Davidson Environmental Limited

Significant marine site survey and monitoring programme (survey 6): Summary report 2019-2020

Research, survey and monitoring report number 1023

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Summary

Davidson and Richards (2015) conducted the first survey and monitoring programme for Marlborough's significant marine sites programme in the summer of 2014 - 2015. Their study focused on 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 second and third survey events were conducted in the outer north-western Marlborough Sounds and Croisilles Harbour (Davidson and Richards, 2016; Davidson *et al*., 2017). The fourth and fifth survey events were conducted in the summers of 2018 and 2019 and targeted Pelorus Sound (Davidson *et al*., 2018, 2019).

In the present 2020 study, only a small amount of fieldwork was possible due to the Covid19 event. It was, however, possible to update many sites using data collected in recent years during other surveys undertaken for the Marlborough District Council. All sites in the present report are from the Queen Charlotte Sound, Tory Channel and Port Underwood.

During fieldwork conducted as part of the present study, a variety of qualitative and quantitative methods were adopted (Davidson *et al.,* 2013). Methods varied between sites depending on site-specific environmental factors and information needs outlined in Davidson *et al.* (2014). As part of the present survey programme, a variety of sonar and drop camera methods were adopted. Remote HD video and still photographs were also collected using GoPro Hero or Paralenz cameras.

A total of 18 sites are discussed in the present report (Table 1). Two of these significant sites have associated subsites: Site 5.4 Tory Channel west (18 subsites) and Site 5.8 Tory Channel east (12 subsites). Of the 18 sites, one was rejected, three sites are new and the remaining 14 are either enlarged or reduced in size due to an improved level of information. Overall the total area of significant sites discussed in this report has increased by 375.35 ha.

This report makes recommendations to the MDC expert review panel which may accept to reject recommendations. Therefore, the status of each site remains pending until assessment occurs (see Davidson *et al.,* 2013 for a detailed description of the process).

Note: Raw data collected during the 2019-2020 season were collated into excel spreadsheets and supplied to MDC for storage (e.g. HD video, photographs). The present report is, therefore, a summary and does not include all raw and compiled data.

Table 1. Summary of recommended significant sites.

Attribute *	Values
New sites discovered	3
Sites rejected	1
Sites with reductions	17 sites or subsites
Sites with additions	25 sites or subsites
Sites recovered	0
Significant site area before the survey (ha)	1450.71
Suggested significant site area after survey (ha)	1826.06
Overall change (ha)	375.35
Sites *	Recommendations
Site 4.16 Perano Shoal (tubeworm mounds)	Adjust site boundary
Site 4.23 Matiere Point (lampshell and burrowing anemone)	Adjust site boundary
Site 4.24 Onauku head (scallop and horse mussel)	Adjust site boundary
Site 4.25 East Bay north (lampshells, anemones and tubeworm mounds)	Adjust site boundary
Site 5.4 Tory Channel west (biogenic patch reefs)	Adjust site boundary, rename some subsites
Site 5.8 Tory Channel east (biogenic patch reefs)	Adjust site boundary
Site 5.9 Tory Channel entrance (reef)	Adjust site boundary
Site 6.1 The Knobbys (tubeworm mounds and reef)	Adjust site boundary
Site 6.3 Port Underwood south-east (algae)	Adjust site boundary
Site 7.1 Cape Jackson & Walker Rock (reef)	Adjust site boundary
Site 7.2 Cape Jackson south	Reject site
Site 7.8 White Rocks (reef)	Adjust site boundary
Site 7.10 Cook Rock to Cape Koamaru (reef)	Adjust site boundary
Site 7.11 Brothers Islands (reef)	Adjust site boundary
Site 7.13 Awash Rock (reefs)	Adjust site boundary
New Site 7.15 Kokomohua Island (tubeworm mounds)	New site
New Site 7.16 Long Island (horse mussels)	New site
New Site 5.10 o-v Tory Channel north (seagrass)	New site (8 subsites)

*Changes are subject to expert peer review

1.0 Background information

The Resource Management Act requires local authorities to monitor the state of the whole or any part of the environment (s35 2(a)). Additional obligations also exist, 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 report identifying and ranking known ecologically significant marine sites in Marlborough (Davidson *et al.*, 2011). The assembled group of expert authors applied 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, some 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 regularly.

Davidson *et al.* (2013) outlined a protocol for receiving information for new candidate sites and for reassessing existing ecologically significant marine sites. That report aimed to ensure a rigorous and consistent process that establishes:

(1) The level of information required for new candidate sites.
(2) The process for assessment of new sites and reassessment of existing sites.
(3) 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". This report included surveying and monitoring methodologies, options for prioritizing survey sites and guidance on reporting.

In particular, Davidson *et al.* (2014) aimed to add to the ecologically significant marine sites programme by guiding the collection, storage and publication of biophysical data from potential new significant sites as well as existing sites.

From 2015 onwards a programme of survey and monitoring has been conducted (see Appendix 1 for a summary). Each year data for new and existing sites are reviewed by an expert panel and recommendations provided to the MDC Environment Committee. Approved updated significant sites are then compiled and updated into the Council Plan.

2.0 Species, communities and habitats

In New Zealand and the world, important or significant biological features have usually been identified as those that provide important ecosystem services (e.g. provide food or habitat, or sequester carbon), have become threatened or rare due to anthropogenic activities (e.g. physical disturbance, sedimentation) or are naturally rare. Important or significant marine species, habitats or communities include features such as beds or zones of tubeworms (calcareous and non-calcareous), bryozoans, sponges, ascidians, hydroids, shellfish, algae, seagrass, saltmarsh, mangroves, rhodoliths, stony corals, sea pens and xenophyophores). These features are often fragile, slow-growing and have been historically reduced in extent and quality world-wide (Airoldi and Beck, 2007; MacDiarmid *et al.,* 2013; Anderson *et al*., 2019c).

Numerous studies have highlighted the importance of marine biogenic structures. Kuti *et al*. (2014) reported that complex habitats like coral reefs attracted many times the abundance of reef fish compared to simpler habitats. De Smet *et al*. (2015) reported that biogenic reefs composed of the tube-building polychaete *Lanice conchilega* increased the biodiversity in otherwise species-poor environments. Rabaut *et al.* (2010) reported that biogenic tubeworm structures were important to juvenile flatfish. The ecological functions provided by biogenic habitats are diverse and can include the elevation of biodiversity, bentho-pelagic coupling, sediment baffling, protection from erosion, nutrient recycling, the provision of shelter and food for a wide range of other organisms, and even the creation of geological features over longer time scales (Bradstock and Gordon, 1983; Turner *et al*., 1999; Carbines and Cole, 2009; Wood *et al*., 2012; Morrison *et al*., 2014). Morrison *et al*. (2014) stated biogenic habitats also directly underpin fisheries production for a range of species through (1) the provision of shelter from predation; (2) the provision of associated prey species; (3) the provision of surfaces for reproductive purposes (e.g. the laying of elasmobranch egg cases); and (4) indirectly through primary production.

The following report is part of an on-going programme that surveys and monitors Marlboroughs significant (important) sites.

The following major species, community or habitat types have been used to categorise species, habitats or community types.

1. Bryozoan beds
2. Biogenic patch reef
3. Shellfish bed (e.g. dog cockle, horse mussel, scallop, cockle)
4. Brachiopod bed
5. Calcareous tubeworm bed (e.g. *Galeolaria hystix*)
6. Non-calcareous tubeworm bed (e.g. *Owenia, Spiochaetopterus, Acromegalomma suspiciens, Bispira bispira* spA*)*
7. Burrowing sea cucumbers (e.g. *Thyone* spA)
8. Rhodoliths
9. Algae forests and meadows (*Macrocystis, Ecklonia, Lessionia, Carpophyllum, Marginariella, Landsburgia, Durvillaea, Sargassum, Caulerpa* spp., *Caulerpa* spp.)
10. Soft sediment macroalgae beds (red, green and brown algae, drift algae)
11. Seagrass (eelgrass)
12. Fish spawning sites (e.g. elephantfish egg-cases)
13. Shell rubble and shell hash
14. Reef (bedrock, boulders, cobbles)

3.0 Methods and analysis

A variety of standard field survey methods were used at each site depending on the level of survey required (i.e. survey or monitoring) and the environmental variables at each site (e.g. depth, water currents, water clarity). These and subsequent analyses are described below.

3.1 Sonar imaging

Sonar investigations were conducted at selected sites using a Lowrance HDS-12 Gen 2 and HDS-8 Gen2 linked with a Lowrance StructureScan^{TM} Sonar Imaging LSS-1 Module. These units provide right and left side imaging as well as DownScan Imaging^{TM} 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 to overlay onto Google Earth imagery.

3.2 Drop camera stations and site depths

At each drop camera station, a standard 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 to obtain a representative range of habitats and targeted any features of 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 biological features (e.g. macroalgae, biogenic clumps) from GPS-positioned drop camera images were estimated both in the field by the boat observer and 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 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), Hero 7 or a Paralenz HD camera. The camera was either (a) mounted on a purpose-built frame amd used in conjunction with the low definition camera, (b) on a purpose-built tripod, or (b) hand-operated by a diver. The GoPro camera also collected HD still photographs at 5-second intervals. Depending on water conditions, the GoPro Hero 4 was often fitted with a macro-lens to improve video resolution, especially at close quarters.

When the GoPro or Paralenz was remotely lowered to the benthos, the survey vessel was allowed to move in a controlled fashion across a selected area. Video footage and photos were collected by allowing the camera to settle on the benthos and then intermittently moved across the benthos. 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 usually collected from most sites using a Samsung S8 in panoramic mode. Selected surface photos have been included in the Excel spreadsheets, while all photos collected are held on the MDC database.

3.6 Species sampling

No species samples were collected during the present study.

3.7 Horse mussel counts

Horse mussels were surveyed on the north-western side of Long Island in March 2019. Divers sampled the density of horse mussels from eight 50 x 1 m quadrats sampled by rolling a 1m^2 quadrat 50 times. Each set of 50 quadrats was initiated haphazardly by divers and sampled along a different compass bearing to ensure sets of quadrats were well spaced. All live horse mussels observed in each set of 50 quadrats were recorded.

3.8 Historic data and reports

Data from a variety of sources were compiled from previous reports, significant site surveys or other sampling programmes (e.g. marine reserve monitoring; marine farm monitoring, NIWA multibeam bathymetric survey). These data were integrated with other historical data and also integrated with data collected during annual significant site surveys. For example, multibeam depth contour data were used to delineate boundaries for existing sites where drop camera, diver, HD camera or other data had been previously collected. Using this approach new boundaries for previously described sites were able to be fine-tuned.

3.9 Excel site sheets and data

Field data collected from sites sampled during the present study were entered using a predesigned Excel template. Datasheets include a summary page and several other pages comprising data, maps, photos, sonar images and sample coordinates. A complete set of data for each site is stored on the Marlborough District Council (MDC) database. The spreadsheets also outline other data types that have been stored at MDC for each site (e.g. video clips).

3.10 Ranking

No assessment or ranking of sites was carried out in the present report. Recommendations for each site are, however, included on page 1 of the Excel site spreadsheets. In each year, the expert review panel conducts a ranking exercise based on the findings and recommendations from the present report. The panel's findings are produced in a separate annual report.

3.11 Sensitivity, threats and buffer zone calculations

An assessment of species, community or habitat sensitivity and perceived threats was first attempted by the panel of experts and reported in Davidson *et al*. (2016).

The present report presents an updated version of the original assessment. The revised method requires a site to be assessed for its expected sensitivity: (A) very sensitive, (B) sensitive, or (C) robust/not known. Each category of sensitivity is given a score (Table 3a). The second stage of the assessment involves the level of protection: (A) offshore and/or are accessible to activities such as dredging and trawling, or likely to be impacted by threats due to proximity to human activities/impacts; (B) having a level of protection from threats due to location or remoteness (Table 3b).

These factors were used to calculate appropriate buffer zones that aim to reduce the likelihood of damage from anthropogenic activities (e.g. dredging, trawling, anchoring, sedimentation, pollution).

Table 3a. Sensitivity assessment criteria for species, community or habitat to perceived threats.

Sensitivity to anthropogenic factors.

Category	Disturbance description	Examples	Score
A	**Very sensitive:** Site supports species, habitats or communities that cannot tolerate anthropogenic impacts (e.g. nutrient enrichment, sedimentation, pollution, colonisation by invasive species, anchoring, all forms of trawling and dredging).	Bryozoans mounds/field, sponges garden, tubeworm mounds, eelgrass bed, rhodolith bed, soft tubeworm bed.	100
B	**Sensitive:** Site supports species, habitats or communities that can tolerate low level of elevated turbidity, enrichment, invasive species or pollution. Can tolerate low-level anthropogenic seabed disturbance due to the nature of the substrata, community, species and/or hydrodynamic regimes (i.e. tolerant of occasional recreational anchoring). Not tolerant of dredging and trawling.	Benthic algae bed, elephantfish egg laying, hydroid field, burrowing anemones, horse mussel bed, shellfish bed, shrimp burrows, brachiopod bed, algal forest, rocky reef.	50
C	**Robust and/or not known:** Site supports species, habitats or communities that can tolerate high turbidity, enrichment, pollution or invasive species; and/or site not known to support sensitive or very sensitive attributes. Can be tolerant of anchoring, dredging and trawling.	Shell or coarse substrata, high energy shore, short-lived species/communities, drift macroalgae.	0

Table 3b. Buffer zone distance calculator using sensitivity score and the assessed likelihood of an effect occurring from a perceived threat.

Threat multiplier (chance of threats occuring)

Threat level	Location type	Description	Multiplier
A	Effects are likely	Physical disturbance: offshore, and/or sites accessible to dredging and/or trawling. Other: sites exposed or near threats (i.e. source of sediment, near human development, regularly human activity).	2
B	Effects are unlikely	Physical disturbance: sites close to shore and/or protected by physical barriers or legislation (e.g. reef structure, marine reserve). Other: sites well removed from threats or located at remote locations.	1

Buffer zone calculation (for each site type multiply the scores from each table above)

Sensitivity category	Threat level	Scores	Buffer (m)
A	A	100 x 2	200
A	B	100 X 1	100
B	A	50 x 2	100
B	B	50 x 1	50
C	A	0 x 2	0
C	B	0 x 1	0

4.0 Recommended changes

The present report presents summary information for three new sites and 14 enlarged or reduced existing sites and one rejected site (Figure 1, Table 4). The rejected site (Site 7.2) was recently surveyed by Anderson *et al*., 2020 who reported it no longer supported the biological features that made the site significant (i.e. biogenic communities) (Figure 1, Table 4). It is not known if the original features at the rejected site have been damaged or removed by human activities or they never existed as the original site had not been surveyed and was based on a recommendation from a commercial fisher and included by Davidson *et al*. (2011).

It is recommended that the three original significant sites 5.1 Dieffenbach Point, 5.2 Tikimaeroero Point and 5.3 Hitaua Bay be renamed as subsites of Site 5.4 (Tory Channel west).

Detailed data (i.e. maps, photos, video, sonar) have been compiled for each significant site in separate Excel spreadsheets provided to the Marlborough District Council (MDC) and have been stored in their database.

4.1 Updated existing significant sites and subsites

A variety of new data from recent studies were used to fine-tune the boundaries of 14 existing significant sites (Table 4). Fine-scale surveys were conducted at some of the significant sites as part of the present summer survey season. Also, three separate studies provided additional biological and physical information on sites. Anderson *et al*. (2020) undertook video and camera surveys from Queen Charlotte Sound (QCS), Tory Channel (TC) and Cook Strait areas to ground-truth and visually characterise habitats and communities previously surveyed using multibeam technologies by Neil *et al*. (2018a, 2018b). Anderson *et al*. (2020) collected a total of 58 linear km's of seafloor video, with 6,251 seafloor characterisations from 358 video sites. Of those, the survey collected 36.6 linear km's with 5,062 data points from 149 sites. Davidson *et al*. (2019c) conducted a multiyear biological monitoring study of red algae beds in Whangatoetoe Bay, Port Underwood. Other data utilized in the present study were also collected as part of the Long Island – Kokomohua Marine Reserve monitoring programme.

Based on data collected or reviewed during the present study, the following alterations to existing sites are recommended (see Table 4):

1. Site 4.16 Perano Shoal (subtidal): adjust site boundaries. Rename as Perano Shoal (tubeworm mounds).
2. Site 4.23 Matiere Point (subtidal): adjust site boundaries. Rename as Matiere Point (lampshell and burrowing anemone).
3. Site 4.24 Onauku Bay head (subtidal): adjust site boundaries. Rename as Onauku head (scallops and horse mussels).
4. Site 4.25 Onauku Bay northern coastline (subtidal): adjust site boundaries. Rename as East Bay north (lampshells, anemones and tubeworm mounds).
5. Site 5.1 Dieffenbach Point (subtidal): adjust boundary to encompass reef and deep holothurian beds). Establish as a subsite of Site 5.4 Tory Channel west (biogenic patch reefs). Name subsite as 5.4r Dieffenbach south (subtidal).
6. Site 5.2 Tikimaeroero Point (subtidal): adjust boundary and establish as a subsite of Site 5.4 Tory Channel west (biogenic patch reefs). Name subsite as 5.4q Tikimaeroero Point.
7. Site 5.3 Hitaua Bay (subtidal): adjust boundary and establish as a subsite of Site 5.4 Tory Channel west (biogenic patch reefs). Name subsite as 5.4p Otamango Point to Onapua.
8. Site 5.4 Tory Channel west (subtidal) (subsites a-r): adjust subsite boundaries. Rename as Tory Channel west (biogenic patch reefs).
9. Site 5.8 Tory Channel eastern north coast (subtidal) (subsites a-l): adjust subsite boundaries. Remane as Tory Channel east (biogenic patch reefs).
10. Site 5.9 Tory Channel entrance (subtidal): adjust site boundaries. Renames as Tory Channel entrance (biogenic patch reefs).
11. Site 6.1 The Knobbys (subtidal): update information and adjust site boundaries. Rename as The Knobbys (tubeworm mounds and reef).
12. Site 6.3 Cutters Bay (subtidal): update information and adjust site boundaries. Rename as Site 6.3 Port Underwood south-east (algae).
13. Site 7.1 Cape Jackson and Walker Rock (subtidal): adjust site boundaries. Rename as Cape Jackson & Walker Rock (biogenic patch reefs).
14. Site 7.2 Cape Jackson (subtidal): remove as a significant site.
15. Site 7.8 White Rocks (subtidal): adjust site boundaries. Renames as White Rocks (biogenic patch reefs).
16. Site 7.10 Cook Rock (subtidal): adjust site boundaries. Rename as Cook Rock to Cape Koamaru (biogenic patch reefs).
17. 7.11 Brothers Islands (subtidal): adjust site boundaries. Rename as Brothers Islands (biogenic patch reefs).

18. 7.13 Awash Rock (subtidal): adjust site boundaries and rename as Awash Rock (biogenic patch reefs).

4.2 Suggested new significant sites

Three new candidate significant sites are described (Table 4). Two sites are located inside the Long Island-Kokomohua Marine Reserve and were discovered during annual monitoring of the marine reserve coordinated by Davidson Environmental Limited or during a habitat mapping study by Haggitt (2017). The third site consists of eight subsites supporting subtidal seagrass (eelgrass) along the northern shoreline of Tory Channel. During the present study, the boundaries of these sites were determined, and additional photographs were collected.

Suggested changes are:

1. Approve a new site that supports a high-density bed of tubeworm mounds. Name as 7.15 Kokomohua Island (tubeworm mounds).
2. Approve a new site that supports horse mussels and associated species. Name as 7.16 Long Island (horse mussels).
3. Approve a new site comprising eight subsites that supports subtidal seagrass along the northern shoreline of Tory Chanel. Name as Tory Channel north (seagrass).

4.3 Anthropogenic threats and buffers

Each new and existing site includes an assessment of anthropogenic threats. This includes data on existing impacts and also suggests a buffer distance based on Tables 3a and 3b (Chapter 3.11 in the present report).

The threat assessment section for each site is based on aspects such as fishing intensity and type, sedimentation, human use and observed impacts/damage combined with known environmental variables specific to each site.

Sources of data/information for this assessment include: impact assessments, published reports and papers, Government websites (MPI, MDC, DOC, MfE), personal experience of the authors and anecdotal reports.

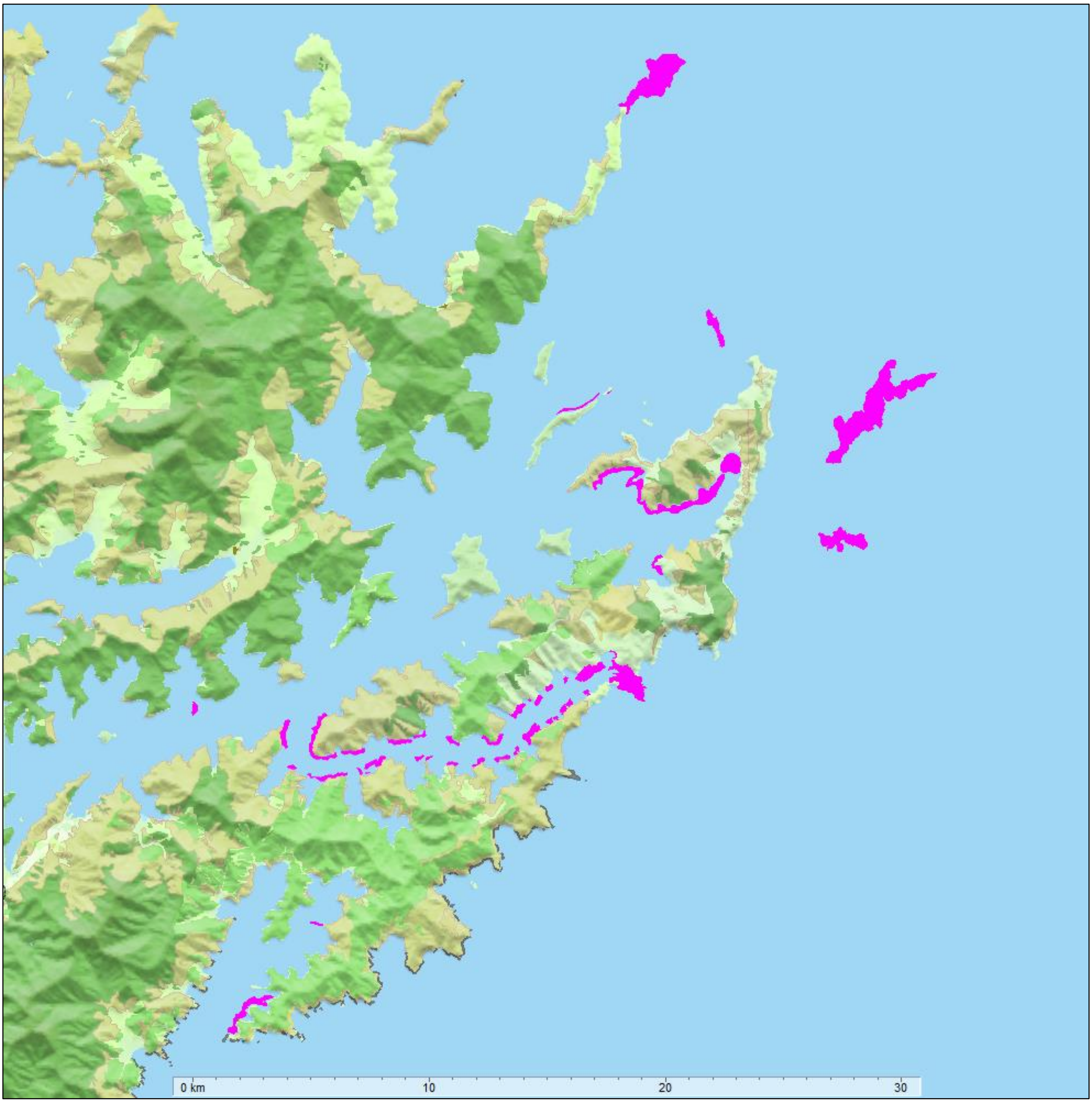


Figure 1. Location of sites (pink polygons) included in the present report.

