Gulf Harbour Marina

Baseline survey for non-indigenous marine species (Research Project ZBS2000/04)

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Executive Summary

This report describes the results of an April 2003 survey to provide a baseline inventory of native, non indigenous and cryptogenic marine species within the Gulf Harbour Marina.

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

- 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. Modifications were made to the CRIMP protocols for use in New Zealand port conditions.

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

- The distribution of sampling effort in the Gulf Harbour Marina was designed to maximise the chances of detecting non-indigenous species and concentrated on high-risk locations and habitats where non-indigenous species were most likely to be found.

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

- A total of 124 species or higher taxa were identified from the Gulf Harbour Marina survey. They consisted of 78 native species, 15 non-indigenous species, 12 cryptogenic species (those whose geographic origins are uncertain) and 19 species indeterminata (taxa for which there is insufficient taxonomic or systematic information available to allow identification to species level).

- The 15 non-indigenous organisms described from the Gulf Harbour Marina included representatives of seven phyla. The non-indigenous species detected (ordered alphabetically by phylum, class, order, family, genus and species) were: (Annelida) *Hydroides elegans* and *Hydroides ezoensis*, (Bryozoa) *Bugula neritina, Schizoporella errata, Zoobotryon verticillatum,* and *Watersipora subtorquata*, (Crustacea) *Apocorophium acutum* and *Ericthonius pugnax*, (Mollusca) *Crassostrea gigas*, *Limaria orientalis*, and *Theora lubrica*, (Phycophyta) *Cutleria multifida*, (Porifera) *Vosmaeropsis cf macera*, (Urochordata) *Ascidiella aspersa* and *Cnemidocarpa sp*. Two of these species (the fouling serpulid polychaete, *Hydroides ezoensis*, and the ascidian, *Cnemidocarpa sp.*) had not previously been reported from New Zealand waters. Two cryptogenic species (an amphipod, *Leucothoe* sp. 1, and an ascidian, *Microcosmus squamiger*) were also recorded for the first time from New Zealand.

- None of the species found in the Gulf Harbour Marina appear on the New Zealand register of unwanted organisms. Two species – the Pacific oyster, *Crassostrea gigas*, and the cryptogenic, toxin-producing dinoflagellate, *Gymnodinium catenatum* – are on the ABWMAC list of unwanted marine pests in Australia.

- Most non-indigenous species located in the Port are likely to have been introduced to New Zealand accidentally by international shipping. Approximately 66.7 % (10 of 15 species) of NIS in the Gulf Harbour Marina are likely to have been introduced in hull fouling assemblages, 6.7 % via ballast water and 26.7 % could have been introduced by either ballast water or hull fouling vectors.

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

Introduction

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

Biosecurity[1] is important to all New Zealanders. New Zealand's geographic isolation makes it particularly vulnerable to marine introductions because more than 95% of its trade in commodities is transported by shipping, with several thousand international vessels arriving and departing from more than 13 ports and recreational boat marinas of first entry (Inglis 2001). The country's geographic remoteness also means that its marine biota and ecosystems have evolved in relative isolation from other coastal ecosystems. New Zealand's marine biota is as unique and distinctive as its terrestrial biota, with large numbers of native marine species occurring nowhere else in the world.

The numbers, identity, distribution and impacts of non-indigenous species in New Zealand's marine environments are poorly known. A recent review of existing records suggested that by 1998, at least 148 species had been deliberately or accidentally introduced to New Zealand's coastal waters, with around 90 % of these establishing permanent populations (Cranfield et al. 1998). To manage the risk from these and other non-indigenous species, better information is needed on the current diversity and distribution of species present within New Zealand.

BIOLOGICAL BASELINE SURVEYS FOR NON-INDIGENOUS MARINE SPECIES

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

[1] Biosecurity is the management of risks posed by introduced species to environmental, economic, social, and cultural values.

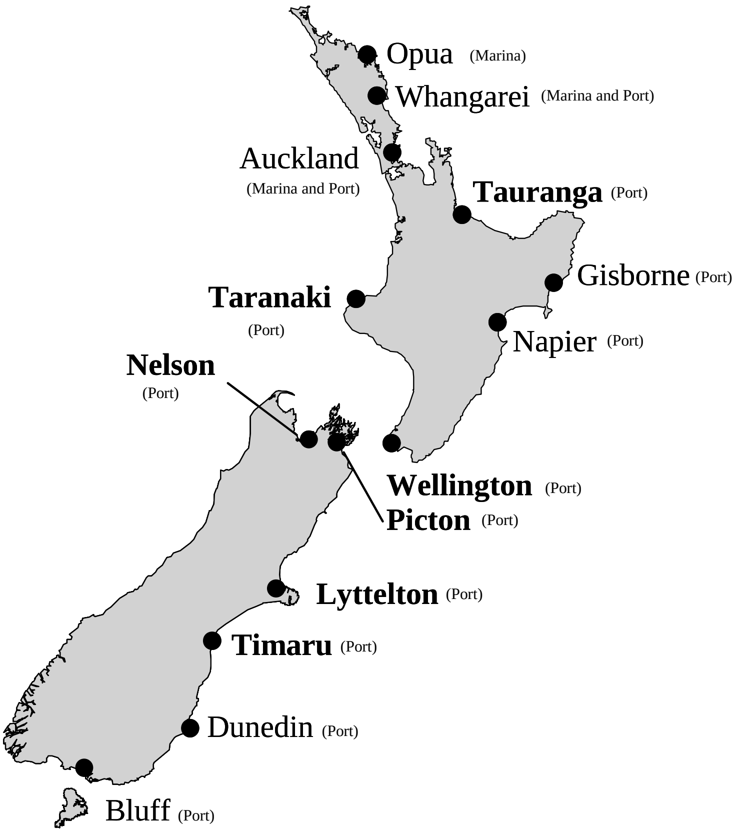

Figure 1: Commercial shipping ports in New Zealand where baseline non-indigenous species surveys have been conducted. Group 1 ports surveyed in the summer of 2001/2002 are indicated in bold and group 2 ports surveyed in the summer of 2002/2003 are indicated in plain font. Marinas were also surveyed for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

The port surveys have two principal objectives:

i. To provide a baseline assessment of native, non-indigenous and cryptogenic[2] species, and
ii. To determine the distribution and relative abundance of a limited number of target species in shipping ports and other high risk points of entry for non-indigenous marine species.

The surveys will form a baseline for future monitoring of new incursions by non-indigenous marine species in port environments nationwide, and will assist international risk profiling of problem species through the sharing of information with other shipping nations.
This report summarises the results of the Gulf Harbour Marina survey and provides an inventory of species detected in the Port. It identifies and categorises native, introduced ("non-indigenous") and cryptogenic species. Organisms that could not be identified to species level are also listed as species indeterminata.

DESCRIPTION OF THE GULF HARBOUR MARINA

The Gulf Harbour Marina (36°37'S, 174°47'E) (Fig. 2) is situated about 240 kilometres north of Auckland City, on the southern edge of the Whangaparoa Peninsula. The Marina is surrounded by rock sea walls and a breakwater protects the entry channel. The main entrance

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

channel is approximately 70 m wide and has a minimum depth of 4.0 m at MLWS. Gulf Harbour Marina is a major hub for recreational and sailing vessels in the northeast of the North Island (Inglis 2001). The Marina currently has 1028 existing berths for vessels up to 55 metres LOA, and a further 25 super-yacht berths.

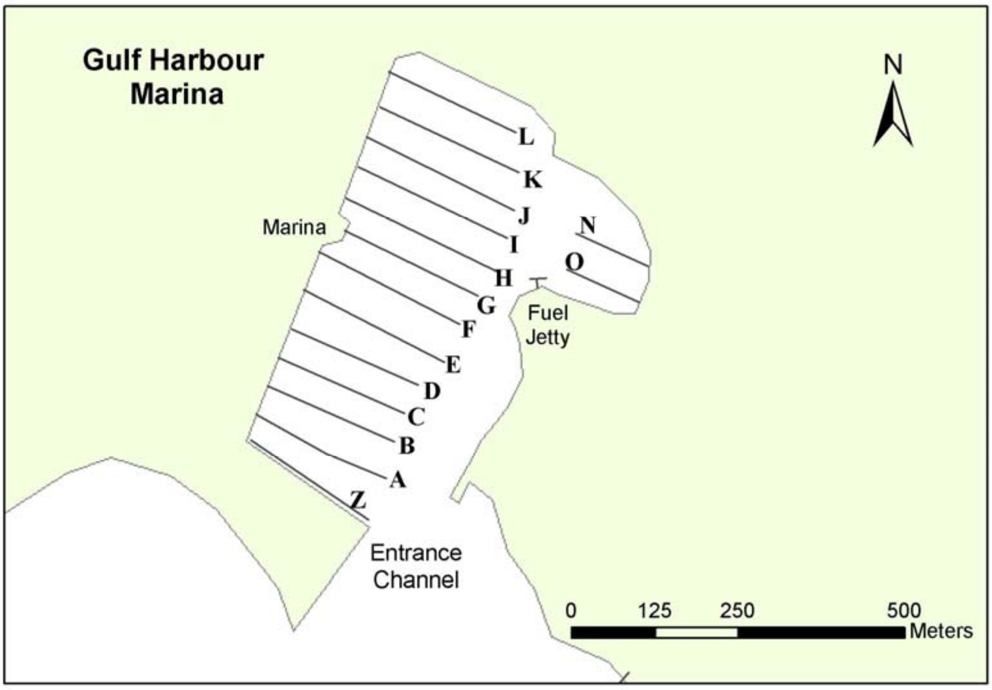

Figure 2: Gulf Harbour Marina map

MARINA OPERATION AND SHIPPING MOVEMENTS

The Whangaparoa Peninsula, at the heart of the Hibiscus Coast, used to be home largely to holidaymakers, but over the years most of the baches have slowly disappeared, replaced with permanent dwellings. With better roads and amenities an increasing number of people have chosen to commute between Auckland and Whangaparaoa, and this has been reflected in the amount of development going on in the area, of which the Gulf Harbour Marina is one example. To facilitate the construction and development of the marina, a special empowering Act of Parliament, the Rodney County Council (Gulf Harbour) Vesting and Empowering Act 1977 was passed (www.rodney.govt.nz). This permitted the development of the marina and associated reclamation, and enabled the Rodney District Council to issue the seabed licence with an effective term of 100 years, as well as to issue registered leases for the same term for adjacent reclamation areas (www.gulf-harbour.co.nz). Subsequent expansion of the eastern side of the marina for the East Marina Extension (EME) involved capital dredging of approximately 52,000 m^3 of sandstone from the interior channel and 40,000 m^3 of silt and sand from the entrance channel, and 30,000m^3 from the EME basin in 2000. Spoil disposal was in landfill (Tom Warren, Gulf Harbour Marina, pers. comm.).

Gulf Harbour Marina Limited (the "Marina Company") is the owner of all of the assets involved in the marina. These include a licence of the Hobbs Bay seabed dated 20 September 1988 (the seabed licence) and originally issued by the then Rodney County Council (now the Rodney District Council) to Wilkins & Davies Company. Berths in the Marina are arranged around floating concrete Bellingham-type piers and vary in length from 10.5 to 55.0 m (www.gulf-harbour.co.nz) (Fig. 2), with predominantly H6-treated pine piles. Details of the berthing facilities available in the Marina are provided in Table 1.

The majority of the berths are contained on the western side of the Marina where piers A-L, Z, and private berths are located (Fig. 2). The eastern side of the Marina (EME) has piers N and O, which are for super-yachts and larger recreational craft and a fuel jetty. Z and O wharves are set up for commercial chartering activities, particularly fishing charters. There is also a commercial ferry service running from and to Auckland four times per day, and Fullers service to Tiritiri Matangi Island runs several times per week.

Vessels unable to be berthed immediately in the marina may anchor outside the marina either in nearby Army Bay or between Kotonui Island and the entrance way to the marina (Tom Warren, Gulf Harbour Marina, pers. comm.).

Within the marina there is no on-going maintenance dredging. The last dredging occurred in 2000 as capital dredging for the EME (Tom Warren, Gulf Harbour Marina, pers. comm.). Gulf Harbour Marina Limited is not currently planning any expansion of the marina facilities. There are plans for a new Mediterannean-style development (incorporating apartments, shopping and cafes) on the eastern side of the marina by Starline Corporation.

PHYSICAL ENVIRONMENT OF GULF HARBOUR MARINA

The sheltered Gulf Harbour Marina on the southern edge of the Whangaparaoa Peninsula (Fig.1), opens to the Hauraki Gulf through a narrow entrance channel bordered by a sea wall. A wave dissipation beach near the channel entrance reduces wave disturbance within the Marina. The Marina is approximately 420 m at its widest point and 760 m in length, with the majority of the Marina in approximately 2.4 m of water depth at LWS. There is little turning space within the Marina (usually 40-60 m) as a result of the extensive pier networks and the Marina's recreational nature. The Marina substratum is composed of silt and sand overlying sandstone. Tidal range within the Marina is around 2 m.

EXISTING BIOLOGICAL INFORMATION

There appears to be no published information on biological surveys from within Gulf Harbour Marina.

Survey methods

SURVEY METHOD DEVELOPMENT

The sampling methods used in this survey were based on the CSIRO Centre for Research on Introduced Marine Pests (CRIMP) protocols developed for baseline port surveys in Australia (Hewitt and Martin 1996, 2001). CRIMP protocols have been adopted as a standard by the International Maritime Organisation's Global Ballast Water Management Programme (GloBallast). Variations of these protocols are being applied to port surveys in many other nations. A group of New Zealand marine scientists reviewed the CRIMP protocols and conducted a workshop in September 2001 to assess their feasibility for surveys in this country (Gust et al. 2001). A number of recommendations for modifications to the protocols ensued from the workshop and were implemented in surveys throughout New Zealand. The modifications were intended to ensure cost effective and efficient collection of baseline species data for New Zealand ports and marinas. The modifications made to the CRIMP protocols and reasons for the changes are summarised in Table 2. Further details are provided in Gust et al. (2001).

Baseline survey protocols are intended to sample a variety of habitats within ports, including epibenthic fouling communities on hard substrata, soft-sediment communities, mobile invertebrates and fishes, and dinoflagellates. Below, we describe the methods and sampling effort used for the Gulf Harbour Marina survey. The survey was undertaken between the 10^{th}

and 13th of April 2003. Most sampling was concentrated around four main piers: C, J, L and N (Fig 2).

DIVER OBSERVATIONS AND COLLECTIONS ON WHARF PILES

Fouling assemblages were sampled on four pilings and the adjacent floating pontoons at each site. Selected pilings were separated by 10 – 15 m on the outer face of the piers (Gust et al. 2001). Because of the shallow depth of the marina (average recorded depth < 4 m) only two quadrat samples (40 cm x 25 cm) could be taken on each piling, at water depths of -0.5 m, and -1.5 m. Two additional quadrat samples were taken at the waterline on the floating pontoons supported by each piling. To take the samples, a diver descended slowly down the outer surface of each pile and filmed a vertical transect from approximately high water to the base of the pile, using a digital video camera in an underwater housing. On reaching the sea floor, the diver then ascended slowly and captured high-resolution still images of each quadrat using the photo capture mechanism on the video camera. Because of limited visibility (typically < 1 m), four overlapping still images, each covering approximately ¼ of the area of the quadrat were taken for each quadrat. A second diver then removed fouling organisms from the pile by scraping the organisms inside each quadrat into a 1 mm mesh collection bag, attached to the base of the quadrat (Fig. 3). Once scraping was completed, the sample bag was sealed and returned to the laboratory for processing. The second diver also made a visual search of each piling for potential invasive species and collected samples of large conspicuous organisms not represented in quadrats. Opportunistic visual searches were also made of breakwalls and rock facings within the marina area. Divers swam vertical profiles of the structures and collected specimens that could not be identified reliably in the field.

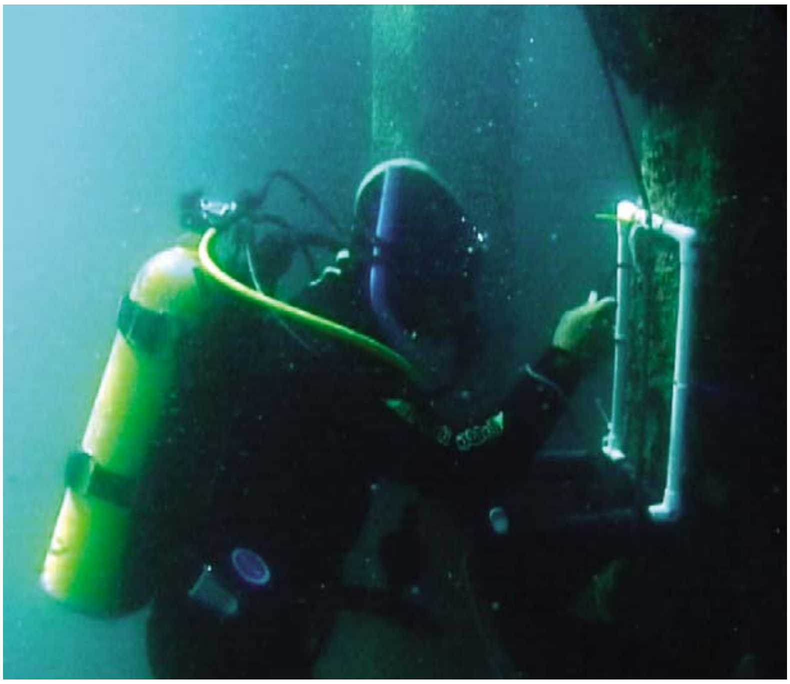

Figure 3: Diver sampling organisms on pier piles.

BENTHIC INFAUNA

Benthic infauna was sampled using a Shipek grab sampler (Fig. 4). The Shipek grab removes a sediment sample of ~3 *l* and covers an area of approximately 0.04 m^2 on the seafloor to a depth of about 10 cm. It is designed to sample unconsolidated sediments ranging from fine muds and sands to hard-packed clays and small cobbles. Because of the strong torsion springs and single, rotating scoop action, the Shipek grab is generally more efficient at retaining samples intact than conventional VanVeen or Smith McIntyre grabs with double jaws (Fenwick *pers obs*). The Shipek grab was deployed from a research vessel. Three grab samples were taken at haphazard locations at each site. Sediment samples were washed through a 1mm mesh sieve and animals retained on the sieve were returned to the field laboratory for sorting and preservation.

Figure 4: Shipek grab sampler: releasing benthic sample into bucket

EPIBENTHOS

Larger benthic organisms were sampled using an Ocklemann sled (hereafter referred to as a "sled"). The sled is approximately one meter long with an entrance width of ~0.7 m x 0.2 m. A short yoke of heavy chain connects the sled to a tow line (Fig. 5). The mouth of the sled partially digs into the sediment and collects organisms in the surface layers to a depth of a few centimetres. Runners on each side of the sled prevent it from sinking completely into the sediment so that shallow burrowing organisms and small, epibenthic fauna pass into the exposed mouth. Sediment and other material that enters the sled is passed through a mesh basket that retains organisms larger than about two mm. Sleds were towed for a standard time of two minutes at approximately two knots. During this time, the sled typically traversed between 80 – 100 m of seafloor before being retrieved. Two to three sled tows were completed at each site within the marina, and the entire contents were sorted and identified.

SEDIMENT SAMPLING FOR CYST-FORMING SPECIES

A TFO gravity corer (hereafter referred to as a "javelin corer") was used to take small sediment cores for dinoflagellate cysts (Fig. 6). The 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). Directional fins on the shaft ensure that the javelin travels vertically through the water so that the point of the sampler makes first contact with the seafloor. The detachable tip of the javelin is weighted and tapered to ensure rapid penetration of unconsolidated sediments to a depth of

20 to 30 cm. A thin (1.2-cm diameter) sediment core is retained in a perspex tube within the hollow spearhead. In muddy sediments, the corer preserves the vertical structure of the sediments and fine flocculant material on the sediment surface more effectively than hand-held coring devices (Matsuoka and Fukuyo 2000). The javelin corer is deployed and retrieved from a small research vessel. Cyst sample sites were not constrained to the locations sampled by pile scraping and trapping techniques. Sampling focused on high sedimentation areas within the Port and avoided areas subject to strong tidal flow. On retrieval, the perspex tube was removed from the spearhead and the top 5 cm of sediment retained for analysis. Sediment samples were kept on ice and refrigerated prior to culturing. Culture procedures generally followed those described by Hewitt and Martin (2001).

