IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of a Board of Inquiry appointed under section 149J of the Resource Management Act 1991 to consider The New Zealand King Salmon Co. Limited's private plan change requests to the Marlborough Sounds Resource Management Plan and resource consent applications for marine farming at nine sites located in the Marlborough Sounds

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STATEMENT OF EVIDENCE OF ROBERT JAMES DAVIDSON IN RELATION TO SIGNIFICANT MARINE SPECIES AND HABITATS FOR THE NEW ZEALAND KING SALMON CO. LIMITED

JUNE 2012

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Executive Summary

A. I was engaged by Cawthron Institute to provide comment on aspects of their seabed, site deposition and benthic impact biological reports that they were preparing for the King Salmon applications. I was engaged due to my knowledge and experience relating to the identification and subsequent ranking and evaluation of biological features in the Marlborough Sounds. I have been involved in this type of work previously in relation to publication of resource inventory documents and a career of biological survey work.

B. My experience and knowledge of the Marlborough marine environment was recently integrated into a study that identified biological features regarded as "significant" in Marlborough (Davidson et al. 2011).

C. My evidence draws on this knowledge and covers

- An overview of the known ecological attributes of the Marlborough.
- A summary of biological values from biogeographic areas where farm applications are located.
- A description of known "significant" marine sites within and immediately adjacent to applications with comments on potential effects.
- A description of the ecological status or biological value of the application sites with comments on potential effects on adjacent biological features.

D. The Marlborough Sounds is 1722 km of convoluted coastline supporting a diverse and exciting marine environment. Biophysical factors including geology, tide, currents, sedimentation, temperature, salinity and variation in wave exposure and depth have created a highly complex marine environment. This physical complexity has resulted in a unique assemblage of species, habitats and communities. No other coastal area in New Zealand exhibits this enormous range of habitat complexity.

E. Cawthron benthic reports produced for each salmon farm application identified biological features close to or under each proposed farm. The next step was to assess their importance and determine if any they would be adversely affected by the establishment of a salmon farm.

F. Five salmon farm applications are located in the Pelorus biogeographic area (Waitata, White Horse Rock, Richmond, Tapipi, and Kaitara). There are 21 known "significant" sites in this biogeographic area. Of the five salmon farm applications located in this area, none are located near known "significant" sites.

G. One salmon farm application is located in the Northern Outer Sounds biogeographic area (Papatua). There are 34 known sites regarded as having "significant" biological value in this biogeographic area. There are four significant sites located in the Bay. One "significant" site is located close by, while the other three sites are located in the wider Port Gore.

H. Two salmon farm applications are located in the Tory Channel biogeographic area (Ngamahau and Ruaomoko). There are nine types of significant community in Tory Channel. Some of these community types are found at multiple sites along the Channel. Two "significant" sites are located near the Ruaomoko site, while three "significant" sites are located close to the Ngamahau salmon farm application.

I. One salmon farm application is located in the Queen Charlotte biogeographic area (Kaitapha). No benthic "significant" sites are located within 1 km of this application site.

J. All of the salmon farm application sites, apart from Papatua in Port Gore, are located in areas swept by relatively strong tidal currents. Habitats in the Marlborough Sounds that receive tidal flow usually support a higher number of benthic and often pelagic species in a greater abundance compared to sites in sheltered or backwater locations such as bays and inlets. The positioning of farm applications in high flow areas increases the risk of conflict between biological values and an activity that can have adverse impacts on biological values.

K. Apart from the Papatua application, a variety of biological features with some level of ecological value were recorded under or close to the applications. These included isolated areas of current swept reef and cobble habitats supporting a variety of species, and tubeworm and bryozoan mounds. Apart from Ngamahau, these biological features were all located well distant to the cage areas and most of were outside and adjacent to the warp and anchor area. Occasionally features were located in the cage and warp zone.

L. Based on impact predictions produced by Cawthron scientists most of these features will not be adversely impacted by a salmon farm due to their physical separation from the cage zone, however, some biological features at Ngamahau application will be lost while others will be impacted to some degree.

M. Mitigation in the form of funding a biological survey to detect areas in Tory Channel with "significant" biological values is proposed to compensate for the biological impact at Ngamahau.

N. A range of monitoring conditions have been provided by the applicant. These suggested monitoring conditions describe a regime of monitoring, reporting and management in relation to the activity of salmon farming. The monitoring programme outlined in these suggested conditions investigates the "notable biological features" associated with the present salmon applications. The proposed MEM-AMP should ensure that any detected adverse impacts on "notable biological features" located close to the consent can be addressed by appropriate actions.

STATEMENT OF EVIDENCE OF ROBERT JAMES DAVIDSON

Education

1. My full name is Robert James Davidson. I am a marine biologist and hold the qualification of Master of Science in Zoology (First Class Honours) obtained from Canterbury University (1986). I have worked for the Ministry of Fisheries (1986-87), and Department of Conservation (1987-95). During my time at DOC, I was based at Nelson and employed as the coordinator of marine biological surveys throughout the Nelson Marlborough Conservancy. I was the principal author of several large-scale ecological reports and biological resource documents for marine areas in the DOC Nelson-Marlborough Conservancy. While at DOC I also coordinated resource inventory reports used by the Marlborough District Council, Nelson City Council, Tasman District Council and Canterbury Regional Council, outlining ecologically important marine areas for inclusion in their respective coastal plans (Davidson et al. 1993; 1995).

Private consultancy and experience

2. In 1995, I left the Department and established my own practice, “Davidson Environmental Limited”, which specializes in ecological research, survey and monitoring. To date I have produced 700 reports most of which have been associated with Resource Consent applications. The majority of these RMA related reports have been for marine farm applications, farm impact assessments, farm revalidations and renewals and also marine farm monitoring.

3. I have also coordinated up to 18 consecutive years of monitoring for each of three Marine Reserves in the top of the South Island. Another long-term monitoring programme was the impact monitoring of ferries travelling through the Marlborough Sounds including Tory Channel (1995-2012). Recently I have coordinated a two year programme updating and reassessing the biological value of sites in the Marlborough Sounds (Davidson et al. 2011).

4. I have also been involved in a number of review and advisory roles including the Ecological Advisory Group for reviewing monitoring of the Tasman Bay Marine Farm Ring Road development, as a member of the MDC marine focus group, Top of the South Biosecurity Partnership, and the MAF *Undaria* Expert Advisory Group.

5. I am a current member of the New Zealand Marine Sciences Society and have presented 17 conference papers in New Zealand and overseas. I have published 12 papers in internationally peer reviewed scientific journals including papers on marine reserves, subtidal soft bottom and reef communities.

6. Based on a wide range of long term studies combined with over 4000 working dives in the Marlborough Sounds, I have a very good understanding of subtidal environment of the Marlborough Sounds.

Conflict of interest declarations

7. I am part owner of a number of marine farm consent areas in the Marlborough Sounds including a research based site located at Treble Tree Point, Waitata Reach. Apart from the research site, water space is leased out or is managed by marine farming companies on contract. I have no shareholding or other beneficial interest in the present salmon farm applications.

8. I also conduct a variety of contract work for some of today's submitters on other matters (e.g. marine reserve monitoring, impact monitoring and aquaculture issues). I also contract to the Marlborough District Council where I manage an ecological database and coordinate two ongoing monitoring studies (i.e. marine farm recovery study and a ferry impact study.

9. I take particular care to ensure that my business interest in marine farms and my role as a consultant for a variety of clients do not influence my role as an independent consultant on other work. My relationship with clients and standing as an expert witness has been based on my responsibilities as a scientist, my expertise and experience. My evidence today is therefore consistent with the best principles of scientific inquiry and any opinions and conclusions are based on my experience and understanding of biological theory, integrated with data collected during field work at and near the application sites.

Code of practice

10. I have read the Environment Court Practice Note for Expert Witnesses, I understand its meaning and effect, and I confirm that this statement of evidence has been prepared in accordance with that practice note and the evidence I give to the Court whether in written or oral form will comply with those directions.

1.0 Background

11. I was engaged by Cawthron Institute to provide comment on aspects of their seabed, site deposition and benthic impact biological reports that they were preparing for the King Salmon applications. I was engaged due to my knowledge and experience relating to the identification and subsequent ranking and evaluation of biological features in the Marlborough Sounds. I have been involved in this type of work previously in relation to publication of resource inventory documents and a career of biological survey work.

12. During the process of their report preparation and writing, I met regularly with Cawthron staff to discuss the biological field work, the issues associated with the field investigation, the description and information requirements for each application site, the issues related to adjusting boundaries to avoid important biological values and finally editing and preparation of the associated final reports. During this process I read and commented on the draft Cawthron reports. I viewed much of the raw

data collected during the field investigations. Particular attention was paid to underwater photographic material.

13. I am familiar with the location of the proposed salmon farm applications. Over the years I have regularly passed by all the application sites. I have previously been involved in the collection of biological data from areas close to or adjacent to some of the application sites.

14. These include:

A. A biological investigation of a proposed mussel farm site at the **Waitata** White Horse Rock site U010272 (Davidson 2001).

B. A biological report for a mussel farm application in **Richmond** Bay U951126 (Davidson 1995).

C. Biological reports for mussel farm applications in Pig Bay, **Papatua**, Port Gore (Davidson 1995a, 1995b, 1995c; Davidson 2001a 2001b).

D. A biological review of marine farm sites in Pig Bay, **Papatua** for Department of Conservation (Davidson 1998).

E. A biological report on soft bottom habitats at a variety of locations in the Sounds including Tory Channel (**Ngamahau**) (Davidson et al. 2010).

F. A biological report outlining significant biological areas in the Sounds including **Ngamahau** (Davidson et al. 2011).

2.0 Scope of evidence

15. My evidence draws on 27 years work on a variety of studies in the Marlborough Sounds. Some of these studies have involved long term repeat monitoring of sites located relatively close to the present salmon farm applications. For example I have coordinated monitoring of intertidal and subtidal sites in Tory Channel and Queen Charlotte Sound since 1995. My experience and knowledge of the marine environment was integrated into a recent study that identified biological features regarded as "significant" in Marlborough (Davidson et al. 2011). During this study a team of experts were brought together to develop a set of ranking criteria that could be used to assess the biological importance or "significance" of marine sites in Marlborough. Information in that report combined with my prolonged and extensive field work in the Sounds have formed the foundation for much of my evidence.

16. My evidence in relation to the present applications will cover the following:

1. An overview of the known ecological attributes of the Marlborough Sounds marine environment based on the most recent resource update (Davidson et al. 2011).
2. A summary of known biological values located within each biogeographic area where a farm application is located.
3. A description of known "significant" marine sites within and immediately adjacent to the farm application areas with comments on potential effects.

4. A description of the ecological status or relative biological value of the application sites themselves with comments on potential effects on adjacent biological features.
5. My evidence concludes with ecologically based comments on benthic issues I consider most important in relation to the present applications in the Marlborough Sounds.

2.1 Terminology and legislation

17. In my evidence I will often refer to the status of benthic features in the Marlborough Sounds and in proximity to the applications. I have provided a short description of the terms used to describe the relative ecological value of a biological feature in the following section.

18. **Biological feature**: A description of biological attributes existing in an area. The description is usually based on existing data or field survey work.

19. **Biological values**: Usually based on an assessment or a ranking applied to biological features. The reliability of the assessment is related to the quality of data available and is usually outlined as part of any assessment.

20. **Significant**: A biological feature that has been ranked using a recognised ranking methodology (e.g. “significant” area report by Davidson et al. 2011). A site with a “significant” rank has a high level of importance and may fulfill Section 6(c) of the RMA.

21. **Important**: A biological feature that may not have been ranked, but is a habitat, species, substrate or community type that is potentially significant (may be ranked as significant in the future, but insufficient data is currently known) or is an example of a biological feature that has some ecological value due to its attributes (e.g. a community type that is not widespread and common throughout the Sounds, important for other species, has some ecological role).

22. **Representative**: Is a biological feature that is a good example of a habitat, community or substrate. Representative is independent of status. For example, the biological feature may be ranked as significant or may be regarded as important or may have a relatively low status and in all cases can be a representative example of a biological feature.

