Cawthron Report No. 744

A biosecurity investigation of a barge in the Marlborough Sounds

Prepared for: Heli Harvest Limited

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Cover Photo: The 'Steel Mariner' anchored west of Kaipupu Point, Picton. Photo courtesy of Peter Brady (Department of Conservation, Picton)

EXECUTIVE SUMMARY

In late December 2001, during a routine survey of Shakespeare Bay, Cawthron Institute divers noticed a heavily fouled steel barge the 'Steel Mariner', moored west of Kaipupu Point, Picton. They observed a colonial ascidian or sea squirt, *Didemnum* sp., smothering the bottom of the barge and the seabed immediately below. In October 2001, the Whangamata Harbour Master had also noticed a similar ascidian dominating wharf piles in Whangamata Harbour (Coromandel Peninsula, North Island). DNA sequence analysis has subsequently confirmed that the *Didemnum* sp. on the 'Steel Mariner' and the seabed below is the same as the specimens found in Whangamata Harbour. While two world authorities on ascidian taxonomy agree that the ascidian is a *Didemnum* sp., their views on its origin differ.

Mussel farms in the Marlborough Sounds are at risk from the ascidian's smothering capabilities. The *Didemnum* sp. may also pose a threat to the Salmon farming industry by fouling salmon cages, however it is unlikely to pose any significant threat to the oyster industry given their predominantly intertidal farming methods.

On 8 December 2001, Heli Harvest Ltd (current leasers of the 'Steel Mariner'), applied to the Marlborough District Council for Resource Consent to berth/moor the 'Steel Mariner' west of Kaipupu Point until 1 December 2002. The Council's Resource Hearings Committee granted Heli Harvest Ltd's Resource Consent application provided "*that within 1 month of the date of this consent, the hull of the barge and the seabed beneath the barge shall be surveyed by a suitably qualified person to ensure that no unwanted exotic marine organisms are present".*

In late February 2002, a team of Cawthron divers quantitatively surveyed the hull of the 'Steel Mariner' and the seabed below for "unwanted exotic organisms" using a series of random transects and quadrats. Targeted organisms included unwanted introduced (the Japanese seaweed *Undaria pinnatifida*), unwanted exotic (the Mediterranean fanworm *Sabella spallanzanii*, the European shore crab *Carcinus maenas*, the northern Pacific seastar *Asterias amurensis*, the Chinese mitten crab *Eriocheir sinensis*, the green seaweed *Caulerpa taxifolia* and the Asian clam *Potamocorbula amurensis*) and undesirable organisms (the paddle crab *Charybdis japonica* and the Whangamata *Didemnum* sp.).

A total of six different algal species and 70 animal taxa were identified on the hull of the 'Steel Mariner'. Interestingly, two North Island species that do not occur in the South Island, the ribbed slipper limpet *Crepidula costata* and the red alga *Cladhymenia lyallii*, were found on the hull. A total of 25,941 ± 3,738 kg of wet biomass fouling was estimated to be present on the hull of the 'Steel Mariner'. *U. pinnatifida* and the Whangamata *Didemnum* sp. were the only target taxa detected in the survey. Several qualitative surveys of the 'Steel Mariner' and the seabed below were also undertaken. A total of 1,396 ± 300 kg[†] of the *Didemnum* sp. was estimated to be present on the barge with a further 460 ± 180 kg on the seabed. Given that there are limited currents in the area, and that the larvae of the *Didemnum* sp. are likely to settle very quickly, offspring may still be confined to an estimated 40 x 80 m (3,200 m^2) area ranging from 5 to 15 m in depth.

The 'Steel Mariner' has never visited Whangamata Harbour, therefore it was probably colonized by the *Didemnum* sp. during its seven month period berthed next to the Tauranga bridge marina. The ascidian must have then survived the slow 5 knot voyage to Picton in late January 2001.

A second barge moored next to the 'Steel Mariner', the 'Waimarie I', has also recently been colonised by what appears to be the same *Didemnum* sp.. This barge has been towed to Napier,

[†] Calculation amended from 2,923 ± 628 kg to 1,396 ± 300 kg on 7 April 2003.

North Island, and has transported Greenshell™ mussels from East Bay in the outer Queen Charlotte Sound to Picton. This illustrates the potential for the *Didemnum* sp. to be artificially dispersed throughout New Zealand.

The opportunity may now exist to successfully eradicate the *Didemnum* sp. from the 'Steel Mariner' and the seabed below. This attempt would need to be undertaken before late winter and early spring, as this is the time of year that the *Didemnum* sp. is most likely to sexually reproduce. On the basis of the information in this report, the following recommendations are made:

1) A sample of the *Didemnum* sp. from north-east America be genetically analysed using DNA sequence analysis and compared with the Whangamata (and barge) *Didemnum* sp. These specimens should also be compared to specimens from Japan. Such tests will assist with determining the origin of the *Didemnum* sp. in New Zealand.

2) The *Didemnum* sp. found in Nelson, Tauranga and on the hull of the 'Waimarie I' should also be genetically analysed using DNA sequence analysis and compared with the Whangamata *Didemnum* sp. This will assist with determining the distribution of the species so that management options can be formulated.

3) The original anchorage positions of the 'Steel Mariner' in Whatamango Bay and the berthing location of the 'Waimarie I' in Picton Harbour are surveyed for the *Didemnum* sp. as soon as possible. If any *Didemnum* sp. look-alikes are found, they should undergo DNA sequence analysis. This will assist with determining the distribution of the species in the Picton area so that management options can be formulated.

4) As far as practicable, the Whangamata *Didemnum* sp. on the hull of the 'Steel Mariner' and the seabed below be removed in a manner that ensures no release of propagules into the surrounding environment, and be disposed of at an appropriate landfill. This should also apply to any of the *Didemnum* sp. found in the surrounding area, e.g. on the hull of the 'Waimarie I, Whatamango Bay or Picton Harbour. An attempted eradication will reduce the risk of the species artificially spreading to mussel farming areas in the Marlborough Sounds.

5) A quarterly 12 month monitoring programme is undertaken to assess the success of any attempted *Didemnum* sp. eradication and, if necessary, a management response implemented (as considered appropriate).

6) Alternative anchorage locations to the embayment west of Kaipupu Point are used for harbouring barges until the monitoring programme is complete. This will minimise the risk of further artificial spread of the species.

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Report reviewed by:

Dr Michael Taylor
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DEFINITIONS OF TERMS

Cryptogenic: the length of time of an organism at a given location is not known, i.e. it is uncertain whether or not it is introduced (e.g. sea squirt *Ciona intestinalis*).

Cosmopolitan: an organism is widely distributed throughout the world (e.g. tubeworm *Hydroides norvegica*).

Endemic: as applied in an ecological sense; natural range of an organism is in a certain location and does not occur anywhere else (e.g. Greenshell mussel *Perna canaliculus*).

Exotic organism: an organism that is not established in any part of New Zealand (e.g. northern Pacific seastar *Asterias amurensis*) (as defined by the New Zealand Biosecurity Council 2002).

Indigenous: an organism originating in a particular area that occurs either nowhere else (endemic) or elsewhere as well (native).

Introduced: an organism that has been either deliberately (e.g. Pacific oyster *Crassotrea gigas*) or accidentally (e.g. Japanese seaweed *Undaria pinnatifida*) introduced to a particular area where it did not formally exist.

Native: an organism originating from a given location, and can originate from elsewhere as well (e.g. acorn barnacle *Elminus modestus*).

Origin: as applied in an ecological sense; where an organism originates from.

Unwanted organism: pursuant to section 2(1) of the Biosecurity Act 1993, means **any** organism that a Chief Technical Officer (CTO) believes is capable or potentially capable of causing unwanted harm to any natural and physical resources or human health (Biosecurity Act 1993; Jackson *et al.* 2000).

Undesirable organism: an organism that has not been classified by the CTO as unwanted to date, but is considered by the author to be capable of causing harm to any natural and physical resources or human health (e.g. the Whangamata *Didemnum* sp. in the Marlborough Sounds).

EXAMPLE OF TERMS USED

The Greenshell™ mussel *Perna canaliculus* is not only indigenous to New Zealand, but it is also endemic because it does not occur anywhere else in the world. The Greenshell™ mussel is native to the Marlborough Sounds, however, because it also occurs in other parts of New Zealand. The Greenshell™ mussel is exotic to the rest of the world, because its origin is New Zealand. If a population of Greenshell™ mussels did establish in Australia, for example, it would no longer be classified as an exotic in that country, it would be classified as an introduced species. Cryptogenic refers to a species whose origin is not known; e.g. the solitary ascidian *Ciona intestinalis*. This species may have always been in New Zealand or alternatively it may have been introduced before historical records began. Furthermore, *C. intestinalis* is commonly referred to as a cosmopolitan species because it occurs throughout the world.

1.0 INTRODUCTION

1.1 Background

In late December 2001, during a routine survey of Shakespeare Bay, Cawthron Institute divers noticed a heavily fouled steel barge the 'Steel Mariner', moored west of Kaipupu Point, Picton (Figure 1). They observed a colonial ascidian or sea squirt, *Didemnum* sp., which appeared to show invasive characteristics (excessive biomass), smothering the bottom of the barge and the seabed immediately below (Figure 2). The barge has remained at Kaipupu Point to the present day.

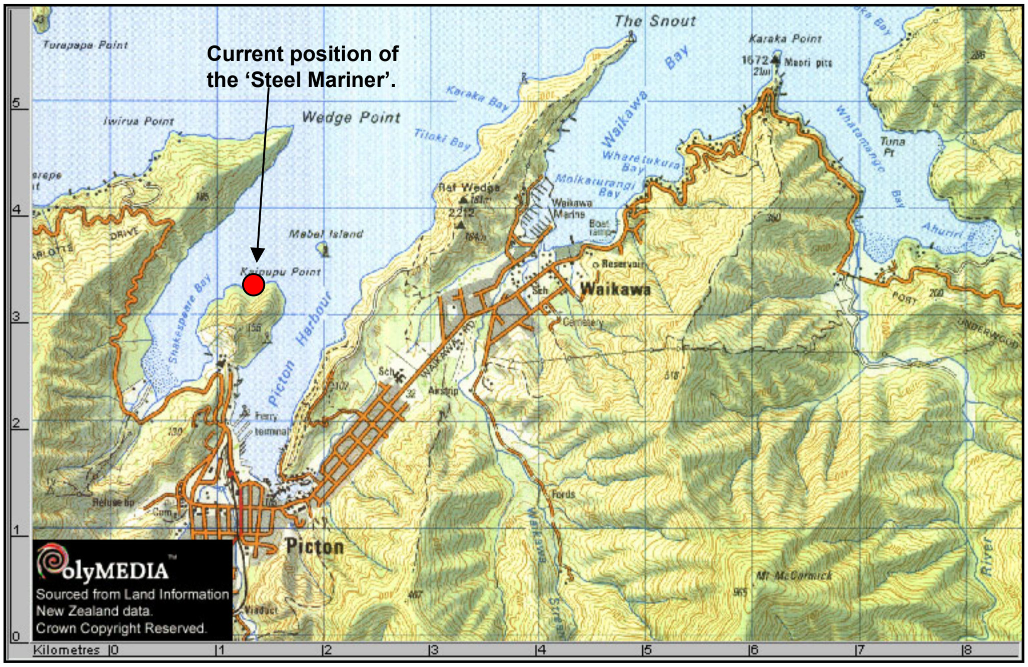

Figure 1. Current position of the 'Steel Mariner' moored west of Kaipupu Point near Picton, Marlborough Sounds.

In October 2001, the Whangamata Harbour Master had also noticed a similar ascidian dominating wharf piles in Whangamata Harbour (Coromandel Peninsula, North Island) (Figure 3). Environment Waikato immediately commissioned marine scientist Dr Brian Coffey, to identify and describe the distribution and pest potential of the organism. Dr Coffey identified the ascidian as a *Didemnum* sp. and stated that "such destruction as witnessed in Whangamata Harbour could be disastrous if the sea squirt took hold in commercial mussel farms or somewhere similar" (Einion 2002). Interestingly, Dr Coffey, along with taxonomists at Te Papa Museum and at the National Institute of Water and Atmospheric Research (NIWA), had never witnessed this particular *Didemnum* species in New Zealand waters before (B. Coffey, pers. comm.). The Ministry of Fisheries (MFish) subsequently contracted Dr Coffey to send samples to two world authorities on ascidian taxonomy; Dr Patricia Mather (Queensland Museum, Australia) and Dr Gretchen Lambert (Californian State University, Department of Biological Sciences, Fullerton, California). While both taxonomists agreed that the ascidian was a *Didemnum* sp., their views on its origin differed.

Figure 2. A typical example of the morphology of the Whangamata *Didemnum* sp. found on the hull of the 'Steel Mariner', west of Kaipupu Point, near Picton, Marlborough Sounds.

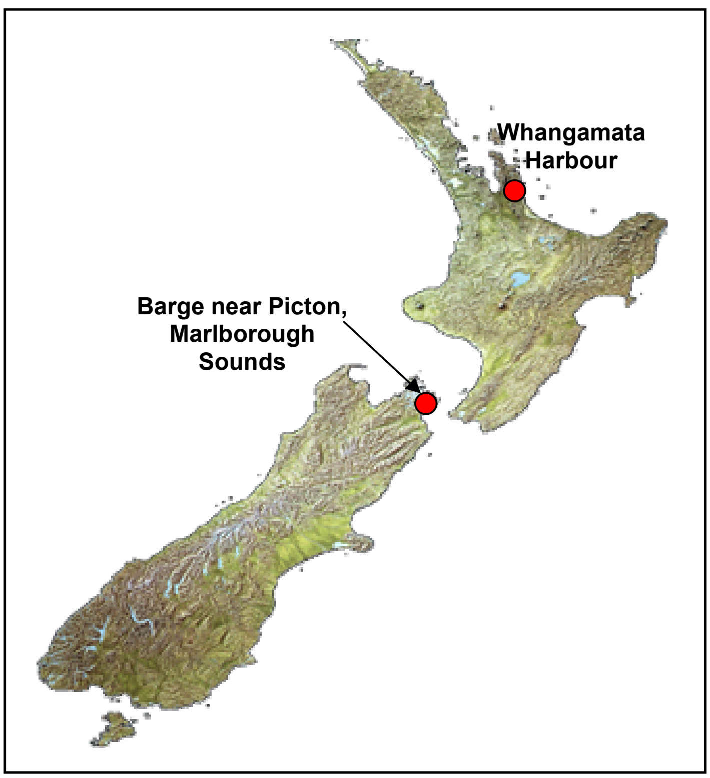

Figure 3. Current known New Zealand distribution of the *Didemnum* sp. found in Whangamata Harbour.

Dr Mather was contracted by MFish in mid January 2002 to formally identify the Whangamata *Didemnum* sp. and provide recommendations on its likely origin. Dr Mather believes the ascidian is not recognizable as any of the more than 100 species of the genus known from Australia and Indo-West Pacific waters, nor as any described species from elsewhere in the world (Mather 2002). Dr Mather reported that its closest affinity is with *Didemnum niveum* (Nott 1892) from Auckland (*Leptoclinum niveum* Nott 1892) and that the undescribed *Didemnum* sp. is indigenous to New Zealand. Dr Mather believes that it has had an extraordinary season due to favourable environmental conditions (see Appendix 1 for Mather 2002 report). Alternatively, Dr Lambert believes the Whangamata *Didemnum* sp. is undoubtedly not indigenous to New Zealand because the species is identical to one found in northeast United States and Canada, which is continuing to spread. Dr Lambert suggests that the species is of Japanese origin, however supporting evidence has yet to be provided.

Recent port surveys around New Zealand undertaken by NIWA have found similar looking *Didemnum* spp. in Tauranga, Wellington and Nelson, and initial DNA restriction analysis, undertaken by Vicki Webb (NIWA, Wellington), revealed that the specimens from these regions matched those from Whangamata Harbour. At the beginning of May 2002, the Chief Technical Officer, MFish Biosecurity, contracted NIWA to collect and DNA sequence as many Whangamata *Didemnum* sp. look-alikes from the Picton Harbour and the surrounding environment as possible. A total of ten samples were collected from the Pelorus Sound and Picton area, including samples from the hull of the 'Steel Mariner' and the seabed below. All ten samples, including samples from Mahanga Bay, Wellington Harbour, underwent a more advanced method of DNA analysis, (sequencing of the 18S rRNA gene) than restriction analysis as used previously. The results revealed that the *Didemnum* sp. on the 'Steel Mariner' and seabed below were the only ones that matched those in Whangamata Harbour (Page and Webb 2002). Given that the "jury is still out" on the origin of the Whangamata *Didemnum* sp., it is safe to say that it is cryptogenic to New Zealand, although NIWA's findings suggest that the species may be introduced to the Marlborough Sounds. The Greenshell™ mussel industry in the Marlborough Sounds is at risk from the fouling and smothering capabilities of *Didemnum* spp.

1.2 The history of the 'Steel Mariner'

This section summarises the history of the 'Steel Mariner' since its arrival in New Zealand. A more detailed account is provided in Appendix 2. The 'Steel Mariner' (formally known as the 'Intermac 256') is a 2,651 gross weight tonnes (GWT), 72 x 21.6 x 4.17 m unpowered deck barge built in Australia in 1969. The barge is understood to have arrived in New Zealand from the Philippines sometime before 1991 (M. Donovan, pers. comm.). The barge was initially employed at an oil rig off Taranaki, North Island, before it was damaged on 16 March 1992 after smashing against the side of the barge 'Baldur' during high winds in Tasman Bay (Figure 4). The 'Steel Mariner' was then towed to Nelson and purchased in a damaged condition by David Brown Construction Ltd and subsequently towed to Tauranga for repairs in May 1992 (Figure 4). Repairs were undertaken by John Dennis of the Gemini Barge Company Ltd, however the cost of the repair work was not paid. As a consequence the barge remained under arrest at Sulphur Point, Tauranga Harbour, until 8 May 1998 where it was refloated and berthed alongside a wharf, where preparations were completed for a tow to Auckland (Appendix 2, Figure 1).

