A SURVEY OF MARINE HABITATS AT KAWERUA.

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SUMMARY

A rocky subtidal area of Northland's west coast was studied using SCUBA. Results of transects adjacent to a reef were used together with photographs of the intertidal topography to produce a generalized habitat map. *Carpophyllum maschalocarpum* was the most abundant macroalga (i.e. large sea weed) and dominated the less exposed sites but formed mixed weed beds with several other macroalgal species:- *(Lessonia variegata, Landsburgia quercifolia, Ecklonia radiata, Sargassum sinclairii* and *Durvillia antarctica)* at the more exposed sites. Differences in mean plant length between transects did not appear to show any trend with the relative level of wave exposure.

INTRODUCTION

Kawerua is an unpopulated and remote locality on the west coast of Northland and about 200 km from Auckland (Figure 1). The Auckland

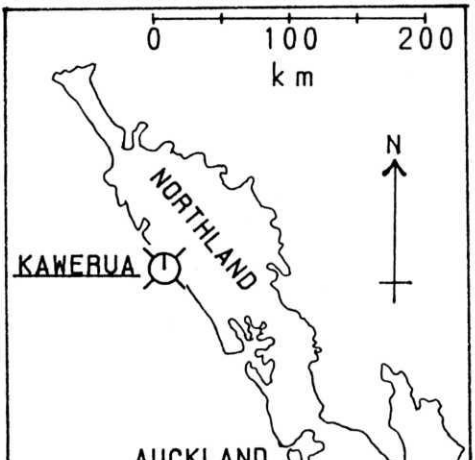

Fig. 1. Location of Kawerua

University Field Club has a scientific station at Kawerua and over the past 15 years numerous scientific articles relating to Kawerua have been published in *Tane.* Hayward (1971) described the zonation pattern of marine organisms in the rocky intertidal at Kawerua and concluded that the degree of wave exposure was the major factor influencing the pattern.

The purpose of this survey was to map and classify the marin habitats and to investigate the effect of wave exposure on subtida organisms. The areas chosen for study were adjacent to a reef tha projected out perpendicularly from the shore (Figure 2). Swells striking

