The role of biodiversity databases in coastal conservation and resource management

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Monalisa C. Palacio

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The laws of biology are written in the language of diversity.

- E. O. Wilson (1989: 243)

Abstract

Marine environmental resource managers and consultants require comprehensive, accurate and current data on the status of marine biodiversity in order to fully evaluate resource consent applications that involve development, impact or encroachment within the marine environment, and for identifying areas of coast appropriate for conservation. The role and efficacy of existing global, national and regional marine biodiversity databases in delivering these types of data are evaluated.

Consultation with environmental consultants revealed that none regularly, if ever used any existing marine biodiversity database during their routine consulting activities. Moreover, no existing biodiversity database had appropriate data-mining tools, although each was determined to provide information of value to resource managers and environmental consultants operating at national and regional scales; none was deemed to provide the sort of information required to manage marine resources at a local scale.

To achieve the objectives of this research programme, resource managers, data users and data compilers were consulted to determine their ideal data and database requirements. Existing biodiversity data sets that included New Zealand marine biodiversity then were searched or procured, and these data and that of a novel data set of species occurring at 296 intertidal and 25 fringe-saline (effectively freshwater) sites within and proximal to the Hauraki Gulf Marine Park (from Mimiwhangata Bay in the north to Tauranga Harbour in the south) were compared with species inventories from environmental consultants operating in this region.

Biodiversity data from the 296 saline, comprising presence/absence data for 713 taxa recorded from the survey region were analysed in detail. Significantly different species assemblages were identified amongst these 296 sites, five intertidal habitats being recognised, each with characteristic species assemblages: marine-hard shores, marine-soft shores, brackish-hard shores, brackish-soft shores, and mangrove shores. Species richness and diversity were consistently higher in marine habitats, and greatest on hard substrata. Most sites host unique assemblages of species.

A novel index of species richness is proposed, and although the spatial distribution of richness isn't particularly revealing, as obvious patterns in the distribution of richness are not apparent, this index has value in that the richness of any shore can

be compared and contrasted with that of others throughout the region. Augmenting this richness index is a novel index of species rarity. Based on the frequency of occurrence of taxa on shores throughout the survey region, very rare through to ubiquitous taxa are recognised to routinely occur on almost all shores, regardless of the total species richness. Moreover, very rare to uncommon taxa often comprise a disproportionately high percentage of the total species occurring on any given intertidal shore, in any habitat. Accordingly, alarm bells should ring for reviewers of resource consent applications wherein environmental consultants state that an area subject to development 'hosts no rare, unique or otherwise remarkable species or ecology.'

Two applications of these novel biodiversity data are demonstrated: the relationship between species richness and regional council consented activities is described, with a negative correlation reported for the intensity of disturbance (using the number of consented activities as a proxy for disturbance) and species richness on marine hard shores; and an appraisal of four selection criteria for marine reserves (naturalness, representativeness, uniqueness and complementarity), wherein the intertidal fauna and flora of no existing or proposed marine reserve appears to be natural, unique or representative, and effort seems to have been spent duplicating certain assemblages of species in reserve networks. The former is intuitively obvious, but the latter is alarming, and the ramifications of it far reaching in terms of conservation of the marine environment.

Protocols for conducting biodiversity surveys must be established and implemented to elevate the standards of environmental consultants, resulting value judgements on the composition of species, and the likely and actual effects of these developments on the marine environment to ensure that statements made in reports are based on current data rather than perceptions and client expectations. It is possible that resource consents have been issued based on spurious appraisals of the immediate and cumulative effect of discharge on the environment, or of the relative rarity (or appreciation of this) of species that occur within it. Prior to development of the novel *Monalisa* data set, no existing database or data set existed that provided the information routinely required by managers and consultants to make informed judgements that affect coastal development throughout the survey region.

Recommendations for additional research to build on findings detailed herein are made.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed:

Monalisa C. Palacio

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Introduction

Despite numerous expeditions and research programmes having been undertaken in New Zealand waters since the pioneering study of the Challenger expedition from 1872–1876, our knowledge of the marine flora and fauna throughout this region remains poor (Key 2002, Froude 1998). The most recent estimate of species richness in New Zealand waters is 22–23,000 species, although fewer than 12,000 of these have been formally identified (Arnold 2004). The vast size of the New Zealand EEZ, over 15 times its land area, with depths to ~9000 metres, is a major impediment towards achieving a complete knowledge of our marine biodiversity (Ministry for the Environment 2008).

Information is considered to be the key to efficient decision making (Parliamentary Commissioner for the Environment 1999). However, accessing relevant, meaningful and current information on the status of New Zealand marine biodiversity is challenging. Currently a diverse range of organisations (such as, but not limited to Crown Research Institutes (CRIs), universities, government ministries, museums, local and regional authorities, and environmental consultants) conduct research on or within the New Zealand marine environment (Ministry for the Environment 2008). Resulting data is as varied in quality as is the diversity of organisations collecting it. With the exception of biological data collected by CRIs, museums and regional councils, there is a tendency for this information to become scattered, and in the worst cases, effectively lost (responses from environmental consultants, herein). Establishing a robust open-access information base with useful data-analysis tools to capture these biodiversity data, and accommodate its varied quality, will vastly improve our knowledge and contribute towards more effective decisions being made for resource management (Ministry for the Environment 2005).

Marine research in New Zealand most recently has focused on understanding the physical, ecological and biological systems of the EEZ and coastal areas (Chapman and Lough 2003). Research initiatives in most cases are publicly funded, and despite a fully contestable funding environment, CRIs generally are most successful in securing funds, followed by universities, museums and environmental consultants (Chapman and Lough 2003).

Biodiversity data is more readily available on larger geographic scales, such as national or global (Costello and Berghe 2006). However, there is often insufficient information on biological assemblages at finer scales (Ministry of Fisheries and

Department of Conservation 2008, Smith 2004). As the coastal areas of New Zealand are becoming increasingly modified as a consequence of population growth and coastal development (Brake 2001), there is an urgent need to improve the quality of data available for managers operating at local, regional and national scales to make informed decisions that affect the rate, nature and extent of development or impact on the marine environment.

The marine environment around Auckland, throughout the Hauraki Gulf, has been extensively modified by development (residential and industrial), discharge, spoil and munitions disposal, pollution, fisheries, recreational activities, and waves of incursion of marine invasive species (Hayward et al. 1997). Although historical data would prove invaluable to document temporal trends, if any, in the distribution of biological diversity throughout this region, should these data exist they should not be taken as a representation of the current biodiversity occurring in a region. Consistent historical and baseline data do not exist for this region although it could be inferred from spatial patterns, experimental results and ecological first principles. Without these data, the effect that anthropogenic disturbances have had on biological diversity around Auckland cannot be quantified.

Although considerable biological data exist for the New Zealand marine fauna and flora, their often disparate and scattered nature, and lack of continuity between survey methodology, reporting and species identification standards does not lend itself to collation for inclusion in a database, or for interrogation to provide consistent and meaningful information. These biodiversity data are scattered in museum, council and CRI databases or collections, tied up in environmental impact reports and appraisals, scientific literature, university theses, and popular articles (Paterson 2000; Ministry for the Environment 2005; questionnaire results, herein). If all were to be incorporated in one common database, or in some way accessible to stewards, managers and policy makers, then this “one-stop data shop” (*sensu* Gordon 2000) would enable far-more-informed decisions to be made with regard to biodiversity management (*sensu* Ministry for the Environment 2005). However, these data cannot be simply uplifted from existing sources, or uncritically accepted as being a true representation of species diversity present at any given location, at any given time — particularly data sourced from environmental consultant reports, as these species inventories most often have been compiled for an area prior to impact (e.g., development, discharge).

A number of biodiversity databases exist that deal with New Zealand species at a global scale; the number of these progressively decreases from global to national,

then to regional scales. None is publicly available (or known) that operates at a local scale. Several additional biological datasets and databases exist in various government agencies and CRIs, however access to these is limited to those organisations (Ministry for the Environment 2008).

At a global scale, The Catalogue of Life, Tree of Life, and Integrated Taxonomic Information System (ITIS) databases deliver taxonomic, distributional, and checklist information on all taxa from all habitats, where data is available (Bisby et al. 2008, Maddison et al. 2007). FishBase holds information on fish species, including synonyms and common names, related data on taxonomy, biology, ecology, and occurrence (Froese and Pauly 2008). AlgaeBase provides a checklist, common names and distribution data on algae for all habitats and thus-far entered taxa, particularly seaweeds (Guiry et al. 2008). CephBase offers taxonomic, distribution and related information on some cephalopod taxa (Wood et al. 2008). Mammal Species of the World provides a taxonomic index with names, distribution, bibliographic references and museum data on cetaceans and other marine mammals (Wilson and Reeder 2005).

National and regional marine biodiversity databases deliver species checklists and classifications, and sometimes some information on the distribution of species. Databases available are those of the Ministry of Fisheries, National Institute of Water and Atmospheric Research Ltd (NIWA), Museum of New Zealand Te Papa Tongarewa (Te Papa), Auckland Regional Council (ARC), and Environment Waikato. Data available from Ocean Biogeographic Information System (OBIS) and New Zealand (NZ) Polychaeta are the same as that collected from various NIWA biological surveys conducted to meet requirements of specific research projects (Southwestern Pacific Regional OBIS Node New Zealand 2008). The National Aquatic Biodiversity Information System (NABIS) provides fish catch and trawl data maintained for fisheries management purposes (Ministry of Fisheries 2008). The Te Papa Mollusc database incorporates all currently entered, identified molluscan taxa in the collections of Te Papa (B. Marshall, pers com. 2008). The ARC coastal database warehouses data collected from its monitoring programmes and environmental assessments and management (S. Kelly, email communication, 2007), as does the Waikato coastal database (Waikato Coastal Database 2008).

Each of these databases has been developed for a specific purpose, and the data content and output are variable. Accuracy in species identification is also greatly variable among data-collecting practitioners (Hammond 1995). Global databases yield information appropriate for interpretation at a global scale (Alroy 2003); national

and regional databases need to be appropriately refined to address biodiversity trends and patterns occurring at lesser scales; local level conservation and resource management therefore require biodiversity data at an even finer, local scale.

In order to reach an informed judgement as to whether development could occur at any given site, simple questions that environmental consultants regularly ask are: what species are there; where else do they occur; how natural, unique or representative is this site relative to others, locally, regionally, and perhaps even nationally? The same questions obviously would be asked by those evaluating resource consent applications, or environmental consultant reports.

Are statements to the effect "The areas to be dredged do not contain species or ecology of special or unique value" (Kingett Mitchell & Associates Ltd 2001a) presenting an ill-informed appraisal of biodiversity, and as a consequence, is it possible that development is occurring within the marine environment without any real appreciation of the ramifications of same, or its sustainability? Without current baseline data we aren't even in a position to identify something as 'common.' Have we been operating in the dark?

The most appropriate and cost-efficient means of acquiring biodiversity data of relevance to resource managers for conservation purposes is to undertake intensive field work to acquire species lists on candidate sites (Balmford and Gaston 1999). Identifying species as baseline data on the marine environment and keying these data into biodiversity databases, are targeted by the current resources and research priorities from various government research programmes (Ministry for the Environment 2005; Ministry of Fisheries 2004).

The efficacy of existing marine biodiversity databases in management of coastal resources has not been earlier studied. Accordingly, the objectives of this thesis were to:

1. evaluate the quality of existing data;
2. determine whether existing databases reveal any temporal or geographic trend in diversity data;
3. evaluate the efficacy of existing databases for coastal resource management at various scales, but most important of these regional and local;
4. ascertain what managers, stakeholders and custodians of the marine environment require from a biodiversity database;

5. develop an appropriate set of biodiversity data and populate a prototype database (if required) to meet the specific requirements of ‘resource managers and data users’ operating at a local scale; and,

6. interrogate these novel data in the database to underscore the role of biodiversity databases as a tool to achieve informed conservation and management of marine biodiversity through practical application throughout the Auckland Region and Hauraki Gulf.

Methods

To meet the objectives of this research programme, a six-phase methodology was followed, although many aspects of this research were undertaken concurrently:

1. Consultation with 'resource managers, data users and data compilers,' to ascertain their prioritised data and database requirements.
2. Identification of existing data sources and procurement of data sets dealing with New Zealand marine biodiversity.
3. Evaluation of the quality of existing data, entailing scrutiny of: a) environmental consultant report biodiversity data; b) biodiversity data from existing databases; and c) spatial analysis of intertidal biodiversity data from existing databases and novel data sets collected in "*Monalisa*" surveys (see 4). Methods 4 and 5 were conducted first prior to spatial analysis.
4. Surveys of marine intertidal shores throughout the greater Hauraki Gulf Marine Park (referred to as *Monalisa* surveys), compiling comprehensive inventories of marine flora and fauna from a range of habitats representative of the region.
5. Development of a prototype biodiversity database to service the prioritised needs of 'resource managers, data users and data collectors.'
6. Evaluation of applications of novel biodiversity data for coastal biodiversity management throughout the Hauraki Gulf Marine Park.

Phase 1: Consultation

As the purpose of this research was to determine the efficacy of existing marine biodiversity databases for resource management at various spatial scales, but specifically at a local scale, local environmental consultancies (Auckland) that advertised their marine consulting services were identified using Yellow Pages. A sample of 10 consultants known to be well established in the environmental consulting industry was chosen, and a survey questionnaire was sent to each by mail.

The purpose of the questionnaire (copy in Appendix 1) was to determine whether any consultancy had access to any existing database/s that provided them with information on the species they would routinely encounter when undertaking marine consulting activities. Each respondent was asked what sort of biodiversity information

would be of greatest value to them in the event a novel biodiversity database was to be developed. Respondents were asked to tick what they would find useful from a list of features.

The questionnaire also aimed to identify what level of systematic expertise (identification skills) existed within their organisation, or was available to them through an external consultant, as the quality of species identification would directly influence any appraisal of sites biodiversity in the event they were subject to development, modification, discharge into, etc. Furthermore, the questionnaire intended to determine which of the environmental consultancies contacted were prepared to provide data for scrutiny and/or incorporation in this study.

Phase 2: Data search

The status of New Zealand coastal biodiversity and associated databases was first assessed by consulting with marine biologists in New Zealand and other countries, particularly those that are or were practising taxonomists, ecologists and/or experts on species databases and geographic information system applications. Nationally, personnel within the Department of Conservation, Auckland and Waikato Regional Councils, Environment Waikato, universities, CRIs and environmental consultancies were consulted (see Table 33 (Appendix 2) for contributors and persons consulted).

To identify online biodiversity data sources at local, regional, national and global levels, common searches of the internet were undertaken. For each identified database, search functions were evaluated; only those databases with search functions, and that delivered appropriate search results were used for subsequent analyses. Major national and regional databases and data sets secured for this study (Figure 1) include all data from Southwestern Pacific Regional Ocean Biogeographic Information System Node New Zealand (hereafter referred to as OBIS), Te Papa Mollusca database (hereafter referred to as 'Te Papa Mollusc', or 'Mollusc database,' with usage depending on context), and the ARC Coastal Environment database. The distribution of data from each of these was depicted at national, then regional or local scales (Figures 2–7), with that from this current research programme in Figure 8. Several additional databases incorporating New Zealand species proved to be specific to certain taxa, namely Global Invasive Species Database (GISD), Hexacorallians of the World, Fishbase, World Register of Marine Organisms (WoRMS), and the Mollusc database.

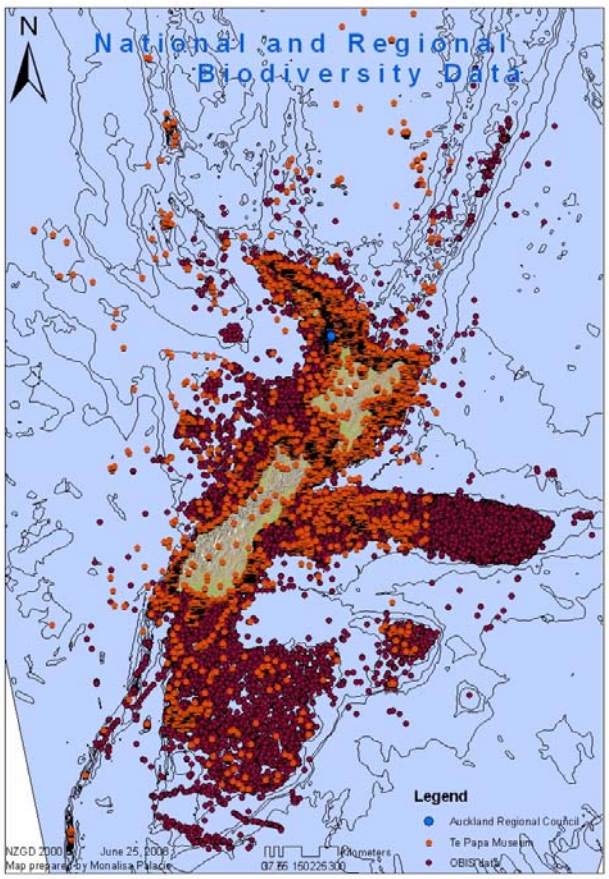

Figure 1: All databases, New Zealand Region

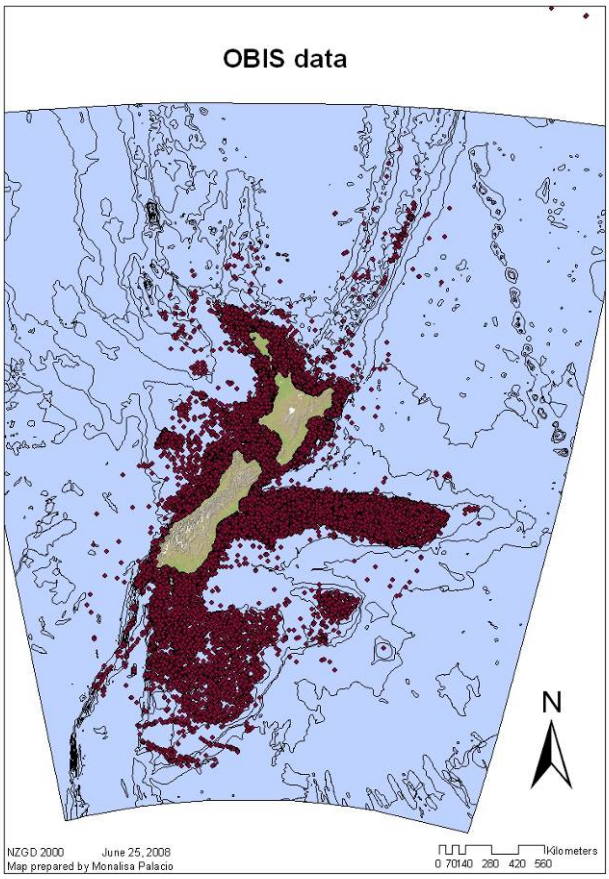

Figure 2: OBIS database, New Zealand Region

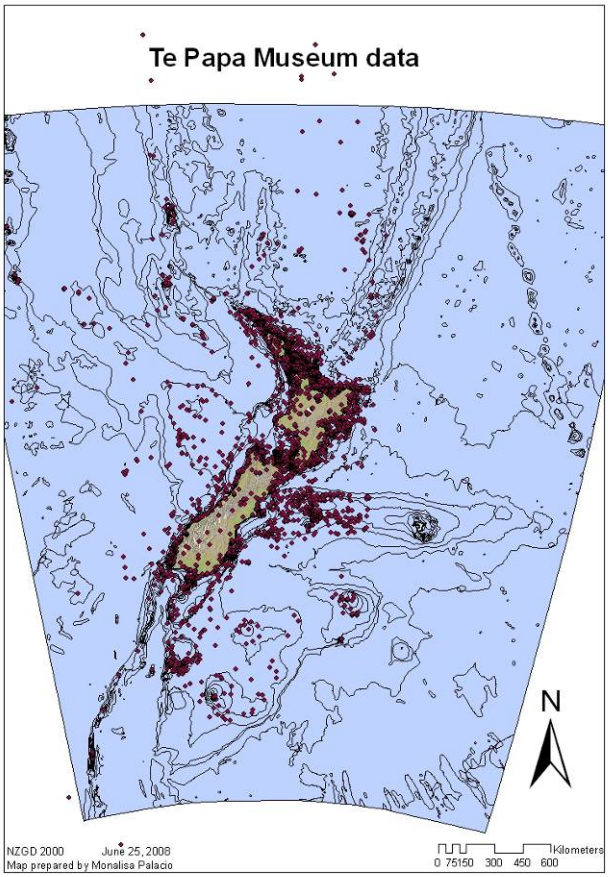

Figure 3: Te Papa Mollusc database, New Zealand Region

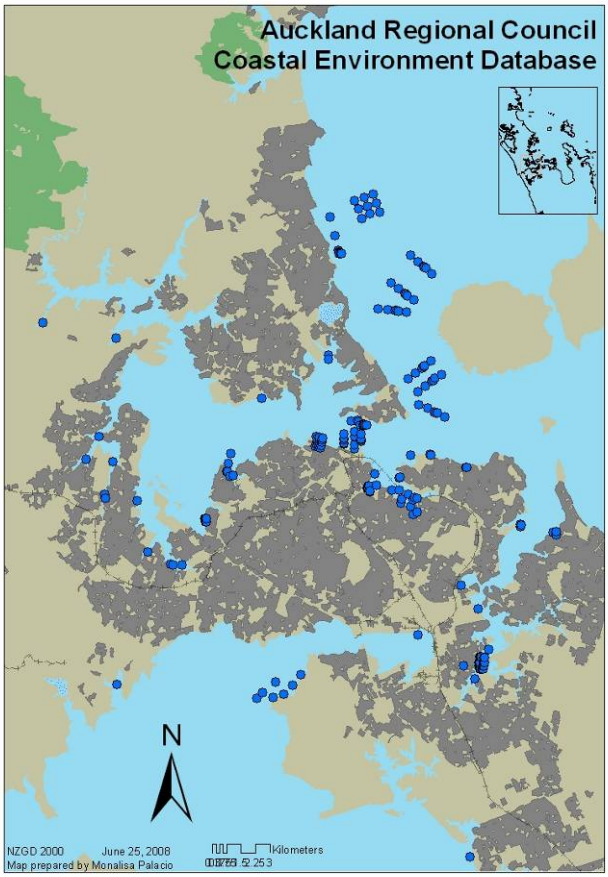

Figure 4: ARC Coastal environment database

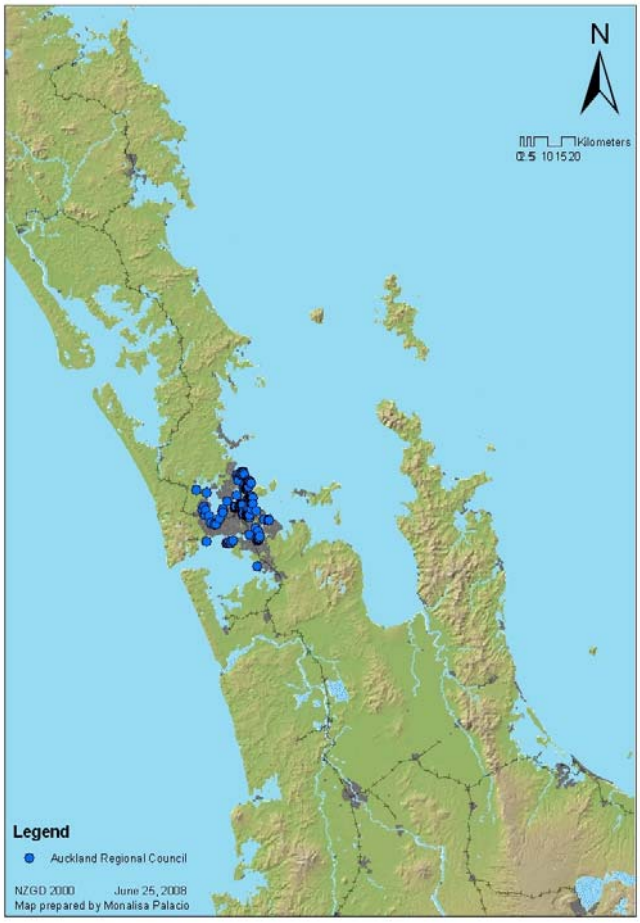

Figure 5: ARC Coastal data, regional scale

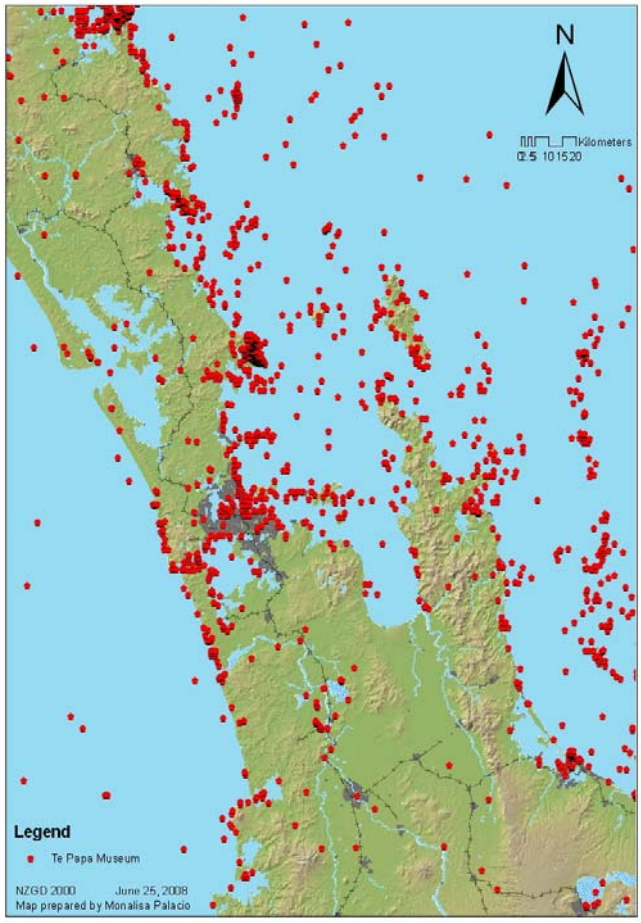

Figure 6: Mollusc data, regional scale

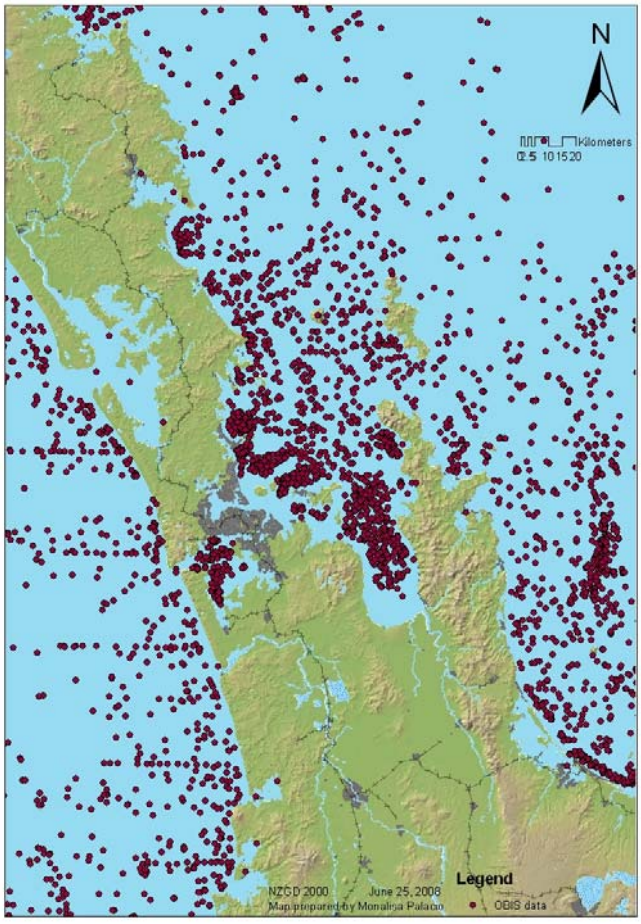

Figure 7: OBIS data, regional scale

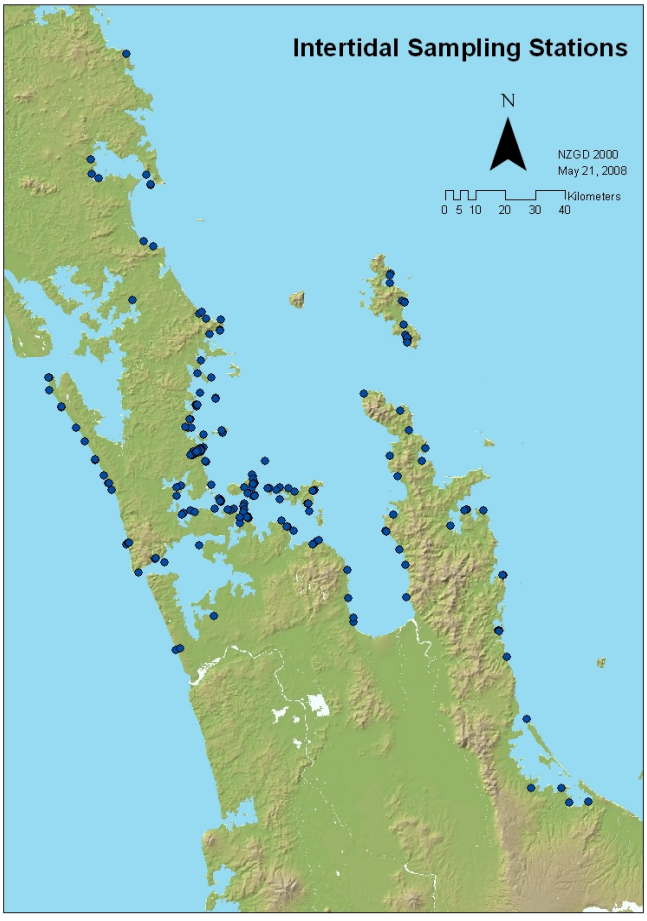

Figure 8: Novel data (herein), regional scale

Phase 3: Data evaluation

Copies of marine biodiversity datasets were secured from database custodians where appropriate and available in Phase 2. Both the online and database accessibility and data quality of each were critiqued. Data format then were standardised, and relevant biological and conservation information integrated into a common Microsoft Access database, augmented with data from a selection of peer-reviewed scientific publications and reports (list provided on page 126, Reference III).

Publicly available databases were interrogated to determine their value to environmental consultants, in accordance with their (Phase 1) prioritised requirements. Should no one database, or the combined, aforementioned three databases (OBIS, Mollusc and ARC), be deemed to serve the needs of consultants, or deliver sufficient or appropriate biological information from searches, then a novel biodiversity database would need to be developed. Moreover, should the quality of output from any search or series of searches on these databases prove insufficiently comprehensive for local-scale coastal biodiversity management, a novel data set also would have to be assembled to populate this new database.

Exactly what constitutes 'sufficient or appropriate biological information', or 'sufficiently comprehensive' data really cannot be defined. However, when interrogated should any database deliver information for less than (a nominal value of) 50% of taxa encountered on any shore then it could be deemed to be inadequate; should it provide data for more than 75% of taxa from any shore then it would certainly be deemed to be more appropriate. These were the same criteria applied on determining the database value of the biodiversity datasets secured for this research.

Existing database interrogation using environmental consultant data

The relative value of existing, publicly available databases to environmental consultants working at a local scale (Auckland) was assessed by comparing presence and absence of species from species checklists taken from three environmental consultant reports (Tonkin & Taylor Ltd 2003, Bioresearches 2004, 2005) with existing global, national and regional biodiversity databases, and with that developed for this thesis (referred to as *Monalisa*) (Tables 11; 34–40, Appendix 2).

The occurrence of each species in each of the three aforementioned checklists was queried on each database by separately typing in each species name and conducting numerous searches. The relative value of each database was appraised by tallying

the total number of presence records (ticks) against the total number of species from each checklist.

Another method of conducting a species search on databases with online interface is through a search by distribution rather than a search by species. However, entirely different results were acquired on databases like Catalogue of Life and World Register of Marine Organisms (Appendix 4). For example, a search by distribution can be done by typing in “New Zealand,” with the expected output from the data source being a species list of New Zealand species. Invariably the resulting species lists were considerably shorter with incomplete species. The species originally searched for often was not even included in the search output. Alternatively, more species are delivered from these databases when a search by species is employed. The search by species method was therefore used for database interrogation.

Only those databases with species search functions were used for analysis, with several interim databases covering specific taxa included to demonstrate the extent to which New Zealand species are represented in specialised data sources (GISD, Hexacorallians of the World, Fishbase, and Mollusc database).

Existing database interrogation using Monalisa data

Although a six-phase approach was adopted for this research, time constraints necessitated phases 3–6 being undertaken concurrently. Thus, the methodology is interconnected between these phases.

Each existing database was interrogated with data sourced from four *Monalisa* surveys (relatively low, medium and high diversity sites throughout the survey region) (see Phase 6) to determine the relative value of each when comparing with primary data only (Tables 11; 37–40, Appendix 2). Queries were issued using the *Monalisa* survey checklists, with each species name being typed into the search function of each database. The occurrence of species in a database was similarly recorded by a tick (presence) or cross (absence), with the relative value of each database appraised by tallying the total number of presence records against the total number of species from each *Monalisa* checklist.

Interrogation by spatial analysis

Intertidal survey sites in all existing databases (OBIS, Mollusca, and ARC) occurring within a two kilometre radius of any of the 321 intertidal survey sites reported herein (Phase 4) were identified. The total number of sites in the database, and total

numbers and identities of species recorded from those sites were matched with species lists from *Monalisa* sites (Figures 10, 13, 16), after each species list had been standardised for nomenclatural continuity (correcting for synonyms). The presence or absence of each species in each dataset was tabulated and analysed using Bray Curtis similarities in Primer. The assumption was that similar species must be found within the same intertidal sites regardless of the data source. A simple ANOSIM test was used to determine whether any significant difference existed in the ability of any database, and all databases combined, to predict assemblages of species at any site, by comparing community structure with that determined from *Monalisa* surveys (Phase 4).

Phase 4: New surveys

This phase entailed collection of novel biodiversity data to characterise the current assemblages of species throughout the greater Hauraki Gulf Marine Park.

To quantify, qualify and report on the diversity, distribution and composition of intertidal marine communities throughout this region, intertidal flora and fauna was determined from exhaustive searches for species at each of 321 sites in accordance with Tables 41–46 (Appendix 2), and Figures 8, 19, 20, 32–36, and 69–71 (Appendix 3).

Sites were first selected following examination of aerial photographs and geological and hydrographic maps, and literature accounts of previous research in the region, taking into consideration other factors such as shore type (soft or hard), salinity gradient (marine, brackish or freshwater), geology (substratum type) and geography (e.g., proximity to urban development, aspect, fetch, exposure, mainland or island) to ensure that a representative range of habitats and locations were surveyed. Final site selection depended on reconnaissance and accessibility of sites (vehicular, pedestrian or small-boat).

Whenever possible, surveys were undertaken immediately prior to, at, or following extreme low water, on tides of 0.3 m or less. This limited sampling to approximately one week per month, and depending on the season (day length) to as many as 12 sites per day in high-tidal mangrove stands within the Okura River system, but usually considerably less (1–3 sites) on relatively complex rocky shores or beaches. Not more than one soft-shore was surveyed per day, although numerous sites (replicates) could be surveyed within it. As final survey locations on any date depended upon wind and sea conditions, a more prescribed, pre-determined

sampling programme that involved surveying specific shores at specific locations on specific dates could not be implemented. Whenever the intention was to survey multiple sites on a given tidal cycle, sites were chosen to be within 15 minutes transit time by vehicle or boat, with one site surveyed prior to and one immediately following low water. In the former case, surveys commenced in the upper shore and worked towards low water with the receding tide; in the latter case, surveys commenced at low water and progressed up the shore with the advancing tide.

Two persons undertook all sampling and species identification (Monalisa Palacio and Steve O'Shea), and as such all surveying methodology and biodiversity data are consistent. Sampling was conducted in a manner that was minimally disruptive to the intertidal environment, species and substratum, with a minimum of species and specimens (potentially problematic or difficult to identify) being removed from any shore for the purposes of subsequent (laboratory) identification. GPS coordinates were recorded from each surveyed site, and representative high-resolution digital photographs were taken of major habitat types, and otherwise unusual species or their assemblages.

Species exceeding a maximum dimension of 2 mm are included in these biodiversity inventories. Where appropriate, small-bodied invertebrates (<5 mm) retained from surveys were identified using a combination of stereo and compound light microscopy. A voucher set of all identified taxa has been accessioned into the biological collections at AUT. For some taxa a general dearth of systematic information or time precluded identification to species, or higher systematic level, particularly for some Polychaeta, Arthropoda, and less-common or poorly known groups; in such instances, taxa have been identified to the lowest practical level, either species, or for poorly known or generally small-bodied groups, such as Amphipoda, Nemertea, Bryozoa, Ascidiacea and Porifera, in some instances to the level of Class or Phylum.

Marine and brackish sites

Marine sites as treated herein are those under fully saline tidal influence throughout the tidal cycle, not being exposed to any freshwater discharge such as a stream, river or stormwater drain. Brackish sites as treated herein are those areas with variable salinity throughout a tidal cycle, directly influenced by freshwater, whether this be by river, stream or stormwater discharge.

For the sake of this research programme, sites were secondarily characterised by substratum, whether hard or soft, for which the survey methodologies are detailed below.

Hard shore surveys

For some shores a transect was run from high to low tidal levels through the intertidal platform at a place deemed representative of the overall shore. Twenty metres either side of this transect all macro-flora or -fauna were identified to the lowest practical taxonomic level during 15–120 minute surveys. For other shores, usually in enclosed or defined bays or mangrove habitats, a search was made over an expanse of shore not more than 40 metres in horizontal extent. A survey was considered complete following an exhaustive examination of all obvious habitat types within the transect or defined stretch of coast when no additional species were encountered after 10 minutes of searching. The time taken for each survey usually depended on the habitat complexity of any shore, as muddy habitats with limited hard structure took considerably less time to document macro-faunal and –floral composition than, for example, the more structured boulder platforms or platform reefs.

Hard substrata recognised from marine shore field surveys included boulders, rocky reef, platform reef and cobbles, and the likes of trees, logs, pipes, pilings, plastics and other extraneous debris. In addition to the exposed intertidal surfaces of a rocky shore, other habitats surveyed included the undersides of rocks, ledges, supra- and sublittoral fringes, and rock-pools. Habitats on platform reefs typically comprised of sand- or mudstone were also studied. Portions of substratum were broken to collect or identify representative infaunal or boring/burrowing species.

For the shores of North Head, Eastern Beach and Kohimarama Beach, replicate quadrats of 1 m^2 were haphazardly placed amongst major sessile zone-forming species, such as oysters and barnacles, to obtain quantitative data on species abundance and/or percentage cover. Permanent quadrats also were established at these shores by first drilling, then cementing two masonry-bolts into the rock, delimiting both upper left and right corners of quadrats. This will be used for monitoring and future studies. Drilling into bedrock below the ‘oyster’ zone (e.g., *Hormosira* or *Corallina* zones, and the sublittoral fringe) proved destructive as far as encrusting species were concerned, in addition to the moisture content of the turfing mat rendering it impractical to drill, plug, cement and, most important, relocate (following overgrowth) quadrat markers (given the frequent $\pm$ 5 m accuracy of GPS signals); permanent quadrats in these zones were not established.

Soft shore surveys

A transect was run from high to low tidal levels at a place deemed representative of the overall shore; for longer shores (e.g., Eastern Beach, Cheltenham Beach) several (to 5) transects were established extending from high to low water. Major in- and epifaunal and floral species along each transect were identified by way of core samples (three to five replicates), with the number of sites surveyed down any transect depending on the width of the intertidal platform. For each soft shore a qualitative 15-minute survey was then undertaken to compile an inventory of less-common macro-flora and -fauna.

Soft substrata were mostly classified as mud or sand, however an admixture of two, sand/mud, was also encountered. Mangrove sites occurred in muddy habitat, usually on enclosed shores, but not necessarily brackish shores.

The 321 sites, classified by major habitat type, were surveyed on months in accordance with Table 1. There is no intended temporal bias in sampling from north to south (or vice versa), east to west (or vice versa), by habitat, or for surveying offshore islands, although certain habitat types have been surveyed more intensively during some months than others, and no sampling could be undertaken in the month of December (with the most appropriate tides falling on or immediately around Christmas day). Major habitat types surveyed include those characterised by: 1) salinity, 2) substratum type, and 3) habitat type in accordance with Tables 2–4.

Phase 5: Novel database development

Data management and development of a novel biodiversity database

Biodiversity data were assembled in a relational database using Microsoft Access. This database is referred to hereafter as the *Monalisa* Biodiversity Database, or *Monalisa* for short. Initially this database was designed with normalised tables wherein no data were repeating; however some denormalisation or repeating of data in selected table fields was found to be necessary after consideration of query performance requirements. Species and any other related data obtained from field surveys and secondary sources were standardised (integrated into a common Access database with standardised fields in appropriate tables), centrally linked through the 'SpeciesAll' table (see Figure 22 for database structure, and Table 47 (Appendix 2) for explanation of tables and fields description).

Table 1: Habitats surveyed by month (2006–2008)

	Mangrove	Brackish (soft)	Marine (soft)	Brackish (hard)	Marine (hard)	Fringe-saline	TOTALS
Jan	0	0	0	0	2	6	**8**
Feb	0	23	0	0	6	2	**31**
Mar	5	19	1	1	9	8	**43**
Apr	0	1	49	0	8	0	**58**
May	2	3	0	0	4	0	**9**
Jun	0	1	1	0	6	1	**9**
Jul	3	0	1	0	7	0	**9**
Aug	1	1	14	0	2	1	**19**
Sep	32	1	2	36	11	1	**83**
Oct	7	1	1	1	13	1	**24**
Nov	6	3	1	2	11	5	**28**
Dec	0	0	0	0	0	0	**0**
TOTALS	**56**	**53**	**70**	**40**	**77**	**25**	**321**

Table 2: Salinity and sampling effort

Habitat	No. of sites
brackish	146
fringe saline	25
marine	150

Table 3: Substratum type and sampling effort

	Mangrove, Brackish (soft), Marine (soft)	Brackish (hard), Marine (hard)	Fringe-saline
# Sites	**179**	**117**	**25**

Table 4: Intertidal habitats and sampling effort

	Mangrove	Brackish (soft)	Marine (soft)	Brackish (hard)	Marine (hard)	Fringe-saline	
# Sites	**56**	**53**	**70**	**40**	**77**	**25**	**Σ = 321**
					Σ = 296		

Biodiversity data

Biodiversity data used in *Monalisa* include species names, common names, synonyms, species distribution and abundance, and other relevant or associated biological data.

Monalisa has been populated with data from both primary and secondary sources. Primary data were collected from intensive biodiversity surveys conducted for this research (Phase 4). Secondary data were collected from selected global, national, regional and local data sources (Phase 2).

Phase 6: Novel database interrogation

Distribution drivers of the intertidal communities

Based on the frequency of occurrence of species in each salinity regime, brackish or marine, or hard or soft substratum, the percent variation in total composition associated to each category was computed to determine which factor has greater influence on the distribution of the intertidal communities encountered during surveys. This factor was treated first in analyses of species communities.

Statistical community analyses

Data analyses were restricted to 296 sites out of the 321 survey sites (see page 44 of Results section of Phase 4).

Community analyses were conducted to examine the similarity in species composition between survey sites.

Species were recorded according to presence-absence from each surveyed sampling site. A resemblance measure of species composition on different locations using Bray Curtis similarity was computed for all 296 sites. The resemblance matrix

was then analysed in PRIMER software using hierarchical agglomerative group average clustering, and non-metric multidimensional scaling (MDS) displaying 2D and 3D scatter plots. Resulting plots were interpreted applying common factors observed and recorded on samples during survey, such as salinity, substratum, combination of two and types of hard and soft substrata. Initially, the clusters and MDS plots produced were examined according to the factor computed to have greater influence in the distribution of species. Decisions as whether to accept or reject the observed species groupings looking into different factors, was done with application of ecological concepts on the aquatic habitat and its species inhabitants. Having this in mind, one-way analysis of similarities (ANOSIM) was conducted on the resemblance matrix to compute for the significance level and validate whether or not significant differences existed within apparent species groupings. When species groupings are found to be significantly different, those species that contribute to the characterisation of that group were determined using similarity percentages (SIMPER).

Ordination and usage of biodiversity measures

Two analyses were undertaken: 1) to determine whether any biodiversity 'hot spots' occurred throughout the surveyed region, or whether any trend in diversity (as indexed by species richness) was apparent; and 2) to determine whether any spatial trends are apparent in the relative contribution of very rare through to ubiquitous species between surveyed sites.

1) Rarity index

A rarity index is proposed for each habitat type based on the tally of the number of occurrences of each species in the total number of surveyed sites, across all habitats. As this rarity index is determined using the entire data set from all *Monalisa* sites in all habitats, and it is possible for one species to occur in more than one habitat, it is equally possible that a single species could have different rarity scores in different habitats (a rare species on a marine hard shore could, for instance, be a common species on a brackish soft shore). A summary of the ordination of a 7-point rarity index is presented in Table 5; rarity values for species found in each intertidal habitat type are presented in Table 48 (Appendix 2). For instance, should one species occur at 3 of 296 surveyed sites, then it would be categorised as a *very rare* species throughout the surveyed region (3 being ~1% of 296), although this is not considered meaningful, given unequal surveying intensity in different habitat types.

An index of a species rarity herein is determined to be a function of the number of occurrences of a taxon as a function of the number of sites surveyed within a particular habitat in accordance with Table 4; thus, if a species occurred at 3 sites in mangrove habitat, within which 56 separate surveys were undertaken, then this species would be deemed to be *rare*, at least within mangrove habitat (3 being 5.5% of 56).

In accordance with the 7-point rarity ordination, the relative contribution of these 7 rarity classes (very rare to ubiquitous) to the total species assemblage at each surveyed site within each habitat is presented in Figures 49–53.

2) Index of species richness

The maximum and minimum number of species (species richness) encountered on shores vary within a certain habitat type (Results). Therefore this newly proposed 7-point ordination of species richness must rank the richness of a given site relative to comparable sites, particularly the maximum count of species recorded for a particular habitat type (Table 6). The ranking of a site as one of very low to very high richness is a function of the sites total species count divided by the maximum number of species identified from a given habitat type. For instance, should the maximum number of species identified from any one surveyed mangrove site be 25, and the total species count at another mangrove site was 2, then the latter site would would be of relatively low species richness (2 being 8% of 25).

Table 5: Ordination of rarity index using a 7-point scale of species occurrences in 296 intertidal sampling sites

Occurrence (%)	**Rarity Index**
< 5	very rare
5–10	rare
11–25	uncommon
26–50	frequent
51–75	common
76–95	very common
96–100	ubiquitous

i.e. occurring at ≥ 96% of survey sites within a habitat type

To determine whether any geographic trend was apparent in the distribution of species richness within habitats throughout the survey region, the spatial distribution of species richness by habitat type is depicted in Figures 54–58.

Table 6: Ordination of Species Richness index using a 7-point scale for all intertidal habitat types

Species richness (%)	Richness index
<5	very low species richness
5–10	low species richness
11–25	fairly low species richness
26–50	medium species richness
51–75	fairly high species richness
76–95	high species richness
96–100	very high species richness

i.e. ≥ 96% of the species richness rank within a habitat type

Biodiversity data applications

Other than the obvious application of these biodiversity data in determining the current distribution of any taxon throughout the survey region, taxon habitat specificity, the relative contribution of very rare to ubiquitous species at any given site, or an appraisal of the species richness of any site relative to similar habitats throughout the survey region, these data can be applied in a number of different ways. Two potential applications of this *Monalisa* Biodiversity database are: 1) development of an index of site 'naturalness'; and 2) an appraisal of the effectiveness of currently advocated selection criteria for marine protected area for current marine reserves throughout the survey region.

The relationship between site naturalness and species richness

Information about locations, dates of approval and type of resource consents applied for were sourced from Auckland Regional Council and Environment Waikato. A subset of these data, the frequency of consented discharges into the marine environment, compared with species richness within a 2 km radius from these point-source discharges (Figure 63) provides an indication of the relationship between frequency of disturbance, herein proposed as an index of site naturalness, and species richness. It is assumed that the greater the numbers of such disturbances

within range of study sites, the greater the likelihood that a site will be less natural. The correlation between species richness of any *Monalisa* site and the number of consents issued within a 2 km radius of these sites, is investigated for hard shores only, being the most diverse and species rich sites.

Appraisal of selection criteria for marine reserves

Naturalness, representativeness, uniqueness and complementarity are frequently advocated selection criteria used for identifying networks of marine reserves (Ministry of Fisheries and Department of Conservation 2008; Ballantine and Langlois 2007; ANZECC TFMPA 1998). Measures of each criterion are proposed and analysed using species richness data from *Monalisa* surveys, comparing and contrasting biodiversity within marine reserves to that outside marine reserves (Figures 64–67) to determine whether these same criteria apply to existing marine reserves throughout the greater Auckland region.

Results

Phase 1: Consultation

Questionnnaires

Responses from eight of ten environmental consultants approached were received. Two of the respondents indicated their availability for a follow-up interview, during which time they discussed their current research procedure and questionnaire responses (Table 7).

Table 7: Summary of consultation with participants

Targeted participants	10
Returned questionnaires	8
Participants that recognised the value of marine biodiversity databases	8
Participants that provided data	2

Responses to the questionnaires (Table 8) revealed the key role taxonomy plays in conducting research within the aquatic environment, whether in-house or contracted expertise was used to ensure taxonomic accuracy and continuity in species inventories. Without an appreciation of what species occur in a given environment there is no reliable way to determine what the likely effects of development or discharge into that environment will be, or any means to determine these effects in monitoring surveys despite of the generalities drawn from past research and monitoring which focused on physical parameters.

All respondents recognised the value of biodiversity data and biodiversity databases, yet questionnaires and follow up interviews revealed that biodiversity data collected by environmental consultants often were scattered in hard-copy reports, and that none of the consultants actually or routinely used any existing biodiversity database in their consulting activities. A synopsis of environmental consultants' prioritised requirements for a biodiversity database is presented in Table 9.

Consultants also identified that as data was not owned by them, and because they were bound by confidentiality agreements with clients (that have paid for data collection), they could not automatically distribute these potentially commercially sensitive biodiversity data. Nevertheless, both the consultants that were interviewed

at Tonkin & Taylor Ltd and Bioresearches Ltd, volunteered biodiversity data for comparison/inclusion in this research; the following three (of five furnished) were critiqued for the purposes of this thesis:

Bioresearches 2004. Appraisal of stormwater effects on marine intertidal habitat. A draft report prepared for the New Zealand Sugar Company Limited, May 2004.

Bioresearches 2005. *Benthic Invertebrate Data from the proposed Wairoa Canal Housing project*.

Tonkin and Taylor Ltd 2003. *Kohimarama Beach Seawall Protection Project Assessment of Environmental Effects*. A report prepared for Auckland City Council, March 2003.

Although the purpose of consultation was to obtain biodiversity data from environmental consultants working at a local scale, one report (and species inventory) furnished for the sake of data interrogation was from Wairoa, Hawke Bay — a region well outside of that surveyed for the purposes of this thesis (the Hauraki Gulf Marine Park).

Table 8: Synopsis of questionnaire results

	Parameter	Results
1	Extent of research within aquatic environments dealing with species identification	• Seven of eight organisations undertake biodiversity surveys in New Zealand aquatic environments (fresh, estuarine, marine)
2	Taxonomic resources available to environmental consultancies	• Two of eight organisations employ in-house expert for species identification • Three of eight organisations employ subcontractor(s) for species identification • Three of eight employ both
3	Trends in archiving data on New Zealand marine biodiversity	• Five of eight organisations kept/used data archives • Three of eight organisations did not keep/use data archives
4	Commonly used archive format among environmental consultancies	• One of four organisations archived data using paper files • Three of four organisations archived data using combinations of paper files, computer files and database

Table 9: Prioritised requirements of environmental consultants in a marine biodiversity database (1= highest, 5 = lowest)

	Information criteria
1	• Generate reports on specific areas and species occurrences • Generate species distribution maps • Search functions using names (scientific names, common names) • Search functions using distribution data • Find useful references on New Zealand marine species and related topics
2	• Generate reports on species checklist • Generate reports on species and associated environmental issues or disturbances • Find ecological data
3	• Find taxonomic data • Find biological data
4	• Find species images • Locate experts in species identification or ecology
5	• Add data into the database

Phase 2: Data search

Although marine biodiversity databases do exist, they have inconsistent formats, and the level to which species have been identified is variable. Databases and data sources as identified during Phase 2 of this research programme are detailed in Table 10.

Phase 3: Data evaluation

Existing database interrogation using environmental consultant data

The extent to which existing biodiversity databases contain meaningful information on the distribution and/or occurrence of species identified in the three reports furnished by the two environmental consultancies, was evaluated. All taxa in each species list from the three locations from which data were available, Chelsea and Kohimarama (Waitemata Harbour), and Wairoa (Hawke Bay), were searched for on existing biodiversity databases. Full results of this evaluation are presented in Tables 34–36 (Appendix 2).

Table 10: Selected data sources encompassing New Zealand marine biodiversity

	Database name	Data content	Taxa	Public access
Global	Catalogue of Life	species checklist, synonymies, classification, distribution	all taxa (8 kingdoms)	yes
	Integrated Taxonomic Information System (ITIS)	species checklist, synonymies, classification, distribution	all taxa (5 kingdoms)	yes
	World Register of Marine Species (WoRMS)	species checklist, synonymies, classification, distribution	marine organisms	yes
	Global Invasive Species Database (GISD)	species checklist, synonymies, distribution, species information & management	invasive species	yes
	FishBase	species checklist, synonymies, classification, distribution, species information, maps	fish	yes
	Hexacorallians of the World	species checklist, synonymies, classification, distribution, species information, maps	sea anemones, corals and allies	yes
	Australian Faunal Directory (AFD)	species checklist, classification, distribution, species information, maps	all animal groups	yes
National	Southwestern Pacific Regional OBIS Node New Zealand	species checklist, classification, distribution, survey details, maps	marine organisms	yes
	National Aquatic Biodiversity Information System (NABIS)	spatial information and fisheries management	marine organisms	yes
	New Zealand Polychaeta (NZ Polychaeta)	species checklist, classification and distribution	polychaetes	yes
	Te Papa Mollusc database	species checklist, classification and distribution	molluscs	soon
	Checklist of the Recent Mollusca described from New Zealand EEZ	species checklist, classification and distribution	molluscs	yes
Regional	ARC Coastal Environment Database	species checklist, distribution, survey details	coastal species	limited
	Waikato Coastal Database	list of references to coastal species reports	not applicable	yes

For each analysis, *Monalisa* consistently outperforms other databases, in that it contains a greater number of species cited in consultant reports than any other database — including the data set from Wairoa, Hawke Bay.

Existing database interrogation using Monalisa data

Species checklists collected from four of the 296 saline *Monalisa* surveys that are representative of low, medium and very high diversity sites were also scrutinised applying the same methods as those applied to the aforementioned environmental consultant data. Results are detailed in Tables 37–40 (Appendix 2). Again, for each analysis, *Monalisa* outperforms all other databases, in that it contains a greater amount of information on species identified in Hauraki Gulf than any other.

A synopsis of these results (Tables 34–40) comparing the information content within each of these databases when interrogated using different data sets (species checklists) is presented in Table 11.

When all existing data sets within existing databases (OBIS, Mollusca and ARC) are combined and treated as a single data source, then interrogated with the seven aforementioned species checklists (Table 12), their combined information results in a significantly improved return on individual species searches, although the number of species for which information is available generally decreases when dealing with biodiversity data obtained during *Monalisa* surveys.

Table 11: Synopsis of database and species list interrogations (from Tables 34–40, Appendix 2).

				Global				National		Regional	
Table No.	Data source	Survey location	Species count	Catalogue of Life	WoRMS	GISD	Hexacorals	OBIS	Mollusc database	ARC Coastal Database	*Monalisa*
34	Bioresearches	Chelsea	34	38%	38%	3%	6%	65%	26%	35%	97%
35	Tonkin & Taylor	Kohimarama Beach	68	47%	53%	1%	1%	59%	18%	69%	93%
36	Bioresearches	Wairoa	38	68%	68%	0%	0%	42%	16%	82%	87%
37	*Monalisa*	Mechanics Bay	58	31%	33%	2%	2%	41%	34%	24%	100%
38	*Monalisa*	Kohimarama Beach	82	35%	38%	4%	24%	59%	29%	35%	100%
39	*Monalisa*	Wenderholm Beach	85	24%	33%	2%	2%	55%	33%	25%	100%
40	*Monalisa*	Home Bay (Motutapu)	179	34%	42%	0.60%	2%	23%	24%	18%	100%

Table 12: Synopsis of all databases combined and species list interrogations.

	List 1 (Chelsea)	List 2 (Kohimarama)	List 3 (Wairoa)	List 4 (Mechanics Bay)	List 5 (Kohimarama)	List 6 (Wenderholm)	List 7 (Home Bay)
All databases	88%	96%	100%	86%	93%	85%	79%
Monalisa	97%	93%	87%	100%	100%	100%	100%

Interrogation by spatial analysis

Those *Monalisa* survey sites falling within a 2 km radius of intertidal OBIS sites (Figure 9) are depicted in Figure 10. Sites in common to these two data sources fall in five habitat classes herein recognised (Table 4), but occur mainly on marine hard shores, with those of a fringe-saline (effectively freshwater) nature being the most poorly represented of all. In total, species inventories from 45 (OBIS) and 42 (*Monalisa*) sites could be directly compared (Table 13).

Table 13: Biodiversity data and numbers of intertidal sites common to national and regional biodiversity databases within a 2 km radius of *Monalisa* sites.

	National				**Regional**		**Summary**	
	OBIS	***Monalisa***	**Te Papa**	***Monalisa***	**ARC**	***Monalisa***	**Secondary data sources**	***Monalisa***
Total No. of sites	45	42	183	196	37	43	265	224
Total No. of species	224	493	343	266	178	281	659	598
No. of species in common to data sources	33		115		67		192	
No. of species unique to data sources	177	460	228	151	111	214	467	406

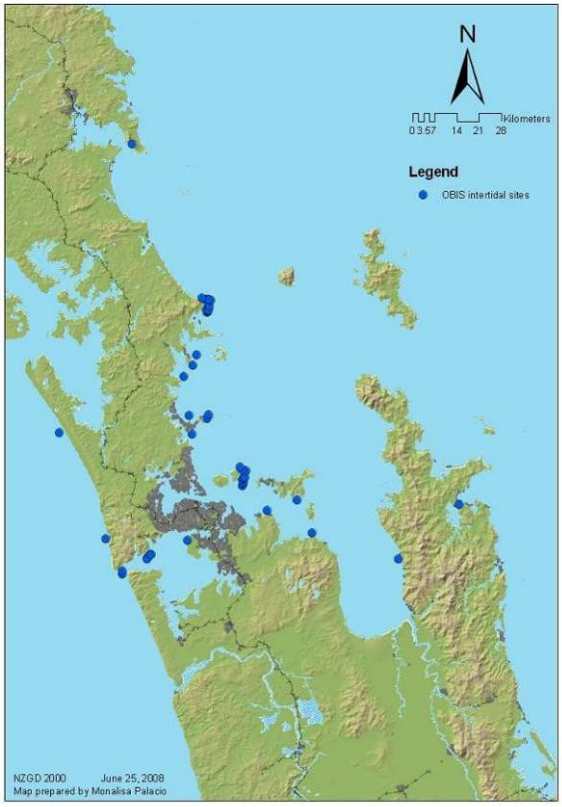

Figure 9: Plot of OBIS intertidal sites

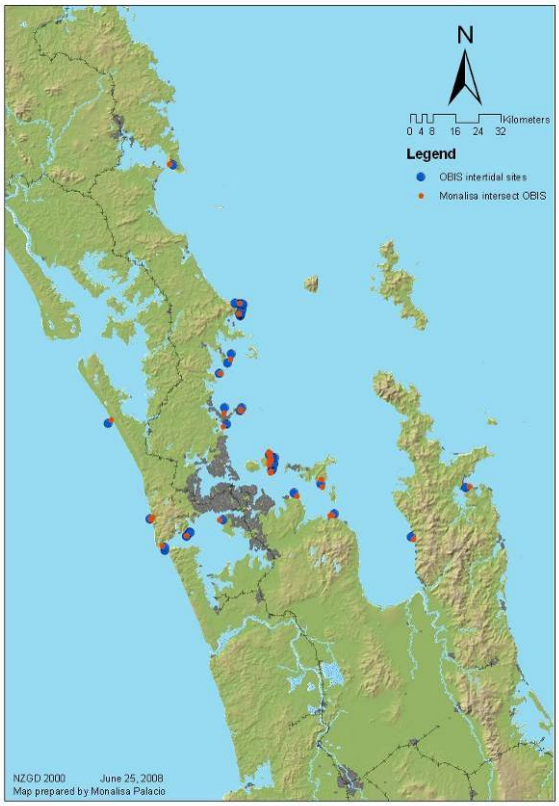

Figure 10: Plot of intertidal sites common to OBIS and *Monalisa* data sources

The MDS plot depicting the relationship between species assemblages occurring within the intertidal environment at sites common to OBIS and *Monalisa* reveals two discrete groupings (Figure 11), confirmed by a high level of significance (p = 0.001) obtained from ANOSIM (Figure 72, Appendix 3). The distinct species groups are explained by the large difference in the total number of species included in each data set, 177 (OBIS) and 460 (*Monalisa*) (Table 13). OBIS intertidal species data fall largely within 10 classes, dominated by polychaete, bivalve, gastropod, bryozoan and arthropod taxa; species communities found in OBIS are both less diverse and rich than those in *Monalisa*, the latter comprising 34 classes, dominated by gastropod, bivalve, polychaete, arthropod and polyplacophoran (chiton) taxa.

Those *Monalisa* survey sites falling within a 2 km radius of intertidal Mollusc database sites (Figure 12) are depicted in Figure 13. Sites in common to these two data sources also occur within each of the five habitat classes reported in Table 4, although sites in common occur mainly on marine hard shores, with those of a fringe-saline (effectively freshwater) nature being poorly represented. In total, species inventories from 183 Mollusc and 196 *Monalisa* sites could be directly compared (Table 13).

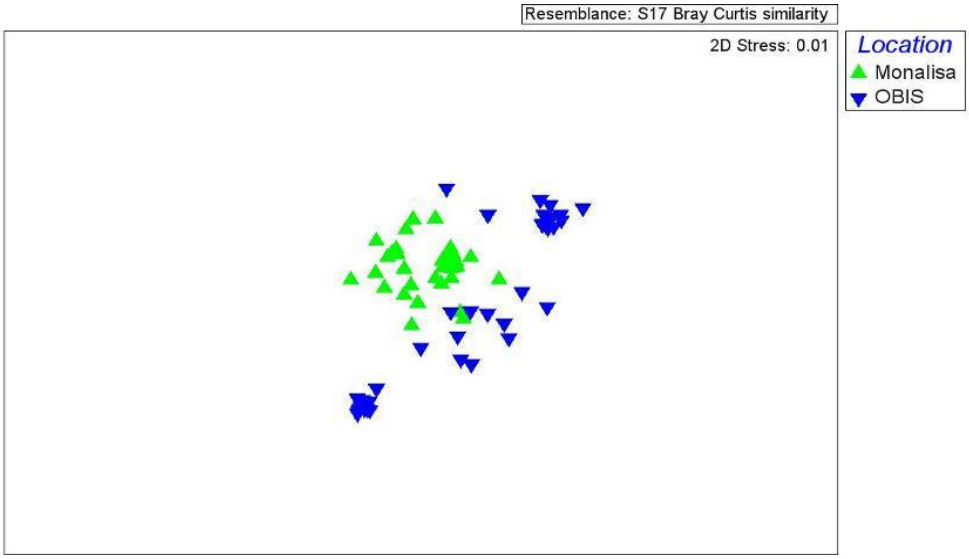

Figure 11: MDS plot of intertidal biodiversity data from OBIS and *Monalisa* data sources

The MDS plot depicting the relationship between species assemblages occurring within the intertidal environment at sites common to the Mollusc database and *Monalisa* reveals two discrete groupings (Figure 14), confirmed by a high level of significance (p = 0.001) obtained from ANOSIM (Figure 73, Appendix 3). Like the OBIS data, the distinct species groups are explained by large differences in numbers of species unique to each data set, 228 (Mollusc database) and 151 (*Monalisa*) (Table 13). The Mollusc database has a greater number of species (343) than *Monalisa* (266), but live and dead Mollusca are not differentiated on the Mollusc database, whereas *Monalisa* records live species only. Both data sources encompass the four mollusc classes Gastropoda, Bivalvia, Polyplacophora and Cephalopoda.

Those *Monalisa* survey sites falling within a 2 km radius of intertidal ARC sites (Figure 15) are depicted in Figure 16. Sites in common to these two data sources similarly fall in five habitat classes herein reported (Table 4), and again marine hard shores are best represented and fringe-saline (effectively freshwater) shores are the most poorly represented habitat types. In total, species inventories from 37 ARC and 43 *Monalisa* sites could be directly compared (Table 13).

The MDS plot depicting the relationship between species assemblages occurring within the intertidal environment at sites in common to the ARC database and *Monalisa* reveals two discrete groupings (Figure 17), confirmed by a high level of significance (p = 0.001) obtained from ANOSIM (Figure 74, Appendix 3). As previously, the distinct species groups are explained by large differences in numbers of species unique to each data set, 111 (ARC database) and 214 (*Monalisa*) (Table

13). The ARC database contains fewer species (178) than *Monalisa* (281) for these common sites. The 281 *Monalisa* species comprise 26 faunal and 7 floral classes, comprised largely of gastropods, bivalves, polychaetes and arthropods, whereas the 178 ARC species comprise 12 faunal classes, with bivalves and polychaetes being the key contributors.