The 'Steel Mariner' left Tauranga on 12 May 1998 and was anchored west of Rangitoto Island in the Hauraki Gulf, Auckland (Figure 4; Appendix 2, Figure 2). Apparently Mr Dennis secured the ownership of the 'Steel Mariner' from David Brown Construction Ltd in compensation for the unpaid repair work. Sometime in the middle of 2000, Heli Harvest Ltd, a helicopter forest harvesting company based in Auckland, successfully negotiated a lease to use the 'Steel Mariner' as a landing platform for harvesting logs in remote areas of the Marlborough Sounds. In late June 2000, the 'Steel Mariner' was towed back to Tauranga for some necessary structural modifications in preparation for her logging work in the Marlborough Sounds (Figure 5). The 'Steel Mariner' spent around seven months berthed next to the Tauranga bridge marina while undergoing structural modifications (Appendix 2; Figure 3).

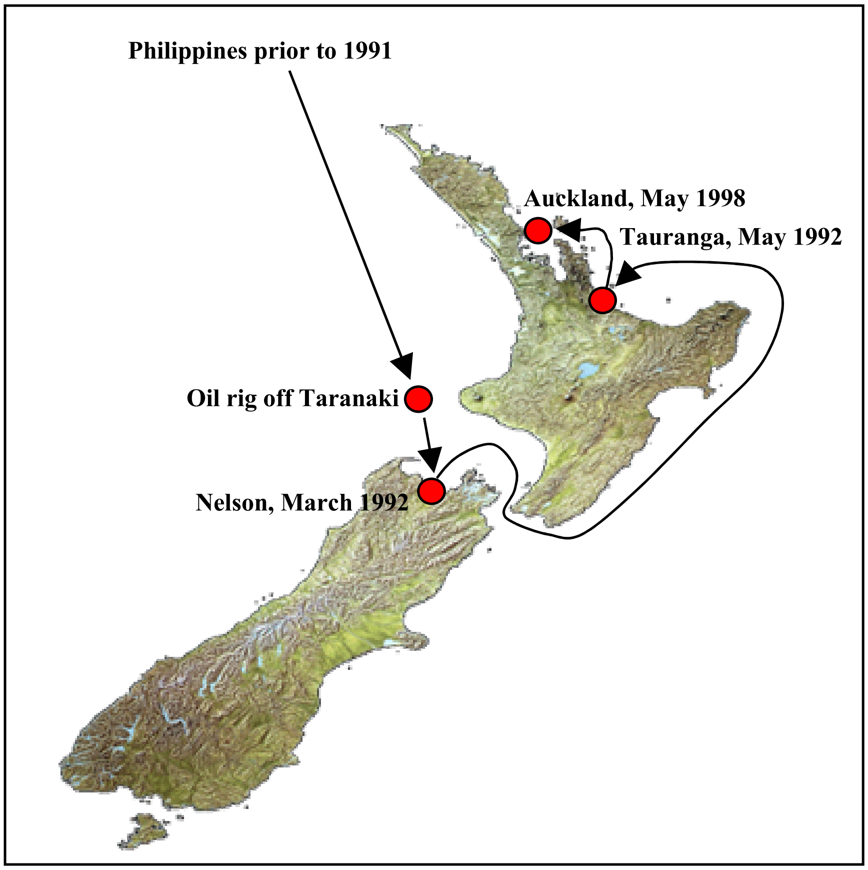

Figure 4. The history of the 'Steel Mariner' in New Zealand since its arrival from the Philippines prior to 1991.

The barge left Tauranga on the 22 January 2001 and arrived seven days later (29 January 2001) at Whatamango Bay, Picton (Figure 5). The 'Steel Mariner' was anchored in the middle of the Bay, but was moved around the corner of Tuna Point in Whatamango Bay approximately two weeks later because the barge was dragging the anchors in bad weather at its previous location (P. McManaway, pers. comm.) (Appendix 2; Figure 4). After spending just short of three months in Whatamango Bay, the barge was then towed to its present position west of Kaipupu Point, Picton, on 23 April 2001, where it has been anchored to this present day (Appendix 2; Figure 4). It is understood that the 'Steel Mariner' has never been slipped since its arrival in New Zealand. This is because the barge is 2,651 (GWT), which is too big for any slipway or syncrolift in New Zealand. The owners investigated the costs of dry docking the barge while it was in Auckland at Babcocks Dockyard/RNZN Dockyard, Devonport, but the availability of the dry dock and cost of doing so prevented this (J. Dennis, pers. comm.).

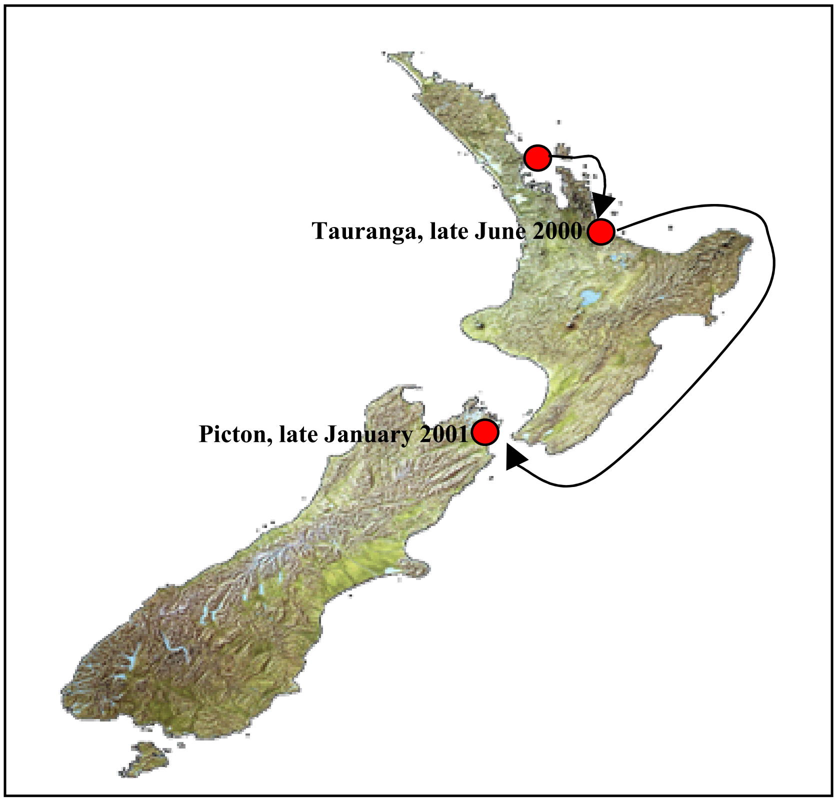

Figure 5. The history of the 'Steel Mariner' after it was towed from Rangitoto Island to Tauranga in late June 1998, then to Picton in late January 2001.

1.3 Application for Resource Consent

On 8 December 2001, Heli Harvest Ltd (current leasers of the 'Steel Mariner'), applied to the Marlborough District Council for Resource Consent for a coastal permit to berth/moor a 72 x 21.6 x 4.16 m unpowered barge by the use of buried anchors and mooring blocks, west of Kaipupu Point, being the point that marks the western entrance to Picton, until 1 December 2002. Apparently business has slowed down in the export log trade, which explains why the barge has remained moored at her present position since 23 April 2001. When the export log trade does improve, it is expected that the 'Steel Mariner' will be towed to various locations throughout Queen Charlotte Sound, where it will be anchored and used as a landing barge for helicopters to deploy harvested logs. Logs will then be deployed onto another barge and be transported to Shakespeare Bay (just around the corner from Kaipupu Point) for export (G. Biel, pers. comm.).

A meeting was held at the Marlborough District Council Office in Blenheim on 3 April 2002, where the Council's Resource Hearings Committee considered Heli Harvest Ltd's Resource Consent application. Cawthron Institute was invited to give evidence at this hearing concerning the presence of any unwanted and/or undesirable organisms on the hull of the 'Steel Marnier' and the seabed below, and an abstract of the Committee's decision is as follows (see Appendix 3 for full report):

That pursuant to the Resource Management Act 1991, a coastal permit (occupancy, disturbance of the foreshore and seabed) by Heli Harvest Ltd, is hereby GRANTED, subject to the following conditions:

That consent shall expire on 1 December 2002.

- *That when the barge is berthed at the approved location (being the location applied for) it shall be restrained in accordance with the application detail and the consent holder shall ensure that the barge is adequately secured at all times.*
- *That within 1 month of the date of this consent, the hull of the barge and the seabed beneath the barge shall be surveyed by a suitably qualified person to ensure that no unwanted exotic marine organisms are present. Details of the survey shall be presented to Council as soon as practicable thereafter.*
- *That where any unwanted exotic organisms are found on the hull and/or the seabed beneath the barge, then, as far as is practicable, they shall be immediately removed in a manner that ensures that there is no release of those organisms into the surrounding waters, and be disposed of at an appropriate landfill.*
- *That throughout the term of this consent the consent holder shall make all reasonable and demonstrable efforts to obtain alternative berthage within the adjoining Port Zone.*

Upon receiving notification of their successful resource consent application, Heli Harvest Ltd approached Cawthron Institute to undertake the required survey to *"ensure that no unwanted exotic marine organisms are present on the hull or seabed below the barge"*.

2.0 METHODS

A team of Cawthron divers visited the 'Steel Mariner' between 26-28 February 2002 to undertake quantitative surveys of the type and extent of fouling on the hull of the 'Steel Mariner' and the seabed below. Although these surveys were originally intended for research purposes, Keith Heather (Resource Management Officer, Marlborough District Council) agreed that, because the 'Steel Mariner' had not moved since the survey had been undertaken, this survey would be suitable for determining if *"any unwanted exotic marine organisms are present on the hull or on the seabed underneath the barge"*.

2.1 Defining "unwanted exotic organisms"

For the purposes of this report, the term "unwanted exotic organisms" referred to in section 1.3 has been defined as unwanted introduced, unwanted exotic, as well as undesirable organisms (see definition of terms). Unwanted organisms, pursuant to section 2(1) of the Biosecurity Act 1993, means **any** organism that a Chief Technical Officer (CTO) believes is capable or potentially capable of causing unwanted harm to any natural and physical resources or human health (Biosecurity Act 1993; Jackson *et al.* 2000). The CTO of marine biosecurity has listed the following species as unwanted: the Japanese seaweed (*Undaria pinnatifida*), which was introduced to New Zealand prior to 1987; and the Mediterranean fanworm (*Sabella spallanzanii*), the European shore crab (*Carcinus maenas*), the northern Pacific seastar (*Asterias amurensis*), the Chinese mitten crab (*Eriocheir sinensis*), the green seaweed (*Caulerpa taxifolia*) and the Asian clam (*Potamocorbula amurensis*), which are not yet thought to be in New Zealand (see Appendix 4).

Two undesirable species were also included in the list of "unwanted exotic organisms" (target taxa). These are the paddle crab (tentatively identified as *Charybdis japonica*), which originates from Asia and was first identified in New Zealand in November 2000 and currently appears to be confined to the Waitemata Harbour, Auckland, and the Whangamata Harbour *Didemnum* sp. discussed in section 1.1. The author considers both species to have pest potential and for this reason has classified them as undesirable. Notably, the New Zealand Marine Farmers Association and Mussel Industry Council consider the Whangamata Harbour *Didemnum* sp. to be a significant threat to the Greenshell™ mussel industry (given its presence in the Picton area).

2.2 Survey for "unwanted exotic organisms"

2.2.1 'Steel Mariner'

An initial inspection of the 'Steel Mariner' revealed that heavy fouling was distributed over the entire submerged area of the hull. Four 25 m transects were therefore randomly placed underneath the barge (port to starboard) (Figure 6). Eight random 50 x 50 cm (0.25 m^2) quadrats, two on each of the vertical sides and four underneath the barge along each of the four transects, were selected to assess the type and extent of fouling on the hull (Figure 6). A Nikonos III underwater camera with a 28 mm lens and 200 ASA Fujichrome film was used to photograph all 32 quadrats to assist with identifying various fouling organisms. Two divers, one using a paint scraper and the second to hold the collection bag, removed and collected all of the fouling material in each quadrat. Fouling material from each quadrat was transported to the surface inside the collection bags.

Samples were transferred to 500 µm bags then allowed to drain for five minutes before being weighed using hand held scales. Given the excessive amount of fouling, the wet weight of all material collected from each quadrat was recorded in kilograms. All fouling material from each quadrat was preserved in separate containers using 5% formaldehyde and 95% seawater for taxonomic analysis. Estimates of the quantity of the fouling on the barge were determined by calculating the mean and standard error of wet biomass weight of fouling per m^2 for each side (port and starboard) and the bottom of the barge. These were then scaled by the submerged area of the hull for each strata (given the marked differences in the level of fouling between strata). An overall estimate of wet biomass fouling on the barge was also determined by calculating the mean and standard error of wet biomass weight of fouling per m^2 amongst all 32 quadrats, then scaling these by the total submerged area of the hull.

A further quantitative survey involved estimating the wet biomass weight of the Whangamata *Didemnum* sp. on the hull of the barge. All *Didemnum* sp. colonies inside four randomly chosen quadrats measuring 2 x 2 m (4 m^2) along four randomly placed transects (port to starboard) were hand-picked by two divers and placed into collection bags (Figure 7). These were then transported to the surface and transferred to 500 µm bags and drained and weighed as described above. The wet weight of the *Didemnum* sp. in each quadrat was recorded in kilograms. The *Didemnum* sp. was then packaged and disposed of at a landfill. An overall estimate of the quantity of the *Didemnum* sp. on the barge was determined by calculating the mean and standard error wet biomass weight per m^2 amongst the 16 quadrats, then scaling these by the submerged area of the hull.

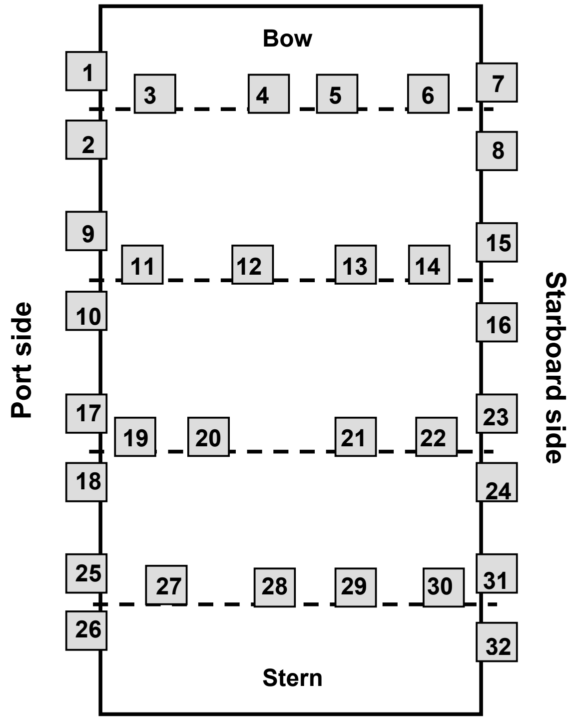

Figure 6. The hull of the 'Steel Mariner' was surveyed for target taxa using 32 randomly chosen 0.25 m^2 quadrats (numbered grey squares) on four random port-starboard transects (dashed lines).

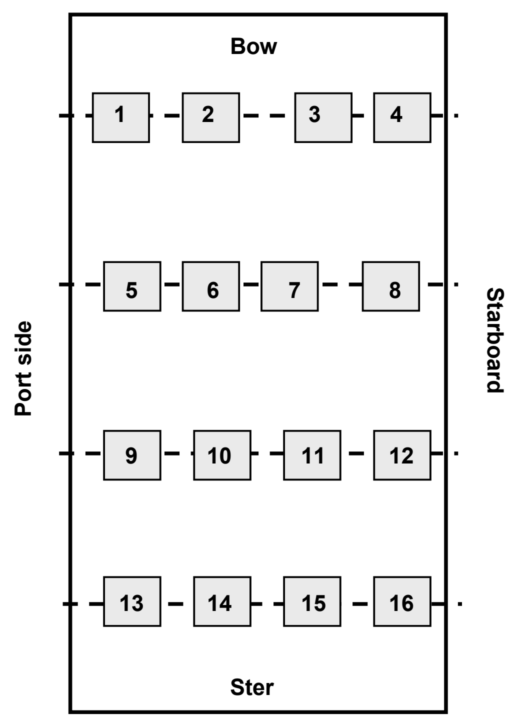

Figure 7. The hull of the 'Steel Mariner' was surveyed for the wet biomass weight of the *Didemnum* sp. using 16 randomly chosen 4 m^2 quadrats (numbered grey squares) on four random port-starboard transects (dashed lines).

All 32 photographs of random quadrats on the hull of the barge were viewed and the occurrence of any target taxa noted. Given the excessive amount of fouling within photo-quadrats, 16 of the 32 samples were randomly selected and sorted to assist with determining if any target taxa were present (Figure 8). Of the 16 random samples chosen, the first eight were fine sorted, and all organisms identified to the lowest taxonomic level possible and enumerated (Figure 8). Dead specimens and organisms smaller than 500 µm were not included in the survey.