23. **Biogeographic area**: Is defined as an area that supports a particular range of species or a species assemblage that is different or distinct to adjacent areas. Biogeographic areas are often delineated by the disappearance of some species and the appearance of others. This often occurs at a particular boundary point or border. For example, in Marlborough, bull kelp is restricted to south of Cape Jackson. Similarly, the giant kelp *Macrocystis* is rare north of the Cape. Girdled wrasse is also seldom seen north of the Cape, but regularly seen in more southern areas. If this transition or change occurs for many species, it is often used to define the border of a biogeographic area. Biogeographic areas therefore define a distinct range of species or species assemblages that characterize that area.

24. **Section 6 (c) of the RMA (the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna):** Many, but not all sites identified as "significant" in the Davidson et al. (2011) would probably be described as significant in Section 6 (c) of the RMA. Many of the significant sites in Davidson et al., (2011) are unique in the Sounds or the biogeographic area, many are the best example of their kind, and many support high status species, while others are important due to their ecological role in the environment. Some sites remain poorly understood and require further investigation. Davidson et al. (2011) did however, include some of these sites due to their potential in the hope that their inclusion in the report would lead to further biological investigation.

25. **Policy 11 of the NZCPS (2010):** Comments on Section 6(c) of the RMA apply.

3.0 The marine environment of the Marlborough Sounds

26. I would like to firstly provide an overview of the Marlborough Sounds benthic marine environment. An understanding of the "big ecological picture" is important to ensure that marine farms are placed in appropriate locations.

27. The Marlborough Sounds is a convoluted 1722 km of coastline supporting a diverse and exciting marine environment. This intricate coastline has been formed as the headwaters of the former Pelorus and Queen Charlotte Valleys were submerged by tectonic forces and sea level changes. The distinctive submerged river valley coastline has formed a range of shore types ranging from sheltered bays and estuaries located in the inner Sounds to wave exposed open bays, channels, tidal passages supporting some of the most exposed coast in the world. Biophysical factors including geology, tide, currents, sedimentation, temperature, salinity and variation in wave exposure and depth have created a highly complex marine environment. This physical complexity has resulted in a unique assemblage of species, habitats and communities. No other coastal area in New Zealand exhibits this enormous range of habitat complexity.

28. The Sounds provides habitat for species ranging from those found nowhere else in the world such as the chiton (*Notoplax latamina*) (Plate 1) to species common and widespread such as the recreationally important blue cod. Many species that inhabit this area are important as habitat formers. Animals such as the bryozoan coral *Galeopsis porcellanicus* (Plate 2) can form a 3-dimentional biological skin over the sea floor, providing habitat for juvenile fish and a wide range of prey for fish. Many species such as hydroids require particular environments to flourish, such as high water flow habitats found in passages and entrances (e.g. Tory Channel entrance) (Plate 3). Species new to science such as a new species of worm found near Picton Harbour are still being discovered in the Sounds (Plate 4).

Plate 1. The endemic chiton *Notoplax latamina*.

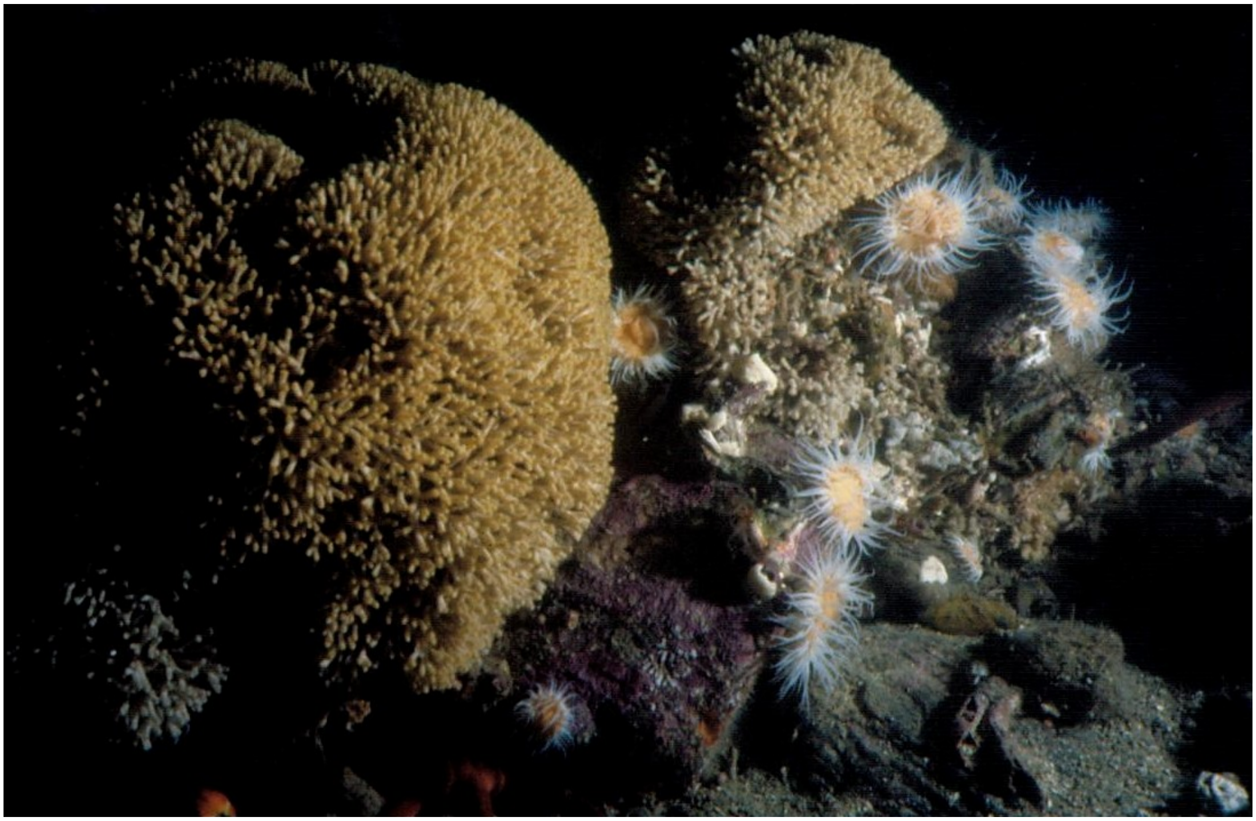


Plate 2. Bryozoan coral *Galeopsis porcellanicus*

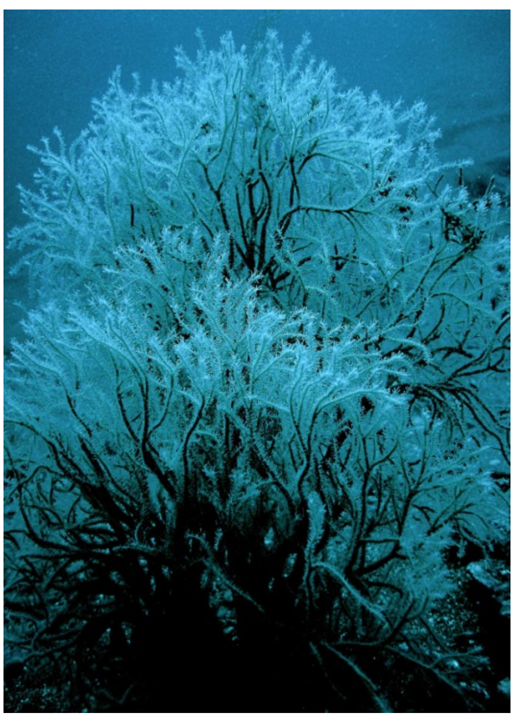


Plate 3. Hydroid tree (left) and associated nudibranch (*Jason miribellus*).

Plate 4. New species of tubeworm found near Picton (Photo Don Morrisey).

29. Some species are only found in particular areas of the Sounds such as the ancient giant lampshell found in shallow areas of East Bay (Plate 5). The Sounds also supports habitats critical to birds such as the king shag found nowhere else in the world (Plate 6) and habitat for a small group of the rarest dolphin in the world (Hector's dolphin).

Plate 5. Giant lampshell.

Plate 6. King shag resting on mussel floats.

30. There is little doubt that the number, extent and quality of important biological values in the Sounds, as well as the quality of the general marine environment, has declined since the arrival of humans. Inappropriate or poorly planned human endeavours have often had a negative effect on the marine environment. This has undoubtedly led to a reduction in the quality and quantity of biological values in the Marlborough Sounds. It is therefore important that remaining sites with significant biological values in the Sounds are not further adversely affected and are well managed.

31. An important function of the Cawthron benthic reports produced for each salmon farm application was to identify biological features close to or under each proposed farm. Once scientists described biological features and plotted their location relative to the each application, it was important to assess their importance and then determine if they would be adversely affected by the establishment of a salmon farm.

32. Before I get into this detail, I would first like to provide some background information and examples of biological features that often have some status in each biogeographic area where farm applications have been located. I would then like to provide a summary of the known biological features close to or under the application sites.

4.0 Biological values in biogeographic areas

30. In the Marlborough Sounds there are seven major biogeographic zones with another two located further south along the East Coast of the South Island (Figure 1). The nine King Salmon applications are located in four distinct biogeographic areas. They are:

- **Pelorus Sound**: (Waitata, White Horse Rock, Richmond, Tapipi, and Kaitara applications).
- **Two Bay Point to Cape Jackson (northern outer Sounds)** (Papatua application).
- **Tory Channel** (Ngamahau and Ruaomoko applications).
- **Queen Charlotte Sound** (Kaitapeha application).

31. In order to assess what biological features are potentially adversely affected by a marine farm application it is important to understand what features are present, their importance and assess if they will be adversely affected by a marine farm.

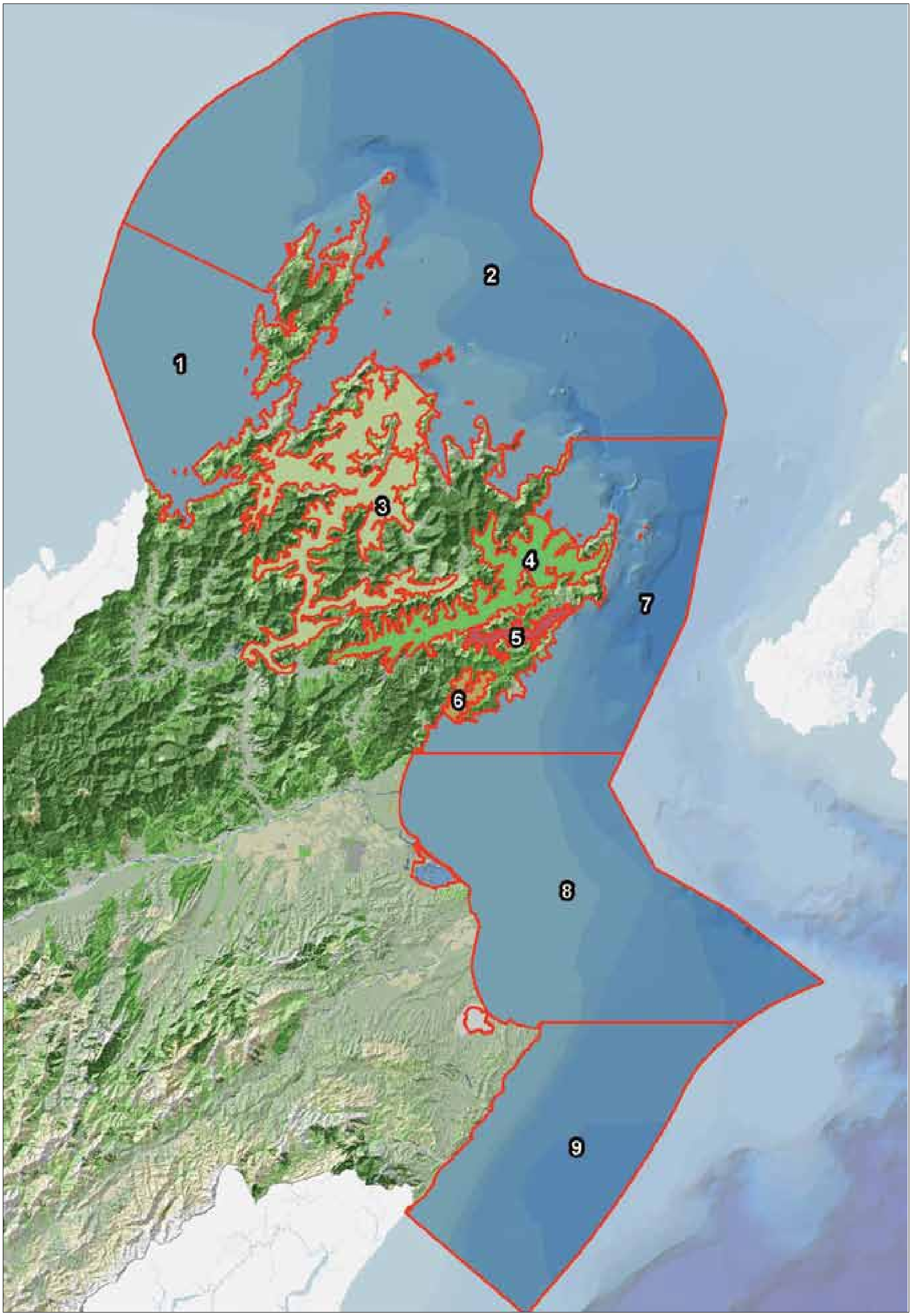


Figure 1. Major biogeographic zones in Marlborough (from Davidson et al. 2011).

