Macroalgal diversity associated with soft sediment habitats in New Zealand

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EXECUTIVE SUMMARY

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- The objectives of this research were to conduct targeted collections in order to examine algal distribution in diverse soft sediment habitats, develop a permanent reference collection and prepared an annotated species list of macroalgae found in soft sediment habitats.
- Collections were made from three harbours with the primary focus on Whangarei and Otago Harbours where seasonal sampling programmes were conducted in spring and in autumn. In the Kaipara Harbour sampling was conducted only in spring.
- Two hundred and forty four taxa were sampled from intertidal and subtidal sites and a range of habitats: 146 (112 spring, 102 autumn) from Whangarei; 150 (107 spring, 115 autumn) from Otago; 43 from Kaipara. Diversity indices indicate that the collecting was not saturated and predict that there is higher diversity of macroalgae in these harbours than found in the samples obtained.
- The flora composition in the harbours was found to differ markedly e.g., only 67 taxa (45%) of the Whangarei flora were found to be in common with Otago Harbour collections; 17 taxa (39%) of the Kaipara flora was in common with the Otago flora; 27 taxa (63%) of the Kaipara flora were also found in Whangarei.
- More taxa were collected in the subtidal (107) in Whangarei Harbour than in the intertidal (84), compared with Otago where numbers of intertidal taxa (120) exceeded the subtidal taxa collected (83).
- Two methods were employed to enable high resolution sampling and these provided differing outcomes in the two main harbours sampled, indicating that there was value in collecting by both methods in order to adequately sample the diversity. In Whangarei Harbour 90 taxa were collected in quadrat sampling compared with 118 taxa via opportunistic collections, and in Otago Harbour 107 taxa were collected in quadrat sampling and 118 taxa via opportunistic collections.
- Nineteen non-indigenous species were found in the harbours, including two new records for the New Zealand algal flora (confirmed by sequence data); *Hypnea cornuta* and *Polysiphonia morrowii*. In Whangarei Harbour eight non-indigenous species were found (four new records for the harbour including *Hypnea*), in Otago Harbour 11 non-indigenous species were found including one new record as well as *P. morrowii*, and in Kaipara Harbour four species were found including two new records for the harbour.
- The macroalgal communities found in Whangarei and Otago Harbours showed very different spatial and temporal distribution patterns within and between harbours. Given these differences, the application of these results to other harbours is cautioned and further sampling recommended.

1. INTRODUCTION

1.1 Overview

Macroalgae contribute significantly to the biodiversity of soft sediment environments, providing structural complexity and habitats for many organisms, as well as sites for reproduction, and settlement of larvae (e.g., Hansen et al. 2010). In addition macroalgae can modify flow and sediment regimes (Lenihan & Micheli 2001) as well as functioning as "coastal filters" in eutrophic coastal bays and embayments (McGlathery et al. 2007). Macroalgal beds are important contributors to productivity and may also be important sites for long-term storage of carbon (Gattuso et al. 1998).

As macroalgae normally require hard substrata for attachment, they occur less frequently in soft sediment environments than on rocky reefs. Macroalgal diversity is increased in areas where there are stable settlement surfaces available. Soft sediment habitats where macroalgae are found vary greatly physically, ranging from harbours and estuaries (with varying sediment types and sizes, freshwater influence, tidal flushing, current flows), to coarse stabilised sediments (shell fragments, cobbles, coarse gravels), and biogenic habitats such as worm tubes, horse mussel beds, brachiopod beds, mangrove forests, rhodolith (maerl) beds, and seagrass meadows. The interface between rocky substrata and sand e.g., beyond the lower edge of the kelp forest, in areas with high sediment loads or shifting sand, has also been observed to be a zone that is characterised by particular algae (e.g. Francis & Grace 1986).

The New Zealand region has a macroalgal flora of ca. 800 species, of which only a small proportion has been reported to live in association with soft sediment environments (Adams 1994; Hurd et al. 2004). Rowden et al. (In press) reviewed the state of knowledge of biodiversity in soft sediment habitats around New Zealand and found that the underlying knowledge of macroalgal diversity, distribution, and abundance was poor. There have been very few targeted collecting programmes for macroalgae in these environments. In addition, little consideration has been given to the role of macroalgae in the assemblages and communities associated with soft sediments. In the international literature macroalgae are recognised as contributing to diversity in soft sediment environments, for example, through the provision of three-dimensional habitat space, influence on water movement and sedimentation, as well as their significant contribution to coastal productivity. In New Zealand the roles of macroalgae in these aspects of soft sediment assemblages have not been explored.

To date the species lists presented in published accounts of soft sediment communities in New Zealand suggest that little regard has been paid to correct identification of macroalgae, and rarely have specimens been lodged in registered herbaria. Few papers refer to permanent voucher specimens thus preventing the development of knowledge based on improved understanding of species concepts, distribution and biology. The combination of few targeted collections, a paucity of permanent material for further examination and study, and an apparent lack of interest in the contribution of macroalgae in soft sediment habitats, have constituted major impediments to an improved understanding of these environments in the New Zealand context. Very little detail is available about macroalgal assemblages, with most accounts simply making reference to the presence of macroalgae encountered in the course of work focused on other organisms. There have been a few studies examining specific aspects of the biology or population dynamics of single species (e.g. Kregting et al. 2008a, b). No papers have been published that specifically address the nature of the relationships between macroalgae associated with soft sediments and high biodiversity in the New Zealand context, although higher macrofaunal diversity has been noted in the presence of macroalgae in Otago Harbour (Rainer 1981) and at Stewart Island (Hare 1992).

The contribution of macroalgae varies greatly between different soft sediment systems. For example, studies have shown that macrophytes (both seagrasses and seaweeds) account for less than 1% of net primary production in turbid and nutrient-rich estuaries, and more than 50% in non-turbid ones (Heip et al. 1995). In some parts of the world seagrass leaves provide important substrata for algal growth

and the interactions between seagrasses and their epiphytic load, for example in relation to shading, photosynthesis, nutrient relationships, has been the focus of a number of studies (e.g. Harlin 1994; Cummins et al. 2004). In New Zealand seagrass (*Zostera*) beds do not appear to serve as significant habitat for macroalgal growth.

Macroalgal diversity in estuarine environments is recognised internationally to be impoverished when compared with that found in coastal waters: relatively few species of macroalgae are tolerant of varying salinity although the contribution these species make to estuarine and harbour biomass and productivity may be very significant in certain locations and/or at particular times of the year (Nienhuis 1994; Raffaelli et al. 1998). Shallow areas of soft sediment such as harbours and estuaries are highly vulnerable to human-induced changes through land and catchment use/management, as well as to sea temperature changes, changes in freshwater inflows (e.g. increased rainfall or altered rainfall patterns), and sedimentation. In a study of sediment macrobenthos in the upper Otago Harbour, Grove & Probert (1999) concluded that a combination of percent sand, macroalgal content, water depth, and chromium concentration correlated best with the observed community structure. Although they recorded the weight of algal material collected from surface of each sample, the macroalgal species present were not identified.

Unattached macroalgae may accumulate intertidally and subtidally over soft sediments and in some areas they continue to grow and to photosynthesise. The proliferation of filamentous and sheet-like macroalgae in harbours and embayments is a worldwide phenomenon, apparently in response to human modification of the environment (organic enrichment and eutrophication) (Valiela et al. 1997). Such 'algal mats' in some situations provide refuge for invertebrates (Raffaelli et al. 1998), although accumulation of large drifts can modify silt deposition and create a hostile chemical environment, preventing recruitment of infauna larvae (Taylor 1999). Some mat forming species have also been shown to produce toxic compounds (Nelson et al. 2003; Van Alstyne et al. 2011) affecting grazers, settlement of invertebrate larvae, and macroalgal growth.

The establishment of algal mats appears to be complex and controlled by factors such as grazing and bioturbation (top-down control) and nutrient availability (bottom-up control) (Nelson et al. 2008; Engelsen et al. 2010) as well as pelagic drift of overwintering thalli to new sites (Schories et al. 2000). Martins et al. (2008) concluded that "hydrodynamics control macroalgae productivity in shallow mesotidal estuaries" with "low hydrodynamic conditions" leading to persistence of macroalgae in the system through the winter and the development of blooms in the spring, whereas "high hydrodynamic conditions" result in adult macroalgae drifting out of the system with dormant spores being the only source of spring biomass. In some studies it appears that the development of anoxic conditions stimulates the growth of macroalgal mats by both increasing the availability of nutrients from the sediments but also reducing grazing pressure by macrofauna (Engelsen et al. 2010).

There is a substantial international literature about the phenomenon of 'green tides' which occur when species of *Ulva* grow very abundantly, frequently in harbours or sheltered soft sediment environments (e.g., Valiela et al. 1997; Raffaelli et al. 1998; Taylor 1999; McGlathery et al. 2007). The most dramatic green tides reported to date occurred during the Olympic sailing competition in China in 2008 when a bloom covered approximately 13 000 to 30 000 km^2 of the Yellow Sea and enormous volumes of drift algae accumulated on shores in the vicinity of Qingdao (Leliaert et al. 2009; Pang et al. 2010). In New Zealand, green tides have been studied in Tauranga and in the Avon-Heathcote estuary (Hawes et al. 1992; Hawes & Smith 1995; de Winton et al. 1998; Hawes 2001).

Harbours and estuaries are often the entry point for non-indigenous species. Of the 35 species of macroalgae considered to be human-mediated introductions to New Zealand, 34 species have been collected from harbour or soft sediment environments (Nelson 1999; Nelson et al. 2004; MITS (Marine Invasives Taxonomic Service); Herbarium of the Museum of New Zealand Te Papa Tongarewa). Russell et al. (2008) documented the spread of *Undaria pinnatifida* within the Otago harbour over 16 years following its initial colonisation in 1990 and also examined the spread of *Undaria* from Otago Harbour into surrounding inlets and the open coast. Williams & Smith (2007) in

a global review of the impacts of introduced macroalgae reported that the most important vectors for seaweed introductions are fouling of vessel hulls and aquaculture (direct and indirect). They also noted that introduced seaweeds can be numerous and abundant in areas subjected to nutrient pollution (e.g., Occhipinti Ambrogi 2000; Boudouresque & Verlaque 2002), suggesting that nutrient enrichment may enhance invasion success, although cautioning "vectors and other factors that co-vary with pollution can confound causality".

It is not possible to arrive at a consistent view of the distribution of macroalgae in soft sediments around New Zealand based on the literature published to date. The data available are geographically patchy, the studies of soft sediment environments have largely overlooked the macroalgae, and the sampling regimes employed make it difficult to compare results between studies. Targeted collections of macroalgae from soft sediment environments in New Zealand are needed to enable the documentation of diversity in these little-studied environments, and to improve the resources and basis for taxonomic studies through the development of permanent reference collections, resulting in an improved understanding of diversity, both geographically and associated with specific environments.

Baseline datasets are important components of biodiversity science (Terlizzi et al. 2003). The value and interpretation of other datasets are frequently predicated on the existence of such baseline data, for example, the ability to recognise change, or to establish cost-effective biomonitoring at a range of scales, the use of biodiversity surrogates, all require that there is baseline knowledge of the biota. As Terlizzi et al. (2003) observe "approximation must not be made *a priori*: the profound knowledge of systems and their species is the first, crucial step".

The primary objective of this study (see 1.2 below) was to document the occurrence and distribution of macroalgae in soft sediment marine environments exemplified by two New Zealand harbours. Widespread sampling was undertaken in northern and southern harbours (primarily Whangarei and Otago Harbours) to gather taxonomic and distributional data, as well as examine distribution in relation to particular environmental variables. The sampling enabled targeted comparative studies of exemplar habitats within these harbours and hypotheses about macroalgal diversity to be examined.

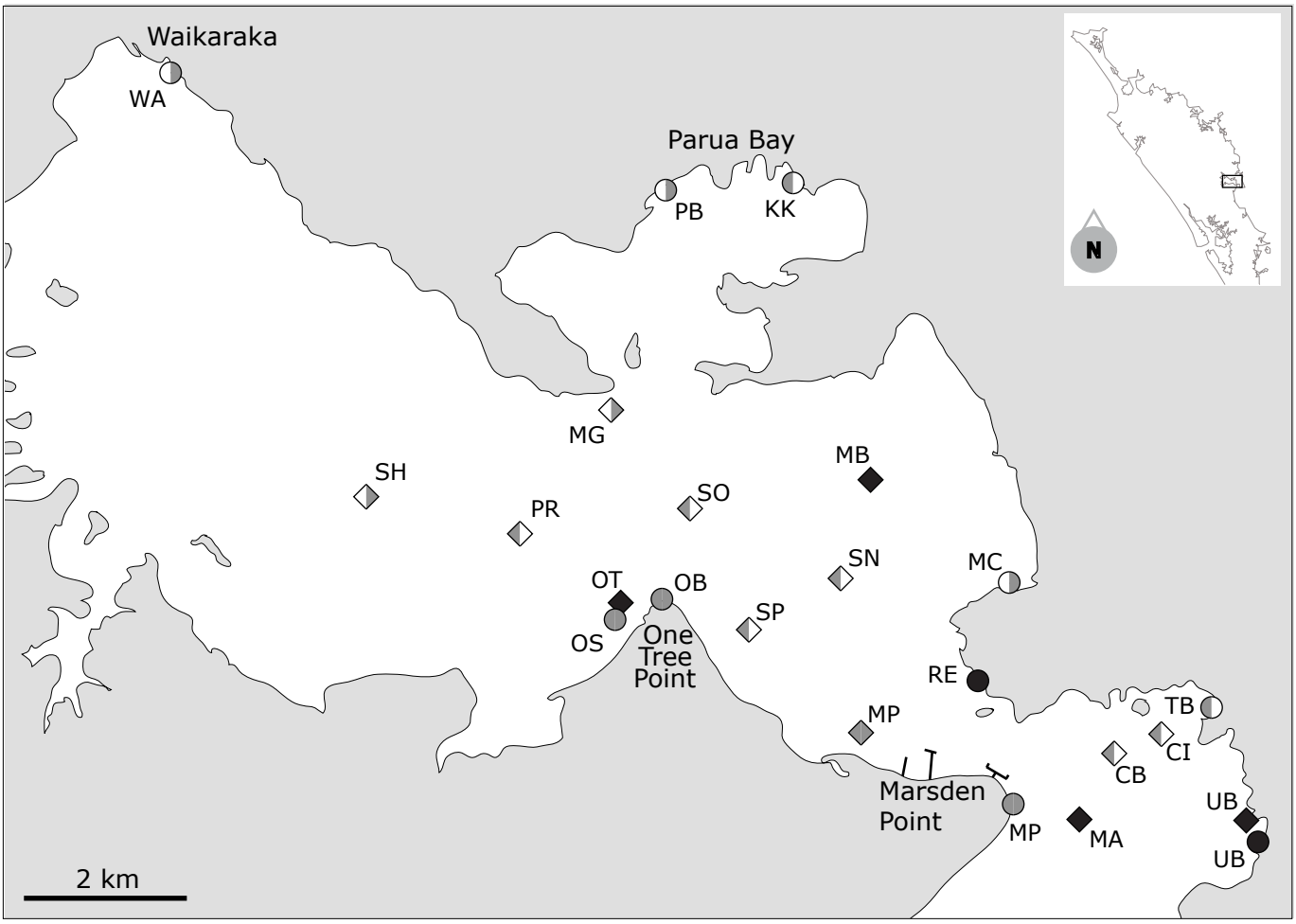
Compilation of reliable species lists requires that all taxa be identified to the highest possible taxonomic resolution. For macroalgae growing in soft sediment environments in many cases there are no simple or reliable morphological characters to permit appropriate field identifications. The focus of this study has been on the macroalgal flora, with high resolution sampling followed by analyses conducted by taxonomically knowledgeable staff, augmented with molecular sequence approaches to identify cryptic /sterile taxa.

1.1 The harbours

1.1.1 Whangarei Harbour

Whangarei Harbour is a drowned river valley 24 km in length and extending over 98 km^2, including 54 km^2 of intertidal flats. The harbour channel splits into two near the entrance (around Snake Bank) and splits again at Limestone Island, where the southern arm leads to the Portland Wharf, and the northern arm to the main port and the Whangarei town basin. All sampling for this research project was undertaken in the outer part of the harbour, i.e. east of Limestone Island (Figure 1).

Whangarei Harbour is considered to be strongly influenced by human activities. In addition to development, run-off, and activities around the ports and Marsden Point, 3 million m^3 of sediment fines and 2 million m^3 of channel dredge spoil have been dumped in the harbour since the 1920s (various authors in Morrison 2003) resulting in major modifications to water clarity, sediments, and ecology (Mason & Ritchie 1979). Suspended sediment input is 54 560 tonnes/yr (approximately 184 $t/km^2/yr$) (Murray Hicks pers comm.). Between 1966 and 1971 a large proportion of the harbour's seagrass (*Zostera muelleri*) beds disappeared (Mason & Ritchie 1979). There is some debate whether this loss was due to dredging and dumping, or a slime mould infection (Mason & Ritchie 1979; Morrison 2003), but due to the lack of recovery, the former seems more likely (Reed et al. 2004).



Code	Locality
CB	Calliope Bank
CI	Calliope Inner
KK	Kirikiri Point
MA	Mair Bank
MB	McDonald Bank
MC	McLeod Bank
MG	Manganese Point
MP	Marsden Point
OB	One Tree Point boat ramp
OS	One Tree Point seagrass
OT	One Tree Point
PB	Parua Bay
PR	Pirihi Road
RE	Reotahi
SH	Shell Cut Reach South (Tamaterau)
SN	Snake Bank Inner
SO	Snake Bank Outer
SP	Sinclair Point
TB	Taurikura Bay
UB	Urquharts Bay
WA	Waikaraka

	Primary	Secondary		
	Autumn & Spring	Autumn only	Spring only	Autumn & Spring
Intertidal	●	◐	◑	●
Subtidal	◆	◇	◇	◆

Figure 1: Map of sampling sites in outer Whangarei Harbour. Throughout this report sites are referred to by the 2-letter code as indicated above. Further information about the sites is provided in Appendix 1.

Previous work on macroalgae in the harbour appears very limited. Only twelve species from the Whangarei Harbour are represented in the Te Papa herbarium from earlier collections. In a review of the natural features of Whangarei Harbour, and as part of a wider Northland review, Morrison (2003, 2005) makes no reference to macroalgae in soft sediment habitats, but does make some reference to algae on rocky shores and subtidal reefs. Discussions with colleagues who have worked in Whangarei Harbour also yielded little in the way of recommended sampling areas; therefore there was little available information as to where sampling should best be conducted.

1.1.2 Otago Harbour

Otago Harbour is a narrow inlet, approximately 21 km long running south-west from its head at Dunedin, north-east to its mouth between Aramoana and Taiaroa Head, and has a regularly dredged shipping channel along its northern edge (Russell et al. 2008). The harbour is divided roughly in half by two peninsulas and several islands; the inner section of the harbour is referred to as the upper harbour, and the outer section as the lower harbour (Grove & Probert 1999). All sampling for this research project was undertaken in the outer/lower harbour (Figure 2).

Otago Harbour experiences a range of tide maximum velocities between 1.03 $m.s^{-1}$ and 1.59 $m.s^{-1}$. Within a tide, velocities vary in different parts of the harbour due to scour holes, constrictions, and the entrance bar. At Port Chalmers tidal range is between 1.25 m and 1.98 m, and the amount of water flowing in during a tidal cycle is between 6.9 x 10^7 m^3 and 7.5 x 10^7 m^3 (authors in Single et al. 2010). Suspended sediment input is 5120 tonnes/yr (approximately 44 $t/km^2/yr$) (Murray Hicks pers comm.).

Bottom sediments within the harbour range from silt to coarse sand/shell, however coarser sediments are more common in the lower harbour, particularly towards the mouth (James et al. 2009; Single et al. 2010). There is currently a proposal by Port Otago Ltd to widen and deepen the channel and to dredge intertidal areas to accommodate larger ships (James et al. 2009). This proposal has brought about various investigations into aspects of the biology, ecology, and physical environment of the harbour with full details publicly available under Project Next Generation (http://www.portotago.co.nz).

In contrast to the other harbours studied, a number of macroalgal collections have been made from the Otago Harbour over a number of decades with 124 specimens lodged in the Te Papa herbarium, collected from 1861 onwards. Recent research on macroalgae in the harbour includes the ecophysiological studies of Kregting et al. (2008a,b) on *Adamsiella chauviii* and an analysis of the range expansion of *Undaria* (Russell et al. 2008).

1.1.3 Kaipara Harbour

The Kaipara Harbour is the largest harbour in New Zealand and one of the largest estuaries in the world. The harbour covers an area of 94 700 ha, including over 40 000 ha of exposed sand and mud flats. The harbour is roughly divided into two by the harbour entrance on the west side and the Okahukura Peninsula on the east side and is subject to strong currents, particularly in restricted channel areas, the shallow arms are also well flushed by tides (Haggitt et al. 2008). Sediments within the harbour are dominated by fine (0.125–0.25 mm) and medium (0.25–0.50 mm) sands (Hume et al. 2003). All sampling for this project was undertaken in the Southern Kaipara (Figure 3).

The southern Kaipara covers an area of 440 km^2, including 250 km^2 of intertidal flats, and has been the focus of recent research on intertidal and subtidal community and habitat types (Hewitt & Funnell 2005).The southern Kaipara Harbour was sampled for this study in March 2009. Subtidal sites were selected to target epibenthic habitats recorded as ‘filamentous weed’, ‘sponge-weed’, and ‘*Atrina* beds’ reported for the southern Kaipara by Hewitt & Funnell (2005).

Previous work on macroalgae in the harbour has been very limited. Only six species from the Kaipara Harbour are represented in the Te Papa herbarium from earlier collections, and all of these were collected from Shelly Beach.

Code	Locality
GP	Between Gills Landing & Portobello
HB	Opposite Hamilton Bay
HW	Harwood
MO	Torpedo Boat Mole
OW	Otakou/Wellers
PP	Pulling Point
TN	Te Ngaru
WO	Opposite Wellers subtidal

	Primary	Secondary		
	Autumn & Spring	Autumn only	Spring only	Autumn & Spring
Intertidal	●	◐	◑	●
Subtidal	◆	◆	◆	◆

Figure 2: Map of sampling sites in outer Otago Harbour. Throughout this report sites are referred to by the 2-letter code as indicated above. Further information about the sites is provided in Appendix 1.

Code	Locality
DS1	Dive Site 1
DR#	Dredge Site #
KP	Karaka Point
SB	Shelly Beach

	Primary	Secondary		
	Autumn & Spring	Autumn only	Spring only	Autumn & Spring
Intertidal	●	◐	◑	●
Subtidal (Dive)	◆	◇	◇	◆
(Dredge)		▮		

Figure 3: Map of sampling sites in southern Kaipara Harbour. Throughout this report sites are referred to by the 2-letter code as indicated above. Further information about the sites is provided in Appendix 1. Note that no collections were made from Dive Site 1.

1.2 Objectives

1.2.1 Overall objective

1. Conduct a targeted collection programme across diverse soft sediment environments to develop a permanent reference collection of representative macroalgae.

1.2.2 Specific objectives

1. Conduct a targeted collection programme across diverse soft sediment environments to develop a permanent reference collection of representative macroalgae.
2. Examine algal distribution in soft sediment habitats in relation to selected environmental variables.
3. Prepare an annotated checklist of macroalgae found in soft sediment environments in the New Zealand region.

2. METHODS

2.1 Harbours, collection methods, and seasons

This research was initially intended to be carried out in one northern (Kaipara) and one southern (Otago) harbour using directly comparable collection methods. Conditions in the Kaipara Harbour were such that subtidal collections by scuba were not possible, necessitating the use of a modified scallop dredge. Collections by dredge were too indiscriminate and not comparable with hand collections, therefore after one collecting trip the target northern harbour was changed from Kaipara to Whangarei. The Kaipara data are presented separately from the Whangarei and Otago data in most cases.

The two main harbours (Whangarei and Otago) were sampled on several occasions in 2009 and 2010, while Kaipara harbour was sampled on only a single occasion in 2009 (Table 1). A summary of the methods used in each harbour is shown in Table 2.

Table 1: A summary of the seasons in which each harbour were sampled.

	Whangarei	**Otago**	**Kaipara**
Spring	September/ October, November	October	-
Autumn	March, April	February	March

Table 2: A summary of the collection methods used within each harbour.

	Whangarei	**Otago**	**Kaipara**
Intertidal transects	Y	Y	Y
Intertidal opportunistic	Y	Y	Y
Scuba transects	Y	Y	N
Scuba opportunistic	Y	Y	N
Dredging	N	N	Y

2.2 Field methods

In Kaipara and Otago Harbours field sites were selected to align with areas where macroalgal assemblages have previously been reported. For Kaipara Harbour, sites were based on the research of Hewitt & Funnell (2005) in the southern part of the harbour. In the outer Otago Harbour the work of Paavo & Probert (2008) guided site selection. In Whangarei Harbour sites were selected randomly as no published reports on macroalgal assemblages were found.

2.2.1 Whangarei and Otago Harbours

Collections were of two types, quadrats and opportunistic. At each primary site quadrats were randomly laid out along a 50 m transect, and for each quadrat percentage cover was recorded (algae, sand, mud, seagrass, shell, rock, coralline, other) before all algae were removed from the quadrat. Opportunistic collections were made over a timed period where a macroalgal expert collected at least one sample of every macroalga that appeared to be unique for that site. The timed period matched the amount of time spent assessing the quadrats at that site.

In the first round of sampling, a subdivided 50 x 50 cm quadrat was used to assess the suitability of different quadrat sizes (10 x 10 cm, 25 x 25 cm and 50 x 50 cm). A nested quadrat is used to assess the quadrat size that best captures a frequency of occurrence of between 20 and 80% for the majority of taxa. After analysis, the 10 x 10 cm quadrat was found to under-represent the majority of species found (0–10%). The 25 x 25 cm was little better (5–23%) while the 50 x 50 cm quadrat gave the best results of the three quadrat sizes trialled (21–52%), however for a number of species the 50 x 50 cm quadrat resulted in frequencies that were too large. Although a change to a 100 x 100 cm quadrat would potentially improve the frequencies for some species, it would also significantly over-represent other species. When sampling multiple species compromises are often necessary in the selection of an appropriate quadrat size as both the number of quadrats to be sampled and the size of the quadrat will differ between species (Kingsford 1998). Although smaller quadrats may underestimate some species, the logistics of using larger quadrats is also an important consideration as they can limit the number of replicates (Kingsford 1998; Lobban & Harrison 1997). In this case the limited time available at turning/slack tides and the significant amount of material generated by a larger quadrat meant that we settled on a 50 x 50 cm quadrat.

2.2.2 Kaipara Harbour

An initial attempt to sample subtidal transects by scuba failed due to strong currents and extremely poor visibility, so sampling was completed using a scallop dredge modified with a 1 cm mesh overlay. A total of 23 dredge sites between 2.0 and 14.0 m depth were sampled (see Figure 3 and Appendix 1) – at each site the dredge was towed for 2 minutes at an approximate speed of 2 knots. Two intertidal sites were also sampled.

2.2.3 Environmental variables

Where possible, environmental data (particularly sediment types) from existing sources were used to inform our sampling design, and to evaluate our biodiversity data in relation to key parameters. Although there are data about sediment characteristics available for each of the harbours sampled, the data are in different formats, and based on different sampling methods and analysis. As a result, it was difficult to standardise or compare sediment characteristics between harbours.

In addition, we observed considerable variation in sediment properties within a single site (sometimes within a quadrat), for example, coarse gravel/shell where a stream or storm water pipe flowed, with fine mud and sand less than a metre away. As we were conducting harbour wide studies, it was beyond the scope of this project to evaluate the finer details of species distributions with respect to sediments and to carry out sediment analyses.
Monthly mean sea surface temperatures for the three harbours for 2009/2010 are presented in Appendix 2.

2.3 Specimen processing

The algae collected from each quadrat were divided into phyla (green – Chlorophyta; red – Rhodophyta; brown – Heterokontophyta) before being further subdivided into structural groupings, e.g. blades, finely divided, tubular, saccate, etc). Each structural group was then weighed and a wet weight recorded. Algae were then further separated into unique samples (preliminary field identification) and each sample was allocated a unique lot number (e.g., SS1421) and recorded before being preserved using the most appropriate method/s for each sample (fresh pressed, ethanol or formalin fixation, air dried, photographed, desiccated in silica gel for molecular analysis).

Subsequent analysis involved the inspection of lots under the microscope, sectioning, preparation, and photographing of permanent slides, and the selection of specimens for molecular analysis. Once all identifications were completed, exemplar specimens for taxa were selected and deposited with WELT (Museum of New Zealand Te Papa Tongarewa, Thiers 2011) for accessioning into the herbarium.

2.4 Molecular methods

2.4.1 Samples

A total of 115 algal specimens collected from soft sediment habitats and desiccated in silica gel were selected for DNA extraction using standard methods appropriate to the genus in question. The Chelex method of Goff & Moon (1993) was used for specimens identified as *Ceramium*, *Centroceras*, *Ulva*, *Plocamium*, *Hypnea*, *Spyridia*, and *Gracilaria*, and the CTAB/Proteinase K method of Zuccarello & Lokhorst (2005) was used for specimens identified as *Codium* and *Adamsiella*. Specimens of *Ceramium*, *Centroceras*, *Polysiphonia*, *Plocamium*, *Hypnea*, *Spyridia*, and *Gracilaria* were prioritised for sequencing based on known taxonomic issues with members of these genera.

2.4.2 Amplification and sequencing

Initially various polymerase chain reaction (PCR) primers were tested on *Centroceras*, *Ceramium*, *Polysiphonia*, and *Plocamium*. While good amplification was obtained for members of the latter two genera, initial attempts to amplify *Centroceras* and *Ceramium* specimens with existing ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit gene (*rbc*L) primers were not effective. In view of this, part of the nuclear ribosomal large subunit (LSU) gene was amplified for these specimens, while new *rbc*L primers were being obtained. The LSU locus provides useful information but is not as informative as the more variable *rbc*L gene. This strategy proved effective, quickly generating initial LSU sequence that allowed the sequences to be assigned to groups, and then the *rbc*L gene was sequenced from representatives of these groups (at least two from each group) once new primers were obtained. This allowed us to compare our data with taxa represented by *rbc*L sequences in GenBank.

2.5 Data Analysis

Comparisons were made at several levels, e.g., harbour, site, season, tidal level, and collection method. Sites were defined as primary or secondary sites based on the type and frequency of collections. Analyses are focused on primary sites however data from secondary sites contribute to the overall diversity analyses:

- Primary sites
    - Sites that were sampled in both seasons, using both collecting methods (4 collecting events)
- Secondary sites
    - Sites that were sampled in only one season (by 1 or 2 methods), or both seasons but only using one method (1–3 collecting events)

The data resulting from this research are presence/absence data for macroalgae at a high level of taxonomic resolution. The following diversity measures were assessed:

- Richness (number of taxa)
    - The observed number of taxa (*S*)
    - γ-diversity (the predicted number of taxa for an area based on taxa accumulation curves)
- Species composition
    - Bray-Curtis similarity
    - Average taxonomic distinctness (ATD) (Clarke & Warwick, 1998)
    - Variation in ATD (VarATD) (Clarke & Warwick, 2001b)

- Rarity

With the exception of the observed number of taxa (*S*) and rarity, these measures were all calculated using the multivariate PRIMER software (Clarke & Warwick 2001a).

2.5.1 Number of taxa

Species richness is the number of species observed (*S*) and is influenced by sampling effort. At sites where both quadrat and opportunistic collections were made, this measure was calculated on both data sets. These two collection types were always made on the same day and for the same amount of time, and are here considered to be equal sampling effort on the assumption that for small species in particular, the more indiscriminate quadrat sampling would balance out the visual collections made opportunistically. Taxa accumulation curves were calculated in PRIMER using the Chao 2 estimator to predict γ-diversity.

2.5.2 Species composition

Bray-Curtis similarities were obtained by generating a resemblance matrix from the presence/absence of all taxa. Resemblances were then used to produce MDS (multi-dimensional scaling) plots. Bray-Curtis produces similarities between 1 and 100; assemblages with higher values are more similar to each other, while lower values indicate that species composition is more distinct. In MDS plots, data points that are close together are more similar to each other than points that are far apart.

Similarity percentages (SIMPER) analyses were also calculated for the seasonal data from the primary sites. SIMPER analyses provide an indication of the contribution of individual taxa to the similarities within a group, and the dissimilarities between groups. In this case for each site it was used to assess the similarity between samples within a season, and the dissimilarity between seasons for each site. Taxa contributing over 10% to the similarities or dissimilarities are listed.

ATD is not influenced by sample size or replication and provides a measure of species richness and phylogenetic diversity (Clarke & Gorley 2006). This index incorporates the taxonomic hierarchy of all taxa analysed, giving a value between 0 and 100. Higher values indicate greater differentiation at the order or class level, while lower values are indicative of greater differentiation at the genus or family level. Recently Ellingsen et al. (2005) recommended the use of ATD within phyla rather than between phyla due to differences in hierarchical classification systems between phyla. In these analyses, ATD have been calculated across the three phyla as the same classification system was used for all three.

In calculating ATD and VarATD a subset of data was used; 13 taxa with a taxonomic resolution of family or above were removed.

2.5.3 Rarity

The number of taxa rare in frequency (S_{RF}) was also investigated using the following index:

$S_{RF} = \Sigma Sj$, where Sj occurs only at 1 site.

Rarity for each harbour was calculated at several levels:

- Taxa that only occurred as a single collection (SC)
- Taxa that only occurred as a single collection at a single site within a harbour, and also occurred in 1 or both of the other harbours (SS)
- Taxa that occurred as multiple collections from a single site, and also occurred in 1 or both of the other harbours (SSM)

2.6 Data management

All data collected during this research are recorded in a purpose-built FileMaker Pro database. The database was used to record and track: specimens and molecular subsamples; richness, biomass and percentage cover data; field site data; distribution data; taxonomic classification data. The database

was also used to produce species lists for each harbour, site, season, tidal level, and collecting method, and eventually to produce the annotated species list.

2.6.1 Distribution data

For each taxon, the distribution data reported in the annotated species list was sourced from Adams (1994) and updated with data from MITS, and records from the collections of NIWA's marine algae group. The classification of macroalgal records into biogeographic regions was based on Shears et al. (2008) and Nelson (1994). The regions Kermadecs, Three Kings, Chathams, and Subantarctic were not included in Shears et al. (2008). In this report mainland New Zealand is divided into three units encompassing the following groupings of bioregions recognised by Shears et al. (2008): Northern (Northeastern, Raglan and Portland bioregions), Central (Abel, Buller, Cook, Banks bioregions), Southern (Westland, Fiordland, Chalmers, Stewart I).