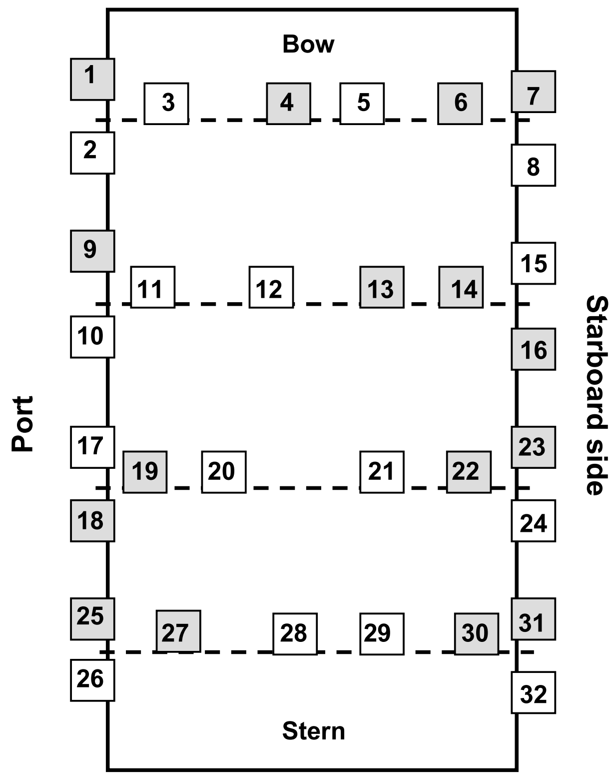

Figure 8. Diagram of the hull of the 'Steel Mariner', showing how it was surveyed for target taxa using 32 photographs of random 0.25 m^2 quadrats (labelled 1-32). Sixteen of the 32 were randomly selected (grey squares) and gross sorted, while all fouling organisms in the first eight samples (1, 4, 6, 7, 9, 13, 14 and 16) were identified to the lowest taxonomic level possible. Dashed lines indicate random transects.

2.2.2 Seabed

The approximate distribution of the Whangamata *Didemnum* sp. on the seabed was determined by Cawthron divers using SCUBA. The outer margin of the *Didemnum* sp. on the seabed was mapped relative to the position of the 'Steel Mariner'. The path of a buoy attached to one of the divers was also mapped at the surface. Given that the *Didemnum* sp. appeared to be randomly distributed on the seabed, four 50 m transects were randomly placed underneath the barge (port to starboard) (Figure 9). The same underwater camera and method as mentioned above were used to photograph eight pre-marked random quadrats (50 x 50 cm) along each transect to assist with taxonomic identification, and to ascertain the approximate percentage cover of any of the target taxa present on the seabed.

Target taxa were hand collected from every second quadrat and placed in collection bags, which were then transported to the surface (Figure 9). The contents of each collection bag were placed inside 500 µm bags and drained and weighed as described above. Marine organisms collected from each of the 16 quadrats were sorted in search of any target organisms. The wet weight of target taxa within each quadrat was recorded in grams. An overall estimate of the quantity of the *Didemnum* sp. on the seabed was determined by calculating the mean and standard error of wet biomass weight per m^2 amongst the 16 quadrats and scaling these by the approximate area of the seabed. All 32 photographs of random quadrats on the seabed were viewed and the percentage cover of target organisms recorded. Three separate qualitative assessments of the composition and abundance of fouling on the barge and seabed were also undertaken by Cawthron divers on the 5 April, 10 May and 13 June 2002.

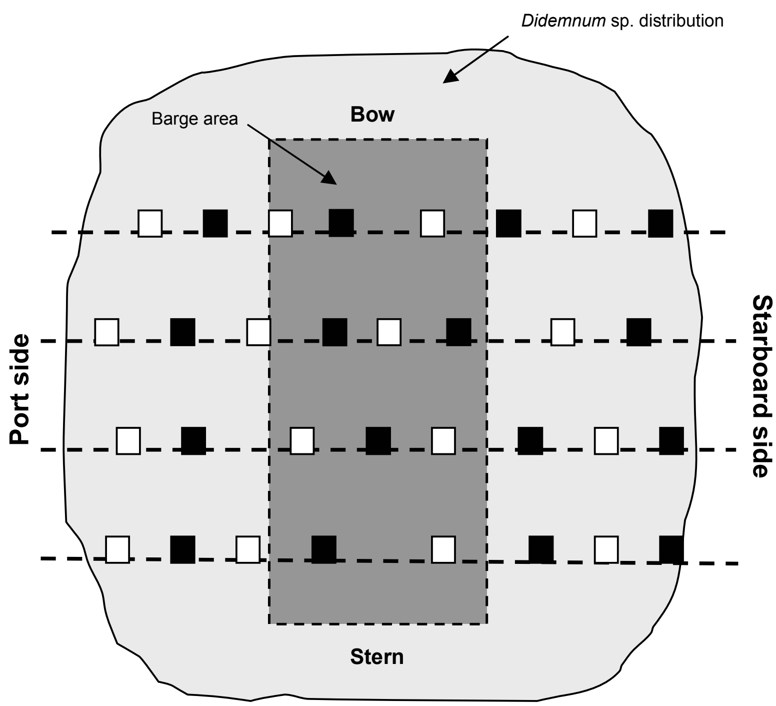

Figure 9. Map of the approximate range of the Whangamata *Didemnum* sp. on the seabed in relation to the 'Steel Mariner'. The seabed was also surveyed for target taxa using 32 photo-quadrats measuring 0.25 m^2 (black and white squares) on four 50 m random transects (dashed lines). Target organisms were collected from every second quadrat (black squares) for estimating wet weight biomass, while photographs were taken of every quadrat.

3.0 RESULTS

Undaria pinnatifida and the Whangamata *Didemnum* sp., were found on both the hull of the 'Steel Mariner' and the seabed below. No other target taxa were detected during the study (Table 1).

3.1 'Steel Mariner'

U. pinnatifida was found in 21.9% (7) of the 32 quadrats used to survey the hull (Table 2). The seaweed was detected in quadrats on both sides of the hull towards the bow and stern, and underneath the hull. As many as 29 reproductive sporophyte plants were detected in one quadrat, most of which were attached to Greenshell™ mussels (*Perna canaliculus*) (Appendix 5). The *Didemnum* sp. was found in 40.6% (13) of the 32 random quadrats sampled (Table 2). Although it was detected in some quadrats on the sides of the hull, the majority of the *Didemnum* sp. occurred on the bottom of the barge. Qualitative surveys also noted the *Didemnum* sp. on the keel and chains submerged at the bow. The *Didemnum* sp. had completely smothered mature Greenshell™ mussels (170 mm in length) attached to submerged chains hanging in the water at the bow. Later visits found a number of dead mussels, which were still smothered by the *Didemnum* sp., on the seabed below. No other target taxa were found amongst the 32 quadrats surveyed.

Table 1. A summary of results over the entire study showing the presence (✓) or absence (x) of target taxa on the hull of the 'Steel Mariner' and/or seabed below.

Common name	Scientific name	'Steel Mariner'	Seabed
Japanese seaweed	*Undaria pinnatifida*	✓	✓
Mediterranean fanworm	*Sabella spallanzanii*	x	x
European green crab	*Carcinus maenas*	x	x
Northern Pacific seastar	*Asterias amurensis*	x	x
Chinese Mitten crab	*Eriocheir sinensis*	x	x
Green seaweed	*Caulerpa taxifolia*	x	x
Asian Clam	*Potamocorbula amurensis*	x	x
Paddle crab	*Charybdis japonica*	x	x
Colonial ascidian	*Didemnum* sp.	✓	✓

A total of six different algal species and 70 animal taxa were identified on the hull of the 'Steel Mariner' (Appendix 5). As many as 41 different marine organisms were identified from a single 0.25 m^2 quadrat with an average of 28.13 ± 2.46 (se) species per quadrat. Interestingly, two North Island species that do not occur in the South Island, the ribbed slipper limpet *Crepidula costata* and the red alga *Cladhymenia lyallii,* were found. The red alga was only found to be abundant in one portside quadrat, while the ribbed slipper limpet was found in all 8 sorted samples, some quadrats containing as many as 560 individuals per 0.25 m^2 (Appendix 5). The wet biomass of fouling on the hull of the 'Steel Mariner' varied from as little as 3.28 kg to 58.32 kg per m^2 (Figure 10). The wet biomass of fouling was considerably higher on the starboard side of the hull (mean of 35.04 ± 7.04 kg of wet biomass per m^2) than the port side (6.24 ± 0.96 kg) and underneath the hull (16.04 ± 1.64 kg) (Figure 10). The starboard side of the hull was dominated by Greenshell™ mussels (*Perna canaliculus*) accounting for up to 70% of a quadrat's total wet biomass (Appendix 5). A total of 25,941 ± 3,738 kg of wet biomass fouling was estimated to be present on the hull of the 'Steel Mariner'.

Table 2. Data illustrating the presence (✓) or absence (x) of target taxa within 32 quadrats (0.25 m^2) used to survey the hull of the 'Steel Mariner'. Refer to Figures 6 and 8 for the location of each quadrat.

Type of organism/ Location	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Undaria pinnatifida	✓	✓	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x
Sabella spallanzanii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Carcinus maenas	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Asterias amurensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Eriocheir sinensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Caulerpa taxifolia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Potamocorbula amurensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Charybdis japonica	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Didemnum sp.	x	x	✓	✓	✓	✓	x	x	✓	x	✓	✓	✓	x	x	✓

Type of organism/ Location	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Undaria pinnatifida	x	x	x	x	x	x	x	x	✓	x	x	x	x	x	✓	✓
Sabella spallanzanii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Carcinus maenas	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Asterias amurensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Eriocheir sinensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Caulerpa taxifolia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Potamocorbula amurensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Charybdis japonica	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Didemnum sp.	x	x	x	x	x	x	x	x	✓	x	✓	x	x	✓	x	✓

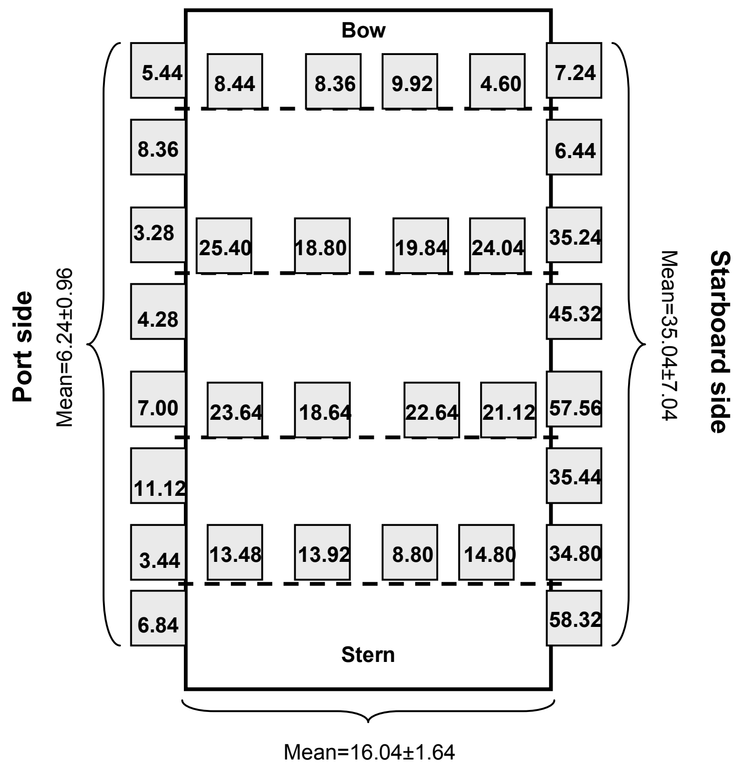

Figure 10. The total and mean wet biomass weights (kg per m^2) of fouling in quadrats (grey squares) used to survey the hull of the 'Steel Mariner'. Figures to the sides and bottom are mean and standard errors of wet biomass fouling per strata. Transects are indicated by dashed lines.

The survey revealed that the wet biomass of the Whangamata *Didemnum* sp. was greatest amongst quadrats at the bow and stern and lowest in the middle of the barge (Figure 12). Overall, an average of 1.08 ± 0.23 kg per m^2 of the *Didemnum* sp. existed within each quadrat on the hull. An estimated total of 1,396 ± 300 kg[1] of the *Didemnum* sp. was present on the barge. The *Didemnum* sp. colonies on the 'Steel Mariner' were sponge-like, yellowish cream in colour and drooped from the bottom of the 'Steel Mariner' towards the seabed (Figure 11). The *Didemnum* sp. colonies averaged approximately 22 cm in circumference and 50-100 cm in length, although some colonies were as long as 220 cm. When they moved with water currents, these outgrowths often resembled macro-algal fronds. These outgrowths often formed as a result of the colony encrusting weed or worm tubes, but often they were solid with a firm gelatinous exterior. Living polychaetes, amphipods, crustaceans, nematodes and ciliates in the samples have also been found. The rancid smell commonly associated with some colonies was a consequence of smothered organisms decaying inside the colonies.

The biomass of the *Didemnum* sp. appears to have declined since it was first discovered on the barge in late December 2001. Specimens of the *Didemnum* sp. that have been collected from the 'Steel Mariner' since January 2002 and been dissected under the microscope, reveal that eggs are only just beginning to develop in the most recent specimens collected (13 June 2002) (pers. obs.). Although many colonial ascidians die back in winter and become somewhat dormant, often the

[1] Calculation amended from 2,923 ± 628 kg to 1,396 ± 300 kg on 7 April 2003.

basal portion of the colony remains present in an undifferentiated state, often very inconspicuous, and when spring arrives they reproduce prolifically (G. Lambert, pers. comm.). On 13 June 2002, Cawthron divers noted that a second barge, the 'Waimarie I', which has been anchored next to the 'Steel Mariner' since February 2002, has also recently been colonised by what appears to be the same *Didemnum* sp..

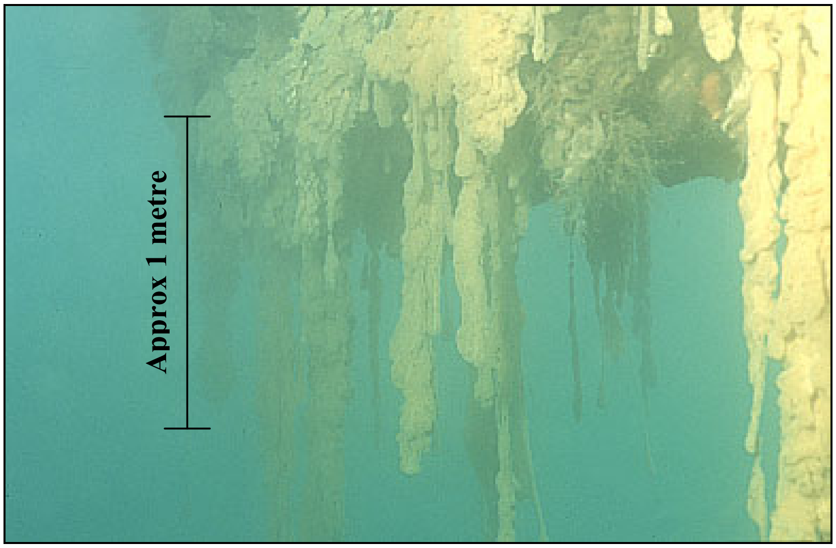

Figure 11. The *Didemnum* sp. colonies hanging from the bottom of the 'Steel Mariner'. Photo courtesy of Sean Handley, NIWA. Colonies were approximately 1 m in length.

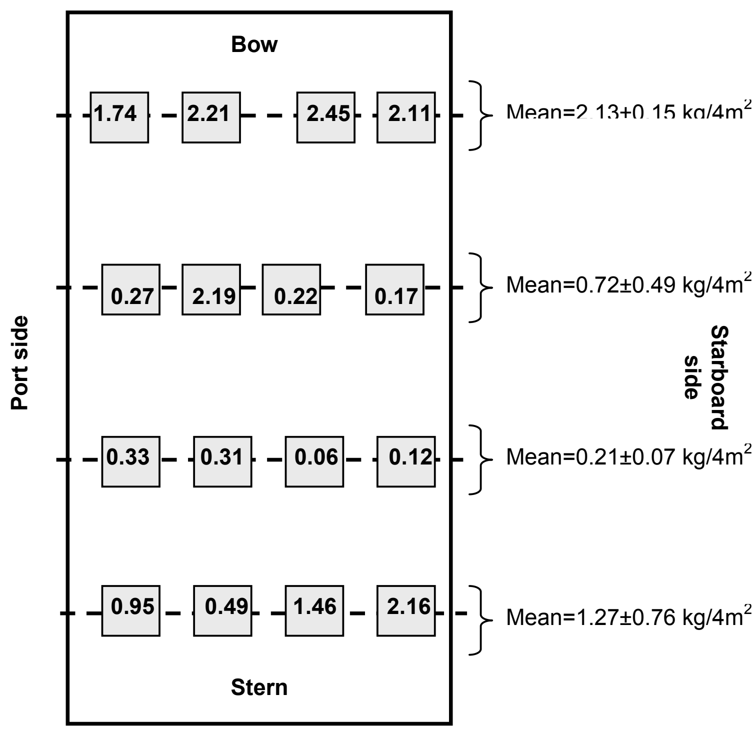

Figure 12. The wet biomass weight (kg per m^2) of the Whangamata *Didemnum* sp. in quadrats used to survey the hull of the 'Steel Mariner'. Figures to the right are mean and standard errors for each transect. Transects are indicated by dashed lines.

3.2 Seabed

Although *U. pinnatifida* was not detected in any of the 32 random quadrats used to survey the seabed for target taxa, qualitative surveys discovered several small plantlets and large reproductive sporophyte plants scattered sparingly on rocky outcrops to the sides of the 'Steel Mariner'. The distribution of the *Didemnum* sp. on the seabed was limited to the immediate area beneath the barge and it did not appear to occur elsewhere in the embayment (Figure 13). The barge is capable of moving to compensate for tidal changes, and in windy conditions can move as much as 10 m from side to side and several metres in and out from the shore (pers. obs.). This movement has caused *Didemnum* sp. colonies to fall off during windy conditions, and has distributed it over an estimated 40 x 80 m (3,200 m^2) below the barge ranging from 5 to 15 m in depth (mean tide level) (Figure 13).

