Davidson Environmental Limited

Significant marine site survey and monitoring programme: Summary report 2015-2016

Research, survey and monitoring report number 836

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Summary

Davidson and Richards (2015) conducted the first survey and monitoring programme of Marlborough's significant marine sites in the summer of 2014 - 2015. Their study focused on particular sites initially described in Davidson *et al*. (2011). Davidson and Richards (2015) investigated sites located in Queen Charlotte Sound, Tory Channel and Port Gore using protocols detailed in Davidson *et al. (*2013). The present report is a summary of the second season of survey and monitoring of sites in Croisilles Harbour and eastern and southern D'Urville Island (see note).

Findings from a total of 15 sites and sub-sites in two biogeographic regions: (1) Croisilles Harbour and southern D'Urville Island (Tasman Bay biogeographic area), and (2) eastern D'Urville Island to Chetwode Islands (Two Bay Point to Cape Jackson biogeographic area) are presented in the present report. Two significant sites have been split into three sub-sites each (Catherine Cove A, B and C; and Coppermine-Ponganui Bays A, B and C).

A variety of qualitative and quantitative methods were adopted (Davidson *et al.,* 2013). Methods varied between sites and sub-sites depending on site specific environmental factors and information needs outlined in Davidson *et al.* (2014). As part of the present survey programme, a remote HD video and still photograph GoPro Hero 4 (black) fitted with a filter and macro lens was also used to collect HD media at selected sites for the first time.

Of the total 15 sites and sub-sites investigated, five increased in reported size (178.4ha total), while eight sites and sub-sites were reduced (-214.6ha). One site remained unchanged (i.e. Hunia king shag colony) between surveys. A new site is also described at Lone Rock, Croisilles Harbour (i.e. rhodoliths bed = 4.68ha). Penguin Island (suggested Site 2.37) was initially described by Davidson *et al*. (2011) as part of a larger site (Site 2.12) and was not therefore recorded as an increase in the present investigation. This site was resurveyed during the present investigation as it supported a different range of habitats and communities compared to the original larger site (2.12). The remaining sites and sub-sites increased or declined in size due to an improved level of survey detail. No sites investigated in the present study are recommended for removal of their significance status.

Note: Raw data collected during the 2015-2016 season were collated into excel spreadsheets and supplied to MDC for storage (e.g. HD video, photographs). The present report is a therefore a summary and does not include all data collected from sites and sub-sites.

Overall the area occupied by significant sites in the Croisilles - D'Urville area declined by 214.6 hectares between that reported in Davidson *et al.* (2011) and the present survey (Table 1). Unlike the previous survey conducted by Davidson and Richards (2015), change is attributed solely to more detailed information compared to previous data.

This report makes recommendations to the review panel for each of the surveyed significant sites. These recommendations may not necessarily be adopted by the expert panel; therefore, the status of each site in the present report remains pending until they are reassessed by the panel (see Davidson *et al.* 2013 for the process).

Marlborough's significant marine sites are likely remnants of larger areas reduced or lost due to historic anthropogenic activities. Davidson and Richards (2015) stated that, based on their 2015 survey, it was clear that some of the remaining significant sites were being degraded or lost. The present study suggests that significant sites surveyed of sites in the Croisilles - D'Urville Island areas are localised and often associated with natural protecting structures such as rock and reef systems. The areas surveyed during the present study, however, appear stable, with no indications they have been recently degraded or reduced in size.

Table 1 Summary of sites and sub-sites investigated during the present study and main recommendations.

Attribute	Values
Area in 2011 (ha)	1009.4
Area in 2016 (ha) *	794.8
Potential new sites*	1
Potential site removed*	0
Increase in area (ha) *	178.35
Decrease in area (ha) *	-398.72
Overall change in ha. *	-214.64
Sites	Recommendations
Site 1.2 Croisilles Harbour Entrance	Quantitative survey/assessment of lancelet to investigate if recreational dredging has an impact
Site 1.4 Motuanauru Is. Boulder Bank	
Site 1.5 (A,B,C) Coppermine-Ponganui Bays	Protect from all physical disturbance, relocate moorings located within the rhodolith beds
Site 2.6 Rangitoto Passage	Continue survey around Islands, protect from all form of physical disturbance
Site 2.13 (A,B,C) Catherine Cove	Protect from all forms of physical disturbance
Site 2.15 Clay Point	
Site 2.18 Paparoa	
Site 2.20 Chetwodes to The Haystack	Protect soft substratum areas from all forms of physical disturbance
Site 2.35 Hunia	Establish an approach distance guideline for colony
Site 1.9 Lone Rock	Protect from all forms of disturbance
Site 2.37 Penguin Island Channel	Protect from all heavy disturbance, anchoring OK

*Recommended but subject to expert peer review

1.0 Background

The Resource Management Act requires local authorities to monitor the state of the whole or any part of the environment (s35(2)(a)). There also exist a variety of other obligations such as maintaining indigenous biodiversity (s30(1)(g)(a)). The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna is considered a matter of national importance (Section 6(c)).

Since 2010, the Marlborough District Council (MDC) has supported a programme for surveying and assessing marine sites within its region. A key milestone in this programme was the publication of a report identifying and ranking known ecologically significant marine sites in Marlborough (Davidson *et al.* 2011). The assembled group of expert authors developed a set of criteria to assess the relative biological importance of a range of candidate sites. Sites that received a medium or high score were ranked “significant”. A total of 129 significant sites were recognised and described during that process.

The authors stated their assessment of significance was based on existing data or information, but was not complete. Many marine areas had not been surveyed or the information available was incomplete or limited. The authors stated that ecologically significant marine sites would exist, but remain unknown until discovered. In addition, some significant sites were assessed on limited information. Further, in some cases, existing sites required more investigation to confirm their status. The authors also stated that many sites not assessed as being significant had the potential to be ranked at a higher level in the future as more information became available. They also recognised the quality of some existing significant sites may decline over time due to natural or human related events or activities. The authors therefore acknowledged that their report had limitations and would require updating on a regular basis.

Two subsequent reports were produced. Davidson *et al.* (2013) produced a protocol for receiving information for new candidate sites and for reassessing existing ecologically significant marine sites. The goal of that protocol was to establish consistency and to ensure a rigorous and consistent process for site identification, data collection and assessment. The aims of that report were to establish:

(a) The level of information required for new candidate sites.
(b) The process for assessment of new sites and reassessment of existing sites.

(c) A protocol for record keeping, selection of experts and publication of an updated ecologically significant marine sites report.

Davidson *et al*. (2014) provided a report outlining "guidance on how to continue a survey and monitoring programme for ecologically significant marine areas in Marlborough and to assist with the management and overarching design of such work to optimise the collection of biological information within resource limitations".

The Davidson *et al.* (2014) report had the following objectives:

1. Provide survey and monitoring options for MDC to consider based on different levels and types of investigation (e.g. health checks, regular monitoring, surveys of new sites, and surveys to fill information gaps at existing sites).
2. Prioritisation of survey and monitoring based on factors such as ecological distinctiveness, rarity and representativeness, as well as vulnerability, issues and threats to marine values.
3. Recommend a simple, robust, and repeatable methodology that enables site health to be monitored and assessed.
4. Provide guidance on the assessment of a site's health that can be conveyed to Council and the community in a simple but effective way that will aid tracking of changes in site condition.

In particular, the Davidson *et al.* (2014) report aimed to add to the ecologically significant marine sites programme by providing guidance for the collection, storage and publication of biophysical data from potential new significant sites as well as existing sites. The biological investigation process was separated into three main elements:

A. Survey of new sites;
B. Collection of additional information from existing significant sites or sites that previously were not ranked as being ecologically significant; and
C. Status monitoring of existing significant sites (i.e. site health checks).

Davidson and Richards (2015) produced the first survey implementing protocols outlined in Davidson *et al.* (2013, 2014). The authors focused on selected sites detailed in Davidson *et al.* (2014) in Queen Charlotte Sound, Tory Channel and Port Gore. These areas were selected by a joint MDC/DOC monitoring steering group that also considered advice from Davidson Environmental Ltd. At the time it was agreed that the work should focus on biogenic habitats because of their biological importance (e.g. substratum stabilisation, increase biodiversity, juvenile habitats, food sources). Biogenic habitats were also prioritised as they have a history of being adversely affected by a variety of anthropogenic activities (Bradstock & Gordon 1983, Morrison 2014).

The work presented by Davidson and Richards (2015) was then reviewed by the peer review panel and their findings produced in Davidson *et al*. (2016). Davidson *et al.* (2016) stated:

> The expert panel was reconvened to reassess the new information for the 21 sites and sub-sites outlined in Davidson and Richards (2015). The review report presents the findings of that reassessment. It also comments on issues associated with physical disturbance of significant sites supporting benthic biological values and appropriate management categories for the protection of those values.

The expert panel also made alterations to particular parts of the seven criteria originally used to assess significant sites as developed by Davidson *et al*. (2011).

The Panel's overall findings recommended that:

a) three sites be removed from the list of significant sites due to the loss or significant degradation of biological values (Hitaua Bay Estuary, Port Gore (central) horse mussel bed and Ship Cove).
b) the offshore site located north of Motuara Island be removed and replaced with a small area located around a rocky reef structure.
c) adjustment to the boundaries of most of the remaining significant sites in accordance with the recommendations of Davidson and Richards (2015).

Based on the removal of the three sites and a number of boundary adjustments, a total of 1544 ha was removed and 113.8 ha added at the significant site level. The overall change between that recorded in 2011 and 2015 was a loss of 1430.8 ha of significant sites.

Prior to the 2015-2016 field work season, a report outlining potential or candidate sites for survey and/or monitoring was produced (Davidson 2016). That report was used to guide the selection of sites surveyed and described in this current report.

2.0 Study sites

All sites and sub-sites investigated were located in two biogeographic regions: (1) Croisilles Harbour and southern D'Urville Island (Tasman Bay biogeographic area), and (2) eastern D'Urville Island to Chetwode Islands (Two Bay Point to Cape Jackson biogeographic area) (Figure 1, Table 2).

Bryozoans (*Celleporaria agglutinans*) and encrusting sponges at Rangitoto Passage (2016).