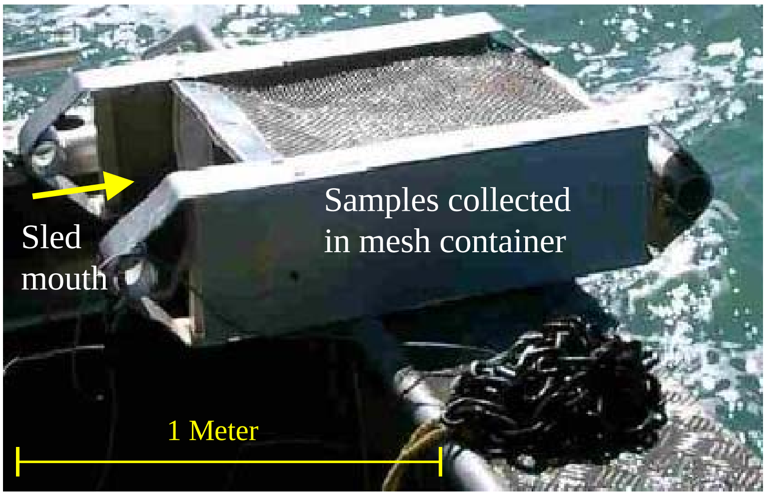

Figure 5: Benthic sled

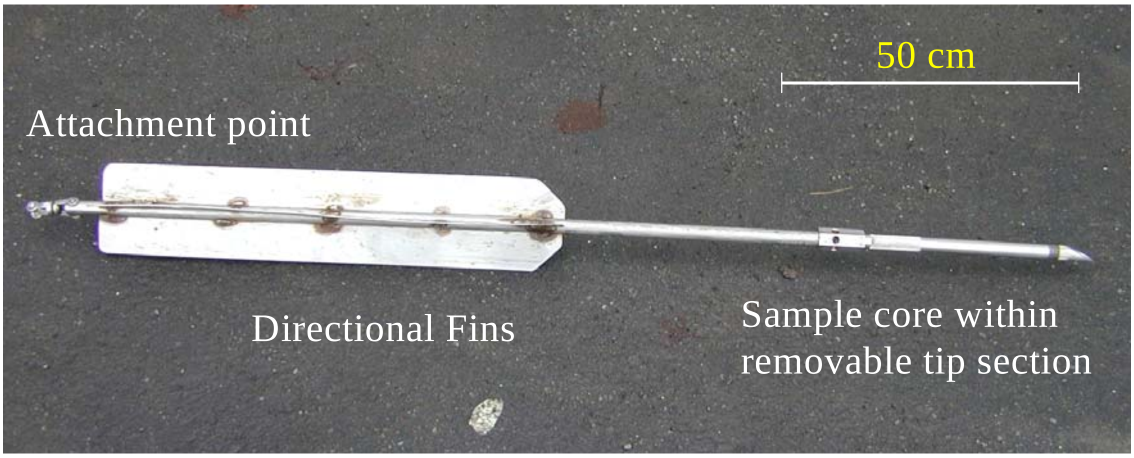

Figure 6: Javelin corer

MOBILE EPIBENTHOS

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

Opera house fish traps

Opera house fish traps (1.2 m long x 0.8 m wide x 0.6 m high) were used to sample fishes and other bentho-pelagic scavengers (Fig. 7). These traps were covered in 1-cm^2 mesh netting and had entrances on each end consisting of 0.25-m long tunnels that tapered in diameter from 40 to 14 cm. The trap was baited with two dead pilchards (*Sardinops neopilchardus*) held in plastic mesh suspended in the centre of the trap. Two trap lines, each containing two opera house traps were set for a period of 1 hour at each site before retrieval. Previous studies have shown opera house traps to be more effective than other types of fish trap and that consistent catches are achieved with soak times of 20 to 50 minutes (Ferrell et al. 1994; Thrush et al. 2002).

Box traps

Fukui-designed box traps (63 cm x 42 cm x 20 cm) with a 1.3-cm mesh netting were used to sample mobile crabs and other small epibenthic scavengers (Fig. 7). A central mesh bait holder containing two dead pilchards was secured inside the trap. Organisms attracted to the bait enter the traps through slits in inward sloping panels at each end. Two trap lines, each containing two box traps, were set on the sea floor at each site and left to soak overnight before retrieval.

Starfish traps

Starfish traps designed by Whayman-Holdsworth were used to catch asteroids and other large benthic scavengers (Fig. 7). These are circular hoop traps with a basal diameter of 100 cm and an opening on the top of 60 cm diameter. The sides and bottom of the trap are covered with 26 mm mesh and a plastic, screw-top bait holder is secured in the centre of the trap entrance (Andrews et al. 1996). Each trap was baited with two dead pilchards. Two trap lines, each with two starfish traps were set on the sea floor at each site and left to soak overnight before retrieval.

Shrimp traps

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

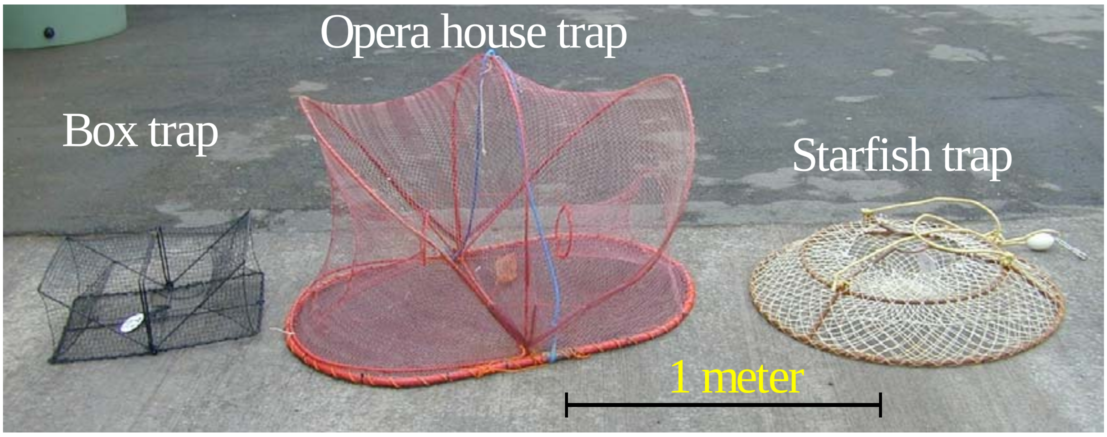

Figure 7: Trap types deployed in the port.

SAMPLING EFFORT

A summary of sampling effort within the Gulf Harbour Marina is provided in Tables 3 a & b. We particularly focused sampling effort on hard substrata (such as pier piles and floating docks) where invasive species are likely to be found (Hewitt and Martin 2001. The distribution of effort within the marina aimed to maximise spatial coverage and represent the diversity of active mooring sites within it. Total sampling effort was constrained by the costs of processing and identifying specimens obtained during the survey.

The spatial distribution of sampling effort for each of the sample methods in the Gulf Harbour Marina is indicated in the following figures: diver pile scrapings and dinoflagellate cyst sampling (Fig. 8), benthic sledding and benthic grabs (Fig. 9), box, starfish, opera house fish trapping and shrimp trapping (Fig. 10). Sampling effort was varied between ports and marinas on the basis of risk assessments (Inglis 2001) to maximise the search efficiency for NIS nationwide. Sampling effort in each of the thirteen ports and three marinas surveyed over two summers is summarised in Table 3c.

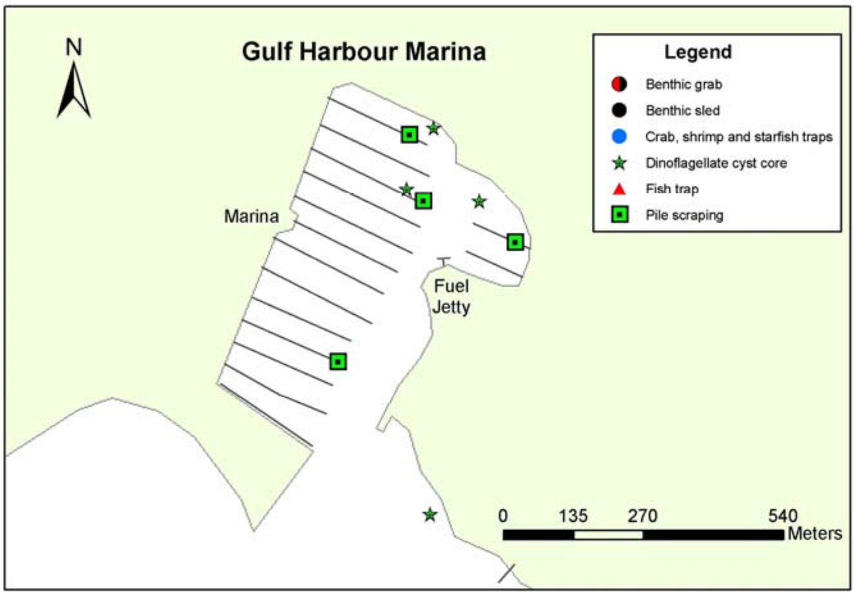

Figure 8: Diver pile scrape sites and dinoflagellate cyst sample sites

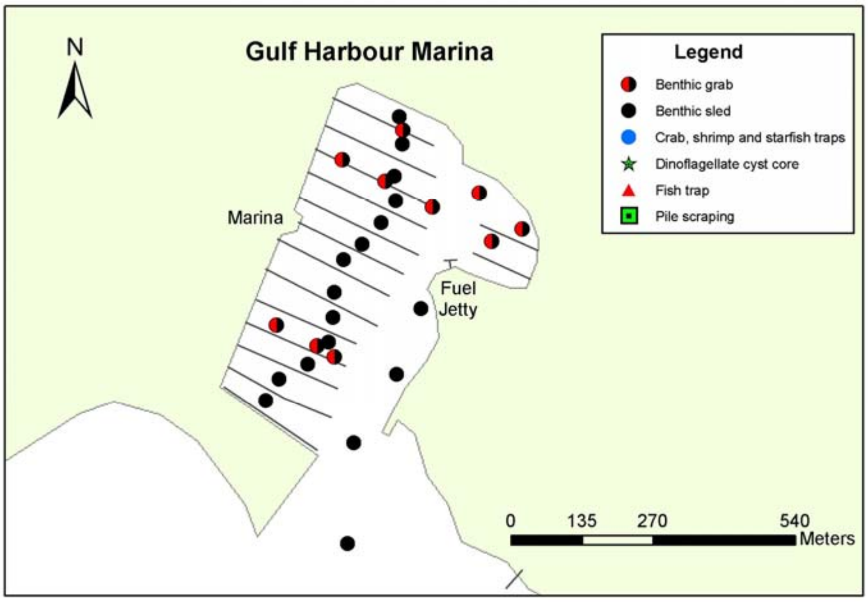

Figure 9: Benthic sled and benthic grab sites.

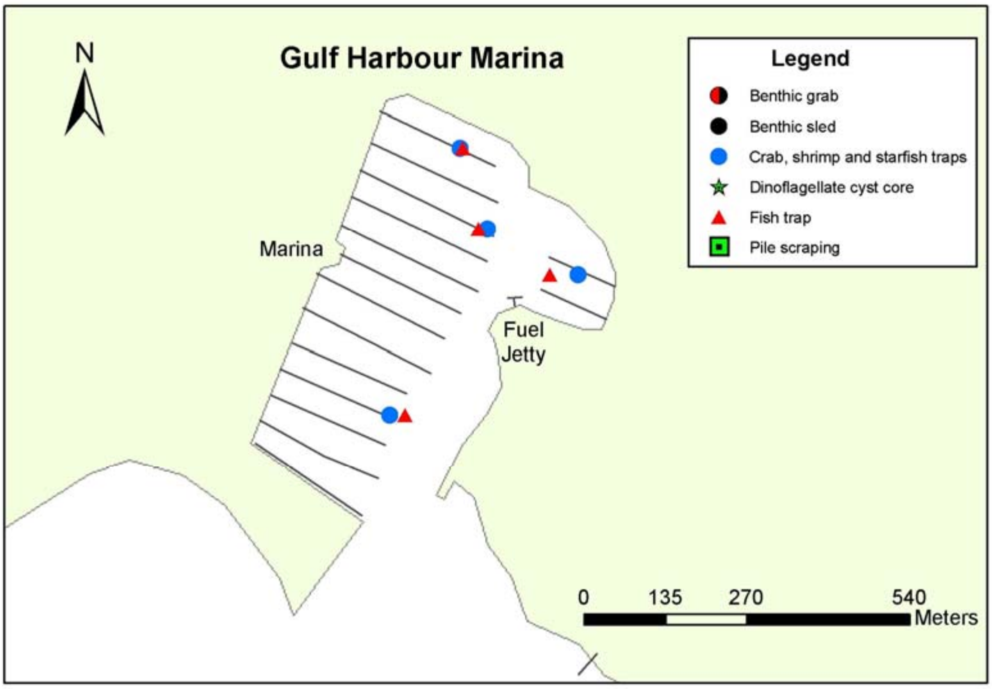

Figure 10: Sites trapped using box, shrimp and starfish traps and opera house fish traps

SORTING AND IDENTIFICATION OF SPECIMENS

Each sample collected in the diver pile scrapings, benthic sleds, box, starfish and shrimp traps, opera house fish traps, shipek grabs and javelin cores was allocated a unique code on waterproof labels and transported to a nearby field laboratory where it was sorted by a team into broad taxonomic groups (e.g. ascidians, barnacles, sponges etc.). These groups were then preserved and individually labelled. Details of the preservation techniques varied for many of the major taxonomic groups collected, and the protocols adopted and preservative solutions used are indicated in Table 4. Specimens were subsequently sent to over 25 taxonomic experts (Appendix 1) 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 5a) and the marine pest list produced by the Australian Ballast Water Management Advisory Council (Table 5b).

DEFINITIONS OF SPECIES CATEGORIES

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

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

Native species

Native species are known to be endemic to the New Zealand biogeographical region 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 by Chapman and Carlton (1991, 1994), as exemplified by Cranfield et al. (1998).

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

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

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

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

Cryptogenic species Category 1:

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

Cryptogenic species Category 2:

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

Species indeterminata

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

Survey results

A total of 124 species or higher taxa was identified from the Gulf Harbour Marina survey. This collection consisted of 78 native (Table 6), 12 cryptogenic (Table 7), 15 non-indigenous species (Table 8) and 19 species indeterminata (Table 9, Fig. 11). The biota included a diverse array of organisms from 10 Phyla (Fig. 12). Four species from the Gulf Harbour Marina (2 NIS and 2 cryptogenic species) had not previously been described from New Zealand waters. For general descriptions of the main groups of organisms (Phyla) encountered during this study refer to Appendix 2.

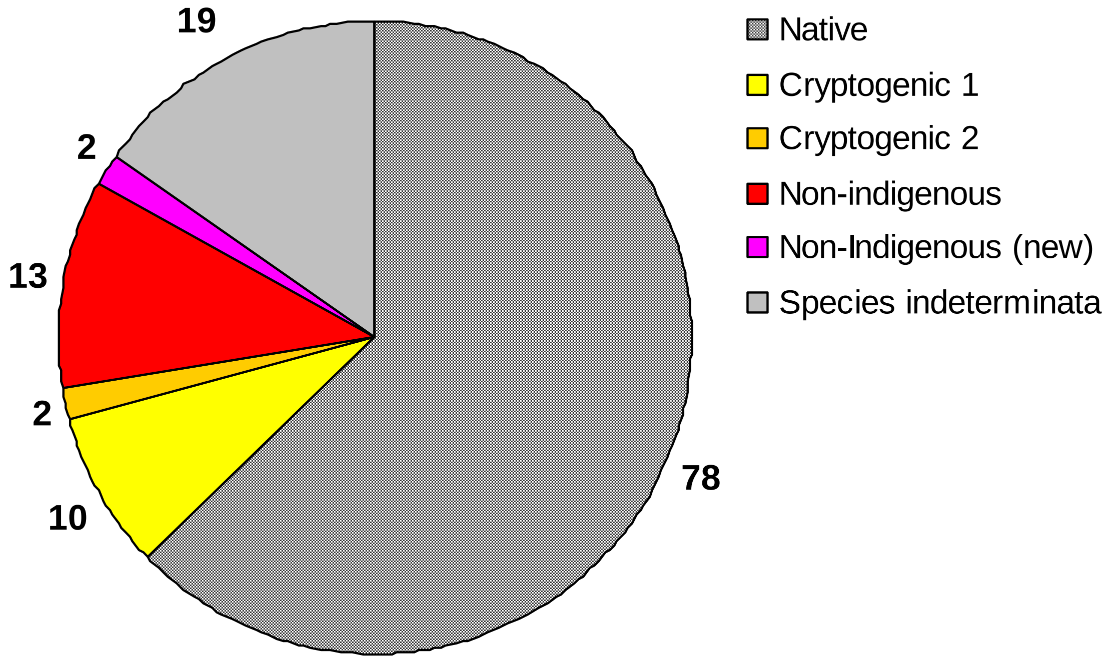

Figure 11: Diversity of marine species sampled in the Gulf Harbour Marina. Values indicate the number of species in native, cryptogenic, non-indigenous and species indeterminata categories.

NATIVE SPECIES

A total of 78 native species was identified from the Gulf Harbour Marina. Native species represent 62.9 % of all species identified from this location (Table 6) and included diverse assemblages of annelids (24 species), crustaceans (14 species), molluscs (15 species), phycophyta (4 species), urochordates (8 species), and vertebrates (5 species). A number of other less diverse phyla including bryozoans, echinoderms, porifera, and pyrrophycophyta were also sampled from the Marina (Table 6).

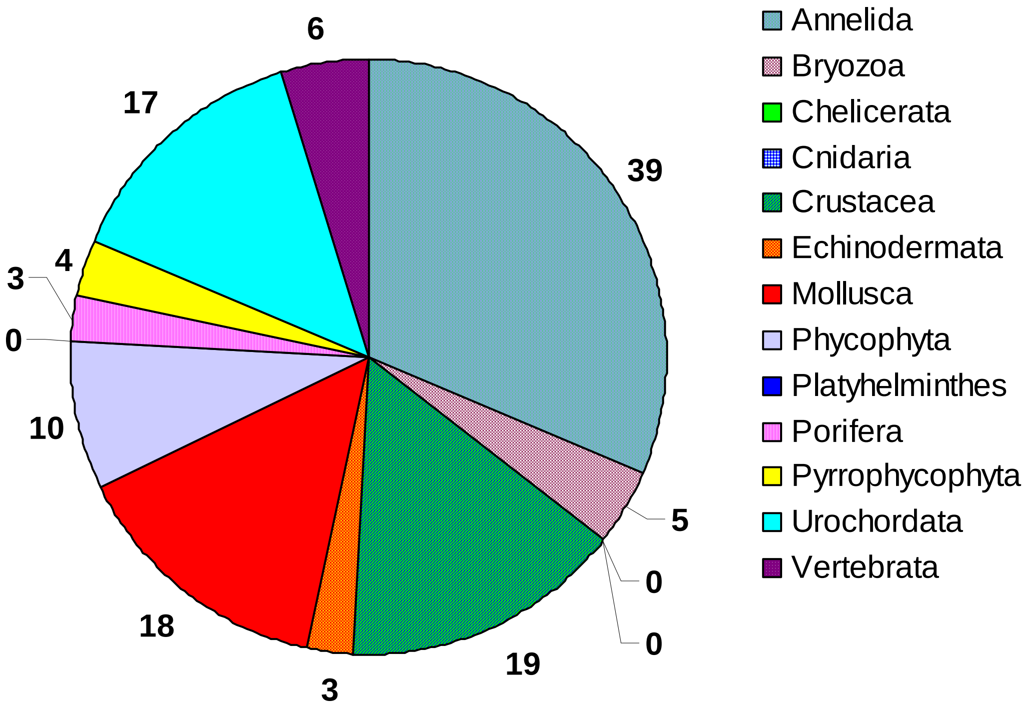

Figure 12: Marine Phyla sampled in the Gulf Harbour Marina. Values indicate the number of species in each of the major taxonomic groups.

CRYPTOGENIC SPECIES

Twelve cryptogenic species were recorded in the Gulf Harbour Marina. Cryptogenic species represent 9.7 % of all species or higher taxa identified from the Marina. The cryptogenic organisms identified included 10 Category 1 and two Category 2 species as defined in Section 2.8 above. These organisms included one annelid (*Chaetopterus* sp. A), three crustaceans (the crab, *Pilumnopeus serratifrons,* the barnacle *Balanus trigonus,* and the amphipod *Leucothoe* sp. 1), one sponge (*Haliclona heterofibrosa*), one dinoflagellate (*Gymnodinium catenatum*), and six ascidian species (*Aplydium phortax*, *Asterocarpa cerea*, *Botrylloides leachii*, *Styela plicata*, *Microcosmus squamiger*, and *Corella eumyota* Table 7). Many of the Category 1 cryptogenic species (e.g. the ascidians *Aplydium phortax*, *Asterocarpa cerea*, *Botrylloides leachii*, and *Corella eumyota*) have been present in New Zealand for more than 100 years but have distributions outside New Zealand that suggest non-native origins (Cranfield et al. 1998). Two cryptogenic species (the amphipod *Leucothoe* sp. 1 and the ascidian *Microcosmus squamiger*) have not previously been reported from New Zealand.

