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Ecological description of a proposed marine farm area

Okuri Bay, Outer Western Marlborough Sounds

Survey and monitoring report no. 137

A report prepared for:
Department of Conservation
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Nelson

Written by:
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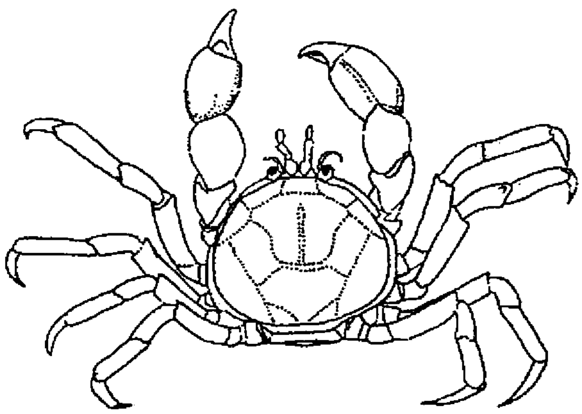


20 SEPTEMBER, 1996

1.0 INTRODUCTION

This report presents a biological description of habitats and associated conspicuous macrobenthic communities from an area proposed for the purposes of marine farming in Okuri Bay, outer western Marlborough Sounds (Figure 1, 1a).

Okuri Bay is located on the western shores of the Marlborough Sounds some 7 km west of French Pass. This coast is exposed to the expansive waters of Tasman Bay and western Cook Strait. Other bays along this stretch of Sounds coast include Waikawa and Taipare Bays located to the east and west of Okuri Bay respectively. These bays grade into relatively shallow areas towards the bay heads and are often dominated by sandy sediments. Okuri bay is the largest of these three bays being some 1.3 to 2 km wide and up to 2 km in length.

The aim of this study was to provide environmental information on the proposed marine farm site and to identify features of biological value that could be threatened by the establishment of a marine farm.

2.0 MATERIALS AND METHODS

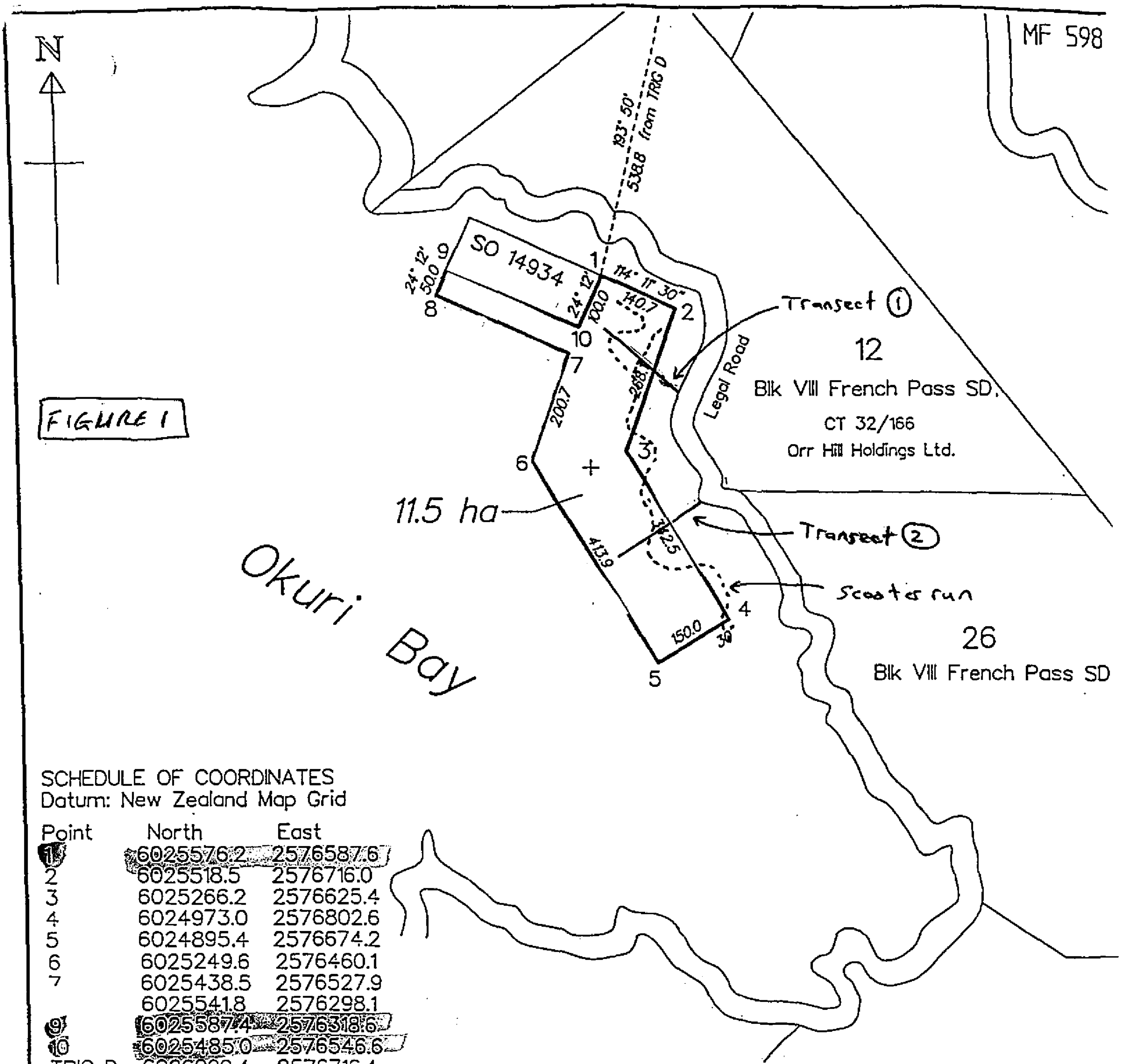
The proposed 18.3 ha site (i.e. two blocks comprising 11.5 and 6.8 ha) were investigated on the 18th September 1996. The study involved remote sensing of the inshore and offshore boundaries of the proposed area using a colour scrolling Furuno depth sounder. Depths and any abnormalities along the sea bottom were noted for later diver inspection. A wide ranging diver swim assisted by an underwater motorised scooter was conducted over much of the study area. Based on depth soundings and scooter run, three areas were selected within the proposed mussel backbone structures and a lead-lined transect line marked at 5 m intervals was installed perpendicular to the shore (Figure 1, 1a). From each transect, data on depth, distance from the low water mark, substrata and conspicuous species and community patterns were recorded.

