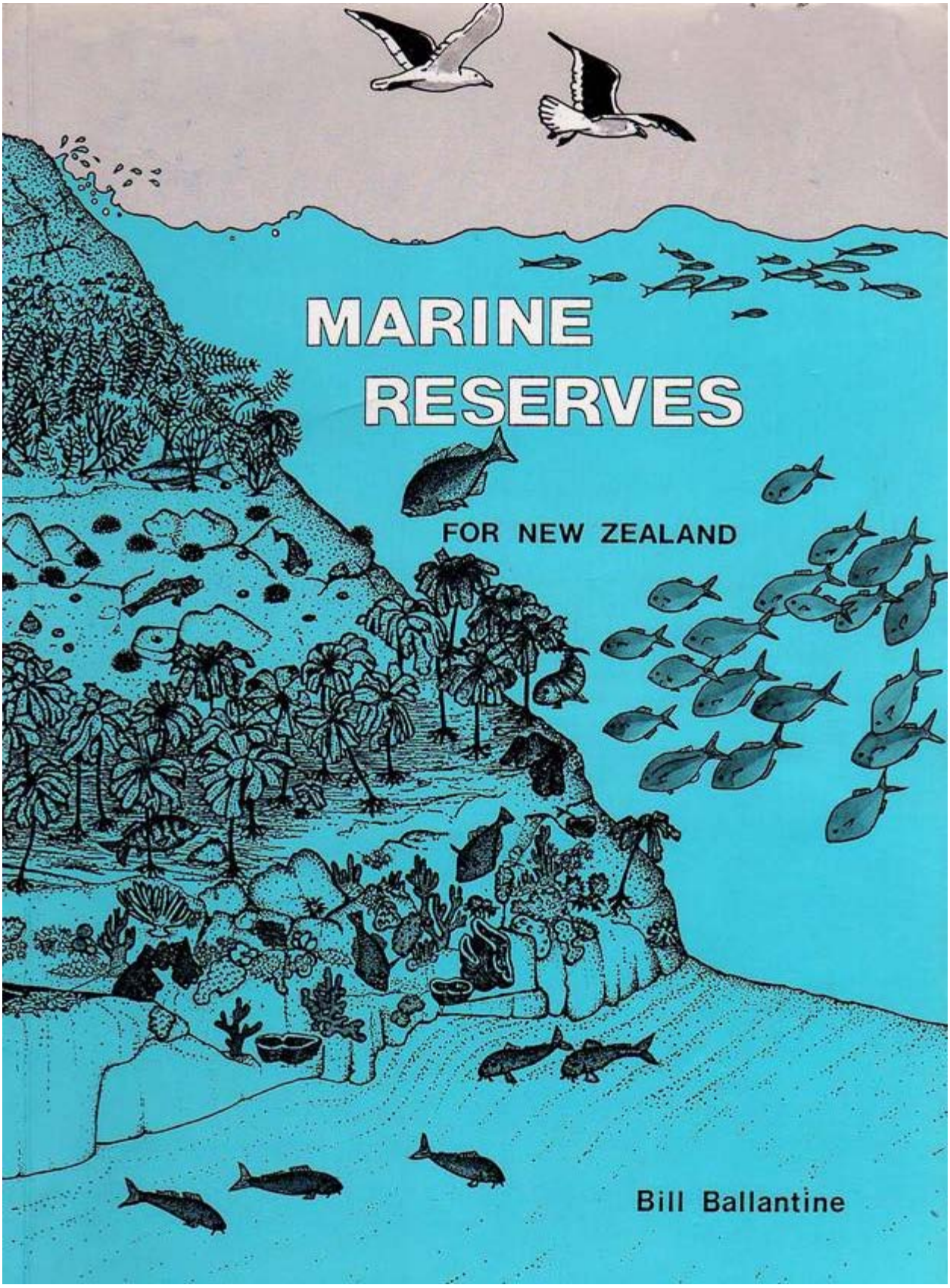


Front Cover inside page of 1991 book publication

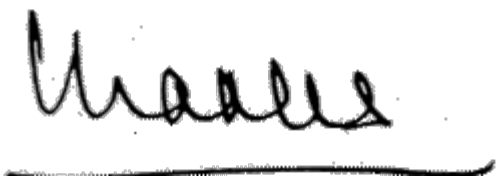
KENSINGTON PALACE

As President of the British Sub Aqua Club and President of the United Kingdom's Marine Conservation Society, I warmly welcome this challenging and informative new book by Dr. Ballantine.

There can be few countries in the world which do not possess, and protect, nature reserves on land, but there are only a handful of marine reserves in existence worldwide. This is perhaps not surprising, but modern technology has given us such potential for causing environmental damage, at sea as well as on land, that I believe the time has come to start looking very carefully at the need for such reserves. The principle is entirely straightforward; that there should be areas set aside in which no human disturbance is allowed. Provided that the areas are carefully chosen, and sufficiently large, natural levels of marine life can be protected and sustained.

Dr. Ballantine makes a persuasive case for marine reserves. Undisturbed, natural marine areas are valuable for their own sake, but will also allow us to measure the effects of our activities elsewhere, provide refuges where stocks of fish and other exploited marine life can build up, and give us something of real value to pass on intact to future generations.

I recognize that establishing a marine reserve takes time, commitment and goodwill from a great many interested parties, but this book establishes the need, sets out the benefits, and shows how it can be done. I hope it will be widely read, not just in New Zealand, but in every maritime nation.



MARINE

RESERVES

for

New Zealand

W. J. Ballantine

UNIVERSITY OF AUCKLAND

Leigh Laboratory Bulletin No. 25

October, 1991

ISBN 0-473-01188-3

Published by:
University of Auckland
Leigh Marine Laboratory
R.D.5 Warkworth, New Zealand.

Printed and bound by:
Uniprint (University of Auckland)
Private Bag, Auckland, New Zealand.

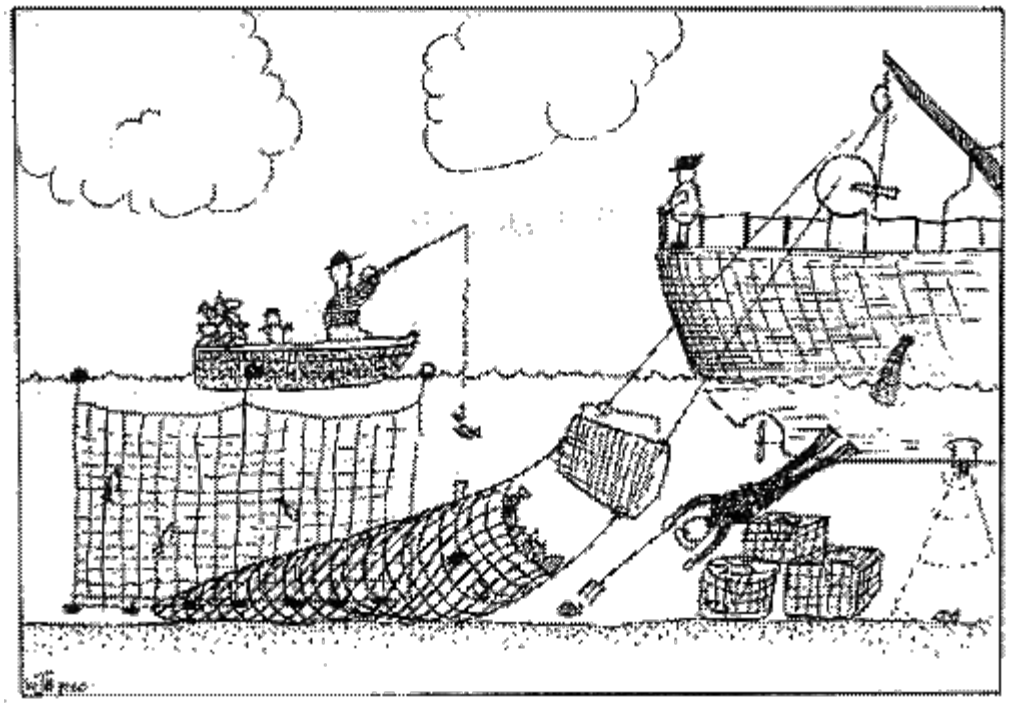
Prepared on:
A Wang PC 260, using
Microsoft Word for Windows
and an Apple Laserwriter.
Text available on disc.

Cover design by John Walsby.

Note:
The views expressed in this book are those of the author and are not necessarily shared by any other persons or organisations, including those assisting in the production and distribution of the book.

FOR DULCIE

WHAT DO YOU MEAN "*Marine Reserves*" ?



First adult : "The fishing's not what it used to be."

Second adult: "No, it must be the greenhouse effect,
the government,
the foreigners,
the pollution, etc."

Small child : "Daddy, where do the fish go to have their babies?"

First adult: "Shut up and cut more bait!"

Last fish: "Aaaaarrh !" (expires)

HEALTH WARNING

Marine reserves are addictive and can affect your health. People who have them do not want to give them up. They start clamoring for more. The side effects are serious. People infected with the idea become interested, enthusiastic, active, knowledgeable, healthy and impatient with silly arguments and no-hopers. They start talking about "*10% of everything*" and "*We want them now*". In the end they become determined, convincing and unstoppable. This process has already started. There is even a government department seriously involved and various societies are organising support groups.

CONTENTS

FOREWORD

This book is a masterpiece of advocacy in a field where Bill Ballantine has given twenty years of service. History, since the Marine Reserves Act was passed in 1971, has several lessons to teach us. In the years that followed, only one Reserve has been achieved on the mainland coasts. The second is at the Poor Knights, with a third recently gazetted in the far Kermadecs. Such dearth of action gives the clear message that the channel provided by the Act will only be

used if there is strong citizen input. By citizens we mean anyone with knowledge of the coast, professional or amateur, and the moral passion needed to become movers and shakers: to persuade fellow New Zealanders and agitate governments.

Governments need not be much condemned for being cautious or requiring time to digest arguments. Changes generally proceed with deliberate speed. The Ministry of Agriculture and Fisheries - when it administered the Marine Reserve Act - was over-deliberate, with no speed at all. It seemed to see its role as one of suspicion and delay. Today, much could be lost if marine reserve policy were to be left solely to the Department of Conservation, under-resourced, and uncertain of its support from more powerful limbs of government.

Since its recent beginning, DoC hasn't been short of vision for marine reserves. Several proposals are in the pipeline as I write. Here is where the ongoing need for citizen input and support lies. For several years past, Bill Ballantine has been not only a national voice, but has been looked to in some sense as a guide and encourager to DoC.

Goat Island Bay, Leigh is not only the site of a flourishing University Marine Laboratory, but of New Zealand's first marine reserve: gazetted by almost the last administrative action of the third Labour government in 1975. This decision has been vindicated by the support of the local people and even the fishing interests. Early critics are today proud of what has been achieved; and impressed with the notable increase in crayfish and other benthic fish stocks, within the Reserve and overflowing its limits.

Dr Ballantine's case is trenchantly argued, with a wealth of knowledge and examples only he could have assembled. Over 30 years I have never known him retreat from a sound argument. Nor does he believe over much in politics as "the art of the possible". Sometimes by bloodying our heads against the boundaries of the "impossible", we in our day can push them back a little. When Leigh was mooted, most supporters would have compromised for the "possible", by allowing leisure fishing with hand-lines; Ballantine stood out for a whole and complete reserve. After 15 years, public opinion and crayfish dynamics are on his side.

John Morton

LIST OF BOXES

PREFACE

Why this book was written

It has been my great good fortune to have lived closely with the development of marine reserves in New Zealand over the past 25 years.

In May 1965, when Professor Val Chapman made the first definite suggestion, I had just started work at Leigh. I lived alongside the site of the first marine reserve through the twelve years of argument about whether it should come into being. Over the next twelve years, I worked with all the scientists and amateur divers who studied in the reserve, and, slowly, I came to understand what was happening.

I talked to visitors, politicians, fishermen, administrators, schools, and everyone who was interested, learning about their perceptions of marine reserves and how their ideas changed.

Two clear conclusions came from all this. Everyone was surprised at what happened when a "no take" marine reserve was created, and all the surprises were pleasant ones.

This book describes the history of the first marine reserves and the lessons that we learnt from them. The purpose of the book is to promote more marine reserves, especially in New Zealand.

How to use it

This book is a compilation. The various parts were written over a period of ten years or more. Each piece had a particular aim that seemed important at the time.

Putting them all together produces some repetitions. However, anyone who battles for marine reserves will have the same sequence of thoughts and doubts.

So I have kept the original styles and wording, hoping these will show the development of the idea. It was slow. Even the keenest promoters of the idea took a long time to see many points which may seem obvious with hindsight.

In order to establish a network of marine reserves in New Zealand, many others will have to go through these same stages. I hope this book will help the process.

The book can be used in two ways:

You can just read it as the story of marine reserves in New Zealand and as a discussion of their uses, advantages and achievements.

You can regard it a source book for those wishing to help the cause. It aims to provide in handy form not just

the scientific data, the historical facts and the political progression but also the arguments, the problems, the red herrings and other excuses that bubble up whenever marine reserves are mentioned.

For a quick *summary* try: Chapters 1, 4 and 14.
If you want *the history of events* go to: Chapters 2, 4, 5 and 6.
For *scientific facts and theory* read: 1, 5, 9, 10, 12 and 13.
For *the benefits of marine reserves* consult: 4, 5, 10, 13 and 14.
For *the development of the concept* refer to: 2, 3, 4, 5, 6 and 8.
If *pressing for new marine reserves* check: 2, 3, 5, 11, 12, 14 & 15.
For *ways of convincing others* try: All the Boxes and Chapters 3, 5, 11 and 14.
In *replying to objections* consult: The Boxes and Chapters 2, 4 and 11.
For a *boost of commitment* look at: Chapters 1, 6, 7 and 10.
Before *giving a talk or lecture* check: The Boxes and Chapters 11, 14 and 15.
When *writing an assignment* begin with: Chapters 4 & 5; *or* 1 & 3, *or* 7 & 9.

Chapters helpful to particular groups:

Politicians and public administrators: 2, 3, 5 through 9 and 11. and the Boxes.
Students and teachers: *for basics* 1 to 4; *advanced* 5, 7, 9 & 10 through to 13.
Commercial and recreational fishermen: 3, 5, 7, 10, 11 and all the Boxes.
Reporters and editors: 1, 2, 4, 7, 8, 11, 14, and all the Boxes.

Acknowledgements

This book owes it existence to hundreds - no, thousands - of people, many of them unknown to me, who worked in many ways to make marine reserves possible and successful. I am unable to name all the groups, still less the individuals, but I would like to express my personal and very sincere thanks to them all.

They include:

Members of the University of Auckland who had the imagination to conceive the idea of a marine reserve, the energy to promote it and the wisdom to guide the first example through the maze of ignorance, indifference and distractions. And especially the members of the original Leigh Laboratory Committee: Professors V. J. Chapman, J. E. Morton, N. A. Mowbray, and Dr J. B. Gilpin-Brown.

All those scientists, visitors, staff, and research students at the Leigh Laboratory whose work over the years in the marine reserve provided steadily increasing information and understanding not just of species, habitats, processes and events but also in new methods and underlying principles.

All those who volunteered to help survey the first reserve, show parties round, write pamphlets, give talks and generally promote the full value of the idea that it represented.

All those divers whose skill in and enthusiasm for the underwater world at Leigh and elsewhere made the idea of marine reserves real, interesting and important..

All those in official positions, whether employed or elected, who found time and energy to help the idea along, including many in the Ministry of Agriculture and Fisheries, the Lands and Survey Department, the Commission for the Environment, the Ministry of Transport and the Department of Conservation, especially Lew Ritchie, George Macmillan, Roger Cornforth, Pat McCoombs, Kathy Walls and Andrew Jeffs.

All those organisations and societies which gave their support to marine reserves, including the N.Z. Underwater Association, the N.Z. Marine Sciences Society and the Royal Forest and Bird Protection Society.

All the underwater photographers whose skill and dedication enabled everyone else to see and appreciate the other world beneath our seas. And especially Wade Doak, Tony Ayling, Roger Grace, Kim Westerskov and Malcolm Francis.

All the grant agencies who supported various aspects of marine reserve science, survey, interpretation and public education, including the University of Auckland, the University Grants Committee, the Lottery Board, the McKenzie Trust, and the Sutherland Trust.

But, most of all, the many "ordinary" citizens who spoke up for marine reserves when it was easier to keep silent, who thought carefully about the issues when it was simpler to press on regardless, and who remembered to think of their grandchildren first - especially Roddy and Eileen Matheson.

The free distribution of this book to schools, public libraries and other institutions has been made possible by grants from a number of conservation, educational and government organisations. I am most grateful for their support.