4.1 Pelorus Sound biogeographic area

32. Five salmon applications are located within the outer areas of the Pelorus Sound biogeographic area (Waitata, White Horse Rock, Richmond, Tapipi, and Kaitara). This biogeographic area stretches the length of Pelorus Sound covering a coastline of 590 km and an area of 38,477 km. To put this in perspective, the Pelorus coastline would extend from Wellington to Auckland along the west coast of the North Island.

33. The main Pelorus Channel generally broadens and deepens as it opens to the sea. Maximum depths increase from approximately 30m at the confluence of Hikapu Reach and Kenepuru Sound to between 63-87m at the mouth of the Sound where it enters northern Cook Strait. Strong tidal currents in the main Pelorus reaches (up to 3 knots) result in scouring around headlands and in narrow passages. Coastal topography is steep and most of the shoreline is fringed by intertidal and subtidal rocky reefs composed of cobbles and small boulders. There are reefs of outcropping bedrock off points and on a number of pinnacles and shoals. At particular locations, rocky reef extends to depths > 40m, but in most areas reefs only extend to approximately 10 -16 m depth. Coarse, silty, shelly sand usually covers the lower slopes of the main channel and marginal bays below the reef. Soft mud covers most of the floor of the Sound and shallow, sheltered bays. Mud is the most common and widespread substratum in the Sound. Sand meets mud at an average depth of 16m, but the range varies from low water to more than 40m.

34. Despite major differences in freshwater flow and circulation, rocky reef assemblages are generally similar to the inner Queen Charlotte Sound. Macroalgal biomass and diversity is generally low. There are virtually no laminarian kelps (a type of large brown seaweed). Paddle weed is only found at a few sites around the entrance (Paparoa and East Entry Point). Fucoids are the main large brown algae present. Narrow flapjack abundance declines rapidly with increasing distance into the Sound where it forms a sparse, patchy fringe at low water on headlands in as far as Tawhitinui Reach and Grant Bay in the Beatrix Basin. Beyond that, it is replaced by a mixed fringe of *Cystophora torulosa* and Neptune's necklace, or dense beds of blue, ribbed and green-lipped mussels. Dense subtidal stands of flexible flapjack grow down to 6-12m depth at headland sites along the main channel of the Sound from approximately Nikau Bay outwards. Plant size and abundance diminishes rapidly inside bays and side arms, and it is absent from Kenepuru Sound, Tennyson Inlet, the eastern side of Beatrix Bay and most of Crail Bay. In Beatrix Basin, Tawhitinui Reach and Tennyson Inlet flexible flapjack is generally replaced by slender zigzag weed as the dominant macroalga. It extends from low water to 6-11 m depth in these areas. Mats of the sea grape weed are common on rocky and sandy substrates to approximately 24m depth in the outer Sound and side arms.

35. Encrusting coralline algae and invertebrates dominate most subtidal reefs. Common reef invertebrates include slaty sponge, small hydroids, the small colonial cup coral, common anemone, serpulid tubeworms (particularly *Galeolaria hystrix* and spirorbids), hermit crabs, starry limpet, green topshell, Cook's turban, turret shell, cats-eye, arc shell, nesting mussel, fan shell, window oyster, jewel star, cushion star, eleven-armed star, snake star, sea cucumber, kina, pink urchin and saddle

seasquirt. Of note are large colonies of tubeworms, predominantly *Galeolaria hystrix* with some *Pomatoceros terranovae*, on reefs in the outer Sound (Tawero Point to East Entry Point, Beatrix Basin, Tawhitinui Reach), Kenepuru Sound and Forsyth Bay. The largest of these is up to 122cm high and 180cm long.

36. Reefs in more than 15m of water in the main channel support a relatively diverse fauna dominated by large sponges, particularly *Ancorina alata,* but also finger sponges, large hydroids, compound ascidians and occasionally stony bryozoans (lace coral, Separation Point coral). Apart from spotty, common triplefin and variable triplefin there are few reef fishes, particularly in the inner Sound. Other relatively common species include short-tailed stingray, eagle ray, rock cod, sea perch, sweep, butterfly perch, yellow-eyed mullet, blue cod, triplefins (yellow-black triplefin, mottled triplefin, *Grahamina* spp., blue-eyed triplefin, spectacled triplefin) and leatherjacket. Tawero Point and West Entry Point were historically recognised "deep sea" fishing grounds where catches of snapper, blue cod, red cod, red gurnard and small sharks could be made from shore.

37. Soft sediments support varied groups of species depending on the depth, composition and hydrology. Coarse sands below rocky reefs support beds of the bivalves (purple sunset shell) and large dog cockle as well as horse mussels, scallop, filter-feeding hermit crab, eleven-armed star, snake star, sea cucumber, pink urchin and the brachiopod *Terebratella haurakiensis* (attached to drift shell). Horse mussel shells are colonised by sponges, hydroids, compound ascidians and brachiopods (*T. sanguinea, Waltonia inconspicua*). Rare species include the burrowing anemone. In several places along the main channel (Dillon Bell Point, Capsize Point, Tapipi, Oke Rock) there appear to be remnant colonies of the Separation Point coral close to the base of the reef. Muddy habitats are dominated by the heart urchin, brittlestars, holothurians, bivalves, small tubeworms and cirolanid sea lice. Other species found in the area include broad-nose sevengill shark, spotted spiny dogfish, school shark, rough skate, short-tailed stingray, eagle ray, elephant fish, red cod, red gurnard, scaly gurnard, john dory, ling, common warehou, snapper, tarakihi, yellow-eyed mullet, spotty, spotted stargazer, opal fish, witch, lemon sole, common sole, sand flounder and greenback flounder. Records of outer-shelf species such as scaly gurnard and ling reflect the Sound's connection with Cook Strait.

38. Elephant fish spawn in Hallam Cove, Garne, Savill, Elaine and Penzance Bays, and off Camel Point. Garne Bay is the most significant spawning ground with large numbers of egg cases between 4-9m depth. Snapper are much more abundant in Pelorus Sound than Queen Charlotte Sound and spawn in Kenepuru where there was once a commercial seine fishery. A Ministry of Agriculture and Fisheries survey in 1987 indicated Mahau Sound, Maori, Nydia and Clova Bays are potentially the most important nursery areas for snapper in the Pelorus Sound, with Te Mahia and Waitaria Bay being the most important in Kenepuru Sound. High catches of juvenile warehou were also recorded in outer Kenepuru Sound, Nikau, Maori, Four Fathom and Nydia Bays. In 1940 Beatrix Bay was identified as one of three spawning grounds for lemon sole in the Marlborough Sounds but it is not known if this is still the case. Up until the 1950s hapuku were often caught around Tawero Point and West Entry Point.

39. New Zealand king shag, a species endemic to the Marlborough Sounds, breed on Duffer's Reef on Forsyth Island. King shags regularly feed in the middle of the main channel and side arms in the outer Pelorus, particularly in Beatrix Bay. Their diet is dominated by sand-eel and flatfish.

4.2 Northern outer Sounds biogeographic area

40. One salmon farm application is located in this biogeographic area (i.e. Papatua, Port Gore). This biogeographic area has a diverse range of habitats due to its complex coastal topography, water depth and hydrology. There are exposed and semi-sheltered rocky headlands and islands, large sheltered coastal bays (Admiralty, Anakoha and Guards Bays; Port Gore), deep and very sheltered inlets (e.g. Port Hardy), intertidal sand and mudflats (e.g. head of Anakoha Bay), high current areas (e.g. French Pass, Stephens Passage, Allen Strait), large areas of subtidal sands and muds and deep rocky reefs. The animal and plant life reflects this diversity of habitats and the change from relatively cool coastal waters in the east to warmer waters in the west.

41. Large seaweed abundance and diversity on the shallow sheltered reefs in Port Hardy, Admiralty Bay, Anakoha Bay, Titirangi and Hikoekoea Bays (inner Guards Bay) and Port Gore is limited and similar to the inner Pelorus and Queen Charlotte Sounds. In contrast, at more exposed locations, shallow rocky reefs have forests of large brown algae. Narrow flapjack forms a broad subtidal fringe from low water to approximately 3m depth. Forests of flexible flapjack or paddle weed grow below 3m depth. Flexible flapjack dominates in the relatively sheltered sites, with paddle weed often restricted to the subtidal fringe. At very exposed offshore sites, paddle weed may form extensive forests to at least 24m depth. Beds of giant kelp are found in outer Port Gore, on the western shoreline of Waitui Bay, around Titi Island, in Lord Ashley Bay, Forsyth Island and at Hapuka Rocks on D'Urville Island.

42. Soft sediments support varied assemblages depending on the depth, composition and hydrology. Bottom trawling, dredging and fishing has modified the species assemblages in Admiralty Bay, Guards Bay and possibly Port Gore. Three widespread invertebrate assemblages are found in this area. The *Amphiura-Echinocardium* (brittle star and sea urchin) assemblages are found in muds in Anakoha Bay and Port Gore and are widespread in inner Pelorus and Queen Charlotte Sounds.

43. Large areas of bryozoan corals (*Celleporaria agglutinans*) are a distinctive feature of this biogeographic area. These bryozoan beds are found on coarse shelly sand, on slopes below approximately 24m depth off Titi, Chetwode, outer Port Gore, Trio and Rangitoto Islands, and at 40m to 60m depth off Sentinel and Jag Rocks. These beds are diverse habitats and support benthic and plankton-eating fish, including commercially valuable species such as blue cod and tarakihi.

4.3 Tory Channel biogeographic area

44. Two salmon farm applications are located in this biogeographic area (i.e. Rauomoko and Ngamahau). Tory Channel connects the inner Queen Charlotte Sound with Cook Strait. Strong tides flow through this narrow, deep (30-75m) passage. Reefs of outcropping bedrock, small boulders and cobbles fringe the shoreline of the main channel. Clean, well sorted sands cover more than half of the seafloor

below 12-15m. Sediments on the bottom of the main channel are mainly silty and muddy sands and calcareous gravels. There are eight large bays, each of which is considerably shallower than the main channel. Maximum charted depth in Deep, Oyster, Erie and Kawhia Bays is only 6-9m, and in Onepua, Hitaua and Maraetai Bays it is 11-17m. Deep, Erie and Kawhia Bays are distinguished by very shallow (1-3m depth) “bay mouth” bars composed of fine silty sand. Tory Channel is characterised by its depth and very strong tidal currents. These run up to 7 knots between East and West Heads at the entrance to Cook Strait, and between 1-3 knots through the rest of the Channel. The flow from Cook Strait brings cold, saline, nutrient-rich water into inner Queen Charlotte Sound. The tidal range is approximately 1.5m.

