (10), followed by 6 from Tasmania and 3 from Western Australia (Table 5). The major vessel types arriving from overseas at the Port of Timaru were container ships and Ro/Ro (20 arrivals), general cargo vessels and bulk / cement carriers (18 arrivals each), fishing vessels (17) and tankers (16 arrivals; Table 4).

During the same period 109 vessels departed from the Port of Timaru to 23 different countries represented by most regions of the world. The greatest number of departures for overseas sailed for the following areas: Australia (44 movements), the northwest Pacific (18), east Asian seas (14), Central America (10) and Japan (8; Table 6). The major vessel types departing to overseas ports from the Port of Timaru were tankers (43), container ships and ro / ro (19), bulk / cement carriers (15), general cargo vessels (13) and passenger / vehicle / livestock carriers (12; Table 6).

Domestic vessel movements

The LMIU database contains movement records for 1,208 vessel arrivals to the Port of Timaru from New Zealand ports between 2002 and 2005 inclusive. These arrived from 16 different ports in both the North and South Islands (Table 7). The greatest number of domestic arrivals during this period came from Timaru (ie. closed-loop trips; 356 arrivals, mostly fishing vessels), followed by Napier (195 arrivals), Wellington (129 arrivals), Auckland (104 arrivals) and Lyttelton (95 arrivals). Fishing vessels were the dominant vessel type arriving at the Port of Timaru on domestic voyages (382 arrivals) followed by container ships and Ro/Ro's (295 arrivals), general cargo vessels (249 arrivals), and tankers (175 arrivals; Table 7).

During the same period, the LMIU database contains movement records for 1,191 vessel departures from the Port of Timaru to 15 New Zealand ports in both the North and South Islands. Movement patterns for domestic departures closely matched the movement patterns for arrivals, with fishing vessels on closed-loop trips back to Timaru representing the greatest number of domestic voyage departure movements from the Port of Timaru (332 of 356 closed-loop departures; Table 8). This was followed by departures from Timaru to Tauranga (137), Dunedin (120), Nelson (98) and Bluff (90). Fishing vessels were the dominant vessel type departing from the Port of Timaru on domestic voyages (382 departures). The next most frequent vessel type departing the Port of Timaru on domestic voyages was container ships and Ro/Ro's (295 departures), general cargo vessels (253), tankers (148) and bulk / cement carriers (97; Table 8).

A commercial vessel, the *Rangatira*, operated by Leslie Shipping, provides a regular freight and livestock carriage service between the Port of Timaru, the Port of Napier, and the Chatham Islands (including Pitt Island).

EXISTING BIOLOGICAL INFORMATION

Several biological studies have taken place just outside the Port of Timaru, most recently as part of studies investigating levels of heavy metal contaminants or assessing the ecological effects of dredging the main shipping channel to the Port. In addition, the supplement of information from the initial NIWA baseline survey of Timaru Harbour (Inglis et al. 2006) has made a valuable addition to the biological information available in the area. This is explained further in the next section. Other studies are related to the biological effects of proposed reclamation works within the Port. We briefly review these studies below, and note that none of these surveys has specifically focused on collecting and identifying non-indigenous marine species.

Jillett (1979) reported on the biological effects of the proposed Evans Bay reclamation, as part of an environmental impact assessment by the Timaru Harbour Board. Benthic samples were collected from the sublittoral zone by dredge in the area of the proposed development, and the intertidal zone was also visually examined. Although animals present were typical of those known elsewhere from New Zealand, the conditions at the site were deemed unstable as there was no evidence of a particularly established benthic population. A limited species list was produced.

Thrush (1986) investigated the ecological implications of a proposed extension of the sea-wall and re-alignment of the beach at South Beach, Timaru. The study was part of a larger environmental impact assessment completed by the Timaru Harbour Board. Visual observations were made of the immediate area upon which the proposed groin would impact. The proposed extension was thought unlikely to significantly affect the ecology of the area. Thrush (1986) also makes reference to the fact that coarser gravel sediments of the type found at Timaru will result generally in a low abundance and biomass of organisms. Furthermore he expected that frequent and severe disturbance due to wave action (and associated sand and gravel scour) would reduce diversity and abundance of flora and fauna along both the outer and more sheltered inner parts of the sea-wall.

The invasive kelp *Undaria pinnatifida* was identified in the Port of Timaru in 1987, and this port is deemed to be in the optimal temperature zone for this macroalga (Sinner et al. 2000).

Royds Consulting Limited (1994) was commissioned by the Port of Timaru to undertake a study of the diversity, abundance and age structure of the benthic community outside the Port. They found a healthy community, high in density and diversity of species covering a broad spectrum of phyla. The fauna characterised both open sand beaches and an annelid assemblage typical of fine sediments and muds. Lists of specimens were produced for each of the study sites. Typically, only molluscs, decapod crustaceans and larger invertebrates were identified to species. Many of the polychaetes and smaller crustaceans were identified only to genus or family level.

Bunckenburg (1997) repeated the Royds Consulting sampling of 1994, and investigated the diversity and abundance of the benthic faunal community at nine offshore sites in the approaches to Timaru Harbour. A total of 6,179 individuals collected from 61 taxa were identified in this study, with polychaetes dominating the fauna. Again, no non-indigenous species were described.

Bunckenburg undertook a further study in 2000 (Bunckenburg 2000). The most striking feature from this study was the presence of large densities of the native Venus shell *Dosinia anus* at all but two sample sites. Maximum densities in excess of 3,300 animals per m^2 were recorded at some sites. No holothurians were present in any of the samples taken, while the prior study had shown the group to be an important member of the local benthic assemblage.

Fenwick (2001) assessed the likely ecological effects of deepening, extending and realigning the main shipping channel and dumping spoil from these operations closer to the Washdyke shore, north of the Port of Timaru. Faunal assemblages from the channel were representative of those over a wide area within the depth zone north and south of the Port, and reported to be of no major significance in terms of New Zealand's marine biodiversity. The bivalve *Theora lubrica* was the only non-indigenous species recorded.

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

Fenwick and Gust (2005) surveyed the benthic infauna quantitatively and mapped the particle size composition and metal contents of bottom sediments in the Port of Timaru and Caroline Bay in December 2004. The study identified 119 benthic species, but within the Port, polychaetes were almost the only benthic animal present (with *Scolecolepides benhami* and *Euchone sp. B* especially common). Total faunal densities increased with distance from shore within the Port operational area. The faunal density at the Port of Timaru sampling stations had a low similarity to those stations in Caroline Bay. The report found no compelling evidence for change in the benthos at the stations sampled in the Port of Timaru between 2004 and a 1998 study for Canterbury Regional Council. As far as the authors could determine with the taxonomic level, the benthic fauna recorded was very similar to that reported elsewhere on the east coast of the South Island, including many widespread species such as *Macrophthalamus hirtipes, Scolecolepides benhami, Prionospio* sp., *Agalaophamus* sp., *Spisula aequilateralis* and *Torridoharpinia hurleyi*. The Timaru harbour stations had different sediment characteristics to the other stations, with silts in the Port of Timaru and medium to very fine sands at undredged stations. Faunal distribution patterns were strongly correlated with particle size and metal content. Species lists were not provided in the report and no reference was made to the presence or absence of non-indigenous species.

PrimePort Timaru conducts sediment sampling from the port basin for trace metal analysis. No high levels have been detected for any metal, except for high background levels of chromium, especially in 1991 (126 +/- 5 µg $g^{-}1$) (P. Hunter, pers. comm.).

RESULTS OF THE FIRST BASELINE SURVEY

An initial baseline survey of the Port of Timaru was completed in February 2002 (Inglis et al. 2006) The report identified a total of 282 species or higher taxa from the Timaru port survey. They consisted of 177 native species, 16 non-indigenous species, 27 cryptogenic species (those whose geographic origins are uncertain) and 62 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level). Twenty-one species of marine organisms collected from the Port of Timaru had not previously been described from New Zealand waters. Three of these were newly discovered non-indigenous species (a crab, *Cancer gibbosulus*, an amphipod, *Caprella mutica*, and an ascidian, *Cnemidocarpa sp.*), and 18 were considered cryptogenic. The 18 cryptogenic species included eight species of amphipod, a pycnogonid, an ascidian, and eight species of sponge that did not match existing descriptions and may be 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*). The revised summary statistics for the Port of Timaru following re-classification were 172 native species, 15 non-indigenous species, 39 cryptogenic species and 49 species indeterminata. These revisions have been incorporated into the comparison of data from the two surveys below.

The 15 non-indigenous organisms described from the Port of Timaru included representatives of five major taxonomic groups. The non-indigenous species detected were *Euchone limnicola*, *Barantolla lepte* (Annelida); *Bugula flabellata, Bugula neritina, Cryptosula pallasiana, Watersipora subtorquata* (Bryozoa); *Caprella mutica, Apocorophium acutum, Monocorophium acherusicum, Jassa slatteryi, Cancer gibbosulus* (Crustacea); *Undaria pinnatifida, Griffithsia crassiuscula, Polysiphonia subtilissima* (Macroalgae); and *Ciona intestinalis* (Urochordata). The only species on the New Zealand register of unwanted organisms found in the Port of Timaru 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 67 % (10 of 15 species) of non-indigenous specis in the Port of Timaru were likely to have been introduced in hull fouling assemblages, and 33 % (five species) could have been introduced by either ballast water or hull fouling vectors.

Methods

SURVEY METHOD DEVELOPMENT

To allow a direct comparison between the initial baseline survey and the resurvey of the Port of Timaru, 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 9. Further details are provided in Gust et al. (2001).

Baseline survey protocols are intended to sample a variety of habitats within ports, including epibenthic fouling communities on hard substrata, soft-sediment communities, mobile invertebrates and fishes, and dinoflagellates. Below, we describe the methods and sampling effort used for the second baseline survey of the Port of Timaru. The survey was undertaken between November 22nd and 26th, 2004.

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 8). 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 9), 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 8: Diver sampling organisms on pier piles.

Figure 9: 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 10). 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 10: 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 11). 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.

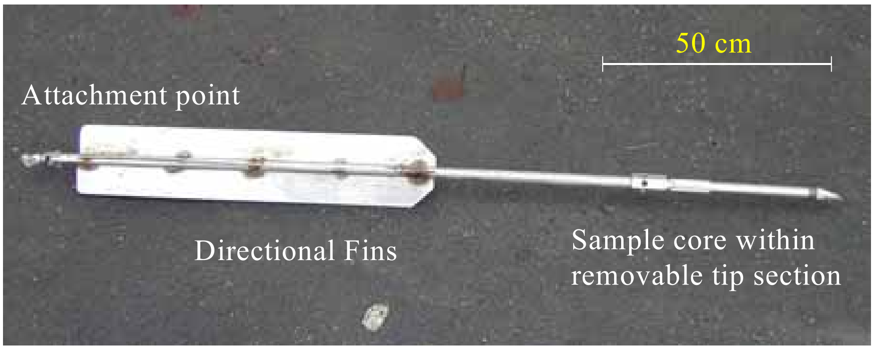


Figure 11: **Javelin corer**

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 12). 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 12). 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 12). 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.

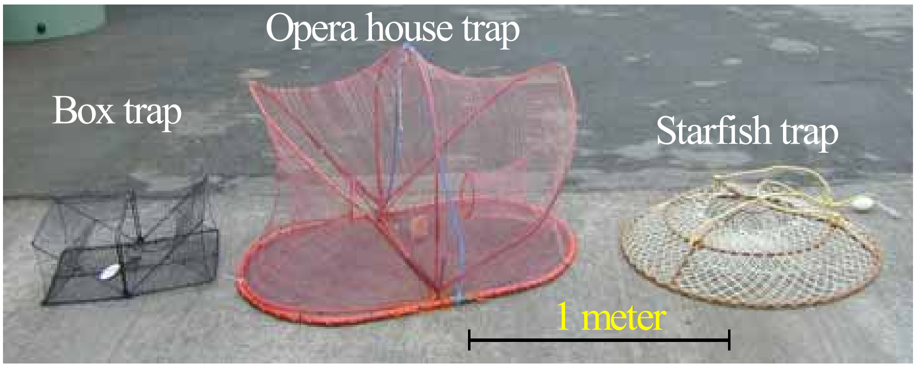


Figure 12: Trap types deployed in the port.

VISUAL SEARCHES

Opportunistic visual searches from above water were conducted at six sites in the port. Observers searched for non-indigenous organisms fouling the breakwalls and associated structures.

SAMPLING EFFORT

A summary of sampling effort during the second baseline survey of the Port of Timaru is provided in Table 10, and the exact geographic locations of sample sites are given 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 four berths – Fisherman's Wharf, North Mole, Wharf 1, and Wharf 3 - that were spread throughout the port and which represented a range of active berths and lay-up areas (Figure 3). Additional trap, benthic grab and benthic sled samples were taken near Inner North Mole and Outer North Mole and duplicate javelin cores were taken from four sites distributed throughout the port (Inglis et al. 2006) . Most of these same locations were sampled during the re-survey of the port, but pile scrape sampling was conducted at Wharf 2 instead of Wharf 1. To improve description of the flora and fauna in the resurvey, we increased sampling effort by adding an additional berth site for all survey techniques (East Mole), and sampling was extended to the eastern side of the Port at Reclamation Point, for traps, benthic grabs and benthic sleds.

The spatial distribution of sampling effort for each of the sample methods in the Port of Timaru is indicated in the following figures: diver pile scrapings (Figure 13), benthic sledding (Figure 14), box, starfish and shrimp trapping (Figure 15), opera house fish trapping (Figure 16), shipek grab sampling (Figure 17), javelin cyst coring (Figure 18) and visual searches (Figure 19).

SORTING AND IDENTIFICATION OF SPECIMENS

Each sample collected in the diver pile scrapings, benthic sleds, box, starfish and shrimp traps, opera house fish traps, shipek grabs and javelin cores was allocated a unique code on waterproof labels and transported to a nearby field laboratory where it was sorted by a team into broad taxonomic groups (e.g. ascidians, barnacles, sponges etc.). These groups were then preserved and individually labelled. Details of the preservation techniques varied for many of the major taxonomic groups collected, and the protocols adopted and preservative solutions used are indicated in Table 11. Specimens were subsequently sent to over 25 taxonomic experts (Appendix 3) for identification to species or lowest taxonomic unit (LTU). We also sought information from each taxonomist on the known biogeography of each species within

New Zealand and overseas. Species lists compiled for each port were compared with the marine species listed on the New Zealand register of unwanted organisms under the Biosecurity Act 1993 (Table 12) and the marine pest list produced by the Australian Ballast Water Management Advisory Council (Table 13).