Densities of horse mussel (*Atrina zelandica*) and scallop (*Pecten novaezelandiae)* were collected from 10 x 1 m quadrats installed at various intervals along the transects lines..

All depths presented in this report are adjusted to datum.

Data collected during the study follow the Department of Conservation guideline on procedures for the investigation of marine farm areas in the Marlborough Sounds (Department of Conservation, 1995).

Notes on water current direction and relative speed were collected at a variety of depths between 10.30 a.m. to 3.30 p.m. at all transects and the scooter run. These observations were all collected during both the incoming and outgoing tides.



SCHEDULE OF COORDINATES
Datum: New Zealand Map Grid

Point	North	East
1	6025576.2	2576587.6
2	6025518.5	2576716.0
3	6025266.2	2576625.4
4	6024973.0	2576802.6
5	6024895.4	2576674.2
6	6025249.6	2576460.1
7	6025438.5	2576527.9
	6025541.8	2576298.1
9	6025587.4	2576318.6
10	6025485.0	2576546.6
TRIG D	6026099.4	2576716.4
Centroid	6025237.6	2576562.0

Plan of Proposed Extension to Marine Farming Licence No. 488

Aqua King Ltd.

Bearing variation Geodetic Datum 1949 to NZMG +12'00"

SCALE 1:10,000

200 100 0 100 200 300 400 500 600 700 800 900 1000 metres

LOCAL AUTHORITY: MARLBOROUGH DISTRICT

NELSON LAND DISTRICT

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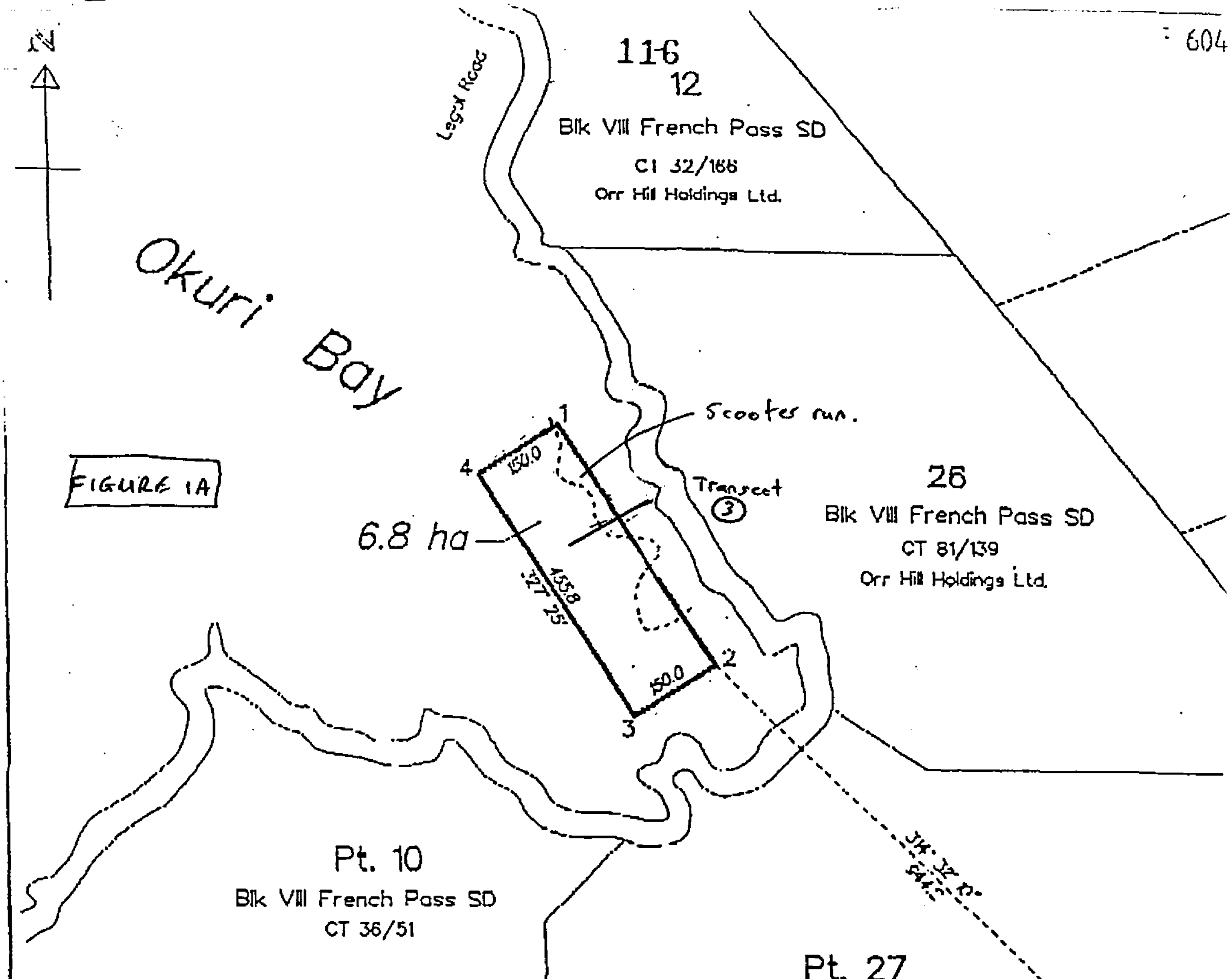

