NORTHWESTERN MUSSELS LTD

ADDITIONAL BENTHIC SURVEY OF WEST WAIKATO MUSSEL NURSERY

COAST & CATCHMENT

ENVIRONMENTAL CONSULTANTS

NORTHWESTERN MUSSELS LTD

ADDITIONAL BENTHIC SURVEY OF WEST WAIKATO MUSSEL NURSERY

Carina Sim-Smith

April 2024

Client report for Northwestern Mussels Ltd

Report Number: 2024-04

Disclaimer

This report has been prepared based on the information described to Coast and Catchment Ltd by the client, and its extent is limited to the scope of work agreed between these two parties. No responsibility is accepted by Coast and Catchment Ltd or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties, and/or for the use of any part of this report for purposes beyond those described in the scope of work. The information in this report is intended for use by the client and no responsibility is accepted for its use by other parties.

CONTENTS

1 Background 4
2 Methods 4
3 Results 6
3.1 Sediment quality 6
3.2 Macrofauna 8
3.3 Epibiota 10
4 Assessment of ecological effects 15
5 Acknowledgements 16
6 References 16
7 Appendices 17

1 BACKGROUND

Northwestern Mussels Ltd are applying for consent for a new green-lipped mussel (*Perna canaliculus*) nursery in west Waikato, approximately 3 km off the Raglan coast. The proposed mussel nursery is divided into four blocks that are separated by a distance of around 35 km. Blocks A–C are 180 ha and are split into three rows that are approximately 2000 × 300 m each, while block D is 160 ha and split into two uneven rows (2500 × 400 m and 1500 × 400 m) (Figure 1). The rows in each block are separated by 300–400 m and only the area within each row is being applied for in the consent application. Water depths in the blocks range from approximately 25 to 45 m.

In 2017, NIWA conducted a benthic baseline survey of the four blocks for Northwestern Mussels (Grange, 2017). However, since the benthic survey was conducted the location of the blocks has shifted so that the area surveyed by Grange (2017) only partially covers the area applied for in the consent application (Figure 1). Waikato Regional Council have issued a S92 request for an additional benthic baseline survey to be conducted for the new sites (not previously surveyed), and an updated assessment of effects.

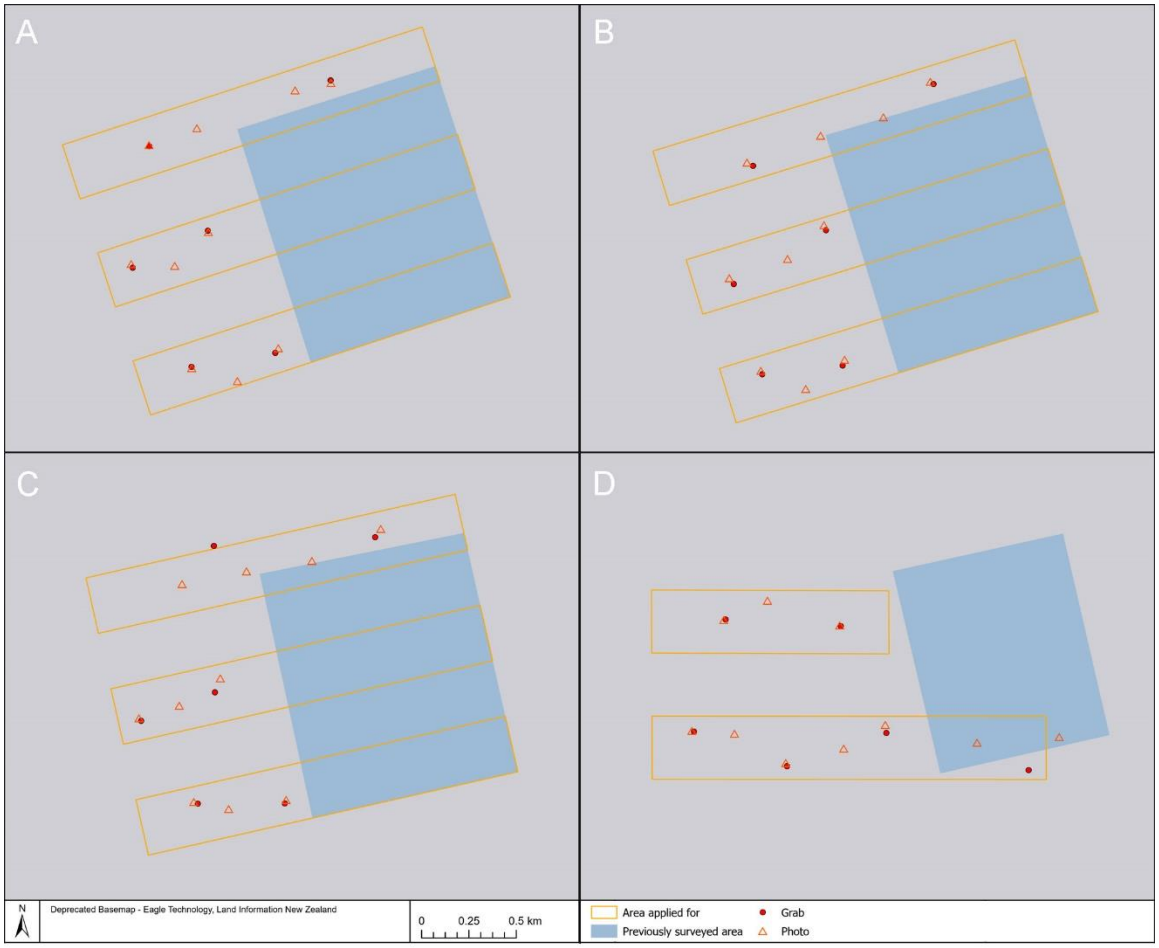
2 METHODS

An additional benthic survey was conducted on the 13 and 14 March 2024 for the unsurveyed application area. The survey was designed to complement the previous survey and involved grab sampling and underwater photography:

1. Sediment grabs were collected using a 6L van Veen grab deployed from a boat at six, random stations per block (24 in total; Figure 2).
    a. Half of each grab sample (surface area 0.023 m^2) was sieved through a 0.5 mm sieve in the field and preserved with 100% isopropanol for the characterisation of the macrofaunal community. Macrofaunal samples were sent to an experienced benthic taxonomist for enumeration and identification.
    b. Sediment samples from every second station (three per block) were taken for grainsize (7-size fractions) and total organic carbon (TOC) analysis. The top 2 cm of the sediment was used for TOC analysis. Sediment samples were placed on ice in a chilly bin and sent to an accredited laboratory for analysis within 48 hours of collection.
2. Ten drop camera photos (field of view width = 90 cm) were taken in each block to detect if any biogenic habitat or large, emergent epibiota are present (Figure 2). Underwater video tows were also trialled, but the poor water clarity, depth and exposed sea conditions prevented the collection of usable footage.

Figure 1: Location of the proposed mussel nursery (blocks A–D) off the west coast of Waikato. The map shows the area surveyed in the previous NIWA baseline survey and the areas actually applied for in the consent application.

Figure 2. Location of the grab samples and drop camera photos in Blocks A, B, C, and D.



3 RESULTS

3.1 SEDIMENT QUALITY

The grab samples mainly consisted of hard-packed sand. Blocks A and B primarily consisted of very fine sand (55–73%) with moderate proportions of mud (15–20%) and fine sand (7–27%). Block C was mainly fine sand (59%) and very fine sand (20%), while Block D had a high variability amongst sites. Station D1 was predominantly medium sand (59%), station D3 was predominantly fine sand (59%), and station D5 was predominantly very fine sand (44%) and mud (44%) (Figure 3, Figure 4 & Appendix).

Grange (2017) only measured grainsize in three size fractions (mud (<63 µm), sand (63 µm–2 mm) and gravel (>2 mm), which produces less detailed information than the seven size fractions used in this study. Similar to this study, Grange (2017) found that all stations had low proportion of mud and gravel, though Block D had a higher proportion of mud (~20–50%) than the other sites.

Mean total organic carbon (TOC) concentrations at all sites were very low (<0.25%). Concentrations in Blocks A–C were lower than in Block D (Figure 5). These results are slightly higher than the previous survey, which found that TOC varied between 0.04–0.1% in Blocks A–C, and between 0.1–0.13% in Block D (Grange, 2017).

Figure 3. Paired examples of the unsieved (left) and sieved (right) grab samples for macrofaunal analysis.

Figure 4. Mean grainsize percentage in each of the four blocks.

