Baseline survey for proposed mussel spat catching sites: Waikato West Coast

Prepared for North Western Mussels Ltd

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Executive summary

A field survey of four potential mussel spat-catching sites off the Waikato west coast was completed in February 2017. A variety of sampling was completed, including high-frequency side-scan sonar, underwater video and drop camera, grabs and water quality. The results indicate a featureless muddy sand sea floor, with no sensitive habitats, reefs or rocky outcrops, and few, if any, epifauna. The infauna was dominated by small mobile taxa that are common and widespread around the New Zealand coast.

In terms of benthic ecology, the proposed seasonal spat catching operation will have minor, if detectable, effects on the ecology of the area.

1 Introduction

North Western Mussels Limited engaged NIWA to conduct a baseline survey of four proposed mussel spat-catching (farm) sites off the Waikato west coast (Figure 1-1), and provide a report suitable to present to Waikato Regional Council as part of a resource consent application.

The survey design is based on the requirements for a baseline survey for non-fed new marine farms, as detailed in the Waikato Regional Council Coastal Plan. We suggest adjustments to those requirements due to the nature of the proposed farming activity (seasonal mussel spat catching) and its location (offshore on an exposed coast). In terms of the farm structures, the backbones and anchors will be permanent, but the actual spat catching ropes will be deployed only for short periods (around a month) during the spat season. Once spat have settled on the ropes, the ropes will be carefully removed, and the spat and rope transported to existing mussel farms.

At each of the proposed farm locations, the following sampling was undertaken:

- Side-scan sonar transects along and beyond the length of each farm were made to visually assess the sea floor, identify the sediment type, and to detect any rock outcrops or biogenic reefs in the vicinity of the proposed farm locations.
- Grab samples were taken from the seabed within the proposed farm boundaries to characterise sediment grain size composition, organic content and infaunal community composition.
- Drop camera photographs were taken to record any epifauna or epiflora.
- Integrated water samples were collected and analysed to determine chlorophyll-*a* content in the upper water column at the time of sampling.

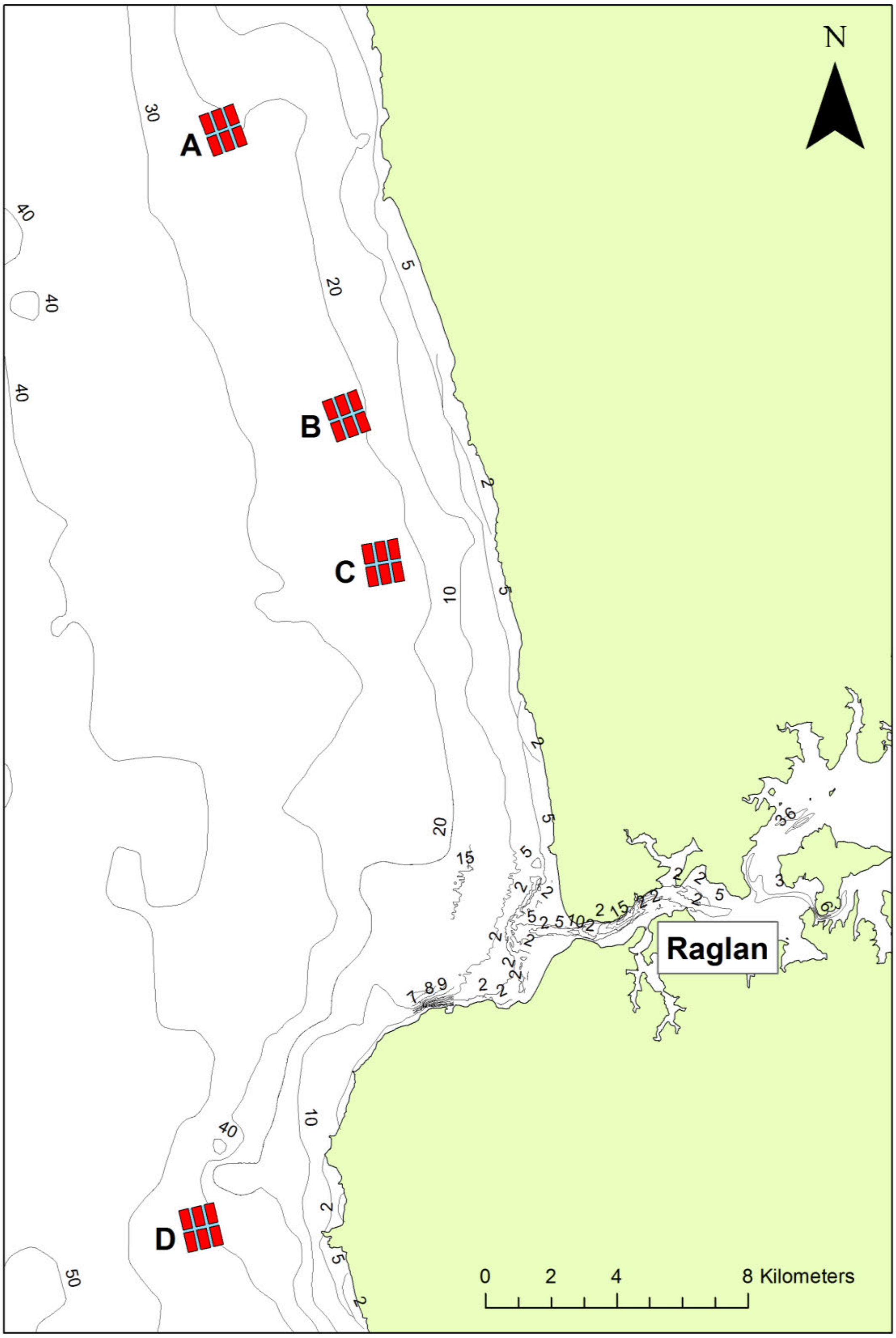


Figure 1-1: Location of the four proposed mussel spat-catching farms (A, B, C, D) and their six blocks off the Waikato west coast.

2 Methods

Sampling was conducted on 21, 22 and 23 February 2017 by experienced, qualified NIWA science staff aboard a NIWA vessel. The sampling plan was identical for all four proposed farm blocks, as illustrated in Figure 2-1. All sampling sites were located and recorded using the vessel's on-board GPS plotter.