SCHEDULE OF COORDINATES
Datum: New Zealand Map Grid

Point	North	East
1	6024922.1	2576815.1
2	6024538.1	2577060.5
3	6024457.3	2576934.1
4	6024841.3	2576688.7
TURNS	6023875.9	2577733.5
Centroid	6024689.7	2576874.6

Plan of Proposed Coastal Permit

Aqua King Ltd.

Bearing variation Geodetic Datum 1949 to NZMG +12'0"

SCALE 1:10,000

200 100 0 100 200 300 400 500 600 700 800 900 1000 metres

LOCAL AUTHORITY: MARLBOROUGH DISTRICT	NELSON LAND DISTRICT
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Prep. By GJR	Date FEB. 95	Job No 726557	File 6475/01/02	Reference P26/2.2

3.0 RESULTS AND DISCUSSION

3.1 Overall findings

Results from bottom soundings and scooter swims along random parts of the proposed farm area indicate that:

1) substrata present were bedrock, small, medium and large boulders, cobbles, pebbles, and various combinations of sand, fine sand, broken shell and dead whole shell. No mud (i.e. silt and clay factions) were observed during the present investigation;
2) extensive reef structures and also isolated offshore rocks were observed within the proposed marine farm area, particularly in the northern parts of the study area;
3) no outcropping rock, bedrock, boulder or cobble substrata were recorded within the boundaries of the proposed marine farm area in the southern 6.8 hectare block (Figure 1a);
4) offshore soft bottoms were dominated by sand and fine sand substrata with variable but low proportions of broken and dead shell material;
5) a bed of snapping shrimp burrows were observed during the scooter run in the vicinity of Point 3 immediately offshore of the bedrock habitat;.
6) extensive and luxuriant beds of large brown algae was observed from the bedrock and boulder substrata in the northern parts of the study area; and
7) green lipped mussels were observed over a widespread area in the northern portion of the study area.

Water currents were observed from the scooter run during the incoming tide. Tidal water currents were moderate to light and were traveling in north-western along-shore direction. Based on the species observed from the transects, is expected that moderate to occasionally strong wave action has a substantial influence on the substrata and associated community structure in the bay.

3.2 Shore Profiles

The intertidal zone adjacent to the proposed marine farm area was dominated by relatively steep bedrock and large/medium boulders shores. In the north, a sandy beach structure had developed in a small embayment.

The subtidal shores investigated by transects were initially dominated by hard substrata. Hard shores were dominated by bedrock, large, medium and small boulders and cobble size material (Figure 2, 3, 4). At all transects, hard shores were replaced by sand or fine sand substrata which extended over the remaining length of all transects.