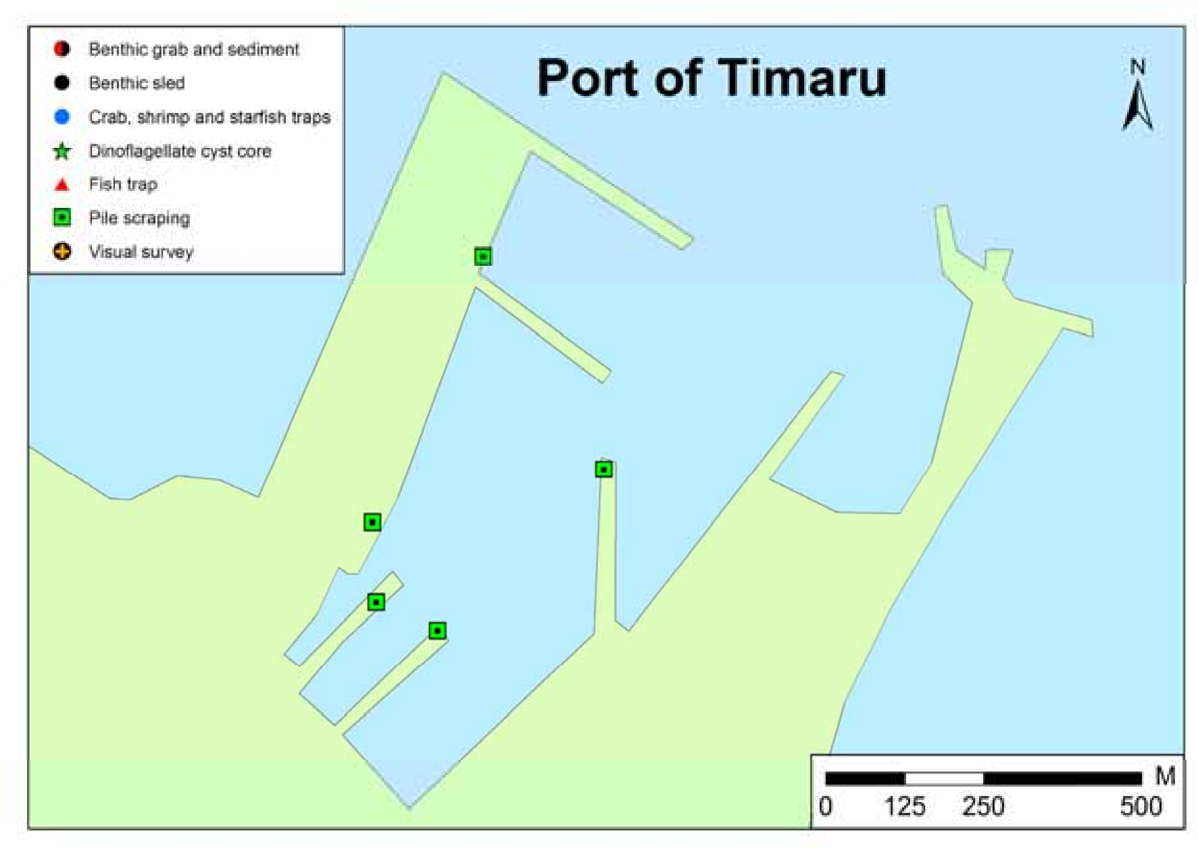


Figure 13: Diver pile scraping sites

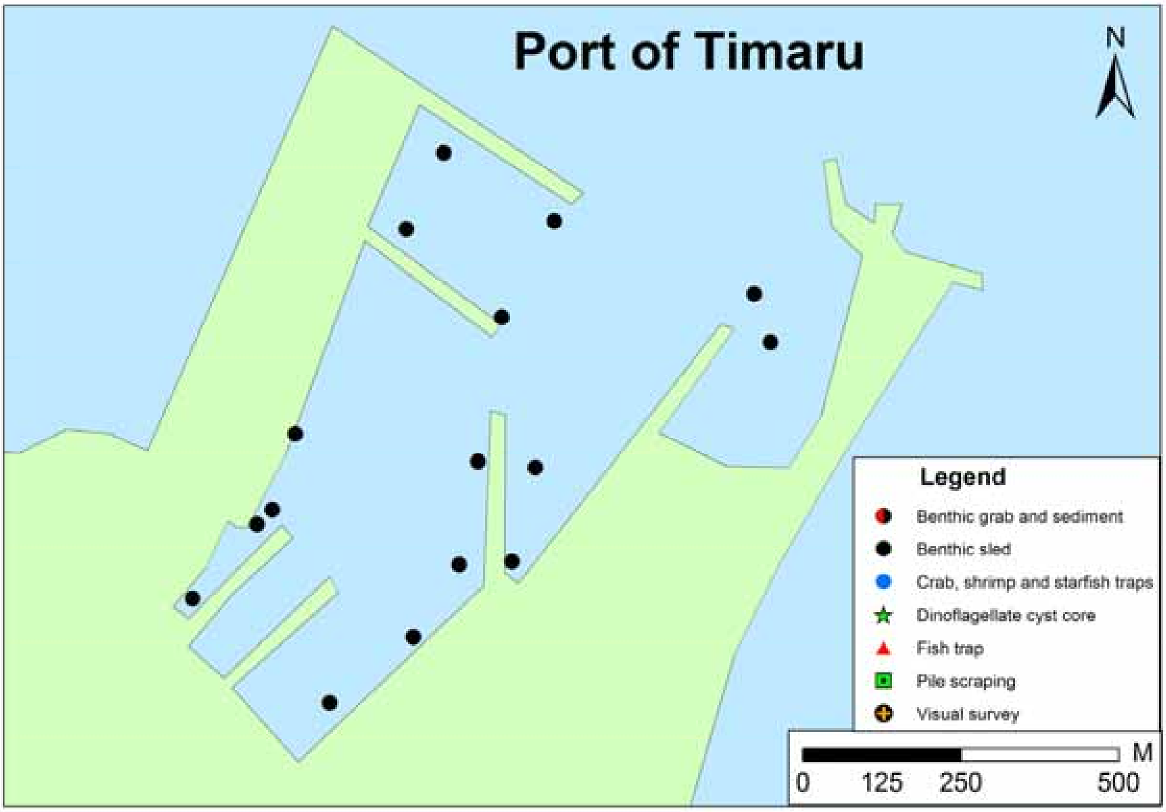


Figure 14: Benthic sled sites

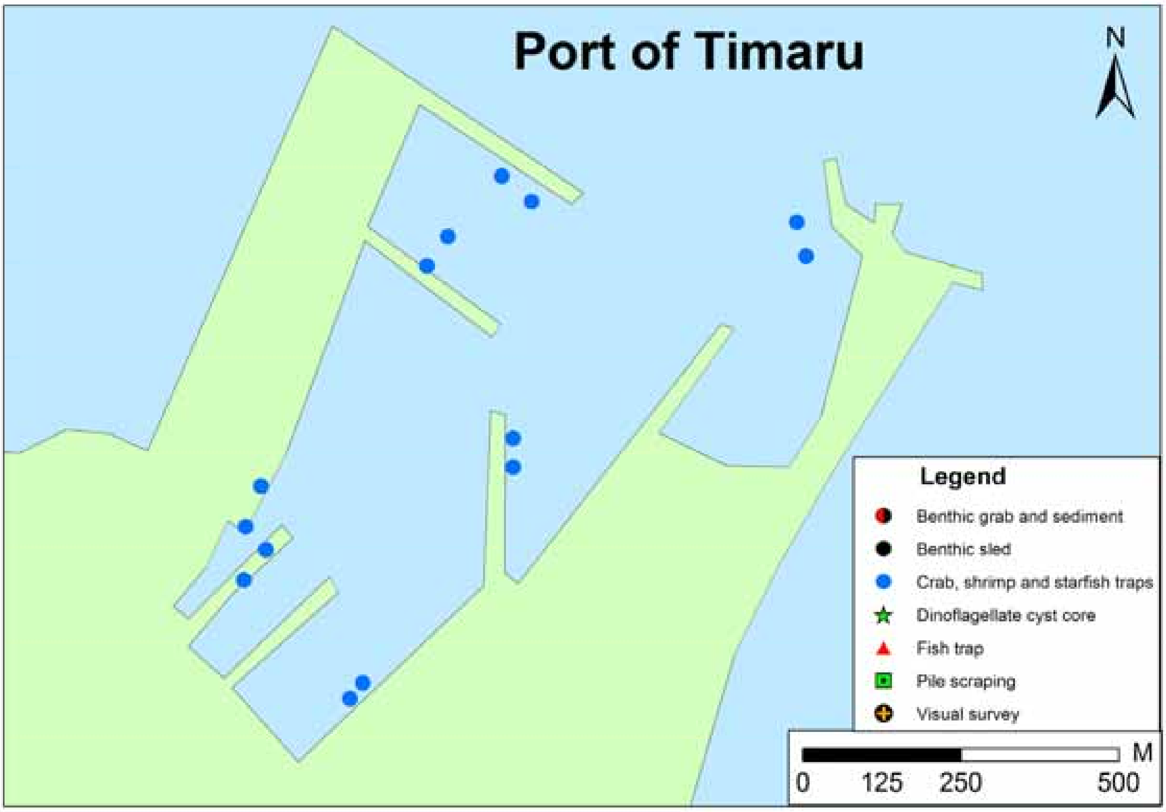


Figure 15: Sites trapped using box (crab), shrimp and starfish traps

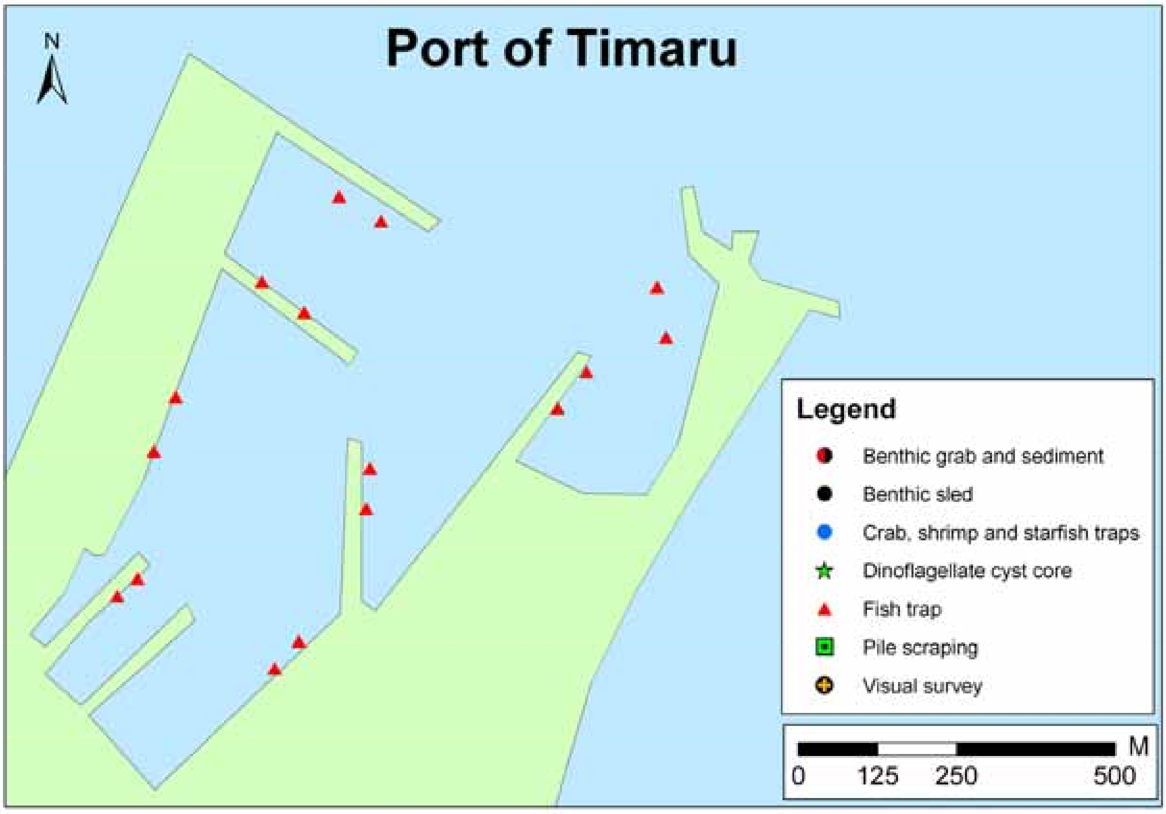


Figure 16: Opera house (fish) trapping sites

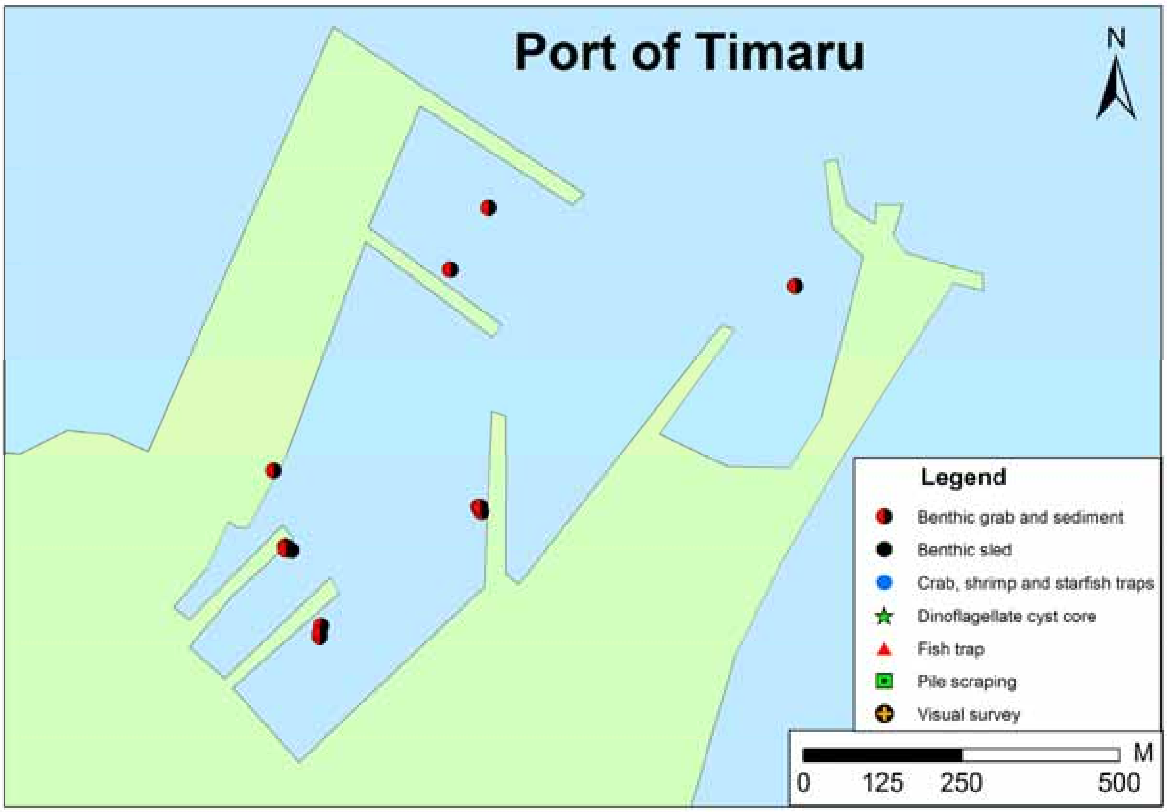


Figure 17: Shipek benthic grab sites

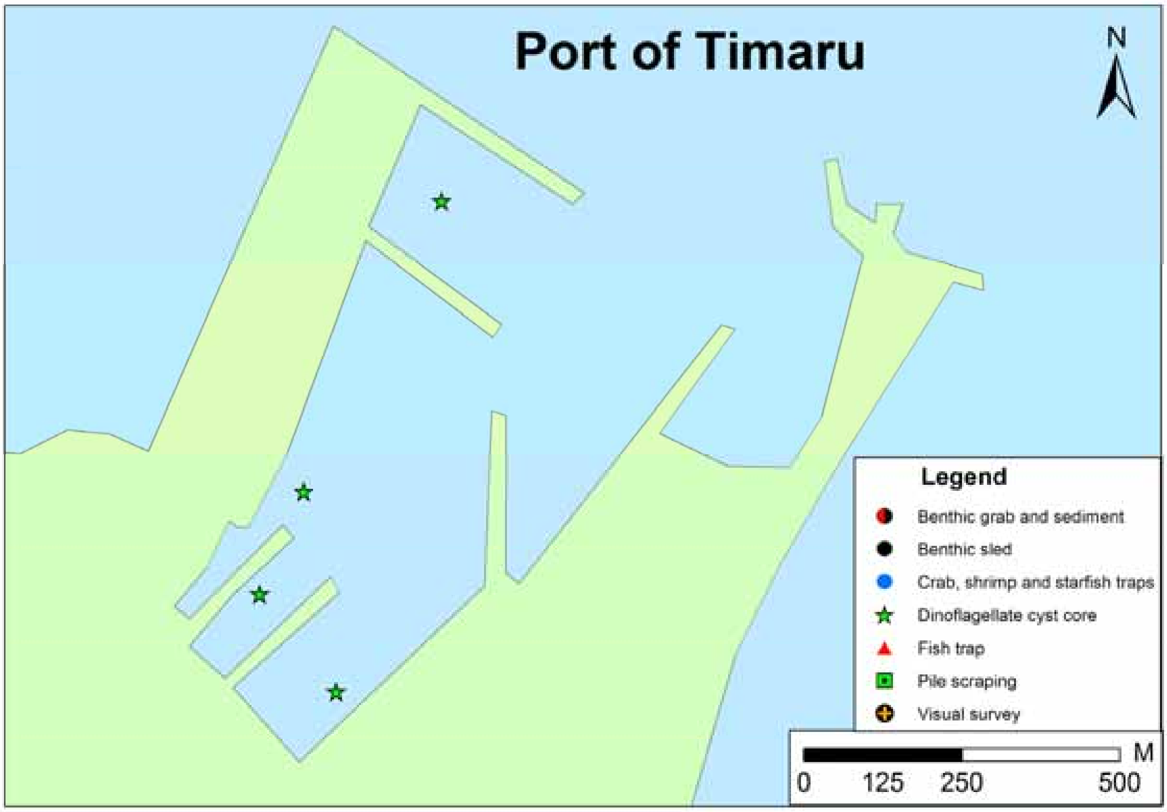


Figure 18: Javelin core sites

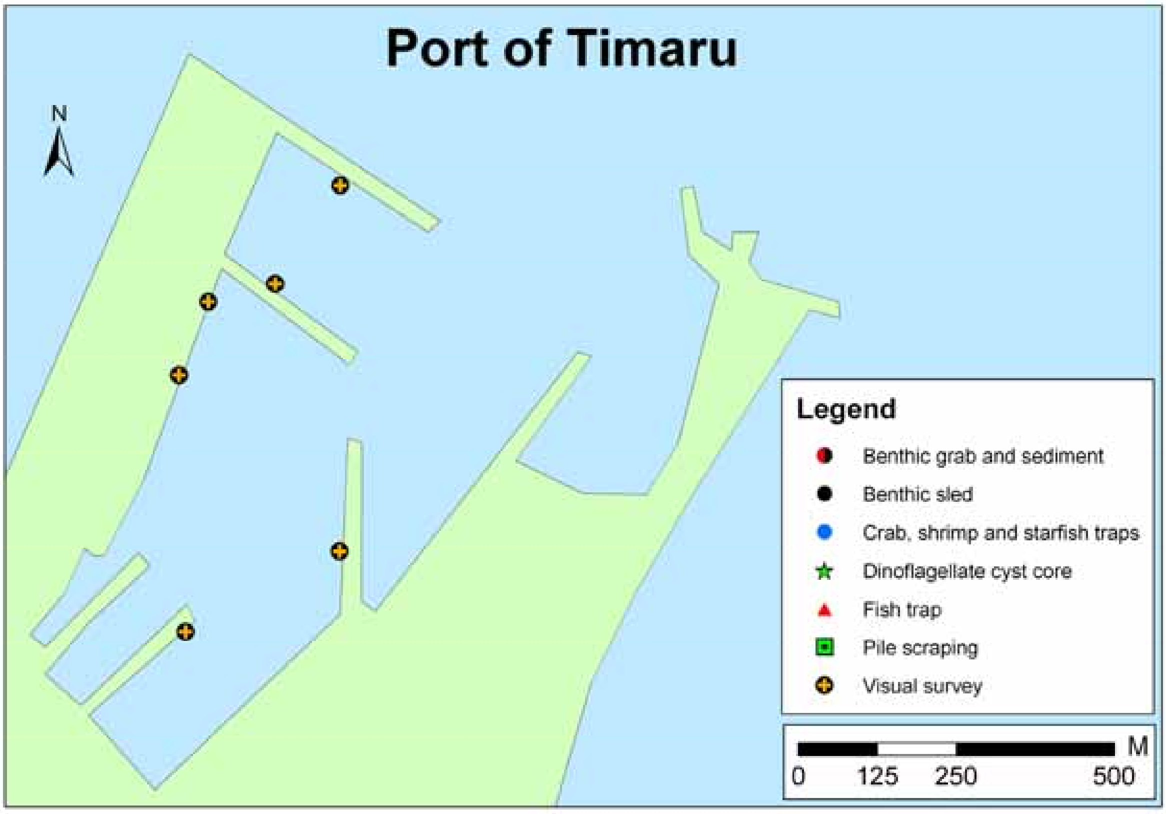


Figure 19: Above-water visual search sites

DEFINITIONS OF SPECIES CATEGORIES

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

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

Native species

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

Non-indigenous species (NIS)

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

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

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

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

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

Cryptogenic species Category 1

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

Cryptogenic species Category 2

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

Species indeterminata

Specimens that could not be reliably identified to species level. This group includes: (1) organisms that were damaged or juvenile and lacked morphological characteristics necessary for identification, and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow identification to species level.

DATA ANALYSIS

Comparison with the initial baseline survey

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

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

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

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

Sample-based rarefaction curves

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

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

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

Estimates of total species richness

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

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

Similarity analyses

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

Survey results

A total of 230 species or higher taxa were identified from the re-survey of the Port of Timaru. This collection consisted of 136 native (Table 14), 33 cryptogenic (Table 15), and 21 non-indigenous species (Table 16), with the remaining 40 taxa being made up of species indeterminata (Figure 20). By comparison, 275 taxa were recorded from the initial survey of the port, comprising 172 native, 39 cryptogenic, 15 non-indigenous species and 49 species indeterminata.

The biota in the re-survey included a diverse array of organisms from 13 major taxonomic groups (Figure 21). 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.

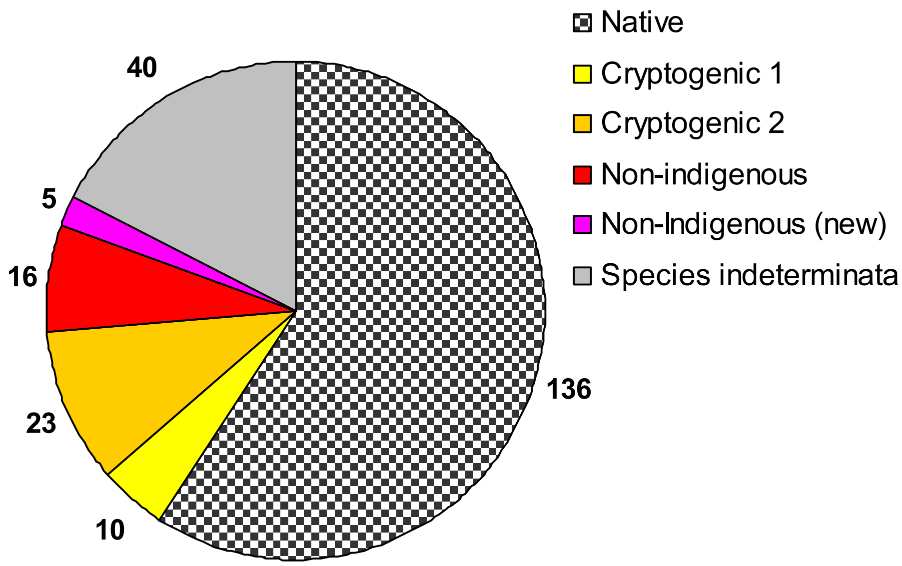


Figure 20: **Diversity of marine species sampled in the Port of Timaru. Values indicate the number of taxa in each category.**

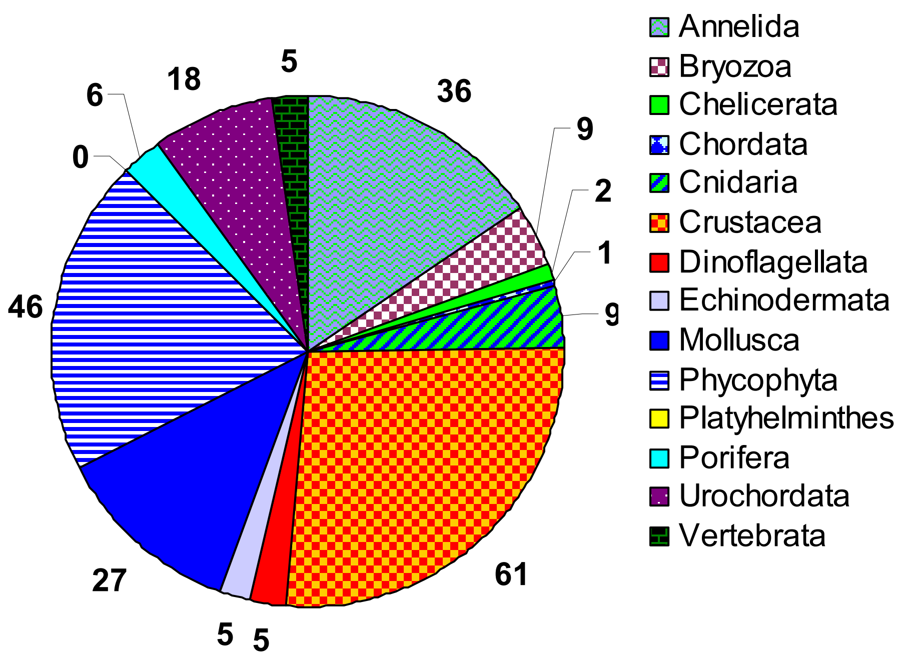


Figure 21: **Major taxonomic groups sampled in the Port of Timaru. Values indicate the number of taxa in each of the major taxonomic groups.**

NATIVE SPECIES

The 136 native species recorded during the resurvey of the Port of Timaru represented 59 % of all species identified from this location (Table 14) and included crustaceans (36 species), molluscs (25 species), algae (24 species), annelids (20 species), urochordates (9 species), vertebrates (6 species), echinoderms (5 species) bryozoans (4 species), dinoflagellates (4 species), chelicerates (1 species) and cnidarians (2 species; Table 14).

CRYPTOGENIC SPECIES

Cryptogenic species ($n = 33$) represented 14 % of all species or higher taxa identified from the Port. The cryptogenic organisms identified included 10 Category 1 and 23 Category 2 species as defined in "Definitions of species categories" above. These organisms included 10 annelids, 6 sponges, 5 crustaceans, 6 ascidians, 3 cnidarians, 1 alga, 1 mollusc, and 1 pycnogonid species (Table 15). Two of the Category 1 cryptogenic species (the hydroids *Obelia dichotoma* and *Halecium delicatulum*) were not recorded in the initial baseline survey of the port. Three of the 11 Category 1 species recorded in the initial baseline survey of the Port of Timaru were not found during the re-survey (the bryozoan *Scruparia ambigua*, the pycnogonid *Achelia* sp. cf. *A. australiensis* and the sponge *Crella (Pytheas) incrustans*). Several of the Category 1 cryptogenic species (e.g the hydroids *Halecium delicatulum* and *Plumularia setacea,* the mussel *Mytilus galloprovincialis*, and the ascidians *Aplidium phortax*, *Asterocarpa 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).

The *Didemnum* species group, which we have included in cryptogenic category 1, warrants further discussion. This genus includes at least two species that have recently been reported from within New Zealand (*D. vexillum* and *D. incanum*) and two related, but distinct species from Europe (*D. lahillei*) and the north Atlantic (*D. vestum* sp. nov.) that have displayed invasive charactertistics (i.e. sudden appearance and rapid spread, Kott 2004a; Kott 2004b). All can be dominant habitat modifiers. The taxonomy of the Didemnidae is complex and it is difficult to identify specimens to species level. The colonies do not display many distinguishing characters at either species or genus level and are comprised of very small, simplified zooids with few distinguishing characters (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). She identified *D. vexillum* among specimens taken from the initial baseline surveys of Nelson and Tauranga, and *D. incanum* from the ports of Tauranga, Picton and Bluff. A third species, *D. tuberatum*, which Dr Kott described as native to New Zealand, was also recorded from Bluff. None of these species was recorded from Timaru. Several specimens of *Didemnum* were recovered from Timaru during the initial survey, but these did not fit any of the existing descriptions and were identified only to genus level. At the time that this report was prepared, we had been unable to secure Dr Kott's services to examine specimens from the repeat-baseline surveys, and all *Didemnum* specimens were identified only to genus level. We have reported these species collectively, as a species group (*Didemnum* sp.; Table 15). During the second baseline survey, *Didemnum* sp. was recorded on wharf pilings at Fisherman's Wharf and East Mole.

NON-INDIGENOUS SPECIES

Twenty-one non-indigenous species (NIS) were recorded in the re-survey of the Port of Timaru (Table 16). They included 3 annelid worms, 5 bryozoans, 4 cnidarians, 6 crustacea, 2 phycophytes and 1 ascidian. By comparison, 15 NIS were found during the initial February 2002 survey. Nine species (the polychaetes *Polydora hoplura* and *Spirobranchus polytrema*; the bryozoan *Celleporaria nodulosa*; the amphipods *Jassa staudei* and *Jassa marmorata*; and the hydroids *Amphisbetia maplestonei?, Monotheca pulchella*, *Symplectoscyphus subdichotomus* and *Synthecium subventricosum*) found in the re-survey were not recorded during the initial survey. Only three NIS recorded in the initial survey (the polychaete *Barantolla lepte,* the crab *Cancer gibbosulus* and the alga *Polysiphonia subtilissima*) were not recorded in the re-survey. Five of the NIS (the polychaete worm *Spirobranchus polytrema,* the bryozoan *Celleporaria nodulosa,* the hydroid *Amphisbetia maplestonei,* and the amphipods *Caprella mutica and Jassa staudei*) are new to New Zealand. *Spirobranchus polytrema* was recorded for the first time during the initial baseline port surveys of Dunedin, Napier and Wellington (see the species description below). *Celleporaria nodulosa* was recorded for the first time during the initial baseline port surveys of Gisborne and Nelson (see the species description below). *Caprella mutica* was first recorded during the initial baseline surveys from Timaru (see the species description below). *Amphisbetia maplestonei* was recorded for the first time during re-surveys of the ports of Timaru and Taranaki. This is the first record of *Jassa staudei* in New Zealand. A list of Chapman and Carlton's (1994) criteria (see "Definitions of species categories", above) that were met by the non-indigenous species sampled in this survey is given in Appendix 5.

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

Euchone limnicola Reish, 1959

Image and information: NIMPIS (2002e)

Euchone limnicola is a sedentary worm, growing to 12 mm in length. The absence of a membranous flap over the anal depression is only seen in *E. limnicola* and is therefore used to distinguish this species from other *Euchone* species. A crown, comprised of 7 pairs of feeding appendages, is seen above the sediment, with the body of the worm in a tube below. *Euchone limnicola* is native to the USA west coast and has been introduced to Australia and New Zealand. It burrows into soft sediments, secreting a mucous layer to enable it to build firm burrow walls. It has been found subtidally to 24 m in Port Phillip Bay, Australia. *Euchone limnicola* establishes dense populations within the sediments, possibly competing with native species for food and space. The process of tube building consolidates the sediments, thereby altering the habitat for other organisms. During the initial port baseline surveys, *E. limnicola* was recorded from the ports of Gisborne and Timaru. In the Port of Timaru it was recorded from the No. 1, 2 and 3 Wharves, Fisherman's Wharf, North Mole and Inner and Outer North Mole during the initial baseline survey (Figure 22). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki and Timaru (Table 18). In the second baseline survey of the Port of Timaru *E. limnicola* occurred in benthic grab samples taken from East Mole, Reclamation Point, Wharf 2 and Wharf 3, and also in a benthic sled sample from Wharf 3 (Figure 23).

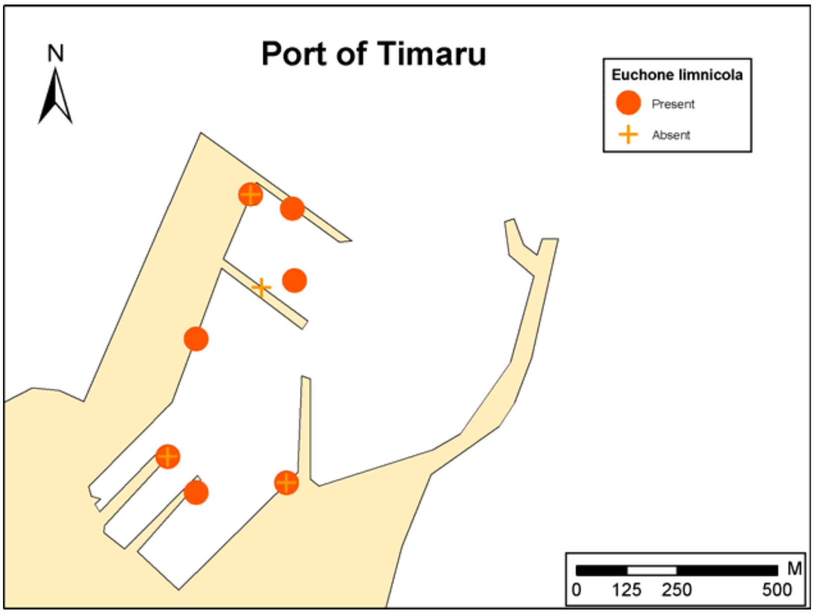


Figure 22: *Euchone limnicola* distribution in the initial baseline survey of the Port of Timaru (February 2002)

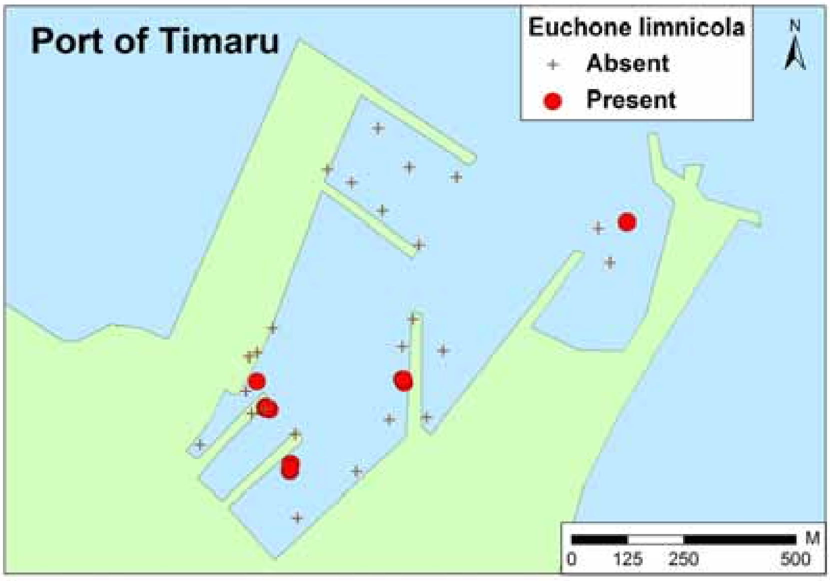


Figure 23: *Euchone limnicola* distribution in the re-survey of the Port of Timaru (November 2004)

***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 18). 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 Timaru *S. polytrema* occurred in pile scrape samples from the East Mole, North Mole, Fisherman's and No. 2 Wharves (Figure 24).

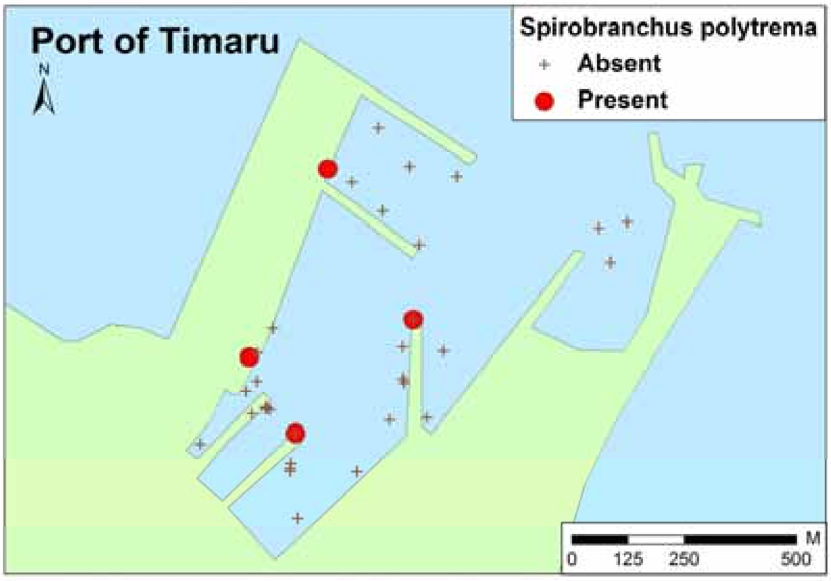
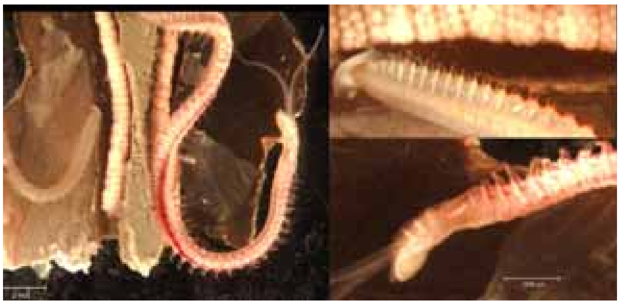


Figure 24: *Spirobranchus polytrema* distribution in the re-survey of the Port of Timaru (November 2004)

***Polydora hoplura* Claparède, 1870**



(Left) with eggmass in an opened blister; (top R) posterior; (bottom R) lateral head

Image: Read (2004)

Polydora hoplura is a spionid polychaete worm that bores into the shells of molluscs. It is a common pest of shellfish mariculture as its burrows cause blisters in the shells of farmed oysters, mussels and abalone (Pregenzer 1983; Handley 1995; Read 2001; Lleonart et al. 2003). It is considered one of New Zealand's worst pest worms (Read 2004). It is often found below the tide mark on jetty piles (Australian Faunal Directory 2005). The type specimen for this species was recorded from the Gulf of Naples, Italy (Claparède, E. 1870). Its native range is thought to be the Atlantic coast of Europe and the Mediterranean (Cranfield et al. 1998). *P. hoplura* has also been recorded from South Africa, southeastern Australia (Bass Strait and Victoria, Central East Coast, Southern Gulf Coast, and Tasmania) and New Zealand where it is thought to have been introduced (Australian Faunal Directory 2005). It is not known when *P. hoplura* first arrived in New Zealand (Read 2001). In Europe and New Zealand, *P. hoplura* is often associated with shells of the introduced Pacific oyster *Crassostrea gigas* (Handley 1995; Read 2004).

Polydora hoplura had previously been recorded from Wellington and the Marlborough Sounds (Cranfield et al. 1998) and was recorded from Whangarei (Marsden Point), Tauranga, Wellington, Picton, Nelson and Dunedin during the initial baseline port surveys (Table 18). During the second baseline surveys of Group 1 ports it was recorded from the ports of Wellington, Lyttelton and Timaru. In the Port of Timaru this species occurred in pile scrape samples taken from No. 2 Wharf (Figure 25).

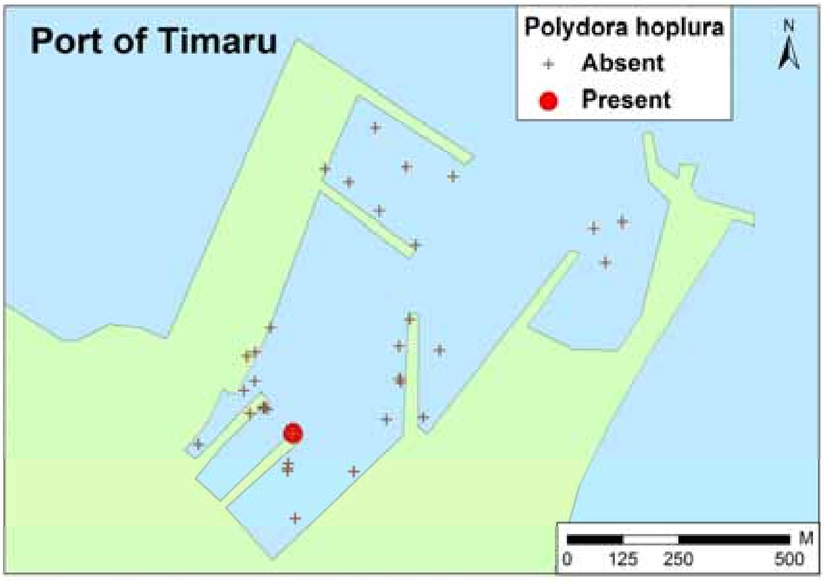


Figure 25: ***Polydora hoplura*** **distribution in the re-survey of the Port of Timaru (November 2004)**

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. In the Port of Timaru it was recorded from No. 1 Wharf, Fishermans Wharf, Inner North Mole and North Mole duringthe initial baseline survey (Figure 26). During the second baseline surveys of Group 1 ports it was recorded from the ports of Tauaranga, Taranaki, Wellington, Picton, Nelson, Lyttelton and Timaru (Table 18). In the second baseline survey of the Port of Timaru *B. flabellata* occurred in pile scrape samples taken from East Mole, Fisherman's and No. 2 Wharves, and in benthic sled samples from Wharf 1, Wharf 3 and the Inner and Outer North Mole Wharves (Figure 27).

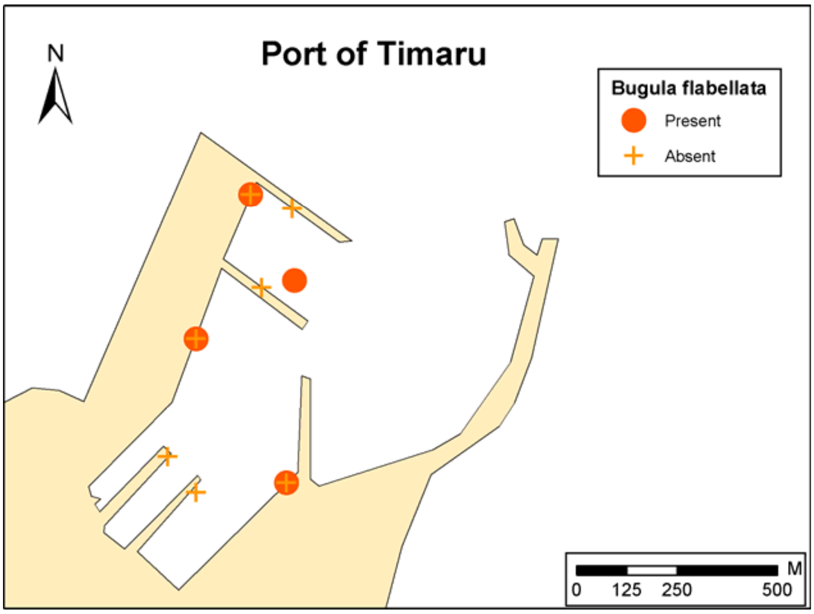


Figure 26: ***Bugula flabellata*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

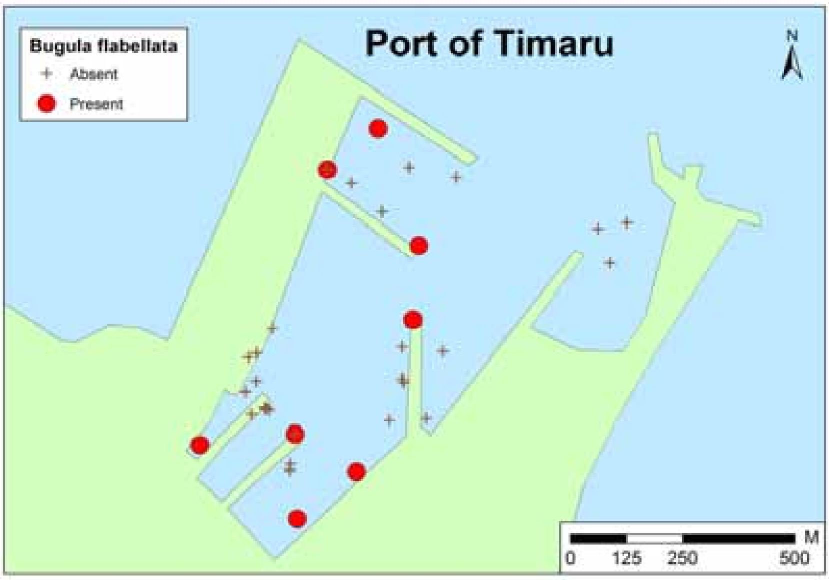


Figure 27: ***Bugula flabellata*** **distribution distribution in the re-survey of the Port of Timaru (November 2004)**

Bugula neritina (Linnaeus, 1758)

Image and information: NIMPIS (2002b)

Bugula neritina is an erect, bushy, red-purple-brown bryozoan. Branching is dichotomous (in series of two) and zooids alternate in two rows on the branches. Unlike all other species of *Bugula*, *B. neritina* has no avicularia (defensive structures) or spines, but there is a single pointed tip on the outer corner of zooids. Ovicells (reproductive structures) are large, globular and white. They often appear in such high numbers that they resemble small snails or beads. *Bugula neritina* is native to the Mediterranean Sea. It has been introduced to most of North America, Hawaii, India, the Japanese and China Seas, Australia and New Zealand. It is cryptogenic in the British Isles. *Bugula neritina* is one of the most abundant bryozoans in ports and harbours and an important member of the fouling community. The species colonises any available substratum and can form extensive monospecific growths. It grows well on pier piles, vessel hulls, buoys and similar submerged surfaces. It even grows heavily in ships' intake pipes and condenser chambers. In North America, *B. neritina* occurs on rocky reefs and seagrass leaves. In Australia, it occurs primarily on artificial substrata. *B. neritina* occurs in all New Zealand ports (Gordon & Matawari 1992). During the initial port baseline surveys it was recorded from the Opua and Gulf Harbour marinas, Whangarei Harbour (Marsden Point, Whangarei Port and Town Basin marina), and the ports of Tauranga, Taranaki, Napier, Gisborne, Lyttelton, Timaru and Dunedin (Table 18). In the Port of Timaru it was recorded from No. 1 Wharf, Fisherman's Wharf and North Mole (Figure 28). In the second baseline surveys of Group 1 ports *B. neritina* was recorded from the ports of Tauranga, Taranaki, Picton, Lyttelton and Timaru. In the second baseline survey of the Port of Timaru it occurred in a pile scrape sample from No. 3 Wharf (Figure 29).