2.1 Side-scan sonar

In order to identify potential features of interest (principally reefs, rock outcrops, or biogenic structures) in the vicinity of the site, side-scan sonar swaths, each 100 m wide (50 m either side of the vessel), were made throughout the proposed extension and adjacent area using a high-frequency (675 kHz) Tritech towfish. The position of the side-scan sonar was automatically recorded every two seconds along each swath from the GPS and saved in real time to a laptop on board the vessel using SeaNet Pro software. Data were 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. Each side-scan sonar track covered approximately 100,000 m^2 (1 km x 100 m) at each site.

2.2 Grab sampling

A benthic grab (bite area ca. 0.13 m^2, maximum bite depth 22 cm) was used to obtain samples to describe sediment physical characteristics, and infaunal species assemblages at eight locations within each of the proposed farm areas (except at farm C where 13 grab stations were sampled).

2.2.1 Sediment physicochemistry

To determine sediment physicochemical characteristics, two core (5 cm diameter) samples were taken to 5-10 cm depth, and photographed. The top 2 cm of the first core was returned to the laboratory for analysis of sediment grain size. The top 2 cm of the second core was retained separately for analysis of organic matter content.

The proportion of mud, sand and gravel was determined by oven drying each sediment sample at 100 °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 sediment organic content was determined by freeze-drying each sample, grinding, and combusting in a furnace at 500 ^{o}C for four 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.

2.2.2 Infauna

To sample the infaunal community (animals living within the sediment), the entire contents of each grab sample was transferred to a mesh bag (mesh size 1.0 mm), and sieved by gently washing the bag in seawater. Following sieving, the infaunal samples were preserved in a solution of 70% ethanol in seawater and transported to the NIWA lab for taxonomic identification and counting.

2.3 Drop-camera photoquadrats

A high-definition, remotely operated underwater camera mounted on a frame (drop-camera) obtained video and still images of 0.5 m x 0.35 m areas of the seabed to characterise surface sediment and biological features. This was deployed at 13 stations at each proposed farm (except farm D, where only eight stations were imaged due to very poor visibility at the seabed) (Figure 2-1).

2.4 Water samples - chlorophyll-*a*

Water samples were collected at 13 sampling stations in and around each farm and analysed for chlorophyll-*a* concentration, an indicator of phytoplankton (the primary food for mussels) abundance. At each sampling station, water was collected with an open, flexible tube sampler to a depth of 8 m and poured into a bucket from which a 1 L sample was extracted. Samples were kept chilled and transported to the NIWA Hamilton laboratory for analysis of chlorophyll-*a*. In the lab, each sample was filtered through separate Whatman 25 mm GFF filters, treated with acetone to extract the pigment, and chlorophyll-*a* concentration determined using a spectrophotometer following standard methods (APHA 2005).

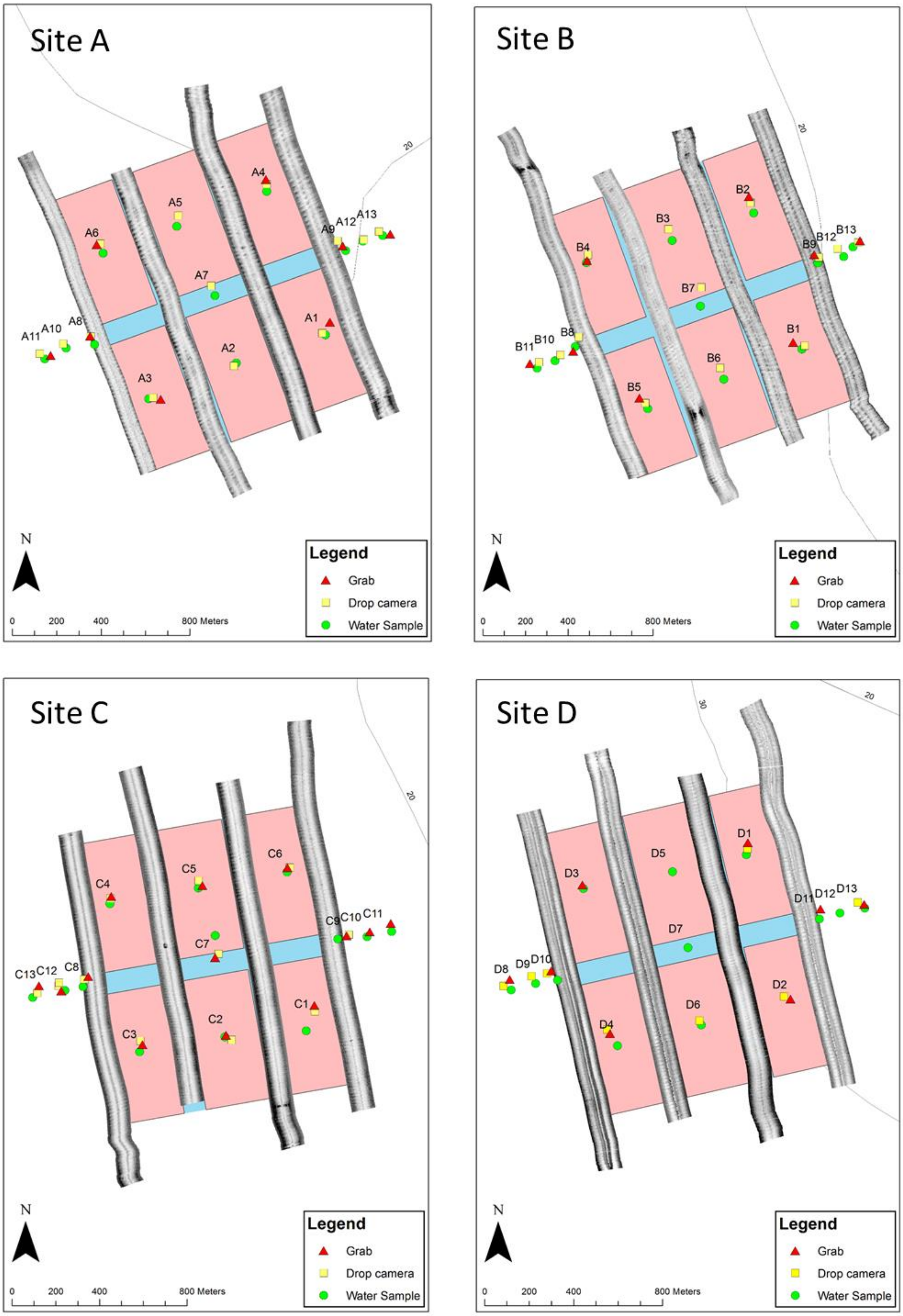


Figure 2-1: Sampling stations at all four proposed farm sites. The four grey bands running the length of each site are georeferenced side-scan sonar swath images.

