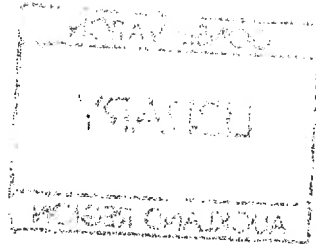


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BLACKSMITHS BAY - MARINE
BIOLOGICAL ASSESSMENT

Prepared by Katherine Walls, MSc. (Hons)

Northland Harbour Board
December 1985

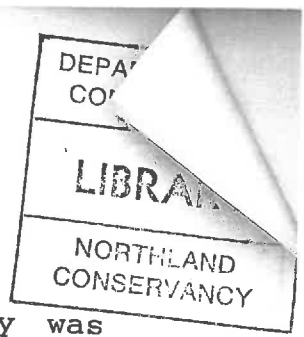
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PREFACE

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This marine biological assessment of Blacksmiths Bay was prepared by the Board's Marine Planning Officer. The study was undertaken in order to provide additional information on the ecology of the proposed marina area for an Environmental Impact Assessment prepared for the developers of the proposed Blacksmiths Bay Marina.

The marine biological investigations were conducted during late 1984 and early 1985 and a summary of these investigations was provided, upon request by the consultants for the developers of the proposed marina, for early inclusion in the draft Environmental Impact Assessment. This summary did not contain all the topics and detail now presented in the technical report. The conclusions arrived at were also not contained in the summary.

The Board considered the possible siting of a marina at Blacksmiths Bay at its meeting of 2nd September, 1982 and resolved as follows:-

" That the Board approve in principle to the siting of
" a marina in Blacksmiths Bay in the Kerikeri Inlet."

Therefore, the reader of this technical report should be aware that the conclusions arrived at were made from a marine biological viewpoint and do not necessarily reflect the opinion of the Northland Harbour Board in its overall evaluation of the proposed marina.

J.A. Brosnahan,
Planning Officer.

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ABSTRACT

The Blacksmiths Bay area, situated on the northern side of the Kerikeri Inlet, Bay of Islands, was investigated to provide a marine biological assessment in partial fulfilment of the requirements of an Environmental Impact Assessment for a proposed marina.

The rocky shore fauna and flora of the headlands which bordered the proposed marina area and nearby Motutapu Island were investigated. Further investigations of the fauna of the soft shores were also undertaken with the proposed marina area and the adjacent bays being studied. To complete the study, the subtidal sediments of the Blacksmiths Bay area were also sampled.

The rocky shores supported a high diversity of species. On the headland intertidal reefs, the snail, Zeacumantus lutulentus and an unidentified species of brown alga were the most common organisms on the upper shores. At mid shore levels Z. lutulentus and Neptune's necklace, Hormosira banksii were predominant, their densities becoming more varied at the lowest intertidal levels.

The island supported large numbers of Pacific oyster, Crassostrea gigas which occurred as clumps on exposed boulders. At the inner side of the island, the slug, Onchidella nigricans was very common amongst the oysters while the boulders at the supralittoral level appeared favourable for a thick covering of lichens.

The three soft shores examined within the Blacksmiths Bay area comprised noticeably differing sedimentary environments ranging from the relatively sandy southeastern bay to the predominantly muddy proposed marina area, while the northwestern bay exhibited features common to these two bays.

The sediments appeared to reflect the biota found at each of the three locations. In the proposed marina area, a wide array of flora and fauna was identified within the extensive area of mangrove forests and open mudflat. The fauna included bivalves, crabs, shrimps, snails, chitons, anemones, barnacles and a number of worms. The most abundant species were: the snail, Zeacumantus lutulentus, the oyster, Crassostrea gigas, the bivalve, Macoma liliana and the cockle, Austrovenus stutchburyi. At the southeastern bay, bivalves, crabs, snails, anemones, barnacles, amphipods, bryozoans and worms were identified. Among these, A. stutchburyi, M. liliana and the pipi, Paphies australis were the most commonly occurring species. The northwestern bay appeared to support the poorest diversity of species. It was found here that P. australis, A. stutchburyi and M. liliana were the most dominant species.

The investigations showed that the cockle, Austrovenus stutchburyi was the most abundantly occurring of all the soft shore species identified, being found in varying densities at all three sites.

A number of bird species was observed and these appeared to utilize the open mudflats and mangroves of the proposed marina area for feeding and roosting.

The subtidal investigations revealed that species diversity was lower compared to the intertidal area, with the bivalve, Theora lubrica being the only predominant species.

Assessment of the biological impacts that a marina development at Blacksmiths Bay might have on the surrounding marine environment led to the conclusion that, from a marine biological viewpoint, an alternative site be investigated. This was made in view of the variety of marine habitats found at Blacksmiths Bay with this variety not being found elsewhere in the Kerikeri Inlet. Other reasons for a marina being considered as undesirable at Blacksmiths Bay included the close proximity of naturally occurring oysters and the nearby oyster farms which could become polluted as a consequence of marina activities.

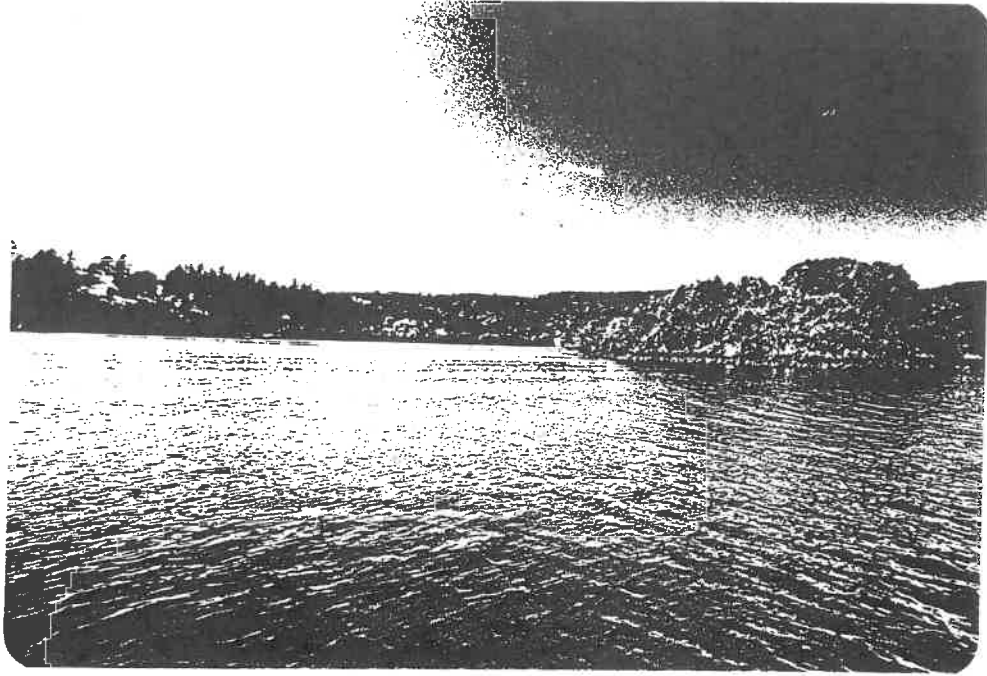


PLATE 1 : Blacksmiths Bay, the site of the proposed marina, and Motutapu Island, which will provide shelter from the south.



PLATE 2 : Blacksmiths Bay at high tide facing south towards Motutapu Island and the opposite side of the Kerikeri Inlet.

BLACKSMITHS BAY - PROPOSED MARINA

1.0 INTRODUCTION

Blacksmiths Bay is a relatively shallow embayment of the Kerikeri Inlet, located in the Bay of Islands (Figure 1). This bay is situated on the northern side of the Kerikeri Inlet and is afforded some protection from prevailing winds and waves by a small island reserve known as Motutapu Island (Figure 2).

The Blacksmiths Bay area actually comprises three smaller bays, each separated by a headland and an associated rocky intertidal platform of weathered greywacke which is covered at the lowest level with a thin layer of mud. The three small bays each have an intertidal area of varying soft sediment types. The island in the bay is made up of large boulders of basaltic origin with a silt matrix at the low tide level. A relatively narrow channel runs around the north side of this island while the remaining subtidal area of the bay comprises a very shallow, fine muddy seafloor.

The most sheltered part of the embayment has been the focus of a proposed marina and would make use of the existing rocky intertidal reefs as part of the protective breakwaters required in such a development. Consequently, a development of this nature demands an Environmental Impact Assessment as outlined in the requirements by the Ministry of Transport. This report provides information relating to marine biological aspects of the Blacksmiths Bay area in partial fulfilment of an Environmental Impact Assessment. Some discussion is also given relating to the projected impact of the proposed development on the marine biota within the Blacksmiths Bay area.

It is the twofold aim of this report to present the results of marine biological investigations carried out in the Blacksmiths Bay area and, on the basis of these results, to evaluate the effects that a development of the type proposed might have on the surrounding marine environment. Conclusions based on the findings of this report then follow.

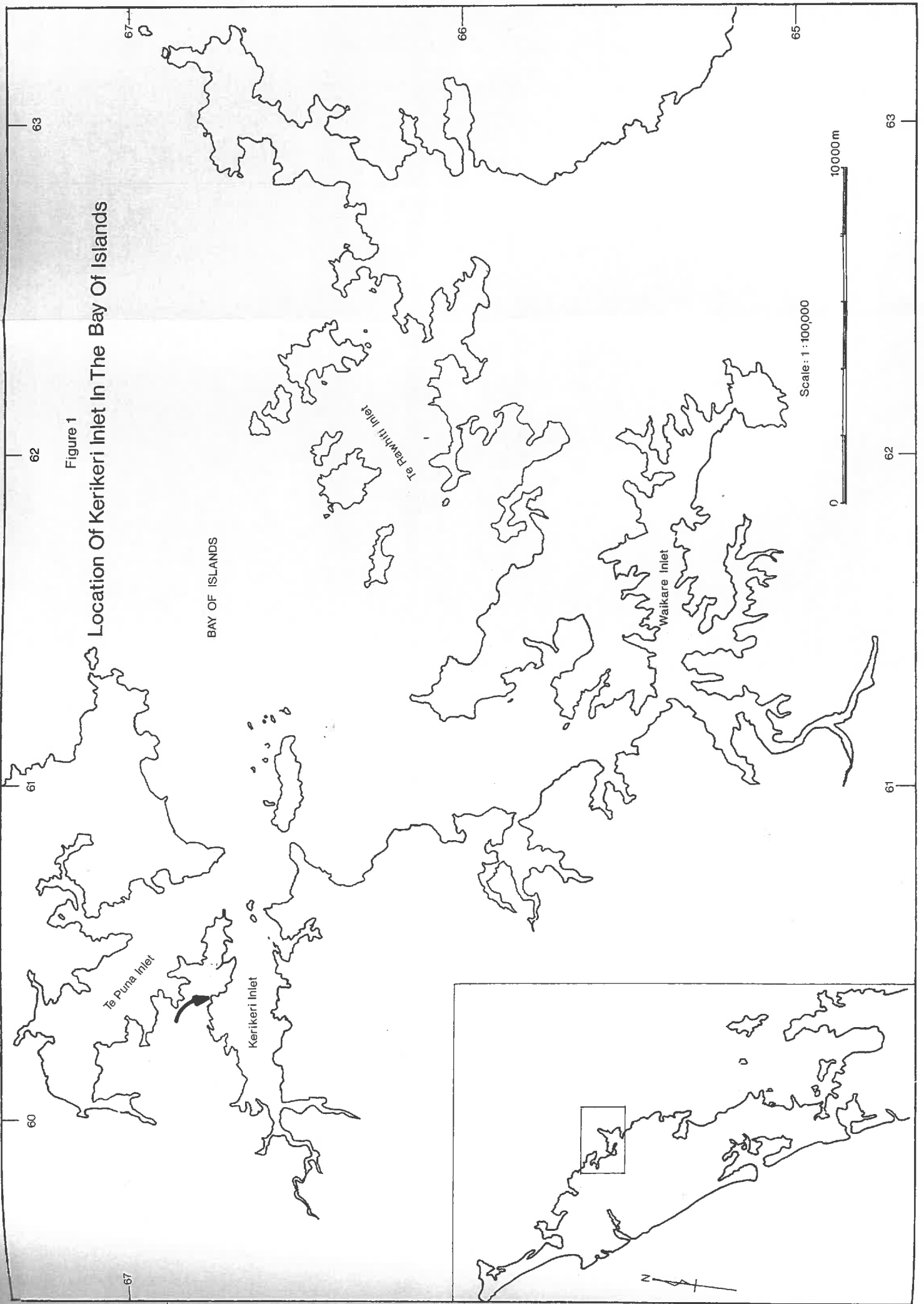


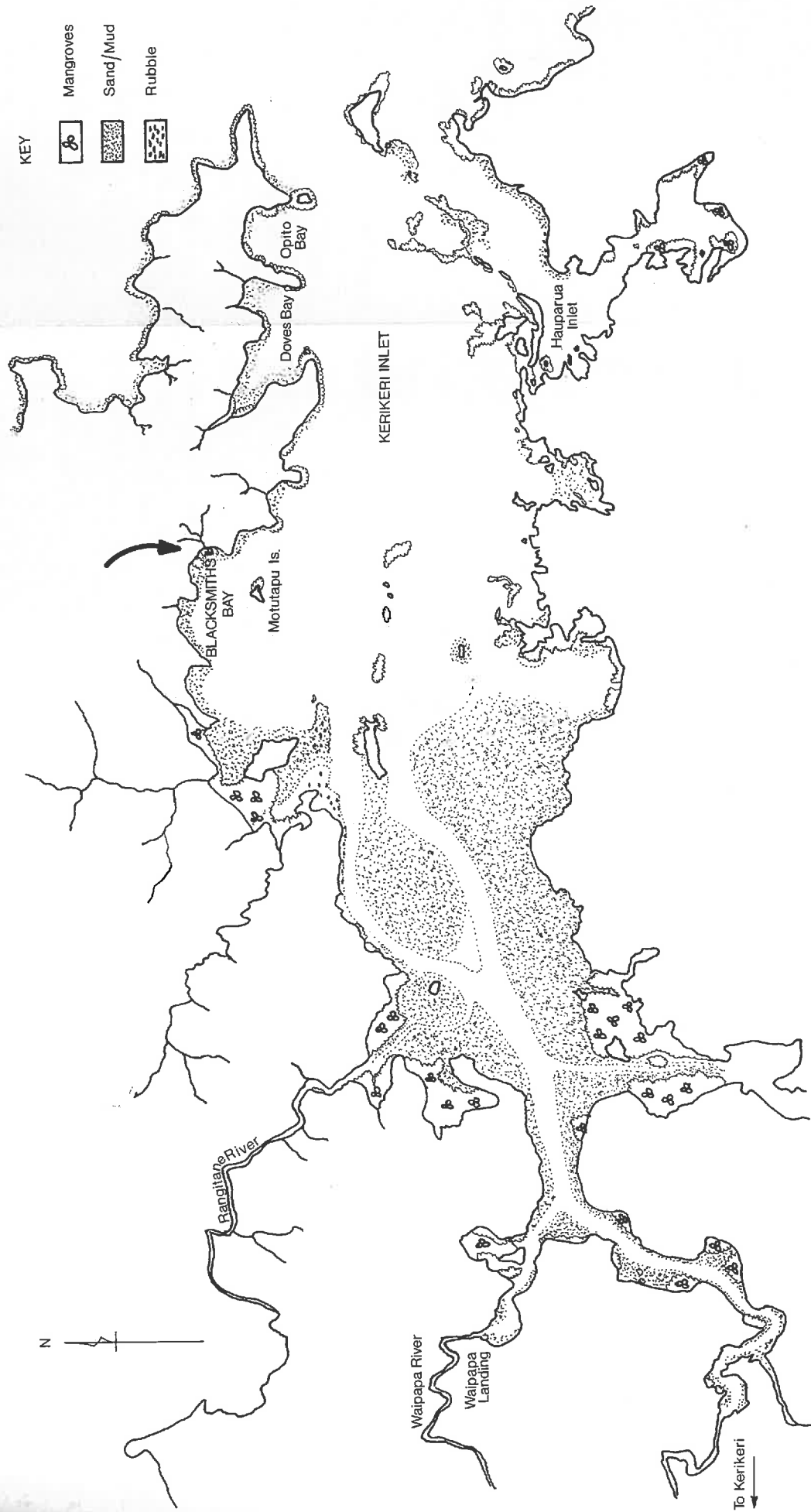
Figure 1
Location of Kerikeri Inlet In The Bay Of Islands

BAY OF ISLANDS

Scale: 1:100,000

0 10000m

Figure 2
 Location Of Blacksmiths Bay In The Kerikeri Inlet



Source : A.H.Pickmere

Scale 1 : 25000



2.0 METHODS

2.1 Intertidal Shores

2.1.1 Rocky Shores

The rocky headlands forming the southeastern and northwestern boundaries of the proposed marina together with Motutapu Island were examined. Site descriptions were made and presented as profiles in this report.

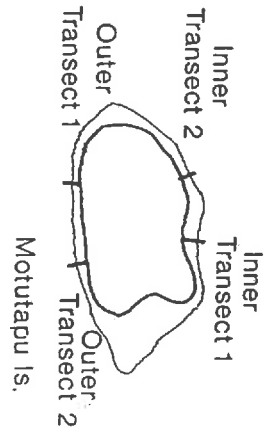
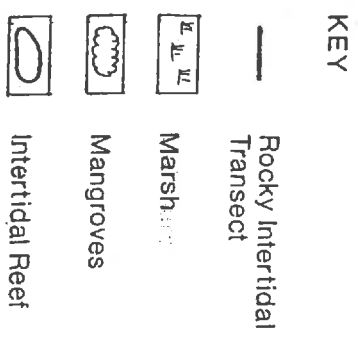
Transects were laid down the shore to low water, perpendicular to the shoreline at the southeastern, northwestern and island locations (Figure 3 and Plate 3). The island was divided into two locations, an inner location (facing Blacksmiths Bay) and an outer location (facing the Kerikeri Inlet). Two transects were laid at each location and all species were recorded from quadrats placed at one metre intervals along the transect. The quadrat size was 0.25 m^2 and quadrats were replicated three times at each one metre interval.

All the organisms within the quadrats were identified and their densities recorded as either: number per 0.25 m^2 or percentage cover per 0.25 m^2 . The information from this was then presented in two ways - firstly, as numbers or percentage cover of species from three random 0.25 m^2 quadrats at four levels down the shore as defined in Morton and Miller, 1968 (supralittoral, upperlittoral, midlittoral and lowerlittoral) and, secondly, as numbers or percentage cover of predominant species per 0.25 m^2 at each one metre interval of the transect to indicate changes in abundance down the shore.

Lichens were not included in this part of the analysis as they comprised several species which were difficult to separate and identify. Their abundance is discussed where they form the predominant growth form on the uppermost part of the shores.

2.1.2 Soft Shores

The muddy shores of the proposed marina area and the bays to the west and east of the proposed development were investigated for the flora and fauna which inhabited the soft shore environment. At each location, two transects were laid down the shore to low water (Figure 4). As the shores were relatively long and the method of species identification was more



BLACKSMITHS BAY

MLW

Transect 2

Northwest Headland

Transect 1

Transect 1

Southeast Headland

Transect 2

Blacksmiths Bay – Rocky Interstitial Sampling Stations

Figure 3

Scale 1 : 5000



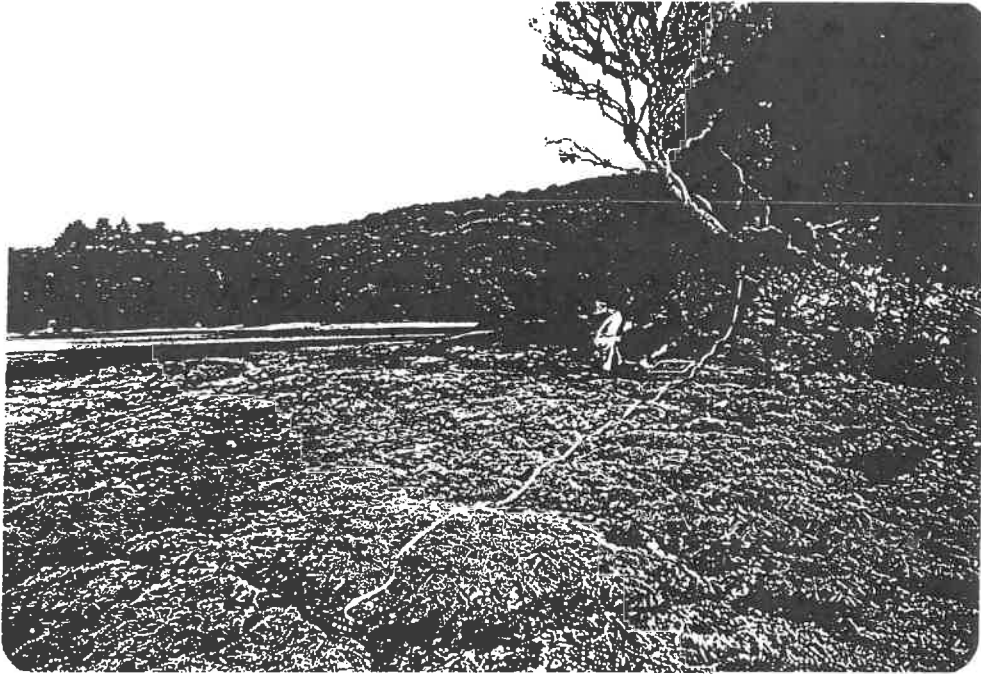
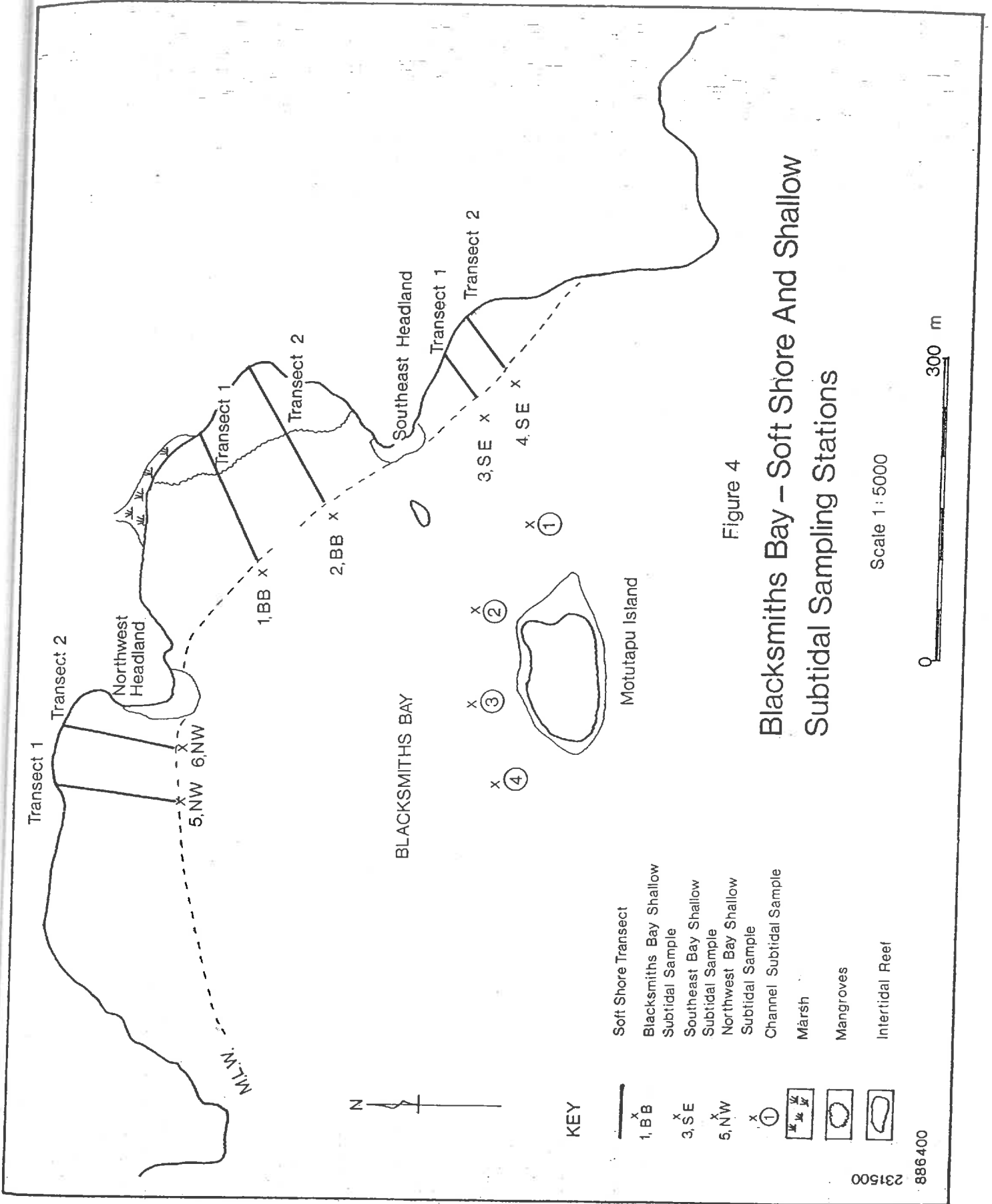


PLATE 3 : Northwestern rocky intertidal location.
The flora and fauna of the rocky headlands at Blacksmiths Bay were investigated using line transects laid perpendicular to the shoreline. All the species were recorded from quadrats placed at one metre intervals along the transect.



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involved than for rocky shores, samples were taken at intervals of: 50 m for long shores, 25 m and 12.5 m for progressively shorter shores. These intervals enabled adequate coverage to be made of the upper, middle and lower sections of the soft shores. Five replicate samples were taken at each level using an intertidal benthic sampler designed to sample animals living within soft sediments. The benthic sampler sampled an area of sediment of 0.1 m² down to a depth of 0.15m (Figure 5). The samples were placed in plastic bags and later washed through sieves (2 mm and 10 mm mesh sizes) to remove the mud, leaving the animals which were identified and counted.

In the bay which forms the site of the proposed marina, there was an extensive upper shore region comprising mature mangrove forest which was not found at either of the adjacent bays. Here, the sediments were compacted and bound together by mangrove pneumatophores while a number of species lived on the mud surface. This part of the soft shore was investigated by laying two transects perpendicular to the shoreline and taking five replicated quadrats of 0.25 m² at five metre intervals (Figure 4).

2.2 Subtidal

As the Blacksmiths Bay area comprised a muddy seafloor, only soft sediment samples were collected. The sample sites were in two differing subtidal habitats (Figure 4) - the shallow Blacksmiths Bay area (less than one metre depth at low water) and in the channel between Blacksmiths Bay and Motutapu Island (two metres deep at low water). Collections were made using a subtidal benthic sampler which gave a sampled area of 0.07 m² down to a depth of 0.08m (Figure 6 and Plate 4). The samples were replicated five times at each site. The samples were put into plastic bags and analysed for fauna using the two sieves described above.

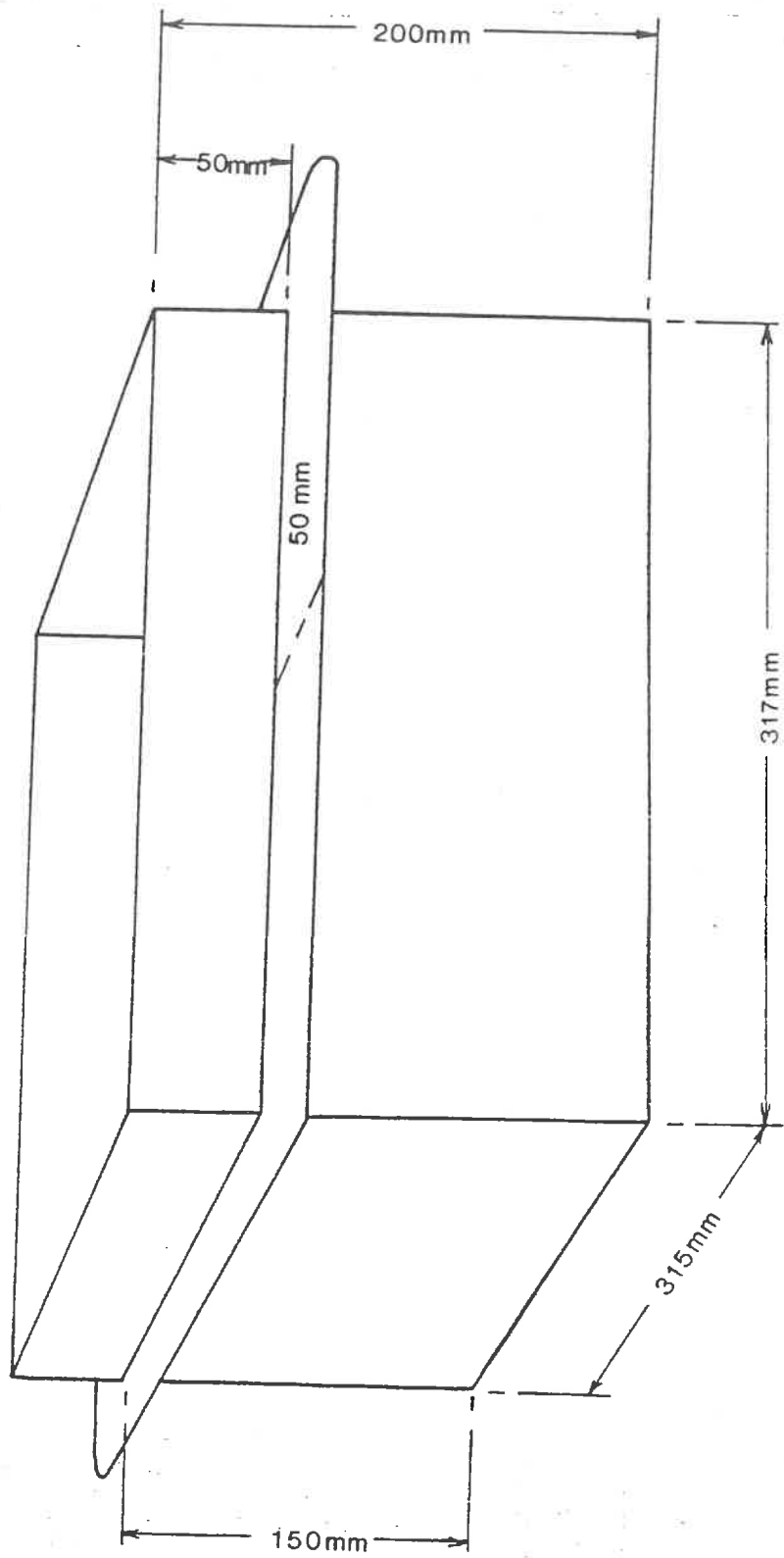
As the water clarity was very low, the subtidal survey work was limited to the analysis of benthic invertebrates only.