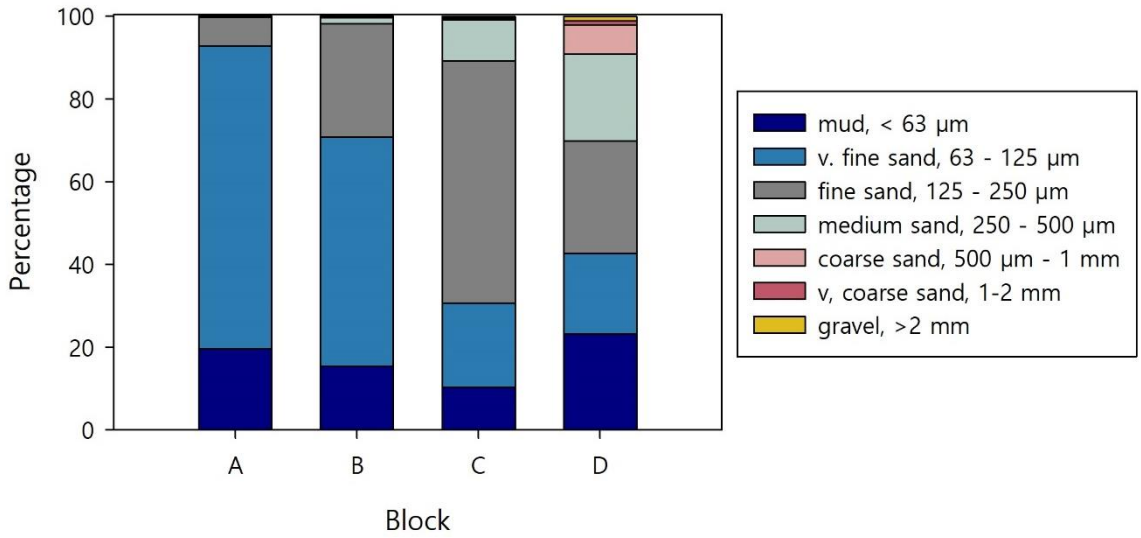
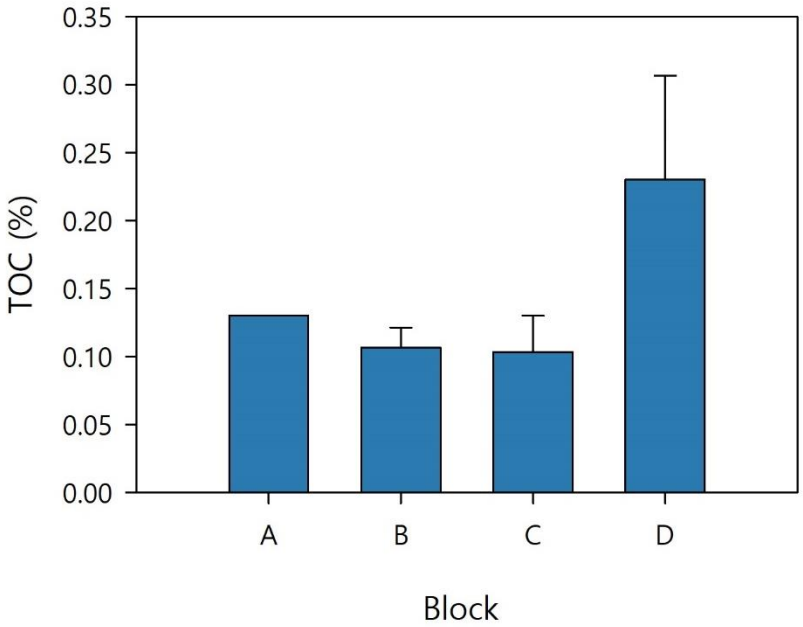


Figure 5. Mean ± S.E. total organic carbon (TOC) percentage in each of the blocks.



3.2 MACROFAUNA

A total of 1246 individuals from 77 taxa were collected in the benthic survey. Most of the taxa collected were found in low abundances, with fewer than 10 individuals obtained for 51 of the 77 taxa collected. Six taxa accounted for 51% of all individuals, these were, in decreasing order: the spionid polychate *Spiophanes modestus*, the opheliid polychaete *Armandia maculata*, a phoxocephalid amphipod, the capitellid polychaete *Heteromastus filiformis*, the shrimp *Ogyrides* sp. and an ampharetid polychaete.

Mean number of individuals and taxa per sample ranged from 31–84 and 13–23, respectively. Blocks A and B had a higher mean number of individuals and taxa than Blocks C and D (Figure 6A–B). The mean number of individuals and taxa were comparable to the

previous survey, which found that mean number of individuals varied from 36–70 per sample, and the mean number of taxa varied from 12–16 (Grange, 2017).

Shannon's Diversity was moderate (2–2.7) and Pielou's Evenness was high and similar for all blocks (0.78–0.87; Figure 6C–D).

A non-metric multidimensional scaling plot and cluster analysis found that the benthic community composition in Block D was distinct from the community composition in the other blocks. There was considerable overlap amongst stations from Blocks A, B and C, indicating that the community composition in those blocks was similar (Figure 7).

The most abundant taxa in Blocks A, B, and C were the polychaetes *S. modestus* and *A. maculata.* By comparison, the top two taxa in Block D were a phoxocephalid amphipod and the shrimp *Ogyrides* sp. Species found in this survey appear to be similar to those found in the previous survey, noting that the results are not strictly comparable as Grange (2017) did not identify any of the polychaete taxa to below family level.

Figure 6. Mean ± S.E. of: A) number of individuals; B) number of taxa; C) Shannon's Diversity; and, D) Pielou's Evenness per sample in blocks A–D.

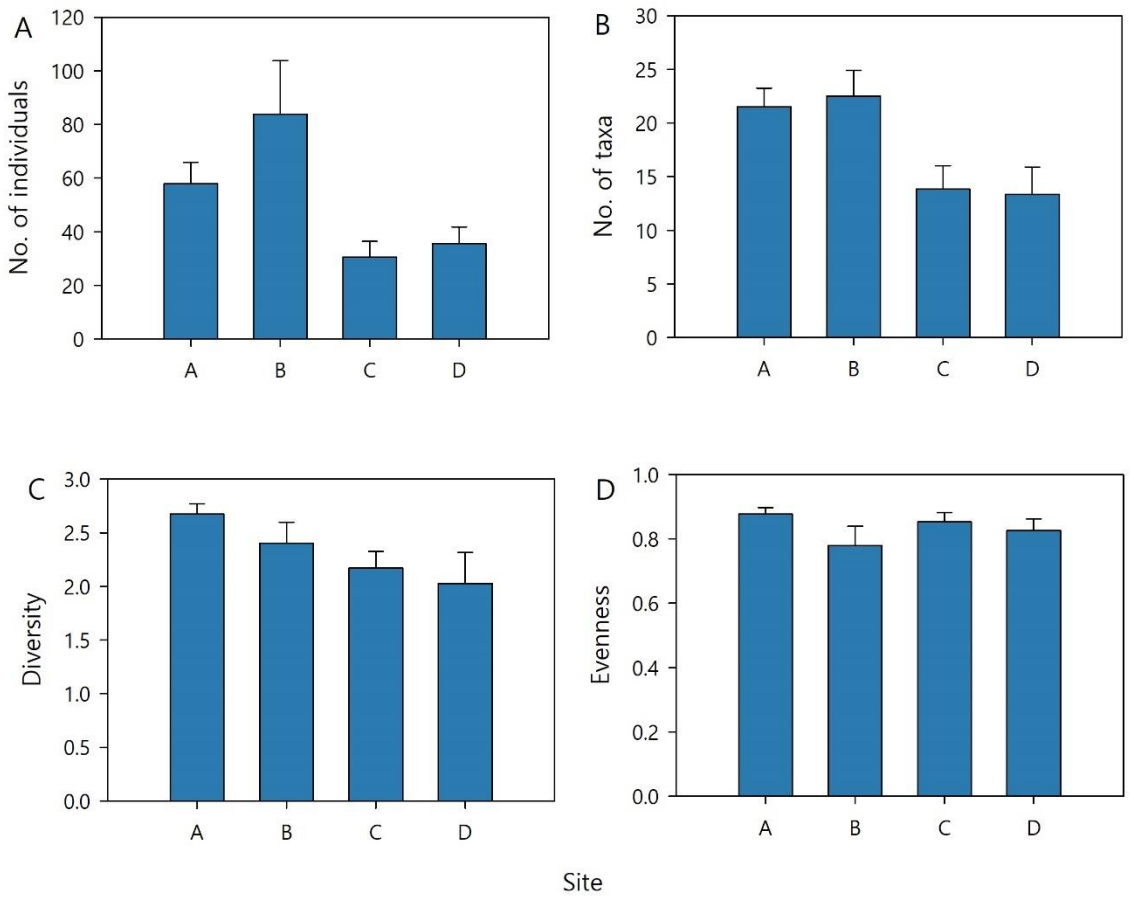
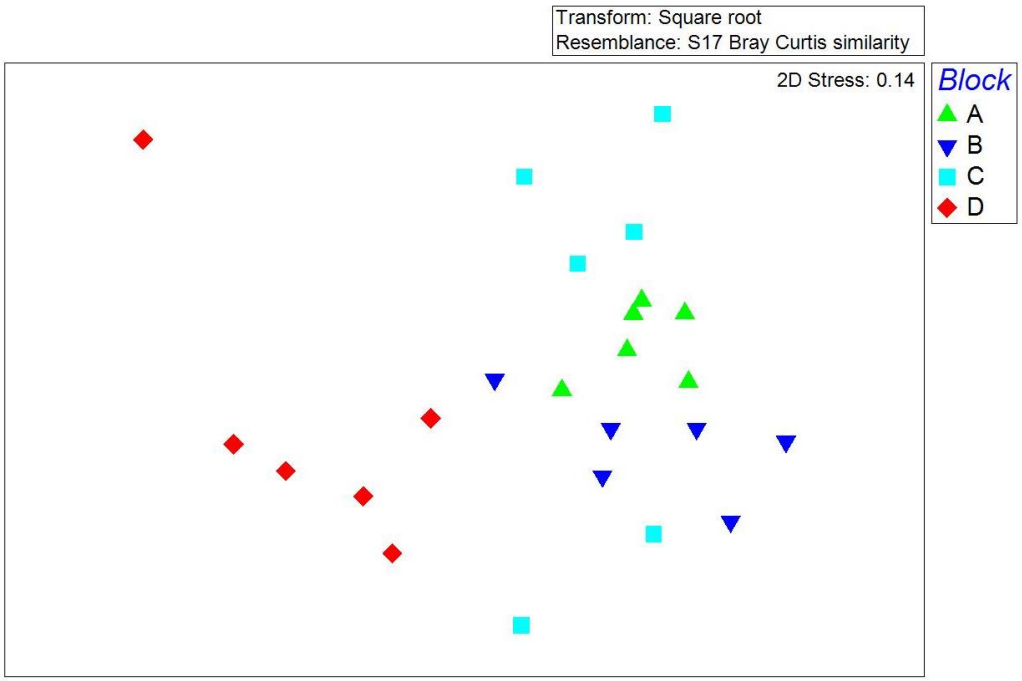