3 Results

3.1 Side-scan sonar

The locations of the side-scan sonar swaths within each farm are shown in Figure 2-1. Analysis of side-scan sonar images of all swaths conducted at all four farms indicated that the seabed was relatively flat, soft sediment, with no evidence of three-dimensional reefs or significant biogenic habitats. A section of the western most swath from farm D (Figure 3-1) is typical and illustrates the absence of hard structures above the sediment surface or of any other features.

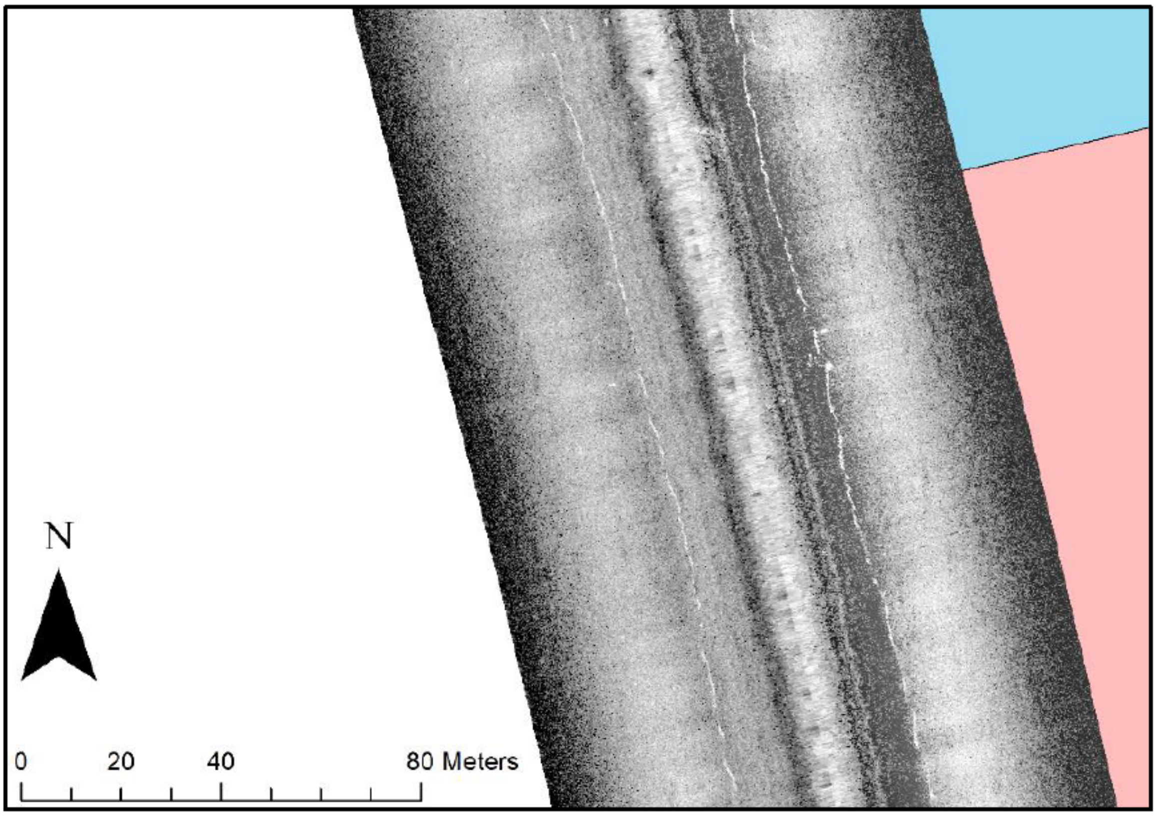


Figure 3-1: Detail of side-scan swath from westernmost side scan sonar transect at proposed farm D.

3.2 Grab sampling

3.2.1 Sediment visible characteristics

Sediments in all grab samples from all farms comprised dark brown/grey muddy sand (Figure 3-2). Grab samples from proposed farm D contained more mud than the sandier sediments at the other farms.