The large (7 cm long), tube-building polychaete, *Chaetopterus* sp. A, present in Gulf Harbour Marina, has exhibited invasive characteristics, but there is some uncertainty about the taxonomy and geographic origins of this species, since museum specimens and holotypes are often poorly preserved making comparisons with other species difficult. It first came to the attention of New Zealand scientists in 1997, when commercial scallop fishers reported dense tube mats that appeared suddenly in scallop grounds in the Hauraki Gulf. It subsequently spread rapidly to other coastal areas of northeastern New Zealand from Bream Head, in the north, to the Motiti Islands covering large areas of seafloor in important scallop grounds (Tricklebank et al. 2001). In Gulf Harbour Marina it occurred in pile scrape samples taken from Piers C, J, and L.

NON INDIGENOUS SPECIES

Fifteen non-indigenous species (NIS) were recorded from the Gulf Harbour Marina (Table 8). NIS represented 12.1 % of all identified species from this location. Two of these species, the annelid *Hydroides ezoensis* and the ascidian *Cnemidocarpa* sp., were not previously known from New Zealand. The NIS included two annelids (the fouling serpulid polychaetes *Hydroides elegans* and *Hydroides ezoensis*), four bryozoans (*Bugula neritina*, *Schizoporella errata*, *Watersipora subtorquata*, *Zoobotryon verticillatum*), two amphipod crustaceans (*Apocorophium acutum*, *Ericthonius pugnax*), three bivalve molluscs (*Crassostrea gigas*, *Limaria orientalis*, *Theora lubrica*), one macroalga (*Cutleria multifida*), one sponge (*Vosmaeropsis* cf *macera*), and two ascidians (*Ascidiella aspersa*, *Cnemidocarpa* sp.,).

A list of Chapman and Carlton's (1994) criteria (see Section 2.9.2) that were met by the non-indigenous species sampled in this survey is given in Appendix 3. Below we summarise available information on the biology of each of these species, providing images where available, and indicate what is known about their distribution, habitat preferences and impacts. This information was sourced from published literature, the taxonomists listed in Appendix 1 and from regional databases on non-indigenous marine species in Australia (National Introduced Marine Pest Information System; http://www.crimp.marine.csiro.au/nimpis) and the USA (National Exotic Marine and Estuarine Species Information System; http://invasions.si.edu/nemesis). Distribution maps for each NIS in the port are composites of multiple replicate samples. Where overlayed presence and absence symbols occur on the map, this indicates the NIS was found in at least one, but not all replicates at that GPS location. NIS are presented below by phyla in the same order as Table 8.

***Hydroides elegans* (Haswell, 1883)**

Image and information: NIMPIS (2002a)

Hydroides elegans is a small, tube dwelling polychaete worm that grows to up to 20mm in length. It constructs hard, sinuous, calcareous tubes. The worm has 65-80 body segments, and an opercular crown with 14-17 spines. *Hydroides elegans* is a fouling species on both natural and artificial structures. It is found subtidally and is highly tolerant of contaminated waters. Although the type specimen for this species was described from Sydney Harbour, Australia (Haswell 1883), the exact native range of *H. elegans* is unknown, as it is possible it was introduced to Australia prior to 1883 (Australian Faunal Directory 2005). *H. elegans* is present in the Caribbean Sea, Brazil, Argentina, north-west Europe, Japan, the Mediterranean, north-west and south-east Africa, and New Zealand. This species is able to grow in high densities, particularly in tropical and sub-tropical ports, sometimes heavily fouling any newly immersed structure. It creates microhabitat for some species and competes with others for food and space. *H. elegans* has been present in New Zealand since at least 1952 and has been recorded from Waitemata and Lyttelton Harbours. During the port baseline surveys, *H. elegans* was recorded in Gulf Harbour Marina and the Port of Auckland. In Gulf Harbour Marina it occurred in pile scrape samples taken from Pier C (Fig 13).

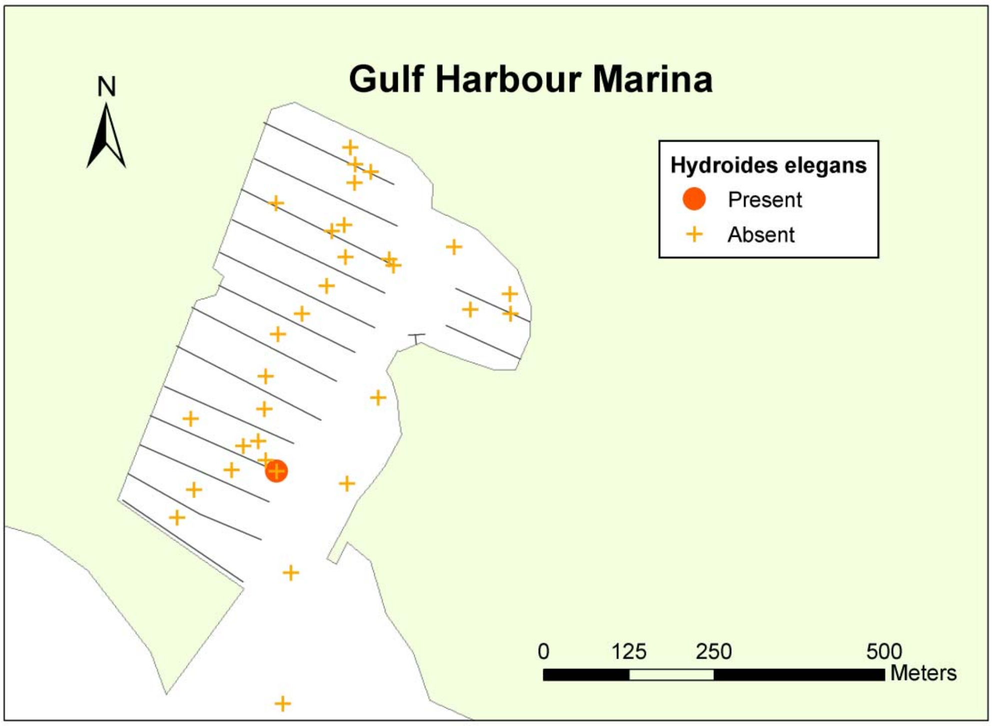

Figure 13: ***Hydroides elegans*** **distribution in Gulf Harbour Marina**

Hydroides ezoensis (Okuda 1934)

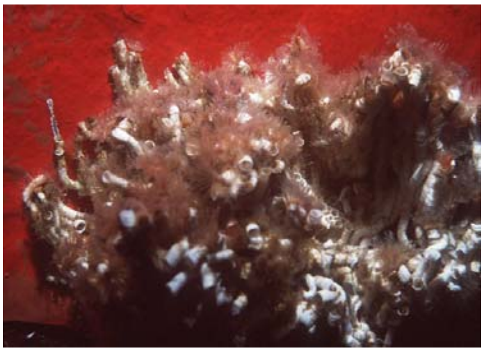

Image: CSIRO http://www.science-in-salamanca.tas.csiro.au
Information: Hewitt (2002) & http://www.jncc.gov.uk

Hydroides ezoensis is a tube dwelling serpulid worm that is a cosmopolitan fouling species on both natural and artificial structures. It constructs hard, sinuous, calcareous tubes that are cemented to hard surfaces. It is found subtidally where it may form large encrustations (e.g. 30 cm thick) and is highly tolerant of environmental fluctuations. It creates microhabitat for some species and competes with others for food and space.
Hydroides ezoensis originates in Asia, where it is found on the Japanese and Chinese coasts, and the Russian waters of the Sea of Japan. It has been introduced into the north-east Atlantic and Australia. It is a relatively recent introduction to Australia, being recorded there for the first time in 1998, from Sydney Harbour (Australian Faunal Directory 2005). During the New Zealand port baseline surveys, *H. ezoensis* was recorded only from Gulf Harbour Marina. This is the first time it has been recorded in New Zealand. It occurred in pile scrape samples taken from Piers C, J, L, & N (Fig 14).

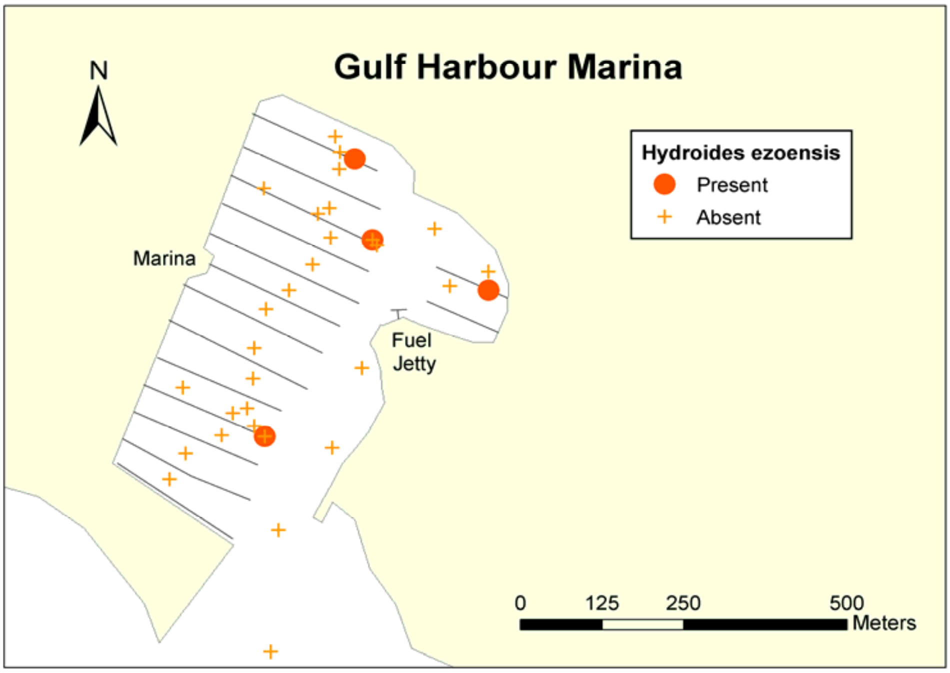

Figure 14: ***Hydroides ezoensis*** **distribution in Gulf Harbour Marina**

Bugula neritina (Linnaeus, 1758)

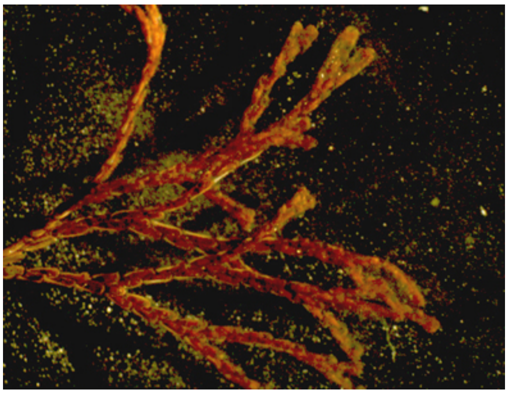

Image and information: NIMPIS (2002b)

Bugula neritina is an erect, bushy, red-purple-brown bryozoan. Branching is dichotomous (in series of two) and zooids alternate in two rows on the branches. Unlike all other species of *Bugula*, *B. neritina* has no avicularia (defensive structures) or spines, but there is a single pointed tip on the outer corner of zooids. Ovicells (reproductive structures) are large, globular and white in colour. They often appear in such high numbers that they resemble small snails or beads. *Bugula neritina* is native to the Mediterranean Sea. It has been introduced to most of North America, Hawaii, India, the Japanese and China Seas, Australia and New Zealand. It is cryptogenic in the British Isles. *Bugula neritina* is one of the most abundant bryozoans in ports and harbours and an important member of the fouling community. The species colonises any available substratum and can form extensive monospecific growths. It grows well on pier piles, vessel hulls, buoys and similar submerged surfaces. It even grows heavily in ships' intake pipes and condenser chambers. In North America, *B. neritina* occurs on rocky reefs and seagrass leaves. In Australia, it occurs primarily on artificial substrata. *B. neritina* occurs in all New Zealand ports (Gordon and Matawari 1992). In Gulf Harbour Marina it occurred in pile scrape samples from Piers C, J, L, and N (Fig. 15).

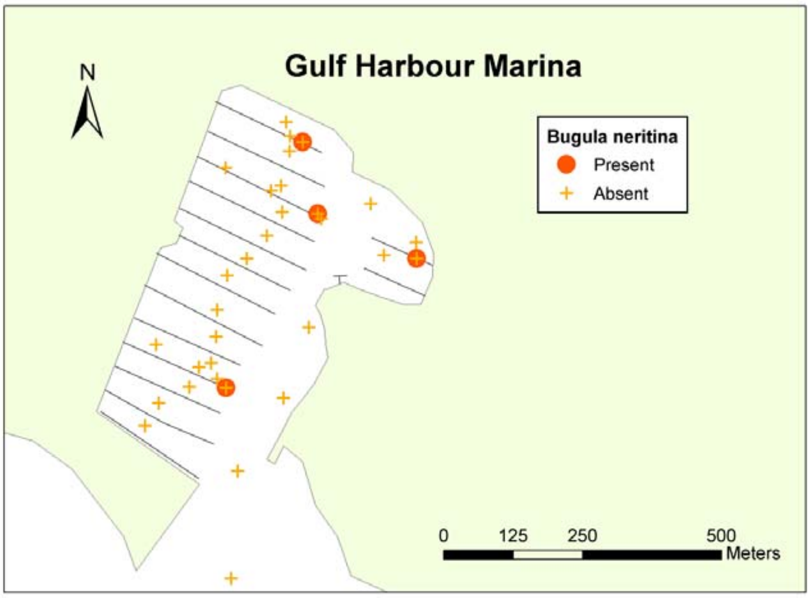

Figure 15: ***Bugula neritina*** **distribution in Gulf Harbour Marina**

Schizoporella errata **(Waters, 1878)**

Image: O. Floerl 2003
Information: Eldredge and Smith (2001)

Schizoporella errata is a heavily calcified, encrusting bryozoan that is typically dark brick red with orange-red growing margins. It assumes the shape of whatever it overgrows. This species may form heavy knobbly incrustations on flexible surfaces such as algae or worm tubes, turning them into solid, sometimes erect branching structures. The thickness of the growth is dependent upon the age of the colony. Multilaminar encrustations 1 cm thick are common. The frontal surface of the zoecium (secreted exoskeleton housing of individual zooids) is porous with a wide semicircular aperture and proximal sinus. It also has single avicularia on the right or left side of the aperture sinus.

Schizoporella errata is thought to be native to the Mediterranean. It has been introduced to many locations worldwide in warm temperate-subtropical seas. It has been reported from West Africa, the Red Sea, the Persian Gulf, South Australia, New Zealand, the Hawaiian Islands, the Pacific coast of North America, the east coast of North America through to the Caribbean and Brazil. *S. errata* occurs in shallow water on various hard substrates (pilings, hulls, coral rubble, etc.) in harbours and embayments. It is also occasionally found on rocky or coral reefs. *S. errata* can compete with other fouling organisms for space and large encrustations of this species are known to smother other biota (Cocito et al. 2000). It is present in Waitemata Harbour and the Bay of Islands and was also recorded from Nelson and

Whangarei Harbour during the baseline port surveys (Table 10). In Gulf Harbour Marina *S. errata* occurred in pile scrape samples taken from Piers C, J, L, and N (Fig. 16).

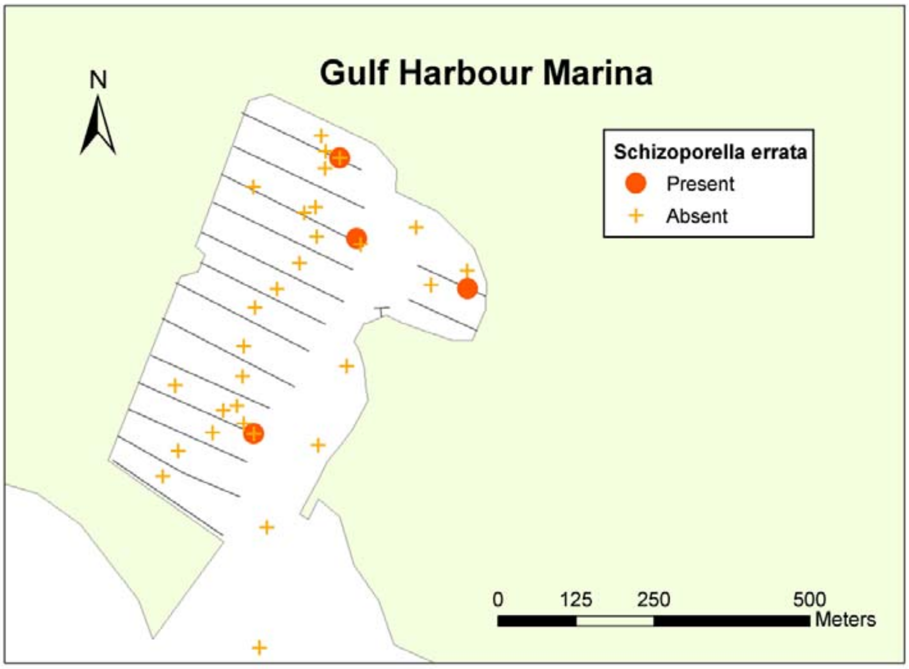

Figure 16: ***Schizoporella errata*** **distribution in Gulf Harbour Marina**

Zoobotryon verticillatum **(Delle Chiaje, 1828)**

Image and information: Gordon and Matawari (1992)

Zoobotryon verticillatum is a bryozoan that grows into large, bushy colonies often 20-30cm in diameter. They often appear like thin, stringy, gelatinous noodles. The young colonies are usually transparent, while older and larger ones have a dirty white appearance. In contrast to most other bryozoans, calcium carbonate is absent in exoskeletons of this species. *Zoobotryon verticillatum* is a subtidal species and mostly occurs on hard surfaces such as rocks, pontoons, pilings or, boat hulls, or as an epibiont on shells or carapaces.

The type locality of *Z. verticillatum* is Naples, Italy, although the species is now widely distributed in tropical and subtropical seas, including the Caribbean, Indian Ocean, north-west and north-east Pacific, Hawaii, New Caledonia and Australia (Gordon and Matawari 1992). It has been present in New Zealand, in the Waitemata and Manukau Harbours, since at least the 1960’s (Gordon and Matawari, 1992). Under optimal conditions *Z. verticillatum* can form large aggregations that can clog fishing nets and potentially exclude other sessile organisms. Large bushes are formed only when water warms to 22°C and above, although the colonies can overwinter during colder periods. Elevated temperature and salinity has been suggested to enhance outbreaks of this bryozoan. In the Gulf Harbour Marina *Z. verticillatum* occurred in pile scrape samples taken from piers C and L (Fig. 17).

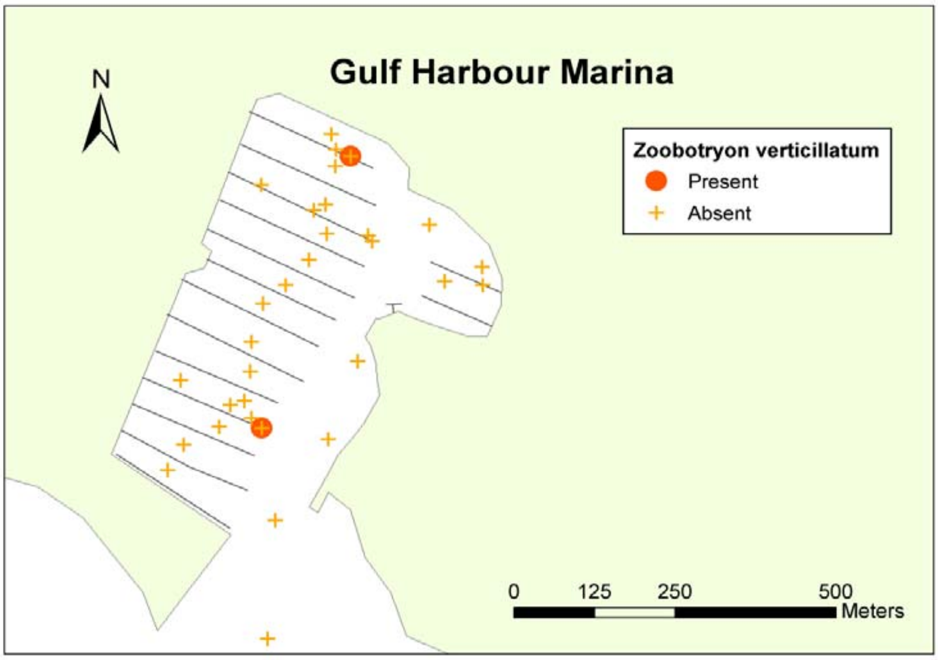

Figure 17: ***Zoobotryon verticillatum*** **distribution in Gulf Harbour Marina**

Watersipora subtorquata **(d'Orbigny, 1842)**

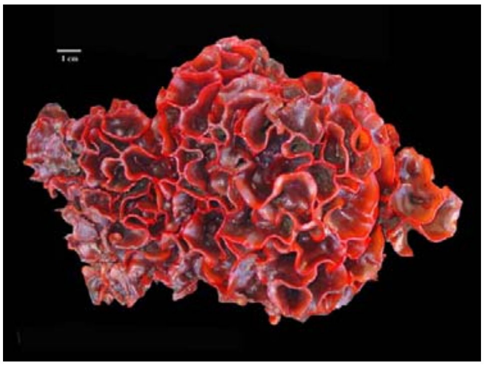

Image: California Academy of Sciences.
Information: Gordon and Matawari (1992)

Watersipora subtorquata is a loosely encrusting bryozoan capable of forming single or multiple layer colonies. The colonies are usually dark red-brown, with a black centre and a thin, bright red margin. The operculum is dark, with a darker mushroom shaped area centrally. *Watersipora subtorquata* has no spines, avicularia or ovicells. The native range of the species is unknown, but is thought to include the wider Caribbean and South Atlantic. The type specimen was described from Rio de Janeiro, Brazil (Gordon and Matawari 1992). It also occurs in the north-west Pacific, Torres Strait and north-eastern and southern Australia.