The principal sponsors were:

World Wide Fund for Nature - New Zealand
New Zealand Education Foundation
Department of Conservation
Royal Forest and Bird Protection Society
New Zealand Underwater Association
also Greenpeace and the Maruia Society

It is my pleasure to record the assistance of many people with the actual preparation of the book. I wish to thank especially:

Kathy Walls and Andrew Jeffs of the Department of Conservation, for the idea and for continued interest, support and faith that I would eventually produce the goods.

John Morton, for providing the foreword, the Leigh Laboratory and much else. As the master of both the art and the science, his example remained a constant inspiration.

My colleagues at the Leigh Laboratory, particularly Sandy Harris, Malcolm Francis, Ned Pankhurst and Bob Creese who responded to my frequent *"Just tell me what you think of this bit"* with remarkable patience and much good advice.

Veronica Harris, not only for critically appraising the draft versions but also for lessons in grammar.

Jo Evans and my son Michael for persistent efforts to counteract my computer illiteracy and to keep me on the straight and narrow path of machine logic.

John Walsby for the cover design and several other illustrations, and Vivienne Ward for the underwater habitat drawings (originally produced with John as pamphlets).

Alistair MacDiarmid for the specially written comment on crayfish and marine reserves.

Bob Earll and the Marine Conservation Society (U.K.) for many useful ideas and for an introduction to their President.

David Emerson, of Dale Fort Field Centre and the Field Studies Council (U.K.) for hospitality and study space while writing chapters 4 and 5.

Lorraine McCowan and the other secondary school science advisers for reading the book and providing a recommendation for its use in schools.

Paul Smith, Peter Lush and the staff of Uniprint for advice to a novice "publisher" and the actual production of the final article.

My daughter Mary for listening and photocopying, and her son Sam for reminding me what was really important.

My wife, Dulcie, not only for TLC but for her continued attempts to raise the tone from dry science to something readable and comprehensible. Any success in that direction is to her credit.

Nevertheless, since I did not always take all the good advice I was given, I must be held responsible for any mistakes, omissions or other faults that remain.

For permission to reprint copyright material, I am grateful to:

Malcolm Francis for the map on page 14
J.T. Hewat for the letter on page 132
Professor J. E. Morton for several illustrations
The publishers of the *New Zealand Herald* for material on pages 100 &129
The publishers of *New Scientist* for Chapter 4
The Underwater Association for Scientific Research for Chapter 5
DSIR Publishing for the second part of Chapter 10
Department of Conservation for Chapters 12 and 13, and several illustrations

Bill Ballantine

August 1991
Leigh Marine Laboratory, University of Auckland

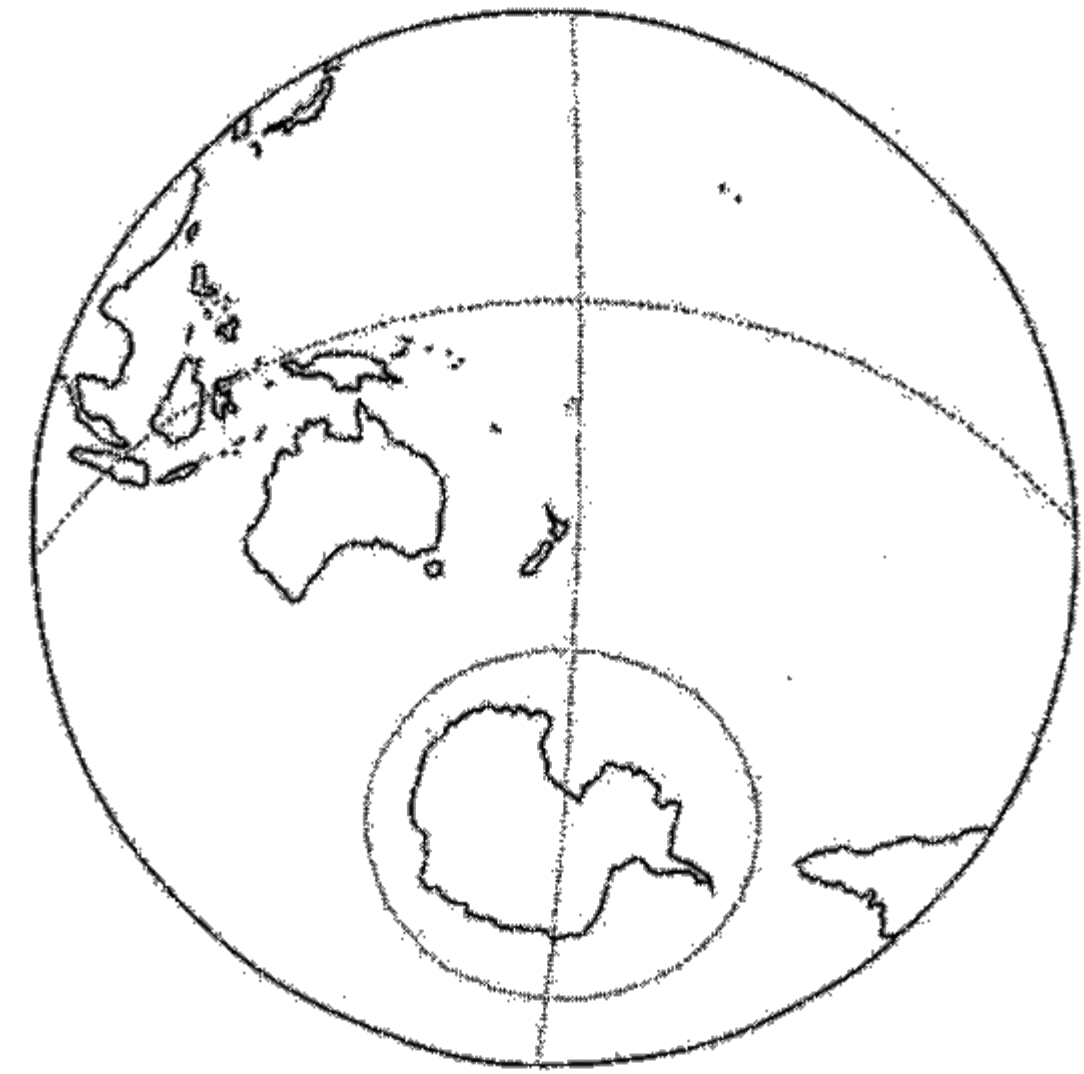


Fig. 1. The hemisphere centred on New Zealand. Our half of the world is 91 % ocean. We are at the centre of the water hemisphere.

CHAPTER 1

THE OPPORTUNITY

Before proceeding to the crusade, the moral imperatives, the scientific needs, the economic benefits, the social advantages, and all the detailed arguments, it is useful to look at the factual background. We are land creatures; most of our time, thoughts and efforts are spent on terrestrial matters. So the basic facts about the marine side of things may not leap to mind or form a clear picture. Yet without a clear factual framework it is not easy to judge the opportunity or even the real aims.

A common way of avoiding the effort of thought is to say, *'That's obvious!"* and then ignore it. However, the *"obvious"* is likely to be basic, common and important; hence its implications are probably worth a good deal of careful thought.

I believe that New Zealand could, and should, lead the world in marine conservation generally, and with marine reserves in particular. The main reasons for thinking this are simple facts that can be classed as "obvious" . However these facts are rarely listed together and, so far as I can discover, their implications are never discussed.

Taken together, the following facts strongly suggest that New Zealand has the best practical opportunity to pioneer the principles of marine conservation, especially the organisation of "no-take" marine reserves.

GEOGRAPHIC FACTS

New Zealand's geographic position

New Zealand lies at the centre of the "water hemisphere" (see Fig. 1). If you turn a globe every way until you are looking at the most blue ocean and the least land, you will find that New Zealand is in the middle of that half of the world.

This hemisphere is 91% ocean and only 9% land (and nearly half of that "land" is Antarctica). It is a simple geographic fact that we are the most maritime nation on earth. It could reasonably be expected that we would take a lead in marine matters.

Our marine environment

Our coastline is very long, about 15,000 km when measured on the standard 1:50,000 maps. Our coast is very varied, including cliffs and harbours, beaches and fiords, little creeks and vast bays. We have everything except coral reefs and icebergs. And almost all of it is easily accessible by ordinary folk in cars or boats.

The waters around New Zealand are vast. It is at least 1500 km over ocean to any other land. Even the waters under our direct responsibility, the territorial waters (to 12 nautical miles) and the Exclusive Economic Zone (to 200 miles), are very large. They also show a great range, extending from the subantarctic to the subtropical, and from the shallow continental shelf to the abyssal depths.

Our marine environment is magnificent. It is not some trivial extra, like the ribbon on a parcel, but a major asset, worthy of our care and attention.

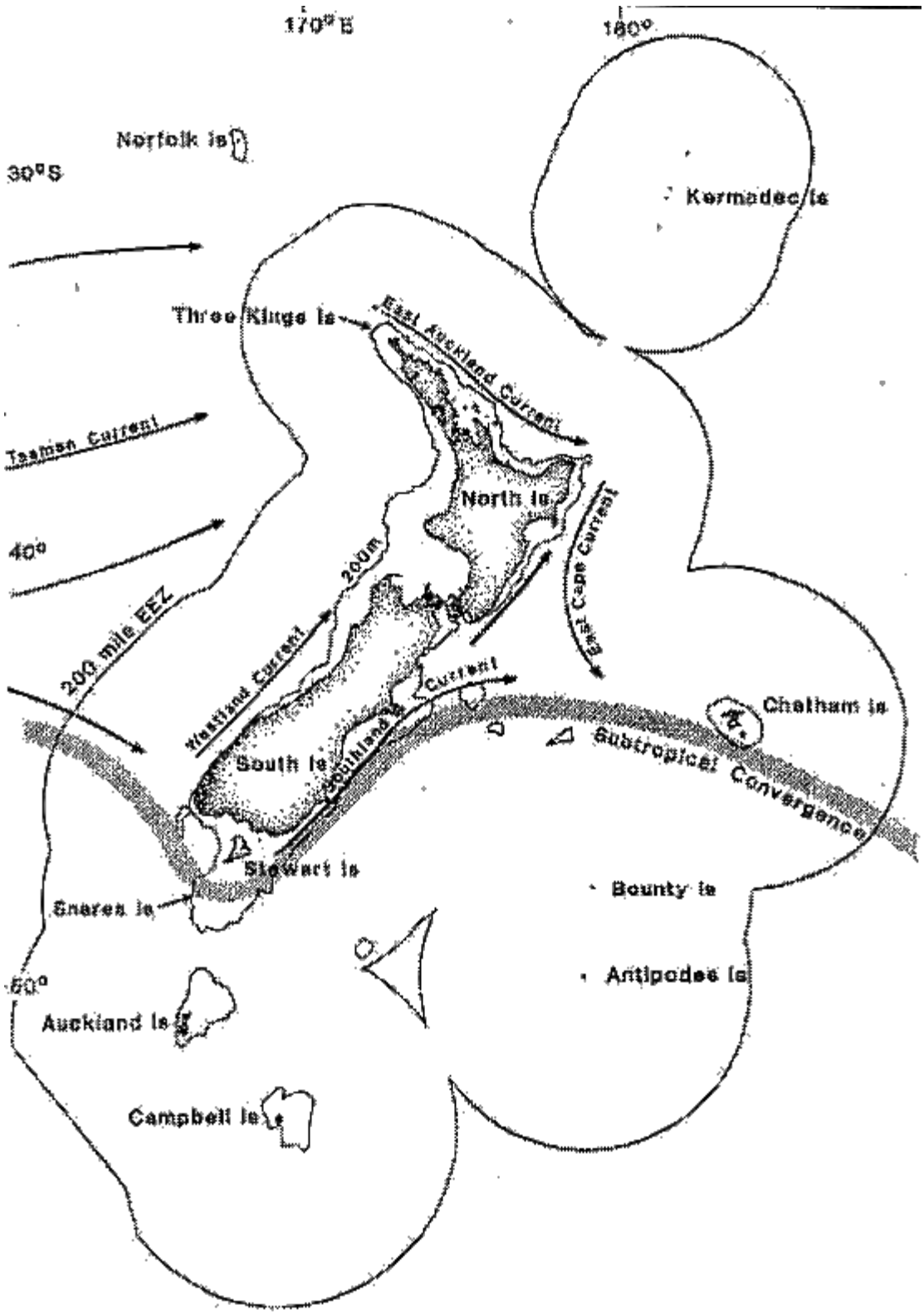


Fig. 2 THE NEW ZEALAND MARINE REGION
Showing the extent of the 200 mile Exclusive Economic Zone (EEZ) and the shallow continental shelf (marked by the 200 metre contour). From Malcolm Francis's book *"Coastal Fishes of New Zealand"*, with permission.

A low population density

By world standards, New Zealand has a small population, and a very low population density. As most of us live in cities, this second point may not be obvious in everyday life, but it is extremely important. Our relatively small

population has a great deal of sea and coast. The temptation is to let the sea look after itself while we do what we like, but there is a unique opportunity to create more sustainable marine management systems than other (and more crowded) countries have been able to achieve.

BIOLOGICAL FACTS

The variety of our marine life

New Zealand's marine animals and plants are rich and varied, scientifically interesting and often very special. This is due to the varied physical conditions we have now, and the geological history which kept our shallow waters almost as isolated as our land. We all know that we are guardians of much precious land life from kiwis to kauri forests, and wetas and snails. We are only just begining to learn of the marine equivalents from Hector's dolphin to giant kelp beds, not to mention bryozoa and brachiopods. We have plenty of marine life to be proud of and protect.

The relevance of our marine biology

Despite all its special features, New Zealand's marine life covers the centre of the world range in terms of total species, types of habitat and biological production. We can learn marine ecological principles from elsewhere, especially the effects of uncontrolled exploitation. But equally we could try to produce better management systems for widespread use. We would get the benefits first, but knowing the methods could be generally applied would help us make the effort.

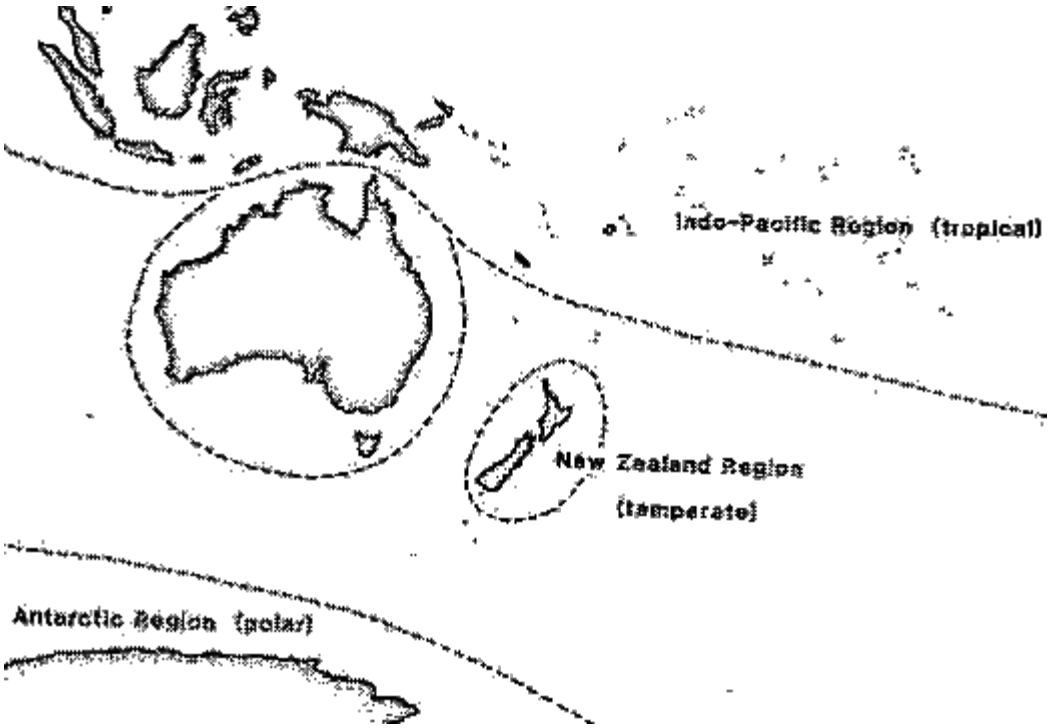


Fig. 3 NEW ZEALAND IN THE SOUTH PACIFIC
The marine biogeography of New Zealand, an area of temperate water between tropical and polar seas.