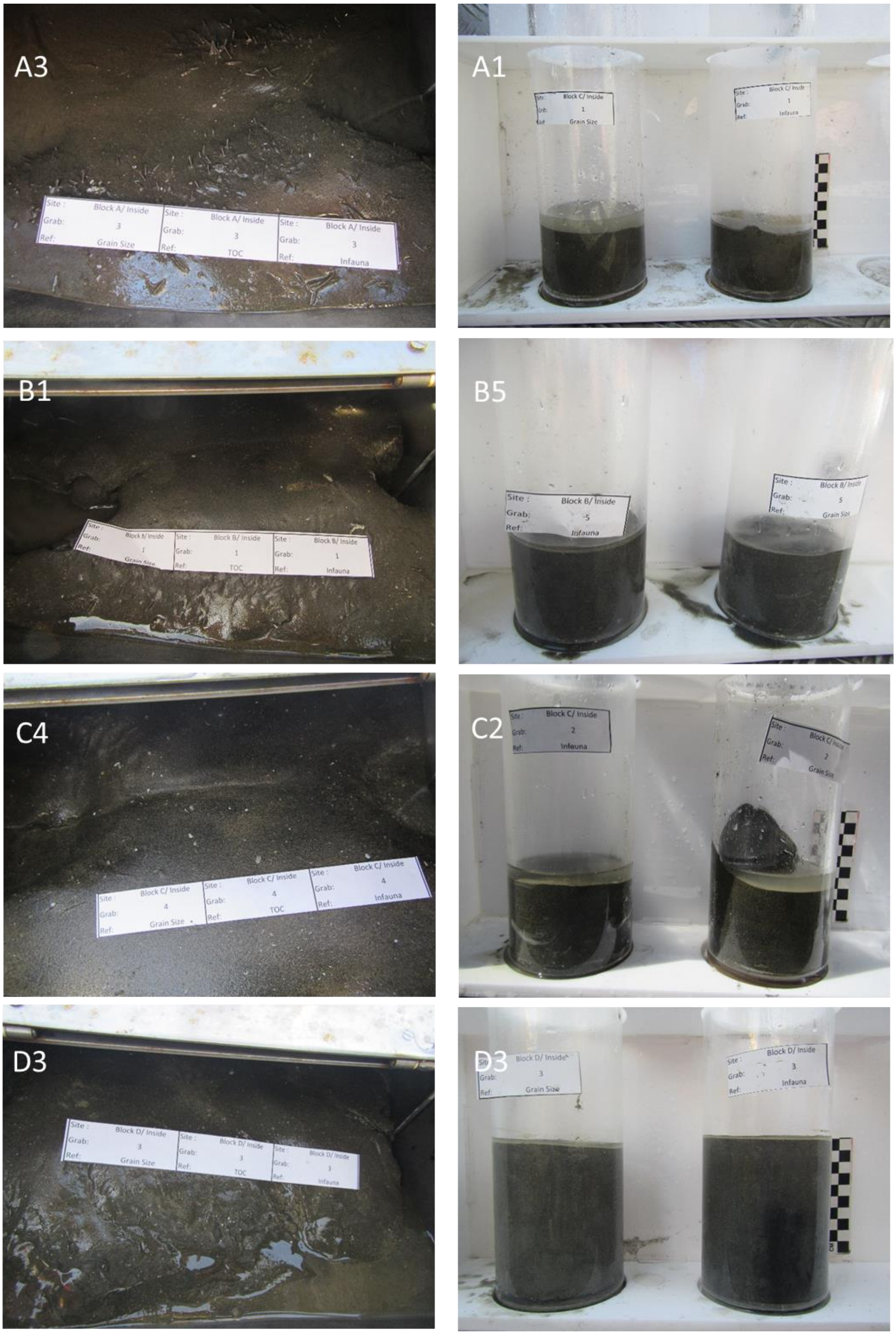


Figure 3-2: Examples of grab sample contents and sediment cores from within proposed farms A, B, C, and D. White text denotes sampling sample station numbers.

3.2.2 Sediment grain size composition

Sediments at all four proposed farms were composed mostly of sand (particle size 63-200 µm), with a lesser component of mud (particle size < 63 µm), and there was a very small component of gravel (particle size >200 µm) (Figure 3-2). Samples from proposed farm D contained more mud relative to the other sites. Sediments at proposed farm A contained least fine mud.

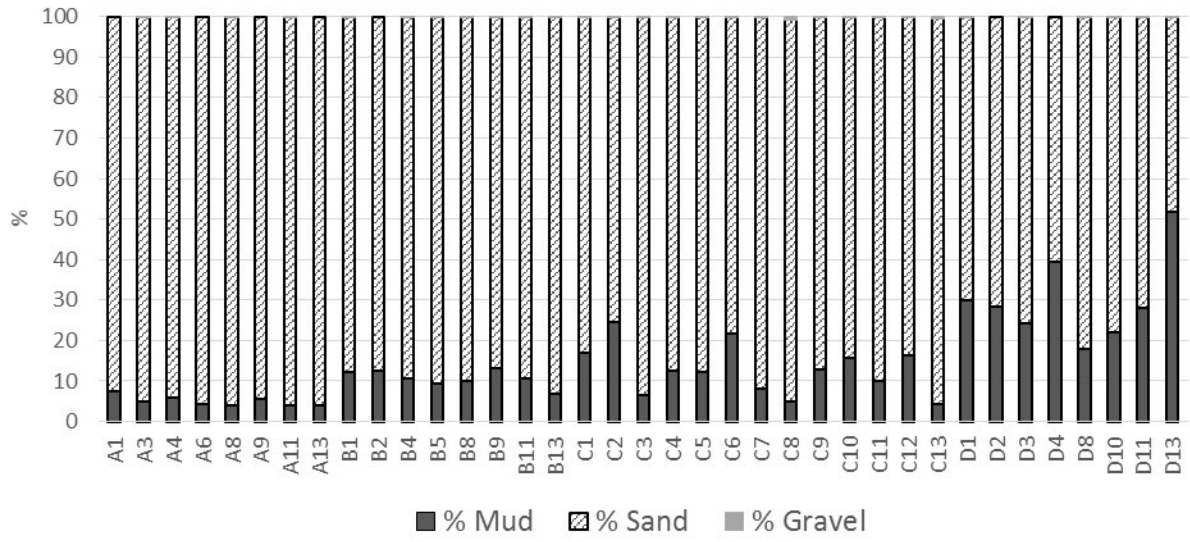


Figure 3-3: Percentage of mud, sand and gravel in sediment from each sampling station at each proposed farm. Note: Gravel comprised <1% in all samples and, hence is not visible in the graph.

3.2.3 Sediment organic content

Organic content of sediments ranged from 0.04% at several stations in the vicinity of proposed farms A and C, to >0.1% at stations in the vicinity of farm D. These concentrations are very low, and reflect the open coast, mobile sandy habitat within this environment.

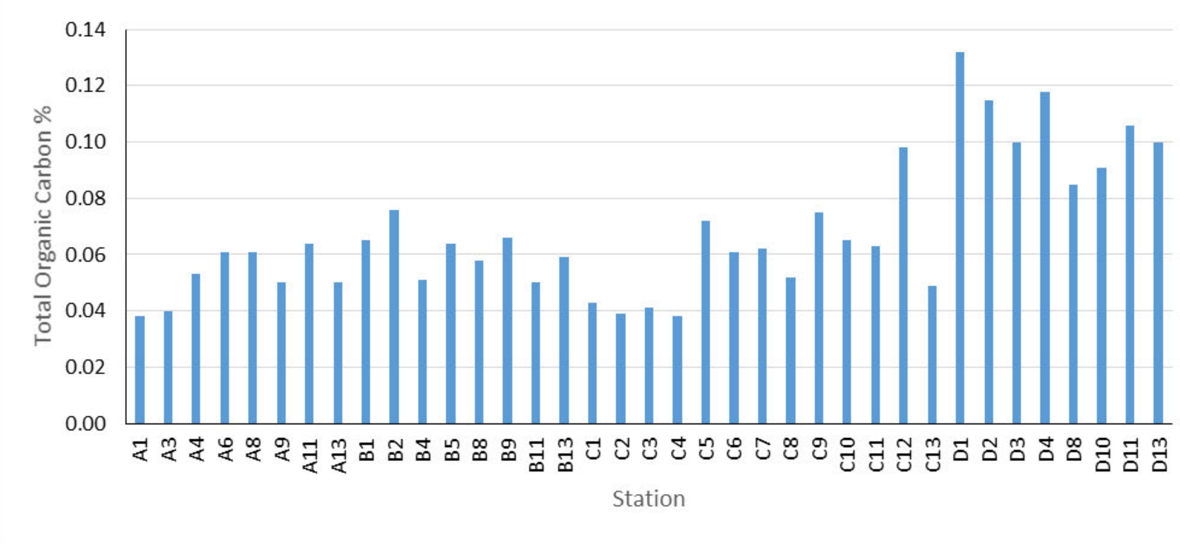


Figure 3-4: Organic content of sediments from each station.