Hard shores were chracterised by a base of bedrock substrata. In areas, various size boulders were also present. At transect 1, the bedrock area extended to approximately 105 m distance from the low water mark. This bedrock habitat was colonised by a dense bed of brown macroalgae growing in up to 100 % cover. At transects 2 and 3, the bedrock and boulder material extended to 30 m to 40 m distance from low

Table 1 Species observed from an area in Okuri Bay.				
Algae	**Common name**	**Invertebrates**	**Habitat**	**Common name**
Corallina spp.(3)	paint and geniculate	SPONGIA		
Colpomenia sp. (2)	bubble weed	Ancorina alata (2)	rubble	grey sponge
Hormosira banksii (2)	Neptune's necklace	Aaptos aaptos (1)	rock	sponge
Rhodomenia sp. (2)	red alga	Aplysilla sulphurea (3)	rubble/rock	sulphur sponge
Carpophyllum maschalocarpum (2)	narrow flap-jack	Crella incrustans (2)	rock	encrusting sponge
Carpophyllum flexuosum (3)	wide flapjack	Callyspongia sp. (2)	shell	finger sponge
Cystophora torulosa (2)		Callyspongia sp. (1)	shell	purple glass sponge
Ulva sp. (1)	sea lettuce	Tethia sp. (1)	rock	golf ball sponge
Microalgal mat (3)	mat	Polymastia fuca (1)	shell/sand	
Halopteris sp. (1)		Stellatid sp. (2)	rock	massive sponge
Codium convolutum (2)	green alga	COELENTERATA		
		Actinothoe albocincta (2)	rubble/bedrock	anemone
		Phylctenactis tuberculosa (2)	soft	wandering anemone
		GASTROPODA		
		Eudoxochiton nobilis (1)	rubble	noble chiton
		Cellana spp. (2)	rubble	limpet
		Haliotis iris (1)	rock	paua
		Cookia sulcata (2)	rock	Cook's turban
		Maoricolpus roseus (3)	sand/shell	spire shell
		Penion sp. (1)	soft	whelk
		Trochus viridus (2)	rubble	top shell
		Turbo smaragdus (2)	rock/rubble	cats eye
		BIVALVIA		
		Atrina zelandica (1)	soft	horse mussel
		Chlamys sp. (2)	rock	queen scallop
		Modiolarca impacta (2)	rubble	Nestling mussel
		Monia zelandica (2)	rock/rubble	window oyster
		Mytilus edulis (2)	rock	blue mussel
		Panopea zelandica (2)	sand	geoduck
		Pecten novaezelandiae (1)	soft	scallop
		Perna canaliculus (3)	rock	green mussel
		POLYCHAETA		
		Brachiomma sp.(2)	sand/rubble	fan worm
		Galeolaria hystrix (2)	sand/rubble	tube worm
		Spriorbid sp. (2)	soft	tube worms
		Serpulid sp. (1)	soft	tube worm
SHARKS		CRUSTACEA		
Cephaloscyllium isabella (1)	carpet shark	Pagurus spp (3)	sand	hermit crab
BONY FISHES		ECHINODERMATA		
Conger verrauxi (1)	conger eel	Allostichaster insignis (2)	rock	star
Chelidonichthys kumu (2)	red gurnard	Coscinasterias calamaris (2)	sand/shell	11 arm star
Notolabrus celidotus (3)	Spotty	Evechinus choroticus (2)	rock/rubble	kina
Notolabrus fucicola (1)	banded wrasse	Patiriella regularis (3)	sand/rubble	cushion starfish
Hemercoetes monopterygius (1)	Opalfish	Pectinura maculata (2)	rubble	snake star
Forsterygion varium (2)	variable trip.	Stegnaster inflatus (3)	rock/rubble	ambush sea star
Forsterygion lapillum (2)	common trip.	Pseudechinus albocinctus (2)	soft	pink urchin
Notoclinops segmentatus (1)	blue eye	Stichaster australis (2)	rock	rock seastar
Parika scaber (1)	leatherjacket	Stichopus mollis (2)	sand/silt	cucumber
Latridopsis ciliaris (1)	blue moki	BRACHIOPODA		
Parapercis colias (2)	blue cod	Waltonia inconspicua (1)	rock	small lampshell
Ruanoko whero (1)	spectacled triplefin	ASCIDEACEA		
Nemadactylus macropterus (1)	tarakihi	Cnemidocarpa sp. (2)	rubble	saddle squirt
Upeneichthys lineatus (2)	goatfish	Didemnium sp. (2)	rubble	cream ascidian
Pelotretis flavilatus (1)	lemon sole	Aplidium adamsii (1)	rubble	orange ascidian
Abudance: 1 = uncommon, 2 = occasional, 3 = common.				