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

W. subtorquata has been present in New Zealand since at least 1982 and is now present in most ports from Opua to Bluff (Gordon and Matawari 1992). In Gulf Harbour Marina it occurred in pile scrape samples taken from Piers C, J, L, and N (Fig. 18).

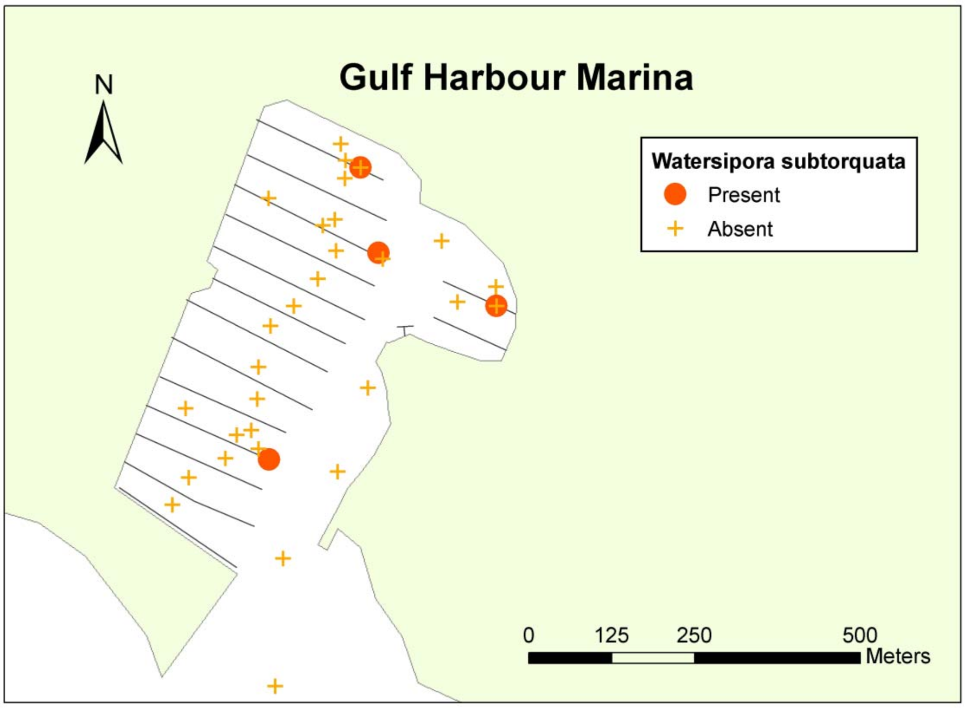

Figure 18: ***Watersipora subtorquata*** **distribution in Gulf Harbour Marina**

Apocorophium acutum **(Chevreux, 1908)**

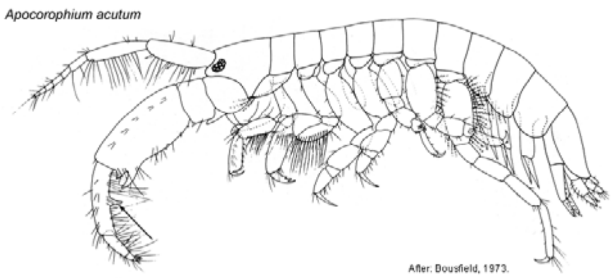

Image and information: Keys to the Northeast Atlantic and Mediterranean amphipods. [http://www.amphipoda.com/acutum.html]

Apocorophium acutum is a corophiid amphipod, known from the Atlantic Ocean (England, France, North America, Brazil, South Africa), Pacific Ocean (New Zealand) and the Mediterranean Sea. The exact native range of this species is not known, although the type specimen of this species was described from the southern Mediterranean. *Apocrophium acutum* inhabits marine sediments in estuarine mudflats and brackish water and fouling assemblages where it builds muddy tubes. It has no known documented impacts. During the port baseline surveys *A. acutum* was recorded from the ports of Lyttelton, Tauranga and Timaru, and from Gulf Harbour and Opua marinas. In Gulf Harbour Marina *A. acutum* occurred in pile scrape samples taken from Piers C, J, L, and N (Fig. 19).

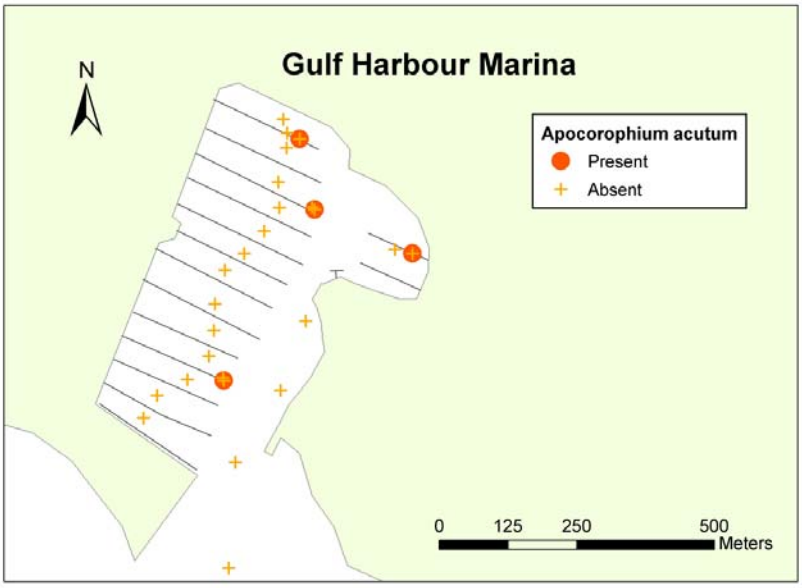

Figure 19: ***Apocorophium acutum*** **distribution in Gulf Harbour Marina**

Ericthonius pugnax **(Dana, 1852)**

No image available

Ericthonius pugnax is an amphipod in the family Ischyroceridae. The type locality for this species is the Sulu Sea, Indonesia, but it has been recorded widely from the tropical and subtropical Indo-West Pacific (Australian Faunal Directory 2005). It is a detritivore that is often common in fouling communities, branched algae and seagrass beds. In Australia, *E. pugnax* can reach densities of up to 100,000 individuals per m^2 in seagrass meadows (Edgar 1990). It has been established in New Zealand waters since at least 1914 in Waitemata Harbour (G. Fenwick pers. comm.). In Gulf Harbour Marina *E. pugnax* occurred in pile scrape samples taken from Pier C (Fig. 20).

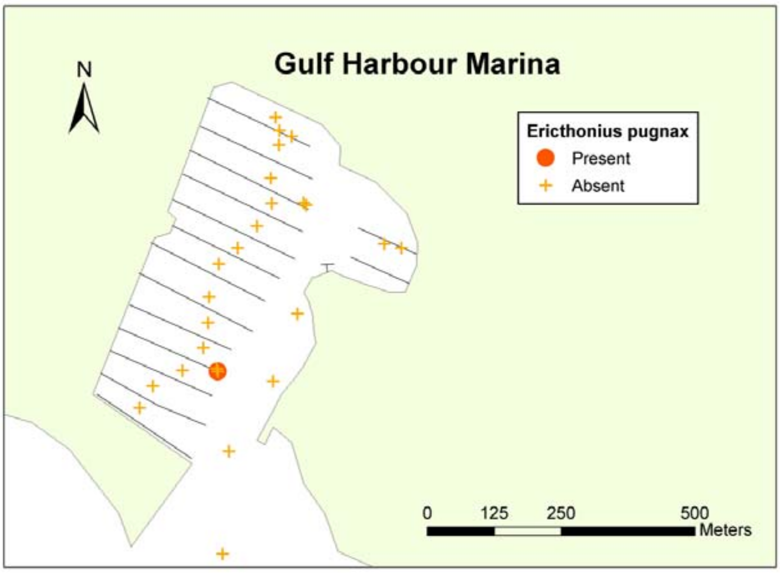

Figure 20: ***Ericthonius pugnax*** **distribution in Gulf Harbour Marina**

***Crassostrea gigas* (Thunberg, 1793)**

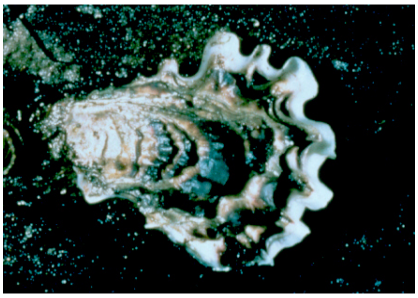

Image and information: NIMPIS (2002c)

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

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

C. gigas has been present in New Zealand since the early 1960s (Cranfield et al. 1998). Little is known about the impacts of this species in New Zealand, but it is now a dominant structural component of fouling assemblages and intertidal shorelines in northern harbours of New Zealand and the upper South Island. *C. gigas* is now the basis of New Zealand's oyster aquaculture industry, having displaced the native rock oyster, *Saccostrea glomerata*. *C. gigas* was recorded from Opua marina, Whangarei Harbour, Gulf Harbour Marina, Auckland, Taranaki, Nelson and Dunedin during the port baseline surveys (Table 10). In Gulf Harbour Marina *C. gigas* occurred in pile scrape samples taken from Piers C, J, L, N (Fig. 21).

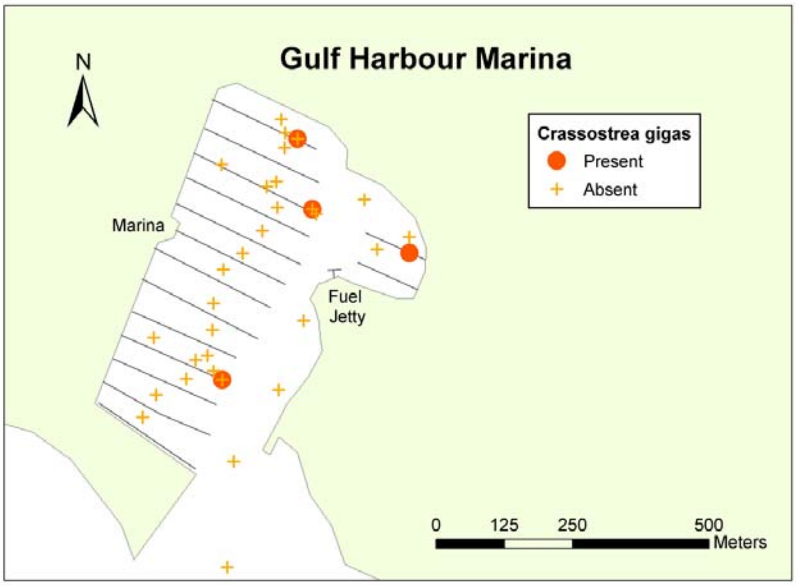

Figure 21: ***Crassostrea gigas* distribution in Gulf Harbour Marina**

***Limaria orientalis* (Adams & Reeve, 1850)**

Image: www.femorale.com.

Limaria orientalis (file shell) is a bivalve in the family Limidae. It is known from Australia and the tropical Indo-Pacific. It was first recorded in New Zealand in 1972 from the Hauraki Gulf and Waitemata Harbour. It has since been recorded from the Bay of Islands and Coromandel (Cranfield et al. 1998), and is also common in the Marlborough Sounds, occurring in fouling communities in and around mussel farms (D. Morrisey, pers. com). *L. orientalis* can be a dominant member of benthic assemblages in muddy shell gravels (Hayward 1997). Its impacts in its introduced range are unknown. In Gulf Harbour Marina, *L. orientalis* occurred in pile scrape samples taken from Pier C (Fig. 22).

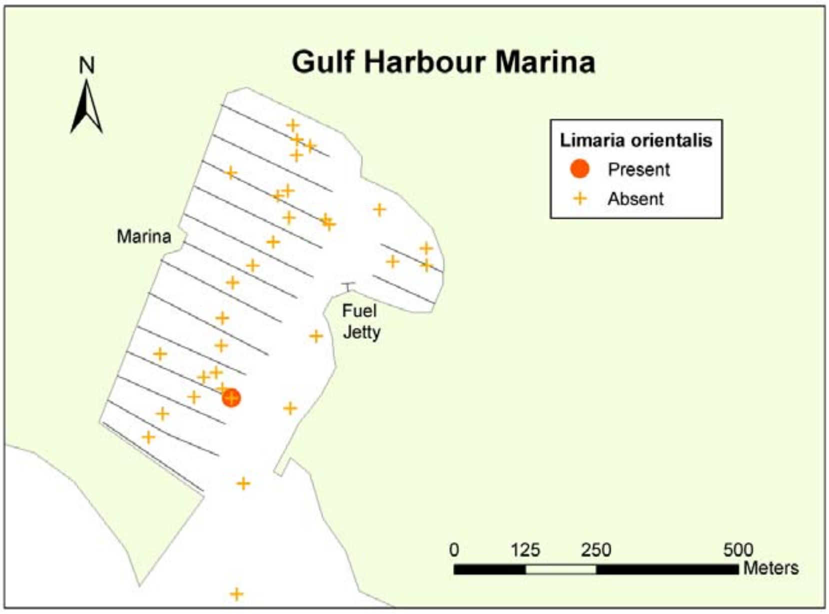

Figure 22: *Limaria orientalis* distribution in Gulf Harbour Marina

***Theora lubrica* (Gould, 1861)**

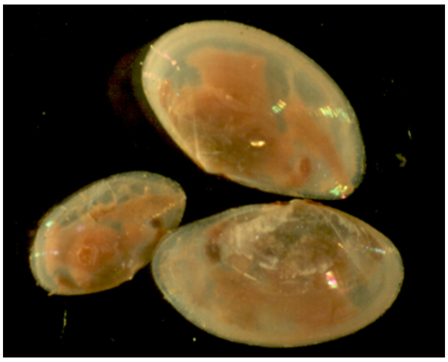

Image and information: NIMPIS (2002d)

Theora lubrica is a small bivalve with an almost transparent shell. The shell is very thin, elongated and has fine concentric ridges. *T. lubrica* grows to about 15 mm in size, and is characterised by a fine elongate rib extending obliquely across the internal surface of the shell. *Theora lubrica* is native to the Japan and China Seas. It has been introduced to the west coast of the USA, Australia and New Zealand.

Theora lubrica typically lives in muddy sediments from the low tide mark to 50 m, however it has been found at 100 m. In many localities, *T. lubrica* is an indicator species for eutrophic and anoxic areas. *T. lubrica* has been present in New Zealand since at least 1971 (Cranfield et al. 1998). It occurs in estuaries of the north-east coast of the North Island, including the Bay of Islands, Whangarei Harbour, Waitemata Harbour, Wellington and Pelorus Sound, where it can reach very large densities. During the port baseline surveys, it was recovered from Opua, Whangarei port and marina, Gulf Harbour Marina, Auckland, Gisborne, Napier, Taranaki, Wellington, Nelson, and Lyttelton. *T. lubrica* occurred throughout Gulf Harbour Marina (Fig. 23). It occurred in all 17 of the benthic sled samples and in benthic grab samples taken near Pier C and the Super Yacht berths.

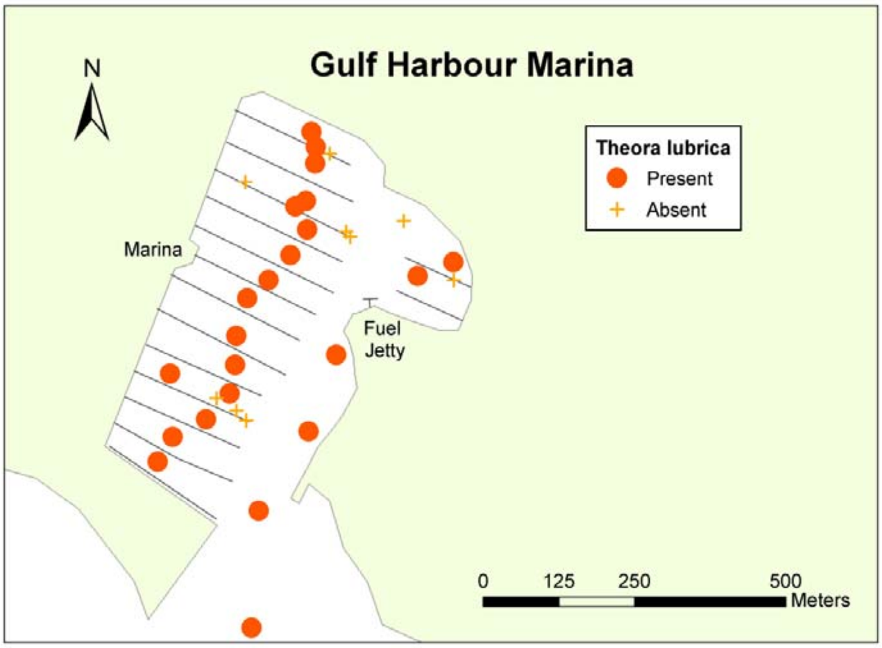

Figure 23: ***Theora lubrica* distribution in Gulf Harbour Marina**

***Cutleria multifida* (Js.Smith) Grev.**

Image: University of the Azores (available at http://www.horta.uac.pt/species/Algae/Cutleria_multifida/Cutleria _multifida.htm)

Cutleria multifida is a brown alga in the family Cutleriaceae. Its native range is thought to be the north-east Atlantic and Mediterranean Seas (Guiry et al. 2005). It has been introduced to temperate West Africa, the Arabian Seas, south and south-east Pacific, north-west Pacific, Australia and New Zealand (Guiry et al. 2005). Within New Zealand, *C. multifida* has been reported from Auckland, Wellington, Picton, Lyttelton, Dunedin and Stewart Island (Cranfield et al. 1998). During the port baseline surveys it was recorded in Gulf Harbour Marina and the Port of Otago. In Gulf Harbour Marina it occurred in pile scrape samples taken from Pier J (Fig. 24).

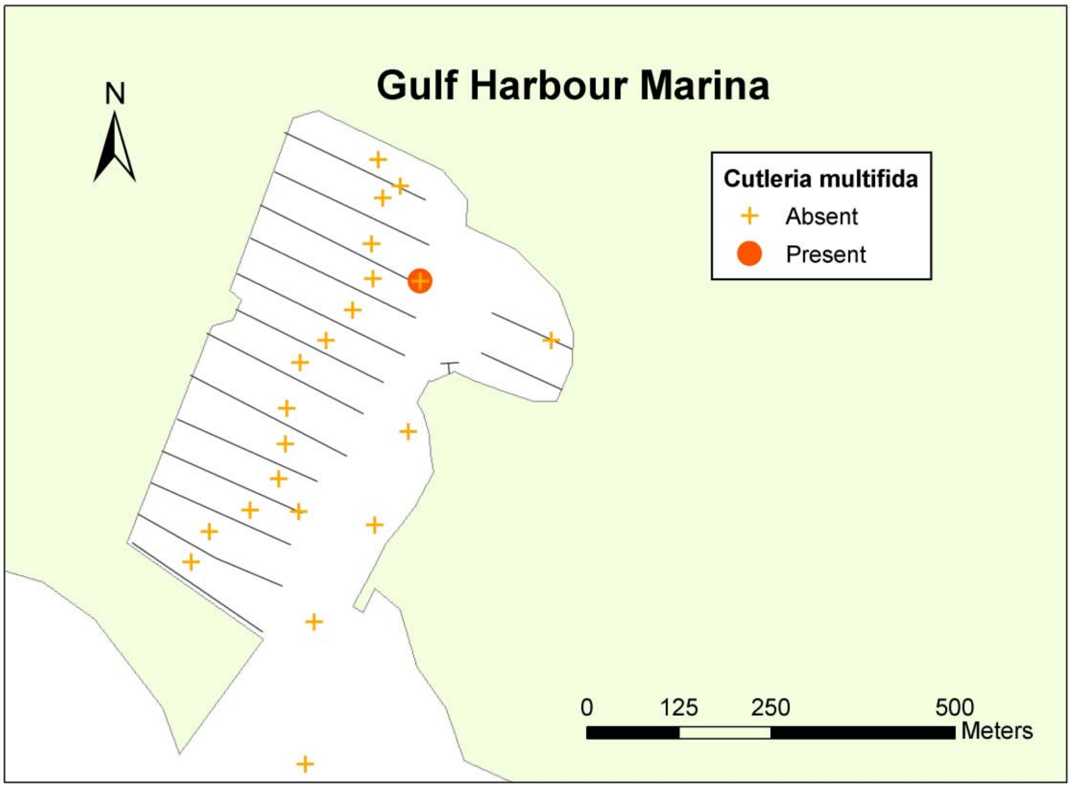

Figure 24: ***Cutleria multifida* distribution in Gulf Harbour Marina**

***Vosmaeropsis cf macera* (Carter, 1886)**

No image available

Vosmaeropsis cf macera is a sponge in the family Heteropiidae. The type locality for this species is Port Phillip Heads, Australia (Carter 1886). It has previously been reported from Lyall Bay, in Wellington (Michelle Kelly-Shanks, pers. com), but was not known from other New Zealand locations. Calcareous sponges, like *V.* cf. *macera* are notorious hull foulers that grow best in sheltered, dark places, and proliferate in pipes and inlets in marine infrastructure. During the port baseline surveys *V.* cf. *macera* was recorded in Whangarei Harbour and Gulf Harbour Marina. In Gulf Harbour Marina it occurred in pile scrape samples taken from Pier J (Fig. 25).

