Expert panel review of selected significant marine sites surveyed during the summer of 2019-2020

Research, survey and monitoring report number 1064

A report prepared for:
Marlborough District Council and Department of Conservation
C/o Seymour Square
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Significant Marine Site Expert Panel

Rob Davidson has been involved in marine biology for over 30 years. Rob holds a Master of Science with First Class Honours from the University of Canterbury, 1987 and has presented 18 conference papers and published 12 papers in international peer-reviewed scientific journals. He has previously worked for MAF and the Department of Conservation. Presently Rob is the director of an independent science consultancy. During his time at DOC, he coordinated or was involved in many large-scale ecological surveys of coastal areas throughout Nelson and Marlborough. Rob compiled this information into the Department's Coastal Resources Inventory which was later reproduced as reports for the Councils' coastal plans. He has implemented monitoring programmes spanning up to 26 years, relating to Cook Strait ferry impacts, marine farm recovery and marine reserve monitoring. As a consultant, Rob has provided scientific information for over 900 resource consent applications and impact assessments. His company has also coordinated a marine ecological database for the Marlborough District Council. Over his working career, he has conducted over 4000 dives throughout the Marlborough area and has extensive knowledge of the underwater features and values of Marlborough.

Clinton Duffy is a marine scientist employed as a Technical Advisor (Marine) with the Department of Conservation's Marine Ecosystems Team. He holds an M.Sc. (Hons) in Zoology from the University of Canterbury, 1990, and worked as a marine and freshwater technical support officer for the Department's Nelson/Marlborough, East Coast Hawke's Bay and Wanganui Conservancies from 1990-1999, and as a Scientific Officer (marine ecology) in the Science & Research and Marine Conservation Units from 1999-2012. He has authored over 80 scientific publications and reports. His areas of expertise include marine survey and monitoring; biogeography of New Zealand reef fishes, algae and invertebrates; and the conservation biology, taxonomy and behaviour of sharks and rays. He has dived, either in a professional or private capacity, around much of New Zealand's coastline, and co-ordinated of a dive survey of shallow subtidal habitats of the Marlborough Sounds in 1989-90.

Andrew Baxter has over 38 years' experience in coastal and marine management, specialising in marine ecology including marine mammals. He graduated from the University of Canterbury in 1981 with a BSc with First Class Honours in Zoology. Following two years working for the Taranaki Catchment Commission as a marine biologist, Andrew worked as a fisheries management scientist for MAF Fisheries based in Wellington from 1984 to 1987. He has been employed as a marine ecologist for the Department of Conservation in Nelson since October 1987. Andrew is currently a Technical Advisor in DOC's Marine Ecosystems Team.

Sean Handley is a Marine Ecologist based at NIWA in Nelson. Sean was awarded his PhD in 1997 by the University of Auckland with support from the Cawthron Institute, where he was studying the ecology of shellfish and their pests (spionid polychaetes). He has a broad range of research and consultancy experience and expertise interacting with a range of marine sectors including: aquaculture, fisheries, conservation, iwi, NGO'S and regional councils. Sean has a very wide range of skills, working on research projects relating to: aquaculture of shellfish and sponges, ballast water testing, biosecurity surveys, ecological surveys and biological collections throughout NZ, Fiordland ecological surveys including deep reef communities, and benthic ecology. More recently he has undertaken reviews of historical changes to seabed and fish communities and has an interest in palaeoecology to establish baselines to inform future management and restoration of coastal resources.

Peter Gaze worked for many years with Ecology Division of DSIR, involved with research into the distribution, conservation and economic value of birdlife in New Zealand. This included a study of forest bird ecology, in particular, rifleman, kereru and mohua. Peter is a co-author of the first atlas of bird distribution in New Zealand. Various research projects took him to the sub-Antarctic, the Kermadecs, Cook Islands and Tahiti. He then moved to the Department of Conservation where his role was primarily to provide technical advice on fauna conservation work in Nelson and Marlborough. This role enabled him to bring a national perspective to local matters. Related fields of interest include the impact and control of mammalian predators as well as reptile conservation including leading the department's recovery of tuatara for the last ten years. Both roles have included projects working on the islands and wildlife of the Marlborough Sounds. A plan written for the management of these islands continues to guide the work of the Department. He has a long association with bird research and conservation throughout the country and was for some time the secretary for the Ornithological Society of NZ. Peter has now works for charitable trusts committed to conservation in Abel Tasman National Park and the outer Marlborough Sounds.

Sam du Fresne has over 20 years of experience studying marine mammals, beginning with his master's thesis in 1998. He has conducted several dolphin surveys in New Zealand focussed mainly on Hector's dolphins and has worked in places as diverse as Far East Russia, Hawaii and Western Australia. After graduating with a PhD from the University of Otago in 2005, Sam worked as an independent consultant, specialising in marine mammals. As a consultant, Sam worked closely with DoC, MFish, NIWA, Cawthron, various regional councils and several industry clients, providing expert advice and research services on a range of species and issues. Sam also spent time at SMRU Ltd in St Andrews (Scotland) where he worked as a senior research scientist, focussing mainly on marine mammals and renewable energy projects. Recently, after working for more than three years in Western Australia on mega-projects such as the Gorgon and Wheatstone LNG developments, Sam returned to New Zealand to join the EEZ Compliance team at the Environmental Protection Authority in Wellington.

Shannel Courtney is a Nelson-based plant ecologist with the Department of Conservation, working as a Technical Advisor in the Terrestrial Ecosystems Unit. In 1983 he attained a Master of Science in plant ecology at Canterbury University and before DOC has worked for the NZ Wildlife Service, NZ Department of Lands and Survey and NZ Forest Service on management issues. For much of the earlier part of his career, he has been involved in the assessment of natural areas for ecological significance and has led various ecological surveys of the East Cape, Taranaki, Marlborough and Nelson regions. Relevant publications and co-authorships include Protected Natural Area reports for North Taranaki, Motu and Pukeamaru Ecological Districts and for Molesworth Station, habitat restoration guides for Nelson City and Tasman District, and several publications on the development of a natural character framework for the Marlborough Sounds. For the last 20 years, he has specialised in threatened plant conservation and co-ordinates the recovery of nationally threatened and at-risk species in the Nelson region and Marlborough Sounds. He is currently on the National Threatened Plant Panel and on the committee of the NZ Plant Conservation Network. In 2008 he was awarded the Loder Cup in recognition of his services to plant conservation.

1.0 Summary

In 2011, a total of 129 significant marine sites were identified for the first time in Marlborough (Davidson *et al.,* 2011). In 2015, the Marlborough District Council (MDC) and Department of Conservation (DOC) embarked on an ongoing survey and monitoring programme aimed at updating and improving the database of significant sites. The programme also collects data for monitoring change at selected significant sites. This programme was guided by a detailed range of survey protocols including techniques suited for rapid reconnaissance (i.e. qualitative descriptions) and techniques suitable for monitoring (i.e. quantitative and certain qualitative data) (Davidson *et al.,* 2014). Significant sites selected each year for investigation were chosen by the Expert Panel that prioritized sites on the basis they:

- Had limited or old biological information.
- Were areas where additional information was needed for management purposes.
- Were under threat or vulnerable to impacts.
- Were suitable for monitoring.
- May contain significant undocumented values.

Summer surveys have been undertaken on five previous occasions (Davidson and Richards, 2015; 2016; Davidson *et al*., 2017a, 2018a, 2020). Reports and raw data from surveys were lodged separately with the MDC. The authors also provided comment on site boundary alterations and made recommendations. At the end of each survey period, the MDC Significant Marine Site Expert Panel reviewed data, assessed sites using accepted criteria and made recommendations.

The present report outlines the Significant Marine Site Expert Panel review of sites reported on following the sixth survey programme conducted in Queen Charlotte Sound, Tory Channel and Port Underwood (Davidson *et al*., 2020). The Expert Panel assessed sites using the seven criteria originally developed by Davidson *et al.* (2011) and modified by the Expert Panel in 2015 and 2016 (see Davidson *et. al.,* 2015; 2016). The updated criteria were presented in Appendix 1 of the 2017 report. No changes to the criteria were made during the present assessment (see Appendix 1).

Overall, the Expert Panel accepted recommendations proposed in the summer fieldwork report produced by Davidson *et al*. (2020). Three new sites were accepted by the Panel (Long Island horse mussels, Kokomohua Island tubeworms and Tory Channel (north) subtidal seagrass). One existing significant site recommended by Davidson *et al*. (2020) and

based on new data collected by Anderson *et al*. (2020) was rejected.

Adjustments to the boundaries of 13 sites comprising many sub-sites in Cook Strait, Tory Channel and Queen Charlotte Sound were accepted.

The Panel also assessed site sensitivity/impacts from a range of anthropogenic threats including physical disturbance.

