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Intertidal Life Around the Coast of the Waitakere Ranges, Auckland

January 2004 Technical Publication 298

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Auckland Regional Council
Technical Publication No. 298, January 2004
ISSN 1175–205X ISBN 1–877353–14–0
Printed on recycled paper

www.arc.govt.nz

INTERTIDAL LIFE AROUND THE COAST OF THE WAITAKERE RANGES, AUCKLAND

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Prepared for
Auckland Regional Council
2002

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Foreword:

Why is Auckland Regional Council publishing this Report?

The Auckland Regional Council was given the opportunity to publish this report on the intertidal plants and animals of the Waitakere Ranges Coast by Bruce Hayward and Margaret Morley. The report is the result of a considerable amount of effort on the part of the authors and a wider group of participants and contributors during field-work, taxonomic identification, analysis and presentation of the information. The report presents the findings of this body of work accompanied by comprehensive species and habitat lists, coupled with an extensive array of handsome figures, illustrations and maps.

The Council considers that the report provides a valuable information resource for those interested in Auckland's coastal ecology and biodiversity. The Council greatly appreciated the opportunity to make this valuable body of work available to the community through contribution of only the comparatively minor costs of formatting and printing.

Objective findings versus subjective viewpoint.

The bulk of the report presents objective findings of the survey work. However, it also includes several sections where the authors' present their personal views on how the information can be used to identify areas they believe are deserving of protection for biodiversity and educational values. It should be recognized that the views on the appropriate level of protection, and where along the Waitakere Ranges coast this should be applied, do not necessarily reflect those of the Auckland Regional Council. The authors' views remain in the report to provide a useful platform for continued discussion and debate by the many parties interested in the ecological future of this special coastal area.

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1.0 SUMMARY

This report includes general descriptive accounts and illustrations of the various intertidal communities that surround the Waitakere Ranges, to accompany a coloured map which shows their distribution. Mapping of the intertidal shore of the Waitakere Ranges is based on a combination of its substrate (e.g. lava, conglomerate, sandstone, mobile or stable cobbles, sand, mud), vegetation (e.g. salt marsh, mangrove forest, seagrass, bull kelp), and dominant visible animals (e.g. mud snails, horn shells, cockles, pipi, wheel shells, spionid worms, sponge gardens). Zonation patterns of the dominant rocky-shore-inhabiting organisms are presented in 13 transects spread around the coast and illustrate the effects of changing exposure to waves and storms. The six major zones recognised going down the rocky shore are: maritime lichen zone; bare rock zone; periwinkle zone; barnacle zone; mussel, tube-worm and coralline zone; and subtidal fringe seaweed zone. Data on habitat and geographic distribution around the Waitakeres' coast are provided for every species.

Five-hundred and ninety-eight species of plants and animals (498 living, 100 dead or washed up from offshore, mostly shells) are recorded from the intertidal zone around the coast of the Waitakere Ranges, west Auckland (from Muriwai to Big Muddy Creek). This total includes: 165 species of gastropod, 133 seaweeds, 80 bivalves, 28 sponges, 23 polychaete worms, 23 crabs, 18 barnacles, 16 salt marsh plants, 14 mangrove-dwelling lichens, 13 nudibranchs, 13 chitons, 11 isopods, 9 tidal pool fish, 9 echinoderms, 9 sea anemones, and 6 sea squirts. Total species numbers are under-reported for some groups that have not been studied in detail. Remarkably similar levels of biodiversity (live plus dead) are recorded from the exposed west coast of the Waitakere Ranges (409 species, 292 live species) as on the more sheltered Manukau Harbour coast (407 species, 335 live species). The biota living in or washed up intertidally around the Waitakeres' coast has similar diversity to that recorded from elsewhere on the North Island's west coast, but somewhat lower diversity to that on the North Island's east coast. The difference is attributed to the lower numbers of warm-water species (living under the influence of the warm East Auckland Current) and the lower number of human-assisted introduced species on the west coast. Although no species appear to be restricted to the Waitakeres' coast, 34 species are identified that are more characteristic of the Waitakere Ranges and west coast of the North Island than the east. This study provides the first west coast records of 9 mollusc species. Eleven currently recognised species have their type localities from around the Waitakeres' coastline.

Multivariate analysis of our survey data (presence/absence; qualitative abundance estimates) on the distribution of organisms around the entire coast of the Waitakere Ranges, identifies three distinct biotic regions – the exposed west coast; the rocky outer north Manukau Harbour coastline (Whatipu – Puponga Pt.); and the mixed sandstone reef - soft sediment inner north Manukau Harbour coastline (Kakamatua – Armour Bay). If protected areas of coastline are to be established to protect, in perpetuity, the best representative examples of the broad diversity of the Waitakeres' intertidal ecosystems in their natural state, then examples of all three biotic regions will need to be selected. Through analysis of our data, we identify five potential coastal sections that have the greatest biodiversity and habitat diversity with examples from each biotic region: Te Waharoa coast; Anawhata coast; Destruction Gully coast; Puponga Pt.; Lawry Pt. coast. Four coastal sections with high educational values are identified: Maori Bay; Piha; west Huia Bay; Armour Bay.

The Waitakere Ranges have a dynamic coastline, particularly on the exposed west coast, where natural factors such as shifting sand, sea water temperature, plankton blooms, and the lottery of successful spat fall and recruitment, appear to have a greater impact on the intertidal biota than human-related factors, such as harvesting, pollution, disease, increased sediment runoff from the land, and introduced marine organisms.

While they are difficult to quantify, some impacts of human activities that are recognisable include:

a. the disappearance, or greatly reduced abundance (particularly on the north Manukau Harbour coastline), of many (~20 species since the 1950s) longer lived invertebrates (mostly carnivorous gastropods) which produce small numbers of offspring with limited dispersal abilities; low numbers of mature paua;

b. lower densities of kina at more accessible localities; and

c. explosive invasion by the introduced Pacific oyster of some more sheltered rocky shores on the inner north Manukau Harbour coast (e.g. Puponga Pt., Mill Bay), greatly reducing the recreational accessibility of these shores.

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2. INTRODUCTION

2.1 Study area

The coastal study area reported on here, consists of 50 km of coastline extending from the south end of Muriwai Beach in the north, to Parau at the head of Big Muddy Creek in the southeast (Fig. 1). About 50% of this coastline faces the exposed Tasman Sea, dominated by a mix of mobile sand beaches and rugged rocky shores. The remaining 50% forms the more sheltered northern shores of the Manukau Harbour, with a mix of muddy sand flats, sheltered boulder beaches, extensive shore platforms, rocky shores, and a large area of mangrove forest. The area studied and mapped covers the full width of the intertidal zone from extreme low water spring level up to extreme high water spring (extreme tidal range ~4 m) and the splash zone above.

2.2 Previous work

Although Lucy Cranwell and her colleagues made extensive collections of seaweeds and lichens at Anawhata, Te Henga and Piha in the 1930s and 1940s, the earliest documented studies on the intertidal algae of the Waitakeres' coast and their tidal zonation were undertaken soon after the second world war by Prof. Val Chapman and some of his students at the University of Auckland (e.g. Beveridge, 1948; Beveridge & Chapman, 1950; Butler, 1948; Trevarthen, 1952). Early studies on the intertidal invertebrates and their zonation was undertaken in the 1950s and 1960s by Prof. John Morton and some of his students, but only reported later as sections in general accounts of the intertidal ecology of Auckland shores (e.g. Morton & Miller, 1968; Morton, 1979; 1993; Cometti & Morton, 1985).

Morton & Miller (1968) include several descriptions of various rocky shore habitats at Piha, with diagrams of zoning organisms in a deep rock pool (Fig. 64), on a shaded rock face (Fig. 94), in a North Piha cave (Fig. 96), on the exposed rocky shore of Lion Rock (Fig. 100), and on clumps of mussels (Fig. 101). Cometti & Morton (1985, pp. 60-63) have a short chapter summarising the dominant intertidal life of Piha and the West Coast. Morton (1993) gives a general account of the major intertidal biota on exposed rock shores of the Waitakeres' west coast, and Ayling (1976) gave a brief account of the intertidal biota of a cave at Maori Bay.

Members of the Conchology Section of the Auckland Institute and Museum compiled a survey of molluscan fauna in the Manukau Harbour from 1952-1963 (unpublished). The list includes 14 species not found (live or dead) in the current survey, and also 16 additional species that appear to have been more frequent then than now.

One of the most detailed studies on aspects of the intertidal life on the Waitakeres' coast was undertaken by Penelope Luckens (1976), who documented the succession and seasonality of the times of recruitment of the major intertidal organisms on a reef at North Piha.

Until now, the most extensive attempt to document and map the intertidal habitat and biota around the Waitakere Ranges has been that of Harding et al. (2000). Initiated in part by the die-off of bull kelp in 1998, the coastline from Muriwai to Karekare was videoed from a helicopter for the Auckland Regional Council, Ministry of Fisheries and Department of Conservation, in the winter of 1999, as an experiment to investigate the feasibility of this method for monitoring changes in intertidal communities. The authors' analysis of the video footage showed that it could be used to map the then, much reduced, extent of bull kelp and the general landform character of the intertidal zone, but was of limited value for monitoring other elements of the biota (Harding et al., 2000). Some of these problems relate to the conditions under which some of the videos were shot – not spring low tide, swells and shade due to winter sunlight direction (Roger Grace, pers. comm.). The difficulties of using the video are illustrated by some of the incorrect rock type assignments based upon this method in their figure 2. Their habitat map (figure 19) is primarily based on substrate type (rock, boulders, sand) and rocky shore profile (continuous, stepped or broken cliff or platform) identified in the video and ground checked at accessible localities. The authors recorded quantitative quadrat data in rocky shore transects through the intertidal zone at nine rocky shore localities, with their biodiversity records limited to the 27 common zoning species encountered.

Although NIWA scientists have been undertaking considerable research on the soft bottom benthos, sediment and tidal dynamics in the Manukau Harbour, most of these studies have been concentrated at sites near the airport or away from our study area. One research project which included Big Muddy Creek study sites, looked at the burrow systems of the mud crab *Helice crassa* (Morrisey et al., 1999).

Associated with a 1993 MoFish closure and rahui of Karekare Beach to shellfish (and other non-fish biota) harvesting, the Karekare Residents and Ratepayers Trust, co-ordinated by John Edgar, has been undertaking annual photographic monitoring of permanent transects across the rocks at both the south and north ends of Karekare Beach since then (Anne Grace, pers. comm.). At the present time this work is being analysed and written up, but clearly shows the dominant role of natural environmental variables in determining the abundance, size and composition of the intertidal biota (Grace, 1997; pers. comm.; Astley, 1997).

More specific studies that have included the intertidal coast of the Waitakere Ranges as one or more of their study sites have included those on bull kelp (South & Hay, 1979), the green seaweed *Codium fragile* (Trowbridge, 1996), a small sea slug *Stiliger felinis* (Trowbridge, 1994), and the mud crab *Helice crassa* (Morrisey et al., 1999).

We know of no published subtidal studies on the inner shelf seafloor biota off the exposed west coast of the Waitakere Ranges. In the subtidal Manukau Harbour, adjacent to the study area, Powell (1937), Hulme (1961) and Grange (1979) have reported on the biota obtained in dredge hauls of channel sand that were taken as part of larger reconnaissance surveys of the Manukau Harbour's soft sediment benthos. In recent years Western Underwater Research has undertaken scuba studies of the biota in Waterfall Bay, near Destruction Gully. The sediments of the Manukau Harbour have been mapped by Gregory et al. (1994). The most detailed account of the harbour's hydrography is given in Bell et al. (1998).

The dynamics and composition of some of the west coast sand beaches have been studied in a number of University of Auckland Masters degree theses (e.g. Delgrosso, 1971; Donohoe, 1998; Hamill, 1979; Hamill & Ballance 1985; King, 2001; Mavoa, 1998; Rooker, 1995; Yock, 1973). Williams (1977) documented the formation and progradation of the Whatipu sand flat up until 1976 and Woolley (1994) provided an update in his MSc thesis. Sand dune vegetation at Piha was the subject of an early MSc thesis (Lush, 1948; Williamson, 1953). Esler (1975) revisited and updated the account of the Piha dune vegetation and also documented the dune vegetation to the south at Whatipu and Karekare (Esler, 1974). Moss (1998) redescribed the dune vegetation at Karekare. The geology of the coastal rocks of the study area is summarised in maps by Hayward (1983) and Kermode (1992). Gregory (1978) documented the abundance of plastic granules washed up on a number of Waitakere coastline beaches.

2.3 Survey methods

All accessible sections of the intertidal coastline were surveyed on foot by the authors during 30 days of field work between January 1998 and March 2002 (Appendix 1). The coastline was subdivided into 24 separate sections (Appendix 3), each of which was of sufficiently small size to enable a thorough survey during one low tidal cycle. Each survey was undertaken on the monthly spring tide, when low tide was in the range 0-0.3 m (mean low tide is 0.8 m and low tide range is 0-1.5 m). Each survey consisted of 3-4 hours of detailed examination of all the intertidal habitats present, recording all the living taxa found, assessing their relative abundance (see Appendix 3), and also recording the presence of any additional dead taxa observed. Specimens of taxa that needed microscopic or other detailed study for identification were taken back to the laboratory, as were samples of shell sand from beneath low tide boulders, and microscopic shells washed off the underside of boulders or washed off seaweeds, including turfs and holdfasts. Bull kelp (*Durvillaea antarctica*) holdfast communities were not included in the survey. The biotic composition of the infauna in soft sediment habitats was periodically surveyed by digging and sieving, especially in Huia Bay.

The distribution of macrohabitats, rocky substrates and distinctive macrocommunities and key organisms was plotted on maps in the field and later traced onto a digital map using Coreldraw software. This map was later transferred onto GIS software by ARC staff and is published at the end of this report.

2.4 Transect methods

The sites of thirteen transects were chosen around the Waitakere Ranges' coastline, to illustrate the tidal and geographic distribution of the dominant zoning organisms on hard rocky shores. Transects were oriented perpendicular to the local shoreline and extended from the highest extent of intertidal biota in the splash zone (usually periwinkles) down to spring low tide level. The transect profile was constructed using a tape measure for horizontal distances, ruler for vertical increments, and a spirit level and long extendible pole to determine horizontal levels. The dominant zoning organisms were determined within ~5 m either side of the transect, their dominant and total tidal ranges documented, and later transferred onto the profiles. This rapid transect method was deemed to give a better overall representation of the intertidal biotic zones present on a shore, than the time-consuming detailed transect and quadrat method of quantitative survey of narrow belts, that may be better suited to seasonal or annual monitoring studies.

2.5 Biodiversity and Specimens

Recent scientific name changes of the more common intertidal species are listed in Appendix 2.

A list of species recorded from the intertidal coast of the Waitakere Ranges is presented in Appendix 3. It is almost entirely based on the results of this survey, but some additional historical records of rarer species have been added from publications and from specimens lodged in the Auckland War Memorial Museum collections (Marine and Botany Departments). Preserved reference specimens of all recorded invertebrate taxa have been placed in the collections of the Marine Department, Auckland War Memorial Museum, and dried reference specimens of many seaweeds have been placed in the herbarium of the Botany Department of the Auckland War Memorial Museum.

This species list is not exhaustive and is clearly weak in some areas, such as polychaete worms, sponges, sea squirts and intertidal fish. There has been no attempt to collect and systematically identify a number of groups of smaller organisms, such as amphipods, isopods, ostracods, bryozoa, foraminifera or marine microalgae. The present list is most complete in groups such as molluscs, seaweeds and echinoderms. A comprehensive species list is likely to result in a census of nearly 1000 species.

3. INTERTIDAL COMMUNITIES

3.1 Exposed west coast rocky shores

Approximately half the length of the west coast of the Waitakere Ranges, between Muriwai and Whatipu, consists of rocky shore. The substrate is mostly volcanic sandstone and grit (Tirikohua and Nihotupu Formations) in the north, between Muriwai and Te Waharoa Bay. South of Te Waharoa, most of the rocky shoreline is composed of somewhat harder volcanic conglomerate (Piha Formation). Even harder, although more jointed dikes, irregular intrusions or flows of basalt and andesite (Waiatarua and Lone Kauri Formations), form localised areas cutting through the background sandstone, grit, and conglomerate of the cliffs and shore platforms. Around the base of some of the cliffs and edges of the shore platforms are large stable, angular boulders of conglomerate or lava, which seldom if ever move, even in storms.

The cliffs, rock platforms, and large angular boulder shores are all colonised by a similar, zoned succession of plants and animals from the splash zone down to low water spring level. High in the splash zone, vascular plants such as flax, taupata and ice plant give way to bare rock and grey, green and yellow splashes of foliose and crustose lichens. Slightly lower, in a bare rock zone stretching from high tide level to 2-4 m above high tide are numerous periwinkles - mostly the small, blue-grey *Nodilittorina antipoda*, and fewer larger, brown *N. cincta*. Sometimes grazing on shaded vertical faces in the lower splash zone are the high-arched limpet *Notoacmea pileopsis*.

Closely approximating the high tide level is a narrow band dominated by the barnacle *Chamaesipho brunnea* and sometimes accompanied by a broader band of the black stubbly lichen *Lichina confinis* on harder rock substrates (not sandstones).

The rocks between high and mid tide levels have a dominant covering of the small, close-packed barnacle *Chamaesipho columna*, sometimes joined on flat-lying platforms and around tidal pools by a few Pacific oysters *Crassostrea gigas* and the green, seasonal sea lettuce *Ulva lactuca*. Frequent ornate limpets *Cellana ornata*, graze microalgae on the rocks at this and lower levels and are joined between mid and low tide levels by more frequent *Cellana radians* and the snakeskin chiton *Sypharochiton pelliserpentis*.

A zone of the larger, ribbed barnacle *Epopella plicata*, often accompanied by dense patches of the small black flea mussel *Xenostrobus pulex*, encrust rocks around mid tide level. The oyster borer *Lepsiella albomarginata*, which preys on these dense beds of barnacles, is most abundant around this level also.

Between mid and low tide levels there is commonly a dense zone of the larger, green-lipped mussel *Perna canaliculus*. Often closely associated with these mussels are their predators – the white rock shell *Dicathais orbita* and the orange reef star *Stichaster australis*.

Below mid tide, seaweeds become more prominent and form identifiable zones. The highest of these, just below mid tide level, usually consists of the red seaweeds *Gigartina laingii* and *G. alveata*. Also sometimes present just below mid tide level are patchy bands of the shelly tube worm *Spirobranchus cariniferus* and the sand tube worm *Neosabellaria kaiparaensis*.

Between neap and spring low tide levels, the rock surface is mostly coated in the calcareous pink algae *Corallina* paint. Commonly grazing over this surface is the small coralline-encrusted limpet *Patelloida corticata*, and on the most exposed places by the larger chiton *Plaxiphora obtecta*. The huge, tall barnacle *Megabalanus tintinnabulum* is also prominent in this zone on some of the most exposed shores. Of the seaweeds, the most common are *Pachymenia lusoria*, *Gigartina marginifera*, *G. atropurpurea*, *Carpophyllum maschalocarpum*, *Nothogenia fastigata*, *Melanthalia abscissa* and *Arthrocardia corymbosa*. In most places along the west coast the dominant low tidal and shallow subtidal seaweed is the huge bull kelp *Durvillaea antarctica*. The orange golf ball sponge *Tethya aurantium* is sometimes common in cracks and crevices around low tide level with bright encrusting crimson and orange sponges present beneath the kelp canopy or in shaded guts in a few places.

The most common crabs on these exposed intertidal rocky shores are the large purple rock crab *Leptograpsus variegatus*, the fast-moving marbled rock crab *Hemigrapsus edwardsi*, and at and below low tide level the red rock crab *Plagusia chabrus*.

Common on the lower half of the rocky shore, particularly adjacent to sand is the brightly coloured purple, pink, and lime green camouflaged anemone *Isocradactis magna*.

3.2 Exposed west coast cobble beaches

In a few places, mostly around mid and high tide level, on northern shores (e.g., south Maori Bay, south Collins Bay, Te Waharoa Bay, north O'Neill Bay), there are mobile cobble and pebble beaches, where the clasts are well rounded and turn and grind against each other with the breaking swells. Few if any organisms live on or beneath the cobbles and pebbles on these inhospitable mobile beaches. The exposed west coast rocky shoreline differs from that on the more sheltered Manukau coast by the general lack of smaller, stable cobbles and boulders that can be turned by hand and expose a rich and characteristic fauna sheltering beneath them (section 3.4).

3.3 Sheltered north Manukau Harbour rocky shores

Sheltered rocky shores line extensive portions of the north Manukau Harbour coast of the Waitakere Ranges. The rock substrate is volcanic conglomerate (Piha Formation) between Paratutae and Little Huia and around the end of Puponga Point. Everywhere else it is slightly softer volcanic grit or sandstone (Cornwallis Grit and Waitemata Sandstones). The volcanic conglomerate shores generally comprise a steep seaward face rising from subtidal depths to the edge of a narrow (1-10 m wide), subhorizontal, mid to high tidal platform. The back of the platform forms the base of steep, near vertical cliffs. The sandstone and grit shores differ from the conglomerate shores in having wider (up to 100 m) platforms backed by lower cliffs.

The base of the cliffs, the rock platforms and their outer slopes, and associated large, stable, angular boulders are colonised by a zoned succession of plants and animals from the narrow splash zone down to low water spring level. Below the maritime zone with crustose and foliose lichens, is the splash zone of bare rock with small, blue-grey periwinkles *Nodilittorina antipoda* sheltering in cracks or other shady places. Also sometimes found grazing on shaded vertical faces in this splash zone are a few of the high-arched limpets *Notoacmea pileopsis*.

Around high tide level, there is commonly a narrow band of the barnacle *Chamaesipho brunnea*, which passes downwards into a broader zone of the small barnacle *C. columna*, sometimes with a few, large, ribbed barnacles *Epopella plicata*, or patches of the black flea mussel *Xenostrobus pulex*. The tufted red seaweed *Gigartina laingii* often covers the rocks just above mid tide level.

Organisms that are common and characteristic of the broad mid-tidal part of the sheltered rocky shores are the acorn barnacles *Austrominius modestus*, the barnacle-eating oyster borer *Lepsiella albomarginata,* red seaweeds *Gelidium caulacantheum* and *Apophlaea sinclairii*, and the grazing herbivorous topshell *Melagraphia aethiops*, limpet *Cellana radians*, and snakeskin chiton *Sypharochiton pelliserpentis*.

In many places there is a narrow, patchy zone of the shelly tube worm *Spirobranchus cariniferus* just below mid tide level. The Pacific oyster *Crassostrea gigas* occurs sporadically on the rocky shore at various levels between mid and low tide, becoming abundant on the more sheltered shores around Cornwallis. In places near the harbour entrance, patches of green-lipped mussels *Perna canaliculus* and one of its predators - the white rock shell *Dicathais orbita*, are found just above low tide.

Below mean low water neap level, large areas of rock are coated in thin pink *Corallina* paint or in and around tidal pools in the pink turf of *Corallina officinalis*. Grazing at this level are numerous small limpets *Patelloida corticata* and the cat's eye *Turbo smaragdus*, which also occurs in large numbers grazing over the dominant, large brown, low tidal seaweeds *Carpophyllum maschalocarpum* and *Ecklonia radiata*. Below mean low tide level, sponges become moderately common, especially on the end of points swept by swift tidal currents. These include the orange golf ball sponge *Tethya aurantium*, orange *Cliona celata*, and scarlet encrusting *Microciona coccinea*, and the yellow finger sponge.

3.4 Sheltered north Manukau Harbour boulder beaches

Beaches composed of relatively stable angular to subrounded boulders and cobbles are present in a number of places along the north Manukau Harbour shoreline of the Waitakere Ranges, such as on the east side of Paratutae, at Boulder Bay, Destruction Gully, Kaiteke Pt., Huia, and Puponga and Lawry Points. In some places the boulder beach does not extend through the full intertidal zone and is limited to the upper or lower shore. Elsewhere, the boulders and cobbles occur separately scattered over a more sandy beach or rocky shore platform. In some places the cobbles and pebbles are more rounded and polished, usually indicating a more mobile beach in a locally more exposed location, with fewer organisms present.

On and particularly underneath the stable cobbles and boulders on these sheltered shores there is a rich and diverse biota living (Fig. 2). Above mean high tide level, the high shore crab *Cyclograpsus lavauxi*, is particularly common, often accompanied by the many-legged, isopod *Ligia novaezelandiae*. Less frequently encountered, often several layers of cobbles down, is the small orange snail *Marinula filholi*. Slightly lower on these shores at around high tide level, there are occasional specimens of the warmth-loving black nerite *Nerita atramentosa*, and the knobbed topshell *Diloma bicanaliculata*, which is often found sheltering beneath the boulders. The leathery red alga *Apophlaea sinclairii* and stubbly black lichen *Lichina confinis* often grow on the exposed surfaces of the most stable boulders near high tide level. Beneath the overhanging sides of the largest of these stable boulders are commonly found the deep-red waratah anemone *Actinia tenebrosa*.

In the mid tidal zone, Pacific oysters *Crassostrea gigas* and spiny, shelly tubeworms *Spirobranchus cariniferus*, can often be seen cemented around the sides of or underneath boulders. Beneath the boulders at this level, the most common organisms are usually crabs, particularly the green half-crab *Petrolisthes elongatus*, but also the fast-running *Hemigrapsus edwardsi*, the black-finger crab *Ozius truncatus*, and the marbled crab *Heterozius rotundifrons*. Green *Chiton glaucus* and the snakeskin chiton *Sypharochiton pelliserpentis* are frequently present under boulders, cobbles and even shells at mid tidal levels, as is the small limpet *Notoacmea helmsi* and the olive-green anemone *Isactinia olivacea*. The most common snails throughout much of the intertidal zone, both on and beneath the boulders are the speckled topshell *Melagraphia aethiops*, and dark topshell *Diloma zelandica*.

Around mean low tide level the biota living beneath the stable boulders and cobbles increases in diversity. Many different encrusting sponges are now present in bright orange, crimson, yellow and white colours. Also commonly

present attached to the boulder undersides are a number of sea squirts, particularly the orange *Cnemidocarpa bicornuta*, the blue and white *Asterocarpa coerulea*, the orange-tinged clear *Corella eumyota*, and the brown wrinkled *Pyura rugosa.* Also part of the underboulder mosaic are mats of the encrusting bryozoan *Beania*, and the firmly attached saucer limpet *Sigapatella novaezealandiae*, colourful fan shell *Chlamys zelandiae*, sometimes the low tide oyster *Ostrea aupouria*, and rarely the golden oyster *Anomia trigonopsis*. Nestling bivalves found in this habitat include *Irus reflexus* and *Hiatella arctica*.

More mobile, grazing gastropods sometimes found sucking onto the undersides of boulders near the Manukau Harbour entrance are the paua *Haliotis iris*, and black slug *Scutus breviculus*. Where the low tide boulders sit on sand or mud, the colourful chiton *Ischnochiton maorianus*, and pale *Leptochiton inquinatus* are commonly present. Less common grazers sometimes found beneath low tidal boulders include the small grooved limpet *Tugali suteri*, and the small, hairy chiton *Acanthochitona zelandica*. This is also the common habitat of colourful nudibranchs, which loosely clinging to the undersides of low tidal boulders.

Other sea-snails often found sheltering beneath low tidal rocks include the lined whelk *Buccinulum lineum*, and brown or grey whelk *B. vittatum*, the small *Xymene plebeius*, red-fleshed *Taron dubius*, and rarely the Cook's turban shell *Cookia sulcata*. The mottled brittlestar *Ophionereis fasciata* has only been found on the Waitakeres' coast beneath low tide boulders on shelly sand near the mouth of the Manukau Harbour.

3.5 Exposed west coast sandy beaches

Highly mobile medium to coarse sand forms beaches along approximately half of the exposed Tasman Sea coast of the Waitakere Ranges. There is virtually no macrobiota living in this hostile habitat, apart from occasional infaunal tuatua *Paphies subtriangulata*. Midden contents suggest that there may have been low numbers of toheroa *P. ventricosa*, in prehistoric times (Hayward & Diamond, 1978).

3.6 Sheltered north Manukau Harbour sandy and muddy shores

On the north Manukau Harbour coast of the Waitakere Ranges there are a number of large sheltered bays (Huia, Kakamatua, Mill, Armour Bays) with extensive intertidal muddy sand flats, as well as smaller bays with narrower stretches of intertidal sand (Little Huia, Orpheus, Kaitarakihi, Cornwallis). These sand flats have a rich and relatively diverse biota (Fig. 3) dominated by abundant cockles *Austrovenus stutchburyi*, with common pipi *Paphies australis* where freshwater crosses the sand flats in Huia, Kakamatua and Mill Bays.

Large numbers of mudsnails *Amphibola crenata* are present on the surface in muddier areas around high tidal level in Huia, Mill, Swanson and Armour Bays. In similar large numbers also on the surface at slightly lower mid tidal levels in the same sheltered bays are horn shells *Zeacumantus lutulentus* and topshells *Diloma subrostrata*. Also commonly present on the mid tidal flats are the predatory and scavenging whelks *Cominella adspersa* and *C. glandiformis*, the bubble shells *Bulla quoyii* and *Haminoea zelandiae*, cheeky burrowing crab *Macrophthalmus hirtipes*, and a wide diversity of burrowing polychaetes (e.g., *Eulalia microphylla*, *Glycera americana*, *Lumbrinereis coccinea*, *Marphysa depressa*, *Owenia fusiformis*), and the phoronid worm *Phoronis ovalis*.

Attached to cockle shells or rocks and partly buried in the intertidal sand are many small anemones *Anthopleura aureoradiata*. Sheltering and attached beneath dead cockle shells or small rocks on the tidal sand flats one often finds the green chiton *Chiton glaucus*, and the tiny limpet *Notoacmea helmsi*.

Draped across the muddy sand at low and mid tide levels in the entrance to Huia Bay and Big Muddy Creek are large numbers of the filamentous seaweed *Gracilaria chilensis*. Less abundant, but similarly draped across the tidal flats at Kakamatua Inlet and along the coast between Mill and Armour Bays is the introduced, unidentified, filamentous, red seaweed of the Family Solieriaceae. Widespread across the low tidal flats in the middle of Huia Bay is the seagrass *Zostera muelleri*, which also occurs in smaller patches in similar environments in Mill Bay. The tiny, elongate limpet *Notoacmea helmsi* f. *scapha* grazes on the blades of the seagrass.

At low and spring low tide levels on the muddy sand flats, the fauna is less abundant but quite diverse. Humps in the sand may be the shallow burrowing olive shell *Amalda australis*, the firm-bodied opisthobranch *Philine angasi*, the ostrich-foot snails *Struthiolaria papulosa* and *S. vermis*, or the sand dollar *Fellaster zelandiae*. Living just below the sand surface at low tide level on the east side of the entrance to Kakamatua Bay are millions of the small wheel shell *Zethalia zelandica*. Living infaunally within the low tidal, and subtidal, sediment are numerous specimens of the small bivalves *Nucula hartvigiana* and *Theora lubrica*. Many of the low tide burrows openings belong to the shrimps *Alpheus novaezelandiae*, *Palaemon affinis,* and *Callianassa filholi*. Occasional large horse mussels *Atrina zelandica* have their tops sticking out of the sand at and below low tide level between Mill and Armour Bays.

3.7 Estuaries

The sandy mouths of several streams flowing into the Tasman Sea on the west coast of the Waitakere Ranges are diurnally impacted by high tides and are effectively small estuaries. Brackish water estuarine organisms are essentially absent however from most of these small sandy west coast estuaries (e.g. Waitakere River estuary, Anawhata Stream "estuary", Karekare Stream estuary). The Piha Stream estuary is the only west coast exception however, in that it supports small numbers of estuarine species, such as the estuarine mussel *Xenostrobus securis* and

brackish snail *Melanopsis trifasciata*, which live attached and beneath cobbles and water-logged logs on the near permanently drowned floor of the beach sand-dammed Piha Estuary. Also present in this estuary is the burrowing crab *Macrophthalmus hirtipes*, and around high tide level small numbers of the mud snail *Amphibola crenata* and the minute *Potamopyrgus estuarinus*. Pacific oysters *Crassostrea gigas*, also live permamnently submerged attached to cobbles in the estuary's entrance.

On the Manukau Harbour shore of the Waitakere Ranges, there are three estuaries supporting brackish water biota – at the mouths of Huia, Kakamatua and Nihotupu Streams. The Huia and Kakamatua Stream estuaries are small compared with Big Muddy Creek estuary at the mouth of the Nihotupu Stream. The biota of the high tidal salt marsh, salt meadow and mangrove forests of these estuaries is described in sections 3.8 and 3.9 below. The unvegetated intertidal mud flats support numerous mud snails *A. crenata*, horn shells *Zeacumantus lutulentus,* and a few whelks *Cominella glandiformis*. There are abundant holes forming the entrances to burrows of the mud crab *Helice crassa*. Andesite pebbles and cobbles on the subtidal and low tidal floors of estuary channels are covered in numerous acorn barnacles *Austrominius modestus* and Pacific oysters *Crassostrea gigas*.

3.8 Salt marsh and salt meadow

Minor areas of salt marsh occur around the fringes of the small estuaries at the mouths of the Waitakere River, Piha and Karekare Streams on the west coast, and also on the northern coast of the Manukau Harbour around the mouths of the Karamatura, Huia, and Kakamatua Streams, and the fringes of the mangrove forest in Big Muddy Creek. Low growing, higher tidal salt meadow is best developed in a small area on the edge of pasture near the mouth of Huia Stream. This salt meadow is primarily composed of patches of white-flowering sea primrose *Samolus repens* and remuremu *Selliera radicans*, and less commonly yellow-flowering Bachelor's button *Cotula coronopifolia*.

The salt marsh is dominated by a mix of the rushes, oioi *Leptocarpus similis*, wiwi *Juncus maritimus* and *Isolepis nodosa*, and on slightly higher ground they are joined by saltmarsh ribbonwood *Plagianthus divaricatus* and pohuehue *Muehlenbeckia complexa.* Older ribbonwood branches often have a thick covering of fruticose lichens, especially *Ramalina celasteri* and yellow-grey *Teloschistes*. Around the roots of the rushes are found mudsnails *Amphibola crenata*, and the small snails *Ophicardelus costellaris* and *Potamopyrgus estuarinus*.