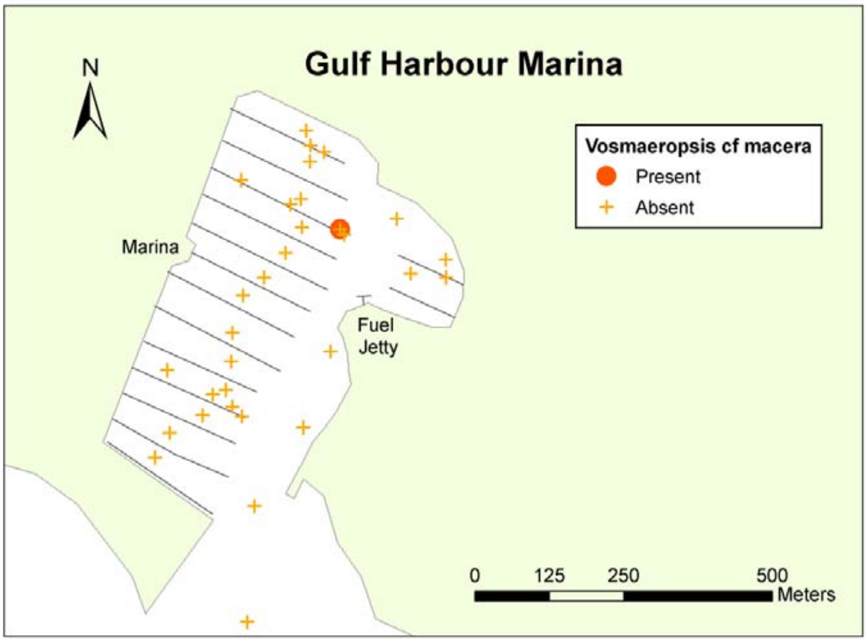

Figure 25: ***Vosmaeropsis cf macera*** **distribution in Gulf Harbour Marina**

Ascidiella aspersa **(Mueler, 1776)**

Image and information: NIMPIS (2002e).

Ascidiella aspersa is a solitary ascidian that is native to north-west Europe, the British Isles, the Mediterranean Sea and the north-west African coasts. It has been introduced to India, Australia and New Zealand, and is cryptogenic to the east coast of the USA. *A. aspersa* attaches to the substratum by its entire left side and grows up to 130 mm in length. The inhalant (branchial) siphon is positioned at the top of the body and is conical in shape. The exhalent (atrial) siphon is positioned around one third of the way down the body and both siphons are ridged. The body wall (test) is firm and is transparent, with numerous papillae scattered over the surface. Small amounts of pink or orange may be visible inside the siphons. *Ascidiella aspersa* is found from intertidal to shallow subtidal waters to 50m depth attached to clay, stones, rocks, algae and wharf piles, where it can be the dominant fouling species. In the southern hemisphere, populations are particularly abundant in the inner-reaches of estuaries and harbours in protected or semi-enclosed marine embayments. Although it is a solitary ascidian (i.e. not colonial) it is often found in dense clumps. During the baseline surveys it was recovered from the ports of Gisborne and Napier, and from Gulf Harbour Marina. It has no known documented impacts. In Gulf Harbour Marina *A. aspersa* occurred in pile scrape samples taken from Piers C and L (Fig. 26).

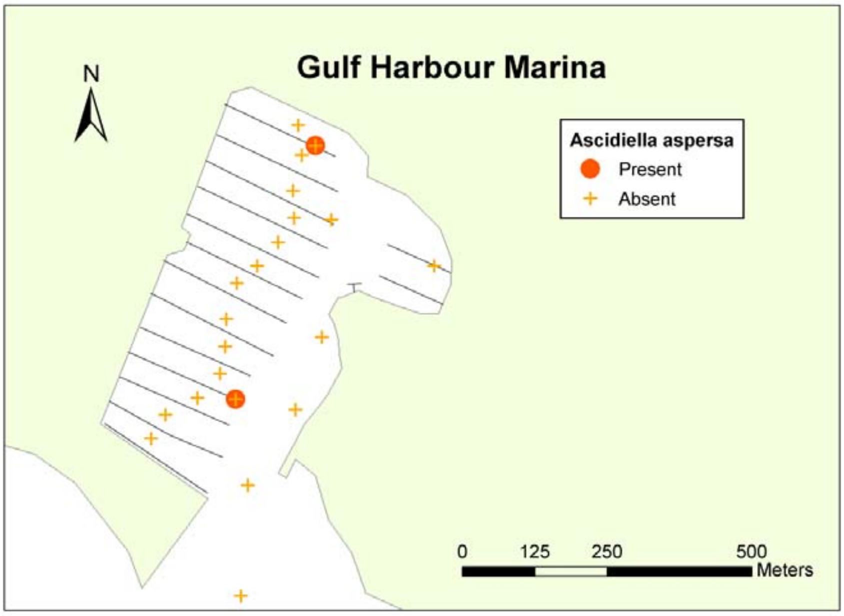

Figure 26: ***Ascidiella aspersa*** **distribution Gulf Harbour Marina**

Cnemidocarpa sp.

No image available

This ascidian is in the family Styelidae. It appears to be a new species that is closely related to *C. nisiotus*, but varies from this species in gonad structure, the number of branchial tentacles and shape of rectal opening. It is not similar to any species described in Australia, Japan or South Africa. Its native distribution, habitat preferences and impacts are unknown. Specimens matching this description were also recovered from Auckland, Tauranga, Gisborne, Taranaki, Picton, Lyttelton and Timaru during the port baseline surveys. In Gulf Harbour Marina, *Cnemidocarpa* sp. occurred in pile scrape samples taken from Pier L (Fig. 27).

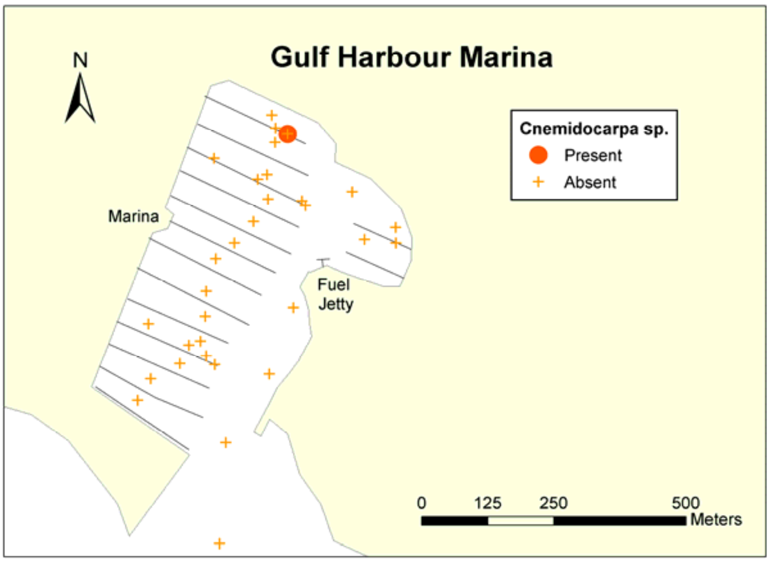

Figure 27: ***Cnemidocarpa sp.*** **distribution Gulf Harbour Marina**

SPECIES INDETERMINATA

Nineteen organisms from the Gulf Harbour Marina were classified as species indeterminata. If each of these organisms is considered a species of unresolved identity, then together they represent 15.3 % of all species collected from this survey (Fig 11). Species indeterminata from the Gulf Harbour Marina included 12 Annelida, five Phycophyta, one Urochordata, and one Vertebrata species (Table 9).

NOTIFIABLE AND UNWANTED SPECIES

Of the non-indigenous species identified from the Gulf Harbour Marina, none are currently listed as Unwanted Organisms on the New Zealand register (Table 5a). However the Pacific oyster, *Crassostrea gigas*, and cysts of the cryptogenic dinoflagellate *Gymnodinium catenatum* were present in the Marina. Both species are included on the Australian ABWMAC list of unwanted marine pests (Table 5b).

PREVIOUSLY UNDESCRIBED SPECIES IN NEW ZEALAND

Two non-indigenous species from the Gulf Harbour Marina (the polychaete *Hydroides ezoensis* (see section 3.3.2 above) and the ascidian *Cnemidocarpa* sp. (see section 3.3.13 above) had not previously been recorded from New Zealand waters (Table 8). The cryptogenic amphipod, *Leucothoe* sp. 1, and the ascidian *Microcosmus squamiger,* also appear to be first records for New Zealand, although species in the cosmopolitan genus *Leucothoe* are notoriously difficult to distinguish morphologically.

CYST-FORMING SPECIES

The cysts of three native species of dinoflagellate and the cryptogenic dinoflagellate *Gymnodinium catenatum* were collected from Gulf Harbour Marina. They are indicated as members of the Pyrrophycophyta (Tables 6 and 7). Toxins produced by the motile form of *G. catenatum* can cause Paralytic Shellfish Poisoning (PSP) and are a significant public health problem. Blooms of *G. catenatum* can cause problems for aquaculture and recreational harvesting of shellfish.

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

The non-indigenous species located in the Port are thought to have arrived in New Zealand via international shipping. Table 8 indicates the possible vectors for the introduction of each NIS. Likely vectors of introduction are largely derived from Cranfield et al. (1998) and indicate that approximately 6.7 % (one of the 15 NIS) probably arrived via ballast water, 66.7 % probably were introduced to New Zealand waters via hull fouling, and 26.7 % could have arrived via either of these mechanisms.

COMPARISON WITH OTHER PORTS

Sixteen locations (13 ports and three marinas) were surveyed during the summers of 2001/2002 and 2002/2003 (Fig. 1). The total number of species identified in these surveys varied from 336 in the Port of Wellington to 56 in Whangarei Town Basin Marina (Fig. 26a). The number of species recorded in each location reflects sampling effort (Table 3c) and local patterns of marine biodiversity within the ports and marinas. Sampling effort alone (expressed as the total number of registered samples in each port), accounted for significant proportions of variation in the numbers of native (linear regression; $F_{1,14} = 33.14$, $P< 0.001$, $R^2 = 0.703$), Cryptogenic 1 ($F_{1,14} = 5.94$, $P = 0.029$, $R^2 = 0.298$) and Cryptogenic 2 ($F_{1,14} = 7.37$, $P = 0.017$, $R^2 = 0.345$) species recorded in each location. However differences in sampling effort did not explain differences in the numbers of NIS found in each location ($F_{1,14} = 0.77$, $P = 0.394$, $R^2 = 0.052$). When sample effort was adjusted for, Gulf Harbour Marina had average numbers of NIS and Cryptogenic 1 species relative to the other ports and marinas surveyed;

and a smaller than average diversity of native and Cryptogenic 2 species (Fig 27a-d). Largest relative numbers of NIS were reported from the ports of Lyttelton and Whangarei, but significantly more Cryptogenic 1 species were recorded in Whangarei port than in other surveyed locations (Fig 27c, Studentised residual = 3.87).

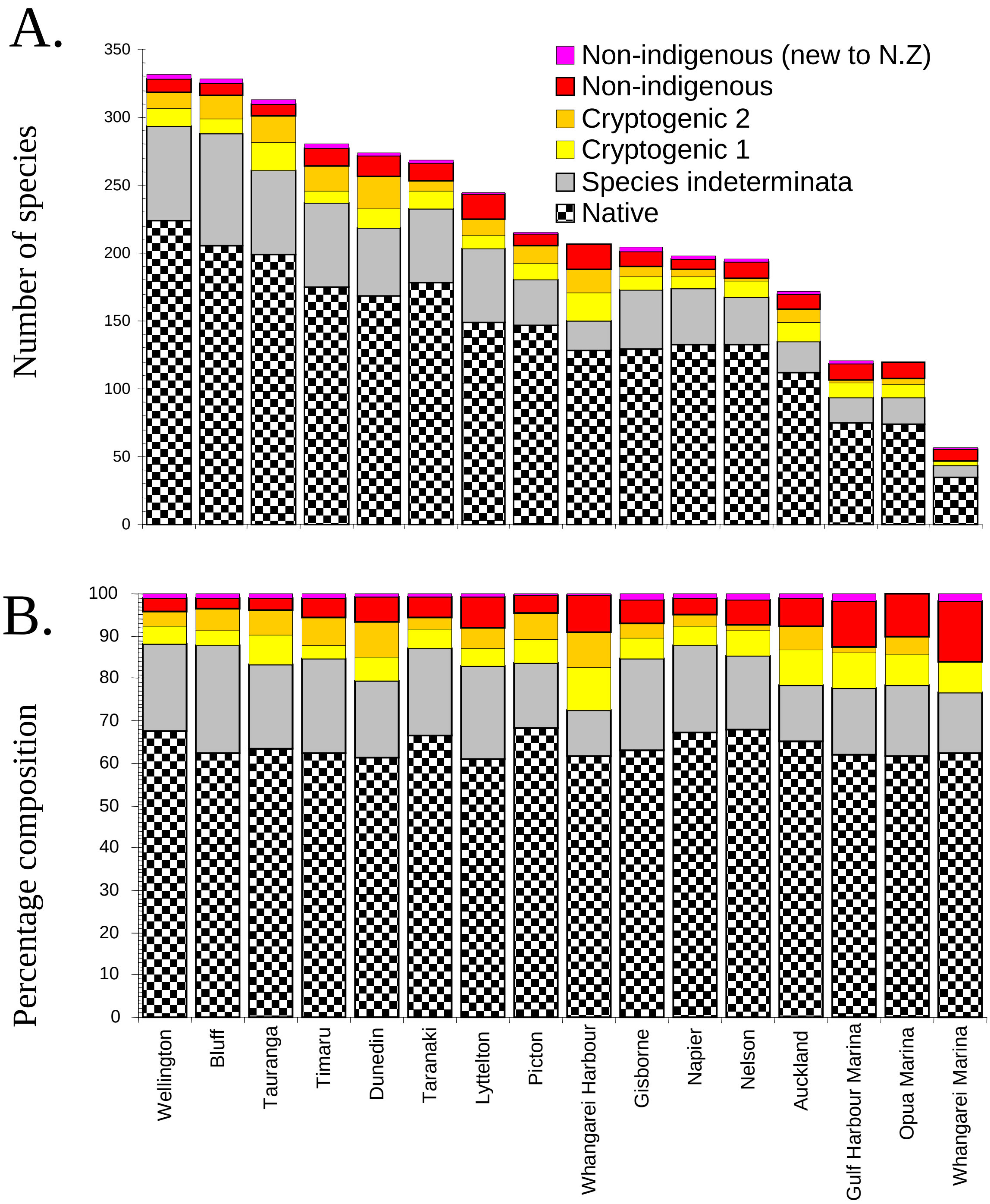

Figure 26: Differences in (a) the number of species, and (b) the relative proportions of non-indigenous, cryptogenic, species indeterminata and native categories among the sixteen locations sampled over the summers of 2001 – 2002, and 2002-2003. Locations are presented in order of decreasing species diversity sampled.

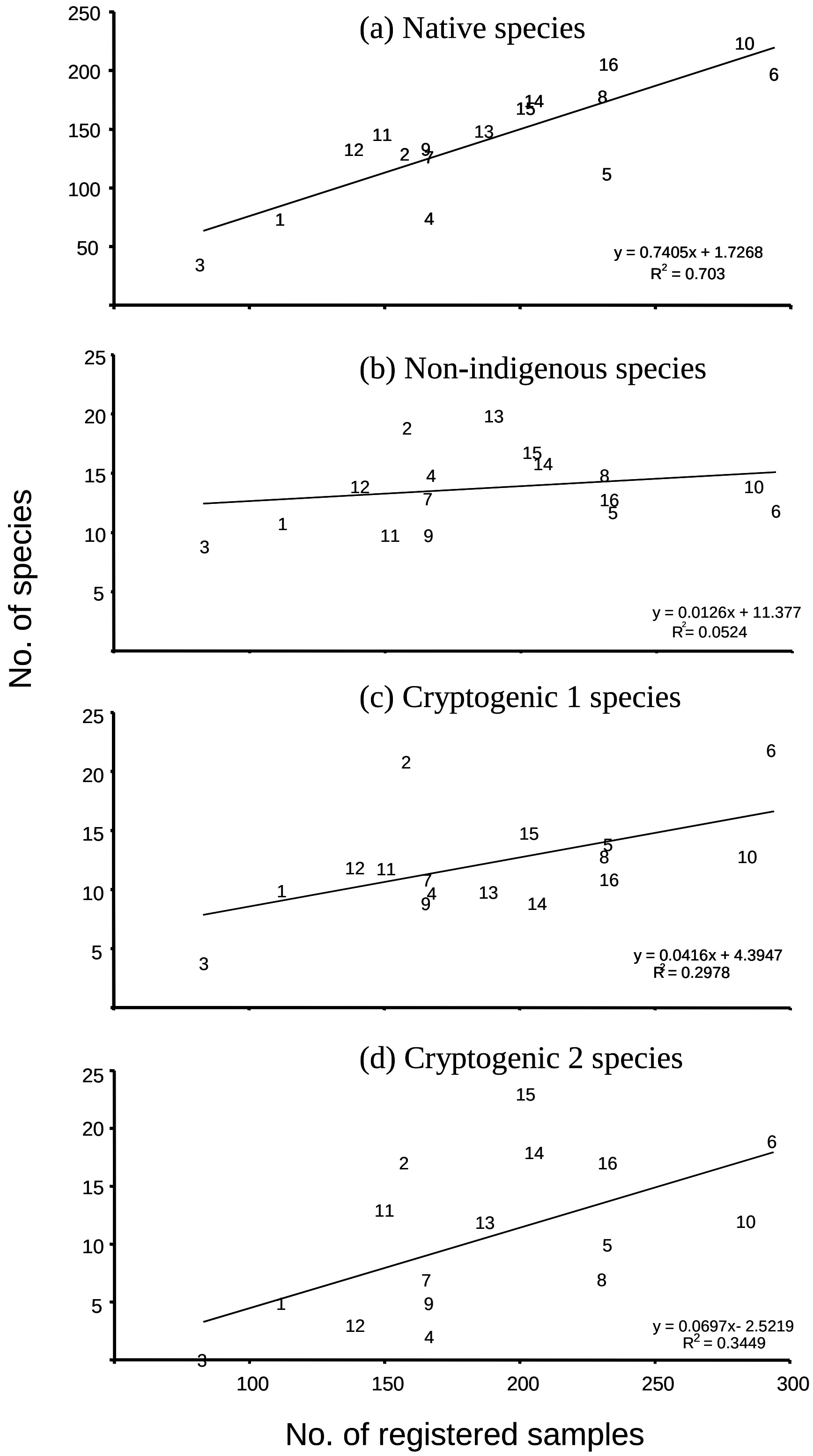

Figure 27: Linear regression equations relating numbers of species detected to sample effort at the 16 locations surveyed nation-wide. Location codes are as follows; 1 = Opua, 2 = Whangarei port, 3 = Whangarei marina, 4 = Gulf Harbour marina, 5 = Auckland port, 6 = Tauranga port, 7 = Gisborne port, 8 = Taranaki port, 9 = Napier Port, 10 = Wellington port, 11 = Picton port, 12 = Nelson port, 13 = Lyttelton port, 14 = Timaru port, 15 = Dunedin port, 16 = Bluff port

Native organisms represented over 60 % of the species diversity sampled in each port and marina surveyed, with a minimum contribution of 61.0 % in the Port of Lyttelton and a maximum of 68.5 % in Picton (Fig. 26b). Species indeterminata organisms represented between 10.6 % and 25.6 % of the sampled diversity in each location. Non-indigenous and Cryptogenic 1 and 2 species were present in each port and marina, although their relative contributions differed between locations (Fig. 26b). Non-indigenous species represented between 3.6 % (Bluff) and 16.1 % (Whangarei Marina) of all identified species. NIS comprised 12.1 % of the total sampled diversity in the Gulf Harbour Marina (Fig. 26b), ranking it 2nd highest in percentage composition of NIS from the sixteen locations surveyed.