3. RESULTS

3.1 Sample sites

The sites sampled in each harbour are shown for Whangarei Harbour (Figure 1), Otago Harbour (Figure 2), and Kaipara Harbour (Figure 3).

3.2 Characteristics of the flora

A total of 244 taxa were recorded from the three harbours; 146 from Whangarei Harbour, 150 from Otago Harbour and 43 from Kaipara Harbour (Appendices 3–5). The majority of samples were able to be identified to species, but some samples were fragmentary or sterile and able only to be identified to genus, or in some cases, family, order or class. The majority of taxa recorded, 155, were red algae compared with 43 green, 46 brown, and one xanthophyte.

Some families were particularly well represented in the material collected e.g., Cladophoraceae, Ulvophyceae, Scytosiphonaceae, Ceramiales (particularly Delesseriaceae, Ceramiaceae, Rhodomelaceae), and in the Gracilariaceae there are four species of the genus *Gracilaria* recorded. About half of the algae sampled were filamentous or small (less than 3–5 cm). For example, amongst the green algae about half of the taxa recorded fell into this category, including 15 identified as belonging to the Cladophoraceae. Although members are both widespread and common, this family is very poorly understood in New Zealand. The majority are filamentous and less than 3 cm in height.

Amongst the brown algae there were 12 records of filamentous taxa, mainly in the families Ectocarpaceae, Acinteosporacaeae, and Sphacelariaceae. More than 70 taxa of finely branched or filamentous red algae were recorded during this study including 18 Ceramicaceae and 18 Rhodomelaceae (of which 16 are *Polysiphonia* spp.). In identifying the material of *Polysiphonia* we applied the species concepts of Adams (1991, 1994). Some sequencing data from New Zealand collections have been made available (D.W. Freshwater pers comm.) in addition to recently published sequence data (Stuercke & Freshwater 2010). Three species, distinguished in the report as *Polysiphonia* species 3, *P*. species 4, and *P*. species 5, are known solely from herbarium specimens and no sequence data are available.

Algae with larger stature that were collected during this study include, for green algae, *Codium fragile*; for brown algae, *Hormosira banksii* and *Undaria pinnatifida*; for red algae, *Adamsiella chauvinii*, *Gracilaria secundata*, *Gracilaria chilensis*, *Gracilaria* 'BB', *Gracilaria truncata*, *Solieria* sp., *Aeodes nitidissima*, *Gigartina atropurpurea*, *Rhodoglossum* sp., and *Sarcothalia livida*.

In the northern harbours there were fewer large, conspicuous algae e.g., in Whangarei *Codium fragile*, *Hormosira banksii*, *Gracilaria chilensis*, *Gracilaria truncata*, *Aeodes nitidissima*, *Gigartina atropurpurea*, and in Kaipara, *Codium fragile*, *Gracilaria chilensis*, *Gracilaria* 'BB', and *Solieria* sp.

In Otago harbour there were more conspicuous, larger taxa present than in the other harbours including *Codium fragile*, *Undaria pinnatifida*, *Adamsiella chauvinii*, *Gracilaria chilensis*, *Gracilaria truncata*, *Gigartina atropurpurea* and *Rhodoglossum* sp.

In Otago harbour subtidal red algal meadows have been reported previously, and these consist primarily of *Adamsiella chauvinii* with *Gracilaria truncata* and associated species of Delesseriaceae (e.g., species of *Schizoseris*, *Haraldiophyllum crispatum*). In Whangarei harbour subtidal populations of *Gracilaria truncata* were also present but did not form such extensive meadows.

A minority of the species recorded in the study we consider are not typical of soft sediment environments as they are commonly found in rocky reef habitats. In some cases these were drift and tangled in quadrats, and were recorded only once or infrequently in this study, e.g., *Carpophyllum* spp., *Cystophora* sp., *Durvillaea antarctica*, *Macrocystis pyrifera*, *Scytothamnus* spp., *Adamsiella angustifolia*, *Melanthalia abscissa*, *Pachymenia dichotoma* and *Pterocladia lucida*.

3.3 Number of taxa

For all three harbours, the observed number of taxa did not approach γ-diversity (gamma-diversity, the number of taxa predicted to be present) (Figure 4).

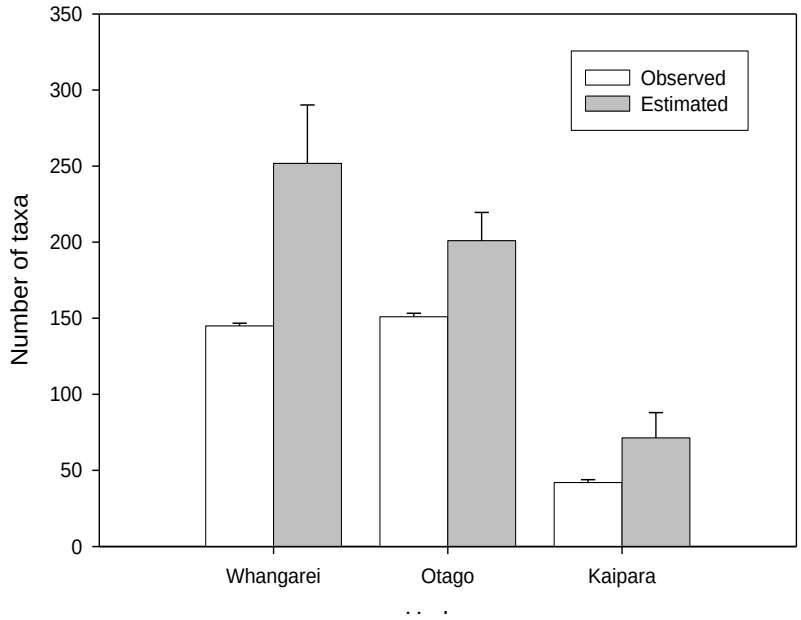


Figure 4: Observed number of taxa and γ-diversity (estimated from taxa accumulation curves) for each harbour.

Figure 5 compares observed and estimated number of taxa between seasons, collection methods, and tidal level for each harbour. The total number of collecting events for each comparison varied, so for calculating gamma diversity all comparisons were standardised to the lowest number of collecting events, n = 14. The estimates of gamma-diversity are therefore conservative, but comparable. In Whangarei Harbour the observed and estimated values for the number of taxa differed in all comparisons, namely, seasonally (in spring and autumn) (Figure 5(a)), by collection method (both in the quadrats and opportunistic collections (Figure 5(c)), and by depth (Figure 5(e)). In all cases the estimated values were higher than the observed values indicating that sampling was not yet saturated, i.e. had not captured all the taxa present within a harbour.

The observed and estimated values for the number of taxa in Otago Harbour differed in all comparisons (Figure 5 (b), (d), (f)) although generally by a smaller margin than seen in the Whangarei sites. This indicates that the Otago sites sampled were more alike, and the sampling was getting closer

to saturation values for the number of taxa collected, particularly for the intertidal collections in Otago Harbour.

In Figure 6, the seasonal and total observed taxon richness for Whangarei Harbour is broken down by site. In the intertidal primary sites (Figure 6(a) – combining quadrat and opportunistic data) there was little difference in the number of species found between seasons, although the species composition differed by season (as seen in the total number of taxa recorded for each site). In the subtidal primary sites, two showed little/no seasonal difference (MA and OT) whereas two sites (MB and UBS) had fewer taxa recorded in autumn than in spring. The innermost harbour site, OT, had very few species recorded (2–3), whereas around 40 species were recorded from the other three primary sites over the two seasons sampled. The collections from the secondary sites (Figure 6(b)) contributed to the overall compilation of representative collections, but as collections were not made from all sites at both seasons no meaningful comparisons can be made between intertidal and subtidal areas, or between seasons. There was a general trend of more taxa being collected at outer rather than inner harbour sites.

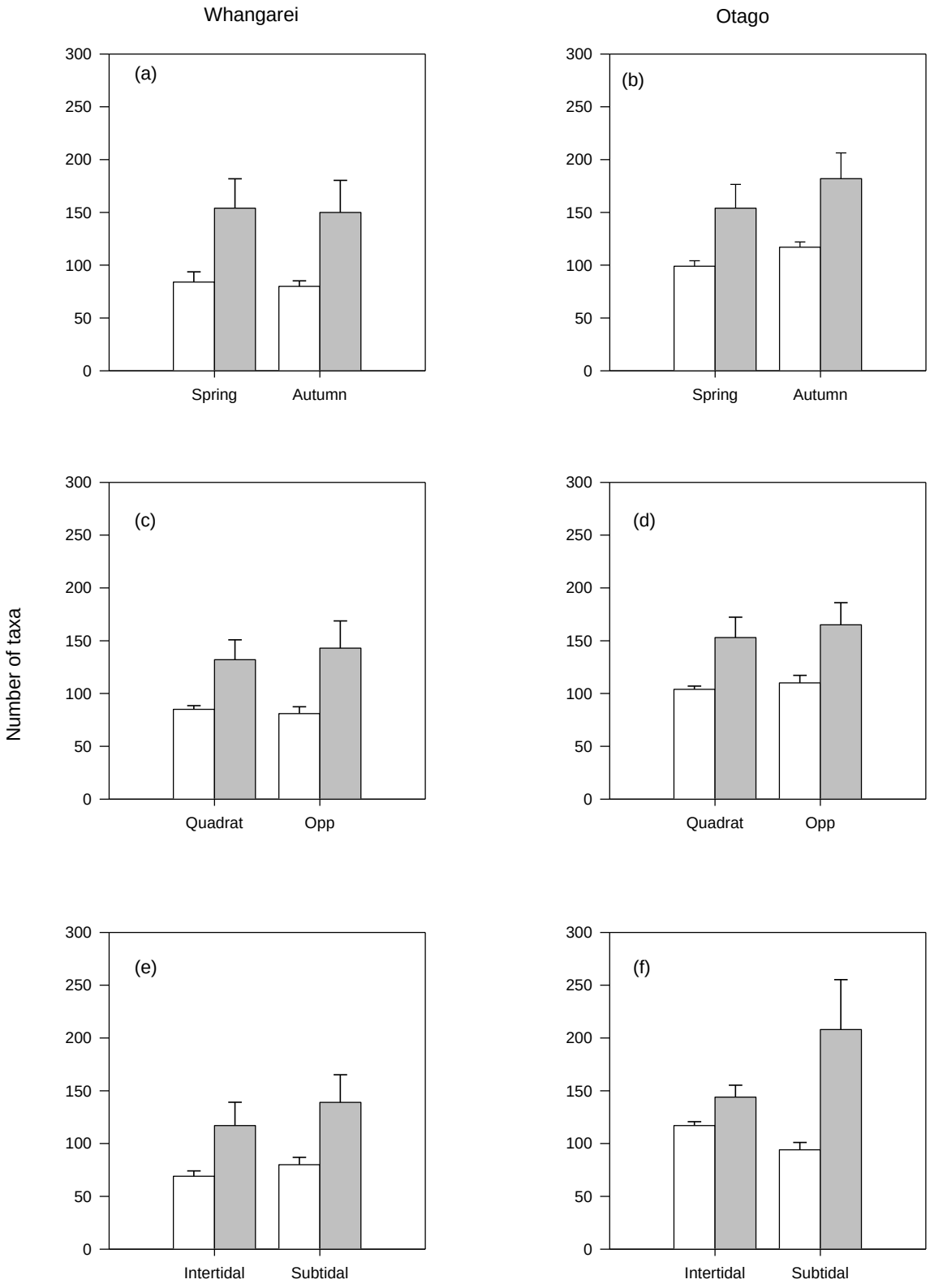


Figure 5: Harbour level comparisons between number of observed taxa (white) and gamma-diversity (predicted from species accumulation curves for n=14)(grey). All plots show mean and standard deviations per collecting event by season (a,b), collection method (c,d), and tidal level (e,f) for Whangarei (left) and Otago (right).

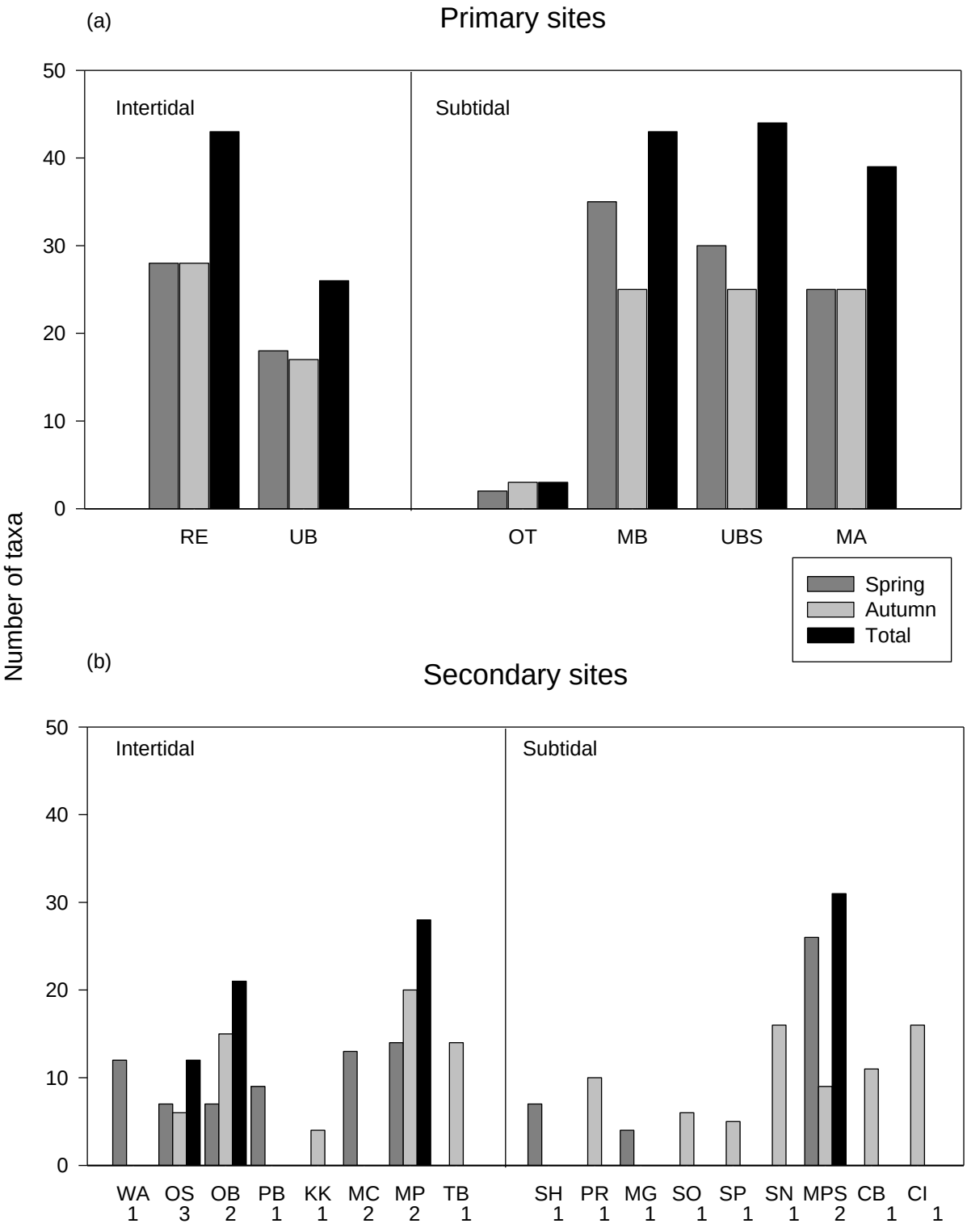


Figure 6: Whangarei Harbour: Number of observed taxa recorded from each site and collecting event. Primary sites have collecting events of n=4, whereas secondary sites have n=1–3 as indicated under site code. The full name of each site can be found in Appendix 1. Within each tidal level sites are listed left to right from inner harbour to outer harbour.

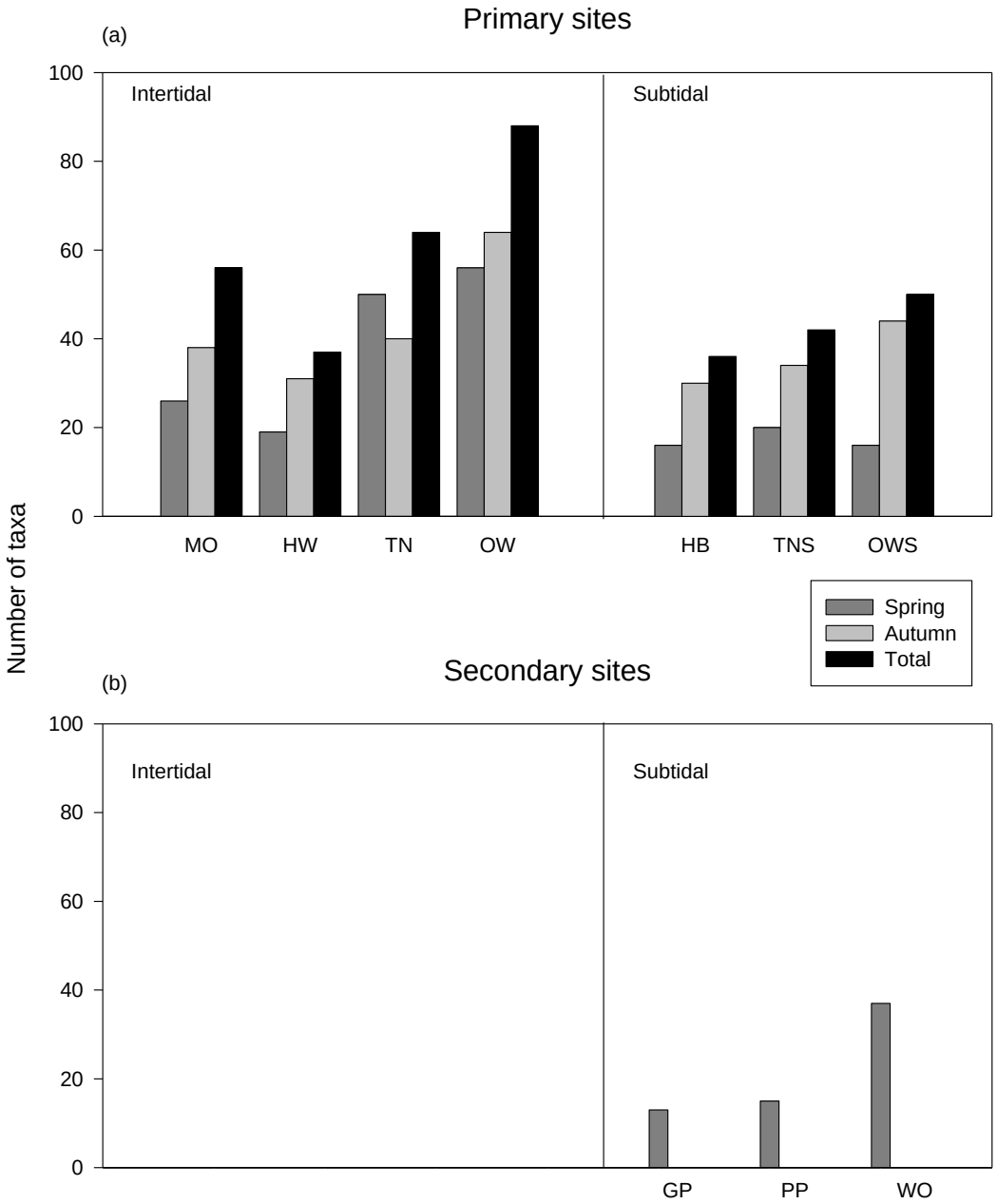


Figure 7: Otago Harbour: Number of taxa recorded from each site and collecting event. Primary sites have collecting events of n=4, whereas secondary sites in this harbour all have n=1. Within each tidal level sites are ordered left to right from inner harbour to outer harbour. Refer to Appendix 1 for full names of sites.

At the primary intertidal sites in Otago Harbour, the number of taxa collected in autumn exceeded the number collected in spring for three of the four sites (Figure 7(a)). In all cases there was clearly a difference in the seasonal composition of the flora (as seen in the total number of taxa recorded for each site).

At the three subtidal sites the same seasonal pattern was reflected but there appears to be less difference in the seasonal composition subtidally than intertidally. The subtidal primary sites in Otago Harbour were less speciose than the intertidal sites. There was a general trend across intertidal and subtidal sites of increasing diversity from inner to outer harbour sites.

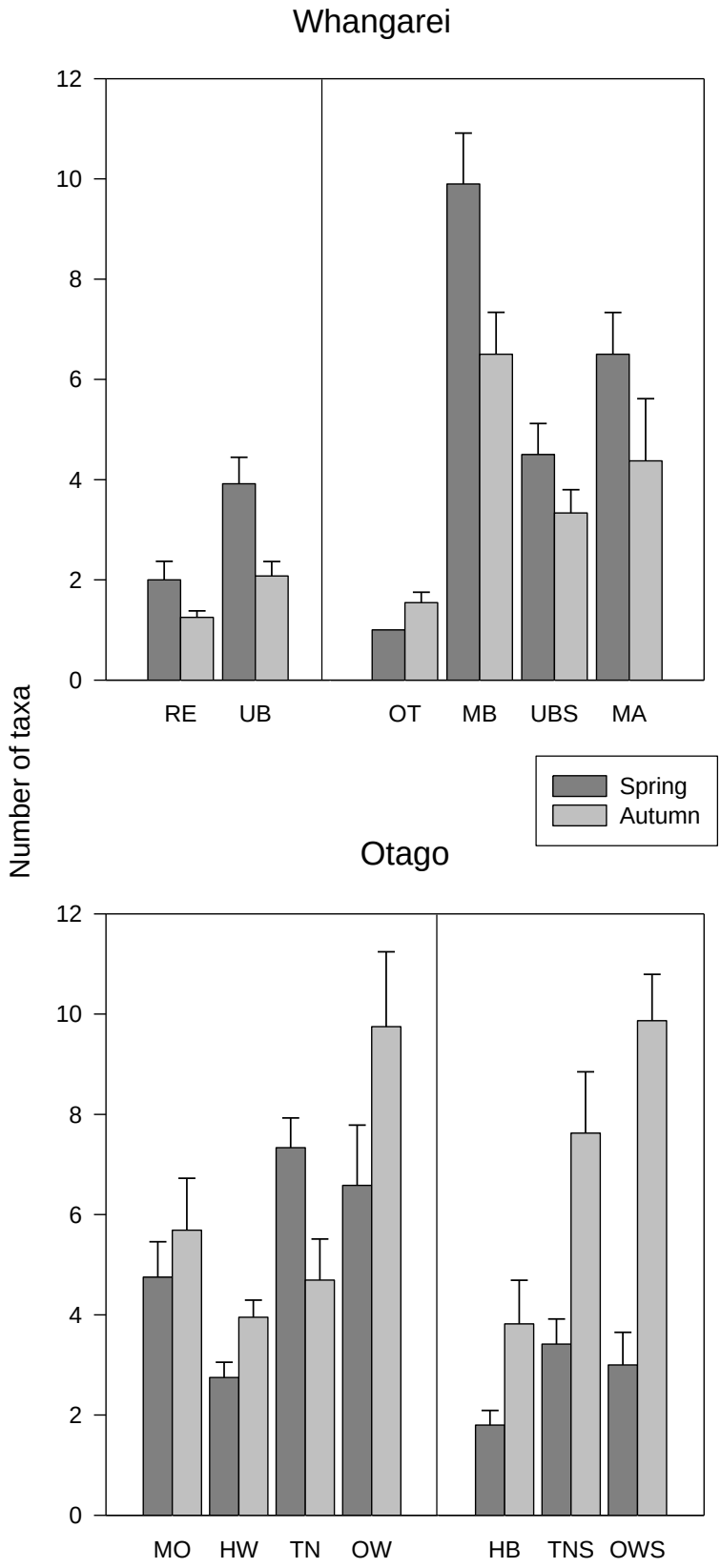


Figure 8: Number of taxa found seasonally in quadrats at each site in Whangarei Harbour (a) and Otago Harbour (b). Plots show means and standard errors for each site. Within each tidal level sites are ordered left to right from inner harbour to outer harbour. Refer to Appendix 1 for full names of sites.

The collections from the secondary sites in Otago Harbour (Figure 7(b)) contributed to the overall compilation of representative collections, but as these collections were made only in spring and subtidally, no comparisons can be made between intertidal and subtidal areas, or between seasons. More taxa were collected from the outer harbour site (WO) than at the inner two sites.

For primary sites, the mean number of taxa collected seasonally in quadrats at each site is shown in Figure 8. In Whangarei Harbour quadrats, fewer species were found intertidally than subtidally (Figure 8(a)), and there were fewer species sampled in the autumn than in spring in all but one of the sites (OT) where quadrats were sampled. Conversely, there were more taxa collected in autumn than in spring in all but one of the quadrat sites in Otago Harbour (Figure 8(b)). The number of taxa sampled subtidally in Otago harbour was markedly lower in spring than in autumn.

3.4. Species composition

Figure 9 is a two-dimensional representation of Bray-Curtis similarity values between all collecting events in Whangarei and Otago Harbours. In this MDS plot it is clear that the Otago collecting events are more similar to each other than the Whangarei collecting events.

In Whangarei Harbour a comparison between quadrats at primary sites (Figure 10) shows separation of sites, indicating that the macroalgal flora is relatively distinct between sites, however that there is still some dissimilarity within sites. In contrast, in most cases the primary sites in Otago Harbour (Figure 11) show little separation, indicating more similarity between sites, but again there is variation in similarities between quadrats within a site.

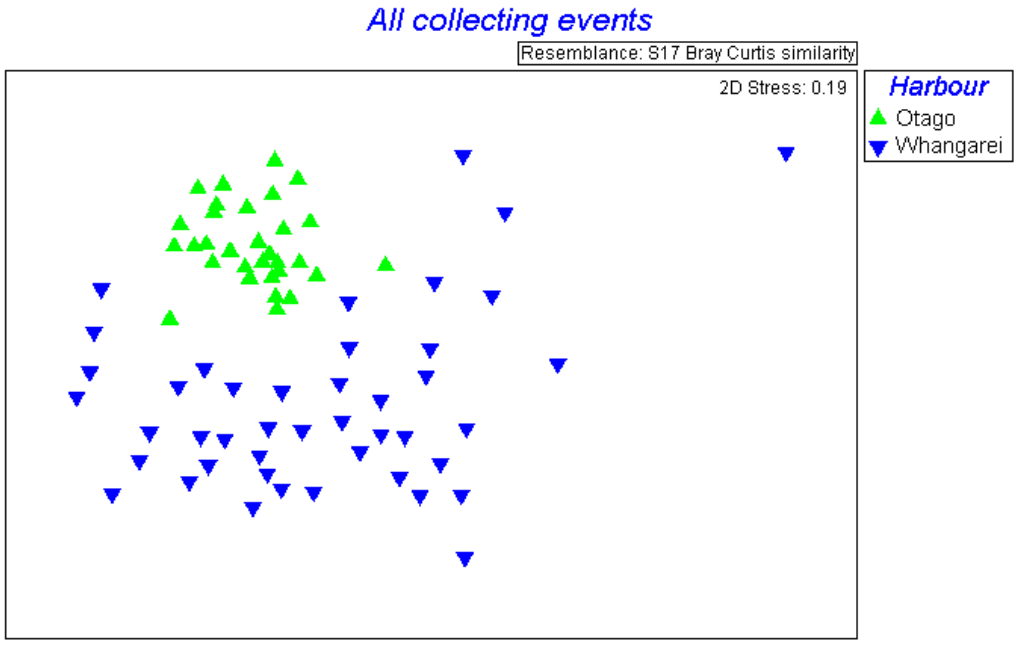


Figure 9: An MDS plot of resemblance values between all collecting events in Whangarei and Otago Harbours.

At all levels of comparison (site, season, collecting method, and tidal level) this general pattern was repeated indicating greater spatial, temporal and depth variability in the Whangarei Harbour flora. For this reason only a small selection of MDS plots will be included here.

Figure 12 shows Bray-Curtis similarities between primary sites for each harbour. For sites in Whangarei Harbour, at both intertidal and subtidal sites, there was a clear pattern of decreasing similarity towards the harbour mouth (Figure 12(a)). Conversely, in Otago Harbour there was no clear pattern (Figure 12(b)).

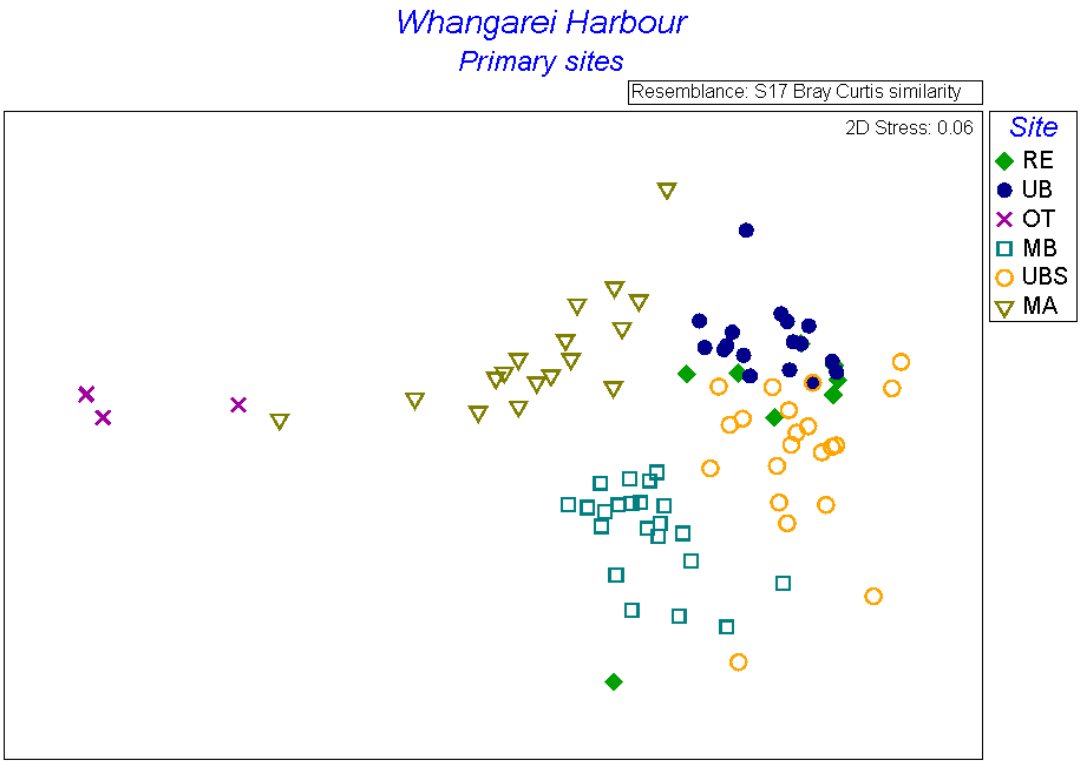


Figure 10: MDS plot of resemblance values between all quadrats at the primary sites in Whangarei Harbour. Intertidal sites have closed symbols, subtidal sites open symbols.

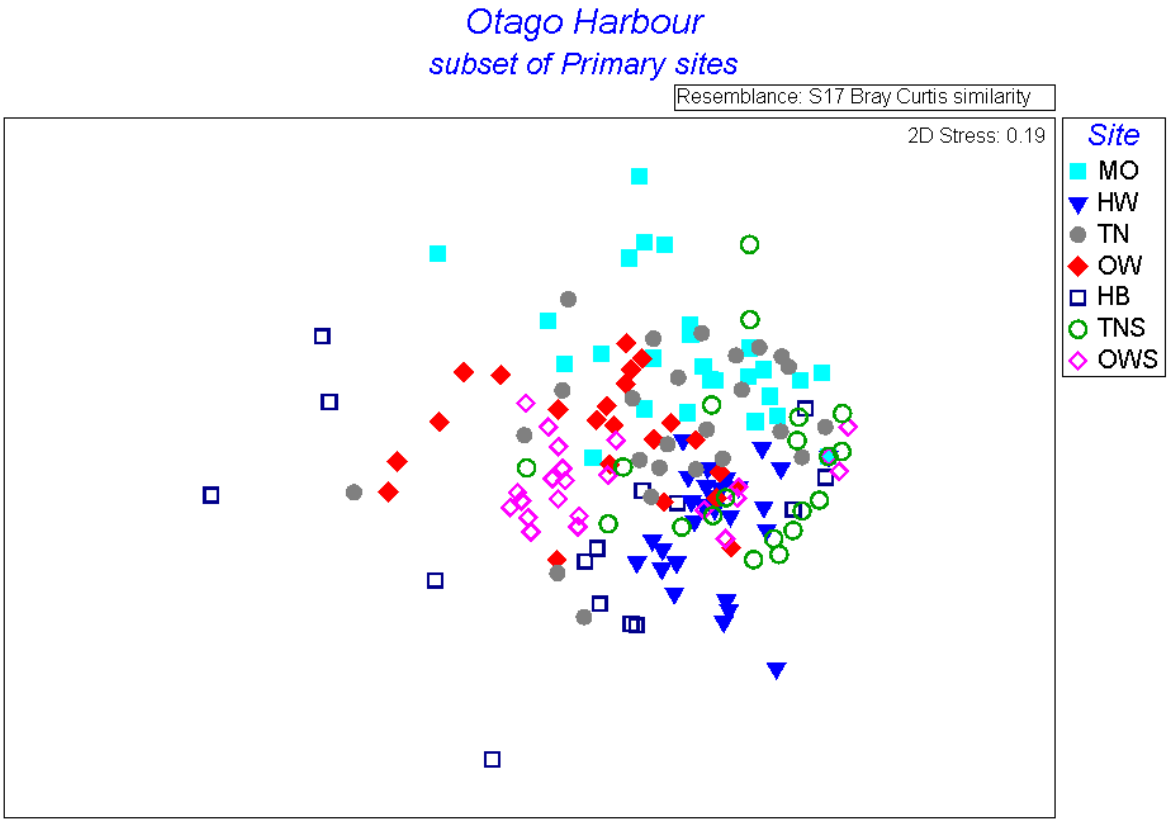


Figure 11. MDS plot of resemblance values between a subset of quadrats at the primary sites in Otago Harbour. Two outliers (i.e. two individual quadrats, one from MO and one from HB) have been removed in order to clarify the relationship between the other quadrats. Intertidal sites have closed symbols, subtidal sites open symbols.

