coastalmanagement

# Stirling Point 2010

## Fine Scale Rocky Shore Monitoring

Prepared for

**Environment Southland**
**November 2010**

**Cover Photo: Stirling Point - Dr Barry Robertson counting animals living under bull kelp on the lower shore.**
**Inside cover: Stirling Point - Sampling Site 2 at high tide. Quadrats are located under the white water in the centre of the picture.**

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By

Leigh Stevens and Barry Robertson

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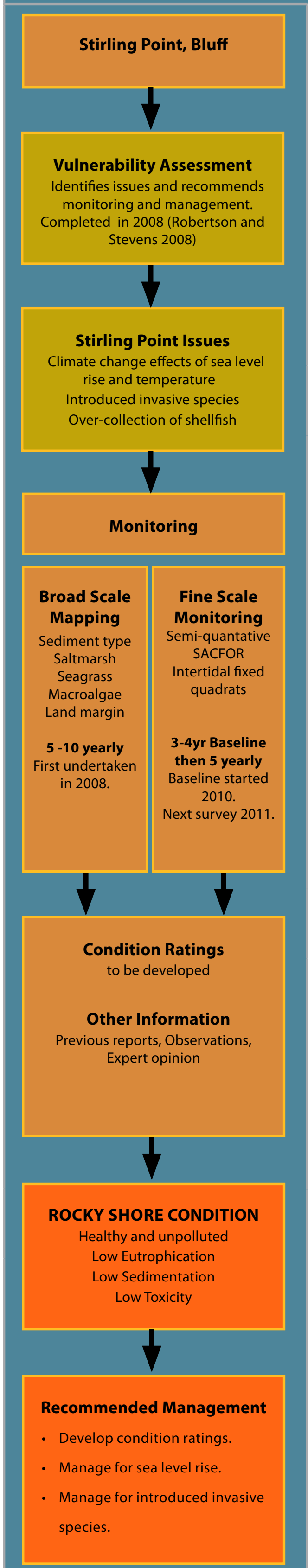
# ROCKY SHORE - EXECUTIVE SUMMARY




This report summarises the results of the first year of fine scale monitoring of the rocky shore community at Stirling Point near Bluff, a southern coast site exposed to high wave energy, southerly and westerly winds, and bathed by the very productive waters of the Southland Current. It is a key site in Environment Southland's (ES's) long-term coastal monitoring programme. This report describes the following:

- Fine scale semi-quantitative monitoring of the abundance and diversity of rocky shore plants and animals, and
- Fine scale quantitative monitoring of the abundance and diversity of plants and animals in 18 x 0.25m$^2$ fixed quadrats at High, Mid, and Low eulittoral (intertidal) levels at three sites.

2010 monitoring results are summarised below.

## FINE SCALE MONITORING RESULTS

The semi-quantitive monitoring identified 43 attached or sessile rocky shore species, excluding those in heavily fissured areas and rock pools. Algae (19 species) were the most dominant, followed by topshells (6) limpets (5), lichens (4), barnacles (3), and chitons, bivalves, and anemones (2 each). Fixed quadrat sampling included 30 of the 43 species identified.

The high shore and spray zone was dominated by bare rock and supported the fewest species (comprising lichens, periwinkles, limpets, barnacles and 7 species of algae).

The mid shore had the highest number of species, but also large areas of bare rock. When colonised it was dominated by barnacles and supported a range of mostly small and sparsely distributed algae (13 species). Topshells (6) were common at this shore height, while other species included limpets, chitons, mussels and barnacles.

The lower shore was dominated by the giant southern bull kelp whose overlying fronds provide shelter and refuge to a variety of smaller algae (10 species) and animals (14 species) from waves, heat and predation.

## ROCKY SHORE ISSUES AND CONDITION

The low-moderate risk to rocky shore ecology on the Southland coast is primarily due to predicted accelerated sea level rise and temperature change and, to a lesser extent, over-collection of living resources and introduction of invasive species. The risk from pathogens, sedimentation, eutrophication, and toxins is considered low.

The first year of baseline monitoring found the coastline in a healthy and unpolluted condition. No introduced invasive species were seen, and there was no indication of excessive nutrient or sediment inputs.

## RECOMMENDED MONITORING AND MANAGEMENT

To provide a robust baseline of rocky shore conditions (particularly to enable monitoring of changes from predicted accelerated sea level rise and increased temperatures), it is recommended fine scale monitoring continue annually for the next 2-3 years with the next monitoring undertaken in February 2011.

It is also recommended that two additional sites on the Southland coast be identified (e.g. West of Cosy Nook, Waipapa Point), and baseline monitoring be initiated in a staged manner in 2011 and 2012.

While the rocky shore baseline is established, it is proposed condition ratings also be developed to characterise the status of the shore. The condition ratings should focus on measuring shifts in community composition, the presence or absence of key indicator species (including introduced plants and animals), as well as indicators of nutrient enrichment and sedimentation.

# 1. INTRODUCTION

## OVERVIEW

Developing an understanding of the condition and risks to coastal habitats is critical to the management of biological resources. The recent "Southland Coast - Te Waewae to the Catlins - Mapping, Risk Assessment and Monitoring" report (Robertson and Stevens 2008) identified a low-moderate risk to rocky shore ecology on the Southland coast. This was primarily from predicted accelerated sea level rise and temperature change, over-collection of living resources, and introduction of invasive species. The primary ecological responses to such pressures are considered to be habitat change, and effects on biodiversity. Due to the generally high clarity, low nutrients, and low disease risk of water that bathes the Southland rocky shoreline, the risk from pathogens, sedimentation, eutrophication, and toxins was considered low. Because of this, the number of monitoring indicators can be kept small.

Therefore, to address the identified risks, and to provide baseline information on rocky shore ecology at key representative locations, Robertson and Stevens (2008) recommended long term monitoring of the abundance and diversity of plants and animals at three high diversity rocky shores (e.g. West of Cosy Nook, Stirling Point, and Waipapa Point) using rapid assessment methods developed under the Marine Biodiversity and Climate Change Project (Hiscock 1996). Wriggle Coastal Management was contracted by Environment Southland (ES) to undertake the first year of a 3-4 year baseline of annual monitoring near Stirling Point, (Bluff) in February 2010. After establishment of the baseline, monitoring will be undertaken 5 yearly and the results will help determine the extent to which the coast is affected by major environmental pressures (Table 1), both in the short and long term.

