# Marine farm survey for consent renewal, U010967, Port Gore, Marlborough Sounds

**NIWA Client Report: NEL2009-010**
**March 2009**

**NIWA Project: PGM09401**

# Marine farm survey for consent renewal, U010967, Port Gore, Marlborough Sounds

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PALMS Ltd

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# Client Report Reviewer's Report

I have reviewed this report, Marine farm survey for consent renewal, U010967, Port Gore, Marlborough Sounds (Project PGM09401), by Morrisey, Brown & Caimey with attention to all of the following:

- ☐ The report's title adequately describes the report's main subject and purpose.
- ☐ The Executive Summary accurately summarises the report's background, scope, methods, results, discussion and conclusions.
- ☐ The report's purpose, objectives and scope are explained clearly and the client's brief is included or summarised.
- ☐ All important methods are described in sufficient detail and justified (where appropriate).
- ☐ The data/findings are analysed and communicated adequately:
  - ☐ Graphics and tables are used effectively to support the text.
  - ~~☐ All graphs are clear.~~
  - ~~☐ Graphs have full but concise legends, they are interpreted correctly in the text, and the key findings/conclusions are explained clearly.~~
  - ☐ Tables have clear, full explanatory captions, are clear, and are discussed and interpreted correctly within the text.
  - ☐ All figures, graphs and tables are referenced in the text.
- ☐ Statistical methods are used where necessary, appropriate tests are applied, relevant statistics and graphics are provided, and the results of these tests are interpreted correctly.
- ☐ The discussion places the findings within the context of existing knowledge and the investigation's purpose/objectives, and refers to the key relevant literature, as far as practical.
- ☐ The report adequately addresses the project's objectives and the client's needs.
- ☐ The information within each section is arranged purposefully and logically, and the order of sections is logical.
- ☐ All assistance is acknowledged, including all contributors to the work and sources of funding and data.
- ☐ All literature cited in the text is fully referenced in the References section.
- ☐ The text is clear and concise, and the vocabulary and content are appropriate to the target readership. No irrelevant material is included. Spelling, grammar, punctuation and formatting are correct.
- ☐ The report meets NIWA's high science and professional standards.

Based on these criteria, I consider that this report meets NIWA's high professional standards and is suitable for release.

Signed

Name Ken Grange Date 24/3/09

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# Contents



*Reviewed by:*

Ken Grange

*Approved for release by:*

Sean Handley

# Executive Summary

NIWA has been requested by PALMS Ltd to undertake a benthic survey of an existing marine farm (U010967, MF 129, MPE 645) in Port Gore, Marlborough Sounds, to provide information to support renewal of the resource consent. This report presents the results and conclusions from the survey, focusing on characterising benthic (seabed) habitats and epifauna (animals living on the surface of the seabed) within and around the existing farm.

The site is located off Gannet Point, on the eastern side of Port Gore. In considering other marine farm consents around Gannet Point, Marlborough District Council (MDC) has expressed concerns over effects of farms on a "sill" community located off Gannet Point. This community includes horse mussels (*Atrina zelandica*) and tube-worm colonies and is listed in *Appendix B Schedule of Areas of Ecological Value* in the MDC Marlborough Sounds Resource Management Plan, citing its "unique subtidal communities on unusual subtidal landform" and rating it as nationally significant. Consequently, the present survey has placed particular emphasis on identifying the boundaries and faunal composition of this community, using sidescan sonar, remote-operated vehicle (ROV) with video, and diver transects.

The 10-m depth contour lies approximately 120 m from shore between Gannet Point and the headland opposite the northern block of existing lines in U010967. This shallow inshore strip continues to the north and south of the study area, and typifies the inner part of Port Gore. The seabed between U010967 and Gannet Point consists of soft sediment with an inshore band of cobbles, rocks and rocky reef. Mussel shells and live mussels fallen from the lines are present within the existing farmed area.

A ROV tow just outside the southwest corner of the existing area of longlines recorded green algae (*Ulva* sp.), hydroids, anemones, horse mussels, hermit crabs (*Pagurus* sp., living in the shells of *Maoricolpus roseus* and *Struthiolaria* sp.), brittle stars (*Ophiopsammus maculata*), sea cucumbers (*Stichopus mollis*) and kina (*Evechinus chloroticus*). There is no evidence of tube-worm mounds within or around U010967 from the ROV or sidescan images.

At the edge and underneath the existing farmed area, patches of seabed were completely covered with Greenshell mussels and their empty shells. Green and red algae were also present in these areas and 11-armed starfish appeared to be relatively more common than outside the farmed area. In the bare areas of sediment among the patches of shell, algae, sea cucumbers and kina were present. No clearly-identifiable horse mussels were recorded inside the area. Shell drop does not extend as far as the anchor blocks, and certainly not beyond them.