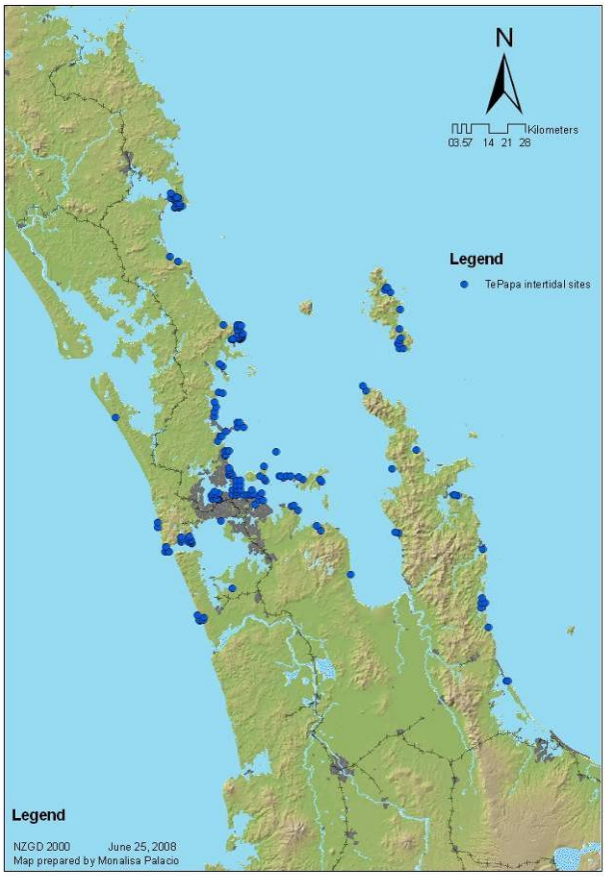

Figure 12: Plot of Te Papa intertidal sites

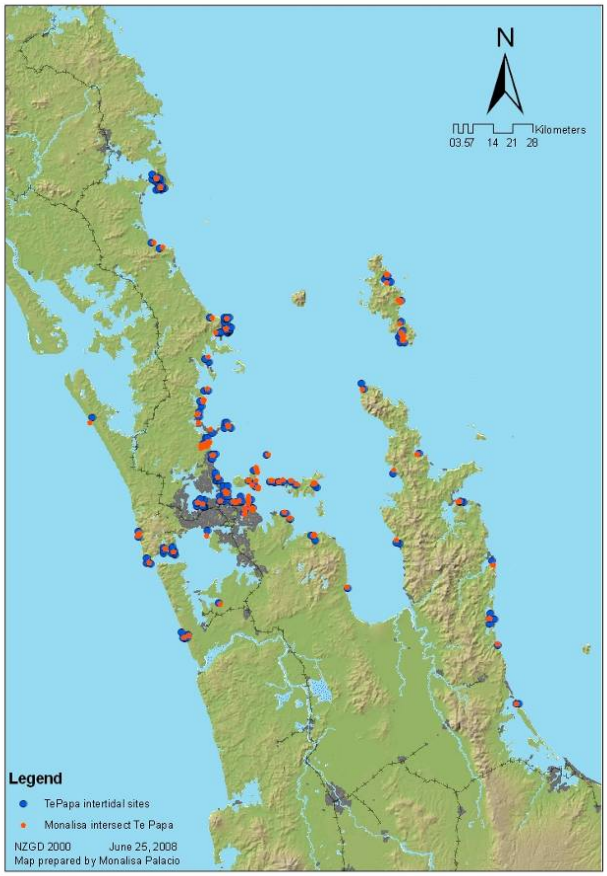

Figure 13: Plot of intertidal sites, Te Papa and *Monalisa*

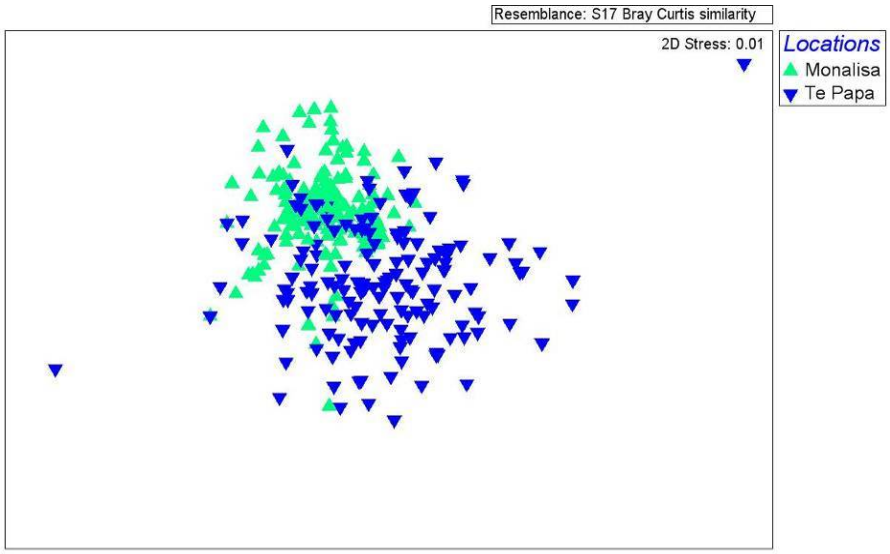

Figure 14: MDS plot of intertidal biodiversity data from Te Papa Mollusc database and *Monalisa*

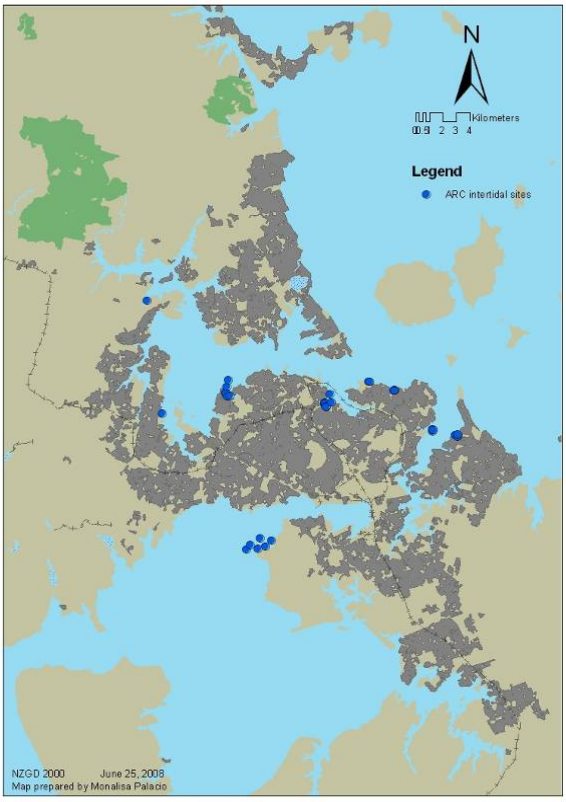

Figure 15: Plot of ARC intertidal sites

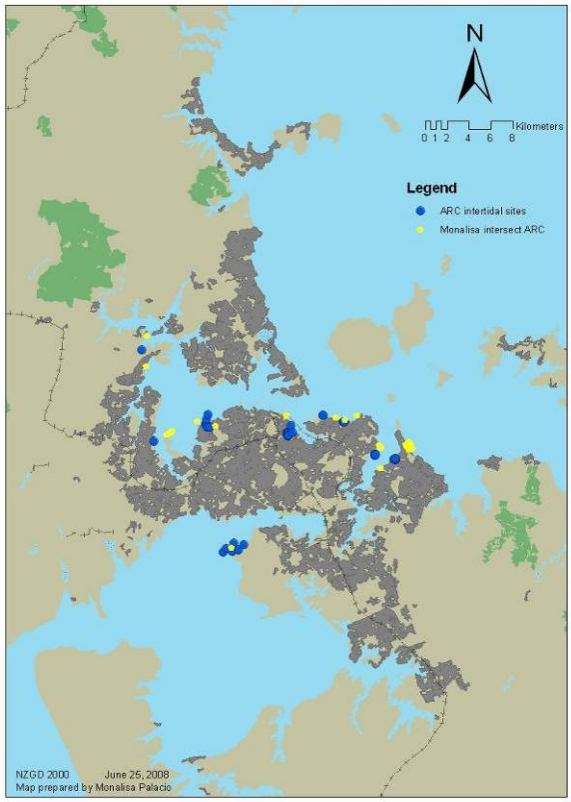

Figure 16: Plot of intertidal sites, ARC and *Monalisa*

When all intertidal species data from all three data sources (OBIS, Mollusc, ARC) are combined into one common database, and these collective data then are compared with *Monalisa* biodiversity data, again two distinct groupings occur (Figure 18), also confirmed by a high level of significance (p = 0.001) obtained from ANOSIM (Figure 75, Appendix 3). As for all previous analyses, the distinct species groups are explained by large differences in numbers of species unique to each data set, 467 (OBIS, Mollusc database and ARC combined) and 406 (*Monalisa*) (Table 13); only 192 species are common to these two data sets. All five intertidal habitat classes and freshwater habitat are represented in all the sites from both data sources (*Monalisa* and others combined), with marine hard shores being represented by the greatest number of sites, through to fringe-saline (effectively freshwater) shores being represented by the least number of sites. Although the combined three databases have a greater number of sites and species compared to *Monalisa*, species diversity is greater in *Monalisa*, comprising 29 faunal and 8 floral classes, with gastropods, polychaetes, bivalves and arthropods being the dominant taxa; secondary data sources (databases combined) have species represented by 16 faunal classes only, with these dominated by gastropod, bivalve, polychaete and arthropod taxa.

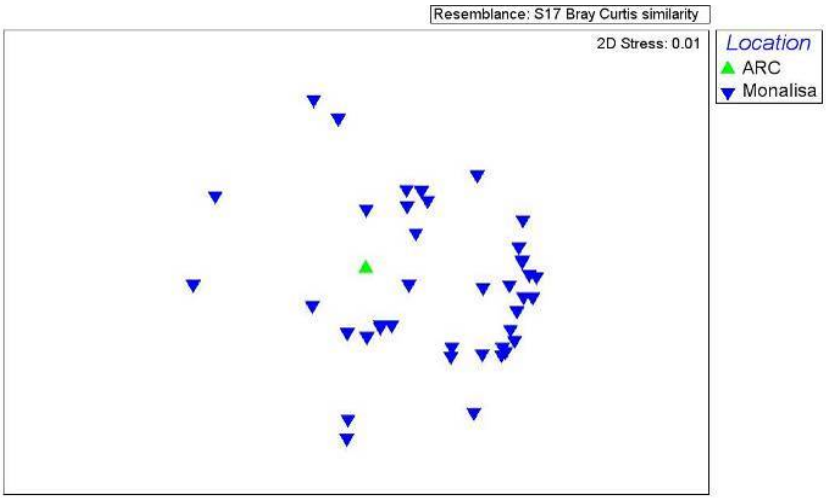

Figure 17: MDS plot of ARC and *Monalisa* intertidal biodiversity data

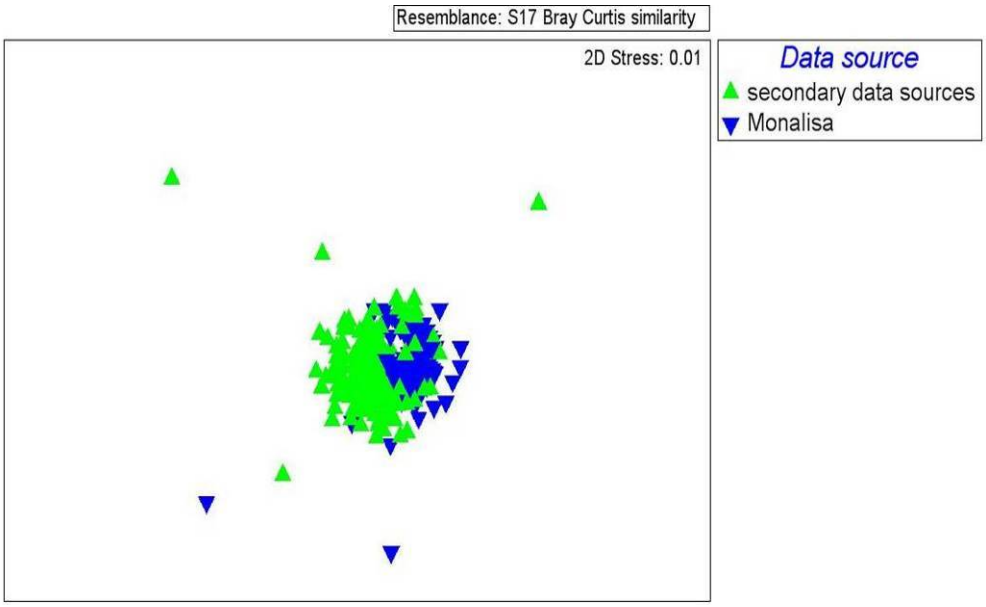

Figure 18: MDS plot of intertidal biodiversity data from national and regional biodiversity databases, and *Monalisa*

Phase 4: New surveys

Survey sites included a diverse intertidal habitat on the mainland and offshore islands throughout the survey region, the Hauraki Gulf Marine Park. When the opportunity presented itself, additional species data were collected from fringe-saline (effectively fresh water) habitat, but a limited number of sites (25) were surveyed, compared with 296 sites in saline conditions.

Of the 321 sites surveyed during this research programme (Figure 19), inventories of species have been collected from marine and brackish hard and soft shores from 296 sites (Figures 20, 32–36). Only these sites and associated species data are further

analysed herein. The distribution of the 25 fringe-saline sites (for which the flora and fauna is not further evaluated) is presented in Figure 69 (Appendix 3). Place names, site-specific codes and survey dates for each of these 296 sites are presented in Tables 41–46 (Appendix 2), with coordinates provided in the accompanying CD.

Species identified from site surveys in all habitats, substrata and salinities

A list of all species, and their supra-specific classification (following ITIS 2008, 5 Kingdom classification), is presented in Tables 50 and 51 (Appendix 2).

Diversity of taxa across intertidal habitat

Diversity of taxa from the 296 sampling sites is depicted in Figure 21. Marine hard shores are consistently the most species rich and diverse of all shores surveyed, from the level of Phylum to species. Species richness and diversity progressively decrease from marine hard shores to marine soft shores, brackish hard shores, and mangrove and brackish soft shores.

Phase 5: Novel database development

Monalisa has been developed to contain all data collected for this research, to archive information and to answer specific questions for analyses. It currently holds primary data for 728 species identified during surveys at 321 intertidal sites, and secondary data of 4,603 species from 35 references.

Database structure (Figure 22) incorporates nine major tables and twelve minor tables. Table names and field descriptions are detailed in Table 47 (Appendix 2).

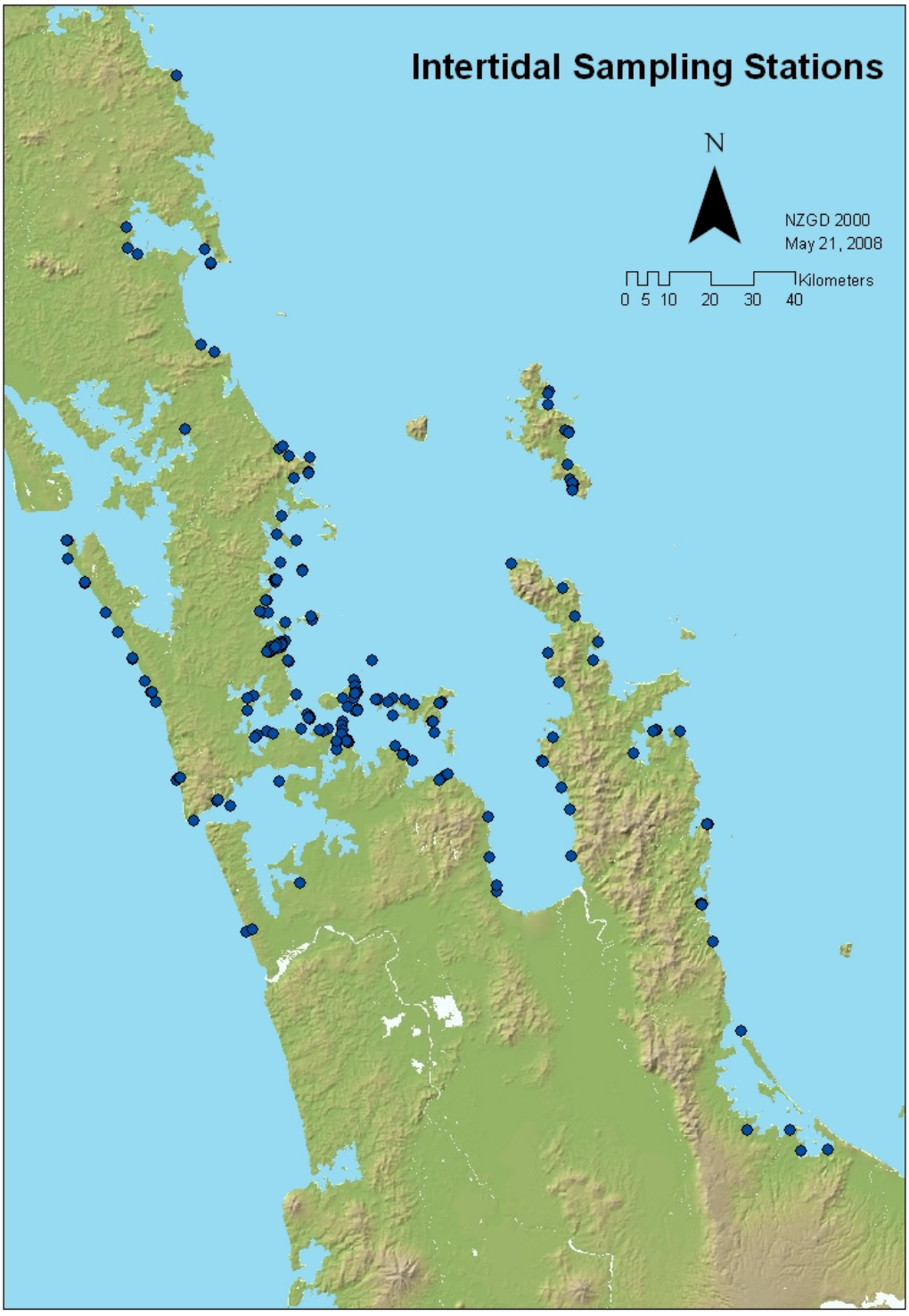

Figure 19: Distribution of biodiversity surveys of 321 intertidal sites

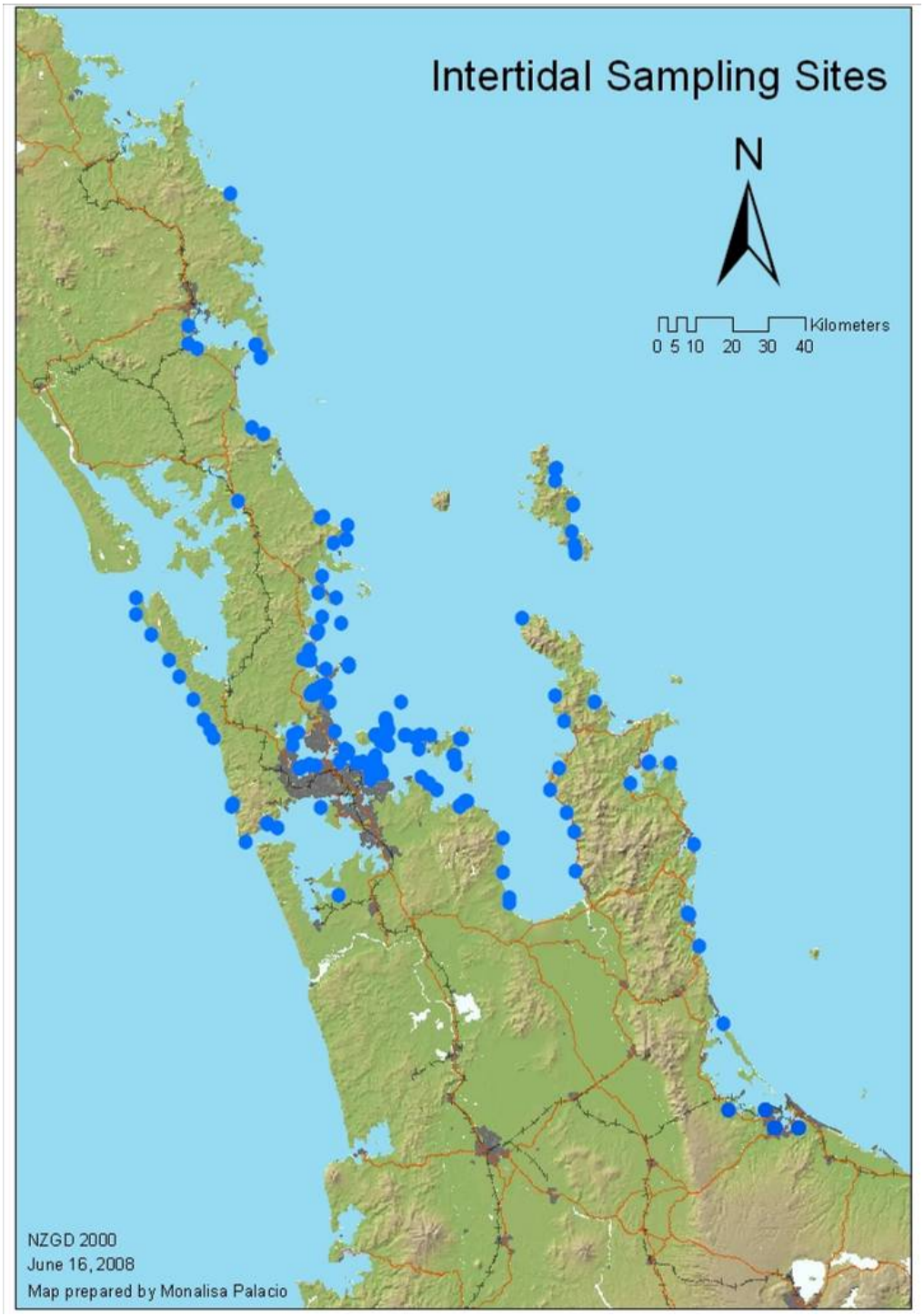

Figure 20: Distribution of biodiversity surveys of 296 intertidal sites (excluding fringe-saline sites)

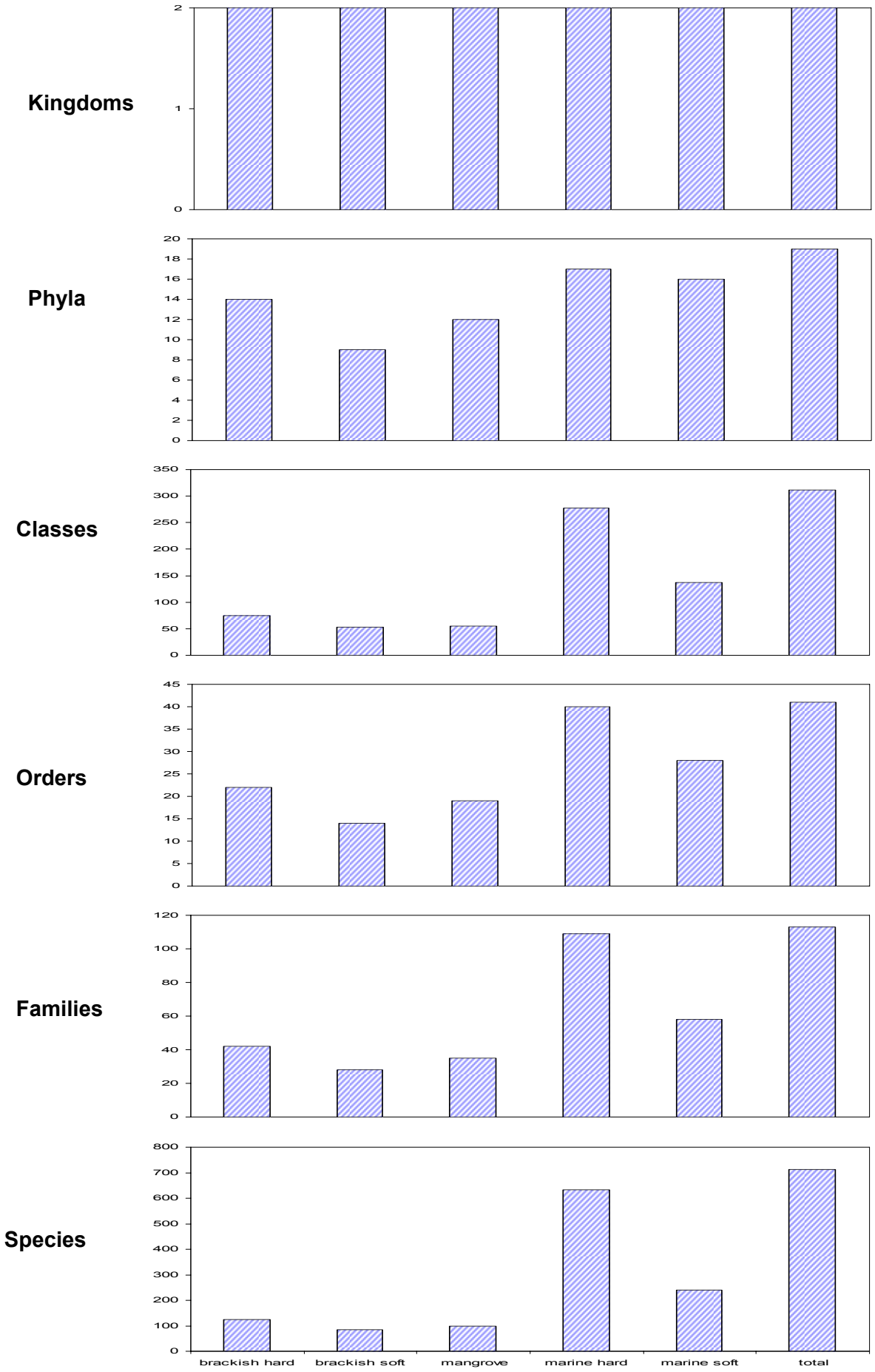

Figure 21: Numbers of (top to bottom) kingdoms, phyla, classes, orders, families and species recorded from each intertidal habitat class (common legend on lower x-axis).

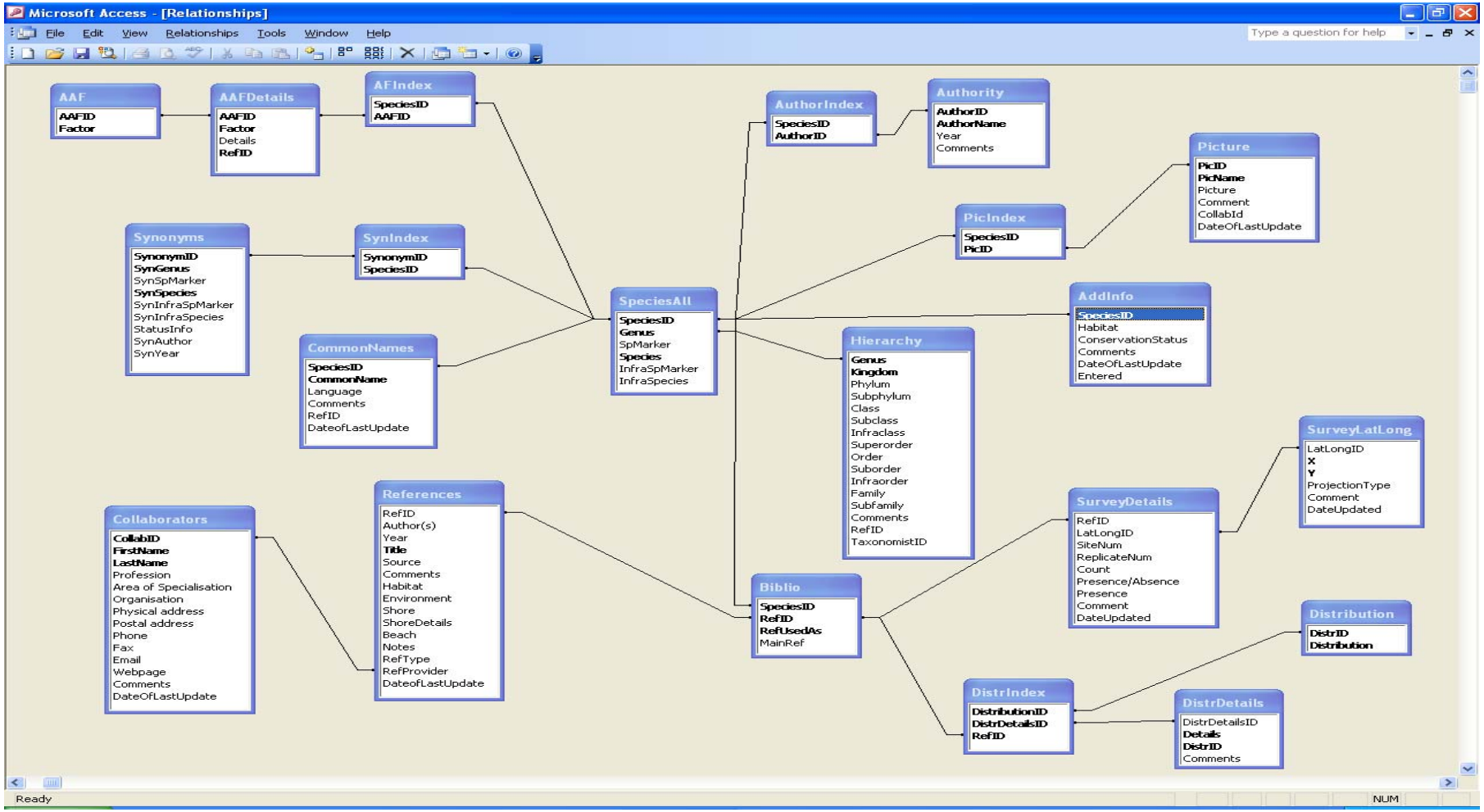

Figure 22: *Monalisa* Biodiversity database structure

Phase 6: Novel database interrogation

Only data collected from *Monalisa* surveys were considered for analyses in this phase.

Of the variables measured, salinity accounts for 70 percent of the variation in species assemblages, while substratum explains only 48 percent of this variation (Table 14). To determine whether distinct assemblages of species occur within the two salinity regimes, the MDS plot (Figure 23) of the similarity matrix was examined and revealed two clear groups. A simple analysis of similarities (ANOSIM) pairwise test shows a high significance level of 0.001 (Figure 76, Appendix 2).

Table 14: Factors and their influence in the distribution of intertidal species assemblages

Category	Details	Species count	Difference in species count	Species count difference/total species count (721), as %	Number of unique species
Salinity	brackish	187	502	70	24
	marine	689			526
Substratum	hard	639	342	48	415
	soft	298			74

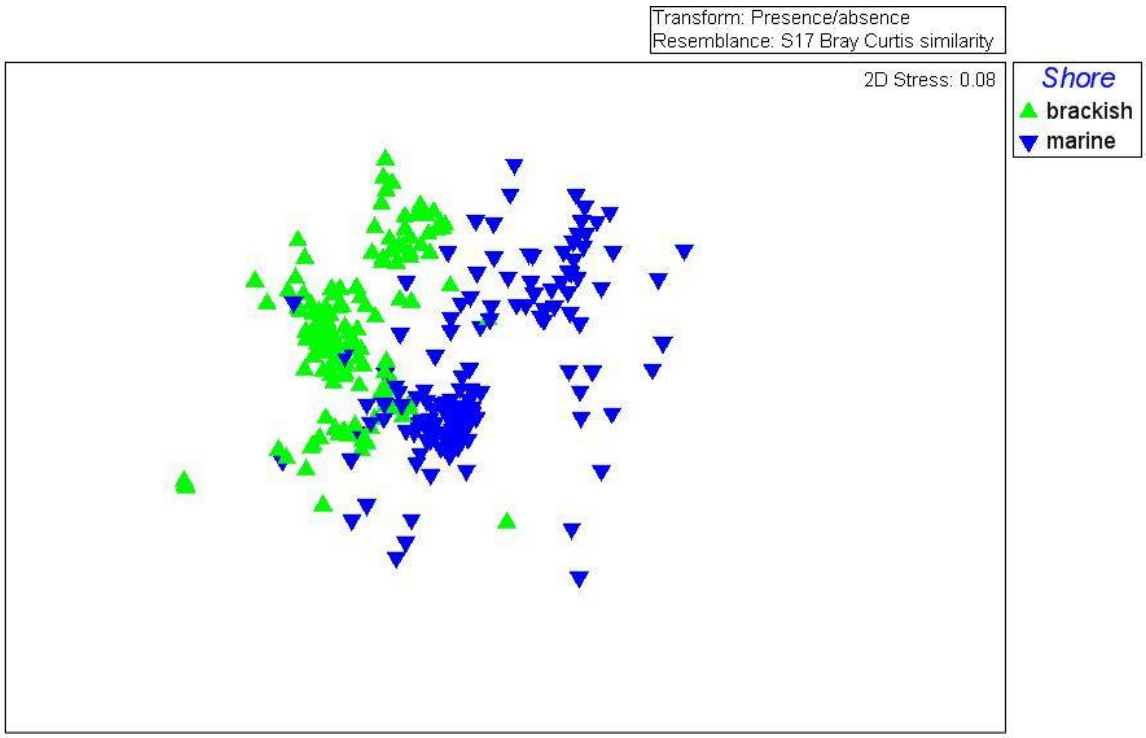

Figure 23: MDS plot of sites and species by salinity regime

Using one-way analysis of similarity percentages test (SIMPER) on the resemblance matrix, species contributions on shore habitat groupings were identified by computing the average dissimilarity from brackish and marine shores, then breaking the average down into separate contributions from each species. The species occurrence data from the presence-absence matrix was used in PRIMER to compute the average abundance of each species.Tables 53 and 54 (Appendix 2) provide lists of those species occurring in communities typical of the two salinity regimes, with explanation of SIMPER indices in Table 52 (Appendix 2). Species with highest contributions in brackish and marine shore characterisation are listed in Tables 15 and 16.

Table 15: Brackish shore species (top 6 out of 25). Breakdown of average similarity (18.80) within brackish-shore groupings into contributions from each species.

Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Helice crassa	0.55	2.47	0.57	13.16	13.16
Potamopyrgus estuarinus	0.45	1.74	0.47	9.23	22.39
Austrominius modestus	0.46	1.37	0.46	7.30	29.69
Ophicardelus costellaris	0.40	1.26	0.40	6.72	36.41
Avicennia resinifera	0.37	1.08	0.38	5.74	42.15
Amphibola crenata	0.35	1.05	0.35	5.58	47.73

Table 16: Marine shore species (top 8 out of 126). Breakdown of average similarity (14.59) within marine-shore groupings into contributions from each species.

Species	**Av.Abund**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Macroclymenella stewartensis	0.19	0.41	0.18	2.83	2.83
Turbo smaragdus	0.54	0.40	0.47	2.72	5.55
Austrominius modestus	0.51	0.38	0.48	2.58	8.13
Melagraphia aethiops	0.52	0.36	0.47	2.50	10.62
Saccoglossus australiensis	0.17	0.34	0.15	2.36	12.98
Chiton glaucus	0.51	0.31	0.51	2.13	15.11
Sypharochiton pelliserpentis	0.51	0.31	0.52	2.11	17.22
Lepsiella scobina	0.50	0.29	0.51	2.00	19.23

Marine shores have considerably greater species richness than brackish shores (Table 17). Of the 713 species that characterise brackish and marine shores, 163 species were found in both shores while there were 24 species found on brackish shores only, and 526 species found on marine shores only (Tables 55–57, Appendix 2).

Species accumulation curves by habitat and substratum

To determine whether sampling adequately describes the flora and fauna of surveyed habitats and substrata (Table 17), species accumulation curves have been prepared for each habitat type.

When sites are grouped by salinity, into brackish, fringe-saline and marine, it is apparent that no asymptote is reached (Figures 24–26). Accordingly, further sampling in these salinity-based habitats almost certainly will result in the identification of additional species.

Table 17: Salinity, sampling effort and species count

	No. of sites	No. of species
brackish	146	187
fringe saline	25	56
marine	150	689

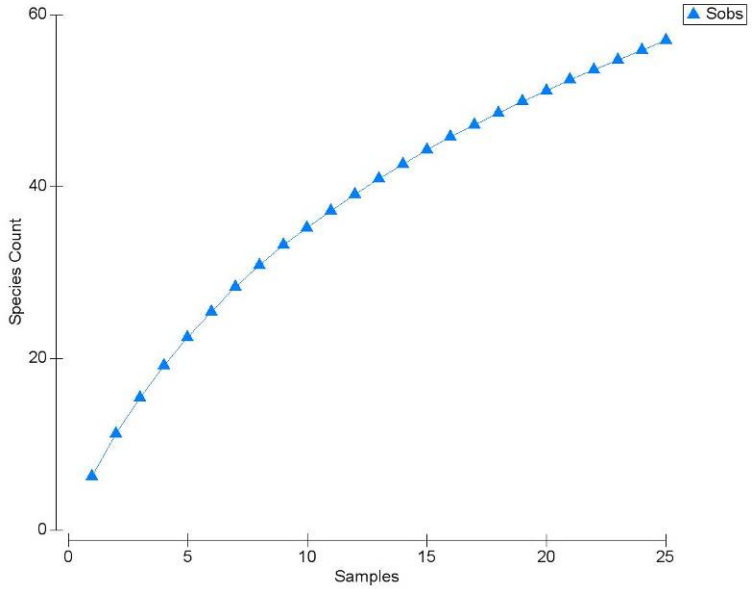

Figure 24: Species accumulation curve, fringe-saline habitat

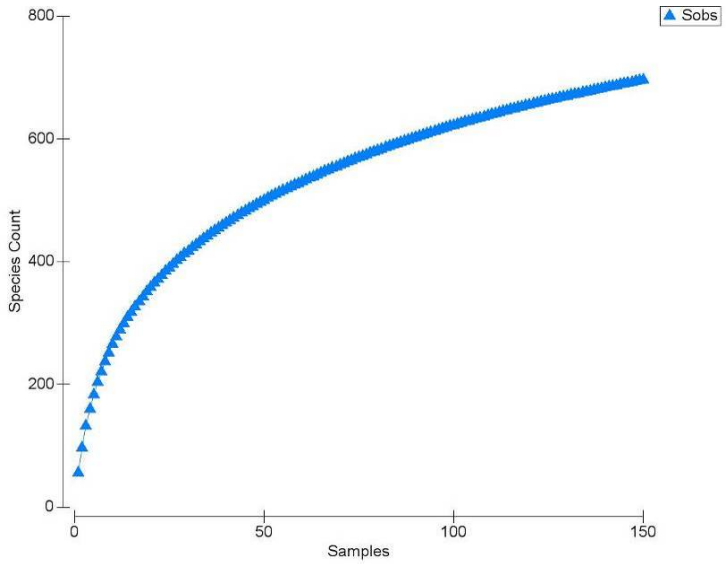

Figure 25: Species accumulation curve, marine substrata (hard, soft)

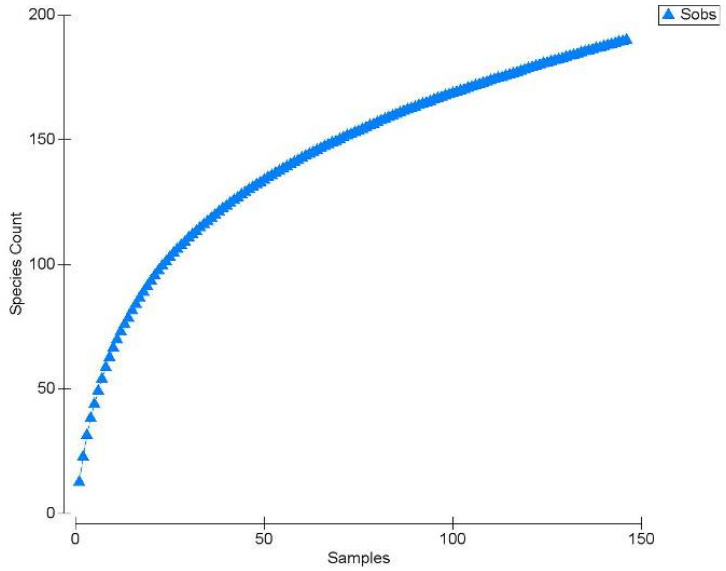

Figure 26: Species accumulation curve, brackish substrata (mangrove, brackish hard, brackish soft)

Substratum type also was reported for each survey site. Based on the resemblance matrix of 296 samples using Bray Curtis similarity, the MDS plot (Figure 27) and ANOSIM pairwise test (Figure 77, Appendix 3) also reveal that substratum influences the composition of species assemblages found at survey sites.

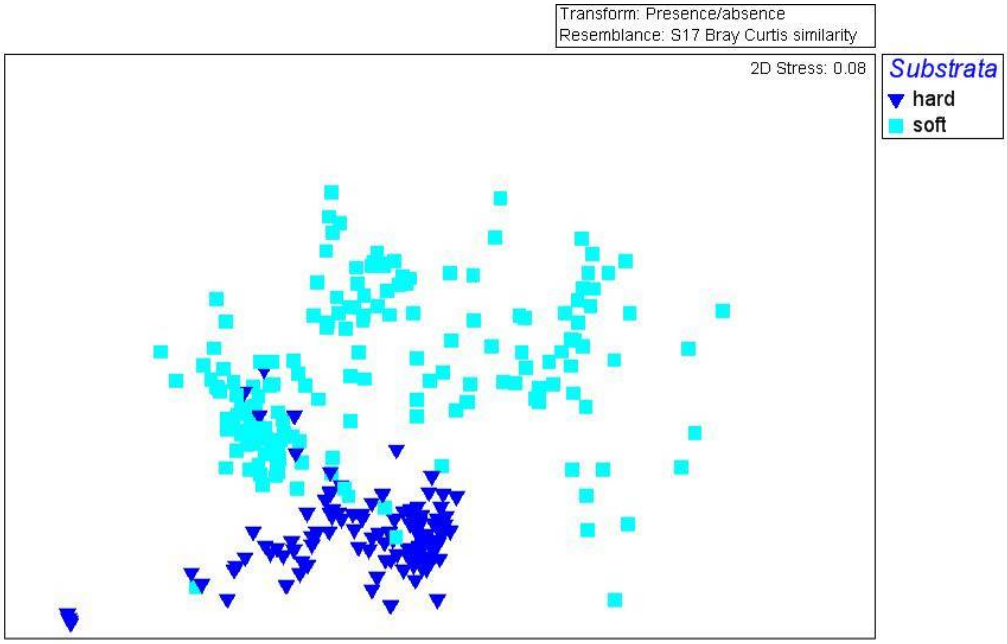

Figure 27: MDS plot of sites and species by substratum

The assemblages of species that characterise each substratum type, based on similarity percentages test (SIMPER), are provided in Tables 58 and 59 (Appendix 2). Taxa with highest contributions for soft-substratum shores are presented in Table 18, and those for hard shores are in Table 19.

Table 18: Soft-substratum species (top 6 out of 30). Breakdown of average similarity (11.85) within soft-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Helice crassa	0.42	1.57	0.41	13.22	13.22
Potamopyrgus estuarinus	0.34	1.04	0.34	8.78	22.00
Avicennia resinifera	0.31	0.78	0.31	6.58	28.58
Ophicardelus costellaris	0.30	0.73	0.29	6.12	34.70
Amphipoda sp.	0.25	0.71	0.23	6.02	40.71
Amphibola crenata	0.28	0.68	0.27	5.74	46.45

Table 19: Hard-substratum species (top 8 out of 101). Breakdown of average similarity (26.58) within hard substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Austrominius modestus	0.82	1.39	0.69	5.23	5.23
Turbo smaragdus	0.79	0.96	0.86	3.61	8.84
Onchidella nigricans	0.73	0.84	0.71	3.18	12.02
Xenostrobus pulex	0.64	0.84	0.56	3.15	15.17
Petrolisthes elongatus	0.72	0.75	0.75	2.81	17.97
Pomatoceros caeruleus	0.72	0.73	0.80	2.75	20.73
Sypharochiton pelliserpentis	0.73	0.72	0.84	2.71	23.44
Crassostrea gigas	0.56	0.72	0.53	2.70	26.15

Hard shores host a higher number of species than soft shores (Table 20). Of 713 species found on hard and soft shores, 224 were common to both shore types, 415 species were found on hard shores only, and 74 species were found only on soft shores (Tables 60–62, Appendix 2).

When sites are grouped by substratum, whether soft, hard, and treating fringe-saline as a separate habitat (Table 20), no asymptote is reached for any species-accumulation curve (Figures 28, 29). Accordingly, further sampling in any of these substratum-based categories almost certainly will result in identification of additional species.

Table 20: Substratum type, sampling effort and species count

	Mangrove, Brackish (soft), Marine (soft)	Brackish (hard), Marine (hard)	Fringe-saline
# Sites	179	117	25
# Species	298	639	56

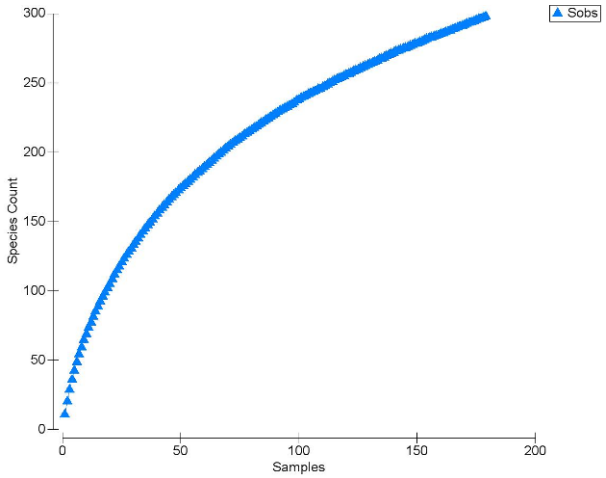

Figure 28: Species accumulation curve, marine and brackish (soft) combined

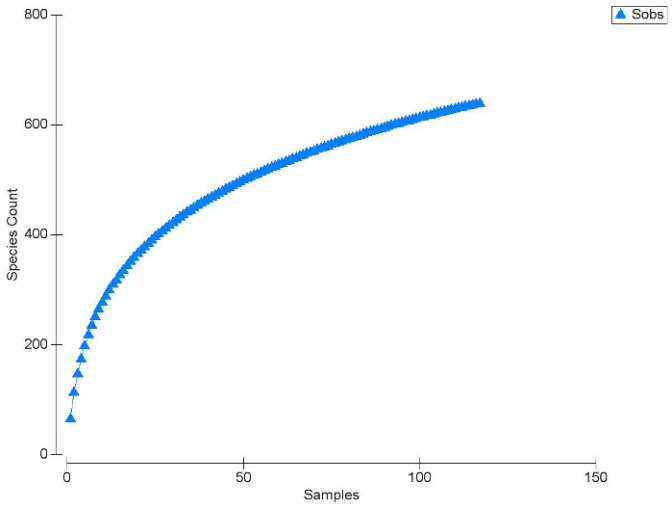

Figure 29: Species accumulation curve, marine and brackish (hard) combined

Communities of major substrata within shore habitat types

Both salinity and substratum type have been shown to affect the composition of species assemblages. However, species assemblages also varied depending on the combination of substratum type and salinity regime. One-way analysis of ANOSIM pairwise test identifies the species assemblages of soft and hard substrata in brackish and marine salinity regimes also to differ (Figures 78, 79, Appendix 3), depicted in the following MDS plots (Figures 30, 31).

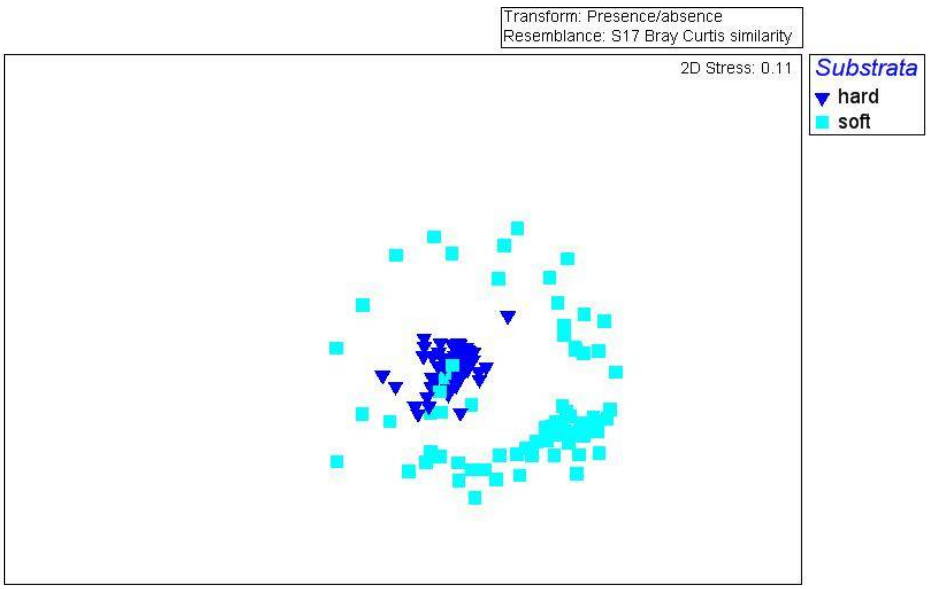

Figure 30: MDS plot of marine shore by substratum type

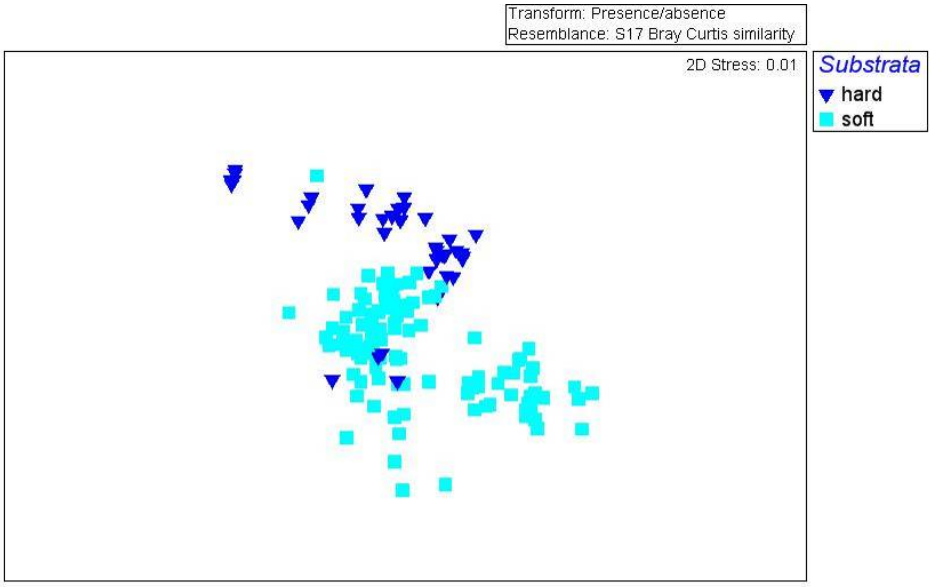

Figure 31: MDS plot of brackish shore by substratum type

SIMPER tests identify the communities characterising these assemblages (Tables 63–66, Appendix 2). Top taxon contributors to brackish hard shore communities are presented in Table 21, and for marine soft shores in Table 22.

These data support characterisation of shores into one of four broad categories: marine hard, marine soft, brackish hard and brackish soft habitats, as shown in Table 23, distributed in accordance with Figures 32–35.

Table 21: Brackish hard-substratum species (top 3 out of 31). Breakdown of average similarity (23.79) within brackish hard-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Fistulobalanus kondakovi	0.43	3.54	0.27	14.87	14.87
Austrominius modestus	0.70	2.89	0.65	12.13	27.01
Xenostrobus pulex	0.60	1.82	0.63	7.66	34.66

Table 22: Marine soft-substratum species (top 5 out of 20). Breakdown of average similarity (9.70) within marine soft-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Macroclymenella stewartensis	0.38	1.76	0.38	18.11	18.11
Saccoglossus australiensis	0.33	1.44	0.32	14.84	32.95
Nemertea sp.	0.26	0.67	0.24	6.85	39.80
Nephtys macroura	0.22	0.65	0.21	6.69	46.50
Orbinia papillosa	0.22	0.55	0.20	5.71	52.21

Table 23: Composition of 296 survey sites by shore habitat and substrata

Habitat classification	No. of sampling sites	Species count
brackish hard	40	125
brackish soft	109	85
marine hard	77	634
marine soft	70	240

When sites are grouped by habitat (Table 23) it is apparent that no asymptote is reached for any species accumulation curve (Figures 37–42). Accordingly, additional sampling in each of these habitats almost certainly will result in identification of additional species.

Table 24: Intertidal habitats and sampling sites, sampling effort and species count

	Mangrove	Brackish (soft)	Marine (soft)	Brackish (hard)	Marine (hard)	Fringe-saline
# Sites	56	53	70	40	77	25
# Species	100	85	240	125	634	56

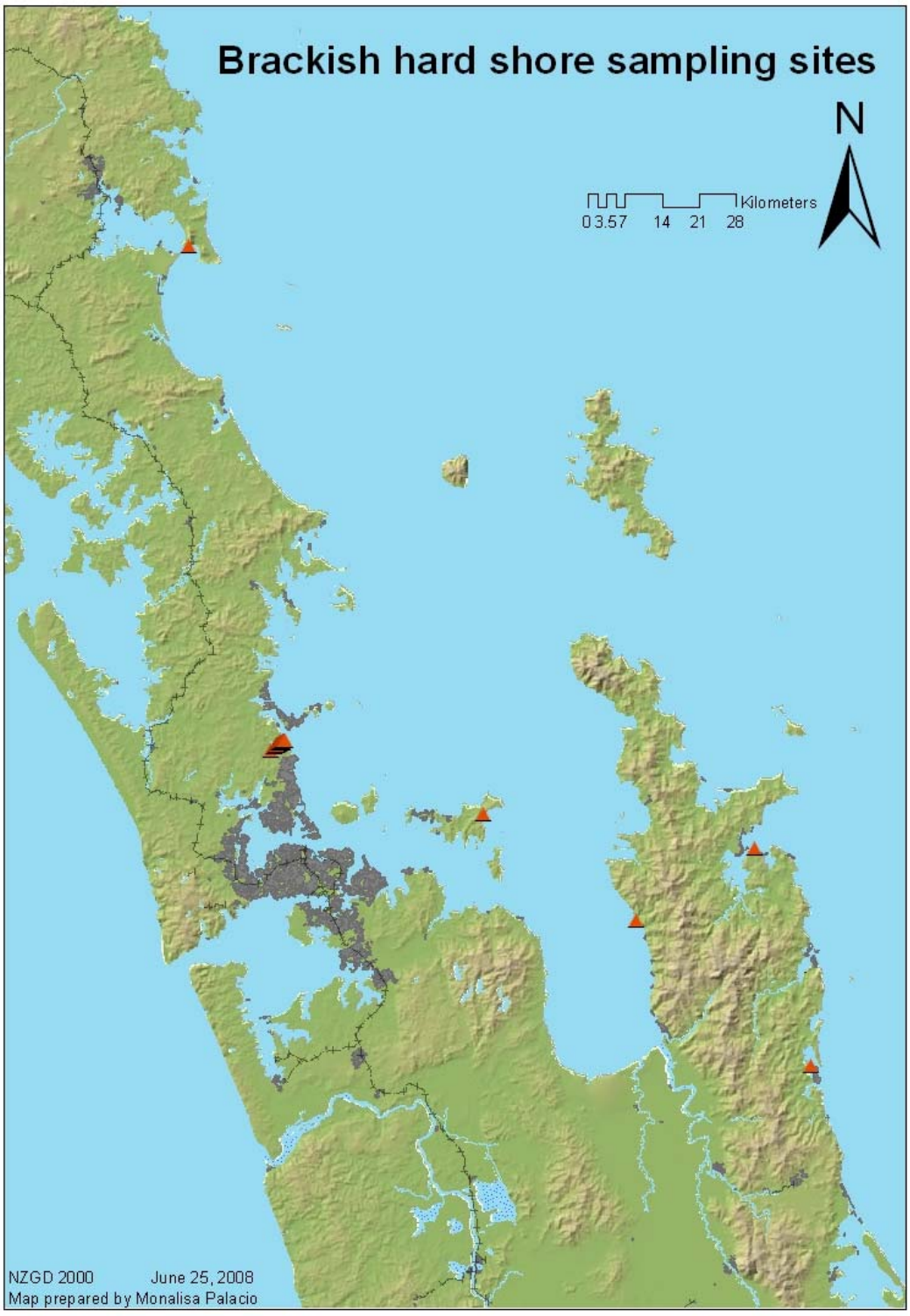

Figure 32: Distribution of brackish hard-shore sampling sites throughout survey region

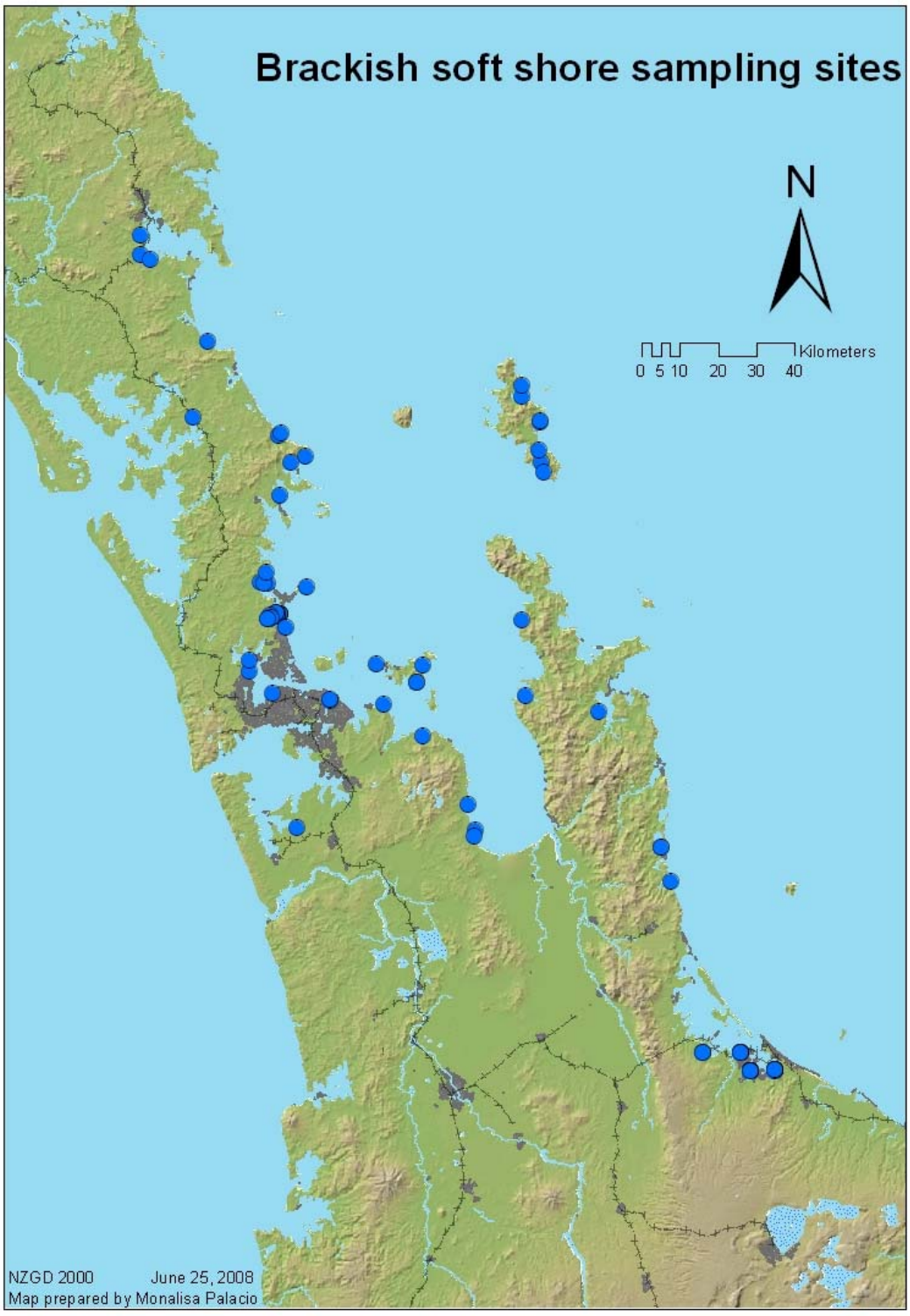

Figure 33: Distribution of brackish soft-shore (inclusive mangroves) sampling sites throughout survey region

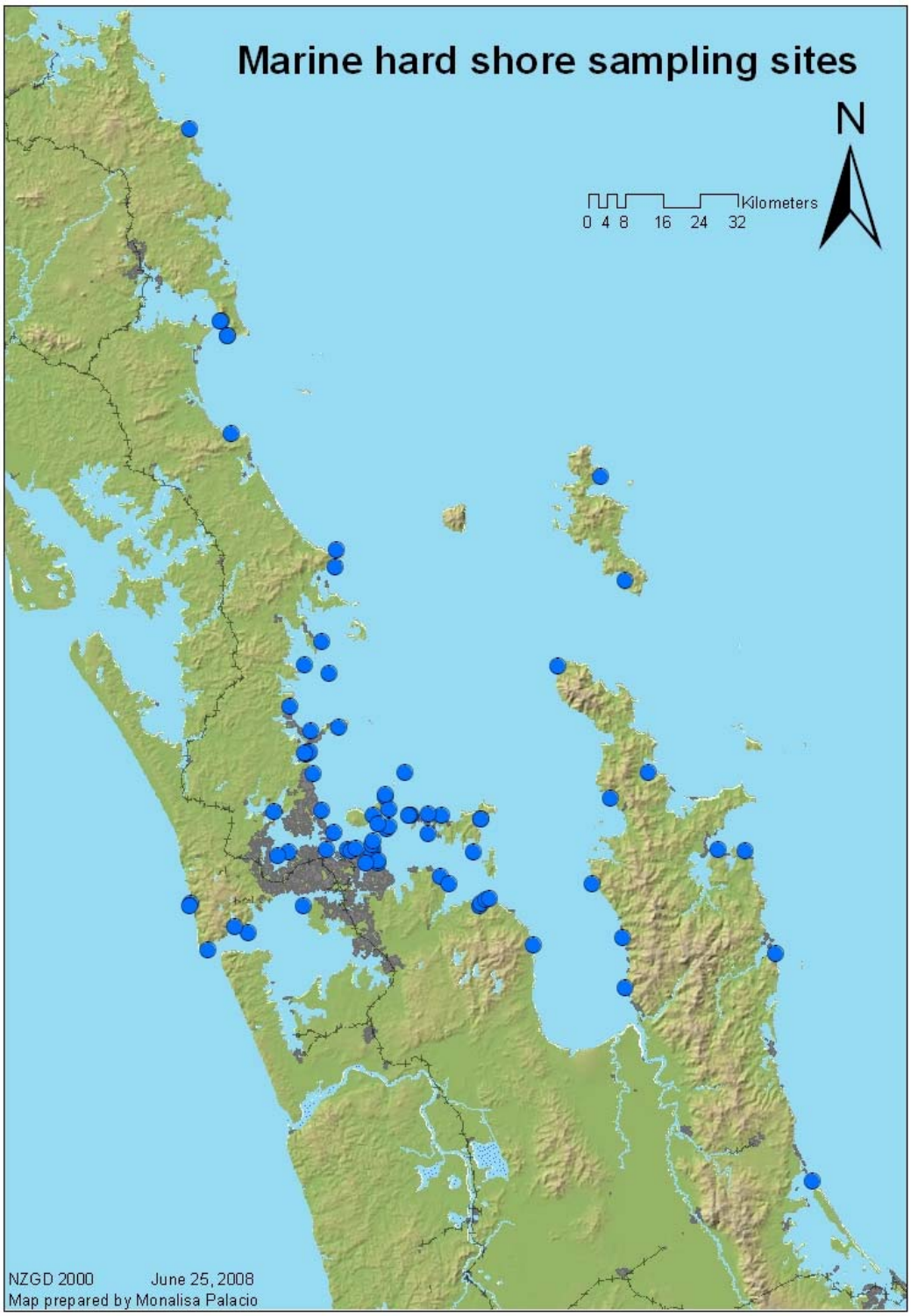

Figure 34: Distribution of marine hard-shore sampling sites throughout survey region

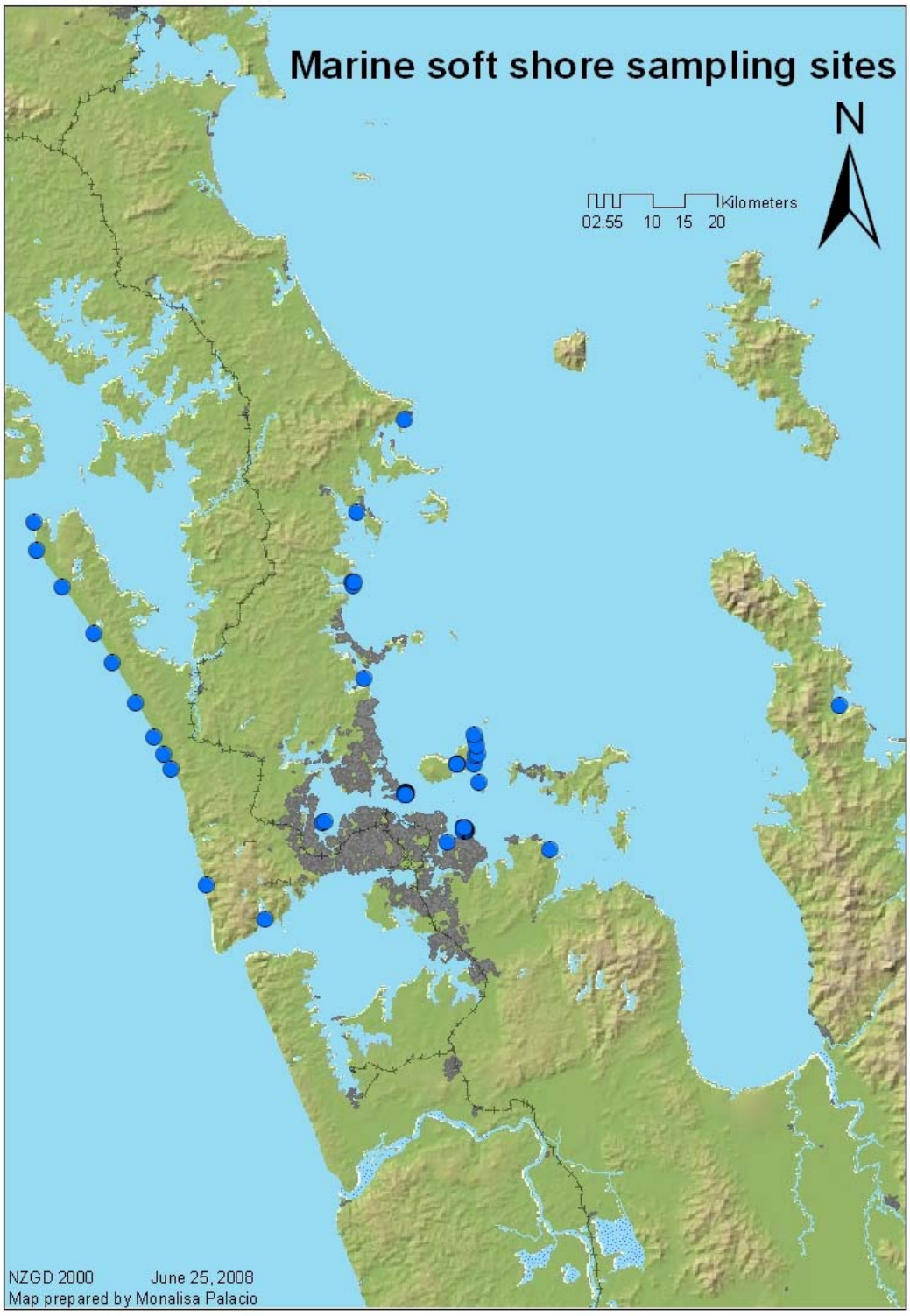

Figure 35: Distribution of marine soft-shore sampling sites throughout survey region (inclusive four mangrove sites)

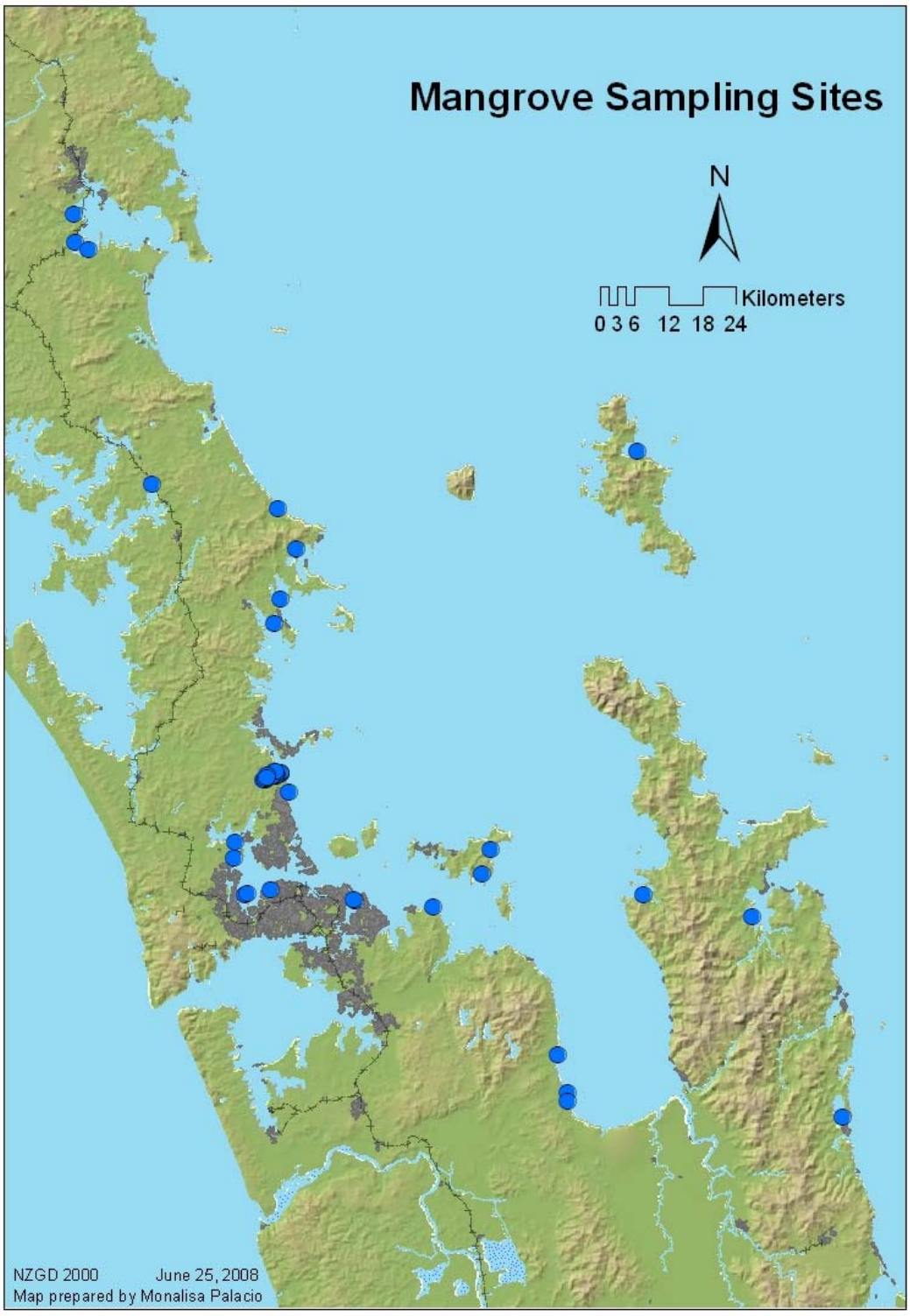

Figure 36: Distribution of mangrove (brackish and marine soft-shore) sampling sites throughout survey region

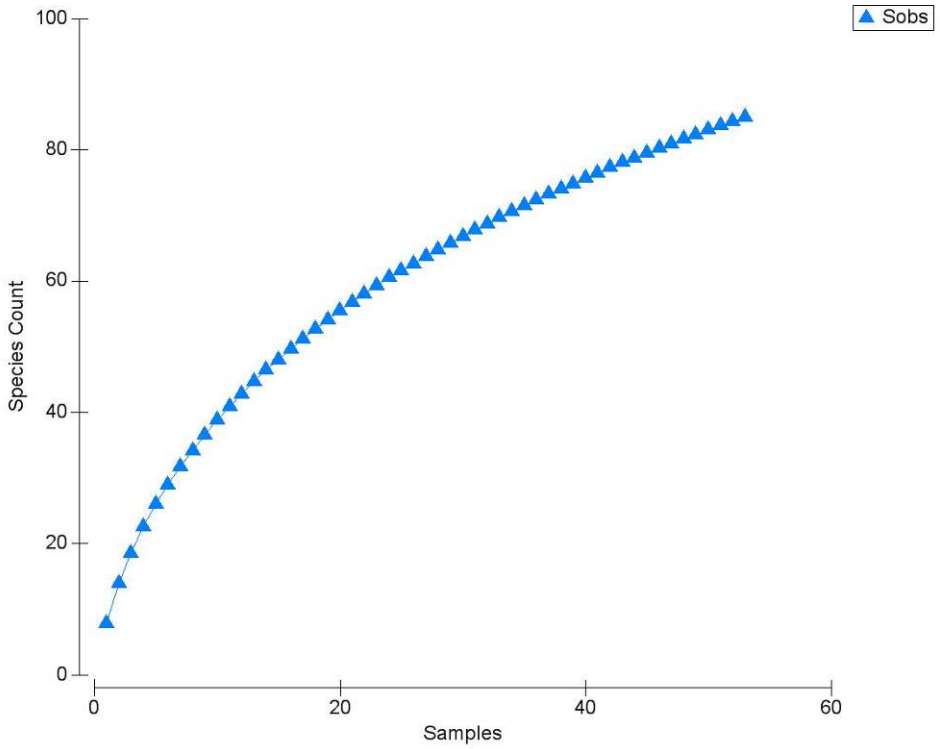

Figure 37: Species accumulation curve, brackish (soft) substrata

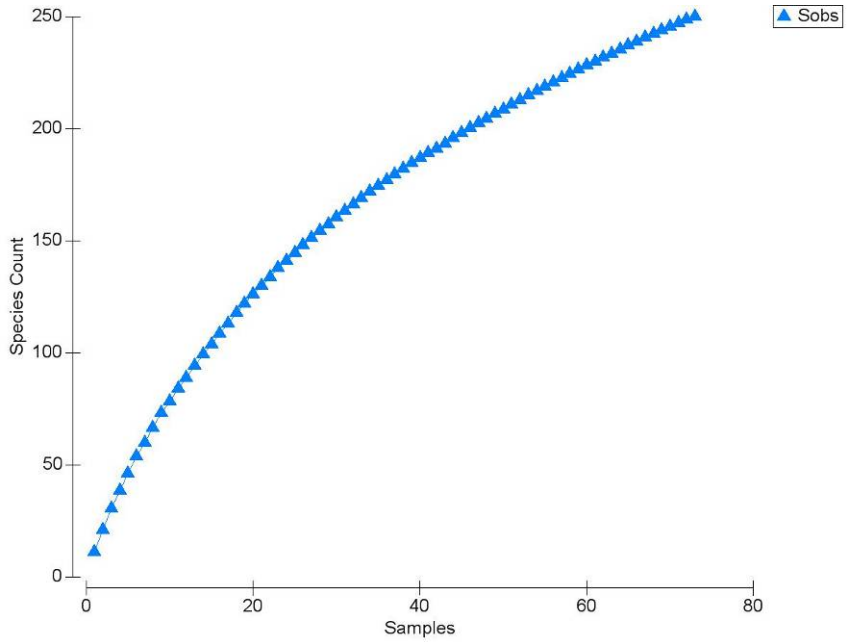

Figure 38: Species accumulation curve, marine (soft) substrata

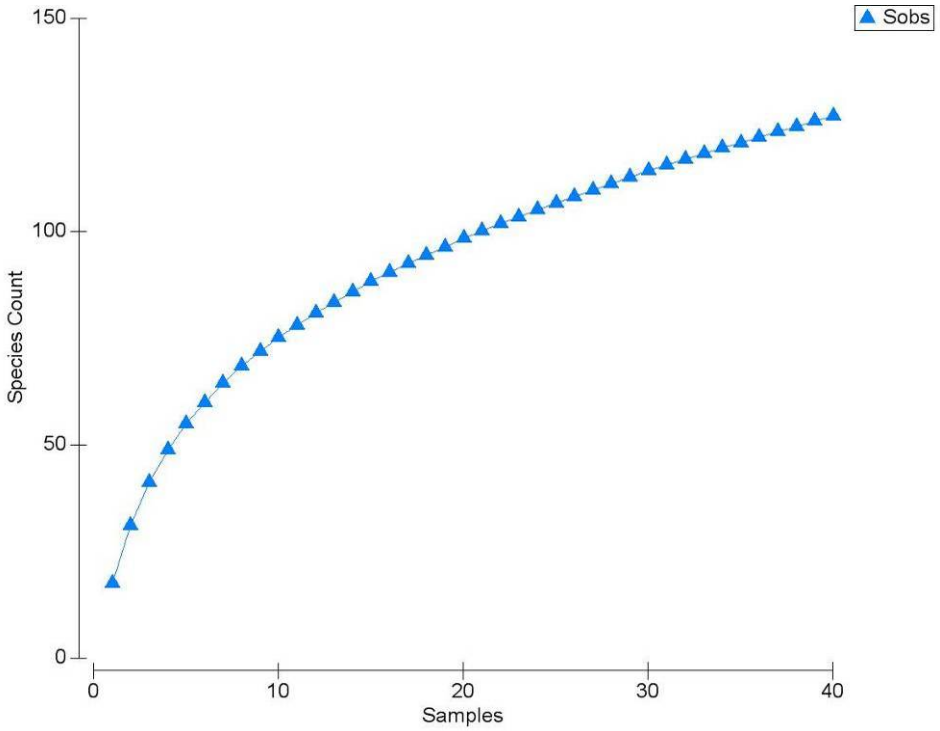

Figure 39: Species accumulation curve, brackish (hard) substrata

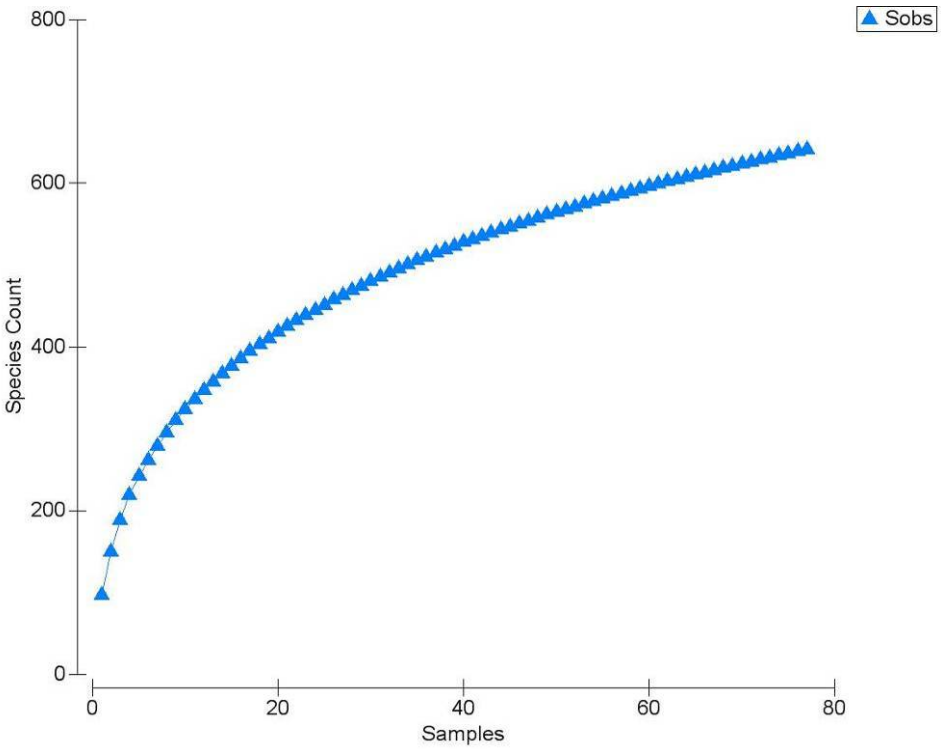

Figure 40: Species accumulation curve, marine (hard) substrata

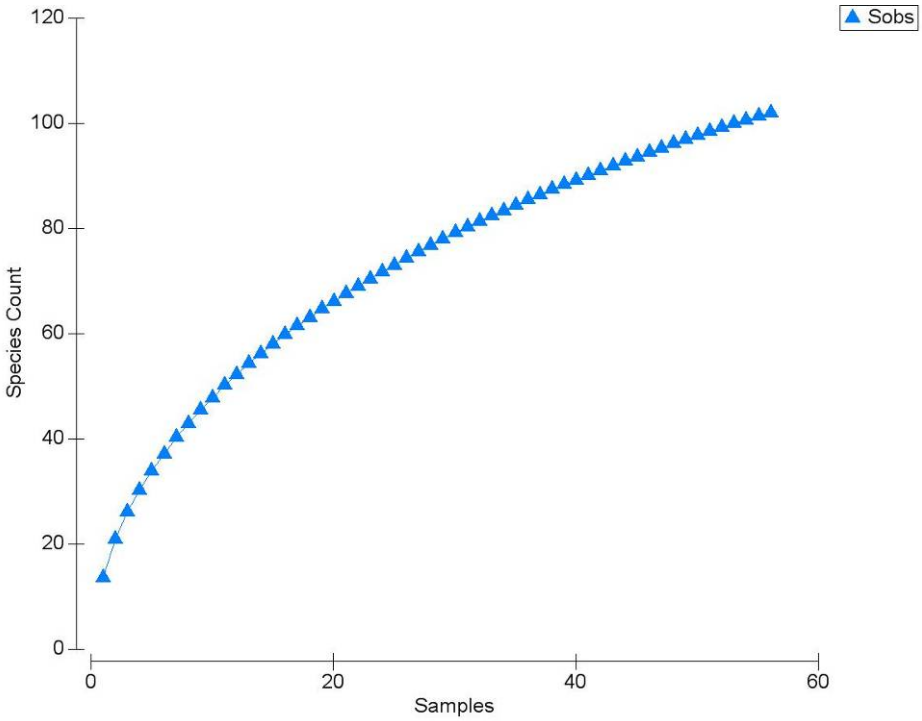

Figure 41: Species accumulation curve, mangrove habitat

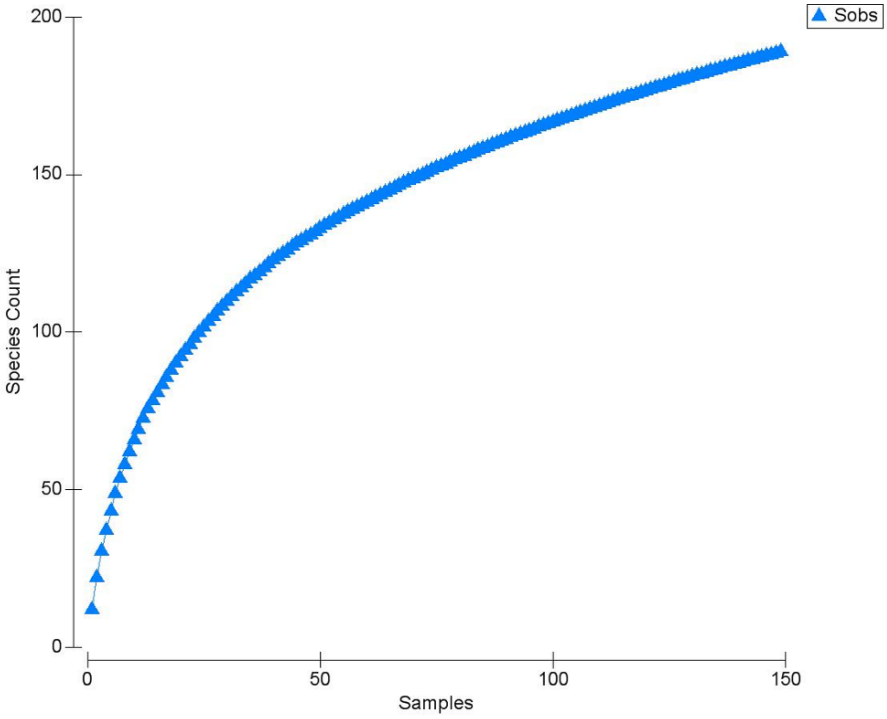

Figure 42: Species accumulation curve, brackish soft, inclusive mangrove

Finally, when sites are grouped by habitat, but treating mangrove sites as brackish soft shores (Table 23), it is apparent that no asymptote is reached on the species accumulation curve for brackish soft shores (Figure 42). Accordingly, further sampling in soft-sediment habitats (inclusive mangrove habitat) almost certainly will result in identification of additional species. This curve differs from that in Figure 41 because not all mangrove sites occur in brackish habitat (mangroves are typical of enclosed coasts, often but not exclusively within estuarine (= brackish) environment).