2.3 Statistics

All rocky intertidal data is expressed in terms of $\bar{x} \pm$ S.E. with three randomly assigned replicates for all species at each of the four levels (supralittoral, upperlittoral, midlittoral and lowerlittoral) at all locations. The predominant or indicator species are also represented graphically as mean densities \pm S.E. as they varied at one metre intervals along the

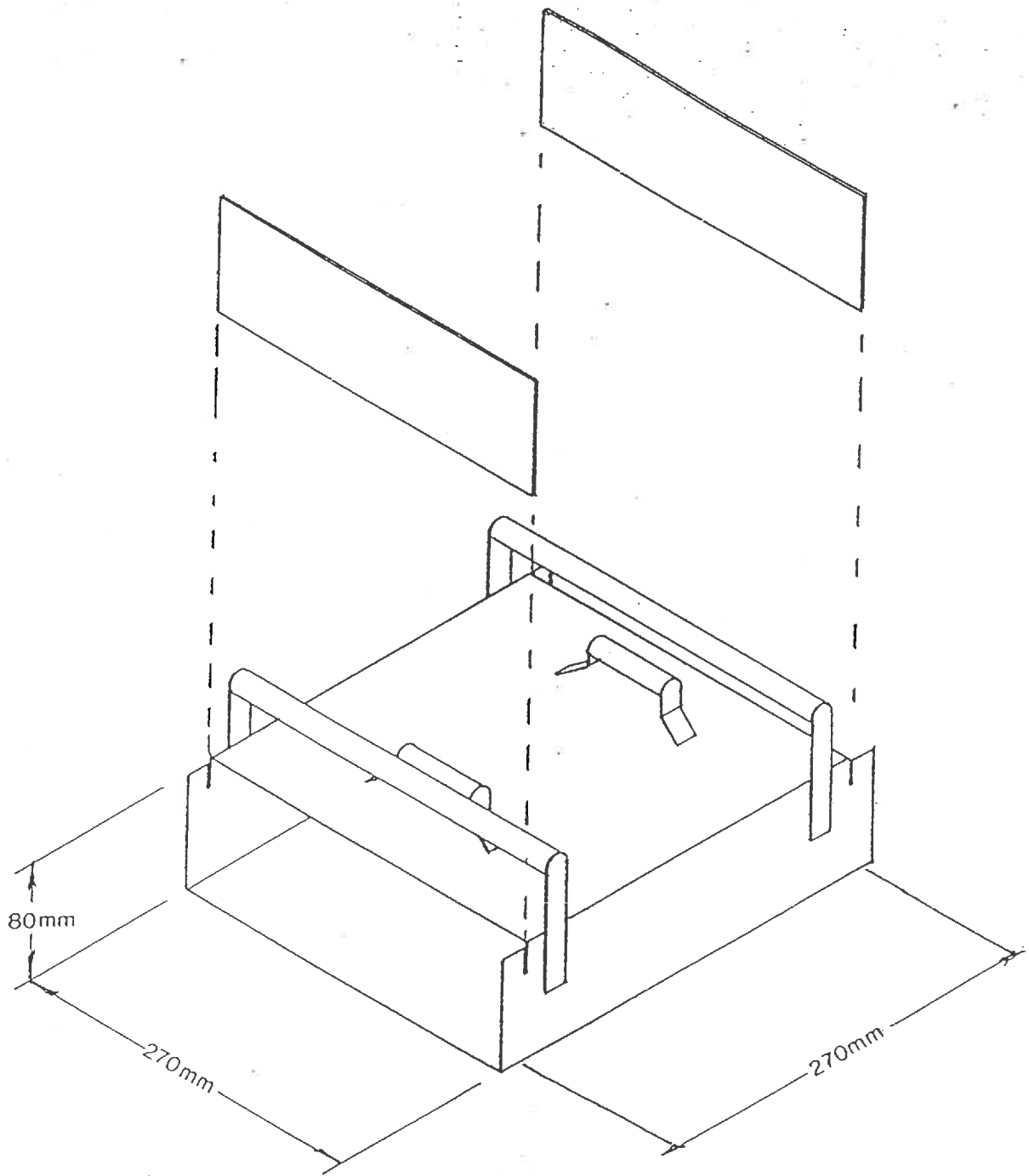
Figure 5

Soft Shore Sampling Quadrat



$$\text{Area} = 315 \times 317 \text{ mm} = 0.1 \text{ m}^2$$

Subtidal Benthic Sampler



$$\text{Area} = 270 \times 270 \text{ mm} = 0.07\text{m}^2$$

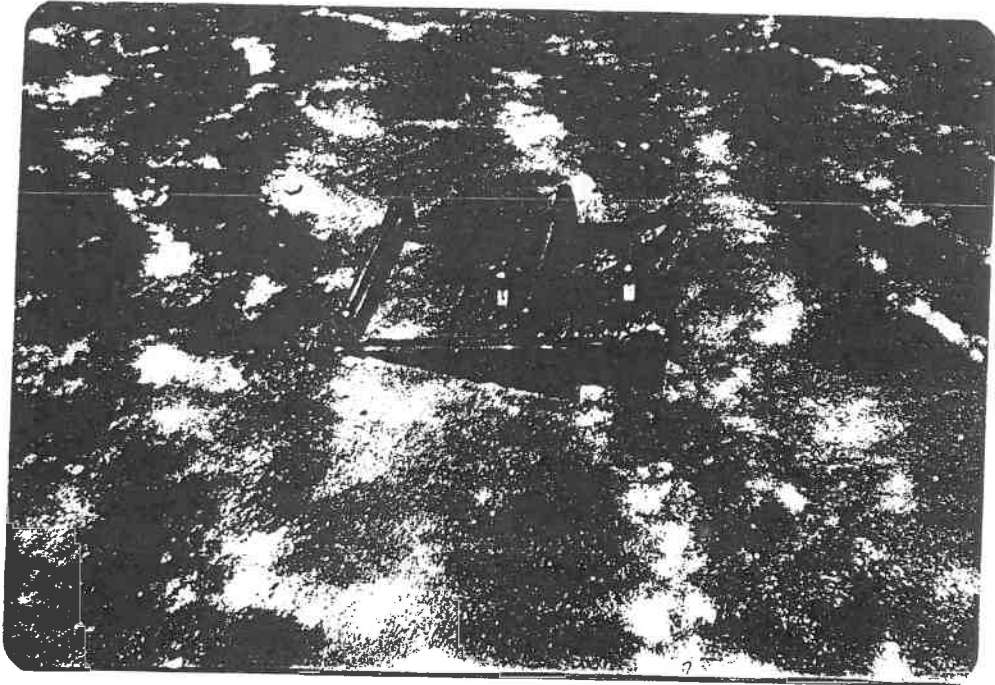


PLATE 4 : The subtidal benthic sampler.

transects.

The fauna identified and counted living in and/or on the intertidal soft sediments is expressed as $\bar{x} \pm S.E.$ with five replicate samples for each level of the soft shore being defined as the mangrove zone together with upper, middle and lower levels. Indicator species are represented graphically as they varied along the transect. The subtidal fauna are represented as $\bar{x} \pm S.E.$ with five replicated samples for the shallow bay and channel sites and the predominant species are displayed graphically.

The intertidal and subtidal soft sediment data could not be statistically compared as three different sample techniques were employed. The quadrat technique investigated the organisms living on the compacted sediments while the other two methods sampled different amounts of sediment. Owing to the constraints imposed by sampling in the subtidal environment, a subtidal benthic sampler of the same size as the intertidal benthic sampler could not be used. For this reason, comparisons of fauna from the different soft shore habitats could only be made on a qualitative basis.

2.4 Comparable Sites

Two rocky intertidal locations covered in the ongoing Bay of Islands Harbour Study (co-ordinated by the Northland Harbour Board) are compared with the Blacksmiths Bay area. The most comparable sites are the rocky intertidal areas of the upper Waikare and Te Puna inlets. There were no similar sites covered by the harbour study investigations within the Kerikeri Inlet.

The same methods of data collection were used as that of the Blacksmiths Bay area investigations.

Comparisons of the soft shores or the subtidal region of the Blacksmiths Bay area were not able to be made as the Bay of Islands Harbour Study had not progressed to include investigations of all soft shores in the Bay of Islands, at the time of the Blacksmiths Bay investigations.

3.0 RESULTS

3.1 Intertidal Shores

3.1.1 Rocky Shores

(a) Site Descriptions -

Southeast headland (Figure 7).
 This location comprises a rocky promontory of greywacke which slopes steeply to a lowlying flat area covered in places with a layer of mud. At low tide a small reef is visible approximately 200m offshore to the southwest and this is separated by a lowlying muddy area. In Profile One the upper part of the shore was characterised by a band of the small black mussel, Xenostrobus pulex while a thin band of tubeworms (Pomatoceros caeruleus) occupied the lower part of the slope. Coralline turf (Corallina officinalis) and Neptune's necklace (Hormosira banksii) predominated over the lowlying shore. This pattern changed in the second profile. Pacific oysters (Crassostrea gigas) formed a thin band at the steep upper shore while coralline turf and H. banksii grew in patches on the gently sloping middle and lower shore. The anemone, Anthopleura aureoradiata occurred in clumps amongst the lower shore algae.

Northwest headland (Figure 8).

The rocky area to the northwest of the proposed marina is a steeply sloping greywacke cliff which gives way to a platform reef of relatively gentle slope. The middle and lower sections of the reef were covered in places with a thin layer of mud. The upper sections of both profiles were relatively bare of characteristic bands of flora and fauna. However, the middle and lower levels showed beds of Hormosira banksii with Anthopleura aureoradiata prevalent lower down on the shore in Transect One and the snail Zeacumantus lutulentus common on the mid shore level of Transect Two.

Motutapu Island - inner shore (Figure 9).

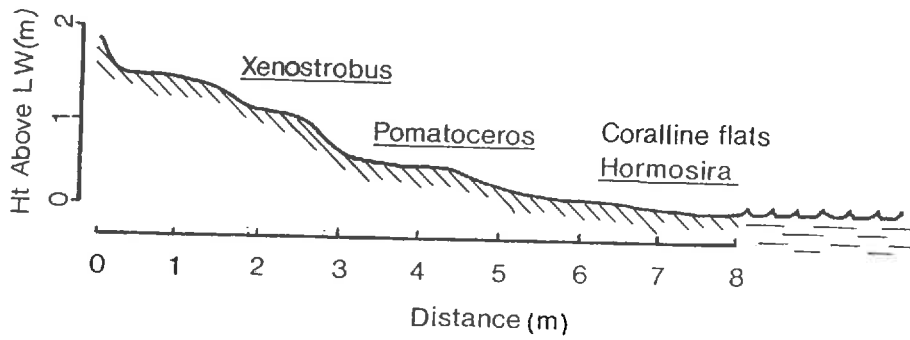
The coastal facing side of the island is made up of large to medium boulders of basalt with interspersed mud at lower levels. The first profile was over a moderate slope comprising both medium sized boulders and mud. The boulders of the uppermost part of the shore were covered with various coloured lichens while Crassostrea gigas dominated the remaining levels. The red alga Apophloea sinclairii and the barnacle Chamaesipho

Figure 7

Blacksmiths Bay – Southeast Headland

Profile 1

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)



Profile 2

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)

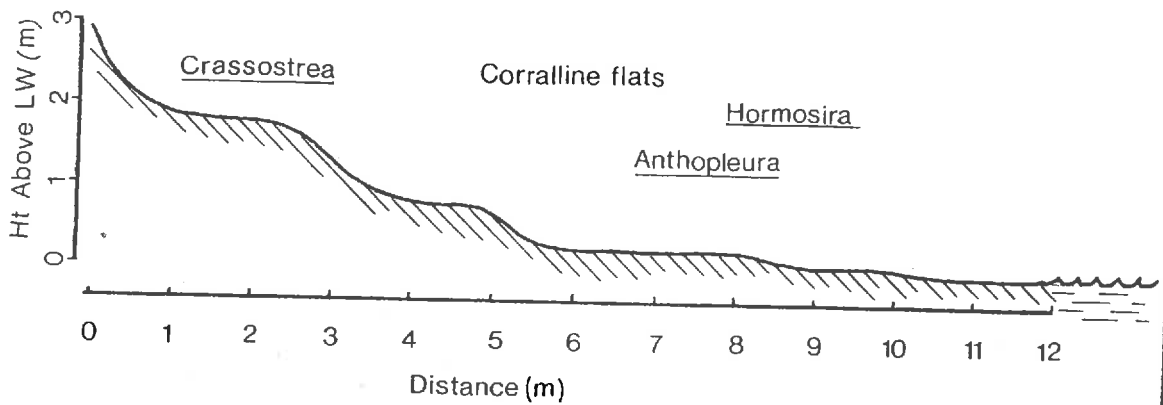
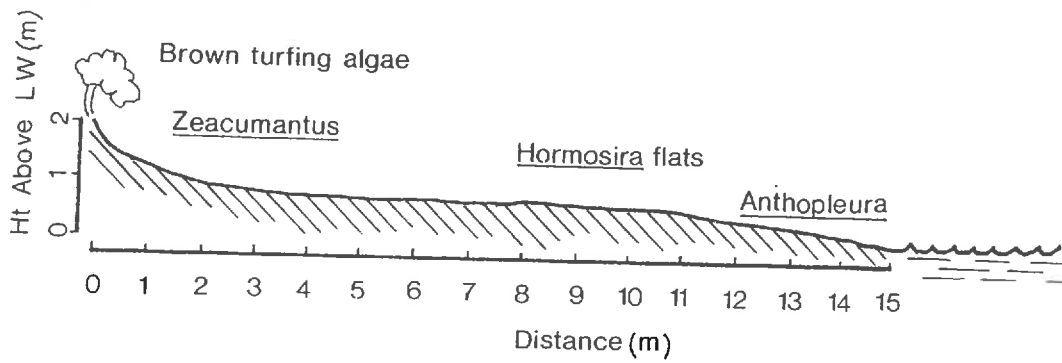


Figure 8

Blacksmiths Bay – Northwest Headland

Profile 1

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)



Profile 2

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)

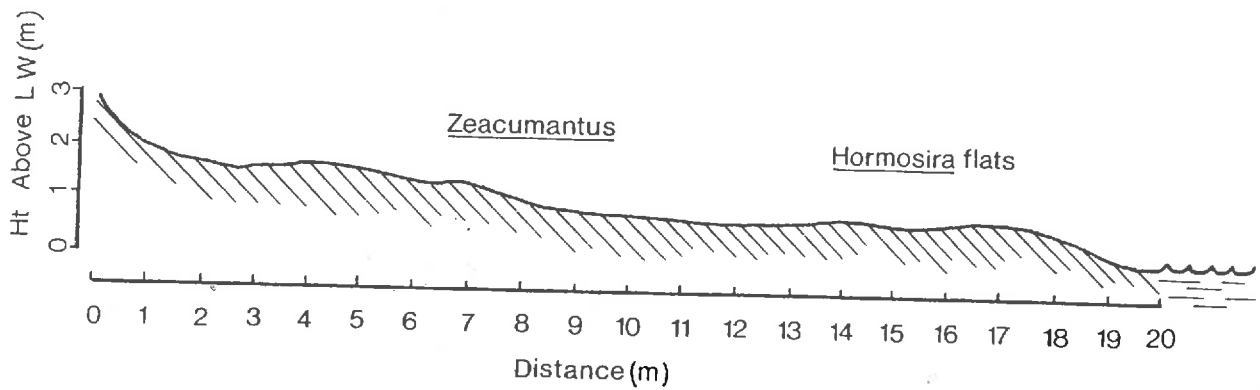
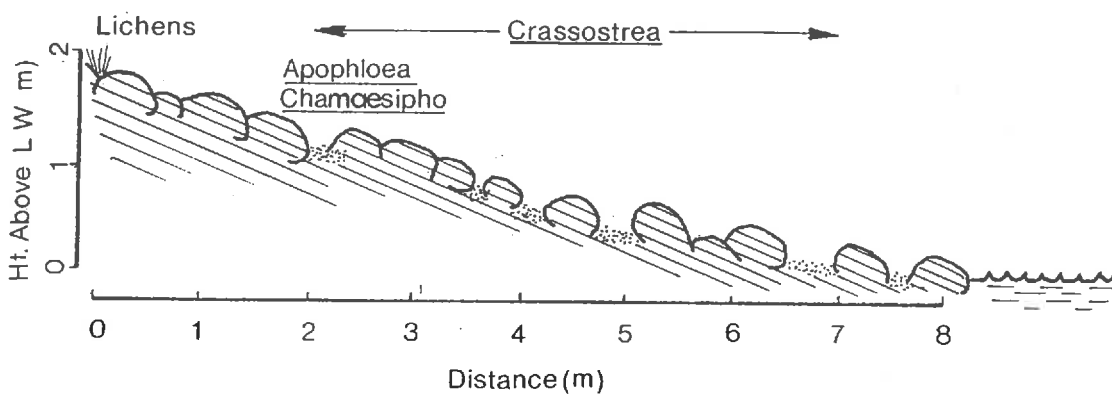


Figure 9

Motutapu Island – Inner

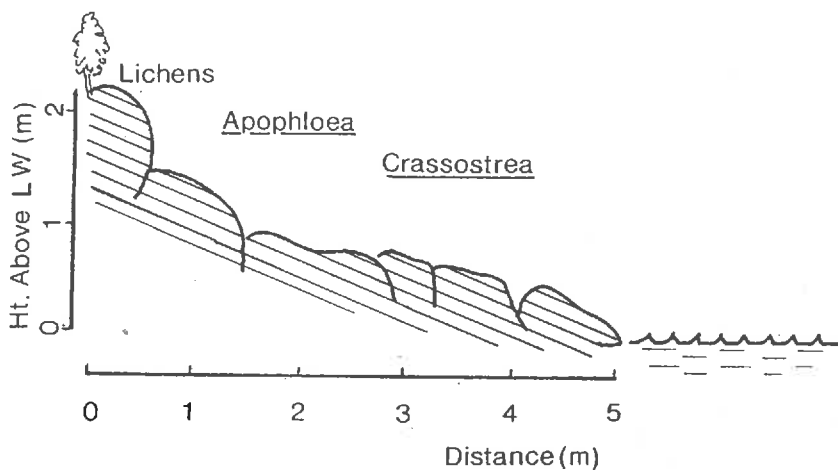
Profile 1

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)



Profile 2

SUPRA UPPER MIDDLE LOWER (LITTORAL ZONES)



columna were also present on the upper shore boulders. The second profile was over larger boulders and a steeper part of the shore compared with Profile One. Again, lichens were predominant on boulders at the highest point of the shore while A. sinclairii occupied the upper shore and C. gigas characterised the middle and low levels.

Motutapu Island - outer shore (Figure 10). The seaward side of the island also comprised large basalt boulders and steeply sloping shores. Lichens covered the boulders of the uppermost shore levels on both profiles, while Crassostrea gigas was dominant at the middle and lower shore levels. In the first profile Chamaesipho columna occupied the high part of the shore with Apophloea sinclairii covering boulders below this. Coralline paint and the blue mussel Mytilus edulis aoteanus were apparent at the lowest level. The low part of the shore in the second profile was characterised by Pomatoceros caeruleus, Hormosira banksii and coralline paint.

(b) Species Distribution - Southeast headland

A wide variety of species was found at this location, totalling 25 species and ranging from various types of algae, several species of marine snails together with encrusting fauna (refer to Appendix 1.1).

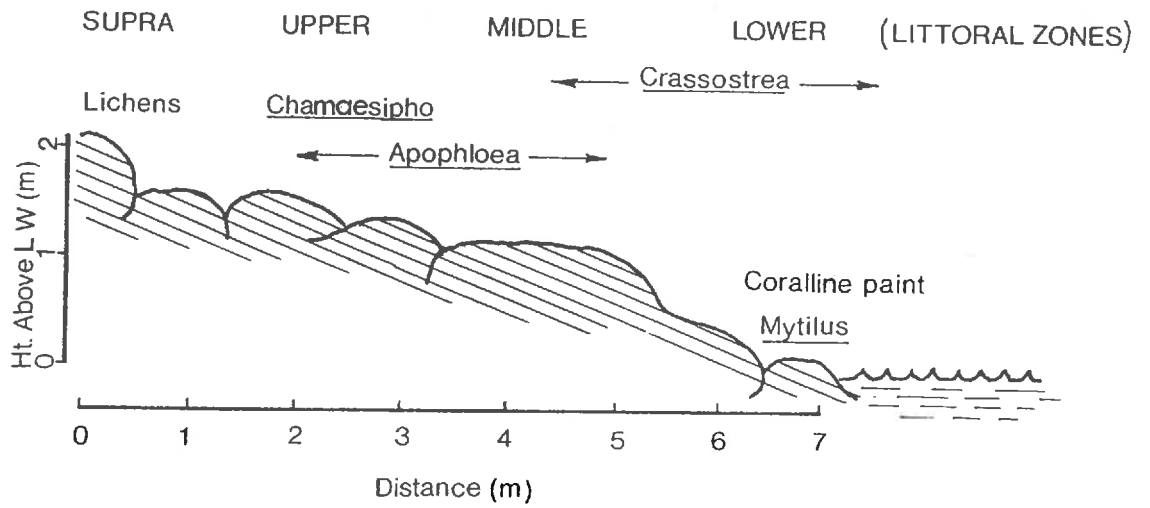
The abundances of species found at each of the four littoral levels, supra, upper, mid and lower for both transects are presented in Tables 1 and 2. It was apparent from both transects that the following species dominated various parts of the shore - Xenostrobus pulex, an unidentified brown turfing alga, Zeacumantus lutulentus, Melagraphia aethiops and Hormosira banksii.

At the upper level of both transects, Xenostrobus pulex, Zeacumantus lutulentus and the unidentified alga were predominant (Figures 11 & 12). However, the densities of these species were greater along the first transect compared with the second transect. Z. lutulentus showed variable patterns of distribution along both transects being initially high at upper and mid levels then declining rapidly. The snail Melagraphia aethiops was distributed relatively

Figure 10

Motutapu Island - Outer

Profile 1



Profile 2

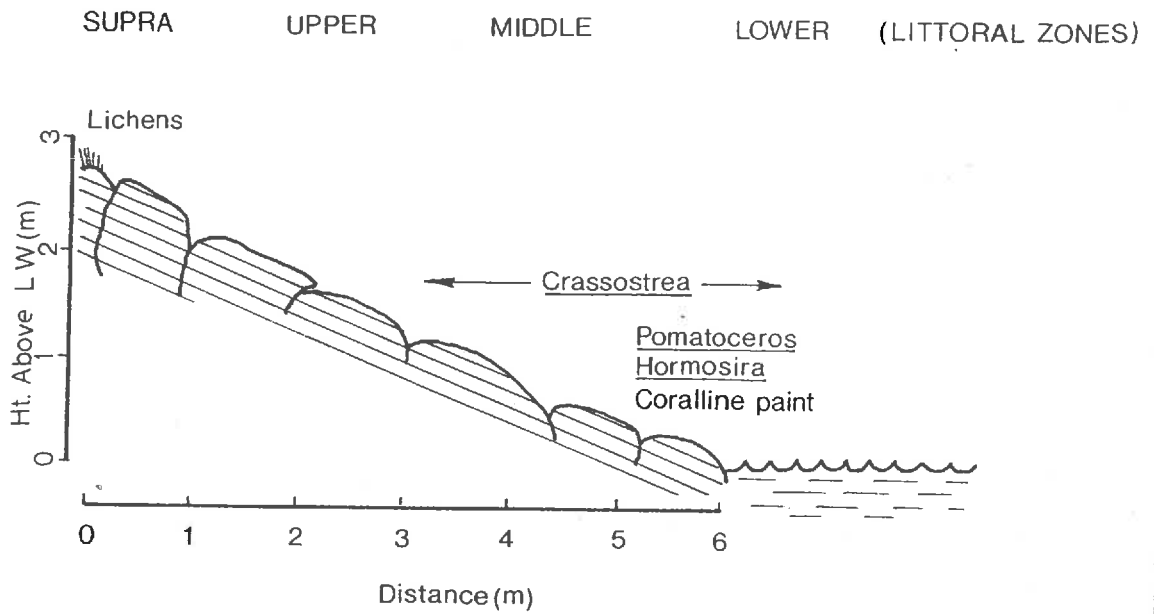


Table: 1

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Southeast headland transect 1

Date: 28/11/84

$\bar{x} \pm S.E., n=3$

Fauna	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
<u>Littorina unifasciata</u>	1.67 ± 1.67	1.0 ± 1.0		
<u>Melagraphia aethiops</u>		6.67 ± 1.45	12.0 ± 5.29	3.33 ± 3.33
<u>Melanerita atrimentosa</u>				
<u>Zeacumantus lutulentus</u>		90.33 ± 33.09	31.67 ± 5.24	
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>		1.33 ± 1.33	3.0 ± 1.53	10.33 ± 3.33
<u>Cominella maculosa</u>		0.33 ± 0.33		
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		2.0 ± 1.16	5.33 ± 2.41	2.33 ± 2.33
<u>Onchidella nigricans</u>				
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		28.33% ± 15.92	5.83% ± 5.84	
<u>Crassostrea gigas</u>		3.33 ± 3.33	2.0 ± 1.16	
<u>Mytilus edulis</u>		1.0 ± 1.0	4.33 ± 4.33	
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>		2.33 ± 1.45	7.0 ± 2.08	0.33 ± 0.33
<u>Acanthochitonia zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>			0.5% ± 0.25	
<u>Pomatoceros caeruleus</u>			1.17% ± 0.6	0.75% ± 0.1
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>			5.0% ± 3.8	5.83% ± 0.8
<u>Anthopleura aureoradiata</u>		0.66 ± 0.66	1.0 ± 1.0	7.0 ± 6.0
<u>Watersipora cucullata</u>				

Table: 1 cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Southeast headland Transect 1

Date: 28/11/84

$\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens				
Unidentified brown turf		2.58% \pm 1.45	5.17% \pm 0.79	1.33% \pm 1.33
Coralline paint		-	1.0% \pm 1.0	0.17% \pm 0.17
Coralline turf			0.92% \pm 0.79	19.17% \pm 2.92
<u>Ulva lactuca</u>				
<u>Hormosira banksii</u>		3.0 \pm 1.53	6.33 \pm 1.86	10.0 \pm 2.52
<u>Scytothamnus australis</u>				

Table: 2

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Southeast headland transect 2

Date: 28/11/84

$\bar{x} \pm S.E., n=3$

Fauna	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
<u>Littorina unifasciata</u>		12.0 ± 12.0		
<u>Melagraphia aethiops</u>		11.67 ± 4.64	1.33 ± 0.88	
<u>Melanerita atrimentosa</u>		1.33 ± 1.33		
<u>Zeacumantus lutulentus</u>		41.0 ± 10.13	15.67 ± 5.55	
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>		0.67 ± 0.67	3.33 ± 1.20	10.67 ± 4.18
<u>Cominella maculosa</u>		-	0.33 ± 0.33	
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>		-	2.67 ± 2.67	1.33 ± 0.88
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		14.0 ± 12.01	0.33 ± 0.33	
<u>Onchidella nigricans</u>		1.33 ± 1.33	19.33 ± 18.86	1.67 ± 0.33
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		7.58% ± 5.62		
<u>Crassostrea gigas</u>		9.0 ± 6.56	1.67 ± 1.20	
<u>Mytilus edulis</u>				
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>		9.5 ± 7.34	7.33 ± 2.19	0.67 ± 0.67
<u>Acanthochitonia zelandica</u>				0.33 ± 0.33
<u>Amaurochiton glaucus</u>				0.33 ± 0.33
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>		0.92% ± 0.92		
<u>Pomatoceros caeruleus</u>		0.42% ± 0.42	0.25% ± 0.14	
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>		0.33% ± 0.33	0.75% ± 0.63	1.17 ± 0.44
<u>Anthopleura aureoradiata</u>		-	6.33 ± 2.19	27.67 ± 14.33
<u>Watersipora cucullata</u>				