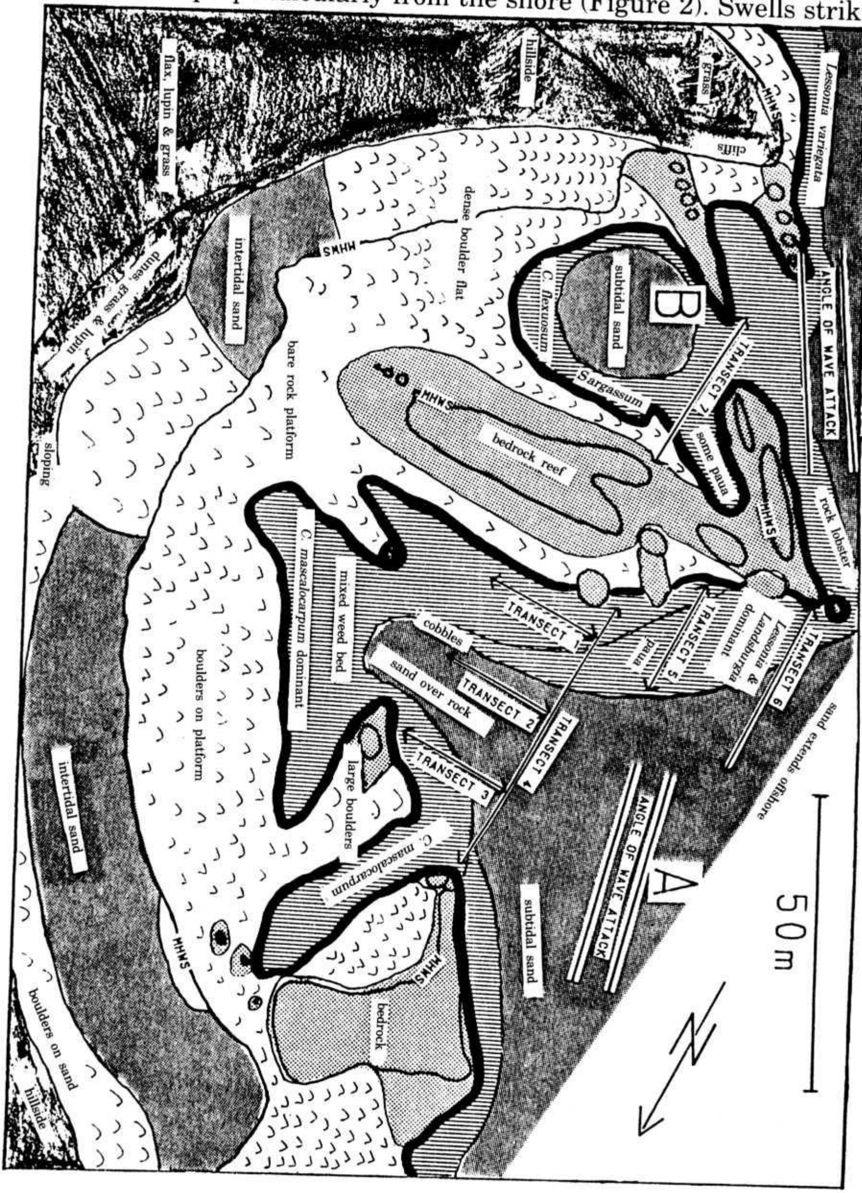

Fig. 2. Habitat map of the Kawerua coastline.

KEY

	Mean spring low tidal level
MHWS	**Mean spring high tidal level**
	Terrestrial vegetation
	Sand (intertidal and subtidal)
	Bedrock reefs & outcrops
	Shallow broken rock & mixed weed beds
	Boulder platform beaches
A	**Exposed bay**
B	**Sheltered Lagoon**

the tip of the reef decreased in size as they travelled towards the base and so it was assumed that a gradient of wave exposure occurred along the side of the reef, lessening towards the shoreline. This exposure gradient was illustrated by water visibilities which ranged from almost zero around the reef tip to 1.5 m at the base of the northern side of the reef. The shoreline here at the base formed a small bay comprised of boulders on a basalt platform that extended to about 1 m below LWS. On the southern side of the reef there was a lagoon sheltered from breaking waves by a subsidiary reef covering the entrance. Visibility in the lagoon was 2-3 m except during high tides when the water became stirred up.

METHODS

Seven subtidal transects were done using SCUBA, from 5th June 1982 to July 1983. Six transects were done on the northern side of the reef and in the bay at its base (marked A in Figure 2) and one transect was done in the sheltered lagoon (marked B). The transect tape was attached as close as possible to the bottom of the intertidal zone and usually run out across the rocks to the sandy bottom. Conspicuous marine life 1 m on either side of the tape was recorded on an underwater slate. The lengths of macroalgae were measured with a metre ruler and the lengths of Paua (*Haliotis iris*) were measured with calipers. A checklist of fish species observed on dives and caught by surfcasters was also compiled.

Transects 1, 2 and 3 were towards the edge of the boulder platform near the base of the reef. Transects 4, 5 and 6 were further out on the side of the reef. Transect 7 was in the sheltered lagoon (see Figure 2 f position of transects).

To aid mapping, photographs were taken at high and low tides ar used to draw intertidal habitats.

RESULTS

The results of the subtidal transects are recorded on Table 1. Th

Table 1. Results from the seven transects.

