Davidson Environmental Limited

Significant marine site survey and monitoring programme: Summary 2014-2015

Research, survey and monitoring report number 819

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Summary

The present report implements established protocols as part the survey and monitoring programme of selected marine significant sites in Marlborough. Field work was undertaken over 2014-2015 and focused on particular sites first identified in Davidson *et al*. (2011). Protocols for field work and data compilation were detailed in Davidson *et al. (*2013), while sites for investigation were outlined in Davidson *et al.* (2014).

A total of 21 sites and sub-sites were identified for investigation in the three study regions: (1) Queen Charlotte Sound (QCS biogeographic area), (2) Tory Channel (Tory Channel biogeographic area) and (3) Port Gore (Two Bay Point to Cape Jackson biogeographic area = D'Urville Island and outer Sounds to Cape Jackson).

A variety of qualitative and quantitative methods were adopted to investigate sites. Methods varied between sites and sub-sites depending on a variety of site specific environmental factors and information needs outlined in Davidson *et al.* (2014).

Data were collated into excel spreadsheets, however, due to the size and format of some data (e.g. video, photographs) were provided to MDC separately to be included in their database. The present report is therefore a summary of the data collected from sites and sub-sites.

Of the total 21 sites and sub-sites investigated, 12 increased in reported size (113.8ha total). The gains were due to detection of new areas supporting medium or high biological values. Increases were detected at sites supporting a component of rocky substrata and/or were located close to shore.

Nine sites and sub-sites declined in reported size. It was recommended that two sites be removed as significant sites. Site 2.32 did not support beds of horse mussels, while site 5.3 no longer represented the best example of an estuary in Tory Channel due to sedimentation from the catchment.

The remaining seven sites declined in size by 26.7% to 95.8%. At two of these sites, the reduction in area was due to an increased level of survey detail showing biological values occupied a smaller area than originally estimated. The remaining five sites showed a decline, probably due to anthropogenic effects such as trawling, dredging and sedimentation. These

sites were characterised by soft bottom substrata and most were located in offshore locations. It is therefore unlikely that all of the size reductions were due to inaccuracies in the original information.

It is recommended that 1317.8ha be removed from nine sites and sub-sites. This represented an area loss of 71.6% from the area reported in Davidson *et al*. (2011) (1840.6ha) compared to the present investigation in 2015 (522.8ha) (Table 1).

All sites and sub-sites investigated in 2015 changed in size, shape or composition. This means that significant sites will continue to change and evolve as new or more accurate information is gathered. Further some historical information used in Davidson *et al.* (2011) was based on old or outdated data or communications. It is recommended that the new MDC coastal plan therefore recognise that many significant sites will continue to change as more data is collected.

Based on data collected during the present study, each site has a recommendation for the significant site review panel. It is important to note that these recommendations may not necessarily be adopted by the expert panel and as such must remain as recommendations until such time as sites are properly ranked (see Davidson *et al.* 2013 for process). Sites should not be ranked without proper implementation of the review process.

Marlborough's significant marine sites are the remnants of much larger areas, however, based on the present investigation of 21 sites and sub-sites it is clear that these sites are being degraded or lost at an alarming rate.

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. Only one significant marine site was fully protected in 2011. No new protected sites have been established since.

During the present study, damage by human activity was directly observed at two sites. The present study shows large declines to the size of significant sites due to loss of medium and high biological values. There is an urgent need for protection of offshore soft bottom habitats.

Based on the trends found during the present study, it is probable that without a programme of protection offshore soft bottom habitats that support medium and high biological values will continue to disappear.

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

Attribute	Values
Area in 2011 (ha)	1840.6
Area in 2015 (ha) *	522.8
Potential number of new sites*	1
Potential number of lost sites*	-2
Increase in area (ha) *	113.8
Decrease in area (ha) *	-1431.6
Overall change in area (ha) *	-1317.8

*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 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 170 page 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 sites. Sites that received a medium or high score were ranked “significant”. A total of 129 significant sites were recognised and described during this 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 patchy. It is likely, therefore, that many ecologically significant marine sites remain undiscovered. In addition, some significant sites were assessed on limited information and, 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 higher in the future as more information became available. Further, they 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 would require updating on a regular basis.

Two subsequent reports have been 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 "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 is 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).

The present study implements the survey and monitoring protocols outlined in Davidson *et al.* (2013, 2014). Field work 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. It was agreed that the present work should focus on biogenic habitats because of their biological importance (e.g. substratum stabilisation, increase biodiversity, juvenile habitats, food sources) and the fact that these habitats have often been reduced due to a variety of anthropogenic activities.

2.0 Study sites

A total of 21 sites and sub-sites were identified as priority sites for investigation located in the three study regions: (1) Queen Charlotte Sound (QCS biogeographic area), (2) Tory Channel (Tory Channel biogeographic area) and (3) Port Gore (Two Bay Point to Cape Jackson biogeographic area = D'Urville Island and outer Sounds to Cape Jackson) (Table 3).

3.0 Methods

A variety of standard biological methods were adopted to investigate sites. Not all survey methods were used at each site. Methods were selected depending on environmental constraints such as depth, current and size of the site, as well as the type of data required (e.g. qualitative versus quantitative).

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 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 Sea Viewer underwater splash camera fixed to an aluminium frame was lowered to the benthos and an oblique still photograph was collected 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 while the benthos was observed on the remote monitor.

3.3 Video and hand held still photography

Underwater video was collected using two methods. On occasion, the drop camera was used to collect low definition video. On these occasions, the survey vessel was allowed to drift over parts of the survey area and video collected by positioning the camera close to the bottom. The start and end GPS positions were recorded. High definition video footage was collected on occasion by divers. An Olympus EPL2 camera in a PT EP03 housing fitted with a Sea and Sea YS-01 TTL strobe was used by divers to collect hand held video and still footage.

3.4 East Bay diver collected quadrats

Divers undertook benthic surveys at 5 sites in East Bay. At each site, a 150 m lead-lined transect was deployed from the survey vessel using GPS positioning. Each transect was deployed in a straight line perpendicular to the shore. Before its release, the line was dragged a short distance to ensure any loose line was straightened. The transect line was marked with plastic labels positioned at 5m intervals along its length. Each end of the transect line was marked using a small float extending to the surface.

Three methods were used to sample a variety of benthic features or species.

(1) Stratified: 1m^2 quadrats: One stratified quadrat was positioned at 10m intervals along each transect (n=15). Divers estimated percentage cover of mussel shell debris and the number of two species of lampshell.

(2) Random stratified 1m^2 quadrats: Three random stratified quadrats were sampled within seven predetermined 10m intervals along each transect (i.e. 140-130 m, 120-110 m, 100-90 m, 80-70 m, 60-50 m, 40-30 m, 20-10 m). A total of 21 random stratified quadrats were sampled along each transect. Divers were instructed to swim between 2 and 8 kicks in a haphazard direction within each sampling zone. At the end of these kicks, the quadrat was deployed onto the benthos with divers being careful not to look when quadrats were deployed. Once a quadrat was sampled, the process was repeated until three quadrats had been collected within each sample zone. Divers estimated percentage cover of mussel shell debris, two species of lampshell and a range of conspicuous invertebrates.

(3) Stratified 10m^2 quadrats: Large stratified quadrats consisted of 10m long by 1m wide quadrats sampled using a 1m^2 quadrat deployed contiguously, parallel and within 3m of each side of the transect line. Divers recorded the abundance of nine pre-selected conspicuous macroinvertebrates.

Density of brachiopods (lampshells)

Divers counted the number of live giant lampshell (*Neothyris lenticularis*) and common lampshell (*Terebratella sanguinea*) from 1m^2 quadrats using stratified and random stratified methods.

Conspicuous macroinvertebrates

Divers recorded the abundance of nine conspicuous surface dwelling macroinvertebrate species from large stratified quadrats (10m long by 1m wide) and 1 m^2 random stratified quadrats (Table 2). Occasionally, other rare or uncommon invertebrates were observed but these were not sampled. Some species were very small and could not be reliably sampled visually by divers.

Table 2. List of conspicuous species sampled from diver quadrats in East Bay.

Common name	**Species**
Scallop	*Pecten novaezelandiae*
Horse mussel	*Atrina zelandica*
11 arm seastar	*Coscinasterias muricata*
Kina	*Evechinus chloroticus*
Cushion seastar	*Patiriella regularis*
Sea cucumber	*Stichopus mollis*
Snake star	*Ophiopsammus maculata*
Pink urchin	*Pseudechinus albocinctus*
Brooch seastar	*Pentagonaster pulchellus*
Burrowing anemone	*Cerianthus* sp.

3.5 Perano Shoal and Bobs Bay quadrats

Divers haphazardly deployed 1m^2 quadrats within predetermined strata at Perano Shoal and Bobs Bay. Divers recorded percentage cover of tubeworms and percentage cover of damaged tubeworms or mounds. At Perano Shoal, a still photograph of each quadrat was also collected.

3.6 Core sampling

Core samples at Hitaua Bay estuary were haphazardly collected within sampling strata using a 13cm diameter by 15cm deep hand held corer. Cores were washed through a 4mm sieve and cockles in each core were measured (maximum width) and counted.

3.7 Site forms and data

Data collected for sites were compiled into standard Excel site forms. Data sheets comprise a summary page and a number of other pages comprising data, maps, photos and sample coordinates. A complete set of data for each site is stored on the MDC database.

3.8 Ranking

No ranking of sites was carried out during the present investigation. However, recommendations for each site are included in page 1 of the Excel site sheets. It is expected that the expert review panel will conduct a ranking exercise for sites at strategic intervals (Davidson *et al.* 2013).

Plate 1. Erosion and associated sediment runoff from a recently logged site in Pelorus Sound. Source: (MDC)

Table 3. Sites surveyed with known original data applied in Davidson *et al.* (2011).

