TECHNICAL PAPER

BIOSECURITY NEW ZEALAND

Milford Sound

First baseline survey for non-indigenous marine species (Research Project ZBS2005/19)

MAF Biosecurity New Zealand Technical Paper No: 2008/01

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ISBN No: 978-0-478-32114-2 (Print)
ISBN No: 978-0-478-32115-9 (Online)

ISSN No: 1176-838X (Print)
ISSN No: 1177-6412 (Online)

May 2008

Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere

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Executive summary

This report describes the results of the first port baseline survey of Milford Sound, undertaken in June 2006. The survey provides an inventory of native, non indigenous and cryptogenic marine species within the fiord and surrounding coastal area and compares the biota with existing marine species records from the area.

- The survey is part of a nationwide investigation of native and non-native marine biodiversity in New Zealand's shipping ports and marinas of first entry for vessels entering New Zealand from overseas.

- Sampling methods used in these surveys were based on protocols developed by the Australian Centre for Research on Introduced Marine Pests (CRIMP) for baseline surveys of non-indigenous species in ports. Some variations to these protocols were necessary for use in the marine environments of Milford Sound.

- A wide range of sampling techniques were used to collect marine organisms from habitats within Milford Sound. Fouling assemblages were scraped from hard substrata by divers, benthic assemblages were sampled using an anchor box dredge, large hand corer and diver visual transects, and a gravity corer or small hand corer was used to sample for dinoflagellate cysts. Phytoplankton and zooplankton were sampled with fine-meshed plankton nets. Mobile predators and scavengers were sampled using baited crab and shrimp traps, and fish were sampled with poison stations and beach seine netting. Beach wrack was surveyed on visual walks along selected shorelines. Sediment samples were also collected to analyse organic content and particle size.

- Sampling effort was distributed in Milford Sound and surrounding coastal environments according to priorities identified by MAF Biosecurity New Zealand. In total, 22 sites were sampled during the survey.

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

- Prior to the port baseline survey, a desktop review was conducted to compile an inventory of non-indigenous marine species that have been recorded previously from Milford Sound and surrounding areas. One non-indigenous species (the alga *Polysiphonia brodiei*) had been reported from within Milford Sound and another five (all algae) from elsewhere in Fiordland. Ten cryptogenic category one taxa (C1: those whose identity as native or non-indigenous is ambiguous) were also reported from within Milford Sound or elsewhere in Fiordland.

- The initial port baseline survey of Milford Sound recorded a total of 390 species or higher taxa. No species known to be non-indigenous to New Zealand were recorded. The collection consisted of 278 native taxa, eight cryptogenic category one taxa, ten cryptogenic category two taxa (species that have recently been discovered but for which there is insufficient biogeographic or taxonomic information to determine the native provenance), and zooplankton (which were screened for target non-indigenous species but otherwise not identified), with the remaining 93 taxa being indeterminate (unable to be identified to species level).

- The eight cryptogenic category one taxa recorded from the initial baseline survey included three sponges (*Leucosolenia* cf. *discoveryi*, *Raspaila agminata* and *Tethya* *bergquistae*), two ascidians (*Diplosoma velatum* and *Didemnum* sp.), one bryozoan (*Scruparia ambigua*), one hydroid (*Orthopyxis integra*) and one dinoflagellate (*Alexandrium tamarense*). All of these taxa are known to have established populations within New Zealand, but their occurrence in Milford Sound represents an extension of the known range in New Zealand for four of them (*Diplosoma velatum, Orthopyxis integra, Tethya bergquistae* and *Raspailia agminata*).

- The eight C1 taxa were recorded from a total of only 14 of the 288 samples identified during the Milford Sound survey, in water depths ranging from 2 m to 35 m. Seven of these occurred only in samples collected from exposed coastal sites just outside of Milford Sound, and were collected by the methods of visual dive transects or quadrat scrapings. Trends in depth stratification were not evident for these organisms due to their low abundances.

- Five species recorded from the initial port baseline survey of Milford Sound are new records from New Zealand waters, and may be new to science. These are the sponges "*Neofibularia* n. sp. 2 (MK)" and "*Tedania* n. sp. 1 (MK)", the amphipod *Liljeborgia* sp. 2, and the bryozoans *Celleporina* sp. and *Electra* sp. The sponges are considered native to New Zealand, as it is unlikely that they have been transported to the remote location of Milford Sound by human means. The bryozoans and the amphipod are considered to be cryptogenic category two (C2), as there is insufficient information to determine whether New Zealand lies within their native range.

- None of the species recorded during the Milford Sound survey or during the desktop review of existing species records are on the New Zealand register of unwanted organisms. However, three species are on the Australian CCIMPE Trigger List (one ascidian and one diatom recorded in the port survey, and one diatom previously recorded from Milford Sound). Another species, the algae *Polysiphonia brodiei* (previously recorded from Milford Sound but not found during the port survey), is listed as a medium-high priority pest on an Australian list of 53 Australian priority domestic pests.

- Three toxin-producing dinoflagellates were recorded during the Milford Sound port baseline survey – the native species *Dinophysis acuminata* and *Lingulodinium polyedrium* and the C1 species *Alexandrium tamarense.* Another native diatom recorded during the port survey, *Chaetoceros convolutus*, is considered harmful to fish due to its barbed setae, but is not directly toxic. Four toxin-producing species have previously been recorded from Milford Sound or elsewhere in Fiordland – the native dinoflagellates *Dinophysis acuminata* and *Dinophysis acuta*, the native diatom *Pseudo-nitzschia australis*, and the C1 dinoflagellate *Alexandrium ostenfeldii*.

- There was only limited overlap in species composition between the desktop review of existing marine species records and the records from the port baseline survey. These differences can be attributed to variation in sampling effort and technique between surveys and to the differences in time-frame over which the records were accumulated (i.e. single snap-shot survey versus accumulation of historical records).

- Most non-indigenous and C1 taxa recorded during the Milford Sound port survey or desktop review 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).

- Fifteen of the 19 species may have been introduced in hull fouling assemblages, one species probably arrived via ballast water, two species could have been introduced by either ballast water or hull fouling vectors, and two species could have arrived either by natural means or associated with shipping.

- Vessels operating in Milford Sound operate under relatively stringent guidelines to reduce the likelihood of introduction of new marine species to the area. These guidelines, whilst voluntary for vessels other than cruise ships, include "zero discharge" of ballast water, cleaning of hulls outside of the water, and inspections of vessels for non-indigenous species before arrival in Milford Sound for vessels planning on staying more than 24 hours in the fiord.

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 recorded from New Zealand, with around 90 % of these establishing permanent populations (Cranfield et al. 1998). Since that review, at least another 41 non-indigenous species or suspected non-indigenous species (i.e. Cryptogenic category 1 – see "Baseline survey methods: Definitions of biosecurity statuses", below) 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. The purpose of these surveys is to:

- improve knowledge of potentially harmful species and of marine biodiversity in areas most at risk from harmful species,
- provide a baseline for monitoring the rate of new incursions by non-indigenous marine species in shipping ports, and
- assist international risk profiling of problem species through the sharing of information with other shipping nations (Hewitt and Martin 2001).

Worldwide, standardised port surveys 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 10 sites throughout the Mediterranean (Raaymakers 2003).

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 port baseline surveys for non-indigenous marine species. These surveys aimed to determine the identity, prevalence and distribution of native, cryptogenic and non-indigenous species in New Zealand's major shipping ports and other high risk points of entry for vessels entering New Zealand from overseas.

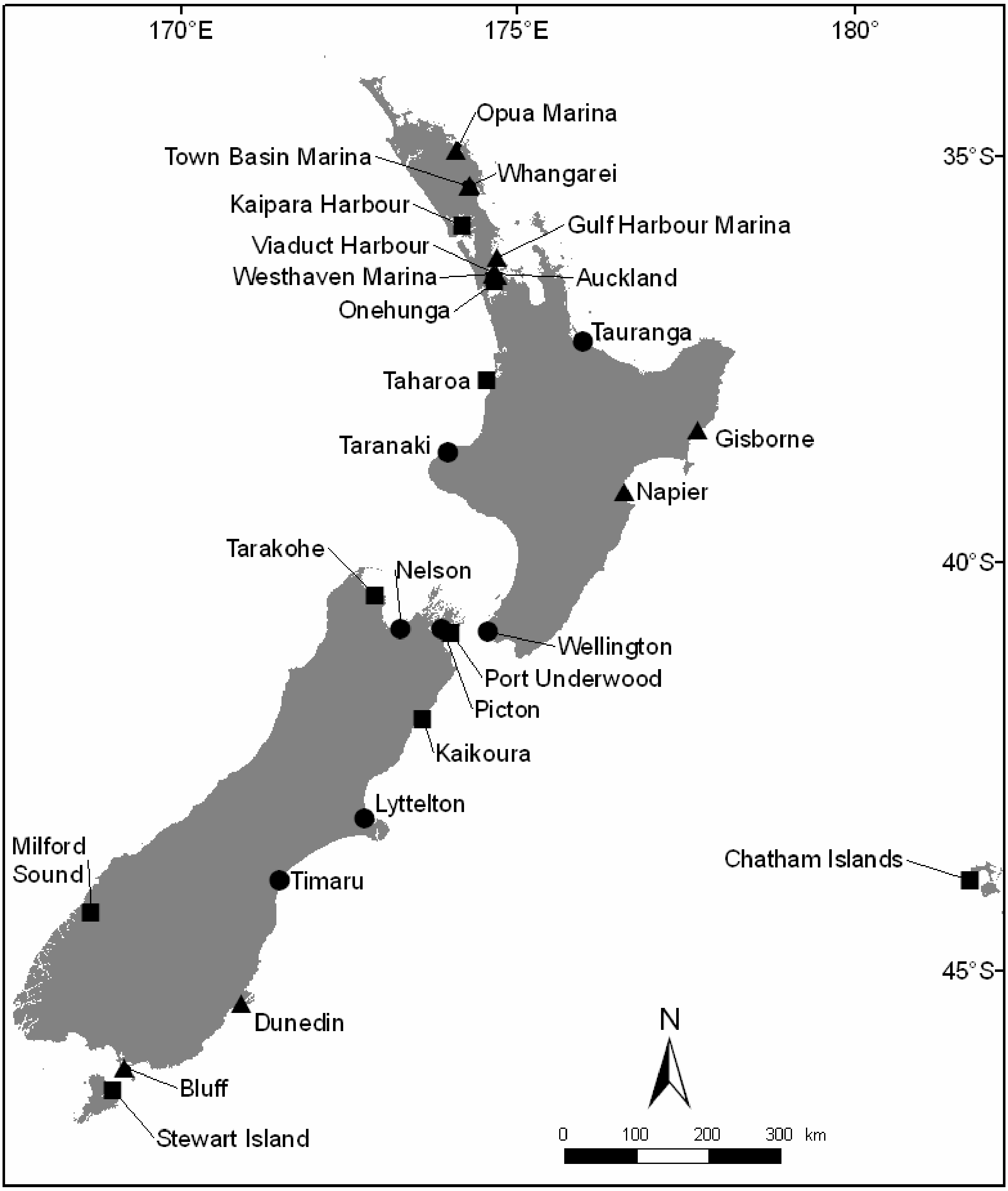


Figure 1: Commercial shipping ports in New Zealand where baseline non-indigenous species surveys have been conducted. Group 1 ports (circles) were surveyed in the summer of 2001/2002 and re-surveyed in the summer of 2004/2005, Group 2 ports (triangles) were surveyed in the summer of 2002/2003 and re-surveyed in the summer of 2005/2006 (except for Viaduct and Westhaven marinas, which were surveyed for the first time during the 2005/2006 summer), and Group 3 ports (squares) were surveyed between May 2006 and December 2007.

Initial surveys were completed during the summers of 2001/2002 and 2002/2003 in 13 major shipping ports and three marinas of first entry for vessels entering New Zealand (Figure 1). The surveys recorded more than 1300 species; 124 of which were known or suspected to have been introduced to New Zealand. At least 18 of the non-indigenous species were recorded for the first time in New Zealand in the port baseline surveys. In addition, 106 species that are potentially new to science were discovered. These 16 locations were subsequently re-surveyed in the summers of 2004/05 and 2005/06 to establish changes in the number and identity of non-indigenous species present.

In 2005, MAF Biosecurity New Zealand extended the national port baseline surveys to a range of secondary, domestic and international ports and marinas within New Zealand to increase our knowledge of the non-indigenous marine species present in regional nodes for shipping. Biological baseline surveys were contracted for the following locations:

- Taharoa Iron Sands Terminal
- Port of Onehunga (Manukau Harbour) & marinas
- Milford Sound
- Kaipara Harbour & marinas
- Golden Bay Marina (Takaka)
- Kaikoura / Port Underwood
- Stewart Island
- Chatham Islands

This report summarises the results of the first port baseline survey of Milford Sound and provides an inventory of species detected in the survey and in a review of existing biological records for the area. It identifies and categorises native, non-indigenous and cryptogenic species. Organisms that could not be identified to species level are also listed as indeterminate taxa (see "Baseline survey methods: Definitions of biosecurity statuses", below).

DESCRIPTION OF MILFORD SOUND

General features

Milford Sound is a glacially carved inlet on the south west coast of the South Island of New Zealand (Figure 1). It is approximately 16 km long. The valley walls drop steeply to water depths reaching 287 m in some parts of the Sound, particularly near Mitre Peak. Like other New Zealand fiords, the marine environments of Milford Sound are characterised by steep rock walls, deep basins, weak tidal currents and large freshwater run-off. The upper levels of the water column are often highly stratified (Gibbs et al. 2000), so that only species tolerant of brackish water are able to inhabit the upper few metres (Smith and Witman 1999). These conditions, combined with the unusual light regime caused by the stratification, and restricted larval dispersal throughout the fiords have allowed the development of unusual marine assemblages that are dominated by invertebrates and which are more characteristic of deep water habitats (Kregting and Gibbs 2006).

History of settlement and use

Maori arrived in the Milford area around 1,000 years ago. The first European to discover the sound was the sealer Captain John Grono, who discovered it in 1823 and named it Milford Haven. Milford's first settler, Donald Sutherland, arrived in 1877. He built several huts and opened the area up to tourism by discovering Sutherland Falls in 1880 and building a 12-room accommodation house (Cruising Milford Sound Ltd 2007). A century later, in the late 1980's, the Milford Development Authority was established, comprising the Queenstown Lakes District Council and several tourist companies (Scoop 2006). It was replaced in 1990 by the private company Milford Sound Development Authority Ltd (MDA), which is owned 49 % by Tourism Holdings Ltd, 49 % by Fiordland Travel Ltd and 2 % by Southland District Council. The MDA manages the facilities in Freshwater Basin (see "Introduction: Port operation, development and maintenance activities", below).

Milford Sound is now one of New Zealand's leading tourist destinations, offering boat cruises, diving and walking tracks. It is the only fiord in Fiordland accessible by road, and therefore the most heavily visited. Milford Sound received around 470,000 visitors in the 2004 / 2005 season, up from around 247,000 in 1992 (Department of Conservation 2007). Most of these are day visitors who take tourists boat trips on the Sound (Butcher Partners Ltd 2006).

Milford Sound is part of the Fiordland National Park and the Te Wahipounamu / South Westland World Heritage Area. A marine reserve - Piopiotahi Marine Reserve - covers 690 hectares along the northern side of Milford Sound, from the head of the Sound to Dale Point.

Figure 2: Milford Sound. Dotted square indicates area of inset shown in Figure 3.

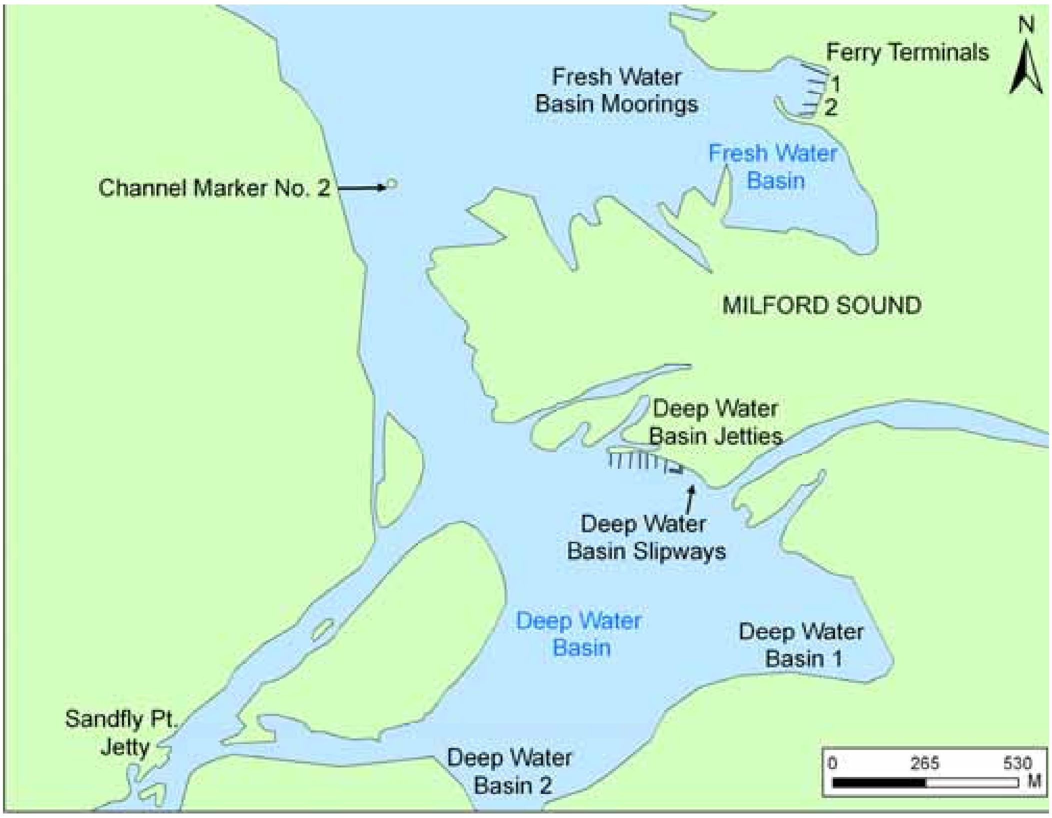


Figure 3: **Map of the head of Milford Sound around Fresh Water and Deep Water Basins (area of inset shown in Figure 2).**

Port operation, development and maintenance activities

Shipping and boating facilities in Milford Sound operate out of two main areas, both at the head of the Sound – Freshwater Basin and Deepwater Basin.

Freshwater Basin is managed by the Milford Sound Development Authority (MDA) and contains the main facilities for the commercial tourist operations in Milford Sound. These facilities are located on reclaimed land and include the visitor terminal wharf, berthage, harbour area, breakwater and numerous other facilities and services (Scoop 2006; Department of Conservation 2007). The visitor terminal wharf at Freshwater Basin (Figure 2) is located in water depths of approximately 3.9 m, although the approach is 13 m to 25 m deep. Freshwater Basin was dredged during initial construction, and maintenance dredging is conducted every ten years. The commercial tourist boat wharf has eleven berths, with construction of concrete platforms, steel pontoons and wooden piles with metal sheeting. The wharf undergoes regular, ongoing maintenance (Rodger Wilson, MDA Secretary, pers. comm.). The commercial tourist vessel companies also operate an underwater observatory and associated ferry wharf at Harrison Cove.

On the southern side of the Deepwater Basin delta are berthing facilities and infrastructure for the Fiordland crayfishing fleet, as well as for other vessels including jet boats, private vessels and sea kayaking ecotourism operators (Department of Conservation 2007, R. Wilson, MDA Secretary, pers. comm.). These facilities include a small slipway and finger berths.

Shipping movements and ballast discharge patterns

Milford Sound is a major tourist attraction and most of its vessel traffic comprises tourist vessels, although a small crayfishing fleet and some private vessels also use it as a base. Any vessel over 1,000 GRT, which is not a cruise ship, must apply for resource consent to enter Milford Sound (Southland Regional Council 2004).

Approximately 15 commercial tourist day boats operate from the Freshwater Basin terminal. These vessels remain in Milford Sound except when maintenance is required (usually once every two years) when they sail around the southern coast to Bluff or Port Chalmers. Other vessels, such as barges, rarely come into the port, only entering if they have an emergency or require maintenance (Rodger Wilson, MDA Secretary, pers. comm.).

Between 9 to 12 crayfishing vessels use the facilities at Deepwater Basin but they usually do not remain in port for long periods (John Robson, Red Boat Cruises, pers. comm.). Some vessels, however, reportedly remained moored in the same place in Deepwater Basin for up to ten years, only leaving for maintenance (Rodger Wilson, MDA Secretary, pers. comm). These fishing vessels are based out of Milford Sound, from where they head out to their fishing grounds and then return to Milford Sound. Most are not slipped in Milford Sound, but sail to the Port of Bluff when maintenance and Survey are required (Alan Cosgrove, Fiordland Lobster Co. Ltd., pers. comm.). Two very small fishing boats do use the slipway at Deepwater Basin, where they are removed from the water, cleaned whilst on the slip, and antifouling paint re-applied. Some fishing vessels reportedly arrive by sea from Invercargill or Jacksons Bay, and some of the larger vessels are able to sail the rough journey down the West Coast from Farewell Spit (John Robson, Red Boat Cruises, pers. comm.). During the tuna season boats occasionally come to Milford Sound from Nelson and Greymouth (Alan Cosgrove, Fiordland Lobster Co. Ltd., pers. comm.).

Private vessels also visit Milford Sound, although their numbers typically reach no more than 10 vessels annually. They are trailered into Milford Sound over the road and then use the slipway at Deepwater Basin to acccess the waters, as the area is too remote and the sea too rough to sail to (John Robson, Red Boat Cruises, pers. comm.).

Large international cruise ships frequently visit Milford Sound, entering as far as the deepwater area between Harrison Cove and the Arthur River. Forty-three cruise ship visits are due between 28th September 2007 and 21st April 2008 (Alan Cosgrove, Fiordland Lobster Co. Ltd., pers. comm.). Common itineraries for these cruise ships have them arriving from Hobart (Tasmania, Australia), Dunedin, or Auckland, and their next port of call after Milford Sound is often Hobart (Alan Cosgrove, Fiordland Lobster Co. Ltd., pers. comm.) or other domestic ports such as Dunedin and Picton (Hapag-Lloyd 2008). Navigational rules for cruise ships operating in Fiordland include:

- Compulsory pilotage for all ships over 100 GRT in the internal waters of Fiordland.
- No more than two cruise ships shall enter the same stretch of water within the Fiords in any one day.
- Cruise ships intending to anchor in Piopiotahi (Milford Sound) require a permit from the Department of Conservation
- The area of Freshwater Basin is a prohibited anchorage except in emergency.
- Anchoring in Harrison Cove , in water less than 60 metres in depth, is a prohibited activity.
- Cruise ships can land passengers so that they can take part in tours ashore at Milford. The use of ships tenders to run passengers ahore is controlled by the Harbour Controller in order to reduce congestion at Freshwater Basin. A maximum of 100 passengers may be landed at Milford on any one visit by a cruise ship (Southland Regional Council 2004).

Any ship being used as an accommodation base or facility in the fiords requires a resource consent under the Environment Southland Regional Coastal Plan. A condition of this resource consent is that the ship must have its hull cleaned and maintained before the vessel enters the internal waters of Fiordland. Logged inspections of vessels for the unwanted invasive alga *Undaria* are required (Ministry for the Environment 2004). Commercial fishing vessels, by contrast, do not require a coastal permit to operate in Fiordland (Ministry for the Environment 2004). Nonetheless, fishing vessels and all other vessels are requested to follow voluntary guidelines to reduce the risk of marine invasions in Fiordland. These include:

- there must be no cleaning hulls below the water line and running gear within the fiords
- cleaning on shore must occur above the high tide mark and ensure that no fouling material or contaminated water could re-enter the sea
- all vessels/structures intending to temporarily reside in the fiords for more than 24 hours must have their hulls inspected for *Undaria* and other unwanted organisms, and any detected unwanted organisms must be removed from the vessel/structure and disposed of on land
- all vessels/structures intending to permanently moor in the fiords must be cleaned and anti-fouled before being transported to the fiords (Ministry for the Environment 2004).

Many of these measures are also promoted in other regulatory and non-regulatory instruments including the *Environment Southland Proposed Regional Pest Management Strategy*, the *Code of Practice for Commercial Tourist Vessels Operating within Milford Sound Harbour Limits*, the *Southland Regional Coastal Plan*, the *Biosecurity Act 1993* and the draft *Marine Biosecurity Plan for Fiordland.*

These rules are further expanded upon for cruise ships in a Cruise Ship Deed of Agreement (Environment Southland 2001) and the Regional Coastal Plan for Southland, stating:

- All hull cleaning, painting, and hull scraping activities or any other hull maintenance is prohibited while the vessels are within Internal Waters. Furthermore, operators are advised that it is recommended that any cruise ship intending to temporarily reside in the fiords for more than 24 hours have their hulls inspected for *Undaria* and other unwanted organisms; and that any detected unwanted organisms to be removed from the vessel/structure and disposed of on land.
- All reasonable steps must be taken to operate a "zero discharge" regime while in the Southland Coastal Marine Area. The cruise ships will neither ballast nor deballast in Internal Waters.

Similar voluntary guidelines for "zero discharge" ballast water regimes are also promoted for other vessels (Guardians of Fiordlands's Fisheries & Marine Environment Inc. 2003; Ministry for the Environment 2004). Since June 2005, vessels in New Zealand have been required to comply with the Import Health Standard for Ships' Ballast Water from All Countries (Biosecurity New Zealand 2005). No ballast water is allowed to be discharged without the express permission of a Ministry of Agriculture and Forestry (MAF) inspector. To allow discharge, vessel 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. Ballast water loaded in Tasmania and Port Philip Bay in Victoria (Australia) may not be discharged into New Zealand water under any circumstances, due to the presence of several high-risk non-indigenous species in those areas (Biosecurity New Zealand 2005).

Existing biological information

There are good historical records of marine assemblages in Fiordland. Some of the first marine biological collections from New Zealand were made in Fiordland by early European explorers (eg. the expeditions of Cpt James Cook & Cpt Tobias Furneaux in 1773). Since that time there have been repeated expeditions and studies directed at describing these unusual environments and their biota. These include, amongst others, ecosystem-level studies (eg. Batham 1965; Grange et al. 1981; Grange 1985b; Smith and Witman 1999) and studies of organisms including the endemic black coral *Antipathella fiordensis* (Grange 1985a; Miller 1997; Kregting and Gibbs 2006), the rock lobster *Jasus edwardsii* (Annala et al. 1980; Annala and Bycroft 1993), foraminifera (Eade 1967), wood-boring molluscan shipworms (McKoy 1980), marine macroalgae (Nelson et al. 2002), reef fishes (Roberts et al. 2005), the Fiordland crested penguin *Eudyptes pachyrhynchus* (McLean and Russ 1991) and cetaceans (eg. Brager and Schneider 1998; Lusseau and Slooten 2002; Slooten et al. 2002; Lusseau 2005).

A compilation of marine macroalgae species records from Fiordland (Nelson et al. 2002) includes three species of non-indigenous algae (*Champia affinis, Polysiphonia brodiei* and *Sargassum verruculosum*), although none of these have been reported from Milford Sound itself. *Champia affinis*, a native of Tasmania and South Australia, has been recorded in New Zealand from Port Pegasus (Stewart Island), Preservation Inlet and Otago Harbour. *Polysiphonia brodiei,* native to Ireland and northern Europe and introduced to eastern and western North America, Japan and Australia, has been recorded in New Zealand from Lyttelton, Wellington Timaru, Tarakohe, Stewart Island and Dusky Sound in Fiordland. *Sargassum verruculosum*, native to western and southern Australia, New South Wales and Tasmania, has been recorded in Fiordland from Bligh, Thompson, Doubtful, Breaksea and Dusky Sounds and Chalky/Preservation Inlet, and from elsewhere in New Zealand at Stewart Island, Akaroa Harbour and Kaikoura. These three species were all possibly introduced through early whaling and sealing operations in the late 18th and early 19th centuries, but none of them are considered to present a serious threat to native biodiversity (Nelson et al. 2002). The brown kelp *Undaria pinnatifida,* which could have a major impact on Fiordland's biodiversity, has been introduced to other parts of New Zealand but has not been recorded from Fiordland (Nelson et al. 2002; Environment Southland 2006).

Environment Southland, the government agency responsible for environmental matters in the region that encompasses Milford Sound, is proposing to designate nine marine organisms as pests under their *Regional Pest Management Strategy* (Environment Southland 2006). The species are the brown alga *Undaria pinnatifida*, the Asian clam *Potamocorbula amurensis*, the seaweed *Caulerpa taxifolia*, the Chinese mitten crab *Eriochier sinensis*, the European shore crab *Carcinus maenas*, the Mediterranean fanworm *Sabella spallanzanii*, the Northern pacific seastar *Asterias amurensis*, and the sea squirts *Didemnum vexillum* and *Styela clava*. *Undaria pinnatifida* has been recorded from Paterson's Inlet on Stewart Island and from Bluff Harbour (Environment Southland 2006). As noted earlier, it has not been recorded from Milford Sound or elsewhere in Fiordland (Nelson et al. 2002; Environment Southland 2006). The other eight of these species have not been recorded from Southland (Environment Southland 2006). *P. amurensis*, *C. taxifolia*, *E. sinensis*, *C. maenas*, *S. spallanzanii*, and *A. amurensis* are not known to be established in New Zealand.

The survey of coastal reef fish species conducted by Roberts et al. (2005) in Milford Sound in March-April 1998 recorded 52 marine fish species in 39 genera and 26 families at Milford Sound. None of the species were non-indigenous to New Zealand. The recorded species included two species probably new to science - orange rockfish *Acanthoclinus* ?n.sp. and pygmy sleeper *Thalasseleotris* n.sp.. Two other particularly rare species were recorded at Milford Sound, fiord brotula *Fiordichthys slartibartfasti* Paulin and eyespot clingfish

Modicus tangaroa Hardy. The study recognised the south side of Milford Sound as being particularly special, due to the recovery of rare and new fish species there.

Cranfield et al. (1998) reviewed the published literature and classified 159 species as being adventive in New Zealand. None of these were reported from Milford Sound, but the three non-indigenous macroalgae recorded from elsewhere in Fiordland and noted above from the Nelson et al. (2002) study were also reported by Cranfield et al. (1998). Several other species classed as adventive in New Zealad by Cranfield et al. (1998) were reported with less specific distributions that encompassed most parts of New Zealand and therefore it may be inferred that they could potentially be found in Milford Sound. These are the sponges *Clathrina coriacea*, *Cliona celata*, *Dendya poterium*, *Leucosolenia botryoides* and *Sycon ciliata*; the hydroids *Amphisbetia operculata*, *Obelia longissima* and *Plumularia setacea*; the bryozoan *Bugula flabellata*; and the ascidians *Asterocarpa cerea* and *Corella eumyota*).

Baseline survey methods

REVIEW OF MARINE SPECIES RECORDS FROM MILFORD SOUND

Prior to undertaking the Milford Sound port baseline survey, we conducted a desktop review of biological records (including historical) of marine species previously recorded from Milford Sound. We conducted this review by searching the Southwestern Pacific Regional OBIS Node (SW-PRON) database (NIWA 2008) and relevant published literature.

The SW_PRON database is a work in progress, comprising a growing number of datasets containing marine biodiversity data from the Southwestern Pacific region (NIWA 2008). At the time of our review (mid-2006) it contained two datasets – a "fish" dataset and a "bryozoan" dataset. The "fish" dataset contains mostly fish records as well as some invertebrate records that are derived from various trawl surveys conducted on behalf of New Zealand's Ministry of Fisheries in the Southwest Pacific Ocean between 14/03/1961 and 07/07/2005. The "bryozoan" dataset contains bryozoan species presence data derived from various trips in and around the New Zealand Exclusive Economic Zone between 14/07/1874 and 19/04/2002. These datasets are available for public access on the SW-PRON website (NIWA 2008).

During our desktop review, we compiled a list of all species records that we encountered from Milford Sound or from elsewhere in Fiordland, but focused particularly on obtaining a complete inventory of non-indigenous (NIS) and cryptogenic category 1 (C1) species. After compiling our initial species lists we sent the lists for each taxonomic group to relevant experts for them to review species names, reliability of the records and biosecurity statuses. We also asked the experts to add any NIS or C1 species records that we had missed, and to provide information on the New Zealand and global distribution for the NIS and C1 species. The distribution information was then mapped and species information sheets prepared for each NIS and C1 species.

PORT BASELINE SURVEY OF MILFORD SOUND

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. We surveyed a variety of these habitat types at sites specified by MAF Biosecurity New Zealand within, and around Milford Sound, from June 7^{th} to 14^{th}, 2006.

A variety of sampling techniques was used for the survey of Milford Sound. These sampling methods, specified by MAF Biosecurity New Zealand in the tender documents, are derived from the CSIRO Centre for Research on Introduced Marine Pests (CRIMP) protocols developed for port baseline 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). The methods include small cores for dinoflagellate cysts, large cores and box dredge samples for benthic invertebrates, 20 µm and 100µm plankton nets, crab and shrimp traps, qualitative visual searches, quadrat scraping, photo stills and video, poison stations, beach seines and beach walks (Appendix 1). Due to the exposed nature of the coastline around Milford Sound and the presence of the Piopiotahi Marine Reserve within the Sound, some of the sampling methods and sites were varied in agreement with MAF Biosecurity New Zealand. The sites and methods employed during the survey of Milford Sound are detailed below.

SAMPLING EFFORT

Sampling sites and the methods to be employed at each site were specified by MAF Biosecurity New Zealand. A summary of the sampling completed during the first baseline survey of Milford Sound is provided in Table 1, and the spatial distribution for each of the sample methods is shown in Figure 11 to Figure 19. The exact geographic locations of sample sites are given in Appendix 2. Planned sampling that was not conducted, and the reasons for this, are given in Appendix 3.

Fouling communities

Fouling assemblages at piling and hard substrate sites were surveyed using photographic stills and video as well as qualitative visual surveys and/or scraping samples.

Divers recorded video transects continuously from the surface to 10 m depth (where possible). Following the video transects, quadrats (25 cm x 40 cm) were secured to the hard surfaces at depths of 0.5 m, 3.0 m and 7.0 m depth (where water depths allowed this), and still images were taken with a high-resolution digital camera. Four overlapping photographic stills were taken in each quadrat to cover the area. At sites where scraping was possible and permitted, once the first diver had obtained the photographic images, a second diver then removed fouling organisms by scraping the organisms inside each quadrat into a 1 mm mesh collection bag, attached to the base of the quadrat. Once scraping was completed, the sample bag was sealed and returned to the boat for processing. The divers also made a visual search of the area for known harmful invasive species and collected samples of large conspicuous organisms not represented in quadrats.

No scraping for samples was conducted at site 13 (Stirling Falls wall), which is within the Piopiotahi (Milford Sound) marine reserve. Because of its location in the marine reserve and the presence of black coral trees (a protected species) in the fouling assemblage, sampling of hard substrata at this site was completed with non-destructive video and diver observations, rather than with quadrat scrapes.

Qualitative visual samples and photo stills and video were not conducted at site 16 (Stripe Point) due to the extensive sandy benthos devoid of sessile fouling and fauna and strong surge affecting visibility.

Figure 4: Diver sampling organisms by quadrat scraping in Milford Sound.

Benthic infauna

Benthic infauna were collected by sieving sediment collected using a large hand corer or an anchor box dredge (Figure 5). The large hand corer is 150 mm in diameter and 400 mm long. It is inserted 200 mm into the sediment, resulting in a sediment sample 150 mm in diameter by 200 mm length. The large hand corer was used at all sites except site 22 (Poison Bay), where an equivalent sample was collected remotely using an anchor box dredge. The anchor box dredge consists of a solid metal box (38 cm x 35 cm x 20.5 cm) that attaches to a long chain. The dredge is dropped from a boat or wharf to the seafloor where it sinks down into the sediment. It is then hauled back onto the boat and the retrieved sediment sieved to capture benthic infauna. At each site, triplicate samples were taken 50 m out from the pile and hard structure site (where applicable).

Figure 5: Large hand corer (left) and anchor box dredge (right) for sampling benthic infauna

Dinoflagellate cyst-forming species

Triplicate samples were collected for dinoflagellate cysts at planned pile and hard substrate sites, with triplicate samples 50 m out from the pile and hard structure site (depth permitting). At sites with suitable benthos (sites 1, 2 and 22) samples for dinoflagellate cysts were taken with a TFO gravity corer, but sites with stoney/cobble benthos (sites 3, 6, 7, 8, 10, 11, 12, 16 and 21) required divers to manually take the samples using a small hand core (Figure 6). Sediment samples were kept on ice and refrigerated prior to dispatch to the specialist taxonomist.

The TFO gravity corer consists of a 1 m long x 1.5 cm diameter hollow stainless steel shaft with a detachable 0.5-m long head (total length = 1.5 m; Figure 7). Directional fins on the shaft ensure that the corer travels vertically through the water so that the point of the sampler makes first contact with the seafloor. The detachable tip of the corer 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 effectively preserves the vertical structure of the sediments and fine flocculant material on the sediment surface. The TFO corer is deployed and retrieved from a small research vessel.

The small hand core used by divers is a 20 cm long tube with 2 cm internal diameter. Tubes are forced into the substrate then capped at each end with a rubber bung to provide an airtight seal.

Figure 6: Diver manually taking a small core sediment sample for dinoflagellate cyst-forming species at Seabreeze Point

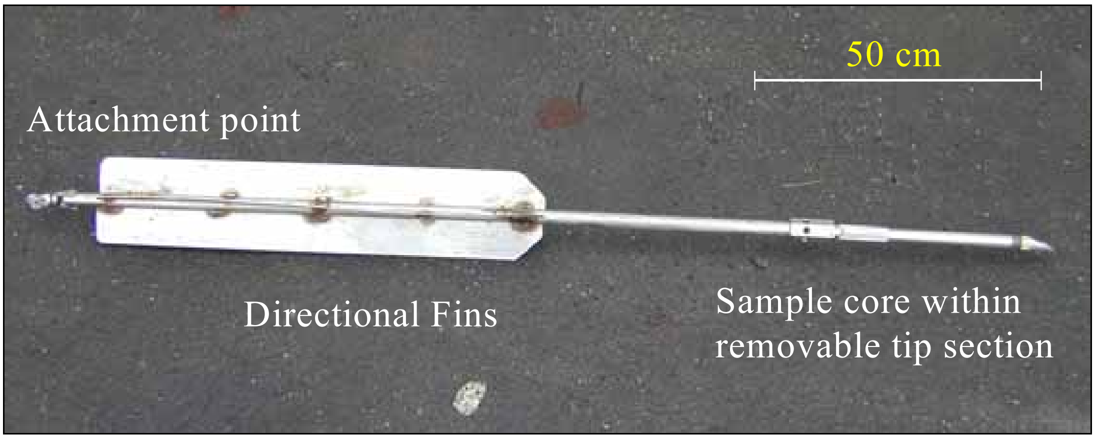


Figure 7: **TFO gravity corer**

Dinoflagellates, phytoplankton and zooplankton in the water column

A 100 µm net with a diameter of 70 cm was used to sample zooplankton in the water column. The net dropped vertically to approximately 1 metre from the substrate. Following the vertical drop the net was retrieved and carefully sprayed down to collect all the sample which was then placed in containers and preserved. A 20 µm net with a diameter of 25 cm was used to sample dinoflagellates and phytoplankton species. This net was towed just below the water surface behind the charter vessel at slow speed for 1 minute then retrieved, washed down, placed in sample containers and labelled for laboratory analysis.

Figure 8: **Zooplankton net commencing its vertical drop.**

Epibenthos

Larger benthic organisms were sampled using qualitative visual surveys, crab box traps and shrimp traps.

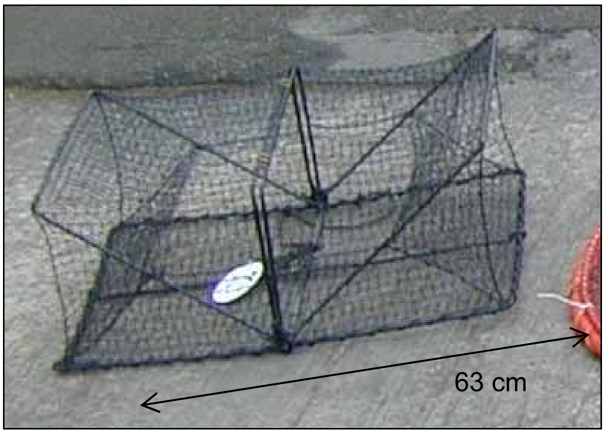
Qualitative visual surveys

Qualitative visual surveys were conducted instead of benthic sled tows at Milford Sound, due to the hard substrate and fragile black corals at many of the sites making sled tows unsuitable. At planned sites a qualitative visual survey dive was conducted over suitable substrata. Three replicate 10 m transects were recorded on video at each qualitative visual survey site. Representative fauna and flora were collected for subsequent identification. Large, conspicuous marcofauna and flora were identified from the video records.

Traps

Crab box traps (63 cm x 42 cm x 20 cm; Figure 9) with a 1.3 cm mesh netting were used to sample mobile crabs and other small epibenthic scavengers. 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 three box traps, were set on the sea floor at each site and left to soak overnight before retrieval.

Shrimp traps (Figure 9) 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 is fitted. The funnel has a 5 cm entrance that tapers in diameter to 1 cm. The entrance is 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 three shrimp traps, were set on the sea floor at each site and left to soak overnight before retrieval.



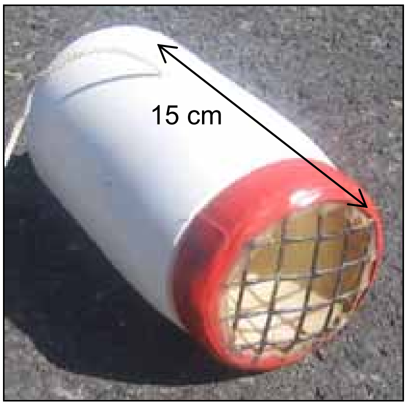


Figure 9: Crab box trap (left) and shrimp trap (right)

Fishes

Fishes were sampled using poison stations and beach seine netting.

Poison stations were sampled over hard substrata using clove oil at three sites (sites 3, 7 and 22). An area with suitable contours was selected and draped with a collection net. Clove oil was then applied to the area paying particular attention to potential hiding places for fish species. As the fish in the selected area became anesthetised they were collected using small aquarium dip nets and placed in a sealed bag. This was then returned to the charter boat for processing and labelling before being frozen.

Beach seine nets (Figure 10) were used to sample fish species at one river mouth (site 3) and one beach (site 22). The net is11 m wide, has a headline height of around 1 m and a 4 m cod end of 9 mm mesh. The net was dragged from a suitable starting position onto the beach where the catch was bagged, labelled and placed on ice for freezing at the first opportunity.

Figure 10: A beach seine net being dragged out before hauling in

Beach wrack

Qualitative visual surveys of beach wrack were conducted at specified sites to collect crab exuviae, target macroalgae or other target organisms. Beach wrack surveys are designed for surveyors to walk parallel to the water's edge 2 m from the shore, 5 m from the shore and 10 m from the shore. However, at Milford Sound the shore was only wide enough to allow surveys at 2 m from the water's edge. At site 22 (Poison Bay), two beach wrack walks - one on each side of the creek - were conducted at 2 m from the water's edge. Collected organisms were bagged and labelled.

Environmental data

Water temperature, salinity and sea state

Field measurements of water temperature and salinity were taken at each site. Turbidity measurements (measured as Secchi depth) were taken at each site using a 150 mm diameter Secchi disk. Observations were also made of daily sea state (Beaufort scale).

Sediment analysis

Sediment samples were taken for analysis of grain size and organic content from each site that was sampled for benthic infauna, where possible (some sites had stoney substrates with very little sediment, which prohibited the collection of one or both sediment samples). A ~100 g wet weight sample was collected from each of two replicate anchor box dredge or large hand core samples at each site, and frozen prior to analysis. A ~30 g sub-sample was removed for analysis of organic content, while the remainder was used to determine the particle size distribution of the sample using a laser grain size analyser.

The organic content of the sediments was estimated using the common method of loss on ignition (LOI). For each sample, the wet sample was well mixed and a representative subsample (approximately 30 g) placed into a pre-weighed crucible. The sample was put into a 104 °C oven until completely dry. It was then transferred to a desiccator to cool before being weighed to the nearest 0.001 g. The sample was then ashed in a muffle furnace at 500 °C for four hours. When cool enough it was transferred to a desiccator to cool further before being weighed to the nearest 0.001 g. The difference between nett dry and nett ash-free dry weights was then calculated. This difference or weight loss, expressed as a percentage (LOI %), is closely correlated with the organic content (combustible carbon) of the sediment sample (Heiri et al. 2001).

The distribution of particle sizes at each port was measured using the standard procedures and equipment of nested sieves to sort the larger particles (down to 0.5 mm) and a laser grain size analyser to sort particles below this size, as follows:

1. Samples were wet sieved using sieves of mesh sizes 8 mm, 5.6 mm, 4 mm, 2.8 mm, 2 mm, 1 mm and 0.5 mm.
2. Sediments retained on each sieve were dried and weighed.
3. The remaining fraction (< 0.5 mm) was prepared for laser analysis: the < 0.5 mm fraction was made up to 1 L in a cylinder fitted with an extraction tap. The sample was homogenised by continuous agitation with a plunger up and down in the cylinder for 20 seconds. With agitation continuing during extraction, approximately 100 ml was drawn off for drying and weighing and a second 100 ml was drawn off for laser particle analysis.
4. The first 100 ml was measured to obtain a percent of the whole sample, then dried, weighed and scaled up to 100 % to return the < 0.5 mm gross dry weight.
5. The laser analysis returns percent distributions of volume in any chosen size ranges. These percents are then applied to the < 0.5 mm gross dry weight.
6. Laser analysis was conducted using a Galai CIS-100 "time-of-transition" (TOT) stream-scanning laser particle sizer. Particles sized between 2 µm and 600 µm were measured by the laser particle sizer. Typically, 250,000 to 500,000 particles were counted per sample.
7. The proportion of particles in each of five size categories (ranging from clay to small pebbles) was then calculated as a percent of the total net dry weight.

SORTING AND IDENTIFICATION OF SPECIMENS

Each sample collected in the survey was allocated a unique code on waterproof labels and transported to a field laboratory onboard the research vessel, 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 2. Specimens were subsequently sent to approximately 20 taxonomic experts 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 3) and the Australian Trigger List produced by the Consultative Committee on Introduced Marine Pest Emergencies (Table 4).

Because of the difficulty of identifying all species from the zooplankton samples, an alternative approach was taken, in consultation with MAF Biosecurity New Zealand, whereby the samples were only screened for target non-indigenous species. The species looked for were larvae that were or were suspected to be the Chinese mitten crab *Eriocheir sinensis* (or other members of this genus), the European green crab *Carcinus maenas*, the northern Pacific seastar *Asterias amurensis* and the ascidian *Styela clava*. Identifications were not made for organisms other than these species in the samples. Cumaceans, ostracods and nemerteans collected by any method were not identified due to NIWA being unable to secure the services of experts to examine these groups. These specimens were therefore classed as indeterminate taxa (see “Baseline survey methods: Definitions of biosecurity statuses”, below).

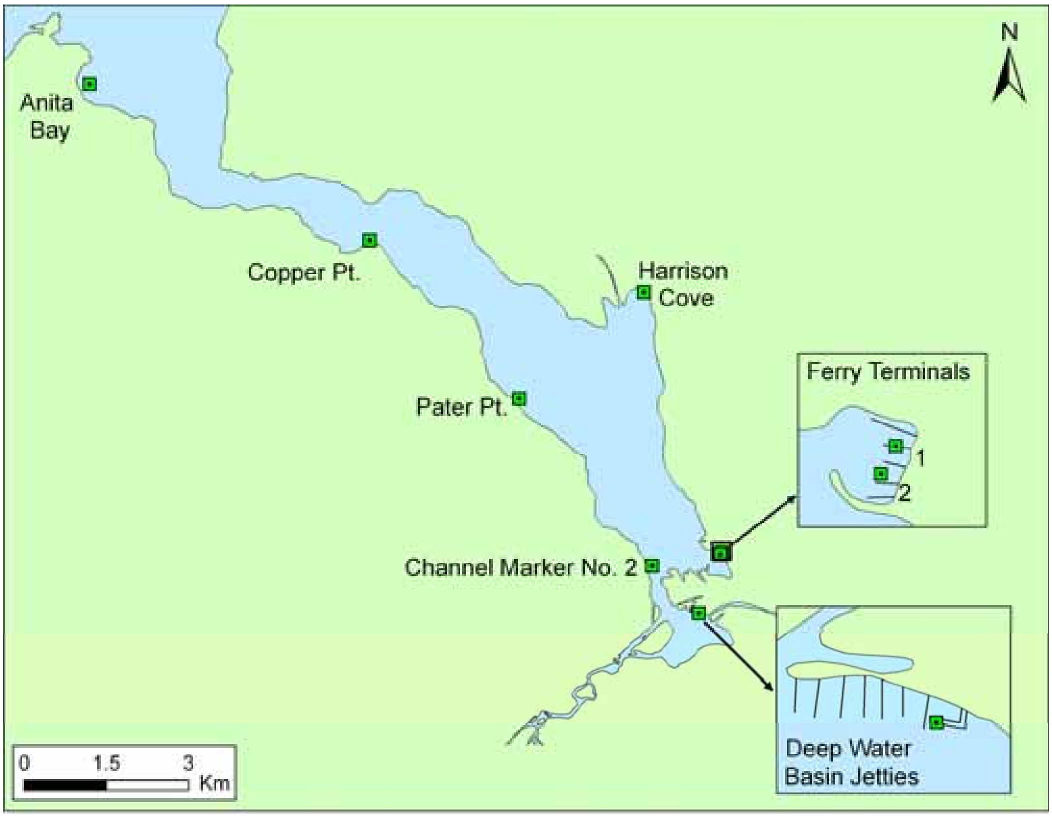


Figure 11: Quadrat scraping sites

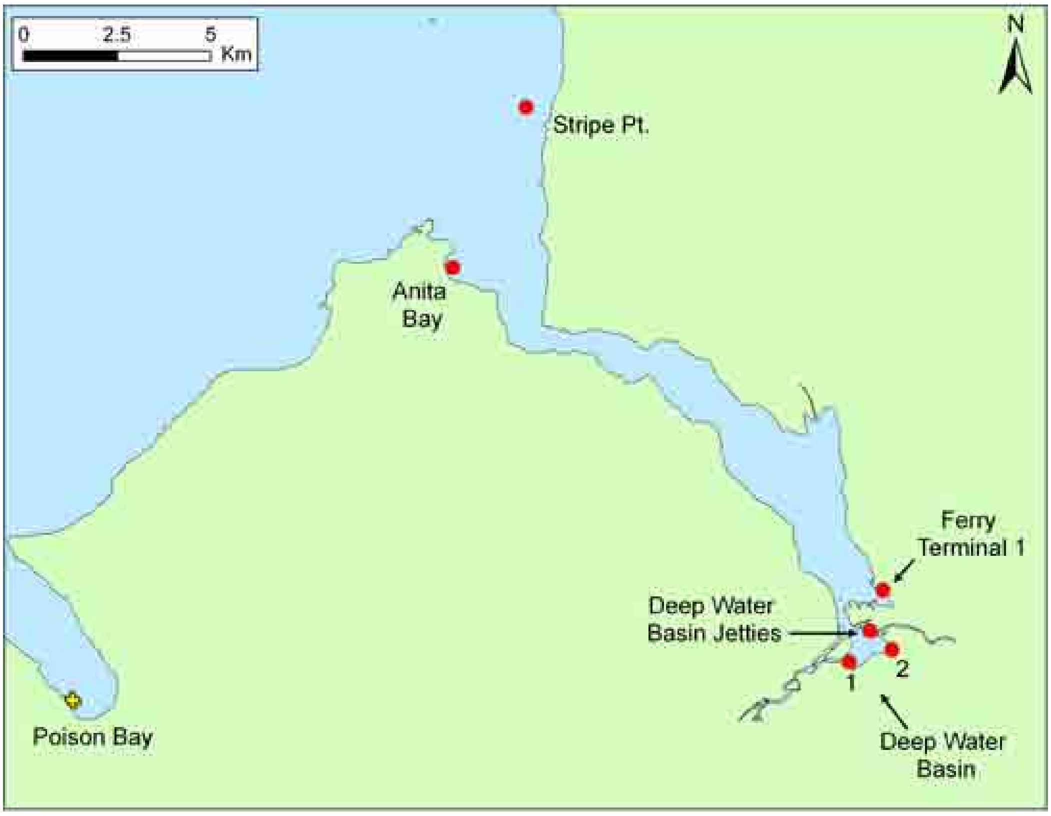


Figure 12: Anchor box dredge (yellow cross) and large benthic core (red circle) sampling sites

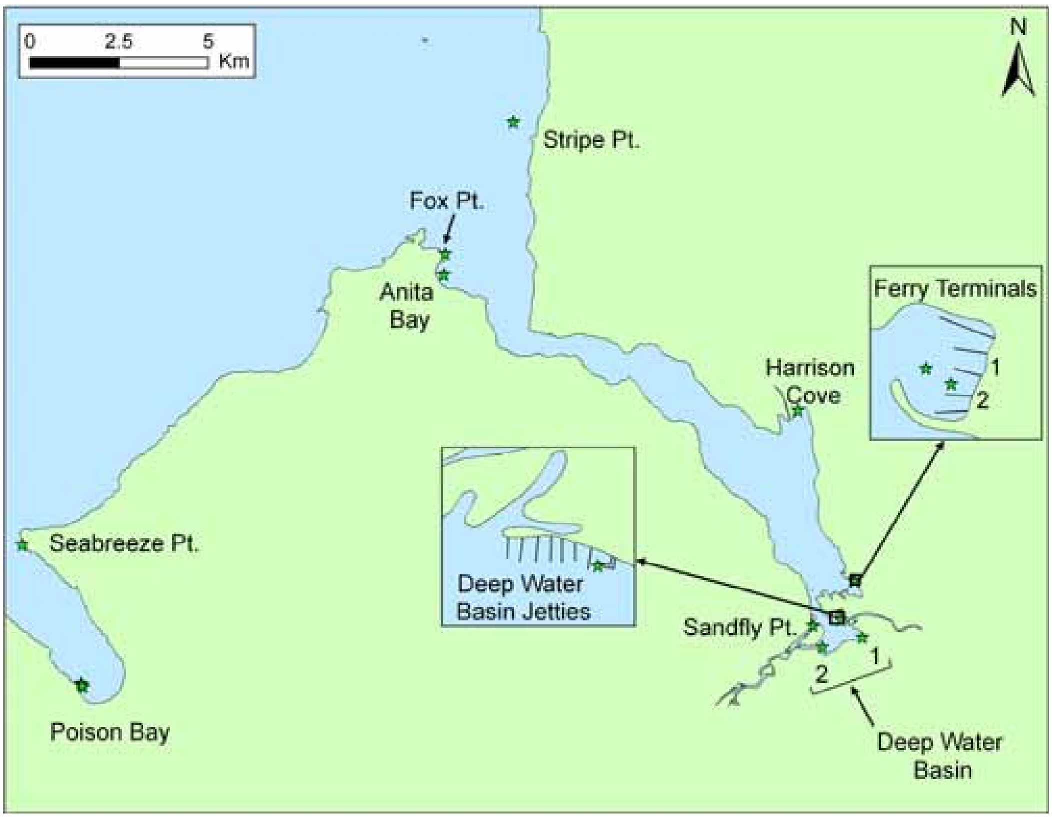


Figure 13: Cyst sampling sites

Figure 14: **Water column sampling sites for zooplankton, phytoplankton and dinoflagellates**

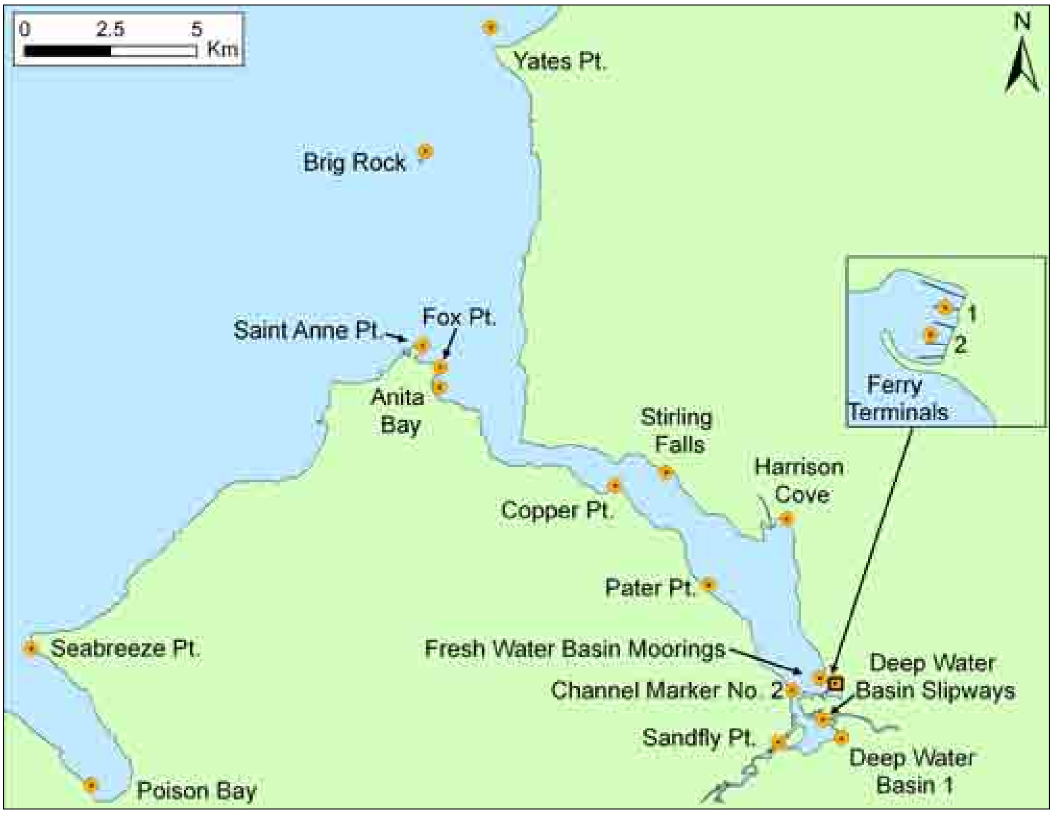


Figure 15: **Diver visual transect sites**

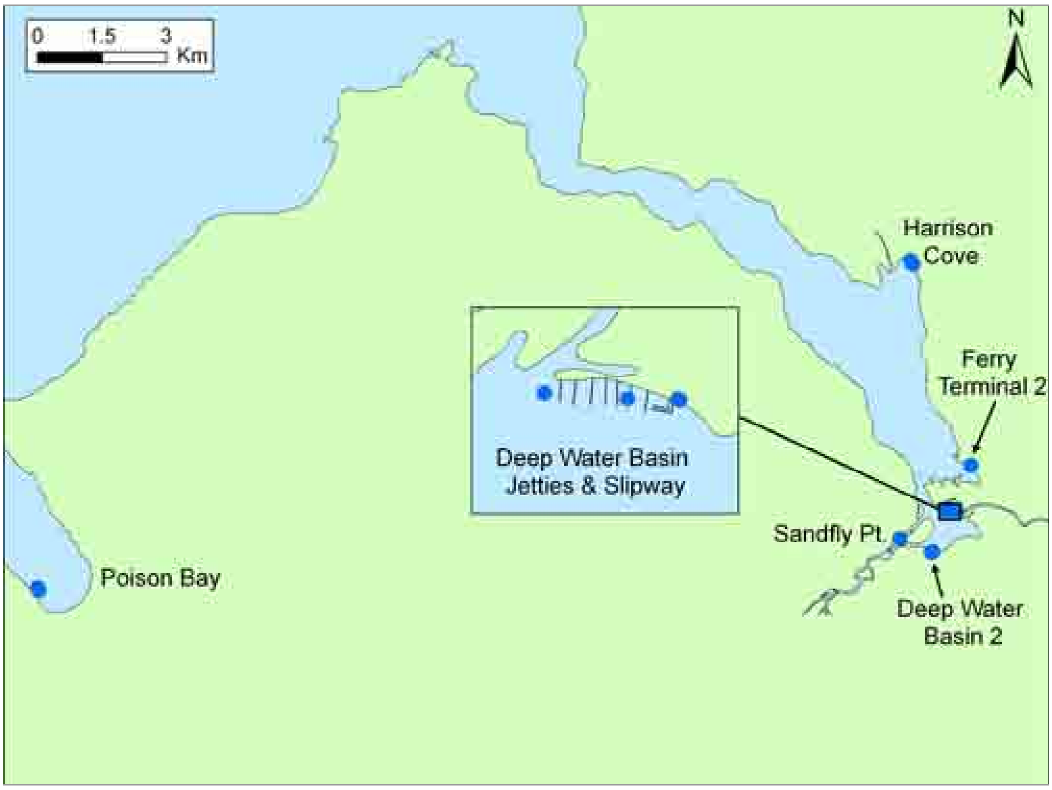


Figure 16: Crab and shrimp trapping sites

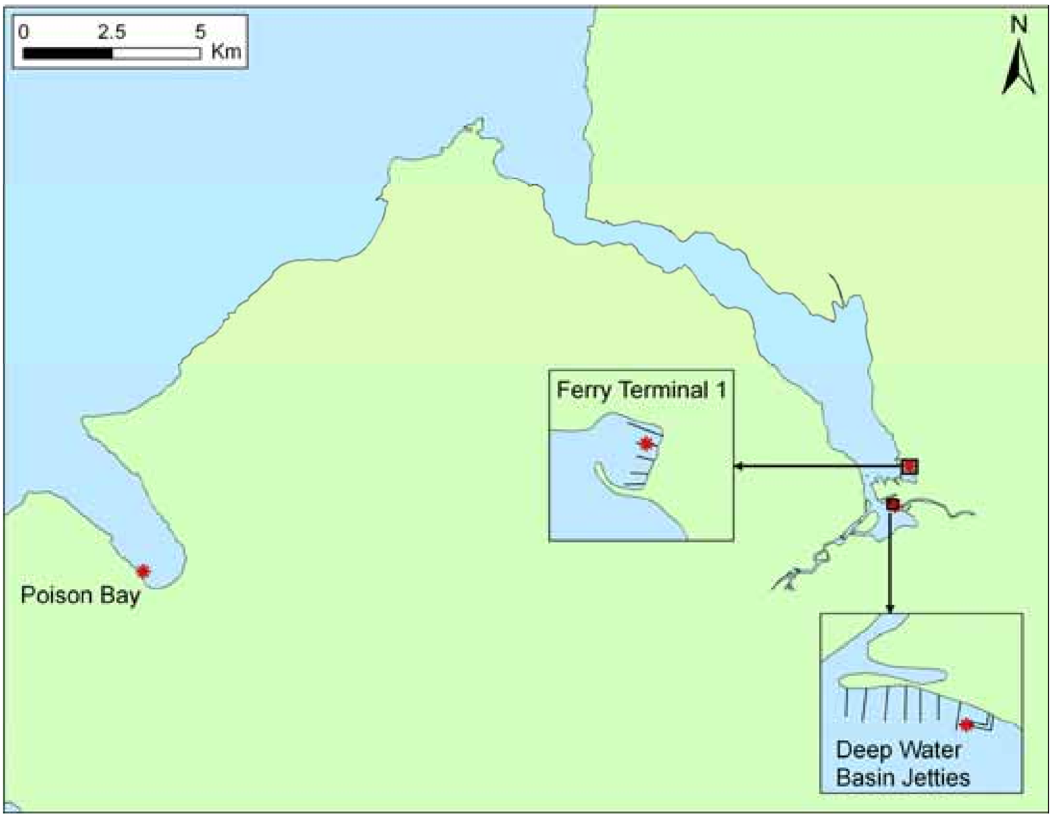


Figure 17: Poison stations sampling sites

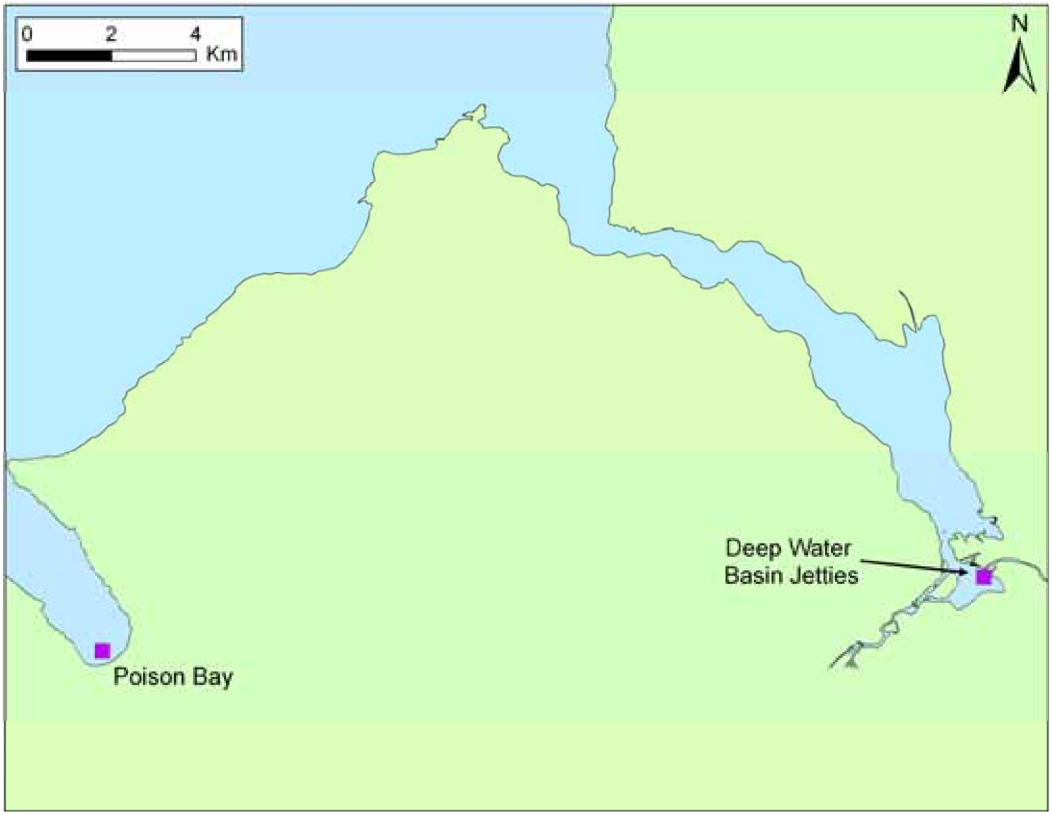


Figure 18: Beach seine sampling sites

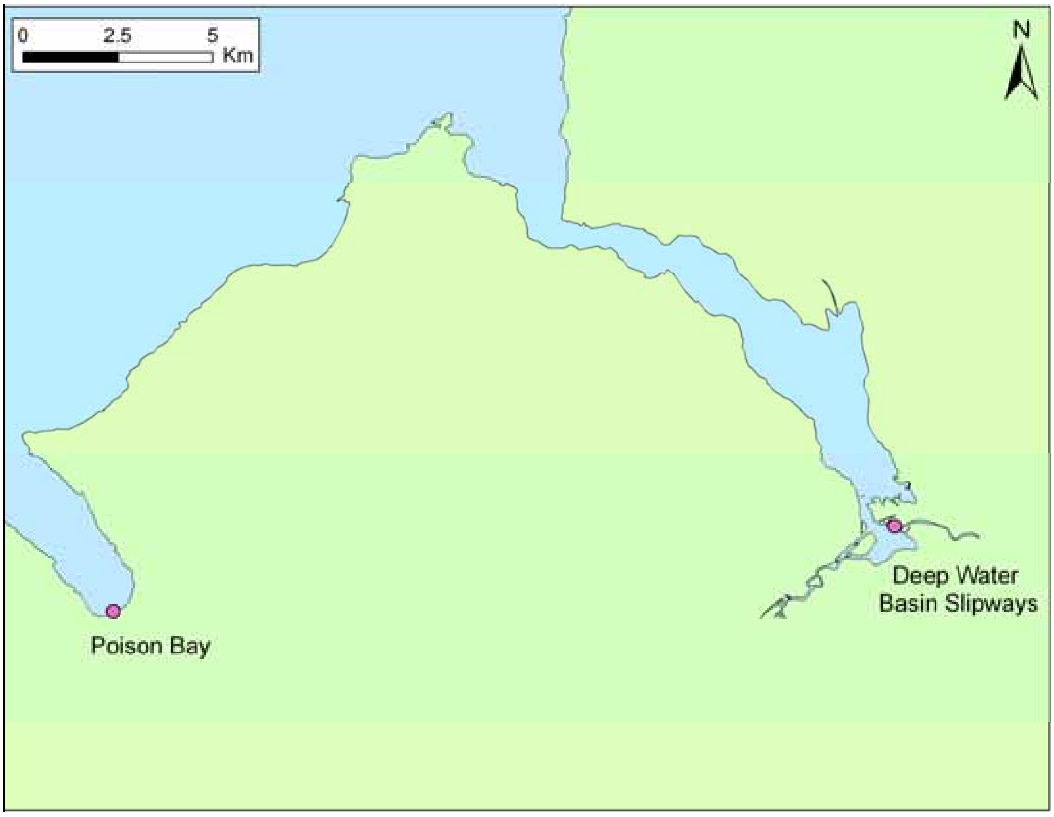


Figure 19: Beach wrack sampling sites

DEFINITIONS OF BIOSECURITY STATUSES

Each species recovered during the survey was classified into one of five categories ("biosecurity statuses") 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 determine the true range and origin of many species reliably. The biosecurity statuses 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. A fifth biosecurity status ("indeterminate taxa") was used for specimens that could not be identified to species-level. Formal definitions for each biosecurity status are given below, and a full glossary is provided at the end of the report.

