Ecological Assessment of Marine Farms in Wainui, Golden Bay

Prepared for Wainui Spat Catching Group

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Executive summary

1. Benthic deposition of faecal material is modelled to be low and almost entirely restricted to within the consent boundaries. Scattered shell debris occurs only directly beneath the spat collecting lines.

2. Benthic sampling has shown no significant increase in organic material beneath the farms. Rather, the levels of mud and organic content of the sediments are related to each other, and to the water depth of the sample locations, not to the presence or absence of the farms.

3. The assemblage of animals observed living within the sediment, and on the sediment surface in the vicinity of the farms is comprised of species commonly observed in the region and is similar within and outside the farm boundaries.

4. It is not expected that continuation of the operation of the farms for spat collection will lead to any additional effects.

1 Introduction

There are six spat mussel farms within Wainui Bay, Golden Bay, that have been in operation for around 35 years (being authorised by marine farm licences in 1980 under the Marine Farming Act). Operationally, these farms use spat catching ropes suspended from surface buoys. Free-living mussel larvae or small spat are swept into the area and settle on the ropes. The ropes are then “harvested” when the spat have grown to 5-15 mm in length and transferred to other mussel farms in Golden Bay and the Marlborough Sounds where they are reseeded on to growing ropes and on-grown to market size.

The Wainui spat catching sites are of particular significance to the mussel farming industry nationally and enable the year round production of spat, providing 20-25% of the national supply (http://www.stuff.co.nz/nelson-mail/news/10579903/Wainui-A-marvellous-spot-for-spat). The plan change is intended to change the status of renewals for the sites from discretionary to controlled activities. The goal is to facilitate renewals for the sites beyond the current consent expiry of 31 December 2024.

The Wainui Bay Spat Catching Group is applying for mussel spat catching up to 40 mm in length and mussel spat holding between 40-60 mm in length as controlled activities at the Wainui Bay sites. This ecological assessment considers both of these eventualities. Full mussel farming at the sites will be a prohibited activity, so an assessment of the ecological effects of full mussel farming was not considered necessary.

Little information exists on the sea bed characteristics of the sites before development, but an investigation for consent renewal of the two offshore (north-eastern) sites in 2007 indicated that few marine ecological effects could be identified from samples within and some distance from the site boundaries (Grange and Hadfield 2007).

NIWA was commissioned to survey the six spat sites and the surrounding area to assess the ecological effects of the existing farms, building on the 2007 survey. Biological and sea bed sampling was included in the survey, but additional hydrodynamic modelling was not undertaken. The rationale for this was previous modelling, assuming full production mussel farms, showed only minor effects on phytoplankton filtration and benthic deposition. The effects of spat farms producing small mussels before being removed, would be significantly less, and unlikely to be measurable within natural seasonal variability. The methodology and results of the previous hydrodynamic modelling are summarised in this report, however, for the sake of completeness.

2 Methods

2.1 Hydrodynamics

Hydrodynamics (water physics) play a key role in the interaction between a mussel farm and the local and wider aquatic environment. Since mussels feed on suspended particulates, the rate of delivery plays a significant role in mussel growth as does the rate of export in the dispersion of faeces, pseudofaeces, and shell drop.

NIWA has developed hydrodynamic models that use net current velocity and direction, flushing time through the farm and mussel filtration to plot depletion footprints. By combining current velocity and direction with water depth and the settling rates of faeces/pseudofaeces it has been possible to predict the footprint of farms in terms of water filtration and benthic deposition. Summaries of these models are found in Morrisey et al. (2006) and in a large number of FRIA reports, e.g. Stenton-Dozey et al. (2006).

An acoustic Doppler current profiler (ADP) was moored at the site over a neap/spring tide from 25 July – 2 August 2007. The data obtained from that instrument was used to validate the output from a ROMS (Regional Oceanographic Model System) model of tidal currents in the area surrounding Wainui Bay. The boundaries of the model were set at 172.834^o E and 173.141^o E longitude, and 40.860^o S and 40.670^o S latitude, with 150 m grid spacing. Tidal heights and currents for the main (M2) tidal component were specified using output from the NIWA EEZ tidal model and bathymetry data were based on LINZ Chart NZ61, with close attention to chart datum heights relative to mean water level.

2.2 Depletion and deposition

Phytoplankton and faecal/pseudofaecal deposition were both estimated using Lagrangian particles, or virtual parcels or floats, released from the position of the farm. These floats will move with the modelled currents, but each is also given a random displacement at each step, equivalent to a diffusion process to allow for mixing. These float trajectories are essentially the same for both the depletion and deposition calculations, except in the model fewer particles are released for the depletion calculation and they are tracked (the model is run) for longer, because the depletion process involves time scales of several days, whereas deposition involves time scales of a few minutes at most.

Phytoplankton depletion is estimated by how much of the water passing through the farms is filtered by the growing spat or mussels, or in the model, how many of the floats have been processed, i.e. had their phytoplankton depleted by the mussels. For these calculations we have assumed a dropper density of 0.06 dropper per metre (600 droppers per hectare), the dropper length is 7 m, the filtration rate per unit length of mussel rope per unit time is 14.35 m^2 day^{-1} (or 0.598 m^2 hr^{-1}), and time scale for processed water to be replenished is 3 days.

Benthic deposition is calculated from how far and in what direction the particles will extend from the farm before reaching the sea floor. For these calculations we have used the same dropper densities and lengths as above, with the deposition rate of the mussels (mass of detritus produced per unit length of mussel rope per unit time) being 0.967 kg day^{-1}, and the sinking speed of the detritus as 0.05 m s^{-1}.