Figure 7. A nMDS plot of the benthic community composition at the four blocks. The closer the stations are the more similar their composition.



3.3 EPIBIOTA

Water visibility was very low at all stations, particularly in Block A. Drop camera photos showed that the substrate in all blocks was sandy sediment, sometimes with scattered fine shell hash and sand ripples (Figure 8–Figure 11). No large emergent epibiota, rocky reef, or biogenic habitats were observed in any of the photos. These results concur with those of the previous survey, which also found sandy substrate and no conspicuous epifauna in all stations (Grange, 2017).

Figure 8. Seabed photos of stations within Block A.

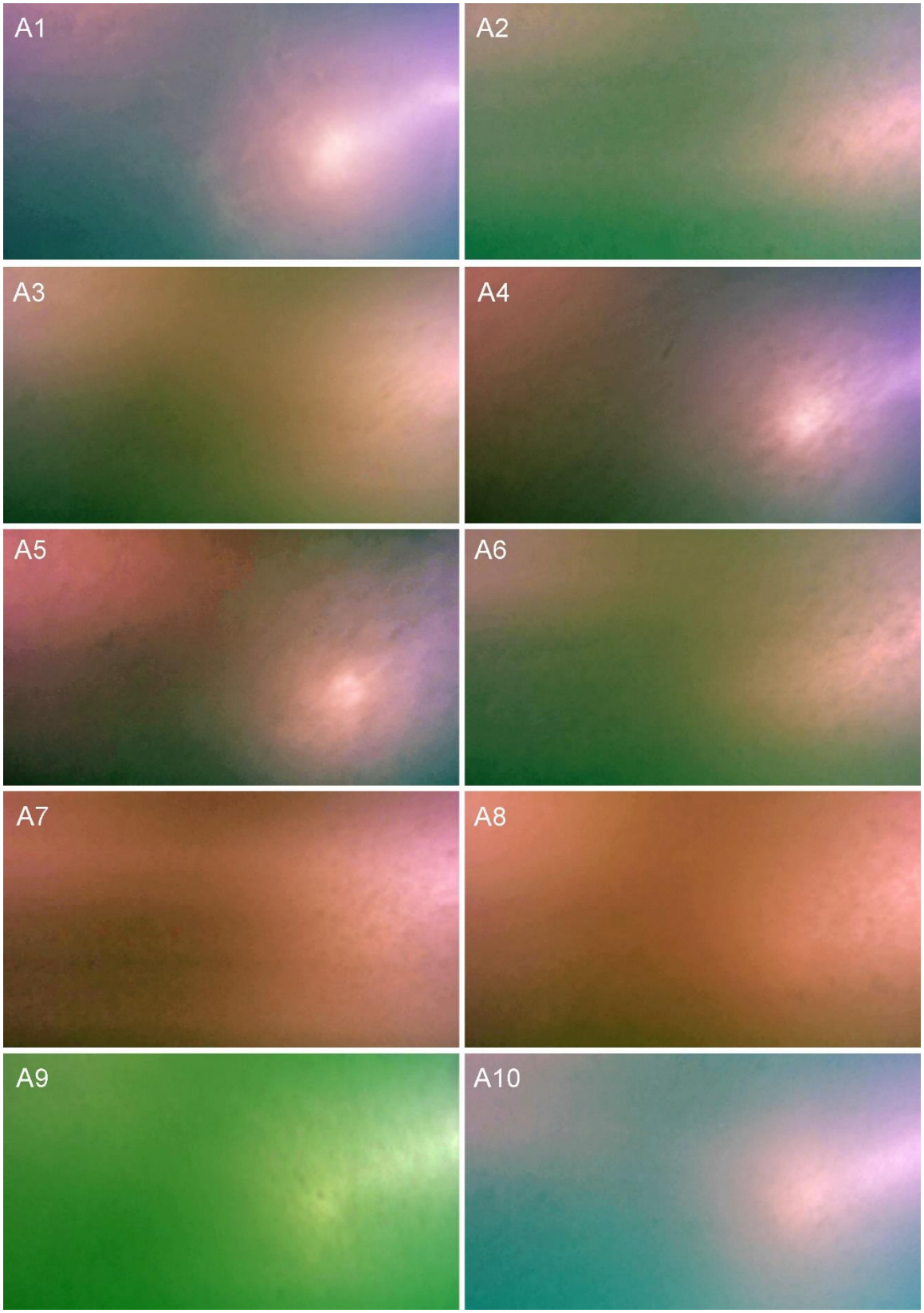


Figure 9. Seabed photos of stations within Block B.

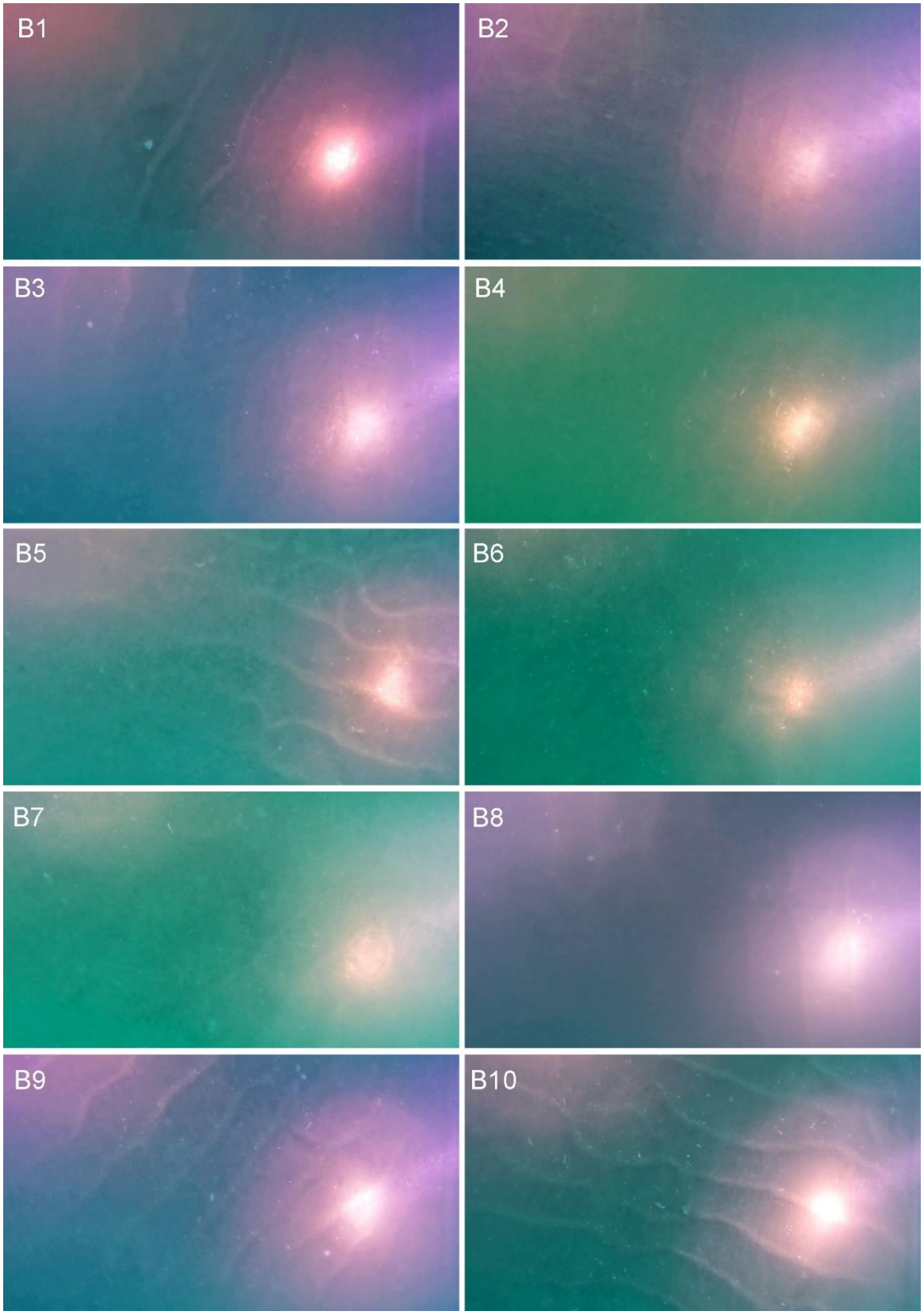


Figure 10. Seabed photos of stations within Block C.