Native species

Native species 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?

Cryptogenic category 1 taxa (C1)

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 category 2 taxa (C2)

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.

Indeterminate taxa

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.

Public awareness programme

A well-targeted public awareness programme is an important component of this project. The attachment of local communities to their surrounding marine environment can act to the advantage of biosecurity if local vigilance can be harnessed for on-going surveillance for marine pests. Developing a strong public awareness programme is, therefore, critical to the success of the project and to on-going protection of New Zealand's marine environment from unwanted marine organisms.

Public awareness of the Milford Sound survey was developed in several ways. Prior to implementation of the survey, a resource consent was sought and obtained from Environment Southland for operation of a research vessel in Fiordland (required under section 16.2.2(2) of the Proposed Regional Coastal Plan for Southland, which came into force in July 2005). The conditions of the consent required notification of the following potentially affected stakeholders of the purpose of the survey and their written approval for the work to proceed:

- MAF Biosecurity New Zealand
- Guardians of Fiordland
- Fiordland Fishermen's Association
- Ministry of Fisheries
- Te Ao Marama Inc.
- Department of Conservation (approval for application and also on behalf of users of the Deepwater Basin wharf and berthage pen structure),
- Milford Sound Development Authority (approval for the application and also on behalf of the users of the Freshwater Basin facility).

In consultation with MAF Biosecurity New Zealand, representatives of each of the stakeholder groups were contacted directly by the NIWA project team. The purposes of the Milford survey, and of the national port baseline survey programme in general, were discussed with each representative. This discussion also covered the survey methods and their likely environmental effects within Milford Sound. It also requested assistance from the stakeholders in reporting any occurrences of unusual or suspect species. A brief background document on the proposed survey, which described the purpose and conduct of the surveys in more detail, was then sent to each stakeholder group along with a form seeking written consent for the activity. Formal consent was received from all seven of the groups listed above and, as a result, resource consent was granted for the survey from Environment Southland (NIWA N066-001).

A research permit was also obtained from the Department of Conservation (DOC) to sample within the Piopiotahi Marine Reserve.

Shortly after the the field survey was completed a joint media statement on the national port survey programme and the survey of Milford Soud was released by NIWA and MAF Biosecurity NZ. Release of the media statement after the survey was necessitated by the short interval between contracting and the required completion date of the surveys. The release outlined the activities undertaken during the survey and encouraged any public reports or observations on potentially introduced species. It included contact details for reporting suspicious species and for further information about the Milford survey and national port baseline survey programme (Appendix 4).

Media releases for the Milford Sound port survey were sent to the following organisations and stakeholders:

Media:
- NZPA
- Fiordland Focus
- West Coast Times
- Otago Daily Times
- Southland Times

Stakeholders:
- Environment Southland
- Department of Conservation
- Milford Sound Development Authority
- Fiordland Fisherman's Association
- Te Ao Marama Inc

Following media release, the following press coverage resulted:

- Southland Times: 'Milford survey results months away – NIWA', 2 September 2006, p.5.

No reports of suspect organisms were received from members of the public following the press coverage.

Results

REVIEW OF MARINE SPECIES RECORDS FROM MILFORD SOUND

Four hundred and fifty-eight taxa representing 17 phyla were recorded during the desktop review of existing marine species records from Milford Sound and surrounding areas. These include 343 native taxa (Table 5), six non-indigenous species (NIS; Table 6), ten cryptogenic category one (C1) taxa (Table 7), six cryptogenic category two (C2) taxa (Table 8), and 93 indeterminate taxa (Table 9). For general descriptions of the main groups of organisms recorded during this review, refer to Appendix 5. A list of Chapman and Carlton's (1994) criteria (see "Baseline survey methods: Definitions of biosecurity statuses", above) that were met by the NIS and C1 taxa is given in Table 10.

The 346 native taxa compiled in our review of existing marine species records from Milford Sound are comprised of 16 phyla but are dominated by bryozoans, foraminiferan protozoans and molluscs (Table 5). It should be noted that whilst our review was thorough, achieving an exhaustive list of native species was not possible within the resources available to the study.

The six non-indigenous species previously recorded from Milford Sound (Table 6) are all algae: the "brown" alga *Sargassum verruculosum* and the "red" algae *Champia affinis*, *Polysiphonia brodiei, P. constricta, P. sertularioides* and *P. subtilissima*. The ten C1 taxa previously recorded from Milford Sound (Table 7) include one bryozoan (*Scruparia ambigua*), one ascidian (*Diplosoma velatum*), one dinoflagellate (*Alexandrium ostenfeldii*), one silicoflagellate (*Heterosigma akashiwo*) and six sponge species (*Crella incrustans*, *Esperiopsis edwardii*, *Haliclona* cf. *clathrata, Leucosolenia* cf. *challengeri, Leucosolenia* cf. *discoveryi* and *Raspaila agminata*). Available information on the ecology of each of these NIS and C1 species, their global and New Zealand distributions, vectors and potential impacts are provided in Appendix 6.

The six C2 taxa compiled in our review of existing marine species records from Milford Sound include one polychaete, one bryozoan, two fish and two sponges (Table 8).

Four of the taxa recorded during the review are harmful algal species. These are the dinoflagellates *Dinophysis acuta, D. acuminata* and *Alexandrium ostenfeldii* and the diatom *Pseudo-nitzschia australis*. All are widely distributed worldwide, and all except *A. ostenfeldii* are considered native in New Zealand (Table 5). Evidence from toxin analyses suggest that *Alexandrium ostenfeldii* may also be native in New Zealand (MacKenzie et al. 1996), but as this has not been confirmed, it is classed here as C1 (Table 7). *Alexandrium ostenfeldii* is capable of producing Paralytic Shellfish Poisoning (PSP) toxins, although it is one of the least toxic of all the *Alexandrium* species tested for PSP toxins. Nonetheless, it may be hazardous for shellfish consumers in New Zealand (MacKenzie et al. 1996). *Dinophysis acuta* and *Dinophysis acuminata* form blooms that are associated with Diarrhetic Shellfish Poisoning (DSP), although it appears that not all *Dinophysis acuminata* blooms are toxic (Faust and Gulledge 2002). *Pseudo-nitzschia australis* can produce a domoic acid, which causes Amnesic Shellfish Poisoning (ASP, New Zealand Food Safety Authority 2003). However, not all isolates of *P. australis* in New Zealand have been confirmed to produce domoic acid (Hay et al. 2000).

MILFORD SOUND PORT SURVEY

Port environment

Sampling was carried out at twenty-one different sites throughout Milford Sound. (Figure 11 to Figure 19, Table 11). Maximum recorded depths ranged from 200 m at Pater Point to around 4-5 m at Sandfly Point Jetty and the Ferry Terminals. Turbidity was greatest at Poison Bay and the Deep Water Basin Jetties (1 m and 1.75 m secchi depths, respectively), whilst it was lowest at the entrance to the fiord, particularly at Brig Rock (an open ocean site; 17 m secchi depth). Salinity was variable and generally less than that of sea water (average of around 24 ppt), influenced by the high degree of freshwater run-off in the fiord. Freshwater sites occurred at the head of the fiord (Deep Water Basin and Jetties), and all other sites varied between 14 and 35 ppt. Water temperature was also lowest at the head of the fiord (6-7 degrees Celsius). The average water temperature across all sites was 11.5 ± 0.6 degrees Celsius. During sampling, sea states ranged from 0-5 on the Beaufort scale (i.e. approximately 0-21 knots wind speed and 0-2 m wind speed), with a general trend, as expected, of increasing

Beaufort scale with increasing distance from the head of the fiord. However, relatively low Beaufort scales were recorded at some of the more exposed, outer sites; this reflects the need to wait for calm weather before accessing these sampling sites rather than indicating the usual sea states at these sites.

The organic content of sediments in the Milford area was low, with a mean LOI (loss on ignition) value across the 8 analysed samples from 6 sites of 2.4 % ± 0.6 % (Figure 20). Organic content was less than 1 % at the coastal sites, whilst it ranged from 2 % to 5 % at the head of the fiord, where there is greater organic runoff from the Cleddau River and probably some influence from the human activity at the ferry terminals.

Sediments at the sampling sites at and around Milford Sound were dominated by sand-sized particles, with smaller proportions of silt-sized particles (Table 12). The three sites in the protected areas at the head of the fiord also had some clay-sized particles. Clay was not present at the outer sites, where water movement is probably too strong to allow clay to accumulate. Two of the protected sites, Deep Water Basin sites 1 and 2, also had some larger gravel- and small pebble-sized particles. This was particularly apparent at Deep Water Basin site 1. The gravel and pebble at this site have probably been washed down the Cleddau River, which empties into Milford Sound near Deep Water Basin site 1. The particle size distributions in Milford Sound are similar to those that have been measured in Doubtful Sound (Brewin 2003).

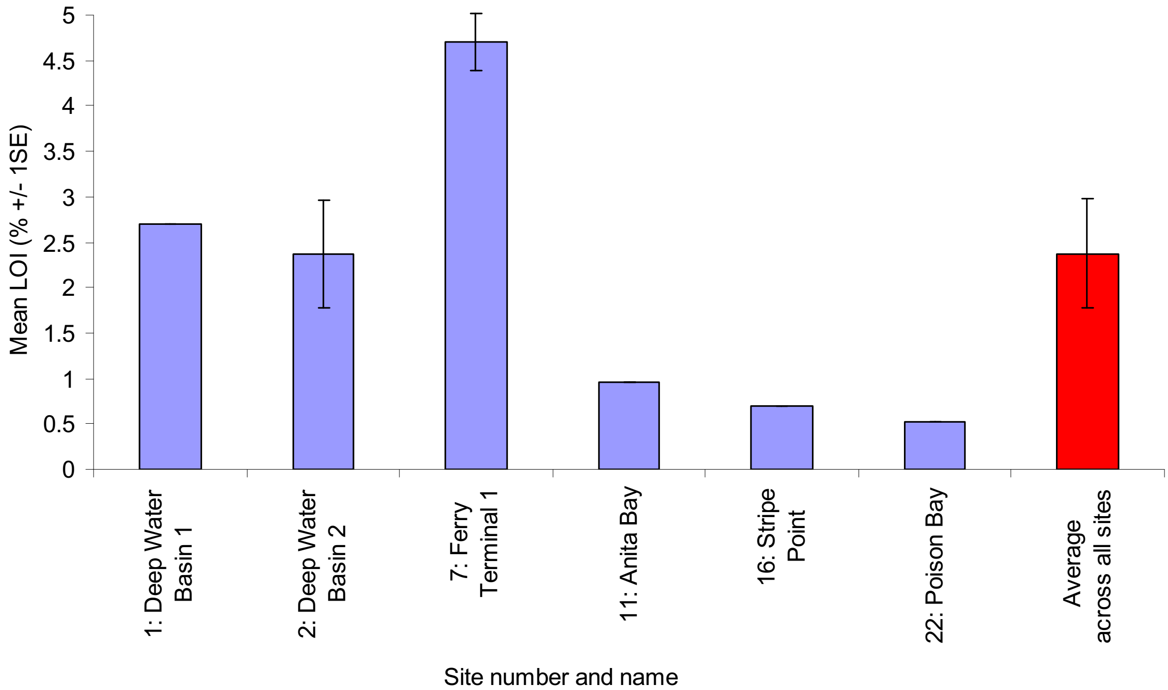


Figure 20: Organic content as determined by loss on ignition analyses of sediments from 6 sites at and around Milford Sound.

Species recorded

A total of 390 species or higher taxa were identified from the initial baseline survey of Milford Sound. This collection consisted of 278 native taxa (Table 13), eight cryptogenic category one taxa (Table 14), ten cryptogenic category two taxa (Table 16), and zooplankton (which were screened for target non-indigenous species but not otherwise identified), with the remaining 93 taxa being indeterminate (Table 17, Figure 21). No species known to be non-indigenous to New Zealand were recorded.

The biota recorded included a diverse array of organisms from 17 phyla, as well as three specimens that couldn't be identified to phylum (Figure 22). For general descriptions of the main groups of organisms (Phyla) encountered during this study refer to Appendix 5, and for detailed species lists collected using each method refer to Appendix 7.

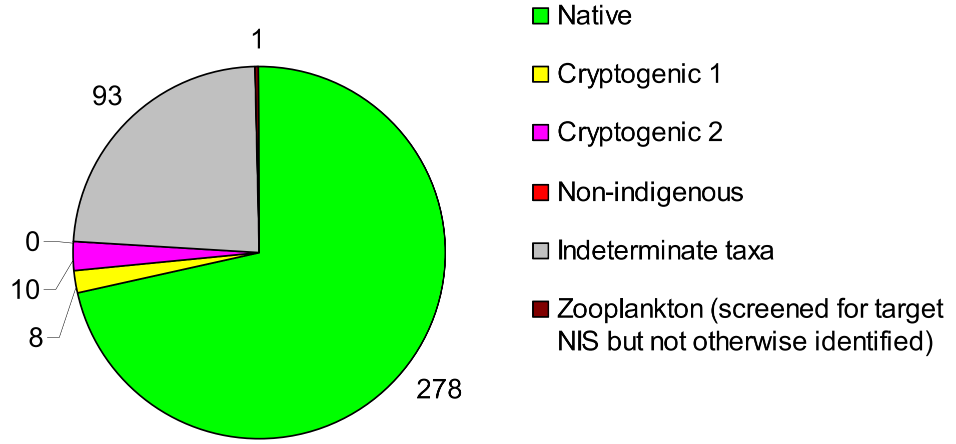


Figure 21: Biosecurity status of marine species collected from the Milford Sound port survey. Values indicate the number of taxa in each biosecurity category. Zooplankton are included separately because they were screened for target NIS but non-target species were not identified.

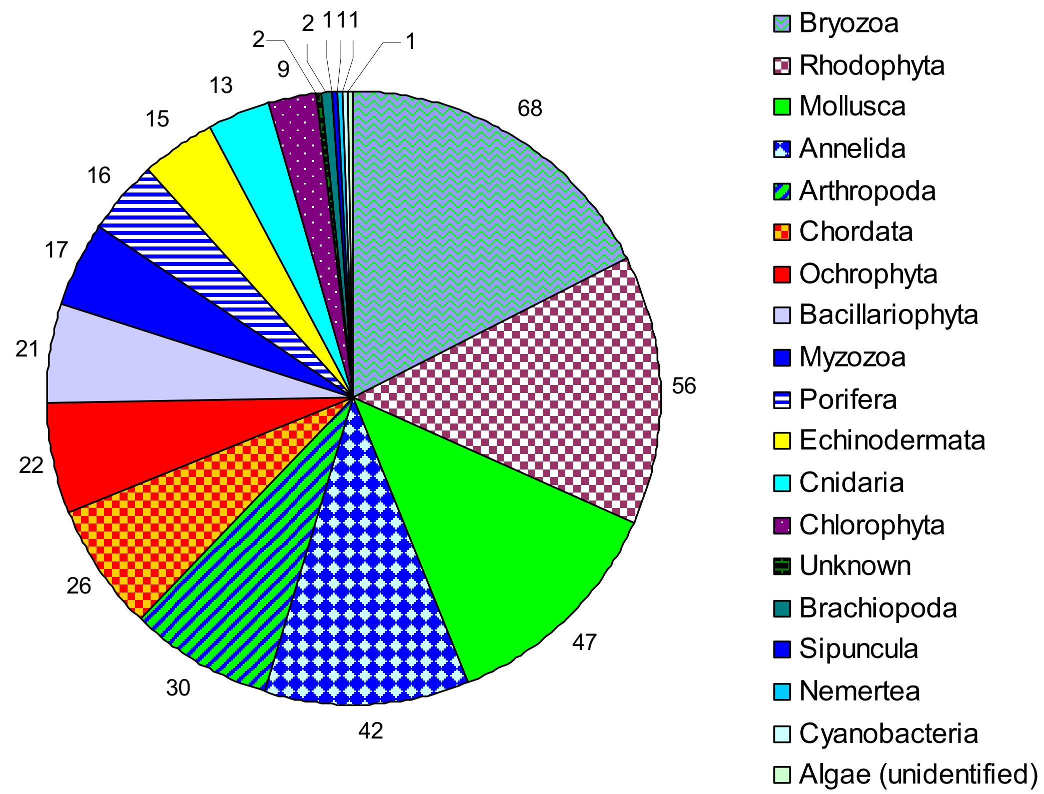


Figure 22: Phyla collected from the Milford Sound port survey. Values indicate the number of taxa in each of the major taxonomic groups.

Native taxa

The 278 native species recorded during the Milford Sound port survey (Table 13) represented 71 % of all species identified from this location and included diverse assemblages of bryozoans (60 taxa), algae (rhodophytes, ochrophytes and chlorophytes; 53 taxa), molluscs (37 taxa), annelids (30 taxa) and crustaceans (23 taxa). A number of other groups were also recorded, including dinoflagellates, diatoms, ascidians, fishes, sponges, cnidarians and echinoderms (Table 13).

Non-indigenous taxa

No species known to be non-indigenous to New Zealand were recorded during the first port baseline survey of Milford Sound.

Cryptogenic category one taxa (C1)

There were eight cryptogenic category one (C1) taxa recorded from the Milford Sound port survey, representing 2.1 % of all species or higher taxa recorded. These organisms included three sponges, two ascidians, one bryozoan, one hydroid and one dinoflagellate (Table 14). A list of Chapman and Carlton's (1994) criteria (see "Baseline survey methods: Definitions of biosecurity statuses", above) that were met by the cryptogenic category one species recorded in this survey is given in Table 10.

One of the taxa included in the C1 category, *Didemnum* sp., encompasses a genus rather than an individual species, due to difficulties in identification of species within this genus. The genus *Didemnum* 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 2004b, 2004a). 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. All *Didemnum* specimens were therefore identified only to genus level. We have reported these species collectively, as a species group (*Didemnum* sp.; Table 14).

None of the C1 taxa are new species records for New Zealand, and all are known from elsewhere in New Zealand. However, the occurrence in Milford Sound represents an extension of the known range within New Zealand for four of these species - the ascidian *Diplosoma velatum*, the hydroid *Orthopyxis integra,* and the sponges *Tethya bergquistae* and *Raspailia agminata* (Table 14; see also "Range extensions", below). Possible means of introduction to New Zealand and their dates of introduction or description are provided in Table 14. Two of the species (the bryozoan *Scruparia ambigua* and the hydroid *Orthopyxis integra*) have been present in New Zealand for almost a century or more but have distributions outside New Zealand that suggest non-native origins, whilst some of the other species have only been recorded in New Zealand in much more recent times (Table 14).

The eight C1 taxa were recorded from a total of only 14 of the 288 samples identified during the Milford Sound survey (Table 15). Seven of the eight C1 taxa only occurred in samples collected from the exposed sites on the coast just outside of Milford Sound, and were collected by the methods of visual dive transects or quadrat scrapings. The other species, the dinoflagellate *Alexandrium tamarense*, was recorded from a cyst sample from the protected sediments of Sandfly Point Jetty. Cysts are unlikely to accumulate in areas of high wave energy.

Available information on the ecology of each C1 species, its global and New Zealand distribution, vectors and potential impacts is provided in Appendix 6. The local distributions as recorded during the port survey are mapped below for each species. These maps are composites of multiple replicate samples. Where overlayed presence and absence symbols occur on the map, this indicates that the species was found in at least one but not all replicates at that precise location.

Scruparia ambigua (d'Orbigny, 1841) occurred in visual dive transects undertaken at Fox Point and Brig Rock (Figure 23).

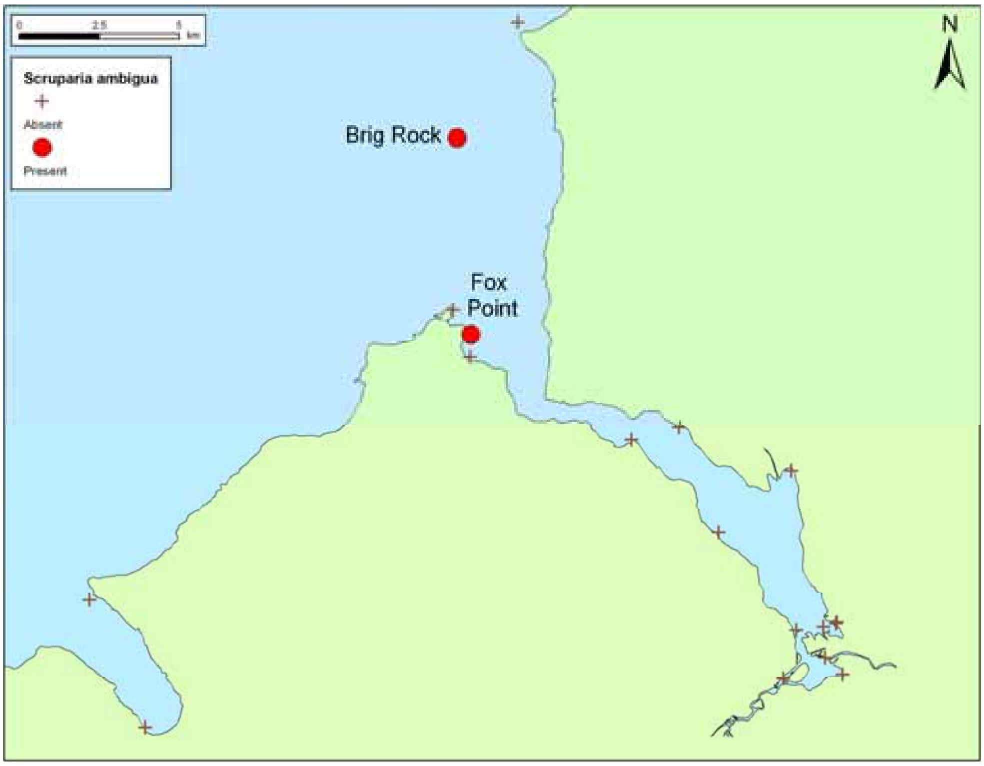


Figure 23: *Scruparia ambigua* distribution in the Milford Sound port survey

Didemnum sp. occurred in visual dive transects undertaken at Anita Bay, Fox Point and Brig Rock (Figure 24).

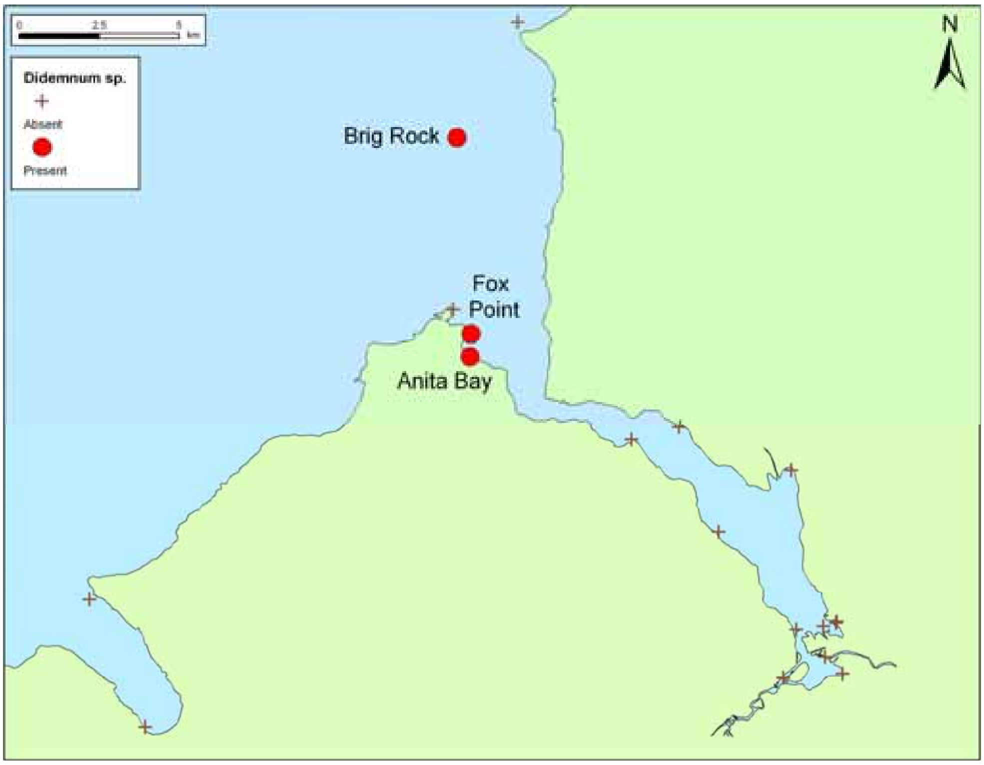


Figure 24: ***Didemnum* sp. distribution in the Milford Sound port survey**

Diplosoma velatum Kott, 2001 occurred in visual dive transects undertaken at Sea Breeze Point (Figure 25).

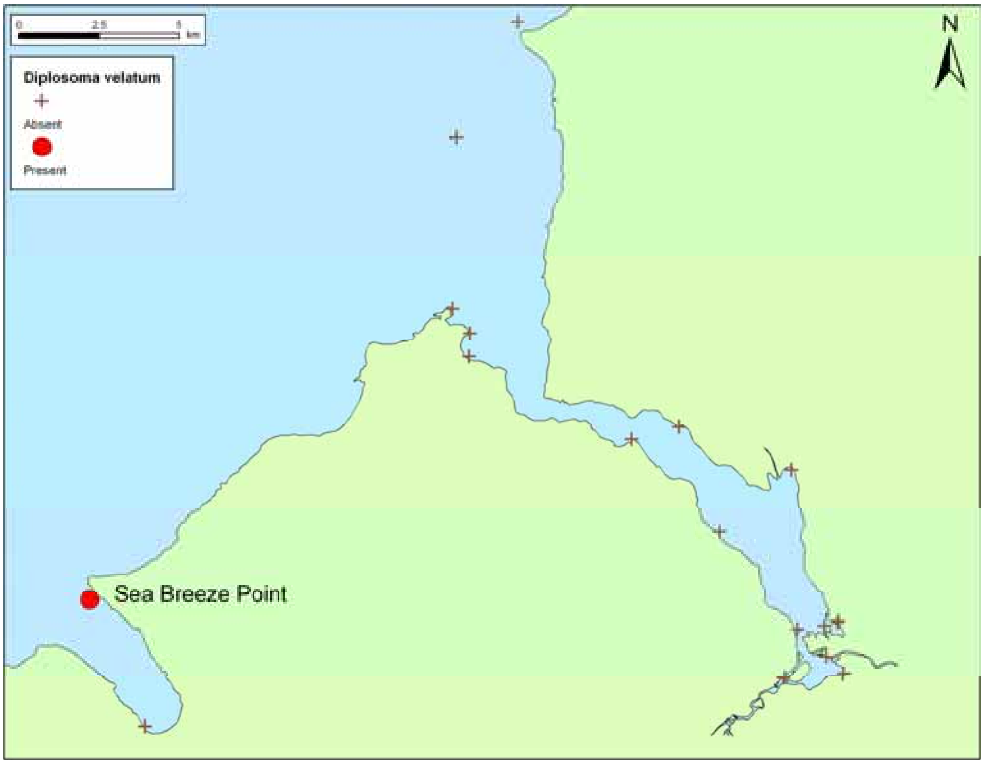


Figure 25: ***Diplosoma velatum* distribution in the Milford Sound port survey**

Orthopyxis integra (MacGillivray, 1842) occurred in pile scrape samples taken at Anita Bay and in visual dive transects undertaken at Fox Point (Figure 26).

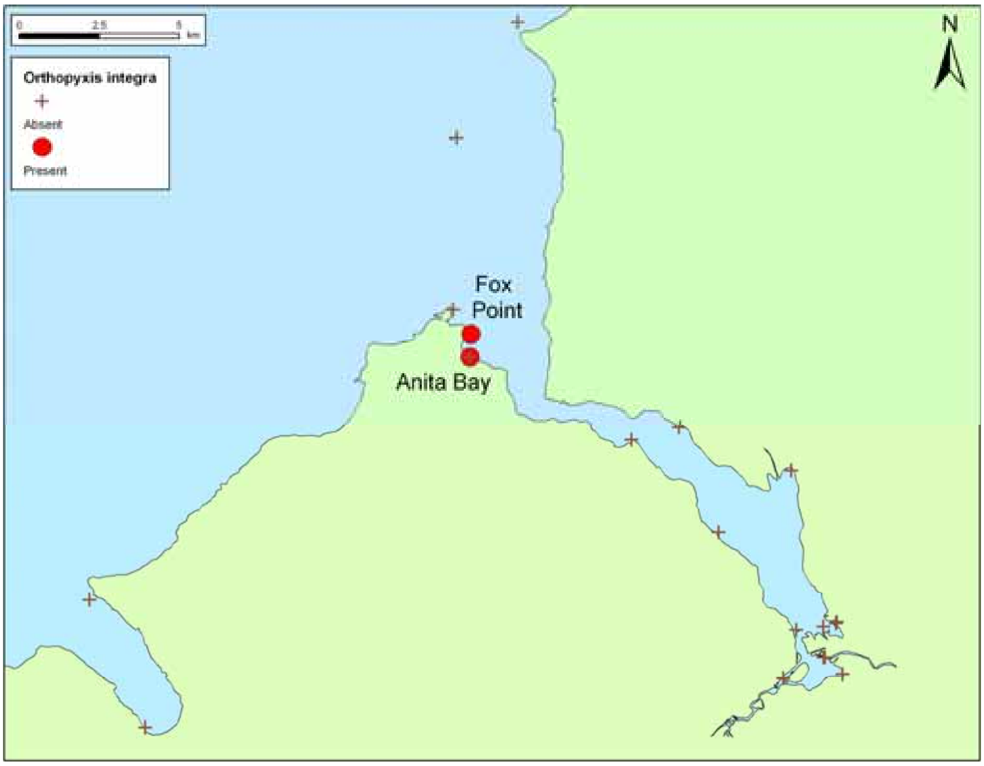


Figure 26: ***Orthopyxis integra*** **distribution in the Milford Sound port survey**

Alexandrium tamarense occurred in a cyst core sample taken from Sandfly Point Jetty (Figure 27).

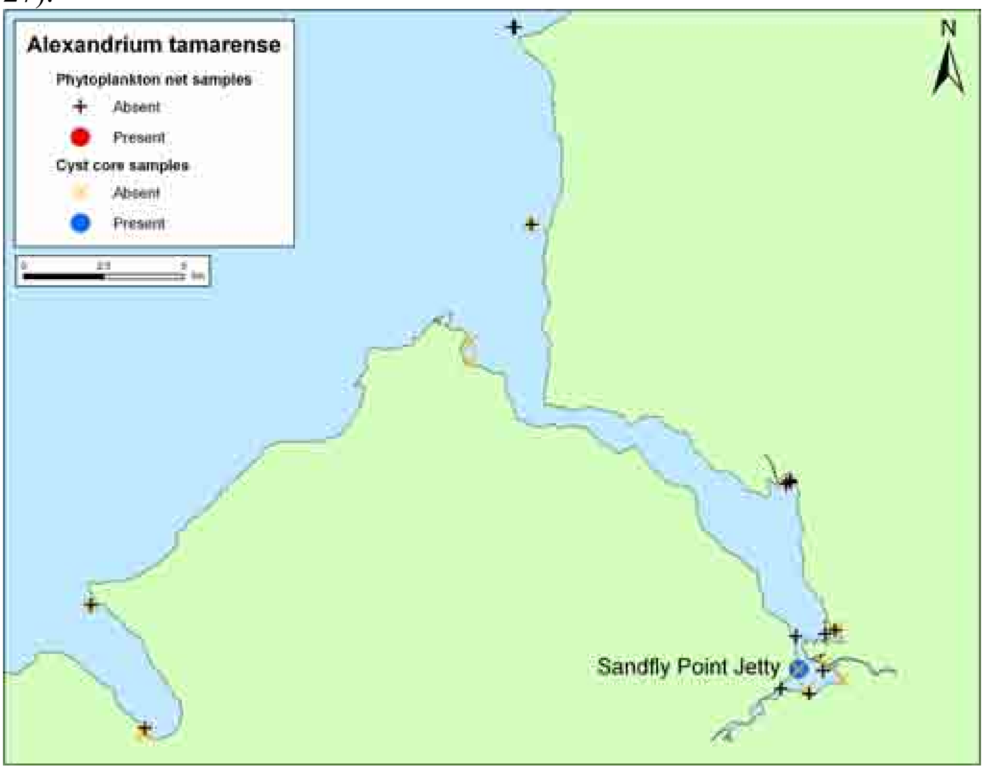


Figure 27: ***Alexandrium tamarense*** **distribution in the Milford Sound port survey**

Leucosolenia cf. *discoveryi* occurred in pile scrape samples taken at Anita Bay and in visual dive transects undertaken at Saint Ann Point and Seabreeze Point (Figure 28).

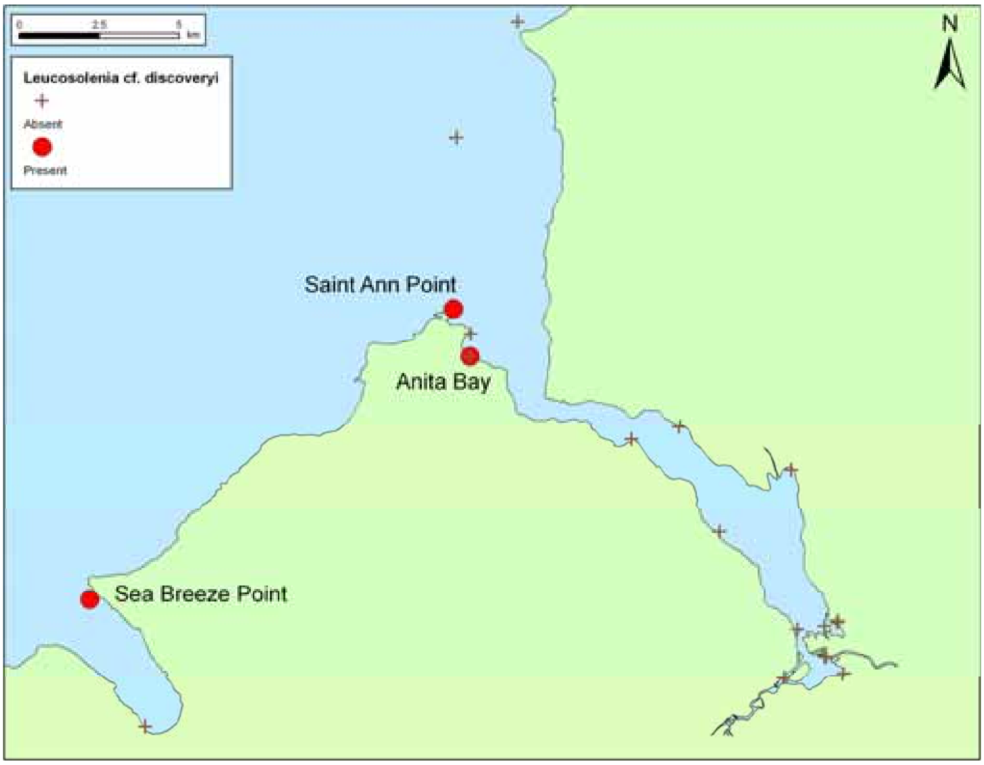


Figure 28: ***Leucosolenia* cf. *discoveryi* distribution in the Milford Sound port survey**

Raspailia agminata Hallman 1914 (sensu Bergquist 1970) occurred in visual dive transects undertaken at Saint Ann Point (Figure 29).

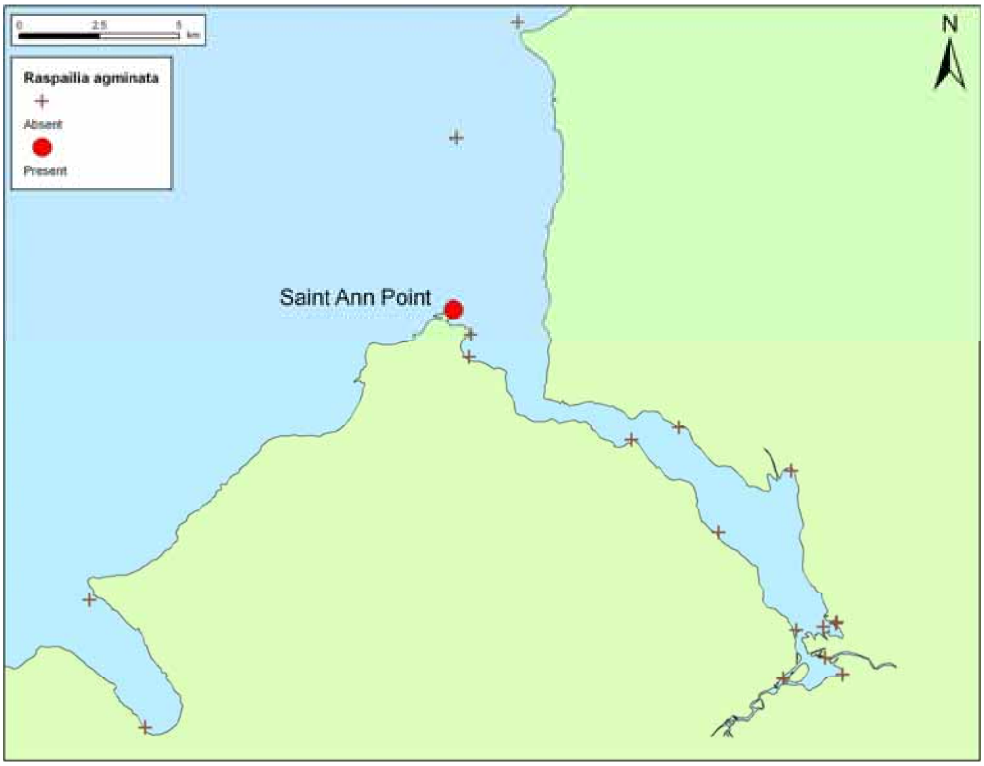


Figure 29: ***Raspailia agminata* distribution in the Milford Sound port survey**

Tethya bergquistae Hooper & Wiedenmayer, 1994 occurred in visual dive transects undertaken at Saint Ann Point (Figure 30).

Figure 30: *Tethya bergquistae* distribution in the Milford Sound port survey

Cryptogenic category two taxa (C2)

Ten cryptogenic category two (C2) taxa were recorded during the Milford Sound port survey (Table 16). These included five polychaetes, an amphipod, two bryozoans and two ascidians. These taxa are recently discovered new species, or might be new species, for which there is insufficient information to determine whether New Zealand lies within their native range. The Milford Sound port survey records represent the first records for some of these taxa (see "Species not previously recorded in New Zealand", below).

Indeterminate taxa

Ninety-three organisms from the Milford Sound port survey were classified as indeterminate taxa. This represents almost 24 % of all determinations made from this survey (Figure 21). Indeterminate taxa from the Milford Sound port survey were mostly algae, diatoms, and molluscs, with several other groups also represented (Table 17).

Zooplankton

No target organisms (the Chinese mitten crab *Eriocheir sinensis* or other members of this genus, the European green crab *Carcinus maenas*, the northern Pacific seastar *Asterias amurensis* and the ascidian *Styela clava*) were identified from any of the zooplankton samples from Milford Sound. Only juvenile calanoid copepods were found in these samples.

Notifiable and unwanted species

None of the species recorded from the Milford Sound port survey are currently listed on the New Zealand Register of Unwanted Organisms (Table 3). However, some species do occur on target species lists used in Australia, as described below.

The Australian Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) has recently endorsed a Trigger List (Table 4) of marine pest species (CCIMPE 2006). Three taxa on this list have been recorded from Milford Sound. Exotic invasive strains of the colonial ascidian *Didemnum* sp. are listed as trigger species still exotic to Australia. *Didemnum* sp. was recorded in the Milford Sound port survey (see “Results: Cryptogenic category one taxa (C1)”, above). The other two species, both diatoms, are listed as “Holoplankton alert species”, which means that their presence should be notified, but an eradication response within Australia is highly unlikely. These diatoms are *Pseudo-nitzschia seriata* (recorded from Milford Sound in 1964 (Wood 1964), now synonymised as *Pseudo-nitzschia australis*; see “Results: Review of marine species records from Milford Sound”, above) and *Chaetoceros convolutus* (recorded from the Milford Sound port survey; see “Results: Cyst- and toxin-producing species”, below). They are both considered native in New Zealand, due to their cosmopolitan oceanic distributions.

Australia has also 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. 2005). A similar watch list for New Zealand is currently being prepared by MAF Biosecurity NZ. None of the 53 Australian priority domestic pests were recorded during the Milford Sound port survey. However, one of these species, the algae *Polysiphonia brodiei*, has previously been recorded from Milford Sound (Nelson et al. 2002, see also "Results: Review of marine species records from Milford Sound", above). It was attributed a “reasonably high” impact potential (in Australia) by Hayes et al. (2005). Three of the 37 priority international pests identified by Hayes et al. (2005) have also been recorded from Milford Sound. These are the same two diatoms as those discussed in the preceding paragraph, on the CCIMPE Trigger List “Holoplankton alert species” (CCIMPE 2006).

Species not previously recorded in New Zealand

Five species recorded from the first port baseline survey of Milford Sound are new records from New Zealand waters, and may be new to science. These are the sponges “*Neofibularia* n. sp. 2 (MK)” and “*Tedania* n. sp. 1 (MK)”, the amphipod *Liljeborgia* sp. 2, and the bryozoans “*Celleporina* sp. MFN”[1] and *Electra* sp. Information given here was provided by the NIWA taxonomists who identified them: Michelle Kelly for the sponges, Graham Fenwick for the amphipods and Dennis Gordon for the bryozoans.

Both sponges are considered native to New Zealand (Table 13), as it is unlikely that they have been transported to the remote location of Milford Sound by human means. The first, “*Neofibularia* n. sp. 2 (MK)”, is a tropical species so it is unusual that it has occurred here. It is possible that the specimen does not actually belong to the genus *Neofibularia*, and further work might determine that it is a new taxon. The second sponge, “*Tedania* n. sp. 1 (MK)”, belongs to a genus whose species are virtually impossible to distinguish.

Both bryozoans and the amphipod are classed as cryptogenic category two (C2; Table 16), as there is insufficient information to determine whether New Zealand lies within their native range. “*Celleporina* sp. MFN” is probably a new, undescribed species, and *Electra* sp. is possibly a new species. Both require further work to resolve their identities. *Liljeborgia* sp. 2 belongs to a genus of extremely cryptic species, and is probably a new species.

[1] MFN = Milford Sound specimens. These specimens are distinguished from specimens with the same species name from other locations, because further taxonomic investigation is required to confirm its identity, including whether the specimens from Milford Sound are the same species as those found in other parts of the country (D. Gordon, NIWA, pers. comm.).

Range extensions

The occurrence of six species in Milford Sound port survey samples were highlighted by taxonomists to represent extensions to the known range of these species in New Zealand. These species are the ascidian *Diplosoma velatum* (C1, previously only known from Doubtful Sound), the hydroid *Orthopyxis integra* (C1; known from several locations from Auckland in the north to Woodpecker Bay on the west coast of the South Island), the sponges *Tethya bergquistae* (C1; previously known from Northland), *Raspailia agminata* (C1; previously known from Doubtful Sound) and *Leucetta* n. sp. 2 (MK) (Native; previously recorded from Kaikoura), and the polychaete *Branchiomma curtum* (Native; known from several locations including Gisborne, Napier, Lyttelton, Timaru and Dunedin).

Cyst- and toxin-producing species

Cysts of 11 dinoflagellate taxa (Phylum Myzozoa) were collected during this survey. Eight of these are considered native species (*Lingulodinium polyedrum, Scrippsiella trochoidea, Protoperidinium americanum, P. avellana, P. conicum, P. latissinum, P. punctulatum* and *P. subinerme*; Table 13), two are indeterminate (*Protoperidinium* sp. and "Peridiniales (?)"; Table 17), and one is a cryptogenic category one (C1) species (*Alexandrium tamarense*; Table 14). Two of them - the C1 species *Alexandrium tamarense* and the native species *Lingulodinium polyedrum* - are known to produce toxins, as described below. Of the organisms identified from the phytoplankton samples (29 different dinoflagellate, diatom and silicoflagellate taxa; Table 13 and Table 17), only one toxin-producing species was identified, the native species *Dinophysis acuminata* (Table 13), also described below. Another native diatom species recorded from the phytoplankton samples, *Chaetoceros convolutus*, is also worth noting. Although no direct toxic effects are known for *Chaetoceros convolutus*, its barbed setae can become lodged in fish gills, causing death (Kraberg and Montagnes 2007).

Alexandrium tamarense is a widely distributed coastal and estuarine planktonic marine dinoflagellate that is associated with toxic Paralytic Shellfish Poisoning blooms (Hay et al. 2000; Faust and Gulledge 2002; New Zealand Food Safety Authority 2003). This species produces very potent PSP neurotoxins which can affect humans, other mammals, fish and birds (Larsen and Moestrup 1989, in Faust and Gulledge 2002). This species is responsible for numerous human illnesses and several deaths after consumption of infected shellfish, including ten deaths in Venezuela in 1977, and one death in Thailand in 1984. Resting cysts of *A. tamarense* can also harbor PSP toxins and may be more than ten times as toxic as their motile stage counterparts. Not all strains of *A. tamarense* are toxic: both toxic and non-toxic strains have been reported in New England within the same red tide event. Strains in Australia, the Gulf of Thailand, and the River Tamar estuary in Britain (the type locality) are all non-toxic. Hay et al. (2000) reported on the specific toxicity of strains of several *Alexandrium* species found in New Zealand, but the toxicity of *Alexandrium tamarense* (from Tasman Bay) was reported as "unknown". The usual route of PSP toxin transmission is via contaminated shellfish; however, bloom events of *A. tamarense* have been linked to several massive fish kills. Kills of Atlantic herring in the Bay of Fundy, Canada, and rainbow trout and salmon in the Faroe Islands, Norway have been attributed to dinoflagellate toxins accumulated in the food chain (Faust and Gulledge 2002).

Lingulodinium polyedrum is a widely distributed species in warm temperate and subtropical coastal waters, and is considered native in New Zealand. It produces a yessotoxin (Armstrong and Kudela 2006; Morton et al. 2007) and can form blooms known as "red tides" which have been associated with fish and shellfish mortality events (Faust and Gulledge 2002). The presence of a paralytic shellfish poison (PSP) toxin, saxitoxin, has also been reported in water samples taken during a bloom of *L. polyedrum* (Bruno 1990, in Faust and Gulledge 2002). However, it is not listed as producing marine biotoxins by either of the recent reviews of the non-commercial marine biotoxin monitoring programme in New Zealand (Hay et al. 2000; New Zealand Food Safety Authority 2003).

Dinophysis acuminata is a toxic bloom-forming marine planktonic dinoflagellate that is associated with Diarrhetic Shellfish Poisoning (DSP) events. The species is distributed widely in temperate waters and has been recorded from most parts of the New Zealand coast (Hay et al. 2000; Faust and Gulledge 2002 and references therein; New Zealand Food Safety Authority 2003). It is most abundant in the coastal northern Atlantic and Pacific, especially in eutrophic areas (Faust and Gulledge 2002 and references therein). Blooms have been reported from many parts of the world, including New Zealand (Faust and Gulledge 2002 and references therein; New Zealand Food Safety Authority 2003). *D. acuminata* can cause shellfish toxicity at very low cell concentrations, but weak or no toxicity has also sometimes been reported in the presence of dense blooms of this species (Faust and Gulledge 2002; Moestrup 2004 and references therein).

Depth stratification trends of NIS and C1 taxa

No NIS taxa were recorded during the Milford Sound port survey. The eight C1 taxa recorded occurred in a total of 14 samples (Table 15). They were collected mostly on visual dive transects, as well as two quadrat scrapings and a cyst core. They were collected from depths between 2.3 m and 35 m, with occurrences spread quite evenly across depths (Table 15). With only 14 records of C1 taxa and no records of NIS from Milford Sound, no clear depth stratification trends in the distribution of C1 and NIS taxa are evident.

Possible vectors for the introduction of NIS and C1 taxa to the port

Almost all of the non-indigenous and cryptogenic category 1 species recorded from Milford Sound during the port survey and review of existing species records are thought to have arrived in New Zealand via international shipping. The exceptions are the planktonic alga *Heterosigma akashiwo*, which may have arrived on ocean currents as well as in ships' ballast water, and the bryozoan *Scruparia ambigua*, which may have arrived naturally by rafting as well as on ships' hulls. All of these NIS and C1 taxa may have reached Milford Sound directly from overseas or through domestic spread (natural and/or anthropogenic) from other New Zealand ports.

The possible vectors for the introduction to New Zealand are indicated in Table 6 and Table 7 for the NIS and C1 species, respectively, from the review of existing species records, and in Table 14 for the C1 species recorded during the port survey. Likely vectors of introduction are largely derived from Cranfield et al. (1998) and expert opinion. They suggest that only one of the 19 species probably arrived in New Zealand via ballast water, 15 species were most likely to be associated with hull fouling, 1 species could have arrived via either of these mechanisms, and two species could have arrived either by natural means or associated with shipping. Several of the NIS and C1 species present in Milford Sound, particularly the algae, were probably introduced to the area through the whaling and sealing operations in the late eighteenth and early nineteenth centuries (Nelson et al. 2002).

COMPARISON BETWEEN DESKTOP REVIEW OF EXISTING RECORDS AND PORT BASELINE SURVEY RECORDS

Of the 458 taxa recorded in the desktop review, only 71 were subsequently recorded during the initial port baseline survey of Milford Sound (66 native (Table 5), four C1 (Table 7) and one indeterminate (Table 9)). Similarly, 225 of the 296 species (76%) that were identified in the port survey were not recorded in the desktop review. The low overlap in the inventories compiled by these different methods is not unusual for surveys of this type (Ruiz and Hewitt 2002). Review of literature and museum records provides a broader spatial and temporal coverage of species from a region than a single field survey can, as such records have been obtained over time from a variety of survey methods and variable search effort. Because of this they do not provide a standardised baseline for comparison to other regions or surveys. All survey methods have inherent biases in the efficiency with which they sample different species. While the CRIMP protocols have been devised to ensure that a standardised methodology is used for baseline port surveys, the methods used do not sample all species efficiently. Thus, the two approaches used provide complementary inventories of the marine biota in Milford Sound.

We did not record any NIS from our port survey samples, despite one non-indigenous alga having previously been recorded from Milford Sound and another five from elsewhere in Fiordland (Nelson 1999; Nelson et al. 2002). It is possible that these species are present in Milford Sound, but were not sufficiently abundant to be detected by the survey, or occurred in habitats within the sound that were not sampled. More detailed surveys targeting these particular organisms would be required to confirm their current abundance and distribution within Milford Sound.

Assessment of the risk of new introductions to Milford Sound

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

There is very little international shipping traffic to Milford Sound (see “Introduction: Port operation, development and maintenance activities”, above). The risk of new introductions from overseas to Milford Sound is therefore very low; many of the NIS previously recorded from Milford Sound were probably introduced through historical whaling and sealing operations (see “Results: Review of marine species records from Milford Sound”, above). Nonetheless, the consequences of a marine invasion in such a relatively valued marine environment could be severe. Therefore, rules for cruise ships and voluntary guidelines for other vessels have been introduced to try to reduce the likelihood of new introductions to Milford Sound (see “Introduction: Port operation, development and maintenance activities”, above). These rules include the prohibition of ballasting and deballasting inside the fiords, and restrictions on hull cleaning procedures. Many of these measures are promoted in other regulatory and non-regulatory instruments including the *Environment Southland Proposed Regional Pest Management Strategy*, the *Code of Practice for Commercial Tourist Vessels Operating within Milford Sound Harbour Limits*, the *Southland Regional Coastal Plan*, the *Biosecurity Act 1993*, the *Fiordland National Park Management Plan* and the draft *Marine Biosecurity Plan for Fiordland* (see “Management of existing NIS and C1 taxa in the port”, below).

Ships arriving in Milford Sound from international waters are almost entirely cruise ships that come predominantly from Hobart, in Tasmania, Australia (Alan Cosgrove, Fiordland Lobster Co. Ltd., pers. comm.). These ships probably present the greatest risk of introducing new non-indigenous species to Milford Sound, both because of the relatively short transit time between Hobart and Milford Sound (approximately two days for a cruise ship) and because of similarities in coastal environments between these locations. Six of the eight marine pests on the New Zealand Register of Unwanted Organisms are already present in southern Australia (*Carcinus maenas*, *Asterias amurensis*, *Undaria pinnatifida*, *Sabella spallanzanii*, *Caulerpa taxifolia*, and *Styela clava*). The native range of the other two species – *Eriocheir sinensis* and *Potamocorbula amurensis* – is the northwestern Pacific, including China and Japan. There appears to be little, if any, shipping traffic between Asia and Milford Sound. Despite the apparent risk presented by the arrival of cruise ships to Milford Sound from Hobart, this risk is reduced by the fact that they are not permitted to deballast whilst in the fiords, and that if intending to reside for more than 24 hours in the fiords, they are advised to have their hulls inspected for *Undaria* and other unwanted organisms before arriving (see "Introduction: Shipping movements and ballast discharge patterns", above).