Around Gannet Point the sediment is sandy, becoming muddier with distance from shore. Patches of acoustically-reflective material, representing horse-mussel beds, occur around the Point. The shallow-water (<10-20 m) benthic assemblage here is more diverse than that north of Gannet Point. It is

characterised, in terms of its epifauna, by beds of tube-building polychaetes (*Owenia petersenae*), horse mussels, hermit crabs, cushion stars (*Patiriella regularis*), kina, sea cucumbers and scallops. Other, less abundant taxa included hydroids, sponges, ascidians and 11-armed starfish.

Mapping by sidescan sonar indicates that the main beds of both horse mussels and tube worms occur from just north of Gannet Point to the southern part of the undeveloped consent area U941456 (south of the Point). Tube-worm colonies occur in shallow inshore areas (up to ca 150 m from shore) and horse mussels beds further offshore (from ca 150 to ca 275 m from shore, 10-20 m water depth) although there is overlap between these two biogenic habitats. Colonies of *Owenia petersenae* such as those at Gannet Point are apparently unusual and the species is not common outside of sheltered harbours.

The seabed beneath the existing farm is now impacted by live mussels and empty shells (and probably various fouling organisms) fallen from the existing longlines. This impact does not appear to spread beyond the immediate boundaries of the farmed area or the boundaries of the consent area. Significant, adverse organic enrichment of sediments outside the consent area is not considered likely. Continued accumulation of shell material is likely over time but there is no reason to expect that this will result in an increase in the size of the shell-affected area of the seabed beyond the consent boundaries. It is therefore likely that what benthic effect the farm is likely to have has already occurred but is not likely to increase in spatial extent to the degree that it threatens the special habitats around Gannet Point. There is, consequently, no reason not to renew the consent.

The location of the farm further offshore than the consent boundaries is likely to reduce any adverse benthic effects and also increases the distance between the farmed area and more diverse, inshore habitats (including rocky reefs) and their biological assemblages. Therefore, we do not advise moving the farm back within the consented area but, rather, adjusting the consent boundaries offshore to enclose the existing farmed area (and anchor blocks). Because of the presence of beds of horse mussels and tube worms, we strongly recommend that the consent area off Gannet Point (U941456) should remain undeveloped.

NIWA
Taihoro Nukurangi

# 1. Introduction

NIWA has been requested by PALMS Ltd to undertake a benthic survey of an existing marine farm (U010967, MF 129, MPE 645) in Port Gore, Marlborough Sounds, to provide information to support renewal of the resource consent. This report presents the results and conclusions from the survey, focusing on characterising benthic (seabed) habitats and epifauna (animals living on the surface of the seabed) within the existing farm.

The site is located off Gannet Point, on the eastern side of Port Gore (Figure 1 – note that the existing farmed area is offsite and extends seaward of the boundaries of the consent area). In considering other marine farm consents around Gannet Point, Marlborough District Council (MDC) has expressed concerns over effects of farms on a "sill" community located off Gannet Point. This community, first described in 1995 in a report by the Department of Conservation (Duffy et al. unpublished), includes horse mussels (*Atrina zelandica*) and tube-worm colonies (species not reported) but the locations of the boundaries of the community were not, apparently, described in any published report (Grange 2007). The Gannet Point subtidal community is listed in *Appendix B Schedule of Areas of Ecological Value* in the MDC Marlborough Sounds Resource Management Plan, citing its "unique subtidal communities on unusual subtidal landform" and rating it as nationally significant. Consequently, the present survey has placed particular emphasis on identifying the boundaries and faunal composition of this community, using sidescan sonar, remote-operated vehicle (ROV) with video, and diver transects.

# 2. Methods

Field work was done on 24-25 February 2009 and included sidescan sonar surveys of the site, benthic video transects to ground-truth the sidescan images and characterise the epifauna, and diver transects off Gannet Point to quantify abundances of horse mussels and scallops and note the boundaries of worm colonies and other habitat features. Locations of all sampling stations were determined using a Garmin handheld GPS and Fugawi mapping software.

Three sidescan sonar swaths of the site were made using a high-frequency (675 kHz) Tritech towfish, running at distances from shore equivalent to the outer boundary, middle and inner boundaries of the consent area U010967 and existing longlines, and roughly parallel to the shore:(Figure 2). Two of these ran from north of the existing farms to the southern boundary of the consent area. The third ran from north of the existing lines to just south of the southern boundary of consent area U941458, south of Gannet Point. A further three swaths were run off Gannet Point, from inshore (as close

to shore as the boat was able to manoeuvre) to approximately 400 m offshore, in a direction roughly perpendicular to the shore (Figure 2). In addition, three shore-parallel swaths were run through consent area U941458. GPS coordinates were recorded automatically throughout each swath at two-second intervals. All sidescan transects were analysed by running the profiles back and recording the positions or boundaries of sediment types, hard substrata and beds of epifaunal shellfish such as horse mussels, and then imported to GIS maps.