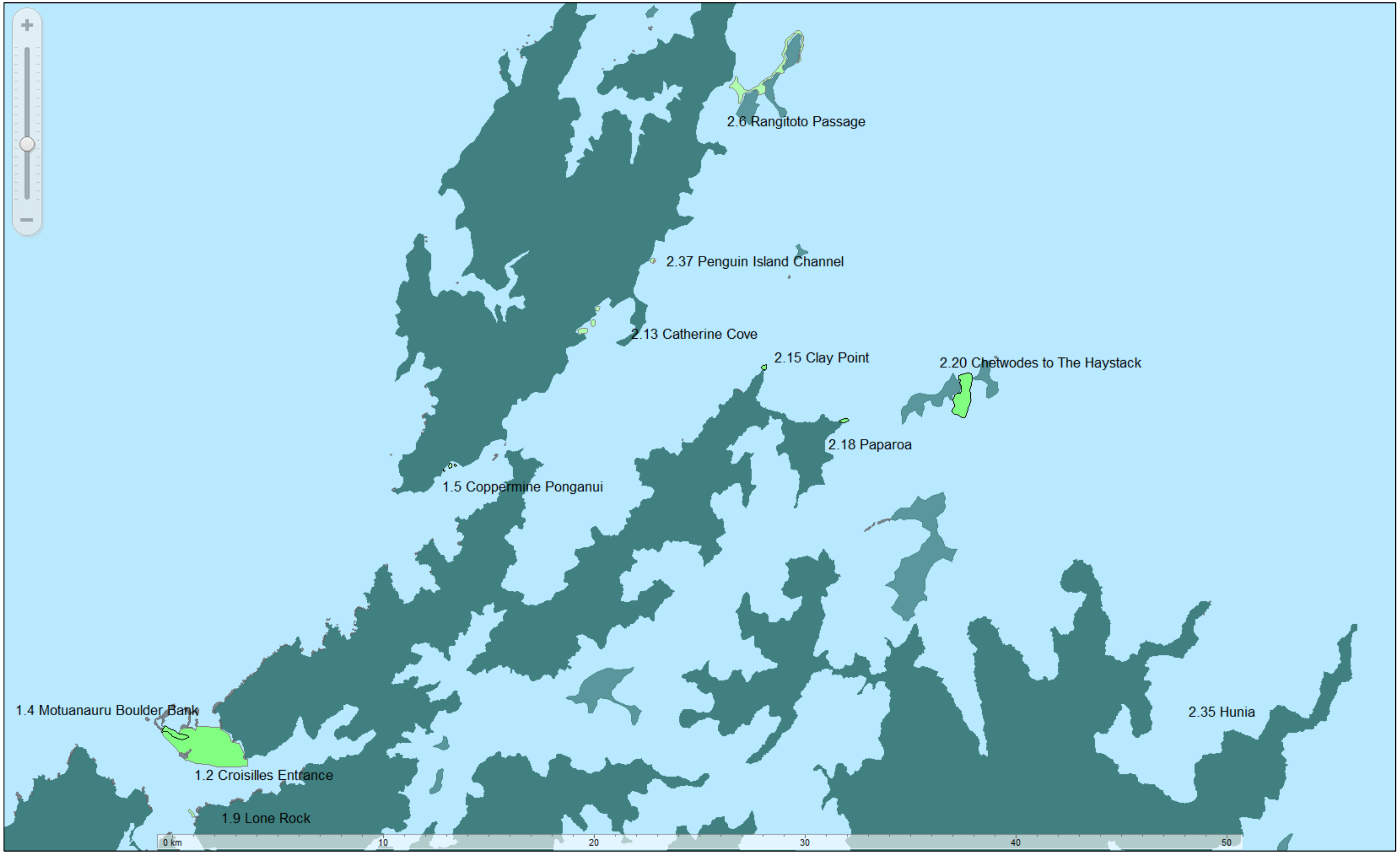

Figure 1. Location of sites and sub-sites investigated in the present study.

3.0 Methods

A variety of standard survey methods were adopted to investigate sites. Different survey methods were used at each site depending on the level of survey required (i.e. survey or monitoring) and the particular environmental variables at each site (e.g. depth, currents, water clarity).

3.1 Sonar imaging

Sonar investigations were conducted using a Lowrance HDS-12 Gen 2 and HDS-8 Gen2 linked with a Lowrance StructureScanTM Sonar Imaging LSS-1 Module. These units provide right and left side imaging as well as DownScan ImagingTM, and were linked to a Point 1 Lowrance GPS Receiver. The unit also allows real time plotting of StructureMap TM overlays onto the installed Platinum NZ underwater chart. A Lowrance HDS 10 Gen 1 unit fitted with a high definition Airmar 1KW transducer was used to collect traditional sonar data from the site. Sonar data were converted into a Google Earth file that could be over laid onto Google Earth imagery.

3.2 Drop camera stations and site depths

At each drop camera station, a low resolution Sea Viewer underwater splash camera fixed to an aluminium frame was lowered to the benthos and an oblique still photograph was taken where the frame landed. The locations of photograph stations were selected in an effort to obtain a representative range of habitats and also targeted any features of particular interest observed from sonar (e.g. reef structures, cobbles). On many occasions, the survey vessel was allowed to drift for short periods while the benthos was observed on the remote monitor. Field notes were collected and appended to the relevant data spreadsheet.

3.3 Percentage cover estimation

The percentage cover of rhodoliths collected from GPS positioned drop camera images were estimated both in the field by the boat observer and also in the laboratory on the computer screen. Percentage cover was estimated into 5% class intervals by the same trained recorder at all sites and for all images in order to ensure consistency. All photo images were numbered and coded to a GPS position, depth and a percentage cover score.

3.4 Underwater HD video and still photographs

HD underwater video was collected using a remote GoPro Hero 4 (black) mounted on a purpose built frame and tripod. The camera also collected HD still photographs at 5 second intervals. The GoPro was fitted with a magenta filter and a macro-lens that were intermittently used to improve video resolution and improved colour representation in certain light and water conditions.

When used the GoPro was lowered to the benthos and the survey vessel allowed to move in a controlled fashion across a selected area. The footage and photos were collected by allowing the camera to settle on the benthos and then intermittently moved across the study area. The area selected for investigation was based on findings from the low resolution camera and sonar data. The start and end GPS positions for video footage were recorded.

3.5 Surface photos

A representative surface photo was collected from most sites using a Samsung S6 in panoramic picture mode. Selected surface photos have been included in the excel spreadsheets while all photos collected are held on the MDC database.

3.6 Core sampling

Four core samples were haphazardly collected at Croisilles Harbour Entrance (Site 1.2) by divers using a 13cm diameter by 15cm deep corer. Cores were sorted on board the survey vessel and lancelets within each core were counted. Video and photos of live lancelets were also collected.

3.7 King shag counts

One king shag count at the Hunia colony was conducted during the present study (4pm, 14 February 2016). Photographs collected by a local land owner (Karen Marchant) on three occasions were used to provide a longer term indication of bird numbers at this mainland site.

3.8 Excel site sheets and data

Data collected from each site during the present study were inputted into a predesigned Excel template. Data sheets include a summary page and a number of other pages comprising data, maps, photos, sonar images and sample coordinates. A complete set of data for each site is stored on the MDC database. The spreadsheets also outline other data types that have been stored at MDC for each site (e.g. video clips).

3.9 Ranking

No assessment or ranking of sites was carried out during the present investigation. Recommendations for each site are, however, included in page 1 of the Excel site sheets. It is expected that the expert review panel will conduct a ranking exercise based on the findings and recommendations of the present report.

Table 2. List of sites investigated during the present study in Croisilles Harbour and eastern and southern D'Urville Island area.

Site	**Location**	**Biological values**	**Original level of information**
Site 1.2 Croisilles Harbour Entrance	Croisilles Harbour	Distinct shallow water habitat, presence of lancelet	Qualitative report
Site 1.4 Motuanauru Is. Boulder Bank	Croisilles Harbour	Large subtidal boulder bank, presence of lancelet	Qualitative report
Site 1.5 (A,B,C) Coppermine-Ponganui Bays	Current Basin	Dense rhodolith bed	Quantitative report
Site 2.6 Rangitoto Passage	D'Urville Island coast and Rangitoto Is.	Bryozoan beds	Quantitative report
Site 2.13 (A,B,C) Catherine Cove	Western coast of Catherine Cove	Dense rhodolith beds	Qualitative report
Site 2.15 Clay Point	North-east Admiralty Bay	Current swept rocky habitats	Brief visit
Site 2.18 Paparoa	Western entrance to Pelorus Sound	Current swept habitats	Brief visit
Site 2.20 Chetwodes to The Haystack	Chetwode Islands	Variety of biogenic soft bottom communities	Brief visit
Site 2.35 Hunia	Hunia, Port Gore	King shag colony on the mainland	Quantitative data
Site 2.37 Penguin Island Channel	Eastern coastline of D'Urville Is.	Tubeworm mounds, shellfish bed	Qualitative report
Site 1.9 Lone Rock	Croisilles Harbour	Rhodoliths	New site

4.0 Results

All sites investigated in the present study were located in two biogeographic regions: (1) Croisilles Harbour - southern D'Urville Island (Tasman Bay biogeographic area), and (2) eastern D'Urville Island - Chetwode Islands (Two Bay Point to Cape Jackson biogeographic area).

4.1 Site and sub-site changes since 2011

Of the sites and sub-sites investigated in the present study, Davidson *et al.* (2011) listed 11 sites in total. Davidson and Richards (2015) added one new site that was revisited during the present study. Based on data collected during the present study it is recommended that:

(A) One of the original 11 sites identified by Davidson *et al.* (2011) be split into 3 sub-sites (Site 1.5 A, B, and C Ponganui-Coppermine rhodoliths).
(B) Davidson *et al.* (2011) recognised three parts to Site 2.13, but called each of them Site 2.13. It is recommended that these sites be called sub-sites (Site 2.13 A, B and C, Catherine Cove rhodoliths),
(C) One new site be established that was originally part of a larger site (Site 2.37 Penguin Island Channel), and
(D) One new site be recognised as a significant site (Site 1.9: Lone Rock rhodolith bed).

4.2 Size change since 2011 report

Of the 15 sites and sub-sites investigated during the present study, all but one were based on the existing significant sites identified in Davidson *et al*. (2011) or Davidson and Richards (2015). A new site was described in Croisilles Harbour (i.e. suggested Site 1.9: Lone Rock rhodoliths). The presence of a rhodolith bed in Croisilles Harbour was first mentioned in correspondence with Rob Murdoch (NIWA). The present survey located this bed, mapped its extent and outlined the percentage cover of rhodoliths for future monitoring purposes.

One site, initially included as part of a larger site (i.e. Site 2.12) that encompassed a large bay located north of Catherine Cove Peninsula, was separately described in the present study. This separate site was located between Penguin Island and D'Urville Island (Proposed Site 2.37 Penguin Island Channel).

Significant Site 2.13 (Catherine Cove rhodoliths) was initially coded as one site with three distinct parts (Davidson *et al*., 2011). It is recommended that this site be split into three separate sub-sites (Site 2.13A = northern, 2.13B = middle, and 2.13C = southern). These sub-sites are, however, located in close proximity.

Significant site 1.5 (Ponganui-Coppermine Bays rhodoliths) was initially described as one site by Davidson *et al*. (2011). Based on the increased level of survey detail, it is recommended that this site be split into three subsites (Site 1.5A = northern, 1.5B = middle, and 1.5C = southern). Again, these sub-sites are located in close proximity to one another.

For all but Site 2.35 (Hunia king shag colony) it is recommended that the size and boundaries of the surveyed significant sites be altered to reflect the new information collected during the present study.

Table 3. Summary of sites and sub-sites surveyed in 2016 including recommended changes and the suggested reason for site changes.