Assessment of the risk of new introductions to the marina

Many NIS introduced to New Zealand ports through hull fouling, ships' sea chests, or ballast water discharge do not survive to establish self-sustaining local populations. Those that do, often come from coastlines with 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 north-west Pacific, and southern Australia (Cranfield et al. 1998).

Pleasure boating is a very popular activity in New Zealand, and there are more than 30 marinas that offer mooring facilities to sailing yachts and cabin cruisers of up to 50m in length. New Zealand is also a popular destination for international yachts. These yachts arrive throughout the year, but predominantly (94 % of all annual arrivals) between October and December. Auckland receives between 90 and 150 international yacht arrivals annually and, after Opua, is the second major arrival port for international yachts in New Zealand (New Zealand Customs Service, personal communication). After clearing customs in Auckland, many of these vessels then move to Gulf Harbour. The majority of international yachts entering New Zealand through Auckland come from Fiji, Australia and Tonga (NIWA unpublished data 2002-2004). Many of the international yachts that enter New Zealand through more northern arrival ports (Opua and Whangarei, approximately 250 and 330km north of Auckland) spend time in Gulf Harbour Marina. In total, the Gulf Harbour Marina receives approximately 480 international yachts every year. It provides mooring space for 996 boats and, on average, 98 % of these are occupied at all times (NIWA unpubl. data).

Recreational yachts generally do not carry ballast water. Fouling of hull surfaces or internal structures (e.g. piping) and natural spread from other locations in New Zealand are, therefore, likely to be the most important pathways for new introductions into the Gulf Harbour Marina. Hull fouling on recreational vessels is recognised as an important means by which marine NIS are spread (Floerl 2002; Floerl et al. 2005).

Assessment of translocation risk for non-indigenous species found in the marina

Recreational vessels departing from the Gulf Harbour Marina travel to a wide range of locations around New Zealand. For example, 26 international yachts that arrived in Auckland and Gulf Harbour Marina from overseas in 2003 subsequently visited Kerikeri, Opua, Whangarei, Tutukaka, the Poor Knight Islands, Great Barrier Island, Tauranga, Picton, Nelson, Stewart Island and Fiordland. Domestic and international yachts that visit the Gulf Harbour Marina directly or indirectly connect it to nearly 100 locations around New Zealand's coastline (NIWA unpubl. data). Movements of yachts between Gulf Harbour and other locations have the potential to spread introduced fouling organisms.

Although many of the non-indigenous species found in the Gulf Harbour Marina survey are already widely distributed in ports and marinas around New Zealand, there were three notable exceptions. During the current surveys the serpulid polychaete *Hydroides ezoensis*, the bryozoan *Zoobotyryon verticillatum* and the amphipod *Ericthonius pugnax* were only located in the Gulf Harbour Marina. *Hydroides ezoensis* is a fouling species highly tolerant of polluted waters and capable of growing in high densities. It is likely to compete with native organisms in fouling assemblages for space and food. Little information exists on the impacts of either *Z. verticillatum* or *E. pugnax,* however both these species may also compete with native fauna in fouling assemblages. Care should be taken to ensure that they are not spread further around the country. The ascidian *Cnemidocarpa sp*. was also found in Gulf Harbour Marina and was first described from New Zealand waters during these port surveys. It was also detected in Auckland, Gisborne, Lyttelton, Nelson, Picton, Tauranga, Taranaki, Timaru and Wellington. Little is currently known about this species, however it appears to now be widely spread through New Zealand's shipping ports where it may be competing with native fauna for space in fouling assemblages.

Management of existing non-indigenous species in the marina

For most marine NIS eradication by physical removal or chemical treatment is not yet a cost-effective option. Many of the species recorded in the Gulf Harbour Marina are widespread and local population controls are unlikely to be effective. Management should be directed toward preventing the spread of species to locations where they do not presently occur. This is particularly relevant to species such as *Hydroides elegans*, *H. ezoensis*, the sponge, *Vosmaeropsis* cf *macera*, and the chaetopterid polychaete *Chaetopterus* sp. A, which are known to be problematic fouling species but which currently have restricted distributions within New Zealand waters. In the nationwide port baseline surveys these species were found only in Gulf Harbour Marina and one other location. Effective management will require better understanding of the frequency of movements by vessels of different types from the Gulf Harbour Marina to other domestic and international locations and improved procedures for hull maintenance by vessels leaving this marina.

Prevention of new introductions

Interception of unwanted species transported by shipping is best achieved offshore, through control and treatment of vessels destined for Gulf Harbour Marina 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. These ballast water control measures are more relevant to large cargo vessels than the international sailing vessels that visit the Gulf Harbour Marina.

Options are currently lacking, for effective in-situ treatment of biofouling on vessel hulls and sea-chests. Biosecurity New Zealand has recently embarked on a national survey of hull fouling on vessels entering New Zealand from overseas. The study will characterise risks from this pathway (including high risk source regions and vessel types) and identify predictors of risk that may be used to manage problem vessels. Shipping companies and vessel owners can reduce the risk of transporting NIS in hull fouling or sea chests through regular maintenance and antifouling of their vessels.

Overseas studies 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). The growing number of baseline port surveys internationally and an associated increase in published literature on marine NIS means that information is becoming available that will allow more robust risk assessments to be carried out for new vessel routes.

The invasive Japanese kelp, *Undaria pinnatifida*, has been spread through shipping and other vectors to 11 of the 16 ports and marinas surveyed during the baseline surveys. At the time that these surveys were undertaken it was not present in Opua Marina, Whangarei port and marina, Gulf Harbour Marina, and the Ports of Auckland, Taranaki and Tauranga. A control programme in Bluff Harbour had removed *U. pinnatifida* populations established there. Since the surveys were completed, *U. pinnatifida* has been discovered in Taranaki and Waitemata Harbour. *U. pinnatifida* is readily transported on the hulls of poorly maintained yachts and mooring lines. In many instances within New Zealand and overseas it has appeared first within marina environments. There is a high risk that yachts, barges, or other slow-moving vessels could transport it to Gulf Harbour Marina from more southern locations where it has already established. Although sea surface temperatures in Gulf Harbour Marina are generally considered 'sub-optimal' for the growth of *Undaria* sporophytes (the visible adult plant), there are opportunities during the cooler months of winter and spring for sporophytes to grow (Sinner et al. 2000). Preventing its establishment will require greater scrutiny of poorly maintained boats entering the marina from infested locations and regular surveillance of marina infrastructure for signs of the presence of *U. pinnatifida* sporophytes.

Conclusions and recommendations

The national biological baseline surveys have significantly increased our understanding of the identity, prevalence and distribution of introduced species in New Zealand's shipping ports. They represent a first step towards a comprehensive assessment of the risks posed to native coastal marine ecosystems from non-indigenous marine species. Although measures are being taken by the New Zealand government to reduce the rate of new incursions, foreign species are likely to continue being introduced to New Zealand waters by shipping, especially considering the lack of management options for hull fouling introductions. There is a need for continued monitoring of marine NIS in port environments to allow for (1) early detection and control of harmful or potentially harmful non-indigenous species, (2) to provide on-going evaluation of the efficacy of management activities, and (3) to allow trading partners to be notified of species that may be potentially harmful. Baseline inventories, like this one, facilitate the second and third of these two purposes. They become outdated when new introductions occur and, therefore, should be repeated on a regular basis to ensure they remain current. Hewitt and Martin (2001) recommend an interval of three to five years between repeat surveys.

The predominance of hull fouling as a likely introduction vector for NIS encountered in the Gulf Harbour Marina (probably responsible for 66.7 % of the NIS introductions) is consistent with previous findings from New Zealand (Cranfield et al. 1998), and a range of overseas locations. For instance, Hewitt et al. (1999) attributed the introduction of 77 % of the 99 NIS encountered in Port Phillip Bay (Australia) to hull fouling, and only 20 % to ballast water. Similarly, 61 % of the 348 marine and brackish water NIS established in the Hawaiian Islands are thought to have arrived on ships' hulls, but only 5 % in ballast water (Eldredge and Carlton 2002). However, ballast water is thought to be responsible for the introduction of 30 % of the 212 marine NIS established in San Francisco Bay (USA), compared to 34 % for hull fouling (Cohen and Carlton 1995). The high percentages of NIS thought to have been introduced by hull fouling in Australasia may reflect the fact that hull fouling has a far longer history (~200 years) as an introduction vector than ballast water (~40 years) (Hewitt et al. 1999). However, the fact that some of New Zealand and Australia's most recent marine NIS introductions (e.g. *Undaria pinnatifida*, *Codium fragile sp. tomentosoides*) have been facilitated by hull fouling suggests that it has remained an important transport mechanism (Cranfield et al. 1998; Hewitt et al. 1999).

Non-indigenous marine species can have a range of adverse impacts through interactions with native organisms. For instance, NIS can cause ecological impacts through competition, predator-prey interactions, hybridisation, parasitism or toxicity and can modify the physical environment through altering habitat structure (Ruiz et al. 1999; Ricciardi 2001). Assessing the impact of a NIS in a given location ideally requires information on a range of factors, including the mechanism of their impact and their local abundance and distribution (Parker et al. 1999). To predict or quantify NIS 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). Further studies may be warranted to establish the abundance and potential impacts of the non-indigenous species encountered in this port to determine if management actions are necessary or possible.

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Tables

Table 1: Berthage facilities in the Gulf Harbour Marina.

Berth	Berth No.	Purpose	Construction	Length of Berth (m)	Depth (m below chart datum)
A	68	Recreational vessels	Floating concrete pier/wood pile	240	2.4
B	67	Recreational vessels	Floating concrete pier/wood pile	225	2.4
C	73	Recreational vessels	Floating concrete pier/wood pile	225	2.4
D	73	Recreational vessels	Floating concrete pier/wood pile	230	2.4
E	81	Recreational vessels	Floating concrete pier/wood pile	235	2.4
F	84	Recreational vessels	Floating concrete pier/wood pile	235	2.4
G	84	Recreational vessels	Floating concrete pier/wood pile	240	2.4
H	84	Recreational vessels	Floating concrete pier/wood pile	240	2.4
I	84	Recreational vessels	Floating concrete pier/wood pile	240	2.4
J	91	Recreational vessels	Floating concrete pier/wood pile	240	2.4
K	88	Recreational vessels	Floating concrete pier/wood pile	235	2.4
L	80	Recreational vessels	Floating concrete pier/wood pile	205	2.4
N	33	Recreational vessels	Floating concrete pier/wood pile + some steel piles	135	4
O	28	Commercial charters/recreational	Floating concrete pier/wood pile + some steel piles	95	4
Z	32	Commercial charters/recreational	Floating concrete pier/wood pile + some steel piles	210	2.4

Table 2. Comparison of survey methods used in this study with the CRIMP protocols (Hewitt and Martin 2001), indicating modifications made to the protocols following recommendations from a workshop of New Zealand scientists. Full details of the workshop recommendations can be found in Gust et al. (2001).

	CRIMP Protocol		NIWA Method		
Taxa sampled	Survey method	Sample procedure	Survey method	Sample procedure	Notes
Dinoflagellate cysts	Small hand core	Cores taken by divers from locations where sediment deposition occurs	TFO Gravity core (“javelin” core)	Cores taken from locations where sediment deposition occurs	Use of the javelin core eliminated the need to expose divers to unnecessary hazards (poor visibility, snags, boat movements, repetitive dives > 10 m). It is a method recommended by the WESTPAC/IOC Harmful Algal Bloom project for dinoflagellate cyst collection (Matsuoka and Fukuyo 2000)
Benthic infauna	Large core	3 cores close to (0 m) and 3 cores away (50 m) from each berth	Shipek benthic grab	3 cores within 10 m of each sampled berth and at sites in the port basin	Use of the benthic grab eliminated need to expose divers to unnecessary hazards (poor visibility, snags, boat movements, repetitive dives > 10 m).
Dinoflagellates	20um plankton net	Horizontal and vertical net tows	Not sampled	Not sampled	Plankton assemblages spatially and temporally variable, time-consuming and difficult to identify to species. Workshop recommended using resources to sample other taxa more comprehensively
Zooplankton and/ phytoplankton	100-um plankton net	Vertical net tow	Not sampled	Not sampled	Plankton assemblages spatially and temporally variable, time-consuming and difficult to identify to species. Workshop recommended using resources to sample other taxa more comprehensively
Crab/shrimp	Baited traps	3 traps of each kind left overnight at each site	Baited traps	4 traps (2 line x 2 traps) of each kind left overnight at each site	
Macrobiota	Qualitative visual survey	Visual searches of wharves & breakwaters for target species	Qualitative visual survey	Visual searches of wharves & breakwaters for target species	
Sedentary / encrusting biota	Quadrat scraping	0.10 m2 quadrats sampled at -0.5 m, -3.0 m and -7.0 m on	Quadrat scraping	0.10 m2 quadrats sampled at -0.5 m, -1.5 m, -3.0 m and -7	Workshop recommended extra quadrat in high diversity algal zone (-1.5 m) and to sample inner pilings for shade tolerant species

	CRIMP Protocol		NIWA Method		
Taxa sampled	Survey method	Sample procedure	Survey method	Sample procedure	Notes
		3 outer piles per berth		m on 2 inner and 2 outer piles per berth	
Sedentary / encrusting biota	Video / photo transect	Video transect of pile/rockwall facing. Still images taken of the three 0.10 m2 quadrats	Video / photo transect	Video transect of pile/rockwall facing. Still images taken of the four 0.10 m2 quadrats	
Mobile epifauna	Beam trawl or benthic sled	1 x 100 m or timed trawl at each site	Benthic sled	2 x 100 m (or 2 min.) tows at each site	
Fish	Poison station	Divers & snorkelers collect fish from poison stations	Opera house fish traps	4 traps (2 lines x 2 traps) left for min. 1 hr at each site	Poor capture rates anticipated from poison stations because of low visibility in NZ ports. Some poisons also an OS&H risk to personnel and may require resource consent.
Fish/mobile epifauna	Beach seine	25 m seine haul on sand or mud flat sites	Opera house fish traps / Whayman Holdsworth starfish traps	4 traps (2 lines x 2 traps) of left at each site (Whayman Holdworth starfish traps left overnight)	Few NZ ports have suitable intertidal areas to beach seine.

Table 3a: Summary of the Gulf Harbour Marina sampling effort.

Sample method	Number of shipping berths sampled	Number of replicate samples taken
Benthic Sled Tows	NB[1]	17
Benthic Grab (Shipek)	4	12
Box traps	4	16
Diver quadrat scraping	4	66
Opera house fish traps	4	16
Starfish traps	4	16
Shrimp traps	4	16
Javelin cores	N/A	8

NB[1] 13 sled tows taken between jetties, and 4 taken in Marina shipping channel (see Fig 9).

Table 3b: Pile scraping sampling effort in the Gulf Harbour Marina. Number of replicate quadrats scraped on Outer (unshaded) and Inner (shaded) pier piles at four depths. Pile materials scraped are indicated. Miscellaneous samples are opportunistic additional specimens collected from piles outside of the scraped quadrat areas.

Sample Depth (M)	Outer Piles	Inner Piles
0.5	16 wood	None (NB[2])
1.5	16 wood	None
3.5	16 wood	None
7	16 wood	None
Miscellaneous	2 wood	None

(NB[2]) No inner piles exist at this Marina due to construction techniques, all piles are unshaded.

Table 3c: Summary of sampling effort in Ports and Marinas surveyed during the austral summers of 2001-2002 (shown in bold type), and 2002-2003 (shown in plain type). The number of shipping berths sampled is indicated, along with the total numbers of samples taken (in brackets).

Survey Location	Benthic sled tows	Benthic grab	Box traps	Diver quadrat scraping	Opera house traps	Starfish traps	Shrimp traps	Javelin cores
Port of Lyttelton	5 (10)	5 (15)	6 (20)	5 (77)	5 (20)	6 (20)	6 (19)	(8)
Port of Nelson	4 (8)	1 (2) *	4 (16)	4 (55)	4 (16)	4 (16)	4 (16)	(8)
Port of Picton	3 (6)	*	3 (18)	3 (53)	3 (16)	3 (24)	3 (24)	(6)
Port of Taranaki	6 (12)	6 (21)	7 (25)	4 (66)	6 (24)	6 (24)	6 (24)	(14)
Port of Tauranga	6 (18)	6 (28)	8 (32)	6 (107)	6 (25)	7 (28)	7 (28)	(8)
Port of Timaru	6 (12)	4 (14)	5 (20)	4 (58)	5 (20)	5 (20)	5 (20)	(8)
Port of Wellington	7 (13)	6 (18)	7 (28)	6 (98)	7 (34)	7 (28)	7 (28)	(6)
Port of Auckland	6 (12)	6 (18)	6 (24)	6 (101)	6 (24)	6 (24)	5 (20)	(10)
Port of Bluff	6 (21)	7 (21)	7 (29)	5 (75)	6 (24)	7 (28)	7 (24)	(12)
Dunedin Harbour	5 (10)	5 (15)	5 (20)	5 (75)	5 (20)	5 (20)	5 (18)	(9)
Port of Gisborne	5 (10)	6 (18)	5 (20)	4 (50)	5 (20)	5 (20)	5 (20)	(8)
Gulf Harbour Marina	(17)	4 (12)	4 (16)	4 (66)	4 (16)	4 (16)	4 (16)	(8)
Port of Napier	5 (10)	5 (15)	5 (18)	4 (59)	5 (20)	5 (18)	5 (18)	(8)
Opua Marina	(10)	4 (12)	4 (12)	4 (46)	4 (8)	4 (8)	4 (8)	(8)
Whangarei Marina	3 (6)	2 (6)	2 (8)	4 (33)	2 (8)	2 (8)	2 (8)	(6)
Whangarei Harbour	4 (9)	4 (12)	4 (16)	4 (65)	4 (16)	4 (16)	4 (16)	(7)

* Shipek grab malfunctioned in the Ports of Nelson and Picton

Table 4: Preservatives used for the major taxonomic groups of organisms collected during the port survey. [1] indicates photographs were taken before preservation, and [2] indicates they were relaxed in magnesium chloride or menthol prior to preservation.

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

Table 5a: 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	*Sabella spallanzanii*
Arthropoda	Decapoda	*Carcinus maenas*
Arthropoda	Decapoda	*Eriocheir sinensis*
Echinodermata	Asteroidea	*Asterias amurensis*
Mollusca	Bivalvia	*Potamocorbula amurensis*
Phycophyta	Chlorophyta	*Caulerpa taxifolia*
Phycophyta	Phaeophyceae	*Undaria pinnatifida*

Table 5b: Marine pest species listed on the Australian Ballast Water Management Advisory Council's (ABWMAC) schedule of non-indigenous pest species.

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

Table 6: Native species recorded from the Gulf Harbour Marina survey.