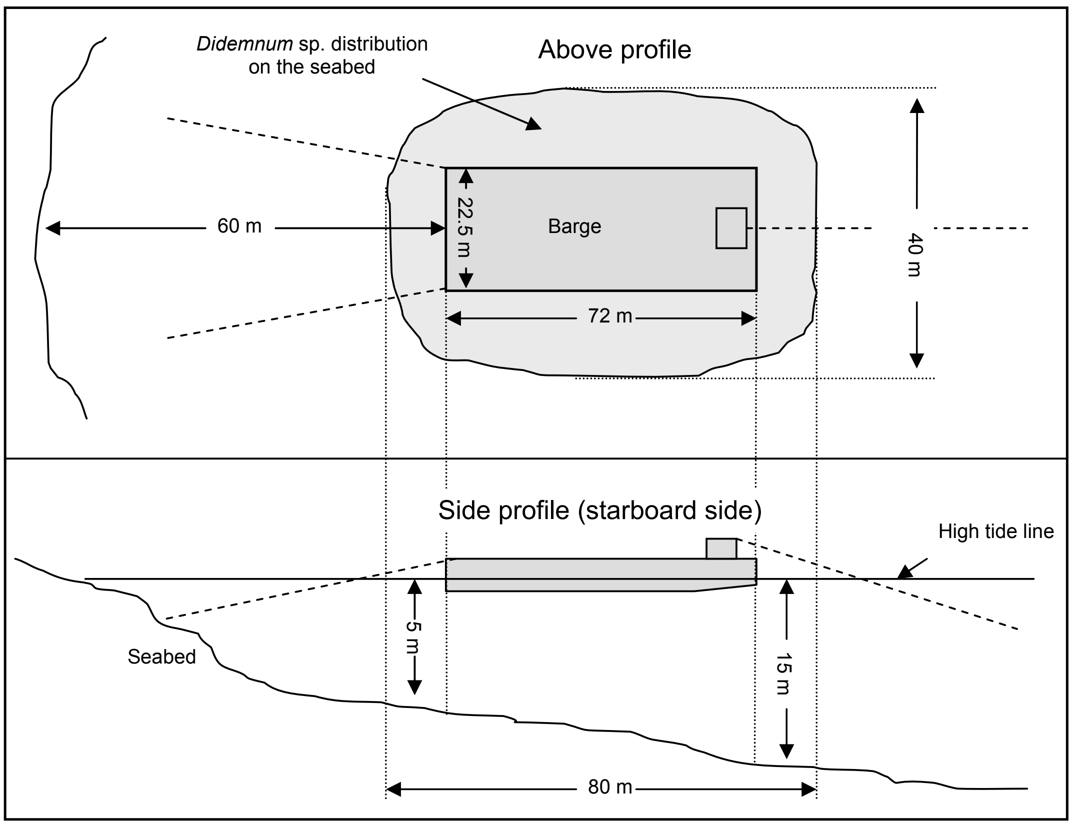

Figure 13. Diagram illustrating the approximate range of the Whangamata *Didemnum* sp. on the seabed in relation to the 'Steel Mariner'. Diagram is not to scale and all measurements are approximate. Dashed lines represent mooring lines.

The *Didemnum* sp. was present in 72% (23) of the 32 random quadrats used to survey the seabed (Figure 14). The *Didemnum* sp. occupied an average percentage cover of 5.45 ± 1.84 per quadrat (Figure 15). Qualitative surveys revealed that some *Didemnum* sp. colonies on the seabed were up to 2 kg in wet biomass weight and occupying up to 50% cover of a photo-quadrat (Figure 16).

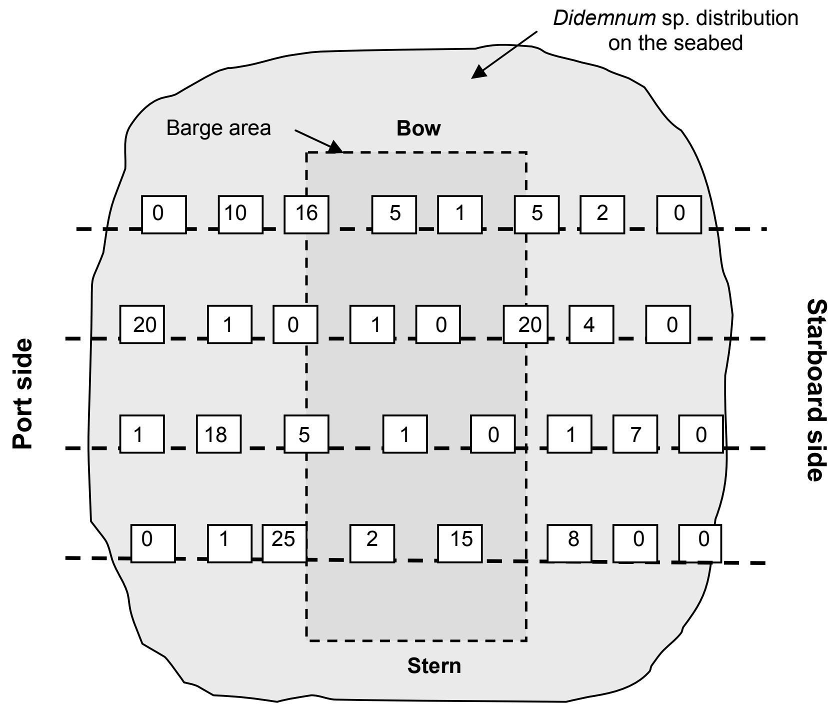

Figure 14. The percentage cover (per m^2) of the Whangamata *Didemnum* sp. in quadrats on the seabed.

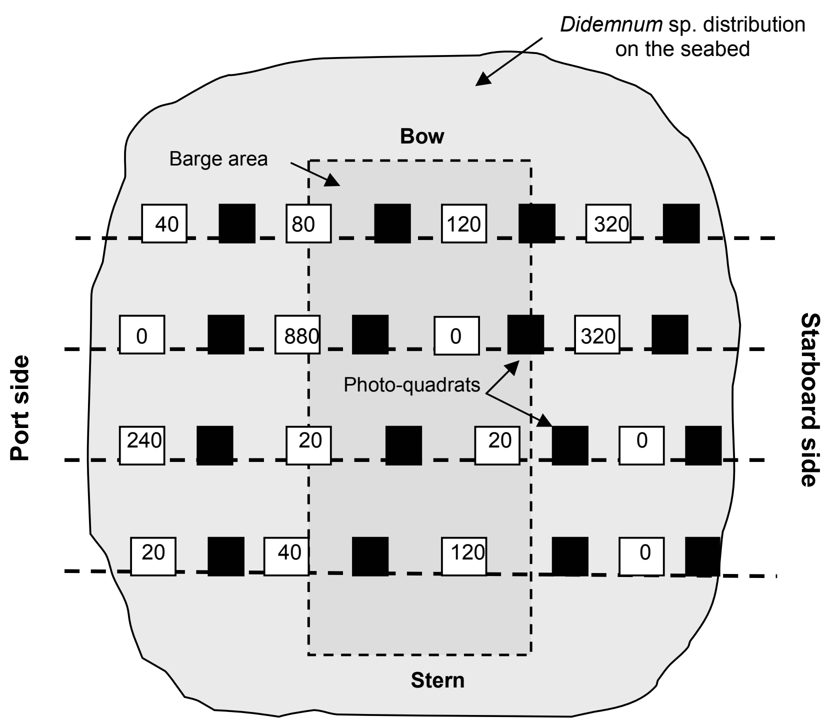

Figure 15. The wet biomass weight (gm per m^2) of the Whangamata *Didemnum* sp. in quadrats (white squares) on the seabed. Black squares denote photo-quadrats only.

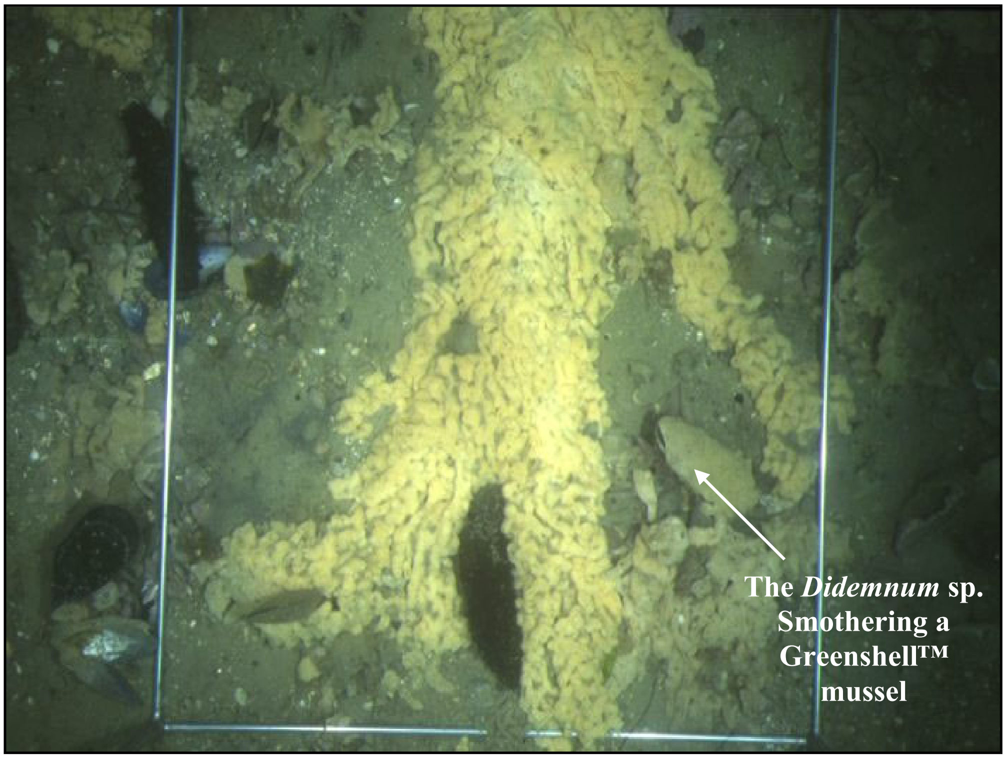

Figure 16. Some Whangamata *Didemnum* sp. colonies occupied up to 50% of photo-quadrats on the seafloor below the 'Steel Mariner'. Some of the colonies had also successfully colonised other organisms.

An average of 143.76 ± 56.24 g of *Didemnum* sp. per m^2 was found within quadrats on the seabed below the barge. Therefore, it was estimated that 460 ± 180 kg of *Didemnum* sp. was present on the seabed below. A large proportion of this was a result of large colonies of the *Didemnum* sp. falling from the bottom of the barge, some of which had colonised hard structures such as rocks and pieces of wood, or growing on other organisms such as blue mussels (*Mytilus edulis*), Greenshell™ mussels (*Perna canaliculus*) and red algae. In some instances, the *Didemnum* sp. had completely smothered the Greenshell™ mussels on the seabed below the 'Steel Mariner' (Figure 17). Subsequent surveys noted that while the *Didemnum* sp. colonies lying on mud or sand on the seabed had died, colonies that had successfully colonised hard structures or other organisms were spreading to surrounding areas.

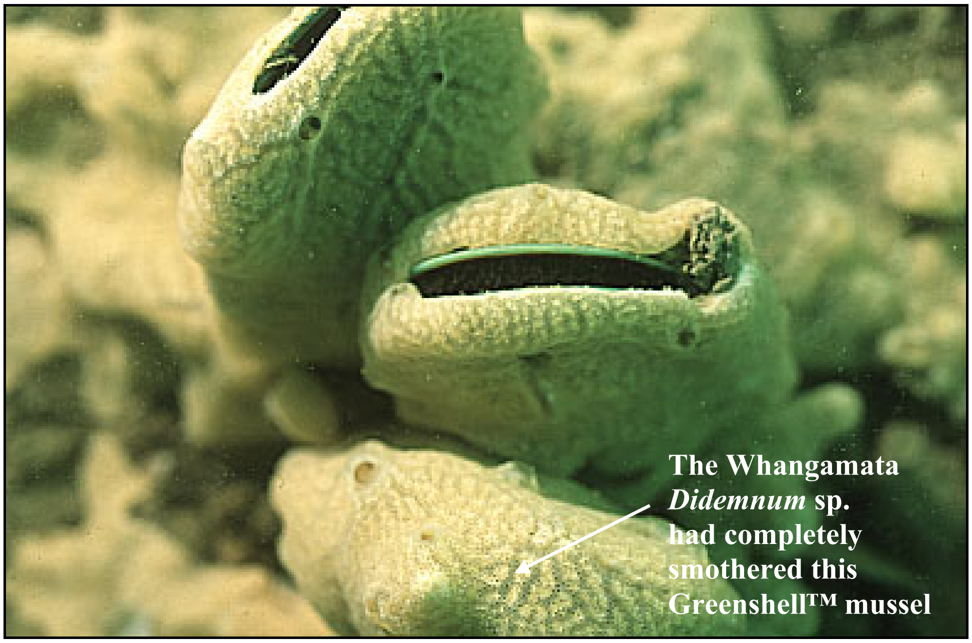

Figure 17. Some Whangamata *Didemnum* sp. colonies had completely smothered Greenshell™ mussels on the seabed below the 'Steel Mariner'. Photo courtesy of Sean Handley, NIWA.

4.0 DISCUSSION

4.1 "Unwanted exotic organisms"

Undaria pinnatifida and the Whangamata *Didemnum* sp., were present on both the 'Steel Mariner' and the seabed below. It is possible, given the voyage history of the 'Steel Mariner', that it had some *U. pinnatifida* on the hull prior to its arrival in the Marlborough Sounds. However, *U. pinnatifida* has been found to occur throughout Shakespeare Bay and the surrounding areas for several years, therefore the barge was probably colonised by the seaweed during the 14 months at its current location. The excessive amount of fouling on the barge would provide a suitable substrate for the settlement of gametophytes (B. Forrest, pers. comm.).

DNA sequence analysis has matched the *Didemnum* sp. on the hull of the 'Steel Mariner' and the seabed below with that from Whangamata Harbour. Interestingly, the 'Steel Mariner' has never visited Whangamata Harbour; only Nelson, Tauranga and Auckland. While *Didemnum* sp. look-alikes have been found in Nelson and Tauranga, they have not yet been DNA sequenced and matched with the Whangamata Harbour *Didemnum* sp.. If DNA sequencing shows that the *Didemnum* sp. also occurs in Nelson, then there is a possibility that the 'Steel Mariner' may have been colonised by the *Didemnum* sp. in Nelson and the barge subsequently transported it to Tauranga as early as 1992. Furthermore, there is a possibility that the *Didemnum* sp. survived on the barge during its time at Sulphur Point, Tauranga Harbour, between 1992 and 1998, given that the portside of the barge remained submerged. Therefore, there is a further possibility that the *Didemnum* sp. even survived a subsequent trip to Rangitoto Island, Auckland.

Dr Brain Coffey, who was originally commissioned by Environment Waikato to identify and assess the pest potential of the *Didemnum* sp. found in Whangamata Harbour, has observed the same *Didemnum* sp. on wharf piles at the Tauranga bridge marina (B. Coffey, pers. comm.). Interestingly, the ‘Steel Mariner’ was berthed next to the marina for seven months (June 2000 to January 2001) while undergoing structural modifications in preparation for logging work in the Marlborough Sounds. Furthermore, the ‘Steel Mariner’ was berthed at this location during the time of year when the *Didemnum* sp. may have been reproductively active. The shaded area underneath the hull and extent of fouling would have provided an ideal substrate for *Didemnum* sp. larvae to colonise. Given the excessive amount of fouling on the hull, it is highly likely that remnants of the *Didemnum* sp. survived the week long voyage at < 5 knots to Whatamango Bay, Marlborough Sounds, then to its current location west of Kaipupu Point, Picton.

Interestingly, the *Didemnum* sp. was first detected in Whangamata Harbour in October 2001. Given that the ‘Steel Mariner’ was most likely colonised in Tauranga Harbour between June 2000 and January 2001, this suggests that the *Didemnum* sp. may have been introduced to New Zealand via the hull of a foreign vessel to Tauranga Harbour first, then translocated to Whangamata Harbour by a pleasure boat or fishing vessel. Ascidian expert Dr Lambert, believes that the *Didemnum* sp. was introduced to New Zealand, with its likely origin in Japan, however no evidence has been provided to support this theory at this point in time. Alternatively, another ascidian expert Dr Mather, believes the *Didemnum* sp. may have lay dormant for some time until October 2001, and suddenly bloomed due to favourable environment conditions in Whangamata Harbour. This is equally plausible given our poor historical records and the difficulties with ascidian taxonomy.

MFish have requested samples of the *Didemnum* sp. from Connecticut, United States, to undertake genetic analysis to confirm whether it is the same species as the one from Whangamata Harbour. These samples will undergo DNA sequence analysis and confirm whether the *Didemnum* sp. in the United States is the same as the *Didemnum* sp. in Whangamata Harbour. While this will move us one step closer to identifying the species’ origin, like many marine species its true origin may never be confirmed. Therefore, the species should be classified as cryptogenic until its true origin is confirmed, and a precautionary approach adopted towards its management.

Interestingly, two North Island species, the ribbed slipper limpet *Crepidula costata* and the red alga *Cladhymenia lyallii*, both of which have not been found previously in the Picton and Shakespeare Bay areas, were found amongst the samples collected from the ‘Steel Mariner’. The ribbed slipper limpet was found in all samples that were fine sorted, some samples containing up to 560 individuals per 0.25 m^2. While the limpet and red alga have yet to be found on the seabed or surrounding embayment area west of Kaipupu Point, the fact remains that they have been transported alive to the Picton and Shakespeare Bay area via the hull of the ‘Steel Mariner’, and they can survive at that latitude. While these two species may not pose any serious biosecurity threat to the Marlborough Sounds, it does confirm, along with the *Didemnum* sp., that vessels which spend large periods of time stationary and are badly fouled, can move at slow speeds transporting species with them to new locations, even if they remain in domestic waters (Lambert 2001).