2.0 Background

In 2011, a report outlining Marlborough's ecologically significant marine sites was produced for MDC and DOC (Davidson *et al*. 2011). The assembled group of expert authors ("Expert Panel") developed a set of criteria to assess the relative biological importance of candidate sites. Sites that received a medium or high score were termed "significant". A total of 129 significant sites were recognized and described during that process.

The authors stated that their assessment of significance was based on existing data or information; however, they noted many sites had limited or old information. Some marine sites had not been surveyed or the information available was incomplete, patchy or potentially not reflective of the current state of the sites. The authors stated more investigation was required to better assess the status of many significant sites.

The authors also stated that many of the sites not assessed as "significant" had the potential to be ranked higher in the future as more information became available. Further, they recognized the quality of some existing significant sites may decline over time due to natural or human-related events or activities. The authors, therefore, acknowledged their assessments would require updating regularly.

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

- The level of information required for new candidate sites.
- The process for assessing new sites and reassessing existing sites.
- A protocol for record-keeping, selection of experts and publication of new reports.

Davidson *et al.* (2014) provided guidance on the collection, storage and publication of biophysical data from potential new significant sites as well as existing sites. The biological investigation process was separated into three main elements:

- Investigation and survey of new sites.
- Collection of additional information from existing significant sites or sites that previously were not ranked as being ecologically significant.
- Status monitoring of existing significant sites (i.e. site health checks).

Davidson *et al.* (2014) also detailed a range of candidate sites for survey and monitoring. The authors also provided comment on survey protocols including techniques suited for rapid reconnaissance (i.e. qualitative descriptions) and techniques suitable for monitoring (i.e. combinations of both qualitative and quantitative data collection).

Follow-up surveys or assessments were undertaken in the summers of:

Year 1: 2014-2015, 21 sites and sub-sites in eastern Marlborough Sounds.
Year 2: 2015-2016, 15 sites, subsites in Croisilles Harbour and D'Urville Island.
Year 3: 2016-2017, 15 sites, subsites Croisilles to Waitui Bay, outer Sounds.
Year 4: 2017-2018, 14 sites in central Pelorus Sound.
Year 5: 2018-2019, 11 sites in Pelorus (8), Tory Channel (2) and Catherine Cove (1).
Year 6: 2019-2020, 17 sites QCS, Tory Channel, Cook Strait and Port Underwood.

Davidson and Richards (2015, 2016) and Davidson *et al*. (2017a, 2018a, 2019, 2020) summarised the new biological data, while raw data and compiled spreadsheets summarising data were provided to MDC for storage. The authors also commented on site boundary alterations and recommended changes to the assessments of significance. After all summer surveys, the Expert Panel was reconvened to reassess the new information and make recommendations.

Davidson *et al*. (2020) reported on a mix of sites which were assessed based on new surveys from the 2019-2020 field season (year 6; five sites) or new information from other data sources notably Anderson *et al*. (2020) and Neil *et al*. (2018a, 2018b). The present report presents the subsequent review by the Expert Panel. The Panel also commented on anthropogenic threats and vulnerability of significant sites.

3.0 The assessment process

3.1 Data collation

All data collated by Davidson *et al*. (2020) were compiled and made available to the expert panel during the present review. Davidson *et al*. (2020) reported on a total of 17 sites (Table 1). Two of those significant sites have associated subsites: Site 5.4 Tory Channel west (18 subsites) and Site 5.8 Tory Channel east (12 subsites). Of the 17 sites, one was rejected as a significant site, three sites were new and the remaining 13 were either enlarged or reduced in size due to an improved level of information. Overall, Davidson *et al*. (2020) recommended the total area of significant sites be increased by 425.34 ha (Table 1).

Information collected during the 2019-2020 fieldwork season included: high definition and low-resolution drop camera photographs, handheld still photography, handheld video, remote video, sonar images, and observations (note: all raw data are held by MDC). Information relating to each original site surveyed by Davidson *et al.* (2011) was also compiled and made available including: site description, site boundaries, ecological assessment, and any data previously compiled or known for the site or sub-site.

Davidson *et al*. (2020) also compiled data from a variety of other sources including previous reports, significant site surveys or other sampling programmes (e.g. marine reserve monitoring; marine farm monitoring; NIWA's multibeam bathymetric survey). These data were integrated with other historical data and 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, Davidson *et al*. (2020) plotted new boundaries for previously described sites.

3.2 Expert Panel

For the present review, most of the Expert Panel involved in the Davidson *et al*., (2011) report and 2015, 2016, 2017, 2018 and 2019 reviews were reconvened, apart from Sam du Fresne (marine mammals), Peter Gaze (birds) and Shannel Courtney (plants). Sean Handley (NIWA) replaced existing member Bruno Brosnan in 2017. Sam du Fresne, Peter Gaze and Shannel Courtney were not involved in the present reassessment meeting as no new or resurveyed marine mammal, bird or plant sites were under scrutiny.

4.0 Wording of the assessment criteria

During previous Expert Panel reviews (Davidson *et al.* 2015; 2016), panel members recognized a need to clarify some of the original assessment criteria used by Davidson *et al.* (2011) to avoid any possible misinterpretation. Some further minor revisions to the criteria were also proposed and adopted during the 2017 review.

The present assessment made no alterations to the 2017 criteria (see Appendix 1 for the revised current criteria). During this process, the Expert Panel took care not to create an inconsistency between the sites assessed in Davidson *et al*. (2011) and subsequent reassessments. It is recognised, however, that some 2011 significant sites will require reassessment using the 2017 criteria to ensure consistency. Existing sites may also need to be reassessed considering information from new or other existing sites (e.g. where criteria are relative scores such as "the best of their kind").

5.0 Review of survey sites (2019-2020)

The Expert Panel assessed all sites based on the information and proposed changes presented in Davidson *et al*. (2020) and recommended to:

- Accept three new sites with the Tory Channel (north) subtidal seagrass beds becoming a separate site from the southern beds.
- Reject one existing significant site based on new data collected by Anderson *et al*. (2020).
- Accept boundary adjustments for 13 existing significant sites.

Significant site boundary refinements and new sites resulted in an overall increase of 425.34 ha (Table 1). The expert panel accepted the suggested boundary change at The Knobbys in Port Underwood; however, the panel has delayed its assessment of this site pending collection of more data in the 2020-2021 survey season.

Table 1. Summary of significant sites and assessment by the expert review panel.

Attribute	Values
New sites discovered	3
Sites rejected	1
Sites with reductions	17 sites or subsites
Sites with additions	24 sites or subsites
Sites recovered	0
Significant site area before the survey (ha)	1392.58
Suggested significant site area after survey (ha)	1817.92
Overall change (ha)	425.34
Sites	Recommendations
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)	Delay assessment until more data collected
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)	Add as a new site
New Site 7.16 Long Island (horse mussels)	Add as a new site
New Site 5.11 a-f Tory Channel north (subtidal seagrass)	Add as a new site (8 subsites)

6.0 Site summaries including expert panel review (see green shading).

Site 4.23 Matiere Point subtidal (giant lampshell and burrowing anemone)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	4.23	
Site name	Matiere Point subtidal (burrowing anemone and giant lampshells)	
Site description	Matiere Point is a headland located along the eastern shore of Otanerau Bay, East Bay.	
Ecological description of attributes	The seabed around Matiere Point supports a variety of species uncommon in many areas in Marlborough. Of particular interest are giant lampshell, burrowing anemone, anemone (Epiactus sp.) and the habitat forming tubeworm (*Galeolaria hystrix*). These species have been recorded from the site in high densities. The bivalve *Cuspidaria wellmani* is also common at this site. Traditionally this species has been regarded as rare, but NIWA have recorded it from other localities in the Marlborough Sounds in recent years. Burrowing anemones are uncommon in Marlborough.	
Biogeographic area	Queen Charlotte Sound	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/09/2011	
Report	Davidson, R.J. and Richards, L.A. 2015. Significant marine site survey and monitoring programme: Summary 2014-2015. Prepared by Davidson Environmental Limited for Marlborough District Council. Survey and monitoring report number 819.	