Rocky shores are a dominant, and visually dramatic, part of the Southland coastline. They reflect the erosive effect of waves where softer rocks are worn down, leaving harder rocks exposed. The habitat is physically complex, with rockpools, gullies, crevices and boulders providing a diverse range of habitats supporting a variety of different species. The harsh and variable physical conditions, including light availability, degree of exposure, large shifts in temperature and salinity, aspect, substrate type, and biotic features, lead to the development of a characteristic zonation of species on stable shoreline substrate, including zones dominated by lichens, periwinkles, barnacles, limpets, mussels, and seaweeds. Intertidal (eulittoral) areas generally have the greatest species diversity, and its zonation is well suited for monitoring changes caused by long-term and global pressures such as climate change.

A suitable fine scale rocky shore intertidal monitoring site was identified approximately 1km west of Stirling Point (Figure 1). The area is representative of the rocky shoreline on this part of the southern coast, and is characterised by the following:

- Hard igneous rocky shores comprising bluffs, cliffs, rock stacks and rocky bays.
- Exposure to high wave energy and southerly and westerly winds.
- Bathed by the relatively warm, and often nutrient depleted, waters of the Southland Current that flows from the south-western end of the South Island and northwards up the east coast.
- Dominated near low water by the giant southern bull kelp (*Durvillaea antarctica*) with mussels and barnacles common above the bull kelp zone.

Importantly, the site is not directly or significantly influenced by river plumes, terrestrial discharges (e.g. stormwater, sewage), or structures (e.g. seawalls, wharfs, marine farms). Access to this part of coast is by foot (a popular walkway runs along the hillside between Stirling Point and Lookout Point), but access to the shoreline is generally difficult. Human use is moderate-high, being very popular for walking, diving, surfing, boating, fishing, and its scenic beauty. The wider area is an important tourist destination, while the coastline is a highly valued recreational paua fishery, and the seabed offshore forms part of the local rock lobster and blue cod fishery. Occasional fur-seals may been seen on rock promontories or outcrops, along with yellow-eyed penguins at Lookout Point.

# 1. Introduction (Continued)

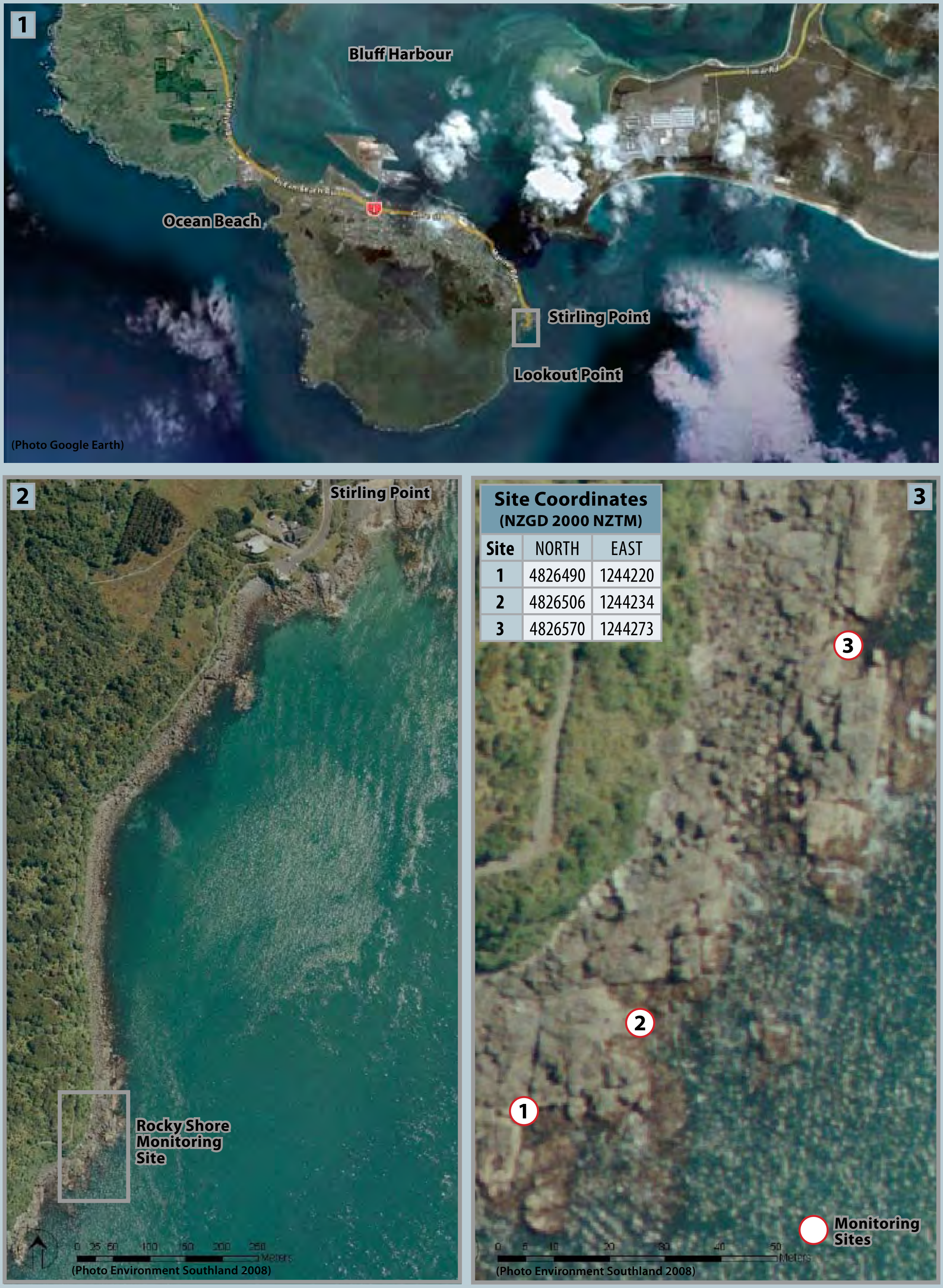
The site, which extends across ~100m of shore, has 3 separate areas with similar substrate, aspect, wave exposure, and tidal height to position replicate quadrats in. Establishing fixed quadrats in such representative habitat reduces the need for extensive sample replication, while seasonal and spatial variation can be minimised by scheduling monitoring for the same time period each year (January to March). Although recreational fishers use the area, the monitoring sites are considered unlikely to be appreciably affected because quadrat locations are discretely marked (unlikely to be noticed), and are in areas on the shore where direct impacts are unlikely.

The current report describes the methods and results of the first year of rocky shore monitoring at Stirling Point, and includes recommendations on monitoring and management.