4.2 Biosecurity risks of towed vessels

Towed vessels have been documented as being a serious biosecurity threat for some years. Foster and Willan (1979), for instance, documented the survival of 12 barnacle species on the hull of a ‘Maui’ oil platform after it was towed from Japan to New Zealand in 1975. Some believe these oil platforms introduced the Pacific oyster *Crassostrea gigas* to Okiwi Bay, Tasman Bay (R. McDonald, pers. comm.). DeFelice (1999) discovered 20 exotic fouling organisms on the hull of the floating dry dock *USS Machinist*, which was towed from Subic Bay, Philippines, to Pearl Harbour, Oahu, in May 1992. More recently, Apte et al. (2000) documented the successful translocation of the smooth shelled blue mussel *Mytilus galloprovincialis* from the hull of the *USS Missouri* to a submarine ballast tank in Pearl Harbour, after it was towed from Bremerton, Puget

Sound. Furthermore, Lambert (2001) states that the survivorship of ascidians on barges is generally high because they are slow moving. Clearly, further research is required to determine the biosecurity risks of hull fouling on towed vessels operating in or visiting New Zealand.

4.3 Risks to the aquaculture industry

Considering that the *Didemnum* sp. colonises artificial structures, it would almost certainly colonise Greenshell™ mussel lines. Artificial structures (like the barge), provide shaded areas, which the larvae of the *Didemnum* sp. are likely to be attracted to during their exploration phase before settlement (Lambert 2001). However, the *Didemnum* sp. had also completely smothered mature Greenshell™ mussels on submerged chains, which were illuminated, at the front of the barge. This suggests that the species has a preference for artificial structures even in highly illuminated areas, although this needs to be further investigated.

It is also likely that the smothering capabilities of the *Didemnum* sp. resulted in the death of some of the Greenshell™ mussels on the submerged chains at the front of the barge. This is because some dead shells, which were still covered by the *Didemnum* sp., were found isolated on red algae weed beds at the deepest point underneath the barge. This could have been a result of Greenshell™ mussels realigning themselves in an attempt to compete for food and space, thereby dislodging the dead mussels (K. Heasman, pers. comm.). It would appear, therefore, that the *Didemnum* sp. has similar smothering capabilities to the cosmopolitan solitary ascidian *Ciona intestinalis,* which in a one off event cost the mussel industry an estimated NZ$10 million in lost production in 1998 (Mussel Industry Council 2000). Hence, this particular *Didemnum* sp. is a very real threat to the Greenshell™ mussel industry. The *Didemnum* sp. may also pose a threat to the Salmon Farming Industry by potentially fouling salmon cages, however it is unlikely to pose any significant threat to the oyster industry given their predominantly intertidal farming methods.

4.4 Potential spread of the *Didemnum* sp.

Given that the 'Steel Mariner' spent close to three months (29 January to 26 April 2001) in Whatamango Bay, Marlborough Sounds, before heading to its current position west of Kaipupu Point, Picton, this raises concerns as to whether the *Didemnum* sp. also exists there. While NIWA have undertaken a survey (three random transects) along Tuna Point where the barge spent most of its time, they only found a single *Didemnum* sp. look-alike, which was confirmed as being different to the Whangamata Harbour species. It is unlikely that any large hanging colonies similar to those witnessed on the barge in December 2001 would have survived the week long voyage from Tauranga to Whatamango Bay. Nevertheless, remnants of the colonies must have survived the voyage to the Marlborough Sounds in amongst the excessive hull fouling. Given the short period of time the barge spent in Whatamango Bay, it is unlikely that the colonies would have reached sufficient biomass to fall onto the seabed. Furthermore, given the time of year, it is unlikely the *Didemnum* sp. released any larvae in Whatamango Bay (assuming the *Didemnum* sp. reproduces around late winter, early spring), although a more thorough survey of the barges' anchorage areas is recommended.

Given that the 'Steel Mariner' has been in the Picton area since the 29 January 2001, and that the *Didemnum* sp. had reached such a prolific state by late December 2001, this indicates that the ascidian has probably undergone at least one sexually reproductive cycle at its present location. Submerged chains hanging from the front of the barge, some ten metres from the hull, were smothered by the *Didemnum* sp., which suggests that the chains must have been colonised by settled larvae. Therefore, the chains could have been colonised by settled larvae at its present location. These chains could have also been colonised in Tauranga Harbour and the *Didemnum* sp.

subsequently survived the voyage to Picton, given that they were submerged during most of the voyage. If the *Didemnum* sp. on the hull of the 'Waimarie I' is also confirmed to be the same *Didemnum* sp., then this will provide further evidence that it has undergone sexual reproduction since its arrival in 2001. However, the hull of the 'Waimarie I' has been monitored since December 2001 and the *Didemnum* sp. look-alike was only detected on 13 June 2002. This suggests that if it is the same species, then the population on the 'Steel Mariner' or on the seabed below probably released some larvae during this period. This would raise further questions as to what time of year and how often this particular *Didemnum* sp. sexually reproduces in this part of New Zealand.

Didemnum spp. are capable of releasing larvae (400-800 µm) which can disperse from a few minutes to a few hours before settling (Morgan 1995; Mather 2002; G. Lambert, pers. comm.). However, given that there are limited currents in the area (M. Gibbs, pers. comm.), and that the larvae are likely to settle very quickly because they are a temperate species unlikely to possess symbiotic algae (Morgan 1995), offspring may still be confined to the immediate area. Interestingly, Lambert (2001) states that introduced ascidians that persist and flourish usually remain restricted to harbours, even many years after their introduction. This seems consistent with both NIWA's and Cawthron's observations, as the *Didemnum* sp. has not been detected outside of the immediate area of the barge and the seabed below. It appears that most of its present distribution on the seabed has come about as a result of large *Didemnum* sp. colonies being swept off the hull during the barges' to and fro movements during windy conditions, rather than a result of larval dispersal. Detached colonies on the seabed were likely to have undergone asexual reproduction and colonised neighbouring mussels, sticks, algae, etc. By comparison, Connell (2000) states that the spread of introduced species from artificial substrates to nearby natural ecosystems rarely happens.

Fortunately, at this point in time the *Didemnum* sp. has not been found in the Picton or Pelorus Sound areas, although, the same *Didemnum* sp. may have colonised on the hull of the 'Waimarie I', which is a more active barge. Since December 2001, the 'Waimarie I' has been towed to Napier, North Island, and transported Greenshell™ mussels from East Bay in the outer Queen Charlotte Sound to Picton. The barge has also spent some time berthed in Picton undergoing structural modifications (P. McManaway, pers. comm.). It is highly recommended, therefore, that the berthing place of the 'Waimarie I' in Picton be surveyed for the *Didemnum* sp.

The *Didemnum* sp. may be successfully introduced to Picton via other vessels, where a hub of maritime transport vectors could subsequently translocate the *Didemnum* sp. throughout much of the country (Lambert 2001). Given that other large barges, mussel harvesting barges and recreational vessels frequently travel between Picton and the mussel farming areas, this highlights the potential for the *Didemnum* sp. to spread via human-mediated vectors to mussel farms. Furthermore, a third barge, the 'Sea-Tow No. 4', which had been anchored some 200 m away from the 'Steel Mariner' between December 2001 and April 2002, may also have been infected by the *Didemnum* sp.. This barge was not inspected before it departed to transport coal from Greymouth to Lyttelton. However if the *Didemnum* sp. did occur on the hull, it may have been killed after being subjected to freshwater in Greymouth (D. Mogridge, pers comm.).

Because it appears that the *Didemnum* sp. is confined to the 'Steel Mariner', the immediate area below the barge and possibly the 'Waimarie I', the opportunity may now exist to successfully eradicate the *Didemnum* sp. from the area. This attempt would need to be undertaken before late winter, early spring, as this is the time that the *Didemnum* sp. is most likely to sexually reproduce.

5.0 RECOMMENDATIONS

On the basis of the information in this report, the following recommendations are made:

1) A sample of the *Didemnum* sp. from north-east America be genetically analysed using DNA sequence analysis and compared with the Whangamata (and barge) *Didemnum* sp. These specimens should also be compared to specimens from Japan. Such tests will assist with determining the origin of the *Didemnum* sp. in New Zealand.

2) The *Didemnum* sp. found in Nelson, Tauranga and on the hull of the 'Waimarie I' should also be genetically analysed using DNA sequence analysis and compared with the Whangamata *Didemnum* sp. This will assist with determining the distribution of the species so that management options can be formulated.

3) The original anchorage positions of the 'Steel Mariner' in Whatamango Bay and the berthing location of the 'Waimarie I' in Picton Harbour are surveyed for the *Didemnum* sp. as soon as possible. If any *Didemnum* sp. look-alikes are found, they should undergo DNA sequence analysis. This will assist with determining the distribution of the species in the Picton area so that management options can be formulated.

4) As far as practicable, the Whangamata *Didemnum* sp. on the hull of the 'Steel Mariner' and the seabed below be removed in a manner that ensures no release of propagules into the surrounding environment, and be disposed of at an appropriate landfill. This should also apply to any of the *Didemnum* sp. found in the surrounding area, e.g. on the hull of the 'Waimarie I, Whatamango Bay or Picton Harbour. An attempted eradication will reduce the risk of the species artificially spreading to mussel farming areas in the Marlborough Sounds.

5) A quarterly 12 month monitoring programme is undertaken to assess the success of any attempted *Didemnum* sp. eradication and, if necessary, a management response implemented (as considered appropriate).

6) Alternative anchorage locations to the embayment west of Kaipupu Point are used for harbouring barges until the monitoring programme is complete. This will minimise the risk of further artificial spread of the species.

6.0 ACKNOWLEDGEMENTS

Firstly, I wish to thank Qwilton and Grant Biel, Heli Harvest Ltd for their cooperation and support for granting us permission to undertake a survey of their leased barge. Moreover, I wish to thank them both for reviewing and releasing this report. Secondly, I wish to thank the following Cawthron staff; Barrie Forrest, Kathryn Blakemore, Kevin Heasman and Rod Asher, who assisted with data collection for this report. Moreover, Rod Asher was instrumental in assisting with the taxonomic identification of the fouling organisms collected. Thanks to Aaron Quaterman (Technician, Cawthron) for scanning images and documents for this report. Thanks must also go to Waterblaster Services Ltd of Nelson for constructing quadrats/photoquadrats and Yvonne Stark for fabricating fouling collection bags for the fieldtrip at such short notice.

I also wish to thank the following people for their invaluable assistance with determining the movements of the 'Steel Mariner' and other barges since their arrival in New Zealand including: Qwilton and Grant Biel, John Dennis (Gemini Barge Company Ltd), Michael Pryce (New Zealand

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Appendix 1

Dr Patricia Mather's report: "Identification of a didemnid? ascidian from Whangamata Harbour"

Final Report

24 January 2002

Dr Patricia Mather

Identification of a didemnid? ascidian from Whangamata Harbour

ZBS2001-08

Dr Patricia Mather

Start date: 14 January 2002
Completion date: 18 January 2002 and 24 January 2002

Executive Summary
The species is undescribed. It is more than likely an indigenous New Zealand species. The growth form may be an adaptation for vertical surfaces.

Methods
As in original proposal 15 January.

Patricia Mather

Didemnum "Whangamata"

Summary: The species is in the genus *Didemnum* , but is not recognisable as any of the more than 100 species of that genus known from Australian and Indo-West Pacific waters. Nor is it recognisable as any described species from anywhere in the world.

Its closest affinity is with *Didemnum niveum* (Kott, 1892) from Auckland (*Leptoclinum* niveum Kott, 1892). Like the material from Whangamata, this species has deep common cloacal cavities, and some that extend posterior abdominally, as well as some posterior abdominal spaces that open to the exterior (which may reflect the overgrowth that occurs in the Whangamata material), small zooids with a relatively short oesophageal neck, 8 or 9 coils of the vas deferens and relatively large stellate spicules, very numerous in the surface test and slightly less numerous basally. Spicules in the newly recorded colony are only sparse in the basal test and this constitutes the principal difference from the reported characters of *D. niveum*. The colony form of the Whangamata material with protrusions from the surface separated from the basal sheet is also novel, but may be the result of the habitat in which it is growing.

It should be noted that the growth form of these colonies does resemble that of species of the family Didemnidae found growing on wharf piles in other locations. *viz. Trididemnum* spp. found in Edithburgh Harbour , South Australia (see Kott. 2001)

It is recommended that a neotype specimen of *D. niveum* be collected and described from the North Shore Reef, Auckland Habour (assuming that Kott's type specimens probably are not to be found). The newly recorded complex colonies from Whangamata Harbour should be studied in more natural habitats in a parallel study.

Location. Whangamata Harbour, New Zealand off vertical concrete and wooden piles (QM G308588)

Colony. The colonies are extensive thin sheets which sometimes overgrow themselves and fuse with the surface to enclose secondary spaces to form thick sponge-like masses. They have. long flat leaf-, frond- or flag-like outgrowths or cylindrical processes extending out from the surface of the basal sheet, separated from it by a narrow constriction. These outgrowths often result from the colony encrusting weed or worm tubes but often they are solid out growths with firm gelatinous core of test. Both have zooids opening all around their surface. Sometimes they also over-grow their own surface. Often they appear to have terminal common cloacal apertures, but these are the tip of overgrown substrate (sometimes worm-tubes) which have not been closed-in by the growing ascidian colony. In the living specimens, the frond-like outgrowths from the surface, move with the currents and resemble macro-algal fronds.

The colonies are a yellowish cream, the yellow colour conferred by the yellow gut loop, eggs and embryos. Thoraces are white. Stellate calcareous spicules are in a layer in the surface test but are not crowded. They are sparse in the basal test. They are up to 0.058 mm diameter and have 9 to 11 robust conical rays in optical transverse section. Zooids are small, crowded in the surface layer of test, and sometimes appear to be lying on their side. They are along each side of branching primary common cloacal canals that extend the full depth of the zooids, sometimes extending into posterior abdominal canals. The course of the primary common cloacal canals can be seen from the upper surface with the zooids arranged along each side. Common cloacal apertures are large, circular, with transparent rims. They are relatively few, and randomly located.

Zooids. Zooids are about 1mm overall, the abdomen about twice the size of the contracted thorax. The branchial siphon is short with 6 small pointed projections around the rim of the aperture. The atrial aperture is sessile and open, exposing the middle part of the branchial sac to the common cloacal cavity. There are 4 rows of stigmata, 8 or 9 in the anterior row of the branchial sac. A short retractor muscle projects from halfway down the oesophageal neck, which is moderately long, about the same length as the thorax. Oesophageal buds are developing. The gut loop is flexed ventrally almost forming a double loop. It has the usual divisions – a cylindrical duodenal part, short posterior stomach and a particularly long rectum. The vas deferens makes 9 coils around the undivided testis, which is almost spherical or egg-shaped. It is present against the dorsal side of the flexed part of the gut loop, i.e. almost behind it. The testes appear to be mature in the examined specimen, eggs are present in the single egg ovaries adjacent to the testis. The specimen appears to be protygynous.

Embryos are being incubated in the basal or central test core but only few are well advanced. The larvae have the tail wound almost halfway around the trunk (barely to its anterior end). The trunk is 0.6 mm long and has 6 long ectodermal ampullae each side of the antero-median adhesive organs. A large, yellow yolk mass in beneath the oozooid in less mature larvae.

Remarks. According to Millar (1982: the most recent review of the New Zealand Ascidiacea) 9 species of *Didemnum* are recorded from New Zealand. This includes the records of Nott (1892), Sluiter (1900), Michaelsen (1924), Brewin (1946 to 1960) and new records from the New Zealand Oceanographic Institute Survey (1960-76). Of these, two are *Polysyncraton* spp., viz *Didemnum lithostrotum* (Brewin, 1956) and *P. mortenseni* (Michaelsen, 1924); *Didemnum studeri* Hartmeyer, 1911 and *Polysyncraton densum* (Nott, 1892) have 2 or more testis follicles; *D. lambitum* (Sluiter, 1900) has distinctive colony lobes with terminal common cloacal apertures. *Didemnum tuberatum*

(Nott, 1892) has distinctive sharply pointed spicule rays; and *Didemnum chilense*: Brewin, 1950c is probably misidentified and maybe conspecific with one or another of the specimens assigned to *D. candidum* by Brewin in her various works. The remaining *Didemnum* species referred to are *D. maculatum* (Nott, 1892) and *D. candidum*.

Didemnum maculatum (Nott, 1892) is an encrusting colony, light brown with spicule patches (dull white spots) above the zooids. This species also has a layer of spicules just beneath the upper surface as in the specimens from Whangamata. However, although their exact spicule size is not known, if it is assumed that the spicules of *D. niveum* (Nott, 1892) are not more than 0.1 mm diameter, spicules of *D. maculatum* appear to be about 0.03 mm in diameter. Further, the zooids of *D. maculatum* have especially long oesophageal necks. Accordingly, the Whangamata species does not appear to be *D. maculatum*.

Many *Didemnum* colonies from New Zealand have been assigned to *D. candidum* by Brewin (Brewin, 1948, 1950a, b, 1951, 1952, 1956, 1957, 1958a, b, and 1960).) but there is no evidence that any of these specimens are either *D. candidum* or anything like the Whangamata specimens. Only the specimens from Otago (Brewin, 1946) were described, but the description may be of a mixture of species. Millar (1982) also suggested, that specimens from Otago with spicules 8-12 stigmata per row and one, two or three testis follicles (Brewin, 1946) are not specimens of *D. candidum* if, indeed, they are conspecific (see also Kott, 2001 for a discussion of *D. candidum* Savigny, 1816.

Michaelsen (1924) thought *D. niveum* (Nott, 1892) to be a junior synonym of *D. candidum* (on the basis of its variable spicules). However, neither *D. niveum* nor *D. candidum* have either diversity of spicules or variable ones (see Nott, 1892; Kott, 2001), and in *D. candidum* there is a horizontal cloacal cavity only. In *D. niveum*, Nott (1892) found well developed cloacal canals in the upper layer of test and numerous canals of large extent in the lower layer (below the zooids). These opened to the exterior and may reflect complex folding of the colony such as that found in the newly recorded – but much more complex colonies. Thus, *D. niveum* is a distinct New Zealand indigenous species with stellate spicules to about 0.06mm with a complex cancellous colony, 8 or 9 stigmata per row and 9 coils of the vas deferens around an undivided testis. It shares most of these characters with the newly recorded colonies from Whangamata which, however, has even more complex colonies.