Hard substrata identified during surveys included boulders, rocky reef, platform reef and cobbles, and to a lesser extent the likes of trees, logs, pipes, plastics, bottles and other extraneous debris (Figure 43). Marine soft substrata encountered during surveys were mostly mud and sand, an admixture of two, and a category referred to as ‘mangrove mud’ (Figure 44).

To determine whether additional relationships exist between the composition of species identified from any site and substratum, an MDS plot (Figure 45) was prepared, and the significance of observed groupings were confirmed using simple ANOSIM pairwise tests (Table 67 (Appendix 2) and Figure 78 (Appendix 3)). This MDS plot reveals 10 apparent communities, although ANOSIM results for marine hard shores reveal none of platform reefs, rocky reefs and boulders have discrete, different assemblages of species, whereas those assemblages on cobble habitat do; marine soft substrata that appear to host discrete assemblages of species include sand, mud, and ‘mangrove mud.’

There are relatively few sites surveyed at which tree logs, pipes, sand/mud and mangrove habitats were encountered (Figures 43, 44), which will affect the significance of any groupings in the MDS plot (Figure 45) and ANOSIM tests (Table 67, Appendix 2).

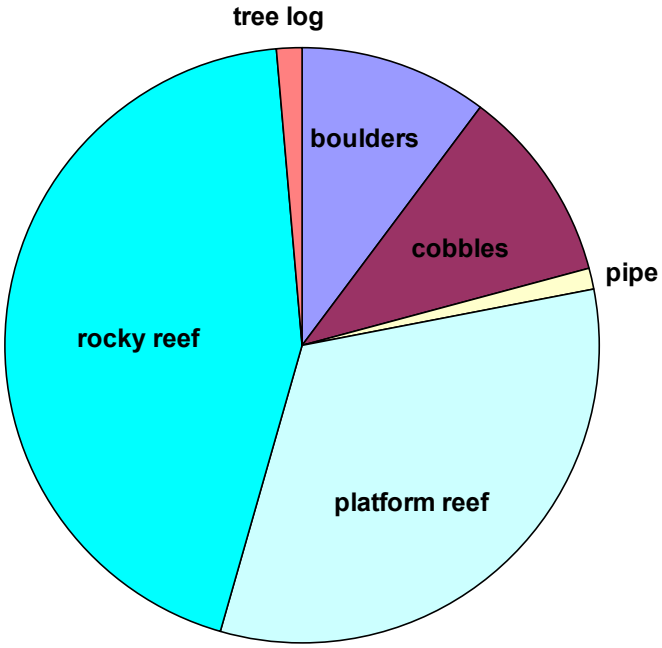

Figure 43: Relative contribution of marine hard-shore substratum type by site

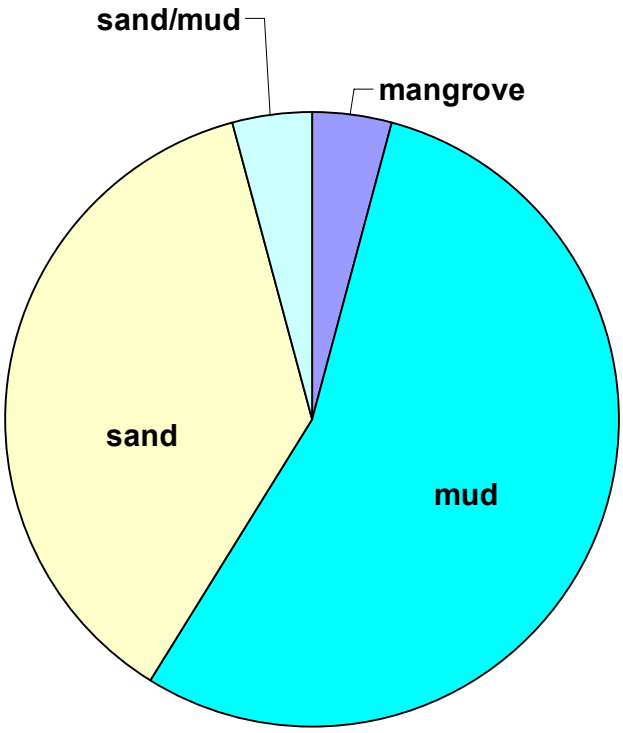

Figure 44: Relative contribution of marine soft-shore substratum type by site

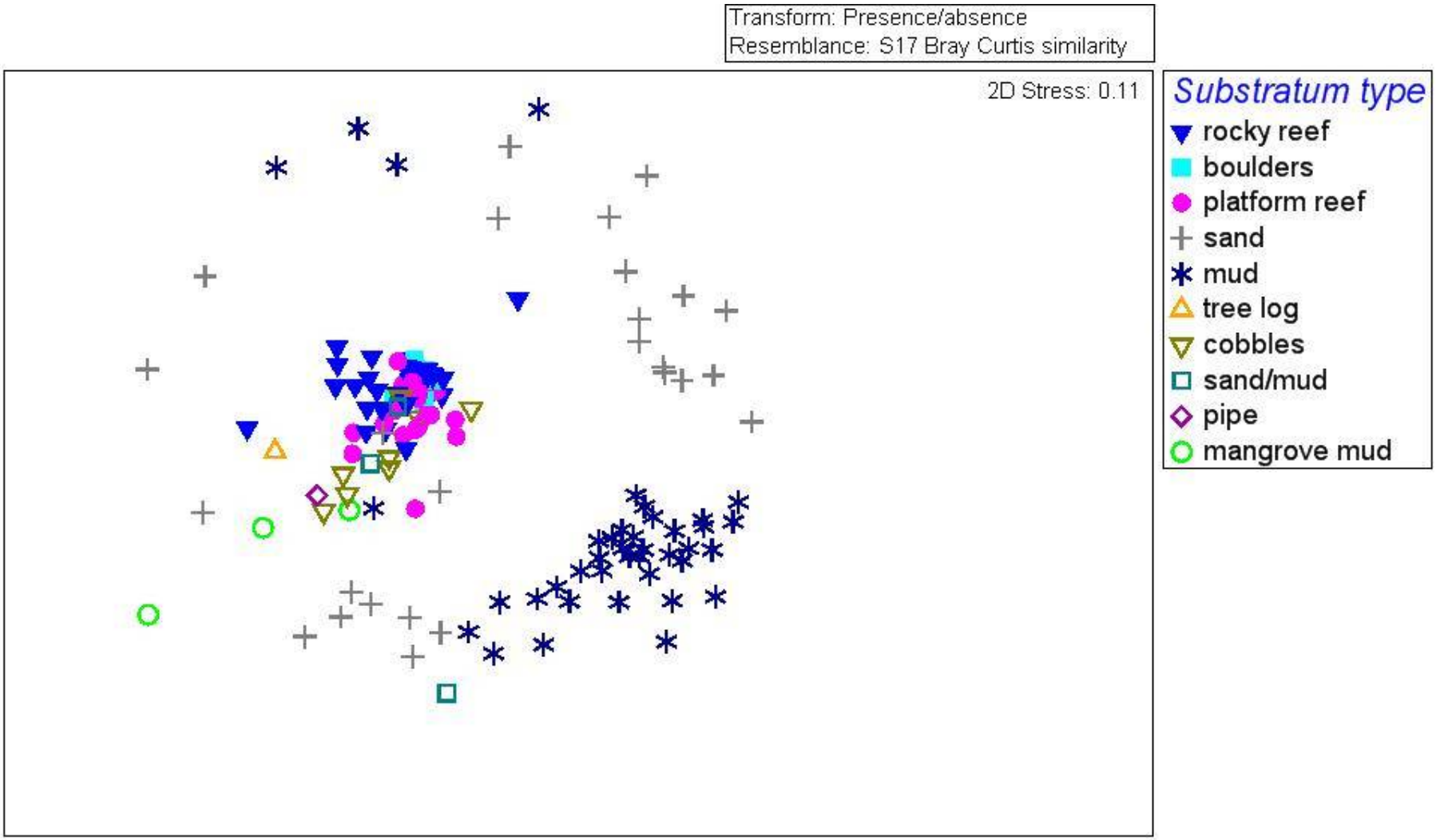

Figure 45: MDS plot of species assemblages occurring on or in marine hard and soft shores by substratum type

Brackish hard and soft substrata

Five different substrata (Figure 46) were identified during surveys in brackish habitat. An MDS plot of these groupings is depicted in Figure 47. Brackish soft shores generally comprised mangrove mud, mud, sand, or an admixture of the two (muddy sand), although some hard substrata occurred, such as cobbles and extraneous debris. ANOSIM results show significant differences in these five habitats (Figure 79, Appendix 3), although further characterisation was not done due to low sample sizes.

The species assemblage characterising muddy shores amongst mangroves is distinct from that otherwise classified as mud, with sites robustly staying together compared with communities occurring on or within other soft-shore substrata.

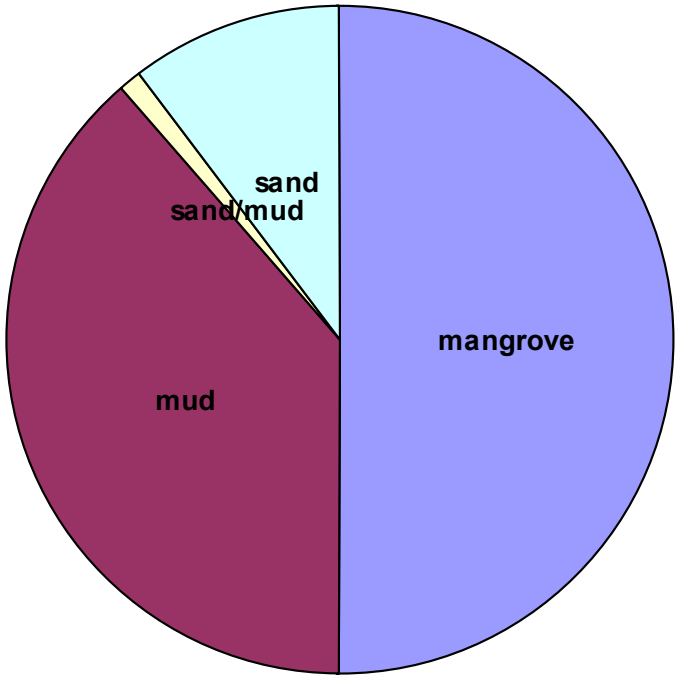

Figure 46: Relative contribution of brackish soft-shore substratum type by site

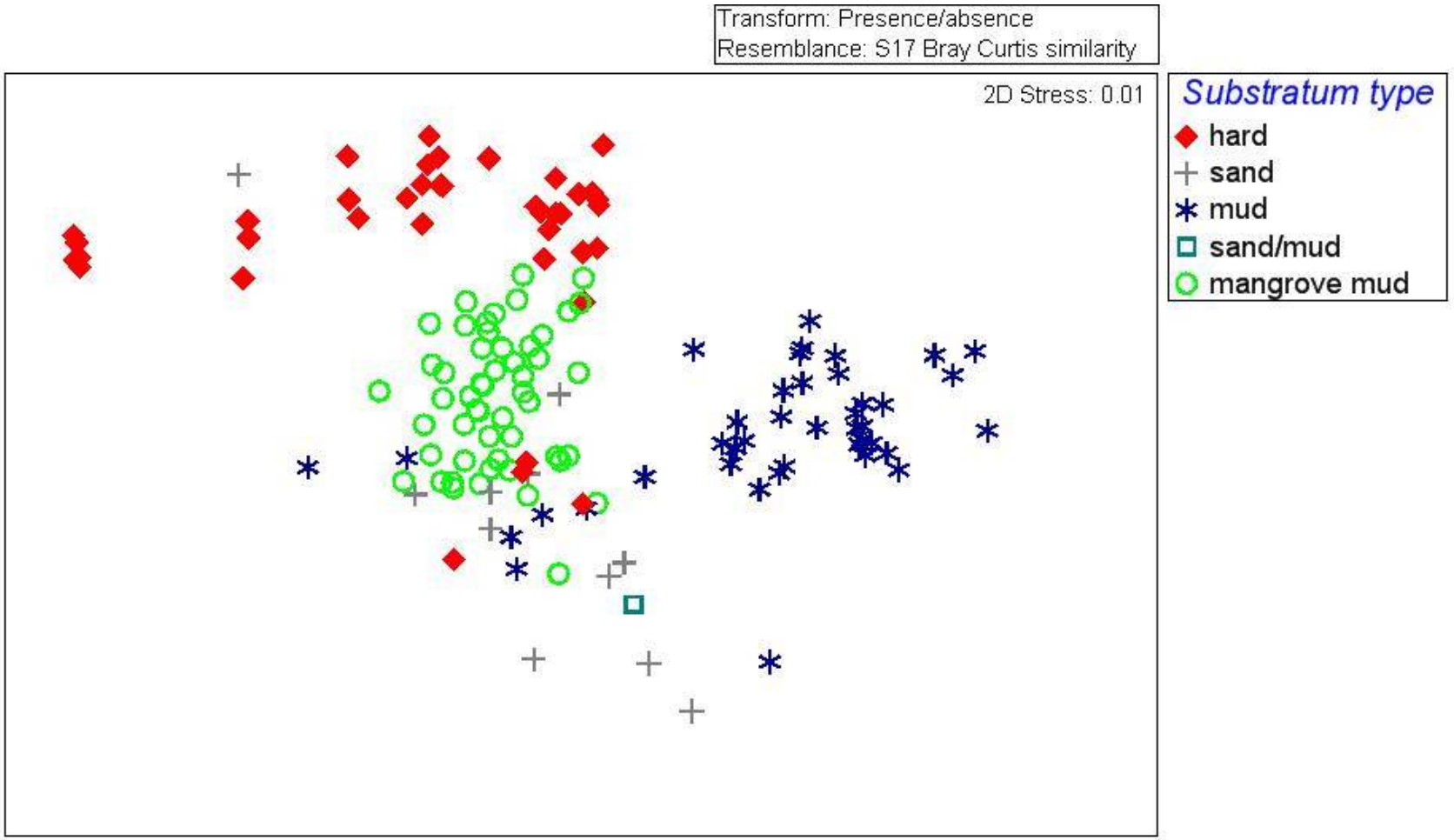

Figure 47: MDS plot of species assemblages found on or in brackish hard and soft shores by substratum type

Adopted intertidal habitat classification

Analyses reveal the species occurring in the two salinity regimes (brackish or saline), and substratum types (soft or hard) differ, and that further resolution is possible at even finer scales (MDS plots, Figures 45, 47). However, additional analyses at these finer scales were not undertaken given the low number of sites for which data are available at these levels (Figures 43, 44, 46).

Mangroves generally (but not exclusively) occur on brackish soft shores, and have distinct assemblages of species. This is the only habitat type for which the number of surveyed sites (Figure 46) is deemed sufficient to warrant analysis and justify separation of species assemblages from any other brackish or marine soft-shore habitat. A simple ANOSIM test (Table 68, Appendix 2; Figure 80, Appendix 3) confirms the difference in assemblages of species occurring in this habitat from those of any other marine or brackish soft or hard shore type. The MDS plot (Figure 48) demonstrates the level of distinction between species assemblages found on mangrove-characterised shores and other habitat types.

These analyses reveal five broad habitat types occur throughout the survey region: marine hard, marine-soft, brackish-hard, brackish-soft and mangrove habitats, with the number of sites surveyed and variability in species richness within each habitat presented in Table 25. Variation in species richness in each of these habitat types influences subsequent analyses, especially the proposal of novel indices of species richness for the surveyed region.

Table 25: Habitat classification of 296 sampling sites

Habitat type	No. of sites	Species count	Site species count (Min)	Site species count (Max)
brackish hard	40	125	1	47
brackish soft	53	85	1	23
mangrove	56	100	4	25
marine hard	77	634	10	179
marine soft	70	241	1	85

With the recognition that mangrove habitat hosts discrete assemblages of species distinct from other muddy habitat surveyed, those species characterising the latter habitat now differ from those earlier proposed for marine and brackish soft shores (Tables 64, 66 (Appendix 2)). The relative importance of taxa characterising each of mangrove, brackish- and marine-soft shores are presented in Tables 26–28.

Table 26: Mangrove species. Breakdown of average similarity (47.63) within mangrove groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Avicennia resinifera	1.00	8.06	3.36	16.93	16.93
Helice crassa	0.91	6.49	1.80	13.63	30.56
Ophicardelus costellaris	0.80	5.26	1.22	11.04	41.60
Potamopyrgus estuarinus	0.79	5.03	1.15	10.56	52.16
Amphibola crenata	0.73	4.56	0.97	9.58	61.74
Austrominius modestus	0.66	3.00	0.84	6.29	68.03
Syncassidina aestuaria	0.57	2.42	0.66	5.08	73.10
Crassostrea gigas	0.61	2.37	0.73	4.98	78.08
Sphaeroma quoyanum	0.57	2.31	0.67	4.85	82.93
Cominella glandiformis	0.48	1.54	0.53	3.23	86.16
Teredinidae sp.	0.45	1.23	0.48	2.58	88.74
Zeacumantus lutulentus	0.39	0.95	0.41	1.99	90.72

Table 27: Brackish soft shore species. Breakdown of average similarity (23.66) within brackish soft shore groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Perinereis nuntia	0.57	4.11	0.62	17.39	17.39
Capitella capitata	0.53	3.54	0.58	14.95	32.34
Nicon aestuariensis	0.45	2.82	0.46	11.93	44.26
Amphipoda sp.	0.42	2.23	0.42	9.41	53.67
Paracorophium excavatum	0.42	1.87	0.43	7.90	61.57
Helice crassa	0.36	1.71	0.31	7.24	68.82
Scolecolepides benhami	0.36	1.63	0.35	6.91	75.72
Potamopyrgus pupoides	0.40	1.60	0.40	6.77	82.49
Potamopyrgus estuarinus	0.32	1.16	0.31	4.90	87.39
Macrophthalmus hirtipes	0.17	0.40	0.16	1.71	89.09
Palaemon affinis	0.19	0.32	0.17	1.36	90.45

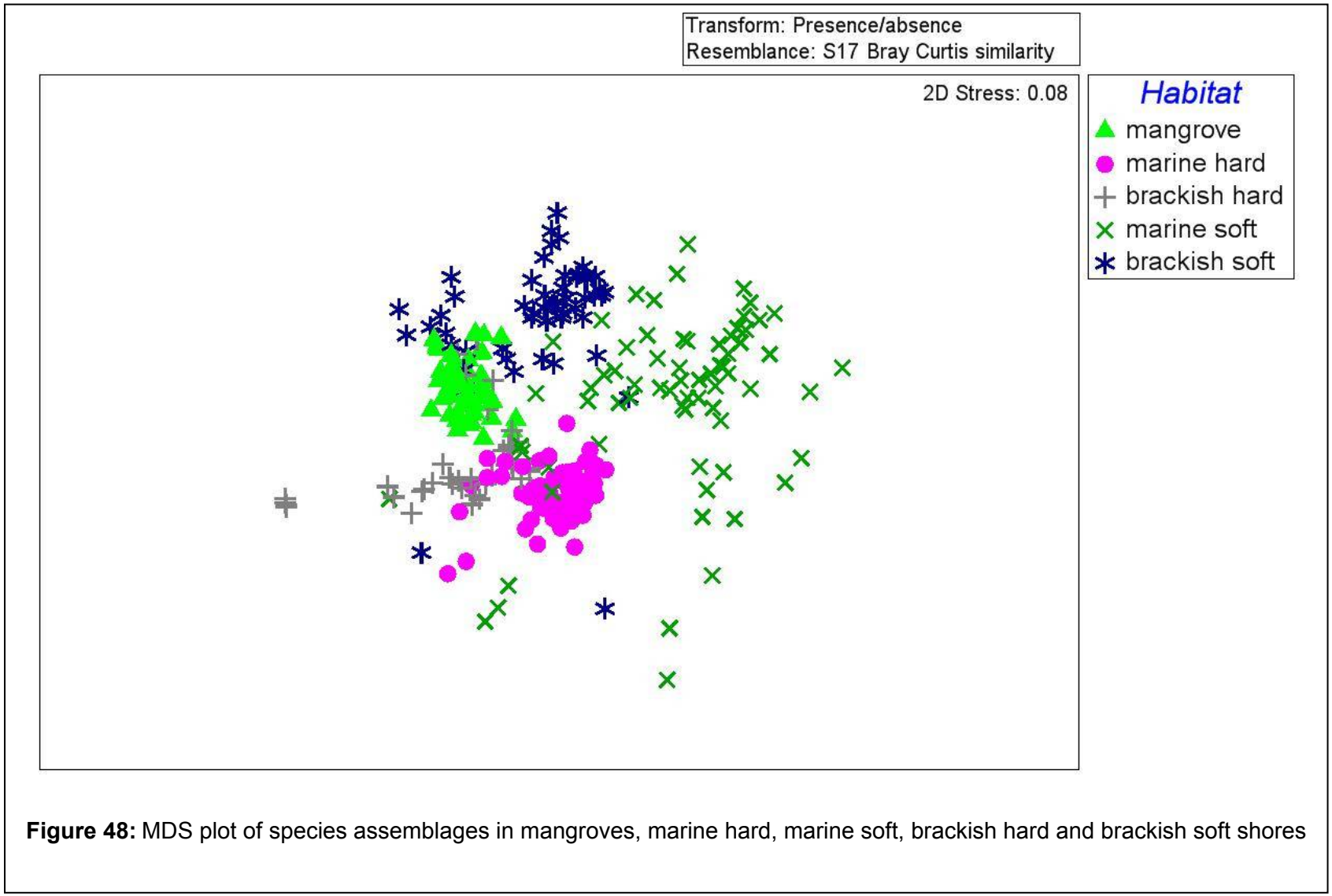

Figure 48: MDS plot of species assemblages in mangroves, marine hard, marine soft, brackish hard and brackish soft shores

Table 28: Marine soft-shore species. Breakdown of average similarity (10.22) within marine soft shore groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Macroclymenella stewartensis	0.40	1.91	0.40	18.71	18.71
Saccoglossus australiensis	0.34	1.57	0.34	15.33	34.03
Nemertea sp.	0.27	0.72	0.25	7.08	41.11
Nephtys macroura	0.23	0.71	0.22	6.91	48.03
Orbinia papillosa	0.23	0.60	0.21	5.90	53.93
Macomona liliana	0.20	0.44	0.18	4.27	58.20
Trochodota dendyi	0.20	0.39	0.19	3.83	62.03
Axiothella serrata	0.20	0.33	0.19	3.23	65.26
Amphipoda sp.	0.14	0.28	0.12	2.77	68.03
Oridia sp.	0.17	0.28	0.16	2.77	70.80
Magelona papillicornis	0.16	0.25	0.14	2.49	73.29
Chaerodes concolor	0.14	0.24	0.12	2.35	75.64
Callianassa filholi	0.11	0.17	0.10	1.68	77.32
Lepidasthenia sp.	0.13	0.15	0.12	1.50	78.83
Haminoea zelandiae	0.13	0.15	0.11	1.47	80.30
Anthopleura aureoradiata	0.17	0.15	0.15	1.46	81.75
Austrovenus stutchburyi	0.16	0.14	0.14	1.35	83.10
Talorchestia quoyana	0.10	0.12	0.08	1.17	84.27
Fellaster zelandiae	0.10	0.11	0.09	1.05	85.32
Paphies australis	0.13	0.09	0.10	0.91	86.23
Polychaeta sp.	0.10	0.08	0.08	0.78	87.00
Cominella glandiformis	0.13	0.08	0.11	0.74	87.74
Zeacumantus lutulentus	0.10	0.07	0.07	0.68	88.42
Notoacmea helmsi	0.10	0.06	0.07	0.63	89.05
Talorchestia sp.	0.07	0.06	0.06	0.55	89.60
Nucula hartvigiana	0.11	0.06	0.10	0.54	90.14

Ordination and usage of biodiversity measures

1) *Rarity index*

In accordance with Table 5 (Methods), each species occurring within each of the five recognised habitat types at each site has been attributed a rarity score of very rare to ubiquitous (Table 48 (Appendix 2)).

Marine-hard shores (Figure 49) are the most species rich of all shores examined. At each surveyed site, regardless of total species richness, a large proportion of species encountered are deemed to be rare or very rare, with most other species assigned to one of uncommon, frequent or common categories; relatively few species are recognised as being very common or ubiquitous in distribution.

Brackish-hard shores (Figure 50) are less species rich than marine hard shores, and the relationship between total species richness and the the rarity of species comprising any assemblage at any site is less apparent, especially at sites where few species occur. As richness increases (progressing from left to right on the X-axis),

the proportion of very rare and rare species to the total species pool increases, but this then decreases again at the most species-rich sites. The largest contribution of taxa are those of an uncommon to common nature, with those of a very common to ubiquitous nature usually contributing relatively few species to the total assemblage at any site.

Marine-soft shores (Figure 51) are the second-most species rich of those surveyed and appear to be dominated by very common, common and frequent species, although very rare species and rare species can comprise a significant proportion of the total species at several sites, particularly at more species-rich sites; ubiquitous species almost always are present, although a recurring pattern is for these to contribute proportionally less to the total assemblage of species at any site as species richness increases.

Brackish-soft shores (Figure 52) have the lowest species richness of all habitat types surveyed, and a high proportion of common to uncommon species, although very rare and rare species occur throughout, usually at sites of higher species richness.

Mangrove shores (Figure 53) have the second lowest richness of all surveyed habitats. Species occurring within this habitat range from very rare to ubiquitous in distribution, with very common to uncommon taxa making up a substantial proportion of the total richness. As for all other habitats, the relative proportion of ubiquitous taxa decreases with an increase in site species richness.

2) *Species Richness index*

Sites within habitats have been characterised as one of very high to very low species richness, using the 7-point species-richness index proposed in Table 6, and the maximum species count of any habitat type (Table 29).

The distribution of species richness on marine hard shores (Figure 54) reveals no consistent geographic trend, with sites of low and very high richness found throughout the survey region, and with several sites in close proximity to the Auckland central business district (CBD) having both fairly low to very high species richness. Proximal to the Auckland CBD the highest species richness usually occurred on islands within Waitemata Harbour (such as Motutapu and Waiheke Islands) and Hauraki Gulf (Great Barrier Island), but elevated levels also occurred at sites on the northern and eastern Coromandel Peninsula, and on the East Coast mainland just north of Auckland, and at Bream Bay and Whangarei Heads.

The distribution of species richness on marine-soft shores (Figure 55) similarly revealed no consistent geographic trend, with sites of low and very high richness occurring throughout the survey region; sites are relatively sparsely distributed.

The distribution of species richness on brackish-hard shores (Figure 56), like that of marine-soft shores, reveals no consistent geographic trend, but again sites are too sparsely distributed to reveal spatial patterns. Remarkably, the greatest species richness at any site was recorded close to the Auckland CBD.

The distribution of species richness on brackish-soft shores (Figure 57), like those of the previous habitat types, similarly reveals no clear geographic trend, although those sites closest to the Auckland CBD generally have the lowest richness of any sites surveyed. Sampling effort in this habitat type is more widely and evenly spread than the previous two habitat types.

Species richness on mangrove shores (Figure 58) is both high and low in the immediate vicinity of the Auckland CBD, but otherwise reveals no clear geographic trend. Sampling effort in this habitat type is about as widely and evenly spread as that of brackish soft shores.

Table 29: Ordination of species richness using a 7-point scale by habitat type (number in parentheses is maximum species count for a given habitat type). Numbers in columns are absolute species counts, or ranges in species count.

Species Richness index	**Marine Hard (179)**	**Soft Marine (85)**	**Brackish Hard (47)**	**Brackish Soft (23)**	**Mangrove (25)**
Very low	< 9	< 5	< 3	< 2	< 2
Low	9−18	5−8	3 or 4	2	2
Fairly low	19−45	9−21	4−11	3−5	3−6
Medium	46−90	22−42	12−23	6−11	7−12
Fairly high	91−134	43−63	24−35	12−17	13−18
High	135−170	64−80	36−44	18−21	19−23
Very high	171−179	81−85	45−47	22 or 23	24 or 25

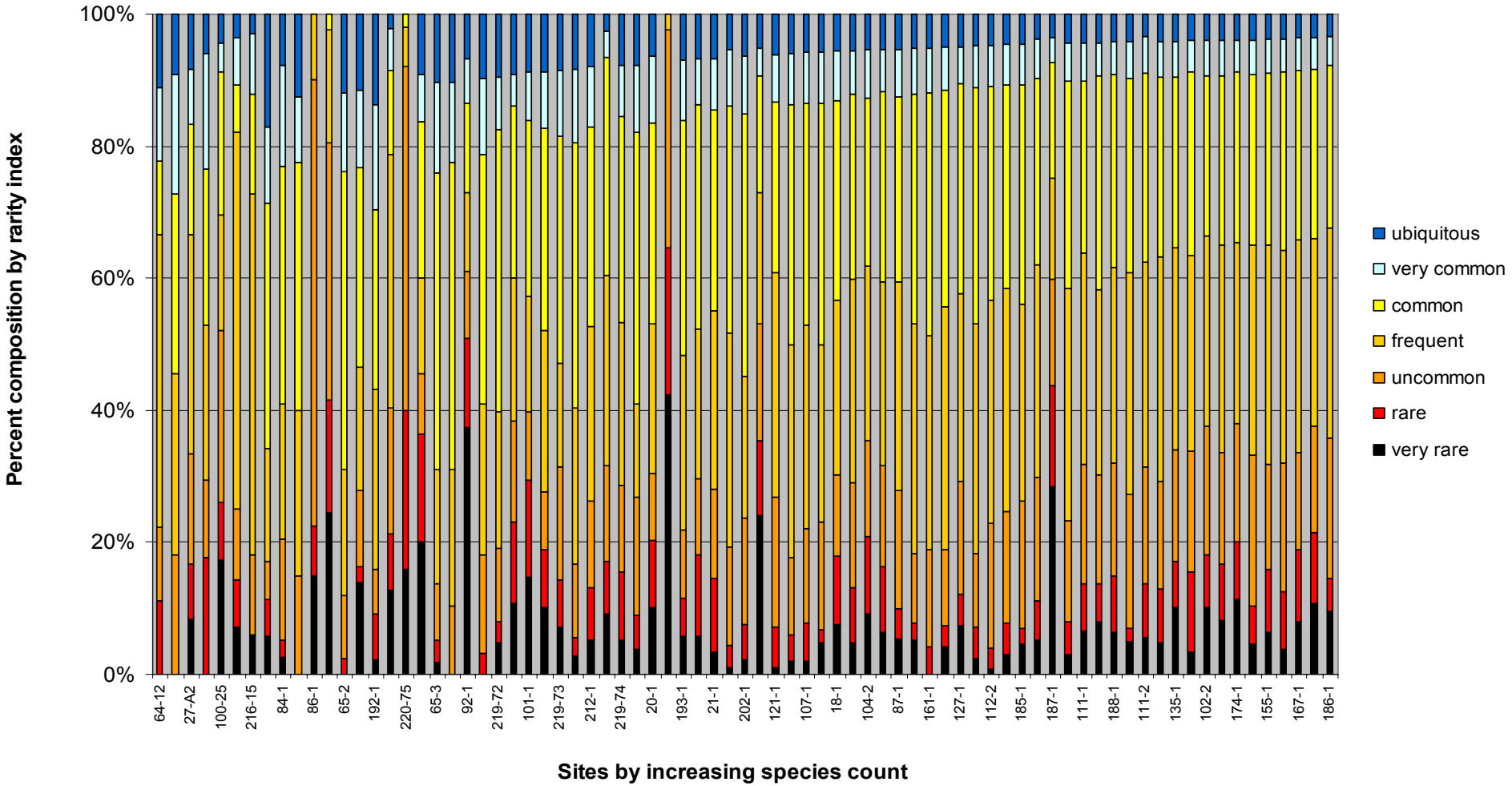

Figure 49: Relative contribution of species at sites by rarity index, marine-hard shores

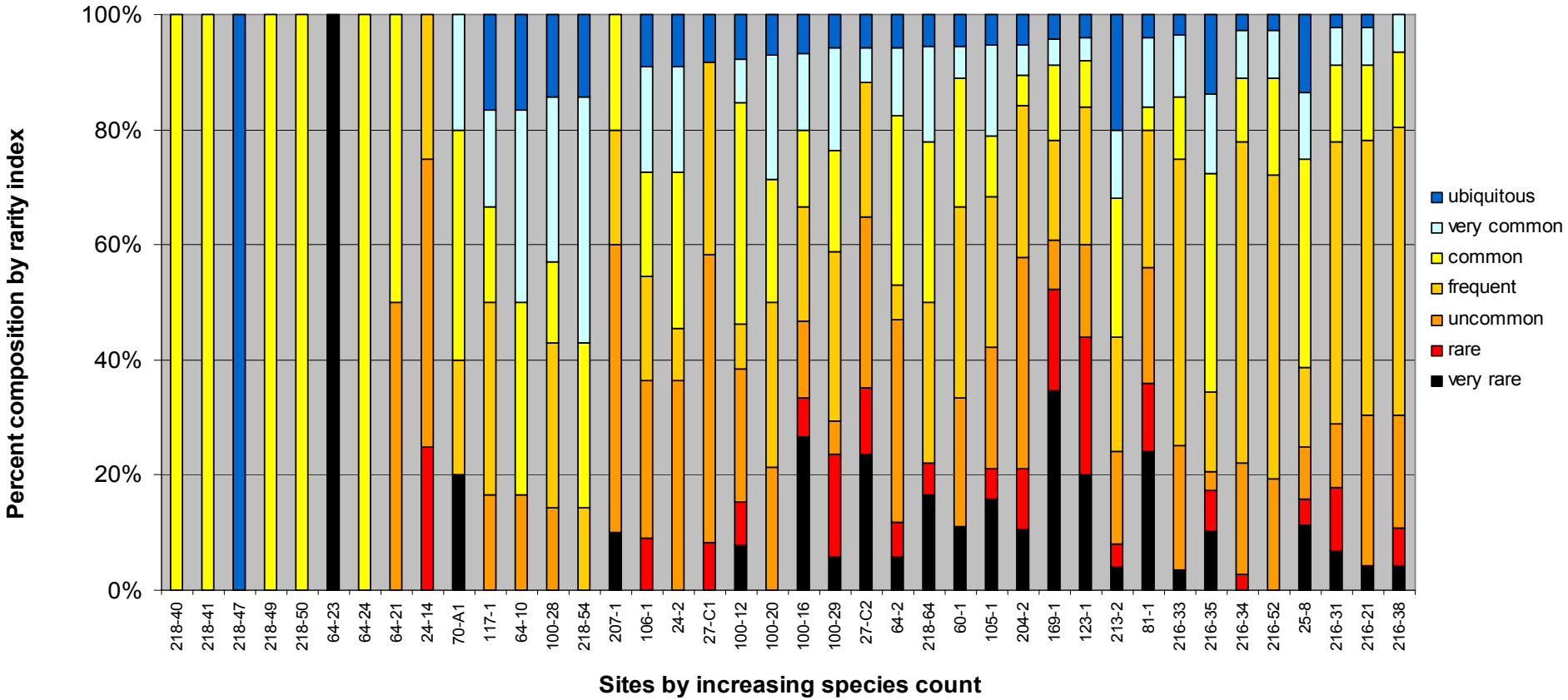

Figure 50: Relative contribution of species at sites by rarity index, brackish-hard shores

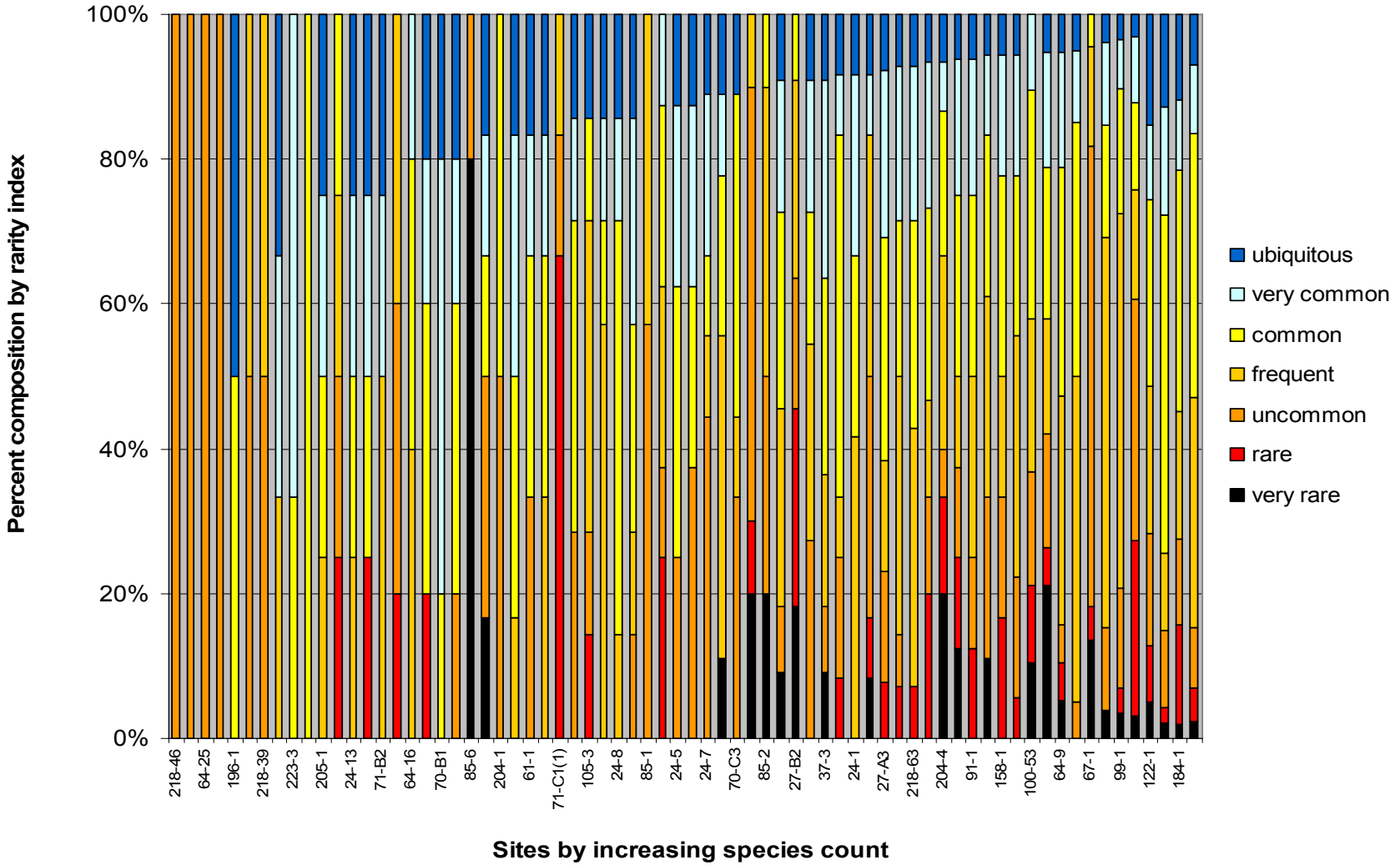

Figure 51: Relative contribution of species at sites by rarity index, marine-soft shores

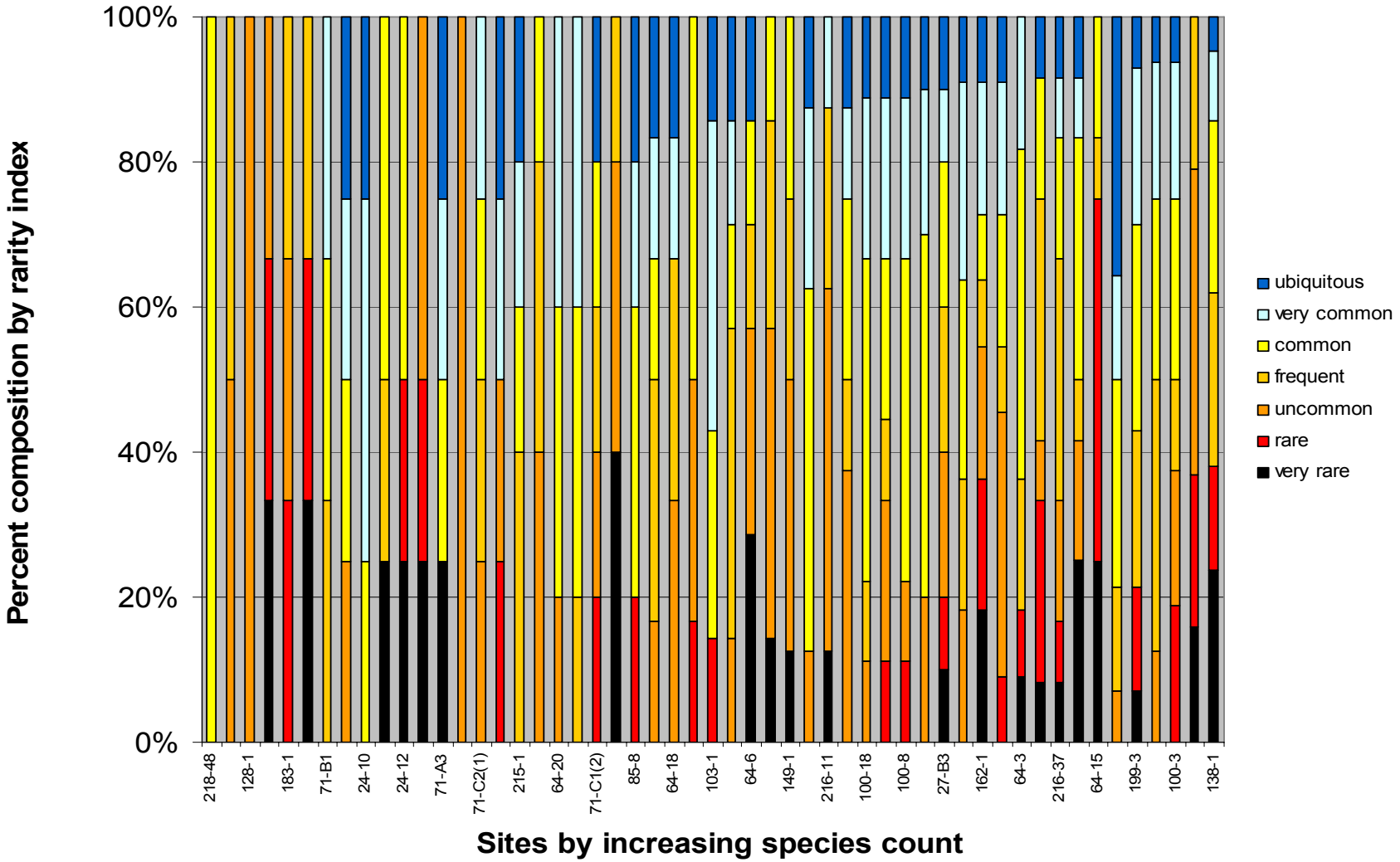

Figure 52: Relative contribution of species at sites by rarity index, brackish-soft shores

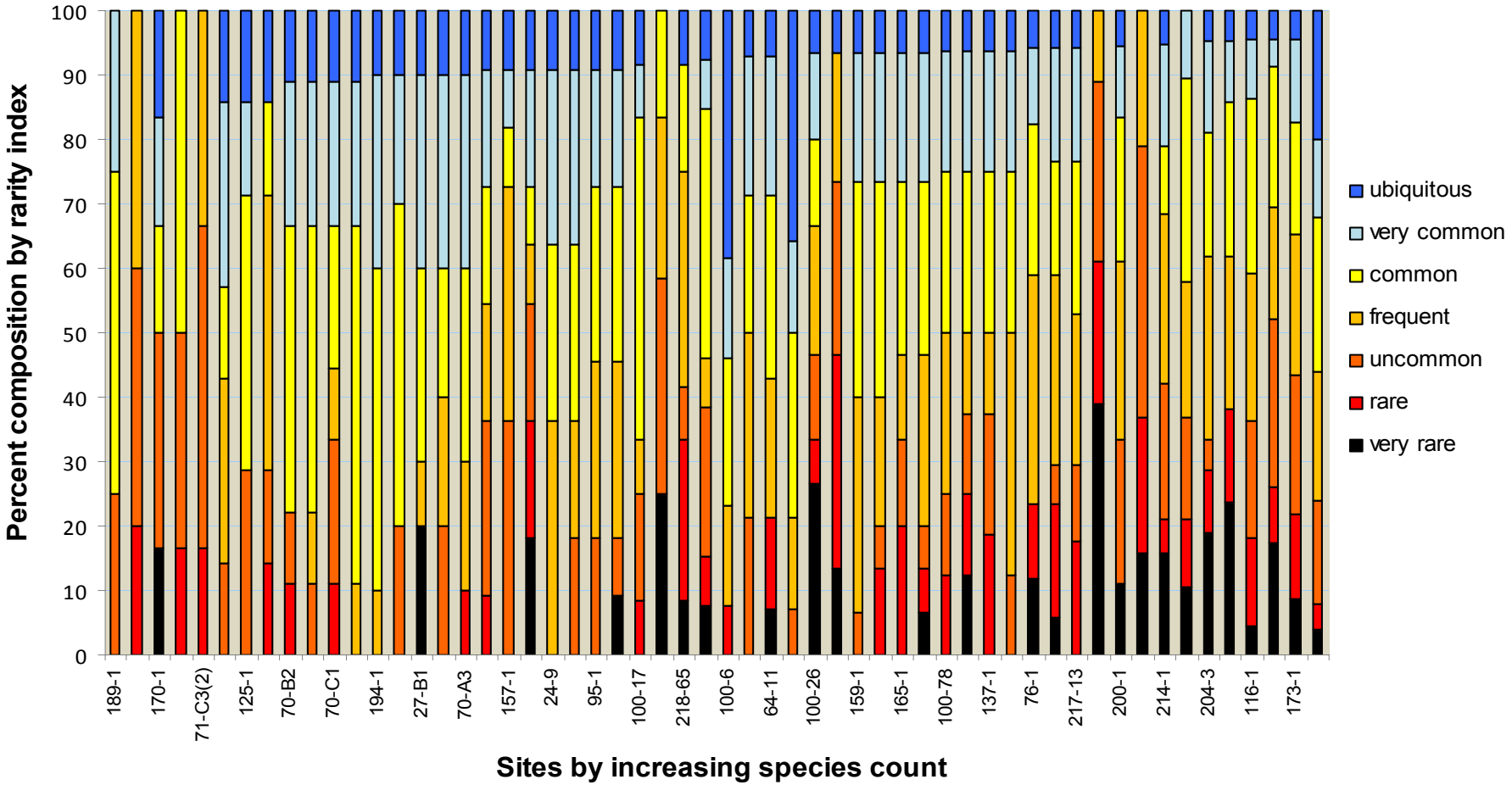

Figure 53: Relative contribution of species at sites by rarity index, mangrove shores

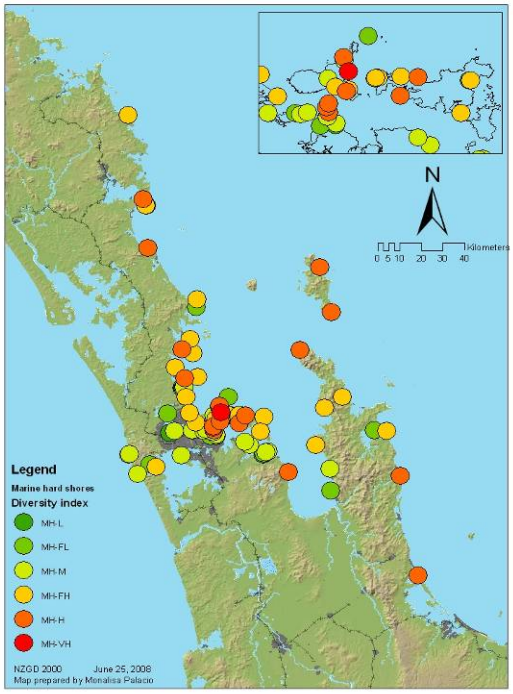

Figure 54: Marine hard shores species richness

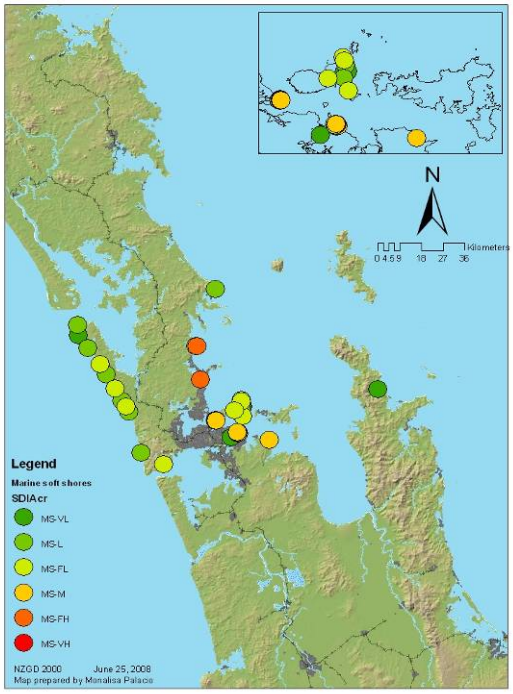

Figure 55: Marine soft shores species richness

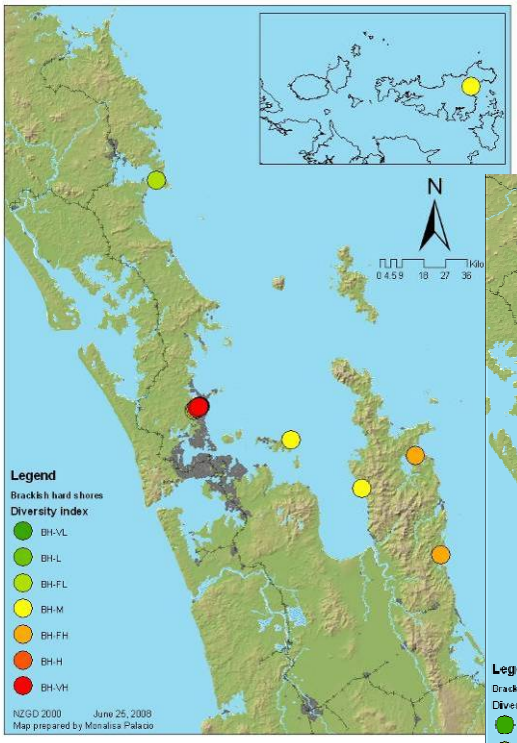

Figure 56: Brackish hard shores species richness

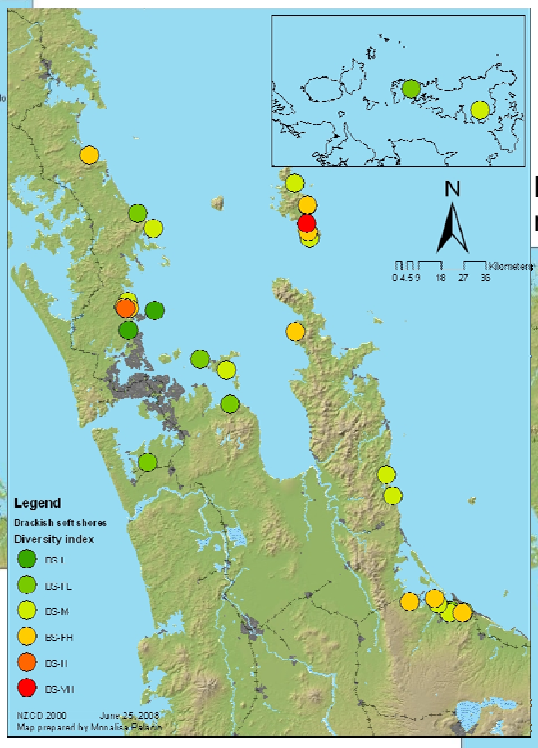

Figure 57: Brackish soft shores species richness

Figure 58: Mangrove species richness

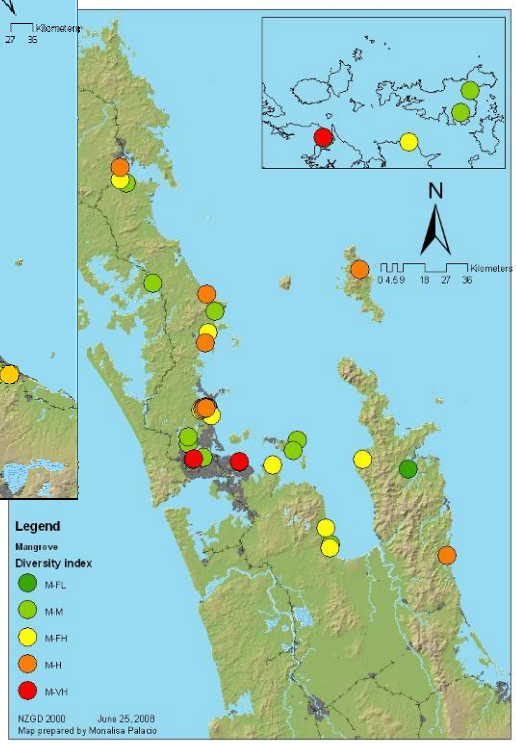

Table 30: Site richness and composition by rarity (Acronyms in Table 49, Appendix 2)

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
MH-VH	Motutapu Island: Home Bay	186-1	179	9	5	21	32	25	4	3
MH-H	McGregors Bay	102-1	168	11	11	16	29	26	5	4
MH-H	Great Barrier Island: Tryphena Harbour Site2	167-1	164	8	11	15	32	26	5	4
MH-H	Scott Point	139-1	159	4	9	19	32	27	5	4
MH-H	Waiheke Island: The Needles	155-1	157	6	10	16	33	26	5	4
MH-H	Motuihe Island	112-1	154	5	6	23	32	26	5	4
MH-H	Great Barrier Island: Whangapoua Beach	174-1	150	11	9	18	27	26	5	4
MH-H	McGregors Bay	102-2	149	10	8	19	29	24	5	4
MH-H	Bowentown	119-1	149	8	9	17	32	26	5	4
MH-H	Port Jackson	109-1	148	3	12	18	30	28	5	4
MH-H	Langs Beach	135-1	147	10	7	17	31	26	5	4
MH-H	Pauanui Beach	115-1	147	5	8	16	34	27	5	4
MH-H	Browns Island	111-2	146	5	8	18	31	29	5	3
MH-H	Waiheke Island: Putiki Bay	164-1	143	5	2	20	34	29	6	4
MH-H	Motutapu Island: Waikarapupu Bay	188-1	141	6	9	17	30	29	5	4
MH-H	Thames (Miranda)	108-1	139	8	6	17	28	32	5	4
MH-H	Browns Island	111-1	138	7	7	18	32	26	6	4
MH-H	Waitemata Harbour Reference Collection	8-1	137	3	5	15	35	31	6	4
MH-H	Whangaparoa Peninsula: Stanmore Bay	187-1	137	28	15	16	15	18	4	4
MH-FH	Oamaru Bay	110-1	134	5	6	19	32	28	6	4
MH-FH	Martins Bay Reserve	140-1	130	3	5	17	34	31	6	5
MH-FH	Motutapu Island: Emu Point	185-1	130	5	2	19	30	33	6	5
MH-FH	Motuihe Island	112-2	127	1	3	19	34	32	6	5
MH-FH	Takapuna Survey	132-1	126	2	5	11	35	36	6	5
MH-FH	Kennedy Bay (1)	127-1	123	7	5	17	28	32	6	5
MH-FH	Long Bay	133-1	122	4	3	11	37	33	7	5
MH-FH	Waiheke Island: Te Matuku Bay	161-1	117	0	4	15	32	37	7	5
MH-FH	Waiheke Island: Enclosure Bay	163-1	115	5	3	10	35	35	7	5
MH-FH	Goat Island	141-1	111	6	10	15	28	29	6	5
MH-FH	Okoromai Beach	87-1	111	5	5	18	32	28	7	5
MH-FH	Smugglers Bay	104-2	110	9	12	15	26	25	7	5
MH-FH	Whananaki: Mimiwhangata Bay	147-1	107	5	8	16	31	28	7	6
MH-FH	NorthHead Beach	18-1	106	8	10	12	26	30	8	6
MH-FH	Waiheke Island: Matiatia	107-2	104	5	2	16	27	37	8	6
MH-FH	Waiheke Island: Matiatia	107-1	104	2	6	14	31	34	8	6
MH-FH	Waiheke Island: Man O'War Bay (2)	160-1	102	2	4	12	32	36	8	6
MH-FH	Gemstone Bay	121-1	97	1	6	20	34	26	7	6
MH-FH	Manukau Harbour Reference Collection	9-1	96	24	11	18	20	18	4	5
MH-FH	Coromandel: Kikowhakarere Bay	202-1	93	2	5	16	22	40	9	6
MH-FH	Orewa Beach	148-1	93	1	3	15	32	34	9	5
MH-M	St. Heliers Bay	21-1	89	3	11	13	27	30	8	7

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
MH-M	Musick Point	22-1	88	6	13	11	23	34	7	7
MH-M	Thames: Ruamahanga Bay	193-1	87	6	6	10	26	36	9	7
MH-M	Waiheke Island: Matiatia	107-3	85	42	22	33	2	0	0	0
MS-VH	Wenderholm Beach	86-2	85	2	5	8	32	36	9	7
MH-M	Kohimarama Beach (2)	20-1	79	10	10	10	23	30	10	6
MH-M	Eastern Beach (2)	63-1	78	4	5	18	14	41	10	8
MH-M	Okura River Marine	219-74	77	5	10	13	25	31	8	8
MH-M	Point Chevalier	212-1	76	5	8	13	26	30	9	8
MH-FH	Motuora Island	35-1	76	9	8	14	29	33	4	3
MH-M	Umupuia Beach (1)	66-1	72	3	3	11	24	40	11	8
MH-M	Okura River Marine	219-73	70	7	7	17	16	34	10	9
MH-M	Station Bay (1)	23-1	69	10	9	9	25	30	9	9
MH-M	Piha Beach	101-1	68	15	15	10	18	26	7	9
MH-M	Whatipu Beach	17-1	65	11	12	15	22	26	5	9
MH-M	Okura River Marine	219-72	63	5	3	11	21	43	8	10
MH-M	Duder's Beach	191-1	61	0	3	15	23	38	11	10
MH-M	Puketutu Island	92-1	59	37	14	10	12	14	7	7
MH-M	Mechanics Bay	74-1	58	0	0	10	21	47	12	10
MH-M	Kawakawa Bay	65-3	58	2	3	9	17	45	14	10
MH-M	Piha Beach	101-2	55	20	16	9	15	24	7	9
MH-M	Motutapu Island: Islington Bay	184-1	51	2	14	12	18	33	10	12
MS-FH	Okura River Soft Shore	220-75	50	16	24	52	6	2	0	0
BH-VH	Okura River Brackish (1)	216-30	47	2	2	11	11	47	15	13
MH-M	Kawakawa Bay	65-4	47	13	9	19	38	13	6	2
BH-VH	Okura River Brackish (1)	216-38	46	4	7	20	50	13	7	0
BH-VH	Okura River Brackish (1)	216-21	46	4	0	26	48	13	7	2
BH-VH	Okura River Brackish (1)	216-31	45	7	11	11	49	13	7	2
MH-FL	Matheson Bay	25-8	44	11	5	9	14	36	11	14
MH-FL	Thames: Whakatete Bay	192-1	44	2	7	7	27	27	16	14
MH-FL	Otata Island, Noises	16-1	43	14	2	12	19	30	12	12
MH-FL	Kawakawa Bay	65-2	42	0	2	10	19	45	12	12
MS-FH	Wenderholm Beach (3)	197-1	41	24	17	39	17	2	0	0
MS-M	Wenderholm Beach	86-1	40	15	8	68	10	0	0	0
MH-FL	Kohimarama Beach (1)	19-1	40	0	0	15	25	38	10	13
MH-FL	Lonely Bay	122-1	39	5	8	15	21	26	10	15
MH-FL	Little Huia Beach	84-1	39	3	3	15	21	36	15	8
BH-H	Okura River Brackish (1)	216-52	36	0	0	19	53	17	8	3
BH-H	Okura River Brackish (1)	216-34	36	0	3	19	56	11	8	3
MH-FL	Okura River Marine	219-76	35	6	6	6	17	37	11	17
MH-FL	Smugglers Bay	104-1	33	3	24	33	15	12	9	3
BH-FH	Okura River Brackish (1)	216-15	33	6	0	12	55	15	9	3
BH-FH	Okura River Brackish (1)	216-35	29	10	7	3	14	38	14	14
MH-FL	Herald Island Wharf	99-1	29	3	3	14	52	17	7	3