45. Macroalgae cover much of the rocky substrata in the main channel. Neptune’s necklace is common in the intertidal zone. Fringing seaweeds found at or just above low water include *Cladophoropsis herpestica*, broccoli weed, narrow flapjack, flexible flapjack, *Cystophora scalaris* and paddle weed.

46. Below low water giant kelp, paddle weed and flexible flapjack are dominant. Stands of giant kelp fringe the shoreline along much of the main channel. Below the canopy of kelp there is a diverse under storey of small seaweeds, including *Ulva laetevirens*, sea rimu, sea grape, *Chaetomorpha darwini, Halopteris* sp., *Colpomenia* sp., brown tongue weed, *Stenogramme interupta, Chladhymenia oblongifolia*, agar weed, *Pterocladiella capillacea, Champia novaezelandiae* and *Plocamium costatum*. The red algae *Asparagopsis armata* is a common epiphyte, particularly on large flexible flapjack. There are extensive forests of paddle weed on some reefs, below the lower depth limit of giant kelp.

47. Common reef invertebrates include jewel anemone, common anemone, speckled anemone, noble chiton, black-foot paua, yellow-foot paua, black sea slug, green topshell, opal topshell, cats-eye, Cook’s turban, common octopus, red rock crab, cushion star, seven-armed star, orange broach star, snake star, sea cucumber, kina and sea tulip. Deep reefs are dominated by crustose coralline algae, sponges, hydroid trees (*Solandaria* sp.), jewel anemones and compound ascidians. Turret shell and the snake star are abundant on these deep reefs and in the sandy areas surrounding them. There are horse mussels in Maraetai, Onapua, Erie, Oyster and Te Rua Bays.

48. Common reef fishes include conger eels, dwarf scorpionfish, sweep, common warehou, butterfly perch, marblefish, yellow-eyed mullet, red moki, tarakihi, blue moki, spotty, banded wrasse, scarlet wrasse, butterfish, blue cod, several triplefin (common triplefin, yellow-black triplefin, mottled triplefin, variable triplefin, blue-eyed triplefin, oblique swimming triplefin, spectacled triplefin) and leatherjacket. The hagfish is common at some sites, particularly Whekenui Bay. Hapuku were once a common catch in Tory Channel, particularly in deep water off Dieffenbach Point, but are now rarely seen inside the Sounds.

49. Common dolphin, dusky dolphin and Hector’s dolphin occasionally come into Tory Channel. Humpback whales migrate through Cook Strait and have been sighted in Tory Channel on rare occasions. Large flocks of red billed gulls gather to feed on zooplankton forced to the surface by the strong currents between East and West Heads.

4.4 Queen Charlotte Sound biogeographic area

50. One salmon farm application is located in this biogeographic area (i.e. Kaitapeha). This biogeographic area extends from Anakiwa (inner Sound) eastward to the outer Sound near Cook Strait encompassing approximately 20 large bays. Maximum depths in most areas range from ~30-45m. Depths reach 75m off Dieffenbach Point at the entrance to Tory Channel, and there is a large depression 50-80m deep along the western side of Blumine Island. Holes up to 58m deep occur either side of Patten Passage, while maximum depths in marginal bays are similar to the main Sound.

51. The surrounding land is steep and most of the shoreline is fringed by cobbles and boulders. There are bedrock outcrops off points and on some pinnacles and shoals. Rocky shores extend to a maximum depth of 33m and average 12m maximum depth. Coarse, silty, shelly sand usually covers the lower slopes of the Sound and marginal bays below the rocky shores. Most of the floor of the Sound is covered by soft mud. The sandy margin meets the mud floor at an average depth of approximately 18.4m but may be as deep as 39m at steep or current swept sites. Sand and pebble beaches occur at the head of many bays and there are extensive sand flats at the head of the Sound in Okiwa Bay.

52. Queen Charlotte Sound has limited amounts of macroalgae. Large brown laminarian kelps are rare or absent with giant kelp and paddle weed restricted to a few bays and headlands either side of the entrance to Tory Channel where colder water from the Channel flow. Fucoids are the dominant large brown algae. Narrow flapjack forms a sparse, patchy fringe at low water on some headlands and marginal bays, but it is absent from most of the inner Sound. Subtidal stands of flexible flapjack are relatively common but patchily distributed. Forests of flexible flapjack are found in Grove Arm, Onahau Bay, Lochmara Bay and along the southern shore of Allport's Island. Most subtidal reefs are dominated by crustose coralline algae and high densities of small kina.

53. Soft sediments support varied assemblages depending on the depth, sediment and hydrology. Fine clean sands at the head of some bays support small populations of tuatua, frilled venus shell and scimitar *Mactra*. Coarse sands below rocky reefs support beds of the bivalves purple sunset shell, *Venerupis largillierti* and large dog cockle. As the silt content of the sand increases the bivalves *Dosina zelandica* and strawberry cockle become more abundant. Common seafloor species include speckled whelk, knobbed whelk, horse mussels, scallops, filter-feeding hermit crab, cushion star, eleven-arm star, snake star, sea cucumber and saddle seasquirt. Muddy habitats are dominated by heart urchin, brittlestars, holothurian (*Pentadactyla longidentis)*, bivalves *Ennucula strangei* and strawberry cockle, small tubeworms *Phyllochaetopterus socialis, Priapulus australis* and sea lice. On steep slopes, shell and tubeworm debris builds up and is colonised by fan shells, a variety of crustaceans and the brachiopod *Terebratella haurakiensis*.

54. Horse mussels can be common in muddy sands and mud, from low water to more than 30m depth, forming extensive beds below 15m deep in many places. There are large beds of the red algae *Adamsiella chauvinii* at a variety of locations along the length of the Sound. Beds of the large brachiopod *Neothyris lenticularis* are present at particular headlands and in East Bay.

5.0 Known “significant” sites near farm application sites

55. The following sections details biological sites located close to the present salmon farm applications that have been ranked in a report by Davidson et al. (2011). These sites were ranked as “significant” for a variety of reasons. The criteria used for ranking was developed by seven experts as part of an update of the marine environment in Marlborough (Davidson et al. 2011). Davidson et al. (2011) applied the following steps to identify a list of potential significant sites.

Biogeographic areas

56. Geographic areas of similar ecology and habitats were defined and described. The boundaries of each area were based on a combination of each author’s experience and also a large scale qualitative study of 360 sites throughout the Sounds conducted by Duffy et al. (in prep.).

Species

57. A list of important species was developed. Many sites identified and then ranked as significant in the Davidson et al. (2011) received their ranking due to the presence of important species.

Species status

58. There exist many national ranking publications that define species status (e.g. Hitchmough 2002, Miskelly et al. 2008). Davidson et al (2011) assessed species using existing assessment publications and also applied some new categories to assign species into categories (e.g. iconic). Categories included in their report were:

1 Nationally critical
2 Nationally endangered
3 Nationally vulnerable
4 Serious decline
5 Gradual decline
6 Sparse
7 Range restricted
8 Conservation/scientific importance
9 Iconic
10 Biogenic habitat-forming species
11 Data deficient
12 No status

59. Many sites were ranked because they provide habitat for a status species, while others are feeding and breeding areas or migratory routes. Species were separated into seabirds, marine mammals, fish (including sharks), invertebrates, algae and vascular plants. The authors of the Davidson et al. (2011) report as well as including species status in the site assessment also considered a variety of other ecological and biological aspects. They included the species:

- Ecosystem role
- Rarity
- Remnant status
- Commercial, cultural or recreational importance
- Representing extremes of geographic distribution

Potential sites listed for ranking

60. A list of sites that supported important species, communities or habitats was developed, based on information from a variety of sources including; (a) scientific papers and reports, (b) the Marlborough District Council biological database (notably information from resource consent applications), (c) consultation with scientists and fishers, (d) Department of Conservation study into soft sediment biogenic habitats in the Marlborough Sounds, and (e) the experts personal knowledge base.

61. Once the list of potential sites was compiled and existing information for each site gathered, the experts identified which sites would be further surveyed. A limited budget was available for field data collection. These data were collected over a period of a year and mostly comprised (a) collection of drop camera and video footage, and (b) diver inspections and collections in association with a variety of other science experts including Te Papa and NIWA.

62. Once all data was gathered each site was ranked by the experts into the following criteria (see Appendix 1 for full criteria):

    1 Representativeness – a good example of biological features.
    2 Rarity – status of plants or animals and communities/habitats.
    3 Diversity – a wide range of species and habitats.
    4 Distinctiveness – ecological features that are unique or outstanding.
    5 Size – how large the site is.
    6 Connectivity – proximity to other significant areas.
    7 Adjacent catchment modifications – protected native vegetation preferred.

63. Each site was individually assessed and ranked as low (L), medium (M) or high (H). Sites with one or more medium or high scores were classed as “significant” and were included in the Davidson et al. (2011) report. The authors stated that sites with a “low” ranking could be elevated in the future as further information was gathered. Further, locations with no status did not mean necessarily mean that biological values did not always exist, rather that the case was more often that no information was available or known. Further, sites could be downgraded if for example, values were found to be more widespread or sites were found to be impacted and the values degraded or lost. The ranking conducted by experts used the existing knowledge database. For some sites the level of information was low or the sites had not been surveyed for some considerable time. Davidson et al. (2011) recognised that assessments were based on variable levels of data with variable levels of quantity and quality. The authors also recommended a list of sites that should be further investigated to determine

the boundaries and quality of biological features. The potential effect of the proposed salmon farms on these "significant" sites is discussed in the following section.

5.1 Waitata, White Horse Rock, Richmond, Tapipi, and Kaitara (Pelorus)

64. There are 21 known significant sites in the Pelorus Sound biogeographic area (Davidson et al. 2011). These sites range from bird breeding rocks and islets to subtidal reef habitats supporting a diverse and unique assemblage of species. For example, in Picnic Bay there exists a 5.5 ha rhodolith bed. This bed of calcified algae is the only known rhodolith bed in the Pelorus Sound biogeographic area and is one of only three beds known from the Sounds.

65. Of the five salmon farm applications located in this biogeographic area none are located near known "significant" sites identified by Davidson et al. (2011) (Figure 2). The closest "significant" site is 3.3 (a king shag breeding area at Duffers Reef). This site is approximately 3.3 km east from the closest salmon application near Kaitira Point. Issues relating to this site are discussed by Paul Sagar in his evidence. No other significant sites are located close to these applications (Figure 2).