3.3 Infauna

A total of 1740 individual animals representing 58 separate taxa were found in samples from all four proposed farms combined (Appendix A). The mean density (individuals per grab sample) for each farm ranged from 35.9 individuals/grab at farm C to 67.5 at farm B (Figure 3-3). The diversity (richness, or mean number of taxa) ranged from 12 taxa (or species) per grab at farm C, to 16 at farm B (Figure 3-4).

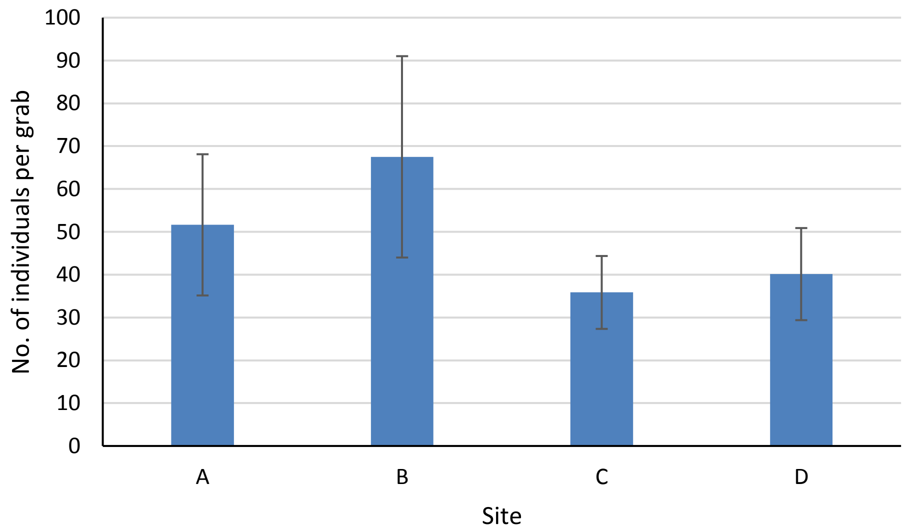


Figure 3-5: Mean number of individuals per grab sample at each proposed farm. Error bars represent 95% CI.

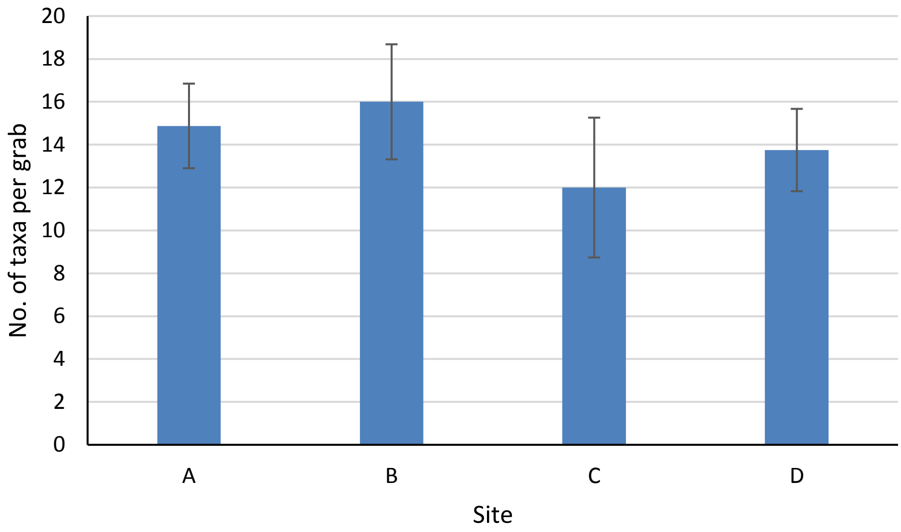


Figure 3-6: **Mean diversity (richness or number of taxa per grab sample) at each proposed farm.**

3.3.1 Farm A infauna

At proposed farm A, a total of 36 different taxa were identified and 413 individual animals were counted in all eight grab samples combined (Appendix A). The most abundant taxa were spionid polychaete worms, amphipod crustaceans, and the bivalve shellfish *Dosinia* sp. and *Mactra ordinaria*.

3.3.2 Farm B infauna

A total of 39 separate taxa was identified and 540 individuals were counted in the eight grab samples from proposed farm B. The community composition at this farm was very similar to that at farm A and the most commonly sampled taxa were spionid and pectinarid polychaete worms, the shrimp *Ogyrides delli*, and the bivalve shellfish *Dosinia* sp. and *Mactra ordinaria.*

3.3.3 Farm C infauna

At proposed farm C, a total of 42 different taxa was identified from 466 individuals in 13 grab samples. The most commonly sampled taxa were representatives from the crustacean orders Amphipoda and Cumacea, polychaete worms (families Spionidae and Ophelidae), and the bivalve shellfish *Dosinia* sp. and *Mactra ordinaria.*

3.3.4 Farm D infauna

A total of 30 separate taxa was identified and 321 individual animals counted from the eight grab samples collected at proposed farm D. At this farm the most commonly sampled taxa were the shrimp *Ogyrides delli,* the gastropod *Pupa affinis*, the bivalve shellfish *Divalucina cumingi*, *Gari* sp., and *Mactra ordinaria,* and polychaete worms from the families Spionidae and Onuphidae.

3.4 Drop camera

Video footage of the seabed from 13 sampling stations at each of proposed farms A, B, and C. At farms B and D, conditions were such that the visibility at the seabed was compromised by movement of sediment, and attempts to obtain video footage were made at eight stations at farm D. Analysis of video footage yielded still images of the seabed at 13 stations from farm A, three stations from farm B, and eight stations at farm C (all still images captured are presented in Appendix B). All of the stills obtained showed a soft sediment sand/mud substratum. Sand ripples were clearly visible in most of the still images, and no conspicuous epifaunal organisms were visible in any of the video recordings or still images. Due to the conditions of poor visibility at the seabed at farm D, video footage confirmed that the substratum was composed of soft sediment (sand and mud), but no still images of sufficient clarity were able to be captured. Examples of stills obtained at farms A, B, and C are shown in Figure 3-5.