**Table 1. Summary of the major environmental issues affecting NZ rocky shores.**

| Key Environmental Rocky Shore Issues | |
|---|---|
| **Habitat Loss or Modification** | The key stressors of rocky shores are; climate change and sea level rise, over collection of living resources, introduction of invasive species, and pollution.<br><br>**Climate Change and Sea level Rise.** Accelerated global change in temperature, sea-level rise, and increases in the frequency of storms will affect rocky shores throughout the world, but this will occur over a long time scale. Consequently, over the next 25 years, most of the responses by rocky shore communities are expected to be quite subtle. In the long term, the predictions include loss of rare species, reduction in species diversity, reduced habitat area, and the loss of entire communities of organisms in some situations.<br><br>**Over-collection of Living Resources and Recreation.** Direct removal of living resources has had major effects on coastlines at both local and regional scales and is likely to increase as expanding human populations put further pressure on resources. Impacts from recreational activities (e.g. trampling) are likely to increase with greater leisure time in wealthier regions of the world.<br><br>**Introduction of Invasive Species.** Increased global transport is responsible for the introduction of invasive plants and animals to our rocky shores which can cause damage to local rocky shore communities. *Undaria* (a golden brown seaweed introduced to NZ in the 1980s) is a prominent marine pest in Southland (Paterson Inlet and Bluff Harbour) that has had extensive effort put into preventing its spread and removing it from the region. |
| **Disease Risk** | If pathogen inputs to the coastal area are excessive (e.g. from coastal wastewater discharges or proximity to a contaminated river plume), the disease risk from bathing, wading or eating shellfish increases to unacceptable levels. |
| **Sedimentation** | If sediment inputs are excessive, coastal water clarity and sediment oxygenation declines, reducing biodiversity and human values and uses. |
| **Eutrophication** | Eutrophication occurs when nutrient inputs are excessive, and can have chronic broad scale impacts over whole coastlines. They have also been implicated in a trend of increasing frequency of catastrophic kills due to harmful algal blooms. Such effects are rare on exposed well-flushed rocky shores. |
| **Toxins** | If potentially toxic contaminant inputs (e.g. heavy metals, pesticides) are excessive, shoreline biodiversity is threatened and shellfish may be unsuitable for eating. Except for large-scale infrequent discharges such as oil spills, pollution tends mainly to influence embayed coastlines. |

# 1. Introduction (Continued)




| Site Coordinates (NZGD 2000 NZTM) | | |
|---|---|---|
| **Site** | NORTH | EAST |
| **1** | 4826490 | 1244220 |
| **2** | 4826506 | 1244234 |
| **3** | 4826570 | 1244273 |

Figure 1. Location of rocky shore sampling sites at Stirling Point.

# 2. METHODS

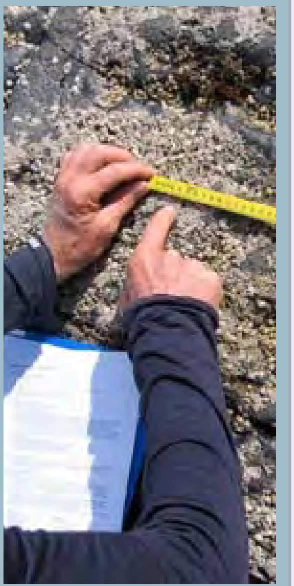


Figure 2. Assessing the percentage cover of barnacles and top-shells on the high shore.

The fine scale rocky shore monitoring programme involves measuring the abundance and diversity of plants and animals present in the supralittoral zone (the area regularly splashed, but not submerged, by seawater) and the eulittoral (intertidal) zone that extends from the rarely inundated spring high water tide line, to the almost always inundated neap low tide line. Results will be used to evaluate impacts associated with climate change, introduced species, over-collection of shellfish, as well as provide a baseline for infrequent risks such as oil spills.

Sampling was undertaken by two scientists during relatively calm sea conditions on 10-12 February 2010 when estuary monitoring was being undertaken in the region.

The methodology is based on that used in the UK MarClim - Marine Biodiversity and Climate Change Project (MNCR 1990, Hiscock 1996, 1998), and consists of two parts,

1. A semi-quantitative assessment to develop a checklist of the species present and record their relative abundance across a representative sampling area.
2. Recording the abundance and diversity of plants and animals in 0.25m$^2$ fixed quadrats positioned in the spatially largest strata at the site, and stratified within 3 eulittoral tide levels (High, Mid, and Low).

The semi-quantitative assessment was applied by walking over and photographing the wider sampling area (~100m x 40m - see Figure 1), and identifying and recording the relative abundance of all the species present from the supralittoral zone to mean low water. Details were recorded on pre-prepared data sheets that included the range of species likely to be found at the site. In addition, a photographic field guide was prepared to assist with field identifications (see Table 2 photo inset). At each site a time limit of 60 minutes was used to guide the sampling effort, with extensively shaded areas, rock pools or heavily fissured areas excluded from the assessment.

The abundance of each species was rated using SACFOR categories described in Table 2 which were applied to the locality on the shore in which each species was most abundant. The SACFOR assessment preferentially uses percentage cover of two growth types of attached organisms - Crust/Meadow (e.g. lichen, barnacles, coralline paint), or Massive/Turf (e.g. bull kelp, coralline turf) - Table 2, A. For all other organisms >5mm in size, individuals present in a fixed area were counted (Figure 2). The size of individual organisms was used to both determine quadrat sizes for counts, and the relevant SACFOR rating as described in Table 2, B.

The semi-quantitative assessment guided the selection of 18 fixed intertidal quadrats because true random sampling approaches are not appropriate on a broken rocky shore. Within the wider sampling area, 3 sites were identified with moderately sloping bedrock sheltered from the direct effect of prevailing wind and waves (e.g. Figure 3). At each site, 6 quadrats were located, 2 each at high, mid and low water.


Figure 3. Position of fixed intertidal quadrats at Site 2 .

# 2. Methods (Continued)

**Figure 4. Fixed quadrat position markers - stainless steel bolts drilled into bedrock.**

Quadrats at each shore height had similar physical characteristics, and were positioned in areas with attached plants or animals as the change to these features is the primary focus of the monitoring. The top right hand corner of each quadrat was marked for repeat sampling by drilling and fixing a stainless steel bolt in the rock (Figure 4), and the site location photographed (e.g. Figure 3), and GPS position recorded.

After selecting and marking each quadrat, the following information was recorded:

**High Shore Quadrats** (the area 1m below the very top of the barnacle zone)

- Percent cover of all barnacles, mussels, and algae.
- Number of each periwinkle species present in a representative 2cm x 2cm section within each quadrat (5cm x 5cm if sparse).

**Mid Shore Quadrats** (the middle of the barnacle zone)

- Percent cover of all barnacles, mussels, and algae.
- Number of each limpet species, recording the total number of individuals greater than 10mm in each 0.25m$^2$ quadrat.
- Number of each species of snail >5mm in the 0.25m$^2$ quadrat or, if appropriate, a 1m$^2$ quadrat.