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Southeast headland transect 2

Date: 28/11/84

 $\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens				
Unidentified brown turf		5.25% \pm 1.26	-	0.83% \pm 0.83
Coralline paint			0.42% \pm 0.22	1.08% \pm 0.51
Coralline turf			13.86% \pm 9.64	59.67% \pm 25.5
<u>Ulva lactuca</u>				
<u>Hormosira banksii</u>		0.33 \pm 0.33	0.67 \pm 0.67	4.0 \pm 0.0
<u>Scytothamnus australis</u>				

Figure 11

Blacksmiths Bay Rocky Intertidal

S.E. Headland Transect 1, ($\bar{x} \pm \text{s.e.}, n=3$)

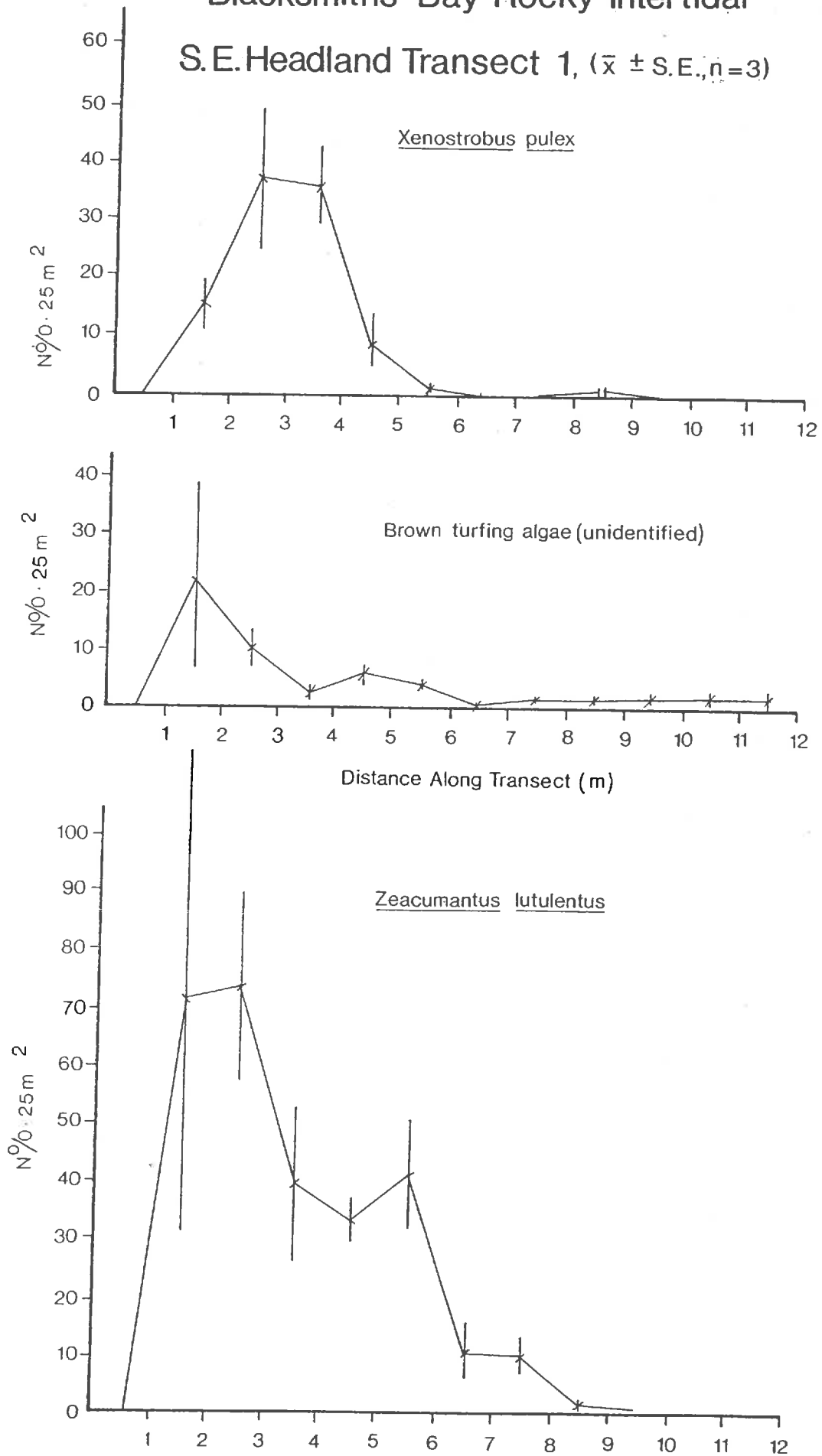


Figure 11 Continued

Blacksmiths Bay Rocky Intertidal
S.E. Headland Transect 1 ($\bar{x} \pm S.E., n = 3$)

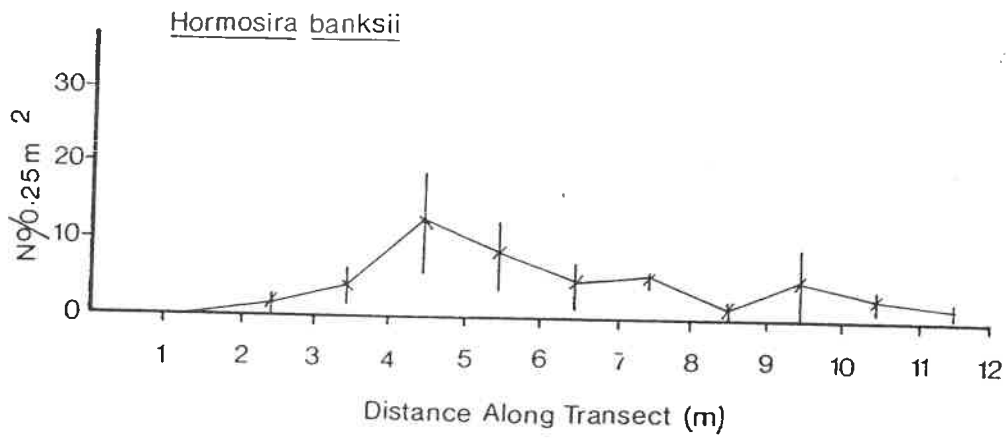
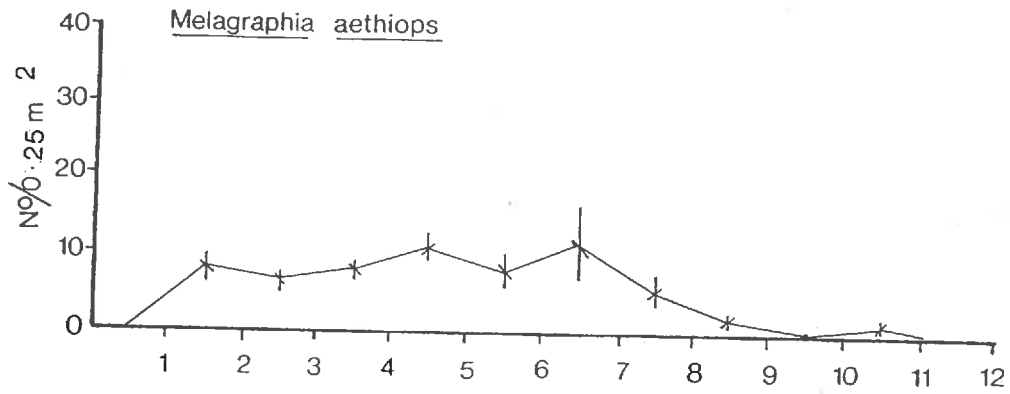


Figure 12

Blacksmiths Bay Rocky Intertidal
S.E. Headland Transect 2, ($\bar{x} \pm S.E.$, n=3)

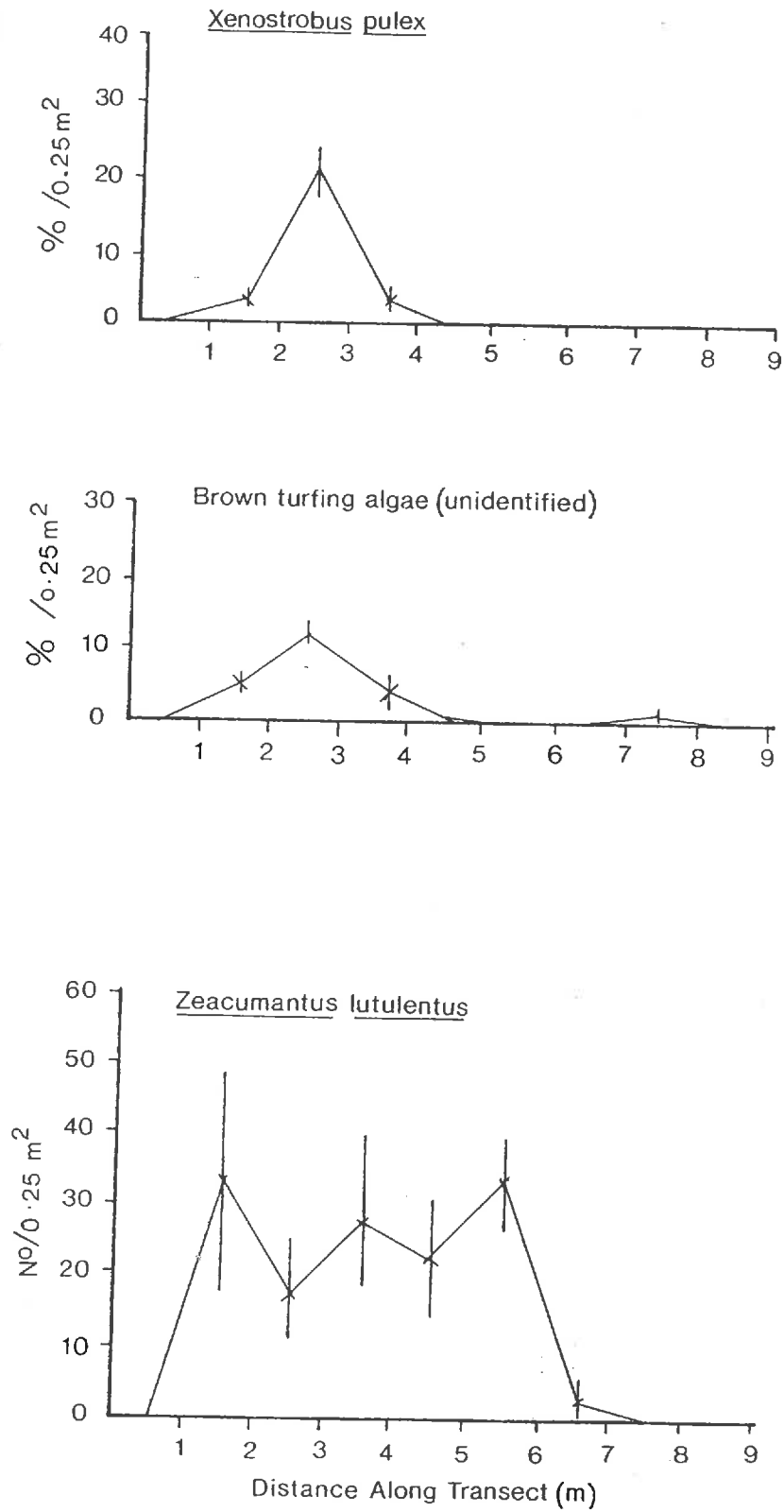
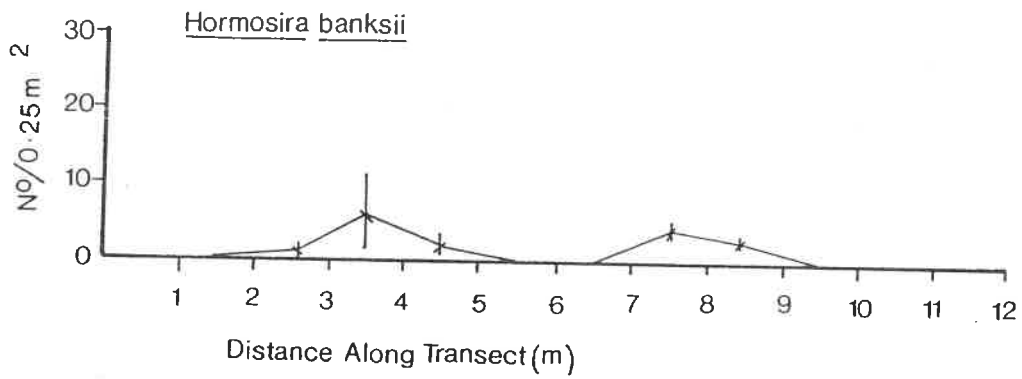
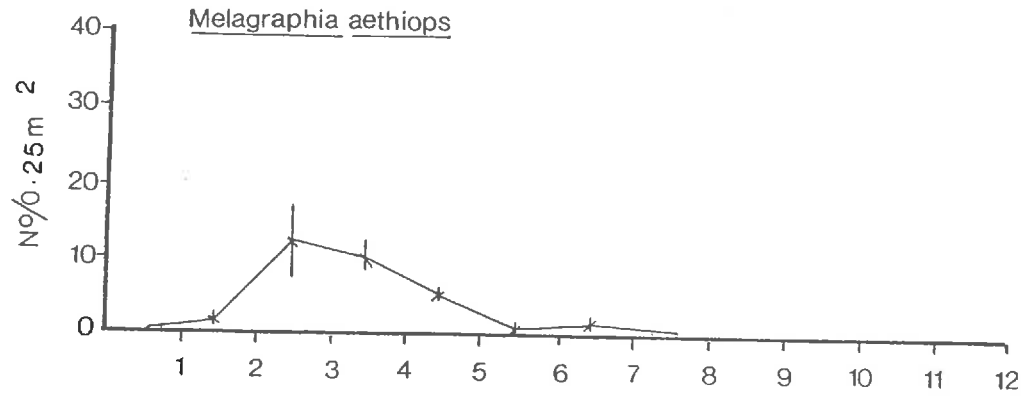


Figure 12 Continued

Blacksmiths Bay Rocky Intertidal

S.E. Headland Transect 2, ($\bar{x} \pm \text{s.e.}, n=3$)



evenly down the shore and tailed off to low numbers at the end of the first transect while there was a brief peak in abundance at the mid shore level in the second transect. Hormosira banksii was predominant from the middle of the shore downwards, although the noticeable reduction of densities in the middle of the second transect indicated a patchier distribution of this seaweed on this part of the reef.

Northwest Headland

The transects at this location revealed 30 species in addition to lichens. The species identified ranged from algae through to a number of marine snail species, a few bivalves and encrusting fauna (Appendix 1,2). The densities of this biota at the four shore levels are presented in Tables 3 and 4.

The main species occurring along the two transects in this area were Xenostrobus pulex, the unidentified brown turfing alga, two species of Zeacumantus - Z. lutulentus and Z. subcarinata, Melagraphia aethiops and Hormosira banksii. Their distribution down the shore is shown in Figures 13 & 14. The unidentified brown turfing alga occupied the upper shore in the first transect while it was barely evident in the second transect. X. pulex grew in small amounts on the upper and mid sections of both transects. The two species of the genus Zeacumantus dominated the transects down the shore. Z. lutulentus was abundant from the top of the shore down to the middle shore where numbers quickly declined while Z. subcarinatus dominated the lower shore. The high variances about the mean values at most points along the transect indicated that both species were patchy in their distributions. Another species of snail, M. aethiops occurred in low densities along the entire shore.

Hormosira banksii showed differing distributions down the shore in the area of the two transects. In the first transect, H. banksii was found in low densities above the middle of the shore then increased in numbers down the shore. In Transect Two H. banksii occupied the middle to lower shore only (Plate 5).

Motutapu Island - inner shore

The number of species recorded from the two transects at this location totalled 24 together with lichens. The species included several

Table: 3

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Northwest headland transect 1

Date: 4/12/84

 $\bar{x} \pm S.E., n=3$

Fauna	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>	6.0 ± 5.51			
<u>Melagraphia aethiops</u>		1.33 ± 0.67	1.0 ± 0.58	0.67 ± 0.33
<u>Melanerita atrimentosa</u>				
<u>Zeacumantus lutulentus</u>		5.0 ± 4.51	.	-
<u>Zeacumantus subcarinatus</u>			0.33 ± 0.33	
<u>Turbo smaragdus</u>		-	1.0 ± 1.0	6.0 ± 2.08
<u>Cominella maculosa</u>				
<u>Cominella glandiformis</u>			-	
<u>Cominella adpersa</u>				
<u>Diloma subrostrata</u>		2.0 ± 1.16	4.0 ± 3.06	0.33 ± 0.33
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		0.33 ± 0.33	1.67 ± 0.67	1.33 ± 0.88
<u>Onchidella nigricans</u>			-	-
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		0.17% ± 0.17		
<u>Crassostrea gigas</u>		-	-	
<u>Mytilus edulis</u>			-	
<u>Austrovenus stutchburyi</u>		0.33 ± 0.33	-	
<u>Anomia triganopsis</u>				0.33 ± 0.33
<u>Sypharochiton pelliserpentis</u>		0.67 ± 0.67	1.67 ± 1.67	2.67 ± 2.19
<u>Acanthochitonia zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>		-	-	
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>				
<u>Pomatoceros caeruleus</u>			0.33% ± 0.33	0.08% ± 0.08
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>		0.25% ± 0.25	1.42% ± 0.3	1.92% ± 1.54
<u>Anthopleura aureoradiata</u>		-	6.33 ± 5.37	32.67 ± 2.91
<u>Watersipora cucullata</u>				

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Northwest headland transect 1

Date: 4/12/84

$\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens				
Unidentified brown turf		1.83% \pm 1.59	-	0.08% \pm 0.08
Coralline paint			4.42% \pm 1.59	6.0% \pm 0.95
Coralline turf		0.08% \pm 0.08	2.08% \pm 0.46	16.75% \pm 12.96
<u>Ulva lactuca</u>				
<u>Hormosira banksii</u>		1.0 \pm 1.0	7.67 \pm 2.67	3.67 \pm 1.33
<u>Scytothamnus australis</u>				

Table: 4

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Northwest headland transect 2

Date: 4/12/84

$\bar{x} \pm S.E., n=3$

Fauna	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>	-			
<u>Melagraphia aethiops</u>			4.33 ± 2.34	2.67 ± 0.88
<u>Melanerita atrimentosa</u>	-			
<u>Zeacumantus lutulentus</u>		8.67 ± 4.38	22.67 ± 20.69	
<u>Zeacumantus subcarinatus</u>			18.67 ± 6.77	7.67 ± 7.67
<u>Turbo smaragdus</u>			1.33 ± 1.33	-
<u>Cominella maculosa</u>				
<u>Cominella glandiformis</u>		0.33 ± 0.33		
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>			2.67 ± 1.33	8.67 ± 4.71
<u>Lepsiella scobina</u>			-	0.33 ± 0.33
<u>Onchidella nigricans</u>			0.33 ± 0.33	
<u>Notoacmea parviconoidea</u>	-			
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		0.08% ± 0.08	0.25% ± 0.25	
<u>Crassostrea gigas</u>		1.0 ± 1.0	0.67 ± 0.67	1.33 ± 0.67
<u>Mytilus edulis</u>		0.33 ± 0.33	-	-
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>			-	1.33 ± 0.33
<u>Acanthochitonia zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>				
<u>Pomatoceros caeruleus</u>				0.42% ± 0.3
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>		1.75% ± 1.75	0.58% ± 0.58	0.83% ± 0.60
<u>Anthopleura aureoradiata</u>				
<u>Watersipora cucullata</u>				

Table. Cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Northwest headland transect 2

Date: 4/12/84

$\bar{x} \pm S.E., n=3$

Flora	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
Lichens	0.08% ± 0.08			
Unidentified brown turf			3.0% ± 2.4	
Coralline paint				
Coralline turf				
<u>Ulva lactuca</u>		6.5% ± 5.54		
<u>Hormosira banksii</u>				
<u>Scytothamnus australis</u>				4.33 ± 2.61

Figure 13
 Blacksmiths Bay Rocky Intertidal

N.W. Headland Transect 1 ($\bar{x} \pm \text{S.E.}$, n = 3)

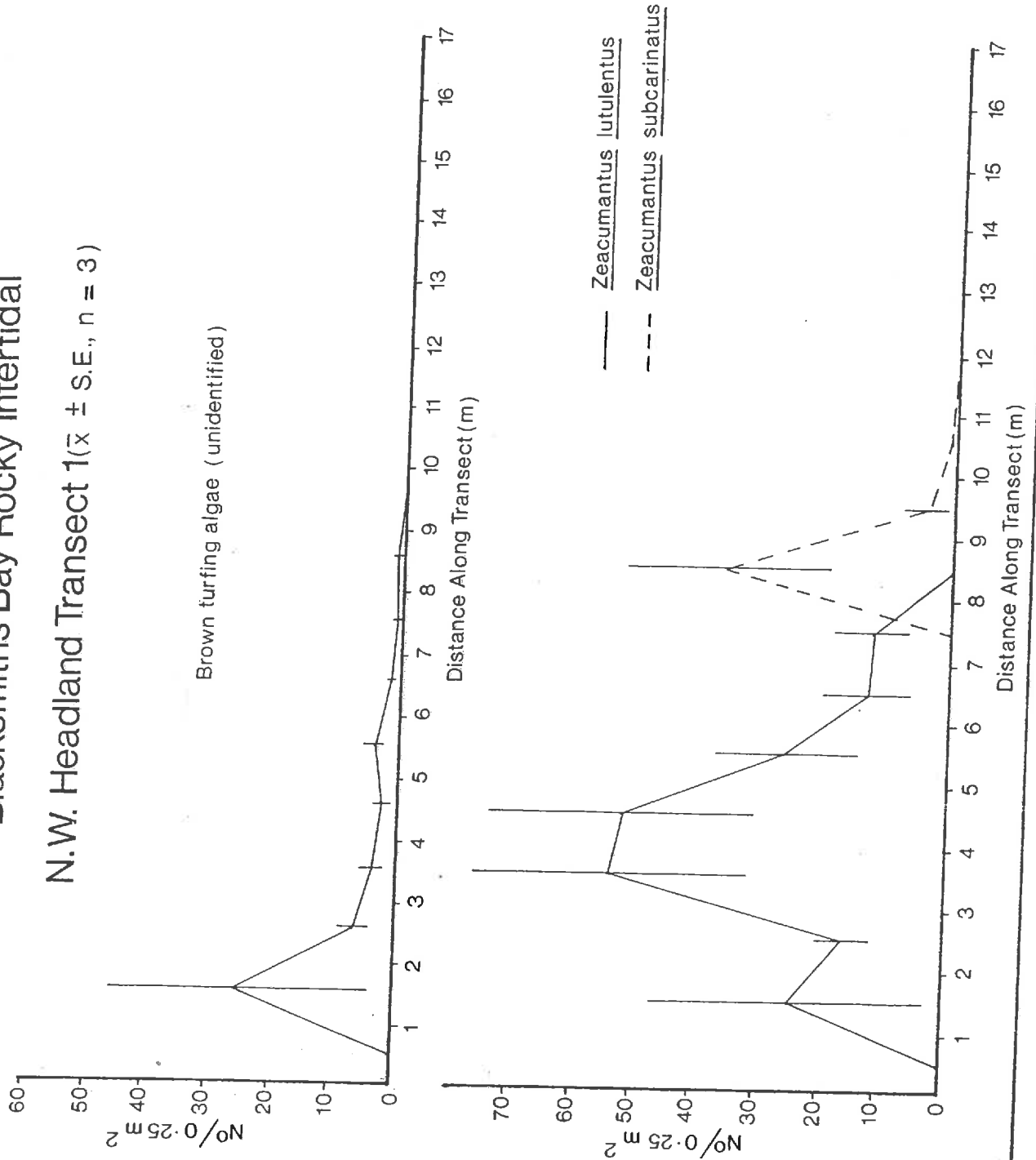


Figure 13 Continued

Blacksmiths Bay Rocky Intertidal

N.W. Headland Transect 1 ($\bar{x} \pm SE, n = 3$)

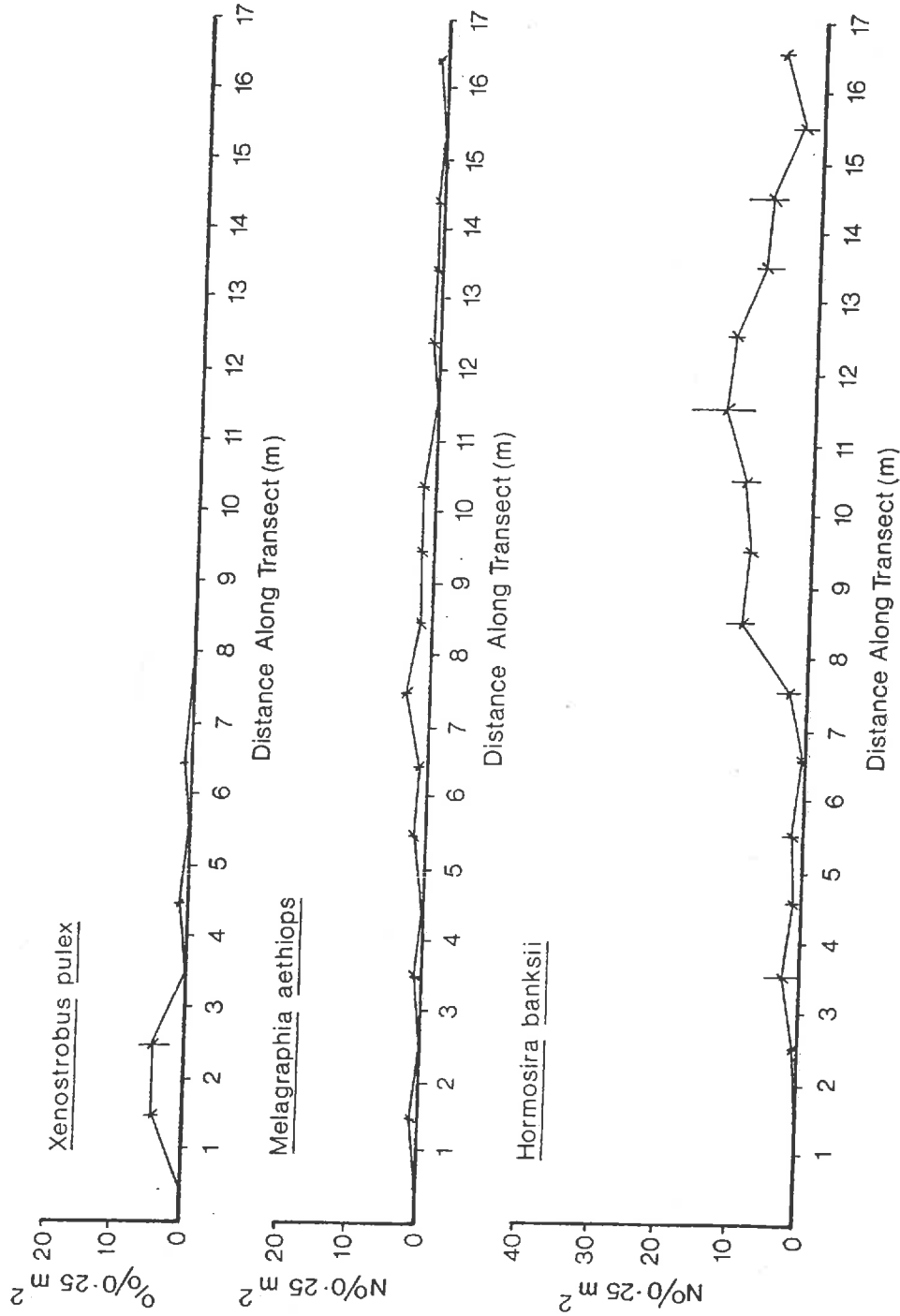


Figure 14

Blacksmiths Bay Rocky Intertidal

N.W. Headland Transect 2 ($\bar{x} \pm S.E.$, n = 3)