3.9 Mangrove forest

Around the Waitakeres' coast, mangrove forest is restricted to inside the Manukau Harbour. Within the mapped area, the only substantial area of mangrove forest fills much of Big Muddy Creek bay, with just a few plants in the small Huia Stream and Kakamatua estuaries, and in the shelter of Swanson Bay. The mangroves at Parau in Big Muddy Creek reach heights up to 4-5 m, some of the biggest in the Auckland region.

Older mangrove plants have a wide variety of lichens growing on their trunks and larger branches. In shade or partial shade the lichens are dominantly foliose, such as grey-green *Rimelia reticulatum, Heterodermia japonica, Physcia caesia*, yellow-green *Pseudoparmelia* and grey *Pannaria elixi*. In less dense shade, fruticose lichens such as old man's beard *Usnea* and *Ramalina,* are more common. Growing on the mud beneath some of the mangroves near the mouth of Big Muddy Creek are extensive patches of the dark filamentous seaweed *Gracilaria chilensis* and the soft, dark alga *Catanella nipae*, which also attaches to the pneumatophores and lower trunks.

Large specimens of the small acorn barnacle *Austrominius modestus* grow on some of the pneumatophores, lower branches and leaves of the mangroves. The small flea mussel *Xenostrobus pulex* and the Pacific oyster grow in clumps on pneumatophores and lower trunks. Sometimes found crawling on the lower trunks are dark leathery slugs *Onchidella nigricans*, while living in the mud beneath the mangroves are mud crabs *Helice crassa*, numerous mud snails *Amphibola crenata*, horn shells *Zeacumantus lutulentus*, topshells *Melagraphia aethiops*, and around mean high water level, small orange-brown snails *Ophicardelus costellaris*. The associated fauna in this habitat at Big Muddy Creek appears to be less diverse than that recorded from similar mangrove forest around the middle and upper Waitemata Harbour (Hayward et al., 1999a).

3.10 Exposed west coast beach wash-up

Many mollusc shells and less frequent other organisms are washed up on the exposed Tasman Sea beaches. They can be allocated to six groups based upon their inferred source habitats (Fig. 4):

3.10.1 Pelagic

A small portion of the washed up biota has a floating or swimming pelagic lifestyle. The most common are the small, spiral, internal ram's horn shells of the cuttlefish *Spirula spirula*, which are often found washed up in their hundreds just above high tide mark. Other cephalopod shells sometimes washed up on the east coast of Northland, but not recorded from the Waitakeres' coast in this study include the paper Nautilus *Argonauta*, and the cuttlebone *Sepia*.

The most common floating pelagic snail shells washed up are the small violet shells *Janthina exigua*, and occasional specimens of *J. globosa* and *J. janthina*. Other purple or blue-coloured pelagic organisms periodically found washed up are the Portuguese Man-o'-War *Physalia physalis*, the small by-the-wind sailor *Vevella vevella*, its relative *Porpita porpita*, and petipeti jellyfish *Aurelia aurita*.

Commonly washed up attached to floating logs, buoys and ropes is the goose barnacle *Lepas anatifera*, and less commonly three other rarer *Lepas* species. In 1970 another barnacle *Conchoderma virgatum*, was washed up on Piha Beach attached to a beached turtle.

3.10.2 Subtidal surf zone

The most common shells washed up on the west coast beaches are bivalves that live infaunally in the shallow subtidal sand within the surf zone just offshore. These surf clams are dominated by tuatua *Paphies donacina* and *P. subtriangulata*, trough shells *Mactra discors*, and triangle shells *Spisula aequilatera*. Less abundant are biscuits shells *Dosinia anus*, frilled Venus shell *Bassina yatei*, thinner-shelled *Peronaea gaimardi*, helmet shell *Semicassis pyrum*, ostrich foot *Struthiolaria papulosa*, and fragments of the sand dollar *Fellaster zelandiae*. Another occupant of the surf-churned sand that is usually found washed up in low numbers is the swimming crab *Ovalipes catharus*.

3.10.3 Offshore subtidal sediment substrates

Washed up in relatively low numbers are a wide variety of shells that live infaunally and epifaunally in the slightly less vigorous sandy sediment in deeper water offshore, >c.10 m (Hayward et al. 1999b, submitted). These include the large volute *Alcithoe arabica*, olive shell *Amalda mucronata*, knobbed whelk *Austrofusus glans*, small wentletrap *Epitonium*, rare spiny murex *Poirieria zelandica*, naticid *Tanea zelandica*, and bivalves *Divalucina cumingii, Dosinia subrosea*, *Maorimactra ordinaria*, *Myadora striata*, *Rexithaerus spenceri*, *Scalpomactra scalpellum, Soletellina nitida, Zenatia acinaces*, morning star shells *Tawera spissa*, sunset shells *Gari lineolata* and *G. stangeri*, nut shells *Nucula nitidula*, scallops *Pecten novaezelandiae*, and the small tusk shells *Antalis nana*.

3.10.4 Subtidal and intertidal exposed rocky shores

Some of the shells washed up on the west coast beaches are of molluscs that live on the nearby intertidal rocky shores (e.g. green-lipped mussels *Perna canaliculus,* and white rock shells *Dicathais orbita).* Some of the rarer rock-dwelling mollusc shells found belong to species that more usually live subtidally. These include occasional paua *Haliotis iris*, the siphon whelk *Penion sulcatus*, smaller snails *Phenatoma*, golden oyster *Anomia trigonopsis,* oyster *Pododesmus zelandicus*, and the common subtidal rocky and gravel shore bivalve *Protothaca crassicosta*.

3.10.5 Harbour soft sediment substrates

Another group of shells that don't live subtidally offshore and presumably are sourced from the tidal flats of the Manukau Harbour include frequent cockles *Austrovenus stutchburyi*, and less common pipi *Paphies australis*, mud snails *Amphibola crenata* and whelks *Cominella adspersa*. Presumably they have been swept out to the Tasman Sea by the strong out-going tidal currents and then washed northwards up the coast. Initially some of the cockles may have floated out into the Manukau Harbour channel on calm days (Hayward & Stilwell, 1995).

Several thick-shelled bivalves, more frequently found washed up on the southern beaches like Whatipu, are probably sourced from the shell-gravel and rocky floor of the entrance channel to Manukau Harbour. These include *Dosina zelandica* and *Ruditapes largillierti*, plus the turret shell gastropod *Maoricolpus roseus manukauensis*.

3.10.6 Reworked fossils

Rare specimens of the Sydney mud cockle *Anadara trapezia*, have been found washed up on Whatipu, Pararaha and Muriwai Beaches over the years (e.g. Oliver, 1923; Powell, 1932). This bivalve has been extinct from around the coast of New Zealand for at least 100 000 years (Murray-Wallace et al., 2000) and the washed up specimens are inferred to be coming from eroding late Pleistocene intertidal harbour deposits possibly exposed on the seafloor somewhere offshore. These are the only recognisably reworked fossils because the species is extinct in New Zealand, but other shells, such as the New Zealand cockle *Austrovenus stutchburyi*, could also be coming from these eroding deposits.

3.11 Sheltered north Manukau Harbour subtidal wash-up

A wide variety of shells are washed up on the beaches and rocks on the north Manukau Harbour shores of the Waitakere Ranges. Many are cockles, pipis and speckled topshells *Melagraphia aethiops*, and other species that live on the local intertidal beaches and rocks. Also washed up are many shells of species that live subtidally just offshore in the harbour, and their presence gives us an insight into these unseen subtidal communities. These include the olive shell *Amalda novaezelandiae*, ostrich shells *Struthiolaria,* snails *Antisolarium egenum*, *Pervicacia tristis*, horse mussel *Atrina zelandica,* basket shell *Corbula zelandica*, lace cockle *Divalucina cumingii*, biscuit shells *Dosina zelandica*, *Dosinia lambata*, *D. maoriana*, and *D. subrosea*, *Leptomya retiaria*, box shells *Myadora boltoni*, *M. striata*, and *M. subrostrata*, oblong venus shell *Ruditapes largillierti*, morning star shell *Tawera spissa*, small tusk shell *Antalis nana*, and swimming crabs *Ovalipes catharus*. Also present are rare valves of geoducks *Panopea zelandica*, fragile bivalves *Soletellina nitida* and *S. siliquens*, and heart urchins *Echinocardium cordatum*. Dredge hauls from offshore in the main Manukau Harbour channel between Paratutae and Puponga Point indicate that the fauna living there is dominated by the sand dollar *Fellaster zelandiae* and hermit crabs *Pagurus* (Powell, 1937; Grange, 1979). In the more sheltered channel offshore from

Cornwallis to Big Muddy Creek, two dredge hauls identified a fauna dominated by the olive shell *Amalda australis* and the box shell *Myadora striata* (Grange, 1979).

4. ROCKY SHORE ZONATION

The locations of the thirteen representative rocky shore transects are shown in figure 5 and their zonation diagrams presented in figures 6-18.

From top down the rocky shore zones can be summarised as:

a. maritime lichen zone
b. bare rock zone
c. periwinkle zone
d. barnacle zone
e. mussel, tube-worm and coralline zone
f. subtidal fringe seaweed zone

The tidal width and height of these zones is greatest on the most exposed shores facing the sea (Figs. 19, 20), where the waves surge up the rocks to well above high tide level. This is best illustrated by the zonation in transect 6 on the steep, west-facing outer slope of Lion Rock, Piha (Fig. 11), where the periwinkle zone extends 4 m above extreme high water springs level (EHWS) and the top of the barnacle zone is 2 m above EHWS. On the west coast these zones are lower where the rock face is side-on to the prevalent sea and only effected by the height of the passing waves, such as in transect 3 in a gut on Erangi Pt, Te Henga (Fig. 8), where the periwinkle zone extends 1.5 m above EHWS and the top of the barnacle zone is 0.5 m below EHWS. A similar effect is evident in transect 5, which is side-on to the passing waves on the south-facing shore of Te Waha Pt, north Piha (Fig. 10). Here the periwinkle zone extends only 1 m above EHWS and the top of the barnacle zone is 0.8 m below EHWS.

The extent of the subtidal fringe seaweed zone is also effected by exposure, with the bull kelp extending 2.5 m above extreme low water springs level (ELWS) on the gently sloping exposed face of transect 2 at Pillow Lava Bay (Fig. 7), but only reaching 1 m above ELWS on the side-on transects 3 (Fig. 8) and 5 (Fig. 10), where *Carpophyllum maschalocarpum* replaces *Durvillaea* (Fig. 20).

4.1 Periwinkle zone

Inside the Manukau Harbour, the maximum height of the periwinkle zone is 1 m above EHWS on the most exposed south-west corner of Puponga Point (transect 12, Fig. 17). Inside the harbour, the barnacle and other lower zones however, are fairly consistent in their tidal height no matter what the degree of exposure, with the top of the barnacle zone 0.6-1 m below EHWS and the top of the subtidal fringe seaweed zone 0.3-0.8 m above ELWS (Fig. 20).

The periwinkle zone is everywhere characterised by an abundance of the small, blue-grey *Nodilittorina antipoda*, supplemented by less common, larger, brown *N. cincta* on many of the west coast transects. The damp-loving, high tidal limpet *Notoacmea pileopsis* is present on shaded near-vertical rock faces within the middle and lower parts of the periwinkle zone in four of the transects (1, 3, 11, 12, Figs. 6, 8, 16, 17).

4.2 Barnacle zone

The top of the barnacle zone in most instances is characterised by fairly dense *Chamaesipho brunnea*, which form a narrow belt (0.5-1 m tidal width) inside the sheltered Manukau Harbour, which widens to 1.5-2.5 m on the more exposed west coast rocky shores (Fig. 19). The small, often crowded barnacle *C. columna*, is everywhere present on the west coast rocky shores, where it has the widest tidal range of the barnacles, spanning the full width of the barnacle zone. Except on the most exposed shore on Puponga Pt. (transect 12, Fig. 17), *C. columna* is replaced as a zone forming barnacle inside the Manukau Harbour by the small acorn barnacle *Austrominius modestus* (Fig. 19). Having a similar geographic distribution to *C. columna* is the large, ribbed barnacle *Epopella plicata*, although it occurs additionally at Huia Pt. (Fig. 16). It mostly occurs at lower levels than *C. brunnea*, in the middle and lower parts of the barnacle zone. Usually also present in the mid-high tide, barnacle zone in zone-forming abundance are the barnacle-eating oyster borers *Lepsiella albomarginata* and the small, flea mussel *Xenostrobus pulex* (Fig. 19). Less commonly present in sufficient zone-forming abundance both on the west coast and inside the Manukau Harbour, are the stubby black lichen *Lichina confinis*, the limpets *Cellana radians* and *C. ornata*, the snakeskin chiton *Sypharochiton pelliserpentis*, the Pacific oyster *Crassostrea gigas*, sea lettuce *Ulva lactuca*, leathery red alga *Apophloea sinclairii*, and the brown algal stubble of *Gigartina laingii*. In the greater shelter of the Manukau Harbour, the barnacle zone sometimes also includes significant abundances of the speckled topshell *Melagraphia aethiops*, cat's eye *Turbo smaragdus*, bright green alga *Chaetomorpha aerea*, and small red seaweed *Gelidium caulacantheum*.

4.3 Mussel, tubeworm and coralline paint zone

The mussel, tubeworm and coralline paint zone extends from mean low water up towards mid tide level. Characteristic of this zone are the green-lipped mussel *Perna canaliculus*, the shelly tube worm *Spirobranchus cariniferus*, and sand tube worm *Neosabellaria kaiparaensis*, although none are as continuous in their cover of the rocks

(Fig. 19) as the barnacles are in the zone above or brown seaweeds in the zone below. Of these three, *Perna* is the most abundant, especially on west coast rocky shores, but it also occurs in lower numbers in many of the north Manukau Harbour transects (e.g. 11, 12, 13, Figs. 16-18). *Spirobranchus* is more common inside the Manukau Harbour, but also occurs in zone-forming abundance in some places on the west coast (e.g. 3, 5, Figs. 8, 10). *Neosabellaria* is the most sporadic in its zone-forming occurrence, both on the west coast and inside the Manukau Harbour (e.g. 3, 10, Figs. 8, 15). Commonly associated with the mussels are two of its predators the white rock shell *Dicathais orbita*, and the large orange reef star *Stichaster australis*.

Pink algal *Corallina* paint coats any bare rock within the lower part of this zone and extends down into the subtidal in all transects. Always closely associated with the paint is the small limpet *Patelloida corticata*. Another coralline alga sometimes abundant enough to be zone-forming at this level is the turf *Haliptilon roseum* (e.g. 5, Fig. 10).

The lower extent of two of the zone-forming organisms in the barnacle zone, the small barnacle *C. columna* and the flea mussel *X. pulex*, commonly extend down into the upper part of this mussel, tube worm and coralline paint zone (Fig. 19). The erect olive-green seaweed *Gigartina alveata* is sometimes conspicuous in this zone on exposed west coast shores, and sometimes extends up into the lower barnacle zone (e.g. 2, 3, 6, Figs. 7, 8, 11).

In some places on the west coast and just inside the entrance to Manukau Harbour (e.g. 4, 7, 8, Figs. 9, 12, 13), tall specimens of the giant barnacle *Megabalanus tintinnabulum linzei* form a band in the lower part of this zone. Also zone-forming at this level and confined to the exposed west coast is the seaweed *Pachymenia lusoria* (e.g. 2, 3, Figs. 7, 8). On the north Manukau Harbour shores, the cat's eye *Turbo smargdus* is abundant through this zone and often extends both up into the barnacle zone and down into the seaweed zone.

4.4 Subtidal fringe seaweed zone

The most abundant zone-forming seaweed around the Waitakeres' coast is the large brown flapjack *Carpophyllum maschalocarpum*, which is ubiquitous at low tide level on north Manukau Harbour shores and also on more sheltered parts of the west coast (e.g. 3, 5, Figs. 8, 10). Only present on the more exposed parts of the west coast is the huge bull kelp *Durvillaea antarctica*. Another common zone-forming kelp, but confined to the Manukau Harbour shores is *Ecklonia radiata* (Figs. 14-18, 20). The only other seaweed to be abundant enough to characterise this zone on the sheltered Manukau Harbour shores is the red alga *Melanthalia abscissa* (e.g. 9, 12, Figs. 14, 17). The red serrate-branched alga *Osmundaria colensoi* is abundant in this zone around Paratutae and Boulder Bay at the entrance to the harbour (e.g. 8, Fig. 13).

On the west coast this low tidal seaweed zone is characterised by the diversity of red alga present, particularly *Gigartina atropurpurea*, *G. marginifera*, *Arthrocardia corymbosa*, *Nothogenia fastigiata*, and *Pterocladia lucida*. Large chitons are usually found in this zone, with *Plaxiphora obtecta* sufficiently abundant to be zone-forming on some of the more exposed, smooth andesite shores, such as the Pillow Lava Bay transect (Fig. 7).

Colourful sponges, such as the orange golf ball sponge *Tethya aurantium*, are often present in crevices, under overhanging ledges and in more shaded guts in the subtidal fringe zone right around the Waitakeres' coast.

5. SPECIES HABITAT AND OCCURRENCE NOTES

AK = in Auckland War Memorial Museum collections
CS= 1950's records of the Conchology Section, Auckland Institute and Museum (1963)
MSM = in Margaret Morley's collection
RW = Richard Willan (pers.comm.) dive and intertidal records

POLYPLACOPHORA (chitons)

Acanthochitona violacea - rare under low tide rock; only found at Lawry Point.
Acanthochitona zelandica - common under rocks at low tide around Cornwallis and Paratutae. Occasional or rare at most exposed west coast beaches.
Chiton glaucus - common under mid tide rocks at Mill Bay, rare or occasional on the west coast.
Cryptoconchus porosus - occasionally found under rocks and overhangs at low tide, right around the coast.
Eudoxochiton nobilis - rare on low tidal exposed rocks, often in guts. Quite common on either side of Paratutae at low tide. Large (12 cm long) specimen at Boulder Bay.
Ischnochiton maorianus - common under rocks on muddy sand at low tide along Manukau Harbour coast, only rarely seen on the open coast.
Leptochiton inquinatus – occasionally under rocks at low tide on the harbour coast.
Plaxiphora biramosa- a large chiton, its dark red girdle has sparse bristles; rare on low tidal rocks at Lion Rock, Piha and Karekare. Recorded in *Durvillaea* holdfast from Piha (AK). It is restricted to exposed coasts.
Plaxiphora caelata - recorded as common on the west coast (Powell, 1979), but only found in low numbers under rocks, on cave walls and in crevices from mid to low tidal level at Pillow Lava Bay, Powell Bay and Lion Rock in this survey.
Plaxiphora murdochi - this rare chiton has been found alive under smooth stones at low tide between Maori and Powell Bays (Powell, 1979, AK and MSM).
Plaxiphora obtecta - common on low tide rocks at Pillow Lava Bay near sand level; frequent to rare at all other localities on the exposed west coast and into the harbour as far as Destruction Gully. Not present in the more sheltered Manukau Harbour.
Rhyssoplax stangeri - common in the Manukau Harbour (Powell, 1979), recorded as occasional at Cornwallis in 1954 (CS), not found in this survey. Earlier records were probably from dredged material, as its usual range is subtidal, 1-25 m (Morley & Hayward, 1999b).
Sypharochiton pelliserpentis - common or frequent on rocky shores all around the coast at most tide levels. Large, colourful, uneroded specimens live on the sides of massive boulders on the seaward side of Lion Rock at Piha and at Boulder Bay.

GASTROPODA (snails)

Alcithoe arabica f. *swainsoni* - occasionally washed up on exposed west coast.
Amalda australis - living in good numbers in low tide sand around Cornwallis wharf. None found at Armour Bay, although this is a typical habitat.
Amalda mucronata - dead specimens commonly washed ashore at Te Waharoa, many in use by hermit crabs. A few dead specimens found washed up on most open coast localities.
Amalda novaezelandiae - single dead specimens found at Maori Bay and Cornwallis.
Amalda novaezelandiae f. *crystallina* - a small freshly dead specimen was found at Maori Bay.
Amphibola crenata - common at high tide on muddy fine sand at Mill and Huia Bays; common in mangrove swamps at Big Muddy Creek. Rare specimens live around high tide inside Piha Stream estuary, but not Te Henga nor Karekare estuaries on the west coast.
Amphithalmus falsestea - occasional under low tide rocks, Destruction Gully.
Amphithalmus semen - occasional under low tide rocks, Destruction Gully and Boulder Bay.
Antisolarium egenum - a few dead specimens washed in at Little Huia and Destruction Gully.
Argobuccinum pusulosum tumidum - single dead specimens found at several locations on the open coast. This species is more common further south.
Assiminea vulgaris - occasional at Puponga Pt., on the underside of rocks sitting on soft clay, in the splash zone, in 1952 (CS); not found in this survey.
Austrofusus glans - specimens washed up on exposed west coast beaches, sometimes in large numbers.
Austromitra rubiginosa - found in low numbers under low tidal rocks on the harbour coast, e.g. Boulder Bay.
Brookula finlayi - rare live micromollusc under low tidal rocks; only at Boulder Bay.
Buccinulum lineum lineum - frequent under low tide stones on sandstone reefs at Mill Bay, spawning in July 2000. Elsewhere on the coast in low numbers.

Buccinulum vittatum - present under low tide stones on north shore of Manukau Harbour and also at Te Waharoa. Live under stones in deep rock pools at Piha.
Bulla quoyii - does not live on the open coast, dead specimens found at Lawry Bay to Big Muddy. Spawn observed at Kakamatua in September 1999.
Cabestana spengleri - rare live specimens among low tide rocks and *Codium convolutum* on east side of Puponga Pt.; about 20 live specimens on low tide sea squirts and scurfy weed-covered rocks at Lawry Pt.
Cabestana tabulata - recorded form low tidal rocks at Mill Bay and Puponga Point in 1954 (CS), but not found in this survey. The Manukau Harbour appears to be the only location where this species has been found intertidally.
Caecum digitulum - lives under low tide rocks on the north side of the Manukau Harbour entrance. Occasional dead specimens found in shell sand under rocks at Te Waharoa, Puponga Point and Mill Bay.
Calliostoma punctulatum - live at low tide feeding on bright orange sponges, particularly on the east side of Puponga Pt. Also live on the east side Paratutae under low tide boulder.
Calliostoma selectum - one dead specimen washed up at Maori Bay.
Calliostoma tigris - rarely found alive intertidally. One live on *Codium convolutum* at low tide on east side of Puponga Pt. Frequent at Cornwallis in 1954 (CS).
Cantharidella tesselata - this small colourful species is common on the open coast living on rocks among seaweed at low tide level. Abundant at Te Henga in this survey.
Cantharidus purpureus - only recorded living at Destruction Gully, on low tide seaweed.
Cellana denticulata - six specimens were found at Muriwai in 1934 (AK), none found in this survey. Cook Strait is the centre of distribution with sporadic occurrences both north and south on offshore islands and prominences (Powell, 1979).
Cellana ornata - does not like softer sandstones around Muriwai or Armour Bay. Present at most other localities on intertidal rocks.
Cellana radians - common at most tidal levels on boulders and rocks around all of the Waitakeres' coast.
Cellana stellifera - rare dead wash-up at Puponga Pt. in the 1950's(AK); not found in this survey.
Charonia lampas - rare in 3 m water off Puponga Pt. in 1956 (CS), and dredged offshore in 1983 (MSM); no evidence of this species in this survey.
Chemnitzia sp. - occasional under low tide rocks along the harbour shores.
Cirsotrema zelebori - single specimens found dead in shell sand at Maori Bay, Whatipu and Huia.
Cominella adspersa – frequent live specimens in mid-low tide mud and sand between Huia and Armour Bay. No live specimens on the exposed west coast.
Cominella glandiformis - only found alive on harbour shores; abundant at Armour Bay.
Cominella maculosa - on low tide, weed-covered rocks east of Mill Bay, and in low tide pools on *Carpophyllum maschalocarpum* at Te Waharoa and Paratutae.
Cominella quoyana quoyana - a rare mollusc intertidally on the west coast; found under low tide rocks inside the entrance to the Manukau Harbour.
Cominella quoyana accuminata - the Northland west coast subspecies (Powell, 1979), only found living under low tide rocks inside the entrance to the Manukau Harbour.
Cookia sulcata – only live specimen found at low tide in rock crevice at Kaitarakihi. Not present (dead or alive) on the exposed west coast.
Crepidula costata – only one dead shell found (at south Karekare) during this survey.
Crepidula monoxyla - often encrusted onto shells of cat's eyes, or occasionally on *Melagraphia aethiops*. Alive on dead shells washed in from deeper water. More common in the harbour.
Cymatium parthenopeum - several seen living on scurfy weed-covered low tide reef and rocks around Lawry Pt. in 2000 and 2002, and in similar habitat at Kaitarakihi in 2001. Rare at Karekare in a deep tidal pool.
Dicathais orbita - common around most of the Waitakeres' coast. Rare under low tide rock Lawry Point, near purple egg capsules 31 Dec 2001.
Diloma arida - low numbers at mid-high tide at Te Waharoa.
Diloma bicanaliculata - under high tide rocks on rock or gravel substrate, around most of the coast..
Diloma coracina - found close to sand level on lower parts of rocks at mid tide level on the exposed west coast.
Diloma nigerrima - found under high tidal rocks on the west coast; small numbers at mid-high tide at Te Waharoa and Boulder Bay.
Diloma subrostrata - in high numbers on sand substrate at mid tidal levels between Huia and Armour Bays. Not living on the open west coast.
Diloma zelandica - in moderate numbers under and on large high tide rocks, on rock or gravel substrate around most of the coast; most abundant just inside the Manukau Harbour entrance (e.g. Boulder Bay) at all tide levels, including juveniles in March 2002.
Eatoniella spp. - microscopic conical species that live mostly on seaweeds, becoming more common in sheltered waters, or where boulders or reefs provide some shelter on the open coast.
Eatoniella albocolumella - live among low tide seaweeds on north Manukau Harbour coast.
Eatoniella atervisceralis - rare at Lion Rock, Piha.
Eatoniella delli – only recorded living at Te Waharoa Bay.
Eatoniella dilatata - rare at Lion Rock.
Eatoniella latebricola - a west coast species rare at Maori Bay.
Eatoniella limbata – only found living on the Manukau Harbour coast.

Eatoniella mortoni - occasional under low tide rocks, Destruction Gully and Boulder Bay.
Eatoniella notalabia - among low tide seaweeds at Mill Bay and Piha.
Eatoniella notata - occasional at Mercer Bay.
Eatoniella olivacea - live on low tide rocks and among low tide seaweeds on Manukau Harbour coast, common at Boulder Bay; low numbers on the open coast.
Eatoniellla pfefferi - rare on seaweeds at Destruction Gully and more frequent at Boulder Bay.
Eatoniella roseola – dead specimen found at Te Waharoa Bay.
Eatoniella varicolor – rare at Pillow Lava Bay, common at Boulder Bay.
Eatonina atomaria - live beneath low tidal rocks on north Manukau Harbour coast, only rarely at Maori Bay and Te Waharoa on the open coast.
Eatonina micans - common at Armour Bay in 1956 and on Te Tau bank off Puponga in 1953 (CS). Not found in this survey.
Eatonina subflavescens – found living under low tide rocks at a number of localities around the entire coast.
Epitonium jukesianum - occasional under low tide rocks with the anemone *Isacradactis magna* on the open coast and at Destruction Gully. This parasitic pyramidellid is known to live with several other host anemones, *Anthopleura aureomarginata* (Morton & Miller, 1968) and *Isactinia olivacea* (MSM pers. obs.), although not in this survey.
Epitonium tenellum – only found dead; lives with sand flat anemones.
Fossarina rimata - found dead at Destruction Gully, Boulder Bay and Puponga Pt.
Gadinia conica - found alive on the roof of caves at Maori Bay in 1985 (MSM); in this survey found live at Powell Bay, dead at Te Waharoa and Boulder Bay.
Haliotis australis - found living attached to the underside of low tide boulders at Destruction Gully and dead at Boulder Bay; previously recorded from Maori Bay, Paratutae and Cornwallis in the 1950's (CS).
Haliotis iris – many juveniles found under low tide rocks just inside the Manukau Harbour entrance (Destruction Gully to Paratutae); previously recorded from Maori Bay, and Cornwallis (CS).
Haminoea zelandiae - egg masses common on low tide flats at Mill Bay in July 2000. Large specimens common in sandy mud at low tide.
Haustrum haustorium - on intertidal rocks in moderate shelter, mostly inside the Manukau Harbour, but also at Te Waharoa Bay.
Incisura lytteltonensis – found living on seaweeds just inside the Manukau Harbour entrance.
Janthina exigua - this pelagic species is washed in along the open coast and at Huia, sometimes in large numbers.
Janthina globosa - only record from the Waitakeres' coast is from wash-up on Muriwai Beach (Morton & Miller, 1968).
Janthina janthina - abundant live specimens were washing ashore on Whatipu Beach in late September 2000, together with egg cases attached to strings of air bubbles.
Lamellaria ophione – living under low tide rocks at Cornwallis and Kaitarakihi.
Lepsiella albomarginata – abundant on mid tidal rocks right around the coast. Egg laying under rocks at Armour Bay, 31 Dec 2001.
Leuconopsis obsoleta - lives in high tide crevices, common at Whites Beach.
Linopyrga rugata - live beneath low tidal rocks on north Manukau Harbour coast.
Lodderia iota – washed in dead at Boulder Bay.
Maoricolpus roseus manukauensis - large numbers at low tide on sheltered northern shores of Manukau Harbour.
Marinula filholi – lives deep within high tide boulder beaches; in this survey recorded dead at Paratutae, live at Boulder Bay; common at Cornwallis in 1952.
Melagraphia aethiops – lives on rocks at all tidal levels, most abundant on more sheltered Manukau Harbour coasts, east of Huia, but also present in lower numbers on exposed west coast.
Melanochlamys cylindrica - rare at Mill Bay in 1954 (CS). Not found in this survey. *Melanopsis trifasciata* - living beneath mostly submerged cobbles in the mouth of Piha Stream estuary, July 2000.
Micrelenchus huttonii - common on blades of sea grass *Zostera* at Mill Bay. Occasional specimens on sand flats at mid tide Armour Bay.
Micrelenchus sanguineus - rare at Puponga Pt. in 1953; only 2 specimens found in this survey at Boulder Bay.
Microtralia occidentalis - recorded as occasional at Armour Bay in 1953 (CS); not seen in this survey.
Neoguraleus manukauensis – low numbers around the sheltered coasts of the Manukau Harbour.
Neoguraleus murdochi - a single specimen dead at Huia.
Neoguraleus oruaensis - recorded as occasional in *Zostera* at Mill Bay in 1955 (CS); not found in this survey.
Nerita atramentosa - low numbers, but always in shade of large stable boulders at high tide level on rocky substrate. Frequent at Destruction Gully, with isolated very large specimens at Boulder Bay.
Nodilittorina antipoda - abundant in the high tide zone on rocks around whole Waitakeres' coast.
Nodilittorina cincta - a typical west coast species, not so common as *N. antipoda*, often living at a slightly higher level in the splash zone. Found all round the Waitakeres' coast. Most abundant on damp shaded faces above high tide level at Te Waharoa.
Notoacmea elongata - attaches to dead shells at mid tide or lives beneath rocks on the northern shores of the Manukau Harbour, and rarely on the west coast.
Notoacmea helmsi - common attached to dead shells within the Manukau Harbour.
Notoacmes helmsi f. *scapha* - rare on blades of *Zostera* at Mill Bay.
Notoacmea parviconoidea - occasional on high tide rock faces among barnacles all round the coast.

Notoacmea pileopsis pileopsis – grazes on shaded rock faces around high tide level both inside the Manukau Harbour and on the west coast.
Notoacmea scopulina – limpet with peach-coloured animal, living on exposed vertical rock faces at mid tide level. Found dead at Boulder Bay in this survey; previously recorded live at Maori Bay (AK); and Lion Rock (Morton & Miller, 1968; MSM, 1992),
Nozeba emarginata - found dead at Puponga Pt. and Mill Bay.
Odostomia geoffreyi ? - one specimen dead at Destruction Gully.
Odostomia incidata - live in muddy sand around worm burrows at low tide, Mill Bay.
Onchidella nigricans – occurs at all tidal levels on hard or soft rocks (Pleistocene at Cornwallis) right around the coast, usually in damp (shaded high tide) locations.
Onoba fumata - washed from algae at Boulder Bay.
Orbitestella parva - microscopic gastropod found in low tide sand under rocks at Puponga Pt.
Ophicardelus costellaris - occasional at Cornwallis in 1957 (CS); abundant on tidal mud banks and reeds in Huia Stream estuary.
Paratrophon cheesemani - present around low tide rocks and pools at Te Waharoa, Maori Bay and around the open coast, but not inside Manukau Harbour.
Patelloida corticata - external surface usually covered in pink coralline algae blending the shell with the background low tidal coralline paint-covered rocks. Common or frequent right around the Waitakeres' coast.
Penion sulcatus - recorded live at Cornwallis in 1950's (CS); a few specimens found dead in this survey.
Pervicacia tristis - single dead specimens found in shell sand from Maori Bay to Huia, probably living offshore, at shallow subtidal depths (Morley & Hayward, 1999a).
Phenatoma rosea - only found dead at Maori Bay and Anawhata.
Phenatoma zealandica - only found dead at Maori Bay.
Philine angasi - recorded as occasional on Te Tau bank, off Puponga Pt. in 1957 (CS),
Philine auriformis - recorded dead at Mill Bay in 1956 (CS).
Philine sp. - one large (animal 8 cm long) live specimen buried in surface sand south of Cornwallis wharf, May 2000.
Pisinna rekohuana - a single specimen found alive in low tide sand at Huia.
Pisinna zosterophila - common under low tide rocks on the Manukau Harbour coast; less frequent on the west coast.
Poirieria zelandica - one hermit-crabbed specimen in pools at Maori Bay.
Potamopyrgus estuarinus - present in dense numbers beneath submerged cobbles in the mouth of Piha Stream estuary, July 2000. Abundant in mud on the edge of tidal Huia estuary.
Pusillina infecta - common in rock wash at Boulder Bay.
Pyramidellidae indet. – small unidentifiable shell washed up at Maori Bay.
Radiacmea inconspicua – lives on low tide boulders most commonly just inside the Manukau Harbour entrance, but also rarely on the west coast.
Ranella australasia - recorded as occasional at Mill Bay in the 1950's (CS), one alive on low tide rocks, Destruction Gully, August 2000.
Rhizorus nesentus - microscopic shell found dead in shell sand at Maori Bay.
Risellopsis varia - a small grazing gastropod found alive inside the Manukau Harbour on mid tide rock faces among clumps of *Crassostrea gigas* and at Boulder Bay among *Corallina officinalis*.
Rissoella cystophora - occasional on low tide seaweed at Boulder Bay.
Rissoella rissoaformis - live among low tide seaweeds on north Manukau Harbour coast, rare on the open coast.
Rissoina chathamensis – live under low tide rocks at Destruction Gully and Boulder Bay; recorded living on Te Tau bank, off Puponga Pt. in 1953 (CS).
Sagenotriphora ampulla - two live specimens under low tidal rocks at Boulder Bay.
Scutus breviculus - found in low numbers at most locations under low tide stable boulders; large specimens at Boulder Bay.
Semicassis pyrum - occasional on Te Tau bank in 1963 (CS), washed up dead in low numbers on all the exposed west coast in this survey.
Sigapatella novaezealandiae - attached beneath extreme low tide rocks on the north Manukau Harbour coast, often among sponge gardens.
Sinezona brevis - dead specimen found at Boulder Bay.
Siphonaria australis - common at around high tide on rock faces at almost all localities.
Siphonaria propria - frequent on low tide rocks at Maori Bay and Puponga Pt.
Struthiolaria papulosa - one specimen seen live in sand at spring low tide on small beach at end of Puponga Peninsula, Aug 2001.
Struthiolaria vermis vermis - frequent buried just under low tidal sand at Armour Bay.
Suterilla neozelanica - occasional at Puponga Pt. under high tide rocks in 1952 (CS); not found in this survey.
Tanea zelandica - hermit-crabbed specimens at Maori Bay and dead at Paratutae.
Taron dubius – easily recognised by its bright red body; live on and under low tide rocks on the north Manukau Harbour coast.
Trichosirius inornatus - recorded dead at Cornwallis in 1952 (CS); one dead specimen washed up at Maori Bay in this survey.
Trochus tiaratus - rare at Huia and washed in dead at Te Henga, Paratutae and Puponga Pt. probably from deeper water.
Trochus viridis - washed-in at Muriwai in 1953 (AK); not found in this survey.