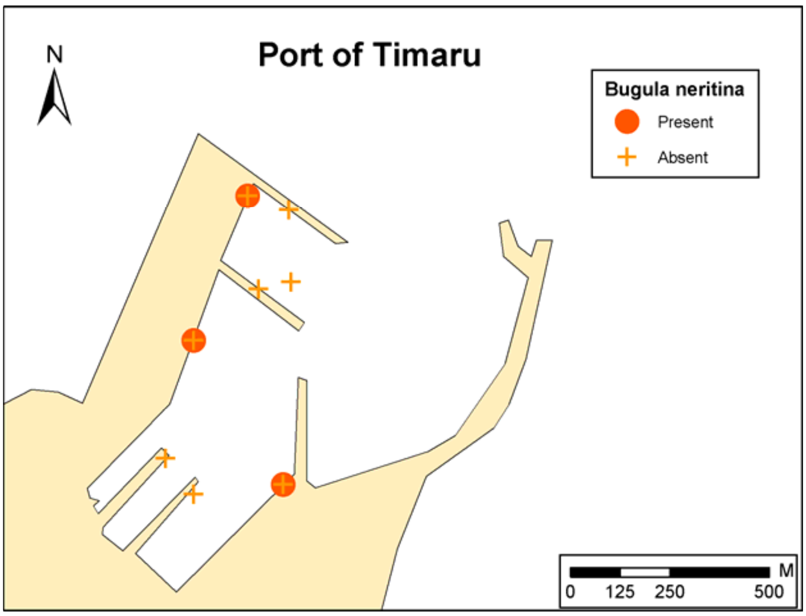


Figure 28: ***Bugula neritina* distribution in the initial baseline survey of the Port of Timaru (February 2002)**

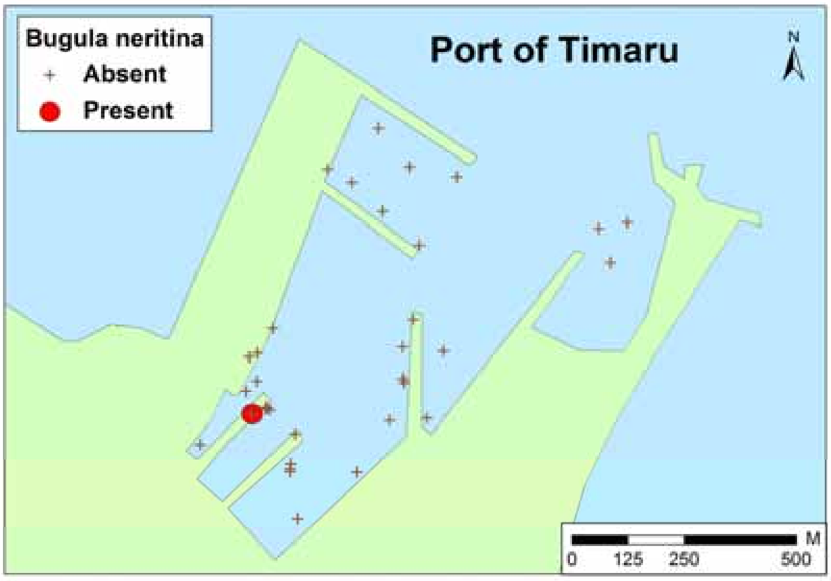


Figure 29: ***Bugula neritina* distribution in the re-survey of the Port of Timaru (November 2004)**

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

Image and information: NIMPIS (2002d)

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

C. pallasiana has been known in New Zealand waters since at 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 18). In the Port of Timaru it was recorded from the No. 1, 2 and 3 Wharves, Fisherman's Wharf and North Mole during the initial baseline survey (Figure 30). 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 Timaru it occurred in pile scrape samples taken from the No. 2, No. 3 and East Mole wharves, and in a benthic sled sample from East Mole wharf (Figure 31).

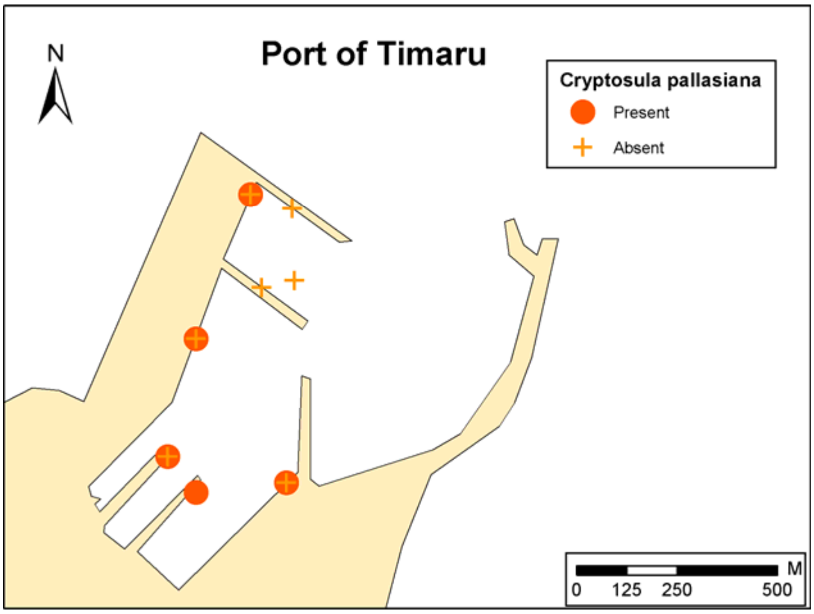


Figure 30: ***Cryptosula pallasiana*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

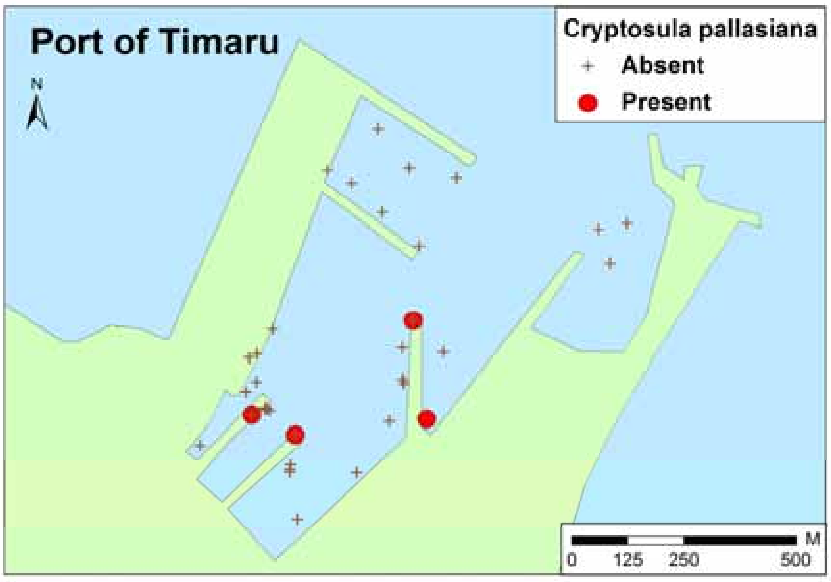


Figure 31: ***Cryptosula pallasiana*** **distribution in the re-survey of the Port of Timaru (November 2004)**

***Celleporaria nodulosa* (Busk, 1881)**
No image available.

Celleporaria nodulosa is an encrusting bryozoan in the family Lepraliellidae. There are more than 100 species in the genus *Celleporaria* world-wide. The type specimen for *C. nodulosa* was first described from the southeastern coast of Australia, where it is widespread. It forms low, flat, spreading colonies that have a blue-green tinge. No information exists on its likely impacts on native species. During the initial port baseline surveys *C. nodulosa* was recorded from the ports of Nelson (the first record of this species in New Zealand; D. Gordon, NIWA, pers. comm.) and Gisborne (Table 18). During the second baseline surveys of Group 1 ports it was recorded from the ports of Nelson and Timaru. In the Port of Timaru, *C. nodulosa* was recorded in a pile scrape sample taken from Wharf No. 3 (Figure 32).

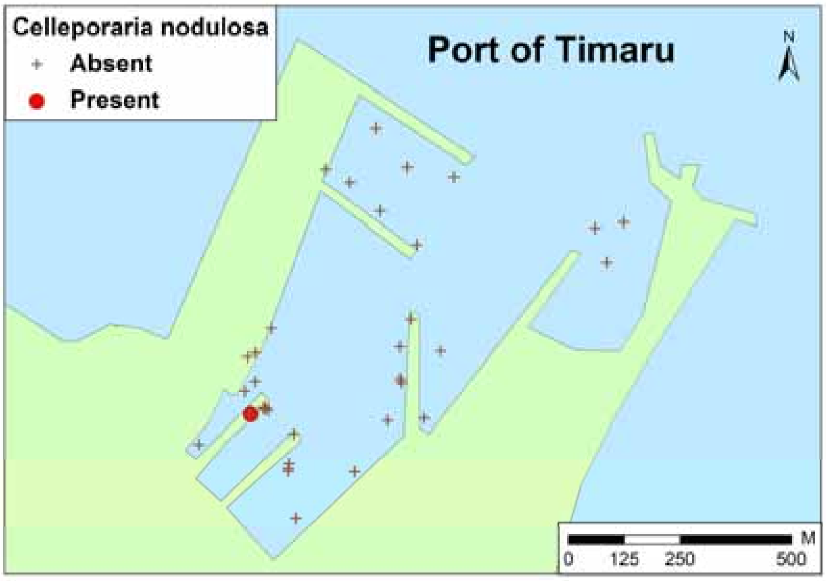


Figure 32: *Celleporaria nodulosa* distribution in the re-survey of the Port of Timaru (November 2004)

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

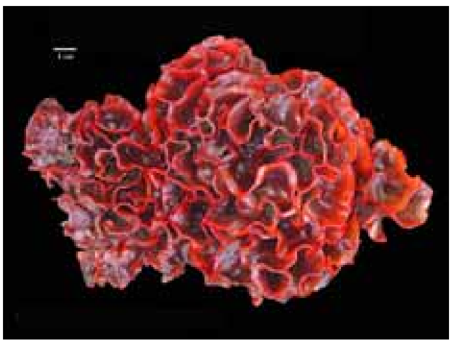


Image: Cohen (2005)
Information: Gordon and Matawari (1992)

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

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

Watersipora subtorquata has been present in New Zealand since at least 1982 and is now present in most ports from Opua to Bluff. During the initial port baseline surveys, it was recorded from the Opua and Gulf Harbour marinas, Whangarei Harbour (Marsden Point and Whangarei Port) and the ports of Tauranga, Gisborne, Napier, Taranaki, Wellington, Picton, Nelson, Lyttelton, Timaru, Dunedin and Bluff (Table 18). In the Port of Timaru *W. subtorquata* was recorded from No. 1 and No. 3 wharves, Fishermans Wharf, Inner North Mole, Outer North Mole and North Mole during the initial baseline survey (Figure 33). 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. During the seond baseline survey it was recorded in the Port of Timaru from pile scrape samples at Wharves 1, 2 and 3, East and North Mole and Fisherman's Wharf. It also occurred in benthic sled samples from East Mole and Wharf 1 (Figure 34).

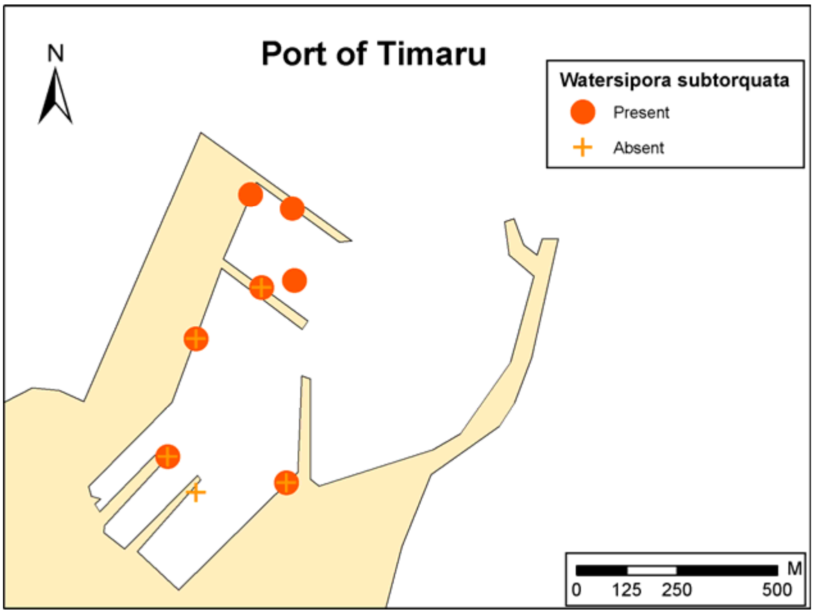


Figure 33: ***Watersipora subtorquata*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

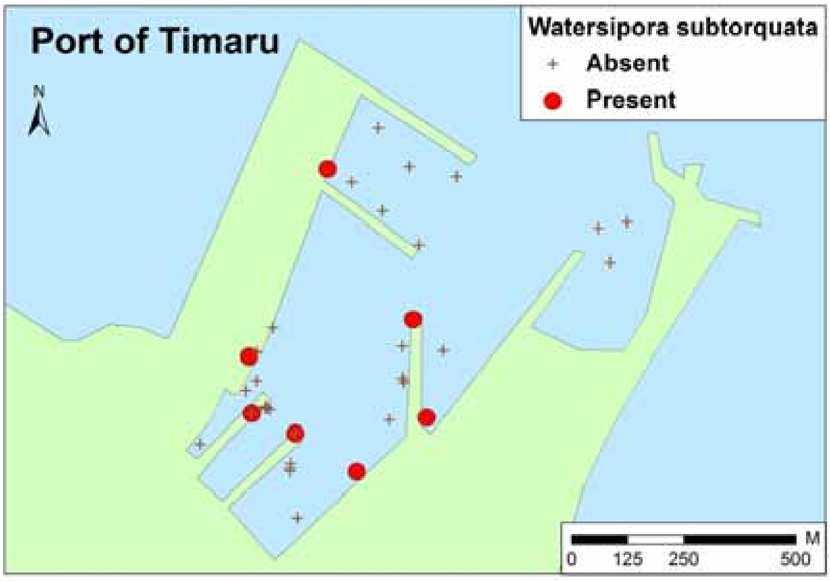


Figure 34: ***Watersipora subtorquata*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Monotheca pulchella **(Bale, 1882)**
No image available.

Monotheca pulchella is a hydroid in the family Plumulariidae. Its forms fine, flexible, monosiphonic, occasionally branched colonies 10 to 15 mm high, rising from tubular stolons (Vervoort and Watson 2003). It attaches to algae, bryozoans and other hydroids. The type locality is Queenscliff, Victoria, Australia. Its distribution is in temperate and subtropical parts of eastern and western Atlantic including the Mediterranean, South African coastal waters, coastal waters of southern Australia and eastern coastal waters of New Zealand (Vervoort and Watson 2003). It was first recorded in New Zealand from Bluff in 1928 (see Vervoort and Watson 2003). *Monotheca pulchella* was not recorded during the initial port baseline surveys. During the second baseline surveys of Group 1 ports it was recorded from the ports of Tauranga, Taranaki, Wellington, Lyttelton and Timaru (Table 18). None of these records are extensions to the known range of the species in New Zealand. In the Port of Timaru it occurred in a pile scrape sample taken from North Mole wharf (Figure 35).

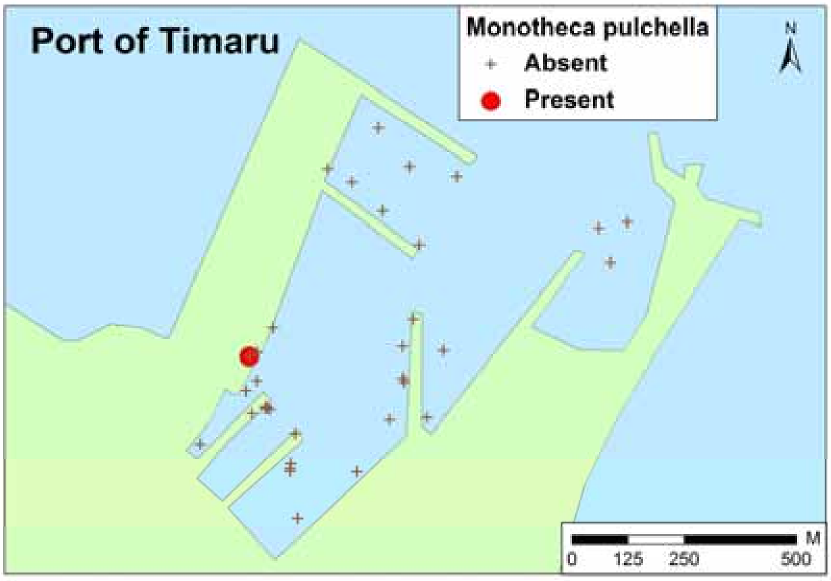


Figure 35: ***Monotheca pulchella*** **distribution in the re-survey of the Port of Timaru (November 2004)**

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

This hydroid is part of an Australian - New Zealand *Amphisbetia* species group that are difficult to distinguish apart unless fertile (J. Watson, Hydrozoan Research Laboratory, pers. comm.). *A. maplestonei* has been recorded from southern Australia and it almost certainly occurs in New Zealand (J. Watson, pers. comm.). However, there are no New Zealand records other than those from the current round of port baseline surveys. In Australia it occurs in temperate waters. Stems are up to 5 cm, plumose, flexuous, with a brownish colour. It often occurs among holdfasts of algae and likes fairly clear water conditions (J. Watson, pers. comm.). *Amphisbetia maplestonei* was not recorded during the initial baseline surveys of Group 1 and Group 2 ports. During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki and Timaru (Table 18). The specimen from the Port of Timaru was small and infertile and the identification is therefore uncertain. It occurred in a benthic grab sample taken from Inner North Mole Wharf (Figure 36).

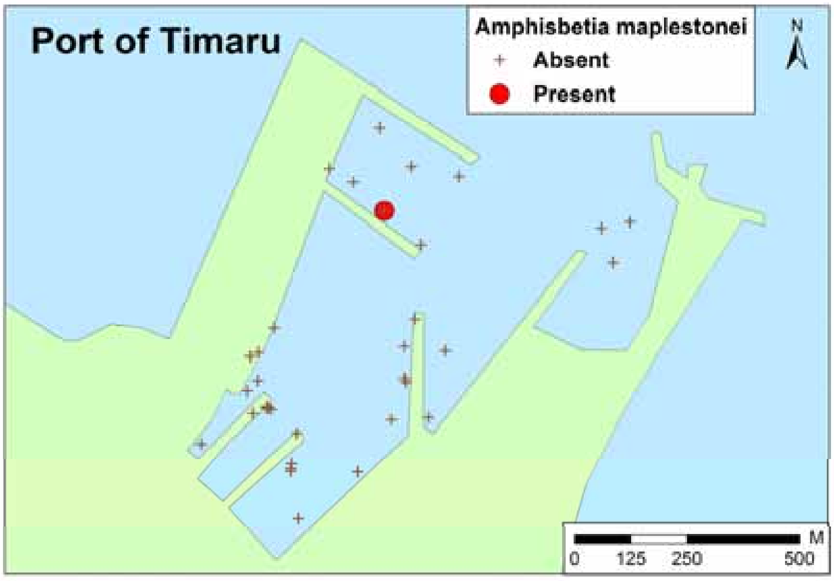


Figure 36: ***Amphisbetia maplestonei?*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Symplectoscyphus subdichotomus **(Kirchenpauer, 1884)**
No image available.

Symplectoscyphus subdichotomus is a hydroid in the family Sertulariidae. Colonies vary from small, straggling colonies on fixed objects to bigger, more or less reticulate colonies of strongly interwoven, repeatedly branched stems (Vervoort and Watson 2003). The type locality is Bass Strait, Australia. Records based on well identified material come from the Bass Strait and seas bordering southeast Australia, and from New Zealand waters. Less reliable records are from the Magellan Strait, South America and South Africa (Vervoort and Watson 2003). Records from New Zealand include off Norfolk Island, Three Kings region, off North Cape, off East Cape, Otago Peninsula and Chatham Islands, in depths from 23 to 183 m (Vervoort and Watson 2003). *S. subdichotomus* was not recorded during the initial baseline surveys. During the second baseline surveys of Group 1 ports it was recorded from the ports of Lyttelton and Timaru (Table 18). All specimens recorded were infertile except one from Lyttelton. In the Port of Timaru it was recorded in pile scrape and benthic grab samples from East Mole, in benthic sled samples from Wharf 1 and Inner North Mole and in a fishtrap from Reclamation Point (Figure 37).

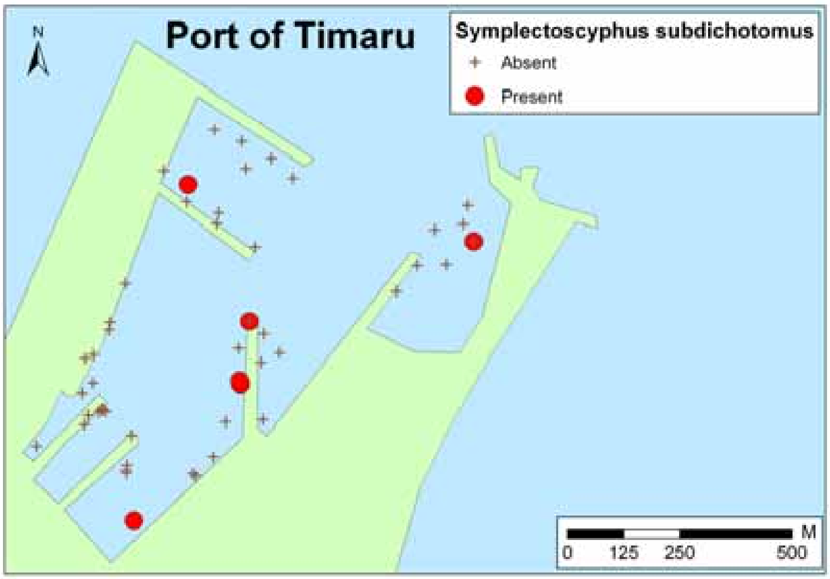


Figure 37: ***Symplectoscyphus subdichotomus*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Synthecium subventricosum **Bale, 1914**
No image available.

Synthecium subventricosum is a hydroid in the family Syntheciidae. Colonies are usually straggly with a strong tendency towards the formation of stolonal tendrils that develop short, secondary stems (Vervoort and Watson 2003). The type locality is the Great Australian Bight, 73-183 m. The species is widely distributed around New Zealand, with records from depths between 37 and 302 m (Vervoort and Watson 2003). *S. subventricosum* was not recorded during the initial baseline surveys. During the second baseline surveys of Group 1 ports it was recorded from the ports of Nelson and Timaru (Table 18), where all specimens recorded were infertile colonies. In the Port of Timaru it was recorded in pile scrape samples from East Mole (Figure 38).

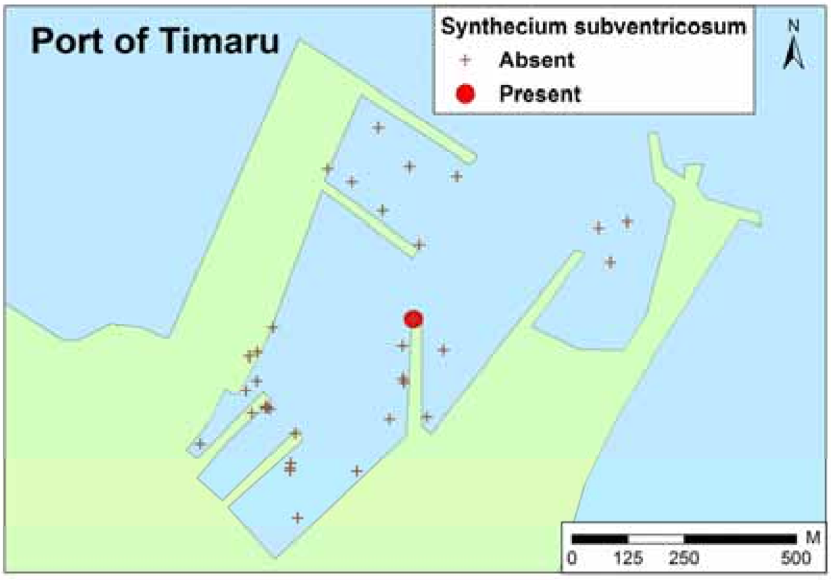


Figure 38: ***Synthecium subventricosum*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Caprella mutica **Schurin, 1935**

Image: MIT Sea Grant (2003)

Caprella mutica is a large (up to 34 mm long) caprellid amphipod from the northwest Pacific (the Siberian coast and the Sea of Japan). It lives as an epibiont on a variety of substrata, including algae, hydroids, bryozoans and brittle stars, and has also been frequently observed on mooring lines and ropes around aquaculture sites, marinas and ports. *Caprella mutica* has a history of accidental introductions. In the 1970s and 1980s, this species was discovered at various locations along the Pacific coast of North America (Cohen and Carlton 1995) and, more recently (1990's), it has been recorded from the Atlantic Coast of the USA, the United Kingdom, Netherlands, Norway, Belgium and Ireland (Ashton et al. 2004). *C. mutica* was recorded from the Port of Timaru during both the initial and the second baseline port surveys, but was not recorded from any other New Zealand port (Table 18). The specimens recorded from the Port of Timaru are the first known occurrence of this species in the southern hemisphere. Little is known about its biology or ecology, or its potential impact on marine ecosystems where it has been introduced. In some introduced populations it can reach very high abundance (>3000 individuals per m2) and biomass (55.38 + 26.96 ash-free dry weight g.m^{-2}) raising concern that it could have impacts on other species (Willis et al. 2004; Buschbaum and Gutow 2005). In the initial baseline survey *C. mutica* occurred in pile scrape samples taken from the No.1 and No.3 wharves, Fisherman's Wharf and North Mole (Figure 39). In the second baseline survey it occurred in pile scrape samples taken from North Mole, Fisherman's and No. 2 wharves, and in benthic sled samples from Inner North Mole and Reclamation Point (Figure 40).

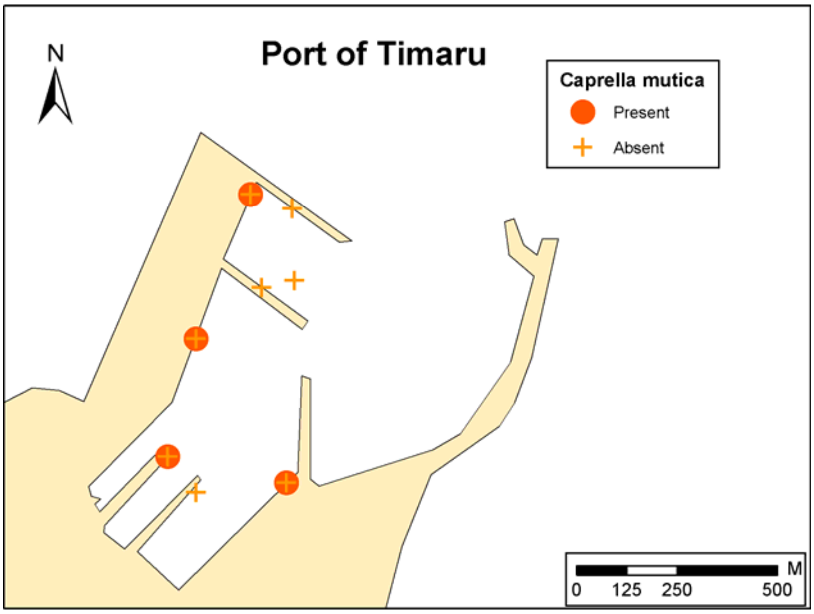


Figure 39: ***Caprella mutica*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

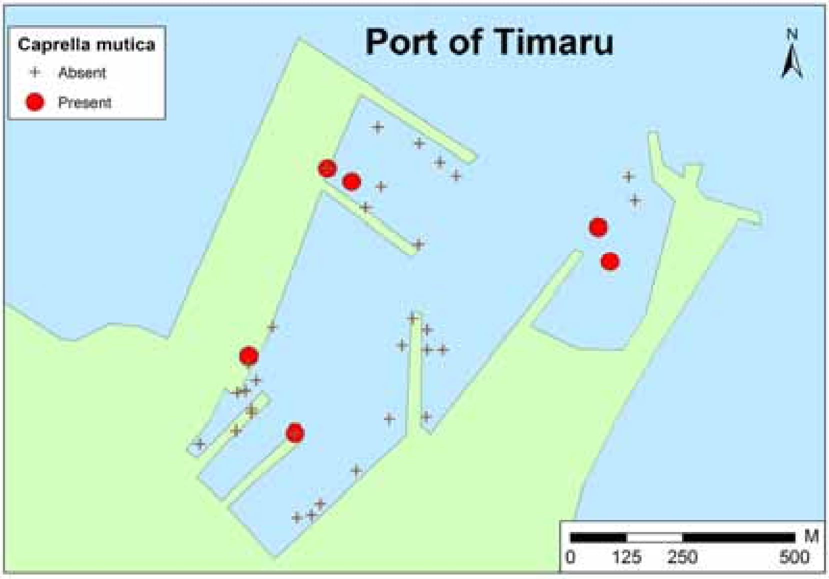


Figure 40: ***Caprella mutica*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Apocorophium acutum (Chevreux, 1908)

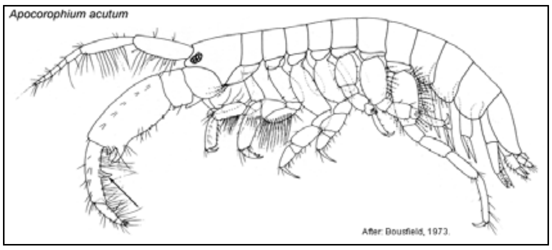


Image and information: Myers et al. (2006)

Apocorophium acutum is a corophiid amphipod, known from the Atlantic Ocean (England, France, North America, Brazil, South Africa), Pacific Ocean (New Zealand) and the Mediterranean Sea. The exact native range of this species is not known, although the type specimen of this species was described from the southern Mediterranean. *Apocorophium acutum* inhabits marine sediments in estuarine mudflats and brackish water and fouling assemblages where it builds muddy tubes. It has no known documented impacts. During the initial port baseline surveys *A. acutum* was recorded from the ports of Tauranga, Lyttelton, Timaru and Dunedin, and from Gulf Harbour and Opua marinas (Table 18). In the Port of Timaru it was recorded in samples taken from No. 3 Wharf, Fishermans Wharf and North Mole during the initial baseline survey (Figure 41). During the second baseline surveys of Group 1 ports it was recorded from the ports of Lyttelton and Timaru. In the second baseline survey of the Port of Timaru it occurred in pile scrape samples taken from the No. 3 and Fisherman's wharves (Figure 42).