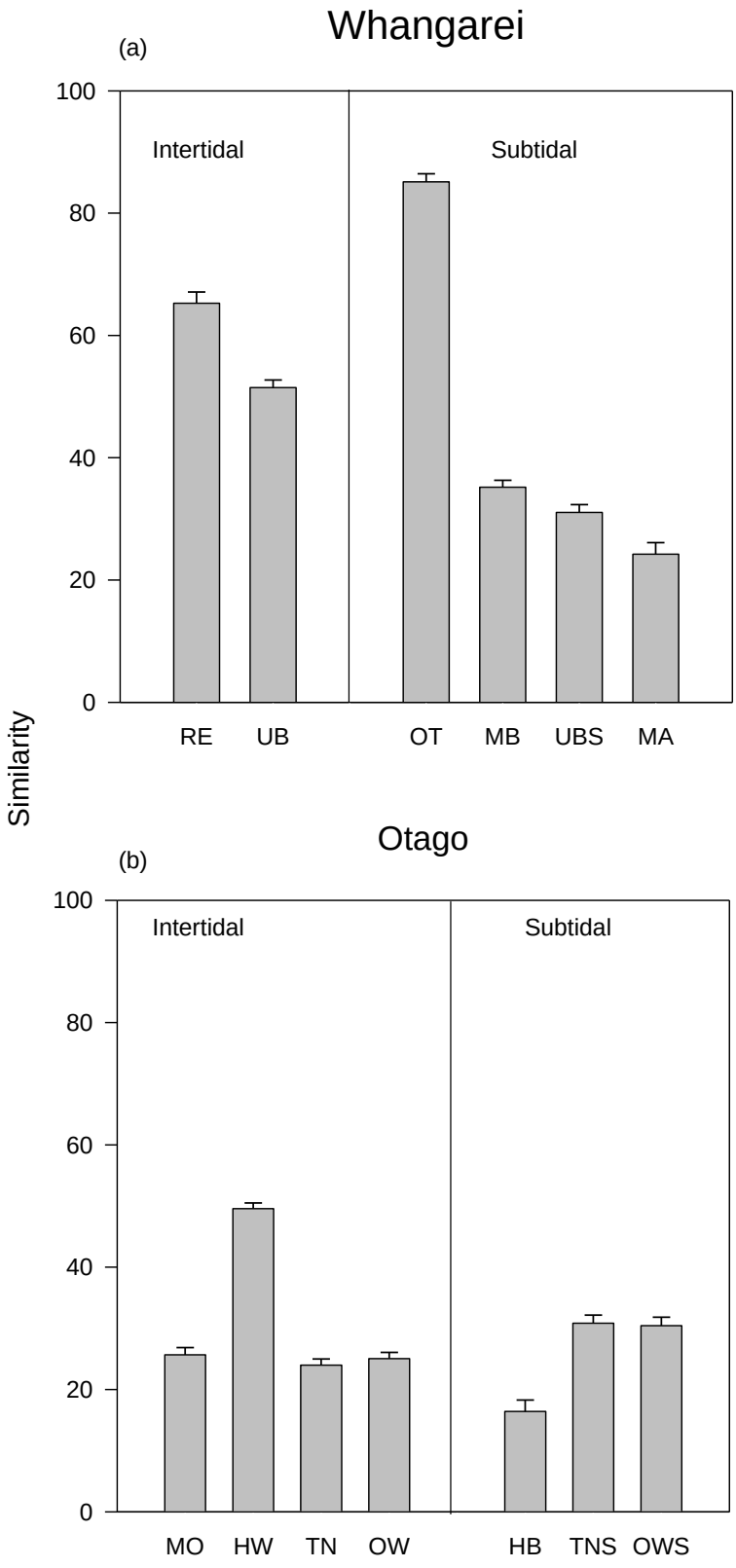


Figure 12. Plot showing Bray-Curtis similarities between quadrats at each primary site in Whangarei (a) and Otago (b) Harbours. Within each tidal level sites are ordered from left to right from inner harbour to outer harbour. Refer to Appendix 1 for site names.

At Whangarei Harbour primary sites, average taxonomic distinctness (ATD) ranged between 70 and 85 with the two intertidal sites being as distinct as the two outer subtidal sites (Figure 13 (a)). ATD values in Otago Harbour were similar to Whangarei Harbour (between 75 and 85), but showed a slight trend of increasing distinctness towards the outer harbour (Figure 13(b)).

With the exception of one site in Whangarei Harbour, variation in average taxonomic distinctness (VarATD) was between 400 and 500. The exception was the OT (One Tree Point) subtidal site, where VarATD was over 1500 (Figure 13 (c)). The range of VarATD for Otago was broader (480–680) (Figure 13(d)).

3.5 Rarity

Of the 244 taxa found in this study 91 were from a single site, and 72 of those were collected only once during the course of this study (Whangarei 34, Otago 30, Kaipara 8) – these were found in equal proportions in the spring and autumn collections. There are 120 taxa that are rare within a harbour for one or more harbours (60 for Whangarei (52 of them single collections within Whangarei); 50 from Otago (44 single from Otago); 23 from Kaipara (20 single from Kaipara) (Figure 13 (e,f)). The only site where no rare taxa were collected was the subtidal One Tree Point (OT) site in Whangarei Harbour (Figure 13 (e)).

3.6 Biomass

Seasonal biomass recorded from primary sites in Whangarei Harbour was generally low (less than 120 g per quadrat), particularly in the intertidal sites (Figure 14 (a)). Three out of four subtidal sites had greater biomass in spring than autumn, and showed a declining pattern towards the harbour mouth. Primary sites in Otago had greater biomass at the intertidal sites, particularly in autumn. Average biomass at primary sites in Otago Harbour (Figure 14 (b)) ranged between 23 and 208 g in spring, and 4 and 370 g in autumn. At six out of the seven sites, biomass was greater in spring than in autumn.

3.7 Percentage cover

At primary sites in Whangarei Harbour, algal percentage cover in spring ranged between 1 and 30 %, and in autumn between 9 and 39% (Figure 15 (a)). At the innermost subtidal site, percentage cover was particularly high in autumn compared to spring, corresponding to a late summer bloom of the filamentous brown alga *Hincksia* sp. Percentage cover in Otago was higher in spring than in autumn at all sites, and was particularly high at the two outermost intertidal and subtidal sites, ranging between 53 and 68 % cover (Figure 15 (b)).

3.8 Kaipara Harbour

A total of 43 taxa were collected in the southern Kaipara. Twenty-four taxa were collected by dredge, five taxa by quadrats in the intertidal (Karaka Point), and 26 taxa collected opportunistically in the intertidal (Karaka Point and Shelly Beach). Analysis of resemblance between these collections (Figure 16) shows that the macroalgal assemblages at the two intertidal sites are quite distinct from each other, and very distinct from the assemblages collected by dredge.

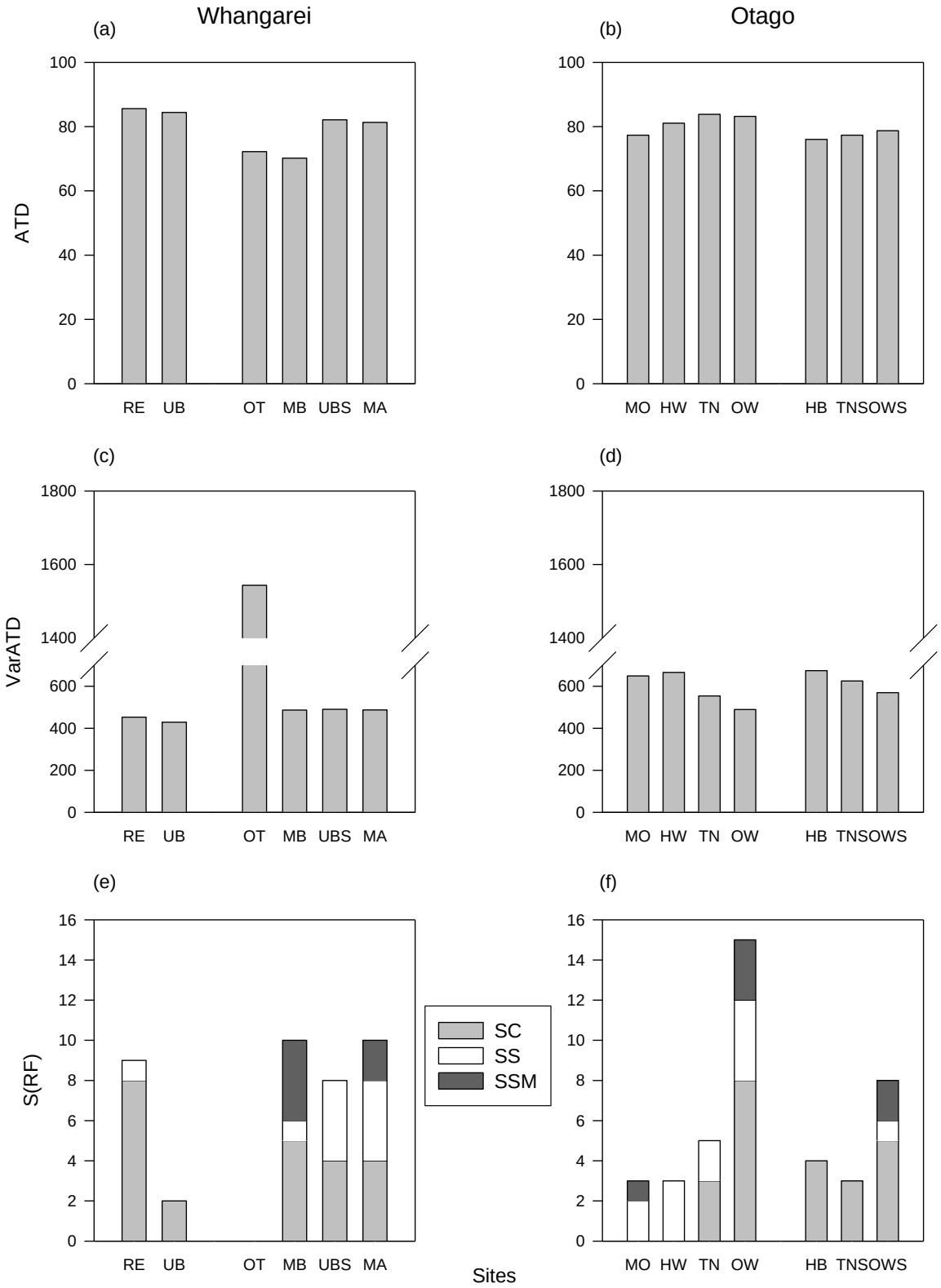


Figure 13: Primary sites: ATD (Average Taxonomic Distinctness) (a,b), VarATD (Variation in ATD) (c,d), and S_{RF} (taxa rare in frequency) (e,f). SC = single collection; SS = single site in harbour, also recorded in one or both of the other harbours; SSM = multiple collections from a single site, also recorded in one or both of the other harbours.

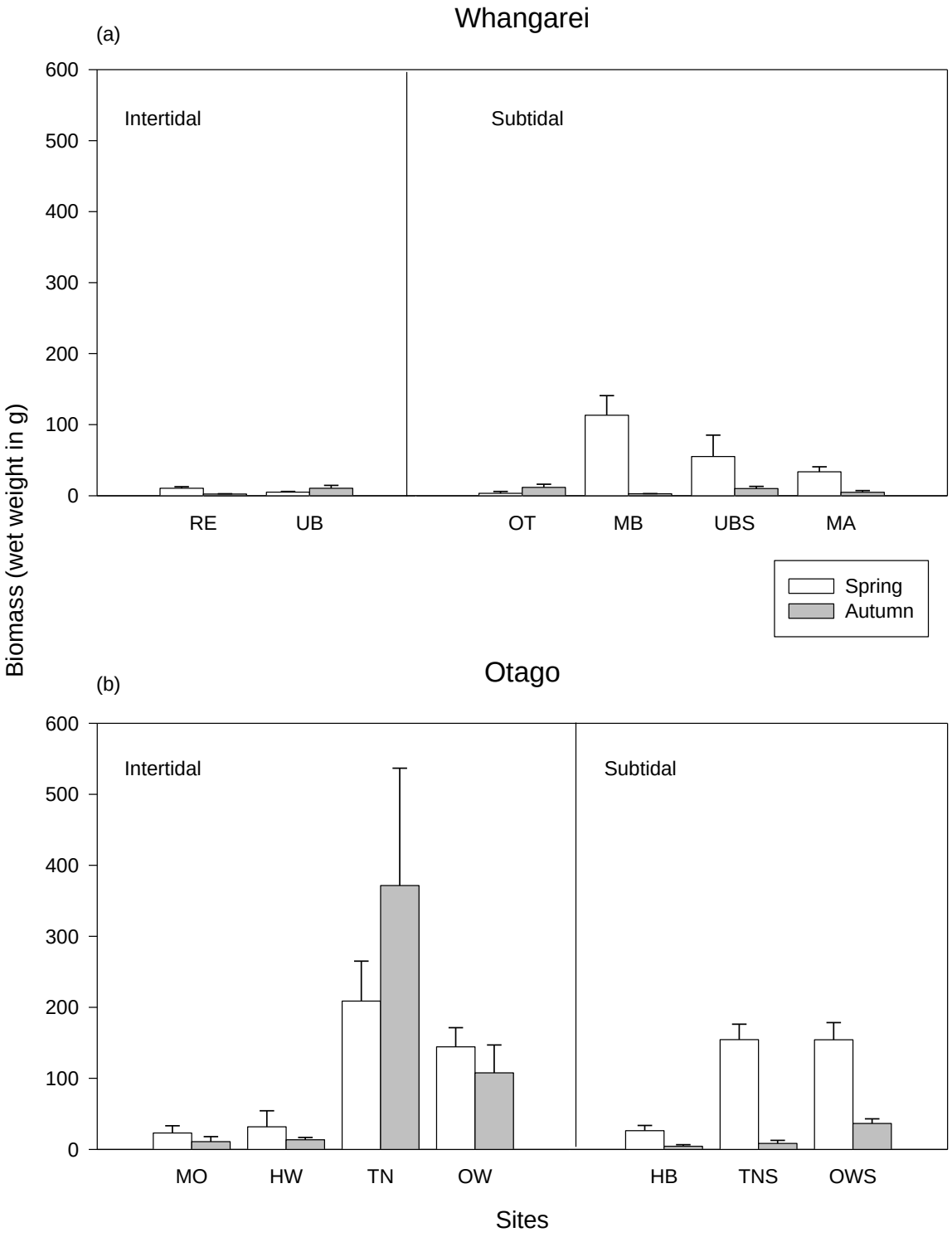


Figure 14: Biomass of macroalgae from primary sites in Whangarei (a) and Otago (b) Harbours. Plots show mean and SE across quadrats for each site. Within each tidal level, sites are listed from left to right from inner harbour to outer harbour.

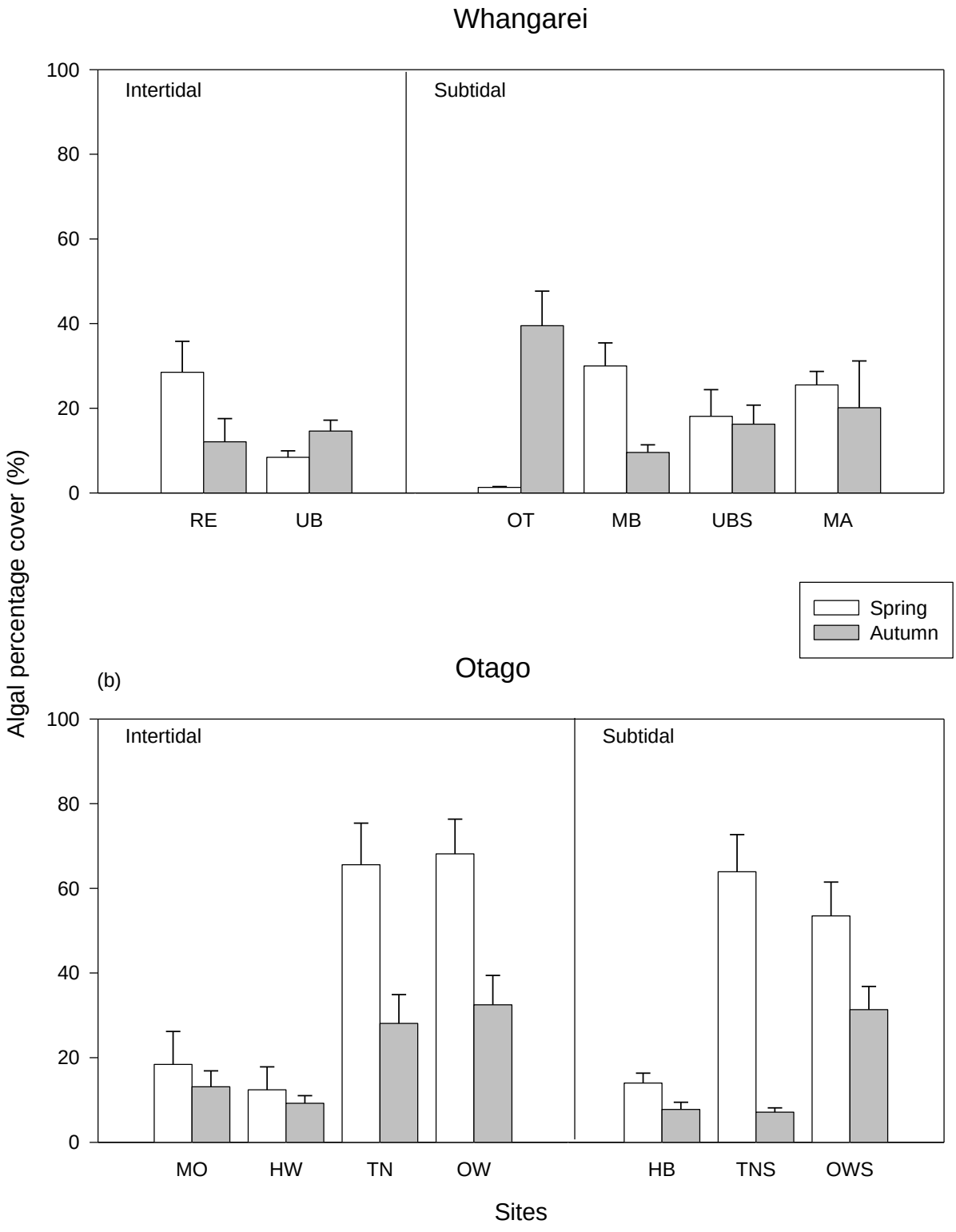


Figure 15: Percentage cover of macroalgae from primary sites in Whangarei (a) and Otago (b) Harbours. Plots show mean and SE across quadrats for each site. Within each tidal level, sites are listed from left to right from inner harbour to outer harbour.

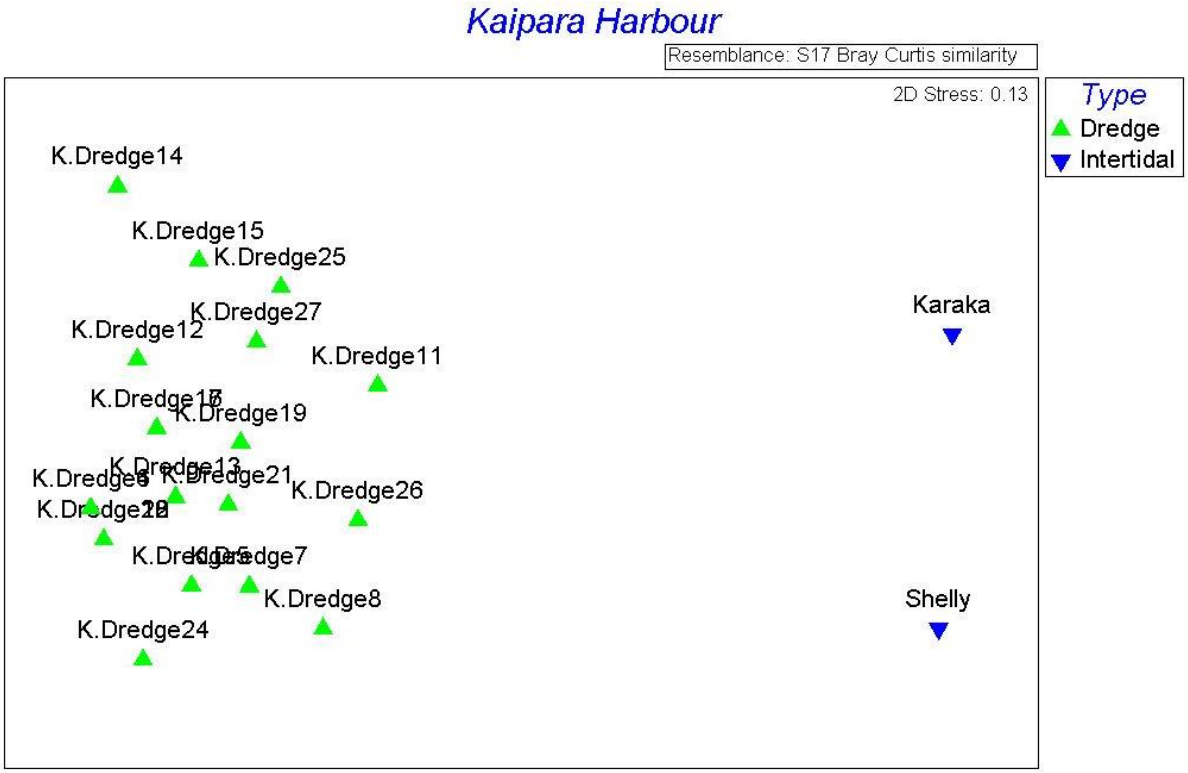


Figure 16: An MDS plot of resemblance values for Kaipara Harbour dredge and intertidal collection sites.

3.9 Molecular results

Twenty seven LSU sequences and 75 *rbc*L sequences were obtained (Appendix 8), with both *rbc*L and LSU sequences from 10 specimens, and a total of 102 sequences from 92 specimens. The following summarises the results by genus.

Spyridia:- All sequences were near identical, indicating that all specimens were con-specific; at present these are referred to *Spyridia filamentosa*.

Hypnea:- The single specimen sequenced differed by 2bp from Genbank entry AB095911, *Hypnea cornuta*, Japan. This is consistent with this specimen being *Hypnea cornuta*. (Yamagishi et al. 2003; Geraldino et al. 2006).

Gracilaria:- Comparison with existing *rbc*L sequences confirm the presence of three species – *Gracilaria truncata*, *G. chilensis*, and the as yet undescribed *Gracilaria* sp. 'Blockhouse Bay'.

Plocamium:- The seven specimens supplied fell into two groups, indicating the presence of two different species. Sequences divided neatly by collection site, indicating the presence of one species at Whangarei and a second in Otago Harbour.

A sequence in GenBank attributed to *Plocamium* sp from Stewart Island (U26821.1) differs from the Otago sequences by 4 substitutions over 1131bp, and may represent a population variant of the same species.

Attempts to amplify *rbc*L from *Plocamium angustum*, *P. cirrhosum*, *Plocamium* sp. DN 5/22 Antipodes Island, and *Plocamium* sp. ASJ 302 Port Pegasus, which were supplied for comparison with the Whangarei and Otago sequences, were unsuccessful.

Ceramiaceae:- *Ceramium* and *Centroceras*:- Samples from these genera are treated together for convenience (Figure 17).

Centroceras:- Four specimens, SS0045, SS1348, SS1181, and ASK011, were very close in *rbc*L sequence to a sequence in GenBank (DQ374328) ascribed to *Centroceras clavulatum*, and the evidence is that they are all members of that species (Won et al. 2009).

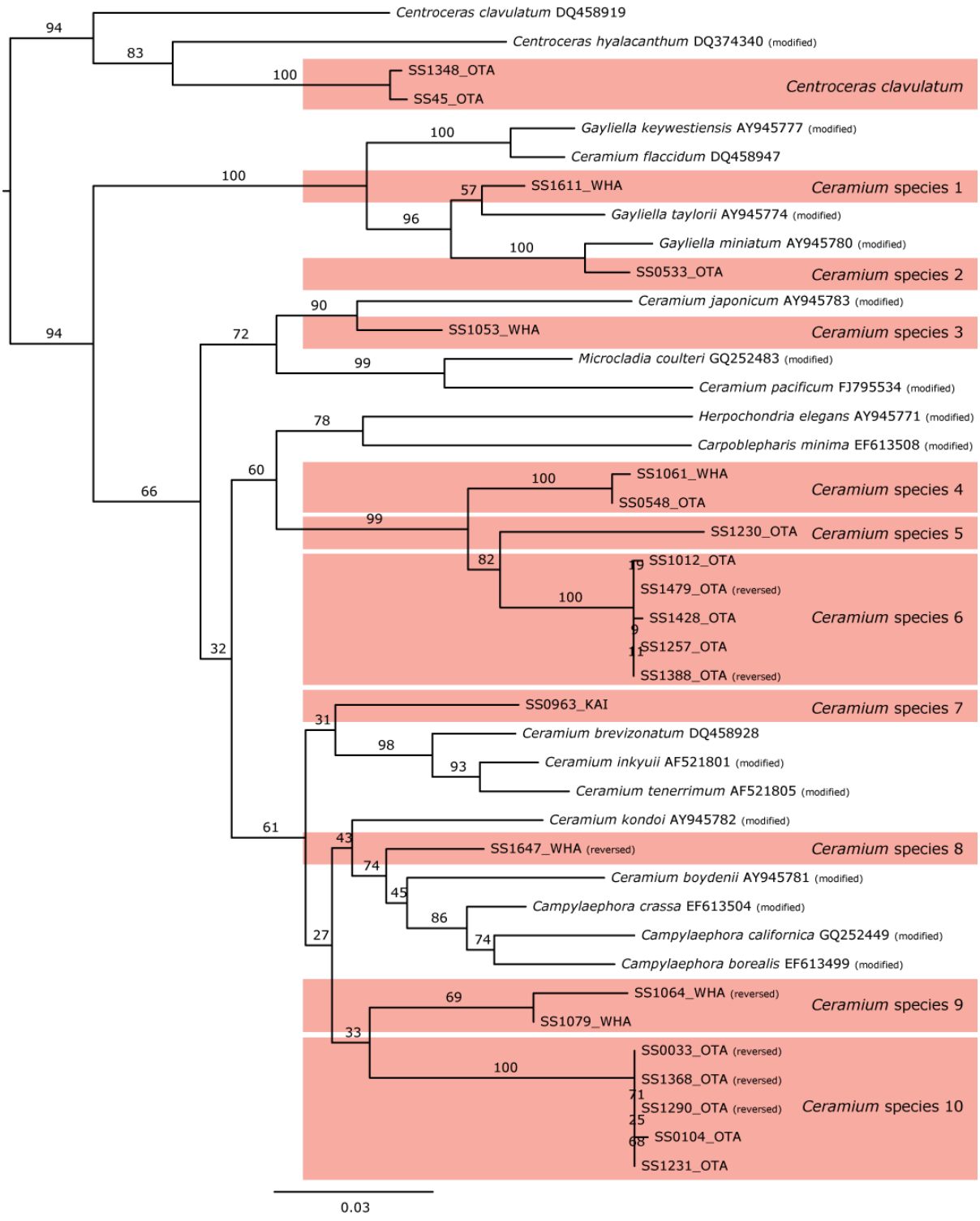


Figure 17: Maximum-likelihood phylogram of *Ceramium* and *Centroceras* based on rbcL sequence data. Highlighted boxes indicate clades containing samples from this study. Support values shown at each node are bootstrap values based on 100 replicates.

Ceramium:- Two specimens, SS1611 from Whangarei and SS0533 from Otago, fall within genus *Gayliella* on phylogenetic analysis of *rbc*L sequences (Cho et al. 2008a). They are not con-specific, indicating the presence of two species of *Gayliella* in New Zealand. These are listed in this report as *Ceramium* sp. 1 and sp. 2 respectively. Sequences obtained from a further 16 specimens were resolved in 8 clades within *Ceramium* in phylogenetic analyses. These sequences probably represent 8 different species. These are listed in the report as *Ceramium* sp. 3–10. The relationship between some of these species and the genus *Campylaephora* needs to be assessed (Cho et al. 2008b).

Polysiphonia:- The picture for *Polysiphonia* specimens is complex. It is apparent that around 10 entities, distinguished by *rbc*L sequence, are present in New Zealand probably corresponding to 10 species (Figure 18). Specimen SS1110, which was supplied as a *Polysiphonia*, is not a member of that genus, but its *rbc*L sequence has no close homologues in GenBank, and it cannot be identified at present on molecular criteria. Aside from that specimen, *rbc*L data were obtained for 31 specimens of *Polysiphonia*. By phylogenetic analysis against existing sequences in GenBank, 5 clades are resolved that each contain at least two sequences, and 5 sequences are resolved within *Polysiphonia* but with no closely related sister taxa.

SS0061 and SS0023, both from Otago, are resolved with *Polysiphonia morrowii* (AY958161) (Kim et al. 2004; pers. comm. D.W. Freshwater).

SS0309, 1458, 0284, 1184, 1427, 0547, 0039, and 0093 are resolved with four GenBank sequences ascribed to *Polysiphonia strictissima,* and are identified as members of that species.

SS1182 is resolved with *Polysiphonia isogona* (HM573578) and may be conspecific with that specimen. In the report this is listed as *Polysiphonia isogona* sensu Freshwater.

Good amplification and high quality sequence data were not obtained for some specimens of *Polysiphonia*, probably because of primer mismatches in the *rbc*L sequences. A number of the sequences are partial, that is, short (Appendix 8). Nevertheless the data are consistent with the presence of at least 10 species in the specimens supplied. Future work would benefit from the design of new primers specific to *Polysiphonia*.

3.10 Human-mediated introductions

In the course of this study 19 non-indigenous species were collected (Table 3) including two new records of red algae for New Zealand.

Eight non-indigenous species were collected from Whangarei harbour of which four were new records for the harbour, including the first confirmed collection of *Hypnea cornuta* from New Zealand. Within the New Zealand region, the brown alga *Hydroclathrus clathratus* is considered to be non-indigenous to the North Island, and native to the Kermadecs. Eleven non-indigenous species were collected from Otago harbour including one new record for the harbour and one new record for New Zealand, *Polysiphonia morrowii*. Four non-indigenous species previously recorded from Otago were not found during this study. Four non-indigenous species were collected from Kaipara harbour and two of these were new records for the harbour.

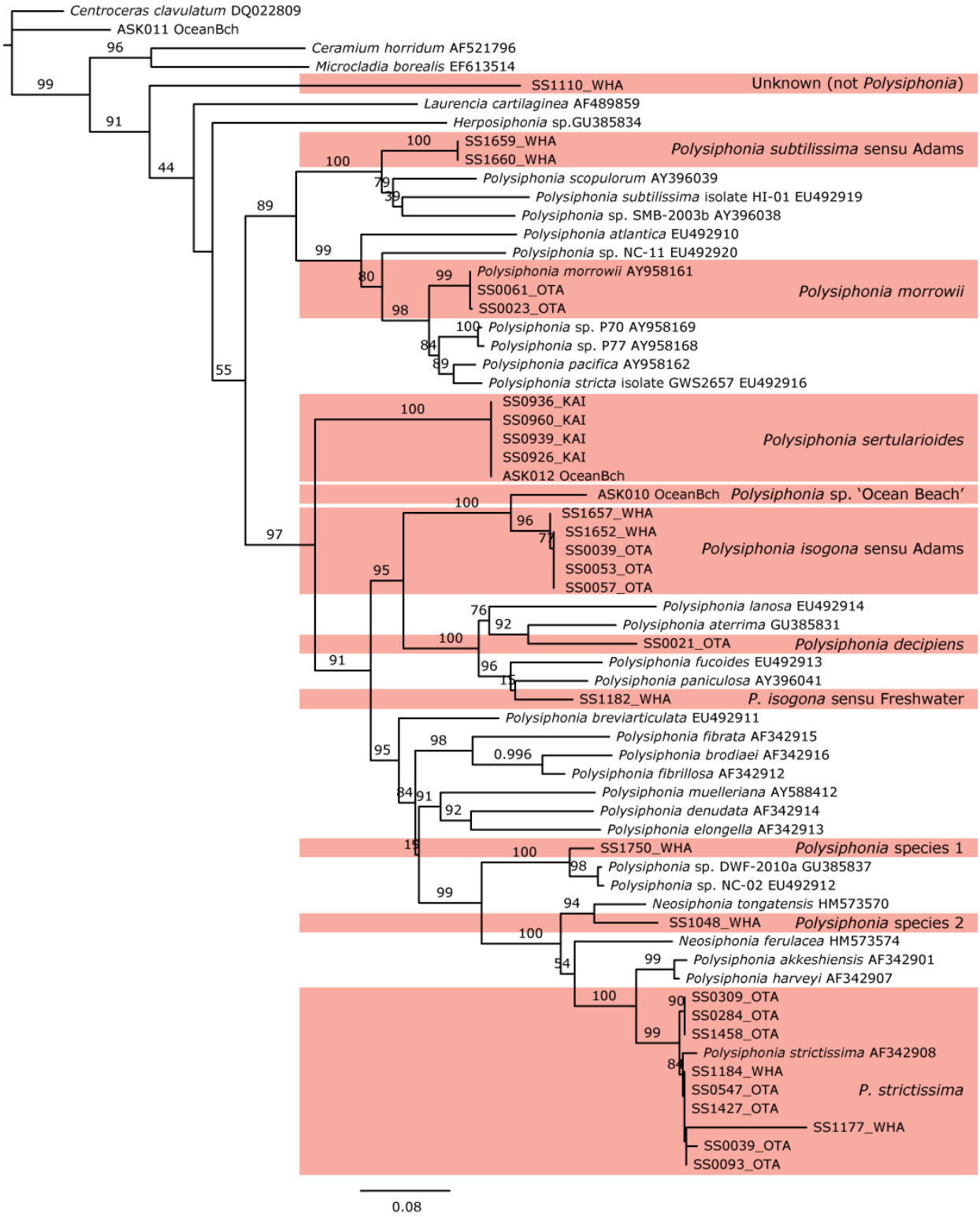


Figure 18: Maximum-likelihood phylogram of *Polysiphonia* based on rbcL sequence data. Highlighted boxes indicate clades containing samples from this study. Support values shown at each node are approximate likelihood ratio values (alrt) expressed as percentages.

Table 3: List of species considered to be introduced in each of Whangarei, Otago and Kaipara harbours. p = previously recorded; x = found in this study; n = new record for New Zealand.