**Low Shore Quadrats** (1m above the bottom of the barnacle zone)

- Percent cover of all barnacles, mussels, and algae.
- Number of each limpet species, recording the total number of individuals greater than 10mm in each 0.25m$^2$ quadrat.
- Number of each species of snail >5mm in the 0.25m$^2$ quadrat or, if appropriate, a 1m$^2$ quadrat.

**Table 2. SACFOR Percentage Cover and Density Scales (after Marine Nature Conservation Review - MNCR).**

| **A.** Percentage cover | Growth Form | |
|---|---|---|
| | i. Crust/Meadow | ii. Massive/Turf |
| >80 | S | - |
| 40-79 | A | S |
| 20-39 | C | A |
| 10-19 | F | C |
| 5-9 | O | F |
| 1-4 | R | O |
| <1 | - | R |

| SACFOR Category |
|---|
| S = Super Abundant |
| A = Abundant |
| C = Common |
| F = Frequent |
| O = Occasional |
| R = Rare |

- Whenever percentage cover can be estimated for an attached species, it should be used in preference to the density scale.
- The massive/turf percentage cover scale should be used for all species except those classified under crust/meadow.
- Where two or more layers exist, for instance foliose algae overgrowing crustose algae, total percentage cover can be over 100%.

**B.** Density Scales

| SACFOR size class | | | | Density of individuals/colonies | | | |
|---|---|---|---|---|---|---|---|
| i | ii | iii | iv | | | | |
| <1cm | 1-3cm | 3-15cm | >15cm | No | Area (m$^2$) | No/m$^2$ | No/0.25m$^2$ |
| S | - | - | - | >9 | 0.001m$^2$ (1x1cm) | >10,000 | >2500 |
| A | S | - | - | 1-9 | 0.001m$^2$ (1x1cm) | 1000-9999 | 250-2500 |
| C | A | S | - | 1-9 | 0.01m$^2$ (10x10cm) | 100-999 | 25-249 |
| F | C | A | S | 1-9 | 0.1m$^2$ (31.6x31.6cm) | 10-99 | 3-24 |
| O | F | C | A | 1-9 | 1.0m$^2$ (100x100cm) | 1-9 | 1-2 |
| R | O | F | C | 1-9 | 10m$^2$ (3.16x3.16m) | - | - |
| - | R | O | F | 1-9 | 100m$^2$ (10x10m) | - | - |
| - | - | R | O | 1-9 | 1000m$^2$ (31.6x31.6m) | - | - |
| - | - | - | R | <1 | 1000m$^2$ (31.6x31.6m) | - | - |

# 3. RESULTS AND DISCUSSION


**Figure 5. Example of general rocky shore zonation at the Stirling Point site.**

Results of the 10-12 February 2010 fine scale rocky shore monitoring at Stirling Point are summarised below in two sections - the semi-quantitive assessment, followed by the fixed quadrat sampling.

The semi-quantitive assessment identified 43 species (Table 3), excluding creviced areas and rock pools. Algae were dominant (19 species), but a wide range of common rocky shore organisms able to withstand the physical rigours of the exposed wave environment were present in a predictable zonation across the shoreline. These included barnacles, limpets, chitons, topshells and bivalve shellfish.

The zonation fell into four key zones (Figure 5), the spray zone of the upper shore (supralittoral), and high, mid, and low intertidal (eulittoral) zones. Within these broad zones, most species comprised two broad categories, those either directly attached to the rock (e.g. lichens, barnacles, seaweeds, mussels), or sessile species such as limpets and chitons, that are physically adapted to high energy wave conditions (they have a broad base and the ability to cling strongly to the rock), or utilise cracks and depressions in the rock for shelter. Also present were a few relatively fast moving mobile species like the topshell *Diloma nigerrima*, that leave their crack and boulder refuges to forage. Because this regular zonation of attached and sessile organisms is primarily governed by tidal inundation, monitoring changes to the shore composition provides a very good way of tracking long-term climate change effects such as predicted accelerated sea level rise or increased temperatures.

**Supralittoral Zone**

At Stirling Point, the supralittoral zone was dominated by bare rock, with a relatively low cover of lichens on the near-vertical rock and boulders present above the intertidal platform. Four species of lichen were recorded, all firmly attached as thin crustose sheets within the spray zone. Most abundant was the white *Pertusaria*, present in relatively large patches and often closely associated with frequent grey-green *Ramalina* (below left). While classified as rare, the strikingly coloured orange *Xanthoria* was visually distinctive (below middle), while the black *Verrucaria* (below right) was common along the lower supralittoral fringe.

Also appearing at the lower edge of the supralittoral fringe were the brown and banded periwinkles *Austrolittorina cincta* and *A. antipodum*. These small topshells graze on the attached lichens, and while extremely tolerant of the sun, tend to congregate in cracks and fissures in the rock that provide some protection from the elements. *A. cincta* (below left) was classified as abundant, and the smaller *A. antipodum* (below right) common. No other topshells were observed.

**Table 3. Results of the semi-quantative SACFOR assessment at Stirling Point, February 2010.**

Note: 'Height' refers to where on the shore the species is most abundant and SACFOR ratings are applied. Value # = No. per m².