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
BH-FH	Whangamata (2)	118-1	28	7	7	11	57	7	7	4
BH-FH	Okura River Brackish (1)	216-33	28	4	0	21	50	11	11	4
BH-FH	Okura River Brackish (1)	216-45	26	4	0	12	54	15	12	4
M-VH	Pollen Island Mangrove	213-2	25	4	4	16	20	24	12	20
BH-FH	Lonely Bay (1)	123-1	25	20	24	16	24	8	4	4
MH-FL	Tahuna Torea	81-1	25	24	12	20	24	4	12	4
M-H	Okura River Mangrove	100-25	23	17	9	26	17	22	4	4
M-H	Great Barrier Island: Mangrove, Whangapoua Estuary	173-1	23	9	13	22	22	17	13	4
BS-VH	Great Barrier Island: Estuary, Medlands Rd	169-1	23	35	17	9	17	13	4	4
BH-M	Okura River Brackish (3)	218-58	23	35	26	22	4	9	0	4
MS-M	Umupuia Beach (2)	67-1	22	14	5	64	14	5	0	0
M-VH	Tahuna Torea Mangrove (2)	83-1	22	5	14	18	23	27	9	5
M-H	Snells Beach	138-1	21	24	14	0	24	24	10	5
M-H	Whangamata mangrove	116-1	21	19	10	5	29	19	14	5
BH-M	Okura River Brackish (3)	218-62	20	0	0	5	45	35	10	5
MS-FL	Motutapu Island: Islington Bay Soft Shore	204-2	19	11	11	37	26	5	5	5
M-H	Pakiri Beach Estuarine Stream2	182-1	19	16	21	42	21	0	0	0
MS-FL	Motutapu Island: Islington Bay soft shore	204-3	19	11	16	58	16	0	0	0
BH-M	Okura River Brackish (3)	218-59	19	5	16	5	26	26	16	5
BH-M	Okura River Brackish (3)	218-61	19	21	5	16	16	21	16	5
M-H	Whangarei: Oaks Rd and Oakleigh Mangrove	105-1	19	16	5	21	26	11	16	5
MS-M	Eastern Beach (3)	64-9	19	5	5	5	32	32	16	5
M-H	Okura River Mangrove	100-53	19	11	11	16	21	32	11	0
MH-L	Pollen Island	214-1	18	6	6	39	39	0	6	6
M-FH	Okura River Mangrove	100-9	18	39	22	28	11	0	0	0
MS-M	Eastern Beach Site 3	64-14	18	6	6	11	11	39	17	11
BH-M	Okura River Brackish (3)	218-56	18	0	6	17	33	22	17	6
BH-M	Okura River Brackish (3)	218-64	18	17	6	0	28	28	17	6
MS-FL	Station Bay (2)	60-1	18	11	0	22	33	22	6	6
BH-M	Waiheke Island: Stream beside Man O'War Bay	158-1	18	0	17	17	17	28	17	6
M-FH	East Coast Coromandel mangrove	126-1	18	11	0	22	28	22	11	6
BH-M	Oamaru Bay Estuary	200-1	17	18	12	29	24	12	0	6
M-FH	Thames Mangrove (Miranda)	199-1	17	12	12	0	35	24	12	6
M-FH	Okura River Mangrove	100-29	17	6	18	6	29	18	18	6
M-FH	Okura River Mangrove	100-32	17	0	18	12	24	24	18	6
BS-FH	Bay of Plenty (Matua)	27-C2	17	24	12	29	24	0	6	6
MS-FL	Eastern Beach Site 3	64-2	17	6	6	35	6	29	12	6
M-FH	Okura River Mangrove	100-22	16	0	0	13	38	25	19	6
M-FH	Okura River Mangrove	100-3	16	0	19	19	13	25	19	6
M-FH	Awanohi Bridge	91-1	16	0	13	13	25	25	19	6
M-FH	Long Bay mangrove	134-1	16	13	13	13	13	25	19	6
BS-FH	Waipu Cove stream	136-1	16	13	13	13	31	19	13	0

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
BH-M	Okura River Brackish (2)	217-13	16	25	6	44	6	19	0	0
M-FH	Okura River Mangrove	100-78	15	13	33	27	20	0	0	7
M-FH	Okura River Mangrove	100-16	15	27	7	13	20	13	13	7
MS-FL	Motutapu Island: Islington Bay, soft shore	204-4	15	20	13	7	27	20	7	7
M-FH	Okura River Mangrove	100-7	15	0	20	13	13	27	20	7
BH-M	Okura River Brackish (3)	218-57	15	13	13	7	27	20	13	7
M-FH	Maraetai Beach	76-1	15	7	7	7	27	27	20	7
M-FH	Whangarei: Oaks Rd and Oakleigh Mangrove	105-2	15	0	13	7	20	33	20	7
M-FH	Sandspit Bay	137-1	15	0	0	7	33	33	20	7
MS-FL	Eastern Beach Site 3	64-13	14	7	7	29	43	0	7	7
M-FH	Okura River Mangrove	100-23	14	0	0	7	14	29	14	36
M-FH	Okura River Mangrove	100-20	14	0	0	21	29	21	21	7
BH-M	Okura River Brackish (3)	218-63	14	0	7	0	36	29	21	7
M-FH	Thames Mangrove (Miranda)	199-3	14	7	14	0	21	29	21	7
BS-FH	Great Barrier Island: Estuary beside Stony Beach	171-1	14	0	7	7	36	21	21	7
BS-FH	Great Barrier Island: Tryphena Harbour (1)	165-1	14	7	21	43	7	21	0	0
MH-L	Eastern Beach (1)	26-1	14	14	36	29	7	14	0	0
MS-FL	Motuihe Island (2)	113-1	13	8	15	38	38	0	0	0
M-FH	Okura River Mangrove	100-26	13	0	8	0	15	23	15	38
MH-L	Waiheke Island: Man O'War Bay (1)	159-1	13	0	0	15	23	31	23	8
BS-FH	Bay of Plenty (Matua)	27-A3	13	0	8	15	15	31	23	8
M-FH	Okura River Mangrove	100-12	13	8	8	23	8	38	8	8
MS-FL	Muriwai Beach	85-4	12	8	8	33	33	0	8	8
BS-FH	Bay of Plenty (Matua)	27-A2	12	8	8	17	33	17	8	8
M-M	Okura River Mangrove	100-19	12	8	25	8	33	17	0	8
BS-FH	Coromandel: Tukituki Bay Estuary	203-1	12	0	8	33	42	8	0	8
M-M	Okura River Mangrove	100-6	12	25	0	33	25	17	0	0
BH-FL	Okura River Brackish (1)	216-37	12	8	8	17	33	17	8	8
BH-FL	Okura River Brackish (3)	218-60	12	25	0	17	8	33	8	8
MS-FL	Eastern Beach (3)	64-5	12	8	8	0	17	33	25	8
BS-FH	Bay of Plenty (Matua)	27-C1	12	0	8	50	33	0	0	8
MS-M	Cheltenham Beach	24-1	12	0	0	0	42	25	25	8
M-M	Pakiri Beach Estuarine Stream1	180-1	12	0	8	17	8	50	8	8
MS-M	Eastern Beach Site 3	64-15	12	25	50	0	8	17	0	0
MS-FL	Eastern Beach Site 3	64-11	12	0	17	33	8	17	17	8
M-M	Okura River Mangrove	100-17	11	0	0	36	36	9	9	9
BS-M	Bay of Plenty (Matua)	27-B2	11	18	27	18	27	9	0	0
M-M	Herald Island Mangrove	98-1	11	0	0	18	27	27	18	9
M-M	Okura River Mangrove	100-10	11	9	0	9	27	27	18	9
M-M	Okura River Mangrove	100-14	11	0	0	18	18	27	27	9
BS-M	Bay of Plenty (Matua)	27-C3	11	0	0	27	27	18	18	9
M-M	Waiheke Island: Mangrove, Te Matuku Bay	162-1	11	18	18	18	9	9	18	9
BS-H	Orewa	37-3	11	9	0	9	18	27	27	9

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
M-M	Okura River Mangrove	100-51	11	0	0	0	36	27	27	9
BH-FL	Okura River Brackish (3)	218-65	11	18	0	9	18	18	27	9
BS-FH	Bay of Plenty (Rangataua Bay)	70-A2	11	27	9	0	9	27	18	9
MS-FL	Eastern Beach (3)	64-3	11	9	9	0	18	45	18	0
M-M	Kaipara: Topuni Bridge Mangrove	106-1	11	0	9	27	18	18	18	9
MS-FL	Cheltenham Beach	24-2	11	0	0	36	9	27	18	9
BS-FH	Orewa	37-1	11	0	9	36	9	18	18	9
BS-M	Bay of Plenty (Matua)	27-B3	10	10	10	20	20	20	10	10
MS-FL	Muriwai Beach	85-2	10	20	0	30	40	10	0	0
MS-FL	Eastern Beach (3)	64-8	10	20	10	60	10	0	0	0
MS-FL	Cheltenham Beach	24-9	10	20	10	30	20	20	0	0
MH-L	Kawakawa Bay	65-1	10	0	0	10	0	30	40	20
M-M	Westpark Marina	97-1	10	20	0	0	10	30	30	10
M-M	Okura River Mangrove	100-24	10	0	0	0	10	50	30	10
M-M	Meola Rd Bridge	95-1	10	0	0	20	20	20	30	10
M-M	Waiheke Isalnd: Mangrove, Man O'War Bay	157-1	10	0	10	0	20	30	30	10
BS-M	Great Barrier Island: stream, Cape Barrier Rd	179-1	10	40	0	10	0	10	30	10
MS-FL	Motutapu Island: Waikarapupu Bay Soft Shore	207-1	10	10	0	50	20	20	0	0
M-M	Okura River Mangrove	100-80	10	0	0	20	0	50	20	10
MS-FL	Eastern Beach Site 3	64-12	9	0	11	11	44	11	11	11
BS-M	Bay of Plenty (Matua)	27-A1	9	11	0	0	44	22	11	11
BS-M	Bay of Plenty (Matua)	27-B1	9	0	0	56	44	0	0	0
M-M	Thames Mangrove (Miranda)	199-2	9	0	0	0	11	56	22	11
BS-FH	Orewa	37-2	9	0	0	0	11	44	33	11
BS-M	Bay of Plenty (Rangataua Bay)	70-A3	9	0	11	22	11	33	11	11
MS-FL	Little Huia Beach (1)	194-1	9	11	11	11	0	22	33	11
M-M	Okura River Mangrove	100-8	9	0	11	11	0	44	22	11
BS-M	Bay of Plenty (Rangataua Bay)	70-C3	9	0	0	33	11	44	0	11
M-M	Okura River Mangrove	100-18	9	0	0	11	11	44	22	11
M-M	Okura River Mangrove	100-27	9	0	11	22	11	22	22	11
MS-FL	Cheltenham Beach	24-7	9	0	0	44	11	11	22	11
BH-FL	Okura River Brackish (3)	218-55	8	0	25	13	25	25	13	0
BS-M	Orewa Stream	149-1	8	13	0	38	25	25	0	0
BH-FL	Okura River Brackish (1)	216-11	8	13	0	50	25	0	13	0
BS-M	Great Barrier Island: Whangapoua Estuary	175-1	8	0	0	13	0	50	25	13
MS-L	Muriwai Beach	85-7	8	0	0	38	13	25	13	13
MS-FL	Cheltenham Beach	24-5	8	0	0	25	0	38	25	13
BS-M	Bay of Plenty (Rangataua Bay)	70-C1	8	13	25	38	0	25	0	0
BS-M	Bay of Plenty (Rangataua Bay)	70-C21	8	0	0	38	25	38	0	0
BS-M	Waiheke Island: Stream beside Te Matuku Bay	156-1	8	13	63	0	13	13	0	0
BS-M	Bay of Plenty (Rangataua Bay)	70-B3	8	0	0	38	0	25	25	13
BS-M	Bay of Plenty (Rangataua Bay)	70-B2	7	0	0	14	29	29	14	14
MS-FL	Eastern Beach (3)	64-17	7	0	0	14	43	14	14	14

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
M-M	Whangarei: Oaks Rd and Oakleigh Mangrove	105-3	7	0	14	14	43	14	0	14
MS-FL	Cheltenham Beach	24-3	7	0	0	0	57	14	14	14
BS-M	Bay of Plenty (Rangataua Bay)	70-C2	7	14	0	43	29	14	0	0
MS-L	Eastern Beach (3)	64-6	7	29	0	29	14	14	0	14
BH-FL	Brackish Stream beside McGregors Bay	103-1	7	0	14	0	0	29	43	14
M-M	Okura River Mangrove	100-28	7	0	0	14	29	14	29	14
BH-FL	Okura River Brackish (3)	218-54	7	0	0	0	14	29	43	14
MS-L	Muriwai Beach	85-1	7	0	0	57	43	0	0	0
MS-FL	Cheltenham Beach	24-8	7	0	0	0	14	57	14	14
M-M	Okura River Mangrove	100-5	7	0	0	29	0	43	14	14
MS-FL	Eastern Beach (3)	64-19	7	0	0	14	14	29	29	14
MS-L	Eastern Beach (3)	64-4	6	0	0	0	33	33	17	17
BH-FL	Okura River Brackish (3)	218-66	6	0	0	17	33	17	17	17
MS-L	Eastern Beach (3)	64-18	6	0	0	33	33	0	17	17
M-FL	Mill Creek mangrove	125-1	6	0	17	50	33	0	0	0
BS-M	Waimama estuary	120-1	6	17	17	33	17	17	0	0
BS-M	Whangamata (1)	117-1	6	0	0	17	33	17	17	17
BS-M	Matheson Bay Brackish	62-1	6	17	0	0	0	17	50	17
MS-FL	Eastern Beach (3)	64-10	6	0	0	17	0	33	33	17
M-FL	Okura River Mangrove	100-79	6	17	0	33	0	17	17	17
MS-L	Matheson Bay Soft Shore	61-1	6	0	0	33	0	33	17	17
MS-L	Motutapu Island: Islington Bay soft shore	204-1	6	0	0	50	0	50	0	0
BS-M	Bay of Plenty (Waimapu)	71-C1(1)	6	0	67	17	17	0	0	0
M-FL	Tahuna Torea Mangrove (1)	82-1	6	0	17	33	0	50	0	0
MS-FL	Cheltenham Beach	24-6	6	0	0	0	17	33	33	17
MS-L	Eastern Beach (3)	64-16	5	0	0	0	40	40	20	0
MS-FL	Cheltenham Beach	24-4	5	0	0	40	40	20	0	0
MS-L	Piha Beach Soft Shore	215-1	5	0	0	0	40	20	20	20
BH-FL	Okura River Brackish (3)	218-36	5	0	0	40	40	0	0	20
M-FL	Okura River Mangrove	100-4	5	0	20	40	40	0	0	0
BS-FL	Great Barrier Island: Estuary beside Stony Beach	170-1	5	40	20	20	20	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-C1(2)	5	0	20	20	20	20	0	20
BS-FL	Bay of Plenty (Waimapu)	71-C2(2)	5	40	0	40	20	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-C3(2)	5	0	20	20	20	40	0	0
BS-M	Bay of Plenty (Rangataua Bay)	70-B1	5	0	0	0	0	20	60	20
BS-FL	Bay of Plenty (Rangataua Bay)	70-A1	5	20	0	0	20	40	20	0
MS-L	Muriwai Beach	85-3	5	0	0	20	0	40	20	20
MS-FL	Muriwai Beach	85-6	5	80	0	20	0	0	0	0
MS-L	Eastern Beach (3)	64-22	5	0	20	0	0	40	20	20
MS-L	Eastern Beach (3)	64-7	5	0	0	0	20	40	40	0
MS-L	Muriwai Beach	85-8	5	0	20	0	0	40	20	20
MS-L	Eastern Beach (3)	64-20	5	0	0	20	0	40	40	0
MS-L	Muriwai Beach	85-5	4	0	25	25	0	0	25	25

Habitat species richness index	Survey	Site	Species count	Percent composition (%)						
				very rare	rare	uncommon	frequent	common	very common	ubiquitous
BS-FL	Bay of Plenty (Waimapu)	71-B2	4	0	0	0	50	0	25	25
MS-L	Cheltenham Beach	24-13	4	0	0	0	25	25	25	25
M-FL	Pollen Island Mangrove	213-1	4	0	0	25	0	50	25	0
BS-FL	Bay of Plenty (Waimapu)	71-C2(1)	4	0	0	25	25	25	25	0
MS-L	Motutapu Island: Station Bay soft shore	206-1	4	0	25	25	25	25	0	0
MS-L	Cheltenham Beach	24-14	4	0	25	50	25	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-A1	4	25	25	50	0	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-B3	4	0	0	100	0	0	0	0
MS-L	Cheltenham Beach	24-10	4	0	0	0	0	25	50	25
MS-L	Cheltenham Beach	24-12	4	25	25	0	0	50	0	0
MS-L	Cheltenham Beach	24-11	4	25	0	0	25	50	0	0
BS-FL	Bay of Plenty (Waimapu)	71-A3	4	25	0	0	0	25	25	25
BS-FL	Waiheke Island: Stream beside Little Oneroa	153-1	4	0	0	25	0	25	25	25
MS-L	Motutapu Island: Home Bay soft shore	205-1	4	0	0	0	25	25	25	25
MS-L	Eastern Beach (3)	64-1	4	0	25	0	0	25	25	25
BS-FL	Clevedon Kawakawa Rd Estuary	189-1	4	0	0	0	0	50	25	25
BS-FL	Manukau Heads: Stream beside Glenbrook Rd	150-1	3	33	33	33	0	0	0	0
MS-VL	Kennedy Bay (2)	128-1	3	0	0	100	0	0	0	0
BS-FL	Pakiri Beach Estuarine Stream (3)	183-1	3	0	33	33	33	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-C3(1)	3	0	0	0	0	100	0	0
BS-FL	Bay of Plenty (Waimapu)	71-A2	3	33	33	0	33	0	0	0
BS-FL	Bay of Plenty (Waimapu)	71-B1	3	0	0	0	33	33	33	0
MS-VL	Motutapu Island: Home Bay soft shore	205-3	3	0	0	0	33	0	33	33
MS-VL	Wakaaranga Creek	223-3	3	0	0	0	0	33	67	0
BH-L	Okura River Brackish (3)	218-39	2	0	0	50	50	0	0	0
MS-VL	Motutapu Island: Home Bay soft shore	205-2	2	0	0	50	50	0	0	0
BS-L	Shakespear Park Estuary	198-1	2	0	0	50	50	0	0	0
MS-VL	Wenderholm Beach (2)	196-1	2	0	0	0	0	50	0	50
MS-VL	Eastern Beach (3)	64-21	2	0	0	50	0	50	0	0
BH-VL	Okura River Brackish (3)	218-46	1	0	0	100	0	0	0	0
BS-L	Okura River Brackish (4)	221-2	1	0	0	100	0	0	0	0
MS-VL	Muriwai Beach	85-9	1	0	0	100	0	0	0	0
MS-VL	Eastern Beach (3)	64-25	1	0	0	100	0	0	0	0
MS-VL	Eastern Beach (3)	64-24	1	0	0	0	0	100	0	0
BH-VL	Okura River Brackish (3)	218-50	1	0	0	0	0	100	0	0
BH-VL	Okura River Brackish (3)	218-49	1	0	0	0	0	100	0	0
MS-VL	Eastern Beach (3)	64-23	1	100	0	0	0	0	0	0
BH-VL	Okura River Brackish (3)	218-47	1	0	0	0	0	0	0	100
BH-VL	Okura River Brackish (3)	218-40	1	0	0	0	0	100	0	0
BH-VL	Okura River Brackish (3)	218-41	1	0	0	0	0	100	0	0
BH-VL	Okura River Brackish (3)	218-48	1	0	0	0	0	100	0	0

Existing database biases

Despite its taxon-specific nature, the information content of the Mollusc database generally improved when interrogating it with data sourced from four *Monalisa* surveys compared to data sourced from environmental consultant reports, whereas the performance of others (Catalogue of Life and OBIS) decreased when interrogating it with these same data (Table 11).

Comparing the distributions of a subset of very rare, rare and ubiquitous molluscan taxa, as determined by the frequency of occurrence in species inventories from 296 *Monalisa* sites, with the distributions of these same species within a 2 km radius of any *Monalisa* site in the Te Papa Mollusc database reveals the incidence of specimen lots in Te Papa collections, and the distribution of specimens throughout the region does not reflect the current recognised distribution of live individuals of these same species.

Molluscan taxa identified as very rare in *Monalisa* surveys, *Acar sandersonae, Caecum digitalum* and *Calliostoma punctulata*, are represented in the Mollusc database by 43, 100 and 270 specimen-lot records respectively. Molluscan taxa identified as rare in *Monalisa* surveys, *Daphnella cancellata, Mesoginella koma* and *Epitonium minora*, are represented in the Mollusc database by 30, 102 and 71 specimen-lot records respectively. Molluscan taxa identified as ubiquitous in *Monalisa* surveys, *Turbo smaragdus*, *Chiton glaucus* and *Sypharochiton pelliserpentis*, are represented in the Mollusc database by 110, 140 and 125 specimen-lot records respectively.

Based on numbers of specimens lots in the Te Papa collection from sites within a radius of 2 km of those also surveyed in this current research programme (Table 31), should equal effort have been expended collecting representative taxa from shores, one taxon identified in *Monalisa* surveys as very rare, *Calliostoma punctulata*, would be more common than at least one other taxon currently recognised as ubiquitous based upon *Monalisa* surveys, with the most rare of these species in accordance with the Te Papa specimen-lot records, *Daphnella cancellata*, being classified only as rare in *Monalisa* surveys.

Either unequal collection effort has been expended on representative taxa from locations around New Zealand; the composition of molluscan species assemblages throughout this region has changed over time; live individuals have not been differentiated from dead specimens (shells) (and we know this to be the case), biasing collection holdings; or certain species have distributions extending beyond the survey region, and are more common outside it than within (and we know the former to be the case (Figures 60–62), but without abundance data we cannot determine whether the latter also is the case).

Table 31: Comparison of Te Papa and *Monalisa* records of species in three rarity index categories (VR, very rare; R, rare; U, ubiquitous).

Taxon	Rarity index	Number of Te Papa records	Number of *Monalisa* records
Acar sandersonae	VR	1	1
Caecum digitalum	VR	1	1
Epitonium minora	R	2	5
Daphnella cancellata	R	3	4
Mesoginella koma	R	7	4
Turbo smaragdus	U	10	103
Calliostoma punctulatum	VR	14	1
Sypharochiton pelliserpentis	U	24	98
Chiton glaucus	U	29	88

Biodiversity data applications

Two resource management-based analyses were conducted to demonstrate additional, potential applications of biodiversity data collected for the purposes of this research.

The relationship between site naturalness and species richness

By way of example, Figure 59 depicts the number of resource consents issued within the inner Waitemata Harbour (Auckland) (triangles), with *Monalisa* survey sites (circles).

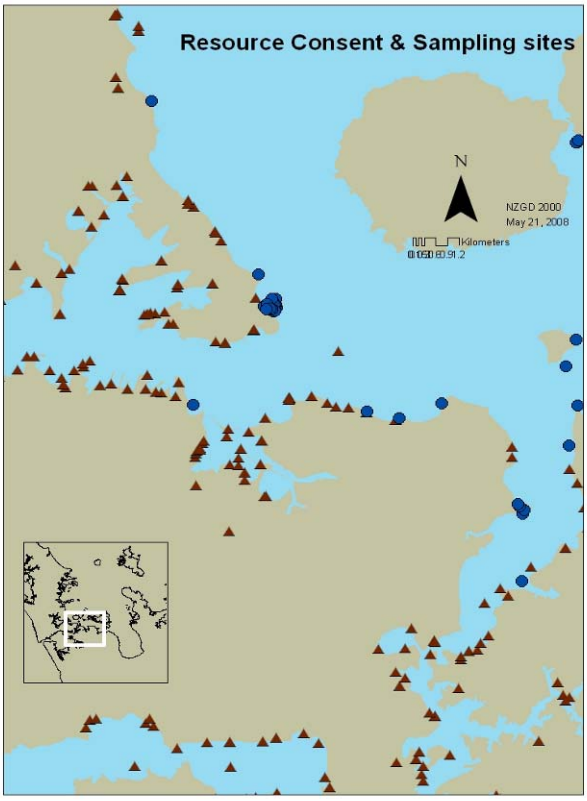

Figure 59: North Head, Waitemata Harbour, *Monalisa* survey sites (circles) and ARC Resource Consent data (triangles).

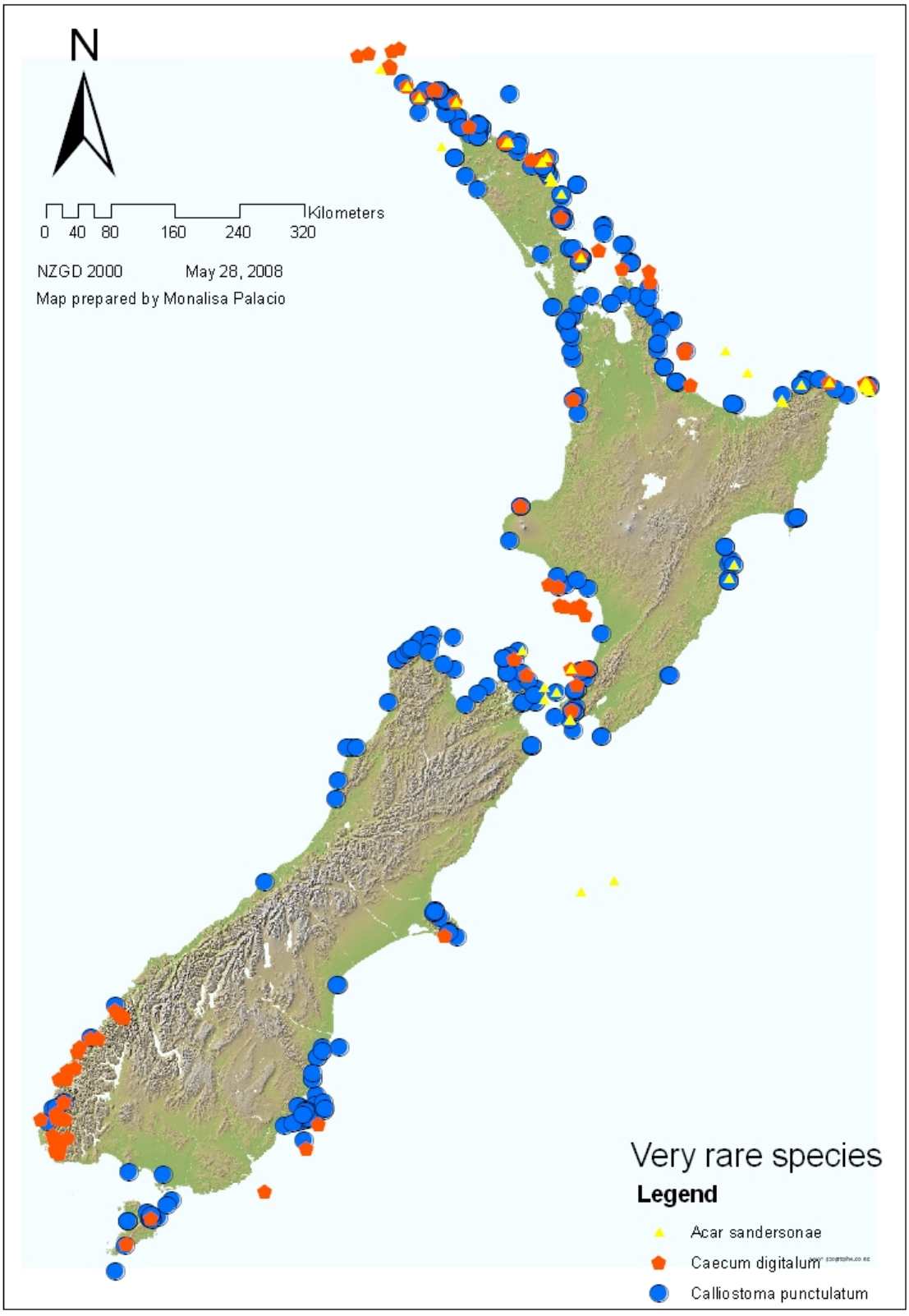

Figure 60: Occurrence of very rare molluscan taxa in Te Papa Mollusc database: *Acar sandersonae, Caecum digitalum* and *Calliostoma punctulata*

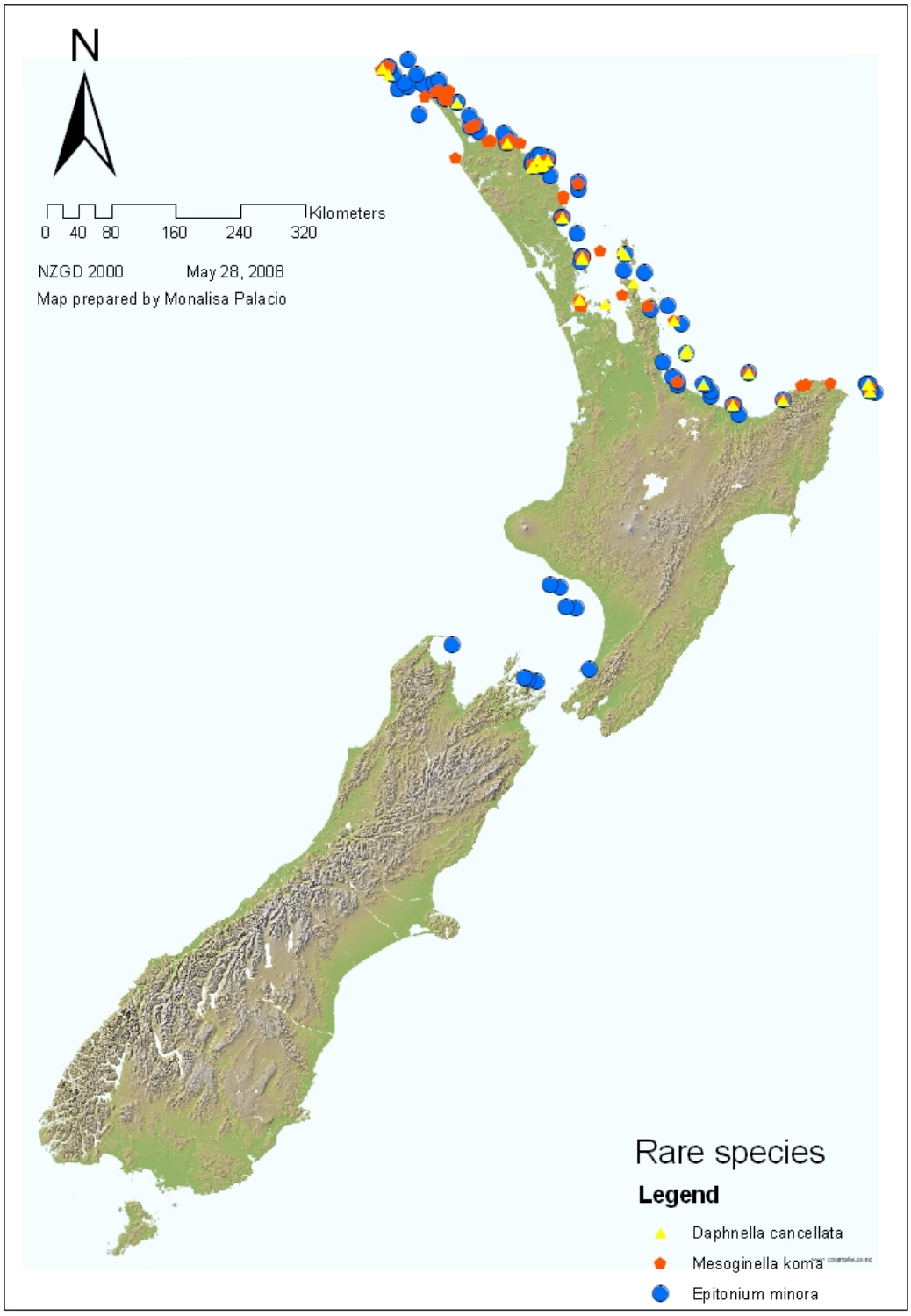

Figure 61: Occurrence of rare molluscan taxa in Te Papa Mollusc database: *Daphnella cancellata, Mesoginella koma* and *Epitonium minora*

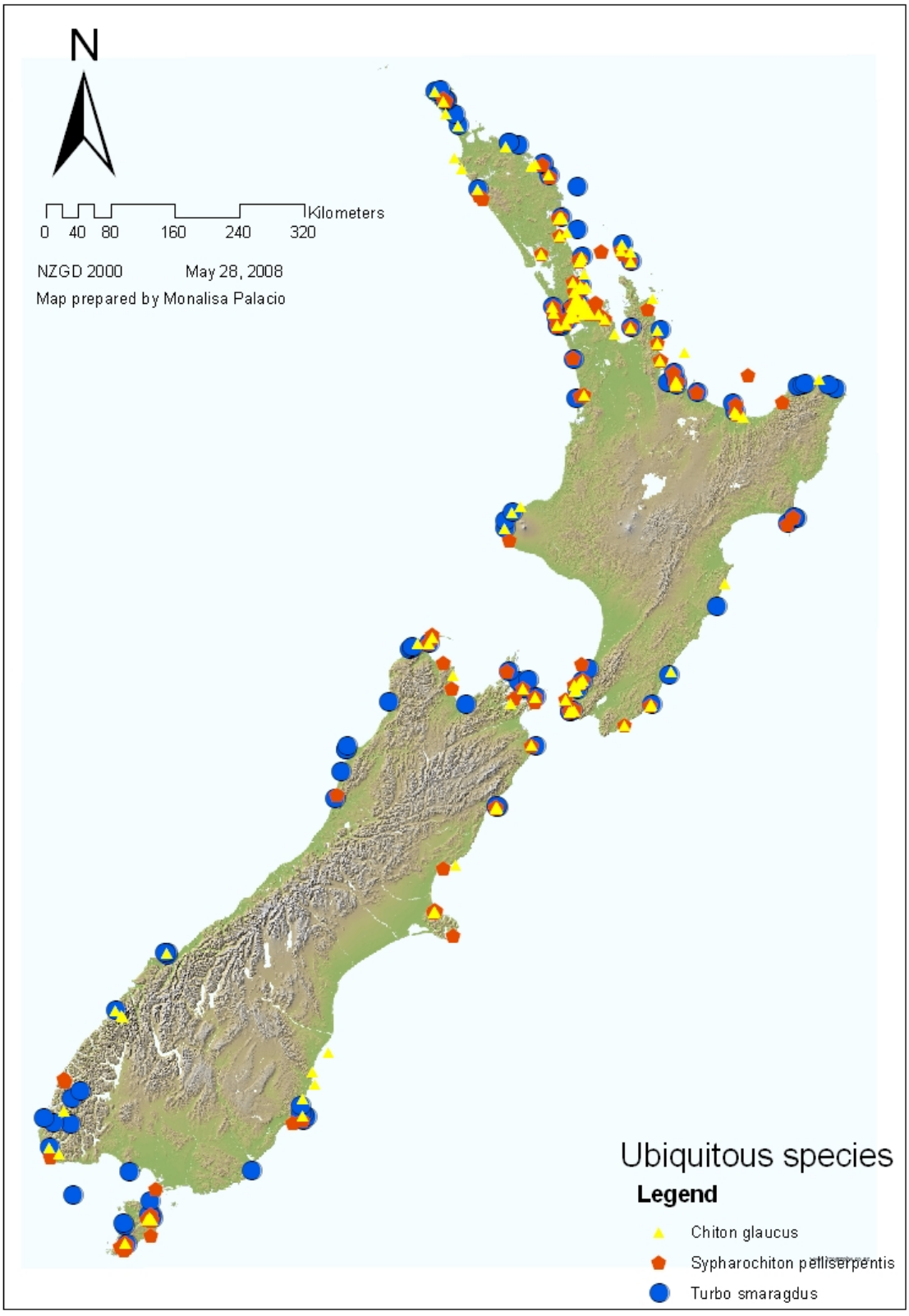

Figure 62: Occurrence of ubiquitous molluscan taxa in Te Papa Mollusc database: *Turbo smaragdus*, *Chiton glaucus* and *Sypharochiton pelliserpentis*

Limiting analysis to an appraisal of the relationship between the number of consented activities (discharges) and species richness on 61 of 75 hard shores (excluding two shores of an artificial nature) for which resource consent data was available throughout the survey region, a negative correlation between the intensity of discharge and the number of species occuring within a 2 km radius of these discharge points is apparent (Figure 63).

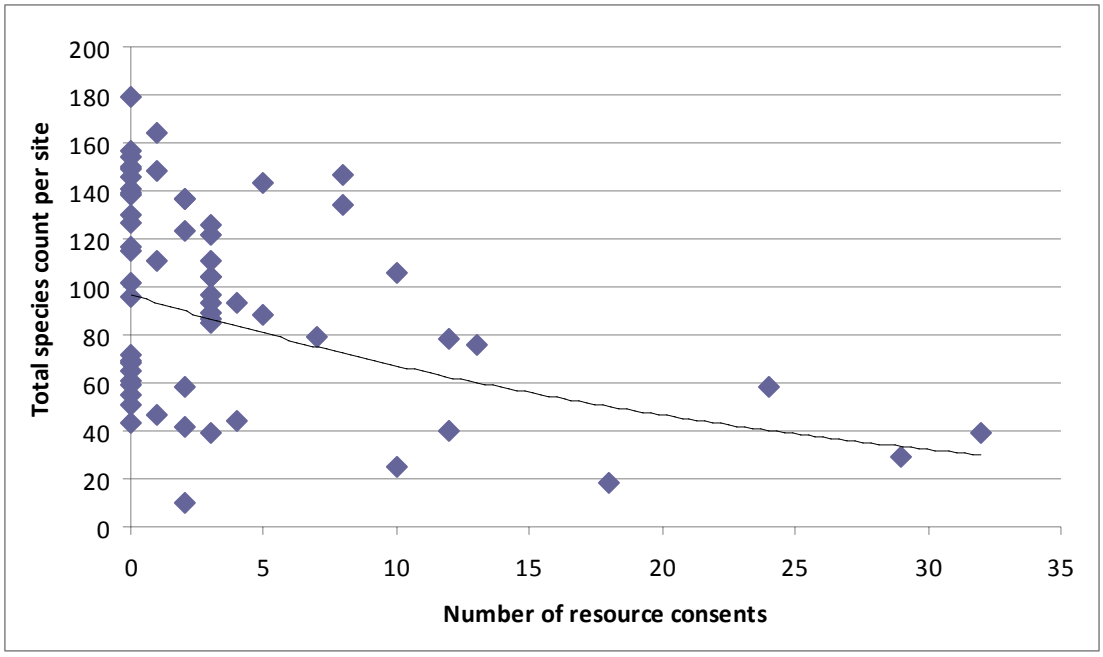

Figure 63: Relationship between the frequency of consented discharges within a 2 km radius of marine hard shores, and species richness

Appraisal of selection criteria for marine reserves

The number of species identified from sites on the total 77 marine-hard shores ranges from 179 to 10 (Table 30). The following histogram (Figure 64) categorises the number of these sites with common species richness in increments of 20 species, both within (labelled) and outside actual or proposed marine reserves surveyed throughout the Hauraki Gulf Marine Park.

It is apparent that no existing marine reserve (Pollen Island, *Te Whanganui a Hei*, Goat Island, Long Bay/Okura or Te Matuku Bay) has even the median number of species occuring within it, at least for the intertidal rocky-shore habitat component. Two further sites that have been advocated as or considered for marine reserves, off eastern Great Barrier Island, and possibly Enclosure Bay (northern Waiheke Island), although only the eastern Great Barrier is relatively rich in species.

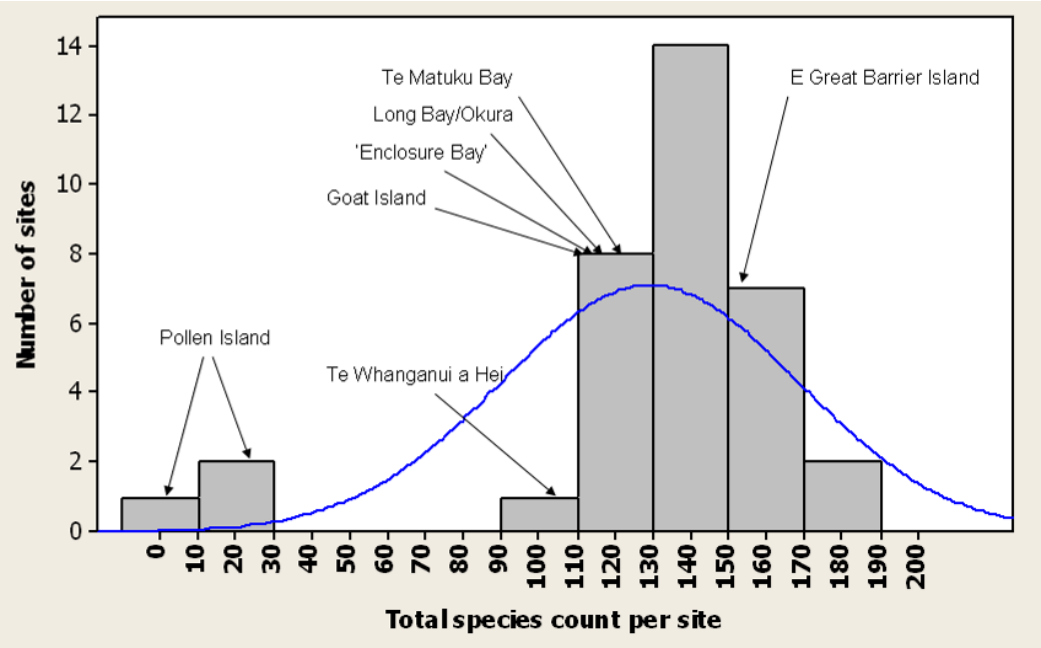

Figure 64: Relationship between intertidal hard-shore species count and marine reserve placement

Looking at these data for hard-shore sites further, Figure 65 illustrates the degree of similarity in composition of species assemblages between the 32 most-rich sites (from Table 30), similarly including actual, and recently proposed and/or potential marine reserve sites. Each *Monalisa* site is given a unique reference number (e.g., 132-1, 111-2; see Table 30), and those actual, proposed and potential marine reserve sites are prefixed “M”. The length of the vertical branches represents the degree of similarity in species composition between sites; for example, the branch between M121-1 and M141-1 means that approximately 65% of species are common to these two sites.

It is apparent that the intertidal, rocky-shore species assemblages of *Te Whanganui a Hei* and Cape Rodney marine reserves are comparable, and to an extent could be considered to duplicate reserve effort (given the low number of reserves in the region), but they are also complementary, in the event a network of reserves was established. It is also apparent that the assemblage of species found on rocky shore habitat at Pollen Island differs from all other reserves thus-far established, although this ostensibly soft-shore site had limited hard-shore habitat; Pollen Island also had a high number of consented discharges into or in close proximity to it.

Figure 65 has been prepared using only a subset of these hard-shore species assemblage data, including the most-species-rich sites, but it does enable broad comparisons to be made between the assemblages of species occurring at different sites throughout the surveyed region. At an arbitrary 50% level, three major groupings of species are apparent: Pollen Island (214-1, low species richness), Musick Point (8-1, high species richness), and

all other sites. At an equally arbitrary level of 55% similarity, five different clusters of species assemblages are apparent. No two sites share the exact same assemblage of species — rendering the assemblage of species found at each site effectively unique.

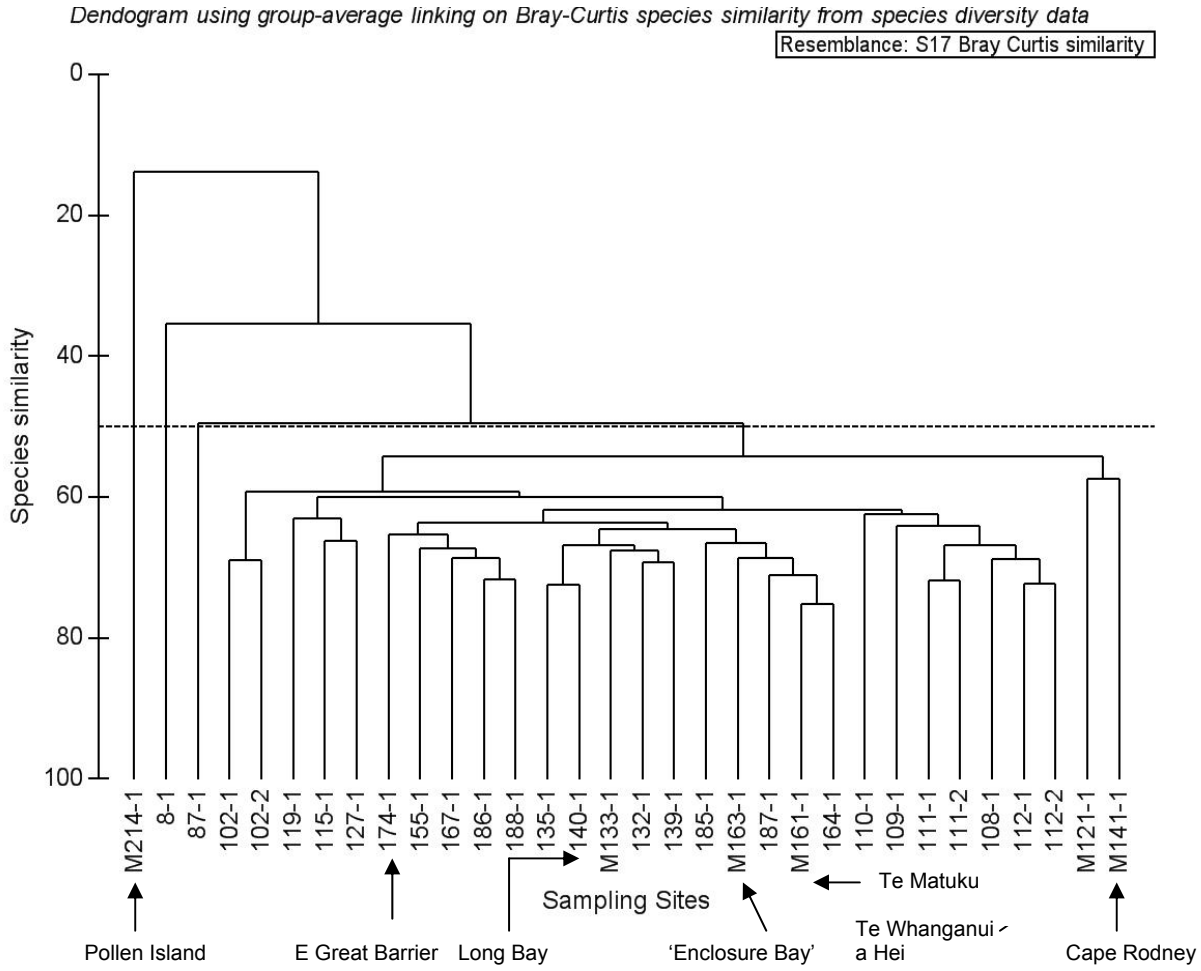

Figure 65: Similarity of intertidal rocky-shore species assemblages at 32 most-species-rich sites throughout the survey region, excluding all species recorded from one site only

The relative contribution of very rare to ubiquitous species to the richness at these most-species-rich hard-shore sites is displayed in Figures 66 and 67, with actual, proposed or potential reserve sites prefixed M.

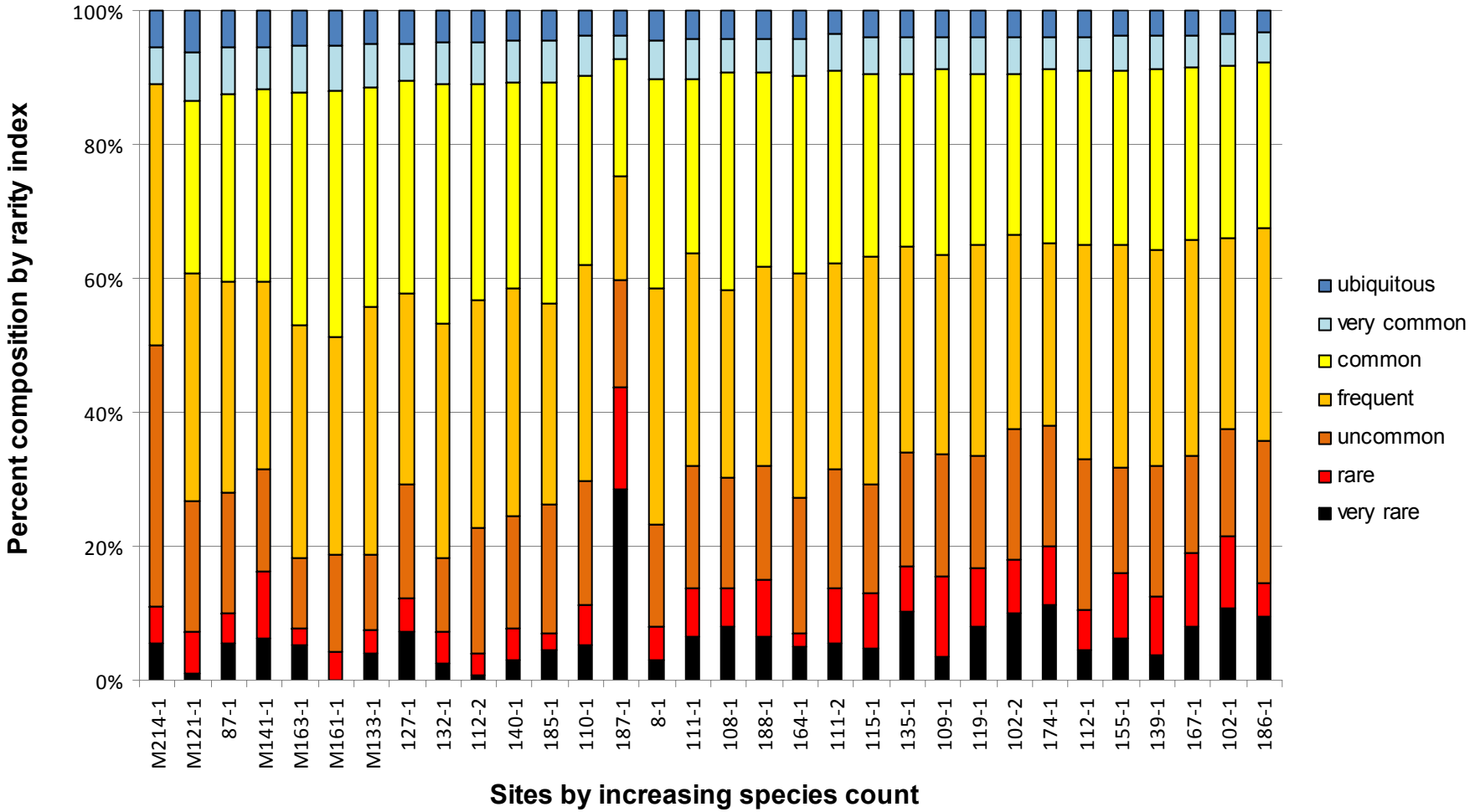

Figure 66: Relative contribution of very rare to ubiquitous taxa on the most- species-rich hard-shore sites (the prefix M denotes actual, considered or potential Marine Reserves)

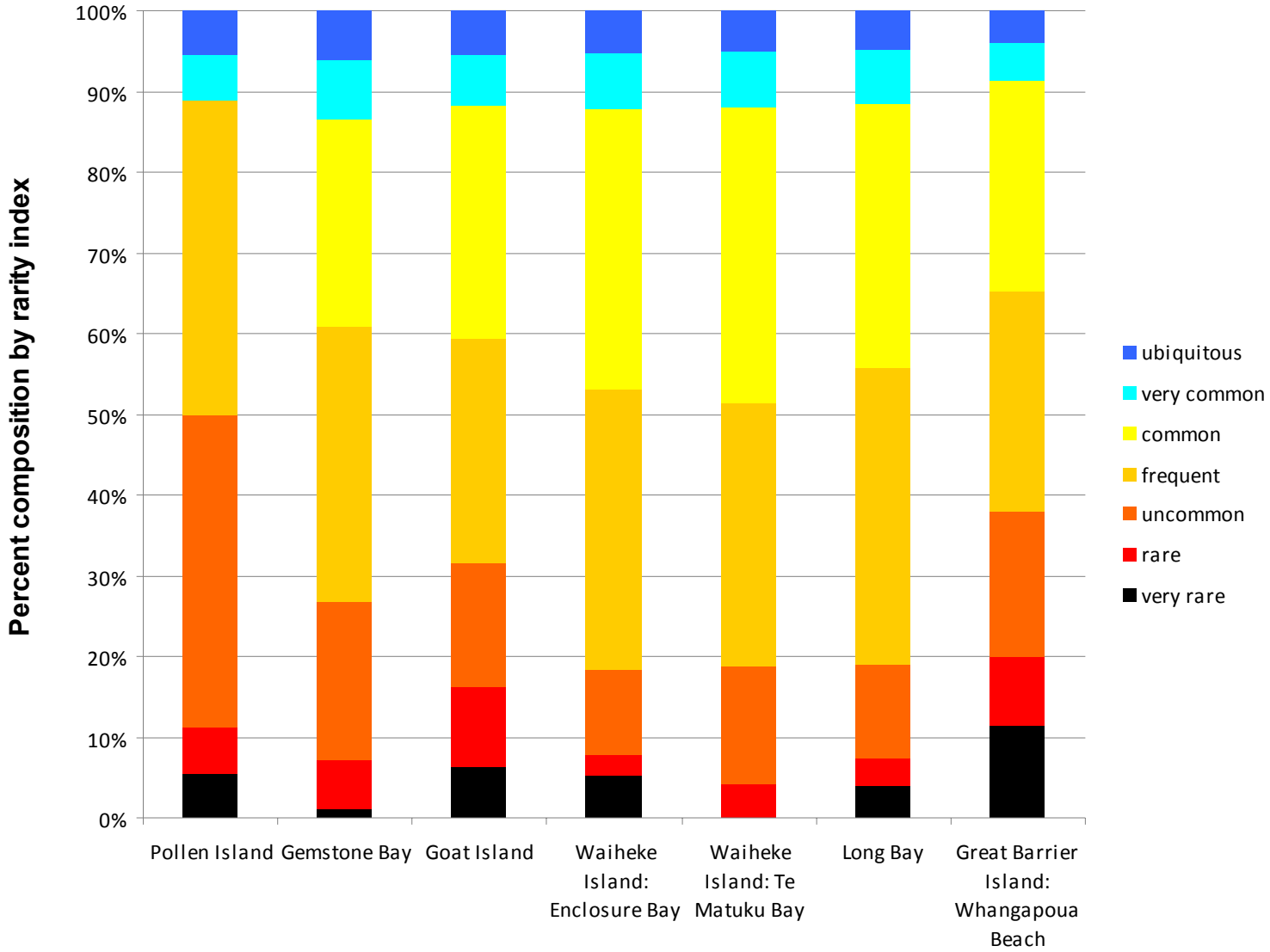

Figure 67: Relative contribution of very rare to ubiquitous taxa on intertidal hard shores within actual, considered or potential marine reserves

Discussion

Phase 1: Consultation

The first phase of this research programme, questionnaire and interviews, revealed a considerable body of biodiversity data collected by environmental consultants remained in hard-copy or electronic-file format, often was scattered throughout various reports, and generally was not available for dissemination. Several respondents identified the existence of in-house databases, although none was available for interrogation in the course of this research programme. Both interviewed respondents realised the value of more appropriate data-management tools, such as databases, but neither had access to or had developed one.

It transpired that consultancies did not share biodiversity data, maintaining that such data had been collected for specific clients, was potentially commercially sensitive in nature, and that these data could not be used for successive reports for different clients. Despite this apparent confidentiality, many of these reports are available through the Auckland Regional Council.

All respondents recognised the importance of data-management tools for more effective and informed management of coastal marine biological resources, and each respondent prioritised their requirements for a biodiversity database from those identified in the questionnaire. On the basis of these responses the design of the prototype *Monalisa* database was established. Of those criteria identified by environmental consultants as being of greatest priority for a biodiversity database (Table 9), only those prioritised 1 or 2 could be completed within the time available to complete this research programme[1].

Phases 2 and 3: Data search and database interrogation

No current database is deemed to have appropriate data mining tools that would enable resource managers or environmental consultants to rapidly or conveniently appraise the relative uniqueness or naturalness of any shore type, or given assemblage of species occurring there. Each requires of the user to individually enter in each species in an inventory and undertake as many individual searches on these taxa as species have been identified. This cumbersome, time-consuming data-mining technique is likely to dissuade resource managers or environmental consultants from undertaking the necessary comprehensive search of the flora and fauna encountered at any site prior to formulating a value judgement

[1] To deliver these criteria more effectively, a database interface is being developed to enable users with limited computing experience to undertake searches; prepare reports on species occurrences within specific areas; search for and produce maps on the distribution of taxa throughout the survey region; and to generate reports from species' checklists, rather than the present, cumbersome and time-consuming requirement of a user to search separately for species in a checklist. It also will generate reports on the relative uniqueness or representativeness of a species assemblage from a site relative to all other sites for which biodiversity data occurs in the database.

as to whether consent for any activity should be recommended, and on the basis of this, whether consent for this activity should be granted.

Data available to resource managers and environmental consultants dealing with New Zealand coastal biodiversity appears to be extensive (Figure 1), in that the density of sites (spots) on maps at all of national, regional and local scales is high. Most of these data can be sourced to two organisations: the National Institute of Water and Atmospheric Research Ltd (OBIS data) and Museum of New Zealand Te Papa Tongarewa (Te Papa Mollusc data). Several additional databases incorporating New Zealand species proved to be specific to certain taxa, namely FishBase, Hexacorallians of the World, and the Global Invasive Species Database (GISD).

Despite the apparent density of sampling around New Zealand, the resulting data sets are primarily of a historical nature, most data have been collected in a manner that has or potentially could alter the habitat structure and assemblages of species occurring there, data often have been collected for purposes other than they were intended and accordingly lacks consistency and are of varied quality, and the databases lack appropriate data-mining tools. These are major obstacles to resource managers that need to extract meaningful, current and consistent data from databases.

To evaluate the relative usefulness of these existing databases for furnishing data of relevance to environmental consultants and resource managers operating at a local scale, a subset of databases detailed in Table 10 was interrogated using data sourced from environmental consultants' reports, and data collected from surveys specifically conducted for this research programme.

Interrogation of only that global database that deals with all taxa (Catalogue of Life), results for 38–68% of taxa recorded by environmental consultants are returned. Similarly limiting interrogation to that national database that deals with all taxa (OBIS), results are returned for 23–59% of taxa recorded in environmental consultant reports. When limiting interrogation to that national database that deals with a subset of taxa, Mollusca (Te Papa database), results are returned for 24–34% of taxa recorded in these environmental consultant reports. The sole regional database available, ARC, returned results for 35–82% of these environmental consultant taxa. Outperforming all databases, the sole local database available (*Monalisa*) returned results for 84–97% of these same taxa (Tables 11, 34–36).

When interrogating data from four of the 296 saline sites surveyed for the purposes of this thesis (Tables 37–40), each one of low, medium, high and very high species richness (in accordance with Table 30), OBIS proved to be less informative, providing data for only

23–59% of taxa, with the majority of this being higher level taxa (i.e. Decapoda sp, Ostracoda sp., Amphipoda sp.) rather than to the actual level of species.

Global biodiversity databases appear to contain data for a significant proportion of taxa reported in consultant reports, and are roughly comparable to or only slightly less informative than databases operating at a national level. These returns usually are for taxa identified at levels higher than the species (such as Genus, Family or Class). At national and regional levels, more information is provided on the species identified by environmental consultants, but at neither of these scales do existing databases provide as much information as that of the *Monalisa* data set.

OBIS data

OBIS data is the most comprehensive of all. However, most of these data (Figures 2, 7) were collected by applying fisheries-based techniques to acquire knowledge on fisheries impacts and stocks. With commercial fishing being one of the most pervasive human activities in marine benthic communities to at least 1200 metres (Cryer et al. 2002), these resulting data describing benthic communities are of a historical nature, and as such cannot be taken to reflect the current, diversity, distribution or abundance of any taxon.

Te Papa data

As for OBIS data, Mollusc database coverage appears comprehensive (Figures 3, 6) at both national and regional scales. However, when interrogating species lists sourced from consultant reports (Tables 11, 34–36 (Appendix 2)), mollusc data is available for 16–26% of all identified taxa, and from surveys conducted for the purposes of this current research programme (Tables 37–40 (Appendix 2)), 24–34% of taxa.

Intertidal Te Papa molluscan collections have accrued jointly through research operations on vessels, and as a consequence of removal of molluscs from the intertidal environment for more than a century by a combination of amateur shell collectors and professional malacologists. The intertidal component of these collections and resulting data need not necessarily reflect the entire molluscan fauna from any site, but only those taxa collected because they were of greatest interest to period collectors, were remarkable specimens of species, or otherwise tended to be rarer, hence more coveted than other species. These biases reduce the value of these intertidal data for ecological studies, especially those that involve appraisals of the current molluscan communities around New Zealand, as certain species have been targeted for collection, and their removal is likely to have affected the relative abundance and/or occurrence of species throughout the intertidal realm. Having said this, the number of specimen lots of nine species, three each of very rare, rare and

ubiquitous, in Te Papa collections within a radius of 2 km from any *Monalisa* survey site is broadly comparable to their relative rarity in the *Monalisa* data set (Table 31).

Generally live individuals have not been differentiated from dead shells in the Mollusc database (Bruce Marshall, Te Papa, pers com. 2008). Consequently the collective data set does not necessarily reflect the living assemblages (biocoenose) of any surveyed site, as dead-shell assemblages in nearshore and shelf settings can be age-mixtures of species that have formed over thousands to tens of thousands of years (Kidwell 1997). Although limited radiocarbon data exist for New Zealand shell deposits, the relatively fragile valves of the bivalve *Tawera spissa* (Deshayes, 1835) collected from the sea-bed surface on the Wanganui shelf have been dated at 12,250 ± 230 yr BP (Gillespie et al. 1998). The valves of *Tucetona laticostata* (Quoy & Gaimard, 1835) also collected from the Wanganui shelf have been carbon-dated at 9,170 ± 210 yr BP (Gillespie et al. 1998), and Bay of Plenty at 35,800 ± 2,250 yr BP (Beu 2004). As such, Te Papa molluscan distributional data must be treated with some caution, given records of species from any site could be an accumulation of taxa from many millennia, potentially dating to the last glacial maximum or earlier.

Consequently, the ability of both of these databases (OBIS and Te Papa), singularly (MDS plots in Figures 11, 14) or collectively (MDS plot in Figure 18), to predict the current diversity of species occurring at any site is limited. Not only has the habitat at each surveyed site, and the assemblages of species occurring there likely been modified as a consequence of various methods applied in data collection, but communities can change naturally over time.

ARC data

At all scales the coverage provided by the ARC database is the least spatially comprehensive of those interrogated (Figures 4, 5), although it performs the best in providing information for 35–82% of species from consultants reports. Remarkably this range drops considerably when interrogated with species data collected from surveys within the ARC jurisdiction, conducted for the purposes of compiling species inventories for analysis in this thesis, to 18–35% (Table 11).

Technical report data

A considerable body of biodiversity information is contained within reports prepared by environmental consultants. Like those data populating OBIS and Te Papa databases, information contained within these reports should be used with caution, and should not be used to predict the current diversity of species at any site in the absence of any other data, given data contained within consultant reports generally has been collected or compiled for the purposes of evaluating a particular area for development, or some other activity requiring resource consent. For reasons similar to those described for OBIS and Te Papa data sets,

the ability of these technical report data, in the event they were made available and entered into a database, to predict the current diversity of species occurring at any site is limited, as the locations for which biodiversity data are available, in the event consent was granted for an activity, are likely to have been modified as a consequence (Figure 63).

Monalisa data

Data collected for *Monalisa* did not involve extractive techniques (such as trawls or dredges) that damage the environment, and all taxa (as opposed to a subset, as is the case of mollusc data) encountered on a shore were identified to the lowest practicable denominator. Also, the *Monalisa* database incorporates only data based on live-individual occurrence. This means that for ecological studies this data set most accurately reports the current diversity of species on any shore.

Although the prototype *Monalisa* database was established to serve the needs of resource managers operating at a local scale, the geographic coverage of surveys conducted to populate it with biodiversity data is greater than that of the ARC regional database. Accordingly, it would be more appropriate to refer to the prototype *Monalisa* database as a regional database than a local one. Nevertheless, for two of the consultant reports operating at a local scale, and even that of the third report operating outside of the Hauraki Gulf Marine Park (Wairoa), the prototype *Monalisa* database provides more information on the distribution and diversity of intertidal marine invertebrates throughout the survey region than that of any other, with information available for 93 and 97% of taxa cited in the two local reports, and 87% of data from the Wairoa report (Table 11).

Combined (OBIS, Mollusc, ARC) databases and Monalisa

In the event all existing global, national and regional (Table 10, Figure 1) data sets were combined to increase their collective interrogative power, the amount of information available to an environmental consultant operating at a local scale increases considerably, with data for 88–100% of species from environmental consultant reports (with *Monalisa* returning results for 87–97% of species), and 79–93% of species identified during *Monalisa* surveys (with *Monalisa* obviously being 100% in these instances) (Table 12). As species richness increases for *Monalisa* sites (low to very high species richness), the combined (OBIS, Mollusca, ARC) interrogative return-rate on data searches for these three combined databases decreases.

When species lists from OBIS, Mollusc and ARC intertidal sites deemed to be the same as or proximal to (within a 2 km radius) any *Monalisa* survey site are compared, MDS plots reveal significant differences in species assemblages, whether data sources are compared singularly (Figures 11, 14, 17) or collectively (Figure 18). *Monalisa* surveys were conducted to

provide an unbiased inventory of species occurring at any site; this may not be the case for other data sources. Although species and synonyms have been standardised prior to interrogation of different data sets, significant differences in the quality and quantity of data were apparent, and these likely contributed considerably to apparent dissimilarities in the MDS plots.

Two options were available for liberation of these newly collected *Monalisa* biodiversity data. The first was to develop a novel database (called *Monalisa*) designed for local users to characterise the biodiversity of the greater Auckland intertidal region. The second was to liberate these data by submitting them to the Southwestern Pacific Regional OBIS Node for inclusion in the OBIS database. For reasons that will become apparent in the discussion of Phase 6, and are apparent in in the combined data set MDS plot in Figure 18, the first of these options is preferred.

Phase 4: New surveys

The fourth phase of this research programme involved collection of novel biodiversity data from throughout the greater Hauraki Gulf Marine Park. Within the time available to conduct this research, constrained by tidal cycles, day length, weather and sea conditions, and the actual time required to fully survey an area, 321 sites could be examined for the purposes of compiling site-specific species inventories.

Decreasing species richness is correlated with decreasing average salinity and increase in salinity variation, which is detrimental to marine organisms (Little et al. 1996). Salinity accounted for the greatest variation in species composition at any site (Table 14), with the greatest species richness encounted in marine habitats, followed by brackish and freshwater habitats. A combination of both salinity regime and substratum type are further shown to affect the composition of species assemblages, with assemblages from each of the five habitats recognised herein (marine hard, marine soft, brackish hard, brackish soft, and mangrove) being distinct (Figure 48). However, a complete inventory of species occurring within each habitat is not available, as no species accumulation curve (Figures 37–42) reaches any plateau, nor is a plateau reached when all of these data are combined (Figure 68). Despite the intensity of surveying throughout the survey region, it is apparent that additional taxa will be encountered within each habitat type with additional survey effort.

Additional surveying within certain habitats is required to determine whether additional habitat categories with distinct, hitherto unrecognised (not reported herein) species assemblages exist. Surveys were conducted to incorporate a representative sample of recognised habitat throughout the survey region, but with some habitat types more frequent or surveyed with

greater intensity than others, limitations on the time available to conduct this research, and a generally poor understanding of the proportional representation of different habitat types throughout the survey region prior to commencing this research, not all could be recognised, surveyed or accessed in the time available. For instance, hard substrata were secondarily divided into one of rocky, platform, boulder and cobble reefs, but hard substrata also included the likes of artificial substrata such as concrete pipes and extraneous debris, to fallen trees. More rocky and platform reefs were surveyed than cobble and boulder shores, and more of the aforementioned were surveyed than artificial substrata and fallen trees (Figure 43); each of the latter also were more scarce.

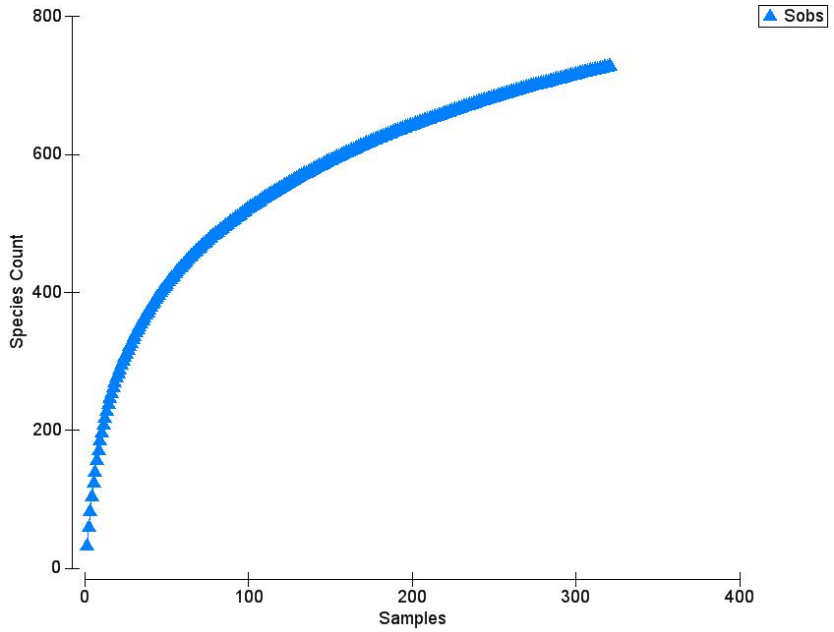

Figure 68: Species accumulation curve, all habitats combined

Given significant differences in the complexity of any shore it was expected to find differences in the composition of species on rocky reefs, platform reefs, boulder platforms, and to a lesser extent between boulder platforms and cobble platforms. However, ANOSIM results (Table 67, Appendix 2; Figure 78, Appendix 3) do not reveal any significant difference in the species composition of platform, rocky and boulder reef platforms, but they do separate out those assemblages reported for cobble habitat. Because only eight cobble habitat sites were surveyed (of 296 intertidal saline sites in total), it is perhaps premature to recognise this habitat type as having discrete species assemblages. As a generalisation, cobble shores generally were less species rich than other hard-shore categories (18–96 species), and fell within low to medium richness sites (Table 30). Cobble habitats are dominated by gastropod, bivalve, decapod crustacean and polychaete taxa, whereas other hard-shore categories,

boulders, platform reefs and rocky reefs, were more species rich (120–179 species), high to very high in species richness (Table 30), but similarly with the greatest number of species being attributed to the same taxonomic groups, with the addition of polyplacophoran taxa.