Four ROV tows were run over the seabed around Gannet Point, three running from inshore to offshore and the fourth running parallel to shore along the southwestern corner of the existing area of longlines in U101967, as shown in Figure 2. Video recordings were later viewed to determine species and habitats present.

Five diver transects were surveyed in the area off Gannet Point (Figure 2). Two divers laid a 20-m tape-measure and then swam back along it counting horse mussels and scallops and noting habitat features in a 1-m wide strip. A second area, to the south of Gannet Point (Figure 2), was also inspected by divers to determine whether the "sill" habitat and associated species were present.

NIWA
Taihoro Nukurangi

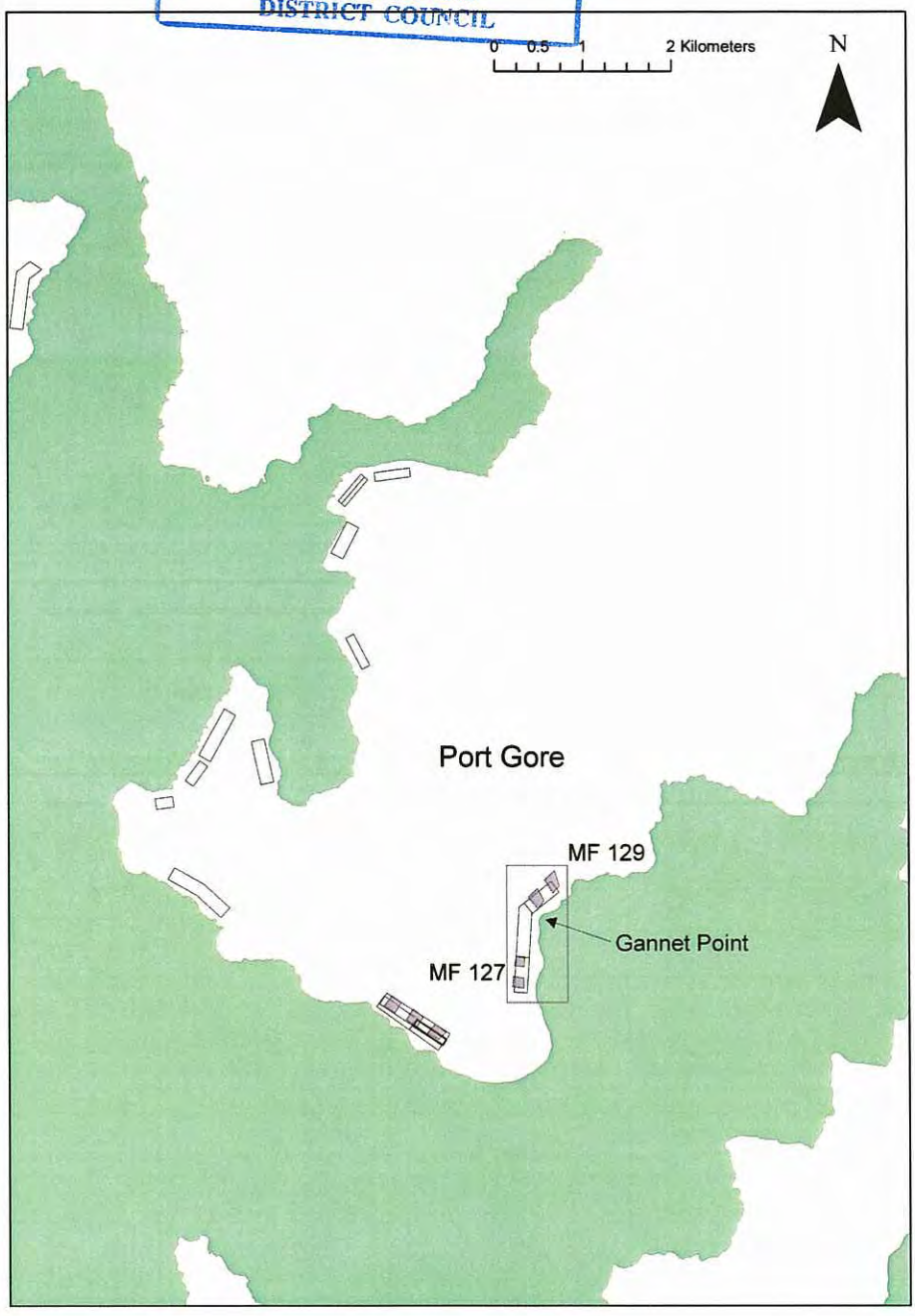



**Figure 1** **Port Gore, Marlborough Sounds, showing location of consent area U010967 and the adjacent MF 127. Existing farm structures are shown in purple and consent areas are shown in white.**