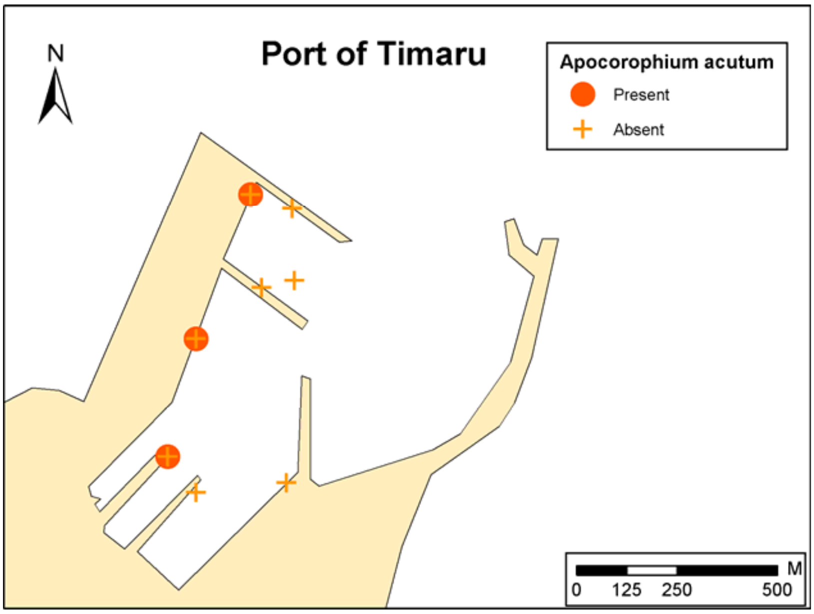


Figure 41: ***Apocorophium acutum*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

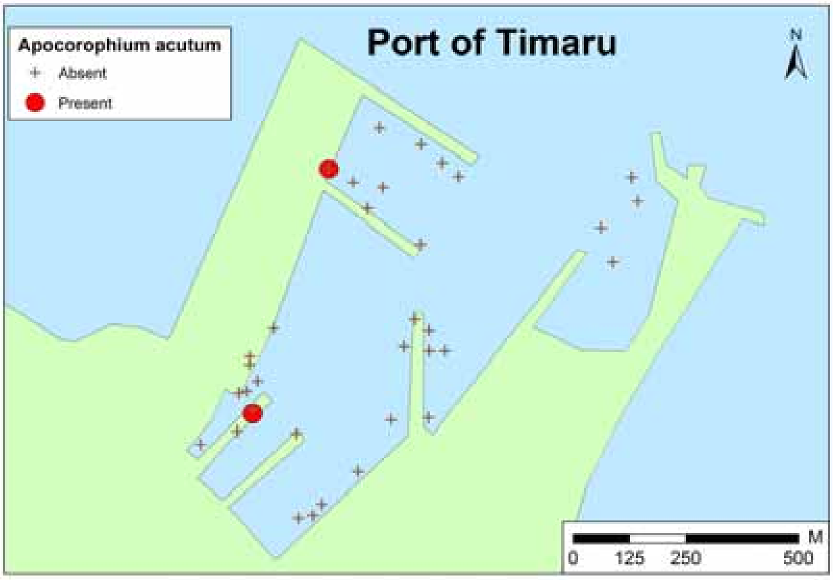


Figure 42: ***Apocorophium acutum*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Monocorophium acherusicum **(A. Costa, 1851)**

Image and information: NIMPIS (2002f)

Monocorophium acherusicum is a flat, yellowish-brown amphipod crustacean that lives amongst assemblages of marine invertebrates and plants or in soft-bottom habitats, and feeds by grazing on bacteria on sediment particles or on organic matter suspended in the water column. It is native to the northeast Atlantic, the Mediterranean and the northwest African coast and has been introduced to Brazil, southeast Africa, India, the Japanese and China Seas, Australia and New Zealand. It is cryptogenic in the Baltic Sea, the Caribbean and the east and northwest coasts of the USA. *Monocorophium acherusicum* occurs subtidally on sediments or where silt and detritus accumulate among fouling communities such as algae, ascidians and bryozoans, and man-made installations eg. wharf pylons, rafts and buoys. It is a tube building species constructing conspicuous, fragile U-shaped tubes of silk, mud and sand particles. It can reach high abundances and can tolerate a wide range of salinities. Pilisuctorid ciliates are parasites on this species in the Black Sea, but it is unknown whether these parasites could transfer to native species and cause negative impacts in New Zealand. During the initial port baseline surveys, *M. acheruscium* was recorded from the ports of Tauranga, Gisborne, Lyttelton, Timaru, Dunedin and the Whangarei Town Basin marina (Table 18). In the Port of Timaru it occurred in samples from North Mole and No. 1 and No. 3 Wharves during the initial baseline survey (Figure 43). During the second baseline surveys of Group 1 ports it was recorded from ports of Wellington, Timaru and Lyttelton. In the second baseline survey of the Port of Timaru it occurred in pile scrape samples from North Mole and No. 2 Wharf (Figure 44).

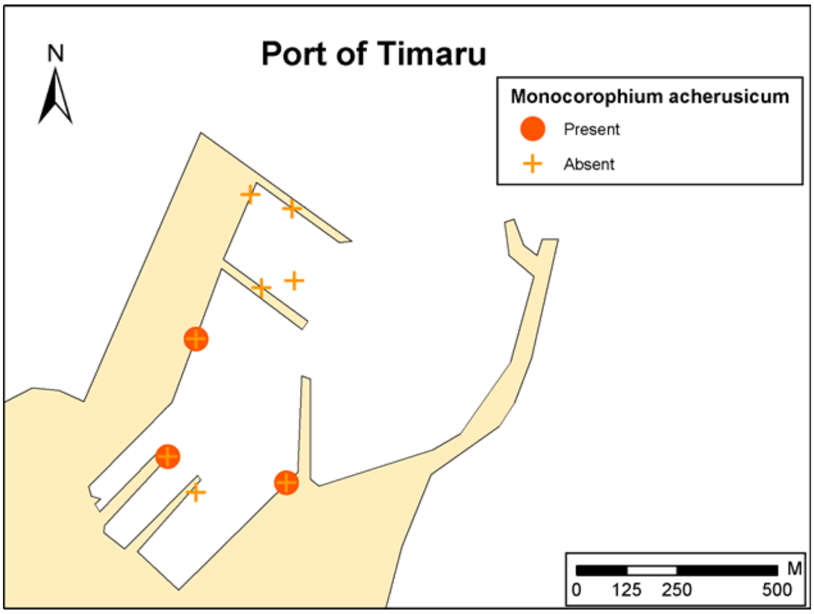


Figure 43: ***Monocorophium acherusicum* distribution in the initial baseline survey of the Port of Timaru (February 2002)**

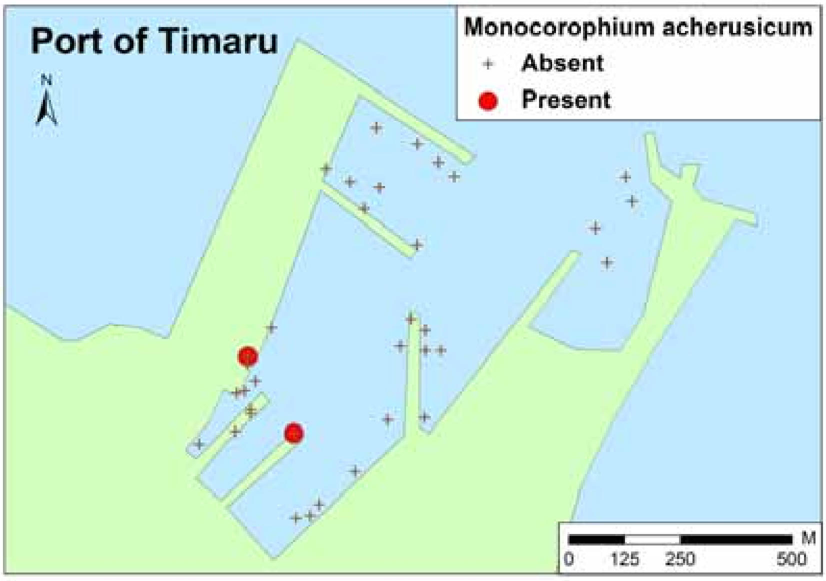


Figure 44: ***Monocorophium acherusicum*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Jassa marmorata Holmes, 1903

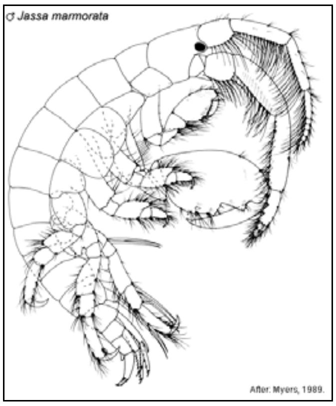


Image: Myers et al. (2006)

Jassa marmorata is an amphipod in the family Ischyroceridae that builds tubes among algae, sponges, and tunicates and on solid surfaces as a fouling organism (Myers et al. 2006). The type specimen for this species was described from the northwest Atlantic (Barren Islands marina, Jamaica Bay Wildlife Refuge, Brooklyn, New York, USA). It is considered cryptogenic in the eastern Atlantic, Mediterranean Sea, and Gulf of Mexico and is thought to have been introduced to the northeast Pacific, China, Japan, Russia, Chile, the south Atlantic (Brazil, west Africa, and South Africa), the Indian Ocean (Zanzibar), southeastern Australia, and New Zealand. *J. marmorata* reaches high abundances within fouling communities on floating pontoons and pilings and in subtidal algal communities along rocky shores, from the intertidal to 30m depth (Australian Faunal Directory 2005). This species undergoes seasonal changes in abundance; in some cases reaching densities as high as 8,000 animals per 10 cm^2. Males of this species differ in morphology as well as behaviour. This dimorphism corresponds to two contrasting reproductive strategies: small sneaker males, and large fighter males (Kurdziel and Knowles 2002). During the initial baseline port survey *J. marmorata* was recorded only from the Port of Otago (Table 18). During the second baseline surveys of Group 1 ports it was recorded from the Port of Timaru, where it occurred in pile scrape samples taken from No. 2, No. 3 and North Mole Wharves (Figure 45).

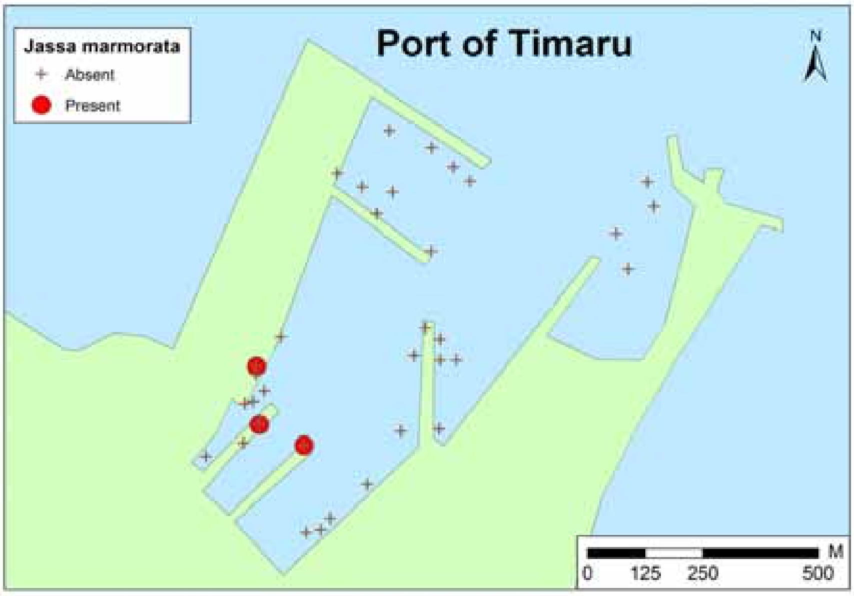


Figure 45: ***Jassa marmorata* distribution in the re-survey of the Port of Timaru (November 2004)**

***Jassa slatteryi* Conlan, 1990**

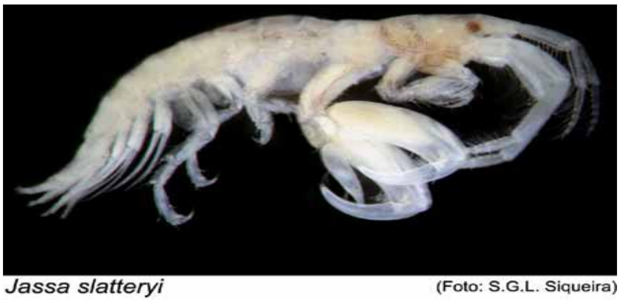


Image: Instituto de Biologia (no date)

Jassa slatteryi is an amphipod in the family Ischyroceridae. It is a cosmopolitan species. The type specimen was recorded from California, but it is known to be present in the Atlantic and Pacific Oceans and the Mediterranean Sea, and in southeastern Australia and New Zealand (Australian Faunal Directory 2005). Its habitat requirements and impacts are unknown. During the initial baseline port surveys it was recorded from Whangarei (Marsden Point), Lyttelton and Timaru (Table 18). In the Port of Timaru it was recorded from No. 1 Wharf, No. 3 Wharf, Fishermans Wharf and North Mole during the initial baseline survey (Figure 47). During the second baseline surveys of Group 1 ports it was again recorded from the ports of Lyttelton and Timaru. In the second baseline survey of the Port of Timaru it was recorded in pile scrape samples taken from Fisherman's Wharf (Figure 47).

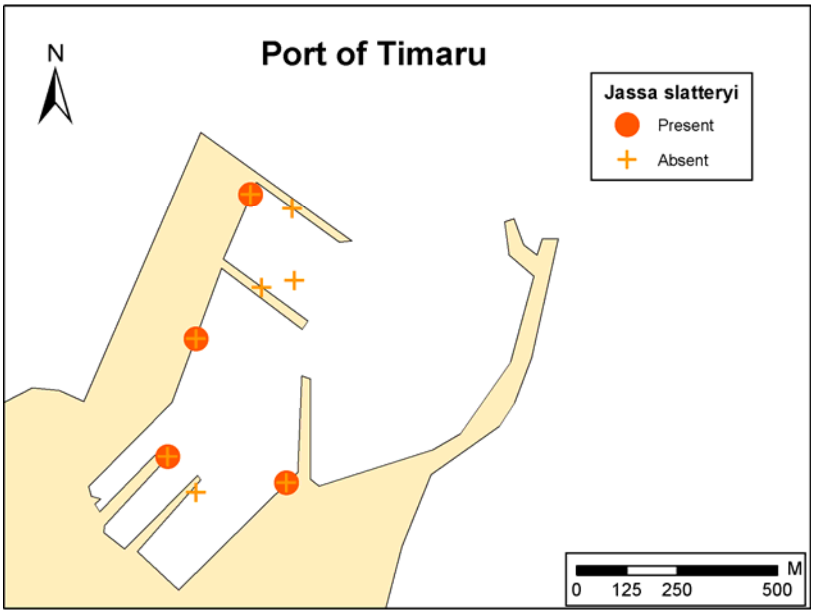


Figure 46: ***Jassa slatteryi*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

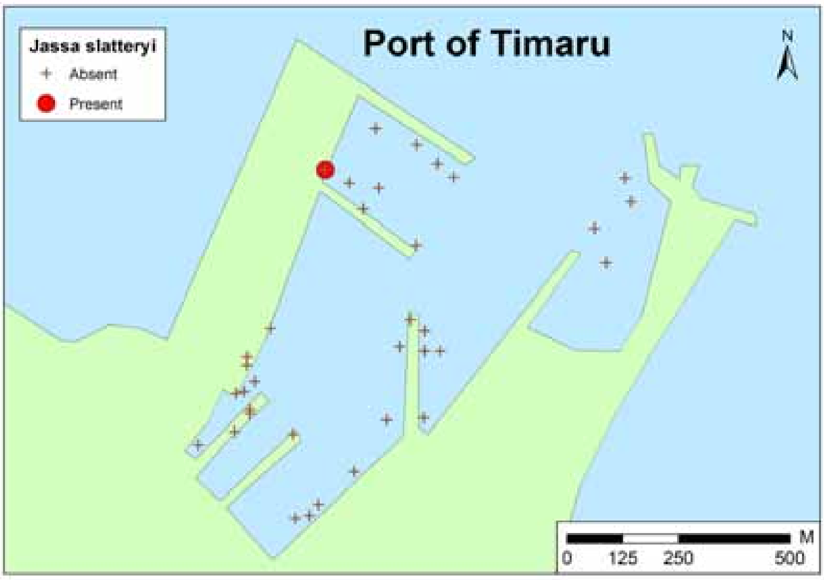


Figure 47: ***Jassa slatteryi*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Jassa staudei **Conlan, 1990**
No image available.

Jassa staudei is a relatively newly described (Conlan 1990) amphipod in the family Ischyroceridae. The type locality is in British Columbia (Canada) and it is distributed from British Colombia to California. It has been found from the low intertidal to 82 m depth (Conlan 1990). *J. staudei* has not previously been recorded in New Zealand (G. Fenwick, NIWA, pers. comm.). It was not recorded during the initial baseline surveys of Group 1 and Group 2 ports, but it was recorded from the Port of Timaru during the second baseline surveys of Group 1 ports (Table 18). In the Port of Timaru it occurred in pile scrape samples taken from Fisherman's Wharf (Figure 48).

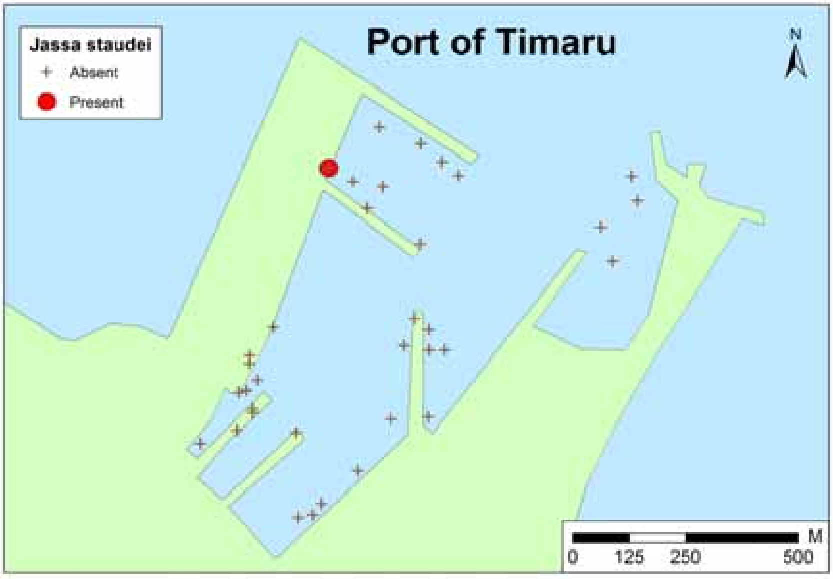


Figure 48: *Jassa staudei* distribution in the re-survey of the Port of Timaru (November 2004)

***Griffithsia crassiuscula* C.Agardh 1824**

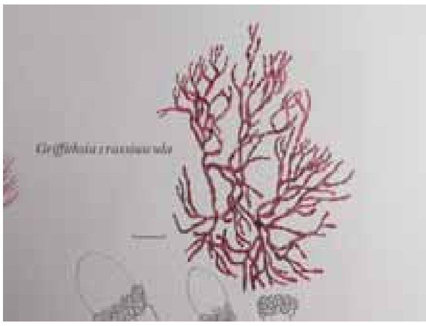


Image and information: Adams (1994)

Griffithsia crassiuscula is a small filamentous red alga. Plants are up to 10 cm high, dichotomously branched, with holdfasts of copious rhizoids. This species is bright rosy red to pink and of a turgid texture. Its native origin is thought to be southern Australia. *Griffithsia crassiuscula* is found subtidally and is mainly epiphytic on other algae and shells, but can also be found on rocks and pebbles. It has no known impacts. During the initial port baseline surveys, *G. crassiuscula* was recorded from the ports of Taranaki (an extension of its known range), Wellington, Picton, Lyttelton, Timaru and Bluff (Table 18). In the Port of Timaru it was recorded from North Mole Wharf during the initial baseline surveys (Figure 49). During the second baseline surveys of Group 1 ports it was recorded from the ports of Taranaki, Wellingon, Picton, Lyttelton and Timaru. In the second baseline survey of the Port of Timaru it occurred in a benthic sled sample from Reclamation Point (Figure 50).

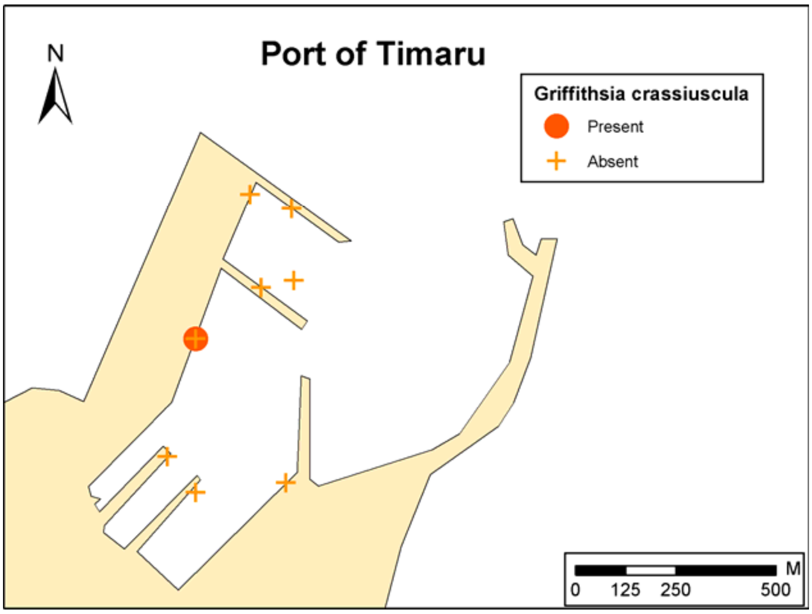


Figure 49: ***Griffithsia crassiuscula*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

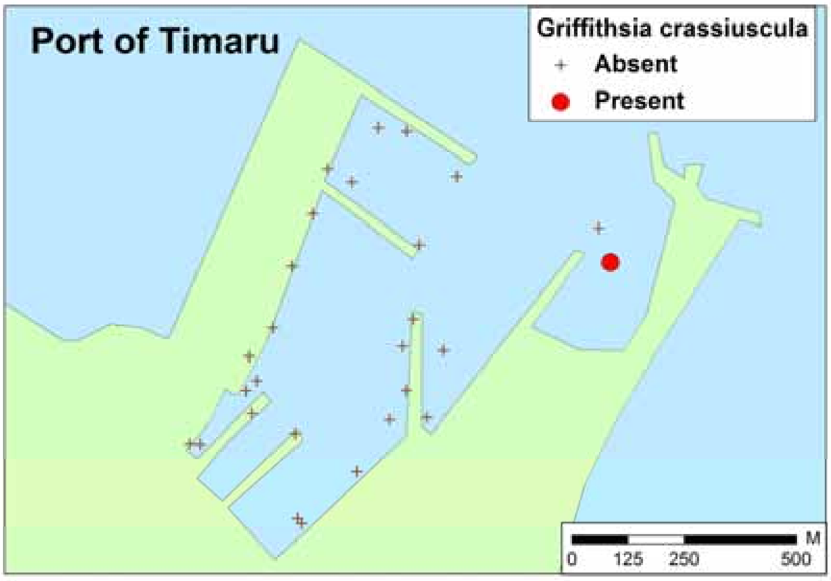


Figure 50: ***Griffithsia crassiuscula*** **distribution in the re-survey of the Port of Timaru (November 2004)**

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

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

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

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

Undaria pinnatifida is known to occur in a range of ports and marinas throughout eastern New Zealand, from Gisborne to Stewart Island. During the initial port baseline surveys, it was recorded from the ports of Gisborne, Napier, Wellington, Picton, Lyttelton, Timaru and Dunedin (Table 18). In the Port of Timaru it was recorded from No. 1, 2 and 3 wharves, Fishermans Wharf, Outer North Mole and North Mole in the initial baseline survey (Figure 51). 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 second baseline survey of the Port of Timaru, *U. pinnatifida* was recorded in pile scrape samples from No. 2 and Fisherman’s wharves, in benthic sled samples from Reclamation Point, Outer North Mole and No. 3 Wharf, and in visual searches of North Mole, Inner and Outer North Mole, East Mole and No. 2 Wharf (Figure 52).

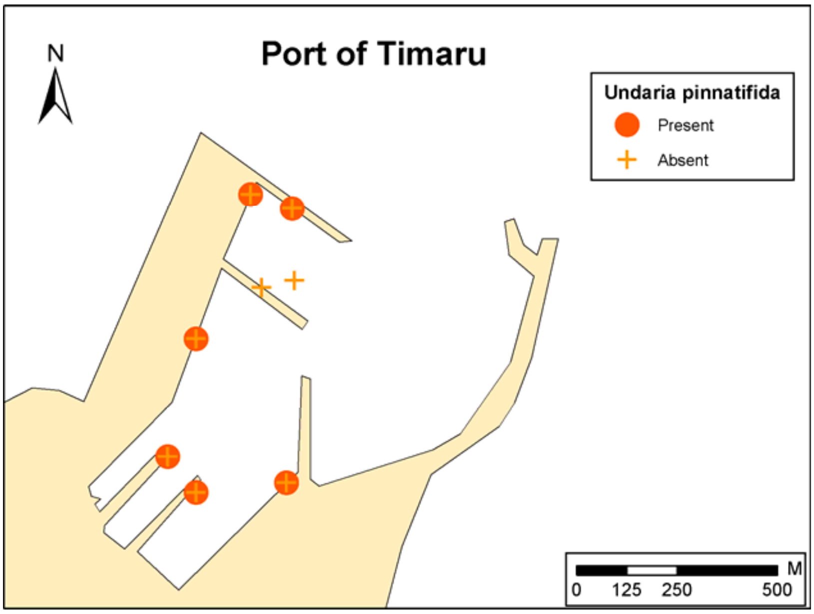


Figure 51: ***Undaria pinnatifida*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

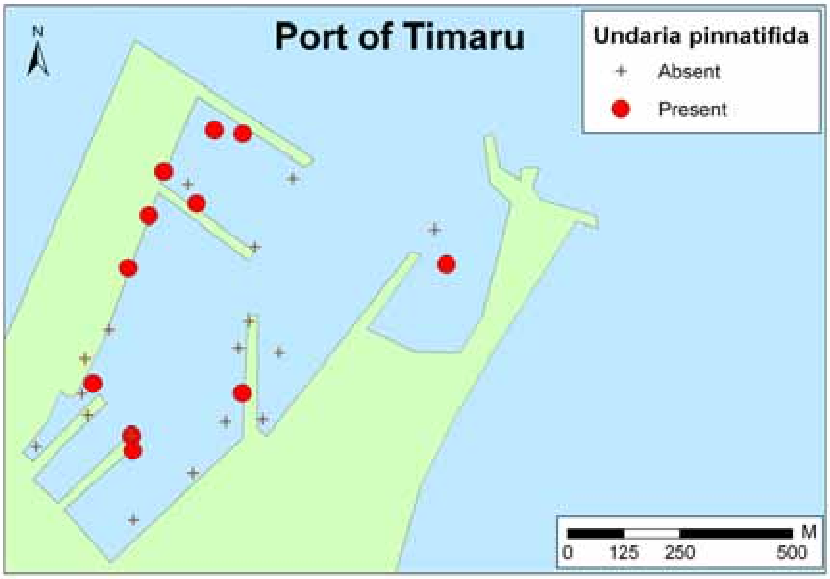


Figure 52: ***Undaria pinnatifida*** **distribution in the re-survey of the Port of Timaru (November 2004)**

Ciona intestinalis (Linnaeus, 1767)

Image and information: NIMPIS (2002c)

Ciona intestinalis is a solitary ascidian, commonly found in dense aggregations on rocks, algal holdfasts, seagrass, shells and artificial structures such as pylons, buoys and ships hulls. It usually hangs vertically upside-down in the water column, attached to hard surfaces. It is cylindrical, and 100-150 mm in length with distinctive inhalant and exhalant apertures (siphons) having yellow margins and orange/red spots. The body wall is generally soft and translucent with the internal organs visible. They can also be hard and leathery due to heavy fouling. Short projections (villi) at its base anchor the animal to the substratum.