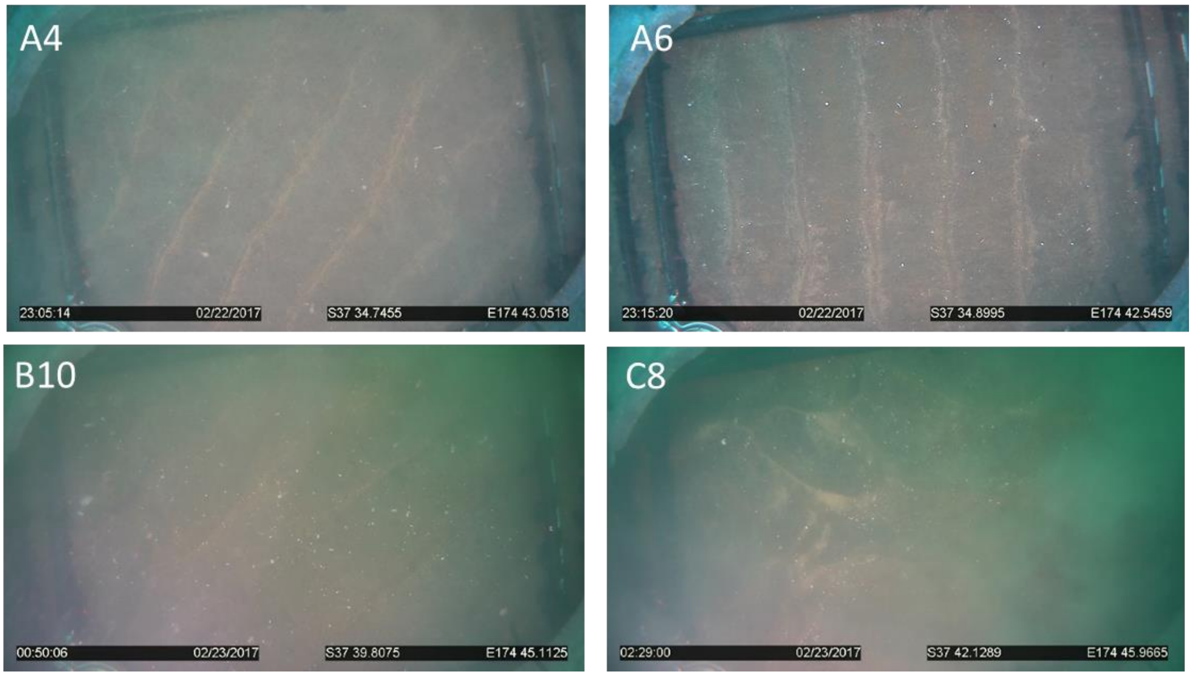
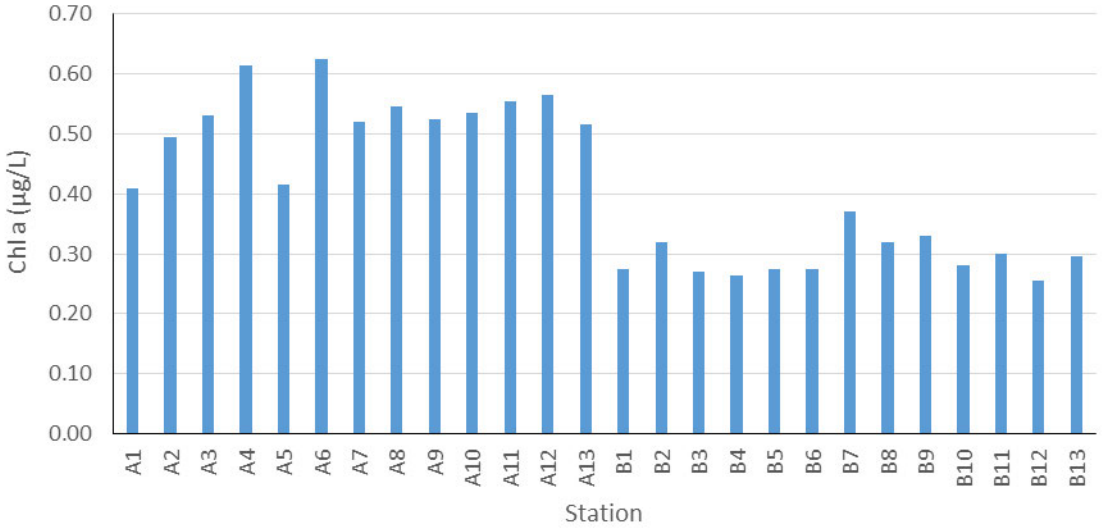


Figure 3-7: Example stills captured from drop-camera video footage of the seabed at proposed farms A, B and C. White text labels denote sampling stations. Note visible sand ripples and absence of conspicuous epifauna and epiflora.

3.5 Water samples – chlorophyll-*a*

Chlorophyll-*a* concentrations in water samples from each station are shown in Figure 3-7. Concentrations were lowest at farm D and greatest at site A and values ranged from 0.14 µg/L at station D4 to 0.63 µg/L at station A6.



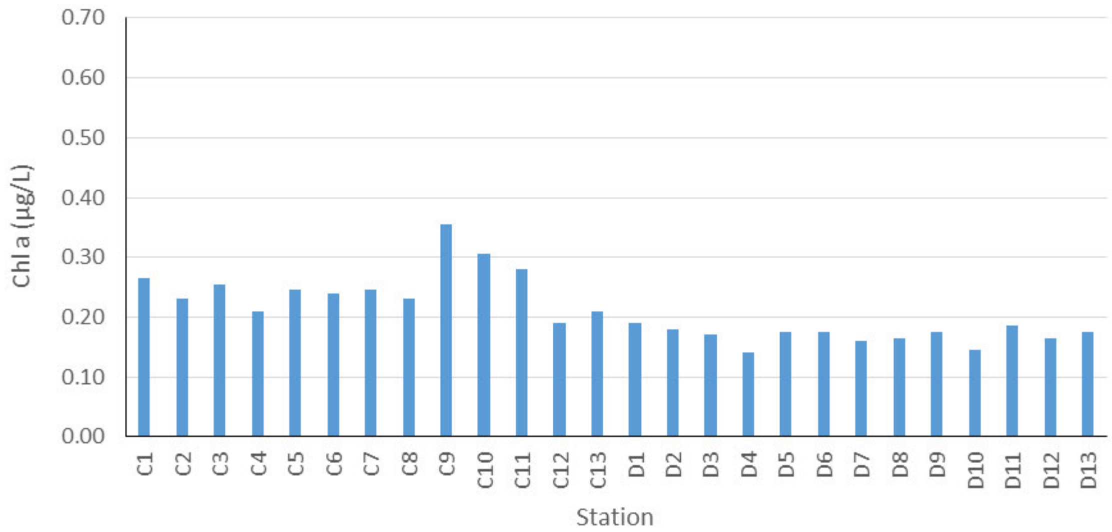


Figure 3-8: Chlorophyll-*a* concentrations in water samples from sampling stations at proposed farms A and B (above) and farms C and D (below).