	Species	Whangarei	Otago	Kaipara
Florideophyceae				
Gracilariaceae	*Gracilaria* sp. BB			x, p
Wrangeliaceae	*Griffithsia crassiuscula*		x, p	
Rhodomelaceae	*Polysiphonia constricta*		x, p	
Rhodomelaceae	*Polysiphonia morrowii*		x, n	
Rhodomelaceae	*Polysiphonia sertularioides*	x, p	p	x
Rhodomelaceae	*Polysiphonia subtilissima*	x	p	
Solieriaceae	*Solieria* sp.			x, p
Hypneaceae	*Hypnea cornuta*	x, n		
Champiaceae	*Champia affinis*		p	
Rhodomelaceae	*Polysiphionia brodiei*		p	
Phaeophyceae				
Scytosiphonaceae	*Colpomenia bullosa*	x		
Cutleriaceae	*Cutleria multifida*		x, p	
Scytosiphonaceae	*Hydroclathrus clathratus*	x, p		
Chordariaceae	*Punctaria latifolia*		x, p	
Alariaceae	*Undaria pinnatifida*		x, p	
Sargassaceae	*Sargassum verruculosum*		p	
Chordariaceae	*Striaria attenuata*		p	
Ulvophyceae				
Codiaceae	*Codium fragile* s.sp. *fragile*	x, p		
Ulvaceae	*Ulva compressa*	x	x, p	
Ulvaceae	*Ulva intestinalis*		x, p	
Ulvaceae	*Ulva pertusa*		x, p	x
Ulvaceae	*Ulva* species 1	x, p	x, p	
Ulvaceae	*Umbraulva olivascens*		x	

3.10.1 New records

Hypnea cornuta (Kütz.) J.Agardh: *Hypnea cornuta*, originally described from material thought to have been collected in Guinea (eastern Atlantic Ocean), has been recorded from the Atlantic and Indian Oceans, the Caribbean, Asia as well as south-west and south-east Asia, Australia, and Fiji (Guiry & Guiry 2011). It has been reported as an introduced species in the Mediterranean, with the first report shortly after the opening of the Suez Canal and with subsequent reports from Egypt, Israel, and Italy (refer to Cerere et al. 2004).

Polysiphonia morrowii *Harv*. (Ceramiales, Rhodophyta) is a red alga, originally described from Hakodate, northern Japan (Harvey 1857; Masuda et al. 1995: 199). The thalli consist of primary upright axes, with four pericentral cells and lacking cortication. Thalli are densely tufted, slender and elongate, and often tightly entangled, attached to substrata with prostrate filaments and adventitious unicellular rhizoids which arise as outgrowths of pericentral cells without septation. *Polysiphonia morrowii* is native to the north-western Pacific, with its native range considered to include Japan, Korea, China and Russia (Tseng 1984; Masuda et al. 1995; Kim et al. 2004; Kozhenkova 2009). This species has also been reported from the Mediterranean Sea and Punta Arenas, Chile (Verlaque 2001; Curiel et al. 2002; Kim et al. 2004; Erdugan et al. 2009).

In its native range it is recorded to grow to ca. 35 cm in Japan and 16–25 cm in Korea. In Korea this species is reported to complete a life cycle within four months in the field, with all reproductive stages being present concurrently (Kim et al. 2004). This species has been reported from a wide variety of substrata – rocks, wooden piles, ropes, mussels, crabs, tunicates, and also as an epiphyte on other large algae such as species of *Sargassum* and on *Undaria pinnatifida* (Curiel et al. 2002, Kim et al. 1994, 2004).

4. DISCUSSION

Macroalgae are highly diverse in both Whangarei and Otago Harbours. In the course of this study we have recorded 244 taxa, approximately 30% of the currently recognised New Zealand macroalgal flora. In the past macroalgae have been overlooked in studies of New Zealand soft sediment environments. This is the first study of its type in New Zealand and we have not been able to find a comparable study undertaken elsewhere. Finding similar, high numbers of taxa in Whangarei and Otago Harbours was unexpected. Based on existing collections (e.g., specimens deposited in the Te Papa herbarium), and on literature reports (summarised in Rowden et al. 2007), we had anticipated relatively low diversity of taxa, and further, more species to be present in Otago than in Whangarei.

Although we employed high resolution sampling methods, analyses indicate that these results under-represent the diversity actually present in the harbours. A high proportion (ca. 50%) of the taxa recorded in the harbours were rare, either collected on a single occasion, from a single locality within a harbour, or rare in one of the harbours although more common in another harbour. The use of two sampling methods, and having skilled phycologists in the field, were important strategies in this study. However, as clearly evidenced in the results, there was a great deal of variability at all levels (between quadrats, collection method, sites, seasons, and harbours). Another approach to gathering base-line data on floral composition of harbours would have been to sample fewer sites (i.e., exclude secondary sites), restricting attention to two to three primary sites per harbour and then within these, sampling more quadrats and across four seasons. However, this approach while providing higher resolution within sites would potentially lose information within the harbours and may have restricted the ability to compare harbours. Given the results of this study it is clear that that generalisations about harbour floras, and flora variability need to be made with caution.

As noted by Terlizzi et al. (2003) baseline datasets are important components of biodiversity science as the value and interpretation of other datasets are frequently predicated on the existence of such baseline data. The ability to recognise change, or to establish cost-effective biomonitoring and confirm appropriate biodiversity surrogates, all require that there is baseline knowledge of the biota. In an ideal situation on the basis of the baseline data, it may be possible to identify the species which have substantial influence on community or ecosystem processes. As Terlizzi et al. (2003) observe "approximation must not be made *a priori*: the profound knowledge of systems and their species is the first, crucial step". This study has been targeted at establishing baseline data, and our results, in terms of overall biodiversity, differences between harbours and the high proportion of rare taxa, indicate that further work is still warranted.

Ellingsen et al. (2007) investigated the contribution of rare invertebrate species to marine soft-sediment communities from New Zealand, focussing on the relationships of range size with abundance, environment, habitat diversity, and life history traits. One of their conclusions was that in marine systems, rare species are important to functional biodiversity. An equivalent investigation of marine macroalgal ecology is warranted given the high proportion of rare species found in this study.

Taxonomic background information on some of the major groups found in the harbours is not strong, for example identification of members of the Ceramiaceae and Rhodomelaceae can be challenging. Twenty-three species of *Ceramium* are currently reported to occur in the New Zealand region, including six species regarded as endemic (Nelson in press). However, there have been no recent investigations of the genus *Ceramium* in New Zealand. The species *Centoceras clavulatum* is widely reported as a cosmopolitan species. A recent morphological and molecular study has confirmed its presence in New Zealand, while concluding that material identified as this species from throughout the world has been frequently confused, and in fact there are at least nine discrete species within the genus (Won et al. 2009).

The other eight species of *Ceramium* distinguished in this study also require further work. In the time available in this study we have not been able to align the names and species concepts previously applied in New Zealand to the species that have been able to be segregated with molecular data. Some

of the species of *Ceramium* recorded in this study were very abundant and frequently recorded (e.g., species 4, 6, 10), whereas others (e.g., species 7, 8, 9) were known from very few samples. Cho et al. (2008a) conclude on the basis of their study on *Gayliella* and *Ceramium* "that the genus *Ceramium* is not monophyletic and is in need of a major systematic overhaul". It is clear that further research is required on these algae in New Zealand.

An interesting discovery of this project has been the confirmation of the presence of the genus *Gayliella* for the first time in New Zealand. Two species have been confirmed by sequence data (referred to as *Ceramium* sp. 1 and *Ceramium* sp. 2 in this report). This genus was recently segregated from *Ceramium*, based on morphological and phylogenetic data (Cho et al. 2008a). The type species of *Gayliella*, *G. flaccida*, has been reported from New Zealand (as *Ceramium flaccidum*) and has been considered to be common and widespread (Adams 1994). However no samples sequenced in our study aligned with the sequence data for *G. flaccida*. Material previously identified as *Ceramium flaccidum* from Australia was described as a new species *G. womersleyi* (Cho et al. 2008a). The sequence data from the two *Gayliella* species recognised here differed from all data available in GenBank. Further work is required to document this genus in New Zealand and to characterise these two species. Only one sample of each species of *Gayliella* was collected in this study, and these came from Whangarei Harbour (species 1) and Otago Harbour (species 2).

The genus *Polysiphonia* was very well represented in the collections made during this study with 15 distinguished at a species level and an additional category of specimens (consisting of sterile or fragmentary material) that were only able to be identified to genus. Some of the species of *Polysiphonia* collected in this study were restricted to a single harbour e.g., *P. subtilissima* (Whangarei), *P. sertularioides* (Kaipara), *P. constricta* (Otago), whereas *P. strictissima* was found in all three harbours. A detailed study of the genus by Adams (1991) recognised 15 species, and Adams (1994) subsequently distinguished 16 species. Twenty-one species of *Polysiphonia*/*Neosiphonia* are currently reported to occur in the New Zealand region, including six species regarded as endemic and seven species considered to be introduced (Nelson in press). It is clear that further work is required on the New Zealand species. The genus *Neosiphonia* was segregated from *Polysiphonia* on the basis of both vegetative and reproductive characters (Kim & Lee 1999), and two species are recorded from New Zealand, *N. apiculata* and *N. harveyi*, neither of which was found during this study. Based on the molecular data from this study, the endemic species *Polysiphonia strictissima* needs to be examined more closely with respect to its affinities with *Neosiphonia*, as does *Polysiphonia* species 2.

Prior to this study thirty-five marine macroalgae had been considered to be human-mediated introductions to New Zealand, with all but one of these (*Asperococcus ensiformis*) recorded from harbours or soft sediment environments (Nelson 1999; Nelson et al. 2004; MITS; Te Papa Herbarium). The discovery of two new species of introduced algae during this study brings the total to 37 non-indigenous marine macroalgae in New Zealand. There have been very few studies of non-indigenous macroalgae in New Zealand, including their spread after initial introduction or their impact on native flora and fauna. However, Russell et al. (2008) documented the spread of *Undaria pinnatifida* within the Otago harbour over 16 years following its initial colonisation in 1990 and also examined the spread of *Undaria* from Otago Harbour into surrounding inlets and the open coast.

Williams & Smith (2007) in their global analysis of introduced macroalgae tested whether the number of invaders in a given family was significantly higher or lower than expected by chance. Of the families found in our study, the following were identified by Williams & Smith as containing more introduced species than expected by chance: Codiaceae, Ulvaceae, Rhodomelaceae, Gracilariaceae, Solieriaceae, Alariaceae. They also concluded that *Hypnea* may be an exceptionally invasive genus with nine known invasive species in a genus of approximately 54 species (Guiry & Guiry 2011).

Hypnea is a large genus with 111 names recorded in AlgaeBase of which 54 are considered to be current names (Guiry & Guiry 2011). The genus is widespread geographically, and is particularly speciose in tropical and warm-water regions. The taxonomy of *Hypnea* based on morphological and anatomical criteria has been regarded as difficult, with confusion in the literature about the reliability

of criteria for species delimitation (e.g. Abbott 1997). There have been only two reports on the molecular taxonomy of *Hypnea* (Yamagishi & Masuda 2000; Geraldino et al. 2006) and these studies resulted in clarification of *Hypnea* species concepts and reports of new taxa in Japan and Korea respectively. Two species of *Hypnea* have been reported from the North Island: *H. charoides* J.V.Lamour (previously known as *H. seticulosa* J.Agardh) and *H. nidifica* J.Agardh. A third species, *H. esperi* Bory (Nelson & Adams, 1984), has been reported from the Kermadec Islands. The first collections of *Hypnea* in New Zealand were made from Tauranga Harbour in 1874 by the Swedish explorer and collector S. Berggren. According to herbarium records prior to 2001, subsequent collections of *Hypnea* had been made only from the Bay of Islands and Tauranga Harbour (in the 1930s and 1940s). *Hypnea* has remained unknown from all other northern North Island harbours, estuaries or protected shorelines. In 2001 a collection of *Hypnea* sp. was made at the entrance to Rangaunu Harbour, and in 2002 *Hypnea* specimens were recorded from the Port of Tauranga during baseline Biosecurity surveys. In May 2007 *Hypnea* has appeared on the shoreline of the Whangaparaoa Peninsula and has been collected from reefs at Army Bay, as large clumps of unattached thalli. There have been doubts raised about the status of *Hypnea* and whether in fact any of the species recorded from New Zealand are native. The confirmation of *H. cornuta* in this study indicates that further work is required on the identity of species in New Zealand and their distribution.

Members of the Rhodomelaceae include finely branching, uniaxial species with relatively simple morphologies, and the introduced species of the genus *Polysiphonia* are particularly well represented in the harbours studied. A species of *Polysiphonia*, *P. senticulosa*, which has very similar morphology to *P. morrowii*, has been found in Australia and in New Zealand, and is considered to be non-indigenous to these areas (Womersley 1979, as *P. pungens*; Nelson & Maggs 1996) as well as to the Netherlands (Stegenga et al. 2007). There has been some debate as to whether *P. senticulosa* and *P. morrowii* are conspecific or whether they are closely related taxa of the north-eastern and north-western Pacific respectively (Kudo & Masuda 1981, 1988; Kim et al. 1994). Further investigation is required to compare sequences of *P. morrowii* with sequence data from *P. senticulosa* collected in New Zealand. At present these data are not available.

This study has examined macroalgae in only two harbours in detail using as examples a single northern and single southern harbour. There are many other soft sediment habitats in which macroalgae occur which remain poorly documented, with the macroalgae under-represented in collections, and under-represented in assessments of coastal biodiversity and in evaluations of coastal environments. In the evaluation of sites for conservation priorities in coastal waters of New Zealand, scant or no regard has been given to macroalgal communities of soft sediment habitats.

The complexity of the interactions between biotic, physical and chemical components in intertidal and subtidal soft sediment environments is clear from a wide range of studies (e.g., Cardoso et al. 2004, Rossi 2007, Engelsen et al. 2010, Van Alstyne et al. 2011). Anibal et al. (2007) looked at the importance of the surface morphology of mudflats in structuring algal and macroepifauna communities. They concluded that there was a difference in the benthic communities associated with convex and concave surfaces, with a greater diversity and higher biomass present in the concave areas. They attributed this in part to the moisture retention, and reduction to exposure to wind and solar radiation afforded by the concave morphology. Murphy & Tolhurst (2009) manipulated microalgae and fauna in soft sediment intertidal areas to test the hypothesis that removal of fauna and of algae would affect the properties of the sediment in different ways. They found that algae "appear to be more important in governing the surface properties of the sediment than are benthic fauna". They further suggested that "variability in algae may be driving spatial and seasonal variations in sediment properties", and "therefore algae are of primary importance in determining the ecological structure and functioning of these coastal habitats as well as mediating physical processes such as sediment erosion". Investigations of the ecology of macroalgae in soft sediment environments in New Zealand remain at a very early stage (e.g. Kregting et al. 2008 a, b): they have been largely overlooked, not only with respect to their contributions to productivity but also to system complexity. The results of this study will provide a stronger basis for research on interactions and complexity within these environments.

4.1 Conclusions

Collections were made from three harbours with the primary focus on Whangarei and Otago Harbours where seasonal sampling programmes were conducted in spring and in autumn. In the Kaipara Harbour sampling was conducted only in spring. Two hundred and forty four taxa were sampled from intertidal and subtidal sites and a range of habitats: 146 (112 spring, 102 autumn) from Whangarei; 150 (107 spring, 115 autumn) from Otago; 43 were from Kaipara. Diversity indices indicate that the collecting was not saturated and predict that there is higher diversity of macroalgae in these harbours than found in the samples obtained.

The flora composition in the harbours was found to differ markedly e.g., only 67 taxa (45%) of the Whangarei flora were found to be in common with Otago Harbour collections; 17 taxa (39%) of the Kaipara flora was in common with the Otago flora; 27 taxa (63%) of the Kaipara flora were also found in Whangarei. More taxa were collected in the subtidal (107) in Whangarei Harbour than in the intertidal (84), compared with Otago where numbers of intertidal taxa (120) exceeded the subtidal taxa collected (83). More taxa were collected in spring (112) in Whangarei Harbour than in the autumn (102), compared with Otago where lower numbers of spring taxa (107) were found than in autumn (115).

Two methods were employed to enable high resolution sampling and these provided differing outcomes in the two main harbours sampled, clearly indicating that there was value in collecting by both methods in order to adequately sample the diversity: Whangarei Harbour 90 taxa were collected in quadrat sampling compared with 118 taxa via opportunistic collections, and in Otago Harbour 107 taxa were collected in quadrat sampling and 118 taxa via opportunistic collections.

Nineteen non-indigenous species were found in the harbours, including two new records for the New Zealand algal flora (confirmed by sequence data), *Hypnea cornuta* and *Polysiphonia morrowii*. In Whangarei Harbour eight non-indigenous species were found (4 new records for the harbour including *Hypnea*), in Otago Harbour 11 non-indigenous species were found including one new record as well as *P. morrowii,* and in Kaipara Harbour four species were found including two new records for the harbour.

The macroalgal communities found in Whangarei and Otago Harbours showed very different spatial and temporal distribution patterns within and between harbours. Given these differences, the application of these results to other harbours is cautioned and further sampling recommended. Macroalgae in soft sediment environments in New Zealand have been largely overlooked, not only with respect to their contributions to productivity but also to system complexity. The results of this study will provide a stronger basis for research on interactions and complexity within these environments.

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Appendix 1. Information on sites sampled in Whangarei, Otago and Kaipara Harbours.

Harbour	Locality	Locality code	Locality type	Date	Method	Latitude	Longitude	Habitat	Depth (from)	Depth (to)	Field notes and substrates
Whangarei	Calliope Bank	CB	Secondary	06 Apr 2010	Scuba	35° 50.039' S	174° 30.923' E	Subtidal	9.00	9.00	
Whangarei	Calliope Inner	CI	Secondary	06 Apr 2010	Scuba	35° 49.928' S	174° 31.294' E	Subtidal	6.50	6.50	
Whangarei	Kirikiri Point	KK	Secondary	02 Mar 2010	Hand	35° 46.3278' S	174° 28.1868' E	Intertidal			
Whangarei	Mair Bank	MA	Primary	01 Oct 2009	Scuba	35° 50.517' S	174° 30.620' E	Subtidal	0.50	0.50	sand, shell
Whangarei	Mair Bank	MA	Primary	06 Apr 2010	Scuba	35° 50.517' S	174° 30.620' E	Subtidal	0.50	0.50	sand, shell
Whangarei	Manganese Point	MG	Secondary	29 Sep 2009	Scuba	35° 47.819' S	174° 26.735' E	Subtidal	7.10	7.10	sand, mud
Whangarei	Marsden Point	MP	Secondary	05 Nov 2009	Hand	35° 50.23495' S	174° 29.54738' E	Intertidal			clean sand, algae on shells and cobbles, relatively little drift, shell/sand banks very extensive
Whangarei	Marsden Point	MP	Secondary	03 Mar 2010	Hand	35° 50.23495' S	174° 29.54738' E	Intertidal			sandbank
Whangarei	Marsden Point	MPS	Secondary	01 Oct 2009	Scuba	35° 49.944' S	174° 28.858' E	Subtidal	7.00	7.50	Mud, shell
Whangarei	Marsden Point	MPS	Secondary	07 Apr 2010	Scuba	35° 49.944' S	174° 28.858' E	Subtidal	7.20	7.20	Mud, shell, egg masses
Whangarei	McDonald Bank	MB	Primary	29 Sep 2009	Scuba	35° 48.301' S	174° 28.885' E	Subtidal	5.00	5.00	sand, shell gravel
Whangarei	McDonald Bank	MB	Primary	08 Apr 2010	Scuba	35° 48.301' S	174° 28.885' E	Subtidal	6.00	6.00	sand, shell gravel
Whangarei	McLeod Bay	MC	Secondary	06 Nov 2009	Hand	35° 48.948' S	175° 30.037' E	Intertidal			Sand, shell, seagrass, rocks
Whangarei	One Tree Point	OT	Primary	29 Sep 2009	Scuba	35° 49.325' S	174° 26.768' E	Subtidal	7.50	7.50	Sand, seagrass
Whangarei	One Tree Point	OT	Primary	07 Apr 2010	Scuba	35° 49.325' S	174° 26.768' E	Subtidal	1.20	1.20	Sand, seagrass
Whangarei	One Tree Point boat ramp	OB	Secondary	05 Nov 2009	Hand	35° 49.10016' S	174° 27.21208' E	Intertidal			mud/sand compacted by invertebrates
Whangarei	One Tree Point boat ramp	OB	Secondary	03 Mar 2010	Hand	35° 49.10016' S	174° 27.21208' E	Intertidal			mud/sand compacted by invertebrates
Whangarei	One Tree Point seagrass	OS	Secondary	05 Nov 2009	Hand	35° 49.23514' S	174° 26.84311' E	Intertidal			Sand, shell, seagrass
Whangarei	One Tree Point seagrass	OS	Secondary	03 Mar 2010	Hand	35° 49.23514' S	174° 26.84311' E	Intertidal			Sand, shell, seagrass
Whangarei	Parua Bay	PB	Secondary	04 Nov 2009	Hand	35° 46.38080' S	174° 27.11749' E	Intertidal			Intertidal soft mud with some cockle etc, more consolidated around mangroves on upper shore, river/stream bed consolidated with shell
Whangarei	Pirihi Road	PR	Secondary	07 Apr 2010	Scuba	35° 48.656' S	174° 26.042' E	Subtidal	6.20	6.20	sand, mud
Whangarei	Reotahi	RE	Primary	04 Nov 2009	Hand	35° 49.608' S	174° 29.790' E	Intertidal			Sand, shell, corallines, rocks
Whangarei	Reotahi	RE	Primary	02 Mar 2010	Hand	35° 49.608' S	174° 29.790' E	Intertidal			Sand, shell, corallines, rocks
Whangarei	Shell Cut Reach South (Tamaterau)	SH	Secondary	01 Oct 2009	Scuba	35° 48.441' S	174° 24.783' E	Subtidal	5.70	5.70	muddy
Whangarei	Sinclair Point	SP	Secondary	07 Apr 2010	Scuba	35° 49.255' S	174° 27.926' E	Subtidal	8.30	8.30	Mud, fine sand
Whangarei	Snake Bank Inner	SN	Secondary	08 Apr 2010	Scuba	35° 48.924' S	174° 28.672' E	Subtidal	4.60	4.60	sand, shell gravel
Whangarei	Snake Bank Outer	SO	Secondary	08 Apr 2010	Scuba	35° 48.475' S	174° 27.413' E	Subtidal	4.30	4.30	sand, shell gravel
Whangarei	Taurikura Bay	TB	Secondary	01 Mar 2010	Hand	35° 49.7268' S	174° 31.7226' E	Intertidal			Mud, fine sand

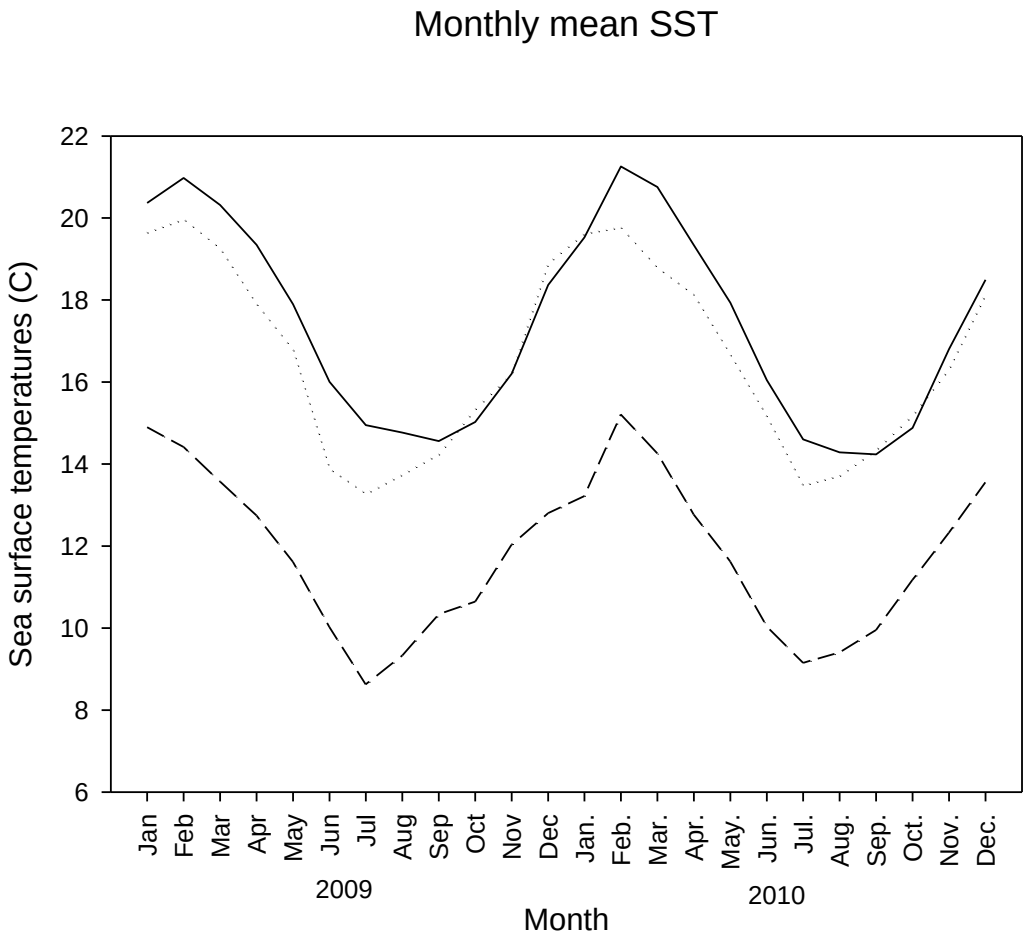
Appendix 1. Information on sites sampled in Whangarei, Otago and Kaipara Harbours.

Whangarei	Urquharts Bay	UB	Primary	02 Nov 2009	Hand	35° 50.648' S	174° 32.140' E	Intertidal			Small cobbles/stones on sand/mud extensive low intertidal, algae only apparent near low water, in upper subtidal small cobbles and stones covered in corallines and barnacles
Whangarei	Urquharts Bay	UB	Primary	01 Mar 2010	Hand	35° 50.648' S	174° 32.140' E	Intertidal			Small cobbles/stones on sand/mud extensive low intertidal, algae only apparent near low water, in upper subtidal small cobbles and stones covered in corallines and barnacles
Whangarei	Urquharts Bay	UBS	Primary	28 Sep 2009	Scuba	35° 50.495' S	174° 32.004' E	Subtidal	7.60	7.60	Subtidal flat sandy site with thin layer of silt, horse mussel clumps every 3-6m
Whangarei	Urquharts Bay	UBS	Primary	08 Apr 2010	Scuba	35° 50.495' S	174° 32.004' E	Subtidal	6.20	6.20	Sand, mud, shell, glass
Whangarei	Waikaraka	WA	Secondary	04 Nov 2009	Hand	35° 45.87243' S	174° 23.44800' E	Intertidal			Intertidal shell/stones on mud/sand, stream bed, mangrove pneumatophores
Otago	Between Gills Landing & Portobello	GP	Secondary	28 Oct 2009	Scuba	45° 49.500' S	170° 39.768' E	Subtidal	3.00	6.00	Hollow subtidal area full of algae drift (dying)
Otago	Harwood	HW	Primary	09 Feb 2009	Hand	45° 48.856' S	170° 39.987' E	Intertidal			fine sand and exposed seagrass flats, gentle sand undulations
Otago	Harwood	HW	Primary	19 Oct 2009	Hand	45° 48.856' S	170° 39.987' E	Intertidal			Sand, seagrass
Otago	Opposite Hamilton Bay	HB	Primary	11 Mar 2009	Scuba	45° 48.224' S	170° 38.131' E	Subtidal	5.00	6.00	Sand
Otago	Opposite Hamilton Bay	HB	Primary	28 Oct 2009	Scuba	45° 48.273' S	170° 38.122' E	Subtidal	6.50	6.50	Sand with bed of Adamsiella with Ulva and Gracilaria and branching brown algae abundant
Otago	Opposite Wellers subtidal	WO	Secondary	27 Oct 2009	Scuba	45° 47.564' S	170° 42.754' E	Subtidal	1.30	2.90	Sandy bottom with patches of Ulva abundant
Otago	Otakou/Wellers intertidal	OW	Primary	12 Feb 2009	Hand	45° 47.910' S	170° 42.863' E	Intertidal			seagrass, sand, patchy rocks, coralline and shells, Macrocystis around rocks and rock wall heading to channel
Otago	Otakou/Wellers intertidal	OW	Primary	18 Oct 2009	Hand	45° 47.910' S	170° 42.863' E	Intertidal			sand, shell, coralline, rocks
Otago	Otakou/Wellers subtidal	OWS	Primary	12 Feb 2009	Scuba	45° 47.908' S	170° 42.800' E	Subtidal	1.00	1.00	Sand, seagrass, 50-100 m offshore from Wellers Rock
Otago	Otakou/Wellers subtidal	OWS	Primary	29 Oct 2009	Scuba	45° 47.883' S	170° 42.842' E	Subtidal	2.00	2.00	Sand and seagrass patches
Otago	Pulling Point	PP	Secondary	29 Oct 2009	Scuba	45° 47.620' S	170° 39.556' E	Subtidal	3.00	5.00	Subtidal
Otago	Te Ngaru intertidal	TN	Primary	10 Feb 2009	Hand	45° 47.222' S	170° 40.662' E	Intertidal			Cobbles, sandflats extending beyond boulders, seagrass and shell patches, logs semi-submerged in sand, many algae attached to these
Otago	Te Ngaru intertidal	TN	Primary	16 Oct 2009	Hand	45° 47.222' S	170° 40.662' E	Intertidal			Cobbles, sandflats extending beyond boulders, seagrass and shell patches, logs semi-submerged in sand, many algae attached to these
Otago	Te Ngaru subtidal	TNS	Primary	10 Feb 2009	Scuba	45° 47.665' S	170° 40.545' E	Subtidal	10.00	10.40	sand, shell

Appendix 1. Information on sites sampled in Whangarei, Otago and Kaipara Harbours.

Otago	Te Ngaru subtidal	TNS	Primary	27 Oct 2009	Scuba	45° 47.665' S	170° 40.800' E	Subtidal	6.50	6.50	Strong current, sand and shell bed, mostly covered in algae, algae attached to shells
Otago	Torpedo Boat Mole	MO	Primary	12 Feb 2009	Hand	45° 47.859' S	170° 37.677' E	Intertidal			Intertidal boulders, cobbles, shell debris, small stones on soft fine sediment (sticky mud)
Otago	Torpedo Boat Mole	MO	Primary	17 Oct 2009	Hand	45° 47.859' S	170° 37.677' E	Intertidal			mud, shell
Kaipara	Dive Site 1	DS1	Secondary	09 Mar 2009	Scuba	36° 26.382' S	174° 17.486' E	Subtidal	5.80	5.80	shell on compact sand, strong current, dead barnacles
Kaipara	Dive Site 2	DS2	Secondary	09 Mar 2009	Scuba	36° 28.216' S	174° 16.444' E	Subtidal	3.30	3.30	shell on compact sand, strong current, sand dollars, no collections
Kaipara	Dredge Site 11	DR11	Secondary	10 Mar 2009	Dredge	36° 26.153' S	174° 18.034' E	Subtidal	2.70	3.40	horse mussel bed
Kaipara	Dredge Site 12	DR12	Secondary	10 Mar 2009	Dredge	36° 25.858' S	174° 18.281' E	Subtidal	3.40	3.40	horse mussels, sponges
Kaipara	Dredge Site 13	DR13	Secondary	10 Mar 2009	Dredge	36° 24.612' S	174° 19.215' E	Subtidal	6.00	12.00	scallops
Kaipara	Dredge Site 14	DR14	Secondary	10 Mar 2009	Dredge	36° 24.301' S	174° 19.374' E	Subtidal	4.00	13.00	horse mussel bed
Kaipara	Dredge Site 15	DR15	Secondary	10 Mar 2009	Dredge	36° 24.404' S	174° 18.653' E	Subtidal	6.00	12.00	horse mussel bed
Kaipara	Dredge Site 16	DR16	Secondary	10 Mar 2009	Dredge	36° 24.523' S	174° 17.834' E	Subtidal	5.40	10.30	some sand dollars, horse mussel
Kaipara	Dredge Site 17	DR17	Secondary	10 Mar 2009	Dredge	36° 24.899' S	174° 17.532' E	Subtidal	2.00	10.40	
Kaipara	Dredge Site 18	DR18	Secondary	10 Mar 2009	Dredge	36° 32.432' S	174° 22.841' E	Subtidal	6.50	6.50	some scallops
Kaipara	Dredge Site 19	DR19	Secondary	10 Mar 2009	Dredge	36° 34.464' S	174° 23.133' E	Subtidal	5.30	5.30	mud and Solieria
Kaipara	Dredge Site 20	DR20	Secondary	12 Mar 2009	Dredge	36° 31.262' S	174° 22.013' E	Subtidal	2.10	2.10	mud, Musculista, Patiriella, few macroalgae
Kaipara	Dredge Site 21	DR21	Secondary	12 Mar 2009	Dredge	36° 30.518' S	174° 21.778' E	Subtidal	10.00	10.00	
Kaipara	Dredge Site 22	DR22	Secondary	12 Mar 2009	Dredge	36° 30.802' S	174° 21.773' E	Subtidal	5.00	5.00	mud, sand dollars
Kaipara	Dredge Site 23	DR23	Secondary	12 Mar 2009	Dredge	36° 30.184' S	174° 21.12' E	Subtidal	7.00	7.00	few sand dollars, seagrass, few macroalgae
Kaipara	Dredge Site 24	DR24	Secondary	12 Mar 2009	Dredge	36° 29.808' S	174° 21.712' E	Subtidal	9.00	9.00	sponge, barnacle, few scallops, few macroalgae
Kaipara	Dredge Site 25	DR25	Secondary	12 Mar 2009	Dredge	36° 29.374' S	174° 20.951' E	Subtidal	10.00	10.00	Patiriella, few scallops, shells with some seaweed attached
Kaipara	Dredge Site 26	DR26	Secondary	12 Mar 2009	Dredge	36° 28.579' S	174° 19.685' E	Subtidal	8.00	8.00	scallops, Patiriella
Kaipara	Dredge Site 27	DR27	Secondary	12 Mar 2009	Dredge	36° 28.208' S	174° 20.213' E	Subtidal	3.80	3.80	sponge, shell debris
Kaipara	Dredge Site 3	DR3	Secondary	09 Mar 2009	Dredge	36° 28.222' S	174° 16.454' E	Subtidal	5.00	5.00	zero seaweed
Kaipara	Dredge Site 4	DR4	Secondary	09 Mar 2009	Dredge	36° 28.215' S	174° 17.15' E	Subtidal	4.50	5.60	many sand dollars
Kaipara	Dredge Site 5	DR5	Secondary	09 Mar 2009	Dredge	36° 29.141' S	174° 18.233' E	Subtidal	3.00	3.00	sand dollars, few macroalgae
Kaipara	Dredge Site 6	DR6	Secondary	09 Mar 2009	Dredge	36° 28.806' S	174° 18.157' E	Subtidal	9.60	9.60	sand dollars
Kaipara	Dredge Site 7	DR7	Secondary	09 Mar 2009	Dredge	36° 29.126' S	174° 18.369' E	Subtidal	2.00	2.00	
Kaipara	Dredge Site 8	DR8	Secondary	09 Mar 2009	Dredge	36° 31.532' S	174° 22.743' E	Subtidal	14.00	14.00	
Kaipara	Karaka Point	KP	Secondary	09 Mar 2009	Hand	36° 24.203' S	174° 22.058' E	Intertidal			sand beach, to muddy intertidal with scattered mangroves, mudstone reef, oysters, extensive intertidal fine sand mud flats bare of seaweed, but with patches of Zostera
Kaipara	Shelly Beach	SB	Secondary	10 Mar 2009	Hand	36° 34.279' S	174° 22.763' E	Intertidal			mud flats, occas. shells

Appendix 2. Mean monthly SST data for the three harbours over 2009 and 2010. Whangarei = solid line, Kaipara = dotted line, Otago = dashed line.