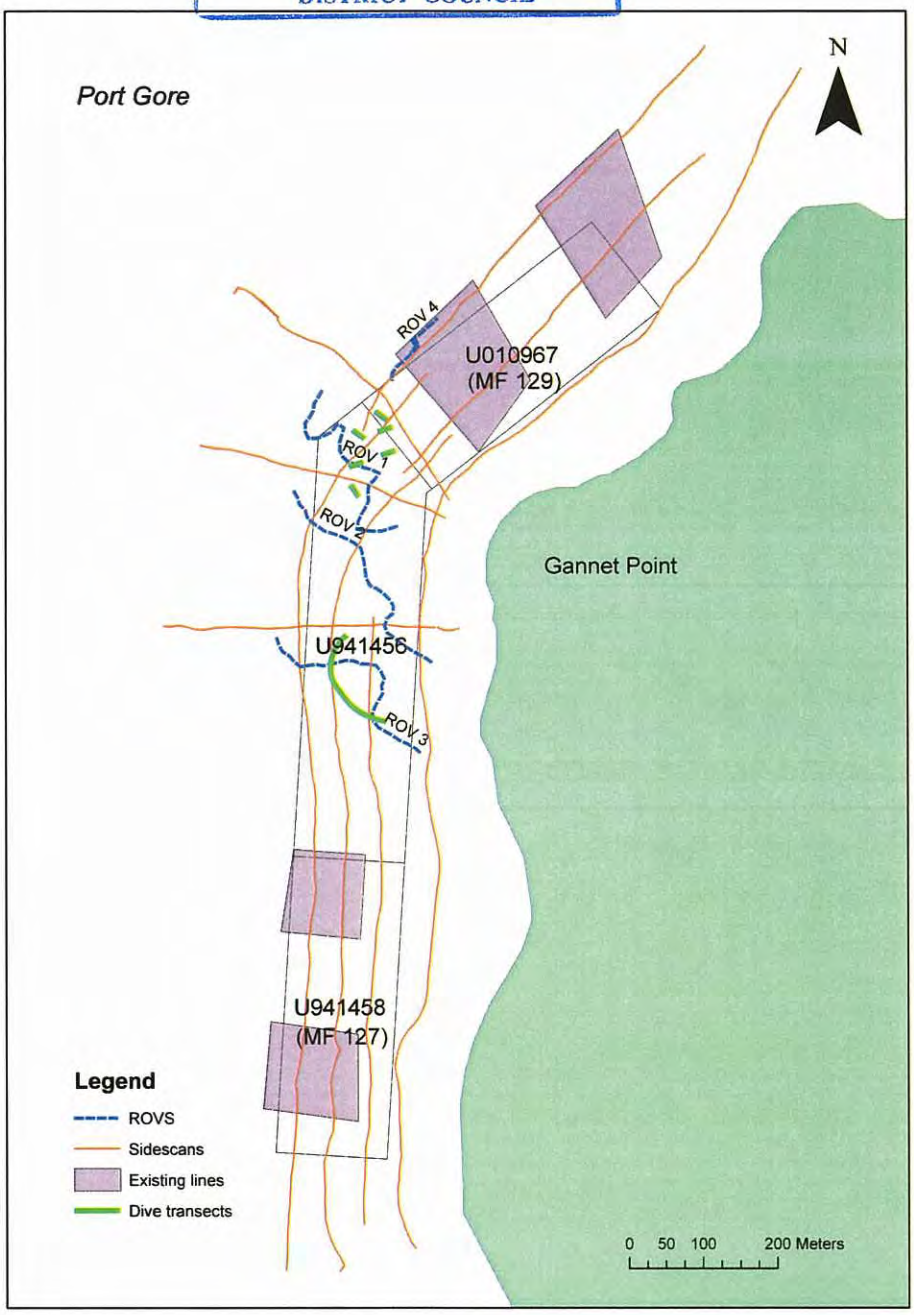



**Figure 2** **Location of sidescan swaths (red lines), ROV video transects (dotted blue lines) and diver surveys (green lines) around Gannet Point, Port Gore. Consent areas are shown in white and areas of existing longlines are shown in purple.**

# 3. Results and discussion

## 3.1 Nature of the seabed around Gannet Point and U010967

The 10-m depth contour (relative to Chart Datum) lies approximately 120 m from shore between Gannet Point and the headland opposite the northern block of existing lines in MF 129, as shown on Hydrographic Chart NZ6151 (Figure 3). This shallow inshore strip continues to the north and south of the study area, and typifies the inner part of Port Gore. The seabed between U010967 and Gannet Point, as identified from the sidescan images (Figure 4), consists of soft sediment with an inshore band of cobbles, rocks and rocky reef. The reef and cobbles extend up to 150 m from shore. The ROV videos (tows 1-3) show that the sediment is sandy around Gannet Point, becoming muddier with distance from shore.