Tubbreva exigua - common at Mill Bay, and sporadically alive around the rest of the Waitakeres' coast.
Tugali suteri - clump of four at low tide beneath low tide rock in sponge garden east side Puponga Pt., rare at Destruction Gully and Boulder Bay.
Turbo smaragdus - common on mid to low tide rocks right around the Waitakeres' coast, although more abundant in the shelter of the Manukau Harbour.
Volarinella cairoma - occasional at Kakamatua in 1955 (CS), not found in this survey.
Xymene ambiguus - one dead specimen found at Maori Bay.
Xymene plebeius - under low tide rocks on sheltered harbour sandy substrate at Cornwallis and Lawry Pt.
Xymene pusillus - only dead specimens found at Anawhata and Mill Bay.
Xymene traversi - a common species living at and below low water on rocks throughout the study area; most common on the Destruction Gully coast.
Zalipais lissa - live among seaweeds on low tide rocks on north Manukau Harbour coast, not present on the open west coast.
Zeacolpus ahiparanus - found dead washed up at Maori Bay.
Zeacolpus pagoda - found dead washed up at Little Huia.
Zeacumantus lutulentus - abundant at mid tide level, grazing in the muddy fine sand of Mill and Huia Bays. Also common in mangrove forest.
Zeacumantus subcarinatus - common at mid tide level on silt-covered sandstone reefs at Mill and Armour Bays. Not found on the open coast.
Zegalerus tenuis - recorded as occasional in 1950's at Cornwallis (CS), dead specimens uncommon in shell sand on the open coast and more common in the Manukau Harbour in this survey.
Zemitrella choava - live under low tide rocks on north Manukau Harbour coast and at Te Waiharoa.
Zemitrella fallax - rare under low tide rocks, only at Destruction Gully.
Zemitrella sp. - dead eroded specimen washed in at Maori Bay.
Zethalia zelandica - recorded as common on Te Tau bank in 1953 (CS). Huge patches of enormous numbers of live *Zethalia* in low tide sand at east side of Kakamatua Bay in September 1999 and again in September 2001 (when next revisited).

NUDIBRANCHIA (sea slugs)

Acanthodoris molicella - although recorded as common throughout New Zealand (Morton & Miller, 1968), this yellowish brown nudibranch covered in soft pointed tubercles, only a single specimen was seen in this survey at Huia, on low tide rocks.
Alloiodoris lanuginata – seen at Destruction Gully in this survey and at Maori Bay (RW).
Aphelodoris sp. - six specimens of this creamy-coloured sea slug, without the radial markings of *A. luctuosa*, were seen at low tide on and under rocks at Destruction Gully, July 2000.
Archidoris wellingtonensis - one found in entrance to low tidal cave at Destruction Gully, August 2000; another recorded from Maori Bay (RW); this species feeds on sponges (Powell, 1979).
Berthella ornata - rare at Mill Bay in 1956 (CS), not found in this survey.
Dendrodoris citrina - common at Cornwallis in 1955 (CS). Good numbers at low tide on and under rocks in May 2000 on east side of Puponga Pt. Large numbers on scurfy weed-covered low tide reef east of Mill Bay in July 2000.
Doriopsis flabellifera - found in low numbers in August 2000 at Maori Bay and Huia Point. A pair found under low tide rocks at Boulder Bay, one pale grey, the other tan.
Eubranchus agrius - Powell (1979) recorded this small species at Lion Rock and Anawhata. living on hydroids in tidal pools. Not found in this survey.
Flabellina albomarginata - type at Lion Rock, Piha (Miller, 1971). Not found in this survey.
Phidiana milleri - good numbers of this small colourful nudibranch with spawn coils found under low tide boulders on coralline paint on both sides of Paratutae in Sept 2001.
Rostanga muscula - small, bright tomato red nudibranch; one live east side of Puponga Pt. in May 2000 at low tide on rock substrate; another on east side of Paratutae in Sept 2001; three on scurfy weed-covered low tide rocks east of Mill Bay together with spawn, July 2000. A single specimen seen under low tidal rocks at Boulder Bay in March 2002.
Stiliger felinus – a minute black nudibranch that lives in high tide pools feeding on the bright green seaweed *Chaetomorpha aerea*. Only found on east side of Paratutae in Sept 2001. Not found in similar habitats at other places on the exposed coast, although previously recorded from Lion Rock (Trowbridge, 1994).
Tritonia incerta - at Paratutae and Maori Bay (RW).

BIVALVIA (clams)

Anadara trapezia - single valves of the extinct Sydney cockle washed up at Karekare 2001; previously recorded from Muriwai and Whatipu (AK).
Anomia trigonopsis - attached beneath low tide and subtidal rocks inside harbour. Rare on exposed west coast.
Arthritica bifurca - sieved from low tide sand on north shore of Manukau Harbour.
Atrina zelandica - recorded live at Cornwallis and Mill Bay in 1955 (CS). Occasional specimens alive in low tide sand and mud at Armour Bay in Dec 2001. Washed up specimens on Manukau Harbour shores thickly encrusted with large red and yellow sponges.
Austrovenus stutchburyi- small populations alive at Armour Bay some in rocky hollows and sparse sand towards Big Muddy Creek; abundant at Mill Bay, Cornwallis and Huia Bay.

Bankia australis - in old waterlogged trees and wood in mangrove swamps, and washed up on north shore of Manukau Harbour.
Bankia neztalia - in wood washed up at North Piha.
Barbatia novaezelandiae - occasional at Cornwallis in1950's (CS). Dead at Te Waharoa in this survey.
Barnea similis - large numbers at low tide in Pleistocene sandstone at Cornwallis and Waitemata Sandstones at Mill Bay. Also boring into sandstones at Te Waharoa and Bartrum Bay on the west coast.
Bassina yatei - found alive on Te Tau bank in the 1950's (CS). In this survey washed up dead at several localities.
Borniola reniformis - only found dead on the north shore of the Manukau Harbour. This species lives attached to the underside of low tidal rocks.
Cardita aoteana - a freshly dead valve was found among low tide rocks at Boulder Bay.
Chlamys zelandiae - attached beneath extreme low tide rocks on the north coast of the Manukau Harbour, sometimes in sponge gardens with *Sigapatella novaezelandiae*. Dead valves found at most locations.
Cleidothaerus albidus - rare at low tide on sandstone east of Mill Bay; large specimens recorded at Cornwallis in 1981 (MSM) and Puponga Pt. (AK).
Corbula zelandica - dead at Whatipu and Destruction Gully, washed up from subtidal habitat (Morley and & Hayward 1999a).
Crassostrea gigas – most abundant on the Manukau Harbour rocky shores, especially at mid tide on the east side of Puponga Pt. where they cover the entire rocks. Large specimens are present in low numbers attached to cobbles in the mouth of Piha, Huia and Big Muddy Creek estuaries; form a narrow mid tidal belt on gentler slopes at Huia and Kaiteke Points, and scattered specimens on more sheltered portions of the west coast rocky shores.
Cyclomactra ovata - dense beds of dead *C. ovata* in life position in more muddy sand in sheltered parts of Huia Bay, north of Karamatura delta and just outside the mouth of Huia Stream; numerous single and double shells strewn across Huia Bay sand flats. Not found on the open coast.
Divalucina cumingii - found dead at several open coast and harbour locations.
Dosina zelandica - live specimen at low tide at Kaitarakihi in sediment among rocks, frequent at the mouth of Huia Bay.
Dosinia anus - many washed up dead only on the open coast.
Dosinia anus white form - one specimen washed up at Muriwai Beach.
Dosinia lambata – washed-in freshly dead at Armour Bay and Huia.
Dosinia maoriana – washed-in at Huia and Cornwallis.
Dosinia subrosea – commonly washed up dead on sheltered Manukau Harbour beaches, and less commonly on the open coast.
Felaniella zelandica - a few valves washed up on the north shore of the Manukau Harbour.
Gaimardia finlayi - although usually living on the fronds of *Osmundaria colensoi*, this small bivalve was attached by its byssal threads to *Corallina officinalis* at Mercer Bay, it is only found on the exposed west coast.
Gari lineolata - single valves washed in on the open coast.
Gari stangeri - single valves washed in at Anawhata and Huia.
Glycymeris modesta - single valves washed in at Maori Bay and Anawhata.
Hiatella arctica - a common species living under holdfasts and low tide stable rocks at most localities around the Waitakeres' coast.
Hunkydora australica novozelandica - found alive at low tide on Te Tau bank in 1961 (CS), and washed up at Puponga Pt. in 1994 (MSM). Not found in this survey.
Irus elegans - uncommon, only found dead at Puponga Pt.
Irus reflexus – found at many localities right around the coast, nestling in old rock borer holes at Te Waharoa; dead in sediment beneath low tide boulders on the west side of Paratutae; boring in algae holdfasts at Boulder Bay.
Lasaea hinemoa – restricted to the Manukau Harbour coast, only found live at Mill Bay.
Lasaea maoria - occasional at Cornwallis in 1953 attached to the underside of high tide stones (CS). Not found in this survey.
Lasaea parengaensis - one specimen found dead beneath low tidal rocks at Mill Bay.
Leptomya retiaria - dead valves washed up within the harbour, from its usual subtidal habitat.
Macomona liliana - common at mid tide in muddy fine sand between Huia and Armour Bays. Not found living on the open coast.
Mactra discors – a surf clam commonly washed up on the open coast.
Maorimactra ordinaria – dead shells washed-in from their offshore sand habitat on exposed west coast at Te Waharoa Bay.
Modiolarca impacta - live at Mill Bay, single valves washed up on harbour beaches.
Modiolus areolatus - recorded from Powell Bay (AK) and dead at Cornwallis in the 1950's (CS).
Myadora boltoni - dead specimens washed up at Huia and Kakamatua Inlet.
Myadora striata - recorded as occasional at Cornwallis in the1950's (CS); found washed up dead at several locations in this survey.
Myadora subrostrata – washed up dead at Kakamatua.
Myllitella vivens vivens - a valve found in shell sand at Te Waharoa Bay.
Nucula hartvigiana - only found alive on the north coast of the Manukau Harbour, abundant at Huia on intertidal sand flats. Rare in sand and algae between rocks at Boulder Bay.
Nucula nitidula - found dead on the open coast and at Kakamatua. A single live specimen in low tidal sand sieved at Boulder Bay.

Ostrea aupouria - abundant on spring low tide rocks at Destruction Gully and Huia.
Ostrea lutaria - live at low tide attached to loose rocks at Armour Bay and Lawry Bay; also recorded from Mill Bay in the1950's (CS).
Panopea zelandica - a single valve washed in at Huia.
Paphies australis – in mid tide sand often where stream flows across beach; abundant alive in parts of Huia Bay; common alive at Cornwallis.
Paphies donacina – this surf clam is commonly washed-in along the open coast and carried as far into the Manukau Harbour as far as Huia.
Paphies subtriangulata - rarely washed up in the harbour and on the open coast.
Paphies ventricosa - single valves found at Muriwai and Powell Bays. Very large valves north of Muriwai are washed out from middens.
Pecten novaezelandiae – a few live specimens in sand at spring low tide on northern shores of Manukau Harbour.
Periploma angasi - two specimens dug alive in low tide sand at Cornwallis Beach in 1981 (MSM); not found in this survey.
Perna canaliculus - abundant on low tidal rocks on exposed west coast. Large spat fall in December 1999. From Huia Pt. to Puponga Pt. is a zone of *Perna* below mid tide level, in association with oysters.
Peronaea gaimardi – commonly washed up all along most of the exposed west coast.
Philobrya munita - common attached by byssal threads in holdfast and base of *Osmundaria colensoi* seaweed wherever this occurs on the exposed coast. Also in the base of *Melanthalia abscissa* at Boulder Bay.
Pholadidea suteri – found boring into low tide mudstone reefs at Huia, Mill Bay and Te Waharoa.
Pholadidea tridens - found boring into low tide sandstone at Powell Bay, and dead at Puponga Pt.
Pododesmus zelandicus - only found washed up dead at Muriwai Beach.
Protothaca crassicosta - a few valves found washed up on the open coast and inside the entrance of the Manukau Harbour.
Pseudarcopagia disculus - only found dead inside the entrance to the Manukau Harbour.
Rexithaerus spenceri - recorded washed up at Muriwai Beach (AK) and at Te Henga in this survey.
Ruditapes largillierti - one live specimen found at Anawhata, frequently washed up on harbour shores.
Saccostrea cucullata –previously recorded alive on low tide rocks along the north Manukau Harbour coast in the 1950s (CS), prior to the arrival of the Pacific oyster.
Scalpomactra scalpellum - single valves found washed up at Destruction Gully and Te Waharoa.
Solemya parkinsoni - found washed-in at Muriwai in this survey; previously recorded dead at Puponga Pt. in the 1950's (CS).
Soletellina nitida – washed-in at Te Waharoa, Te Henga and Mill Bay.
Soletellina siliquens - one valve washed in at Cornwallis.
Spisula aequilatera - large numbers of this surf clam are washed up after strong on-shore winds on the open coast, many strongly marked with purple inside the valves.
Tawera spissa – washed-in at several sites on the open coast and at Kakamatua Inlet.
Tellinota edgari – an uncommon species, found dead at Muriwai and Karekare.
Theora lubrica - several small specimens were sieved in low tide sediment at Mill Bay in July 2000 and twenty or more (4-15 mm length) were sieved in soft gloopy mud at extreme low tide on the edge of the channel of Big Muddy Creek in Sept. 2000. These are the first records of this introduced species from the Manukau Harbour.
Xenostrobus pulex - abundant or common on intertidal rocks around all the Waitakeres' coast. Populations have cycles, increasing when there is abundant sand present (Michael Miller, pers. comm.). Also attached to mangrove trunks at Big Muddy Creek.
Xenostrobus securis - many specimens present attached to submerged cobbles and water-logged logs in the mouth of Piha Stream estuary and up at least as far as the foot bridge, July 2000.
Zelithophaga truncata - rare at Te Waharoa in this survey; recorded as occasional at Mill Bay in the 1950's (CS) and Puponga Pt. (AK).
Zenatia acinaces – found washed up dead at Te Henga in this survey; recorded dead at Cornwallis in the 1950's (CS) and Puponga Pt. (AK).

SCAPHOPODA (tusk shells)

Antalis nana - washed up in large numbers at Kaitarakihi and lower numbers all along north Manukau shore and sporadically on the west coast at Te Waharoa and Maori Bay. It clearly lives in high numbers in subtidal sediment inside the entrance to the Manukau Harbour. There are no reports of this species washing ashore on the east coast of the North Island.

CEPHALOPODA (squid, octopus)

Octopus indet. - single specimens seen at low tide in rocky areas at Maori Bay, Mercer Bay and Destruction Gully.
Spirula spirula - large numbers washed up along the open coast and into the Manukau Harbour as far as Puponga Pt., often with goose-necked barnacles *Lepas antifera* attached.

ECHINODERMATA (seastars, sea eggs, sea cucumbers)

Allostichaster polyplax – most frequently encountered under cobbles at low tide on the north Manukau shore; more rare in similar habitat on the exposed west coast.

Australocnus calcarea - a single specimen found alive under a boulder at Destruction Gully. This attractive small white species has scattered red tubercles on the back. It attaches to the substrate with tube feet.
Coscinasterias muricata - frequent under and around low tide boulders on the north Manukau Harbour coast; rarer on the open coast.
Echinocardium cordatum - not found alive, recorded dead at Kakamatua Inlet.
Evechinus chloroticus - in good numbers under low tide ledges and between stable boulders at Te Waharoa; kina is less common but present right around the Waitakeres' coast.
Fellaster zelandiae - live specimens in low tide sand at Kakamatua, Huia and Cornwallis; broken specimens are washed up on west coast beaches, where they presumably are a prominent part of the subtidal surf zone biota.
Patiriella regularis - found right around the Waitakeres' coast, although mostly rare on the open coast; more common at some Manukau Harbour locations, e.g. Huia.
Stichaster australis – a typical west coast species. Abundant among and below mussels at low tide on exposed rocky west coast; extends into the entrance of the Manukau Harbour as far as Kaiteke Pt., Little Huia.
Ophionereis fasciatus - only found rare on sand beneath low tidal stones, just inside the Manukau Harbour entrance at Boulder Bay and Destruction Gully.

CRUSTACEA – DECAPODA (crabs, shrimps)

Cancer novaezelandiae – rare on the northern rocky shores of the Manukau Harbour from Whatipu to Puponga Pt.
Cyclograpsus lavauxi - a single specimen found on the west coast (at Wigmore Bay, south Te Henga); common beneath high tidal and splash zone cobbles and boulders all along the north Manukau Harbour coast.
Halicarcinus spp. - live among low tide seaweeds and under low tidal boulders right around the Waitakeres' coast, not always identified to species level.
Halicarcinus cookii – previously collected at Piha (AK3658).
Halicarcinus innominatus – previously collected from Muriwai and Piha (AK6218).
Halicarcinus ovatus – previously collected from Te Waharoa (AK76232).
Halicarcinus whitei – previously collected from Huia (AK3623).
Helice crassa - abundant in mid-high tide burrows at Big Muddy Creek, not found on the open coast.
Hemigrapsus crenulatus - in mid and low tidal muddy sand at Mill and Armour Bays; not found on the open coast.
Hemigrapsus edwardsi – common right around the Waitakeres' coast.
Heterozius rotundifrons - many under mid-low tide rocks on the shore from Cornwallis to Armour Bay; not found elsewhere in this survey.
Leptograpsus variegatus - common in cracks on intertidal rocks on the open coast; less common inside the Manukau Harbour.
Macrophthalmus hirtipes – restricted to the sheltered shores of the Manukau Harbour, except for rare specimens in burrows beneath cobbles in sand subtidally in the entrance to Piha Stream estuary. Common in mid and low tidal sand at Mill and Armour Bays, where large specimens threaten visitors with the yellow underside of their chelae.
Notomithrax peronii - common among scurfy weeds on low tide rocks around Lawry Pt.; not found on the open coast..
Notomithrax ursus – occasionally present among low tidal seaweeds on the open coast and inside the Manukau Harbour.
Ovalipes catharus – this swimming crab is periodically washed ashore dead right around the Waitakeres' coast.
Ozius truncatus - common under low to mid tidal stones on the shores of the outer part of the Manukau Harbour, from Paratutae to Kaitarakihi; less common on the exposed west coast.
Pagurus novizelandiae – moderately common among rocks at low tide along most of Waitakeres' coast.
Petalomera wilsoni - bronze-red crab found in washed up bright red sponge attached to a horse mussel, at Armour Bay. Slow moving and docile. Holds a cap of fitted sponge over the rubbery carapace with the last pair of legs. Presumably sourced from subtidal or low tidal horse mussel beds on Puponga Bank or nearby in the Manukau Harbour.
Petrolisthes elongatus - rare on the open coast living under rocks and at Mercer Bay in the base of mussel mats; common under mid tide rocks on north side of Manukau Harbour.
Pilumnus lumpinus – occasionally found under mid and low tidal rocks on the shores of the north Manukau Harbour; not recorded from the open west coast.
Pinnotheres novaezelandiae – the pea mussel lives inside many green mussels, mostly on the open west coast but also inside the Manukau Harbour, wherever *Perna* grows.
Plagusia chabrus - Frequent at and below low tide among rocks right around the Waitakeres' coast.
Alope spinifrons - occasional or rare under low tide stones right around the Waitakeres' coast.
Alpheus sp. – this burrowing shrimp is frequent at Big Muddy Creek.
Callianassa filholi- present in low tide sediments along the sheltered shores of the north Manukau Harbour (AK101124).
Palaemon affinis - live among low tide seaweeds at Mill Bay.
Pontophilus australis – recorded from intertidal muddy pools at Cornwallis (AK8386).

AMPHIPODA (sea hoppers)

Talorchestia sp. – sand hopper encountered under cobbles and in sand at high tide level right around the Waitakeres' coast.

ISOPODA (sea lice)

Batedotea elongata – collected from Anawhata in 1930 (AK130453).
Dynamenella cordiforaminalis – recorded from Te Henga by Hurley & Jansen (1977).
Dynamenella huttoni - recorded from Te Henga and Piha by Hurley & Jansen (1977).
Euiodotea durvillei- collected from Anawhata in 1931 (AK130449).
Idotea metallica – only recorded from Huia Point in this survey.
Isocladus armatus - recorded from Te Henga and Piha by Hurley & Jansen (1977).
Ligia novaezelandiae – moderately common in the splash zone under boulders on the north Manukau Harbour coast.
Pseudosphaeroma campbellensis - recorded from Te Henga by Hurley & Jansen (1977).
Scutuloidea kuta – recorded from low tide in a gut at Lion Rock, Piha (AK72951), by Stephenson & Riley (1996).
Scutuloidea maculata – recorded on *Osmundaria colensoi* in a low tide gut at Lion Rock, Piha (AK98200).

BARNACLES

Australophialus melampygos - this tiny shell-less barnacle bores into the beaks of old mussel shells, living *Dicathais orbita, Plaxiphora obtecta* and *Haliotis iris*; recorded from Lion Rock, Piha by Morton & Miller (1968, p 290).
Austrominius modestus - common at all tide levels on rocks and shells on the north Manukau Harbour shores; also on high tide mangroves at Huia and Big Muddy Creek; not on exposed west coast.
Balanus trigonus – rare on low tide rocks on the exposed west coast.
Calantica spinosa – at mid tide levels in caves and dark crevices on the exposed west coast and just inside the Manukau Harbour entrance at Boulder Bay.
Calantica villosa – recorded from under a dark overhang at mid tide level at Piha by Morton & Miller (1968, p.273).
Chamaesipho brunnea – common barnacle forming a narrow belt at the top of the barnacle zone right around the Waitakeres' coast, although less abundant in the most sheltered Manukau Harbour shores on soft sandstone substrates.
Chamaesipho columna - abundant zone-forming barnacle on rocky shores right around the Waitakeres' coast, as far into the Manukau Harbour as Puponga Pt.
Conchoderma virgatum – recorded attached to the flipper of a hawksbill turtle washed up on North Piha in 1970 (Foster, 1978; AK75777).
Epopella plicata – common zone-forming barnacles at mid-high tide levels on rocky shores right around the Waitakeres' coast; less common inside the Manukau Harbour.
Lepas anatifera - attached to drift wood washed up in large numbers on the open coast.
Lepas fascicularis – sometimes found as a pair of barnacles attached each side of a central float resembling an iridescent blue butterfly. Rarely washed up on New Zealand beaches; recorded here washed up dead at Muriwai (AK78209) and still alive on Piha Beach.
Lepas pectinata – rarely washed ashore in northern New Zealand; recorded here washed up at Muriwai in 1993 (AK78210) and Piha (Foster, 1978).
Lepas testudinata – not found in this survey, but previously recorded washed up at Muriwai in 1993 (AK78208) and Piha (Foster, 1978).
Megabalanus tintinnabulum linzei – a large tall barnacle, frequent on exposed rock faces near low tide on exposed west coast and just inside the Manukau Harbour.
Notobalanus vestitus - sporadic and rare occurrences beneath low tide boulders on the exposed coast and inside the Manukau Harbour entrance.
Tetraclitella aoranga – not recognised in this survey; historical record from beneath low tide boulders at Anawhata (Foster, 1978).
Tetraclitella depressa - under low tide stones and in caves at low to mid tide on the open coast and inside the Manukau Harbour entrance.

OSTRACODA

Leuroleberis zealandica - dead in beach sand at Destruction Gully.

COELENTERATA (sea anemones, corals)

Actinia tenebrosa - on the open coast and on the north shore of the Manukau Harbour, in shaded areas, often under boulders and overhangs at mid-high tidal level.
Actinothoe albocincta - in mid tidal pools and rocks around most of the Waitakeres' west coast.
Alcyonium aurantiacum – recorded by Morton & Miller (1968) from Piha.
Amphisbetia bispinosa - attached to green mussel shells, *Perna canaliculus* on the open coast.
Anthopleura aureoradiata - attached to live and dead cockle shells on mid and low tide sand flats on the north shore of the Manukau Harbour.
Corynactis australis – rare, found at and below low tide under rock overhangs or in caves, often mixed with sponge gardens; on exposed west coast and inside the Manukau Harbour as far as Puponga Pt.
Cricophorus nutrix - one specimen attached to *Carpophyllum maschalocarpum* at low tide at Te Waharoa.
Culicia rubeola - on shaded rock faces and under rocks at low tide and subtidal level on exposed coast and in the Manukau Harbour entrance.
Diadumene neozelanica - on shaded and overhanging rock at low tide, right around the Waitakeres' west coast.

Isactinia olivacea - in mid to high tidal pools and on sandstone reefs inside the Manukau Harbour; present right around the Waitakeres' coast.
Isocradactis magna – a typical west coast species found at low tide in cracks and guts, often partly submerged in sand; sometimes in mid tide rock pools, partly camouflaged by shell and sand.
Orthopyxis sp. - recorded by Morton & Miller (1968) from Lion Rock.
Oulactis muscosa - recorded sporadically from intertidal rock pools on the north Manukau Harbour coast (AK131998).
Physalia physalis – Portuguese man-of-war, washed up on exposed beaches, particularly in March 2000.
Plumularia sp. - recorded by Morton & Miller (1968) from Lion Rock.
Porpita porpita - a pelagic hydrozoan from tropical seas that dries to a flat disc; an uncommon wash-up on exposed beaches of northern New Zealand. Discs found at Whites Beach. Six living specimens washed into pools at Boulder Bay in March 2002. Exquisitely coloured in iridescent blues and purple. The ring of serrated tentacles fell off when disturbed.
Velella velella - washed up on exposed beaches, particularly in March 2000.

BRYOZOA

Beania sp. - found on the underside of low tide rocks from Destruction Gully to Mill Bay on the north Manukau Harbour coast.

WORMS

Aglaophamus macroura – collected from high tidal sand pool at Karekare in 1996 (AK101508).
Boccardia sp. - recorded by Morton & Miller (1968) from Piha.
Eulalia microphylla – infaunal in intertidal sand flats on north Manukau Harbour coast.
Eupholoe sp. - infaunal in intertidal sand flats on north Manukau Harbour coast.
Flabelligera bicolor - under low tide rocks inside the Manukau Harbour.
Galeolaria hystrix – rarely encountered under low tidal rocks on the exposed west coast.
Glycera americana - infaunal in intertidal sand flats on north Manukau Harbour coast.
Hydroides elegans – under low tidal rocks inside the Manukau Harbour entrance.
Lepidastheniella sp. - infaunal in intertidal sand flats on north Manukau Harbour coast.
Lumbrinereis coccinea - infaunal in intertidal sand flats on north Manukau Harbour coast.
Marphysa depressa - infaunal in intertidal sand flats on north Manukau Harbour coast.
Neosabellaria kaiparaensis – sand tube worm often zone-forming at low-mid tidal level on rocky shores right around the Waitakeres' coast.
Onophis aucklandensis - infaunal in intertidal sand flats on north Manukau Harbour coast.
Owenia fusiformis - infaunal in intertidal sand flats on north Manukau Harbour coast.
Paraidanthyrsus quadricornis – occasionally found forming encrusting mat covered with coralline paint at low tide level on rocks on the west coast and just inside the Manukau Harbour entrance.
Pectinaria australis – the dead tusk-like tube of this worm is commonly washed ashore on the north Manukau Harbour beaches.
Perinereis novaehollandiae - recorded by Morton & Miller (1968) from Piha.
Phyllodocid indet. - infaunal in intertidal sand flats on north Manukau Harbour coast.
Platynereis australis - infaunal in intertidal sand flats on north Manukau Harbour coast.
Salmacina australis - has a narrow tube that spreads a delicate network over shells and the undersides of low tidal boulders; occurs right around the Waitakeres' coast.
Spirobranchus cariniferus - common zone-forming tube worm at mid-low tide level on rocky shores right around the Waitakeres' west coast; extensive area with specimens attached to cobbles near Lawry Point.
Spirorbis sp. - frequent beneath low tide stones and on dead shells right around the Waitakeres' coast.
Terebellidae indet. - infaunal in intertidal sand flats on north Manukau Harbour coast.

NEMERTINE WORMS

slender orange nemertean - recorded by Morton & Miller (1968) from Piha.

PLATYHELMITHS

flat worms - frequent under low and mid tide rocks on the north Manukau Harbour coast.

SIPUNCULIDS

Themiste minor huttoni – occasionally recorded from low tidal borings in softer sandstone substrates at Te Waharoa, Huia and Puponga Pt.

PHORONIDS

Phoronis ovalis – recorded from Lion Rock by Morton & Miller (1968).

SPONGES

Aaptos globosum – historical record from Puponga Pt.
Aaptos tentum - rare on low tide reef near Lawry Pt.
Adocia venustina - historical record from Puponga Pt.
Ancorina alata - a heavy black sponge beneath overhanging low tide boulders and in low tide caves, becomes more common subtidally. Common under rocks at Boulder Bay; sporadically present right around the coast.
Callyspongia fistulosa – recorded from Anawhata and North Piha by Bergquist & Warne (1980).
Callyspongia ramosa - rare at Puponga Pt.
Carmia hentscheli – recorded from Maori Bay by Bergquist & Fromont (1988).
Carmia macilenta – recorded from Maori Bay by Bergquist & Fromont (1988).
Cliona celata – this yellow-orange sponge is common under low tide ledges around the whole Waitakeres' coast.
Darwinella gardineri – a red spiky, branched sponge recorded from Puponga Pt. and Anawhata by Bergquist (1996).
Darwinella oxeata – a sulphur yellow, spiky sponge recorded from Puponga Pt. by Bergquist (1996).
Halichondria moorei – the bread crust sponge occurs sporadically at low tide on the west coast and north Manukau Harbour shores.
Halichondria panicea – recorded from Anawhata and Piha by Bergquist (1970).
Haliclona brondstedi - recorded from Anawhata and Piha by Bergquist & Warne (1980).
Haliclona heterofibrosa - recorded from Cornwallis and Mill Bay by Bergquist & Warne (1980).
Haliclona tenacior - recorded from North Piha, Huia and Cornwallis by Bergquist & Warne (1980).
Hymeniacidon perleve - recorded from Anawhata and Piha by Bergquist (1970).
Isociella incrustans – historical record from Maori Bay.
Microciona coccinea - this sponge grows as a bright red sheet, present at low tide at most localities around the Waitakeres' coast.
Ophlitaspongia reticulata – recorded from Piha by Bergquist & Fromont (1988).
Polymastia aurantium – historical record from North Piha.
Polymastia fusca - recorded by Morton & Miller (1968) from Piha.
Polymastia granulosa - recorded by Morton & Miller (1968) from Piha and from Piha by Bergquist (1968).
?Suberites axinellooides - this bright orange encrusting sponge occurs right around the Waitakeres' coast.
Tethya aurantium – occurs in low tide in cracks and under overhangs, on the exposed coast and on the north Manukau Harbour coast.
Tethya australis – sporadic records at low tide right around the Waitakeres' coast.
Tethya mortoni - this small, maize yellow sponge, has previously been recorded from Cornwallis.
Tethya stolonifera - this small, red and yellow sponge, has previously been recorded from Cornwallis.

SEA SQUIRTS

Aplidium phortax - compound ascidian occurring under ledges and overhangs at low tide at various places right around the Waitakeres' west coast.
Asterocarpa coerulea - a white and blue ascidian, frequent under low tide rocks east of Mill Bay and near Huia Pt.; fewer specimens at other locations on the north shore of Manukau Harbour; not recorded from exposed west coast.
Botryllus schlosseri - yellow-grey compound ascidian, present under edges of low tide rocks and boulders in various places right around the Waitakeres' coast.
Cnemidocarpa bicornuata - an orange ascidian, frequent under low tide rocks east of Mill Bay; less common elsewhere on the north Manukau Harbour coast; not present on the exposed coast.
Corella eumyota - under low tide boulders along the north Manukau Harbour shore; not found on exposed west coast.
Pyura rugosa - occasional under low tidal boulders on the exposed west coast; less frequent on the Manukau Harbour shores.

FISH

Acanthoclinus fuscus - frequent under low tide rocks along the north Manukau Harbour coast; not present on the exposed coast,
Bellapiscis medius – collected from intertidal rock pool at Paratutae in 1973 (AK592).
Grahamina capito – collected from low tide sand pools at Cornwallis Beach in 1973 (AK80682).
Hemerocoetes monopterygius – recorded from the Waitakeres' west coast by Paulin & Roberts (1992).
Parablennus laticlavus - recorded from the Waitakeres' west coast by Paulin & Roberts (1992).
Paratrachichthys trailli - recorded from the Waitakeres' west coast by Paulin & Roberts (1992).
Pseudophycis bachus - recorded from the Waitakeres' west coast by Paulin & Roberts (1992).
Trachylochismus melobesia – sucker fish present under low tide rocks just inside the Manukau Harbour entrance.