Table 4. Summary of recommended significant site changes in 2020.

Site	Change type	Original sites (2011)	Original area (ha)	Recent surveys	Previous area (ha)	Recommended area (ha)	Recent change (ha)	Change %	Benthos type	Reason for change	Notes
Site 4.16 Perano Shoal (tubeworm mounds)	Edit boundary	2011	3.78	2015	5.46	8.14	2.68	49.1	Rocky and soft	New data	
Site 4.23 Matiere Point (lampshell and burrowing anemone)	Edit boundary	2011	20.25	2015	10.93	12.41	1.49	13.6	Rocky and soft	New data	
Site 4.24 Onauku head (scallop and horse mussel)	Edit boundary	2011	63.20			52.67	-10.53	16.7	Soft	New data	
Site 4.25 East Bay north (lampshells, anemones and tubeworm mounds)	Edit boundary	2011	120.47			167.07	46.60	38.7	Rocky and soft	New data	
Site 5.4 Tory Channel west (biogenic patch reefs)											
5.4a Ruaomoko Point	Edit boundary	2011		2015	64.95	36.00	-28.95	44.6	Rocky and soft	New data	
5.4b Wiriwaka Point	Edit boundary	2011	11.06	2015	16.32	13.85	-2.47	15.2	Rocky and soft	New data	
5.4c Tokaroro Point	Edit boundary	2011	4.20	2015	7.42	8.30	0.88	11.8	Rocky and soft	New data	
5.4d Te Uira-Karapa Point	Edit boundary	2011	9.77	2015	16.34	14.15	-2.19	13.4	Rocky and soft	New data	
5.4e Katoa point	Edit boundary			2017	3.31	2.90	-0.41	12.4	Rocky and soft	New data	
5.4f Te Weka Bay	Edit boundary			2017	4.50	0.49	-4.02	89.2	Rocky and soft	New data	
5.4g Moioio Point	Edit boundary			2017	4.19	3.79	-0.40	9.6	Rocky and soft	New data	
5.4h Kaihinui Point	Edit boundary			2017	4.95	2.28	-2.68	54.0	Rocky and soft	New data	
5.4i Papatea Point	Edit boundary			2017	7.57	5.02	-2.55	33.6	Rocky and soft	New data	
5.4j Tio Point (originally site 5.6)	Edit boundary	2011	3.63		6.28	5.94	2.31	36.8	Rocky and soft	New data	
5.4k Motukina Point	Edit boundary			2017	7.97	9.05	1.09	13.7	Rocky and soft	New data	
5.4l Te Rua Point	Edit boundary			2017	2.13	3.13	1.00	47.2	Rocky and soft	New data	
5.4m Tapapaweke Point	Edit boundary			2017	2.16	15.84	13.68	633.8	Rocky and soft	New data	
5.4n Puhe Point	Edit boundary			2017	5.66	5.42	-0.23	4.1	Rocky and soft	New data	
5.4o Konini Point (originally part of 5.4a)	Edit boundary	2011				11.90	11.90	100.0	Rocky and soft	New data	
5.4p Otamango Point to Onapua (originally site 5.3)	Edit boundary	2011	20.37			17.62	-2.75	13.5	Rocky and soft	New data	
5.4q Tikimaeroero Point (originally site 5.2)	Edit boundary	2011	3.34			4.19	0.85	25.6	Rocky and soft	New data	
5.4r Dieffenbach (originally site 5.1)	Edit boundary	2011	6.31			21.45	15.14	240.1	Rocky and soft	New data	
Site 5.8 Tory Channel east (biogenic patch reefs)											
5.8a Ngamahau (south)	Edit boundary			2015	21.22	14.42	-6.80	32.1	Rocky and soft	New data	
5.8b Ngamahau (central)	Edit boundary			2015	0.67	0.55	-0.12	17.4	Rocky and soft	New data	
5.8c Ngamahau (north)	Edit boundary			2015	11.61	6.93	-4.68	40.3	Rocky and soft	New data	
5.8d Kotaitoi Bay	Edit boundary			2015	6.75	4.55	-2.20	32.6	Rocky and soft	New data	
5.8e Jacksons Bay	Edit boundary			2015	17.45	2.63	-14.82	84.9	Rocky and soft	New data	
5.8f Fishermans Bay	Edit boundary			2015	32.77	44.06	11.29	34.5	Rocky and soft	New data	
5.8g Te Rua (east)	Edit boundary			2017	19.75	23.76	4.01	20.3	Rocky and soft	New data	
5.8h Tipi Bay (west)	Edit boundary			2017	2.36	3.64	1.28	54.0	Rocky and soft	New data	
5.8i Tipi Bay (east 1)	Edit boundary			2017	1.47	1.92	1.92	131.2	Rocky and soft	New data	
5.8j Tipi Bay (east 2)	Edit boundary			2017	3.61	4.87	1.26	35.1	Rocky and soft	New data	
5.8k Thoms Bay (west)	Edit boundary			2017	3.16	4.20	1.03	32.7	Rocky and soft	New data	
5.8l Thoms Bay (east)	Edit boundary			2017	2.11	2.59	0.48	22.7	Rocky and soft	New data	
Site 5.9 Tory Channel entrance (reef)	Edit boundary	2011	120.17			114.26	-5.91	4.9	Rocky and soft	New data	
Site 6.1 The Knobbys (tubeworm mounds and reef)	Edit boundary	2011	2.42			3.41	1.00	41.2	Rocky and soft	New data	
Site 6.3 Port Underwood south-east (algae)	Edit boundary	2011	3.91			50.23	46.32	1183.3	Soft	New data	Part of a monitoring study
Site 7.1 Cape Jackson & Walker Rock (reef)	Edit boundary	2011	183.73			239.57	55.83	30.4	Rocky and soft	New data	
Site 7.2 Cape Jackson south	Remove site	2011	177.14			0.00	-177.14	100.0	Soft	New data	
Site 7.8 White Rocks (reef)	Edit boundary	2011	19.55			34.49	14.94	76.4	Rocky and soft	New data	
Site 7.10 Cook Rock to Cape Koamaru (reef)	Edit boundary	2011	94.33			306.55	212.22	225.0	Rocky and soft	New data	
Site 7.11 Brothers Islands (reef)	Edit boundary	2011	219.23			437.97	218.74	99.8	Rocky and soft	New data	
Site 7.13 Awash Rock (reefs)	Edit boundary	2011	70.82			100.96	30.15	42.6	Rocky and soft	New data	
New Site 7.15 Kokomohua Island (tubeworm mounds)	New site					0.97	0.97	100.0	Rocky	New data	
New Site 7.16 Long Island (horse mussels)	New site					0.46	0.46	100.0	Soft	New data	
New Site 5.10o-v Tory Channel north (seagrass)	New site					1.47	1.47	100.0	Soft	New data	
Total			**1157.66**		**293.05**	**1826.06**					
Change to total area of significant sites							**375.35**				

5.0 Significant sites (existing and new)

The following sections outline: (1) suggested changes to existing significant sites and (2) recommendations for new significant sites. Existing sites have been further split into a subgroup comprising sites that have many common attributes (i.e. Cook Strait reefs, islands and pinnacles). This section of the chapter introduces the group of sites followed by subsections outlining attributes specific to each Cook Strait site.

5.1 Site 4.16 Perano Shoal (tubeworm mounds)

Location: Perano Shoal is an offshore rise located in the entrance to Blackwood Bay and adjacent to the smaller Tauranga Bay, 10.7km north-east of Picton.

Features: The presence of tubeworm mounds was first documented during a dive survey in the early 1990's (Duffy *et al*., in prep). The Shoal was included as a significant site because of the high density of tubeworm mounds (Davidson *et al*., 2011). The site was surveyed in more detail by Davidson and Richards (2015) and a percentage cover of damage was also established. The authors stated "the top of the shoal is between 5m and 7m depth and is predominantly exposed bedrock with few or sparse mounds. Below and surrounding the bedrock outcrop are areas of shell and fine sand, swept by low-moderate tidal currents (Hadfield *et al*., 2014)". Davidson and Richards (2015) stated Perano Shoal supported a high-density bed of tubeworms dominated by *Galeolaria hystrix*, *Spirobranchus latiscapus* and an unidentified *Serpula* sp. The authors stated mean percentage coverage recorded from diver collected quadrats was 76.67%. 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.).

New data: Anderson *et al*. (2020) conducted a new survey of Perano Shoal and confirmed the presence of continuous tubeworm mounds from 5.9m to 30m with some mounds extending beyond the base of the reef to 40m depth. The authors also reported live dog cockle beds (*Tucetona laticostata*) along the upper slopes of the Shoal in water depths of 14.1 to 25.5 m. They also suggested these beds have contributed to a shell rubble biogenic habitat located down the flanks of the Shoal. The authors recommended the existing significant site be adjusted to include these features (Figure 2).

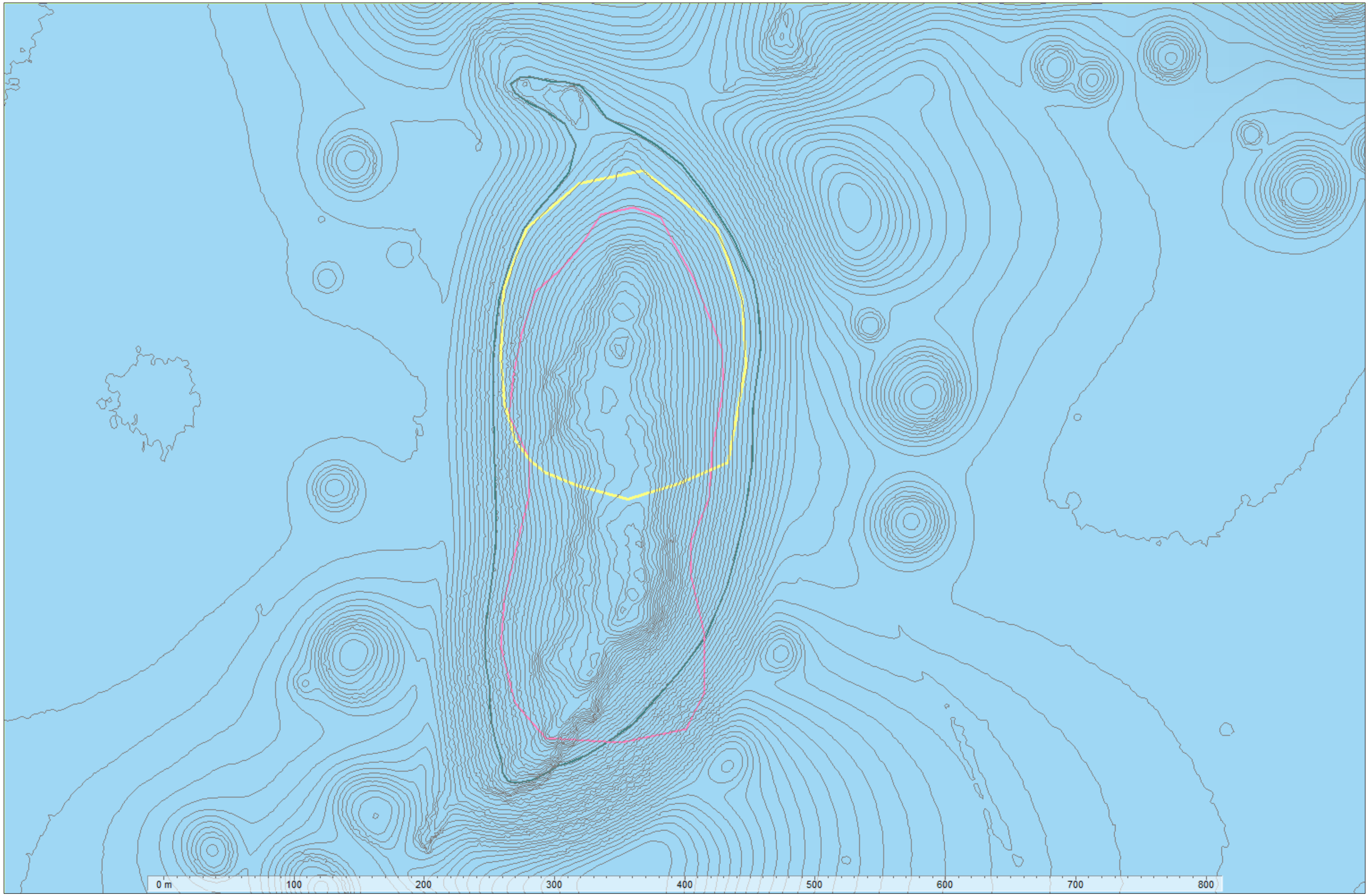


Figure 2. Perano Shoal depth contours relative to 2011 (yellow), 2015 (red) and the presently suggested 40m contour boundary (teal).

Anthropogenic issues: Davidson and Richards (2015) collected data on tubeworm mound damage from an area at the southern end of the Shoal. They observed anchor drag marks running off the high point of the Shoal into deeper waters and reported 13.6% of the substratum sampled was damaged by anchoring activities.

Anderson *et al*. (2020) reported widespread damage to *Galeoaria* mounds at 36% of their 47 sample sites where mounds were recorded in Queen Charlotte Sound and Tory Channel.

Plate 1. *Galeolaria hystrix* tubeworms at Peroano Shoal (photo Vincent Zintzen).

Table 5. Assessment of anthropogenic impacts for Site 4.16 (Perano Shoal).

Original area of significant site (ha)	3.775
Previous area of significant site (ha)	5.463
Recommended area of site (ha)	8.143
Change (ha)	2.68
Percentage change from original (%)	49.1%
Sensitivity	Very sensitive. Site support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threats	Site is located close to a natural reef thereby reducing the chance of dredging or trawling. Anchoring occurs.
Impact observed	Damage from anchoring has been previously observed and quantitatively surveyed.
Suggested buffer	100 m

5.2 Site 4.23 Matiere Point (subtidal)

Location: Matiere Point coast is located in East Bay, outer Queen Charlotte Sound.

Features: Southern parts of this site were monitored regularly for 11 years as part of a marine farm recovery study (Davidson and Richards, 2014). Giant lampshells were consistently recorded from the southern sample sites. Davidson and Richards (2015) sampled a new transect installed on the northern side of Matiere Point. The authors reported giant lampshells were present but were recorded in lower numbers compared to the southern transects sampled by Davidson and Richards (2014). Davidson and Richards (2015) reported the burrowing anemone (*Cerianthus* sp.) was regularly observed between 22m and 28m depth along the northern transect. The authors stated the site represented the best-known example of where these species co-exist along the southern coastline of East Bay, with the best site being Site 4.24 (see next section).

New data: Detailed bathymetric and multibeam sonar data were collected from this area by Neil *et al*. (2018a, 2018b). The new depth contour data were used to improve the accuracy of the depth range where burrowing anemones at this site and other sites in the Sounds (approximately 10m and 28m depth) and giant lampshells in East Bay (approximately 20m to 34m depth) had been previously determined by Davidson and Richards (2014; 2015) (Figure 3).

Anthropogenic Issues: The widespread existence of giant lampshells and burrowing anemones in East Bay may be related to low turbidity as no large freshwater inputs exist and the catchments are mostly stable. The exception is western Puriri Bay were logging activities have recently occurred. Anderson *et al*. (2020) recorded a decline in the percentage cover of red algae in Puriri Bay and commented on the presence of fine sediment over remaining plant material. The impact of this sediment on lampshells and burrowing anemones elsewhere in East Bay is not known. However, as fine clay particles flocculate rapidly in seawater and tend to settle out relatively quickly, impacts should be greatest closer to the source of any sediment carrying runoff.

Table 6. Assessment of anthropogenic impacts for Site 4.23 (Matiere Point).

Original area of significant site (ha)	20.25
Previous area of significant site (ha)	10.93
Recommended area of site (ha)	12.41
Change (ha)	1.49
Percentage change from original (%)	13.6%
Sensitivity	Sensitive. Supports species, habitats or communities that can tolerate low-level anthropogenic seabed disturbance due to the nature of the substrata, community, species and/or hydrodynamic regimes (i.e. tolerant of occasional recreational anchoring). Not tolerant of dredging and trawling.
Threats	Site is located along and close to a rubble bank thereby reducing the chance of dredging or trawling. Anchoring is possible. Logging of pine plantation in Puriri Bay has likely increased turbidity in the local area. The impact of sediment at this site is not known.
Impact observed	No damage from anchoring has been previously observed.
Suggested buffer	50 m

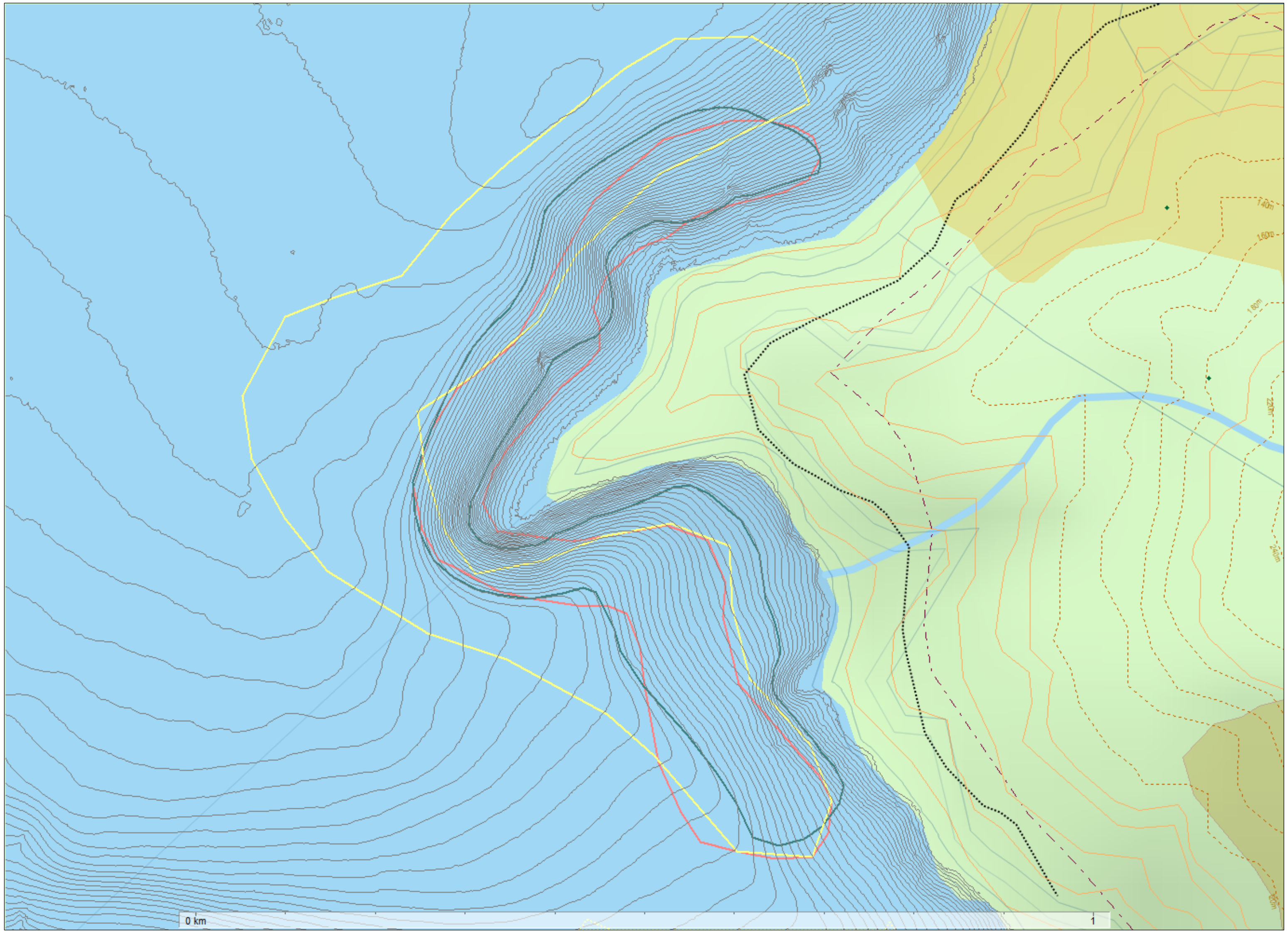
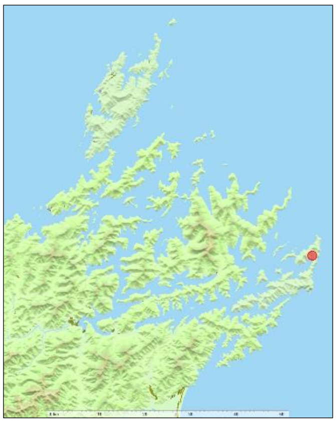


Figure 3. Matiere Point depth contours relative to 2011 (yellow), 2015 (red) and the presently suggested boundary ranging from approximately 10 to 34 m depth (teal).

5.3 Site 4.24 Onauku Bay head (subtidal)



Location: Onauku Bay is located at the northern end of East Bay, outer Queen Charlotte Sound (Plate 2).

Features: The site was established as a horse mussel study site by Cameron Hay (DSIR) in the 1980s, however, data produced from that study was not published. The area is closed to trawling and dredging (MPI closure FRC4023).

Historically, the head of Onauku Bay is known as a reliable recreational scallop fishery, however, locals report their abundance varies from year to year. In this area, scallops and horse mussels are generally most abundant from approximately 4 m to 26 m depth, however, they can be found outside this depth range.

New data: New bathymetric data by Neil *et al*. (2018a, 2018b) has accurately plotting depth contours in the bay (Figure 4). This has enabled delineation of depths where horse mussel and scallops are historically known to be most common.

Plate 2. Head of Onauku Bay, East Bay.

Anthropogenic issues: Onauku Bay head was included as a significant site by Davidson *et al*. (2011) because it is one of the few areas in Marlborough that support scallops and horse mussels protected from commercial bottom fishing by MPI regulations. The area is not, however, protected from recreational dredging during open scallops seasons. Davidson *et al*. (2011) stated horse mussels are known in the area but their abundance is likely influenced by recreational scallop dredging.

Table 7. Assessment of anthropogenic impacts for Site 4.24 (Onauku Bay head).