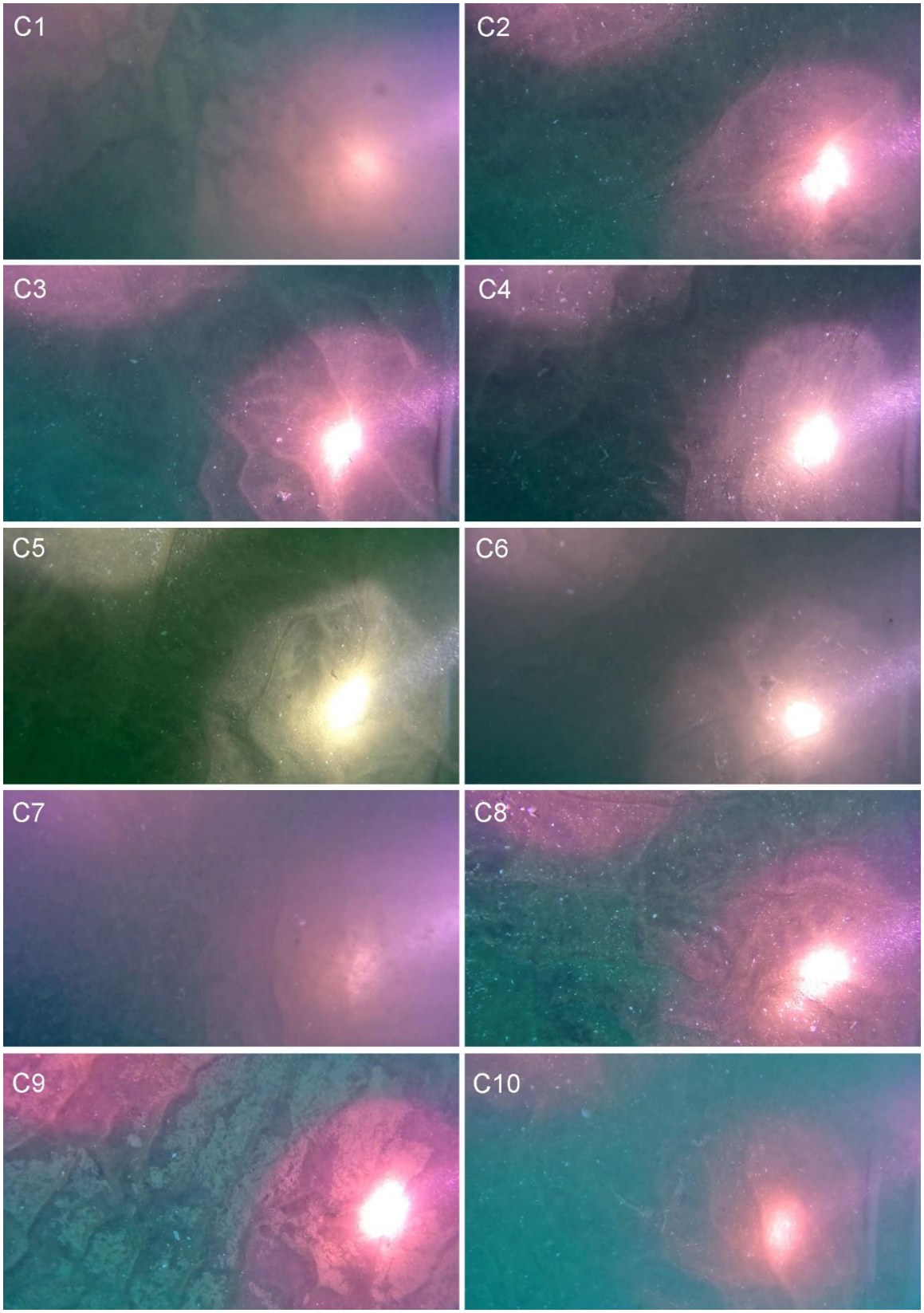
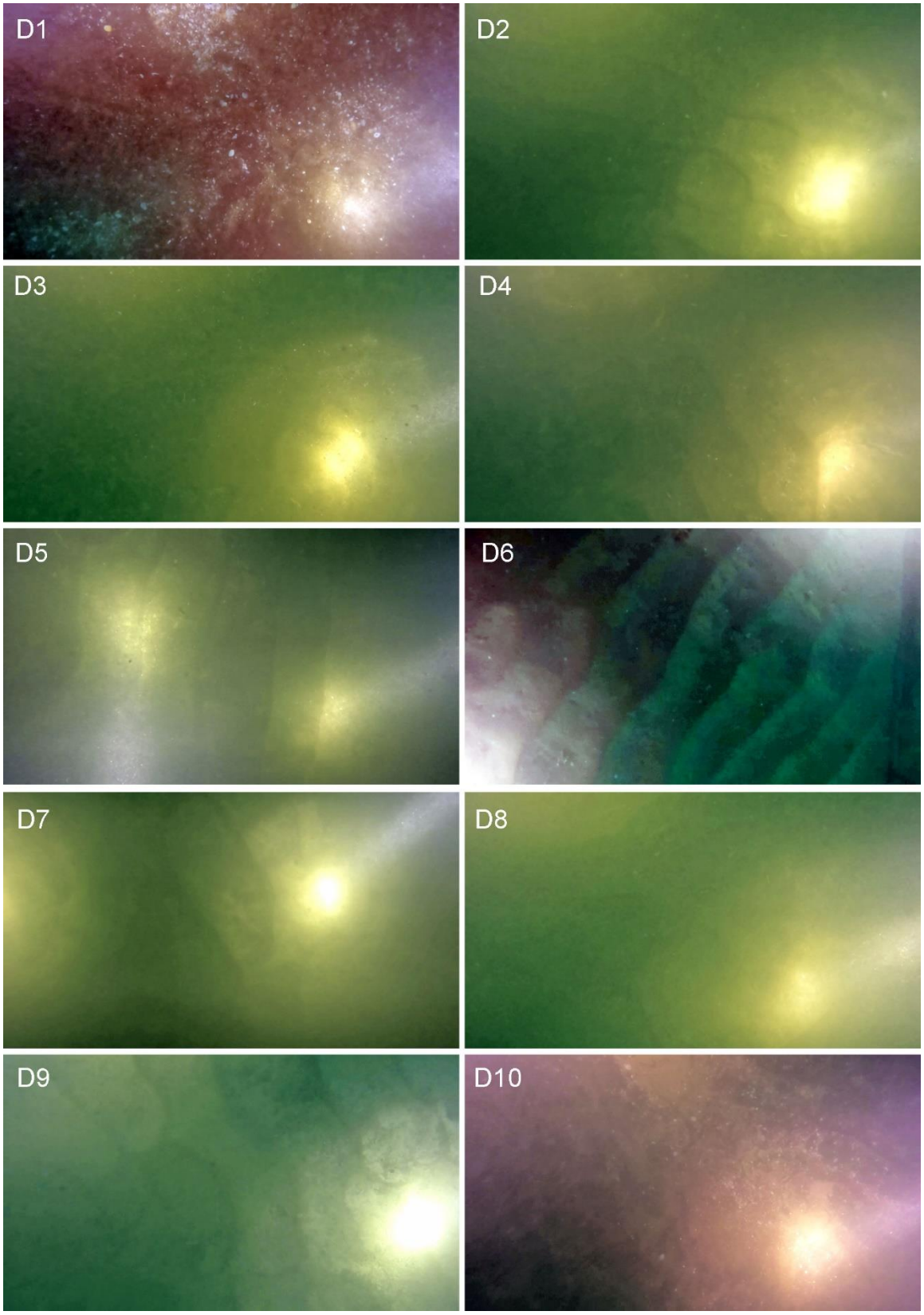


Figure 11. Seabed photos of stations within Block D.



4 ASSESSMENT OF ECOLOGICAL EFFECTS

The results from this study of the unsurveyed areas within Blocks A–D concur with those of the previous survey by Grange (2017). That is:

- The substrate throughout the blocks was predominantly sand, with a minor proportion of mud. Visible sand ripples on the seabed indicate that the seabed is subjected to strong wave/current action and thus, is likely to be mobile.
- Concentrations of TOC were very low in all blocks, though they were slightly higher in Block D.
- No large emergent epifauna, biogenic habitat or rocky reef were observed in the benthic survey.
- The benthic macrofaunal community was diverse, but most species were present at very low abundances, which is typical of exposed sandy, subtidal habitats. No marine invertebrates are specified to be nationally threatened or regionally uncommon for the Waikato Region (Overdyck, 2019).