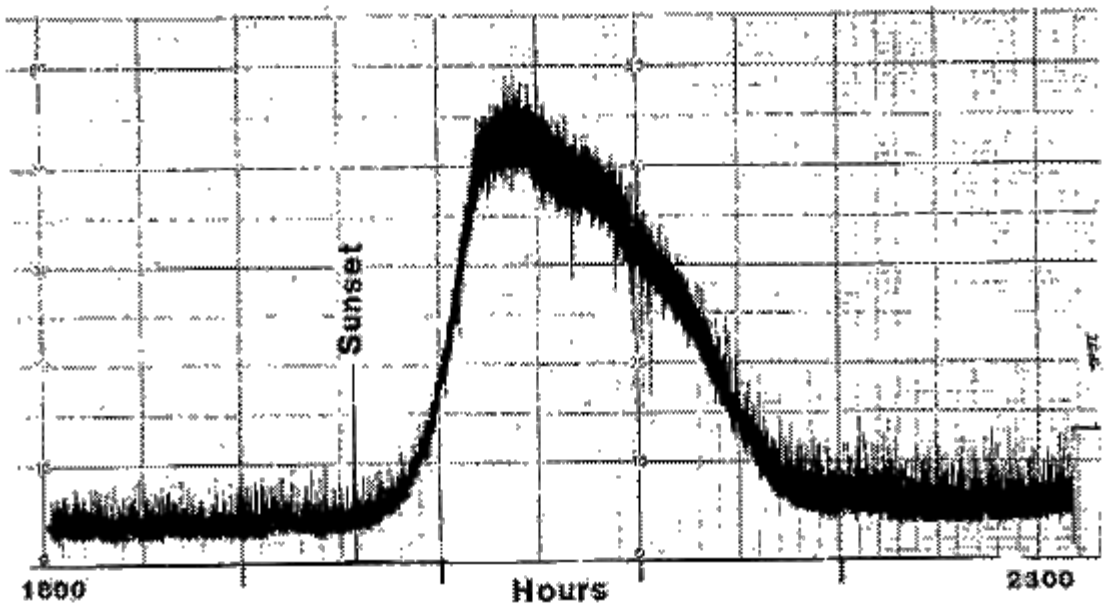


Fig. 4 A MARINE EVENING CHORUS
A sound recording showing the dramatic increase in underwater noise caused by sea urchins (kina) going out to feed at dusk. It was made by Malcom Castle at Leigh, on December 12th 1971, whilst a research student in the Physics Department (supervisor Professor Kibblewhite, technician Jo Evans).

ECONOMIC FACTS

The social and economic value of our fisheries

New Zealand's marine fisheries are of considerable economic value. Most of the product is exported and forms a significant part of our trade. Fisheries, including aquaculture, are of real economic importance to the country. Politicians give a lot of attention to this economic asset, because of the direct revenue, the employment and the export receipts.

Marine fishing is a very popular recreational activity in New Zealand and it gets a lot of social as well as political attention. Although fish are only one aspect of marine conservation, the great interest in fishing in this country ensures that any discussion affecting it will attract real and widespread interest. This does not necessarily mean that marine reserve proposals will be supported, but it does mean they will not be ignored!

The history of fisheries management

Our experience of fisheries management in New Zealand is unhappy, but this is generally true worldwide. Some of the problem can be explained as "the tragedy of the commons". If any resource is communally owned, then it is in constant danger of short-term rip-offs, booms followed by collapses. In marine fisheries there are the added difficulties of never knowing enough about stocks, and of the participants being largely occupied with the mechanics of getting a catch and staying alive while doing so.

The best existing fisheries management schemes are inevitably full of political and practical compromises. They must be worked out for one species at a time, without adequate basic information. The resulting policies often involve high risks to the stocks. We have enough experience of this in New Zealand for it to be clear that some additional insurance would be a good idea. A network of "no take" marine reserves is an insurance option we have yet to try,

LEGAL FACTS

The sea is public domain

Although in New Zealand we spend a lot of time arguing about how this should be worded, arranged and managed, it is generally accepted. The sea is "owned" by the community at large. While this can lead to all kinds of problems, it also means that we, the people, can decide on a different management policy when and where we wish. We

have already done this. We have laid and protected undersea cables, drilled for gas and oil, made container ports, allowed effluent disposal, banned the killing of seals, and organised mussel farms - all by simple decision within the democratic process. If we wish to create areas that are not exploited or fished in any way, all we need is enough people to agree. The only cost is the full democratic process.

Simple, straightforward systems

New Zealand has a relatively simple system of government. There are no states or provinces making for additional complications and our government departments are relatively autonomous. In Britain, the U.S.A. or even Australia, getting any kind of change requires not only convincing more people but making more complex arrangements between different government agencies, all with overlapping interests and responsibilities. We are small and new, and because of this things can be more straightforward. It has its problems, but for making changes to public management it is a great advantage.

Empowering legislation already exists

The Marine Reserves Act was passed in 1971. It is not perfect, but it would permit the creation of a network of marine reserves. The Department of Conservation is charged with responsibility for this Act, and under the Conservation Act 1985 has a mandate to advocate and promote marine conservation. Again, the situation is far from ideal; the Department has many other tasks, it is short of staff and funds and has little marine experience. But it exists, and is working to promote marine conservation in general and marine reserves in particular, by education, suggestion and research.

In short the practical, legal and administrative system for making marine reserves already exists, and can be used whenever enough people wish to use it.

SOCIAL AND CULTURAL FACTS

An open sea for all the community

Despite our energy and ingenuity in using the sea, New Zealand still has most of its sea open for general public use. All the port facilities, coastal industries, fish farms, waste disposal sites, drilling rigs, firing ranges, marinas and ski lanes may cause some real problems, but they still occupy only a minor proportion of our coastal waters. Even our most crowded waters are still largely open to everybody, and the concern of every citizen.

This is not true in many places overseas. Where people and activities are more densely crowded, much of their coastal waters (like our urban land) is zoned for specific purposes. When this happens the average citizen has little opportunity for management decisions. These become technical problems decided by experts on shipping lanes, waste disposal, industrial

requirements, aquaculture, etc. In New Zealand ordinary citizens still have the opportunity to make basic decisions about the sea.

Successful examples of marine reserves

New Zealand has already carried out some experiments with pieces of sea protected from extraction and exploitation. Two of these have been in existence for more than 10 years, and are clearly successful in providing many public benefits. Despite the small number, this is very helpful when arguing for more. In the absence of real examples it is difficult for many people to understand the idea of marine reserves, still less see any point in them. It took 12 years to establish the first marine reserve because of this problem (and most countries haven't got any fully protected marine areas yet).

Given some successful examples of marine reserves, it is much easier to suggest more. Both opponents and supporters have real reference points. While it is still common to have plenty of heat in the discussions, there is also some clear light.

The cultural traditions of New Zealand

It is easy, when commenting on cultural attitudes or heritage values, merely to annoy through ignorance or lack of sensitivity, nevertheless one point should be made with as much clarity as possible.

For various reasons built into our history and tradition, the inhabitants of New Zealand are able to accept the *idea* of no-take marine reserves. They already have plenty of practise with the same idea on land. This is not the case on a world basis. In most countries the idea of not exploiting an area at all is almost unimaginable. Outside New Zealand, people can understand management for restricted use but can rarely see any point in what they would call non-use. In Britain, reserves originally meant places where the King went hunting, and even today the national parks, although carefully controlled, are inhabited, farmed and managed for restricted purposes, not kept as pristine and unused.

New Zealanders, whether they have a predominantly Maori or European background, are familiar with the concept of preservation from exploitive and active use. Indeed the combination of traditional and pioneer attitudes has already produced some major results of which we can all be proud. The New Zealand national park concept derives from the gift of three sacred mountains, Ruapehu, Tongariro and Ngaruhoe, over a hundred years ago. We have learnt from this, the idea has grown and developed, and we have added further values to it. Our National Park system is now a world leader and a justifiable source of pride.

We have many other examples on land, the Queen's chain, city parks, scenic reserves, wildlife refuges, protection forests, etc.; places that have been preserved from exploitation. While many of these originally had a single purpose and public benefit, we have learnt that not "using" a place actually provides many benefits. The Queen's chain was originally simply a device to provide access along the coast in practical terms - a man could ride his horse along even at high tide without asking the "owner". But this reserve is now seen as having all kinds of additional benefits e.g. for children, holiday-makers and tourists, protection against erosion, etc.

Protection forests round city reservoirs were simply to safeguard the water supply, but now provide the "lungs of the city", scenic views for tourists, wildlife refuges, places to educate children, etc.

We are only beginning to spread this idea to the sea, but we have the same advantages there. The traditional Maori had no-take areas in the sea for many reasons, including the idea of allowing stock replenishment. These areas were usually temporary, but to keep the same spirit and purpose in our times, they would have to be permanent.

The principles recognised

The idea of marine reserves has been actively discussed in New Zealand for more than 25 years. The point is generally understood and is widely regarded as reasonable in principle. Even opponents of particular proposals for marine reserves frequently state their support for the general principle before launching into their objections. Whether this is just a tactic or not, it shows that the principle is recognised. This certainly puts New Zealand in a special category, because in most countries the idea of full protection in the sea is simply not understood.

CONCLUSION

Each of the above facts makes it a little easier to promote marine reserves in New Zealand. Each provides another reason to favour their creation. The points reinforce each other, so that the cumulative effect is to create a very strong case. Indeed, I believe it makes a unique opportunity on a world scale. New Zealand is already a leader in some aspects of marine conservation, if only by default (the record in many parts of the world is near zero). We have the best chance to go further and achieve a really sensible system of marine management.

Instead of the usual business of crisis-solving, of patching up problems, and oscillating between opportunism and expediency, we could base our marine management on the principle of sustainability. We would need to guard this principle not just against short-term or local greed but also against our general ignorance of how the sea and its living systems really work. Marine reserves would be the foundation stone of this insurance, as well as having many other benefits.

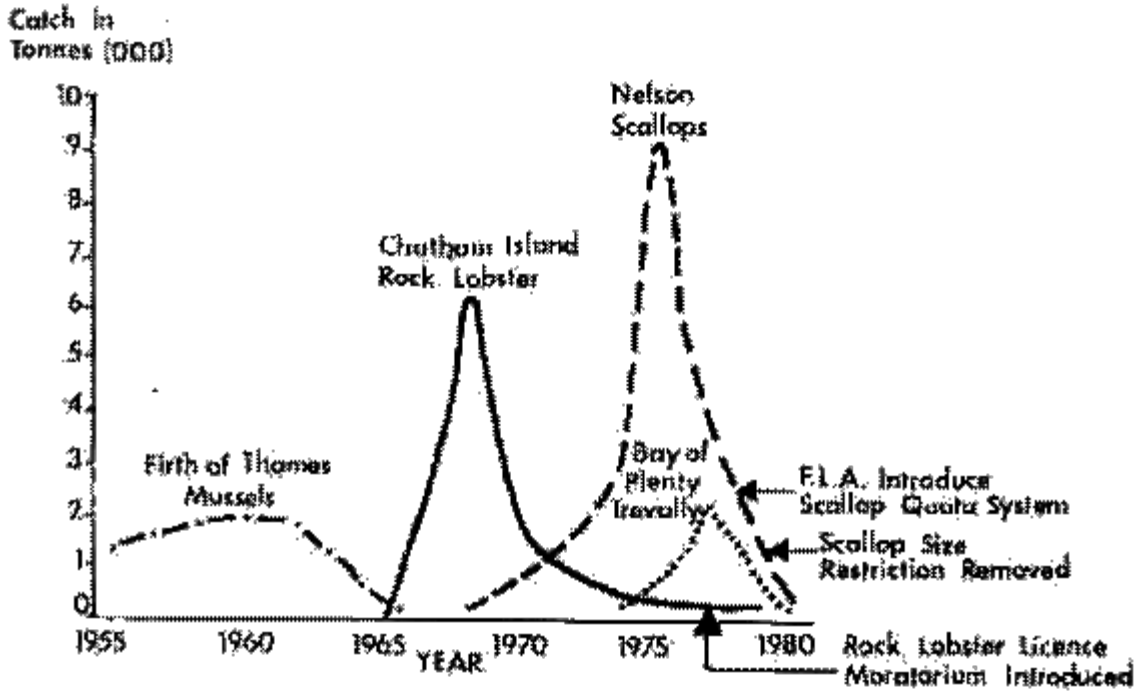


Fig. 5 FISHERY TRENDS
Some of the booms and subsequent collapses in New Zealand fisheries. *Adapted from "Integrating Conservation and Development", NCC, 1981)*

Box 1

WHAT'S THE PROBLEM? PLEASE REMEMBER I'M BUSY.

There are always people trying to bother you with some matter that seems terribly important to them, but turns out to be trivial, or just another crank theory for saving the world. Why should you even think about marine reserves?

Well, our whole world is mainly sea (about two-thirds of the planet's surface), but because we have been so busy with our affairs on land, we haven't given the sea much real thought yet. We have just done whatever seemed useful, and let anyone else do the same. As a result, we have already made quite a mess of the sea, and it's getting worse.

There are so many things wrong, that those concerned could easily spend all their energy rushing from problem to problem, solving crises and generally fire-fighting. We do. If it isn't wall-of-death nets, oil spills or saving the whales, it's marinas, rubbish dumping or quotas for orange roughy. We need an opportunity to think about basics. What do we really want from the sea? Is this sustainable? Somehow we have to stop behaving like kids raiding a lolly shop. We must stop assuming the only problems are sharing out the goodies and not getting in each other's way. We have to think about the sea itself.

This is very difficult. The sea is big, mobile, wild and intractable. It doesn't fit our land-based ideas. Finding out anything about the sea is very hard. But we make it worse. We spread our activities anywhere we can get some profit, fun or an easier life. Each year there is more activity in more places. What is the baseline, where is natural, how does it all really work?

Marine reserves will not solve all the problems, but they would certainly help us think clearly. If we decided to have some places in the sea as undisturbed and natural as possible, we could learn what was natural, instead of just imagining it. If we had some clear baselines, we could measure the effects of our activities, instead of just arguing about them. If we had better ideas about how the sea operates as a system, we could plan sustainable harvests and sensible manipulations, instead of having booms and busts. We could even show our children what the marine world was like (education), enjoy looking at it ourselves (recreation) and invite others to do so (tourism).

In New Zealand , we have the option. It is quite practical to have a network of non-extractive marine reserves. We have the idea, some examples that work, plenty more areas for others, the legislation and administrative systems to create a real network, and the democratic system to make the decision. All we need to do is to think about it and decide. The only serious danger is that we won't bother to do that, we could easily say we were too busy.

Fig 6 A VIEW OF A MARINE RESERVE
A panoramic view of Goat Island Bay, from the hill behind the Leigh Marine Laboratory. Drawing by Dr John Walsby.

CHAPTER 2

NEW ZEALAND'S FIRST MARINE RESERVE

(Cape Rodney to Okakari Point))

This piece was written in early 1977 and first presented at the Coastal Zone Problems Workshop during the `ENVIRONMENT 77' conference, in Christchurch, February. 1977. This was just before the then Minister of Fisheries (Mr. Bolger) came up to Leigh and formally declared the Marine Reserve established, in May 1977. I have not altered the writing, except for minor editing, because it gives the feeling of that time, a mixture of triumph and frustration. Over the next five years most of the local practical problems were sorted out as the reserve became both a success in popular and scientific terms. But many of the more general problems are still with us as anyone struggling for a new reserve knows only too well.

Abstract

The twelve years of public discussion and political process leading to N.Z.'s first marine reserve are described: the social history of the matter. A short description of the area is provided, as well as comment on the attitudes of various groups to the marine reserve.

The Nature of the Reserve

The first marine reserve in New Zealand is on the N.E. coast, 100 km north of Auckland by road. It lies just outside the Hauraki Gulf and is the nearest open coast to Auckland. It extends 800 m (half a mile) seawards from high water mark, and from Cape Rodney to Okakari Point - a distance of about 5 km (3 miles). The reserve comprises about 500 hectares of seabed and shore, and centres on Goat Island and its small bay.

The shoreline is almost all rocky - with a few small patches of coarse sand on the upper shore. The rock areas extend 100-300m offshore to a nearly-level area of coarse sand which extends out beyond the seaward boundary. The rock habitats of shore and subtidal are very diverse, owing to varying rock type, topography and wave action.

The eastern half has hard indurated greywacke rocks, which are smooth in detail but well-jointed, and form rough sloping shores jumbled with boulders. Offshore there are stacks, block beds, gullied rock and sloping reefs falling steeply to sand at 15-20 m depth. The western half has softer and more varied beds of sandstone and mudstone (nearly horizontal Waitemata series) which form long flat platforms and shallow pools filled with loose stones on the shore. Subtidally the gentle contours continue as reefs with small "steps" merging into the sand at 8-10 m depth.