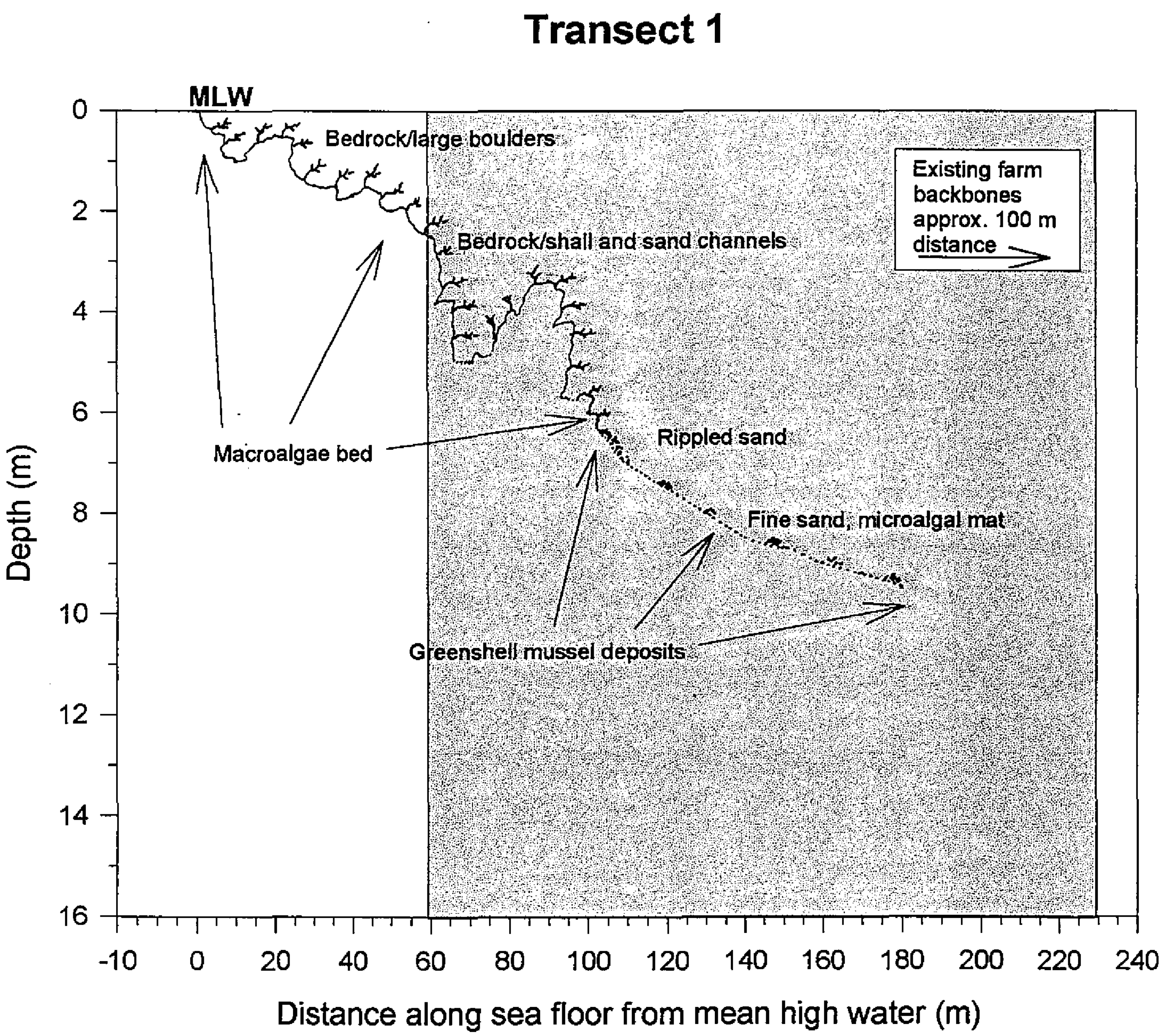

Figure 2 Subtidal shore profile and substratum from an area proposed as a marine farm in Okuri Bay. Approximate boundaries of proposed farm are shaded grey. All depths are adjusted to datum.