KEY

Very Common	**— V**
Common	**— C**
Present	**— P**
Uncommon	**— U**

TRANSECT NUMBER TRANSCECT LENGTH (m)	1 20	2 20	3 20	4 50	5 20	6 50	 3
Landsburgia quercifolia	8	2	-	23	2	94	
Lessonia variegata	2	3	3	-	1	18	
Ecklonia radiata	-	-	1	-	1	6	
Carpophyllun maschalocarpum	36	4	68	56	3	16	4
Carpophyllum flexuosum	-	-	-	-	-	-	I
Sargassum sinclairii	2	-	-	-	-	-	U
Pterocladia lucida	V	-	-	-	U	-	C
Zonaria angustata	F	-	2	-	V	V	C
Vidalia colensoi	P	-	-	-	V	U	.
Xiphophora chondrophylla	U	-	-	-	-		V
Melanthalia abscissa	U	P	V	-	U	-	.
Patiriella regularis	3	-	4	-	5	-	3
ephemeral green & red algae	-	C	-	-	-	-	-
kina *(Evechinus chloroticus)*	-	-	-	-	-	10	1
rock lobster *(Jasus edwardsii)*	-	-	-	-	-	6	-
paua *(Haliotis iris)*	-	-	6	-	17	67	12
Cellana stellifera	-	-	13	-	-	U	C
Cookia sulcata	-	-	-	-	5	4	-
Tethya spp.	-	-	-	-	-	20	2

marine habitats are described by geophysical features. Extensions of boulder platforms into the subtidal were called 'shallow broken rock habitats' and usually had boulders larger than those occurring in the intertidal, especially in the more exposed areas. This habitat also had bedrock outcrops. The focus of interest in this habitat however, was the presence of a mixed weed bed which covered most of the rocks.

Habitats recognised were:-

INTERTIDAL	Sandy beaches Boulder platform beaches Bedrock reefs

UBTIDAL	Shallow broken rock = mixed weed beds Sandy bottoms

The mixed weed bed sampled by transects 1, 2 and 3 at the base of the eef consisted predominantly of *Carpopyllum maschalocarpum,* with *andsburgia quercifolia, Sargassum sinclarii, Ecklonia radiata* with *essonia variegata* being present in low numbers. The commonest maller algae present were *Melanthalia abscissa, Pterocladia lucida, onaria angustata, Vidalia colensoi* and *Xiphophora chondrophylla* var *ninor*. The mixed weed bed absorbed any remaining wave energy before he waves reached the intertidal boulder platform. At transect 7, *arpophyllum maschalocarpum* was again dominant with *Carpophyl- um flexuosum* and *Sargassum sinclairii* also present. In order to letermine the effects of wave exposure, the transects were ranked elative to each other in order of increasing exposure:-

relatively sheltered 7 < 1 = 2 = 3 < 4 < 5 < 6 exposed

By referring to Table 1, trends in the abundance of organisms in relation to wave exposure can be observed.

Carpophyllum maschalocarpum is numerically dominant in all transect sites except site 6 (the most exposed site) where *Landsburgia* is dominant. *Lessonia* also occurs more frequently than *C. maschalocarpum* at site 6. Transect 7 (the least exposed site) on the other hand, had almost no *Lessonia* and *Landsburgia. C. flexuosum* only occurred in this transect. *Ecklonia radiata* appeared to prefer relatively exposed sites but was uncommon.

There were major differences in the lengths of plants between transects. The 4 individuals of *C. maschalocarpum* at site 2 were much larger than *C. maschalocarpum* at other sites. (Figure 3). This was probably because the transect was laid down on a sandy bottom which had small isolated patches of bedrock showing. The few plants growing on these would have less density dependent competition. Interestingly, *Landsburgia* was shorter at the sites where it is more common. This result may be due to intraspecific competition. Big differences in mean lengths of *Lessonia* occurred between transects 1 and 3. However the sample size was very low.