Patches of acoustically-reflective material (appearing as white dots in the images) occur along the three offshore sidescan transects around Gannet Point. Ground-truthing by ROV and divers showed that these represent beds of horse mussels. The ROV and sidescan records around Gannet Point also show the presence of hummocky seabed topography, generally in the inshore half of the area covered by along-shore sidescans, representing the mounds of a tube-living polychaete worm, identified during the present study as *Owenia petersenae*[1]. The extent of horse mussel and tube worm beds is discussed below.

Reflective material is also present beneath the existing farmed areas and represents mussel shells and live mussels fallen from the lines (Figure 4). Horse mussels may also contribute to this reflective material, but it is not possible to determine this from the images.

The ROV tow under the southern block of existing lines (ROV 4 in Figure 2) shows sandy mud at the start of the tow (outside the farmed area), with horse mussels present (at densities >1 $m^{-2}$). No tube worms were present. At the edge of and inside the farm there are patches of seabed completely covered with Greenshell mussel shell and live mussels, interspersed with areas of bare sediment with the occasional mussel or shell.

[1] Geoff Read, NIWA Wellington, pers. comm.

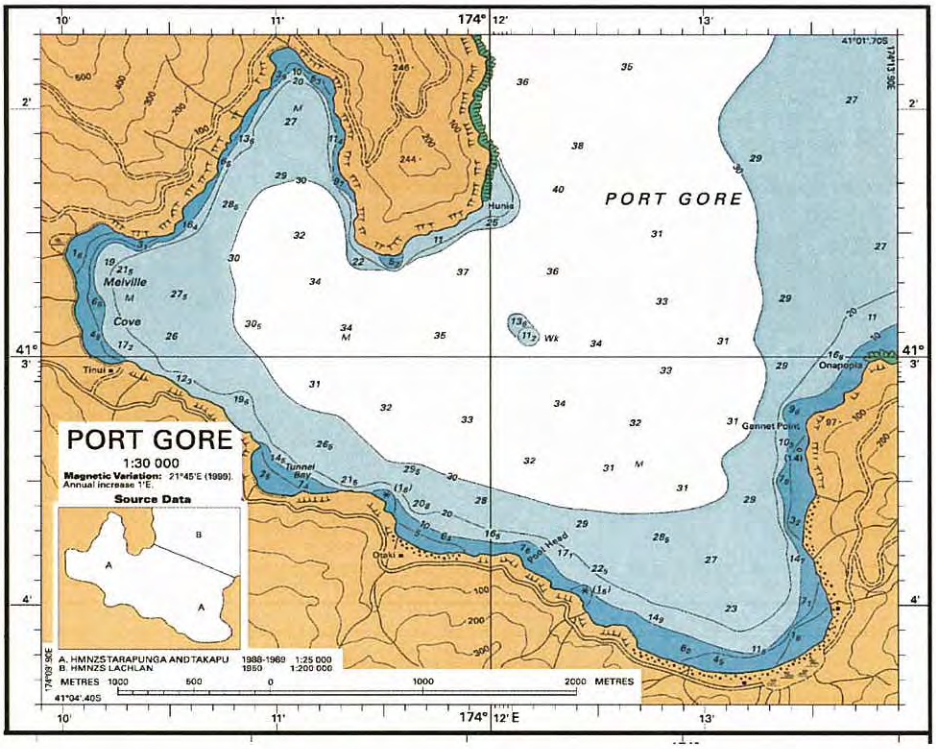



**Figure 3** **Detail of Hydrographic Chart No. NZ6151, showing Port Gore (source: LINZ, http://www.linz.govt.nz/hydro/. Crown Copyright reserved). The depths in the harbour are shown by colours as: dark blue = 0-10 m, light blue = 10-30 m, white >30 m.**