4 Discussion and conclusions

North Western Mussels Ltd has carefully considered the location of the potential spat-catching farms, to ensure they are distant from known reefs, such as Jackson Reef just south of Raglan, and sufficiently distant from shore (over 3 km) to minimise any effects on inshore benthic communities. In addition, the farms are intended for only seasonal occupation (principally winter and spring). Each farm is in water depths greater than 20 m (20-27 m at the time of sampling), and in locations where mussel spat is known to occur (Jake Bartrom, pers. comm.).

The sites are along an exposed open coast, where wind and swell action plus tides will rapidly disperse any potential biodeposits (mainly pseudofaeces and fallen spat and shells) from the farms. The variable currents and frequently strong water movement associated with wind, waves, and swell will reduce any phytoplankton depletion that may be caused by the feeding spat to below detectable limits. The chlorophyll-*a* concentrations recorded in this report are sufficient for mussel growth.

Each proposed farm location is similar in terms of sediment composition, water depth, organic content of the sediments, and infaunal abundance and composition. As such, there are unlikely to be any differences in how each site is likely to support and respond to mussel spat catching. While the sampling for this report assumed the farms would be developed as shown in terms or orientation, the overall uniformity of the entire area means that no preferred orientation is obvious, and the final locations may be decided in relation to structure integrity around wind and swell direction.

It is possible there will be engineering challenges to operating mussel spat catching structures in an exposed open coast locality, but this report provides an ecological assessment of the proposed activity, not engineering. The existing environment comprises sediments that are mobile at times and, therefore, unlikely to be significantly affected by biodeposits from a seasonal spat collecting. No reefs, rocky outcrops, biogenic, or other sensitive habitats were detected by the field sampling, and epifauna was very sparse (or non-existent), as recorded by the video and drop-camera stations. The infauna was remarkably similar in abundance and composition across all four proposed farms, and no rare or unusual species were recorded in the grab samples. The infaunal species were dominated by mobile polychaete worms, amphipod and cumacean crustaceans, and common and widespread bivalves. Such species tolerate mobile sediments and, therefore, are likely to be resilient to any minor changes to the sediments that may occur under spat-catching structures.

The seasonal use of the sites to catch and hold mussel spat will not, in our opinion, result in any more than very minor alteration to the marine environment at the sites. Phytoplankton depletion by the small spat will be undetectable against the background of open coastal water movement that will constantly replenish phytoplankton.

Biosecurity effects can be eliminated by using only new equipment when the farms are established, and by using only thoroughly cleaned and dried ropes when placed on the sites during the spat catching season.

Overall, provided the structures are engineered to withstand the exposed environment, the proposed spat catching operation will have minor, if any, impacts on local marine ecosystems and probably on the local marine environment.

5 Acknowledgements

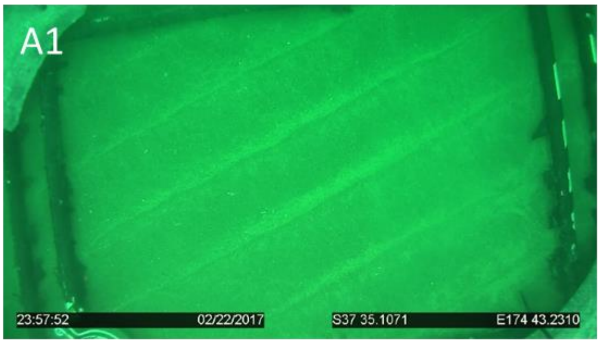
Thanks to Stephen Brown for completing much of the work for this project, and to Louis Olsen, Jon Stead, Rod Budd, and Scott Edhouse for coordinating and conducting the field work. Thanks also to Anna Bradley and Megan Carter for invertebrate sorting and identification. Louis Olsen analysed the side-scan sonar files. The NIWA Hamilton laboratory completed the organic content and chlorophyll analyses.