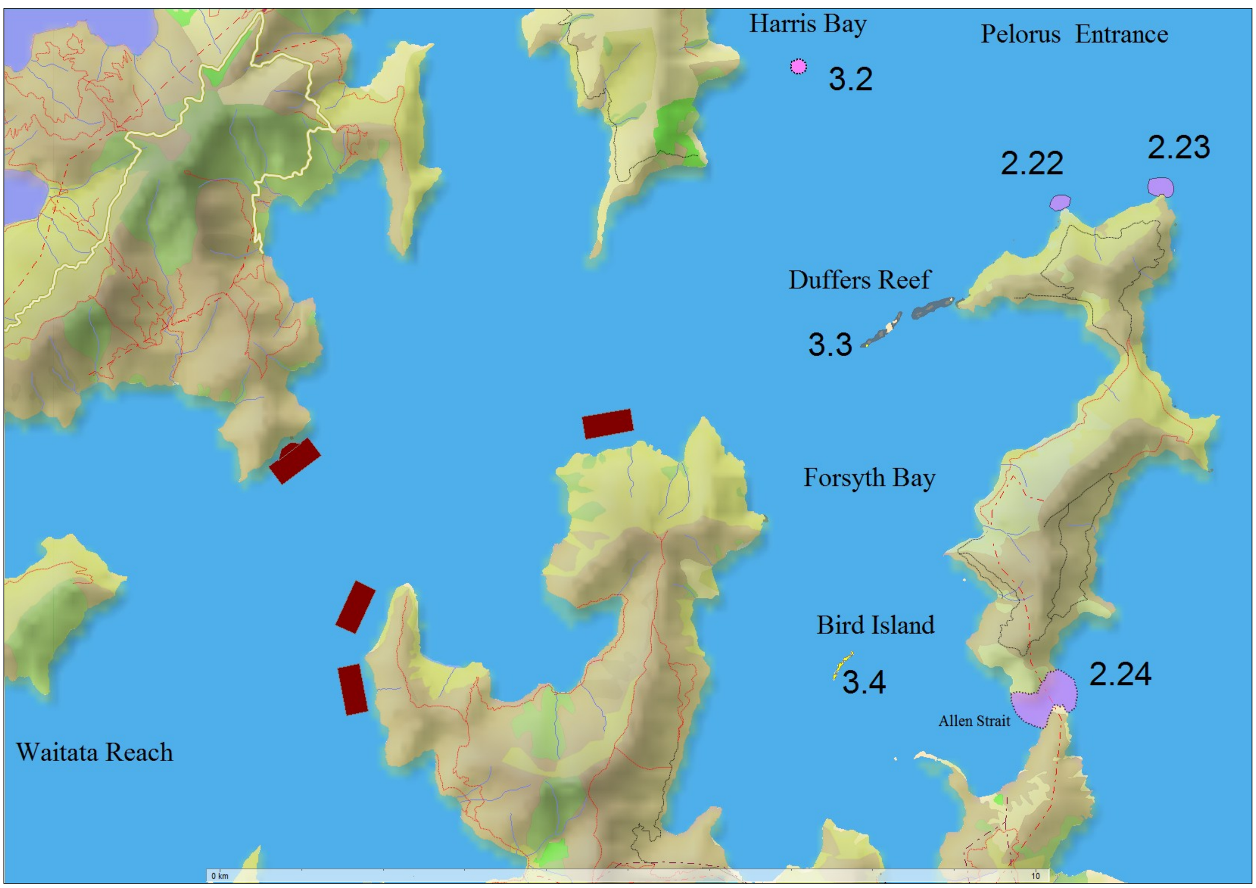


Figure 2. Location of known "significant" sites in close proximity to the Pelorus applications (red).

5.2 Papatua (Port Gore)

66. There are 34 known sites with significant biological value in northern outer Sounds biogeographic area (Davidson et al. 2011). These range from three dimensional biogenic bottom dwelling habitats to high flow tidal passages such as French Pass. At Gannet Point in Port Gore for example, there exists a community dominated by tubeworms. No other dense tubeworm community dominated by this species is known from the Marlborough Sounds. One salmon farm application is located in this biogeographic area (Papatua). One "significant area" is located close by (site 2.33 In: Davidson et al. 2011), while another three sites are located in the wider Port Gore (sites 2.31, 2.32, 2.34) (Figure 3).

67. Inshore and south-west of the salmon application is a site with known "significant" values (site 2.33). This site extends from Hunia north to the southern boundary of Pig Bay. This stretch of edge coastline is located inshore and south of the proposed salmon site. The "significant site" is approximately 2 km long supports a variety of species often in high abundance. Within this area there are dense beds of horse mussels, scallops and red algae as well as a variety of other species associated with these communities. Up to 14 horse mussels per m^2 have been reported. Beds of tubeworm (*Owenia petersenae*), and small and large dog cockle are also known along this coastline. Egg cases from elephant fish have also been recorded, and blue cod are common. Davidson et al. (2011) stated that the density of horse mussels and the associated variety of species make this relatively short stretch of shallow subtidal shoreline unique in the northern Sounds biogeographic area.

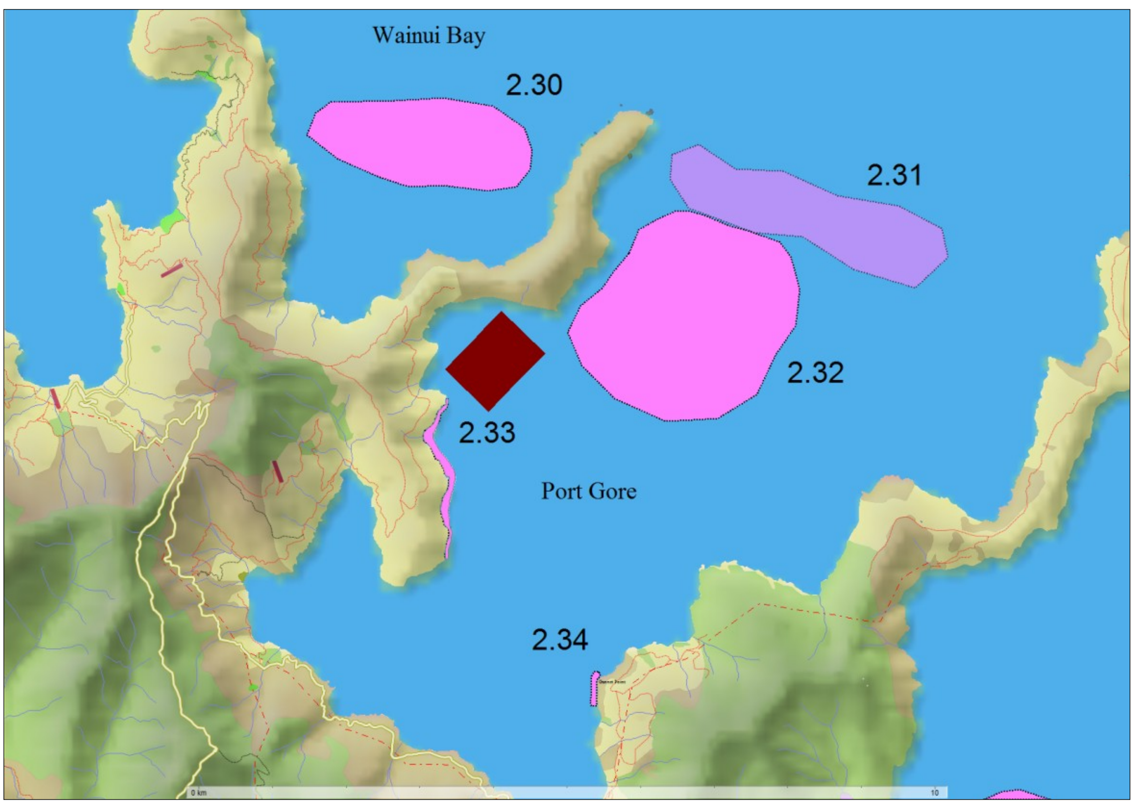


Figure 3. Location of known "significant" sites in close proximity to the Port Gore application.

68. Offshore and north-east of the application site are two offshore significant sites (Figure 3). The closest site is based on historic surveys and is a large area (site 2.32) that reportedly supports a horse mussel bed and associated encrusting species. If still intact, this area would represent one of the two largest horse mussel beds in this biogeographic area, however, this area has been reportedly trawled and their present condition is unknown. This site was listed in Davidson et al. (2011) as requiring a survey to determine its size and quality. If intact, horse mussel beds on this scale are important components of the ecosystem. They provide a substratum for other species to settle and refuge from predators; they influence water flows and sedimentation rates; they produce deposits rich in organic carbon and nitrogen. Horse mussels can also influence phytoplankton concentrations and water clarity. However, there is often scallops living in these areas and these attract commercial fishing activity that usually results in the destruction of horse mussel beds and subsequent loss of biological functions.

69. Further to the north-east is an area reportedly dominated by bryozoans, probably Separation Point "coral", according to commercial fishers (site 2.31) (Figure 3). This site has not been surveyed, however, was included in the Davidson et al. (2011) report due to the biological importance of large (314 ha) areas of bryozoan "coral". The authors identified this site as requiring a survey to determine its size and quality. If intact, this site is some 3 km away from the proposed farm site.

70. The last significant site located near the proposed salmon farm is at Gannet Point (site 2.34). Gannet Point is a headland located on the eastern side of inner Port Gore some 3.8 km from the application. A dense bed of dog cockles is present 50-70m offshore. Mounds of tubeworms (*O. petersenae*) have colonised sand at 10-20m depth and covered up to 90% of the seafloor 110-150m offshore. Within this offshore zone, other species include horse mussels, scallops and red macroalgae. Beyond 190m this community is replaced by a silt and fine sand with relatively few species and low abundance. This community assemblage is the only one of its type known in Marlborough. The colonies of this tubeworm are unusual as this species is not common outside sheltered harbours such as Manakau and Ranganunu. The Port Gore salmon farm application site does not overlap with known "significant" sites.

5.3 Ngamahau and Ruaomoko applications (Tory Channel)

71. There are nine types of significant community in Tory Channel. Some of these community types are found at multiple sites along the Channel (Davidson et al. 2011). Significant sites range from high current passages such as the entrance to Tory Channel from Cook Strait to bryozoan beds. In addition, Tory Channel is occasionally used by migrating whales.

72. Two salmon farm applications are located in this biogeographic area (Ngamahau and Ruaomoko). Two "significant sites" are located near the Ruaomoko application (sites 5.1 and 5.4), while three sites are located close to the Ngamahau application (all sites 5.8) (Figure 4).

Ruaomoko application

73. The closest "significant" site to the Ruaomoko application is approximately 600 m to the south (site 5.4), while a significant site is also located to the south of Dieffenbach approximately 950 m west from this application (site 5.1) (Figure 4).

74. Dieffenbach Point is the western headland of Tory Channel where it joins Queen Charlotte Sound, 14.5 km by sea from Picton. The western shoreline south of the Point (site 5.1) is swept by moderate tidal currents. There are coarse soft substrata and occasional cobbles at depths of 12-25m. Here there exist high density beds of the anemone *Actinothoe albocincta* as well as bryozoan mounds dominated by Separation Point coral. Other species living with these mounds include sponges, hydroids, ascidians, molluscs and crustaceans. Bryozoan colonies are restricted to particular locations in the Sounds and are important as they provide biogenic habitat and food for a variety of reef fish including blue cod.

75. There are a number of tidal current communities located along the northern coast at the western end of Tory Channel. One of these is located south of the Ruaomoko application site (site 5.4). This significant site is a 2.8 km stretch of coast from Ruaomoko south to Ngaionui Point. The steep seafloor of bedrock, boulder, cobble and shelly habitats are swept by strong and regular tidal currents on the incoming and outgoing tides. This community is dominated by habitat forming bryozoan mounds, hydroids, sponges (*Callyspongia* spp., *Crella incrustans*) and ascidians. Large schools of butterfly perch and tarakihi have been observed associated with these biogenic habitats.

Ngamahau application

76. "Significant" sites are located relatively close on the east and west end of the Ngamahau application. The same type of community is found at all three significant site locations (site 5.8) (Figure 4). The tidal current communities that inhabit rock, boulder and cobble substrata have been recorded at seven locations along the northern coastline of Tory Channel between Deep Bay and Whekenui Bay (Davidson et al. 2011). The most abundant current communities are found on rock outcrops and headlands where tidal currents are strongest. These communities are dominated by dense colonies of hydroids, many of them large. This dense hydroid dominated community is found nowhere else in Marlborough. Hydroid trees (*Solandaria* sp.?), bushy bryozoans, sponges, zooanthids, macroalgae and ascidians are all common on these outcrops.

Whale migratory route

77. Three salmon farm applications (Ruaomoko, Ngamahau and Kaitapeha) are located inside the "Cook Strait whale migratory corridor". This corridor through Cook Strait also extends into Tory Channel and Queen Charlotte Sound (see site 7.15 In: Davidson et al. 2011). Although not strictly part of the migration route, the sheltered waters of Tory and QCS are occasionally utilised by migrating whales. Issues relating to marine mammals will be discussed in evidence presented by Martin Cawthorn.