Field work (present)	
Date	NA
Lead organisation	
Personnel	

Site Characteristics	
Original area of significant site (ha)	10.95
Suggested revision of significant site (ha)	12.4
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	6.5 - 38 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Fine sand
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Silt
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Burrowing anemone
Species status	Conservation/scientific importance
Biogenic type (if applicable)	
Important species 2	Giant lampshell
Species status	Conservation/scientific importance
Biogenic type (if applicable)	Shellfish beds (e.g. dog cockles)
Important species 3	
Species status	
Biogenic type (if applicable)	

Human Impacts	
Damage and or impacts noted	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 (Table 5). 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.
Proportion of significant site effected	< 10%
Level of impact	None observed previously
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	10.95	
Recommended area of significant site (ha)	12.4	
Change to original site	Increase	
Change (ha)	1.45	
Percentage change from original area (%)	13.2%	
Anthropogenic disturbance	Low	
Vulnerability assessment	Low-moderate	
Key species sensitivity	Sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness	M (medium)	M (medium)
2. Rarity	M (medium)	M (medium)
3. Diversity	M (medium)	M (medium)
4. Distinctiveness	M (medium)	H (high)
5. Size and shape	L (low)	L (low)
6. Connectivity	M (medium)	M (medium)
7. Sustainability		
8. Catchment	L (low)	M (medium)
Comments		Forestry is 2 km distant so unlikely to impact this site. Remainder of catchment is stable.
Recommendations		Adopt boundary alterations

REFERENCES		
	Davidson, R.J. and Richards, L.A. 2015. Significant marine site survey and monitoring programme: Summary 2014-2015. Prepared by Davidson Environmental Limited for Marlborough District Council. Survey and monitoring report number 819	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018b. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 2. NIWA Client Report
	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018a. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 1. NIWA Client Report 2018085WN: 229.	

Site 4.24 Onauku Head (subtidal)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	4.24	
Site name	Onauku Head subtidal (horse mussel and scallop)	
Site description	Onauku Bay is located at the northern end of East Bay, outer Queen Charlotte Sound	
Ecological description of attributes	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	
Biogeographic area	Queen Charlotte Sound	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/09/2011	
Report	Davidson, R.J.; Duffy, C.A.J.; Gaze, P.; Baxter, A.; du Fresne, S.; Courtney, S.; Hamill, P. 2011. Ecologically significant marine sites in Marlborough, New Zealand. Co-ordinated by Davidson Environmental Limited for Marlborough District Council and Department of Conservation. Published by Marlborough District Council.	

Field work (present)	
Date	NA
Lead organisation	
Personnel	

Site Characteristics	
Original area of significant site (ha)	63.2
Suggested revision of significant site (ha)	52.67
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	3-20 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Fine sand
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Silt
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Horse mussel
Species status	Conservation/scientific importance
Biogenic type (if applicable)	Horse mussel
Important species 2	Scallop
Species status	Iconic
Biogenic type (if applicable)	Shellfish beds (e.g. dog cockles)
Important species 3	
Species status	
Biogenic type (if applicable)	

Human Impacts	Column1
Damage and or impacts noted	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.
Proportion of significant site effected	< 10%
Level of impact	Low to moderate
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	63.2	
Recommended area of significant site (ha)	52.67	
Change to original site	Decrease	
Change (ha)	-10.53	
Percentage change from original area (%)	-16.7%	
Anthropogenic disturbance	Low	Low due to closed scallop season
Vulnerability assessment	Moderate-high	
Key species sensitivity	Sensitive	
Assessment criteria scores	Assessment criteria scores (original)	Assessment criteria scores (present review)
1. Representativeness	M (medium)	M (medium)
2. Rarity	L (low)	M (medium)
3. Diversity	L (low)	M (medium)
4. Distinctiveness	M (medium)	M (medium)
5. Size and shape	L (low)	M (medium)
6. Connectivity	L (low)	H (high)
7. Sustainability		
8. Catchment	L (low)	M (medium)
Comments		Non-dredged area warrants some biological survey in the future. New area captures prime scallop and horse mussels habitats. Horse mussel beds uncommon in Sounds. Distinctive due to low disturbance. Scallops and horse mussels present together. Well connected as larvae spend long period in water column. Deeper areas of closed site expected to be little different to remainder of deep Onauku Bay.
Recommendations		Accept alterations

REFERENCES		
	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018a. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 1. NIWA Client Report 2018085WN: 229.	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018b. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 2. NIWA Client Report 2018085WN: 118.

Site 4.25 East Bay north (lampshell and burrowing anemone)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	4.25	
Site name	East Bay north (lampshell and burrowing anemone)	
Site description	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.	
Ecological description of attributes	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).	
Biogeographic area	Queen Charlotte Sound	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/09/2011	
Report	Davidson, R.J.; Duffy, C.A.J.; Gaze, P.; Baxter, A.; du Fresne, S.; Courtney, S.; Hamill, P. 2011. Ecologically significant marine sites in Marlborough, New Zealand. Co-ordinated by Davidson Environmental Limited for Marlborough District Council and Department of Conservation. Published by Marlborough District Council.	

Field work (present)	
Date	NA
Lead organisation	
Personnel	

Site Characteristics	
Original area of significant site (ha)	120.47
Suggested revision of significant site (ha)	167.07
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	16-42 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Fine sand
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Silt
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	Bedrock
Substrata (localised patch or patches)	Cobble
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Giant lampshell
Species status	Conservation/scientific importance
Biogenic type (if applicable)	Shellfish beds (e.g. dog cockles)
Important species 2	Burrowing anemone
Species status	Conservation/scientific importance
Biogenic type (if applicable)	
Important species 3	Tubeworm mounds
Species status	Biogenic habitat forming
Biogenic type (if applicable)	High relief biogenic (variety of species)

Human Impacts	Column1
Damage and or impacts noted	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. The present level of anchoring and associated human activity along this coast is low. A more detailed survey of this coast would enable key areas to be identified and protected from anchoring.
Proportion of significant site effected	< 10%
Level of impact	Low to moderate
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	120.47	
Recommended area of significant site (ha)	167.07	
Change to original site	Increase	
Change (ha)	46.6	
Percentage change from original area (%)	38.7%	
Anthropogenic disturbance	Low	Low due to closed scallop season
Vulnerability assessment	High	
Key species sensitivity	Extremely sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness	H (high)	H (high)
2. Rarity	M (medium)	M (medium)
3. Diversity	M (medium)	M (medium)
4. Distinctiveness	M (medium)	H (high)
5. Size and shape	H (high)	H (high)
6. Connectivity	L (low)	M (medium)
7. Sustainability		
8. Catchment	L (low)	M (medium)
Comments		Moderate priority for survey in the future. Low level of threats at present. Connectivity to other areas in East Bay. Largest and best known area makes this site a high for distinctiveness.
Recommendations		Accept alterations

REFERENCES		
	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018a. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 1. NIWA Client Report 2018085WN: 229.	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018b. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 2. NIWA Client Report 2018085WN: 118.

Site 5.4 a-r Tory Channel west (biogenic patch reefs)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	5.4 a-r	
Site name	Tory Channel west (biogenic patch reefs)	
Site description	Tory Channel west subsites are located in the western half of the Channel between Dieffenbach Point and Te Rua Bay.	
Ecological importance	Tory Channel (west) is comprised of 18 subsites ranging in size from 0.49 ha to 36 ha (Table 4, Figure 5). 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. Davidson and Richards (2015) noted these sites also often included shallow reef habitats with a high cover of macroalgae. Based on an arbitrary 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).	
Biogeographic area	Tory Channel	
Level of original information	2. Qualitative internal report	
Date of original assessment	2016	
Report	Davidson, R.J.; Richards, L.A.; Rayes, C. 2017b. Benthic biological survey of central and south-eastern Tory Channel, Marlborough Sounds. Prepared by Davidson Environmental Limited for New Zealand King Salmon Limited. Survey and monitoring report no. 857.	

Present work	
Date	Adjust boundaries based on existing data.
Lead organisation	Davidson Environmental
Personnel	Rob Davidson
Area surveyed	

Site Characteristics	
Original area of significant site (ha)	NA
Suggested revision of significant site (ha)	NA
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	2-45 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Granule
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Coarse sand
Substrata (common 30-50% cover)	Dead broken shell
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Shell hash
Substrata (localised patch)	Cobble
Substrata (localised patch)	Bedrock
Substrata (localised patch)	Boulder

Important species (revised site)	
Are important species present?	Yes
Important species 1	Biogenic mounds (bryozoans, sponges, hydroids)
Species status	Biogenic habitat forming
Biogenic type (if applicable)	High relief biogenic (variety of species)
Important species 2	
Species status	
Biogenic type (if applicable)	

Human Impacts		
Damage and or impacts noted	Historic dredging targeting kina has historically occurred in Tory Channel.	Some dredging for kina may occur in Tory Channel. No trawling is permitted in Tory Channel.
Proportion of significant site effected		
Level of damage	Unknown	
Type of damage or activity observed		
Type of damage or activity observed		
Type of damage or activity observed		
Type of damage or activity observed		

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	58.67	
Previous area (ha)	183.76	
Recommended area of significant site (ha)	181.31	
Change to original site	Decrease	
Change (ha)	2.45	
Percentage change from original area (%)	0.0	
Anthropogenic disturbance	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. Recreational fishers regularly anchor along this coast.	Recreational anchoring occurs in these sites and likely causes damage to communities.
Vulnerability assessment	Medium to high (bryozoans, sponges and hydroids are vulnerable to physical disturbance). Many remnant habitats are associated with outcropping rock that appears to provide refuge from physical damage.	
Sensitivity	Very Sensitive. Subsites support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).	
Assessment criteria scores (original)		**Assessment criteria scores (revised)**
1. Representativeness	H (high)	H (high)
2. Rarity	H (high)	M (medium)
3. Diversity and pattern	L (low)	H (high)
4. Distinctiveness	H (high)	H (high)
5. Size	L (low)	H (high)
6. Connectivity	L (low)	H (high)
7. Catchment	H (high)	NA
Comments	The new sites described in this site record form are comparable to sites 5.1, 5.2, 5.3, and 5.4a-d (Davidson and Richards, 2015).	High flow environment likely negates adjacent sediment catchment effects. Relative to sites of this type they are add up to a large set of sub-sites. Holuthurians (*Thyone* spA) are of note.
Recommendations	Assess these sites for significant site status. Group any sites with the existing Significant Site 5.4. New sites should be listed as sub-sites.	Adopt changes to boundaries. Adopt new numbering to sub-sites.