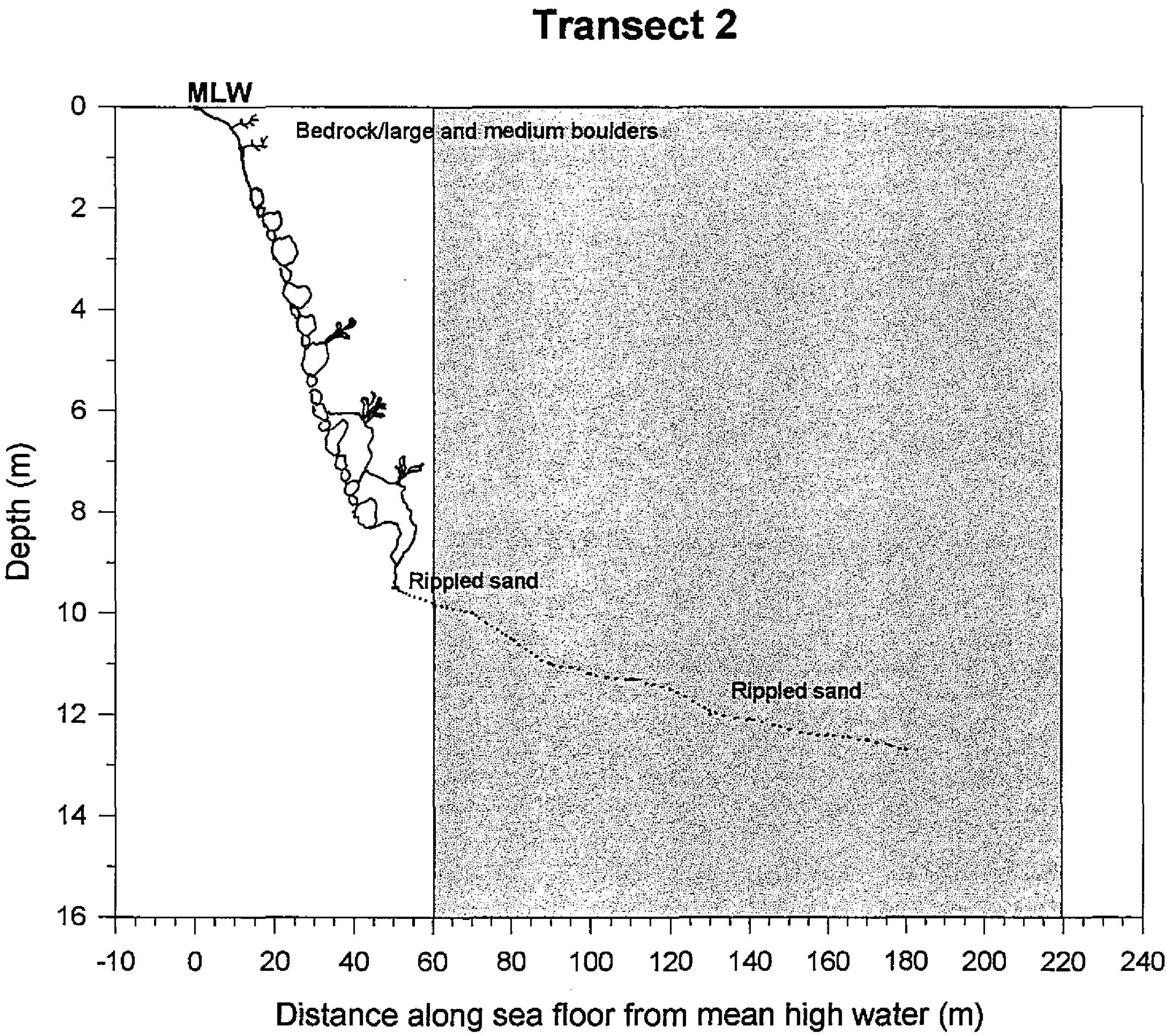

Figure 3 Subtidal shore profile and substratum from an area proposed as a marine farm in Okuri Bay. Approximate boundaries of proposed farm are shaded grey. All depths are adjusted to datum.