| Group | Family | Species | Common name | Value | Scale | Class | Height | SACFOR Rating |
|---|---|---|---|---|---|---|---|---|
| Lichens | *Pertusariaceae* | *Pertusaria* sp. | White pore lichen | 50-80 | % | i | Supra | A |
| Lichens | *Teloschistaceae* | *Xanthoria* sp. *?parietina* | Yellow/orange lichen | 1-5 | % | i | Supra | R |
| Lichens | *Ramalinaceae* | *Ramalina* sp. *?scopulorum* | Grey/green lichen | 5-20 | % | i | Supra | F |
| Lichens | *Verrucariaceae* | *Verrucaria* sp. *?maura* | Black lichen | 20-50 | % | i | Supra | C |
| Barnacles | *Catophragmidae* | *Chamaesipho columna* | Column barnacles | 50-80 | % | i | Mid | A |
| Barnacles | *Balanidae* | *Elminius plicatus* | Ridged surf barnacle | 5-20 | % | i | Mid | F |
| Barnacles | *Cirripedia* | *Calantica ?spinosa* | Spiny goose neck barnacle | 1-5 | # | ii | Low | F |
| Anemones | *Actiniidae* | *Isacitina olivacea* | Olive anemone | 1-5 | # | ii | Low | F |
| Anemones | *Actiniidae* | *Oulactis mucosa* | Camouflage anemone | 1-5 | # | ii | Low | F |
| Bivalves | *Mytilidae* | *Mytilus galloprovincialis* | Blue mussel | 1-5 | # | ii | Mid | F |
| Bivalves | *Mytilidae* | *Perna canaliculus* | Green lipped mussel | 1-5 | # | iii | Low | C |
| Topshells | *Littorinidae* | *Austrolittorina cincta* | Brown periwinkle | 300-500 | # | i | Supra | A |
| Topshells | *Littorinidae* | *Austrolittorina antipodum* | Blue banded periwinkle | 50-100 | # | i | Supra | C |
| Topshells | *Trochidae* | *Diloma aethiops* | Grooved topshell | 1-5 | # | ii | Mid | F |
| Topshells | *Trochidae* | *Diloma nigerrima* | Bluish top shell | 50-100 | # | ii | Mid | A |
| Topshells | *Muricidae* | *Haustrum lacunosum* | Rock whelk | 5-10 | # | i | Mid | F |
| Topshells | *Turbinidae* | *Turbo smaragdus* | Cats eye | 1-5 | # | ii | Mid | F |
| Limpets | *Siphonarridae* | *Benhamina obliquata* | Large siphon limpet | <1 | # | ii | Low | R |
| Limpets | *Nacellidae* | *Cellana radians* | Tortoiseshell limpet | 20-50 | # | ii | Mid | A |
| Limpets | *Nacellidae* | *Cellana ornata* | Ornate limpet | 1-5 | # | ii | Low | F |
| Limpets | *Nacellidae* | *Cellana strigilis redmiculum* | Striated limpet | 20-50 | # | ii | Mid | A |
| Limpets | *Lottiidae* | *Patelloida corticata* | Encrusted slit limpet | 1-5 | # | ii | Mid | F |
| Chitons | *Callochitonidae* | *Eudoxochiton nobilis* | Noble chiton | <1 | # | iii | Low | R |
| Chitons | *Chitonidae* | *Sypharochiton pelliserpentis* | Snake's skin chiton | 1-5 | # | ii | Mid | F |
| Brown Algae | *Adenocystaceae* | *Adenocystis utricularis* | Sea bladders | <1 | % | ii | High | R |
| Brown Algae | *Durvillaeaceae* | *Durvillaea antarctica* | Bull kelp | 50-80 | % | ii | Low | S |
| Brown Algae | *Seirococcaceae* | *Marginariella urvilliana* | | 20-50 | % | ii | Low | A |
| Brown Algae | *Ralfsiaceae* | *Ralfsia verrucosa* | | <1 | % | i | Low | R |
| Brown Algae | *Scytosiphonaceae* | *Scytosiphon lomentaria* | | 1-5 | % | ii | Mid | O |
| Brown Algae | *Splachnidiaceae* | *Splachnidium rugosum* | Gummy weed, Dead man's fingers | 1-5 | % | ii | Mid | O |
| Brown Algae | *Fucaceae* | *Xiphophora gladiata* | | 50-80 | % | ii | Low | S |
| Green Algae | *Bryopsidaceae* | *Bryopsis* sp. | Green fern | <1 | % | ii | Mid | R |
| Green Algae | *Cladophoraceae* | *Chaetomorpha coliformis* | Sea emerald | <1 | % | ii | Mid | R |
| Green Algae | *Codiaceae* | *Codium convolutum* | Encrusting velvet | <1 | % | i | Low | R |
| Red Algae | *Hildenbrandiaceae* | *Apophlaea lyallii* | | 1-5 | % | ii | High | O |
| Red Algae | *Corallinaceae* | *Corallina officinalis* | Pink turf | 20-50 | % | ii | Low | A |
| Red Algae | *Corallinaceae* | *Corallina polymorphum* | Pink globules | 1-5 | % | i | Low | R |
| Red Algae | *Gigartinaceae* | *Gigartina* sp. | Agar, Irish moss | 5-20 | % | ii | Low | C |
| Red Algae | *Gracilariaceae* | *Gracilaria* sp.*?secundata* | | <1 | % | ii | Mid | R |
| Red Algae | *Corallinaceae* | *Lithothamnion* sp. | Pink/white paint | 50-80 | % | i | Low | A |
| Red Algae | *Halymeniaceae* | *Pachymenia lusoria* | | 1-5 | % | ii | Mid | O |
| Red Algae | *Bangiaceae* | *Porphyra* sp. | Nori | <1 | % | ii | High | R |
| Red Algae | *Rhodomelaceae* | *Stictosiphonia arbuscula* | Moss | 20-50 | % | ii | High | A |

Figure 6. *Stictosiphonia arbuscula* growing on bare rock in the high eulittoral zone.

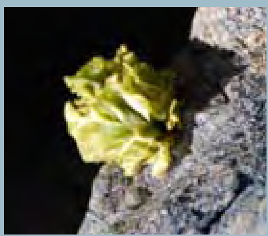


Figure 7. *Porphyra* growing on bare rock in the high eulittoral zone.

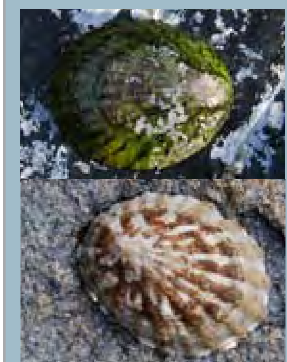


Figure 8. The limpets *Cellana radians (top)* and *C. strigilis redmiculum*.

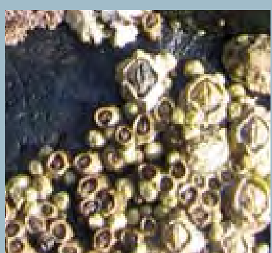


Figure 9. The barnacles *Chamaeosipho columna* and the larger *Elminius plicatus* on bare rock in the high eulittoral zone.

### High Eulittoral Zone

The high eulittoral zone is submerged for short periods on each tide and, because of the exposed nature of the site, is also frequently doused by waves and spray. This high energy zone was characterised by extensive patches of bare rock that supported a relatively sparse community. The dominant species was the red algae *Stictosiphonia arbuscula* (Figure 6), which forms dense bushy bands with often curled short hairy branchlets that helps it minimise dessication. Occasional tufts of *Porphyra* (Figure 7) were also seen on vertical rock faces, and were classified as rare. Nestled among algae were the herbivorous limpets *Cellana radians* and *C. strigilis redmiculum* (Figure 8), which were common/frequent respectively. The predatory rock whelk *Haustrum lacunosum* was frequently seen, while brown and banded periwinkles were common at the upper tidal fringe. The barnacles *Chamaeosipho columna* and *Elminius plicatus* (Figure 9) were also starting to appear at the lower fringe of the zone (see below), but were rated rare in terms of overall abundance.