Appendix 3. List of collection sites in Whangarei Harbour and the taxa collected at them in spring (Spr) and Autum (Aut). Primary sites are in bold, secondary sites in italics.

Class	Family	Species	Intertidal																Subtidal																			
			Waikaraka		*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**	*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
Ulvophyceae	Caulerpaceae	*Caulerpa flexilis*																									•									
	Codiaceae	*Codium convolutum*									•	•				•	•	•										•			•	•	•	•		
		C. fragile s.sp. *fragile*	•									•															•					•			•	•
		C. fragile s.sp. *novae-zelandiae*								•																										
		Codium sp.																								•		•		•	•			•		•
	Derbesiaceae	*Derbesia novae-zelandiae*													•									•				•								
	Anadyomenaceae	*Microdictyon mutabile*									•	•																								
		Microdictyon umbilicatum											•																							
	Cladophoraceae	*Chaetomorpha aerea*									•																									
		Chaetomorpha capillaris										•																								
		Chaetomorpha sp.									•		•																					•		
		Cladophora herpestica									•																									
		C. montagneana									•																									
		Cladophora sp.				•					•	•				•	•	•								•						•		•	•
		Rhizoclonium sp.	•								•																									
	Monostromataceae	*Monostroma* sp.	•					•																												
	Ulotrichaceae	*Ulothrix* sp.			•																															
	Ulvaceae	*Ulva compressa*	•																																	
		Ulva species 1				•								•					•								•		•					•	
		Ulva species 2																																	•	
		Ulva sp.			•		•	•			•	•		•	•										•	•			•	•			•		•	•

Appendix 3 continued.

Class	Family	Species	Intertidal																Subtidal																					
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**	*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
		green shells	•			•						•		•	•		•																			
Xanthophyceae		*Vaucheria sp.*		•			•					•																							
Phaeophyceae	Dictyotaceae	*Dictyota* sp.																	•							•			•		•	•			
		Zonaria turneriana																								•									
	Acinetosporaceae	*Hincksia granulosa*																																•	
		Hincksia mitchelliae			•		•				•			•																					
		Hincksia sp.		•		•																•	•											•	
	Chordariaceae	*Leathesia difformis*								•	•	•			•	•	•																		
		Leathesia sp.											•																						
		Myrionema strangulans											•																						
	Ectocarpaceae	*Ectocarpus siliculosus*	•																				•												
		Ectocarpus sp.																•														•			
	Ralfsiaceae	*Ralfsia* c.f. *expansa*								•	•					•																			
		Ralfsia sp.								•					•	•	•																		
	Scytosiphonaceae	*Colpomenia bullosa*														•																			
		Colpomenia ecuticulata											•																			•			
		Colpomenia peregrina									•	•		•												•			•		•	•			
		Colpomenia sinuosa					•			•			•			•	•																		
		Colpomenia sp.				•		•		•	•			•	•		•										•		•	•		•	•		
		Hydroclathrus clathratus									•							•								•	•			•	•	•	•		
		Petalonia fascia																																•	
		Scytosiphon lomentaria											•																					•	

Appendix 3 continued.

Class	Family	Species	Intertidal															Subtidal																		
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**	*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
Phaeophyceae		Ectocarpales					•				•						•						•	•						•				•	
	Hormosiraceae	*Hormosira banksii*		•	•		•	•	•	•	•	•		•	•	•	•									•	•					•	•		
	Sargassaceae	*Carpophyllum flexuosum*														•										•						•	•		
		C. maschalocarpum																														•			
		Carpophyllum sp.																•	•							•							•		
		Sargassum scabridum																													•				
		Sargassum sinclairii														•										•						•	•		
	Lessoniaceae	*Ecklonia radiata*								•																•						•	•		
	Scytothamnaceae	*Scytothamnus australis*						•							•	•																			
	Sphacelariaceae	*Sphacelaria rigidula*									•	•																							•
		Sphacelaria tribuloides		•			•																						•						
		Sphacelaria variabilis																																•	
		Sphacelaria sp.					•								•																		•		
		Phaeophyceae													•		•								•										•
Compsopogonophyceae		Erythropeltidales																	•																
Florideophyceae	Corallinaceae	*Corallina officinalis*	•				•		•	•	•	•		•	•	•	•														•	•	•		
		Jania rosea								•																									
		Jania verrucosa																																	•
		Lithophyllum sp.																														•			
		Spongites tunicatus									•																								
		Spongites yendoi								•	•	•			•	•	•																		

Appendix 3. Continued.

Class	Family	Species	Intertidal																Subtidal																							
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**	*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
Florideophyceae	Hapalidaceae	*Lithothamnion* sp.																															•	•		
		Mesophyllum sp.												•			•												•						
	Sporolithaceae	*Sporolithon durum*															•																		
		Corallinophycidae																	•																
	Hildenbrandiaceae	*Hildenbrandia* sp.																																•		
	Acrochaetiaceae	*Rhodochorton* sp.		•			•										•																		
	Bonnemaisoniaceae	*Falkenbergia rufolanosa*																										•							
	Callithamniaceae	*Callithamnion* sp.									•																	•							
	Ceramiaceae	*Antithamnionella adnata*																					•												
		Centroceras clavulatum																																•	•
		Ceramium species 1															•																		
		Ceramium species 3																										•							
		Ceramium species 4																								•		•	•	•					
		Ceramium species 6																														•			
		Ceramium species 8												•																					
		Ceramium species 9																										•							
		Ceramium species 10																										•							
		Ceramium sp.					•				•		•	•	•								•	•	•		•	•	•	•	•	•		•
	Dasyaceae	*Dasya subtilis*									•														•	•		•				•			
		Dasya sp.												•														•				•	•		
		Heterosiphonia squarrosa																														•			

Appendix 3. Continued.

Class	Family	Species	Intertidal																Subtidal																					
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Paruа Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**		*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
Florideophyceae	Delesseriaceae	*Acrosorium venulosum*									•		•	•						•				•	•		•	•	•	•			•		•	
		Apoglossum montagneanum																										•	•						
		Caloglossa ogasawaraensis																																	•
		Caloglossa vieillardii	•					•																											
		Delesseriaceae																								•		•							•
		Hymenena variolosa																•							•	•		•				•			
		Hymenena sp.																								•		•					•		
		Phycodrys adamsiae																								•									
		Schizoseris sp.																										•							
	Rhodomelaceae	*Aphanocladia delicatula*																							•			•	•		•	•			
		Bostrychia gracilis								•																									
		Bostrychia moritziana	•																													•			
		Bostrychia sp.						•																											
		Chondria sp.																								•		•	•		•				
		Cladhymenia oblongifolia																													•				
		Dasyclonium incisum																																	•
		Laurencia thyrsifera								•	•					•																			
		Polysiphonia isogona sensu Adams												•																					
		P. isogona sensu Freshwater																																•	
		P. rhododactyla																										•							

Appendix 3. Continued.

Class	Family	Species	Intertidal																Subtidal																									
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**			*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**		*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
Florideophyceae	Rhodomelaceae	*P. strictissima*												•												•							•	•	•
		P. subtilissima					•																													
		Polysiphonia species 1																				•														
		Polysiphonia species 2																										•								
		Polysiphonia species 4																															•			
		Polysiphonia species 5																																		•
		Polysiphonia sp.		•		•	•															•	•					•			•		•	•	•
		Pterosiphonia pennata																										•	•	•					•	
		Rhodomelaceae																										•								
	Spyridiaceae	*Spyridia filamentosa*			•						•			•						•				•	•	•	•	•		•			•		•
	Wrangeliaceae	*Anotrichium crinitum*																		•																
		Anotrichium sp.																																	•	
		Griffithsia teges																		•								•	•						
		Griffithsia sp.												•															•						
		Lophothamnion hirtum																														•				
		Spongoclonium pastorale								•																			•				•			
	Corallinaceae	*Spongites yendoi*								•	•	•			•	•	•																			
	Gelidiaceae	*Gelidium caulacantheum*	•				•	•	•		•		•		•	•	•																		•	•
		Gelidium sp.				•											•																			•
		Pterocladia lucida																																	•	•
	Caulacanthaceae	*Catenella nipae*						•																												
		Caulacanthus ustulatus	•							•																									•	•

Appendix 3. Continued.

Class	Family	Species	Intertidal															Subtidal																		
			Waikaraka	*One Tree Point seagrass*		*One Tree Point boat ramp*		*Parua Bay*	*Kirikiri Point*	**Reotahi**		*McLeod Bay*	*Marsden Point*		*Taurikura Bay*	**Urquharts Bay**		*Shell Cut Rch S (Tamaterau)*	*Pirihi Road*	*Manganese Point*	**One Tree Point**		*Snake Bank Outer*	*Sinclair Point*	*Snake Bank Inner*	*Marsden Point*		**McDonald Bank**		*Calliope Bank*	*Calliope Inner*	**Urquharts Bay**		**Mair Bank**	
			Spr	*Spr*	*Aut*	*Spr*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Spr*	*Spr*	*Aut*	*Aut*	**Spr**	**Aut**	*Spr*	*Aut*	*Spr*	**Spr**	**Aut**	*Aut*	*Aut*	*Aut*	*Spr*	*Aut*	**Spr**	**Aut**	*Aut*	*Aut*	**Spr**	**Aut**	**Spr**	**Aut**
	Gigartinaceae	*Chondracanthus chapmanii*								•		•	•	•		•									•			•	•					•	•
		Gigartina atropurpurea								•		•														•		•	•			•		•	
		Gigartina sp.																							•										
	Hypneaceae	*Hypnea cornuta*																	•																
	Kallymeniaceae	*Ectophora depressa*																														•			
	Gracilariaceae	*Gracilaria chilensis*	•		•		•					•	•	•						•								•						•	
		Gracilaria truncata											•					•		•						•		•	•			•			
	Halymeniaceae	*Aeodes nitidissima*								•	•					•																			
	Scinaiaceae	*Nothogenia pulvinata*									•																								
	Peyssonneliaceae	*Peyssonnelia* sp.																																•	
	Plocamiaceae	*Plocamiocolax*								•																									
		Plocamium angustum																										•	•	•	•				•
		Plocamium cirrhosum								•	•		•	•				•	•	•						•		•	•						
		Plocamium sp.																										•	•						
	Lomentariaceae	*Lomentaria caespitosa*																													•				
		Lomentaria sp.																								•	•	•	•		•	•			
	Rhodymeniaceae	*Rhodymenia leptophylla*																										•							
		Rhodymenia sp.																							•	•		•		•	•	•	•		
		Florideophyceae																							•	•						•		•	•
Stylonematophyceae		*Stylonema alsidii*		•																															•

Appendix 4. List of collection sites in Otago Harbour and the taxa collected at each in spring (Spr) and autumn (Aut). Primary sites are in bold, secondary sites in italics.

			Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers intertidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers subtidal**		*Opposite Wellers subtidal*
Class	Family	Species	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Ulvophyceae	Bryopsidaceae	*Bryopsis plumosa*		•						•									
		Bryopsis vestita					•		•	•									
		Bryopsis sp.					•												
	Codiaceae	*Codium convolutum*						•											
		Codium fragile s.sp. *novae-zelandiae*		•	•	•	•	•	•	•	•							•	
	Derbesiaceae	*Derbesia novae-zelandiae*												•					
	Cladophoraceae	*Chaetomorpha aerea*				•		•	•	•			•			•		•	
		Chaetomorpha coliformis							•										
		Chaetomorpha sp.				•				•			•						
		Cladophora subsimplex							•										
		C. vagabunda s.l. (incl. *C. dalmatica*)						•	•	•									
		Cladophora valonioides				•	•	•		•		•	•		•	•		•	•
		Cladophora sp.		•		•	•	•		•			•	•		•		•	
		Rhizoclonium implexum								•									
	Acrosiphoniaceae	c.f. *Spongomorpha pacifica*								•									
	Monostromataceae	*Monostroma* sp.	•																
	Ulvaceae	*Ulva compressa*				•	•	•		•		•							•
		Ulva intestinalis	•						•	•									
		Ulva pertusa				•	•												
		Ulva procera					•	•	•						•				
		Ulva prolifera							•		•								
		Ulva ralfsii	•	•	•	•					•								

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal									
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers intertidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers subtidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Ulvophyceae	Ulvaceae	*Ulva rigida*					•		•			•	•			•			
		Ulva species 1	•		•	•	•	•	•	•	•	•	•		•	•	•	•	
		Ulva species 2	•																
		Ulva sp.	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•
		Umbraulva olivascens													•				
		Ulvophyceae											•						
		green shells		•		•													
Xanthophyceae	Vaucheriaceae	*Vaucheria* sp.						•	•										
Phaeophyceae	Cutleriaceae	*Cutleria multifida*						•	•	•	•								
	Acinetosporaceae	*Hincksia* c.f. *ovata*					•												
		Hincksia granulosa							•										•
		Hincksia mitchelliae		•			•	•									•		
		Hincksia sp.							•										
	Adenocystaceae	*Adenocystis utricularis*				•	•	•											
	Chordariacae	*Tinocladia novae-zelandiae*	•		•		•	•											•
		Leathesia difformis	•		•		•												
		Leathesia sp.						•											
		Myrionema strangulans	•				•	•		•									
		Punctaria latifolia					•										•		
	Ectocarpaceae	*Ectocarpus siliculosus*						•			•				•				
		Ectocarpus sp.					•								•				
	Ralfsiaceae	*Ralfsia* sp.		•															

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers inter-tidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers subtidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Phaeophyceae	Scytosiphonaceae	*Colpomenia peregrina*					•		•	•	•						•	•	•
		Colpomenia sp.		•	•	•	•	•		•			•				•	•	
		Petalonia fascia							•	•									
		Scytosiphon lomentaria	•				•	•	•	•					•		•	•	
		Ectocarpales	•							•									
	Durvillaeaceae	*Durvillaea antarctica*								•									
	Hormosiraceae	*Hormosira banksii*								•									
	Sargassaceae	*Carpophyllum flexuosum*																•	
		Cystophora sp.											•						
	Alariaceae	*Undaria pinnatifida*	•		•		•	•	•	•						•	•		•
	Laminariaceae	*Macrocystis pyrifera*	•				•	•		•			•					•	•
	Lessoniaceae	*Ecklonia radiata*																	•
	Scytothamnaceae	*Scytothamnus australis*								•									
		Scytothamnus fasciculatus							•										
	Cladostephaceae	*Cladostephus spongiosus*						•	•	•									
	Sphacelariaceae	*Sphacelaria rigidula*																•	
	Stypocaulaceae	*Halopteris* sp.																•	
		Phaeophyceae					•			•						•			
Bangiophyceae	Bangiaceae	*Porphyra* (*Pyropia*) *rakiura*							•										
Florideophyceae	Corallinaceae	*Corallina officinalis*		•					•	•									
		Jania sp.								•								•	
		Lithophyllum pustulatum							•	•									

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers inter-tidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers subtidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Florideophyceae	Corallinaceae	*Lithophyllum* sp.							•										
		Pneophyllum coronatum																•	
		Pneophyllum fragile			•				•										
		Pneophyllum sp.																•	
		Spongites yendoi		•						•									
	Hapalidaceae	*Mesophyllum* sp.							•	•									
		Corallinophycidae							•	•									
	Colaconemataceae	*Colaconema* sp.					•		•										
	Halymeniaceae	*Pachymenia dichotoma*								•									
	Scinaiaceae	*Nothogenia fastigiata*							•	•									
	Callithamniaceae	*Callithamnion* sp.		•						•									
	Ceramiaceae	*Acrothamnion* sp. sensu Adams																	•
		Antithamnion pectinatum														•			•
		Antithamnionella adnata		•						•	•			•					•
		Centroceras clavulatum				•			•										
		Ceramium species 2								•									
		Ceramium species 4	•	•			•	•	•	•			•			•			•
		Ceramium species 5					•					•							
		Ceramium species 6		•		•	•	•	•	•			•		•	•	•	•	•
		Ceramium species 10	•	•	•	•	•	•		•						•		•	
		Ceramium sp.		•		•		•		•			•			•		•	•
		Pterothamnion confusum																	•
		Pterothamnion simile																	•

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers inter-tidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers sub-tidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Florideophyceae	Dasyaceae	*Heterosiphonia squarrosa*								•									
	Delesseriaceae	*Abroteia suborbiculare*																•	
		Delesseriaceae								•		•	•			•		•	
		Erythroglossum undulatissimum		•						•						•		•	
		Haraldiophyllum crispatum		•				•					•		•	•		•	
		Phycodrys novae-zelandiae		•			•		•				•	•				•	•
		Schizoseris dichotoma		•				•						•					
		Schizoseris griffithsia			•				•	•		•		•		•			
		Schizoseris sp. aff. *M. gattyana*											•						•
		Schizoseris sp. sensu Adams											•						
		Schizoseris sp.		•			•		•							•		•	•
	Rhodomelaceae	*Adamsiella angustifolia*							•	•							•		
		Adamsiella chauvinii	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•
		Aphanocladia delicatula			•														
		Bostrychia arbuscula						•									•		
		Brongniartella australis				•	•	•	•		•	•	•	•		•		•	•
		Dipterosiphonia heteroclada																•	
		Echinothamnion lyallii								•								•	
		Echinothamnion sp.													•				
		Metamorphe colensoi																•	
		Perrinia ericoides		•						•									•
		Polysiphonia constricta		•		•													

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers inter-tidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers sub-tidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
Florideophyceae	Rhodomelaceae	*Polysiphonia decipiens*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
		Polysiphonia isogona sensu Adams		•		•	•	•	•										•
		Polysiphonia morrowii	•		•	•	•												
		Polysiphonia muelleriana					•												
		Polysiphonia strictissima	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•
		Polysiphonia species 3		•															
		Polysiphonia species 4		•					•									•	
		Polysiphonia sp.	•	•	•	•	•	•	•	•		•				•		•	
		Pterosiphonia pennata		•			•		•	•									
	Wrangeliaceae	*Anotrichium crinitum*		•									•	•					
		Anotrichium sp.		•									•						
		Griffithsia crassiuscula		•				•					•					•	
		Griffithsia sp.		•			•												
		Medeiothamnion lyallii		•									•	•		•	•	•	•
		Spongoclonium pastorale					•		•										•
	Caulacanthaceae	*Caulacanthus ustulatus*								•								•	
	Cystocloniaceae	*Rhodophyllis acanthocarpa*																•	
		Rhodophyllis sensu *lacerata*																	•
	Gigartinaceae	*Chondracanthus chapmanii*				•													
		Gigartina atropurpurea	•				•	•		•						•			•
		Gigartina sp.	•						•						•				

Appendix 4. Continued.

Class	Family	Species	Intertidal								Subtidal								
			Torpedo Boat Mole		**Harwood**		**Te Ngaru intertidal**		**Otakou/Wellers inter-tidal**		*Btwn Gills & Portobello*	**Opposite Hamilton Bay**		*Pulling Point*	**Te Ngaru subtidal**		**Otakou/Wellers subtidal**		*Opposite Wellers subtidal*
			Spr	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	*Spr*	**Spr**	**Aut**	**Spr**	**Aut**	*Spr*
	Gigartinaceae	*Rhodoglossum* sp.	•		•	•	•	•	•	•		•		•	•	•			•
		Sarcothalia livida					•	•	•	•								•	
		Gigartinaceae		•		•		•		•						•		•	
	Kallymeniaceae	*Callophyllis calliblepharoides*																	•
		Pugetia delicatissima										•							
		Pugetia sp.																	•
		Gigartinales													•				
	Gracilariaceae	*Gracilaria chilensis*	•	•	•	•	•		•	•	•		•		•	•	•	•	•
		Gracilaria secundata				•			•	•		•	•		•	•			•
		Gracilaria truncata	•				•		•	•		•	•			•		•	•
	Halymeniaceae	*Glaphyrosiphon intestinalis*					•												
	Plocamiaceae	*Plocamium cartilagineum*	•				•		•	•				•	•	•	•		•
		Plocamium sp.																•	
	Champiaceae	*Champia* sp.														•			
	Lomentariaceae	*Lomentaria secunda*								•									
	Rhodymeniaceae	*Gloioderma saccatum*												•					
		Florideophyceae						•	•									•	
Stylonematophyceae		*Stylonema alsidii*				•													

Appendix 5. List of collection sites in Kaipara Harbour and the taxa collected at each.

Class	Family	Species	Inter-tidal		Subtidal																								
			Karaka Point	*Shelly Beach*	*Dive Site 1*	*Dredge Site 3*	*Dredge Site 4*	*Dredge Site 5*	*Dredge Site 6*	*Dredge Site 7*	*Dredge Site 8*	*Dredge Site 11*	*Dredge Site 12*	*Dredge Site 13*	*Dredge Site 14*	*Dredge Site 15*	*Dredge Site 16*	*Dredge Site 17*	*Dredge Site 18*	*Dredge Site 19*	*Dredge Site 20*	*Dredge Site 21*	*Dredge Site 22*	*Dredge Site 23*	*Dredge Site 24*	*Dredge Site 25*	*Dredge Site 26*	*Dredge Site 27*
Ulvophyceae	Codiaceae	*Codium fragile* s.sp. *novae-zelandiae*	•							•		•				•	•	•		•						•		•
	Cladophoraceae	*Chaetomorpha valida*	•	•																									
		Chaetomorpha sp.													•														
		Rhizoclonium curvatum		•																									
		Wittrockiella sp.	•																										
	Ulvaceae	*Ulva pertusa*	•	•																									
		Ulva sp.		•							•																		
		green shells		•																									
Xanthophyceae		*Vaucheria sp.*	•																							•			
Phaeophyceae	Hormosiraceae	*Hormosira banksii*	•																										
	Scytothamnaceae	*Scytothamnus australis*	•																										
Florideophyceae	Corallinaceae	*Corallina officinalis*	•																										
		Phymatolithon sp.	•																										
	Ceramiaceae	*Ceramium* species 7											•																
		Ceramium sp.																									•	•	
	Dasyaceae	*Dasya* sp.										•																	
	Delesseriaceae	*Apoglossum montagneanum*																							•				
		Apoglossum sp.																								•			
		Caloglossa ogasawaraensis		•																									
		Caloglossa vieillardii	•	•																									
		Hymenena variolosa																									•		
	Rhodomelaceae	*Bostrychia intricata*		•																									

Appendix 5. Continued.

Class	Family	Species	Inter-tidal		Subtidal																									
			Karaka Point	*Shelly Beach*	*Dive Site 1*	*Dredge Site 3*	*Dredge Site 4*	*Dredge Site 5*	*Dredge Site 6*	*Dredge Site 7*	*Dredge Site 8*	*Dredge Site 11*	*Dredge Site 12*	*Dredge Site 13*	*Dredge Site 14*	*Dredge Site 15*	*Dredge Site 16*	*Dredge Site 17*	*Dredge Site 18*	*Dredge Site 19*	*Dredge Site 20*	*Dredge Site 21*	*Dredge Site 22*	*Dredge Site 23*	*Dredge Site 24*	*Dredge Site 25*	*Dredge Site 26*	*Dredge Site 27*
Florideophyceae	Rhodomelaceae	*Bostrychia moritziana*	•	•																										
		Bostrychia sp.		•																										
		Polysiphonia sertularioides	•							•		•	•													•		•		
		Polysiphonia strictissima										•																		
		Polysiphonia sp.																							•		•			
	Spyridiaceae	*Spyridia filamentosa*	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Wrangeliaceae	*Anotrichium crinitum*																													•
		Anotrichium sp.								•	•																			•	
		Griffithsia teges										•															•		•		•
		Griffithsia sp.						•		•		•		•								•			•						
	Gelidiaceae	*Capreolia implexa*	•	•																											
		Gelidium caulacantheum	•																												
	Caulacanthaceae	*Catenella nipae*		•								•																			
		Caulacanthus ustulatus	•																												
	Solieriaceae	*Solieria* sp.					•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Gracilariaceae	*Gracilaria chilensis*						•		•				•					•	•	•		•	•							•
		Gracilaria sp. BB		•				•			•	•								•		•						•			
		Melanthalia abscissa	•																												
	Rhodymeniaceae	*Rhodymenia leptophylla*										•	•	•	•	•				•		•				•	•	•			
		Florideophyceae																								•					
Incertae sedis		Rhodophyta	•																												

Appendix 6. Whangarei Harbour SIMPER analysis for primary sites. The analysis was run at a cut off for low contributions of 90%, giving the number of taxa contributing to similarities and dissimilarities between seasons at each site, and the taxa making the largest contributions.

Site	Season	Similarity	No. taxa contributing	Taxa contributing over 10% to similarity	Seasonal dissimilarity	No. taxa contributing	Taxa contributing over 10% to dissimilarity
RE	Spring	51.09	1	*Corallina officinalis*	36.84	10	*Chondracanthus chapmanii* *Colpomenia* sp. *Corallina officinalis* *Plocamium cirrhosum*
	Autumn	84.09	1	*Corallina officinalis*			
UB	Spring	54.15	4	*Chondracanthus chapmanii* *Colpomenia bulosa* *Corallina officinalis*	56.33	9	*Chondracanthus chapmanii* *Colpomenia bulosa* *Spongites yendoi* *Ralfsia* sp.
	Autumn	64.84	2	*Corallina officinalis* *Spongites yendoi*			
OT	Spring	100	1	*Hincksia* sp.	18.33	2	*Polysiphonia* species 1 *Polysiphonia* sp.
	Autumn	77.85	2	*Hincksia* sp. *Polysiphonia* species 1			
MB	Spring	47.28	8	*Acrosorium venulosum* *Apoglossum montag* *Ceramium* sp. *Ulva* sp.	70.81	27	None
	Autumn	37.84	8	*Acrosorium venulosum* *Ceramium* species 4 *Chondracanthus chapmanii* *Gracilaria truncata* *Plocamium cirrhosum*			
UBS	Spring	29.8	4	*Aphanocladia delicatula* *Corallina officinalis* *Hymenena variolosa*	77.55	26	*Aphanocladia delicatula*
	Autumn	45.75	2	*Ceramium* sp. *Corallina officinalis*			
MA	Spring	39.75	8	Centroceros clavulatum *Polysiphonia isogona* sensu Freshwater *Ulva* sp.	86.09	21	None
	Autumn	30.63	5	*Chondracanthus chapmanii* Phaeophyceae *Ulva* sp.			

Appendix 7. Otago Harbour SIMPER analysis for primary sites. The analysis was run at a cut off for low contributions of 90%, giving the number of taxa contributing to similarities and dissimilarities between seasons at each site, and the taxa making the largest contributions.

Site	Season	Similarity	No. taxa contributing	Taxa contributing over 10%	Seasonal dissimilarity	No. taxa contributing	Taxa contributing over 10%
MO	Spring	47.69	5	*Gracilaria chilensis* *Ulva ralfsii* *Ulva* species 2 *Ulva* sp.	84.87	23	None
	Autumn	30.42	7	*Ceramium* species 10 *Polysiphonia strcitissima*			
HW	Spring	49.14	3	*Adamsiella chauvinii* *Gracilaria chilensis* *Ulva* sp.	51.96	12	*Adamsiella chauvinii* *Gracilaria chilensis* *Polysiphonia decipiens* *Ulva* sp.
	Autumn	51.56	4	*Adamsiella chauvinii* *Gracilaria chilensis* *Polysiphonia decipiens* *Ulva* sp.			
TN	Spring	24.27	11	*Polysiphonia decipiens* *Polysiphonia* sp. *Ulva* sp.	79.81	30	None
	Autumn	31.34	6	*Codium fragile ssp. nz* *Polysiphonia* sp. *Ulva* sp.			
OW	Spring	34.98	5	*Polysiphonia decipiens* *Ulva* sp.	82.76	36	None
	Autumn	32.17	14	*Ulva* species 1			
HB	Spring	46.22	1	*Ulva* sp.	94.41	21	*Polysiphonia decipiens* *Ulva* sp.
	Autumn	13.69	4	*Adamsiella chauvinii* *Polysiphonia decipiens*			
TNS	Spring	37.89	3	*Gigartina* sp. *Ulva* sp.	76.31	25	None
	Autumn	38.72	6	*Adamsiella chauvinii* *Erythroglossum undulatissimum* *Polysiphonia* sp. *Ulva* sp.			

Appendix 7. Otago Harbour SIMPER analysis for primary sites. The analysis was run at a cut off for low contributions of 90%, giving the number of taxa contributing to similarities and dissimilarities between seasons at each site, and the taxa making the largest contributions. (CONTINUED)

Site	Season	Similarity	No. taxa contributing	*Taxa contributing over 10%*	Seasonal dissimilarity	No. taxa contributing	Taxa contributing over 10%
OWS	Spring	43.59	2	*Ulva* sp.	88.15	29	None
	Autumn	51.35	8	*Carpophyllum flexuosum* *Chaetomorpha aerea* *Colpomenia* sp. *Polysiphonia decipiens* *Ulva* sp.			

Appendix 8. Details of taxa sequenced in molecular analysis. Y = rbcL or LSU sequence obtained, P = partial rbcL or LSU sequence obtained. Bp = base pair.

Sample number	Identification used in this report	Collected from	rbcL seq?	LSU seq?	Comment
45	Centroceras clavulatum	Otago, HW	Y	Y	Gap between 5' and 3' end of gene sequence. Entity designated on basis of LSU
1181	Centroceras clavulatum	Whangarei, MA	Y		Identical to (1 uncertainty code) C clavulatum from Ahipara
1348	Centroceras clavulatum	Otago, OW	Y		3bp + 1 uncerts to C clavulatum from Ahipara
ASK011	Centroceras clavulatum	Whangarei, Ocean Beach	Y		
1611	Ceramium species 1	Whangarei, UB	P		
533	Ceramium species 2	Otago, OW	Y	Y	Entity designated on basis of LSU
1053	Ceramium species 3	Whangarei, MB	Y		Need to resequence 3' end of gene (lots of ambiguity). LSU sequence messy, needs resequencing. psbA seq only 500bp
106	Ceramium species 4	Otago, TN		Y	Entity designated on basis of LSU
548	Ceramium species 4	Otago, OW	Y	Y	Entity designated on basis of LSU
1046	Ceramium species 4	Whangarei, MB		Y	Entity designated on basis of LSU
1061	Ceramium species 4	Whangarei, MB	Y	Y	Gap between 5' and 3' end of gene sequence. Entity designated on basis of LSU, psbA not analysed.
1300	Ceramium species 4	Otago, OW		Y	Entity designated on basis of LSU
1307	Ceramium species 4	Otago, OW		Y	Entity designated on basis of LSU
1230	Ceramium species 5	Otago, TN	Y		
100	Ceramium species 6	Otago, TN		Y	Entity designated on basis of LSU
1257	Ceramium species 6	Otago, TN	Y		
1388	Ceramium species 6	Otago, TN	P		
1479	Ceramium species 6	Otago, OW	P		
101	Ceramium species 6	Otago, TN		Y	Entity designated on basis of LSU
102	Ceramium species 6	Otago, TN	Y	Y	Entity designated on basis of LSU
103	Ceramium species 6	Otago, TN		Y	Entity designated on basis of LSU
112	Ceramium species 6	Otago, TN		Y	Entity designated on basis of LSU
13	Ceramium species 6	Otago, HW		Y	Entity designated on basis of LSU
34	Ceramium species 6	Otago, HW		Y	Entity designated on basis of LSU
14	Ceramium species 6	Otago, HW		Y	Entity designated on basis of LSU

1428	Ceramium species 6	Otago, WO	Y	Y	Gap between 5’ and 3’ end of gene sequence. Entity designated on basis of LSU
963	Ceramium species 7	Kaipara, DR12	Y	Y	Entity designated on basis of LSU
1647	Ceramium species 8	Whangarei, MP	P		
1079	Ceramium species 9	Whangarei, MB	Y	Y	Gap between 5’ and 3’ end of gene sequence. Entity designated on basis of LSU
1064	Ceramium species 9	Whangarei, MB	P		
104	Ceramium species 10	Otago, TN	Y	Y	Gap between 5’ and 3’ end of gene sequence. Entity designated on basis of LSU
49	Ceramium species 10	Otago, HW		Y	Entity designated on basis of LSU
1284	Ceramium species 10	Otago, MO		Y	Entity designated on basis of LSU
1231	Ceramium species 10	Otago, TN	Y		
1290	Ceramium species 10	Otago, MO	P		
1368	Ceramium species 10	Otago, HW	P		
105	Ceramium species 10	Otago, TN		Y	Entity designated on basis of LSU
33	Ceramium species 10	Otago, HW	Y	Y	Gap between 5’ and 3’ end of gene sequence. Entity designated on basis of LSU
298	Ceramium species 10	Otago, MO		Y	Entity designated on basis of LSU
40	Ceramium species 10	Otago, HW		Y	Entity designated on basis of LSU
16	Ceramium species 10	Otago, HW		Y	Entity designated on basis of LSU
965	Gracilaria chilensis	Kaipara, DR19	Y		
949	Gracilaria sp. Blockhouse Bay	Kaipara, SB	Y		
966	Gracilaria sp. Blockhouse Bay	Kaipara, DR19	Y		
1001	Gracilaria truncata	Whangarei, UB	Y		
1132	Gracilaria truncata	Whangarei, SH	Y		
1065	Gracilaria truncata	Whangarei, MB	Y		
1754	Hypnea cornuta	Whangarei, PR	Y		2 substitutions away from Hypnea cornuta, AB095911, Japan
240	Plocamium cartilagineum	Otago, TN	Y		
546	Plocamium cartilagineum	Otago, OW	Y		
1058	Plocamium cirrhosum	Whangarei, MB	Y		
1546 (host)	Plocamium cirrhosum	Whangarei, RE	Y		
1136	Plocamium cirrhosum	Whangarei, MP	Y		
1339	Plocamium cartilagineum	Otago, OW	Y		
1395	Plocamium cartilagineum	Otago, TN	Y		
21	Polysiphonia decipiens	Otago, HW	P		5’ end only, rather poor
1659	Polysiphonia subtilissima sensu Adams	Whangarei, OB	Y		
1660	Polysiphonia subtilissima sensu Adams	Whangarei, OB	Y		

1652	Polysiphonia isogona sensu Adams	Whangarei, MP	Y	
1184	Polysiphonia strictissima	Whangarei, MA	P	3’ end only
1182	Polysiphonia isogona sensu Freshwater	Whangarei, MA	Y	
1177	Polysiphonia strictissima	Whangarei, MA	P	Need to repeat 5’ end for better sequence
1048	Polysiphonia species 2	Whangarei, MB	Y	
ASK010	Polysiphonia Ocean Beach	Whangarei, Ocean Beach	P	1196bp sequence rather poor
ASK012	Polysiphonia sertularioides sensu Adams	Whangarei, Ocean Beach	Y	
23	Polysiphonia morrowii	Otago, HW	Y	
61	Polysiphonia morrowii	Otago, HW	P	rA
57	Polysiphonia isogona sensu Adams	Otago, HW	P	rA
53	Polysiphonia isogona sensu Adams	Otago, HW	P	rA
1750	Polysiphonia species 1	Whangarei, OT	Y	
1427	Polysiphonia strictissima	Otago, OW	Y	
39	Polysiphonia strictissima	Otago, HW	P	5’ end only
284	Polysiphonia strictissima	Otago, HB	Y	
309	Polysiphonia strictissima	Otago, MO	Y	
547	Polysiphonia strictissima	Otago, OW	Y	
926	Polysiphonia sertularioides sensu Adams	Kaipara, KP	Y	
936	Polysiphonia sertularioides sensu Adams	Kaipara, DR7	Y	
939	Polysiphonia sertularioides sensu Adams	Kaipara, DR7	Y	
960	Polysiphonia sertularioides sensu Adams	Kaipara, DR11	Y	
37	Polysiphonia isogona sensu Adams	Otago, HW	P	5’ end only
1657	Polysiphonia isogona sensu Adams	Whangarei, MP	P	3’ end only
937	Spyridia filamentosa	Kaipara, DR8	Y	
1161	Spyridia filamentosa	Whangarei, MP	Y	
1645	Spyridia filamentosa	Whangarei, MP	Y	
1711	Spyridia filamentosa	Whangarei, MA	Y	
1748	Spyridia filamentosa	Whangarei, SP	Y	
931	Spyridia filamentosa	Kaipara, DS1	Y	
946	Spyridia filamentosa	Kaipara, SB	Y	
1110	Rhodomelaceae sp. 1	Whangarei, MB	P	Not Polysiphonia

Appendix 9. Field site images (selected).