ALGAE (sea weeds)

Acrosorium venulosum – only record from a rock pool at Karekare in 1950 (AK239286).
Adamsiella chauvinii – recorded from Piha and Anawhata in the 1930s-1940s (AK148478).
Aeodes nitidissima - occasional at Te Henga and Anawhata.

Apophlaea sinclairii - an endemic species, dark red patches on mid-high tide rocks on exposed coast and around mid tide at Kaiteke Pt.
Arthrocardia corymbosa - common or occasional as a pink turf with other algal species on the exposed coast.
Audouinella purpurea – present on intertidal rocks at Destruction Gully (identified by Wendy Nelson).
Bachelotia antillarum – present on mussels at low tide level at Maori Bay.
Bangia sp. – recorded on intertidal rock platform at the mouth of Waitakere River in 1934 (AK146978).
Bryopsis plumosa – growing on low tidal rocks and mussels on exposed west coast rocks.
Bryopsis vestita - occasional in intertidal rock pools at Te Henga, Anawhata , Paratutae and Kakamatua Inlet.
Caloglossa leprieurii - only found at Mill Bay growing on mid-high tide rocks; also washed up attached to mangrove twigs.
Callophyllis calliblepharoides – attached to low tide rocks on the exposed west coast.
Callophyllis hombroniana - present on the exposed coast.
Capreolia implexa – on low tidal rocks and mussels at Pillow Lava and Maori Bays.
Capreolia sp. – on intertidal rocks at Karekare.
Carpophyllum maschalocarpum – dominant seaweed in the subtidal fringe on the north Manukau Harbour coast; also common on exposed west coast.
Carpophyllum plumosum - subtidal fringe, only found at Te Henga.
Catenella fusiformis – abundant on high tide rocks at Destruction Gully (identified by Wendy Nelson).
Catanella nipae - continuous dark woven masses attached to mangrove trunks and pneumatophores in Huia and Big Muddy Creek estuaries.
Centroceras clavulatum – on intertidal rocks at Foster Bay, Huia (identified by Wendy Nelson).
Chaetomorpha aerea - occasional in high tide pools on the open coast; luxurious at Boulder Bay in March 2002.
Chaetomorpha capillaris – on intertidal rocks at Boulder Bay.
Chaetomorpha linum – in high tidal rock pools on the open west coast.
Champia novae-zelandiae - occasional at low tide level on the open west coast.
Cladhymenia oblongifolia – on low tide rocks on the open west coast.
Cladophora sp. - occasional on the open coast and inside the Manukau Harbour.
Cladophoropsis herpestica – on low tidal rocks at The Gap, Piha.
Codium convolutum - grows close to the rock as dark green-lobed cushions at mid and low tide levels both in the Manukau Harbour and in more sheltered habitats on the west coast.
Codium aff. *dimorphum* - occasional at Cornwallis.
Codium fragile ssp. *novae-zealandiae* - endemic green alga, its narrow velvety fronds have conspicuous hairs; this is the typical west coast species on lower intertidal rocks on exposed coast, especially at Maori Bay and Te Waharoa. The introduced *C. fragile* ssp. *tomentosoides* is found on the east coast of Auckland.
Codium gracile - occasional on open coast rocks.
Colpomenia peregrina - bladder-like green algae on mid to low tide rocks at Kakamatua Inlet.
Colpomenia sinuosa - occasional from Kakamatua to Mill Bay.
Corallina officinalis - a pink turf often consisting of more than one red coralline and *Gigartina* species; in mid tidal pools, on low tidal and subtidal on rock, abundant or common on most rocky shores in the survey. Plants more stunted in exposed situations.
Curdiea codioides? – on intertidal rocks at Te Waharoa.
Curdiea coriacea – common in tidal pools at north Te Henga in 1931 (AK147510).
Curdiea cf. *flabellata* – only recorded on low tide rocks at Powell Bay.
Dasyclonium incisum – epiphytic on *Pterocladia lucida* at Destruction Gully (identified by Wendy Nelson).
Dasyclonium ovalifolium – epiphytic on *Pterocladia lucida* found at several exposed west coast shores.
Dictyota dichotoma - occasional on intertidal rocks at Cornwallis.
Dipterosiphonia heteroclada – collected at Piha in 1943 (AK148234).
Durvillaea antarctica – major subtidal fringe seaweed off the ends of the most exposed points from Maori Bay to Pararaha (see map).
Echinothamnion hystrix - epiphytic on *Gymnogongrus torulosus;* only recorded at Pillow Lava Bay.
Ecklonia radiata - large healthy plants just below low spring tide all along the north Manukau Harbour coast from Paratutae to Mill Bay.
Endarachne binghamiae – on intertidal rocks along the west coast.
Enteromorpha bulbosa - grass green alga frequent on intertidal reef platform at Whites Beach, occasional elsewhere on the open coast (AK247498).
Enteromorpha intestinalis – present on high tide rocks and cliffs in water seepage right around the Waitakeres' coast.
Enteromorpha linza – collected at Piha and Anawhata in the 1930s (AK145860).
Enteromorpha ramulosa - sporadic on the north Manukau Harbour coast.
Gelidium caulacantheum - common zone-forming stubbly brown alga at mid tide level on rocks right around the Waitakeres' coast.
Gigartina alveata - commonly forms a conspicuous dark zone above low water on many open coast rocky shores; not found inside the Manukau Harbour.
Gigartina atropurpurea - a large red alga with many broad fronds attached to rock at low tide or in pools. Common on the exposed west coast, but not recorded inside Manukau Harbour. The fronds of young plants are smooth and graded with yellowish pink and pale green; when mature they are rich purplish-red covered with many blunt papillae.

Gigartina chapmanii – only found at Kaiteke Pt.
Gigartina circumcincta - a large alga, on low tidal to subtidal on rock, only on the exposed west coast.
Gigartina decipiens – many specimens collected from Te Henga in 1930 and 1931 (AK147661).
Gigartina laingii – common zone forming scurfy seaweed on intertidal rocks and in pools, on the north Manukau Harbour coast between Paratutae and Kaitarakihi.
Gigartina livida – only recorded from Te Waharoa.
Gigartina macrocarpa - occasional on intertidal rocks on the exposed west coast.
Gigartina marginifera – present and sometimes zone-forming on low tide rocks along most of the exposed west coast; not present in the Manukau Harbour.
Glossophora kunthii - occasional on low tidal rocks on the open coast and just inside the Manukau Harbour.
Gracilaria chilensis - large area of low tide flats across middle of Huia Bay and entrance to Big Muddy Creek are covered in this 10-20 cm purple pink algae in April 2001 and January 2002. Also present in sheltered tidal pools on the west coast.
Gracilaria truncata – collected from intertidal rock pools around Kauwahaia Island, O'Neills Beach in 1995 (AK222509).
Gracilaria sp.- occasional at Mill Bay.
Grateloupia intestinalis – only recorded from Anawhata in 1930 and 1931 (AK147273).
Grateloupia stipitata – collected from Te Henga, Whites Beach and Piha in the 1930s (AK128758).
Grateloupia urvilleana – sporadically present on exposed west coast rocks.
Griffithsia traversii – recorded as epiphytic on *Pterocladia lucida* from Anawhata-Paikea Bay in the 1930s and 1940s (AK148040).
Griffithsia sp.- a fine red alga, epiphytic on *Callophyllis hombroniana* at low tide at Powell Bay.
Gymnogongrus furcatus – widespread on intertidal rocks up and down the west coast and at Paratutae, Whatipu.
Gymnogongrus humilis - occasional on intertidal rocks at Mercer Bay.
Gymnogongrus torulosus - occasional on intertidal rocks and in pools on the open west coast.
Haliptilon roseum - a red turf, common on west coast rocks and occasional inside the Manukau Harbour.
Helminthocladia australis – recorded from Anawhata and Te Henga in tidal pools in the 1930s (AK147098).
?Helminthora lindaureri – only recorded from Te Waharoa.
Heterosiphona tessellata – only recorded from Te Waharoa.
Hormosira banksii - common on semi-sheltered mid tide rock platforms and pools at Powell Bay, Bartrum Bay and Te Waharoa, and also inside Manukau Harbour.
Hymenena palmata - rich crimson algae with a blue iridescence; on low tidal rocks on the exposed west coast and occasionally inside the harbour, at Kakamatua.
?Hymenena sp. - only found at Mill Bay.
Jania crassa – recorded from tidal pools at Piha in 1995 (AK223747).
Landsburgia quercifolia - a large brown alga with oak-shaped fronds on low tide rocks, sporadically right around the Waitakeres' coast.
Laurencia thyrsifera – sporadic occurrences on low tidal rocks on the open coast.
Lessonia variegata - a large golden brown alga with long strap-like blades, growing below low tide on the exposed west coast, especially at Te Waharoa.
Lophurella caespitosa – sporadic occurrences on intertidal rocks growing with *Gelidium caulacantheum* on the west coast and inside the Manukau Harbour entrance.
Melanthalia abscissa – a common seaweed in the subtidal fringe seaweed zone with *Carpophyllum maschalocarpum* on the open coast and on the northern shore of the Manukau Harbour.
Microcladia novae-zelandiae? - a red alga on low tidal rocks found at Te Waharoa Bay.
Microzonia velutina – recorded from Anawhata in 1931 (AK146533).
Myriogloea intestinalis – in intertidal rock pools at Maori Bay.
Nemalion helminthoides - occasional on low tidal rocks at Te Waharoa.
Notheia anomala - a small brown alga, parasitic on *Hormosira banksii,* frequent at Powell Bay; also recorded from Anawhata.
Nothogenia fastigiata - frequent on low tidal rocks at Te Henga and Anawhata.
Nothogenia pulvinata – only found in this survey on low tidal rocks at Mercer Bay.
Nothogenia cf. *pseudosaccata* – only found in this survey at Te Waharoa.
Osmundaria colensoi - a distinctive red alga with narrow fronds with serrated edges, found in the subtidal fringe on rocks and in guts on the exposed west coast; not present on more sheltered shores inside the Manukau Harbour, east of Destruction Gully.
Pachymenia crassa - occasional on the open west coast.
Pachymenia lusoria – common on mid tide rocks on the exposed west coast.
Petalonia fascia – sporadic on intertidal rocks on the open coast and inside the Manukau Harbour entrance.
Placentophora colensoi – recorded from Anawhata in 1934 (AK130692).
Plenosporum hirtum – recorded from Karekare in 1950 (AK239282).
Plocamium angustum – in intertidal pool around Kauwahaia Island, O'Neills Bay (AK222513).
Plocamium cirrhosum – found at Fosters Bay, Huia during this survey.
Plocamium microcladioides – found at Fosters Bay, Huia, during this survey.
Polysiphonia sp. – in tidal pools and on rocks on the west coast and occasionally on the north Manukau Harbour coast.

Porphyra columbina – seasonally grows on mid to high tide rocks in spring and early summer on the exposed west coast and just inside the Manukau Harbour entrance.
Porphyra cf. *subtumens* – recorded growing on *Durvillaea* on Anawhata in 1930 (AK146945).
Pterocladia lucida – frequent in subtidal fringe on exposed rocks only on the west coast.
Pterocladiella capillacea - frequent in subtidal fringe on exposed rocks only on the west coast.
Rhizoclonium sp. – sporadic records at several sites around the Waitakeres' coast.
Rhodophyllis gunnii? - occasional at Te Waharoa and Boulder Bay.
Rhodymenia dichotoma – recorded in mid tide rock pools and on low tide rocks on exposed west coast (AK239248).
Rhodymenia leptophylla – recorded in tidal rock pool at Karekare in 1950 (AK239284).
Rhodymenia linearis - occasional on rocks at south Te Henga.
Rhodymenia obtusa – collected from Keyhole Rock, Anawhata, in 1944 (AK147867).
Rhodymenia sp. - occasional at Mill Bay.
?Rivularia – only recorded in this study from Whatipu.
Sargassum sinclairii - occasional plants in the subtidal fringe with *Carpophyllum maschalocarpum*, on the east side of Puponga Pt. No *Sargassum* recorded elsewhere around the Waitakeres' coast.
Schizymenia novae-zelandiae – recorded from low tidal rocks at Anawhata and Te Henga in 1930s (AK148196).
Scinaia berggrenii – recorded from Anawhata.
Scytosiphon lomentaria - occasional at Te Henga.
Scytothamnus australis - on mid tide rocks on open coast and inside the Manukau Harbour entrance.
Solieriaceae indet. – common on intertidal sand flats at Kakamatua, and Mill Bay to Armour Bay on the more sheltered shore of the north Manukau Harbour.
Splachnidium rugosum – recorded from intertidal rocks at Anawhata and Te Henga in 1930s (AK146265); not found in this survey.
Stenogramme interrupta - high numbers of this attractive bright pink alga washed in and growing at low tide at Huia. Less common on the more sheltered harbour beaches; rare on the exposed west coast.
Synarthrophyton patena – recorded from Lion Rock by Morton and Miller (1968) as *Lithothamnion*.
Thamnophyllis sp. – recorded from The Gap, Piha in 1972 (AK239014).
Tinocladia novae-zelandiae – recorded from rock pools at Anawhata in 1931 (AK146279).
Ulva lactuca - on mid to high tidal rocks and around the edges of pools, seasonal; common on the west coast and into the harbour entrance.
Ulva rigida – occasionally on intertidal rocks on exposed west coast.
Ulva spathulata - seasonally common on high tide rock platforms on the open west coast.
Ulva ?stenophylla - occasional on rock at Mill Bay.
Xiphophora chondrophylla - occasional at Powell Bay; not recorded elsewhere on the Waitakeres' coast.
Zonaria turneriana – recorded from Anawhata in 1944 (AK146576).

LICHENS

Lichina confinis - on hard andesite breccia and lava at high tide level; most common just inside the Manukau Harbour entrance between Whatipu and Little Huia; periodically on exposed west coast.
Verrucaria maura – on harder mid tidal rocks around the Waitakeres' coast.
Xanthoria parietina – yellow foliose lichen growing low on maritime rocks in the splash zone in various places around the Waitakeres' coast.
All other recorded lichens are recorded growing on mangroves or *Plagianthus* in Huia estuary or Big Muddy Creek.

ANGIOSPERMS (flowering plants)

Avicennia maritimus - abundant over a large area in Big Muddy Creek, rare plants at the head of Kakamatua Islet and a small area in the Huia Stream estuary.
Zostera muelleri- numerous healthy patches at low tide at Mill Bay, even on sand among boulder field. Large portions of the low tide to spring low tide sand flats across the middle of Huia Bay were covered in *Zostera,* April 2001; not found on the west coast.
All other recorded angiosperms are recorded from salt marsh and salt meadow beside Huia estuary and around the head of Big Muddy Creek.

6. BIOGEOGRAPHY

6.1 Biodiversity comparisons (Fig. 21)

The total (live plus dead) recorded biodiversity (Table 1) of all intertidal biota (excluding salt marsh vascular plants and mangrove lichens) around the coast of the Waitakere Ranges is 569 species, with remarkably similar biodiversity levels on the exposed west coast (409 species) as on the more sheltered Manukau Harbour coast (407 species). The number of species actually recorded living intertidally however, is higher inside the harbour (335 species), than on the exposed west coast (292).

Comparisons of biodiversity numbers with other areas of coast around New Zealand are difficult, because of the differing intensities of surveying and taxonomic identification, and differing extents of the survey areas (e.g. some include subtidal dredging, some exclude sheltered harbour habitats). Keeping this in mind, the biodiversity values for the Waitakeres' coast are not radically different from other west coast North Island areas (Fig. 21) studied by the authors and their colleagues using similar methodologies to those in this study. Clearly the Waitakeres' coast has been more intensely surveyed than other areas, but it also provides perhaps the largest and most diverse range of coastal habitats on the North Island's west coast. A combination of these two factors explains the somewhat higher biodiversity values for the Waitakeres than other west coast areas.

On the east coast, there have been few surveys of a sufficiently similar nature, in terms of the total intertidal biota, with which to make meaningful comparisons. The most similar in terms of intensity of study are those on the Parengarenga and Waitemata Harbours, which should best be compared with the recorded biota of the Manukau Harbour coast of the Waitakeres. The two east coast harbours have slightly greater diversity (452, 522) than that recorded here from the Manukau (407) on the west coast. This difference probably is a good reflector of both slightly greater diversity on the east coast due to both warmer water and more introduced species, especially in the Waitemata Harbour (Hayward, 1997). The highest recorded total biodiversity (623) comes from the inner and middle Waitemata Harbour study, but this is not comparable because it included many dredge stations and far greater intensity of survey and identification of polychaetes, amphipods and isopods.

The taxonomic group most thoroughly studied and identified in each area is the molluscs and this group shows some interesting results (Fig. 21). On the exposed west coast, the diversity of molluscs in each area is close to 200 species, increasing slightly in the north around Ahipara (238) and slightly lower in the south (150-197). Comparing the diversity of molluscs inside Manukau Harbour with other similar sized harbours with a subjectively similar range of exposure levels and habitats, we find comparable results – north Manukau Harbour (237 species), intertidal Waitemata Harbour out to Whangaparoua Peninsula (259), and Parengarenga Harbour (266). The total molluscan fauna of the Waitakeres' coast (274) however, is somewhat lower than that recorded from a number of similar-sized or smaller east coast areas – Bay of Islands (551), Great Barrier I. (472), Whananaki area (360), dredgings off Pakiri in 40 m depth (403), west end Waiheke I. (340), Mahia Peninsula (334). Only the Bay of Islands has received similar intensity of collecting and study to the Waitakeres, and a major reason for its much higher biodiversity is the inclusion of records from several hundred dredge stations. Similarly the Pakiri records are from 40 m water depth, dredged and dumped on Mission Bay beach, and so is not exactly comparable. The other clear reason for the higher diversities of molluscs in east coast areas is the presence of numerous, often somewhat rarer, warmer water species, as a result of the warm East Auckland Current that flows offshore in southwards-moving eddies down the east side of the northern North Island. A few of these warmer water species come around North Cape and part way down the west side of Northland, explaining the slightly increased diversity around Ahipara (Fig. 21).

6.2 Distinctiveness of the Waitakeres' and west coast intertidal biota

The paucity of detailed geographic surveys and accurate taxonomic work in groups outside of mollusca (and foraminifera) makes it difficult to accurately assess the biogeographic distribution patterns of most elements of the biota. We are unaware of any intertidal or marine species that have their distribution limited to the coast of the Waitakere Ranges. The vast majority of species recorded here are widespread in suitable habitats on both the west and east coasts of northern New Zealand and to a slightly lesser extent the North Island in general. The main differences between the west and east coast intertidal biotas are in the additional species (e.g. whelk *Cominella virgata virgata*, *Muricopsis octogonus*, vermetid gastropod *Novastoa lamellosa*, sea hare *Bursatella leachii*, bivalve, *Venericardia purpurata*, high tide crab *Cyclograpsus insularum*, seaweed *Sargassum scabridum*) living on the east coast, because of the warmer water and the human-aided introductions (e.g. *Limaria orientalis*, *Musculista senhousia*, sea squirt *Styela plicata*).

A number of warm-water species live primarily on the east coast, but come part of the way down the coast of Northland from the north (e.g. *Stephanopoma rosea*, sea anemone *Isoparactis ferax*), but are not present as far south as the Waitakeres. Some species are common or abundant on the east coast, but have been recorded rarely in low numbers on the west (e.g. chiton *Onithochiton neglectus*, microgastropod *Anabathron hedleyi*, slipper limpet *Crepidula costata*, *Trochus viridus*, turret shell *Zeacolpus pagoda*, dog cockle *Tucetona laticostata*, seastar *Stegnaster inflatus*, fan

coral *Monomyces rubrum*, sponge *Aaptos confertus*). Several of this latter group have rare records from the Waitakeres' coast and others are absent.

There are also a number of species that are conspicuous on the Waitakeres' west coast shores with their distribution predominantly on the west, rather than east, side of the northern North Island, although they do occur in the most exposed places on the east coast:

6.2.1 Species characteristic of the exposed west coast of the North Island and Waitakeres

Chitons

Plaxiphora biramosa - rare chiton found throughout New Zealand on very exposed coasts, such as the Waitakeres.
Plaxiphora caelata - previously recorded as common on the west coast (Powell, 1979), but our data suggests that their abundance is better expressed as occasional (Lion Rock, Pillow Lava and Powell Bays in this survey).
Plaxiphora murdochi – an extremely rare chiton found on the west coast under stones from Kawerua to Kawhia and Taranaki.
Plaxiphora obtecta – the most common *Plaxiphora* intertidally on the west coast, but also present on more exposed east coast shores.

Gastropods

Alcithoe arabica f. *swainsoni* - typical west coast form with a smooth body whorl; it is washed in after storms.
Calliostoma selectum - especially abundant along the Wellington west coast, but also found from Kariotahi to Ninety Mile Beach after storms (pers. obs.). Only found dead at Maori Bay in this survey.
Cantharidella tesselata - an abundant species on the west coast among algae and low tide rocks.
Cominella quoyana accuminata - this west coast subspecies was found dead at Destruction Gully and Boulder Bay in this survey. Rare living shells of the east coast subspecies *Cominella quoyana quoyana*, were found in this survey on the northern coast of the Manukau Harbour and have also been found at New Plymouth (Hayward & Morley 2002). We cast doubt on the validity of recognising the subspecies as separate, because some specimens from Whatipu in this survey have mixed characteristics of both subspecies and both subspecies occur together. Specimens with mixed characteristics are shouldered and have strong axials on the body whorl, which are characteristics of the typical species, but the red maculations on a buff ground are typical of the west coast subspecies.
Dicathais orbita - a common west coast species which does not develop heavy ridges and has graded brown colouring, whereas most populations on the east coast are entirely white, hence its common name white rock shell.
Eatoniella latebricola - there are only sparse records from the west coast in its specialised habitat under the holdfast of *Durvillaea*. No records are known from the east coast.
Gadinia conica - this species requires an exposed habitat, such as that on the open west coast.
Janthina species - these pelagic violet shells are frequently washed in on the west coast far more abundantly than on the east coast, sometimes in large numbers during on-shore winds.
Lepsiella albomarginata - the two species *Lepsiella albomarginata* and *L. scobina* appear to be indistinguishable on shell characteristics alone. Specimens at Maori Bay (AK) are shouldered, moderately crenulated with the spirals speckled in brown, as described for *L. scobina*. A different collection from the same locality (MSM) lack a shoulder and are smooth, as described for *L. albomarginata*. Specimens from Kawhia also show a mix of characteristics. Overall, forms referable to *L. albomarginata* seem to be more common on the west coast of the North Island and become the form present around the South and Stewart Islands (AK). There is however, on shell characteristics, a population of typical *L. scobina* at Pukerua Bay Wellington (MSM).
Maoricolpus roseus manukauensis – appears to be restricted to the west coast, from Ahipara (pers. obs.) to New Plymouth (Hayward & Morley 2002), and the only subspecies of this turret shell on the west coast.
Nodilittorina cincta - although present on exposed high tidal rocks on the east coast, this species reaches its greatest abundance on the west coast.
Notoacmea pileopsis pileopsis - lives in the splash zone, particularly abundant on the west coast.
Notoacmea scopulina – characteristic of the west coast of both North and South Islands on low tide rock faces (Powell, 1979), and has also been found in low numbers on the east side of northern New Zealand (pers.obs.).
Paratrophon cheesemani cheesemani - the two subspecies *P. cheesemani cheesemani* and *P. cheesemani exsculptus* are typical west coast subspecies. Examination of 25 Museum lots of these subspecies shows a grading of characteristics. Specimens from the southern end of the range towards New Plymouth have wider proportions and wider interspaces, but a single lot from Waikato Heads have specimens of both subspecies. It appears that there is a single variable species *P. cheesemani*.

Bivalves

Crassostrea gigas - this introduced species is abundant in the Manukau Harbour, probably more abundant than anywhere else in New Zealand. The vast quantities of both living and dead shells have changed sand, mud or rock into sharp, jagged inhospitable places with reduced recreational opportunities. Similar large populations are present in all west coast harbours and estuaries from Herekino to north Taranaki. Single specimens are found on the exposed coast. The Pacific oyster is present on the east coast of the North Island, where numbers are increasing in some areas such as rocky reefs east of Auckland (pers. obs.).

Gaimardia finlayi - frequent in this survey living on the red seaweed *Osmundaria colensoi* at most localities on the exposed Waitakeres' coast. Also recorded from Tom Bowling Bay (Powell, 1979), Kawhia and Raglan (Hayward et al., submitted).
Paphies donacina - the dominant *Paphies* species on the open Waitakeres' coast and North Island west coast beaches..
Perna canaliculus – the most conspicuous species on the exposed west coast rocks.
Spisula aequilatera - commonly washed up on west coast beaches, sometimes in large numbers, but also found on exposed east coast beaches.

Seastars
Stichaster australis - a common seastar on west coast rocks at and below low tide and in low tidal pools, often attached to rocks just below its prey *Perna canaliculus*.

Barnacles
Megabalanus tintinnabulum linzei – a large tall barnacle characteristic of exposed low tide rocks on the west coast and only occasionally found on the east coast.

Polychaetes
Neosabellaria kaparaensis - friable masses of this sand tube worm are present at all west coast localities in this survey, often near the base of rocks in contact with sand.

Sea anemones
Corynactis australis – bright-coloured jewel anemones are more characteristic of the west coast than the east.
Isocradactis magna - although found on exposed east coast rocky shores this large, variously coloured anemone is a conspicuous member of the west coast fauna.

Cnidaria
Physalia physalia and *Velella velella* – the Portuguese man-of-war and by-the-wind sailor are more commonly washed up on the west coast in large numbers than on the east coast, often stranding at the high tide line with *Janthina*.
Amphisbetia bispinosa – this hydrozoan is commonly attached to *Perna canaliculus*.

Seaweeds
Durvillaea antarctica – the exposed Waitakeres' west coast is the northernmost major outpost for the large southern bull kelp. It does occur in small numbers further north and on several extremely exposed points on the east coast.
Gigartina alveata – a characteristic west coast zoning seaweed on exposed mid-low tidal rocks.
Osmundaria colensoi - found at extreme low tide on exposed points and in guts on the Waitakeres' west coast, but also found in similar exposed habitats on the east coast.

6.3 Extension of recorded geographic ranges of mollusc species

The mollusc species listed below and found in this Waitakeres' coastline study, provide the first published records of 9 taxa from New Zealand's west coast. The Waitakeres' records of a further 5 mollusc species extend their published range southwards down the west coast, and a further 3 species extend their published northernmost range on the west coast of the North Island. Powell's (1979) and subsequent published ranges have been used when commenting on range extensions, because Spencer & Willan (1995) give zoogeographic provinces only. These provinces (Powell, 1955) are used here to summarise the known range of each species (A = Aupourian, C =Cookian, F = Forsterian, M = Moriorian, An = Antipodean). Additional unpublished records from the collections of the Auckland War Memorial Museum (AK) and Margaret Morley (MSM), are cited where they additionally extend the published range of species found on the Waitakeres' coast.

6.3.1 First West Coast records (Fig. 22)

Gastropoda
Amalda novaezelandiae (Sowerby, 1857) f. *crystallina*. This white form is known from Cape Maria van Diemen, Spirits Bay (AK), Bay of Islands (MSM) and Pakiri sand at Mission Bay (Morley et al., 1996). This specimen from Maori Bay (AK141070) extends the southern limit and is the first record on the west coast of the North Island.
Assiminea vulgaris (Webster, 1905). This species found living at Puponga Point in the 1950's (CS) extends the range from A province to A and C. but requires confirmation as the specimens have not been located to check identification. None have been recorded elsewhere from the west coast of the North Island (AK).
Brookula finlayi Powell, 1933. Previously recorded from Three Kings Islands to Chatham Islands (Powell, 1979), with specific occurrences at Cape Maria, Kaikoura, Whanganui Bight, off Pakiri (MSM) and in ODP1119, 100 km off Timaru (pers.obs.). Three specimens (AK110230) under low tidal rocks from Boulder Bay in the Manukau Harbour entrance, appear to be the first live intertidal records from the west coast. Recorded range in Spencer & Willan (1995) is A and C

provinces. These specific new records update the range for *B. finlayi* to A, C, F and M provinces, including the west coast of the North Island.
Eatoniella notata Ponder and Yoo, 1977. Recorded from the east coast of the North Island (Powell 1979). This Mercer Bay specimen (AK140674) is the first west coast record and updates the range to A and C provinces.
Eatonina micans (Webster, 1905). The specimens recorded here from Te Tau bank (CS) require confirmation, as the specimens have not been located to check their identification. This species is present on the east coast of Northland, but none have been recorded elsewhere from the west coast of the North Island (AK).
Eatoniella pfefferi (Suter, 1909). Specimens found living on algae at Destruction Gully and Boulder Bay provide the first record on the west coast of the North Island. We also have unpublished records from Ahipara and Herekino (pers. obs.).
Lodderia iota Powell, 1940. Previously with a recorded range from the east coast of the northern North Island (Powell, 1979). The specimens recorded here washed in at Boulder Bay now update the range to A and C provinces, including the first records from the west coast of the North Island.
Rostanga muscula (Abraham, 1877). Recorded from Northland and the Waitemata Harbour (Powell, 1979). The specimens found in several localities in this survey (AK102575) are the first west coast records and extend its range to A and C provinces.

Bivalvia
Lasaea parengaensis Powell, 1935. The only previous record of this species is from Parengarenga Harbour. The dead specimen found at Mill Bay (AK102589) provides the first west coast record.

6.3.2 Northward extension of range on the west coast (Fig. 22)

Gastropoda
Argobuccinum pusulosum tumidum (Dunker, 1862) - this predominantly southern species found dead at Maori Bay, Te Henga, (AK140839) Karekare and Whatipu appears to have its northern limit on the west coast at Ahipara of the North Island (pers. obs., unpubl.).
Onoba fumata (Suter, 1898). Recorded from Bream Tail, Leigh, Wellington, Lyttleton, and Chatham and Auckland Islands by Powell (1979), and New Plymouth by Hayward & Morley (2002). The live specimens recorded here washed from algae at Boulder Bay (AK110239) provide a northern extension of range on the west coast. However we have an additional record from further north at Cape Maria van Dieman, living on *Osmundaria colensoi* (MSM).
Pusillina infecta (Suter, 1908). Specimens common at Boulder Bay were washed off low tidal rocks (AK110240). They provide a northward extension of range on the west coast of the North Island, previously recorded from Kawhia (Morley et al., 1997).

6.3.3 Southward extension of range on the west coast (Fig. 22)

Gastropoda
Rhizorus nesentus Finlay, 1926. This microscopic shell found dead in shell sand at Maori Bay (AK141788) is a new record on the west coast of the North Island, south of Ahipara. The species is already recorded from A and C provinces (Spencer & Willan, 1995).
Rissoella rissoaformis (Powell, 1939). Already known from A, C, F and An provinces. The specimens living on algae at Puponga Point and Cornwallis (AK142832) provide a southward extension of range down the west coast of the North Island, south of Ahipara.
Saganotriphora ampulla (Hedley, 1902). Already recorded from A and C provinces (Spencer & Willan, 1995), these live specimens, found in low tide rock washes at Boulder Bay (AK110242) provide a southward extension of range on the west coast, south of Kawerua (Hayward et al., 1995).
Zemitrella fallax Powell, 1940. Previously recorded from Tom Bowling Bay (Powell, 1979) and on the west coast at Kawerua, Northland (Hayward et al. 1995). This specimen from Destruction Gully (AK102971) extends its range southwards down the west coast.

Bivalvia
Dosinia anus white form. One specimen washed up at Muriwai Beach is the first record of this form south of Ninety Mile Beach.

6.4 Taxa with type localities on the Waitakeres' coast

At least sixteen species or subspecies (7 molluscs, 1 isopod, 3 sponges, 4 lichens, 1 moss) have been described with their type localities around the coast of the Waitakere Ranges (Table 2). Five of these molluscs have subsequently been accepted to be junior synonyms of previously described taxa (Powell, 1979), leaving 11 currently recognised species with Waitakere coast type localities. All of these species also occur beyond the Waitakeres' coastline with none endemic to this area. The type localities for the 11 species include low tidal rocks south of Muriwai, at Anawhata, North Piha, Lion Rock and Cornwallis, and low tide mud flats at Mill Bay. Maritime rocks, up to 20 m above high tide level, between Anawhata and Fishermans Rock Pt. are the type locality of four species of crustose lichens collected in the

1930s by Lucy Cranwell and subsequently described by Zahlbruckner (1941). Similar maritime rocks at Piha are the type locality of a species of moss (Lewinsky, 1977).

7. Geographic distribution patterns around the Waitakeres' coast

7.1 Cluster analysis methodology

Cluster analyses were undertaken to investigate whether the intertidal biota is randomly distributed around the coast of the Waitakere Ranges or whether it exhibits distinct geographic patterns. Our field survey methodology (see section 2.3) was designed to enable this kind of analysis. Species presence was recorded in each of 24 separate coastal sections, and each live species was allocated a qualitative assessment of abundance, which was converted to numbers for generation of a similarity matrix (abundant = 5, common = 4, frequent = 3, occasional = 2, rare = 1). Dead specimens were also recorded.

Four cluster analyses were run (Fig. 23):

a. numerical conversions of abundance data on all live species recorded in our surveys. Bray Curtis Similarity coefficient used as basis for clustering.

b. numerical conversions of abundance data on all live macroinvertebrates (micromolluscs smaller than 2 mm not included) that live in rocky habitats. Bray Curtis Similarity coefficient used as basis for clustering.

c. Presence/absence records of all seaweeds recorded (our surveys and verified historical records). Jaccards Similarity coefficient used as basis for clustering.

d. Presence/absence records of all biota recorded (live and dead, wash-up and in situ), excluding records of taxa that were not systematically searched for and included in our surveys (amphipods, isopods, infaunal polychaetes). Jaccards Similarity coefficient used as basis for clustering.

7.2 Cluster analysis results

All four cluster analyses produced three high level clusters (Fig. 23) – one comprised all the west coast localities including western Paratutae-Whatipu (WPar), and the other two comprised all the localities inside the Manukau Harbour (Fig. 24). The clustering of localities along the Manukau coastline corresponded closely to their distance inside the harbour and the nature of the habitats present.