### Mid Eulittoral Zone

Although still containing bare patches, the mid eulittoral zone was generally dominated by barnacles which filter-feed from the water column at high tide. *Chamaeosipho* was abundant and often present extensive sheets across the rock (see photo below), while *Elminius plicatus* was rated frequent and comprised smaller colonies often nestled among the *Chamaeosipho* (Figure 9). These barnacles tended to be most common in unshaded areas on both flat and vertical rock.

Gastropod topshells were sparse on exposed surfaces, preferring to shelter in crevices and under boulders. Periwinkles were again present, but fewer compared to higher on the shore, while the larger gastropods *Diloma aethiops, Haustrum lacunosum,* and *Turbo smaragdus* were rated frequent. *Diloma nigerrima* was rated abundant and was present at low tide in clumped aggregations in shaded areas (Figure 10). Also present was the blue mussel *Mytilus galloprovincialis,* rated frequent.

A wide range of algae also appeared in this zone for the first time, although they were generally small in size and patchy in their distribution. They included the brown algae *Adenocystis utricularis, Ralfsia verrucosa, Scytosiphon lomentaria,* and *Splachnidium rugosum,* the green algae *Bryopsis sp.* and *Codium convolutum,* and the red algae *Corallina officinalis , Gracilaria sp.?secundata, Lithothamnion sp., Pachymenia lusoria, Porphyra sp.,* and *Stictosiphonia arbuscula.* All were classified as rare with the exception of the calcareous red algal turf *Corallina officinalis* which was rated frequent.

# 3. Results and Discussion (Continued)


**Figure 10. Topshells, limpet and chiton from the mid eulittoral zone.**

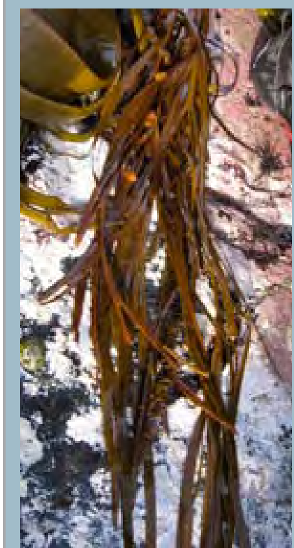


**Figure 11. *Marginariella urvilliana* overlying pink/white *Lithothamnion* paint on the low shore.**

### Low Eulittoral Zone

The lower eulittoral is exposed to the air for only a short period on each tidal cycle and is the where the brown algae have their stronghold on the shore. It is dominated by an almost exclusive (superabundant) cover of bull kelp *Durvillaea antarctica* which spreads over the low intertidal and shallow subtidal fringe (see photo below). A variety of sessile animals and algae take advantage of the shelter and refuge provided from waves, heat and predation by the overlying fronds. In particular, limpets (e.g. *Benhamina obliquata, Cellana radians, C. ornata, Patelloida corticata*) and chitons (e.g. *Eudoxochiton nobilis, Sypharochiton pelliserpentis*) with a strong ability to cling to the rocks were common, many returning to a home spot where their shell has adapted to fit the rock and provide a snug fit that offers protection from the elements. These species graze on the abundant cover of the calcareous red algae *Corallina officinalis* and pink/white paint *Lithothamnion* sp. present on the rock (see Figure 10). Topshells were generally uncommon, most likely due to the high wave exposure. Among the *Durvillaea* other algal species present included *Xiphophora gladiata* - superabundant, *Marginariella urvilliana* (Figure 11) - abundant, *Gigartina sp.*, - common, *Pachymenia lusoria* (Figure 12)- occasional, and *Codium convolutum* and *Ralfsia verrucosa* - rare. These species were generally relatively small in size, often growing on vertical faces at low water where the cover of *Durvillaea* was slightly less dominant. Also present attached to the rock were the anemones *Isacitina olivacea* and *Oulactis mucosa,* the spiny goose neck barnacle *Calantica ?spinosa*.- frequent, and the greenshell mussel *Perna canaliculus* - common.

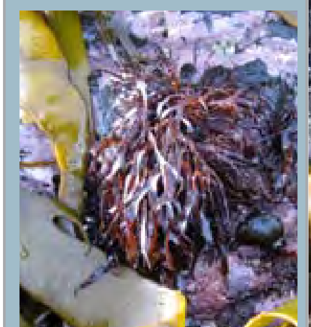



**Figure 12. The red algae *Pachymenia lusoria.***

# 3. Results and Discussion (Continued)

Overall, the semi-quantitive SACFOR assessment identified a wide range of robust rocky shore species, that while tolerant of extreme conditions, are representative of a healthy and unpolluted coastline. Despite its currently healthy condition, it is important to establish a multi-year baseline because exposed rocky shore habitats have a relatively high likelihood of disturbance from a variety of sources, including mechanical stress from wave force, dessication, thermal stress, predation, and from energetic constraints in terms of available food and nutrients (Tomanek and Helmuth 2002). As a result, a key attribute of many rocky shore species is the ability to rapidly colonise disturbed areas. Those species able to take advantage of new space will depend on a variety of factors including their numbers, condition and reproductive stage, and the time of year a disturbance event occurs. Therefore, there is the potential that whenever the shoreline is disturbed either naturally, or by human activities such as over-collection of shellfish or algae, a shift in the community composition may occur. Any disturbance related change however, is expected to remain within the broad zonation patterns identified on the shore. In contrast, long-term impacts such as climate change effects from predicted sea level rise or increasing temperatures are likely to be identified through changes in zonation on the shore, which will be addressed through the fixed quadrat sampling.

**Fixed Quadrats**

The principle purpose of repeat sampling fixed quadrats over time is to collect information on the stability of the sessile and attached community at representative shore heights. Figure 13 presents the mean SACFOR rating for each species by shore height for the first year of baseline monitoring, with full data and photos of quadrats presented in Appendix 1. While it is too early in the monitoring programme to use these data, after the scheduled 3-4 years of monitoring they will provide a robust measure of natural baseline variation against which any future shift in vertical zonation on the shoreline can be assessed. It will also provide an invaluable benchmark for assessing the possible impacts from infrequent events such as oil spills or toxic algal blooms should they occur.

Because current scientific knowledge of many NZ rocky shore species is scarce or incomplete, as the baseline monitoring continues it is proposed that the semi- quantitative assessment and fixed quadrat results be used to develop condition ratings to characterise the status of the shore. The condition ratings are expected to focus on measuring shifts in community composition, the presence or absence of key indicator species (including introduced plants and animals), as well as indicators of nutrient enrichment and sedimentation.