Original area of significant site (ha)	63.2
Previous area of significant site (ha)	
Recommended area of site (ha)	52.67
Change (ha)	-10.53
Percentage change from original (%)	-16.7
Sensitivity	Sensitive. Supports species, habitats or communities that can tolerate low-level anthropogenic seabed disturbance due to the nature of the substrata, community, species and/or hydrodynamic regimes (i.e. tolerant of occasional recreational anchoring). Not tolerant of dredging and trawling.
Threat	Site is protected from commercial trawling. Recreational dredging occurs during scallop seasons. Anchoring occurs. Logging of pine plantation in Puriri Bay has likely increased turbidity in the local area. The impact of sediment at this site is not known.
Impact observed	No
Suggested buffer	50 m

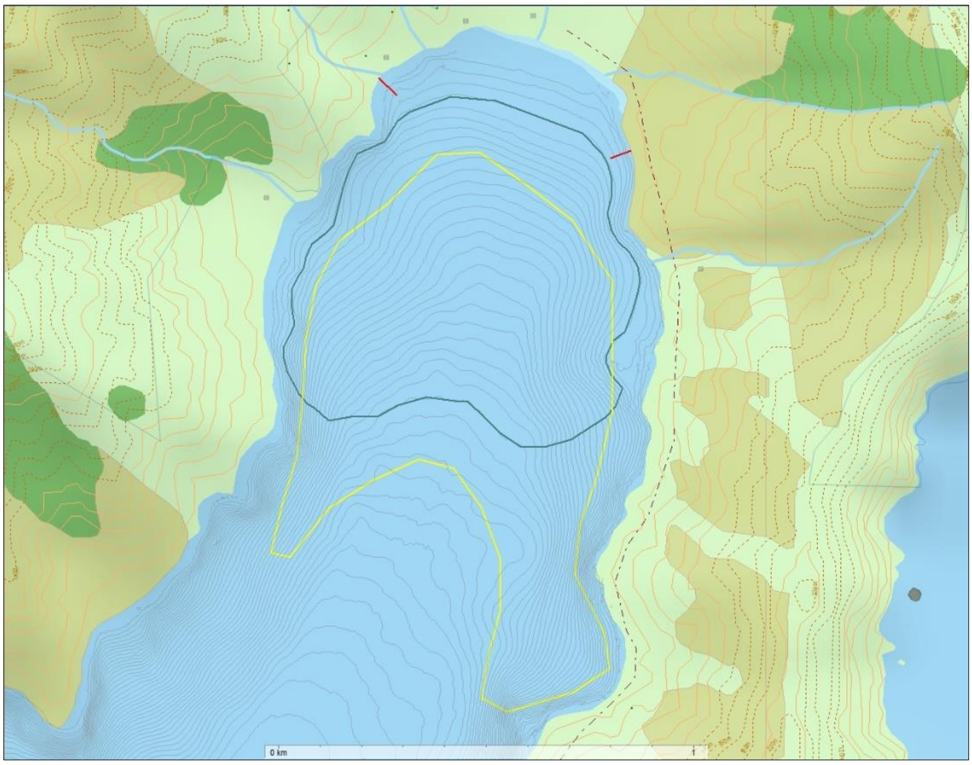
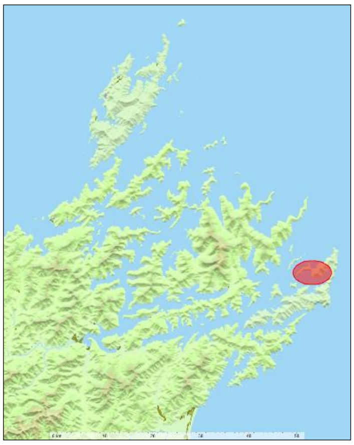


Figure 4. Onauku Bay head depth contours relative to 2011 (yellow) and the presently suggested boundary ranging from approximately 4 to 26 m depth (teal).

5.4 Site 4.25 East Bay north (lampshell and burrowing anemone)



Location: The East Bay north site stretches some 7.3 km along the coastline from Onario Point in the west to Paerata Point in the east (Figure 5).

Features: The site was first described by Davidson *et al*. (2011). Several unpublished survey dives were conducted along this coast and confirmed the presence of giant lampshells (*Neothyrus lenticularis*) (Plate 3), burrowing anemones (*Cerianthus* sp.), anemone (*Epiactus* sp.) and *Galeolaria hystrix* tubeworm mounds.

Giant lampshells were present at an average density of 1.4 per m^2 between 24 and 32 m depth, however, more recent studies have shown giant lampshell can be present at 20m depths in East Bay (Davidson and Richards, 2014).

New data: New multibeam survey data by Neil et al. (2018a, 2018b) has enabled accurate plotting of depth contours and other habitat information to delineate where species, communities and habitats of special interest are likely to occur.

At this site, a depth range of 16 m to 42 m was selected as it captured the foot of the shore slope where giant lampshells will likely be present. It is recognised that some tubeworm mounds will be located at depths less than 16 m, however, these mounds are patchily distributed and have not been surveyed in sufficient detail to enable accurate mapping.

The decline in the site size from 2011 is due to the increased level of depth contour information available (Figure 5).

Anthropogenic issues: This significant site is located on the shore slope and is a mix of rocky and soft substrata. As such is it unlikely to be dredged or trawled. Recreational fishers anchor along this coast and may damage tubeworm mounds. Most species should be able to cope with the present level of human-related impacts (Table 8).

Table 8. Assessment of anthropogenic impacts for Site 4.25 (East Bay north).

	63.2
Previous area of significant site (ha)	
Recommended area of site (ha)	52.67
Change (ha)	-10.53
Percentage change from original (%)	-16.7
Sensitivity	Very sensitive and sensitive. Tubeworm mounds are very sensitive and cannot physical disturbance. Other species are sensitive and can tolerate low-level anthropogenic seabed disturbance.
Threat	Recreational fishers anchor along this coast. Site unlikely to be trawled or dredged.
Impact observed	No, but some tubeworm mound damage is probable.
Suggested buffer	100 m

Plate 3. *Neothyrus lenticularis* in East Bay.

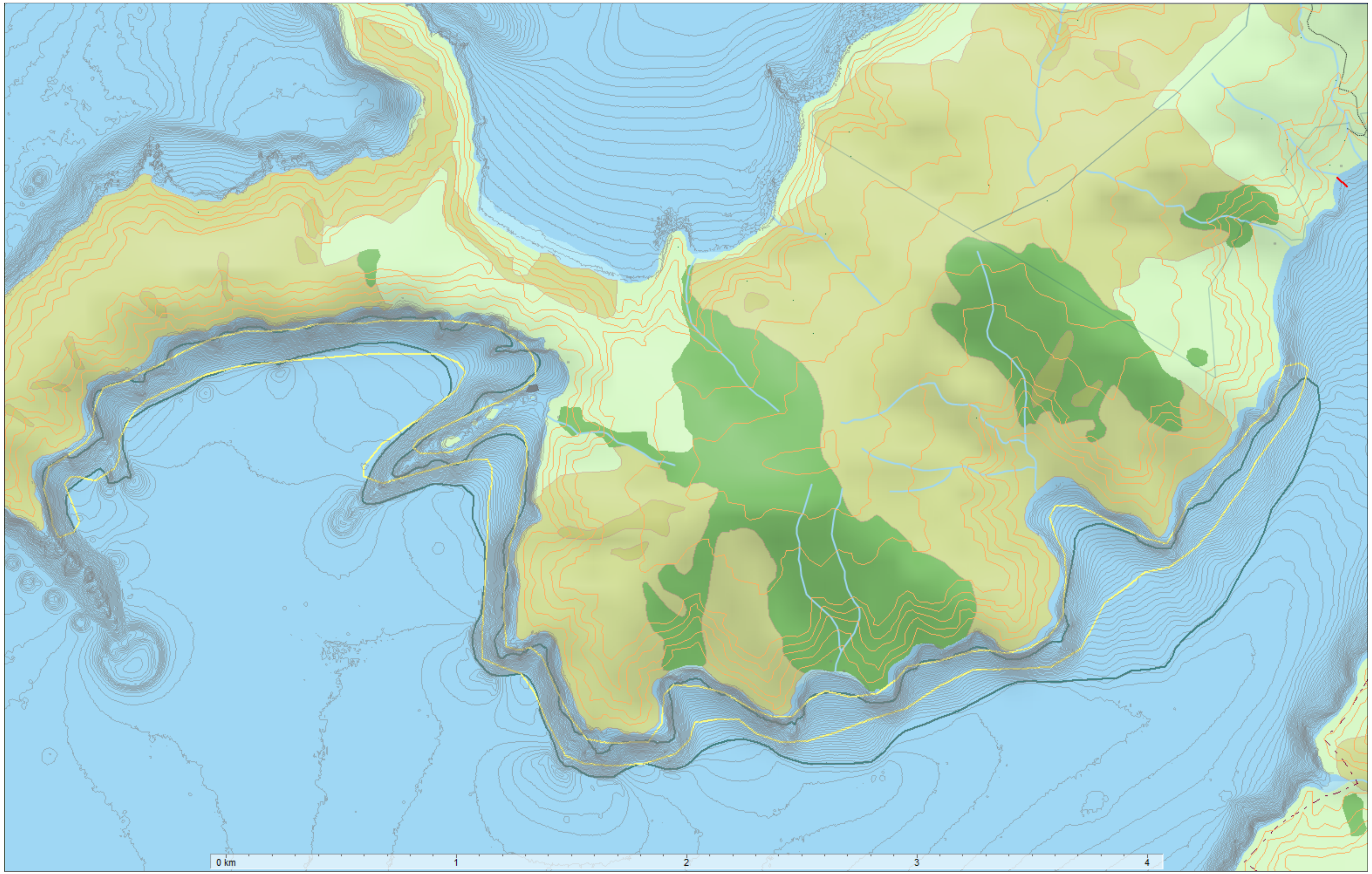


Figure 5. East Bay north original 2011 significant site (yellow) and the presently suggested boundary extending between approximately 16m to 42m depth(teal).

5.5 Site 5.4 Tory Channel west (biogenic patch reefs)

Location: Tory Channel west subsites are located in the western half of the Channel between Dieffenbach Point and Te Rua Bay.

Features: Tory Channel (west) is comprised of 18 subsites ranging in size from 0.49 ha to 36 ha (Table 4, Figure 6). These subsites were first described by Davidson *et al*. (2011), Davidson and Richards (2015) and Davidson *et al*. (2017b). Davidson *et al*. (2011) stated the often steep edges of Tory Channel comprise combinations of bedrock, boulder, cobble and shelly habitats that are swept by strong and regular tidal currents. As a result of the substrate and tidal flows, they support a variety of biogenic habitat-forming species including bryozoans, sponges, hydroids and ascidians (Plate 4). Davidson and Richards (2015) noted these sites also often included shallow reef habitats with a high cover of macroalgae. Based on a threshold of 10% cover, Davidson *et al*. (2017b) suggested the addition of new sub-sites at several locations (mean biogenic cover was 28.7 %, + /- 17.8 SD).

New data: New multibeam survey data by Neil et al. (2018a, 2018b) has enabled accurate plotting of depth contours and other habitat information to delineate where species, communities and habitats of special interest are likely to occur. Subsites increased or decreased in size due to the increased level of depth contour information available.

Davidson *et al*. (2017b) reported biogenic communities along Tory Channel were generally found between 10 m and 50 m depth provided currents were present. Suggested significant sites have also been extended to low tide based on previous recommendations from the MDC expert review panel.

Anderson *et al*. (2020) also collected new data from some of these subsites. The authors suggested Dieffenbach Point reef, deep reef and deep soft-sediment habitats be added. The authors reported deep reef supporting a rich variety of encrusting invertebrates down to 50m depth. Anderson *et al*. (2020) stated "deep reefs were characterised by extremely steep and jagged rock walls, ledges and fissures, with notable amounts of conglomerate/biogenic covering (cement-like crust over the reef surface, likely a mix of relict biological material from encrusting bryozoans, epiphytic bivalves, barnacles, and other species found growing in clumps across these reefs). Rock walls and ledges were densely covered by invertebrate communities, where white barnacles densely covered ridgelines, zones of small rock anemones covered upper rock walls, dense patches of jewel anemones occurred on the mid-sections of the rock faces, with both charcoal-grey and large-sized bleach-white *E. alata* sponges projecting out from exposed rock ledges. Other taxa included brachiopods, dense patches of epiphytic bivalves, solitary sea squirts and colonial ascidians, hydroids, large digitate sponges, large red-purple rock anemones, cup corals (mostly deep), a few individual green-lipped mussels, and some hard encrusting and erect bryozoans." The authors also reported deep soft sediments (>55m depth) supported high numbers of a new species of burrowing holothurian (*Thyone* spA.) (Plate 5).

Anthropogenic issues: Davidson *et al*. (2017b) stated no biogenic habitats of the type found in Tory Channel are protected in Marlborough and these community types are vulnerable to damage. Tory Channel is closed to commercial trawling but some dredging for kina has historically occurred (Table 9).

Table 9. Assessment of anthropogenic impacts for Site 5.4 (Tory Channel west).

Original area of significant site (ha)	58.67
Previous area of significant site (ha)	183.76
Recommended area of site (ha)	181.31
Change (ha)	0.21
Percentage change from original (%)	0.4
Sensitivity	Very sensitive Subsites support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	Recreational fishers regularly anchor along this coast. Parts of some subsites are vulnerable to dredging.
Impact observed	No, but anchor damage is probable
Suggested buffer	100 m

Plate 4. A biogenic mound dominated by *Celleporaria* from western Tory Channel area.

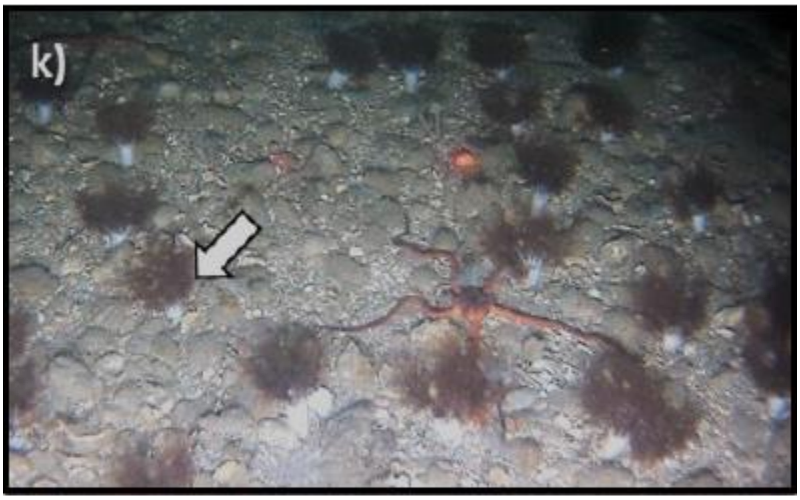


Plate 5. Burrowing sea cucumber (*Thyone* spA) images collected by Anderson *et al*. (2020) in Tory Channel.

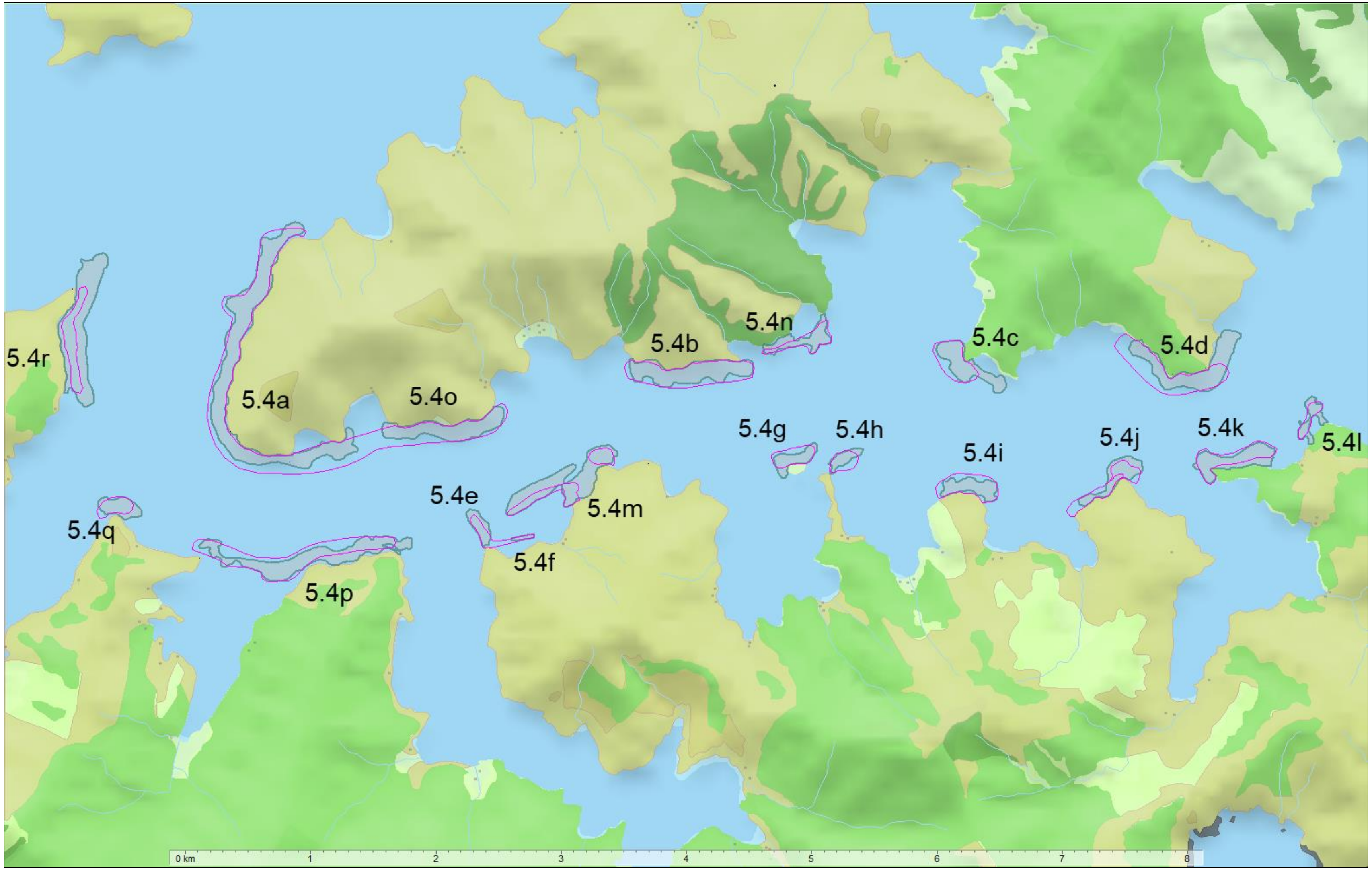
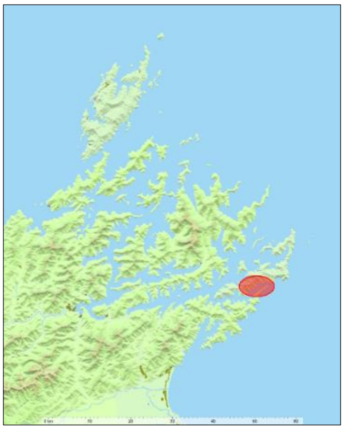


Figure 6. Tory Channel west (sub-sites 5.4) 2015 significant subsites (red) and the presently suggested boundaries (teal-grey).

5.6 Site 5.8 Tory Channel east (biogenic patch reefs)



Location: Tory Channel east subsites are located in the eastern half of the Channel between Te Rua Bay and Okukari Bay near the entrance.

Features: Tory Channel (east) is comprised of 12 subsites ranging in size from 0.55 ha to 44.06 ha (Table 4, Figure 6). These subsites were first described by Davidson and Richards (2015) and Davidson *et al*. (2017b). Davidson *et al*. (2017b) stated the often steep edges of Tory Channel comprise combinations of bedrock, boulder, cobble and shelly habitats that are swept by strong and regular tidal currents. As a result of the substrate and tidal flows, they support a variety of biogenic habitat-forming species including hydroids, bryozoans, sponges, and ascidians. These subsites are similar to subsites located in the western Channel; however, the composition of biogenic species is distinct, the most notable difference being the abundance of hydroid trees (*Solanderia* sp.) in the eastern areas of Tory Channel, particularly along the northern side of the Channel between Ngamahau and Fishermans Bay.

Davidson and Richards (2015) stated these sites also often included shallow reef habitats with a high cover of macroalgae. Based on a recommended threshold of 10%, Davidson *et al*. (2017b) suggested the addition of new sub-sites at several locations (mean biogenic cover was 37.8 %, + /- 24.7 SD).

New data: New multibeam survey data by Neil *et al*. (2018a, 2018b) has enabled accurate plotting of depth contours and other habitat information to delineate where species, communities and habitats of special interest are likely to occur. Subsites increased or decreased in size due to the increased level of depth contour information available.

Davidson *et al*. (2017b) reported biogenic communities along Tory Channel were generally found between 10 m and 50 m depth provided currents were present. Suggested significant sites have also been extended to low tide based on previous recommendations from the MDC expert review panel.

Anderson *et al*. (2020) also collected new data from some of these subsites. These authors stated reef-slopes have moderate to high relief with various combinations of rocky reef and biogenic-reef structure supporting diverse and colourful filter-feeding communities. They stated biogenic-reef structure was characterised by a convoluted cement-like crust over the reef surface in varying amounts. The authors also found mixed species of hydroids were a characteristic feature of most deep-reef slopes including a variety of small fern-like and fan morphologies occurring at most Tory Channel sites, along with larger hydroid trees (*Solanderia* sp.) more commonly seen at outer Tory Channel sites. Anderson *et al*. (2020) analysed video data and shore slope data and found richest reef-slope communities were in depths of >20 m and at slope angles >30 degrees.

Anthropogenic issues: Davidson *et al*. (2017b) stated no biogenic habitats of the type found in Tory Channel are protected in Marlborough and these community types are vulnerable to damage. Tory Channel is closed to commercial trawling but some dredging for kina has historically occurred (Table 10).

Table 10. Assessment of anthropogenic impacts for Site 5.8 (Tory Channel east).

Original area of significant site (ha)	122.92
Previous area of significant site (ha)	
Recommended area of site (ha)	114.11
Change (ha)	-7.34
Percentage change from original (%)	-6
Sensitivity	Very sensitive Subsites support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	Recreational fishers regularly anchor along this coast. Parts of some subsites are vulnerable to dredging.
Impact observed	No
Suggested buffer	100 m

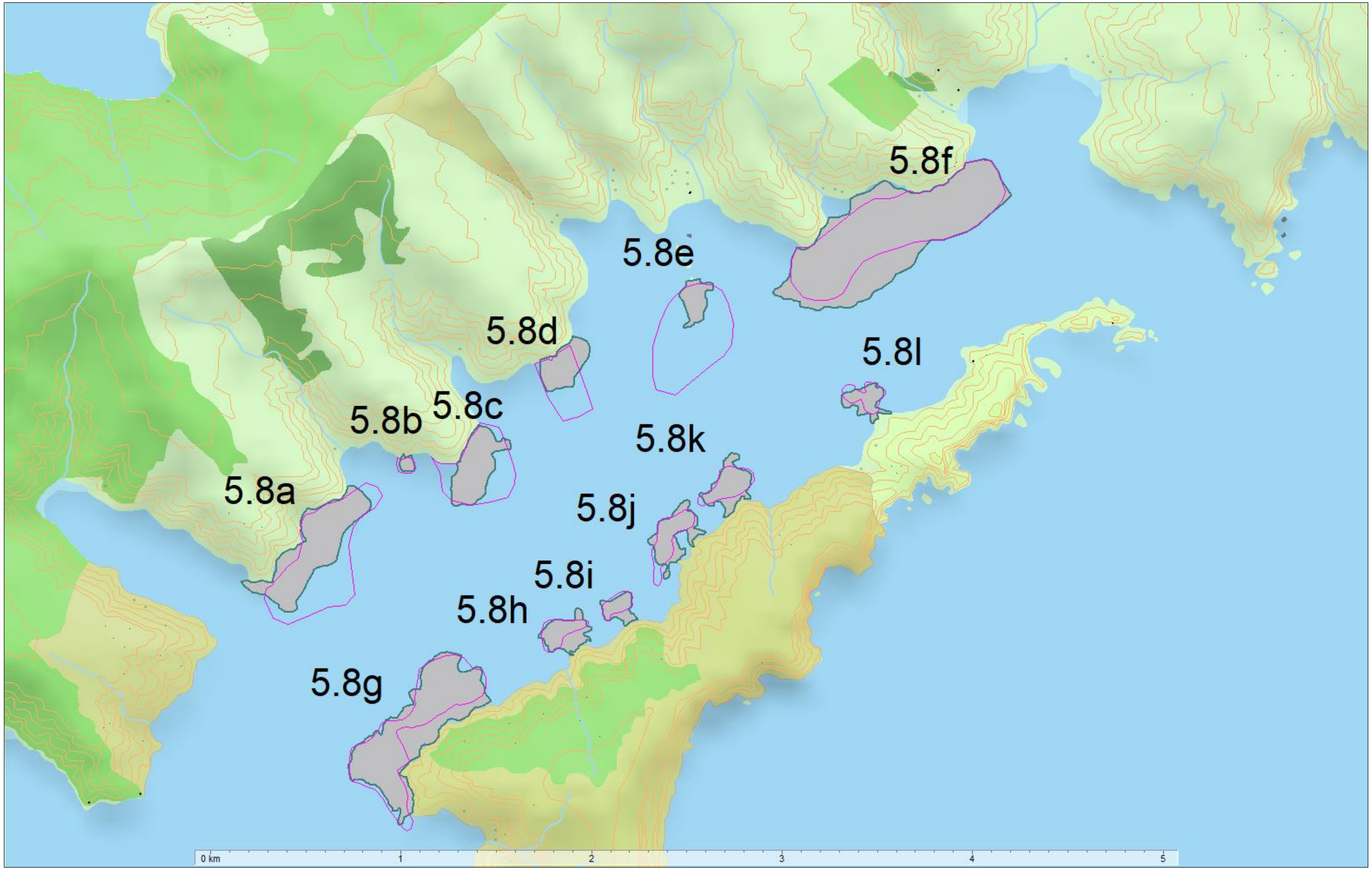


Figure 7. Tory Channel east original 2015 significant subsites (red) and the presently suggested boundaries (teal-grey).