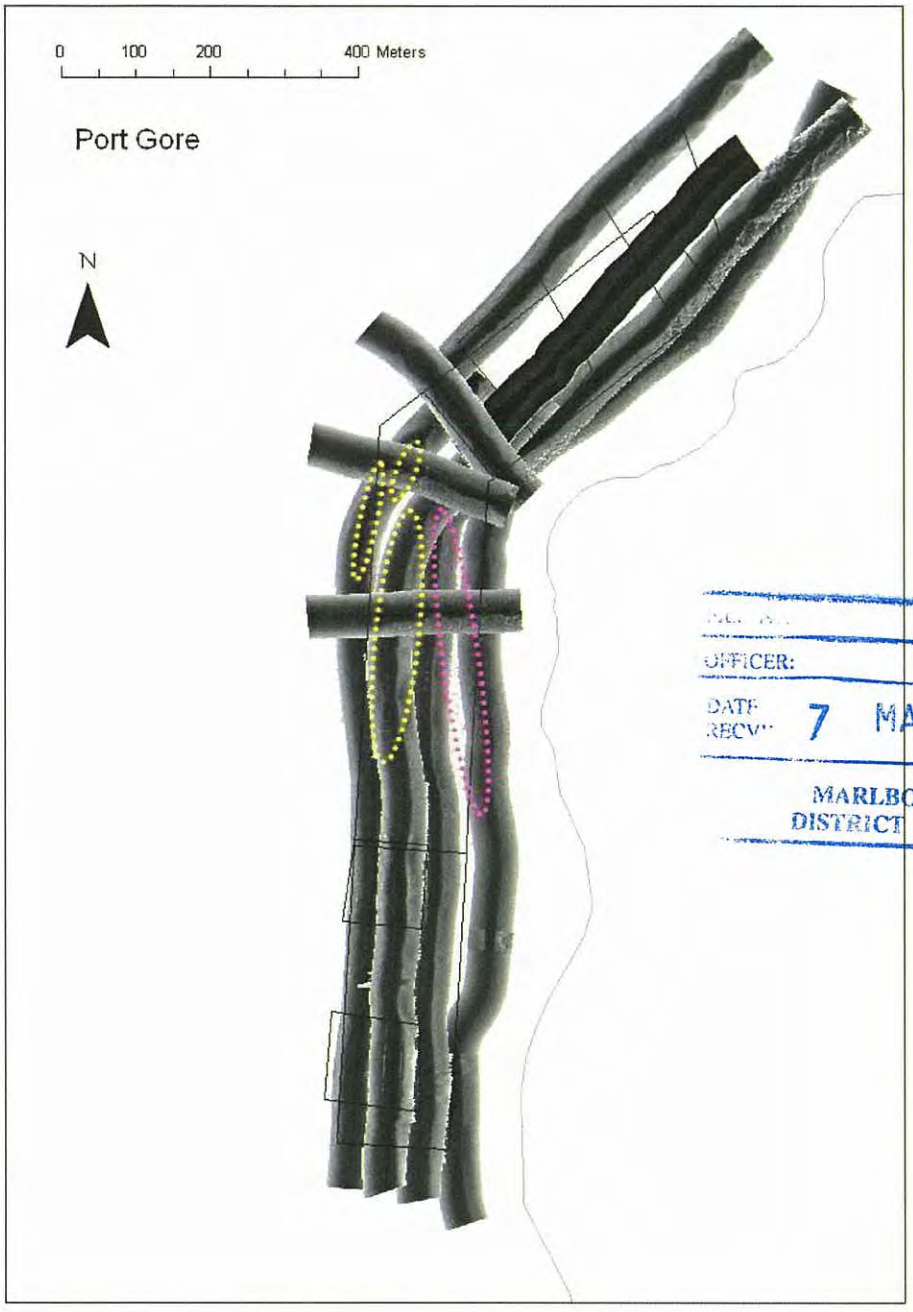





**Figure 4** **Sidescan swaths of the area around Gannet Point, showing locations of main beds of horse mussels (yellow) and tube-worm mounds (pink). Both features, and particularly horse mussels, occur in other parts of the surveyed area but not as such distinct beds.**

### 3.2 Nature of the benthic fauna between Gannet Point and U010967

The ROV tow (tow 4) just outside the southwest corner of the existing longlines recorded green algae (*Ulva* sp.), hydroids, anemones, horse mussels, hermit crabs (*Pagurus* sp., living in the shells of *Maoricolpus roseus* and *Struthiolaria* sp.), brittle stars (*Ophiopsammus maculata*), sea cucumbers (*Stichopus mollis*) and kina (*Evechinus chloroticus*). 11-armed starfish (*Coscinasterias muricata*) were common within the area beneath the existing longlines, together with clumps of live Greenshell mussels (*Perna canaliculus*). There is no evidence of tube-worm mounds within or around U010967 from either the ROV tow (although it is likely that this habitat, had it been present, would have occurred inshore of the ROV location) or the sidescan swaths (particularly the two inshore, shore-parallel swaths through the consent area and the northern offshore swath: Figure 4).

South of U010697, diver and ROV surveys identified a shallow-water (<10-20 m) benthic assemblage around and south of Gannet Point that is more diverse than that north of Gannet Point. It is characterised, in terms of its epifauna, by tube-building polychaetes (*Owenia petersenae*), horse mussels, hermit crabs, cushion stars (*Patiriella regularis*), kina, sea cucumbers and scallops. Other, less abundant taxa included hydroids, sponges, ascidians and 11-armed starfish. Horse mussels and scallops were more characteristic of deeper areas (10-20 m), with tube worms present further inshore (<10 m: Figures 3 and 4), although their distributions overlapped.

Abundances of horse mussels in the five diver transects ranged from 7-37 per transect (Table 1: equivalent to 0.35-1.85 $m^{-2}$) with an average of 21.8 (SE 6.26) per transect, or just over one per $m^2$. Based on the diver and ROV surveys over the total area studied, the area in which counts were made was representative of other areas of "sill" community in terms of abundances of horse mussels.