Rock lobster *(Jasus edwardsii)* were very common under large boulders around the reef tip. Paua (*Haliotis iris*) were also very common. Clumps of Paua occurred under about half the boulders near the reef tip. Most paua in the bay would be inaccessable to divers (paua may be taken on snorkel but not SCUBA). The fact that paua in the sheltered lagoon are smaller is probably not due to the effects of exposure but because the lagoon is more suitable for diving and the largest individuals would have

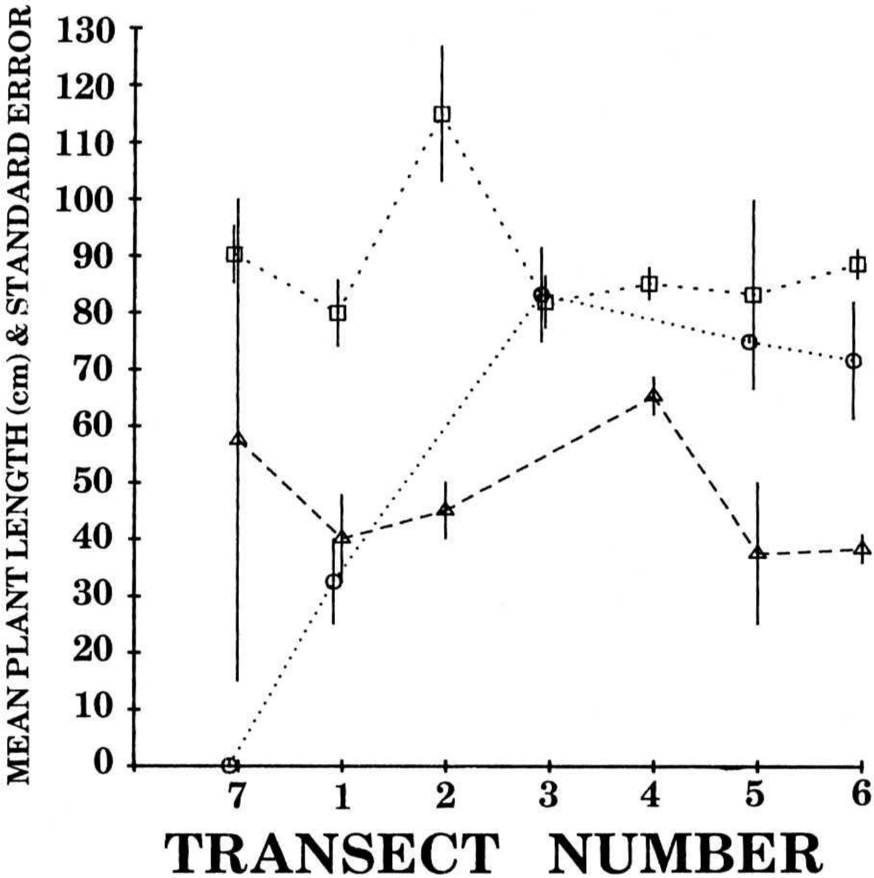

Fig. 3. Size of the major macroalgae from the seven transects.

KEY

□ - - - □ = ***C. maschalocarpum***
△ - - - △ = ***L. quercifolia***
○ - - - ○ = ***L. variegata***

been removed. None of the ninety live paua measured or the twelve empty shells left behind by divers were over the legal limit of 12.5 cm. (Table 2).

10 of the 14 species of fish recorded at Kawerua occurred in the mixed weed bed at the base of the reef (see Appendix), indicating the importance of mixed weed beds for fish.

Table 2. Paua size measurements.

Mean size (cm) $^{+}/_{-}$	**Standard error of paua recorded in the exposed lagoon = 11.31** $^{+}/_{-}$ **0.12**
Mean size (cm) $^{+}/_{-}$	**Standard error of paua recorded in the sheltered lagoon = 9.95** $^{+}/_{-}$ **0.28**
Mean size (cm) $^{+}/_{-}$	**Standard error of empty shells left behind by visitors = 10.8** $^{+}/_{-}$ **0.17**