5.7 Site 6.1 The Knobbys (tubeworm mounds and reef)

Location: The Knobbys Reef lies approximately 2.5 km from Ngakuta Bay near the head of the eastern arm of Port underwood and 6.6 km from the seaward entrance to the Port (Plates 6 & 8).

Features: The Knobbys is a shallow ridge dominated by pebbles, coarse sands and broken and dead shells with rocky outcrops along its length. The site was first described by Davidson (1993) during a marine farm survey. Davidson (1993) stated "most outcropping rock was colonised by very large colonies of tubeworms which formed mounds up to 20m x 10 m diameter and up to approximately 3 m in height. These colonies appeared healthy with few areas of dead worms. Extensive shallow beds of red algae (*Adamsiella* spp.) were recorded over soft substrates along much of the reef." The author also noted the presence of the adventive alga *Chnoospora minima* (Nelson and Duffy, 1991) that formed a mat over the benthos south-east of the reef. Davidson *et al*. (2011) stated these mounds were some of the largest known from Marlborough and one of two areas of dense colonies known from Port Underwood.

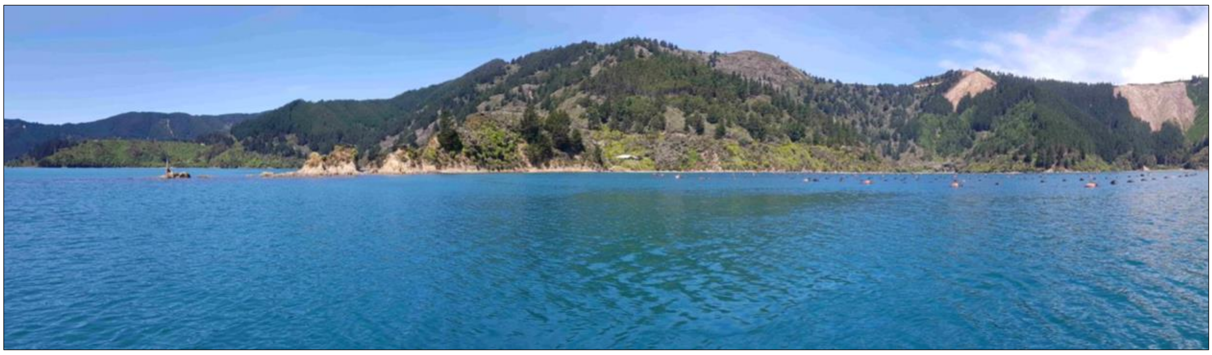


Plate 6. The Knobbys (left), adjacent coast and nearby mussel farm.

New data: The site was investigated using sonar and a drop camera as part of the present study in December 2019. The extent of the reef structure was found to be longer than originally described (Plate 7, Figure 9). Tubeworm mounds were observed from four of the 19 photos. Most photos showed a high cover (usually 100%) of macroalgae (*Adamsiella* spp.; *Choospora minima*). It is probable macroalgae beds obscured the detection of more tubeworm mounds and a dive inspection is recommended.

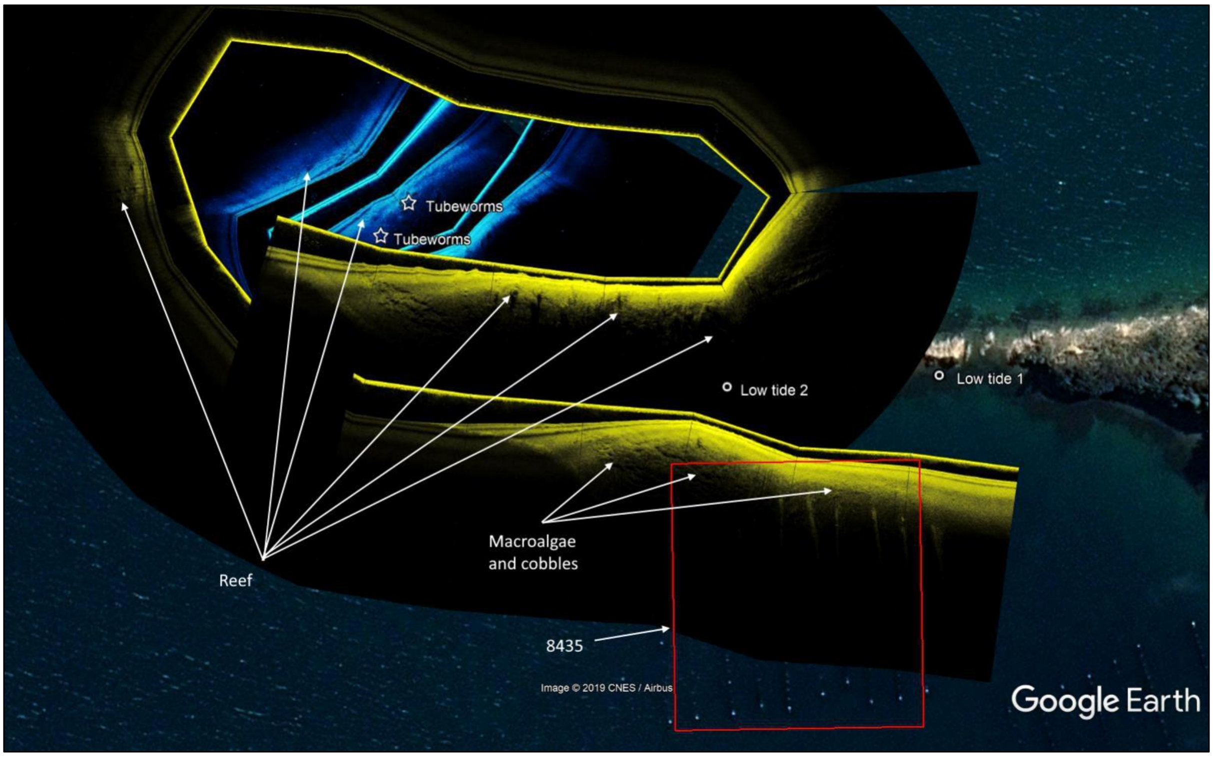


Plate 7. Sonar data collected from The Knobbys showing the reef, tubeworm mounds and adjacent marine farm (red).

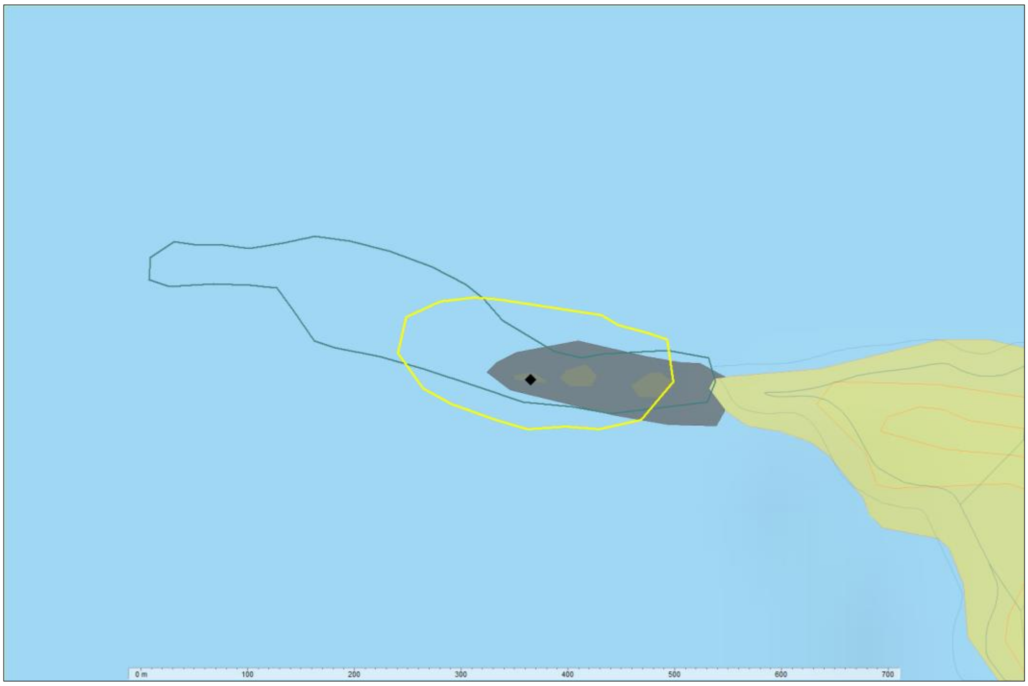


Figure 8. The Knobbys original 2011 significant site (yellow) and the presently suggested boundary (teal).

Anthropogenic issues: The site supports tubeworm mounds that have been recognised as being a very sensitive biogenic habitat. The remainder of the reef supports macroalgae beds comprised of native and an introduced species.

Threats to this site are most likely from physical damage and sediment smothering (Table 11). Much of the hillsides surrounding Port Underwood have been logged over the last 10 years (Plate 8). Some recreational fishing occurs in the Port and occasional anchoring may occur at The Knobbys. Dredging and trawling are unlikely due to the presence of the reef structure. The adjacent marine farm does not appear to have impacted the reef.

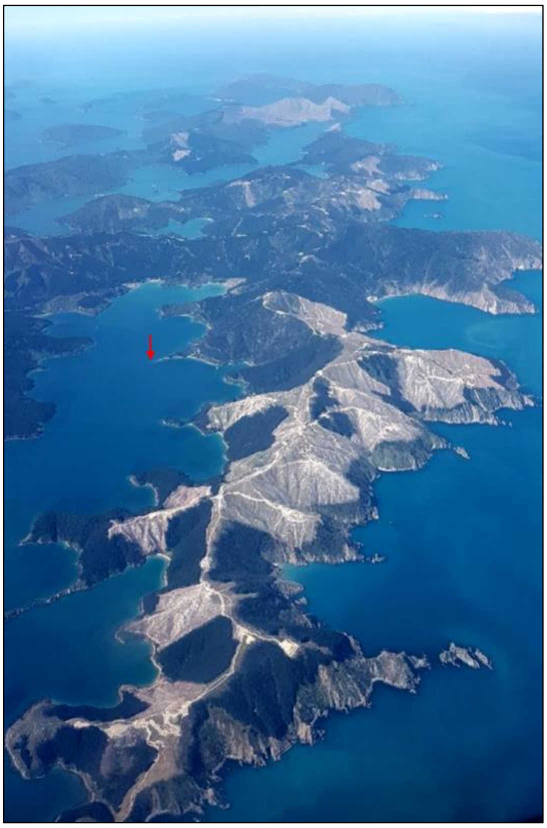


Plate 8. Aerial photo of eastern Port Underwood and The Knobbys (red arrow). (L. Richards, 2017).

Table 11. Assessment of anthropogenic impacts for Site 6.1 (The Knobbys).

Original area of significant site (ha)	2.42
Previous area of significant site (ha)	
Recommended area of site (ha)	3.41
Change (ha)	1
Percentage change from original (%)	41.2
Sensitivity	Very sensitive and sensitive The site supports tubeworm mounds that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling). Macroalgae beds can tolerate low-level disturbance but are likely to be intolerant of sediment smothering.
Threat	Recreational fishers may anchor. Sediment levels are likely elevated due to recent forest logging.
Impact observed	Yes, sediment was observed on algae foliage.
Suggested buffer	100 m

5.8 Site 6.3 Port Underwood south-east (algae bed)

Location: The Port Underwood south east algae site is between Robertson Point and Pipi Bay (Figure 9).

Features: The site was initially described in Davidson *et al*. (2011) in Cutters Bay where a bed of macroalgae (mostly *Adamsiella* spp.) was observed growing on soft sediment. More recent surveys and a marine farm monitoring programme have shown the macroalgae bed to be more widespread than originally thought. (Figure 10). Davidson (2015) reported the red algae beds were characterised by a range of red algae species with stations located in the north-east dominated by different species than the south and west (Plate 9). In the north, one of the dominant species is the adventive *Chnoospora minima,* a brown alga that forms a mat over the benthos (Nelson and Duffy, 1991). Centrally, the red algae *Adamsiella* spp. are often abundant and, further south the bed is dominated by Rhodymenia sp.

New data: A variety of data has been collected at this site since 2013 (see Davidson *et al*. 2019c) (Figure 9). Data from several marine farm reconsenting studies have been used to map the extent of the macroalgae. Macroalgae appear to vary in abundance between years and also seasonally with lowest percentage covers recorded in winter. Davidson *et al*. (2019c) recorded macroalgae was found on soft substrata between approximately 9 and 15m depth with summer mean percentage ranging from 75 % to 95% cover. Davidson *et al*. (2019) also recorded the presence of a small and localised patch of *Bispira bispira* spA; it is not known if this species is introduced or native (G. Reid,NIWA, pers comm.).

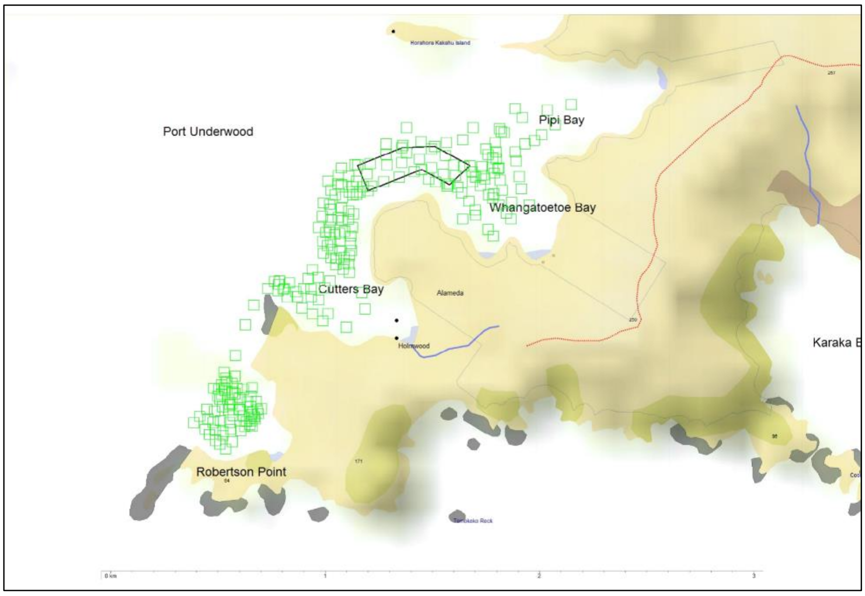


Figure 9. Location of drop camera stations collected in by Davidson (2013) used to define the red algae bed.

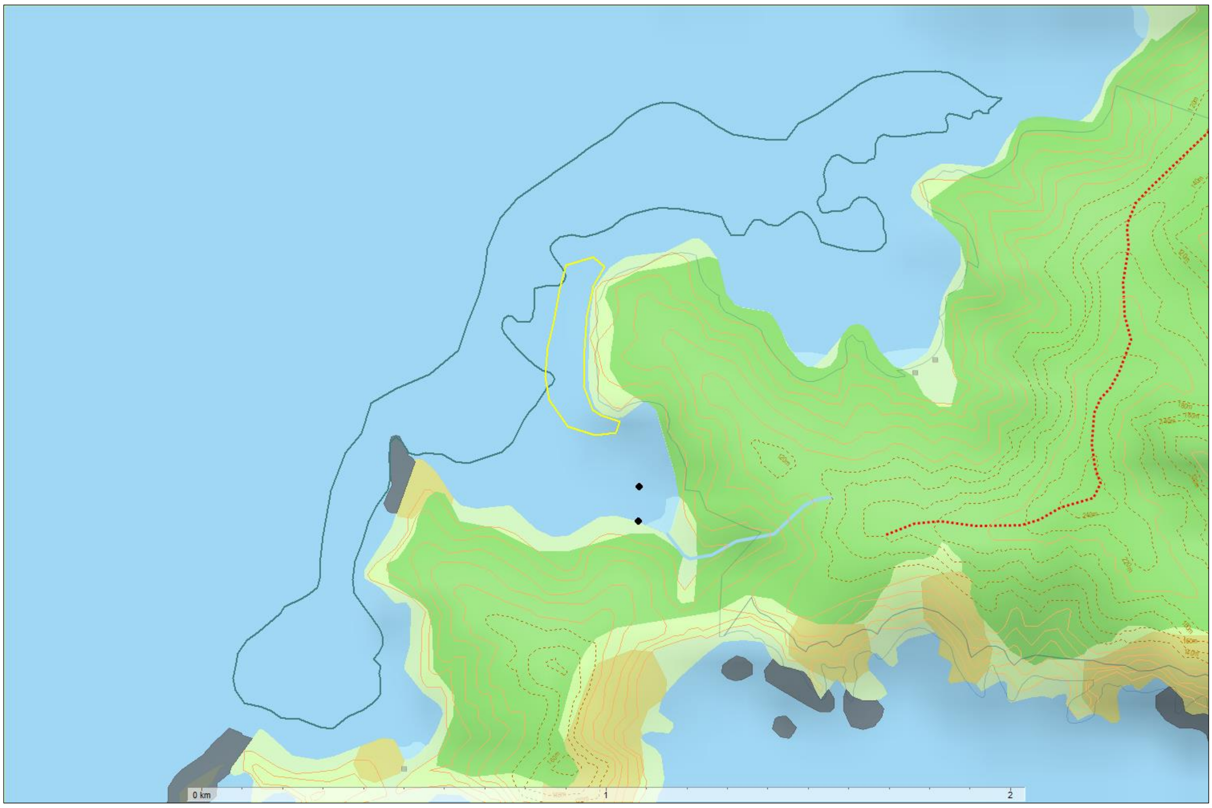


Figure 10. Location of south-east Port Underwood macroalgae site (teal-grey) relative to the original 2011 boundary (yellow).

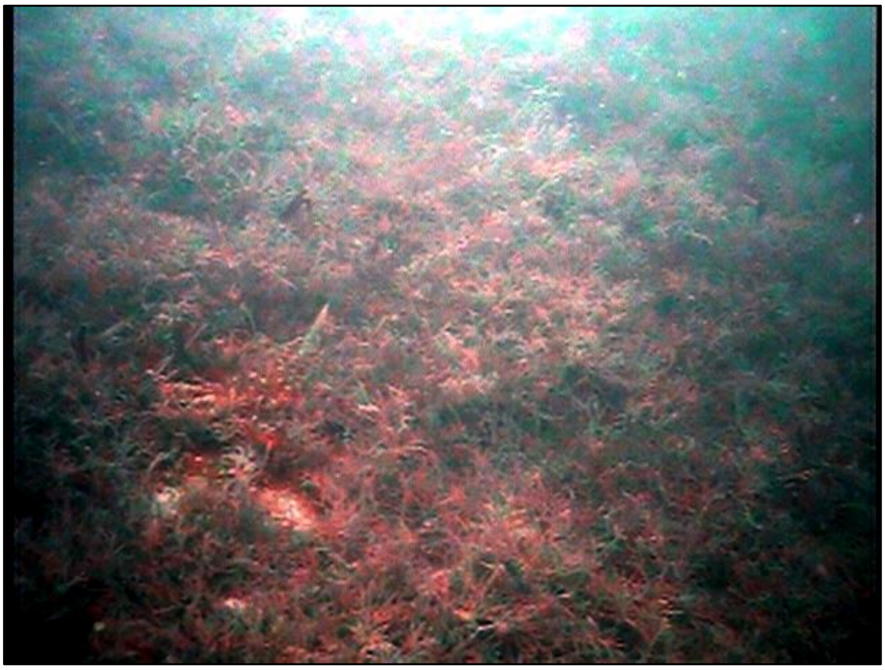


Plate 9. Red algae bed from Port Underwood.

Anthropogenic issues: Macroalgae is regarded as a sensitive biogenic habitat former as it can be impacted by sediment smothering and/or shading (Table 12). Considerable areas of Port Underwood have been logged and this has likely increased sediment inputs into the bay. Marine farms can shade the benthos which in some circumstances may cause a decline in algae percentage cover. In some instances, marine farms have little or no apparent effect on algae cover (Davidson *et al.* 2019c).

Table 12. Assessment of anthropogenic impacts for Site 6.3 (Port Underwood macroalgae).

Original area of significant site (ha)	3.91
Previous area of significant site (ha)	
Recommended area of site (ha)	50.23
Change (ha)	46.32
Percentage change from original (%)	1183%
Sensitivity	Sensitive Site supports species, habitats or communities that can tolerate low-level anthropogenic seabed disturbance due to the nature of the substrata, community, species and/or hydrodynamic regimes (i.e. tolerant of occasional recreational anchoring). Not tolerant of dredging and trawling.
Threat	Marine farms may shade the benthos. Sediment levels are likely elevated due to recent forest logging.
Impact observed	Macroalgae can decline in some circumstances under marine farm lines.
Suggested buffer	50 m

5.7 Cook Strait reefs, islands and pinnacles

The following section provides information common to all Cook Strait sites outlined in this report. This section of the report is followed by site-specific data unique to each site.

Locations: All six Cook Strait significant sites are located in or directly adjacent to Cook Strait between Cape Jackson southwards to the entrance to Tory Channel.

Features: All sites were first described by divers during a DOC qualitative survey of 260 sites throughout the Marlborough Sounds (Duffy *et al.,* in prep). Based on diving data, these sites were included as significant sites in Davidson *et al*. (2011). Diver observations revealed that species, communities and habitats were comparable between all Cook Strait sites (i.e. Cape Jackson, White Rocks, The Brothers Island, Cook Rock, Tory Channel Entrance and Awash Rock). It is noted, however, that there are biological aspects that distinguish each reef, but these are not presently well known due to the difficulties sampling these sites.

Plate 10. Cook Strait reef covered in biogenic habitat-forming species (Photo Steve de C Cook).