2.3 Benthic habitats

An assessment of the benthic effects from the existing spat catching farms was made using three methods. The first used high-resolution side-scan sonar to delimit the spatial extent of mussel shells and debris beneath and around the farms. The second used grab sampling to quantify the benthic species and sediments present within and beyond the farm boundaries, and the third used a remote camera to provide an assessment of the magnitude of shell-drop and identity of species living on the surface of the sediment. The field survey was done on 30 April and 1 May 2015 by 3 qualified NIWA science staff aboard the NIWA vessel RV *Tio*.

2.3.1 Side-scan sonar

Side-scan sonar swaths, each 60 m wide (30 m either side of the vessel) were made using a high-frequency (675 kHz) Tritech towfish. The position of the side-scan sonar was automatically recorded every 2 seconds along each swath from a GPS and saved in real time to a laptop on board the vessel using SeaNet Pro software and post-processed with Triton Perspective software to produce geo-referenced images that could be opened in ArcMap v9 GIS or Google Earth, where locations of features of interest could be determined.

2.3.2 Benthic infauna and sediments

Benthic samples were taken using a Ponar grab (bite area ca 0.05 m^2, maximum bite depth 15 cm) at 26 locations – 3 within the boundaries of each of the 6 farm blocks, and 8 outside (Figure 2-1). From each grab sample, two core (5 cm diameter) sub-samples were taken to 10 cm depth, and the sediment colour and smell was noted. The top 3 cm of the first core from each of the replicate grabs was composited and returned to the laboratory for analysis of sediment grain size. The top 3 cm of the second core from each replicate grab was retained separately for analysis of organic matter content. The remainder of the grab sample was washed through a 1.0 mm sieve and all material retained was preserved in 70% ethanol and returned to the laboratory to be sorted to the greatest practical taxonomic resolution. A multivariate analysis was performed whereby quantitative infaunal data were expressed as matrices of Bray-Curtis similarities among sites, and then subjected to non-metric multidimensional scaling analyses (nMDS, Field et al. 1982, PRIMER 6 2006). This method compares multivariate observations of the species composition at each site, such that if two sites showed a similar assemblage of organisms, then the corresponding points on the resulting nMDS plot would lie close together.

Grain-size distribution was determined by oven drying each sediment sample at 100^{o}C overnight and washing a weighed subsample through stacked 200 µm and 63 µm sieves. The fraction retained on each sieve was dried and weighed and the weight of material passing the 63 µm sieve obtained by subtraction from the original weight. Dry weights for each fraction were expressed as percentages of the total dry weight.

The amount of organic matter in the sediments was determined by freeze-drying each sample, grinding, and combusting in a furnace at 500^{o}C for 4 hours, and reweighing. The weight of organic matter was determined by subtracting the combusted weight from the original (freeze-dried) weight and expressed as a percentage.

2.3.3 Video/Photoquadrats

A remote video camera was used to record photoquadrats both within and beyond the farm boundaries to describe large bodied epifauna living within and outside farms and to qualitatively assess the shell drop beneath farm lines. At each of the 6 farm blocks, twelve photoquadrats comprising 6 inside the area of the farm longlines, and 6 photoquadrats outside the area of the farm longlines were recorded. In total, 72 photoquadrats were recorded; 36 within the boundaries of each farm, and 36 beyond the area of the longlines. The positions of each photoquadrat was recorded on GPS, and shown in Figure 2-1.