Otago Harbour

Otakou/Wellers, intertidal (OW)

Te Ngaru, intertidal (TN)

Between Gills Landing and Portobello, subtidal (GP)

Pulling Point, subtidal (PP)

Te Ngaru, subtidal (TN/S)

Opposite Wellers, subtidal (WO)

Opposite Wellers, subtidal (WO)

Whangarei Harbour

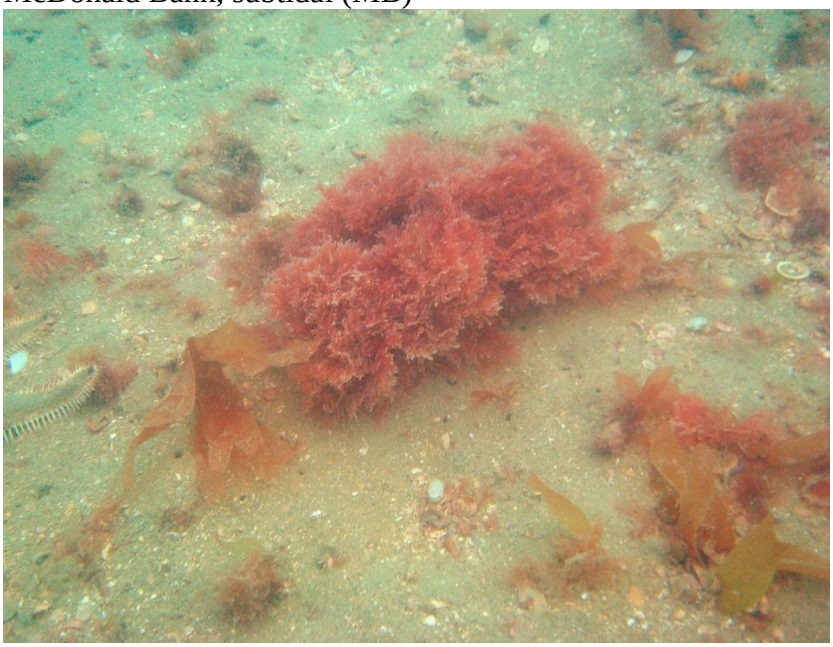
One Tree Point seagrass, intertidal (OS)

McLeod Bay, intertidal (MC)

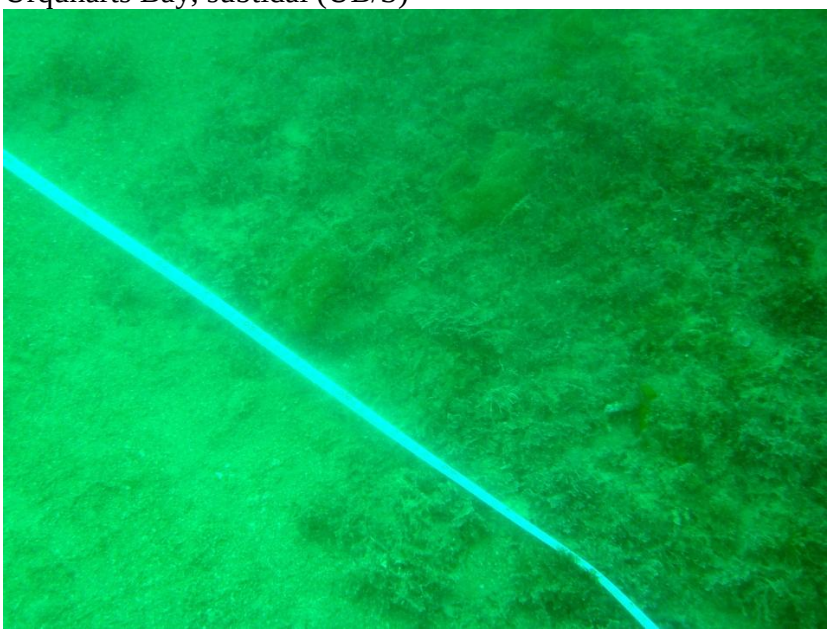
Mair Bank, subtidal (MA)

McDonald Bank, subtidal (MB)

McDonald Bank, subtidal (MB)



Urquharts Bay, subtidal (UB/S)



McDonald Bank, subtidal (MB)

Kaipara Harbour

Karaka Point, intertidal (KP)

Karaka Point, intertidal (KP)

Shelly Beach, intertidal (SB)

Dredge site, subtidal

Appendix 10. Images of common taxa from each harbour.

Otago Harbour

Adamsiella chauvinii

Codium fragile s.sp. *novae-zelandiae*

Polysiphonia strictissima

Ceramium sp.

Cladophora sp.

Plocamium cartilagineum

Gracilaria secundata

Brongniartella australis

Whangarei Harbour

Ulva sp.

Codium convolutum

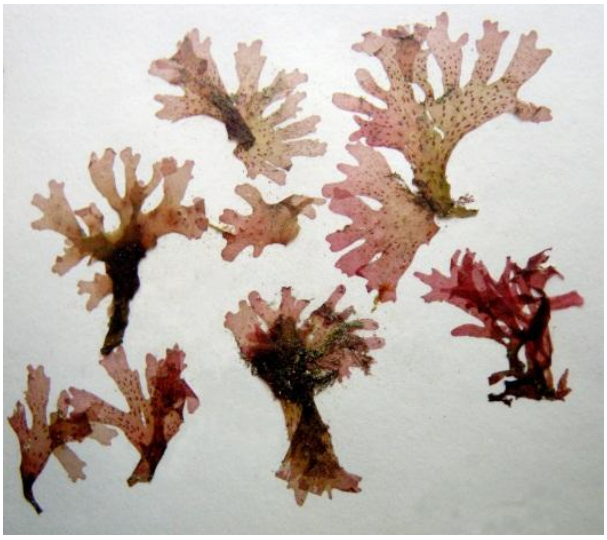
Codium fragile s.sp. *fragile*

Gracilaria truncata

Colpomenia sp.

Hydroclathrus clathratus

Chondracanthus chapmanii



Hymenena variolosa

Kaipara Harbour

Gracilaria chilensis

Spyridia filamentosa

Solieria sp.

Appendix 11. Annotated species list for macroalgae collected from soft sediment habitats in Whangarei, Otago and Kaipara Harbours. Species are listed alphabetically within divisions, and each species name is followed by the authority. Localities within the three harbours are followed by distribution over the rest of New Zealand. In many cases notes follow taxa where there is need for comment or clarification. Exemplar specimens were deposited in the Herbarium of the Museum of New Zealand Te Papa Tongarewa; their reference numbers appear in the list below as 6 digit numbers with an A-prefix. Other specimens remain at NIWA for further study.

ULVOPHYCEAE
BRYOPSIDALES
BRYOPSIDACEAE
Bryopsis plumosa (Huds.) C.Agardh
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031431; Torpedo Boat Mole, Broom & Nelson, Feb 2009, A031429; Torpedo Boat Mole, *Farr & Neill*, Feb 2009, A031427
Intertidal; on rock, cockle shells
Distribution: Northern
Habitat: Intertidal, on rock, cobbles and shells.
Characters: Fine feather-like branches, generally less than 5 cm high.

Bryopsis vestita J.Agardh
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031430; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031482; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031483
Intertidal; on rock
Distribution: Central, Southern, Subantarctic
Habitat: Intertidal, on rock and cobbles in sand.
Characters: Finely, radially branched, up to 12 cm high.

Bryopsis sp.
Otago Harbour: Collected from Te Ngaru intertidal
Intertidal
Habitat: Intertidal, on rock.
Characters: Fragmentary, unable to be identified to species.

CAULERPACEAE
Caulerpa flexilis J.V.Lamour. ex C.Agardh
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009
Subtidal
Distribution: Three Kings, Northern, Central
Habitat: Subtidal.
Characters: Robust, fern-like branching, with stolons; single collection.

CODIACEAE
Codium convolutum (Dellow) P.C.Silva
Whangarei Harbour: Calliope Inner, *Crocker & D'Archino*, Apr 2010, A031388; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031390; Urquharts Bay subtidal, *Crocker & Miller*, Apr 2010, A031389; also collected from Calliope Bank, Marsden Point Subtidal, Reotahi, Taurikura Bay, Urquharts Bay intertidal
Intertidal and subtidal; on cobbles and shells
Otago Harbour: Collected from Te Ngaru intertidal
Intertidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on cobbles and shell.
Characters: Prostrate, thick velvety thallus.

Codium fragile (Suringar) Har. s.sp. *fragile* (Suringar) Har.
Whangarei Harbour: Reotahi, *Nelson*, Mar 2010, A031155; Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031156; also collected from Calliope Inner, Mair Bank, Marsden Point Subtidal
Intertidal and subtidal; on shell, drift
Distribution: uncertain, requiring further investigation with molecular markers.
Habitat: Intertidal and subtidal, on shell, and drift.

Characters: Robust, dichotomous, finger-like branches, up to 30 cm high.
Notes: Introduced sub-species.

Codium fragile s.sp. *novae-zelandiae* (J.Agardh) P.C.Silva
Whangarei Harbour: Collected from Kirikiri Point
Intertidal
Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031078; also collected from Dredge Site 7, Dredge Site 11, Dredge Site 15, Dredge Site 16, Dredge Site 17, Dredge Site 19, Dredge Site 25, Dredge Site 27 Intertidal and subtidal; on shell, drift
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031391; Harwood, Nelson, Feb 2009, A031394, A031395; Harwood, *Neill & Nelson*, Oct 2009, A031392; Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031393; also collected from Otakou/Wellers intertidal, Te Ngaru intertidal, Torpedo Boat Mole
Intertidal (infrequently subtidal); on shells, cobbles, drift
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on shell, cobbles, and drift.
Characters: Robust, dichotomous, finger-like branches, up to 30 cm high.
Notes: Common.

Codium sp.
Whangarei Harbour: Collected from Calliope Bank, McDonald Bank, Mair Bank, Marsden Point Subtidal, Snake Bank Inner, Urquharts Bay subtidal
Subtidal
Habitat: Subtidal, on shell and cobbles.
Characters: Robust, dichotomous, finger-like branches, up to 30 cm high; unable to be identified to species.

DERBESIACEAE
Derbesia novae-zelandiae V.J.Chapm.
Whangarei Harbour: Marsden Point Intertidal, *Farr, Neill & Nelson*, Mar 2010, A031478; Marsden Point Subtidal, *Crocker & Miller*, Apr 2010, A030985; Snake Bank Outer, *Crocker & D'Archino*, Apr 2010, A030977
Intertidal and subtidal;
Otago Harbour: Pulling Point, *Crocker & D'Archino*, Oct 2009, A031159
Subtidal
Distribution: Kermadec, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal.
Characters: Very fine, silky filaments.

CLADOPHORALES
ANADYOMENACEAE
Microdictyon mutabile Dellow
Whangarei Harbour: Reotahi, *Nelson*, Mar 2010, A031009, A031377, A031379; Reotahi, *Nelson*, Nov 2009, A031378
Intertidal; epiphytic on *Corallina*
Distribution: Northern
Habitat: Intertidal, epiphytic on *Corallina* turf.
Characters: Irregular mesh-like growth, thalli generally less than 5 cm across.
Notes: The species had been transferred to the genus *Boodlea* (Adams 1994), but molecular data indicate it is correctly placed in *Microdicyon* (pers. comm. C. Boedeker)

Microdictyon umbilicatum (Velley) Zanardini
Whangarei Harbour: McLeod Bay, *Nelson*, Nov 2009, A031017
Intertidal
Distribution: Kermadec, Three Kings, Northern
Habitat: Intertidal, on *Corallina* turf.
Characters: Semi-prostrate, fan shaped, fine mesh lying in one plane; single collection.

CLADOPHORACEAE

Recent investigations of New Zealand members of this family indicate that the diversity is incompletely sampled, and that species concepts are poorly understood. Assistance with identification of members of this family was provided by Dr C. Boedeker.

Chaetomorpha aerea (Dillwyn) Kütz.
Whangarei Harbour: Reotahi, *Crocker & Neill*, Nov 2009, A031035
Intertidal
Otago Harbour: Otakou/Wellers intertidal, Farr, *Neill & Nelson*, Feb 2009, A031432; Otakou/Wellers intertidal, Broom, *Dalen & Nelson*, Oct 2009, A031480; also collected from Harwood, Opposite Hamilton Bay, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal
Intertidal and subtidal; on rock, and epiphytic
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock and epiphytic.
Characters: Unbranched filaments.
Notes: Common.

Chaetomorpha capillaris sensu N.M.Adams
Whangarei Harbour: Reotahi, *Nelson*, Mar 2010
Intertidal
Distribution: Central, Chatham, Southern
Habitat: Intertidal.
Characters: Unbranched filaments; single collection.

Chaetomorpha coliformis (Mont.) Kütz.
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Oct 2009
Intertidal
Distribution: Central, Chatham, Southern
Habitat: Intertidal.
Characters: Unbranched filaments of large bead like cells.

Chaetomorpha valida (Hook.f. & Harv.) Kütz.
Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031083; also collected from Karaka Point
Intertidal; on mangrove pneumatophores and fallen logs, and on drift *Caulacanthus*
Distribution: Kermadec, Central, Southern
Habitat: Intertidal, on mangrove pneumatophores and fallen logs, and on drift *Caulacanthus*.
Characters: Unbranched filaments.

Chaetomorpha sp.
Whangarei Harbour: Collected from McLeod Bay, Reotahi, Urquharts Bay subtidal
Intertidal and subtidal
Kaipara Harbour: Collected from Dredge Site 14
Subtidal; on *Atrina* and sponge
Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Otakou/Wellers intertidal
Intertidal and subtidal
Habitat: Intertidal and subtidal, on shell, sponge and cobbles.
Characters: Unbranched filaments.

Cladophora herpestica (Mont.) Kütz.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A030999
Intertidal
Distribution: Kermadec, Three Kings, Northern, Central
Habitat: Intertidal, on rock.
Characters: Stiff branched filaments, 2-3 cm high; single collection.

Cladophora montagneana Kütz.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009
Intertidal
Distribution: Northern
Habitat: Intertidal.
Characters: Single collection.

Cladophora subsimplex Kütz.
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031369
Intertidal; on rock
Distribution: Southern
Habitat: Intertidal, on rock.
Characters: Branched filament, large cells; single collection.

Cladophora vagabunda (L.) C.Hoek s.l. (incl *C. dalmatica*)
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031374, A031375; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031373; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031376; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031355
Intertidal; on rock, epiphytic on *Cladostephus*, *Ptilopogon*
Distribution: No records in Te Papa; not recorded in Adams (1994).
Habitat: Intertidal, on rock, cobbles, and epiphytic.
Characters: Bushy, branched filaments.

Cladophora valonioides (Sond.) Kütz.
Otago Harbour: Harwood, *Nelson*, Feb 2009, A031367; Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031361, A031358, A031368, A031359; Opposite Hamilton Bay, *Crocker & D'Archino*, Oct 2009, A031371; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031365; Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031357, A031366; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031356; Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031362; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031370, A031364; Te Ngaru intertidal, *Farr & Neill*, Feb 2009, A031363; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031360, A031354; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031381, A031372
Intertidal and subtidal; on shells, wood
Distribution: Northern, Central, Southern
Habitat: Intertidal and subtidal, on rock, wood and shells.
Characters: Branched filaments.

Cladophora sp.
Whangarei Harbour: Collected from Mair Bank, One Tree Point boat ramp, Reotahi, Snake Bank Inner, Taurikura Bay, Urquharts Bay intertidal, Urquharts Bay subtidal
Intertidal and subtidal
Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Pulling Point, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; on rock, epiphytic on *Gigartina*
Habitat: Intertidal and subtidal, on rock, cobbles, and epiphytic.
Characters: Branched filaments.
Notes: Common.

Rhizoclonium curvatum V.J.Chapm.
Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031066
Intertidal; on rock
Distribution: Northern
Habitat: Intertidal, on rock.
Characters: Fluff-like green alga; single collection.
Notes: The New Zealand members of this genus are poorly understood.

Rhizoclonium implexum (Dillwyn) Kütz.
Otago Harbour: Collected from Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009
Intertidal
Distribution: Northern, Central, Southern
Habitat: Intertidal.
Characters: Fine, unbranched filaments; single collection.

Rhizoclonium sp.
Whangarei Harbour: Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031380
Intertidal; on mangrove pneumatophores

Habitat: Intertidal, on mangrove pneumatophores.
Characters: Fine, unbranched filaments.

Wittrockiella sp.
Kaipara Harbour: Collected from Karaka Point
Intertidal; on drift *Caulacanthus*
Habitat: Intertidal, on drift *Caulacanthus*.
Characters: Fine filaments; single collection.

ULOTRICHALES
ACROSIPHONIACEAE
cf. *Spongomorpha pacifica* (Mont.) Kütz.
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031366
Intertidal
Distribution: Southern, Subantarctic
Habitat: Intertidal.
Characters: Tufted, bushy up to 10 cm high; single collection.

MONOSTROMATACEAE
Monostroma sp.
Whangarei Harbour: Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031425; also collected from Parua Bay
Intertidal; on mangrove pneumatophores
Otago Harbour: Torpedo Boat Mole, Dalen & Nelson, Oct 2009, A031481
Intertidal
Habitat: Intertidal on various substrata.
Characters: Delicate green blades, one cell layer thick.
Notes: Although many species of *Monostroma* were described and documented by Chapman (1956) subsequent workers have had difficulty recognising the majority of these and further work is required to understand the diversity in this genus in New Zealand.

ULOTRICHACEAE
Ulothrix sp.
Whangarei Harbour: One Tree Point seagrass, *Farr, Neill & Nelson*, Mar 2010, A031010
Intertidal
Characters: Uniseriate, unbranched fine filaments; single collection.
Notes: No records in Te Papa; 3 species recorded by Chapman (1956); not recorded in Adams (1994).

ULVALES
ULVACEAE
Species previously placed in *Enteromorpha* have been transferred to *Ulva* (Hayden et al. 2003).

Ulva compressa (L.) Nees
Whangarei Harbour: Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031407
Intertidal
Otago Harbour: Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031405; also collected from Harwood, Opposite Hamilton Bay, Opposite Wellers subtidal, Otakou/Wellers intertidal
Intertidal and subtidal; on wood and rock
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on wood and rock.
Characters: Tubular thalli, typically much branched.
Notes: Introduced, common species.

Ulva intestinalis (L.) Nees
Otago Harbour: Collected from Otakou/Wellers intertidal, Torpedo Boat Mole
Intertidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal.
Characters: Long, unbranched, crinkled or smooth ribbons or tubes, sometimes convoluted or slightly inflated.
Notes: Introduced species.

Ulva pertusa Kjellm.
Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031400; Shelly Beach, *Nelson*, Mar 2009, A031401
Intertidal; on rock, Corallina
Otago Harbour: Te Ngaru intertidal, *Farr & Neill*, Oct 2009, A031408; also collected from Harwood
Intertidal; on crab
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, on rock, Corallina turf, epizoic (on crab).
Characters: Large rounded blades or ribbons, often with a spathulate or rosette appearance, frequently with round holes, and a stiff base.
Notes: Introduced, common species.

Ulva procera Ahlner
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031399; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031402; also collected from Otakou/Wellers intertidal, Te Ngaru subtidal
Intertidal (infrequently subtidal); on wood
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, infrequently subtidal, on wood, cobbles and rock.
Characters: Tubular thalli, often finely branched.

Ulva prolifera (O.F.Mull.) J.Agardh
Otago Harbour: Collected from Between Gills Landing & Portobello, Otakou/Wellers intertidal
Intertidal and subtidal;
Distribution: Central, Southern
Habitat: Intertidal and subtidal.
Characters: Thin, hair-like tubes or ribbons, up to 100 mm long, often richly branched but occasionally without any proliferations.

Ulva ralfsii Harv.
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031398; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031166; also collected from Harwood
Intertidal (infrequently subtidal); in tangled clumps, drift
Distribution: Northern, Central, Southern
Habitat: Intertidal, infrequently subtidal, in tangled clumps, drift.
Characters: Long and thin, stringy or hair-like tubes.

Ulva rigida C.Agardh
Otago Harbour: Opposite Hamilton Bay, *Crocker & D'Archino*, Oct 2009, A031403; Te Ngaru intertidal, *Farr & Neill*, Oct 2009, A031404; also collected from Otakou/Wellers intertidal, Te Ngaru subtidal
Intertidal and subtidal;
Distribution: Central, Southern
Habitat: Intertidal and subtidal.
Characters: Lobed blades with a crisp texture and a stiff base, margins of the blades often ruffled and with microscopic teeth.

Ulva species 1
Whangarei Harbour: Marsden Point Intertidal, *Nelson*, Nov 2009, A031397; also collected from Mair Bank, McDonald Bank, Marsden Point Subtidal, One Tree Point boat ramp, Shell Cut Reach South (Tamaterau)
Intertidal
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031396; also collected from Between Gills Landing & Portobello, Harwood, Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; on sand, shell, cobbles, and drift
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on sand, shell, cobbles, and drift.
Characters: Sheet-like thalli in a range of morphologies; usually with microscopic teeth and often also macroscopically visible outgrowths.

Notes: An introduced species, very common in Otago Harbour collections and infrequently collected from Whangarei Harbour.

Ulva species 2
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031410, A031409
Subtidal
Otago Harbour: Collected from Torpedo Boat Mole
Intertidal; drift
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on cobbles, shell, and drift.
Characters: small tubes or ribbons, up to 30 mm long and 2 mm wide, either unbranched or branched close to the base; often curly.

Ulva sp.
Whangarei Harbour: Collected from Mair Bank, Marsden Point Intertidal, McDonald Bank, One Tree Point boat ramp, One Tree Point seagrass, Parua Bay, Reotahi, Sinclair Point, Snake Bank Inner, Urquharts Bay subtidal
Intertidal and subtidal; on *Gelidium*
Kaipara Harbour: Collected from Dredge Site 8, Shelly Beach
Intertidal and subtidal; on rock
Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Opposite Wellers subtidal, Otakou/Wellers intertidal,Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; on cockle shells, rope, epiphytic on *Gigartina*, *Gracilaria*, *Polysiphonia*, *Cladostephus*
Habitat: Intertidal and subtidal, on shells, rock, rope, and epiphytic (on *Gigartina, Gracilaria, Polysiphonia, Cladostephus*, *Gelidium*).
Notes: 205 records, unable to be identified to species; common.

Umbraulva olivascens (P.J.L.Dang.) E.H.Bae & I.K.Lee
Otago Harbour: Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031158
Subtidal
Distribution: in New Zealand only previously recorded from a single collection from Timaru.
Habitat: Intertidal, drift.
Characters: Blade with many perforations throughout; single collection.
Notes: An introduced species, this record extends its known range in New Zealand.

XANTHOPHYCEAE
VAUCHERIALES
VAUCHERIACEAE
Vaucheria sp.
Whangarei Harbour: One Tree Point seagrass, *Nelson*, Nov 2009, A031151; McLeod Bay, *Crocker, Neill & Nelson*, Nov 2009, A031150; also collected from One Tree Point boat ramp
Intertidal; drift
Kaipara Harbour: Collected from Dredge Site 25, Karaka Point
Intertidal and subtidal; on *Atrina*
Otago Harbour: Collected from Otakou/Wellers intertidal, Te Ngaru intertidal
Intertidal; on wood
Habitat: Intertidal and subtidal, on wood, shell, and drift.
Characters: Very fine and flaccid filaments infrequently branched often tangled.
Notes: Although Chapman (1956) recorded 4 species, the genus remains poorly known in New Zealand.

PHAEOPHYCEAE
CUTLERIALES
CUTLERIACEAE
Cutleria multifida (Turner) Grev.
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031171; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031172; Te Ngaru intertidal, *Broom &*

Nelson, Feb 2009, A031238
Intertidal and subtidal; drift
Distribution: Northern, Central, Southern
Habitat: Intertidal and subtidal, on rock, cobbles, and drift.
Characters: Narrow flattened branches, usually less than 25cm high.
Notes: Introduced species.

DICTYOTALES
DICTYOTACEAE
Dictyota sp.
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031094; also collected from Calliope Inner, McDonald Bank, Pirihi Road, Urquharts Bay subtidal
Subtidal; on shell
Characters: Fragmentary and unable to be identified to species.

Zonaria turneriana J.Agardh
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031160
Subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Fan shaped thallus generally up to 12 cm high, divided into narrow strap-like branches with pale tips; single collection.

ECTOCARPALES
ACINETOSPORACEAE
Hincksia granulosa (Js.Sm.) P.C.Silva
Whangarei Harbour: Collected from Mair Bank
Subtidal
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031423; also collected from Opposite Wellers subtidal
Intertidal
Distribution: Northern, Central, Southern, Subantarctic
Habitat: Intertidal and subtidal.
Characters: Finely branched filaments.

Hincksia mitchelliae (Harv.) P.C.Silva
Whangarei Harbour: Marsden Point Intertidal, *Farr, Neill & Nelson*, Mar 2010, A031154; One Tree Point boat ramp, *Farr, Neill & Nelson*, Mar 2010, A031153; also collected from One Tree Point seagrass, Reotahi
Intertidal; drift, and epiphytic on *Codium*
Otago Harbour: Otakou/Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031422; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031178; also collected from Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Bryopsis*, at base of *Scytothamnus*
Distribution: Kermadec, Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, drift and epiphytic.
Characters: Finely branched filaments.

Hincksia c.f. *ovata*
Otago Harbour: Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031157
Intertidal
Habitat: Intertidal.
Characters: Finely branched filaments; single collection.

Hincksia sp.
Whangarei Harbour: Collected from Mair Bank, One Tree Point, One Tree Point boat ramp, One Tree Point seagrass
Intertidal and subtidal
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal
Habitat: Intertidal and subtidal.
Characters: Finely branched filaments.

ADENOCYSTACEAE
Adenocystis utricularis (Bory) Skottsb.
Otago Harbour: Harwood, *Nelson*, Feb 2009, A031231; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031177
Intertidal; on cobble, drift
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, on rock, cobbles, and drift.
Characters: Golden brown, elongated, water filled sacs usually 2-6 cm high.

CHORDARIACAE
Tinocladia novae-zelandiae Kylin
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031174; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031440; Torpedo Boat Mole, *Dalen & Nelson*, Oct 2009, A031173; also collected from Harwood
Intertidal (infrequently subtidal); on shells, cobbles, drift
Distribution: Northern, Central, Southern
Habitat: Intertidal, infrequently subtidal, on shells, cobbles, and drift.
Characters: Very mucilaginous, irregularly and densely branched cylindrical thallus, up to 20 cm high.

Leathesia difformis (L.) Aresch.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031026; Reotahi, *Nelson*, Mar 2010, A031424; Urquharts Bay intertidal, *Nelson*, Nov 2009, A031042; also collected from McLeod Bay, Taurikura Bay
Intertidal; on rock and coralline algae
Otago Harbour: Harwood, *Neill & Nelson*, Oct 2009, A031184; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031185; also collected from Torpedo Boat Mole Intertidal; drift
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, on rock, cobbles, epiphytic and drift.
Characters: Mucilaginous sacs.

Leathesia sp.
Whangarei Harbour: Collected from Marsden Point Intertidal
Intertidal; drift
Otago Harbour: Collected from Te Ngaru intertidal
Intertidal; on wood
Characters: Material too small or fragmentary to be placed into species.

Myrionema strangulans Grev.
Whangarei Harbour: Marsden Point Intertidal, Nelson, Nov 2009, A031000
Intertidal; epiphytic on *Ulva*
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031411; Te Ngaru intertidal, *Farr & Neill*, Oct 2009, A031168; also collected from Otakou/Wellers intertidal, Torpedo Boat Mole
Intertidal; epiphytic on Ulva
Distribution: Three Kings, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, epiphytic on *Ulva*.
Characters: Forms small brown circular patches on blades of *Ulva* spp.

Punctaria latifolia Grev.
Otago Harbour: Otakou/Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031169; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031170
Intertidal and subtidal
Distribution: Northern, Southern
Habitat: Intertidal and subtidal.
Characters: Leaf-like with frilled margin.
Notes: Introduced, probably in the nineteenth century by sailing vessels. Very seasonal (October to January) and local in its occurrence.

ECTOCARPACEAE
Ectocarpus siliculosus (Dillwyn) Lyngb.

Whangarei Harbour: Snake Bank Outer, *Crocker & D'Archino*, Apr 2010, A031167; Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031152
Intertidal and subtidal; drift on mangrove pneumatophore
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031189; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031421; also collected from Te Ngaru intertidal
Intertidal and subtidal; epiphytic on *Codium*
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, drift, on mangrove pneumatophores, and epiphytic.
Characters: Very finely branched filaments, usually less than 4 cm high.

Ectocarpus sp.
Whangarei Harbour: Shell Cut Reach South (Tamaterau), *Crocker & D'Archino*, Oct 2009, A031161; also collected from Urquharts Bay subtidal
Subtidal;
Otago Harbour: Collected from Te Ngaru intertidal, Te Ngaru subtidal
Intertidal and subtidal
Habitat: Intertidal and subtidal.
Characters: Very finely branched filaments; sterile and/or fragmentary and unable to be identified to species.

SCYTOSIPHONACEAE
Colpomenia bullosa (D.A.Saunders) Yamada
Whangarei Harbour: Urquharts Bay intertidal, *Nelson*, Nov 2009, A030995
Intertidal; on rock and coralline algae
Distribution: Northern, Central, Chatham
Habitat: Intertidal, on rock and coralline algae.
Characters: Finger like sacs and also brown crustose phase.
Notes: Introduced species.

Colpomenia ecuticulata M.J.Parsons
Whangarei Harbour: Marsden Point Intertidal, *Nelson*, Nov 2009, A030993; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A030994
Intertidal and subtidal; epiphytic on coralline algae
Distribution: Three Kings, Northern
Habitat: Intertidal and subtidal, epiphytic.
Characters: Smooth, round sacs.

Colpomenia peregrina Sauv.
Whangarei Harbour: McLeod Bay, *Nelson*, Nov 2009, A030996; also collected from Calliope Bank, Marsden Point Intertidal, McDonald Bank, Opposite Wellers subtidal, Reotahi, Snake Bank Inner, Urquharts Bay subtidal
Intertidal and subtidal; on shells, cobbles, worm tubes
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031142, A031141; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031140; Otakou/Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031299; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031300; also collected from Between Gills Landing & Portobello, Opposite Wellers subtidal
Intertidal and subtidal; on rock, and epiphytic
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on rock, cobbles, shells, worm tubes, and epiphytic.
Characters: Sacs, smooth when young, becoming folded.

Colpomenia sinuosa (Mertens ex Roth) Derbes & Solier
Whangarei Harbour: Marsden Point Intertidal, *Nelson*, Nov 2009, A030986; Reotahi, *Nelson*, Nov 2009, A030997; Urquharts Bay intertidal, *Nelson*, Nov 2009, A031297; also collected from One Tree Point boat ramp, Urquharts Bay intertidal
Intertidal; on shell, rock, wood
Distribution: Three Kings, Northern, Central, Chatham
Habitat: Intertidal, on rock, shell and wood.
Characters: Rounded and lobed sacs with folds

Colpomenia sp.

Whangarei Harbour: One Tree Point boat ramp, *Nelson*, Nov 2009, A031303; Parua Bay, *Crocker, Neill & Nelson*, Nov 2009, A031302; Reotahi, *Nelson*, Nov 2009, A031301; also collected from Calliope Inner, McDonald Bank, Marsden Point Intertidal, Marsden Point Subtidal, Taurikura Bay, Urquharts Bay intertidal, Urquharts Bay subtidal
Intertidal and subtidal; on shells, cobbles, worm tubes
Otago Harbour: Harwood, I, Oct 2009, A031187; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031183; also collected from Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Torpedo Boat Mole
Intertidal and subtidal; occasionally on wood, usually epiphytic on *Brongniartella*, *Colpomenia*, *Polysiphonia*, *Ulva*, *Zostera*
Habitat: Intertidal and subtidal, on shells, cobbles, worm tubes, wood, and epiphytic.
Characters: Sacs; sterile and/or small thalli, unable to be identified to species.