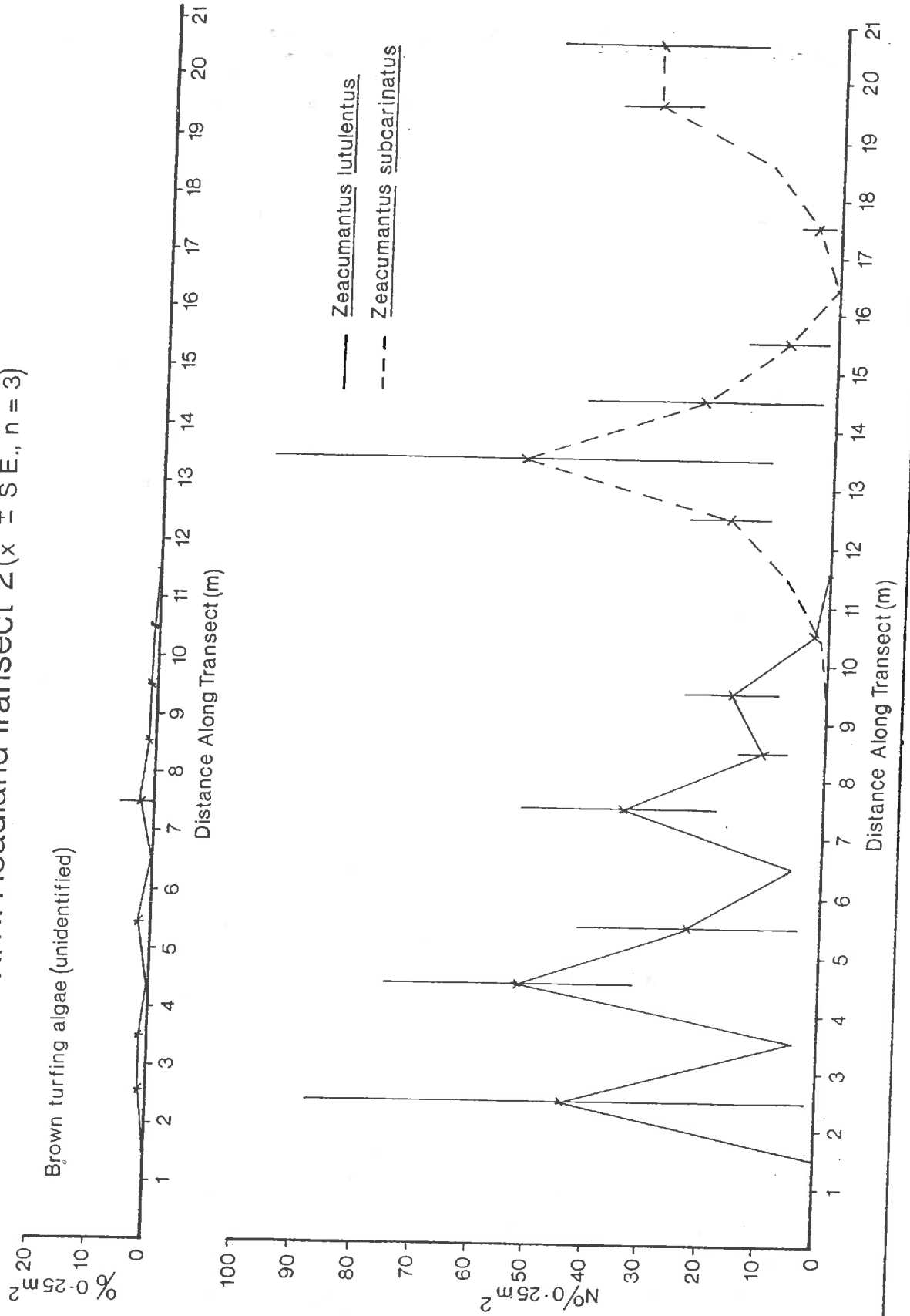
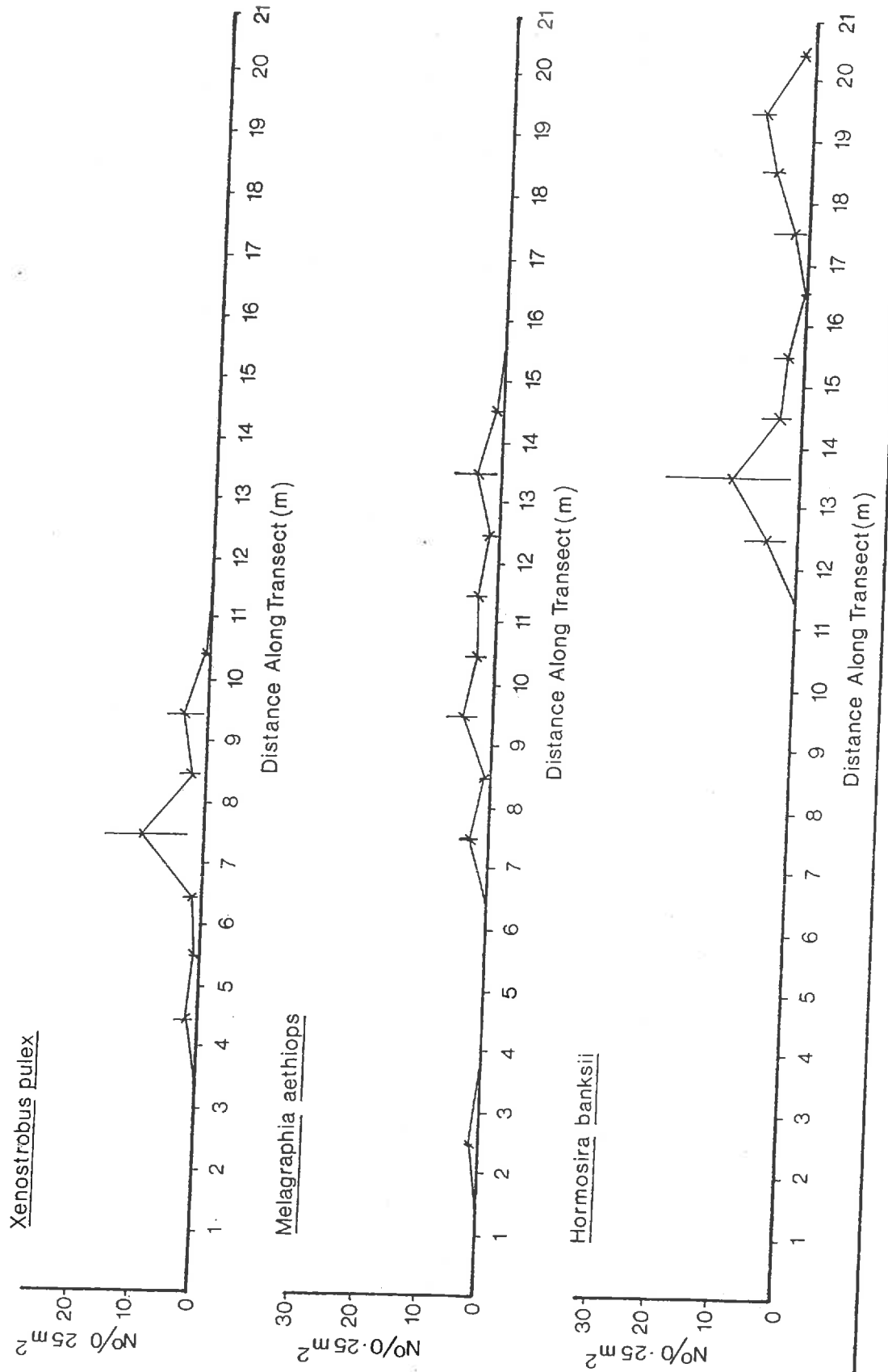


Figure 14 Continued
 Blacksmiths Bay Rocky Intertidal

N.W. Headland Transect 2 ($\bar{x} \pm S.E.$, n = 3)



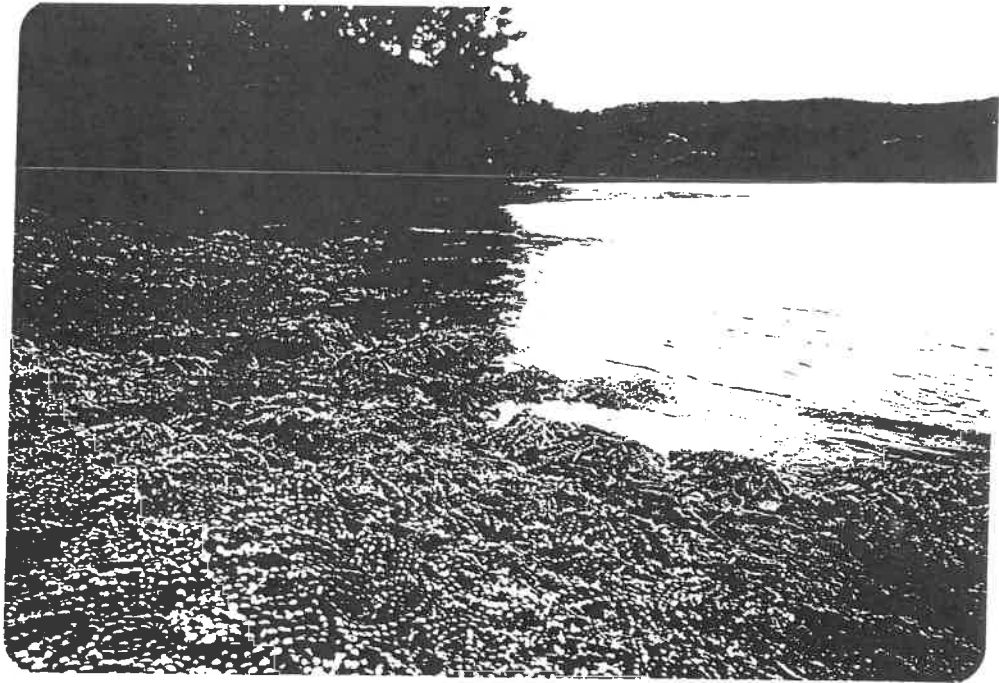


PLATE 5 : The Hormosira banksii (Neptune's necklace) bed in transect 1 on the Northwest headland site. The mangrove stand at Blacksmiths Bay can be seen in the background.

marine algae, a variety of snails, encrusting bivalves, and sponges and a crab (Appendix 1.3). The densities of these various organisms at the four levels of the shore are recorded in Tables 5 and 6.

Some of the predominant species have been graphed to show their changing densities along the two transects. Chamaesipho columna was the most abundant organism of the upper shore, although it covered a greater area in transect one than in transect two where its presence was negligible (Figures 15 & 16). In contrast Crassostrea gigas was noticeably abundant at mid to low shore levels in both transects. The clustering nature of the oyster around the boulders in this habitat allowed them to attain high densities. The chiton, Sypharochiton pelliserpentis, the oyster borer, Lepsiella scobina and the slug, Onchidella nigricans were also abundant in both transects at the same levels as these species are often found living amongst oysters.

Motutapu Island - outer shore

There were 23 species of flora and fauna counted along the transects at this location in addition to an unidentified ascidian and several unknown lichens (Appendix 1.4). Their densities at supra-, upper-, mid- and lowerlittoral shore levels are provided in Tables 7 and 8.

The predominant species on this shore were examined and graphed (Figures 17 & 18). It can be seen that Chamaesipho columna is slightly more common on this side of the island, occurring in both transects and peaking in abundance above the main beds of oysters in both transects. Crassostrea gigas occupied the middle to lower parts of the two transects and attained high densities although this species showed high variability owing to their clumping habit. Lepsiella scobina and Sypharochiton pelliserpentis showed similar trends, being found in greatest numbers amongst the oyster beds. An interesting feature is the densities and extremely high variability of S. pelliserpentis in the second transect. No explanation is immediately obvious from the data. However, as these animals can be very mobile, it could be expected that they would tend to clump in variable densities amongst the oysters. Onchidella nigricans was poorly represented on this shore.

Table: 5

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - inner transect 1

Date: 11/12/84

 $\bar{x} \pm S.E., n=3$

Fauna	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>	0.33 ± 0.33			
<u>Melagraphia aethiops</u>		0.33 ± 0.33	2.0 ± 1.16	0.67 ± 0.33
<u>Melanerita atrimentosa</u>		1.33 ± 0.33	-	
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>				
<u>Cominella maculosa</u>				
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		1.33 ± 1.33	3.33 ± 0.33	2.33 ± 0.88
<u>Onchidella nigricans</u>		-	18.33 ± 16.36	1.0 ± 0.0
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		1.11% ± 1.11	0.67% ± 0.17	
<u>Crassostrea gigas</u>		20.0 ± 8.55	48.0 ± 4.73	16.0 ± 7.95
<u>Mytilus edulis</u>			0.67 ± 0.67	3.33 ± 2.34
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>			2.0 ± 1.0	3.67 ± 1.67
<u>Acanthochitonia zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>	3.17% ± 2.80	15.08% ± 2.68		
<u>Pomatoceros caeruleus</u>				2.86% ± 1.54
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>				
<u>Anthopleura aureoradiata</u>				
<u>Watersipora cucullata</u>				

Table: 5 cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - inner, transect 1

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens	30.67% \pm 14.89			
Unidentified brown turf				0.08% \pm 0.08
Coralline paint				
Coralline turf				
<u>Ulva lactuca</u>				
<u>Hormosira banksii</u>				
<u>Scytothamnus australis</u>				
<u>Apophloea sinclairii</u>		12.33% \pm 7.76	0.08% \pm 0.08	

Table: 6

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - inner, transect 2

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Fauna	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>				
<u>Melagraphia aethiops</u>		0.33 ± 0.33	1.33 ± 0.88	0.33 ± 0.33
<u>Melanerita atrimentosa</u>				
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>			0.33 ± 0.33	1.67 ± 0.33
<u>Cominella maculosa</u>				
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				1.67 ± 1.2
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		2.67 ± 0.88	6.67 ± 0.67	7.67 ± 1.20
<u>Onchidella nigricans</u>			41.67 ± 17.21	46.33 ± 18.96
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>			1.67 ± 1.20	
<u>Xenostrobus pulex</u>				
<u>Crassostrea gigas</u>		3.0 ± 2.0	25.0 ± 5.87	17.67 ± 5.93
<u>Mytilus edulis</u>				12.33 ± 3.72
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>			2.33 ± 1.86	6.33 ± 3.76
<u>Acanthochitonia zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				0.67 ± 0.55
<u>Chamaesipho columna</u>				
<u>Pomatoceros caeruleus</u>			0.08% ± 0.08	3.83% ± 0.73
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>				
<u>Anthopleura aureoradiata</u>				
<u>Watersipora cucullata</u>				

Table: 6 cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - inner, transect 2

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Flora	Littoral Zones of the intertidal			Lower
	Supra	Upper	Mid	
Lichens	22.42% ± 15.46			
Unidentified brown turf				0.58% ± 0.58
Coralline paint				
Coralline turf				
<u>Ulva lactuca</u>				0.83% ± 0.58
<u>Hormosira banksii</u>				
<u>Scytothamnus australis</u>				
<u>Apophloea sinclairii</u>		7.25% ± 2.75		

Figure 15

Blacksmiths Bay Rocky Intertidal

Motutapu Island Inner Shore Tr 1 ($\bar{x} \pm S.E., n=3$)

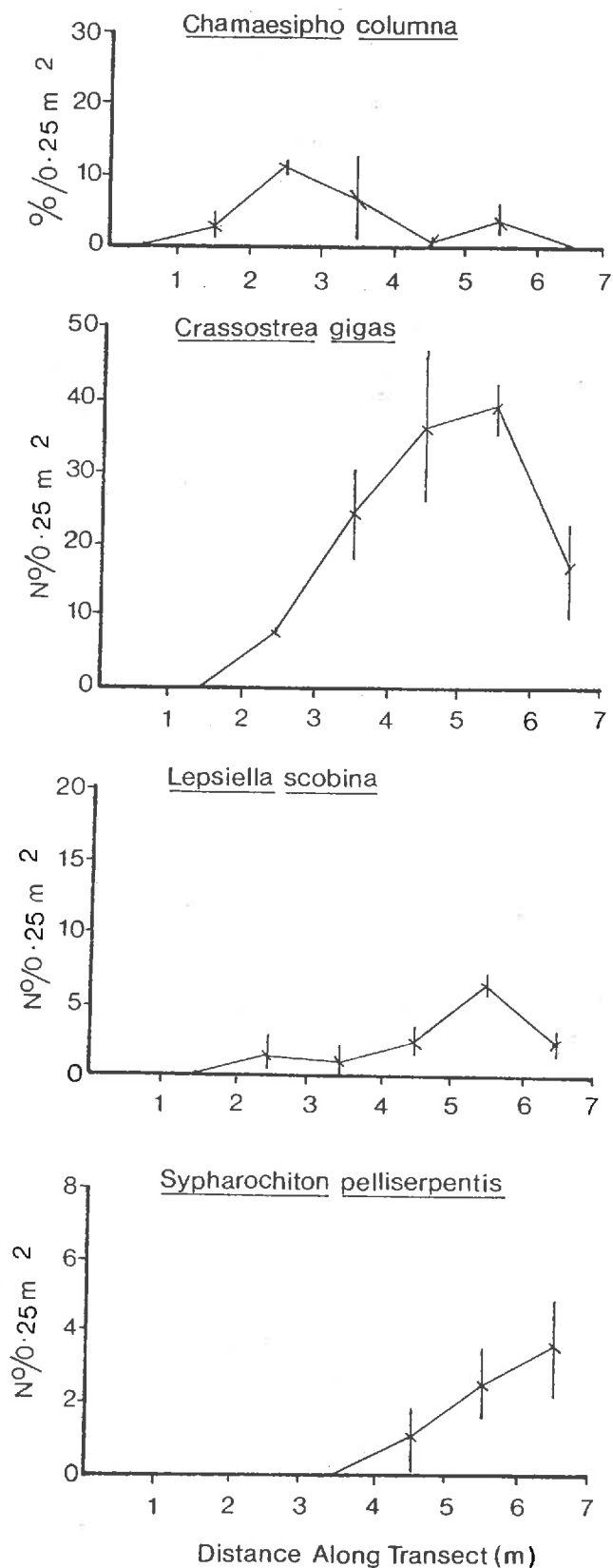


Figure 15 Continued

Blacksmiths Bay Rocky Intertidal

Motutapu Island Inner Shore Tr 1 ($\bar{x} \pm s E, n=3$)

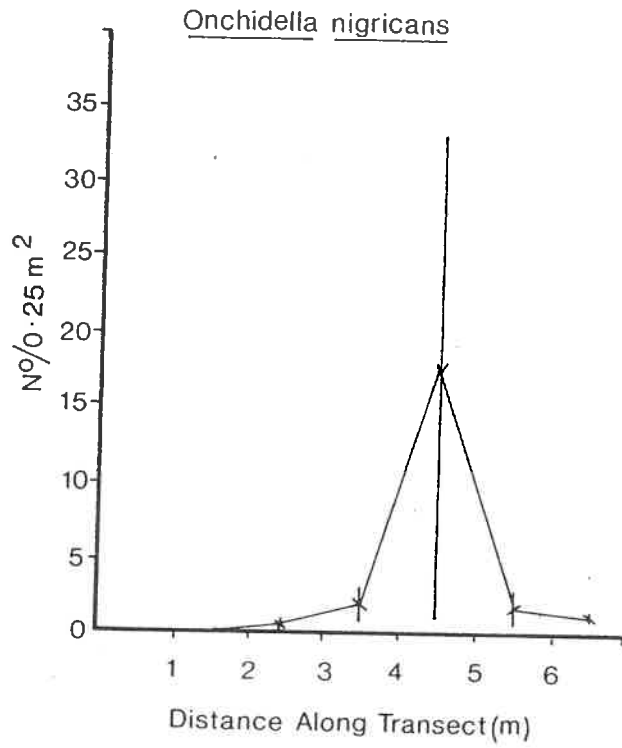


Figure 16

Blacksmiths Bay Rocky Intertidal

Motutapu Island Inner Shore Tr 2 ($\bar{x} \pm S.E., n=3$)

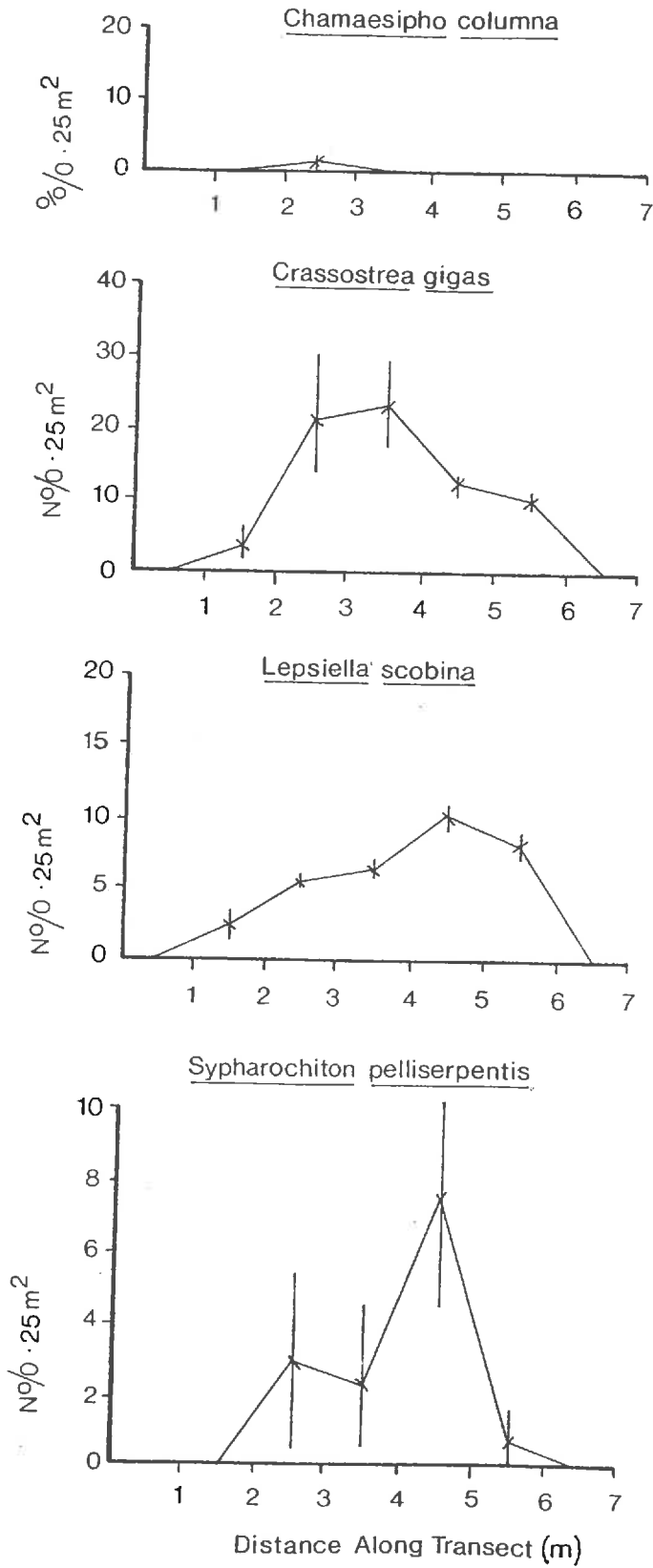


Figure 16 Continued

Blacksmiths Bay Rocky Intertidal

Motutapu Island Inner Shore Tr 2 ($\bar{x} \pm S E., n=3$)

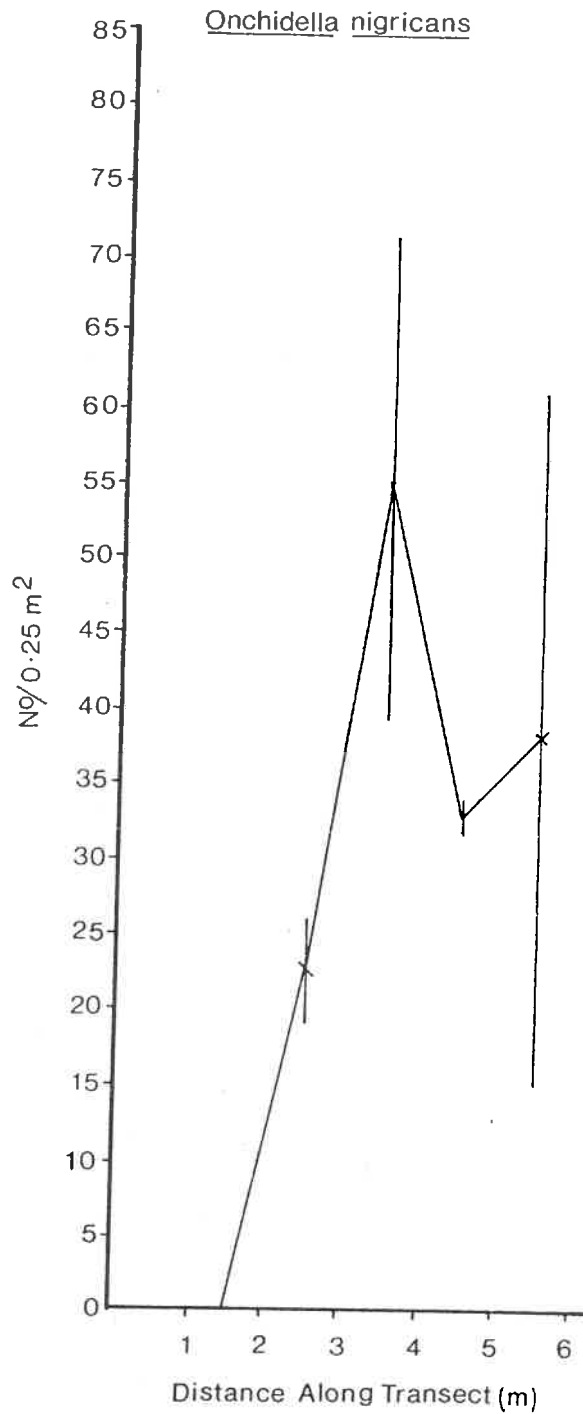


Table: 7

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - Outer, Transect 1

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Fauna	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
<u>Littorina unifasciata</u>		0.33 ± 0.33		
<u>Melagraphia aethiops</u>			1.33 ± 1.33	0.66 ± 0.66
<u>Melanerita atrimentosa</u>		1.33 ± 0.33		
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>		0.33 ± 0.33	1.67 ± 0.88	
<u>Cominella maculosa</u>				1.0 ± 1.0
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		1.0 ± 0.58	14.33 ± 6.07	3.33 ± 1.33
<u>Onchidella nigricans</u>			0.33 ± 0.33	
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>				
<u>Crassostrea gigas</u>		0.33 ± 0.33	11.33 ± 1.45	23.0 ± 5.04
<u>Mytilus edulis</u>			1.67 ± 1.67	5.0 ± 2.08
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>				6.33 ± 1.45
<u>Acanthochitonia zelandica</u>				1.0 ± 1.0
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>	0.16% ± 0.16	9.42% ± 3.87		
<u>Pomatoceros caeruleus</u>				2.58% ± 0.65
<u>Maoricrypta monoxyla</u>				
<u>Ascidian</u>				
<u>Elminius modestus</u>				
<u>Anthopleura aureoradiata</u>				
<u>Watersipora cucullata</u>				

Table: / cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - outer, transect 1.

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens	21.33% \pm 12.99			
Unidentified brown turf		0.5% \pm 0.5	0.25% \pm 0.25	0.25% \pm 0.14
Coralline paint			0.42% \pm 0.42	3.33% \pm 2.21
Coralline turf				0.58% \pm 0.58
<u>Ulva lactuca</u>				
<u>Hormosira banksii</u>			1.0 \pm 1.0	1.0 \pm 0.58
<u>Scytothamnus australis</u>				
<u>Apophloea sinclairii</u>		10.92% \pm 5.5	5.42% \pm 2.47	

Table: 8

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - Outer, transect 2

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Fauna	Littoral Zones of the intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>				
<u>Melagraphia aethiops</u>				
<u>Melanerita atrimentosa</u>		1.67 ± 1.2	2.0 ± 1.00	
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>			0.67 ± 0.33	1.33 ± 0.33
<u>Cominella maculosa</u>				0.33 ± 0.33
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>			5.0 ± 2.52	5.0 ± 2.08
<u>Onchidella nigricans</u>				0.33 ± 0.33
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				1.33 ± 1.33
<u>Xenostrobus pulex</u>				
<u>Crassostrea gigas</u>		0.66 ± 0.33	21.67 ± 12.36	17.0 ± 4.0
<u>Mytilus edulis</u>			3.67 ± 2.34	3.33 ± 2.03
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>				10.67 ± 8.75
<u>Acanthochitonia zelandica</u>				0.66 ± 0.66
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				0.33 ± 0.33
<u>Cliona</u>				0.17 ± 0.17
<u>Chamaesipho columna</u>	0.25 ± 0.14	4.08 ± 0.65		
<u>Pomatoceros caeruleus</u>				5.33 ± 3.80
<u>Maoricrypta monoxyla</u>			0.33 ± 0.33	0.67 ± 0.33
<u>Ascidian</u>				1.67 ± 1.67
<u>Elminius modestus</u>				
<u>Anthopleura aureoradiata</u>				
<u>Watersipora cucullata</u>				

Table: 8 cont.