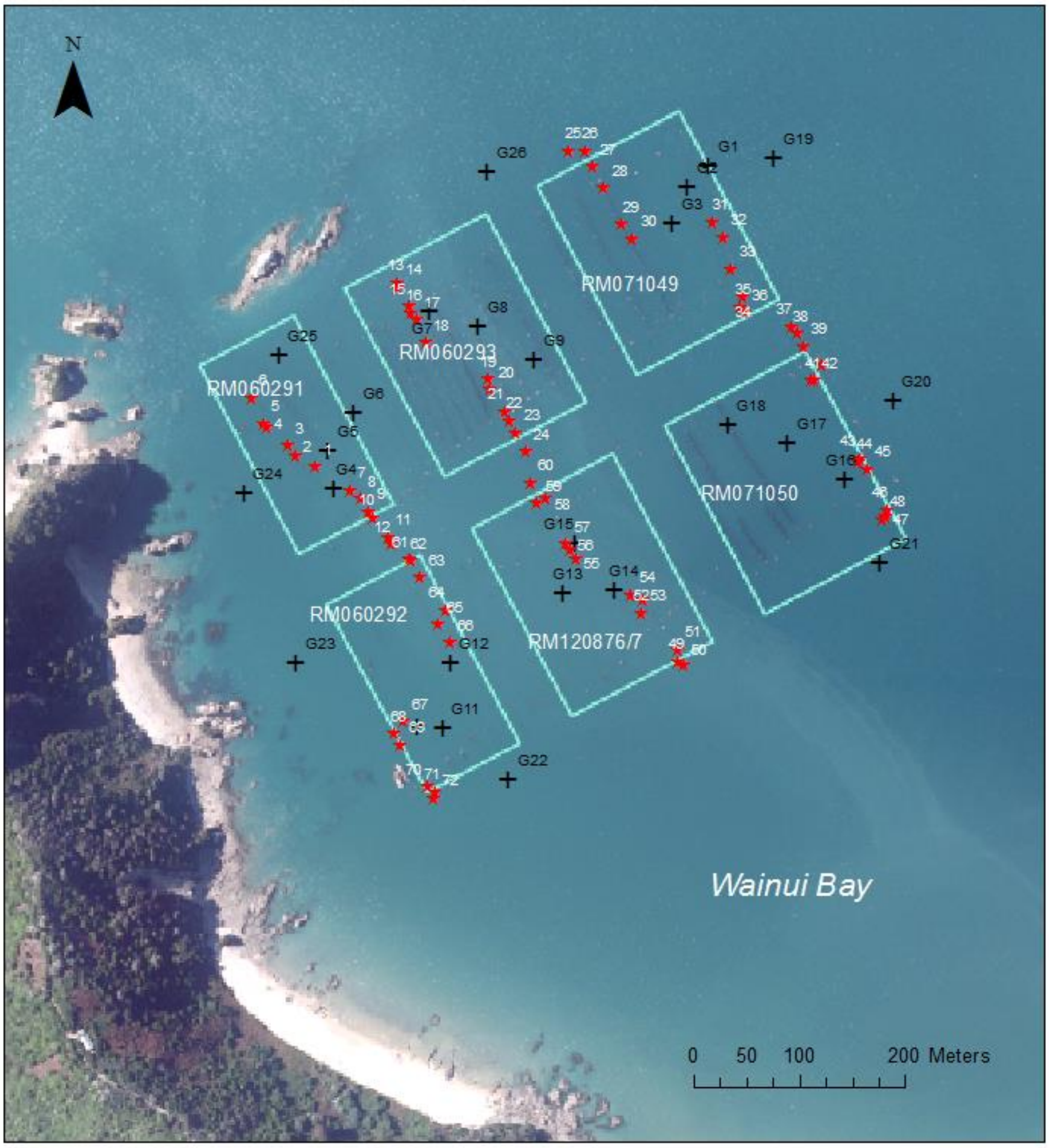

Figure 2-1: Location of grab samples (black crosses) and photoquadrats (red stars, white numbers).

3 Results

3.1 Hydrodynamics

The following results are taken from Grange and Hadfield (2007). Analysis of the tidal currents at 5 m depth showed the strength of the currents along the dominant direction increasing from 5.7 $cm.s^{-1}$ at neap tide to 12.8 $cm.s^{-1}$ at spring tide, with the average over the period of 9.5 $cm.s^{-1}$. The residual current was directed westward at 3.1 $cm.s^{-1}$. These currents are moderate to high compared with many existing mussel farming areas in the Marlborough Sounds, and elsewhere in Golden Bay.

3.2 Filtration

Maximum percentage of water processed by the stocked farm is largely within the boundaries and slightly to the south, reflecting the current speed and direction, with a maximum of 10-12% of the water flowing through the farm being processed.

While this could assume that 10-12% of the phytoplankton passing through the farm is depleted by the mussels, this would be an over-estimate of the potential depletion because mussels do not filter with 100% efficiency, and some of the water flowing through the farm will be filtered more than once by mussels. This value also does not take into account any re-growth of phytoplankton, or seasonal differences. The modelled results also assume each farm is stocked with mussels at standardised densities and sizes, as would occur in a full mussel farm, not a spat farm, which would filter considerably less water given the small size of the mussels and their relatively temporary existence on the farm.

To put these results into context, a recent report summarising many studies at the Collingwood Marine Farm block over several years (Grange, 2010) stated that 27-40% of the phytoplankton was potentially removed by the farm block during winter, due to slow phytoplankton growth, but there was no evidence of phytoplankton depletion in summer. No adverse effects have been recorded downstream of the Collingwood marine farms.

3.3 Deposition

Modelled deposition of pseudofaeces and faeces from the mussels indicates both that the amount of deposition (<0.5 $g.m^{-2}.d^{-1}$) and the spread of it is small, not occurring beyond each farm boundary. The amount of deposition is equivalent to one-tenth of a teaspoon being spread over $1m^2$ of sea floor in a day. Although quantifiable by modelling, it is unlikely that this deposited material would be measurable or distinguishable from background sediment. Beyond the farm boundaries, the deposition falls to background levels and is not measurable. This is also supported by the sediment grain size and organic content (see Sections 3.6 and 3.7 below) where there were no significant differences between sediment samples taken within and adjacent to the farms.

3.4 Side-scan sonar

A total of 4 swaths was completed, covering the area between the farm blocks and also inshore and offshore of the farms (Figure 3-1). Features noted from the analysis of the side-scan output included farm spat collection lines, areas of flat sea bed and some areas of shell drop beneath the lines.

Figure 3-1: Location of side-scan swathes.

Adjacent to the inshore edge of the farms some rocky reefs were noted. Figure 3-2 is a portion of the inshore side-scan sonar transect, which clearly shows the extent of low-lying reefs and rocky outcrops extending from the shoreline. The innermost backbone of the spat farm is approximately 25 m from the closest reef, and there is no indication of shell debris extending to the reef.