The introduction of fouling organisms is more likely to occur via slow-moving vessels, such as barges and fishing boats. Very few of these travel between Milford Sound and other ports. The few fishing boats that do operate from Milford Sound travel to other ports, such as Bluff or Dunedin, only once every year or few years for maintenance and survey. Although the ports of Bluff and Dunedin do contain numerous NIS and C1 taxa that have not been recorded in Milford Sound, including the unwanted alga *Undaria pinnatifida* (Inglis et al. 2006b, 2006a), the infrequent travel between these ports reduces the risk of introduction of NIS and C1 taxa to Milford Sound. Furthermore, since these fishing boats visit these other ports for maintenance which may include hull cleaning and the re-application of antifouling paint, these vessels might be presumed to usually be quite free of fouling organisms when they return to Milford Sound. Voluntary guidelines also advise that vessels intending to permanently moor in the fiords must be cleaned and anti-fouled before being transported to the fiords (Ministry for the Environment 2004).

Assessment of translocation risk for NIS and C1 taxa found in the port

Although many of the NIS and C1 taxa recorded in Milford Sound have been recorded in other locations throughout New Zealand (see species information sheets, Appendix 6), they were not detected in all of the other New Zealand ports that have so far been surveyed (Inglis et al. 2007). There is, therefore, a risk that species established in Milford Sound could be spread to other New Zealand locations. However, due to its remote and exposed location, there is very little shipping traffic between Milford Sound and other parts of New Zealand.

The cruise ships that travel between Milford Sound and other areas do not take on ballast water whilst in the fiords, and spend only short periods of time in Milford Sound, reducing the available time for organisms to foul ships' hulls whilst in Milford Sound. Because many of the NIS and C1 in Milford Sound are fouling organisms, the risk of translocating them is highest for slow-moving vessels, such as yachts and barges, and vessels that have long residence times in port. Commercial fishing vessels and some private vessels do spend longer periods in Milford Sound. During this time they could potentially become fouled with NIS or C1 taxa and may subsequently translocate them to other parts of New Zealand.

However, the densities of the NIS and C1 taxa in Milford Sound appear to be very low. As indicated in the "Results" section, none of the NIS previously recorded from Milford Sound were recorded during the port survey, despite sampling suitable habitats. Of the eight C1 taxa recorded during the port survey, none were recorded from more than three specimens, and seven out of eight of the C1 taxa (all except *Alexandrium tamarense*) were only collected from the exposed sites on the coast just outside of Milford Sound (Table 15), where vessels may transit but are unlikely to anchor.

One of the species previously recorded from Fiordland (Doubtful and Dusky Sounds, but not Milford Sound, Nelson et al. 2002), the alga *Polysiphonia brodiei*, is listed as a medium-high priority invasive species in Australia and was given an impact ranking of eighth out of 53 domestic marine priority pests in Australia (Hayes et al. 2005). *Polysiphonia brodiei* occurs as a nuisance fouling species and may also reduce the performance of fouled vessels. The translocation of this species to other parts of New Zealand is therefore undesirable. However, this species has already been recorded from most other parts of the South Island, with the exception of the North West South Island (see *Polysiphonia brodiei* species information sheet, Appendix 6). Some commercial fishing vessels and cruise ships occasionally travel from Fiordland to the North West South Island (see "Introduction: Shipping movements and ballast discharge patterns", above), posing a potential risk of translocation of this species north from Fiordland.

The three taxa listed on the CCIMPE Trigger List (CCIMPE 2006) that have previously been recorded in Milford Sound – *Didemnum* sp., *Pseudo-nitzschia seriata* (= *P. australis*), and *Chaetoceros convolutus*, might also be considered particularly undesirable to translocate to other parts of New Zealand. The latter two species, both diatoms, are most likely to be transported by ballast water. The tight guidelines for no ballast water to be exchanged within the fiords (see "Introduction: Shipping movements and ballast discharge patterns", above) is likely to reduce the chance of translocation of these species. The ascidian, *Didemnum* sp., is likely to be transported on vessels' hulls. Whilst management guidelines encourage the inspection and cleaning of hulls before vessels arrive in the fiords, it may be prudent for them also to be inspected before departing, in order to reduce the risk of translocation of *Didemnum, Polysiphonia brodiei*, and other fouling species out of Milford Sound.

Several other NIS and C1 taxa recorded from Milford Sound or Fiordland have relatively restricted distributions nationwide (see species information sheets, Appendix 6) and could potentially, therefore, be spread from Fiordland to other locations. These include the dinoflagellate *Alexandrium tamarense,* the silicoflagellate *Heterosigma akashiwo*, the algae *Champia affinis, Sargassum verruculosum* and *Polysiphonia constricta,* the ascidian *Diplosoma velatum,* and the sponges *Esperiopsis edwardii, Leucosolenia* cf. *challengeri, Leucosolenia* cf. *discoveryi* and *Raspailia agminata*. Information on the ecology of these species is limited, but only the flagellates are known to have potential for significant impacts, as described in the next section.

Management of existing NIS and C1 taxa in the port

Milford Sound is of high ecological value and is part of a World Heritage Area. The prevention or reduction of impacts from non-indigenous species is therefore a high priority. Biosecurity management in Fiordland is addressed in the strategic *Marine Biosecurity Plan for Fiordland*, which is currently in the final draft phase by MAFBNZ. An associated operational plan will also be developed. The *Marine Biosecurity Plan for Fiordland* ("the Plan") provides a framework to develop interagency operational activites in relation to marine biosecurity, outlines biosecurity measures to reduce the risk of invasive organisms affecting Fiordland's marine environment, and sets out steps to implement these measures. The Plan includes a number of components:

- coordination – to support the cooperative approach to management in Fiordland;
- risk assessment – to identify the organisms, pathways and vectors that pose the greatest risk to Fiordland;
- vector control – to reduce the risk of human mediated vectors introducing invasive marine organisms to Fiordland;
- surveillance – to detect and identify unwanted organisms and other invasive species at an early stage;
- public awareness – to increase awareness of the Plan, the identity and risks of invasive organisms in Fiordland, and the actions to take to prevent introductions;

- performance monitoring – to get an indication of the effectiveness of management measures;
- incursion response – to respond effectively to incursions of invasive marine species; and
- pest management – to manage pests within Fiordland.

The Plan outlines the proposed actions and legislative context relevant to each of these components. Legislation relevant to biosecurity in Fiordland and the *Marine Biosecurity Plan for Fiordland* include the Biosecurity Act 1993, the Resource Management Act 1991, the Fiordland Marine Management Act 2005 and the Local Government Act 1974 and 2002.

The *Marine Biosecurity Plan for Fiordland* lists eight target species that are of particular interest for surveillance activities in Fiordland, due to the high risk that they pose to the Fiordland marine environment and their listing on the register of Unwanted Species under the Biosecurity Act 1993. These are the Mediterranean fanworm *Sabella spallanzanii*, the northern Pacific seastar *Asterias amurensis*, the Asian clam *Potamocorbula amurensis*, the Japanese alga *Undaria pinnatifida*, the European shore crab *Carcinus maenas*, the Chinese mitten crab *Eriocheir sinensis*, the sea squirt *Styela clava* and the green aquarium seaweed *Caulerpa*. None of these eight species were detected during the Milford Sound port survey, nor have they previously been recorded from Fiordland.

The six NIS (all algae) that were recorded during our review of existing marine species records from Milford Sound and nearby areas (Table 6) are considered to present a lesser risk of ecological impact in New Zealand than the eight species listed in the *Marine Biosecurity Plan for Fiordland*. Five of these six species appear to have little ecological impact in New Zealand (see species information sheets in Appendix 6 for potential impacts of each species). The sixth, *Polysiphonia brodiei*, is likely to have a medium to high impact as a nuisance fouling species (see "Assessment of translocation risk for NIS and C1 taxa found in the port", above), and control of this species in Fiordland may be warranted. No records of this species exist from Milford Sound itself, but it was included in the review of biological records due to it having been recorded from elsewhere in Fiordland (Doubtful and Dusky Sounds, Nelson et al. 2002).

Of the thirteen C1 taxa recorded from the port survey or desktop review of existing records, three – the ascidian *Didemnum* sp., the dinoflagellate *Alexandrium tamarense* and the flagellate *Heterosigma akashiwo* – have high or potentially high impacts in New Zealand. The other taxa appear to have lesser or no impacts, or their impacts are unknown but appear to be low (see species information sheets in Appendix 6 for information about the ecology, distribution and potential impacts of each species).

Species in the genus *Didemnum* are common in ports, harbours and on vessel hulls. They are capable of rapid growth under ideal conditions, and are able to shed fragments and recolonize substrata, making them a high risk for smothering natural and man-made substrata. *Didemnum* ascidians have not previously been recorded from Milford Sound. However, removal or control of this species from the exposed sites where it was collected (Brig Rock, Fox Point and Anita Bay; Figure 24) might be extremely difficult due to the challenging weather and sea conditions that prevail in the area.

The dinoflagellate *Alexandrium tamarense* causes paralytic shellfish poisoning, making it a concern for human health. It was only recorded from one cyst sample, from Sandfly Point Jetty near the head of the sound. The flagellate *Heterosigma akashiwo* has been associated with massive fish kills in New Zealand, although none have been reported from Milford

Sound. It was isolated from a Milford Sound sample in 1984 (see Bowers et al. 2006). A variety of physical and chemical treatments have been trialled for killing flagellate cysts in ballast water, but it appears that none of these are suitable to use on sediments in the natural environment (McEnnulty et al. 2000). Eradication of cysts and plankton from the natural environment is likely to be logistically far more difficult and potentially damaging to native taxa.

Due to the logistical and/ or technical difficulties associated with eradication of the potentially high impact NIS and C1 taxa in and near Milford Sound, it is recommended that management activity be directed toward mitigating the spread of these organisms to locations where they do not presently occur. Such management will require more detailed delimitation surveys of their distribution within Milford Sound and Fiordland, and of the location and frequency of movements of potential vectors that might spread them 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 Milford Sound 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 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. A companion project is investigating the risk from fouling assemblages carried on vessels that travel to Fiordland, the Chatham Islands and New Zealand sub-Antarctic Islands. 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. Slow moving barges or vessels that are laid up in ports for long periods before travelling to Milford Sound can carry large densities of non-indigenous marine organisms with them. Cleaning and maintenance of these vessels is suggested to be encouraged by port authorities and shipping companies prior to their departure for New Zealand waters.

Milford Sound is relatively well protected from new marine introductions, through its remote location, high freshwater stratification, relatively low levels of shipping traffic, and regulatory and non-regulatory instruments controlling ballast discharge and hull cleaning in the fiords. In addition to the ballast water and hull fouling controls described earlier in this section and addressed in the *Marine Biosecurity Plan for Fiordland*, Fiordland's protection against marine invasions is strengthened by a Cruise Ship Deed of Agreement and voluntary guidelines for other vessels. These promote "zero discharge" of ballast water within the fiords, advise against in-water hull-cleaning, and recommend that vessels entering the fiords be inspected for fouling organisms (see “Introduction: Shipping movements and ballast discharge patterns” above).

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 port baseline 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 or cruising routes. We recommend that port companies consider undertaking such assessments for their ports when new import or export markets are forecast to develop, or when new cruise itineraries are suggested. The assessment would allow potential problem species to be identified and appropriate management and monitoring requirements to be put in place.

Conclusions and recommendations for monitoring and re-surveying

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

The initial port baseline survey of Milford Sound recorded 390 species or higher taxa. Excluding the 93 indeterminate records and the one collective zooplankton taxon, 225 of these did not occur in our desktop review of existing marine species records from Milford Sound, and may be new records for the area. The initial port baseline survey has highlighted the diversity of the Milford Sound marine assemblage, with results indicating that it has few NIS and C1 taxa, and even fewer that are likely to be of significant impact to the native environment.

Despite the large number of species detected, the large area of habitat available for marine organisms and the logistic difficulties of sampling in fiord environments means 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. 2006c). In generalised pest surveys, such as the port baseline 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; 46 % of native species recorded in the Milford Sound port survey 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, 1992b) and the difficulties that are involved in characterising diversity within hyper-diverse assemblages (Gray 2000; Gotelli and Colwell 2001; Longino et al. 2002).

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

The baseline survey provides a starting point for further investigations of the distribution, abundance and ecology of the species described within Milford Sound and for monitoring the rate of new incursions by NIS over time. 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 or C1 organism discovered 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).

Acknowledgements

We thank Environment Southland and the Department of Conservation for resource consents and concessions to conduct sampling in and around Milford Sound. The Milford Sound Development Authority and tourist operators at Milford Sound provided access to their facilities and assistance during the survey, and John Robson (Red Boat Cruises), Alan Cosgrove (Fiordland Lobster Co.) and Rodger Wilson (Milford Sound Development Authority) provided useful port information. We also thank Fiordland Expeditions for providing the vessel and crew to support our survey.

Glossary

Term	Definition	Terms with the same or similar meaning
Biosecurity	The *Biosecurity Strategy for New Zealand* defines Biosecurity as the exclusion, eradication or effective management of risks posed by pests and diseases to the economy, environment and human health.	
Biosecurity status	A determination of the known or suspected geographic origin of a species or higher taxon. Categories of biosecurity status used in this report are *native, non-indigenous, cryptogenic* (category 1 or category 2), and *indeterminate*.	
Chief Technical Officer†	A person appointed as a Chief Technical Officer under section 101 of the Biosecurity Act 1993	
Cryptogenic species	Species that are neither clearly indigenous nor non-indigenous.	
Endemic	An organism restricted to a specified region or locality.	
Environment†	(a) Ecosystems and their constituent parts, including people and their communities; and (b) All natural and physical resources; and (c) Amenity values; and (d) The aesthetic, cultural, economic, and social conditions that affect or are affected by any matter referred to in paragraphs (a) to (c) of this definition	
Established	A non-indigenous organism that has formed self-sustaining populations within the new area of introduction, but is not necessarily an invasive species.	Naturalised
Generalised pest survey	A survey to identify and inventory the range of non-indigenous species present in an area	Blitz survey
Introduction	Direct or indirect movement by a human agency of an organism across a major geographical barrier to a region or locality that is beyond its natural distribution potential.	Translocation (*usually applied to secondary movement of the organism within a new region*)
Indeterminate taxa	Specimens that could not be identified to species level reliably because they were damaged, incomplete or immature, or because there was insufficient taxonomic or systematic information to allow identification to species level.	*(referred to as "Species indeterminata" in previous NZ port survey reports)*
Harmful organism	Organisms considered harmful to the environment, where "*environment*" has the broad definition described above.	Noxious, Pest
Invasive species	A *non-indigenous species* that has established in a new area and is expanding its range	
Indigenous	An organism occurring within its natural past or	Native

Term	**Definition**	**Terms with the same or similar meaning**
species	present range and dispersal potential (organisms whose dispersal potential is independent of human intervention).	
Non-indigenous species	Any organism (including its seeds, eggs, spores, or other biological material capable of propagating that species) occurring outside its natural past or present range and dispersal potential (organisms whose dispersal is caused by human action).	Adventive Alien, Allochthonous, Exotic, Introduced, Non-native
Pathway	Used interchangeably with *vector*, but can also include the purpose (the reason why a species is moved), and route (the geographic corridor) by which a species is moved from one point to another (Carlton 2001).	Vector
Pest†	(1) A non-indigenous organism that is considered harmful to the environment, where "*environment*" has the broad definition described above. (2) An organism specified as a pest in a pest management strategy that has been approved under Part V of Biosecurity Act 1993.	
Prevalence	The ratio of the number of recorded occurrences of a species relative to the total number of observations.	
Species richness	The number of species present in an area.	
Species composition	The types or identities of species present in a sample, site, or region.	
Species density	The number of species per unit area.	
Targeted pest survey	A survey to determine characteristics of a particular pest population	
Unwanted organism†	Any organism that a *Chief Technical Officer* believes is capable or potentially capable of causing unwanted harm to any natural resources	
Vector	The physical means by which a species is transported	Pathway

†Terms defined by the New Zealand *Biosecurity Act 1993*

Sources for definitions of commonly used biosecurity terms include: Biosecurity Council (2003), Carlton (2001), Cohen and Carlton (1998), Colautii and MacIsaac (2004), Falk-Petersen et al. (2006), Gotelli and Colwell (2001), Gray (2000) and Occhipinti-Ambrogi and Galil (2004).

References

Alvarez, B.; Bergquist, P.; Battershill, C. (2002). Taxonomic revision of the genus *Latrunculia* Du Bocage (Porifera: Demospongiae: Latrunculiidae) in New Zealand. *New Zealand Journal of Marine and Freshwater Research 36(1)*: 151-184.

AMOG Consulting. (2002). Hull fouling as a vector for the translocation of marine organisms. Phase I: Hull fouling research. Ballast Water Research Series, Report No. 14. Department of Agriculture, Fisheries and Forestry Australia, Canberra, 142 p.

Annala, J.H.; Bycroft, B.L. (1993). Movements of rock lobsters (*Jasus edwardsii*) tagged in Fiordland, New Zealand. *New Zealand Journal of Marine and Freshwater Research 27*: 183-190.

Annala, J.H.; McKoy, J.L.; Booth, J.D.; Pike, R.B. (1980). Size at the onset of sexual maturity in female Jasus edwardsii (Decapoda: Palinuridae) in New Zealand. *New Zealand Journal of Marine and Freshwater Research 14(3)*: 217-227.

Armstrong, M.; Kudela, R. (2006). Evaluation of California isolates of *Lingulodinium polyedrum* for the production of yessotoxin. *African Journal of Marine Science 28(2)*: 399-401.

Batham, E.J. (1965). Rocky shore ecology of a southern New Zealand fiord. *Transactions of the Royal Society of New Zealand 6(21)*: 215-227.

Bentley, N.; Breen, P.A.; Starr, P.J. (2004). An examination of the utility of settlement indices for stock assessments of New Zealand red rock lobsters. *No.* 58 p.

Bergquist, P.R.; Fromont, P.J. (1988). The Marine fauna of New Zealand: Porifera, Demospongiae, Part 4 (Poecilosclerida). New Zealand Oceanographic Institute Memoir 96. 197 p.

Biosecurity Council. (2003). Tiakina Aotearoa: Protect New Zealand. The Biosecurity Strategy for New Zealand. Available online at: www.maf.govt.nz/biosecurity-strategy. Biosecurity Council, Wellington. 67 p.

Biosecurity New Zealand (2005). Import health standards for ships' ballast water from all countries. Issued pursuant to Section 22 of the Biosecurity Act 1993. Dated 13 June 2005. Available online <http://www.biosecurity.govt.nz/imports/non-organic/standards/ballastwater.htm>.

Bowers, H.A.; Tomas, C.; Tengs, T.; Kempton, J.W.; Lewitus, A.J.; Oldach, D.W. (2006). Raphidophyceae [Chadefaud ex Silva] systematics and rapid identification: sequence analysis and real-time PCR assays. *Journal of Phycology 42*: 1333-1348.

Boyle, M.; Jillett, J.B.; Mladenov, P. (2001). Intertidal communities in Doubtful Sound, New Zealand: changes over time. *New Zealand Journal of Marine and Freshwater Research 35(4)*: 663-673.

Brager, S.; Schneider, K. (1998). Near-shore distribution and abundance of dolphins along the West Coast of the South Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research 32*: 105-112.

Brewin, P. (2003). Local and fjord-wide patterns of benthic community structure in the deep-basins of Doubtful Sound, Fiordland, New Zealand. PhD. University of Otago, Dunedin. p.

Butcher Partners Ltd (2006). Regional economic impacts of Fiordland National Park. Report prepared for the Department of Conservation. Available at <http://www.doc.govt.nz/templates/MultiPageDocumentTOC.aspx?id=40123>.

Carlton, J. (1985). Transoceanic and interoceanic dispersal of coastal marine organisms: the biology of ballast water. *Oceanography and Marine Biology Annual Reviews 23*: 313-371.

Carlton, J. (1987). Patterns of transoceanic marine biological invasions in the Pacific Ocean. *Bulletin of Marine Science 41*: 452-465.

Carlton, J. (1996). Biological invasions and cryptogenic species. *Ecology 77*: 1653-1655.
Carlton, J.; Geller, J. (1993). Ecological roulette: The global transport of nonindigenous marine organisms. *Science 261(5117)*: 78-82.
Carlton, J.T. (1992). Blue immigrants: the marine biology of maritime history. *The log of Mystic Seaport Museum 44(2)*: 31-36.
Carlton, J.T. (1999). The scale and ecological consequences of biological invasions in the world's oceans. *In*: Sandlund, T.; Schei, P.J.; Viken, A. (eds). Invasive species and biodiversity management, pp. 195-212. Kluwer academic, Dordrecht.
Carlton, J.T. (2001). *Introduced Species in U.S. Coastal Waters: Pew Oceans Commissions Report*. Pew Oceans Commissions: Washington, DC.
CCIMPE (2006). Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) Trigger List. Final agreed list 2006. CCIMPE, Canberra. .
Chapman, J.W.; Carlton, J.T. (1991). A test of criteria for introduced species: the global invasion by the isopod *Synidotea laevidorsalis* (Miers, 1881). *Journal of Crustacean Biology 11*: 386-400.
Chapman, J.W.; Carlton, J.T. (1994). Predicted discoveries of the introduced isopod *Synidotea laevidorsalis* (Miers, 1881). *Journal of Crustacean Biology 14*: 700-714.
Cohen, A.; Carlton, J. (1998). Accelerating invasion rate in a highly invaded estuary. *Science 279*: 555-558.
Cohen, A.N.; Carlton, J.T. (1995). Nonindigenous aquatic species in a United States estuary: a case study of the biological invasions of the San Francisco Bay and delta. Report for the U. S. Fish and Wildlife Service, Washington DC.
Colautti, R.I.; MacIsaac, H.J. (2004). A neutral terminology to define 'invasive' species. . *Diversity and Distributions 10*: 134-141.
Coutts, A.; Moore, K.; Hewitt, C. (2003). Ships' sea chests: an overlooked transfer mechanism for non-indigenous marine species? *Marine Pollution Bulletin 46*: 1504-1515.
Cranfield, H.; Gordon, D.; Willan, R.; Marshall, B.; Battershill, C.; Francis, M.; Nelson, W.; Glasby, C.; Read, G. (1998). Adventive marine species in New Zealand. NIWA technical report No. 34. Hamilton, NIWA.
Cruising Milford Sound Ltd (2007). About Milford Sound. Website <http://www.cruisingms.co.nz/milford-sound.htm>. Accessed 12/01/2007.
Dell, R.K. (1964). A list of Mollusca and Brachiopoda collected by N.Z.O.I. from Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 91-92. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.
Department of Conservation (2007). Fiordland National Park Management Plan. 447pp. Available online <http://www.doc.govt.nz/templates/MultiPageDocumentTOC.aspx?id=44161>. Invercargill, Department of Conservation.
Eade, J.V. (1967). New Zealand recent foraminifera of the families Islandiellidae and Cassidulinidae. *New Zealand Journal of Marine and Freshwater Research 1*: 421-454.
Eldredge, L.; Carlton, J.T. (2002). Hawaiian marine bioinvasions: a preliminary assessment. *Pacific Science 56*: 211-212.
Environment Southland (2001). Deed of Agreement between the New Zealand cruise ship industry and Environment Southland. Dated 26 September 2001. Available online <http://www.es.govt.nz/Departments/Maritime%20Activities/Fiordland%20Passage%20Courses%20and%20Distances/Cruise%20Ship%20Agreement.pdf>. Accessed 28/01/2008.
Environment Southland (2006). Proposed regional pest management strategy. Available online at <http://www.es.govt.nz/Departments/Biosecurity/DraftRPMSReview/documents.aspx>.

Falk-Petersen, J.; Bohn, T.; Sandlund, O.T. (2006). On the numerous concepts in invasion biology. *Biological Invasions 8(6)*: 1409-1424.
Faust, M.A.; Gulledge, R.A. (2002). Identifying harmful marine dinoflagellates. *Smithsonian Contributions from the United States National Herbarium 42*: 1-144. Available online at <http://www.nmnh.si.edu/botany/projects/dinoflag/index.htm>.
Fell, H.B. (1964). A list of Echinodermata collected by N.Z.O.I. from Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 95. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.
Gardner, J.P.A. (2004). A historical perspective of the genus *Mytilus* (Bivalvia: Mollusca) in New Zealand: multivariate morphometric analyses of fossil, midden and contemporary blue mussels. *Biological Journal of the Linnean Society 82*: 329-344.
Gibbs, M.T.; Bowman, M.J.; Dietrich, D.E. (2000). Maintenance of near-surface stratification in Doubtful Sound, a New Zealand fjord. *Estuarine, Coastal and Shelf Science 51*: 683-704.
Gotelli, N.J.; Colwell, R.K. (2001). Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology Letters 4*: 379-391.
Grange, K.; Singleton, R.; Richardson, J.; Hill, P.; Main, W. (1981). Shallow rock-wall biological associations of some southern fiords of New Zealand. *New Zealand Journal of Zoology 8(2)*: 209-227.
Grange, K.R. (1985a). Distribution, standing crop, population structure, and growth rates of black coral in the southern fiords of New Zealand. *New Zealand Journal of Marine and Freshwater Research. 19*: 467-475.
Grange, K.R. (1985b). The intertidal ecology of the soft shores of Freshwater Basin, Milford Sound. Report prepared by the New Zealand Oceanographic Institute for the Department of Lands and Survey, Wellington. 12pp.
Gray, J.S. (2000). The measurement of marine species diversity, with an application to the benthic fauna of the Norwegian continental shelf. *Journal of Experimental Marine Biology and Ecology 250*: 23-49.
Grosholz, E. (2002). Ecological and evolutionary consequences of coastal invasions. *Trends in Ecology & Evolution 17*: 22-27.
Guardians of Fiordlands's Fisheries & Marine Environment Inc. (2003). Fiordland marine conservation strategy. Available online at <http://www.mfe.govt.nz/publications/biodiversity/fiordland-marine-strategy/index.html>. Guardians of Fiordlands's Fisheries & Marine Environment Inc.
Gust, N.; Inglis, G.J.; Peacock, L.; Miller, S.; Floerl, O.; Hayden, B.J.; Fitridge, I.; Johnston, O.; Hurren, H. (2006). Rapid nationwide delimitation surveys for *Styela clava*. NIWA Client Report: CHC2006-24. Prepared for Biosecurity New Zealand Project ZBS2005-32. Christchurch, NIWA. 81 pp.
Hapag-Lloyd. (2008). Hapag-Lloyd Cruises. Website <http://www.hl-cruises.com/redwork/do.php?layoutid=100&node=161156&language=2>. Accessed 29/01/2008.
Hay, B.; Grant, C.; McCoubrey, D. (2000). A review of the marine biotoxin monitoring programme for non-commercially harvested shellfish. Part 1: Technical Report. A report prepared for the NZ Ministry of Health by AquaBio Consultants Ltd. NZ Ministry of Health.
Hayden, B.J.; Inglis, G.J.; Schiel, D.R. (in review). Marine invasions in New Zealand: a history of complex supply-side dynamics. *In*: Rilov, G.; Crooks, J. (eds). Marine Bioinvasions: Ecology, Conservation and Management Perspectives, pp. Springer, Heidelberg.
Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Hayward, B.W.; Grenfell, H.R.; Scott, D.B. (1999). Tidal range of marsh foraminifera for determining former sea-level heights in New Zealand. *New Zealand journal of geology and geophysics 42*: 395-413.

Heiri, O.; Lotter, A.F.; Lemcke, G. (2001). Loss on ignition as a method for estimating organic and carbonate content in sediments: reproducibility and comparability of results. *Journal of Paleolimnology 25*: 101-110.

Hewitt, C.; Campbell, M.; Thresher, R.; Martin, R. (1999). Marine biological invasions of Port Phillip Bay, Victoria. CRIMP Technical Report NO. 20. Hobart, Centre for Research on Introduced Marine Species.

Hewitt, C.; Martin, R. (1996). Port surveys for introduced marine species - background considerations and sampling protocols. CRIMP technical report No 4. Hobart, CSIRO Division of Fisheries.

Hewitt, C.; Martin, R. (2001). Revised protocols for baseline surveys for introduced marine species - survey design, sampling protocols and specimen handling. CRIMP Technical Report No. 22. Hobart, Centre for Research on Introduced Marine Pests.

Hurley, D.E. (1964). Benthic ecology of Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 79-89. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.

Inglis, G.; Kospartov, M.; Fitridge, I.; Gust, N.; Floerl, O.; Fenwick, G.; Hayden, B. (2007). Port baseline surveys for introduced marine species. Summary of results: Research Project ZBS2000/04. Biosecurity New Zealand Technical Paper. Prepared for Biosecurity New Zealand Post-clearance Directorate for Project ZBS2000-04. 97 pp. + Appendices + Supp.

Inglis, G.J. (2003). Invasive aquatic species surveys and monitoring in New Zealand. *In*: Raaymakers, S. (ed.). 1st International Workshop on Guidelines and Standards for Invasive Aquatic Species Surveys and Monitoring, Arraial do Cabo, Brazil, 13-17 April 2003. Workshop Report. GloBallast Monograph Series, I.M.O. London., pp.

Inglis, G.J.; Gust, N.; Fitridge, I.; Fenwick, G.D.; Floerl, O.; Hayden, B.J. (2003). Surveillance design for new exotic marine organisms in New Zealand's ports and other high risk entry points. Final Research Report for Ministry of Fisheries Research Projects ZBS2000/04 Objective 5. NIWA Client Report. Wellington. 47p, National Institute of Water and Atmospheric Research.

Inglis, G.J.; Gust, N.; Fitridge, I.; Floerl, O.; Hayden, B.J.; Fenwick, G.D. (2006a). Dunedin Harbour (Port Otago and Port Chalmers): baseline survey for non-indenous marine species. Biosecurity New Zealand Technical Paper No: 2005/10. Prepared for Biosecurity New Zealand Post-clearance Directorate for Project ZBS2000-04. 67 pp. + Appendices.

Inglis, G.J.; Gust, N.; Fitridge, I.; Floerl, O.; Hayden, B.J.; Fenwick, G.D. (2006b). Port of Bluff: baseline survey for non-indenous marine species. Biosecurity New Zealand Technical Paper No: 2005/09. Prepared for Biosecurity New Zealand Post-clearance Directorate for Project ZBS2000-04. 57 pp. + Appendices.

Inglis, G.J.; Hurren, H.; Oldman, J.; Haskew, R. (2006c). Using habitat suitability index and particle dispersion models for early detection of marine invaders. *Ecological Applications 16*: 1377-1390.

Knox, G.A. (1964). A list of Polychaeta collected by N.Z.O.I. from Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 93-94. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.

Kott, P. (2002). A complex didemnid ascidian from Whangamata, New Zealand. *Journal of Marine Biology Association of the United Kingdom 82*: 625-628.

Kott, P. (2004a). New and little-known species of Didemnidae (Ascidiacea, Tunicata) from Australia (part 2). *Journal of Natural History 38*: 2455-2526.

Kott, P. (2004b). A new species of *Didemnum* (Ascidiacea, Tunicata) from the Atlantic coast of North America. *Zootaxa 732*: 1-10.

Kraberg, A.; Montagnes, D. (2007). The Harmful Phytoplankton Project: The user-friendly guide to harmful phytoplankton in EU waters. Website <http://www.liv.ac.uk/hab/>. Last updated 12/07/2007; accessed 18/11/2007.

Kregting, L.T.; Gibbs, M.T. (2006). Salinity controls the upper depth limit of black corals in Doubtful Sound, New Zealand. *New Zealand Journal of Marine and Freshwater Research 40*: 43-52.

Kustanowich, S. (1964). Foraminifera of Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 49-63. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.

Leppakoski, E.; Gollasch, S.; Gruszka, P.; Ojaveer, H.; Olenin, S.; Panov, V. (2002). The Baltic - a sea of invaders. *Canadian Journal of Fisheries and Aquatic Sciences 59*: 1175-1188.

Longino, J.T.; Coddington, J.; Colwell, R.K. (2002). The ant fauna of a tropical rain forest: estimating species richness three different ways. *Ecology 83*: 689-702.

Lusseau, D. (2005). Residency pattern of bottlenose dolphins *Tursiops* spp. in Milford Sound,New Zealand, is related to boat traffic. *Marine Ecology Progress Series 295*: 265-272.

Lusseau, D.; Slooten, E. (2002). Cetacean sightings off the Fiordland coastline: Analysis of commercial marine mammal viewing data 1996–99. *Science for conservation 187*: 1-42.

Mack, R.; Simberloff, D.; Lonsdale, W.; Evans, H.; Clout, M.; Bazzaz, F. (2000). Biotic invasions: causes, epidemiology, global consequences and control. *Ecological Applications 10(3)*: 689-710.

MacKenzie, A.L.; White, D.; Oshima, Y.; Kapa, J. (1996). The resting cyst and toxicity of *Alexandrium ostenfeldii* (Dinophyceae) in New Zealand. *Phycologia 35(2)*: 148-155.

MacKenzie, D.I.; Royle, J.A.; Brown, J.A.; Nichols, J.D. (2004). Occupancy estimation and modelling for rare and elusive populations. *In*: Thompson, W.R. (ed.). Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters, pp. 149-171. Island Press, Washington.

McEnnulty, F.R.; Bax, N.; Schaffelke, B.; Campbell, M.L. (2000). A review of rapid response options for the control of ABWMAC listed introduced marine pest species and related taxa in Australian waters. *Technical Report No.* 101pp p.

McKnight, D.G. (1968). Features of the benthic ecology of Chalky and Preservation Inlets. *New Zealand Journal of Marine and Freshwater Research 2((4))*: 716-720.

McKoy, J.L. (1980). Distribution of shipworms (Bivalvia: Teredinidae) in the New Zealand region. *New Zealand Journal of Marine and Freshwater Research 14(3)*: 263-275.

McLean, I.; Russ, R. (1991). The Fiordland Crested Penguin survey, stage I: Doubtful to Milford Sounds. *Notornis 38(3)*: 183-190.

Miller, A., W; Mundy, C.N.; Chadderton, W.L. (2004). Ecological and genetic evidence of the vulnerability of shallow-water populations of the stylasterid hydrocoral *Errina novaezelandiae* in New Zealand’s fiords. *Aquatic Conservation: Marine and Freshwater Ecosystems 14*: 75-94.

Miller, K.; Alvarez, B.; Battershill, C.; Northcote, P.; Parthasarathy, H. (2001). Genetic, morphological, and chemical divergence in the sponge genus Latrunculia (Porifera: Demospongiae) from New Zealand. *Marine biology. 139(2)*: 235-250.

Miller, K.J. (1997). Genetic structure of black coral populations in New Zealand's fiords. *Marine Ecology Progress Series 161*: 123-132.

Ministry for the Environment (2004). Implementing the Fiordland Marine Conservaton Strategy: Report of the Fiordland Marine Conservation Strategy Investigative Group.

Available online <http://www.mfe.govt.nz/>. Wellington, Ministry for the Environment.
Mladenov, P.V. (2001). New Zealand fiords: researching, managing, and conserving a unique ecosystem. *New Zealand Journal of Marine and Freshwater Research 35*.
Moestrup, Ø. (ed.) (2004). IOC Taxonomic Reference List of Toxic Algae. Intergovernmental Oceanographic Commission of UNESCO. Available online at <ioc.unesco.org/hab/data.htm>.
Morrisey, D.J.; Howitt, L.; Underwood, A.J.; Stark, J.S. (1992a). Spatial variation in soft-sediment benthos. *Marine Ecology Progress Series 81*: 197-204.
Morrisey, D.J.; Howitt, L.; Underwood, A.J.; Stark, J.S. (1992b). Temporal variation in soft-sediment benthos. *Journal of Experimental Marine Biology and Ecology 164*: 233-245.
Morton, S.; Vershinin, A.; Leighfield, T.; Smith, L.; Quilliam, M. (2007). Identification of yessotoxin in mussels from the Caucasian Black Sea Coast of the Russian Federation. *Toxicon 50*: 581-584.
Nelson, W.A. (1999). A revised checklist of marine algae naturalised in New Zealand. *New Zealand Journal of Botany 37*: 355-359.
Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.
New Zealand Food Safety Authority (2003). Non-Commercial Marine Biotoxin Monitoring in New Zealand Risk-Based Programme Enhancement - Final Report May 2003.
NIWA (2008). South Western Pacific Regional OBIS node. Website <http://obis.niwa.co.nz/index.do> Accessed 18/07/2006.
Occhipinti-Ambrogi, A.; Galil, B.S. (2004). A uniform terminology on bioinvasions: a chimera or an operational tool? *Marine Pollution Bulletin 49*: 688-694.
Parker, I.; Simberloff, D.; Lonsdale, W.; Goodell, K.; Wonham, M.; Kareiva, P.; Williamson, M.; Holle, B.V.; Moyle, P.; Byers, J.; Goldwasser, L. (1999). Impact: Toward a Framework for Understanding the Ecological Effects of Invaders. *Biological Invasions 1*: 3-19.
Paul, L.J. (2005). Indices for groper, *Polyprion* spp., when targeted and as a bycatch in four New Zealand fisheries, 1990-2003. New Zealand fisheries assessment report ; 2005/51. Wellington, Ministry of Fisheries.
Raaymakers, S. (2003). AIS survey network spreads. *Ballast Water News 15*: 5-7.
Ricciardi, A. (2001). Facilitative interactions among aquatic invaders: is an "invasional meltdown" occurring in the Great Lakes? *Canadian Journal of Fisheries and Aquatic Sciences 58*: 2513-2525.
Roberts, C.; Stewart, A.; Paulin, C.; Neale, D. (2005). Regional diversity and biogeography of coastal fishes on the West Coast South Island of New Zealand. *Science for conservation 250*: 1-70.
Ruiz, G.; Fofonoff, P.; Hines, A.; Grosholz, E. (1999). Non-indigenous species as stressors in estuarine and marine communities: assessing invasion impacts and interactions. *Limnology Oceanography 44*: 950-972.
Ruiz, G.M.; Hewitt, C.L. (2002). Toward understanding patterns of coastal marine invasions: a prospectus. *In*: Leppäkoski, E.; Gollasch, S.; Olenin, S. (eds). Invasive aquatic species of Europe: distribution, impacts and management, pp. 529-547. Kluwer, Dordrecht.
Scoop (2006). Leading destination's multi-millino dollar upgrade. News article published 24 February 2006 by Scoop independent news . Available online at <http://www.scoop.co.nz/stories/BU0602/S00342.htm>.
Slooten, E.; Dawson, S.; Rayment, W. (2002). Quantifying abundance of Hector's dolphins between Farewell Spit and Milford Sound. *DOC Science Internal Series 35 No.* 18 p.

Smith, F.; Witman, J.D. (1999). Species diversity in subtidal landscapes: maintenance by physical processes and larval recruitment. *Ecology 80*: 51-69.

Southland Regional Council (2004). Fiordland Passage Courses and Distances. Website <http://www.es.govt.nz/Departments/Maritime%20Activities/Fiordland%20Passage%20Courses%20and%20Distances/default.html>. Date last updated unknown. Accessed 28/01/2008. .

Trueswich, B.; Sim, B.; Busby, P.; Hughes, C. (1996). *Management of marine biotoxins in New Zealand*. *In*: Yasumoto, T.; Oshima, Y.; Fukuyo, Y. (eds). Harmful and toxic algal blooms. Proceedings of the seventh international conference on toxic phytoplankton. Sendai, Japan, 12-16 July 1995, pp. 27-30. Intergovernmental Oceanographic Commission of UNESCO, Paris.

Warwick, R.M. (1996). Marine biodiversity: a selection of papers presented at the conference "Marine Biodiversity: causes and consequences", York, U.K. 30 August - 2 September 1994. *Journal of Experimental Marine Biology and Ecology 202*: IX-X.

Wilcove, D.; Rothstein, D.; Dubow, J.; Phillips, A.; Losos, E. (1998). Quantifying threats to imperiled species in the United States. *Bioscience 48(8)*: 607-615.

Wood, E.J.F. (1964). A note on diatoms occurring in Milford Sound. *In*: Skerman, T.M. (ed.). Studies of a southern fiord, pp. 97. *New Zealand Department of Scientific and Industrial Research Bulletin 157*. Government Printer, Wellington.

Tables

Table 1: **Number of replicate samples taken for each sampling method at each site in the baseline survey of Milford Sound. Exact geographic locations of survey sites are provided in Appendix 2.**

Site #	Site name	Quadrat scraping	Photo stills & video	Large hand core	Anchor Box Dredge	Sediment sample	Cyst core	Zoo-plankton net *	Phyto-plankton net *	Visual dive transect	Crab trap	Shrimp trap	Poison station	Beach seine net	Beach wrack walk	Total*
1	**Deep Water Basin 1**		3	3		1	3	3 (3)	3 (3)	1	6	6				26
2	**Deep Water Basin 2**		3	3		2	3			1						9
3	**Deep Water Basin Jetties**	6	3	6			6	3 (3)	3 (1)		6	6	1	3		40
4	**Deep Water Basin Slipways**		3							1	6	6			1	14
5	**Channel Marker No 2**	2	3					3 (0)	3 (3)	1						9
6	**Sandfly Point Jetty**		3				6	3 (3)	3 (1)	1	6	6				25
7	**Ferry Terminal 1**	6	3	6		2	6			1			1			22
8	**Ferry Terminal 2**	6	3				3	3 (3)	3 (1)	1	6	6				28
9	**Freshwater Basin Mooring**		3					3 (3)	3 (2)	1						7
10	**Harrison Cove**	9	3				3	3 (3)	3 (3)	1	6					25
11	**Anita Bay**	9	3	3		1	4			1						18
12	**Fox Point**		3				3			1						4
13	**Stirling Falls Wall**		3							1						1
14	**Pater Point**	9	3							1						10
15	**Copper Point**	9	3							1						10
16	**Stripe Point**			3		1	3	3 (3)	3 (2)							13
17	**Yates Point**		3					3 (3)	3 (3)	1						7
18	**Brig Rock**		3							1						1
19	**Saint Ann Point**		3							1						1
21	**Sea Breeze Point**		3				3	3 (3)	3 (1)	1						10
22	**Poison Bay**		3		3	1	3	3 (3)	3 (1)	1	6	6	1	3	2	32
Total		56	60	24	3	8	46	33 (30)	33 (21)	19	42	36	3	6	3	312 (288)

* Numbers in parentheses indicate the number of samples actually examined by specialists for phytoplankton and zooplankton. Some phytoplankton and zooplankton samples from the Milford Sound survey were lost after despatch from the field survey site, and therefore were not identified by specialists.

Table 2: Preservatives used for the major taxonomic groups of organisms collected during the port survey.

5 % Formalin solution	10 % Formalin solution	70 % Ethanol solution	80 % Ethanol solution	100 % Ethanol solution	Press instead of preserving
Algae (except *Codium* and *Ulva*)	Ascidiacea (colonial) [1, 2]	Alcyonacea [2]	Ascidiacea (solitary) [1]	Bryozoa	*Ulva* [4]
	Asteroidea	Crustacea (small)			
	Echinoidea	Holothuria [1, 2]			
	Ophiuroidea	Zoantharia [1, 2]			
	Brachiopoda	Porifera [1]			
	Crustacea (large)	Mollusca (with shell)			
	Ctenophora [1]	Mollusca [1, 2] (without shell)			
	Scyphozoa [1, 2]	Platyhelminthes [1, 3]			
	Hydrozoa	*Codium* [4]			
	Actiniaria & Corallimorpharia[1, 2]				
	Scleractinia				
	Nudibranchia [1]				
	Polychaeta				
	Actinopterygii & Elasmobranchii [1]				

[1] photographs were taken before preservation
[2] relaxed in menthol prior to preservation
[3] a formalin fix was carried out before final preservation took place
[4] a sub-sample was retained in silica gel beads for DNA analysis

Table 3: 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*

Table 4: Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) Trigger List (Endorsed by the National Introduced Marine Pest Coordinating Group, 2006).

	Scientific Name/s	**Common Name/s**
Species Still Exotic to Australia		
1 *	*Eriocheir* spp.	Chinese Mitten Crab
2	*Hemigrapsus sanguineus*	Japanese/Asian Shore Crab
3	*Crepidula fornicata*	American Slipper Limpet
4 *	*Mytilopsis sallei*	Black Striped Mussel
5	*Perna viridis*	Asian Green Mussel
6	*Perna perna*	Brown Mussel
7 *	*Corbula* (*Potamocorbula*) *amurensis*	Asian Clam, Brackish-Water Corbula
8 *	*Rapana venosa* (syn *Rapana thomasiana*)	Rapa Whelk
9 *	*Mnemiopsis leidyi*	Comb Jelly
10 *	*Caulerpa taxifolia* (exotic strains only)	Green Macroalga
11	*Didemnum* spp. (exotic invasive strains only)	Colonial Sea Squirt
12 *	*Sargassum muticum*	Asian Seaweed
13	*Neogobius melanostomus* (marine/estuarine incursions only)	Round Goby
14	*Marenzelleria* spp. (invasive species and marine/estuarine incursions only)	Red Gilled Mudworm
15	*Balanus improvisus*	Barnacle
16	*Siganus rivulatus*	Marbled Spinefoot, Rabbit Fish
17	*Mya arenaria*	Soft Shell Clam
18	*Ensis directus*	Jack-Knife Clam
19	*Hemigrapsus takanoi/penicillatus*	Pacific Crab
20	*Charybdis japonica*	Lady Crab
Species Established in Australia, but not Widespread		
21 *	*Asterias amurensis*	Northern Pacific Seastar
22	*Carcinus maenas*	European Green Crab
23	*Varicorbula gibba*	European Clam
24 *	*Musculista senhousia*	Asian Bag Mussel, Asian Date Mussel
25	*Sabella spallanzanii*	European Fan Worm
26 *	*Undaria pinnatifida*	Japanese Seaweed
27 *	*Codium fragile* spp. *tomentosoides*	Green Macroalga
28	*Grateloupia turuturu*	Red Macroalga
29	*Maoricolpus roseus*	New Zealand Screwshell
Holoplankton Alert Species * For notification purposes, eradication response from CCIMPE is highly unlikely		
30 *	*Pfiesteria piscicida*	Toxic Dinoflagellate
31	*Pseudo-nitzschia seriata*	Pennate Diatom
32	*Dinophysis norvegica*	Toxic Dinoflagellate
33	*Alexandrium monilatum*	Toxic Dinoflagellate
34	*Chaetoceros concavicornis*	Centric Diatom
35	*Chaetoceros convolutus*	Centric Diatom

* species on Interim CCIMPE Trigger List

WATCHING BRIEF SPECIES

3. Watching List		
	Species Name	**Common Name**
1	*Styela clava*	Clubbed Tunicate
2	*Euchone limnicola*	Sabellid Polychaete Worm
3	*Theora lubrica*	Asian Semelid Bivalve
4	*Polydora websteri*	Mudworm
5	*Polydora cornuta*	Spionid Polychaete
6	*Boccardia proboscidea*	Spionid Polychaete
7	*Alitta succinea*	Pile Worm
8	*Petrolisthes elongatus*	New Zealand Half Shell Crab
9	*Ciona intestinalis*.	Sea Vase

4. Notification/More Information List (more information required before it could be on CCIMPE Trigger List but CCIMPE may still need to know about it if it arrives and may respond after consideration)		
	Scientific Name/s	**Common Name/s**
1	*Womersleyella setacea*	Red Macroalga
2	*Bonnemaisonia hamifera*	Red Macroalga
3	*Balanus eburneus*	Ivory Barnacle
4	*Hydroides dianthus*	Limy Tubeworm
5	*Tortanus dextrilobatus*	Asian Copepod
6	*Tridentiger barbatus*	Shokihazi Goby
7	*Siganus luridus*	Dusky Spinefoot
8	*Pseudodiaptomus marinus*	Asian Copepod
9	*Acartia tonsa*	Asian Copepod
10	*Rhithropanopeus harrisii*	Harris Mud Crab
11	*Callinectes sapidus*	Blue Crab
12	*Beroe ovata*	Ctenophore
13	*Blackfordia virginica*	Ctenophore
	*Caulerpa racemosa***	Green Macroalga

** *Caulerpa racemosa* was nominated due to concern about an 'invasive strain' in the Mediterranean – question marks exist over whether this strain originates from Australia. Recent evidence suggests that the 'invasive strain' occurs naturally in Australia therefore it is likely that this species will be removed from all lists during the annual review.

Table 5: Native taxa recorded during the desktop review of existing marine species records from Milford Sound and nearby areas. Also indicated is whether the taxon was subsequently recorded from the Milford Sound port baseline survey (this report).

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Annelida							
Polychaeta	Amphinomida	Amphinomidae	*Chloeia inermis*		Knox (1964), Hurley (1964)		
Polychaeta	Eunicida	Dorvilleidae	*Schistomeringos loveni*	*Dorvillea loveni*	Knox (1964), Hurley (1964)		
Polychaeta	Eunicida	Eunicidae	*Eunice australis*		Knox (1964), Hurley (1964)		Yes
Polychaeta	Eunicida	Onuphidae	*Hyalinoecia longibranchiata*	*Hyalinecia tubicola*	Knox (1964), Hurley (1964)		
Polychaeta	Phyllodocida	Aphroditidae	*Aphrodita talpa*		Knox (1964), Hurley (1964)		
Polychaeta	Phyllodocida	Glyceridae	*Glycera lamelliformis*	*Glycera lamellipoda*	Knox (1964), Hurley (1964)		Yes
Polychaeta	Phyllodocida	Goniadidae	*Goniada maorica*		Knox (1964), Hurley (1964)		
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus angustifrons*	*Podarke augustifrons*	Knox (1964), Hurley (1964)		Yes
Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus verrilli*		Knox (1964), Hurley (1964)		
Polychaeta	Phyllodocida	Nereididae	*Nicon aestuariensis*		Grange (1985b)		Yes
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe macrolepidota*		Knox (1964), Hurley (1964)		
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis laevis*	*Leanira laevis*	Knox (1964), Hurley (1964)		
Polychaeta	Scolecida	Orbiniidae	*Haploscoloplos kerguelensis*		Knox (1964), Hurley (1964)		
Polychaeta	Scolecida	Opheliidae	*Armandia maculata*		Knox (1964), Hurley (1964)		Yes
Polychaeta	Scolecida	Orbiniidae	*Orbinia papillosa*		Knox (1964), Hurley (1964)		
Polychaeta	Scolecida	Scalibregmatidae	*Scalibregma inflatum*		Knox (1964), Hurley (1964)		
Polychaeta	Terebellida	Trichobranchidae	*Terebellides narribri*	*Terebellides stroemi*	Knox (1964), Hurley (1964)		
Arthropoda							
Malacostraca	Brachyura	Grapsidae	*Austrohelice crassa*	*Helice crassa*	Grange (1985)		
Malacostraca	Decapoda	Palinuridae	*Jasus edwardsi*		Annala & Bycroft (1993 Bentley (2004)		
Bacillariophyta							
Bacillariophyceae	Bacillariales	Bacillariaceae	*Pseudo-nitzschia australis*	*Nitzschia seriata*	Wood (1964)		
Bacillariophyceae	Naviculales	Diploneidaceae	*Diploneis crabro*		Wood (1964)		
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros danicus*		Wood (1964)		
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros teres*		Wood (1964)		
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros vanheurckii*	*Chaetoceros vanheurcki*	Wood (1964)		
Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus marginatus*		Wood (1964)		
Coscinodiscophyceae	Hemiaulales	Bellerocheaceae	*Helicotheca tamesis*	*Streptotheca thamesis*	Wood (1964)		

Phylum & Class	**Order**	**Family**	**Taxon name**	**Name as given in literature record[1]**	**Reference**	**Locations recorded if not from Milford Sound itself**	**Recorded in port survey?**
Coscinodiscophyceae	Leptocylindrales	Leptocylindraceae	*Leptocylindrus danicus*		Wood (1964)		
Coscinodiscophyceae	Thalassiosirales	Skeletonemaceae	*Detonula pumila*	*Schroederella delicatula*	Wood (1964)		
Fragilariophyceae	Fragilariales	Fragilariaceae	*Asterionellopsis glacialis*	*Asterionella japonica*	Wood (1964)		
Fragilariophyceae	Striatellales	Striatellaceae	*Striatella interrupta*		Wood (1964)		
Fragilariophyceae	Thalassionemales	Thalassionemataceae	*Thalassiothrix nitzschioides*		Wood (1964)		
Brachiopoda							
Articulata	Rhynchonellida	Hemithyrididae	*Tegulorhynchia nigricans*		Dell (1964)		
Bryozoa							
Gymnolaemata	Cheilostomata	Calloporidae	*Retevirgula acuta*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Beaniidae	*Beania discodermiae*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Bugulidae	*Dimetopia barbata*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Bugulidae	*Dimetopia cornuta*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Calloporidae	*Amphiblestrum blandum*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Calloporidae	*Corbulella corbula*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Calloporidae	*Crassimarginatella fossa*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Calloporidae	*Ellisina sericea*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Bitectiporidae	*Schizosmittina conjuncta*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Calloporidae	*Odontionella cyclops*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Schizomavella aotearoa*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Calloporidae	*Valdemunitella fraudatrix*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Menipea vectifera*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Catenicellidae	*Catenicella elegans*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Cornuticella taurina*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Costaticella bicuspis*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Catenicellidae	*Orthoscuticella innominata*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Pterocella scutella*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Calloporidae	*Leptinatella gordoni*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Beaniidae	*Beania magellanica*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Aeteidae	*Aetea australis*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Buffonellodidae	*Buffonellodes rhomboidalis*	*Xenogma rhomboidalis*	NIWA (2008)		
Gymnolaemata	Cheilostomata	Arachnopusiidae	*Arachnopusia unicornis*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Beaniidae	*Beania plurispinosa*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Beaniidae	*Beania quadricornuta*		NIWA (2008)		

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Gymnolaemata	Cheilostomata	Beaniidae	*Beania stonycha*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora mucronifera*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora rostrata*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Parkermavella incurvata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Bitectiporidae	*Parkermavella punctigera*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Aeteidae	*Aetea truncata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporellidae	*Microporella discors*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Celleporidae	*Celleporina costazii*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina thyreophora*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Microporellidae	*Microporella speculum*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporidae	*Micropora elegans*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporidae	*Micropora mortenseni*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporidae	*Opaeophora lepida*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Microporidae	*Opaeophora monopia*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Smittinidae	*Smittina rosacea*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Smittinidae	*Smittoidea maunganuiensis*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Petraliellidae	*Mucropetraliella ligulata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Escharinidae	*Chiastosella umbonata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Caberea boryi*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Caberea darwinii*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Candidae	*Caberea helicina*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Candidae	*Caberea rostrata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Caberea solida*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Candidae	*Canda filifera*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Emma triangula*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Candidae	*Scrupocellaria ornithorhyncus*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Phidoloporidae	*Stephanollona scintillans*	*Stephanollona longispinata*	NIWA (2008)		
Gymnolaemata	Cheilostomata	Romancheinidae	*Exochella conjuncta*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Celleporidae	*Celleporina sinuata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Celleporidae	*Galeopsis polyporus*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Chaperiidae	*Chaperiopsis cervicornis*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Chaperiidae	*Chaperiopsis lanceola*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Chorizoporidae	*Chorizopora brongniartii*		NIWA (2008)		

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Gymnolaemata	Cheilostomata	Crepidacanthidae	*Crepidacantha crinispina*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Crepidacanthidae	*Crepidacantha kirkpatricki*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Cribrilinidae	*Figularia huttoni*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Escharellidae	*Escharella spinosissima*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporellidae	*Microporella agonistes*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Exochellidae	*Escharoides aff. excavata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina specca*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Exochellidae	*Exochella jullieni*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Flustridae	*Gregarinidra serrata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Hippopodinidae	*Cosciniopsis vallata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Hippopodinidae	*Hippomenella vellicata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella bathamae*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella delta*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Hippothoidae	*Hippothoa flagellum*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Lacernidae	*Phonicosia circinata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Eurystomellidae	*Eurystomella biperforata*	*Eurystomella biperforata n. sp.*	NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Tricellaria aculeata*		NIWA (2008)		Yes
Gymnolaemata	Cheilostomata	Celleporidae	*Celleporina hemiperistomata*		NIWA (2008)		
Gymnolaemata	Cheilostomata	Steginoporellidae	*Steginoporella magnifica*		NIWA (2008)		Yes
Gymnolaemata	Ctenostomata	Penetrantiidae	*Penetrantia irregularis*		NIWA (2008)		
Stenolaemata	Cyclostomata	Diastoporidae	*Plagioecia sarniensis*		NIWA (2008)		Yes
Stenolaemata	Cyclostomata	Phidoloporidae	*Phidolopora avicularis*		NIWA (2008)		Yes
Stenolaemata	Cyclostomata	Margarettidae	*Margaretta barbata*		NIWA (2008)		Yes
Stenolaemata	Cyclostomata	Theonoidae	*Telopora lobata*		NIWA (2008)		Yes
Stenolaemata	Cyclostomata	Crisiidae	*Bicrisia edwardsiana*		NIWA (2008)		Yes
Stenolaemata	Cyclostomata	Lichenoporidae	*Disporella novaehollandiae*		NIWA (2008)		
Stenolaemata	Cyclostomata	Lichenoporidae	*Disporella pristis*		NIWA (2008)		Yes
Chlorophyta							
Ulvophyceae	Bryopsidales	Codiaceae	*Codium gracile*		Nelson et al. (2002)		Yes
Ulvophyceae	Caulerpales	Caulerpaceae	*Caulerpa brownii*		Nelson et al. (2002)		Yes
Ulvophyceae	Cladophorales	Witrockiellaceae	*Wittrockiella lyallii*		Nelson et al. (2002)		
Chordata							
Actinopterygii	Anguilliformes	Congridae	*Conger verreauxi*		Roberts et al. (2005)		

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Actinopterygii	Beryciformes	Trachichthyidae	*Paratrachichthys trailli*		Roberts et al. (2005)		
Actinopterygii	Gadiformes	Moridae	*Lotella rhacina*		Roberts et al. (2005)		Yes
Actinopterygii	Gadiformes	Moridae	*Pseudophycis barbata*		Roberts et al. (2005)		
Actinopterygii	Gadiformes	Phycidae	*Gaidropsarus novaezelandiae*		Roberts et al. (2005)		
Actinopterygii	Gobiesociformes	Gobiesocidae	*Modicus minimus*		Roberts et al. (2005)		
Actinopterygii	Gobiesociformes	Gobiesocidae	*Modicus tangaroa*		Roberts et al. (2005)		
Actinopterygii	Mugiliformes	Mugilidae	*Parapercis colias*		McKnight (1968)	Preservation Inlet	
Actinopterygii	Ophidiiformes	Bythitidae	*Fiordichthys slartibartfasti*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Aplodactylidae	*Aplodactylus arctidens*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Bovichthyidae	*Bovichtus variegatus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Cheilodactylidae	*Nemadactylus macropterus*		NIWA (2008), Roberts et al. (2005)		
Actinopterygii	Perciformes	Cheilodactylidae	*Nemadactylus macropterus*	*Cheilodactylus macropterus*	Mladenov (2001)		
Actinopterygii	Perciformes	Gempylidae	*Thyrsites atun*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Gobiidae	*Gobiopsis atrata*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Kyphosidae	*Scorpis lineolata*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*	*Pseudolabrus celidotus*	Grange (1985)		Yes
Actinopterygii	Perciformes	Labridae	*Notolabrus cinctus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Labridae	*Notolabrus fucicola*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Labridae	*Pseudolabrus miles*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Latrididae	*Latridopsis ciliaris*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Latrididae	*Latris lineata*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Latrididae	*Mendosoma lineatum*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Mugilidae	*Aldrichetta forsteri*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Pinguipedidae	*Parapercis colias*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus fuscus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus littoreus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus marilynae*		Roberts et al. (2005)		Yes
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus matti*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus rua*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Polyprionidae	*Polyprion oxygeneios*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Serranidae	*Caesioperca lepidoptera*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Serranidae	*Hypoplectrodes huntii*		Roberts et al. (2005)		