Blacksmiths Bay Marina Proposal

Rocky Intertidal Quadrat Sample Sheet

Site: Motutapu Island - Outer, transect 2

Date: 11/12/84

$\bar{x} \pm S.E., n=3$

Flora	Supra	Littoral Zones of the intertidal		
		Upper	Mid	Lower
Lichens	14.08% \pm 7.44			
Unidentified brown turf			1.33% \pm 0.44	0.25% \pm 0.25
Coralline paint				3.0% \pm 1.44
Coralline turf				1.5% \pm 0.58
<u>Ulva lactuca</u>				4.33 \pm 1.67
<u>Hormosira banksii</u>				
<u>Scytothamnus australis</u>				
<u>Apophloea sinclairii</u>			5.67% \pm 4.77	

Figure 17

Blacksmiths Bay Rocky Intertidal

Motutapu Island Outer Shore Tr 1 ($\bar{x} \pm S E, n=3$)

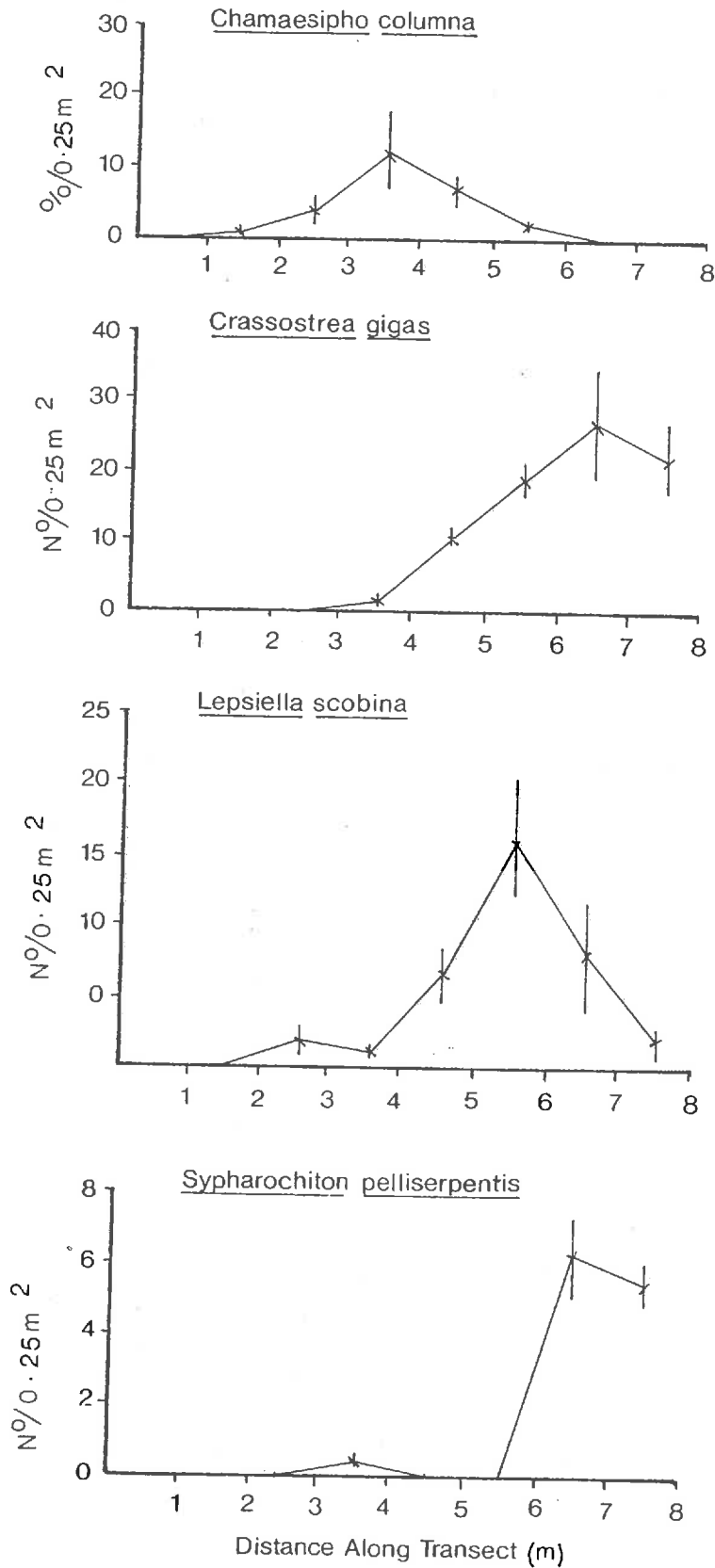


Figure 17 Continued

Blacksmiths Bay Rocky Intertidal

Motutapu Island Outer Shore Tr1($\bar{x} \pm S.E., n = 3$)

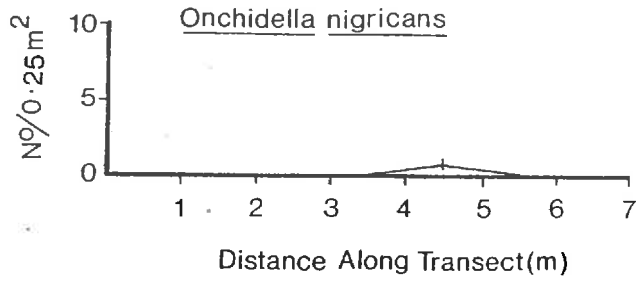


Figure 18

Blacksmiths Bay Rocky Intertidal

Motutapu Island Outer Shore Tr 2 ($\bar{x} \pm s E n=3$)

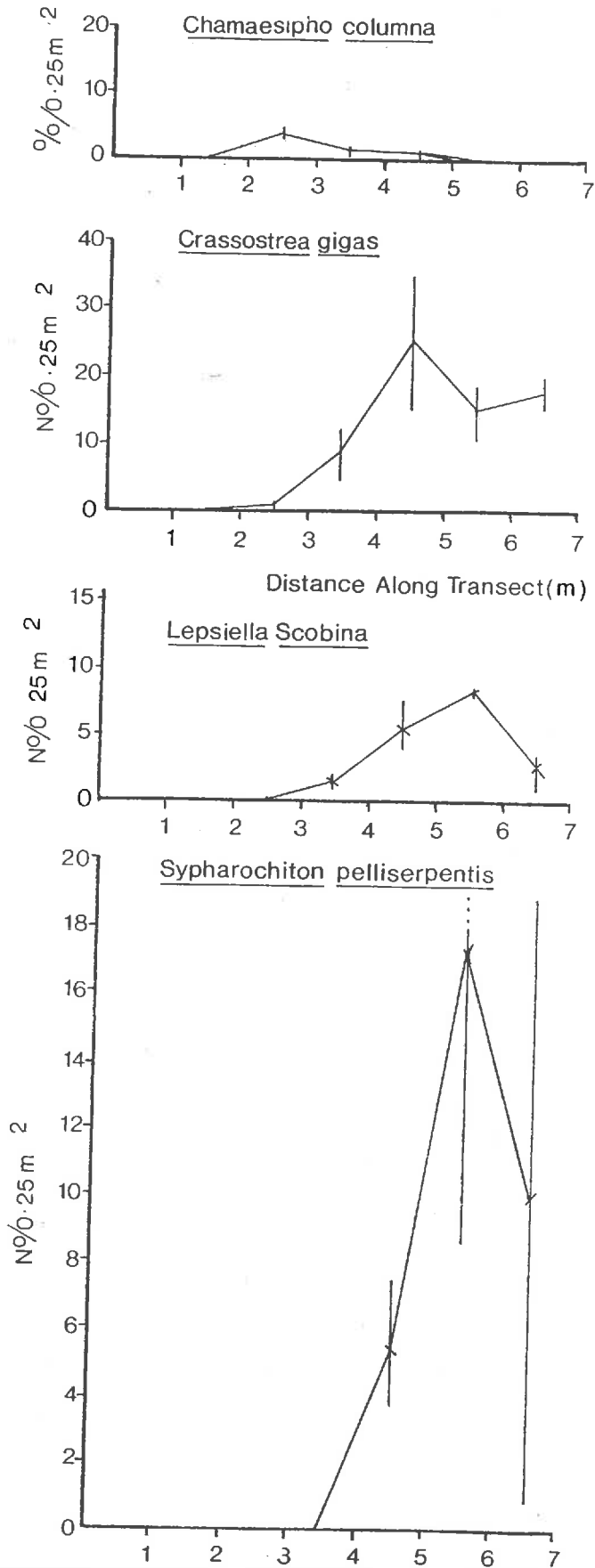
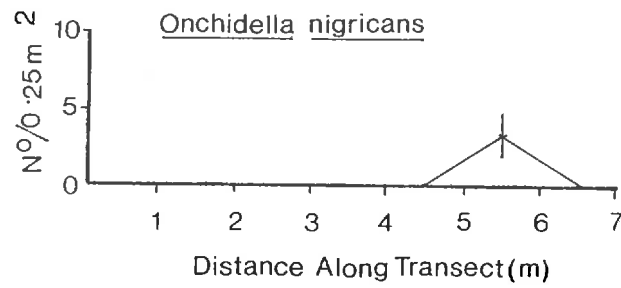


Figure 18 Continued

Blacksmiths Bay Rocky Intertidal

Motutapu Island Outer Shore Tr 2 ($\bar{x} \pm S E., n = 3$)



As a general comparison, the species of flora and fauna identified from the upper Waikare Inlet and the upper Te Puna Inlet sites are presented in Appendices 4.1 & 4.2.

3.1.2 Soft Shores

(a) Site Descriptions

Blacksmiths Bay - proposed marina site (Figure 19).

This area comprises a shallow, predominantly muddy, embayment which drains at low water to expose a large area of intertidal mudflat. A mature mangrove forest covers a significant proportion of the upper intertidal area while a sandbar containing live cockles intersects the middle part of this area. A small stream runs through the mudflat area.

Southeast Blacksmiths Bay (Figure 19).

This site is sandier than the proposed marina area and the sediments comprise coarse sand and small pebbles in the upper and mid levels while the sediments become progressively muddier at the lower level. A slight flow of fresh water runs across a layer of hard sandstone at the eastern end of the beach while the western end tends to be muddier. There are few maritime species of vegetation and no mangroves while the upper shore level is bordered by a moderately steep native bush-covered slope.

Northwest Blacksmiths Bay (Figure 19).

This area appears to show the combined physical characteristics of both the proposed marina site and the southeastern location. There is a moderately large intertidal area exposed at low tide with a small stream passing through the upper level and near the centre of the bay. The sediments are coarse and sandy with small pebbles at the upper level while the finer muds become progressively deeper at the middle and lower levels. Cockle and pipi banks are apparent at upper to middle levels. There is no mangrove zone at this location although a band of maritime plant species occupies a small area above the intertidal zone.

(b) Species Distribution

Blacksmiths Bay - proposed marina site (Appendix 2.1).

A varying assemblage of animals was identified from samples made in this area including two

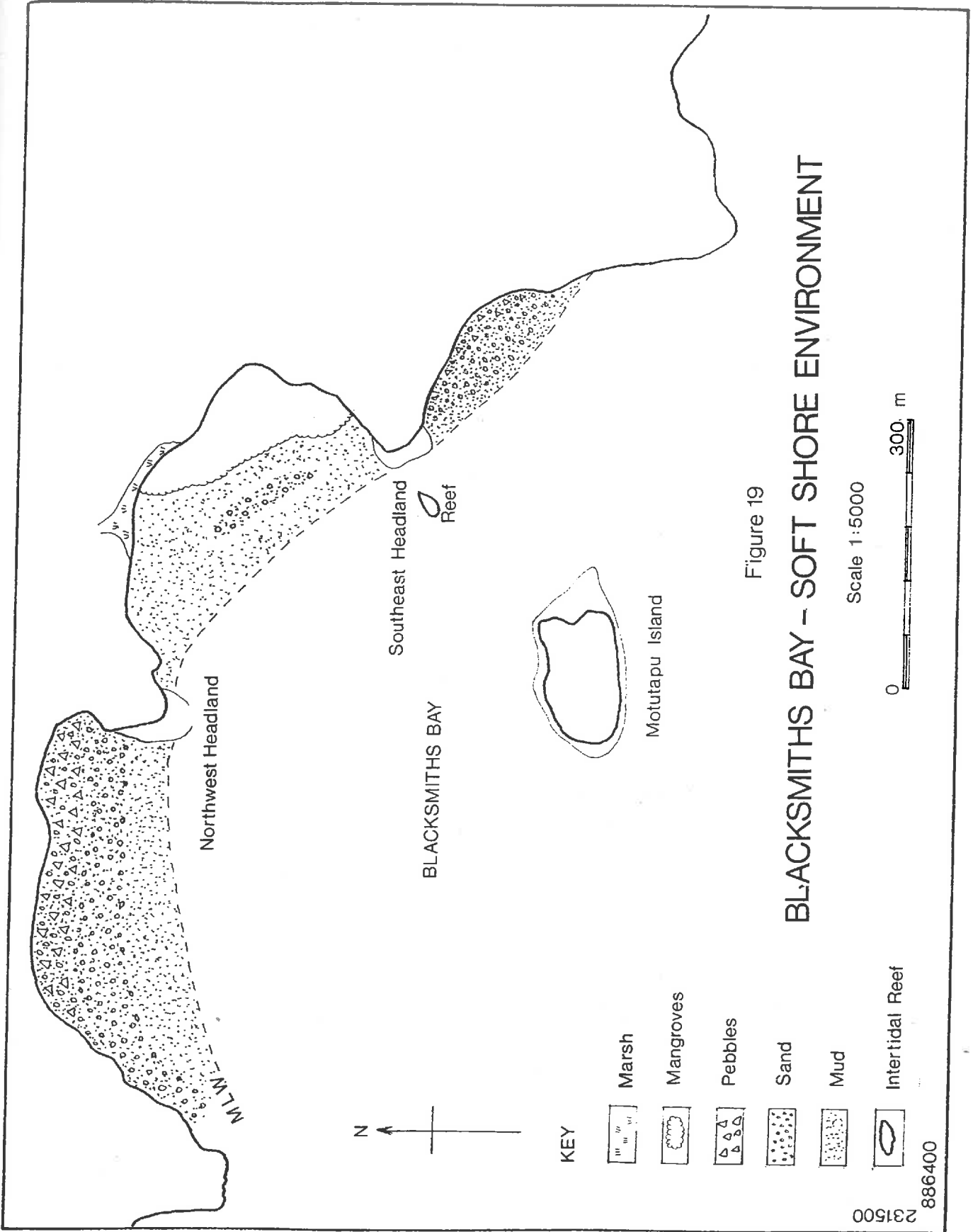








Figure 19

BLACKSMITHS BAY - SOFT SHORE ENVIRONMENT

Scale 1:5000



KEY

-  Marsh
-  Mangroves
-  Pebbles
-  Sand
-  Mud
-  Intertidal Reef

231500
886400

unidentified species of worms, while two plant species (Hormosira banksii and the mangrove, Avicennia marina var. resinifera) were recorded from the upper intertidal shore.

The densities of species were examined along the two transects at the four shore levels - mangrove zone, upper, mid and lower levels.

On the shore under the mangrove forest, there were a number of species of animals living on top of the compacted sediments or on the mangrove pneumatophores which protruded from the sediments. Zeacumantus lutulentus was the most abundant species and was found throughout the mangrove area (Tables 9 and 10, Figures 20 & 21). In both transects Z. lutulentus occurred in moderate densities in the upper and middle sections of the mangrove forest and peaked in densities just before the seaward edge of the mangrove forest where the sediments became very soft and uncompacted. It was in this area that Crassostrea gigas proliferated, being virtually absent at the upper and middle area.

The barnacle Elminius modestus was common at mid and lower sections of the mangrove area, its presence dependent upon the mangrove pneumatophores for a settlement surface. This was true also for the less common Xenostrobus pulex. Density estimates of these two species were not made as the pneumatophores on which they lived provided an additional surface area to that within the 0.25 m² sampling quadrat.

The remaining species were mainly snails and Hormosira banksii which occurred in low densities.

The other three shore levels contained animals which lived both within the uncompacted, soft sediments and on the surface. These are outlined in Tables 11 and 12.

In the first transect the three predominant species (Austrovenus stutchburyi, Macoma liliana and Macrophthalmus hirtipes) which occurred in relatively high densities were examined in detail (Figure 22). The A. stutchburyi and M. liliana bed occurred at upper to mid intertidal levels with A. stutchburyi living in the well oxygenated top sediment layer and M. liliana, with their longer siphons, able to tolerate the large area of deeper, anoxic sediments. The numbers of both

TABLE: 9

BLACKSMITHS BAY MARINA PROPOSAL

DATE: 30/1/85

Soft Intertidal Shore Quadrat Sample Sheet

Site: Blacksmiths Bay, proposed marina site - Mangrove forest, Transect 1

 $\bar{x} \pm S.E., n=5$

p = present

DISTANCE THROUGH MANGROVE FOREST (m)

Fauna	DISTANCE THROUGH MANGROVE FOREST (m)						30
	0	5	10	15	20	25	
<u>Zeacumantus lutulentus</u>	-	11.0 ± 4.88	3.6 ± 2.2	9.2 ± 1.24	22.4 ± 11.19	0.6 ± 0.39	0.6 ± 0.59
<u>Crassostrea gigas</u>	-	-	-	-	25.2 ± 6.7	17.0 ± 6.78	20.6 ± 1.12
<u>Diloma subrostrata</u>	-	0.2 ± 0.2	-	0.4 ± 0.24	0.2 ± 0.20	0.4 ± 0.24	0.6 ± 0.39
<u>Cominella glandiformis</u>	-	-	0.2 ± 0.2	-	0.8 ± 0.49	-	-
<u>Turbo smaragdus</u>	-	-	-	-	1.6 ± 0.59	0.4 ± 0.24	0.4 ± 0.24
<u>Melanerita atrimentosa</u>	-	-	-	-	0.2 ± 0.2	-	-
<u>Onchidella nigricans</u>	-	-	-	-	-	0.4 ± 0.4	-
<u>Xenostrobus pulex</u>	-	-	-	-	P	P	P
<u>Elminius modestus</u>	P	-	-	-	P	P	P
Flora							
<u>Hormosira banksii</u>	-	0.2 ± 0.2	-	-	0.2 ± 0.2	-	-

Soft Inter-tidal Shore Quadrat Sample Sheet.

Site - Blacksmiths Bay proposed Marina Site - Mangrove Forest.
transect 2. $\bar{x} \pm SE, n = 5$

p = present

FAUNA

DISTANCE THROUGH MANGROVE FOREST (m)

	0	5	10	15	20	25	30
<u>ZeaCumantus</u> <u>lutulentus</u>	5.0 ± 2.4	6.6 ± 1.21	7.6 ± 1.63	7.0 ± 0.95	8.0 ± 2.46	3.8 ± 1.85	5.2 ± 2.0
<u>Crassostrea</u> <u>gigas</u>	-	1.0 ± 0.45	-	-	0.6 ± 0.39	0.4 ± 0.24	1.4 ± 0.9
<u>Diloma sub-</u> <u>rostrata</u>	-	-	-	-	-	-	-
<u>Cominella</u> <u>glandiformis</u>	0.8 ± 0.8	-	-	0.8 ± 0.49	1.0 ± 0.32	0.4 ± 0.24	0.2 ± 0.0
<u>Turbo</u> <u>smaragdus</u>	-	-	-	-	-	-	-
<u>Melanerita</u> <u>atrimentosa</u>	-	-	-	-	-	-	-
<u>Onchidella</u> <u>nigricans</u>	-	-	-	-	-	-	-
<u>Xenostrobus</u> <u>pulex</u>	-	-	-	-	-	-	-
<u>Elminius</u> <u>modestus</u>	-	-	-	-	-	-	p
FLORA							
<u>Hormosira</u> <u>banksii</u>	0.2 ± 0.2	-	-	-	-	0.2 ± 0.2	2.0 ± 1.0

Soft, Inter-tidal Shore Quadrat Sample Sheet.

Site - Blacksmiths Bay Proposed Marina Site - Mangrove Forest transect 2.

 $\bar{x} \pm SE, n = 5$

p = present

FAUNADISTANCE THROUGH MANGROVE FOREST (m)

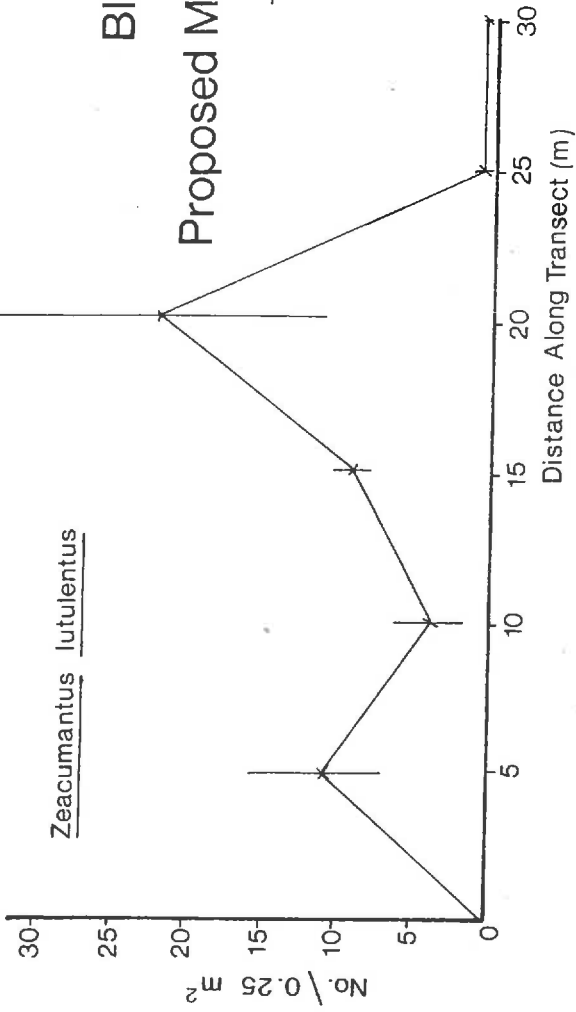
	35	40	45	50	55	60
<u>Zeacumantus</u> <u>lutulentus</u>	3.6 \pm 1.29	5.8 \pm 1.59	7.6 \pm 2.69	32.0 \pm 4.29	34.4 \pm 18.16	0.6 \pm 0.
<u>Crassostrea</u> <u>gigas</u>	-	0.4 \pm 0.24	2.0 \pm 0.89	2.0 \pm 1.09	10.2 \pm 3.27	14.2 \pm 2.
<u>Diloma</u> <u>subrostrata</u>	0.2 \pm 0.2	0.2 \pm 0.2	-	0.8 \pm 0.49	-	-
<u>Cominella</u> <u>glandiformis</u>	0.4 \pm 0.4	0.2 \pm 0.2	0.4 \pm 0.24	0.6 \pm 0.4	1.4 \pm 0.51	0.2 \pm 0.
<u>Turbo</u> <u>smaragdus</u>	-	-	-	-	0.4 \pm 0.24	0.6 \pm 0.
<u>Melanerita</u> <u>atrimentosa</u>	-	-	-	-	-	-
<u>Onchidella</u> <u>nigricans</u>	-	-	-	-	-	-
<u>Xenostrobus</u> <u>pulex</u>	-	-	-	p	p	p
<u>Elminius</u> <u>modestus</u>	p	p	p	p	p	p
<u>FLORA</u>						
<u>Hormosira</u> <u>banksii</u>	1.2 \pm 0.37	1.8 \pm 0.66	-	0.8 \pm 0.37	-	0.8 \pm 0.1

Figure 20

Blacksmiths Bay Soft Shore Intertidal

Proposed Marina Area - Mangrove Zone ($\bar{x} \pm SE, n=5$)

Transect 1



Transect 2

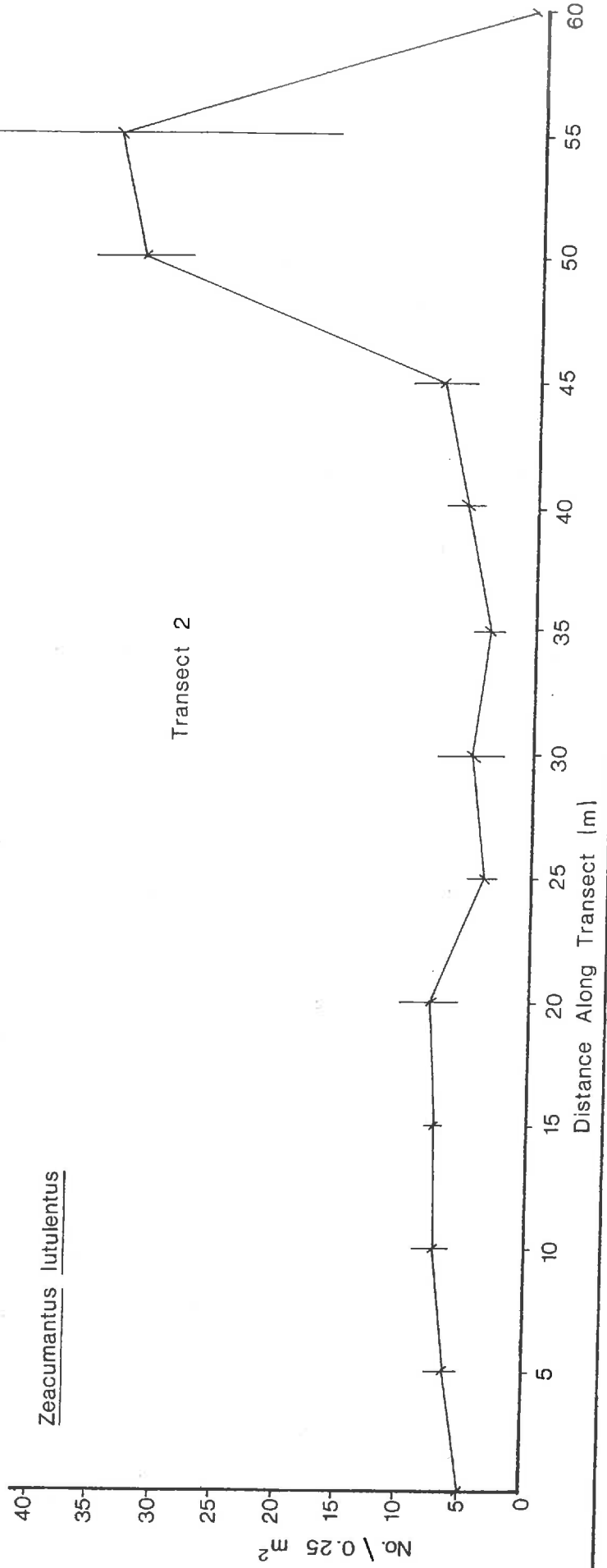


Figure 21

Blacksmiths Bay Soft Shore Intertidal

Proposed Marina Area - Mangrove Zone ($\bar{x} \pm S.E., n=5$)

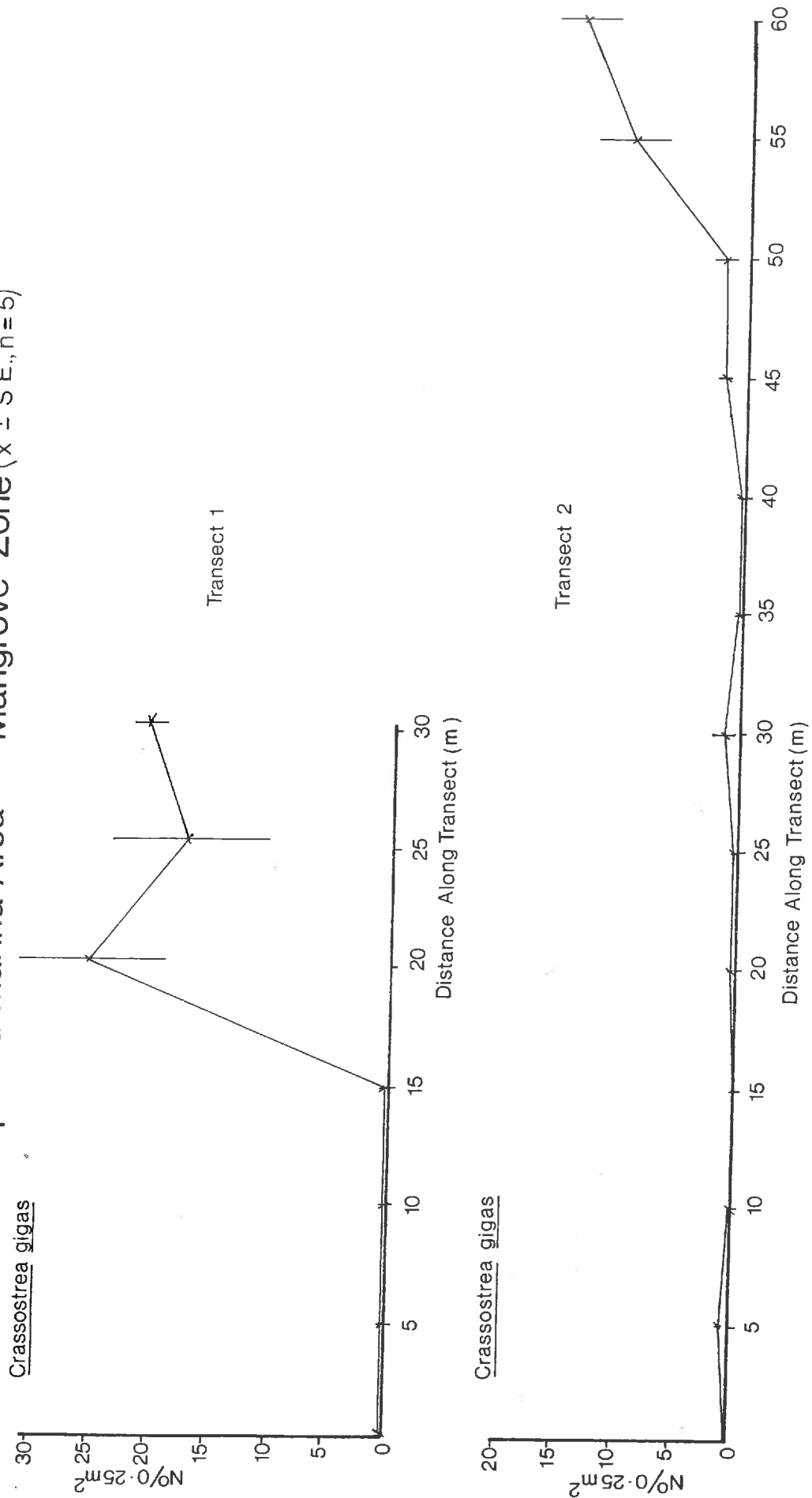


Table: 11

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Blacksmiths Bay Marina site - Transect 1