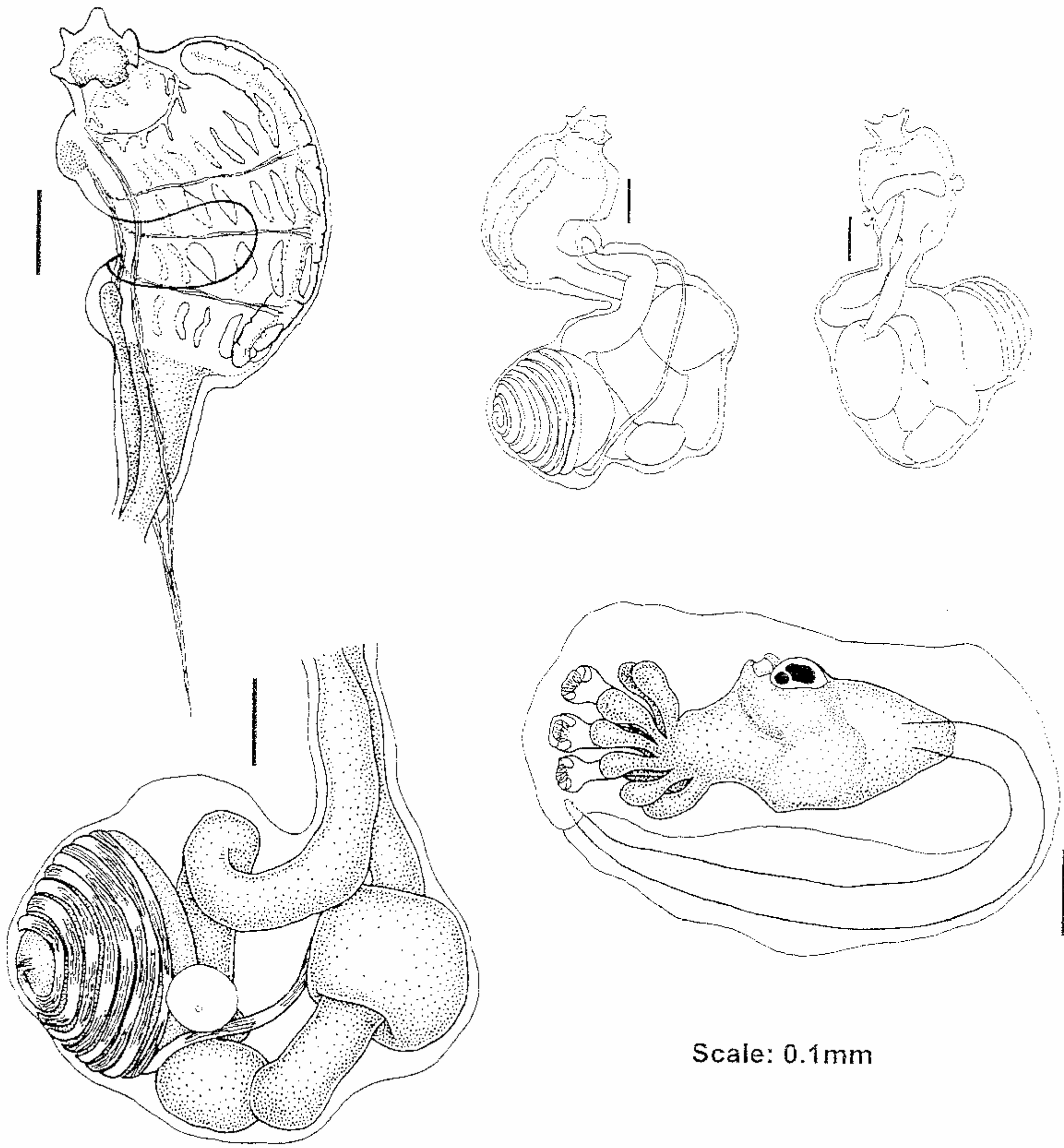
4

The spicules of the newly recorded colonies are similar to but smaller than those of *D. spadix* (0.045 mm diameter) and vas deferens coils and stigmata are more numerous. *Didemnum sucosum* has similar but larger spicules. Species recorded from other geographic area with the same combination of zooids, spicules larvae and colonies are not known (see Kott, 2001).

Recommendations. The growth form of the newly recorded colonies has not previously been recorded, although possibly juvenile colonies were described as *D. niveum* from Auckland Harbour.

Efforts should be made to find a neotype of *D. niveum* from Auckland Harbour, establish its identy, variations in its morphology, its geographic and ecological range and life history. Newly settled colonies of prolific populations of the complex colonies from Whangamata Harbour should be readily detected under rocks and rubble in Whangamata Harbour and compared with what is know of *D. niveum*: and by documenting the subsequent development of these colonies it may be possible to determine whether the more complex colonies are a normal growth form or an abnormal condition resulting from the establishment of artificial substrates and/or other artificial conditions.

5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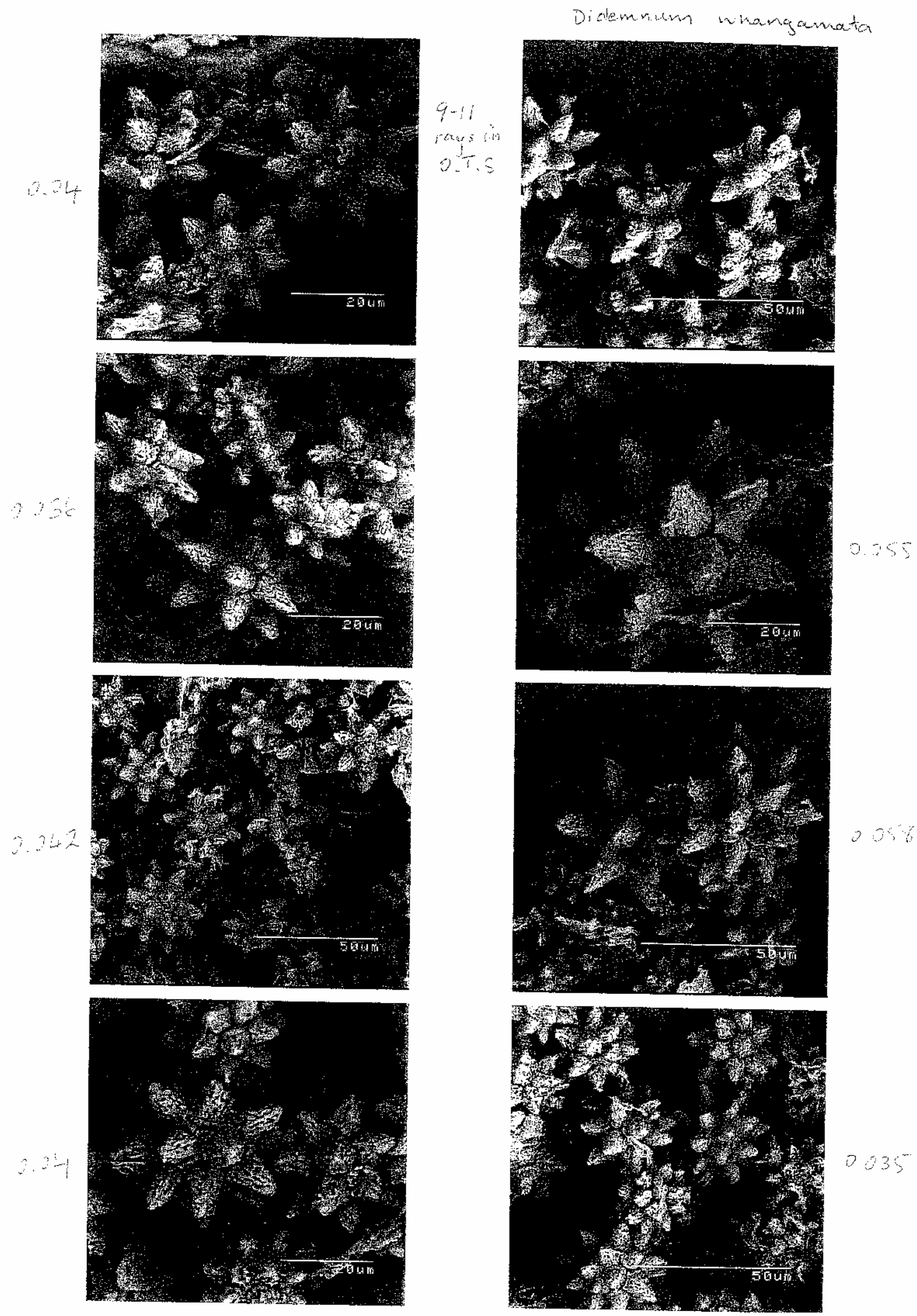
Didemnum whangamata
9-11 rays in O.T.S
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Biology of the Didemnidae

(see also Kott, 2001, Glossary)

Species of the family are amongst the most efficient colonial organisms in the Ascidiacea. While displaying all the characters of most aplousobranch ascidians (i.e. gut loop with gonads behind the perforated pharynx and replication of zooids involving the endodermal epicardial sacs as regenerative tissue).

Characteristic of the Didemnidae are the rapid rate of replication, almost two-dimensional colony growth, small zooids with only 3 to 4 rows of stigmata, lacking posterior abdomen and with relatively small gonads in the abdomen. The zooids are embedded in common test, their excurrent apertures expelling the spent ciliary feeding current into a common cloacal cavity in the common test so that the zooids' only direct interaction with the environment is the incurrent ciliary feeding stream through each separately opening branchial aperture (mouth). As in all ascidians, gonads are hermaphrodite and, as with all colonial species, fertilisation is internal and embryos are incubated in the colony. Presumably sperm reaches the ovum via the oviduct from the atrial cavity, although it is not known how it gets into the atrial cavity. Entry via the atrial aperture is against the excurrent ciliary stream which passes out though the common cloacal aperture; and entry via the branchial aperture would risk the male gametes becoming part of the food which is enmeshed in the mucous sheet moving up over the pharyngeal wall from the endostyle.

Embryos develop to tailed larvae (with the tail wound from half to the whole way around the trunk, which is usually between 0.4 mm to 1.0 mm long) in the colonial test in the base of cushion to sheet-like colonies or in the centre of cylindrical colonies. Larvae move up in the colony before their release through either the common cloacal cavity or the surface of the colony. Larval organs are 3 antero-median adhesive organs with accessory adhesive ampullae and a developing oozooid with, in *Didemnum*, 3 rows of stigmata, vertical gut loop and cerebral vesicle with ocellus and otolith.

The liberated larvae swim around in the water column for 10 mins or more (?) before becoming positively geotropic and swimming down, away from the surface. They are then attracted into shaded places (e.g. under-surfaces, crevices) – i.e. negatively heliotropic. On metamorphosis the tail is withdrawn into the larval haemocoel by the ectoderm and there it is resorbed. The larval trunk attaches to the substrate, the larval test develops to enclose a common cloacal chamber with the atrial aperture opening into it and buds developing around it to form a rudimentary colony.

The colony grows as the zooids replicate, by oesphageal building - from the oesophageal region of the zooid. The parental zooid divides across the oesophagus, leaving parental thorax with an abdominal bud and vice versa – a very economic and prolific process that least interrupts the normal operation of the zooids and colony. It is this prolific budding that is thought to have resulted in the evolution of the small, simplified, convergent, didemnid zooids, by interrupting the growth of individual zooids in favour of replication; and it is prolific budding that results in the rapid almost two-dimensional space-occupying growth of the colony.

The test is synthesised by the blood in the ectodermal vessels that project out from the adult haemococl into the test from the vicinity of the gut-loop. A unique aspect of most species of most genera of the Didemnidae (except *Diplosoma*) is the synthesis of calcareous (aragonite) spicules by a pair of thoracic lateral organs, one on each side of the thoracic wall. Their shape and maximum size is genetically controlled and they represent a stable character that is particularly useful in this family in which convergence has obscured most differences.

Ascidians (including Didemnidae) have an unique but imperfectly understood chemistry, with intracellular reducing systems otherwise unknown in the biological world. A result of this is the generation of acid (to pH2) on lysis of cells. This could contribute to the dissolving of calcium carbonate following overgrowth by ascidian colonies that has been observed with *D. perlucidum* in the Gulf of Mexico (*pers. comm.* Jan Culbertson) – although usually this would be neutralised by the spicules contained in the test.

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Appendix 2

Details on the History of the 'Steel Mariner'

The 'Steel Mariner' (formally known as the 'Intermac 256') is an unpowered deck barge that was built in Australia in 1969 with dimensions of 72 m length, 21.6 m beam and 4.17 m depth. Light displacement is 1,047 tonnes, loaded displacement is 6,145 tonnes and measurement is 2,651 gross tonnage. The barge is understood to have arrived in New Zealand from the Philippines sometime before 1991 (M. Donavon pers. comm.). The barge was initially employed at an oil rig off Taranaki, North Island, before it was damaged on 16 March 1992 after smashing against the side of the barge 'Baldur' during high winds in Tasman Bay. The 'Steel Mariner' was then towed to Nelson and purchased in a damaged condition by David Brown Construction Ltd of Ocean Towing and Salvage and subsequently towed to Tauranga for repairs in mid-1992. Work stopped on repairs after the port side bulkheads were renewed in September 1992.

During March 1994, the starboard side of the barge was beached at high tide on the northern side of the Tauranga Harbour, upstream from Sulphur Point, to enable further repairs to chines and frames while the portside remained submerged (Figure 1). These repairs were undertaken by John Dennis of the Gemini Barge Company Ltd, Tauranga and required about 60 tonnes of new steel, after which time it was expected to be towed to Brisbane in May 1994 to begin work carrying containers. However, the cost of the repair work was not paid and legal action was sort by Mr Dennis against David Brown Construction Ltd of Ocean Towing and Salvage. As a consequence of the proceedings against the barge for the unpaid accounts, the barge remained under arrest at Sulphur Point until 8 May 1998, when it was refloated and berthed alongside a Tauranga wharf and preparations completed for a tow to Auckland.

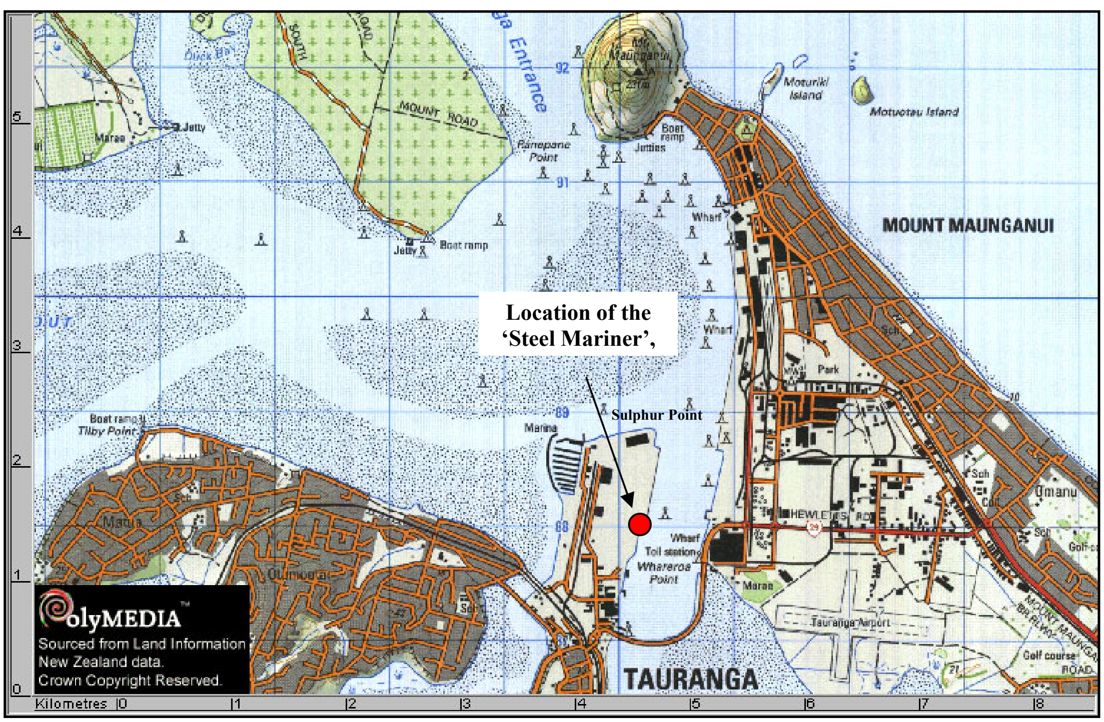

Figure 1. Location of the 'Steel Mariner' in Tauranga Harbour in March 1994 when the starboard side was beached to enable further repairs to chimes and frames.

The 'Steel Mariner', still owned by David Brown Construction Ltd at this point, left Tauranga on 12 May 1998 in tow of the tug 'Alfred Brown' and was advertised as lying at an anchorage west of

Rangitoto Island in the Hauraki Gulf, Auckland, with tenders due by 13 January 2000 (Figure 2). There was some interest by prospective tenderers to use the 'Steel Mariner' as a viewing platform for the Americas Cup, however this did not eventuate. Apparently Mr Dennis had his day in court and secured the ownership of the 'Steel Mariner' from David Brown Construction Ltd of Ocean Towing and Salvage in compensation for the unpaid repair work.

Figure 2. Location of the 'Steel Mariner' anchored off Rangitoto Island, Auckland, between mid May 1998 to late June 2000.

Sometimes in mid 2000, Heli Harvest Ltd, a helicopter forest harvesting company based in Auckland, successfully negotiated a lease to use the 'Steel Mariner' as a landing platform for harvesting logs in remote areas of the Marlborough Sounds. In late June 2000 the 'Steel Mariner' was towed back to Tauranga for some necessary structural modifications in preparation for logging work in the Marlborough Sounds. The 'Steel Mariner' spent around seven months berthed next to the Tauranga bridge marina while undergoing structural modifications (Figure 3). It left Tauranga on the 22 January 2001 and arrived seven days later (29 January 2001) at Whatamango Bay, Picton. The barge was initially anchored in the middle of the bay, but was moved around the corner of Tuna Point in Whatamango Bay approximately a week later because it was dragging the anchors in bad weather at the previous location (P. McManaway pers. comm.) (Figure 4). After spending just short of three months in Whatamango Bay, the barge was then towed to its present position west of Kaipupu Point on 23 April 2001, where it has been anchored to this present day.