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Actinopterygii	Perciformes	Tripterygiidae	*Bellapiscis lesleyae*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Bellapiscis medius*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Cryptichthys jojettae*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion flavonigrum*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion lapillum*		Roberts et al. (2005)		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion malcolmi*		Roberts et al. (2005)		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion varium*		Roberts et al. (2005)		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Grahamina capito*	*Tripterygion capito*	Grange (1985)		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Karalepis stewarti*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Notoclinops caerulepunctus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Notoclinops segmentatus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Notoclinus fenestratus*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Obliquichthys maryannae*		Roberts et al. (2005)		
Actinopterygii	Perciformes	Tripterygiidae	*Ruanoho whero*		Roberts et al. (2005)		Yes
Actinopterygii	Pleuronectiformes	Pleuronectidae	*Rhombosolea plebeia*		Grange (1985)		
Actinopterygii	Scorpaeniformes	Scorpaenidae	*Helicolenus percoides*		Roberts et al. (2005)		Yes
Actinopterygii	Scorpaeniformes	Scorpaenidae	*Scorpaena papillosa*		Roberts et al. (2005)		Yes
Actinopterygii	Syngnathiformes	Syngnathidae	*Lissocampus filum*		Roberts et al. (2005)		
Elasmobranchii	Squaliformes	Squalidae	*Squalus acanthias*		Roberts et al. (2005)		
Myxini	Myxiniformes	Myxinidae	*Eptatretus cirrahtus*		Roberts et al. (2005)		
Cnidaria							
Anthozoa	Antipatharia	Myriopathidae	*Antipathella fiordensis*	*Antipathes fiordensis*	Grange (1985)		
Anthozoa	Antipatharia	Myriopathidae	*Antipathella fiordensis*	*Antipathes aperta*	Miller (1997)		
Hydrozoa	Filifera	Stylasteridae	*Errina novaezelandiae*		Miller et al. (2004)	Te Awaatu Marine Reserve (Doubtful Sound)	
Hydrozoa	Hydroida	Sertulariidae	*Sertularia marginata*		Grange (1985)	Doubtful Sound	
Echinodermata							
Asteroidea	Paxillosida	Astropectinidae	*Psilaster acuminatus*		McKnight (1968)	Preservation & Chalky Inlets	
Echinoidea	Echinoida	Echinometridae	*Evechinus chloroticus*		Fell (1964)		Yes
Echinoidea	Spatangoida	Loveniidae	*Echinocardium cordatum*		Fell (1964)		
Echinoidea	Spatangoida	Brissidae	*Brissopsis oldhami*		McKnight (1968)	Preservation & Chalky Inlets	
Ophiuroidea	Ophiurida	Amphiuridae	*Amphiura norae*		Fell (1964)		

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Ophiuroidea	Ophiurida	Ophiacanthidae	*Ophiacantha imago*		McKnight (1968)	Preservation & Chalky Inlets	
Ophiuroidea	Ophiurida	Ophiuridae	*Ophiuroglypha irrorata*		McKnight (1968)	Preservation & Chalky Inlets	
Magnoliophyta							
Liliopsida	Cyperales	Cyperaceae	*Isolepis cernua*	*Scirpus cornuus*	Grange (1985)		
Magnoliopsida	Campanulales	Goodeniaceae	*Selliera radicans*		Grange (1985)		
Mollusca							
Bivalvia	Arcoida	Arcidae	*Barbatia novaezelandiae*		Dell (1964), Hurley (1964)		
Bivalvia	Arcoida	Arcidae	*Bathyarca cybaea*		Dell (1964), Hurley (1964)		
Bivalvia	Arcoida	Philobryidae	*Cosa costata*		Dell (1964), Hurley (1964)		
Bivalvia	Myoida	Teredinidae	*Bankia neztalia*		McKoy (1980)		
Bivalvia	Mytiloida	Mytilidae	*Aulacomya maoriana*		Dell (1964), Hurley (1964)		Yes
Bivalvia	Mytiloida	Mytilidae	*Modiolus aerolatus*		Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Malletiidae	*Neilo australis*		Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Nuculanidae	*Saccella maxwelli*	*Nuculana bellula*	Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Nuculanidae	*Poroleda lanceolata*		Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Nuculidae	*Linucula gallinacea*		Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Nuculidae	*Nucula hartvigiana*		Dell (1964), Hurley (1964)		
Bivalvia	Nuculoida	Nuculidae	*Nucula (Ennucula) strangei*		Dell (1964), Hurley (1964)		
Bivalvia	Pholadomyoida	Thraciidae	*Parvithracia suteri*		Dell (1964), Hurley (1964)		
Bivalvia	Pholadomyoida	Myochamidae	*Myadora antipoda*		Dell (1964), Hurley (1964)		
Bivalvia	Pholadomyoida	Verticordiidae	*Haliris (Setaliris) setosa*		Dell (1964), Hurley (1964)		
Bivalvia	Pholadomyoida	Cuspidariidae	*Pseudoneaera wellmani*	*Austroneaera wellmani*	Dell (1964), Hurley (1964)		
Bivalvia	Pholadomyoida	Cuspidariidae	*Cuspidaria fairchildi*		Dell (1964), Hurley (1964)		
Bivalvia	Pterioida	Limidae	*Escalima regularis*		Dell (1964), Hurley (1964)		
Bivalvia	Pterioida	Limidae	*Limatula maoria*		Dell (1964), Hurley (1964)		
Bivalvia	Pterioida	Pectinidae	*Talochlamys zelandiae*	*Chlamys suprasilis crepusculi*	Dell (1964), Hurley (1964)		
Bivalvia	Solemyoida	Solemyidae	*Solemya parkinsoni*		Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Sportellidae	*Anisodonta (Tahunanuia) alata alata*	*Tahunauia alata*	Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Cardiidae	*Pratulum pulchellum*	*Nemocardium pulchellum*	Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Carditidae	*Cardita aoteana*		Dell (1964), Hurley (1964)		

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Bivalvia	Veneroida	Lasaeidae	*Borniola reniformis*	*Rochefortula reniformis*	Dell (1964), Hurley (1964)		Yes
Bivalvia	Veneroida	Lucinidae	*Divaricella huttoniana*		Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Mesodesmatidae	*Paphies australis*		Dell (1964), Hurley (1964)		Yes
Bivalvia	Veneroida	Tellinidae	*Serratina charlottae*	*Tellinella charlottae*	Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Tellinidae	*Moerella huttoni*	*Moerella huttoni huttoni*	Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Thyasiridae	*Maorithyas marama*		Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Thyasiridae	*Thyasira peregrina*	*Thyasira peroniana peregrina*	Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Veneridae	*Austrovenus stutchburyi*	*Chione stutchburyi*	Grange (1985)		Yes
Bivalvia	Veneroida	Semelidae	*Leptomya retiaria*		Dell (1964), Hurley (1964)		
Bivalvia	Veneroida	Lucinidae	*Lucinoma galathea*		Dell (1964), Hurley (1964)		
Gastropoda	Basommatophora	Siphonariidae	*Siphonaria australis*	*Siphonaria zelandica*	Dell (1964), Hurley (1964)		Yes
Gastropoda	Caenogastropoda	Turritellidae	*Zeacolpus (Stiracolpus) delli*		Dell (1964), Hurley (1964)		
Gastropoda	Cocculiniformia	Lepetellidae	*Tecticrater cervae*		Dell (1964), Hurley (1964)		
Gastropoda	Docoglossa	Lottiidae	*Notoacmea parviconoidea*		Dell (1964), Hurley (1964)		
Gastropoda	Docoglossa	Lepetidae	*Maoricrater explorata*		Dell (1964), Hurley (1964)		
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella novaezealandiae*		Dell (1964), Hurley (1964)		
Gastropoda	Neogastropoda	Buccinulidae	*Cominella (Eucominia) mirabilis powelli*	*Fax mirabilis powelli*	Dell (1964), Hurley (1964)		
Gastropoda	Neogastropoda	Volutomitridae	*Microvoluta marginata*	*Microvoluta biconica*	Dell (1964), Hurley (1964)		
Gastropoda	Neotaenioglossa	Calyptraeidae	*Sigapatella tenuis*	*Zegalurus tenuis*	Dell (1964), Hurley (1964)		
Gastropoda	Neotaenioglossa	Hydrobiidae	*Potamopyrgus estuarinus*		Grange (1985)		
Gastropoda	Neotaenioglossa	Naticidae	*Uberella denticulifera*		Dell (1964), Hurley (1964)		
Gastropoda	Neotaenioglossa	Naticidae	*Uberella vitrea*		Dell (1964), Hurley (1964)		
Gastropoda	Neotaenioglossa	Naticidae	*Pisinna sp.*	*Estea sp.*	Grange (1985)		
Gastropoda	Pulmonata	Amphibolidae	*Amphibola crenata*		Grange (1985)		
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus artizona*	*Micrelenchus micans*	Dell (1964), Hurley (1964)		
Gastropoda	Vetigastropoda	Fissurellidae	*Emarginula striatula*		Dell (1964), Hurley (1964)		
Scaphopoda	Dentaliida	Dentaliidae	*Antalis nana*	*Dentalium nanum*	Dell (1964), Hurley (1964)		
Scaphopoda	Dentaliida	Dentaliidae	*Antalis suteri*	*Dentalium suteri*	Dell (1964), Hurley (1964)		
Scaphopoda	Dentaliida	Dentaliidae	*Fissidentalium zelandicum*		Dell (1964), Hurley (1964)		
Scaphopoda	Gadilida	Gadilidae	*Cadulus delicatulus*		Dell (1964), Hurley (1964)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Myzozoa							
Dinophyceae	Dinophysiales	Dinophysiaceae	*Dinophysis acuta*		F.H. Chang, NIWA, pers. comm.		
Dinophyceae	Dinophysiales	Dinophysiaceae	*Dinophysis acuminata*		Trueswich (1996), F. H. Chang, NIWA, pers. comm.		Yes
Dinophyceae	Dinophysiales	Dinophysiaceae	*Dinophysis fortii*	*Dinophysis forti*	Wood (1964)		
Dinophyceae	Peridiniales	Peridiniaceae	*Peridinium divergens*		Wood (1964)		
Dinophyceae	Peridiniales	Ceratiaceae	*Ceratium buceros*		Wood (1964)		
Dinophyceae	Peridiniales	Ceratiaceae	*Ceratium lineatum*		Wood (1964)		
Dinophyceae	Peridiniales	Gonyaulacaceae	*Lingulodinium polyedrum*	*Goniaulax polyedra*	Wood (1964)		Yes
Dinophyceae	Peridiniales	Gonyaulacaceae	*Gonyaulax polygramma*	*Goniaulax polygramma*	Wood (1964)		
Ochrophyta							
Phaeophyceae	Ectocarpales	Scytothamnaceae	*Scytothamnus australis*		Nelson et al. (2002)		
Phaeophyceae	Ectocarpales	Acinetosporaceae	*Pilayella littoralis*		Nelson et al. (2002) Grange (1985)		
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum flexuosum*		Nelson et al. (2002)		Yes
Phaeophyceae	Fucales	Seirococcaceae	*Marginariella urvilliana*		Nelson et al. (2002)		
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum maschalocarpum*		Nelson et al. (2002)		
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora distenta*		Nelson et al. (2002)		
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora retroflexa*		Nelson et al. (2002)	Dusky Sound and Chalky/ Preservation Inlet	
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora scalaris*		Nelson et al. (2002)	Dusky Sound and Chalky/ Preservation Inlet	
Phaeophyceae	Fucales	Hormosiraceae	*Hormosira banksii*		Nelson et al. (2002)		
Phaeophyceae	Laminariales	Alariaceae	*Ecklonia brevipes*		Nelson et al. (2002)	Bligh Sound south to Preservation Inlet	
Phaeophyceae	Laminariales	Alariaceae	*Ecklonia radiata*		Nelson et al. (2002)		Yes
Phaeophyceae	Laminariales	Lessoniaceae	*Macrocystis pyrifera*		Nelson et al. (2002)	Caswell Sound, Doubtful Sound, Dusky Sound, Chalky Inlet and Preservation Inlet	

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Phaeophyceae	Scytothamnales	Scytothamnaceae	*Scytothamnus fasciculatus*		Nelson et al. (2002)		
Porifera							
Demospongiae	Dictyoceratida	Thorectidae	*Thorecta reticulata*		M. Kelly NIWA (Unpublished record)	Doubtful Sound	Yes
Demospongiae	Poecilosclerida	Chondropsidae	*Strongylacidon conulosa*		Bergquist & Fromont (1988)		Yes
Demospongiae	Poecilosclerida	Latrunculiidae	*Latrunculia fiordensis*		Alvarez et al. (2002)		Yes
Demospongiae	Poecilosclerida	Latruncullidae	*Latrunculia millerae*		Alvarez et al. (2002)		
Protozoa							
Granuloreticulosea	Foraminiferida	Elphidiidae	*Elphidium charlottense*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Cassidulina carinata*		Eade (1967)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Cassidulina islandica*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Evolvocassidulina orientalis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Fursenkoinidae	*Fursenkoina rotundata*	*Virgulina rotundata*	Kustanowich (1964), Eade (1967)		
Granuloreticulosea	Foraminiferida	Fursenkoinidae	*Fursenkoina spinosa*	*Fursenkoina spinosa*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cibicididae	*Cibicides dispars*	*Cibicides marlboroughensis*	Kustanowich (1964), Hayward et al. (1999)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Elphidium novozealandicum*	*Elphidium novo-zealandicum*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Haynesina depressula*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Notorotalia inornata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Notorotalia zelandica*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Epistominidae	*Hoglundina elegans*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Eponididae	*Eponides umbonatus*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Chilostomellidae	*Chilostomella ovoidea*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Buliminidae	*Globobulimina turgida*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Buliminidae	*Bulimina marginata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina bulloides*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Ellipsolagenidae	*Oolina emaciata*	*Dentalina emaciata*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina inflata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina pachyderma*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Ellipsolagenidae	*Fissurina marginata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Bolivinidae	*Brizalina malovensis*	*Bolivina malovensis*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Heterolepidae	*Anomalinoides sphericus*	*Anomalinoides spherica*	Kustanowich (1964)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Granuloreticulosea	Foraminiferida	Bolivinidae	*Bolivina cacozela*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Bolivinidae	*Bolivina pseudoplicata*	*Bolivina pseudo-plicata*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Bolivinidae	*Brizalina pygmaea*	*Bolivina pygmaea*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Bolivinidae	*Bolivina seminuda*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Buliminidae	*Bulimina denudata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina quinqueloba*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerinella aequilateralis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerinoides ruber*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Orbulina universa*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Hormosinidae	*Reophax scorpiurus*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Textularia ensis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Nonion subturgidum*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Nonionoides turgida*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Pullenia bulloides*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Pullenia quinqueloba*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Spiroloculinidae	*Spiroloculina elevata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Placentulinidae	*Patellinella inconspicua*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Sphaeroidinidae	*Sphaeroidina bulloides*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Spirillinidae	*Patellina corrugata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globorotaliidae	*Globorotalia truncatulinoides*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Textularia conica*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lagena striata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Spiroplectinella proxispira*	*Textularia proxispira*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Trochamminidae	*Trochammina squamata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Uvigerinidae	*Trifarina angulosa*		Kustanowich (1964), Hayward et al. (1999)		
Granuloreticulosea	Foraminiferida	Loxostomatidae	*Loxostomum karrerianum*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Siphotextularia fretensis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lenticulina rotulatus*	*Robulus* cf. *rotulatus*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Hormosinidae	*Reophax subfusiformis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Miliolinella vigilax*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Quinqueloculina delicatula*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Quinqueloculina kapitiensis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Quinqueloculina lamarckiana*		Kustanowich (1964)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Granuloreticulosea	Foraminiferida	Miliolidae	*Quinqueloculina suborbicularis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Quinquinella hornibrooki*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nodosariidae	*Laevidentalina subsoluta*	*Dentalina subsoluta*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lenticulina gibba*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Nonionellina flemingi*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Marginulina glabra*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nonionidae	*Astrononion novozealandicum*	*Astrononion novo-zealandicum*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lenticulina limbosa*	*Lenticulina limbosus*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lenticulina orbicularis*	*Lenticulina orbicularis*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lenticulina suborbicularis*	*Lenticulina suborbicularis*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Saracenaria latifrons*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Vaginulinopsis reniformis*	*Astacolus reniformis*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Vaginulinopsis tasmanica*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lagena costata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Lagena laevis*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Vaginulinidae	*Neolenticulina peregrina*	*Lenticulina peregrina*	Kustanowich (1964)		
Rhodophyta							
Florideophyceae	Gelidiales	Gelidiaceae	*Pterocladiella capillacea*		Nelson et al. (2002)		
Florideophyceae	Gracilariales	Gracilariceae	*Gracilaria chilensis*		Nelson et al. (2002)		Yes
Florideophyceae	Gracilariales	Gracilariaceae	*Gracilaria secundata*		Grange (1985)		
Florideophyceae	Hildenbrandiales	Hildenbrandiaceae	*Apophlaea lyallii*		Nelson et al. (2002)		Yes
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium cirrhosum*		Nelson et al. (2002)		Yes

[1] If the taxon name given in the cited literature record has since been synonymised, this column contains the name as it was given in the literature record. The column to the left ("Taxon name") contains the current valid name.

Table 6: Non-indigenous species recorded during the desktop review of existing marine species records from Milford Sound and nearby areas. Also indicated are the probable means of introduction to New Zealand (H = Hull fouling, B = Ballast water transport), the date of introduction or detection (d) in New Zealand, and whether the taxon was subsequently recorded in the Milford Sound port baseline survey (this report).

Phylum & Class	Order	Family	Taxon name	Reference	Locations recorded if not from Milford Sound itself	Probable means of introduction to New Zealand	Date of introduction, or detection (d)	Recorded in port survey?
Ochrophyta								
Phaeophyceae	Fucales	Sargassaceae	*Sargassum verruculosum*	Nelson et al. (2002)	Doubtful, Thompson, Dusky, Bligh & Breaksea Sounds. Preservation and Chalky Inlets	H	1900's	
Rhodophyta								
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia brodiei*	Nelson et al. (2002)	Dusky Sound	H	Pre-1940	
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia constricta*	Nelson (1999)	Doubtful Sound	H	? Pre-1999	
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sertularioides*	Nelson et al. (2002)	Doubtful Sound	H	Pre-1938	
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia* aff. *subtilissima*	Nelson et al. (2002)	Breaksea Sound	H	Pre-1974	
Florideophyceae	Rhodymeniales	Champiaceae	*Champia affinis*	Nelson et al. (2002)	Preservation Inlet	H	Pre-1855	

Table 7: **Cryptogenic category one (C1) taxa recorded during the desktop review of existing marine species records from Milford Sound and nearby areas. Also indicated are the probable means of introduction to New Zealand (H = Hull fouling, B = Ballast water transport), the date of introduction or detection (d) in New Zealand, and whether the taxon was subsequently recorded in the Milford Sound port baseline survey (this report).**

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Probable means of introduction to NZ	Date of introduction, or detection (d)	Recorded in port survey?
Bryozoa									
Gymnolaemata	Cheilostomata	Scrupariidae	*Scruparia ambigua*		NIWA (2008)		H or by rafting	1911 d *	
Chordata									
Ascidiacea	Enterogona	Didemnidae	*Diplosoma velatum*		M. Page, NIWA, Unpublished record	Doubtful Sound	H	2006 d	Yes
Myzozoa									
Dinophyceae	Peridiniales	Gonyaulacaceae	*Alexandrium ostenfeldii*		MacKenzie et. al (1996)	Doubtful Sound & Jackson Bay	B or on ocean currents	1992 d	
Ochrophyta									
Raphidophyceae	Chattonellales	Chattonellaceae	*Heterosigma akashiwo*		Bowers et al. (2006)		B or on ocean currents	1989 d	
Porifera									
Demospongiae	Poecilosclerida	Esperiopsidae	*Esperiopsis edwardii*	*Amphilectus edwardii*	M. Kelly, NIWA, Unpublished record	Doubtful Sound	H	1924 d	Yes
Demospongiae	Poecilosclerida	Raspailiidae	*Raspailia agminata*		M. Kelly, NIWA, Unpublished record	Doubtful Sound	H	1961 d *	Yes
Demospongiae	Poecilosclerida	Crellidae	*Crella incrustans*		M. Kelly, NIWA, Unpublished record	Doubtful Sound	H	1924 d *	
Demospongiae	Haplosclerida	Chalinidae	*Haliclona* cf. *clathrata*		M. Kelly, NIWA, Unpublished record	Doubtful Sound	H	1923 d*	
Calcarea	Leucosolenida	Leucosoleniidae	*Leucosolenia* cf. *challengeri*		M. Kelly, NIWA, Unpublished record	Doubtful Sound	H or B	2006 d *	
Calcarea	Leucosolenida	Leucosoleniidae	*Leucosolenia* cf. *discoveryi* ^		M. Kelly, NIWA, Unpublished record	Doubtful Sound	H	Feb 2003 d *	Yes

Notes:

[1] If the taxon name given in the cited literature record has since been synonymised, this column contains the name as it was given in the literature record. The column to the left ("Taxon name") contains the current valid name.

* This is the first published record for the species in New Zealand. The actual date of collection of the specimen was probably 5-10 years prior to publication.

^ The biosecurity status of *Leucosolenia* cf. *discoveryi* was reported as NIS in earlier New Zealand port survey reports. It has since been revised to C1, following expert advice on uncertainty in the identity of the species: "After extensive search, this is the closest species to our southern New Zealand species. There are some minor differences that indicate it might rather be a New Zealand endemic that is very similar to *L. discoveryi*. There is only minor overlap with Antarctica species in the southern NZ fauna (Dunedin, Bluff, Milford)" (M. Kelly, NIWA, pers. comm.).

Table 8: Cryptogenic category two (C2) taxa recorded during the desktop review of existing marine species records from Milford Sound and nearby areas. Also indicated is whether the taxon was subsequently recorded in the Milford Sound port baseline survey (this report).

Phylum & Class	Order	Family	Taxon name	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Annelida						
Polychaeta	Phyllodocida	Pilargidae	*Ancistrosyllis* sp.	Knox (1964), Hurley (1964)		
Bryozoa						
Gymnolaemata	Cheilostomata	Cellariidae	*Euginoma gracillima* n. sp.	NIWA (2008)		
Chordata						
Actinopterygii	Perciformes	Clinidae	*Acanthoclinus* ?n.sp.	Roberts et al. (2005)		
Actinopterygii	Perciformes	Eleotridae	*Thalasseleotris* n.sp.	Roberts et al. (2005)		
Porifera						
Demospongiae	Halichondrida	Halichondriidae	*Halichondria* cf. *rugosa*	(M. Kelly, NIWA, Unpublished record)	Doubtful Sound	
Demospongiae	Hadromerida	Polymastiidae	*Polymastia* cf. *massalis*	(M. Kelly, NIWA, Unpublished record)	Doubtful Sound	

Table 9: Indeterminate taxa recorded during the desktop review of existing marine species records from Milford Sound and nearby areas. Also indicated is whether the taxon was subsequently recorded in the Milford Sound port baseline survey (this report).

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Annelida							
Polychaeta	Eunicida	Onuphidae	*Onuphis* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Eunicida	Lumbrineridae	*Ninoe* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Phyllodocida	Phyllodocidae	*Phyllodocid* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Phyllodocida	Nereididae	*Platynereis* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Phyllodocida	Nereididae	*Perinereis* sp.		Grange (1985b)		
Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus* sp.	*Aglaophamus maoriana*	Hurley (1964), Knox (1964)		
Polychaeta	Phyllodocida	Glyceridae	*Glycera* sp.	*Glycera americana*	Hurley (1964), Knox (1964)		
Polychaeta	Phyllodocida	Acoetidae	*Eupanthalis* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Sabellida	Oweniidae	*Myriochele* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Scolecida	Maldanidae	*Maldanid* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Scolecida	Maldanidae	*Euclymene* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Scolecida	Capitellidae	*Notomastus* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Spionida	Spionidae	*Pygospio* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Spionida	Spionidae	*Prionospio* sp.	*Prionospio malmgreni*	Hurley (1964), Knox (1964)		
Polychaeta	Spionida	Spionidae	*Spionid* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Spionida	Spionidae	*Polydora* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Ampharetidae	*Melinna* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Cirratulidae	*Cirratulus* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Terebellidae	*Nicolea* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Terebellidae	*Lysilla* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Pectinariidae	*Pectinaria* sp.		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Terebellidae	Terebellid		Hurley (1964), Knox (1964)		
Polychaeta	Terebellida	Flabelligeridae	*Brada* sp.		Hurley (1964), Knox (1964)		
Arthropoda							
Malacostraca	Amphipoda		Amphipods		Boyle et al. (2001)	Doubtful Sound	
Malacostraca	Amphipoda		Unidentified sp. 1		Grange (1985)		
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus* sp.		Grange (1985)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Bacillariophyta							
Bacillariophyceae	Naviculales	Naviculaceae	*Navicula* sp.		Wood (1964)		
Bacillariophyceae	Thalassiophysales	Catenulaceae	*Amphora* sp. prob. *javanica*		Wood (1964)		
Bryozoa							
Gymnolaemata	Cheilostomata	Phidoloporidae	*Rhynchozoon* sp.	*Rhynchozoon larreyi*	NIWA (2008)		
Gymnolaemata	Cheilostomata	Candidae	*Caberea* sp.		NIWA (2008)		
Gymnolaemata	Ctenostomata	Alcyonidiidae	*Alcyonidium* cf. mytili		NIWA (2008)		
Stenolaemata	Cyclostomata	Tubuliporidae	*Idmidronea* sp.		NIWA (2008)		
Stenolaemata	Cyclostomata	Tubuliporidae	*Idmidronea* sp. 2 [gracile]		NIWA (2008)		
Chlorophyta							
Bryopsidophyceae	Bryopsidales	Codiaceae	*Codium convolutum*		Nelson et al. (2002)		
Bryopsidophyceae	Bryopsidales	Codiaceae	*Codium dichotomum*		Nelson et al. (2002)	Chalky Inlet, Dusky Sound	
Bryopsidophyceae	Bryopsidales	Codiaceae	*Codium dimorphum*		Nelson et al. (2002)		
Bryopsidophyceae	Bryopsidales	Codiaceae	*Codium fragile*		Nelson et al. (2002)	Dusky Sound, Chalky/ Preservation Inlet.	
Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha* sp.		Grange (1985), Nelson et al. (2002)		
Ulvophyceae	Ulvales	Ulvaceae	*Ulva* sp.		Grange (1985), Nelson et al. (2002)		Yes
Chordata							
Actinopterygii	Perciformes	Nototheniidae	*Notothenia* sp (?)		Roberts et al. (2005)		
Actinopterygii	Perciformes	Serranidae	*Poyprion* spp.		Paul (2005)		
Actinopterygii	Scorpaeniformes	Sebastidae	*Helicolenus* spp.		NIWA (2008)		
Cnidaria							
Anthozoa	Antipatharia	Antipathidae	Antipathidae				
Echinodermata							
Echinoidea	Temnopleuroida	Temnopleuridae	*Pseudechinus* sp.		Fell (1964)		
Mollusca							
Bivalvia	Pterioida	Pectinidae	*Chlamys* sp.		Dell (1964), Hurley (1964)		
Nemertea							
?			Unidentified sp. 1		Grange (1985)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Porifera							
Demospongiae	Hadromerida	Latrunculiidae	*Latrunculia* spp.		Miller et al. (2001)	Doubtful Sound	
Protozoa							
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina* sp. A.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Gavellinellidae	*Gyroidina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Bathysiphonidae	*Rhabdammina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina* sp. B.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Notorotalia* cf. *clathrata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Elphidiononion* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Elphidiidae	*Elphidium* aff. *advenum*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Rosalinidae	*Rosalina* sp.		Kustanowich (1964), Hayward et al. (1999)		
Granuloreticulosea	Foraminiferida	Haplophragmoididae	*Cribrostomoides* cf. *crassimargo*	*Alveolophragmium cf. crassimargo*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Haplophragmoididae	*Cribrostomoides* cf. *jeffreysii*	*Cribrstomoides cf. jeffreysei*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Buliminidae	*Bulimina marginata* f. *aculeata*	*Bulimina aculeata*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Pyrgo* aff. ezo		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cyclamminidae	*Alveolophragmium* sp. B		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Globigerinidae	*Globigerina* cf. *subcretacea*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Glandulinidae	*Seabrookia* cf. *earlandi*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Ellipsolagenidae	*Oolina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cyclamminidae	*Cyclammina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Rosalinidae	*Rosalina* cf. *bradyi*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Ophthalmidiidae	*Cornuloculina* aff. *inconstans*	*Hauerinella aff. inconstans*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Robertinidae	*Robertinoides* cf. *pumilum*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Saccamminidae	*Lagenammina* cf. *difflugiformis*	*Proteonina cf. difflugiformis*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Spirillinidae	*Spirillina* aff. *tuberculata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Spirillinidae	*Spirillina* cf. *vivipara*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Siphotextularia* aff. *mestayerae*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Cassidulina* aff. *laevigata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Textularia* cf. *tenuissima*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Textulariidae	*Textularia* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Trochamminidae	*Trochammina* cf. *astrifica*		Kustanowich (1964)		

Phylum & Class	Order	Family	Taxon name	Name as given in literature record[1]	Reference	Locations recorded if not from Milford Sound itself	Recorded in port survey?
Granuloreticulosea	Foraminiferida	Trochamminidae	*Trochammina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Uvigerinidae	*Uvigerina* cf. *peregrina*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cibicididae	*Cibicides* large sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Pateoris* cf. *hauerinoides*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Glabratellidae	*Pileolina* cf. *radiata*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Discorbidae	*Gavelinopsis* aff. *lobatulus*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Discorbidae	*Discorbis* (=*Gavelinopsis*) spp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Discorbidae	*Discorbinella* cf. *bertheloti*	*Discopulvinulina* cf. *bertheloti*	Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cornuspiridae	*Cornuspira* cf. *involvens*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cibicididae	*Dyocibicides* sp. B		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Siphonaperta* sp. A		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Miliolidae	*Siphonaperta* sp. B		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cibicididae	*Dyocibicides* sp. A		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Nodosariidae	*Frondicularia* cf. *californica*		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Cassidulina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cassidulinidae	*Ehrenbergina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Ceratobuliminidae	*Ceratobulimina* sp.		Kustanowich (1964)		
Granuloreticulosea	Foraminiferida	Cibicididae	*Cibicides* sp. aff. *marlboroughensis*		Kustanowich (1964)		

[1] If the taxon name given in the cited literature record has since been synonymised, this column contains the name as it was given in the literature record. The column to the left ("Taxon name") contains the current valid name.

Table 10: The Chapman and Carlton (1994) criteria (C1 – C9) that each NIS and C1 taxon from the Milford Sound desktop review and port survey meets. Criteria were assigned following expert advice or are based on those give by Cranfield et al. (1998).

Species	Biosecurity Status	Source of record	C1: Has the species suddenly appeared locally where it has not been found before?	C2: Has the species spread subsequently?	C3: Is the species' distribution associated with human mechanisms of dispersal?	C4: Is the species associated with, or dependent on, other introduced species?	C5: Is the species prevalent in, or restricted to, new or artificial environments?	C6: Is the species' distribution restricted compared to natives?	C7: Does the species have a disjunct worldwide distribution?	C8: 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 NZ?	C9: Is the species isolated from the genetically and morphologically most similar species elsewhere in the world?
***Champia affinis* (Alga)**	NIS	Desktop review						Yes	Yes	Yes	Yes
***Polysiphonia brodiei* (Alga)**	NIS	Desktop review	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
***Polysiphonia constricta* (Alga)**	NIS	Desktop review			Yes			Yes		Yes	
***Polysiphonia sertularioides* (Alga)**	NIS	Desktop review	Yes	Yes				Yes	Yes	Yes	Yes
***Polysiphonia subtilissima* (Alga)**	NIS	Desktop review	Yes	Yes			Yes	Yes	Yes	Yes	Yes
***Sargassum verruculosum* (Alga)**	NIS	Desktop review			Yes			Yes	Yes	Yes	
***Didemnum* sp. (Ascidian)**	C1	Port survey	Unable to assess criteria for the genus as a whole.								
***Diplosoma velatum* (Ascidian)**	C1	Port survey								Yes	Yes

Orthopyxis integra **(Hydroid)**	C1	Port survey			Probably	Don't know			Yes		Don't know
Scruparia ambigua **(Bryozoan)**	C1	Desktop review & port survey		Unsure; inadequate records to know about absences, let alone presences.	Not necessesarily. Can attach to seaweeds. Nothing to preclude drifting throughout southern oceans.	Sometimes, not entirely.					Don't think so.
Alexandrium tamarense **(Dinoflagellate)**	C1	Port survey	Yes								
Heterosigma akashiwo **(Raphidophyte alga)**	C1	Desktop review	Yes								
Leucosolenia* cf. *discoveryi **(Sponge)**	C1	Desktop review & port survey	Yes		Yes		Yes	Yes		Yes	Yes
Leucosolenia* cf. *challengeri **(Sponge)**	C1	Desktop review	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.					Yes	Unlikely (short-lived viviparous larvae)	Probably; don't know enough about interocean genetics
Tethya bergquistae **(Sponge)**	C1	Port survey	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Likely				Yes	Unlikely (oviparous, creeping larvae, and buds)	Probably; don't know enough about interocean genetics

***Raspailia agminata* (Sponge)**	C1	Desktop review & port survey	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.					Yes	Unlikely (oviparous, creeping larvae)	Probably; don't know enough about interocean genetics
***Crella incrustans* (Sponge)**	C1	Desktop review	Possibly. A very common species, but early collections were not comprehensive and this species could have been overlooked. Species was recorded for the first time only recently (Yes990s).	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Likely				Yes	Unlikely (short-lived viviparous larvae)	Probably; don't know enough about interocean genetics
***Esperiopsis edwardsii* (Sponge)**	C1	Desktop review	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Early collections in these locations were not at all comprehensive and the species could have been overlooked.					Yes	Unlikely (short-lived viviparous larvae)	Probably; don't know enough about interocean genetics
***Haliclona* cf. *clathrata* (Sponge)**	C1	Desktop review		? Early collections in these locations were not at all comprehensive and the species could have been overlooked.	? Likely				Yes	Unlikely (short-lived viviparous larvae)	Probably; don't know enough about interocean genetics

Table 11: Physical characteristics of the sites sampled during the first port baseline survey of Milford Sound.

Site number	Site name	Maximum recorded depth (m)	Secchi depth (m)	Salinity (ppt)	Water temperature (degC)	Sea state (Beaufort scale)
1	Deep Water Basin 1	30	5.2	0	6	1
2	Deep Water Basin 2	13	5.2	2	7.1	1
3	Deep Water Basin Jetties	22	1.75	0	7.1	0
4	Deep Water Basin Slipways	13	N/R	N/R	N/R	N/R
5	Channel Marker No 2	8	5.0	18	8.7	1
6	Sandfly Point Jetty	4.2	N/R	N/R	N/R	N/R
7	Ferry Terminal 1	5	5.0	30	12.5	1
8	Ferry Terminal 2	5	5.0	30	12.5	1
9	Freshwater Basin Mooring	23	6.0	30	12.4	1
10	Harrison Cove	65	4.3	10	9.1	1
11	Anita Bay	16	9.8	35	13.4	2
12	Fox Point	16	9.9	34.5	13.4	2
13	Stirling Falls Wall	N/R	4.2	35	13.7	2
14	Pater Point	200	5.0	20	9.7	4
15	Copper Point	N/R	4.6	32	13.7	2
16	Stripe Point	20	9.2	35	13.7	2
17	Yates Point	15	7.0	33	13.6	4
18	Brig Rock	23	17.0	33	13.6	4
19	Saint Anne Point	35	10.0	32	13.7	2
21	Sea Breeze Point	45	11.0	35	14.3	5
22	Poison Bay	40	1.0	14	10.6	2
Average across all sites		31.5	6.64	24.1	11.5	2.0
SE of average across all sites		10.0	0.9	2.9	0.6	0.3

N/R: Measurements were not recorded from these sites

Table 12: Sediment particle sizes at six sites sampled during the first port baseline survey of Milford Sound. Data are percent net dry weight in each size class.

Site number	Site name	Clay <3.9um, >2um	Silt <62.5um, >3.9um	Sand >62.5um, <2mm	Gravel >2mm, <4mm	Small pebbles >4mm, <8mm
1	Deep Water Basin 1	0.02	3.49	92.46	1.53	2.51
2	Deep Water Basin 2	0.02	4.80	66.58	7.94	20.66
7	Ferry Terminal 1	0.03	13.19	86.78	0.00	0.00
11	Anita Bay	0.00	3.03	96.96	0.00	0.00
16	Stripe Point	0.00	1.26	96.74	2.01	0.00
22	Poison Bay	0.00	4.01	95.99	0.00	0.00

Table 13: Native taxa recorded from Milford Sound in the first port baseline survey. Also indicated is whether the taxon represents a new record for New Zealand and if it was recorded from the desktop review of existing marine species records from Milford Sound and nearby locations.

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Annelida					
Polychaeta	Eunicida	Dorvilleidae	*Dorvillea australiensis*		
Polychaeta	Eunicida	Eunicidae	*Eunice australis*		Yes
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sphaerocephala*		
Polychaeta	Phyllodocida	Glyceridae	*Glycera benhami*		
Polychaeta	Phyllodocida	Glyceridae	*Glycera lamelliformis*		Yes
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus angustifrons*		Yes
Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus macroura*		
Polychaeta	Phyllodocida	Nereididae	*Nicon aestuariensis*		Yes
Polychaeta	Phyllodocida	Nereididae	*Perinereis camiguinoides*		
Polychaeta	Phyllodocida	Nereididae	*Platynereis australis group*		
Polychaeta	Phyllodocida	Phyllodocidae	*Nereiphylla* cf. *castanea*		
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus jacksoni*		
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus polychromus*		
Polychaeta	Phyllodocida	Sigalionidae	*Sigalion oviger*		
Polychaeta	Sabellida	Oweniidae	*Owenia petersenae*		
Polychaeta	Sabellida	Sabellidae	*Branchiomma curtum*^		
Polychaeta	Sabellida	Sabellidae	*Megalomma suspiciens*		
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla laciniosa*		
Polychaeta	Sabellida	Serpulidae	*Galeolaria hystrix*		
Polychaeta	Sabellida	Serpulidae	*Spirobranchus cariniferus*		
Polychaeta	Scolecida	Arenicolidae	*Abarenicola devia*		
Polychaeta	Scolecida	Opheliidae	*Armandia maculata*		Yes
Polychaeta	Scolecida	Orbiniidae	*Scoloplos simplex*		
Polychaeta	Spionida	Spionidae	*Boccardia chilensis*		
Polychaeta	Spionida	Spionidae	*Boccardia knoxi*		
Polychaeta	Spionida	Spionidae	*Prionospio australiensis*		
Polychaeta	Terebellida	Cirratulidae	*Timarete anchylochaetus*		
Polychaeta	Terebellida	Pectinariidae	*Pectinaria australis*		
Polychaeta	Terebellida	Terebellidae	*Nicolea maxima*		
Polychaeta	Terebellida	Terebellidae	*Streblosoma toddae*		
Arthropoda					
Malacostraca	Amphipoda	Dexaminidae	*Paradexamine houtete*		
Malacostraca	Amphipoda	Melitidae	*Mallacoota subcarinata*		
Malacostraca	Amphipoda	Phoxocephalidae	*Torridoharpinia hurleyi*		
Malacostraca	Amphipoda	Phoxocephalidae	*Waitangi rakiura*		
Malacostraca	Amphipoda	Podoceridae	*Podocerus karu*		
Malacostraca	Decapoda	Crangonidae	*Philocheras australis*		
Malacostraca	Decapoda	Hippolytidae	*Hippolyte bifidirostris*		
Malacostraca	Decapoda	Hymenosomatidae	*Elamena producta*		
Malacostraca	Decapoda	Hymenosomatidae	*Halicarcinus cookii*		
Malacostraca	Decapoda	Hymenosomatidae	*Halicarcinus innominatus*		
Malacostraca	Decapoda	Hymenosomatidae	*Halicarcinus varius*		
Malacostraca	Decapoda	Majidae	*Eurynolambrus australis*		
Malacostraca	Decapoda	Majidae	*Leptomithrax mortenseni*		
Malacostraca	Decapoda	Majidae	*Notomithrax ursus*		
Malacostraca	Decapoda	Ocypodidae	*Macrophthalmus hirtipes*		
Malacostraca	Decapoda	Paguridae	*Lophopagurus (A.) cooki*		
Malacostraca	Decapoda	Paguridae	*Lophopagurus pumilus*		

Phylum & Class	**Order**	**Family**	**Taxon name**	**New record for NZ?**	**Recorded in desktop review?**
Malacostraca	Decapoda	Paguridae	*Pagurus albidianthus*		
Malacostraca	Decapoda	Pinnotheridae	*Pinnotheres novaezelandiae*		
Malacostraca	Decapoda	Porcellanidae	*Petrolisthes novaezelandiae*		
Malacostraca	Isopoda	Cirolanidae	*Natatolana rossi*		
Maxillopoda	Sessilia	Archaeobalanidae	*Austrominius modestus*		
Maxillopoda	Sessilia	Balanidae	*Notomegabalanus campbelli*		
Bacillariophyta					
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros affinis*		
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros convolutus*		
Coscinodiscophyceae	Corethrales	Corethraceae	*Corethron criophilum*		
Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus wailesii*		
Coscinodiscophyceae	Melosirales	Melosiraceae	*Melosira moniliformis*		
Coscinodiscophyceae	Melosirales	Stephanopyxidaceae	*Stephanopyxis orbicularis*		
Coscinodiscophyceae	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia alata*		
Coscinodiscophyceae	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia imbricata*		
Coscinodiscophyceae	Thalassiosirales	Lauderiaceae	*Lauderia annulata*		
Coscinodiscophyceae	Triceratiales	Triceratiaceae	*Odontella sinensis*		
Fragilariophyceae	Thalassionemales	Thalassionemataceae	*Thalassionema nitzschioides*		
Brachiopoda					
Rhynchonellata	Rhynchonellida	Notosariidae	*Notosaria nigricans*		
Rhynchonellata	Terebratulida	Terebratulidae	*Calloria inconspicua*		
Bryozoa					
Gymnolaemata	Cheilostomata	Aeteidae	*Aetea australis*		Yes
Gymnolaemata	Cheilostomata	Beaniidae	*Beania bilaminata*		
Gymnolaemata	Cheilostomata	Beaniidae	*Beania intermedia*		
Gymnolaemata	Cheilostomata	Beaniidae	*Beania plurispinosa*		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora mucronifera*		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Bitectipora rostrata*		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Parkermavella punctigera*		Yes
Gymnolaemata	Cheilostomata	Bitectiporidae	*Schizosmittina cinctipora*		
Gymnolaemata	Cheilostomata	Bugulidae	*Dimetopia barbata*		Yes
Gymnolaemata	Cheilostomata	Bugulidae	*Dimetopia cornuta*		Yes
Gymnolaemata	Cheilostomata	Calloporidae	*Crassimarginatella fossa*		Yes
Gymnolaemata	Cheilostomata	Calloporidae	*Odontionella cyclops*		Yes
Gymnolaemata	Cheilostomata	Calwelliidae	*Calwellia gracilis*		
Gymnolaemata	Cheilostomata	Candidae	*Caberea darwinii*		Yes
Gymnolaemata	Cheilostomata	Candidae	*Caberea helicina*		Yes
Gymnolaemata	Cheilostomata	Candidae	*Caberea solida*		Yes
Gymnolaemata	Cheilostomata	Candidae	*Caberea zelandica*		
Gymnolaemata	Cheilostomata	Candidae	*Emma crystallina*		
Gymnolaemata	Cheilostomata	Candidae	*Emma rotunda*		
Gymnolaemata	Cheilostomata	Candidae	*Emma triangula*		Yes
Gymnolaemata	Cheilostomata	Candidae	*Scrupocellaria ornithorhyncus*		
Gymnolaemata	Cheilostomata	Candidae	*Tricellaria aculeata*		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Catenicella elegans*		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Cornuticella taurina*		
Gymnolaemata	Cheilostomata	Catenicellidae	*Cribricellina cribraria*		
Gymnolaemata	Cheilostomata	Catenicellidae	*Orthoscuticella innominata*		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Orthoscuticella margaritacea*		
Gymnolaemata	Cheilostomata	Catenicellidae	*Pterocella scutella*		Yes
Gymnolaemata	Cheilostomata	Catenicellidae	*Scalicella crystallina*		
Gymnolaemata	Cheilostomata	Cellariidae	*Cellaria pilosa*		
Gymnolaemata	Cheilostomata	Cellariidae	*Cellaria tenuirostris*		
Gymnolaemata	Cheilostomata	Chaperiidae	*Chaperia granulosa*		

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Gymnolaemata	Cheilostomata	Chaperiidae	*Chaperiopsis cervicornis*		Yes
Gymnolaemata	Cheilostomata	Cribilinidae	*Figularia spinea*		
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella aporosa*		
Gymnolaemata	Cheilostomata	Hippothoidae	*Celleporella bathamae*		Yes
Gymnolaemata	Cheilostomata	Hippothoidae	*Hippothoa flagellum*		Yes
Gymnolaemata	Cheilostomata	Lepraliellidae	*Celleporaria agglutinans*		
Gymnolaemata	Cheilostomata	Membraniporidae	*Membranipora membranacea*		
Gymnolaemata	Cheilostomata	Membraniporidae	*Membranipora pura*		
Gymnolaemata	Cheilostomata	Microporellidae	*Calloporina angustipora*		
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina disjuncta*		
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina multicava*		
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina specca*		Yes
Gymnolaemata	Cheilostomata	Microporellidae	*Fenestrulina thyreophora*		Yes
Gymnolaemata	Cheilostomata	Microporellidae	*Microporella agonistes*		Yes
Gymnolaemata	Cheilostomata	Microporidae	*Opaeophora lepida*		Yes
Gymnolaemata	Cheilostomata	Romancheinidae	*Escharoides excavata*		
Gymnolaemata	Cheilostomata	Smittinidae	*Smittoidea maunganuiensis*		Yes
Gymnolaemata	Cheilostomata	Steginoporellidae	*Steginoporella magnifica*		Yes
Stenolaemata	Cyclostomata	Crisiidae	*Bicrisia biciliata*		
Stenolaemata	Cyclostomata	Crisiidae	*Bicrisia edwardsiana*		Yes
Stenolaemata	Cyclostomata	Crisiidae	*Crisia acropora*		
Stenolaemata	Cyclostomata	Crisiidae	*Crisia margaritacea*		
Stenolaemata	Cyclostomata	Crisiidae	*Crisia setosa*		
Stenolaemata	Cyclostomata	Crisiidae	*Crisia tenuis*		
Stenolaemata	Cyclostomata	Diastoporidae	*Plagioecia sarniensis*		Yes
Stenolaemata	Cyclostomata	Lichenoporidae	*Disporella pristis*		Yes
Stenolaemata	Cyclostomata	Margarettidae	*Margaretta barbata*		Yes
Stenolaemata	Cyclostomata	Phidoloporidae	*Phidolopora avicularis*		Yes
Chlorophyta					
Ulvophyceae	Bryopsidales	Codiaceae	*Codium convolutum*		
Ulvophyceae	Bryopsidales	Codiaceae	*Codium dichotomum f. novozelandicum*		
Ulvophyceae	Bryopsidales	Codiaceae	*Codium fragile ssp. novae-zelandiae*		
Ulvophyceae	Bryopsidales	Codiaceae	*Codium gracile*		Yes
Ulvophyceae	Caulerpales	Caulerpaceae	*Caulerpa brownii*		
Chordata					
Actinopterygii	Atheriniformes	Atherinidae	*Atherinomorus lacunosa*		
Actinopterygii	Gadiformes	Moridae	*Lotella rhacinus*		Yes
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*		Yes
Actinopterygii	Perciformes	Plesiopidae	*Acanthoclinus marilynae*		Yes
Actinopterygii	Perciformes	Scorpidinae	*Helicolenus percoides*		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion lapillum*		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion malcolmi*		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Forsterygion varium*		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Grahamina capito*		Yes
Actinopterygii	Perciformes	Tripterygiidae	*Ruanoho decemdigitatus*		
Actinopterygii	Perciformes	Tripterygiidae	*Ruanoho whero*		Yes
Actinopterygii	Pleuronectiformes	Pleuronectidae	*Rhombosolea plebia*		
Actinopterygii	Salmoniformes	Retropinnidae	*Retropinna retropinna*		
Actinopterygii	Scorpaeniformes	Scorpaenidae	*Scorpaena papillosa*		Yes
Ascidiacea	Enterogona	Polyclinidae	*Aplidium adamsi*		
Ascidiacea	Enterogona	Polyclinidae	*Pseudodistoma cereum*		
Ascidiacea	Pleurogona	Pyuridae	*Pyura cancellata*		
Ascidiacea	Pleurogona	Pyuridae	*Pyura pulla*		

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Ascidiacea	Pleurogona	Styelidae	*Cnemidocarpa bicornuta*		
Ascidiacea	Pleurogona	Styelidae	*Cnemidocarpa nisiotus*		
Cnidaria					
Anthozoa	Scleractinia	Flabellidae	*Flabellum rubrum*		
Anthozoa	Scleractinia	Rhizangiidae	*Culicia rubeola*		
Hydrozoa	Hydroida	Sertulariidae	*Crateritheca novaezelandiae*		
Hydrozoa	Hydroida	Sertulariidae	*Sertularella robusta*		
Hydrozoa	Hydroida	Sertulariidae	*Stereotheca elongata*		
Hydrozoa	Hydroida	Sertulariidae	*Symplectoscyphus subarticulatus*		
Hydrozoa	Hydroida	Syntheciidae	*Synthecium tottoni*		
Echinodermata					
Asteroidea	Forcipulatida	Asteriidae	*Coscinasterias muricata*		
Asteroidea	Forcipulatida	Asteriidae	*Stichaster australis*		
Asteroidea	Valvatida	Asterinidae	*Patiriella mortenseni*		
Asteroidea	Valvatida	Asterinidae	*Patiriella regularis*		
Asteroidea	Valvatida	Goniasteridae	*Pentagonaster pulchellus*		
Asteroidea	Valvatida	Odontasteridae	*Diplodontias dilatatus*		
Echinoidea	Echinoida	Echinometridae	*Evechinus chloroticus*		Yes
Echinoidea	Temnopleurida	Temnopleuridae	*Pseudechinus novaezealandiae*		
Holothuroidea	Aspidochirotida	Stichopodidae	*Stichopus mollis*		
Ophiuroidea	Ophiurida	Amphiuridae	*Amphiura eugenie*		
Ophiuroidea	Ophiurida	Ophiodermatidae	*Ophiopsammus maculata*		
Mollusca					
Bivalvia	Mytiloida	Mytilidae	*Aulacomya maoriana*		Yes
Bivalvia	Mytiloida	Mytilidae	*Mytilus galloprovincialis* [#]		
Bivalvia	Pholadomyoida	Myochamidae	*Myadora striata*		
Bivalvia	Solemyoida	Solemyidae	*Solemya parkinsonii*		
Bivalvia	Veneroida	Lasaeidae	*Borniola reniformis*		Yes
Bivalvia	Veneroida	Mactridae	*Scalpomactra scalpellum*		
Bivalvia	Veneroida	Mesodesmatidae	*Paphies australis*		Yes
Bivalvia	Veneroida	Psammobiidae	*Soletellina nitida*		Yes
Bivalvia	Veneroida	Tellinidae	*Macomona liliana*		
Bivalvia	Veneroida	Thyasiridae	*Genaxinus cookianus*		
Bivalvia	Veneroida	Veneridae	*Austrovenus stutchburyi*		Yes
Bivalvia	Veneroida	Veneridae	*Irus reflexus*		
Bivalvia	Veneroida	Veneridae	*Notocallista multistriata*		
Gastropoda	Basommatophora	Siphonariidae	*Siphonaria australis*		Yes
Gastropoda	Docoglossa	Lottiidae	*Notoacmea helmsi*		
Gastropoda	Docoglossa	Lottiidae	*Patelloida corticata*		
Gastropoda	Docoglossa	Nacellidae	*Cellana stellifera*		
Gastropoda	Neogastropoda	Buccinidae	*Austrofusus glans*		
Gastropoda	Neogastropoda	Muricidae	*Xymene ambiguus*		
Gastropoda	Neogastropoda	Muricidae	*Xymene traversi*		
Gastropoda	Neogastropoda	Olividae	*Amalda australis*		
Gastropoda	Neogastropoda	Olividae	*Amalda novaezelandiae*		
Gastropoda	Neogastropoda	Terebridae	*Pervicacia tristis*		
Gastropoda	Neotaenioglossa	Batillariidae	*Zeacumantus subcarinatus*		
Gastropoda	Neotaenioglossa	Ranellidae	*Argobuccinum pustulosum* ssp. *tumidum*		
Gastropoda	Neotaenioglossa	Ranellidae	*Ranella australasia*		
Gastropoda	Neotaenioglossa	Turritellidae	*Maoricolpus roseus*		
Gastropoda	Vetigastropoda	Calliostomatidae	*Calliostoma granti*		
Gastropoda	Vetigastropoda	Haliotidae	*Haliotis australis*		
Gastropoda	Vetigastropoda	Trochidae	*Antisolarium egenum*		

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Gastropoda	Vetigastropoda	Trochidae	*Cantharidella tesselata*		
Gastropoda	Vetigastropoda	Trochidae	*Melagraphia aethiops*		
Gastropoda	Vetigastropoda	Trochidae	*Micrelenchus huttonii*		
Gastropoda	Vetigastropoda	Trochidae	*Trochus viridus*		
Gastropoda	Vetigastropoda	Turbinidae	*Cookia sulcata*		
Gastropoda	Vetigastropoda	Turbinidae	*Modelia granosa*		
Gastropoda	Vetigastropoda	Turbinidae	*Turbo smaragdus*		
Myzozoa					
Dinophyceae	Dinophysiales	Dinophysiaceae	*Dinophysis acuminata*		Yes
Dinophyceae	Peridiniales	Ceratiaceae	*Ceratium arietinum*		
Dinophyceae	Peridiniales	Ceratiaceae	*Ceratium fusus*		
Dinophyceae	Peridiniales	Ceratiaceae	*Ceratium tripos*		
Dinophyceae	Peridiniales	Gonyaulacaceae	*Lingulodinium polyedrum*		Yes
Dinophyceae	Peridiniales	Peridiniaceae	*Scrippsiella trochoidea*		
Dinophyceae	Peridiniales	Podolampadaceae	*Podolampas palmipes*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium americanum*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium avellana*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium conicum*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium latissinum*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium punctulatum*		
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium subinerme*		
Dinophyceae	Prorocentrales	Prorocentraceae	*Prorocentrum micans*		
Ochrophyta					
Dictyochophyceae	Dictyochales	Dictyochaceae	*Distephanus speculum*		
Phaeophyceae	Dictyotales	Dictyotaceae	*Zonaria turneriana*		
Phaeophyceae	Ectocarpales	Adenocystaceae	*Adenocystis utricularis*		
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia peregrina*		
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Scytosiphon lomentaria*		
Phaeophyceae	Fucales	Cystoseiraceae	*Landsburgia quercifolia*		
Phaeophyceae	Fucales	Fucaceae	*Xiphophora gladiata*		
Phaeophyceae	Fucales	Fucaceae	*Xiphophora radiata*		
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum flexuosum*		Yes
Phaeophyceae	Fucales	Sargassaceae	*Sargassum sinclairii*		
Phaeophyceae	Laminariales	Alariaceae	*Ecklonia radiata*		
Phaeophyceae	Sphacelariales	Stypocaulaceae	*Halopteris funicularis*		
Phaeophyceae	Sphacelariales	Stypocaulaceae	*Ptilopogon botryocladus*		
Phaeophyceae	Sporochnales	Sporochnaceae	*Carpomitra costata*		
Porifera					
Calcarea	Clathrinida	Leucaltidae	*Leucettusa* cf. *tubulosa*		
Calcarea	Clathrinida	Leucettidae	*Leucetta* n.sp.2 (MK)		
Demospongiae	Dictyoceratida	Irciniidae	*Ircinia akaroa*		
Demospongiae	Dictyoceratida	Thorectidae	*Thorecta reticulata*		Yes
Demospongiae	Halichondrida	Axinellidae	*Cymbastella* n.sp.1 (MK)		
Demospongiae	Poecilosclerida	Chondropsidae	*Strongylacidon conulosa*		Yes
Demospongiae	Poecilosclerida	Desmacellidae	*Neofibularia* n.sp.2 (MK)	New	
Demospongiae	Poecilosclerida	Latrunculiidae	*Latrunculia fiordensis*		Yes
Demospongiae	Poecilosclerida	Mycalidae	*Mycale (Carmia) hentscheli*		
Demospongiae	Poecilosclerida	Tedaniidae	*Tedania* n.sp.1 (MK)	New	
Rhodophyta					
Florideophyceae	Balliales	Balliaceae	*Ballia callitricha*		
Florideophyceae	Bonnemaisonales	Bonnemaisonaceae	*Asparagopsis armata*		
Florideophyceae	Ceramiales	Ceramiaceae	*Anotrichium crinitum*		
Florideophyceae	Ceramiales	Ceramiaceae	*Antithamnion pectinatum*		
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium vestitum*		

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Florideophyceae	Ceramiales	Ceramiaceae	*Euptilota formosissima*		
Florideophyceae	Ceramiales	Ceramiaceae	*Perithamnion ceramioides*		
Florideophyceae	Ceramiales	Dasyaceae	*Heterosiphonia squarrosa*		
Florideophyceae	Ceramiales	Delesseriaceae	*Abroteia suborbiculare*		
Florideophyceae	Ceramiales	Delesseriaceae	*Apoglossum oppositifolium*		
Florideophyceae	Ceramiales	Delesseriaceae	*Caloglossa viellardii*		
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena* aff. *variolosa* (MFN)*		
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena variolosa*		
Florideophyceae	Ceramiales	Delesseriaceae	*Nancythalia humilis*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Aphanocladia delicatula*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Bostrychia harveyi*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Chondria macrocarpa*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Dipterosiphonia heteroclada*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Echinothamnion lyallii*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Lophurella hookeriana*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia muelleriana*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Pterosiphonia pennata*		
Florideophyceae	Ceramiales	Rhodomelaceae	*Stictosiphonia vaga*		
Florideophyceae	Corallinales	Corallinaceae	*Arthrocardia corymbosa*		
Florideophyceae	Corallinales	Corallinaceae	*Corallina officinalis*		
Florideophyceae	Gigartinales	Cystocloniaceae	*Rhodophyllis membranacea*		
Florideophyceae	Gigartinales	Gigartinaceae	*Chondracanthus chapmanii*		
Florideophyceae	Gigartinales	Gigartinaceae	*Gigartina ancistroclada*		
Florideophyceae	Gigartinales	Gigartinaceae	*Sarcothalia livida*		
Florideophyceae	Gracilariales	Gracilariceae	*Gracilaria chilensis*		Yes
Florideophyceae	Hildenbrandiales	Hildenbrandiaceae	*Apophlaea lyallii*		Yes
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium angustum*		
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium cirrhosum*		Yes
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium microcladioides*		

Notes:

^ The biosecurity status of *Branchiomma curtum* was reported as C1 in earlier New Zealand port survey reports. It has since been revised to Native, following expert advice: "The disjunct distribution reported in literature was likely due to misidentifications of similar or cryptic species. I now am unconvinced the disjunct Caribbean records are the same species, although quite similar" (G. Read, NIWA, pers. comm.).

The biosecurity status of *Mytilus galloprovincialis* was reported as C1 in earlier New Zealand port survey reports. It has since been revised to Native, because recent morphometric analysis of fossil, midden and contemporary *Mytilus* in New Zealand indicate that contemporary mussels, with one possible regional exception (Bay of Islands), are best regarded as *M. galloprovincialis* (Gardner 2004). Therefore, the current evidence suggests it is native in New Zealand.

* MFN = Milford Sound specimens. Further taxonomic investigation is required to confirm whether the specimens of *Hymenena* aff. *variolosa* from Milford Sound are the same species as those found in other parts of the country.

Table 14: Cryptogenic category one (C1) taxa recorded from Milford Sound in the first port baseline survey. Also indicated are whether the Milford Sound port survey collection represents a new record for New Zealand or an extension to the known range of the species in New Zealand, the probable means of introduction to New Zealand (H = Hull fouling, B = Ballast water transport), the date of introduction or detection (d) in New Zealand, and whether the taxon was recorded from the desktop review of existing marine species records from Milford Sound and nearby locations.

Phylum & Class	Order	Family	Taxon name	New record NZ?	Range extension?	Probable means of introduction to NZ	Date of introduction, or detection (d)	Recorded in desktop review?
Bryozoa								
Gymnolaemata	Cheilostomata	Scrupariidae	*Scruparia ambigua*	No	No	H. Could occur in NZ naturally by rafting but has almost certainly also arrived on ships	31/08/1911 d	Yes
Chordata								
Ascidiacea	Enterogona	Didemnidae	*Didemnum* sp.[#]	No	No	H	Unable to answer for the genus as a group	
Ascidiacea	Enterogona	Didemnidae	*Diplosoma velatum*	No	Yes	H	2006 d	Yes
Cnidaria								
Hydrozoa	Hydroida	Campanulariidae	*Orthopyxis integra*	No	Yes	H	1875 d	
Myzozoa								
Dinophyceae	Peridiniales	Gonyaulacaceae	*Alexandrium tamarense*	No	Possible	B	April 1997 d	
Porifera								
Calcarea	Leucosolenida	Leucosoleniidae	*Leucosolenia* cf. *discoveryi* ^	No	No	H	Feb 2003 d	Yes
Demospongiae	Poecilosclerida	Raspailiidae	*Raspailia agminata*	No	Yes	H	1961 d*	Yes
Demospongiae	Hadromerida	Tethyidae	*Tethya bergquistae*	No	Yes	H	1961 d*	

Notes:
[#] Because of the complex taxonomy of this genus, *Didemnum* specimens could not be identified to species level, and are reported here collectively as a species group "*Didemnum* sp."