Davidson *et al*. (2011) stated these areas were poorly known due to strong tidal flows and depths. Diver surveys by Duffy *et al*., (in prep.) described an abundance of encrusting species such as bryozoans, hydroids, zoanthids and sponges (Plates 10 & 12). Davidson *et al*. (2011) argued these sites were significant because Cook Strait reefs, islands and pinnacles were swept by high currents, were not a common or widespread habitat in Marlborough, and they supported a distinct range of species, usually in very high abundance. Further, the remote location and regular bad weather limited fishing and netting which resulted in a rich and diverse range of fish. The authors also argued the wide range of water depths, wave exposures and good light penetration increased the variety of habitats, species and communities.

Plate 12. Cook Strait reef smothered in sponges and zoanthids (Photo Steve de C Cook).

New data: New bathymetric data by Neil *et al*. (2018a, 2018b) has enabled accurate plotting of depth contours at all of the Cook Strait sites. This high detail bathymetry was used to delineate depth ranges where previously described species, communities and habitats of special interest are likely to be most common. The new bathymetric data were combined with diver collected data collected by previous authors to better describe the location of features likely to be assessed as significant. Where possible sites were also extended up to the low water mark based on previous recommendations from the significant site expert review panel.

Anderson *et al*. (2020) investigated many of the Cook Strait sites including Walker Rock, Cook Rock, The Brothers, Awash Rock and an unnamed reef in the entrance to Tory Channel. The authors stated that not all reef systems could be surveyed due to difficult conditions. Anderson *et al*. (2020) reported systems comprised extremely high-relief reefs comprising rock walls, ridgelines, ledges, and steep ravine with vertical heights of ≤10-40 m and slope angles ≤58-78 degrees.

The authors reported shallow reefs below the kelp zone were often dominated by *Caulerpa* meadows (Plate 13). The authors stated, *Caulerpa* spp. distributions were restricted to highly exposed rocky reef areas in water depths of 3.8 m down to 26.8 m, although dense meadows were most common in depths of 10-20 m. The densest and most extensive meadows recorded from Waihi Point at Cape Jackson and White Rocks down to two Cook Strait reefs either side of the entrance into Tory Channel.

Plate 13. *Caulerpa brownii* meadow in Cook Strait (photo R. Davidson).

Anderson *et al*. (2020) recorded some species of note from these reef systems. The authors stated the sponge "*Ecionemia alata* is a common New Zealand sponge species known to grow up to 1 m in diameter and although variable in colour generally ranges from shark-grey to charcoal grey colour (Kelly, 2015). Both the bleach-white colour morph and the extreme sizes of this species on the deep reefs in Cook Strait provide new records for this species (M. Kelly pers. comm.). Although the colouration of *E. alata* is variable, this bleach-white colour morph is a new record for this species (M. Kelly pers. comm.), while the exceptionally large *E. alata* sponges (≥1.5 m in diam.) from these sites provide new max. size records for New Zealand (M. Kelly pers. comm.). The extraordinarily large sizes and bleach-white colouration of *E. alata* sponges along with the sheer number of these sponges on some deep reefs (especially Cook Rock) were very impressive, and contributes to the uniqueness of these deep reef systems."

Anderson *et al.* (2020) also noted "goose barnacles, identified from video-images are likely *C. villosa* (Andrew Hosie, barnacle specialist at Western Australian Museum), and appear to be new records for the Marlborough Sounds region. These goose barnacles were recorded from all three deep reef systems (Cook Rock, The Brothers and Te Whētero) and five out of the six video-sites in depths of 90.7 m down to 130.5 m. One Tory Channel site, inside the entrance to Tory Channel, appeared to have six small clusters of goose barnacles on the high-current cobble-rock bottom in the main channel."

Overall, Anderson *et al*. (2020) reported all six Cook Strait sites shared very similar community structures, where virtually all rock surfaces were covered by a diverse, densely-packed and colourful assortment of encrusting and sessile filter-feeding organisms, characterised by various mixtures of diverse sponges (incl. bleach-white *E. alata* sponges the size of tractor tyres), bright yellow zoanthids (*Parazoanthus* sp.), dense patches of goose barnacles (cf *Calantica villosa*), hydroids, ascidians, jewel anemones, soft bryozoans, clusters of epiphytic bivalves, brachiopods and cup corals.

5.7.1 Site 5.9 Tory Channel entrance (biogenic patch reefs)

Location: Site 5.9 reef is located where Tory Channel exists into Cook Strait.

Features: Davidson *et al*. (2011) stated the site is one of the best Marlborough examples of a very strong tidal current habitat (Plate 14).

New data: Neil *et al*. (2018a, 2018b) for bathymetric data.

Anderson *et al*. (2020) reported their Tory Channel entrance reef transect traversed up-slope from 112 m to 80 m distance over very high-relief steep ridges with some flat reef tops interspersed by narrow gullies infilled with pebbles, cave-like recesses and sloping ledges. The authors reported this reef supported an abundance of large yellow cup sponge (*Stellata crater*) which was a key species characterising the sponge gardens seen on the upper slopes and reef tops. These sponge gardens supported a colourful assortment of other sponge species and morphologies includng: the cream-brown sponges (*Polymastia* cf *massalis*), orange and red strappy sponges (*P. sinclairii* and *Crella* cf *incrustans*), pink ball sponges (*Aaptos* sp.), grey chimneys (possibly *Psammocinia beresfordae*), green spheres (*Latrunculia* sp.) and orange bushy (poss. *Axinella* sp.) erect sponges along with pink spikey-looking encrusting sponge (*Darwinella gardineri*), yellow papillate sponges (*Polymastia* cf *crocea* and poss. *P. hirsuta*). While many of these sponges were seen on the other deep reefs, most were less prolific whicg the authors suggested may reflect the rarity of flat reef tops and ledges sampled at Cook Rock and the Brothers Islands.

Anthropogenic issues: The site supports sensitive species, communities and biogenic habitats. The presence of rocky substratum reduces the risk of physical damage from dredging and trawling. The site is occasionally used by recreational fishers, however, anchoring seldom attempted (Table 13). The site is swept by strong currents reducing the likelihood of sediment smothering. Cray pots are deployed along the channel edges and these likely cause damage to biogenic habitats.

Table 13. Assessment of anthropogenic impacts for Site 5.9 (Tory Channel entrance).

Original area of significant site (ha)	120.17
Previous area of significant site (ha)	
Recommended area of site (ha)	114.26
Change (ha)	-5.91
Percentage change from original (%)	-4.9
Sensitivity	Very sensitive Subsites support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	Recreational fishers seldom anchor and dredging and trawling are unlikely. Large steel cray-pots are common along the channel edges at particular times.
Impact observed	No, but physical damage is likely from cray-pots.
Suggested buffer	100 m

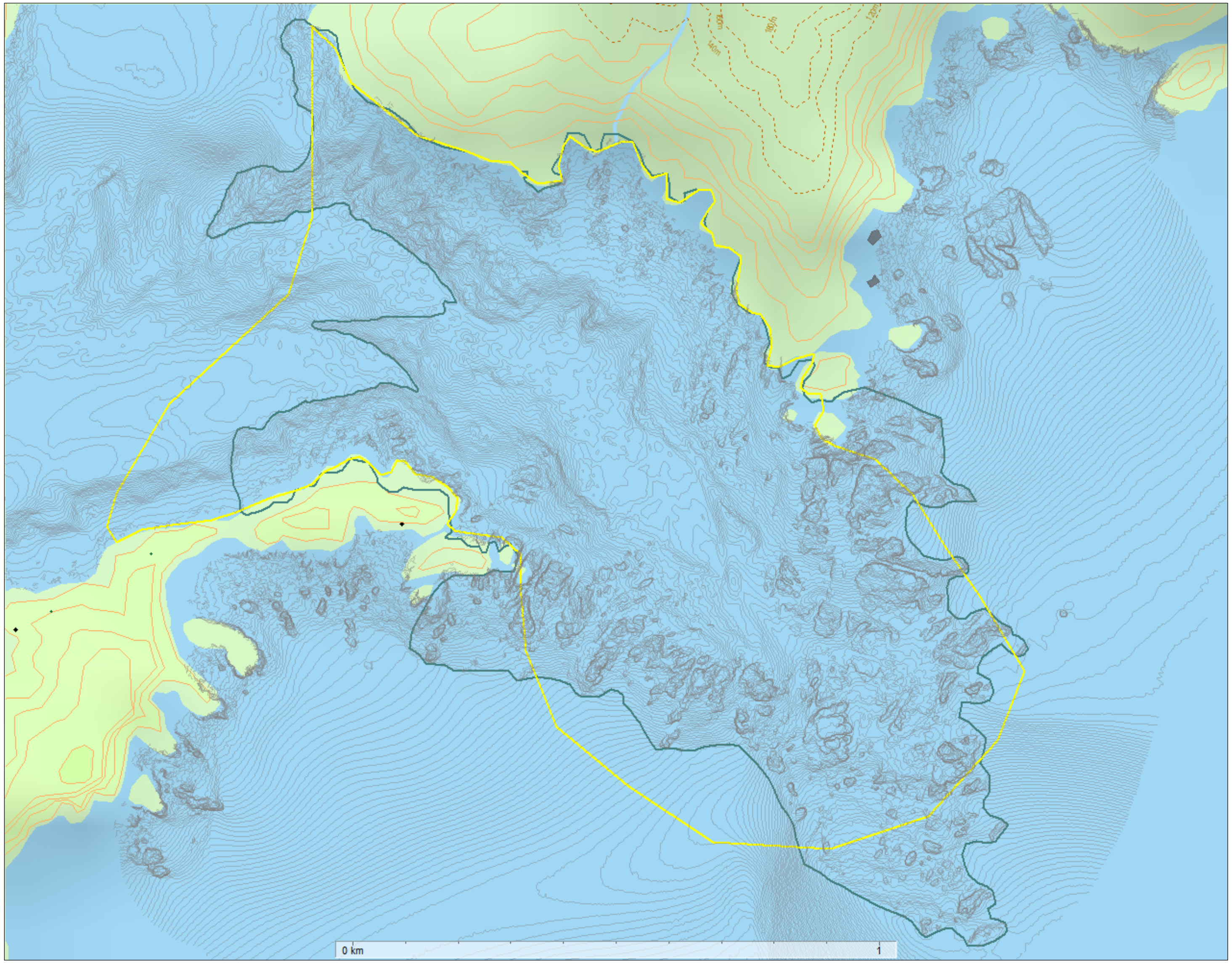


Figure 11. Tory Channel entrance original 2011 significant site (yellow) and the presently suggested boundary (teal).

5.7.2 Site 7.1 Cape Jackson & Walker Rock (reef)

Location: Cape Jackson is a long peninsula that extends into Cook Strait and forms the northern headland of Queen Charlotte Sound. Walker Rock is a rock stack located approximately 530 m distance north-east of the Cape.

Features: Duffy *et al*. (in prep.) conducted some limited diving at Cape Jackson. The authors stated: "on the east side of Walker Rock there are rocky terraces and pinnacles with clean coarse sand, pebbles and shell in pockets and gutters. Dense paddle weed forest covers the reef at 3-12m depth. Small patches of oak-leafed seaweed and urchin barrens exist. Between 12-18m thick mats of sea rimu (*Caulerpa*) cover the reef. Seaweed at this depth includes *Carpomitra costata, Plocamium costatum* and *Asparagopsis armata*. The erect, branching seaweed *Codium fragile* is also common. Slaty sponge, hydroids, colonial cup corals, zoanthids, jewel anemones and arborescent bryozoans (*Orthoscuticella* sp.) live on vertical faces and beneath overhangs".

The authors also stated "On the east side of Cape Jackson there is a band of the large barnacle *Epopella plicata* at the high watermark. Below this, there are bands of gummy weed, *Codium adherens* and *Enteromorpha* sp. narrow flapjack, *Marginariella boryana, Zonaria angustata* and green-lipped mussels form a fringe at low water. At 2-5m depth is paddleweed forest, and flexible flapjack forest from 5-11m depth. High numbers of kina create urchin barrens below approximately 11m. The substrate supports crustose coralline seaweed, encrusting sponges, colonial cup corals, jewel anemones, bivalves, and solitary and compound ascidians. The small brachiopods *Waltonia inconspicua* and *Nostosaria nigricans* are abundant. On the west side of Cape Jackson, bull kelp, narrow flapjack and sparse strap kelp are in low water to approximately 2m depth. Below this is a mixed seaweed forest dominated by flexible flapjack to 12m. From 12-18m there is scattered paddleweed, with turfing red seaweed and mats of sea rimu covering up to 90% of the seafloor."

New data: Neil *et al*. (2018a, 2018b) for bathymetric data (Figure 12).

Anderson *et al*. (2020) stated Walker Rock was a deep reef system approx. 1.3 x >3 km, north of Cape Jackson, ranging in depths from the emergent reef down to ~365 m.

Anthropogenic issues: Cape Jackson and Walker Rock comprise a reef system swept by regular and strong tidal currents. It is unlikely dredging, trawling, netting and anchoring activities occur at this site (Table 14). Sediment smothering is likely low due to the currents and its location in Cook Strait.

Table 14. Assessment of anthropogenic impacts,Site 7.1 (Cape Jackson and Walker Rock).

Original area of significant site (ha)	183.73
Previous area of significant site (ha)	
Recommended area of site (ha)	239.57
Change (ha)	55.83
Percentage change from original (%)	30.4%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the environment at this site due to rocky substrata and its remoteness
Impact observed	No
Suggested buffer	100 m

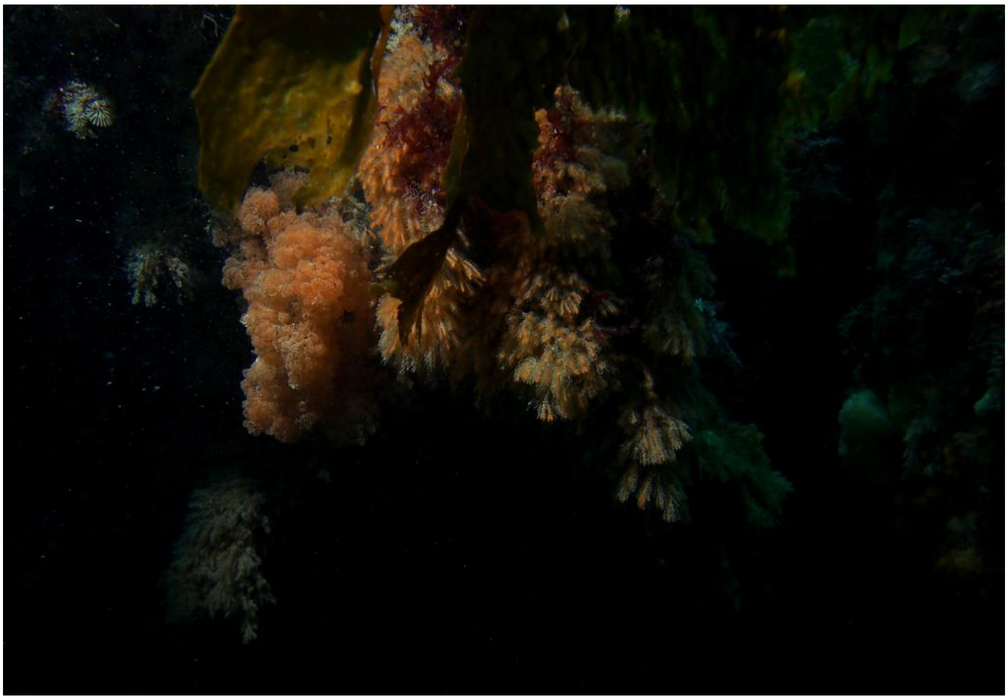


Plate 14. Bushy bryozoans around the entrance to a cave on a Cook Strait reef (photo R. Davidson).

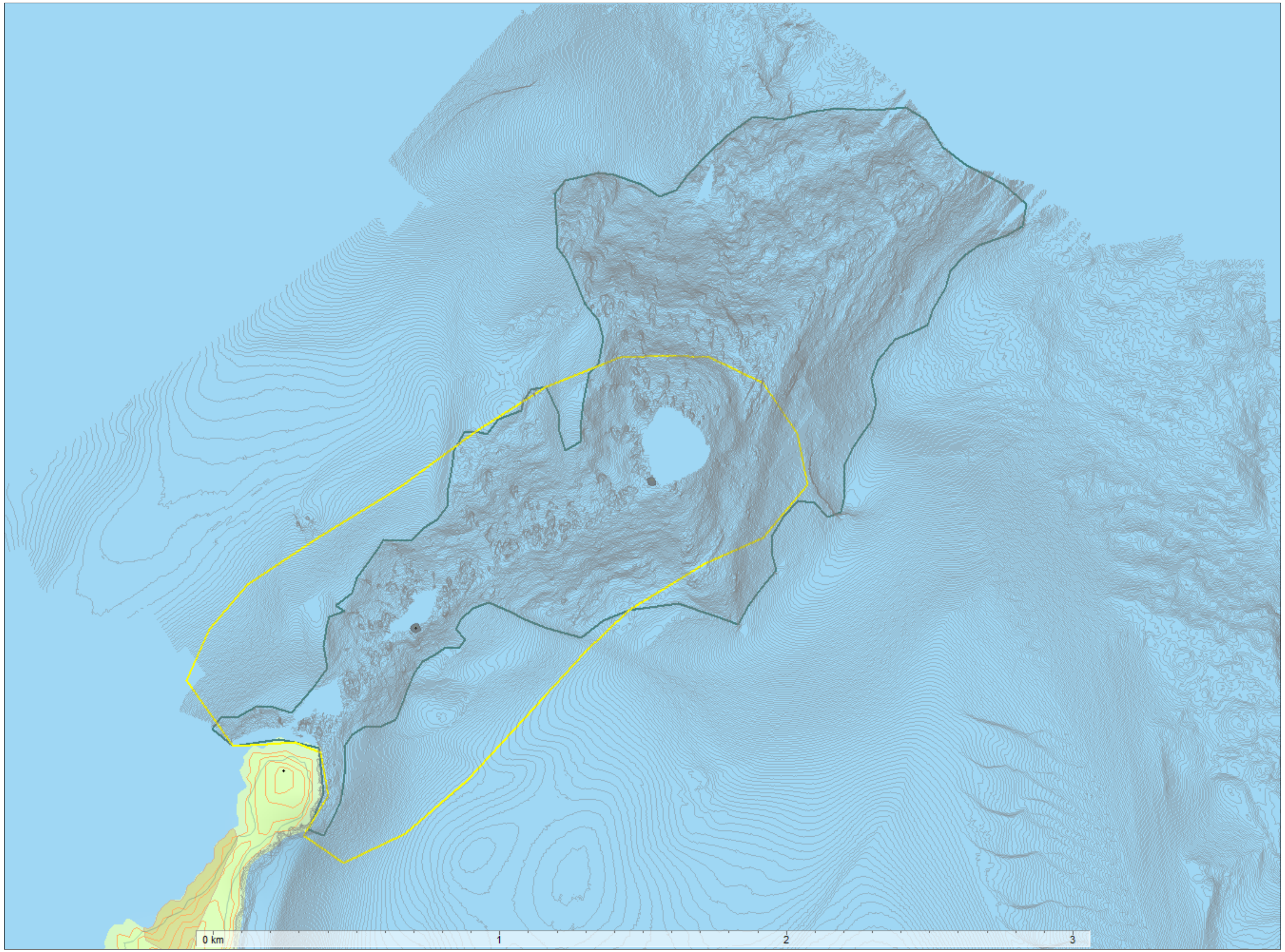


Figure 12. Cape Jackson and Walker Rock original 2011 significant site (yellow) and the presently suggested boundary (teal).

5.7.3 Site 7.8 White Rocks (reef)

Location: White Rocks are located at the entrance of Queen Charlotte Sound 2 km north-west of Cape Koamaru (Figure 15).

Features: Duffy *et al*. (in prep.) conducted some limited diving in the area. Davidson *et al*. (2011) also conducted a small number of dives at the site.

New data: Neil *et al*. (2018a, 2018b) for bathymetric data (Figure 13).

Anderson *et al*. (2020) reported "*Caulerpa* meadows were growing across the steep to near-vertical rock walls and ravine-like fractures on the reef, forming a very dense and expansive mono-specific meadow of *C. flexilis* within a depth zone of ~13-20 m (*C. flexilis* were also found in low % cover in slightly deeper and shallower sections of this reef). Overall, *C. flexilis* was present along 50% of the transect. Within the higher density '*Caulerpa*-zone', a near contiguous meadow of lush *C. flexilis* was present covering >~75-100% of the reef. Our video-transect traversed up the slope and then along and round a series of steep rock walls, spanning a meadow distance of 74 m that covered a near-continuous band of *C. flexilis*. This new footage shows *C. flexilis* to be the dominant-habitat former within this depth zone, and given the symmetrical relief structure around White Rock, would likely extend around large sections (at least the wave-exposed front and sides, if not all) of this large rock feature - within the 13-20 m depth-zone."

Anderson *et al*. (2020) also stated "On the outer exposed side of White Rocks, rock walls in 30-44 m depth comprised relatively flat rock slope with increasing steepness as we ran up slope. At 44 m depth, the angle of the slope was ~20°, with the rock surface covered in a veneer of sediment and supported a range of small sessile invertebrates characterised by orange soft bryozoans, solitary cup corals (≤8 indiv. per image), encrusting sponges, along with the sediment tolerant sponge (*P. hirsuta*). Sections of reef-slope were infilled with coarse gravelly sediments, and in places looked like a scree slope – here green soft bryozoans were common with some solitary cup corals (≤1-3 indiv. per image). Small low-relief ledges on the rock wall were encrusted with relict bryozoan-reef with various sized patches of living *C. agglutinans* also present. Further up the slope the angle steadily increased to 60°, here the rock wall supported a variety of sponge garden species including cream-brown sponges (*P*.cf *massalis*), pink ball sponge (*Aaptos* sp.), and moderate to large yellow cup sponge (*S. crater*), along with several orange strappy sponges (*P. sinclairii*) and grey chimney sponges (*P. beresfordae*). These rock walls also had a thin but noticeable veneer of fine sediments. These sponge garden species were also common on deep reefs in the entrance to Tory Channel, but markedly less than the gentler slopes down deeper."

Anthropogenic issues: White Rocks comprise a reef system swept by regular and strong tidal currents. It is unlikely dredging, trawling, netting and anchoring activities occur at this site (Table 15). Sediment smothering is likely low due to the currents and its location in Cook Strait. Occasional recreation anchoring may occur but most fishers drift fish due to tidal currents and the risk of anchor snag (authors pers. obs.). Trawling is prohibited inside a straight line from Cape Jackson to Cape Koamaru, but the area is open to scallop dredging.

Table 15. Assessment of anthropogenic impacts for Site 7.8 (White Rocks).