Mangrove habitat was recognised to have distinct species assemblages from other habitat types reported herein, but it also is recognised to have the second lowest species richness of all habitats (with a maximum of 25 and minimum of four species recorded in surveys at 56 sites, and a total of 100 species recognised from all sites, Table 25). Both hard and soft substrata occur in mangrove habitat, that usually but not exclusively occurred in brackish environments. The aerial roots or pneumatophores of mangroves provide a hard substratum upon which animals can attach in an otherwise soft-sediment environment, largely accounting for the unique assemblage of species.

Phase 5: Novel database development

Development of both a novel biodiversity database and data set proved to be necessary given no existing (Figures 11, 14, 17) or combined (Figure 18) biodiversity database/s adequately characterise current intertidal biodiversity throughout the greater survey area, the Hauraki Gulf Marine Park, or provided adequate biological data and data-mining tools to meet the needs of local resource managers and users. An anonymised copy of this data set (with encrypted species names) is appended in the accompanying CD.

The prototype *Monalisa* species database is populated with data of both an intertidal and subtidal nature for the greater Auckland Region, but for the purposes of analyses conducted herein is interrogated only for intertidal data. Currently, it aims to characterise the intertidal and subtidal biodiversity of the greater part of the North Island and Hauraki Gulf by collecting novel data from field surveys and sediment collection, and partly augmenting it with secondary data.

Phase 6: Novel database interrogation

Rarity index

A 7-point rarity index has been assigned to each taxon from the 296 (of 321) intertidal surveys in each of the five habitats throughout the survey region (Table 5). The resulting graphs depict the relative contribution (%) of species assigned rarity-index categories by site (Figures 49–53), enabling a comparison of the relative contribution of ubiquitous to very rare species between sites, across habitats.

For each of the five major habitat types the relative proportion of ubiquitous taxa decreases as species richness increases, although for the least-species-rich brackish soft-shore sites, no ubiquitous taxa are encountered, similar to a pattern seen on brackish-hard shores; for the most-species-rich of habitats, marine-hard shores, ubiquitous taxa almost always are present. Regardless of a site's total species richness, the species present can range from very rare to ubiquitous in distribution, with the total number of ubiquitous species in each habitat low compared to the number of very rare species. Thus, there are less species occurring everywhere than species of a more restricted distribution, unique to one or several of the 296 survey sites.

In each of three cases, species cited in environmental consultant reports range from very rare to of ubiquitous distribution (Table 32). Had it been recognised that 26% (approximately one quarter) of the species occurring at Kohimarama Beach were of very rare distribution throughout the Hauraki Gulf Marine Park, and a further 23% of those species cited from this shore were rare or uncommon (approximately half of the species were uncommon to very rare), would development of a sea wall have been endorsed by the Regional Council, and consent for this activity granted? Probably not.

Without baseline data on the status of the distribution and abundance of species throughout the Hauraki Gulf Marine Park, consents are likely being issued for activities that will result in losses of important biodiversity. For the Kohimarama site, the ARC, OBIS, and Mollusca databases returned results for 69, 59 and 18% of taxa respectively, whereas *Monalisa* returned results for 93% of these taxa; when the ARC, OBIS and Mollusca data sets are combined into a common database, results are returned for 96% of these Kohimarama species — marginally better than for *Monalisa* alone (93%). However, only the *Monalisa* data set has the ability to report on the current status of any of these species throughout the Hauraki Gulf Marine Park, by assigning individual species an index of rarity. Although the relative abundance of molluscan specimen lots in the Mollusca database for this region mirrors to an extent the relative occurrence of these molluscan species in *Monalisa* surveys (Table 31), ubiquitous taxa are considerably under-represented in collections made

throughout the survey region, and certain very rare species (at least today) are represented in collections by a disproportionate number of specimen lots; further limitations of the Te Papa Mollusc database have been discussed already, and this database also returned the least number of returns on species searches for this particular stretch of coast (18%).

Of the 713 identified taxa at 296 sites, 555 are recognised to be very rare, although 120 of these are relatively poorly identified (Table 48, Appendix 2). A number of these rarer taxa could have more substantial subtidal distributions, with their occurrence intertidally being an extension of their normal bathymetric range; they could equally be more frequently encountered elsewhere, with their incidence in the Hauraki Gulf Marine Park survey region being at the limits of their normal distribution in New Zealand. However, until more comprehensive data sets are established for subtidal species throughout the entire survey region[2], and for species occurring in adjacent regions, neither can be eliminated as possible contributors to the reported relative rarity of taxa occurring intertidally. Regardless, based on the relative contribution of very rare and rare taxa encountered at each surveyed site, and within each major habitat, it would be expected that environmental consultants would record very rare to rare taxa in most surveys, and that a significant proportion of these species would be of uncommon to very rare occurrence. Moreover, the relative contribution of common to ubiquitous species to the total species richness of any site decreases as the number of species occurring at any site increases.

Table 32: Proportion breakdown of species rarity in each of three environmental consultant reports, using the *Monalisa* data set for reference ('w/o RI' denotes species without any currently recognised rarity index).

Checklist	Rarity index used	very rare	rare	uncommon	frequent	common	very common	ubiquitous	w/o RI
Chelsea	marine hard shore	6%	6%	3%	9%	41%	15%	15%	6%
Kohimarama	marine hard shore	26%	11%	12%	8%	11%	9%	6%	17%
Wairoa	marine soft shore	16%	18%	16%	8%	5%	0%	0%	37%

[2] *Monalisa* currently is populated with subtidal data from only 636 grab and core samples from the Waitemata Harbour and inner Hauraki Gulf, to 25 metres depth

Species richness index

Despite the high intensity of surveys conducted to compile this novel biodiversity data set (296 saline sites), large gaps remain in the distribution of sites attributed to each of the five habitat types that proved to have discrete assemblages of species (Figures 54–58). Accordingly, the spatial distribution of species richness throughout the region that can be reported herein is not as informative as that of species rarity.

Species richness negatively correlates with increased intensity of (primarily discharge) consented activities in the marine environment (Figure 63), however such consented activities are not the sole disturbances to affect the intertidal environment, and might not have the most persistent effects on the receiving environment. Pollution discharges to waterbodies in the urban Auckland region are not uncommon. Between January 2001 and April 2007 approximately 1400 non-consented sewer overflows, 1300 hydrocarbon discharges and 700 concrete wastewater discharges were reported to the Auckland Regional Council Water Pollution Hotline service (pers com. Peter Conway, Auckland Regional Council, 28/11/2007). These three substances are considered the most dangerous of those that are regularly received by the aquatic environment in the Auckland region. Other discharges, of more or less toxicity, are also less-frequently introduced to waterbodies in the region. Data for non-consented activities such as these were not available for this thesis, so their effect on species richness at any *Monalisa* survey site could not be determined.

Of the five habitat types recognised throughout the survey region, the spread of only three is likely sufficient to identify any spatial trend, in the event one was apparent: marine-hard, brackish-soft and mangrove shores. No consistent trend is apparent in the distribution of species richness on marine hard shores (Figure 54), although the highest richness of species usually occurred on islands within Waitemata Harbour (such as Motutapu and Waiheke Islands) and Hauraki Gulf (Great Barrier Island), on the northern and eastern Coromandel Peninsula, East Coast mainland just north of Auckland, and both Bream Bay and Whangarei Heads. The distribution of species richness on brackish soft shores (Figure 57) also revealed no clear trend, although those sites closest to the Auckland CBD generally had the lowest richness of any surveyed. To the contrary, species richness on mangrove shores (Figure 58) was both high and low in the immediate vicinity of the Auckland CBD, although again no clear geographic trend was apparent. Additional sampling is required on marine-soft and brackish-hard shores before any pattern in the distribution of species richness can be identified.

The spatial distribution of species richness reveals little, but the ability to evaluate any one site within a particular habitat as being of high to low richness is a powerful tool for resource managers and environmental consultants. The species richness index would be of greatest value when used in conjunction with an index of species rarity to evaluate the relative

diversity and composition of species assemblages at a site. A site with low species richness, comprised largely of very rare to rare species is probably more important than a site of high species richness comprising primarily of ubiquitous taxa. An index that takes into account both species richness and rarity would be of considerable value to resource managers and environmental consultants, enabling more-informed value judgements to be made when evaluating the relative merits of protecting any given site within a habitat type.

Biodiversity data convey rich information relevant to conservation and resource management, such as information on species composition, and their spatial and temporal distribution. When augmented with other data, such as the life histories of key taxa, physical variables such as water salinity, sediment grain size, rock size, actual measures of abundance of taxa, and measures of anthropogenic pressure (such as the types, chemical details, density and periodicity of discharges on the coastal areas), these data would provide resource managers with a greater understanding of the mechanisms influencing the current distributions of species. This information could be utilised in the development of ecological and biogeographic models.

Biodiversity data applications

Several applications of these novel biodiversity data already have been discussed in preceding sections, but additional applications include the development of an index of site 'naturalness,' and appraisal of the effectiveness of currently advocated selection criteria for marine protected areas.

The relationship between site naturalness and species richness

The intensity of consents has not been previously used as a proxy for site naturalness in New Zealand. To the best of my knowledge, the relationship between species richness and the intensity of consented discharges (Figure 63) has also not earlier been documented. Unfortunately resource consent data for all sites surveyed throughout the Hauraki Gulf Marine Park were not available for incorporation in the prototype *Monalisa* biodiversity database, and those consent data that were made available for this thesis are incomplete and do not describe the total or cumulative effects of anthropogenic disturbance on the marine environment (for instance, data for two other non-consentable activities, such pollution events and the intensity and type of fisheries activities on this environment are not available for incorporation in this database).

Resource consent data were not made available until late in this study, and consequently could not be used to assist in site identification for Phase 4 surveying. Accordingly, the relationship between the intensity of resource consents granted for discharge into the marine

environment (or other activities) and the richness of species in the immediate vicinity of these point-source discharges cannot be fully evaluated. Nevertheless, given the intensity of *Monalisa* surveying throughout the survey region, and similarly the intensity of consented activities throughout this region, preliminary relationships between these two variables are described, and a pattern, a negative correlation between species richness and intensity of consented activities, can be reported. More complete consent data, and data on the nature, extent and periodicity of pollution events would likely facilitate determination of the causes of this correlation. The relationship between these consent data and other habitat types, such as on soft, mangrove or brackish shores, has not been evaluated.

The ramifications of this correlation are many, but one that is rather important and relevant to this thesis is the effect such activities could have on the establishment of marine reserves, and their subsequent networks.

Appraisal of selection criteria for marine reserves

The marine environment around Auckland has been extensively modified, but the full effect of this on biodiversity cannot be determined as historical data on species assemblages throughout this region do not exist. Since the establishment of the Resource Management Act in 1991, resource consent applications for development of or discharge into the coastal environment have been lodged for evaluation with regional councils. Unfortunately data on the location and intensity of consent applications are not entirely compiled in electronic format, rendering assessment of the relative naturalness of any piece of coast effectively unknown, especially prior to 1991.

Marine reserves are established under the provisions of the Marine Reserves Act 1971 ‘for the purposes of preserving, as marine reserves for scientific study of marine life, areas of New Zealand that contain underwater scenery, natural features, or marine life, of such distinctive quality, or so typical, or beautiful, or unique, that their continued preservation [is] in the national interest’ (Section 3(1) of the Marine Reserves Act 1971). Additionally, the public has the freedom to access these reserves, and is encouraged to do so ‘so that they may enjoy in full measure the opportunity to study, observe and record marine life in its natural habitat’ (McCrone 2001). Central to the purpose of establishing an area as a reserve are attributes of its uniqueness, naturalness, representativeness (in being typical), and for the purposes of establishing a network of these, complementarity.

Intuitively a relationship is likely to exist between species richness and coastal naturalness, but given aforementioned limitations in the data available for the purposes of conducting this thesis, the true extent of naturalness cannot be determined. All that can be reported from

data presented in this thesis is a probable negative correlation between relatively recent (post-1991) consented activities and species richness. With these limitations in mind, only a preliminary appraisal of four selection criteria for MPAs can be made.

Naturalness

Naturalness would not appear to be an attribute of any existing marine reserve, given some (e.g. Pollen Island) are exposed to continued and intensive (at least 18) consented discharges, and all others that have been surveyed also have consented discharges, ranging from at least 4 to 1. Moreover, as the public are encouraged to visit reserves, the effects of increased visitation can significantly impact the areas natural attributes, thus jeopardising what the reserve initially sought to protect (McCrone 2001).

Representativeness

Using the total number of species found within each of the 75 intertidal rocky shore sites (as an index of representativeness), these biodiversity data reveal that no existing (surveyed) marine reserve within the greater Hauraki Gulf adequately protects even the median number of species encountered on rocky shores throughout this region (Figure 64). Accordingly, most intertidal rocky-shore biodiversity throughout the greater Hauraki Gulf appears to be afforded no formal protection. Surveys could not be conducted within the available time frame within one coastal marine reserve in Whangarei Harbour, falling within the area surveyed for the purposes of this thesis; it is possible that species richness at each of this site exceeds that of any other surveyed marine reserve.

Representativeness does not appear to be an attribute of any current marine reserve surveyed herein, as the diversity of species found within any existing marine reserve is below the median (and therefore typical, at least in terms of species richness) number of species encountered in all shore surveys.

Uniqueness

Given the data in Figure 64, the upper 10% of sites could be considered unique in that they are rare sites in terms of high species richness. However, the 32 most species-rich hard-shore sites are all unique, in the sense that the same assemblage of species does not occur at any two or more sites. Defining uniqueness on the basis of data presented herein (presence/absence, and relative measures of species richness) is problematic; nevertheless, no marine reserve surveyed throughout the greater Hauraki Gulf Marine Park currently appears to protect remarkably rich (in this context unique) assemblages of species. Three of the most species rich sites are located on Motutapu and Browns Islands in Hauraki Gulf, both administered by the Department of Conservation. Given the controls on land usage, and that anthropogenic disturbance (and discharge) are minimal to non-existent (see Figure 63 for

relationship), the diverse intertidal communities around both islands are afforded some protection by default (although neither has any formal MPA status).

Complementarity

The assemblages of species occurring on intertidal rocky-shore platforms at Long and Te Matuku Bay reserves and those of two sites off the eastern Great Barrier Island and Enclosure Bay (Waiheke Island) are broadly comparable. In the event each was to be or had been approved as a marine reserve there would have been considerable duplication of effort for protection of broadly comparable intertidal species assemblages. In fact, should each branch of this dendrogram (Figure 65) carry equivalent rank for identifying marine reserve sites, then two sites would be far more appropriate for reserve designation than eastern Great Barrier Island: 8–1 (Musick Point, Auckland) and 87–1 (Okoromai Bay, Whangaparoa Peninsula), as both are quite different in species composition to all other sites. Care needs to be taken to ensure non-duplication of effort at an early stage of MPA network development to ensure a representative range of habitats, species and assemblages of species, in addition to scenery, are selected.

Based on these *Monalisa* survey data, 271 intertidal rocky-shore marine species (or OTUs [operational taxonomic units]) have been identified within marine reserves, and 728 species (or OTUs) have been identified from all the 321 sites thus-far surveyed throughout greater Hauraki Gulf. Accordingly, throughout the survey region, only 37% of species occurring in the intertidal realm are presently afforded protection within the current network of surveyed marine reserves.

Not only are current marine reserve sites unremarkable in the richness of species that they protect, but the relative proportion of very rare to uncommon intertidal species to the total assemblage of species within any existing reserve (Figures 66, 67) is also not particularly remarkable. Additional data on the absolute and relative abundances of these species would enable a more informed appraisal of the effectiveness of existing reserves and their networks.

Conclusions and Recommendations

Data collected for the purposes of this thesis provide the most current and comprehensive account of intertidal biodiversity throughout the survey region (from Mimiwhangata Bay in the north to Tauranga Harbour in the south, North Island northeast coast). Although temporal trends in biodiversity have not been identified from currently available data, changes intuitively have occurred during more than one and a half centuries of at least European anthropogenic disturbance throughout this region.

Earlier (p. 15) the question was asked whether we 'had we been operating in the dark?' On the bases of analyses and findings reported herein this is highly likely, with unsupported statements being made by consultants to facilitate coastal development (see Kingett Mitchell & Associates 2001a). A stock take of coastal biodiversity is urgently required, and a pressing need exists to have this information readily available for resource managers, so that further development does not occur, justified on the basis of perceptions or statements made in ignorance. There is no such thing as 'no rare or unique taxa' on the greatest majority of intertidal shores surveyed herein, and almost certainly the same applies to subtidal habitat.

The following recommendations are made to advance analyses and preliminary findings reported herein that could not be addressed within the time and financial constraints imposed on this Masters research programme.

Despite the high sampling effort undertaken to compile this biodiversity inventory (321 sites), no asymptote in any species accumulation curve is reached, whether by salinity, substratum, combination of salinity and substratum, and the 5 intertidal habitats recognised herein. Additional sampling is required in each habitat type to compile a more complete inventory of species, especially within disproportionately under-represented habitat such as fringe-saline and brackish hard shores. Additional sampling on marine hard substrata (such as boulders, rocky reef, platform reef and cobbles) would determine whether associated species assemblages are distinct from those of cobble habitat. The same applies in marine- and brackish-soft substrata, such as mud, sand, and mixture of two.

Few systematic works review or describe coastal marine biodiversity. The NIWA Biodiversity Memoir series, formerly NZOI memoir series, the most comprehensive monographic reviews of the New Zealand marine fauna, focuses systematic revision on the relatively better sampled-shelf and deep-sea fauna. Consequently, intertidal and shallow subtidal invertebrates frequently encountered in coastal surveys, such as polychaetes, amphipods, sponges and sea anemones, prove difficult to accurately identify. Each requires urgent systematic attention. Also, it will be more beneficial to focus attention on ecological and

regional reviews of taxa as it is more feasible to achieve these in the immediate time than larger-scale monographic reviews for the New Zealand EEZ. Even if the specific status of species cannot be resolved, species-specific enumerated unknowns could be standardised.

An accurate inventory of marine invasive species is also required, so that the relative contribution of these taxa to the total species richness of any shore can be more fully evaluated.

The functionality of the prototype marine biodiversity database developed herein needs to be improved as a decision-support tool for conservation and resource management.

The relationship between intertidal and subtidal species diversity throughout the survey region, and secondarily greater northeastern New Zealand bioregion, needs to be determined. An MPA network evaluated on the basis of intertidal communities, as undertaken herein, does not consider potential unique, representative or otherwise natural subtidal habitat or species assemblages.

Complete data for consented discharges into the marine environment must be procured, as must data on non-consented discharges (such as pollution events, oil spills, sewerage overflows etc.), given the nature and periodicity of the latter is more likely to have greater and more persistent effects on biodiversity than the former. These data, when analysed with recent biodiversity data, would provide a more comprehensive measure of the effects of anthropogenic disturbance on coastal biodiversity. Aside from marine hard shores, the relationship between consent data and other habitat types must also be investigated to establish more robust information on the overall effects of anthropogenic disturbances in coastal habitat.

Improved quality controls for environmental consultants are necessary to ensure species diversity data acquired and used by them during consulting activities is accurate and comprehensive, and that statements made in reports are based on current data rather than perceptions and client expectations. It is possible that resource consents have been issued based on somewhat spurious appraisals of the immediate and cumulative effect of discharge on the environment, or of the relative rarity (or appreciation of this) of species that occur within it.

Finally, resource management decisions affecting the marine environment must be based on current biodiversity data collected specifically for the purposes for which its use was intended, rather than on the basis of the apparent proximity and number of spots on maps. Should historical data be used to identify areas meriting conservation, then the possibility exists that extant areas of significant diversity are afforded no protection.

It was earlier (p. 15) asserted that global databases yield information appropriate for interpretation at a global scale, that national and regional databases needed to be tailored to address biodiversity trends and patterns occurring at each of these scales (Alroy 2003), and accordingly local-level conservation and resource management would require biodiversity data at an even finer, local scale. In light of analyses conducted herein, reviewing data sets at each of global, national, regional and local scales (Table 11), this appears to hold true, with the greatest amount of information returned from the sole local database available (*Monalisa*).

Although all OBIS, Te Papa and ARC data sets combined improve the amount of information available to resource managers, significantly improving the return rate on individual species searches from environmental consultant reports (Table 12), the biases in these existing data sets, and historical and inconsistent methods of data collection, will likely lead to erroneous predictions of environmental quality and current species assemblages in the event they are used solely as a basis upon which decisions affecting the marine environment are made. However, rather than liberating *Monalisa* data to the Southwestern Pacific Regional OBIS Node for inclusion in the OBIS database, thus improving its interrogative power at regional and local scales, at least for the Hauraki Gulf Marine Park region, these data will be maintained separately. A considerable amount of information populating the *Monalisa* database is based on current AUT staff and postgraduate research programmes, and has yet to be published. To protect the interests of those contributing parties that have invested many thousands of hours collecting these data, and will use them for research and commercial purposes, the decision has been made to liberate these data in a novel database, *Monalisa*, for imminent internet release, with appropriate access controls.

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Appendices

Appendix 1: QUESTIONNAIRE

Survey on Existing Marine Biodiversity Databases in New Zealand Questionnaire

I. Correspondent's Information

1. Name: ……...

2. Position: ……

3. Organisation: ……

4. Physical address: ……

5. Postal address (if different from above):

   ……...……

   …….....

6. Phone/Fax No. ……..

7. Email address: ……..

☐ I would like a copy of the prototype marine biodiversity database on cd/dvd.

II. Existing Marine Biodiversity Information

1. Does your organisation conduct research involving collection of data on species in New Zealand aquatic (fresh, estuarine, marine) environments?

   ☐ Yes ☐ No

   If **No**, then you have effectively finished this questionnaire, although you may proceed and answer the following.

2. Does your organisation employ an in-house expert for identification of aquatic organisms, or does it contract identification out to another party?

   ☐ In-house expertise ☐ Subcontractor(s) employed

3. Do you see value for your organisation in archiving biodiversity data in a database?

   Note: Biodiversity data refers to details of organisms, such as scientific names, common names, synonymies, species distributions and abundances (spatial and temporal), reproductive status, other observational and associated biological data.

   ☐ Yes ☐ No

4. If a comprehensive biodiversity database was available, would you make use of it?

☐ Yes ☐ No

Comments: …….....

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5. What are the features of a biodiversity database that you would find useful?

☐ Search functions using names (scientific names, common names).
☐ Search functions using distribution data.
☐ Generate reports on species checklist.
☐ Generate reports on specific areas and species occurrences.
☐ Generate reports on species and associated environmental issues/disturbances.
☐ Add data into the database.
☐ Generate species distribution maps.
☐ Find useful references on New Zealand marine species and related topics.
☐ Find taxonomic data.
☐ Find biological data.
☐ Find ecological data.
☐ Find species images.
☐ Locate experts in species identification or ecology.

Other: …….....

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6. Does your organisation or has it ever archive data on New Zealand marine biodiversity?

☐ Yes ☐ No

6.1 If **Yes**, what format is the data currently, ultimately archived in?

☐ Paper files
☐ Computer files
☐ Database

6.2 If you ticked 'database', would you be prepared to provide the following information?

Name of database(s)	Data content	Format
1.		
2.		
3.		
4.		
5.		

7. For the purpose of developing a prototype biodiversity database for this research programme, would you be willing to provide:

   a) A copy of (Please tick):

   ☐ Paper files (entire reports, scientific papers)
   ☐ Paper files (sections of reports dealing with biological data)
   ☐ Computer files (entire files or reports)
   ☐ Computer files (sections of files or reports dealing with biological data)
   ☐ Database(s)

   or b) Access to (Please tick):

   ☐ Paper files (entire reports, scientific papers)
   ☐ Paper files (sections of reports dealing with biological data)
   ☐ Computer files (entire files or reports)
   ☐ Computer files (sections of files or reports dealing with biological data)
   ☐ Database(s)

8. Would you be prepared to meet with me to discuss the aims and objectives of this research programme, and if so, when would be a convenient time for this meeting?

   ☐ Sorry, I'm unavailable.
   ☐ 3rd week of August 2006
   ☐ 4th week of August 2006
   ☐ 1st week of September 2006
   ☐ 2nd week of September 2006
   ☐ Later on ……

   Comments: ..…….....

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Appendix 2: TABLES

Table 33: List of experts consulted and data contributors to this research project.

Name	Affiliation	Contribution to this research
Barry Charles	Environment Waikato	Provided resource consent applications data in Thames-Coromandel region
Brett Ogilvie	Tonkin and Taylor	Provided environmental impact assessment reports
Brian McArdle	University of Auckland	Provided comments and information on MDS application on biodiversity data
Bruce Marshall	Te Papa	Provided a copy of Te Papa Mollusc database
Dan Breen	Auckland Conservancy, Department of Conservation	Provided habitat shapefile in the Hauraki Gulf region used for interrogation with novel data collected
Dianne Quadling	ARC	Provided data on resource consent applications in the Auckland region
Don Robertson	SW Pacific Regional OBIS Node, NIWA Wellington	Provided SW Pacific Regional OBIS Node data download
Frank Bisby, Yuri Roskov	Species 2000, University of Reading UK,	Provided latest copy of Catalogue of Life Annual Checklist
Karen Wilson	Species 2000, Royal Botanic Gardens Australia	Provided Catalogue of Life Annual Checklist 2008
Mark Costello	OBIS, Census of Marine Life, GBIF, University of Auckland	Provided information on what are the existing biodiversity data in New Zealand, their location and contact persons
Michael Browne	GISD, University of Auckland	Provided data access and download on their in-house database on invasive species
Neil Andrew	World Fish Center Malaysia Office	Provided contact persons in New Zealand when this research was in its initial stage
Neil Binnie	AUT	Statistical support during initial biodiversity data analyses
Nicolas Bailly	FishBase, Species 2000, World Fish Center Philippine office	Provided critical comments on utility of global databases and its potential in the local scale
Peter Conway	ARC	Provided assistance on procurement of ARC resource consent applications, and data on non-consented pollution events
Shane Kelly	ARC	Provided a copy of ARC Coastal Environment Database
Shyama Pagad	GISD, University of Auckland	Facilitated data access and download on GISD in-house copy; provided information on locations of New Zealand biodiversity data
Steve Massey	SW Pacific Regional OBIS Node, NIWA Christchurch	Facilitated OBIS data download
Steve White	Bioresearches Ltd	Provided environmental impact assessment reports

Table 34: Presence/absence of Chelsea species across data sources, n=34

	Global				Regional		Local	
Species list	**Catalogue of Life**	**WoRMS**	**GISD**	**Hexacorals**	**OBIS**	**Mollusc database**	**ARC Coastal Database**	***Monalisa***
Acanthochitona zelandica	×	×	NA	NA	✓	✓	✓	✓
Anthopleura aureoradiata	×	✓	NA	✓	✓	NA	✓	✓
Apophloea sinclairii	×	×	NA	NA	NA	NA	×	✓
Austrominius modestus	✓	✓	NA	NA	✓	NA	✓	✓
Cellana ornata	×	×	NA	NA	✓	×	×	✓
Chiton glaucus	×	×	NA	NA	✓	✓	✓	✓
Chlorophyceae sp.	✓	✓	NA	NA	NA	NA	×	✓
Colpomenia sinuosa	✓	✓	NA	NA	NA	NA	×	✓
Cominella adspersa	×	×	NA	NA	✓	✓	✓	✓
Cominella maculosa	×	×	NA	NA	✓	✓	×	✓
Corallina officinalis	✓	✓	NA	NA	NA	NA	×	✓
Coscinasterias calamaria	×	✓	NA	NA	✓	NA	×	✓
Crassostrea gigas	✓	✓	✓	NA	NA	✓	✓	✓
Dakaria subovoidea	×	×	×	NA	×	NA	×	×
Fungi sp.	✓	✓	NA	NA	NA	NA	×	✓
Gelidium caulacantheum	✓	×	NA	NA	NA	NA	×	✓
Hemigrapsus edwardsi	×	×	NA	NA	NA	NA	×	✓
Hormosira banksii	✓	×	NA	NA	✓	NA	×	✓
Isactinia olivacea	✓	✓	NA	✓	✓	NA	×	✓
Ischnochiton maorianus	×	×	NA	NA	NA	✓	✓	✓
Melagraphia aethiops	×	×	NA	NA	✓	×	×	✓
Notoacmea daedala	×	×	NA	NA	✓	✓	×	✓
Onchidella nigricans	×	×	NA	NA	NA	×	×	✓
Pagurus sp.	✓	✓	NA	NA	✓	NA	✓	✓
Patiriella regularis	×	×	NA	NA	✓	NA	✓	✓
Perna canaliculus	×	×	NA	NA	✓	✓	×	✓
Petrolisthes elongatus	×	×	NA	NA	✓	NA	×	✓
Pomatoceros caeruleus	✓	✓	NA	NA	✓	NA	×	✓
Ralfsia verrucosa	✓	✓	NA	NA	NA	×	×	✓
Saccostrea glomerata	✓	✓	NA	NA	✓	×	✓	✓
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓	✓
Turbo smaragdus	×	×	NA	NA	✓	✓	×	✓
Xenostrobus pulex	×	×	NA	NA	✓	×	×	✓
Zeacumantus lutulentus	×	×	NA	NA	✓	×	✓	✓
No. of species present from data source over expected no. of species from this list	13/34	10/34	1/2	2/2	22/34	9/16	12/34	33/34
No. of species present from data source over total no. of species from this list	13/34	13/34	1/34	2/34	22/34	9/34	12/34	33/34
% Actual data present from databases	**38%**	**38%**	**3%**	**6%**	**65%**	**26%**	**35%**	**97% ***

✓ = present, × = absent, **NA** = not applicable/taxa not covered by data source,* = primary data only

Table 35: Presence/absence of Kohimarama species across data sources, n=68

	Global				National		Regional	
Species list	**Catalogue of Life**	**WoRMS**	**GISD**	**Hexacorals**	**OBIS**	**Molluscdatabase**	**ARC Coastal Database**	***Monalisa***
Amalda mucronata	×	×	NA	NA	✓	✓	×	×
Amphipoda a	✓	✓	NA	NA	×	NA	✓	✓
Amphipoda b	✓	✓	NA	NA	×	NA	✓	✓
Amphipoda c	✓	✓	NA	NA	×	NA	✓	✓
Amphipoda d	✓	✓	NA	NA	×	NA	✓	✓
Anthopleura aureoradiata	×	✓	NA	✓	✓	NA	✓	✓
Aonides sp.	✓	✓	NA	NA	✓	NA	✓	✓
Arenicolidae sp.	✓	✓	NA	NA	×	NA	×	✓
Aricidea sp.	✓	✓	NA	NA	✓	NA	✓	✓
Austrolittorina antipodum	×	×	NA	NA	×	✓	✓	✓
Austrominius modestus	✓	✓	NA	NA	✓	NA	✓	✓
Austrovenus stutchburyi	×	×	NA	NA	✓	×	✓	✓
Bulla quoyi	×	×	NA	NA	×	×	✓	✓
Cirratulidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Cominella adspersa	×	×	NA	NA	✓	✓	✓	✓
Cominella glandiformis	×	×	NA	NA	✓	✓	✓	✓
Cominella maculosa	×	×	NA	NA	✓	✓	×	✓
Cominella virgata	×	×	NA	NA	×	✓	×	✓
Crassostrea gigas	✓	✓	✓	NA	×	×	✓	✓
Cumacea sp.	✓	✓	NA	NA	×	NA	✓	✓
Decapoda sp.	✓	✓	NA	NA	×	NA	✓	✓
Dendrobranchiata unid.	×	✓	NA	NA	×	NA	×	×
Elamena producta	×	×	NA	NA	✓	NA	×	✓
Exosphaeroma sp.	✓	✓	NA	NA	✓	NA	✓	✓
Fellaster zelandiae	×	×	NA	NA	✓	NA	×	✓
Glyceridae sp.	✓	✓	NA	NA	✓	NA	✓	✓
Halicarcinus cookii	×	×	NA	NA	✓	NA	×	✓
Hemigrapsus edwardsi	×	×	NA	NA	×	NA	×	✓
Hesionidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Heteromastus filiformis	✓	✓	NA	NA	✓	NA	✓	✓
Lophogastrida sp.	✓	✓	NA	NA	×	NA	✓	×
Macomona liliana	×	×	NA	NA	✓	×	✓	✓
Macrophthalmus hirtipes	×	×	NA	NA	✓	NA	✓	✓
Maldanidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Melagraphia aethiops	×	×	NA	NA	✓	×	×	✓
Mytilus edulis galloprovincialis	✓	✓	NA	NA	✓	✓	×	✓
Nematoda sp.	×	✓	NA	NA	×	NA	✓	✓
Nemertea sp.	✓	✓	NA	NA	×	NA	✓	✓
Nereididae sp.	✓	✓	NA	NA	×	NA	✓	✓
Nerita atramentosa	×	×	NA	NA	✓	×	×	✓
Nucula hartvigiana	×	×	NA	NA	✓	✓	✓	✓
Oligochaeta sp.	✓	✓	NA	NA	×	NA	✓	✓
Onchidella nigricans	×	×	NA	NA	×	×	×	✓
Orbinia papillosa	×	×	NA	NA	✓	NA	✓	✓

Ostracoda sp.	✓	✓	NA	NA	✓	NA	✓	✓
Owenia fusiformis	✓	✓	NA	NA	✓	NA	✓	✓
Pagurus novizealandiae	×	×	NA	NA	✓	NA	×	✓
Palaemon affinis	×	×	NA	NA	✓	NA	✓	✓
Paphies australis	×	×	NA	NA	✓	✓	✓	✓
Paraonidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Patiriella regularis	×	×	NA	NA	✓	NA	✓	✓
Perinereis camiguinoides	×	✓	NA	NA	×	NA	×	✓
Pomatoceros cariniferus	✓	×	NA	NA	✓	NA	×	✓
Pontophilus australis	×	×	NA	NA	×	NA	✓	✓
Prionospio sp.	✓	✓	NA	NA	✓	NA	✓	✓
Sabellidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Saccostrea glomerata	✓	✓	NA	NA	✓	×	✓	✓
Scalibregmidae sp.	×	✓	NA	NA	✓	NA	✓	×
Solemya parkinsoni	×	×	NA	NA	✓	✓	✓	✓
Squilla armata	×	×	NA	NA	✓	NA	×	×
Syllidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓	✓
Tanaidae sp.	✓	✓	NA	NA	×	NA	✓	✓
Trochodota dendyi	×	×	NA	NA	✓	NA	✓	✓
Turbo smaragdus	×	×	NA	NA	✓	✓	×	✓
Turbonilla sp.	✓	✓	NA	NA	✓	×	×	✓
Xenostrobus pulex	×	×	NA	NA	✓	×	×	✓
Zeacumantus subcarinatus	×	×	NA	NA	✓	×	×	✓
No. of species present from data source over expected no. of species from this list	32/68	36/68	1/1	1/1	40/68	12/23	47/68	63/68
No. of species present from data source over total no. of species from this list	32/68	36/68	1/68	1/68	40/68	12/68	47/68	63/68
% Actual data present from databases	**47%**	**53%**	**1%**	**1%**	**59%**	**18%**	**69%**	**93% ***

✓ = present, × = absent, NA = not applicable/taxa not covered by data source
* = primary data only

Table 36: Presence/absence of Wairoa species across data sources (n=38)

	Global			National		Regional	
Species list	**Catalogue of Life**	**WorMS**	**GISD**	**OBIS**	**Mollusc database**	**ARC Coastal Database**	***Monalisa***
Aglaophamus macroura	×	✓	NA	✓	NA	✓	✓
Alpheus sp.	✓	✓	NA	✓	NA	✓	✓
Amphiura aster	✓	✓	NA	✓	NA	✓	✓
Apseudes australis	✓	×	NA	×	NA	×	×
Armandia maculata	✓	✓	NA	×	NA	✓	✓
Arthritica bifurca	×	×	NA	×	✓	✓	✓
Austrovenus stutchburyi	×	×	NA	✓	×	✓	✓
Boccardia sp.	✓	✓	NA	✓	NA	✓	✓
Cirolana arcuata	×	✓	NA	×	NA	×	✓
Cirratulidae sp.	✓	✓	NA	×	NA	✓	✓
Cossura coasta	✓	✓	NA	×	NA	✓	×
Cumacea sp.	✓	✓	NA	×	NA	✓	✓
Glycera americana	✓	✓	NA	✓	NA	✓	✓
Goniada sp.	✓	✓	NA	×	NA	✓	✓
Heteromastus filiformis	✓	✓	NA	✓	NA	✓	✓
Lumbrineris sp.	✓	✓	NA	✓	NA	✓	✓
Macrophthalmus hirtipes	×	×	NA	✓	NA	✓	✓
Maldanidae sp.	✓	✓	NA	×	NA	✓	✓
Musculista senhousia	✓	✓	×	×	✓	✓	✓
Neilo australis	×	×	NA	✓	✓	✓	×
Nicon aestuariensis	×	×	NA	✓	NA	✓	✓
Nucula hartvigiana	×	×	NA	✓	✓	✓	✓
Orbinia papillosa	×	×	NA	✓	NA	✓	✓
Ostracoda A	✓	✓	NA	×	NA	✓	✓
Ostracoda B	✓	✓	NA	×	NA	✓	✓
Paguroidea sp.	✓	✓	NA	×	NA	×	✓
Paracorophium excavatum	×	×	NA	×	NA	✓	✓
Paranthura flagellata	✓	×	NA	×	NA	×	×
Paraonidae sp.	✓	✓	NA	×	NA	✓	✓
Pectinaria australis	×	×	NA	✓	NA	✓	✓
Philine sp.	✓	✓	NA	×	✓	✓	×
Phoxocephalidae A	✓	✓	NA	×	NA	✓	✓
Phoxocephalidae C	✓	✓	NA	×	NA	✓	✓
Sabellidae sp.	✓	✓	NA	×	NA	✓	✓
Sigalionidae sp.	✓	✓	NA	×	NA	✓	✓
Thelepus sp.	✓	✓	NA	×	NA	✓	✓
Theora lubrica	✓	✓	×	✓	✓	✓	✓
Trochodota dendyi	×	×	NA	✓	NA	✓	✓
No. of species present from data source over expected no. of species from this list	26/38	23/38	0/2	16/38	6/7	31/38	33/38
No. of species present from data source over total no. of species from this list	26/38	26/38	0/38	16/38	6/38	31/38	33/38
% Actual data present from primary and secondary databases	**68%**	**68%**	**0%**	**42%**	**16%**	**82%**	**87% ***

✓=present, ×=absent, NA=not applicable/taxa not covered by data source, *primary data only

Table 37: Presence/absence of Mechanics Bay species across data sources (low species rich marine hard-shore habitat, n=58). Species list source *Monalisa*

	Global				National		Regional
Species list	**Catalogue of Life**	**WoRMS**	**GISD**	**Hexacorals**	**OBIS**	**Mollusc database**	**ARC Coastal Database**
Acanthochitona zelandica	×	×	NA	NA	✓	✓	✓
Acarina sp.	✓	✓	NA	NA	×	NA	×
Amphiporus sp.	✓	✓	NA	NA	×	NA	×
Arthritica bifurca	×	×	NA	NA	✓	✓	✓
Asterocarpa cerea	×	✓	NA	NA	×	NA	×
Atalacmea fragilis	×	×	NA	NA	×	✓	×
Austrolittorina antipodum	×	×	NA	NA	×	✓	✓
Austrominius modestus	✓	✓	NA	NA	✓	NA	✓
Beania sp.	✓	✓	NA	NA	✓	NA	×
Calantica spinosa	×	×	NA	NA	×	NA	×
Cellana ornata	×	×	NA	NA	✓	×	×
Chamaesipho columna	×	×	NA	NA	×	NA	×
Chaperiopsis sp.	✓	✓	NA	NA	✓	NA	×
Chiton glaucus	×	×	NA	NA	×	✓	✓
Codium adhaerens	✓	✓	NA	NA	×	NA	×
Colpomenia sinuosa	✓	✓	NA	NA	×	NA	×
Cominella virgata	×	×	NA	NA	×	✓	×
Corallina officinalis	✓	✓	NA	NA	×	NA	×
Coscinasterias muricata	×	×	NA	NA	✓	NA	×
Crassostrea gigas	✓	✓	✓	NA	×	×	✓
Cyclograpsus lavauxi	×	×	NA	NA	×	NA	×
Diloma zelandica	×	×	NA	NA	×	✓	×
Ecklonia radiata	✓	×	NA	NA	×	NA	×
Epopella plicata	×	×	NA	NA	✓	NA	×
Exosphaeroma chilensis	×	✓	NA	NA	×	NA	✓
Fossarina rimata	×	×	NA	NA	×	✓	×
Halicarcinus pubescens	×	×	NA	NA	×	NA	×
Haustrum haustorium	×	×	NA	NA	×	✓	×
Isactinia olivacea	✓	✓	NA	✓	✓	NA	×
Leathesia difformis	✓	✓	×	NA	×	NA	×
Lepidonotus polychroma	×	×	NA	NA	×	NA	✓
Lepsiella scobina	×	×	NA	NA	×	×	×
Leuconopsis obsoleta	×	×	NA	NA	×	✓	×
Maoricrypta costata	×	×	NA	NA	×	✓	×
Melagraphia aethiops	×	×	NA	NA	✓	×	×
Neosabellaria kaiparaensis	×	✓	NA	NA	✓	NA	×
Nerita atramentosa	×	×	NA	NA	✓	×	×
Notoacmea daedala	×	×	NA	NA	✓	✓	×
Onchidella nigricans	×	×	NA	NA	×	×	×
Patiriella regularis	×	×	NA	NA	✓	NA	✓
Perna canaliculus	×	×	NA	NA	✓	✓	✓
Petrolisthes elongatus	×	×	NA	NA	✓	NA	×
Pomatoceros caeruleus	×	✓	NA	NA	✓	NA	×

Pycnogonida sp.	✓	✓	NA	NA	×	NA	✓
Pyura rugata	×	×	NA	NA	×	NA	×
Pyura subuculata	✓	✓	NA	NA	×	NA	×
Risellopsis varia	×	×	NA	NA	×	✓	×
Saccostrea glomerata	✓	✓	NA	NA	✓	×	✓
Sigapatella novaezelandiae	×	×	NA	NA	✓	✓	✓
Siphonaria australis	×	×	NA	NA	✓	×	×
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓
Sypharochiton sinclairii	×	×	NA	NA	×	✓	×
Taron dubius	×	×	NA	NA	×	✓	×
Tetraclitella depressa	×	×	NA	NA	×	NA	×
Trochus viridis	✓	×	NA	NA	✓	✓	×
Turbo smaragdus	✓	×	NA	NA	✓	✓	×
Watersipora sp.	✓	✓	×	NA	×	NA	×
Xenostrobus pulex	×	×	NA	NA	✓	×	×
No. of species present from data source over expected no. of species from this list	18/58	19/58	1/3	1/1	24/58	20/29	14/58
No. of species present from data source over total no. of species from this list	18/58	19/58	1/58	1/58	24/58	20/58	14/58
%Actual data present from database	**31%**	**33%**	**2%**	**2%**	**41%**	**34%**	**24%**

✓ = present, × = absent, NA = not applicable/taxa not covered by data source

Table 38: Presence/absence of Kohimarama Beach species across data sources (medium species rich marine hard-shore habitat, n=82). Species list source: *Monalisa*

	Global				National		Regional
Species list	**Catalogue of Life**	**WoRMS**	**GISD**	**Hexacorals**	**OBIS**	**Mollusc database**	**ARC Coastal Database**
Aaptos aaptos	✓	✓	NA	NA	×	NA	×
Acanthochitona zelandica	×	×	NA	NA	✓	✓	✓
Acanthoclinus littoreus	✓	×	NA	NA	✓	NA	×
Alpheus sp.	✓	✓	NA	NA	✓	NA	✓
Amalda australis	×	×	NA	NA	✓	✓	✓
Amphiporus sp.	✓	✓	NA	NA	×	NA	×
Anthopleura aureoradiata	×	✓	NA	✓	✓	NA	✓
Apodida sp.	✓	✓	NA	NA	✓	NA	×
Asterocarpa coerulea	✓	✓	NA	NA	×	NA	×
Austrolittorina antipodum	×	×	NA	NA	×	✓	✓
Austrominius modestus	✓	✓	NA	NA	✓	NA	✓
Austrovenus stutchburyi	×	×	NA	NA	✓	×	✓
Barnea similis	×	×	NA	NA	×	✓	×
Buccinulum lineum	×	×	NA	NA	✓	✓	×
Buccinulum vittatum	×	×	NA	NA	✓	✓	×
Bulla quoyi	×	×	NA	NA	×	×	✓
Charybdis japonica	✓	✓	✓	NA	×	NA	×
Cnemidocarpa bicornuta	×	✓	NA	NA	✓	NA	×
Colpomenia sinuosa	✓	✓	NA	NA	×	NA	×
Cominella adspersa	×	×	NA	NA	✓	✓	✓
Cominella glandiformis	×	×	NA	NA	✓	✓	✓
Cominella maculosa	×	×	NA	NA	✓	✓	×
Cominella quoyana	×	×	NA	NA	✓	✓	×
Cominella virgata	×	×	NA	NA	×	✓	×
Corallina officinalis	✓	✓	NA	NA	×	NA	×
Corella eumyota	✓	✓	NA	NA	✓	NA	✓
Crassostrea gigas	✓	✓	✓	NA	×	×	✓
Eulalia microphylla	×	✓	NA	NA	×	NA	×
Flabelligera affinis	×	✓	NA	NA	×	NA	×
Haematopus ostralegus	✓	✓	NA	NA	×	NA	×
Halicarcinus pubescens	×	×	NA	NA	×	NA	×
Irus reflexus	×	×	NA	NA	×	✓	×
Isactinia olivacea	✓	✓	NA	✓	✓	NA	×
Ischnochiton maorianus	×	×	NA	NA	×	✓	✓
Larus novaehollandiae	×	×	NA	NA	✓	NA	×
Lepidonotus purpureus	✓	✓	NA	NA	×	NA	×
Lepsiella scobina	×	×	NA	NA	×	×	×
Leptochiton inquinatus	×	×	NA	NA	✓	✓	×
Maoricolpus roseus	×	×	NA	NA	×	✓	✓
Maoricrypta monoxyla	×	×	NA	NA	✓	✓	✓
Melagraphia aethiops	×	×	NA	NA	✓	×	×
Microciona sp.	✓	✓	NA	NA	✓	NA	×
Modiolarca impacta	×	×	NA	NA	✓	✓	✓

Musculista senhousia	✓	✓	✓	NA	×	✓	✓
Neosabellaria kaiparaensis	×	✓	NA	NA	✓	NA	×
Nerita atramentosa	×	×	NA	NA	✓	×	×
Notomithrax minor	×	×	NA	NA	✓	NA	×
Notoplax mariae	×	×	NA	NA	✓	×	×
Nucula hartvigiana	×	×	NA	NA	✓	×	✓
Onchidella nigricans	×	×	NA	NA	×	×	×
Paguristes sp.	✓	✓	NA	NA	✓	NA	×
Paguroidea sp.	✓	×	NA	NA	✓	NA	×
Pagurus novizealandiae	×	×	NA	NA	✓	NA	×
Palaemon affinis	×	×	NA	NA	✓	NA	✓
Patiriella regularis	×	×	NA	NA	×	NA	✓
Perinereis novaehollandiae	✓	✓	NA	NA	×	NA	×
Perna canaliculus	×	×	NA	NA	✓	✓	✓
Pertusaria sp.	✓	×	NA	NA	×	NA	×
Petrolisthes elongatus	×	×	NA	NA	✓	NA	×
Pherusa parmatus	✓	×	NA	NA	×	NA	×
Pholadidea spathulata	×	×	NA	NA	×	×	×
Pilumnopeus serratifrons	×	×	NA	NA	×	NA	×
Pilumnus lumpinus	×	×	NA	NA	×	NA	×
Pilumnus novaezelandiae	×	×	NA	NA	✓	NA	✓
Polychaeta sp.	✓	✓	NA	NA	✓	NA	✓
Pomatoceros caeruleus	×	✓	NA	NA	✓	NA	×
Scintillona zelandica	×	×	NA	NA	×	✓	✓
Scytothamnus australis	✓	×	NA	NA	×	NA	×
Sigapatella novaezelandiae	×	×	NA	NA	✓	✓	✓
Siphonaria australis	×	×	NA	NA	✓	×	×
Sipunculidae sp.	✓	✓	NA	NA	×	NA	×
Spirorbinae sp.	×	✓	NA	NA	✓	NA	×
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓
Tanaidae sp.	✓	✓	NA	NA	×	NA	✓
Terebella sp.	✓	✓	NA	NA	✓	NA	×
Tethya aurantium	✓	✓	NA	NA	✓	NA	×
Thelepus spectabilis	×	✓	NA	NA	×	NA	×
Trochodota dendyi	×	×	NA	NA	✓	NA	✓
Turbo smaragdus	×	×	NA	NA	✓	✓	×
Watersipora sp.	✓	×	×	NA	✓	NA	×
Zelithophaga truncata	×	×	NA	NA	✓	✓	×
Zostera nana	×	×	NA	NA	✓	NA	×
No. of species present from data source over expected no. of species from this list	29/82	31/82	3/4	2/2	48/82	24/35	28/82
No. of species present from data source over total no. of species from this list	29/82	31/82	3/82	2/82	48/82	24/82	28/82
%Actual data present from database	**35%**	**38%**	**4%**	**24%**	**59%**	**29%**	**34%**

✓ = present, × = absent, NA = not applicable/taxa not covered by data source

Table 39: Presence/absence of Wenderholm Beach species across data sources (high species rich marine soft-shore habitat, n=85). Species list source: *Monalisa*

	Global				National		Regional
Species list	**Catalogue of Life**	**WoRMS**	**GISD**	**Hexacorals**	**OBIS**	**Mollusc database**	**ARC Coastal Database**
Actinia tenebrosa	✓	✓	NA	✓	✓	NA	×
Actiniaria sp.	✓	✓	NA	NA	×	NA	×
Amphiporus sp.	✓	✓	NA	NA	×	NA	×
Anisolabis littorea	×	×	NA	NA	×	NA	×
Asterocarpa cerea	×	✓	NA	NA	×	NA	×
Austrolittorina antipodum	×	×	NA	NA	×	✓	✓
Austrominius modestus	✓	✓	NA	NA	×	NA	✓
Betaeus aequimanus	×	×	NA	NA	✓	NA	×
Branchiomma sp.	✓	×	NA	NA	✓	NA	×
Buccinulum vittatum	×	×	NA	NA	✓	✓	×
Bulla quoyi	×	×	NA	NA	×	×	✓
Cellana radians	×	✓	NA	NA	✓	✓	×
Chamaesipho columna	×	×	NA	NA	×	NA	×
Chiton glaucus	×	×	NA	NA	×	✓	✓
Codium adhaerens	✓	✓	NA	NA	×	NA	×
Codium fragilis	×	×	NA	NA	×	NA	×
Cominella maculosa	×	×	NA	NA	✓	✓	×
Cominella virgata	×	×	NA	NA	×	✓	×
Coscinasterias muricata	×	✓	NA	NA	✓	NA	×
Crassostrea gigas	✓	✓	✓	NA	×	×	✓
Cryptoconchus porosus	✓	✓	NA	NA	✓	✓	×
Cyclograpsus lavauxi	×	×	NA	NA	×	NA	×
Dendrodoris citrina	×	×	NA	NA	×	×	×
Dendrodoris nigra	×	✓	NA	NA	×	×	×
Diloma bicanaliculata	×	×	NA	NA	×	✓	×
Diloma subrostrata	×	×	NA	NA	✓	✓	✓
Diloma zelandica	×	×	NA	NA	×	✓	×
Epopella plicata	×	×	NA	NA	✓	NA	×
Eulalia microphylla	×	✓	NA	NA	×	NA	×
Evechinus chloroticus	×	×	NA	NA	✓	NA	×
Halicarcinus varius	×	×	NA	NA	✓	NA	
Haustrum haustorium	×	×	NA	NA	×	✓	×
Helice crassa	×	×	NA	NA	✓	NA	✓
Heterozius rotundifrons	×	×	NA	NA	✓	NA	×
Hydroides norvegicus	×	✓	NA	NA	×	NA	×
Irus reflexus	×	×	NA	NA	×	✓	×
Isactinia olivacea	✓	✓	NA	✓	✓	NA	×
Ischnochiton maorianus	×	×	NA	NA	×	✓	✓
Lepidonotus polychroma	×	×	NA	NA	✓	NA	✓
Lepsiella scobina	×	×	NA	NA	×	×	×
Leptochiton inquinatus	×	×	NA	NA	×	✓	×
Ligia novaezelandiae	×	×	NA	NA	×	NA	×
Maoricolpus roseus	×	×	NA	NA	✓	✓	✓

Maoricrypta monoxyla	×	×	NA	NA	✓	✓	✓
Marginella sp.	×	✓	NA	NA	✓	×	×
Marinula filholi	×	×	NA	NA	×	✓	×
Melagraphia aethiops	×	×	NA	NA	✓	×	×
Nerita atramentosa	×	×	NA	NA	✓	×	×
Notoacmea daedala	×	×	NA	NA	✓	✓	×
Notoacmea helmsi	×	×	NA	NA	✓	×	✓
Notoplax violacea	×	×	NA	NA	✓	×	×
Nucula hartvigiana	×	×	NA	NA	✓	×	✓
Oligochaeta sp.	✓	✓	NA	NA	×	NA	✓
Onchidella nigricans	×	×	NA	NA	×	×	×
Onoscolex sp.	×	×	NA	NA	×	NA	×
Pagurus novizealandiae	×	×	NA	NA	✓	NA	×
Paphies australis	×	×	NA	NA	✓	✓	✓
Pericoptus humeralis	×	×	NA	NA	×	NA	×
Perinereis camiguinoides	×	✓	NA	NA	×	NA	×
Perinereis novaehollandiae	×	✓	NA	NA	×	NA	×
Perna canaliculus	×	×	NA	NA	✓	✓	✓
Petrolisthes elongatus	×	×	NA	NA	✓	NA	×
Platyhelminthes sp.	✓	✓	NA	NA	×	NA	✓
Polychaeta sp.	✓	✓	NA	NA	×	NA	✓
Pomatoceros caeruleus	✓	✓	NA	NA	✓	NA	×
Pseudosphaeroma campbellensis	✓	✓	NA	NA	×	NA	×
Pyura sp.	✓	✓	NA	NA	✓	NA	×
Risellopsis varia	×	×	NA	NA	×	✓	×
Rissoina chathamensis	×	×	NA	NA	×	✓	×
Scolioplanes sp.	×	×	NA	NA	×	NA	×
Sigapatella novaezelandiae	×	×	NA	NA	✓	✓	✓
Siphonaria australis	×	×	NA	NA	✓	×	×
Sipunculidae sp.	✓	✓	NA	NA	×	NA	×
Stephopoma roseum	×	×	NA	NA	×	×	×
Struthiolaria papulosa	×	×	NA	NA	✓	✓	×
Struthiolaria vermis	×	×	NA	NA	✓	✓	×
Styela clava	✓	✓	✓	NA	×	NA	×
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓
Terebella sp.	✓	✓	NA	NA	×	NA	×
Tethya sp.	✓	✓	NA	NA	✓	NA	✓
Thais orbita	×	×	NA	NA	×	×	×
Turbo smaragdus	×	×	NA	NA	✓	✓	×
Watersipora sp.	✓	✓	×	NA	✓	NA	×
Zeacumantus subcarinatus	×	×	NA	NA	✓	×	×
Zelithophaga truncata	×	×	NA	NA	×	✓	×
No. of species present from data source over expected no. of species from this list	20/85	28/85	2/3	2/2	40/85	28/ 44	21/85
No. of species present from data source over total no. of species from this list	20/85	28/85	2/85	2/85	40/85	28/85	21/85
%Actual data present from database	**24%**	**33%**	**2%**	**2%**	**55%**	**33%**	**25%**

✓ = present, × = absent, NA = not applicable/taxa not covered by data source

Table 40: Presence/absence of Home Bay (Motutapu Island) species across data sources (very high species rich marine hard-shore habitat, n = 179); species list source: *Monalisa*

	Global				National		Regional
	Catalogue of Life	WoRMS	GISD	Hexacorals	OBIS	Mollusc database	ARC Coastal Database
Aaptos aaptos	✓	✓	NA	NA	×	NA	×
Acanthochitona zelandica	×	×	NA	NA	✓	✓	✓
Acanthoclinus fuscus	✓	✓	NA	NA	×	NA	×
Acarina sp.	✓	✓	NA	NA	×	NA	×
Actinia tenebrosa	✓	✓	NA	✓	×	NA	×
Allostichaster polyplax	×	✓	NA	NA	×	NA	×
Alope spinifrons	×	×	NA	NA	×	NA	×
Alpheus sp.	✓	✓	NA	NA	✓	NA	✓
Amaurobioides maritima	✓	×	NA	NA	×	NA	×
Amphiporus sp.	✓	✓	NA	NA	✓	NA	×
Anisolabis littorea	×	×	NA	NA	×	NA	×
Arthritica bifurca	×	×	NA	NA	✓	✓	✓
Ascidiacea sp.	✓	✓	NA	NA	×	NA	✓
Asterocarpa cerea	×	✓	NA	NA	×	NA	×
Asterocarpa coerulea	×	✓	NA	NA	×	NA	×
Austrolittorina antipodum	×	×	NA	NA	×	✓	✓
Austrominius modestus	✓	✓	NA	NA	×	NA	✓
Austromitra rubiginosa	×	×	NA	NA	×	✓	×
Balanus trigonus	✓	✓	NA	NA	✓	NA	×
Balanus vestitus	✓	×	NA	NA	×	NA	×
Beania sp.	✓	✓	NA	NA	✓	NA	×
Betaeus aequimanus	×	×	NA	NA	×	NA	×
Borniola reniformis	×	×	NA	NA	×	✓	✓
Branchiomma sp.	✓	×	NA	NA	×	NA	×
Bryopsis plumosa	✓	✓	NA	NA	×	NA	×
Buccinulum lineum	×	×	NA	NA	✓	×	×
Buccinulum mariae	×	×	NA	NA	×	✓	×
Buccinulum pallidum powelli	×	×	NA	NA	×	×	×
Buccinulum vittatum	×	×	NA	NA	×	✓	×
Calantica spinosa	×	×	NA	NA	×	NA	×
Carpophyllum maschalocarpum	✓	×	NA	NA	×	NA	×
Cellana ornata	✓	✓	NA	NA	×	×	×
Cellana radians	×	✓	NA	NA	×	✓	×
Chaetopterus sp.	✓	✓	NA	NA	✓	NA	✓
Chamaesipho brunnea	×	×	NA	NA	✓	NA	×
Chamaesipho columna	×	×	NA	NA	✓	NA	×
Chiton glaucus	×	×	NA	NA	✓	✓	✓
Chlamys zelandiae	×	×	NA	NA	×	×	×
Cliona celata	✓	✓	NA	NA	×	NA	×
Cnemidocarpa bicornuta	×	✓	NA	NA	✓	NA	×
Codium adhaerens	✓	✓	NA	NA	×	NA	×
Colpomenia peregrina	✓	✓	NA	NA	×	NA	×
Colpomenia sinuosa	✓	✓	NA	NA	×	NA	×
Cominella maculosa	×	×	NA	NA	×	✓	×

Cominella virgata	×	×	NA	NA	×	✓	×
Corallina officinalis	✓	✓	NA	NA	×	NA	×
Coscinasterias muricata	×	✓	NA	NA	✓	NA	×
Crassostrea gigas	✓	✓	✓	NA	×	×	✓
Cryptoconchus porosus	✓	✓	NA	NA	×	✓	×
Culicia rubeola	×	×	NA	✓	✓	NA	×
Cyclograpsus lavauxi	×	×	NA	NA	✓	NA	×
Cystophora retroflexa	×	✓	NA	NA	×	NA	×
Cystophora torulosa	✓	✓	NA	NA	×	NA	×
Dendrostomum aeneum	×	×	NA	NA	×	NA	×
Desis robsoni	×	×	NA	NA	×	NA	×
Diadumene lineata	×	×	×	×	×	NA	×
Didemnum candidum	✓	✓	NA	NA	×	NA	×
Diloma bicanaliculata	×	×	NA	NA	×	✓	×
Diloma zelandica	×	×	NA	NA	×	✓	×
Dodecaceria berkeleyi	×	✓	NA	NA	×	NA	×
Ecklonia radiata	✓	✓	NA	NA	×	NA	×
Elamena producta	×	×	NA	NA	×	NA	×
Elysia maoria	×	×	NA	NA	×	×	×
Epopella plicata	×	×	NA	NA	✓	NA	×
Eudoxochiton nobilis	×	×	NA	NA	×	✓	×
Eulalia microphylla	×	✓	NA	NA	×	NA	×
Evechinus chloroticus	×	×	NA	NA	×	NA	×
Exosphaeroma gigas	✓	✓	NA	NA	×	NA	×
Filograna sp.	✓	✓	NA	NA	×	NA	×
Flabelligera affinis	✓	✓	NA	NA	×	NA	×
Galeolaria hystrix	×	✓	NA	NA	×	NA	×
Gobiesocidae sp.	✓	✓	NA	NA	×	NA	×
Gregariella barbata	×	×	NA	NA	×	×	×
Halicarcinus cookii	×	×	NA	NA	×	NA	×
Halicarcinus pubescens	×	×	NA	NA	×	NA	×
Halichondria sp.	✓	✓	NA	NA	✓	NA	×
Haustrum haustorium	×	×	NA	NA	×	✓	×
Hemigrapsus edwardsi	×	×	NA	NA	×	NA	×
Herpetopoma bella	×	×	NA	NA	×	✓	×
Heterozius rotundifrons	×	×	NA	NA	×	NA	×
Hiatella arctica	✓	✓	NA	NA	×	×	✓
Hildenbrandtia sp.	✓	×	NA	NA	×	NA	×
Hormosira banksii	✓	×	NA	NA	×	NA	×
Hydroides norvegicus	×	✓	NA	NA	×	NA	×
Isactinia olivacea	✓	✓	NA	✓	×	NA	×
Ischnochiton maorianus	×	×	NA	NA	×	✓	✓
Isocladus dulciculus	✓	✓	NA	NA	✓	NA	×
Isocradactis magna	✓	✓	NA	✓	×	NA	×
Isoparactis ferax	✓	×	NA	×	×	NA	×
Leathesia difformis	✓	✓	×	NA	×	NA	×
Lepidonotus polychroma	×	×	NA	NA	✓	NA	✓
Lepidonotus purpureus	✓	✓	NA	NA	×	NA	×
Lepsiella scobina	×	×	NA	NA	×	×	×
Leptochiton inquinatus	×	×	NA	NA	✓	✓	×
Leuconopsis obsoleta	×	×	NA	NA	×	✓	×

Ligia novaezelandiae	×	×	NA	NA	✓	NA	×
Lithophyllum sp.	✓	✓	NA	NA	×	NA	×
Maoricolpus roseus	×	×	NA	NA	✓	✓	✓
Maoricrypta costata	×	×	NA	NA	×	✓	×
Maoricrypta monoxyla	×	×	NA	NA	✓	✓	✓
Marginella cairoma	×	×	NA	NA	×	×	×
Marphysa depressa	✓	✓	NA	NA	×	NA	×
Melagraphia aethiops	×	×	NA	NA	✓	×	×
Merelina taupoensis	×	×	NA	NA	×	✓	×
Mesoginella koma	×	×	NA	NA	×	✓	×
Microciona sp.	✓	✓	NA	NA	✓	NA	×
Microcosmus kura	×	✓	NA	NA	✓	NA	×
Modiolarca impacta	×	×	NA	NA	✓	✓	✓
Monia zelandica	×	×	NA	NA	×	×	×
Mytilus edulis	✓	✓	NA	NA	×	×	×
Nemertea sp.	✓	✓	NA	NA	×	NA	✓
Neosabellaria kaiparaensis	×	✓	NA	NA	✓	NA	×
Nerita atramentosa	×	×	NA	NA	×	×	×
Notoacmea daedala	×	×	NA	NA	✓	✓	×
Notoacmea parviconoidea	×	×	NA	NA	×	✓	×
Notoplax violacea	×	×	NA	NA	×	×	×
Ocnus brevidentis	×	×	NA	NA	×	NA	×
Octocorallia sp.	×	✓	NA	×	×	NA	×
Okamia thilenii	×	✓	NA	NA	×	NA	×
Onchidella nigricans	×	×	NA	NA	×	×	×
Onithochiton neglectus	×	×	NA	NA	×	✓	×
Ophionereis fasciata	×	✓	NA	NA	×	NA	×
Pagurus novizealandiae	×	×	NA	NA	✓	NA	×
Palaemon affinis	×	×	NA	NA	✓	NA	✓
Patiriella regularis	×	×	NA	NA	×	NA	✓
Paxula paxillus	×	×	NA	NA	×	✓	×
Perinereis novaehollandiae	✓	✓	NA	NA	×	NA	×
Perinereis nuntia	×	✓	NA	NA	×	NA	✓
Perinereis sp.	✓	✓	NA	NA	✓	NA	✓
Perna canaliculus	×	×	NA	NA	✓	✓	✓
Petrocheles spinosus	×	×	NA	NA	×	NA	×
Petrolisthes elongatus	×	×	NA	NA	✓	NA	×
Pherusa parmatus	×	×	NA	NA	✓	NA	×
Philobrya sp.	✓	✓	NA	NA	×	×	×
Pilumnus lumpinus	×	×	NA	NA	×	NA	×
Pilumnus novaezelandiae	×	×	NA	NA	✓	NA	✓
Pisidium hodgkini	×	×	NA	NA	×	×	×
Pisinna zosterophila	×	×	NA	NA	×	✓	×
Plagusia chabrus	×	✓	NA	NA	×	NA	×
Platyhelminthes sp.	✓	✓	NA	NA	✓	NA	✓
Platynereis australis	✓	✓	NA	NA	✓	NA	✓
Pomatoceros caeruleus	✓	✓	NA	NA	×	NA	×
Pseudechinus huttoni	×	×	NA	NA	×	NA	×
Pyura rugata	×	✓	NA	NA	×	NA	×
Rhyssoplax aerea	×	×	NA	NA	×	✓	×
Risellopsis varia	×	×	NA	NA	×	✓	×

Rissoina chathamensis	×	×	NA	NA	×	✓	×
Saccostrea glomerata	×	✓	NA	NA	×	×	✓
Scolioplanes sp.	✓	×	NA	NA	×	NA	×
Scutus breviculus	×	×	NA	NA	×	✓	×
Serpulorbis sp.	✓	✓	NA	NA	×	×	×
Sigapatella novaezelandiae	×	×	NA	NA	✓	✓	✓
Siphonaria australis	×	×	NA	NA	×	×	×
Sphaerium novaezelandiae	×	×	NA	NA	×	×	×
Sphaeromatidae sp.	✓	✓	NA	NA	×	NA	✓
Spirorbinae sp.	×	✓	NA	NA	×	NA	×
Splachnidium rugosum	✓	✓	NA	NA	×	NA	×
Steginoporella perplexa	×	×	NA	NA	×	NA	×
Stegnaster inflatus	×	×	NA	NA	×	NA	×
Stephopoma roseum	×	×	NA	NA	×	×	×
Suterilla imperforata	×	×	NA	NA	×	×	×
Syngnathidae sp.	✓	✓	NA	NA	×	NA	×
Sypharochiton pelliserpentis	×	×	NA	NA	✓	✓	✓
Sypharochiton sinclairii	×	×	NA	NA	×	×	×
Talorchestia sp.	×	×	NA	NA	×	NA	×
Taron dubius	×	×	NA	NA	×	✓	×
Terebellidae sp.	✓	✓	NA	NA	×	NA	✓
Tethya aurantium	✓	✓	NA	NA	×	NA	×
Tetraclitella depressa	×	×	NA	NA	✓	NA	×
Thais orbita	×	×	NA	NA	×	×	×
Thoristella oppressa	×	×	NA	NA	×	✓	×
Timarete anchylochaetus	✓	✓	NA	NA	×	NA	✓
Trachelochismus melobesia	✓	✓	NA	NA	×	NA	×
Trochus viridis	×	×	NA	NA	×	✓	×
Tugali suteri	×	×	NA	NA	×	✓	×
Turbo smaragdus	×	×	NA	NA	×	✓	×
Watersipora sp.	✓	✓	×	NA	✓	NA	×
Xenostrobus securis	×	✓	NA	NA	×	×	✓
Zeacumantus subcarinatus	×	×	NA	NA	×	×	×
No. of species present from data source over expected no. of species from this list	62/179	76/179	1/4	4/7	42/179	43/71	32/179
No. of species present from data source over total no. of species from this list	62/180	76/180	1/179	4/179	42/179	43/179	32/179
%Actual data present from database	**34%**	**42%**	**0.60%**	**2%**	**23%**	**24%**	**18%**

✓ = present, × = absent, NA = not applicable/taxa not covered by data source

Table 41: Locations (and site identifier) for fringe saline (freshwater) sampling

Cape Barrier Rd	177-1	13/03/2008
Cape Barrier Rd	178-1	13/03/2008
Carey Road	131-1	25/11/2007
Garden Road	166-1	11/03/2008
Kariotahi Road	151-1	23/02/2008
Kawakawa	190-1	18/06/2007
Kariotahi Road	152-1	23/02/2008
Little Huia	195-1	08/08/2007
Lonely Bay	124-1	24/11/2007
Mulberry Grove	176-1	13/03/2008
Oamaru Bay	201-1	28/10/2007
Onetangi Bay	154-1	08/03/2008
Pakiri Beach	181-1	17/03/2008
Pauanui	114-1	21/11/2007
Piha Beach	12-1	26/09/2007
Stony Beach	172-1	12/03/2008
Tryphena	168-1	12/03/2008
Tuateawa	129-1	25/11/2007
Tuateawa	130-1	25/11/2007
Wairoa	208-1	21/01/2008
Wairoa	208-2	21/01/2008
Wairoa	208-3	21/01/2008
Wairoa	208-4	21/01/2008
Wairoa	208-5	21/01/2008
Wairoa	208-6	21/01/2008