The benthic effects of mussel farming are well understood and are mainly related to the accumulation of biodeposits (mussel faeces and pseudofaeces), shell, live shellfish and other organisms below the farm, which alter the physical, chemical and biological characteristics of the seafloor (e.g., see Keeley, 2013; Forrest *et al.*, 2015). Typical responses include:

- Increased sedimentation leading to reduced particle size and the minor enrichment of marine sediments within and slightly beyond farm boundaries. This may have an associated effect on benthic communities such as an increase in infaunal community richness and abundance. Associated ecological effects are typically minor for areas that don't have particularly sensitive, vulnerable, or special benthic communities.
- The accumulation of live shellfish and shell material under the farm, which can provide food and a hard substrate for other benthic species (e.g., the eleven-armed starfish, ascidians, sponges, and calcareous polychaetes), which typically leads to a more diverse epifaunal community than what was originally present on the soft sediment.
- The deposition of other fouling biota that either fall naturally to the seabed, or which are deliberately or incidentally removed during farm operations.

Benthic effects related to the accumulation of fine particles and nutrients under the farm are greatly reduced for offshore shellfish farms that are subjected to high wave and current action. For example, research on the impacts of offshore mussel farms found that organic matter content, particle size, and carbon/nitrogen ratios in the sediment beneath the farms was not significantly different from reference sites (Lacoste *et al.*, 2018; Cabre *et al.*, 2021).

Given the strong wave and current action and depth at the proposed site, any biodeposits from the farm are likely to be dispersed over a large area reducing the accumulation of biodeposits. Thus, any increase in fine particles and nutrients are likely to be minor and are unlikely to be ecologically significant. Accumulation of live mussels and shell under the farms is possible, which may increase the diversity and abundance of the epibenthic community (which is currently very sparse or non-existent). However, given: 1) the proposed nursery will not rear mussels to harvestable size; 2) the strong wave action at the site; and 3) the large

distances between mussel lines and rows, any accumulation of mussel and shell on the seabed is likely to be sparse.

Grange (2017) concluded that "*the proposed spat catching operation will have minor, if any, impacts on local marine ecosystems and probably on the local marine environment*." The results of this additional survey concur with Grange's conclusion. Overall, given macrofaunal and epibenthic community present, and the physical conditions at the site, the benthic impacts of the proposed mussel nursery are assessed as being less than minor.

5 ACKNOWLEDGEMENTS

Field work was conducted with the assistance of John McMeeking, Craig Bridgman, and Allan Bartrom. Macrofaunal identification was conducted by Rod Asher, Biolive, and laboratory analyses were conducted by Hill Laboratories.

6 REFERENCES

Cabre, L.M.; Hosegood, P.; Attrill, M.J.; Bridger, D.; Sheehan, E.V. (2021). Offshore longline mussel farms: a review of oceanographic and ecological interactions to inform future research needs, policy and management. *Reviews in Aquaculture 13(4)*: 1864–1887.

Forrest, B.; Cornelisen, C.; Clement, D.; Keeley, N.; Taylor, D. (2015). Monitoring framework for the Waikato coastal marine area: report 2 – Regional aquaculture monitoring priorities and guidance. WRC technical report no. 2015/39 prepared by Cawthron Institute. Waikato Regional Council, Hamilton. 68 pp. Available from http://www.cawthron.org.nz/media_new/publications/pdf/2016_05/Wai_2015-39_CawRpt_2429.pdf (Accessed May 2017).

Grange, K.R. (2017). Baseline survey for proposed mussel spat catching sites: Waikato West Coast. NIWA Client report 2017107CH prepared for North Western Mussels Ltd. National Institute of Water and Atmospheric Research, Nelson. 23 pp.

Keeley, N. (2013). Benthic effects. *In*: Literature review of ecological effects of aquaculture. Ministry for Primary Industries, Nelson, New Zealand. pp. 3-1–3-33.

Lacoste, E.; Drouin, A.; Weise, A.M.; Archambault, P.; McKindsey, C.W. (2018). Low benthic impact of an offshore mussel farm in Îles-de-la-Madeleine, eastern Canada. *Aquaculture Environment Interactions 10*: 473–485.

Overdyck, E. (2019). Nationally threatened and regionally uncommon species of the Waikato Region. Waikato Regional Council Technical Report 2019/28. Waikato Regional Council, Hamilton, New Zealand. 50 pp.

7 APPENDICES

Table 1. Station locations for the grab samples.

Name	Depth	Latitude	Longitude
A1	27.6	-37.58051902	174.701596
A2	25.0	-37.57721697	174.712362
A3	29.0	-37.58629097	174.700737
A4	27.9	-37.58447	174.705185
A5	28.4	-37.590956	174.704347
A6	26.2	-37.59022501	174.709352
B1	24.9	-37.65494303	174.755484
B2	28.2	-37.65899501	174.744775
B3	27.9	-37.66199598	174.749205
B4	30.2	-37.66462999	174.743752
B5	28.6	-37.668414	174.750357
B6	29.0	-37.66888901	174.745558
C1	26.0	-37.69547498	174.770179
C2	31.2	-37.69602701	174.760529
C3	30.7	-37.70299396	174.760757
C4	30.8	-37.70441403	174.75636
C5	31.5	-37.70830197	174.759858
C6	29.0	-37.70821304	174.765064
D1	41.1	-37.88291504	174.694177
D2	39.2	-37.883167	174.702485
D3	42.2	-37.88933499	174.692041
D4	40.8	-37.89121999	174.698804
D5	39.1	-37.88921697	174.705915
D6	36.5	-37.89118798	174.716215

Table 2. Station locations for the drop camera photos.

Name	Depth	Latitude	Longitude
A1	28.4	-37.58045096	174.701571
A2	25.0	-37.57734002	174.712385
A3	28.3	-37.58612098	174.700635
A4	26.6	-37.584527	174.705216
A5	28.4	-37.591014	174.704371
A6	27.7	-37.58999401	174.709526
A7	28.7	-37.59159302	174.707113
A8	28.3	-37.58617002	174.70324
A9	26.7	-37.57960699	174.704415
A10	25.5	-37.57772097	174.710249
B1	24.9	-37.65483599	174.755289
B2	29.2	-37.65883902	174.744406
B3	27.0	-37.66174897	174.749086
B4	29.7	-37.66435398	174.743476
B5	28.7	-37.66812701	174.750469
B6	29.1	-37.668729	174.745465
B7	29.0	-37.66955202	174.748175
B8	28.7	-37.66338796	174.74694
B9	26.8	-37.65749901	174.748781
B10	26.8	-37.65656602	174.752521
C1	26.6	-37.69506996	174.7705
C2	30.0	-37.69787002	174.758663
C3	30.0	-37.70231696	174.76106
C4	30.7	-37.70428796	174.756233
C5	30.8	-37.70821899	174.759609
C6	29.4	-37.70804004	174.765137
C7	30.1	-37.70852099	174.761707
C8	30.5	-37.70365597	174.758631
C9	28.9	-37.69720903	174.762508
C10	27.5	-37.69665498	174.766412
D1	43.8	-37.882937	174.694046
D2	41.1	-37.883124	174.702415
D3	44.4	-37.88929199	174.691894
D4	41.7	-37.89102998	174.698703
D5	40.6	-37.88875303	174.705824
D6	39.0	-37.88925896	174.718373
D7	37.5	-37.889667	174.712461
D8	40.5	-37.89014401	174.702861
D9	43.0	-37.88941001	174.69497
D10	42.1	-37.88178901	174.697173

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

0508 HILL LAB (44 555 22)
+64 7 858 2000
mail@hill-labs.co.nz
www.hill-labs.co.nz

Certificate of Analysis

Client:	Coast & Catchment Limited	**Lab No:**	3499519	SPv1
Contact:	Carina Sim-Smith	**Date Received:**	15-Mar-2024	
	C/- Coast & Catchment Limited	**Date Reported:**	17-Apr-2024	
	799 North Road	**Quote No:**	97226	
	Beachlands	**Order No:**		
	Clevedon 2582	**Client Reference:**	Raglan	
		Submitted By:	Carina Sim-Smith	

Sample Type: Sediment

Sample Name:		C&C Raglan, A1 13-Mar-2024	C&C Raglan, A3 13-Mar-2024	C&C Raglan, A5 13-Mar-2024	C&C Raglan, B1 13-Mar-2024	C&C Raglan, B3 13-Mar-2024
Lab Number:		3499519.1	3499519.2	3499519.3	3499519.4	3499519.5
Individual Tests						
Total Organic Carbon	g/100g dry wt	< 0.13	< 0.13	< 0.13	< 0.13	0.11
7 Grain Sizes Profile as received						
Dry Matter of Sieved Sample	g/100g as rcvd	76	73	76	79	81
Fraction >/= 2 mm	g/100g dry wt	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fraction < 2 mm, >/= 1 mm	g/100g dry wt	< 0.1	< 0.1	< 0.1	< 0.1	0.1
Fraction < 1 mm, >/= 500 µm	g/100g dry wt	< 0.1	0.1	< 0.1	< 0.1	0.2
Fraction < 500 µm, >/= 250 µm	g/100g dry wt	< 0.1	< 0.1	< 0.1	0.3	1.1
Fraction < 250 µm, >/= 125 µm	g/100g dry wt	7.7	6.7	6.7	20.1	29.7
Fraction < 125 µm, >/= 63 µm	g/100g dry wt	77.8	75.6	66.3	65.2	53.4
Fraction < 63 µm	g/100g dry wt	14.3	17.5	26.9	14.2	15.5