Phylum, Class	Order	Family	Genus and species
Annelida			
Polychaeta	Eunicida	Eunicidae	*Marphysa unibranchiata*
Polychaeta	Eunicida	Lumbrineridae	*Abyssoninoe galatheae*
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris sphaerocephala*
Polychaeta	Phyllodocida	Glyceridae	*Glycera lamelliformis*
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus angustifrons*
Polychaeta	Phyllodocida	Nereididae	*Neanthes kerguelensis*
Polychaeta	Phyllodocida	Nereididae	*Nereis falcaria*
Polychaeta	Phyllodocida	Nereididae	*Perinereis camiguinoides*
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe macrolepidota*
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus polychromus*
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis laevis*
Polychaeta	Sabellida	Sabellidae	*Demonax aberrans*
Polychaeta	Sabellida	Sabellidae	*Megalomma suspiciens*
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla laciniosa*
Polychaeta	Sabellida	Serpulidae	*Filograna implexa*
Polychaeta	Sabellida	Serpulidae	*Galeolaria hystrix*
Polychaeta	Sabellida	Serpulidae	*Spirobranchus cariniferus*
Polychaeta	Scolecida	Orbiniidae	*Phylo novazealandiae*
Polychaeta	Spionida	Spionidae	*Boccardia syrtis*
Polychaeta	Terebellida	Acrocirridae	*Acrocirrus trisectus*
Polychaeta	Terebellida	Flabelligeridae	*Pherusa-parmata parmata*
Polychaeta	Terebellida	Pectinariidae	*Pectinaria australis*
Polychaeta	Terebellida	Terebellidae	*Pseudopista rostrata*
Polychaeta	Terebellida	Terebellidae	*Streblosoma toddae*
Bryozoa			
Gymnolaemata	Cheilostomata	Candidae	*Caberea rostrata*
Crustacea			
Cirripedia	Thoracica	Balanidae	*Austrominius modestus*
Malacostraca	Amphipoda	Aoridae	*Aora typica*
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus cookii*

Phylum, Class	Order	Family	Genus and species
Malacostraca	Brachyura	Hymenosomatidae	*Halicarcinus varius*
Malacostraca	Brachyura	Majidae	*Notomithrax minor*
Malacostraca	Brachyura	Ocypodidae	*Macrophthalmus hirtipes*
Malacostraca	Brachyura	Pinnotheridae	*Pinnotheres atrinocola*
Malacostraca	Brachyura	Xanthidae	*Pilumnus lumpinus*
Malacostraca	Caridea	Alpheidae	*Alpheus richardsoni*
Malacostraca	Caridea	Crangonidae	*Pontophilus australis*
Malacostraca	Caridea	Crangonidae	*Pontophilus hamiltoni*
Malacostraca	Caridea	Hippolytidae	*Hippolyte bifidirostris*
Malacostraca	Caridea	Palemonidae	*Palaemon affinis*
Malacostraca	Caridea	Palemonidae	*Periclimenes yaldwyni*
Echinodermata			
Asteroidea	Valvatida	Asterinidae	*Patiriella mortenseni*
Asteroidea	Valvatida	Asterinidae	*Patiriella regularis*
Echinoidea	Spatangoida	Loveniidae	*Echinocardium cordatum*
Mollusca			
Bivalvia	Myoida	Hiatellidae	*Hiatella arctica*
Bivalvia	Mytiloida	Mytilidae	*Modiolarca impacta*
Bivalvia	Mytiloida	Mytilidae	*Perna canaliculus*
Bivalvia	Nuculoida	Nuculidae	*Nucula hartvigiana*
Bivalvia	Nuculoida	Nuculidae	*Nucula nitidula*
Bivalvia	Ostreoida	Ostreidae	*Ostrea chilensis*
Bivalvia	Veneroida	Kelliidae	*Kellia cycladiformis*
Bivalvia	Veneroida	Semelidae	*Leptomya retiaria*
Bivalvia	Veneroida	Veneridae	*Irus reflexus*
Gastropoda	Littorinimorpha	Calyptraeidae	*Maoricrypta costata*
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella novaezelandiae*
Gastropoda	Neogastropoda	Buccinidae	*Cominella adspersa*
Gastropoda	Nudibranchia	Dorididae	*Alloiodoris lanuginata*
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus porosus*
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton pelliserpentis*

Phylum, Class	Order	Family	Genus and species
Phycophyta			
Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia velutina*
Phaeophyceae	Dictyotales	Dictyotaceae	*Dictyota dichotoma*
Phaeophyceae	Fucales	Sargassaceae	*Sargassum scabridum*
Phaeophyceae	Fucales	Sargassaceae	*Sargassum sinclairii*
Porifera			
Calcarea	Leucosolenida	Sycettidae	*Sycon cf. ornatum*
Pyrrophycophyta			
Dinophyceae	Gymnodiniales	Polykrikaceae	*Pheopolykrikos sp.*
Dinophyceae	Peridiniales	Gonyaulacaceae	*Gonyaulax grindleyi*
Dinophyceae	Peridiniales	Peridiniaceae	*Protoperidinium sp.*
Urochordata			
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium adamsi*
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula amokurae*
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula mortenseni*
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus australis*
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura picta*
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura rugata*
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura subuculata*
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa nisiotus*
Vertebrata			
Actinopterygii	Mugiliformes	Mugilidae	*Aldrichetta forsteri*
Actinopterygii	Perciformes	Carangidae	*Decapterus koheru*
Actinopterygii	Perciformes	Gobiidae	*Favonigobius exquisitus*
Actinopterygii	Perciformes	Labridae	*Notolabrus celidotus*
Actinopterygii	Perciformes	Sparidae	*Pagrus auratus*

Table 7. Cryptogenic marine species recorded from the Gulf Harbour Marina survey. Category 1 cryptogenic species (C1); Category 2 cryptogenic species (C2). Refer to section 2.9 for definitions.

Phylum, Class	Order	Family	Genus and species	
Annelida				
Polychaeta	Spionida	Chaetopteridae	*Chaetopterus Chaetopterus-A*	C1
Crustacea				
Cirripedia	Thoracica	Balanidae	*Balanus trigonus*	C1
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe sp. 1*	C2
Malacostraca	Brachyura	Xanthidae	*Pilumnopeus serratifrons*	C1
Porifera				
Demospongiae	Haplosclerida	Chalinidae	*Haliclona heterofibrosa*	C1
Pyrrophycophyta				
Dinophyceae	Gymnodiniales	Gymnodiniacea	*Gymnodinium catenatum*	C1
Urochordata				
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium phortax*	C1
Ascidiacea	Phlebobranchia	Pyuridae	*Microcosmus squamiger*	C2
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella eumyota*	C1
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes leachii*	C1
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa cerea*	C1
Ascidiacea	Stolidobranchia	Styelidae	*Styela plicata*	C1

Table 8: Non-indigenous marine species recorded from the Gulf Harbour Marina survey. Likely vectors of introduction are largely derived from Cranfield et al. (1998), where H = Hull fouling and B = Ballast water transport. Novel NIS not listed in Cranfield et al. (1998) or previously encountered by taxonomic experts in New Zealand waters are marked as New Records (NR). For these species and others for which information is scarce, we provide dates of first detection rather than probable dates of introduction.

Phylum, Class	Order	Family	Genus and species	Probable means of introduction	Date of introduction or detection (d)
Annelida					
Polychaeta	Sabellida	Serpulidae	*Hydroides elegans*	H or B	Pre-1952
Polychaeta	Sabellida	Serpulidae	*Hydroides ezoensis* **(NR)**	H	April 2003 [d]
Bryozoa					
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula neritina*	H	1949
Gymnolaemata	Cheilostomata	Schizoporellidae	*Schizoporella errata*	H	Pre-1960
Gymnolaemata	Ctenostomata	Vesiculariidae	*Zoobotryon verticillatum*	H or B	1960
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora subtorquata*	H or B	Pre-1982
Crustacea					
Malacostraca	Amphipoda	Corophiidae	*Apocorophium acutum*	H	Pre-1921
Malacostraca	Amphipoda	Ischyroceridae	*Ericthonius pugnax*	H	Unknown [1]
Mollusca					
Bivalvia	Ostreoida	Ostreidae	*Crassostrea gigas*	H	1961
Bivalvia	Pterioida	Limidae	*Limaria orientalis*	H or B	Pre-1972
Bivalvia	Veneroida	Semelidae	*Theora lubrica*	B	1971
Phycophyta					
Phaeophyceae	Cutleriales	Cutleriaceae	*Cutleria multifida*	H	Pre-1870
Porifera					
Calcarea	Leucosolenida	Heteropiidae	*Vosmaeropsis cf macera*	H	Unknown [1]
Urochordata					
Ascidiacea	Phlebobranchia	Ascidiidae	*Ascidiella aspersa*	H	1900s
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa sp.* **(NR)**	H	Dec. 2001 [d]

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

Table 9: Species indeterminata recorded from the Gulf Harbour Marina survey. This group includes: (1) organisms that were damaged or juvenile and lacked cruical morphological characteristics, and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow positive identification to species level.

Phylum, Class	Order	Family	Genus and species
Annelida			
Polychaeta	Phyllodocida	Nereididae	*Platynereis Platynereis_australis_group*
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe Indet*
Polychaeta	Phyllodocida	Syllidae	*Syllin-unknown indet*
Polychaeta	Phyllodocida	Syllidae	*Typosyllis Typosyllis-B*
Polychaeta	Sabellida	Sabellidae	*Demonax Demonax-B*
Polychaeta	Sabellida	Sabellidae	*Sabellidae Indet*
Polychaeta	Sabellida	Serpulidae	*Serpula Serpula-D*
Polychaeta	Sabellida	Serpulidae	*Serpulidae Indet*
Polychaeta	Spionida	Spionidae	*Pseudopolydora Indet*
Polychaeta	Terebellida	Cirratulidae	*Cirratulus Cirratulus-A*
Polychaeta	Terebellida	Terebellidae	*Terebella Terebella-B*
Polychaeta	Terebellida	Terebellidae	*Terebellidae Indet*
Phycophyta			
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia sp.*
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora sp.*
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum sp.*
Phaeophyceae	Fucales	Sargassaceae	*Sargassum sp.*
Rhodophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia sp.*
Urochordata			
Ascidiacea	Aplousobranchia	Holozoidae	*Distaplia s.p.*
Vertebrata			
Actinopterygii	Perciformes	Gobiidae	*Favonigobius sp.*

Table 10: Non-indigenous marine organisms recorded from the Gulf Harbour Marina survey and the techniques used to capture each species. Species distributions throughout the port and in other ports around New Zealand are indicated.

Non –Indigenous species	Capture technique in Gulf Harbour marina	Locations detected in Gulf Harbour marina	Detected in other locations surveyed in ZBS2000_04
Hydroides elegans	Pile scrape	Pier C, (Fig 13)	Auckland
Hydroides ezoensis	Pile scrape	Piers C, J, L, N, (Fig 14)	None
Bugula neritina	Pile scrape	Piers C, J, L, N (Fig 15)	Auckland, Dunedin, Gisborne, Lyttleton, Napier, Opua Marina, Taranaki, Tauranga, Timaru, Whangarei Harbour, Whangarei Marina
Schizoporella errata	Pile scrape	Piers C, J, L, N (Fig 16)	Nelson, Whangarei Harbour
Zoobotryon verticillatum	Pile scrape	Piers C, L, (Fig 17)	None
Watersipora subtorquata	Pile scrape	Piers C, J, L, N (Fig 18)	Bluff, Dunedin, Gisborne, Lyttleton, Napier, Nelson, Opua Marina, Picton, Taranaki, Tauranga, Timaru, Whangarei Harbour, Wellington
Apocorophium acutum	Pile scrape	Piers C, J, L, N, (Fig 19)	Dunedin, Lyttleton, Opua, Tauranga, Timaru
Ericthonius pugnax	Pile scrape	Pier C, (Fig 20)	None
Crassostrea gigas	Pile scrape	Piers C, J, L, N (Fig 21)	Auckland, Dunedin, Opua Marina, Taranaki, Whangarei Harbour
Limaria orientalis	Pile scrape	Pier C, (Fig 22)	Opua Marina
Theora lubrica	Benthic grab, Benthic sled	Piers A-O, Z, Fuel Jetty, Entrance Channel, (Fig 23)	Auckland, Gisborne, Lyttleton, Napier, Nelson, Opua Marina, Taranaki, Whangarei Harbour, Whangarei Marina, Wellington
Cutleria multifida	Pile scrape	Pier J, (Fig 24)	Dunedin
Vosmaeropsis cf macera	Pile scrape	Pier J, (Fig 25)	Whangarei Harbour
Ascidiella aspersa	Pile scrape	Piers C & L, (Fig 26)	Gisborne, Napier
Cnemidocarpa sp.	Pile scrape	Pier L, (Fig 27)	Auckland, Gisborne, Nelson, Picton, Taranaki, Tauranga, Timaru, Wellington

Appendices

Appendix 1: Specialists engaged to identify specimens obtained from the New Zealand Port surveys.

Phylum	Class	Specialist	Institution
Annelida	Polychaeta	Geoff Read, Jeff Forman	NIWA Greta Point
Bryozoa	Gymnolaemata	Dennis Gordon	NIWA Greta Point
Chelicerata	Pycnogonida	David Staples	Melbourne Museum, Victoria, Australia
Cnidaria	Anthozoa	Adorian Ardelean	West University of Timisoara, Timisoara, 1900, Romania
Cnidaria	Hydrozoa	Jan Watson	Hydrozoan Research Laboratory, Clifton Springs, Victoria, Australia
Crustacea	Amphipoda	Graham Fenwick	NIWA Christchurch
Crustacea	Cirripedia	Graham Fenwick, Isla Fitridge John Buckeridge[1]	NIWA Christchurch and [1]Auckland University of Technology
Crustacea	Decapoda	Colin McLay[1] Graham Fenwick, Nick Gust	[1]University of Canterbury and NIWA Christchurch
Crustacea	Isopoda	Niel Bruce	NIWA Greta Point
Crustacea	Mysidacea	Fukuoka Kouki	National Science Museum, Tokyo
Echinodermata	Asteroidea	Don McKnight	NIWA Greta Point
Echinodermata	Echinoidea	Don McKnight	NIWA Greta Point
Echinodermata	Holothuroidea	Niki Davey	NIWA Nelson
Echinodermata	Ophiuroidea	Don McKnight, Helen Rotman	NIWA Greta Point
Echiura	Echiuroidea	Geoff Read	NIWA Greta Point
Mollusca	Bivalvia. Cephalopoda, Gastropoda, Polyplacophora	Bruce Marshall	Museum of NZ Te Papa Tongarewa
Nemertea	Anopla, Enopla	Geoff Read	NIWA Greta Point
Phycophyta	Phaeophyceae, Rhodophyceae, Ulvophyceae	Wendy Nelson, Kate Neill	NIWA Greta Point
Platyhelminthes	Turbellaria	Sean Handley	NIWA Nelson
Porifera	Demospongiae, Calcarea	Michelle Kelly-Shanks	NIWA Auckland
Priapula	Priapulidae	Geoff Read	NIWA Greta Point
Pyrrophycophyta	Dinophyceae	Hoe Chang, Rob Stewart	NIWA Greta Point
Urochordata	Ascidiacea	Mike Page, Anna Bradley Patricia Kott[1]	NIWA Nelson and [1]Queensland Museum
Vertebrata	Osteichthyes	Clive Roberts, Andrew Stewart	Museum of NZ Te Papa Tongarewa

APPENDIX 2: GENERIC DESCRIPTIONS OF REPRESENTATIVE GROUPS OF THE MAIN MARINE PHYLA COLLECTED DURING SAMPLING.

Phylum Annelida

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

Phylum 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.

Phylum Chelicerata

Pycnogonids: The pycnogonids, or sea spiders, are a group within the Arthropoda, and closely related to land spiders. They are commonly encountered living among sponges, hydroids and bryozoans on the seafloor. They range in size from a few mm to many cm and superficially resemble spiders found on land.

Phylum Cnidaria

Hydroids: 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.

Phylum Crustacea

Crustaceans: The crustaceans represent one of the sea's most diverse groups of organisms, well known examples include shrimps, crabs and lobsters. 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.

Phylum Echinodermata

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

Phylum Mollusca

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

Phylum Phycophyta

Algae: These are the marine plants. Several types were encountered during our survey. 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. These include the green algae (Ulvophyceae), red algae (Rhodophyceae) and brown algae (Phaecophyceae). We also encountered microscopic algal species called *dinoflagellates* (phylum Pyrrophycophyta), single-celled algae that live in the water column or within the sediments.

Phylum Porifera

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

Phylum Pyrrophycophyta

Dinoflagellates: Dinoflagellates are a large group of unicellular algae common in marine plankton. 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 Urochordata

Ascidians: This group of organisms is sometimes referred to as ‘sea squirts’. 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.

Phylum Vertebrata

Fishes: Fishes are an extremely diverse group of the verterbrates familiar to most people. Approximately 200 families of fish are represented in New Zealand waters ranging from tropical and subtropical groups in the north to subantarctic groups in the south. Fishes can be classified according to their depth preferences. Fish that live on or near the sea floor are considered demersal while those living in the upper water column are termed pelagics.

Appendix 3: Criteria for assigning non-indigenous status to species sampled from the Gulf Harbour Marina.

Criteria that apply to each species are indicated by (+). Criteria (C1-C9) were developed by Chapman and Carlton (1994). Here we apply Cranfield et al.'s (1998) analysis to species previously known from New Zealand waters. For non-indigenous species first detected during the present study, criteria were assigned using advice from the taxonomists that identified them. Refer to footnote for a full description of C1–C9 criteria.

Phylum and species	C1	C2	C3	C4	C5	C6	C7	C8	C9
Annelida									
Hydroides elegans	+	+	+	+	+	+	+	+	+
Hydroides ezoensis	+		+		+			+	
Bryozoa									
Bugula neritina	+				+	+	+	+	+
Schizoporella errata	+	+	+			+	+	+	+
Zoobotryon verticillatum	+	+			+	+	+	+	+
Watersipora subtorquata	+	+	+		+	+	+	+	+
Crustacea									
Apocorophium acutum			+			+		+	+
Ericthonius pugnax	+		+					+	+
Mollusca									
Crassostrea gigas	+	+	+			+	+	+	+
Limaria orientalis	+	+	+			+	+	+	+
Theora lubrica	+	+			+	+	+	+	+
Phycophyta									
Cutleria multifida	+	+			+	+	+	+	+
Porifera									
Vosmaeropsis cf macera	+				+		+	+	+
Urochordata									
Ascidiella aspersa	+	+	+	+	+	+	+	+	+
Cnemidocarpa sp.	+		+		+			+	

Criterion 1: Has the species suddenly appeared locally where it has not been found before?
Criterion 2: Has the species spread subsequently?
Criterion 3: Is the species' distribution associated with human mechanisms of dispersal?
Criterion 4: Is the species associated with, or dependent on, other introduced species?
Criterion 5: Is the species prevalent in, or restricted to, new or artificial environments?
Criterion 6: Is the species' distribution restricted compared to natives?
Criterion 7: Does the species have a disjunct worldwide distribution?
Criterion 8: Are dispersal mechanisms of the species inadequate to reach New Zealand, and is passive dispersal in ocean currents unlikely to bridge ocean gaps to reach New Zealand?
Criterion 9: Is the species isolated from the genetically and morphologically most similar species elsewhere in the world?