Site	Location	Biological values	Level of information
Site 2.31 Port Gore (outer)	Port Gore	Bryozoans	Personal communication
Site 2.32 Port Gore (central)	Port Gore	Horse mussels	Personal communication
Site 2.33 Port Gore (inner)	Port Gore	Horse mussels, red algae, tubeworms	Quantitative report
Site 4.11 Bobs Bay	Picton Harbour, QCS	Tubeworm colony	Brief visit
Site 4.16 Perano Shoal	Blackwood Bay, QCS	Tubeworm mounds	Qualitative report
Site 4.19 Ship Cove	Ship Cove, Cannibal Cove, Little Waikawa Bay, QCS	Low impacted, intact catchment	Brief visit
Site 4.22 Puriri Bay	East Bay, QCS	Red algae	Quantitative report
Site 4.23 Matiere Point	East Bay, QCS	Burrowing anemone, giant lampshell	Qualitative report
Site 5.3 Hitaua Bay head	Tory Channel	Estuarine habitats	Quantitative report
Site 5.4 Tory Channel north-west	Tory Channel	Bryozoans, sponges, ascidians	Brief visit
Site 5.8 Tory Channel north-east	Tory Channel	Hydroids, sponges	Brief visit
Site 7.4 Motuara subtidal	Outer QCS	Horse mussels, macroalgae	Personal communication

4.0 Results

4.1 Sites investigated

A total of 12 existing significant sites were identified for investigation in the 2014-2015 season. Significant site 5.4 consisted of four sub-sites, while site 5.8 consisted of 7 sub-sites. A total of 21 sites and sub-sites were therefore investigated during the present study.

4.2 Summary of change

Of the 21 sites and sub-sites investigated, one site was split into four new sites (Sites 5.3A, 5.3B, 5.4C, 5.5D). Site 5.8 originally comprised of 7 sub-sites was adjusted to make 6 sub-sites, all located along the north-east coast of Tory Channel. Each of the sub-sites associated with site 5.8 supported comparable communities and it is probable, as more information is collected, some or all of these sites will join into a contiguous site. One new site was also described in Port Gore (i.e. Hunia king shag colony).

Of the total 21 sites and sub-sites investigated, 12 increased in reported size comprising a total gain of 113.8ha. Hunia king shag site was included in this increase as it was previously not recorded (an increase from 0 to 0.025ha). The other five sites increased from sizes reported in Davidson *et al.* (2011) largely due to more areas supporting medium to high biological values being found (Table 4). Largest gains in area occurred along the northern coast of Tory Channel.

Nine sites and sub-sites declined in area (Table 4). It is recommended that two sites be removed as significant sites (Site 2.32 Port Gore central, Site 5.3 Hitaua Bay Estuary). Site 2.32 no longer supported beds of horse mussels, while site 5.3 had been impacted by high levels of sedimentation from the catchment compared to 2003 samples (Davidson and Richards 2003).

The remaining seven sites declined in size by 26.7% to 95.8% (Table 4). At two of these sites, the reduction in area was due to an increased level of detail in the survey showing the biological values occupied a smaller area than first estimated (site 4.11 Bobs Bay and site 4.23 Matiere Point)(Table 3). Five sites showed a decline in value, probably due to human related activities such as trawling, dredging and sedimentation. These sites were initially identified based on observations by scientists and commercial fishers. Unfortunately limited historic data exists on the quality of these habitats and the associated biological values. The present survey shows that significant biological values no longer exist resulting in the reduction in their size. However, it should be noted that the largest reductions occurred in areas offshore sites in Port Gore and north of Motuara Island were data were relatively old (1980's) and were never been produced in a report. The original quality and distribution of the biological values at these sites was therefore poorly known.

Overall, a total of 1317.8 ha were recommended to be removed from nine sites and sub-sites (Table 3). This represented an overall reduction of 71.6% between values reported in Davidson *et al.* (2011) (1840.6ha) and the present study in 2015 (522.8ha).

4.3 Substratum versus change

All of the sites exhibiting a loss in area supporting medium or high biological values were dominated by flat soft substrata (Table 3). Further, most of these sites were located in offshore positions. Sites where additional new areas supporting medium or high biological values were found were all characterised as having a component of rocky substrata and were often close to shore.

Anchor damage at a rhodolith bed.

Table 4. Summary of sites and sub-sites surveyed in 2015 including recommended changes and reasons.

Site	Sites and subsites 2011	Sites and subsites 2015	Original area (ha)	Recommended area (ha)	Change (ha)	Change %	Benthos type	Reason for change
Site 2.31 Port Gore (outer)	1	1	314.6	157.8	156.8	-49.8	Soft	Reduced area with biological values
Site 2.32 Port Gore (central)	1	0	635.6	0	635.6	-100.0	Soft	No remaining medium of high biological values
Site 2.33 Port Gore (inner)	1	1	17.52	12.85	4.67	-26.7	Soft	Reduced area with biological values
Hunia king shag site, Port Gore		1	0	0.025	0.025	100.0	Terrestrial rock	New site described
Site 4.11 Bobs Bay	1	1	2.9	0.363	2.537	-87.5	Soft	Survey defined smaller area than first thought
Site 4.16 Perano Shoal	1	1	3.775	5.463	1.688	44.7	Rock/soft	New area discovered with medium or high values
Site 4.19 Ship Cove	1	1	437.7	121.8	315.9	-72.2	Soft	Reduced area with biological values
Site 4.22 Puriri Bay	1	1	14.3	5.54	8.76	-61.3	Soft	Reduced area with biological values
Site 4.23 Matiere Point	1	1	28.5	10.95	17.55	61.6	Soft	Survey defined smaller area than first thought
Site 5.3 Hitaua Bay head	1	0	1.86	0	1.86	-100.0	Cobble/soft	Reduction in biological values due to sedimentation
Site 5.4A Ruaomoko Coast	1	1	44	64.95	20.95	47.6	Rock, coarse soft	New area discovered with medium or high values
Site 5.4B Wiriwaka Point	1	1	11	16.3	5.3	48.2	Rock, coarse soft	New area discovered with medium or high values
Site 5.4C Tokakaroro Point	1	1	4.197	7.4	3.203	76.3	Rock, coarse soft	New area discovered with medium or high values
Site 5.4D Te Uira-Karapa Point	1	1	9.768	16.34	6.572	67.3	Rock, coarse soft	New area discovered with medium or high values
Site 5.8 Tory Channel north-east	7	6	14.3	90.35	76.05	531.8	Rock, coarse soft	New area discovered with medium or high values
Site 7.4 Motuara subtidal	1	1	300.6	12.7	287.9	-95.8	Soft	Reduced area with biological values
Totals	**21**	**19**	**1840.62**	**522.831**	**-1317.789**	**-71.6**		
Increase to significant sites					113.788			
Decrease to significant sites					1431.577			

New sites =

4.2.1 Recommended new sites

Hunia king shag site, Port Gore (new site)

The Hunia coast stretches around a promontory located Port Gore (Figure 1). The Hunia king shag colony is on the eastern side of the promontory north of Hunia (Plate 2). It is used by approximately 30 king shags, however, no breeding has yet been reported. A previous site in Port Gore (Taratara) was also utilised by approximately 28 birds (Bell 2010). This latter site appears to have been abandoned in favour of the Hunia site. Limited breeding was recorded at Taratara in 2006 (Bell 2006). It is recommended that the Hunia site be recognised as a king shag colony, however, it is noted that birds may abandon this site in the future.

Original area of significant site (ha)	0
Recommended area of significant site (ha)	0.025
Change to original site	Increase
Change (ha)	0.025
Percentage change from original area (%)	100
Human Use	Low
Vulnerability	High
Impact observed	No

Figure 1. Hunia king shag site, Port Gore (red circle). Plate 2. King shags at Hunia, January 2015

4.2.2 Recommended site size increases

Site 4.16 Perano Shoal

Perano Shoal is an offshore bank located in the entrance to Blackwood Bay and adjacent to the smaller Tauranga Bay, 10.7km north-east of Picton by sea (Plate 3). The top of the shoal is between 5m and 7m depth and is predominantly exposed bedrock. Below and surrounding the bedrock outcrop are areas of shell and fine sand, swept by low-moderate tidal currents.

Plate 3. Blackwood Bay from QCS track. Red arrow approximate location of Perano Shoal.

Perano Shoal supports a high density bed of tubeworms dominated by *Galeolaria hystrix, Spirobranchus latiscapus* and an unidentified *Serpula* sp. (Plate 4). The mean percentage coverage recorded from quadrats was 76.67%. Anchor drag marks were observed running off the high point of the Shoal into deeper waters. From diver quadrats, 13.6% of the substratum sampled was damaged by anchoring activities. Perano Shoal is the only known locality for a living example of *Protulophila,* a putative hydroid previously known only from Europe and the Middle East, Jurassic to Pliocene (Dennis Gordon pers. comm.).

Based on new data collected during the present investigation (sonar and drop camera), the extent of the shoal and tubeworm mounds is larger than was recognised by Davidson *et al.* (2011). The tubeworm bed is the largest known bed in Marlborough and supports a species of considerable scientific interest (i.e. *Protulophila*).

It is recommended that the significant area be enlarged to encompass the whole tubeworm bed. Damage from anchoring has been documented. Based on the site's high level of importance, it is also recommended that a no-anchoring zone be established around the Shoal (Figure 2).