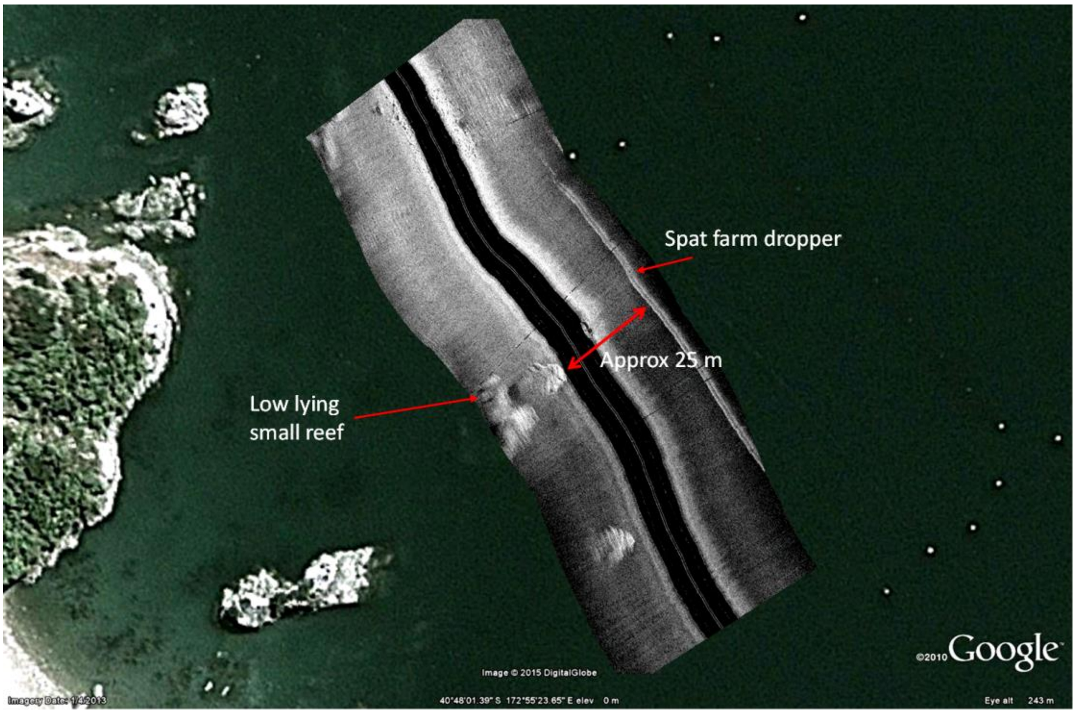

Figure 3-2: Portion of inshore side-scan sonar transect with shoreline reefs. Side-scan image is 165 m x 60 m.

3.5 Benthic characteristics

The depth of each sample, along with the sediment grain size and organic content is shown in Table 1.

Table 1: Depth and sediment characteristics of each benthic sample, Wainui Bay.

Sample/site ID	Water Depth (m)	LOI%	% Mud
G1 In	11.6	7.06	98.84593
G2 In	11.4	6.60	94.46512
G3 In	11.2	6.11	82.1315
G4 In	8.6	4.14	28.10057
G5 In	8.7	5.27	58.16243
G6 In	9	3.84	50.19639
G7 In	9.8	4.47	55.0792
G8 In	9.8	2.93	34.01938
G9 In	9.7	4.67	64.58625
G10 In	5.5	1.39	7.723877
G11 In	5.7	1.09	5.988712
G12 In	6.4	1.65	10.1834
G13 In	8	1.65	7.633833
G14 In	8.5	2.24	20.61469
G15 In	8.6	2.51	31.31608
G16 In	9.2	4.75	77.61068
G17 In	9.3	4.06	62.14219
G18 In	9.5	4.74	68.04938
G19 Out	10	5.31	91.56282
G20 Out	9.7	5.18	94.47554
G21 Out	9.3	5.45	91.70654
G22 Out	9	1.52	9.251927
G23 Out	5.5	1.35	9.853831
G24 Out	7.2	4.71	63.15789
G25 Out	7.6	4.94	55.23321
G26 Out	10.7	6.08	95.11699

3.6 Sediment Grain Size

Sediment composition ranged widely from samples dominated by up to 94% sand (particle size 63-200 µm) at the inshore, shallower stations (G11) to samples dominated by 95-99% mud (particle size < 63 µm) at the deeper, stations (e.g. G1, G26) (Figures 2-1 and 3-3). There was no clear pattern of grain size composition in relation to whether samples were from within farms vs outside farm structures (Figure 3-3).

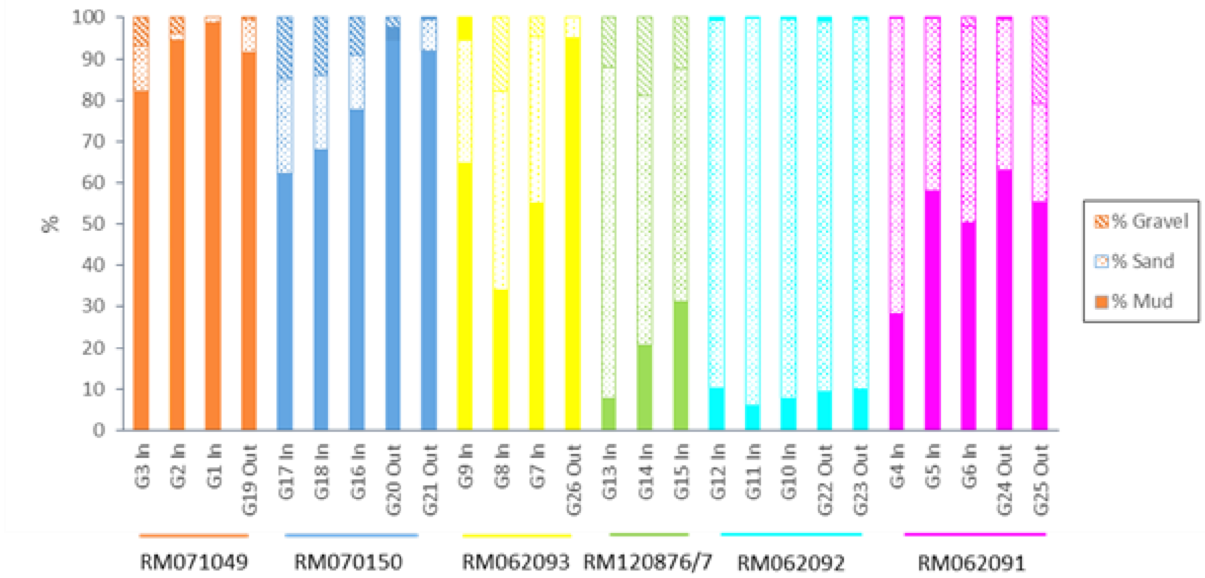

Figure 3-3: Sediment grain size distribution at each grab station.