^ The biosecurity status of *Leucosolenia* cf. *discoveryi* was reported as NIS in earlier New Zealand port survey reports. It has since been revised to C1, following expert advice explaining uncertainty in the identity of the species: "After extensive search, this is the closest species to our southern New Zealand species. There are some minor differences that indicate it might rather be a New Zealand endemic that is very similar to *L. discoveryi*. There is only minor overlap with Antarctica species in the southern NZ fauna (Dunedin, Bluff, Milford)" (M. Kelly, NIWA, pers. comm.).

* This is the first published record for the species in New Zealand. The actual date of collection of the specimen was probably 5-10 years prior to publication.

Table 15: Collection methods and depths for the cryptogenic category one taxa recorded from the Milford Sound port survey. No NIS taxa were recorded during the port survey.

Taxon name	Method of collection	0 – 10 m	>10 – 20 m	>20 – 30 m	>30 – 40 m	Total
Alexandrium tamarense	Cyst sediment sample	1				1
Didemnum sp.	Visual dive transect		2	1		3
Diplosoma velatum	Visual dive transect			1		1
Leucosolenia cf. *discoveryi*	Quadrat scraping	1				1
	Visual dive transect			1	1	2
Orthopyxis integra	Quadrat scraping	1				1
	Visual dive transect		1			1
Raspailia agminata	Visual dive transect				1	1
Scruparia ambigua	Visual dive transect		1	1		2
Tethya bergquistae	Visual dive transect				1	1
Total		3	4	4	3	14

Table 16: Cryptogenic category two (C2) taxa recorded from Milford Sound in the first port baseline survey. Also indicated is whether the taxon represents a new record for New Zealand and if it was recorded from the desktop review of existing marine species records from Milford Sound and nearby locations.

Phylum & Class	Order	Family	Taxon name	New record for NZ?	Recorded in desktop review?
Annelida					
Polychaeta	Phyllodocida	Nereididae	*Neanthes Neanthes*-A		
Polychaeta	Phyllodocida	Phyllodocidae	*Eulalia Eulalia*-NIWA-2		
Polychaeta	Sabellida	Serpulidae	*Spirobranchus S. polytrema* complex ^		
Polychaeta	Spionida	Chaetopteridae	*Phyllochaetopterus Phyllochaetopterus*-A		
Polychaeta	Terebellida	Terebellidae	*Terebella Terebella*-B		
Arthropoda					
Malacostraca	Amphipoda	Liljeborgiidae	*Liljeborgia* sp. 2	Yes	
Bryozoa					
Gymnolaemata	Cheilostomata	Celleporidae	*Celleporina* sp. MFN*	Yes?*	
Gymnolaemata	Cheilostomata	Electridae	*Electra* sp.	Yes	
Chordata					
Ascidiacea	Enterogona	Polyclinidae	*Aplidiopsis* sp.		
Ascidiacea	Enterogona	Polyclinidae	*Aplidium* sp. 19		

Notes:
^ The biosecurity status of *Spirobranchus S. polytrema* complex was reported as NIS in earlier New Zealand port survey reports. We have since been advised that C2 is a more appropriate designation due to this taxon being a species complex (G. Read, NIWA, pers. comm.).

* MFN = Milford Sound specimens. This is probably a new, undescribed species, but further taxonomic investigation is required to confirm its identity, including whether the specimens of *Celleporina* sp. from Milford Sound are the same species as those found in other parts of the country (D. Gordon, NIWA, pers. comm.).

Table 17: Indeterminate taxa recorded from Milford Sound in the first port survey. Also indicated is whether the taxon was recorded from the review of existing marine species records from Milford Sound and nearby locations.

Phylum & Class	Order	Family	Taxon name	Recorded in desktop review?
Unknown				
?			Unidentifiable	
Algae (unidentified)			Unidentified algae	
Annelida				
Polychaeta			Polychaeta	
Polychaeta	Phyllodocida	Phyllodocidae	Phyllodocidae Indet	
Polychaeta	Phyllodocida	Syllidae	Syllidae Indet	
Polychaeta	Sabellida	Sabellidae	*Fabricia*	
Polychaeta	Sabellida	Sabellidae	Sabellidae Indet	
Polychaeta	Sabellida	Serpulidae	*Serpula* Indet	
Polychaeta	Terebellida	Terebellidae	Terebellidae Indet	
Arthropoda				
Malacostraca	Amphipoda		Amphipoda	
Malacostraca	Amphipoda	Lysianassidae	Lysianassidae sp.	
Malacostraca	Amphipoda	Melitidae	*Maera*	
Malacostraca	Isopoda		Isopoda sp.	
Malacostraca	Isopoda	Sphaeromatidae	*Cilicaea* sp.	
Ostracoda			Ostracoda	
Bacillariophyta				
Bacillariophyceae	Naviculales	Naviculaceae	*Navicula*	
Bacillariophyceae	Naviculales	Pleurosigmataceae	*Gyrosigma*	
Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*	
Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	*Chaetoceros*	
Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus*	
Coscinodiscophyceae	Melosirales	Melosiraceae	*Melosira*	
Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Thalassiosira*	
Fragilariophyceae	Fragilariales	Fragilariaceae	*Fragilaria*	
Fragilariophyceae	Licmophorales	Licmophoraceae	*Licmophora*	
Fragilariophyceae	Thalassionemales	Thalassionemataceae	*Thalassionema*	
Bryozoa				
Gymnolaemata	Cheilostomata	Bugulidae	*Dimetopia*	
Gymnolaemata	Cheilostomata	Catenicellidae	*Orthoscuticella*	
Gymnolaemata	Cheilostomata	Flustridae	*Gregarinidra*	
Stenolaemata	Cyclostomata	Lichenoporidae	*Disporella*	
Stenolaemata	Cyclostomata	Tubuliporidae	*Tubulipora* sp.	
Chlorophyta				
Ulvophyceae	Cladophorales	Cladophoraceae	*Chaetomorpha*	
Ulvophyceae	Cladophorales	Cladophoraceae	*Cladophora* sp.	
Ulvophyceae	Codiolales	Monostromataceae	*Monostroma* sp.	
Ulvophyceae	Ulvales	Ulvaceae	*Ulva* sp.	Yes
Chordata				
Ascidiacea	Enterogona	Ascidiidae	Ascidiidae	
Ascidiacea	Enterogona	Didemnidae	Didemnidae	
Cnidaria				
Anthozoa	Epizoanthidea	Epizoanthdae	*Epizoanthus*	
Hydrozoa			Hydrozoa	
Hydrozoa	Hydroida	Campanulariidae	*Obelia* sp.	
Hydrozoa	Hydroida	Sertulariidae	Sertulariidae	
Hydrozoa	Hydroida	Sertulariidae	*Symplectoscyphus*	

Phylum & Class	Order	Family	Taxon name	Recorded in desktop review?
Cyanobacteria				
?			Cyanobacteria	
Echinodermata				
Asteroidea	Forcipulatida	Asteriidae	*Allostichaster*	
Asteroidea	Valvatida	Asterinidae	*Patiriella* sp.	
Asteroidea	Valvatida	Goniasteridae	*Pentagonaster*	
Holothuroidea?			Holothuroidea?	
Mollusca				
?			Mollusca	
Bivalvia			Bivalvia	
Bivalvia	Mytiloida	Mytilidae	*Aulacomya*	
Bivalvia	Mytiloida	Mytilidae	*Modiolarca*	
Bivalvia	Mytiloida	Mytilidae	*Mytilus* sp.	
Bivalvia	Mytiloida	Mytilidae	*Xenostrobus*	
Bivalvia	Veneroida	Neoleptonidae	*Neolepton*	
Bivalvia	Veneroida	Tellinidae	*Macomona*	
Gastropoda	Heterostropha	Pyramidellidae	*Odostomia*	
Gastropoda	Neogastropoda	Buccinidae	*Cominella* sp.	
Myzozoa				
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium* sp.	
Dinophyceae	Peridiniales (?)		Peridiniales (?)	
Nemertea				
?			Nemertea	
Ochrophyta				
Dictyochophyceae	Dictyochales	Dictyochaceae	*Dictyota* sp.	
Phaeophyceae	Dictyotales		*Dictyotales* sp.	
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Ectocarpus* sp.	
Phaeophyceae	Ectocarpales	Ectocarpaceae	*Hincksia* sp.	
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia* sp.	
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora* sp.	
Phaeophyceae	Sphacelariales	Sphacelariaceae	*Sphacelaria* sp.	
Phaeophyceae	Sphacelariales	Stypocaulaceae	*Halopteris* sp.	
Porifera				
?			Porifera	
Demospongiae	Dendroceratida	Darwinellidae	Darwinellidae	
Demospongiae	Haplosclerida	Chalinidae	*Haliclona*	
Rhodophyta				
Florideophyceae	Acrochaetiales	Acrochaetiaceae	*Audouinella* sp.	
Florideophyceae	Ceramiales	Ceramiaceae	*Acrothamnion* sp.	
Florideophyceae	Ceramiales	Ceramiaceae	*Callithamnion* sp.	
Florideophyceae	Ceramiales	Ceramiaceae	*Ceramium* sp.	
Florideophyceae	Ceramiales	Ceramiaceae	*Griffithsia* sp.	
Florideophyceae	Ceramiales	Delesseriaceae	Delesseriaceae	
Florideophyceae	Ceramiales	Delesseriaceae	*Hymenena* sp.	
Florideophyceae	Ceramiales	Rhodomelaceae	*Chondria* sp.	
Florideophyceae	Ceramiales	Rhodomelaceae	*Lophurella* sp.	
Florideophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia* sp.	
Florideophyceae	Ceramiales	Rhodomelaceae	*Stictosiphonia* sp.	
Florideophyceae	Corallinales	Corallinaceae	*Haliptilon*	
Florideophyceae	Corallinales	Corallinaceae	*Jania* sp.	
Florideophyceae	Corallinales	Corallinaceae	Non-geniculate coralline	
Florideophyceae	Gigartinales	Gigartinaceae	*Gigartina* sp.	
Florideophyceae	Gigartinales	Gigartinaceae	*Gigartina?* MFN*	
Florideophyceae	Gigartinales	Kallymeniaceae	*Iridaea*	

<u>Phylum</u> & Class	**Order**	**Family**	**Taxon name**	**Recorded in desktop review?**
Florideophyceae	Gigartinales	Peyssonneliaceae	*Peyssonnelia*	
Florideophyceae	Plocamiales	Plocamiaceae	*Plocamium* sp.	
Florideophyceae	Rhodymeniales	Lomentariaceae	*Lomentaria* sp.	
Florideophyceae	Rhodymeniales	Rhodomeniaceae	*Rhodymenia* sp.	
Rhodophyceae	Ceramiales	Ceramiaceae	*Microcladia*	
<u>Sipuncula</u>				
?			Sipuncula	

* MFN = Milford Sound specimens. Further taxonomic investigation is required to confirm whether the specimens of *Gigartina?* from Milford Sound are the same species as those found in other parts of the country.

Appendices

APPENDIX 1: SAMPLING PROCEDURES FOR ZBS2005-19 SURVEYS.

These sampling procedures were specified by MAF Biosecurity New Zealand in the tender documents for Project ZBS2005-19. Modifications to the procedures necessitated by local conditions in the Milford Sound survey are described in the "Methods" section of this current report and were agreed to by MAF Biosecurity New Zealand prior to the survey.

Appendix A: Sampling Procedures

(Derived and modified from Hewitt and Martin 1996, 2001(Appendix C))

All samples collected are to be labeled with data that will allow the determination of: the date samples were collected; where the sampling occurred (regional); the site of collection (wharf, breakwater etc); the sample method (pile, core, qualitative); and the depth. The Hewitt and Martin protocols provide an easy and informative site code and sample labeling method; however other methods may be considered and will need to be negotiated with Biosecurity New Zealand to ensure that specimen linkage with sample information can be maintained. Special care should be given to quality assurance, quality control including chain-of-custody.

1.0 Dinoflagellates

1.1. Sediment sampling for cyst-forming species (small cores)

Sediment cores are taken from locations where the deposition and undisturbed accumulation of dinoflagellate cysts are likely to occur. Selection of sites will be based on depth, local biogeography and sediment characteristics of the area. As a general guide, sites where there is an accumulation of uncompacted fine sediment to a depth of 20-30 cm are suitable sites for constructing the sedimentary history of the port environment however, recent work has shown that sandy substrates should not be overlooked (C. Bolch pers.comm.). These samples are taken using cores. The cores will provide information on the formation of dinoflagellate blooms. Coarse-grained habitats may provide gross level information (presence/absence) for a port environment. At each site, sediment cores are to be taken by divers using 20 cm long tubes with 2.5 cm internal diameter. Tubes are forced into the substrate then capped at each end with a rubber bung to provide an airtight seal. Cores are labeled and are stored upright in the dark at 4°C prior to size fractionation and examination for dinoflagellate cysts.

1.2. Sediment preparation and cyst identification

The top 6 cm of sediment core is to be carefully extruded from the coring tube and stored at 4°C in a sealed container until further examination. Subsamples (approx. 1-2 cm^3) of each core sample are mixed with filtered seawater to obtain a watery slurry. Subsamples (5-10 mL) are sonicated for 2 min (Braun Labsonic homogenizer, intermediate probe, 100 watts) to dislodge detritus particles. The sample is screened through a 90 µm sieve and the remaining fraction is panned to remove denser sand grains and large detrital particles. Subsamples (1 mL) are examined and counted on wet-mount slides, using a compound light microscope. Where possible, a total of at least 100 cysts are counted in each sample. Identification of species follows Bolch and Hallegraeff (1990). Cysts of suspected toxic species are photographed with a light microscope using bright field or differential interference contrast illumination.

1.3. Cyst germination

Following sonication and size-fractionation of sediments, cysts of suspected toxic species are located and isolated by micropipette under a light microscope and then washed twice in filtered seawater. Individual cysts are placed into tissue culture wells containing 2mL of 75% filtered seawater with nutrients added according to medium GPM of Loeblich (1975). Additional incubations are to be carried out using size-fractionated sediments. Subsamples of the 20-90µm size fraction are added to 20mL of growth medium in sterile polystyrene petri-dishes, and sealed with parafilm. All incubations are be carried out at 20ºC at a light intensity of 80µEm^{-2}s^{-1} (12h light:12h dark) and examined regularly for germination. Active swimming dinoflagellate cells from incubations should be isolated by micropipette, washed in sterile growth medium and their identity determined where possible.

1.4. Plankton sampling and culture

Plankton samples are to be collected by vertical and horizontal tows of a hand-deployed plankton net (25cm diam. Opening, 20µm Nytal mesh, Swiss Screens, Melbourne Vic.). The samples should be sealed in plankton jars and labeled using waterproof labels, placed in a cooled container and returned to the laboratory, net samples diluted 1:1 with growth medium. Germanium dioxide (10mg.l^{-1}) is added to inhibit overgrowth by diatom species and these enrichment cultures incubated as described above. Incubations are examined regularly by light microscopy, and single cells of suspected toxic species isolated by micropipette for further culture and toxicity determination.

1.5. Toxicity testing

Suspected toxic species are grown in laboratory culture, under the conditions described previously, and tested for toxin (saxitoxin) production by High Performance Liquid Chromatography (HPLC) (Oshima et al. 1989).

2.0 Crabs, Macroalgae, Seastars

2.1. Trapping

Crab species are sampled using light-weight plastic-coated wire-framed traps (60cm long, 45cm wide and 20cm high) covered 1.27cm square mesh netting. Entry to the trap is through slits at the apex of inwardly-directed V-shaped panels at each end of the trap. The internal bait bag should be baited with fish heads or carcasses. Traps weighted with chain or lead weights and deployed with surface buoys. Whenever possible, traps should be deployed in the late afternoon and recovered early the next morning. Each collected sample is labeled using waterproof labels. Crab traps are also effective for targeting the known introduced species *Charybdis japonica* and *Carcinus maenas*.

2.2. Visual searches – wharves and marinas

Visual searches for crab, target species (e.g., *Charybdis japonica, Undaria pinnatifida, Asterias amurensis*) and unusual/rare species (species not seen before in the region) should also be made at selected wharves in the port and marina areas. Divers are to swim the length of the wharf at two depths (5m and bottom) to provide a completed visual survey of the outer wharf between about 5m depth and the bottom (10-14m). Surveys of beach wrack are to be made of suitable beaches to collect crab exuviae. Each collected sample is labeled using waterproof labels.

2.3 Visual searches – other regions

Visual searches for crab, macroalgae and target species will be carried out by divers in rocky reef, rocky rip-rap, shipwrecks, kelp and seagrass meadows, over soft bottoms and beach searches. Divers will either be free swimming or towed using a manta board (snorkel). When using the manta board, (skin) divers will be towed along 100m transects at a speed of less than 2 knots. Beach wrack surveys along beach and estuaries will search the beach using parallel transects to the waters edge at distances of 2, 5 and 10 m (and further if required) up the shoreline. Each collected sample is labelled using waterproof labels.

3.0 Zooplankton

Zooplankton is sampled with a standard 100µm mesh, 70cm diameter free-fall drop net. The net is weighted so as to achieve a fall rate of approximately 1m per second and the depth reached is monitored using a Tekna maximum indicating (divers) depth gauge (or similar) attached to the frame of the net. Each drop is timed with a stopwatch and the net is allowed to fall from the surface to a depth 0.5-1 m from the substrate. Timing commences when the cod end of the net sinks below the surface. One drop is conducted at each site. On recovery the net is washed down on the outside only to avoid contamination of the sample. Each individual sample is labelled using waterproof labels. Retained plankton is preserved in 5% formalin and returned to the laboratory for sorting and identification. Replicate plankton tows are made at each sample site.

4.0 Hard Substrate Invertebrates and Plants

4.1 Wharf pile communities

Piles or projecting steel facings are to be selected from wharves having different types of shipping activity. Three piles or facings are to be selected in series from near one end of each wharf, starting about 10 m from the end to reduce "edge" effects, with 10 to 20 m distance separating each pile or facing. Three outer and three inner piles may be sampled from wharves with inner piles, which are likely to have much reduced water movement or ambient light levels. Thus the minimum number of piles sampled is three outer and the maximum is six (three outer and three inner). Data suggests that sampling inner piles increases biodiversity information but it does not significantly increase detection of introduced species compared to sampling outer piles only.

The selected piles or facings are to be marked (spray paint) and their positions recorded (GPS) and photographed. For each pile divers then take:

a) Video film of the outer surface of each pile/facing from approximately high-water level down to the deepest exposed part of the pile/facing using digital video cameras (or similar). The video camera is to be fitted with lights to ensure colour correctness of the footage. A distance-measuring rod with a scale and digital depth meter is also attached to the camera to ensure that the camera remains a constant distance (approx. 50 cm) from the pile or substrate. The scale and depth meter are positioned so they fall within the field of view of the camera and provide real-time depth information on the video footage.

b) Still photographs using an underwater film camera (e.g., Nikonos V) or a digital camera (of adequate resolution) are taken using a 35 mm lens and overlens to provide a 1:6 frame image (which is suitable for taxonomic work). A strobe is used to ensure that colour correctness is maintained. The use of the framer and strobe both ensure that higher-resolution records of the fouling communities and selected species are taken and can be compared between and amongst quadrats images. Each quadrat is photographed. The 1:6 framer ensures that four photographs will cover the 0.1m^2 quadrat. Thus, to photograph three piles, with three quadrats each will use 36 images. Divers will record the order of photographs by using a label within the images or noting pile and photo order on a dive slate that is then recorded on the boat data sheet.

c) Quantitative 0.1 m^2 (33.33 v 33.33 cm) quadrat samples of the fouling communities present at three depths (0.5, 3.0 and 7.0 m) are collected by scraping the attached flora and fauna as carefully as possible into plastic bags. These samples are labeled (using pre-labeled waterproof labels) and sealed under water. The samples are then rough sorted within 12 hours of collection and narcotised where needed (e.g., anemones, chitons, flatworms) and preserved in the suitable fixative (5% formalin or 70% ethanol) for subsequent fine sorting and identification in the laboratory.

4.2. Breakwaters

Using equipment detailed in section 4.1 above, divers will take video and still photographs and collect representative samples of the attached plant and animal communities within a distance of 0.5 m from a weighted transect line. Each sample is labeled using waterproof labels to indicate that it is a qualitative sample. The transect line is 50 m in distance and therefore an area of 50 m^2 is covered. Transects run parallel to the breakwater. Typically, breakwaters are sampled on the inside and outside of the structure.

5.0 Soft Substrate Invertebrates and Plants

5.1. Epibenthos

Visual searches by divers to locate and collect representative samples of soft-bottom epibenthic species are to be carried out at selected sites as described in sections 2.2 and 2.3. Each individual sample for a location is labeled as qualitative sample using waterproof labels.

At each wharf to be sampled, divers will video a 50 m transect between one of the piles and the outer series of infaunal cores (see section 5.2), along a weighted transect line marked at 1m intervals. Video and 35 mm still photographs will also be taken at offshore dredge disposal sites and within kelp forests and seagrass meadows. Qualitative samples may also be taken during this sampling activity. Samples taken are labeled using waterproof labels.

5.2. Benthic Infauna

Divers will take infaunal samples using a tubular 0.025m^2 (17.9cm internal diameter) hand corer. The corer is 40 cm in length and marked (grooves) at 20 cm and 25 cm from the bottom to indicate the depth to which a core is taken. The upper end of the corer is closed except for a mesh-covered 8 cm diameter hole, which is sealed with a rubber bung to aid retention of the infaunal sample when the corer is withdrawn from the sediment.

When sampling around wharves, channel markers and facings, a core is taken from the bottom of each outer pile or facing sampled. A second set of three replicated cores are then taken 50 m directly out from the wharf/facing. Thus, for each wharf area sampled this provides a total of six core samples (three at the base of the piles/facings and three 50 m out from the piles/facings).

Each core sampled is transferred to a 1-mm mesh bag with a drawstring mouth and then sieved underwater, either in situ or after the divers returns to the surface. Each individual sample is labeled using waterproof labels. The retained sieved material is then washed into a plastic bag and preserved in 5% buffered formalin for subsequent sorting and identification in the laboratory.

To avoid the use of divers, core samples may also be taken using vessel deployed grab samplers (see Hewitt and Martin 2001). If using vessel deployed grab samples caution must be taken to ensure that the cores taken at the base of the piles/facings occurs within 1m out from the base of the pile/facing.

6.0 Fish

6.1. Poison Stations

Rotenone, clove oil or a similar poison is to be used to sample fish associated with shipwrecks, hulks, breakwaters and around the base of piles and facings. The poison is mixed according to instructions immediately before use and dispensed using squeeze bottles. Poisoned fish are collected by divers and snorklers using hand nets and either frozen or preserved in buffered 5% formalin for identification and photographing upon return to the laboratory. The use of poisons may require permits or may not be allowed within a region. In such cases an alternative method to poison sampling the fish must be negotiated with Biosecurity New Zealand.

6.2. Nets

Seine nets are to be used to collect fish on ocean beaches and in estuaries. All species of fish and invertebrate taken with the seine nets are to be recorded and a representative sample collected and preserved (frozen or buffered 5% formalin) for identification upon return to the laboratory. Each species collected must be photographed. The use of nets may require permits or may not be allowed within a region. In such cases an alternative method to net sampling the fish must be negotiated with Biosecurity New Zealand.

7.0 Environmental Data

7.1. Temperature, salinity and dissolved oxygen

A submersible data logger (SDL) equipped with pressure, conductivity and temperature sensors will be used to record data on salinity and water temperature at 0.5 m intervals from the surface to near bottom. Light levels will be estimated from Secchi disk readings. The researchers undertaking this work should also endeavour to collect existing salinity, water temperature and dissolved oxygen information from the region to provide a seasonal and temporal overview of the salinity and water temperature. It is expected that collected and existing data will be analysed and reported upon within the survey report. Field data is recorded on boat data sheets.

7.2. Sediment Analysis

7.2.1 Sediment Collection

Sediment samples (minimum 100 g wet weight) are to be taken for analysis of grain size and organic content, to characterise the habitats of any introduced epibenthic and infaunal species found. Samples are taken with each set of infaunal cores and at other selected sites. Thus as a minimum 2 sediment samples are collected (one at the base of the pile/facing and one 50 m out from the base of the pile/facing) when core samples are collected. The sediment is collected by divers using sealable plastic containers, which are then labeled and frozen to stabilise the organic content levels and returned to the laboratory for analysis.

7.2.2 Particle Size Analysis

After samples are thawed in the laboratory a sub-sample, approximately 25 g (dry weight), of sediment is taken for organic content analysis. The remaining sediment is wet-sieved through a 2mm mesh sieve and separated into <2 mm and > 2 mm fractions. Both fractions and the organic content sub-sampled are then oven dried at 80ºC (2-4 days). The two fractions are analysed as follows:

- > 2 mm fraction. The total fraction is dry-sieved through a nest of sieves and the fraction retained on each sieve (2, 2.8, 4, 5.6, and 8 mm meshes: 0.5 Phi intervals) is weighed. Sediment retained on the largest sieve includes all particles with size larger than 8 mm. The individual sieved weights are then added to the dry weight of the > 2 mm fraction to give a total dry weight for the entire sediment sample. The proportion of each component in the > 2 mm fraction is then calculated as a percentage of the total dry sample.
- < 2 mm fraction. The dry weight of the total < 2 mm fraction is measured to 0.01 g and the sediment or, depending on the amount available, a sub-sample (taken by "coning and quartering") is analysed using a Malvern Laser Particle Size Analyser. Particle size data from this analysis is then combined with data analysis of the > 2 mm fraction.

7.2.3 Organic Content

Approximately 25 g of dry, unsieved sediment is weighed in a crucible to 0.00001 g then ashed in a muffle furnace at 480ºC for 4 hrs. The crucible is allowed to cool before being reweighed. The difference between the net dry and net ash-free weights is then calculated. This difference, or weight loss, is expressed as a percentage of the initial dry weight and represents the organic content of the sediment sample.

8.0 References

Bolch, C. J. and Hallegraeff, G. M. 1990. Dinoflagellate cysts in recent marine sediments from Tasmania, Australia. Botanica Marina 33: 173-192.

Hewitt, C. L. and Martin, R. B. 1996. Port Surveys for Introduced Marine Species – Background Considerations and Sampling Protocols. CRIMP Technical Report 4. CSIRO Division of fisheries, Hobart.

Hewitt, C. L. and Martin, R. B. 2001. Revised Protocols for Port baseline Surveys for Introduced Marine Species – Survey Design, Sampling Protocols and Specimen Handling. CRIMP Technical Report 22. CSIRO Marine Research, Hobart.

Loeblich, A. R. 1975. A seawater medium for dinoflagellates and the nutrition of *Cachinina niei.* Journal of Phycology 11: 80-86.

Oshima, Y., Sugino, K., Yasumoto, T. 1989. Latest advances in HPLC analysis of paralytic shellfish toxins. pp 319-326. In: Natori, S., Hashimoto, K., Ueno, Y. (eds.). Mycotoxins and Phycotoxins '88. Elsevier Science Publishing Co., New York.

APPENDIX 2. GEOGRAPHIC LOCATIONS (NZGD49) OF SAMPLE SITES IN THE MILFORD SOUND INITIAL PORT BASELINE SURVEY

Site number	Site name	Easting	Northing	Survey method*	Number of sample units
1	Deep Water Basin 1	2106982	5601286	BCOR	3
1	Deep Water Basin 1	2107020	5601158	CRBTP	3
1	Deep Water Basin 1	2107039	5601161	CRBTP	3
1	Deep Water Basin 1	2107014	5601326	CYST	3
1	Deep Water Basin 1	2107095	5601177	PHYT	3
1	Deep Water Basin 1	2106982	5601286	SEDIMENT	1
1	Deep Water Basin 1	2107020	5601158	SHRTP	3
1	Deep Water Basin 1	2107039	5601161	SHRTP	3
1	Deep Water Basin 1	2108130	5601601	VISD	1
1	Deep Water Basin 1	2107055	5601159	ZOOP	3
2	Deep Water Basin 2	2108136	5601613	BCOR	3
2	Deep Water Basin 2	2108137	5601597	CYST	3
2	Deep Water Basin 2	2108136	5601613	SEDIMENT	2
2	Deep Water Basin 2	2108130	5601595	VISD	1
3	Deep Water Basin Jetties	2107539	5602114	BCOR	6
3	Deep Water Basin Jetties	2107338	5602144	CRBTP	3
3	Deep Water Basin Jetties	2107489	5602134	CRBTP	3
3	Deep Water Basin Jetties	2107539	5602114	CYST	6
3	Deep Water Basin Jetties	2107515	5601903	PHYT	3
3	Deep Water Basin Jetties	2107535	5602116	POIS	1
3	Deep Water Basin Jetties	2107535	5602116	PSC	6
3	Deep Water Basin Jetties	2107685	5601865	SEINE	3
3	Deep Water Basin Jetties	2107338	5602144	SHRTP	3
3	Deep Water Basin Jetties	2107489	5602134	SHRTP	3
3	Deep Water Basin Jetties	2107479	5601896	ZOOP	3
4	Deep Water Basin Slipways	2107581	5602133	CRBTP	3
4	Deep Water Basin Slipways	2107584	5602131	CRBTP	3
4	Deep Water Basin Slipways	2107581	5602133	SHRTP	3
4	Deep Water Basin Slipways	2107584	5602131	SHRTP	3
4	Deep Water Basin Slipways	2107581	5602133	VISD	1
4	Deep Water Basin Slipways	2107581	5602133	WRACK	1
5	Channel Marker No 2	2106683	5602978	PHYT	3
5	Channel Marker No 2	2106683	5602978	PSC	2
5	Channel Marker No 2	2106683	5602978	VISD	1
5	Channel Marker No 2	2106704	5602960	ZOOP	3
6	Sandfly Point Jetty	2106277	5601470	CRBTP	6
6	Sandfly Point Jetty	2106747	5601948	CYST	6
6	Sandfly Point Jetty	2106216	5601341	PHYT	3
6	Sandfly Point Jetty	2106277	5601470	SHRTP	6
6	Sandfly Point Jetty	2106277	5601470	VISD	1
6	Sandfly Point Jetty	2106608	5601709	ZOOP	3
7	Ferry Terminal 1	2107889	5603208	BCOR	6
7	Ferry Terminal 1	2107889	5603208	CYST	6
7	Ferry Terminal 1	2107954	5603236	POIS	1
7	Ferry Terminal 1	2107954	5603236	PSC	6
7	Ferry Terminal 1	2107889	5603208	SEDIMENT	2
7	Ferry Terminal 1	2107954	5603236	VISD	1
8	Ferry Terminal 2	2107930	5603187	CRBTP	6
8	Ferry Terminal 2	2107927	5603185	CYST	3

8	Ferry Terminal 2	2107900	5603172	PHYT	3
8	Ferry Terminal 2	2107927	5603185	PSC	6
8	Ferry Terminal 2	2107930	5603187	SHRTP	6
8	Ferry Terminal 2	2107927	5603185	VISD	1
8	Ferry Terminal 2	2107930	5603187	ZOOP	3
9	Freshwater Basin Mooring	2107527	5603080	PHYT	1
9	Freshwater Basin Mooring	2107595	5603046	PHYT	2
9	Freshwater Basin Mooring	2107527	5603080	VISD	1
9	Freshwater Basin Mooring	2107595	5603046	ZOOP	3
10	Harrison Cove	2106529	5607981	CRBTP	3
10	Harrison Cove	2106583	5607882	CRBTP	3
10	Harrison Cove	2106372	5607731	CYST	3
10	Harrison Cove	2106372	5607731	PHYT	1
10	Harrison Cove	2106485	5607846	PHYT	1
10	Harrison Cove	2106522	5607783	PHYT	1
10	Harrison Cove	2106529	5607981	PSC	9
10	Harrison Cove	2106529	5607981	VISD	1
10	Harrison Cove	2106497	5607934	ZOOP	3
11	Anita Bay	2096448	5611536	BCOR	3
11	Anita Bay	2096448	5611536	CYST	4
11	Anita Bay	2096448	5611536	PSC	9
11	Anita Bay	2096448	5611536	SEDIMENT	1
11	Anita Bay	2096448	5611536	VISD	1
12	Fox Point	2096482	5612121	CYST	3
12	Fox Point	2096482	5612252	VISD	1
13	Stirling Falls Wall	2103018	5609332	VISD	1
14	Pater Point	2104254	5606043	PSC	9
14	Pater Point	2104254	5606043	VISD	1
15	Copper Point	2101529	5608944	PSC	9
15	Copper Point	2101529	5608944	VISD	1
16	Stripe Point	2098399	5615822	BCOR	3
16	Stripe Point	2098399	5615822	CYST	3
16	Stripe Point	2098399	5615822	PHYT	3
16	Stripe Point	2098399	5615822	SEDIMENT	1
16	Stripe Point	2098601	5615809	ZOOP	3
17	Yates Point	2097821	5621993	PHYT	1
17	Yates Point	2097891	5621988	PHYT	2
17	Yates Point	2097946	5622025	VISD	1
17	Yates Point	2097897	5621998	ZOOP	1
17	Yates Point	2097946	5622025	ZOOP	1
17	Yates Point	2097950	5622048	ZOOP	1
18	Brig Rock	2096046	5618407	VISD	1
19	Saint Ann Point	2095930	5613029	VISD	1
21	Sea Breeze Point	2084626	5603947	CYST	3
21	Sea Breeze Point	2084389	5603976	PHYT	1
21	Sea Breeze Point	2084545	5603943	PHYT	1
21	Sea Breeze Point	2084626	5603947	PHYT	1
21	Sea Breeze Point	2084576	5603932	VISD	1
21	Sea Breeze Point	2084576	5603932	ZOOP	1
21	Sea Breeze Point	2084616	5603929	ZOOP	1
21	Sea Breeze Point	2084618	5603905	ZOOP	1
22	Poison Bay	2086277	5600044	ANCH	1
22	Poison Bay	2086309	5600001	ANCH	1

22	Poison Bay	2086335	5599942	ANCH	1
22	Poison Bay	2086250	5600060	CRBTP	3
22	Poison Bay	2086276	5600004	CRBTP	3
22	Poison Bay	2086277	5600044	CYST	1
22	Poison Bay	2086309	5600001	CYST	1
22	Poison Bay	2086335	5599942	CYST	1
22	Poison Bay	2086305	5600107	PHYT	1
22	Poison Bay	2086313	5600100	PHYT	1
22	Poison Bay	2086339	5600198	PHYT	1
22	Poison Bay	2086321	5599967	POIS	1
22	Poison Bay	2086382	5599945	SEDIMENT	1
22	Poison Bay	2086833	5599829	SEINE	3
22	Poison Bay	2086250	5600060	SHRTP	3
22	Poison Bay	2086276	5600004	SHRTP	3
22	Poison Bay	2086321	5599967	VISD	1
22	Poison Bay	2086937	5599881	WRACK	2
22	Poison Bay	2086339	5600092	ZOOP	1
22	Poison Bay	2086342	5600078	ZOOP	1
22	Poison Bay	2086356	5600058	ZOOP	1

*Survey methods: ANCH = anchor box dredge; BCOR = large benthic hand corer; CRBTP = crab trap; CYST = dinoflagellate cyst core; PHYT = phytoplankton net; POIS = fish poison station; PSC = pile scrape quadrats and diver observations on wharf pilings and hard substrata; SEDIMENT = sediment samples; SEINE = beach seine net; SHRTP = shrimp trap; VISD = visual diver transects; WRACK = beach wrack walks; ZOOP = zooplankton net.

APPENDIX 3: SAMPLING SITE/ METHOD COMBINATIONS SPECIFIED BY MAF BIOSECURITY NEW ZEALAND THAT WERE NOT CONDUCTED

Site number	Site name	Sampling method	Replicates	Reason for not sampling
4	Deep Water Basin Slipways	Beach wrack	5m & 10m from water edge	Shore not wide enough for searches at 5m or 10m up from shoreline
5	Channel Marker No 2	Cyst core	1-3	No sample obtainable - stoney/cobble benthos
6	Sandfly Point Jetty	Large hand core or anchor box dredge	1-6	No sample obtainable - stoney/cobble benthos
8	Ferry Terminal 2	Poison station	1	Ferry Terminal too busy - tour boat skippers unable to deviate from timetables and were therefore unable to guarantee divers safety for duration of poison station sampling
9	Freshwater Basin Mooring	Cyst core	1-3	No sample obtainable - stoney/cobble benthos
10	Harrison Cove	Large hand core or anchor box dredge	1-3	No sample obtainable - unsuitable substrate
10	Harrison Cove	Shrimp trap	1-6	Shrimp trap sampling accidentally ommitted
12	Fox Point	Large hand core or anchor box dredge	1-3	Substrate too hard
16	Stripe Point	Diver visual survey	1	No qualitative visual survey or photo stills/video due to extensive sandy benthos devoid of sessile fouling and fauna, and strong surge affecting visibility
17	Yates Point	Large hand core or anchor box dredge	1-3	No sample obtainable - rocky benthos
17	Yates Point	Cyst core	1-3	No sample obtainable - rocky benthos
20	Transit Beach	Beach seine net	1-3	Not possible to reach site due to heavy surf
20	Transit Beach	Beach wrack	2m, 5m & 10m from water edge	Not possible to reach site due to heavy surf
21	Sea Breeze Point	Large hand core or anchor box dredge	1-3	No sample obtainable - stoney/cobble benthos
22	Poison Bay	Beach wrack	5m & 10m from water edge	Shore not wide enough for searches at 5m or 10m up from shoreline

APPENDIX 4. MEDIA RELEASE CIRCULATED AS PART OF THE PUBLIC AWARENESS PROGRAMME

Media Release **31 August 2006**

Ports surveyed for marine pests

Researchers from the National Institute of Water & Atmospheric Research (NIWA) have recently surveyed ports at Milford Sound (Fiordland) and Taharoa Ironsands Terminal (Waikato) for foreign marine organisms.

The surveys were carried out in May and June as part of a nationwide port surveillance programme set up by Biosecurity New Zealand in 2001.

The surveys are designed to determine which non-native marine species have already become established and to develop a baseline for early detection of new pests. Additional surveillance surveys are targeted at eight problem species, two of which have been recorded in New Zealand.

A team of divers carried out a thorough search of all port and marina structures, seabed habitats, and beaches, collecting samples of plants, plankton, invertebrates, fish, and seafloor sediments. They also laid baited traps to collect crabs and shrimps. Video and still images were captured of seabed communities and fouling organisms to identify species growing on underwater structures such as wharf pilings.

The 1645 samples (1130 from Taharoa and 515 from Milford) are being distributed to experts in New Zealand and overseas for identification through Biosecurity New Zealand's Marine Invasives Taxonomic Service, managed by NIWA. This process will take several months.

Once identified, NIWA will report on each species' status (whether native, non-native, or of unknown status), its location at the surveyed ports, and its known distribution within New Zealand and globally. Biosecurity New Zealand will use this information to assess any management actions required. Their conclusions will be made publicly available.

'Port users and operators, including fishers and boat-owners, can play an active role in marine biosecurity by reporting the presence of new or unusual organisms to Biosecurity New Zealand', says NIWA survey project leader Dr Graeme Inglis.

To report suspicious finds, please phone the free Biosecurity New Zealand hotline:
0800 80 99 66.

For further information, please contact:

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Additional Information:

1. The Milford Sound survey was carried out from 7 to 14 June, covering the area from Deepwater Basin to Poison Bay.

2. The Taharoa Ironsands Terminal survey was carried out over 8 days from 23 May to 1 July. The survey area extended from Waioioi Reef to Waiohipa Stream.

3. The eight problem species targeted by additional surveillance are:
   - *Asterias amurensis* (North Pacific seastar)
   - *Carcinus maenas* (European shore crab),
   - *Caulerpa taxifolia* (aquarium weed)
   - *Eriochier sinensis* (Chinese mitten crab)
   - *Potamocorbula amurensis* (Asian clam)
   - *Sabella spallanzanii* (Mediterranean fanworm) *Styela clava* (clubbed tunicate - a seasquirt)*
   - *Undaria pinnatifida* (undaria – a type of seaweed)*

   * These species are known to be in New Zealand. The rest have not been recorded in New Zealand.

APPENDIX 5: 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 attached to each of their body segments as well as external gills. The anterior segments bear the tentacles used as sensory organs, tasting palps and eyespots, however, some are blind. 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 are 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 millimetres to many centimetres and superficially resemble spiders found on land.

Phylum Bacillariophyta

Diatoms: Diatoms are abundant unicellular organisms that are capable of inhabiting marine and freshwater environments. Their cell walls are made of silica which form radial or bilaterally symmetrical patterns. They reproduce asexually and produce energy via photosynthesis.

Phylum Brachiopoda

Brachiopods have a shell consisting of two valves that enclose the animal. Most living brachiopods are fixed to the substrate with a leathery holdfast called a pedicle. They feed via a lophophore; a cartilage based fan with flexible filaments. They are specialists in nutrient poor environments, have low metabolic rates and very small body to lophophore ratios.

Phylum Bryozoa

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.

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, most 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 sub Antarctic 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 Cyanobacteria

Cyanobacteria or blue-green algae are photosynthetic prokaryotes. They form a pigment during photosynthesis that leads to their blue-green colour and some species are also capable of fixing nitrogen under certain circumstances. They lack cilia and perform locomotion by gliding across surfaces. They also possess thick cell walls to protect them from desiccation. They show considerable morphological diversity and are found in a wide variety of terrestrial and aquatic habitats.

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 Echinodermata

Echinoderms: The phylum echinodermata is made up of five classes. They are: Crinoidea (sea lilies), Asteroidea (sea stars), Holothuroidea (sea cucumbers), Ophiuroidea (brittle stars), and Echinoidea (sea urchins). This phylum is an exclusively marine phylum that lack eyes or brains but have radially symmetrical body plans. Their most notable features are their external calcareous plates and spines from which they get their name (Echinoderm means 'spiny-skinned'). Internally they are unique as well with a hydraulic water vascular system that controls their movement and is monitored by the madreporite which controls their intake of water. They occupy a wide range of habitats including subtidal and intertidal zones.

Phylum Entoprocta
Superficially this phylum is very similar to the Bryozoans and both are referred to as moss animals. There are about 60 known species worldwide and all of them are small with no individual exceeding 1.5mm in length. They live in moss-like colonies containing thousands of individuals, forming mats of considerable size. Each animal is crowned with a circlet of ciliated tentacles, within which lies the mouth. The defining characteristic between entoprocts and bryozoans is the location of the anal opening. In entoprocts it is within the crown circlet, in bryozoans the anus is located outside the tentacles.

Phylum Haptophyta
Most species from this phylum are single-celled flagellates, also having amoeboid, coccoid, palmelloid or filamentous stages. The cells are golden or yellow-brown due to the presence of accessory pigments. It usually has two flagella of equal or sub equal length both of which are smooth and an appendage between them called a haptonema which may be used for capturing food. The surface of the cell is covered in granules and calcified scales may potentially be visible under a light microscope.

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.

Phylum Mollusca
Molluscs: There are 4 main classes of Mollusca which include Polyplacophora (Chitons), Gastropoda (marine snails, sea hares, nudibranchs and limpets), Bivalvia (mussels, clams, oysters), and Cephalopoda (squid, cuttlefish and octopus). They are a highly diverse group of marine animals characterised by the presence of an external or internal shell. There are two structures in this phylum that are found no where else in the animal kingdom; they are the mantle and the radula. The mantle is a fold in the body wall that secretes the calcareous shell which is typical of the phylum. The radula is a toothed, tongue or ribbon like organ variously modified for special feeding techniques.

Phylum Myzozoa
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 Nemertea
Ribbon worms: The ribbon worms are cylindrical to somewhat flattened, highly contractile, soft-bodied, unsegmented worms. Generally they are small but a few species can reach up to 6m in length. They are usually very slender, brightly coloured, and have an unusual anterior proboscis equipped with a sharp spine to capture prey. They live by either burrowing in sand,

living in algal clumps or mats or in oyster shells. They reproduce sexually as well as asexually by fragmentation.

Phylum Platyhelminthes
Flatworms: The flatworms are unsegmented, flattened, and very soft-bodied. The mouth is located ventrally near the midpoint of the animal or at the anterior end. There are three Classes of flatworm; Turbellaria, Trematoda, and the Cestoda. Many are very small but some can reach considerable sizes and they range in colour from very drab, transparent animals to ones with bright colours.

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 are a taxonomically difficult group of marine invertebrates. Most sponges possess skeletal support from need-like spicules and 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.

Phylum Sipuncula
Sipunculids: The phylum Sipuncula (peanut worms) is a group of unsegmented, marine coelomates that are closely related to annelids and molluscs. They have two body regions: a trunk and a more slender proboscis or introvert. This introvert lies enrolled in the body cavity of the animal giving it an oval or peanut shape and only when it is feeding does the introvert fold out. They have a variety of epidermal structures, such as papillae, hooks and shields. They live in a variety of habitats including burrows in silt and sand, under rock crevices and some species bore into coral or soft rock. They have also been known to inhabit the empty shells and tubes of other species.

APPENDIX 6: SPECIES INFORMATION SHEETS FOR EACH NON-INDIGENOUS AND CRYPTOGENIC CATEGORY 1 SPECIES RECORDED FROM THE MILFORD SOUND PORT SURVEY OR DESKTOP REVIEW OF EXISTING MARINE SPECIES RECORDS.

The species information sheets are designed to summarise basic information on the biology, ecology, distribution (international and national), and potential impacts of each of the non-indigenous and cryptogenic category one (C1) taxa that was recorded during the port baseline survey. They are modeled on similar fact sheets that have been developed for on-line databases on non-indigenous marine species elsewhere in the world (e.g NIMPIS, NISbase, NASbase, Global Invasive Species Database, NEMESIS, Baltic Sea Alien Species, etc). Information on each species was compiled from available literature, on-line databases on alien marine species, searchable databases with taxonomic and/or biogeographic data (e.g. ITIS, OBIS, Australian Faunal Directory, Algaebase, Fishbase, etc) and from background material provided by the specialist taxonomists who identified the specimens. Key published sources of information for each species are listed on the bottom of each sheet. Whilst the sources of all photographs and diagrams are acknowledged, we have not sought specific permission to use them.

Pathways for introduction and dispersal

Likely pathways for the introduction and spread of each species are classified according to the 22 vector categories used by Hayes et al. (2005) in recent risk profiling of priority Australian marine pests (Table 1). Three additional categories – N1, N2, N3 – have been added to describe different pathways for natural spread of the species within New Zealand. For each species, the likely pathways of introduction to New Zealand are largely derived from Cranfield et al. (1998), published information, or expert opinion. The categories met by any given species are indicated in its species information sheet.

Table 1: Potential pathways for the introduction and spread of non-indigenous species within New Zealand (after Hayes et al. 2005).

Code	Description
B1	Biocontrol: deliberate translocation as a biocontrol agent
B2	Biocontrol: accidental translocation with deliberate biocontrol release
C	Canals: natural range expansion through man-made canals
D	Debris: transport of species on human generated debris
F1	Fisheries: deliberate translocations of fish or shellfish to establish or support fishery
F2	Fisheries: accidental with deliberate translocations of fish or shellfish
F3	Fisheries: accidental with fishery products, packing or substrate
F4	Fisheries: accidental as bait
IR1	Individual release: deliberate release by individuals
IR2	Individual release: accidental release by individuals (e.g. aquarium discards)
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms
P1	Plant introductions: deliberate translocation of plant species (e.g. for erosion control)
P2	Plant introductions: accidental with deliberate plant translocations
RE	Recreational equipment: accidental with recreational equipment
S1	Ships: accidental as attached or free-living fouling organisms
S2	Ships: accidental with solid ballast (e.g. rocks, sand, etc)
S3	Ships: accidental with ballast water, sea water systems, live wells or other deck

	basins
S4	Ships: accidental associated with cargo
S5	Ships: accidental associated with dredge spoil
SP	Seaplanes: accidental as attached or free-living fouling organisms
SR1	Scientific research: deliberate release with research activities
SR2	Scientific research: accidental release with research activities
U	Unknown
N1	Natural: planktonic dispersal
N2	Natural: rafting of adults on biogenic substrata
N3	Natural: long-distance movement of adults

Potential impacts

The impacts on New Zealand ecosystems have not been documented for most species. Where detailed information is available on known impacts of the species here or overseas, this is included. "Potential impacts" were identified on the basis of the species' life habits or those of similar functional species. We classified "potential" impacts into the 15 categories used by Hayes et al. (2005) to evaluate the impacts of priority Australian marine pests (Table 2). The categories met by any given species are indicated in its species information sheet. Some species met none of the potential impact categories and therefore none of these categories are listed for those species.

Table 2: Categories used to identify potential impacts of each species (after Hayes et al. 2005).

Impact category	Code	Description
Human health	H1	Human health
Economic	M1	Aquatic transport
Economic	M2	Water abstraction/nuisance fouling
Economic	M3	Loss of aquaculture/commercial/recreational harvest
Economic	M4	Loss of public/tourist amenity
Economic	M5	Damage to marine structures/archaeology
Environmental	E1	Detrimental habitat modification
Environmental	E2	Alters trophic interactions and food-webs
Environmental	E3	Dominates/out competes and limits resources of native species.
Environmental	E4	Predation of native species
Environmental	E5	Introduces/facilitates new pathogens, parasites or other NIS
Environmental	E6	Alters bio-geochemical cycles
Environmental	E7	Induces novel behavioral or eco-physiological responses
Environmental	E8	Genetic impacts: hybridisation and introgression
Environmental	E9	Herbivory

Distribution maps

We followed the approach used by the Australian National Introduced Marine Pest Information System (NIMPIS) to present information on the global distribution of each species. NIMPIS uses a bioregional classification of the world's oceans developed by The World Conservation Union (IUCN) to define areas for conservation purposes (Kelleher et al. 1995). A conservative approach has been adopted whereby a species is considered present in all areas of a bioregion if it has been recorded from any location within that bioregion's boundaries[2]. Since bioregions represent environmentally similar geographic areas, if a species is present in one portion of a bioregion, there is a strong likelihood that it could spread via natural processes to other areas in that bioregion. Nonetheless, the species does not necessarily occur throughout the entire bioregion. In preparing the maps, published distribution information was not always precise, so if a location record indicated a whole country or large area of coastline and provided no further information, all regions encompassing that country or coastline were shaded on our maps. Also note that the species could occur in other (unshaded) regions, but we have not seen records for these regions. The same conditions apply to the New Zealand distribution maps, which divides New Zealand and its offshore islands into 16 regions (after Francis 1996).

We have made our best attempt to identify the provenance of each species. In each case we have attempted to identify: (1) the natural biogeographic range of the species ("native range"), (2) bioregions in which it has been introduced by humans (deliberately or inadvertently; "non-native" range), and (3) regions in which the species' provenance is uncertain ("cryptogenic" range). In many instances, the provenance for particular bioregions is not clear from existing distribution records. In some cases this is because we have not been able to access primary monographs or publications that might resolve this, but in most cases it is simply because the biogeographic information and/or systematics do not permit clear identification of provenance. In these instances, we have had to make our own interpretations of the information available to us.

References

Cranfield, H.; Gordon, D.; Willan, R.; Marshall, B.; Battershill, C.; Francis, M.; Nelson, W.; Glasby, C.; Read, G. (1998). Adventive marine species in New Zealand. NIWA technical report No. 34. Hamilton, NIWA.

Francis, M.P. (1996). Geographic distribution of marine reef fishes in the New Zealand region. *New Zealand Journal of Marine and Freshwater Research* 30: 35-55.

Kelleher, G., Bleakley, C. and Wells, S. (1995), A Global Representative System of Marine Protected Areas, The World Bank, Washington, USA

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia. 102 p

[2] The geographic locations of each sample in which the species was found during the New Zealand port baseline surveys are available within the BIODS database associated with this project.

Scientific name: *Champia affinis* (J.D. Hooker & Harvey) Harvey
Common name: None

Image: Adams (1994)

Species information sheet prepared by:	NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Rhodophyta
Class: Florideophyceae
Order: Rhodymeniales
Family: Champiaceae

General species description:
Champia affinis is a red alga up to 18 cm in height, pinnately much-branched from a main stem. The holdfast is a basal disc. It is pink in colour and has a soft and flaccid texture (Adams 1994).

Distribution:
The native range of *C. affinis* is thought to be southern Australia. Extralimital records have been reported from Sri Lanka and New Zealand (Guiry 2006) (Figure 1).

In New Zealand *C. affinis* has been reported from Otago Harbour, Preservation Inlet in Fiordland and Port Pegasus, Stewart Island (Adams 1994; Nelson et al. 2002) (Figure 2).

During the New Zealand port baseline surveys, *C. affinis* was recorded from Port Chalmers in Otago Harbour, Dunedin (Figure 2).

Ecology (habitat & known interactions):
C. affinis occurs on a range of hard substrata and as detached plants. It is found predominantly subtidally in sheltered harbours and inlets and is unable to persist on open coast environments (Adams 1994; Nelson et al. 2002).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
N1	Natural: planktonic dispersal		Yes (broadcast spores)
N3	Natural: long-distance movement of adults		Yes (as detached plants)
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
The impacts of this species in its introduced range are currently unknown, although it is not considered to be a threat to native flora and fauna (Nelson et al. 2002).

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:

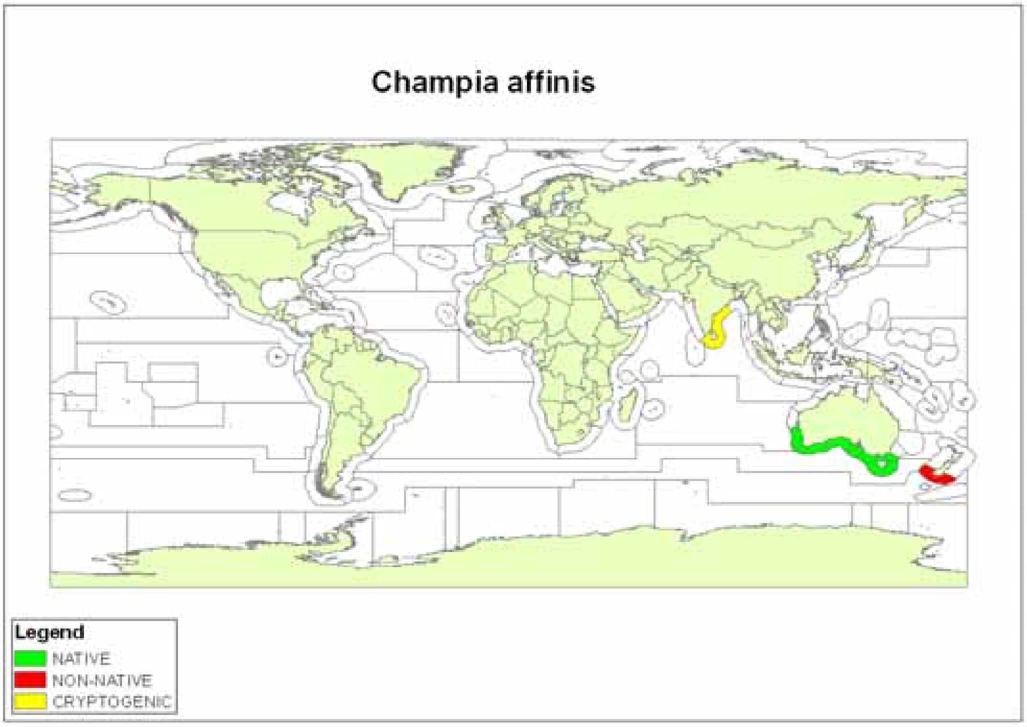


Figure 1: Global distribution of *Champia affinis*

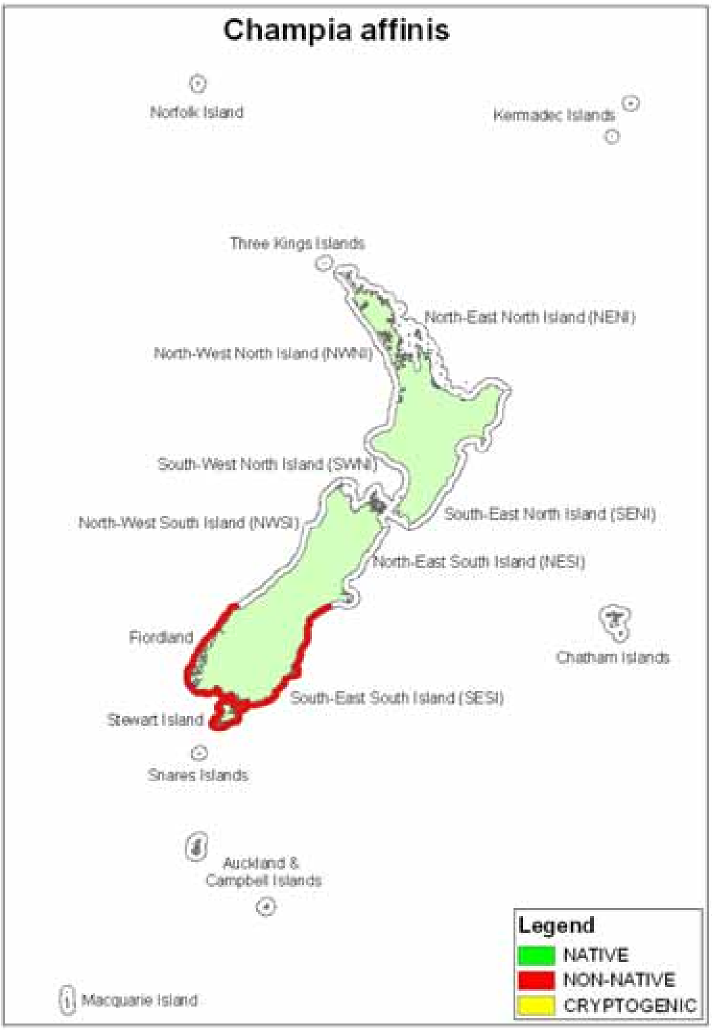


Figure 2: Distribution of *Champia affinis* in New Zealand

References:

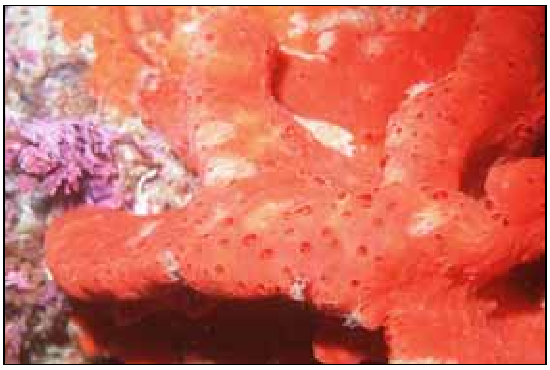
Adams, N. (1994). Seaweeds of New Zealand: an illustrated guide. Canterbury University Press, Christchurch. 360 p.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.

Scientific name: *Crella incrustans* (Carter, 1885) *sensu* Bergquist & Fromont (1988)
Common name: None

Images by Coral Reef Research Foundation, Micronesia

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Demospongiae
Order: Poecilosclerida
Family: Crellidae

General species description:
Crella incrustans (Carter, 1885) *sensu* Bergquist & Fromont (1988) may be either encrusting or lamellate, with palm-like branches extending from a basal mass. The colour in life is typically bright red to orange yellow. The texture is compressible and elastic but tough and fibrous. The surface is distinctly fibrous with channels in the surface. The sponges vary in size but are typically c. 100 mm long, 50 mm wide, 0.1 cm thick.

Distribution:
This sponge was originally described as *Anchinoe novaezelandiae* Dendy, 1924, from North Cape, 26-55 m. Hallman (1914) transferred this to the "cosmopolitan species" *Crella incrustans* (Carter, 1885), first described from Atlantic coasts by Carter in the 1800s, and later by Hallman and Lendenfeld and others from south-east Australian coasts. Although Bergquist & Fromont (1988) concurred with this transfer, it should be treated with caution as Dendy was a highly reputable taxonomist and would have had access to literature and type specimens from the British Museum of Natural History for comparison with the New Zealand material. Even though the species is widespread throughout New Zealand and is common subtidally as well as intertidally (and might therefore be thought to be native to New Zealand), without examination of type material in conjunction with New Zealand material, its status in New Zealand can only be considered cryptogenic at best.

During the New Zealand baseline port surveys, *Crella incrustans* was found at Napier, Dunedin, Wellington, Whangarei, Timaru and Picton (Figure 1). There are also records for the Three Kings Islands, Stewart Island, the Auckland and Campbell Islands, Doubtful Sound and Kaikoura (M. Kelly, NIWA, Unpublished records).

Ecology (habitat & known interactions):
This species is extremely common in New Zealand waters, in the intertidal and subtidal regions, and has been recorded to a depth of greater than 60 m (Bergquist and Fromont 1988).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Crella incrustans (Carter, 1885) has no known ecological impacts on New Zealand intertidal and subtidal communities, despite it being relatively common.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
A map of the global distribution of *Crella incrustans* is not provided, as the global distribution of this species is disparate and does not make sense biogeographically. This is most likely due to there being insufficient diagnostic characters available in the older literature (when specimens were never described in the fresh state) to distinguish from contemporary specimens at today. Moreover, 'cosmopolitanism' of certain species was a widely held phenomenon in the biology community and the sponge community also concurred with this notion. Today we are certain that this notion is not valid except in a few select cases. Thus, further taxonomic work might indicate that the New Zealand specimens are actually different species to those with the same name elsewhere in the world (see also “Distribution” section above).

The map which illustrates the New Zealand regions from which *Crella incrustans* has been recorded is shown below (Figure 1).