# 3. Results and Discussion (Continued)

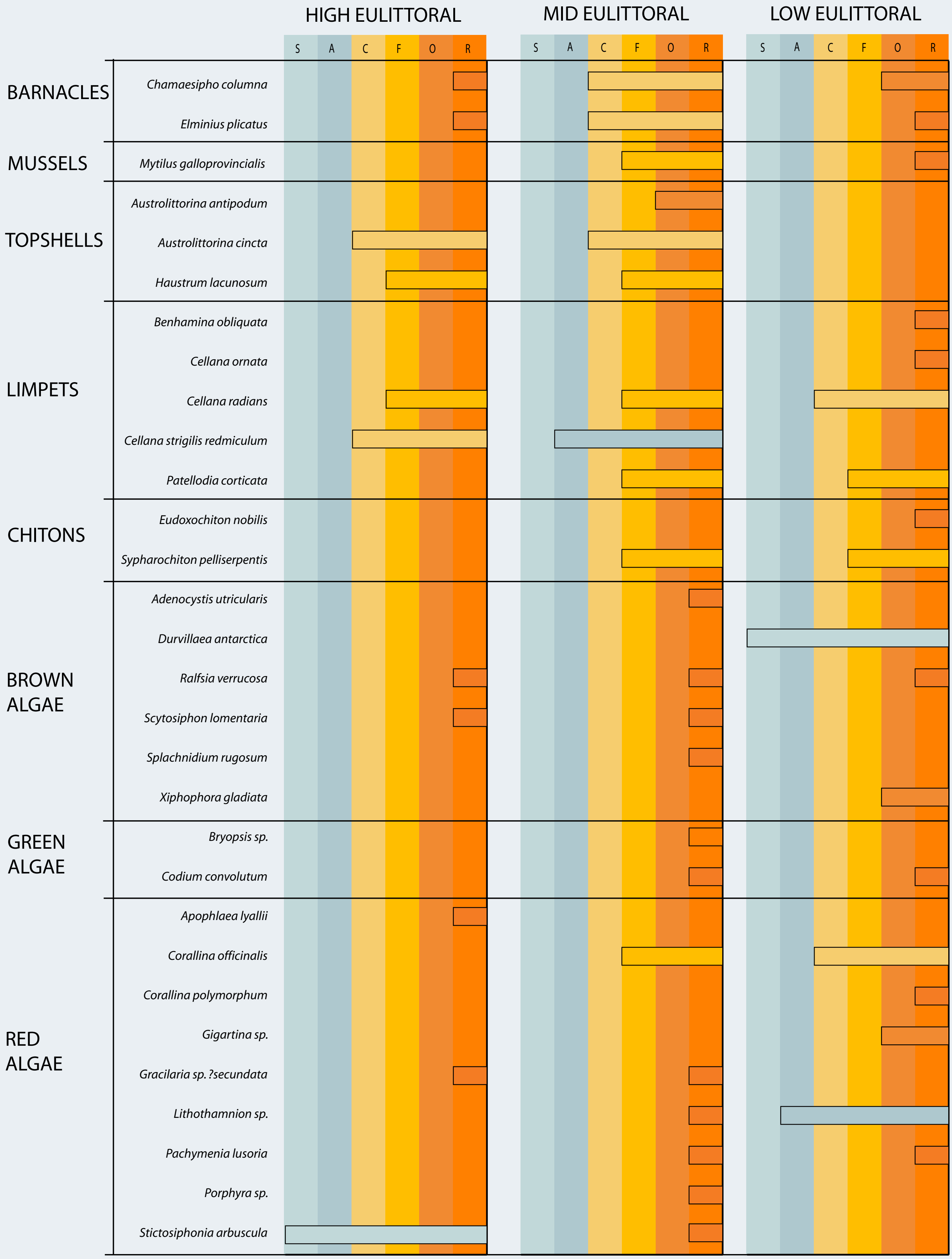



**Figure 13. Mean SACFOR rating for species present in 6 fixed quadrats in high, mid and low eulittoral zones.**

# 4. SUMMARY


*Eudoxochiton nobilis*

The inaugural year of rocky shore monitoring at Stirling Point showed a healthy and unpolluted coastline supporting a collection of common rocky shore organisms present in a predictable shoreline zonation.

The zonation extended from the bare rock, lichens and periwinkles of the upper shore, through the barnacle zone in the mid shore, to the low shore algal zone dominated by the giant southern bull kelp *Durvillaea*. Topshells, limpets and chitons were most common on the mid shore.

Over the scheduled 3-4 years of baseline monitoring, condition ratings will be developed to characterise the status of the shore.

# 5. MONITORING


*Corallina officinalis*

Stirling Point has been identified by Environment Southland as a priority for monitoring the effects of predicted accelerated sea level rise and temperature change, over-collection of living resources, and introduction of invasive species. It is recommended that monitoring continue as outlined below:

**Rocky Shore Monitoring**:

- Continue the scheduled baseline monitoring at Stirling Point in February 2011. After the 3-4 year baseline is established, reduce monitoring to 5 yearly intervals or as deemed necessary based on rocky shore condition ratings (to be developed).
- Identify monitoring sites at two other representative locations on the Southland coast (e.g. West of Cosy Nook, Waipapa Point), and initiate baseline monitoring in a staged manner in 2011 and 2012.

# 6. ACKNOWLEDGEMENTS

This survey and report has been undertaken with the extensive help and support of Greg Larkin (Coastal Scientist, Environment Southland), and Maz Robertson (Wriggle) for editing.

# 7. REFERENCES

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# APPENDIX 1. DETAILED FIXED QUADRAT RESULTS

High Eulittoral Quadrats

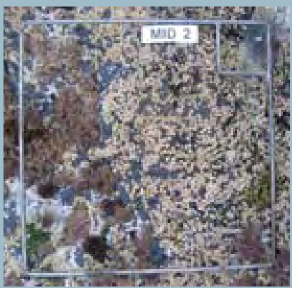


| HIGH SHORE SITE | Unit | Quad 1 | Quad 2 | Quad 3 | Quad 4 | Quad 5 | Quad 6 | Mean | SACFOR RATING |
|---|---|---|---|---|---|---|---|---|---|
| *Chamaesipho columna* | % | 1 | 3 | 0 | 0.1 | 0 | 0.5 | 1 | R |
| *Elminius plicatus* | % | 1 | 0.5 | 0.1 | 0.2 | 1 | 2 | 1 | R |
| *Austrolittorina cincta* | # | 0 | 30 | 350 | 200 | 400 | 400 | 230 | C |
| *Haustrum lacunosum* | # | 4 | 0 | 3 | 5 | 2 | 0 | 2 | F |
| *Cellana radians* | # | 0 | 0 | 2 | 2 | 1 | 0 | 1 | F |
| *Cellana strigilis redmiculum* | # | 2 | 2 | 3 | 7 | 2 | 1 | 3 | C |
| *Ralfsia verrucosa* | % | 0 | 0 | 0 | 0 | 3 | 0 | 1 | R |
| *Scytosiphon lomentaria* | % | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | R |
| *Apophlaea lyallii* | % | 0 | 0.5 | 0 | 2 | 0 | 0 | 0 | R |
| *Gracilaria* sp. ?*secundata* | % | 0 | 0 | 0 | 0 | 1 | 0 | 0 | R |
| *Stictosiphonia arbuscula* | % | 80 | 20 | 80 | 70 | 85 | 90 | 71 | S |