Site	Sites/subsites 2011	Sites/subsites 2015	Sites/subsites 2016	Original area (ha)	Recommended area (ha)	Change (ha)	Change %	Benthos type	Reason for change
Site 1.2 Croisilles Harbour Entrance	1	NA	1	368	492	124	33.7	Soft	Improved detail of survey
Site 1.4 Motuanauru Is. Boulder Bank	1	NA	1	39	29.3	9.7	-24.9	Soft	Improved detail of survey
Site 1.5 (A) Coppermine-Ponganui Bays rhodoliths	Undescribed	NA	1	0	1.13	1.13	100.0	Soft	New subsite
Site 1.5 (B) Coppermine-Ponganui Bays rhodoliths	1	NA	1	22.3	2.88	19.42	-87.1	Soft	Improved detail of survey
Site 1.5 (C) Coppermine-Ponganui Bays rhodoliths	Undescribed	NA	1	0	0.54	0.54	100.0	Soft	New subsite
Site 2.6 Rangitoto Passage	1	NA	1	429.8	111.6	318.2	-74.0	Soft	Improved detail of survey
Site 2.13 (A) Catherine Cove rhodoliths	1	NA	1	5.9	3.5	2.4	40.7	Soft	Improved detail of survey
Site 2.13 (B) Catherine Cove rhodoliths	1	NA	1	6.8	5.06	1.74	25.6	Soft	Improved detail of survey
Site 2.13 (C) Catherine Cove rhodoliths	1	NA	1	16	10.27	5.73	35.8	Soft	Improved detail of survey
Site 2.15 Clay Point	1	NA	1	33.5	4.3	29.2	-87.2	Rock, coarse soft	Improved detail of survey
Site 2.18 Paparoa	1	NA	1	12.6	6	6.6	-52.4	Rock, coarse soft	Improved detail of survey
Site 2.20 Chetwodes to The Haystack	1	NA	1	71.7	119.7	48	66.9	Rock, coarse soft	Improved detail of survey
Site 2.35 Hunia king shag colony	Undescribed	1	1	0.025	0.025	0	0.0	Terrestrial rock	No change
Site 1.9 Lone Rock rhodoliths	Undescribed	Undescribed	1	0	4.68	4.68	100.0	Soft	New area discovered with medium or high values
Site 2.37 Penguin Island Channel	1	NA	1	3.8	3.8	0	0.0	Soft	Site was initially described as part of a larger site
Totals	**11**	**1**	**15**	**1009.425**	**794.785**	**-214.64**			
Increase to significant sites						178.35			
Decrease to significant sites						398.72			

New sites =

4.3 Significant sites

4.3.1 Site 1.2 Croisilles Harbour Entrance

The shallow Croisilles Harbour entrance supports three main soft substratum types: (A) rippled mobile sand and shell, (B) medium sand, fine sand and shell and (C) silt. There are indications this shallow habitat area may have an underlying base of cobble material as one patch of sparse cobbles was recorded at a central location. The size of the recommended site increased since the report by Davidson *et al.* (2011) (Figure 2). The increase in area was due to improved survey methodology and equipment that identified a greater area of the shallow sandy area than first recorded. Silt areas located along the southern boundary were removed as they do not provide habitat for lancelet.

Plate 1. Looking through the Croisilles Islands towards the Croisilles Harbour Entrance area.

It is unknown how much of the significant site supports lancelets. Previously, Davidson and Duffy (1992) sampled one site and recorded a mean of 450 individuals per m^2. In the present study, four replicate cores were collected from one mobile rippled sand and shell substratum site: mean = 1315 individuals per m^2 (SE = 422.4) (Table 4). This substratum type covers at least 250 ha of the Harbour. No other lancelet density measurements for this species have been conducted at the few sites where this species has been found in Marlborough.

It is recommended that a widespread quantitative survey of lancelet abundance and distribution be conducted at this significant site with the aim of documenting its distribution and abundance and to investigate if recreational dredging of the site is having any effect on this species. Experimental studies may also be need to assess the impact of dredging

Plate 2. Lancelet collected from Croisilles Harbour Entrance (Site 1.2).

Table 4. Density of lancelet from four cores collected from mobile rippled sand and shell substratum in Croisilles Harbour Entance (24/2/2016).

Core number	Depth (m)	Number of lancelet per core	Density m^2
1	5.5	10	565.9
2	6	39	2206.9
3	6.5	11	622.5
4	5.5	33	1867.4
Mean	5.9	23.25	1315.7
SD	0.48	14.93	844.9
Number cores	4	4	4
SE	0.24	7.47	422.4

The shallow soft bottom habitats located in the entrance to Croisilles Harbour are a very popular recreational scallop fishery (Table 5). During the scallop season, dredging by recreational fishers is regularly observed. Most fishers avoid the rocky reef areas located around the islands. Recreational diving for scallops also occurs in this area. Recreational line fishing and anchoring most often occurs around the islands and reef structures.

Table 5. Assessment of anthropogenic impacts for Site 1.2 (Croisilles Harbour Entrance).

Original area of significant site (ha)	368
Recommended area of site (ha)	492
Change to original site	Increase
Change (ha)	124
Percentage change from original (%)	33.7
Human Use	High (recreational dredging frequent event during scallop season).
Vulnerability	Low ? (dredging has occurred historically, it is probable the benthos has been modified). The impact of dredging on lancelets is unknown.
Impact observed	No dredge tracks noted during survey

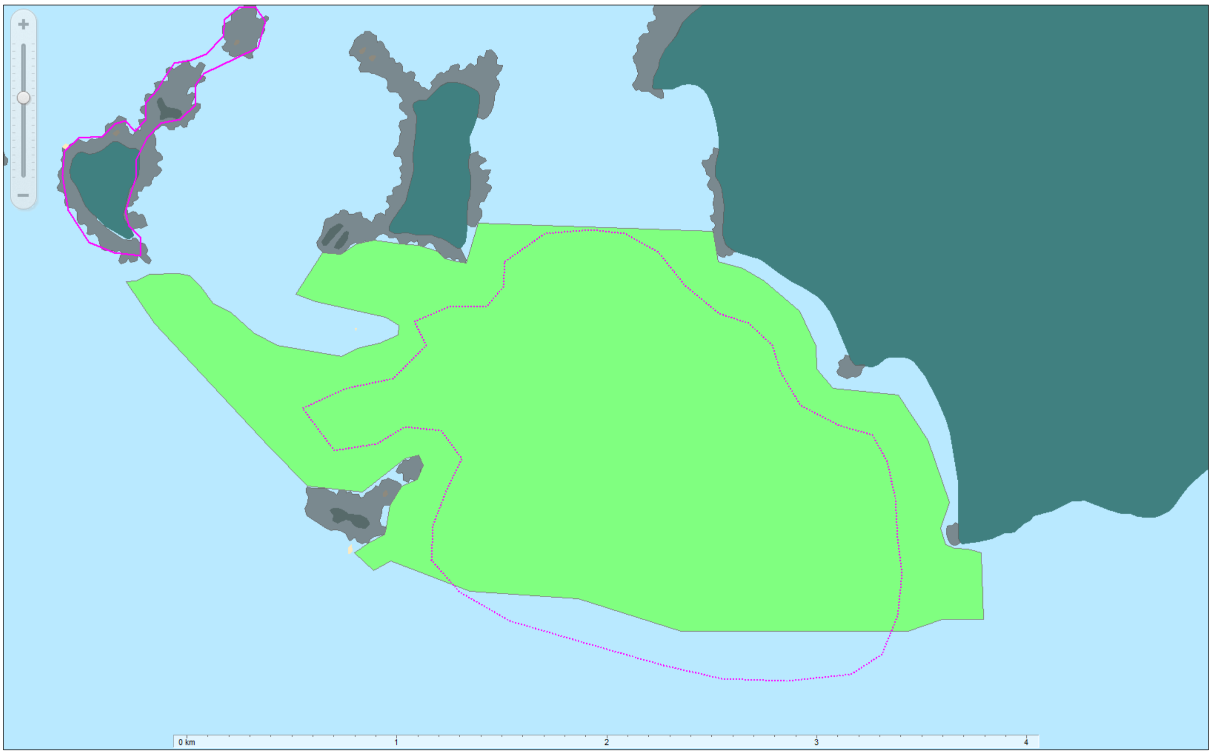

Figure 2. Original site 1.2 described by Davidson *et al.* (2011) (red line)and the suggested revised boundary (green).

4.3.2 Site 1.4 Motuanauru Island Boulder Bank

The Motuanauru Island Boulder Bank is an intertidal and subtidal structure comprising a bank of boulders and cobbles that extends south-east from the southern tip of Motuanauru Island (Plate 3). The structure consists of round boulder and cobble material (Plate 4). It was regarded as the largest subtidal boulder bank structure in the Marlborough Sounds by Davidson & Duffy (1992)

Plate 3. Motuanauru Island Boulder Bank site.

During the present survey, the location and extent of the structure was surveyed using sonar and drop camera imagery. As a result, the structure was more accurately mapped and found to be 1.4 km long and approximately 250m wide (Figure 3).

The size of the significant site reduced between Davidson *et al.* (2011) and the present survey. This decrease was due to improved survey methodology and equipment, combined with the removal of soft substratum habitat. It is recommended that the boundaries of the significant area be adjusted accordingly. It is also recommended that the soft substratum that surrounds the boulder bank be included as part of Site 1.2 (i.e. Croisilles Harbour Entrance).

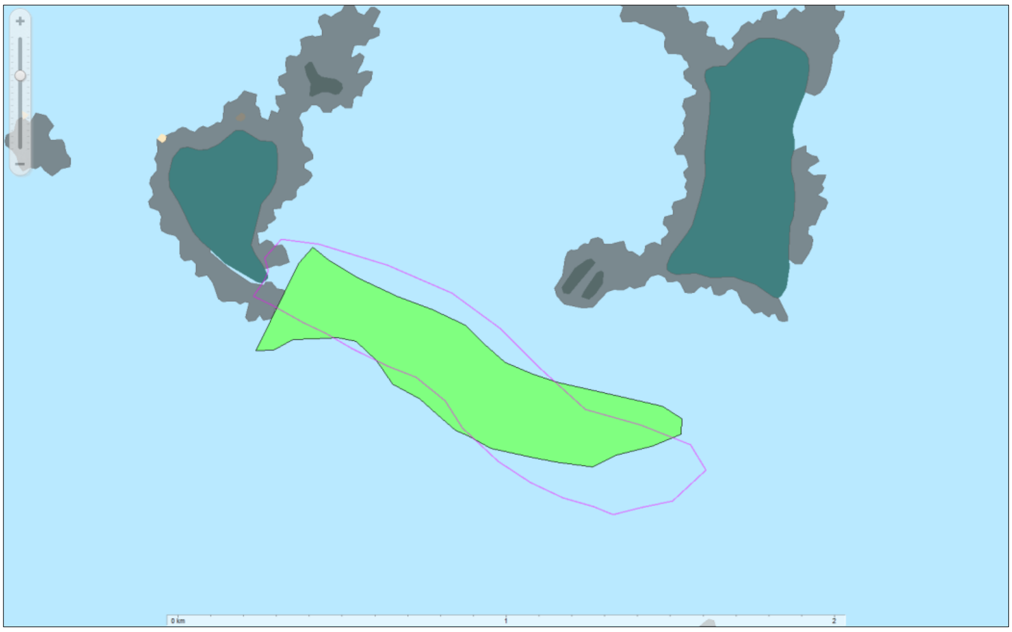

Figure 3. Original Site 1.4 described in Davidson *et al*. (2011) (red line) and the suggested revised boundary (green).