Appendix 4. Geographic locations of the sample sites in Gulf Harbour Marina

Site	Eastings	Northings	NZ Latitude	NZ Longitude	Survey Method	No. of sample units
A & B	2670257	6507128	-36.62506	174.78659	BSLD	1
B & C	2670312	6507157	-36.62479	174.78720	BSLD	1
C	2670252	6507232	-36.62413	174.78652	BGRB	1
C	2670329	6507192	-36.62448	174.78738	BGRB	1
C	2670362	6507171	-36.62466	174.78775	BGRB	1
C	2670376	6507160	-36.62475	174.78791	CRBTP	4
C	2670401	6507160	-36.62475	174.78819	FSHTP	4
C	2670378	6507155	-36.62480	174.78794	PSC	16
C	2670376	6507160	-36.62475	174.78791	SHRTP	4
C	2670376	6507160	-36.62475	174.78791	STFTP	4
C & D	2670351	6507199	-36.62441	174.78763	BSLD	1
CHAN 1	2670387	6506814	-36.62787	174.78812	BSLD	1
CHAN 2	2670399	6507006	-36.62614	174.78821	BSLD	1
CHAN 3	2670527	6507263	-36.62380	174.78958	BSLD	1
CHAN 4	2670481	6507137	-36.62494	174.78909	BSLD	1
CRAB COVE	2670557	6506860	-36.62742	174.79000	CYST	2
D & E	2670360	6507246	-36.62398	174.78772	BSLD	1
E & F	2670362	6507294	-36.62355	174.78773	BSLD	1
F & G	2670380	6507356	-36.62299	174.78791	BSLD	1
G & H	2670415	6507386	-36.62271	174.78830	BSLD	1
H & I	2670451	6507427	-36.62233	174.78869	BSLD	1
I & J	2670479	6507469	-36.62195	174.78899	BSLD	1
J	2670377	6507548	-36.62126	174.78783	BGRB	1
J	2670459	6507507	-36.62161	174.78877	BGRB	1
J	2670549	6507457	-36.62204	174.78978	BGRB	1
J	2670538	6507470	-36.62193	174.78965	CRBTP	4
J	2670511	6507489	-36.62176	174.78935	CYST	2
J	2670523	6507470	-36.62193	174.78948	FSHTP	4
J	2670543	6507466	-36.62196	174.78971	PSC	17
J	2670538	6507470	-36.62193	174.78965	SHRTP	4
J	2670538	6507470	-36.62193	174.78965	STFTP	4
J & K	2670477	6507516	-36.62153	174.78896	BSLD	1
K & L	2670492	6507578	-36.62097	174.78911	BSLD	1
L	2670493	6507605	-36.62072	174.78912	BGRB	3
L	2670493	6507605	-36.62072	174.78912	CRBTP	4
L	2670497	6507605	-36.62072	174.78916	FSHTP	4
L	2670516	6507594	-36.62082	174.78938	PSC	17
L	2670493	6507605	-36.62072	174.78912	SHRTP	4
L	2670493	6507605	-36.62072	174.78912	STFTP	4
L & SHORE	2670486	6507630	-36.62050	174.78903	BSLD	1
SY	2670638	6507484	-36.62179	174.79077	BGRB	1
SY	2670662	6507392	-36.62261	174.79105	BGRB	1
SY	2670720	6507415	-36.62239	174.79170	BGRB	1
SY	2670689	6507393	-36.62260	174.79136	CRBTP	4
SY	2670652	6507466	-36.62194	174.79093	CYST	2
SY	2670642	6507393	-36.62260	174.79083	FSHTP	4
SY	2670721	6507386	-36.62265	174.79172	PSC	16
SY	2670689	6507393	-36.62260	174.79136	SHRTP	4

Site	Eastings	Northings	NZ Latitude	NZ Longitude	Survey Method	No. of sample units
SY	2670689	6507393	-36.62260	174.79136	STFTP	4
Z & A	2670232	6507087	-36.62544	174.78632	BSLD	1
Z & A	2670563	6507607	-36.62069	174.78990	CYST	2

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

Appendix 5a. Results from the diver collections and pile scrapings

					Site code	C																J																L				
					Pile replicate	1				2				3				4				1					2				3				4				1				
Class	Orders	Family	Genus	Species	*Status	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	MISC	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	MISC
Ascidiacea	Aplousobranchia	Holozoidae	*Distaplia*	*s.p.*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium*	*adamsi*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium*	*phortax*	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Phlebobranchia	Ascidiidae	*Ascidiella*	*aspersa*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Ascidiacea	Phlebobranchia	Pyuridae	*Microcosmus*	*squamiger*	C2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0	1	0	1	0
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella*	*eumyota*	C1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes*	*leachii*	C1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula*	*mortenseni*	N	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula*	*amokurae*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*rugata*	N	1	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	0	0	1	1	0	1	0	0	0	1	1	0	1	0	0	0	1	0	1	1	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus*	*australis*	N	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*subuculata*	N	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*picta*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Ascidiacea	Stolidobranchia	Styelidae	*Styela*	*plicata*	C1	0	0	0	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	1
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa*	*cerea*	C1	1	1	0	1	1	0	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa*	*nisiotus*	N	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa*	*sp.*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Asteroidea	Valvatida	Asterinidae	*Patiriella*	*regularis*	N	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
Asteroidea	Valvatida	Asterinidae	*Patiriella*	*mortenseni*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Myoida	Hiatellidae	*Hiatella*	*arctica*	N	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Mytiloida	Mytilidae	*Perna*	*canaliculus*	N	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Mytiloida	Mytilidae	*Modiolarca*	*impacta*	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bivalvia	Ostreoida	Ostreidae	*Crassostrea*	*gigas*	A	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bivalvia	Ostreoida	Ostreidae	*Ostrea*	*chilensis*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bivalvia	Pterioida	Limidae	*Limaria*	*orientalis*	A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Veneroida	Kelliidae	*Kellia*	*cycladiformis*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Veneroida	Veneridae	*Irus*	*reflexus*	N	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Calcarea	Leucosolenida	Heteropiidae	*Vosmaeropsis*	*cf macera*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calcarea	Leucosolenida	Sycettidae	*Sycon*	*cf. ornatum*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Hymenosomatidae	*Halicarcinus*	*cookii*	N	0	1	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	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Hymenosomatidae	*Halicarcinus*	*varius*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Crustacea	Brachyura	Majidae	*Notomithrax*	*minor*	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Pinnotheridae	*Pinnotheres*	*atrinocola*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Xanthidae	*Pilumnopeus*	*serratifrons*	C1	0	1	1	0	1	1	0	1	0	1	0	1	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Crustacea	Brachyura	Xanthidae	*Pilumnus*	*lumpinus*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Caridea	Hippolytidae	*Hippolyte*	*bifidirostris*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Caridea	Palemonidae	*Palaemon*	*affinis*	N	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Thoracica	Balanidae	*Balanus*	*trigonus*	C1	0	1	1	0	1	1	1	0	0	1	1	0	0	0	1	1	0	1	1	0	0	0	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0	0
Crustacea	Thoracica	Balanidae	*Austrominius*	*modestus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Demospongiae	Haplosclerida	Chalinidae	*Haliclona*	*heterofibrosa*	C1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Littorinimorpha	Calyptraeidae	*Maoricrypta*	*costata*	N	1	1	1	1	1	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella*	*novaezelandiae*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Nudibranchia	Dorididae	*Alloiodoris*	*lanuginata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula*	*neritina*	A	0	0	0	0	0	1	1	0	0	0	1	0	0	1	1	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0
Gymnolaemata	Cheilostomata	Candidae	*Caberea*	*rostrata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Gymnolaemata	Cheilostomata	Schizoporellidae	*Schizoporella*	*errata*	A	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora*	*subtorquata*	A	1	1	1	1	0	1	0	0	0	0	1	0	1	0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Gymnolaemata	Ctenostomata	Vesiculariidae	*Zoobotryon*	*verticillatum*	A	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Aoridae	*Aora*	*typica*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Corophiidae	*Apocorophium*	*acutum*	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Ischyroceridae	*Ericthonius*	*pugnax*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe*	*sp. 1*	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Cutleriales	Cutleriaceae	*Cutleria*	*multifida*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia*	*velutina*	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Dictyotales	Dictyotaceae	*Dictyota*	*dichotoma*	N	1	0	0	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	0	1	0	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	0

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

Appendix 5a. Results from the diver collections and pile scrapings

					Site code	C																J																L				
					Pile replicate	1				2				3				4				1					2				3				4				1				
Class	Orders	Family	Genus	Species	*Status	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	MISC	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	MISC
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia*	*sp.*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum*	*scabridum*	N	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
Phaeophyceae	Fucales	Sargassaceae	*Sargassum*	*sinclairii*	N	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Eunicida	Eunicidae	*Marphysa*	*unibranchiata*	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris*	*sphaerocephala*	N	1	1	1	1	0	0	0	1	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	0	1	0
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus*	*angustifrons*	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Neanthes*	*kerguelensis*	N	0	1	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis*	*camiguinoides*	N	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Nereis*	*falcaria*	N	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
Polychaeta	Phyllodocida	Nereididae	*Platynereis*	*Platynereis_australis_group*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus*	*polychromus*	N	0	1	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe*	*macrolepidota*	N	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Polychaeta	Phyllodocida	Syllidae	*Syllin-unknown*	*indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Syllidae	*Typosyllis*	*Typosyllis-B*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Demonax*	*Demonax-B*	SI	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
Polychaeta	Sabellida	Sabellidae	*Megalomma*	*suspiciens*	N	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
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla*	*laciniosa*	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Demonax*	*aberrans*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Sabellidae*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Hydroides*	*ezoensis*	A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0
Polychaeta	Sabellida	Serpulidae	*Serpula*	*Serpula-D*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Spirobranchus*	*cariniferus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Filograna*	*implexa*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Galeolaria*	*hystrix*	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Hydroides*	*elegans*	A	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Serpulidae*	*Indet*	SI	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Spionida	Chaetopteridae	*Chaetopterus*	*Chaetopterus-A*	C1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Acrocirridae	*Acrocirrus*	*trisectus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Cirratulidae	*Cirratulus*	*Cirratulus-A*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Flabelligeridae	*Pherusa*	*parmata*	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Pseudopista*	*rostrata*	N	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Terebella*	*Terebella-B*	SI	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Streblosoma*	*toddae*	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Terebellidae*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus*	*porosus*	N	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton*	*pelliserpentis*	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Rhodophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia*	*sp.*	SI	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0

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

Appendix 5a. Results from the diver collections and pile scrapings

					Site code													SY															
					Pile replicate	2				3				4				1				2				3				4			
Class	Orders	Family	Genus	Species	*Status	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Ascidiacea	Aplousobranchia	Holozoidae	*Distaplia*	*s.p.*	SI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium*	*adamsi*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Aplousobranchia	Polyclinidae	*Aplidium*	*phortax*	C1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Phlebobranchia	Ascidiidae	*Ascidiella*	*aspersa*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Phlebobranchia	Pyuridae	*Microcosmus*	*squamiger*	C2	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ascidiacea	Phlebobranchia	Rhodosomatidae	*Corella*	*eumyota*	C1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
Ascidiacea	Stolidobranchia	Botryllinae	*Botrylliodes*	*leachii*	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula*	*mortenseni*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Molgulidae	*Molgula*	*amokurae*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*rugata*	N	1	0	1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Pyuridae	*Microcosmus*	*australis*	N	1	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
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*subuculata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Ascidiacea	Stolidobranchia	Pyuridae	*Pyura*	*picta*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Styelidae	*Styela*	*plicata*	C1	0	0	1	0	0	1	1	1	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	0	1	0
Ascidiacea	Stolidobranchia	Styelidae	*Asterocarpa*	*cerea*	C1	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa*	*nisiotus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ascidiacea	Stolidobranchia	Styelidae	*Cnemidocarpa*	*sp.*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asteroidea	Valvatida	Asterinidae	*Patiriella*	*regularis*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asteroidea	Valvatida	Asterinidae	*Patiriella*	*mortenseni*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Myoida	Hiatellidae	*Hiatella*	*arctica*	N	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Bivalvia	Mytiloida	Mytilidae	*Perna*	*canaliculus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
Bivalvia	Mytiloida	Mytilidae	*Modiolarca*	*impacta*	N	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Ostreoida	Ostreidae	*Crassostrea*	*gigas*	A	0	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	1	0
Bivalvia	Ostreoida	Ostreidae	*Ostrea*	*chilensis*	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Pterioida	Limidae	*Limaria*	*orientalis*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Veneroida	Kelliidae	*Kellia*	*cycladiformis*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Veneroida	Veneridae	*Irus*	*reflexus*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calcarea	Leucosolenida	Heteropiidae	*Vosmaeropsis*	*cf macera*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calcarea	Leucosolenida	Sycettidae	*Sycon*	*cf. ornatum*	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Hymenosomatidae	*Halicarcinus*	*cookii*	N	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Hymenosomatidae	*Halicarcinus*	*varius*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Brachyura	Majidae	*Notomithrax*	*minor*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Pinnotheridae	*Pinnotheres*	*atrinocola*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Xanthidae	*Pilumnopeus*	*serratifrons*	C1	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	0	1	0
Crustacea	Brachyura	Xanthidae	*Pilumnus*	*lumpinus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Caridea	Hippolytidae	*Hippolyte*	*bifidirostris*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Caridea	Palemonidae	*Palaemon*	*affinis*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Crustacea	Thoracica	Balanidae	*Balanus*	*trigonus*	C1	0	1	1	0	0	1	1	0	0	1	1	0	1	1	1	0	0	1	1	1	0	0	1	0	0	1	1	0
Crustacea	Thoracica	Balanidae	*Austrominius*	*modestus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Demospongiae	Haplosclerida	Chalinidae	*Haliclona*	*heterofibrosa*	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
Gastropoda	Littorinimorpha	Calyptraeidae	*Maoricrypta*	*costata*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Littorinimorpha	Calyptraeidae	*Sigapatella*	*novaezelandiae*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Nudibranchia	Dorididae	*Alloiodoris*	*lanuginata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnolaemata	Cheilostomata	Bugulidae	*Bugula*	*neritina*	A	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	0	0	0	0	1
Gymnolaemata	Cheilostomata	Candidae	*Caberea*	*rostrata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnolaemata	Cheilostomata	Schizoporellidae	*Schizoporella*	*errata*	A	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1
Gymnolaemata	Cheilostomata	Watersiporidae	*Watersipora*	*subtorquata*	A	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	1
Gymnolaemata	Ctenostomata	Vesiculariidae	*Zoobotryon*	*verticillatum*	A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Aoridae	*Aora*	*typica*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Corophiidae	*Apocorophium*	*acutum*	A	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Ischyroceridae	*Ericthonius*	*pugnax*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malacostraca	Amphipoda	Leucothoidae	*Leucothoe*	*sp. 1*	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Cutleriales	Cutleriaceae	*Cutleria*	*multifida*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia*	*velutina*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Dictyotales	Dictyotaceae	*Dictyota*	*dichotoma*	N	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

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

Appendix 5a. Results from the diver collections and pile scrapings

					Site code													SY															
					Pile replicate	2				3				4				1				2				3				4			
Class	Orders	Family	Genus	Species	*Status	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Phaeophyceae	Ectocarpales	Scytosiphonaceae	*Colpomenia*	*sp.*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum*	*scabridum*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum*	*sinclairii*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Eunicida	Eunicidae	*Marphysa*	*unibranchiata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris*	*sphaerocephala*	N	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus*	*angustifrons*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Neanthes*	*kerguelensis*	N	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Perinereis*	*camiguinoides*	N	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Nereis*	*falcaria*	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Nereididae	*Platynereis*	*Platynereis_australis_group*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus*	*polychromus*	N	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe*	*macrolepidota*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Polynoidae	*Harmothoe*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Syllidae	*Syllin-unknown*	*indet*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Syllidae	*Typosyllis*	*Typosyllis-B*	SI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Demonax*	*Demonax-B*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Polychaeta	Sabellida	Sabellidae	*Megalomma*	*suspiciens*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Pseudopotamilla*	*laciniosa*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Demonax*	*aberrans*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Sabellidae	*Sabellidae*	*Indet*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Hydroides*	*ezoensis*	A	0	0	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	1
Polychaeta	Sabellida	Serpulidae	*Serpula*	*Serpula-D*	SI	1	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
Polychaeta	Sabellida	Serpulidae	*Spirobranchus*	*cariniferus*	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Filograna*	*implexa*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polychaeta	Sabellida	Serpulidae	*Galeolaria*	*hystrix*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Hydroides*	*elegans*	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Sabellida	Serpulidae	*Serpulidae*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Spionida	Chaetopteridae	*Chaetopterus*	*Chaetopterus-A*	C1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Acrocirridae	*Acrocirrus*	*trisectus*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Cirratulidae	*Cirratulus*	*Cirratulus-A*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Polychaeta	Terebellida	Flabelligeridae	*Pherusa*	*parmata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Pseudopista*	*rostrata*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Terebella*	*Terebella-B*	SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Streblosoma*	*toddae*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Terebellidae	*Terebellidae*	*Indet*	SI	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyplacophora	Acanthochitonina	Acanthochitonidae	*Cryptoconchus*	*porosus*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyplacophora	Ischnochitonina	Chitonidae	*Sypharochiton*	*pelliserpentis*	N	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodophyceae	Ceramiales	Rhodomelaceae	*Polysiphonia*	*sp.*	SI	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

Appendix 5b. Results from the benthic grab samples.

				Berth code	C			J			L			SY		
Class	Order	Family	Genus	Species	*Status	1	2	3	1	2	3	1	2	3	1	2	3
Bivalvia	Veneroida	Semelidae	*Theora*	*lubrica*	A	1	1	1	0	0	0	0	0	0	0	1	1
Crustacea	Caridea	Alpheidae	*Alpheus*	*richardsoni*	N	0	0	0	0	0	0	0	0	1	0	0	0
Polychaeta	Eunicida	Lumbrineridae	*Abyssoninoe*	*galatheae*	N	1	0	0	0	0	1	0	0	0	0	0	1
Polychaeta	Phyllodocida	Glyceridae	*Glycera*	*lamelliformis*	N	0	0	0	0	0	0	1	0	0	0	0	0
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis*	*laevis*	N	0	1	0	0	0	0	0	0	0	0	0	0
Polychaeta	Scolecida	Orbiniidae	*Phylo*	*novazealandiae*	N	0	0	0	0	1	1	0	0	0	0	0	0
Polychaeta	Spionida	Spionidae	*Pseudopolydora*	*Indet*	SI	0	0	1	0	1	0	0	0	0	0	0	0
Polychaeta	Spionida	Spionidae	*Boccardia*	*syrtis*	N	0	0	0	1	0	0	0	0	0	0	0	0
Polychaeta	Terebellida	Pectinariidae	*Pectinaria*	*australis*	N	0	1	0	0	0	0	0	0	0	0	0	0

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

Appendix 5c. Results from the benthic sled samples.

					Berth code	A & B	B & C	C & D	CHAN 1	CHAN 2	CHAN 3	CHAN 4	D & E	E & F	F & G	G & H	H & I	I & J	J & K	K & L	L & SHORE	Z & A
Class	Order	Family	Genus	Species	*Status	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Actinopterygii	Perciformes	Gobiidae	*Favonigobius*	*exquisitus*	N	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0
Actinopterygii	Perciformes	Gobiidae	*Favonigobius*	*sp.*	SI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Nuculoida	Nuculidae	*Nucula*	*hartvigiana*	N	0	1	1	0	0	0	0	1	1	1	0	1	0	0	0	0	0
Bivalvia	Nuculoida	Nuculidae	*Nucula*	*nitidula*	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Veneroida	Semelidae	*Theora*	*lubrica*	A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bivalvia	Veneroida	Semelidae	*Leptomya*	*retiaria*	N	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Brachyura	Ocypodidae	*Macrophthalmus*	*hirtipes*	N	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
Crustacea	Caridea	Alpheidae	*Alpheus*	*richardsoni*	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
Crustacea	Caridea	Crangonidae	*Pontophilus*	*hamiltoni*	N	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Crustacea	Caridea	Crangonidae	*Pontophilus*	*australis*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Crustacea	Caridea	Hippolytidae	*Hippolyte*	*bifidirostris*	N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Caridea	Palemonidae	*Periclimenes*	*yaldwyni*	N	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Echinoidea	Spatangoida	Loveniidae	*Echinocardium*	*cordatum*	N	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Phaeophyceae	Fucales	Cystoseiraceae	*Cystophora*	*sp.*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Fucales	Sargassaceae	*Carpophyllum*	*sp.*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaeophyceae	Fucales	Sargassaceae	*Sargassum*	*sp.*	SI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus*	*angustifrons*	N	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	Phyllodocida	Sigalionidae	*Labiosthenolepis*	*laevis*	N	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1
Polychaeta	Scolecida	Orbiniidae	*Phylo*	*novazealandiae*	N	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Polychaeta	Spionida	Spionidae	*Pseudopolydora*	*Indet*	SI	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0
Polychaeta	Terebellida	Pectinariidae	*Pectinaria*	*australis*	N	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0

*Status: A = non-indigenous (highlighted by shading), N = native, C! = cryptogenic category 1, C2 = cryptogenic category 2, SI = species indeterminata. See text for details.

Appendix 5d. Results from the dinoflagellate cyst core samples.

					Berth code	1	2 CRAB COVE		J			SY	
Class	Order	Family	Genus	Species	*Status	1	1	1	2	1	2	1	2
Dinophyceae	Gymnodiniales	Gymnodiniacea	*Gymnodinium*	*catenatum*	C1	0	1	1	0	1	0	0	0
Dinophyceae	Gymnodiniales	Polykrikaceae	*Pheopolykrikos*	*sp.*	N	0	0	0	0	0	1	0	0
Dinophyceae	Peridiniales	Gonyaulacaceae	*Gonyaulax*	*grindleyi*	N	0	0	0	0	0	0	1	0
Dinophyceae	Peridiniales	Peridiniaceae	*Protoperidinium*	*sp.*	N	0	0	0	0	0	1	0	0

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

Appendix 5e. Results from the fish trap samples.

					Berth code	C				J				L				SY			
					Line No.	1		2		1		2		1		2		1		2	
Class	Order	Family	Genus	Species	*Status	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Actinopterygii	Mugiliformes	Mugilidae	*Aldrichetta*	*forsteri*	N	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Actinopterygii	Perciformes	Carangidae	*Decapterus*	*koheru*	N	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Actinopterygii	Perciformes	Labridae	*Notolabrus*	*celidotus*	N	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Actinopterygii	Perciformes	Sparidae	*Pagrus*	*auratus*	N	0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	0

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

Appendix 5f. Results from the crab trap samples.

					Berth code	C				J				L				SY			
					Line no.	1		2		1		2		1		2		1		2	
Class	Order	Family	Genus	Species	*Status	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Actinopterygii	Mugiliformes	Mugilidae	Aldrichetta	forsteri	N	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Actinopterygii	Perciformes	Labridae	Notolabrus	celidotus	N	0	0	1	0	0	1	1	0	0	1	0	1	0	0	0	0
Actinopterygii	Perciformes	Sparidae	Pagrus	auratus	N	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0

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

Appendix 5g. Results from the starfish trap samples.

					Site code	C				J				L				SY			
					Line No.	1		2		1		2		1		2		1		2	
Class	Order	Family	Genus	Species	*Status	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Gastropoda	Neogastropoda	Buccinidae	*Cominella*	*adspersa*	N	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

Appendix 5h. Results from the shrimp trap samples.

					Site code	C				J				L				SY			
					Line No.	1		2		1		2		1		2		1		2	
Class	Order	Family	Genus	Species	*Status	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2

Nothing captured in shrimp traps

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

Addendum

After completing these reports we were advised of changes in the identification of one species. The ascidian *Cnemidocarpa sp*. refered to in this report as a new introduction to New Zealand has been revised to *Cnemidocarpa nisiotus* (status: native).