Date: 13/11/84

 $\bar{x} \pm S.E., n = 5$

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Austrovenus stutchburyi</u>	2.8 ± 1.82	10.2 ± 2.39	2.0 ± 0.63
<u>Macoma liliiana</u>	1.0 ± 1.0	21.0 ± 1.30	4.2 ± 1.02
<u>Crassostrea gigas</u>	14.4 ± 5.37		
<u>Macrophthalmus hirtipes</u>	7.8 ± 2.59	1.2 ± 0.37	0.4 ± 0.24
<u>Alpheus sp</u>	0.6 ± 0.39	0.4 ± 0.4	
<u>Callianassa filholi</u>			
<u>Onchidella nigricans</u>	0.8 ± 0.79		
<u>Turbo smaragdus</u>	0.2 ± 0.2		
<u>Zeacumantus lutulentus</u>	1.4 ± 1.16	0.4 ± 0.4	
<u>Cominella glandiformis</u>	2.0 ± 1.14	0.2 ± 0.2	
<u>Cominella maculosa</u>			
<u>Diloma subrostrata</u>	0.2 ± 0.2	1.6 ± 0.59	
<u>Xenostrobus pulex</u>	present		
<u>Sypharochiton pelliserpentis</u>	0.4 ± 0.24		
<u>Amaurochiton glaucus</u>	0.2 ± 0.2		
<u>Mactra ovata</u>		1.0 ± 0.45	1.8 ± 0.66
<u>Nucula hartvigiana</u>		1.2 ± 0.19	1.2 ± 0.37
<u>Solentellina nitida</u>		0.2 ± 0.2	0.2 ± 0.2
<u>Anthopleura aureoradiata</u>		present	
<u>Elminius modestus</u>			
<u>Corbula zelandica</u>		0.4 ± 0.24	
<u>Pinnotheres novaezelandiae</u>			0.4 ± 0.4
<u>Xymene plebius</u>			0.2 ± 0.2
<u>Theora lubrica</u>			
<u>Pectinaria australis</u>			
<u>Notoacmea daedala</u>			
<u>Notoacmea helmsi</u>			
Isopod			
Amphipod			
<u>Glycera americana</u>		0.2 ± 0.2	
<u>Nicon aestuariensis</u>			
<u>Lepidonotus polychromus</u>			

Table: 11 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Blacksmiths Bay Marina Site - Transect 1

Date: 13/11/84

$\bar{x} \pm S.E.$, n = 5

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B			
<u>Orbinia papillosa</u>	0.2 ± 0.2	-	3.4 ± 0.87
Glycerid worm		-	
Nemertine worm			
<u>Micrelenchus huttoni</u>			
<u>Paphies australis</u>			
<u>Pomatoceros caeruleus</u>			
Bryozoan			
<u>Amphibola crenata</u>			

Table: 12

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Blacksmiths Bay Marina Site - transect 2

Date: 21/11/84

 $\bar{x} \pm S.E., n = 5$

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Austrovenus stutchburyi</u>		51.6 ± 18.31	-
<u>Macoma liliana</u>	0.2 ± 0.2	6.8 ± 5.33	6.2 ± 2.41
<u>Crassostrea gigas</u>	12.6 ± 6.0		
<u>Macrophthalmus hirtipes</u>	4.8 ± 1.77	1.0 ± 0.45	1.8 ± 0.79
<u>Alpheus sp</u>	0.8 ± 0.37	-	
<u>Callianassa filholi</u>			
<u>Onchidella nigricans</u>	6.8 ± 2.55		
<u>Turbo smaragdus</u>	0.2 ± 0.2		
<u>Zeacumantus lutulentus</u>		0.2 ± 0.2	
<u>Cominella glandiformis</u>		0.6 ± 0.24	0.4 ± 0.24
<u>Cominella maculosa</u>			
<u>Diloma subrostrata</u>		2.2 ± 0.86	
<u>Xenostrobus pulex</u>	present		
<u>Sypharochiton pelliserpentis</u>			
<u>Amaurochiton glaucus</u>		0.4 ± 0.24	
<u>Mactra ovata</u>		2.0 ± 0.84	0.4 ± 0.24
<u>Nucula hartvigiana</u>		2.2 ± 1.42	2.6 ± 0.39
<u>Solentellina nitida</u>			
<u>Anthopleura aureoradiata</u>		present	
<u>Elminius modestus</u>	present		
<u>Corbula zelandica</u>		-	-
<u>Pinnotheres novaezelandiae</u>		-	0.2 ± 0.2
<u>Xymene plebius</u>			
<u>Theora lubrica</u>	0.2 ± 0.2	1.6 ± 1.16	
<u>Pectinaria australis</u>		-	-
<u>Notoacmea daedala</u>			
<u>Notoacmea helmsi</u>			
Isopod			
Amphipod			
<u>Glycera americana</u>	0.2 ± 0.2	0.4 ± 0.4	
<u>Nicon aestuariensis</u>			
<u>Lepidonotus polychromus</u>	0.2 ± 0.2		

Table: 12 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Blacksmiths Bay Marina Site - transect 2
 $\bar{x} \pm S.E., n = 5$

Date: 21/11/84

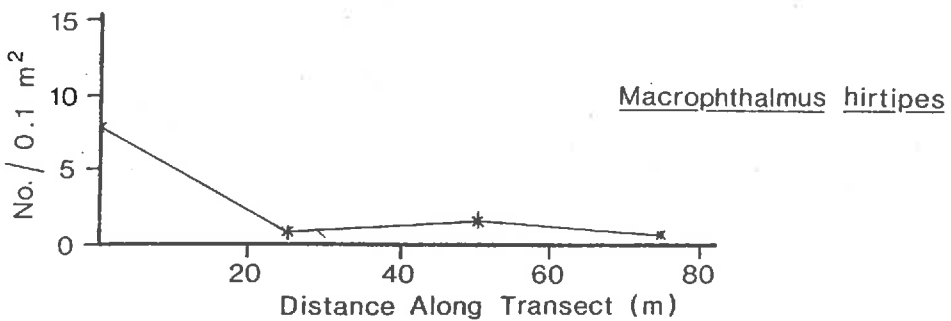
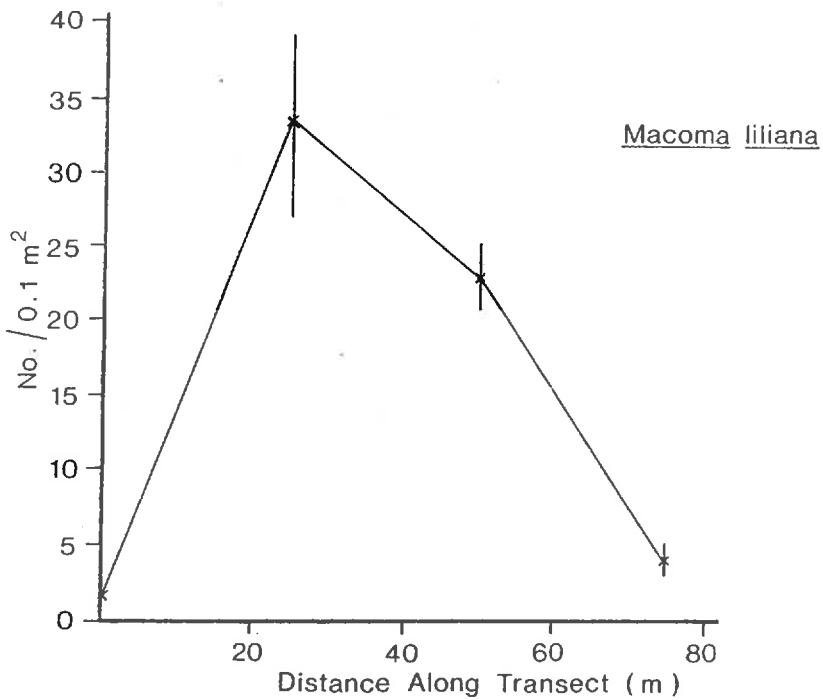
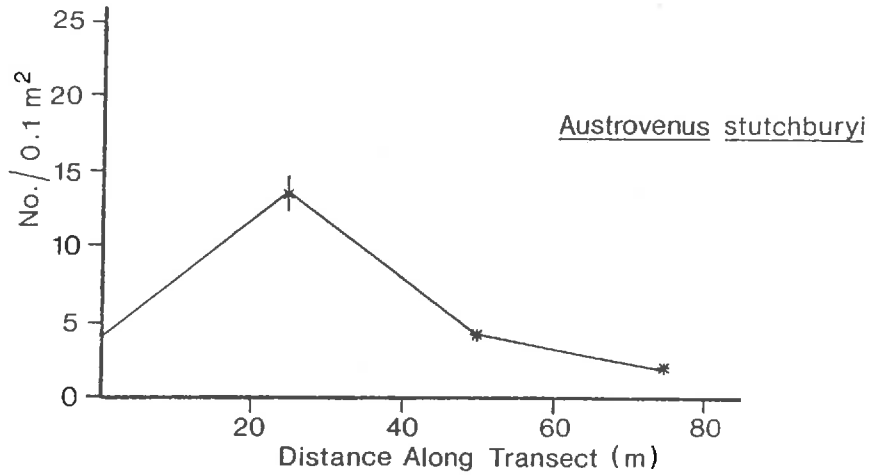
Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B		-	-
<u>Orbinia papillosa</u>		0.2 \pm 0.2	2.2 \pm 0.66
Glycerid worm			
Nemertine worm			
<u>Micrelenchus huttoni</u>			0.4 \pm 0.24
<u>Paphies australis</u>			
<u>Pomatoceros caeruleus</u>			
Bryozoan			
<u>Amphibola crenata</u>			

Figure 22

Blacksmiths Bay Soft Shore Intertidal Proposed Marina Area - Upper, Mid & Lower Shore Levels

($\bar{x} \pm$ S.E., n=5)

Transect 1



species declined rapidly at the lowest part of the shore where the oxygenated layer was reduced further and the sediments became increasingly muddy.

Macrophthalmus hirtipes was abundant at the upper level around the oyster band but maintained low densities further down the shore.

The densities of the three most common species occurring in the sample from the second transect (Austrovenus stutchburyi, Macoma liliana and Macrophthalmus hirtipes) were graphed (Figure 23). An A. stutchburyi bed occupied the middle level while M. liliana was found in moderate densities in the middle to lower parts of the shore. M. hirtipes was found in low numbers down the entire length of the transect.

Southeast Blacksmiths Bay (Appendix 2.2)

Fewer species were recorded from the two transects in this area when compared to the previous site. There was no mangrove forested area at this bay. The densities of animals at each of the shore levels are recorded in Tables 13 and 14.

In the first transect (Figure 24) at the upper shore level there were only two species, Paphies australis and sandhoppers (Talorchestia sp.), both of which were poorly represented. For the remainder of the transect, P. australis, Austrovenus stutchburyi and Macoma liliana were the most commonly occurring species. P. australis was the most abundant species at the mid shore level. At the lowest level, P. australis continued to be the most abundant species while a few A. stutchburyi and M. liliana also lived here.

The second transect showed a general paucity of species with only the worm Glycera americana and a few Talorchestia sp occurring at the upper level. The two predominantly occurring species were Paphies australis and Austrovenus stutchburyi (Figure 25). The P. australis bed occurred around the mid level while A. stutchburyi was represented by very low densities down most of the shore.

Northwest Blacksmiths Bay - Appendix 2.3

The species of marine animals recorded from samples taken in this area are outlined in Appendix 2.3. Again, there was no mangrove

Figure 23

Blacksmiths Bay Soft Shore Intertidal
Proposed Marina Area - Upper, Mid & Lower Shore Levels

($\bar{x} \pm S.E., n=5$) Transect 2

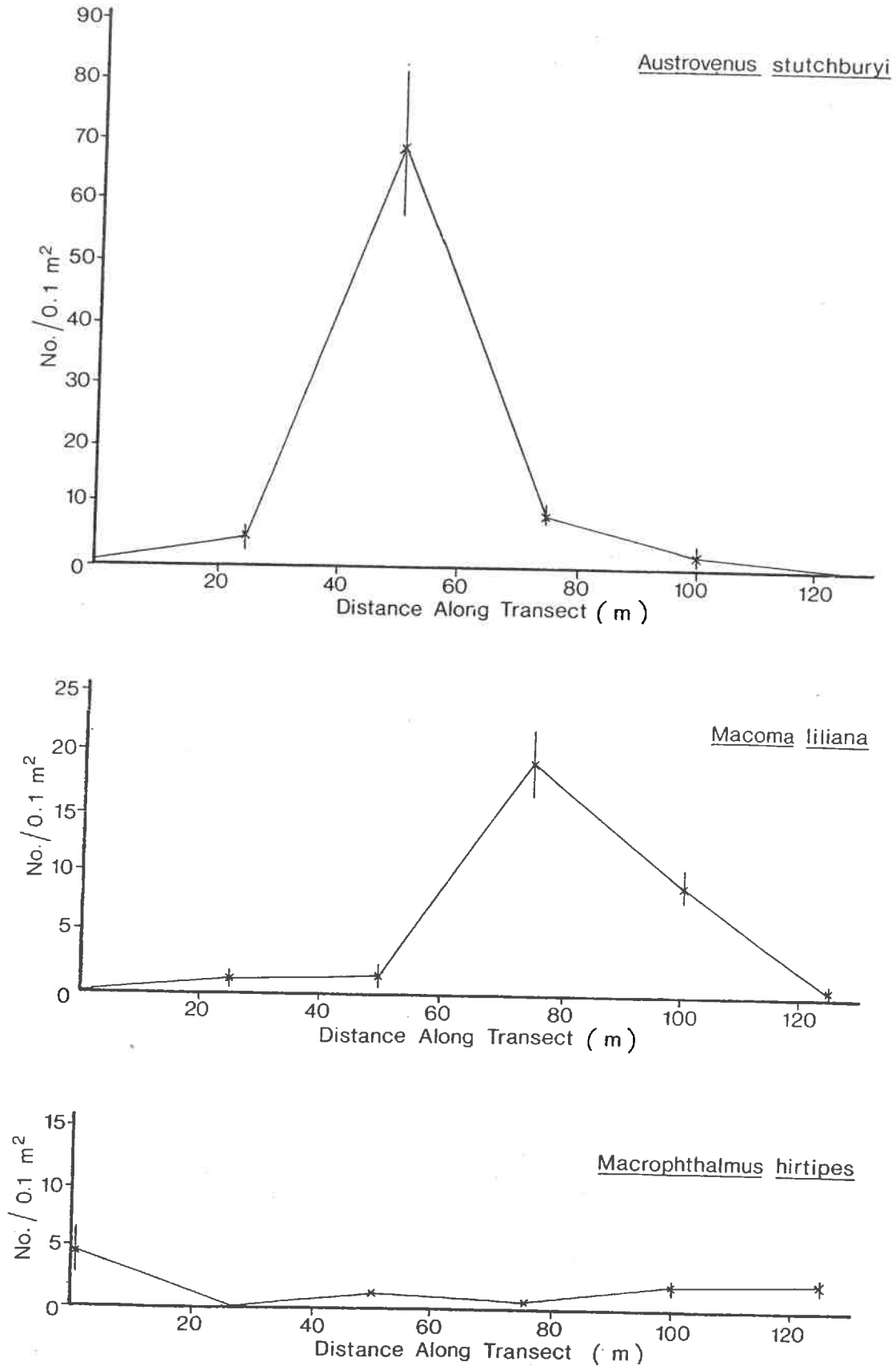


Table: 13 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Southeast Blacksmiths Bay - Transect 1

Date: 19/12/84

$\bar{x} \pm S.E.$, n = 5

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B			
<u>Orbinia papillosa</u>			
Glycerid worm			
Nemertine worm			0.6 \pm 0.39
<u>Micrelenchus huttoni</u>			
<u>Paphies australis</u>	0.2 \pm 0.19	42.6 \pm 7.81	30.8 \pm 6.74
<u>Pomatoceros caeruleus</u>	present		present
Bryozoan			present
<u>Amphibola crenata</u>			

Table: 14

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Southeast Blacksmiths Bay - transect 2

Date: 8/1/85

 $\bar{x} \pm S.E., n = 5$

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Austrovenus stutchburyi</u>		1.4 ± 0.74	1.4 ± 0.93
<u>Macoma liliana</u>		1.6 ± 1.16	1.4 ± 0.87
<u>Crassostrea gigas</u>			
<u>Macrophthalmus hirtipes</u>		0.2 ± 0.2	2.2 ± 0.58
<u>Alpheus sp</u>			
<u>Callianassa filholi</u>			0.2 ± 0.2
<u>Onchidella nigricans</u>			
<u>Turbo smaragdus</u>			
<u>Zeacumantus lutulentus</u>			
<u>Cominella glandiformis</u>		0.4 ± 0.4	0.4 ± 0.24
<u>Cominella maculosa</u>		-	0.2 ± 0.2
<u>Diloma subrostrata</u>		0.8 ± 0.49	0.2 ± 0.2
<u>Xenostrobus pulex</u>			
<u>Sypharochiton pelliserpentis</u>			
<u>Amaurochiton glaucus</u>		-	0.6 ± 0.39
<u>Mactra ovata</u>		0.4 ± 0.4	2.0 ± 1.38
<u>Nucula hartvigiana</u>		0.2 ± 0.2	
<u>Solentellina nitida</u>			
<u>Anthopleura aureoradiata</u>		present	present
<u>Elminius modestus</u>		present	
<u>Corbula zelandica</u>		0.6 ± 0.39	0.8 ± 0.58
<u>Pinnotheres novaezelandiae</u>			
<u>Xymene plebius</u>			
<u>Theora lubrica</u>			
<u>Pectinaria australis</u>			
<u>Notoacmea daedala</u>			
<u>Notoacmea helmsi</u>			
Isopod			
Amphipod			
<u>Glycera americana</u>	0.2 ± 0.19	0.4 ± 0.24	
<u>Nicon aestuariensis</u>		-	0.2 ± 0.2
<u>Lepidonotus polychromus</u>			
<u>Talorchestia</u>	0.8 ± 0.58	0.6 ± 0.6	

Table: 14 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Southeast Blacksmiths Bay - transect 2

Date: 8/1/85

$\bar{x} \pm S.E.$, n = 5

Fauna	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B			
<u>Orbinia papillosa</u>			
Glycerid worm			
Nemertine worm			
<u>Micrelenchnus huttoni</u>			
<u>Paphies australis</u>		11.6 \pm 4.89	-
<u>Pomatoceros caeruleus</u>		present	present
Bryozoan			
<u>Amphibola crenata</u>			

Figure 24

Blacksmiths Bay Soft Shore Intertidal
Southeastern Bay Upper, Mid & Lower Shore Levels
($\bar{x} \pm$ S.E., n=5)

Transect 1

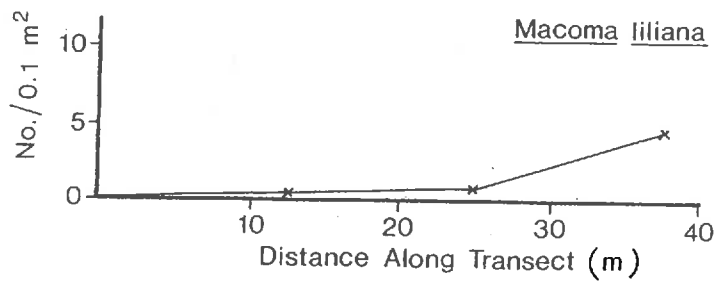
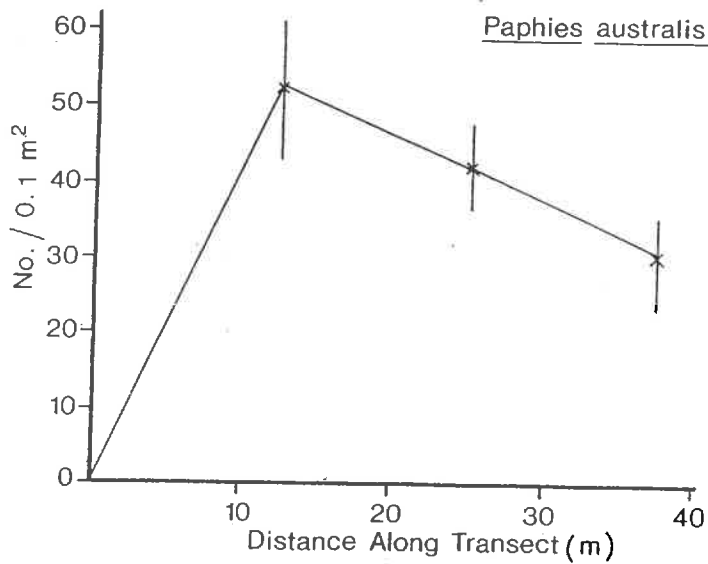
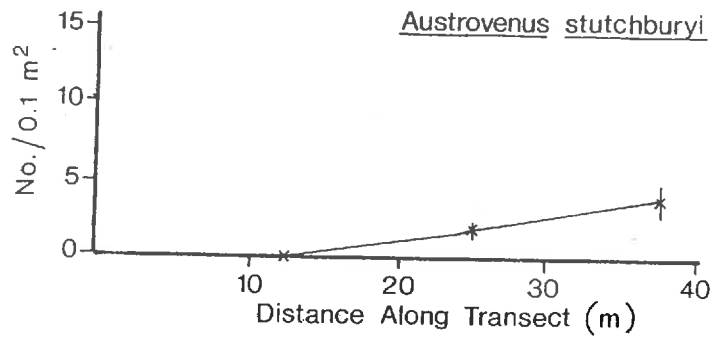
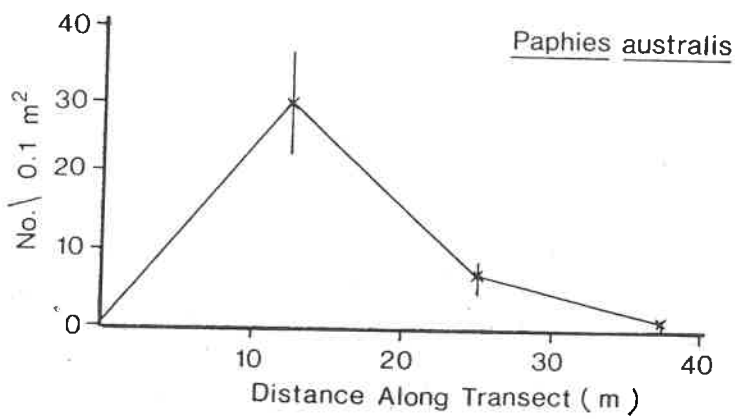
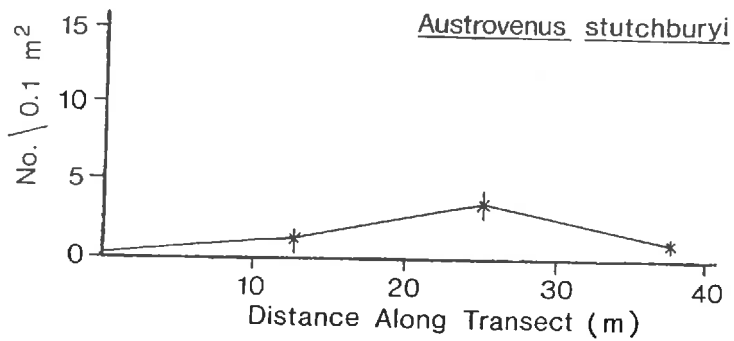


Figure 25

Blacksmiths Bay Soft Shore Intertidal
Southeastern Bay – Upper, Mid & Lower Shore Levels
($\bar{x} \pm$ S.E., n=5)

Transect 2



forest. The species, together with their densities found along the two transects, are presented in Tables 15 and 16.

The densities of the three predominant species were examined and they varied along the two transects (Figures 26 & 27). Austrovenus stutchburyi showed interesting patterns of densities which peaked at mid shore levels in both transects while in Transect Two this was preceded by a further upper level peak and decline in densities. This could be explained in part by the large numbers of small (3-10mm) A. stutchburyi individuals found at the upper level while at the middle level these declined in the presence of another bed containing high densities of larger individuals (10-20mm) at the mid shore level. While this indicates that two populations containing different size classes of A. stutchburyi exist, these being an upper shore juvenile population and a mid shore adult population, further studies would need to be made to verify this.

Paphies australis showed similar patterns of densities along the two transects although at lower levels of abundance. Again, it was noted from the samples that juveniles tended to be more numerous at the upper shore while adults were in greatest abundance at the mid shore. The steep decline in numbers apparent for Austrovenus stutchburyi in the second transect was similar for P. australis. No obvious reason for this similarity was apparent although it was possible that a small freshwater stream running near this part of the transect could have had an effect on the population of A. stutchburyi and P. australis.

Macoma liliana was relatively abundant at mid to low levels in both transects however densities declined rapidly at the lowest level near mean low water.

3.2 Subtidal

Species Distribution-

Shallow Subtidal (Appendix 3.1).

The species which were identified from the subtidal samples collected around the Blacksmiths Bay area are presented in Appendix 3.1. Most species were poorly represented with the exception of Theora lubrica at some of the stations (Table 17). This was expected as the stations were only just below mean low water level

Table: 15

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Northwest Blacksmiths Bay - transect 1

Date: 4/2/85

R ± S.E., n = 5

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Austrovenus stutchburyi</u>	38.6 ± 16.19	194.0 ± 48.62	3.0 ± 3.0
<u>Macoma liliana</u>	0.2 ± 0.2	3.4 ± 1.47	2.2 ± 1.56
<u>Crassostrea gigas</u>			
<u>Macrophthalmus hirtipes</u>	0.4 ± 0.4	0.2 ± 0.2	0.4 ± 0.24
<u>Alpheus sp</u>			
<u>Callianassa filholi</u>			
<u>Onchidella nigricans</u>			
<u>Turbo smaragdus</u>			
<u>Zeacumantus lutulentus</u>	0.4 ± 0.24	1.0 ± 0.45	
<u>Cominella glandiformis</u>	0.8 ± 0.37	0.6 ± 0.39	0.8 ± 0.37
<u>Cominella maculosa</u>			
<u>Diloma subrostrata</u>	2.6 ± 0.98	1.6 ± 0.92	-
<u>Xenostrobus pulex</u>			
<u>Sypharochiton pelliserpentis</u>			
<u>Amaurochiton glaucus</u>		0.8 ± 0.8	
<u>Mactra ovata</u>		0.2 ± 0.2	5.4 ± 2.06
<u>Nucula hartvigiana</u>	0.2 ± 0.2	0.2 ± 0.2	0.4 ± 0.4
<u>Solentellina nitida</u>			
<u>Anthopleura aureoradiata</u>	present	present	present
<u>Elminius modestus</u>	present		
<u>Corbula zelandica</u>			0.6 ± 0.6
<u>Pinnotheres novaezelandiae</u>			0.2 ± 0.2
<u>Xymene plebius</u>			
<u>Theora lubrica</u>			1.2 ± 0.79
<u>Pectinaria australis</u>			
<u>Notoacmea daedala</u>	0.6 ± 0.39	0.8 ± 0.8	
<u>Notoacmea helmsi</u>			
Isopod			
Amphipod			
<u>Glycera americana</u>	0.4 ± 0.24	0.2 ± 0.2	
<u>Nicon aestuariensis</u>	0.6 ± 0.39	2.2 ± 1.56	0.6 ± 0.24
<u>Lepidonotus polychromus</u>			
<u>Micrelenchus sanguineus</u>		0.2 ± 0.2	

Table: 15 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Northwest Blacksmiths Bay - transect 1
 $\bar{x} \pm S.E., n = 5$

Date: 4/2/85

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B			
<u>Orbinia papillosa</u>			
Glycerid worm			
Nemertine worm			
<u>Micrelenchus huttoni</u>			
<u>Paphies australis</u>	14.6 \pm 3.07	10.4 \pm 2.0	0.2 \pm 0.2
<u>Pomatoceros caeruleus</u>			
Bryozoan			
<u>Amphibola crenata</u>	2.0 \pm 0.95	0.6 \pm 0.6	

Table: 16

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Northwest Blacksmiths Bay - transect 2

Date: 20/2/85

 $\bar{x} \pm S.E., n = 5$

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Austrovenus stutchburyi</u>	68.2 ± 20.25	61.8 ± 27.46	3.6 ± 1.36
<u>Macoma liliana</u>	0.4 ± 0.24	3.6 ± 2.39	6.6 ± 1.5
<u>Crassostrea gigas</u>			
<u>Macrophthalmus hirtipes</u>		0.8 ± 0.37	1.6 ± 0.39
<u>Alpheus sp</u>			
<u>Callianassa filholi</u>			
<u>Onchidella nigricans</u>			
<u>Turbo smaragdus</u>			
<u>Zeacumantus lutulentus</u>	1.2 ± 0.97	0.2 ± 0.2	
<u>Cominella glandiformis</u>	0.2 ± 0.2	3.0 ± 2.14	
<u>Cominella maculosa</u>			
<u>Diloma subrostrata</u>	0.2 ± 0.19	2.2 ± 1.06	
<u>Xenostrobus pulex</u>			
<u>Sypharochiton pelliserpentis</u>			
<u>Amaurochiton glaucus</u>		1.4 ± 0.59	
<u>Mactra ovata</u>			0.4 ± 0.2
<u>Nucula hartvigiana</u>			0.4 ± 0.2
<u>Solentellina nitida</u>			
<u>Anthopleura aureoradiata</u>		present	present
<u>Elminius modestus</u>			
<u>Corbula zelandica</u>			0.6 ± 0.39
<u>Pinnotheres novaezelandiae</u>			
<u>Xymene plebius</u>			
<u>Theora lubrica</u>			
<u>Pectinaria australis</u>			
<u>Notoacmea daedala</u>	0.6 ± 0.24	2.2 ± 1.35	
<u>Notoacmea helmsi</u>			
Isopod			
Amphipod			
<u>Glycera americana</u>		0.2 ± 0.2	
<u>Nicon aestuariensis</u>	0.8 ± 0.49	0.6 ± 0.39	0.4 ± 0.4
<u>Lepidonotus polychromus</u>			
<u>Talorchestia</u>	0.2 ± 0.2		

Table: 16 cont.