Original area of significant site (ha)	19.55
Previous area of significant site (ha)	
Recommended area of site (ha)	34.49
Change (ha)	14.94
Percentage change from original (%)	76.4%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the rocky and current swept environment and at this site.
Impact observed	No
Suggested buffer	100 m

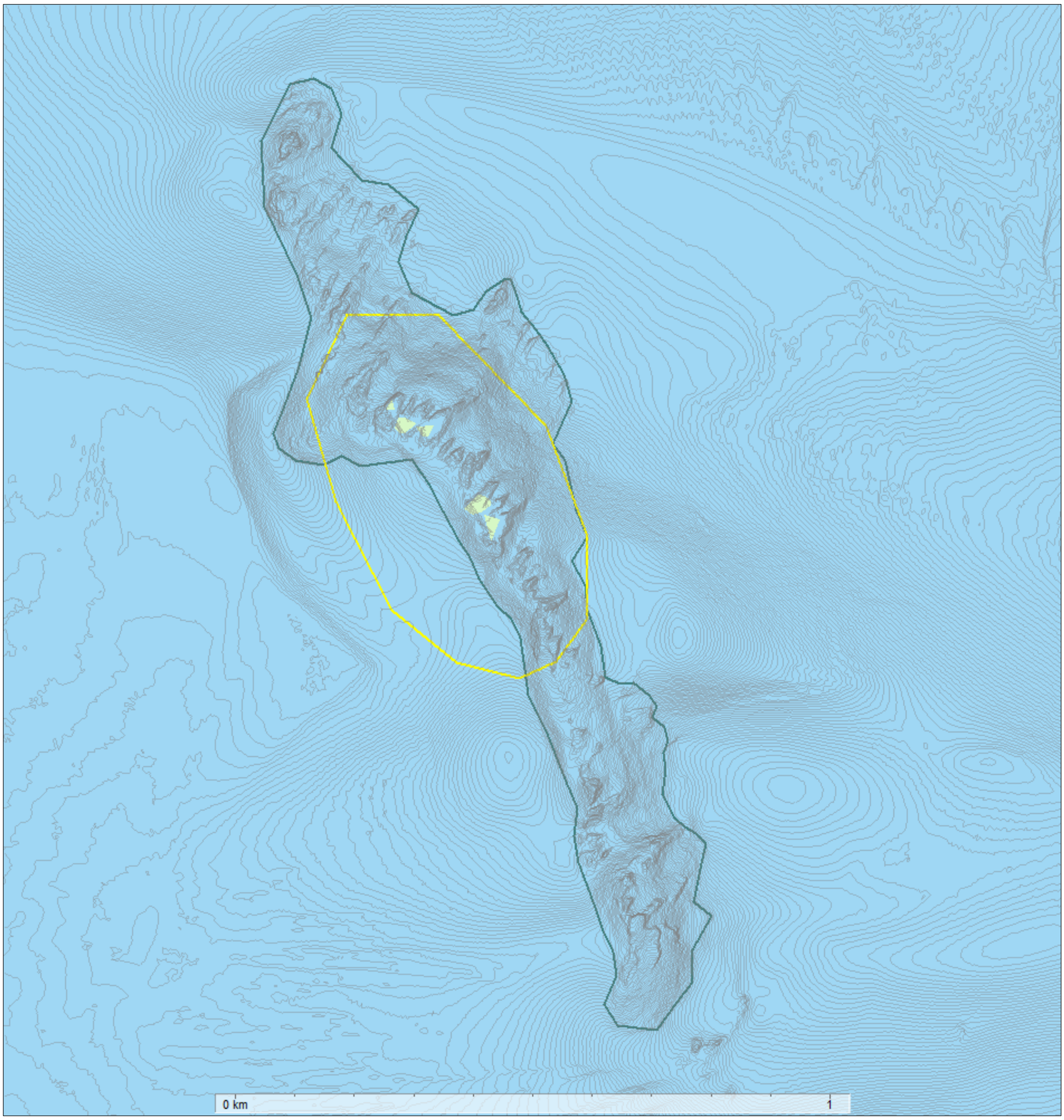
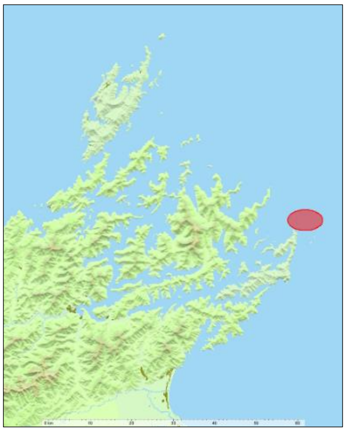


Figure 13. White Rocks original 2011 significant site (yellow) and the presently suggested boundary (teal).

5.7.4 Site 7.10 Cook Rock to Cape Koamaru (reef)



Location: Cook Rock is located offshore of the entrance to Queen Charlotte Sound. A reef extends 6.1 m north-east from Cape Koamaru to Cook Rock (Figure 14).

Features: Duffy *et al*. (in prep.) conducted some limited diving in the area. The authors described the site as having waved-exposed kelps, *Caulerpa* species and mixed fleshy sub-canopy macroalgae in depths of 0-10.5 m, while deeper reefs (>10.5-<20 m), supported diverse filter-feeding communities, characterised by "bushy bryozoans, sponges and hydroids.

New data: Neil *et al*. (2018a, 2018b) for bathymetric data (Figure 14). Anderson *et al*. (2020) stated Cook Rock reef (7km long to 176 m depth) was characterised by steep pinnacles, vertical rock walls and steep ridgelines, while in the lower sections between these ridges were sloping ledges and brief rock gullies often infilled with brachiopod and goose barnacle shell debris. Notable species included large bleached sponge *E. alata* and goose barnacle *C. villosa*.

Anthropogenic issues: Cook Rock to Cape Koamaru is a current swept reef. It is unlikely dredging, trawling, netting and anchoring activities occur at this site (Table 16). Sediment smothering is likely low due to currents and its location in Cook Strait. Occasional recreation anchoring may occur but most fishers drift fish due to currents (Authors. Pers.obs.).

Table 16. Assessment of anthropogenic impacts, Site 7.10 (Cook Rock to Cape Koamaru).

Original area of significant site (ha)	94.33
Previous area of significant site (ha)	
Recommended area of site (ha)	306.55
Change (ha)	212.22
Percentage change from original (%)	225%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the rocky and current swept environment and at this site.
Impact observed	No
Suggested buffer	100 m

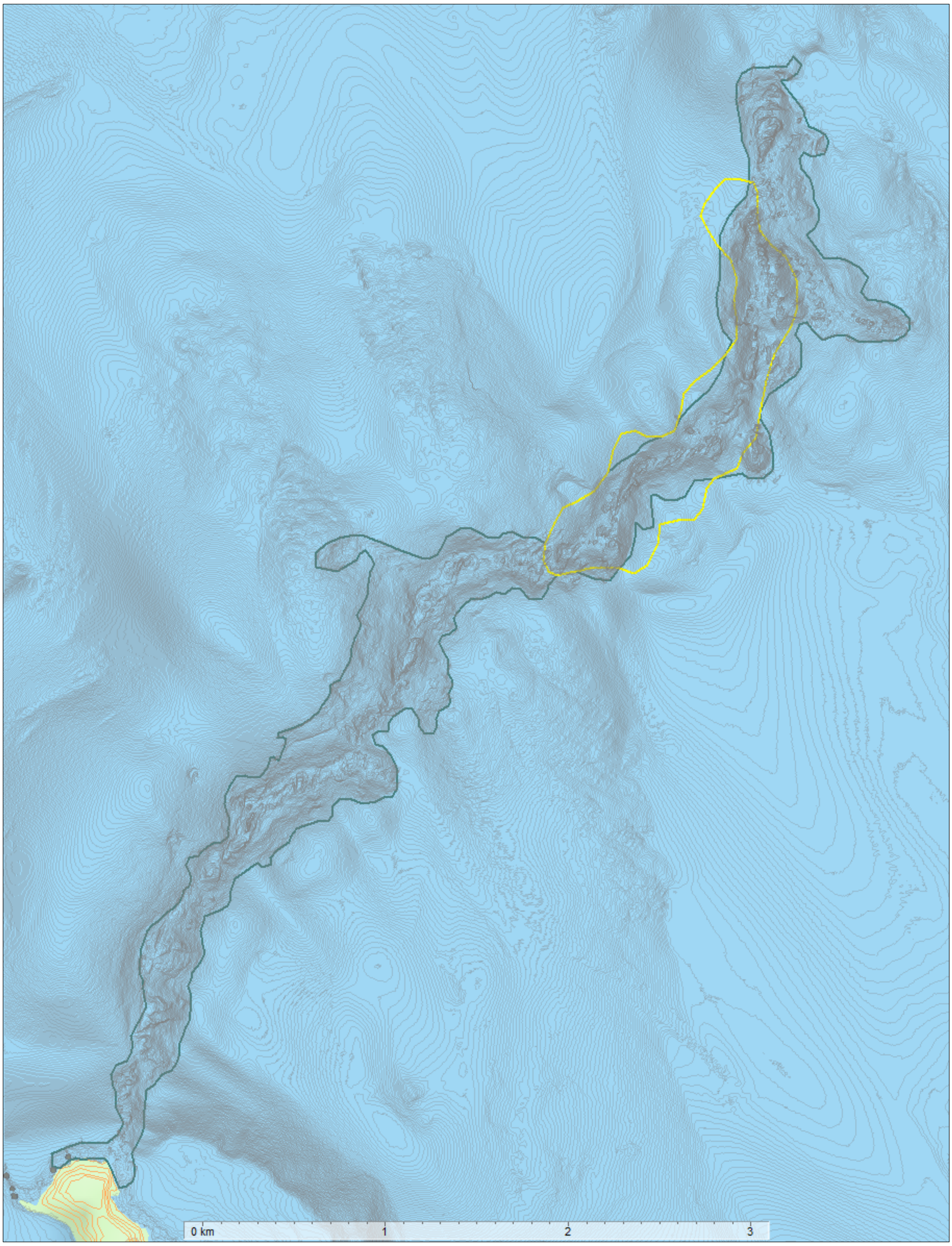
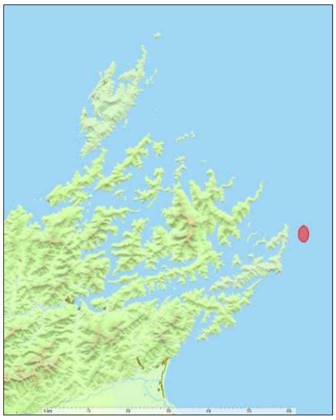


Figure 14. Cook Rock original 2011 significant site (yelllow) and the presently suggested boundary to Cape Koamaru (teal).

5.7.5 Site 7.11 The Brothers (reef)



Location: The Brothers Islands and rocky stacks are located approximately 5 km east of Cape Koamaru in Cook Strait. (Figure 15).

Features: Duffy *et al*. (in prep.) collected qualitative diving data from the reef.

New data: Neil *et al*. (2018a, 2018b) bathymetric data (Figure 15).

Anderson *et al*. (2020) stated: "The Brothers, transect began in 95 m depth near the edge of the reef in a low relief gravel and cobble field with shell debris, then over a gravel-scoured reef, quickly traversing up and over a series of steep ridges and pinnacles." The authors reported the reef-system comprised extremely high-relief reefs comprising rock walls, ridgelines, ledges, and steep ravine with vertical heights of ≤10-40 m and slope angles ≤58-78 degrees.

Anthropogenic issues: The Brothers site comprises a current swept reef. It is unlikely dredging, trawling, netting and anchoring activities occur at this site (Table 17). Sediment smothering is likely low due to currents in this offshore location. Recreational fishers rarely anchor and instead drift fish due to the risk of anchor snag (Authors. Pers. obs.).

Table 17. Assessment of anthropogenic impacts for Site 7.11 (The Brothers reef).

Original area of significant site (ha)	219.23
Previous area of significant site (ha)	
Recommended area of site (ha)	437.97
Change (ha)	218.74
Percentage change from original (%)	99.8%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the rocky and current swept environment and at this site.
Impact observed	No
Suggested buffer	100 m

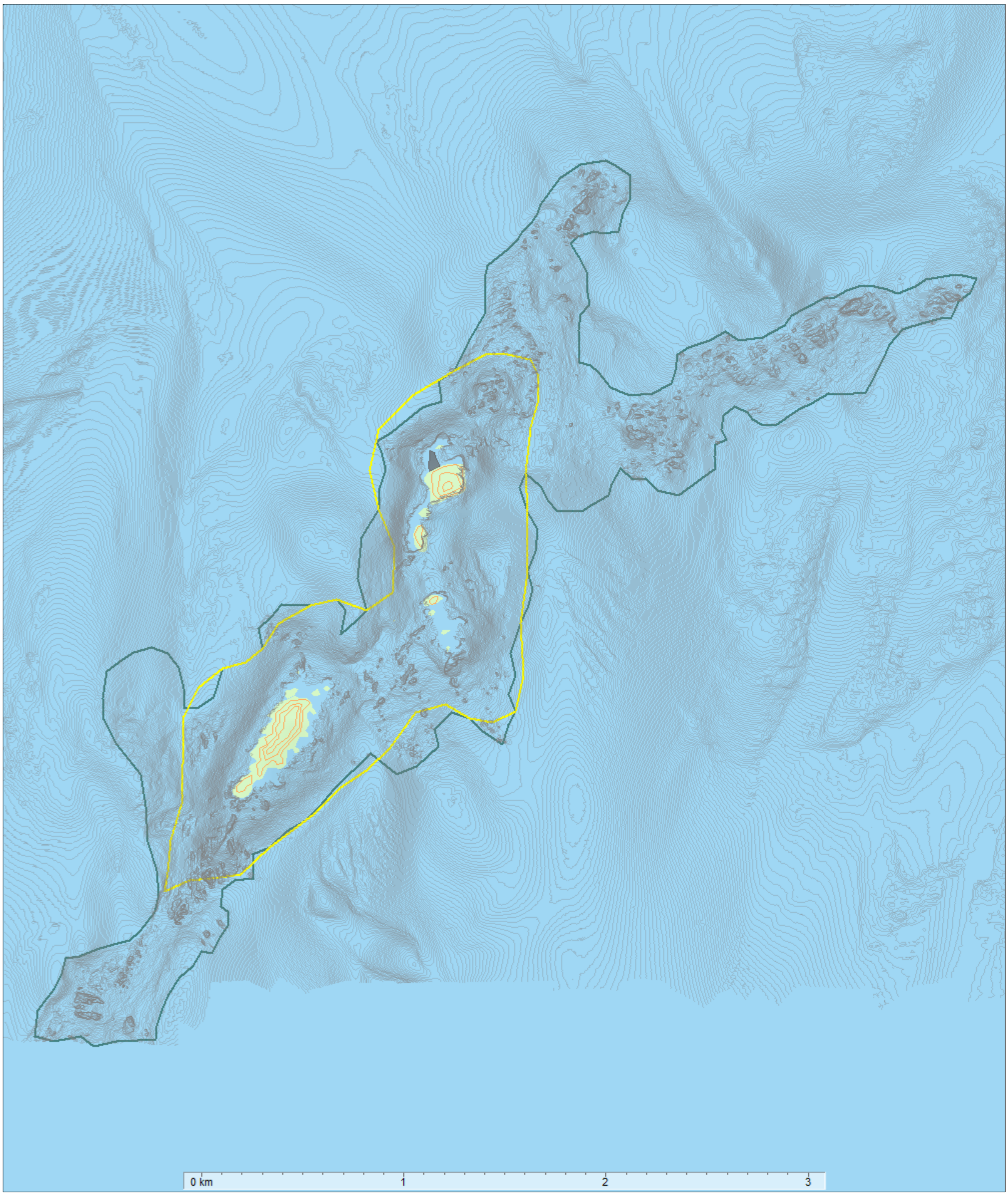


Figure 15. The Brothers reef original 2011 significant site (yellow) and the presently suggested boundary (teal).

5.7.6 Site 7.13 Awash Rock (reef)

Location: Awash Rock is a rocky pinnacle 4.4 km south of The Brothers Islands and 10.7 km north-east of Tory Channel entrance (Figure 16).

Features: Duffy *et al*. (in prep.) conducted some limited diving in the area. Based on the Duffy data, Davidson *et al*. (2011) reported "the top of the rock is covered in crustose coralline algae, short turfing species (predominantly broccoli weed, brown tongue weed, *Carpomitra costata*, branching coralline algae, *Plocamium costatum*, agar weed), common anemone, large sessile solitary ascidians and sea tulips to approximately 10.5m depth. Below, the sides of the rock are densely encrusted with large sponges, hydroid trees, colonial cup coral, jewel anemones and zoanthids (*Parazoanthus* sp.), stalked barnacles, stalked colonial ascidians (*Hypsistozoa* sp.) and sea tulips".

New data: Neil *et al*. (2018a, 2018b) bathymetric data (Figure 15).

Anderson *et al*. (2020) stated Awash Rock comprised an isolated series of deep reefs spanning approx. 1.5 x 0.8 km, in depths of 3.5 m below the sea surface down to depths of ~101 m on its eastern side. The authors also stated "a single short-duration (<1 min) drop camera that was surveyed in 20 m at Awash rock, recorded encrusting coralline algae (20-50% cover), bladed-coarse branching red alga (poss. *Euptilota formosissima* ≤ 20% cover) and fleshy brown algae (poss. *Halopteris*); along with yellow and orange encrusting sponges, orange soft bryozoa, mixed hydroids, cream-orange zoanthids, and a few large grey *E. alata* sponges.

Anthropogenic issues: Awash Rock comprises a reef system swept by regular and strong tidal currents. It is unlikely dredging, trawling, netting and anchoring activities occur at this site (Table 18). Sediment smothering is likely low due to the currents and its location in Cook Strait. Occasional recreational anchoring may occur but most fishers drift fish due to tidal currents and the risk of anchor snag (Authors, pers. obs.).

Table 18. Assessment of anthropogenic impacts for Site 7.13 (Awash Rock).

Original area of significant site (ha)	70.82
Previous area of significant site (ha)	
Recommended area of site (ha)	100.96
Change (ha)	30.15
Percentage change from original (%)	42.6%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the rocky and current swept environment and at this site.
Impact observed	No
Suggested buffer	100 m

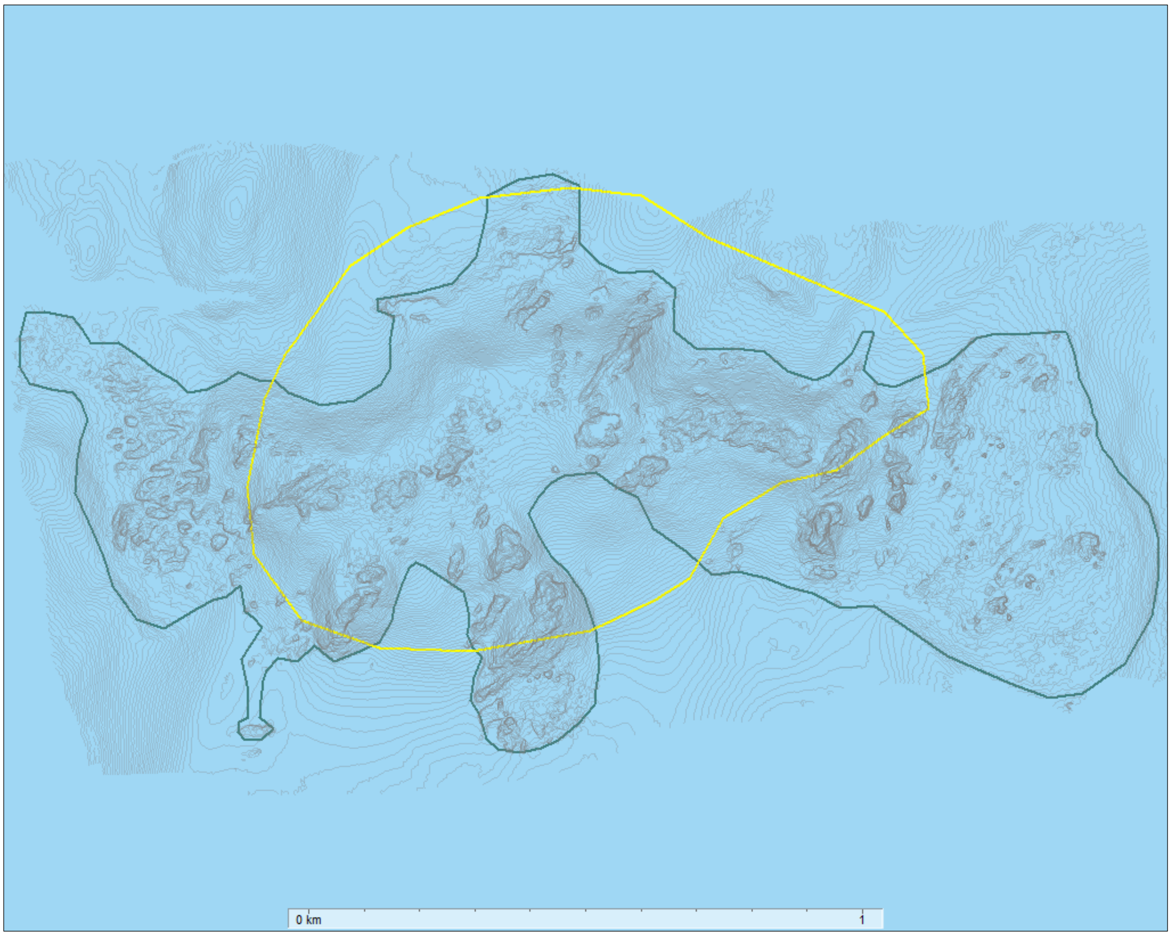


Figure 16. Awash Rock original 2011 significant site (yellow) and the presently suggested boundary (teal).

5.8 Site 7.2 Cape Jackson south (reject site)

Location: Site 7.2 is located approximately 1.6 km south-east of Cape Jackson in outer QCS (Figure 17).

Features: Davidson *et al*. (2011) recorded this 177 ha area as a significant site because it was thought to support offshore soft bottom bryozoan mounds, however, the authors also noted "the area has not been scientifically surveyed and is only known from reports by commercial fishers".

New data: Anderson *et al*. (2020) surveyed several areas in the entrance to Queen Charlotte Sound including Significant site 7.2. The authors confirmed the presence of occasional bryozoan dominated patch reefs <15 cm in height (Page 46).

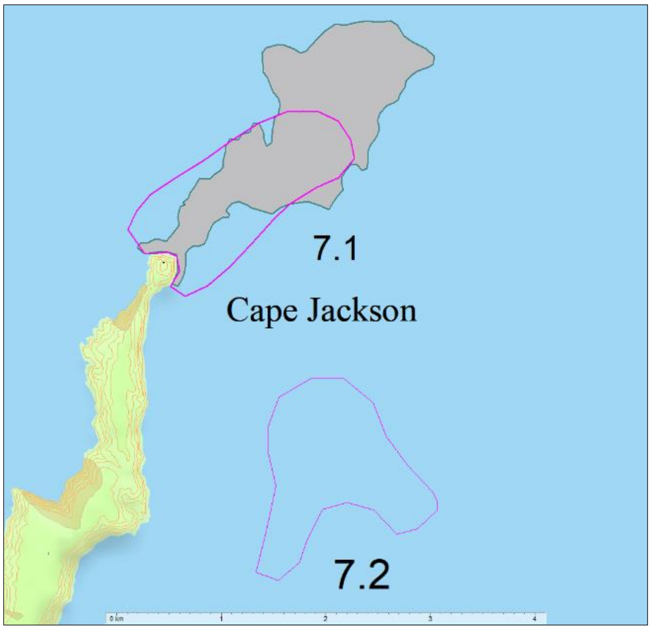


Figure 17. Location of Cape Jackson south significant site 7.2 (red dotted polygon).

Anderson *et al*. (2020) reported the presence of remnant bryozoan dominated patch reefs at some locations and suggested Site 7.2 be reassessed in light of the new findings. The authors dod, however, discover bryozoan patch-reefs at the eastern and western entrances to QCS between 20 and 30 m depth (Figure 18). Thick muddy sands were interspersed by clusters of bryozoan patch reefs of various sizes and heights, each composed of various amounts of relict and living bryozoa, dominated by the encrusting reef-building species *C. agglutinans* (Tasman Bay coral). Patches varied in size from as small as 20 cm in diameter to large interwoven clumps of patches that spanned 100's of metres, while their vertical heights varied, often within and between sites, from 20 cm up to ~1 m. Anderson *et al*. (2020) stated: "these are important fragile and vulnerable habitats that currently are not included in any management plan or significant site."