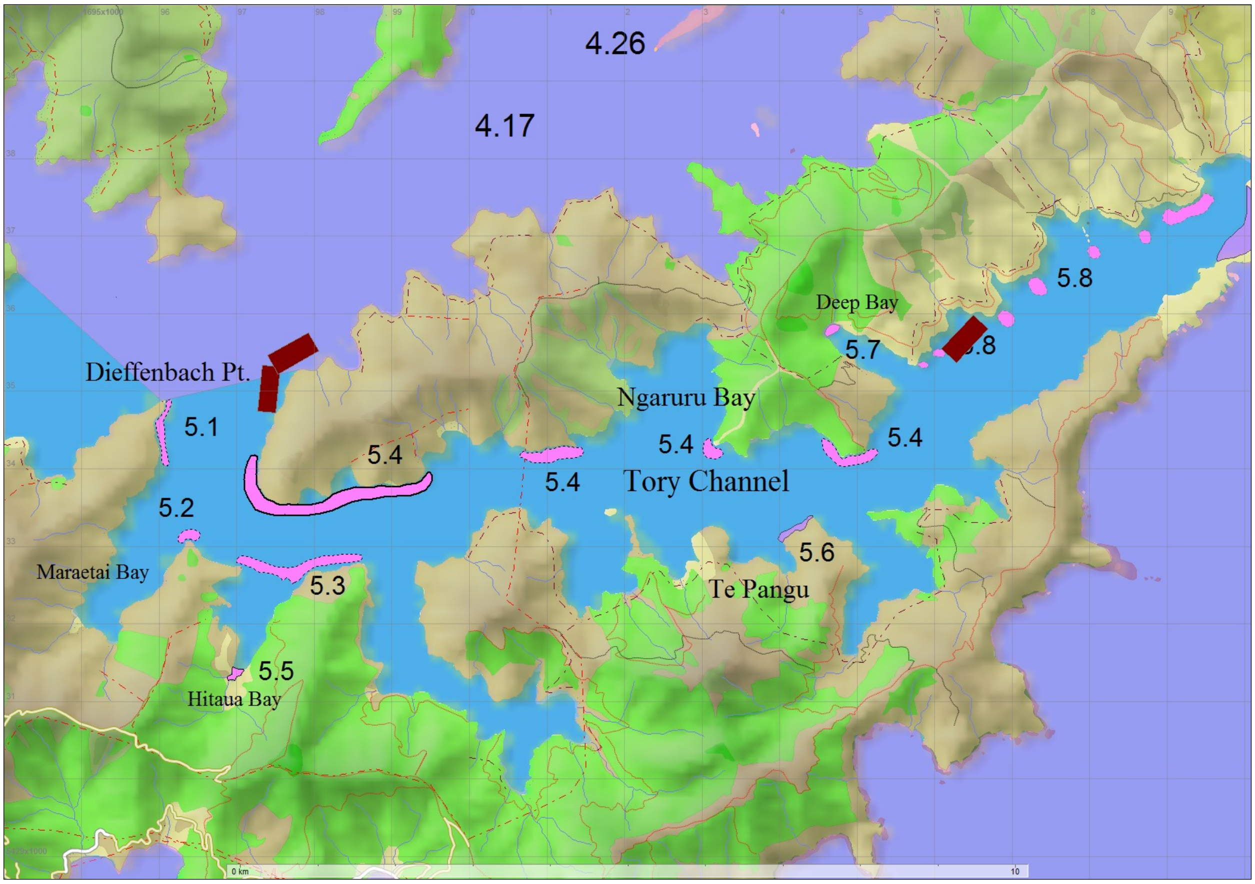


Figure 4. Location of known "significant" sites close to Tory Channel and QCS applications (red).

5.4 Kaitapeha (Queen Charlotte Sound)

78. No benthic "significant" sites are located within 1 km of this application site (Figure 4). Tidal currents decline with increasing distance from Tory Channel, however, the cold waters of Tory Channel pass this site and beyond influencing the assemblage of species in this area, particularly large brown species of algae.

79. This application site does, however, overlap with the area utilized by a resident population of approximately 20 Hector's dolphins (site 4.17 In: Davidson et al. 2011) (Figure 4). Hector's dolphin are most frequently observed in an area bounded by a line in the north-east from Clark Point to Bottle Rock (Resolution Bay) and south-west from Dieffenbach Point to Ngatakore Point (Ruakaka Bay). Queen Charlotte Sound is home to one of two resident populations of Hector's dolphins in Marlborough and the only area in the Marlborough Sounds. Issues relating to Hector's dolphin will be discussed in evidence presented by Martin Cawthorn.

6.0 The ecological status of the application sites

80. All of the salmon farm application sites, apart from Papatua in Port Gore, are located in areas swept by relatively strong tidal currents. Habitats in the Marlborough Sounds that receive tidal flow usually support a higher number of benthic and often pelagic species often in a greater abundance compared to sites in sheltered or backwater locations such as bays and inlets. Substratum is also usually coarser at current swept sites with mud (i.e. silt and clay) substratum often encountered at greater depths compared to sheltered locations. For example, in Kenepuru Sound, mud can appear at as shallow as 2-3 m depth, whereas at high current areas, mud may only be present at depths > 40 m.

81. The positioning of farm applications in high flow areas increases the risk of conflict between biological values and an activity that can have adverse impacts on the biological values. The potential for conflict was an important consideration when positioning the present farm boundaries. Some farm boundaries were moved from their initially identified location in an effort to avoid particular substrates or habitats that support a greater diversity of species compared to habitats such as mud. Mud is the preferred substratum for marine farms as it is widespread throughout the Sounds and supports a relatively consistent flora and fauna. As such it has been traditionally regarded as suitable for consideration for marine farming activities. For example, the Ngamahau site in Tory Channel was relocated eastward in an effort to place it away from high density communities characterised by large and abundant hydroid trees growing on hard substrata.

6.1 Waitata, White Horse Rock, Richmond, Tapipi, and Kaitara (Pelorus)

82. These sites are swept by tidal currents flowing into and out of Pelorus Sound. The steep edges of the Reach are lined by rocky substratum that extends relatively deep. No rock or hard substrata was found within any of the application areas (i.e. farm boundary or caged area).

83. At these applications (excluding the small White Horse Rock application), areas proposed to be occupied by cages have been located over mud substratum. For the areas around the cages where warps and anchors are located, the majority of the areas are characterised by mud (Plate 7, E). Along inshore boundaries, there is often a component of shell material found in association with the silt and clay substrata (Plate 7, D). This shell material often forms at the foot of the adjacent sloping shore. Mud and shell habitats are almost always found at greater depths than sands and rocky substrata and are usually colonised by species able to cope with higher turbidity and lower light that is often prevalent at greater depths in the Sounds. At most of the application sites in Waitata Reach, this silt and shell substrata overlapped little with the proposed warp and anchor area. The exception was the Waitata site where the coarser soft substrata extended almost to the cage boundary. At White Horse Rock the cage area and the anchor and warp area were located entirely over silt and shell and also sand and shell (Plate 7, F).

84. Many marine farms in the Sounds have been located over silt and whole dead and broken shell substrata. In areas swept by tidal currents this habitat can be colonised by occasional hydroids, sponges and other encrusting invertebrates (Plate 7, F). The tidal currents ensure that these species are not smothered by soft sediment, while the shell provides a hard surface for attachment. In some parts of the Sounds currents are sufficiently strong to support very high densities of invertebrates. Such sites have been identified in a report on significant sites in Marlborough (Davidson et al., 2011) (Figure 5). Although the present application sites support shell substrata, tidal currents are not sufficiently strong to form high density invertebrate habitats within the application boundaries. The Waitata and White Horse Rock sites support the coarsest substrata of the Waitata Reach sites, but do not produce the right environmental conditions to be ranked as "significant". They are therefore best regarded as "representative" of a moderate tidal flow deep shell community found throughout much of the edge areas of Waitata Reach where currents are sufficiently strong to reach relatively deep areas.

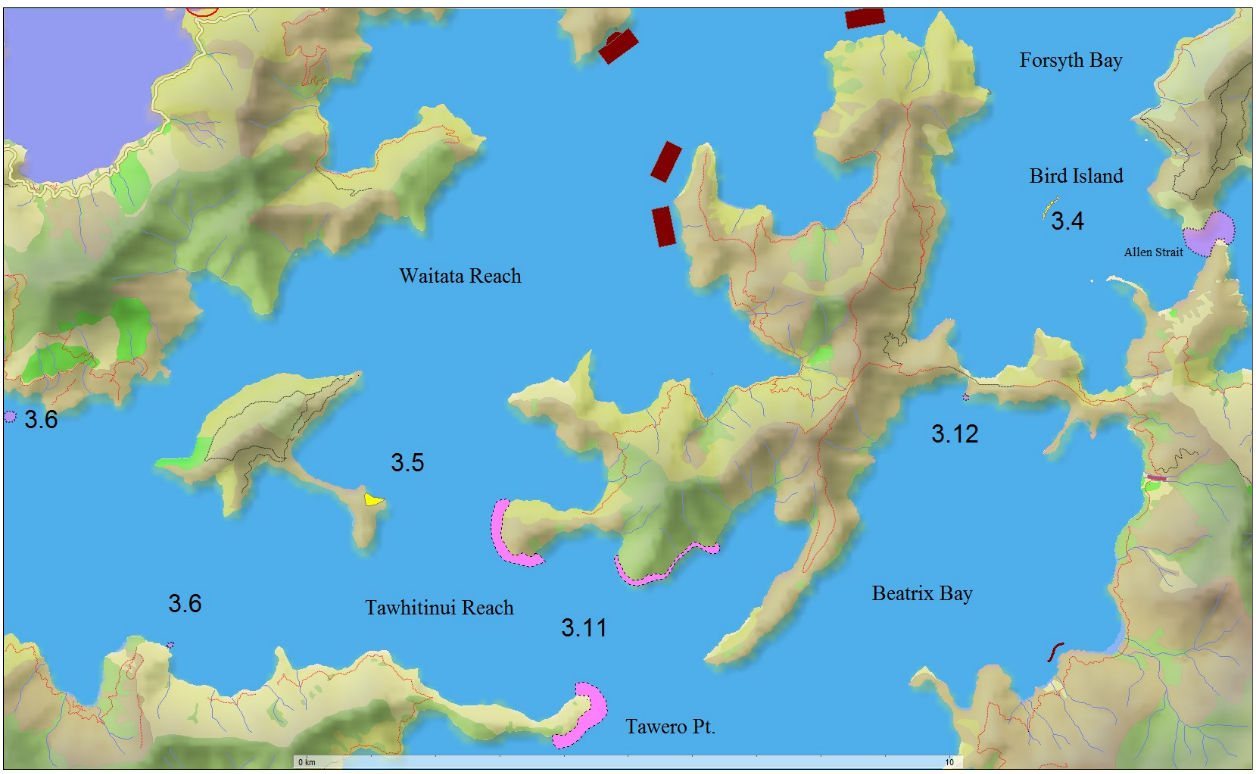


Figure 5. Significant tidal flow areas in Pelorus Sound located south of the salmon farm applications (Sites 3.11).