7.2.1 Manukau Harbour coast biogeographic clusters

Both analyses based on live abundance data (total and rock-inhabiting macroinvertebrates) produced identical clustering of Manukau Harbour localities, with two high level groups and two slightly lower level subgroups identifiable (Figs. 23-24):

Group 1. inner Manukau Harbour localities: sheltered beach-dominated, with softer Waitemata Sandstone tidal platforms, furthest inside the harbour (Armour Bay to Cornwallis coast, plus Kakamatua Inlet)

Group 2. outer Manukau Harbour localities:

Subgroup 2a. middle portions of Manukau Harbour coastline, dominated by breccias, grit and hard sandstone rock platforms plus Huia Bay's extensive intertidal sediment flats and adjacent rocks (Kaitarakihi to Kaiteke Points, plus Puponga Pt)

Subgroup 2b. harbour entrance coastline dominated by hard breccia coasts and small stable boulder beaches (Destruction Gully to east Paratutae)

Clustering based on the presence or absence just of seaweeds, replicated the above groupings, except that Armour Bay and Huia are separate and do not cluster with any subgroups, largely because only two seaweeds are recorded from Armour Bay (Fig. 23) and those from Huia include sand flat and mangrove-inhabiting algae.

Clustering based on the simple presence or absence of live and dead records together, produced a similar pattern, except that Mill Bay grouped with 2a, and Kaiteke Pt. grouped with 2b (Figs. 23-24).

The consistency of this clustering suggests that there is a strong geographic gradient effecting the north Manukau Harbour coastline intertidal biota, moving progressively away from the influence of the open sea at the entrance.

7.2.2 West coast biogeographic clusters

Lower level clustering within the west coast group of localities shows little consistency between the four methods (Figs. 23-24). Thus there is not the same level of biogeographic structuring nor gradient as that recognisable on the Manukau Harbour coastline. The clustering appears to reflect a combination of a number of factors, particularly: the diversity of habitats present (impacts on total biodiversity, Fig. 25); the presence of refugia providing a level of shelter from full wave exposure; the presence of relatively stable gravel beaches with under-boulder biota; the level of detailed

historic study (increased biotic records from Piha, Anawhata, north Te Henga and Maori Bay); and the presence of sand-bottomed tidal pools with large hermit crab populations carrying a wide diversity of gastropod shells (increased diversity of dead species records).

Probably the most useful clustering for identifying the similarity and differences between the intertidal biotas of the different coastal localities is that based on the abundances of all live biota identified in our study. Two groups are produced by this method, with three separate ungrouped localities (Fig. 23):

a. Low biotic diversity (51-78 live species, Fig. 25) low habitat diversity localities; characterised by a section of exposed sand beach (no live biota) and adjacent wave-swept rocky coast, with stable gravel beach or secondary sheltered habitat generally lacking (Karekare, Mercer Bay, North Piha, Whites Beach, south Te Henga, Pillow Lava Bay).

b. Higher biotic diversity (89-114 live species, Fig. 25), higher habitat diversity localities; characterised by a mixture of exposed sand beach, exposed rocky shore, partially sheltered shore (by headland, islands or large reefs) and some stable gravel beach with under-boulder biota (Piha, Anawhata, north Te Henga-O'Neills, Powell Bay-Tirikohua Pt).

c. Ungrouped localities:

West side Paratutae-Ninepin Rock – differs because of its location at the entrance to the Manukau Harbour, without full exposure and with a small area of stable gravel beach; low biotic diversity (68 live species).

Maori Bay – extensive low tide shore platform and mid-high tide large boulders provide a slightly different habitat combination with moderate biotic diversity (94 live species).

Te Waharoa Bay – little sand, but large reefs provide some protection for nearer shore rocky habitat and areas of stable gravel beach; high biotic diversity (109 live species).

These broad groupings are partly repeated in the clustering based on total (dead plus live) records and on the abundance of rock-dwelling macroinvertebrates.

The clustering based on the presence or absence of different seaweeds is quite different (Fig. 23). The two localities with the highest diversity (Anawhata 42 species, north Te Henga 55 species) cluster together. Their high diversity partly reflects the greater amount of detailed historical collecting they have received from algologists (especially Lucy Cranwell). Three sites with the lowest seaweed diversity (10-14 species), also cluster together (Mercer Bay, North Piha, west Paratutae), and probably reflects the small areas of low diversity, rocky shore habitat at these sites compared with all others. Te Waharoa Bay and Powell Bay-Tirikohua Point cluster together and are adjacent sections of coast dominantly composed of volcanic sandstone, with a mix of fully exposed and partially sheltered habitats. The exact reasons why the other two clusters have similar seaweed floras is unclear. The other clusters are Piha, Whites Beach and Pillow Lava Bay; and south Te Henga, Karekare and Maori Bay.

7.3 Geographic distribution of species around the Waitakeres' coast

Some species occur around the entire coast of the Waitakere Ranges (e.g. Neptune's necklace *Hormosira banksii*, flea mussel *Xenostrobus pulex*, half-crab *Petrolisthes elongatus*), but many have more limited geographic distributions (rather than habitat or substrate), mostly influenced by their distance from the open sea coast and exposure to wave energy. As shown by the cluster analyses, the major biotic division is between that on the open west coast and that on the shores of the Manukau Harbour.

7.3.1 Chitons (Fig. 26)

Of the 13 chiton species recorded, the 6 most common (e.g. *Chiton glaucus*, *Sypharochiton pelliserpentis*) occur around most of the coast both inside and outside the harbour. Inside the Manukau Harbour, one of these (the giant *Eudoxochiton nobilis*) occurs only on the more exposed sections of coast inside the entrance and on Huia Pt. and Puponga Pt. Two rare species (*Acanthochitona violacea*, *Rhyssoplax stangeri*) have their recorded distributions restricted to inside the harbour and four species of *Plaxiphora* are only recorded from the west coast and Paratutae (e.g. *P. caelata*, *P. obtecta*).

7.3.2 Gastropods (Fig. 27)

Only 6 of the 113 live gastropod species recorded (not counting nudibranchs) are restricted to the west coast, and 4 of these are microscopic species of *Eatoniella*. The other two west coast-restricted species are *Diloma coracina* and *Paratrophon cheesemani*. 58 species (e.g. trumpet shell *Cabestana spengleri*, whelk *Cominella maculosa*, *Haustrum haustorium*, oyster borer *Lepsiella albomarginata*, topshell *Melagraphia aethiops*, leathery slug *Onchidella nigricans*, cat's eye *Turbo smaragdus*) occur alive on both the west coast and harbour shores, and 49 are restricted to inside the Manukau Harbour. Some of the harbour-restricted gastropods (e.g. olive shell *Amalda australis*, whelk *Cominella adspersa*, *Diloma subrostrata*, bubble shell *Haminoea zelandiae*, turret shell *Maoricolpus roseus manukauensis*, wheel shell *Zethalia zelandica*) live on soft substrates, and others (e.g. *Calliostoma punctulatum*, *Cookia sulcata*, *Cymatium parthenopeum*, paua *Haliotis iris*, limpet *Radiacmea inconspicua*, *Ranella australasia*, horn shell *Zeacumantus subcarinatus*) live on rocky shores or under stable boulders.

7.3.3 Nudibranchs (Fig. 28)

Of the 13 sea slugs recorded, 7 (*Alloiodoris lanuginata*, *Archidoris wellingtonensis*, *Doriopsis flabellifera*, *Phidiana milleri*, *Rostanga muscula*, *Stiliger felinus*, *Tritonia incerta*) occur both on the west coast and inside the

Manukau Harbour. Four species (*Acanthodoris molicella*, *Aphledoris* sp., *Berthella ornata*, *Dendrodoris citrina*) are only recorded from inside the harbour and two (*Eubranchus arius*, *Flabellina albomarginata*) are restricted to the west coast.

7.3.4 Bivalves (Fig. 29)

All 38 live bivalves species recorded, occur along the coast of the Manukau Harbour, although the small epiphytic (attached to seaweed) *Gaimardia finlayi*, has only been recorded just inside the entrance, on the west side of Paratutae Island, as well as more commonly up the exposed west coast. Another microscopic epiphytic bivalve *Philobrya munita*, has only been recorded as far into the harbour as Destruction Gully. 23 of the bivalve species have only been recorded live inside the harbour, although the shells of some have been found washed up dead on the west coast beaches. A few may live subtidally offshore from the west coast, but the shells of others have clearly been carried out of the harbour by out-going tides. Many of the harbour-restricted species (e.g. horse mussel *Atrina zelandica,* cockle *Austrovenus stutchburyi*, trough shell *Cyclomactra ovata*, wedge shell *Macomona liliana*, mud oyster *Ostrea lutaria*, pipi *Paphies australis*, scallop *Pecten novaezelandiae*) live infaunally or in the surface sediment of the low tidal and subtidal soft shores. Several of the harbour-restricted bivalves are rock-inhabiting (e.g. *Anomia trigonopsis*, *Cleidothaerus albidus*, *Ostrea aupouria*).

7.3.5 Echinoderms (Fig. 30)

The two echinoids (sand dollar *Fellaster zelandiae*, sea egg *Evechinus chloroticus*) and four seastars (e.g. *Stichaster australis*) all occur right around the Waitakeres' coast. The only holothurians (*Australocnus calcarea*) and brittle stars (*Ophionereis fasciata*) are rare and their recorded occurrences restricted to under boulders just inside the entrance to Manukau Harbour.

7.3.6 Crabs (Fig. 31)

Most of the 20 or so crabs recorded are distributed right around the Waitakeres' coast (e.g. *Ozius truncatus*, *Plagusia chabrus*). No species are restricted to the west coast, but 6 (*Cancer novaezelandiae*, *Helice crassa*, *Hemigrapsus crenulatus*, *Heterozius rotundifrons, Notomithrax peronii*, *Pilumnus lumpinus*) are restricted to the harbour shores. Two species are common inside the harbour, but rare on the outside – the mud crab *Macrophthalmus hirtipes* occurs in Piha estuary on the west coast, and the high tidal rock crab *Cyclograpsus lavauxi* is only recorded on the west coast from Wigmore Bay.

7.3.7 Barnacles (Fig. 30)

Most of the barnacles (e.g. *Tetraclitella depressa*) occur on both the west and Manukau coasts, with several rarer species (e.g. *Balanus trigonus*, *Calantica villosa*) only recorded on the exposed coast, and just one species, the small acorn barnacle *Austrominius modestus*, restricted to inside the Manukau. Several species (e.g. *Megabalanus tintinnabulum linzei*) are restricted to the higher energy shores on the west coast and just inside the entrance to the Manukau Harbour.

7.3.8 Sea anemones (Fig. 30)

Virtually all sea anemones (e.g. *Isocradactis magna*) can be found on both the west and Manukau Harbour coasts. Only the small, harbour anenome *Anthopleura aureoradiata*, which lives partly buried in sediment attached to cockle shells, has its distribution confined to harbour shores. The brightly-coloured jewel anenome *Corynactis australis* is confined to more exposed, current- or wave-swept shores, with records inside the Manukau confined to near the entrance and on the tip of Puponga Peninsula – a distribution pattern that is mimicked by the low tidal and subtidal encrusting, colonial coral *Culicia rubeola*.

7.3.9 Sea squirts (Fig. 30)

Two species of compound ascidian and the wrinkled sea squirt *Pyura rugosa* occur on both the west and Manukau Harbour coasts. Three other species of sea squirt (*Asterocarpa coerulea*, *Cnemidocarpa bicornuta*, *Corella eumyota*) however, are restricted in their distributions to inside the Manukau Harbour, under and around the edges of stable, low tidal cobbles and boulders.

7.3.10 Seaweeds

Of the 117 recorded species of seaweed, 21 (e.g. *Colpomenia sinuosa*, *Ecklonia radiata*, Solieriaceae indet., *Stenogramme interrupta*) are only recorded from Manukau Harbour shores, 64 (e.g. *Champia novae-zelandiae*, *Codium fragile*, *Durvillaea antarctica*, *Gigatina alveata*, *G. atropurpurea*, *G. circumcincta*, G. *marginifera*, *Lessonia variegata*, *Pachymenia lusoria*, *Pterocladiella capillacea*) are only recorded from west coast shores, and the remaining 32 occur on both. Of the 32 occurring both inside and outside the harbour, 19 seaweeds (e.g. *Arthrocardia corymbosa*, *Chaetomorpha aerea*, *Glossophora kunthii*, *Osmundaria colensoi*, *Petalonia fascia*, *Porphyra columbina*, *Scytothamnus australis*) are not recorded any further inside the Manukau Harbour than the rocks along its northern entrance from Ninepin Rock to Little Huia.

8. COASTAL DYNAMICS AND CHANGES TO THE INTERTIDAL BIOTA

8.1 Physical changes to the Waitakeres' coastline

8.1.1 Young age of coastal landforms

At the peak of the Last Ice Age (18 000 years ago), sea level was 120-130 m below present. At that time the Manukau Harbour was a forested valley system drained by the Manukau River, which flowed out past Whatipu to reach the coast, 20 km or so off the present coastline. Lying west of the present Waitakeres would have been a low-lying, gently sloping, forested coastal plain. The main streams draining the Waitakeres to the west and south would have been incised into their valleys several tens of metres below present sea level, in the vicinity of their present mouths. The present day coastal cliffs would have been a mix of steep, weathered slopes and inland bluffs. The last time sea level had been up around its present level was about 100 000 years earlier. Over the last 2.5 million years, there had been about 50 similar occasions when sea level was up close to the present level for short periods of a few thousand years duration each. During these periods of higher sea level, the offshore, now submerged, coastal plain and west coast cliffs had been eroded out of the western Waitakere Ranges.

After the peak of the Last Ice Age, global climate warmed, the northern hemisphere ice caps melted, and sea level progressively rose reaching approximately its present level about 7000 years ago. Rising sea level initially flooded the mouths of the Waitakere Ranges' stream valleys forming an embayed coast. Erosion of the old coastal cliffs was restarted and much of the scree and soil on the lower slopes would have quickly been stripped away to expose fresh bare rock, which continues to erode slowly even today. In the first few thousand years following sea level rise, large quantities of sand were swept into the bays creating the sand flats, dunes and beaches that fill them today. In the bigger valleys, sand barriers and dunes blocked their entrances damming lakes behind (e.g. Te Henga, Karekare). Most of these have subsequently filled in with alluvium carried down by the streams, or with sand blown in from the beach.

Inside the Manukau Harbour, the sand supply has been more limited, and while extensive intertidal flats fill Huia, Kakamatua and Big Muddy Creek bays, the valleys have not been fully filled to create the almost straight coastline of the west coast. Alluvium brought down by the streams has built flat coastal terraces around the heads of Little Huia, Karamatura, Huia and Big Muddy Creek bays. Sediment carried down the Karamatura Stream has actually built a small delta in the last few thousand years, extending out into the west side of Huia Bay.

8.1.2 Coastal erosion

At the present time, coastal erosion of the rocky shores of the Waitakere Ranges is relatively slow, and is largely influenced by the degree of exposure to waves, and the hardness of the parent rock, and the presence of joints in it. The extent of intertidal rock platforms suggest that the most rapid erosion over the last 7000 years has been of the softer Waitemata Sandstone shores between Huia and Big Muddy Creek.

The soft, relatively unconsolidated Holocene sediments deposited since sea level reached its present height, are the most susceptible to modern coastal erosion, and there have been several historic periods of erosion of sand dunes at Muriwai and Piha. These are the result of natural climatic and oceanographic cycles and at the time of writing, we seem to be in the middle of a major cycle of sand build-up on the west coast beaches, rather than erosion.

This sand accretion at Karekare Beach has recently diverted the mouth of Karekare Stream to the south, resulting in high tide storm waves flowing up the new mouth of the stream and actively eroding a steep bank into the face of the foredunes.

8.1.3 Coastal sand accretion and movement

Inside the Manukau Harbour in the last few decades an area of low sand flat and dune has accumulated in the head of Kakamatua Bay, and it is becoming stabilised by vegetation (pers.obs.).

The exposed west coast has a long history of documented sand movement coming and going. The best known is the accumulation and creation of the vast sand flat at Whatipu, mostly accreted during the 1930s and 1940s (Williams, 1977, Woolley, 1994). It has remained relatively stable in area since then at the Whatipu end, but has grown considerably at the northern end off Pararaha, since the 1970s, and is currently extending north towards Karekare (pers. obs.). Main changes to the sand flat in the past 50 years have been its stabilisation by the establishment of vegetation, and a rising water table, related to beach sand build-up across the mouths of Whatipu and Pararaha Streams, with the resulting establishment of vast areas of freshwater swamps.

Sand on the west coast beaches comes and goes in irregular cycles, relating to a variety of climatic and oceanographic factors. It is not unknown for 2 m depth of sand to disappear or accumulate during one storm, and this

can kill most immobile hard shore biota if it is buried. Notwithstanding these recognised weekly or seasonal beach sand variations, there has also been a clear build-up of sand right along the west coast of the Waitakeres in the last 5 or more years (during the course of this survey). The sandy beaches at almost all west coast sites are at the largest extent they have been for at least the last 50 years, and possibly longer. Maybe this is a result of a decadal cycle in storm and swell patterns, that have been favourable to sand accumulation, or maybe there is a longer term explanation.

It is tempting to postulate that there may be a long term trend towards a build-up of sand all the way along the west coast, with a "batch" of sand progressively moving northwards. This is supported by the fact that there used to be an extensive sand flat south of the Manukau Harbour entrance in the eighteenth and early nineteenth centuries. This lost land of Paorae was eroded away over many decades, and 100 or so years later a similar sand flat grew at Whatipu, which now is growing northwards. Maybe in the not too distant future it will be possible to walk on beach from Karekare to Piha.

Maybe this "batch" of sand was a result of the last Taupo eruption, 1800 years ago, with vast amounts of sediment pouring down the Waikato River, and the oversupply of sand in the onshore-offshore coastal system has been slowly working its way north since then, with net longshore drift. If this is the case, then erosion can be expected to remove the Whatipu sand flat in future years, as longshore drift continues. Certainly, active erosion is continuing to the south along the west coast of Awhitu Peninsula, where Paorae once stood, possibly because of a deficit of sand in the coastal system down there, maybe as a result of the dams across the Waikato River and the dredging in the lower Waikato River.

8.1.4 Impact of moving beach sand

Although some rock-inhabiting species, such as the sand tube worm *Neosabellaria* and the flea mussel *Xenostrobus pulex*, are adapted to live in sand-rich habitats, most organisms (other than those adapted to live infaunally in sediment) will die if buried by sand for very long. With the widespread accumulation of sand along many stretches of the west coast in recent years, many rocky shores and boulder beaches have been buried, or partially buried by sand, with the resultant death of those inhabitants that could not move away. This is a natural process, and when (if) the sand level drops again, the exhumed bare rock surfaces will start to be recolonised returning to their former level of occupancy within a year or two (pers.obs.).

Areas of rocky coast, that are subject to frequent or extensive submergence by moving sand (e.g. Ninepin Rock, Karekare Beach, Mercer Bay), are of lesser biotic value as places to protect to maintain sustainable breeding populations of intertidal species.

8.2 Biotic changes on the Waitakeres' coastline

8.2.1 Bull-kelp die-offs

In February and March 1998, all the giant bull-kelp *Durvillaea antarctica* that was growing along the west coast of the Waitakere Ranges died and was washed up on the west coast beaches (Morley and Hayward, 1999b). Many people feared a mystery disease had arrived. Examination of satellite images of sea surface temperatures for January and February 1998, showed that a plume of unusually warm water had been carried down the west coast from the north raising the temperature 1-3 degrees above the average summer optimum (M. Uddstrom, NIWA, pers.comm.). Clearly the southern, cold-loving bull-kelp is living near the extreme of its warm temperature tolerance on the Waitakeres' coast, and just a few degree rise for several weeks was sufficient to cause wholesale death.

Similar, although less severe, bull-kelp die-backs along the west coast have been noted previously (e.g. 1960s, 1995), and presumably had similar causes. Following the 1998 die-off, young plants were observed already recolonising the low tidal rocks within 6 months (Morley and Hayward, 1999b), and with their rapid growth rates the extent of large mature bull-kelp had returned to its previous level within 2 years, although the exact same pattern of local colonisation was not replicated (pers.obs.).

This event raises several questions: if global warming continues, are we likely to get more frequent occurrences of these die-backs and eventual extinction of the Waitakeres' coast bull-kelp ? and if all the Waitakeres' coast bull-kelp and those to the north were killed off in 1998, where did the young propagules that recolonised so soon afterwards come from ?

8.2.2 Introduced marine biota

Only four definite marine invaders are recorded here from the intertidal coast of the Waitakere Ranges. These are the Pacific oyster *Crassostrea gigas*, the small, infaunal, semeliid bivalve *Theora lubrica*, the high tidal gastropod *Microtralia occidentalis*, and the unidentifiable filamentous red alga, belonging to the Solieriaceae (pers.comm. Wendy Nelson).

The most widespread of these is the Pacific oyster, which has over-run some parts of the north Manukau coast (e.g. east side Puponga Pt), and also occurs in low numbers on the west coast rocky shores. It arrived in New Zealand in the 1960s (Hayward, 1997). The small ellobiid high tidal snail *Microtralia occidentalis* has only been recorded from around the Waitemata and Manukau Harbours (Hayward et al., 1999a; Cranfield et al., 1998) and is thought to have been introduced from the West Indies a long time ago. The other two marine invaders are first recorded from the Manukau Harbour as a result of this study. *Theora lubrica* arrived on the east coast of Northland about 1972, and is a dominant member of low tidal and subtidal fine sediment communities in the Waitemata Harbour (Hayward, 1997). These records

from similar sheltered fine sediment in the Manukau Harbour at low tide are not unexpected, as it has recently been recorded from west coast harbours to the north (Morley, 1995) and south (Morley et al., 1997). The filiamentous Solierieacean alga had previously only been recorded from Orakei Basin in New Zealand. In this study we found large quantities along the soft sediment shores of the north Manukau Harbour, a considerable range extension.

If we fully accept the list of additional widespread, yet inferred marine invaders, compiled by Cranfield et al. (1998), then a further 10 species from the Waitakere Ranges' coastline may have been introduced with human assistance more than 100 years ago. These are: sponges *Cliona celata*, *Halichondria panicea*, *Hymeniacidon perleve*, *Tethya aurantium*, polychaete *Hydroides elegans*, barnacle *Balanus trigonus*, crab *Plagusia chabrus*, and ascidians *Aplidium phortax*, *Botryllus schlosseri*, and *Corella eumyota*.

Thus the Waitakeres' coastline is inhabited by four definite, and possibly 14 introduced marine species, or 10 % of the total number of recognised introduced species in New Zealand (148), according to Cranfield et al. (1998). This contrasts with 66 introduced species recognised living in Waitemata Harbour (Hayward et al., 1999a).

8.2.3 Variations in recruitment success

Many of the intertidal organisms (e.g. bivalves, barnacles, crabs, bryozoa, polychaetes, sponges, anemones, sea squirts, algae) produce juvenile propogules that have a free-living stage in the sea water, where they are dispersed along the coast by surface currents, long-shore drift and storms. Those that are thrown back ashore and encounter a suitable substrate and habitat, manage to settle and survive, but the majority of these propagules are lost. The season of settlement varies with different organisms and the actual time and amount of settlement varies between years (Luckens, 1976). Thus there can be good and bad years for colonisation by different organisms along a whole coast, or it may vary from place to place. There are many possible reasons why there are variations in the success level, not all of which are fully understood.

Many propagules successfully colonising north Manukau Harbour shorelines are probably sourced from breeding stock within the harbour. Here the main dispersal currents are the tidal currents that sweep along the north Manukau coast and may carry the propagules up the harbour with the incoming tide and return them on the outgoing. Tidal currents may carry in propagules sourced from other areas of harbour coast that have been transported in via other tidal channels. A few propagules carried into the harbour from the exposed west coast will also successfully settle, particularly where conditions are more suitable, such as inside the entrance channel.

Our understanding of surface currents and longshore current drift, and the role of onshore waves on the exposed west coast, is not good. It seems clear that at different times, net transport directions can be northwards or southwards along the Waitakeres' coast, and that propagules thrown ashore here may be sourced from distant coastal areas at times in the north and at other times in the south, or even sourced locally and transported around by an offshore eddy. Thus good recruitment years for some species, may at times, rely on optimum breeding and spawning conditions up to several hundred kilometres away.

8.2.4 Human harvesting impacts

Recreational and offshore commercial fishing largely impacts on subtidal ecosystems, but these were not investigated here. Human harvesting of intertidal biota on the west coast is restricted to rocky shore and stable gravel beach habitats, as intertidal sandy beach infauna is virtually non-existent. The dense beds of green-lipped mussel are the main target of intertidal rocky shore harvesting on the west coast and along the Destruction Gully coast inside the Manukau Harbour entrance. Beds with easy access can at times become heavily impacted. These mussel beds can also be stripped off by transient sand submergence leaving bare rock with abundant remnant byssus threads attached. The present level of harvesting seems sustainable, as heavy spat fall recruitment has, up till now, reseeded the coast every so often with dense populations.

Paua harvesting is presumably concentrated along the Destruction Gully coast, where our surveys largely only found juveniles under low tide boulders, undoubtedly a result of collection of all accessible adults. The presence of juveniles is encouraging as it indicates the survival of breeding adults, presumably subtidally. Paua (of unspecified size) were recorded as common at low tide around Mill Bay rocks in the 1950s (Conchology Section, 1963), but were not found here in this survey. This could be due to harvesting and/or silt build-up.

Kina *Evechinus chloroticus*, is another intertidal species commonly targeted for harvesting. They are present in low numbers right around the Waitakeres' coast, except at Te Waharoa and Mercer Bay, where they are noticeably more abundant. Te Waharoa and Mercer Bays are two of the most difficult stretches of coast to get to, which suggests that harvesting is likely impacting on kina numbers elsewhere.

With Auckland's growing multicultural population, many other rocky shore species, both on the west coast and inside the Manukau, are now periodically targeted for selective harvesting. In some instances wholesale clear-stripping of everything living has been reported. The full impact of these activities is hard to assess as no monitoring programmes are in place that might detect and quantify it. Like the green-lipped mussels, some of the other biota (e.g. algae, barnacles, crabs) are also reseeded by floating/free-swimming propogules carried in from some distance, and short-term impacts are repaired by periodic further recruitment. Thus in general this form of harvesting is sustainable so long as breeding populations of all taxa remain to reseed impacted coastlines. Times of heavily reduced abundance of these dominant taxa (as a result of high harvesting pressure) will presumably have some impact on the intertidal food chain and particularly their predators, and the presence of additional bare rock may alter natural patterns of colonisation and succession.

It is unclear what impact harvesting may be having on less common, slower growing species, with less well-developed methods of mass production of propagules with capacity for long distance dispersal, such as many egg-laying carnivorous gastropods. These have the potential to be more impacted in the long term, and indeed there are qualitative records that indicate a decrease in the diversity of these kinds of rarer biota, both on the West Coast (John Morton, pers.comm.) and on the north Manukau Harbour coastline (Conchology Section, 1963). At least eleven species of larger, mostly carnivorous gastropods and larger bivalves (e.g. *Cabestana tabulata*, *Calliostoma tigris*, *Charonia lampas*, *Cominella quoyana accuminata*, *Cookia sulcata*, *Neoguraleus oruaensis*, *Penion sulcatus*, *Ranella australasia*, *Barbatia novaezelandiae*, *Cleidothaerus albidus*, *Zelithophaga truncata*), that were recorded living on the rocky shores of Mill Bay and Puponga Pt. in the 1950s (Conchology Section, 1963), were not found alive in our survey. All could have been harvested for food and in some instances could have been collected for their pretty shells or as bait by fishermen. Silt build-up is unlikely to be the reason, as specimens of related species still survive on these shores.

Harvesting of soft sediment biota occurs on the sandy and muddy beaches along the north Manukau coast, especially at Huia, Cornwallis, Mill and Armour Bays. The main target species are cockle and the less common pipi, but also includes rare scallop, mudsnail and whelk. Anecdotal and other evidence seems to indicate that abundances of these species have been decreasing on most beaches throughout the Auckland region for many years. Harvesting is presumably contributing to this decline, but may not be the most important factor, as beaches that have been closed to harvesting for a number of years show little recovery in biotic abundance (MSM, pers.obs.).

8.2.5 Other changes

The apparent decline in the abundance of cockles and other soft sediment biota, and also the decline in the diversity of rarer rocky shore species, both on the north Manukau Harbour coast (20 mollusc species recorded live in the 1950s, not in the present survey) and to a lesser extent on the west coast (John Morton, pers.comm.), parallels similar reported declines in abundance and diversity elsewhere around Auckland, particularly on the east coast in the inner Waitemata Harbour (Hayward et al., 1999a), at Bucklands Beach (Morley, 2002), and at Howick Beach (Morley et al., 2001). The cause of these changes cannot all be attributed to human harvesting. Anti-fouling paint (TBT) poisoning is responsible for some declines in the Waitemata, but is unlikely to be a major factor around the Waitakeres' coast. Clearly there has been an increase in silt accumulation along the more sheltered Huia-Armour Bay coast, that may have had some impact in reducing diversity, but this is unlikely to be the total reason. Other less well-defined factors may include combinations of chemical pollutants of various kinds, increased nutrients and diseases, resulting from the proximity of New Zealand's largest city. Widespread decreased abundance of breeding populations to reseed the coastlines may also be a factor, especially in the case of cockles.

9. COASTAL SECTIONS WITH POTENTIAL FOR PROTECTIVE STATUS

The views expressed in this report are those of the authors and do not necessarily reflect those of the Auckland Regional Council

The authors believe that the main reason for establishing marine protected areas, by whatever means, is "**to protect, in perpetuity, the best representative examples of the broad diversity of marine ecosystems in, as near as possible, their natural state**" for the purposes of:

a. aesthetic appreciation of the beauty, abundance and diversity of marine life and habitats;

b. ensuring the continued survival of all marine ecosystems and their constituent species;

c. sustainable maintenance of breeding populations of all species so that their offspring can be dispersed and reseed areas that are not protected and have been impacted by human harvesting or other activities;

d. educational opportunities for formal school, tertiary and extra-curricula classes and informal groups;

e. scientific research unimpeded by harvesting or other human interference;

f. protecting fragile and unique natural features and ecosystems.

The first four of these purposes appear to be the most relevant for the intertidal coast of the Waitakere Ranges. The values of this coastline can be considered in two categories:

a. those sections with high biodiversity values, which provide sustainable living conditions for the majority of the common and rare species present around the coast (section 9.1);

b. those sections with high potential as educational sites (section 9.2).

9.1 Sections with high biodiversity values

As previously discussed (section 7.2), cluster analysis using three methods consistently divides the Waitakeres' coastline into three biotic areas (Figs. 23-24):

a. the west coast (Muriwai-Karekare);

b. the outer, more rocky Manukau Harbour coast (Paratutae-Puponga Pt);

c. the inner Manukau Harbour coast (Kakamatua-Armour Bay).

In order to protect the greatest diversity of ecosystems and species, ideally a representative section of coastline within each of these three biotic areas should be selected. In order to include sustainable populations of the greatest diversity of intertidal and shallow subtidal species, the sections identified should contain the most diverse range of habitats available, including examples of the most common. An aid to identifying those sections of coast containing the most diverse range of habitats, comes from our records of the number of species found live (and to a lesser extent dead) within them (Fig. 25).

From the above we identify below (9.1.1-9.1.5) five sections of coast (Fig. 32) with high biodiversity and habitat diversity, that could be used as a basis for selecting totally protected areas around the Waitakeres' coast:

9.1.1 West coast

Five open coast sections each have records of a total of over 140 species (live plus dead). Two of these (Maori Bay-Muriwai, and Piha) have records of large numbers of washed up dead shells that inflate their biodiversity. The other three sections also have the highest numbers of live species and seaweeds (Fig. 25) – Te Waharoa (live 109, seaweeds 33), north Te Henga-O'Neills (114, 55), and Anawhata-Paikea Bay (104, 42). These can be combined into two coastal sections (below):

9.1.1.1 Te Waharoa coast

The 4 km section of coast considered here, extends from Bartrum Bay in the north to the northern end of O'Neills Bay in the south. This section is dominated by rocky shores, with a number of large reefs projecting out into the Tasman Seas. The rocky shore is broken in a few places by mobile and partly stable gravel beaches (especially at Te Waharoa), and several pocket sand beaches. The northern half of this section is composed of softer sandstone and the southern half by harder volcanic conglomerate and even andesite flows in the back of O'Neills Bay. By extending the

boundaries north and south of Te Waharoa Bay it includes two special, more sheltered habitats on the north side of Tirikohua Pt. and inside the northern end of O'Neills Bay.

On the north side of Tirikohua Pt, large sandstone reefs stretch 50 m offshore and provide considerable shelter to large mid to high tide pools tucked in behind, which support beds of Neptune's necklace with some unusual grazers for the exposed west coast, such as *Cominella maculosa*. The north end of O'Neills Bay has a mixed mobile and stable gravel beach, partly sheltered by the rocky Te Raitahinga Pt. A combination of the more stable boulders and additional shelter, provides habitat for several unusual west coast gastropods, such as *Diloma nigerrima*.

This combined length of coast clearly has the most diverse range of habitats on the west coast and as a result the most diverse biota. The high diversity recorded for north Te Henga and O'Neills Bay is partly inflated by the level of historic study its seaweeds have received.

9.1.1.2 Anawhata coast

The 1.5 km stretch of coast, from Paikea Bay to the north end of Anawhata Beach, might be extended 1 km north to include the largely inaccessible rocky coast up to Wigmore Bay (Fig. 32). This coastline consists of a large expanse of exposed sandy Anawhata Beach with rocky shores on either side, and some areas of stable boulder beach, particularly in Paikea Bay and in the shelter of Keyhole Rock. The increased accumulation of sand in recent years has smothered some of the previously rich intertidal communities, especially in the south in the lee of Keyhole Rock and in Paikea Bay.

As previously discussed Anawhata-Paikea Bay has the third highest recorded number of live species (Fig. 25). This diversity is slightly inflated by the level of intense collecting of seaweeds undertaken by Lucy Cranwell in the 1930s, resulting in the slightly inflated number of seaweed records. Similarly, Anawhata has received more intense historical study of its sponges, mainly by Patricia Bergquist, resulting in an inflated sponge record. If these two influences are removed the diversity on this coastal stretch is about the same as most other parts of the west coast (except the higher diversity Te Waharoa stretch).

Particular attributes of the Anawhata coast are its natural beauty unspoilt by subdivision; the habitat diversity attributable to the presence of the sandy beach, the shelter provided in the lee of Keyhole Rock, and the deep low tide guts with bright sponge gardens on the point at the north end of the beach.