Plate 4. Boulder sized substratum covered with anemones (*Actinothoe albocincta*).

The boulder bank is composed of rocky substrata that protects it from dredging and trawling activities (Table 6). The area is very shallow and few recreational fishers appear to anchor in this area. Overall the boulder bank appears resilient to anthropogenic effects.

Table 6. Assessment of anthropogenic impacts for Site 1.4 (Motuanauru Is. Boulder Bank).

Original area of significant site (ha)	39
Recommended area of site (ha)	29.3
Change to original site	Decrease
Change (ha)	9.74
Percentage change from original (%)	-24.9
Human Use	Low (occasional recreational fishing and diving).
Vulnerability	Low (rocky structure is avoided for dredging)
Impact observed	None

4.3.3 Site 1.5 (A,B,C) Coppermine Ponganui Bays

Coppermine and Ponganui Bays are located along the southern coastline of D'Urville Island in Current Basin (2.9 km west of French Pass) (Plate 5). Duffy *et al.*, (in prep.) first described the presence of rhodoliths in this area. Davidson *et al.* (2011) undertook a brief investigation to confirm their presence and estimated a bed of 22 ha between 6m and 26m depth and covering up to 100 % cover over the silt and dead shell seafloor. The authors stated this was the largest known rhodolith bed in Marlborough.

Plate 5. Coppermine and Ponganui Bays with French Pass located to the left, out of shot.

During the present survey the rhodolith beds were mapped in considerably greater detail (Figure 4). The beds are dominated by an often high percentage cover of rhodoliths in three distinct areas. Site 1.5 (A = north-east) = 1.13ha; Site 1.5(B = middle) = 2.88ha; Site 1.5 (C = south-west) = 0.54ha (Table 7). The total area occupied by rhodoliths is 4.55ha compared to the original 22.33 ha originally estimated by Davidson *et al*. (2011).

It is recommended that the boundaries of site 1.5 be modified as depicted in Figure 4. Two of the three significant sub-sites have existing moorings located within the boundaries. These are traditional chain swing moorings and are known to damage seabed communities (Walker *et al*. 1989, Hastings *et al*. 1995, Herbert *et al*. 2009, Demmers *et al.* 2013). It is recommended that moorings located within two of the significant sub-sites be relocated outside the rhodolith beds.

Percentage cover of rhodoliths from each drop camera station was estimated by a trained observer (Table 8). The mean percentage cover of rhodoliths from within the boundaries of the sub-sites was 82.5 % (+/- 8.41 se). As expected, this value was higher than the mean for all stations that also included benthos with no rhodoliths.

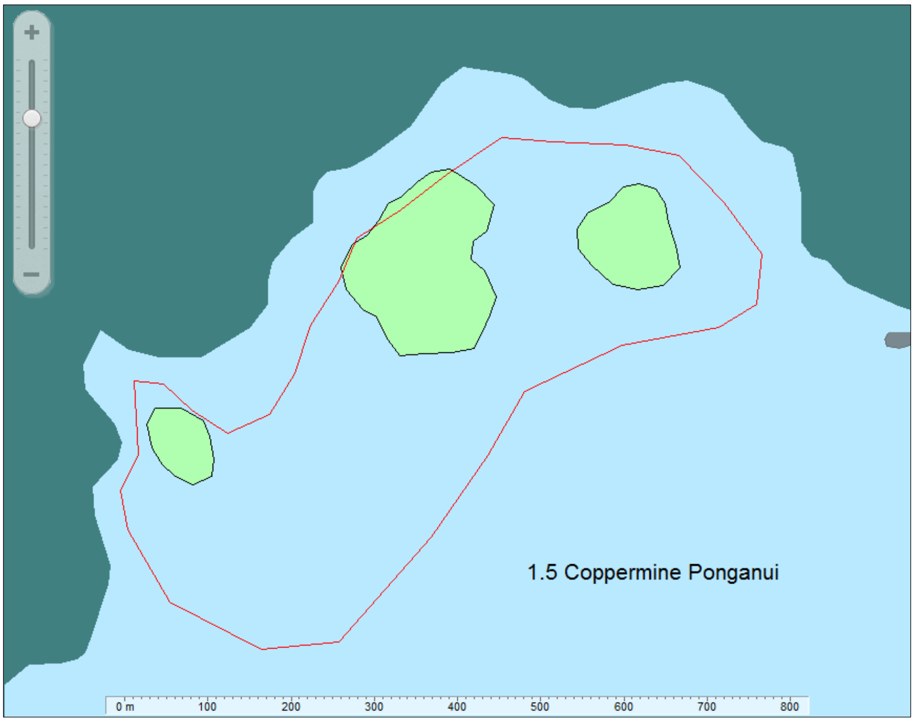

Figure 4. Original Site 1.5 described in Davidson *et al*. (2011) (red line) and the suggested revised boundary areas (green).

Table 7. Percentage cover estimates from (a) all drop camera stations and (b) stations within the Coppermine - Ponganui significant sub-sites.

Rhodoliths	All stations	Signficant site 2016
Mean % cover	16.50	82.50
CD	35.94	31.49
Number	70	14
SE	4.30	8.41

Rhodoliths are fragile and easily damaged by physical disturbance. Although no assessment of the impact of moorings was conducted it is probable rhodoliths have been damaged in the vicinity of the mooring chains (Table 8). Rocky structures in these bays discourages dredging and trawling activities. The moorings also discourage such activities.

Table 8. Assessment of anthropogenic impacts for Site 1.5 (Coppermine Ponganui Bays).

Original area of significant site (ha)	22.3
Recommended area of site (ha)	4.55
Change to original site	Decrease
Change (ha)	17.75
Percentage change from original (%)	-79.6
Human Use	Moderate (swing moorings are located within the rhodolith sites).
Vulnerability	High (rhodoliths are sensitive to smothering and physical disturbance)
Impact observed	An investigation of the mooring impacts was not conducted

Plate 6. Rhodoliths (100% cover) from Coppermine - Ponganui Bays.

4.3.4 Site 2.6 Rangitoto Passage

This current swept area is located in the passage between the Rangitoto Islands and D'Urville Island (Plate 4). Davidson & Brown (1994) stated areas of the seafloor were dominated by bryozoans, mostly Separation Point coral and lace coral. Davidson *et al*. (2011) noted that the rocky habitat located in the passage appears to have protected part of this area from the impact of commercial dredging and trawling, however, much of the deep parts of the Passage remained unknown being beyond safe diver limits.

The present survey was only able to provide partial coverage of the large Rangitoto Passage area. The survey targeted biogenic habitats first reported by Davidson & Brown (1994). Based on the present study, a biogenic community was recorded on a cobble ridge extending between Tinui and D'Urville Islands (Figure 5, Plate 8). This current-swept location was dominated by low-lying sponge, anemone, ascidian and bryozoan colonies.

Biogenic communities of variable percentage cover and composition were also recorded along the edges of the passage near the Rangitoto Islands (Figure 5, Plate 9). These communities were variable but often dominated by upright bryozoans colonised by often large sponges.

Plate 7 Looking south from north-eastern end of Wakaterepapanui Island into the Rangitoto Passage (D'Urville Island on right).

Based on preliminary data collected in the present study, it is recommended that the original site outlined in Davidson *et al.* (2011) be modified (Figure 5). Further data collection is required to complete the survey of all of the coastline of the Rangitoto Islands. It is probable that more biogenic habitats will be found along the eastern shores of the Islands. It is also recommended that the high current sites located between and at the northern end of the Rangitoto Islands become part of this large current swept site.

Commercial trawlers periodically fish the Rangitoto Passage. The frequency and location of this activity is not publically available. The biogenic communities located around the edges of the Islands and on the subtidal ridge located between Tinui and D'Urville Island are fragile and vulnerable to physical disturbance (Table 9). It is recommended that the biogenic communities be protected from physical disturbance.

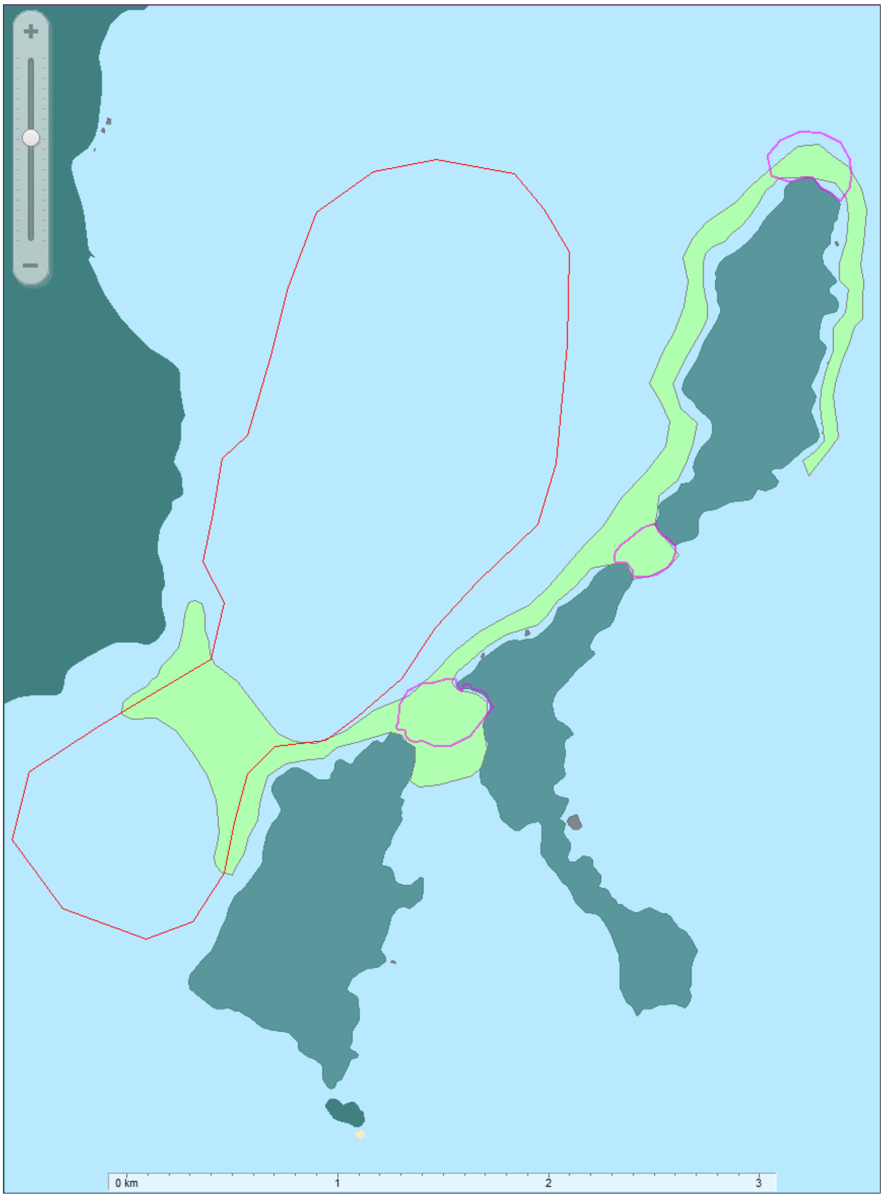

Figure 5. Original significant site 2.6 in Rangitoto Passage described by Davidson *et al.* (2011) (red line) and suggested preliminary boundary (green).