Hydroclathrus clathratus (C.Agardh) M.Howe
Whangarei Harbour: Calliope Inner, *Crocker & D'Archino*, Apr 2010, A031031; Shell Cut Reach South (Tamaterau), *Crocker & D'Archino*, Oct 2009, A031032; also collected from Calliope Bank, Marsden Point Subtidal, Reotahi, Urquharts Bay subtidal
Subtidal (infrequently intertidal)
Distribution: Kermadec, Northern
Habitat: Subtidal, infrequently intertidal, on rock, shell, and epiphytic.
Characters: Perforated sacs up to 10 cm across.
Notes: Introduced species in the New Zealand mainland, native to the Kermadec Islands.

Petalonia fascia (O.F.Müll.) Kuntze
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031473
Subtidal
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031439; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031186
Intertidal; on rock
Distribution: Northern, Central, Southern
Habitat: Intertidal, on rock.
Characters: Unbranched, leaf-like blades.

Scytosiphon lomentaria (Lyngb.) Link
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031016; Marsden Point Intertidal, *Nelson*, Nov 2009, A031036
Intertidal and subtidal; on rock
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031233, A031236, A031235; Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031234; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031237; Torpedo Boat Mole, *Dalen & Nelson*, Oct 2009, A031175; also collected from Te Ngaru subtidal
Intertidal and subtidal; on shells, cobbles, wood
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on shells, rock, cobbles and wood.
Characters: Slender, tubular unbranched thalli, variable in height, generally less than 15 cm.

Ectocarpales
Whangarei Harbour: Collected from Calliope Bank, Mair Bank, One Tree Point boat ramp, Reotahi, Sinclair Point, Snake Bank Outer, Urquharts Bay intertidal
Intertidal and subtidal; on scallop shells, worm tubes, and drift
Otago Harbour: Collected from Torpedo Boat Mole, Otakou/Wellers intertidal
Intertidal; epiphytic on *Bryopsis*
Habitat: Intertidal and subtidal, on shells, worm tubes, and drift.
Characters: Sterile and/or fragmentary and unable to be identified to genus or species.

FUCALES
DURVILLAEACEAE
Durvillaea antarctica (Cham.) Har.
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal; drift

Distribution: Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, drift.
Characters: Large, leathery thallus (bull kelp).
Notes: Clearly not part of the harbour flora as this species is restricted to wave exposed shores.

HORMOSIRACEAE
Hormosira banksii (Turner) Decne.
Whangarei Harbour: McLeod Bay, *Crocker & Neill*, Nov 2009, A031015; Parua Bay, *Crocker, Neill & Nelson*, Nov 2009, A031030; Reotahi, *Crocker & Neill*, Nov 2009, A030998; also collected from Kirikiri Point, Marsden Point Intertidal, Marsden Point Subtidal, One Tree Point boat ramp, One Tree Point seagrass, Taurikura Bay, Urquharts Bay intertidal, Urquharts Bay subtidal
Intertidal and subtidal; on cobbles
Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031064
Intertidal; on rock
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on cobbles and rock.
Characters: Dichotomously branched chains of large hollow beads, usually 20-30 cm high.

SARGASSACEAE
Carpophyllum flexuosum (Esper) Grev.
Whangarei Harbour: Urquharts Bay intertidal, *Nelson*, Nov 2009, A031041; Marsden Point Subtidal, *Crocker & D'Archino*, Oct 2009, A031038; also collected from Urquharts Bay subtidal
Subtidal (infrequently intertidal)
Otago Harbour: Collected from Otakou/Wellers subtidal
Subtidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal, on rock or larger stones.
Characters: Large, generally 50 cm to 1.5 m high; frequently recorded as drift or fragments.

Carpophyllum maschalocarpum (Turner) Grev.
Whangarei Harbour: Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031040
Subtidal; drift
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Upper subtidal, drift.
Characters: Large, generally 50 cm to 1.5 m high; single collection.

Carpophyllum sp.
Whangarei Harbour: Collected from Marsden Point Subtidal, Pirihi Road, Shell Cut Reach South (Tamaterau), Urquharts Bay subtidal
Subtidal
Habitat: Subtidal.
Characters: Fragments, unable to be identified to species.

Cystophora sp.
Otago Harbour: Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031406
Subtidal
Habitat: Subtidal.
Characters: Unable to be identified to species; single collection.

Sargassum scabridum Hook.f. & Harv.
Whangarei Harbour: Calliope Inner, *Crocker & D'Archino*, Apr 2010, A031033
Subtidal
Distribution: Northern
Habitat: Subtidal.
Characters: Large, thallus with leaf-like blades, and spines on terete main axis; single collection.

Sargassum sinclairii Hook.f. & Harv.

Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031197; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031196, A031039; also collected from Urquharts Bay intertidal
Subtidal (infrequently intertidal); attached
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal and infrequently in the low intertidal.
Characters: Large, thallus with leaf-like blades, and smooth terete main axis.

LAMINARIALES
ALARIACEAE
Undaria pinnatifida (Harv.) Suringar
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031176; also collected from Harwood, Opposite Wellers subtidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal
Distribution: Northern, Central, Southern, Subantarctic
Habitat: Subtidal, on rock and cobbles.
Characters: Large thalli, generally less than 1 m high in harbour, with distinct curled sporophyll at base of main axis, prominent mid-rib extending the length of the deeply lobed blade.
Notes: Introduced species.

LAMINARIACEAE
Macrocystis pyrifera (L.) C.Agardh
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031232; also collected from Opposite Hamilton Bay, Opposite Wellers subtidal, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Torpedo Boat Mole
Intertidal and subtidal; drift and attached
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, and drift.
Characters: Large kelp with multiple terete stipes and leaf-like blades supported by oval bladders.

LESSONIACEAE
Ecklonia radiata (C.Agardh) J.Agardh
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031045; also collected from Marsden Point Subtidal, Urquharts Bay subtidal
Intertidal and subtidal
Otago Harbour: Collected from Opposite Wellers subtidal
Subtidal
Distribution: Northern, Central, Southern
Habitat: Low intertidal and subtidal, on rock.
Characters: Unbranched stipe with flattened and lobed blade.

SCYTOTHAMNALES
SCYTOTHAMNACEAE
Scytothamnus australis (J.Agardh) Hook.f. & Harv.
Whangarei Harbour: Parua Bay, *Crocker, Neill & Nelson*, Nov 2009, A031037; Taurikura Bay, *Farr, Neill & Nelson*, Mar 2010, A031011; Urquharts Bay intertidal, *Farr, Neill & Nelson*, Nov 2009, A031043
Intertidal; on cobbles
Kaipara Harbour: Karaka Point, Nelson, Mar 2009, A031065
Intertidal
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031230
Intertidal; on rock
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, on rock and cobbles.
Characters: Irregularly and densely branched thallus, usually up to 15 cm high.

Scytothamnus fasciculatus (Hook.f. & Harv.) Cotton
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031181
Intertidal
Distribution: Central, Southern, Subantarctic
Habitat: Intertidal, on rock.

Characters: Irregularly branched, generally less than 15 cm high, with side branches of varying lengths and narrowing upper axes.

SPHACELARIALES
CLADOSTEPHACEAE
Cladostephus spongiosus (Huds.) C.Agardh
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031446; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031454; Otakou/Wellers intertidal, *Broom, Farr & Neill*, Oct 2009, A031179; Te Ngaru intertidal, *Farr & Neill*, Feb 2009, A031453
Intertidal; on rock, in sand
Distribution: Northern, Central, Southern
Habitat: Intertidal, on rock in sand.
Characters: Stiff axes with tufted fine branching, up to 20 cm high.

SPHACELARIACEAE
Sphacelaria rigidula Kütz.
Whangarei Harbour: McLeod Bay, *Nelson*, Nov 2009, A031267; also collected from Mair Bank, Reotahi
Intertidal and subtidal; on shell
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031188
Subtidal
Distribution: Central
Habitat: Intertidal and subtidal, on shell and in turf.
Characters: Tufted, fine regularly branched filaments.

Sphacelaria tribuloides Menegh.
Whangarei Harbour: McDonald Bank, *Crocker & Miller*, Apr 2010, A031163; also collected from One Tree Point boat ramp, One Tree Point seagrass
Intertidal and subtidal; on rock
Distribution: Northern, Southern
Habitat: Intertidal and subtidal, on rock and in turf.
Characters: Fine, regularly branched filaments.

Sphacelaria variabilis Sauv.
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031143
Subtidal
Distribution: Southern, Subantarctic
Habitat: Subtidal.
Characters: Fine, regularly branched filaments; single collection.

Sphacelaria sp.
Whangarei Harbour: Collected from One Tree Point boat ramp, Taurikura Bay, Urquharts Bay subtidal
Intertidal and subtidal; on *Atrina*
Habitat: Intertidal and subtidal, on shell and in turf.
Characters: Fine, regularly branched filaments.

STYPOCAULACEAE
Halopteris sp.
Otago Harbour: Collected from Otakou/Wellers subtidal
Subtidal
Habitat: Subtidal.
Characters: Fragment; single collection.

RALFSIALES
RALFSIACEAE
Ralfsia c.f. *expansa* (J.Agardh) J.Agardh
Whangarei Harbour: Reotahi, *Nelson*, Mar 2010, A031046; Urquharts Bay intertidal, *Nelson*, Nov 2009, A031049
Intertidal; on shell and rock
Distribution: Central
Habitat: Intertidal, on shell, cobbles and rock.

Characters: Circular crusts with golden margins.

Ralfsia sp.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031050; Urquharts Bay intertidal, *Nelson*, Nov 2009, A031048; Urquharts Bay intertidal, *Farr & Neill*, A031047; also collected from Taurikura Bay
Intertidal; on rock
Otago Harbour: Collected from Torpedo Boat Mole
Intertidal; on ceramic
Habitat: Intertidal, on rock and ceramic.
Notes: Brown crustose algae are poorly understood in New Zealand. It is likely that there are more species than are currently recognised. At present brown crusts are often placed in *Ralfsia* when in fact further work is likely to reveal the presence of other genera of brown crustose algae, not all of which belong to the order Ralfsiales. Some brown crusts are the alternative life history phases of species of Scytosiphonaceae.

BANGIOPHYCEAE
BANGIALES
BANGIACEAE
Porphyra rakiura W.A.Nelson
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031136
Intertidal; on tyre
Distribution: Central, Southern
Habitat: Intertidal.
Characters: Very soft and thin thallus with highly characteristic streaks of golden and pink tissue (male and female fertile areas respectively), usually less than 10 cm high; single collection.
Notes: This species will be transferred to another genus as a result of a detailed examination of the order Bangiales (Sutherland et al. in press).

COMPSOPOGONOPHYCEAE
ERYTHROPELTIDIALES
Erythropeltidales
Whangarei Harbour: Collected from Pirihi Road
Subtidal
Habitat: Subtidal, epiphytic.
Characters: Very fine filaments, less than 1 cm high; single collection.

STYLONEMATOPHYCEAE
STYLONEMATALES
STYLONEMATACEAE
Stylonema alsidii (Zanardini) K.M.Drew
Whangarei Harbour: Collected from Mair Bank, One Tree Point seagrass
Intertidal and subtidal
Otago Harbour: Collected from Harwood
Intertidal
Distribution: North, Central, Southern
Habitat: Intertidal and subtidal, epiphytic.
Characters: Microscopic, sparsely branched filaments.
Notes: Widespread but few herbarium records.

FLORIDEOPHYCEAE
CORALLINOPHYCIDAE
CORALLINALES
CORALLINACEAE
Corallina officinalis L.
Whangarei Harbour: Reotahi, *Crocker & Neill*, Nov 2009, A030978; Urquharts Bay intertidal, *Nelson*, Nov 2009, A030981; Urquharts Bay intertidal, *Farr, Neill & Nelson*, Mar 2010, A030983; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031194; also collected from Calliope Inner, Kirikiri Point, McLeod Bay, Marsden Point Intertidal, One Tree Point boat ramp, Taurikura Bay, Waikaraka
Intertidal and subtidal; on rock and shells

Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031052; Karaka Point, *Farr & Neill*, Mar 2009, A031053
Intertidal; on rock
Otago Harbour: Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031352; also collected from Otakou/Wellers intertidal
Intertidal; on rock
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on rock and shells.
Characters: Calcified geniculate coralline, up to 4 cm high, forming dense turfs.
Notes: Very common.

Jania rosea (Lam.) Decne.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A030982
Intertidal;
Distribution: Kermadec, Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal.
Characters: Geniculate coralline; single collection.

Jania verrucosa J.V.Lamour.
Whangarei Harbour: Collected from Mair Bank
Subtidal; on shell
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal, on shell.
Characters: Geniculate coralline; single collection.

Jania sp.
Otago Harbour: Collected from Otakou/Wellers intertidal, Otakou/Wellers subtidal
Intertidal and subtidal; epiphytic
Habitat: Intertidal and subtidal.
Characters: Geniculate coralline.

Lithophyllum pustulatum (J.V.Lamour.) Foslie
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031349
Intertidal; epiphytic on *Sarcothalia*
Distribution: Northern, Central
Habitat: Intertidal, epiphytic on *Sarcothalia livida*.
Characters: Non-geniculate coralline.

Lithophyllum sp.
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal; on wood
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal; on oyster shell
Habitat: Intertidal and subtidal, on wood and shell.
Characters: Non-geniculate coralline.

Pneophyllum coronatum (Rosanoff) Penrose
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031130
Subtidal; epiphytic on *Carpophyllum*
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal, epiphytic on *Carpophyllum*.
Characters: Non-geniculate coralline.

Pneophyllum fragile Kütz.
Otago Harbour: Harwood, *Neill & Nelson*, Oct 2009, A031348; also collected from Otakou/Wellers intertidal
Intertidal; epiphytic on *Ulva*, *Zostera*
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, epiphytic on *Ulva*, *Zostera*.
Characters: Non-geniculate coralline.

Pneophyllum sp.
Otago Harbour: Collected from Otakou/Wellers subtidal
Subtidal; epiphytic on *Carpophyllum*
Habitat: Subtidal; epiphytic on *Carpophyllum*.
Characters: Non-geniculate coralline.

Spongites tunicatus Penrose
Whangarei Harbour: Collected from Reotahi
Intertidal; on rock
Distribution: Central
Habitat: Intertidal, on rock.
Characters: Non-geniculate coralline; single collection.

Spongites yendoi (Foslie) Y.M.Chamb.
Whangarei Harbour: Collected from McLeod Bay, Reotahi, Taurikura Bay, Urquharts Bay intertidal
Intertidal; on rock
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031353; Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031350; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031351
Intertidal; on rock
Distribution: Northern, Central, Chatham
Habitat: Intertidal, on rock.
Characters: Non-geniculate coralline.

HAPALIDACEAE
Lithothamnion sp.
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal; on *Atrina*, wood
Habitat: Subtidal, on wood and shell.
Characters: Non-geniculate coralline.

Mesophyllum sp.
Whangarei Harbour: Collected from Marsden Point Intertidal, McDonald Bank, Urquharts Bay intertidal
Intertidal and subtidal; on shell, drift
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal; on rock, oyster shells
Habitat: Intertidal and subtidal, on shell, rock, and drift.
Characters: Non-geniculate coralline.

Phymatolithon sp.
Kaipara Harbour: Collected from Karaka Point
Intertidal; on rock
Habitat: Intertidal, on rock.
Characters: Non-geniculate coralline; single collection.

SPOROLITHALES
SPOROLITHACEAE
Sporolithon durum (Foslie) R.A.Towns. & Woelk.
Whangarei Harbour: Collected from Urquharts Bay intertidal
Intertidal; on rock
Distribution: Northern, Central
Habitat: Intertidal, on rock.
Characters: Non-geniculate coralline; single collection.

Corallinophycidae
Whangarei Harbour: Collected from Pirihi Road
Subtidal; on scallop shells
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal; on rock, oyster shells
Habitat: Intertidal and subtidal.
Characters: Sterile and unable to be identified further.

HILDENBRANDIOPHYCIDAE
HILDENBRANDIALES
HILDENBRANDIACEAE
Hildenbrandia sp.
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal
Habitat: Subtidal.
Characters: Crustose.
Notes: Genus poorly known in New Zealand.

NEMALIOPHYCIDAE
ACROCHAETIALES
ACROCHAETIACEAE
Rhodochorton sp.
Whangarei Harbour: Collected from One Tree Point boat ramp, One Tree Point seagrass, Urquharts Bay intertidal
Intertidal; epiphytic on *Gelidium*
Habitat: Intertidal, epiphytic.
Characters: Very fine filaments.
Notes: *Rhodochorton* is poorly understood in New Zealand. Species in this genus are found in marine habitats, lack monospores, and have one to many plastids without pyrenoids.

COLACONEMATALES
COLACONEMATACEAE
Colaconema sp.
Otago Harbour: Collected from Otakou/Wellers intertidal, Te Ngaru intertidal
Intertidal; epiphytic on *Codium*
Habitat: Intertidal, epiphytic.
Notes: *Colaconema* is poorly known in New Zealand. Species possess one parietal plastid (infrequently several) with a pyrenoid, and produce monospores.

HALYMENIALES
HALYMENIACEAE
Pachymenia dichotoma J.Agardh
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal
Distribution: Southern, Subantarctic
Habitat: Intertidal, on rock adjacent to soft sediments.
Characters: Thick, leathery thallus, bifurcate to irregularly dichotomous; single collection.
Notes: Typical of open water habitats.

NEMALIALES
SCINAIACEAE
Nothogenia fastigiata (Bory) P.G.Parkinson
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031441; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031138
Intertidal; on rock
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, on rock adjacent to soft sediments.
Characters: Tufted, bushy, up to 8 cm high.

Nothogenia pulvinata (Levring) P.G.Parkinson
Whangarei Harbour: Reotahi, *Nelson*, Mar 2010, A031044
Intertidal; on rock
Distribution: Three Kings, Northern, Central
Habitat: Intertidal, on rock adjacent to soft sediments.
Characters: Wiry, densely branched clumps, less than 1.5 cm; single collection.

RHODYMENIOPHYCIDAE
BONNEMAISONIALES
BONNEMAISONIACEAE
Falkenbergia rufolanosa (Harv.) F.Schmitz
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Very fine filaments, tangled amongst other collections.
Notes: Alternative life history phase of *Asparagopsis armata*.

CERAMIALES
CALLITHAMNIACEAE
Callithamnion sp.
Whangarei Harbour: Collected from McDonald Bank, Reotahi
Intertidal and subtidal;
Otago Harbour: Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031434; Torpedo Boat Mole, *Farr & Neill*, Feb 2009, A031470; also collected from Otakou/Wellers intertidal
Intertidal; on jetty piling, epiphytic on *Polysiphonia*
Habitat: Intertidal and subtidal, on wood, stones, and epiphytic.
Characters: Very finely branched, less than 2 cm.
Notes: This genus is large with world wide distribution. The taxonomy of New Zealand species is "highly confused" (Adams 1994).

CERAMIACEAE
Acrothamnion sp. *sensu* Adams
Otago Harbour: Collected from Opposite Wellers subtidal
Subtidal
Distribution: Central, Chatham
Habitat: Subtidal.
Characters: Finely branched, less than 2 cm; single collection.
Notes: Rarely collected, undescribed species.

Antithamnion pectinatum (Mont.) Brauner
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031137; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031433
Subtidal;
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Finely branched, less than 2 cm high; epiphytic.
Notes: Previously known as *A. applicitum*.

Antithamnionella adnata (J.Agardh) N.M.Adams
Whangarei Harbour: Collected from Snake Bank Outer
Subtidal
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031164; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031127; also collected from Opposite Wellers subtidal, Otakou/Wellers intertidal, Snake Bank Outer, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Polysiphonia*, *Ulva*
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal, less frequently intertidal.
Characters: Finely branched, less than 2 cm high; epiphytic on *Polysiphonia*, *Ulva*.

Centroceras clavulatum (C.Agardh) Mont.
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031085
Subtidal; on shell
Otago Harbour: Harwood, *Nelson*, Feb 2009, A031296; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031298
Intertidal; on rock
Distribution: Kermadec, Three Kings, Northern, Central, Chatham, Southern, Subantarctic

Habitat: Intertidal and subtidal, on rock and shell.
Characters: Very finely branched, continuously corticated, distinctive spines at the nodes, less than 2 cm high.

"*Ceramium*" species 1
Whangarei Harbour: Collected from Urquharts Bay intertidal
Intertidal; on *Atrina*, epiphytic on *Corallina*
Habitat: Intertidal, epiphytic on *Corallina*.
Characters: Forcipate tips, incomplete cortication.
Notes: On the basis of sequence data this is a species of *Gayliella* (sp. 1).

"*Ceramium*" species 2
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal
Habitat: Intertidal
Characters: Forcipate tips; incompletely corticated.
Notes: On the basis of sequence data this is a species of *Gayliella* (sp. 2).

Ceramium species 3
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Habitat: Intertidal
Characters: Forcipate tips, extremely fine, ca. 1 cm high.

Ceramium species 4
Whangarei Harbour: Collected from Calliope Bank, McDonald Bank, Marsden Point Subtidal
Subtidal; on shell, epiphytic on *Gigartina*
Otago Harbour: Collected from Opposite Hamilton Bay, Opposite Wellers subtidal, Otakou/Wellers intertidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Gracilaria*, *Polysiphonia*, *Ulva*
Habitat: Intertidal (Otago) and subtidal (Whangarei, Otago), on shell and stones and also epiphytic on a number of hosts
Characters: Robust, fully corticated with spines and adventitious branching, dark red.
Notes: Very common in Otago.

Ceramium species 5
Otago Harbour: Collected from Opposite Hamilton Bay, Te Ngaru intertidal
Intertidal (infrequently subtidal); epiphytic on *Gracilaria*
Habitat: Intertidal, infrequently subtidal, on shell, cobbles and epiphytic.
Characters: Robust up to 14 cm, fully corticated, bright red.

Ceramium species 6
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal
Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Gracilaria*, *Gigartina*, *Ulva*
Habitat: Commonly collected from intertidal and subtidal, Otago Harbour; single subtidal collection from Whangarei Harbour. Epiphytic and epilithic.
Characters: Coarse, up to 14 cm, fully corticated.
Notes: Very common in Otago.

Ceramium species 7
Kaipara Harbour: Collected from Dredge Site 12
Subtidal
Habitat: Subtidal
Characters: Small, not fully corticated.

Ceramium species 8
Whangarei Harbour: Collected from Marsden Point Intertidal
Intertidal

Habitat: drift
Characters: Very fine axes, not strictly dichotomously branched, 1-cm high, not fully corticated.

Ceramium species 9
Whangarei Harbour: Collected from McDonald Bank
Subtidal; epiphytic on *Aphanocladia*
Habitat: Subtidal, epiphytic.
Characters: Very fine axes tangled in clump ca. 1-2 cm, incompletely corticated, forcipate tips.

Ceramium species 10
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Otago Harbour: Collected from Harwood, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal (infrequently subtidal); on shell, anchored in sand, epiphytic on *Ulva*
Habitat: Intertidal (infrequently subtidal in Otago Harbour; single subtidal collection from Whangarei Harbour; on shells, cobbles in sand, epiphytic.
Characters: Incompletely corticated, very conspicuous nodes, spines, forcipate tips, to 12 cm high, bright red fading to ginger colour.
Notes: Very common in Otago Harbour

Ceramium sp.
Whangarei Harbour: Collected from Calliope Bank, Calliope Inner, McDonald Bank, Mair Bank, Marsden Point Intertidal, Marsden Point Subtidal, One Tree Point boat ramp, Pirihi Road, Reotahi, Snake Bank Inner, Snake Bank Outer, Taurikura Bay, Urquharts Bay subtidal
Intertidal and subtidal; on shell and sponge, epiphytic on *Corallina* and *Codium*
Kaipara Harbour: Collected from Dredge Site 26, Dredge Site 27
Subtidal
Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Opposite Wellers subtidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Adamsiella*, *Gracilaria*, *Codium* spp.
Notes: 79 records, unable to be assigned to species

Pterothamnion confusum (J.Agardh) Athanas.
Otago Harbour: Collected from Opposite Wellers subtidal
Subtidal
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Delicate, finely branched; single collection.

Pterothamnion simile (Hook.f. & Harv.) Nageli
Otago Harbour: Collected from Opposite Wellers subtidal
Subtidal
Distribution: Central
Habitat: Subtidal.
Characters: Delicate, finely branched; single collection.
Notes: *Pterothamnion simile* has been infrequently collected. This is the first record from Otago and the southern South Island.

DASYACEAE
Dasya subtilis Lindauer
Whangarei Harbour: McDonald Bank, *Crocker & Miller*, Apr 2010, A031024; Reotahi, *Farr & Neill*, Mar 2010, A031007; Snake Bank Inner, *Crocker & D'Archino*, Apr 2010, A031025; also collected from Marsden Point Subtidal, Urquharts Bay subtidal
Intertidal and subtidal; epiphytic on *Corallina*
Distribution: Northern, Central
Habitat: Intertidal and subtidal, on cobbles, shell, and epiphytic on *Corallina* turf.
Characters: Very finely branched, less than 3 cm high.

Dasya sp.

Whangarei Harbour: Collected from McDonald Bank, Marsden Point Intertidal, Urquharts Bay subtidal
Intertidal and subtidal; on shell
Kaipara Harbour: Dredge Site 11, *Crocker, D'Archino & Miller*, Mar 2009, A031084
Subtidal
Habitat: Intertidal and subtidal, on shell and stones.
Characters: Very finely branched, less than 3 cm high.

Heterosiphonia squarrosa (Hook.f.& Harv.) Falkenb.
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal
Otago Harbour: Collected from Otakou/Wellers intertidal
Intertidal; epiphytic on *Gigartina*
Distribution: Northern, Central, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock and epiphytic.
Characters: Finely branched, bushy, less than 4 cm high; single collection from both north and south.

DELESSERIACEAE
Abroteia suborbiculare (Harv.) Kylin
Otago Harbour: Collected from Otakou/Wellers subtidal
Subtidal; epiphytic on *Carpophyllum*
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Delicate rounded to oval blades, less than 2 cm high; species exclusively epiphytic, predominantly on species of *Carpophyllum*; single collection.

Acrosorium venulosum (Zanardini) Kylin
Whangarei Harbour: Marsden Point Intertidal, *Nelson*, Nov 2009, A031474; Marsden Point Intertidal, *Farr, Neill & Nelson*, Mar 2010, A030991; McDonald Bank, *D'Archino & Miller*, Sep 2009, A030992; also collected from Calliope Bank, Mair Bank, Manganese Point, Marsden Point Subtidal, Reotahi, Sinclair Point, Snake Bank Inner, Urquharts Bay subtidal
Subtidal (infrequently intertidal); on shells and worm tubes, also drift
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal, infrequently intertidal, on shells and worm tubes.
Characters: Membranous with irregular narrow branching, less than 10 cm high.
Notes: Common and widely distributed.

Apoglossum montagneanum (J.Agardh) J.Agardh
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031212; McDonald Bank, *Crocker & Miller*, Apr 2010, A031209
Subtidal
Kaipara Harbour: Dredge Site 24, *Crocker, D'Archino, Miller, Neill & Nelson*, Mar 2009, A031082
Subtidal; on barnacle
Distribution: Three Kings, Northern, Central
Habitat: Subtidal, on cobbles, shell and barnacles.
Characters: Delicate membranous, finely branched, less than 4 cm high.

Apoglossum sp.
Kaipara Harbour: Collected from Dredge Site 25
Subtidal; on scallop shells
Distribution:
Habitat: Subtidal, on scallop shells.
Characters: Fragmentary, unable to be identified to species; single collection.

Caloglossa ogasawaraensis Okamura
Whangarei Harbour: Collected from Mair Bank
Subtidal
Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031081
Intertidal; on mangrove pneumatophores and fallen logs
Distribution: Northern
Habitat: Intertidal, on mangrove pneumatophores and fallen logs.

Characters: Delicate, membranous, finely branched, less than 2 cm high.

Caloglossa vieillardii (Kütz.) Setch.
Whangarei Harbour: Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031475; also collected from Parua Bay
Intertidal; on mangrove pneumatophores
Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031080; also collected from Karaka Point
Intertidal; on mangrove pneumatophores and fallen logs, and on drift *Caulacanthus*
Distribution: Northern, Central, Southern
Habitat: Intertidal, on mangrove pneumatophores and fallen logs.
Characters: Delicate, membranous, finely branched, less than 2 cm high.

Delesseriaceae
Whangarei Harbour: Collected from McDonald Bank, Mair Bank, Marsden Point Subtidal
Subtidal
Otago Harbour: Collected from Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru subtidal
Intertidal and subtidal; epiphytic on *Carpophyllum*, *Gigartina*, *Polysiphonia* spp.
Habitat: Intertidal and subtidal, drift, epiphytic, and on rock and cobbles.
Characters: Sterile and/or fragmentary and unable to be identified to species.

Erythroglossum undulatissimum (J.Agardh) Kylin
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031458; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031465, A031466; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031461, A031448; also collected from Otakou/Wellers subtidal
Intertidal and subtidal
Distribution: Central, Southern
Habitat: Intertidal and subtidal, on cobbles, stones, and drift.
Characters: Very delicate, membranous, divided, frilly thalli, most less than 6 cm high.

Haraldiophyllum crispatum (Hook.f & Harv.) S.-M.Lin, Hommers. & W.A.Nelson
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031456; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031103; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031464; also collected from Opposite Hamilton Bay, Otakou/Wellers subtidal
Intertidal and subtidal;
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal, on shell and cobbles.
Characters: Membranous, delicate blade, generally less than 20 cm high.

Hymenena variolosa (Harv.) Kylin
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031221, A030979; McDonald Bank, *D'Archino & Miller*, Sep 2009, A031224, A031222, A031223; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031226, A031227; also collected from Shell Cut Reach South (Tamaterau), Snake Bank Inner
Subtidal; on Atrina
Kaipara Harbour: Collected from Dredge Site 26
Subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal, on rock, cobbles and shell.
Characters: Membranous, dichotomously branched.

Hymenena sp.
Whangarei Harbour: Collected from Marsden Point Subtidal, McDonald Bank, Urquharts Bay subtidal
Habitat: Subtidal, epiphytic.
Characters: Fragmentary and/or sterile, unable to be identified to species.

Phycodrys adamsiae S.-M.Lin & W.A.Nelson
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031148
Subtidal;
Distribution: Three Kings, Northern
Habitat: Subtidal.

Characters: Membranous, narrow, stalked side lobes; single collection.

Phycodrys novae-zelandiae S.-M.Lin & W.A.Nelson
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031106; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031107; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031462; also collected from Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal
Intertidal and subtidal;
Distribution: Central, Southern
Habitat: Intertidal and subtidal, on cobbles, shell, epiphytic, and drift.
Characters: Membranous, frilly, lobed.

Schizoseris dichotoma (Hook.f & Harv.) Kylin
Otago Harbour: Pulling Point, *Crocker & D'Archino*, Oct 2009, A031104; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031447
Intertidal and subtidal
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, cobbles, and drift.
Characters: Membranous blades up to 20 cm high, with prominent, regularly dichotomous veins extending almost to the margins.

Schizoseris griffithsia (Suhr) M.J.Wynne
Otago Harbour: Harwood, *Neill & Nelson*, Oct 2009, A031101; Opposite Hamilton Bay, *Crocker & D'Archino*, Oct 2009, A031110; Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031463; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031455, A031479; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031102; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031105; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031457
Intertidal and subtidal; drift
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, cobbles, and drift.
Characters: Membranous divided blades, up to 20 cm high, with prominent veins extending into leafy side blades.

Schizoseris sp. aff. *M. gattyana*
Otago Harbour: Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031460; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031108
Subtidal
Distribution: Central, Southern
Habitat: Subtidal.
Characters: Membranous blades up to 15 cm, with ruffled margins and prominent parallel veins extending from the base of the thallus.

Schizoseris sp. *sensu* Adams
Otago Harbour: Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031459
Subtidal
Distribution: Northern, Central, Southern
Habitat: Subtidal.
Characters: Membranous blades up to 15 cm, with many slender, parallel veins extending from the base to the upper margin of the frond.

Schizoseris sp.
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031109; also collected from Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal;
Habitat: Intertidal and subtidal.
Characters: Fragmentary and/or sterile, unable to be identified to species.

RHODOMELACEAE

Adamsiella angustifolia (Harv.) L.E.Phillips & W.A.Nelson
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031121
Intertidal and subtidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal.
Characters: Strap-like branches, up to 12 cm high.
Notes: Occurs on rock on open coasts and areas of moderate wave exposure; infrequently found in sheltered habitats.

Adamsiella chauvinii (Harv.) L.E.Phillips & W.A.Nelson
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031261; Harwood, Nelson, Feb 2009, A031256, A031257; Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031262; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031258; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031260; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031122; Otakou/Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031255; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031263; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031264; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031259; also collected from Torpedo Boat Mole
Intertidal and subtidal; attached, drift, and buried
Distribution: Northern, Central, Southern, Subantarctic
Habitat: Intertidal and subtidal, attached, drift and partially buried, forming extensive meadows, with both attached and also drift thalli.
Characters: Strap-like branches, up to 15 cm high.
Notes: Very common in Otago Harbour.

Adamsiella sp.
Otago Harbour: Collected from Te Ngaru subtidal
Subtidal
Characters: Material too small and fragmentary to be identified to species.

Aphanocladia delicatula (Hook.f. & Harv.) Falkenb.
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031027; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031028; also collected from Calliope Inner, Snake Bank Inner Subtidal; on *Atrina*
Otago Harbour: Harwood, Neill & Nelson, Oct 2009, A031095
Intertidal; embedded in sand
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal, less frequently intertidal, on horse mussels, cobbles, shell, and buried in sand.
Characters: Tufted, delicately branched, usually less than 5 cm high.

Bostrychia arbuscula Hook.f. & Harv.
Otago Harbour: Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031253; also collected from Otakou/Wellers subtidal
Intertidal and subtidal;
Distribution: Central, Chatham, Southern
Habitat: Intertidal, on rock.
Characters: Tufted with curled tips, generally up to 3 cm high.

Bostrychia gracilis (R.J.King & Puttock) Zuccarello & J.A.West
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031146
Intertidal
Distribution: Northern
Habitat: Upper intertidal.
Characters: Finely branched, less than 2 cm; single collection.

Bostrychia intricata (Bory) Mont.
Kaipara Harbour: Collected from Shelly Beach
Intertidal; on rock
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, on rock.
Characters: Finely branched, less than 2 cm; single collection.

Bostrychia moritziana (Sond. ex Kütz.) J.Agardh
Whangarei Harbour: Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031023; Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031147
Intertidal and subtidal; on mangrove pneumatophores
Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031057; also collected from Karaka Point
Intertidal; on mangrove pneumatophores and fallen logs, on barnacles, and on drift *Caulacanthus*
Distribution: Northern, Central, Southern
Habitat: Intertidal, on mangrove pneumatophores, fallen logs, on barnacles, and on drift *Caulacanthus*
Characters: Finely branched, less than 2 cm.