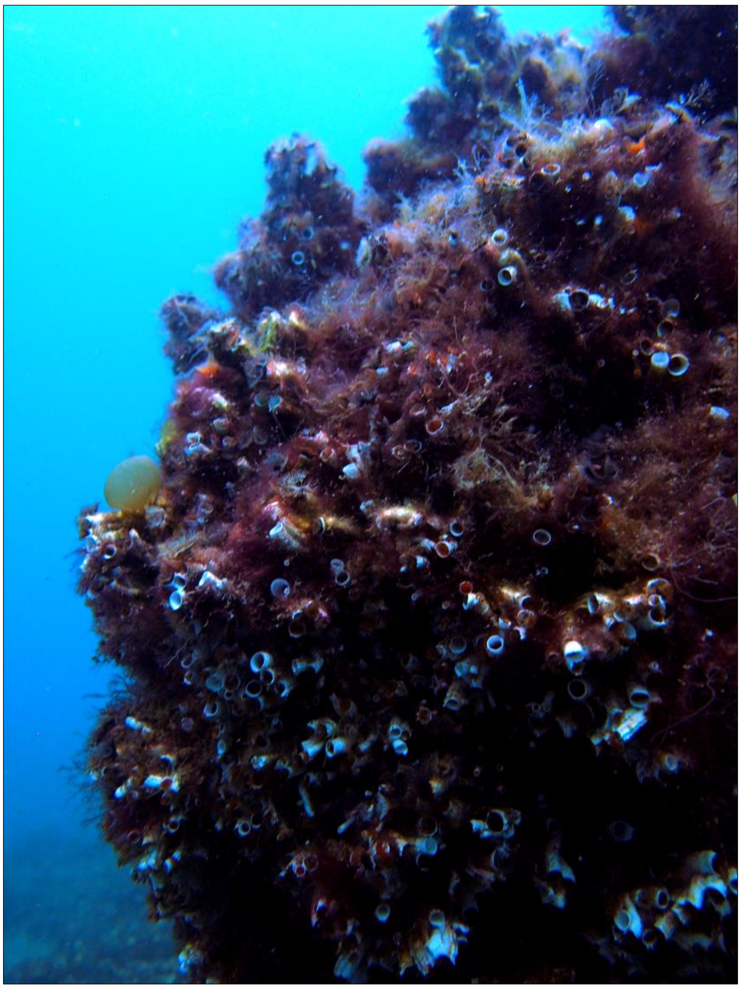

Plate 4. Tubeworm clump at Perano Shoal.

Original area of significant site (ha)	3.775
Recommended area of significant site (ha)	5.463
Change to original site	Increase
Change (ha)	1.688
Percentage change from original area (%)	44.7
Human Use	High
Vulnerability	Very high
Impact observed	Yes

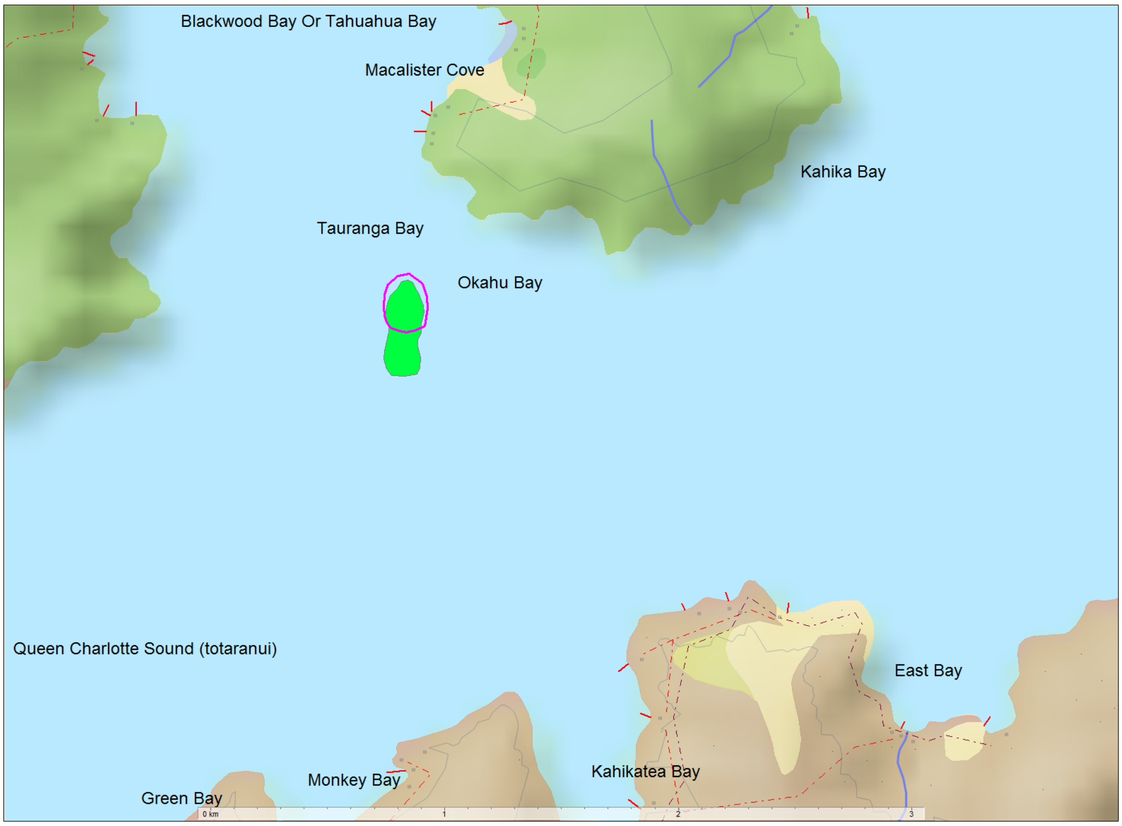

Figure 2. Site 4.16 Perano Shoal (QCS) original area (pink circle) and suggested increased area (green).

Site 5.4A Ruaomoko Coast

This site is located along the northern coast at the western end of Tory Channel (Figure 3, Plate 5). This site is swept by moderate to strong tidal currents. The predominantly rocky and coarse substratum habitats support a range of biogenic habitats dominated by bryozoans, sponges, ascidians and tubeworms as well as areas of red and brown macroalgae located in shallow areas (Plate 5). The present survey identified biogenic habitats further north towards Queen Charlotte Sounds than previously recorded in Davidson *et al*. (2011). Data collected by Clark *et al.* 2011 also shows biogenic habitats north and into Queen Charlotte Sound. This potentially adds another 21ha to this site.

Plate 5. Ruaomoko Coast looking west into Tory Channel (right) and QCS (left).

It is recommended that the existing site be extended to encompass the area towards Queen Charlotte Sound. It is also suggested that the inner boundary be adjusted closer to shore to encompass brown and red macroalgal areas (Figure 3).

Original area of significant site (ha)	44
Recommended area of significant site (ha)	64.95
Change to original site	Increase
Change (ha)	20.95
Percentage change from original area (%)	47.6
Human Use	High
Vulnerability	Moderate
Impact observed	No

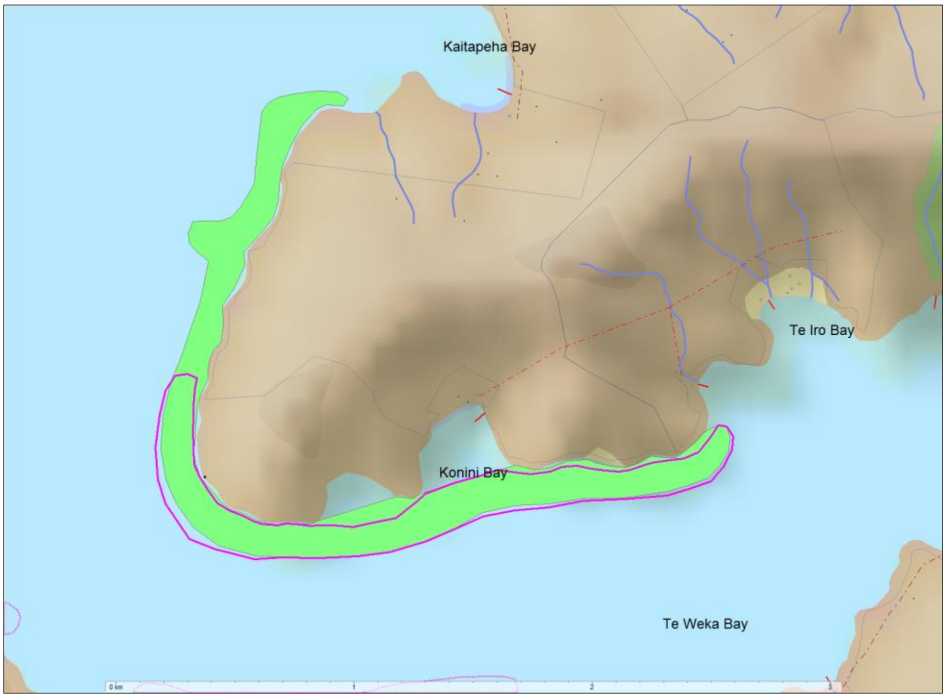

Figure 3. Site 5.4A Ruaomoko Coast (Tory Channel) original area (pink) and suggested increased area (green).

Plate 6. Biogenic clumps at sites along the north-western coast of Tory Channel

Site 5.4B Wiriwaka Point

This site is located along the northern coast of Tory Channel and is swept by moderate to strong tidal currents (Figure 4, Plate 7). The predominantly boulder, cobble and coarse substratum habitats with some areas of bedrock support a range of biogenic habitats as well as areas of red and brown macroalgae located in shallow areas. The present survey identified biogenic habitats further west than previously recorded in Davidson *et al*. (2011). This potentially adds another 5.3ha to this site.

Plate 7 Wiriwaka coast looking northward from Tory Channel.

It is recommended that the existing site be extended to encompass the area to the west. It is also suggested that the inner boundary be adjusted closer to shore to encompass brown and red macroalgal areas (Figure 4).