Plate 8. Biogenic community located on cobble substratum.

Plate 9. Biogenic community located on soft substratum.

Table 9. Assessment of anthropogenic impacts for Site 2.6 (Rangitoto Passage).

Original area of significant site (ha)	429.8
Recommended area of site (ha)	111.6
Change to original site	Decrease
Change (ha)	318.2
Percentage change from original (%)	-74
Human Use	Moderate (commercial trawling periodically occurs).
Vulnerability	High (biogenic communities are fragile and slow to recover from physical disturbance)
Impact observed	Commercial trawling is known to periodically occur in the area.

4.3.5 Site 2.13 (A, B, C) Catherine Cove

Rhodolith beds were first recorded along the western shoreline of Catherine Cove on D'Urville Island by Stephen Brown of NIWA (pers. comm.). Davidson *et al.,* (2011) surveyed this area and recorded three distinct beds (Figure 6, Plates 10 and 11). The present detailed survey recorded three distinct sub-sites, each separated by small distances (Figure 6). These sub-sites are characterised by dense beds of rhodoliths located in depths between 6.7m and 27m. These subsites are the only rhodolith beds described for the northern outer Sounds biogeographic area (Davidson *et al.* 2011).

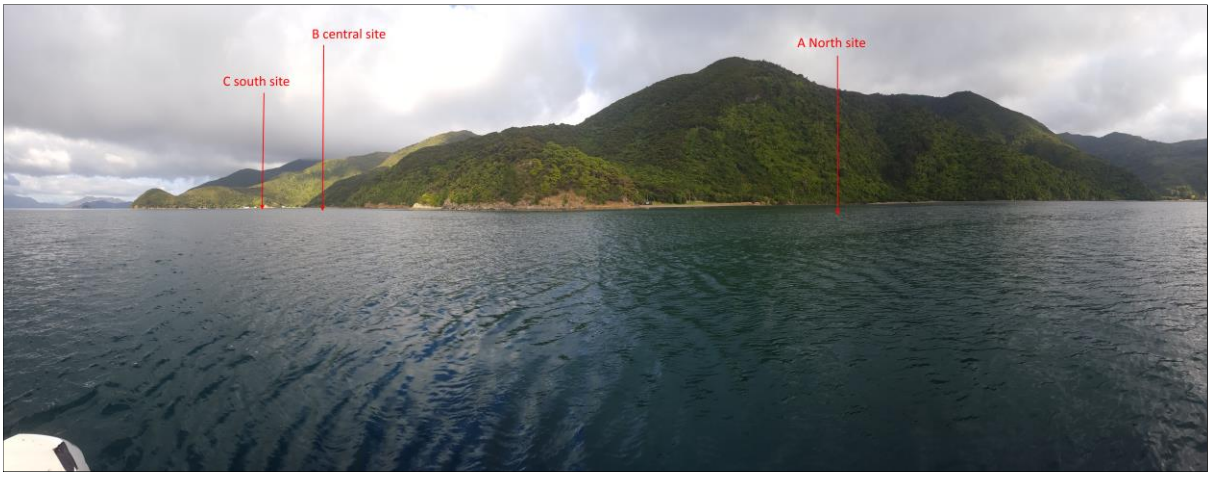

Plate 10. Location of the three sub-site rhodolith beds located along the western shore of Catherine Cove.

The present survey increased the intensity and extent of drop camera photographs resulting in improved boundary definitions for each sub-site. All three sub-sites are reduced in size due to this increased accuracy compared to the initial survey reported in Davidson *et al*. (2011) (Figure 6). It is also recommended that the boundaries of the sub-sites be adjusted as depicted in Figure 6.

A mussel farm is located between two of the sub-sites. It is probable this farm has had an impact the seafloor under the farm; however, the adjacent rhodolith beds do not appear to be affected. It is of note that mussel farm structures act as a deterrent to trawling and dredging activities.

Rhodoliths are vulnerable to physical disturbance and smothering by sediment and therefore require appropriate protection from all forms of bottom disturbance (Table 10). A number of moorings are located close to the southern sub-sites in Cherry Bay. Based on photographs collected from the rhodolith bed in this area there were no indications that these moorings adversely affected the bed. It is recommended that no new moorings be placed within the sub-sites.

Figure 6. Original Site 2.13 described in Davidson *et al.* (2011) and the suggested revised boundaries (green).

Table 10. Assessment of anthropogenic impacts for Site 2.13 (Catherine Cove Rhodoliths).

Original area of significant site (ha)	27.7
Recommended area of site (ha)	18.8
Change to original site	Decrease
Change (ha)	9.9
Percentage change from original (%)	-31.7
Human Use	Moderate (a mussel farm is located adjacent to two sub-sites; adjacent landowners transit these waters)
Vulnerability	High (rhodolith communities are fragile and vulnerable to physical disturbance and smothering)
Impact observed	None.

Plate 11. Rhodolith bed (100% cover) located in Cherry Bay, Catherine Cove.

The percentage cover of rhodoliths from each drop camera station were estimated by a trained observer (Table 11). The mean percentage cover of rhodoliths within the boundaries of the three sub-sites was 79.62 % (+/- 5.03 se). As expected, this value was higher than the mean for all stations that also included benthos outside the sub-sites with no rhodoliths.

Table 11. Percentage cover estimates from (a) all drop camera stations and (b) stations within the Catherine Cove significant sub-sites.

Rhodoliths	All stations	Significant sub-sites 2016
Mean % cover	42.53	79.62
SD	46.05	31.42
Number	73	39
SE	5.39	5.03

4.3.6 Site 2.15 Clay Point

Clay Point, the northern-most mainland point of the Marlborough Sounds, is located 13 km north-east of French Pass (Plate 12, Figure 7). It forms the eastern headland to Admiralty Bay and comprises a rocky reef with combinations of boulder and cobble material and coarse soft substrata swept by strong tidal currents.

Plate 12. Clay Point in foreground looking towards French Pass and D'Urville Island

In shallow areas of the reef, outcrops of bedrock create near vertical walls covered in rich encrusting organisms, including a wide variety of sponges, brachiopods, ascidians and jewel anemones (Duffy *et al*. in prep.). A dense bed of brown macroalgae dominated by paddle weed and flexible flapjack was recorded to 11m depth. Other species of red and brown seaweed including *Zonaria angustata* and *Asparagopsis armata* occur under the algal canopy growing on shallow bedrock. The substratum at greater depths is a mix of rock, cobbles, shell and sand (Plate 13). Davidson *et al.* (2011) stated Clay Point represented one of the best examples of a high current rocky reef in the northern Sounds biographical area. The extensive reef system covers a wide variety of depths and aspects thereby establishing a wide range of habitats.

The present survey provided a better resolution of the location of the reef resulting in a reduction in the significant site compared to that reported in Davidson *et al*. (2011) (Figure 7).

Plate 13. Deep bedrock reef at Clay Point encrusted with a variety of algae and invertebrate species.

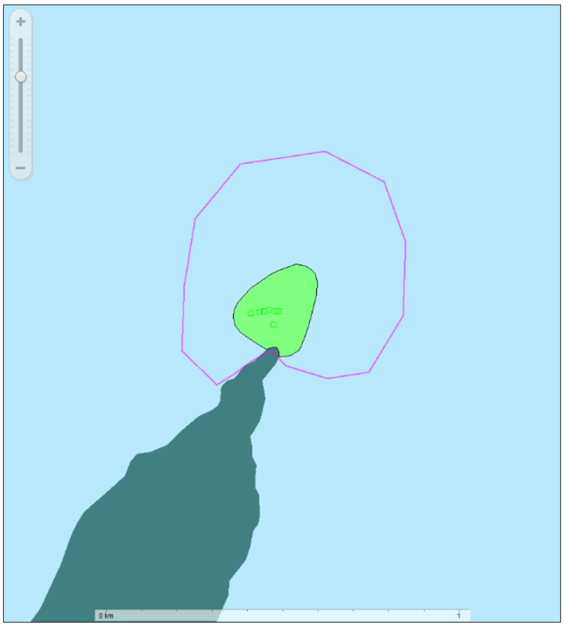

Figure 7. Original Site 2.15 described in Davidson *et al.* (2011) (red line) and the suggested revised boundary (green).

The presence of rocky substratum eliminates the chance of physical damage from dredging and trawling and its location in a current swept position in the outer Sounds means this site is unlikely to be adversely affected by sedimentation. The site is a popular site for recreational fishers that venture this far out in the Sounds. Most fishers drift fish due to the currents and depths, therefore the impact of this activity on habitats is very low compared to many other anthropogenic activities in the marine environment (Table 12).

Table 12. Assessment of anthropogenic impacts for Site 2.15 (Clay Point).

Original area of significant site (ha)	33.5
Recommended area of site (ha)	4.3
Change to original site	Decrease
Change (ha)	29.2
Percentage change from original (%)	-87.2
Human Use	Low-moderate (the site is a popular site for recreational fishers, the impact of this activity on habitats is low)
Vulnerability	Low (the rocky reef deters dredging and trawling activities. Sedimentation levels are likely to be low.
Impact observed	None.

4.3.7 Site 2.18 Paparoa

Paparoa is a rocky headland defining the western entrance to Pelorus Sound (Plate 14). This area is swept by regular and relatively strong tidal currents, particularly on the outgoing tide. Davidson and Brown (1994) reported rock outcrops close to shore covered in biogenic habitat-forming species such as ascidians, hydroids, sponges, anemones and bryozoans.

Davidson *et al.* (2011) reported Paparoa reef was one of a limited number of reef sites swept by regular and strong tidal currents in this biogeographic area. The authors also stated the regular tidal currents allow habitat forming species such as bryozoans, sponges and hydroids to establish on the rocky and soft coarse substrata.

The present survey confirmed the reef supporting a range of biogenic habitats including sponges, anemones, bryozoans and ascidians (Plate 15). Blue cod were numerous over the reef with occasional large predatory fish such as kingfish also observed.

The survey provided improved resolution of the location of the reef resulting in a reduction in the extent of the significant site compared to Davidson *et al.* (2011) (Figure 8).