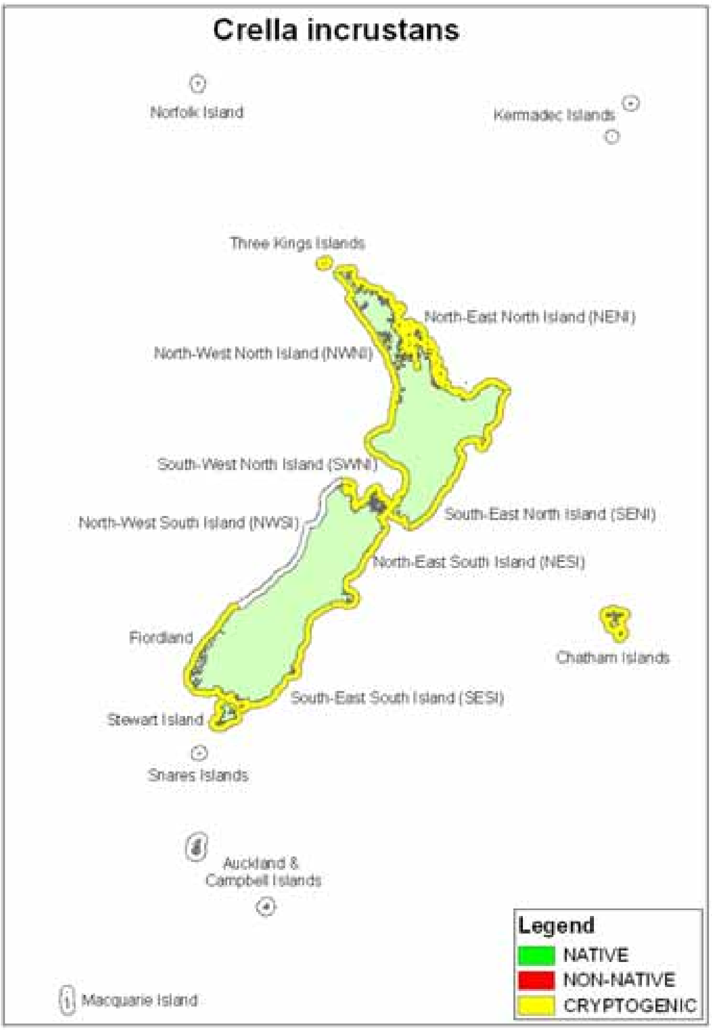


Figure 1: Distribution of *Crella incrustans* in New Zealand

References:

Bergquist, P.R.; Fromont, P.J. (1988). The Marine fauna of New Zealand: Porifera, Demospongiae, Part 4 (Poecilosclerida). New Zealand Oceanographic Institute Memoir 96. 197 p.

Hallman, E. (1914). A revision of the monaxonid species described as new in Lendenfeld's "Catalogue of the sponges in the Australian Museum". Part I. Proceedings of the Linnean Society of New South Wales 39: 263-315.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Scientific name: *Didemnum* sp.
Common name: None

Image by Mike Page, NIWA

Species information sheet prepared by:	Mike Page (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Tunicata
Class: Ascidiacea
Order: Enterogona
Family: Didemnidae

General species description:
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.

Distribution:
Didemnum is a diverse and cosmopolitan genus, occurring around all continents, including polar regions. The geographic range of many species is extensive, from the western tropical Pacific to tropical Australia. Temperate species are less diverse (Kott 2001). Indigenous species in Australian waters abound. *Didemnum* is the most difficult of ascidian genera to identify. (Millar 1982) casts doubt on the identity of many early descriptions of New Zealand didemnids (Croxall 1972). This genus is cryptogenic, and requires further detailed collection and revision to identify true diversity and biogeography in New Zealand. Kott et al. (2002)

recognized seven species of *Didemnum* in New Zealand, and further emphasized the need for systematic collection and taxonomy to understand this group for the use and management of marine resources. Because of difficulty distinguishing between species, most *Didemnum* species collected for port surveys were grouped together.

During the New Zealand baseline port surveys, *Didemnum* sp. has been found at the ports of Gisborne, Auckland, Bluff, Dunedin (Otago), Timaru, Tauranga, Wellington, New Plymouth, Picton, Nelson, Lyttelton and Milford Sound.

Ecology (habitat & known interactions):
Didemnum species occupy a wide range of habitats from artificial structures in ports and estuarine environments to deep subtidal reefs. None have been identified in abyssal depths. Exponential growth of colonies by budding of zooids enables this genus to cover substrata and overgrow other benthic species at an alarming rate.

Potential pathways for introduction to and spread within New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
D	Debris: transport of species on human generated debris		Yes
F2	Fisheries: accidental with deliberate translocations of fish or shellfish		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
RE	Recreational equipment: accidental with recreational equipment		Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes
N1	Natural: planktonic dispersal		Yes
N2	Natural: rafting of adults on biogenic substrata		Yes

Potential impacts in New Zealand:
Didemnum species are common in ports, harbours and on vessel hulls. Because of rapid growth in ideal conditions, and the ability shed fragments and recolonize substrata, the species of this cryptogenic genus are considered high-risk.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M1	Aquatic transport
Economic	M2	Water abstraction/nuisance fouling
Economic	M3	Loss of aquaculture/commercial/recreational harvest
Economic	M4	Loss of public/tourist amenity
Environmental	E2	Alters trophic interactions and food-webs
Environmental	E3	Dominates/ outcompetes and limits resources of native species

Global and New Zealand distribution maps:
Distribution maps were not prepared for *Didemnum* sp. because different species within the genus have different distributions, and due to the taxonomic difficulties in identifying the species it is uncertain which species of *Didemnum* occur in Milford Sound.

References:

Croxall, J.P. (1972). A check-list of New Zealand ascidians, with preliminary notes on their distribution. *Tane 18*: 177-185.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Kott, P. (2001). The Australian ascidiacea Pt. 4, Didemnidae. *Memoirs of the Queensland Museum 47(1)*: 1-410.

Kott, P. (2002). A complex didemnid ascidian from Whangamata, New Zealand. *Journal of Marine Biology Association of the United Kingdom 82*: 625-628.

Kott, P. (2004a). New and little-known species of Didemnidae (Ascidiacea, Tunicata) from Australia (part 2). *Journal of Natural History 38*: 2455-2526.

Kott, P. (2004b). A new species of *Didemnum* (Ascidiacea, Tunicata) from the Atlantic coast of North America. *Zootaxa 732*: 1-10.

Kott, P.; Bradford-Greive, J.; Esnal, G.; Murdoch, R. (2002). Phylum Tunicata: Sea squirts, salps and appendicularians. *In*: Gordon, D.P. (ed.). Species 2000 : New Zealand - the challenge of biodiversity assessment, with special reference to the marine environment, pp. 75. New Zealand National Institute of Water and Atmospheric Research, Wellington.

Millar, R. (1982). The marine fauna of New Zealand: Ascidiacea. New Zealand Oceanographic Memoir 85.

Scientific names: *Alexandrium affine* (Inoue et Fukuyo) Balech 1984
Alexandrium minutum Halim 1960
Alexandrium ostenfeldii (Paulsen) Balech & Tangen
Alexandrium tamarense (Lebour, 1925) Balech, 1985
Alexandrium catenella (Whedon and Kofoid) Balech 1985
Gymnodinium catenatum Graham 1943

Common name: Dinoflagellates

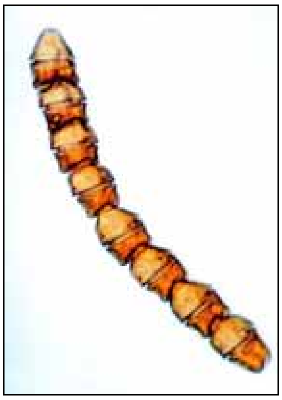


Image: *Gymnodinium catenatum* (courtesy of F.H. Chang, NIWA).

Species information sheet prepared by:	Dr F. Hoe Chang (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1 for all species listed above
Species recorded during New Zealand port baseline surveys:	*Alexandrium affine* *Alexandrium ostenfeldii* *Alexandrium catenella* *Alexandrium tamarense* *Gymnodinium catenatum*
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	*Alexandrium minutum* *Alexandrium ostenfeldii* *Gymnodinium catenatum*

Taxonomy:
Phylum: Myzozoa
Class: Dinophyceae
Order: Gonyaulacales (for genus *Alexandrium*)
Gymnodiniales (for genus *Gymnodinium*)
Family: Goniodomataceae (for genus *Alexandrium*)
Gymnodiniaceae (for genus *Gymnodinium*)

General description:
Dinoflagellates are single-celled,eukaryotic organisms with a large nucleus with clearly visible chromosomes. Approximately 50 % of the species are photosynthetic. They have two flagella, one protruding from the horizontal girdle groove and the other from the vertical sulcus groove. "Unarmoured" species are bounded by a membranous covering only while "armoured" species have a covering of cellulose plates (Hallegraeff 1991).

Alexandrium affine is an armoured chain-forming (2 - 8 cells long) species of medium sized cells that are slightly longer (26.4 – 44 µm) than wide (24.5-44 µm) and dorso-ventrally flattened (Faust and Gulledge 2002).

Alexandrium minutum is a small armoured species. The cells are nearly spherical to ellipsoidal (16-25 µm), somewhat dorsoventrally flattened, occasionally longer than wide, and occur as single cells or rarely in pairs (Chang et al. 1997; Faust and Gulledge 2002).

Alexandrium ostenfeldii is an armoured species with large, nearly spherical cells. Cells are single, ranging in size between 40-56 µm in length and 40-50 µm in transdiameter width, but are often found in two-celled chains. *A. ostenfeldii* is a photosynthetic species with radiating chloroplasts. The nucleus is U-shaped and equatorial (Faust and Gulledge 2002).

Alexandrium tamarense is an armoured species with small to medium sized cells, nearly spherical, slightly longer than wide, and occurs either as single cells or in pairs. The size and shape of this species is highly variable: cells range in size between 22-38 µm in length and 17-44 µm in transdiameter width. It is a photosynthetic species with a number of orange-brown chloroplasts. A lunar-shaped nucleus is situated ventrally just inside the cingulum (Faust and Gulledge 2002).

Alexandrium catenella is an armoured planktonic species. It most often occurs in short chains of 2, 4 or 8 cells long, which swim together in a snake-like fashion. The cells are often anterio-posteriorly compressed, 20-48 µm long and 18-32 µm wide (Hallegraeff 1991; Faust and Gulledge 2002). *A. catenella* is a photosynthetic species with numerous yellow-green to orange-brown chloroplasts. The nucleus is large and U-shaped (Faust and Gulledge 2002).

Gymnodinium catenatum is an unarmoured species. It is typically seen in chain formation with up to 64 cells (see figure, above), but may also occur as single cells. Single cells are generally elongate-ovoid with slight dorso-ventral compression. Chain formers, in general, are squarish-ovoid with anterior-posterior compression. Single cells range in size from 27-43 µm in width to 34-65 µm in length. Chain-forming cells are slightly smaller with sizes ranging from 27-43 µm in width to 23-60 µm in length; terminal cells are slightly larger, similar to single cells. It is a photosynthetic species with numerous yellow-brown chloroplasts (Faust and Gulledge 2002; Kraberg and Montagnes 2007).

Distribution:
Being planktonic, most dinoflagellates, including those considered here, are widely distributed throughout the world's oceans. Distribution records for these species tend to be scattered and they often reflect sampling effort; the lack of a record from a particular location is more likely to represent the lack of sampling in that location than the true absence of the species.

Alexandrium affine is a coastal species which has been recorded from Japan, the Gulf of Thailand, the Philippines, Malaysia, Vietnam, Korea, France, Spain, Mexico, Gulf of California (USA), Australia, and from the north-east of the North and South Islands of New Zealand (Guiry 2006; Kraberg and Montagnes 2007) (Figure 1). During the New Zealand port baseline surveys *A. affine* was recorded from New Plymouth (Chang et al. in press) and Taharoa. The New Plymouth record occurred in a sample from the second baseline survey of New Plymouth, but was not identified until much later, because cysts were required to hatch before the taxonomist was able to make a positive identification. It was therefore not reported in the New Plymouth second baseline port survey report.

Alexandrium minutum is a cosmopolitan species and is mainly found in coastal areas of many parts of the world. The type locality is Alexandria, Egypt. It has also been recorded from Denmark, England, Ireland, France, Italy, northern Adriatic waters (Mediterranean Sea), Turkey, Spain, Portugal, France, the east coast of the United States, Taiwan, Peninsular Malaysia, Vietnam, Thailand, India, South Australia and New Zealand (Chang et al. 1999; Faust and Gulledge 2002; Lin et al. 2007). In New Zealand it has been reported in the Bay of Plenty, north-east coast of North Island, Cape Egmont, the Marlborough Sounds, Dunedin and Bluff (Smith et al. 1993; Chang et al. 1999). During the New Zealand port baseline surveys, cysts of *A. minutum* were collected from the second baseline surveys of Lyttelton, Tauranga and Auckland (Chang et al. in press) (Figure 2). Cysts were required to be hatched before positive identifications could be made, and this inevitable delay resulted in the Lyttelton and Tauranga specimens not being identified until after the reports had been published for these two ports. The report for the second baseline port survey of Auckland is in preparation.

Alexandrium ostenfeldii is generally a cold-water coastal / estuarine planktonic species found in Denmark, Belgium Norway, Spain and Iceland. Recently, it has been discovered in Alexandria Harbor, Egypt, and also off Washington State, U.S.A. Populations have also been observed from British Columbia and the Kamchatka Peninsula in the north Pacific Ocean. In the northwest Atlantic Ocean, cells have been reported in Canada from the Gulf of St. Lawrence and southeastern Nova Scotia (Faust and Gulledge 2002). In the southwest Pacific this species has also been found in Australia and New Zealand. In New Zealand, it has been recorded from all coasts of the North and South Islands, except the north-west South Island (despite sampling having been conducted for it in Westport and Nelson, MacKenzie et al. 1996). During the New Zealand port baseline surveys, *A. ostenfeldii* was not recorded from any of the major ports, but was recorded from Taharoa (Figure 3). Analyses of toxin composition in the various New Zealand populations of *A. ostenfeldii* suggest that this species may be part of New Zealand's indigenous marine dinoflagellate flora, rather than a non-indigenous species (MacKenzie et al. 1996). As this has not been confirmed, it is treated as a cryptogenic category one (C1) species here.

Alexandrium tamarense is widely distributed in coastal and estuarine environments, mainly in cold to cold-temperate waters. Records include Nova Scotia and Quebec in north-east North America, England and Ireland in Europe, South Africa in Africa, and the Peoples Republic of China, Korea and Japan in Asia. It has also been reported from warmer waters around the world, including Australia, New Zealand, Venezuela, Malaysia and the Gulf of Thailand (Faust and Gulledge 2002; MacKenzie et al. 2004). During the New Zealand port baseline surveys, *A. tamarense* was recorded from Tauranga, Taharoa and Milford Sound (Figure 4).

Alexandrium catenella is widely distributed in cold temperate coastal waters. Populations have been recorded from the west coast of North America (from California to Alaska), Chile, Argentina, western South Africa, Japan, Australia (Port Phillip Bay and Tasmania), and the Bay of Plenty in New Zealand (Hallegraeff 1991; Hay et al. 2000; Chang 2002; Faust and Gulledge 2002; MacKenzie et al. 2004). During the New Zealand port baseline surveys, *A. catenella* was recorded from Taharoa, and cysts identified as *Alexandrium* cf. *catenella* were recorded from the ports of Bluff and Whangarei (Figure 5).

Gymnodinium catenatum is planktonic and mainly found in warm, temperate coastal waters. Its native range is unknown. Populations of this species have been recorded from the Pacific coast of Mexico and the USA, Argentina, Uruguay, Venezuela, Morocco, Spain, Portugal, Singapore, Malaysia, the Philippines, the Gulf of Thailand, Korea, Japan, Hong Kong, Australia and New Zealand. Whilst definitive proof is impossible, the available evidence indicates that it was introduced to Australasia during the past 100 years, most probably via ballast water from bulk-cargo shipping from Japan and/ or south-east Asia (Bolch and de Salas 2007). *Gymnodinium catenatum* was first recorded in New Zealand in the year 2000, from Ninety Mile Beach in the far north-west of the North Island (Taylor and MacKenzie 2001). It has since been recorded from a variety of locations throughout the North Island of New Zealand, and in Port Underwood in the north of the South Island (Taylor and MacKenzie 2001). During the New Zealand port baseline surveys, *G. catenatum* was recorded from the ports of Opua, Whangarei, Auckland, Gisborne, Napier, Taharoa, New Plymouth and Wellington (Figure 6).

Ecology (life history, habitat & known interactions):
A study by Band-Schmidt et al. (2003) has shown *Alexandrium affine* to be homothallic (not of different sexes; able to fertilise itself) and isogamous (having haploid gametes similar in size, structure and motility), and to form cysts in nutrient-deficient mediums. In this study, the rate of cyst germination increased with increasing temperature, and was not significantly affected by light. The optimal temperature for vegetative cells was 20-30 °C. No vegetative growth was observed below 15 °C or above 35 °C.

Alexandrium minutum produces dense (reddish-brown) red tides (Hallegraeff 1991). It reproduces asexually by binary fission and also has a sexual cycle that produces a characteristic resting cyst. This species produces a clear resting mucilage-covered cyst as part of its life cycle. Cysts vary from hemispherical to circular in shape: cyst circular in apical view (24-29 µm in diameter) and kidney-shaped in lateral view (15-19 µm long) (Faust and Gulledge 2002). Studies of the *A. minutum* blooms in the Bay of Plenty showed that the appearance of this species coincided with enhanced rainfall and freshwater runoff and with stabilization of the water column. Cyst beds and low salinities are probably necessary to initiate a bloom (Chang et al. 1996).

Alexandrium ostenfeldii produces temporary resting cysts. Cysts are large and spherical, ranging in size from 35 to 40 µm in diameter. Cysts are pale in color with a reddish-brown granule. The smooth and clear cell wall is covered with mucilage (MacKenzie et al. 1996). *A. ostenfeldii* reproduces asexually by binary fission. This species also has a sexual cycle with isogamous mating types; a planozygote is formed (Faust and Gulledge 2002). *Alexandrium ostenfeldii* is a member of the "hidden flora" assemblage easily overlooked in field surveys until its modest blooms occur. It often co-occurs with *Alexandrium tamarense*, with which it can be confused taxonomically.

Alexandrium tamarense produces an ellipsoidal resting cyst that cannot be distinguished from the cyst produced by its conspecific *A. catenella*. This cyst has rounded ends with a thick cell wall, and is covered in mucilage. Cysts often contain colorless granules and distinct reddish lipid bodies. Size ranges from 36-56 µm in length and 23-32 µm in width. *A. tamarense* reproduces asexually by binary fission; the plane of fission is oblique. This species also has a sexual cycle with anisogamous mating types (ie. the gametes differ morphologically from each other). The gametes join laterally for sexual fusion, produce a planozygote which then encysts into a characteristic resting cyst (Faust and Gulledge 2002). *A. tamarense* blooms in Japan have been demonstrated to initiate from in-situ cyst populations (Shimada et al. 1996). High concentrations of *A. tamarense* have also been linked to freshwater plumes generated by a highly stratified water column which favours proliferation and retention of this species in the upper water column (Anderson 1998).

Alexandrium catenella reproduces asexually by binary fission. This species also has a sexual cycle with opposite mating types (heterothallism). After gamete fusion, a planozygote forms which then encysts into a characteristic resting cyst (Faust and Gulledge 2002). *A. catenella* produces a colourless mucoid resting cyst as part of its life cycle, which cannot be distinguished from the cyst produced by *A. tamarense*. The cyst is of roughy ellipsoidal shape with rounded ends (35-56 µm long) as part of its lifecycle (Hallegraeff 1991; Faust and Gulledge 2002).

Gymnodinium catenatum reproduces asexually by binary fission. This species also has a sexual cycle with opposite mating types (heterothallism). After gamete fusion, a planozygote forms, and after two weeks, this form encysts into a characteristic resting cyst. Nutrient deficiency induces the sexual phase. *G. catenatum* produces a characteristic resting cyst. Cysts are 42-52 µm in diameter, spherical and brown. They have a very distinct morphology: the surface is covered with microreticulate ornamentations. These cysts can germinate after just two weeks of dormancy and initiate new populations. Cysts are not only a reseeding tool, but also assist in dispersal; for example, *G. catenatum* was introduced to Australian waters via ships' ballast water (Faust and Gulledge 2002). Blooms of *G. catenatum* in Tasmania tend to occur mainly in the period from December to June (spring and autumn), when the water temperatures range from 12 to 18 °C and salinities range from 28 to 34 ppt. These blooms also tend to be confined to the humus-laden Huon and Derwent Rivers and appear to require a rainfall as a trigger. However, blooms of *G. catenatum* in Spain were commonly reported inside the rias at the end of summer, when the upwelling favourable winds relax, or when they reverse in their direction and become southerlies (Hallegraeff and Fraga 1998).

Potential pathways for introduction to, and spread within, New Zealand:

Table 1: Potential pathways for introduction to, and spread within, New Zealand, for the dinoflagellates covered in this species information sheet.

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F2	Fisheries: accidental with deliberate translocations of fish or shellfish	Yes	Yes
S3	Ships: accidental with ballast water, sea water systems, live wells, etc.	Yes	Yes
N1	Natural: planktonic dispersal	Yes	Yes

Potential impacts in New Zealand:
The potential impacts of these dinoflagellates are summarized in Table 2 and further detail is provided below for each species.

Table 2: Potential impacts in New Zealand of the dinoflagellates covered in this species information sheet.

Impact category	Code	Description (after Hayes et al. 2005)
Human health	H1	Human health
Economic	M2	Water abstraction/nuisance fouling
Economic	M3	Loss of aquaculture/commercial/recreational harvest
Economic	M4	Loss of public/tourist amenity
Environmental	E2	Alters trophic interactions and food-webs

Alexandrium affine is generally considered non-toxic (Band-Schmidt et al. 2003). Although low toxicity (PSP) has been confirmed to occur occasionally in some cultured strains of *A. affine*, toxicity is only a fraction of that produced by *A. tamarense*.

Alexandrium minutum is a strong producer of paralytic shellfish poison (PSP) gonyautoxins (GTXs) and neosaxitoxin (neoSTX) (Chang et al. 1997). *A. minutum* was the first species to be associated with PSP outbreaks in New Zealand (Chang et al. 1995). These toxins can affect humans, other mammals, birds and possibly fish (Hallegraeff 1991). This species is also responsible for PSP events in Taiwan, South Australia, and France.

Alexandrium ostenfeldii is capable of producing PSP toxins, although it is one of the least toxic of all the *Alexandrium* species tested for PSP toxins. This species has been associated with shellfish poisoning in Scandinavia, and there has been one report of mussel toxicity (as *Pyrodinium phoneus*) from Belgium. Recently, western Atlantic strains of *A. ostenfeldii* have been found to produce spirolides, fast-acting neurotoxins, in aquaculture shellfish from Nova Scotia, Canada (Faust and Gulledge 2002). Resting cysts have been discovered in abundance at some locations around New Zealand, suggesting that substantial *A. ostenfeldii* blooms may have occurred around New Zealand in the recent past, and the species may present a hazard to shellfish consumers in New Zealand (MacKenzie et al. 1996).

Alexandrium tamarense is a widely distributed coastal and estuarine planktonic marine dinoflagellate that is associated with toxic Paralytic Shellfish Poisoning blooms (Hay et al. 2000; Faust and Gulledge 2002; New Zealand Food Safety Authority 2003). This species produces very potent PSP neurotoxins which can affect humans, other mammals, fish and birds (Larsen and Moestrup 1989, in Faust and Gulledge 2002). This species is responsible for numerous human illnesses and several deaths after consumption of infected shellfish, including ten deaths in Venezuela in 1977, and one death in Thailand in 1984. Resting cysts of *A. tamarense* can also harbor PSP toxins and may be more than ten times as toxic as their motile stage counterparts. Not all strains of *A. tamarense* are toxic: both toxic and non-toxic strains have been reported in New England within the same red tide event. Strains in Australia, the Gulf of Thailand, and the River Tamar estuary in Britain (the type locality) are all non-toxic. Hay et al. (2000) reported on the specific toxicity of strains of several *Alexandrium* species found in New Zealand, but the toxicity of *Alexandrium tamarense* (from Tasman Bay) was reported as "unknown". The usual route of PSP toxin transmission is via contaminated shellfish; however, bloom events of *A. tamarense* have been linked to several massive fish kills. Kills of Atlantic herring in the Bay of Fundy, Canada, and rainbow trout and salmon in the Faroe Islands, Norway have been attributed to dinoflagellate toxins accumulated in the food chain (Faust and Gulledge 2002).

Alexandrium catenella produces strong PSP, c1-c4 toxins, saxitoxins (SXT) and gonyautoxins (GTX). These toxins can poison shellfish and, via shellfish consumption, affect humans, other mammals, fish and birds. Numerous human illnesses and several deaths have occurred after consumption of shellfish infected with *Alexandrium catenella.* Ichthyotoxins (toxins that poison fish) have also been reported in cultured media of *A. catenella* . Red tides of this species have also been observed. Toxic blooms and PSP in shellfish have been reported in Chile, Japan, California and most of the Pacific coast of the U.S.A. (Faust and Gulledge 2002). Highest toxicity along the Pacific coast of the USA occurs in July and August during outbreaks that occur when coastal upwelling decreases in intensity (Bigelow Laboratory 2008). In New Zealand *A. catenella* has been associated with toxic blooms in the Bay of Plenty (Chang 2002).

Gymnodinium catenatum is the only gymnodinioid that is capable of producing PSP. Toxin profiles of different populations of *G. catenatum* show quite different toxin components. The Spanish strains tend to produce a high proportion of the low potency sulfocarbamoyl toxins, while strains in warmer waters from Singapore tend to produce highly potent carbamate gonyautoxin as dominant (GTX1 and 4), with lesser amount of GTX2, GTX3, neosaxitoxin (neoSTX) and saxitoxin (STX).

Global and New Zealand distribution maps:

Being planktonic, most dinoflagellates, including those considered here, are widely distributed throughout the world's oceans. Distribution records for these species tend to be scattered and they often reflect sampling effort; the lack of a record from a particular location is more likely to represent the lack of sampling in that location than the true absence of the species. Global distribution maps are therefore not provided here as mapping the known records would suggest disjunct coastal distributions, whereas the true distributions are cosmopolitan, and both oceanic as well as coastal.

Maps illustrating the New Zealand region from which each species has been recorded are shown below.

Figure 1: Distribution of *Alexandrium affine* in New Zealand

Figure 2: Distribution of *Alexandrium minutum* in New Zealand

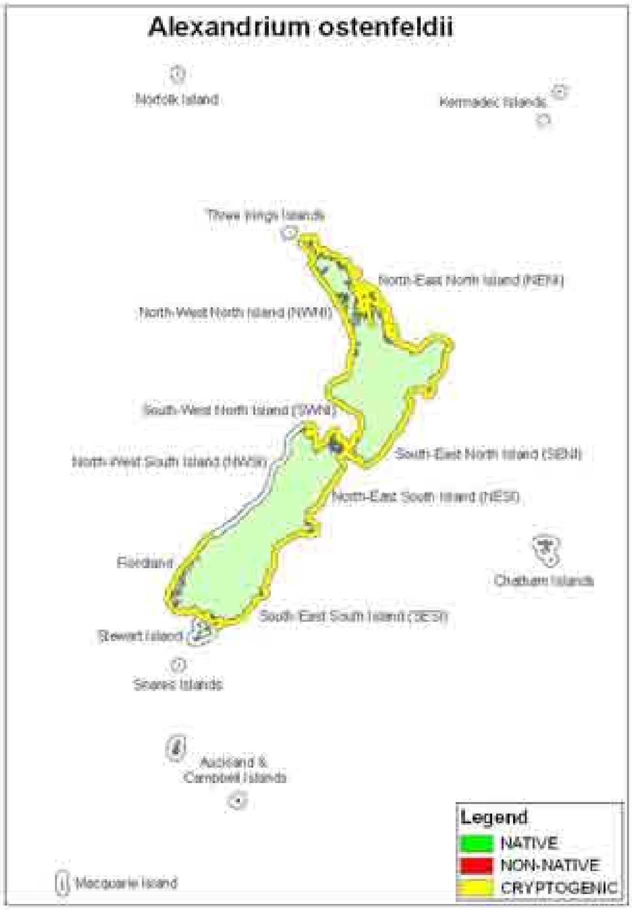


Figure 3: Distribution of *Alexandrium ostenfeldii* in New Zealand

Figure 4: Distribution of *Alexandrium tamarense* in New Zealand. This species was also "tentatively identified" from Port Gore in the Marlborough Sounds (MacKenzie et al. 2004) but due to the uncertainty of this identification it is not shown on the map.

Figure 5: Distribution of *Alexandrium catenella* in New Zealand

Figure 6: Distribution of *Gymnodinium catenatum* in New Zealand

References:

Anderson, D.M. (1998). Physiology and bloom dynamics of toxic *Alexandrium* species, with emphasis on life cycle transitions. *In*: Anderson, D.M.; Cembella, D.; Hallegraeff, G. (eds). Physiological ecology of harmful algal blooms, pp. 29-48. *NATO ASI Series*. Springer-Verlag Berlin Heidelberg New York.

Band-Schmidt, D.; Lechuga-Deveze, C.; Kulis, D.; Anderson, D. (2003). Culture studies of *Alexandrium affine* (Dinophyceae) a non-toxic cyst forming dinoflagellate from Bahia Concepcion, Gulf of California. *Botanica Marina 46*: 44-54.

Bigelow Laboratory (2008). Toxic & Harmful Algal Blooms. Website <http://www.bigelow.org/hab/cause.html>. Date last updated unknown. Accessed 17/01/08.

Bolch, C.; de Salas, M. (2007). A review of the molecular evidence for ballast water introduction of the toxic dinoflagellates *Gymnodinium catenatum* and the *Alexandrium* "*tamarensis* complex" to Australasia. *Harmful Algae 6*: 465-485.

Chang, F.H. (2002). Phytoplankton Species Associated with Either Toxic (T) or Nuisance (N) Blooms/Events in New Zealand. Website <http://www.niwa.cri.nz/__data/assets/pdf_file/0020/43526/phytoplankton.pdf>. Date last updated unknown. Last accessed 17/01/08.

Chang, F.H.; Anderson, D.M.; Kulis, D.M.; Till, D.G. (1997). Toxin production of *Alexandrium minutum* (Dinophyceae) from the Bay of Plenty, New Zealand. *Toxicon 35*: 393-409.

Chang, F.H.; Garthwaite, I.; Anderson, D.M.; Towers, N.; Stewart, R.; MacKenzie, L. (1999). Immunofluorescent detection of a PSP-producing dinoflagellate, *Alexandrium minutum*, from Bay of Plenty, New Zealand. *New Zealand Journal of Marine and Freshwater Research 33*: 533-543.

Chang, F.H.; MacKenzie, L.; Till, D.; Hannah, D.; Rhodes, L. (1995). The first toxic shellfish outbreaks and associated phytoplankton blooms in early 1993, in New Zealand. *In*: Lassus, P.; Arzul, G.; Erad, E.; Gentien, P.; Marcallou, C. (eds). Harmful marine algal blooms, pp. 145-150. Lavosier Intercept, Paris.

Chang, F.H.; Sharples, J.; Grieve, J.M. (1996). Temporal and spatial distribution of toxic dinoflagellates in Bay of Plenty, New Zealand, during the early 1993 toxic shellfish outbreaks. *In*: Yasumoto, T.; Oshima, Y.; Fukuyo, Y. (eds). Harmful and toxic algal blooms, pp. 235-238. Intergovernmental Oceanographic Commission of UNESCO, Tokyo.

Chang, F.H.; Stewart, R.; Inglis, G.; Fitridge, I. (in press). Dinoflagellate cysts from New Zealand ports and harbours wih emphasis on the distribution of harmful species. In: Proceedings of 12th International Conference on Harmful Algae, Copenhagen, Denmark, 4-8 September 2006.

Faust, M.A.; Gulledge, R.A. (2002). Identifying harmful marine dinoflagellates. *Smithsonian Contributions from the United States National Herbarium 42*: 1-144. Available online at <http://www.nmnh.si.edu/botany/projects/dinoflag/index.htm>.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hallegraeff, G. (1991). Aquaculturists' guide to harmful Australian microalgae. CSIRO Division of Fisheries, Hobart. 112 p.

Hallegraeff, G.; Fraga, S. (1998). Bloom dynamics of the toxic dinoflagellate *Gymnodinium catenatum*, with emphasis on Tasmanian and Spanish Coastal waters. *In*: Anderson, D.M.; Cembella, D.; Hallegraeff, G. (eds). Physiological ecology of harmful algal blooms, pp. 59-80. *NATO ASI Series*. Springer-Verlag Berlin Heidelberg New York.

Hay, B.; Grant, C.; McCoubrey, D. (2000). A review of the marine biotoxin monitoring programme for non-commercially harvested shellfish. Part 1: Technical Report. A

report prepared for the NZ Ministry of Health by AquaBio Consultants Ltd. NZ Ministry of Health.
Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.
Kraberg, A.; Montagnes, D. (2007). The Harmful Phytoplankton Project: The user-friendly guide to harmful phytoplankton in EU waters. Website <http://www.liv.ac.uk/hab/>. Last updated 12/07/2007; accessed 18/11/2007.
Lin, P.-T.; Leaw, C.-P.; Ogata, T. (2007). Morphological variation of two *Alexandrium* species responsible for paralytic shellfish poisoning in Southeast Asia. *Botanica Marina 50*: 14-21.
MacKenzie, A.L.; White, D.; Oshima, Y.; Kapa, J. (1996). The resting cyst and toxicity of *Alexandrium ostenfeldii* (Dinophyceae) in New Zealand. *Phycologia 35(2)*: 148-155.
MacKenzie, L.; de Salas, M.; Adamson, J.; Beuzenberg, V. (2004). The dinoflagellate genus *Alexandrium* (Halim) in New Zealand coastal waters: comparative morphology, toxicity and molecular genetics. *Harmful Algae 3*: 71-92.
New Zealand Food Safety Authority (2003). Non-Commercial Marine Biotoxin Monitoring in New Zealand Risk-Based Programme Enhancement - Final Report May 2003.
Shimada, H.; Hayashi, T.; Mizushima, T. (1996). Spatial distribution of *Alexandrium tamarense* in Funka Bay, Southwestern Hokkaido. *In*: Yasumoto, T.; Oshima, Y.; Fukuyo, Y. (eds). Harmful and toxic algal blooms, pp. 219-221. Intergovernmental Oceanographic Commission of UNESCO, Tokyo.
Smith, P.; Chang, F.H.; MacKenzie, L. (1993). Toxic phytoplankton and algal blooms, summer 1992/93. *In*: Jasperse, J. (ed.). Marine toxins and New Zealand shellfish. Proceedings of a workshop on research issues, 10-11 June 1993, pp. 11-17. The Royal Society of New Zealand, Miscellaneous series 24.
Taylor, M.; MacKenzie, L. (2001). Delimitation survey of the toxic dinoflagellate *Gymnodinium catenatum* in New Zealand. Cawthron Report 661, 12pp. Prepared for Ministry of Fisheries.

Scientific name: *Diplosoma velatum* Kott, 2001
Common name: None

Image by Mike Page, NIWA.

Species information sheet prepared by:	Mike Page (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Tunicata
Class: Ascidiacea
Order: Enterogona
Family: Didemnidae

General species description:
Diplosoma velatum is a colonial ascidian made-up of many small individuals in a common gelatinous body. It is soft, jelly-like; smooth to touch and falls apart easily when handled. It has several large openings interspersed with many small apertures. Colonies can grow as lobate sheets 10cm in diameter and 2-3cm deep. Colour ranges from orange to cream depending on exposure to light. For a detailed taxonomic description see Kott (2001).

Distribution:
Diplosoma velatum is native to western and southern Australia (Kott 2001) (Figure 1). It was first recorded in New Zealand from Doubtful Sound in 2006 (M. Page, NIWA, Unpublished record), and subsequently in the Milford Sound baseline port survey (Figure 2). This species is widely distributed throughout Doubtful Sound, occurring for example, near the head of Crooked Arm. Given this distribution pattern, and limited dispersal distances of aplousobranch larvae, it can be assumed that these populations reflect either a Gondwana relict fauna or a very early introduction from Australia. Furthermore, unpublished data from ascidian collections carried as part of the Terra Marine NIWA biotechnology programme in Fiordland have identified several other colonial species with trans-Tasman affinities.

Ecology (habitat & known interactions):
Diplosoma velatum is found encrusting fiord rock walls from 5-20m depth. It ranges from reasonably high abundance in mid fiord environments, to one of the only colonial ascidians inhabiting rock walls in inner fiords. There is no published information on seasonal growth or reproduction for this species. It is an encrusting species; unlike some didemnid species it has not been observed overgrowing or smothering other sessile invertebrates.

Potential pathways for introduction to and spread within New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F3	Fisheries: accidental with fishery products, packing or substrate		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N2	Natural: rafting of adults on biogenic substrata		Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Even if introduced, this species would probably have little impact in New Zealand.

Global and New Zealand distribution maps:

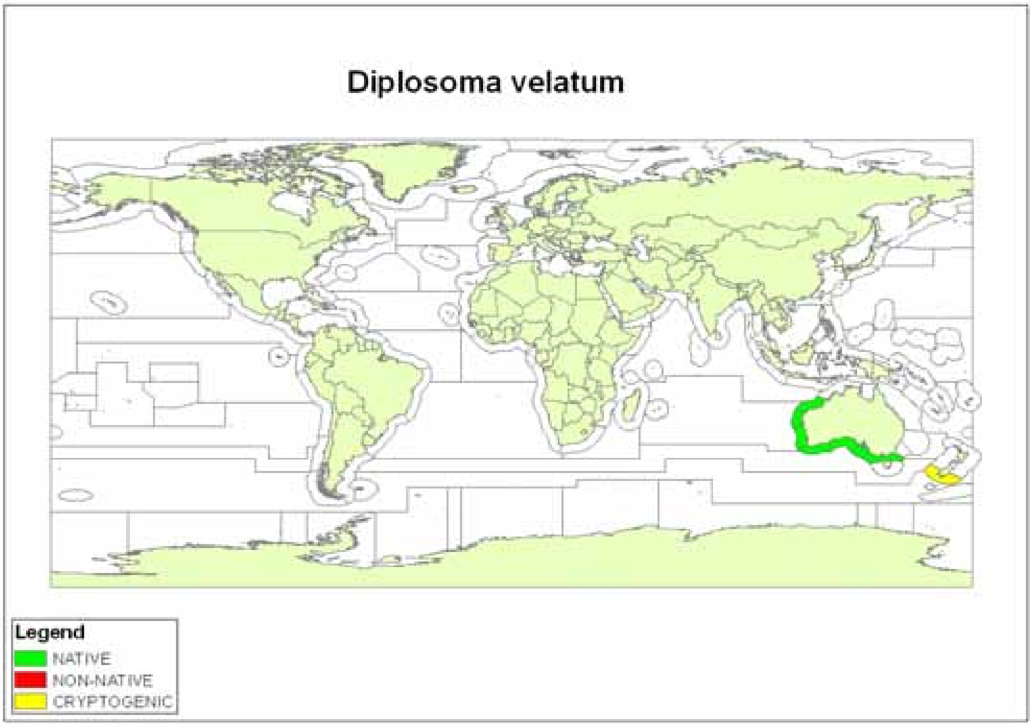


Figure 1: Global distribution of *Diplosoma velatum*

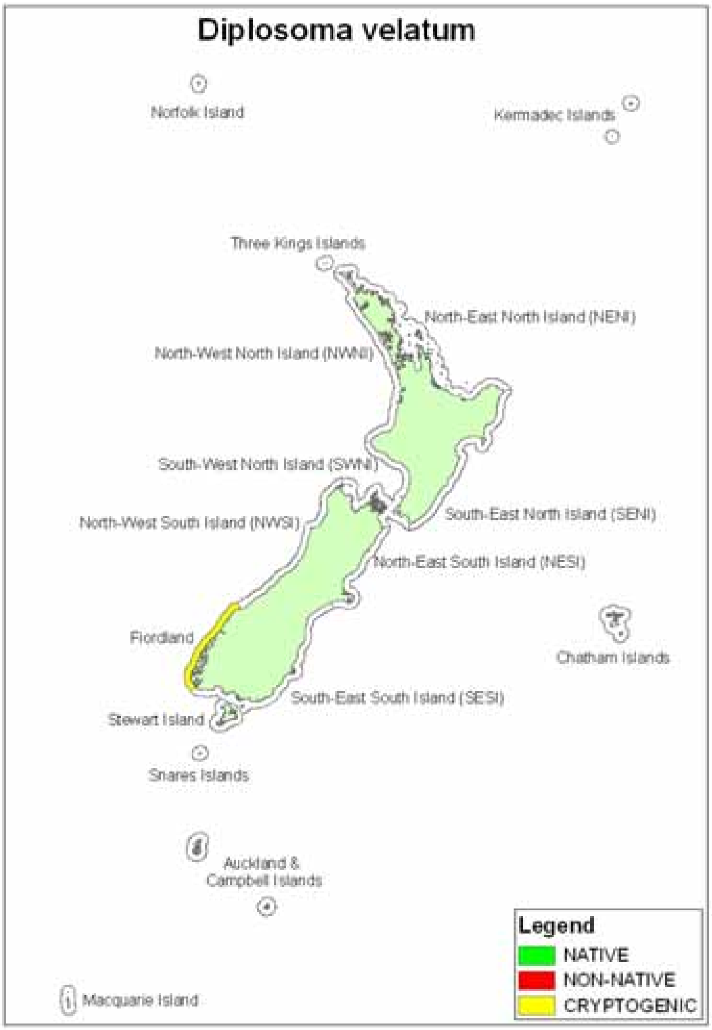


Figure 2: Distribution of *Diplosoma velatum* in New Zealand

References:

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Kott, P. (2001). The Australian ascidiacea Pt. 4, Didemnidae. *Memoirs of the Queensland Museum 47(1)*: 1-410.

Scientific name: *Esperiopsis edwardii* (Bowerbank, 1866) *sensu* Dendy (1924)
Common name: None

Images by Mike Page (NIWA).

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Demospongiae
Order: Poecilosclerida
Family: Esperiopsidae

General species description:
Esperiopsis edwardii (Bowerbank, 1866) *sensu* Dendy (1924) forms a fist-sized soft cushion with large oscules on the apex of softly rounded mounds. The surface is slightly pock-marked and granular. The colour in life is brownish orange.

Distribution:
The type specimen was originally described from Plymouth, Britian, by Bowerbank (1866). (Burton 1932) lumped several species including *edwardii* in the species *fucorum*, but noted that the southern hemisphere specimens invariably had larger styles and chelae than did the northern hemisphere specimens. Bergquist & Fromont (1988) noted that there was nothing to support the lumping of these two species together but failed to relegate the New Zealand specimens to a new species. Due to the taxonomic uncertainty this species is treated here as cryptogenic.

In New Zealand, *Esperiopsis edwardii* has been recorded from Doubtful Sound (M. Kelly, NIWA, Unpublished record) and the Three Kings Islands (Dendy 1924) (Figure 1). However, the specimens from these two locations bear little physical resemblance to each other, although the speculation is very similar (M. Kelly, NIWA, pers. comm.). *Esperiopsis edwardii* was not recorded during the New Zealand port baseline surveys.

Ecology (habitat & known interactions):
The ecology of *Esperiopsis edwardii* is not well known. At the Three Kings Islands it was collected from a depth of 30 m (Dendy 1924).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Esperiopsis edwardii (Bowerbank, 1866) is uncommon and has no known impacts on the New Zealand intertidal and subtidal communities.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
A map of the global distribution of *Esperiopsis edwardii* is not provided, as the global distribution of this species is disparate and does not make sense biogeographically. This is most likely due to there being insufficient diagnostic characters available in the older literature (when specimens were never described in the fresh state) to distinguish from contemporary specimens at today. Moreover, 'cosmopolitanism' of certain species was a widely held phenomenon in the biology community and the sponge community also concurred with this notion. Today we are certain that this notion is not valid except in a few select cases. Thus, further taxonomic work might indicate that the New Zealand specimens are actually different species to those with the same name elsewhere in the world (see also “Distribution” section above).

The map which illustrates the New Zealand regions from which *Esperiopsis edwardii* has been recorded is shown below (Figure 1).

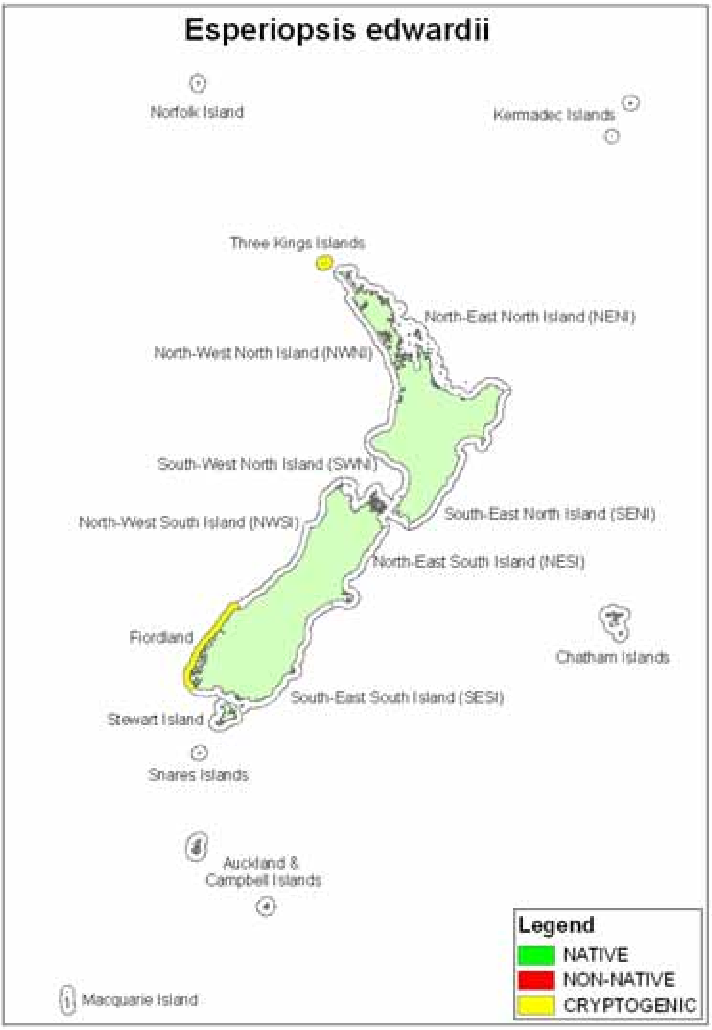


Figure 1: Distribution of *Esperiopsis edwardii* in New Zealand

References:

Bergquist, P.R.; Fromont, P.J. (1988). The Marine fauna of New Zealand: Porifera, Demospongiae, Part 4 (Poecilosclerida). New Zealand Oceanographic Institute Memoir 96. 197 p.

Burton, M. (1932). Sponges. *"Discovery" Reports 6*: 237-392.

Dendy, A.O. (1924). Porifera. Part I. Non-Antarctic Sponges. *Natural History Report. British Antarctic ("Terra Nova") Expedition, 1910, Zoology 6(3)*: 269-392, pls 261-215.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Scientific name: *Haliclona* cf. *clathrata* (Dendy, 1895) *sensu* Bergquist & Warne (1980)
Common name: None

No image available

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Demospongiae
Order: Haplosclerida
Family: Chalinidae

General species description:
Haliclona cf. *clathrata* (Dendy, 1895) *sensu* Bergquist & Warne (1980) forms a thick encrustation up to 6 cm long, 4 cm wide, and about 3 cm thick, with large conical elevated oscules on the smooth reticulate surface. The colour in life is yellow-brown to mauve, the texture soft and friable.

Distribution:
Haliclona clathrata (Dendy, 1895) was first described from the 'south coast of Australia' by Dendy (1895), and from Campbell Island, Malaya (Hentschel 1912), and the Great Barrier Reef (Burton 1934). The New Zealand material was described from the Chatham Islands, Hauraki Gulf, Kaikoura and Portobello in Otago Harbour (Figure 1). The likelihood that these are the same species is extremely low as Chalinidae are extremely difficult to differentiate reliably at the species level without fresh and diverse material. Colouration in life takes on significance in this genus as the morphology can be plastic and highly responsive to wave action, etc. *Haliclona* cf. *clathrata* has subsequently been recorded at Doubtful Sound (M. Kelly, NIWA, Unpublished record).

Haliclona cf. *clathrata* was not recorded during the New Zealand port baseline surveys.

Ecology (habitat & known interactions):
Haliclona cf. *clathrata* is an encrusting species, found on hard ground in relatively shallow water (6-20 m).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Haliclona cf. *clathrata* (Dendy, 1895) has no known ecological impacts on New Zealand intertidal and subtidal communities.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
A map of the global distribution of *Haliclona* cf. *clathrata* is not provided, as the global distribution of this species is disparate and does not make sense biogeographically. This is most likely due to there being insufficient diagnostic characters available in the older literature (when specimens were never described in the fresh state) to distinguish from contemporary specimens at today. Moreover, 'cosmopolitanism' of certain species was a widely held phenomenon in the biology community and the sponge community also concurred with this notion. Today we are certain that this notion is not valid except in a few select cases. Thus, further taxonomic work might indicate that the New Zealand specimens are actually different species to those with the same name elsewhere in the world (see also “Distribution” section above).

The map which illustrates the New Zealand regions from which *Haliclona* cf. *clathrata* has been recorded is shown below (Figure 1).

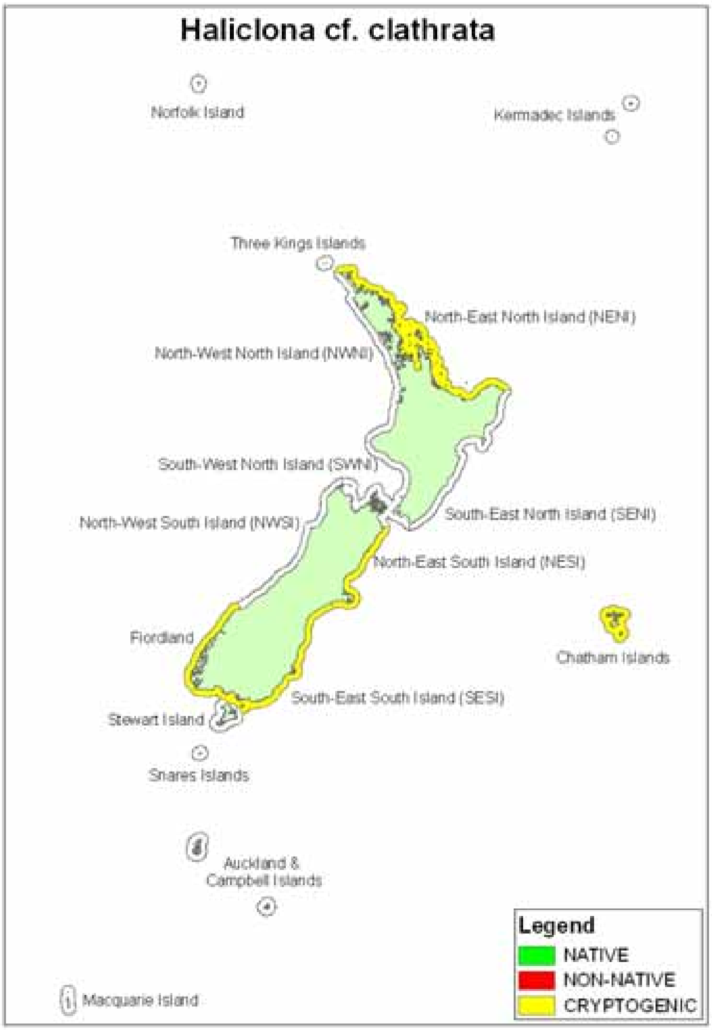


Figure 1: Distribution of *Haliclona* cf. *clathrata* in New Zealand

References:

Bergquist, P.; Warne, K. (1980). The marine fauna of New Zealand: Porifera, Demospongiae, Part 3 (Haplosclerida and Nepheliospongida). New Zealand Oceanographic Institute Memoir 87. 77 p.

Burton, M. (1934). Sponges. *Scientific Reports of the Great Barrier Reef Expedition, 1928-29 4(14)*: 513-621.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Hentschel, E. (1912). Tetraxonida. 2. Tiel. In Michaelsen, W.; Hart-meyer, R. (eds), Die Fauna sudwest-Australiens, 3:279-393.

Scientific names: *Heterosigma akashiwo* (Y. Hada) Y. Hada ex Y. Hara & M. Chihara 1967
Common name: None known

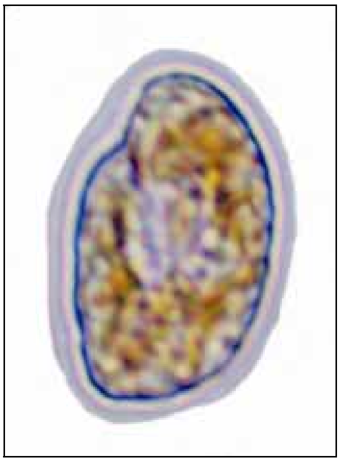


Image: *Heterosigma akashiwo* (courtesy of F. H. Chang, NIWA)

Species information sheet prepared by:	Dr F. Hoe Chang (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Ochrophyta
Class: Raphidophyceae
Order: Chattonellales
Family: Chattonellaceae

General description:
Heterosigma akashiwo is a bi-flagellated, single celled, golden brown alga. It has variable-shaped cells ranging from spheroidal to oblong, and is 11-25 µm long, 8-13 µm wide, 8-11 µm thick. The cells rotate during swimming (Hallegraeff 1991). Cells contain many yellow green chloroplasts which are distributed around the periphery of the cell.

Distribution:
Being planktonic, this species is widely distributed throughout the world's oceans. Distribution records tend to be scattered and they often reflect sampling effort; the lack of a record from a particular location is more likely to represent the lack of sampling in that location than the true absence of the species.

Heterosigma akashiwo was first recorded from Japan. However, its native range is uncertain and this species is therefore treated as cryptogenic throughout its range. It has also been found in China, Korea, Singapore, Norway, Ireland; the Canadian west coast from Barkley Sound; the US west coast from California and Washington; the US east coast in Rhode Island, Delaware, New Jersey, New York, North Carolina, South Carolina; Chile; Port Phillip Bay and West Lake in Australia, and New Zealand (Bowers et al. 2006; Cawthron Institute 2007).

In New Zealand *Heterosigma akashiwo* was first reported in 1989, causing massive cage-reared salmon kills in Big Glory Bay, Stewart Island (Chang et al. 1990). Subsequently this species was found in the Marlborough Sounds, Leigh, Ruakaka, Hauraki Gulf, Nelson Harbour, Port Underwood, Milford Sound and Wellington Harbour (Ayers et al. 2005; Bowers et al. 2006; Guiry 2006; O'Halloran et al. 2006; Cawthron Institute 2007) (Figure 1).

Heterosigma akashiwo has not been recorded during the New Zealand port baseline surveys.

Ecology (life history, habitat & known interactions):
The vegetative cells of *Heterosigma akashiwo* have been reported to migrate in a circadian manner within the water column - they photosynthesize in the photic zone during the day and then move in the deeper waters at night to glean macronutrients such as nitrate. They use one flagellum to swim in a spiraling pattern. *H. akashiwo* cells can enter a benthic resting phase, consisting of agglutinated masses of non-motile brown cells of variable shape and size in response to specific environmental conditions. When in this state, cells become immobile but do not lose their flagella (Hallegraeff 1991).

Heterosigma akashiwo blooms appear to be most strongly related to temperature (warmer season waters >15 °C) and moderate salinity (approximately 15 ppt) in the coastal zone (Li and Smayda 2000). Blooms have been observed to persist as long as stable water stratification persists in the warmer conditions. In the case of Big Glory Bay, New Zealand, it appears that nitrogen is most important limiting nutrient (Chang et al. 1993).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F2	Fisheries: accidental with deliberate translocations of fish or shellfish	Yes	Yes
S3	Ships: accidental with ballast water, sea water systems, live wells, etc.	Yes	Yes
N1	Natural: planktonic dispersal	Yes	Yes

Potential impacts in New Zealand:
H. akashiwo is a toxic flagellate which blooms in coastal regions worldwide. In the field, it forms massive brown tides that can kill finfish, copepods and oysters, and affect fish and sea urchin egg development (Cattolico 2007). The killing mechanism of *Heterosigma* blooms is not fully understood, but the production of reactive oxygen species such as superoxide, hydroxide and hydrogen peroxide radicals along with the production of hemolytic substances presumably cause gill damage leading to fish mortality (Bowers et al. 2006). An unidentified ichtyotoxin (fish killing toxin) has been speculated as the causative agent in the net pen fish kills.

This species has been circumstantially linked to deaths of caged fish in Japan, Canada, Chile, New Zealand and possibly Singapore. In January 1989 a bloom event in Big Glory Bay, Stewart Island killed NZD$17 million worth of cage-reared Chinook salmon (Chang et al. 1990). In early July 2006, a massive *H. akashiwo* bloom formed in and moved through waters of northern Puget Sound, Washington USA and the Strait of Juan de Fuca. High densities of *H. akashiwo* in the waters around the San Juan Islands resulted in the death of thousands of penned Atlantic salmon (Anderson 2006).

Impact category	Code	Description (after Hayes et al. 2005)
Human health	H1	Human health
Economic	M2	Water abstraction/nuisance fouling
Economic	M3	Loss of aquaculture/commercial/recreational harvest
Economic	M4	Loss of public/tourist amenity
Environmental	E2	Alters trophic interactions and food-webs

Global and New Zealand distribution maps:
It is not possible to map the global distribution of *Heterosigma akashiwo* because it is a cosmopolitan oceanic species. Most published information only refers to the locations of blooms, which are described in the "Distribution" section above.

The map which illustrates the New Zealand regions from which this species has been recorded is shown below (Figure 1).

Figure 1: Distribution of *Heterosigma akashiwo* in New Zealand

References:

Anderson, R. (2006). Deadly plankton invasion takes toll on fish. *The Seattle Times*, July 11, 2006.

Ayers, K.; Rhodes, L.; Tyrrell, J.; Gladstone, M. (2005). International accreditation of sandwich hybridisation assay format DNA probes for micro-algae. *New Zealand Journal of Marine and Freshwater Research 39*: 1225-1231.

Bowers, H.A.; Tomas, C.; Tengs, T.; Kempton, J.W.; Lewitus, A.J.; Oldach, D.W. (2006). Raphidophyceae [Chadefaud ex Silva] systematics and rapid identification: sequence analysis and real-time PCR assays. *Journal of Phycology 42*: 1333-1348.

Cattolico, R. (2007). Research Interests - University of Washington Marine Molecular Biology. Website <http://faculty.washington.edu/racat/research.php>. Accessed 21/11/2007.

Cawthron Institute (2007). Cawthron Institute culture collection of micro-algae (CICCM) Catalogue of strains: June 2007 Website edition. Accessible online at <http://www.cawthron.org.nz/seafood-safety-biotechnology/downloads/cat-web-july-2007.pdf>. Accessed 10/07/2007. Nelson, Cawthron Institute.

Chang, F.H.; Anderson, C.; Boustead, N.C. (1990). First record of a *Heterosigma* (Raphidophyceae) bloom with associated mortality of cage-reared salmon in Big Glory Bay, New Zealand. *New Zealand Journal of Marine and Freshwater Research 24*: 461-469.

Chang, F.H.; Pridmore, R.; Boustead. (1993). Occurrence and distribution of Heterosigma cf. akashiwo (Raphidophyceae) in a 1989 bloom in Big Glory bay, New Zealand. *In*: Smayda, T.J.; Shimizu, Y. (eds). Toxic Phytoplankton Blooms in the Sea, pp. 675-680. Elsevier Science Publishers B. V.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hallegraeff, G. (1991). Aquaculturists' guide to harmful Australian microalgae. CSIRO Division of Fisheries, Hobart. 112 p.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Li, Y.; Smayda, T. (2000). *Heterosigma akashiwo* (Raphidophyceae): On prediction of the week of bloom initiation and maximum during the initial pulse of its bimodal bloom cycle in Narragansett Bay. *Plankton Biology and Ecology 47*: 80-84

O'Halloran, C.; Silver, M.; Holman, T.; Scholin, C. (2006). *Heterosigma akashiwo* in central California waters. *Harmful Algae 5*: 124-132.

Scientific name: *Leucosolenia* cf. *challengeri* Polejaeff, 1883
Common name: Perforated vase sponge

No image available.

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Calcarea
Order: Leucosolenida
Family: Leucosoleniidae

General species description:
Leucosolenia cf. *challengeri* Polejaeff, 1883 is a globular hollow mass up to 5 cm diameter with a stalk-like base. The apex of the sponge is depressed and thrown into folds, especially when non-inflated (when out of water). The apex contains an oscular cavity. The surface is perforated and smooth. The colour in life is creamy lemon, the surface scratchy, the texture non-elastic but flexible.