In the centre, Goat Island provides many caves, a channel and local shelter. The whole area is open to the Pacific Ocean from north to east, with some slight shelter from the outer Gulf islands of Little and Great Barrier (20 and 50 km to the northeast). The fetch over this open quadrant is up to 10,000 km and storms bring heavy wave action. The prevailing winds, however, are west to southwest and relatively calm conditions exist about two-thirds of the time. This combined with the clear and relatively warm water make the area very suitable for diving. The area is rich in reef fish, kelp beds (*Carpophyllum* species at low tide and *Ecklonia* forests subtidally), sea eggs and sponges. The diversity of all forms of encrusting invertebrates, molluscs and other rocky benthos is generally high.

While the depths are not great and the grandeur and special tropical elements of the Poor Knights Islands are absent, the area is typical of the NE coast. It compresses great variety into a small area. It is visually most attractive both above and below water; and it is easily accessible from Auckland (one and a half hours drive).

These features attracted the first skindivers in large numbers in the late 1950's. At that time divers were virtually all spearfishermen using just snorkels (not SCUBA). Great depredations were made in the reef fish, crayfish and paua of the central area (close to the only access road). A little later the same attractions drew the attention of Professor John Morton, who selected the site for the University of Auckland's marine laboratory. The subsequent development of both diving and the laboratory led to the marine reserve proposals.

Events leading to the establishment of the reserve

Very early in the history of the laboratory it became clear that without some form of official protection many useful experiments could not be carried out. With this limited idea in mind the notion of a "marine reserve" was first suggested by Professor Chapman in May 1965. As Chairman of the Leigh Laboratory Committee he wrote to the (then) Marine Department. The reply was discouraging in the extreme. No legislation existed to allow the sea to be "reserved", the Department felt that if anything was to be reserved it should be in areas remote from population centres, they could see no reason to promote any legislation and in any case Parliament was very busy.

If the reply was intended to cause the death of the proposal, it failed. While a refusal to agree to the particular proposal might have been accepted, a total indifference to any such problem produced a determination to widen the issue and get something done. Professor Chapman began a systematic campaign to collect evidence (both locally and overseas) to show that legal protection of marine areas was practical and worthwhile in many circumstances. This material was dispatched at regular intervals over the next few years. As a result of courses run for diving clubs, public lectures, research projects, legal investigations and open days at the laboratory, support for the idea of a marine reserve grew wider and stronger.

The N.Z. Marine Sciences Society gave its official backing, as did the N.Z. Underwater Association (national combination of diving clubs) and both these organisations became active in lobbying. Virtually everyone approached felt that power to give some protection in the sea (apart from control of commercial fisheries and around cables etc) should exist. After a few years of increasing pressure the Marine Department produced some draft legislation. It leaned heavily on the specific ideas produced (merely as examples) for the Goat Island area, was narrow in scope and negative in tone. Special purpose scientific reserves were the only kind envisaged, it was heavily stressed that reserves should not "unduly interfere" with all kinds of things (regardless of whether these were sensible or not), and no reserves were to be suggested or promoted by the Department itself. Although some minor changes were made later, the final Act (passed into law in September 1971) was in the same spirit as the original draft. Six years had passed since the original query.

The Marine Reserves Act requires that some non-government organisation proposes each reserve and does all the (quite complex) notification, definition and advertisement for objections. The Marine Department (later replaced by the Ministry of Agriculture and Fisheries in this context) merely considers the application, reviews the objections and makes a decision (via the Minister) which is final.

The University of Auckland's first attempt at an application was returned with the suggestion that wide consultation to reduce subsequent objections should precede the formal application. This was done but it took a further year and added greatly to subsequent confusion. In the absence of any definite proposal, many of the parties consulted developed all kinds of ideas at variance with the final application.

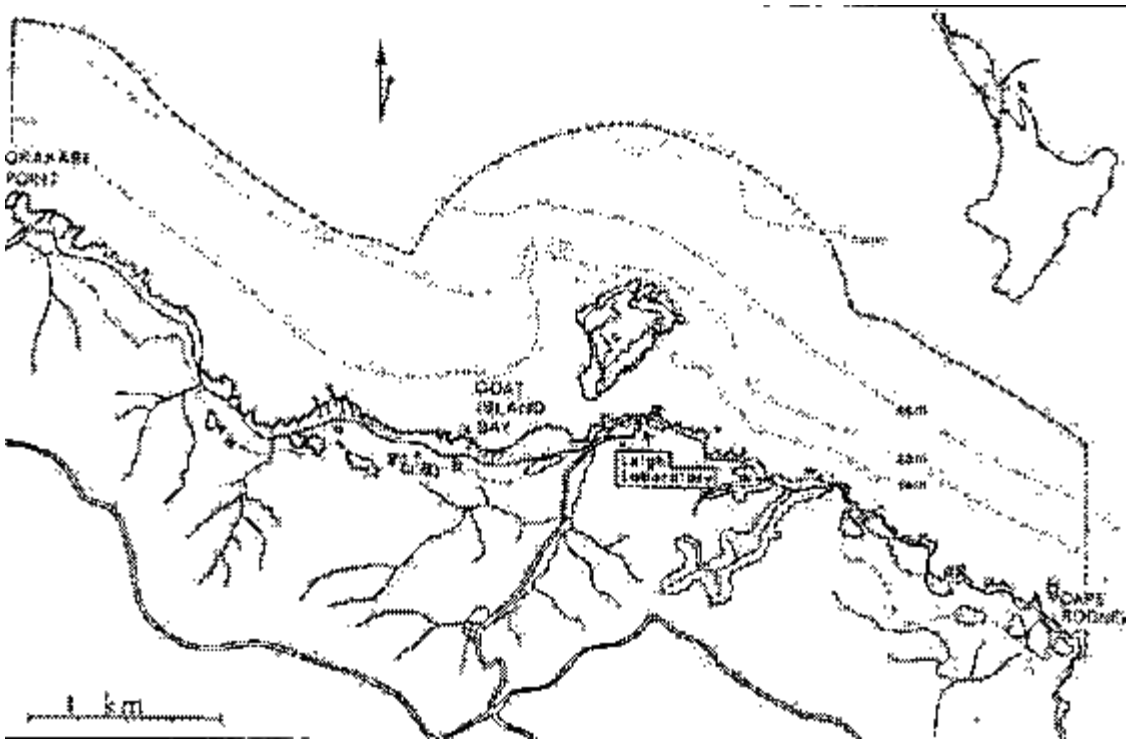


Fig. 7 THE FIRST MARINE RESERVE
The location and area of the Cape Rodney to Okakari Point Marine Reserve, which was established in May 1977. The dashed line shows the seaward boundary.

The second attempt was accepted in mid-1973 and formally advertised for objections. There were plenty of these and they covered a wide range. Some were quite practical and dealt with apparent or real deficiencies in the Act (but there seemed to be no procedure to deal with these), some were against the area proposed, and some were simply mistaken about the whole thing (many thought the public would be excluded from a reserve, and one - apparently unable to conceive of a "sea" reserve - objected to the "large amount of land being taken").

Apart from those objections which were understandable but narrowly selfish -"this is my nearest and best fishing spot" - there were a number which reflected the ground swell of opposition to the whole notion. Much time and energy was wasted trying to determine precisely which parts of the management proposals were objectionable to these people. Only very slowly was it realised that their real feeling was against any management programme.

It seems that many New Zealanders, from all kinds of background, feel that high water mark is a kind of last frontier beyond which one is free from regulations and restraints. They feel that the sea is the one place where you can do what you like and don't even have to feel guilty. This idea is often subconscious (and is any case a myth) but is all the more powerful because of these points. Anyone proposing even a sensible and properly structured programme for a area of sea is seen as destroying a treasured ideal, and real anger may develop. The fact that many who hold such views are quite aware that the arguments in favour of some regulation are sound and in the public interest may just make matters worse. The proposers of the regulations then become the bearers of bad news as well as the violators of personal freedom, and no argument is too trivial or too bad to use against them.

Reading or listening to some objections to the marine reserve proposal, one was made very aware that they were using anything and everything except the real reason -

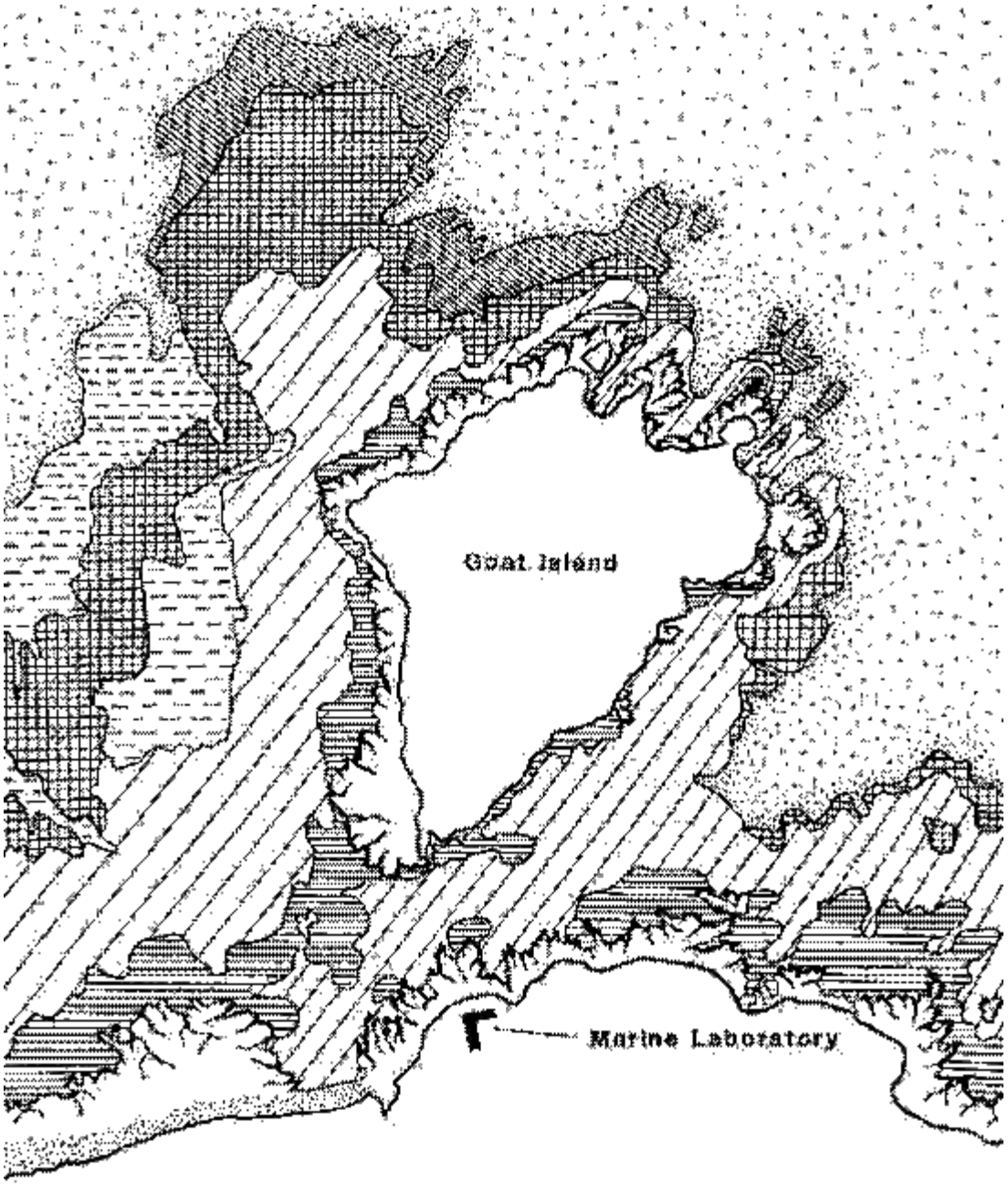


Fig. 8 AN UNDERWATER HABITAT MAP

The main habitats in the central part of the first marine reserve, near Leigh. In descending depth order, it shows: Intertidal rocks; the low tidal fringe of mixed seaweeds, the sea urchin (kina) grazed flats; the kelp forest (cross-hatched); the deep reefs (diagonal); and the sand and shell gravel (dotted). The dashed areas are where rock is lightly covered with sand - the sponge gardens. (Redrawn from A. M Ayling's *Cape Rodney to Okakari Point Marine Reserve Survey,* 1978).

"I don't want it to be like that at all". There should be sympathy for this view - it would be pleasant to live in a place and time where no conflicts would result if everyone did just as they pleased below high water mark, and to a large extent New Zealand was such a place not so long ago - but nothing is to be gained by trying to let the holders of this view down lightly. It is not possible to reduce or modify any regulatory programme to their liking: what they dislike is the idea of a programme at all. While some will eventually be reconciled by the advantages gained from an organised reserve, others will continue to rage at it as those American frontiersmen did at the Pacific Ocean that prevented them moving endlessly westwards.

It would be charitable to assume that the Fisheries Management Division of the Ministry of Agriculture were having such thoughts when they withheld any decision on the marine reserve for two years after receiving all the

objections and the University's carefully factual comments in reply. All that we know is that neither the objectors nor the proponents heard anything official during that period.

In November 1975 a gazette notice appeared, legally establishing the "Cape Rodney to Okakari Point Marine Reserve". The proponents were pleased until it became clear that nothing whatever had been done to form a management committee (as required by the Act). It is the management committee's duty to pu up notice-boards and to appoint local rangers.

For a further year the reserve remained legal but not operational while a management committee was formed. This met for the first time in December 1976, and arranged for a single "interim" notice to be erected in the car park at the access road. No local rangers have been appointed *[January 1977],* and the disregard of the notice has been sufficiently common to provoke at least one disgusted letter to an Auckland newspaper by a visitor to the marine reserve.

The management committee consists of five voting members (plus a secretary): the chairman who is an officer of the Fisheries Management Division, a nominee of the University of Auckland, two nominees of the local authority (the Rodney County Council) and a nominee of the N.Z. Underwater Association. The strong local representation, and the lack of any from the Auckland region as a whole, apparently results from local pressure on the Minister for this. While this composition of the committee will undoubtedly be of great long-term benefit once the reserve is running successfully, it does little to speed management decisions or to inject imaginative ideas. All decisions for the first few years will, of necessity, be experimental - no reserves of this kind have existed before in the country. Assessment and even suggestion will require technical and practical aspects to be stressed as much as social and political ones.

The Act itself, which requires a body like the University to do all the initial proposing (in detail), and the obvious presence of the University's marine laboratory at the centre of the reserve, leads to the suspicion that the reserve is in some way "for the University" and a feeling that this needs to be counter-balanced by local control. The University naturally reacts to protect its public image by not forcing any issues and by adopting a low profile whenever possible. With the Ministry providing nothing in the way of public policy statements or guidelines on marine reserves in general, the whole situation could become close to a policy vacuum. The only organisation both able and willing to provide positive ideas and practical assistance is the University, but it is not possible to put these forward strongly in case it is thought to be acting merely in its own interests.

Objectors to the idea of a reserve are already unhappy with its mere existence, but those in favour will be disappointed, and even disillusioned, if effective regulation and imaginative positive use are not generated quickly.

The survey of the Marine Reserve

One aspect of the marine reserve has been moving ahead with reasonable speed, thanks to generous grants from the University Grants Committee and the Golden Kiwi Committee. This is a rapid in-depth survey of its state at the time of creation, taking in both physical and biological features. It began in the summer of 1975-6 and the first phase involved the production of maps at 1:5,000 (one sheet covering the whole area) and 1:1000 (five sheets covering shores and the rocky subtidal areas). These were produced mainly from aerial photographs, supplemented by shore surveys, echo-sounding from a small launch, and existing diving information.

This summer, production of 1:1000 maps showing complete underwater classification is being completed, using underwater transects and some helicopter photography. Permanent quadrats are being set up with detailed photographic records of encrusting life, counts of sea-eggs, kelp measurements and grazing mollusc surveys in each. Fish counts are also undertaken, crayfish counts, and some permanent transects established across kelp forest boundaries.

The main idea is to establish the starting point against which changes that protection may generate can be accurately measured. The survey also aims to provide factual data for management decisions, and information for public education and entertainment (either on visits to the reserve or via school class material, etc.)