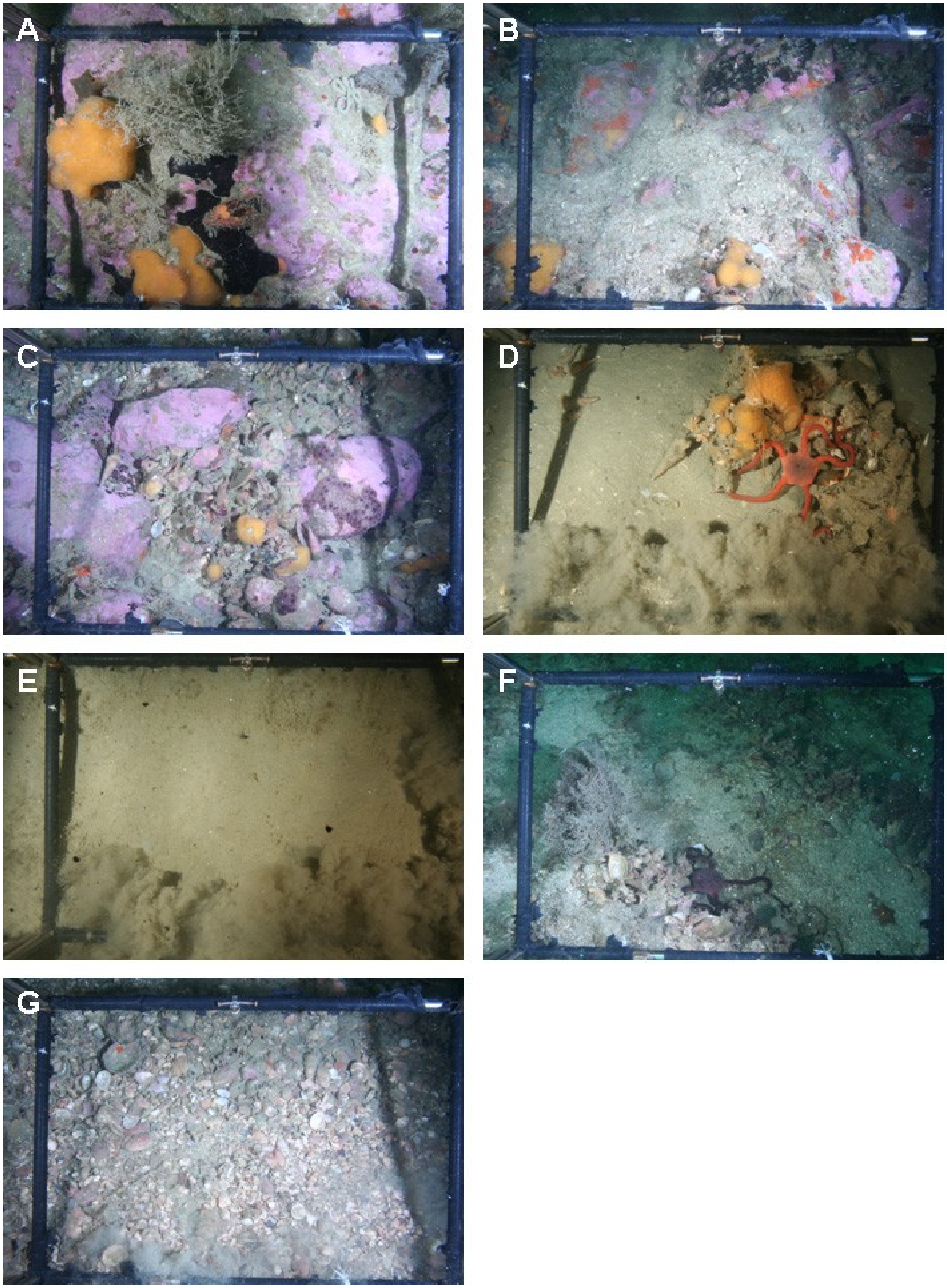


Plate 7. Examples of habitats identified beneath and adjacent to the Waitata site from drop-camera images: A) reef, B) cobble and sand, C) cobble and boulders, D) mud and shell, E) mud, F) sand and shell, G) shell (from Ellis et al. 2011).

6.2 Papatua (Port Gore)

85. This site is subject to the least tidal flow of any of the present applications. The site boundaries are located over a relatively flat bottom situated distant to the sloping habitats located around the edge of Pig Bay. Due to the depth, low tidal flow and distance from shore, the application site is dominated by silt and clay (i.e. mud).

86. McKnight and Grange (1991) stated that mud was the most widespread substratum in the sheltered parts of the Marlborough Sounds and was colonised by a typical community of invertebrates dominated by the snake seastar (*Amphiura* and heart urchin *Echinocardium*). The mud community they reported is found from muddy habitats around the coast of New Zealand (McKnight 1969). These authors sampled a site in Pig Bay and found the same mud dwelling community.

87. As this application site is characterised by mud and supports an invertebrate community type widespread around the sheltered shore of New Zealand. The benthos under the Papatua application site can therefore be regarded as representative of a very widespread and common habitat type supporting a typical mud dwelling community of invertebrates.

6.3 Ngamahau and Ruaomoko (Tory Channel)

88. These application sites are subjected to relatively strong tidal currents that flow through Tory Channel from Cook Strait to Queen Charlotte Sound.

6.3.1 Ruaomoko

89. The cages for the proposed Ruaomoko site are located at the foot of the sloping shore. The benthos under and close to the cages is characterized by deep shell hash comprising silt and dead whole and broken shell material (Figure 6) (Clarke et al., 2011a). The presence of shell in this area is probably due to the tidal flows that expose shell material ensuring it is not smothered by mud substrata.

90. Of note are tubeworm mounds located within the application area, but well outside the cage zone (green hatched area in Figure 6). These tubeworms represent a biogenic habitat that supports a wide variety of species and also provides food and refuge for many other invertebrates and fish. Habitats of this kind are regarded as being ecologically important and if present in sufficient density a site would be considered a significant in the Sounds (Davidson et al. 2011) (Plate 8). Based on impact predictions produced by Clark et al. (2011a*) it is unlikely that these inshore habitats would be adversely impacted by a salmon farm at this site. It is however, recommended that the tubeworm zone located within the application be monitored as part of an annual monitoring programme. Although the reef outcrops located within the application, but outside the cage zone, are of lower ecological importance compared to tubeworm mounds, it is recommended that these also be included as part of a monitoring programme.

** Clarke et al. (2011a) was attached to the King Salmon application as the Ruaomoko site deposition and benthic effects appendix to the seabed report".*

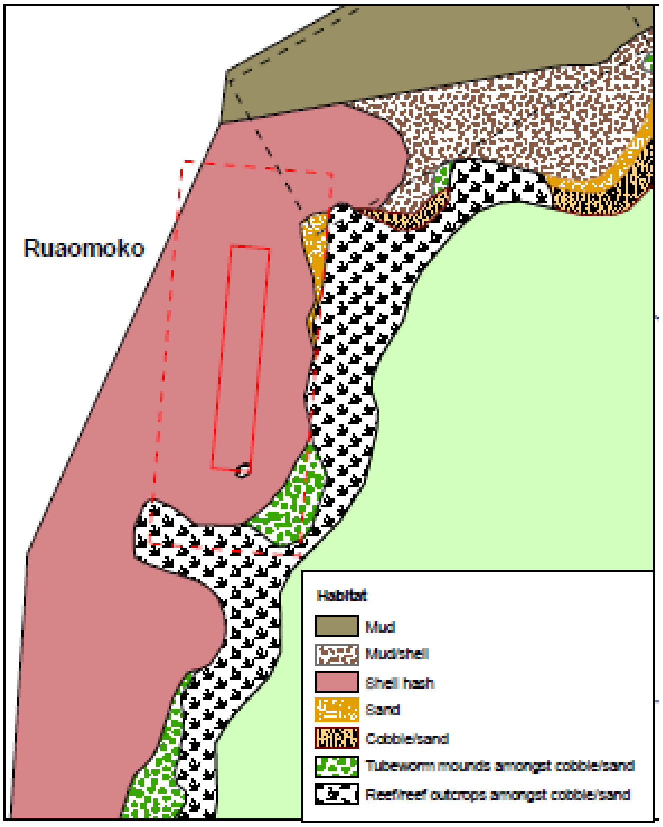


Figure 6. Habitats from Ruaomoko site (from Clark et al. 2011a).

Plate 8. Tubeworm mounds associated with the Ruaomoko site. Image taken from dive transect 3 located inshore of the application (from Clarke et al. 2011a).

6.3.2 Ngamahau

91. The cage area at the proposed Ngamahau site is located toward the lower part of the sloping shore. The benthos under and close to the cages is dominated by mud and dead whole and broken shell material. The presence of shell in this area is probably due to the tidal flows exposing shell material. At the south-western end of the cage area is a zone characterised by sand and shell with variable abundance of biogenic clumps comprising, bryozoans, sponges and hydroids (see Figure 7 from Clark et al. 2011b) Clark et al. (2011b) classified this corner of the cage zone as sand-shell substrata with biogenic clumps as occasional-common. The south-western corner of the application outside the cage zone was described by Clarke et al. (2011b) as pebble, sand and shell with biogenic clumps abundant-common. Based on these descriptions and photographs from field work it is probable that the area located outside the cages would be ranked as significant due to the presence of abundant-common biogenic clumps. The biogenic clumps located inside the cage zone, although of biological value are representative of much of the edge habitats located along Tory Channel that support sparse biogenic clumps and would probably not therefore be ranked as significant.

92. Clark et al. (2011b*) states that the biogenic colonies located under the proposed salmon farm cage area will be smothered and be replaced by an impacted salmon farm zone. It is therefore recommended that an appropriate mitigation action be implemented to offset the loss of this habitat should this application be approved.

93. Of particular note in the area, but located outside the cage and anchor area are dense hydroid colonies. These are located south-west and north-east and inshore of the application area (Figure 7, Plate 9). These dense hydroid colonies are located on outcropping hard substrata and have been recorded from a number of sites along the lower parts of Tory Channel (Davidson et al. 2011). These dense hydroid areas located at particular location along Tory Channel have been ranked as significant and are regarded as unique in the Marlborough Sounds (Davidson et al. 2011).

94. The present application area was modified to avoid the "significant" sites first identified in Davidson et al. (2011). Based on impact predictions produced by Clark et al. (2011b*) it is unlikely that these inshore habitats will be impacted by a salmon farm located at this site. It is however, recommended that the hydroids be monitored as part of an annual monitoring programme. The reef outcrops located within the inshore part of the application and also to the south-west and north-east should also be included as part of a monitoring programme.

** Clarke et al. (2011b) was attached to the King Salmon application as the Ngamahau site deposition and benthic effects appendix to the seabed report"*.

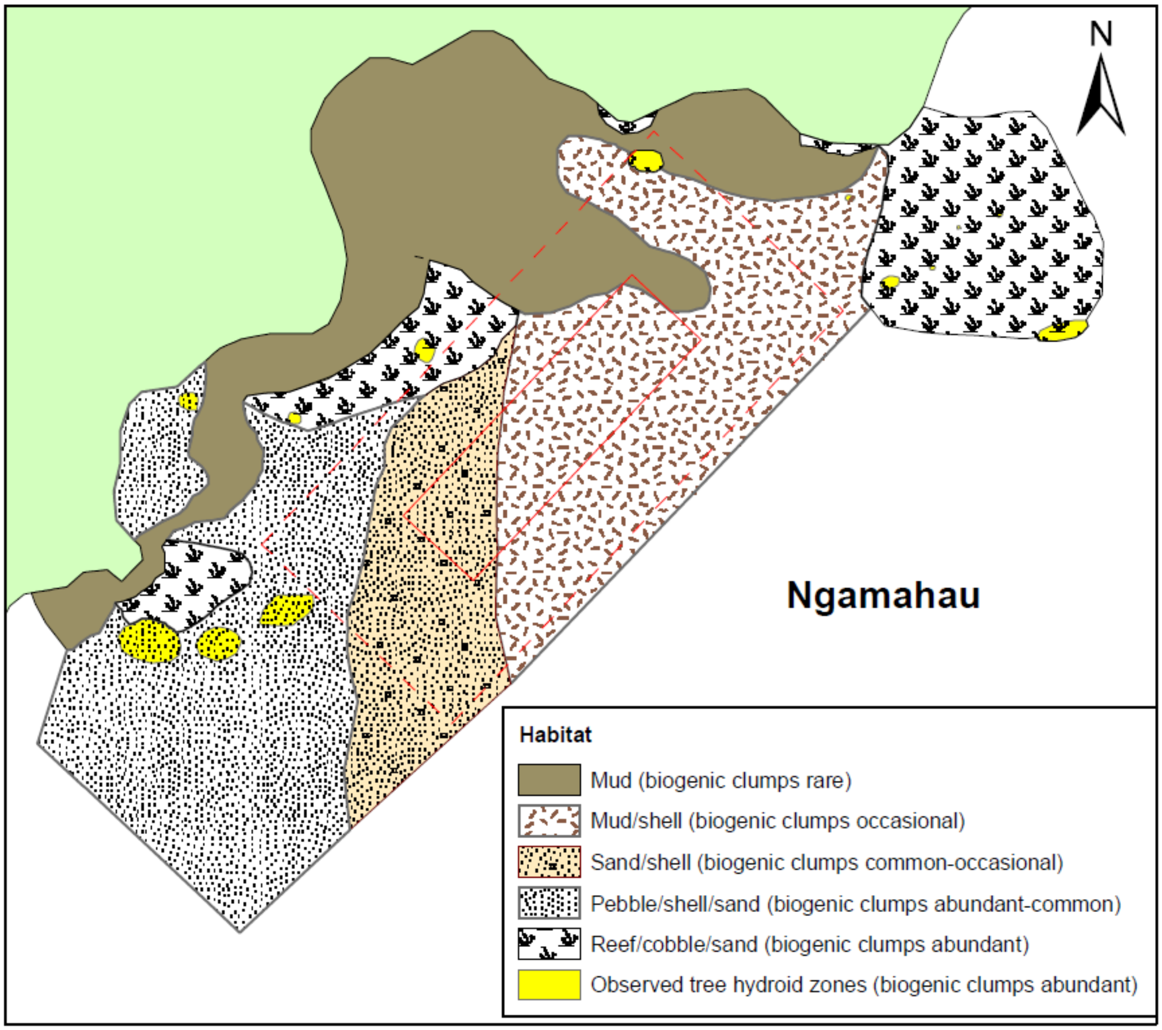


Figure 7. Habitats from Ngamahau site (from Clark et al. 2011b).