Sample Name:		C&C Raglan, B5 13-Mar-2024	C&C Raglan, C1 13-Mar-2024	C&C Raglan, C3 13-Mar-2024	C&C Raglan, C5 13-Mar-2024	C&C Raglan, D1 14-Mar-2024
Lab Number:		3499519.6	3499519.7	3499519.8	3499519.9	3499519.10
Individual Tests						
Total Organic Carbon	g/100g dry wt	0.08	< 0.13	< 0.13	< 0.05	< 0.13
7 Grain Sizes Profile as received						
Dry Matter of Sieved Sample	g/100g as rcvd	83	83	84	82	84
Fraction >/= 2 mm	g/100g dry wt	< 0.1	0.2	0.3	0.2	3.1
Fraction < 2 mm, >/= 1 mm	g/100g dry wt	0.2	0.3	0.4	0.2	2.5
Fraction < 1 mm, >/= 500 µm	g/100g dry wt	0.3	0.3	0.4	0.4	21.1
Fraction < 500 µm, >/= 250 µm	g/100g dry wt	2.8	6.0	5.9	17.6	59.1
Fraction < 250 µm, >/= 125 µm	g/100g dry wt	32.5	55.5	50.0	70.2	12.4
Fraction < 125 µm, >/= 63 µm	g/100g dry wt	47.5	22.9	28.9	9.1	0.6
Fraction < 63 µm	g/100g dry wt	16.6	14.6	14.1	2.4	1.0

Sample Name:		C&C Raglan, D3 14-Mar-2024	C&C Raglan, D5 14-Mar-2024
Lab Number:		3499519.11	3499519.12
Individual Tests			
Total Organic Carbon	g/100g dry wt	0.38	0.18
7 Grain Sizes Profile as received			
Dry Matter of Sieved Sample	g/100g as rcvd	76	74
Fraction >/= 2 mm	g/100g dry wt	< 0.1	< 0.1
Fraction < 2 mm, >/= 1 mm	g/100g dry wt	< 0.1	< 0.1
Fraction < 1 mm, >/= 500 µm	g/100g dry wt	0.2	0.3
Fraction < 500 µm, >/= 250 µm	g/100g dry wt	2.6	0.9
Fraction < 250 µm, >/= 125 µm	g/100g dry wt	58.9	10.5
Fraction < 125 µm, >/= 63 µm	g/100g dry wt	13.9	44.0
Fraction < 63 µm	g/100g dry wt	24.2	44.2

Table 3. Macrofaunal results for Block A.

General Group	Taxa	Common Name	A-1	A-2	A-3	A-4	A-5	A-6
Anthozoa	*Edwardsia* sp.	Burrowing anemone						
Nemertea	Nemertea	Proboscis worms	2	1	1	2	1	1
Nematoda	Nematoda (large size)	Roundworm	2	1			2	1
Sipuncula	Sipuncula	Peanut worm			1			
Scaphopoda	*Antalis nana*	Common tusk shell						
Gastropoda	Gastropoda unid. juv.	Unidentified juvenile gastropod		1			1	2
Gastropoda	Pyramidellidae	Snail (Family)						
Gastropoda	*Amalda northlandica*	Olive shell				1		
Gastropoda	*Duplicaria* sp.	Small gastropod						
Gastropoda	*Sigapatella tenuis*	Small circular slipper shell						
Gastropoda	*Turbonilla* sp.	Small spiral shell						2
Opisthobranchia	*Acteon (Maxacteon)* sp.	Snail						
Bivalvia	Bivalvia unid. (juv)	Unid. juvenile bivalve			1			
Bivalvia	*Arthritica bifurca*	Small bivalve				1		
Bivalvia	Tellinidae (juvenile)	Juvenile bivalve			1	5		2
Bivalvia	Thraciidae	Bivalve family				1		
Bivalvia	*Bassina yatei*	Frilled venus shell			1			
Bivalvia	*Dosinia lambata*	Silky biscuit shell				1		
Bivalvia	*Dosinia* sp. (juvinile)	Surf clam	1	1			1	2
Bivalvia	*Gari* sp. (juvenile)	Sunset shell	1	1		6	2	4
Bivalvia	*Mactra ordinaria*	Trough shell						
Bivalvia	*Myadora antipodum*	Bivalve						
Bivalvia	*Myllitella vivens vivens*	Small bivalve	1					2
Bivalvia	*Neolepton antipodum*	Small bivalve	1	8	3	2	2	4
Bivalvia	*Nucula nitidula*	Nut shell	1		1	1		3
Bivalvia	*Scalpomactra scalpellum*	Bivalve			1	2	1	

General Group	Taxa	Common Name	A-1	A-2	A-3	A-4	A-5	A-6
Bivalvia	*Tellinota edgari*	Wedge shell		1	1	1		
Bivalvia	*Theora lubrica*	Window shell						
Bivalvia	*Varinucula gallinacea*	Nut shell						
Bivalvia	*Zenatia acinaces*	Scimitar shell						
Polychaeta: Orbiniidae	*Phylo novazealandiae*	Polychaete worm						
Polychaeta: Paraonidae	Paraonidae	Polychaete worm						
Polychaeta: Paraonidae	*Aricidea* sp.	Polychaete worm						
Polychaeta: Spionidae	*Paraprionospio pinnata*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio aucklandica*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio* sp.	Polychaete worm	2	1	1	3		2
Polychaeta: Spionidae	*Prionospio yuriel*	Polychaete worm						
Polychaeta: Spionidae	*Spiophanes kroyeri*	Polychaete worm						
Polychaeta: Spionidae	*Spiophanes modestus*	Polychaete worm	14	8	3	28	8	9
Polychaeta: Magelonidae	*Magelona dakini*	Polychaete worm	1		1			1
Polychaeta: Chaetopteridae	*Phyllochaetopterus socialis*	Parchment worm						
Polychaeta: Capitellidae	*Heteromastus filiformis*	Polychaete worm			2	7	1	2
Polychaeta: Capitellidae	*Notomastus zeylanicus*	Polychaete worm	1					
Polychaeta: Maldanidae	Maldanidae	Bamboo Worms				2		1
Polychaeta: Opheliidae	*Armandia maculata*	Polychaete worm	3	5	4	17	7	5
Polychaeta: Phyllodocidae	Phyllodocidae	Paddle worms	1	1	1	1	1	
Polychaeta: Pilargidae	Pilargidae	Polychaete family						
Polychaeta: Hesionidae	Hesionidae	Polychaete Worm						
Polychaeta: Syllidae	Syllidae	Polychaete worm						
Polychaeta: Glyceridae	Glyceridae	Polychaete worm						
Polychaeta: Goniadidae	Goniadidae	Polychaete worm	3	3	2	3	3	2
Polychaeta: Nephtyidae	*Aglaophamus* sp.	Polychaete worm						
Polychaeta: Onuphidae	*Onuphis aucklandensis*	Polychaete worm			1		1	1
Polychaeta: Lumbrineridae	Lumbrineridae	Polychaete worm						

General Group	Taxa	Common Name	A-1	A-2	A-3	A-4	A-5	A-6
Polychaeta: Oweniidae	*Owenia petersenae*	Polychaete worm						
Polychaeta: Ampharetidae	Ampharetidae	Polychaete worm		3	2	2		
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm			1			
Polychaeta: Flabelligeridae	Flabelligeridae	Polychaete worm			1			
Polychaeta: Sabellidae	Sabellidae	Umbrella worms			1			
Polychaeta: Sabellidae	*Euchone pallida*	Fan worm			1		1	
Crustacea	Nebalia sp.	Small crustacean					1	
Cumacea	Cumacea	Cumaceans	4	1	3	1	4	2
Tanaidacea	Tanaidacea	Tanaid shrimp						
Isopoda	*Munna neozelanica*	Isopod						
Isopoda	Valvifera	Isopod						1
Amphipoda	Phoxocephalidae	Amphipod (family)	1					1
Amphipoda	Urothoidae	Amphipod (family)	5	7	5	4	3	4
Amphipoda	*Ampelisca* sp.	Amphipod (large)				1		
Amphipoda	Amphipoda unid.	Amphipod						
Decapoda	*Callianassa filholi*	Ghost shrimp						
Decapoda	*Ogyrides* sp.	Shrimp (long eyes)	2	3	11	2	2	2
Ostracoda	Ostracoda	Ostracods						3
Phoronida	*Phoronus* sp.	Horseshoe worms						
Echinoidea	*Echinocardium cordatum*	Heart urchin		3		1		3
Ophiuroidea	Ophiuroidea	Brittle stars			1	1		
Holothuroidea	*Rynkatorpa uncinata*	Sea cucumber						
Chaetognatha	Chaetognatha	Arrow worm						

Table 4. Macrofaunal results for Block B.