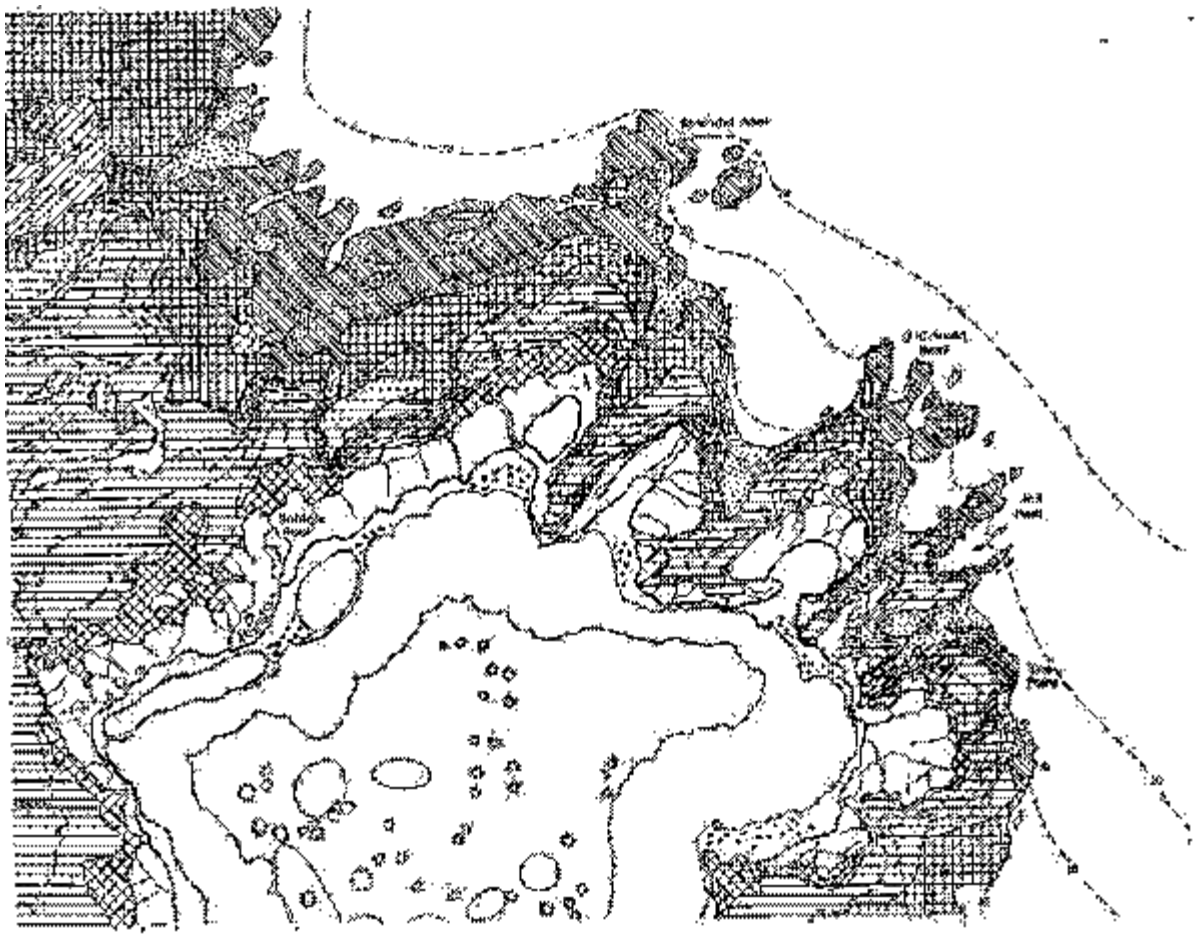


Fig 9 A DETAILED MARINE HABITAT MAP
A section from the survey maps of the first marine reserve produced by volunteer student divers led by Dr. Tony Ayling. It shows the seaward side of Goat Island. See fig. 8 for location and fig. 10 for more detailed explanation. (From Ayling, 1978)

The future of marine reserves in New Zealand

-

The management problems of the first marine reserve will sort themselves out in time, but what of the future in other areas? The outlook is poor. In the twelve years since the first move was made, there has been ample time for experiment, i.e. to try something, at least in one place, and see what does happen and whether people really like or dislike it. There have been plenty of opportunities for politicians to become interested in one or more of the possibilities There has even been time for administrators to become aware of their responsibilities and to evolve policies, and to get these widely known. None of these things have happened.

The effect of these lost opportunities, this waste of time, will be very serious unless it is made up by vigorous pre-emptive action. It is no longer possible to show the need by careful experimentation in a few small areas. Many reserves must be established quickly in case they are needed, the presumption of need is strong and if we wait for proof we will be too late to save much that is really worth having.

Marine reserves are needed for several reasons

(a) True marine wilderness is disappearing at a great rate as affluence, leisure, access, and population increase and as exploitive techniques improve and become more wide-ranging. Large remote "national park" marine reserves are needed immediately, simply to preserve some marine areas which are both grand and natural. There are still some left, but until there is a will and the means to do something about protecting them, it would be unwise to publish their existence widely. The Poor Knights Islands can be mentioned because a voluntary effort to protect the surrounding seas already exists and has had wide publicity and support. It is, however, a public scandal, that nothing official has yet been done to protect this area. The N.Z. Herald's third editorial on the subject in eight months is headed "*Nothing but excuses*" and finishes "*Mr McIntyre should insist that creation of the reserve has become a priority."*

(b) Other reserves will be needed to protect some natural examples of each major habitat and some special features. Considering the range of climate and topography on the New Zealand coast that will be quite a lot, but even these will be simply a minimum archive A salvage operation needed to ensure that at least we know what we had. In many countries there are hundreds of miles of coastline which no one will ever know in their original natural state. And for those who think it can't happen here for years, I should mention that the second largest harbour in the country has less than half its coastline even in a semi-natural state, while every estuary on the coast between Auckland and Whangarei seems to be an actual or planned site for oxidation ponds.

(c) Still further reserves are needed with recreation as the prime concern. These would be relatively small, numerous and close to population or holiday centres. People wish to see marine creatures and natural habitats for themselves, without having to go long distances or just view television. They want to enjoy watching fish as well as catching them. Anglers and spearfishermen need somewhere close at hand where stocks can breed undisturbed and replenish, if their catches are to be worth having. On land acclimatisation societies build and stock ponds with wild-fowl, and rear trout and control rivers. In the sea we do not even have the prospect of legislation which would permit us to enhance the natural stocks with reserve areas.

Fig. 10 A UNDERWATER VIEW (by Dr. John Walsby)

If you dived down the steep outer rock face of Goat Island on a good clear day, you would see in sequence four of the main marine habitats in the Marine Reserve:

(a) Just below low tide, **a bed of large brown seaweeds**, mainly *Carpophyllum* species, but also *Sargassum, Cystophora* and even some kelp. These plants are good at resisting waves but cannot stand drying or much ultra-violet light. They shelter many red seaweeds, like *Pterocladia*.

(b) **A zone grazed by sea urchins** (kina). The kina cannot move to feed in heavy waves, so their grazing is restricted to a depth where the waves are damped down. Here, they graze over the coralline paint and turf, removing other seaweeds.

(c) Deeper down **a kelp forest** develops. This kelp, *Ecklonia radiata*, can grow higher up, but the kina graze the sporelings (just as sheep graze tree seedlings in a paddock). We do not know what stops the kina from grazing into the kelp forest.

(d) Below 15-20 metres, **the deep reef community** starts. The light is too dim for kelp and the rocks are covered by animals that simply filter seawater to catch their food. Wierd and wonderful shapes and colours, these belong to groups unknown on land and rare in freshwater - sponges, sea squirts, bryozoans and brachiopods.

What can be done

Suggestions have been made that amendments to the Marine Reserve Act are needed - and they certainly are - but if we are to wait for these to be produced in a useful form by these currently responsible it could take for ever.

Other suggestions have been made to transfer the responsibility to a different department, perhaps the Lands and Survey, who have shown some interest and have experience with reserves on land. This might be a good plan if the Fisheries Management Division of the Ministry of Agriculture and Fisheries would relinquish the matter quickly and without fuss. But interdepartmental rows can also go on for ever and often do.

These and other suggestions are basically adjustments of the system from within the system. They imply that there is a system. I believe that it is time to broadcast widely the unvarnished truth - in marine affairs generally the system is weak in this country, and so far as Marine Reserves or anything connected with them is concerned there is no system at all.

If twelve years of solid effort by careful and responsible people, going through the proper channels, only results in one tiny reserve (5 km in 15,000) and that one without a management policy, it is time to stop worrying about the proper channels and go straight to the responsible politicians for a new and real policy.

Much has happened since the above article was written, but despite two more marine reserves, the tone still seems appropriate. Although the public mood has been moving steadily in favour of more marine reserves - indeed for a network of them - there is little to show for the 14 years. In the next year or two at least a dozen marine reserves will be formally proposed and ministers will have to make decisions. If the public make it clear that they want these proposals

approved, they will be. It is really up to us.

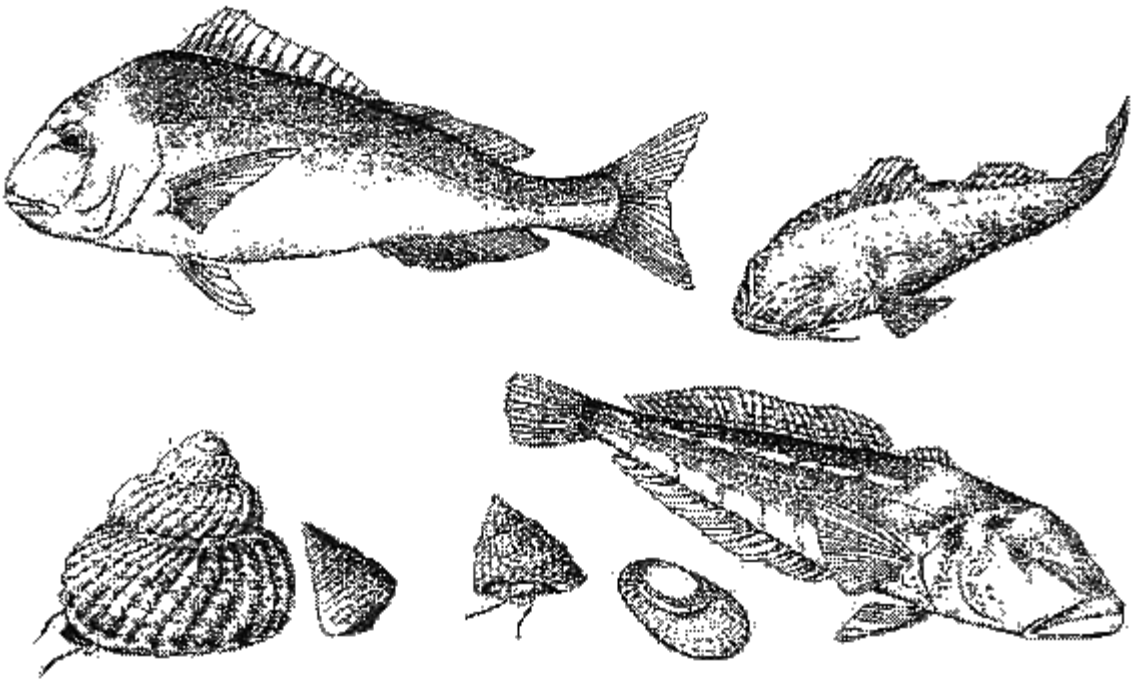


Fig.11 ANIMALS FROM THE KINA GRAZED AREAS
Snapper (*Chrysophrys auratus*), blue cod (*Parapercis colias*), and Goatfish (*Upenicthys porosus*) are the common fish. The mollusc grazers include the topshells *Cantharidus purpureus* and *Trochus viridus*, as well as the large turban shell, *Cookia sulcata*, and the limpet, *Cellana stellifera*. Drawings by Vivienne Ward.

Box 2

THE FIRST TOUGH DECISION

In the early 1970s, when the N. Z. authorities were trying to decide whether or not to establish the first marine reserve, the opposition concentrated on recreational fishing (especially angling from the rocks) in the proposed area. The issue seemed quite simple:

Not many people came to Goat Island Bay to fish off the rocks.
They didn't catch very many fish.
Their catches seemed unlikely to be having much effect.
The scientists were unable to show any adverse effect of this angling.
It seemed unreasonable to insist on banning this activity.
The opponents of the marine reserve said this was their only real problem.
The politicians recommended permitting recreational angling.

However, at that time, this was not possible under the Marine Reserves Act, 1971. The Act was originally written in a strict fashion, and said "No Fishing" of any kind in a marine reserve. The choice was a reserve with no fishing, or no reserve.

The politicians tried to get round this by getting everyone to agree, pending some alteration to the Act. After all if *nobody* objected, it didn't matter what the law said. But one or two did object, and went on objecting, despite intense pressure. (I had the Attorney General of New Zealand camped in my house for hours trying to convince me!)

Were these purists just bloody-minded? Nearly everyone thought so at the time, and said so quite loudly. It was rather lonely and distinctly uncomfortable. At one stage, finding no support anywhere for my views, I went to see Roddy Matheson, the farmer who had lived all his life overlooking the site. I told him the state of play and asked him what he thought. He was never one for a quick answer, so we had a cup of tea, discussed the grass growth, and rolled a cigarette or two. But as I got up to go. he said: "*It used to be quite different round here; I would like my grandchildren*

to see what it was like then." I have always been very grateful for his wisdom.

It is necessary to look forward. The answer may not be in current activities, or their effects, but in the future aims. If a marine reserve is "successful" in terms of fish, it will mean there are more fish and they are less scared. In such a situation, if any type of fishing is permitted, people will flock there to gain this advantage. If recreational angling is permitted, then every angling club in the North Island could hold its annual championship there. The fishing would increase and continue at a high level until there seemed to be no extra benefit - in other words, until the reserve was *not a success* in terms of fish. In short, until the point of the whole exercise had gone. When this had been explained to hundreds of people, the reserve was finally gazetted.

In 1978 an amendment to the Marine Reserves Act made it possible for a management committee to permit specified fishing, and this was arranged at the second marine reserve, round the Poor Knights Islands. But this has never been done at Leigh, because by the time the opportunity arose, the numerous visitors to Goat Island Bay were enjoying looking at the fish there. There seemed to be more fish and they were certainly less scared and therefore much easier to see. An attempt to re-introduce any kind of fishing would clearly destroy this pleasure, and would have led to a outcry.

It should be carefully noted, however, that the outcome - a chance to look at undisturbed populations of fish - only resulted from a series of accidents. Had the "sensible" people had their way, it would not have happened. Fifteen years after the first marine reserve was gazetted, there are still no others on the mainland coast of New Zealand where you can see undisturbed populations of fish. We must look to the future and remember the first example.

CHAPTER 3

THE NEED FOR MARINE RESERVES IN NEW ZEALAND

The following account was written in March 1980 and presented to the "Coastal Zone Management" Seminar, organised by the Ministry of Transport, in Wellington. It was delivered like a hell-fire and brimstone sermon to a large number of local authority and harbour board officials and politicians; but the verbal impact was softened by showing a large number of slides, illustrating the wonders of underwater life. These photos, taken by student divers like Tony Ayling, Roger Grace and Kim Westerskov, did more to convince the audience than any spoken words. This speech was the first time the idea of 10% was mentioned in public; most of the audience thought I was joking. Although I would now express some points differently, I have not changed anything significant because this piece reflects the mood of the time, a slowly growing confidence about marine reserves amongst a small number of people.

MANAGEMENT INCLUDES INSURANCE AND CONSERVATION OF ASSETS

This Conference is concerned with the management of the coastal zone - that is, the rational and proper use of our marine resources. How do we arrange to use our marine assets properly? The events of recent years and the points made in earlier papers indicate that there are "only" two problems:

(i) We haven't been doing much planning so far - we've just muddled along.
(ii) We don't really know how to do it - we do not yet have either the necessary information, the requisite administrative structures and planning arrangements,
or the appropriate public awareness. We are progressing with all of these
slowly and will get them in time.

Hence we need some insurance. We need to make sure that our options remain open. We must avoid spoiling things in ignorance or by mistake. We need to conserve and protect large portions of our assets until we know how to manage them to best effect. We will probably find that we need to keep some of these assets permanently in their pristine condition, but this will not be an available option if we do not act soon and effectively.

Marine conservation is an essential part of management, and is especially valuable in the early phases. At present there is only a single small marine reserve (5 km x 800 m) in New Zealand and no immediate prospect of more -

except at the Poor Knights Islands in a highly diluted form. The existing legislation for marine conservation is inadequate and even what exists is scarcely used. A change in attitude is required. The idea that natural marine resources will preserve themselves sufficiently for our future needs while continually subjected to a wide variety of exploitation and experimental managements systems has no basis except in wishful thinking.

New Zealand once led the world in the concept and development of land reserves. From the Queen`s chain to National Parks, from recreational reserves to wildlife refuges, more than 20% of the land surface of New Zealand is in some form of reserve. There are many reasons for these reserves, there are many types and they are very widely accepted as worthwhile.

There is no reason to suppose that anything is different below high water mark in terms of either ecological principles or human behaviour. If there is any difference, it is that we are even more ignorant of the marine world **now** than our predecessors were of the land when they began the process of preserving from exploitation large pieces of everything they came across.