REFERENCES		
	Davidson R.J.; Richards L.A. 2015. Significant marine site survey and monitoring programme: Summary 2014-2015. Prepared by Davidson Environmental Limited for Marlborough District Council. Survey and monitoring report number 819.	
	Davidson, R. J.; Baxter, A. S.; Duffy, C. A. J.; Gaze, P.; du Fresne, S.; Courtney, S.; Brosnan, B. 2015. Reassessment of selected significant marine sites (2014-2015) and evaluation of protection requirements for significant sites with benthic values. Prepared by Davidson Environmental Limited for Marlborough District Council and Department of Conservation. Survey and monitoring report no. 824.	
	Brown S, Anderson TJ, Watts A, Carter M, Olsen L, Bradley A 2016. Benthic ecological assessments for proposed salmon farm sites. Prepared for Ministry for Primary Industries, NIWA Client Report No. NEL2016-003.	

Site 5.8 a-g Tory Channel east (biogenic patch reefs)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	Site 5.8 a-g	
Site name	Tory Channel east (biogenic patch reefs)	
Site description	Tory Channel east subsites are located in the eastern half of the Channel between Te Rua Bay and Okukari Bay near the entrance.	
Ecological importance	Tory Channel (east) is comprised of 12 subsites ranging in size from 0.55 ha to 44.06 ha. 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 ericopsis) 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).	
Biogeographic area	Tory Channel	
Level of original information	2. Qualitative internal report	
Date of original assessment	2016	
Report	Brown S, Anderson TJ, Watts A, Carter M, Olsen L, Bradley A 2016. Benthic ecological assessments for proposed salmon farm sites. Prepared for Ministry for Primary Industries, NIWA Client Report No. NEL2016-003.	

Present work

Date	Adjust boundaries based on existing data.
Lead organisation	Davidson Environmental
Personnel	Rob Davidson
Area surveyed	

Site Characteristics

Original area of significant site (ha)	NA
Suggested revision of significant site (ha)	NA
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	2-45 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Substratum (revised site)

Substrata (widespread and dominant >50% cover)	Granule
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Coarse sand
Substrata (common 30-50% cover)	Dead broken shell
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Shell hash
Substrata (localised patch)	Cobble
Substrata (localised patch)	Bedrock
Substrata (localised patch)	Boulder

Important species (revised site)

Are important species present?	Yes
Important species 1	Biogenic mounds (bryozoans, sponges, hydroids)
Species status	Biogenic habitat forming
Biogenic type (if applicable)	High relief biogenic (variety of species)
Important species 2	Hydroid trees
Species status	Biogenic habitat forming
Biogenic type (if applicable)	Hydroid garden

Human Impacts

Damage and or impacts noted	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. recreational anchoring occurs and likely cause damage to biogenic communities.	
Proportion of significant site effected		
Level of damage	Unknown	
Type of damage or activity observed	Anchoring	
Type of damage or activity observed		
Type of damage or activity observed		
Type of damage or activity observed		

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	122.92	
Sites		
Recommended area of significant site (ha)	114.11	
Change to original site	Decrease	
Change (ha)	7.34	
Percentage change from original area (%)	0.1	
Anthropogenic disturbance	Kina dredging may occur. Three salmon farms are located along the edges of the main reach. Several mussel farms are located in adjacent bays to the main reach. Pine plantations are widespread in most catchments of the bays along Tory Channel. The intertidal and shallow subtidal received wakes from ferry	Recreational anchoring occurs and likely damages biogenic structures.
Vulnerability assessment	Very sensitive. Subsites support species, habitats or communities that cannot tolerate anthropogenic seabed disturbance (i.e. anchoring, all forms of dredging and trawling).	
Assessment criteria scores (original)		**Assessment criteria scores (revised)**
1. Representativeness	H (high)	H (high)
2. Rarity	M (medium)	M (medium)
3. Diversity	H (high)	H (high)
4. Distinctiveness	H (high)	H (high)
5. Size	M (medium)	H (high)
6. Connectivity	H (high)	H (high)
7. Catchment	L (low)	NA
Comments		Largest sites of their type known.
Recommendations		Accept boundary adjustments. Tidal flow negates adjacent catchment effects.

REFERENCES		
	Davidson R.J.; Richards L.A. 2015. Significant marine site survey and monitoring programme: Summary 2014-2015. Prepared by Davidson Environmental Limited for Marlborough District Council. Survey and monitoring report number 819.	
	Davidson, R. J.; Baxter, A. S.; Duffy, C. A. J.; Gaze, P.; du Fresne, S.; Courtney, S.; Brosnan, B. 2015. Reassessment of selected significant marine sites (2014-2015) and evaluation of protection requirements for significant sites with benthic values. Prepared by Davidson Environmental Limited for Marlborough District Council and Department of Conservation. Survey and monitoring report no. 824.	

Site 6.1 The Knobbys (reef)

To be assessed by expert panel once more data is collected.

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

The Knobbys original 2011 significant site (yellow) and the boundary suggested by Davidson *et al*. (2020) (teal).

Site 6.3 Port Underwood south-east (algae bed)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	6.3	
Site name	Site 6.3 Port Underwood south-east (algae bed)	
Site description	Area of seabed located along the south-eastern shoreline of Port Underwood between Robertson Point and Pipi Bay.	
Ecological description of attributes	Red algae was described from this area by Davidson *et al*. (2011). Since that time a number of surveys and red algae monitoring reports have been produced in relation to this coast. Much of this area supports a variety of species of macroalgae including a variety of red algae species. Davidson (2015) stated that red algae beds described by Davidson (2013, 2013a) were characterised by a range of species that appeared to vary geographically from north to south. Stations located in the north-east were dominated by a different set of red algae species compared to stations located further to the south and west. In the north, one of the dominant species is the adventive *Chnoospora minima* which is a brown alga but forms a mat over the benthos (Nelson and Duffy, 1991). Centrally, the red algae Adamsiella spp. are often abundant and, further south, appears to be *Rhodymenia* sp.	
Biogeographic area	Port Underwood	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/09/2011	
Report	Davidson R. J.; Duffy C.A.J.; Gaze P.; Baxter, A.; DuFresne S.; Courtney S.; Hamill P. 2011. Ecologically significant marine sites in Marlborough, New Zealand. Co-ordinated by Davidson environmental limited for Marlborough District Council and Department of Conservation.	

Field work (present)	
Date	1 April 2019
Lead organisation	Davidson Environmental
Personnel	Rob Davidson, Laura Richards , Courtney Rayes

Site Characteristics	
Original area of significant site (ha)	3.914
Suggested revision of significant site (ha)	50.229
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	6.5 - 14.5 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	Drop camera (cable remote) HD photographs (remote underwater) HD video (remote underwater)

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Mud (silt and clay)
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Red algae
Species status	Biogenic habitat forming
Biogenic type (if applicable)	
Important species 2	
Species status	
Biogenic type (if applicable)	

Human Impacts	
Damage and or impacts noted	Mussel farms are located in this area. The adventive brown alga *Chnoospora minima* (Nelson and Duffy, 1991) is common in sheltered northern areas of this site. It is not known if this species compete with native algal species.
Proportion of significant site effected	25-50 %
Level of impact	Annual monitoring of algae beds in this area has shown that algae grows under marine farm structures (Davidson *et al*, 2019). Sedimentation levels appear high as indicated by high turbidity and sediment often dusting rocks and plant surfaces. Considerable areas of the catchment have been logged in recent years. It is not known if the adventive alga *Chnoospora minim* a (Nelson and Duffy, 1991) competes with native algae.
Type of damage or activity observed	Introduced or exotic species
Type of damage or activity observed	Aquaculture
Type of damage or activity observed	Sedimentation
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	3.914	
Recommended area of significant site (ha)	50.229	
Change to original site	Increase	
Change (ha)	46.315	
Percentage change from original area (%)	1183.3%	
Anthropogenic disturbance	Moderate	
Vulnerability assessment	Low-moderate	
Key species sensitivity	Resilient	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness	M (medium)	H (high)
2. Rarity	L (low)	M (medium)
3. Diversity	L (low)	M (medium)
4. Distinctiveness	L (low)	H (high)
5. Size and shape	L (low)	H (high)
6. Connectivity	L (low)	H (high)
7. Sustainability		
8. Catchment	L (low)	L (low)
Comments	Increase in bed size due to extended survey coverage and more intense sampling. Red algae percentage cover varies seasonally with lower cover in winter months (Davidson, 2015).	Monitoring reports have been undertaken on the impact of marine farms. Results suggest mussel farm impact is low.
Recommendations	Adopt new site boundaries. Encourage collection of algae samples by Te Papa.	Adjust boundaries. Encourage collection of samples.