General Group	Taxa	Common Name	B-1	B-2	B-3	B-4	B-5	B-6
Anthozoa	*Edwardsia* sp.	Burrowing anemone		2	3	2		6
Nemertea	Nemertea	Proboscis worms	1	3	2	1		5
Nematoda	Nematoda (large size)	Roundworm				1		3
Sipuncula	Sipuncula	Peanut worm						
Scaphopoda	*Antalis nana*	Common tusk shell	1	1	1			
Gastropoda	Gastropoda unid. juv.	Unidentified juvenile gastropod						
Gastropoda	Pyramidellidae	Snail (Family)						
Gastropoda	*Amalda northlandica*	Olive shell		1				
Gastropoda	*Duplicaria* sp.	Small gastropod			1			
Gastropoda	*Sigapatella tenuis*	Small circular slipper shell		2	2		1	2
Gastropoda	*Turbonilla* sp.	Small spiral shell		1				
Opisthobranchia	*Acteon (Maxacteon)* sp.	Snail	3	1	3		1	2
Bivalvia	Bivalvia unid. (juv)	Unid. juvenile bivalve						
Bivalvia	*Arthritica bifurca*	Small bivalve						
Bivalvia	Tellinidae (juvenile)	Juvenile bivalve				1	1	1
Bivalvia	Thraciidae	Bivalve family						
Bivalvia	*Bassina yatei*	Frilled venus shell			2	2		
Bivalvia	*Dosinia lambata*	Silky biscuit shell						
Bivalvia	*Dosinia* sp. (juvinile)	Surf clam						
Bivalvia	*Gari* sp. (juvenile)	Sunset shell		1				
Bivalvia	*Mactra ordinaria*	Trough shell				1	1	
Bivalvia	*Myadora antipodum*	Bivalve						2
Bivalvia	*Myllitella vivens vivens*	Small bivalve		8	1	12	1	6
Bivalvia	*Neolepton antipodum*	Small bivalve						
Bivalvia	*Nucula nitidula*	Nut shell						2
Bivalvia	*Scalpomactra scalpellum*	Bivalve		1		2	1	1
Bivalvia	*Tellinota edgari*	Wedge shell						

General Group	Taxa	Common Name	B-1	B-2	B-3	B-4	B-5	B-6
Bivalvia	*Theora lubrica*	Window shell		1				
Bivalvia	*Varinucula gallinacea*	Nut shell	1					
Bivalvia	*Zenatia acinaces*	Scimitar shell				1		
Polychaeta: Orbiniidae	*Phylo novazealandiae*	Polychaete worm						
Polychaeta: Paraonidae	Paraonidae	Polychaete worm						
Polychaeta: Paraonidae	*Aricidea* sp.	Polychaete worm		3	2		1	2
Polychaeta: Spionidae	*Paraprionospio pinnata*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio aucklandica*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio* sp.	Polychaete worm	1		2			4
Polychaeta: Spionidae	*Prionospio yuriel*	Polychaete worm						
Polychaeta: Spionidae	*Spiophanes kroyeri*	Polychaete worm		5	3	1		18
Polychaeta: Spionidae	*Spiophanes modestus*	Polychaete worm	2	25	8	41	33	81
Polychaeta: Magelonidae	*Magelona dakini*	Polychaete worm			1	2		
Polychaeta: Chaetopteridae	*Phyllochaetopterus socialis*	Parchment worm				1		1
Polychaeta: Capitellidae	*Heteromastus filiformis*	Polychaete worm	2	3	3	3		4
Polychaeta: Capitellidae	*Notomastus zeylanicus*	Polychaete worm						
Polychaeta: Maldanidae	Maldanidae	Bamboo Worms	1	1		1	1	3
Polychaeta: Opheliidae	*Armandia maculata*	Polychaete worm		13	8	1	9	2
Polychaeta: Phyllodocidae	Phyllodocidae	Paddle worms				1		
Polychaeta: Pilargidae	Pilargidae	Polychaete family						
Polychaeta: Hesionidae	Hesionidae	Polychaete Worm						
Polychaeta: Syllidae	Syllidae	Polychaete worm			1			
Polychaeta: Glyceridae	Glyceridae	Polychaete worm						1
Polychaeta: Goniadidae	Goniadidae	Polychaete worm	1	3	1	2	1	
Polychaeta: Nephtyidae	*Aglaophamus* sp.	Polychaete worm	2	3	1	1	1	2
Polychaeta: Onuphidae	*Onuphis aucklandensis*	Polychaete worm						
Polychaeta: Lumbrineridae	Lumbrineridae	Polychaete worm						
Polychaeta: Oweniidae	*Owenia petersenae*	Polychaete worm						

General Group	Taxa	Common Name	B-1	B-2	B-3	B-4	B-5	B-6
Polychaeta: Ampharetidae	Ampharetidae	Polychaete worm	4	5	5	6		4
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm	1	1				
Polychaeta: Flabelligeridae	Flabelligeridae	Polychaete worm						
Polychaeta: Sabellidae	Sabellidae	Umbrella worms						1
Polychaeta: Sabellidae	*Euchone pallida*	Fan worm				1		1
Crustacea	Nebalia sp.	Small crustacean				2		2
Cumacea	Cumacea	Cumaceans	1	4	2	3	3	5
Tanaidacea	Tanaidacea	Tanaid shrimp						
Isopoda	*Munna neozelanica*	Isopod						
Isopoda	Valvifera	Isopod						
Amphipoda	Phoxocephalidae	Amphipod (family)	3			3		
Amphipoda	Urothoidae	Amphipod (family)	2	3	1			
Amphipoda	*Ampelisca* sp.	Amphipod (large)						
Amphipoda	Amphipoda unid.	Amphipod						
Decapoda	*Callianassa filholi*	Ghost shrimp						
Decapoda	*Ogyrides* sp.	Shrimp (long eyes)	3	2	3	1		2
Ostracoda	Ostracoda	Ostracods		1	2	2	1	1
Phoronida	*Phoronus* sp.	Horseshoe worms				1		4
Echinoidea	*Echinocardium cordatum*	Heart urchin						
Ophiuroidea	Ophiuroidea	Brittle stars	1					
Holothuroidea	*Rynkatorpa uncinata*	Sea cucumber						
Chaetognatha	Chaetognatha	Arrow worm						1

Table 5. Macrofaunal results for Block C.

General Group	Taxa	Common Name	C-1	C-2	C-3	C-4	C-5	C-6
Anthozoa	*Edwardsia* sp.	Burrowing anemone	1					1
Nemertea	Nemertea	Proboscis worms	1	1	1		1	2
Nematoda	Nematoda (large size)	Roundworm	5	3	2			
Sipuncula	Sipuncula	Peanut worm						
Scaphopoda	*Antalis nana*	Common tusk shell						
Gastropoda	Gastropoda unid. juv.	Unidentified juvenile gastropod						
Gastropoda	Pyramidellidae	Snail (Family)	1					
Gastropoda	*Amalda northlandica*	Olive shell						
Gastropoda	*Duplicaria* sp.	Small gastropod						
Gastropoda	*Sigapatella tenuis*	Small circular slipper shell						
Gastropoda	*Turbonilla* sp.	Small spiral shell						
Opisthobranchia	*Acteon (Maxacteon)* sp.	Snail						
Bivalvia	Bivalvia unid. (juv)	Unid. juvenile bivalve						
Bivalvia	*Arthritica bifurca*	Small bivalve						1
Bivalvia	Tellinidae (juvenile)	Juvenile bivalve						1
Bivalvia	Thraciidae	Bivalve family			1			
Bivalvia	*Bassina yatei*	Frilled venus shell	1	1				
Bivalvia	*Dosinia lambata*	Silky biscuit shell						
Bivalvia	*Dosinia* sp. (juvinile)	Surf clam		1	1	1	1	
Bivalvia	*Gari* sp. (juvenile)	Sunset shell	2	1				
Bivalvia	*Mactra ordinaria*	Trough shell	1		1			1
Bivalvia	*Myadora antipodum*	Bivalve						
Bivalvia	*Myllitella vivens vivens*	Small bivalve		1	3			
Bivalvia	*Neolepton antipodum*	Small bivalve	3					
Bivalvia	*Nucula nitidula*	Nut shell			1			
Bivalvia	*Scalpomactra scalpellum*	Bivalve	1					
Bivalvia	*Tellinota edgari*	Wedge shell						