Original area of significant site (ha)	11
Recommended area of significant site (ha)	16.3
Change to original site	Increase
Change (ha)	5.3
Percentage change from original area (%)	48.2
Human Use	High
Vulnerability	High
Impact observed	No

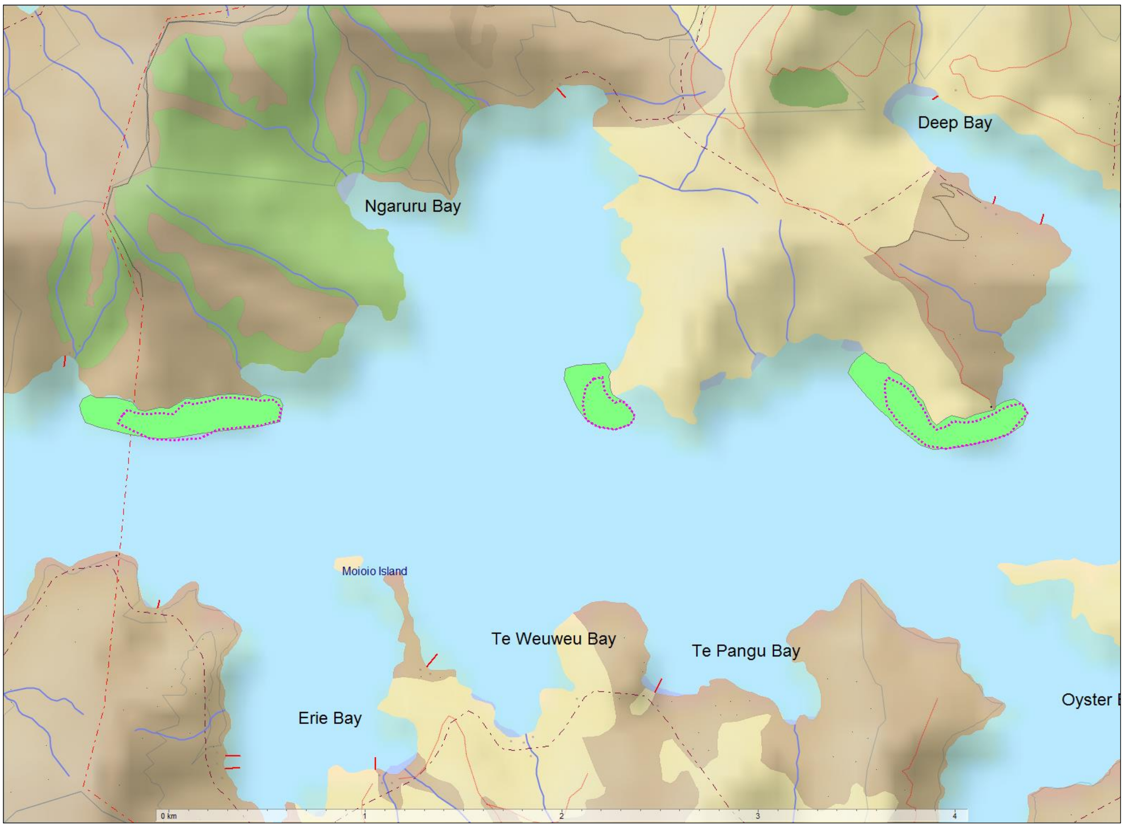

Figure 4. Site 5.4B Wiriwaka Point (left), Site 5.4C Tokakaroro Point (middle), and Site 5.4D Te Uira-Karapa Point (right); original areas (pink) and suggested increased areas (green).

Site 5.4C Tokakaroro Point

This site is located along the northern coast of Tory Channel and is swept by moderate to strong tidal currents (Figure 4, Plate 8). The predominantly cobble and coarse substratum habitats with some areas of bedrock support a range of biogenic habitats including offshore bryozoan mounds as well as areas of red and brown macroalgae located in shallow areas. The present survey identified biogenic habitats further north into Ngaruru Bay than previously recorded in Davidson *et al*. (2011).

It is recommended that the existing site be extended to encompass the area to the west. This potentially adds 3.2ha to this site. It is also suggested that the inner boundary be adjusted closer to shore to encompass brown and red algal areas (Figure 4).

Plate 8. Tokakaroro Point, Tory Channel.

Original area of significant site (ha)	4.197
Recommended area of significant site (ha)	7.4
Change to original site	Increase
Change (ha)	3.2
Percentage change from original area (%)	76.3
Human Use	High
Vulnerability	High
Impact observed	No

Site 5.4D Te Uira-Karapa Point

This site is located along the northern coast of Tory Channel and influenced by moderate to strong currents (Figure 4, Plate 9). It is a predominantly rocky substratum (bedrock, boulder, cobble) with areas of coarse substratum . The coast supports a range of biogenic habitats including offshore bryozoan mounds as well as areas of red and brown macroalgae located in shallow areas. The survey identified biogenic habitats further north-west than previously recorded in Davidson *et al*. (2011).

It is recommended the site be extended to the west. This potentially adds 6.57ha. It is also suggested that the inner boundary be adjusted close to shore to encompass brown and red algal areas (Figure 4).

Plate 9. Te Uira-Karapa Point looking west.

Original area of significant site (ha)	9.768
Recommended area of significant site (ha)	16.34
Change to original site	Increase
Change (ha)	6.57
Percentage change from original area (%)	67.3
Human Use	Moderate
Vulnerability	High
Imnpact observed	No

Site 5.8 Tory Channel north-east

This coast is located along the northern side of Tory Channel from Deep Bay to the entrance (Plate 10). This site originally comprised seven separate sub-sites with comparable habitats and communities. One new sub-site has been described and four have been amalgamated into two larger sub-sites (Figure 5). Sub-sites are swept by regular strong currents on both incoming and outgoing tides. The substrate is predominantly rocky dominated by bedrock, boulder and cobbles off points and promontories and coarse substratum at greater depth.

Plate 10. Looking eastward towards entrance to Tory Channel.

The coast supports a range of biogenic habitats including sponges and ascidians as well as dense brown and red macroalgae beds. Of note are often dense areas of hydroid trees (Plate 11). The present survey identified additional biogenic habitats adjacent to existing sites previously recorded in Davidson *et al*. (2011). This potentially adds another 76ha to these sub-sites.

It is recommended that the existing sub-sites be enlarged to encompass the new areas. It is also suggested that the inner boundary be adjusted closer to shore to encompass brown and red macroalgal areas (Figure 5). It is also suggested that more survey work be conducted to further survey and map habitats along this coast.

Original area of significant site (ha)	14.3
Recommended area of significant site (ha)	90.35
Change to original site	Increase
Change (ha)	76.05
Percentage change from original area (%)	531.8
Human Use	Moderate
Vulnerability	High
Impact observed	No

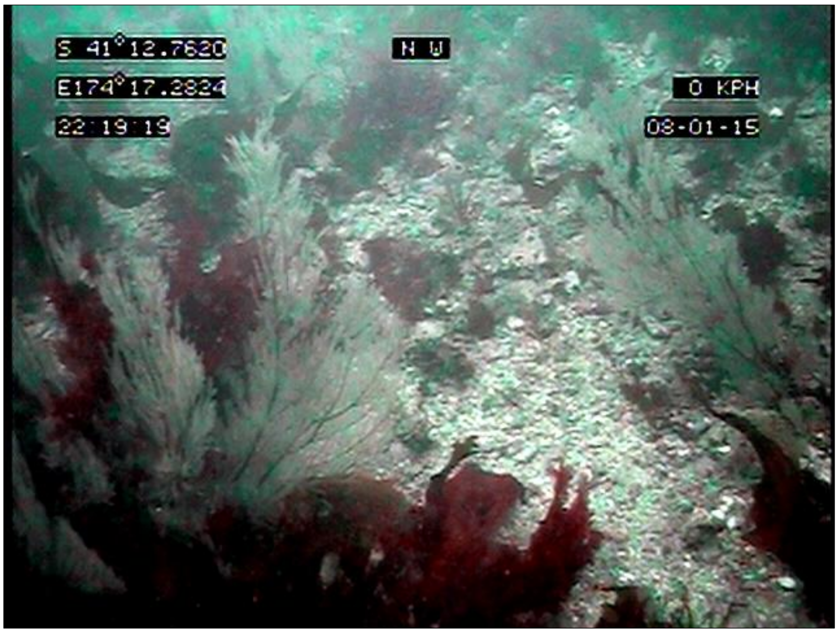

Plate 11. Hydroids and red algae on rocks.

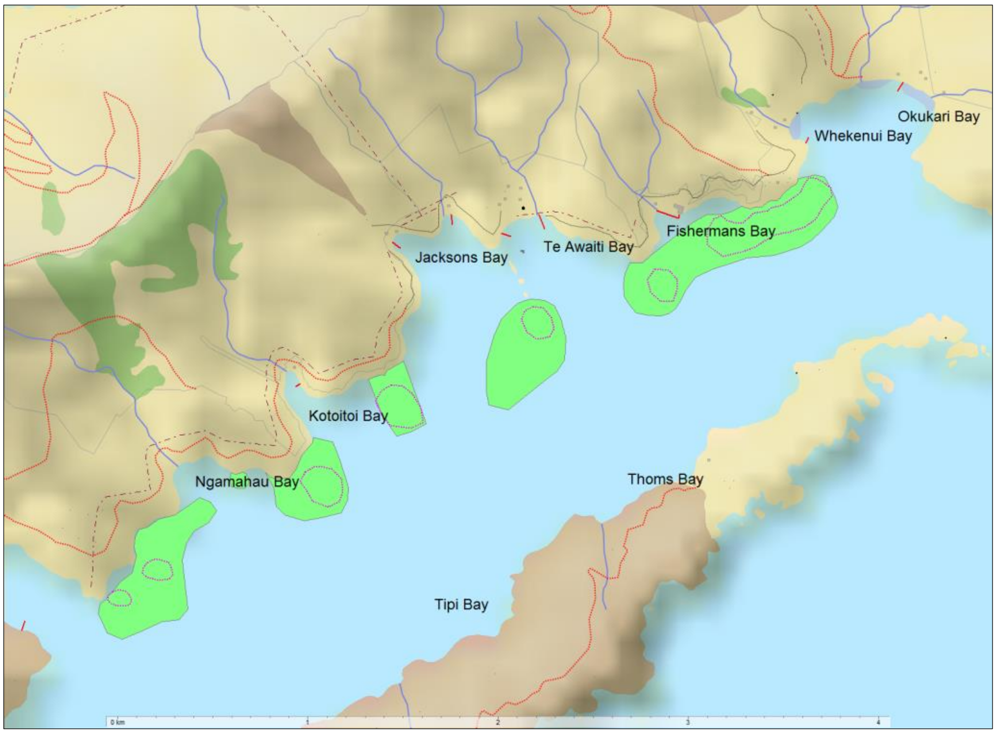

Figure 5. Sub-sites 5.8 located along the north-east coast of Tory Channel. Map shows original areas (pink) and suggested increased areas (green).