9.1.2 Outer north Manukau Harbour coastline

Five coastal sections have a total (live plus dead) biota of 140 or more species recorded (Fig. 25), but at west Paratutae-Whatipu half of these are washed up dead shells. Huia and Huia Pt-Kaitarakihi also have high numbers of dead wash-in shells, leaving two sites with the highest diversity of living species - Puponga Pt. (134) and Boulder Bay (126). Boulder Bay-Destruction Gully section has the highest diversity of seaweeds (combined total 24 species) in this biotic region.

9.1.2.1 Destruction Gully coast

The 4 km section of coast from Wonga Wonga Bay to Sawyers Pt, on the north side of the Manukau Harbour entrance, consists of moderately sheltered, hard volcanic breccia rocky shores, with stable cobble and boulder beaches at Boulder Bay, Makaka Bay (Destruction Gully) and Waterfall Bay. This section includes the combined records of both Boulder Bay and Destruction Gully (156 live species, Appendix 3) – the greatest live diversity of any section of similar length along the coast.

The composition of the biota along this section is a mix of exposed west coast species that extend into the harbour entrance, and sheltered harbour species, that do not extend out into the Tasman Sea. In addition, there are 19 species that have only been found alive around the Waitakeres on this coastal section (e.g. bivalve *Pseudarcopagia disculus*, brittlestar *Ophionereis fasciata*, suckerfish *Trachylochismus melobesia*, 8 micromolluscs, and 4 seaweeds).

This section of coast appears to be excellent habitat for colourful low tidal nudibranchs, with 6 species recorded. Reportedly the subtidal ecosystems along this section of the Waitakeres' coast are rich and diverse, and it provides the best diving conditions (at slack tide), given the dominantly exposed conditions on the west coast, and the lower underwater visibility further inside the harbour. The combination of subtidal and intertidal values gives this coastal section additional significance.

9.1.2.2 Puponga Point coast

This section of coast extends 2.5 km around the end of Puponga Pt, from Cornwallis wharf to the south-east corner of Kakamatua Inlet. It consists predominantly of rough volcanic breccia rocky shores. Around the point there are several small pocket beaches of sand or stable cobbles, and there is a small sandy beach between the rocks and Cornwallis wharf. The mid tide boulders and rocks along the eastern side of the point are smothered in thick Pacific oysters, which make walking hazardous. The rocks and large boulders around the end of Puponga Pt. are swept by extremely strong tidal currents, which keep silt from settling. Here at spring low tide, and especially beneath the edges of giant boulders, are the richest intertidal sponge gardens around the Waitakeres' coast. A minimum of 14 species of sponge occur around the point, and two species of the pretty, and relatively rare *Calliostoma* snail, feed on the sponges.

One of the reasons for the exceptionally high recorded biodiversity is the 16 historical records of live molluscs recorded by Conchology Section members in the 1950s, but not found alive during our survey. Another reason for the high biodiversity is the mix of relatively exposed and sheltered shores around the point, making this the furthest

incursion into the harbour by a number of exposed shore species, where they live in close proximity to sheltered shore biota.

9.1.3 Inner north Manukau Harbour coastline

Of the four coastal sections in this biotic group, the Lawry Pt.-Mill Bay section has the most recorded total species (146), live species (116), and live rock-dwelling macroinvertebrates (68), and equal highest number of seaweeds (12). A representative example of mangrove forest ecosystem should also be protected in the Manukau Harbour – Big Muddy Creek would be an excellent candidate area because of the adjacent forest-covered reserve on its east side and other adjoining reserve areas around portions of its west side and head.

9.1.3.1 Lawry Point coast

This section of sheltered coast consists of silt-mantled sandstone reefs, and sandstone and andesite boulders at all tidal levels, interspersed with pocket beaches of muddy, sandy and gravelly sediment. It is a 2 km stretch of coast extending from the north-east side of Mill Bay to the south-west side of Armour Bay. This coastal section could be extended to include a representative area of extensive intertidal muddy sand flats at either Mill Bay or Armour Bay. If Armour Bay was chosen, then a protected area could be considered for the 3 km stretch from north-east Mill Bay through Armour Bay to include Big Muddy Creek's mangrove forest.

Several rather special features of the Lawry Pt. area provide additional biotic value to this stretch of coast. These are:

a. the presence of live, low tide populations of the now rather rare ranellid trumpet shells, often the targets of shell collectors – *Cabestana spengleri* and *Cymateum parthenopeum*, and historic records of *Cabestana tabulata* and *Ranella australasia*, two species that could still very well be present or able to recolonise;

b. the presence of several colourful nudibranchs on the same low tidal, scurfy-weed covered sandstone reefs as the trumpet shells – yellow *Dendrodoris citrina*, and orange-red *Rostanga muscula*;

c. a highly unusual low tide area, just north of Lawry Pt, with stable cobbles heavily encrusted with the shelly tube worm *Spirobranchus cariniferus*, sitting on sandy mud. The sides and undersides of these cobbles support a diverse fauna, including perhaps the richest sea squirt habitat on the north Manukau Harbour coast.

Similar, unsurveyed sections of north Manukau Harbour coastline occur further up the harbour between Big Muddy Creek and Onehunga. Moving progressively further into the harbour, the infestation by Pacific oysters increases, the amount of mud deposited on the foreshore increases, and the diversity of intertidal life decreases, with few, if any, additional inner harbour taxa appearing. Thus the Lawry Pt coastal section is likely to have greater biodiversity than anywhere further up the harbour.

9.2 Sections with high educational values

The biology syallabus of senior secondary schools includes studies on intertidal zonation, ecology and mud crabs. These studies need to be undertaken in the field. Some Tertiary marine ecology courses also have intertidal field components. Primary and intermediate school level classes sometimes include sections of work on intertidal and marine life that benefit from a visit to the seashore. Informal family and other groups also periodically use the intertidal shore for recreational educational experiences.

Sites that are of most use for these educational pursuits need to have easy foot access from nearby roads. Additionally they should be safe for intertidal study, which is not always the case on the exposed rocky west coast shores with large waves surging up the rocks, or where strong tidal currents sweep close to the shore (e.g. Puponga Pt.). The sites should have a relatively rich and diverse biota that illustrates the principle zonation patterns. Quite commonly intertidal studies are undertaken as an activity while students are staying at an outdoor education camp. Thus the proximity of such camps is one of the major factors influencing the educational use of a section of coast around the Waitakeres.

Four sites are recognised (Fig. 32) as having the highest level of usage or potential usage for educational purposes:

9.2.1 Maori Bay coast

This section of coast is close to the outdoor education camp at Houghtons Bush and also to the Muriwai Regional Park campground and Muriwai Surf Life Saving Club, which are also periodically used as base camps. Day visits are often attracted to the gannet colony and sometimes tack on an examination of the geology and/or intertidal life as part of the day's activities. The rocky shore at the south end of Muriwai Beach is mostly vertical and too dangerous for educational use. Maori Bay has good pedestrian access down to the beach, which provides a relatively safe area for studying the intertidal zonation at low tide in the cave and around the north end of the beach and on the rocks at the south end. It is by no means a perfect site for educational purposes, but it is the best available in the area and is extensively used for this purpose. It has been subject to considerable recreational harvesting pressure.

9.2.2 Piha coast

Piha is probably the most easily accessible piece of west coast in the Waitakeres. It has one outdoor education camp (Stedfast Park) in the Piha Valley, two surf life saving clubs and a campground, all of which can be used as bases

for groups that might wish to study the intertidal life on the rocky shore. The rocky shore at Lion Rock is too exposed to be particularly safe for group study, although with the build up of beach sand the coast around to The Gap from south Piha is more accessible and safer at low tide. Probably the safest and educationally most useful section of rocky shore is the reef at the north end of North Piha, but it is too far away to walk to for most groups staying around south Piha. Piha has been subjected to considerable harvesting pressure, but a no-take campaign by local residents may be reducing this.

9.2.3 West Huia coast

The high educational value of the Huia Bay and its western side results from the presence of three outdoor educational camps at Karamatura and Little Huia. Access is easy and the nearby intertidal habitats provide a variety of educational opportunities in intertidal soft sediment, rock platform, and stable boulder beach studies, all in a relatively safe study environment compared with the exposed west coast. Some schools that regularly visit Huia have undertaken annual monitoring studies of Huia Bay's shellfish, especially the cockles.

9.2.4 Armour Bay coast

Armour Bay Reserve provides easy access to this section of coast at Parau and its educational value is enhanced by the presence of an adjacent outdoor education camp. Armour Bay provides opportunities for studies of sheltered shore beach and shore platform studies in a safe environment away from the threat of dangerous waves. A slight detraction of the site is the greater silt and mud, the lower biotic diversity, the lack of nearby low tide rocks and thus the less obvious tidal zonation patterns.

9.3 Protection from what ?

As discussed in section 8, a number of natural physical and biotic factors, as well as human-related activities impact on the intertidal biota of the Waitakeres' coast. Indeed the natural influences, such as sand burial and abrasion, storms, water temperature, blooms, predator-prey perturbations, and factors influencing breeding and recruitment success, generally have greater impact on the composition of the intertidal biota than human-related activities. No amount of legal protection can influence these natural processes, nor should we want it to.

Assigning various levels of protective status to sections of the coastline will not prevent the impact of many human-related activities, such as the effects of increased silt, nutrients, chemical, bacterial or viral pollution, global climate warming, ozone depletion, offshore commercial fishing, introduced species etc. Only long-term global, national or regional initiatives on land may assist in reducing some of these problems.

Physical disturbance to the intertidal zone by humans, such as reclamations, construction of wharfs, boat ramps, or erosion retardation barriers, is now more strictly controlled through the RMA legislation, but the assignment of protective status to a coastal section would raise its profile and make it less likely that any of the above physical impacts would be permitted, unless they could be shown to have minimal impact on the natural ecosystems.

The main purpose of protective status is to protect the intertidal (and subtidal) biota against the impacts of harvesting. As previously discussed, all intertidal harvesting has short-term impacts on the biota, but some major, fast-growing species that produce abundant propogules that can be widely dispersed by the sea (e.g. mussels, barnacles, seaweeds) exhibit periodic complete recovery. Few of these species are ever so heavily impacted by harvesting that their low numbers are likely to cause starvation or prey-switching by their predators (e.g. carnivorous snails and seastars).

These fast-growing species, that are dispersed by propogules that can live in the sea for several days to several weeks, require the continued existence of mature breeding populations, somewhere up-current. Spawn from the Waitakeres' coast mussels and other biota, is undoubtedly assisting to repopulate other coastal areas further afield. Thus protection of some breeding populations on the Waitakeres' coast would contribute to sustaining the total west coast biota.

Rarer, long-lived species (e.g. many carnivorous gastropods live for many years), which produce low numbers of young with lower dispersal abilities, are the group of organisms likely to be impacted the most by harvesting or collecting. There is some evidence, particularly on the north Manukau Harbour coast, that this is already happening, with the recorded loss or significant reduction in live specimens of at least 11 such species.

Protective status would likely increase the population density of several other targeted food species that are currently in low numbers along the Waitakeres' coast, such as kina *Evechinus chloroticus* and paua *Haliotis iris*. Subtidal benefits would mostly be for the reef fish population, although crayfish numbers might increase inside the harbour entrance.

Closures of areas that include sandy beaches to harvesting have yet to show significant restoration or increased biotic abundance or diversity elsewhere around Auckland, and a similar result might be expected on the north Manukau Harbour beaches.

In summary, implementation of protective status for sections of the Waitakeres' coastline would help protect the biodiversity of intertidal life, particularly the rarer longer-lived species. It would also provide protection for breeding populations of some more resilient, shorter-lived species, who's spawn would help recolonise and sustain other sections of the west coast. There would likely be other major benefits to the subtidal fish life not considered specifically here.

10. ACKNOWLEDGEMENTS

We thank Rob Astley, Wilma Blom, Hugh Grenfell, Glenys and Kathryn Hayward, Fraser Morgan, and Doug Rogan, for company in the field on one or more occasions. We also thank members of the Auckland Museum Conchology Section for assistance with the survey of South Piha (Morley and Hayward, 1999b). Jessica and Clare Hayward prepared the original map and some of the figures, and Ashwaq Sabaa, Hugh Grenfell and Carol Diebel assisted with scanning. As usual Hugh Grenfell was indispensable in solving our many computer questions. For assistance with identifications we thank Wilma Blom (polychaetes), Wendy Nelson and Doug Rogan (seaweeds), Brett Stephenson (crustaceans), Richard Willan and Michael Miller (nudibranchs). For assistance with placing reference specimens in the Auckland Museum collections we thank Doug Rogan, Ewen Cameron, Carol Diebel and Todd Landers. For preparing a list of all the marine algal specimens from the Waitakeres' coast in the Auckland Museum Botany collections we are indebted to Mei Nee Lee. We thank Anne Grace for discussions on the unpublished results of intertidal monitoring at Karekare, and as always we thank John Morton, Michael Miller and Roger Grace for their encouragement, support and willingness to share their vast knowledge and experience.

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12. APPENDICES

12.1 Appendix 1 - Field surveys

Maori Bay-Collins Bay; 10 August 1999, 1 Jan 2002
Pillow Lava Bay; 21 Feb 2000, 1 Jan 2002
Powell Bay-north Tirikohua Pt; 29 March 1998
Te Waharoa Bay; 10 Jan 2001
North Te Henga-O'Neills Bay; 14 June 1999, 21 June 2001, 13 April 2002
South Te Henga-Wigmore Bay; 12 July 1999, 21 June 2001
Anawhata-Paikea Bay; 25 Sept 1999
Whites Beach; 21 March 2000
North Piha; 21 March 2000, 8 May 2001
Piha; 28 March 1998, 8 May 2001
Mercer Bay; 27 Feb 1998
Karekare – Pararaha; 25 Oct 1999
Whatipu – west Paratutae; 21 Jan 2000, 18 Sept 2001
East Paratutae; 21 Jan 2000, 18 Sept 2001
Boulder Bay; 28 March 2002
Destruction Gully; 31 July 2000
Kaiteke Point-Little Huia; 25 May 1998, 7 April 2001
Huia Bay; 18 March 1999; 31 Dec 2001
Huia Point – Kaitarakihi; 17 Feb 1999, 7 April 2001
Kaitarakihi – Kakamatua Inlet; 10 Sept 1999, Sept 2001
Puponga Pt; 5 May 2000, 19 August 2001
Cornwallis – Mill Bay; 19 February 1996, 5 May 2000
Mill Bay – Lawry Pt, 1 July 2000
Armour Bay – Big Muddy Creek; 31 Dec 2001

12.2 Appendix 2 - Name changes

Recent scientific name changes for common intertidal animals and plants in this report.

Old name	New name
Mollusca:	
Amaurochiton glaucus	*Chiton glaucus*
Anchomasa similis	*Barnea similis*
Crassostrea glomerata	*Saccostrea cucullata*
Divaricella huttoniana	*Divalucina cumingii*
Gadinalea nivea	*Gadinia conica*
Guildingia obtecta	*Plaxiphora obtecta*
Lithophaga truncata	*Zelithophaga truncata*
Littorina	*Nodilittorina*
Lunella smaragda	*Turbo smaragdus*
Maoricrypta	*Crepidula*
Maurea	*Calliostoma*
Mayena australasia	*Ranella australasia*
Melaraphe oliveri	*Nodilittorina antipoda*
Modiolus neozelanicus	*Xenostrobus pulex*
Neothais scalaris	*Dicathais orbita*
Notirus	*Irus*
Notopaphia elegans	*Irus elegans*
Ostrea heffordi	*Ostrea lutaria*
Paphirus largillierti	*Ruditapes largillierti*
Rostanga rubicunda	*Rostanga muscula*
Siphonaria zelandica	*Siphonaria australis*
Sypharochiton sinclairi	*Sypharochiton pelliserpentis*
Terenochiton inquinatus	*Leptochiton inquinatus*
Thais orbita	*Dicathais orbita*
Tiostrea	*Ostrea*

Turbonilla	*Chemnitzia*
Echinodermata:	
Arachnoides zelandiae	*Fellaster zelandiae*
Coscinasterias calamaria	*Coscinasterias muricata*
Ocnus calcarea	*Australocnus calcarea*
Crustacea:	
Balanus decorus	*Notomegabalanus decorus*
Balanus tintinnabulum	*Megabalanus tintinnabulum linzei*
Balanus vestitus	*Notobalanus vestitus*
Elminius modestus	*Austrominius modestus*
Elminius plicatus	*Epopella plicata*
Mitella spinosa	*Calantica spinosa*
Ovalipes punctatus	*Ovalipes catharus*
Pagurus novae-zelandiae	*Pagurus novizelandiae*
Plagusia capensis	*Plagusia chabrus*
Tetraclita purpurascens	*Tetraclitella depressa*
Polychaeta:	
Hydroides norvegicus	*Hydroides elegans*
Idanthyrsus	*Paraidanthyrsus*
Pomatoceros caeruleus	*Spirobranchus cariniferus*
Sabellaria kaiparaensis	*Neosabellaria kaiparaensis*
Porifera:	
Aaptos aaptos	*Aaptos tentum*
Tethya ingalli	*Tethya australis*
Cnidaria:	
Corynactis haddoni	*Corynactis australis*
Isactinia tenebrosa	*Actinia tenebrosa*
Ascidians:	
Cnemidocarpa bicornuata	*Cnemidocarpa bicornuta*
Fish:	
Acanthoclinus quadridactylus	*Acanthoclinus fuscus*
Algae:	
Apophloea	*Apophlaea*
Codium adhaerens	*Codium convolutum*
Durvillea	*Durvillaea*
Pterocladia capillacea	*Pterocladiella capillacea*
Vidalia colensoi	*Osmundaria colensoi*
Vascular plants:	
Avicennia marina var. *resinifera*	*Avicennia marina*
Salicornia australis	*Sarcocornia quinqueflora*

12.3 Appendix 3 - Species list

List of animal and plant species identified from the intertidal zone around the Waitakere Ranges and their distribution from north to south.

Qualitative assessment of abundance:

a = abundant (c.>10,000 live specimens), c = common (c.50-10,000 live specimens), f = frequent (c.6-50 live specimens), o = occasional (3-5 live specimens), r = rare (1-2 live specimens), d = dead wash-up record only, x = additional records to those recorded in this survey by the authors, from earlier voucher specimen in Auckland Museum collections, nudibranch records of Richard Willan (pers.comm.), or published historic records in Adams (1994), Bergquist (1968, 1970, 1996), Bergquist & Fromont (1988), Bergquist & Warne (1980), Conchology Section Auckland Institute and Museum (1963), Foster (1978), Hurley & Jansen (1977), Melrose (1975), Morton & Miller (1968), and Paulin & Roberts (1992). Mollusc names have been updated to follow Spencer and Willan (1995) and Marshall and Burch (2000). * = new west coast records.

Key to abbreviations of coastal localities:

Ana	Anawhata Beach and Paikea Bay
Arm	Armour Bay, from Big Muddy Creek to Lawry Pt.
Bou	Boulder Bay, east of Whatipu
Cor	Cornwallis Beach to south end Mill Bay
Des	Destruction Gully bay
EPar	east side of Paratutae Island, Whatipu
Huia	Huia Bay, from Little Huia to just inside Huia Pt.
HuPt	Huia Pt. to west side Kaitarakihi Bay
Kai	Kaiteke Point, Little Huia
Kak	Kakamatua Inlet to east side Kaitarakihi Bay
Kar	Karekare Beach and Paratahi Island to Pararaha
Mao	Maori Bay, from south end of Muriwai Beach to Collins Bay
Mer	Mercer Bay
Mill	Mill Bay to Lawry Pt.
NPih	North Piha
NTeH	North Te Henga and O'Neills Beach
Pih	South Piha and Lion Rock
Pill	Pillow Lava Bay, south of Muriwai
Pow	Powell Bay, Bartrum Bay and north side Tirikohua Pt.
Pup	south half of Puponga Peninsula, Cornwallis
STeH	South Te Henga and Wigmore Bay
TeW	Te Waharoa Bay to south side Tirikohua Pt.
Whi	Whites Beach
WPar	west side of Paratutae Island, Ninepin Rocks and Whatipu Beach

Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm
MOLLUSCA: POLYPLACOPHORA (chitons)																								
Acanthochitona violacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Acanthochitona zelandica	o	.	o	r	o	r	o	r	r	o	r	.	o	o	o	r	f	f	r	.	r	f	r	r
Chiton glaucus	r	.	r	o	r	.	.	.	.	.	r	r	.	o	r	o	.	f	o	r	o	o	c	o
Cryptoconchus porosus	x	.	r	.	r	.	r	o	.	r	o	.	f	o	r	o	o	.	r	.	r	.	r	.
Eudoxochiton nobilis	.	.	r	r	r	.	.	.	r	r	.	.	f	o	o	r	o	r	.	.	r	.	.	.
Ischnochiton maorianus	r	.	.	r	r	.	.	.	.	.	.	.	.	f	o	o	.	.	f	.	o	r	c	.
Leptochiton inquinatus	o	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	o	.	r	o	.	.
Plaxiphora biramosa	x	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Plaxiphora caelata	x	r	r	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plaxiphora murdochi	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plaxiphora obtecta	o	f	r	r	x	o	o	f	f	o	f	r	f	r	.	.	.	.	.	.	.	.	.	.
Rhyssoplax stangeri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Sypharochiton pelliserpentis	c	c	c	f	c	f	f	f	f	c	c	f	f	f	f	f	c	c	c	f	c	f	o	o
MOLLUSCA: GASTROPODA (snails)																								
Alcithoe arabica f. swainsoni	d	d	.	d	.	.	.	.	.	d	d	.	d	.	.	.	.	.	d	.	c	.	.	.
Amalda australis	d	.	.	d	d	.	d	.	.	.	.	.	.	.	d	.	d	d	r	o	.	o	d	.
Amalda mucronata	d	d	d	d	d	d	d	.	.	.	.	d	d	.	.	.	.	.	.	.	.	.	.	.
Amalda novaezelandiae	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	d	.	.
Amalda novaezelandiae f. crystallina*	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amphibola crenata	.	.	d	.	.	.	.	.	.	r	.	d	.	.	.	.	.	c	.	.	.	c	c	c
Amphithalmus falsestea	c	r	r	c	.	.	o	.	.	.	.	.	.	.	.	o	.	.	r	.	o	.	.	.
Amphithalmus semen	.	.	.	c	.	.	.	.	.	.	.	.	.	.	c	o	.	f	r	.	o	.	.	.
Antisolarium egenum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	.	.	.	.	.	.
Argobuccinum pustulosum tumidum	d	.	.	.	.	d	.	.	.	.	.	d	d	.	.	.	.	.	.	.	.	.	.	.
Assiminea vulgaris*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.
Austrofusus glans	d	.	.	d	d	d	d	.	.	d	.	d	d	d	.	.	.	.	.	.	.	.	.	.
Austromitra rubiginosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	d	.	r	r	.	o	.	.	.
Brookula finlayi*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Buccinulum lineum lineum	x	.	.	o	.	.	.	.	.	.	.	.	d	d	.	.	d	d	r	.	.	.	f	.
Buccinulum vittatum	d	.	o	o	o	.	d	.	.	o	.	.	d	.	r	o	f	f	r	.	o	.	o	.
Bulla quoyii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	d	.	d
Cabestana spengleri	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	o	r
Cabestana tabulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	o	.
Caecum digitulum	.	.	.	d	.	.	.	.	.	.	.	.	d	.	c	o	.	.	.	.	d	.	d	.
Calliostoma punctulatum	d	.	.	d	.	.	.	.	.	.	.	d	d	r	.	r	.	.	.	d	o	.	.	.
Calliostoma selectum	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calliostoma tigris	d	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	d	f	.	.
Cantharidella tesselata	a	f	f	c	a	f	f	.	f	.	f	.	o	.	.	o	.	.	.	.	.	.	.	.
Cantharidus purpureus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	d	.	.	.	.	.
Cellana denticulata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cellana ornata	r	o	o	o	r	r	o	o	r	o	r	r	o	f	o	f	f	o	o	r	f	.	.	.
Cominella adspersa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cellana radians	c	c	c	c	c	f	f	f	c	c	c	o	f	f	a	a	f	f	c	o	f	.	.	.
Cellana stellifera	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Charonia lampas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.
Chemnitzia sp.	d	.	.	.	.	.	.	d	.	.	.	.	o	.	d	o	.	d	o	.	d	f	c	.
Cirsotrema zelebori	d	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	d	.	.	.	.	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm

Cominella adspersa	d	.	.	d	d	d	d	.	.	.	.	d	d	o	.	.	.	c	f	o	o	o	o	c
Cominella glandiformis	d	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	o	o	c	o	o	o	a
Cominella maculosa	.	.	o	o	.	.	.	.	.	.	.	.	.	o	.	r	o	f	f	r	o	o	o	.
Cominella quoyana quoyana	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	r	r	.	r	.	r	.	.	.
Cominella quoyana accuminata	.	.	x	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	o	.
Cookia sulcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	d	.	.	r	.	o	.	.	.
Crepidula costata	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.
Crepidula monoxyla	.	.	.	o	.	.	.	.	.	.	.	.	o	.	o	o	o	.	o	.	.	o	o	r
Cymatium parthenopeum	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	o	.	.	x	o	r
Dicathais orbita	a	c	a	c	c	f	c	a	f	c	c	f	c	f	o	f	f	r	f	.	o	.	.	r
Diloma arida	r	d	.	o	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.
Diloma bicanaliculata	r	d	o	d	r	o	o	.	.	d	o	r	.	f	f	o	.	.	r	.	r	.	.	.
Diloma coracina	o	r	o	o	.	o	o	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diloma nigerrima	d	d	.	o	c	r	o	.	.	x	.	o	.	o	o	.	.	.	.	.	.	.	.	.
Diloma subrostrata	.	.	.	.	.	d	.	.	.	.	.	.	d	.	r	.	.	a	d	d	x	f	o	a
Diloma zelandica	r	.	.	f	o	o	r	.	.	.	.	.	.	o	a	f	c	c	.	.	o	.	.	.
Eatoniella albocolumella	x	c	r	c	.	.	o	.	.	.	.	.	.	.	r	.	.	o	r	.	c	.	o	.
Eatoniella atervisceralis	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella delli	.	.	.	c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella dilatata	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella latebricola	d	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella limbata	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.
Eatoniella mortoni	.	.	.	.	.	.	c	.	.	.	.	.	.	.	c	o	.	.	.	.	o	.	.	.
Eatoniella notalabia	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	o	.	.	.	.	.	.	o	.
Eatoniella notata*	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella olivacea	.	.	r	c	.	r	o	.	.	.	o	.	o	d	c	c	c	f	o	.	c	c	c	.
Eatoniella pfefferi *	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	r	.	.	.	.	.	.	.	.
Eatoniella roseola	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eatoniella varicolor	.	r	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	.	.	.
Eatonina atomaria	r	.	.	r	.	.	.	.	.	.	.	.	.	.	r	r	.	f	r	.	.	.	o	.
Eatonina micans*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.
Eatonina subflavescens	.	.	.	o	r	.	.	.	.	.	.	.	.	.	o	o	.	o	.	.	o	.	.	.
Epitonium jukesianum	o	.	.	.	o	r	.	.	.	.	.	.	.	.	d	o	.	.	.	.	o	d	.	.
Epitonium tenellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	d	d	.
Fossarina rimata	.	.	.	.	.	.	.	.	.	.	.	.	.	d	d	d	.	.	.	.	d	.	.	.
Gadinia conica	.	.	r	d	.	.	.	.	.	x	.	.	.	.	d	.	.	.	.	.	.	.	.	.
Haliotis australis	x	.	.	.	.	.	.	.	.	.	.	.	.	o	d	.	o	.	.	.	.	o	.	.
Haliotis iris	x	.	.	d	.	.	.	.	.	.	.	.	r	f	f	o	r	.	.	.	r	c	.	.
Haminoea zelandiae	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	o	r	.	.	o	d	f
Haustrum haustorium	.	.	.	o	.	.	.	.	.	.	.	.	.	.	o	o	o	o	o	.	o	.	r	.
Incisura lytteltonensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	o	.	.	.	.	.	.	.	.
Janthina exigua	d	.	.	d	.	d	d	d	.	d	d	d	d	.	.	.	.	.	d	.	.	.	.	.
Janthina globosa	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Janthina janthina	d	.	.	.	.	.	.	.	.	.	.	d	d	.	.	.	.	.	.	d	.	.	.	.
Lamellaria ophione	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	o	.	.	.
Lepsiella albomarginata	c	a	c	c	c	c	c	f	c	c	c	c	c	c	f	c	c	c	a	o	c	c	f	f
Leuconopsis obsoleta	.	.	.	.	.	.	.	c	.	.	.	.	.	d	.	.	d	.	.	.	o	.	.	.
Linopyrga rugata	.	.	.	d	.	.	.	.	.	.	.	l	o	.	d	d	.	.	.	.	.	.	d	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm

Lodderia iota*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	
Maoricolpus roseus manukauensis	d	.	.	d	d	d	.	.	.	.	.	d	d	d	d	d	d	c	f	d	c	d	c	d	
Marinula filholi	.	.	.	.	.	.	.	.	.	.	.	.	d	.	f	.	.	.	.	.	.	c	.	.	
Melagraphia aethiops	x	.	c	o	.	o	r	.	.	r	f	.	d	o	r	o	c	a	a	o	f	a	a	a	
Melanochlamys cylindrica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	
Melanopsis trifasciata	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Micrelenchus huttonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	f	
Micrelenchus sanguineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	.	.	
Micrelenchus tenebrosus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	r	.	r	.	.	.	
Microtralia occidentalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	
Neoguraleus manukauensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	d	.	
Neoguraleus murdochi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	
Neoguraleus oruaensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Nerita atramentosa	x	.	.	.	.	r	r	.	.	.	.	r	.	r	o	f	.	f	r	.	r	r	r	.	
Nodilittorina antipoda	c	c	c	f	c	c	c	c	c	c	c	c	a	a	f	f	c	a	c	r	c	c	a	f	
Nodilittorina cincta	c	o	x	c	o	o	f	o	o	f	o	o	f	o	o	o	c	r	r	.	r	.	o	o	
Notoacmea elongata	x	.	.	.	.	.	r	.	.	.	.	.	.	o	f	o	d	o	d	.	d	.	d	.	
Notoacmea helmsi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	f	o	.	f	.	c	o	
Notoacmea helmsi f. scapha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	d	.	o	.	
Notoacmea parviconoidea	o	o	r	o	o	f	o	o	o	o	o	o	o	.	o	o	o	o	r	.	c	.	.	.	
Notoacmea pileopsis pileopsis	o	o	o	o	f	.	c	f	f	c	o	d	.	o	f	.	o	o	.	.	o	.	r	.	
Notoacmea scopulina	x	.	.	.	.	.	.	.	.	x	.	.	.	.	d	.	.	.	.	.	.	.	.	.	
Nozeba emarginata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	.	
Odostomia geoffreyi ?	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	
Odostomia incidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	.	o	.	
Onchidella nigricans	f	.	o	f	o	f	o	o	f	o	o	r	.	o	o	r	o	o	.	r	c	c	f	f	
Onoba fumata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	
Ophicardelus costellaris	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	a	.	.	.	o	.	f	
Orbitestella parva	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	
Paratrophon cheesemani	o	r	o	o	o	.	o	.	.	x	.	.	d	.	.	.	.	.	.	.	.	.	.	.	
Patelloidea corticata	f	f	f	o	f	f	f	f	f	f	f	f	c	c	f	o	f	.	o	.	c	.	.	.	
Penion sulcatus	d	.	.	.	.	.	.	.	.	.	.	d	d	.	.	.	d	.	.	.	d	o	.	.	
Pervicacia tristis	d	.	.	d	d	.	d	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	
Phenatoma rosea	d	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Phenatoma zealandica	d	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Philine angasi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	.	.	
Philine auriformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	
Philine sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	
Pisinna rekohuana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	
Pisinna zosterophila	.	r	.	c	.	.	c	.	.	.	.	.	.	.	c	o	d	o	r	.	c	.	d	.	
Poirieria zelandica	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Potamopyrgus estuarinus	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	o	.	.	c	.	
Pusillina infecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	.	.	.	
Pyramidellidae indet.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Radiacmea inconspicua	x	.	.	.	.	.	.	.	.	x	.	.	r	o	o	r	.	.	o	.	.	.	.	.	
Ranella australasia	.	.	.	d	.	.	.	.	.	.	.	.	d	.	.	r	.	.	.	.	o	.	o	.	
Rhizorus nesentus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Risellopsis varia	x	d	.	d	.	.	.	d	.	x	.	.	o	d	o	d	o	.	f	.	c	.	.	.	
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Rissoella cystophora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	

Rissoella rissoaformis	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	f	.	o	.
Rissoina chathamensis	.	.	.	.	.	.	.	.	.	.	.	.	d	d	f	o	d	.	d	.	.	.	.	.
Sagenotriphora ampulla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Scutus breviculus	r	.	.	f	o	.	o	r	.	.	.	.	.	o	o	o	r	d	o	.	o	o	.	.
Semicassis pyrum	d	.	d	d	d	d	d	d	d	d	d	d	d	d	.	.	.	.	.	.	o	.	.	.
Sigapatella novaezealandiae	d	.	.	d	.	d	.	.	.	d	.	d	d	f	f	o	f	o	f	d	o	.	r	o
Sinezona brevis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.
Siphonaria australis	.	o	o	f	f	.	o	o	o	o	d	f	.	r	o	o	o	o	o	o	f	r	o	.
Siphonaria propria	f	o	r	o	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	r
Struthiolaria papulosa	r	d	d	d	d	d	d	d	d	.	.	d	d	d	.	.	.	.	d	d	o	.	.	.
Struthiolaria vermis vermis	d	.	.	.	d	d	.	.	.	.	.	.	d	.	.	.	d	.	d	d	o	d	d	o
Suterilla neozelandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.
Tanea zelandica	d	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.
Taron dubius	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	o	o	o	.	r	.	d	.
Trichosirius inornatus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.
Trochus tiaratus	.	.	.	.	.	d	.	.	.	.	.	.	d	.	.	.	.	r	d	.	d	.	.	.
Trochus viridis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tubbreva exigua	.	.	.	r	.	.	.	.	.	.	o	.	.	.	o	.	.	.	.	.	.	.	c	.
Tugali suteri	.	.	.	.	.	.	.	.	.	.	.	.	d	.	r	d	r	.	.	.	o	.	.	.
Turbo smaragdus	.	.	f	f	o	o	o	.	o	c	f	o	o	o	f	f	a	a	a	o	f	f	c	o
Volvarinella cairoma	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.
Xymene ambiguus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xymene plebeius	d	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	d	d	.	.	o	c	o
Xymene pusillus	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.
Xymene traversi	d	.	.	d	f	.	d	.	.	.	.	.	d	.	d	c	o	.	o	.	o	.	.	.
Zalipais lissa	.	.	.	.	.	.	.	.	.	.	.	.	.	o	c	o	.	.	r	.	o	.	c	.
Zeacolpus ahiparanus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zeacolpus pagoda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.
Zeacumantus lutulentus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	d	.	.	d	a	a
Zeacumantus subcarinatus	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	o	c	.	o	c	a	a
Zegalerus tenuis	d	.	.	d	.	.	.	.	.	d	.	.	d	.	.	.	.	d	d	d	r	.	d	.
Zemitrella choava	.	.	.	o	.	.	.	.	.	.	.	.	d	.	r	.	.	.	r	.	o	o	o	.
Zemitrella fallax	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Zemitrella sp.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zethalia zelandica	d	.	d	.	.	.	.	.	.	.	.	.	d	.	.	.	d	d	d	a	d	d	d	.
MOLLUSCA: NUDIBRANCHS (sea slugs)																								
Acanthodoris molicella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.
Alloiodoris lanuginata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Aphelodoris sp.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	o	.	.	.	.	.	.	.	.
Archidoris wellingtonensis	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Berthella ornata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.
Dendrodoris citrina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	c	f	.
Doriopsis flabellifera	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.
Eubranchus agrius	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flabellina albomarginata	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phidiana milleri	x	.	.	.	.	.	.	.	.	.	.	.	f	o	.	.	.	.	.	.	.	.	.	.
Rostanga muscula*	x	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	o	o	.	.	r	.	r	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm
Stiliger felinus	x	.	.	.	.	.	.	.	.	x	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Tritonia incerta	x	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.