REFERENCES	
	Davidson, R.J.; Richards, L.A.; Rayes, C. 2019. Biological monitoring report for a marine farm 8628 located near Whangatoetoe Bay, Port Underwood: Fifth sample event (Summer). Prepared by Davidson Environmental Ltd. for F Scott Madsen & Penny Fredricks (for Scott Madsen Family Trust). Survey and monitoring report no. 937.
	Davidson, R.J. 2015. Biological monitoring report for a marine farm located at western Whangatoetoe Bay, Port Underwood: Baseline and year 1 report. Prepared by Davidson Environmental Ltd. for F Scott Madsen & Penny Fredricks (for Scott Madsen Family Trust). Survey and monitoring report no. 821.
	Nelson, W.A.; Duffy, C.A.J. 1991. Chnoospora minima (Phaeophyta) in Port Underwood, Marlborough - a curious new algal record for New Zealand, New Zealand Journal of Botany, 29:3, 341-344, DOI: 10.1080/0028825X.1991.10416612.

Site 5.9 Tory Channel entrance (biogenic patch reefs)
Site 7.1 Cape Jackson & Walker Rock (reef)
Site 7.8 White Rocks (reef)
Site 7.10 Cook Rock to Cape Koamaru (reef)
Site 7.11 The Brothers (reef)
Site 7.13 Awash Rock (reef)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	5.9, 7.1, 7.8, 7.10, 7.11, 7.13	
Site name	Cook Strait reefs	
Site description	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. The Tory Channel site spans two biogeographic zones (Tory Channel and Cape Jackson to Rarangi. The remaining sites are all located in the later biogeographic zone.	
Ecological description of attributes	These sites were included as significant sites in Davidson et al. (2011) based on a 1990 qualitative survey of 260 sites throughout the Marlborough Sounds (Duffy et al., unpublished data). 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 surveying these sites. Davidson et al. (2011) stated these areas were poorly known due to strong tidal flows and depths. Diver surveys by Duffy et al. (unpublished data) recorded 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. New bathymetric data collected 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 the existing diver collected data to better describe the location of potential ecologically significant features. Where possible sites were extended to low tide 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. The authors reported these systems comprised extremely high-relief reefs with rock walls, ridgelines, ledges, and steep ravines up to ≤10 m up to 40 m in height with slope angles between approximately 58 to 78 degrees. Sections of shallow reefs below the kelp zone were often dominated by Caulerpa meadows. Caulerpa spp. 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 were recorded from Waihi Point at Cape Jackson, from White Rocks south to Cook Strait reefs located either side of the entrance into Tory Channel. The sponge Ecionemia alata is a common species known to grow up to 1 m in diameter and its external colour generally ranges from shark-grey to charcoal grey (Kelly, 2015). The extraordinarily large sizes (up to 1.5m identified by Anderson et al., 2020) and bleach-white colouration along with the sheer number of these sponges on some	
Biogeographic area	Port Underwood	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/09/2011	
Report	Davidson R. J.; Duffy C.A.J.; Gaze P.; Baxter, A.; DuFresne S.; Courtney S.; Hamill P. 2011. Ecologically significant marine sites in Marlborough, New Zealand. Co-ordinated by Davidson environmental limited for Marlborough District Council and Department of Conservation.	

Site Characteristics	
Original area of significant site (ha)	707.83
Suggested revision of significant site (ha)	1233.8
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	0 - 60 m
Wave Climate	Exposed open coast

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Bedrock
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Cobble
Substrata (minor <30%)	Boulder
Substrata (localised patch or patches)	Coarse sand
Substrata (localised patch or patches)	Dead broken shell
Substrata (localised patch or patches)	Shell hash

Important species (revised site)	
Are important species present?	Yes
Important species 1	Large sponges including bleached variety
Species status	Conservation/scientific importance
Biogenic type (if applicable)	High relief biogenic (variety of species)
Important species 2	Biogenic high current communities
Species status	Conservation/scientific importance
Biogenic type (if applicable)	High relief biogenic (variety of species)
Important species 3	
Species status	
Biogenic type (if applicable)	

Human Impacts	
Damage and or impacts noted	The sites support 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. The sites are swept by strong currents reducing the likelihood of sediment smothering. Cray pots are deployed in some of these sites and these likely cause damage to biogenic habitats.
Proportion of significant site effected	
Level of impact	Likely to be low in most areas, may be higher in Tory Channel sites where many pots can be deployed.
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)	707.83	
Recommended area of significant site (ha)	1233.8	
Change to original site	Increase	
Change (ha)	525.97	
Percentage change from original area (%)	74.3%	
Anthropogenic disturbance	Low	
Vulnerability assessment	Low-moderate	
Key species sensitivity	Extremely sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness	H (high)	M (medium)
2. Rarity	L (low)	M (medium)
3. Diversity	H (high)	H (high)
4. Distinctiveness	H (high)	H (high)
5. Size and shape	L (low)	H (high)
6. Connectivity	L (low)	H (high)
7. Sustainability		
8. Catchment	L (low)	NA
Comments		Tory Channel is located in two biogeographic zones. Representativeness for inner Tory Channel sites was ranked as high.
Recommendations	Adopt new site boundaries.	Adopt new boundaries.

REFERENCES	
	Anderson, T.; Stewart, R.; D'Archino, R.; Stead J.; Eton, N. 2020. Life on the seafloor in Queen Charlotte Sound, Tory Channel and Cook Strait. Prepared for Marlborough District Council by NIWA NIWA client report No: 2019081WN
	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018a. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 1. NIWA Client Report 2018085WN: 229.
	Neil, H., Mackay, K., Wilcox, S., Kane, T., Lamarche, G., Wallen, B., Orpin, A., Steinmetz, T., Pallentin, A. 2018b. Queen Charlotte Sound / Tōtaranui and Tory Channel / Kura Te Au (HS51) survey: What lies beneath? Guide to survey results and graphical portfolio. Part 2. NIWA Client Report 2018085WN: 118.
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New site 7.15 Kokomohua Island (tubeworm mounds)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	7.15	
Site name	Kokomohua Island (tubeworms)	
Site description	Small area of seabed located immediately east of Kokomohua Island.	
Ecological description of attributes	Occasional *Galeolaria* tubeworm mounds were first observed in 1993 from this area as part of the annual marine reserve monitoring programme. In recent years the tubeworms have grown and formed a dense bed. Video footage was collected in summer 2018. The present survey in May 2020 used drop camera to map the bed. During the present survey an abundant bed of Chaetopterus had appeared. Occasional Chaetopterus were present in 2018, however, they are now abundant an appeared to be growing on and amongst *Galeolaria* mounds. It is possible both NZ species of *Chaetoperus* are present (Geoff Read pers.	
Biogeographic area	Cape Jackson to Rarangi	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/06/2020	
Report		

Field work (present)	
Date	20 May 2020
Lead organisation	Davidson Environmental
Personnel	Rob Davidson, Laura Richards , Courtney Rayes

Site Characteristics	
Original area of significant site (ha)	0
Suggested revision of significant site (ha)	0.27
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	8-17 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	Drop camera (cable remote) HD photographs (remote underwater) HD video (remote underwater)

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Fine sand
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Silt
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Galeolaria mounds
Species status	Biogenic habitat forming
Biogenic type (if applicable)	Tubeworm mounds (e.g. G. hystrix)
Important species 2	
Species status	
Biogenic type (if applicable)	
Important species 3	
Species status	
Biogenic type (if applicable)	
Important species 4	
Species status	
Biogenic type (if applicable)	
Important species 5	
Species status	
Biogenic type (if applicable)	
Important species 6	
Species status	
Biogenic type (if applicable)	