4.2.3 Recommended site size decreases

Site 2.31 Port Gore outer

This site is located in outer Port Gore between Cape Lambert and Cape Jackson (Figure 6, Plate 12). The original significant site 2.31 (Port Gore outer) was based on personal communications with commercial fishers (Davidson *et al*. 2011).

Data collected from site 2.31 in 2015 shows a remnant horse mussel bed (Plate 13); however, no bryozoans were observed (Figure 6). It is possible that fishers who described the attributes of site 2.31 confused bryozoans with the presence of a dense horse mussel bed. It is probable that the horse mussel bed has survived trawling due to its location on a sloping shore.

Plate 12. Melville Cove looking north-east into Port Gore (far left).

It is recommended that the site 2.31 boundary be adjusted to encompass the dense horse mussel bed recorded at this locality. This bed is the highest density bed known from Marlborough. It is also suggested that a no trawling and dredging zone be established over this bed.

Original area of significant site (ha)	314.6
Recommended area of significant site (ha)	157.8
Change to original site	Decrease
Change (ha)	-156.8
Percentage change from original area (%)	49.8
Human Use	Low
Vulnerability	High
Impact observed	No

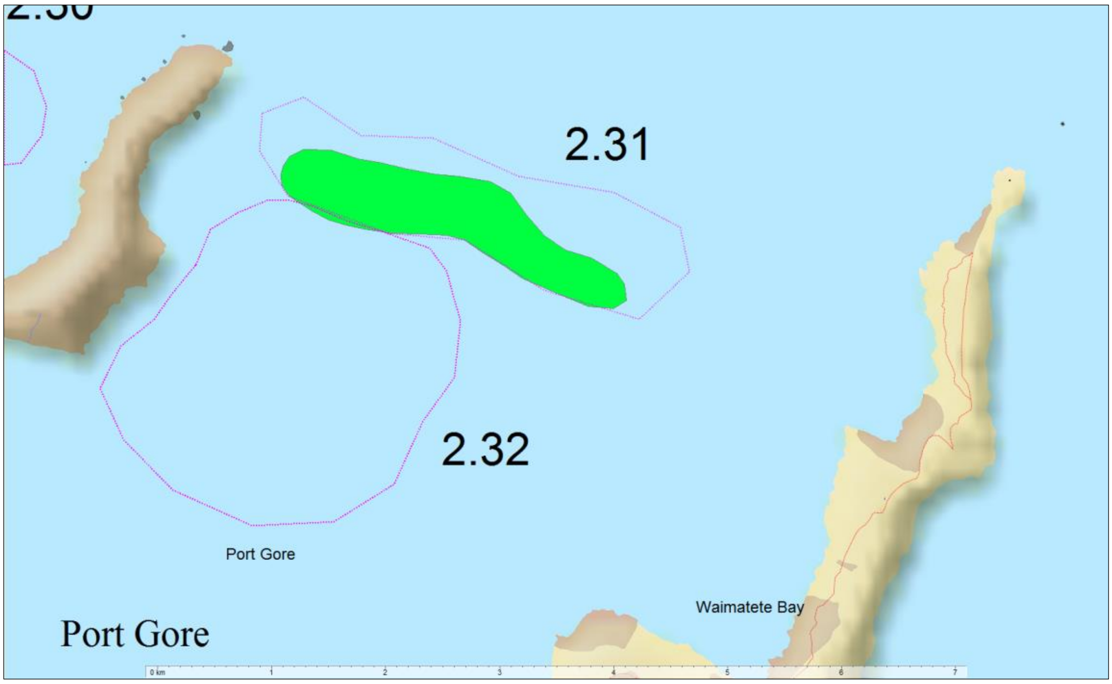

Figure 6. Original sites 2.31 and 2.32 (pink lines) and suggested new boundary for 2.31 (green) in Port Gore.

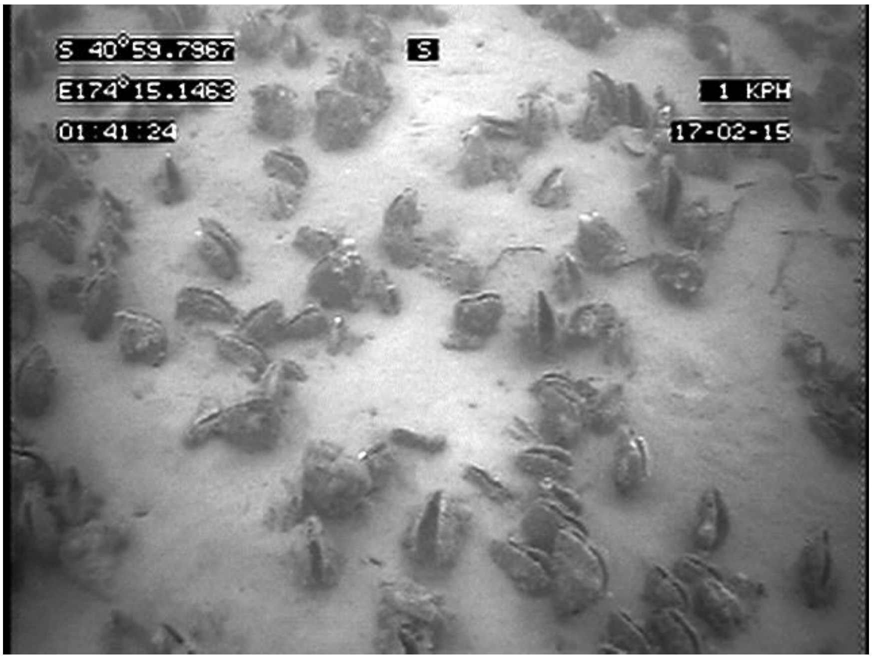

Plate 13. Dense horse mussel bed at outer Port Gore site 2.31.

Site 2.32 Port Gore (shallow offshore)

The original significant site 2.32 was based on early data collected by Cameron Hay (Hay 1990); however the extent and boundaries of the horse mussel bed were not accurately mapped (Figure 6). The present data collected in 2015 shows few horse mussels. It is not possible to attribute the present state to human activities such as dredging as no prior data apart from Hay (1990) has been published. In particular locations within the site, clumps of filamentous red algae were observed from drop camera images. These are likely seasonal and therefore variable in abundance. It is recommended that this site be removed from the significant site list.

Original area of significant site (ha)	635.6
Recommended area of significant site (ha)	0
Change to original site	Decrease
Change (ha)	-635.6
Percentage change from original area (%)	100
Human Use	Low
Vulnerability	High
Impact observed	No

Site 2.33 Port Gore (inner)

Three sites supporting tubeworms (*Owenia petersenae*) were found along this coast (Figure 7, Plate 14). Tubeworms were most abundant between 11m and 14m depth on gently sloping shores. Another larger tubeworm zone is known from significant site 2.34 at Gannet Point (south-eastern, Port Gore). Tubeworm beds are vulnerable to sedimentation, smothering and physical damage.

Plate 14. Tubeworm bed with occasional horse mussels and snake stars from inner Port Gore.

It is recommended that these three sub-sites be ranked as significant. The northern tubeworm sub-site may extend further west than its present location, however, this western area was not surveyed during the present investigation and the full extent of this bed remains unknown.

Original area of significant site (ha)	17.52
Recommended area of significant site (ha)	9+3.2+0.648 = 12.85
Change to original site	Decrease
Change (ha)	-4.67
Percentage change from original area (%)	26.7
Human Use	Low
Vulnerability	High
Impact observed	No