3.7 Sediment organic content (loss on ignition or LOI)

Organic content of sediments sampled ranged from 7.06% at station G1 to 1.09% at station G12 (Figure 3-4). These levels of organic content are within the range experienced in comparable semi-enclosed embayments in the Marlborough Sounds (e.g. Stenton-Dozey et al. 2003). None of the sediment samples exhibited back colour or strong sulphide odours that would be associated with excessive organic enrichment. Organic content of sediments closely reflected the grain size distribution (Figure 3-3 and 3-4).

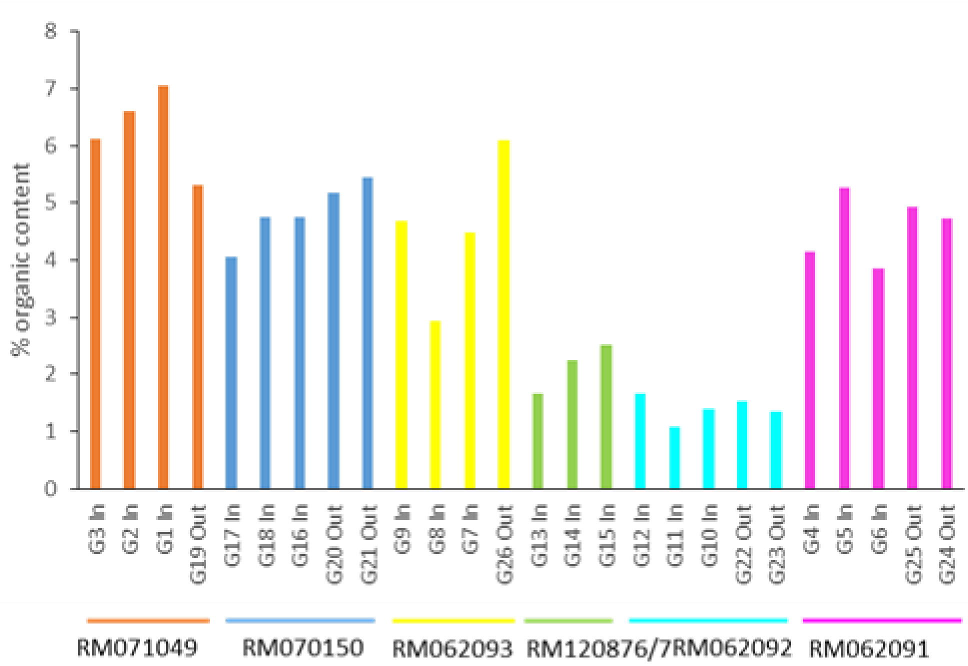

Figure 3-4: Organic content of sediments from each grab station.

Figures 3-5 and 3-6 show the close relationship between water depth and the sediment characteristics. Samples from deeper locations clearly have higher organic content (Figure 3-5), but there is no clear relationship with samples from within and outside the spat farms. Similarly, there is a clear relationship between increasing mud in the samples and increasing organic content, irrespective of whether the samples were collected from within or outside the farms (Figure 3-6).

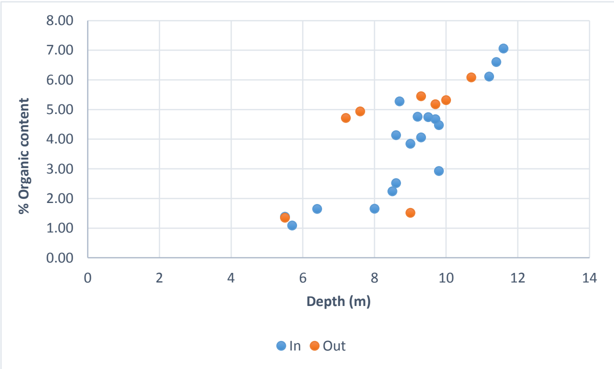

Figure 3-5: Depth of sample vs organic content of the sediment, Wainui Bay.

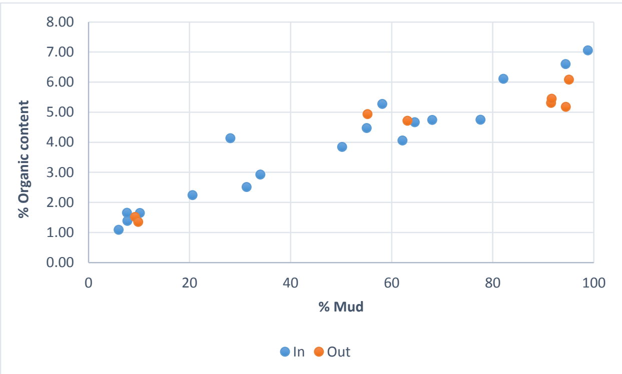

Figure 3-6: The percentage of mud in the sediment samples vs organic content.

The mean percentage of organic content in the sediments within the existing spat farms was 3.8%, while it was 4.3% outside the farms. (Figure 3-7). The means did not differ significantly.