Human Impacts	
Damage and or impacts noted	*The Galeolaria bed has gradually grown since 1993 probably due to the decline in anchoring in the area. This was once a popular cod fishing location and fishers regularly anchored. Chaetopterus* sp. is presently colonising the inshore edges of this coast and has formed dense beds approximately 6 and 17 m depth. The status of this species remains uncertain. Both species found in NZ have been found nowhere else (Geoff Read, pers. comm.). This species is likely to be the Marlborough Sounds species that has appeared in Queen Charlotte and East in recent years.
Proportion of significant site effected	75-100%
Level of impact	The site is located within the Long Island-Kokomohua Marine Reserve and is now little impacted by human activity.
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)		
Recommended area of significant site (ha)	0.27	
Change to original site	Increase	
Change (ha)	0.27	
Percentage change from original area (%)	100.0%	
Anthropogenic disturbance	Low	
Vulnerability assessment	Low	
Key species sensitivity	Extremely sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness		H (high)
2. Rarity		H (high)
3. Diversity		H (high)
4. Distinctiveness		H (high)
5. Size and shape		H (high)
6. Connectivity		H (high)
7. Sustainability		
8. Catchment		NA
Comments	At present there are few Galeolaria beds known bed in the Cape Jackson to Rarangi biogeographic area.	Largest known horse mussel bed in biogeographic area
Recommendations	Adopt new site boundaries. Collect samples of *Chaetopterus* for identification.	Adopt as a new site

New site 7.16 Long Island (horse mussels)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	7.2	
Site name	Long Island (horse mussels)	
Site description	Area of seabed located immediately in front of the Cliffs located along the northern shoreline of Long Island.	
Ecological description of attributes	Horse mussels were first observed in this area during the annual marine reserve monitoring programme by Courtney Rayes and Ton Scott-Simmonds. During the establishment of a scallop and horse mussel monitoring site a bed of horse mussels was discovered (2019). The present survey in May 2020 mapped the extent of the bed along the shore. Mean density of horse mussels reached 7.8 individuals per m^2.	
Biogeographic area	Cape Jackson to Rarangi	
Level of original information	3. Quantitative internal report	
Date of original assessment	1/06/2020	
Report		

Field work (present)	
Date	20 May 2020
Lead organisation	Davidson Environmental
Personnel	Rob Davidson, Courtney Rayes, Tom Scott-Simmonds

Site Characteristics	
Original area of significant site (ha)	0
Suggested revision of significant site (ha)	9.3
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	10-17 m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods	
Method of assessment	Drop camera (cable remote) HD photographs (remote underwater) HD video (remote underwater)

Substratum (revised site)	
Substrata (widespread and dominant >50% cover)	Mud (silt and clay)
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	Fine sand
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)	
Are important species present?	Yes
Important species 1	Horse mussel
Species status	Biogenic habitat forming
Biogenic type (if applicable)	Horse mussel
Important species 2	
Species status	
Biogenic type (if applicable)	

Human Impacts	
Damage and or impacts noted	*Chaetopterus* sp. is presently colonising the inshore edges of this coast and has formed dense beds at the southern end of this site between approximately 8 and 20 m depth. The status of this species remains uncertain. Both species found in NZ have been found nowhere else (Geoff Read, pers. comm.). This species is likely to be the Marlborough Sounds species that has appeared in Queen Charlotte and East in recent years. 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. The site supports species that can tolerate low-intensity anchoring (i.e. a rare occurrence and recreational size anchors), however, because the bed is located in a marine reserve, it would be appropriate to prohibit anchoring using the MR Act or the RMA. Because the site is well mapped and located in a Marine Reserve, no buffer zone is recommended.
Proportion of significant site effected	
Level of impact	The site is located within the Long Island-Kokomohua Marine Reserve and is little impacted by human activity.
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)		
Recommended area of significant site (ha)	9.3	
Change to original site	Increase	
Change (ha)	9.3	
Percentage change from original area (%)	100.0%	
Anthropogenic disturbance	Low	
Vulnerability assessment	Low	
Key species sensitivity	Sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness		H (high)
2. Rarity		H (high)
3. Diversity		M (medium)
4. Distinctiveness		H (high)
5. Size and shape		H (high)
6. Connectivity		H (high)
7. Sustainability		
8. Catchment		NA
Comments	Intact horse mussel beds were likely once widespread in the Marlborough Sounds. They are no an uncommon feature. This is the only known horse mussel bed in the Cape Jackson to Rarangi biogeographic area.	Adjacent Island is protected and stable but < 400 ha. Anchoring is inappropriate.
Recommendations	Adopt new site boundaries.	Adopt as a new site.

New site 5.11 Tory Channel north (subtidal seagrass)

Site Registration Detail (original)	Existing and present survey information	Expert panel assessment
Site number	5.11 a-f	5.11 a-f
Site name	Tory Channel north (seagrass)	
Site description	Area of seabed located along the northern shoreline of Tory Channel between Deep Bay and Okukari Bay.	
Ecological description of attributes	Permanently submerged beds of seagrass (Zosteraceae) in coastal waters are rare in New Zealand, where most seagrass beds are confined to the intertidal zone of estuaries (Schwarz *et al*., 2006). Subtidal beds are knowns from offshore islands including Slipper Is (Bay of Islands), Cavallis and Great Mercury Island. Seagrasses including eelgrass are among the most productive plants of earth (McRoy and McMillan, 1977; Knox, 1986; Duarte and Chiscano, 1999). They influence community structure and function through a combination of physical, chemical, and biological mechanisms (Phillips 1984, Thayer *et al*., 1984). Declining seagrass populations worldwide have been largely due to increases in anthropogenic disturbance (Short and Burdick, 1996) including 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). At present, no intertidal or subtidal eelgrass beds are protected in the Marlborough Sounds.	
Biogeographic area	Tory Channel	
Level of original information	2. Qualitative internal report	
Date of original assessment		
Report	Duffy, C.A.J; Smith, A.; Davidson, R.J.; Cook, S.; Briden. In prep. Shallow subtidal species assemblages and benthic habitats of the Marlborough Sounds. Prepared by Department of Conservation.	

Field work (present)

Date	21 May 2020
Lead organisation	Davidson Environmental
Personnel	Rob Davidson, Laura Richards , Courtney Rayes

Site Characteristics

Original area of significant site (ha)	0
Suggested revision of significant site (ha)	1.471
Marine zone	Sublittoral (low tide to continental shelf)
Depth range (m)	0.5 to 3m
Wave Climate	Sheltered coast (enclosed or semi-enclosed water body)

Methods

Method of assessment	Drop camera (cable remote) Photographs (handheld surface)

Substratum (revised site)

Substrata (widespread and dominant >50% cover)	Fine sand
Substrata (widespread and dominant >50% cover)	
Substrata (widespread and dominant >50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (common 30-50% cover)	
Substrata (minor <30%)	Dead whole shell
Substrata (minor <30%)	Dead broken shell
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	
Substrata (localised patch or patches)	

Important species (revised site)

Are important species present?	Yes
Important species 1	Seagrass
Species status	Biogenic habitat forming
Biogenic type (if applicable)	Seagrass (subtidal)
Important species 2	
Species status	
Biogenic type (if applicable)	

Human Impacts

Damage and or impacts noted	Most sites exhibited fine sediment coating plant leaves. Seagrass is vulnerable to smothering by sediment.
Proportion of significant site effected	75-100%
Level of impact	It is not known if these beds have historically declined in size.
Type of damage or activity observed	Sedimentation
Type of damage or activity observed	
Type of damage or activity observed	
Type of damage or activity observed	

SIGNIFICANT SITE SUMMARY	Existing and present survey information	Expert panel assessment
Original area of significant site (ha)		
Recommended area of significant site (ha)	1.471	
Change to original site	Increase	
Change (ha)	1.471	
Percentage change from original area (%)	100.0%	
Anthropogenic disturbance	Moderate	
Vulnerability assessment	High	
Key species sensitivity	Extremely sensitive	
Assessment criteria scores	**Assessment criteria scores (original)**	**Assessment criteria scores (present review)**
1. Representativeness	H (high)	M (medium)
2. Rarity	H (high)	H (high)
3. Diversity	H (high)	M (medium)
4. Distinctiveness	H (high)	H (high)
5. Size and shape	H (high)	M (medium)
6. Connectivity	L (low)	H (high)
7. Sustainability		
8. Catchment	L (low)	L (low)
Comments	Intertidal eelgrass beds have been recorded from a variety of sites in the Marlborough Sounds and Tasman/Golden Bays, but subtidal eelgrass beds appear to be restricted to outer reaches of Tory Channel. Subtidal seagrass in New Zealand is found from relatively few sites.	Establish a new site and subsites because northern sites are small, shallow and percentage covers are low compared to southern seagrass sites (5.10). These sites are therefore different for criteria 1 and 5.
Recommendations	Adopt new sites. Periodically monitor sites.	Adopt as a new site (and subsites). Periodically monitor.