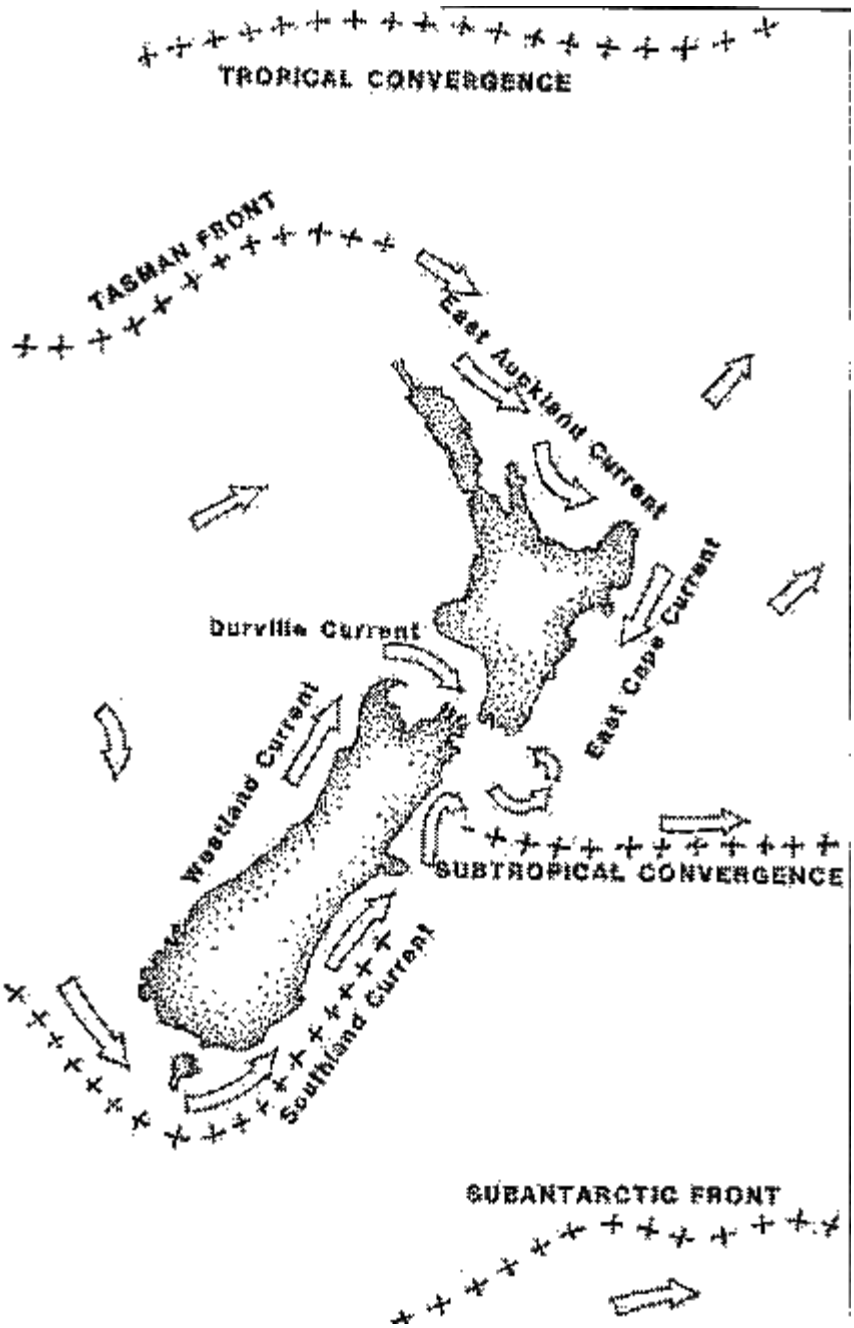


Fig. 12 CURRENTS AND OCEAN FRONTS IN THE NEW ZEALAND REGION
The general circulation pattern round New Zealand and the positions of the semi-permanent fronts and convergences in the ocean. Detailed water movements are very complex and include the effects of tides, winds, local submarine

topography. The currents vary from year to year and, at any one time, show pulses and eddies within the main flows. (Based on Heath, 1985, which should be consulted for more information.)

The aim of our immediate marine conservation programme should be to preserve from exploitation at least 10% of all marine assets - by area and content. This should be a basic principle on insurance grounds. Our best experience suggests this is a minimal aim. Our experience is largely land-based, from overseas, or of the disastrous results of previous "management"; therefore a 10% aim is conservative.

TYPES OF MARINE RESERVES

Marine reserves - like land reserves - should include a variety of types:

Large, pristine, natural areas

- the partial equivalent of natural parks, wildernesses etc., but these would also, in the marine situation, act as major reserves of breeding stock (including species not yet directly exploited but liable to damage by other activities), genetic reserves, controls for the measurement of management practices (or lack of them) elsewhere etc.

Viable examples of every ecosystem and community

- to act as natural living museums. No amount of political or social regret will restore a system that is extinct. Even seriously damaged ecosystems cannot be "restored" when the original state is unknown. Such situations exist over large marine areas already - the most notorious being in the Mediterranean, New England, Japan's "inland sea", the Baltic, and the British North Sea coasts. There are distinct signs of them developing in New Zealand - and not merely in industrial ports.

Anyone over 50 knows how difficult it is to find any area in New Zealand which now matches the normal state of coasts in their childhood in terms of crayfish, sea eggs, paua, or even recreational line fishing. What scientific measurements there are support this view. It is, of course, inevitable that a slow decline in many natural features will accompany the increase in population, industry, leisure activity, etc. But it is neither inevitable nor desirable that such creeping losses should be allowed to occur over the *whole* coast. We can and should insist on retaining at least examples of all natural marine conditions in an untouched form; or, if necessary, by restoration to natural form.

Specific reserves

- will be needed in addition to the above to cover special cases like scientific or educational uses, to preserve things of scenic value, to act as particular marine "wildlife" refuges, etc. There will probably be large numbers of such reserves but they will be relatively small in most cases - comparable to scenic, scientific and wildfowl reserves on land.

Recreational reserves

- with the prime aim of accessibility and usefulness for non-exploitive recreation. They would often be very close to or within urban areas and include uses such as rowing, sailing, surfing, bathing, diving, picnicing, beach-walking, sunbathing and enjoying the scenery above and below water etc., but *not* fishing, powerboating, wharves, marinas, etc. (Note. While planning arrangements for the latter will also be required there is nothing to be gained by including them under a marine *conservation* system).

THE NEED FOR URGENT ACTION

The approach should be to create all these types of conservation area as quickly as possible :

(a) before *ad hoc* and unplanned uses become too thickly overlaid.

(b) before we miss most of the advantages (i.e. before slow loss of natural amenity is too advanced).

(c) before it is possible to demonstrate the precise benefits (with our present level of knowledge that would only be *after* significant damage was widespread).

Box 3

THE IMPORTANCE OF INSURANCE

When we know a lot about a system, it still seems sensible to guard against the unpredictable: natural disasters, human error, accidents and other unknowns. For example, supermarkets are very well understood systems, but a good supermarket manager, despite all the detailed knowledge, will have:

fire insurance
cash reserves
membership of some trade association
third party insurance, etc.

All of these cost real money, yet none of them have an exactly-foreseen function. They are a protection against ignorance. Of course, there are smoke detectors, fire extinguishers, staff training, fire walls, inspections, etc. but there is also fire insurance. It is a sign of good management not to assume that one can foresee everything in precise terms, and to take general precautionary action as well. Furthermore, there will be no complaints from the owners if, after many years, no fires occurred and all the fire insurance money could be said to have been unnecessary! The owners also understand the need to cover against human error, natural disasters and other labels for ignorance.

Oddly enough, when we know very little about a system, it is less likely that we will take sensible precautions. Compared to supermarket systems, where there are books about the best arrangement of the shelves, we know very little about any of the systems in the sea. But in the sea we tend to be satisfied with little or no insurance.

If we are told that a fisheries management programme is the best practical option for the particular stock or species, we tend to say "*Fine, no problem*!" rather than "*What are the risks and how can we guard against them*?" It seems that if ignorance is both great and widespread, we lose sight of the need for precautionary principles just when we need them most.

Even when attempts have made to measure the risks, in fisheries and other marine management we tend to accept very high risk levels. Warned of impending dangers, politicians and the public tend to worry about false alarms rather than the price to be paid if the warning is accurate. This is partly because of communal ownership of marine resources, but mainly because everyone has great difficulty in assessing the risks, or even imagining their nature. In the marine field, the "experts" are those who realise how ignorant they are; the others don't even know that much.

In the sea we tend to say, "*What harm is it doing*?" and challenge someone to produce clear evidence before we will even consider precautions or controls. We fail to notice that even the measurement of "harm" will be difficult if our "management" is general and our knowledge poor. What sounds like a sensible "*If it's not broken, don't fix it.*" is really more like "*We will take out insurance only when we can see the flames*".

Marine reserves are not a substitute for careful and intelligent marine management, but they are a sensible part of it. At the very least they are a useful precaution against the unknown. Every citizen knows this is wise even when we have good understanding and a high level of control. You put more oil in your car before you can "prove any harm". You keep a straight edge in the workshop so you can measure kinks and bumps. You keep some savings in the bank in case of unforeseen developments. You insure your property against fire, theft , and natural disasters.

But in the sea, we just "go for it" with a single management plan for each activity. When some reservation is suggested, we say "*What exactly will this achieve*?"

(d) beforedefinite proposals are made to exploit or indirectly damage the areas - there is no point in encouraging proposals that we will wish to deny or transfer elsewhere.
(e) before everyone gets used to the piecemeal decline in natural quality, and accepts each bit as natural.

We need to reverse the "logical" arguments used at present to justify inaction. If there are really plenty of untouched coastal resources around still, then it would be cheap and simple to announce that some of them will be permanently reserved. If there are actually lots of existing uses and vested interests everywhere it is urgently necessary to reserve some areas before the results are universal damage. The truth is that the usual "reasons" given for inactivity in marine conservation are merely excuses.

MANAGEMENT -TRIALS, COST AND PRINCIPLES

We should use trial and error for the management of marine conservation areas. At present we seem to insist on everything being perfectly arranged before the first trial. It took more than 10 years of discussions before the first reserve was created and 5 years later we still do not have a second one. Trial and error means many trials and not worrying about some errors so long as we learn from them and don't repeat them. We do not know much about managing marine reserves. People are unused to them and are accustomed to doing whatever they like.

Management trials should be designed (and announced) as efforts to determine the most effective conservation as quickly as possible, *not* to see what is the least people will accept without any argument. To most people *any* management plan below high water mark will come as a shock - they have never come across one before. Nothing is gained (except more effective criticism) by having a weak or tentative plan. It will be simple to relax if experience shows initial rules to be unnecessary, but increasing controls as "need" arises is both ecologically and politically dangerous. The sooner and more positively we act to introduce real effective principles the better. Time is not on our side. The faster we move the fewer problems we will have.

It will be necessary to be quite firm about costs. Marine reserves and marine conservation generally have few direct costs. Since everything in the sea is already under the control of the Nation, a common property, all that is necessary, provided the political will is there, is an administrative decision to effect a different management programme. Nothing need be purchased nor any compensation paid.

The indirect costs are likely to be in favour of conservation. In contrast with the direct benefits of marine nursery grounds, recreation opportunities, tourist attraction, research simplification, educational benefits (and prevention of the more hare-brained exploitive ventures) the indirect costs are likely to be laughably small.

In this paper the desirable principles are being discussed, not ways and means under existing legislation. It is assumed that if the principles are agreed then suitable means will be arranged. The nature of the political and administrative actions needed is fairly clear:

(i) immediate, high-level (political and departmental) statements on the importance of marine conservation and what this means.

(ii) the rapid, vigorous and imaginative use of existing legislation to create a spatter of trial marine reserves and conservation areas.

(iii) the development of a system to determine the best array of marine reserves and conservation areas under the 10% plus principle. The system should involve as many people and organisations as possible (because expertise of all kinds including local

Fig. 13 COMMON FISH AT GOAT ISLAND, NEAR LEIGH
The distribution over a rocky slope in the centre of the first marine reserve, near Leigh:
1, piper, *Hyporhamphus ihi*. 2, parore, *Girella tricuspidata*. 3, banded wrasse, *Notolabrus fucicola*. 4, marblefish (keke), *Aplodactylus arctidens*. 5, Red moki (nanua), *Cheilodactylus specabilis*. 6, blue maomao, *Scorpis violaceus*. 7, leatherjacket (kookiri), *Parika scaber*. 8, snapper (taamure), *Chrysophrys auratus*. 9, scarlet wrasse (puuwaiwhakarua), *Pseudolabrus miles*. 10, kingfish (haku), *Seriola lalandi*. 11, demoiselle, *Chromis dispilus*. 12, butterfly perch (oia), *Caesioperca lepidoptera*. 13, goatfish (or red mullet), *Upeneichthys lineatus*. 14, yellow moray (puuharakeke), Gymnothorax prasinus. 15, John dory (kuparu), *Zeus faber*. 16, blue cod (paakirikiri), *Parapercis colias*. (Names as in Francis's *Coastal Fishes of New Zealand*, 1988, figure reproduced from Morton and Miller's *New Zealand Sea Shore*, 1968, with permission.)

knowledge will be needed), but should have a clear "centre" exercising leadership and having a responsibility to get the job done.

(iv) New broad legislation empowering the creation of a variety of marine reserves and conservation areas, paralleling the "land" Reserves Act. It should contain the principle that marine conservation is a basic requirement (not a luxury tacked on after "use" is satisfied) for the proper management of our marine resources. It should make provision

for defining the prime purpose of each conservation, in each case then encouraging **compatible** uses or purposes, while prohibiting any that might inhibit the prime function.

THE REASONS FOR MARINE RESERVES

Aesthetic and moral

-

We have learnt slowly and painfully on land that we need beauty, variety, naturalness and some quiet opportunities simply to stay sane. Tastes vary, so we need a wide range, and handy as well as remote. The natural marine world will not preserve itself any better than the land habitats did. We now applaud the imagination and foresight of those who retained and protected some of the natural habitats on land, and we condemn those who failed to do so through greed, indifference or ignorance. We learnt that on land the effort of preservation is worthwhile *in itself* and is best applied quickly and on principle.

Moral duties are always difficult to define, but there now seems widespread agreement that we have a duty to preserve at least examples of what exists and where possible restore what did. It is surely ridiculous, if not actually contemptible, that while boasting to our grandchildren of the crevices we knew packed with crayfish we cannot even *show* them one like that. In my personal view we should go further and announce firmly that the ideas of multiple compatible use, maximum sustainable yield and general good husbandry are not merely sound economics and ecology, but are also basic moral principles. An appeal to "good stewardship" may not be effective in restraining an individual with a vested interest, but it is still an excellent call to the remaining population to exercise democratic principles and put some sensible control on him.

Recreational

Most recreational activities require the control of other activities in order to exist :

You cannot sail over oyster racks
Sunbathe comfortably on a beach covered in oil
Observe the natural behaviour of fish where spearfishing is common
Race a rowing boat through a maze of launch moorings
or commune with nature in a container terminal

These are facts and do not depend on whether you and I are personally interested in doing any of these things. The point is that most recreational activities, especially the less exploitive kinds, are gradually squeezed out by "development". Yet people require recreation and it is pointless to make this more and more expensive (in time and distance) by not providing for it close to where the people live. One of the most absurd facts of our city ports is the way *every* quiet bay not actually needed for harbour development is filled up with marinas and large boat moorings. These are occupied mainly by people who own the boats "to get away from it all". No one seems to notice the glaring contradictions. The immense savings that would result from *not* developing some of the quiet bays so as to provide more recreational opportunities close to the people are disregarded.