The distribution of the main beds of horse mussels are shown in Figure 4 and represent those areas appearing as distinct patches of reflective material in the sidescan swaths (excluding those areas below existing longlines, which were assumed to represent shell material from the lines). Tube-worm colonies are also shown in Figure 4 and appear in the sidescan images as a hummocky texture to the seabed. The sidescan images indicate that the main beds of both horse mussels and tube worms occur from just north of Gannet Point to the southern part of the undeveloped consent area U941456. Tube-worm colonies occur in shallow inshore areas (up to ca 150 m from shore), as indicated by the diver and ROV surveys (see above). Horse mussel beds occur in the same stretch of coast as the horse mussels beds, but further offshore

(from ca 150 to ca 275 m from shore) although, as mentioned above, there is overlap between these two biogenic habitats (but not as such distinct beds).

Abundances of scallops in the five diver transects ranged from 0-6 per transect (Table 1: equivalent to 0-0.3 $m^{-2}$) with an average of 4.2 (SE 1.11) per transect, or just over 0.2 per $m^2$. Again, based on the diver and ROV surveys over the total area studied, the area in which counts were made was representative of other areas of "sill" community in terms of abundances of scallops.

**Table 1** **Numbers of horse mussels and scallops per 20 x 1-m diver transect (numbers per $m^2$ in brackets). See Figure 2 for the location of the transects.**

| Transect no. | Depth start (m) | Depth end (m) | Horse mussels | Scallops |
|---|---|---|---|---|
| 1 | 16 | 18 | 11 (0.55) | 6 (0.30) |
| 2 | 18 | 17 | 36 (1.80) | 0 |
| 3 | 16 | 16 | 37 (1.85) | 5 (0.25) |
| 4 | 16 | 19 | 18 (0.90) | 4 (0.20) |
| 5 | 19 | 19 | 7 (0.35) | 6 (0.30) |

The community assemblage encountered during both dives was similar. Between 16 and 13 m depth, horse mussels were present at similar densities in both dives (see above), and decreased in abundance closer to shore. Scallops were also present at similar densities in both dives (see above), and wandering anemones (*Phlyctenactis tuberculosa*), sea cucumbers and kina were observed. Closer inshore, between 10 and 7 m depth, hermit crabs were abundant and extensive colonies of *Owenia petersenae* were present.

McKnight & Grange (1991) included a sample from Gannet Point (station number T521) in their Group 1 of stations from the Marlborough Sounds, based on fauna present. Group 1 was the largest station grouping and is dominated by infaunal, mud-dwelling echinoderms, namely the ophiuroids *Amphiura correcta* and *Ophiocentrus novaezealandiae* and the heart urchin *Echinocardium cordatum*. Subdominant species are infaunal bivalves (including *Ennucula strangei* and *Nemocardium pulchellum*), polychaetes (including maldanids and *Phyllochaetopterus socialis*), the priapulid *Priapulus australis*, and the holothurian *Pentadactyla longidentis*. Secondary species include oweniid polychaetes, horse mussels and the bivalve *Dosinia lambata*.

Of the epifaunal species listed by McKnight & Grange (1991), oweniid polychaetes and horse mussels were also prominent members of the fauna recorded during the present study. Shells of large, infaunal bivalves of the genus *Dosinia* were also noted during the diver and ROV surveys.

Colonies of *Owenia petersenae* such as those at Gannet Point are apparently unusual and the species is not common outside of sheltered harbours (for example, subtidal areas of the Manukau and Rangaunu Harbours) (Geoff Read, NIWA Wellington, pers. comm.). Consequently, the high density and relatively exposed habitat of the species in Port Gore is consistent with Marlborough District Council's assessment of the Gannet Point assemblage as "nationally significant".

## 3.3 Evidence for benthic effect of the existing longlines between Gannet Point and MF 129

As mentioned above, outside the southern boundary of the southern block of existing lines the sediment consists of sandy muddy, with no tube-worm mounds present. The area of tube-worm mounds off Gannet Point is ca 150 m south of the nearest part of the existing farm. Kina, cushion stars, 11-armed starfish, sea cucumbers (*Stichopus mollis*) and red and green algae were commonly present within the consent area. At the edge and underneath the existing farmed area, patches of seabed were completely covered with Greenshell mussels and their empty shells. Green and red algae were also present in these areas and 11-armed starfish appeared to be relatively more common than outside the farmed area. In the bare areas of sediment among the patches, algae, sea cucumbers and kina were present. Horse mussels were common just outside and to the south of the existing farmed area but no clearly-identifiable horse mussels were recorded inside the area.

The ROV tow started in the area between the farm anchor blocks and the block of longlines and indicates that shell drop does not extend as far as the anchor blocks, and certainly not beyond them. This is confirmed by the sidescan swaths through the consent area.