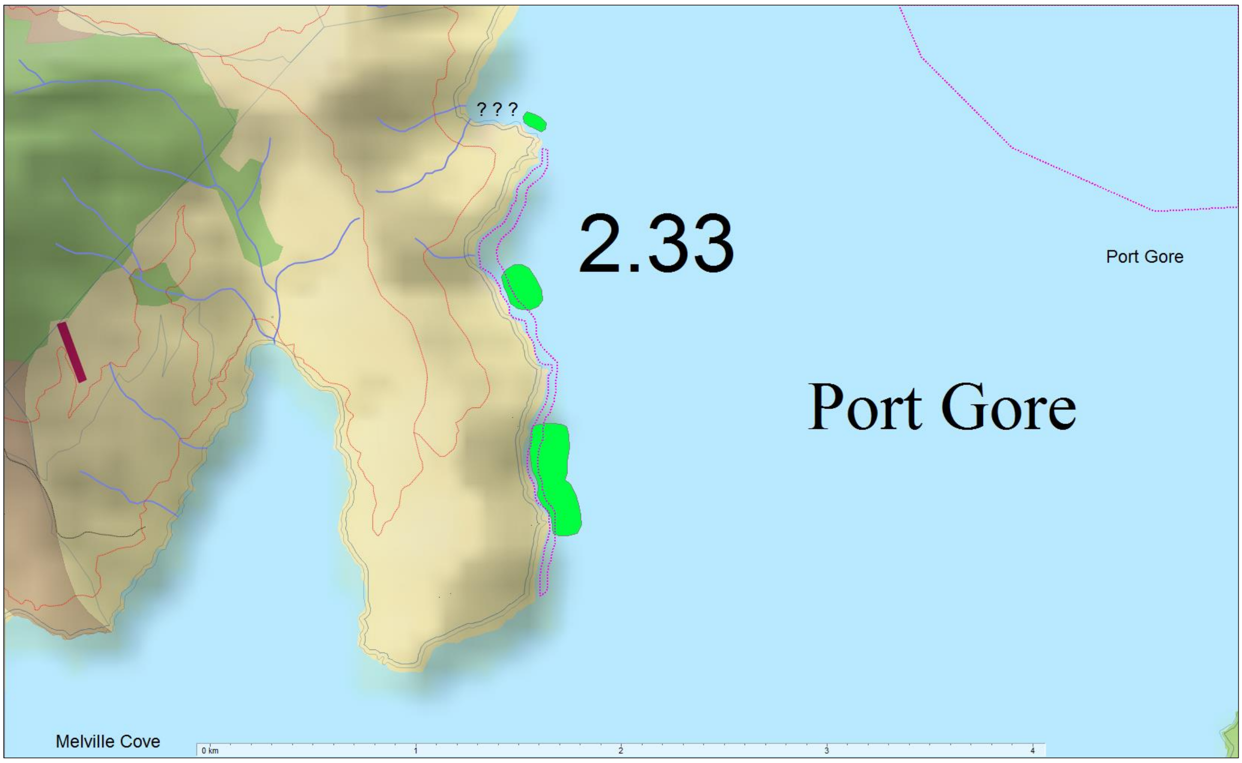

Figure 7. Original site 2.33 (pink) and suggested new boundary of three sub-sites for 2.33 (green) in Port Gore.

Site 4.11 Bobs Bay

Bobs Bay is located along the eastern side of Picton Harbour (Figure 8, Plate 15). At present, the tubeworm species located at this site is being treated as an undescribed native *Bispira bispira* A (Plate 16). Until recently, this species had only been recorded from one other site in the Marlborough Sounds as an individual from Blow Hole Point, Pelorus Sound (Davidson *et al.* (2010). There are however, two other sitings in the Sounds (Waikawa Bay and Port Underwood) that require further investigation. It is also known from Wellington Harbour, Whangarei Harbour, Mount Manganui, and Houhora Harbour in Northland.

This site is smaller than originally, however the change is not due to a decline in the extent of the tubeworm bed, rather because the bed had not been accurately mapped originally (Figure 8).

It is recommended that this site remain as a significant marine site, but should be reassessed if the status for this species changes to introduced or invasive.

Plate 15. Bobs Bay looking northward (MDC).

***Plate 16. Bispira bispira* sp. tubeworm bed in Bobs Bay (Don Morrisey).**

Original area of significant site (ha)	2.9
Recommended area of significant site (ha)	0.363
Change to original site	Decrease
Change (ha)	-2.537
Percentage change from original area (%)	87
Human Use	High
Vulnerability	High
Impact observed	No

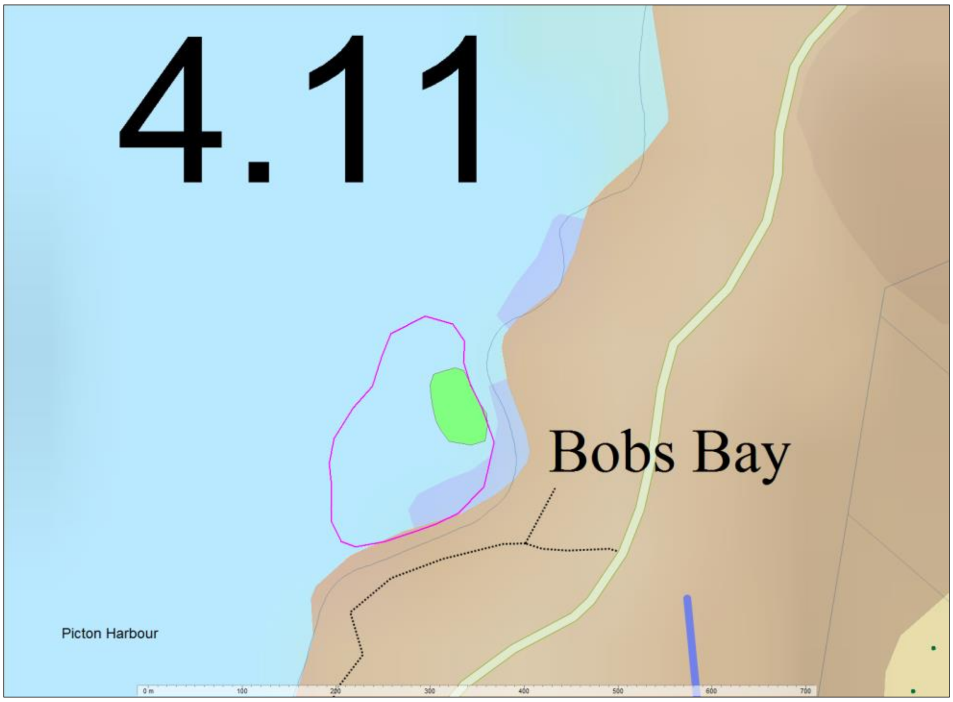

Figure 8. Original site 4.11 (pink) and suggested new boundary (green) in Bobs Bay.

Site 4.19 Ship Cove to Cannibal Cove

This site is located along the northern coast of outer Queen Charlotte Sound (Figure 9, Plate 17). Most of the offshore area is characterised by silt and clay substrata with no notable species or communities being observed during the survey. Recreational and commercial dredging is common offshore. Areas of reduced visibility due to re-suspension of fine sediment following dredging activities were observed by the remote camera during the present survey.

Plate 17. Looking westward towards Ship Cove coast from Motuara Island.

The inshore areas ranged from characteristic sheltered Sounds communities in the south to outer Sounds communities in the north. This area therefore represents a transition in community types associated with wave exposure.

The site was initially ranked significant due to the protected catchment and lack of human land impacts. The site is, however, regularly dredged offshore and therefore influenced by physical disturbance and resuspension and subsequent smothering by disturbed sediments. If ranked as significant, it is suggested the inshore zone be considered only (Figure 9). The inshore area represents a stretch of coast forming the transition between inner and outer Queen Charlotte Sound habitats and communities.

Original area of significant site (ha)	437.7
Recommended area of significant site (ha)	121.8
Change to original site	Decrease
Change (ha)	-315.9
Percentage change from original area (%)	72
Human Use	High
Vulnerability	High
Impact observed	Yes

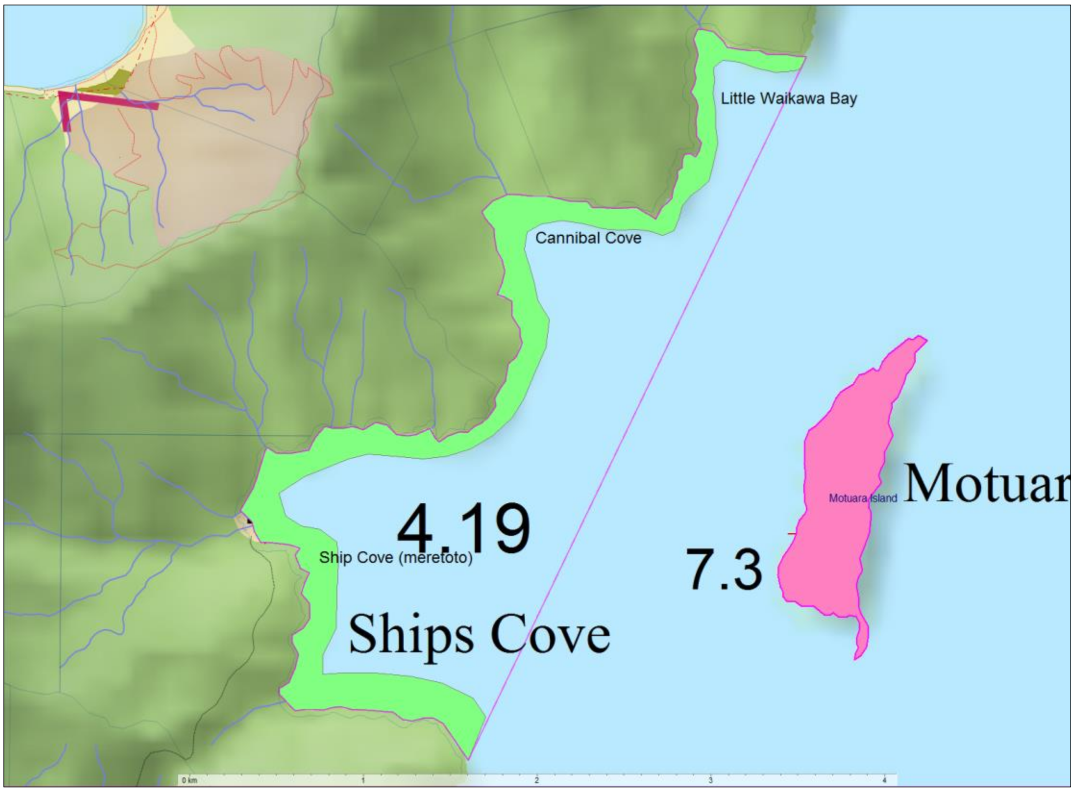

Figure 9. Original site 4.19 (pink) and suggested new boundary (green).