REFERENCES		
	United Nations Environment Programme 2020. Out of the blue: The value of seagrasses to the Environment and to people. UNEP, Nairobi.	
	Short, F.T.; Burdick, D.M. 1996. Quantifying seagrass habitat loss in relation to housing development and nitrogen loading in Waquoit Bay, Massachusetts. Estuaries 19:730–739.	
	Fonseca, M.S.; Thayer, G.W.; Chester, A.J. 1984. Impact of scallop harvesting on eelgrass (Zostera marina) meadows: implications for management. N Am J Fish Manag 4:286–293.	
	Matheson, F.; Dos Santos, V.; Inglis, G.; Pilditch, C.; Reed, J.; Morrison, M.; Lundquist, C.; Van Houte-Howes, K.; Hailes, S.; Hewitt, J. 2009. New Zealand seagrass - General Information Guide NIWA Information Series No. 72	
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6.0 Significant site sensitivity and anthropogenic disturbance

6.1 Anthropogenic impacts

Ranking of significant sites in Davidson *et al*. (2011) revealed the biological assemblages they supported were often uncommon with many representing one of few or the last of their kind in each biogeographic area. The existence of significant sites or their persistence was often attributed to environmental factors such as topography or substratum providing some level of natural protection from anthropogenic impacts.

Many of Marlborough's significant marine sites are thought to be remnants of habitats and communities historically more widespread (Davidson *et al*., 2011; Davidson and Richards 2015; 2016; Handley 2015, 2016; Davidson *et al*., 2017; 2018). This situation reflects a global trend of declining biogenic habitat area and quality with consequential effects on wider ecological values (Thrush *et al.,* 2006a, 2006b; Gray *et al.,* 2006; Lotz *et al*., 2006; Airoldi *et al.,* 2008; McCauley *et al.,* 2015; Anderson *et al*., 2019; Urlich and Handley, 2020). Aside from climate change effects, key threats to biogenic habitats include bottom trawling, shellfish dredging, sedimentation, invasive species, coastal infrastructure, water quality and port-related dredging (MacDiarmind *et al*., 2012).

Anderson *et al*. (2019) stated: "biogenic habitats growing along the New Zealand coast (e.g. eelgrass meadows, mangrove forests and kelp forests) especially those close to urban areas, face a range of threats and stresses associated with increased sedimentation, benthic disturbance through coastal development (infrastructure) and coastal maintenance (e.g. channel dredging), along with declines in water quality (e.g. increased suspended sediments, nutrification and pollution) associated with these activities". The authors also stated: "although some biogenic habitats occur within Marine Reserves, and they are afforded protection against direct physical disturbance (e.g. benthic fishing activities), they do not safeguard them against key threats from land-based issues such as sediment and nutrient run-off."

A decline in biogenic habitats in New Zealand has been linked to declining juvenile fish habitat and identified as a contributor to declines in fish abundance and biomass (see Morrison *et al*. 2014 for review). Hurst *et al*. (2000) stated: "The Environmental Principles of the 1996 Fisheries Act require that habitat of particular significance for fisheries management should be protected". Because the Fisheries Act 1996 has not prevented the continued fragmentation and loss of habitats (e.g. Davidson & Richards 2015; Urlich 2017), Urlich *et al*. (2018) contended that the definition of "maintained" (see: CBD, NZBS, Fisheries Act 1996) has not prevented the frequency and extent of fishing disturbance from outstripping the recovery potential of resident organisms, highlighting the need for management of cumulative impacts on the seafloor. Urlich *et al*. (2018) proposed that anthropogenic disturbance should be

managed to "safeguard" ecological functioning of biogenic habitats as fundamental coastal processes underpinning biodiversity and its contingent ecological complexes. Urlich and Handley (202) suggested a need for improved catchment management, along with more effective integration of marine management responsibilities and marine spatial planning (i.e. ecosystem-based management).

Importantly, significant sites that support biogenic habitats have often been described as important to juvenile fish (Diaz, *et al*., 2003; Dahlgren *et al.*, 2006; McCain *et al*., 2016). Wilson *et al*. (2010) for example reported habitat degradation compounded effects of fishing on coral reefs as increased fishing reduces large-bodied target species, while habitat loss resulted in fewer small-bodied juveniles and prey that replenish stocks and provide dietary resources for predators. Loss and degradation of marine biological values around New Zealand and internationally has usually been linked to anthropogenic activities (Lauder 1987, Stead 1991, Cranfield *et al.* 1999, Cranfield *et al.* 2003, Morrison *et al.,* 2009; Davidson *et al.,* 2011; Paul 2012; Morrison *et al.,* 2014, 2014a; Handley 2015, 2016). Direct physical disturbance by trawling and dredging for example, has been assessed as one of the main causes of damage to marine benthic biological values (MacDiarmid *et al.*, 2012; MfE, 2016). It is likely that without protection or strong management, Marlborough's less resilient significant marine sites will continue to be lost or degraded with consequential impacts on fish abundance.

Davidson and Richards (2015) highlighted the decline of biological attributes at several significant sites originally identified by Davidson *et al.* (2011), including sites becoming smaller and some being functionally lost. In contrast, Davidson and Richards (2016) did not document loss that could be directly attributed to human activities; rather site boundaries were adjusted based on improved information. Davidson *et al*. (2017a) reported that some sites were adversely affected by anthropogenic activities. In the most recent studies, Davidson *et al*. (2018; 2019; 2020) reported many sites were altered in size due to improvements in survey detail, while others had their attributes degraded by physical disturbance, exotic species and/or increased sedimentation.

Some biogenic habitats once damaged and lost may not recover, but rather may shift to an alternate ecosystem state (Airoldi and Beck, 2007). Large scale historical losses of biogenic habitats have been documented in New Zealand's history (e.g. the loss of ~500 km^2 of green-lipped mussel beds within the Firth of Thames has coincided with large declines in water quality, increased sedimentation and resuspension of sediments (described in Morrison *et al*., 2014a). Large-scale losses of green-lipped mussels within Kenepuru Sounds and horse mussel beds from across the outer Marlborough Sounds are also described by long-time fishers and residents (Handley, 2015, 2016; Davidson and Richards 2015).

6.2 Threat assessment process

The Expert Panel assessed anthropogenic threats for each significant site surveyed in 2020 (Table 3).

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 assessment adopted an updated version of the original assessment (Davidson *et al*. 2020). The revised method required 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 3). 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 by Davidson et al. (2020) to calculate appropriate buffer zones that aim to reduce the likelihood of damage from anthropogenic activities (e.g. dredging, trawling, anchoring, sedimentation, pollution).

The expert panel reviewed these buffer zone distances based on the panel's collective knowledge of the biophysical characteristics of each significant site (e.g. personal knowledge) and/or from the literature (including bathymetry charts), as well as information on the distribution and intensity of marine pressures such as bottom trawling and dredging.

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 respond to potential "stressors".

Definitions for the threat categories used in the present assessment of significant sites were:

> **Anthropogenic disturbance:** 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 those from

the adjacent catchments.

Sensitivity: Assessment of the sensitivity of habitats, species and/or communities present at a site. Scores ranged from extremely sensitive biological features such as lace corals and brittle tubeworm mounds (high vulnerability score) to relatively robust species or habitats such as coarse substrate/mobile shores and high energy kelp forests (low vulnerability score).

Table 3. 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

6.3 Threat assessment summary

Sensitivity to anthropogenic disturbance is likely to be an important consideration for the management of significant sites. Sensitive and very sensitive sites are vulnerable to human activities and management action is usually appropriate to ensure the continuation of natural values at the site.

Watson *et al.* (2020) used NIWA multibeam bathymetric data to calculate the extend and cover of anthropogenic benthic impacts in Queen Charlotte Sound (QCS), Tory Channel and adjacent areas of Cook Strait. The authors recorded a variety of benthic impacts including anchor drag marks,

aquaculture, moorings and port structures. The authors stated these impacts were most pronounced in inner QCS, however, they cautioned that the true spatial extent of physical disturbance related to anthropogenic activities was likely to be even more extensive than estimated in their study as the physical anthropogenic footprint measured using the multibeam bathymetric data only captured seabed features observable in the 2 m resolution data. Further, the authors stated the inner QCS has a relatively low influence from tidal currents with only very minor evidence of scouring, suggesting that human-induced seafloor disturbance may be better preserved in this part of the sounds compared to other higher energy environments (e.g., outer QCS). Watson *et al.* (2020) concluded that the dramatic increases in global marine traffic since the 1990s with trends of growth predicted in the coming decades may mean that seafloor disruption by anchor dragging becomes a major concern for marine habitats and therefore ecosystem health for shallow marine regions like QCS and Tory Channel.