Table 42: Locations (and site identifier) for marine hard-shore sampling

Bowentown	119-1	22/11/2007
Browns Island	111-1	29/09/2007
Browns Island	111-2	29/09/2007
Cornwallis Beach	9-1	17/07–10/11/2006
Eastern Beach	26-1	18/04/2007
Eastern Beach	63-1	21/04/2007
Emu Point	185-1	07/04/2008
Enclosure Bay	163-1	10/03/2008
Gemstone Bay	121-1	24/11/2007
Goat Island	141-1	29/11/2007
Herald Island Wharf	99-1	04/09/2007
Home Bay	186-1	08/04/2008
Islington Bay	184-1	07/04/2008
Kawakawa Bay	65-1	17/06/2007
Kawakawa Bay	65-2	17/06/2007
Kawakawa Bay	65-3	17/06/2007
Kawakawa Bay	65-4	17/06/2007
Kennedy Bay	127-1	25/11/2007
Kohimarama Beach	19-1	21/02/2007
Kohimarama Beach	20-1	21/02/2007
Langs Beach	135-1	27/11/2007
Little Huia Beach	84-1	08/08/2007
Lonely Bay	122-1	24/11/2007
Long Bay	133-1	26/11/2007
Man O'War Bay	159-1	09/03/2008
Man O'War Bay	160-1	09/03/2008
Martins Bay	140-1	28/11/2007
Mathesons Bay	25-8	17/04/2007
Matiatia	107-1	25/10/2007
Matiatia	107-2	25/10/2007
Matiatia	107-3	25/10/2007
McGregors Bay	102-1	29/09/2007
McGregors Bay	102-2	29/09/2007
Mechanics Bay	74-1	13/07/2007
Mimiwhangata Bay	147-1	24/01/2008
Miranda	108-1	26/10/2007
Motoura Island	35-1	02/05/2007
Motuihe Island	112-1	30/10/2007
Motuihe Island	112-2	30/10/2007
Musick Point	8-1	17/07–10/11/2006
Musick Point	22-1	22/02/2007
NorthHead Beach	18-1	20/02/2007
Oamaru Bay	110-1	28/10/2007
Okoromai Bay	87-1	15/08/2007
Okura River	219-72	10–14/09/2007
Okura River	219-73	10–14/09/2007
Okura River	219-74	10–14/09/2007
Okura River	219-76	10–14/09/2007
Orewa Beach	148-1	20/02/2008
Otata Island	16-1	25/01/2007
Pauanui Beach	115-1	21/11/2007
Piha Beach	101-1	26/09/2007
Piha Beach	101-2	26/09/2007
Point Chevalier	212-1	07/05/2008
Pollen Island	214-1	07/05/2008
Port Jackson	109-1	27/10/2007
Puketutu Island	92-1	-/07/2003–-/05/2004
Putiki Bay	164-1	10/03/2008
Ruamahanga Bay	192-1	28/10/2007
Ruamahanga Bay	193-1	28/10/2007
Scott Point	139-1	28/11/2007
Smugglers Bay	104-1	30/09/2007
Smugglers Bay	104-2	30/09/2007
St. Heliers Bay	21-1	21/02/2007
Stanmore Bay	187-1	09/04/2008
Station Bay	23-1	23/03/2007
Tahuna Torea	81-1	31/07/2007
Takapuna Beach	132-1	26/11/2007
Te Matuku Bay	161-1	09/03/2008
The Needles	155-1	08/03/2008
Tryphena Harbour	167-1	11/03/2008
Tukituki Bay	202-1	28/10/2007
Umupuia Beach	66-1	18/06/2007
Umupuia Beach	191-1	18/06/2007
Waikarapupu Bay	188-1	10/04/2008
Whangapoua Beach	174-1	12/03/2008
Whatipu Beach	17-1	31/01/2007

Table 43: Locations (and site identifier) for brackish-hard sampling

Lonely Bay	123-1	24/11/2007	Okura	218-41	10–14/09/2007
Man O'War Bay	158-1	09/03/2008	Okura	218-46	10–14/09/2007
McGregors Bay	103-1	29/09/2007	Okura	218-47	10–14/09/2007
Oamaru Bay	200-1	28/10/2007	Okura	218-48	10–14/09/2007
Okura	216-11	10–14/09/2007	Okura	218-49	10–14/09/2007
Okura	216-15	10–14/09/2007	Okura	218-50	10–14/09/2007
Okura	216-21	10–14/09/2007	Okura	218-54	10–14/09/2007
Okura	216-30	10–14/09/2007	Okura	218-55	10–14/09/2007
Okura	216-31	10–14/09/2007	Okura	218-56	10–14/09/2007
Okura	216-33	10–14/09/2007	Okura	218-57	10–14/09/2007
Okura	216-34	10–14/09/2007	Okura	218-58	10–14/09/2007
Okura	216-35	10–14/09/2007	Okura	218-59	10–14/09/2007
Okura	216-37	10–14/09/2007	Okura	218-60	10–14/09/2007
Okura	216-38	10–14/09/2007	Okura	218-61	10–14/09/2007
Okura	216-45	10–14/09/2007	Okura	218-62	10–14/09/2007
Okura	216-52	10–14/09/2007	Okura	218-63	10–14/09/2007
Okura	217-13	10–14/09/2007	Okura	218-64	10–14/09/2007
Okura	218-36	10–14/09/2007	Okura	218-65	10–14/09/2007
Okura	218-39	10–14/09/2007	Okura	218-66	10–14/09/2007
Okura	218-40	10–14/09/2007	Whangamata	118-1	21/11/2007

Table 44: Locations (and site identifier) for marine soft-shore sampling

Cheltenham Beach	24-1	17/04/2007	Eastern Beach	64-6	21/04/2007
Cheltenham Beach	24-10	17/04/2007	Eastern Beach	64-7	21/04/2007
Cheltenham Beach	24-11	17/04/2007	Eastern Beach	64-8	21/04/2007
Cheltenham Beach	24-12	17/04/2007	Eastern Beach	64-9	21/04/2007
Cheltenham Beach	24-13	17/04/2007	Home Bay	205-1	08/04/2008
Cheltenham Beach	24-14	17/04/2007	Home Bay	205-2	08/04/2008
Cheltenham Beach	24-2	17/04/2007	Home Bay	205-3	08/04/2008
Cheltenham Beach	24-3	17/04/2007	Islington Bay	204-1	07/04/2008
Cheltenham Beach	24-4	17/04/2007	Islington Bay	204-2	07/04/2008
Cheltenham Beach	24-5	17/04/2007	Islington Bay	204-3	07/04/2008
Cheltenham Beach	24-6	17/04/2007	Islington Bay	204-4	07/04/2008
Cheltenham Beach	24-7	17/04/2007	Kennedy Bay	128-1	25/11/2007
Cheltenham Beach	24-8	17/04/2007	Little Huia Beach	194-1	08/08/2007
Cheltenham Beach	24-9	17/04/2007	Mathesons Bay	61-1	17/04/2007
Eastern Beach	64-1	21/04/2007	Motuihe Island	113-1	30/10/2007
Eastern Beach	64-10	21/04/2007	Muriwai Beach	85-1	10/08/2007
Eastern Beach	64-11	21/04/2007	Muriwai Beach	85-2	10/08/2007
Eastern Beach	64-12	21/04/2007	Muriwai Beach	85-3	10/08/2007
Eastern Beach	64-13	21/04/2007	Muriwai Beach	85-4	10/08/2007
Eastern Beach	64-14	21/04/2007	Muriwai Beach	85-5	10/08/2007
Eastern Beach	64-15	21/04/2007	Muriwai Beach	85-6	10/08/2007
Eastern Beach	64-16	21/04/2007	Muriwai Beach	85-7	10/08/2007
Eastern Beach	64-17	21/04/2007	Muriwai Beach	85-8	10/08/2007
Eastern Beach	64-18	21/04/2007	Muriwai Beach	85-9	10/08/2007
Eastern Beach	64-19	21/04/2007	Okura River	220-75	10–14/09/2007
Eastern Beach	64-2	21/04/2007	Piha Beach	215-1	26/09/2007
Eastern Beach	64-20	21/04/2007	Station Bay	60-1	23/03/2007
Eastern Beach	64-21	21/04/2007	Station Bay	206-1	07/04/2008
Eastern Beach	64-22	21/04/2007	Umupuia Beach	67-1	19/06/2007
Eastern Beach	64-23	21/04/2007	Waikarapupu Bay	207-1	10/04/2008
Eastern Beach	64-24	21/04/2007	Wakaaranga	223-3	31/07/2007
Eastern Beach	64-25	21/04/2007	Wenderholm Beach	86-1	13/08/2007
Eastern Beach	64-3	21/04/2007	Wenderholm Beach	86-2	13/08/2007
Eastern Beach	64-4	21/04/2007	Wenderholm Beach	196-1	13/08/2007
Eastern Beach	64-5	21/04/2007	Wenderholm Beach	197-1	13/08/2007

Table 45: Locations (and site identifier) for brackish-soft sampling

Cape Barrier Rd	179-1	13/03/2008
Glenbrook Rd	150-1	23/02/2008
Kawakawa Bay	189-1	17/06/2007
Little Oneroa	153-1	08/03/2008
Mathesons Bay	62-1	17/04/2007
Matua	27-A1	28/02/2007
Matua	27-A2	28/02/2007
Matua	27-A3	28/02/2007
Matua	27-B1	28/02/2007
Matua	27-B2	28/02/2007
Matua	27-B3	28/02/2007
Matua	27-C1	28/02/2007
Matua	27-C2	28/02/2007
Matua	27-C3	28/02/2007
Medlands Rd	169-1	12/03/2008
Okoromai Bay	198-1	15/08/2007
Okura	221-2	10–14/09/2007
Orewa	37-1	02/05/2007
Orewa	37-2	02/05/2007
Orewa	37-3	02/05/2007
Orewa	149-1	20/02/2008
Pakiri Beach	183-1	17/03/2008
Rangataua Bay	70-A1	01/03/2007
Rangataua Bay	70-A2	01/03/2007
Rangataua Bay	70-A3	01/03/2007
Rangataua Bay	70-B1	01/03/2007
Rangataua Bay	70-B2	01/03/2007
Rangataua Bay	70-B3	01/03/2007
Rangataua Bay	70-C1	01/03/2007
Rangataua Bay	70-C2	01/03/2007
Rangataua Bay	70-C21	01/03/2007
Rangataua Bay	70-C3	01/03/2007
Stony Beach	170-1	12/03/2008
Stony Beach	171-1	12/032008
Te Matuku Bay	156-1	08/03/2008
Tryphena Harbour	165-1	11/03/2008
Tukituki Bay	203-1	28/10/2007
Waimama	120-1	22/11/2007
Waimapu	71-A1	26/02/2007
Waimapu	71-A2	26/02/2007
Waimapu	71-A3	26/02/2007
Waimapu	71-B1	26/02/2007
Waimapu	71-B2	26/02/2007
Waimapu	71-B3	26/02/2007
Waimapu	71-C1(1)	26/02/2007
Waimapu	71-C1(2)	26/02/2007
Waimapu	71-C2(1)	26/02/2007
Waimapu	71-C2(2)	26/02/2007
Waimapu	71-C3(1)	26/02/2007
Waimapu	71-C3(2)	26/02/2007
Waipu Cove	136-1	27/11/2007
Whangamata	117-1	21/11/2007
Whangapoua	175-1	12/03/2008

Table 46: Locations (and site identifier) for mangrove sampling

Awanohi Bridge	91-1	15/08/2007	Okura	100-51	10–14/09/2007
Herald Island	98-1	04/09/2007	Okura	100-53	10–14/09/2007
Long Bay	134-1	26/11/2007	Okura	100-6	10–14/09/2007
Manaia	126-1	25/11/2007	Okura	100-7	10–14/09/2007
Maraetai Beach	76-1	24/07/2007	Okura	100-78	10–14/09/2007
Meola Road	95-1	04/09/2007	Okura	100-79	10–14/09/2007
Mill Creek	125-1	24/11/2007	Okura	100-8	10–14/09/2007
Miranda	199-1	2610/2007	Okura	100-80	10–14/09/2007
Miranda	199-2	2610/2007	Okura	100-9	10–14/09/2007
Miranda	199-3	2610/2007	Pakiri Beach	180-1	17/03/2008
Okura	100-10	10–14/09/2007	Pakiri Beach	182-1	17/03/2008
Okura	100-12	10–14/09/2007	Pollen Island	213-1	07/05/2008
Okura	100-14	10–14/09/2007	Pollen Island	213-2	07/05/2008
Okura	100-16	10–14/09/2007	Sandspit Bay	137-1	28/11/2007
Okura	100-17	10–14/09/2007	Snells Beach	138-1	28/11/2007
Okura	100-18	10–14/09/2007	Tahuna Torea	82-1	31/07/2007
Okura	100-19	10–14/09/2007	Tahuna Torea	83-1	31/07/2007
Okura	100-20	10–14/09/2007	Te Matuku Bay	157-1	08/03/2008
Okura	100-22	10–14/09/2007	Te Matuku Bay	162-1	09/03/2008
Okura	100-23	10–14/09/2007	Topuni Bridge	106-1	12/10/2007
Okura	100-24	10–14/09/2007	West Park Marina	97-1	04/09/2007
Okura	100-25	10–14/09/2007	Whangamata	116-1	21/11/2007
Okura	100-26	10–14/09/2007	Whangapoua	173-1	12/03/2008
Okura	100-27	10–14/09/2007	Whangarei: Oakleigh	105-1	12/10/2007
Okura	100-28	10–14/09/2007	Whangarei: Oakleigh	105-2	12/10/2007
Okura	100-29	10–14/09/2007	Whangarei: Oakleigh	105-3	12/10/2007
Okura	100-3	10–14/09/2007			
Okura	100-32	10–14/09/2007			
Okura	100-4	10–14/09/2007			
Okura	100-5	10–14/09/2007			

Table 47: The *Monalisa* biodiversity database table and field descriptions

Table name	Field #	Table Fields	Field description
SpeciesAll			Species names of organisms identified from field work and secondary sources.
	1	SpeciesID	Identification number assigned to a species.
	2	Genus	Genus of taxon.
	3	SpMarker	Species marker given to species.
	4	Species	Species name of taxon.
	5	InfraSpMarker	Infra-speies marker given to subspecies or varieties
	6	InfraSpecies	Infraspecies name of taxon

Table name	Field #	Table Fields	Field description
Hierarchy			Classification of higher taxa assigned to a species.
	1	Genus	Genus of taxon.
	2	Kingdom	Kingdom.
	3	Phylum	Phylum.
	4	Subphylum	Subphylum.
	5	Class	Class.
	6	Subclass	Subclass.
	7	Infraclass	Infraclass.
	8	Superorder	Superorder.
	9	Order	Order.
	10	Suborder	Suborder.
	11	Infraorder	Infraorder.
	12	Family	Family.
	13	Subfamily	Subfamily.
	14	Comments	Additional information about the classification used or any taxa in this table.
	15	RefID	Reference ID adopted for this classification.
	16	TaxonomistID	Taxonomist ID of the taxon specialist who provided/checked the classification.

Table name	Field #	Table Fields	Field description
Biblio			Index of bibliographic reference used for each species record.
	1	SpeciesID	Identification number assigned to a species
	2	RefID	Reference ID to where the species name was acquired.
	3	RefUsedAs	Defines how the reference is used in the database, i.e. StatusRef, AuthorRef, CommonNameRef, DistributionRef, AnthropogenicFactorRef.
	4	MainRef	The main reference is the source of ALL data available to a species.

Table name	Field #	Table Fields	Field description
References			Source reference of each dataset/publication that provided a species list.
	1	RefID	Identification number assigned to each reference.
	2	Author(s)	Author(s) of publication; owner of the dataset as appropriate.
	3	Year	Year of publication/ when dataset was collected.
	4	Title	Title of publication/dataset.
	5	Source	Publisher.
	6	Comments	Additional information on the publication/dataset.
	7	Habitat	Details of subtidal or intertidal source. Required if dataset is an outcome of a field survey.
	8	Environment	Details of marine, brackish or freshwater source. Required if dataset is an outcome of a field survey.
	9	Shore	Details of hard/soft substratum. Required if dataset is an outcome of a field survey.
	10	ShoreDetails	Additional information on the substratum. Required if dataset is an outcome of a field survey.

	11	Beach	Name of beach, if available. Optional for field surveys datasets.
	12	Notes	Additional information about the publication/dataset.
	13	RefType	Defines whether the reference is a journal, thesis, report etc. Important for ranking the reliability of the source.
	14	RefProvider	Collaborator who provided the reference.
	15	DateOfLastUpdate	Date when reference was last updated.

Table name	Field #	Table Fields	Field description
DistIndex			Index of tables linked to distribution data.
	1	SpeciesID	Identification number assigned to a species
	2	DistributionID	Distribution ID assigned to a reference.
	3	DistrDetailsID	Distribution details ID assigned to a reference.
	4	RefID	Identification number assigned to each reference.

Table name	Field #	Table Fields	Field description
Distribution			Defines large marine area/terrestrial boundary where species are located.
	1	DistrID	Identification number assigned to a distribution.
	2	Distribution	Large marine area/terrestrial boundary where species are located.

Table name	Field #	Table Fields	Field description
DistrDetails			Defines place names and assigned distribution to where species are located.
	1	DistrDetailsID	Identification number assigned to a place name.
	2	Details	Information on specific area of distribution. Place name of sampling site.
	3	DistrID	Identification number assigned to a distribution.
	4	Comments	Additional information about the distribution.

Table name	Field #	Table Fields	Field description
SurveyDetails			Complete information about the field survey conducted.
	1	RefID	Identification number assigned to a reference.
	2	LatLongID	Identification number assigned to a pair of coordinates.
	3	SiteNum	Number or name given to a single site of a field survey.
	4	ReplicateNum	Replicate number of a sampling site from a field survey.
	5	Count	Count of individuals, for quantitative field surveys.
	6	Presence/Absence	Indicates the presence or absence of a species from a field survey, as appropriate in the methods of data collection.
	7	Presence	Indicates the presence of a species from a field survey, as appropriate in the methods of data collection.
	8	Comment	Additional information about the field survey.
	9	DateUpdated	Date when field survey information was last updated.

Table name	Field #	Table Fields	Field description
SurveyLatLong			Provides coordinates to species locations.
	1	LatLongID	Identification number of coordinates of locations where species were sampled from.
	2	X	X coordinate, southing.
	3	Y	Y coordinate, easting.
	4	ProjectionType	Defines whether coordinates are in decimal degrees, grid, etc.
	5	Comment	Additional information about the coordinates used.
	6	DateUpdated	Date when coordinates were last updated.

Table name	Field #	Table Fields	Field description
CommonNames			Common names of species.
	1	SpeciesID	Identification number assigned to a species
	2	CommonName	Common names or vernacular names associated to a species.

	3	Language	Language used when the common/vernacular name was given.
	4	Comments	Additional information about the common/vernacular name.
	5	RefID	Reference ID of the source of common/vernacular name.
	6	DateOfLastUpdate	Date when common name was added/last updated.

Table name	Field #	Table Fields	Field description
Collaborators			Names and contact details of data contributors to this database.
	1	CollabID	Identification number of the person/collaborator who provided information in this database.
	2	FirstName	First name of the collaborator.
	3	LastName	Last name of the collaborator.
	4	Profession	Profession of the collaborator, as appropriate.
	5	Area of Specialisation	Area of expertise of the collaborator, as appropriate.
	6	Organisation	Organisation to which the collaborator is associated.
	7	Physical address	Office location of the collaborator.
	8	Postal address	Mailing address of the collaborator.
	9	Phone	Phone number of the collaborator.
	10	Fax	Fax number of the collaborator.
	11	Email	Email address of the collaborator.
	12	Webpage	Webpage/website about the collaborator.
	13	Comments	Any additional information about the collaborator.
	14	DateOfLastUpdate	Date of last update about the collaborator.

Table name	Field #	Table Fields	Field description
SynIndex			Index of synonyms identified to a species.
	1	SynonymID	Identification number of a synonym.
	2	SpeciesID	Identification number assigned to a species.

Table name	Field #	Table Fields	Field description
Synonyms			Other scientific names associated to a species.
	1	SynonymID	Identification number of a synonym.
	2	SynGenus	Genus of synonym.
	3	SynSpMarker	Species marker of a synonym.
	4	SynSpecies	Species name of synonym.
	5	SynInfraSpMarker	Infra species marker of a synonym.
	6	StatusInfo	Is the scientific name an original combination, new combination, junior synonym, homonym?
	7	SynAuthor	Author responsible for the scientific name combination.
	8	SynYear	Year when the synonym was described.

Table name	Field #	Table Fields	Field description
AuthorIndex			Index of information about species author(s).
	1	SpeciesID	Identification number assigned to a species.
	2	AuthorID	Identification number assigned to author(s).

Table name	Field #	Table Fields	Field description
Authority			Author(s) who described the species.
	1	AuthorID	Identification number assigned to author(s).
	2	AuthorName	Name of author(s) who described the species.
	3	Year	Year when species was described.
	4	Comments	Additional information about the species author(s).

Table name	Field #	Table Fields	Field description
AFIndex			Index of anthropogenic factor(s) associated to species.
	1	SpeciesID	Identification number assigned to a species.
	2	AAFID	Identification number of the anthropogenic factor.

Table name	Field #	Table Fields	Metadata
AAFDetails			Information on associated anthropogenic factors.
	1	AAFID	Identification number of the anthropogenic factor.
	2	Details	Detailed information about the anthropogenic factor.
	3	RefID	Reference ID of the source of information about the anthropogenic factor.

Table name	Field #	Table Fields	Field description
AAF			Index of associated anthropogenic factor.
	1	AAFID	Identification number of anthropogenic factor.
	2	Factor	Anthropogenic factor.

Table name	Field #	Table Fields	Field description
PicIndex			Index of pictures available to a species.
	1	SpeciesID	Identification number assigned to a species.
	2	PicID	Identification number of a picture available to a species.

Table name	Field #	Table Fields	Field description
Picture			Picture files available to species
	1	PicID	Identification number of a picture available to a species.
	2	PicName	Picture name assigned to a picture file.
	3	Picture	Embedded picture/graphic of a species.
	4	Comment	Details about the picture.
	5	CollabID	Identification number of the person who provided picture/graphic.
	6	DateOfLastUpdate	Date when picture was added/last updated.

Table name	Field #	Table Fields	Field description
AddInfo			Biology/conservation status information available to species.
	1	SpeciesID	Identification number assigned to a species.
	2	Habitat	Habitat range of species.
	3	ConservationStatus	Species conservation status based on New Zealand Threat Classification System lists 2002 by Rod Hitchmough.
	4	Comments	Information on biology, ecology and/or taxonomy of the species. Additional information from the source, i.e. methods used in species collection.
	5	DateOfLastUpdate	Date when information was added/last updated.
	6	Entered	Collaborator ID of the person who added/last updated information about the species.

Table 48: Rarity indices of species/taxa from five intertidal habitat classes

Brackish soft-shore species

'Very rare' species/taxa

Austrolittorina antipodum	*Iais* sp.	*Pseudosphaeroma campbellensis*
Conopeum seurati	*Isocladus armatus*	*Saccostrea glomerata*
Cyclograpsus lavauxi	*Nerita atramentosa*	*Scolioplanes* sp.
Diloma zelandica	*Oligosoma smithi*	Stratiomyidae sp.
Girella triscuspidata	*Paratya curvirostris*	*Talorchestia quoyana*
Glycera americana	*Pilumnus novaezelandiae*	*Tenagomysis novaezelandiae*
Halopyrgus pagodulus	*Pisidium hodgkini*	*Xenostrobus pulex*
Heteromastus filiformis	*Polydora* sp.	*Zeacumantus lutulentus*
Hydroides norvegicus	*Prionospio* sp.	
Hyridella menziesi		

Poorly identified 'very rare' taxa

Bivalvia sp.	Congridae sp.	Nereididae sp.
Chironomidae sp.	Mysidae sp.	Teredinidae sp.
Chlorophyceae sp.	Nematoda sp.	

'Rare' species/taxa

Aldrichetta forsteri	*Isocladus dulciculus*	*Potamopyrgus antipodarum*
Anisolabis littorea	*Latia neritoides*	*Suterilla imperforata*
Boccardia sp.	*Ligia novaezelandiae*	*Talorchestia telluris*
Crassostrea gigas	*Macomona liliana*	*Tenagomysis* sp.
Exosphaeroma planulum	*Mesanthura maculata*	
Gobiomorphus basalis	*Orbinia papillosa*	
Halicarcinus cookii	*Paphies australis*	

Poorly identified 'rare' taxa

Acarina sp.	*Talorchestia* sp.

'Uncommon' species/taxa

Arthritica bifurca	*Corophium acutum*	*Ophicardelus costellaris*
Austrominius modestus	*Edwardsia tricolor*	*Scolelepis* sp.
Austrovenus stutchburyi	*Hemigrapsus crenulatus*	*Sphaeroma quoyanum*
Colurostylis lemurum	*Hyale rubra*	*Syncassidina aestuaria*
Cominella glandiformis	*Melanopsis trifasciata*	*Xenostrobus securis*

Poorly identified 'uncommon' taxa

Nemertea sp.	Sphaeromatidae sp.

'Frequent' species

Amphibola crenata	*Macrophthalmus hirtipes*
Halicarcinus whitei	*Palaemon affinis*

'Common' species of brackish soft shores

Helice crassa	*Potamopyrgus estuarinus*
Paracorophium excavatum	*Potamopyrgus pupoides*
	Scolecolepides benhami

Poorly identified ‘common’ taxa of brackish soft shores

Amphipoda sp.

‘Very common’ species of brackish soft shores

Capitella capitata	*Nicon aestuariensis*

‘Ubiquitous’ species of brackish soft shores

Perinereis nuntia

Brackish hard-shore species

‘Very rare’ species

Acanthoclinus fuscus	*Exosphaeroma planulum*	*Notoacmea parviconoidea*
Avicennia resinifera	*Forsterygion varium*	*Nucula hartvigiana*
Balanus amphitrite	*Halicarcinus cookii*	*Patiriella regularis*
Balanus trigonus	*Halicarcinus whitei*	*Pectinaria australis*
Balanus variegatus	*Ischnochiton maorianus*	*Perinereis camiguinoides*
Betaeus aequimanus	*Isoparactis ferax*	*Perinereis nuntia*
Buccinulum lineum	*Lasaea rubra*	*Rhombosolea plebeia*
Buccinulum vittatum	*Macrophthalmus hirtipes*	*Talorchestia quoyana*
Cellana radians	*Maoricrypta monoxyla*	*Tenagomysis novaezelandiae*
Colpomenia sinuosa	*Micrura pleuropolia*	*Thelepus spectabilis*
Cominella maculosa	*Modiolarca impacta*	*Travisia olens*
Corallina officinalis	*Mytilus edulis*	*Xenostrobus securis*

Poorly identified ‘very rare’ taxa

Alpheus sp.	Coleoptera sp.	Sphaeromatidae sp.
Amphipoda sp.	*Eatoniella* sp.	*Watersipora* sp.
Chelifer sp.	*Iais* sp.	*Tenagomysis* sp.

‘Rare’ species

Acanthoclinus littoreus	*Grahamina nigripenne*	*Musculista senhousia*
Chamaesipho columna	*Haminoea zelandiae*	*Neosabellaria kaiparaensis*
Diadumene lineata	*Macomona liliana*	*Pagurus novizealandiae*
Epopella plicata	*Maoricrypta costata*	*Xymene plebeius*

Poorly identified ‘rare’ species/taxa

Demospongiae sp.	*Talorchestia* sp.	Teredinidae sp.
Suterilla sp.	Terebellidae sp.	

‘Uncommon’ species

Acanthochitona zelandica	*Notoacmea helmsi*	*Saccostrea glomerata*
Alpheus richardsoni	*Ophicardelus costellaris*	*Scytothamnus australis*
Amphibola crenata	*Paphies australis*	*Siphonaria australis*
Austrovenus stutchburyi	*Perna canaliculus*	*Syncassidina aestuaria*
Leuconopsis obsoleta	*Potamopyrgus estuarinus*	*Talorchestia telluris*
Notoacmea daedala	*Potamopyrgus pupoides*	*Timarete anchylochaetus*

Poorly identified ‘uncommon’ taxa

Austrominius sp.	Platyhelminthes sp.	Talitridae sp.
Halichondria sp.	*Pyura* sp.	
Isopoda sp.	*Scolioplanes* sp.	

‘Frequent’ species

Anthopleura aureoradiata	*Hemigrapsus crenulatus*	*Palaemon affinis*
Austrolittorina antipodum	*Hormosira banksii*	*Perinereis novaehollandiae*
Chiton glaucus	*Isactinia olivacea*	*Pomatoceros caeruleus*
Cyclograpsus lavauxi	*Lepidonotus purpureus*	*Risellopsis varia*
Dendrostomum aeneum	*Lepsiella scobina*	*Sphaeroma quoyanum*
Halicarcinus pubescens	*Ligia novaezelandiae*	*Sypharochiton pelliserpentis*
Halicarcinus varius	*Melagraphia aethiops*	*Zeacumantus lutulentus*
Helice crassa	*Nerita atramentosa*	*Zeacumantus subcarinatus*

Poorly identified ‘frequent’ taxa

Acarina sp.	*Amphiporus* sp.	*Diadumene* sp.

‘Common’ species

Diloma subrostrata	*Onchidella nigricans*	*Turbo smaragdus*
Eulalia microphylla	*Petrolisthes elongatus*	
Fistulobalanus kondakovi	*Pilumnopeus serratifrons*	

‘Very common’ species

Cominella glandiformis	*Crassostrea gigas*	*Xenostrobus pulex*

‘Ubiquitous’ species

Austrominius modestus

Marine hard-shore species

'Very rare' species/taxa

Aaptos tentum
Acanthoclinus rua
Acar sandersonae
Acar sociella
Achelia assimilis
Aeolidiella faustina
Alcithoe arabica
Alloiodoris lanuginata
Allostichaster insignis
Amalda depressa
Amalda novaezelandiae
Amathia biseriata
Amaurobioides maritima
Amphibola crenata
Amphiura aster
Ancorina alata
Aonides oxycephala
Aphelodoris luctuosa
Aplidium phortax
Archidoris wellingtonensis
Armandia maculata
Avicennia resinifera
Balanus variegatus
Bankia setacea
Berthella medietus
Berthella ornata
*Bostrychia arbusc*ula
Botryllus sp.
Branchiomma sp.2
Bryopsis plumosa
Bryopsis vestita
Bursatella glauca
Bursatella leachii
Caecum digitulum
Calantica villosa
Calliostoma punctulata
Callochiton crocinus
Capitella capitata
Caprellina longicollis
Cardita aeoteana
Caulerpa flexilis
Caulerpa sp.
Cellana denticulata
Chaerodes concolor
Champia laingiii
Charonia lampas
Chelifer sp.
Chlamys dieffenbachi
Chromodoris amoena
Chromodoris aureomarginata
Cleidothaerus albidus
Colpomenia peregrina
Coralliophila sertata
Craspedochiton rubiginosus
Ctenodoris flabellifera
Cyclograpsus insularum
Cyclomactra ovata
Cymodocella capra
Cymodopsis montis
Dendrodoris gemmacea
Dictyota papenfussi
Dictyota sp.
Didemnum sp.
Didemnum studeri
Diloma arida
Diplodonta striatula
Diplopolydora sp.
Dosinia subrosea
Durvillaea antarctica
Dynamenella hirsuta
Dynamenella huttoni
Dynamenella insulsa
Dynamenoides vulcanata
Dynamenopsis varicolor
Eatoniella albocolumella
Eatoniella maculosa
Eatoniella olivacea
Echinocardium cordatum
Edwardsia tricolor
Elamena producta
Elysia maoria
Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha ramulosa
Enteromorpha sp.
Epitonium jukesianum
Euidotea stricta
Eurynolambrus australis
Exosphaeroma obtusum
Exosphaeroma planulum
Fictonoba carnosa
Gastroscyphus hectoris
Gelidium sp.
Gigartina circumcincta
Girella triscuspidata
Glycera lamellipodia
Gracilaria sp.
Grahamina nigripenne
Haliclona heterofibrosa
Haliotis australis
Halopteris funicularis
Heteromastus filiformis
Hippolyte sp.
Iais sp.
Ibla idiotica
Isocladus inaccuratus
Kolostoneura novaezelandiae
Lamellaria cerebroides
Lepidasthenia sp.
Lepidastheniella sp.
Leptomya retiaria
Lessonia variegata
Lumbrineris sp.
Lumbrineris sphaerocephala
Macrophthalmus hirtipes
Marginella mustelina
Melanochlamys cylindrica
Microcosmus australis
Microzonia velutina
Modiolus areolatus
Monomyces rubrum
Monoplex parthenopeus
Myadora boltoni
Myadora striata
Nebalia sp.
Neoguraleus interruptus
Nereis cricognatha
Nicolea sp.
Nicon aestuariensis
Ninoe leptognatha
Notoacmea scopulina
Notoclinops sp.
Notomithrax peronii
Notoplax mariae
Nucula nitidula
Ocnus brevidentis
Octocorallia sp.
Octopus gibbsi
Okamia thilenii
Okenia sp.
Oligosoma acrinasum
Oligosoma smithi
Omobranchus anolius
Ophelia sp.
Ophicardelus costellaris
Ophiodromus angustifrons
Ophiopsammus maculata
Orbinia papillosa
Ostrea aupouria
Oulactis muscosa
Ovalipes catharus
Owenia fusiformis
Pachydictyon sp.
Pachymenia lusoria
Pagurapseudes sp.
Paguristes barbatus
Paguristes pilosus
Paguristes setosus
Pagurixus hectori
Paphies subtriangulata
Paradexamine houtete
Paratrophon cheesemani
Paratrophon patens
Paratrophon quoyi

Pecten novaezelandiae
Penion sulcatus
Pericoptus humeralis
Periploma angasi
Phascolosoma annulatum
Pleurobranchaea novaezelandiae
Plocamium costatum
Plumularia setacea
Podocerus sp.
Polycera fujitai
Polysyncraton chondrilla
Pontophilus australis
Porphyra columbina
Porphyra sp.
Potamopyrgus estuarinus
Prionospio sp.
Protothaca crassicosta
Pseudechinus huttoni
Pseudotonicia cuneata
Pyromaia tuberculata
Pyura carnea
Radiacmea inconspicua
Ralfsia verrucosa
Raspailia sp.
Rhyssoplax aerea
Rhyssoplax stangeri
Rissoa hamiltoni
Rissoina achatina
Philobrya munita
Philobrya sp.
Pisinna rekohuana lactorubra
Pleurobranchaea maculata
Rissoina fucosa
Rissoina zonata
Saccoglossus australiensis
Salmacina sp.
Scintillona zelandica
Scolecolepides benhami
Scytothamnus fasciculatus
Sepioloidea pacifica
Sepioteuthis australis
Sigapatella tenuis
Siliquaria weldii
Solemya parkinsoni
Soletellina nitida
Soletellina siliqua
Specula marginata
Specula sp.
Sphaerium novaezelandiae
Spisula aequilateralis
Spongomorpha pacifica
Stichaster australis
Struthiolaria vermis
Pinnotheres novaezelandiae
Pisidium hodgkini
Suterilla imperforata
Suterilla sp.
Talorchestia telluris
Tanea zelandica
Tenagomysis sp.
Terebella sp.
Terebratella inconspicua
Tethya burtoni
Thysanozoon brochii
Tiostrea chilensis lutaria
Trachelochismus melobesia
Trachelochismus pinnulatus
Travisia olens
Triphora infelix
Triphora sp.
Trochodota dendyi
Tucetona laticostata
Turbonilla sp.
Xenostrobus securis
Xymene gouldi
Zebittium exile
Zonaria turneriana

Poorly identified 'very rare' species/taxa

Acanthochitona sp.
Actinopterygii sp.
Aeolidiidae sp.
Alpheoidea sp.
Amphisbetia sp.
Amphitrite sp.
Amphiura sp.
Anthozoa sp.
Aplidium sp.
Aplysia sp.
Apodida sp.
Arachnida sp.
Arcturidae sp.
Asellota sp.
Asychis sp.
Austrominius sp.
Balanus sp.
Berthella sp.
Bivalvia sp.
Bugula sp.
Caberea sp.
Cantareus aspersus
Chaperiopsis sp.
Chlorophyceae sp.
Cirripedia sp.
Coleoptera sp.
Congridae sp.
Crustacea sp.
Decapoda sp.
Dictyoceratida sp.
Eulalia sp.
Eunice sp.
Haliplanellidae sp.
Hesionidae sp.
Isocladus sp.
Isocradactis sp.
Janthina janthina
Lithothamnium sp.
Maldanidae sp.
Membraniporidae sp.
Micrelenchus sp.
Mysidae sp.
Neoguraleus sp.
Nephtyidae sp.
Nereididae sp.
Nereis sp.
Notomithrax sp.
Nucula sp.
Nudibranchia sp.
Oligochaeta sp.
Orbiniidae sp.
Ostracoda sp.
Ostrea sp.
Paguristes sp.
Phoxocephalidae sp.
Pilumnus sp.
Polynoidae sp.
Polynoidae sp.2
Pulmonata sp.
Sipunculidae sp.
Spionidae sp.
Syngnathidae sp.
Talitridae sp.
Tanaidae sp.
Thelepus sp.
Xymene sp.

‘Rare’ species/taxa

Actinothoe albocincta
Alpheus novaezealandiae
Alpheus richardsoni
Amalda australis
Anisolabis littorea
Anomia trigonopsis
Arthritica bifurca
Astropecten polyacanthus
Atrina zelandica
Austrolittorina cincta
Barbatia novaezealandiae
Botryllus schlosseri
Buccinulum robustum
Bulla quoyi
Callyspongia ramosa
Cantharidella tesselata
Cantharidus purpureus
Cardita brookesi
Caulerpa geminata
Cellana stellifera
Champia sp.
Chaperiopsis cervicornis
Charybdis japonica
Cirratulus nuchalis
Cominella quoyana
Corbula zelandica
Corynactis haddoni
Daphnella cancellata
Dendrodoris nigra
Diloma coracina
Diplocrepis puniceus
Diplodonta globus
Eatoniella limbata
Eatoniella sp.
Epitonium minora
Exosphaeroma chilensis
Fellaster zelandiae
Gadinalea nivea
Gelidium caulacantheum
Gigartina alveata
Glycera americana
Gregariella barbata
Guildingia obtecta
Halicarcinus innominatus
Halicarcinus whitei
Haliotis iris
Helice crassa
Lamellaria sp.
Lasaea rubra
Limaria orientalis
Macomona liliana
Marginella cairoma
Mesoginella koma
Mesogloia intestinalis
Micrelenchus sanguineus
Micrelenchus huttonii
Micrura pleuropolia
Muricopsis octogonus
Musculista senhousia
Neoguraleus murdochi
Neoguraleus sinclairi
Notomithrax ursus
Ophiopteris antipodum
Ostrea lutaria
Patelloida corticata
Pectinaria australis
Perinereis camiguinoides
Perinereis nuntia
Petrolisthes novaezelandiae
Pholadidea spathulata
Pholadidea tridens
Platynereis australis
Pseudosphaeroma campbellensis
Pyura cancellata
Ranella australasia
Rostanga rubicunda
Ruditapes largillierti
Seila cincta
Sphaeroma quoyanum
Steginoporella perplexa
Stegnaster inflatus
Stichopus mollis
Talorchestia quoyana
Tawera spissa
Trichosirius inornatus
Xiphophora gladiata
Xymene plebeius
Zostera nana

Poorly identified ‘rare’ species/taxa

Caridea sp.
Eatoniellidae sp.
Forsterygion sp.
Isopoda sp.
Lepidonotus sp.
Lysianassidae sp.
Paguridae sp.
Paguroidea sp.
Rhodophyceae sp.
Sabellidae sp.
Syllidae sp.
Teredinidae sp.

‘Uncommon’ species/taxa

Acanthoclinus fuscus
Allostichaster polyplax
Atalacmea fragilis
Balanus amphitrite
Balanus vestitus
Barnea similis
Buccinulum mariae
Buccinulum pallidum powelli
Cabestana spengleri
Carpophyllum plumosum
Chlamys zelandiae
Cirolana arcuata
Cookia sulcata
Culicia rubeola
Cystophora retroflexa
Dendrodoris citrina
Desis robsoni
Diadumene lineata
Diadumene sp.
Didemnum candidum
Diloma subrostrata
Dodecaceria berkeleyi
Dosina zelandica
Eudoxochiton nobilis
Exosphaeroma gigas
Filograna sp.
Forsterygion varium
Fossarina rimata
Galeolaria hystrix
Glossophora kunthii
Halicarcinus cookii
Halicarcinus varius
Haminoea zelandiae
Hemigrapsus crenulatus
Hemigrapsus edwardsi
Ircinia sp.
Irus reflexus
Isocladus armatus
Isocladus dulciculus
Isocradactis magna
Jania sp.
Lamellaria ophione
Lithophyllum sp.
Marinula filholi
Marphysa depressa
Merelina taupoensis
Monia zelandica

Notoacmea pileopsis
Nucula hartvigiana
Odontosyllis sp.
Ozius truncatus
Paphies australis
Parablennius laticlavius
Petrocheles spinosus
Pherusa parmatus
Pisinna zosterophila
Polymastia sp.
Pycnogonida sp.
Pyura subuculata
Sargassum sinclairii
Scolioplanes sp.
Serpulorbis sp.
Smittoidea sp.
Splachnidium rugosum
Styela plicata
Tethya aurantium
Tethya ingalli
Thelepus spectabilis
Timarete anchylochaetus
Trochus viridis
Tugali elegans
Tugali suteri
Ulva lactuca
Upogebia hirtifrons
Xiphophora chondrophylla
Xymene traversi
Zelithophaga truncata
Zemitrella choava

Poorly identified 'uncommon' species/taxa

Actiniaria sp.
Amphipoda sp.
Cirratulidae sp.
Demospongiae sp.
Ectoprocta sp.
Gobiesocidae sp.
Halicarcinus sp.
Nemertea sp.
Notoacmea sp.
Ophiuroidea sp.
Polychaeta sp.
Pyura sp.
Sphaeromatidae sp.
Talorchestia sp.

'Frequent' species/taxa

Aaptos aaptos
Acanthoclinus littoreus
Actinia tenebrosa
Alope spinifrons
Apophloea sinclairii
Austromitra rubiginosa
Austrovenus stutchburyi
Betaeus aequimanus
Borniola reniformis
Branchiomma sp.
Buccinulum lineum
Calantica spinosa
Carpophyllum flexuosum
Carpophyllum maschalocarpum
Chaetopterus sp.
Chamaesipho brunnea
Cliona celata
Codium adhaerens
Codium fragilis
Cominella adspersa
Cominella glandiformis
Corella eumyota
Cryptoconchus porosus
Cystophora torulosa
Dendrostomum aeneum
Diloma bicanaliculata
Diloma zelandica
Ecklonia radiata
Estea sp.
Evechinus chloroticus
Halichondria sp.
Herpetopoma bella
Hildenbrandtia sp.
Isoparactis ferax
Leathesia difformis
Lepidonotus purpureus
Leptograpsus variegatus
Leuconopsis obsoleta
Ligia novaezelandiae
Maoricolpus roseus
Microcosmus kura
Modiolarca impacta
Mytilus edulis
Notoacmea helmsi
Notoacmea parviconoidea
Notomithrax minor
Notoplax violacea
Onithochiton neglectus
Ophionereis fasciata
Palaemon affinis
Paxula paxillus
Perinereis novaehollandiae
Pilumnus lumpinus
Pilumnus novaezelandiae
Plagusia chabrus
Plaxiphora caelata
Pyura rugata
Rissoina chathamensis
Scutus breviculus
Scytothamnus australis
Stephopoma roseum
Styela clava
Taron dubius
Tetraclitella depressa
Thais orbita
Thoristella oppressa
Zeacumantus lutulentus

Poorly identified 'uncommon' taxa

Acarina sp.
Alpheus sp.
Ascidiacea sp.
Perinereis sp.
Spirorbinae sp.
Terebellidae sp.
Tethya sp.

'Common' species

Acanthochitona zelandica
Anthopleura aureoradiata
Asterocarpa cerea
Asterocarpa coerulea
Balanus trigonus
Buccinulum vittatum
Cellana ornata
Cellana radians
Chamaesipho columna
Cnemidocarpa bicornuta
Colpomenia sinuosa
Cominella maculosa
Coscinasterias muricata
Crassostrea gigas
Cyclograpsus lavauxi
Epopella plicata
Eulalia microphylla
Flabelligera affinis

Halicarcinus pubescens	*Lepidonotus polychroma*	*Pilumnopeus serratifrons*
Haustrum haustorium	*Leptochiton inquinatus*	*Risellopsis varia*
Heterozius rotundifrons	*Maoricrypta costata*	*Saccostrea glomerata*
Hiatella arctica	*Maoricrypta monoxyla*	*Sigapatella novaezelandiae*
Hormosira banksii	*Neosabellaria kaiparaensis*	*Siphonaria australis*
Hydroides norvegicus	*Notoacmea daedala*	*Sypharochiton sinclairii*
Isactinia olivacea	*Pagurus novizealandiae*	*Xenostrobus pulex*
Ischnochiton maorianus	*Perna canaliculus*	*Zeacumantus subcarinatus*

Poorly identified ‘common’ taxa

Amphiporus sp.	*Microciona* sp.	*Watersipora* sp.
Beania sp.	Platyhelminthes sp.	

‘Very common’ species

Austrolittorina antipodum	*Corallina officinalis*	*Patiriella regularis*
Austrominius modestus	*Nerita atramentosa*	*Petrolisthes elongatus*
Cominella virgata	*Onchidella nigricans*	

‘Ubiquitous’ species

Chiton glaucus	*Melagraphia aethiops*	*Sypharochiton pelliserpentis*
Lepsiella scobina	*Pomatoceros caeruleus*	*Turbo smaragdus*

Marine soft-shore species

'Very rare' species/taxa

Acanthochitona zelandica
Alcithoe arabica
Amalda novaezelandiae
Amphibola crenata
Aonides trifidus
Asterocarpa cerea
Astropecten polyacanthus
Balanus trigonus
Branchiomma sp.
Buccinulum vittatum
Bulla quoyi
Cellana ornata
Chaetozone cincinnata
Codium adhaerens
Codium fragilis
Cominella maculosa
Cominella virgata
Corophium acutum
Cryptoconchus porosus
Cyclomactra ovata
Cystophora torulosa
Dendrodoris citrina
Dendrodoris nigra
Diastylis insularum
Diloma bicanaliculata
Diloma zelandica
Diopatra sp.
Diplopolydora flava
Divaricella huttoniana
Echinocardium cordatum
Elamena producta
Evechinus chloroticus
Felaniella zelandica
Gari lineolata
Glycera tesselata
Goniada sp.
Halicarcinus pubescens
Halicarcinus whitei
Halichondria sp.
Haustrum haustorium
Hemigrapsus crenulatus
Hemigrapsus edwardsi
Hemipodus simplex
Hormosira banksii
Hydroides norvegicus
Irus reflexus
Lepas anatifera
Lepidonotus purpureus
Leptochiton inquinatus
Leuconopsis obsoleta
Luidia maculata
Lumbrineris sphaerocephala
Lysidice sp.
Maoricrypta costata
Marginella sp.
Marinula filholi
Musculista senhousia
Neosabellaria kaiparaensis
Ninoe leptognatha
Notoplax violacea
Onoscolex pacificus
Ophicardelus costellaris
Oxychilus cellarius
Pagurapseudes sp.
Paphies subtriangulata
Pectinaria australis
Perinereis camiguinoides
Perinereis novaehollandiae
Phoronis sp.
Pilumnopeus serratifrons
Pinnotheres atrenicola
Planes cyaneus
Rissoina chathamensis
Scintillona zelandica
Scolecolepides benhami
Scyphax ornatus
Scytothamnus australis
Sigapatella novaezelandiae
Soletellina nitida
Sphaerosyllis sp.
Stephopoma roseum
Struthiolaria vermis
Suterilla imperforata
Talorchestia dentata
Terebella sp.
Tetraclitella depressa
Thais orbita
Xymene plebeius
Zelithophaga truncata

Poorly identified 'very rare' taxa

Acarina sp.
Actiniaria sp.
Corophiidae sp.
Diptera sp.
Haustoriidae sp.
Hesionidae sp.
Isopoda sp.
Mysidae sp.
Nereididae sp.
Notoacmea sp.
Oedicerotidae sp.
Onoscolex sp.
Paguroidea sp.
Phoxocephalidae sp.
Polyplacophora sp.
Pontogeniidae sp.
Pyura sp.
Sipunculidae sp.
Sphaeromatidae sp.
Talitridae sp.
Tethya sp.
Velella velella
Watersipora sp.

‘Rare’ species/taxa

Actinia tenebrosa
Amphiura aster
Anisolabis littorea
Atrina zelandica
Betaeus aequimanus
Cellana radians
Corallina officinalis
Coscinasterias muricata
Dendrostomum aeneum
Dosinia anus
Dosinia subrosea
Edwardsia tricolor
Epopella plicata
Halicarcinus cookii
Heterozius rotundifrons
Isactinia olivacea
Lepidonotus polychroma
Macrophthalmus hirtipes
Maoricolpus roseus
Marphysa depressa
Micrelenchus huttonii
Myadora striata
Ophiodromus angustifrons
Paraphoxus sp.
Pericoptus humeralis
Perinereis nuntia
Perna canaliculus
Platynereis australis
Pomatoceros caeruleus
Pseudosphaeroma campbellensis
Scolioplanes sp.
Sigalion sp.
Siphonaria australis
Talorchestia telluris
Theora lubrica
Turbonilla sp.
Zeacumantus subcarinatus

Poorly identified ‘rare’ taxa

Alpheus sp.
Amphiporus sp.
Arabellidae sp.
Cirratulidae sp.
Crustacea sp.
Eunice sp.
Oligochaeta sp.
Polynoidae sp.
Sabellidae sp.
Spionidae sp.

‘Uncommon’ species/taxa

Amalda australis
Amalda depressa
Austrolittorina antipodum
Austrominius modestus
Chamaesipho columna
Chiton glaucus
Cirolana arcuata
Cominella adspersa
Corophium sp.
Crassostrea gigas
Cyclaspis argus
Cyclograpsus lavauxi
Diloma subrostrata
Eulalia microphylla
Exosphaeroma gigas
Fellaster zelandiae
Glycera americana
Glycera lamellipodia
Halicarcinus varius
Haustorius sp.
Helice crassa
Hemileucon comes
Heteromastus filiformis
Ischnochiton maorianus
Isocladus armatus
Lepsiella scobina
Ligia novaezelandiae
Maoricrypta monoxyla
Melagraphia aethiops
Nerita atramentosa
Notoacmea daedala
Notoacmea helmsi
Onchidella nigricans
Pagurus novizealandiae
Palaemon affinis
Paphies ventricosa
Patiriella regularis
Petrolisthes elongatus
Phyllodoce sp.
Polydora sp.
Pontophilus australis
Prionospio sp.
Risellopsis varia
Saccostrea glomerata
Scolelepis antipoda
Struthiolaria papulosa
Styela clava
Sypharochiton pelliserpentis
Talorchestia quoyana
Travisia olens
Turbo smaragdus
Xenostrobus pulex
Zeacumantus lutulentus

Poorly identified ‘uncommon’ taxa

Arachnida sp.
Aricidea sp.
Halicarcinus sp.
Ostracoda sp.
Platyhelminthes sp.
Polychaeta sp.
Syllidae sp.
Talorchestia sp.

‘Frequent’ species/taxa

Anthopleura aureoradiata
Austrovenus stutchburyi
Axiothella serrata
Callianassa filholi
Chaerodes concolor
Cominella glandiformis
Haminoea zelandiae
Lepidasthenia sp.
Macomona liliana
Magelona papillicornis
Nucula hartvigiana
Oridia sp.
Paphies australis
Trochodota dendyi

Poorly identified ‘frequent’ taxa

Amphipoda sp.

‘Common’ species

Nephtys macroura	*Orbinia papillosa*

Poorly identified ‘common’ taxa

Nemertea sp.

‘Very common’ species

Saccoglossus australiensis

‘Ubiquitous’ species

Macroclymenella stewartensis

Mangrove species

‘Very rare’ species/taxa

Anisolabis littorea	*Halicarcinus whitei*	*Notoacmea* sp.
Asterocarpa cerea	*Haminoea zelandiae*	*Omobranchus anolius*
Austrolittorina antipodum	*Hormosira banksii*	*Ostrea chilensis*
Balanus trigonus	*Iais* sp.	*Paphies australis*
Carpophyllum maschalocarpum	*Isactinia olivacea*	*Perinereis nuntia*
	Isocladus armatus	*Perna canaliculus*
Chiton glaucus	*Lauria cylindracea*	*Pomatoceros caeruleus*
Cominella quoyana	*Macomona liliana*	*Potamopyrgus antipodarum*
Dendrostomum aeneum	*Marinula filholi*	
Diadumene lineata	*Melagraphia aethiops*	*Pseudosphaeroma campbellensis*
Eulalia microphylla	*Melanopsis trifasciata*	
Forsterygion varium	*Micrelenchus huttonii*	*Risellopsis varia*
Halicarcinus cookii	*Musculista senhousia*	*Saccostrea glomerata*
Halicarcinus pubescens	*Nerita atramentosa*	*Scolioplanes* sp.
Halicarcinus varius	*Notoacmea daedala*	*Talorchestia quoyana*

Poorly identified ‘very rare’ taxa

Acarina sp.	*Diadumene* sp.	*Sphaeroma* sp.
Alpheus sp.	Membraniporidae sp.	Sphaeromatidae sp.
Asellota sp.	Mysidae sp.	Talitridae sp.
Caridea sp.	Platyhelminthes sp.	*Talorchestia* sp.
Chlorophyceae sp.	Polychaeta sp.	

‘Rare’ species

Anthopleura aureoradiata	*Leuconopsis obsoleta*	*Tenagomysis novaezelandiae*
Cyclograpsus lavauxi	*Notoacmea helmsi*	
Desis robsoni	*Perinereis novaehollandiae*	*Turbo smaragdus*
Fistulobalanus kondakovi	*Suterilla imperforata*	*Zeacumantus subcarinatus*

Poorly identified ‘rare’ taxa

Actinopterygii sp.
Amphiporus sp.
Halicarcinus sp.
Isopoda sp.
Perinereis sp.

‘Uncommon’ species

Alpheus richardsoni	*Hemigrapsus crenulatus*	*Sypharochiton pelliserpentis*
Austrovenus stutchburyi	*Palaemon affinis*	
Conopeum seurati	*Pilumnopeus serratifrons*	
Diloma subrostrata	*Suterilla* sp.	

Poorly identified ‘uncommon’ taxa

Amphipoda sp.	Congridae sp.

‘Frequent’ species

Cominella glandiformis	*Potamopyrgus pupoides*	*Zeacumantus lutulentus*
Ligia novaezelandiae	*Xenostrobus pulex*	
Onchidella nigricans	*Xenostrobus securis*	

Poorly identified ‘frequent’ taxa

Teredinidae sp.

‘Common’ species

Amphibola crenata	*Crassostrea gigas*	*Syncassidina aestuaria*
Austrominius modestus	*Sphaeroma quoyanum*	

‘Very common’ species

Helice crassa
Ophicardelus costellaris
Potamopyrgus estuarinus

‘Ubiquitous’ species

Avicenia resinifera

Table 49: Habitat and species richness acronyms used in Table 30.

Code	Habitat diversity index
BH-VL	brackish hard very low diversity
BH-L	brackish hard low diversity
BH-FL	brackish hard fairly low diversity
BH-M	brackish hard medium diversity
BH-FH	brackish hard fairly high diversity
BH-H	brackish hard high diversity
BH-VH	brackish hard very high diversity
BS-VL	brackish soft very low diversity
BS-L	brackish soft low diversity
BS-FL	brackish soft fairly low diversity
BS-M	brackish soft medium diversity
BS-FH	brackish soft fairly high diversity
BS-H	brackish soft high diversity
BS-VH	brackish soft very high diversity
M-VL	mangrove very low diversity
M-L	mangrove low diversity
M-FL	mangrove fairly low diversity
M-M	mangrove medium diversity
M-FH	mangrove fairly high diversity
M-H	mangrove high diversity
M-VH	mangrove very high diversity
MH-VL	marine hard very low diversity
MH-L	marine hard low diversity
MH-FL	marine hard fairly low diversity
MH-M	marine hard medium diversity
MH-FH	marine hard fairly high diversity
MH-H	marine hard high diversity
MH-VH	marine hard very high diversity
MS-VL	marine soft very low diversity
MS-L	marine soft low diversity
MS-FL	marine soft fairly low diversity
MS-M	marine soft medium diversity
MS-FH	marine soft fairly high diversity
MS-H	marine soft high diversity
MS-VH	marine soft very high diversity

Table 50: Faunal (Kingdom Animalia) inventory for all survey sites

Phylum	Class	Order	Family	Species
Annelida	Clitellata	NA	NA	Hirudinea sp.
				Oligochaeta sp.
	Polychaeta	Aciculata	Eunicidae	*Eunice* sp.
				Lysidice sp.
				Marphysa depressa
			Glyceridae	*Glycera americana*
				Glycera lamellipodia
				Glycera tesselata
				Hemipodus simplex
			Goniadidae	*Goniada* sp.
			Hesionidae	Hesionidae sp.
				Ophiodromus angustifrons
			Lumbrineridae	*Lumbrineris* sp.
				Lumbrineris sphaerocephala
				Ninoe leptognatha
			Nephtyidae	Nephtyidae sp.
				Nephtys macroura
			Nereididae	Nereididae sp.
				Nereis cricognatha
				Nereis sp.
				Nicon aestuariensis
				Perinereis camiguinoides
				Perinereis novaehollandiae
				Perinereis nuntia
				Perinereis sp.
				Platynereis australis
			Onuphidae	*Diopatra* sp.
			Phyllodocidae	*Eulalia microphylla*
				Eulalia sp.
				Phyllodoce sp.
			Polynoidae	*Lepidasthenia* sp.
				Lepidastheniella sp.
				Lepidonotus polychroma
				Lepidonotus purpureus
				Lepidonotus sp.
				Polynoidae sp.
				Polynoidae sp.2
			Sigalionidae	*Sigalion* sp.
			Syllidae	*Odontosyllis* sp.
				Sphaerosyllis sp.
				Syllidae sp.
		Canalipalpata	Arabellidae	Arabellidae sp.
			Chaetopteridae	*Chaetopterus* sp.
			Cirratulidae	*Chaetozone cincinnata*
				Cirratulidae sp.
				Cirratulus nuchalis
				Dodecaceria berkeleyi
				Timarete anchylochaetus

Phylum	Class	Order	Family	Species
			Flabelligeridae	*Flabelligera affinis*
				Pherusa parmatus
			Magelonidae	*Magelona papillicornis*
			Oweniidae	*Owenia fusiformis*
			Pectinariidae	*Pectinaria australis*
			Sabellariidae	*Neosabellaria kaiparaensis*
			Sabellidae	*Branchiomma* sp.
				Branchiomma sp.2
				Oridia sp.
				Sabellidae sp.
			Serpulidae	*Filograna* sp.
				Galeolaria hystrix
				Hydroides norvegicus
				Pomatoceros caeruleus
				Salmacina sp.
				Spirorbinae sp.
			Spionidae	*Aonides oxycephala*
				Aonides trifidus
				Boccardia sp.
				Diplopolydora flava
				Diplopolydora sp.
				Polydora sp.
				Prionospio sp.
				Scolecolepides benhami
				Scolelepis antipoda
				Scolelepis sp.
				Spionidae sp.
			Terebellidae	*Amphitrite* sp.
				Nicolea sp.
				Terebella sp.
				Terebellidae sp.
				Thelepus sp.
				Thelepus spectabilis
		NA	Scalibregmidae	*Onoscolex pacificus*
				Onoscolex sp.
		Not assigned	Arenicolidae	*Abarenicola affinis*
			Maldanidae	*Asychis sp.*
				Axiothella serrata
				Maldanidae sp.
			Opheliidae	*Travisia olens*
			Paraonidae	*Aricidea* sp.
		Not specified	Capitellidae	*Capitella capitata*
				Heteromastus filiformis
			Maldanidae	*Macroclymenella stewartensis*
			Opheliidae	*Armandia maculata*
			Orbiniidae	*Orbinia papillosa*
				Orbiniidae sp.
Arthropoda	Arachnida	Araneae	Anyphaenidae	*Amaurobioides maritima*
			Desidae	*Desis robsoni*
			Sparassidae	Isopoda sp.
		NA	NA	Acarina sp.
				Arachnida sp.
		Pseudoscorpiones	Cheliferidae	*Chelifer* sp.

Phylum	Class	Order	Family	Species
	Chilopoda	NA	NA	*Scolioplanes* sp.
	Insecta	Coleoptera	Dynastidae	*Pericoptus humeralis*
			NA	Coleoptera sp.
			Tenebrionidae	*Chaerodes concolor*
		Dermaptera	Carcinophoridae	*Anisolabis littorea*
		Diptera	Chironomidae	Chironomidae sp.
				Chironomus zeylanicus
			NA	*Diptera* sp.
			Sarcophagidae	*Ophelia* sp.
			Stratiomyidae	Stratiomyidae sp.
			Tachinidae	Polychaeta sp.
		Trichoptera	NA	Trichoptera sp.
	Malacostraca	Amphipoda	Corophiidae	Corophiidae sp.
				Corophium acutum
				Corophium sp.
				Paracorophium excavatum
			Dexaminidae	*Paradexamine houtete*
			Haustoriidae	Haustoriidae sp.
				Haustorius sp.
			Hyalidae	*Hyale rubra*
			Lysianassidae	Lysianassidae sp.
			NA	Amphipoda sp.
			Oedicerotidae	Oedicerotidae sp.
			Phoxocephalidae	*Paraphoxus* sp.
				Phoxocephalidae sp.
			Phtisicidae	*Caprellina longicollis*
			Podoceridae	*Podocerus* sp.
			Pontogeniidae	Pontogeniidae sp.
			Talitridae	Talitridae sp.
				Talorchestia dentata
				Talorchestia quoyana
				Talorchestia sp.
				Talorchestia spadix
				Talorchestia telluris
		Cumacea	Bodotriidae	*Cyclaspis argus*
			Diastylidae	*Colurostylis lemurum*
				Diastylis insularum
			Leuconidae	*Hemileucon comes*
		Decapoda	Alpheidae	*Alpheus novaezealandiae*
				Alpheus richardsoni
				Alpheus sp.
				Betaeus aequimanus
			Atyidae	*Paratya curvirostris*
			Bellioidea	*Heterozius rotundifrons*
			Callianassidae	*Callianassa filholi*
			Crangonidae	*Pontophilus australis*
			Diogenidae	*Paguristes barbatus*
				Paguristes pilosus
				Paguristes setosus
				Paguristes sp.
				Pagurus novizealandiae
			Grapsidae	*Helice crassa*
				Leptograpsus variegatus

Phylum	Class	Order	Family	Species
				Planes cyaneus
			Hippolytidae	*Alope spinifrons*
				Hippolyte sp.
			Hymenosomatidae	*Elamena producta*
				Halicarcinus cookii
				Halicarcinus innominatus
				Halicarcinus pubescens
				Halicarcinus sp.
				Halicarcinus varius
				Halicarcinus whitei
			Majidae	*Notomithrax minor*
				Notomithrax peronii
				Notomithrax sp.
				Notomithrax ursus
				Pyromaia tuberculata
			Menippidae	*Ozius truncatus*
			NA	Alpheoidea sp.
				Caridea sp.
				Decapoda sp.
				Paguroidea sp.
			Ocypodidae	*Macrophthalmus hirtipes*
			Paguridae	Paguridae sp.
				Pagurixus hectori
			Palaemonidae	*Palaemon affinis*
			Parthenopidae	*Eurynolambrus australis*
			Pilumnidae	*Pilumnopeus serratifrons*
			Pinnotheridae	*Pinnotheres atrenicola*
				Pinnotheres novaezelandiae
			Plagusiidae	*Plagusia chabrus*
			Porcellanidae	*Petrocheles spinosus*
				Petrolisthes elongatus
				Petrolisthes novaezelandiae
			Portunidae	*Charybdis japonica*
				Ovalipes catharus
			Upogebiidae	*Upogebia hirtifrons*
			Varunidae	*Cyclograpsus insularum*
				Cyclograpsus lavauxi
				Hemigrapsus crenulatus
				Hemigrapsus edwardsi
			Xanthidae	*Pilumnus lumpinus*
				Pilumnus novaezelandiae
				Pilumnus sp.
		Isopoda	Anthuridae	*Mesanthura maculata*
			Arcturidae	Arcturidae sp.
			Cirolanidae	*Cirolana arcuata*
			Idoteidae	*Euidotea stricta*
			Janiridae	*Iais* sp.
			Ligiidae	*Ligia novaezelandiae*
			NA	Asellota sp.
			Scyphacidae	*Scyphax ornatus*
			Sphaeromatidae	*Cymodocella capra*
				Cymodopsis montis
				Dynamenella hirsuta

Phylum	Class	Order	Family	Species
				Dynamenella huttoni
				Dynamenella insulsa
				Dynamenoides vulcanata
				Dynamenopsis varicolor
				Exosphaeroma chilensis
				Exosphaeroma gigas
				Exosphaeroma obtusum
				Exosphaeroma planulum
				Isocladus armatus
				Isocladus dulciculus
				Isocladus inaccuratus
				Isocladus sp.
				Pseudosphaeroma campbellensis
				Sphaeroma quoyanum
				Sphaeroma sp.
				Sphaeromatidae sp.
				Syncassidina aestuaria
		Leptostraca	Nebaliidae	*Nebalia* sp.
		Mysida	Mysidae	Mysidae sp.
				Tenagomysis chiltoni
				Tenagomysis novaezelandiae
				Tenagomysis sp.
		Tanaidacea	Pagurapseudidae	*Pagurapseudes* sp.
			Tanaidae	Tanaidae sp.
	Maxillopoda	NA	NA	Cirripedia sp.
		Pedunculata	Calanticidae	*Calantica spinosa*
				Calantica villosa
			Iblidae	*Ibla idiotica*
			Lepadidae	*Lepas anatifera*
		Sessilia	Balanidae	*Austrominius modestus*
				Austrominius sp.
				Balanus amphitrite
				Balanus sp.
				Balanus trigonus
				Balanus variegatus
				Balanus vestitus
				Epopella plicata
				Fistulobalanus kondakovi
			Chthamalidae	*Chamaesipho brunnea*
				Chamaesipho columna
			Tetraclitidae	*Tetraclitella depressa*
	NA	NA	NA	Crustacea sp.
	Ostracoda	NA	NA	Ostracoda sp.
	Pycnogonida	NA	NA	Pycnogonida sp.
		Pantopoda	Ammotheidae	*Achelia assimilis*
Brachiopoda	Articulata	Terebratulida	Terebratellidae	*Terebratella inconspicua*
Chordata	Actinopterygii	Anguilliformes	Congridae	Congridae sp.
		Gasterosteiformes	Syngnathidae	Syngnathidae sp.
		Gobiesociformes	Gobiesocidae	*Diplocrepis puniceus*
				Gastroscyphus hectoris
				Gobiesocidae sp.
				Trachelochismus melobesia
				Trachelochismus pinnulatus

Phylum	Class	Order	Family	Species
		NA	NA	Actinopterygii sp.
		Perciformes	Arripidae	*Arripis trutta*
			Blenniidae	*Omobranchus anolius*
				Parablennius laticlavius
			Eleotridae	*Gobiomorphus basalis*
			Kyphosidae	*Girella triscuspidata*
			Mugilidae	*Aldrichetta forsteri*
			Plesiopidae	*Acanthoclinus fuscus*
				Acanthoclinus littoreus
				Acanthoclinus rua
			Tripterygiidae	*Forsterygion* sp.
				Forsterygion varium
				Grahamina nigripenne
				Notoclinops sp.
		Pleuronectiformes	Pleuronectidae	*Rhombosolea plebeia*
	Ascidiacea	Enterogona	Corellidae	*Corella eumyota*
			Didemnidae	*Didemnum candidum*
				Didemnum sp.
				Didemnum studeri
				Polysyncraton chondrilla
			Polyclinidae	*Aplidium phortax*
				Aplidium sp.
		NA	NA	Ascidiacea sp.
		Pleurogona	Pyuridae	*Microcosmus australis*
				Microcosmus kura
				Pyura cancellata
				Pyura carnea
				Pyura rugata
				Pyura sp.
				Pyura subuculata
			Styelidae	*Asterocarpa cerea*
				Asterocarpa coerulea
				Botryllus schlosseri
				Botryllus sp.
				Cnemidocarpa bicornuta
				Okamia thilenii
				Styela clava
				Styela plicata
	Reptilia	Squamata	Scincidae	*Oligosoma acrinasum*
				Oligosoma smithi
Cnidaria	Anthozoa	Actiniaria	Actiniidae	*Anthopleura aureoradiata*
				Isactinia olivacea
				Isocradactis magna
				Isocradactis sp.
				Oulactis muscosa
			Bathyphellidae	*Isoparactis ferax*
			Diadumenidae	*Diadumene lineata*
				Diadumene sp.
			Edwardsiidae	*Edwardsia tricolor*
			Haliplanellidae	Haliplanellidae sp.
			NA	*Actinia tenebrosa*
				Actiniaria sp.
			Sagartiidae	*Actinothoe albocincta*

Phylum	Class	Order	Family	Species
		Corallimorpharia	Corallimorphidae	*Corynactis haddoni*
		NA	NA	Anthozoa sp.
				Octocorallia sp.
		Scleractinia	Flabellidae	*Monomyces rubrum*
			Rhizangiidae	*Culicia rubeola*
	Hydrozoa	Anthoathecatae	Porpitidae	*Velella velella*
		Hydroida	Sertulariidae	*Amphisbetia* sp.
		Leptothecatae	Plumulariidae	*Plumularia setacea*
Echinodermata	Asteroidea	Forcipulatida	Asteriidae	*Allostichaster insignis*
				Allostichaster polyplax
				Coscinasterias muricata
				Stichaster australis
		Paxillosida	Astropectinidae	*Astropecten polyacanthus*
			Luidiidae	*Luidia maculata*
		Spinulosida	Asterinidae	*Patiriella regularis*
			Echinasteridae	*Stegnaster inflatus*
	Echinoidea	Clypeasteroida	Arachnoididae	*Fellaster zelandiae*
		Echinoida	Echinometridae	*Evechinus chloroticus*
				Pseudechinus huttoni
		Spatangoida	Loveniidae	*Echinocardium cordatum*
	Holothuroidea	Apodida	Chiridotidae	*Trochodota dendyi*
				Kolostoneura novaezelandiae
			NA	Apodida sp.
		Aspidochirotida	Stichopodidae	*Stichopus mollis*
		Dendrochirotida	Cucumariidae	*Ocnus brevidentis*
	Ophiuroidea	NA	NA	Ophiuroidea sp.
		Ophiurida	Amphiuridae	*Amphiura aster*
				Amphiura sp.
			Ophiocomidae	*Ophiopteris antipodum*
			Ophiodermatidae	*Ophiopsammus maculata*
			Ophionereididae	*Ophionereis fasciata*
Ectoprocta	Gymnolaemata	Cheilostomata	Beaniidae	*Beania* sp.
			Bugulidae	*Bugula* sp.
			Chaperiidae	*Chaperiopsis cervicornis*
				Chaperiopsis sp.
			Electridae	*Conopeum seurati*
			Membraniporidae	Membraniporidae sp.
			Schizoporellidae	*Smittoidea* sp.
			Scrupocellariidae	*Caberea* sp.
			Steginoporellidae	*Steginoporella perplexa*
			Watersiporidae	*Watersipora* sp.
		Ctenostomata	Vesiculariidae	*Amathia biseriata*
	NA	NA	NA	Ectoprocta sp.
Hemichordata	Enteropneusta	Not specified	Harrimaniidae	*Saccoglossus australiensis*
Mollusca	Bivalvia	Arcoida	Arcidae	*Acar sandersonae*
				Acar sociella
				Barbatia novaezealandiae
			Glycymeridae	*Tucetona laticostata*
			Philobryidae	*Philobrya munita*
				Philobrya sp.
		Limoida	Limidae	*Limaria orientalis*
		Myoida	Corbulidae	*Corbula zelandica*
			Hiatellidae	*Hiatella arctica*

Phylum	Class	Order	Family	Species
			Pholadidae	*Barnea similis*
				Pholadidea spathulata
				Pholadidea tridens
			Teredinidae	*Bankia setacea*
				Teredinidae sp.
		Mytiloida	Mytilidae	*Gregariella barbata*
				Modiolarca impacta
				Modiolus areolatus
				Musculista senhousia
				Mytilus edulis
				Perna canaliculus
				Xenostrobus pulex
				Xenostrobus securis
				Zelithophaga truncata
		NA	NA	Bivalvia sp.
		Nuculoida	Nuculidae	*Nucula hartvigiana*
				Nucula nitidula
				Nucula sp.
		Ostreoida	Anomiidae	*Anomia trigonopsis*
				Monia zelandica
			Ostreidae	*Crassostrea gigas*
				Ostrea aupouria
				Ostrea chilensis
				Ostrea lutaria
				Ostrea sp.
				Saccostrea glomerata
				Tiostrea chilensis lutaria
			Pectinidae	*Chlamys dieffenbachi*
				Chlamys zelandiae
				Pecten novaezelandiae
		Pholadomyoida	Cleidothaeridae	*Cleidothaerus albidus*
			Periplomatidae	*Periploma angasi*
			Thraciidae	*Myadora boltoni*
				Myadora striata
		Pterioida	Pinnidae	*Atrina zelandica*
		Solemyoida	Solemyidae	*Solemya parkinsoni*
		Unionoida	Unionidae	*Cucumerunio websteri*
				Hyridella menziesi
		Veneroida	Carditidae	*Cardita aeoteana*
				Cardita brookesi
			Galeommatidae	*Arthritica bifurca*
				Scintillona zelandica
			Lasaeidae	*Borniola reniformis*
				Lasaea rubra
			Lucinidae	*Divaricella huttoniana*
			Mactridae	*Cyclomactra ovata*
				Spisula aequilateralis
			Mesodesmatidae	*Paphies australis*
				Paphies subtriangulata
				Paphies ventricosa
			Pisidiidae	*Pisidium hodgkini*
				Sphaerium novaezelandiae

Phylum	Class	Order	Family	Species
			Psammobiidae	*Gari lineolata*
				Soletellina nitida
				Soletellina siliqua
			Semelidae	*Leptomya retiaria*
				Theora lubrica
			Tellinidae	*Macomona liliana*
			Ungulinidae	*Diplodonta globus*
				Diplodonta striatula
				Felaniella zelandica
			Veneridae	*Austrovenus stutchburyi*
				Dosina zelandica
				Dosinia anus
				Dosinia subrosea
				Irus reflexus
				Protothaca crassicosta
				Ruditapes largillierti
				Tawera spissa
	Cephalopoda	Octopoda	Octopodidae	*Octopus gibbsi*
		Sepiida	Sepiadariidae	*Sepioloidea pacifica*
		Teuthida	Loliginidae	*Sepioteuthis australis*
	Gastropoda	Anaspidea	Aplysiidae	*Aplysia* sp.
			Notarchidae	*Bursatella glauca*
				Bursatella leachii
		Archaeogastropoda	Calliostomatidae	*Calliostoma punctulata*
			Fissurellidae	*Scutus breviculus*
				Tugali elegans
				Tugali suteri
			Haliotididae	*Haliotis australis*
				Haliotis iris
			Nacellidae	*Cellana denticulata*
				Cellana ornata
				Cellana radians
				Cellana stellifera
			Trochidae	*Cantharidella tesselata*
				Cantharidus purpureus
				Fossarina rimata
				Herpetopoma bella
				Melagraphia aethiops
				Micrelenchus sanguineus
				Micrelenchus sp.
				Micrelenchus huttonii
				Thoristella oppressa
				Trochus viridis
			Turbinidae	*Cookia sulcata*
				Turbo smaragdus
		Basommatophora	Latiidae	*Latia neritoides*
			Siphonariidae	*Siphonaria australis*
		Cephalaspidea	Trimusculidae	*Gadinalea nivea*
			Aglajidae	*Melanochlamys cylindrica*
			Bullidae	*Bulla quoyi*
			Haminoeidae	*Haminoea zelandiae*
		Heterostropha	Pyramidellidae	*Turbonilla* sp.
		Mesogastropoda	Melanopsidae	*Melanopsis trifasciata*

Phylum	Class	Order	Family	Species
			Struthiolariidae	*Struthiolaria papulosa*
				Struthiolaria vermis
		NA	NA	*Diloma arida*
				Diloma bicanaliculata
				Diloma coracina
				Diloma subrostrata
				Diloma zelandica
		Neogastropoda	Buccinulidae	*Buccinulum lineum*
				Buccinulum mariae
				Buccinulum pallidum powelli
				Buccinulum robustum
				Buccinulum vittatum
				Cominella adspersa
				Cominella glandiformis
				Cominella maculosa
				Cominella quoyana
				Cominella virgata
				Penion sulcatus
			Columbellidae	*Paxula paxillus*
				Zemitrella choava
			Conidae	*Daphnella cancellata*
				Neoguraleus interruptus
				Neoguraleus murdochi
				Neoguraleus sinclairi
				Neoguraleus sp.
			Coralliophilidae	*Coralliophila sertata*
			Costellariidae	*Austromitra rubiginosa*
			Fasciolariidae	*Taron dubius*
			Marginellidae	*Marginella cairoma*
				Marginella mustelina
				Marginella sp.
				Mesoginella koma
			Muricidae	*Haustrum haustorium*
				Lepsiella scobina
				Muricopsis octogonus
				Paratrophon cheesemani
				Paratrophon patens
				Paratrophon quoyi
				Thais orbita
				Xymene gouldi
				Xymene plebeius
				Xymene sp.
				Xymene traversi
			Olividae	*Amalda australis*
				Amalda depressa
				Amalda novaezelandiae
			Volutidae	*Alcithoe arabica*
		Neotaenioglossa	Anabathridae	*Estea* sp.
				Pisinna rekohuana lactorubra
				Pisinna zosterophila
			Assimineidae	*Suterilla imperforata*
				Suterilla sp.