# APPENDIX 1. DETAILED RESULTS (CONT.)

Mid Eulittoral Quadrats

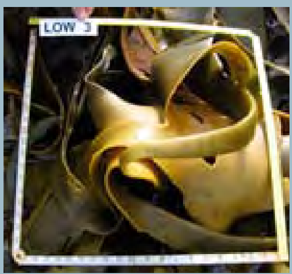



| MID SHORE SITE | Unit | Quad 1 | Quad 2 | Quad 3 | Quad 4 | Quad 5 | Quad 6 | Mean | SACFOR RATING |
|---|---|---|---|---|---|---|---|---|---|
| *Chamaesipho columna* | % | 2 | 5 | 50 | 50 | 1-5 | 1-5 | 19 | C |
| *Elminius plicatus* | % | 20 | 50 | 10 | 20 | 20-50 | 20-50 | 28 | C |
| *Mytilus galloprovincialis* | # | 2 | 0 | 0 | 4 | 0 | 1 | 1 | F |
| *Austrolittorina antipodum* | # | 0 | 0 | 0 | 0 | 3 | 0 | 1 | O |
| *Austrolittorina cincta* | # | 100 | 50 | 450 | 600 | 6 | 0 | 201 | C |
| *Haustrum lacunosum* | # | 0 | 0 | 0 | 0 | 3 | 0 | 1 | F |
| *Cellana radians* | # | 5 | 2 | 4 | 1 | 0 | 0 | 2 | F |
| *Cellana strigilis redmiculum* | # | 20 | 22 | 27 | 23 | 80 | 45 | 36 | A |
| *Patellodia corticata* | # | 2 | 3 | 7 | 0 | 0 | 0 | 2 | F |
| *Sypharochiton pelliserpentis* | # | 0 | 1 | 1 | 0 | 0 | 1 | 1 | F |
| *Adenocystis utricularis* | % | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | R |
| *Ralfsia verrucosa* | % | 3 | 0 | 0 | 0 | 0 | 0 | 1 | R |
| *Scytosiphon lomentaria* | % | 0 | 0 | 0 | 1 | 0 | 0.5 | 0 | R |
| *Splachnidium rugosum* | % | 0.1 | 0 | 0 | 0 | 0 | 0.5 | 0 | R |
| *Bryopsis* sp. | % | 0.1 | 1 | 0 | 0 | 0 | 0 | 0 | R |
| *Codium convolutum* | % | | 0 | 0 | 0 | 0 | 0.5 | 0 | R |
| *Corallina officinalis* | % | 20 | 20 | 0 | 0 | 0 | 0.5 | 7 | F |
| *Gracilaria* sp. *?secundata* | % | 0 | 0 | 0 | 1 | 0 | 0 | 0 | R |
| *Lithothamnion* sp. | % | 15 | 0 | 3 | 0 | 0 | 0 | 3 | R |
| *Pachymenia lusoria* | % | 5 | 0 | 0 | 0 | 0 | 0 | 1 | R |
| *Porphyra* sp. | % | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | R |
| *Stictosiphonia arbuscula* | % | 0.1 | 0.2 | 0.5 | 0 | 0 | 1-5 | 1 | R |



# APPENDIX 1. DETAILED RESULTS (CONT.)

## Low Eulittoral Quadrats



| LOW SHORE SITE | Unit | Quad 1 | Quad 2 | Quad 3 | Quad 4 | Quad 5 | Quad 6 | Mean | SACFOR RATING |
|---|---|---|---|---|---|---|---|---|---|
| *Chamaesipho columna* | % | 1-5 | 1-5 | 20 | 1-5 | 0 | 0 | 5 | O |
| *Elminius plicatus* | % | 1-5 | 1-5 | 0 | 0 | 0 | 0 | 1 | R |
| *Mytilus galloprovincialis* | # | 1 | 1 | 0 | 0 | 0 | 0 | 0 | R |
| *Benhamina obliquata* | # | 1 | 0 | 0 | 0 | 0 | 1 | 0 | R |
| *Cellana ornata* | # | 0 | 0 | 0 | 2 | 0 | 0 | 0 | R |
| *Cellana radians* | # | 0 | 3 | 10 | 2 | 3 | 1 | 3 | C |
| *Patellodia corticata* | # | 9 | 7 | 5 | 4 | 4 | 3 | 5 | F |
| *Eudoxochiton nobilis* | # | 0 | 0 | 0 | 0 | 1 | 1 | 0 | R |
| *Sypharochiton pelliserpentis* | # | 2 | 0 | 1 | 3 | 1 | 3 | 2 | F |
| *Durvillaea antarctica* | % | 50-80 | 50-80 | 80-100 | 50-80 | 50-80 | 50-80 | 69 | S |
| *Ralfsia verrucosa* | % | 0 | 1-5 | 0 | 0 | 0 | 0 | 0 | R |
| *Xiphophora gladiata* | % | 1-5 | 1-5 | 0 | 0 | 1-5 | 1-5 | 2 | O |
| *Codium convolutum* | % | 0.5 | 1 | 0 | 0 | 0.5 | 0.5 | 0 | R |
| *Corallina officinalis* | % | 10-20 | 10-20 | 10-20 | 1-5 | 5-10 | 1-5 | 10 | C |
| *Corallina polymorphum* | % | 0 | 0 | 0 | 0 | 1-5 | 1-5 | 1 | R |
| *Gigartina* sp. | % | 1-5 | 5-10 | 1-5 | 5-10 | 1-5 | 1-5 | 4 | O |
| *Lithothamnion* sp. | % | 20-50 | 10-20 | 50-80 | 50-80 | 50-80 | 50-80 | 52 | A |
| *Pachymenia lusoria* | % | 1-5 | 0 | 0 | 0 | 0 | 0 | 0 | R |