Recommendations: Remove existing Site 7.2 as a significant site due to a lack of features that would be regarded as significant. Compile data for the potential new sites identified by Anderson *et al*. (2020) in outer QCS (Figure 18).

Anthropogenic issues: Offshore biogenic structures growing on soft sediment as described by Anderson et al. (2020) are rare in Marlborough. At present, the only significant sites of these kinds are located in the outer Sounds east of D'Urville Island. This type of biogenic feature is very susceptible to physical damage because they are fragile and also because they are usually located offshore and away from reef structure. Trawling is prohibited inside a straight line from Cape Jackson to Cape Koamaru, but the area is open to scallop dredging.

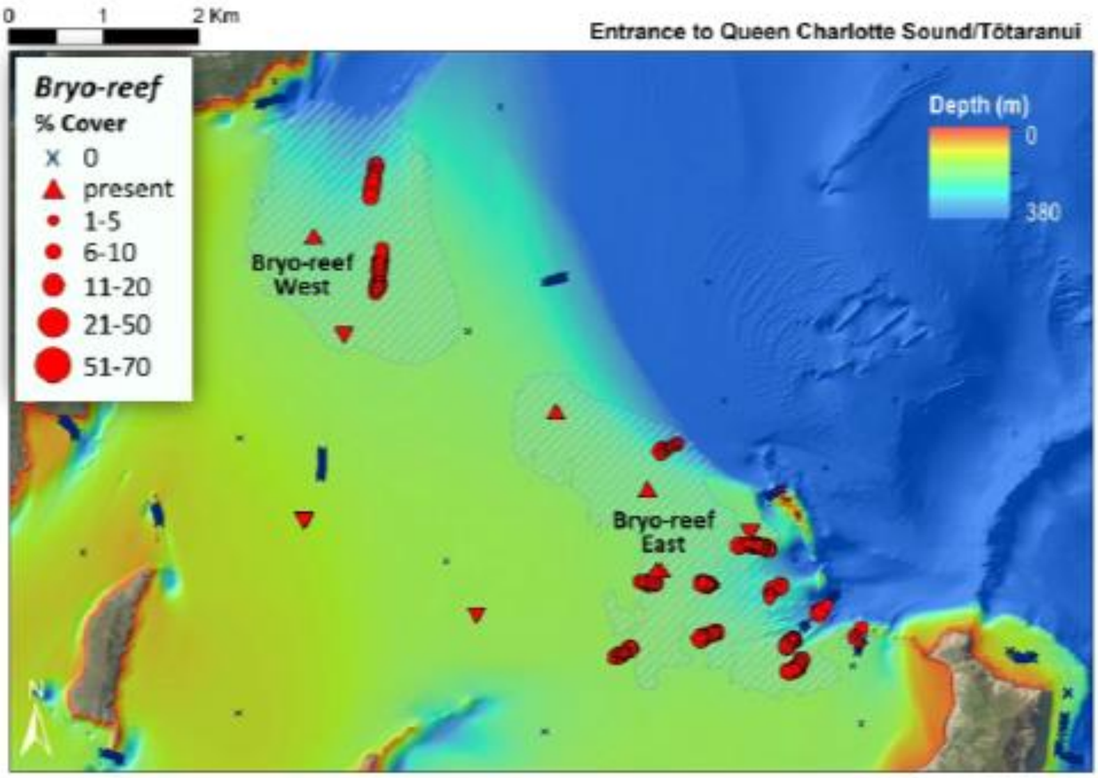


Figure 18. Location of NIWA sample sites and estimated percentage cover of bryozoan patch reefs from outer QCS (from Anderson *et al*., 2020).

5.9 New site 7.15 Kokomohua Island (tubeworm mounds)

Location: Kokomohua Island is located immediately north-east of Long Island in outer Queen Charlotte Sound (QCS) (Figure 19). A tubeworm bed is located on the eastern side of Kokomohua Island on a sloping cobble, sand and shell bank (10 m and 18 m depth.

New data: This site has been visited annually since 1993 as part of the Long Island-Kokomohua Marine Reserve monitoring programme. The site has always supported low-density tubeworm mounds, however, these have grown in size and now support an area of dense tubeworm mounds. The site was surveyed in 2020 using drop and HD camera. Drop camera data were combined with previous diving observations and footage to plot the location of tubeworms (Figure 20, Plate 15). In May 2020, high numbers of *Chaetopterus* sp were observed growing amongst and within the tubeworm mounds. This species of tubeworm was also recorded forming beds at the southern end of the new horse mussel bed (site 7.12).

Anthropogenic issues: This site is located inside the Long Island-Kokomohua Marine Reserve and is therefore legally protected from physical damage created by fishing devices. While the site is not, however, protected from anchoring, anchoring is an uncommon activity at this part of the reserve (Authors, pers. obs.). As a precaution, it is suggested a 100 m buffer be applied and anchoring be restricted at this site.

Table 19. Assessment of anthropogenic impacts for Site 7.15 (Kokomohua Island tubeworm mounds).

Original area of significant site (ha)	
Previous area of significant site (ha)	
Recommended area of site (ha)	0.27
Change (ha)	0.27
Percentage change from original (%)	100%
Sensitivity	Very sensitive Site supports deep reef species that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a low level of threat due to the environment at this site
Impact observed	No
Suggested buffer	100 m

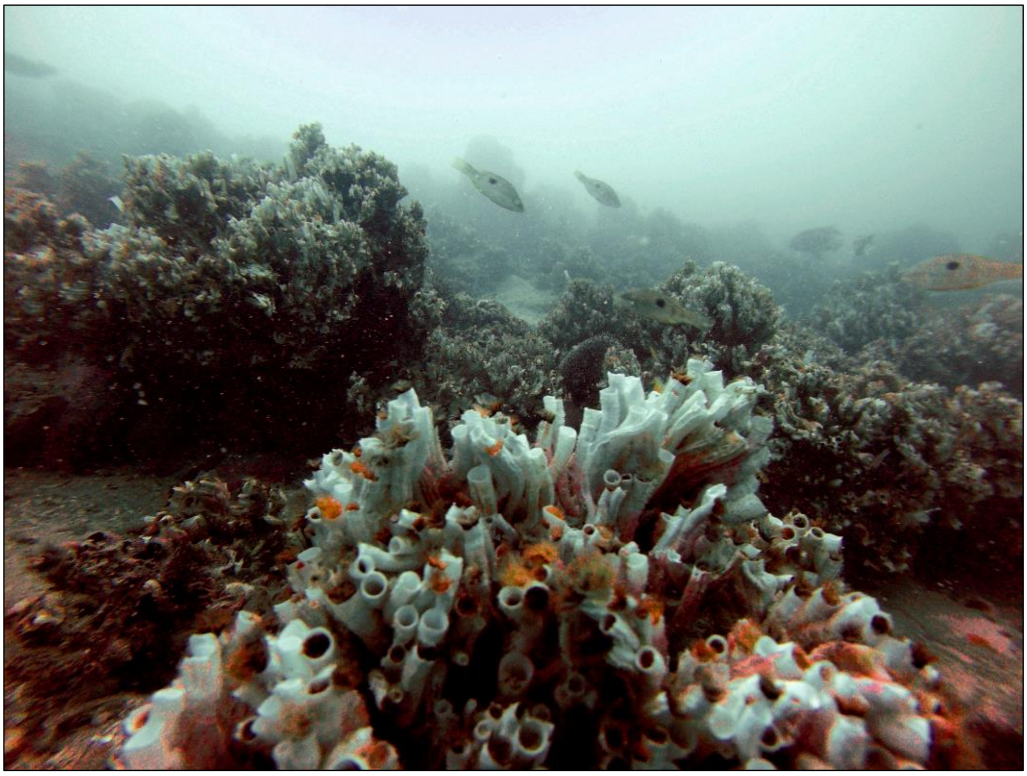


Plate 15. Tubeworm mounds at eastern Kokomohua Island (2018).

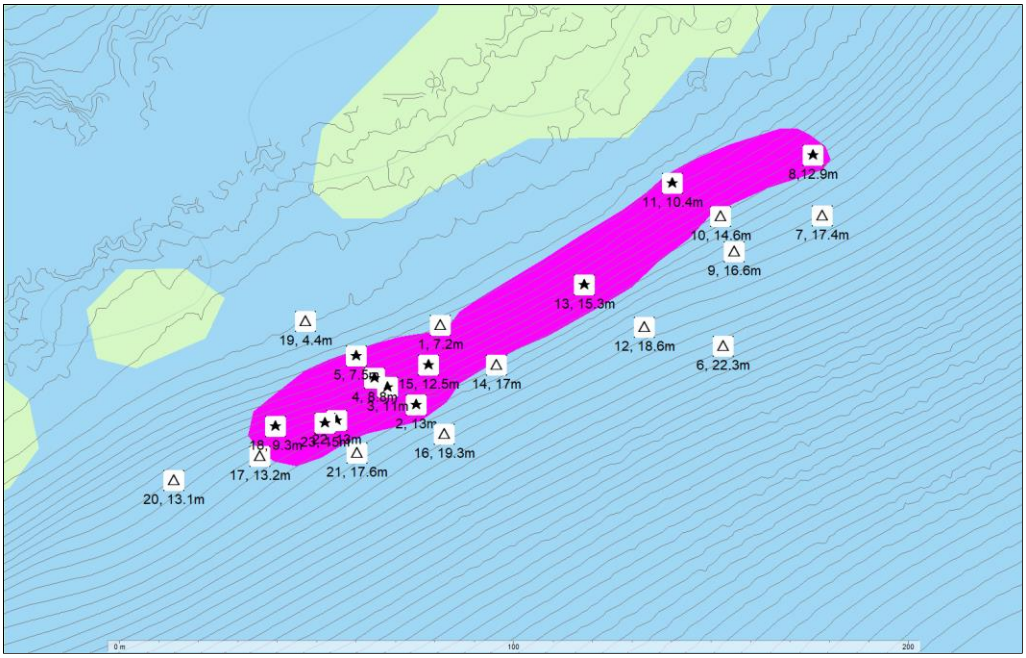


Figure 20. Location of drop camera stations relative to the suggested significant site boundary (pink). Note cadastral map shows the islands (light green) further south than they are located in the real world.

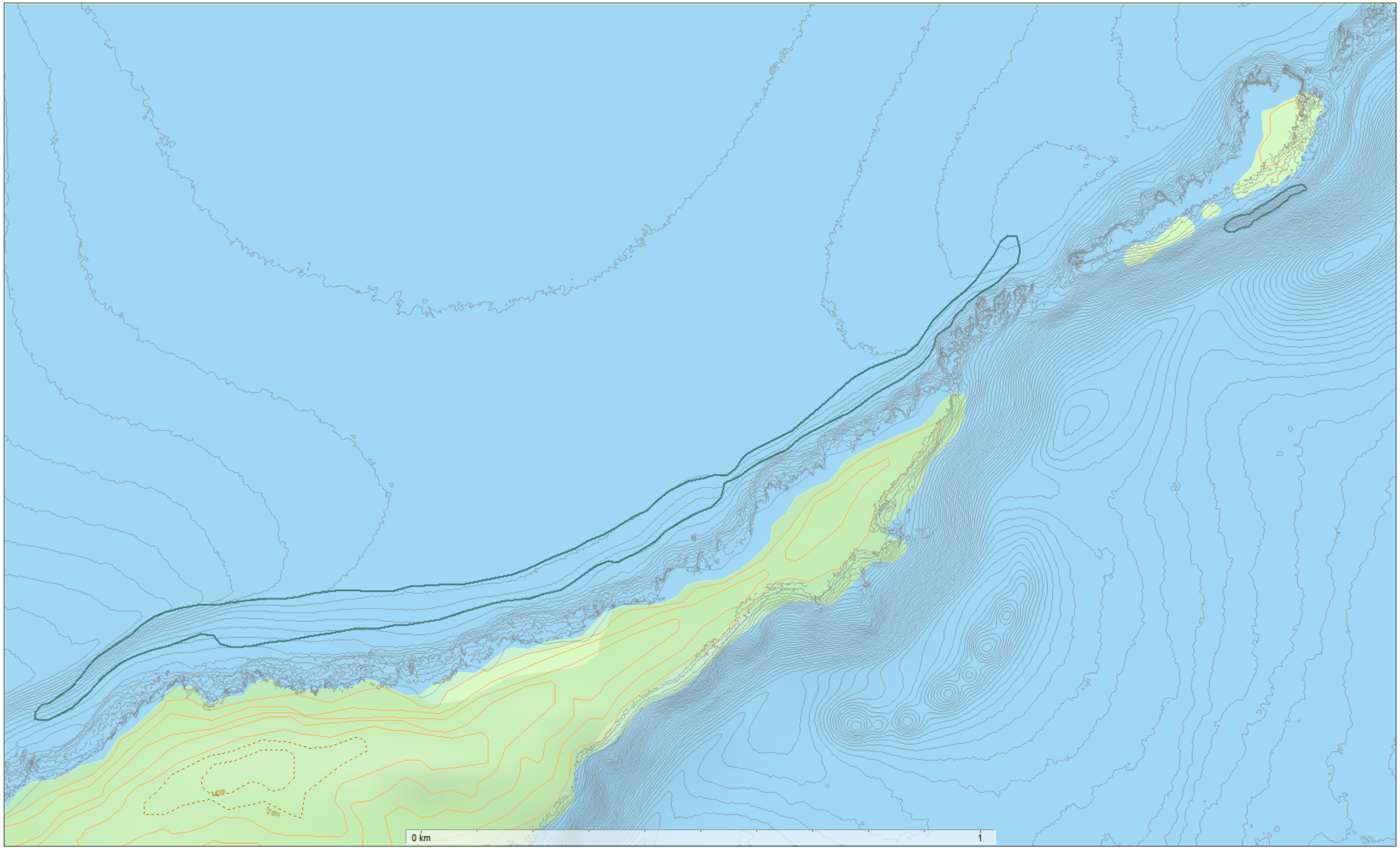


Figure 19. Kokomohua Island tubeworm mounds (7.15) and Long Island horse mussels (7.16) with suggested boundaries (teal). Note: Long Island and Kokomohua Islands are shown on cadastral maps further south relative to their real locations.

5.10 New site 7.16 Long Island (horse mussels)

Location: Long Island is located in outer Queen Charlotte Sound (Figure 18). The horse mussel bed is relatively narrow and stretches approximately 2km along from the northern tip of Long Island to the southern end of the Long Island northern cliffs (Plate 16, Figure 21).

New data: The presence of horse mussels west of Kokomohua Island was detected by Haggitt (2017). Horse mussels were also discovered further south and adjacent to the Long Island northern cliffs during the establishment of soft shore sample sites as part of the marine reserve monitoring programme (2019). In May 2020, the horse mussel bed was mapping using drop camera technology, with a mean density of 7.8 individuals per m^2.

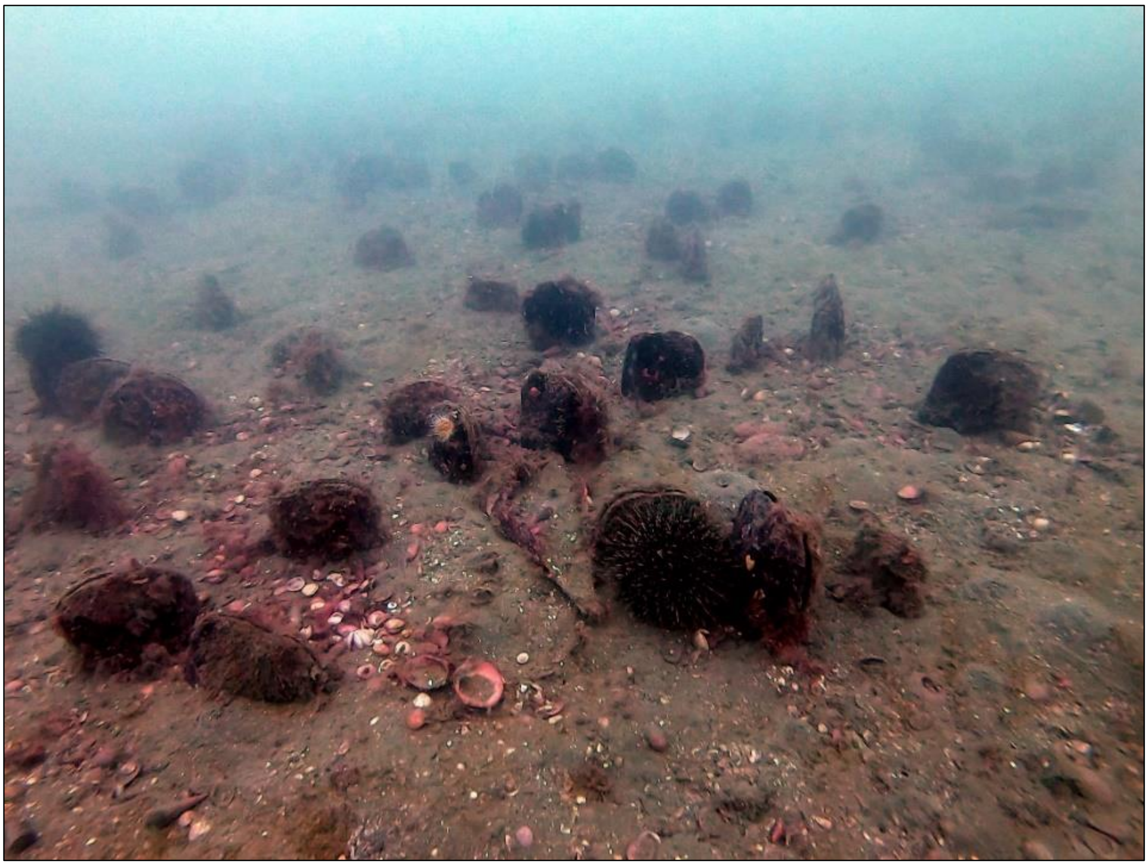


Plate 16 Horse mussel bed located north of the cliffs at Long Island (photo Courtney Rayes).

Anthropogenic issues: This site is located inside the Long Island-Kokomohua Marine Reserve and, therefore, legally protected from physical damage associated with fishing devices. The site is not protected from occasional anchoring of recreational vessels that occur along this stretch of the Marine Reserve. Because the site supports species tolerant of low-intensity anchoring and is located in a Marine Reserve, no buffer zone is recommended (Table 19).

Table 19. Assessment of anthropogenic impacts for Site 7.17 (Long Island horse mussel bed).

Original area of significant site (ha)	NA
Previous area of significant site (ha)	
Recommended area of site (ha)	9.3
Change (ha)	9.3
Percentage change from original (%)	100%
Sensitivity	Sensitive Site supports species, habitats or communities that can tolerate low-level anthropogenic seabed disturbance due to the nature of the substrate, community, species and/or hydrodynamic regimes (i.e. tolerant of occasional recreational anchoring). Not tolerant of dredging and trawling.
Threat	There is a low level of threat due to the environment at this site due to the presence of the marine reserve.
Impact observed	No
Suggested buffer	NA

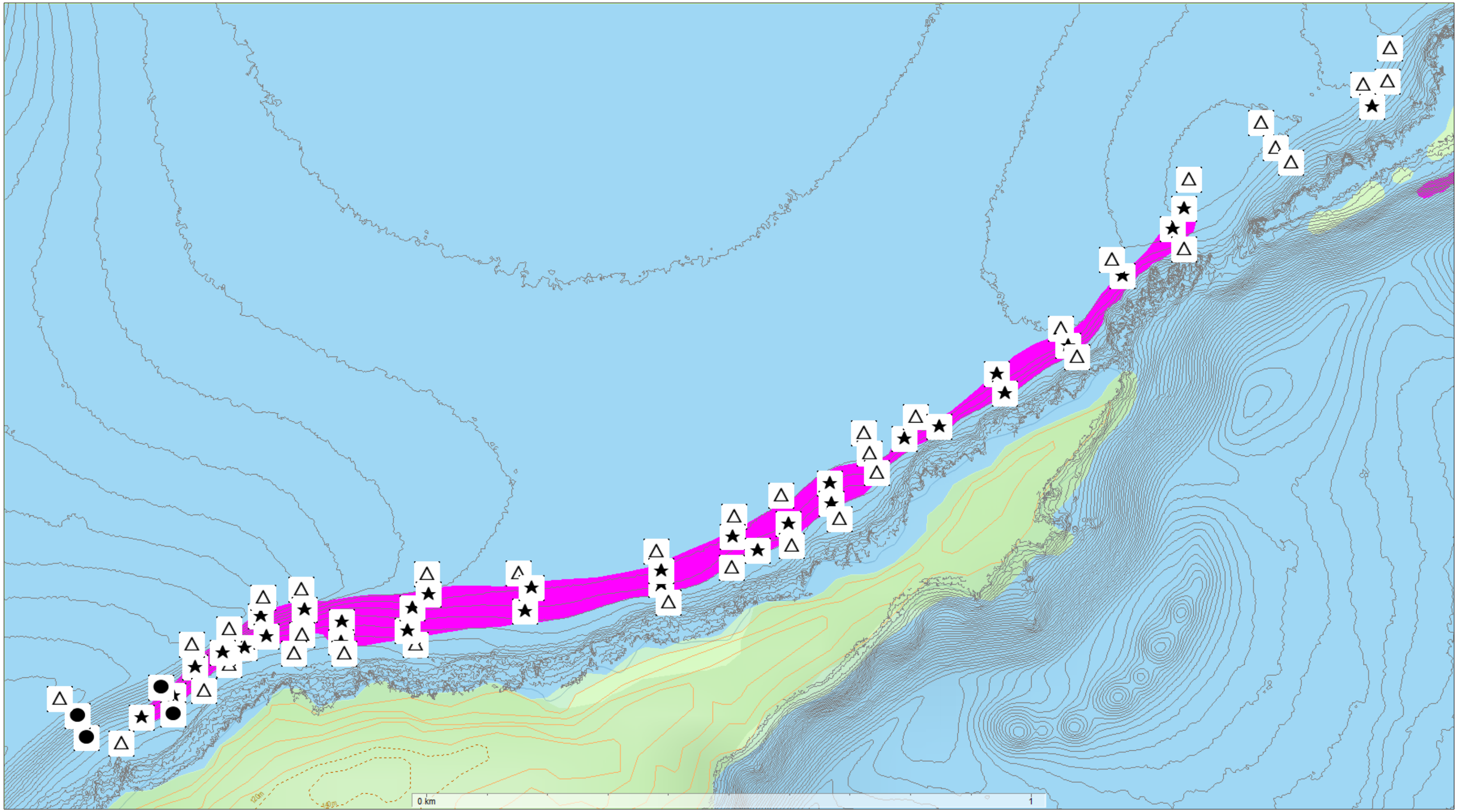
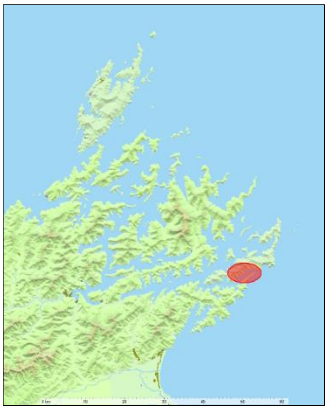


Figure 21. Location of drop camera stations relative to suggested significant site (pink). Stars = horse mussels present, open triangles = no or few horse mussels present, closed circles = *Chaetopterus* sp. abundant.

5.11 New site 5.10 Tory Channel north (seagrass)



Location: The Tory Channel biogeographic area is located between Dieffenbach Point and the entrance to Cook Strait (Figure 22). Areas supporting seagrass are located in the eastern half of the Channel.