Planning our harbours and coastlines to maintain the diversity of areas and uses

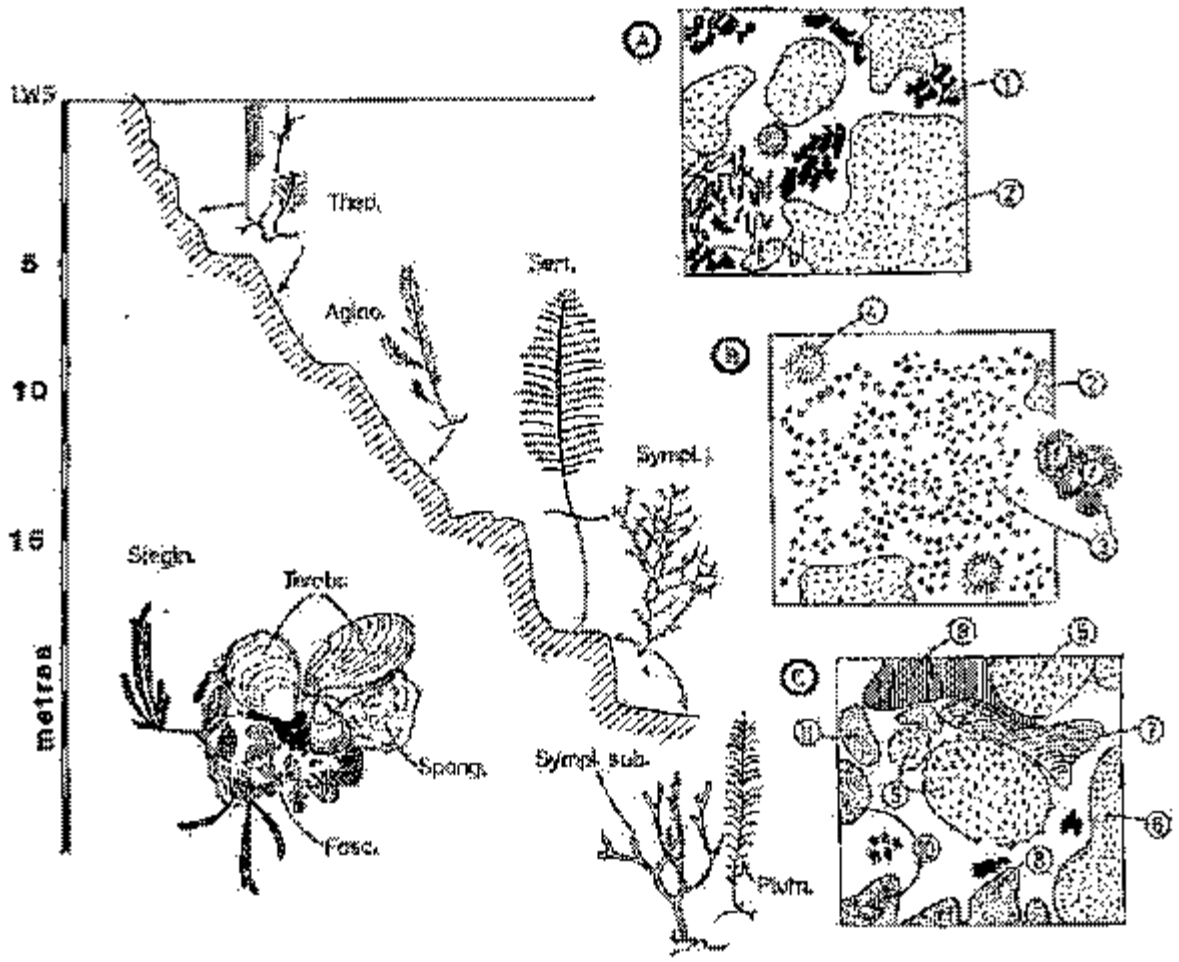


Fig. 14 FIXED ANIMALS ON THE DEEP REEF
Some details of the sessile animals on the rock slopes of Goat Island in the first marine reserve. The profile shows six feathery hydroid colonies characteristic of different depths, and the squares the encrusting sponges, sea squirts, sea urchins and sea anemones found at (A) 7 metres; (B) 12 metres and (C) 22 metres. The detail at bottom left is of species typical of vertical rock faces.

Aglao. Aglaophenia laxa. Fasc. Fasicularia ramosa. Plum. Plumularia diplotera. Sert. Sertularia unguiculata. Spong. Spongia reticulata (sponge). *Stegin. Geteginoporella novaezelandiae* (bryozoan). *Sympl. j. Symplectoscyphus johnstoni. Sympl. sub. Symplectoscyphus subarticulatus. Terebr, Terebratella inconspicua* (brachiopod). *Theo. Theocarpus incisus.*

1. Cnemidocara bicornuta (sea squirt). *.2. Tedania sp.* (sponge) *3. Actinothoe albocincta* (sea anemone). *4. Evechinus chloroticus* (kina) *5. Polymastia granulosa. 6. Tedania sp. 7. Raspailia agminata.* (all sponges) *8. Didemnum canididum.* (colonial sea squirt) *9. Hymedesmia sp. 10. Ophlitaspongia sp.* (more sponges). *11. Sigillinaria arenosa.*
(Reproduced from Morton and Miller's *The New Zealand Sea Shore,* with permission)

makes economic sense to anyone who has studied the history of overseas ports. The largest port in the world (New York) now has scarcely a ship in it. So much for those who say, "*You can't stop progress*". The truth is that mere expediency and unplanned expansion is a recipe for disaster

Educational

We now realize the importance of providing children (and others whose minds have not yet been closed to learning experiences!) with variety, with examples of what the world can show. It saves money and effort if these examples are conveniently handy. It is not as effective to read about it or see it on T.V. You need to go and stand in the

mangrove mud, feel the spines of the crayfish, watch the schools of fish, touch the bull kelp and see the crusts of sponge lining the cave.

People can learn from examining the real thing much more effectively than from theory - and the transfer to principle from example is easier and more immediate than in reverse. When one looks at an underwater cliff face, the ideas of diversity, natural stability (and vulnerability to new stresses) become obvious. Visits to the tropical jungle or a coral reef would do just as well but would be a lot more expensive and difficult. Half a day in an untouched mangrove forest teaches more ecology than a lot of reading, but it is hard to find one near Auckland nowadays.

Gain of information

If areas are specially set aside, not to be interfered with for profit or convenience, then they become a focus for study. Not merely because such places are easier to study - experiments will not be messed about - but because the results will be of permanent value. The base line will be preserved for comparison; principles can be discovered, not just accidental left-overs from exploitation; long-term investigations will be possible, and the incremental development of knowledge assured.

We really are appallingly ignorant about the sea. After 5 years of intensive study in the marine reserve we have just begun to realize that the ordinary sea urchin is probably the most important organism, because it controls the whole balance of the kelp beds which in turn provide for crayfish and other organisms. The general ignorance of marine situations does not seem to be recognised. An expert in marine science seems to be the only person who knows how ignorant he is; the others don't even know that, and in consequence are blissfully indifferent even to urgent problems like conservation.

Trials of management

Most techniques of management require testing and this is difficult (if not impossible) without areas where controls are available. What is the effect of our current activity? How would we know? If fish are less common this year, is it the effect of overfishing or a bad season? Will crayfish return in 5 years or not to an area when fished out? Can you significantly decrease the reef fish without affecting other important things? We need places where such things are automatically clear or can be easily checked. It could, of course, go much further, into enhancement programmes. This would require many conservation areas.

Refuges and nursery grounds

The simplest and most effective form of conservation of commercial species is to have areas where they are not exploited at all. In most well-understood systems this is already carried out. If you shoot duck, you join the acclimatisation society and they buy (or even build) ponds, put fences

round them, and erect notices that say "*No shooting - wildfowl refuge*". This ensures that there are some duck to shoot. Marine fishermen (and all those in control of them) do not seem to have noticed this; they appear to conclude that "*God will provide*". In reality, N.Z's exploitable marine assets from whales and seals to Chatham Island crayfish, Thames mussels, Golden Bay scallops etc., have been exploited to collapse when this was technically possible. The Almighty, quite reasonably, seems to require something rather more than a belief in his endless beneficence.

Protection of rare and endangered species or habitats

The number of marine species in N.Z. is not known even for the best studied groups with any degree of certainty. Even in the fish there are several undescribed but common blennies. When one considers worms or sandhoppers, the chances are that less than half the existing species have been seen yet, and in the most unfamiliar groups it is likely that we do not know more than a few percent. Consequently the only hope of protecting any rare or endangered species would be to preserve whole habitats and communities in as near a pristine state as possible. Marine reserves would automatically do this.

But although all these benefits of conservation areas are real and worthwhile, the most important of all is the most humbling. We need protection not just against our specific greed - we need it against ignorance. Even if we were

more controlled than we are in our actions, and even if we had well developed management plans, we would still need insurance.

Whether it is gill nets or reclamation, foreshore subdivisions or sand-dredging, resort development or just the collection of souvenirs, we need some places where we *don't* operate, because experience has already shown we can be very badly wrong in our assumptions.

THE BRITISH EXPERIENCE

This view of marine reserves may give the impression that it is an extreme or over-enthusiastic one. Let me quote from the two official reports on the subject in the U.K.

The first report "*Marine Wildlife Conservation*", produced in 1973, included remarks in the recommendations like:

- *"we cannot assess the priority that should be given to conserving intertidal habitats"*
- *"even if certain areas suffer biological damage there are likely to be ample reserves"*
- *"there is little evidence that sublittoral habitats are at present endangered*"

but it did strongly advise more scientific investigation, legal examination of how to create marine reserves, more liaison between parties, and continuing review of the subject. The general tone was there was no hurry, just to keep a watching brief and develop policy slowly.

But in 1979 a second report "Nature Conservation in the Marine Environment" recommended:

- " *the development of a formal marine conservation policy*
- *additional resources to develop an effective strategy for marine conservation*
- *to establish representative conservation areas, large areas should be designated*
- *for specialised habitats, designation of a series of small areas in addition*
- *high priority should be given to sublittoral rocky communities*
- *legislation to permit the establishment of conservation areas below low water*
- *the data base should be improved urgently.*
- *the education process should be stepped up*
- *research programmes should be increased*".

The general tone of the second report is that the matter is urgent and important, with a strong implication that past inactivity was a serious mistake. The first report mirrors official views here; it is time we moved to those of the second.

CONCLUSIONS

In New Zealand the late development of concern for marine conservation may yet be turned to advantage. The hard-won experience with terrestrial conservation can be used fairly directly to define principles and to get them publicly accepted.

Attitudes towards the marine environment have not yet hardened sufficiently to inhibit an objective approach, provided people wake up to the need to concern themselves at all.

We could easily develop, at very small cost, a system of multi-purpose marine conservation areas, of tremendous benefit to present and future New Zealanders, but some leadership and energy are needed, and, unfortunately, so far are lacking.

Fig. 15 THE FIRST ZONE BELOW LOW TIDE

In all temperate seas, the zone at the base of the shore is dominated by large brown seaweeds. In the marine reserve, near Leigh, these are mainly *Carpophyllum* species, although *Sargussum, Cystophora* and *Landsbergia* occur in patches. All these seaweeds have strongly attached holdfasts, long flexible stems and fine pointed "leaflets". As they sweep and sway in the strong wave surge, all these features help them maintain their grip on the rock. *(Drawing by Vivienne Ward, first published in pamphlet No. 22 for the marine reserve by Dr. John Walsby in 1983)*

Box 4

WHY 10%

Since 1980, I have been recommending that 10% of all New Zealand seas be made into non-extractive marine reserves. One tenth of all marine habitats in all regions of the country. Why the figure of 10%, is this just a nice round number? No, it has a reasonable basis in experience and principle.

One tenth has a long traditional use as a figure that signals importance without serious hurt. In religious tithes, insurance premiums, business contingencies and other fields, one tenth is commonly used to indicate that the point to be covered is of great importance and must be provided for, but that precise measurements of necessity are not possible.

The 10% contrasts with the **90% for exploitation,** for fishing ,aquaculture, and other extractive or intensive uses, and clearly recognises the importance of these uses. We are not trying to change direction, we are trying to support, insure, and protect the system that allows " business as usual".

There is virtually no direct marine experience for a reservation amount, but on land in New Zealand, much more than 10% reservation from extractive and intensive use has been found worthwhile. Land reserves comprise between 20-30% of the total area of New Zealand. **10% is therefore a conservative figure for our seas**.

Natural variation in marine resources (such as fishable stocks) is known exceed one tenth. The year to year variation, due to natural changes in weather and other uncontrollable factors is generally much more than 10%. The implications of this are many and subtle, but it means that any arrangements made for using these resources must have at least a **10% safety factor** built into them, if they are to be sustainable. Because of economic and political pressures, it is very difficult to build a safety factor into actual extraction quotas, indeed they are often set with a risk factor of damage or collapse. This may be acceptable to the particular industry and the immediate economic conditions. We need a separate and additional system to provide for the overall public interest in long-term sustainability.

It can be questioned why we need a figure at all for marine reservation. Would it not be possible to operate step by step, without setting any general aim point? Well this is what we have been doing until now. The results have been 3 marine reserves after 25 years of step by step discussion, while the resource base is increasingly pressured and shows clear signs of general degradation and particular losses.

There are two reasons for setting a clear aim for marine reservation. One is to reassure those who might be worried about "*where will it all end*". It is an amazing fact that even when the first tiny marine reserve was proposed some people leapt up and started crying, "*We must make a stand before they lock it all up*!" Even if this is merely a slogan produced by those who have no better argument, it is important to have a figure representing **the aim for the foreseeable future**, which would not be exceeded unless there was a clear demonstration that more was necessary..

Much more importantly, however, we need to propose an amount which would be **enough to provide worthwhile and widespread benefits**. The idea of 10% is not just to produce an easily-remembered, conservative and traditional figure, it is also designed as an aimpoint for those who really wish to protect our marine heritage and ensure the sustainability of our marine resources. A network of marine reserves comprising 10% of every type of marine habitat and spread round the country has every chance of achieving these aims, and is a worthy cause for every citizen. 10% is a rallying cry.

CHAPTER 4

NEW ZEALAND'S EXPERIENCE WITH MARINE RESERVES

This article was an attempt to summarise the political and social experience gained from New Zealand's first two marine reserves. It contrasts the two places, Leigh and the Poor Knights, in terms of their nature and the arrangements made for the reserves there. I wanted to show that simple strict rules not only produced more benefits, but were, in fact, easier to arrange and much less trouble to enforce. The article was first published in "New Scientist", the British scientific weekly, on 4th June 1987 as part of an article on the U.K.'s approach to marine reserves. In New Zealand it helped to establish the idea that marine reserves should be "no take" areas.

For many years, all over the world, pieces of shore and shallow sea have been "reserved" for special purposes - harbours, shellfish farms, underwater cables, dredging for minerals, shipping channels, dumping sites, firing ranges and so on. Setting aside areas for no purpose at all but to leave them unused and unspoilt is a very new idea and has rarely been put into effect.

New Zealand created its first statutory marine reserve 10 years ago. The idea of legally established reserves first cropped up in 1965. By 1970, the country had voluntary marine reserves, backed by organisations of divers and marine scientists. A year later, the government passed an enabling law, the Marine Reserves Act. The first statutory marine reserve became fully operational in 1977. New Zealand now has four well-established marine parks and reserves with official plans for many more.

At every stage of the procedure, New Zealand has run about 10 years ahead of Britain. Although New Zealand is at the opposite end of the globe, it is similar in many ways to Britain - in size, culture and its political system. The main differences are the much smaller population, only about 5 per cent of Britain's, and its much shorter history. These differences might explain why New Zealand is more open to pioneering ideas, and has raced ahead of Britain in marine conservation. Despite this, the similarities between the two countries mean that the practical results of conservation efforts are likely to be the same.

Despite New Zealand's head start, its marine reserves are still radically new experiments. It is impossible to foresee the results of the experiments in detail - and difficult even to spot likely trends in advance. Before marine reserves are created, politicians and the public naturally ask marine scientists why we need them, where they should be, and what the benefits would be. Such questions are reasonable but it is impossible to answer them without a large amount of guesswork.

Conservationists in New Zealand have two ways of handling this dilemma. The first is to admit ignorance but to insist on the importance of getting the proper answers; and press on with the experiment by closing the reserve to all

exploitation. This was the approach taken at the first marine reserve near Leigh. (Its official title is The Cape Rodney to Okakari Point Marine Reserve). The alternative approach is to limit the aims of the reserve; to cooperate with people who use the area, to restrict only those activities known to be damaging; and hope to step up protection if the experiment suggests it is necessary. This was the general idea behind the management of New Zealand's second marine reserve, around the Poor Knights Islands.