Blacksmiths Bay Marina Proposal

Soft intertidal shore quadrat sample sheet

Site: Northwest Blacksmiths Bay - transect 2

Date: 20/2/85

$\bar{x} \pm S.E.$, n = 5

Fauna	Regions of the intertidal		
	Upper	Mid	Lower
<u>Asychis theodori</u>			
Worm B			
<u>Orbinia papillosa</u>			
Glycerid worm			
Nemertine worm			
<u>Micrelenchus huttoni</u>			
<u>Paphies australis</u>	22.4 \pm 5.19	39.2 \pm 25.35	
<u>Pomatoceros caeruleus</u>			
Bryozoan			
<u>Amphibola crenata</u>	2.4 \pm 1.08	0.6 \pm 0.6	

Figure 26

Blacksmiths Bay Soft Shore Intertidal
Northwestern Bay - Upper, Mid & Lower Shore Levels

($\bar{x} \pm S.E., n=5$) Transect 1

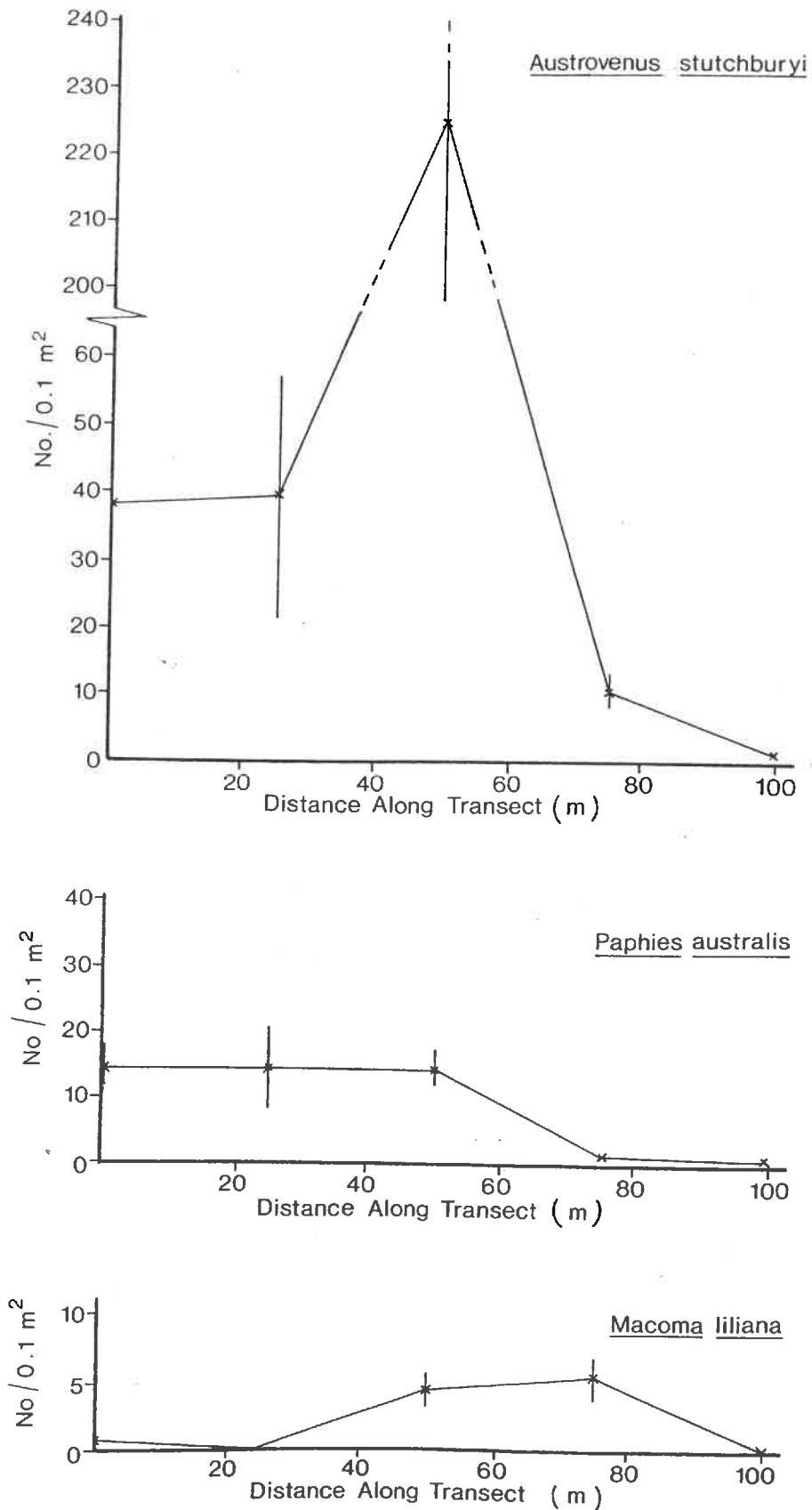


Figure 27

Blacksmiths Bay Soft Shore Intertidal Northwestern Bay - Upper, Mid & Lower Shore Levels

($\bar{x} \pm$ S.E., n 5) Transect 2

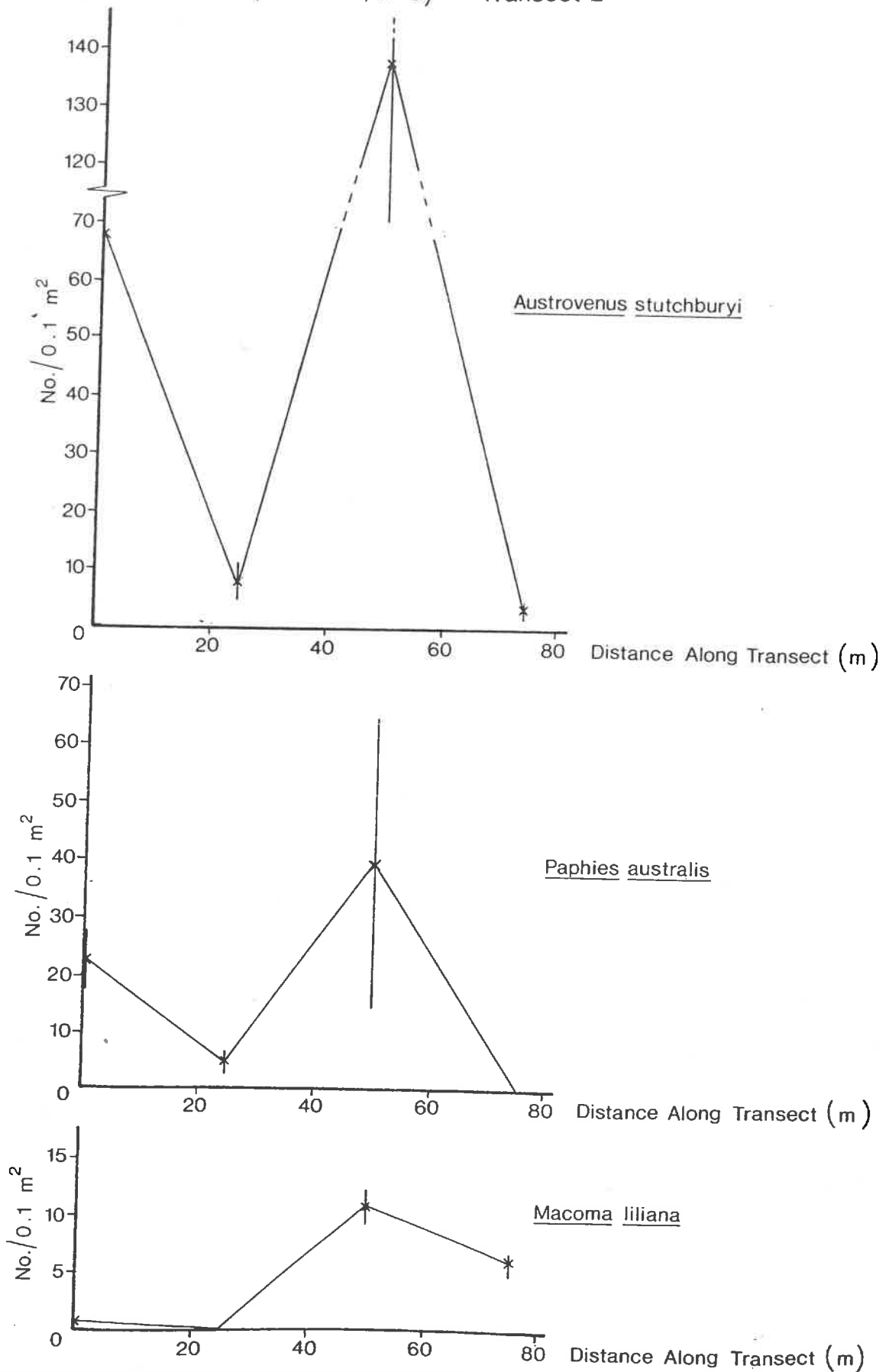


TABLE: 17

BLACKSMITHS BAY MARINA PROPOSAL

Description - shallow sub-tidal stations in Blacksmiths Bay area.

DATE: 4/12/84

k ± SE, n = 5

FAUNA	STATIONS					
	1, BB	2, BB	3, SE	4, SE	5, NW	6, NW
<u>Theora lubrica</u>	0.8 ± 0.37	37.2 ± 5.49	0.4 ± 0.39	1.6 ± 0.68	11.2 ± 3.12	15.2 ± 3.43
<u>Macrophthalmus hirtipes</u>	2.0 ± 0.55	2.0 ± 0.89	0.4 ± 0.24	1.0 ± 0.32	0.2 ± 0.2	0.2 ± 0.2
<u>Perinereis nuntia</u>	-	0.2 ± 0.2	-	-	0.2 ± 0.2	-
Nemertine worm	-	-	-	-	0.2 ± 0.2	-
<u>Mactra ovata</u>	0.2 ± 0.2	-	2.33 ± 0.26	-	-	-
<u>Macoma liliana</u>	0.2 ± 0.2	-	1.8 ± 0.97	1.2 ± 0.73	-	-
<u>Chione stutchburyi</u>	0.4 ± 0.4	-	-	-	-	-
<u>Asychis theodori</u>	0.4 ± 0.24	0.6 ± 0.6	-	-	-	-
<u>Glycera</u>	0.2 ± 0.2	-	-	-	-	-
<u>Pectinaria australis</u>	1.0 ± 0.63	0.6 ± 0.4	-	-	-	-
<u>Isopod</u>	0.2 ± 0.2	-	-	-	-	-
<u>Diloma subrostrata</u>	0.6 ± 0.6	-	-	-	-	-
<u>Nucula hartvigiana</u>	-	0.6 ± 0.4	0.2 ± 0.2	1.4 ± 0.68	-	-
<u>Cominella glandiformis</u>	-	0.2 ± 0.2	-	0.2 ± 0.2	-	-
<u>Corbula zelandica</u>	-	-	0.2 ± 0.2	-	-	-
<u>Nicon aestuariensis</u>	-	-	0.8 ± 0.49	0.4 ± 0.24	-	0.2 ± 0.2
<u>Alpheus sp</u>	-	-	-	-	-	0.2 ± 0.2
<u>Paphies australis</u>	-	-	-	-	-	0.2 ± 0.2

BB - Blacksmiths Bay Marina Stations

SE - Southeast Bay Stations

NW - Northwest Bay Stations

and most of the species represented were commonly found at the low intertidal shore level. This subtidal area therefore reflected a variety of species of both low shore and subtidal habit.

Channel (Appendix 3.2)

The species which were found in the subtidal samples collected in the channel sediments are recorded in Appendix 3.2. The only species of note was Theora lubrica which occurred in comparatively high densities, although a variety of worms were also found in the samples (Table 18).

The densities of the only major species, Theora lubrica were compared at shallow subtidal and channel sites (Figure 28). Differences in densities were evident and could be attributable to the preferred habitat of this species. This very small bivalve lives mainly in subtidal muddy sediments and appears to be very patchy in its distribution, particularly at the shallow subtidal stations.

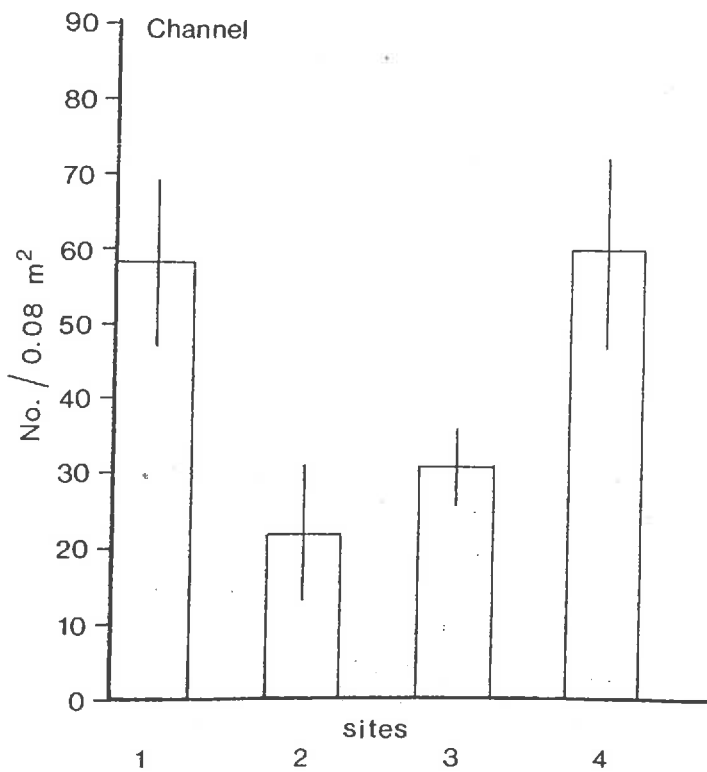
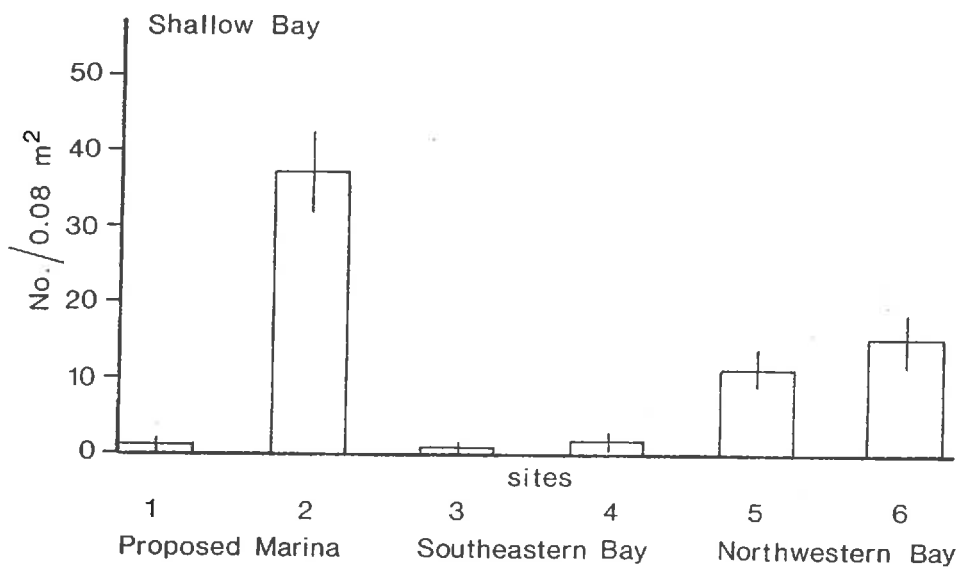
Description - Channel between Blacksmiths Bay and Motutapu Island.

 $\bar{x} \pm S.E., n = 5$

FAUNA	STATIONS			
	1	2	3	4
<u>Theora lubrica</u>	58.0 ± 11.57	22.40 ± 9.87	31.0 ± 5.57	60.80 ± 12.54
<u>Asychis theodori</u>	-	5.60 ± 1.54	0.60 ± 0.40	0.20 ± 0.20
<u>Orbinia papillosa</u>	0.4 ± 0.24	0.6 ± 0.4	-	0.6 ± 0.4
Worm E	-	0.2 ± 0.2	-	-
<u>Perinereis nuntia</u>	1.6 ± 0.81	-	1.0 ± 0.45	0.6 ± 0.4
<u>Macrophthalmus hirtipes</u>	0.2 ± 0.2	0.6 ± 0.6	0.8 ± 0.37	-
<u>Alpheus sp</u>	-	0.2 ± 0.2	0.4 ± 0.4	-
<u>Pectinaria australis</u>		0.2 ± 0.2	0.4 ± 0.4	

Figure 28

Blacksmiths Bay Soft Shore Intertidal Densities of the Bivalve *Theora lubrica* in Shallow Bay and Channel Sites ($\bar{x} \pm SE, n=5$)



4.0 DISCUSSION

4.1 Intertidal Shores

4.1.1 Rocky Shore

A wide array of species was found on both headlands. There was a greater diversity of species on the northwestern rocky intertidal study area and this could be attributed to the increased length and relatively gentle slope of the intertidal reef platform. This provided an extended area for the important shade forming species, Hormosira banksii, and allowed a variety of fauna to live beneath its fronds.

The following species were the most abundant species found on the various levels of the intertidal reefs and could be considered as indicator species. They were: Zeacumantus lutulentus and an unidentified brown alga found on the upper part of both shores while Xenostrobus pulex only grew on the southeastern headland. At mid shore levels Z.lutulentus and Hormosira banksii were predominant while at the lowest intertidal levels Zeacumantus subcarinatus and H. banksii showed localised variations in densities.

Motutapu Island showed some variation when compared with the nearby rocky headland locations. The major physical difference was the steep, short shores of the island, formed by basaltic boulders. The nature of the island's shoreline appeared to be unfavourable for the successful growth of several species of flora and fauna found on the weathered greywacke reefs.

The lowest levels of the island sites comprised a thick layer of silt with clumps of Crassostrea gigas living on exposed boulders. This was typical of other areas in the upper Kerikeri Inlet.

The inner and outer locations of Motutapu Island were slightly different. The increased muddiness on the inner side occurred concurrently with high densities of Crassostrea gigas, while the increased shelter on this side may also have been favourable for the thick covering of lichen species on the upper shore boulders. A further difference was the presence of high densities of Onchidella nigricans at the inner island location while the density of this species was negligible on the outer side. This apparent discrepancy could be related to this species habitat preference for moist, shaded areas with an abundance

of organic material for food (Morton and Miller, 1968). The silty oyster-covered inner side of Motutapu Island would provide an ideal habitat. On the other hand, a further important factor could be the degree of cloudiness during the time over which the investigations were conducted. It was often observed that O. nigricans moved about freely in the open during periods of thick cloud cover.

4.1.2 Soft Shores

The sediments within the proposed marina area and the adjacent bays to the southeast and northwest were noticeably different in composition. This appeared to be reflected in the biota found at each of these three locations.

In the proposed marina area, a wide array of species of flora and fauna were identified within the extensive area of mangrove forests and open mudflat. The types of fauna identified included bivalves, crabs, shrimps, snails, chitons, anemones, barnacles and several worm species. Some of the species reached high densities, these being - Zeacumantus lutulentus, Crassostrea gigas, Macoma liliana and Austrovenus stutchburyi.

Within the mangrove area the predominant species was Zeacumantus lutulentus, while Austrovenus stutchburyi and Macoma liliana were the most numerous species within the upper to mid levels of the mudflats.

The southeastern bay was the sandiest of the three locations with mud occurring only at the lower level. The beach was also short and relatively steep and was exposed to the south and southwest. Here, species diversity appeared to be lower than at the adjacent marina site. The species identified fell into the following groups; bivalves, crabs, snails, anemones, barnacles, amphipods, bryozoans and worms. Few of these animal groups were found at the upper beach level while the densities of two of the three predominant species, Austrovenus stutchburyi and Macoma liliana were generally low while Paphies australis attained relatively high densities.

The northwestern bay also exhibited lower species diversity than that found at the proposed marina site. It was found that populations of juvenile Paphies australis and Austrovenus stutchburyi lived at the upper level while larger individuals of these two species were more predominant at the mid intertidal level. A Macoma liliana bed occurred at the lower

level.

When taking all three locations of Blacksmiths Bay into account, it is evident that Austrovenus stutchburyi is the most abundantly occurring of all the species identified. This species was found in high densities in beds at both the proposed marina site and the northwestern bay although it was poorly represented in the southeastern bay sediments. However, Paphies australis was the most abundant species at this bay, reaching higher densities than at the northwestern bay, the only other location at which they were found.

The variable distribution of Austrovenus stutchburyi and Paphies australis within the shore sediments of the Blacksmiths Bay area can be attributed to the varying sediments found at the three locations. This feature has been described in general terms by Morton and Miller (1968). In their account of soft shores it is noted that the assemblage of fauna within beach sediments is dependent on the type of sediment composing the beaches combined with the degree of movement or stability of the soft shore. At Blacksmiths Bay the marina site was the most sheltered of the three locations examined, being protected from prevailing winds by Motutapu Island and located the furthest away from effects of main channel tidal currents. Therefore it would be expected that P. australis, being intolerant of very muddy shores, would not be found at the marina site. Conversely, the sediments appeared to be more favourable for A. stutchburyi as this species was found at all the locations.

3.1 Birdlife

The Wildlife Service has rated the Kerikeri Inlet, with its mudflats, mangroves, saltmarsh, higher freshwater swamp and scrub zones and related birdlife, as a moderate to high value coastal and estuarine habitat (Ogle 1982). In this report it is explained that, while much of the adjacent land has been cleared and that the inlet is popular for boating, disturbance to wildlife is reduced by the large area still available for wildlife.

The array of marine invertebrates identified on and within the soft shores of Blacksmiths Bay appeared to provide an important source of food for several species of birds.

The following species were consistently observed

feeding on the mudflats of the proposed marina site at low tide - white faced heron (Ardea novaehollandiae) black oyster catcher (Haematopus unicolor) black backed gull (Larus dominicanus) and red billed gull (Larus scopulinus).

At high water the following species were often observed - pied shag (Phalacrocorax varius), kingfisher (Halcyon sancta) and white fronted tern (Sterna striata). While most species used the exposed intertidal mudflats to feed, however, both pied shags and white fronted terns fished over the submerged mudflats and more open water (Parrish, 1984). Many of these species would also use the mangroves and coastal vegetation for roosting and nesting (Parrish, 1984).

4.2 Subtidal

Species diversity in the subtidal areas of Blacksmiths Bay was markedly lower than in the intertidal areas and many of these species were of low intertidal habit. In the deeper channel there were no intertidal representatives and the diversity of species was reduced further.

The small bivalve Theora lubrica appeared to be indicative of the subtidal environment at Blacksmiths Bay and was found to be the only predominantly occurring species of note. It was very patchy in its distribution throughout Blacksmiths Bay although less patchy in the channel area.

Theora lubrica forms an important food source for benthic feeding fish species such as flounder. The bivalve has relatively recently become well established in New Zealand waters and has quickly become an important food source for fish.

4.2.1 Fishlife

While the water visibility was too poor to enable underwater fish count surveys, some casual observations of fish species were made. Flounder (Rhombosolea sp), eel, (Angiulla dieffenbachii and A. australis) and John dory (Zeus japonicus) were commonly sighted at the low water level. Other species which could be expected include kahawai (Arripis trutta), mullet (Aldrichetta forsteri and Mugil cephalus) and parore (Girella tricuspidata), (Ayling and Cox, 1982).

5.0 BIOLOGICAL IMPACTS

The development currently proposed will involve:

- (a) dredging an area of approximately five hectares to form the marina basin and down to a depth which will give 1.8m to 2.5m of draught below sounding datum,
- (b) dredging an area approximately 500m southeast of Motutapu Island to create a navigation channel from the marina,
- (c) reclamation of an area of approximately three hectares for use as hard standing parking, haulout and building areas together with picnic areas.

The dredging, reclamation, rockwall breakwater, floating breakwater and rubble beach construction activities associated with the development of the proposed marina will remove the majority of the intertidal and subtidal biota within and nearby the marina site.

The dredging will destroy the existing benthic marine life in the subtidal and mid to lower intertidal areas of the proposed site. The coarse and medium fractions of the dredging material will form part of the material to be used in reclamation to build up the hardstand area and this will result in the loss of the mangroves and benthic animals at the upper intertidal level of this site.

The feeding and roosting activities of the various bird species which frequent Blacksmiths Bay will be disturbed as a consequence of removal of the intertidal sediments, mangroves and foreshore vegetation.

Species of fish which presently utilize the submerged area for feeding will not be able to use the dredged area to the same extent as prior to dredging. However, after a period of time some subtidal benthic species may establish while the water body will remain available for fish providing that both the water and the sediments within the marina remain unpolluted.

The construction of the protective rockwall at the southeast headland will eliminate the populations of rocky intertidal biota in this area while the rubble beach on the northwest headland will modify the upper intertidal level of this habitat and affect the biota

accordingly.

Some species may recover sufficiently to occupy parts of the rockwall and rubble beach while possibly recolonising the remaining section of the northwest reef which had been disturbed during the marina construction phase. However, the rubble beach could not support the present upper intertidal population which, in its natural state, comprises areas of an unidentified encrusting turf-like alga together with high densities of the snail, Zeacumantus lutulentus.

The information available on current flows suggests that water flow rates within the Blacksmiths Bay area are slight (up to 400m per tide) probably due to a slowly rotating clockwise eddy around Blacksmiths Bay and Motutapu Island. The slow currents may cause greater than ambient levels of silt deposition in the immediate vicinity of the proposed marina site during the construction phase. This would affect the adjacent embayments, rocky intertidal platforms and the nearby Motutapu Island intertidal region by silt smothering.

Therefore, it is likely that some of the species inhabiting the soft shores adjacent to the marina development will be affected by the increased rate and overall amount of sedimentation from resuspended silt and mud as a consequence of construction of the marina. Some of the important species likely to be affected are discussed below.

The pipi, Paphies australis, is typically found in middle beach sediments of shell sand, in particular, near the mouths of estuaries (Morton and Miller, 1968). This was observed in the populations found at both the southeastern and northwestern bays. These populations would not be able to tolerate a rapidly increased rate of sediment deposition and would not be able to recruit into a subsequently muddier environment. On the other hand the cockle, Austrovenus stutchburyi, is typically abundant in the soft muds of the lower mudflats (Morton and Miller, 1968) and this was confirmed in the present investigation. While the cockle populations would not be able to tolerate rapid deposition of layers of silt, they would probably recolonise some muddier areas when rates of deposition declined and the sediments had stabilized.

Pacific oysters (Crassostrea gigas) were found in abundance at the seaward fringe of the mangrove forest at Blacksmiths Bay and on Motutapu Island. Where the oysters remained following marina construction, they would probably be able to survive high rates of silt

deposition. Studies of the oyster, C. virginica, overseas have shown that this genus can feed in the presence of high concentrations of silt in the water (Jorgensen, 1966). Certainly, C. gigas has been found in high densities further up the Kerikeri Inlet where conditions are generally much siltier. It should be noted, however, that excessively silty shellfish are unpalatable for human consumption.

Other species may not be able to survive a possible high degree of siltation of surrounding waters and the subsequent deposition of this silt. The scavenging whelk, Cominella glandiformis, was absent from investigations in the Portland Arm of the Whangarei Harbour where resuspension and deposition of silt is known to be high (Dickie, Northland Harbour Board, 1984). The report suggests that the clogging of the gills and the osphradium (organ used to locate prey by tasting the water), combined with a reduction in prey species as a consequence of the highly turbid water, may have contributed to the absence of this species. In the Blacksmiths Bay area, C. glandiformis and another carnivorous snail species, Xymene plebius, were found on the mudflats at the proposed marina site. These two species, together with C. maculosa, another carnivorous snail, were found at the southeast bay while C. glandiformis was the only species recorded from the northwest bay. C. glandiformis was also found in the shallow subtidal samples. The rocky intertidal reefs also supported several carnivorous snail species. On the southeast reef C. maculosa and the oyster borer, Lepsiella scobina were recorded while C. glandiformis, L. scobina and C. adspersa inhabited the northwestern reef. On Motutapu Island, C. adspersa, C. maculosa and L. scobina were recorded.

The surrounding marine environment could also be detrimentally disturbed by pollution resulting from marina-related activities and the recreational craft which use the marina. Of most concern is the potential threat posed by the use of organotin-based antifouling paints. These organometallic based paints have become increasingly popular, as the salts of tributyl tin (TBT) contained in the antifouling paint are colourless and allow a wide range of boat hull colours by ready mixing with pigments. Research in Great Britain in 1982 indicated that Pacific oysters, in the presence of TBT, became deformed with abnormal shell thickening while the meat yield was extremely low (Waldock, 1984). Investigations of water quality around two marina systems in Great Britain showed detectable concentrations of TBT while thickened oysters which were analysed all contained detectable

levels of TBT compounds. Laboratory investigations also showed that oyster spat grew slowly, the shells thickened abnormally, and were generally in poor condition in the presence of tributyl tin oxide (TBTO) (Waldock and Thain, 1983). The authors concluded that the cultivation of Pacific oysters was incompatible in areas where high numbers of pleasure craft using organotin-based paints occurred. Further tests also showed that the larvae of both Crassostrea gigas and the European blue mussel, Mytilus edulis, were killed by concentrations of TBT found in marinas. The larvae of other marine species were also found to be extremely susceptible (Waldock, 1984).