Plate 14. Paparoa located in the foreground with Pelorus Sound entrance to the left and D'Urville Island to the far right.

Plate 15. Deep reef with a high percentage cover of encrusting organisms.

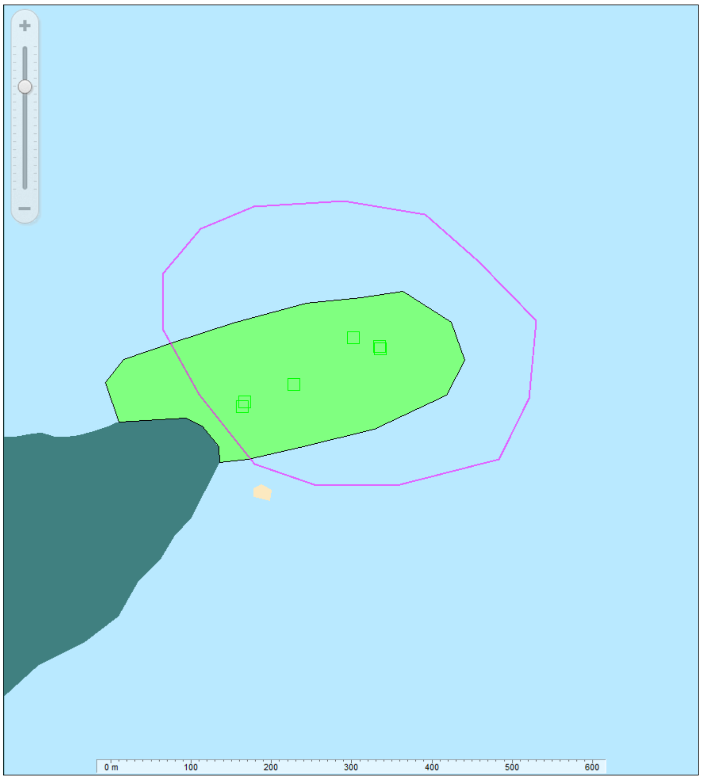

Figure 8. Original Site 2.18 described in Davidson *et al.,* (2011) (red line) and suggested revised site boundary (green).

The presence of rocky substratum at this site eliminates the chance of physical damage from dredging and trawling. Its location in a current swept position in the outer Sounds also means sedimentation is unlikely to have an adverse impact on the site's biological values.

The site is a popular site for recreational fishers; however, the impact of this activity on habitats is low compared to many other anthropogenic activities in the marine environment (Table 13). During the present survey a commercial fisher was observed checking a number of lobster pots. Lobster potting is an uncommon activity at this location (pers. obs.), however, it likely causes small and localised damage to some biogenic species.

Table 13. Assessment of anthropogenic impacts for Site 2.15 (Clay Point).

Original area of significant site (ha)	12.9
Recommended area of site (ha)	6
Change to original site	Decrease
Change (ha)	6.9
Percentage change from original (%)	-53.5
Human Use	Low-moderate (the site is a popular site for recreational fishers, the impact of this activity on habitats is likely low)
Vulnerability	Low (the rocky reef deters dredging and trawling activities. Sedimentation levels are likely to be low.
Impact observed	None.

4.3.8 Site 2.20 Chetwodes

This site was initially recognised by Duffy *et al.* (in prep.) for supporting a variety of biogenic communities on soft substratum. Davidson *et al*. (2011) described this area comprising two distinct habitats: (A) the channel located between the two main Chetwode Islands (525m wide) featuring a number of small rocky stacks swept by strong tidal currents; and (B) soft substrata (Plate 17) with occasional rocky reef habitats located between the Chetwodes Islands and a small offshore stack (The Haystack) located to the south (Plate 16).

The present study confirmed that the channel between the islands supports a combination of rocky and coarse soft substratum habitats (Plate 17). Rock supports a high percentage cover of encrusting species including anemones (*Actinothoe albocincta*), red algae, mussels and ascidians.

Plate 16. Chetwodes Islands site with The Haystack to the left of the photo and the channel between the main islands (right).

Soft substratum areas supported variable, low density biogenic communities estimated to range between 0 and 30 percent cover (Plate 18). The survey also identified occasional areas of rocky substratum particularly in the offshore southern parts of this site. This rock supported a high percentage cover of encrusting species (Plate 19). Blue cod and juvenile tarakihi were common around these reef areas.

Plate 17. Rocky and coarse substratum with rock supporting a high percentage cover of encrusted species.

Plate 18. Soft substratum with low density biogenic habitat forming species (0-30% cover).

Plate 19. Offshore rocky substratum supporting a high percentage cover of encrusting species. Blue cod and juvenile tarakihi were common around reef structures.

The present survey provided an improved level of detail compared to descriptions by Davidson *et al*. (2011). It is recommended that the site be increased in size to encompass a greater area of the soft substrata supporting low density biogenic habitats (Figure 9).

The presence of rocky substratum eliminates the chance of physical damage from dredging and trawling in the channel between the Chetwode Islands and around the offshore rocky outcrops to the south. In contrast, soft bottom areas away from rocky areas are vulnerable to bottom towed devises (Table 14). The occurrence and frequency of such activities in not publically available. The site is a popular site for recreational line fishers; however, the impact of this activity on benthic habitats is low compared to many other anthropogenic activities in the marine environment.

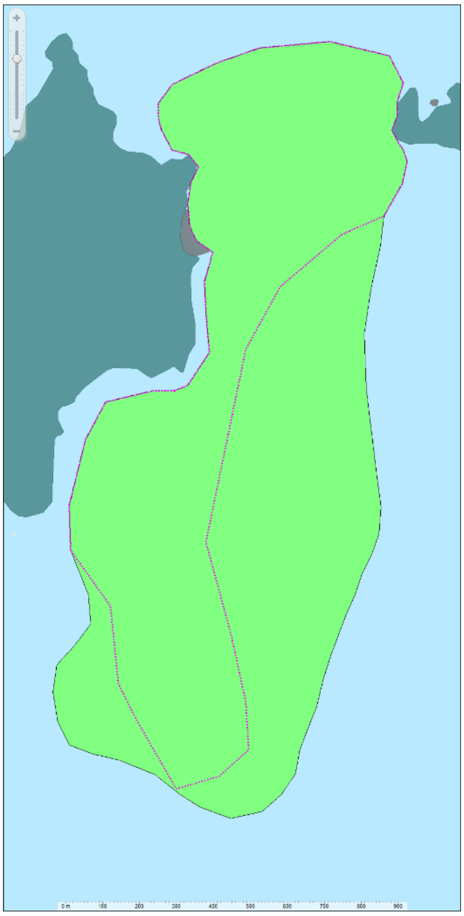

Figure 9. Original Site 2.20 described in Davidson *et. al.*, (2011) (red line) and the suggested revised boundary (green).

Table 14. Assessment of anthropogenic impacts for Site 2.20 (Chetwodes).

Original area of significant site (ha)	71.7
Recommended area of site (ha)	119.7
Change to original site	Increase
Change (ha)	48
Percentage change from original (%)	66.9
Human Use	Moderate (the area is a popular site for recreational fishers, use by commercial fishers in unknown)
Vulnerability	High (the rocky reef deters dredging and trawling activities. Soft substrata areas are vulnerable to physical disturbance).
Impact observed	None

4.3.8 Site 2.35 Hunia (Port Gore)

Hunia is a promontory located centrally in Port Gore (Figure 10). Bell (2010) stated that no king shag colony was known from Port Gore between the years 1992 to 2002. A colony established at Taratara (north-east of Pig Bay) between 2002 and 2006 and was initially used as a roosting site (Schuckard 2006). In 2006, the Taratara colony was estimated at 28 adults with 8 nests and 3 chicks (Bell 2010). Bell (2010) stated this colony was "atypical" because it was the only colony located on the mainland.

In recent years the Taratara site was abandoned in favour of the Hunia site. Davidson and Richards (2015) stated: "The Hunia king shag colony is used by approximately 30 king shags, however, no breeding has yet been reported". The authors of that report recommended that the Hunia site be recognised as a king shag colony. The site was subsequently adopted as a significant site by the peer review panel (Davidson *et al.* 2015).

Photographs of the Hunia king shag colony by Karen Marchant (pers. comm.) recorded 27 adults on 18th June 2013, 20 adults on 28 July 2013 and 26 adults on 21st May 2016. During the present survey 5 adult birds were observed on 11 February 2016 (4pm). Photos suggest that an occasional nest was present on most photo occasions.

Figure 10. Location of king shag site at Hunia, Port Gore (black dot in red circle).

Plate 20. King shag colony at Hunia (Photo Karen Marchant, 21 05 2016).

The king shag colony at Hunia is relatively remote in the Marlborough Sounds. The area is occasionally visited by recreational fishers and divers (Table 15). The colony is vulnerable to disturbance from humans that approach too close and cause birds to panic. Panic can cause chick mortalities during the breeding season due to predation from black-backed gulls (Plate 20). A guideline outlining a minimum recommended approach distance to king shag colonies is recommended.

Table 15. Assessment of anthropogenic impacts for Site 2.35 (Hunia).

Original area of significant site (ha)	0.025
Recommended area of site (ha)	0.025
Change to original site	No change
Change (ha)	0
Percentage change from original (%)	0
Human Use	Low (the area is occasional visited by fishers and divers, marine farm vessels also transit the offshore area)
Vulnerability	High (king shags are easily disturbed and this can result in chick and egg mortalities).
Impact observed	None

4.3.9 Site 1.9 Lone Rock

A new rhodolith bed was discovered during the present study on the leeward side of a rocky reef located at Lone Rock, Croisilles Harbour (Figure 11, Plate 21). The presence of a rhodolith bed in Croisilles Harbour was first mentioned in correspondence with Rob Murdoch (NIWA). The present survey located this bed, mapped its extent and outlined the percentage cover of rhodoliths for future monitoring purposes.

This rhodolith bed is one of two known from the Tasman Bay biogeographic area, the other being Site 1.5 (A, B, C) located in Coppermine - Ponganui Bays, Current Basin. This is the only rhodolith bed known from Croisilles Harbour despite the presence of other suitable areas where comparable habitat can be found.