MOLLUSCA: BIVALVIA (clams)																									
Anadara trapezia	x	.	.	.	.	.	.	.	.	.	.	d	x	.	.	.	.	.	.	.	.	.	.	.	.
Anomia trigonopsis	d	.	.	d	.	.	d	.	.	.	.	.	.	o	d	.	o	.	o	d	d	r	r	d	
Arthritica bifurca	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	d	.	d	.	d	o	.	
Atrina zelandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	d	d	d	d	o	r	
Austrovenus stutchburyi	d	.	.	.	d	d	d	.	d	d	.	d	d	d	.	.	d	a	d	c	d	a	a	a	
Bankia australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	f	o	
Bankia neztalia	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Barbatia novaezelandiae	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	
Barnea similis	.	d	o	o	.	.	.	.	.	.	.	d	d	.	d	.	.	d	f	.	o	c	f	d	
Bassina yatei	.	.	.	d	.	d	d	.	.	d	.	.	d	.	.	.	.	.	.	d	d	.	.	.	
Borniola reniformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	.	.	.	d	.	.	
Cardita aoteana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	
Chlamys zelandiae	d	.	.	d	d	d	d	.	.	.	.	d	r	o	d	d	d	x	o	.	o	.	o	d	
Cleidothaerus albidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	o	r	.	
Corbula zelandica	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	d	.	.	.	.	.	.	.	.	
Crassostrea gigas	r	r	.	d	r	o	d	r	o	o	.	f	d	f	o	o	f	c	a	c	a	c	a	a	
Cyclomactra ovata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	d	d	.	d	d	.	
Divalucina cumingii	d	.	.	d	.	d	d	.	.	d	.	.	d	.	.	.	.	.	.	d	d	d	.	.	
Dosina zelandica	.	.	.	.	.	d	.	.	.	.	.	d	d	.	d	d	d	f	o	.	d	.	.	x	
Dosinia anus	d	d	d	d	d	d	d	d	.	d	.	.	d	.	.	.	.	.	.	.	.	.	.	.	
Dosinia anus white form	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Dosinia lambata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	d	
Dosinia maoriana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	d	.	.	.	
Dosinia subrosea	d	.	.	.	d	d	.	d	.	.	.	.	d	.	.	.	.	d	d	d	d	d	.	.	
Felaniella zelandica	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	d	.	d	.	.	
Gaimardia finlayi	.	f	f	d	f	.	r	.	.	f	o	.	r	.	.	.	.	.	.	.	.	.	.	.	
Gari lineolata	d	.	d	.	d	d	.	d	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Gari stangeri	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	d	d	.	.	.	.	.	
Glycymeris modesta	d	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Hiatella arctica	o	d	o	o	.	.	c	d	d	o	o	.	c	c	f	o	d	.	r	.	o	o	.	.	
Hunkydora australica novozelandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	
Irus elegans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	
Irus reflexus	d	d	o	f	.	.	.	.	.	r	o	d	f	.	o	d	d	d	o	.	o	o	c	.	
Lasaea hinemoa	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	d	d	.	.	.	d	.	o	.	
Lasaea maoria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	
Lasaea parengaensis *	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	
Leptomya retiaria	.	.	.	d	.	.	.	.	.	.	.	.	.	d	d	d	.	d	d	d	d	.	d	.	
Macomona liliana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	r	f	d	c	c	.	
Mactra discors	d	.	d	d	d	d	d	d	d	d	d	d	d	.	.	.	.	.	.	.	.	.	.	.	
Maorimactra ordinaria	d	.	.	d	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	
Modiolarca impacta	d	.	.	.	.	.	.	.	.	.	.	d	d	.	.	.	.	d	d	.	d	d	o	.	
Modiolus areolatus	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	
Myadora boltoni	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	d	.	.	.	.	
Myadora striata	d	.	.	d	d	d	.	.	.	.	.	.	.	.	.	.	.	d	d	d	d	o	.	d	
Myadora subrostrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Myllitella vivens vivens	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Nucula hartvigiana	.	.	.	.	.	d	.	d	.	.	.	.	.	.	r	o	.	a	f	o	d	f	o	d	
Nucula nitidula	d	.	d	d	.	.	d	.	.	.	.	.	.	.	r	.	.	.	.	d	.	.	.	.	

Ostrea aupouria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	.	.	o	.	.	.
Ostrea lutaria	.	.	.	.	.	x	.	.	.	.	.	.	d	.	.	.	.	d	d	.	.	d	o	o
Panopea zelandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.
Paphies australis	.	.	.	.	d	.	.	.	.	.	.	.	d	.	.	.	.	a	d	a	d	c	f	o
Paphies donacina	d	d	d	d	.	d	d	d	.	d	d	d	d	.	.	.	.	.	d	.	.	.	.	.
Paphies subtriangulata	x	.	.	.	d	.	.	.	.	x	.	x	.	.	.	.	.	d	d	d	.	d	.	.
Paphies ventricosa	d	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pecten novaezelandiae	d	.	.	.	.	d	.	.	.	d	.	d	d	.	.	.	d	r	d	r	d	r	o	r
Periploma angasi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Perna canaliculus	a	a	a	f	a	a	a	a	c	c	a	c	a	c	f	r	o	r	c	o	c	o	o	r
Peronaea gaimardi	d	.	.	d	d	d	d	d	d	d	d	d	d	.	.	.	.	.	.	.	.	.	.	.
Philobrya munita	.	c	o	o	r	.	d	.	.	f	o	.	o	o	o	o	.	.	.	.	.	.	.	.
Pholadidea suteri	.	d	o	f	.	.	.	.	.	.	.	.	.	.	.	.	.	o	o	.	o	.	o	.
Pholadidea tridens	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.
Pododesmus zelandicus	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Protothaca crassicosta	d	.	x	d	.	d	.	.	.	.	.	.	d	.	.	d	.	.	.	.	.	.	.	.
Pseudarcopagia disculus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	d	.	.	.	.	.	.	.	.
Rexithaerus spenceri	x	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruditapes largillierti	r	.	.	d	.	.	r	.	.	d	.	.	d	.	d	d	d	d	d	d	d	d	d	d
Saccostrea cucullata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scalpomactra scalpellum	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.
Solemya parkinsoni	d	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	d	.	.	.
Soletellina nitida	.	.	.	d	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.
Soletellina siliquens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.
Spisula aequilatera	d	d	d	d	d	d	d	d	d	d	d	d	d	.	.	.	.	.	.	.	.	.	.	.
Tawera spissa	d	.	d	.	.	d	d	.	.	.	.	d	d	.	r	d	.	.	.	d	.	.	.	.
Tellinota edgari	d	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.
Theora lubrica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	f
Xenostrobus pulex	a	a	a	c	c	a	a	a	a	c	a	c	a	a	o	o	c	a	a	c	c	f	f	f
Xenostrobus securis	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Zelithophaga truncata	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	o	.
Zenatia acinaces	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
MOLLUSCA: SCAPHOPODA (tusk shells)																								
Antalis nana	d	.	.	d	.	.	.	.	.	.	.	.	d	.	.	.	.	d	d	.	.	.	d	.
MOLLUSCA: CEPHALAPODA																								
Octopus indet.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.
Spirula spirula	d	d	d	.	d	d	d	d	d	d	d	d	d	.	d	d	.	.	.	d	d	.	.	.
ECHINODERMATA: ASTEROIDEA (seastars)																								
Allostichaster polyplax	r	.	.	.	.	.	.	.	.	o	.	.	.	.	o	.	o	r	o	.	f	.	o	o
Coscinasterias muricata	o	.	x	r	.	.	.	.	.	.	.	r	.	.	r	.	f	o	f	r	f	.	o	r
Patiriella regularis	r	.	r	o	r	r	r	r	.	r	o	r	o	o	r	r	f	c	o	r	o	f	o	o
Stichaster australis	c	c	c	f	o	o	f	f	f	c	c	o	o	.	o	o	r	.	.	.	.	.	.	.
ECHINODERMATA: ECHINOIDEA (sea eggs)																								
Echinocardium cordatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.
Evechinus chloroticus	.	r	r	f	r	.	r	.	.	r	o	r	r	r	r	r	.	.	o	.	r	.	r	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm
Fellaster zelandiae	d	.	.	d	d	d	d	d	d	d	.	d	d	.	.	.	.	a	.	a	d	o	d	d
ECHINODERMATA: HOLOTHURIA (sea cucumbers)																								
Australocnus calcarea	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
ECHINODERMATA: OPHIUROIDEA (brittlestars)																								

Ophionereis fasciata	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.
CRUSTACEA - REPTANTIA (crabs)																									
Cancer novaezelandiae	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	r	r	.	d	.	.	.	
Cyclograpsus lavauxi	.	.	.	.	.	r	.	.	.	.	.	.	.	.	f	.	.	c	f	o	o	o	o	o	
Halicarcinus spp. Indet	.	.	.	r	o	o	r	r	.	.	r	.	.	.	.	o	.	f	.	.	o	.	o	.	
Halicarcinus cookii	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Halicarcinus innominatus	x	.	o	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Halicarcinus ovatus	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Halicarcinus whitei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	
Helice crassa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	a	
Hemigrapsus crenulatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	o	o	
Hemigrapsus edwardsi	o	o	c	f	o	o	c	f	f	c	o	f	f	f	f	r	.	.	o	c	f	o	.	o	
Heterozoius rotundifrons	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	f	f	
Leptograpsus variegatus	.	f	f	c	r	o	f	o	o	c	f	o	o	o	o	r	.	o	o	d	r	d	.	.	
Macrophthalmus hirtipes	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	o	r	.	.	.	o	f	
Notomithrax peronii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	o	.	f	f	
Notomithrax ursus	x	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	r	.	.	.	.	.	
Ovalipes catharus	o	.	.	.	d	.	.	r	.	.	.	d	d	d	.	.	.	.	.	d	d	d	.	.	
Ozius truncatus	.	.	o	.	.	d	d	.	.	.	.	.	.	c	f	o	f	f	c	.	o	.	d	d	
Pagurus novizelandiae	f	.	f	f	o	o	o	.	.	.	.	o	o	o	o	o	f	f	f	r	f	f	.	o	
Petalomera wilsoni	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	
Petrolisthes elongatus	r	.	o	r	r	r	.	.	.	o	c	r	.	o	o	f	c	c	c	r	c	f	f	f	
Pilumnus lumpinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	r	.	r	.	
Pinnotheres novaezelandiae	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	r	.	.	.	.	.	
Plagusia chabrus	o	f	o	o	o	r	o	f	o	o	f	f	f	o	o	o	c	o	r	d	r	.	.	.	
CRUSTACEA: DECAPODA (shrimps)																									
Alope spinifrons	.	.	.	r	.	.	.	.	.	.	o	.	r	o	o	.	o	o	.	.	r	.	.	.	
Alpheus novaezelandiae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	
Callianassa filholi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	o	.	.	.	
Palaemon affinis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	
Pontophilus australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	
CRUSTACEA: AMPHIPODA																									
Talorchestia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	
CRUSTACEA: ISOPODA																									
Batedotea elongata	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Dynamenella cordiforaminalis	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Dynamenella huttoni	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Euiodotea durvillei	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Exosphaeroma obtusum	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Idotea metallica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	
Isocladus armatus	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Ligia novaezelandiae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	
Pseudosphaeroma campbellensis	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Scutuloidea kuta	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Scutuloidea maculata	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
CRUSTACEA: CIRRIPEDIA (barnacles)																									
Australophialus melampygos	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Austrominius modestus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	c	a	a	a	c	c	a	f	
Balanus trigonus	.	.	.	.	.	r	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	

Calantica spinosa	r	.	.	.	.	.	.	.	.	r	r	.	x	.	r	.	.	.	.	.	.	.	.	.	
Calantica villosa	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Chamaesipho brunnea	f	c	f	f	c	f	c	o	a	c	a	c	c	f	f	f	f	o	o	.	f	.	r	.	
Chamaesipho columna	a	a	a	c	c	a	a	a	a	a	a	a	a	a	c	c	f	f	c	.	f	.	.	.	
Conchoderma virgatum	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	
Epopella plicata	c	c	a	f	c	c	c	f	c	c	c	c	c	f	f	f	f	r	o	f	f	.	r	.	
Ibla idiotica	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Lepas anatifera	.	.	x	.	.	d	d	d	.	x	x	d	.	.	d	.	.	.	.	.	.	.	.	.	
Lepas fascicularis	x	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Lepas pectinata	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Lepas testudinata	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	55	.	.	.	.	.	.	.	
Megabalanus tintinnabulum linzei	.	o	o	.	r	o	.	r	.	f	o	r	r	r	o	.	.	.	.	.	.	.	.	.	
Notobalanus vestitus	.	.	.	.	.	r	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	
Tetraclita aoranga	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Tetraclitella depressa	o	.	o	f	.	.	.	.	f	f	o	o	.	o	r	f	.	.	.	.	r	.	.	.	
CRUSTACEA: OSTRACODA																									
Leuroleberis zealandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	.	.	.	.	
CNIDARIA: ALCYONACEA																									
Alcyonium aurantiacum	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
CNIDARIA: ACTINIARIA (sea anenomes)																									
Actinia tenebrosa	o	r	.	o	o	f	f	f	o	o	o	o	.	o	.	o	.	o	r	.	.	r	.	.	
Actinothoe albocincta	.	.	.	.	.	r	.	.	r	x	.	.	.	o	.	.	.	.	.	r	.	o	o	f	
Anthopleura aureoradiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	f	o	
Corynactis australis	o	.	.	.	.	.	r	x	o	x	o	.	.	.	r	.	.	.	.	.	r	.	.	.	
Cricophorus nutrix	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Diadumene neozelanica	o	.	r	.	r	o	r	r	.	r	f	o	.	.	.	.	.	r	.	.	r	.	o	.	
Isactinia olivacea	.	r	o	f	o	o	.	o	o	f	o	o	o	.	o	o	o	f	f	o	o	f	f	f	
Isocradactis magna	f	o	o	r	o	f	f	f	o	o	o	c	o	.	.	r	o	.	o	r	o	.	.	.	
Oulactis muscosa	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	o	.	.	
CNIDARIA: SCLERACTINIA (corals)																									
Culicia rubeola	.	.	r	.	.	o	.	.	.	.	x	.	x	.	r	r	.	.	.	.	r	.	.	.	
CNIDARIA: HYDROZOA (hydroids)																									
Amphisbetia bispinosa	c	f	c	.	c	c	f	f	c	.	c	o	d	d	.	.	.	.	.	.	.	.	.	.	
Orthopyxis sp.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Plumularia sp.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
CNIDARIA: SCYPHOZOA (jellyfish)																									
Aurelia aurita	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Physalia physalis	d	d	.	.	.	.	.	d	d	.	d	.	d	.	d	.	.	.	.	.	.	.	.	.	
Porpita porpita	.	.	.	.	.	.	.	d	.	.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	
Vevella vevella	d	d	.	.	.	.	.	d	d	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	
BRYOZOA (sea mosses)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Beania sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	c	c	f	.	f	.	r	.	

Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm
ANNELIDA: POLYCHAETA (worms)																								
Aglaophamus macroura	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Boccardia sp.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eulalia microphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.
Eupholoe sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.
Flabelligera bicolor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	f	.	r	.	r	r

Galeolaria hystrix	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glycera americana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Hydroides elegans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Lepidastheniella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Lumbrinereis coccinea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Marphysa depressa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	.	.	.	.	.	.
Neosabellaria kaiparaensis	f	o	o	o	f	f	o	o	o	o	.	o	r	.	.	f	c	c	c	c	c	.	f	.	
Onophis aucklandensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Owenia fusiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	r	.	.	.	.	.	.
Paraidanthyrsus quadricornis	.	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.
Pectinaria australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	d	.	.	.	d	d	.	
Perinereis ambylodonta	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllodocid	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.
Platynereis australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Spirobranchus cariniferus	r	r	f	f	o	o	o	o	o	f	c	f	o	c	a	a	c	c	c	c	a	c	c	a	
Salmacina australis	o	.	o	.	.	o	.	.	.	f	.	f	.	o	.	o	.	.	r	d	o	.	.	.	
Spirorbis spp.	o	o	.	o	o	.	.	.	.	.	.	.	.	.	.	o	.	d	.	.	f	.	.	.	
Terebellidae (indet.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
NEMERTEA (ribbon worms)																									
slender orange nemertean	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	r	
PLATYHELMINTHES (flatworms)																									
SIPUNCULIDS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Themiste minor huttoni	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	x	r	.	.	.	
PHORONIDA																									
Phoronis ovalis	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PORIFERA (sponges)																									
Aaptos globosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	
Aaptos tentum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	
Adocia venustina	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	
Ancorina alata	.	.	.	.	.	.	.	.	.	.	o	.	o	.	o	f	.	.	.	.	r	.	.	.	
Callyspongia fistulosa	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Callyspongia ramosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	d	
Carmia hentscheli	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carmia macilenta	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cliona celata	r	r	f	o	r	r	o	.	.	x	r	r	r	.	r	.	r	.	o	.	o	.	.	.	
Darwinella gardineri	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	
Darwinella oxeata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	
Halichondria moorei	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	r	
Halichondria panicea	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Haliclona brondstedi	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Haliclona heterofibrosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	
Haliclona tenacior	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Hymeniacidon perleve	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Isociella incrustans	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Microciona coccinea	o	f	o	o	r	r	o	o	f	o	f	o	o	.	o	o	o	o	r	.	o	.	.	.	
Ophlitaspongia reticulata	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Polymastia aurantium	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Polymastia fusca	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Polymastia granulosa	.	.	.	.	.	.	x	.	.	x	.	.	.	.	r	.	.	.	.	.	.	.	.	.	

?Suberites axinellooides	o	f	o	o	r	o	o	.	f	o	f	.	.	.	.	.	o	o	.	.	r	.	o	.		
Tethya aurantium	o	o	f	f	f	o	f	o	.	o	r	o	o	o	o	f	f	o	f	.	f	.	f	.		
Tethya australis	.	.	o	.	.	.	.	.	r	x	.	.	.	.	r	.	.	.	r	.	o	.	.	.		
Tethya mortoni	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.		
Tethya stolonifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.		
ASCIDIA (sea squirts)																										
Aplidium phortax	.	.	o	.	r	.	o	.	.	o	.	.	o	.	o	o	.	.	o	.	f	.	.	.		
Asterocarpa coerulea	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	o	r	f	.	r	.	o	.		
Botryllus schlosseri	f	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	c	c	.	.	.	.	.	.		
Cnemidocarpa bicornuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	r	.	r	.	f	.		
Corella eumyota	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	r	o	r	.	.	r	.	.	.		
Pyura rugosa	r	.	.	.	.	r	o	.	.	.	o	r	.	r	.	.	.	.	r	.	o	r	f	o		
VERTEBRATA: OSTEICHTHYES (tidal pool fish)																										
Acanthoclinus fuscus	.	.	.	.	.	.	.	.	.	.	.	.	x	r	r	.	o	o	r	.	r	r	o	r		
Aplodactylus arctidens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Bellapiscis medius	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.		
Grahamina capito	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.		
Hemerocoetes monopterygius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Parablennus laticlavus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Paratrachichthys trailli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Pseudophycis bachus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Trachylochismus melobesia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.		
ALGAE (seaweeds)																										
Acrosorium venulosum	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.		
Adamsiella chauvinii	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Aeodes nitidissima	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Apophlaea sinclairii	.	.	.	o	r	.	.	.	.	.	.	.	.	.	o	o	o	o	r	.	r	.	.	.		
Arthrocardia corymbosa	.	.	.	o	o	c	o	.	.	.	.	.	.	c	o	.	.	.	.	.	.	.	.	.		
Audouinella purpurea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.		
Bachelotia antillarum	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Bangia sp.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Bryopsis plumosa	o	.	.	.	.	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.		
Bryopsis vestita	.	.	.	.	o	.	o	.	.	o	.	.	o	.	.	.	.	.	.	o	.	.	.	.		
Caloglossa leprieurii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	o	.		
Callophyllis calliblepharoides	.	o	.	.	.	.	o	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.		
Callophyllis hombroniana	.	.	o	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Capreolia implexa	o	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Capreolia sp.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.		
Carpophyllum maschalocarpum	o	o	.	f	c	o	o	.	c	.	.	f	c	c	a	c	c	.	c	f	c	c	o	.		
Carpophyllum plumosum	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Catenella fusiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.		
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm		
Catenella nipae	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	c		
Centroceras clavulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.		
Chaetomorpha aerea	.	.	o	.	o	.	.	o	.	o	.	.	.	f	o	.	.	.	.	.	.	.	.	.		
Chaetomorpha capillaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.		
Chaetomorpha linum	.	.	.	o	o	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Champia novae-zelandiae	o	.	.	.	o	o	o	o	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.		
Cladhymenia oblongifolia	o	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cladophora sp.	.	.	.	.	o	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.		

Cladophoropsis herpestica	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Codium convolutum	.	.	.	r	.	.	.	.	f	.	.	.	.	.	.	.	.	.	r	.	c	f	.	.	.
Codium aff. dimorphum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.
Codium fragile ssp.novae-zelandiae	f	o	.	f	.	.	o	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Codium gracile	.	.	o	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Colpomenia peregrina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.
Colpomenia sinuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	o	o	.	.	.
Corallina officinalis	a	c	a	a	a	a	.	.	.	a	a	a	c	c	c	a	a	c	a	c	c	c	a	.	.
Curdiea codioides?	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Curdiea coriacea	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Curdiea cf. flabellata	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dasyclonium incisum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.
Dasyclonium ovalifolium	.	.	.	o	o	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dictyota dichotoma	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.
Dipterosiphonia heteroclada	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durvillaea antarctica	r	o	f	f	o	o	f	o	o	f	a	o	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinothamnion hystrix	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ecklonia radiata	.	.	.	.	.	.	.	.	.	.	.	.	.	f	f	f	o	.	o	o	f	o	.	.	.
Endarachne binghamiae	.	.	.	.	.	.	o	.	o	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.
Enteromorpha bulbosa	.	.	.	o	.	.	o	f	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Enteromorpha intestinalis	.	.	.	.	o	.	.	.	o	o	o	o	.	.	o	.	.	o	.	.	.	.	.	.	.
Enteromorpha linza	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Enteromorpha ramulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	o	.	.	.	.	.
Enteromorpha sp.	f	.	.	.	.	o	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Gelidium caulacantheum	o	.	.	.	.	.	o	.	o	.	.	o	o	.	.	o	.	.	.	.	c	o	o	.	.
Gigartina alveata	o	o	o	c	c	c	o	o	.	f	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina atropurpurea	o	.	o	o	f	o	o	.	.	x	f	o	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina chapmanii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	.	.	.
Gigartina circumcincta	.	o	.	.	o	o	o	o	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina decipiens	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina laingii	.	.	.	o	f	.	.	.	.	.	.	.	.	c	c	c	c	.	o	.	.	.	.	.	.
Gigartina livida	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina macrocarpa	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gigartina marginifera	o	o	o	o	o	o	o	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glossophora kunthii	o	o	.	o	o	.	o	.	.	o	o	o	o	.	o	.	.	.	.	.	.	.	.	.	.
Gracilaria chilensis	.	.	.	.	o	.	o	o	.	.	.	o	.	.	.	.	.	a	.	.	.	o	.	a	
Gracilaria truncata	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gracilaria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Grateloupia intestinalis	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Grateloupia stipitata	.	.	.	.	o	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Grateloupia urvilleana	o	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Griffithsia traversii	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Griffithsia sp.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Gymnogongrus furcatus	.	.	.	.	o	.	o	o	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	
Gymnogongrus humilis	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	
Gymnogongrus torulosus	.	o	.	o	o	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Haliptilon roseum	.	.	.	.	o	o	.	.	c	c	.	.	.	.	.	.	.	.	.	o	.	.	.	.	
Helminthocladia australis	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
?Helminthora lindaureri	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

Heterosiphona tessellata	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hormosira banksii	.	.	c	c	.	.	.	.	.	o	.	.	.	.	f	o	.	o	c	.	o	.	.	.	.
Hymenena palmata	o	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.
?Hymenena sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Jania crassa	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Landsburgia quercifolia	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	o	.	.	.
Laurencia thyrsifera	.	o	.	o	.	o	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.
Lessonia variegata	o	.	o	o	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophurella caespitosa	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.
Melanthalia abscissa	.	o	o	o	f	.	o	.	o	f	o	.	.	c	f	o	.	.	.	o	c	.	.	.	.
Microcladia novae-zelandiae?	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Microzonia velutina	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myriogloea intestinalis	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nemalion helminthoides	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notheia anomala	.	.	f	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nothogenia fastigiata	.	.	.	.	o	f	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nothogenia pulvinata	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nothogenia cf. pseudosaccata	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Osmundaria colensoi	.	r	.	o	o	.	o	.	.	f	.	.	o	o	f	r	.	.	.	.	.	.	.	.	.
Pachymenia crassa	o	.	o	.	o	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pachymenia lusoria	.	o	.	o	f	.	x	o	o	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petalonia fascia	.	.	.	.	o	.	o	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Placentophora colensoi	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plenosporum hirtum	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Plocamium angustum	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plocamium cirrhosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Plocamium microcladioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Polysiphonia sp.	o	.	.	.	.	o	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Porphyra columbina	.	o	.	.	o	o	o	o	.	o	f	.	o	.	.	o	.	.	.	.	.	.	.	.	.
Porphyra cf. subtumens	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pterocladia lucida	.	o	o	.	o	.	o	.	.	f	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.
Pterocladiella capillacea	.	.	o	.	o	.	o	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhizoclonium sp.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Rhodophyllis gunnii?	.	.	.	o	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	.	.	.	.
Rhodymenia dichotoma	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhodymenia leptophylla	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhodymenia linearis	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhodymenia obtusa	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhodymenia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
?Rivularia sp.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.
Sargassum sinclairii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.
Schizymenia novae-zelandiae	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scinaia berggrenii	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scytosiphon lomentaria	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scytothamnus australis	.	.	o	o	o	.	o	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.
Solieriaceae indet.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	o	o	.	.
Splachnidium rugosum	.	.	.	.	o	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stenogramme interrupta	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	c	o	.	o	o	.	.
Synarthrophyton patena	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Thamnophyllis sp.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tinocladia novae-zelandiae	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulva lactuca	o	o	c	c	f	o	.	o	o	o	f	o	o	o	o	o	.	.	.	.	.	.	.	.	o
Ulva rigida	o	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulva spathulata	.	.	.	.	o	.	o	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulva ?stenophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.
Ulva sp.	.	.	.	.	.	o	.	.	.	x	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.
Xiphophora chondrophylla	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zonaria turneriana	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LICHENS																									
Buellia punctata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Heterodermia japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Leptogium sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Lichina confinis	.	.	.	.	c	r	.	.	.	.	.	.	.	o	o	o	f	r	.	.	.	.	.	.	.
Menegazzia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Pannaria elixi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Physcia caesia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	.	.
Pseudocyphellaria aurata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Pseudoparmelia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	o
Pyrenula sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r
Ramalina celasteri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	c
Rimelia reticulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	c
Teloschistes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	.
Usnea spp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	c
Verrucaria maura	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.
Xanthoria parietina	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ANGIOSPERMAE (vascular plants)																									
Avicennia maritimus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	r	.	.	.	.	a
Atriplex prostrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o
Calystegia soldanella	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cortaderia splendens	.	o	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cotula coronopifolia	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	r
Disphyma australe	c	f	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Isolepas nodosa	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Juncus maritimus var. australiensis	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	.	c
Leptocarpus similis	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	f	.	.	.	.	.	.	c
Muehlenbeckia complexa	o	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Pennisetum clandestinum	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.
Coastal sections	Mao	Pil	Pow	TeW	NTeH	STeH	Ana	Whi	NPih	Pih	Mer	Kar	WPar	EPar	Bou	Des	Kai	Huia	HuPt	Kak	Pup	Cor	Mill	Arm	
Phormium tenax	c	c	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	o	
Plagianthus divaricatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	c	
Samolus repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	c	
Sarcocornia quinqueflora	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	
Selliera radicans	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	c	.	.	.	.	.	o	
Stenotaphrum secundatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Zostera muelleri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	r	.	.	.	c	r	

Table 1. Total number of species (live + dead) of different animal and plant groups recorded from the coast of the Waitakere Ranges.

Molluscs	274
Chitons	13
Gastropods	165
Sea slugs	13
Bivalves	80
Scaphopods	1
Cephalopods	2
Echinoderms	9
Asteroids	4
Echinoids	3
Holuthurians	1
Ophiuroids	1
Crustacea	59
Crabs	23
Shrimps	5
Amphipods	1
Isopods	11
Barnacles	18
Ostracods	1
Cnidaria	18
Alcyonians	1
Sea anenomes	9
Corals	1
Hydroids	3
Jellyfish	4
Bryozoa	1
Polychaete worms	23
Nemertine worms	1
Flatworms	1
Sipunculids	1
Phoronids	1
Sponges	28
Sea squirts	6
Tidal pool fish	9
Seaweeds	133
Lichens	16
Vascular plants	18
TOTAL	598

Table 2. Taxa with type localities on the coast of the Waitakere Ranges

Taxon	Type locality	Junior synonym of:
Mollusca: Gastropoda		
Alcithoe swainsoni motutaraensis Powell 1928	Muriwai Beach	*Alcithoe arabica*
Buccinulum motutaraense Powell, 1929	Motutara	*Buccinulum vittatum vittatum*
Cabestana waterhousei segregata Powell, 1933	near Cornwallis	*Cabestana tabulata*
Cominella euthriaformis Powell, 1929	Muriwai-Te Henga	*Cominella quoyana accuminata*
Eatoniella (Dardanula) latebricola Ponder, 1965	South Muriwai,	*Durvillaea* holdfasts
Maoricolpus roseus manukauensis Powell, 1931	Mill Bay coast mud flats	
Mollusca: Nudibranch		
Coryphella albomarginata Miller, 1971	Piha	*Flabellina albomarginata*
Crustacea: Isopoda		
Scutuloidea kuta Stephenson & Riley 1996	Lion Rock	
Porifera		
Aaptos globosum Kelly-Borges & Bergquist, 1994	Cornwallis	
Haliclona brondstedi Bergquist & Warne, 1980	Anawhata	
Polymastia aurantium Kelly-Borges & Bergquist, 1997	North Piha	
Lichens		
Buellia cranwellae Zahlbruckner, 1941	Anawhata coastal rocks	
Caloplaca allanii Zahlbruckner, 1941	Anawhata coastal rocks, 10m above sea level	
Rinodina cacaotina Zahlbruckner, 1941	Anawhata coastal rocks	
Verrucaria aucklandica Zahlbruckner, 1941	Anawhata coastal rocks	
Bryophytes		
Lindbergia maritima Lewinsky, 1977	Piha maritime rocks	

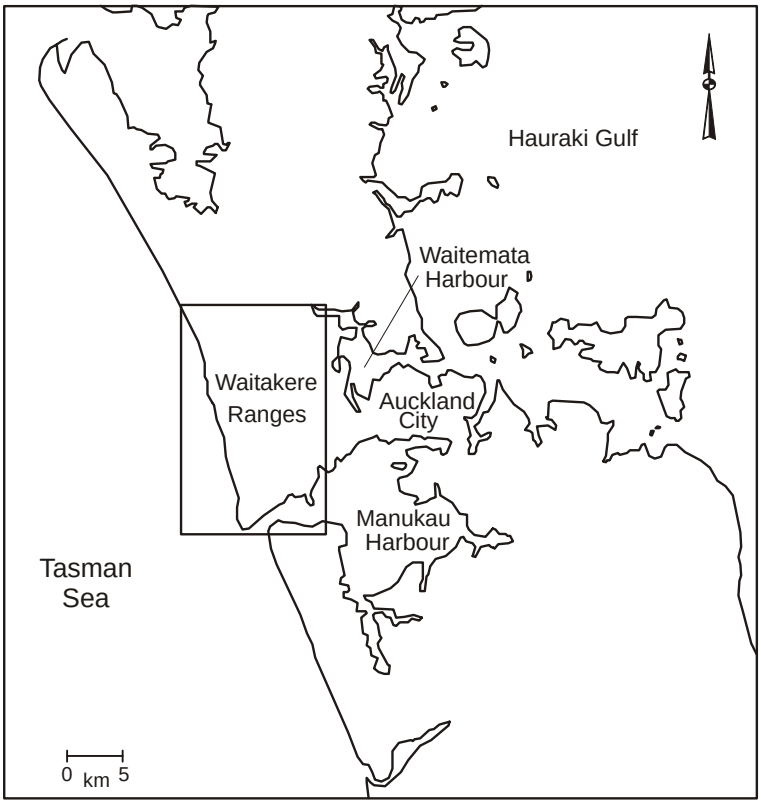

Fig. 1

Fig. 1. Location of Waitakere Ranges coastline study area on the west coast of the Auckland region.