It is understood that the 'Steel Mariner' has never been slipped since its arrival in New Zealand. This is because the barge is 2,651 gross weight tonnes which is too big for any slipway or syncrolift in New Zealand. The owners investigated the costs of dry docking the barge while it was in Auckland at Babcocks Dockyard/RNZN Dockyard, Devonport, but the availability of the dry dock and cost of doing so prevented this (J. Dennis pers. comm.).

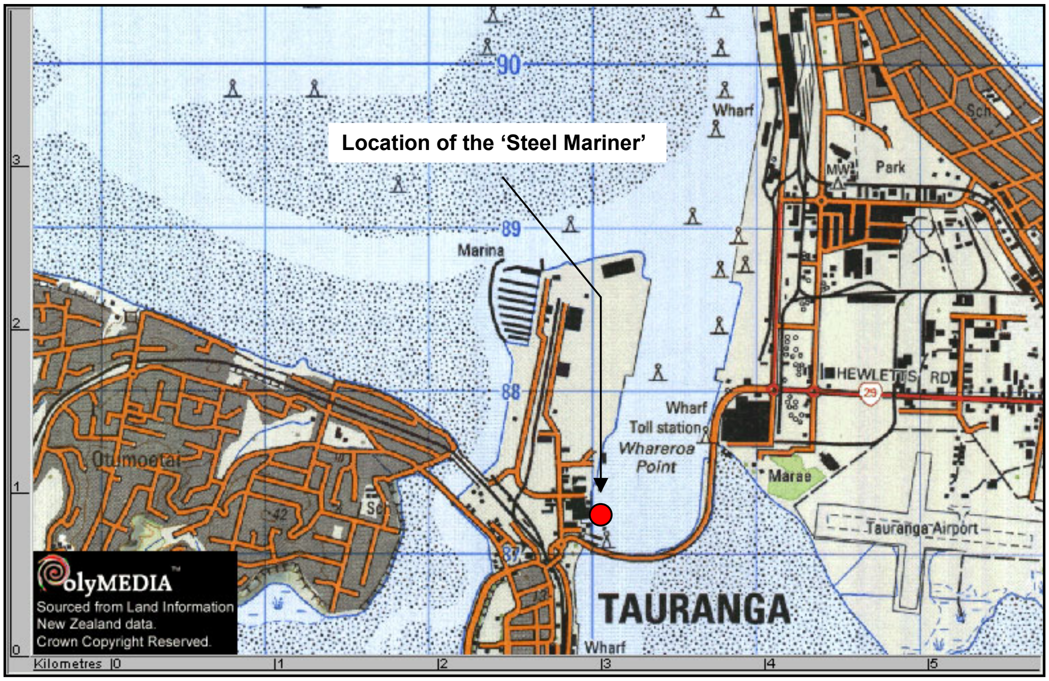

Figure 3. Location of the 'Steel Mariner' next to the Tauranga bridge marina between late June 2000 and 22 January 2001.

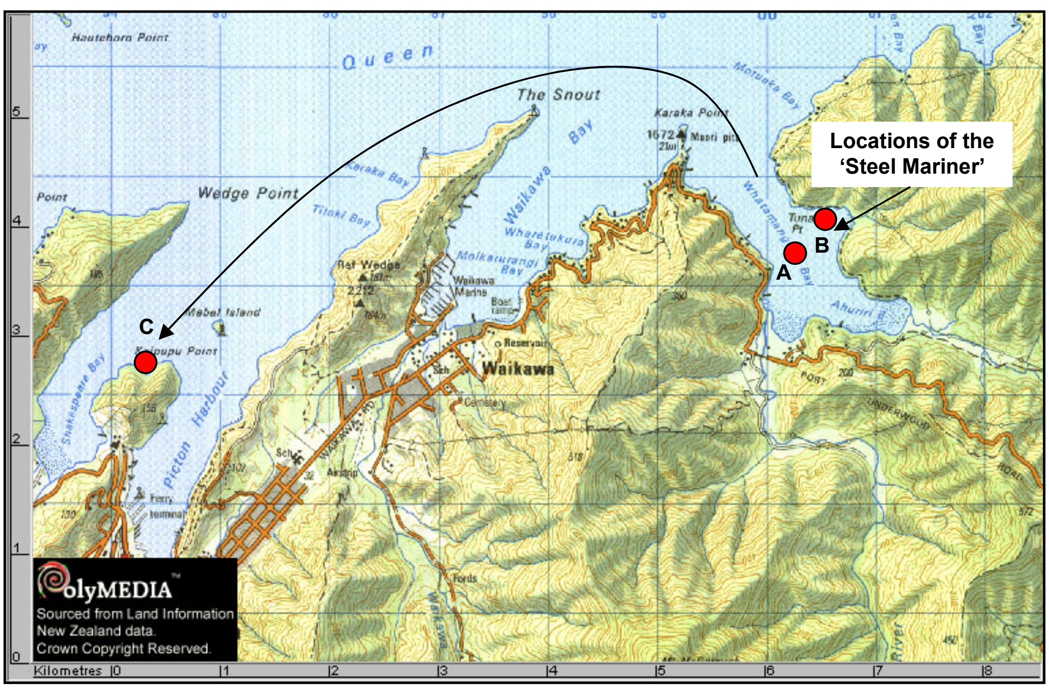

Figure 4. Location of the 'Steel Mariner' in Whatamango Bay, Marlborough Sounds, between 29 January and 5 February 2001 (Position A) and the 5 February and the 23 April 2001 (Position B). It was towed to its current position west of Kaipupu Point on the 23 April 2001 (C).

Appendix 3

Copy of Heli Harvest Limited's Granted Resource Consent

MARLBOROUGH DISTRICT COUNCIL
SEYMOUR SQUARE, PO BOX 443
BLENHEIM
NEW ZEALAND

TELEPHONE (0064) 3 578 5249
FACSIMILE (0064) 3 578 6866
EMAIL mdc@marlborough.govt.nz
WEB www.marlborough.govt.nz

MARLBOROUGH DISTRICT COUNCIL

Quality Assurance
ISO 9002
Ref: CI 157

File Ref: U011512
Ask For: Keith Heather

11 April 2002

Heli Harvest Ltd
18 Page Point
Howick
AUCKLAND 1704

Dear Sir/Madam

Decision on Application for Resource Consent - Coastal Permit (Occupancy and Disturbance of the Foreshore and Seabed)

APPLICANT: Heli Harvest Limited

LOCATION: Kaipupu Point, Western Entrance to Picton Harbour

At a meeting held on Wednesday, 3 April 2002, Council's Resource Hearings Committee considered an application seeking resource consent for a coastal permit to berth/moor a 72 metre unpowered deck barge named the "Steel Mariner" by the use of buried anchors and mooring blocks, at Kaipupu Point, being the Point that marks the western entrance to Picton Harbour.

The Committee's decision is as follows:

That pursuant to the Resource Management Act 1991, a coastal permit (occupancy, disturbance of the foreshore and seabed) by Heli Harvest Limited, is hereby GRANTED, subject to the following conditions:

That consent shall expire on 1 December 2002.

1. **That when the barge is berthed at the approved location (being the location applied for) it shall be restrained in accordance with the application detail and the consent holder shall ensure that the barge is adequately secured at all times.**

2. **That within 1 month of the date of this consent, the hull of the barge and the seabed beneath the barge shall be surveyed by a suitably qualified person to ensure that no unwanted exotic marine organisms are present. Details of the survey shall be presented to Council as soon as practicable thereafter.**

3. **That where any unwanted exotic organisms are found on the hull and/or the seabed beneath the barge, then, as far as is practicable, they shall be immediately removed in a manner that ensures that there is no release of those organisms into the surrounding waters, and be disposed of at an appropriate landfill.**

4. **That throughout the term of this consent the consent holder shall make all reasonable and demonstrable efforts to obtain alternative berthage within the adjoining Port Zone.**

LOVE MARLBOROUGH

NB: Discussions will need to be initiated by the consent holder with Port Marlborough New Zealand Limited to that end.

The reasons for the decision were as follows:

1. **The Committee accepted that vessels such as the Steel Mariner were required for a variety of tasks and acknowledged that there was a need for short term berthing of "industrial" vessels between work contracts.**

2. **The Committee agreed that the nature of the barge was such that it could not be left at anchor and required specific mooring facilities to avoid it becoming a potential navigational hazard.**

3. **The subject site was, as stated by the Harbourmaster, an acknowledged anchorage area for vessels visiting Picton Harbour and Shakespeare Bay, and that when properly berthed in that location, it would not constitute a navigational hazard.**

4. **In approving the site applied for, the Committee was mindful of comments by the Harbourmaster to the effect that no other suitable location was currently available, and that the barge should be located close to Picton so that should problems of any kind occur, a quick response would be possible.**

5. **The Committee acknowledged that the nature of the Marlborough Sounds was such that there are many interests in the waterways, be it from a conservation/reserve management perspective, or the use of the Sounds by residents, visitors and tourists. Inevitably, the berthing of a large vessel of the size and configuration of the Steel Mariner would lead to conflict with one or more of those other interests. However, those interests also needed to be balanced against the applicant's needs. The Committee considered that a balance could be met on this occasion by the granting of a limited duration of consent.**

6. **The subject site is adjacent to a scenic reserve and that site is locationally significant to vessels accessing Picton Harbour. The vessel can also be viewed by vehicles using Queen Charlotte Drive. In those respects, the Committee accepted that effects on landscape and visual amenity were adverse, however, considered those adverse effects were mitigated in this instance by the limited duration of consent granted.**

7. **There was general agreement between the applicant, the Committee and submitters that a more appropriate location for berthing the vessel would be within the industrial environment of the Port Zone which encompasses Shakespeare Bay, however, the Committee noted that the applicant had been unsuccessful in obtaining consent from Port Marlborough New Zealand Limited to berth the vessel within the Port Zone.**

8. **In that respect, the Committee had to accept the statements of the Harbourmaster that given the use of Shakespeare Bay by large freight vessels, there was insufficient room for the applicant's vessel to be berthed in that area. Therefore until that position changed, the Committee concluded that the subject site was the best possible alternative.**

9. **The Committee noted the applicant's request that the duration of consent be extended to April 2003, however, considered an extended term of consent to be inappropriate given that the application has been made on the basis of a 1 year duration.**

FOOTNOTES:

1. **That the berthage of the vessel may be subject to specific requirements of the Harbourmaster in terms of the Harbour Bylaws and/or the Maritime Transport Act.**

2. Te Tau Ihu Iwi have made a claim in the Courts that they own the foreshore and/or seabed at this site and others. In the event that the claim is upheld by the Courts, it is possible that the consent holder may need to reach agreement with Te Tau Ihu iwi in relation to the exercise of this consent.

Accordingly the grant of this consent:

(a) Is without prejudice to the claim of Te Tau Ihu iwi to customary ownership of the foreshore and/or seabed at this site; and

(b) Does not preclude the possibility that the consent holder may need to reach agreement with Te Tau Ihu iwi in the exercise of this consent in the event that the claim to customary ownership is upheld by the Court.

Please note that the foregoing is the full text of the decision.

Your status as an applicant/person making a submission provides you with certain legal rights with regard to the Committee's decision.

For your general guidance, Sections 120 and 121 of the Resource Management Act provide information with regard to appeals.

If you wish to exercise your right of appeal, a "Notice of Appeal" is required to be lodged with the Registrar of the Environment Court and served on Council within 15 working days of your receipt (or receipt by the person who filed the application on your behalf) of the Committee's formal decision. The address of the Environment Court is P O Box 5027, Lambton Quay, Wellington.

Please note that a resource consent lapses on the expiry of **two years** after the date of commencement of that consent, unless the consent is given effect to, **or** after the expiry of such shorter/longer period as is expressly provided for in the consent.

If you are intending to exercise your legal rights regarding the Committee's decision, it is strongly recommended that you seek legal advice.

Yours faithfully

JACKIE STRATFORD
COMMITTEE SECRETARY

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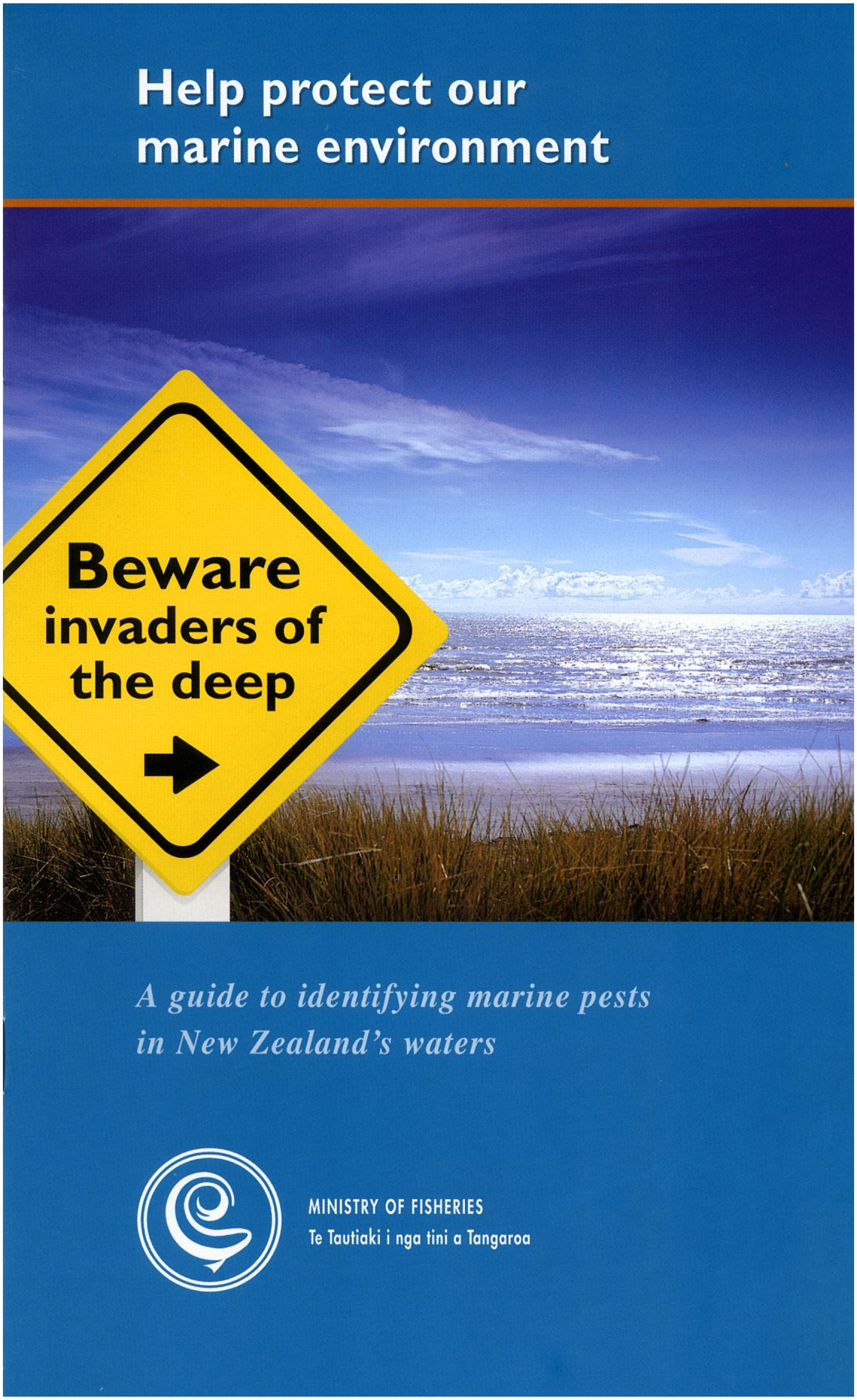
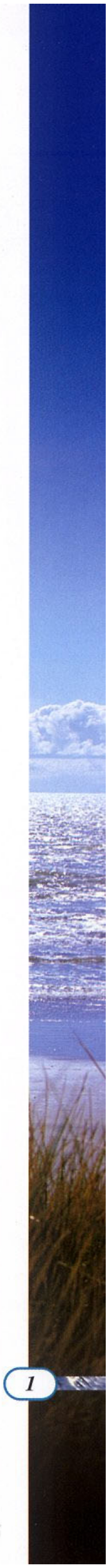
Appendix 4

The Ministry of Fisheries Guide to Identifying Marine Pests in New Zealand Waters


Help protect our
marine environment
Beware
invaders of
the deep
A guide to identifying marine pests
in New Zealand's waters
MINISTRY OF FISHERIES
Te Tautiaki i nga tini a Tangaroa



Look out for these invaders in our waters

The Ministry of Fisheries needs your help to keep a look out for new pests in our marine environment. We have identified six pests that could cause serious problems if they were to invade our marine environment.

Mediterranean Fanworm
Sabella spallanzanii

European Shore (or Green) Crab
Carcinus maenas

Northern Pacific Seastar
Asterias amurensis

Chinese Mitten Crab
Eriocheir sinensis

Green Seaweed
Caulerpa taxifolia

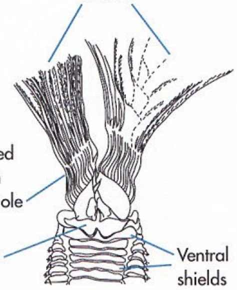
Asian Clam
Potamocorbula amurensis

1

Mediterranean Fanworm

Mediterranean Fanworm

Sabella spallanzanii



Overview

The Mediterranean Fanworm is not yet found in New Zealand although it is found on the south and south-west coasts of Australia, and in Tasmania. It lives in the open seas at depths of 1–30 m and on hard substrates in shallow harbour areas. It prefers sheltered areas away from wave action. The fanworm has a rapid growth rate and can form high-density beds displacing other species that are already there and foul boats and other marine structures. This species could be a threat to our marine ecosystem and could cause problems for marine farmers and boat owners.