Distribution:
This species was first described from Cape York, Australia by Polejaeff (1883). Dendy and Row (1913) and Kirk (1895) subsequently used this name for similar looking species from Wellington and Cook Strait. Although the sponges look quite similar morphologically, the known distribution is disparate and it is possible that the New Zealand specimens represent an endemic species. Due to the taxonomic uncertainty this species is considered here to be cryptogenic in New Zealand. In addition the Wellington/ Cook Strait records, *Leucosolenia* cf. *challengeri* has been recorded from Doubtful Sound (M. Kelly, NIWA, Unpublished record) (Figure 1).

Leucosolenia cf. *challengeri* was not recorded during the New Zealand port baseline surveys.

Ecology (habitat & known interactions):
Leucosolenia cf. *challengeri* occurs attached to hard substrate.

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Leucosolenia cf. *challengeri* Polejaeff, 1883 has no known ecological impacts on New Zealand intertidal and subtidal communities. Only a few specimens are known.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
A map of the global distribution of *Leucosolenia* cf. *challengeri* is not provided, as the global distribution of this species is disparate and does not make sense biogeographically. This is most likely due to there being insufficient diagnostic characters available in the older literature (when specimens were never described in the fresh state) to distinguish from contemporary specimens at today. Moreover, 'cosmopolitanism' of certain species was a widely held phenomenon in the biology community and the sponge community also concurred with this notion. Today we are certain that this notion is not valid except in a few select cases. Thus, further taxonomic work might indicate that the New Zealand specimens are actually different species to those with the same name elsewhere in the world (see also "Distribution" section above).

The New Zealand regions from which *Leucosolenia* cf. *challengeri* has been recorded is shown below (Figure 1).

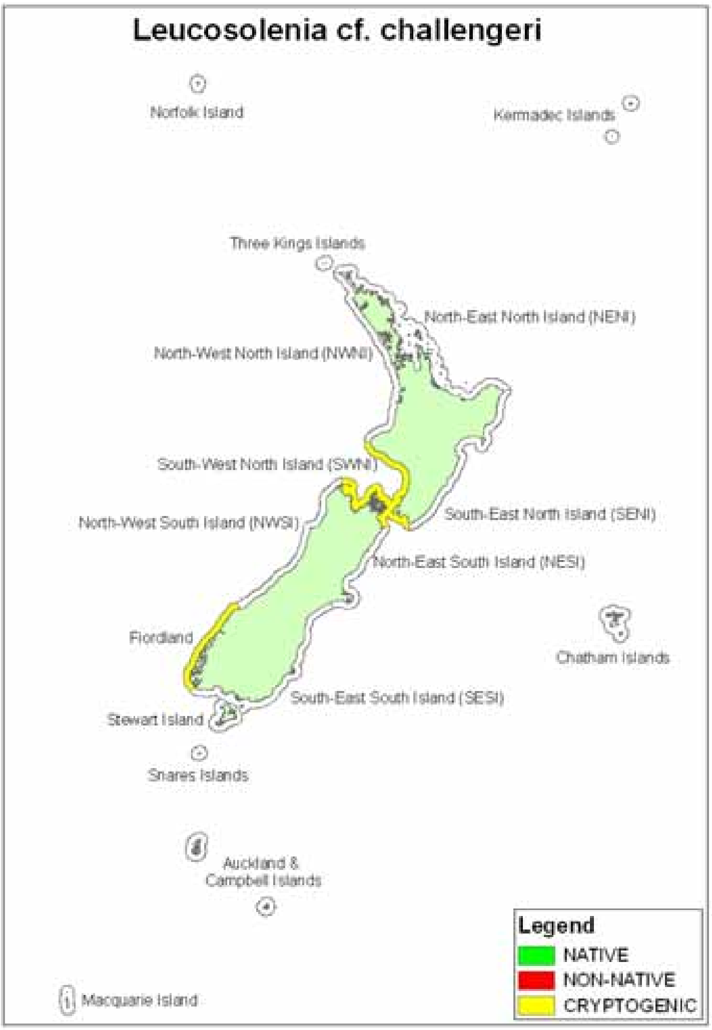


Figure 1: Distribution of *Leucosolenia* cf. *challengeri* in New Zealand

References:

Dendy, A.; Row, R.W.H. (1913). The classification and phylogeny of the Calcareous Sponges. *Proceedings of the Zoological Society of London*: 704-813.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Kirk, H.B. (1895). New Zealand sponges. Third Paper. *Transactions of the New Zealand Institute 28*: 205-210.

Polejaeff, N. (1883). Report on the Calcarea dredged by the HMS Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage Challenger (Zoology) 8*: 1-73.

Scientific name: *Leucosolenia* cf. *discoveryi* Jenkin, 1908
Common name: None

No image available.

Species information sheet prepared by:	NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Calcarea
Order: Leucosolenida
Family: Leucosoleniidae

After an extensive search, the specimens recorded in New Zealand are closest to the Antarctic species *Leucosolenia discoveryi* Jenkin, 1908. There are some minor differences that indicate that these specimens, recorded as *Leucosolenia* cf. *discoveryi*, might rather be a New Zealand endemic that is very similar to *L. discoveryi*. There is only minor overlap with Antarctic species in the southern New Zealand fauna (M. Kelly, NIWA, pers. comm.).

General species description:
Leucosolenia discoveryi is a calcareous sponge. Members of the *Leucosolenia* genus are typically small creeping tubular sponges (Borojevic et al. 2000).

Distribution:
Leucosolenia discoveryi was first described from Discovery Bay in the Antarctic and is common in Antarctica and the Australian sub-Antarctic islands (Australian Faunal Directory 2005) (Figure 1).

During the New Zealand baseline port surveys, *Leucosolenia* cf. *discoveryi* was found in Bluff, Dunedin (Port Otago) and Milford Sound (Figure 2). It has also previously been recorded from Doubtful Sound (M. Kelly, NIWA, Unpublished record).

Ecology (habitat & known interactions):
Leucosolenia cf. *discoveryi* is a filter feeder. Members of the Calcarea are viviparous and their larvae are blastulae (hollow).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes
N1	Natural: planktonic dispersal		Yes

Potential Impacts:

The impacts of *Leucosolenia* cf. *discoveryi* have not been documented.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:

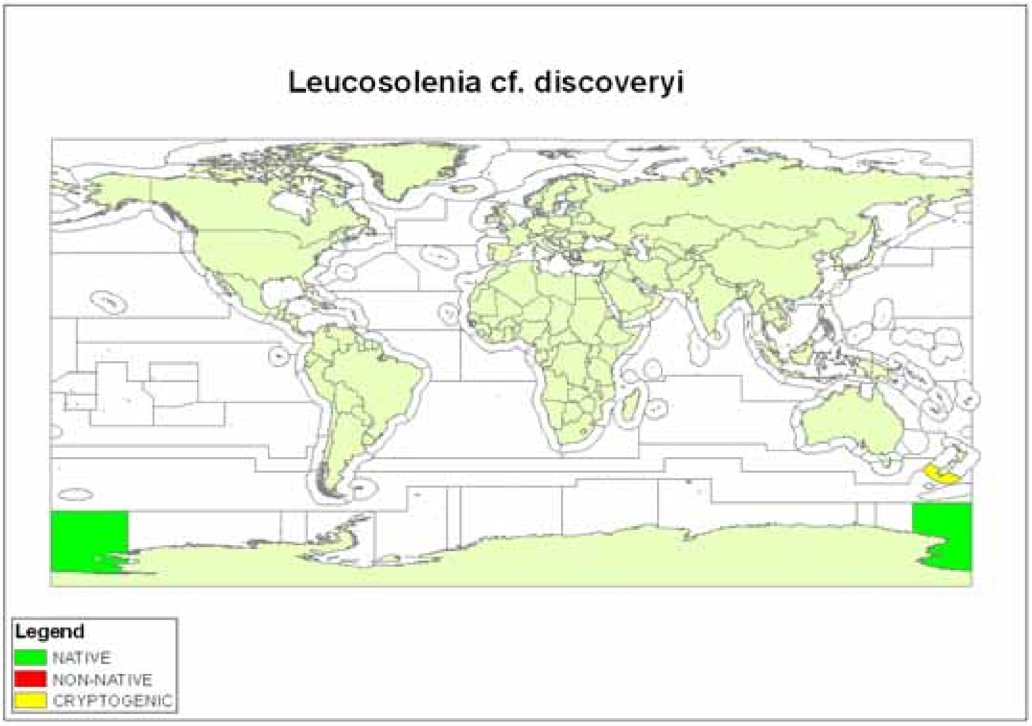


Figure 1: Global distribution of *Leucosolenia* cf. *discoveryi*

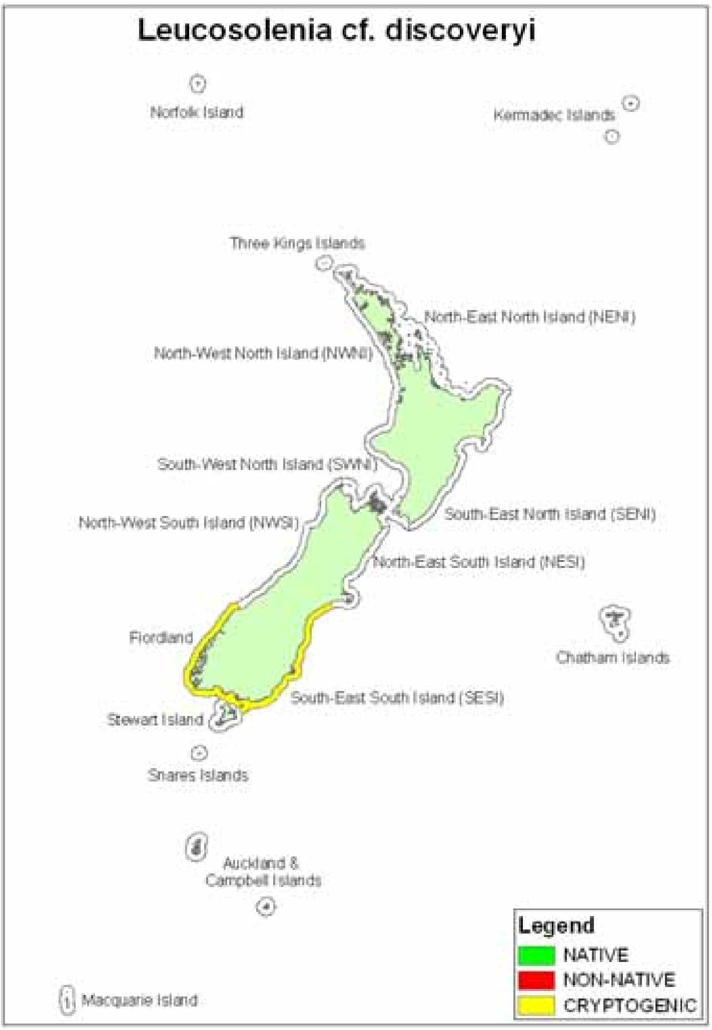


Figure 2: Distribution of *Leucosolenia* cf. *discoveryi* in New Zealand

References:

Australian Faunal Directory (2005). Australian Biological Resources Study Web publication <http://www.deh.gov.au/biodiversity/abrs/online-resources/fauna/afd/index.html>, Accessed 22/07/2005.

Borojevic, R.; Boury-Esnault, N.; Vacelet, J. (2000). A revision of the supraspecific classification of the subclass Calcaronea (Porifera, class Calcarea). *Zoosystema 22(2)*: 203-263.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Scientific name: *Orthopyxis integra* (MacGillivray, 1842)
Common name: None

No image available.

Species information sheet prepared by:	Dr Jan Watson (Hydrozoan Research Laboratory) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	No

Taxonomy:
The taxonomy of the hydroids is currently under review
Phylum: Cnidaria
Class: Leptolida, but currently under review
Subclass: Leptothecata, but currently under review
Order: Hydroida, but currently under review
Family: Campanulariidae, but currently under review

General species description:
Orthopyxis integra is a thecate hydroid, meaning that during the sessile phase it has a chitinous cup, called the hydrotheca, supporting the individual polyps, called hydranths (Watson 1982). Like all hydroids in the family Campanulariidae, the hydrothecae are deeper than they are wide, and may or may not have marginal teeth (Watson 1982). *Orthopyxis integra* produces a eumedusoid (a primitive type of medusa).

Orthopyxis integra colonies consist of hydrothecae on pedicles (stalks) up to 8 mm long arising from thick, smooth, branching stolonal tubes. The pedicles are indistinctly ringed with short smooth parts and a globular internode with thick walls directly below the hydrotheca. The hydrotheca are cup- to- bell-shaped with a thin smooth rim, straight walls of varying thickness and 20-30 tentacles (Vervoort and Watson 2003). The gonotheca are short, broad, roughly parallel sided, taper toward the base and have thick walls (Cornelius 1982). The medusae are short lived and lack feeding organs. They have an umbrella height of 1 mm and width of 0.6 5mm with a broad velum and four narrow radial canals and no tentacles.

Distribution:
Orthopyxis integra has a near cosmopolitan distribution and is one of the most widely distributed of all hydroids. It occurs in all oceans from the intertidal to a little below continental shelf depths (at least in cold seas); and from the tropics to as far north as Greenland (Cornelius 1982; Brinckmann-Voss 1996; Vervoort and Watson 2003; MarBEF 2004; Galea 2007; GBIF 2007). There are a few gaps in this wide distribution; for example, there are no records from the Baltic Sea or from Puget Sound. Records from the Irish Sea and western coast of Scotland are few but this species is small and may have been overlooked (Cornelius 1982). It has not been recorded from brackish waters (Vervoort and Watson 2003).

Orthopyxis integra was first recorded in New Zealand from Wellington Harbour in 1875. It has also been recorded from Lyttelton Harbour, New Brighton (Christchurch), Ananwhata beach (west coast of Auckland), Dunedin, Paraparaumu Beach and Woodpecker Bay on the west coast of the South Island (Figure 1). The free medusa has not yet been recorded from New Zealand waters (Vervoort and Watson 2003).

During the New Zealand port baseline surveys, *Orthopyxis integra* was not recorded from any of the main ports, but was recorded from Milford Sound (Figure 1).

Ecology (habitat & known interactions):
Orthopyxis integra is usually found growing intertidally to depths of 300 m (exceptionally to 470 m). The deepest records are from cold waters. It has been found growing on a wide variety of substrata such as algae, hydroids and other animals as well as inorganic substrates and there appears to be no regular association. *O. integra* can only tolerate a narrow range of salinities and has not been recorded from brackish waters, which may explain the absence of this species from the Baltic Sea (Cornelius 1982; Vervoort and Watson 2003).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
D	Debris: transport of species on human generated debris		Yes
F2	Fisheries: accidental with deliberate translocations of fish or shellfish		Yes
F3	Fisheries: accidental with fishery products, packing or substrate		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N2	Natural: rafting of adults on biogenic substrata	Yes	Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes
S3	Ships: accidental with ballast water, sea water systems, live wells, etc.	Yes	Yes

Potential impacts in New Zealand:
The impacts of *Orthopyxis integra* have not been documented, but as a fouling organism it could compete with other organisms for space and food. It could also potentially have impacts on port structures and vessel hulls, although its diminutive size might reduce these impacts.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
The global distribution of *Orthopyxis integra* has not been mapped because this species has a near cosmopolitan distribution (in coastal waters of Atlantic, Pacific and Indian Oceans) and specific location records in the literature are scarce and very difficult to find.

The map which illustrates the New Zealand regions from which *Orthopyxis integra* has been recorded is shown below (Figure 1).

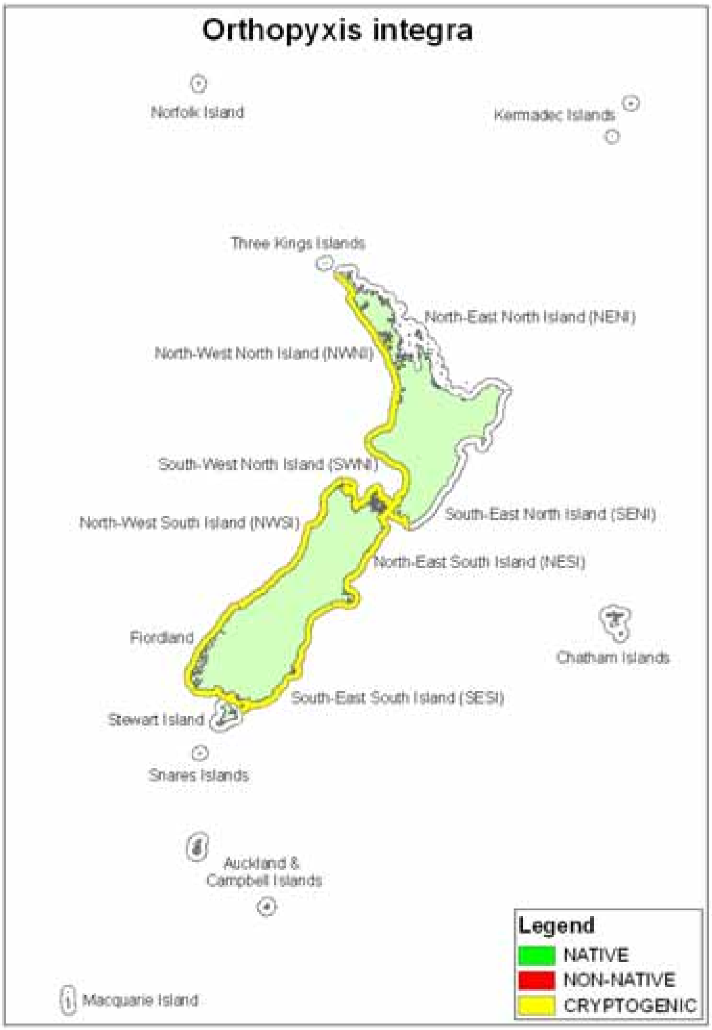


Figure 1: Distribution of *Orthopyxis integra* in New Zealand

References:
Brinckmann-Voss, A. (1996). Seasonality of hydroids (Hydrozoa, Cnidaria) from an intertidal pool and adjacent subtidal habitat at Race Rocks, off Vancouver Island, Canada. *Scientia Marina 60(1)*: 89-97.
Cornelius, P. (1982). Hydroids and medusae of the family Campanulariidae recorded from the eastern North Atlantic, with a world synopsis of genera. *Bulletin of the British Museum (Natural History), Zoology series 42(2)*: 37-148.
Galea, H. (2007). Hydrozoa, La Ciotat and nearby areas, Mediterranean coast of France. *Check List 3(3)*: 193-199.
GBIF (2007). Global Biodiversity Information Facility GBIF Data Portal. Website www.gbif.org. Accessed 07/12/2007.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

MarBEF (2004). European Marine Biodiversity Datasets. Available online at http://www.marbef.org/data/dataset.php. Accessed 27/08/2007.

Vervoort, W.; Watson, J. (2003). The marine fauna of New Zealand: Leptothecata (Cnidaria: Hydrozoa) (Thecate Hydroids). NIWA Biodiversity Memoir 119. Wellington, NIWA.

Watson, J. (1982). Hydroids (Class Hydrozoa). *In*: Shepherd, S.; Thomas, I. (eds). Marine Invertebrates of Southern Australia: Part I. Handbook of the Flora and Fauna of South Australia, pp. 77-115. Government Printer of South Australia, Adelaide.

Scientific name: *Polysiphonia brodiei* (Dillwyn) Sprengel, 1827
Common name: None

Image: Guiry (2006)

Species information sheet prepared by:	NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Rhodophyta
Class: Florideophyceae
Order: Ceramiales
Family: Rhodomelaceae

General species description:
Polysiphonia brodiei is a dark reddish brown to crimson red alga, typically up to 15 cm high, but occasionally growing to 40 cm. It has many soft branches arising from one or several main stems that grow from a truncate disc holdfast (Adams 1994; NIMPIS 2002).

Distribution:
Polysiphonia brodiei is native to the Mediterranean and northeastern Atlantic down to the equatorial coast of west Africa and the Madeira & Salvage Islands. It has been introduced to New Zealand, southern Australia and the northeast and northwest coasts of North America. Records also exist from Japan, Korea, India, Scandinavia, Kuwait, Qatar and Saudi Arabia (NIMPIS 2002; Guiry 2006; ISSG 2007) where it is considered cryptogenic (Figure 1).

Within New Zealand, *P. brodiei* is known from Wellington, Golden Bay, Nelson, Lyttelton, Timaru, Fiordland (Dusky, Doubtful, Milford and George Sounds) and Stewart Island (Adams 1994; Cranfield et al. 1998, W. Nelson, pers. comm.; Nelson et al. 2002).

During the New Zealand port baseline surveys it was recorded from Lyttelton, Dunedin, Bluff and Taharoa terminal (Figure 2).

Ecology (habitat & known interactions):
Polysiphonia brodiei is found in the subtidal zone just below low tide level where it colonises wooden structures, floating structures including ropes, buoys and vessels, and other fouling species, such as mussels (Adams 1994; NIMPIS 2002). *Polysiphonia brodiei* seems to prefer

moderately exposed localities. In Australia, New Zealand and California, specimens have been collected mostly from port environments where the species is frequently found fouling the hulls of slow moving vessels, such as barges (NIMPIS 2002).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F3	Fisheries: accidental with fishery products, packing or substrate		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N1	Natural: planktonic dispersal		Yes (broadcast spores)
N2	Natural: rafting of adults on biogenic substrata		Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Polysiphonia brodiei may impact upon vessel performance on fouled vessels and occurs as a nuisance fouling species on ropes, buoys and other harbour structures such as pylons and boat ramps. *Polysiphonia brodiei* is listed as a medium-high priority invasive species and as having the eighth highest impact ranking of 53 domestic marine priority pests in Australia by Hayes et al. (2005).

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M1	Aquatic transport
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:

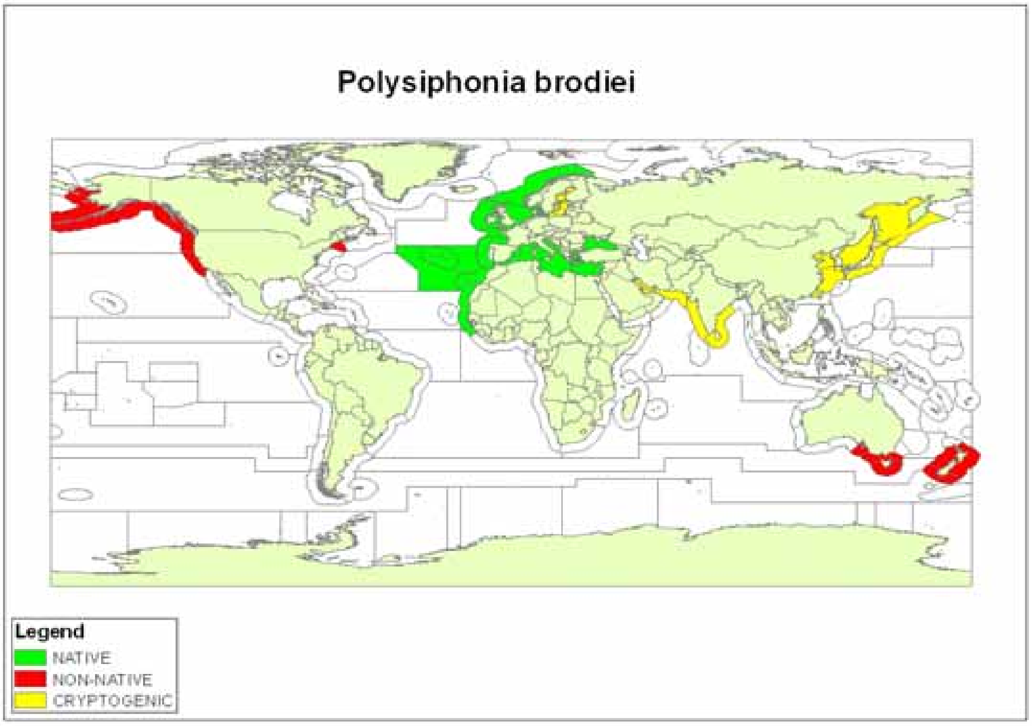


Figure 1: Global distribution of *Polysiphonia brodiei*

Figure 2: Distribution of *Polysiphonia brodiei* in New Zealand

References:

Adams, N. (1994). Seaweeds of New Zealand: an illustrated guide. Canterbury University Press, Christchurch. 360 p.

Cranfield, H.; Gordon, D.; Willan, R.; Marshall, B.; Battershill, C.; Francis, M.; Nelson, W.; Glasby, C.; Read, G. (1998). Adventive marine species in New Zealand. NIWA technical report No. 34. Hamilton, NIWA.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

ISSG (2007). ISSG Global Invasive Species Database. Web Publication. http://www.issg.org/database, Date of access: 10/07/2007.

Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.

NIMPIS (2002). *Polysiphonia brodiei* species summary. National Introduced Marine Pest Information System (Eds: Hewitt CL, Martin RB, Sliwa C, McEnnulty FR, Murphy NE, Jones T & Cooper S). Web publication <http://crimp.marine.csiro.au/nimpis>, Date of access: 3/24/2004.

Scientific name: *Polysiphonia constricta* Womersley 1979
Common name: None

No image available

Species information sheet prepared by:	Dr Wendy Nelson (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Rhodophyta
Class: Florideophyceae
Order: Ceramiales
Family: Rhodomelaceae

General species description:
Plants are rich chestnut to brick red in colour, delicate, tufted, and grow up to 5 – 12 cm high, branched sub-dichotomously to alternately, with 7 pericentral cells and ecorticate throughout. Lateral branches constricted where they join the main axis. Trichoblasts long and delicate, leaving conspicuous scar cells on every third segment when shed. Tetrasporangia are in linear series, sexual reproduction unknown.

Distribution:
The native range of *Polysiphonia constricta* is from Coffin Bay, South Australia to Westernport Bay Victoria (Womersley 2003), and along the NSW coast (Millar and Kraft 1993) (Figure 1).

In New Zealand *Polysiphonia constricta* is known from Otago Harbour (Adams 1991; Nelson 1999) and from one collection from Doubtful Sound, Fiordland (Nelson et al. 2002) (Figure 2). *Polysiphonia constricta* was not found during the New Zealand port baseline surveys.

Ecology (habitat & known interactions):
Polysiphonia constricta is found in the upper subtidal, epilithic and epiphytic, including on other *Polysiphonia* species. Its distribution is restricted to sheltered bays and inlets.

Potential pathways for introduction to, and spread within, New Zealand:
Polysiphonia constricta is presumed to be spread by vessels.

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
N1	Natural: planktonic dispersal		Yes (broadcast spores)
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes
S3	Ships: accidental with ballast water, sea water systems, live wells, etc.		Possible

Potential impacts in New Zealand:
The impacts of *Polysiphonia constricta* appear to be minimal at present and the long-term impacts are unknown.

Global and New Zealand distribution maps:

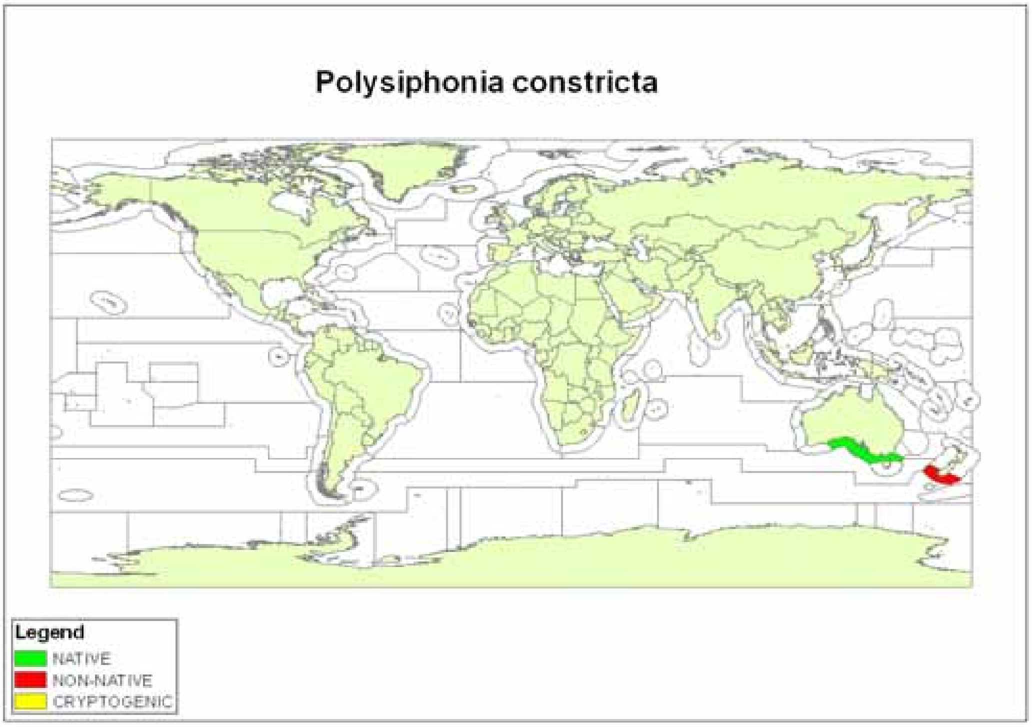


Figure 1: Global distribution of *Polysiphonia constricta*

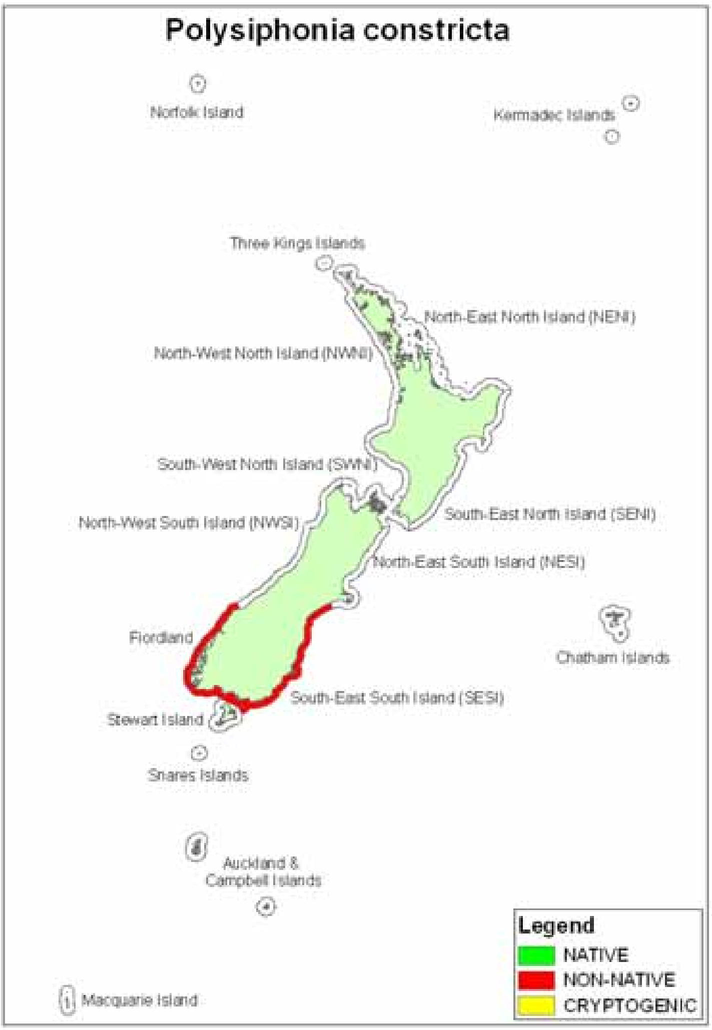


Figure 2: Distribution of *Polysiphonia constricta* in New Zealand

References:

Adams, N.M. (1991). The New Zealand species of *Polysiphonia* Greville (Rhodophyta). *New Zealand Journal of Botany 29*: 411-427.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Millar, A.J.K.; Kraft, G.T. (1993). Catalogue of the marine and freshwater red algae (Rhodophyta) of New South Wales, including Lord Howe Island, South-western Pacific. *Australian Systematic Botany 6*: 1-90.

Nelson, W.A. (1999). A revised checklist of marine algae naturalised in New Zealand. *New Zealand Journal of Botany 37*: 355-359.

Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.

Womersley, H.B.S. (2003). The marine benthic flora of southern Australia. Rhodophyta. Part IIID, Ceramiales – Delesseriaceae, Sarcomenicaeae, Rhodomelaceae. Australian Biological Resources, Study, Canberra, & State Herbarium Adelaide. 533 pp.

Scientific name: *Polysiphonia sertularioides* (Grateloup) J. Agardh
Common name: None

Image: University of French Polynesia (no date)

Species information sheet prepared by:	NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Rhodophyta
Class: Florideophyceae
Order: Ceramiales
Family: Rhodomelaceae

This is a complex species in terms of taxonomy. It has been synonymised with taxa from the west coast of the USA (*P. flaccidissima*); Womersley (2003) notes there are no satisfactory differences between *sertularioides* and *flaccidissima* from the Pacific coast of North America and the tropical Pacific. There are also questions about the relationship of *sertularioides* to *P. havanensis*, a Caribbean, Atlantic species Schneider & Searles (1991) and Silva et al. (1996).

General species description:
Polysiphonia sertularioides is a small filamentous red alga. Plants are delicate and tufted and grow up to 4 cm high. They have very slender stems and a holdfast of creeping stems. They are of a reddish brown colour and soft and flaccid texture (Adams 1994).

Distribution:
The type specimen for *Polysiphonia sertularioides* was described from the French Mediterranean, but although it is found throughout the European and African coasts of the Mediterranean its native range is largely unknown. *P. sertularioides* has also been recorded from the Canary Islands, Madeira and Salvage Island, Cuba, Venezuela, the Indian Ocean (Maldives, India and Levant States), the Pacific Ocean (French Polynesia and Micronesia), and eastern and western Australia and Tasmania (see Guiry 2006 and references therein).

In New Zealand *P. sertularioides* has been recorded from the North Island, South Island, Stewart Island and the Chatham Islands (Adams 1994; Nelson et al. 2002).

During the port baseline surveys *P. sertularioides* was recorded from the port of New Plymouth and Opua marina. Specimens were also collected from Taharoa, and identified as *P.* aff. *sertularioides* THH, indicating that these probably belong to *P. sertularioides* but further taxonomic work is required to confirm this (W. Nelson, NIWA, pers. comm.) (Figure 1).

Ecology (habitat & known interactions):
Polysiphonia sertularioides usually occurs on pebbles and twigs, and is epiphytic on various other seaweeds and *Zostera*. It can be found in sheltered bays and tidal pools (Adams 1994).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F3	Fisheries: accidental with fishery products, packing or substrate		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N1	Natural: planktonic dispersal		Yes (broadcast spores)
N2	Natural: rafting of adults on biogenic substrata		Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
The impacts of *P. sertularoides* are not known, but like *Polysiphonia brodiei,* it may impact upon the performance of fouled vessels and occur as a nuisance fouling species on ropes, buoys and other harbour structures such as pylons and boat ramps.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:
In light of the taxonomic issues described above, it is currently not possible to reliably map the global distribution of *Polysiphonia sertularioides* (W. Nelson, NIWA, pers. comm.).

The map which illustrates the New Zealand regions from which *Polysiphonia sertularioides* has been recorded is shown below (Figure 1).

Figure 1: Distribution of *Polysiphonia sertularioides* in New Zealand

References:

Adams, N. (1994). Seaweeds of New Zealand: an illustrated guide. Canterbury University Press, Christchurch. 360 p.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.

Schneider, C.; Searles, R. (1991). Seaweeds of the Southeastern United States, Cape Hatteras to Cape Canaveral. Duke University Press, Durham, NC.

Silva, P.; Basson, P.; Moe, R. (1996). Catalogue of the benthic marine algae of the Indian Ocean. *Univ. Calif. Publ. Bot. 79*: 1-1259.

University of French Polynesia (no date). Plantes marines: Algues et vegetaux superieurs. Web publication <http://biodiv.upf.pf/base/> Accessed 16/08/2006.

Womersley, H.B.S. (2003). The marine benthic flora of southern Australia. Rhodophyta. Part IIID, Ceramiales – Delesseriaceae, Sarcomenicaeae, Rhodomelaceae. Australian Biological Resources, Study, Canberra, & State Herbarium Adelaide. 533 pp.

Scientific name: *Polysiphonia subtilissima* Montagne
Common name: None

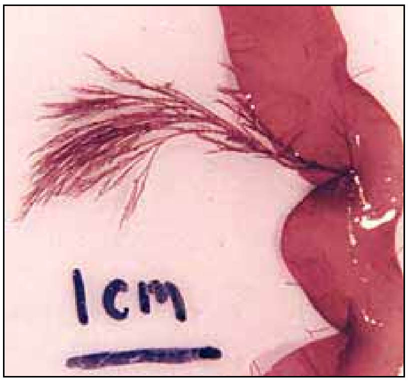


Image: The filamentous red alga *Polysiphonia subtilissima,* growing on another (larger) red alga (University of Rhode Island 2001)

Species information sheet prepared by:	NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Rhodophyta
Class: Florideophyceae
Order: Ceramiales
Family: Rhodomelaceae

General species description:
Polysiphonia subtilissima is a red alga with delicate, tufted structures up to 4 cm high with slender and much-divided stems and a holdfast of prostrate branches. It is pink to pale crimson and has a soft and flaccid texture (Adams 1994).

Distribution:
Polysiphonia subtilissima has a broad geographic distribution. The type specimen for this species was recorded from Cayenne, French Guiana (Guiry 2006). It is considered non-indigenous in New Zealand but the biosecurity status elsewhere is unclear (W. Nelson, NIWA, pers. comm.). It is present throughout the tropical and subtropical western and eastern Atlantic, including Spain, Ireland, the Adriatic Sea, Greece and Italy, eastern and southern USA (Florida, Georgia, Louisiana, Mississippi, North Carolina, Texas, Virginia), the Caribbean (Bahamas, Barbados, Cayman Islands, Cuba, Jamaica, Lesser Antilles, Trinidad, Virgin Islands), South America (Brazil, Chile, Guyana, Uruguay, Venezuela), the Atlantic Islands (Ascension, Bermuda, Cape Verde Islands, and St. Helena), and western Africa (Angola, Cameroon, Côte d'Ivoire, Equatorial Guinea, Gambia, Ghana, Kenya, Liberia, Mauritius, Senegal, Sierra Leone, South Africa), Hawaiian Islands, the Indian Ocean (India, Aldabra Islands, Seychelles), south-east Asia (Philippines, Vietnam), the Federated States of Micronesia, parts of Australia (from the Swan River estuary in Western Australia through to Botany Bay in New South Wales, and Tasmania) and New Zealand (Adams 1994; Guiry 2006) (Figure 1).

P. subtilissima has been present in New Zealand since at least 1974 (Cranfield et al. 1998). It has been recorded from the North Island, northern South Island to Lyttelton, and the Chatham Islands (Adams 1994; Nelson 1999). There is a record of *Polysiphonia* aff. *subtilissima* from Breaksea Sound in Fiordland (Nelson et al. 2002).

During the port baseline surveys *P. subtilissima* was recorded from Lyttelton, Timaru, Dunedin (Port Chalmers) and Taharoa terminal (Figure 2).

Ecology (habitat & known interactions):
Polysiphonia subtilissima usually occurs as a subtidal epiphyte in sheltered, warm and muddy bays (Adams 1994).

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
F3	Fisheries: accidental with fishery products, packing or substrate		Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N1	Natural: planktonic dispersal		Yes (broadcast spores)
N2	Natural: rafting of adults on biogenic substrata		Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential Impacts:
The impacts of *P. subtilissima* are not known, but could include nuisance fouling of other macroalage.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:

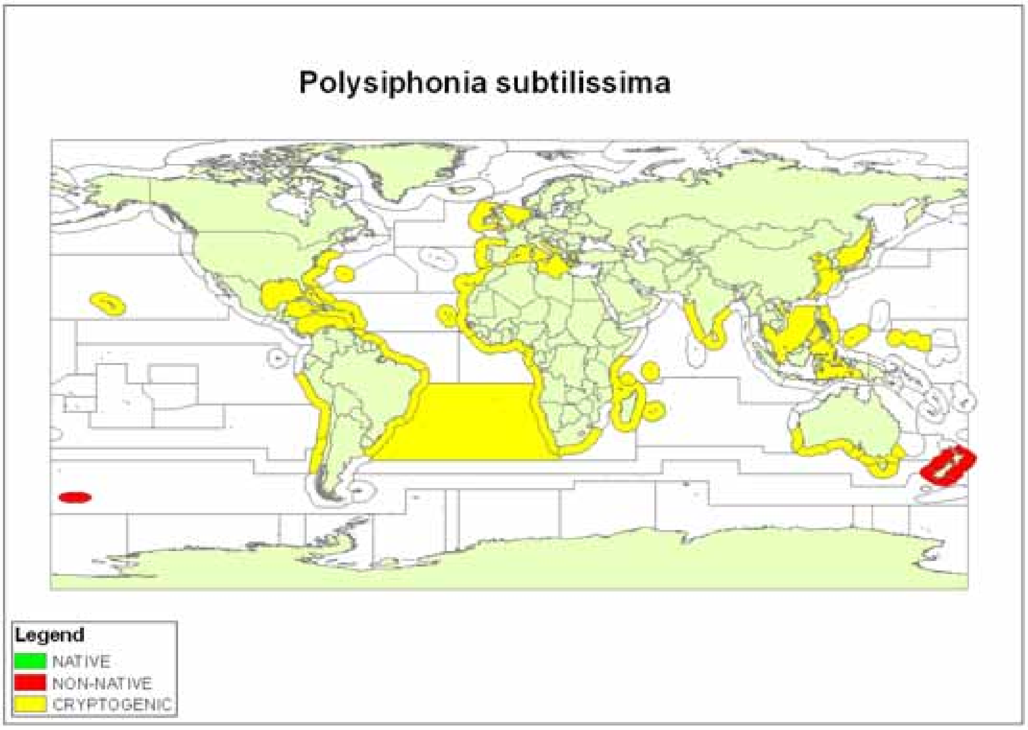


Figure 1: Global distribution of *Polysiphonia subtilissima*

Figure 2: Distribution of *Polysiphonia subtilissima* in New Zealand

References:

Adams, N. (1994). Seaweeds of New Zealand: an illustrated guide. Canterbury University Press, Christchurch. 360 p.

Cranfield, H.; Gordon, D.; Willan, R.; Marshall, B.; Battershill, C.; Francis, M.; Nelson, W.; Glasby, C.; Read, G. (1998). Adventive marine species in New Zealand. NIWA technical report No. 34. Hamilton, NIWA.

Guiry, M. (2006). AlgaeBase version 4.1. Web publication, National University of Ireland, Galway. http://www.algaebase.org. Accessed 21/11/2007.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Nelson, W.A. (1999). A revised checklist of marine algae naturalised in New Zealand. *New Zealand Journal of Botany 37*: 355-359.

Nelson, W.A.; Villouta, E.; Neill, K.F.; Williams, G.C.; Adams, N.M.; Slivsgaard, R. (2002). Marine macroalgae of Fiordland, New Zealand. *Tuhinga 13*: 117-152.

University of Rhode Island (2001). Narragansett Bay biota gallery. Office of Marine Programs web publication <http://omp.gso.uri.edu/doee/biota/biota4.htm> Accessed 16/08/06.

Scientific name: *Raspailia agminata* Hallman 1914 *sensu* Bergquist (1970)
Common name: None

No image available.

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Demospongiae
Order: Poecilosclerida
Family: Raspailiidae

General species description:
Raspailia agminata Hallman, 1914 *sensu* Bergquist (1970) forms a hemispherical mass with sharp apical projections, or a thick rough encrustation. The colour in life is brown with a purplish grey tinge; the texture is firm but compressible. Maximum height c. 60 mm, width, c. 40 mm. The morphology of this species within the genus *Raspailia* is atypical and thus the species is reasonably easy to recognize.

Distribution:
Raspailia agminata is native to south-eastern Australia, and has also been recorded in New Zealand (Figure 1). The New Zealand records could very well be conspecific with specimens from the type locality in Port Jackson (Australia), but examination of the type material is critical before a definitive assessment can be made. This species is therefore treated here as cryptogenic in New Zealand.

There are few New Zealand records for this species. The original Bergquist (1970) records are quite disparate: from the Chatham Rise at about 400 m, and in the shallow subtidal of the Hauraki Gulf. More recently it has been recorded from Doubtful Sound (M. Kelly, NIWA, Unpublished record) (Figure 2).

During the New Zealand baseline port surveys, *Raspailia agminata* was only found at Milford Sound.

Ecology (habitat & known interactions):
The ecology of *Raspailia agminata* is not well known. It is a filter feeder and encrusts rocky surfaces alongside other invertebrates.

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Raspailia agminata Hallman 1914 has no known impacts on the intertidal and subtidal communities around New Zealand as it is quite rare.

Impact category	Code	Description (after Hayes et al. 2005)
Economic	M2	Water abstraction/nuisance fouling

Global and New Zealand distribution maps:

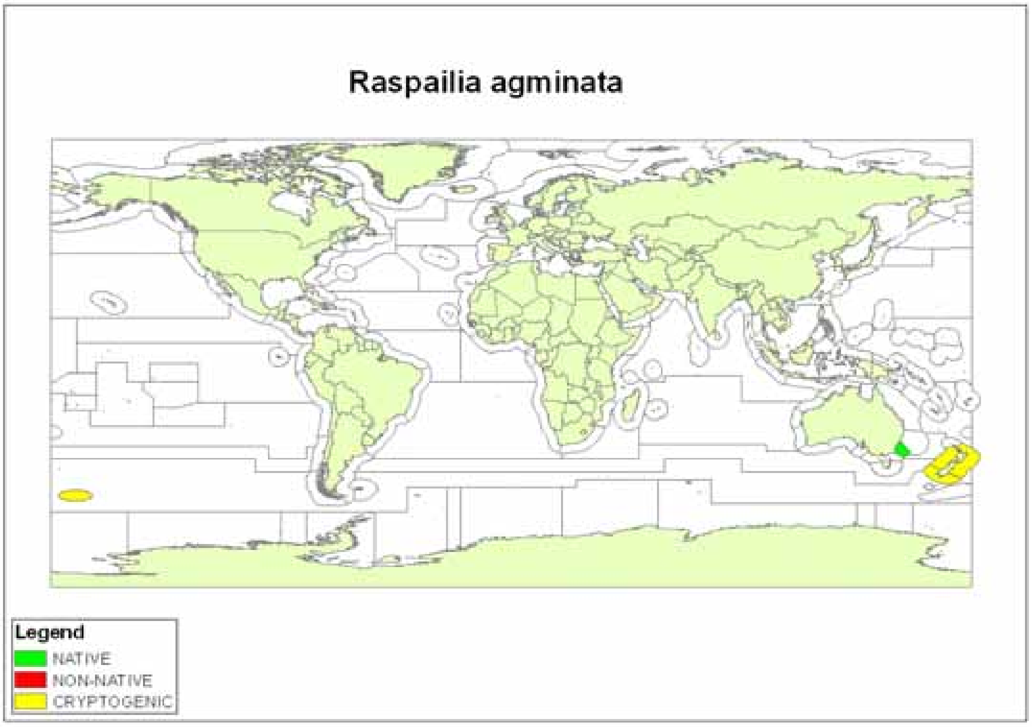


Figure 1: Global distribution of *Raspailia agminata*

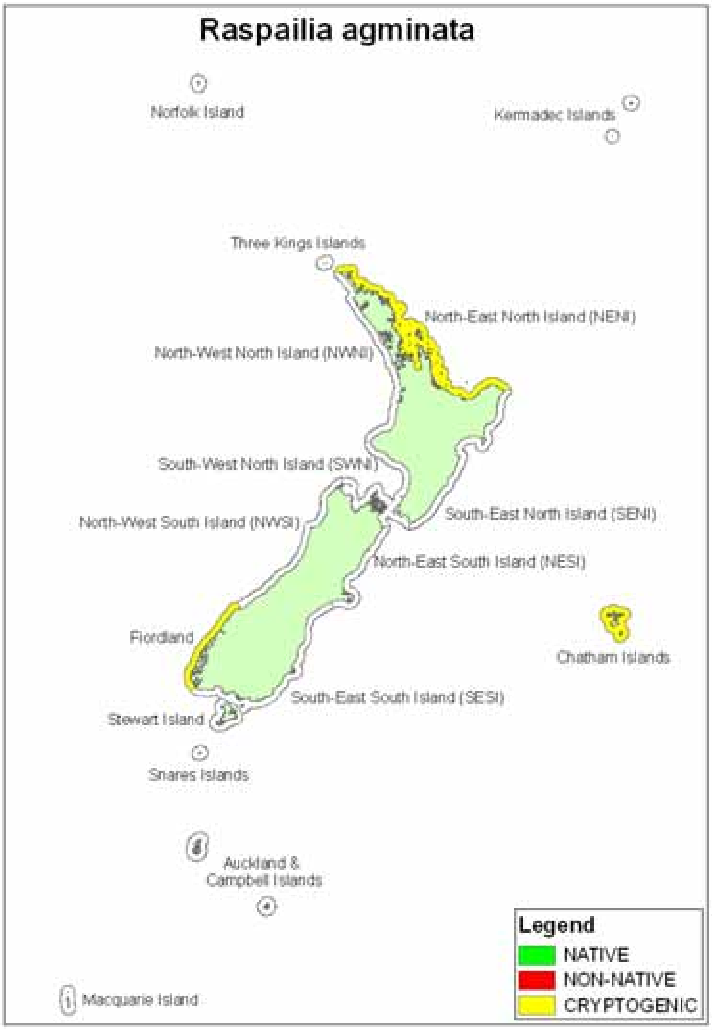


Figure 2: Distribution of *Raspailia agminata* in New Zealand

References:

Bergquist, P.R. (1970). The Marine Fauna of New Zealand: Porifera, Demospongiae, Part 2 (Axinellida and Halichondrida). *New Zealand Oceanographic Institute Memoir No. 61*: 85.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Scientific name: *Sargassum verruculosum* C. Agardh 1820
Common name: None

No image available

Species information sheet prepared by:	Dr Wendy Nelson (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	NIS
Species recorded during New Zealand port baseline surveys:	No
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Ochrophyta
Class: Phaeophyceae
Order: Fucales
Family: Sargassaceae

General species description:
Thalli brown, up to a metre or more in height, with a short main stem, and elongated basal leaves, pinnately lobed. The upper stems are long, slender and zig-zag with dichotomously divided leaves with a faint mid-rib and often prominent cryptostomata. Holdfasts are conical and bladders are round usually with a foliar apiculus (Adams 1994).

Distribution:
Sargassum verruculosum is native to Australia and is found from southern Western Australia to NSW and also around Tasmania (Womersley 1987) (Figure 1).

It was first found in New Zealand at Akaroa in 1845 (described as *S. raoulii* Hook f. et Harv.). The current known distribution is Kaikoura, Akaroa, Fiordland (Doubtful, Thompson, Dusky, Bligh, Breaksea Sounds, Preservation and Chalky Inlets), Otago Harbour, Bluff and Stewart Island (Adams 1983, W. Nelson, NIWA, pers. comm.; Nelson 1999) (Figure 2).

Sargassum verruculosum was not found during the New Zealand port baseline surveys.

Ecology (habitat & known interactions):
Sargassum verruculosum grows on rock in sheltered bays and harbours from low intertidal channels and pools to ca. 16m depth.

Potential pathways for introduction to, and spread within, New Zealand:
As all collections have been from places frequented by nineteenth century whalers and sealers, this species has been regarded as an introduction by early sailing vessels (Adams 1983).

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms	Yes	Yes
N1	Natural: planktonic dispersal		Yes (broadcast spores)
N2	Natural: rafting of adults on biogenic substrata		Yes
N3	Natural: long-distance movement of adults		Yes (as detached plants)
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential Impacts:
Sargassum verruculosum has been present in New Zealand for more than 150 years. During this time it has undergone very little expansion of range and appears to be having minimal impact at present.

Impact category	Code	Description (after Hayes et al. 2005)
Environmental	E5	Introduces/facilitates new pathogens, parasites or other NIS

Global and New Zealand distribution maps:

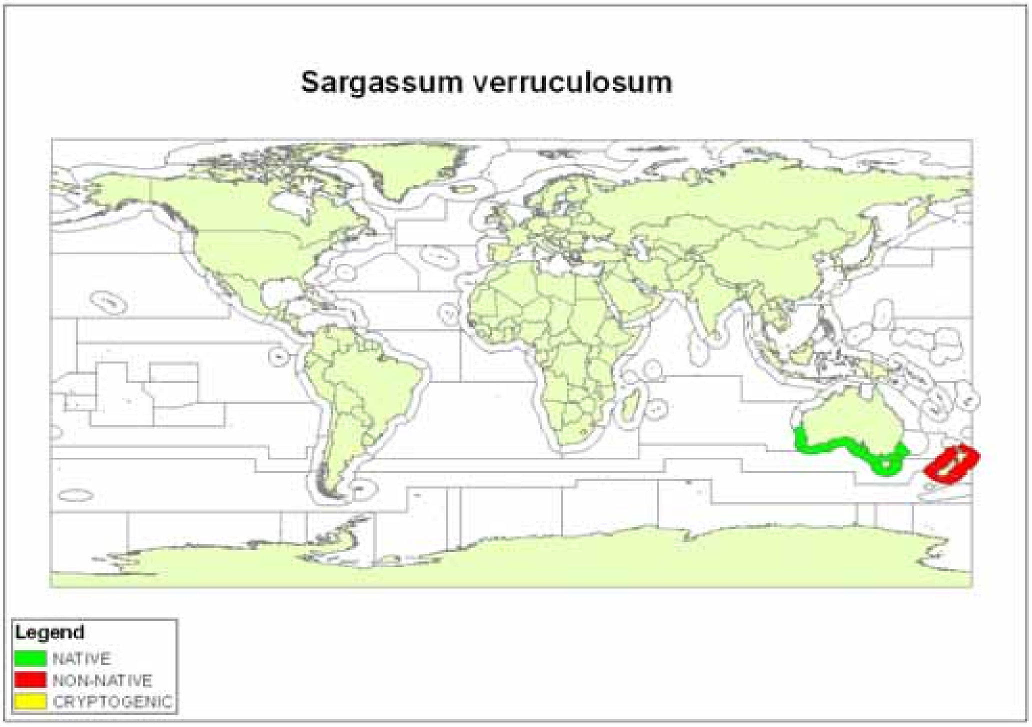


Figure 1: Global distribution of *Sargassum verruculosum*

Figure 2: Distribution of *Sargassum verruculosum* in New Zealand

References:

Adams, N. (1994). Seaweeds of New Zealand: an illustrated guide. Canterbury University Press, Christchurch. 360 p.

Adams, N.M. (1983). Checklist of marine algae possibly naturalised in New Zealand. *New Zealand Journal of Botany 21*: 1-2.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Nelson, W.A. (1999). A revised checklist of marine algae naturalised in New Zealand. *New Zealand Journal of Botany 37*: 355-359.

Womersley, H.B.S. (1987). The marine benthic flora of southern Australia. Part II. South Australian Government Printing Division, Adelaide. 484 p.

Scientific name: *Scruparia ambigua* (d'Orbigny, 1841)
Common name: None

Image: Zooid and ovicell of *Scruparia ambigua*, overgrowing zooids of *Catenicella* sp (Bock 2007).

Species information sheet prepared by:	Dr Dennis Gordon (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Bryozoa
Class: Gymnolaemata
Order: Cheilostomata
Family: Scrupariidae

General species description:
Scruparia ambigua is a diminutive bryozoan comprising uniserial chains of clavate zooids, from the front of which arise uniserial chains of similar zooids. These are lightly calcified and transparent and have an area of frontal membrane in the expanded distal half. Average zooid length is approximately 0.4 mm. Some bear ovoid ovicells that have a frontal keel (Gordon 1986).

Distribution:
Scruparia ambigua is a cosmopolitan species, widely distributed around the world except in polar waters (Gordon and Mawatari 1992). It was first described from the Falkland Islands in southern South America, but its native provenance is uncertain. Worldwide records include Europe (the Adriatic and North Seas, Sweden, Norway, Ireland, Great Britian, France), California, the Galapagos Islands, Patagonia, the Falkland Islands, Cape Horn, the Amsterdam Islands in the southern Indian Ocean, Japan, Australia, Tasmania and New Zealand (Figure 1).

The first record of *Scruparia ambigua* in New Zealand waters was from the Terra Nova expedition, collected on 31 August 1911 from Spirits Bay "near North Cape" at a depth of 20-37 m. Other records from New Zealand include Paterson Inlet on Stewart Island, Fiordland, Cape Saunders (Otago Peninsula), Portobello (Otago Harbour), Kaikoura, Tarakohe, Castlepoint, Napier, Mt Maunganui, Manukau Harbour, Waitemata Harbour, Marsden Point, North Cape and the Cavalli Islands (Figure 2).

During the New Zealand baseline port surveys, *Scruparia ambigua* was recorded from the ports of Whangarei, New Plymouth, Tauranga, Gisborne, Napier, Wellington, Picton, Nelson, Lyttelton, Timaru, Dunedin, Bluff, Taharoa Terminal and Milford Sound (Figure 2).

Ecology (habitat & known interactions):
As an opportunistic epizooite or epiphyte, *Scruparia ambigua* can be found growing on a variety of organisms. In New Zealand, it is often found attached to non-indigenous species of *Bugula* (*B. flabellata, B. neritina*). In the Woods Hole region of the north-eastern United States, *Scruparia ambigua* has also been found growing on *Bugula turrita* and eleven algal species, and also in close association with hydroids and an encrusting bryozoan (Rogick and Croasdale 1949). In San Francisco it has been found growing on the bryozoan *Scrupocellaria diegensis* (California Academy of Sciences 2002).

Scruparia ambigua occurs in marine and brackish waters, and has been recorded from locations with salinities as low as 18 ‰ (Winston 1977). It has been recorded in New Zealand from 0 m to 84 m depth (D. Gordon, NIWA, pers. comm.).

Potential pathways for introduction to, and spread within, New Zealand:
As a short-lived opportunistic species that can settle on naturally drifting substrate as well as artificial materials, *Scruparia ambigua* could spread by rafting on other organisms as well as by fouling ships' hulls and man-made materials.

Code	Pathway (after Hayes et al. 2005)	1 = Potential pathway for introduction to NZ	1 = Potential pathway for spread within NZ
D	Debris: transport of species on human generated debris	Yes	Yes
NB	Navigation buoys and marina floats: accidental as attached or free-living fouling organisms		Yes
N2	Natural: rafting of adults on biogenic substrata		Yes
P2	Plant introductions: accidental with deliberate plant translocations	Yes	Yes
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Owing to its diminutive size, *Scruparia ambigua* is unlikely to have any negative impact. Certainly none is known.

Global and New Zealand distribution maps:

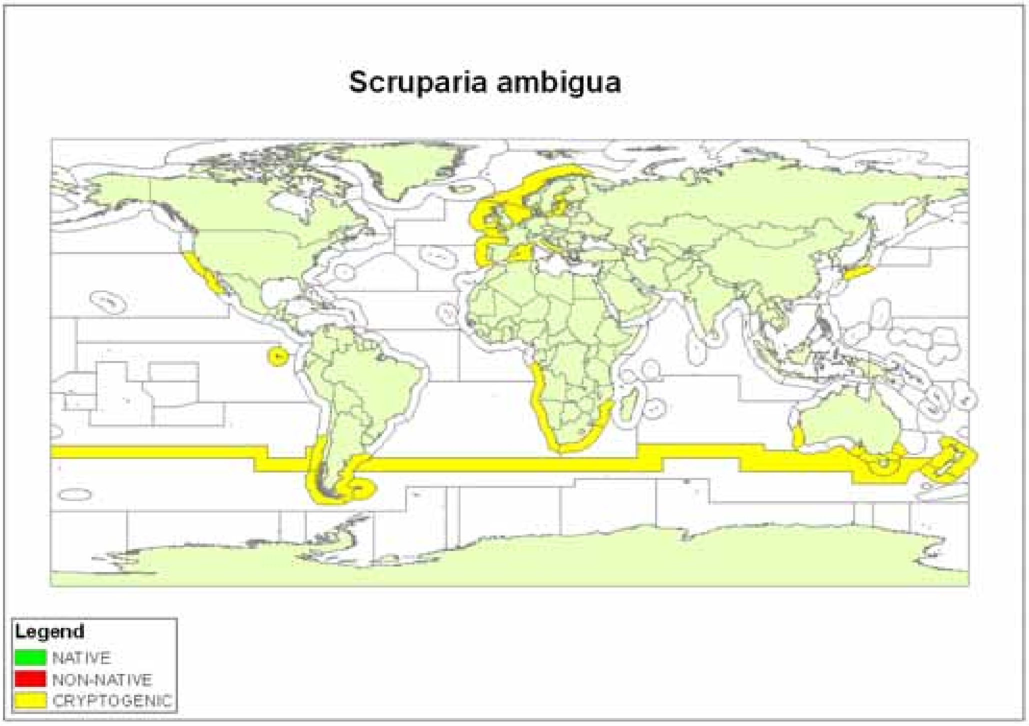


Figure 1: Global distribution of *Scruparia ambigua.* NB: the large shaded region spanning the Southern Ocean is shaded due to *Scruparia ambigua* having been recorded from the Amsterdam Islands in the southern Indian Ocean.