The use of paints containing TBT on boats smaller than 25m in length has been banned in France (Waldock and Thain, 1983) while concern has been raised in Great Britain and the United States. However, these organotin-based antifouling paints are readily obtainable in New Zealand. This has important consequences in relation to the Pacific oysters in the Kerikeri Inlet growing naturally on Motutapu Island, the nearby oyster farms at Aroha Island and in the Hauparua Inlet and the surrounding intertidal and subtidal marine fauna in general.

Sewage pollution from boats could pose health problems with productive shellfish beds and the commercial oyster farm which is located approximately 0.86km west southwest of the proposed marina site. In Virginia, U.S.A., shellfish beds are automatically closed when marinas are established nearby in accordance with the following recommended criteria:

No. of boats	Condemned area (all directions)
1 - 50	1/8 mile (1/5km)
51 - 100	1/4 mile (2/5km)
100+	1/2 mile (4/5km)

(Source: Clark (ed), 1977).

The discharge of untreated sewage from boats is now usually prohibited in marina areas in the United States and many state regulations require pumpout facilities for the treatment of sewage from boats (Clark, 1977). However, this level of protection of shellfish beds has not been met in marinas in New

Zealand to date.

Therefore, the effects of pollution of shellfish beds and other marine species from organotin-based antifouling paints and sewage discharges from marinas need to be investigated in relation to the New Zealand situation.

6.0 CONCLUSIONS

The Blacksmiths Bay area can be regarded as a muddy estuarine habitat encompassing three small embayments, two partially silt-covered platform reefs and a small island. Sections of the Blacksmiths Bay area appear to be sheltered from prevailing onshore winds and waves by the presence of Motutapu Island. The varying degrees of shelter afforded by the island are reflected by the variable sedimentary regimes of the intertidal mudflats of the three small embayments.

The sediments within the embayments range from being mainly muddy at the proposed marina site while the two adjacent bays have coarser sediments with markedly less mud. The sediments support a wide variety of organisms with the muddier proposed marina site supporting the greatest diversity of species. This area also appeared to be the most utilized by birds.

The rocky intertidal areas, both headland reefs and the island, support a wide variety of species with the greatest species diversity occurring on the northwestern headland.

The subtidal area of Blacksmiths Bay supported a comparatively low diversity of fauna with the small bivalve Theora lubrica being the only species of consequence.

The results of the investigation indicate that the ecological environment of the Blacksmiths Bay area is reasonably typical of harbours and estuaries in their natural state, as described by Morton and Miller (1968). However, Blacksmiths Bay cannot be considered typical of the Kerikeri Inlet. The array of marine biota of the rocky shores of Blacksmiths Bay were not paralleled elsewhere in this inlet although sites in the Waikare and Te Puna inlets were comparable. No other part of the Kerikeri Inlet contained the variety of marine habitats found within the Blacksmiths Bay area, these being; a mangrove forest, open mudflats, sandier embayments rocky reef platforms and a basalt rock island. All similar areas in the Kerikeri Inlet were occupied by either oyster farms or boats.

It is considered from a marine biological viewpoint, that the area of Blacksmiths Bay, including Blacksmiths Bay itself, should be retained in its natural state and that an alternative site be sought which is environmentally less sensitive and which suits the requirements of the boating populace of the northern Bay of Islands. Any decision to proceed with

a marina development elsewhere must also take into account the importance of the ecological environment likely to be affected. In addition, the following criteria should be followed during the development of a marina in the Kerikeri Inlet. These criteria would act as safeguards against detrimental changes to the surrounding environment:

- Dredging and filling operations are confined to the outgoing high flow part of the tide.

This would reduce the risk of sedimentation from resuspended fine sediments.

- Filtration cloth is used to retain dredgings and adequate settlement ponds are constructed in the reclamation area.

This would reduce the risk of sedimentation from resuspended silt.

- Breakwaters and rockwalls should be constructed in such a way as to be of minimum impact on the adjacent rocky intertidal biota.

Construction materials and works should be confined to as small an area as is practical. It should also be ensured that provision is made for the permeability of rockwalls to groundwater and runoff using appropriate designs. Allowance should be made for the enhanced settlement of intertidal organisms common to the area by using local materials.

- Dredging of the marina and its access channels should be undertaken in such a way as to maximise circulation, to avoid dead water areas and to avoid the possibility of coastal erosion from poorly designed access channels.
- Following development of the marina, strict management policies should be implemented to avoid any possibility of contamination of the receiving waters and the surrounding biota from sump or other oils, fuels, paints, biodegradable and non-biodegradable rubbish and domestic sewage.

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APPENDIX 1.0

Species Lists - rocky intertidal shores of the Blacksmiths
Bay area.

APPENDIX 1.1

Rocky Intertidal Shores - Southeast headland

Fauna

Gastropoda

- Cominella adspersa - carnivorous snail
Cominella glandiformis - carnivorous snail
Cominella maculosa - " "
Diloma subrostrata - snail
Lepsiella scobina - oyster borer
Littorina unifasciata antipodum - periwinkle
Melanerita atrimentosa - snail
Melagraphia aethiops - snail
Onchidella nigricans - pulmonate limpet-like slug
Turbo smaragdus - cats eye snail
Zeacumantus lutulentus - mudsnail

Amphineura

- Acanthochitona zelandica - chiton
Amaurochiton glaucus - chiton
Sypharochiton pelliserpentis - chiton

Bivalvia

- Crassostrea gigas - Pacific oyster
Mytilus edulis aoteanus - blue mussel
Xenostrobus pulex - intertidal black mussel

Tubeworms

- Pomatoceros caeruleus

Crustacea

- Chamaesipho columna - barnacle
Elminius modestus - barnacle
Macrophthalmus hirtipes - burrowing crab

Coelenterata

- Anthopleura aureoradiata - anemone

Flora

Algae

- Brown turfing algae - unidentified
Corallina officinalis - coralline turf
Corallina officinalis - " paint
Hormosira banksii - Neptune's necklace

APPENDIX 1.2

Rocky Intertidal Shores - Northwest headland

Fauna

Gastropoda

- Cominella adpersa - carnivorous snail
Cominella glandiformis - carnivorous
Diloma subrostrata - snail
Lepsiella scobina - oyster borer
Littorina unifasciata antipodum - periwinkle
Melagraphia aethiops - snail
Melanerita atrimentosa - snail
Notoacmea daedala - limpet
Notoacmea parviconoidea - limpet
Onchidella nigricans - pulmonate limpet-like slug
Siphonaria zelandica - pulmonate limpet
Turbo smaragdus - cats eye snail
Zeacumantus lutulentus - mudsnail
Zeacumantus subcarinatus - mudsnail

Amphineura

- Sypharochiton pelliserpentis - chiton

Bivalvia

- Anomia triganopsis - golden oyster
Austrovenus stutchburyi - cockle
Crassostrea gigas - Pacific oyster
Mytilus edulis aoteanus - blue mussel
Xenostrobus pulex - intertidal black oyster

Tubeworms

- Pomatoceros caeruleus

Crustacea

- Chamaesipho columna - barnacle
Elminius modestus - barnacle

Bryozoa

- Watersipora cucullata - lace coral

Coelenterata

- Anthopleura aureoradiata - anemone

Flora

- Lichens - unidentified

Algae

- Brown turfing algae (unidentified)
Hormosira banksii - Neptune's necklace
Corallina officinalis - coralline turf
Corallina officinalis - coralline paint
Scytothamnus australis
Ulva lactuca - sea lettuce

APPENDIX 1.3

Rocky Intertidal Shores - Motutapu Island, inner shore

Fauna

Gastropoda

- Cominella adspersa - carnivorous snail
Cominella maculosa - "
Lepsiella scobina - oyster borer
Littorina unifasciata antipodum - periwinkle
Melagraphia aethiops - snail
Melanerita atrimentosa - snail
Notoacmea daedala - limpet
Onchidella nigricans - pulmonate limpet-like slug
Turbo smaragdus - cats eye snail

Amphineura

- Acanthochitona zelandica - chiton
Sypharochiton pelliserpentis - chiton

Bivalvia

- Crassostrea gigas - Pacific oyster
Mytilus edulis aoteanus - blue mussel
Xenostrobus pulex - intertidal black mussel

Porifera

- Cliona - sponge

Tubeworms

- Pomatoceros caeruleus

Crustacea

- Chamaesipho columna - barnacle
Elminius modestus - barnacle
Macrophthalmus hirtipes - burrowing crab

Flora

- Lichens - unidentified
 Algae
Apophloea sinclairii
 Brown turfing algae (unidentified)
Hormosira banksii - Neptune's necklace
Scytothamnus australis
Ulva lactuca - sea lettuce

APPENDIX 1.4

Rocky Intertidal Shores - Motutapu Island, Outer Shore

Fauna

Gastropoda

- Cominella maculosa - carnivorous snail
Lepsiella scobina - oyster borer
Littorina unifasciata antipodum - periwinkle
Maoricrypta monoxyla - slipper limpet
Melagraphia aethiops - snail
Melanerita atrimentosa - snail
Notoacmea daedala - limpet
Onchidella nigricans - pulmonate limpet-like slug.
Siphonaria zelandica - pulmonate limpet
Turbo smaragdus - cats eye snail

Amphineura

- Acanthochitona zelandica - chiton
Sypharochiton pelliserpentis - chiton

Bivalvia

- Crassostrea gigas - Pacific oyster
Mytilus edulis acetanus - blue mussel

Echinodermata

- Asterina regularis - starfish

Ascidian - unidentified sea squirt

Porifera

- Cliona - sponge

Tubeworms

- Pomatoceros caeruleus

Crustacea

- Chamaesipho columna - barnacle
Elminius modestus - barnacle

Flora

Lichens - unidentified

Algae

- Apophloeoa sinclairii
 Brown turfing algae (unidentified)
Corallina officinalis - coralline paint
Hormosira banksii - Neptune's necklace

APPENDIX 2.0

Species Lists - soft intertidal shores of the Blacksmiths Bay area.

APPENDIX 2.1

Soft Intertidal Shores - Blacksmiths Bay, proposed marina site

Fauna

Gastropoda

Cominella glandiformis - carnivorous snail
Diloma subrostrata - snail
Melanerita atrimentosa - snail
Micrelenchus sanguineus - topshell
Notoacmea daedala - limpet
Onchidella nigricans - pulmonate limpet-like slug
Turbo smaragdus - cats eye snail
Xymene plebius - carnivorous snail
Zeacumantus lutulentus - mudsnail

Amphineura

Amaurochiton glaucus - chiton
Sypharochiton pelliserpentis - chiton

Bivalvia

Austrovenus stutchburyi - cockle
Corbula zelandica - basket shell
Crassostrea gigas - Pacific Oyster
Macoma lilliania - bivalve
Mactra ovata - bivalve
Nucula hartvigiana - nutshell
Soletellina nitida - sunset shell
Theora lubrica - bivalve
Zenostrobos pulex - intertidal black mussell

Crustacea

Alpheus sp - snapping shrimp
Elminius modestus - barnacle
Macrophthalmus hirtipes - burrowing crab

Pinnotheres novaezelandiae - pea crab

Annelida

Glycera americana - worm
Lepidonotus polychromus - scale worm
Pectinaria australis - tubeworm
Asychis theodori - worm
 Worm B - unidentified
Orbinia papillosa - worm
 Glycerid worm

Coelenterata

Anthopleura aureoradiata - anemone

Flora

Algae

Hormosira banksii - Neptune's necklace

Maritime Plants

Avicennia marina - var. resinifera - mangrove

APPENDIX 2.3

Soft Intertidal Shores - Northwest Blacksmiths Bay

Fauna

Gastropoda

Amphibola crenata - mudsnailCominella glandiformis - carnivorous snailDiloma subrostrata - snailMicrelenchus sanguineus - topshellNotoacmea daedala - limpetZeacumantus lutulentus - mudsnail

Amphineura

Amaurochiton glaucus - chiton

Bivalvia

Austrovenus stutchburyi - cockleCorbula zelandica - basket shellMacoma liliana - bivalveMactra ovata - bivalveNucula hartvigiana - nut shellPaphies australis - pipiTheora lubrica - bivalve

Crustacea

Elminius modestus - barnacleMacrophthalmus hirtipes - burrowing crabPinnotheres novaezelandiae - pea crabTalorchestia - sandhopper

Annelida

Glycera americana - wormNicon aestuariensis - worm

Coelenterata

Anthopleura aureoradiata - anemone

APPENDIX 2.2

Soft Intertidal Shores - Southeast Blacksmiths Bay

Fauna

Gastropoda

Cominella glandiformis - carnivorous snailCominella maculosa - carnivorous snailDiloma subrostrata - snailXymene plebius - carnivorous snail

Amphineura

Amaurochiton glaucus - chiton

Bivalvia

Austrovenus stutchburyi - cockleCorbula zelandica - basket shellMacoma liliana - bivalveMactra ovata - bivalveNucula hartvigiana - nut shellPaphies australis - pipiTheora lubrica - bivalve

Crustacea

Callianassa filholi - ghost shrimpElminius modestus - barnacleMacrophthalmus hirtipes - burrowing crabPinnotheres novaezelandiae - pea crabTalorchestia - sand hopper

Annelida

Glycera americana - wormNicon aestuariensis - wormPomatoceros caeruleus - tubeworm

Nemertine worm

Bryozoans - lace corals

Unidentified species

Coelenterata

Anthopleura aureoradiata - anemone

APPENDIX 3.0

Species Lists - subtidal of the Blacksmiths Bay area.

APPENDIX 3.1

Subtidal - Blacksmiths Bay area, shallow subtidal

Fauna

Gastropoda

Cominella glandiformis - carnivorous snail

Diloma subrostrata - snail

Bivalvia

Austrovenus stutchburyi - cockle

Corbula zelandica - basket shell

Mactra ovata - bivalve

Macoma liliana - bivalve

Nucula hartvigiana - nut shell

Paphies australis - pipi

Theora lubrica - bivalve

Crustacea

Alpheus sp - snapping shrimp

Isopod - unidentified

Macrophthalmus hirtipes - burrowing crab

Annelida

Glycera americana - worm

Nicon aestuariensis - worm

Asychis theodori - worm

Nemertine worm

Perinereis nuntia - worm

Pectinaria australis - tubeworm

APPENDIX 3.2

Subtidal - Blacksmiths Bay area, channel

Fauna

Bivalvia

Theora lubrica - bivalve

Crustacea

Alpheus sp - snapping shrimp

Macrophthalmus hirtipes - burrowing crab

Annelida

Glycera americana - worm

Asychis theodori - worm

Orbinia papillosa - worm

Worm E - unidentified

Perinereis nuntia - worm

Pectinaria australis - tube worm

APPENDIX 4.0

Comparable rocky intertidal shores in the Bay of Islands.

4.1.1 Species List

Rocky Intertidal Shores - Waikare Inlet, upper inlet location

Fauna

Gastropoda

Zeacumantus subcarinatus - mudsnailZeacumantus lutulentus - mudsnailLepsiella scobina - oyster borerLittorina unifasciata antipodum - periwinkleCabestana waterhousei - whelkOnchidella nigricans - pulmonate limpet-like slug

Amphineura

Sypharochiton pelliserpentis - chiton

Bivalvia

Xenostrobus pulex - intertidal black musselCrassostrea gigas - Pacific oysterMytilus edulis aoteanus - blue musselPerna canaliculus - green mussel

Tubeworms

Pomatoceros caeruleusSalmacina australis

Crustacea

Chamaesipho columna - barnacleElminius modestus - barnacle

Bryozoa

Watersiporia cucullata - lace coral

Unidentified - brown bryozoan

Coelenterata

Anthopleura aureoradiata - anemoneFlora

Lichens - unidentified

Algae

Brown turfing algae - unidentified

Corallina officinalis - coralline turfCorallina officinalis - coralline paintHormosira banksii - Neptune's necklaceUlva lactuca - sea lettuceEnteromorphaScytothamnus australisGelidium

Table 1

Daily Intertidal Quadrat Sample

Site: Waikare Inlet - inner site, transect 1

2/10/84

Form	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>				
<u>Nelusetta aethiops</u>				
<u>Nelusetta atrimentosa</u>				
<u>Zonitoides lutulentus</u>			-	
<u>Zonitoides subcarinatus</u>			-	
<u>Turbo smaragdus</u>				
<u>Cucullia maculosa</u>				
<u>Cucullia glandiformis</u>				
<u>Cucullia adpersa</u>				
<u>Diluvium subrostrata</u>				
<u>Diluvium zelandica</u>				
<u>Lepidodonta scobina</u>			0.33 ± 0.33	0.67 ± 0.67
<u>Gastropoda nigricans</u>				-
<u>Nelusetta parviconoidea</u>				
<u>Nelusetta daedala</u>				
<u>Xenodonta pulex</u>			0.83% ± 0.17	
<u>Crepidula gigas</u>		-	-	
<u>Mytilus edulis</u>			-	
<u>Acanthina stutchburyi</u>				
<u>Acanthina triganopsis</u>				
<u>Siphonaria pelleriserpentis</u>			-	5.33 ± 5.33
<u>Acanthina zelandica</u>				
<u>Acanthina glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterias regularis</u>				
<u>Cliona</u>				
<u>Chamaelea columna</u>		0.42% ± 0.30	42.5% ± 11.12	
<u>Porolithidium caeruleus</u>				11.83% ± 5.05
<u>Mastomys monoxyla</u>				
<u>Ascidia</u>				
<u>Elanus modestus</u>			-	3.0 ± 3.0
<u>Amphioxus aureoradiata</u>				
<u>Wakatara cucullata</u>				
<u>Peramphiculus</u>				0.67 ± 0.67

Species Distribution and Abundance

Table 1 cont.

Rocky Intertidal Quadrat Sample

Site: Waikare Inlet - inner site, transect 1

2/10/84

Flora	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
Lichens	5.5% ± 3.13			
Unidentified brown turf		0.42% ± 0.42	3.5% ± 2.18	-
Coralline paint				
Coralline turf				11.0% ± 4.76
<u>Ulva lactuca</u>		-	1.33% ± 0.71	
<u>Hormosira banksii</u>			-	5.67 ± 0.33
<u>Scytothamnus australis</u>				
<u>Enteromorpha</u>	0.25% ± 0.25	1.33% ± 0.88	0.08% ± 0.08	
Weed b		-	-	
<u>Gelidium</u>		-	0.17% ± 0.08	

Table 2

Rocky Intertidal Quadrat Sample Sheet

Site: Waikare Inlet - inner site, transect 2

16/10/84

Fauna	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>		1.0 ± 1.0	1.0 ± 1.0	
<u>Melagraphia aethiops</u>				
<u>Melanerita atrimentosa</u>				
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>				
<u>Turbo smaragdus</u>				
<u>Cominella maculosa</u>				
<u>Cominella glandiformis</u>				
<u>Cominella adpersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>			1.0 ± 1.0	9.0 ± 1.73
<u>Onchidella nigricans</u>			-	9.0 ± 5.69
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		-	0.33% ± 0.33	
<u>Crassostrea gigas</u>		1.0 ± 1.0	1.67 ± 0.33	4.0 ± 2.08
<u>Mytilus edulis</u>			3.67 ± 1.86	10.0 ± 5.30
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>				
<u>Acanthochitona zelandica</u>				
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				
<u>Chamaesipho columna</u>		8.58% ± 5.07	24.17% ± 15.32	
<u>Pomatoceros caeruleus</u>			0.17% ± 0.17	7.83% ± 6.09
<u>Maoricrypta monoxyla</u>				
Ascidian				
<u>Elminius modestus</u>			2.0% ± 1.64	
<u>Anthopleura aureoradiata</u>			1.0 ± 0.58	2.33 ± 1.86
<u>Watersipora cucullata</u>				1.83% ± 1.59
<u>Salmacina australis</u>			-	0.17 ± 0.17
Unidentified bryozoan				0.08% ± 0.08
<u>Cabestana waterhousei</u>				1.0 ± 0.58

Rocky Intertidal Quadrat Sample Sheet

Site: Waikare inlet - inner site, transect 2

16/10/84

Flora	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
Lichens	2.3 ± 2.3			
Unidentified brown turf			31.0% ± 12.03	2.83% ± 1.53
Coralline paint			0.08% ± 0.08	0.83% ± 0.83
Coralline turf			-	9.67% ± 8.34
<u>Ulva lactuca</u>		0.17% ± 0.17	3.08% ± 2.59	3.0% ± 0.0
<u>Hormosira banksii</u>			0.33 ± 0.33	15.33 ± 6.90
<u>Scytothamnus australis</u>				1.0 ± 1.0
<u>Enteromorpha</u>		0.08% ± 0.08		

APPENDIX 4.2

4.2.1 Species List

Rocky Intertidal Shores - Te Puna Inlet, upper inlet location

Gastropoda

Zeacumantus subcarinatus - mudsnail
Lepsiella scobina - oyster borer
Littorina unifasciata - periwinkle
Onchidella nigricans - pulmonate limpet-like slug
Turbo smaragdus - cats eye snail
Notoacmea daedala - limpet
Diloma subrostrata - mudsnail
Cominella maculosa - carnivorous snail
Haustrum haustorium - carnivorous snail
Xymene plebius - carnivorous snail
Siphonaria zelandica - pulmonate limpet
Melagraphia aethiops - snail
Maoricrypta monoxyla - slipper limpet

Amphineura

Sypharochiton pelliserpentis - chiton
Acanthochitoria zelandica - chiton
Amaurochiton glaucus - chiton
Cryptoconchus porosus - chiton

Bivalvia

Xenostrobus pulex - intertidal black mussel
Crassostrea gigas - Pacific oyster
Mytilus edulis aoteanus - blue mussel
Atrina zelandica - horse mussel

Echinodermata

Asterina regularis - starfish
Coscinasterias calamaria - starfish

Porifera

Cliona - sponge
 Orange golf ball sponge - unidentified

Tubeworms

Pomatoceros caeruleus

Crustacea

Chamaesipho columna - barnacle
Elminius modestus - barnacle
Petrolisthes elongatus - half crab
Macrophthalmus hirtipes - burrowing crab
Pagurus novaezelandiae - hermit crab
Helice crassa - mud crab
Notomithrax - masking crab

Bryozoa

Watersipora cucullata - lace coral
 White unidentified bryozoan

Appendix 4.2.1 cont.

Coelenterata

Anthopleura aureoradiata - anemone

Flora

Lichens - unidentified

Algae

Brown turfing algae - unidentified

Corallina officinalis - coralline turf

Corallina officinalis - coralline paint

Ulva lactuca - sea lettuce

Hormosira banksii - Neptune's necklace

Table 1

Species Distribution and Abundance

Rocky Intertidal Quadrat Sample

Site: Te Puna Inlet - inner site, transect 1

25-26/10/84

Fauna	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>		22.67 ± 15.79		
<u>Melagraphia aethiops</u>		0.67 ± 0.67	2.67 ± 1.76	
<u>Melanerita atrimentosa</u>		-		
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>	1.67 ± 1.67	8.88 ± 8.6	14.33 ± 7.63	
<u>Turbo smaragdus</u>			0.67 ± 0.67	4.33 ± 2.5
<u>Cominella maculosa</u>			-	1.0 ± 1.0
<u>Xymene plebius</u>				-
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>				
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		-	0.66 ± 0.33	
<u>Onchidella nigricans</u>		0.67 ± 0.67	-	
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>		-	3.25% ± 3.25	
<u>Crassostrea gigas</u>			0.67 ± 0.67	
<u>Mytilus edulis</u>			-	0.66 ± 0.66
<u>Austrovenus stutchburyi</u>				
<u>Macrophthalmus hirtipes</u>				-
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>			10.0 ± 6.81	-
<u>Acanthochitona zelandica</u>				
<u>Amaurochiton glaucus</u>			-	
<u>Notomithrax</u>				-
<u>Siphonaria zelandica</u>			-	
<u>Asterina regularis</u>				
<u>Cliona</u>				
Orange golf ball spg				
<u>Chamaesipho columna</u>		1.08% ± 0.96	21.75% ± 13.87	
<u>Pomatoceros caeruleus</u>			30.08% ± 16.67	
<u>Maoricrypta monoxyla</u>			-	2.0 ± 1.16
<u>Cryptoconchus porosus</u>				-
<u>Ascidian</u>				
<u>Atrina zelandica</u>				-
<u>Elminius modestus</u>				-
<u>Anthopleura aureoradiata</u>			5.0 ± 5.0	-
White bryozoan				-

Rocky Intertidal Quadrat Sample

Site: Te Puna Inlet - Inner site, transect 1

25-26/10/84

Fauna	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
<u>Watersipora cucullata</u>				0.08% ± 0.08
<u>Risselopsis</u>		-	5.33 ± 2.91	
<u>Haustrum haustorium</u>			1.0 ± 0.58	-
<u>Coscinasterias calamaria</u>			-	-
<u>Pagurus novaezelandiae</u>				-

Table 1 cont.

Rocky Intertidal Quadrat

Site: Te Puna Inlet - inner site, transect 1

25-26/10/84

Flora	Littoral Zones of the Intertidal			
	Supra	Upper	Mid	Lower
Lichens	0.16% ± 0.16			
Unidentified brown turf		-	0.17% ± 0.17	
Coralline paint			-	0.25% ± 0.25
Coralline turf			-	28.0% ± 18.56
<u>Ulva lactuca</u>	0.08% ± 0.08	-	0.08% ± 0.08	0.08% ± 0.08
<u>Hormosira banksii</u>				0.33 ± 0.33
<u>Scytothamnus australis</u>				

Rocky Intertidal Quadrat Sample

Site: Te Puna Inlet - inner site, transect 2

25-26/10/84

Littoral Zones of the Intertidal

Fauna	Supra	Upper	Mid	Lower
<u>Littorina unifasciata</u>	20.67 ± 10.6	-		
<u>Melagraphia aethiops</u>		3.33 ± 1.2	4.33 ± 2.19	
<u>Melanerita atrimentosa</u>				
<u>Zeacumantus lutulentus</u>				
<u>Zeacumantus subcarinatus</u>	6.67 ± 4.81	46.67 ± 27.17	0.67 ± 0.33	-
<u>Turbo smaragdus</u>		-	2.33 ± 1.2	6.33 ± 0.88
<u>Cominella maculosa</u>			0.33 ± 0.33	-
<u>Cominella glandiformis</u>				
<u>Cominella adspersa</u>				
<u>Diloma subrostrata</u>		0.33 ± 0.33		
<u>Diloma zelandica</u>				
<u>Lepsiella scobina</u>		-	2.66 ± 1.45	
<u>Onchidella nigricans</u>	-		-	
<u>Notoacmea parviconoidea</u>				
<u>Notoacmea daedala</u>				
<u>Xenostrobus pulex</u>	-	5.5% ± 3.02	10.0% ± 10.0	-
<u>Crassostrea gigas</u>			0.33 ± 0.33	
<u>Mytilus edulis</u>		0.33 ± 0.33	218.0 ± 70.65	-
<u>Austrovenus stutchburyi</u>				
<u>Anomia triganopsis</u>				
<u>Sypharochiton pelliserpentis</u>		1.67 ± 0.88	3.33 ± 2.03	
<u>Acanthochitona zelandica</u>				0.33 ± 0.33
<u>Amaurochiton glaucus</u>				
<u>Siphonaria zelandica</u>				
<u>Asterina regularis</u>				
<u>Cliona</u>				0.08% ± 0.08
<u>Chamaesipho columna</u>	0.08% ± 0.08	7.42% ± 4.49	1.08% ± 1.08	-
<u>Pomatoceros caeruleus</u>		-	12.64% ± 12.03	1.92% ± 1.29
<u>Maoricrypta monoxyla</u>				1.33 ± 0.88
Ascidian				
<u>Pagurus</u>				0.33 ± 0.33
<u>Elminius modestus</u>				
<u>Anthopleura aureoradiata</u>		3.67 ± 1.33	3.33 ± 3.33	7.22 ± 3.85
White bryozoan				2.92% ± 0.68
<u>Watersipora cucullata</u>				1.58% ± 1.58
<u>Cosginasterias</u>			0.33 ± 0.33	-
<u>Risselopsis</u>				
<u>Haustrum haustorium</u>		0.33 ± 0.33		
<u>Helice crassa</u>			0.33 ± 0.33	
<u>Petrolithses elongatus</u>				

Species Distribution and Abundance

Table 2 cont.

Rocky Intertidal Quadrat Sample

Site: Te Puna Inlet - inner site, transect 2

25-26/10/84

Littoral Zones of the Intertidal

Flora	Supra	Upper	Mid	Lower
Lichens				
Unidentified brown turf			0.08% ± 0.08	
Coralline paint			-	-
Coralline turf			0.08% ± 0.08	51.25% ± 8.14
<u>Ulva lactuca</u>				-
<u>Hormosira banksii</u>		1.33 ± 1.33	0.67 ± 0.67	2.33 ± 1.2
<u>Scytothamnus australis</u>				