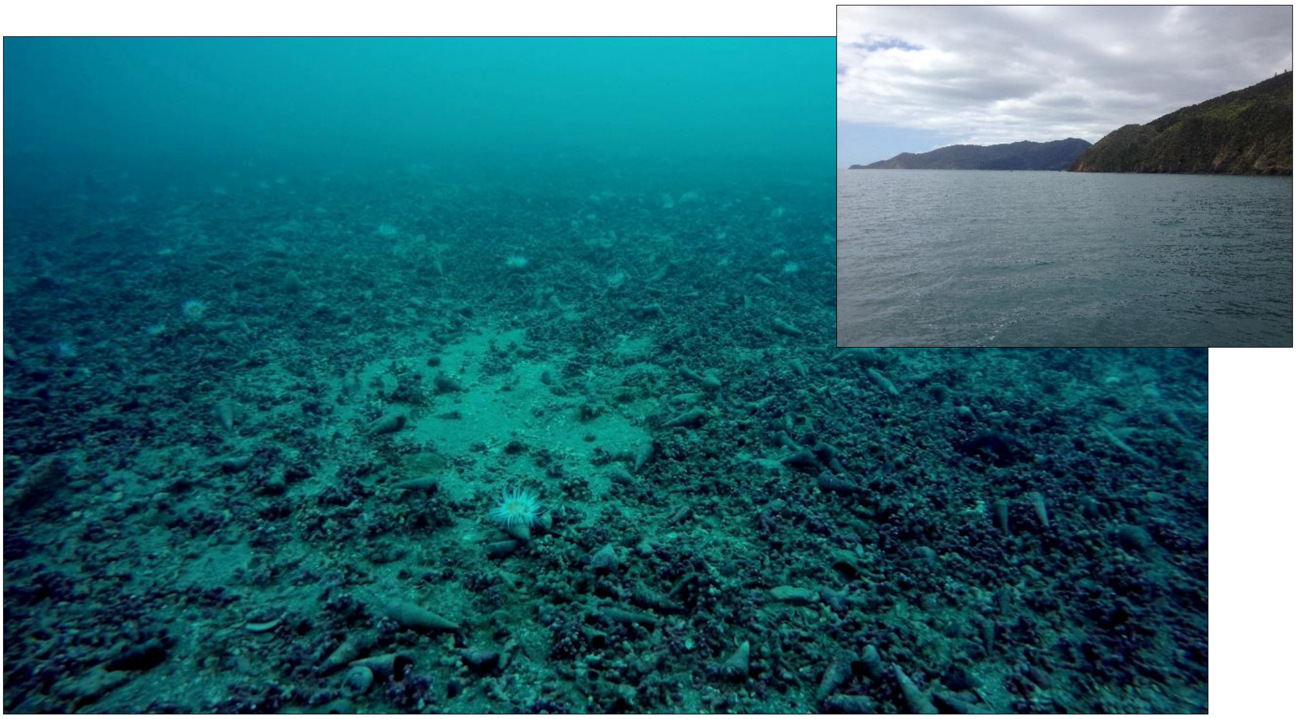

Plate 21. Lone Rock rhodolith bed located at Lone Rock, Croisilles Harbour.

No human impacts were observed from photos collected within the Lone Rock rhodolith bed (Table 16). The bed is located on the leeward side of a reef that likely provides protection from recreational dredging activities and historic commercial dredging and trawling. Occasional anchoring occurs in this area by recreational fishers. Most people, however, anchor further north near the end of the reef. It is recommended that the site be protected from all forms of physical disturbance.

Figure 11. Location of Lone Rock rhodolith bed (green polygon) located in Croisilles Harbour.

Table 16. Assessment of anthropogenic impacts for Site 1.9 (Lone Rock Rhodoliths).

Original area of significant site (ha)	NA
Recommended area of site (ha)	4.68
Change to original site	NA
Change (ha)	NA
Percentage change from original (%)	NA
Human Use	Low (recreational fishers occasionally anchor in this area)
Vulnerability	High (rhodolith communities are fragile and vulnerable physical to disturbance and smothering by sediment)
Impact observed	None

The percentage cover of rhodoliths from each drop camera station were estimated by a trained observer (Table 17). The mean percentage cover of rhodoliths from within the boundaries of the site was 81.9 % (+/- 5.03 se). As expected, this value was higher than the mean from all stations that also included the benthos outside the site with no rhodoliths.

Table 17. Percentage cover estimates from (a) all drop camera stations and (b) stations within the Lone Rock significant site.

	All photos	In Significant site
Mean % cover	29.25	81.9
SD	44.19	32.67
N	28	10
SE	8.35	10.33

4.3.10 Site 2.37 Penguin Island Channel

The Penguin Island Channel is located on the eastern site of the D'Urville Coast north of Catherine Cove Peninsula. Penguin Island (suggested Site 2.37) was initially described by Davidson *et al*. (2011) as part of a larger site (Site 2.12). This site was resurveyed during the present investigation as it supported a different range of habitats and communities compared to the original larger site (2.12).

The Penguin Island Channel site comprises the seabed located between D'Urville Island and Penguin Island (Plate 22, Figure 12). The area between Penguin Island and D'Urville Island is one of the best examples of a dense and relatively large dog cockle bed known in this biogeographic area (Plate 23 and 24). Blue cod of all sizes are common at this site (Plate 23).

Plate 22. Looking across the Channel between Penguin and D'Urville Islands. Penguin Island is in the foreground and D'Urville Peninsula on the far right.

Plate 23. Dead dog cockle shells, coarse substratum and rocky outcrops in the Channel.

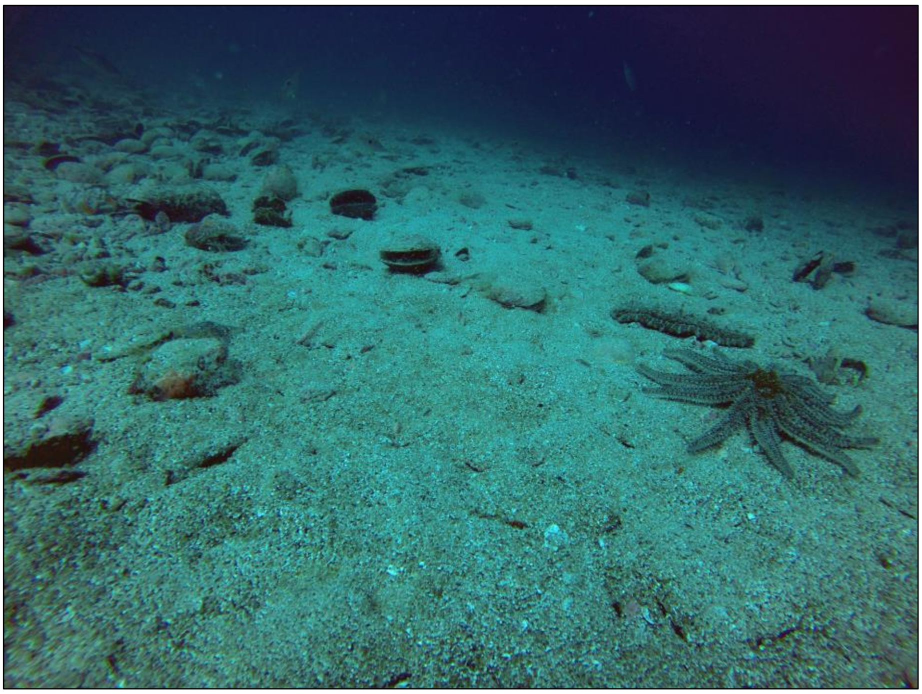

Plate 24. Dog cockle bed located in Penguin Island Channel.

The Penguin Island Channel is a combination of coarse soft substrata and outcropping bedrock habitat. The presence of rocky substrata deters activities such as dredging and trawling. Occasional anchoring by recreational fishers occurs in the area. Habitats located in the Channel are considered resilient to occasional anchoring (Table 18).

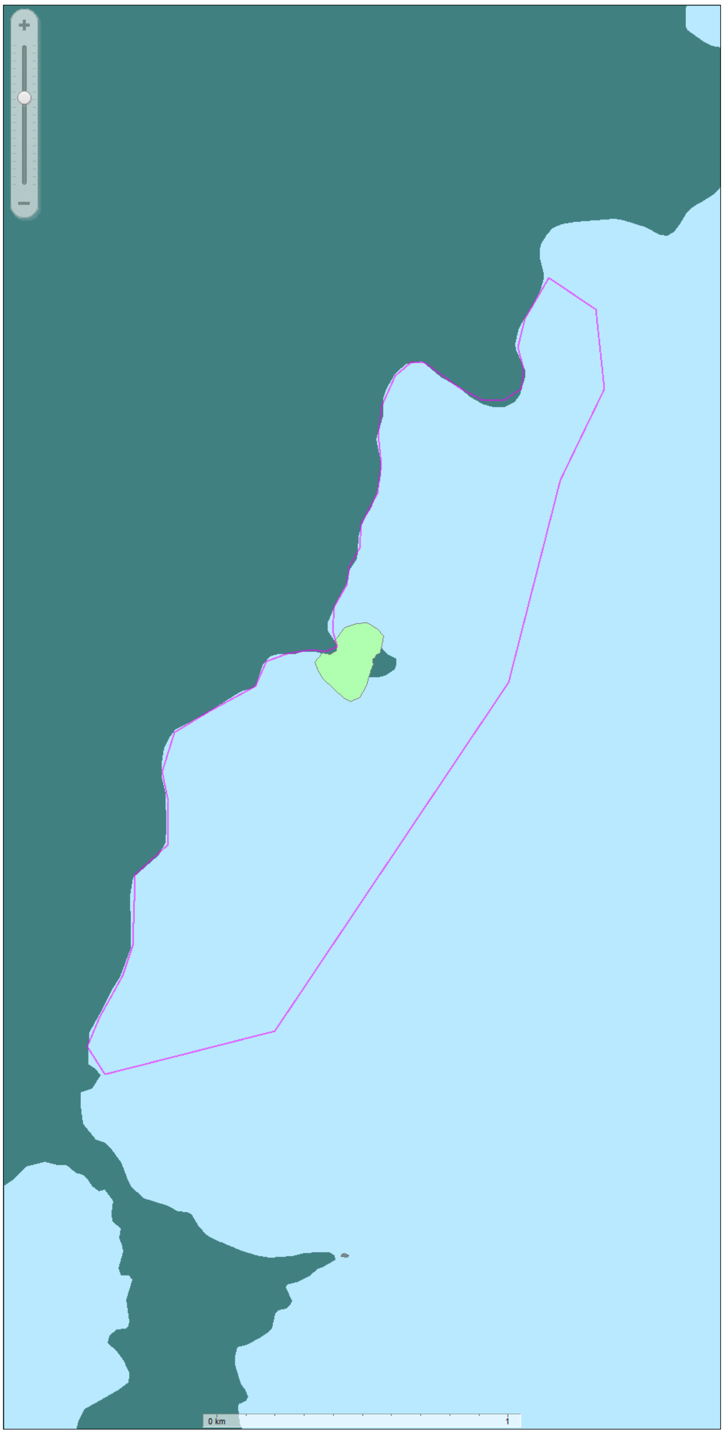

Figure 12. Original Site 2.12 described in Davidson *et al*., (2011) (red line). Location of suggested Penguin Island Channel Site 2.37 (green).

Table 18. Assessment of anthropogenic impacts for Site 2.37 (Penguin Island Channel).

Original area of significant site (ha)	180 ha (Note: part of a larger area recognised for its stable catchment).
Recommended area of site (ha)	3.8
Change to original site	NA
Change (ha)	NA
Percentage change from original (%)	NA
Human Use	Low (recreational fishers rarely anchor in the area)
Vulnerability	Low (the rocky substrata protects the area from dredging and trawling. The habitats are resilient to anchoring)
Impact observed	None.