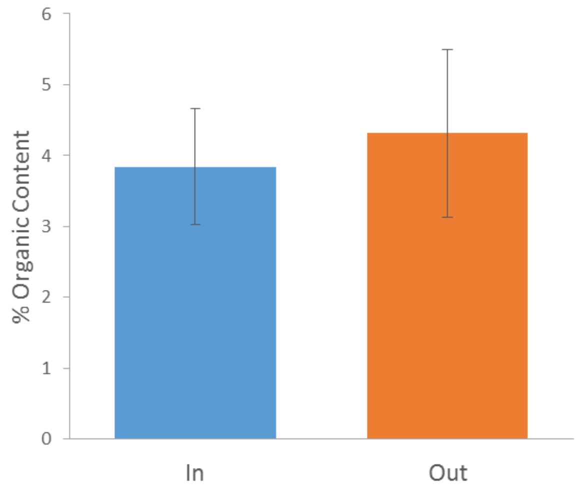

Figure 3-7: Comparison of mean organic content of sediments within and outside spat farms. (Error bars represent 95% CI)

3.8 Infauna: Animals living within the sediment.

The benthic fauna comprised species that are generally common and widespread in mud habitats around New Zealand, including the Marlborough Sounds and Tasman/Golden Bay (Appendix A). In total, 69 taxa were identified from all grab samples. The most commonly sampled taxa from the grab samples were polychaete worms from the families Capitellidae, Glyceridae and Nephtyidae, small bivalve molluscs *Nucula nitidula* and *Theora lubrica*, mud crabs (*Hemiplax hirtipes)* and hermit crabs (*Pagurus* sp.). There were no significant differences in mean numbers of taxa, or mean numbers of individuals in grab samples within and outside of the farm boundaries (Figure 3-8).

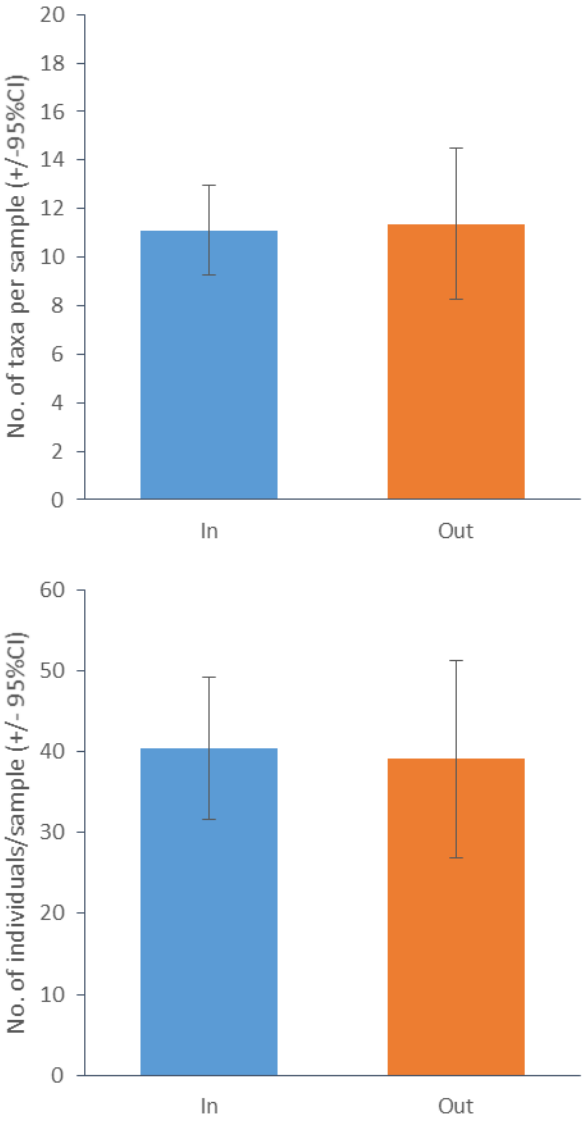

Figure 3-8: Comparison of mean numbers of taxa (above), and mean numbers of individual animals (below) found in grab samples inside and outside of farms. (Error bars represent 95% CI)

The Multidimensional Scaling (MDS) analysis of the numbers of individuals from particular species in each sample does not depict any clear grouping of samples from inside the farms vs. samples from outside the farms (Figure 3-9). This indicates that the faunal assemblages inside and outside the farm boundaries are similar.