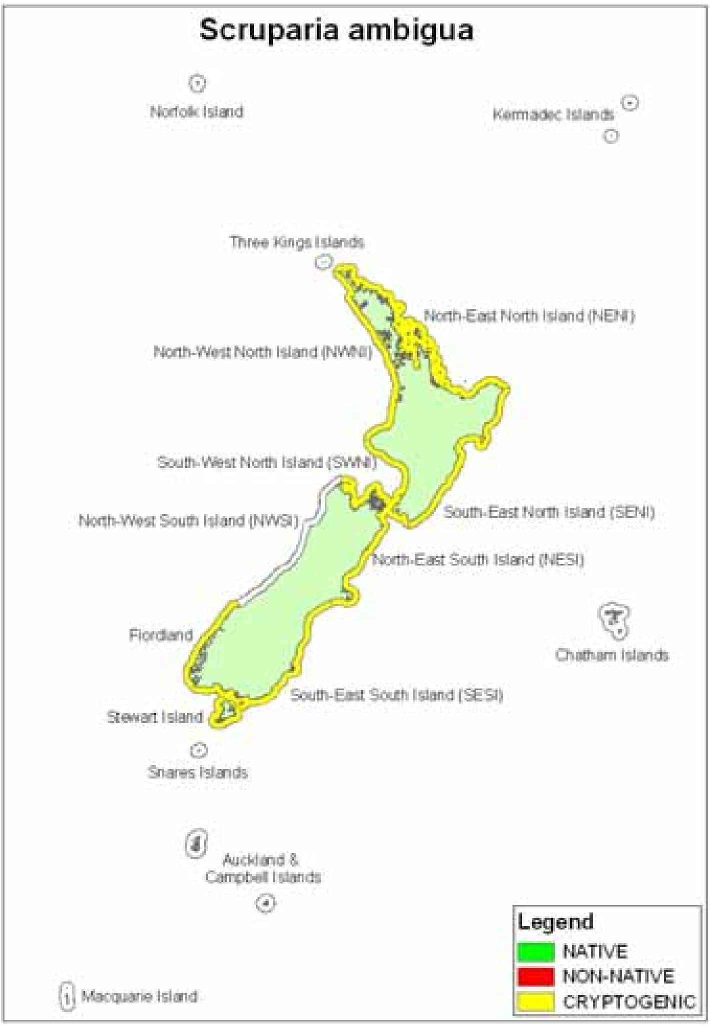


Figure 2: Distribution of *Scruparia ambigua* in New Zealand

References:

Bock, P. (2007). The Bryozoa Home Page. Website <http://bryozoa.net/index.html>. Last updated 04/06/2007. Accessed 04/12/2007.

California Academy of Sciences (2002). Animal Images. Web publication <http://www.calacademy.org/research/izg/SFBay2K/animalthumbnailimages.htm>. Accessed 12/07/2006.

Gordon, D.; Mawatari, S. (1992). Atlas of marine fouling bryozoa of New Zealand Ports and Harbours. Miscellaneous Publications of the New Zealand Oceanographic Institute Vol 107. New Zealand Oceanographic Institute.

Gordon, D.P. (1986). The marine fauna of New Zealand: Bryozoa: Gymnolaemata (Ctenostomata and Cheilostomata Anasca) from the western South Island continental shelf and slope. *New Zealand Oceanographic Institute Memoir 95*: 1-121.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Rogick, M.D.; Croasdale, H. (1949). Studies on marine bryozoa, III. Woods Hole region bryozoa associated with algae. *Biological Bulletin 96(1)*: 32-69.

Winston, J. (1977). Distribution and ecology of estuarine ecotoprocts: a critical review. *Chesapeake Science 18(1)*: 34-57.

Scientific name: *Tethya bergquistae* Hooper & Wiedenmayer, 1994
Common name: Pink golfball sponge

No image available.

Species information sheet prepared by:	Dr Michelle Kelly (NIWA) & NIWA Marine Biosecurity Group
Biosecurity status:	C1
Species recorded during New Zealand port baseline surveys:	Yes
Species recorded during review of historical marine species records from Kaipara Harbour, Taharoa, Milford Sound, Port Underwood, Kaikoura & nearby locations:	Yes

Taxonomy:
Phylum: Porifera
Class: Demospongiae
Order: Hadromerida
Family: Tethyidae

In the southwest Pacific, species of *Tethya* are well known and have been thoroughly revised by Bergquist & Kelly-Borges (1991) and Sara & Sara (2004). Bergquist & Kelly-Borges (1991) renamed this common sponge (known until 1991 as *Tethya ingalli* Sollas, 1888), *Tethya australis* Bergquist & Kelly-Borges, 1991, as it was very similar to specimens described from South Australia as well. These authors stated that, "The general skeletal structure, spiculation, colouration and body morphology of specimens described as *Tethya ingalli* by Wiedenmayer (1989) from Bass Strait, South Australia, by Bergquist (1968) from New Zealand, and by Sollas (1988), Hentschel (1909) and (Hallman 1914) from South Australia, are in general agreement with each other and fall within the species described here as *Tethya australis*". Hooper (1994) discovered that the new name '*australis*' was a junior secondary homonym of *Donatia lyncurium australis* Kirk 1911, and changed this species name to *T. bergquistae*, the name by which it is presently known.

General species description:
Tethya bergquistae is a spherical sponge with a mammilate surface from which arises spherical buds on filaments. The colour in life is deep rose or candy pink with a dull yellow interior, the texture is tough. It ranges in size from 1-5 cm diameter.

Distribution:
Tethya bergquistae is native to Australia with records from Western Australia, Bass Strait and the New South Wales coast (Figure1). It has also been recorded in New Zealand. It should be noted that we cannot be sure about which way the introduction went, i.e. from New Zealand to Australia or vice versa. It should also be noted that unless a direct comparison of all material described in the older literature is conducted, conspecificity cannot be certain. This species is therefore considered cryptogenic in New Zealand.

Tethya bergquistae Hooper & Wiedenmayer, 1994 is a relatively common sponge in Northland coastal waters, on both the west and east coasts. Records also exist from Chatham and Stewart Islands, and most parts of mainland New Zealand (Figure 2).

During the New Zealand baseline port surveys, *Tethya bergquistae* was only found at Milford Sound (Figure 2).

Ecology (habitat & known interactions):
The sponge is solitary and found most commonly in the upper subtidal fringe amongst algae, and in deeper water (down to 26 m) the sponge is found on open rock faces. *Tethya bergquistae* is a filter feeder.

Potential pathways for introduction to, and spread within, New Zealand:

Code	Pathway (after Hayes et al. 2005)	Potential pathway for introduction to NZ	Potential pathway for spread within NZ
S1	Ships: accidental as attached or free-living fouling organisms	Yes	Yes

Potential impacts in New Zealand:
Tethya bergquistae Hooper & Wiedenmayer, 1994 has no known ecological impacts on New Zealand interdidal and subtidal communities.

Global and New Zealand distribution maps:

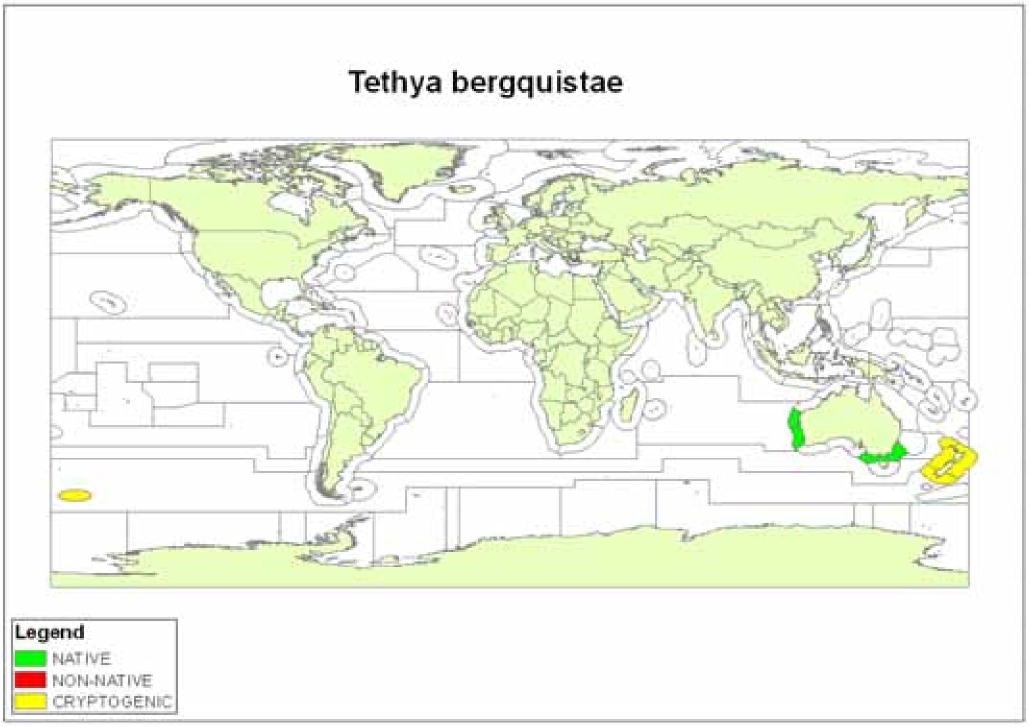


Figure 1: Global distribution of *Tethya bergquistae*

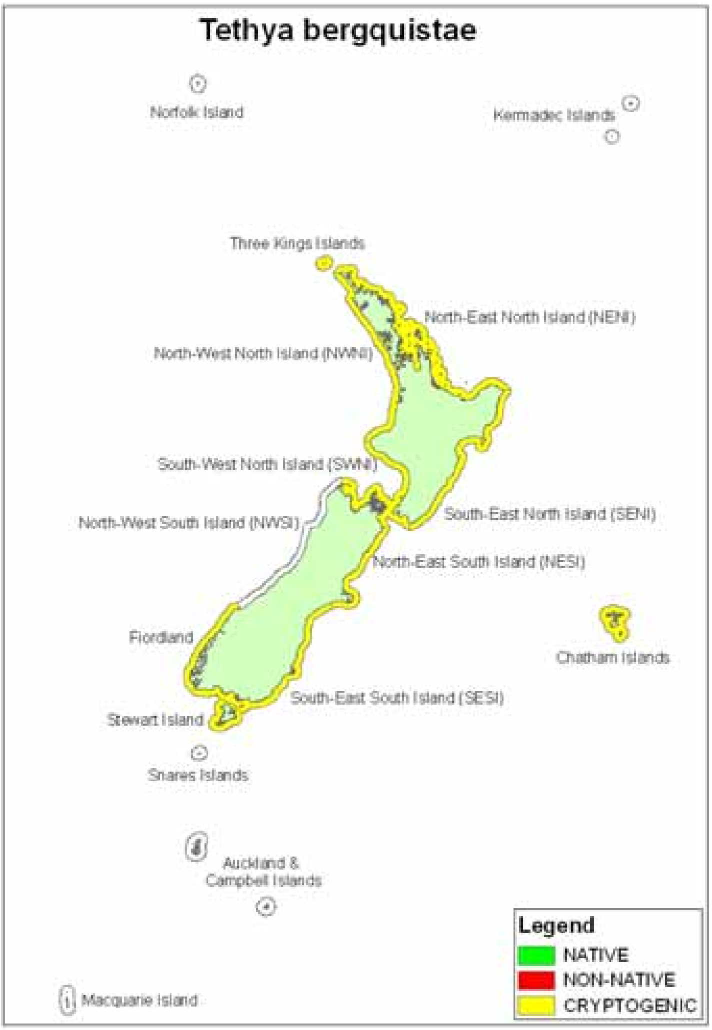


Figure 2: Distribution of *Tethya bergquistae* in New Zealand

References:

Bergquist, P. (1968). The marine fauna of New Zealand: Porifera, Demospongiae, Part 1 (Tetractinomorpha and Lithistida). New Zealand Oceanographic Institute Memoir 37. 106 p.

Bergquist, P.R.; Kelly-Borges, M. (1991). An evaluation of the genus *Tethya* (Porifera: Demospongiae: Hadromerida) with descriptions of new species from the Southwest Pacific. *The Beagle, Records of the Northern Territory Museum of Arts and Sciences 8(1)*: 37-72.

Hallman, E. (1914). A revision of the monaxonid species described as new in Lendenfeld's "Catalogue of the sponges in the Australian Museum". Part I. Proceedings of the Linnean Society of New South Wales 39: 263-315.

Hayes, K.; Sliwa, C.; Migus, S.; McEnnulty, F.; Dunstan, P. (2005). National priority pests. Part II, Ranking of Australian marine pests. Report undertaken for the Department of Environment and Heritage by CSIRO Marine Research. Commonwealth of Australia.

Hentschel, E. (1909). Tetraxonida. *In*: Michaelsen, W.; Hartmeyer, R. (eds). Die Fauna Südwest-Australiens, pp. 347-402. G. Fischer, Jena, Germany.

Hooper, J. (1994). Coral reef sponges of the Sahul shelf - a case for habitat preservation. *Memoirs of the Queensland Museum 36(1)*: 93-106.

Sarà, M.; Sarà, A. (2004). A revision of Australian and New Zealand Tethya (Porifera : Demospongiae) with a preliminary analysis of species-groupings. *Invertebrate Systematics 18*: 117-156.

Sollas, W.J. (1988). Report on the Tetractinellida collected by H. M. S. Challenger, during the years 1873-1876. *Reports on the Scientific Results of the Voyage of the H. M. S. Challenger, Zoology 25(63)*: 1-458.

Wiedenmayer, F. (1989). Demospongiae (Porifera) from northern Bass Strait, Southern Australia. *Memoirs of the Museum of Victoria 50(1)*: 1-242.

APPENDIX 7. SPECIES X SAMPLE X SITE RESULTS FOR ALL TAXA RECORDED BY EACH METHOD FROM THE MILFORD SOUND PORT SURVEY.

Appendix 7a. Results from the anchor box dredge samples

						Site name ->	Poison Bay			
						Replicate ->	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status				
Annelida	Polychaeta	Phyllodocida	Nephtyidae	Aglaophamus	macroura	Native	1	1	1	3
Annelida	Polychaeta	Sabellida	Oweniidae	Owenia	petersenae	Native	0	0	1	1
Annelida	Polychaeta	Scolecida	Orbiniidae	Scoloplos	simplex	Native	1	0	0	1
Annelida	Polychaeta	Spionida	Spionidae	Prionospio	australiensis	Native	0	1	1	2
Annelida	Polychaeta	Terebellida	Cirratulidae	Timarete	anchylochaetus	Native	0	0	1	1
Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	Liljeborgia	sp. 2	C2	1	0	0	1
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Lysianassidae	sp.	Indeterminate	0	1	0	1
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	Waitangi	rakiura	Native	0	0	1	1
Arthropoda	Ostracoda					Indeterminate	1	1	1	3
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	Indeterminate	0	1	0	1
Cnidaria	Hydrozoa					Indeterminate	0	0	1	1
Echinodermata	Holothuroidea?					Indeterminate	0	0	1	1
Mollusca	Bivalvia	Pholadomyoida	Myochamidae	Myadora	striata	Native	0	0	1	1
Mollusca	Bivalvia	Veneroida	Mactridae	Scalpomactra	scalpellum	Native	1	0	0	1
Mollusca	Bivalvia	Veneroida	Neoleptonidae	Neolepton		Indeterminate	0	0	1	1
Mollusca	Bivalvia	Veneroida	Veneridae	Notocallista	multistriata	Native	0	1	0	1
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	Native	0	1	0	1
Mollusca	Gastropoda	Neogastropoda	Olividae	Amalda	australis	Native	0	0	1	1
Mollusca	Gastropoda	Neogastropoda	Olividae	Amalda	novaezelandiae	Native	0	0	1	1
Mollusca	Gastropoda	Neogastropoda	Terebridae	Pervicacia	tristis	Native	0	0	1	1
Mollusca	Gastropoda	Neotaenioglossa	Batillariidae	Zeacumantus	subcarinatus	Native	0	1	0	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Antisolarium	egenum	Native	0	0	1	1
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	sp.	Indeterminate	0	1	0	1
						Total	5	9	#	28

Appendix 7b. Results from the benthic core samples

						Site name ->	Anita Bay			Deep Water Basin 1			Deep Water Basin 2			Deep Water Basin Jetties						Ferry Terminal						Stripe Point			
						Replicate ->	1	2	3	1	2	3	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																									
Annelida	Polychaeta	Phyllodocida	Nereididae	Nicon	aestuariensis	Native	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	3
Annelida	Polychaeta	Phyllodocida	Sigalionidae	Sigalion	oviger	Native	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
Annelida	Polychaeta	Scolecida	Arenicolidae	Abarenicola	devia	Native	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
Annelida	Polychaeta	Terebellida	Pectinariidae	Pectinaria	australis	Native	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Lysianassidae	sp.	Indeterminate	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
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	Torridoharpinia	hurleyi	Native	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
Arthropoda	Malacostraca	Decapoda	Ocypodidae	Macrophthalmus	hirtipes	Native	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Decapoda	Paguridae	Pagurus	albidianthus	Native	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
Arthropoda	Ostracoda					Indeterminate	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
Chlorophyta	Ulvophyceae	Caulerpales	Caulerpaceae	Caulerpa	brownii	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	Indeterminate	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	4
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subarticulatus	Native	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
Mollusca	Bivalvia	Solemyoida	Solemyidae	Solemya	parkinsonii	Native	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
Mollusca	Bivalvia	Veneroida	Mactridae	Scalpomactra	scalpellum	Native	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
Mollusca	Bivalvia	Veneroida	Psammobiidae	Soletellina	nitida	Native	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
Mollusca	Bivalvia	Veneroida	Tellinidae	Macomona	liliana	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
Mollusca	Bivalvia	Veneroida	Veneridae	Austrovenus	stutchburyi	Native	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
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	Native	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
Mollusca	Gastropoda	Docoglossa	Lottiidae	Notoacmea	helmsi	Native	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
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Cantharidella	tesselata	Native	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
Nemertea						Indeterminate	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
Ochrophyta	Phaeophyceae	Sphacelariales	Stypocaulaceae	Halopteris	sp.	Indeterminate	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
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	macrocarpa	Native	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
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae			Indeterminate	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
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Corallina	officinalis	Native	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
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Haliptilon		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
						Total	2	2	3	1	1	2	2	2	0	0	0	1	1	2	0	1	1	1	1	0	0	7	5	1	36

Appendix 7c. Results from the crab trap samples

						Site name ->	Deep Water Basin						Deep Water Basin Jetties						Deep Water Basin Slipways					
						Replicate ->	1	2	3	3	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																		
Chordata	Actinopterygii	Gadiformes	Moridae	Lotella	rhacinum	Native	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	Native	1	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	0
Chordata	Actinopterygii	Perciformes	Scorpidinae	Helicolenus	percoides	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chordata	Actinopterygii	Scorpaeniformes	Scorpaenidae	Scorpaena	papillosus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Cominella	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
						Total	1	1	1	1	1	2	1	1	1	0	0	0	1	0	1	1	1	0

		Ferry Terminal 2						Harrison Cove						Poison Bay						Sandfly Point Jetty		
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3
Genus	species epithet																					
Lotella	rhacinum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notolabrus	celidotus	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Helicolenus	percoides	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Scorpaena	papillosus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patiriella	regularis	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0
Austrofusus	glans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Cominella	sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Total	0	0	0	1	1	1	1	0	0	0	0	0	0	2	2	1	2	1	1	0	0

Appendix 7d. Results from cyst samples

						Site name ->	Anita Bay			Deep Water Basin 1			Deep water Basin 2			Deep Water Basin Jetties						Ferry Terminal						Ferry Terminal 2			Fox Point			Harrisons Cove			Poison Bay			Sandfly Jetty Point						Sea Breeze Point			Stripe Point			
						Replicate ->	1	2	3	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	5	6	1	2	3	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																																														
Myzozoa	Dinophyceae	Peridiniales	Gonyaulacaceae	Alexandrium	tamarense	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Myzozoa	Dinophyceae	Peridiniales	Gonyaulacaceae	Lingulodinium	polyedrum	Native	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	4
Myzozoa	Dinophyceae	Peridiniales	Peridiniaceae	Scrippsiella	trochoidea	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	11
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	americanum	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	8
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	avellana	Native	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	10
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	conicum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	5
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	latissinum	Native	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
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	punctulatum	Native	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	2
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	sp.	Indeterminate	1	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	0	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	1	0	1	1	26
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	subinerme	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Myzozoa	Dinophyceae	Peridiniales (?)				Indeterminate	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	2
						Total	2	1	1	1	1	1	1	2	2	1	1	1	1	1	1	3	1	4	1	3	1	1	2	2	3	1	2	1	1	4	1	1	3	2	2	1	1	4	0	2	2	2	1	1	1	72

Appendix 7e. Results from the phytoplankton samples

						Site name ->	Channel Marker No 2			Deep Water Basin			Deep Water Basin Jetties			Ferry Terminal 2			Freshwater Basin Mooring			Harrison Cove			Poison Bay			Sandfly Point Jetty			Sea Breeze Point			Stripe Point			Yates Point			
						Replicate ->	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	1	2	3	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																																		
Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula		Indeterminate	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	2
Bacillariophyta	Bacillariophyceae	Naviculales	Pleurosigmataceae	Gyrosigma		Indeterminate	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
Bacillariophyta	Bacillariophyceae	Naviculales	Pleurosigmataceae	Pleurosigma		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	5
Bacillariophyta	Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	Chaetoceros		Indeterminate	0	0	0	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	1	0	1	0	4
Bacillariophyta	Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	Chaetoceros	affinis	Native	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	1	0	1	0	4
Bacillariophyta	Coscinodiscophyceae	Chaetocerotales	Chaetocerotaceae	Chaetoceros	convolutus	Native	0	0	0	0	0	0	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	2
Bacillariophyta	Coscinodiscophyceae	Corethrales	Corethraceae	Corethron	criophilum	Native	0	0	0	0	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	2
Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	Coscinodiscus		Indeterminate	0	1	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	1	0	0	0	0	0	4
Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	Coscinodiscus	wailesii	Native	1	0	0	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	10
Bacillariophyta	Coscinodiscophyceae	Melosirales	Melosiraceae	Melosira		Indeterminate	0	1	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	3
Bacillariophyta	Coscinodiscophyceae	Melosirales	Melosiraceae	Melosira	moniliformis	Native	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	9
Bacillariophyta	Coscinodiscophyceae	Melosirales	Stephanopyxidaceae	Stephanopyxis	orbicularis	Native	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5
Bacillariophyta	Coscinodiscophyceae	Rhizosoleniales	Rhizosoleniaceae	Rhizosolenia	alata	Native	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bacillariophyta	Coscinodiscophyceae	Rhizosoleniales	Rhizosoleniaceae	Rhizosolenia	imbricata	Native	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	2
Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Lauderiaceae	Lauderia	annulata	Native	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	Thalassiosira		Indeterminate	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	1	1	12
Bacillariophyta	Coscinodiscophyceae	Triceratiales	Triceratiaceae	Odontella	sinensis	Native	0	1	1	1	1	1	0	1	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	9
Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria		Indeterminate	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Bacillariophyta	Fragilariophyceae	Licmophorales	Licmophoraceae	Licmophora		Indeterminate	0	0	0	0	0	0	0	0	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	2
Bacillariophyta	Fragilariophyceae	Thalassionemales	Thalassionemataceae	Thalassionema		Indeterminate	0	0	0	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	1	0	1	0	4
Bacillariophyta	Fragilariophyceae	Thalassionemales	Thalassionemataceae	Thalassionema	nitzschioides	Native	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Myzozoa	Dinophyceae	Dinophysiales	Dinophysiaceae	Dinophysis	acuminata	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Myzozoa	Dinophyceae	Peridiniales	Ceratiaceae	Ceratium	arietinum	Native	0	0	0	0	0	0	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
Myzozoa	Dinophyceae	Peridiniales	Ceratiaceae	Ceratium	fusus	Native	0	0	0	0	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
Myzozoa	Dinophyceae	Peridiniales	Ceratiaceae	Ceratium	tripos	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	3
Myzozoa	Dinophyceae	Peridiniales	Podolampadaceae	Podolampas	palmipes	Native	0	0	0	0	0	0	0	0	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
Myzozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	Protoperidinium	sp.	Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Myzozoa	Dinophyceae	Prorocentrales	Prorocentraceae	Prorocentrum	micans	Native	0	1	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	13
Ochrophyta	Dictyochophyceae	Dictyochales	Dictyochaceae	Distephanus	speculum	Native	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
						Total	3	8	4	7	7	5	0	4	0	0	0	3	0	5	5	5	6	7	0	7	0	2	0	0	2	0	0	11	0	8	2	9	3	113

Appendix 7f. Results from the poison station samples

						Site name ->	Deep Water Basin Jetties	Ferry Terminal	Poison Bay	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status				
Chordata	Actinopterygii	Perciformes	Plesiopidae	Acanthoclinus	marilynae	Native	0	0	1	1
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Forsterygion	lapillum	Native	1	0	1	2
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Forsterygion	malcolmi	Native	0	0	1	1
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Forsterygion	varium	Native	0	0	1	1
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Grahamina	capito	Native	1	0	0	1
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Ruanoho	decemdigitatus	Native	0	0	1	1
Chordata	Actinopterygii	Perciformes	Tripterygiidae	Ruanoho	whero	Native	0	0	1	1
Chordata	Actinopterygii	Scorpaeniformes	Scorpaenidae	Scorpaena	papillosus	Native	0	0	1	1
						Total	2	0	7	9

Appendix 7g. Results from the quadrat scrapings.

						Site name ->	Anita Bay									Channel marker No. 2		Cooper Point									Deep Water Basin Jetties						Ferry Terminal						Ferry Terminal 2						Harrison Cove									Pater Point									
						Pile number ->	1			2			3			1		1			2			3			1			2			1			2			1			2			1			2			3			1			2			3			
						Replicate ->	1	2	3	1	2	3	1	2	3	1	2	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	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																																																								
Unidentifiable						Indeterminate	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	1	0	0	3
Algae (unidentified)						Indeterminate	0	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	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
Annelida	Polychaeta					Indeterminate	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	1
Annelida	Polychaeta	Eunicida	Eunicidae	Eunice	australis	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	sphaerocephala	Native	1	1	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	1	0	0	0	0	0	0	0	0	0	0	5
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	benhami	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	4
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	lamelliformis	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Hesionidae	Ophiodromus	angustifrons	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	Neanthes-A	C2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	1	0	0	7
Annelida	Polychaeta	Phyllodocida	Nereididae	Perinereis	camiguinoides	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	4
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	australis group	Native	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Nereiphylla	cf. castanea	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	jacksoni	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	polychromus	Native	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	1	1	1	1	0	0	0	0	0	1	0	1	8
Annelida	Polychaeta	Phyllodocida	Syllidae	Syllidae	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Sabellidae	Branchiomma	curtum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Annelida	Polychaeta	Sabellida	Sabellidae	Fabricia		Indeterminate	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Sabellidae	Megalomma	suspiciens	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Sabellidae	Sabellidae	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	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
Annelida	Polychaeta	Sabellida	Serpulidae	Galeolaria	hystrix	Native	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	3
Annelida	Polychaeta	Sabellida	Serpulidae	Serpula	Indet	Indeterminate	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	1	1	0	0	0	0	0	0	0	0	1	4
Annelida	Polychaeta	Sabellida	Serpulidae	Spirobranchus	cariniferus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	5
Annelida	Polychaeta	Sabellida	Serpulidae	Spirobranchus	S. polytrema complex	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	1
Annelida	Polychaeta	Scolecida	Opheliidae	Armandia	maculata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Annelida	Polychaeta	Spionida	Chaetopteridae	Phyllochaetopter	Phyllochaetopterus-A	C2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Spionida	Spionidae	Boccardia	knoxi	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Terebellida	Terebellidae	Nicolea	maxima	Native	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	1
Annelida	Polychaeta	Terebellida	Terebellidae	Streblosoma	toddae	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Annelida	Polychaeta	Terebellida	Terebellidae	Terebella	Terebella-B	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Annelida	Polychaeta	Terebellida	Terebellidae	Terebellidae	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda				Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Paradexamine	houtete	Native	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	Liljeborgia	sp. 2	C2	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	1
Arthropoda	Malacostraca	Amphipoda	Lysianassidae	Lysianassidae	sp.	Indeterminate	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
Arthropoda	Malacostraca	Amphipoda	Melitidae	Maera		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda	Melitidae	Mallacoota	subcarinata	Native	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	Torridoharpinia	hurleyi	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	Waitangi	rakiura	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Amphipoda	Podoceridae	Podocerus	karu	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Arthropoda	Malacostraca	Decapoda	Hippolytidae	Hippolyte	bifidirostris	Native	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Halicarcinus	cookii	Native	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Halicarcinus	innominatus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Halicarcinus	varius	Native	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	6
Arthropoda	Malacostraca	Decapoda	Paguridae	Lophopagurus	pumilus	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Arthropoda	Malacostraca	Isopoda	Sphaeromatidae	Cilicaea	sp.	Indeterminate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Maxillopoda	Sessilia	Archaeobalanidae	Austrominius	modestus	Native	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	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Brachiopoda	Rhynchonellata	Rhynchonellida	Notosariidae	Notosaria	nigricans	Native	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	1
Brachiopoda	Rhynchonellata	Terebratulida	Terebratulidae	Calloria	inconspicua	Native	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	1
Bryozoa	Gymnolaemata	Cheilostomata	Beaniidae	Beania	intermedia	Native	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bitectiporidae	Bitectipora	mucronifera	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia		Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia	barbata	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia	cornuta	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Calloporidae	Crassimarginatella	fossa	Native	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	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Caberea	darwinii	Native	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	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Caberea	helicina	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3

Appendix 7g. Results from the quadrat scrapings.

						Site name ->	Anita Bay									Channel marker No. 2		Cooper Point									Deep Water Basin Jetties						Ferry Terminal						Ferry Terminal 2						Harrison Cove									Pater Point									
						Pile number ->	1			2			3			1		1			2			3			1			2			1			2			1			2			1			2			3			1			2			3			
						Replicate ->	1	2	3	1	2	3	1	2	3	1	2	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	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																																																							
Bryozoa	Gymnolaemat	Cheilostomata	Candidae	Emma	crystallina	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemat	Cheilostomata	Catenicellidae	Orthoscuticella		Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemat	Cheilostomata	Catenicellidae	Scalicella	crystallina	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemat	Cheilostomata	Cellariidae	Cellaria	tenuirostris	Native	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	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemat	Cheilostomata	Celleporidae	Celleporina	sp.	C2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemat	Cheilostomata	Chaperiidae	Chaperiopsis	cervicornis	Native	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemat	Cheilostomata	Flustridae	Gregarinidra		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Bryozoa	Gymnolaemat	Cheilostomata	Hippothoidae	Celleporella	bathamae	Native	0	0	0	0	0	0	0	0	0	0	1	0	0	0	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	2
Bryozoa	Gymnolaemat	Cheilostomata	Membraniporida	Membranipora	pura	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemat	Cheilostomata	Microporellidae	Fenestrulina	disjuncta	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemat	Cheilostomata	Microporellidae	Fenestrulina	thyreophora	Native	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
Bryozoa	Gymnolaemat	Cheilostomata	Smittinidae	Smittoidea	maunganuiensis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemat	Cheilostomata	Steginoporellida	Steginoporella	magnifica	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Bicrisia	biciliata	Native	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	2
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Bicrisia	edwardsiana	Native	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	2
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Crisia	acropora	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Crisia	tenuis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Bryozoa	Stenolaemata	Cyclostomata	Lichenoporidae	Disporella	pristis	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Tubuliporidae	Tubulipora	sp.	Indeterminate	0	1	0	0	1	0	0	0	0	0	0	1	1	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	0	0	0	0	0	0	0	0	0	0	0	0	8
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	dichotomum f. novozelandicum	Native	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	1
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	gracile	Native	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Chlorophyta	Ulvophyceae	Caulerpales	Caulerpaceae	Caulerpa	brownii	Native	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	sp.	Indeterminate	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	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Chlorophyta	Ulvophyceae	Codiolales	Monostromatace	Monostroma	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	20
Chordata	Ascidiacea	Enterogona	Ascidiidae			Indeterminate	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Enterogona	Polyclinidae	Aplidiopsis	sp.	C2	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	1
Chordata	Ascidiacea	Enterogona	Polyclinidae	Aplidium	sp. 19	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Chordata	Ascidiacea	Pleurogona	Pyuridae	Pyura	cancellata	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Pleurogona	Pyuridae	Pyura	pulla	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Pleurogona	Styelidae	Cnemidocarpa	bicornuta	Native	1	1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Chordata	Ascidiacea	Pleurogona	Styelidae	Cnemidocarpa	nisiotis	Native	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cnidaria	Anthozoa	Scleractinia	Rhizangiidae	Culicia	rubeola	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Obelia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Orthopyxis	integra	C1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cyanobacteria						Indeterminate	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	1	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Echinodermata	Asteroidea	Forcipulatida	Asteriidae	Allostichaster		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	mortenseni	Native	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	Native	0	0	0	0	0	0	0	0	0	0	0	1	1	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	1	0	0	1	0	0	0	0	0	0	0	0	8
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Echinodermata	Asteroidea	Valvatida	Goniasteridae	Pentagonaster	pulchellus	Native	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	1
Echinodermata	Echinoidea	Echinoida	Echinometridae	Evechinus	chloroticus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Echinodermata	Echinoidea	Temnopleurid	Temnopleuridae	Pseudechinus	novaezealandiae	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Echinodermata	Holothuroidea	Aspidochirotid	Stichopodidae	Stichopus	mollis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Mollusca						Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	6
Mollusca	Bivalvia					Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya		Indeterminate	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Modiolarca		Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	Native	0	0	0	0	0	0	0	0	0	1	1	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Mollusca	Bivalvia	Mytiloida	Mytilidae	Xenostrobus		Indeterminate	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	1	1	1	1	1	1	1	1	1	14
Mollusca	Bivalvia	Veneroida	Lasaeidae	Borniola	reniformis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Mollusca	Bivalvia	Veneroida	Thyasiridae	Genaxinus	cookianus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Basommatoph	Siphonariidae	Siphonaria	australis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Mollusca	Gastropoda	Docoglossa	Lottiidae	Notoacmea	helmsi	Native	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	1	0	0	0	0	0	0	0	0	2
Mollusca	Gastropoda	Docoglossa	Lottiidae	Patelloida	corticata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3

Appendix 7g. Results from the quadrat scrapings.

						Site name ->	Anita Bay									Channel marker No. 2		Cooper Point									Deep Water Basin Jetties						Ferry Terminal						Ferry Terminal 2						Harrison Cove									Pater Point									
						Pile number ->	1			2			3			1		1			2			3			1			2			1			2			1			2			1			2			3			1			2			3			
						Replicate ->	1	2	3	1	2	3	1	2	3	1	2	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	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																																																									
Mollusca	Gastropoda	Heterostropha	Pyramidellidae	Odostomia		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Neogastropod	Muricidae	Xymene	traversi	Native	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	1	0	0	0	0	0	0	3
Mollusca	Gastropoda	Neotaenioglos	Turritellidae	Maoricolpus	roseus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Mollusca	Gastropoda	Vetigastropod	Trochidae	Cantharidella	tesselata	Native	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Mollusca	Gastropoda	Vetigastropod	Trochidae	Melagraphia	aethiops	Native	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Mollusca	Gastropoda	Vetigastropod	Turbinidae	Cookia	sulcata	Native	0	0	0	1	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	3
Ochrophyta	Phaeophycea	Dictyotales				Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
Ochrophyta	Phaeophycea	Dictyotales	Dictyotaceae	Zonaria	turneriana	Native	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Ochrophyta	Phaeophycea	Ectocarpales	Adenocystaceae	Adenocystis	utricularis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophycea	Ectocarpales	Ectocarpaceae	Ectocarpus	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Ochrophyta	Phaeophycea	Ectocarpales	Ectocarpaceae	Hincksia	sp.	Indeterminate	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Ochrophyta	Phaeophycea	Ectocarpales	Scytosiphonacea	Colpomenia	peregrina	Native	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	1
Ochrophyta	Phaeophycea	Ectocarpales	Scytosiphonacea	Colpomenia	sp.	Indeterminate	0	0	0	0	0	1	0	0	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	2
Ochrophyta	Phaeophycea	Ectocarpales	Scytosiphonacea	Scytosiphon	lomentaria	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Ochrophyta	Phaeophycea	Fucales	Cystoseiraceae	Cystophora	sp.	Indeterminate	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Ochrophyta	Phaeophycea	Fucales	Sargassaceae	Carpophyllum	flexuosum	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophycea	Fucales	Sargassaceae	Sargassum	sinclairii	Native	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Ochrophyta	Phaeophycea	Laminariales	Alariaceae	Ecklonia	radiata	Native	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ochrophyta	Phaeophycea	Sphacelariale	Sphacelariaceae	Sphacelaria	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Ochrophyta	Phaeophycea	Sphacelariale	Stypocaulaceae	Halopteris	funicularis	Native	1	1	0	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Ochrophyta	Phaeophycea	Sphacelariale	Stypocaulaceae	Halopteris	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Ochrophyta	Phaeophycea	Sphacelariale	Stypocaulaceae	Pilopogon	botryocladus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3
Ochrophyta	Phaeophycea	Sporochnales	Sporochnaceae	Carpomitra	costata	Native	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Porifera						Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Calcarea	Leucosolenida	Leucosoleniidae	Leucosolenia	cf. discoveryi	C1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongia	Dendroceratid	Darwinellidae			Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Porifera	Demospongia	Haplosclerida	Chalinidae	Haliclona		Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Acrochaetiales	Acrochaetiaceae	Audouinella	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyce	Balliales	Balliaceae	Ballia	callitricha	Native	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
Rhodophyta	Florideophyce	Bonnemaison	Bonnemaisonac	Asparagopsis	armata	Native	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Rhodophyta	Florideophyce	Ceramiales	Ceramiaceae	Antithamnion	pectinatum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyce	Ceramiales	Ceramiaceae	Callithamnion	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Rhodophyta	Florideophyce	Ceramiales	Ceramiaceae	Ceramium	sp.	Indeterminate	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Rhodophyta	Florideophyce	Ceramiales	Ceramiaceae	Ceramium	vestitum	Native	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyce	Ceramiales	Delesseriaceae			Indeterminate	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	0	0	0	0	0	0	0	0	0	1	0	0	4
Rhodophyta	Florideophyce	Ceramiales	Delesseriaceae	Apoglossum	oppositifolium	Native	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Rhodophyta	Florideophyce	Ceramiales	Delesseriaceae	Caloglossa	viellardii	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyce	Ceramiales	Delesseriaceae	Hymenena	aff. variolosa MFN	Native	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	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	8
Rhodophyta	Florideophyce	Ceramiales	Delesseriaceae	Hymenena	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Aphanocladia	delicatula	Native	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	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	5
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Bostrychia	harveyi	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1	0	1	0	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	10
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Dipterosiphonia	heteroclada	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Lophurella	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Stictosiphonia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Rhodophyta	Florideophyce	Ceramiales	Rhodomelaceae	Stictosiphonia	vaga	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Corallinales	Corallinaceae			Indeterminate	1	0	1	1	1	0	0	1	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	1	0	0	0	1	0	0	1	0	0	21
Rhodophyta	Florideophyce	Corallinales	Corallinaceae	Arthrocardia	corymbosa	Native	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Corallinales	Corallinaceae	Corallina	officinalis	Native	1	0	1	1	1	1	0	0	1	0	0	0	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	1	1	1	27
Rhodophyta	Florideophyce	Corallinales	Corallinaceae	Haliptilon		Indeterminate	0	1	0	1	1	0	1	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Rhodophyta	Florideophyce	Corallinales	Corallinaceae	Jania	sp.	Indeterminate	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	2
Rhodophyta	Florideophyce	Gigartinales	Cystocloniaceae	Rhodophyllis	membranacea	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Gigartinales	Gigartinaceae	Chondracanthus	chapmanii	Native	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	9
Rhodophyta	Florideophyce	Gigartinales	Gigartinaceae	Gigartina	ancistroclada	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Gigartinales	Gigartinaceae	Gigartina	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyce	Gigartinales	Gigartinaceae	Gigartina? MFN		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rhodophyta	Florideophyce	Gigartinales	Gigartinaceae	Sarcothalia	livida	Native	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	1	0	1	0	0	3

Appendix 7g. Results from the quadrat scrapings.

Phylum	Class	Order	Family	Genus	species epithet	Site name ->	Anita Bay									Channel marker No. 2		Cooper Point								
						Pile number ->	1			2			3			1		1			2			3		
						Replicate ->	1	2	3	1	2	3	1	2	3	1	2	1	2	3	1	2	3	1	2	3
						Biosec. status																				
Rhodophyta	Florideophyce	Gigartinales	Peyssonneliacea	Peyssonnelia		Indeterminate	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyce	Gracilariales	Gracilariceae	Gracilaria	chilensis	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyce	Hildenbrandia	Hildenbrandiace	Apophlaea	lyallii	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyce	Plocamiales	Plocamiaceae	Plocamium	angustum	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Rhodophyta	Florideophyce	Plocamiales	Plocamiaceae	Plocamium	microcladioides	Native	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyta	Florideophyce	Rhodymeniale	Rhodomeniacea	Rhodymenia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sipuncula						Indeterminate	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1
						Total	13	27	5	24	17	17	6	7	5	10	14	10	8	8	20	13	16	8	20	20

Genus	species epithet	Site name ->	Deep Water Basin Jetties						Ferry Terminal						Ferry Terminal 2					
		Pile number ->	1			2			1			2			1			2		
		Replicate ->	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Peyssonnelia		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gracilaria	chilensis	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Apophlaea	lyallii	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plocamium	angustum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plocamium	microcladioides	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodymenia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Sipuncula)		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Total	4	2	6	3	2	1	4	2	5	6	6	3	4	2	7	4	6	8

Genus	species epithet	Site name ->	Harrison Cove									Pater Point									
		Pile number ->	1			2			3			1			2			3			
		Replicate ->	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Total
Peyssonnelia		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Gracilaria	chilensis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Apophlaea	lyallii	Native	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Plocamium	angustum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Plocamium	microcladioides	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rhodymenia	sp.	Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
(Sipuncula)		Indeterminate	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	9
		Total	8	7	3	6	14	9	10	12	13	5	3	6	5	5	5	13	4	11	482

Appendix 7h. Results from the shrimp trap samples

						Site Name ->	Deep Water Basin			Deep Water Basin Jetties			Deep Water Basin Slipways						Ferry Terminal 2			Poison Bay			Sandfly Point Jetty						
						Replicate ->	1	2	3	1	2	3	1	2	3	4	5	6	1	2	3	1	2	3	1	2	3	4	5	6	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																									
Arthropoda	Malacostraca	Isopoda		Isopoda	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	5
Arthropoda	Malacostraca	Isopoda	Cirolanidae	Natatolana	rossi	Native	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
						Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	6

Appendix 7i. Results from the diver visual survey samples

Phylum	Class	Order	Family	Genus	species epithet	Site name -> / Biosec. status	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Unidentifiable						Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Algae (unidentified)						Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Annelida	Polychaeta	Eunicida	Dorvilleidae	Dorvillea	australiensis	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Eunicida	Eunicidae	Eunice	australis	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Eunicida	Lumbrineridae	Lumbrineris	sphaerocephala	Native	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	4
Annelida	Polychaeta	Phyllodocida	Glyceridae	Glycera	benhami	Native	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	4
Annelida	Polychaeta	Phyllodocida	Nereididae	Neanthes	Neanthes-A	C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Nereididae	Platynereis	australis group	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	Eulalia-NIWA-2	C2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Phyllodocida	Phyllodocidae	Phyllodocidae	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	jacksoni	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Annelida	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	polychromus	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Sabellidae	Megalomma	suspiciens	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Sabellidae	Pseudopotamilla	laciniosa	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Serpulidae	Galeolaria	hystrix	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Sabellida	Serpulidae	Serpula	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Annelida	Polychaeta	Sabellida	Serpulidae	Spirobranchus	cariniferus	Native	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	3
Annelida	Polychaeta	Sabellida	Serpulidae	Spirobranchus	S. polytrema complex	C2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Spionida	Spionidae	Boccardia	chilensis	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida	Polychaeta	Terebellida	Terebellidae	Streblosoma	toddae	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Annelida	Polychaeta	Terebellida	Terebellidae	Terebellidae	Indet	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Arthropoda	Malacostraca	Amphipoda	Dexaminidae	Paradexamine	houtete	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Decapoda	Crangonidae	Philocheras	australis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Arthropoda	Malacostraca	Decapoda	Hippolytidae	Hippolyte	bifidirostris	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Elamena	producta	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Halicarcinus	cookii	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Arthropoda	Malacostraca	Decapoda	Hymenosomatidae	Halicarcinus	varius	Native	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Decapoda	Majidae	Eurynolambrus	australis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Arthropoda	Malacostraca	Decapoda	Majidae	Leptomithrax	mortenseni	Native	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	3
Arthropoda	Malacostraca	Decapoda	Majidae	Notomithrax	ursus	Native	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Arthropoda	Malacostraca	Decapoda	Paguridae	Lophopagurus (A.)	cooki	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Arthropoda	Malacostraca	Decapoda	Pinnotheridae	Pinnotheres	novaezelandiae	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Arthropoda	Malacostraca	Decapoda	Porcellanidae	Petrolisthes	novaezelandiae	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Arthropoda	Maxillopoda	Sessilia	Archaeobalanidae	Austrominius	modestus	Native	0	0	1	0	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	6
Arthropoda	Maxillopoda	Sessilia	Balanidae	Notomegabalanus	campbelli	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Brachiopoda	Rhynchonellata	Rhynchonellida	Notosariidae	Notosaria	nigricans	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
Brachiopoda	Rhynchonellata	Terebratulida	Terebratulidae	Calloria	inconspicua	Native	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	6
Bryozoa	Gymnolaemata	Cheilostomata	Aeteidae	Aetea	australis	Native	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	5
Bryozoa	Gymnolaemata	Cheilostomata	Beaniidae	Beania	bilaminata	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Beaniidae	Beania	intermedia	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Beaniidae	Beania	plurispinosa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Bitectiporidae	Bitectipora	mucronifera	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bitectiporidae	Bitectipora	rostrata	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Appendix 7i. Results from the diver visual survey samples

						Site name ->	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status																				
Bryozoa	Gymnolaemata	Cheilostomata	Bitectiporidae	Parkermavella	punctigera	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bitectiporidae	Schizosmittina	cinctipora	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia		Indeterminate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia	barbata	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Bugulidae	Dimetopia	cornuta	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Calloporidae	Odontionella	cyclops	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Calwelliidae	Calwellia	gracilis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Caberea	helicina	Native	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Caberea	solida	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Caberea	zelandica	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Emma	crystallina	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Emma	rotunda	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Emma	triangula	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Scrupocellaria	ornithorhyncus	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	4
Bryozoa	Gymnolaemata	Cheilostomata	Candidae	Tricellaria	aculeata	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Catenicella	elegans	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Cornuticella	taurina	Native	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Cribricellina	cribraria	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Orthoscuticella	innominata	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Orthoscuticella	margaritacea	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Pterocella	scutella	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Catenicellidae	Scalicella	crystallina	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Bryozoa	Gymnolaemata	Cheilostomata	Cellariidae	Cellaria	pilosa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Cellariidae	Cellaria	tenuirostris	Native	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	3
Bryozoa	Gymnolaemata	Cheilostomata	Celleporidae	Celleporina	sp.	C2	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	4
Bryozoa	Gymnolaemata	Cheilostomata	Chaperiidae	Chaperia	granulosa	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Chaperiidae	Chaperiopsis	cervicornis	Native	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	5
Bryozoa	Gymnolaemata	Cheilostomata	Cribilinidae	Figularia	spinea	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
Bryozoa	Gymnolaemata	Cheilostomata	Electridae	Electra	sp.	C2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Hippothoidae	Celleporella	aporosa	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Hippothoidae	Celleporella	bathamae	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Hippothoidae	Hippothoa	flagellum	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Lepraliellidae	Celleporaria	agglutinans	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Membraniporidae	Membranipora	membranacea	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Microporellidae	Calloporina	angustipora	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Microporellidae	Fenestrulina	multicava	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Microporellidae	Fenestrulina	specca	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Microporellidae	Fenestrulina	thyreophora	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Microporellidae	Microporella	agonistes	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Gymnolaemata	Cheilostomata	Microporidae	Opaeophora	lepida	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	3
Bryozoa	Gymnolaemata	Cheilostomata	Romancheinidae	Escharoides	excavata	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Gymnolaemata	Cheilostomata	Scrupariidae	Scruparia	ambigua	C1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Bryozoa	Gymnolaemata	Cheilostomata	Smittinidae	Smittoidea	maunganuiensis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Appendix 7i. Results from the diver visual survey samples

Phylum	Class	Order	Family	Genus	species epithet	Site name -> / Biosec. status	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Bryozoa	Gymnolaemata	Cheilostomata	Steginoporellidae	Steginoporella	magnifica	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Bicrisia	biciliata	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Bicrisia	edwardsiana	Native	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	4
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Crisia	acropora	Native	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Crisia	margaritacea	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Crisiidae	Crisia	setosa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Stenolaemata	Cyclostomata	Diastoporidae	Plagioecia	sarniensis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Bryozoa	Stenolaemata	Cyclostomata	Lichenoporicae	Disporella		Indeterminate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Lichenoporicae	Disporella	pristis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
Bryozoa	Stenolaemata	Cyclostomata	Margarettidae	Margaretta	barbata	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Bryozoa	Stenolaemata	Cyclostomata	Phidoloporidae	Phidolopora	avicularis	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bryozoa	Stenolaemata	Cyclostomata	Tubuliporidae	Tubulipora	sp.	Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	convolutum	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	fragile ssp. novae-zelandiae	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Bryopsidales	Codiaceae	Codium	gracile	Native	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3
Chlorophyta	Ulvophyceae	Caulerpales	Caulerpaceae	Caulerpa	brownii	Native	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	6
Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Chaetomorpha		Indeterminate	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Codiolales	Monostromataceae	Monostroma	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	sp.	Indeterminate	0	0	1	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	8
Chordata	Actinopterygii	Pleuronectiformes	Pleuronectidae	Rhombosolea	plebia	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Enterogona	Didemnidae			Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Chordata	Ascidiacea	Enterogona	Didemnidae	Didemnum	sp.	C1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Chordata	Ascidiacea	Enterogona	Didemnidae	Diplosoma	velatum	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Chordata	Ascidiacea	Enterogona	Polyclinidae	Aplidium	adamsi	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Enterogona	Polyclinidae	Aplidium	sp. 19	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Chordata	Ascidiacea	Enterogona	Polyclinidae	Pseudodistoma	cereum	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Chordata	Ascidiacea	Pleurogona	Styelidae	Cnemidocarpa	bicornuta	Native	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	7
Chordata	Ascidiacea	Pleurogona	Styelidae	Cnemidocarpa	nisiotis	Native	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	3
Cnidaria	Anthozoa	Epizoanthidea	Epizoanthdae	Epizoanthus		Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Anthozoa	Scleractinia	Flabellidae	Flabellum	rubrum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Cnidaria	Hydrozoa	Hydroida	Campanulariidae	Orthopyxis	integra	C1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae			Indeterminate	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Crateritheca	novaezelandiae	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Sertularella	robusta	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Stereotheca	elongata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus		Indeterminate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Sertulariidae	Symplectoscyphus	subarticulatus	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cnidaria	Hydrozoa	Hydroida	Syntheciidae	Synthecium	tottoni	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cyanobacteria						Indeterminate	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Echinodermata	Asteroidea	Forcipulatida	Asteriidae	Coscinasterias	muricata	Native	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	5
Echinodermata	Asteroidea	Forcipulatida	Asteriidae	Stichaster	australis	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	3
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	mortenseni	Native	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	4
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	regularis	Native	0	0	1	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	1	6

Appendix 7i. Results from the diver visual survey samples

Phylum	Class	Order	Family	Genus	species epithet	Site name -> / Biosec. status	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Echinodermata	Asteroidea	Valvatida	Asterinidae	Patiriella	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Echinodermata	Asteroidea	Valvatida	Goniasteridae	Pentagonaster		Indeterminate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Echinodermata	Asteroidea	Valvatida	Goniasteridae	Pentagonaster	pulchellus	Native	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4
Echinodermata	Asteroidea	Valvatida	Odontastericae	Diplodontias	dilatatus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
Echinodermata	Echinoidea	Echinoida	Echinometridae	Evechinus	chloroticus	Native	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	5
Echinodermata	Echinoidea	Temnopleurida	Temnopleuridae	Pseudechinus	novaezealandiae	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Echinodermata	Holothuroidea	Aspidochirotida	Stichopodidae	Stichopus	mollis	Native	1	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	1	1	1	8
Echinodermata	Ophiuroida	Ophiurida	Amphiuridae	Amphiura	eugenie	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Echinodermata	Ophiuroida	Ophiurida	Ophiodermatidae	Ophiopsammus	maculata	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Mollusca						Indeterminate	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	3
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Aulacomya	maoriana	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	galloprovincialis	Native	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Mollusca	Bivalvia	Mytiloida	Mytilidae	Mytilus	sp.	Indeterminate	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Bivalvia	Mytiloida	Mytilidae	Xenostrobus		Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3
Mollusca	Bivalvia	Pholadomyoida	Myochamidae	Myadora	striata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mollusca	Bivalvia	Veneroida	Mesodesmatidae	Paphies	australis	Native	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3
Mollusca	Bivalvia	Veneroida	Veneridae	Austrovenus	stutchburyi	Native	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Bivalvia	Veneroida	Veneridae	Irus	reflexus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mollusca	Gastropoda	Basommatophora	Siphonariidae	Siphonaria	australis	Native	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Mollusca	Gastropoda	Docoglossa	Nacellidae	Cellana	stellifera	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2
Mollusca	Gastropoda	Neogastropoda	Buccinidae	Austrofusus	glans	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	ambiguus	Native	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Mollusca	Gastropoda	Neogastropoda	Muricidae	Xymene	traversi	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Neotaenioglossa	Ranellidae	Argobuccinum	pustulosum ssp. tumidum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Mollusca	Gastropoda	Neotaenioglossa	Ranellidae	Ranella	australasia	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Mollusca	Gastropoda	Neotaenioglossa	Turritellidae	Maoricolpus	roseus	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Calliostomatidae	Calliostoma	granti	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Haliotidae	Haliotis	australis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Melagraphia	aethiops	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Micrelenchus	huttonii	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Trochidae	Trochus	viridis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Cookia	sulcata	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	3
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Modelia	granosa	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
Mollusca	Gastropoda	Vetigastropoda	Turbinidae	Turbo	smaragdus	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Dictyochophyceae	Dictyochales	Dictyochaceae	Dictyota	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Ochrophyta	Phaeophyceae	Dictyotales				Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Ectocarpus	sp.	Indeterminate	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Ectocarpales	Ectocarpaceae	Hincksia	sp.	Indeterminate	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	3
Ochrophyta	Phaeophyceae	Fucales	Cystoseiraceae	Landsburgia	quercifolia	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ochrophyta	Phaeophyceae	Fucales	Fucaceae	Xiphophora	gladiata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ochrophyta	Phaeophyceae	Fucales	Fucaceae	Xiphophora	radiata	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Fucales	Sargassaceae	Carpophyllum	flexuosum	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2

Appendix 7i. Results from the diver visual survey samples

Phylum	Class	Order	Family	Genus	species epithet	Site name -> Biosec. status	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Ochrophyta	Phaeophyceae	Fucales	Sargassaceae	Sargassum	sinclairii	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ochrophyta	Phaeophyceae	Laminariales	Alariaceae	Ecklonia	radiata	Native	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Ochrophyta	Phaeophyceae	Sphacelariales	Sphacelariaceae	Sphacelaria	sp.	Indeterminate	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Ochrophyta	Phaeophyceae	Sphacelariales	Stypocaulaceae	Halopteris	funicularis	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2
Ochrophyta	Phaeophyceae	Sphacelariales	Stypocaulaceae	Halopteris	sp.	Indeterminate	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	4
Ochrophyta	Phaeophyceae	Sphacelariales	Stypocaulaceae	Ptilopogon	botryocladus	Native	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Ochrophyta	Phaeophyceae	Sporochnales	Sporochnaceae	Carpomitra	costata	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	4
Porifera	Calcarea	Clathrinida	Leucaltidae	Leucettusa	cf. tubulosa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
Porifera	Calcarea	Clathrinida	Leucettidae	Leucetta	n.sp.2 (MK)	Native	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3
Porifera	Calcarea	Leucosolenida	Leucosoleniidae	Leucosolenia	cf. discoveryi	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
Porifera	Demospongiae	Dictyoceratida	Irciniidae	Ircinia	akaroa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Porifera	Demospongiae	Dictyoceratida	Thorectidae	Thorecta	reticulata	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Porifera	Demospongiae	Hadromerida	Tethyidae	Tethya	bergquistae	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Porifera	Demospongiae	Halichondrida	Axinellidae	Cymbastella	n.sp.1 (MK)	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Porifera	Demospongiae	Poecilosclerida	Chondropsidae	Strongylacidon	conulosa	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	3
Porifera	Demospongiae	Poecilosclerida	Desmacellidae	Neofibularia	n.sp.2 (MK)	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Porifera	Demospongiae	Poecilosclerida	Latrunculiidae	Latrunculia	fiordensis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Porifera	Demospongiae	Poecilosclerida	Mycalidae	Mycale (Carmia)	hentscheli	Native	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Porifera	Demospongiae	Poecilosclerida	Raspailiidae	Raspailia	agminata	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Porifera	Demospongiae	Poecilosclerida	Tedaniidae	Tedania	n.sp.1 (MK)	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Acrochaetiales	Acrochaetiaceae	Audouinella	sp.	Indeterminate	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Acrothamnion	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Anotrichium	crinitum	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Appendix 7i. Results from the diver visual survey samples

						Site name ->	Anita Bay	Brig Rock	Channel Marker No 2	Copper Point	Deep Water Basin 1	Deep Water Basin 2	Deep Water Basin Slipways	Ferry Terminal 1	Ferry Terminal 2	Fox Point	Freshwater Basin Mooring	Harrison Cove	Pater Point	Poison Bay	Saint Ann Point	Sandfly Point Jetty	Sea Breeze Point	Stirling Falls Wall	Yates Point	Total
Phylum	**Class**	**Order**	**Family**	**Genus**	**species epithet**	**Biosec. status**																				
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Antithamnion	pectinatum	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Callithamnion	sp.	Indeterminate	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	5
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	sp.	Indeterminate	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	vestitum	Native	1	0	0	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	6
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Euptilota	formosissima	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Griffithsia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Perithamnion	ceramioides	Native	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Dasyaceae	Heterosiphonia	squarrosa	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae			Indeterminate	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	2
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Abroteia	suborbiculare	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	aff. variolosa MFN	Native	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	3
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hymenena	variolosa	Native	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Nancythalia	humilis	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Aphanocladia	delicatula	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Bostrychia	harveyi	Native	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	macrocarpa	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Echinothamnion	lyallii	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Lophurella	hookeriana	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	muelleriana	Native	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	sp.	Indeterminate	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Pterosiphonia	pennata	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae			Indeterminate	1	1	0	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	9
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Arthrocardia	corymbosa	Native	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	6
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Corallina	officinalis	Native	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Haliptilon		Indeterminate	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Jania	sp.	Indeterminate	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Rhodophyllis	membranacea	Native	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	3
Rhodophyta	Florideophyceae	Gigartinales	Gigartinaceae	Gigartina	ancistroclada	Native	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Gigartinales	Gigartinaceae	Sarcothalia	livida	Native	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Rhodophyta	Florideophyceae	Gigartinales	Kallymeniaceae	Iridaea		Indeterminate	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Gracilariales	Gracilariceae	Gracilaria	chilensis	Native	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	3
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	angustum	Native	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	6
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	cirrhosum	Native	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	4
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	microcladioides	Native	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	sp.	Indeterminate	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2
Rhodophyta	Florideophyceae	Rhodymeniales	Lomentariaceae	Lomentaria	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Rhodophyta	Florideophyceae	Rhodymeniales	Rhodomeniaceae	Rhodymenia	sp.	Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Rhodophyta	Rhodophyceae	Ceramiales	Ceramiaceae	Microcladia		Indeterminate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Sipuncula						Indeterminate	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	6
						Total	45	33	16	18	9	6	5	13	13	66	14	29	8	13	48	0	37	24	44	441

Appendix 7j. Results from the zooplankton samples

						Site name ->	Deep Water Basin			Deep Water Basin Jetties			Ferry Terminal 2			Freshwater Basin Mooring			Harrison Cove			Poison Bay			Sandfly Point Jetty			Sea Breeze Point			Stripe Point			Yates Point			
						Replicate ->	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	1	2	3	Tc
Phylum	**Class**	**Order**	**Family**	**Genus**	**species epithet**	**Biosec. status**																															
No target species (see note)						(see note)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Mollusca	Bivalvia	Veneroida	Tellinidae	Macomona		Indeterminate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
						Total	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Note: Zooplankton samples were screened for target non-indigenous organisms (*Eriocheir* , *Carcinus* , echinoderm and ascidian larvae), but identifications were not made for organisms other than these species in the zooplankton samples. None of these organisms were identified from any of the zooplankton samples from Milford Sound; rather, only juvenile calanoid copepods were found.

						Site name ->	Deep Water Basin Slipways	Poison Bay, right side of cre	Poison Bay, left side of cree
						Distance below high tide line (m)	2	2	2
Phylum	Class	Order	Family	Genus	species epithet	Biosec. status			

No target species recorded.

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