5.0 Discussion

5.1 Change from 2011 to 2015

As noted by Davidson and Richards (2015), changes to significant marine sites and sub-sites can be due to five different reasons.

(1) Discovery
A new site that supports biological features with a medium or high ranking.

(2) Rejection
The site no longer supports biological features with a medium or high ranking.

(3) Reduction
Part of the significant site does not support biological features with a medium or high ranking.

(4) Addition
An area adjacent to or contiguous with an existing significant site supports biological features with medium or high ranking.

(5) Rehabilitation/recovery
Biological values increase to a medium or high ranking due to recovery or rehabilitation.

The reasons for change and the type of change at a significant site is based on data for that site. Good quality data enables assessment of each sites biological attributes over a temporal and spatial scale; however, because most significant sites are subtidal, knowledge of all their biological attributes will never be absolute or certain and there will always be a level of the "unknown".

Of the 15 sites and sub-sites investigated in the present study, six sites were found to be larger in size compared to that originally reported in Davidson *et al.* (2011) (total increase of 178.35ha). The increases in site size were due to improved survey methodology and better resolution and precision. As a result, new areas adjacent to these existing significant sites were often recommended to be added to the original significant site.

Eight sites and sub-sites were found to be smaller in size (total reduction of 214.64ha). The recommended reductions were also due to improved survey precision with parts of these significant sites found not supporting biological values with medium or high scores in the assessment criteria.

One new site was recorded at Lone Rock, Croisilles Harbour (4.68 ha).

Davidson and Richards (2015) recommended the removal of large areas from some significant sites and stated this was due to a loss of biological attributes described in Davidson *et al.* (2011). The authors considered that this decline was a result of physical damage primarily from trawling and dredging as well as sedimentation at one estuarine site. In the present study, reductions or additions to significant sites were due to improved survey precision with no obvious changes due to recent anthropogenic effects. Although there is no evidence of recent changes to size, extent or quality for these significant sites, it is likely that some) especially those near or over soft substrata: e.g. rhodolith beds) will be remnants of much larger and more widespread areas which historically would have occurred in and around the Marlborough Sounds (Stead 1971, Handley 2015).

5.2 Information issues (plan updates, data management)

5.2.1 Planning and Resource Consenting

The present survey is the second since Davidson *et al.* (2011). Like the first survey conducted by Davidson and Richards (2015), most surveyed sites changed in size, shape and/or attributes compared to the Davidson *et al.* (2011) report. It is certain that further changes will be detected in future surveys of significant sites. An important issue is, therefore, how to integrate these changes into the Marlborough District Council planning and Resource Consent processes.

5.2.2 Data management

Survey data from the 2015-2016 survey are summarised in the present report. Detailed data (maps, photos, video, sonar) are either produced or listed in a separate Excel spreadsheet. All media and spreadsheets have been supplied to MDC to be stored in an MDC database.

5.3 Review and assessment of sites

Following the acceptance of the present report by the MDC Environment Committee, the significant site expert peer review panel will assess the new data and review and rank sites and sub-sites. A report similar to Davidson *et al*. (2015) will be produced.

Based on data collected during the present study, each site has a recommendation to the review panel. It is important to note that these are only recommendations at this stage and may not necessarily be adopted by the expert panel (see Davidson *et al.* 2013 for process).

5.4 Protection and protection initiatives

5.4.1 Anthropogenic impacts

The largest sources of anthropogenic impacts in the marine environment come from outside the marine zone (MacDiarmid et al., 2012). Climate change, ocean acidification and catchment inputs cannot be stopped overnight and long term strategies are needed to reduce these effects.

MacDiarmid *et al.* (2012) ranked catchment effects such as the introduction of sediment as an important issue leading to serious impacts in the marine environment. The authors also ranked direct physical disturbance of the seafloor from activities such as the use of bottom towed fishing gear as an important anthropogenic effect.

5.4.2 Historic change

The amount of change that has occurred to New Zealand's marine environment since humans arrived is difficult to quantify due to a lack of before, during and after data. As a result, the scale of change has been lost over the generations as people's recollection or perception changes (i.e. generational change). Nevertheless, it is clear from certain historical accounts that large changes have occurred. For example, Handley (2016) cited a statement calling for habitat protection from physical disturbance in the Sounds as early as 1939:

> Sir Harry Twyford, in 1939 on a return visit to New Zealand after a 35 year absence, lamented "a great deterioration of sea fishing at Cable Bay and in Queen Charlotte Sound" and the "loss of bush on the country that does not look good for grazing or anything else". Sir Twyford also stated "fishermen blamed trawlers for destroying breeding grounds" and suggested an exclusion of commercial trawlers from the Sounds.

Some early scientific publications investigated resources such as commercially viable intertidal mussel beds and subtidal scallop and horse mussel beds in the Pelorus Sound (Stead 1991). Widespread benthic mussel beds in the Firth of Thames also collapsed due to dredging by 1965 (Paul 2012). Both Marlborough and Firth of Thames mussel beds have not recovered. Another indication of the effect of anthropogenic activities on the marine benthos can be derived from locations in New Zealand where biological values remain intact over widespread areas. Paterson Inlet in Stewart Island is a good example where the forest catchments are mostly intact and biological values on the soft bottom habitats of the Inlet are healthy and widespread (Smith *et al*., 2005, Willan 1982).

There is little doubt that historic human activities have had a major and widespread effect on the New Zealand (and Marlborough) marine environment resulting in the loss of many areas with high biological value (Turner *et al*. 1999, Cranfield *et al.* 2003, Morrison *et al*. 2009, NIWA 2013, Morrison *et al*. 2014 A and B, Handley 2015, 2016). Anthropogenic impacts in the marine environment have continued leading to ongoing loss leaving only remnant areas we now call significant sites. Despite the intense and widespread level of human pressure, and the knowledge that few significant sites remain, there is a poor record of marine protection in Marlborough. Davidson *et al.* (2011) reported that only one (non-terrestrial) significant site was fully protected (i.e. Long Island-Kokomohua Marine Reserve). This reserve represents approximately 0.2 % of the Marlborough Sounds marine environment. In contrast, most of the terrestrial sites listed in the Davidson *et al*. (2011) report were protected under the Reserves or Wildlife Acts (e.g. site 2.6 Titi Island).

At the time of writing the present report, no new protected areas have been established in Marlborough. While there are a variety of partial protection mechanisms, notably fisheries regulations, these focus more on fishing *per se* and do not provide comprehensive protection to vulnerable marine habitats.

5.4.3 The need for protection

Davidson and Richards (2015) reported a decline of significant sites particularly at offshore soft bottom areas in the Marlborough Sounds. For example, at Perano Shoal, the authors reported the presence of dense tubeworm mounds that are fragile and susceptible to physical damage from anchoring activities. They argued that, if left unprotected, Perano Shoal would eventually lose its status as a significant site. Many of the sites and sub-sites investigated during the present study also supported biogenic habitats that are considered fragile and easily damaged or destroyed notable those occurring on soft substrata (Plate 25).

In the present study, direct evidence of human damage to significant sites was not observed. Human activities, however, do occur near or in two cases, within these significant sites (i.e. Site 1.2 Croisilles Entrance and 1.5 Coppermine – Ponganui)). Many of the significant sites investigated during the present study are partially protected due to the presence of physical structures such as rocks or reefs (e.g. Lone Rock, Penguin Island Channel). This does not, however, provide long term certainty from damage should human activity or behaviours change.

5.4.4 Protection of habitats

In terrestrial ecology it is accepted that protection of a species cannot occur without protection of each species' habitat. In the marine environment, this link is seldom considered. For example, considerable attention has been given to blue cod stocks in the Marlborough Sounds. Most of the focus has been on recreational fishing rules such as size limits, fishing seasons and bag limits. Virtually no attention has been given to the protection of adult and juvenile blue cod habitat. Blue cod regularly inhabit soft bottom biogenic habitats with juveniles < 10 cm often preferring sand and shell habitats (Cole *et al.,* 2000). It is these habitats that are under serious threat and declining and it is strongly recommended that a programme of protection that prioritizes these types of habitats be initiated. Without such a programme, these habitats are at risk of ongoing decline.

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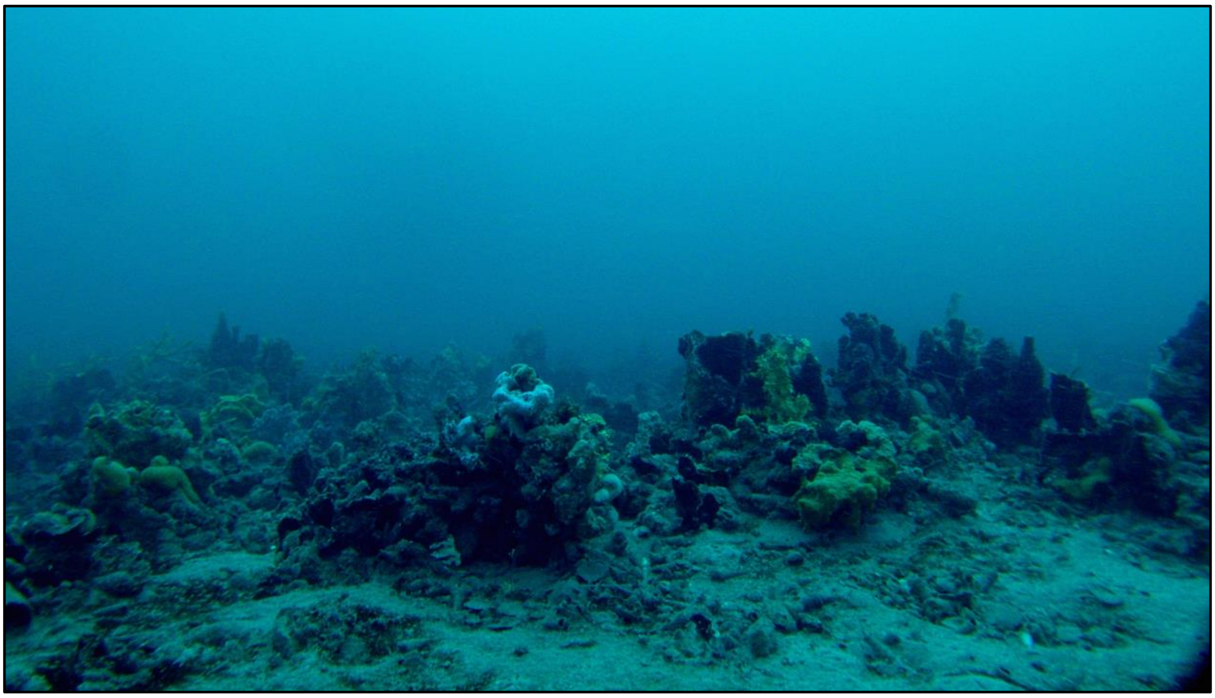

Plate 25. Biogenic community located at North-eastern Rangitoto Passage (6 April 2016).

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