Bostrychia sp.
Whangarei Harbour: Collected from Parua Bay
Intertidal
Kaipara Harbour: Collected from Shelly Beach
Intertidal; on rock
Habitat: Intertidal, on rock.
Characters: Finely branched, less than 2 cm; sterile, unable to be identified to species.

Brongniartella australis (C.Agardh) F.Schmitz
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031098; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031099; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031100; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031097; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031254; also collected from Opposite Hamilton Bay, Otakou/Wellers subtidal, Te Ngaru subtidal
Intertidal and subtidal; drift, and epiphytic on *Cladophora*
Distribution: Central, Southern
Habitat: Intertidal and subtidal, drift, on shell and stones, and epiphytic.
Characters: Finely branched with strong main axes, up to 30 cm high.

Chondria sp.
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031195; also collected from Calliope Inner, Marsden Point Subtidal, McDonald Bank
Subtidal; epiphytic on *Sargassum*
Habitat: Subtidal, on rock and epiphytic.
Characters: Branched, terete, up to 10 cm high.
Notes: Although common and widespread, the New Zealand species in this genus (ca. 5) are poorly known.

Cladhymenia oblongifolia Harv.
Whangarei Harbour: Calliope Inner, *Crocker & D'Archino*, Apr 2010, A031192
Subtidal
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Strap-like branches with rounded tips; single collection.

Dasyclonium incisum (J.Agardh) Kylin
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Apr 2010, A031468
Subtidal
Distribution: Kermadec, Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal, epiphytic on *Pterocladia lucida*.
Characters: Finely branched, less than 2 cm high; single collection.

Dipterosiphonia heteroclada (J.Agardh) Falkenb.
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031436, A031437
Subtidal; epiphytic on *Gigartina*
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal, epiphytic.
Characters: Finely branched, less than 3 cm high.

Echinothamnion lyallii (Hook.f. & Harv.) Kylin
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031435; also collected from Otakou/Wellers subtidal
Intertidal and subtidal;
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock and cobbles.
Characters: Axes densely covered with fine branchlets, thalli up to 12 cm high.

Echinothamnion sp. *sensu* Adams (1994)
Otago Harbour: Collected from Te Ngaru subtidal
Subtidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Axes densely covered with fine branchlets; single collection.
Notes: Undescribed species.

Laurencia thyrsifera J.Agardh
Whangarei Harbour: Urquharts Bay intertidal, *Nelson*, Nov 2009, A031471; also collected from Reotahi
Intertidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal.
Characters: Terete, densely branched, up to 20 cm high.

Metamorphe colensoi (Hook.f. & Harv.) Falkenb.
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031438
Subtidal; epiphytic on *Carpophyllum*
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal, epiphytic on *Carpophyllum*.
Characters: Finely branched, less than 2 cm; single collection.

Perrinia ericoides (Harv.) Womersley
Otago Harbour: Collected from Opposite Wellers subtidal, Otakou/Wellers intertidal, Torpedo Boat Mole
Intertidal and subtidal; epiphytic
Distribution: Central, Chatham, Southern
Habitat: Intertidal and subtidal, on rock, cobbles, and epiphytic.
Characters: Mat-like growth initially, upright axes generally less than 2 cm high.
Notes: Previously known as *Bryocladia ericoides*.

Polysiphonia constricta Womersley
Otago Harbour: Collected from Harwood, Torpedo Boat Mole
Intertidal
Distribution: Southern
Habitat: Upper subtidal to low intertidal.
Characters: Fine axes to ca. 5 cm, 7 pericentral cells, typically brick red to chestnut.
Notes: Introduced, first recorded from Otago harbour in 1983.

Polysiphonia decipiens Mont.
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031286; Harwood, *Nelson*, Feb 2009, A031289; Harwood, *Neill & Nelson*, Oct 2009, A031292; Opposite Hamilton Bay, *Crocker & D'Archino*, Oct 2009, A031285; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031282, A031287; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031291; Otakou/Wellers intertidal, *Farr & Neill*, Oct 2009, A031293; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031283; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031288; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031290; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031284; also collected from Otakou/Wellers subtidal, Torpedo Boat Mole
Intertidal and subtidal; drift, and epiphytic on *Adamsiella*
Distribution: Central, Southern
Habitat: Intertidal and subtidal, drift, and epiphytic on *Adamsiella*.
Characters: Bushy and much branched, 7(-8) pericentral cells, dark reddish brown to black on drying.
Notes: Extremely common in Otago Harbour collections.

Polysiphonia isogona sensu Adams
Whangarei Harbour: Collected from Marsden Point Intertidal
Intertidal; on shell and rock
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031131; also collected from Harwood, Otakou/Wellers intertidal, Te Ngaru intertidal, Torpedo Boat Mole
Intertidal (infrequently subtidal); on shells, wood
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal (infrequently subtidal), on shell, rock and wood.
Characters: Slender axes, 9-10 (-12) pericentral cells, dark, reddish brown.
Notes: Northern specimens tend to be very much smaller than southern specimens (Adams 1991).

Polysiphonia isogona sensu Freshwater
Whangarei Harbour: Collected from Mair Bank
Subtidal
Habitat: Subtidal.
Notes: Sequencing has revealed two genetically distinct species. This species aligns with sequence data submitted to Genbank as *P. isogona* by D.W. Freshwater, and differs from the sequence for specimens identified as *P. isogona* based on morphological and anatomical characters outlined by Adams (1991). *Polysiphonia isogona* was originally described from material collected in Cook Strait and further work is required to clarify the identity of *P. isogona*.

Polysiphonia morrowii Harv.
Otago Harbour: Collected from Harwood, Te Ngaru intertidal, Torpedo Boat Mole
Intertidal; on wood, and drift
Habitat: Intertidal, on wood and drift.
Characters: Fine axes in busy clumps, 4 pericentral cells, red.
Notes: Introduced species and a new record for New Zealand, confirmed by sequencing both in this study and by D.W. Freshwater (pers. comm.)

Polysiphonia muelleriana J.Agardh
Otago Harbour: Collected from Te Ngaru intertidal
Intertidal; on shell
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal, on shell. Typical of open coasts.
Characters: Large (up to 40 cm), 9-12 pericentral cells, heavily corticated, dark reddish brown.

Polysiphonia rhododactyla Harv.
Whangarei Harbour: Collected from McDonald Bank
Subtidal; on shell
Distribution: Northern, Central, Southern
Habitat: Subtidal, on shell.
Characters: Typically with bare lower axes, 4 pericentral cells, bright rosy crimson.

Polysiphonia sertularioides (Gratel.) J.Agardh (*sensu* Adams)
Kaipara Harbour: Collected from Dredge Site 7, Dredge Site 11, Dredge Site 12, Dredge Site 25, Dredge Site 27, Karaka Point
Subtidal; on shell, and epiphytic on *Codium* and *Zostera*
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal, on shell and epiphytic.
Characters: Delicate, tufted, 4 pericentral cells, reddish brown.
Notes: Introduced species.

Polysiphonia strictissima Hook.f. & Harv.
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031270; also collected from Marsden Point Intertidal, Snake Bank Inner, Urquharts Bay subtidal
Subtidal; on shell, epiphytic on *Gigartina*
Kaipara Harbour: Collected from Dredge Site 11
Subtidal

Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031275, A031272; Harwood, *Nelson*, Feb 2009, A031279; Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031269; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031271; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031274; Otakou/Wellers intertidal, *Farr & Neill*, Oct 2009, A031281; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031278, A031277; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031280; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031276; Torpedo Boat Mole, *Broom & Nelson*, Feb 2009, A031273; also collected from Otakou/Wellers subtidal
Intertidal and subtidal; on shells, epiphytic on *Gigartina*, *Gracilaria*
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, on shell and epiphytic.
Characters: Fine, glassy appearance, up to 15 cm high, 4 pericentral cells, reddish brown fading to ginger colour.
Notes: Very common in Otago Harbour.

Polysiphonia subtilissima Mont. (*sensu* Adams)
Whangarei Harbour: One Tree Point boat ramp, *Farr, Neill & Nelson*, Mar 2010, A031268
Intertidal; on *Corallina* turf
Distribution: Northern, Central
Habitat: Intertidal, on *Corallina* turf.
Characters: Tufted to 5 cm, 4 pericentral cells, pink to pale red.
Notes: Introduced species.

Polysiphonia species 1
Whangarei Harbour: Collected from One Tree Point
Subtidal
Habitat: Subtidal.
Notes: Distinguished by sequence data.

Polysiphonia species 2
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Habitat: Subtidal.
Notes: Distinguished by sequence data.

Polysiphonia species 3
Otago Harbour: Collected from Torpedo Boat Mole
Intertidal; on wood
Habitat: Intertidal, on wood.
Characters: Fine, 4 pericentral cells.

Polysiphonia species 4
Whangarei Harbour: Collected from Urquharts Bay subtidal
Subtidal
Otago Harbour: Collected from Otakou/Wellers subtidal, Otakou/Wellers intertidal, Torpedo Boat Mole
Intertidal and subtidal
Habitat: Intertidal and subtidal.
Characters: Very fine, 6-7 pericentral cells, urceolate cystocarps.

Polysiphonia species 5
Whangarei Harbour: Collected from Mair Bank
Subtidal; on shell
Habitat: Subtidal, on shell.
Characters: Very fine, 4 pericentral cells.

Polysiphonia sp.
Whangarei Harbour: Collected from Calliope Inner, Mair Bank, One Tree Point, One Tree Point boat ramp, One Tree Point seagrass, Urquharts Bay subtidal
Subtidal (infrequently intertidal); on shell, ascidian, and epiphytic on *Codium*
Kaipara Harbour: Collected from Dredge Site 24, Dredge Site 26
Subtidal; on scallop shells

Otago Harbour: Collected from Harwood, Opposite Hamilton Bay, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; in sand, and on *Zostera*, *Gracilaria*
Habitat: Intertidal and subtidal, in sand, on shell, ascidian, and epiphytic.
Notes: 75 records, material fragmentary and/or sterile and unable to be identified to species.

Pterosiphonia pennata (C.Agardh) Sauv.
Whangarei Harbour: Collected from Calliope Bank, Mair Bank, McDonald Bank,
Subtidal; on shell
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Oct 2009, A031129; also collected from Te Ngaru intertidal, Torpedo Boat Mole
Intertidal
Distribution: Northern, Central, Southern
Habitat: Intertidal and subtidal, on shell and cobbles.
Characters: Delicately pinnately branched, generally less than 3 cm high.
Notes: Molecular sequence data and morphological investigations have revealed that there are several, probably undescribed, species currently being confused with this species.

Rhodomelaceae
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Habitat: Subtidal.
Characters: Fragmentary, unable to be identified to genus.

SPYRIDIACEAE
Spyridia filamentosa (Wulfen) Harv.
Whangarei Harbour: Marsden Point Intertidal, *Farr, Neill & Nelson*, Mar 2010, A031005; Sinclair Point, *Crocker & D'Archino*, Apr 2010, A031006; also collected from Mair Bank, Marsden Point Subtidal, McDonald Bank, One Tree Point seagrass, Pirihi Road, Reotahi, Snake Bank Inner, Snake Bank Outer, Urquharts Bay subtidal
Intertidal and subtidal; epizoic on *Chaetopterus*, epiphytic on *Codium* sp.
Kaipara Harbour: Dive Site 1, *Crocker, D'Archino & Miller*, Mar 2009, A031060; Karaka Point, *Nelson*, Mar 2009, A031061; Shelly Beach, *Nelson*, Mar 2009, A031059; also collected from Dredge Site 4, Dredge Site 5, Dredge Site 6, Dredge Site 7, Dredge Site 8, Dredge Site 11, Dredge Site 12, Dredge Site 13, Dredge Site 14, Dredge Site 15, Dredge Site 16, Dredge Site 17, Dredge Site 18, Dredge Site 19, Dredge Site 20, Dredge Site 21, Dredge Site 22, Dredge Site 23, Dredge Site 24, Dredge Site 25, Dredge Site 26, Dredge Site 27
Intertidal and subtidal; epizoic on *Atrina* and sponge, epiphytic on *Codium* sp.
Distribution: Kermadec, Northern
Habitat: Intertidal and subtidal, epiphytic, epizoic, on shell, cobbles, worm tubes, and drift.
Characters: Bushy up to 16 cm high, with prominent main axes and many radially arranged side branchlets with nodal bands.
Notes: Common in summer.

WRANGELIACEAE
Anotrichium crinitum (Kütz.) Baldock
Whangarei Harbour: Pirihi Road, *Crocker & D'Archino*, Apr 2010, A030987
Subtidal
Kaipara Harbour: Collected from Dredge Site 27
Subtidal
Otago Harbour: Pulling Point, *Crocker & D'Archino*, Oct 2009, A031125; Torpedo Boat Mole, *Farr & Neill*, Feb 2009, A031240; also collected from Opposite Hamilton Bay, Torpedo Boat Mole
Intertidal and subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal, less common intertidally.
Characters: Finely branched usually less than 12 cm high.

Anotrichium sp.
Whangarei Harbour: Collected from Mair Bank
Subtidal

Kaipara Harbour: Collected from Dredge Site 7, Dredge Site 8, Dredge Site 26
Subtidal
Otago Harbour: Collected from Opposite Hamilton Bay, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Ceramium* sp.
Characters: Material too small and fragmentary to be identified to species.

Griffithsia crassiuscula C.Agardh
Otago Harbour: Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031251, A031250; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031252; also collected from Otakou/Wellers subtidal, Torpedo Boat Mole
Intertidal and subtidal
Distribution: Central, Southern
Habitat: Intertidal and subtidal.
Characters: Dichotomously branched, fan shaped thallus, up to 7 cm high, with bead-like cells.
Notes: Introduced species.

Griffithsia teges Harv.
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031018; McDonald Bank, *Crocker & Miller*, Apr 2010, A031019; Pirihi Road, *Crocker & D'Archino*, Apr 2010, A031020
Subtidal; on sponge
Kaipara Harbour: Dredge Site 11, *Crocker, D'Archino & Miller*, Mar 2009, A031074; Dredge Site 25, *Crocker, D'Archino, Miller, Neill & Nelson*, Mar 2009, A031072; Dredge Site 27, *Crocker, D'Archino, Miller, Neill & Nelson*, Mar 2009, A031073
Subtidal; on scallop and *Atrina* shells
Distribution: Northern, Chatham
Habitat: Subtidal, on sponge, shells and cobbles.
Characters: Irregularly dichotomously branched, up to 5 cm high, bead-like cells.

Griffithsia sp.
Whangarei Harbour: Collected from McDonald Bank
Subtidal (infrequently intertidal)
Kaipara Harbour: Collected from Dredge Site 5, Dredge Site 7, Dredge Site 11, Dredge Site 13, Dredge Site 21, Dredge Site 24
Subtidal; on scallop shells and *Griffithsia* sp.
Otago Harbour: Collected from Te Ngaru intertidal, Torpedo Boat Mole
Intertidal
Habitat: Subtidal.
Characters: Fragmentary and sterile samples.

Lophothamnion hirtum (Hook.f. & Harv.) Womersley
Whangarei Harbour: Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031467
Subtidal
Distribution: Central, Chatham, Southern
Habitat: Subtidal.
Characters: Finely and very densely branched, usually less than 15 cm high; single collection.

Medeiothamnion lyallii (Harv.) Gordon
Otago Harbour: Opposite Hamilton Bay, *Crocker & Miller*, Feb 2009, A031241; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031126; also collected from Opposite Wellers subtidal, Otakou/Wellers subtidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; epiphytic on *Carpophyllum*, *Polysiphonia*
Distribution: Central, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, cobbles, and epiphytic.
Characters: Finely and regularly branched lying in one place, up to 20 cm high.

Spongoclonium pastorale Laing
Whangarei Harbour: McDonald Bank, *Crocker & Miller*, Apr 2010, A031149; Reotahi, *Nelson*, Nov 2009, A031145; Urquharts Bay subtidal, *Crocker & Miller*, Apr 2010, A031165
Intertidal and subtidal; on shell

Otago Harbour: Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031128; also collected from Opposite Wellers subtidal, Otakou/Wellers intertidal
Intertidal and subtidal; on rock
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, shell, and epiphytic.
Characters: Very finely and densely branched thallus, generally up to 6 cm high.

GELIDIALES
GELIDIACEAE
Capreolia implexa Guiry & Womersley
Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031070; Shelly Beach, *Nelson*, Mar 2009, A031071
Intertidal; on mangrove pneumatophores and fallen logs
Distribution: Kermadec, Three Kings, Northern, Central, Chatham, Southern
Habitat: Upper intertidal, on rock, mangrove pneumatophores and fallen logs.
Characters: Densely branched, short turf-forming species, less than 2 cm high.

Gelidium caulacantheum J.Agardh
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Apr 2010, A031190; Parua Bay, *Crocker, Neill & Nelson*, Nov 2009, A030988; Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A030989; also collected from Kirikiri Point, One Tree Point boat ramp, Marsden Point Intertidal, Reotahi, Taurikura Bay, Urquharts Bay intertidal
Intertidal and subtidal; on shell and rock
Kaipara Harbour: Karaka Point, *Farr & Neill*, Mar 2009, A031068; Karaka Point, *Nelson*, Mar 2009, A031069
Intertidal; on oyster shells
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal, on shell, cobbles and rock.
Characters: Densely branched, terete, less than 3 cm high, often forming tufts or turf.

Gelidium sp.
Whangarei Harbour: One Tree Point boat ramp, *Nelson*, Nov 2009, A031034; also collected from Mair Bank, Urquharts Bay intertidal
Intertidal and subtidal
Habitat: Intertidal and subtidal.
Characters: Sparsely branched, terete, less than 2 cm high.
Notes: Undescribed species.

Pterocladia lucida (Turner) J.Agardh
Whangarei Harbour: Collected from Mair Bank
Subtidal
Distribution: Three Kings, Northern, Central, Chatham
Habitat: Subtidal.
Characters: Robust thallus, pinnately branched with thick main axes, up to 20-30 cm high.
Notes: *Pterocladia lucida* typically grows in the upper subtidal on exposed to moderately exposed coasts.

GIGARTINALES
CAULACANTHACEAE
Catenella nipae Zanardini
Whangarei Harbour: Parua Bay, *Crocker, Neill & Nelson*, Nov 2009, A031476
Intertidal
Kaipara Harbour: Dredge Site 11, *Crocker, D'Archino & Miller*, Mar 2009, A031062; Shelly Beach, *Nelson*, Mar 2009, A031063
Intertidal and subtidal; on mangrove pneumatophores and fallen logs
Distribution: Northern, Central
Habitat: Intertidal, on mangrove pneumatophores and fallen logs.
Characters: Slender, constricted fine branches, less than 3 cm high, forming clumps.

Caulacanthus ustulatus (Turner) Kütz.
Whangarei Harbour: Waikaraka, *Crocker, Neill & Nelson*, Nov 2009, A031001; also collected from Mair Bank, Reotahi
Intertidal and subtidal; on mangrove pneumatophores

Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031067
Intertidal; on oyster shells
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031294; also collected from Otakou/Wellers intertidal
Intertidal and subtidal; on *Gigartina*
Distribution: Kermadec, Three Kings, Northern, Central, Chatham, Southern
Habitat: Intertidal, infrequently subtidal, on oyster shell, cobbles, and epiphytic.
Characters: Tufted, densely branched, 2-3 cm high, forming turf or clumps.

CYSTOCLONIACEAE
Rhodophyllis acanthocarpa (Harv.) J.Agardh
Otago Harbour: Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031295
Subtidal
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Irregularly divided foliose blades; single collection.

Rhodophyllis sensu lacerata Hook.f. & Harv.
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031134
Subtidal
Distribution: Central, Southern, Subantarctic
Habitat: Subtidal.
Characters: Finely divided foliose blade; single collection.

GIGARTINACEAE
Chondracanthus chapmanii (Hook.f. & Harv.) Fredericq
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031193; Urquharts Bay intertidal, *Nelson*, Nov 2009, A031477; also collected from McDonald Bank, McLeod Bay, Marsden Point Intertidal, Reotahi, Snake Bank Inner
Intertidal and subtidal; on shell and epiphytic on coralline algae
Otago Harbour: Harwood, *Nelson*, Feb 2009, A031162
Intertidal
Distribution: Kermadec, Northern, Central, Southern
Habitat: Intertidal and subtidal, on shell and epiphytic on coralline algae.
Characters: Bushy, branched, up to 7 cm high.
Notes: Common.

Gigartina atropurpurea (J.Agardh) J.Agardh
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A031004; Reotahi, *Nelson*, Nov 2009, A031412; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A030990; also collected from McDonald Bank, McLeod Bay, Marsden Point Subtidal
Subtidal (infrequently intertidal); on shell
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031416; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031442; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031420; also collected from Otakou/Wellers intertidal, Te Ngaru subtidal, Torpedo Boat Mole,
Intertidal (infrequently subtidal)
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal (commonly subtidal in the north and intertidal in the south), on rock, cobbles and shell.
Characters: Large rubbery blades, occasionally lobed, up to 35 cm high.

Gigartina sp.
Whangarei Harbour: Collected from Snake Bank Inner
Subtidal
Otago Harbour: Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031123; also collected from Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal;
Habitat: Intertidal and subtidal.
Characters: Fragmentary and unable to be identified to species.

Rhodoglossum sp.
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031469; Otakou/Wellers intertidal, *Farr & Neill*, Oct 2009, A031419; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031415; Te Ngaru subtidal, *Crocker & Miller*, Feb 2009, A031417; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031414, A031418; also collected from Harwood, Opposite Hamilton Bay, Te Ngaru intertidal, Torpedo Boat Mole, Opposite Wellers subtidal
Intertidal and subtidal; on rock, cockle shells, drift
Distribution: Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, cockle shells, and drift.
Characters: Large, robust blades up to 30 cm high.
Notes: Common. Further research is required to characterise the species of *Rhodoglossum* in New Zealand.

Sarcothalia livida (Turner) Grev.
Otago Harbour: Otakou/Wellers intertidal, *Farr & Neill*, Feb 2009, A031444; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031445; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031124; Te Ngaru intertidal, *Broom & Nelson*, Feb 2009, A031443; also collected from Otakou/Wellers subtidal
Intertidal and subtidal
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal.
Characters: Rubbery, pinnately branched, flattened leaf-life laterals, up to 15 cm high.
Notes: Common.

Gigartinaceae
Otago Harbour: Collected from Harwood, Otakou/Wellers intertidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal
Habitat: Intertidal and subtidal.
Characters: Fragmentary and unable to be identified to genus.

HYPNEACEAE
Hypnea cornuta (Kütz.) J.Agardh
Whangarei Harbour: Pirihi Road, *Crocker & D'Archino*, Apr 2010, A031214
Subtidal
Habitat: Subtidal.
Characters: Terete, irregularly branched; single collection.
Notes: Introduced species, first record from New Zealand.

KALLYMENIACEAE
Callophyllis calliblepharoides J.Agardh
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031135
Subtidal
Distribution: Three Kings, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Strap-like branches, up to 20 cm; single collection

Ectophora depressa J.Agardh
Whangarei Harbour: Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031191
Subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Lobed, prostrate thallus; single collection.
Notes: Formerly known as *Callophyllis depressa*.

Pugetia delicatissima R.E.Norris
Otago Harbour: Collected from Opposite Hamilton Bay
Subtidal
Distribution: Central, Chatham, Southern, Subantarctic
Habitat: Subtidal.
Characters: Unbranched fine blade; single collection.

Notes: Research is underway on this family. New Zealand species currently placed in *Pugetia* belong to several undescribed genera.

Pugetia sp.
Otago Harbour: Collected from Opposite Wellers subtidal
Subtidal
Habitat: Subtidal.
Characters: Unbranched fine blade; single collection.

SOLIERIACEAE
Solieria sp.
Kaipara Harbour: Collected from Dredge Site 4, Dredge Site 5, Dredge Site 6, Dredge Site 7, Dredge Site 8, Dredge Site 11, Dredge Site 12, Dredge Site 13, Dredge Site 16, Dredge Site 17, Dredge Site 18, Dredge Site 19, Dredge Site 20, Dredge Site 21, Dredge Site 22, Dredge Site 23, Dredge Site 24, Dredge Site 25, Dredge Site 26, Dredge Site 27
Subtidal
Distribution: Northern
Habitat: Subtidal, drift.
Characters: Irregularly and densely branched terete thallus up to 25 cm high.
Notes: An introduced species known only from drift specimens, it was first recognised in the Orakei Basin, Waitemata Harbour, and was then introduced to the Manukau Harbour and subsequently the Kaipara Harbour.

Gigartinales
Otago Harbour: Collected from Te Ngaru subtidal
Subtidal
Characters: Fragmentary and unable to be identified further.

GRACILARIALES
GRACILARIACEAE
Gracilaria chilensis Bird, McLachlan & Oliveira
Whangarei Harbour: Mair Bank, *Crocker & D'Archino*, Oct 2009, A030984; Manganese Point, *Crocker & D'Archino*, Sep 2009, A030980; also collected from Marsden Point Intertidal, McDonald Bank, McLeod Bay, One Tree Point boat ramp, One Tree Point seagrass, Waikaraka
Intertidal and subtidal; in mud and on shells and fishing line
Kaipara Harbour: Collected from Dredge Site 5, Dredge Site 7, Dredge Site 13, Dredge Site 18, Dredge Site 19, Dredge Site 20, Dredge Site 22, Dredge Site 23, Dredge Site 27
Subtidal; on cockle shells
Otago Harbour: Between Gills Landing & Portobello, *Crocker & D'Archino*, Oct 2009, A031113; Harwood, *Nelson*, Feb 2009, A031242; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031119; Otakou/Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031111; Te Ngaru subtidal, *Crocker & D'Archino*, Oct 2009, A031118; also collected from Opposite Hamilton Bay, Otakou/Wellers intertidal, Te Ngaru intertidal, Torpedo Boat Mole
Intertidal and subtidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Intertidal and subtidal, partially buried in sediments, also on shells, cobbles and fishing line.
Characters: Terete, irregularly and densely branched, variable in size up to 30 cm high.
Notes: Very common.

Gracilaria secundata Harv.
Otago Harbour: Opposite Hamilton Bay, *Crocker & D'Archino*, Oct 2009, A031112; Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031120; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031245; also collected from Harwood, Te Ngaru subtidal
Intertidal and subtidal; on rock, and drift
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock surrounded by sand and in drift.
Characters: Terete, secundly branched, generally less than 20 cm high.

Gracilaria sp. "BB"

Kaipara Harbour: Shelly Beach, *Nelson*, Mar 2009, A031077; also collected from Dredge Site 5, Dredge Site 8, Dredge Site 11, Dredge Site 19, Dredge Site 21, Dredge Site 26
Subtidal and intertidal; on fishing line
Distribution: Northern
Habitat: Subtidal and less frequently intertidal, drift, partially buried in sediments, also on shells, cobbles and fishing line.
Characters: Terete, irregularly and densely branched, variable in size up to 30 cm high. Indistinguishable in the field from *G. chilensis*.
Notes: This is considered to be an introduced species. It has become abundant and widespread on the Manukau Harbour, and is also present in the Orakei Basin in the Waitemata Harbour. Its presence in the Kaipara Harbour has been confirmed only within the past 5 years.

Gracilaria truncata Kraft
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031013, A031014; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031008; also collected from Manganese Point, Marsden Point Intertidal, Marsden Point Subtidal, Shell Cut Reach South (Tamaterau)
Subtidal
Otago Harbour: Opposite Wellers subtidal, *Crocker & D'Archino*, Oct 2009, A031114; Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031249; Otakou/Wellers subtidal, *Crocker & Miller*, Feb 2009, A031248; Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031115; Torpedo Boat Mole, *Dalen & Nelson*, Oct 2009, A031116; also collected from opposite Hamilton Bay, Te Ngaru subtidal
Intertidal and subtidal
Distribution: Northern, Central, Southern
Habitat: Intertidal and subtidal, drift, and on rock, cobbles and shell, forming meadows.
Characters: Strap-like, dichotomously branched blades up to 20 cm.
Notes: Very common.

Melanthalia abscissa (Turner) Hook.f. & Harv.
Kaipara Harbour: Karaka Point, *Nelson*, Mar 2009, A031058
Intertidal; drift
Distribution: Three Kings, Northern, Central
Habitat: Intertidal, drift.
Characters: Robust, narrow, dichotomous branching; single collection.
Notes: Typically this species grows in open coast habitats in the upper subtidal.

HALYMENIALES
HALYMENIACEAE
Aeodes nitidissima J.Agardh
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031413; also collected from Urquarts Bay
Intertidal
Distribution: Three Kings, Northern
Habitat: Low intertidal and subtidal.
Characters: Large blade.

Glaphyrosiphon intestinalis (Harv.) Leister & W.A.Nelson
Otago Harbour: Te Ngaru intertidal, *Dalen & Nelson*, Oct 2009, A031139
Intertidal
Distribution: Central, Chatham, Southern
Habitat: Intertidal, on cobbles.
Characters: Tubular, infrequently branched, mucilaginous.
Notes: Formerly known as *Grateloupia intestinalis*.

PEYSSONNELIALES
PEYSSONNELIACEAE
Peyssonnelia sp.
Whangarei Harbour: Collected from Mair Bank
Subtidal; on shell
Habitat: Subtidal, on shell.
Characters: Red crust with white to grey, calcified lower surface.
Notes: *Peyssonnelia* is poorly understood in New Zealand and there are relatively few collections in herbaria.

PLOCAMIALES
PLOCAMIACEAE
Plocamiocolax sp.
Whangarei Harbour: Reotahi, *Nelson*, Nov 2009, A031387
Intertidal; on *Plocamium*
Habitat: Intertidal, epiphyte on *Plocamium*.
Characters: Minute, hemispherical; single collection.
Notes: A parasite restricted to the host *Plocamium*. Although infrequently collected these parasites are probably more common than currently recognised. This species has not been described.

Plocamium angustum (J.Agardh) Hook.f. & Harv.
Whangarei Harbour: McDonald Bank, *Crocker & Miller*, Apr 2010, A031096; also collected from Calliope Bank, Calliope Inner, Mair Bank
Subtidal; on shell
Distribution: Northern, Central, Chatham, Southern, Subantarctic
Habitat: Subtidal, on cobbles, rock and shell.
Characters: Slender, side branches in pairs.
Notes: New Zealand members of the genus *Plocamium* require taxonomic attention.

Plocamium cartilagineum (L.) P.S.Dixon
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031383; Otakou/Wellers intertidal, *Broom, Dalen & Nelson*, Oct 2009, A031382; Pulling Point, *Crocker & D'Archino*, Oct 2009, A031384; also collected from Opposite Wellers subtidal, Otakou/Wellers subtidal, Te Ngaru intertidal, Te Ngaru subtidal, Torpedo Boat Mole
Intertidal and subtidal; on rock
Distribution: Three Kings, Northern, Central, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock and cobbles.
Characters: Slender, side branches in alternating series of 3-4.

Plocamium cirrhosum (Turner) M.J.Wynne
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031386; McDonald Bank, *D'Archino & Miller*, Sep 2009, A031385; also collected from Manganese Point, Marsden Point Intertidal, Pirihi Road, Reotahi, Shell Cut Reach South (Tamaterau)
Intertidal and subtidal
Distribution: Three Kings, Northern, Central, Chatham, Southern, Subantarctic
Habitat: Intertidal and subtidal, on rock, cobbles, and drift.
Characters: Side branches in pairs, determinate branches with a serrated margin.
Notes: Formerly known as *P. costatum* (Adams 1994).

Plocamium sp.
Whangarei Harbour: Collected from McDonald Bank
Subtidal
Otago Harbour: Collected from Otakou/Wellers subtidal
Subtidal
Characters: Fragments, unable to be identified to species.

RHODYMENIALES
CHAMPIACEAE
Champia sp.
Otago Harbour: Collected from Te Ngaru subtidal
Subtidal
Habitat: Subtidal.
Characters: Fragmentary material, unable to be identified to species.

LOMENTARIACEAE
Lomentaria caespitosa (Harv.) V.J.Chapm.
Whangarei Harbour: Collected from Calliope Inner
Subtidal; epiphytic on *Sargassum*
Distribution: Northern, Central, Southern

Habitat: Subtidal, epiphytic on *Sargassum*.
Characters: Axes, terete, hollow, tufted, up to 3 cm high; single collection.

Lomentaria secunda (Hook.f. & Harv.) V.J.Chapm.
Otago Harbour: Otakou/Wellers intertidal, *Farr, Neill & Nelson*, Feb 2009, A031239
Intertidal; drift
Distribution: Northern, Central, Chatham
Habitat: Intertidal, drift.
Characters: Axes, terete, hollow, with secund branching, up to 2 cm high; single collection.

Lomentaria sp.
Whangarei Harbour: Marsden Point Subtidal, *Miller*, Oct 2009, A031206; Marsden Point Subtidal, *Crocker & Miller*, Apr 2010, A031202; McDonald Bank, *D'Archino & Miller*, Sep 2009, A031198; McDonald Bank, *Crocker & Miller*, Apr 2010, A031199; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031204; also collected from Calliope Inner
Subtidal
Habitat: Subtidal.
Characters: Material immature and unable to be identified to species.

RHODYMENIACEAE
Gloioderma saccatum (J.Agardh) Kylin
Otago Harbour: Pulling Point, *Crocker & D'Archino*, Oct 2009, A031133
Subtidal
Distribution: Northern, Central, Chatham, Southern
Habitat: Subtidal.
Characters: Dichotomously branched blade, frond in one plane; single collection.

Rhodymenia leptophylla J.Agardh
Whangarei Harbour: McDonald Bank, *D'Archino & Miller*, Sep 2009, A031215, A031220
Subtidal
Kaipara Harbour: Dredge Site 11, *Crocker, D'Archino & Miller*, Mar 2009, A031075; Dredge Site 19, *Crocker, D'Archino & Miller*, Mar 2009, A031076; also collected from Dredge Site 12, Dredge Site 13, Dredge Site 14, Dredge Site 15, Dredge Site 21, Dredge Site 26, Dredge Site 27
Subtidal; on scallop and *Atrina* shells, sponge
Distribution: Three Kings, Northern, Central
Habitat: Subtidal, on shell, sponge.
Characters: Blades with 1-2 dichotomies, arising from stolons.

Rhodymenia sp.
Whangarei Harbour: Calliope Bank, *Crocker & D'Archino*, Apr 2010, A031217; Calliope Inner, *Crocker & D'Archino*, Apr 2010, A031216; Marsden Point Subtidal, *Crocker & D'Archino*, Oct 2009, A031218; Marsden Point Subtidal, *Miller*, Oct 2009, A031219; Urquharts Bay subtidal, *Crocker & D'Archino*, Sep 2009, A031225; also collected from McDonald Bank, Snake Bank Inner
Subtidal; on *Atrina*
Habitat: Subtidal, on shell.
Characters: Fan shaped, arising from stolon, sterile and unable to be identified to species.