The type specimen of *C. intestinalis* was described from Europe by Linnaeus in 1767. It is thought to have been introduced to Chile and Peru, the northern west coast of the USA, equatorial West Africa and South Africa, Australia and New Zealand. *Ciona intestinalis* is considered cryptogenic to Alaska, the east coast of the USA and Canada, Greenland, Iceland, Japan, China and south east Asia. It is often found in enclosed and semi-protected marine embayments and estuaries and although it occurs in the low intertidal and shallow subtidal zones, *C. intestinalis* clearly decreases in abundance with depth. Australian populations appear to be in decline, disappearing from port areas where the species had previously dominated in the 1950s-1960s and the same phenomenon has been observed in New England, USA. Its high filtration rates and large numbers can reduce water turbidity and food availability in shallow waters and it can out-compete native species for food and space. Since it appeared in southern California in 1917, native species of ascidians previously found in the harbours have disappeared or have become much rarer. It is known to be a nuisance fouling species in aquaculture facilities such as mussel rope culture, oyster farms and suspended scallop ropes in Nova Scotia and other parts of North America, the Mediterranean, South Africa, Korea and Chile, and recently in the Marlborough Sounds, New Zealand. During the initial port baseline surveys *C. intestinalis* was recorded from the ports of Napier, Nelson, Lyttelton and Timaru (Table 18). In the Port of Timaru it was recorded from No. 1, Fisherman's and North Mole Wharves during the initial baseline survey (Figure 53). During the second baseline surveys of Group 1 ports it was recorded from the ports of Lyttelton and Timaru. In the second baseline survey of the Port of Timaru it occurred in pile scrape samples taken from No. 2, North Mole and Fisherman's Wharves (Figure 54).

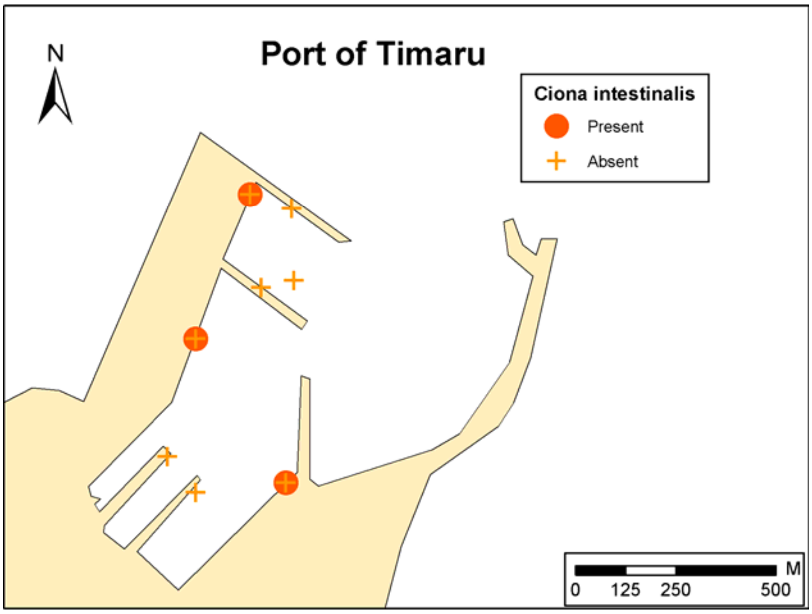


Figure 53: ***Ciona intestinalis*** **distribution in the initial baseline survey of the Port of Timaru (February 2002)**

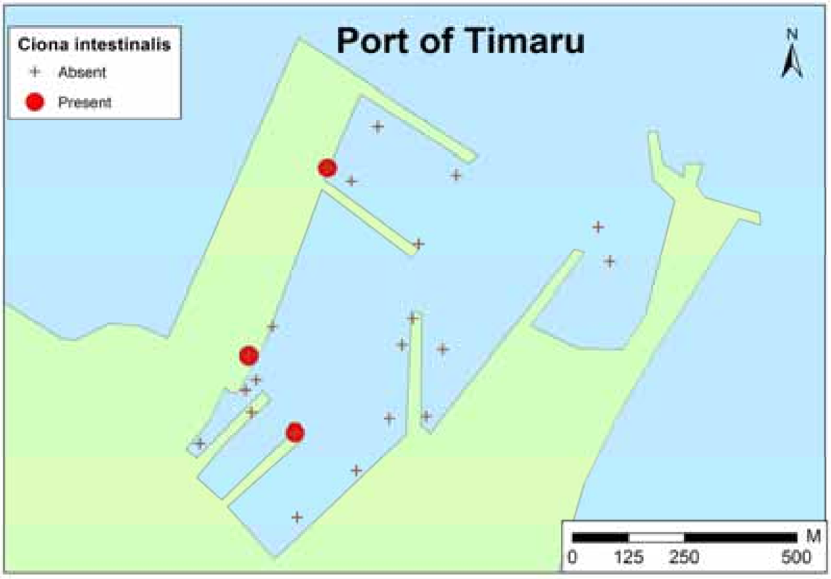


Figure 54: ***Ciona intestinalis*** **distribution in the re-survey of the Port of Timaru (November 2004)**

SPECIES INDETERMINATA

Forty organisms from the Port of Timaru were classified as species indeterminata. If each of these organisms is considered a species of unresolved identity, then together they represent 17% of all species collected from this survey (Figure 20). Species indeterminata from the Port of Timaru included 19 algae, 14 crustaceans, 2 ascidians, 3 annelid worms, 1 dinoflagellate and 1 mollusc (Table 17).

NOTIFIABLE AND UNWANTED SPECIES

One species recorded from the Port of Timaru, the Asian seaweed, *Undaria pinnatifida*, is currently listed on the New Zealand Register of Unwanted Organisms (Table 12). None of the species listed on the ABWMAC Australian list of marine pest species was recorded from the re-survey of the Port of Timaru (Table 13).

Australia has recently prepared an expanded list of priority marine pests that includes 53 non-indigenous species that have already established in Australia and 37 potential pests that have not yet reached its shores (Hayes et al. 2004). A similar watch list for New Zealand is currently being prepared by Biosecurity NZ. Nine of the 53 Australian priority domestic pests are present in the Port of Timaru. These are listed in descending order of the impact potential ranking attributed to them by Hayes et al. (2004): *Ciona intestinalis*, *Bugula neritina*, *Bugula flabellata*, *Undaria pinnatifida*, *Watersipora subtorquata*, *Cryptosula pallasiana*, *Apocorophium acutum*, *Monocorophium acherusicum* and *Euchone limnicola*. None of the 37 priority international pests identified by Hayes et al. (2004) was present in the Port of Timaru.

PREVIOUSLY UNDESCRIBED SPECIES IN NEW ZEALAND

Five species recorded from the re-survey of the Port of Timaru are new records from New Zealand waters: the non-indigenous hydroid *Amphisbetia maplestonei* (also recorded during the recent Port of Taranaki re-survey), the non-indigenous amphipod, *Jassa staudei*, and the sponges *Adocia* new sp. 4, *Halichondria* new sp. 2 and *Haliclona* new sp. 11 (the latter two species were also recorded during the recent re-surveys of the ports of Lyttelton and Wellington). A further 11 species from the present survey were described for the first time during the initial port baseline surveys. These were the polychaete *Spirobranchus polytrema*, the bryozoan *Celleporaria nodulosa,* the ascidian *Distaplia* sp., the pycnogonid *Tanystylum* sp. B, the amphipods *Aora* sp. aff. *A. typica, Caprella mutica, Parawaldeckia* sp. aff. *angusta*, and *Photis* sp. aff. *P. nigrocula* and the sponges *Adocia* new sp. 5, *Euryspongia* new sp. 2 and *Halichondria* new sp. 1. Six of these species - *Tanystylum* sp. B, *Caprella mutica, Parawaldeckia* sp. aff. *angusta, Photis* sp. aff. *P. nigrocula, Euryspongia* new sp. 2 and *Halichondria* new sp. 1 – were recorded during the earlier port baseline survey of the Port of Timaru. The remainder represent new records for this location.

CYST-FORMING SPECIES

Cysts of five species of dinoflagellate were collected during this survey. These were all considered native species (Table 14) or species indeterminata (Table 17). One of the native species, *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). 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). In the Port of Timaru *Lingulodinium polyedrum* was recorded in javelin core samples from Fisherman's Wharf, Wharf 1 and North Mole Wharf.

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

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 Timaru are presented in Figure 55a. Curves for the native species assemblage in each survey increased steadily as more samples were taken and did not approach an asymptote. Despite an 18% increase in sample effort over the first baseline survey, 15% fewer native species were recorded from pile scrape samples during the repeat survey. Overall, the average observed density of native species was lower in the second survey, with ~ 21 fewer species recorded for the same survey effort. Indeed, the average per sample species richness for all species was significantly lower in the repeat survey (Mean ± S.E. = 5.5 ± 0.4 species per sample) than in the initial baseline survey (7.9 ± 0.7 species per sample; t-test statistic $p < 0.01$). Estimates of total species richness in each survey also increased with sample size and did not plateau or converge with observed richness, indicating a high proportion of unsampled species in the assemblage. Estimated richness was between 48% (ICE = 145 species) and 96% (Chao2 = 163 species) greater than observed richness in each survey, respectively (Figure 55a). As sample size increased, more unique species (i.e. those that occurred in only one sample) were added to the survey. These 'rare' species comprised large proportions of the sampled assemblage. Of the native species, 38% of those from the first survey and 48% from the second survey occurred in just a single sample (Table 19).

The species composition of the sampled assemblage was also quite different in each survey. Only 51 species (39% of the total number) were recorded in both surveys. Again, this reflects the large number of comparatively rare species in the assemblage, with non-detection of many of these species accounting for much of the difference observed between the two surveys. For example, the classic Jaccard and Sorenson measures of compositional similarity indicate very little similarity between assemblages recorded in the initial and repeat baseline surveys of Timaru (0.392 and 0.564, respectively; Table 19). Once the effects of undetected rare species were adjusted for, there was much greater resemblance between the two sampled assemblages (Chao bias-adjusted Jaccard = 0.928, Chao bias-adjusted Sorrenson = 0.963; Table 19).

Cryptogenic category 2 species

The rate at which cryptogenic category 2 species were accumulated in the pile scrape samples was similar in both surveys, with slightly greater density of species in the initial baseline survey undertaken in February 2002 (Figure 55b). Neither rarefaction curve approached an asymptote. There were, however, quite marked differences in estimates of the total richness of cryptogenic category two species in each survey. In samples taken from the initial baseline survey, the ICE estimate reached a plateau at around 23 species after an average of 27 samples had been taken, suggesting that fewer than 7 species remained unobserved in the assemblage (Figure 55b). In the repeat survey, the ICE estimate did not stabilise and was more than 3x the observed number of species (Figure 55b). This reflects a difference in the number of unique species that was recorded in each survey. Eleven of the 15 species (73%) observed in the second survey occurred in just a single sample, compared with just 6 of the 16 species (38%) in the first survey (Table 19).

Only 5 of the 26 (19%) cryptogenic category two species recorded were common to both surveys (Table 19). This high species turn-over is reflected in the comparatively low similarity indices calculated for the two assemblages, even when adjustment is made for undetected species (Chao bias-adjusted Jaccard = 0.258, Chao bias-adjusted Sorenson = 0.41; Table 19).

Non-indigenous and cryptogenic category 1 species

The resurvey of the Port of Timaru recorded a larger number of non-indigenous and cryptogenic category 1 species in the pile scrape samples (28 species) than the initial baseline survey (22 species; Table 19). In the initial survey, the observed species density in this group appeared to have plateaued above 40 samples and, at 42 samples, had converged with the estimated total richness of 21 species. This indicated a relatively complete inventory, with a small sampled population of uniques (1 species, 5%) and, therefore, few undetected species (Table 19). In the second survey, the observed species density was ~27% higher with, on average, 5 more species in this category being recovered for an equivalent level of sample effort (at n=55 samples). The rate of species accumulation showed no sign of approaching an asymptote in the second survey, but did almost converge with the estimated richness, which had stabilised at ~29 species (Figure 55c). More uniques occurred in the sample from the second survey (5 species, 18% of the total), but there was moderate overlap in the species composition of the two surveys. Eighteen of the 32 non-indigenous and cryptogenic category 1 species (56%) that were recorded from the Port of Timaru occurred in both surveys. As a result, the compositional similarity of the two assemblages was relatively high, once undetected species were adjusted for (Chao bias-adjusted Jaccard = 0.812, Chao bias-adjusted Sorenson = 0.896; Table 19).

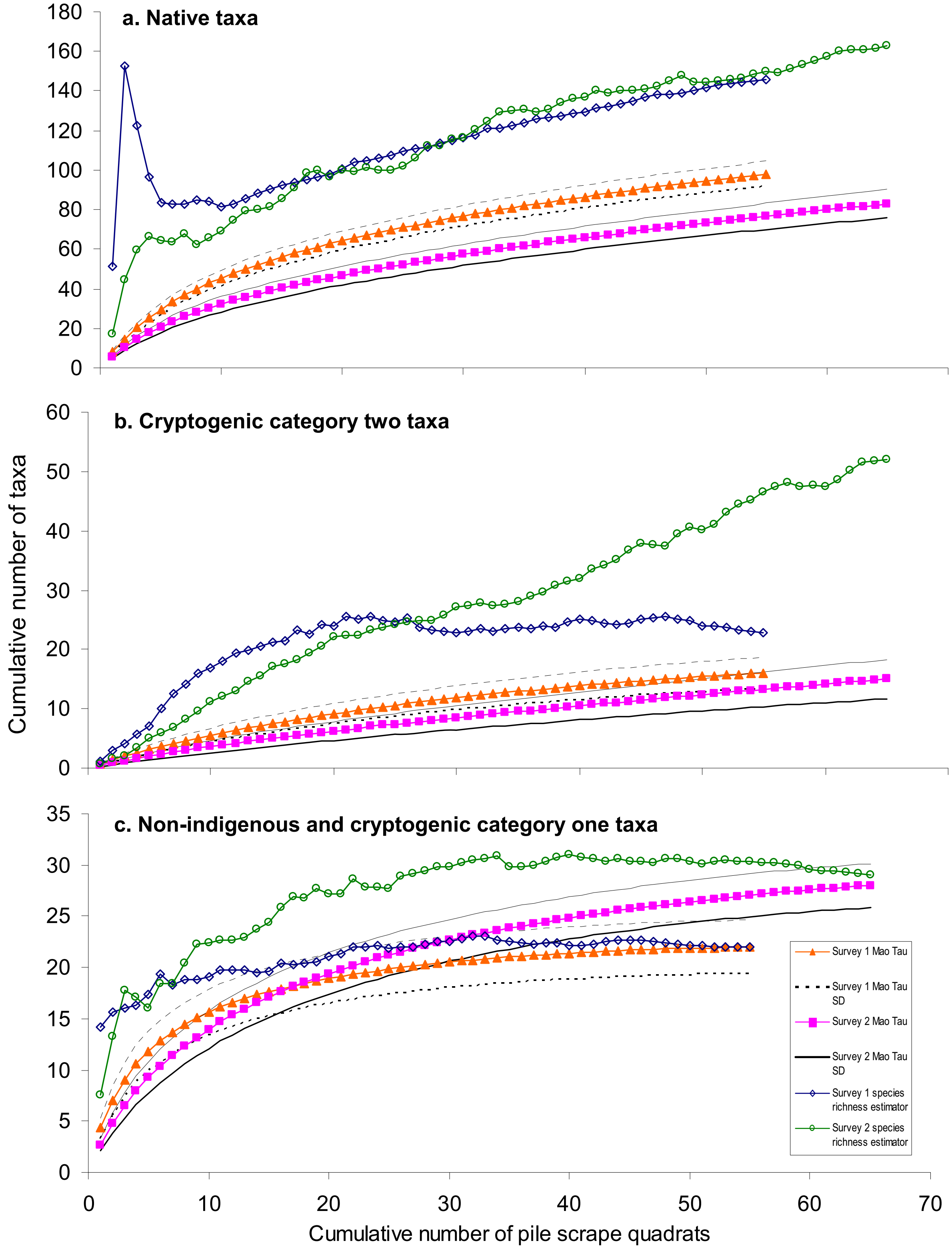


Figure 55: Rarefaction curves (Mao Tau) for native (top), cryptogenic category two (middle) and non-indigenous and cryptogenic category one (bottom) taxa from pile scrape quadrats for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 bias-corrected formula was used for NIS & C1 taxa in both surveys, the Chao 2 classic formula was used for native taxa in the second survey, and the ICE formula was used in all other cases.

Benthic sled samples

Native species

Survey effort for the benthic sled samples was increased by ~33% in the repeat baseline survey in an attempt to improve description of the epibenthic fauna of the port (Table 19). In both surveys, samples taken using this method were dominated by uniques (56% and 60% of species, respectively), resulting in comparatively large estimates of total species richness (Figure 56a). To some extent, this is a function of the small sample size, since a single sled sample represented 8% of the total survey effort in the first survey and 6% in the repeat survey. In each survey, the estimated richness of native species was relatively stable at between 121 species (repeat survey) and 130 species (initial survey). Nevertheless, the slow rate of accumulation of native species in the sled samples and high proportion of uniques meant that the observed species richness was only around half the estimated total richness in both surveys (Figure 56a). At the rate of species accumulation indicated in Figure 56a, survey effort would need to be at least doubled (i.e. ≥32 samples) to capture the estimated species richness of the assemblage. Nineteen of the 55 species recorded in the second survey (35%) were also recorded in the initial survey, with comparatively low similarity between the two samples (Chao bias-adjusted Jaccard = 0.342; Chao bias-adjusted Sorenson = 0.51; Table 19).

Cryptogenic category 2 species

Equal numbers of cryptogenic category 2 species (8 species) were recorded in each survey from the benthic sled samples (Table 19), with approximately similar rates of species accumulation in both samples (Figure 56b). Although the observed rate of species accumulation did not plateau as the number of samples increased, both surveys approached the estimated species richness, which in both surveys was around 12 species. Despite these similarities in richness, there was little overlap in species composition between the two surveys (only 2 species were common to both surveys) and each had a high proportion of uniques (63% and 50% of the sample respectively). As a result, the Chao bias-adjusted Jaccard (0.199) and Chao bias-adjusted Sorenson (0.332) measures of compositional similarity were quite low (Table 19).

Non-indigenous and cryptogenic category 1 species

Rarefaction curves for the combined non-indigenous and cryptogenic category 1 species exhibited similar patterns of accumulation in each survey, with the additional 2 species recovered in the repeat survey reflecting the slightly greater survey effort (Figure 56c). For both surveys, the estimated total richness of non-indigenous and cryptogenic category 1 species for this method type was relatively constant at around 14 species, indicating a relatively complete inventory in the repeat survey (n_{obs} = 12 species). Eight of the 12 species recorded in the second survey were also recorded in benthic sled samples taken during the initial baseline survey and there were moderate numbers of unique species in each survey sample (30% and 42% of each sample, respectively; Table 19). As a result, the computed similarity between the two assemblages was moderate-to-high (Chao bias-adjusted Jaccard = 0.769, Chao bias-adjusted Sorenson = 0.869).

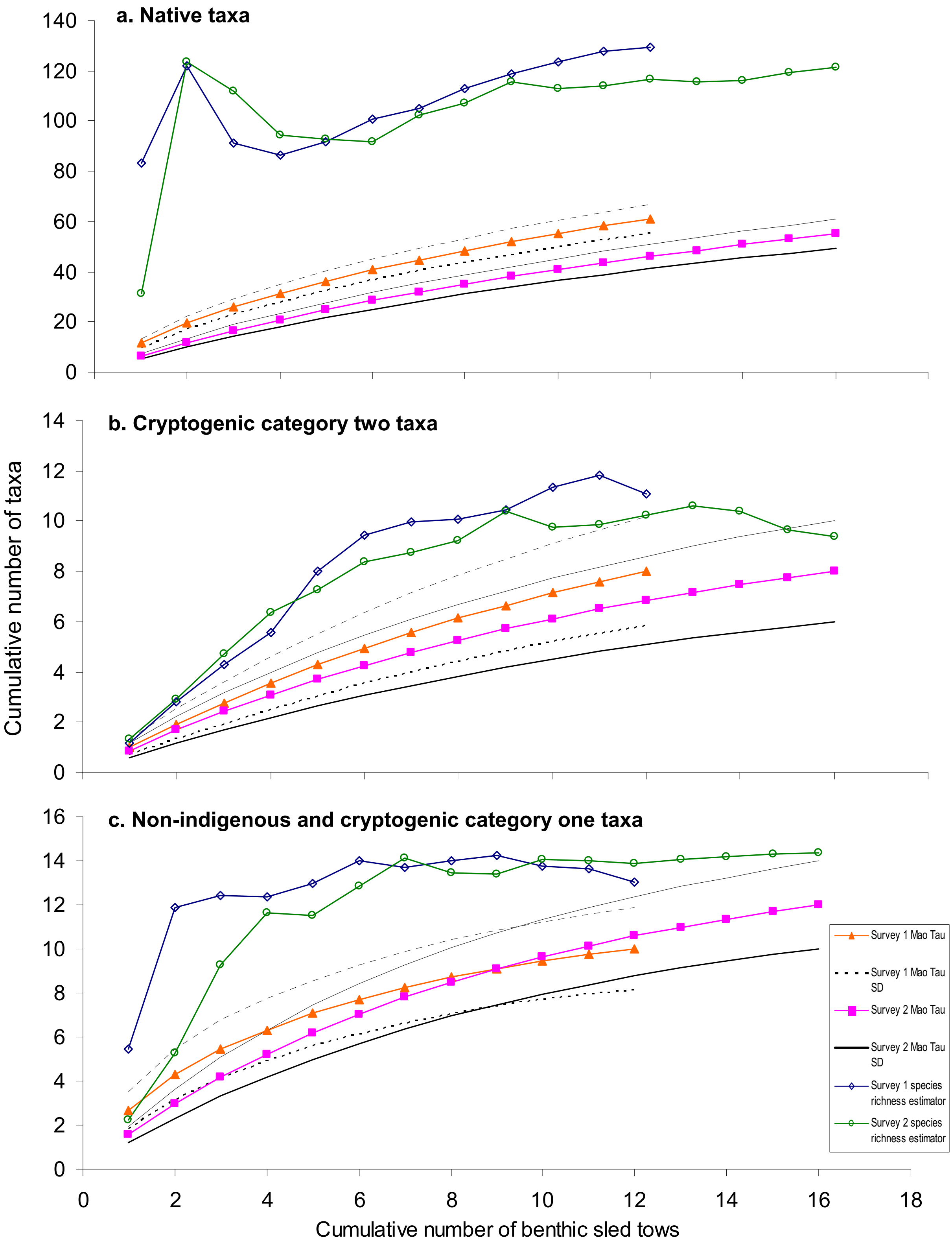


Figure 56: Rarefaction curves (Mao Tau) for native (top), cryptogenic category two (middle) and non-indigenous and cryptogenic category one (bottom) taxa from benthic sled tows for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds) and second survey (empty circles); the Chao 2 bias-corrected formula was used for cryptogenic category two taxa in both surveys and for NIS & C1 taxa in the first survey. The ICE formula was used in all other instances.

Benthic grab samples

Samples taken with the benthic grab contained too few species for separate analysis of the different species categories (Table 19). For this reason, analysis was done on the pooled species assemblage (Figure 57).

As with the benthic sled samples, survey effort was increased substantially in the re-survey of the port to improve description of the fauna (Table 19). Despite the greater number of samples, however, substantially fewer species were recorded in the second survey of the Port of Timaru (n_{obs} = 21 species *cf.* 62 species in the initial survey). The shapes of rarefaction curves and richness estimates generated from the benthic grab samples were also quite different between the two surveys (Figure 57). In the initial baseline survey, the species accumulation curve increased quite steeply as the number of samples increased. The sample contained a relatively high proportion of uniques (56%) so that the estimated richness did not stablise and remained much greater than the observed number of species (Figure 57). In contrast, the rate of accumulation of species in the second survey was comparatively slow and the sample contained only a moderate number of unique species (38%), so that the observed richness was within 10 species of the total estimate of species richness.

The large difference in the number of species recorded from benthic grab samples in each survey and the high proportion of uniques in the first survey meant that there was only limited overlap in species composition (14 of 69 species, 20%). This was reflected in moderate-to-low measures of compositional similarity between the two sampled assemblages (Chao bias-adjusted Jaccard = 0.399; Chao bias-adjusted Sorenson = 0.57; Table 19).

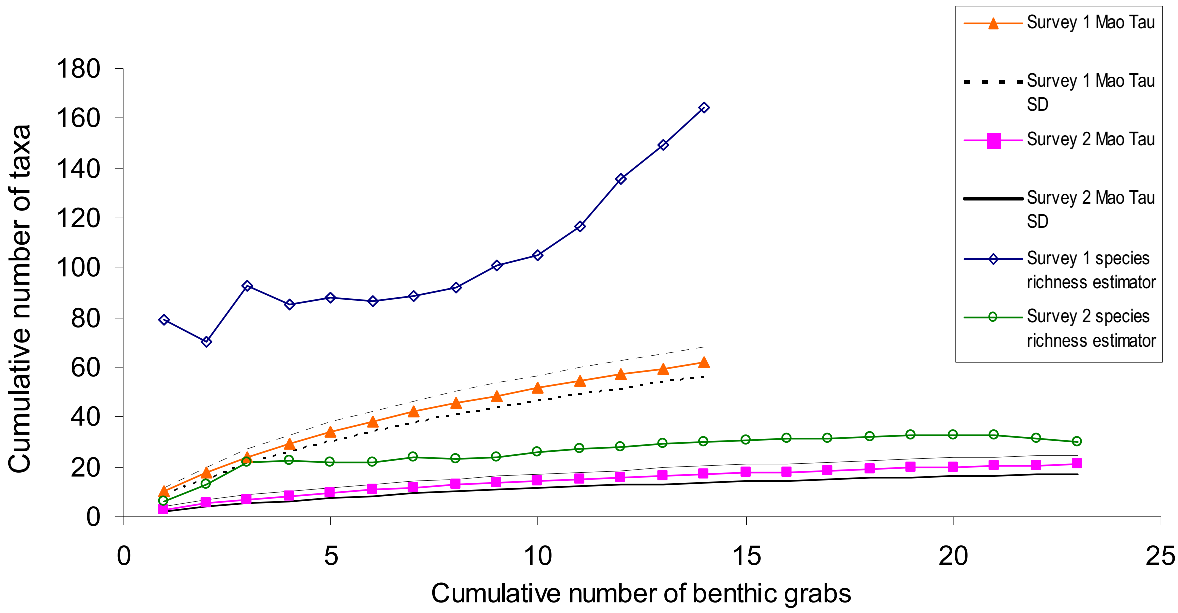


Figure 57: Rarefaction curves (Mao Tau) for native, cryptogenic and non-indigenous taxa combined from benthic grabs for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 classic formula) and second survey (empty circles, ICE formula).

Crab trap samples

Samples obtained using baited crab traps were characterised by relatively few species (Mean + S.E. = 1.6 + 0.2 species per trap). This was a feature of all of the passive trapping techniques (see below). In total, 15 species were sampled using the crab traps, over both surveys. All were native species. Both species density and estimated richness were greater in samples taken during the first survey. The richness estimate increased steeply as more samples were taken (Figure 58), reflecting the high proportion of species that were captured in just a single sample (6 of 12 species in the first survey; Table 19). As a result, the observed number of species underestimated the total richness. In contrast, most species caught in the crab traps during the re-survey were relatively common. Only one species occurred in just a single crab trap sample and the observed and estimated species richness converged at 7 species after 21 samples, indicating a complete inventory (Figure 58).

Nevertheless, there was comparatively little overlap in the species composition of samples taken during the two surveys. Only 4 of the 15 species (27%) recovered using the crab traps occurred in both surveys (Table 19).

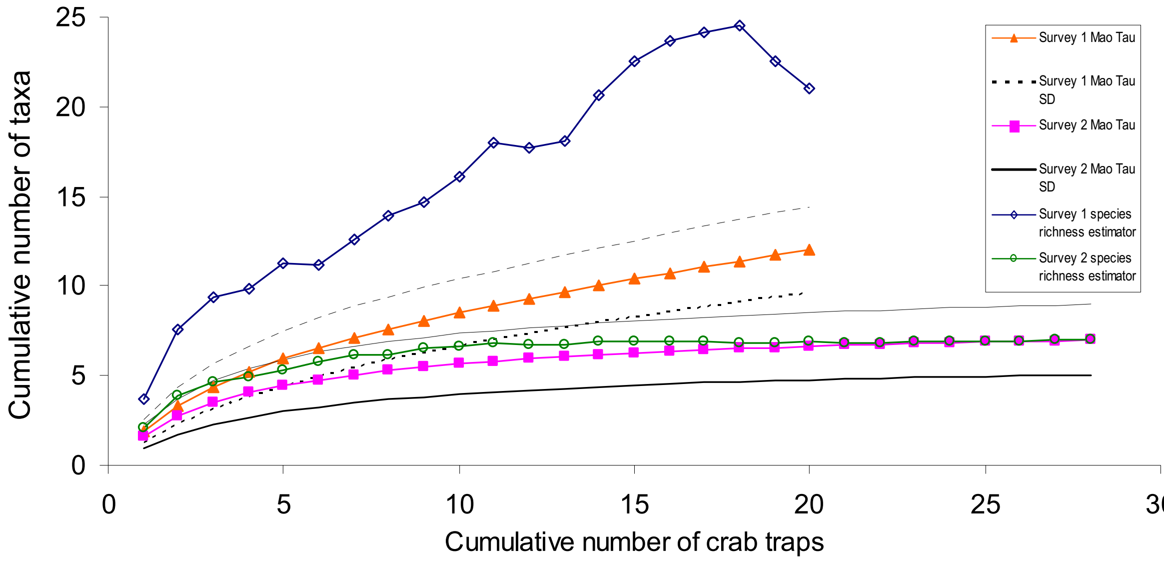


Figure 58: Rarefaction curves (Mao Tau) for native taxa from crab traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No non-indigenous or cryptogenic taxa were encountered during either survey. Species richness estimators are also shown for the first survey (empty diamonds, Chao 2 classic formula) and second survey (empty circles, Chao 2 bias-corrected formula).