Site 4.22 Puriri Bay

Puriri Bay is located in East Bay, Queen Charlotte Sound (Figure 10). Divers estimated the percentage cover of red algae from one transect in 2002 (Davidson and Richards 2014). The extent of the red algae bed in the wider bay was first sampled using a drop camera in November 2008 and used to map the its boundaries for the Davidson *et al.* (2011) report.

Photos collected during the present study in January 2015 showed a reduction in the area occupied by red algae since 2008 (Plate 18), however, percentage cover estimates by divers in 2002 showed an increase from mean 10-15% cover to 40-45% in 2015. The transect located in the red algae bed was sampled regularly by Davidson and Richards (2014) from 2002 to 2011 and the authors reported that it consistently supported red algae. Unfortunately percentage cover estimates were only collected in 2002 and again during the present study in 2015.

The reason for the decline of red algae area over the wider bay is unknown and may be natural as red algae in the western bay was less dense compared to the eastern side of the bay in 2008. However, the decline may also be related to recent logging activities leading to increased turbidity. It is suggested that an annual collection of drop camera photos be collected to monitor change in an attempt to determine if the fluctuations are human related or natural.

Plate 18. Red algae bed in Puriri Bay.

Original area of significant site (ha)	14.3
Recommended area of significant site (ha)	5.54
Change to original site	Decrease
Change (ha)	-8.7
Percentage change from original area (%)	61
Human Use	Low
Vulnerability	High
Impact observed	Yes

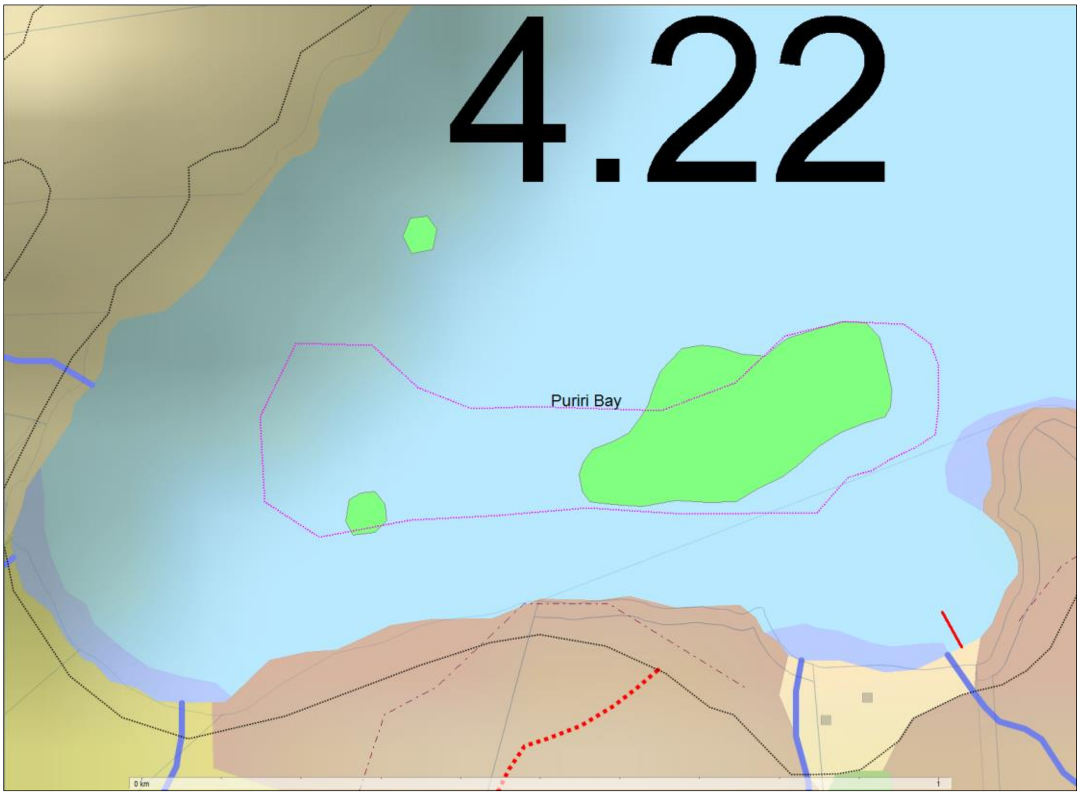

Figure 10. Original site 4.22 (pink) and present area occupied by red algae (2015) (green).

Site 4.23 Matiere Point

Matiere Point is located in East Bay (Figure 11). Parts of the site have been monitored regularly since 2002 (Davidson and Richards 2014). Giant lampshells are consistently recorded in this area. An additional transect was surveyed on the northern side of Matiere Point in January 2015. Giant lampshells were present at the new transect, but were recorded in relatively low abundance.

Plate 19. Burrowing anemone at Matiere Point.

On the northern side of the point, the burrowing anemone was regularly observed between 22m and 28m depth (Plate 19). Both giant lampshell and burrowing anemone are also known from the northern coastline of East Bay. The present site represents the best known example of where these species exist along the southern coast of East Bay.

The reduction in the size of the site is based on new depth data and not a decline in habitat quality or due to human impact. It is recommended that the site be adjusted to 10.95 ha.

Original area of significant site (ha)	28.5
Recommended area of significant site (ha)	10.95
Change to original site	Decrease
Change (ha)	-17.55
Percentage change from original area (%)	61.6
Human Use	Low
Vulnerability	Moderate
Impact observed	No

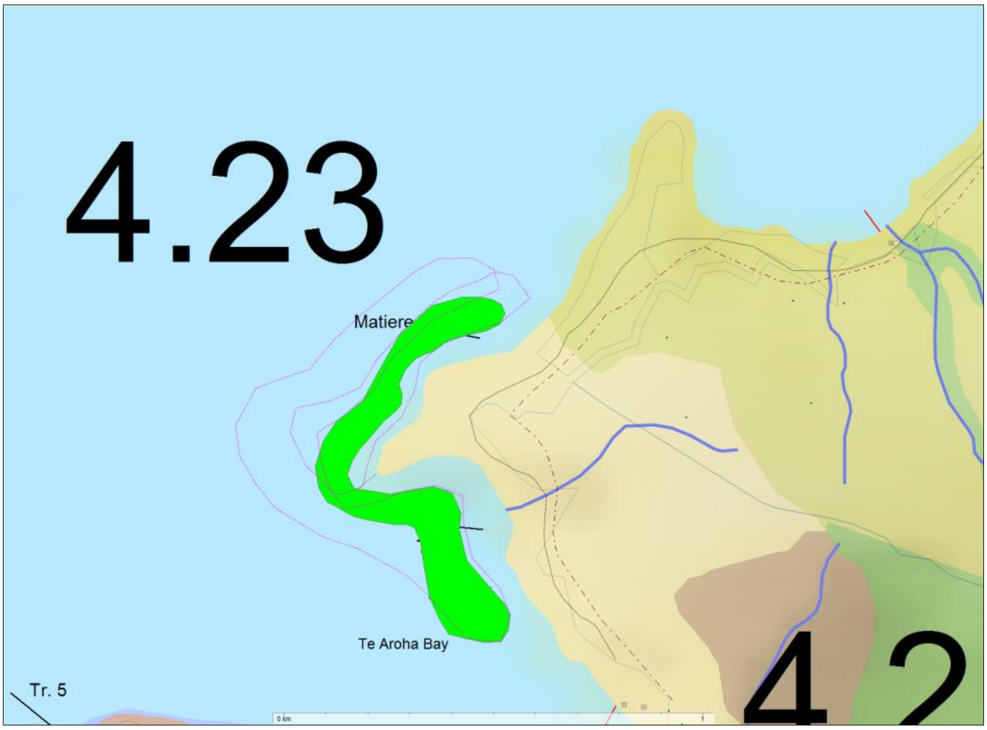

Figure 11. Original site 4.23 (pink) and present area occupied by biological values (green).

Site 5.3 Hitaua Bay Estuary

Hitaua Bay Estuary was the best example of an estuarine habitat in the Tory Channel biogeographic area (Plate 20). Although it still supports estuarine habitats, it appears to have recently been influenced by the deposition of fine sediment from the logged catchment. Observations show a build-up of fine sediment over and around intertidal cobbles and a disappearance of some intertidal species compared to a baseline survey conducted in 2003 (Plate 22) (Davidson and Richards 2003). Cockles do remain in comparable densities to samples collected in 2003, however their mean size appears to have declined. The site is no longer the best example of an estuarine habitat in Tory Channel and it is recommended that it be removed from the list of significant sites. It is also recommended that Ngaruru Bay be reassessed as a potential significant estuarine site.

Plate 20. Hitaua Bay Estuary January 2015.

Original area of significant site (ha)	1.86
Recommended area of significant site (ha)	0
Change to original site	Decrease
Change (ha)	-1.86
Percentage change from original area (%)	100
Human Use	Low
Vulnerability	High
Impact observed	Yes

Plate 22. Stream at head of Hitaua Bay in 2003 (top) and 2015 (bottom).

Plate 23. Ngaruru Bay Stream 2003 compared to Hitaua Bay stream in 2015 (insert).

Site 7.5 Motuara Island subtidal

This site is located north and offshore of Motuara Island, Queen Charlotte Sound (Figure 12). The site was described by Davidson *et al*. (2011) as a combination of reefs and soft bottom habitats supporting horse mussel beds. Outcrops of bedrock occur in the site and rise to approximately 4-6m below the surface from about 9m depth. The top of the reef supports algal forest dominated by *Macrocystis* kelp. Below the *Macrocystis* zone, the reef is covered in dense turfing red seaweed, coralline crusts, large sponges (*Polymastia fusca, Iophon minor, Raspalia topsenti, Polymastia* sp., pink golfball sponge), *Actinothoe*, large pale colonies of jewel anemone, and brachiopods (*W. inconspicua*). Between 9-12m depth, the bottom is soft mud and horse mussels, eleven-arm seastar, sea cucumber and kina are common. The snakestar *Ophiopsammus maculata* is abundant (Davidson *et al.* 2011).