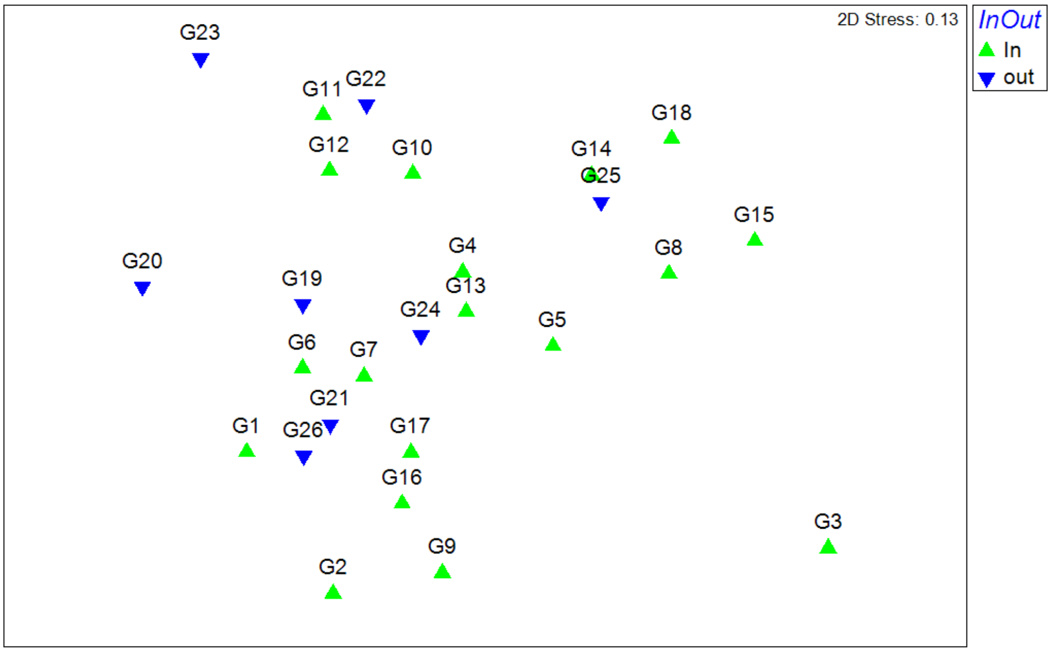

Figure 3-9: MDS plot showing the relative faunal similarities among samples from inside and outside the Wainui Bay farms.

3.9 Photoquadrats: Large bodied epifauna and assessment of shell litter.

Large-bodied fauna noted from photoquadrats were all animals that are commonly found on the seabed in Golden Bay (Appendix B). Species most commonly seen in the photoquadrats were the cushion star (*Patiriella regularis*) and the turret shell (*Maoricolpus roseus*), which were present in photoquadrats taken both within and outside farm boundaries (Appendix B). Shell drop, seen in photoquadrats recorded within the farm boundaries was patchy and moderate only in some sites (Figure 3-8). Clumps of live mussels were only rarely seen, and only in photoquadrats recorded outside the area of the farm structures (Appendix B).

Figure 3-10: Photoquadrat from beneath the farm structures at RM071049 showing moderate shell drop (left) and photoquadrat from outside the area of farm structures adjacent to RM060291 (right).

4 Discussion and Conclusions

Sea bed characteristics examined in this benthic survey showed that the marine farming (spat catching) activity has had few effects on the seabed other than some shell litter beneath the spat collecting structures.

Side-scan swathes of the seabed in the vicinity of the farms showed some rocky reef habitat extending from the shore to within 25 m of the inshore boundary of the farm blocks. This habitat feature is sufficiently distant from the farm structures that it is unlikely to be affected by deposition from the marine farming activity, which is modelled to be very low and not extending beyond the farm boundaries, or be measurable from background sediments.

There was no indication of organic enrichment of sediments, there was some shell litter observed within the farm boundaries, as expected, but this was sparsely distributed. The assemblage of seabed-dwelling animals sampled inside and outside the farm boundaries was similar, and comprised species commonly found in the region. There was no evidence of unusually high or low abundance of animals on the seabed within the farm boundaries.

In summary, this survey shows effects from around 35 years of mussel spat catching activity to be less than minor. This would not be expected to change with the on-going marine farming activity of spat catching in the future.

5 Acknowledgements

Thanks to Louis Olsen and Ashleigh Watts for assistance in the field and to Anna Bradley and Karen Robinson for laboratory analyses.

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Appendix A Fauna in grab samples.