Plate 9 Large hydroid trees growing on rocky substrata near the Ngamahau site (Photos Cawthron).

6.3.3 Alternative (original) Ngamahau site

95. An alternative to the Ngamahau application has been provided by the applicant (Figure 8). This site was the original application area investigated and was positioned west of the present application site. This alternative has been presented by the applicant to the Board as it may be preferred over the present application site by adjacent landowners.

96. During the scientific investigation stage, this original site was relocated eastwards to avoid the rocky substratum where hydroids and biogenic clumps were abundant (see yellow polygons in Figure 7). These habitats have been ranked as "significant" because of high density hydroid communities considered unique in Marlborough (Davidson et al. 2011). It is probable, based on impact predictions provided by Cawthron scientists, that these significant habitats would be adversely impacted or lost should this western Ngamahau application be approved. In my opinion the alternative Ngamahau application therefore triggers Section 6 (c) of the RMA and Policy 11 of the NZCPS (2010). From this perspective, the positioning of salmon cages over this "significant" habitat is inappropriate.

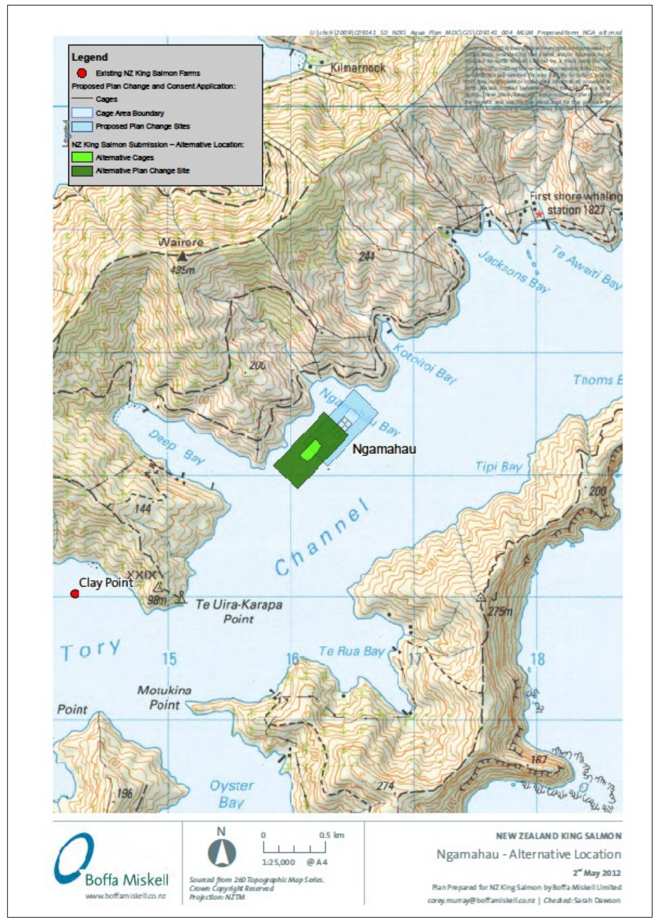


Figure 8. Present Ngamahau site (light blue) relative to the western alternative (original) application (green).

6.4 Kaitapeha (Queen Charlotte Sound)

97. The cages for the proposed Kaitapeha site are located on the relatively flat and deep benthos located at the foot of the sloping shore. The benthos under and close to the cages is dominated by mud substrata, however, a small area at the southern inshore corner was characterised by mud and shell and also shell hash (shell with silt and clay) (see Figure 7 In Clark et al. 2011c*). The presence of shell in this area is probably due to the tidal flows acting to expose shell material rather than being smothered by mud substrata.

** Clarke et al. (2011c) was attached to the King Salmon application as the Kaitapeha site deposition and benthic effects appendix to the seabed report".*

98. Of note are relatively small areas located inshore of the application boundaries that support tubeworm mounds. Based on impact predictions produced by Clark et al. (2011c) it is unlikely that these inshore habitats will be affected by a salmon farm located at this site. It is however, recommended that the tubeworm zone be monitored as part of an annual monitoring programme. Although the small area of reef substrata located within the application (i.e. south-western inshore corner) has a lower ecological importance compared to tubeworm mounds, it is also recommended that the reef habitat also be included as part of a monitoring programme.

7.0 Biological monitoring conditions

99. The applicant has provided a set of suggested conditions in relation to the present applications. The sections relevant to my expertise are found in the “marine environmental monitoring and adaptive management” paragraphs 62-72. The key issue with regard to my evidence is in relation to monitoring of any “notable biological features” located within or immediately adjacent to the present applications. They are:

- The baseline dataset shall include “habitats that support notable biological features within and adjacent to the farm (“reef” monitoring); and in locations highlighted as potential areas for nutrient accumulation by the outputs from spatially explicit nutrient modeling; as well as comparable habitats at appropriate control / reference sites” (paragraph 62c).

- On-going monitoring of the “notable biological features” for a minimum of three years after a stable level of feed has been reached (paragraph 68a).

- Each year an annual monitoring report (AMR) will be produced including data collected at sample sites with “notable biological features” (paragraph 64b, 69).

- Each year a “marine environmental monitoring and adaptive management plan (MEM-AMP) will be produced and include proposed monitoring and farm management actions for the following year (paragraph 64a).

- The MEM-AMP and AMR shall address, but not be limited to the potential effects from the operation of the farm “of deposition on the seabed and foreshore” (paragraph 65a).

- The MEM-AMP shall specify in relation to the potential effects from the operation of the farm set out in Condition 65 “any other actions to be undertaken to avoid, remedy or mitigate any significant adverse effects from the operation of the farm identified in the previous year’s AMR” (paragraph 66f).

- “The Marlborough District Council may require an independent peer review of any particular part, or the whole, of the Baseline Monitoring Plan and/or Report, the MEM-AMP and/or the AMR, required by Conditions 62-72. Such a peer review may be undertaken in relation to the Baseline Monitoring Plan and/or Report; and in relation to the MEM-AMP and the AMR only in any of the first 3 years following the initial development of the farm and at any fifth year thereafter. Such a peer review shall be at the cost of the consent holder” (paragraph 72).

100. In my opinion the suggested monitoring conditions describe a thorough regime of monitoring, reporting and management in relation to the activity of salmon farming. I consider the monitoring programme outlined in these suggested conditions adequately investigates the “notable biological features” associated with the present salmon applications. The proposed MEM-AMP should ensure that any detected adverse impacts on "notable biological features" located close to the consent can be addressed by appropriate actions.

8.0 Conclusions

101. The Papatua application is located over a deep mud benthos subject to low tidal currents. The mud substrata is colonised by a community type widespread around New Zealand. Mud is common and widespread in the sheltered parts of the Sounds and is traditionally regarded as suitable for consideration for marine farming activities.

102. In contrast, the other salmon farm applications are located in an environment swept by tidal flows. As a consequence, ecological values are often higher compared to areas with low tidal current. Further, biological values in current swept locations often extend to greater depths than would be expected at sheltered situations. This phenomenon introduces conflict between a marine farm application positioned relatively close to shore and the biological values present. The applicant has targeted these high flow areas in an effort to minimize adverse effects as higher currents minimize the effects from salmon farming activities. This choice, although minimizing farm effects, has often put the application sites close to benthic biological features.

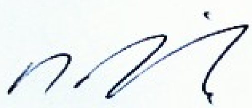
Significant sites (excludes Papatua)

103. All but one of the proposed salmon farm applications are located relatively distant to known benthic areas of “significant” ecological value. Each application site does, however, support habitats and associated communities that are of some biological value. Highest values are located on the shore slope and are therefore outside the proposed cage zone where highest impacts will occur (see evidence by David Taylor and Nigel Keeley). Two of the application sites (i.e. Kaitapeha and Ruaomoko) support tubeworm mounds in proximity to the cage area. According to predictions based on many years of monitoring by Cawthron at other salmon farm sites, these biological features should not be adversely affected. For example at the Ngamahau site, dense hydroid colonies located close by should not be adversely affected by the proposed activity. Most application sites have reef substrata

and associated communities close by or within part of the non-cages area. In all of these instances it is recommended that monitoring of these biological features should form part of the monitoring protocols.

104. In contrast, the Ngamahau site supports occasional-common biogenic habitats located under a section of the cage zone and abundant-common biogenic clumps under part of the application site outside the cage zone. The clumps within the cage zone and some of the clumps in the warp and anchor zone will be smothered and/or adversely affected by a salmon farm if positioned in this area. This loss is unavoidable should the farm be established at the proposed location. It is therefore appropriate that biological compensation be considered should the Ngamahau farm be approved. Funding of a benthic biological survey to investigate and describe biological features in the Tory Channel biogeographic area provides an opportunity to compensate for the loss of some biogenic habitat. A survey searching for and describing new, potentially high quality or "significant" biogenic habitats would be a valuable contribution to the knowledge of the Sounds. Identification of such areas would enable future robust management of the presently undescribed features.

Name: Robert James Davidson

Signature: 

Date: 19 June 2012

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Appendix 1.

Ecological assessment criteria from Davidson et al. (2011)

The following provides explanations for the criteria used in the present study to evaluate the ecological significance of sites. Each significant site can be a composite of biological attributes (i.e. habitat, species, community features).

Rankings for each criterion are: H = high, M = medium and L = low. They collectively contribute to the overall ranking, indicating the degree of significance. Any site for which all criteria rank L is not ecologically significant however, if any criteria rank M or H, the site is significant. Sites with an L ranking have not been discussed or included in the present report.

Representativeness

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

H: The site contains one of the best examples of its type known from the biogeographic area.

M: The site contains one of the better examples, but not the best, of its type known from the biogeographic area.

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

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.

H: 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.

M: 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.

L: The site is not known to contain flora, fauna or communities that are threatened, rare or uncommon in the biogeographic area, region or nationally.

Diversity and pattern

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).

H: The site contains a high diversity of species, habitats or communities.

M: The site contains a moderate diversity of species, habitats or communities.

L: The site contains a low diversity of species, habitats or communities.

Distinctiveness/special ecological characteristics

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.

H: 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.
M: 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.
L: 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).

Size

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

H: The site is large in size.
M: The site is moderate in size.
L: The site is small in size.

Connectivity

The site is significant if it is adjacent to, or close to other significant marine, freshwater or terrestrial areas.

H: The site is close to or well connected to a large significant area or several other significant areas.
M: The site is in the vicinity of other significant areas, but only partially connected to them or at an appreciable distance.
L: The site is isolated from other significant areas.

Adjacent catchment modification

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.

H: The site is dominated by a stable and relatively mature native vegetated catchment (>400 ha) that is legally protected.
M: The site is dominated by a stable and relatively mature native vegetated catchment (>400 ha) with partial or no legal protection.
L: The site is surrounded by a catchment (>400 ha) that is farmed, highly modified or has limited Nikau Bay relatively mature vegetative cover.