Fish trap samples

Only 14 species in total were captured in the fish traps in the two surveys. Twelve of these were were native species, one was non-indigenous and one was cryptogenic category 1(Table 19). Eight species were captured in the first survey whilst ten were captured in the second. The rate of accumulation was almost identical, despite greater sample effort in the second survey (20 samples vs 32 samples, respectively; Figure 59). Rarefaction curves for both surveys neither approached an asymptote nor converged with the estimate of total richness. In both surveys, half of the species that were recovered occurred in just a single sample, resulting in estimated total richness values that continued to increase as more samples were added. Despite the low diversity, the species composition of samples taken during each survey was quite similar (Chao bias-adjusted Jaccard = 0.69; Chao bias-adjusted Sorenson = 0.817; Table 19).

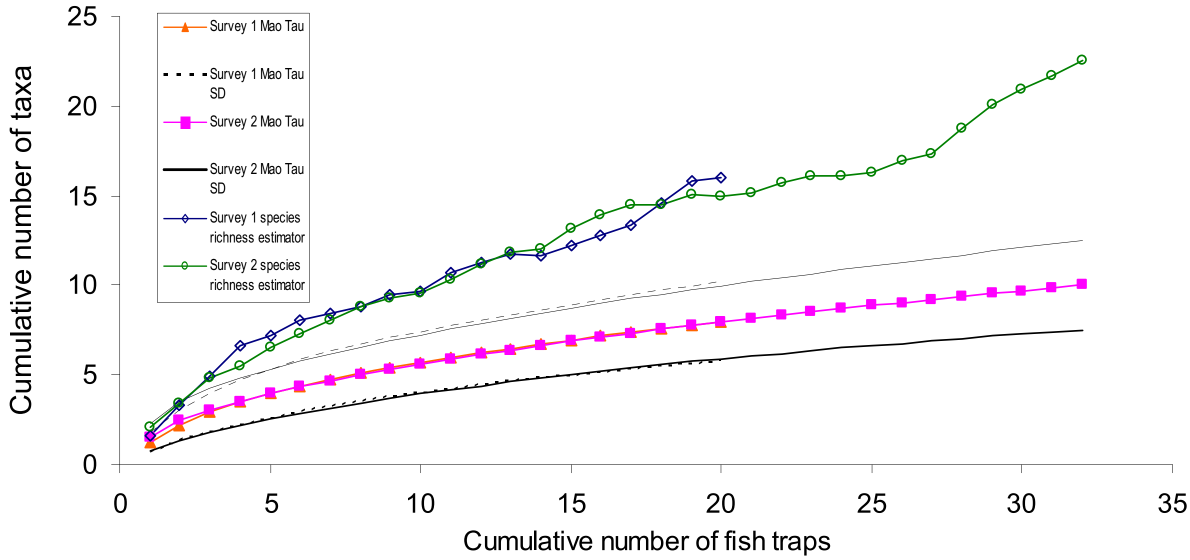


Figure 59: Rarefaction curves (Mao Tau) for native, non-indigenous and cryptogenic category one taxa combined from fish traps for the first survey (full triangles, ± SD (dashed lines)) and second survey (full squares, ± SD (solid lines)). No cryptogenic category two taxa were encountered in either survey. Species richness estimators (Chao 2 classic formula) are also shown for the first survey (empty diamonds formula) and second survey (empty circles).

Starfish trap samples

Only five native species were recorded from the starfish traps (Table 19): the cancrid crab, *Metacarcinus novaezelandiae*, the cushion star, *Patiriella regularis*, the common octopus, *Octopus maorum*, red cod, *Pseudophycis bachus*, and the spotted stargazer, *Genyagnus monopterygius*. All were native species. Two of these species - *M. novaezelandiae* and *P. regularis* – occurred in both surveys in this sample type.

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

The non-indigenous species in the Port of Timaru are most likely to have arrived in New Zealand via international shipping. They may have reached the Port of Timaru directly from overseas or through domestic spread (natural and / or anthropogenic) from other New Zealand ports. Table 16 indicates the possible vectors for the introduction of each non-indigenous species recorded from the Port of Timaru during the baseline port surveys. Likely vectors of introduction are largely derived from Cranfield et al. (1998) and expert opinion. They suggest that 18 of the 21 non-indigenous species (86%) were most likely to be associated with hull fouling, and the remaining 3 species (14 %) could have arrived via either of these mechanisms.

Assessment of the risk of new introductions to the port

Many NIS introduced to New Zealand ports, through hull fouling, ships' sea chests, or ballast water discharge, 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 non-indigenous species known to be present within New Zealand are native to temperate coastlines of Europe, the northwest Pacific, and southern Australia (Cranfield et al. 1998).

Commercial shipping arrivals in the port of Timaru from overseas are relatively low in number and frequency. Between 2002 and 2005, there were 105 vessel arrivals from overseas to the Port of Timaru. The greatest number of these came from: southeastern Australia (27), east Asian seas (18), the northwest Pacific (12), areas not stated in the database (9), and the Gulf States (6; Table 4). Some of this trade, particularly with southern Australia and the northwest Pacific, is with ports from other temperate regions that have coastal environments similar to New Zealand's, whilst the coastal environments of ports in other areas such as east Asian seas and the Gulf States are more tropical and less similar to the Timaru coastal environment.

Bulk carriers and tankers that arrive empty carry the largest volumes of ballast water. In the Port of Timaru these came predominantly from Australia (18 visits), east Asian seas (5 visits), the northwest Pacific (3 visits) and the Gulf States (3 visits; Table 4). The majority (78 %) of ballast water discharged in the Port of Timaru originates from South Korea and only 6 % from Australia (Inglis 2001). Non-indigenous species that arrive in the Port of Timaru from the temperate regions of the northwest Pacific and southern Australia pose the greatest risk of becoming locally established, since these source regions have coastal environments that are broadly compatible with those around Timaru.

Smaller, slower moving vessels, such as barges and fishing boats, tend to carry a greater density of fouling organisms than faster cargo vessels. In the Port of Timaru, there were only 17 overseas fishing vessel arrivals and no overseas barge arrivals recorded by the LMIU between 2002 and 2005 (Table 4). Of the 17 fishing vessel arrivals, nine were from unstated countries, with the remainder arriving from Australia (3 arrivals), the South America Pacific coast (3 arrivals) the northwest Pacific and Japan (one arrival each). Shipping from these regions presents an on-going risk of introduction of new NIS to the Port of Timaru.

Shipping from southern Australia and the northwest Pacific presents the greatest risk of introducing new non-indigenous species to the Port of Timaru. Because of the relatively short transit time, shipping originating in southern Australia (particularly Victoria and Tasmania) carries, perhaps, the greatest overall risk since six of the eight marine pests on the New Zealand Register of Unwanted Organisms are already present there (*Carcinus maenas*, *Asterias amurensis*, *Undaria pinnatifida*, *Sabella spallanzanii*, *Caulerpa taxifolia*, and *Styela clava*). The native range of the other two species – *Eriocheir sinensis* and *Potamocorbula amurensis* – is the northwestern Pacific, including China and Japan.

Assessment of translocation risk for introduced species found in the port

Between 2002 and 2005, vessels departing from the Port of Timaru travelled to 14 ports throughout New Zealand. Tauranga, Dunedin, Nelson, Bluff and Wellington were the next ports of call for the most domestic vessel movements from Timaru (Table 8). Although many of the non-indigenous species found in the re-survey of the Port of Timaru have been recorded in other locations throughout New Zealand (Table 18), they were not detected in all of the other ports surveyed.. There is, therefore, a risk that species established in the Port of Timaru could be spread to other New Zealand locations.

Of particular note is the one species in Timaru 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), although a control programme in Bluff Harbour has subsequently reduced populations established there. 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. Commercial vessels regularly ply between Timaru and the Port of Tauranga (Table 8) and, to a much lesser extent, ports north of Auckland where *U. pinnatifida* has not yet become established. There is, therefore, a risk that it could be spread to these locations by shipping from Timaru. The risk of translocation of *U. pinnatifida* and other fouling species is highest for slow-moving vessels, such as yachts and barges, and vessels that have long residence times in port. In Timaru, bulk carriers, recreational craft, and seasonal fishing vessels that are laid up for significant periods of time pose a particular risk for the spread of these species.

Several other species recorded during the baseline re-survey have only been recorded from the Port of Timaru or have relatively restricted distributions nationwide and could, therefore, be spread from Timaru to other locations. These include the amphipods *Caprella mutica*, *Jassa staudei* and *Jassa marmorata,* the hydroids *Symplectoscyphus subdichotomus*, *Synthecium subventricosum* and *Amphisbetia maplestonei* and the bryozoan *Celleporaria nodulosa* (Table 18). Information on the ecology of these species is limited, but none is known to have potential for significant impacts, although the high abundances sometimes reached by *Jassa marmorata* in fouling communities and algal communities could result in heavy fouling by the tubes this amphipod builds. Because of its association with aquaculture equipment and ropes overseas (Willis et al. 2004; Buschbaum and Gutow 2005) there has also been some recent, but as yet unsubstantiated, speculation that the caprellid amphipod, *Caprella mutica*, may prey on settling mussel spat when it occurs in high densities. Because each of these species is relatively abundant in the Port of Timaru, they may be transported relatively easily to other locations in fouling assemblages.

Three non-indigenous species recorded from Timaru during the initial baseline survey were not found during the re-survey. The small Japanese cancrid crab, *Cancer gibbosulus*, is known only from a few specimens recovered from Lyttelton, Timaru and Wellington during the initial port baseline surveys. *C. gibbosulus* was not recovered from any of these locations during the recent re-surveys. The polychaete worm *Barantolla lepte* was recorded during the initial port baseline surveys from just a single specimen each from Timaru and Taranaki and from two specimens from Napier. *B. lepte* was not recovered from Timaru during the recent Group 1 port re-surveys, but was again recovered from Taranaki. The alga *Polysiphonia subtilissima* was recorded during the initial baseline surveys from just two specimens from Timaru and a single specimen from each of Dunedin and Lyttelton. *P. subtilissima* was not recorded during the recent Group 1 port re-surveys from either Timaru or Lyttelton. At this stage it is unclear whether the absence of these three species from the re-surveys samples is due to sampling error, as a consequence of very small population densities in each port, or because the initial populations that were discovered were not viable. In either case, they appear to pose a small risk of translocation at current levels of abundance.

The port of Timaru is the principal port of departure for vessels travelling to the Chatham Islands. Although no surveys for NIS have been undertaken in the Chatham Islands, it is thought to be relatively free of marine pests and its marine environments are valued for their fisheries productivity and unique biodiversity (including species endemic to the Chatham

Islands). The invasive alga *Undaria pinnatifida*, which is present throughout the Port of Timaru, has not yet established wild populations in the Chatham Islands, but has been the subject of a successful incursion response there (Wotton et al. 2004). The non-indigenous hydroid *Symplectoscyphus subdichotomous,* which has been recorded from Timaru and Lyttelton during the port baseline surveys, has also been recorded from the Chatham Islands (Vervoort and Watson 2003). Shipping departing the port of Timaru, particularly slow-moving barges, or vessels that have been laid up within Timaru, poses a continuing threat of spreading this and other NIS to the Chatham Islands. Between 2002 and 2005, all commercial vessels travelling from Timaru to the Chatham Islands recorded by the LMIU were general cargo vessels (Table 8), which tend to move relatively quickly and discharge relatively small amounts of ballast water. Nevertheless, these vessels that regularly ply between the Port of Timaru and the Chatham Islands represent a high risk for translocation of non-indigenous species to the Chatham Islands.

Management of existing non-indigenous species in the port

Most of the NIS detected in this survey appear to be well established in the port. However, there were several NIS recorded in this survey that were recorded from only one site and were not recorded during the intial port baseline survey. These were the polychaete worm *Polydora hoplura,* the bryozoan *Celleporaria nodulosa*, the hydroids *Monotheca pulchella, Amphisbetia maplestonei* and *Synthecium subventricosum* and the amphipod *Jassa staudei* (Table 18). Furthermore, *C. nodulosa, M. pulchella, A. maplestonei* and *J. staudei* were represented in only a single sample. These species may not be well established in the Port of Timaru, and all of them except *P. hoplura* and *M. pulchella* have been recorded in no or few other New Zealand ports, and thus, based on survey results, do not appear to be well established in New Zealand, either. Because of their small size and colonial habits, control options for many of these species are limited, but may warrant further consideration so that they do not become more widely established in New Zealand waters. Any attempted control measures should be scaled by the potential impacts of the species, but these are unknown for most of these species.

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 Timaru, but may be worth considering for the more restricted species noted above. 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. This is particularly important for the unwanted species *Undaria pinnatifida*, and for species found only in the Port of Timaru, such as the amphipods *Caprella mutica* and *Jassa staudei*, which have exhibited invasive characteristics (see Appendix 5) and were not detected in any other port or marina surveyed nationwide. Such management will require better description of the location and frequency of movements of potential vectors that might spread these species from Timaru to other domestic and international locations.

Prevention of new introductions

Interception of unwanted species transported by shipping is best achieved offshore, through control and treatment of ships destined for Timaru 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 being introduced to New Zealand waters by shipping, especially considering the lack of management options for hull fouling introductions. There is a need for continued monitoring of marine NIS 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. Baseline inventories, like this one, facilitate the second and third of these two purposes. They become outdated when new introductions occur and, therefore, should be repeated on a regular basis to ensure they remain current. Hewitt and Martin (2001) recommend an interval of three to five years between repeat surveys.

The repeat survey of the Port of Timaru recorded 230 species or higher taxa, including 21 non-indigenous species. Although many species also occurred in the initial, February 2002 baseline survey of the port, the degree of overlap was not high. Around 41% of the native species, 43% of non-indigenous species, and 42% 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 for some groups (particularly native species) and survey methods.

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 up to 40% of native species recorded in the surveys 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).

In general, however, the surveys provided a relatively good inventory of the numbers of non-indigenous species in the Port of Timaru on each survey date. In each survey method that non-indigenous species were detected in (predominantly pile scrapes, benthic grabs and benthic sleds) there was good agreement between the observed and estimated numbers of species in the assemblage, indicating that relatively few species were likely to have remained undetected. The increased sampling effort in the second survey had only a limited effect on the rate of recovery of non-indigenous species, but the overall richness of the non-indigenous assemblage, summed over all methods, was greater during the second survey. Most of the non-indigenous species (19 of 24 species) recorded from the Port of Timaru were recorded in pile scrape samples and were relatively abundant throughout the port on each occasion. Exceptions were some of the newly recorded species, such as *Celleporaria nodulosa*, *Monotheca pulchella* and *Jassa staudei*, which occurred in just a single sample each. It is difficult to determine if these new records represent incursions that occurred after the first survey or, rather, were species that were present, but undetected during the first survey. Given the strong concordance between the estimated and observed diversity of non-indigenous species in each survey and the relative rarity of these new species in the second survey, it is possible that they are recent incursions. Similarly, the absence of the non-indigenous polychaete worm, *Barantolla lepte*, the Japanese cancer crab, *Cancer gibbosulus*, and the red alga, *Polysiphonia sublitissima*, in the second survey could be explained either by sampling error or local extinction since the initial baseline survey. It is possible that these populations have not persisted, although more detailed studies of their distribution and abundance are required to confirm this.

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 3 (or more) surveys and 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 Timaru.

Berth	Purpose	Construction	Length of Berth (m)	Depth at LWOST (m)
No. 1 Wharf	Fish, reefer exports, bulk chemicals	Wood deck/wood piles	200	8.5
No. 1 Extension (Reclaimation point)	Bulk liquids, fish, logs, diesel bunkers	Concrete deck/wood piles	220	10.6
Old No.1 Wharf (No. 1 East / East Mole)	Fish, reefer exports, diesel bunkers	Concrete deck/wood piles	100	8.6
No.2 Wharf (Nth)	Grain exports	Concrete + wood deck/wood piles	200	10.5
No.3 Wharf (Sth)	Fish cargoes, repair	Concrete deck/wood piles	200	10.5
Outer North Mole	Containers, liner breakbulk, fertiliser, woodchips, project cargoes, milk products, reefer exports, livestock	Concrete deck/concrete piles	460	11.0
Fishermans Wharf (Fish Processing Freezers)	Fish imports/exports	Concrete deck/wood piles	165	6.2

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

Year ended June	Gross weight (tonnes)	% weight change from previous year	Value (CIF[1]) ($million)	% value change from previous year	Proportion by weight of all NZ Seaports	Proportion by value of all NZ Seaports
2002	235,245		171		1.5	0.7
2003	287,243	22.1	259	51.5	1.8	1.0
2004	303,604	5.7	311	20.1	1.7	1.2
2005[P]	336,612	10.9	362	16.4	1.8	1.3
Change from 2002 to 2005	101,367	43.1	191	111.7		

[1] CIF: Cost including insurance and freight

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

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

Year ended June	Gross weight (tonnes)	% weight change from previous year	Value (FOB[1]) ($million)	% value change from previous year	Proportion by weight of all NZ Seaports	Proportion by value of all NZ Seaports
2002	245,291		607		1.0	2.2
2003	385,331	57.1	828	36.4	1.5	3.3
2004	397,858	3.3	905	9.3	1.8	3.5
2005[P]	401,664	1.0	1,021	12.8	1.8	3.9
Change from 2002 to 2005	156,373	63.7	414	68.2		

[1] FOB: Free on board

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

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

Geographical area of previous port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger/ vehicle/ livestock	Other (inc pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (inc chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Australia	6		1	3	9		3				12	11		45
East Asian seas	3				2		3				2	8		18
Northwest Pacific	2			1	2		5				1	1		12
Unknown (not stated in database)				9										9
Gulf States	3				3									6
Japan	1			1	1								1	4
South America Pacific coast	1			3										4
West coast North America inc USA, Canada & Alaska	1						2							3
Pacific Islands	1										1			2
Central America inc Mexico to Panama							1							1
North European Atlantic coast					1									1
Total	18	0	1	17	18	0	14	0	0	0	16	20	1	105

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

Australian state of previous port of call	Bulk/ cement carrier	Bulk/ oil carrier	Dredge	Fishing	General cargo	LPG/ LNG	Passenger/ vehicle/ livestock	Other (inc pontoons, barges, mining & supply ships, etc)	Passenger ro/ro	Research	Tanker (inc chemical/ oil and ashphalt)	Container/ unitised carrier and ro/ro	Tug	Total
Queensland	2										3	10		15
Victoria	4		1		1						4	1		11
New South Wales					6						4			10
Tasmania				3	2						1			6
Western Australia							3							3
Total	6	0	1	3	9	0	3	0	0	0	12	11	0	45

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

Geographical area of next 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 chem/ oil/ ashphalt)	Container/ unitised carrier/ ro/ro	Tug	Total
Australia	6		1	2	3		1				25	6		44
Northwest Pacific	6			1			5				6			18
East Asian seas							1				9	4		14
Central America inc Mexico to Panama							2					8		10
Japan				1	6						1			8
South America Pacific coast	1			2										3
Central Indian Ocean	1										1			2
West coast North America inc USA, Canada & Alaska							2							2
South America Atlantic coast	1						1							2
Caribbean Islands					2									2
North European Atlantic coast					1									1
Pacific Islands											1			1
Gulf of Mexico												1		1
North African coast					1									1
Total	15	0	1	6	13	0	12	0	0	0	43	19	0	109

Table 7: **Number of vessel arrivals from New Zealand ports to the Port of Timaru 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
Timaru				332	20						2	2		356
Napier	12				32		3				12	136		195
Wellington	2			1	25		2				45	54		129
Auckland	1			3	82						14	4		104
Lyttelton	13		1	27	7		1			1	33	12		95
Tauranga	17		1		3		1				40	13		75
New Plymouth	2				2						17	39		60
Bluff	18				25						6	8		57
Nelson	6			17	4						1	24		52
Chatham Islands					46									46
Whangarei	17										3			20
Dunedin	5			2	3						1	3		14
Westport								1					1	2
Gisborne	1													1
Onehunga													1	1
Mount Maunganui											1			1
Total	94	0	2	382	249	0	7	1	0	1	175	295	2	1208

Table 8: **Number of vessel departures from the Port of Timaru 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
Timaru				332	20						2	2		356
Tauranga	11		1		18						24	83		137
Dunedin	8			1	20		1				10	80		120
Nelson	5			13	7						4	68	1	98
Bluff	28				33						29			90
Wellington	8			1	59						16	4		88
New Plymouth	9				2			1			36	35		83
Lyttelton	11		2	32	8		1			1	7	17		79
Napier	5				33		7				10	5		60
Chatham Islands					44									44
Auckland	1			3	7						4	1		16
Whangarei	2				1						6			9
Gisborne	4				1									5
Picton	5													5
Westport													1	1
Total	97	0	3	382	253	0	9	1	0	1	148	295	2	1191

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

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

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

Table 10: Summary of sampling effort in the Port of Timaru. 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 (including 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
Between Inner & Outer North Mole											2									
Between Wharf 1 & 2																			2	
Between Wharf 2 & 3																			2	
Old No.1 Wharf / East Mole		4		4		1		4		3		4		12		12		5		
Fish Processing Freezers				8																
Fisherman's Wharf (Fish Processing Freezers)									3				10	12	10	12	4	4		2
Inner North Mole	4	4	4		1	1	4	4		3	2	2						1		
Mid port																			2	
North Mole Wharf	4	4	4	4	1	1	4	4	3	2		2	15	14	15	14	4	6		2
Outer mid port																			2	
Outer North Mole	4	4	4		1	2	4	4		3	2	2						1		
Reclamation Point (Commercial Slipway & Evans Bay Reclaimation incl.)		4		8		1		4		3		2								
Rockwall																	2			
No. 1 Wharf	4	4	4	4		1	4	4	5		2	2	14		14		4			2
No. 2 Wharf										3	2			13		13		5		2
No. 3 Wharf	4	4	4	4	1	1	4	4	3	6	2	2	16	14	16	14	4	4		
Total	20	28	20	32	4	8	20	28	14	23	12	16	55	65	55	65	14	18	8	8

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

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

NB: Changes since the first survey:

Ascidians now considered separately as colonial and solitary species, and preserved in different solutions. The solitary species are no longer relaxed prior to preservation and the strength of preservative for these species has been increased. The colonials are now preserved in formalin as opposed to ethanol.

The Bryozoa are now initially preserved in 100% ethanol, then air dried at a later date prior to identification.

Platyhelminthes are now fixed in formalin, rather than relaxed, before preservation in ethanol.

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

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

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

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

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

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

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Eunicida	Dorvilleidae	*Dorvillea australiensis*	1	0
Polychaeta	Eunicida	Dorvilleidae	*Schistomeringos loveni*	1	1
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sphaerocephala*	1	1
Polychaeta	Eunicida	Onuphidae	*Onuphis aucklandensis*	1	0
Polychaeta	Phyllodocida	Glyceridae	*Glycera lamelliformis*	1	1
Polychaeta	Phyllodocida	Glyceridae	*Glycera ovigera*	1	0
Polychaeta	Phyllodocida	Glyceridae	*Hemipodus simplex*	1	0
Polychaeta	Phyllodocida	Goniadidae	*Glycinde trifida*	1	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	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis camiguinoides*	1	1
Polychaeta	Phyllodocida	Nereididae	*Perinereis pseudocamiguina*	1	0
Polychaeta	Phyllodocida	Nereididae	*Platynereis Platynereis_australis_group*	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia microphylla*	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Nereiphylla cf. castanea*	1	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidastheniella comma*	1	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus polychromus*	1	1
Polychaeta	Phyllodocida	Polynoidae	*Ophiodromus angustifrons*	1	1
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis laevis*	1	1
Polychaeta	Phyllodocida	Sigalionidae	*Sthenelais novaezealandiae*	1	0
Polychaeta	Phyllodocida	Syllidae	*Amblyosyllis granosa*	1	0
Polychaeta	Sabellida	Oweniidae	*Owenia petersenae*	1	0
Polychaeta	Sabellida	Sabellidae	*Demonax aberrans*	1	1
Polychaeta	Sabellida	Sabellidae	*Megalomma kaikourense*	1	0
Polychaeta	Sabellida	Serpulidae	*Galeolaria hystrix*	1	0
Polychaeta	Sabellida	Serpulidae	*Neovermilia sphaeropomatus*	1	0
Polychaeta	Scolecida	Opheliidae	*Armandia maculata*	1	1
Polychaeta	Scolecida	Orbiniidae	*Scoloplos cylindrifer*	1	0
Polychaeta	Scolecida	Orbiniidae	*Scoloplos simplex*	1	0
Polychaeta	Scolecida	Orbiniidae	*Scoloplos (Scoloplos) simplex*	0	1
Polychaeta	Spionida	Spionidae	*Boccardia chilensis*	1	0
Polychaeta	Spionida	Spionidae	*Boccardia lamellata*	1	0
Polychaeta	Spionida	Spionidae	*Boccardia syrtis*	1	1
Polychaeta	Spionida	Spionidae	*Prionospio aucklandica*	1	0
Polychaeta	Spionida	Spionidae	*Prionospio multicristata*	1	0
Polychaeta	Spionida	Spionidae	*Scolecolepides benhami*	1	1
Polychaeta	Terebellida	Ampharetidae	*Ampharete kerguelensis*	1	0
Polychaeta	Terebellida	Cirratulidae	*Protocirrineris nuchalis*	1	0
Polychaeta	Terebellida	Cirratulidae	*Timarete anchylochaetus*	1	1
Polychaeta	Terebellida	Flabelligeridae	*Flabelligera affinis*	1	1
Polychaeta	Terebellida	Flabelligeridae	*Pherusa parmata*	1	0
Polychaeta	Terebellida	Pectinariidae	*Pectinaria australis*	1	0
Polychaeta	Terebellida	Terebellidae	*Amaeana antipoda*	1	0
Polychaeta	Terebellida	Terebellidae	*Streblosoma toddae*	1	1
Bryozoa					
Gymnolaemata	Cheilostomata	Arachnopusiidae	*Arachnopusia unicornis*	1	1
Gymnolaemata	Cheilostomata	Beaniidae	*Beania new sp. [whitten]*	1	0
Gymnolaemata	Cheilostomata	Calloporidae	*Odontionella cyclops*	1	0
Gymnolaemata	Cheilostomata	Calwelliidae	*Calwellia gracilis*	1	0
Gymnolaemata	Cheilostomata	Candidae	*Caberea zelandica*	1	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina disjuncta*	1	0
Gymnolaemata	Cheilostomata	Romancheinidae	*Escharoides angela*	1	1
Gymnolaemata	Cheilostomata	Romancheinidae	*Escharoides excavata*	1	0
Gymnolaemata	Cheilostomata	Schizoporellidae	*Chiastosella watersi*	0	1
Gymnolaemata	Ctenostomata	Flustrellidridae	*Elzerina binderi*	1	0
Chelicerata					
Pycnogonida	Pantopoda	Ammotheidae	*Achelia assimilis*	1	0
Pycnogonida	Pantopoda	Ammotheidae	*Ammothea magniceps*	1	0
Pycnogonida	Pantopoda	Callipallenidae	*Pallenopsis obliqua*	1	1
Chordata					
Chondrichthyes	Squaliformes	Squalidae	*Squalus acanthias*	1	1
Cnidaria					
Anthozoa	Actiniaria	Diadumenidae	*Diadumene neozelandica*	1	0
Anthozoa	Actiniaria	Sagartiidae	*Anthothoe vagrans*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia bispinosa*	1	1
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia fasciculata*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia trispinosa*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Sertularia unguiculata*	1	1
Hydrozoa	Hydroida	Sertulariidae	*Stereotheca elongata*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Symplectoscyphus johnstoni*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Symplectoscyphus subarticulatus*	1	0
Hydrozoa	Hydroida	Syntheciidae	*Synthecium elegans*	1	0
Crustacea					
Cirripedia	Thoracica	Balanidae	*Austrominius modestus*	1	1
Cirripedia	Thoracica	Balanidae	*Notomegabalanus decorus*	1	1
Cirripedia	Thoracica	Pachylasmidae	*Epopella plicata*	0	1
Malacostraca	Amphipoda	Ampithoidae	*Perampithoe aorangi*	0	1
Malacostraca	Amphipoda	Aoridae	*Haplocheira barbimana*	1	1
Malacostraca	Amphipoda	Caprellidae	*Caprella equilibra*	0	1
Malacostraca	Amphipoda	Cyproideidae	*Peltopes peninsulae*	1	0
Malacostraca	Amphipoda	Dexaminidae	*Paradexamine pacifica*	1	1
Malacostraca	Amphipoda	Dexaminidae	*Polycheria obtusa*	0	1
Malacostraca	Amphipoda	Eusiridae	*Eusiroides monoculoides*	1	1
Malacostraca	Amphipoda	Eusiridae	*Gondogeneia danai*	0	1
Malacostraca	Amphipoda	Eusiridae	*Oradarea novaezealandiae*	1	0
Malacostraca	Amphipoda	Eusiridae	*Paramoera rangitira*	1	0
Malacostraca	Amphipoda	Hyalidae	*Hyale grandicornis*	1	0
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis dentifera*	1	0
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis typica*	1	0
Malacostraca	Amphipoda	Ischyroceridae	*Ischyrocerus longimanus*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe trailli*	0	1
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia barhami*	0	1
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia hansoni*	1	0
Malacostraca	Amphipoda	Lysianassidae	*Orchomene aahu*	1	0
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia angusta*	1	1
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia stephenseni*	1	1
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia vesca*	1	1
Malacostraca	Amphipoda	Melitidae	*Elasmopus neglectus*	0	1
Malacostraca	Amphipoda	Melitidae	*Melita inaequistylis*	1	1
Malacostraca	Amphipoda	Phoxocephalidae	*Torridoharpinia hurleyi*	1	0
Malacostraca	Amphipoda	Podoceridae	*Podocerus cristatus*	1	0
Malacostraca	Amphipoda	Podoceridae	*Podocerus karu*	1	0
Malacostraca	Amphipoda	Podoceridae	*Podocerus manawatu*	1	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Malacostraca	Amphipoda	Stenothoidae	*Stenothoe moe*	1	0
Malacostraca	Amphipoda	Stenothoidae	*Stenothoe ornata*	0	1
Malacostraca	Anomura	Paguridae	*Pagurus novizealandiae*	1	1
Malacostraca	Anomura	Porcellanidae	*Petrolisthes elongatus*	1	1
Malacostraca	Anomura	Porcellanidae	*Petrolisthes novaezelandiae*	1	1
Malacostraca	Brachyura	Cancridae	*Metacarcinus novaezelandiae*	1	1
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus innominatus*	0	1
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus varius*	0	1
Malacostraca	Brachyura	Hymenosomatidae	*Hymenosoma depressum*	1	1
Malacostraca	Brachyura	Majidae	*Notomithrax peronii*	1	0
Malacostraca	Brachyura	Majidae	*Notomithrax ursus*	1	0
Malacostraca	Brachyura	Ocypodidae	*Macrophthalmus hirtipes*	1	1
Malacostraca	Brachyura	Pinnotheridae	*Pinnotheres novaezelandiae*	0	1
Malacostraca	Caridea	Crangonidae	*Pontophilus australis*	1	1
Malacostraca	Caridea	Palemonidae	*Palaemon affinis*	0	1
Malacostraca	Isopoda	Anthuridae	*Mesanthura affinis*	0	1
Malacostraca	Isopoda	Cirolanidae	*Natatolana rossi*	1	0
Malacostraca	Isopoda	Holognathiidae	*Cleantis tubicola*	1	0
Malacostraca	Isopoda	Paranthuridae	*Paranthura cf. flagellata*	1	0
Malacostraca	Isopoda	Paranthuridae	*Paranthura flagellata*	0	1
Malacostraca	Isopoda	Sphaeromatidae	*Cilicaea caniculata*	1	1
Malacostraca	Isopoda	Sphaeromatidae	*Pseudosphaeroma campbellensis*	1	1
Malacostraca	Mysida	Mysidae	*Tenogomysis macropsis*	1	0
Malacostraca	Mysida	Mysidae	*Tenogomysis producta*	1	0
Malacostraca	Palinura	Palinuridae	*Jasus edwardsi*	0	1
Echinodermata					
Asteroidea	Forcipulata	Asteriidae	*Allostichaster polyplax*	1	1
Asteroidea	Forcipulata	Asteriidae	*Coscinasterias muricata*	0	1
Asteroidea	Valvatida	Asterinidae	*Meridiastra mortenseni*	0	1
Asteroidea	Valvatida	Asterinidae	*Patiriella regularis*	1	1
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*	0	1
Bivalvia	Mytiloida	Mytilidae	*Perna canaliculus*	1	1
Bivalvia	Mytiloida	Mytilidae	*Xenostrobus pulex*	1	1
Bivalvia	Ostreoida	Ostreidae	*Ostrea chilensis*	1	1
Bivalvia	Veneroida	Lasaeidae	*Arthritica bifurca*	1	1
Bivalvia	Veneroida	Lasaeidae	*Lasaea hinemoa*	1	1
Bivalvia	Veneroida	Mactridae	*Cyclomactra ovata*	1	0
Bivalvia	Veneroida	Semelidae	*Leptomya retiaria*	1	1
Bivalvia	Veneroida	Veneridae	*Irus reflexus*	1	1
Bivalvia	Veneroida	Veneridae	*Ruditapes largillierti*	1	1
Cephalopoda	Octopoda	Octopodidae	*Octopus maorum*	1	1
Gastropoda	Basommatophora	Siphonariidae	*Siphonaria australis*	0	1
Gastropoda	Cephalaspidea	Aglajidae	*Melanochlamys cylindrica*	1	0
Gastropoda	Cephalaspidea	Philinidae	*Philine auriformis*	0	1
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella novaezelandiae*	0	1
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella tenuis*	1	0
Gastropoda	Littorinimorpha	Littorinidae	*Austrolittorina antipodum*	0	1
Gastropoda	Littorinimorpha	Littorinidae	*Risellopsis varia*	1	0
Gastropoda	Neogastropoda	Buccinidae	*Buccinulum pallidum*	1	0
Gastropoda	Neogastropoda	Muricidae	*Xymene aucklandicus*	0	1
Gastropoda	Neogastropoda	Muricidae	*Xymene plebeius*	1	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Gastropoda	Neogastropoda	Muricidae	*Xymene pusillus*	1	0
Gastropoda	Notaspidea	Pleurobranchidae	*Pleurobranchaea maculata*	0	1
Gastropoda	Nudibranchia	Discodorididae	*Hoplodoris nodulosa*	0	1
Gastropoda	Nudibranchia	Dorididae	*Archidoris nanula*	1	0
Gastropoda	Patellogastropoda	Lottiidae	*Notoacmea helmsi*	1	0
Gastropoda	Vetigastropoda	Fissurellidae	*Scutus breviculus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus huttonii*	0	1
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus sanguineus*	1	1
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus tenebrosus*	1	0
Gastropoda	Vetigastropoda	Trochidae	*Trochus tiaratus*	1	1
Gastropoda	Vetigastropoda	Trochidae	*Trochus viridus*	0	1
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus porosus*	1	0
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton pelliserpentis*	1	1
Macroalgae					
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnion applicitum*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium apiculatum*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Medeiothamnion lyallii*	0	1
Florideophyceae	Ceramiales	Dasyaceae	*Heterosiphonia squarrosa*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Erythroglossum undulatissimum*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Myriogramme denticulata*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Phycodrys quercifolia*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris dichotoma*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris griffithsia*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia harveyi*	1	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Brongniartella australis*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Chondria macrocarpa*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia strictissima*	0	1
Florideophyceae	Corallinales	Corallinaceae	*Corallina officinalis*	1	0
Florideophyceae	Gigartinales	Cystocloniaceae	*Rhodophyllis centrocarpa*	0	1
Florideophyceae	Gigartinales	Gigartinaceae	*Gigartina decipiens*	1	1
Florideophyceae	Gigartinales	Kallymeniaceae	*Callophyllis calliblepharoides*	1	0
Florideophyceae	Gigartinales	Phyllophoraceae	*Stenogramme interrupta*	1	0
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria secunda*	1	0
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria umbellata*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia foliifera*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia leptophylla*	1	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia novazelandica*	1	0
Phaeophyceae	Desmarestiales	Desmarestiaceae	*Desmarestia ligulata*	0	1
Phaeophyceae	Ectocarpales	Chordariaceae	*Papenfussiella lutea*	0	1
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Ectocarpus siliculosus*	0	1
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Hincksia mitchelliae*	0	1
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Scytosiphon lomentaria*	0	1
Phaeophyceae	Ectocarpales	Scytothamnaceae	*Scytothamnus australis*	0	1
Phaeophyceae	Laminariales	Lessoniaceae	*Macrocystis pyrifera*	0	1
Ulvophyceae	Bryopsidales	Bryopsidaceae	*Bryopsis vestita*	0	1
Ulvophyceae	Cladophorales	Wittrockiellaceae	*Wittrockiella salina*	1	0
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha intestinalis*	1	0
Porifera					
Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. fistulosa*	1	0
Demospongiae	Haplosclerida	Chalinidae	*Haliclona cf. punctata*	1	0
Demospongiae	Poecilosclerida	Mycalidae	*Mycale (Carmia) tasmani*	1	0
Dinophyta					
Dinophyceae	Peridinales	Gonyaulacaceae	*Gonyaulax scrippsae*	0	1
Dinophyceae	Peridinales	Gonyaulacaceae	*Protoceratium reticulatum*	0	1