## 3.4 Recommendations

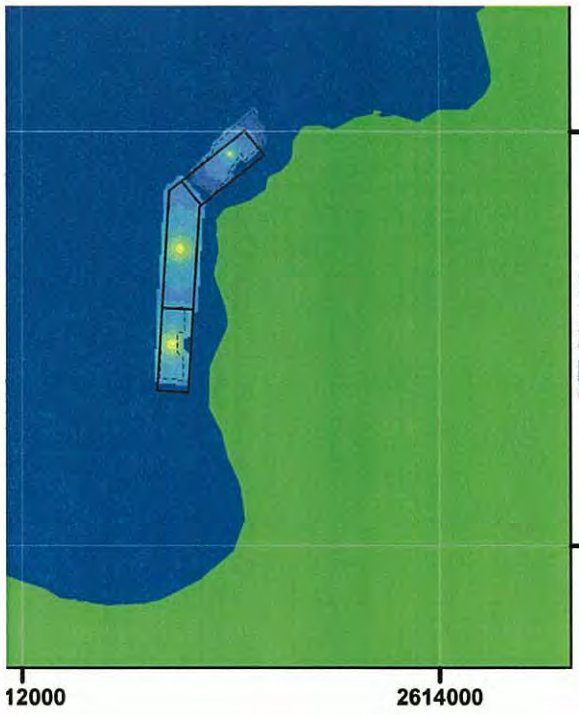
The seabed beneath the existing farm is now impacted by live mussels and empty shells (and probably various fouling organisms) fallen from the existing longlines. This impact does not appear to spread beyond the immediate boundaries of the farmed area or the boundaries of the consent area.

Although we do not have any information on concentrations of organic matter or the depth of the redox discontinuity layer in the sediments within and around the existing farmed area, there is no visual evidence from the ROV tow to suggest that organic enrichment is occurring inside or outside the farmed area. Deposition of organic matter from mussel farms throughout Port Gore was modelled as part of the Fisheries Resource Impact Assessment (FRIA) for new marine farm consents in the bay (Stenton-Dozey et al. 2004). The model assumed "standardised" stocking densities on existing farms based on 20% of each farm being seeded with spat (20-35 mm) at a density of 1000 individuals/m of dropper length, the remaining 80% of the farm being evenly divided between 3 sizes: 35-60 mm (180 individuals/m dropper length), 60-85 mm (150 individuals/m) & 85-110 mm (120 individuals/m). The output from the modelling is shown in Figure 5 as contours of deposition rate (kg/d/100 $m^2$). At the southern boundary of the existing farmed area within U010967, closest to the special habitats around Gannet Point, the predicted deposition rate is <0.01 kg/d/100 $m^2$, an amount so small that it is unlikely to be measurable against natural deposition. For example, Morrisey et al. (2000) measured deposition rates of 11-13.5 g $m^2$ d (equivalent to 1.1-1.35 kg/d/100 $m^2$) at control sites away from mussel lines in Big Glory Bay, Stewart Island. The predicted rate of deposition along the inshore boundary of the existing farmed area is <0.05 kg/d/100 $m^2$, again likely to be less than natural deposition.

Continued accumulation of shell material beneath the farm is likely over time but there is no reason to expect that the shell-affected area of the seabed will increase beyond the consent boundaries as a result. It is therefore likely that what benthic effect the farm is likely to have has already occurred but is not likely to increase in spatial extent to the degree that it threatens the special habitats around Gannet Point. Nor is there any reason to expect that continued farming will result in significant, adverse organic enrichment of the sediments outside the consent area. There is, consequently, no reason not to renew the consent.

The location of the farm further offshore than the consent boundaries is likely to reduce any adverse benthic effects and also increases the distance between the farmed area and more diverse, inshore habitats (including rocky reefs) and their biological assemblages. Therefore, we do not advise moving the farm back within the consented area but, rather, the farm should remain in its present position and the consent boundaries adjusted offshore to enclose the existing farmed area (and anchor blocks).

Because of the presence of beds of horse mussels and tube worms, we strongly recommend that the consent area off Gannet Point (U941456) should remain undeveloped.





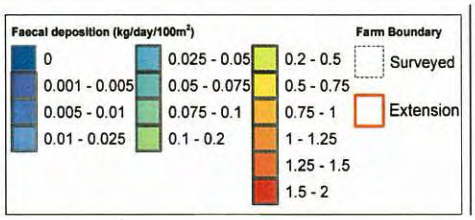




**Figure 5** **Map showing modelled density of benthic deposition by mussel farms around Gannet Point. The central consent area (U941456) was included in the modelling to provide a "worst-case" scenario but does not currently contain any longlines.**

## 4. Acknowledgements

Rob Davidson kindly provided information on the Department of Conservation survey of the site in 1995. Geoff Read, NIWA Wellington, identified *Owenia petersenae* and provided comments on its distribution. Thanks to Anna Bradley (NIWA Nelson) for analysis of ROV recordings and to Don Roach for boating services.

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