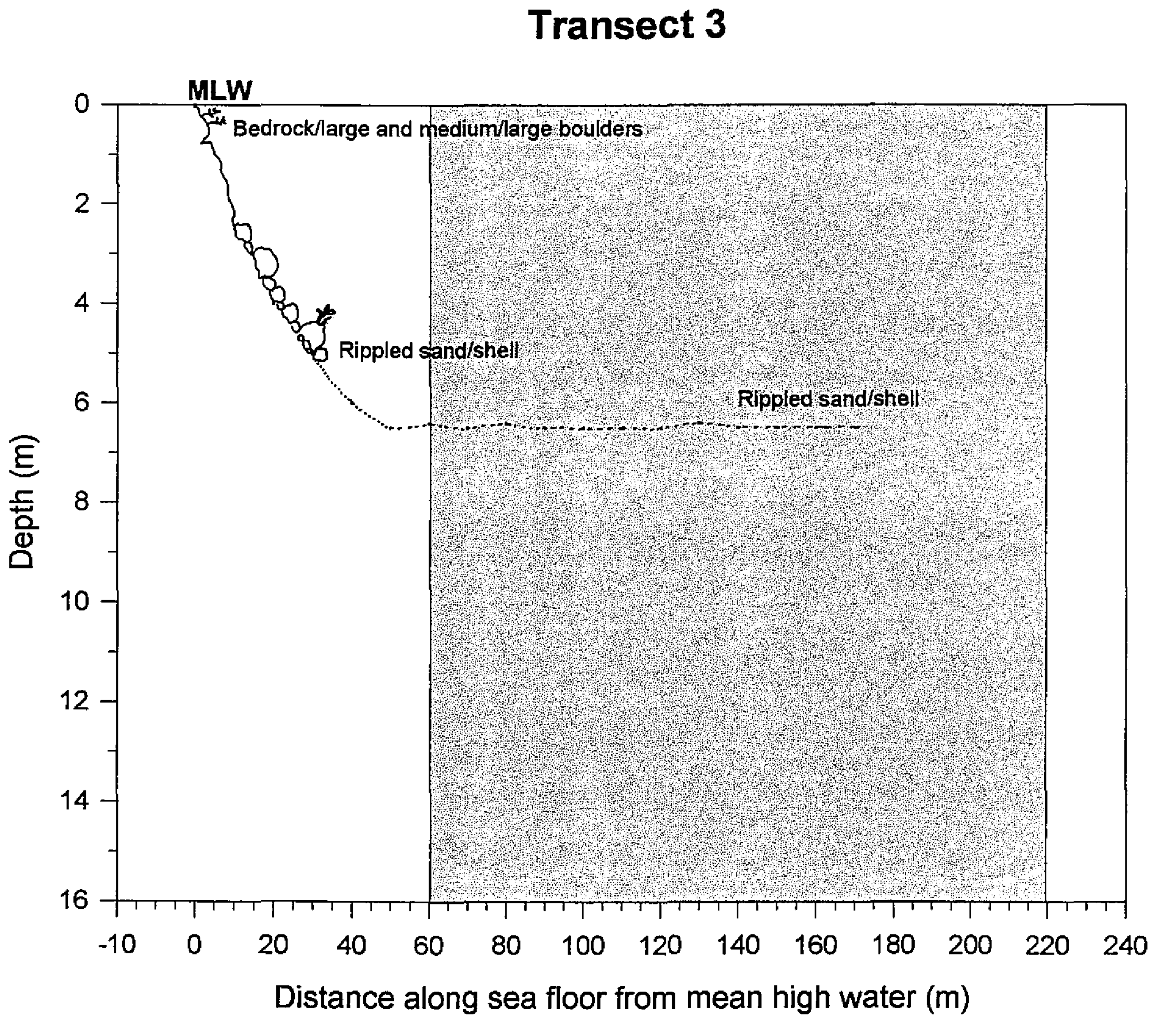

Figure 4 Subtidal shore profile and substratum from an area proposed as a marine farm in Okuri Bay. Approximate boundaries of proposed farm are shaded grey. All depths are adjusted to datum.

water. Macroalgae was restricted to a relatively narrow sublittoral fringe at these transects (Figure 3, 4). Instead of macroalgal beds at these transects, rock was colonised by a relatively diverse community of encrusting species such as sponges, ascidians, anemones, tube worms and shellfish. In deeper areas, these communities covered the entire surface of the rock substrata.

A relatively low diversity of species were observed from most soft shores within the study area. Isolated patches of low density horse mussels were observed during the scooter run. Most notable was a dense bed of snapping shrimp located in the vicinity of Point 3 (Figure 1). A greater variety of soft bottom species were observed at transect 1 probably due to the lower wave energy experienced in this area.

From transects and the scooter swim both within and adjacent to the proposed marine farm, a total of 72 plants and animals comprising 42 conspicuous species of invertebrate, 11 algae, 3 ascidians, 15 species of bony fish and one species of shark were observed. The number of species and the community composition are representative of sand and shallow reef habitats in moderately exposed locations from Croisilles Harbour to French Pass (Davidson and Duffy 1992, Davidson and Brown 1994).

A list of species recorded from the study area are presented in Table 1, while the shore profiles are plotted in Figures 2, 3 and 4.

3.3 Fish

Fifteen species of bony fish and one shark were recorded within and adjacent to the proposed marine farm site. The number and composition of fish species were representative of bedrock and sand habitats found in bays in the outer Sounds areas. Most common reef fish were spotty and blue cod. Blue cod were observed in moderate abundance and in a variety of sizes through to legal size principally from the bedrock and adjacent fine sand/shell areas. One individual blue moki and an occasional tarakihi were also observed from the fine sand/shell area. This fine sand/shell substrata also supported red gurnard, goatfish and carpet shark. Holes in this substrata suggested that snapper and also eagle rays may utilize this shallow fringing habitat. Opal fish and four species of triplefin were also observed during the study.

3.4 Scallops (*Pecten novaezelandiae*)

Scallops were not recorded from transects 1 or 3 although they were present in these areas. At transect 2, densities of scallops were calculated from 24 quadrats of 10 x 1 m^2 size. Quadrats were installed between 40 m to 150 m distance from shore and between depths of 9 m and 12 m. Results showed:

1) no pattern in the distribution of scallops at the study site;

2) densities from transect 2 were: mean = 0.03 per m^{-2}, Standard Error = 0.013; and

3) scallops sizes ranged between 40 mm to 60 mm.

Densities from transect 2 were below the Department of Conservation guideline value for densities representing a scallop bed. It was notable, however, that all scallops observed were juveniles from the same year class.

3.5 Horse mussels (*Atrina zelandica*)

Horse mussels were not recorded from quadrats but were observed from all transects in low abundance. Patches of horse mussels in low abundance were also observed from the scooter run.

3.6 Lampshells

Lampshells (*Waltonia inconspicua*) were observed in low abundance from bedrock substrata at transect 1. Brachiopod densities were below the Department of Conservation guideline threshold for values of ecological or scientific interest (DOC 1995).

4.0 IMPACT OF THE EXISTING MARINE FARM

During the investigation of the northern part of the study area, relatively large numbers of live green-lip mussel (*Perna canaliculus*) were observed over a wide area. At transect 1, green lipped mussels were recorded from the base of the reef to the offshore extent of the transect (Figure 2). Abundance of mussels ranged from 5 % cover on most of the offshore sand flats, to 100 % cover around the base of the reef. The depth of the shell cover was up to 3 to 4 shells thick and formed a mat of shell and byssal threads.