DISCUSSION

A relationship between wave exposure and the composition of mixed weed beds on shallow broken rock is apparent from the results. *Carpophyllum maschalocarpum* is dominant in the relatively sheltered sites but as the degree of exposure increases the abundance of most other species of macroalgae also increases, producing more composite forests. The habitat diversity also increases with exposure. The trends caused by wave exposure were more evident than depth related zonation. No obvious zonation patterns were observed within the shallow broken rock habitats sampled. This was due probably to the topographic complexity of the habitat and the poor water visibility. Some of the larger boulders had *Lessonia* growing on top and *C. maschalocarpum* on the sides but this small scale pattern was obscured by the sampling design. On a dive at another more highly exposed point along the coast however, Bull kelp *(Durvillea antarctica)* was observed (no quantitative results) growing in a narrow band along the top of the shallow mixed weed zone, with *Lessonia variegata* and *Landsburgia* predominating beneath it. However at this site the plants were attached directly to the steep sloping bedrock of the reef rather than the diverse broken boulders and rocky outcrops where the survey was concentrated. *Sargassum sinclairii* was seen only at this exposed site and at the most sheltered site; it thus appears to be relatively indifferent to wave exposure.

Mapping of rocky subtidal habitats on the northeast New Zealand coast and its offshore islands by Ballantine, Grace and Doak (1973), Ayling (1978), Choat and Schiel (1982) has shown mixed weed beds to be very common in shallow water. Grace (1983) and Dickson (1984) describe the effects of differences in wave exposure on the composition of the macroalgae within these beds. The wave exposure at Kawerua is roughly similar to the offshore islands of northeast New Zealand and although most species of macroalgae are found on both coasts there are several important differences. On the northeast coast and offshore islands, the more exposed sites are often of greater depth which enables several biological habitats to occur beneath the shallow mixed weed zone. Areas from 6-10 m are often sea urchin dominated zones almost bare of algae, and from 10-17 m there is usually a forest of *Ecklonia* *radiata.* Grace (op. cit.) notes that these two habitats usually do no occur on the sheltered coasts of the inner Hauraki gulf. The absence o urchin/bare rock and *Ecklonia* forest zones at Kawerua is due to a depth effect rather than an influence of wave exposure. At Kawerua the sandy bottom around reefs occurs at a depth of 6-10 m. (i.e. similar to the inner Hauraki Gulf). This sand is disturbed by wave motion so no organisms live in it. The to-and-fro sand movement has a scouring effect on the organisms living on the rocks close to the sand. The effect of the scouring combined with the reduced water visibility forces the algae to live close to the surface. It is noticeable that algae are much more common at Kawerua than on the northeast coast. Grazers do not appear to be especially common at Kawerua however, except for paua subtidally and *Cellana radians* in the intertidal. *Cellana* often reaches a size of 5-6 cm.

On exposed areas of northeast New Zealand *Carpophyllum angustifolium* is a characteristic indicator species of shallow mixed weed beds, but is entirely absent from the west coast of Northland. Other macroalgae not recorded at Kawerua were the shelter loving *Cystophora* species and *Carpophyllum plumosum* which can tolerate moderate exposure but does not seem to do well in conditions of poor water visibility. The sea on the northeast coast of New Zealand is influenced by the subtropical East Auckland current whereas the water at Kawerua is much cooler. Kawerua is at the convergence of the southward flowing West Auckland current and the Westland current which flows up from the South Island. Kawerua is thus likely to receive current dispersed organisms from a wide area of origin. *Landsburgia* and *Lessonia,* as well as *Durvillea,* are of southern affinity.

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APPENDIX. Macrofaunal species list from the Kawerua subtidal and intertidal. (Organisms recorded by Hayward are included.)

ALGAE
Amphiroa anceps ****
Apophloea sinclairii *
Carpophyllum maschalocarpum
C. flexuosum
Colpomenia sinuosa ****
Corallina officinalis *
Durvillea antarctica *
Ecklonia radiata
Enteromorpha sp. ****
Gelidium caulacantheum *
Glossophora kunthii
Gymnogongrus humilis *
Hormosira banksii ****
Jania rubens
Landsburgia quercifolia
Lophurella caespitosa *
Lessonia variegata *
Lithophyllum sp. *
Melanthalia abscissa *
Microdictyon mutabile *
Pachymenia himantophora *
Porphyra columbina *
Pterocladia capillacea
P. lucida *
Sargassum sinclairii *
Splanchnidium rugosum *
Ulva lactuca ****
Vidalia colensoi *
Xiphophora chondrophylla var. *minor* *
Zonaria angustata *
Zostera capricorni ****