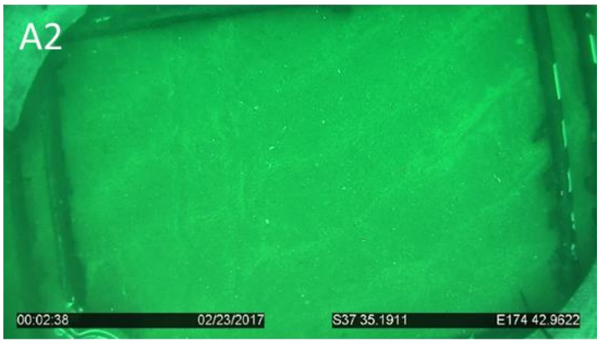
Appendix A Infauna: Taxa and abundance

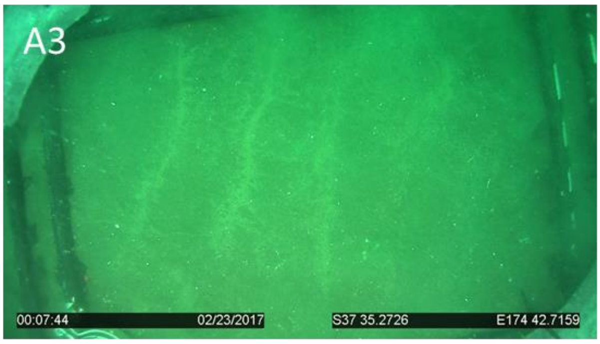
Class/Order	Taxon	A1	A3	A4	A6	A8	A9	A11	A13	B1	B2	B4	B5	B8	B9	B11	B13	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	D1	D2	D3	D4	D8	D10	D11	D13
Polychaeta	Ampharetidae	1			2				1	4	1	10	5	1	3	2		1					3				1								4			
Polychaeta	Capitellidae							2			1	32	2						1	8	8	10	1						3	8	3	1	1		1		1	4
Polychaeta	Cirratulidae																	1	1																			
Polychaeta	Cossuridae																														1		1				1	
Polychaeta	Flabelligeridae													1																								
Polychaeta	Glyceridae	2			2				2	3	1	1	2	2	1	2					2	1	1		1	1	1						1				1	
Polychaeta	Lumbrineridae																										1											
Polychaeta	Maldanidae	1		1	1	1	1	1			3	3	2	2		2	1			1																		
Polychaeta	Nephtyidae				1									1									1					1		1	1	2						1
Polychaeta	Nereidae			1			1						1				1				1		1														1	1
Polychaeta	Onuphidae																										1				3	1	2	1	2	1	1	1
Polychaeta	Opheliidae		1	1	2	1	1	1	1		2		5					6	5	5	7	4	3	5		3	4	1	1									
Polychaeta	Orbiniidae																	1			1		1															
Polychaeta	Oweniidae				1	1						1																										
Polychaeta	Pectinaridae							3		2		8	25	10		6							1			1		1										
Polychaeta	Polynoidae				1	1	1																			1												
Polychaeta	Sabellidae													1																								
Polychaeta	Sigalionidae	1			1					1				1					1	1	1					1												
Polychaeta	Spionidae	14	26	19	58	14	10	48	12	28	1	50	2	34	21	9	7	2	2	6	3	5	4	5	3	9	32	6	9	1	1	3	4	1	5	1	4	2
Polychaeta	Syllidae																																					1
Polychaeta	Magelonidae	1			1		1	2	1				1	1		7			3	1	1	2		1											3			
Amphipoda	Amphipoda	7	7	13	6	5	2	9	3	2	3	4		4		2	4	4	8	4	12	6	5	6	15	2	11	4	6	7		1		3	1	1	4	1
Cumacea	Cumacea	1	1	1	6			1	2			4	3		3	2	1	2	2	2	3	6	3		5	1	2	1	3						3			1
Decapoda	Crab zoea	1																																				
Decapoda	*Ogyrides delli*	2			1			2		9		3	3			21	3					1	10								21	5	4	13	15	2	14	25
Decapoda	*Pagurus* sp.																				1				1				1							1		
Decapoda	*Pontophilus australis*																														1	1						1
Isopoda	Isopoda			1	2				2														1			1												
Ostracoda	Ostracoda	1							1			1	1			2			1		1	1	1		1		1								2			
Anthozoa	*Edwardsia* sp.									1													1												1			
Echinoidea	*Fellaster zelandiae*	1	1			1			2				3				1		2		1	1		2	2		1		1									
Holothuroidea	*Paracaudina chilensis*																					1													1			
Ophiuroidea	Ophiuroidea				1			1	1				1			1															1	1	2	3	3	1		1
Nemertea	Nemertea										1																			1							1	
Bivalvia	*Arthritica* sp.																																1					1
Bivalvia	*Divalucina cumingi*		1			1	1	1	1	1	2		1			1								1		1		1					8	2	10	6	1	1
Bivalvia	*Dosinia* sp. (juvenile)		8	3	4	1	3	1	4	7	14	5	10	5		8	2	1	1	3	4	1	4	1	3	5	5	3	2	2			1	2	6	4		
Bivalvia	*Gari* sp.	2	1	1	2			2			2		3			1									2	1		1	1		1	2	1	2	8	2	1	
Bivalvia	*Hunkydora novozelandica*																		2																			
Bivalvia	*Mactra ordinaria*	1	1	1	4	6	2	1	1		3	8	4	5	1	7	2	2	1	4	1	1	4	1	3	3	1	2	3		4		1	2	4	3	1	
Bivalvia	*Myadora boltoni*		1			2	1	3				3	3	2	1	1				1	2			1						1								
Bivalvia	*Myllita vivens*		1													1						1																
Bivalvia	*Nucula nitidula*				3	1	3		2	1	2		1	1	1		1	2					1				2					1	1	1		2		1
Bivalvia	*Scalpomactra scalpellum*		1																																			
Bivalvia	Unidentified Bivalve A.			1																																		
Bivalvia	Unidentified Bivalve B.																1							1														
Gastropoda	*Amalda mucronata*																									1			1									
Gastropoda	*Amalda* sp. (juvenile)																										1											
Gastropoda	*Cylichna thetidis*							1	1	1				1			3																		1			
Gastropoda	*Euterebra tristis*							1							1							1		2	2					1								
Gastropoda	*Odostomia sp.*												1	1																								
Gastropoda	*Pupa affinis*				1	1		1		2	2	3		1			1	1													2	3	6	8	3	6	2	4
Gastropoda	*Sigapatella sp. (juvenile)*		1							2			2	1				1					1															
Gastropoda	*Turbonilla sp.*					1						1																										
Gastropoda	Unidentified Gastropod A.																						3			1												
Scaphopoda	*Antalis nana*					1										1							1										1		2			
Scaphopoda	*Antalis suteri*									4		3			1																							
Scaphopoda	*Cadulus teliger*													1																	1				2	1		

Appendix B Drop-camera still images of seabed.

Labels denote drop cam station locations.







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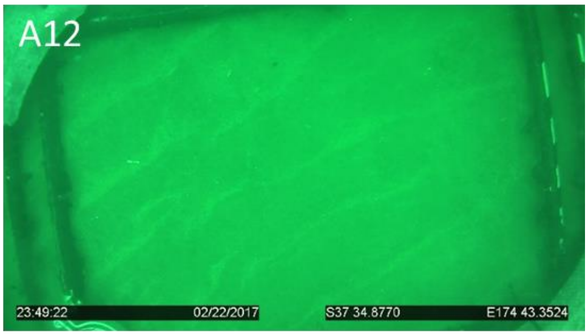

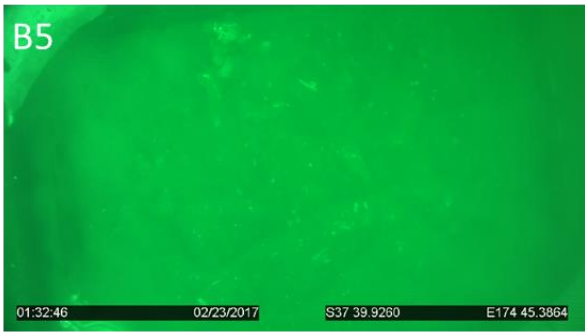

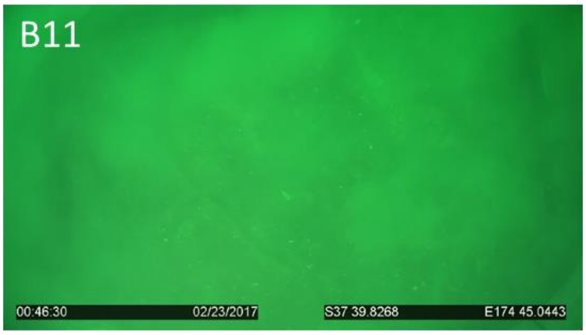

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