In the annual survey report, Davidson *et al*. (2020) ranked all sites as supporting either “very sensitive” or “sensitive” species, habitats or communities. Threats were also outlined in that report ranging from physical disturbance from anchoring to effects from sedimentation (Table 4).

Of particular concern to the expert panel is recreational anchoring in Tory Channel. This area is regularly targeted by recreational fishers and any deployment of anchors along this current swept channel often results in anchor drag and damage to the very sensitive biogenic habitats along its length. It is in fisher’s best interest to ensure habitats that support fish and their juveniles are protected from anchor damage.

Two new significant sites were described in Long Island-Kokomohua Marine Reserve. Although protected from dredging and trawling, there is no present restrictions on anchoring. The expert panel suggest anchoring be prohibited at these two sites in the reserve. The horse mussel bed was ranked as sensitive and able to cope with low intensity anchoring, however, this site was ranked the best of its kind in the biogeographic area and the panel believed this warranted a no-anchoring status.

The significant site located at the head of Onauku Bay is closed to commercial dredging and trawling; however, recreational dredging is presently permitted. It is suggested that this area be protected from all dredging and trawling. It is likely this site can cope with low intensity recreational anchoring as horse mussels were not dense at this site.

Table 4. Summary of anthropogenic disturbance and vulnerability assessment for 2020 significant sites.

Sites	Sensitivity (species, habitat)	Anthropogenic threats	Impacts observed	Buffer (m)	Main issues	Comments
Site 4.23 Matiere Point (lampshell and burrowing anemone)	Sensitive	Low	No	50	Increased sedimentation	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.
Site 4.24 Onauku head (scallop and horse mussel)	Sensitive	Moderate	No	50	Recreational dredging, anchoring	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.
Site 4.25 East Bay north (lampshells, anemones and tubeworm mounds)	Very sensitive	Moderate	No	100	Anchoring	Recreational fishers anchor along this coast. Site unlikely to be trawled or dredged.
Site 5.4 Tory Channel west (biogenic patch reefs)	Very sensitive	Moderate	Yes	100	Anchoring, kina dredging	Recreational fishers regularly anchor along this coast. Parts of some subsites are vulnerable to dredging. Some damage to biogenic structures exist.
Site 5.8 Tory Channel east (biogenic patch reefs)	Very sensitive	Moderate	Yes	100	Anchoring, kina dredging	Recreational fishers regularly anchor along this coast. Parts of some subsites are vulnerable to dredging. Some damage to biogenic structures exist.
Sites 5.9, 7.1, 7.8, 7.10, 7.11, 7.13 Cook Strait reefs	Very sensitive	Low	No	100	Cray pot damage	Recreational fishers seldom anchor and dredging and trawling are unlikely. Large steel cray-pots are common along the channel edges at particular times.
Site 6.3 Port Underwood south-east (algae)	Sensitive	Moderate	Yes	50	Sedimentation, marine farms	In some circumstances marine farms may shade the benthos. Sediment levels are likely elevated due to recent forest logging. Physical damage can occur from trawling.
New Site 7.15 Kokomohua Island (tubeworm mounds)	Very sensitive	Low	No	100	Anchoring	There is a low level of threat due to the environment at this site due to marine reserve status. Anchoring is permitted but is inappropriate.
New Site 7.16 Long Island (horse mussels)	Sensitive	Low	No	None	Anchoring	There is a low level of threat due to the environment at this site due to marine reserve status. Anchoring is permitted but is inappropriate. No buffer suggested due to MR status.
New Site 5.11 a-f Tory Channel north (subtidal seagrass)	Very sensitive	Moderate	Yes	100	Sedimentation	There is a moderate level of threat due to catchment effects that can increase sedimentation.

7.0 Erratum

The following are errors in Davidson *et al*. (2011).

Page 62 Map 7
Site names and numbers located in wrong positions on Map 7.
Fix: Site 2.29 Witt Rock with Site 2.28 MacManaway mislabeled Map 7

Page 66
Table 3 Sites 2.29 should be McManaway Rock, Sites 2.28Should read Witt Rocks.

Page 91 Map 15
Site names and numbers located in wrong positions on Map 15.
Fix: Swap labels 4.22 Puriri Bay with 4.23 Matiere Point on Map 15

Page 19 Table 2
Fix: Willawa Point (spelling error)

Page 73 Line 3
Fix: Replace reference numbers 337, 338, 339 with 251, 373, 374, 375

Page 73 Para 2 Line 4
Fix: Replace reference numbers 94 with 102

Page 114, Table 8
Brothers Island intertidal should read “subtidal”

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Appendix 1. Assessment criteria (2017)

The following section presents the updated assessment criteria used to evaluate the ecological significance in the present review report. The ranking for each criterion are: H = High (which can be thought of as outstanding), M = Medium (which is still highly significant) and L = Low (which is more representative or typical of ecosystems that pre-dated human disturbance). Criteria scores collectively contribute to the overall site ranking and indicate the reason/s for the significance of a site. A site that does not achieve "H" or "M" is not ranked as reaching the planning threshold of being an ecologically significant site in the present report, however, such sites may possess a variety of biological attributes considered important for other reasons or have insufficient data to enable ranking.

1. Representativeness

The site is significant if it contains biological features (habitat, species, community) that represent a good example within the biogeographic area.

High: The site contains the best example of its type known from the biogeographic area.
Medium: The site contains one of the better examples, but not the best, of its type known from the biogeographic area.
Low: The site contains an example, but not one of the better or best, of its type known from the biogeographic area.

2 Rarity

The site is significant if it contains flora and fauna listed as nationally threatened nationally endangered, nationally vulnerable, or in serious decline. The site is also considered significant if it supports flora and fauna that are sparse, locally endemic, or at an extreme in their national distribution. The site is also significant if it supports a habitat or habitats or community assemblages that are rare nationally, regionally or within the biogeographic area.

High: The site contains a nationally important species, habitat or community; or the site contains several species, habitats, communities that are threatened within the biogeographic area.
Medium: The site contains one or a few species, habitats or communities that are threatened but not nationally, or contains rare or uncommon species, habitats or communities within the biogeographic area.
Low: The site is not known to contain flora, fauna or communities that are threatened, rare or uncommon in the biogeographic area, region or nationally.

3 Diversity

The site is significant if it contains a range of species and habitat types notable for their complexity (i.e. diversity of species, habitat, community).

High: The site contains a high diversity of species, habitats or communities.
Medium: The site contains a moderate diversity of species, habitats or communities.
Low: The site contains a low diversity of species, habitats or communities.

4 Distinctiveness

The site is significant if it contains ecological features (e.g. species, habitats, communities) that are outstanding or unique nationally, in the region, or in the biogeographic area.

High: The site contains any ecological feature that is unique nationally, in the region, or in the biogeographic area, or it contains several features that are outstanding regionally or in the biogeographic area.
Medium: The site contains any ecological feature that is notable or unusual but not outstanding or unique nationally, in the region or in the biogeographic area.
Low: The site contains no known ecological features that are outstanding or unique nationally, in the region or in the biogeographic area (i.e. ecological features are typical rather than distinctive).

5 Size

The site is significant if it is moderate to large relative or other habitats or communities of its type in the biogeographic area.

High: The site is large relative to other habitats or communities of its type in the biogeographic area.
Medium: The site is moderate size relative to other habitats or communities of its type in the biogeographic area.
Low: The site is small relative to other habitats or communities of its type in the biogeographic area.

6 Connectivity

The site is significant if it is adjacent to, or close to other significant marine, freshwater or terrestrial areas or the site is sufficiently close to other sites of its kind to enable biological interchange (e.g. larval transport, settlement of juveniles).

High: The site is near or well connected to a large significant site or several other significant sites.
Medium: The site is near other significant sites, but only partially connected to them or at an appreciable distance.
Low: The site is isolated from other significant sites.

7 Adjacent catchment modifications

Catchments that drain large tracts of land can lead to high sediment loading into adjacent marine areas. A site is significant if the adjacent catchment is >400 ha and clad in relatively mature native vegetative cover resulting in a long term stable environment with markedly reduced sediment and contaminant run-off compared to developed or modified catchments.

High: The site is dominated by a stable and relatively mature native vegetated catchment (>400 ha) that is legally protected.
Medium: The site is dominated by a stable and relatively mature native vegetated catchment (>400 ha) with partial or no legal protection.
Low: The site is surrounded by a catchment (>400 ha) that is farmed, highly modified or has limited, relatively mature, vegetative cover.
Not applicable: The site is little influenced by catchment effects (e.g. offshore site, current swept site).