Phylum	Class	Order	Family	Species
			Barleeidae	*Fictonoba carnosa*
			Batillariidae	*Zeacumantus lutulentus*
				Zeacumantus subcarinatus
			Caecidae	*Caecum digitulum*
			Calyptraeidae	*Maoricrypta costata*
				Maoricrypta monoxyla
				Sigapatella novaezelandiae
				Sigapatella tenuis
			Capulidae	*Trichosirius inornatus*
			Cerithiidae	*Zebittium exile*
			Cerithiopsidae	*Seila cincta*
				Specula marginata
				Specula sp.
			Eatoniellidae	*Eatoniella albocolumella*
				Eatoniella limbata
				Eatoniella maculosa
				Eatoniella olivacea
				Eatoniella sp.
				Eatoniellidae sp.
			Epitoniidae	*Epitonium jukesianum*
				Epitonium minora
			Hydrobiidae	*Halopyrgus pagodulus*
				Potamopyrgus antipodarum
				Potamopyrgus estuarinus
				Potamopyrgus pupoides
			Janthinidae	*Janthina janthina*
			Lamellariidae	*Lamellaria cerebroides*
				Lamellaria ophione
				Lamellaria sp.
			Littorinidae	*Austrolittorina antipodum*
				Austrolittorina cincta
				Risellopsis varia
			Naticidae	*Tanea zelandica*
			Ranellidae	*Cabestana spengleri*
				Charonia lampas
				Monoplex parthenopeus
				Ranella australasia
			Rissoidae	*Merelina taupoensis*
				Rissoa hamiltoni
				Rissoina achatina
				Rissoina chathamensis
				Rissoina fucosa
				Rissoina zonata
			Siliquariidae	*Siliquaria weldii*
				Stephopoma roseum
			Triphoridae	*Triphora infelix*
				Triphora sp.
			Turritellidae	*Maoricolpus roseus*
			Vermetidae	*Serpulorbis* sp.
		Neritopsina	Neritidae	*Nerita atramentosa*
		Notaspidea	Pleurobranchidae	*Berthella medietus*
				Berthella ornata

Phylum	Class	Order	Family	Species
				Berthella sp.
				Pleurobranchaea maculata
				Pleurobranchaea novaezelandiae
		Nudibranchia	Aeolidiidae	*Aeolidiella faustina*
				Aeolidiidae sp.
			Archidorididae	*Archidoris wellingtonensis*
			Asteronotidae	*Aphelodoris luctuosa*
			Chromodorididae	*Chromodoris amoena*
				Chromodoris aureomarginata
			Dendrodorididae	*Dendrodoris citrina*
				Dendrodoris gemmacea
				Dendrodoris nigra
			Doridiidae	*Alloiodoris lanuginata*
				Ctenodoris flabellifera
			Goniodorididae	*Okenia* sp.
			NA	Nudibranchia sp.
			Polyceridae	*Polycera fujitai*
			Rostangidae	*Rostanga rubicunda*
		Patellogastropoda	Acmaeidae	*Notoacmea daedala*
				Notoacmea helmsi
				Notoacmea parviconoidea
				Notoacmea pileopsis
				Notoacmea scopulina
				Notoacmea sp.
				Radiacmea inconspicua
			Lottiidae	*Atalacmea fragilis*
				Patelloida corticata
		Pulmonata	Amphibolidae	*Amphibola crenata*
			Ellobiidae	*Leuconopsis obsoleta*
				Marinula filholi
				Ophicardelus costellaris
			NA	*Pulmonata* sp.
		Sacoglossa	Elysiidae	*Elysia maoria*
		Stylommatophora	Helicidae	*Cantareus aspersus*
			Pupillidae	*Lauria cylindracea*
			Zonitidae	*Oxychilus cellarius*
		Systellommatophora	Onchidiidae	*Onchidella nigricans*
	Polyplacophora	NA	NA	*Polyplacophora* sp.
		Neoloricata	Acanthochitonidae	*Acanthochitona* sp.
				Acanthochitona zelandica
				Craspedochiton rubiginosus
				Cryptoconchus porosus
				Notoplax mariae
				Notoplax violacea
				Pseudotonicia cuneata
			Chitonidae	*Chiton glaucus*
				Onithochiton neglectus
				Rhyssoplax aerea
				Rhyssoplax stangeri
				Sypharochiton pelliserpentis
				Sypharochiton sinclairii
			Ischnochitonidae	*Callochiton crocinus*

Phylum	Class	Order	Family	Species
				Eudoxochiton nobilis
				Ischnochiton maorianus
			Leptochitonidae	*Leptochiton inquinatus*
			Mopaliidae	*Guildingia obtecta*
				Plaxiphora caelata
Nematoda	NA	NA	NA	Nematoda sp.
Nemertea	Anopla	Heteronemertea	Lineidae	*Micrura pleuropolia*
	Enopla	Hoplonemertea	Amphiporidae	*Amphiporus* sp.
	NA	NA	NA	Nemertea sp.
Phoronida	Not specified	Not specified	Phoronidae	*Phoronis* sp.
Platyhelminthes	NA	NA	NA	Platyhelminthes sp.
	Turbellaria	Polycladida	Pseudoceritidae	*Thysanozoon brochii*
Porifera	Demospongiae	Axinellida	Raspailiidae	*Raspailia* sp.
		Choristida	Stellettidae	*Ancorina alata*
		Dictyoceratida	Irciniidae	*Ircinia* sp.
			NA	Dictyoceratida sp.
		Hadromerida	Clionidae	*Cliona celata*
			Polymastiidae	*Polymastia* sp.
			Suberitidae	*Aaptos aaptos*
				Aaptos tentum
			Tethyidae	*Tethya aurantium*
				Tethya burtoni
				Tethya ingalli
				Tethya sp.
		Halichondrida	Halichondriidae	*Halichondria* sp.
		Haplosclerida	Callyspongiidae	*Callyspongia ramosa*
			Chalinidae	*Haliclona heterofibrosa*
		Poecilosclerida	Microcionidae	*Microciona* sp.
	NA	NA	NA	Demospongiae sp.
Sipuncula	Sipunculidea	Golfingiformes	Themistidae	*Dendrostomum aeneum*
		Phascolosomatiformes	Phascolosomatidae	*Phascolosoma annulatum*
		Sipunculiformes	Sipunculidae	Sipunculidae sp.

Table 51: Floral (Kingdom Plantae) inventory for all survey sites

Phylum	Class	Order	Family	Species
Chlorophyta	Bryopsidophyceae	Bryopsidales	Bryopsidaceae	*Bryopsis plumosa*
				Bryopsis vestita
			Caulerpaceae	*Caulerpa flexilis*
				Caulerpa geminata
				Caulerpa sp.
			Codiaceae	*Codium adhaerens*
				Codium fragilis
	Chlorophyceae	Acrosiphoniales	Acrosiphoniaceae	*Spongomorpha pacifica*
		NA	NA	Chlorophyceae sp.
	Ulvophyceae	Ulvales	Ulvaceae	*Enteromorpha intestinalis*
				Enteromorpha linza
				Enteromorpha ramulosa
				Enteromorpha sp.
				Ulva lactuca
Magnoliophyta	Liliopsida	Potamogetonales	Zosteraceae	*Zostera nana*
	Magnoliopsida	Lamiales	Verbenaceae	*Avicennia resinifera*
Phaeophyta	Phaeophyceae	Cutleriales	Cutleriaceae	*Microzonia velutina*
		Dictyotales	Dictyotaceae	*Dictyota papenfussi*
				Dictyota sp.
				Glossophora kunthii
				Pachydictyon sp.
				Zonaria turneriana
		Durvillaeales	Durvillaeaceae	*Durvillaea antarctica*
		Ectocarpales	Chordariaceae	*Leathesia difformis*
				Mesogloia intestinalis
			Ralfsiaceae	*Ralfsia verrucosa*
		Fucales	Cystoseiraceae	*Cystophora retroflexa*
				Cystophora torulosa
			Fucaceae	*Xiphophora chondrophylla*
				Xiphophora gladiata
			Hormosiraceae	*Hormosira banksii*
			Sargassaceae	*Carpophyllum flexuosum*
				Carpophyllum maschalocarpum
				Carpophyllum plumosum
				Sargassum sinclairii
		Laminariales	Alariaceae	*Ecklonia radiata*
			Lessoniaceae	*Lessonia variegata*
		Scytosiphonales	Scytosiphonaceae	*Colpomenia peregrina*
				Colpomenia sinuosa
		Scytothamnales	Scytothamnaceae	*Scytothamnus australis*
				Scytothamnus fasciculatus
			Splachnidiaceae	*Splachnidium rugosum*
		Sphacelariales	Stypocaulaceae	*Halopteris funicularis*
Rhodophyta	Bangiophyceae	Bangiales	Bangiaceae	*Porphyra columbina*
				Porphyra sp.
	Florideophyceae	Corallinales	Corallinaceae	*Corallina officinalis*
				Jania sp.
				Lithophyllum sp.
				Lithothamnium sp.
		Gelidiales	Gelidiaceae	*Gelidium caulacantheum*
				Gelidium sp.

Phylum	Class	Order	Family	Species
Rhodophyta		Halymeniales	Halymeniaceae	*Pachymenia lusoria*
	Rhodophyceae	Ceramiales	Rhodomelaceae	*Bostrychia arbuscula*
		Cryptonemiales	Hildenbrandiaceae	*Apophloea sinclairii*
				Hildenbrandtia sp.
		Gigartinales	Gigartinaceae	*Gigartina alveata*
				Gigartina circumcincta
			Gracilariaceae	*Gracilaria* sp.
			Plocamiaceae	*Plocamium costatum*
		NA	NA	Rhodophyceae sp.
		Rhodymeniales	Champiaceae	*Champia laingiii*
				Champia sp.

Table 52: Abbreviations used in Simper indices,Tables 15, 16, 18, 19, 21, 22, 27–29, 54, 55, 60, 64–67

Abbreviation	Simper indices
Av.Abund	average abundance of species
Av.Sim	average similarity within the group
Sim/SD	similarity/standard deviation
Contrib%	percent contribution of species
Cum.%	cumulative percent contribution of species

Table 53: Brackish shore species. Breakdown of average similarity (18.80) within brackish-shore groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Helice crassa	0.55	2.47	0.57	13.16	13.16
Potamopyrgus estuarinus	0.45	1.74	0.47	9.23	22.39
Austrominius modestus	0.46	1.37	0.46	7.30	29.69
Ophicardelus costellaris	0.40	1.26	0.40	6.72	36.41
Avicennia resinifera	0.37	1.08	0.38	5.74	42.15
Amphibola crenata	0.35	1.05	0.35	5.58	47.73
Crassostrea gigas	0.40	0.89	0.41	4.74	52.47
Cominella glandiformis	0.36	0.74	0.35	3.93	56.40
Potamopyrgus pupoides	0.28	0.67	0.27	3.58	59.97
Sphaeroma quoyanum	0.32	0.65	0.31	3.47	63.45
Syncassidina aestuaria	0.29	0.63	0.29	3.36	66.81
Amphipoda sp.	0.23	0.58	0.22	3.11	69.92
Perinereis nuntia	0.22	0.58	0.21	3.06	72.98
Capitella capitata	0.19	0.46	0.18	2.45	75.43
Xenostrobus pulex	0.28	0.42	0.27	2.26	77.68
Nicon aestuariensis	0.16	0.37	0.15	1.95	79.64
Fistulobalanus kondakovi	0.14	0.33	0.09	1.74	81.38
Onchidella nigricans	0.25	0.31	0.25	1.67	83.05
Zeacumantus lutulentus	0.23	0.25	0.22	1.34	84.39
Paracorophium excavatum	0.15	0.24	0.15	1.29	85.69
Scolecolepides benhami	0.13	0.21	0.12	1.13	86.82
Teredinidae sp.	0.18	0.20	0.18	1.07	87.89
Ligia novaezelandiae	0.18	0.19	0.17	1.03	88.92
Palaemon affinis	0.17	0.18	0.15	0.96	89.88
Xenostrobus securis	0.14	0.15	0.14	0.82	90.70

Table 54: Marine shore species. Breakdown of average similarity (14.59) within marine-shore groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Macroclymenella stewartensis	0.19	0.41	0.18	2.83	2.83
Turbo smaragdus	0.54	0.40	0.47	2.72	5.55
Austrominius modestus	0.51	0.38	0.48	2.58	8.13
Melagraphia aethiops	0.52	0.36	0.47	2.50	10.62
Saccoglossus australiensis	0.17	0.34	0.15	2.36	12.98
Chiton glaucus	0.51	0.31	0.51	2.13	15.11
Sypharochiton pelliserpentis	0.51	0.31	0.52	2.11	17.22
Lepsiella scobina	0.50	0.29	0.51	2.00	19.23
Pomatoceros caeruleus	0.48	0.27	0.48	1.88	21.11
Petrolisthes elongatus	0.48	0.27	0.48	1.83	22.93
Onchidella nigricans	0.47	0.27	0.44	1.82	24.76
Anthopleura aureoradiata	0.39	0.26	0.32	1.79	26.55
Nemertea sp.	0.23	0.21	0.15	1.46	28.01
Nerita atramentosa	0.42	0.20	0.41	1.37	29.38
Austrolittorina antipodum	0.43	0.20	0.44	1.37	30.75
Corallina officinalis	0.43	0.20	0.43	1.34	32.09
Patiriella regularis	0.43	0.19	0.44	1.29	33.38
Xenostrobus pulex	0.37	0.18	0.34	1.23	34.60
Pagurus novizealandiae	0.39	0.17	0.36	1.17	35.77
Isactinia olivacea	0.39	0.17	0.37	1.15	36.92
Cominella virgata	0.41	0.16	0.42	1.12	38.05
Crassostrea gigas	0.31	0.16	0.28	1.07	39.12
Nephtys macroura	0.11	0.15	0.10	1.05	40.17
Amphiporus sp.	0.37	0.15	0.36	1.03	41.20
Perna canaliculus	0.37	0.15	0.38	1.02	42.21
Chamaesipho columna	0.37	0.15	0.35	1.00	43.22
Cominella glandiformis	0.25	0.14	0.21	0.99	44.21
Siphonaria australis	0.36	0.14	0.35	0.99	45.20
Orbinia papillosa	0.13	0.14	0.10	0.95	46.14
Ischnochiton maorianus	0.38	0.14	0.39	0.95	47.09
Eulalia microphylla	0.35	0.13	0.34	0.92	48.01
Acanthochitona zelandica	0.37	0.13	0.37	0.91	48.92
Maoricrypta monoxyla	0.36	0.13	0.33	0.91	49.83
Risellopsis varia	0.35	0.13	0.36	0.86	50.70
Hormosira banksii	0.35	0.12	0.36	0.84	51.54
Watersipora sp.	0.35	0.12	0.35	0.82	52.36
Saccostrea glomerata	0.35	0.12	0.34	0.82	53.18
Zeacumantus subcarinatus	0.33	0.12	0.31	0.79	53.97
Macomona liliana	0.13	0.11	0.10	0.77	54.75
Epopella plicata	0.35	0.11	0.35	0.77	55.52
Amphipoda sp.	0.17	0.11	0.09	0.74	56.26
Balanus trigonus	0.33	0.11	0.34	0.74	57.00
Austrovenus stutchburyi	0.21	0.11	0.17	0.73	57.73
Halicarcinus pubescens	0.34	0.11	0.34	0.73	58.46
Zeacumantus lutulentus	0.23	0.10	0.16	0.70	59.16
Coscinasterias muricata	0.33	0.10	0.33	0.67	59.83
Microciona sp.	0.33	0.10	0.33	0.67	60.50
Cominella adspersa	0.27	0.10	0.22	0.66	61.16
Cellana ornata	0.32	0.10	0.32	0.66	61.82
Lepidonotus polychroma	0.31	0.10	0.30	0.66	62.48

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Notoacmea daedala	0.31	0.10	0.29	0.66	63.14
Maoricrypta costata	0.33	0.10	0.33	0.66	63.80
Colpomenia sinuosa	0.32	0.10	0.32	0.66	64.46
Platyhelminthes sp.	0.31	0.10	0.29	0.65	65.11
Neosabellaria kaiparaensis	0.31	0.09	0.30	0.64	65.75
Trochodota dendyi	0.11	0.09	0.09	0.63	66.38
Haustrum haustorium	0.32	0.09	0.33	0.62	67.00
Cominella maculosa	0.31	0.09	0.31	0.59	67.59
Leptochiton inquinatus	0.30	0.08	0.30	0.56	68.15
Cyclograpsus lavauxi	0.30	0.08	0.30	0.55	68.70
Sypharochiton sinclairii	0.30	0.08	0.30	0.55	69.25
Notoacmea helmsi	0.21	0.08	0.14	0.55	69.80
Flabelligera affinis	0.30	0.08	0.30	0.54	70.35
Palaemon affinis	0.26	0.08	0.23	0.54	70.89
Sigapatella novaezelandiae	0.30	0.07	0.31	0.51	71.40
Pilumnopeus serratifrons	0.26	0.07	0.25	0.50	71.90
Axiothella serrata	0.09	0.07	0.09	0.49	72.39
Hydroides norvegicus	0.27	0.07	0.27	0.48	72.86
Ligia novaezelandiae	0.27	0.07	0.25	0.47	73.33
Buccinulum vittatum	0.27	0.07	0.27	0.45	73.78
Beania sp.	0.27	0.06	0.26	0.44	74.22
Cellana radians	0.26	0.06	0.25	0.43	74.65
Oridia sp.	0.08	0.06	0.07	0.42	75.07
Asterocarpa cerea	0.26	0.06	0.26	0.42	75.48
Diloma subrostrata	0.17	0.06	0.15	0.42	75.90
Cnemidocarpa bicornuta	0.25	0.06	0.25	0.40	76.30
Chaerodes concolor	0.07	0.06	0.06	0.38	76.68
Heterozius rotundifrons	0.26	0.06	0.26	0.38	77.06
Magelona papillicornis	0.07	0.06	0.07	0.38	77.44
Asterocarpa coerulea	0.26	0.05	0.26	0.37	77.81
Diloma zelandica	0.25	0.05	0.24	0.37	78.18
Tetraclitella depressa	0.25	0.05	0.24	0.36	78.54
Haminoea zelandiae	0.11	0.05	0.08	0.35	78.89
Scytothamnus australis	0.23	0.05	0.23	0.35	79.24
Hiatella arctica	0.25	0.05	0.25	0.34	79.58
Codium adhaerens	0.25	0.05	0.25	0.34	79.92
Actinia tenebrosa	0.23	0.05	0.23	0.33	80.25
Evechinus chloroticus	0.25	0.05	0.25	0.33	80.58
Modiolarca impacta	0.23	0.05	0.23	0.32	80.91
Carpophyllum maschalocarpum	0.24	0.05	0.24	0.31	81.22
Cliona celata	0.24	0.05	0.24	0.31	81.53
Dendrostomum aeneum	0.22	0.05	0.21	0.31	81.84
Perinereis novaehollandiae	0.22	0.04	0.21	0.31	82.15
Thais orbita	0.23	0.04	0.22	0.30	82.45
Ecklonia radiata	0.23	0.04	0.23	0.30	82.75
Taron dubius	0.23	0.04	0.23	0.29	83.04
Paphies australis	0.13	0.04	0.09	0.29	83.33
Maoricolpus roseus	0.22	0.04	0.22	0.29	83.62
Nucula hartvigiana	0.15	0.04	0.12	0.28	83.90
Corella eumyota	0.21	0.04	0.21	0.27	84.17
Buccinulum lineum	0.22	0.04	0.22	0.27	84.44
Halichondria sp.	0.22	0.04	0.22	0.27	84.71
Stephopoma roseum	0.22	0.04	0.22	0.26	84.97

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Leathesia difformis	0.21	0.04	0.21	0.26	85.23
Callianassa filholi	0.05	0.04	0.05	0.26	85.48
Pyura rugata	0.20	0.04	0.19	0.25	85.73
Talorchestia quoyana	0.09	0.04	0.05	0.25	85.98
Isoparactis ferax	0.21	0.04	0.21	0.25	86.23
Helice crassa	0.11	0.04	0.08	0.25	86.47
Spirorbinae sp.	0.20	0.04	0.20	0.24	86.72
Lepidasthenia sp.	0.07	0.04	0.06	0.24	86.96
Isocladus armatus	0.14	0.03	0.07	0.23	87.19
Styela clava	0.17	0.03	0.16	0.23	87.43
Tethya sp.	0.20	0.03	0.20	0.22	87.65
Betaeus aequimanus	0.20	0.03	0.20	0.22	87.88
Polychaeta sp.	0.12	0.03	0.07	0.22	88.10
Chaetopterus sp.	0.19	0.03	0.19	0.21	88.31
Alpheus sp.	0.17	0.03	0.14	0.21	88.52
Cryptoconchus porosus	0.20	0.03	0.20	0.21	88.73
Terebellidae sp.	0.19	0.03	0.18	0.21	88.94
Halicarcinus sp.	0.13	0.03	0.10	0.21	89.15
Diloma bicanaliculata	0.19	0.03	0.19	0.21	89.36
Aaptos aaptos	0.18	0.03	0.17	0.20	89.56
Fellaster zelandiae	0.07	0.03	0.05	0.19	89.75
Notoplax violacea	0.19	0.03	0.19	0.19	89.94
Microcosmus kura	0.18	0.03	0.18	0.19	90.12

Table 55: Species common to brackish and marine shores (n=163)

Acanthochitona zelandica	*Eulalia microphylla*	*Orbinia papillosa*
Acanthoclinus fuscus	*Exosphaeroma planulum*	*Pagurus novizealandiae*
Acanthoclinus littoreus	*Forsterygion varium*	*Palaemon affinis*
Acarina sp.	*Girella triscuspidata*	*Paphies australis*
Actinopterygii sp.	*Glycera americana*	*Patiriella regularis*
Alpheus richardsoni	*Grahamina nigripenne*	*Pectinaria australis*
Alpheus sp.	*Halicarcinus cookii*	*Perinereis camiguinoides*
Amphibola crenata	*Halicarcinus pubescens*	*Perinereis novaehollandiae*
Amphipoda sp.	*Halicarcinus* sp.	*Perinereis nuntia*
Amphiporus sp.	*Halicarcinus varius*	*Perinereis* sp.
Anisolabis littorea	*Halicarcinus whitei*	*Perna canaliculus*
Anthopleura aureoradiata	*Halichondria* sp.	*Petrolisthes elongatus*
Arthritica bifurca	*Haminoea zelandiae*	*Pilumnopeus serratifrons*
Asellota sp.	*Helice crassa*	*Pilumnus novaezelandiae*
Asterocarpa cerea	*Hemigrapsus crenulatus*	*Pisidium hodgkini*
Austrolittorina antipodum	*Heteromastus filiformis*	Platyhelminthes sp.
Austrominius modestus	*Hormosira banksii*	Polychaeta sp.
Austrominius sp.	*Hydroides norvegicus*	*Polydora* sp.
Austrovenus stutchburyi	*Iais* sp.	*Pomatoceros caeruleus*
Avicennia resinifera	*Isactinia olivacea*	*Potamopyrgus estuarinus*
Balanus amphitrite	*Ischnochiton maorianus*	*Potamopyrgus pupoides*
Balanus trigonus	*Isocladus armatus*	*Prionospio* sp.
Balanus variegatus	*Isocladus dulciculus*	*Pseudosphaeroma*
Betaeus aequimanus	*Isoparactis ferax*	*campbellensis*
Bivalvia sp.	Isopoda sp.	*Pyura sp.*
Buccinulum lineum	*Lasaea rubra*	*Risellopsis varia*
Buccinulum vittatum	*Lepidonotus purpureus*	*Saccostrea glomerata*
Capitella capitata	*Lepsiella scobina*	*Scolecolepides benhami*
Caridea sp.	*Leuconopsis obsoleta*	*Scolioplanes* sp.
Carpophyllum maschalocarpum	*Ligia novaezelandiae*	*Scytothamnus australis*
Cellana radians	*Macomona liliana*	*Siphonaria australis*
Chamaesipho columna	*Macrophthalmus hirtipes*	*Sphaeroma quoyanum*
Chelifer sp.	*Maoricrypta costata*	Sphaeromatidae sp.
Chiton glaucus	*Maoricrypta monoxyla*	*Suterilla imperforata*
Chlorophyceae sp.	*Marinula filholi*	*Suterilla* sp.
Coleoptera sp.	*Melagraphia aethiops*	*Syncassidina aestuaria*
Colpomenia sinuosa	Membraniporidae sp.	*Sypharochiton pelliserpentis*
Cominella glandiformis	*Micrura pleuropolia*	Talitridae sp.
Cominella maculosa	*Modiolarca impacta*	*Talorchestia quoyana*
Cominella quoyana	*Musculista senhousia*	*Talorchestia* sp.
Congridae sp.	Mysidae sp.	*Talorchestia telluris*
Corallina officinalis	*Mytilus edulis*	*Tenagomysis* sp.
Corophium acutum	Nemertea sp.	Terebellidae sp.
Crassostrea gigas	*Neosabellaria kaiparaensis*	Teredinidae sp.
Cyclograpsus lavauxi	Nereididae sp.	*Thelepus spectabilis*
Demospongiae sp.	*Nerita atramentosa*	*Timarete anchylochaetus*
Dendrostomum aeneum	*Nicon aestuariensis*	*Travisia olens*
Desis robsoni	*Notoacmea daedala*	*Turbo smaragdus*
Diadumene lineata	*Notoacmea helmsi*	*Watersipora* sp.
Diadumene sp.	*Notoacmea parviconoidea*	*Xenostrobus pulex*
Diloma subrostrata	*Nucula hartvigiana*	*Xenostrobus securis*
Diloma zelandica	*Oligosoma smithi*	*Xymene plebeius*
Eatoniella sp.	*Omobranchus anolius*	*Zeacumantus lutulentus*
Edwardsia tricolor	*Onchidella nigricans*	*Zeacumantus subcarinatus*
Epopella plicata	*Ophicardelus costellaris*	

Table 56: Species unique to brackish shores (n=24)

Aldrichetta forsteri
Boccardia sp.
Chironomidae sp.
Colurostylis lemurum
Conopeum seurati
Fistulobalanus kondakovi
Gobiomorphus basalis
Halopyrgus pagodulus
Hyale rubra
Hyridella menziesi
Latia neritoides
Lauria cylindracea
Melanopsis trifasciata
Mesanthura maculata
Nematoda sp.
Ostrea chilensis
Paracorophium excavatum
Paratya curvirostris
Potamopyrgus antipodarum
Rhombosolea plebeia
Scolelepis sp.
Sphaeroma sp.
Stratiomyidae sp.
Tenagomysis novaezelandiae

Table 57: Species unique to marine shores (n=526)

Aaptos aaptos
Aaptos tentum
Acanthochitona sp.
Acanthoclinus rua
Acar sandersonae
Acar sociella
Achelia assimilis
Actinia tenebrosa
Actiniaria sp.
Actinothoe albocincta
Aeolidiella faustina
Aeolidiidae sp.
Alcithoe arabica
Alloiodoris lanuginata
Allostichaster insignis
Allostichaster polyplax
Alope spinifrons
Alpheoidea sp.
Alpheus novaezealandiae
Amalda australis
Amalda depressa
Amalda novaezelandiae
Amathia biseriata
Amaurobioides maritima
Amphisbetia sp.
Amphitrite sp.
Amphiura aster
Amphiura sp.
Ancorina alata
Anomia trigonopsis
Anthozoa sp.
Aonides oxycephala
Aonides trifidus
Aphelodoris luctuosa
Aplidium phortax
Aplidium sp.
Aplysia sp.
Apodida sp.
Apophloea sinclairii
Arabellidae sp.
Arachnida sp.
Archidoris wellingtonensis
Arcturidae sp.
Aricidea sp.
Armandia maculata
Ascidiacea sp.
Asterocarpa coerulea
Astropecten polyacanthus
Asychis sp.
Atalacmea fragilis
Atrina zelandica
Austrolittorina cincta
Austromitra rubiginosa
Axiothella serrata
Balanus sp.
Balanus vestitus
Bankia setacea
Barbatia novaezealandiae
Barnea similis
Beania sp.
Berthella medietus
Berthella ornata
Berthella sp.
Borniola reniformis
Bostrychia arbuscula
Botryllus schlosseri
Botryllus sp.
Branchiomma sp.
Branchiomma sp.2
Bryopsis plumosa
Bryopsis vestita
Buccinulum mariae
Buccinulum pallidum powelli
Buccinulum robustum
Bugula sp.
Bulla quoyi
Bursatella glauca
Bursatella leachii
Caberea sp.
Cabestana spengleri
Caecum digitulum
Calantica spinosa
Calantica villosa
Callianassa filholi
Calliostoma punctulata
Callochiton crocinus
Callyspongia ramosa
Cantareus aspersus
Cantharidella tesselata
Cantharidus purpureus
Caprellina longicollis
Cardita aeoteana
Cardita brookesi
Carpophyllum flexuosum
Carpophyllum plumosum
Caulerpa flexilis
Caulerpa geminata
Caulerpa sp.
Cellana denticulata
Cellana ornata
Cellana stellifera
Chaerodes concolor
Chaetopterus sp.
Chaetozone cincinnata
Chamaesipho brunnea
Champia laingiii
Champia sp.
Chaperiopsis cervicornis
Chaperiopsis sp.
Charonia lampas
Charybdis japonica
Chlamys dieffenbachi
Chlamys zelandiae
Chromodoris amoena
Chromodoris aureomarginata
Cirolana arcuata
Cirratulidae sp.

Cirratulus nuchalis
Cirripedia sp.
Cleidothaerus albidus
Cliona celata
Cnemidocarpa bicornuta
Codium adhaerens
Codium fragilis
Colpomenia peregrina
Cominella adspersa
Cominella virgata
Cookia sulcata
Coralliophila sertata
Corbula zelandica
Corella eumyota
Corophiidae sp.
Corophium sp.
Corynactis haddoni
Coscinasterias muricata
Craspedochiton rubiginosus
Crustacea sp.
Cryptoconchus porosus
Ctenodoris flabellifera
Culicia rubeola
Cyclaspis argus
Cyclograpsus insularum
Cyclomactra ovata
Cymodocella capra
Cymodopsis montis
Cystophora retroflexa
Cystophora torulosa
Daphnella cancellata
Decapoda sp.
Dendrodoris citrina
Dendrodoris gemmacea
Dendrodoris nigra
Diastylis insularum
Dictyoceratida sp.
Dictyota papenfussi
Dictyota sp.
Didemnum candidum
Didemnum sp.
Didemnum studeri
Diloma arida
Diloma bicanaliculata
Diloma coracina
Diopatra sp.
Diplocrepis puniceus
Diplodonta globus
Diplodonta striatula
Diplopolydora flava
Diplopolydora sp.
Diptera sp.
Divaricella huttoniana
Dodecaceria berkeleyi
Dosina zelandica
Dosinia anus
Dosinia subrosea
Durvillaea antarctica
Dynamenella hirsuta
Dynamenella huttoni
Dynamenella insulsa
Dynamenoides vulcanata
Dynamenopsis varicolor
Eatoniella albocolumella
Eatoniella limbata
Eatoniella maculosa
Eatoniella olivacea
Eatoniellidae sp.
Echinocardium cordatum
Ecklonia radiata
Ectoprocta sp.
Elamena producta
Elysia maoria
Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha ramulosa
Enteromorpha sp.
Epitonium jukesianum
Epitonium minora
Estea sp.
Eudoxochiton nobilis
Euidotea stricta
Eulalia sp.
Eunice sp.
Eurynolambrus australis
Evechinus chloroticus
Exosphaeroma chilensis
Exosphaeroma gigas
Exosphaeroma obtusum
Felaniella zelandica
Fellaster zelandiae
Fictonoba carnosa
Filograna sp.
Flabelligera affinis
Forsterygion sp.
Fossarina rimata
Gadinalea nivea
Galeolaria hystrix
Gari lineolata
Gastroscyphus hectoris
Gelidium caulacantheum
Gelidium sp.
Gigartina alveata
Gigartina circumcincta
Glossophora kunthii
Glycera lamellipodia
Glycera tesselata
Gobiesocidae sp.
Goniada sp.
Gracilaria sp.
Gregariella barbata
Guildingia obtecta
Halicarcinus innominatus
Haliclona heterofibrosa
Haliotis australis
Haliotis iris
Haliplanellidae sp.
Halopteris funicularis
Haustoriidae sp.
Haustorius sp.
Haustrum haustorium
Hemigrapsus edwardsi
Hemileucon comes
Hemipodus simplex
Herpetopoma bella
Hesionidae sp.
Heterozius rotundifrons
Hiatella arctica
Hildenbrandtia sp.
Hippolyte sp.
Ibla idiotica
Ircinia sp.
Irus reflexus
Isocladus inaccuratus
Isocladus sp.
Isocradactis magna
Isocradactis sp.
Jania sp.
Janthina janthina
Kolostoneura novaezelandiae
Lamellaria cerebroides
Lamellaria ophione
Lamellaria sp.
Leathesia difformis
Lepas anatifera
Lepidasthenia sp.
Lepidastheniella sp.
Lepidonotus polychroma
Lepidonotus sp.
Leptochiton inquinatus
Leptograpsus variegatus
Leptomya retiaria
Lessonia variegata
Limaria orientalis
Lithophyllum sp.
Lithothamnium sp.
Luidia maculata
Lumbrineris sp.
Lumbrineris sphaerocephala

Lysianassidae sp.
Lysidice sp.
Macroclymenella stewartensis
Magelona papillicornis
Maldanidae sp.
Maoricolpus roseus
Marginella cairoma
Marginella mustelina
Marginella sp.
Marphysa depressa
Melanochlamys cylindrica
Merelina taupoensis
Mesoginella koma
Mesogloia intestinalis
Micrelenchus sanguineus
Micrelenchus sp.
Micrelenchus huttonii
Microciona sp.
Microcosmus australis
Microcosmus kura
Microzonia velutina
Modiolus areolatus
Monia zelandica
Monomyces rubrum
Monoplex parthenopeus
Muricopsis octogonus
Myadora boltoni
Myadora striata
Nebalia sp.
Neoguraleus interruptus
Neoguraleus murdochi
Neoguraleus sinclairi
Neoguraleus sp.
Nephtyidae sp.
Nephtys macroura
Nereis cricognatha
Nereis sp.
Nicolea sp.
Ninoe leptognatha
Notoacmea pileopsis
Notoacmea scopulina
Notoacmea sp.
Notoclinops sp.
Notomithrax minor
Notomithrax peronii
Notomithrax sp.
Notomithrax ursus
Notoplax mariae
Notoplax violacea
Nucula nitidula
Nucula sp.
Nudibranchia sp.
Ocnus brevidentis
Octocorallia sp.
Octopus gibbsi
Odontosyllis sp.
Oedicerotidae sp.
Okamia thilenii
Okenia sp.
Oligochaeta sp.
Oligosoma acrinasum
Onithochiton neglectus
Onoscolex pacificus
Onoscolex sp.
Ophelia sp.
Ophiodromus angustifrons
Ophionereis fasciata
Ophiopsammus maculata
Ophiopteris antipodum
Ophiuroidea sp.
Orbiniidae sp.
Oridia sp.
Ostracoda sp.
Ostrea aupouria
Ostrea lutaria
Ostrea sp.
Oulactis muscosa
Ovalipes catharus
Owenia fusiformis
Oxychilus cellarius
Ozius truncatus
Pachydictyon sp.
Pachymenia lusoria
Pagurapseudes sp.
Paguridae sp.
Paguristes barbatus
Paguristes pilosus
Paguristes setosus
Paguristes sp.
Pagurixus hectori
Paguroidea sp.
Paphies subtriangulata
Paphies ventricosa
Parablennius laticlavius
Paradexamine houtete
Paraphoxus sp.
Paratrophon cheesemani
Paratrophon patens
Paratrophon quoyi
Patelloida corticata
Paxula paxillus
Pecten novaezelandiae
Penion sulcatus
Pericoptus humeralis
Periploma angasi
Petrocheles spinosus
Petrolisthes novaezelandiae
Phascolosoma annulatum
Pherusa parmatus
Philobrya munita
Philobrya sp.
Pholadidea spathulata
Pholadidea tridens
Phoronis sp.
Phoxocephalidae sp.
Phyllodoce sp.
Pilumnus lumpinus
Pilumnus sp.
Pinnotheres atrenicola
Pinnotheres novaezelandiae
Pisinna rekohuana lactorubra
Pisinna zosterophila
Plagusia chabrus
Planes cyaneus
Platynereis australis
Plaxiphora caelata
Pleurobranchaea maculata
Pleurobranchaea novaezelandiae
Plocamium costatum
Plumularia setacea
Podocerus sp.
Polycera fujitai
Polymastia sp.
Polynoidae sp.
Polynoidae sp.2
Polyplacophora sp.
Polysyncraton chondrilla
Pontogeniidae sp.
Pontophilus australis
Porphyra columbina
Porphyra sp.
Protothaca crassicosta
Pseudechinus huttoni
Pseudotonicia cuneata
Pulmonata sp.
Pycnogonida sp.
Pyromaia tuberculata
Pyura cancellata
Pyura carnea
Pyura rugata
Pyura subuculata
Radiacmea inconspicua
Ralfsia verrucosa
Ranella australasia
Raspailia sp.
Rhodophyceae sp.
Rhyssoplax aerea
Rhyssoplax stangeri

Rissoa hamiltoni
Rissoina achatina
Rissoina chathamensis
Rissoina fucosa
Rissoina zonata
Rostanga rubicunda
Ruditapes largillierti
Sabellidae sp.
Saccoglossus australiensis
Salmacina sp.
Sargassum sinclairii
Scintillona zelandica
Scolelepis antipoda
Scutus breviculus
Scyphax ornatus
Scytothamnus fasciculatus
Seila cincta
Sepioloidea pacifica
Sepioteuthis australis
Serpulorbis sp.
Sigalion sp.
Sigapatella novaezelandiae
Sigapatella tenuis
Siliquaria weldii
Sipunculidae sp.
Smittoidea sp.
Solemya parkinsoni
Soletellina nitida
Soletellina siliqua
Specula marginata
Specula sp.
Sphaerium novaezelandiae
Sphaerosyllis sp.
Spionidae sp.
Spirorbinae sp.
Spisula aequilateralis
Splachnidium rugosum
Spongomorpha pacifica
Steginoporella perplexa
Stegnaster inflatus
Stephopoma roseum
Stichaster australis
Stichopus mollis
Struthiolaria papulosa
Struthiolaria vermis
Styela clava
Styela plicata
Syllidae sp.
Syngnathidae sp.
Sypharochiton sinclairii
Talorchestia dentata
Tanaidae sp.
Tanea zelandica
Taron dubius
Tawera spissa
Terebella sp.
Terebratella inconspicua
Tethya aurantium
Tethya burtoni
Tethya ingalli
Tethya sp.
Tetraclitella depressa
Thais orbita
Thelepus sp.
Theora lubrica
Thoristella oppressa
Thysanozoon brochii
Tiostrea chilensis lutaria
Trachelochismus melobesia
Trachelochismus pinnulatus
Trichosirius inornatus
Triphora infelix
Triphora sp.
Trochodota dendyi
Trochus viridis
Tucetona laticostata
Tugali elegans
Tugali suteri
Turbonilla sp.
Ulva lactuca
Upogebia hirtifrons
Velella velella
Xiphophora chondrophylla
Xiphophora gladiata
Xymene gouldi
Xymene sp.
Xymene traversi
Zebittium exile
Zelithophaga truncata
Zemitrella choava
Zonaria turneriana
Zostera nana

Table 58: Soft-substratum species. Breakdown of average similarity (11.85) within soft-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Helice crassa	0.42	1.57	0.41	13.22	13.22
Potamopyrgus estuarinus	0.34	1.04	0.34	8.78	22.00
Avicennia resinifera	0.31	0.78	0.31	6.58	28.58
Ophicardelus costellaris	0.30	0.73	0.29	6.12	34.70
Amphipoda sp.	0.25	0.71	0.23	6.02	40.71
Amphibola crenata	0.28	0.68	0.27	5.74	46.45
Austrominius modestus	0.27	0.44	0.26	3.73	50.19
Perinereis nuntia	0.18	0.40	0.17	3.40	53.59
Syncassidina aestuaria	0.22	0.37	0.21	3.09	56.67
Potamopyrgus pupoides	0.20	0.35	0.19	2.97	59.64
Cominella glandiformis	0.23	0.34	0.22	2.89	62.53
Sphaeroma quoyanum	0.21	0.32	0.21	2.74	65.27
Capitella capitata	0.16	0.31	0.15	2.58	67.85
Macroclymenella stewartensis	0.16	0.29	0.15	2.45	70.29
Crassostrea gigas	0.22	0.29	0.21	2.44	72.73
Nicon aestuariensis	0.13	0.24	0.12	2.06	74.79
Saccoglossus australiensis	0.13	0.24	0.13	2.00	76.79
Nemertea sp.	0.14	0.20	0.13	1.65	78.44
Zeacumantus lutulentus	0.17	0.18	0.15	1.53	79.97
Paracorophium excavatum	0.12	0.16	0.12	1.36	81.34
Scolecolepides benhami	0.11	0.15	0.10	1.27	82.61
Teredinidae sp.	0.15	0.13	0.14	1.10	83.71
Orbinia papillosa	0.11	0.13	0.10	1.06	84.77
Nephtys macroura	0.09	0.11	0.08	0.90	85.68
Palaemon affinis	0.12	0.10	0.11	0.88	86.56
Macomona liliana	0.09	0.10	0.08	0.86	87.42
Xenostrobus securis	0.12	0.10	0.11	0.82	88.24
Austrovenus stutchburyi	0.12	0.09	0.11	0.79	89.03
Ligia novaezelandiae	0.12	0.09	0.11	0.75	89.78
Onchidella nigricans	0.12	0.07	0.12	0.62	90.40

Table 59: Hard-substratum species. Breakdown of average similarity (26.58) within hard substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Austrominius modestus	0.82	1.39	0.69	5.23	5.23
Turbo smaragdus	0.79	0.96	0.86	3.61	8.84
Onchidella nigricans	0.73	0.84	0.71	3.18	12.02
Xenostrobus pulex	0.64	0.84	0.56	3.15	15.17
Petrolisthes elongatus	0.72	0.75	0.75	2.81	17.97
Pomatoceros caeruleus	0.72	0.73	0.80	2.75	20.73
Sypharochiton pelliserpentis	0.73	0.72	0.84	2.71	23.44
Crassostrea gigas	0.56	0.72	0.53	2.70	26.15
Lepsiella scobina	0.70	0.64	0.80	2.40	28.55
Chiton glaucus	0.68	0.61	0.76	2.30	30.85
Melagraphia aethiops	0.68	0.60	0.74	2.26	33.11
Eulalia microphylla	0.55	0.45	0.45	1.70	34.81
Cominella glandiformis	0.42	0.45	0.38	1.69	36.50
Amphiporus sp.	0.57	0.45	0.56	1.68	38.18
Austrolittorina antipodum	0.61	0.45	0.64	1.68	39.86
Nerita atramentosa	0.59	0.44	0.62	1.66	41.52
Fistulobalanus kondakovi	0.15	0.41	0.09	1.53	43.05
Pilumnopeus serratifrons	0.49	0.40	0.43	1.51	44.55
Isactinia olivacea	0.54	0.35	0.55	1.33	45.89
Anthopleura aureoradiata	0.47	0.34	0.43	1.28	47.17
Siphonaria australis	0.50	0.32	0.49	1.20	48.36
Hormosira banksii	0.52	0.31	0.55	1.16	49.52
Corallina officinalis	0.54	0.31	0.58	1.16	50.68
Acanthochitona zelandica	0.52	0.31	0.53	1.15	51.84
Risellopsis varia	0.50	0.29	0.48	1.09	52.93
Zeacumantus subcarinatus	0.48	0.29	0.46	1.09	54.02
Perna canaliculus	0.50	0.28	0.51	1.07	55.08
Patiriella regularis	0.53	0.28	0.59	1.05	56.13
Halicarcinus pubescens	0.50	0.27	0.50	1.01	57.14
Cominella virgata	0.51	0.26	0.56	0.98	58.12
Diloma subrostrata	0.32	0.26	0.29	0.97	59.08
Cyclograpsus lavauxi	0.46	0.25	0.42	0.94	60.03
Chamaesipho columna	0.47	0.23	0.48	0.85	60.88
Pagurus novizealandiae	0.46	0.22	0.48	0.82	61.70
Ischnochiton maorianus	0.47	0.21	0.50	0.78	62.48
Perinereis novaehollandiae	0.38	0.20	0.31	0.77	63.25
Watersipora sp.	0.44	0.20	0.46	0.75	64.00
Saccostrea glomerata	0.44	0.20	0.45	0.75	64.75
Maoricrypta monoxyla	0.44	0.19	0.46	0.73	65.48
Epopella plicata	0.44	0.19	0.47	0.71	66.18
Balanus trigonus	0.43	0.18	0.45	0.67	66.85
Zeacumantus lutulentus	0.32	0.17	0.30	0.65	67.50
Ligia novaezelandiae	0.38	0.17	0.34	0.65	68.15
Maoricrypta costata	0.43	0.17	0.44	0.65	68.79
Palaemon affinis	0.37	0.17	0.35	0.63	69.43
Platyhelminthes sp.	0.40	0.17	0.39	0.63	70.06
Colpomenia sinuosa	0.42	0.17	0.44	0.63	70.69
Neosabellaria kaiparaensis	0.40	0.16	0.41	0.60	71.29
Microciona sp.	0.42	0.16	0.44	0.60	71.89
Cellana ornata	0.40	0.15	0.41	0.56	72.46

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Cominella maculosa	0.39	0.15	0.40	0.55	73.00
Coscinasterias muricata	0.40	0.14	0.42	0.54	73.54
Haustrum haustorium	0.40	0.14	0.42	0.54	74.08
Notoacmea daedala	0.38	0.14	0.37	0.53	74.61
Lepidonotus polychroma	0.38	0.14	0.38	0.52	75.14
Sypharochiton sinclairii	0.38	0.13	0.40	0.50	75.64
Flabelligera affinis	0.38	0.13	0.40	0.49	76.13
Leptochiton inquinatus	0.38	0.13	0.38	0.48	76.61
Dendrostomum aeneum	0.33	0.12	0.31	0.46	77.07
Lepidonotus purpureus	0.26	0.12	0.22	0.45	77.52
Scytothamnus australis	0.33	0.12	0.33	0.44	77.96
Sigapatella novaezelandiae	0.38	0.12	0.39	0.44	78.40
Buccinulum vittatum	0.35	0.11	0.35	0.42	78.82
Hydroides norvegicus	0.34	0.11	0.34	0.41	79.22
Beania sp.	0.34	0.11	0.35	0.40	79.62
Acarina sp.	0.30	0.10	0.26	0.39	80.02
Cellana radians	0.32	0.10	0.31	0.37	80.39
Halichondria sp.	0.32	0.10	0.27	0.37	80.76
Cnemidocarpa bicornuta	0.32	0.10	0.33	0.36	81.12
Helice crassa	0.18	0.09	0.16	0.36	81.48
Asterocarpa cerea	0.32	0.09	0.33	0.35	81.83
Austrovenus stutchburyi	0.23	0.09	0.22	0.35	82.18
Notoacmea helmsi	0.26	0.09	0.24	0.34	82.52
Asterocarpa coerulea	0.33	0.09	0.34	0.34	82.85
Cominella adspersa	0.30	0.09	0.29	0.34	83.19
Diadumene sp.	0.21	0.09	0.17	0.33	83.52
Modiolarca impacta	0.31	0.09	0.30	0.32	83.85
Diloma zelandica	0.31	0.08	0.31	0.31	84.16
Hiatella arctica	0.32	0.08	0.32	0.31	84.47
Heterozius rotundifrons	0.32	0.08	0.33	0.30	84.77
Tetraclitella depressa	0.31	0.08	0.31	0.29	85.06
Codium adhaerens	0.31	0.08	0.31	0.29	85.34
Carpophyllum maschalocarpum	0.31	0.08	0.31	0.28	85.63
Cliona celata	0.31	0.07	0.31	0.28	85.91
Evechinus chloroticus	0.31	0.07	0.32	0.28	86.19
Ecklonia radiata	0.30	0.07	0.30	0.27	86.46
Buccinulum lineum	0.29	0.07	0.29	0.27	86.73
Halicarcinus varius	0.19	0.07	0.16	0.27	87.00
Taron dubius	0.30	0.07	0.31	0.27	87.26
Hemigrapsus crenulatus	0.21	0.07	0.19	0.27	87.53
Actinia tenebrosa	0.28	0.07	0.28	0.26	87.79
Thais orbita	0.28	0.07	0.28	0.25	88.04
Isoparactis ferax	0.28	0.07	0.27	0.25	88.29
Corella eumyota	0.27	0.06	0.27	0.24	88.54
Leathesia difformis	0.27	0.06	0.27	0.23	88.77
Terebellidae sp.	0.26	0.06	0.25	0.23	89.00
Pyura rugata	0.26	0.06	0.25	0.23	89.23
Leuconopsis obsoleta	0.25	0.06	0.24	0.22	89.45
Stephopoma roseum	0.27	0.06	0.28	0.22	89.67
Spirorbinae sp.	0.26	0.06	0.25	0.22	89.89
Maoricolpus roseus	0.26	0.06	0.27	0.22	90.11

Table 60: Species common to hard and soft shores (n=224)

Acanthochitona zelandica
Acarina sp.
Actinia tenebrosa
Actiniaria sp.
Actinopterygii sp.
Alcithoe arabica
Alpheus richardsoni
Alpheus sp.
Amalda australis
Amalda depressa
Amalda novaezelandiae
Amphibola crenata
Amphipoda sp.
Amphiporus sp.
Amphiura aster
Anisolabis littorea
Anthopleura aureoradiata
Arachnida sp.
Arthritica bifurca
Asellota sp.
Asterocarpa cerea
Astropecten polyacanthus
Atrina zelandica
Austrolittorina antipodum
Austrominius modestus
Austrovenus stutchburyi
Avicennia resinifera
Balanus trigonus
Betaeus aequimanus
Bivalvia sp.
Branchiomma sp.
Buccinulum vittatum
Bulla quoyi
Capitella capitata
Caridea sp.
Carpophyllum maschalocarpum
Cellana ornata
Cellana radians
Chaerodes concolor
Chamaesipho columna
Chiton glaucus
Chlorophyceae sp.
Cirolana arcuata
Cirratulidae sp.
Codium adhaerens
Codium fragilis
Cominella adspersa
Cominella glandiformis
Cominella maculosa
Cominella quoyana
Cominella virgata
Congridae sp.
Corallina officinalis
Coscinasterias muricata
Crassostrea gigas
Crustacea sp.
Cryptoconchus porosus
Cyclograpsus lavauxi
Cyclomactra ovata
Cystophora torulosa
Dendrodoris citrina
Dendrodoris nigra
Dendrostomum aeneum
Desis robsoni
Diadumene lineata
Diadumene sp.
Diloma bicanaliculata
Diloma subrostrata
Diloma zelandica
Dosinia subrosea
Echinocardium cordatum
Edwardsia tricolor
Elamena producta
Epopella plicata
Eulalia microphylla
Eunice sp.
Evechinus chloroticus
Exosphaeroma gigas
Exosphaeroma planulum
Fellaster zelandiae
Fistulobalanus kondakovi
Forsterygion varium
Girella triscuspidata
Glycera americana
Glycera lamellipodia
Halicarcinus cookii
Halicarcinus pubescens
Halicarcinus sp.
Halicarcinus varius
Halicarcinus whitei
Halichondria sp.
Haminoea zelandiae
Haustrum haustorium
Helice crassa
Hemigrapsus crenulatus
Hemigrapsus edwardsi
Hesionidae sp.
Heteromastus filiformis
Heterozius rotundifrons
Hormosira banksii
Hydroides norvegicus
Iais sp.
Irus reflexus
Isactinia olivacea
Ischnochiton maorianus
Isocladus armatus
Isocladus dulciculus
Isopoda sp.
Lepidasthenia sp.
Lepidonotus polychroma
Lepidonotus purpureus
Lepsiella scobina
Leptochiton inquinatus
Leuconopsis obsoleta
Ligia novaezelandiae
Lumbrineris sphaerocephala
Macomona liliana
Macrophthalmus hirtipes
Maoricolpus roseus
Maoricrypta costata
Maoricrypta monoxyla
Marinula filholi
Marphysa depressa
Melagraphia aethiops
Membraniporidae sp.
Micrelenchus huttonii
Musculista senhousia
Myadora striata
Mysidae sp.
Nemertea sp.
Neosabellaria kaiparaensis
Nereididae sp.
Nerita atramentosa
Nicon aestuariensis
Ninoe leptognatha
Notoacmea daedala
Notoacmea helmsi
Notoacmea sp.
Notoplax violacea
Nucula hartvigiana
Oligochaeta sp.
Oligosoma smithi
Omobranchus anolius
Onchidella nigricans
Ophicardelus costellaris
Ophiodromus angustifrons
Orbinia papillosa
Ostracoda sp.
Pagurapseudes sp.
Paguroidea sp.
Pagurus novizealandiae
Palaemon affinis
Paphies australis
Paphies subtriangulata
Patiriella regularis
Pectinaria australis

Pericoptus humeralis
Perinereis camiguinoides
Perinereis novaehollandiae
Perinereis nuntia
Perinereis sp.
Perna canaliculus
Petrolisthes elongatus
Phoxocephalidae sp.
Pilumnopeus serratifrons
Pilumnus novaezelandiae
Pisidium hodgkini
Platyhelminthes sp.
Platynereis australis
Polychaeta sp.
Polynoidae sp.
Pomatoceros caeruleus
Pontophilus australis
Potamopyrgus estuarinus
Potamopyrgus pupoides
Prionospio sp.
Pseudosphaeroma campbellensis
Pyura sp.
Risellopsis varia
Rissoina chathamensis
Sabellidae sp.
Saccoglossus australiensis
Saccostrea glomerata
Scintillona zelandica
Scolecolepides benhami
Scolioplanes sp.
Scytothamnus australis
Sigapatella novaezelandiae
Siphonaria australis
Sipunculidae sp.
Soletellina nitida
Sphaeroma quoyanum
Sphaeromatidae sp.
Spionidae sp.
Stephopoma roseum
Struthiolaria vermis
Styela clava
Suterilla imperforata
Suterilla sp.
Syllidae sp.
Syncassidina aestuaria
Sypharochiton pelliserpentis
Talitridae sp.
Talorchestia quoyana
Talorchestia sp.
Talorchestia telluris
Tenagomysis novaezelandiae
Tenagomysis sp.
Terebella sp.
Teredinidae sp.
Tethya sp.
Tetraclitella depressa
Thais orbita
Travisia olens
Trochodota dendyi
Turbo smaragdus
Turbonilla sp.
Watersipora sp.
Xenostrobus pulex
Xenostrobus securis
Xymene plebeius
Zeacumantus lutulentus
Zeacumantus subcarinatus
Zelithophaga truncata

Table 61: Species unique to hard shores (n=415)

Aaptos aaptos
Aaptos tentum
Acanthochitona sp.
Acanthoclinus fuscus
Acanthoclinus littoreus
Acanthoclinus rua
Acar sandersonae
Acar sociella
Achelia assimilis
Actinothoe albocincta
Aeolidiella faustina
Aeolidiidae sp.
Alloiodoris lanuginata
Allostichaster insignis
Allostichaster polyplax
Alope spinifrons
Alpheoidea sp.
Alpheus novaezealandiae
Amathia biseriata
Amaurobioides maritima
Amphisbetia sp.
Amphitrite sp.
Amphiura sp.
Ancorina alata
Anomia trigonopsis
Anthozoa sp.
Aonides oxycephala
Aphelodoris luctuosa
Aplidium phortax
Aplidium sp.
Aplysia sp.
Apodida sp.
Apophloea sinclairii
Archidoris wellingtonensis
Arcturidae sp.
Armandia maculata
Ascidiacea sp.
Asterocarpa coerulea
Asychis sp.
Atalacmea fragilis
Austrolittorina cincta
Austrominius sp.
Austromitra rubiginosa
Balanus amphitrite
Balanus sp.
Balanus variegatus
Balanus vestitus
Bankia setacea
Barbatia novaezealandiae
Barnea similis
Beania sp.
Berthella medietus
Berthella ornata
Berthella sp.
Borniola reniformis
Bostrychia arbuscula
Botryllus schlosseri
Botryllus sp.
Branchiomma sp.2
Bryopsis plumosa
Bryopsis vestita
Buccinulum lineum
Buccinulum mariae
Buccinulum pallidum powelli
Buccinulum robustum
Bugula sp.
Bursatella glauca
Bursatella leachii
Caberea sp.
Cabestana spengleri
Caecum digitulum
Calantica spinosa
Calantica villosa
Calliostoma punctulata
Callochiton crocinus
Callyspongia ramosa
Cantareus aspersus
Cantharidella tesselata
Cantharidus purpureus
Caprellina longicollis

Cardita aeoteana
Cardita brookesi
Carpophyllum flexuosum
Carpophyllum plumosum
Caulerpa flexilis
Caulerpa geminata
Caulerpa sp.
Cellana denticulata
Cellana stellifera
Chaetopterus sp.
Chamaesipho brunnea
Champia laingiii
Champia sp.
Chaperiopsis cervicornis
Chaperiopsis sp.
Charonia lampas
Charybdis japonica
Chelifer sp.
Chlamys dieffenbachi
Chlamys zelandiae
Chromodoris amoena
Chromodoris aureomarginata
Cirratulus nuchalis
Cirripedia sp.
Cleidothaerus albidus
Cliona celata
Cnemidocarpa bicornuta
Coleoptera sp.
Colpomenia peregrina
Colpomenia sinuosa
Cookia sulcata
Coralliophila sertata
Corbula zelandica
Corella eumyota
Corynactis haddoni
Craspedochiton rubiginosus
Ctenodoris flabellifera
Culicia rubeola
Cyclograpsus insularum
Cymodocella capra
Cymodopsis montis
Cystophora retroflexa
Daphnella cancellata
Decapoda sp.
Demospongiae sp.
Dendrodoris gemmacea
Dictyoceratida sp.
Dictyota papenfussi
Dictyota sp.
Didemnum candidum
Didemnum sp.
Didemnum studeri
Diloma arida
Diloma coracina
Diplocrepis puniceus
Diplodonta globus
Diplodonta striatula
Diplopolydora sp.
Dodecaceria berkeleyi
Dosina zelandica
Durvillaea antarctica
Dynamenella hirsuta
Dynamenella huttoni
Dynamenella insulsa
Dynamenoides vulcanata
Dynamenopsis varicolor
Eatoniella albocolumella
Eatoniella limbata
Eatoniella maculosa
Eatoniella olivacea
Eatoniella sp.
Eatoniellidae sp.
Ecklonia radiata
Ectoprocta sp.
Elysia maoria
Enteromorpha intestinalis
Enteromorpha linza
Enteromorpha ramulosa
Enteromorpha sp.
Epitonium jukesianum
Epitonium minora
Estea sp.
Eudoxochiton nobilis
Euidotea stricta
Eulalia sp.
Eurynolambrus australis
Exosphaeroma chilensis
Exosphaeroma obtusum
Fictonoba carnosa
Filograna sp.
Flabelligera affinis
Forsterygion sp.
Fossarina rimata
Gadinalea nivea
Galeolaria hystrix
Gastroscyphus hectoris
Gelidium caulacantheum
Gelidium sp.
Gigartina alveata
Gigartina circumcincta
Glossophora kunthii
Gobiesocidae sp.
Gracilaria sp.
Grahamina nigripenne
Gregariella barbata
Guildingia obtecta
Halicarcinus innominatus
Haliclona heterofibrosa
Haliotis australis
Haliotis iris
Haliplanellidae sp.
Halopteris funicularis
Herpetopoma bella
Hiatella arctica
Hildenbrandtia sp.
Hippolyte sp.
Ibla idiotica
Ircinia sp.
Isocladus inaccuratus
Isocladus sp.
Isocradactis magna
Isocradactis sp.
Isoparactis ferax
Jania sp.
Janthina janthina
Kolostoneura novaezelandiae
Lamellaria cerebroides
Lamellaria ophione
Lamellaria sp.
Lasaea rubra
Leathesia difformis
Lepidastheniella sp.
Lepidonotus sp.
Leptograpsus variegatus
Leptomya retiaria
Lessonia variegata
Limaria orientalis
Lithophyllum sp.
Lithothamnium sp.
Lumbrineris sp.
Lysianassidae sp.
Maldanidae sp.
Marginella cairoma
Marginella mustelina
Melanochlamys cylindrica
Merelina taupoensis
Mesoginella koma
Mesogloia intestinalis
Micrelenchus sanguineus
Micrelenchus sp.
Microciona sp.
Microcosmus australis
Microcosmus kura
Microzonia velutina
Micrura pleuropolia
Modiolarca impacta
Modiolus areolatus
Monia zelandica