This phenomenon is not natural and is most likely a result of the presence of the adjacent operational marine farm in the bay. There appear to be three possible explanations for the widespread distribution of mussels outside the existing consent area:

- mussels may have been spread over a wider area during harvesting operations or during cleaning of the harvester vessel
- mussels may have been dumped
- mussels which have dropped off lines and fallen onto the sea floor may have been redistributed by wave action.

It is the latter explanation which appears to be the most likely explanation for the spread of the marine farm impact outside the consent area. Mussels were evenly spread over the offshore sand flats and were not observed in patches which is more characteristic of dumping or boat cleaning activities. Further, the buildup of concentrations of shell at the foot of the reef structures suggests that shell has been transported by northerly swells which enter Okuri Bay during storm events.

Observations of mussel shell debris over a widespread area and the build up of shell at the foot of reef habitat suggests that in shallow areas where wave can be considerable, marine farm impacts can be spread over a wider area than has been previously documented.

5.0 POTENTIAL IMPACT OF A BIVALVE MARINE FARM

The impact of shell and sediment deposition on the benthos under a mussel marine farm results in a shift from the initial ecological state to a new state. The degree of change depends on the habitat type and communities present prior to mussel material deposition. In general, a build up of mussel shell on a mud bottom will result in an increased diversity of species living on the surface and a decrease of infaunal species due to increased sedimentation (Kaspar et al. 1985). On a rocky bottom, a decrease in species diversity as a result of shell and sediment deposition would be expected.

In northern parts of the study area, reef habitat extended considerable distance offshore (i.e. up to 105 m distance from low water). The establishment of a marine farm over such reef would probably result in smothering of the macroalgal stands and the reduction of species diversity on the reef. Reef substrata and algal beds usually support a wide range of often abundant marine species compared to offshore mud habitats. Macroalgal beds as well as providing refuge for species have an important part to play in the food chain. Macroalgae often support large numbers of small invertebrates which are in turn food for fish. Smothering of reef habitat, macroalgal beds and their associated communities therefore represents an ecologically unacceptable impact.

Although the species and communities observed from the offshore soft bottom areas were supported by a relatively low variety of species mostly in low abundance, these sand flats appear to be utilised by a variety of fish species for food. Deposition of shell over these sand shores may result in a shift in community structure from and area where food preferred by fish is available to an area dominated by large mussels which may not be accessible to many fish species.

Observations of the spread of mussel shell by wave action in the northern and more sheltered part of the study area, suggests that the impact of a mussel marine farm at the proposed area may not be limited to the consent area alone. It is likely that shell deposited onto the benthos below a mussel farm would be transported by wave action onto the reef structure along the sides of Okuri Bay.

6.0 CONCLUSION

The aims of the study were to provide a biological description of the benthos under and adjacent to a proposed marine farm area in Okuri Bay, outer western Marlborough Sounds and to identify potential threats to any subtidal ecological values posed by the proposed activity.

The soft and hard shore communities recorded from the present study were dominated by species that occur on subtidal shores influenced by occasional moderate to strong wave action in shallow bays of the outer Marlborough Sounds (Dell 1951; Estcourt 1967; McKnight 1969, 1974; Roberts and Asher 1993; McKnight and Grange 1991; Davidson and Duffy, 1992; Davidson, 1995; Davidson and Brown 1994; Duffy *et al.* in prep; Chadderton *et al.*, in prep, Chadderton and Davidson in prep).

Offshore areas were dominated by sand and fine sand sediments with a relatively low variety of species in mostly low abundance. In contrast, inshore areas were characterised by hard substrata habitats with a higher number of species in higher abundance than were observed from offshore soft bottom areas. These inshore areas and their high associated ecological values would be threatened by a mussel marine farm placed overhead or immediately adjacent.

Observations of mussel shell debris over a widespread area in the northern parts of the study area and the build up of shell at the foot of reef areas suggests that in shallow areas where wave can be considerable, marine farm impacts can be spread over a wider area than has been previously documented. These observations from the most sheltered part of the study area, suggests that the impact of a mussel marine farm at the proposed area may not be limited to the consent area alone. It is likely that shell deposited onto the benthos below a mussel farm would be transported by wave action onto the reef structure along the sides of Okuri Bay resulting in an impact on reef habitats.

In consideration of the ecological data collected during the present study it seems that the establishment of a marine farm in shallow areas subject to periodic large wave action is inappropriate as this wave action appears to result in a marine farm impact over a much wider area than the consent area alone. This phenomenon has not been previously documented. It is widely accepted that under normal circumstances shell material falls to the benthos below a mussel farm and remains there. In these situations, marine farms have often been situated relatively close to reef habitats with only small buffer zones separating the farm and ecological values. In the present situation it is unknown what separation distance would constitute an appropriate buffer zone.

Although observations from the present study are preliminary and have not been the result of an intensive scientific study focusing on the effect of wave climate on shell deposition and subsequent movement, it is recommended that a precautionary approach to the approval of marine farms in these shallow exposed environments be adopted until more information on this phenomenon can be collected.

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