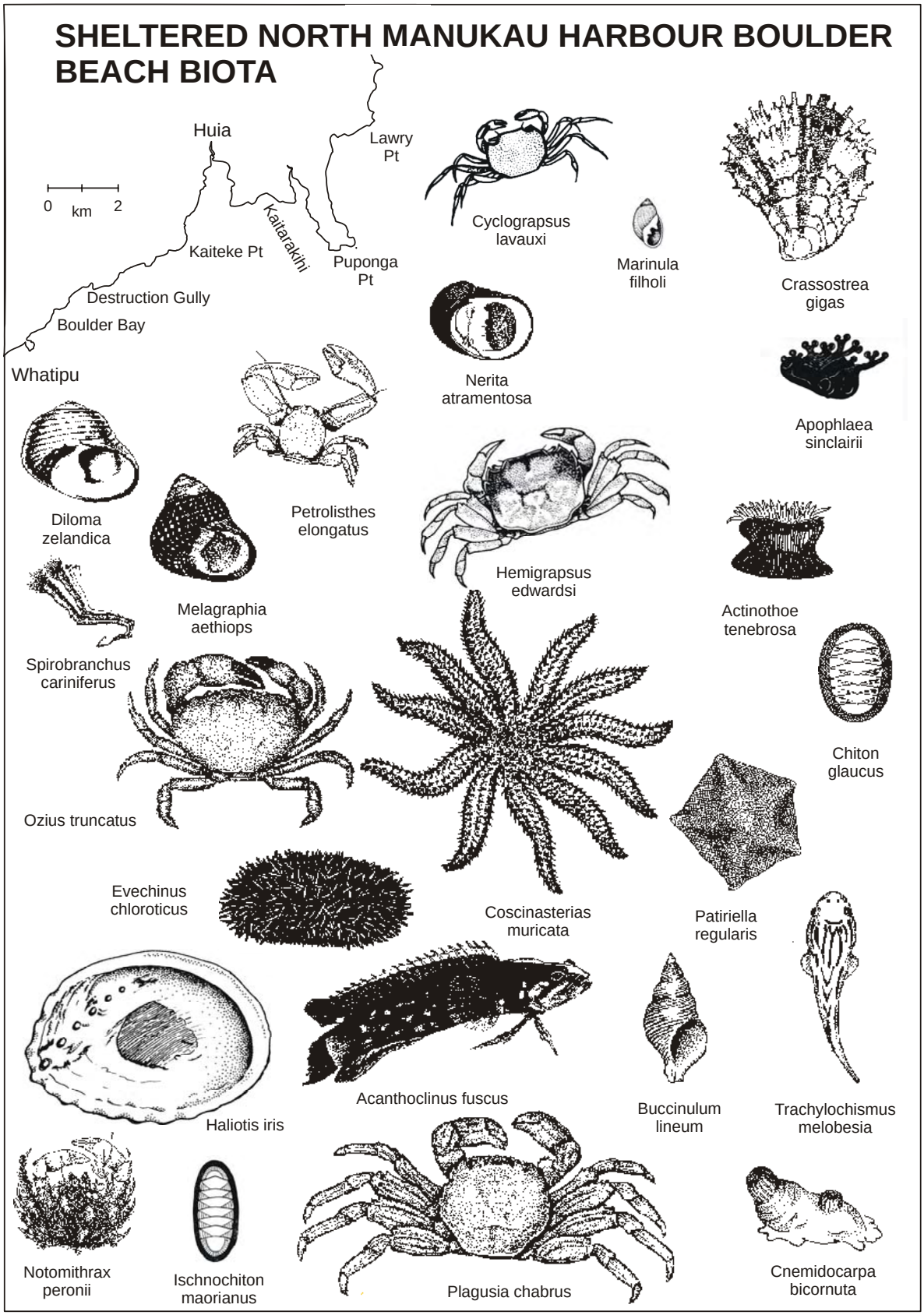

Fig. 2

Characteristic biota of the sheltered stable boulder beaches along the north Manukau Harbour coastline of the Waitakere Ranges. Illustrations by Margaret Morley, Morton & Miller (1968), and Powell (1979, 1987).

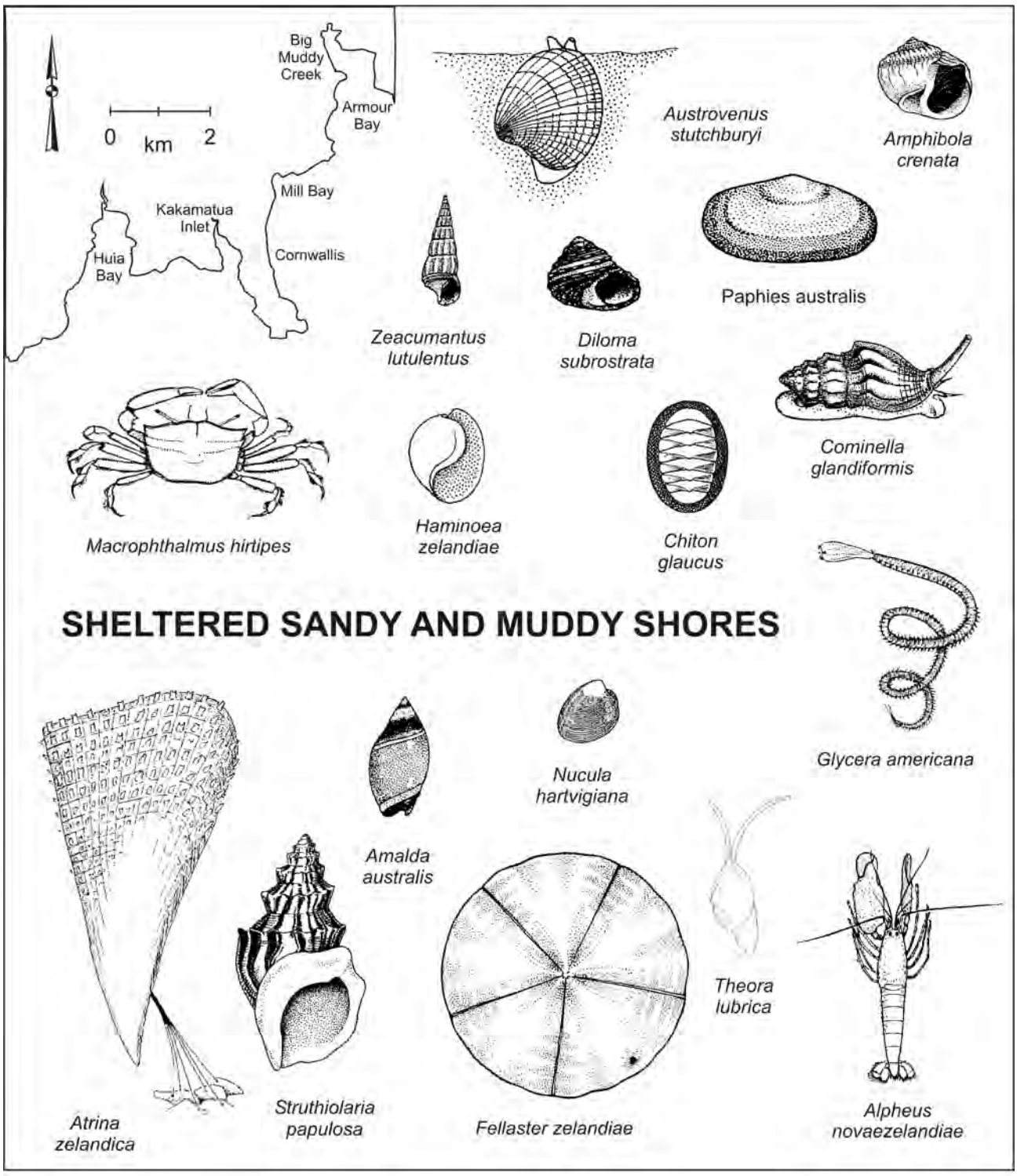

Fig. 3

Characteristic biota of the sheltered soft sediment intertidal habitats along the north Manukau Harbour coast of the Waitakere Ranges. Illustrations by Margaret Morley, Morton & Miller (1968), and Powell (1979, 1987).

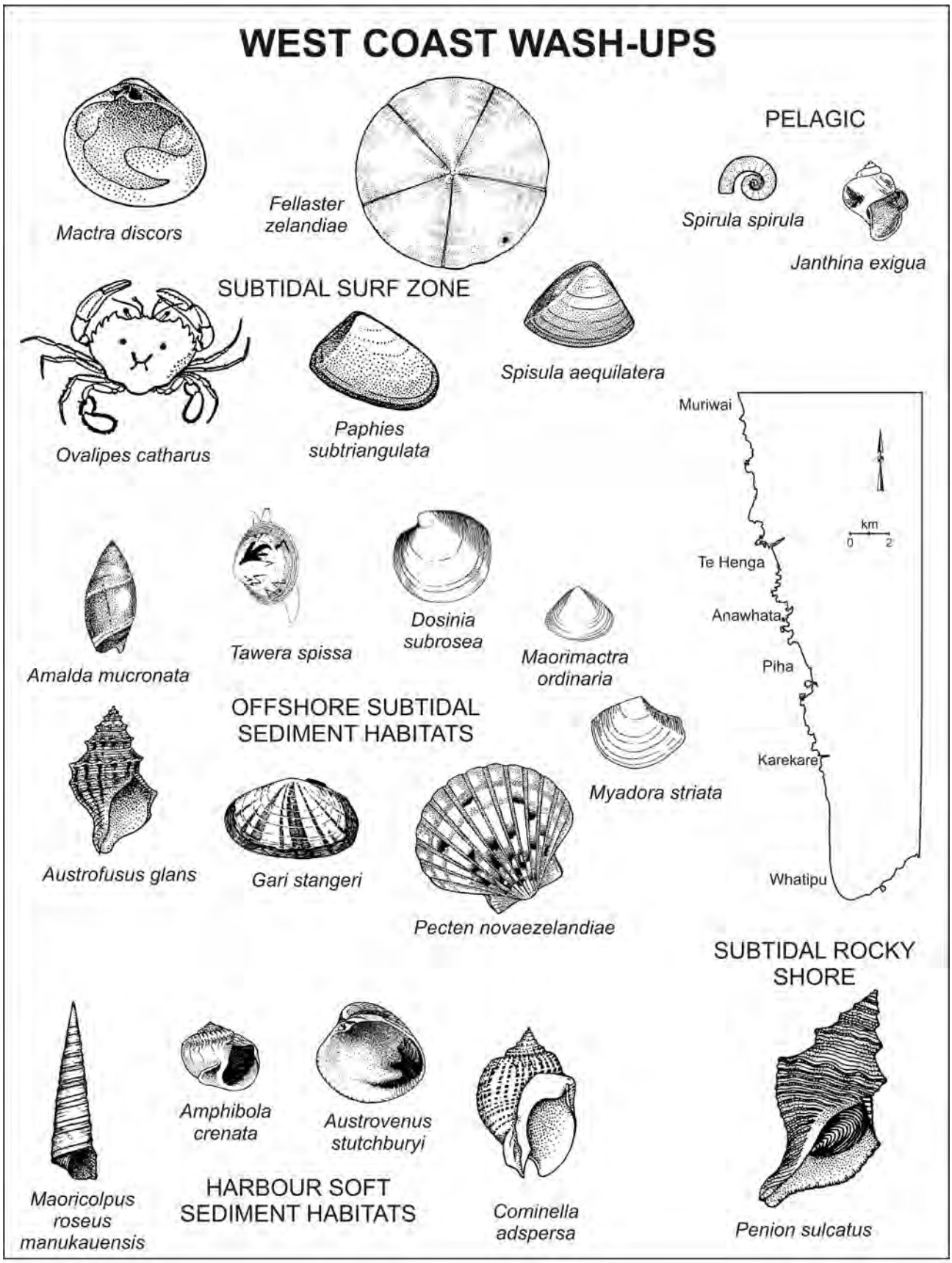

Fig. 4

Animals, grouped according to their original source habitat, that are commonly found washed up on the exposed west coast sandy beaches of the Waitakere Ranges. Illustrations by Margaret Morley, Morton & Miller (1968), and Powell (1979, 1987).

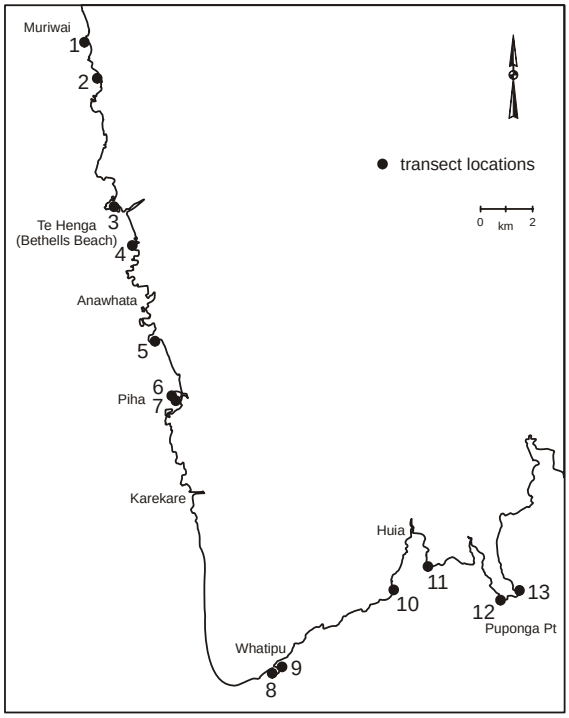

Fig. 5

Fig. 5. Location of intertidal transects (Figs. 6-18) around the rocky coast of the Waitakere Ranges.

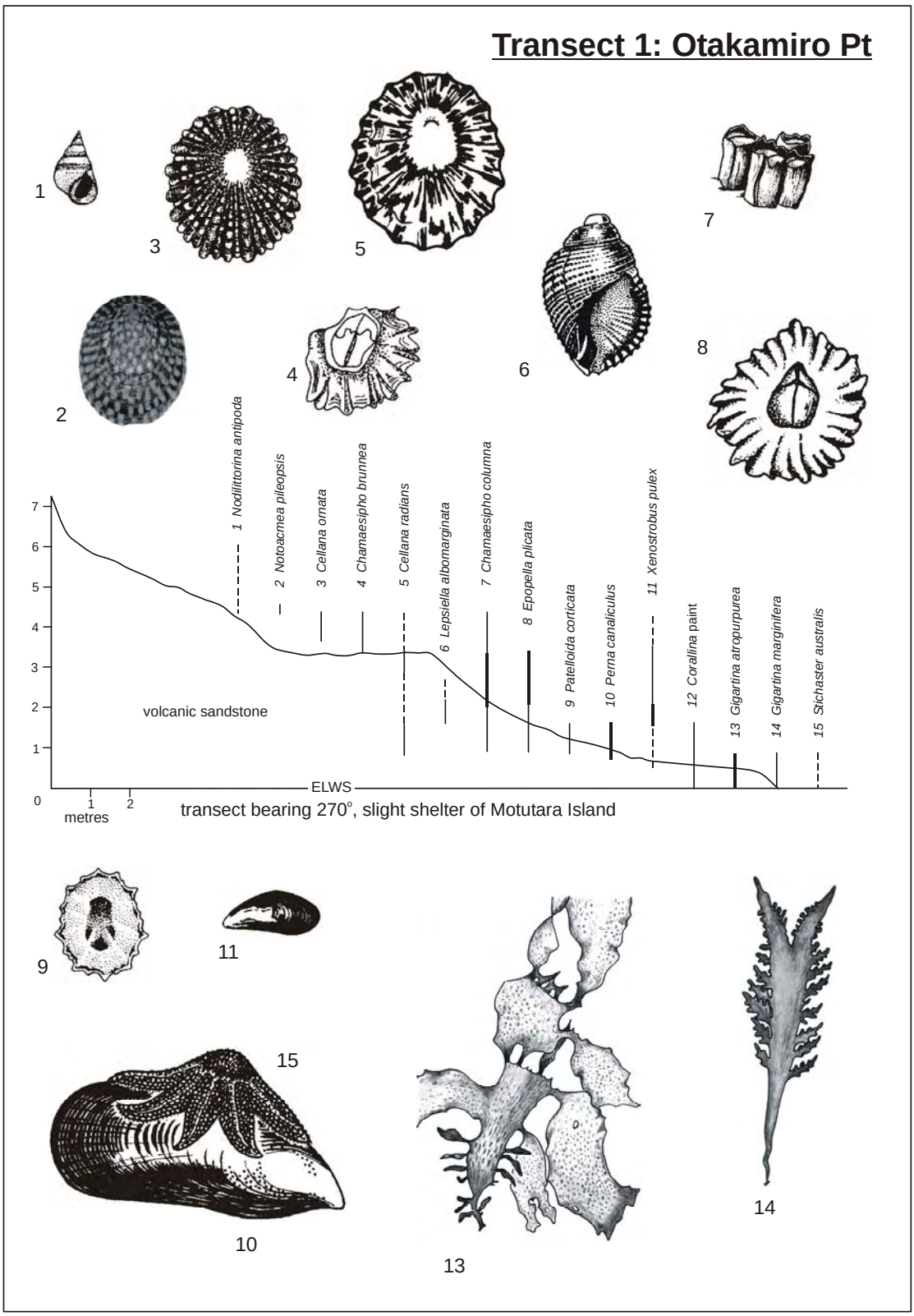

Fig. 6

Transect 1 showing the intertidal zonation of the dominant plants and animals on the rocky shore beneath the gannet colony at Otakamiro Point, Muriwai. Illustrations by Margaret Morley, Morton & Miller (1968), Powell (1979, 1987), and Adams (1994). Thick line = interval as dominant or co-dominant zoning organism, solid line = interval as subdominant zoning organism, dashed lines = interval of sporadic occurrence.

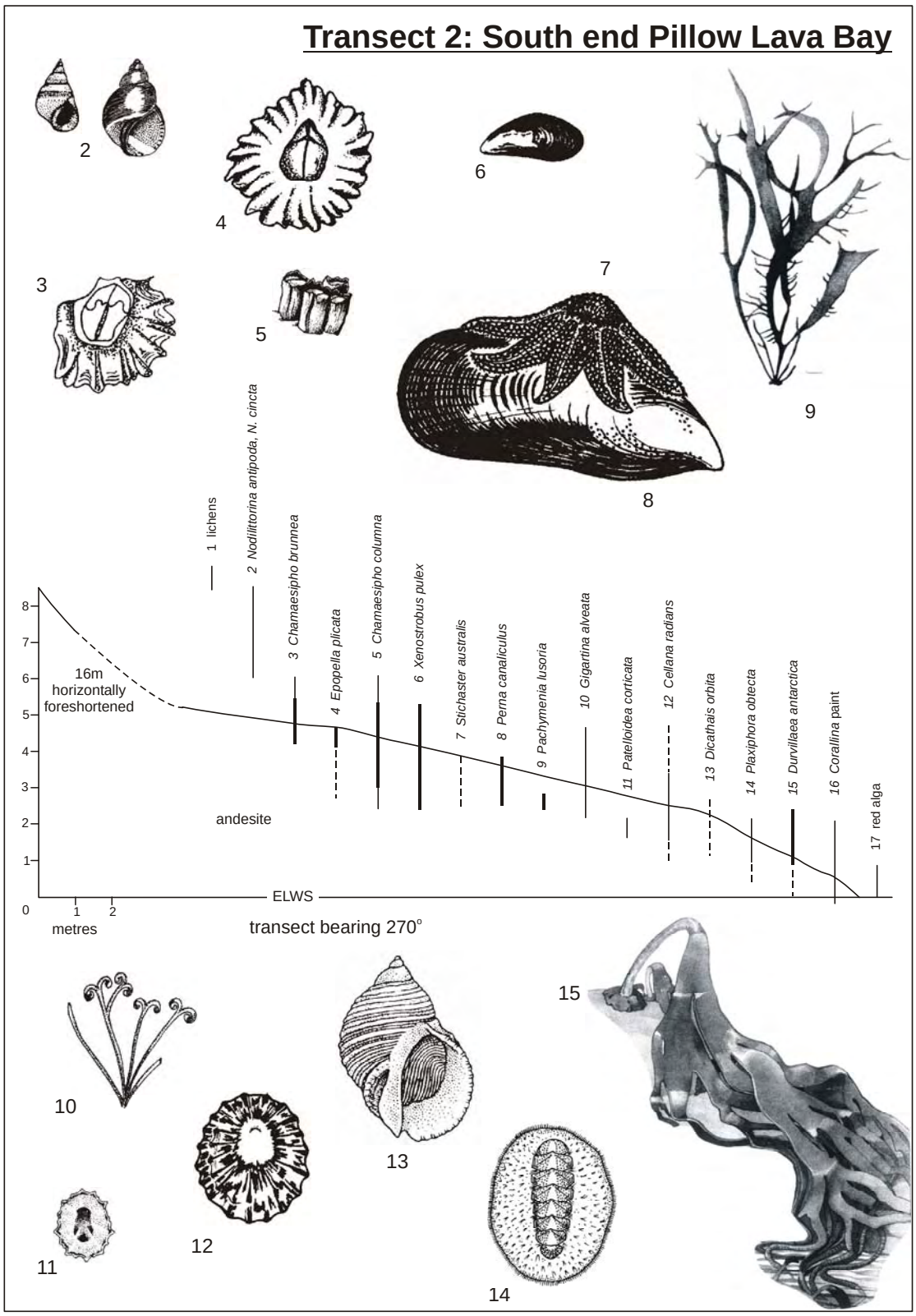

Fig. 7

Transect 2 showing the intertidal zonation of the dominant plants and animals on the rocky shore composed of hard basaltic andesite at the south end of Pillow Lava Bay, south of Muriwai. Illustrations by Margaret Morley, Morton & Miller (1968), Powell (1979, 1987), and Adams (1994). Thick line = interval as dominant or co-dominant zoning organism, solid line = interval as subdominant zoning organism, dashed lines = interval of sporadic occurrence.

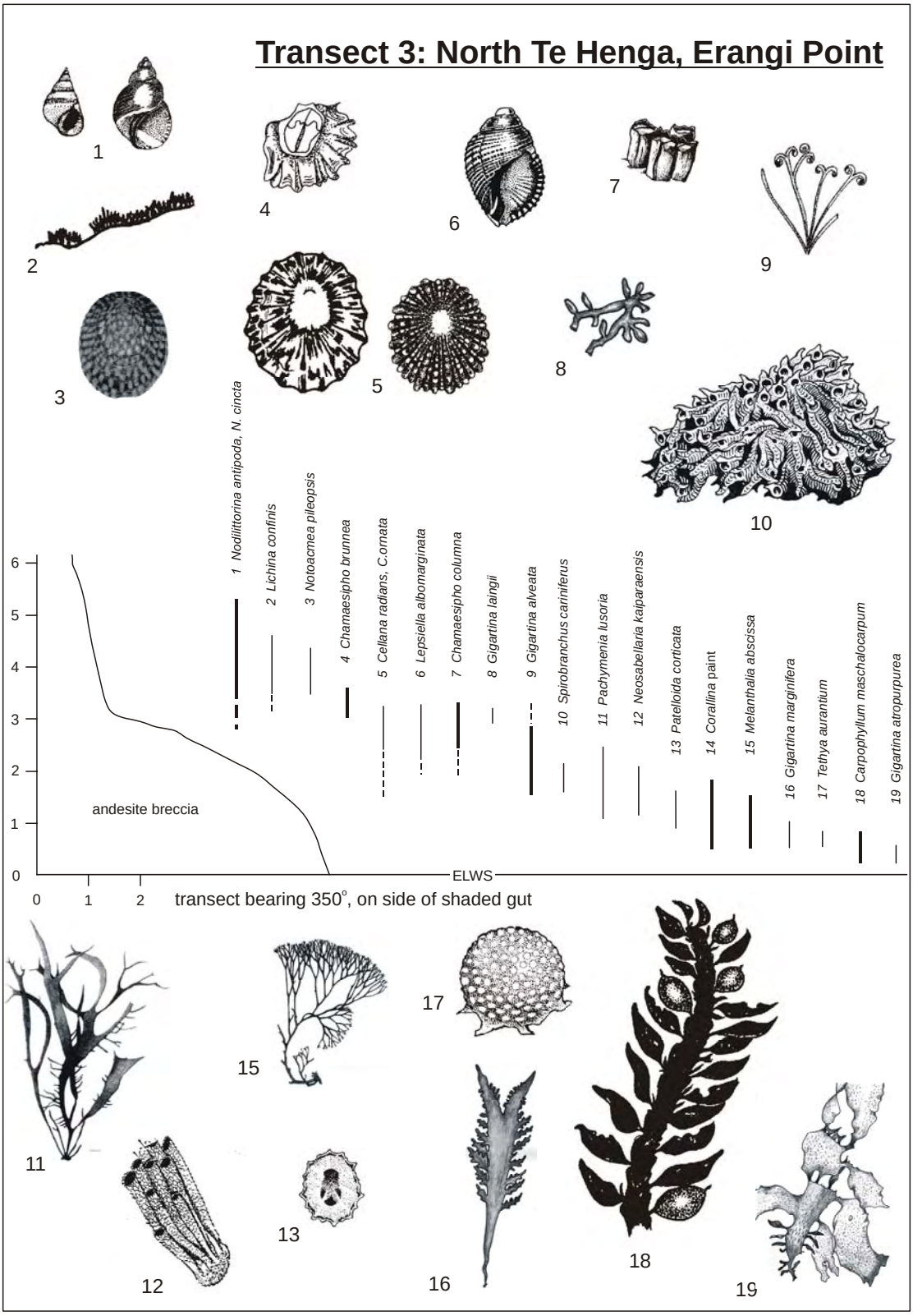

Fig. 8

Transect 3 showing the intertidal zonation of the dominant plants and animals on the rocky shore in a gut at Kotau Point, north Te Henga. Illustrations by Margaret Morley, Morton & Miller (1968), Powell (1979, 1987), and Adams (1994). Thick line = interval as dominant or co-dominant zoning organism, solid line = interval as subdominant zoning organism, dashed lines = interval of sporadic occurrence.

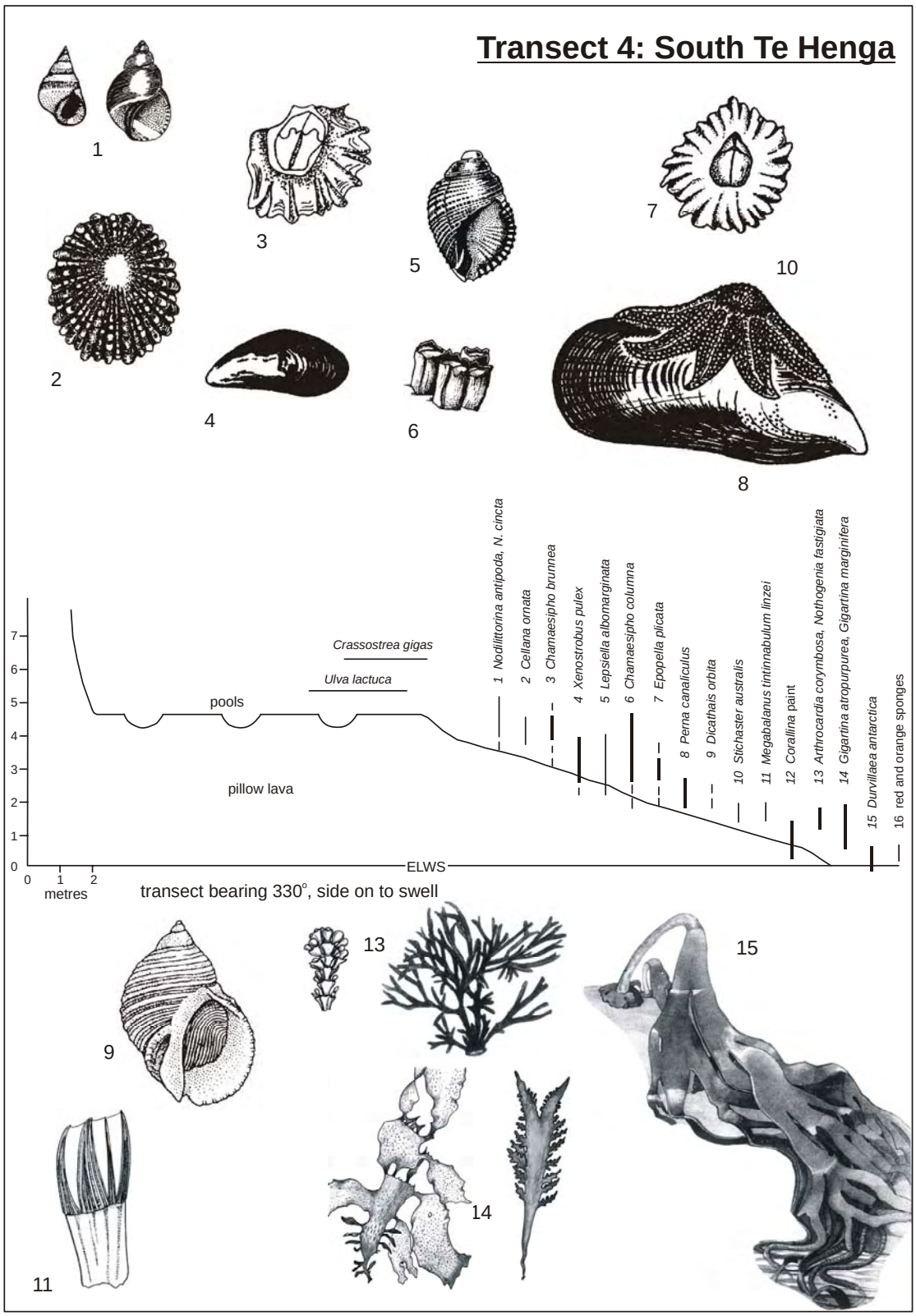

Fig. 9

Transect 4 showing the intertidal zonation of the dominant plants and animals on the rocky shore composed of pillow lava at the south end of Te Henga Beach. Illustrations by Margaret Morley, Morton & Miller (1968), Powell (1979, 1987), and Adams (1994). Thick line = interval as dominant or co-dominant zoning organism, solid line = interval as subdominant zoning organism, dashed lines = interval of sporadic occurrence.

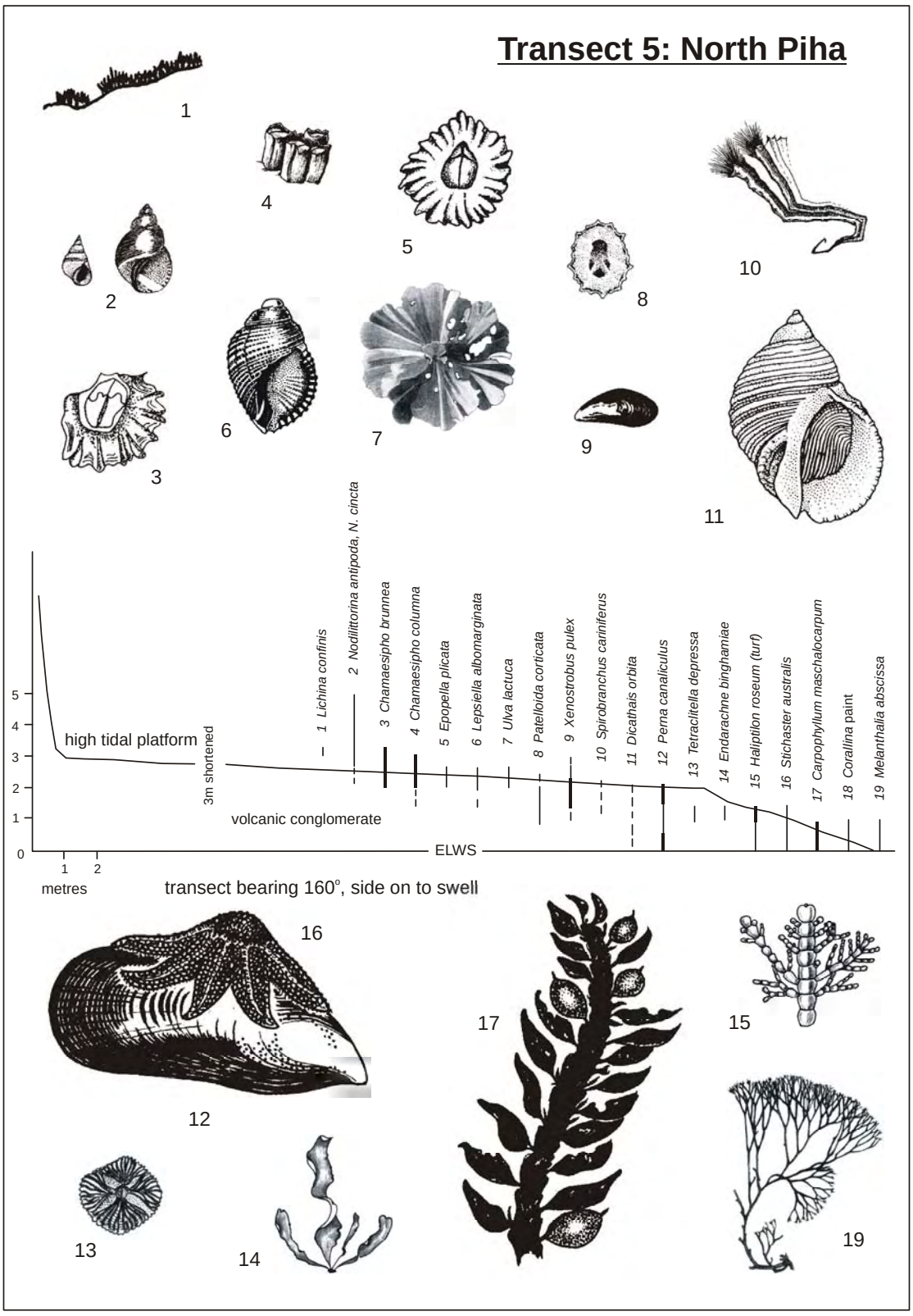

Fig. 10

Transect 5 showing the intertidal zonation of the dominant plants and animals on the rocky shore on the south facing, partly sheltered, side of Te Waha Point, North Piha. Illustrations by Margaret Morley, Morton & Miller (1968), Powell (1979, 1987), and Adams (1994). Thick line = interval as dominant or co-dominant zoning organism, solid line = interval as subdominant zoning organism, dashed lines = interval of sporadic occurrence.