New data: Fourteen existing seagrass (*Zostera capricorni*) significant sites (total = 12.22 ha) have been mapped on the southern shoreline of the Channel (Davidson *et al*., 2017b)(Figure 22). These sites were approved by the expert panel in 2017. Duffy *et al.* (in prep.) observed seagrass at Te Awiti Bay reef in 1990, prompting the present survey of the northern coastline of Tory Channel.

The survey found eight new seagrass sites totalling 1.47 ha. All new sites were very small compared to the southern Tory Channel sites (i.e. all but one <0.1 ha) (Table 20). The northern coast sites did not extend below 2 m depth compared to southern sites where seagrass was recorded to 5.5 m depth. The Tory Channel seagrass sites are some of a very small number of mainland sites where this species grows permanently in the subtidal environment (Helen Kettles, pers, comm.). Most of the new northern coast seagrass patches were present at <50% cover (Plate 11). The exception was an area along the eastern shores of Okakari Bay where up to 80% cover was observed at two stations. Overall the mean cover was 27.8 % when seagrass was present.

Table 20. List of new seagrass sites found from Tory Channel north.

Number	Name	Size (ha)
5.10o	Deep Bay (south)	0.022
5.10p	Ngamahau (south)	0.248
5.10q	Ngamahau (north)	0.038
5.10r	Kotoitoi (north)	0.087
5.10s	Jacksons (south)	0.042
5.10t	Te Awaiti (south)	0.019
5.10u	Te Awaiti (north)	0.087
5.10v	Okukari Bay	0.928
Total		1.471

Figure 22. Outer Tory Channel showing the new northern and existing southern seagrass beds.

Plate 11 Permanently submerged seagrass beds location along the northern shoreline of Tory Channel.

Anthropogenic issues: Declining seagrass populations worldwide have been largely due to increases in anthropogenic disturbance (Short and Burdick, 1996; Grech *et al*., 2012; Bainbridge *et al*., 2018). Human related impacts include lowered water quality or clarity, nutrient and sediment loading from runoff and sewage disposal, dredging and filling for navigation, pollution, upland development, and commercial fishing (Fonseca *et al*., 1984; Short and Burdick, 1996; Short and Wyllie-Echeverria, 1996; Lavery et al. 2009; Grech *et al*. 2012).

The United Nations Environment Programme (2020) stated "Seagrasses form extensive underwater meadows, creating complex, highly productive and biologically rich habitats. Seagrasses also play a significant role in providing a plethora of highly valuable ecosystem services that greatly contribute to the health of the world's ecosystems, human well-being and the security of coastal communities. Seagrasses provide powerful nature-based solutions to tackle climate change impacts, as a key component of mitigation and adaptation efforts. Despite covering only 0.1 per cent of the ocean floor, these meadows are highly efficient carbon sinks, storing up to 18 per cent of the world's oceanic carbon. Seagrasses can also buffer ocean acidification, thus contributing to the resilience of the most vulnerable ecosystems and species."

The United Nations Environment Programme (2020) raise concerns "seagrasses have been declining globally since the 1930s (Orth *et al*., 2006), with the most recent census estimating that 7 per cent of this key marine habitat is being lost worldwide per year, which is equivalent to a football field of seagrass lost every 30 minutes (Waycott *et al*., 2009). Only 26 per cent of recorded seagrass meadows fall within marine protected areas (MPAs) compared with 40 per cent of coral reefs and 43 per cent of mangroves. Threats with the highest impact to seagrasses include agricultural and industrial run-off, coastal development and climate change. Unregulated fishing activities, anchoring, trampling and dredging also pose major threats. However, despite a general global trend of seagrass loss, there is a reason for hope, as some areas have shown abating declines or substantial recovery of seagrasses. These recoveries can often be attributed to human interventions reducing the effect of human-caused stressors."

Permanently submerged beds of seagrass (Zosteraceae) in coastal waters are rare in New Zealand and have predominantly been reported at a small number of locations on offshore islands such as the Bay of Islands and Slipper Island (Cavalli's) and Great Mercury Island (Schwartz *et al*., 2006).

Tory Channel north subtidal seagrass beds are assessed as a very sensitive feature. It is not known why there are so few subtidal seagrass beds in New Zealand, but it is probably due to human-related effects such as sedimentation resulting in high turbidity and low light (Inglis, 2003; Schwarz, 2004). The absence of subtidal beds from other areas around mainland New Zealand is reflected in their high sensitivity score.

Table 21. Assessment of anthropogenic impacts for Site 5.10 o-v (Tory Channel north (seagrass beds).

Original area of significant site (ha)	NA
Previous area of significant site (ha)	
Recommended area of site (ha)	1.471
Change (ha)	1.471
Percentage change from original (%)	100%
Sensitivity	Very Sensitive Site supports species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).
Threat	There is a moderate level of threat due to catchment effects that can increase sedimentation.
Impact observed	Yes Fine sediment was observed on many leaves.
Suggested buffer	100 m

6.0 Discussion

6.1 Changes to significant sites

6.1.1 Reasons for change

Davidson and Richards (2015) stated change to significant marine sites and subsites can be due to:

(1) Discovery
A new site 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 the same or comparable biological features with medium or high ranking.

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

Based on data in the present report, three new sites are proposed (**discovery**). The remaining sites and subsites are adjustments seen as either **additions or reductions.** These edits were due to an improved level of data. Based on the new data, it is suggested that one existing site be removed (**rejection**).

6.1.2 Confidence to make a change

A change to the size of a significant site is data-driven thereby also enabling reassessment of a site's biological ranking. However, because most significant sites are subtidal, temporal knowledge of biological value is usually patchy and infrequent. These factors lead to a degree of uncertainty regarding the level of change over time. This issue is compounded by a lack of data before the start of human activities. This uncertainty is exacerbated due to difficulties of sampling in the marine environment, especially in deep or current swept locations.

For significant sites that have increased or decreased solely because of data quality, there is no need for "before" quantitative or qualitative data. The issue of change becomes more complex when a decline in size occurs wholly, or in part, due to anthropogenic activities (e.g. sediment smothering, physical disturbance). Historically, scientists have collected little data on habitat extent and condition in New Zealand. When available, data are often poor quality or lacking good spatial resolution. Despite these issues, historic data can still indicate the presence of biological features of medium or high quality. These data are usually unsuitable to provide a scale or intensity of change; however, they can confirm a change from a previous state to a new state (e.g. rhodolith bed replaced by uniform mud).

A site's boundaries or significance may change based on: (1) published literature, (2) personal experience of researchers or the expert peer review panel, and/or (3) a comparison of before and after data. For example, Davidson and Richards (2015) surveyed an offshore soft bottom site in outer Queen Charlotte Sound and reported few horse mussels. Historically, this site was known to support horse mussels in densities that would have warranted classification as a "horse mussel bed" (Hay, 1990a; Davidson *et al*., 2011). No data exist to show an incremental loss over the intervening years, however, based on the literature, the most likely cause for the decline is physical damage from scallop dredging. Dredging has occurred regularly in outer Queen Charlotte Sound and literature shows species like horse mussels can be significantly degraded by such activities (Thrush *et al*., 2001; Wood *et al*. 2012, Morrison et al. 2014; Anderson *et al*. 2019; Anderson *et al*., 2020). Anderson *et al*. (2020) stated: "there is some evidence, based both on historic catches and anecdotes from past fishers, that horse mussels and bryozoan patch reefs may once have been more extensive across the mid and inner sections of the Duck Pond, outer QCS".

6.1.3 Site increases and decreases

Of the 18 sites discussed in the present report, 1 was rejected, 3 were new and the remaining 14 sites (and sub-sites) either increased or decreased in size relative to previous surveys. All suggested changes were based on an improved level of data enabling a greater level of resolution and precision.

6.2 Information issues (plan updates, data management)

6.2.1 Planning and Resource Consenting

The present assessment is the sixth since the original report outlining significant sites was produced (Davidson *et al.,* 2011). Like the previous studies conducted by Davidson and Richards (2015, 2016) and Davidson *et al.* (2017, 2018, 2019), many existing sites changed in size and shape compared to the original sites described by Davidson *et al.* (2011). Further, the level of information known for each site almost always changed.

Significant sites will potentially change each time a new survey or assessment is undertaken. It is therefore important that changes be regularly incorporated into the operative Marlborough Environment Plan. Ideally, this process should occur annually to ensure the most up-to-date information is available for use.

6.2.2 Data management and raw data

Survey data from the 2019-2020 survey are summarised in the present report. Detailed data (i.e. maps, photos, video, sonar) are either produced or listed in separate Excel spreadsheets. All media, raw data and spreadsheets have been stored in an MDC database. It is therefore recommended that the present document be treated as a summary with further additional detail provided by the excel spreadsheets and raw data files.

6.3 Anthropogenic impacts

Some of the greatest sources of anthropogenic impacts in New Zealand's marine environment come from external sources with climate change, ocean acidification and catchment inputs considered the largest threats. (MacDiarmid et al., 2012; MFE, 2016; 2019). MacDiarmid *et al.* (2012) ranked catchment effects, such as the introduction of sediment, as one of the most important local issues leading to serious impacts in the marine environment. These authors also reported rated trawling (3rd equal with sedimentation) and dredging were high on the list of sources of anthropogenic impacts.

In the present study, direct evidence of human-related impacts on existing or suggested significant sites was observed. Subtidal seagrass (eelgrass) in Tory Channel often had a layer of sediment over plant leaves. This sediment likely originated from local forestry harvests and catchments as far away as the Wairau, Awatere and possibly Clarence Rivers. Fortunately, most freshwater inputs into the Channel are small thereby minimizing potential sediment inputs; however, the potential loss of these mainland subtidal seagrass beds remains.

At the Long Island horse mussel and Kokomohua Island tubeworm mounds, dense beds of *Chaetopterus* sp. were present in high numbers for the first time in the 28 years of marine reserve monitoring (Plate 12). It is not known if this is an NZ native or introduced (Geoff Reid, pers. comm.). This tubeworm species was first noted in the Marlborough Sounds the early 1990's (Duffy *et al*., in prep.) but has been present in New Zealand from the 1960s (Geoff Reid, pers. comm.). In a recent dredge survey to assess scallop biomass, *Chaetopterus* sp. was found in 25 survey stations from Queen Charlotte Sound to Pelorus Sound (Williams *et al*., 2019). The reasons for its recent apparent population explosion in Queen Charlotte Sounds and the impact on other communities remains unknown.

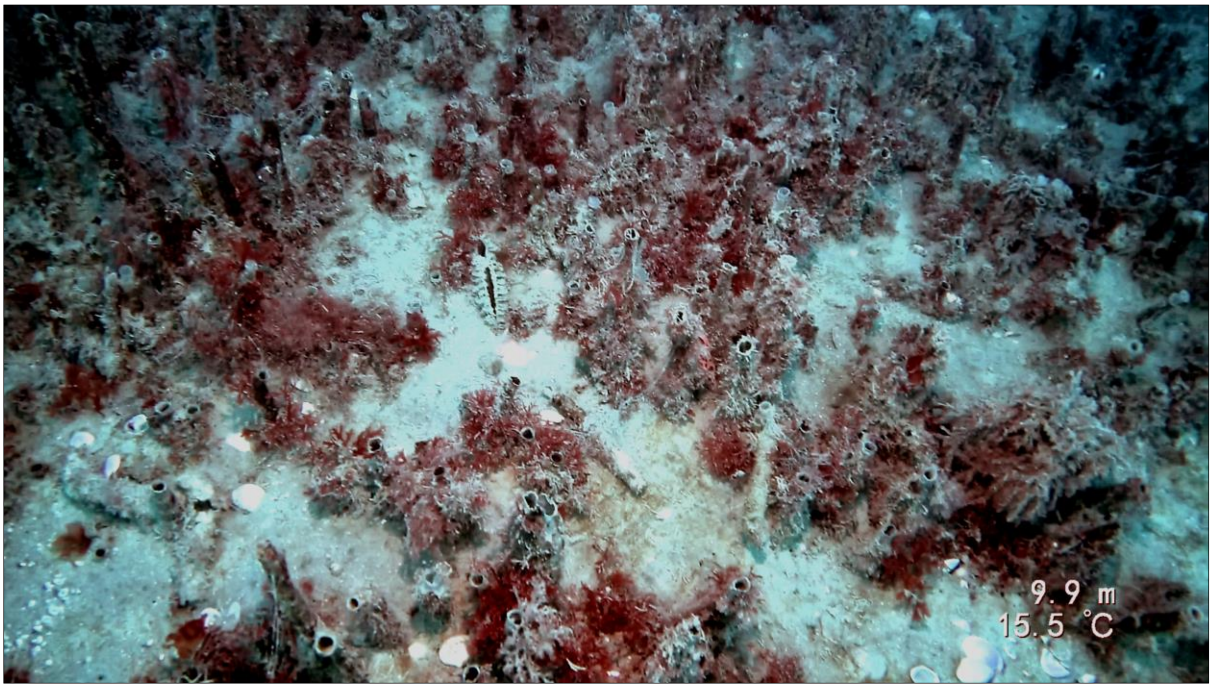


Plate 12 *Chaetopterus* sp. bed located in approximately 7 m depth adjacent to the Long Island horse mussel bed.

6.4 Review and assessment of sites

Following approval and 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. A report outlining the expert peer review findings will be produced in due course.

Each site assessment in the present report has associated recommendations to the review panel. It is important to note that these are recommendations and may not necessarily be adopted by the expert panel (see Davidson *et al.,* 2013 for the process).

Acknowledgements

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Appendix 1. History of annual field surveys

1.1 Field survey 1 and expert peer review

Davidson and Richards (2015) undertook the first survey following the protocols outlined in Davidson *et al.* (2013, 2014). The authors focused on selected sites detailed by 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 fish 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 expert 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 subsites outlined in Davidson and Richards (2015). The review report presents the findings of that reassessment. It also comments on issues associated with the 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 some of the seven assessment criteria originally used to determine significant sites as developed by Davidson *et al*. (2011).

The Panel's overall findings recommended that:

(1) three sites are 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).

(2) the offshore site located north of Motuara Island be removed and replaced with a small area located around a rocky reef structure.

(3) adjustment to the boundaries of most of the remaining significant sites following the recommendations of Davidson and Richards (2015).

Based on the removal of the three sites and several 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.

1.2 Field survey 2 and expert peer review

Before the 2015-2016 fieldwork season, a report outlining potential or candidate sites for a survey and/or monitoring was produced (Davidson, 2016). That report was used to guide the selection of sites surveyed and described in the second field survey report by Davidson and Richards (2016).

Davidson and Richards (2016) reported on a total of 15 sites and sub-sites. The authors suggested that five sites and sub-sites be increased in size (178.4 ha total), while eight sites and sub-sites be reduced (-214.6 ha). One site remained unchanged between surveys (Hunia king shag colony). A new site was also described at Lone Rock, Croisilles Harbour (rhodoliths bed = 4.68 ha). 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. This site was resurveyed as it supported a different range of habitats and communities compared to the original larger site (2.12). The remaining sites and subsites increased or declined in size due to an improved level of survey detail. No sites were identified as no longer supporting significant values.

The Davidson and Richards (2016) report was reviewed by the MDC expert peer review panel (Davidson *et al*., 2016). The expert peer review panel accepted all but one boundary modification proposed by Davidson and Richards (2016). The panel recommended that the Chetwode significant site (2.20) remain unchanged and only be enlarged when further data were collected to support an increase in size.

The review panel also suggested one change to the Davidson *et al*. (2011) criteria. Criteria 7 (adjacent catchment modification) was amended to include a "not applicable" option in recognition of sites located in areas little influenced by catchment effects.

The new rank is: **NA = The site is little influenced or is not influenced by catchment effects.**

The reviewed boundary refinements suggested by Davidson and Richards (2016) led to both increases and decreases to the size of individual significant sites and an overall decline of 262.6ha between 2011 and 2016.

For each significant site, the expert peer review panel assessed anthropogenic threats based on (1) the level of anthropogenic disturbance and (2) the site's vulnerability (Table 2). This assessment was based on the review panel's knowledge of the biophysical characteristics of each significant site (e.g. personal knowledge and/or from the literature).

Similar approaches have been adopted by Halpern *et al.* (2007) and further adapted for the assessment of New Zealand's marine environment by MacDiarmid *et al.* (2012). Robertson and Stevens (2012) described an ecological vulnerability assessment (originally developed by UNESCO (2000)) for use at estuarine sites in Tasman and Golden Bays. The UNESCO methodology was designed to be used by experts to represent how coastline ecosystems were likely to react to the effects of potential "stressors".

Anthropogenic disturbance is known or expected (based on experts' experience) level of impact associated with human-related activities. Disturbance levels range from little or no disturbance (low score) to sites regularly subjected to disturbance (high score). Impacts range from direct physical disturbance to indirect effects, including from the adjacent catchments.

Vulnerability is the sensitivity of habitats, species and communities to disturbance and damage. Scores ranged from relatively robust species or habitats such as coarse substrate/mobile shores and high energy kelp forests (low vulnerability score) to extremely sensitive biological features such as lace corals and brittle tubeworm mounds (high vulnerability score).

Table 2. Previously used in 2016. Environmental variables used to assess the vulnerability of significant sites to benthic damage from physical disturbance.

Variables	Descriptions, definitions and examples
Anthropogenic disturbance level	
Low	Little or no human associated impacts. Catchment effects low (i.e. vegetated, stable catchments).
Moderate	Light equipment and/or anchoring disturbance. Well managed catchment.
High	Subjected to regular and heavy equipment, seabed disturbance, and/to catchment effects high due to modification or poor management.
Vulnerability	
Resilient (low or unlikely)	Algae forest, coarse substrata, moderate or high energy reef, high energy shore, short-lived species.
Sensistive (moderate)	Horse mussels, soft tubeworms, shellfish beds, red algae bed, low current (sheltered reefs).
Very sensitive (high)	Massive bryozoans, sponges, hydroids, burrowing anemone.
Extremely sensitive (very high)	Lace or fragile bryozoans, tubeworm mounds, rhodoliths.

1.3 Field survey 3 and expert peer review

A total of 10 sites were described during the study of 2016-2017. One site (Titi Island) was split into 3 sub-sites while one site (Rangitoto Islands) was split into four subsites. Subsites were defined as having comparable habitats and communities, but each sub-site was physically separate. One new subsite was added to an existing set of three subsites at Hunia (Port Gore). In total, 15 sites and subsites were investigated.

Three new sites were investigated and described (6.04 ha). Three sites increased in size by a total of 583.3 ha (Sites 1.2, 2.10 and 2.33). Increases were due to an improvement in the level of survey detail. Four sites declined in size by a total of 458.9 ha (Sites 2.6, 2.27, 2.30 3.1). Declines were due to a combination of improved information and, in two cases (Sites 2.30 and 2.27), a loss of habitat likely due to physical damage. No existing significant sites were recommended for removal.

The Expert Panel accepted the boundary modifications proposed by Davidson *et al*. (2017a) and Tory Channel sites suggested by Davidson *et al*. (2017b). Two other new sites and one new sub-site were also accepted by the review group. The Expert Panel recommended that one site (Titi Island rock) proposed by Davidson *et al*. (2017a) be reassessed in the future once more information was available.

1.4 Field survey 4 and expert peer review

A total of 14 sites were described during the study of 2017-2018. Six potential new significant sites (Woodlands west rhodoliths, Ouokaha Island coast, Tuhitarata Bay reef, Matai Bay tubeworms, Penzance Bay elephantfish egg-laying, Treble Tree coastline) were described. Matai Bay tubeworms and Penzance Bay elephantfish egg-laying sites were located within the larger Tennyson Inlet site.

Three existing significant sites increased in size by a total of 146.2 ha: site 3.9 = 143.12 ha, site 3.12 = 1.175 ha and site 3.15 = 1.9 ha. Those increases were due to either an improvement in the level of detail or redefining of the boundaries. Four sites declined in size by a total of 112.68 ha (Sites 3.7, 3.8, 3.11 and 3.25). Declines were mostly due to the improved level of information, however, small areas of site 3.8 (Fitzroy elephantfish egg-laying habitat) were impacted by marine farms and therefore removed. Parts of this significant site (i.e. Garne and Savill Bays) appeared impacted by the exotic alga *Asperococcus bullosus* (Nelson and Knight, 1995). This brown alga was abundant and often covered much of the benthos. Further, these bays appeared siltier compared to historic observations conducted in the 1990's. It is unknown if one or both factors explain the decline in elephantfish egg cases recorded during the present study. Another exotic species was also widespread at site 3.8. A tubeworm in the Family Chaetopteridea was abundant at many locations between 4 to 12 m depth. It was considered possible that these tubeworm beds may also influence egg-laying elephantfish.

Human impact was observed at three of the potential new significant sites (site 3.23 Woodlands west, site 3.26 Ouokaha Island, site 3.29 Treble Tree coast). At site 3.26, *Galeolaria hystrix* tubeworm mounds had been overturned, probably from anchors or anchor chains used by recreational fishers. At site 3.23, farm anchor blocks had been dragged through the rhodolith bed. At site 3.29, evidence of commercial dredging was observed. No existing significant sites were recommended for removal.

The Expert Panel (Davidson *et al*., 2018a) accepted all the boundary modifications proposed by Davidson *et al*. (2018). Five new sites were also accepted by the Panel, while one site (Treble Tree coast) proposed by Davidson *et al*. (2018) was declined until more data is made available.

1.5 Field survey 5 and expert peer review

Davidson *et al*. (2019a) presented data for a total of 11 sites. At four existing significant sites, additional data were collected and presented (Tennyson Inlet, Penzance Bay, Ouokaha Island and Deep Bay). Of these, it was suggested that two sites be increased in size. Four potential new significant sites (Hitaua Bay Head, Rat Point Reef, Nikau Bay outer coast, and Gold Reef Bay (west) were described. Of these, Hitaua Bay had been a significant site previously. Three sites were investigated that did not support biological values likely to be sufficient to warrant ranking as a significant site.

For the existing significant sites, proposed increases were: Tennyson Inlet 740.2 ha and Deep Bay 0.07 ha. These increases were due to either an improvement in the level of detail or redefining of the boundaries. No existing significant sites declined in size. Parts of the Tennyson Inlet significant site were impacted by the exotic tubeworm in the Family Chaetopteridea. This worm was abundant at many locations between 4 to 12 m depth. The authors stated, “it is unknown if these tubeworm beds influence site selection by egg-laying elephantfish”.

Direct human impact was observed at Ouokaha Island where approximately 11% of tubeworm mounds had been likely impacted by anchoring. The indirect human impact from sedimentation was observed at the proposed new site along the coast north and south of Nikau Bay. Inorganic rubbish was observed under a moored boat in Penzance Bay.

The expert panel accepted recommendations proposed in the summer fieldwork report produced by Davidson *et al*. (2019a). Three new sites were accepted by the Panel (Rat Point (reef), Gold Reef Bay west (biogenic community) and Nikau Bay outer coast (current swept biogenic community)). Three sites that were surveyed were rejected as they did not support features that were considered significant (see Davidson *et al*., 2019b). existing sites were accepted (Penzance Bay (elephantfish spawning), Ouokaha Island (tubeworm mounds)). Adjustments to the boundaries of two existing sites were approved (Tennyson Inlet (stable protected catchment), Deep Bay (subtidal cockle bed)). One site located at the head of Hitaua Bay (subtidal cockle bed), previously removed as a significant site was reinstated.

The Panel also assessed site sensitivity/impacts from a range of anthropogenic threats including physical disturbance. One site was recommended for urgent management action (Ouokaha Island), and other sites were recommended for future management action (e.g. at the time of forest harvest). Other recommended management actions included the selection of mooring types in Penzance Bay and widespread actions to minimise sediment originating from the Pelorus catchment.