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Dinophyceae	Peridinales	Peridiniaceae	*Lingulodinium polyedrum*	1	1
Dinophyceae	Peridinales	Peridiniaceae	*Scrippsiella trochoidea*	0	1
Urochordata					
Ascidiacea	Aplousobranchia	Holozoidae	*Hypsistozoa fasmeriana*	1	1
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium adamsi*	1	1
Ascidiacea	Stolidobranchia	Botryllinae	*Botryllus stewartensis*	0	1
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula mortenseni*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura cancellata*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura carnea*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura lutea*	1	0
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura pachydermatina*	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura pulla*	1	0
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa bicornuta*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa nisiotus*	1	1
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa otagoensis*	1	0
Vertebrata					
Actinopterygii	Gadiformes	Moridae	*Lotella rhacinum*	0	1
Actinopterygii	Gadiformes	Moridae	*Pseudophycis bachus*	1	1
Actinopterygii	Mugiliformes	Mugilidae	*Aldrichetta forsteri*	1	0
Actinopterygii	Perciformes	Cheilodactylidae	*Nemadactylus macropterus*	0	1
Actinopterygii	Perciformes	Eleotridae	*Grahamichthys radiatus*	1	0
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*	1	1
Actinopterygii	Perciformes	Trypterigiidae	*Blennodon dorsale*	1	0
Actinopterygii	Perciformes	Trypterigiidae	*Grahamina gymnota*	1	0
Actinopterygii	Perciformes	Uranoscopidae	*Genyagnus monopterygius*	0	1
Actinopterygii	Tetradontiformes	Tetraodontidae	*Contusus richiei*	1	0

* 1 = Present, 0 = Absent

Table 15: Cryptogenic marine species recorded from the Port of Timaru 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	Order	Family	Genus and species	Status	T1*	T2*
Annelida						
Polychaeta	Phyllodocida	Nereididae	*Neanthes Neanthes-A*	C2	1	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis Perinereis-A*	C2	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia Eulalia-NIWA-2*	C2	1	1
Polychaeta	Phyllodocida	Phyllodocidae	*Mystides Mystides-B*	C2	0	1
Polychaeta	Phyllodocida	Phyllodocidae	*Pirakia Pirakia-A*	C2	1	1
Polychaeta	Phyllodocida	Syllidae	*Eusyllin-unknown Eusyllin-*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Eusyllis Eusyllis-B*	C2	1	1
Polychaeta	Phyllodocida	Syllidae	*Syllis Syllis-B*	C2	1	0
Polychaeta	Phyllodocida	Syllidae	*Syllis Syllis-C*	C2	1	0
Polychaeta	Sabellida	Sabellidae	*Branchiomma curtum*	C1	1	1
Polychaeta	Scolecida	Maldanidae	*Asychis Asychis-B*	C2	1	1
Polychaeta	Spionida	Spionidae	*Paraprionospio*	C2	1	1
Polychaeta	Spionida	Spionidae	*Rhynchospio Rhynchospio-A*	C2	1	0
Polychaeta	Terebellida	Cirratulidae	*Cirratulus Cirratulus-A*	C2	1	1
Polychaeta	Terebellida	Terebellidae	*Lanassa Lanassa-A*	C2	0	1
Bryozoa						
Gymnolaemata	Cheilostomata	Scrupariidae	*Scruparia ambigua*	C1	1	0
Chelicerata						
Pycnogonida	Pantopoda	Ammotheidae	*Achelia sp. cf. A. australiensis*	C1	1	0
Pycnogonida	Pantopoda	Ammotheidae	*Tanystylum sp. B*	C2	1	1
Cnidaria						
Hydrozoa	Hydroida	Campanulariidae	*Obelia dichotoma*	C1	0	1
Hydrozoa	Hydroida	Haleciidae	*Halecium delicatulum*	C1	0	1
Hydrozoa	Hydroida	Plumulariidae	*Plumularia setacea*	C1	1	1
Crustacea						
Malacostraca	Amphipoda	Aoridae	*Aora sp. aff. A. typica*	C2	0	1
Malacostraca	Amphipoda	Corophiidae	*Meridiolembos sp. aff.*	C2	1	0
Malacostraca	Amphipoda	Corophiidae	*Meridiolembos sp. aff. M.*	C2	1	0
Malacostraca	Amphipoda	Dexaminidae	*Polycheria sp. aff. P. obtusa*	C2	1	0
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis sp. 1*	C2	1	0
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis sp. aff. typica*	C2	1	0
Malacostraca	Amphipoda	Isaeidae	*Photis sp. aff. P. nigrocula*	C2	1	1
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia sp aff P.*	C2	0	1

Major taxonomic	Order	Family	Genus and species	Status	T1*	T2*
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia sp. aff. angusta*	C2	1	1
Malacostraca	Amphipoda	Lysianassidae	*Parawaldeckia sp. aff. P.*	C2	0	1
Malacostraca	Amphipoda	Lysianassidae	*Stomacontion sp. aff. S.*	C2	1	0
Malacostraca	Amphipoda	Oedicerotidae	*Oedicerotidae n. gen et sp.*	C2	1	0
Mollusca						
Bivalvia	Mytiloida	Mytilidae	*Mytilus galloprovincialis*	C1	1	1
Macroalgae						
Florideophyceae	Ceramiales	Delesseriaceae	*Valeriemaya undescribed*	C2	0	1
Porifera						
Demospongiae	Dictyoceratida	Dysideidae	*Euryspongia new sp. 2*	C2	1	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 1*	C2	1	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 2*	C2	0	1
Demospongiae	Halichondrida	Halichondriidae	*Halichondria new sp. 6*	C2	1	0
Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia new sp. 1*	C2	1	0
Demospongiae	Haplosclerida	Callyspongiidae	*Chalinopsilla new sp. 1*	C2	1	0
Demospongiae	Haplosclerida	Chalinidae	*Adocia new sp. 4*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Adocia new sp. 5*	C2	0	1
Demospongiae	Haplosclerida	Chalinidae	*Haliclona new sp. 11*	C2	0	1
Demospongiae	Poecilosclerida	Crellidae	*Crella (Pytheas) incrustans*	C1	1	0
Demospongiae	Poecilosclerida	Microcionidae	*Axociella new sp. 1*	C2	1	0
Urochordata						
Ascidiacea	Aplousobranchia	Didemnidae	*Didemnum* species group (includes *D.vexillum, D. incanum,* and other *Didemnum* species)	C1	1	1#
Ascidiacea	Aplousobranchia	Holozoidae	*Distaplia sp.*	C2	0	1
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium phortax*	C1	1	1
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella eumyota*	C1	1	1
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes leachii*	C1	1	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura sp. (new?)*	C2	1	0
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 16: **Non-indigenous marine species recorded from the Port of Timaru 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	Order	Family	Genus and species	T1*	T2*	Probable means of introduction	Date of introduction or detection
Annelida							
Polychaeta	Sabellida	Sabellidae	*Euchone limnicola*	1	1	H or B	Unknown[1]
Polychaeta	Sabellida	Serpulidae	*Spirobranchus polytrema* ***(NR)***	0	1	H	Nov 2001[d]
Polychaeta	Scolecida	Capitellidae	*Barantolla lepte*	1	0	H or B	Unknown[1]
Polychaeta	Spionida	Spionidae	*Polydora hoplura*	0	1	H	Unknown[1]
Bryozoa							
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula flabellata*	1	1	H	Pre-1949
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula neritina*	1	1	H	1949
Gymnolaemata	Cheilostomata	Cryptosulidae	*Cryptosula pallasiana*	1	1	H	1890s
Gymnolaemata	Cheilostomata	Lepraliellidae	*Celleporaria nodulosa* ***(NR)***	0	1	H	Jan 2002[d]
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora subtorquata*	1	1	H or B	Pre-1982
Cnidaria							
Hydrozoa	Hydroida	Plumulariidae	*Monotheca pulchella*	0	1	H	1928
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia maplestonei?*[2] ***(NR)***	0	1	H	Dec 2004[d]
Hydrozoa	Hydroida	Sertulariidae	*Symplectoscyphus*	0	1	H	1930
Hydrozoa	Hydroida	Syntheciidae	*Synthecium subventricosum*	0	1	H	1955
Crustacea							
Malacostraca	Amphipoda	Caprellidae	*Caprella mutica* ***(NR)***	1	1	H	Feb 2002[d]
Malacostraca	Amphipoda	Corophiidae	*Apocorophium acutum*	1	1	H	Pre-1921
Malacostraca	Amphipoda	Corophiidae	*Monocorophium acherusicum*	1	1	H	Pre-1921
Malacostraca	Amphipoda	Ischyroceridae	*Jassa marmorata*	0	1	H	Unknown[1]
Malacostraca	Amphipoda	Ischyroceridae	*Jassa slatteryi*	1	1	H	Unknown[1]
Major taxonomic	**Order**	**Family**	***Genus and species***	**T1***	**T2***	**Probable means of introduction**	**Date of introduction or detection**

Major taxonomic	Order	Family	Genus and species	T1*	T2*	Probable means of introduction	Date of introduction or detection
Malacostraca	Amphipoda	Ischyroceridae	*Jassa staudei* ***(NR)***	0	1	H	Dec 2004[d]
Malacostraca	Brachyura	Cancridae	*Cancer gibbosulus* ***(NR)***	1	0	H or B	Nov 2001[d]
Macroalgae							
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia crassiuscula*	1	1	H	Pre-1954
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia subtilissima*	1	0	H	Pre-1974
Phaeophyceae	Laminariales	Alariaceae	*Undaria pinnatifida*	1	1	H or B	Pre-1987
Urochordata							
Ascidiacea	Aplousobranchia	Cionidae	*Ciona intestinalis*	1	1	H	Pre-1950

* 1 = Present, 0 = Absent
[1] Date of introduction currently unknown but species had been encountered in New Zealand prior to the present survey
[2] This specimen was small and infertile, and the identification is therefore uncertain

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

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Annelida					
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris Indet*	0	1
Polychaeta	Phyllodocida	Nereididae	*Nereididae indet*	0	1
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus Indet*	1	0
Polychaeta	Phyllodocida	Syllidae	*Syllidae Indet*	1	0
Polychaeta	Sabellida	Sabellidae	*Sabellidae Indet*	1	0
Polychaeta	Sabellida	Serpulidae	*Serpulidae Indet*	1	0
Polychaeta	Terebellida	Cirratulidae	*Cirratulidae Indet*	1	0
Polychaeta	Terebellida	Terebellidae	*Terebellidae Indet*	1	1
Cnidaria					
Anthozoa	Actiniaria		*Acontiaria sp.*	1	0
Anthozoa	Actiniaria	Acontiophoridae	*Mimetridium sp.*	1	0
Anthozoa	Actiniaria	Diadumenidae	*Unidentified Diadumenidae*	1	0
Anthozoa	Actiniaria	Diadumenidae	*Diadumene sp.*	1	0
Anthozoa	Actiniaria	Sagartiidae	*Actinothoe sp.*	1	0
Anthozoa	Actiniaria	Sagartiidae	*Anthothoe sp.*	1	0
Anthozoa	Actiniaria	Sagartiidae	*Sagartiidae sp.*	1	0
Hydrozoa	Hydroida	Sertulariidae	*Amphisbetia ?bispinosa*	1	0
Crustacea					
Malacostraca	Amphipoda		*Unidentified Amphipoda*	0	1
Malacostraca	Amphipoda	Aoridae	*Aoridae indet. gen. et sp.*	0	1
Malacostraca	Amphipoda	Caprellidae	*Unidentified Caprellidae*	0	1
Malacostraca	Amphipoda	Corophiidae	*Meridiolembos sp.*	1	0
Malacostraca	Amphipoda	Hyalidae	*Hyale sp.*	0	1
Malacostraca	Amphipoda	Isaeidae	*Gammaropsis indet sp.*	0	1
Malacostraca	Amphipoda	Ischyroceridae	*Jassa sp.*	0	1
Malacostraca	Amphipoda	Leucothoidae	*Paraleucothoe sp. A*	0	1
Malacostraca	Amphipoda	Podoceridae	*Podocerus sp.*	0	1
Malacostraca	Brachyura	Majidae	*Notomithrax sp.*	0	1
Malacostraca	Decapoda		*Unidentified Decapoda*	1	0
Malacostraca	Isopoda		*Isopoda sp.*	0	1
Malacostraca	Isopoda	Anthuridae	*Mesanthura ?affinis*	1	0
Malacostraca	Isopoda	Sphaeromatidae	*?Cilicaea sp*	1	0
Malacostraca	Isopoda	Sphaeromatidae	*Isocladus sp.*	0	1
Malacostraca	Isopoda	Sphaeromatidae	*Exosphaeroma sp.*	0	1
Malacostraca	Mysida	Mysidae	*Siriella sp.*	1	0
Malacostraca	Mysida	Mysidae	*Tenogomysis sp. 1*	1	0
Malacostraca	Mysidacea		*Unidentified Mysidacea*	0	1
Malacostraca	Tanaidacea		*Tanaidacea sp.*	0	1
Malacostraca	Tanaidacea	Tanaidae	*Zeuxoides sp.*	1	0
Malacostraca	Tanaidacea	Tanaidae	*Zeuxoides sp. 1*	1	0
Malacostraca	Tanaidacea	Tanaidae	*Zeuxoides sp. 2*	1	0

Major taxonomic groups, Class	Order	Family	Genus and species	T1*	T2*
Mollusca					
Bivalvia	Nuculoida	Nuculidae	*Linucula sp.*	1	0
Gastropoda	Neogastropoda	Buccinidae	*Cominella sp.*	0	1
Gastropoda	Neogastropoda	Turridae	*Neoguraleus sp.*	1	0
Macroalgae					
			Unidentified Phycophyta	0	1
Florideophyceae			*Unidentified Rhodophyceae*	1	1
Florideophyceae	Acrochaetiales	Acrochaetiaceae	*Audouinella sp.*	1	0
Florideophyceae	Bangiales	Bangiaceae	*Bangia sp.*	1	0
Florideophyceae	Bangiales	Bangiaceae	*Porphyra sp.*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnionella sp.*	1	0
Florideophyceae	Ceramiales	Ceramiaceae	*Callithamnion sp.*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium sp.*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia sp.*	1	1
Florideophyceae	Ceramiales	Ceramiaceae	*Medeiothamnion sp.*	0	1
Florideophyceae	Ceramiales	Ceramiaceae	*Pterothamnion sp.*	1	0
Florideophyceae	Ceramiales	Delesseriaceae	*Unidentified Delesseriaceae*	1	1
Florideophyceae	Ceramiales	Delesseriaceae	*aff. Myriogramme gattyana*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Erythroglossum sp.*	1	0
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena sp.*	0	1
Florideophyceae	Ceramiales	Delesseriaceae	*Schizoseris sp.*	0	1
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia sp.*	1	0
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sp.*	1	0
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia aff. dichotoma*	0	1
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia sp.*	1	1
Florideophyceae	Stylonematales	Stylonemataceae	*Stylonema sp.*	0	1
Phaeophyceae	Ectocarpales	Acinetosporaceae	*Pylaiella sp.*	0	1
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Ectocarpus sp.*	0	1
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Hincksia sp.*	1	0
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia sp.*	1	0
Phaeophyceae	Laminariales	Alariaceae	*Ecklonia sp.*	1	0
Phaeophyceae	Sphacelariales	Sphacelariaceae	*Sphacelaria sp.*	1	1
Ulvophyceae	Bryopsidales	Bryopsidaceae	*Bryopsis sp.*	1	0
Ulvophyceae	Cladophorales	Cladophoraceae	*Cladophora sp.*	1	1
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha sp.*	1	1
Ulvophyceae	Ulvales	Ulvaceae	*Ulva sp.*	1	1
Platyhelminthes					
Turbellaria	Polycladida		*Unidentified Polycladida*	1	0
Dinophyta					
Dinophyceae	Gymnodiniales	Polykrikaceae	*Pheopolykrikos sp.*	1	0
Dinophyceae	Peridinales	Peridiniaceae	*Protoperidinium sp.*	1	1
Urochordata					
Ascidiacea	Aplousobranchia	Didemnidae	*Unidentified Didemnidae*	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus sp.*	0	1

* 1 = Present, 0 = Absent

Table 18: Non-indigenous marine organisms recorded from the Port of Timaru 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 Timaru	Locations detected in the Port of Timaru		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
Annelida				
Euchone limnicola	Benthic grab, benthic sled	Wharf 1, Wharf 2, Wharf 3, Fisherman's Wharf, North Mole Wharf, Outer North Mole (See Figure 22)	East Mole, Reclamation Point, Wharf 2, Wharf 3 (See Figure 23)	Gisborne, New Plymouth
Spirobranchus polytrema	Pile scrape		East Mole, Fisherman's Wharf, North Mole Wharf, Wharf 2 (See Figure 24)	Dunedin, Lyttelton, Napier, Picton, Wellington,
Barantolla lepte	Benthic grab	Wharf 1		Napier, New Plymouth
Polydora hoplura	Pile scrape		Wharf 2 (See Figure 25)	Dunedin, Lyttelton, Nelson, Picton, Tauranga, Wellington, Whangarei
Bryozoa				
Bugula flabellata	Benthic grab, benthic sled, pile scrape	Wharf 1, Wharf 2, Wharf 3, Fisherman's Wharf, North Mole Wharf (See Figure 26)	East Mole, Fisherman's Wharf, Inner North Mole, Outer North Mole, Wharf 1, Wharf 2, Wharf 3 (See Figure 27)	Auckland, Bluff, Dunedin, Lyttelton, Napier, Nelson, New Plymouth, Opua, Picton, Tauranga, Wellington, Whangarei
Bugula neritina	Pile scrape	Fisherman's Wharf, North Mole Wharf, Wharf 1 (See Figure 28)	Wharf 3 (See Figure 29)	Auckland, Dunedin, Gisborne, Lyttelton, Napier, New Plymouth, Opua, Picton, Tauranga, Whangarei
Cryptosula pallasiana	Benthic grab, benthic sled, pile scrape, pile visual	Fisherman's Wharf, North Mole Wharf, Wharf 1, Wharf 2, Wharf 3 (See Figure 30)	East Mole, Wharf 2, Wharf 3 (See Figure 31)	Dunedin, Gisborne, Lyttelton, Nelson, New Plymouth, Picton, Wellington, Whangarei
Celleporaria nodulosa	Pile scrape		Wharf 3 (See Figure 32)	Gisborne, Nelson
Watersipora subtorquata	Benthic grab, benthic sled, pile scrape, pile visual	Fisherman's Wharf, Inner North Mole, Outer North Mole, North Mole Wharf, Wharf 1, Wharf 3 (See Figure 33)	East Mole, Fisherman's Wharf, North Mole Wharf, Wharf 1, Wharf 2, Wharf 3 (See Figure 34)	Auckland, Bluff, Dunedin, Gisborne, Lyttelton, Napier, Nelson, New Plymouth, Opua, Picton, Tauranga, Wellington, Whangarei
Cnidaria				
Monotheca pulchella	Pile scrape		North Mole Wharf (See Figure 35)	Lyttelton, New Plymouth, Tauranga, Wellington

Genus & species	Capture techniques in the Port of Timaru	Locations detected in the Port of Timaru		Detected in other locations surveyed in ZBS2000_04
		First survey	Second survey	
*Amphisbetia maplestonei?**	Benthic grab		Inner North Mole (See Figure 36)	New Plymouth
Symplectoscyphus subdichotomus	Benthic grab, benthic sled, fish trap, pile scrape		East Mole, Inner North Mole, Reclamation Point, Wharf 1 (See Figure 37)	Lyttelton
Synthecium subventricosum	Pile scrape		East Mole (See Figure 38)	Nelson
Crustacea				
Caprella mutica	Benthic sled, pile scrape	Fisherman's Wharf, North Mole Wharf, Wharf 1, Wharf 3 (See Figure 39)	Fisherman's Wharf, Inner North Mole, North Mole Wharf, Reclamation Point, Wharf 2 (See Figure 40)	
Apocorophium acutum	Pile scrape	Fisherman's Wharf, North Mole, Wharf 3 (See Figure 41)	Fisherman's Wharf, Wharf 3 (See Figure 42)	Auckland, Dunedin, Lyttelton, Opua, Tauranga
Monocorophium acherusicum	Pile scrape	North Mole Wharf, Wharf 1, Wharf 3 (See Figure 43)	North Mole Wharf, Wharf 2 (See Figure 44)	Dunedin, Gisborne, Lyttelton, Tauranga,Wellington, Whangarei
Jassa marmorata	Pile scrape		North Mole Wharf, Wharf 2, Wharf 3 (See Figure 45)	Dunedin
Jassa slatteryi	Pile scrape, pile visual	Fisherman's Wharf, North Mole Wharf, Wharf 1, Wharf 3 (See Figure 46)	Fisherman's Wharf (See Figure 47)	Lyttelton, Whangarei
Jassa staudei	Pile scrape		Fisherman's Wharf (See Figure 48)	
Cancer gibbosulus	Benthic grab, pile scrape	Fisherman's Wharf, Wharf 1, Wharf 3		Lyttelton, Wellington
Macroalgae				
Griffithsia crassiuscula	Benthic sled, pile scrape	North Mole Wharf (See Figure 49)	Reclamation Point (See Figure 50)	Bluff, Lyttelton, New Plymouth, Picton, Wellington
Polysiphonia subtilissima	Pile scrape	Wharf 1		Dunedin, Lyttelton
Undaria pinnatifida	Benthic sled, pile scrape, pile visual, visual	Fisherman's Wharf, North Mole Wharf, Outer North Mole Wharf 1, Wharf 2, Wharf 3 (See Figure 51)	East Mole, Fisherman's Wharf, Inner North Mole, Outer North Mole, North Mole Wharf, Reclamation Point, Wharf 2, Wharf 3 (See Figure 52)	Dunedin, Gisborne, Lyttelton, Napier, Nelson, New Plymouth, Picton, Wellington
Urochordata				
Ciona intestinalis	Pile scrape	Fisherman's Wharf, North Mole Wharf, Wharf 1 (See Figure 53)	Fisherman's Wharf, North Mole Wharf, Wharf 2 (See Figure 54)	Lyttelton, Napier, Nelson

*Identification is uncertain for this specimen

Table 19: Summary statistics for taxon assemblages collected in the Port of Timaru 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	55	65	98	83	51 (39%)	47	32	37 (38%)	40 (48%)	99.312	0.392	0.564	0.928	0.963
C2	55	65	16	15	5 (19%)	11	10	6 (38%)	11 (73%)	6.739	0.192	0.323	0.258	0.41
NIS & C1	55	65	22	28	18 (56%)	4	10	1 (5%)	5 (18%)	18.701	0.563	0.72	0.812	0.896
Benthic sleds														
Native	12	16	61	55	19 (20%)	42	36	34 (56%)	33 (60%)	60.43	0.196	0.328	0.342	0.51
C2	12	16	8	8	2 (14%)	6	6	5 (63%)	4 (50%)	2.5	0.143	0.25	0.199	0.332
NIS & C1	12	16	10	12	8 (57%)	2	4	3 (30%)	5 (42%)	12.15	0.571	0.727	0.769	0.869
Benthic grabs														
Native	14	23	42	16	11 (23%)	31	5	21 (50%)	7 (44%)	See analysis for all taxa combined				
C2	14	23	9	2	2 (22%)	7	0	7 (78%)	0 (0%)	See analysis for all taxa combined				
NIS & C1	14	23	11	3	1 (8%)	10	2	7 (64%)	1 (33%)	See analysis for all taxa combined				
Native, C2, NIS & C1 taxa combined	14	23	62	21	14 (20%)	48	7	35 (56%)	8 (38%)	21.51	0.203	0.337	0.399	0.57
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	20	28	12	7	4 (27%)	8	3	6 (50%)	1 (14%)	4	0.267	0.421	0.581	0.735
C2	20	28	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	20	28	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
Fish traps														
Native	20	32	8	8	4 (33%)	4	4	4 (50%)	3 (38%)	See analysis for all taxa combined				
C2	20	32	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	20	32	0	2	0 (0%)	0	2	0 (0%)	2 (100%)	Not enough taxa encountered for a meaningful analysis				
Native, NIS & C1 taxa combined	20	32	8	10	4 (29%)	4	6	4 (50%)	5 (50%)	4	0.286	0.444	0.69	0.817
Starfish traps														
Native	20	28	3	4	2 (40%)	1	2	1 (33%)	2 (50%)	Not enough taxa encountered for meaningful analysis				
C2	20	28	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				
NIS & C1	20	28	0	0	0 (0%)	0	0	0 (0%)	0 (0%)	No taxa encountered				