Mode of distribution

Adult fanworms could travel to New Zealand on the outside of a vessel's hull or in the seachests. Young fanworms could be carried here in a ship's ballast water.

Description

Size: Tube length 90–400 mm, crown radioles 9–64 mm long.

Shape: Cylindrical body, two groups of radioles – one spiral, the other forming a semicircle.

Construction: The outer layer of tube is comprised of silt or mud and often has organisms growing on it.

Key features

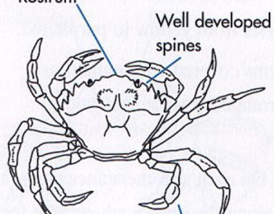
Only **one** of the two groups of radioles making up the crown is in a spiral shape. The radioles are **webbed** for the first 5 mm. Turned down lappets are often **orange** in colour and the first ventral shield is the **widest**.

Photo: Karen Gowlett Holmes

2

European Shore (or Green) Crab

Carcinus maenas



Overview

If this predator invades New Zealand it could reduce the number of different organisms we see in our marine environment and have a serious impact on our scallop and mussel industries. The European Shore Crab is found extensively outside its native range and adapts very well to new places. It is found in sheltered rocky shores mainly under large boulders between the high and low tide marks or buried in the sand on sheltered rocky foreshores. It eats other crabs, clams, limpets, barnacles, mussels and even young scallops.

Mode of distribution

The European Shore Crab could travel to New Zealand in a ship's seachests, ballast water or on fishing equipment.

Description

Size: Up to 8 cm across the body though more commonly 5–6 cm.

Shape: The body is broad at the front with a narrower but blunt rear forming a triangular shape.

Colour: The young crabs vary in colour but are usually olive green, while the upper surface of the adult crabs is distinctly dark green. The adults also often have yellow/orange patches.

Key features

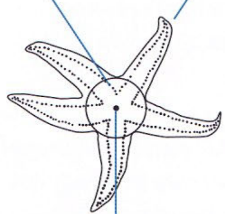
The shore crabs have **10** well-developed spines on the front edge of the body, five on either side of the rostrum. The broad **triangular body** shape and the **absence** of swimming paddles on the last pair of legs are also notable features of this crab. Finally, it will generally show **no aggression** when handled.

3

Photo: Karen Gowlett Holmes

Northern Pacific Seastar

Asterias amurensis



Overview

If this seastar arrives in New Zealand it could have a serious impact on our aquaculture industry and our marine environment generally. The Northern Pacific Seastar is currently found in huge numbers in southern parts of Australia. It feeds on wild and farmed shellfish and a wide variety of other marine animals. It is normally found in shallow water but can be found as deep as 200 m. It prefers muddy, sandy or pebbly surfaces. You would not normally see it on reefs or in areas with high wave action.

Mode of distribution

Northern Pacific Seastars could reach New Zealand in ballast water (larvae) in seachests (spawning adults) or as juveniles on the outside of a vessel's hull.

Description

Size: Up to 46 cm across.

Colour: Varies from yellow to purple/red.

Topside: Arms covered with numerous unevenly arranged small spines with jagged ends.

Underside: On each arm the spines are in a single line along the groove where tube feet lie, joining fan-like at mouth.

Key features

Northern Pacific Seastars have **five** arms which have **pointed** and often **up-turned tips**. The arms join onto a **central disc** and have clumps of small **chisel-like** spines along each side.

Photo: Karen Gowlett Holmes

Chinese Mitten Crab

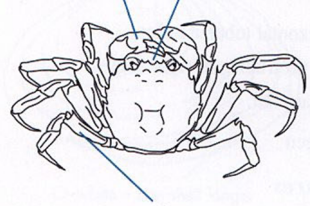
Eriocheir sinensis

Overview

If the Chinese Mitten Crab invaded New Zealand waters it could pose a serious threat to both our marine biological communities and the stability of our river banks. This crab is native to the rivers and estuaries of China and Korea along the Yellow Sea. The young crabs grow and develop in freshwater. When adults, they migrate to the sea to reproduce and die. They burrow into river banks and can cause accelerated erosion and slumping. They have also been known to block water intakes in irrigation and water supply schemes. They carry a lung fluke that infects humans.

Mode of distribution

Chinese Mitten Crabs could arrive in New Zealand as young animals in a ship's ballast water or as adults in a vessel's seachests. It is also a food source in some cultures and so could be introduced deliberately.



Description

Size: Adult up to 80 mm wide, juvenile up to 20–25 mm wide.

Colour: Light brown.

Body shape: Smooth and rounded.

Key features

The front claws of the crabs that are 25 mm or wider are **hairy** with **white tips**. Their legs are twice as long as the width of their body and they have a **notch between the eyes.**

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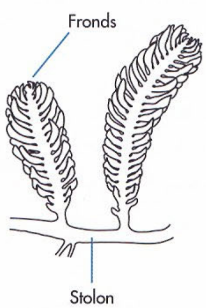
Photo: The National History Museum

Green Seaweed

Caulerpa taxifolia



Overview

This species readily invades new places and is now found on the northern coast of Australia. If it arrived in New Zealand it could cause serious problems to our marine ecosystem. It is found at depths of 3–35 m on rock, sand or mud in sheltered or moderately wave-exposed areas. It smothers other plant life in the area it invades and reduces the habitat available for fish and other animals.

Mode of distribution

This seaweed is used in the marine aquarium trade. Its most likely path of introduction to New Zealand would be by accident (eg, from the dumping of a hobbyist's aquarium into the sea) or possibly from the outflow of a marine pet supplier's holding tanks.

Description

Size: Fronds between 3–15 cm long in shallower lighter conditions and 40–60 cm in deeper water. Stolon diameter of 1.5–1.8 mm but less than 2.8 mm.

Shape: Horizontal tubular stolon with fronds protruding at right angles. The fronds are flat.

Colour: Green

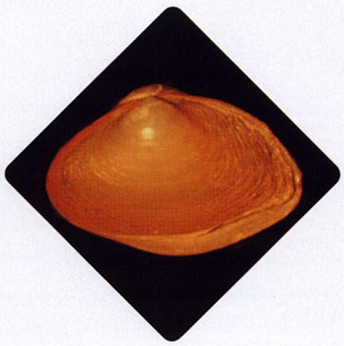
Key features

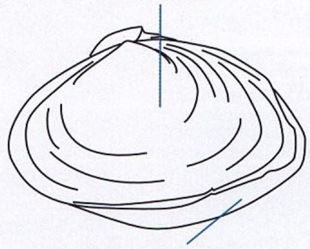
The **flattened** fronds are an important feature to look for. Another important characteristic of Green Seaweed is the fact that the fronds get **narrower** as they near the top of the frond.

Photo courtesy of the Australian Institute of Marine Science

Asian Clam

Potamocorbula amurensis





Overview

If this predator invades it could reduce the number of different clam and bivalve species in our marine environment. It inhabits a wide range of substrate types, temperature and salinity gradients and may reach population densities of more than 25,000/m^2. The native range of this clam is China, Japan and Korea although it has now invaded parts of the west coast of the United States.

Mode of distribution

The young Asian Clams can travel here in a boat's ballast water while the adults can attach to fishing equipment and can invade as fishing vessels move around the world.

Description

Size: Generally 2–3 cm in length. Can be as small as 0.5 cm.

Visibility: Normally $\frac{1}{2}$–$\frac{2}{3}$ of the shell is exposed above the substrate.

Colour: Dirty white (white, tan or yellow).

Key features

This clam has a **smooth unsculptured** shell. One of the clam's two shells is slightly longer than the other, causing the clam to have a slight **overbite**. The portion of the shell exposed above the surface of the sediment is generally **brown** in colour because of sediment that has adhered to the outside of the shell. Sometimes barnacles or other similar organisms can also stick to the exposed portion of the shell.

Photo courtesy of the U.S. Geological Survey

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If you have seen any of these organisms we want to hear from you!

What to do

If you think you've seen any one of these invaders, please collect a sample of the organism(s).

To preserve your sample – except if it is a seaweed – place it in a plastic bag and freeze. If your sample is seaweed, liberally spread salt over the plant, leave overnight, drain off the liquid, re-salt and pack in a plastic bag. If you require any assistance we're ready to help you.

MFish contact details

Please call one of the Ministry of Fisheries numbers below and ask for the biosecurity officer:

Dunedin Office	(03) 474 0333
Nelson Office	(03) 548 1069
Auckland Office	(09) 379 4700
Wellington Office	(04) 470 2633
Toll free	0800 INVADERS
	0800 468 233

Or

E-mail us on: biosecurity@fish.govt.nz

Visit our website: www.fish.govt.nz

Glossary

Ballast water – Water carried in a vessel to maintain its stability while at sea. This water is discharged at port when new cargo is taken on board.

Seachest – A cavity around the water intake area of a vessel. Organisms can attach in these areas and grow relatively undisturbed.

CAWTHRON

NIWA
Taihoro Nukurangi

8

This information booklet was produced by the Ministry of Fisheries with the support of the Cawthron Institute and NIWA.

Appendix 5

Distribution and Abundance Data of Fouling Organisms Found on the 'Steel Mariner'

Table 1. The abundance and wet biomass weight (kg) of fouling organisms found in eight random quadrats surveyed on the 'Steel Mariner". 1, 4, 6, 7, 9, 13, 14 and 16 refer to individual quadrats (see Figures 6 or 8 for the hull location of quadrats). Qualitative refers to presence or absence of species that were identified during qualitative surveys only. Status in Marlborough Sounds refers to a species origin in relation to the Marlborough Sounds area. Abundant = > 100 individuals, rare = < 20 individuals, first figure refers to number of individuals per 0.25 m^2 quadrat, second figure refers to the wet biomass weight (kg) of the organisms in the quadrat. Bold figures refer to organisms that dominated the wet biomass weight of each quadrat (see total wet biomass weights at the bottom of each table).

Taxonomic Group	1	4	6	7	9	13	14	16	Qualitative	Status in Marlborough Sounds
PLANTAE										
Cladhymenia lyallii					Abundant				Present	Exotic (1)
Codium dimorphum				1	2				Present	Native (1)
Filamentous encrusting red algae	Abundant			Abundant	Abundant			Abundant	Present	?
Rhodymenia leptophylla	Rare			Abundant						Native (1)
Ulva luctuca				**36 / 0.23**				1	Present	Native (1)
Undaria pinnatifida			5	**29 / 1.11**					Present	Introduced (2, 3, 20)
PORIFERA										
Callyspongia conica	Rare			Abundant		Abundant	Rare		Present	Native (4)
Callyspongia ramosa									Present	Native (4)
Crella incrustans						Abundant	Rare		Present	Native (4)
Dictyodendrilla sp.									Present	Native (4)
Unidentified sponge								2	Absent	?
CNDARIA										
Hydrozoans										
Unidentified		Abundant	Abundant			Abundant	Abundant		Present	?
Anthozoans										
Anemone unidentified						Abundant	Abundant		Present	?
Cornactis haddoni	Abundant	Abundant	Abundant	Abundant	Abundant		Abundant	Abundant	Present	Native (5)
Platyhelminthes								1	Absent	?
NEMERTEA								1	Absent	?
Wet biomass (kg) / 0.25m^2 qaudrat	**1.36**	**2.09**	**1.15**	**1.81**	**0.82**	**4.96**	**6.01**	**11.33**		

Table 1. Continued.

Taxonomic Group	1	4	6	7	9	13	14	16	Qualitative	Status in Marlborough Sounds
MOLLUSCA										
Polyplacophora										
Acanthochitona (Notoplax) violacea							2		Present	Native (6, 7)
Acanthochitona zelandica	1				1			4	Present	Native (6, 7)
Cryptoconchus porosus						1	2	4	Present	Native (6, 7)
Ischnochiton maorianus					2				Present	Native (6, 7)
Gastropoda										
Crepidula costata	**173 / 0.40**	**7 / 0.02**	**2 / 0.005**	**66 / 0.15**	**94 / 0.32**	**31 / 0.007**	**43 / 0.10**	**560 / 1.29**		Exotic (6, 7)
Nudibranchia									Present	?
Sigapatella novaezelandiae								1	Absent	Native (6, 7)
Tugali suteri							1		Absent	Exotic (6, 7)?
Bivalvia										
Aulacomya atra maoriana							39	1	Absent	Native (6, 7)
Crassostrea gigas							6	4	Present	Introduced (8, 9, 20)
Diplodonta globus						1			Absent	Native (6, 7)
Hiatella arctica	3				3	7	37		Absent	Native (6, 7)
Modiolarca impacta	1			3		**9 / 0.06**	**16 / 0.09**	1	Absent	Native (6, 7)
Monia zelandica						6	1		Absent	Native (6, 7)
Mytilus edulis galloprovincialis	5	8	3	3	2	**5 / 0.001**	6	27	Present	Native (6, 7)
Ostrea chilensis	2	7	12	5	26	**59 / 0.63**	**164 / 1.63**	6	Present	Native (6, 7)
Perna canaliculus	2		1	3		**4 / 0.21**	**4 / 0.10**	**2 / 7.99**	Present	Native (6, 7)
Bryozoa										
Watersipora subtorquata	Rare	Rare	Abundant	Abundant	Rare	Rare	Rare	Abundant	Present	Introduced (10, 20)
Bryozoa unidentified			2			1	1		Present	?
ANNELIDA										
Polychaeta										
Hessonidae	1					3	10	2	Absent	?
Wet biomass (kg) / 0.25m^2 qaudrat	**1.36**	**2.09**	**1.15**	**1.81**	**0.82**	**4.96**	**6.01**	**11.33**		

Table 1. Continued.

Taxonomic Group	1	4	6	7	9	13	14	16	Qualitative	Status in Marlborough Sounds
ANNELIDA Cont.										
Polychaeta										
Polynoidae	1	2	3	2	1	15	51	4	Absent	?
Eunicidae		2					1		Absent	?
Eunice australis		1							Absent	Native (11)
Syllidae								1	Absent	?
Nereidae	6	17	6	7	13	8	14	3	Absent	?
Perinereis camiguinoides	1				1				Absent	Native (11)
Platynereis austrais				1					Absent	Native (11)
Phyllodocidae								1	Absent	?
Dorvilleidae	1	2	3						Absent	?
Dorvillea australiensis		1				9	2		Absent	Native (11)
Lumberinidae	1					14	6	1	Absent	?
Terebellidae			1			20	32	1	Absent	?
Serpulidae										
Galeolaria hystrix			3		7	17	35	64	Present	Native (11)
Pomatoceros terraenovae							1		Absent	Native (11)
Pomatoceros caeruleus							1		Absent	Native (11)
Sabellidae		1				1	2		Present	?
Tanaidacea					Abundant				Absent	?
Tanaid sp.									Absent	?
Asellota						5	14		Absent	?
AMPHIPODA										
Amphipods	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Absent	?
Crustacea										
Caprellidae	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Abundant	Absent	?
Decapoda										
Halicarcinus innominatus (to be confirmed)				1						Exotic (12)
Halicarcinus ovatus (to be confirmed)	1			1				17	Absent	Exotic (12)
Hippolyte bifidirostris				Abundant					Absent	Native (12)
Notomithrax minor		2	1		1		2	1	Present	Native (12)
Plagusia chabrus									Present	Introduced (13, 14, 15, 20)
Wet biomass (kg) / 0.25m^2 qaudrat	**1.36**	**2.09**	**1.15**	**1.81**	**0.82**	**4.96**	**6.01**	**11.33**		

Table 1. Continued.

Taxonomic Group	1	4	6	7	9	13	14	16	Qualitative	Status in Marlborough Sounds
COPEPODA										
Balanus trigonus	12	26	5	7	7		13	42	Present	Introduced (9, 16, 20)
Elminius modestus	12			18	146			292	Present	Native (16)
CHORDATA										
ASCIDIAN (SOLITARY)										
Cnemidocarpa bicornuata			2			4	4	1	Present	Introduced (17, 18)
Pyura rugata	5	24	38	2		**40 / 0.65kg**	**52 / 0.65kg**	8	Present	Native (17, 18)
Pyura subuculata						24	**53 / 0.51kg**		Present	Native (17, 18)
Asterocarpa cerea		17	15			**20 / 0.27kg**	**40 / 0.64kg**		Present	Introduced (17, 18, 19, 20)
Ciona intestinalis			3						Present	Introduced (21, 22)
Microcosmus australis		5	5			5			Present	Native (17, 18)
ASCIDIAN (COMPOUND)										
Aplidium phortax	1					1			Present	Introduced (17, 18, 20)
Aplidium quadriverium	1				1				Present	Native (17, 18)
Aplidium sp.			1						Present	?
Botrylloides leachi					1				Present	Introduced (17 – 21, 23)
Didemnum sp.		**1.03**	**0.4**			**0.01kg**	**0.007kg**		Present	Cryptogenic at this point in time
Taxa richness	**27**	**21**	**25**	**23**	**22**	**33**	**41**	**33**		
Wet biomass (kg) / 0.25m^2 qaudrat	**1.36**	**2.09**	**1.15**	**1.81**	**0.82**	**4.96**	**6.01**	**11.33**		
Mean taxa richness / 0.25m^2 quadrat	**28.13**									
Standard error ~~	**2.46**									

References used for status listings in table-

1) Adams (1994)
2) Hay and Luckens (1987)
3) Hay (1990)
4) Dawson (1993)
5) Cairns (1995)
6) Powell (1979)
7) Walsby and Morton (1982)
8) Dinamani (1971)
9) Dromgoole and Foster (1983)
10) Gordan and Mawatari (1992)
11) Glasby and Read (1998)
12) McLay (1988)
13) Dawson (1987)
14) Dell (1968)
15) Chilton (1910)
16) Foster (1978)
17) Millar (1982)
18) Brewin (1946)
19) Brewin (1948)
20) Crainfield et al. (1998)
21) Brewin (1948)
22) Brewin (1950)
23) Sluiter (1900)