The original significant site 7.4 was based on early data (Hay 1990), however the extent and boundaries of the horse mussel bed were not accurately mapped in that work. The present data collected in 2015 shows horse mussels are present over most of the original site 7.4. Horse mussel relative abundance is low compared to other sites which are known to support densities of up to 10 individuals per m^2. Present densities appear well below those described by Hay (1990). It is not possible to attribute the sites present state to human activities such as dredging as no prior data on the abundance and distribution of horse mussel are available (although the data may exist at NIWA).

It is recommended that site 7.4 be reduced to a 12.7ha area to encompass the reef, microalgae forest and red algae beds that are associated with shell and sand habitats that surround the reef. In the future, this area could be considered as a candidate for habitat protection in the hope that horse mussel beds would recover if dredging ceased.

Original area of significant site (ha)	300.6
Recommended area of significant site (ha)	12.7
Change to original site	Decrease
Change (ha)	-287.9
Percentage change from original area (%)	95.8
Human Use	Moderate
Vulnerability	High
Impact observed	No

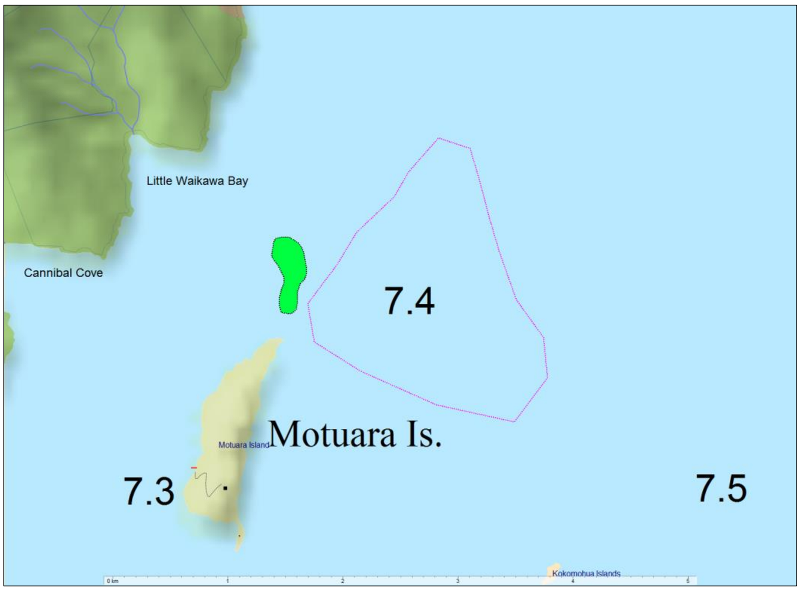

Figure 12. Original site 7.4 (pink) and present area occupied by biological values (green).

5.0 Discussion

5.1 Change from 2011 to 2015

Changes to the list of significant marine sites and sub-sites could be due to five main reasons:

(1) Discovery of a new site

A new site that supports biological features that would likely reach a medium or high rank.

(2) Rejection of an existing site

The site no longer supports medium or high biological attributes.

(3) Reduction in the area or biological attributes

Part of the significant site no longer supports medium or high biological attributes.

(4) Addition to an existing site

An area adjacent or contiguous with an existing significant site also supports medium or high biological attributes.

(5) Rehabilitation/recovery

Biological values increase by recovery or rehabilitation.

Overall, one potential new site was found and two existing sites were recommended to be removed. Seven existing sites were recommended to be reduced in size, whereas 12 sites or sub-sites were recommended to increase in size. The overall result was a decline of 1317.8ha of the significant sites area compared the same sites and sub-sites described in Davidson *et al.* (2011). Much of this change was due to the reduction of offshore sites in Port Gore and the area north of Motuara Island.

Some of the significant sites described in the Davidson *et al*. (2011) report were based on general descriptions by commercial fishers and scientists. It is therefore possible that a proportion of the loss was due to boundary inaccuracies and poor descriptions. It is however, concerning that some described biological values no longer resemble those initial descriptions.

Based on the initial finding from the present survey and monitoring study (2015), the overall decline of 71.6% of area is concerning compared to the original sites reported by Davidson *et al.* (2011).

It is unlikely that all of the reduced area supporting medium or high biological values was due to inaccuracies in the earlier incorporated into the Davidson et al. (2011) report. For example, Site 2.32 in Port Gore was based on field work by Dr Cameron Hay working for NIWA. The site is also located in optimum depths for horse mussels. Horse mussel beds are known to be variable in their distribution and abundance due to variable recruitment and natural mortality events. They are also highly vulnerable to the effects of dredging and trawling. The absence of any whole dead horse mussels suggests that physical disturbance rather than natural events has occurred.

On inspection, all of the sites that have lost all or some of the areas that supported medium of high biological values were characterised by soft substratum bottoms. In contrast, all of the sites that remained and increased in size were characterised by bottoms with a component of rocky substrata making them impossible to dredge or trawl.

5.2 Information issues (plan updates, data management)

During the present survey, the first since Davidson *et al.* (2011), all sites investigated changed in size, shape or composition compared to the earlier report. It is likely that further changes will be detected in future surveys. The important issue is therefore how to integrate these changes into the planning process.

It is recommended that the new MDC Coastal Plan recognise that significant sites should not be “set in stone”, rather they will change over time. Events listed in section 5.1 will occur on a regular basis. The new MDC coastal plan should recognise the probability that most significant sites will not remain constant.

Survey data from the 2014-2015 survey are summarised in the present report. Detailed data (maps, photos, video, sonar) are produced in a separate Excel spreadsheet. These data have been supplied to MDC to be stored in an MDC database. The expert review panel will need to review these data when they undertake a review and ranking of the sites and sub-sites.

5.3 Review and assessment of sites

Based on data collected during the present study, each site has a recommendation to the review panel. It is important to note that these recommendations may not necessarily be adopted by the expert panel and must remain as recommendations until such time as sites are properly ranked (see Davidson *et al.* 2013 for process). At no time should site recommendations be used to rank sites without proper implementation of the review process.

5.4 Protection and protection initiatives

5.4.1 The need for protection

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 discharges cannot be stopped overnight and long term strategies are needed to reduce these effects. The introduction of sediment from the catchments for example, is a result of land practices that have occurred over generations. Direct physical disturbance of the seafloor has also had a long history (e.g. bottom towed fishing gear).

Historic human activities will have had a major and widespread effect on the New Zealand (and Marlborough) marine environment resulting in the loss of many areas with formally high biological value (see reviews Morrison *et al*. 2009, Morrison *et al*. 2014 a and b, Handley 2015). Marlborough's significant marine sites are believed to be the remnants of much larger areas and based on the present investigation of 21 sites and sub-sites it is clear that the biological values at these sites continue to be degraded or lost at an alarming rate.

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). In 2015 no new protected sites have been gazetted or initiated in Marlborough. While there are a variety of partial protection mechanisms, notably fisheries legislation, these focus on fisheries management and are not habitat protection based. As a result, they do not provide comprehensive protection to vulnerable marine habitats.

5.4.2 The level of change and loss

The scale of change to the marine environment in Marlborough is largely unknown as no historic baseline data were established prior to activities such as land clearance and fishing. It is therefore impossible to know how much has changed or has been lost. Some early publications investigated resources such as commercially viable intertidal mussel beds and subtidal scallop and horse mussel beds in the Pelorus Sound (Stead 1991). These mussel beds have disappeared and have not recovered. Another indication can be derived from locations in New Zealand where harmful activities have not occurred or are limited by the environment. 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.

5.4.3 Human impacts based on present study

During the present study damage from human activity was observed at two sites. At Perano Shoal, anchor damage was recorded at half of the samples collected by divers (15 of the 30 quadrats) with mean damage estimated at 13.7 % cover (Plates 24 and 25). At site 7.4 in outer Queen Charlotte Sound, recreational dredging was observed on a number of occasions re-suspending sediment at sufficient levels to obscure the underwater camera.

Although no observations of dredge or trawl marks or resuspension of sediment was observed at most sites, the disappearance of biogenic habitats (e.g. horse mussel beds) from some offshore soft bottom sites where dredging and trawling are known to occur is a serious concern. In contrast, inshore, rocky sites in the present study remained viable and healthy with some increases in their recorded size.

Plate 24. Damaged tubeworm mounds at Perano Shoal due to anchor drag (2015).

5.4.5 The need for protection

There is a large ongoing decline of significant sites in offshore soft bottom areas in the Marlborough Sounds. At Perano Shoal, the sites dense tubeworm mounds which support a living fossil are fragile and susceptible to serious physical damage from anchors. If left unprotected, this site may eventually lose its status as a significant site. At Perano Shoal, protection could be as simple as a habitat protection zone (i.e. no anchoring or other physical damaging activities) located at and immediately around the biogenic reef.

5.4.6 Protection of habitats

In terrestrial ecology it is accepted that protection of a species cannot occur without protection of its 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 protection of adult and juvenile blue cod habitat. Blue cod regularly inhabit soft bottom biogenic habitats. Based on the present investigation, it is these habitats that are under serious threat and are declining. It is strongly recommended that a programme of protection that prioritizes these types of habitat be initiated. Without such a programme, these habitats are at risk of ongoing decline.

5.4.7 Types of protection

Protection of marine habitat values can take a variety of forms depending on the circumstances and include:

1. Marine Reserve Act (total protection).
2. Reserves Act or Wildlife Act (mainly habitat/partial protection over intertidal and on occasion subtidal areas).
3. Fisheries Act (partial or total protection).
4. Resource Management Act (control of activities that impact the environment).
5. Voluntary measures, including codes of practice and voluntary closures.

The type of protection needed will vary depending on the values present and the threats to them.

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Plate 25. Anchor damage at Perano Shoal (2015).

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