Appendices

Appendix 1: Definitions of vessel types and geographical areas used in analyses of the LMIU shipping movements database

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

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

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

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

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

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

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

Vessel type definition in this report	General type as listed in LMIU database	Sub type code from LMIU database	Definition of sub type in LMIU database
	R	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
	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 Timaru second baseline survey (NZGD49)

Site	Easting	Northing	Survey Method	Number of sample units
East Mole	2371353	5644856	BGRB	1
East Mole	2371355	5644856	BGRB	1
East Mole	2371357	5644848	BGRB	1
East Mole	2371324	5644764	BSLD	1
East Mole	2371353	5644928	BSLD	1
East Mole	2371407	5644769	BSLD	1
East Mole	2371444	5644918	BSLD	1
East Mole	2371409	5644918	CRBTP	2
East Mole	2371409	5644964	CRBTP	2
East Mole	2371403	5644897	FSHTP	2
East Mole	2371409	5644961	FSHTP	2
East Mole	2371377	5644989	PSC	12
East Mole	2371409	5644964	SHRTP	1
East Mole	2371409	5644918	STFTP	2
East Mole	2371409	5644964	STFTP	2
East Mole	2371361	5644829	VISS	1
Fish Processing Freezers	2371237	5645256	FSHTP	2
Fish Processing Freezers	2371304	5645207	FSHTP	2
Fish Processing Freezers	2371360	5645391	FSHTP	2
Fish Processing Freezers	2371426	5645352	FSHTP	2
Fisherman's Wharf	2371294	5645340	CYST	2
Fisherman's Wharf	2371186	5645325	PSC	12
Inner North Mole Wharf	2371308	5645231	BGRB	3
Inner North Mole Wharf	2371240	5645295	BSLD	1
Inner North Mole Wharf	2371390	5645155	BSLD	1
Inner North Mole Wharf	2371272	5645236	CRBTP	2
Inner North Mole Wharf	2371306	5645283	CRBTP	2
Inner North Mole Wharf	2371306	5645283	SHRTP	1
Inner North Mole Wharf	2371272	5645236	STFTP	2
Inner North Mole Wharf	2371306	5645283	STFTP	2
Inner North Mole Wharf	2371259	5645252	VISS	1
North Mole Wharf	2371029	5644914	BGRB	2
North Mole Wharf	2371004	5644828	BSLD	1
North Mole Wharf	2371064	5644970	BSLD	1
North Mole Wharf	2370986	5644824	CRBTP	2
North Mole Wharf	2371010	5644888	CRBTP	2
North Mole Wharf	2371076	5644880	CYST	2
North Mole Wharf	2371066	5644987	FSHTP	2
North Mole Wharf	2371101	5645073	FSHTP	2
North Mole Wharf	2371011	5644905	PSC	14
North Mole Wharf	2371010	5644888	SHRTP	1
North Mole Wharf	2370986	5644824	STFTP	2
North Mole Wharf	2371010	5644888	STFTP	2
North Mole Wharf Site 1	2371107	5645108	VISS	1
North Mole Wharf Site 2	2371153	5645224	VISS	1
Outer North Mole Wharf	2371369	5645330	BGRB	3
Outer North Mole Wharf	2371299	5645416	BSLD	1
Outer North Mole Wharf	2371474	5645308	BSLD	1
Outer North Mole Wharf	2371391	5645379	CRBTP	2

Site	Easting	Northing	Survey Method	Number of sample units
Outer North Mole Wharf	2371438	5645339	CRBTP	2
Outer North Mole Wharf	2371391	5645379	SHRTP	1
Outer North Mole Wharf	2371438	5645339	SHRTP	1
Outer North Mole Wharf	2371391	5645379	STFTP	2
Outer North Mole Wharf	2371438	5645339	STFTP	2
Outer North Mole Wharf	2371362	5645408	VISS	1
Reclamation Pt	2371854	5645206	BGRB	3
Reclamation Pt	2371790	5645193	BSLD	1
Reclamation Pt	2371816	5645116	BSLD	1
Reclamation Pt	2371858	5645306	CRBTP	2
Reclamation Pt	2371872	5645252	CRBTP	2
Reclamation Pt	2371705	5645056	FSHTP	2
Reclamation Pt	2371751	5645114	FSHTP	2
Reclamation Pt	2371863	5645248	FSHTP	2
Reclamation Pt	2371877	5645168	FSHTP	2
Reclamation Pt	2371858	5645306	SHRTP	1
Reclamation Pt	2371858	5645306	STFTP	2
Reclamation Pt	2371872	5645252	STFTP	2
Wharf 1	2371119	5644545	BSLD	1
Wharf 1	2371251	5644649	BSLD	1
Wharf 1	2371151	5644551	CRBTP	2
Wharf 1	2371171	5644576	CRBTP	2
Wharf 1	2371127	5644562	CYST	2
Wharf 1	2371257	5644643	FSHTP	2
Wharf 1	2371296	5644686	FSHTP	2
Wharf 1	2371151	5644551	SHRTP	1
Wharf 1	2371151	5644551	STFTP	2
Wharf 1	2371171	5644576	STFTP	2
Wharf 2	2371102	5644650	BGRB	1
Wharf 2	2371102	5644656	BGRB	1
Wharf 2	2371104	5644667	BGRB	1
Wharf 2	2371006	5644717	CYST	2
Wharf 2	2371114	5644734	PSC	13
Wharf 2	2371117	5644701	VISS	1
Wharf 3	2371047	5644793	BGRB	1
Wharf 3	2371048	5644789	BGRB	3
Wharf 3	2371051	5644791	BGRB	1
Wharf 3	2371057	5644787	BGRB	1
Wharf 3	2370902	5644710	BSLD	1
Wharf 3	2371028	5644851	BSLD	1
Wharf 3	2370983	5644739	CRBTP	2
Wharf 3	2371018	5644787	CRBTP	2
Wharf 3	2371009	5644758	FSHTP	2
Wharf 3	2371041	5644786	FSHTP	2
Wharf 3	2371017	5644778	PSC	14
Wharf 3	2371018	5644787	SHRTP	1
Wharf 3	2370983	5644739	STFTP	2
Wharf 3	2371018	5644787	STFTP	2

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix 5: Criteria for assigning non-indigenous status to species sampled from the Port of Timaru 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 Timaru in the second survey. Criteria that apply to each species are indicated by (+). Cranfield et al's (1998) analysis was used for species previously known from New Zealand waters. For non-indigenous species that were first detected during the present study, criteria were assigned using advice from the taxonomists that identified them. Refer to footnote for a full description of C1 – C9.

Major taxonomic groups and Species	C1	C2	C3	C4	C5	C6	C7	C8	C9
Annelida									
Euchone limnicola	+		+		+	+	+	+	
Spirobranchus polytrema	+		+		+			+	
Polydora hoplura			+		+	+	+	+	+
Bryozoa									
Bugula flabellata	+	+	+		+	+	+	+	+
Bugula neritina	+				+	+	+	+	+
Cryptosula pallasiana	+	+	+		+	+	+	+	+
Watersipora subtorquata	+	+	+		+	+	+	+	+
Celleporaria nodulosa	+		+		+		+	+	+
Cnidaria									
Monotheca pulchella	+		+		+		+	+	
Symplectoscyphus subdichotomus	+		+		+	+	+	+	
Synthecium subventricosum	+		+		+		+	+	
*Amphisbetia maplestonei?**	+		+		+		+	+	
Crustacea									
Apocorophium acutum			+			+		+	+
Monocorophium acherusicum			+		+	+		+	+
Jassa marmorata	+		+					+	+
Jassa slatteryi	+		+			+		+	+
Caprella mutica	+		+			+	+	+	+
Jassa staudei	+		+		+	+	+	+	
Macroalgae									
Griffithsia crassiuscula	+	+				+		+	+
Undaria pinnatifida	+	+	+		+	+	+	+	+
Urochordata									
Ciona intestinalis	+		+		+	+	+	+	+

* Identification is uncertain for this specimen

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 diver collections and pile scrapings.

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

						Site code	East Mole												Fisherman's Wharf												North Mole Wharf														Wharf 2													Wharf 3													
						Pile replicate	1						2						1			2			3			4			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	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	1	2	3	4	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	1	2	3	1	2	3	4	1	2	3	1	2	3	4
Annelida	Polychaeta	Eunicida	Dorvilleidae	Schistomeringos	loveni	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	1	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	sphaerocephala	N	1	0	1	0	0	0	0	1	0	0	1	0	0	0	1	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	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	kerguelensis	N	0	0	0	1	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	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Nereis	falcaria	N	0	1	1	1	1	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	camiguinoides	N	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	Perinereis-A	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	1	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	Eulalia-NIWA-2	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	microphylla	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	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
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Mystides	Mystides-B	C2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	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
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	polychromus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0
Annelida	Polychaeta	Phyllodocida	Polynoidae	Ophiodromus	angustifrons	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Sabellida	Sabellidae	Branchiomma	curtum	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Sabellida	Sabellidae	Demonax	aberrans	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	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	Sabellida	Serpulidae	Spirobranchus	polytrema	A	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	1	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
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Polydora	hoplura	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	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Cirratulidae	Cirratulus	Cirratulus-A	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Terebellida	Cirratulidae	Timarete	anchylochaetus	N	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	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Flabelligeridae	Flabelligera	affinis	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Streblosoma	toddae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Terebellida	Terebellidae	Terebellidae	Indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Ectoprocta	Gymnolaemata	Cheilostomata	Arachnopusiidae	Arachnopusia	unicornis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	1	1	0	0	0	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	0	0	0	0	0	0	0	0	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	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	neritina	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Candidae	Caberea	zelandica	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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
Ectoprocta	Gymnolaemata	Cheilostomata	Cryptosulidae	Cryptosula	pallasiana	A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Lepraliellidae	Celleporaria	nodulosa	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	1	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Romancheinidae	Escharoides	angela	N	0	0	0	0	0	0	0	0	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	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
Ectoprocta	Gymnolaemata	Cheilostomata	Schizoporellidae	Chiastosella	watersi	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	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	1	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	1	1	0	0	0	0	1	1	1	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	1	0	0	1	1	0	1	1	1	1	1	0	0	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Obelia	dichotoma	C1	0	0	0	0	0	1	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Haleciidae	Halecium	delicatulum	C1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Monotheca	pulchella	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Plumularia	setacea	C1	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	1	1	0	0	0	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subdichotomus	A	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Syntheciidae	Synthecium	subventricosum	A	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	1	0	0	1	1	0	0	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Balanidae	Notomegabalanus	decorus	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Cirripedia	Thoracica	Pachylasmidae	Epopella	plicata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda				SI	0	0	0	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	0	0	0	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	Ampithoidae	Perampithoe	aorangi	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Aoridae	Aora	sp. aff. A. typica	C2	0	0	0	0	0	0	0	0	0	0	1	0	1	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	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
Arthropoda	Malacostraca	Amphipoda	Aoridae	Aoridae	indet. gen. et 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	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
Arthropoda	Malacostraca	Amphipoda	Aoridae	Haplocheira	barbimana	N	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Amphipoda	Caprellidae			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	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Caprellidae	Caprella	equilibra	N	0	0	1	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Caprellidae	Caprella	mutica	A	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	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
Arthropoda	Malacostraca	Amphipoda	Corophiidae	Apocorophium	acutum	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	1	0
Arthropoda	Malacostraca	Amphipoda	Corophiidae	Monocorophium	acherusicum	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	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
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Paradexamine	pacifica	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	0
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Polycheria	obtusa	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	0
Arthropoda	Malacostraca	Amphipoda	Eusiridae	Eusiroides	monoculoides	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	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	Eusiridae	Gondogeneia	danai	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	1	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
Arthropoda	Malacostraca	Amphipoda	Hyalidae	Hyale	sp.	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Isaeidae	Gammaropsis	indet sp.	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	Ischyrocerus	longimanus	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*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	East Mole											Fisherman's Wharf											North Mole Wharf													Wharf 2												Wharf 3												
						Pile replicate	1						2						1			2			3			4			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	Amphipoda	Ischyroceridae	Jassa	marmorata	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	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	1	0	0	0
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	Jassa	slatteryi	A	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	Jassa	sp.	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	Jassa	staudei	A	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	Amphipoda	Leucothoidae	Leucothoe	trailli	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
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	0	0	0	1	0
Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	Liljeborgia	barhami	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
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	angusta	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	sp aff P. hirsuta	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
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	sp. aff. angusta	C2	1	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	sp. aff. P. stephenseni	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	stephenseni	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Parawaldeckia	vesca	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
Arthropoda	Malacostraca	Amphipoda	Podoceridae	Podocerus	manawatu	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
Arthropoda	Malacostraca	Amphipoda	Stenothoidae	Stenothoe	ornata	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
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	elongatus	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	1	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
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	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
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	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
Arthropoda	Malacostraca	Caridea	Palemonidae	Palaemon	affinis	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	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	Isopoda		Isopoda	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Isopoda	Anthuridae	Mesanthura	affinis	N	0	0	0	0	1	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	1	0
Arthropoda	Malacostraca	Isopoda	Paranthuridae	Paranthura	flagellata	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
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Cilicaea	caniculata	N	0	1	1	0	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0	1	0
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Exosphaeroma	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	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
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Isocladus	sp.	SI	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	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	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0
Arthropoda	Malacostraca	Tanaidacea		Tanaidacea	sp.	SI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Echinodermata	Asteroidea	Valvatida	Asterinidae	Meridiastra	mortenseni	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Patiriella	regularis	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
Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	Amphipholis	squamata	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Mollusca	Bivalvia	Myoida	Hiatellidae	Hiatella	arctica	N	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	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	1	1	0	0	0	1	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya	atra maoriana	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	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
Mollusca	Bivalvia	Mytiloida	Mytilidae	Modiolarca	impacta	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	1	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	C1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Perna	canaliculus	N	1	0	0	1	0	0	1	1	0	0	0	1	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	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
Mollusca	Bivalvia	Ostreoida	Ostreidae	Ostrea	chilensis	N	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	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Lasaeidae	Lasaea	hinemoa	N	0	0	0	1	0	0	0	0	0	0	1	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	1	1	1	1	0	0	0	1	1	1	1	1	0	1	1	0	1	0	0	0	1	0	0	1	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	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
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	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	1	0	0	1	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Veneridae	Ruditapes	largillierti	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
Mollusca	Gastropoda	Basommatophora	Siphonariidae	Siphonaria	australis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Mollusca	Gastropoda	Littorinimorpha	Calyptraeidae	Sigapatella	novaezelandiae	N	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	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
Mollusca	Gastropoda	Littorinimorpha	Littorinidae	Austrolittorina	antipodum	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	1	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	aucklandicus	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	plebeius	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
Mollusca	Gastropoda	Nudibranchia	Discodorididae	Hoplodoris	nodulosa	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
Mollusca	Polyplacophora	Ischnochitonina	Chitonidae	Sypharochiton	pelliserpentis	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	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
Algae (Unidentified)					SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae					SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Callithamnion	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Medeiothamnion	lyallii	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Medeiothamnion	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	aff. Myriogramme	gattyana	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
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Myriogramme	denticulata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Schizoseris	dichotoma	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Valeriemaya	undescribed	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*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	East Mole												Fisherman's Wharf												North Mole Wharf														Wharf 2													Wharf 3													
						Pile replicate	1						2						1			2			3			4			1								2						1						2							1							2						
						Pile position	IN			OUT			IN			OUT															IN				OUT				IN			OUT			IN			OUT			IN			OUT				IN			OUT				IN			OUT			
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	harveyi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	foliifera	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	1	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	leptophylla	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Rhodophyta	Florideophyceae	Stylonematales	Stylonemataceae	Stylonema	sp.	SI	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
Ochrophyta	Phaeophyceae	Ectocarpales	Acinetosporaceae	Pylaiella	sp.	SI	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
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Ectocarpus	siliculosus	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
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Ectocarpus	sp.	SI	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
Ochrophyta	Phaeophyceae	Ectocarpales	Scytothamnaceae	Scytothamnus	australis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Sphacelariales	Sphacelariaceae	Sphacelaria	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Bryopsidales	Bryopsidaceae	Bryopsis	vestita	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	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
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Enteromorpha	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Porifera	Demospongiae	Dictyoceratida	Dysideidae	Euryspongia	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	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
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 1	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Chalinidae	Adocia	new sp. 4	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	Chalinidae	Adocia	new sp. 5	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	1	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Cionidae	Ciona	intestinalis	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	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
Chordata	Ascidiacea	Aplousobranchia	Didemnidae			SI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	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
Chordata	Ascidiacea	Aplousobranchia	Didemnidae	Didemnum	sp.	C1	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	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Holozoidae	Distaplia	sp.	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	1	0	0	0	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Holozoidae	Hypsistozoa	fasmeriana	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	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1
Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Aplidium	adamsi	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Aplidium	phortax	C1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	1	0
Chordata	Ascidiacea	Phlebobranchia	Rhodosomatidae	Corella	eumyota	C1	0	1	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	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Chordata	Ascidiacea	Stolidobranchia	Botryllinae	Botrylloides	leachii	C1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	1
Chordata	Ascidiacea	Stolidobranchia	Botryllinae	Botryllus	stewartensis	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	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
Chordata	Ascidiacea	Stolidobranchia	Molgulidae	Molgula	mortenseni	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
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Microcosmus	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	carnea	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	pachydermatina	N	0	1	1	0	1	0	1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	0	0	1	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	cerea	C1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	0	1	0	1
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	bicornuta	N	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	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
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	0	1	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	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	1	1

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

Appendix 6b. Results from the benthic grab samples.

Appendix 6b. Results from the benthic grab samples.

						Site code	East Mole			Inner North Mole Wharf			North Mole Wharf		Outer North Mole Wharf			Reclaimation Pt			Wharf 2			Wharf 3					
phylum	class	order	family	genus	species	*class_code	1	2	3	1	2	3	1	2	1	2	3	1	2	3	1	2	3	1	2	3	4	5	6
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	Indet	SI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	lamelliformis	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Goniadidae	Glycinde	trifida	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Nereididae	indet	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	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	Ophiodromus	angustifrons	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Labiosthenolepis	laevis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Annelida	Polychaeta	Sabellida	Sabellidae	Euchone	limnicola	A	1	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	1	1
Annelida	Polychaeta	Scolecida	Maldanidae	Asychis	Asychis-B	C2	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	1	1	0	0	0	0	1	1
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Annelida	Polychaeta	Scolecida	Orbiniidae	Scoloplos (Scoloplos)	simplex	N	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	Spionida	Spionidae	Boccardia	syrtis	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Paraprionospio	Paraprionospio-A [pinnata]	C2	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0
Annelida	Polychaeta	Spionida	Spionidae	Scolecolepides	benhami	N	1	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	1	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Amphisbetia	bispinosa	N	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Amphisbetia	maplestonei	A	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subdichotomus	A	1	1	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	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Podoceridae	Podocerus	sp.	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Brachyura	Ocypodidae	Macrophthalmus	hirtipes	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Mollusca	Bivalvia	Veneroida	Lasaeidae	Arthritica	bifurca	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	1	0	1	1	0	0	0	1	1	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	tiaratus	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (Uniden						SI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	sp.	SI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	sp.	SI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Brongniartella	australis	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	aff. dichotoma	SI	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

Appendix 6c. Results from the benthic sled samples.

Appendix 6c. Results from the benthic sled samples.

						Site code	East Mole				Inner North Mole Wharf		North Mole Wharf		Outer North Mole Wharf		Reclaimation Pt		Wharf 1		Wharf 3	
phylum	class	order	family	genus	species	*class_code	1	2	3	4	1	2	1	2	1	2	1	2	1	2	1	2
Annelida	Polychaeta	Phyllodocida	Nereididae	Nereis	falcaria	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	Platynereis_australis_group	N	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Pirakia	Pirakia-A	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Annelida	Polychaeta	Phyllodocida	Polynoidae	Ophiodromus	angustifrons	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Syllidae	Eusyllis	Eusyllis-B	C2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Annelida	Polychaeta	Sabellida	Sabellidae	Euchone	limnicola	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	N	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Annelida	Polychaeta	Terebellida	Terebellidae	Lanassa	Lanassa-A	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Arachnopusiidae	Arachnopusia	unicornis	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae	Bugula	flabellata	A	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1
Ectoprocta	Gymnolaemata	Cheilostomata	Cryptosulidae	Cryptosula	pallasiana	A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ectoprocta	Gymnolaemata	Cheilostomata	Watersiporidae	Watersipora	subtorquata	A	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Cnidaria	Hydrozoa	Hydroida	Plumulariidae	Plumularia	setacea	C1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Amphisbetia	bispinosa	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Sertularia	unguiculata	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subdichotomus	A	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Arthropoda	Malacostraca	Amphipoda	Aoridae	Aora	sp. aff. A. typica	C2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Caprellidae	Caprella	equilibra	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Caprellidae	Caprella	mutica	A	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Isaeidae	Photis	sp. aff. P. nigrocula	C2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Melitidae	Elasmopus	neglectus	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Amphipoda	Melitidae	Melita	inaequistylis	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Anomura	Paguridae	Pagurus	novizealandiae	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Arthropoda	Malacostraca	Anomura	Porcellanidae	Petrolisthes	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Brachyura	Cancridae	Metacarcinus	novaezelandiae	N	0	0	0	0	0	0	0	0	0	0	1	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	0
Arthropoda	Malacostraca	Brachyura	Hymenosomatidae	Hymenosoma	depressum	N	0	0	0	0	1	0	1	1	0	0	0	1	1	0	0	1
Arthropoda	Malacostraca	Brachyura	Ocypodidae	Macrophthalmus	hirtipes	N	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0
Arthropoda	Malacostraca	Caridea	Crangonidae	Pontophilus	australis	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Arthropoda	Malacostraca	Caridea	Palemonidae	Palaemon	affinis	N	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
Arthropoda	Malacostraca	Mysidacea		Mysidacea	sp.	SI	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	1
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Pseudosphaeroma	campbellensis	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Arthropoda	Pycnogonida	Pantopoda	Ammotheidae	Tanystylum	sp. B	C2	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1
Arthropoda	Pycnogonida	Pantopoda	Callipallenidae	Pallenopsis	obliqua	N	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Allostichaster	polyplax	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Echinodermata	Asteroidea	Forcipulata	Asteriidae	Coscinasterias	muricata	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Meridiastra	mortenseni	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1
Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	Amphipholis	squamata	N	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	0
Mollusca	Bivalvia	Mytiloida	Mytilidae	Perna	canaliculus	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Mollusca	Gastropoda	Cephalaspidea	Philinidae	Philine	auriformis	N	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Mollusca	Gastropoda	Littorinimorpha	Calyptraeidae	Sigapatella	novaezelandiae	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	plebeius	N	0	0	0	1	1	1	0	0	1	1	0	1	1	0	1	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Micrelenchus	huttonii	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Micrelenchus	sanguineus	N	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	tiaratus	N	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	viridus	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae					SI	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnion	applicitum	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Callithamnion	sp.	SI	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	apiculatum	N	0	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	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Medeiothamnion	lyallii	N	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Medeiothamnion	sp.	SI	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Dasyaceae	Heterosiphonia	squarrosa	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			SI	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Erythroglossum	undulatissimum	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Myriogramme	denticulata	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Phycodrys	quercifolia	N	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Schizoseris	dichotoma	N	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Schizoseris	sp.	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	harveyi	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Brongniartella	australis	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	macrocarpa	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	strictissima	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Rhodophyllis	centrocarpa	N	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Gigartinales	Gigartinaceae	Gigartina	decipiens	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	aff. dichotoma	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	foliifera	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Phycophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	SI	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
Ochrophyta	Phaeophyceae	Desmarestiales	Desmarestiaceae	Desmarestia	ligulata	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Ochrophyta	Phaeophyceae	Ectocarpales	Chordariaceae	Papenfussiella	lutea	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Hincksia	mitchelliae	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ochrophyta	Phaeophyceae	Ectocarpales	Scytosiphonaceae	Scytosiphon	lomentaria	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	0	0	0	0	0	0	0	0	0	1	0	1	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 6c. Results from the benthic sled samples.

						Site code	East Mole				Inner North Mole Wharf		North Mole Wharf		Outer North Mole Wharf		Reclaimation Pt		Wharf 1		Wharf 3	
Ochrophyta	Phaeophyceae	Laminariales	Lessoniaceae	Macrocystis	pyrifera	N	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Porifera	Demospongiae	Halichondrida	Halichondriidae	Halichondria	new sp. 2	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	Demospongiae	Haplosclerida	Chalinidae	Haliclona	new sp. 11	C2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Aplidium	phortax	C1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Ascidiacea	Phlebobranchia	Rhodosomatidae	Corella	eumyota	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Stolidobranchia	Pyuridae	Pyura	pachydermatina	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Asterocarpa	cerea	C1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Chordata	Ascidiacea	Stolidobranchia	Styelidae	Cnemidocarpa	nisiotus	N	0	0	0	0	1	1	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 6d. Results from the dinoflagellate cyst core samples.

Appendic 6d. Results from the dinoflagellate cyst samples.

							Fisherman's Wharf		North Mole Wharf		Wharf 1		Wharf 2	
phylum	**class**	**order**	**family**	**genus**	**species**	**class_code**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Gonyaulax	scrippsae	N	0	0	1	0	0	0	0	0
Dinophyta	Dinophyceae	Peridinales	Gonyaulacaceae	Protoceratium	reticulatum	N	1	0	1	0	0	0	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Lingulodinium	polyedrum	N	1	0	1	0	1	0	0	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Protoperidinium	sp.	SI	0	0	1	0	1	0	1	0
Dinophyta	Dinophyceae	Peridinales	Peridiniaceae	Scrippsiella	trochoidea	N	1	0	1	0	0	0	1	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	East Mole				Fish Processing Freezers								North Mole Wharf				Reclaimation Pt								Wharf 1				Wharf 3			
						Trap line	**1**		**2**		**1**		**2**		**3**		**4**		**1**		**2**		**1**		**2**		**3**		**4**		**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**
Chordata	Chondrichthyes	Squaliformes	Squalidae	Squalus	acanthias	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	1	0	0	0	0
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Obelia	dichotoma	C1	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
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subdichotomus	A	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
Arthropoda	Malacostraca	Brachyura	Cancridae	Metacarcinus	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	1	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	1	1	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
Mollusca	Gastropoda	Notaspidea	Pleurobranchidae	Pleurobranchaea	maculata	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Gadiformes	Moridae	Lotella	rhacinum	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
Vertebrata	Actinopterygii	Gadiformes	Moridae	Pseudophycis	bachus	N	0	0	1	0	0	1	0	1	0	1	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	1
Vertebrata	Actinopterygii	Perciformes	Cheilodactylidae	Nemadactylus	macropterus	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	1	0	1	0	0	1	1	1	1	0	1	0	1	1	1	1	0	0	0	1	0	1	1	1	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 6f. Results from the crab trap samples.

Appendix 6f. Results from the crab trap samples.

						Site code	East Mole				Inner North Mole Wharf				North Mole Wharf				Outer North Mole Wharf				Reclamation Pt				Wharf 1				Wharf 3			
						Trap line	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
Arthropoda	Malacostraca	Brachyura	Cancridae	Metacarcinus	novaezelandiae	N	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1	1	1	1	0	1	0
Arthropoda	Malacostraca	Brachyura	Majidae	Notomithrax	sp.	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
Arthropoda	Malacostraca	Palinura	Palinuridae	Jasus	edwardsi	N	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
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	sp.	SI	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
Mollusca	Gastropoda	Notaspidea	Pleurobranchidae	Pleurobranchaea	maculata	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
Vertebrata	Actinopterygii	Gadiformes	Moridae	Lotella	rhacinum	N	0	1	1	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Vertebrata	Actinopterygii	Gadiformes	Moridae	Pseudophycis	bachus	N	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	0	0
Vertebrata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

*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	East Mole				Inner North Mole Wharf				North Mole Wharf				Outer North Mole Wharf				Reclamation Pt				Wharf 1				Wharf 3			
						Trap line	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
Arthropoda	Malacostraca	Brachyura	Cancridae	Metacarcinus	novaezelandiae	N	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1	1	1	0	0	1	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	N	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Mollusca	Cephalopoda	Octopoda	Octopodidae	Octopus	maorum	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
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	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
Vertebrata	Actinopterygii	Perciformes	Uranoscopidae	Genyagnus	monopterygius	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

*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	East Mole	Inner North Mole Wharf	North Mole Wharf	Outer North Mole Wharf		Reclamation Pt	Wharf 1	Wharf 3
						Trap line	1	1	1	1	2	1	1	1
phylum	class	order	family	genus	species	*class_code	1	1	1	1	1	1	1	1
no taxa recorded														

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

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

Appendix 6i. Results from the opportunistic visual surveys.

phylum	class	order	family	genus	species	*class_code	East Mole	Inner North Mole Wharf	North Mole Wharf Site 1
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	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 6i. Results from the opportunistic visual surveys.

phylum	class	order	family	genus	species	*class_code	North Mole Wharf Site 2	Outer North Mole Wharf	Wharf 2
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Undaria	pinnatifida	A	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.

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. During the second baseline survey of the Port of Timaru it was recorded in a pile scrape sample from No. 3 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 Timaru but not in the re-survey.

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