		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	G18	G19	G20	G21	G22	G23	G24	G25	G26
Amphineura	Unidentified chiton A.															1											
Amphineura	*Rhyssoplax canaliculata*														2	4			1							2	
Amphineura	*Rhyssoplax strangeri*														1												
Polychaeta	Ampharetidae				1											1								1	1		
Polychaeta	Capitellidae			1	5	25			31	1	1				9	24		1	3				2		3	11	2
Polychaeta	Cirratulidae																							1			
Polychaeta	Cossuridae	2	1			2																					
Polychaeta	Glyceridae	1	3		5			3	3	3	1			4	3	7	1	1		1			1		3	3	1
Polychaeta	Lumbrineridae			1			1	3	1	1	1					1	2		1						2		
Polychaeta	Magelonidae										1			1													
Polychaeta	Maldanidae																						1	1		5	
Polychaeta	Nephtyidae	5			5	3	4	7	1		10	4	9	1	2	1	1	1		8	6	3	5	6	5	1	10
Polychaeta	Nereidae																	1					1				
Polychaeta	Ophelidae								1		3			1	2	6	1		2					1	2	3	
Polychaeta	Orbiniidae			1													1	1	2								
Polychaeta	Phyllodocidae																2										
Polychaeta	Sabellidae										6	10	8	1				1					11	3		1	
Polychaeta	Sigalionidae	1					1			1	1	1					1			1	2	1			1		
Polychaeta	*Spiochaetopterus* sp.																									10	
Polychaeta	Spionidae				1			1			1	2	1	1								2	11	1	1		
Polychaeta	Syllidae	1				2									1	1	1										
Polychaeta	Terebellidae																		1								
Polychaeta	Trichobranchidae																1										
Nemertea	Nemertea				1	1													1								
Gastropoda	*Amalda novaezelandiae*																					1					
Gastropoda	*Amalda sp. (juvenile)*										1																
Gastropoda	*Austrofusus glans*									1																	
Gastropoda	*Cominella adspersa*											1			1												
Gastropoda	*Maoricolpus roseus*			1											1												
Gastropoda	*Neoguraleus sinclairi*																							1		1	
Gastropoda	*Pelicaria vermis*																								1		
Gastropoda	*Sigapatella tenuis*								1																		
Gastropoda	*Tanea zelandica*						1																				
Gastropoda	*Coelotrochus tiaratus*																		1								
Gastropoda	*Xymene plebeius*	1													1												
Bivalvia	*Anomia trigonopsis*								1																		
Bivalvia	*Divalucina cumingi*					1									1										3		
Bivalvia	*Dosinia lambata*									1										1	1	3	1				
Bivalvia	*Dosinia* sp. (juvenile)	2																									
Bivalvia	*Elliptotellina urinatoria*										2																
Bivalvia	*Gari lineolata*										2		4	1									3	2			
Bivalvia	*Kellia cycladiformis*				1																						
Bivalvia	*Leptomya retiaria*				2									1												2	
Bivalvia	*Melliteryx parva*																									1	
Bivalvia	*Myadora striata*																							1			
Bivalvia	*Nucula nitidula*				4	17	2	1		3	8	1		8			8				1	3	1		9	1	
Bivalvia	*Perna canaliculus*					1																					
Bivalvia	*Purpurocardia purpurata*																										
Bivalvia	*Tellinota edgari*					1					1	2															
Bivalvia	*Theora lubrica*	10	7		5	8	6	19		47			3	5			19	11		4	1	17			16	2	17
Bivalvia	*Venerupis largillierti*													1													
Bivalvia	*Zenatia acinaces*	1			1																						
Bivalvia	Unidentified Bivalve A.																					1					
Decapoda	*Hemiplax hirtipes*				1	2	2	1	1				1				3			2	1	3			4		
Decapoda	*Nectocarcinus integrifrons*				1																						
Decapoda	*Neommatocarcinus huttoni*							1																			
Decapoda	*Pagurus* sp.			1	5				4		1		1	1	7	13			9							4	
Decapoda	*Periclimenes yaldwyni*														2				6							1	
Decapoda	Unidentified Decapod A.																						1				
Amphipoda	Unidentified amphipod				8	9	3	6	5	1	14	9	15	7	12			4	7	6		3	11		11	7	
Cumacea	Unidentified cumacea										3												2				
Isopoda	Unidentified isopod					1								1	1	3			1								
Mysidacea	Mysid shrimp					1																					
Ostracoda	Unidentified ostracod				1	8		1	1	2	2			1			1					1	1		3		
Stomatopoda	Mantis shrimp				1							4	4										4	10	1		
Tanaidacea	Unidentified tanaid				2	1																					
Echinoidea	*Echinocardium cordatum*																			1		1					1
Rhodophyta	Branching red algae																									1	
Rhodophyta	Nongeniculate coralline algae																									1	

Appendix B Seabed features in photoquadrats recorded within and outside farm boundaries.

Photoquadrat ID	RM062091_1_In	RM062091_2_In	RM062091_3_In	RM062091_4_Out	RM062091_5_Out	RM062091_6_Out	RM062091_7_In	RM062091_8_In	RM062091_9_In	RM062091_10_Out	RM062091_11_Out	RM062091_12_Out	RM062093_13_Out	RM062093_14_Out	RM062093_15_Out	RM062093_16_In	RM062093_17_In	RM062093_18_In	RM062093_19_In	RM062093_20_In	RM062093_21_In	RM062093_22_Out	RM062093_23_Out	RM062093_24_Out	RM071049_25_Out	RM071049_26_Out	RM071049_27_Out	RM071049_28_In	RM071049_29_In	RM071049_30_In	RM071049_31_In	RM071049_32_In	RM071049_33_In	RM071049_34_Out	RM071049_35_Out	RM071049_36_Out
Infaunal burrows	P	P	P	P	P	P	P	P	P	P	P		P		P	P	P	P			P	P		P	P						P		P	P	P	
Shell litter (% cover)							10	10	5	15				30					5	10						15	10	5	90	90						5
Ophiroidea sp				1																																
Coscinasterias calamaria														1																						
Patiriella sp.				2													1																			
Bugula sp.																								1												
Perna canaliculuas							1																													
Mytilus galloprovincialis														20								10														
Maoricolpus roseus																1											1									
Unid. gastropod																			1	1																
Cominella																																				
Pagurus sp.																																				
Unid. crustacean															1																					

Photoquadrat ID	RM070150_37_Out	RM070150_38_Out	RM070150_39_Out	RM070150_40_In	RM070150_41_In	RM070150_42_In	RM070150_43_In	RM070150_44_In	RM070150_45_In	RM070150_46_Out	RM070150_47_Out	RM070150_48_Out	RM120876_7_49_Out	RM120876_7_50_Out	RM120876_7_51_Out	RM120876_7_52_In	RM120876_7_53_In	RM120876_7_54_In	RM120876_7_55_In	RM120876_7_56_In	RM120876_7_57_In	RM120876_7_58_Out	RM120876_7_59_Out	RM120876_7_60_Out	RM060292_61_Out	RM060292_62_Out	RM060292_63_Out	RM060292_64_In	RM060292_65_In	RM060292_66_In	RM060292_67_In	RM060292_68_In	RM060292_69_In	RM060292_70_Out	RM060292_71_Out	RM060292_72_Out
Infaunal burrows	P						P		P	P	P	P	P	P	P	P	P					P	P	P	P	P	P		P	P	P	P	P	P	P	P
Shell litter (%)		5	5		3	80		5							5	10	10	90	95	15	10	5	5					10						5		5
Ophiroidea sp																																				
Coscinasterias calamaria				2																																
Patiriella sp.																															2				1	
Bugula sp.																																				
Perna canaliculuas																																				
Mytilus galloprovincialis																																				
Maoricolpus roseus		2	4																																	
Unid. gastropod												1								1																
Cominella																						1														
Pagurus sp.																					3															
Unid. crustacean																																				