Monomyces rubrum
Monoplex parthenopeus
Muricopsis octogonus
Myadora boltoni
Mytilus edulis
Nebalia sp.
Neoguraleus interruptus
Neoguraleus murdochi
Neoguraleus sinclairi
Neoguraleus sp.
Nephtyidae sp.
Nereis cricognatha
Nereis sp.
Nicolea sp.
Notoacmea parviconoidea
Notoacmea pileopsis
Notoacmea scopulina
Notoclinops sp.
Notomithrax minor
Notomithrax peronii
Notomithrax sp.
Notomithrax ursus
Notoplax mariae
Nucula nitidula
Nucula sp.
Nudibranchia sp.
Ocnus brevidentis
Octocorallia sp.
Octopus gibbsi
Odontosyllis sp.
Okamia thilenii
Okenia sp.
Oligosoma acrinasum
Onithochiton neglectus
Ophelia sp.
Ophionereis fasciata
Ophiopsammus maculata
Ophiopteris antipodum
Ophiuroidea sp.
Orbiniidae sp.
Ostrea aupouria
Ostrea lutaria
Ostrea sp.
Oulactis muscosa
Ovalipes catharus
Owenia fusiformis
Ozius truncatus
Pachydictyon sp.
Pachymenia lusoria
Paguridae sp.
Paguristes barbatus
Paguristes pilosus
Paguristes setosus
Paguristes sp.
Pagurixus hectori
Parablennius laticlavius
Paradexamine houtete
Paratrophon cheesemani
Paratrophon patens
Paratrophon quoyi
Patelloida corticata
Paxula paxillus
Pecten novaezelandiae
Penion sulcatus
Periploma angasi
Petrocheles spinosus
Petrolisthes novaezelandiae
Phascolosoma annulatum
Pherusa parmatus
Philobrya munita
Philobrya sp.
Pholadidea spathulata
Pholadidea tridens
Pilumnus lumpinus
Pilumnus sp.
Pinnotheres novaezelandiae
Pisinna rekohuana lactorubra
Pisinna zosterophila
Plagusia chabrus
Plaxiphora caelata
Pleurobranchaea maculata
Pleurobranchaea novaezelandiae
Plocamium costatum
Plumularia setacea
Podocerus sp.
Polycera fujitai
Polymastia sp.
Polynoidae sp.2
Polysyncraton chondrilla
Porphyra columbina
Porphyra sp.
Prototthaca crassicosta
Pseudechinus huttoni
Pseudotonicia cuneata
Pulmonata sp.
Pycnogonida sp.
Pyromaia tuberculata
Pyura cancellata
Pyura carnea
Pyura rugata
Pyura subuculata
Radiacmea inconspicua
Ralfsia verrucosa
Ranella australasia
Raspailia sp.
Rhodophyceae sp.
Rhombosolea plebeia
Rhyssoplax aerea
Rhyssoplax stangeri
Rissoa hamiltoni
Rissoina achatina
Rissoina fucosa
Rissoina zonata
Rostanga rubicunda
Ruditapes largillierti
Salmacina sp.
Sargassum sinclairii
Scutus breviculus
Scytothamnus fasciculatus
Seila cincta
Sepioloidea pacifica
Sepioteuthis australis
Serpulorbis sp.
Sigapatella tenuis
Siliquaria weldii
Smittoidea sp.
Solemya parkinsoni
Soletellina siliqua
Specula marginata
Specula sp.
Sphaerium novaezelandiae
Spirorbinae sp.
Spisula aequilateralis
Splachnidium rugosum
Spongomorpha pacifica
Steginoporella perplexa
Stegnaster inflatus
Stichaster australis
Stichopus mollis
Styela plicata
Syngnathidae sp.
Sypharochiton sinclairii
Tanaidae sp.
Tanea zelandica
Taron dubius
Tawera spissa
Terebellidae sp.
Terebratella inconspicua
Tethya aurantium
Tethya burtoni
Tethya ingalli
Thelepus sp.
Thelepus spectabilis
Thoristella oppressa
Thysanozoon brochii
Timarete anchylochaetus

Tiostrea chilensis lutaria
Trachelochismus melobesia
Trachelochismus pinnulatus
Trichosirius inornatus
Triphora infelix
Triphora sp.
Trochus viridis
Tucetona laticostata
Tugali elegans
Tugali suteri
Ulva lactuca
Upogebia hirtifrons
Xiphophora chondrophylla
Xiphophora gladiata
Xymene gouldi
Xymene sp.
Xymene traversi
Zebittium exile
Zemitrella choava
Zonaria turneriana
Zostera nana

Table 62: Species unique to soft shores (n=74)

Aldrichetta forsteri
Aonides trifidus
Arabellidae sp.
Aricidea sp.
Axiothella serrata
Boccardia sp.
Callianassa filholi
Chaetozone cincinnata
Chironomidae sp.
Colurostylis lemurum
Conopeum seurati
Corophiidae sp.
Corophium acutum
Corophium sp.
Cyclaspis argus
Diastylis insularum
Diopatra sp.
Diplopolydora flava
Diptera sp.
Divaricella huttoniana
Dosinia anus
Felaniella zelandica
Gari lineolata
Glycera tesselata
Gobiomorphus basalis
Goniada sp.
Halopyrgus pagodulus
Haustoriidae sp.
Haustorius sp.
Hemileucon comes
Hemipodus simplex
Hyale rubra
Hyridella menziesi
Latia neritoides
Lauria cylindracea
Lepas anatifera
Luidia maculata
Lysidice sp.
Macroclymenella stewartensis
Magelona papillicornis
Marginella sp.
Melanopsis trifasciata
Mesanthura maculata
Nematoda sp.
Nephtys macroura
Oedicerotidae sp.
Onoscolex pacificus
Onoscolex sp.
Oridia sp.
Ostrea chilensis
Oxychilus cellarius
Paphies ventricosa
Paracorophium excavatum
Paraphoxus sp.
Paratya curvirostris
Phoronis sp.
Phyllodoce sp.
Pinnotheres atrenicola
Planes cyaneus
Polydora sp.
Polyplacophora sp.
Pontogeniidae sp.
Potamopyrgus antipodarum
Scolelepis antipoda
Scolelepis sp.
Scyphax ornatus
Sigalion sp.
Sphaeroma sp.
Sphaerosyllis sp.
Stratiomyidae sp.
Struthiolaria papulosa
Talorchestia dentata
Theora lubrica
Velella velella

Table 63: Marine hard-substratum species. Breakdown of average similarity (39.04) within brackish-shore groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Turbo smaragdus	0.95	1.06	1.67	2.71	2.71
Melagraphia aethiops	0.91	0.99	1.39	2.53	5.24
Austrominius modestus	0.88	0.99	1.24	2.53	7.77
Pomatoceros caeruleus	0.91	0.98	1.41	2.52	10.28
Sypharochiton pelliserpentis	0.92	0.97	1.64	2.49	12.77
Lepsiella scobina	0.92	0.96	1.62	2.46	15.24
Chiton glaucus	0.91	0.94	1.50	2.41	17.64
Petrolisthes elongatus	0.88	0.87	1.37	2.23	19.87
Onchidella nigricans	0.83	0.78	1.08	2.00	21.87
Corallina officinalis	0.81	0.68	1.15	1.75	23.62
Austrolittorina antipodum	0.81	0.67	1.16	1.73	25.35
Patiriella regularis	0.79	0.62	1.17	1.58	26.93
Cominella virgata	0.78	0.60	1.11	1.55	28.48
Nerita atramentosa	0.75	0.60	0.99	1.54	30.01
Isactinia olivacea	0.71	0.55	0.87	1.42	31.43
Xenostrobus pulex	0.66	0.55	0.71	1.40	32.83
Amphiporus sp.	0.70	0.53	0.84	1.35	34.18
Perna canaliculus	0.70	0.52	0.90	1.33	35.50
Siphonaria australis	0.68	0.50	0.78	1.28	36.79
Acanthochitona zelandica	0.70	0.48	0.89	1.24	38.03
Chamaesipho columna	0.69	0.47	0.84	1.21	39.24
Ischnochiton maorianus	0.70	0.45	0.92	1.16	40.39
Pagurus novizealandiae	0.68	0.45	0.84	1.15	41.54
Hormosira banksii	0.68	0.45	0.85	1.14	42.68
Watersipora sp.	0.66	0.44	0.81	1.13	43.81
Crassostrea gigas	0.55	0.44	0.53	1.12	44.93
Anthopleura aureoradiata	0.58	0.42	0.61	1.08	46.01
Maoricrypta monoxyla	0.66	0.42	0.82	1.06	47.08
Risellopsis varia	0.65	0.41	0.79	1.05	48.13
Eulalia microphylla	0.64	0.41	0.74	1.05	49.18
Epopella plicata	0.65	0.39	0.80	1.00	50.18
Balanus trigonus	0.64	0.39	0.77	0.99	51.17
Halicarcinus pubescens	0.65	0.38	0.80	0.98	52.15
Saccostrea glomerata	0.64	0.38	0.77	0.97	53.12
Microciona sp.	0.64	0.37	0.77	0.95	54.07
Colpomenia sinuosa	0.62	0.37	0.75	0.94	55.01
Cellana ornata	0.61	0.35	0.72	0.89	55.90
Zeacumantus subcarinatus	0.58	0.35	0.64	0.88	56.78
Maoricrypta costata	0.62	0.34	0.76	0.88	57.67
Coscinasterias muricata	0.61	0.33	0.73	0.85	58.52
Haustrum haustorium	0.61	0.33	0.74	0.85	59.37
Neosabellaria kaiparaensis	0.58	0.32	0.68	0.83	60.20
Lepidonotus polychroma	0.57	0.32	0.64	0.83	61.03
Cominella maculosa	0.58	0.31	0.68	0.80	61.83
Sypharochiton sinclairii	0.58	0.31	0.68	0.79	62.62
Flabelligera affinis	0.58	0.30	0.69	0.78	63.40
Platyhelminthes sp.	0.56	0.30	0.62	0.76	64.16
Leptochiton inquinatus	0.57	0.29	0.65	0.75	64.91
Sigapatella novaezelandiae	0.57	0.27	0.67	0.69	65.60
Notoacmea daedala	0.53	0.26	0.59	0.67	66.27

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Cyclograpsus lavauxi	0.55	0.26	0.62	0.65	66.93
Pilumnopeus serratifrons	0.49	0.25	0.53	0.65	67.58
Hydroides norvegicus	0.52	0.25	0.57	0.64	68.22
Beania sp.	0.52	0.25	0.58	0.63	68.85
Buccinulum vittatum	0.52	0.24	0.58	0.61	69.46
Cnemidocarpa bicornuta	0.49	0.22	0.54	0.57	70.03
Asterocarpa cerea	0.49	0.22	0.54	0.56	70.59
Palaemon affinis	0.45	0.21	0.47	0.54	71.12
Cellana radians	0.48	0.21	0.51	0.53	71.65
Asterocarpa coerulea	0.51	0.21	0.57	0.53	72.18
Cominella adspersa	0.45	0.21	0.47	0.53	72.71
Cominella glandiformis	0.35	0.20	0.33	0.50	73.22
Diloma zelandica	0.47	0.19	0.51	0.49	73.71
Ligia novaezelandiae	0.47	0.19	0.49	0.49	74.20
Hiatella arctica	0.48	0.19	0.53	0.49	74.69
Heterozius rotundifrons	0.48	0.18	0.53	0.47	75.16
Tetraclitella depressa	0.47	0.18	0.51	0.46	75.62
Modiolarca impacta	0.45	0.18	0.49	0.46	76.09
Scytothamnus australis	0.44	0.18	0.47	0.46	76.55
Codium adhaerens	0.47	0.18	0.51	0.45	77.00
Carpophyllum maschalocarpum	0.47	0.17	0.51	0.45	77.45
Cliona celata	0.47	0.17	0.51	0.45	77.89
Evechinus chloroticus	0.47	0.17	0.52	0.44	78.33
Ecklonia radiata	0.45	0.17	0.49	0.43	78.76
Taron dubius	0.45	0.16	0.50	0.42	79.18
Actinia tenebrosa	0.43	0.16	0.45	0.41	79.59
Perinereis novaehollandiae	0.42	0.16	0.43	0.41	80.00
Thais orbita	0.43	0.16	0.45	0.40	80.40
Corella eumyota	0.42	0.15	0.44	0.38	80.78
Buccinulum lineum	0.43	0.15	0.46	0.38	81.17
Leathesia difformis	0.42	0.14	0.44	0.37	81.53
Pyura rugata	0.39	0.14	0.40	0.36	81.89
Isoparactis ferax	0.42	0.14	0.44	0.35	82.24
Stephopoma roseum	0.42	0.14	0.44	0.35	82.59
Spirorbinae sp.	0.39	0.14	0.40	0.35	82.94
Maoricolpus roseus	0.40	0.14	0.42	0.35	83.29
Halichondria sp.	0.42	0.14	0.44	0.35	83.63
Zeacumantus lutulentus	0.34	0.13	0.32	0.35	83.98
Dendrostomum aeneum	0.39	0.13	0.40	0.32	84.30
Chaetopterus sp.	0.38	0.12	0.39	0.30	84.61
Terebellidae sp.	0.36	0.12	0.37	0.30	84.91
Tethya sp.	0.38	0.12	0.39	0.29	85.20
Aaptos aaptos	0.35	0.11	0.35	0.29	85.49
Notoacmea helmsi	0.31	0.11	0.30	0.28	85.78
Cryptoconchus porosus	0.38	0.11	0.40	0.28	86.05
Diloma bicanaliculata	0.36	0.11	0.38	0.27	86.32
Betaeus aequimanus	0.36	0.10	0.38	0.27	86.59
Microcosmus kura	0.35	0.10	0.36	0.27	86.86
Ascidiacea sp.	0.35	0.10	0.36	0.26	87.11
Austrovenus stutchburyi	0.26	0.10	0.24	0.26	87.37
Plaxiphora caelata	0.31	0.10	0.31	0.25	87.62
Notoplax violacea	0.36	0.10	0.38	0.25	87.86
Alope spinifrons	0.34	0.09	0.34	0.24	88.10

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Styela clava	0.30	0.09	0.30	0.24	88.34
Pilumnus lumpinus	0.34	0.09	0.35	0.22	88.57
Diloma subrostrata	0.23	0.09	0.21	0.22	88.79
Ophionereis fasciata	0.34	0.09	0.35	0.22	89.01
Acanthoclinus littoreus	0.29	0.09	0.28	0.22	89.23
Notomithrax minor	0.29	0.08	0.28	0.22	89.44
Scutus breviculus	0.32	0.08	0.33	0.21	89.65
Apophloea sinclairii	0.30	0.08	0.29	0.21	89.86
Acarina sp.	0.32	0.08	0.33	0.21	90.07

Table 64: Marine soft-substratum species. Breakdown of average similarity (9.70) within marine soft-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Macroclymenella stewartensis	0.38	1.76	0.38	18.11	18.11
Saccoglossus australiensis	0.33	1.44	0.32	14.84	32.95
Nemertea sp.	0.26	0.67	0.24	6.85	39.80
Nephtys macroura	0.22	0.65	0.21	6.69	46.50
Orbinia papillosa	0.22	0.55	0.20	5.71	52.21
Macomona liliana	0.19	0.40	0.17	4.14	56.35
Trochodota dendyi	0.19	0.36	0.18	3.71	60.05
Axiothella serrata	0.19	0.30	0.18	3.13	63.18
Amphipoda sp.	0.15	0.28	0.13	2.93	66.11
Oridia sp.	0.16	0.26	0.15	2.68	68.78
Magelona papillicornis	0.15	0.23	0.14	2.41	71.19
Chaerodes concolor	0.14	0.22	0.12	2.28	73.47
Callianassa filholi	0.11	0.16	0.10	1.63	75.10
Anthopleura aureoradiata	0.18	0.16	0.16	1.62	76.73
Lepidasthenia sp.	0.12	0.14	0.11	1.45	78.18
Haminoea zelandiae	0.12	0.14	0.11	1.42	79.61
Austrovenus stutchburyi	0.15	0.13	0.14	1.31	80.91
Talorchestia quoyana	0.10	0.11	0.08	1.13	82.05
Cominella glandiformis	0.15	0.10	0.13	1.06	83.11
Fellaster zelandiae	0.10	0.10	0.09	1.01	84.12
Zeacumantus lutulentus	0.12	0.09	0.09	0.97	85.09
Paphies australis	0.12	0.09	0.10	0.88	85.97
Helice crassa	0.12	0.08	0.10	0.83	86.80
Polychaeta sp.	0.10	0.07	0.08	0.75	87.55
Notoacmea helmsi	0.11	0.07	0.07	0.74	88.29
Turbo smaragdus	0.11	0.06	0.08	0.60	88.89
Talorchestia sp.	0.07	0.05	0.06	0.53	89.42
Nucula hartvigiana	0.11	0.05	0.09	0.52	89.95
Polydora sp.	0.08	0.05	0.07	0.51	90.45

Table 65: Brackish hard-substratum species. Breakdown of average similarity (23.79) within brackish hard-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Fistulobalanus kondakovi	0.43	3.54	0.27	14.87	14.87
Austrominius modestus	0.70	2.89	0.65	12.13	27.01
Xenostrobus pulex	0.60	1.82	0.63	7.66	34.66
Crassostrea gigas	0.60	1.54	0.68	6.47	41.13
Cominella glandiformis	0.55	1.27	0.59	5.34	46.47
Onchidella nigricans	0.53	1.13	0.55	4.73	51.20
Turbo smaragdus	0.48	0.92	0.48	3.86	55.07
Pilumnopeus serratifrons	0.48	0.91	0.49	3.84	58.91
Diloma subrostrata	0.48	0.84	0.49	3.53	62.44
Eulalia microphylla	0.38	0.70	0.34	2.96	65.39
Petrolisthes elongatus	0.40	0.63	0.40	2.65	68.05
Helice crassa	0.35	0.49	0.33	2.05	70.10
Perinereis novaehollandiae	0.30	0.39	0.28	1.65	71.75
Pomatoceros caeruleus	0.35	0.38	0.35	1.61	73.35
Sypharochiton pelliserpentis	0.35	0.38	0.35	1.61	74.96
Amphiporus sp.	0.33	0.36	0.31	1.50	76.46
Lepidonotus purpureus	0.30	0.36	0.29	1.49	77.95
Cyclograpsus lavauxi	0.30	0.30	0.28	1.28	79.23
Diadumene sp.	0.28	0.28	0.26	1.18	80.41
Halicarcinus varius	0.28	0.27	0.26	1.13	81.54
Zeacumantus lutulentus	0.30	0.27	0.30	1.12	82.66
Nerita atramentosa	0.28	0.23	0.27	0.97	83.62
Anthopleura aureoradiata	0.25	0.22	0.23	0.94	84.56
Lepsiella scobina	0.28	0.22	0.27	0.91	85.48
Zeacumantus subcarinatus	0.28	0.21	0.27	0.89	86.37
Chiton glaucus	0.25	0.20	0.24	0.82	87.19
Acarina sp.	0.25	0.19	0.24	0.81	87.99
Ligia novaezelandiae	0.23	0.16	0.21	0.68	88.67
Austrolittorina antipodum	0.23	0.16	0.21	0.68	89.35
Risellopsis varia	0.20	0.15	0.18	0.63	89.98
Sphaeroma quoyanum	0.20	0.14	0.17	0.60	90.58

Table 66: Brackish soft-substratum species. Breakdown of average similarity (24.32) within brackish soft-substratum groupings into contributions from each species.

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Helice crassa	0.63	3.64	0.71	14.96	14.96
Potamopyrgus estuarinus	0.56	2.77	0.62	11.38	26.34
Avicennia resinifera	0.50	2.00	0.55	8.23	34.57
Ophicardelus costellaris	0.48	1.98	0.51	8.16	42.73
Amphibola crenata	0.44	1.75	0.46	7.18	49.91
Amphipoda sp.	0.31	1.09	0.30	4.49	54.40
Perinereis nuntia	0.29	1.05	0.28	4.33	58.73
Syncassidina aestuaria	0.36	1.01	0.37	4.14	62.87
Potamopyrgus pupoides	0.33	0.97	0.33	3.99	66.86
Austrominius modestus	0.37	0.94	0.38	3.87	70.72
Sphaeroma quoyanum	0.36	0.93	0.37	3.82	74.54
Capitella capitata	0.26	0.88	0.26	3.60	78.14
Nicon aestuariensis	0.23	0.70	0.21	2.87	81.01

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Crassostrea gigas	0.32	0.69	0.33	2.83	83.85
Cominella glandiformis	0.28	0.57	0.28	2.36	86.21
Paracorophium excavatum	0.21	0.46	0.20	1.90	88.11
Scolecolepides benhami	0.18	0.40	0.17	1.66	89.78
Teredinidae sp.	0.23	0.33	0.23	1.35	91.13

Table 67: Values of significance level of ANOSIM pairwise test on marine hard and soft substrata

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
rocky reef, boulders	-0.167	93.4	118030185	999	933
rocky reef, platform reef	0.05	7.4	Very large	999	73
rocky reef, sand	0.566	0.1	Very large	999	0
rocky reef, mangrove mud	0.92	0.2	7770	999	1
rocky reef, tree log	0.803	8.6	35	35	3
rocky reef, cobbles	0.454	0.3	118030185	999	2
rocky reef, sand/mud	0.553	2.2	7770	999	21
rocky reef, mud	0.745	0.1	Very large	999	0
rocky reef, pipe	0.747	8.6	35	35	3
boulders, platform reef	-0.039	60.5	13884156	999	604
boulders, sand	-0.005	52.3	23535820	999	522
boulders, mangrove mud	0.981	0.6	165	165	1
boulders, tree log	1	11.1	9	9	1
boulders, cobbles	0.577	0.2	6435	999	1
boulders, sand/mud	0.847	0.6	165	165	1
boulders, mud	0.56	0.1	377348994	999	0
boulders, pipe	1	11.1	9	9	1
platform reef, sand	0.386	0.1	Very large	999	0
platform reef, mangrove mud	0.944	0.1	3276	999	0
platform reef, tree log	0.937	3.8	26	26	1
platform reef, cobbles	0.449	0.2	13884156	999	1
platform reef, sand/mud	0.545	1.6	3276	999	15
platform reef, mud	0.653	0.1	Very large	999	0
platform reef, pipe	0.858	3.8	26	26	1
sand, mangrove mud	0.07	24.3	4060	999	242
sand, tree log	0.15	17.9	28	28	5
sand, cobbles	-0.051	73.4	23535820	999	733
sand, sand/mud	-0.104	83.2	4060	999	831
sand, mud	0.38	0.1	Very large	999	0
sand, pipe	-0.014	57.1	28	28	16
mangrove mud, tree log	0.111	50	4	4	2
mangrove mud, cobbles	0.487	4.8	165	165	8
mangrove mud, sand/mud	0.222	10	10	10	1
mangrove mud, mud	0.614	0.2	12341	999	1
mangrove mud, pipe	-0.111	50	4	4	2
tree log, cobbles	0.232	33.3	9	9	3
tree log, sand/mud	-0.111	75	4	4	3
tree log, mud	0.635	12.2	41	41	5
cobbles, sand/mud	0.194	19.4	165	165	32
cobbles, mud	0.546	0.1	377348994	999	0
cobbles, pipe	-0.08	44.4	9	9	4
sand/mud, mud	0.556	0.9	12341	999	8
sand/mud, pipe	-0.111	75	4	4	3
mud, pipe	0.57	14.6	41	41	6

Table 68: Values of significance level of ANOSIM pairwise test on five intertidal habitats

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= observed
mangrove, marine hard	0.957	0.1	Very large	999	0
mangrove, brackish hard	0.618	0.1	Very large	999	0
mangrove, marine soft	0.565	0.1	Very large	999	0
mangrove, brackish soft	0.584	0.1	Very large	999	0
marine hard, brackish hard	0.631	0.1	Very large	999	0
marine hard, marine soft	0.588	0.1	Very large	999	0
marine hard, brackish soft	0.841	0.1	Very large	999	0
brackish hard, marine soft	0.377	0.1	Very large	999	0
brackish hard, brackish soft	0.543	0.1	Very large	999	0
marine soft, brackish soft	0.387	0.1	Very large	999	0

Appendix 3: FIGURES

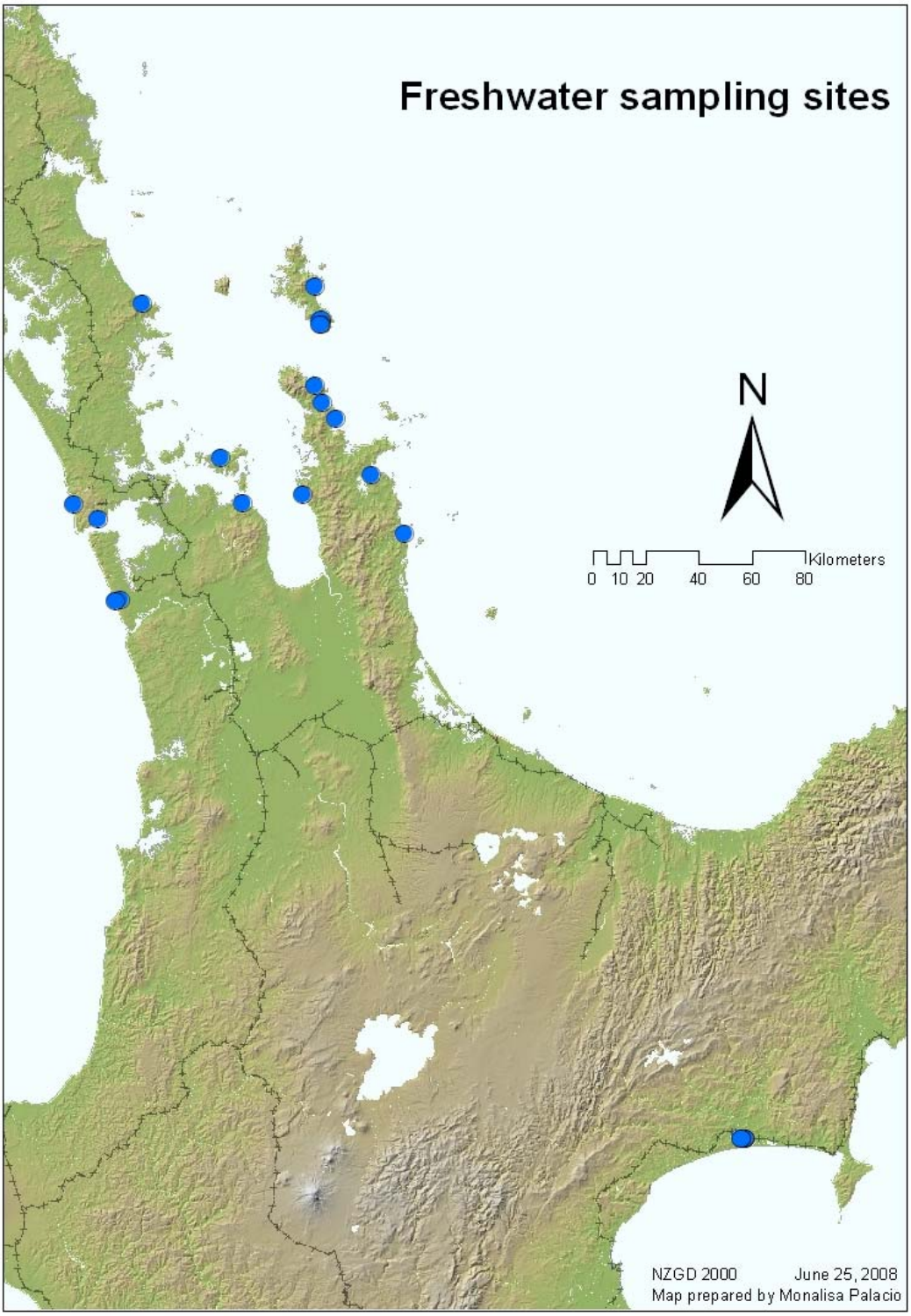


Figure 69: Distribution of biodiversity surveys of 25 fringe-saline sites

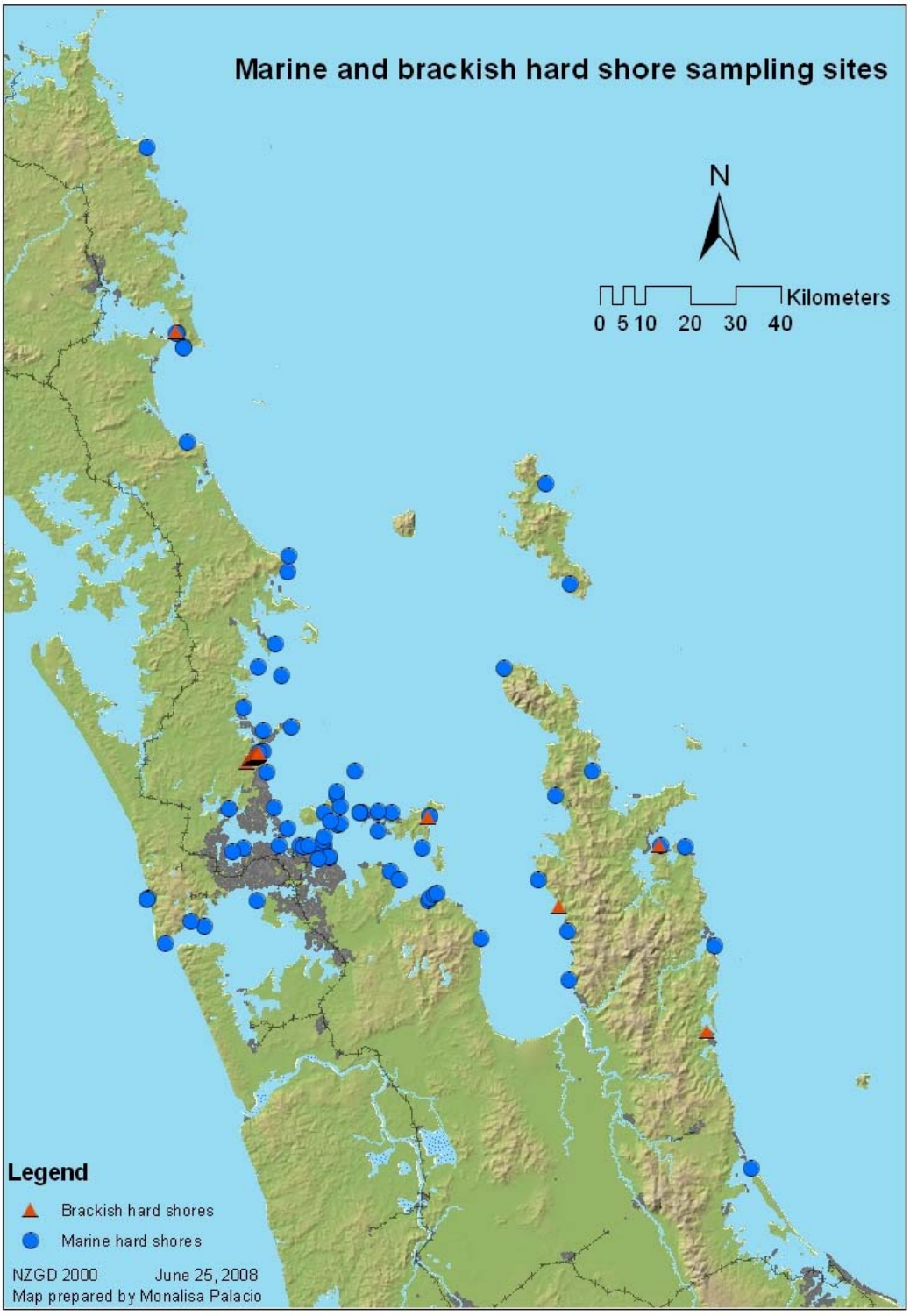


Figure 70: Distribution of biodiversity surveys of 117 marine and brackish hard-shore sites (triangles, brackish hard shores; circles, marine hard shores)

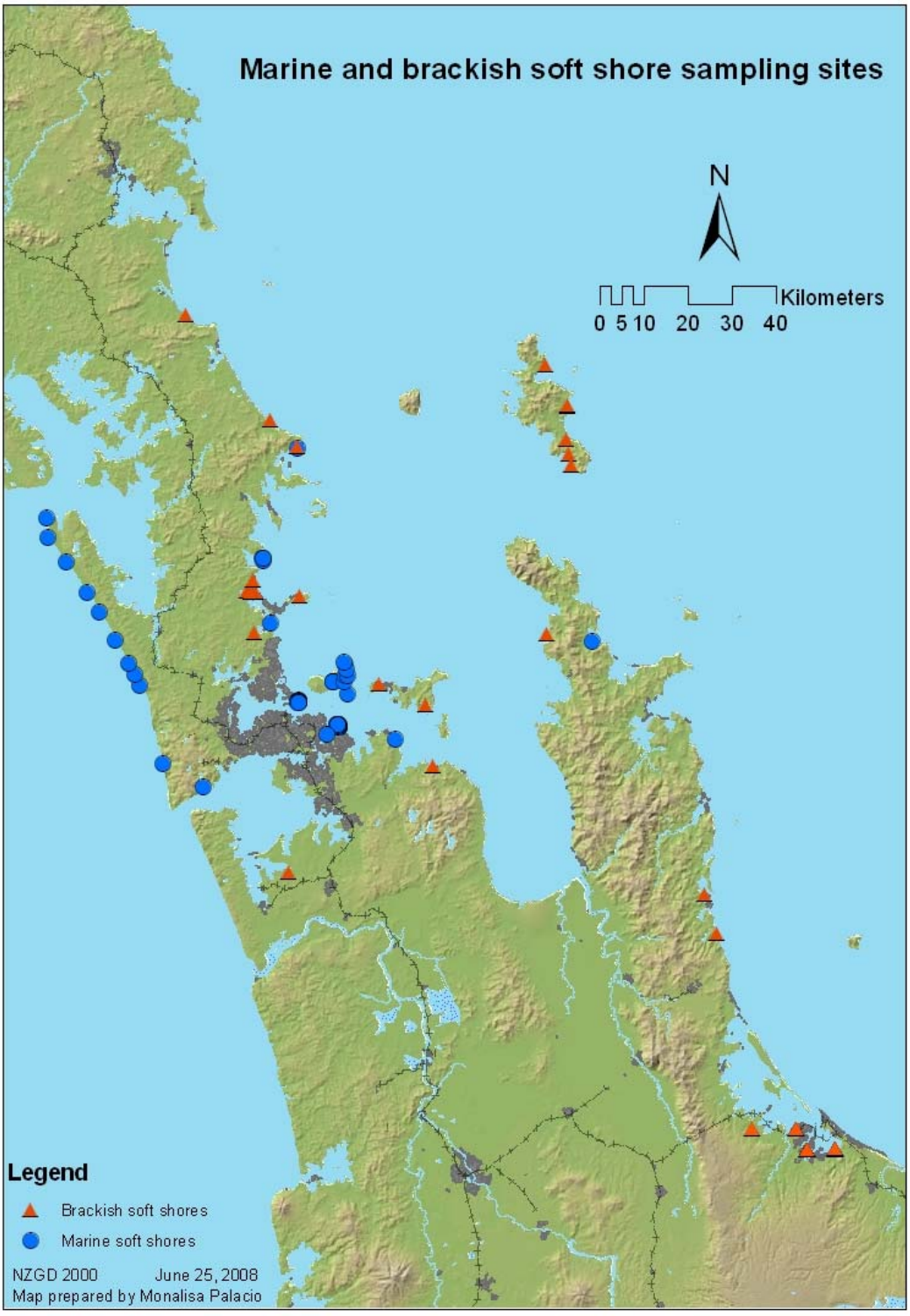


Figure 71: Distribution of biodiversity surveys of 123 marine and brackish soft-shore sites (triangles, brackish soft shores; circles, marine soft shores)

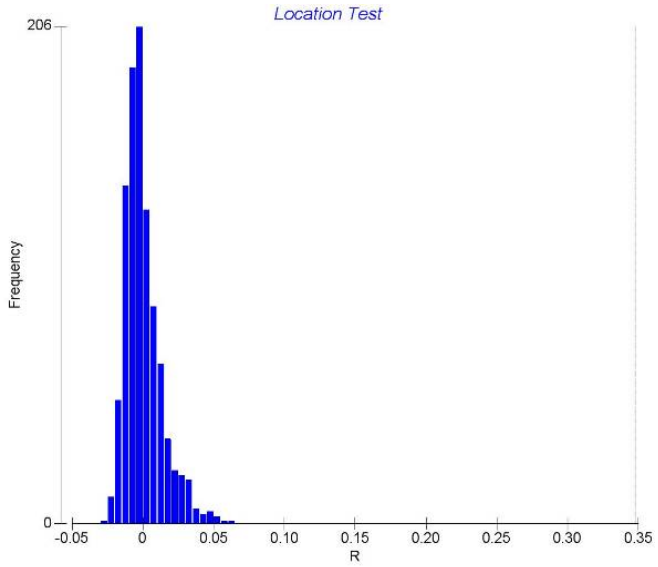


Figure 72: Plot of R Value of pairwise test on OBIS and *Monalisa*

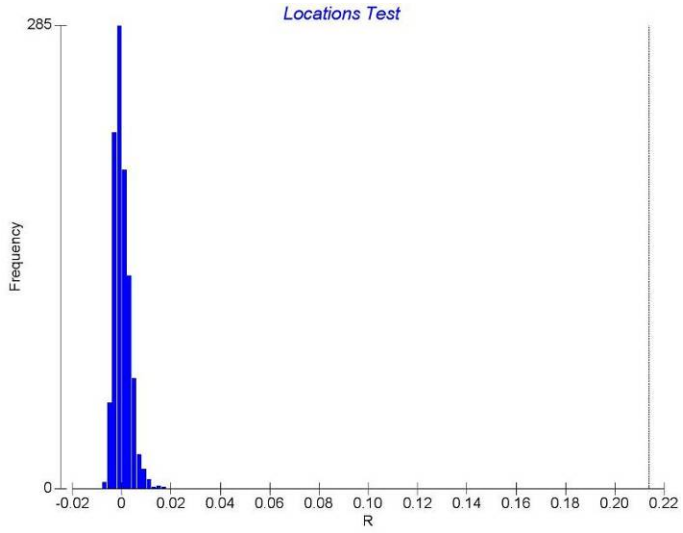


Figure 73: Plot of R Value of pairwise test on Te Papa Mollusca and *Monalisa*

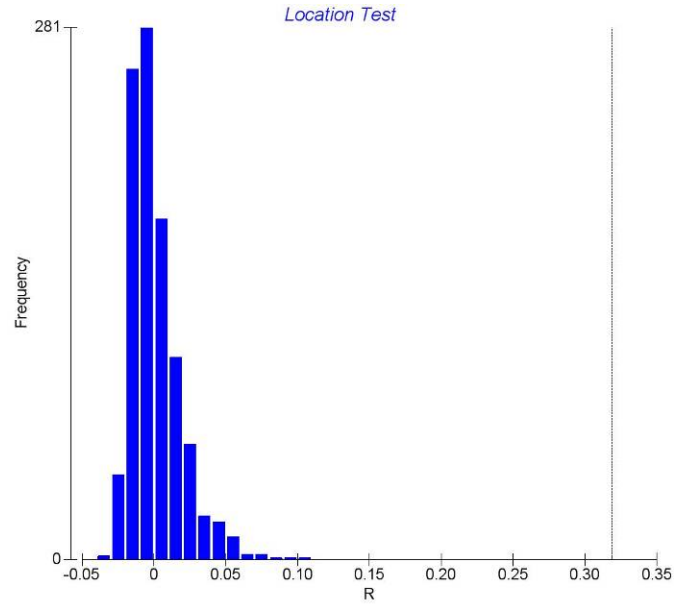


Figure 74: Plot of R Value of pairwise test on ARC Coastal Database and *Monalisa*

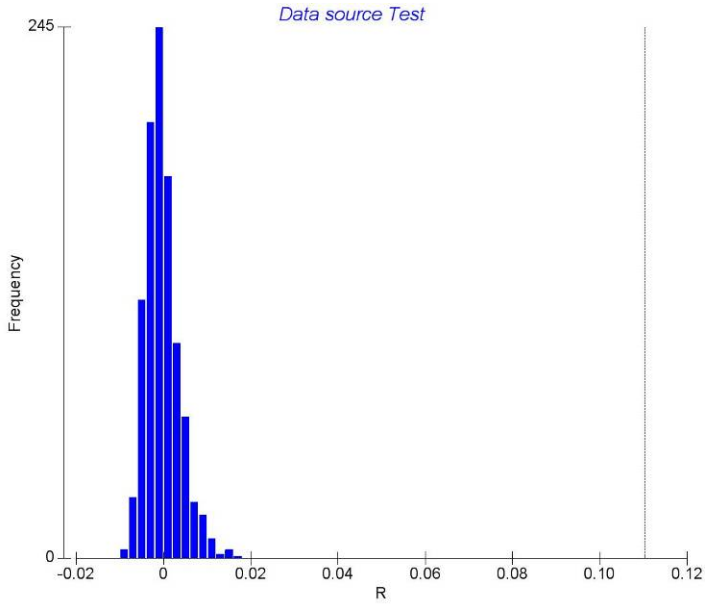


Figure 75: Plot of R Value of all databases and *Monalisa*

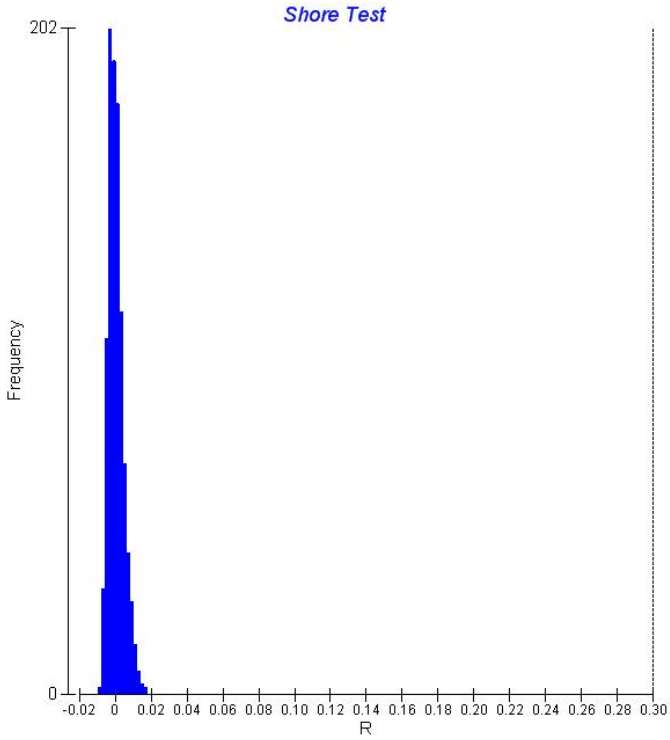


Figure 76: Plot of R value of pairwise test on brackish and marine shores

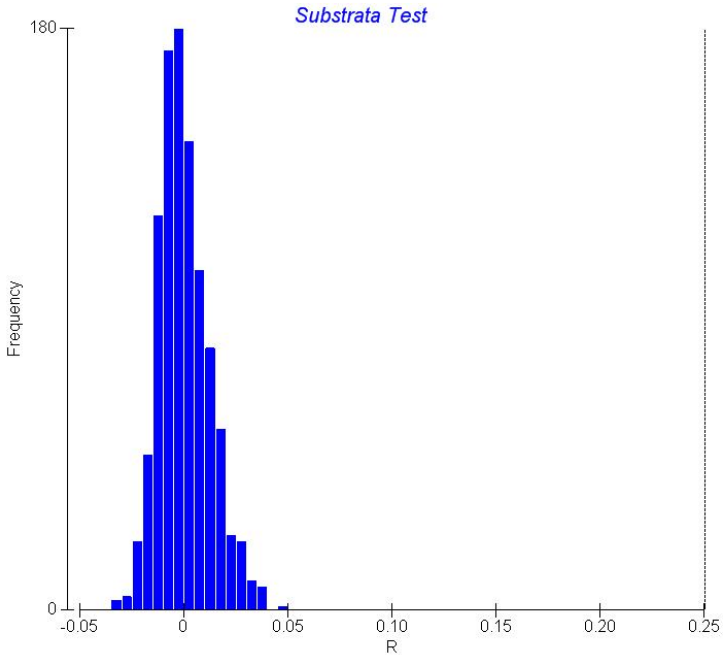


Figure 77: Plot of R value of pairwise test on hard and soft substrata across shore habitat types

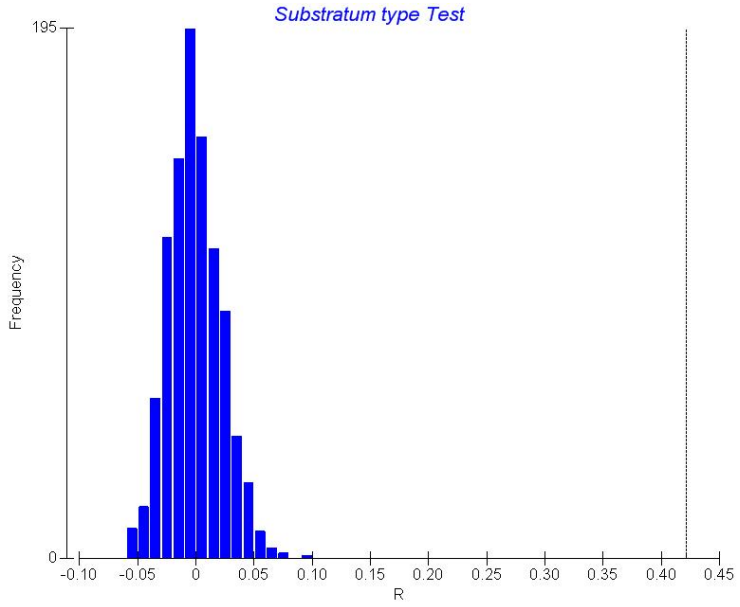


Figure 78: Plot of R value of pairwise test on marine hard and soft substrata

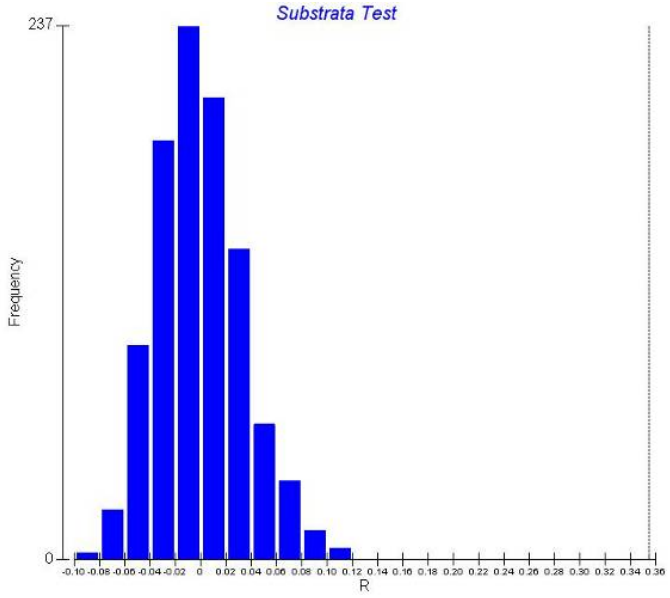


Figure 79: Plot of R value of pairwise test on brackish hard and soft substrata

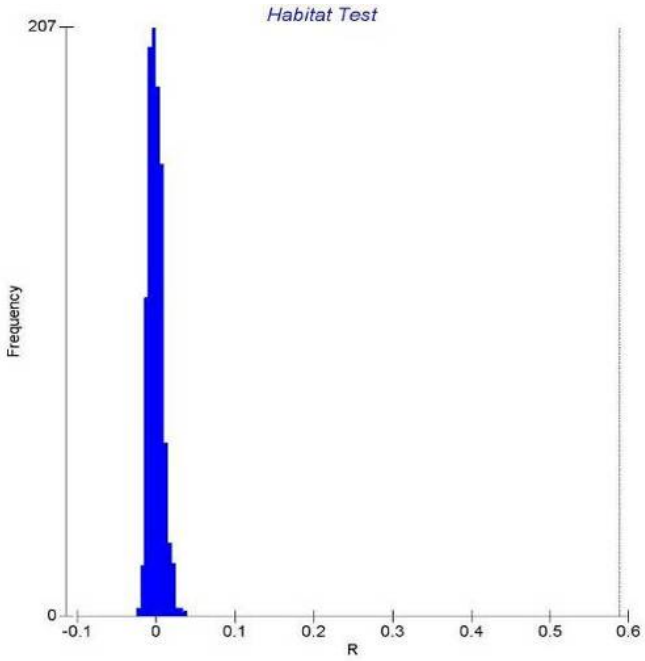
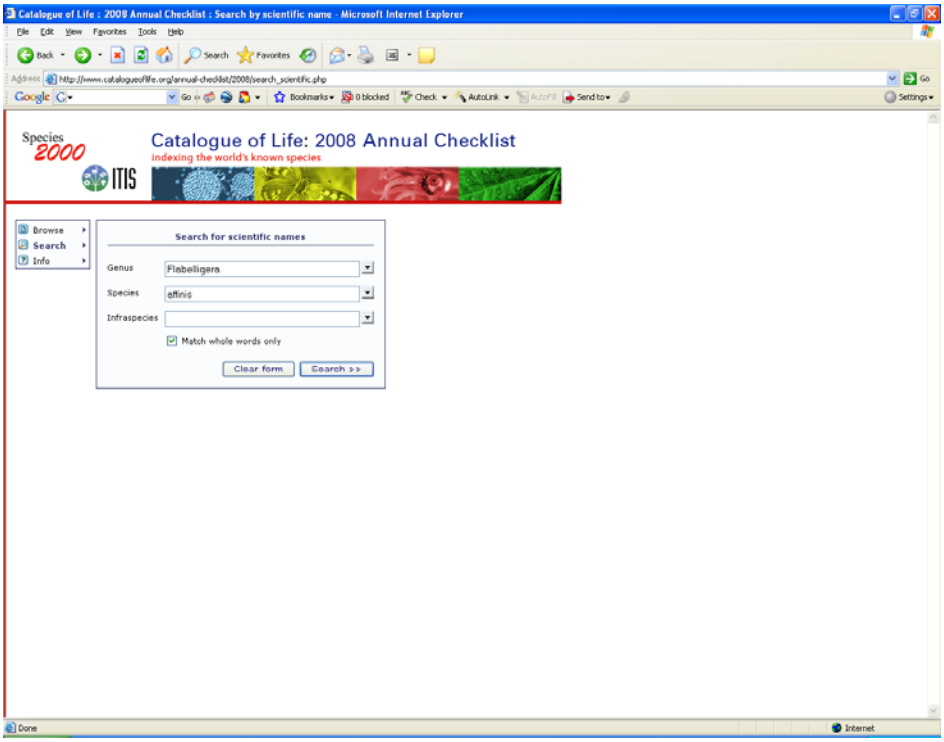


Figure 80: Plot of R value of pairwise test on five intertidal habitats

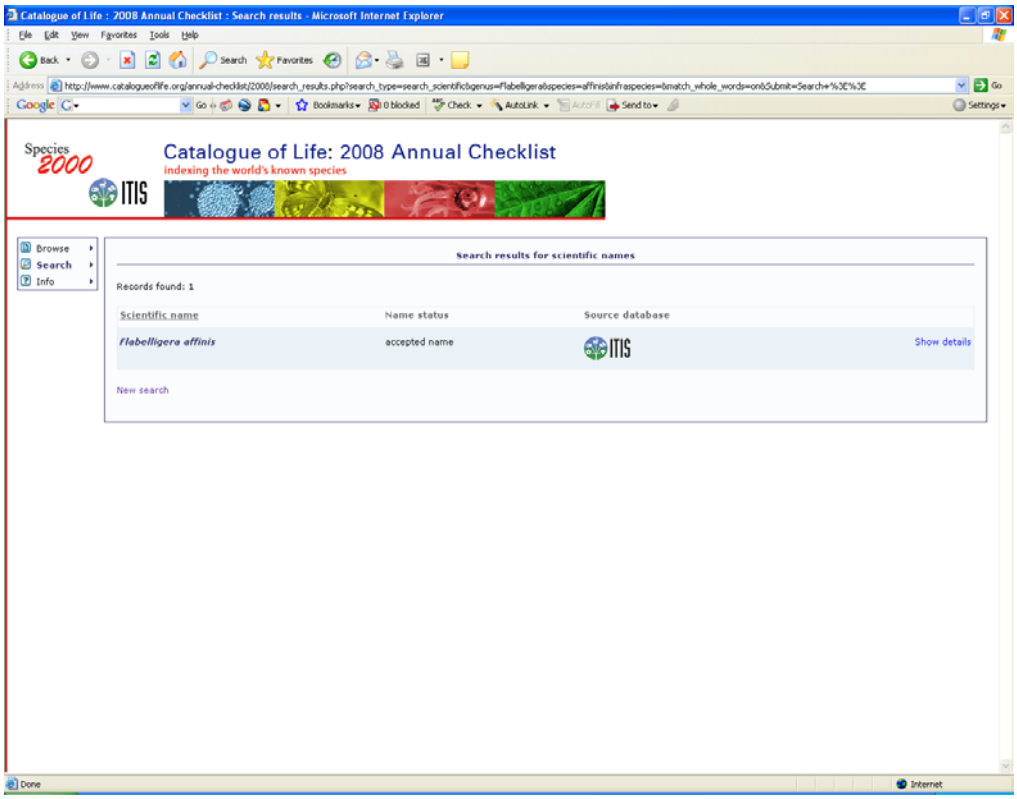
Appendix 4: Database search queries

Sample search for the common chlorhaemid polychaete, *Flabelligera affinis*, in Catalogue of Life.

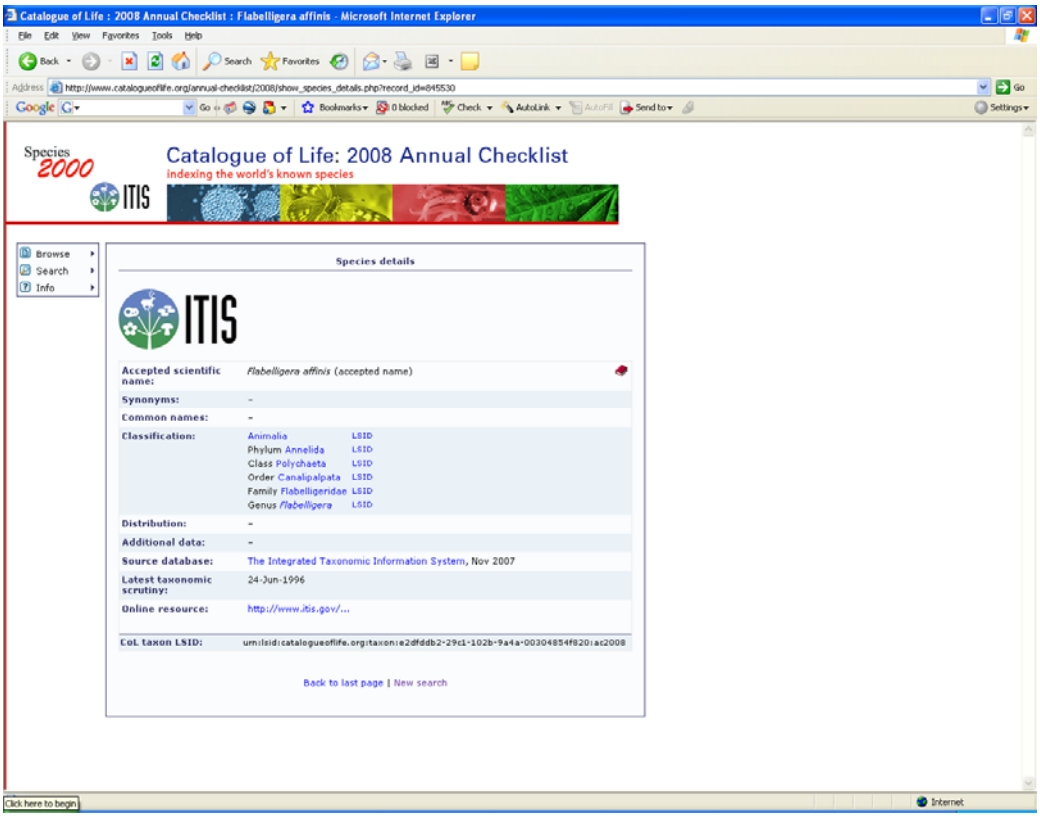
1) Search by species name by typing in "*Flabelligera affinis*".



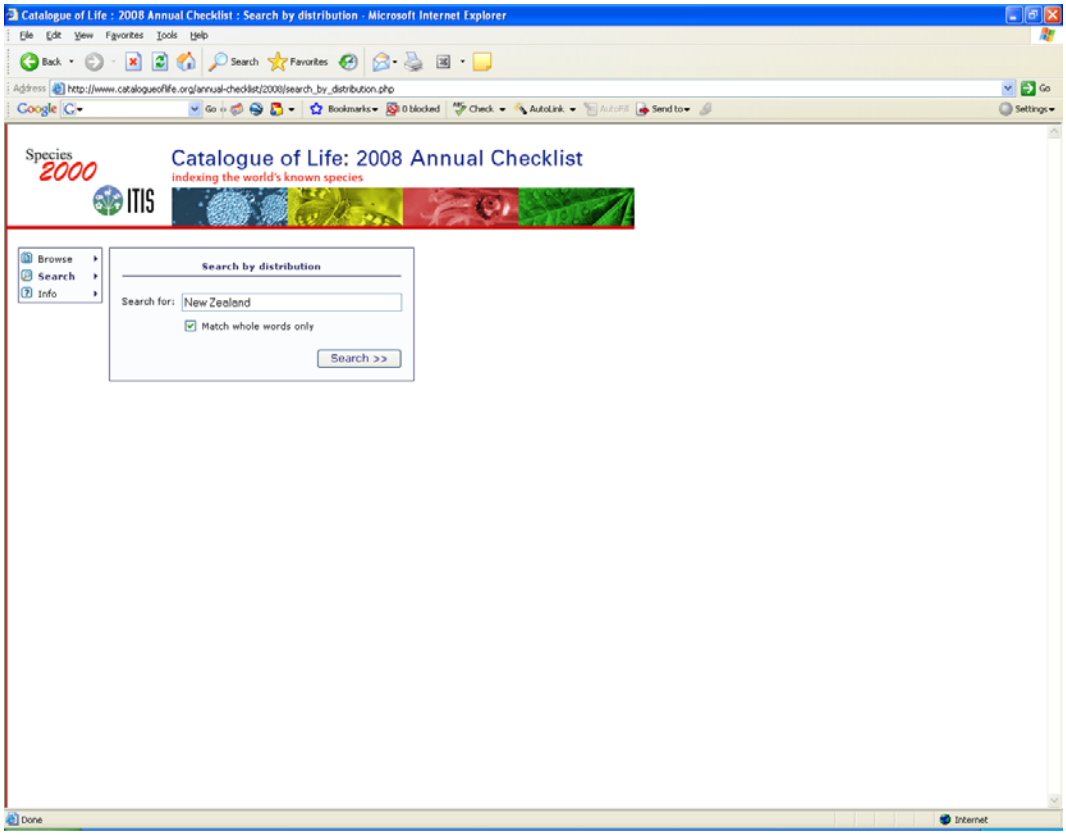
1-1) One species record was found.



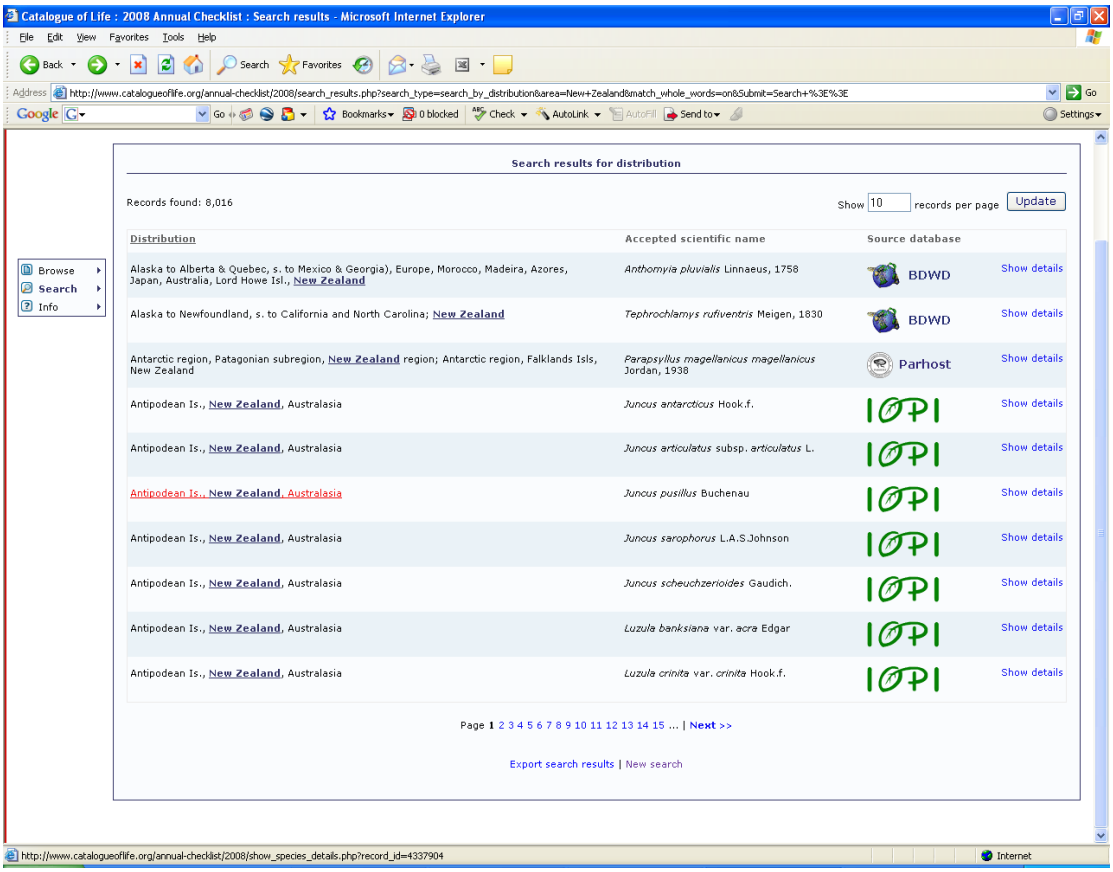
1-2) Species information provided as a result of species search.



2) Search by distribution by typing in “New Zealand”.

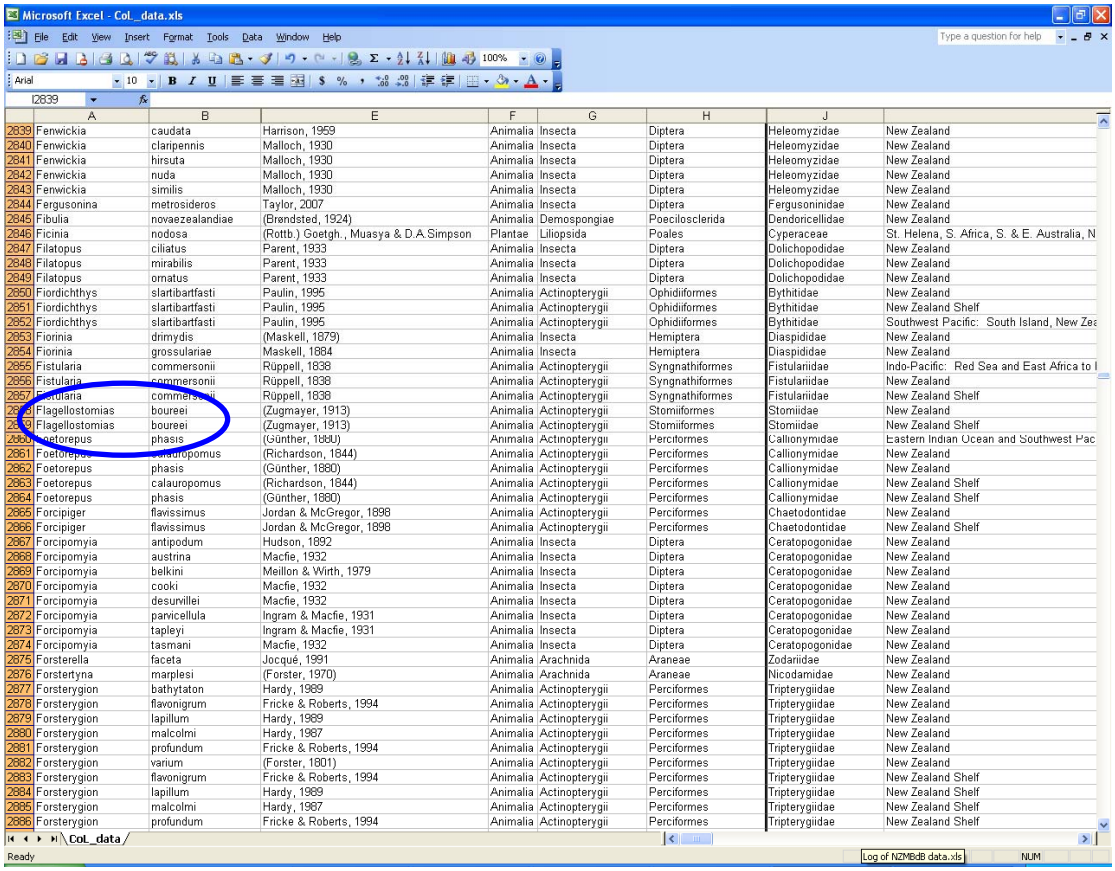


2-1) New Zealand species were provided.



- Found 8,016 species records occurring in New Zealand. This number includes species of all taxa. However the scope of this research is limited on marine taxa.
- “Export search results” button was clicked to enable download of the whole species data.
- A search for “*Flabelligera affinis*” on the downloaded data was not successful. It is not provided in the search results when search by distribution was used.

2-2) A section of the downloaded data showing a species range where "*Flabelligera affinis*" should have been provided.



Microsoft Excel - CoL_data.xls

	A	B	E	F	G	H	J	
2839	Fenwickia	caudata	Harrison, 1959	Animalia	Insecta	Diptera	Heleomyzidae	New Zealand
2840	Fenwickia	claripennis	Malloch, 1930	Animalia	Insecta	Diptera	Heleomyzidae	New Zealand
2841	Fenwickia	hirsuta	Malloch, 1930	Animalia	Insecta	Diptera	Heleomyzidae	New Zealand
2842	Fenwickia	nuda	Malloch, 1930	Animalia	Insecta	Diptera	Heleomyzidae	New Zealand
2843	Fenwickia	similis	Malloch, 1930	Animalia	Insecta	Diptera	Heleomyzidae	New Zealand
2844	Fergusonina	metrosideros	Taylor, 2007	Animalia	Insecta	Diptera	Fergusoninidae	New Zealand
2845	Fibulia	novaezealandiae	(Brøndsted, 1924)	Animalia	Demospongiae	Poecilosclerida	Dendoricellidae	New Zealand
2846	Ficinia	nodosa	(Rottb.) Goetgh., Muasya & D.A.Simpson	Plantae	Liliopsida	Poales	Cyperaceae	St. Helena, S. Africa, S. & E. Australia, N
2847	Filatopus	ciliatus	Parent, 1933	Animalia	Insecta	Diptera	Dolichopodidae	New Zealand
2848	Filatopus	mirabilis	Parent, 1933	Animalia	Insecta	Diptera	Dolichopodidae	New Zealand
2849	Filatopus	ornatus	Parent, 1933	Animalia	Insecta	Diptera	Dolichopodidae	New Zealand
2850	Fiordichthys	slartibartfasti	Paulin, 1995	Animalia	Actinopterygii	Ophidiiformes	Bythitidae	New Zealand
2851	Fiordichthys	slartibartfasti	Paulin, 1995	Animalia	Actinopterygii	Ophidiiformes	Bythitidae	New Zealand Shelf
2852	Fiordichthys	slartibartfasti	Paulin, 1995	Animalia	Actinopterygii	Ophidiiformes	Bythitidae	Southwest Pacific: South Island, New Zea
2853	Fiorinia	drimydis	(Maskell, 1879)	Animalia	Insecta	Hemiptera	Diaspididae	New Zealand
2854	Fiorinia	grossulariae	Maskell, 1884	Animalia	Insecta	Hemiptera	Diaspididae	New Zealand
2855	Fistularia	commersonii	Rüppell, 1838	Animalia	Actinopterygii	Syngnathiformes	Fistularidae	Indo-Pacific: Red Sea and East Africa to I
2856	Fistularia	commersonii	Rüppell, 1838	Animalia	Actinopterygii	Syngnathiformes	Fistulariidae	New Zealand
2857	Fistularia	commersonii	Rüppell, 1838	Animalia	Actinopterygii	Syngnathiformes	Fistulariidae	New Zealand Shelf
2858	Flagellostomias	boureei	(Zugmayer, 1913)	Animalia	Actinopterygii	Stomiiformes	Stomiidae	New Zealand
2859	Flagellostomias	boureei	(Zugmayer, 1913)	Animalia	Actinopterygii	Stomiiformes	Stomiidae	New Zealand Shelf
2860	Foetorepus	phasis	(Günther, 1880)	Animalia	Actinopterygii	Perciformes	Callionymidae	Eastern Indian Ocean and Southwest Pac
2861	Foetorepus	calauropomus	(Richardson, 1844)	Animalia	Actinopterygii	Perciformes	Callionymidae	New Zealand
2862	Foetorepus	phasis	(Günther, 1880)	Animalia	Actinopterygii	Perciformes	Callionymidae	New Zealand
2863	Foetorepus	calauropomus	(Richardson, 1844)	Animalia	Actinopterygii	Perciformes	Callionymidae	New Zealand Shelf
2864	Foetorepus	phasis	(Günther, 1880)	Animalia	Actinopterygii	Perciformes	Callionymidae	New Zealand Shelf
2865	Forcipiger	flavissimus	Jordan & McGregor, 1898	Animalia	Actinopterygii	Perciformes	Chaetodontidae	New Zealand
2866	Forcipiger	flavissimus	Jordan & McGregor, 1898	Animalia	Actinopterygii	Perciformes	Chaetodontidae	New Zealand Shelf
2867	Forcipomyia	antipodum	Hudson, 1892	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2868	Forcipomyia	austrina	Macfie, 1932	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2869	Forcipomyia	belkini	Meillon & Wirth, 1979	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2870	Forcipomyia	cooki	Macfie, 1932	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2871	Forcipomyia	desurvillei	Macfie, 1932	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2872	Forcipomyia	parvicellula	Ingram & Macfie, 1931	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2873	Forcipomyia	tapleyi	Ingram & Macfie, 1931	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2874	Forcipomyia	tasmani	Macfie, 1932	Animalia	Insecta	Diptera	Ceratopogonidae	New Zealand
2875	Forsterella	faceta	Jocqué, 1991	Animalia	Arachnida	Araneae	Zodariidae	New Zealand
2876	Forstertyna	marplesi	(Forster, 1970)	Animalia	Arachnida	Araneae	Nicodamidae	New Zealand
2877	Forsterygion	bathytaton	Hardy, 1989	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2878	Forsterygion	flavonigrum	Fricke & Roberts, 1994	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2879	Forsterygion	lapillum	Hardy, 1989	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2880	Forsterygion	malcolmi	Hardy, 1987	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2881	Forsterygion	profundum	Fricke & Roberts, 1994	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2882	Forsterygion	varium	(Forster, 1801)	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand
2883	Forsterygion	flavonigrum	Fricke & Roberts, 1994	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand Shelf
2884	Forsterygion	lapillum	Hardy, 1989	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand Shelf
2885	Forsterygion	malcolmi	Hardy, 1987	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand Shelf
2886	Forsterygion	profundum	Fricke & Roberts, 1994	Animalia	Actinopterygii	Perciformes	Tripterygiidae	New Zealand Shelf