PORIFERA
Aaptos aaptos
Anchorina alata
Halichondria sp.
Haliclona petrosioides
Hymeniacidon perlevis
Polymastia fusca
P. granulosa
Tethya aurantium

CNIDARIA
Actinea olivacea ****
Isactinia tenebrosa

Isocradactis magna
Oulactis mucosa
Physalia physalis
Syncoryne sp. ****
Velella velella

ANNELIDA
Dendrostomum aeneum ****
Heteronereis sp.
Hydroides norvegica ****
Nereis sp.
Owenia fusiformis ****
Pectinaria australis ****
Pomatoceros caeruleus
Sabellaria kaiparaensis
Spirorbis sp.

MOLLUSCA
Acanthochiton zelandicus
Amaurochiton glaucus
Buccinulum sp.
Cantharidella tessellata ****
Cellana radians
C. ornata
C. stellifera
Cominella sp.
Cookia sulcata
Coryphellina sp. ****
Crassostrea glomerata
Diloma sp.
Eatoniella olivacea ****
Estea zosterophila ****
Eudoxochiton nobilis
Fossarina rimata
Haliotis iris
Haminoea zelandia ****
Ianthina ianthina
Littorina cincta
L. unifasciata
Macomona liliana ****
Melagraphia aethiops
Nerita atramentosa
Neothais scalaris
Notoacmea pileopsis
Notolepton antipodum ****
Nucula hartvigiana ****
Onchidella nigricans
Okadaia cinnebareus ****
Patelloida corticata
Perna canaliculus
Risellopsis varia
Rissoina anguina ****
Sypharochiton pelliserpentis
Turbo smaragda

Tugali elegans
Xenostrobus pulex
Xymene plebeius
Zeacumanthus subcarinatus ****

CRUSTACEA
Chamaesipho brunnea
C. columna
Cyclograpsus lavauxi **
Cyclosterope zelandica ****
Elamena producta **
Epopella plicata **
Halicarcinus innominatus **
Helice crassa **
Hemigrapsus crenulatus **
Heterozius rotundifrons **
Hymenicus pubescens **
Isocladus armatus ****
Jasus edwardsii
Leptograpsus variegatus **
Notomithrax minor **
Notomithrax ursus **
Ozius truncatus **
Ovalipes punctatus **
Pachygrapsus marinus **
Pagurus novaezelandiae **
Palaemon affinis ****
Petrocheles spinosus **
Petrolisthes elongatus **
Pinnotheres novaezelandiae **
Plagusia capensis **
Planes cyaneus **
Tetraclitella purpurasens

ECHINODERMATA
Amphipholis squamata ***
Amphiura sp. ****
Evechinus chloroticus ***
Ophionereis fasciata ***
Patiriella regularis ***
Psilaster acuminatus ***
Stegnaster inflatus ***
Stichaster australis ***
Stichopus mollis ***
Trochodota dunedinensdis ***

PISCES

SCIENTIFIC NAME	COMMON NAME
Aplodactylus meandratus	Marblefish
Arripis trutta	Kahawai
Cheilodactylus spectabilis	Red Moki
Chironemus marmoratus	Kempfish
Chrysophrys auratus	Snapper

Dasyatis brevicaudatus	Short-tailed Stingray
Girella tricuspidata	Parore
Hippocampus abdominalis	Sea Horse ****
Lotella sp. 1	Rock cod
Parapercis colias	Blue cod
Pseudolabrus celidotus	Spotty (=Paketi)
Trahurus declivus	Horse Mackerel
Caranx georgianus	Kingfish
Tripterygion varium	Triplefin

* Hayward (1971)
** Hayward (1974)
*** Hayward (1975)
****Hayward (1979)