General Group	Taxa	Common Name	C-1	C-2	C-3	C-4	C-5	C-6
Bivalvia	*Theora lubrica*	Window shell						
Bivalvia	*Varinucula gallinacea*	Nut shell						
Bivalvia	*Zenatia acinaces*	Scimitar shell						
Polychaeta: Orbiniidae	*Phylo novazealandiae*	Polychaete worm						
Polychaeta: Paraonidae	Paraonidae	Polychaete worm		1	1		1	
Polychaeta: Paraonidae	*Aricidea* sp.	Polychaete worm						
Polychaeta: Spionidae	*Paraprionospio pinnata*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio aucklandica*	Polychaete worm			1			
Polychaeta: Spionidae	*Prionospio* sp.	Polychaete worm	1		4		3	
Polychaeta: Spionidae	*Prionospio yuriel*	Polychaete worm						
Polychaeta: Spionidae	*Spiophanes kroyeri*	Polychaete worm	1					
Polychaeta: Spionidae	*Spiophanes modestus*	Polychaete worm		17	7	2		
Polychaeta: Magelonidae	*Magelona dakini*	Polychaete worm	2	1				
Polychaeta: Chaetopteridae	*Phyllochaetopterus socialis*	Parchment worm						
Polychaeta: Capitellidae	*Heteromastus filiformis*	Polychaete worm	20	1	4	1	1	2
Polychaeta: Capitellidae	*Notomastus zeylanicus*	Polychaete worm						
Polychaeta: Maldanidae	Maldanidae	Bamboo Worms	1					
Polychaeta: Opheliidae	*Armandia maculata*	Polychaete worm	6	3	3	9	5	1
Polychaeta: Phyllodocidae	Phyllodocidae	Paddle worms						
Polychaeta: Pilargidae	Pilargidae	Polychaete family						
Polychaeta: Hesionidae	Hesionidae	Polychaete Worm					1	
Polychaeta: Syllidae	Syllidae	Polychaete worm						
Polychaeta: Glyceridae	Glyceridae	Polychaete worm						
Polychaeta: Goniadidae	Goniadidae	Polychaete worm	1	1				1
Polychaeta: Nephtyidae	*Aglaophamus* sp.	Polychaete worm	1				1	1
Polychaeta: Onuphidae	*Onuphis aucklandensis*	Polychaete worm						1
Polychaeta: Lumbrineridae	Lumbrineridae	Polychaete worm						1
Polychaeta: Oweniidae	*Owenia petersenae*	Polychaete worm						

General Group	Taxa	Common Name	C-1	C-2	C-3	C-4	C-5	C-6
Polychaeta: Ampharetidae	Ampharetidae	Polychaete worm						5
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm		1				
Polychaeta: Flabelligeridae	Flabelligeridae	Polychaete worm	1					
Polychaeta: Sabellidae	Sabellidae	Umbrella worms						
Polychaeta: Sabellidae	*Euchone pallida*	Fan worm						
Crustacea	Nebalia sp.	Small crustacean						
Cumacea	Cumacea	Cumaceans						
Tanaidacea	Tanaidacea	Tanaid shrimp	1	1				
Isopoda	*Munna neozelanica*	Isopod						1
Isopoda	Valvifera	Isopod						
Amphipoda	Phoxocephalidae	Amphipod (family)		3	1		1	
Amphipoda	Urothoidae	Amphipod (family)		1	1	5	2	
Amphipoda	*Ampelisca* sp.	Amphipod (large)						
Amphipoda	Amphipoda unid.	Amphipod						
Decapoda	*Callianassa filholi*	Ghost shrimp	1					
Decapoda	*Ogyrides* sp.	Shrimp (long eyes)						
Ostracoda	Ostracoda	Ostracods	1					
Phoronida	*Phoronus* sp.	Horseshoe worms						
Echinoidea	*Echinocardium cordatum*	Heart urchin	2					
Ophiuroidea	Ophiuroidea	Brittle stars				2	2	
Holothuroidea	*Rynkatorpa uncinata*	Sea cucumber						
Chaetognatha	Chaetognatha	Arrow worm						

Table 6. Macrofaunal results for Block D.

General Group	Taxa	Common Name	D-1	D-2	D-3	D-4	D-5	D-6
Anthozoa	*Edwardsia* sp.	Burrowing anemone						
Nemertea	Nemertea	Proboscis worms		1			1	
Nematoda	Nematoda (large size)	Roundworm						
Sipuncula	Sipuncula	Peanut worm						
Scaphopoda	*Antalis nana*	Common tusk shell						
Gastropoda	Gastropoda unid. juv.	Unidentified juvenile gastropod						
Gastropoda	Pyramidellidae	Snail (Family)						
Gastropoda	*Amalda northlandica*	Olive shell						
Gastropoda	*Duplicaria* sp.	Small gastropod						
Gastropoda	*Sigapatella tenuis*	Small circular slipper shell				1		
Gastropoda	*Turbonilla* sp.	Small spiral shell						
Opisthobranchia	*Acteon (Maxacteon)* sp.	Snail						2
Bivalvia	Bivalvia unid. (juv)	Unid. juvenile bivalve						
Bivalvia	*Arthritica bifurca*	Small bivalve						
Bivalvia	Tellinidae (juvenile)	Juvenile bivalve					2	
Bivalvia	Thraciidae	Bivalve family						
Bivalvia	*Bassina yatei*	Frilled venus shell		2			2	1
Bivalvia	*Dosinia lambata*	Silky biscuit shell						
Bivalvia	*Dosinia* sp. (juvinile)	Surf clam						
Bivalvia	*Gari* sp. (juvenile)	Sunset shell					1	
Bivalvia	*Mactra ordinaria*	Trough shell						2
Bivalvia	*Myadora antipodum*	Bivalve						
Bivalvia	*Myllitella vivens vivens*	Small bivalve						
Bivalvia	*Neolepton antipodum*	Small bivalve						
Bivalvia	*Nucula nitidula*	Nut shell				5	1	
Bivalvia	*Scalpomactra scalpellum*	Bivalve						
Bivalvia	*Tellinota edgari*	Wedge shell		1				

General Group	Taxa	Common Name	D-1	D-2	D-3	D-4	D-5	D-6
Bivalvia	*Theora lubrica*	Window shell						
Bivalvia	*Varinucula gallinacea*	Nut shell						
Bivalvia	*Zenatia acinaces*	Scimitar shell						
Polychaeta: Orbiniidae	*Phylo novazealandiae*	Polychaete worm			1			
Polychaeta: Paraonidae	Paraonidae	Polychaete worm						
Polychaeta: Paraonidae	*Aricidea* sp.	Polychaete worm						
Polychaeta: Spionidae	*Paraprionospio pinnata*	Polychaete worm			1	1		
Polychaeta: Spionidae	*Prionospio aucklandica*	Polychaete worm						
Polychaeta: Spionidae	*Prionospio* sp.	Polychaete worm		2		2	2	1
Polychaeta: Spionidae	*Prionospio yuriel*	Polychaete worm		1			1	
Polychaeta: Spionidae	*Spiophanes kroyeri*	Polychaete worm						
Polychaeta: Spionidae	*Spiophanes modestus*	Polychaete worm					3	
Polychaeta: Magelonidae	*Magelona dakini*	Polychaete worm	2	1	1	1		
Polychaeta: Chaetopteridae	*Phyllochaetopterus socialis*	Parchment worm			1	1		1
Polychaeta: Capitellidae	*Heteromastus filiformis*	Polychaete worm			1	4	1	
Polychaeta: Capitellidae	*Notomastus zeylanicus*	Polychaete worm						
Polychaeta: Maldanidae	Maldanidae	Bamboo Worms						
Polychaeta: Opheliidae	*Armandia maculata*	Polychaete worm						1
Polychaeta: Phyllodocidae	Phyllodocidae	Paddle worms						
Polychaeta: Pilargidae	Pilargidae	Polychaete family			1		3	1
Polychaeta: Hesionidae	Hesionidae	Polychaete Worm				1	2	
Polychaeta: Syllidae	Syllidae	Polychaete worm	7					
Polychaeta: Glyceridae	Glyceridae	Polychaete worm						
Polychaeta: Goniadidae	Goniadidae	Polychaete worm					2	2
Polychaeta: Nephtyidae	*Aglaophamus* sp.	Polychaete worm		1		3	2	
Polychaeta: Onuphidae	*Onuphis aucklandensis*	Polychaete worm		1		4	1	4
Polychaeta: Lumbrineridae	Lumbrineridae	Polychaete worm		1		1		
Polychaeta: Oweniidae	*Owenia petersenae*	Polychaete worm						1

General Group	Taxa	Common Name	D-1	D-2	D-3	D-4	D-5	D-6
Polychaeta: Ampharetidae	Ampharetidae	Polychaete worm		2	2	5	3	4
Polychaeta: Cirratulidae	Cirratulidae	Polychaete worm						
Polychaeta: Flabelligeridae	Flabelligeridae	Polychaete worm						1
Polychaeta: Sabellidae	Sabellidae	Umbrella worms						
Polychaeta: Sabellidae	*Euchone pallida*	Fan worm						
Crustacea	Nebalia sp.	Small crustacean						
Cumacea	Cumacea	Cumaceans				2		2
Tanaidacea	Tanaidacea	Tanaid shrimp						
Isopoda	*Munna neozelanica*	Isopod						
Isopoda	Valvifera	Isopod						
Amphipoda	Phoxocephalidae	Amphipod (family)	2	18	13	11	4	15
Amphipoda	Urothoidae	Amphipod (family)						
Amphipoda	*Ampelisca* sp.	Amphipod (large)						
Amphipoda	Amphipoda unid.	Amphipod					2	3
Decapoda	*Callianassa filholi*	Ghost shrimp		2	1	3	3	
Decapoda	*Ogyrides* sp.	Shrimp (long eyes)			6	12	2	1
Ostracoda	Ostracoda	Ostracods						1
Phoronida	*Phoronus* sp.	Horseshoe worms			1			
Echinoidea	*Echinocardium cordatum*	Heart urchin						
Ophiuroidea	Ophiuroidea	Brittle stars					1	
Holothuroidea	*Rynkatorpa uncinata*	Sea cucumber					1	
Chaetognatha	Chaetognatha	Arrow worm						