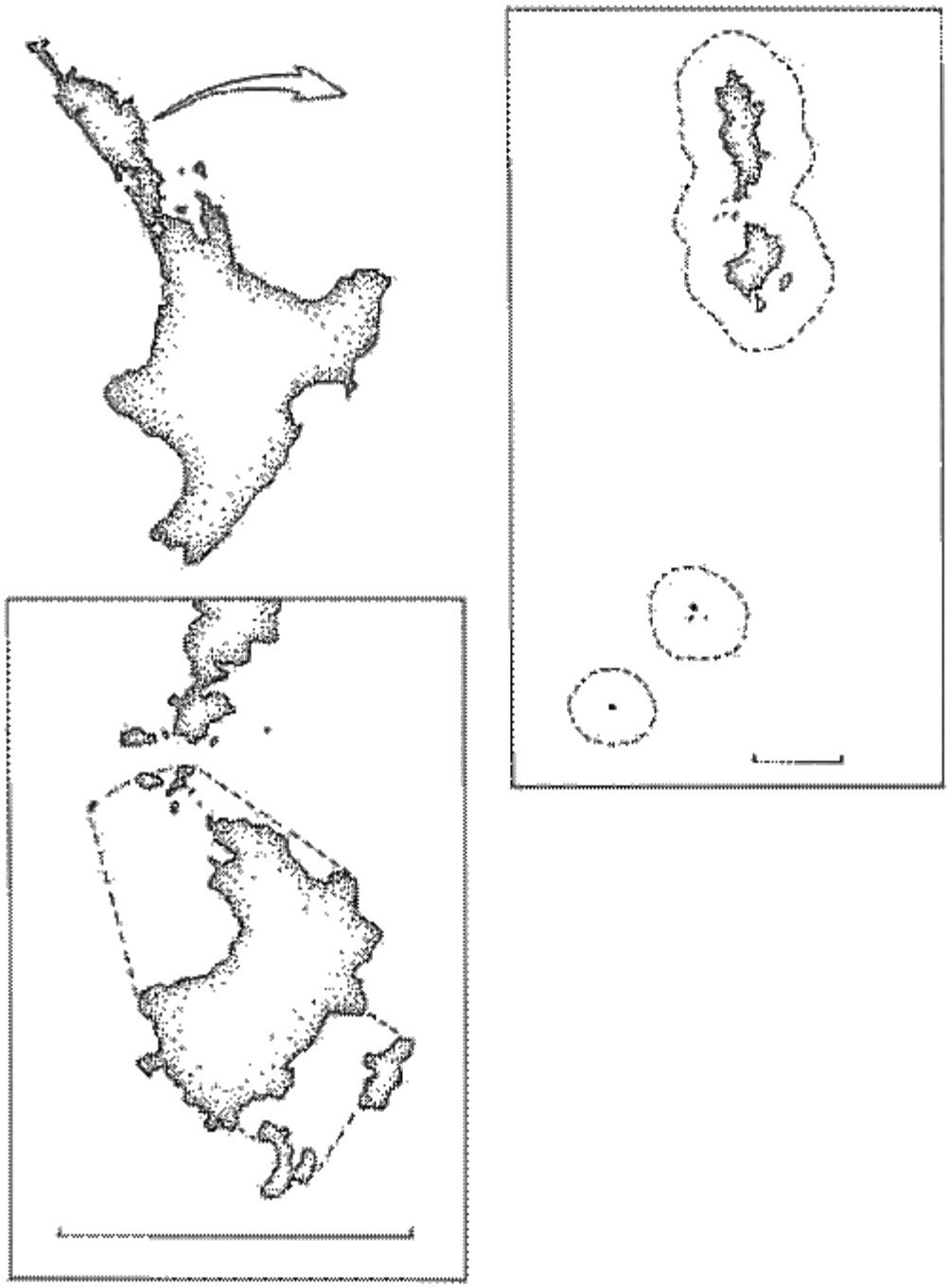


Fig.16 THE SECOND MARINE RESERVE: AT THE POOR KNIGHTS ISLANDS

Top left: the location of the Poor Knigths off the northeast coast. *Top right:* the extent of the marine reserve round the main islands and their outliers. From north to south: Tawhiti Rahi, Aorangi, the Pinnacles and Sugarloaf Rock. Total area approx. 1900 hectares. *Bottom left:* the special parts in which no fishing is permitted. Total area 100 hectares.

Except in these two small areas, amateur or recreational fishermen may, using the method specified, take the following fish:

By spear fishing and trolling: shark, billfish, tuna, mackerel, kahawai, pink maomao, barracouta and kingfish.

By spear fishing and strayline (no leaded lines or lines weighted with anything other than bait): snapper, kingfish, pink maomao, barracouta and trevally.

In the first approach, the main aim of the experiment is to learn the full effects of exploitation. This means a total ban on fishing, dredging and any other disturbance within the marine reserve. It is irrelevant whether damage is proven, who is carrying out the disturbance, or what their motivation is. The reserve must also be representative of a wide area both biologically and in levels of exploitation. The next aim is to demonstrate the benefits, if any, that result from a natural unexploited state, and to maximise those benefits. To this end, the reserve should be easily accessible to the public and researchers.

At Leigh the rules were simple and strict - no fishing, no removals and no disturbance. The plan for management made no concessions to existing users - commercial or recreational - if they conflicted with that policy. Even scientific experiments were permitted only if disturbance fell well within naturally-occuring limits. The site was reasonably typical of the open north-east coast in its biology, coastal morphology and fishing activity. The only special features were its accessibility, an hour-and-a-half's drive from Auckland; and close to the university's marine laboratory.

The Leigh reserve has proved remarkably successful in many ways. Visits by the general public have greatly increased despite predictions that without fishing there would be "nothing to do". A recent survey showed that most visitors know it is a marine reserve before they come, yet they pass places where they could fish on their way, and they support the idea of more reserves with strict rules. Whether they are SCUBA divers, swim with a face-mask or just explore the shore, they can see in the reserve a greater variety of marine life, more abundantly, naturally and conveniently than anywhere else. Fish and their behaviour are the greatest attraction but all forms of marine life and natural activity are popular. The available habitat maps and explanatory pamphlets are appreciated and assist this enjoyment but the prime feature is the guarantee of undisturbed conditions.

The reserve has become a very active research site. The advantages include more natural densities, distributions and behaviour; protection for manipulative experiments and recording equipment; assurance of continuity; availability of detailed maps and background data. For some species, such as the commercially-valuable rock lobster (*Jasus edwardsii*), the changes due to protection have been dramatic and unexpected. Studies by A. Mac-Diarmid, funded by the Fisheries Research Division, have shown the density of adults within the reserve to be more than an order of magnitude higher than on the surrounding coast, despite no evidence of greater recruitment. The reserve animals were also much larger and still growing. It had been assumed, since tagged rock lobsters have been recorded as migrating long distances that a small reserve would make little difference to their density.

Local fishermen, initially divided over marine reserve proposals, now fish intensively at the boundary but are fiercely vigilant against any poaching within the reserve. They are convinced that the reserve provides a valuable stock of fish as well as crayfish and that they benefit from this. Teachers, tourists, diving schools, artists, amateur naturalists, photographers and many others find the reserve provides them with valuable features unavailable elsewhere.

The disadvantage of the approach adopted for the Leigh reserve was that people were prevented from carrying out many of their previous activities without being given any specific or proven reasons. It took several years to convince large sections of the public that such an experiment was worthwhile. They then influenced the politicians who in turn instructed the responsible administrators. These officials were always less than enthusiastic about the radical approach, and, when they did become active, much preferred the alternative method with limited aims.

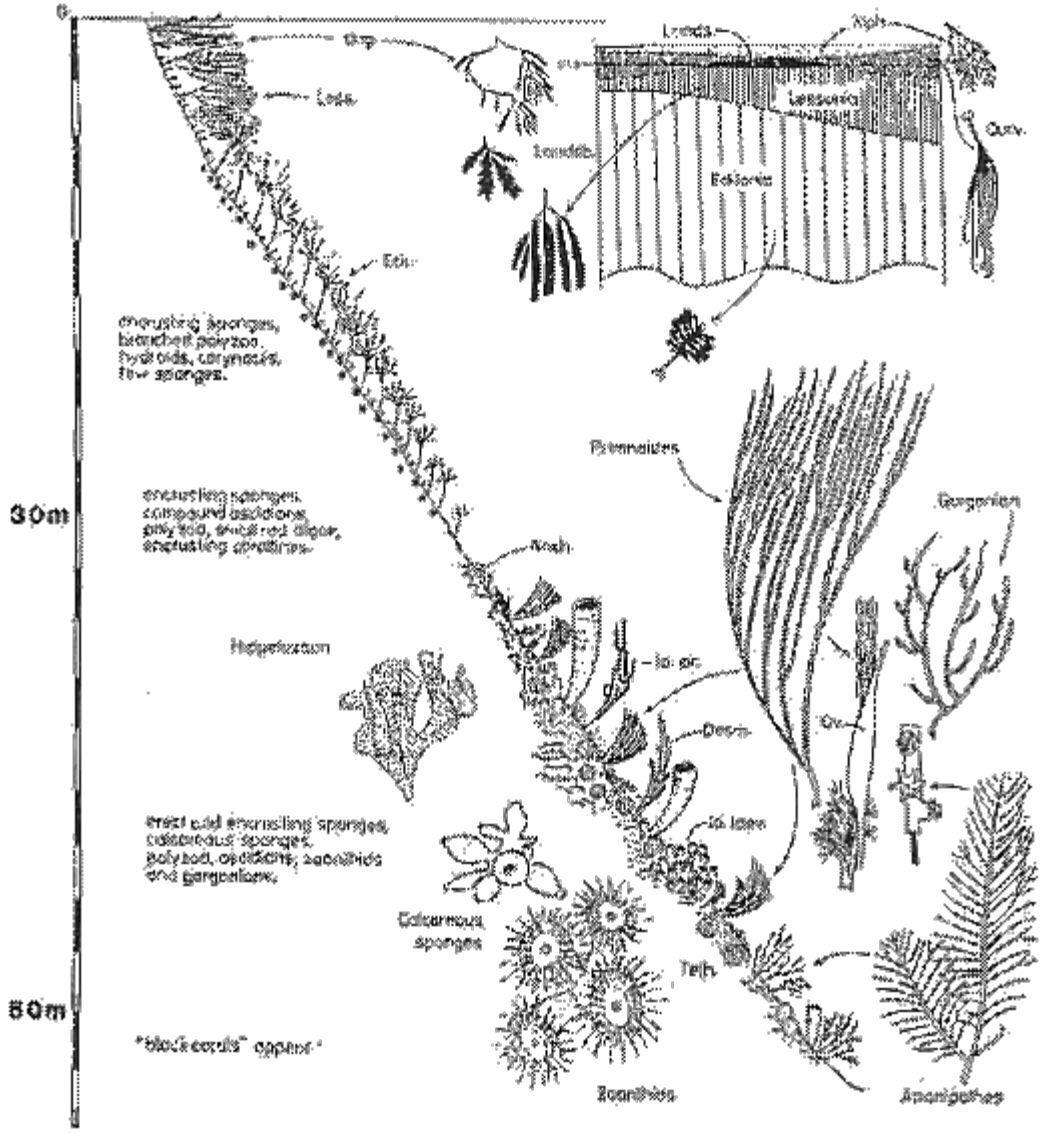


Fig. 17 ZONATION ON UNDERWATER CLIFF AT THE POOR KNIGHTS
The main pattern of plants and animals on a well-lit, steep rocky face extending to 65 metres.
Near the surface are bull kelp (*Durvillea*), and other brown seaweeds like *Xiphophora* and *Landsburgia*. Furtherdown the kelps, *Lessonia* and *Ecklonia*, dominate until about 30 metres. Below that, sponges like *Anchorina*, *Iophon*, *Desmacidon* and *Tethya,* gorgonians like *Primnoides*, lace corals like *Hippelozoon* and zooanthids cover the surface. At around 60 metres the "black coral", *Anitpathes*, becomes common.
(reproduced from Morton and Miller's *The New Zealand Sea Shore*, 1968, with permission)

In the alternative approach to marine reserves, the main objective is to establish a working reserve without antagonising large numbers of existing users and all the protracted fuss that this can entail. The elimination of activities that are already known to have caused damage is regarded as a sufficient first step. It is therefore sensible to consult widely amongst current user groups, stressing that only demonstrably damaging activities will be curtailed. It will greatly assist if the site can be shown to be scenically and biologically very special and hence worthy of protection. It will also help if the area is relatively remote from population centres and low on the general scale of human activity.

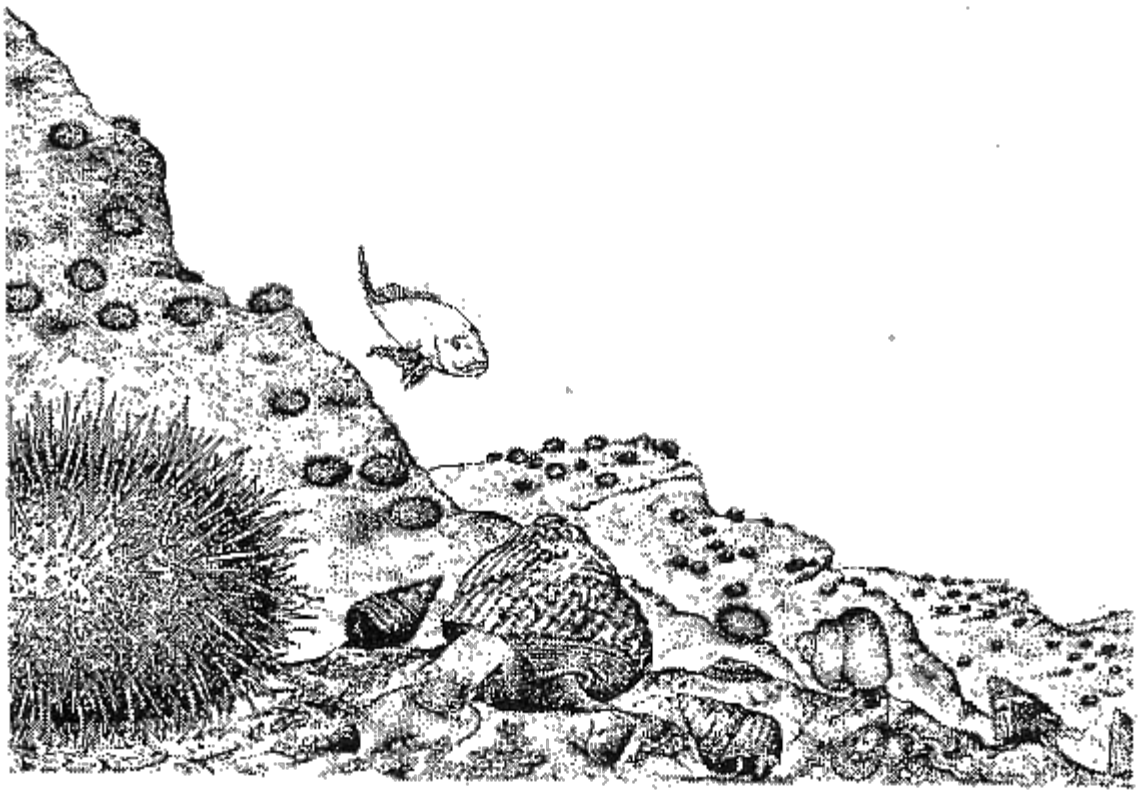
All these conditions were met at the Poor Knights marine reserve. Existing interests were carefully protected except where proven damage had already occurred. The location is scenically spectacular and the marine biology unique in N.Z. The uninhabited islands lie 20 km offshore in the path of warm currents. Tropical species are frequently encountered. The fauna of the steep underwater cliffs provides the most colourful and exciting diving in N.Z. Because of the remote location, despite high levels of interest and special charter boats to cater for them, total human activity is low.

The disadvantages of this approach emerged rather slowly but increased with time. Pragmatic adjustment to existing interests leaves no clear principle around which public support can rally. The necessarily complex rules (including exempt species, zoning and allowable catching techniques) are difficult to remember and the reasons for them hard to understand. Visitors tend to expect more stringent rules while protected user groups become defensive. Although stepwise progress is possible, continued and confused argument about detailed rules seems equally likely.

The Poor Knights marine reserve is successful as a holding action. Since the area was very special and relatively undamaged, prevention of future deterioration is a worthy aim, but that is really all that has been achieved.

At Leigh, while there was initial opposition, the more radical approach has been justified by subsequent events. An ordinary piece of coast, merely by a change in management rules, has been transformed into an important asset to research workers, commercial fishermen, divers, tourists and the general public. The scientific, economic and social benefits of learning about the natural baseline and the real effects of our usual levels of exploitation are still emerging from this reserve. Plans for many more such reserves throughout the country and covering all marine habitats show that New Zealand is clear about the lessons. It will be interesting to see what happens elsewhere.

Fig. 18 THE KINA GRAZED ZONE, AT LEIGH
The kina or sea urchin (*Evechinus chloroticus*) often clears whole areas of large brown seaweeds. These places may look rather empty and barren but, in fact, are highly productive, and are the home of many juvenile fish, including first year snapper.



Box 5 **SCROOGE AND THE SPOTTIES**

Spotties (also known as paketi and *Pseudolabrus celidotus*) are small fish common in shallow rocky areas all round New Zealand. They are of little interest to commercial or most recreational fishermen, but are commonly caught by children just learning and practising.

Many children enjoy fishing off small wharves or sheltered rocks, with hand lines or small rods, using whatever bait happens to be available. The catch, if any, often includes spotties, and even if only really useful for feeding the cat, they are proudly shown off and duly admired. It would seem the act of a real Scrooge to interfere with such simple pleasures.

However, in the marine reserve at Leigh, no fishing is allowed, including no small children fishing for spotties. This complete protection allowed Geoff Jones to study the detailed behaviour of these fish. He had to learn to recognise them individually, without any tagging or artificial aids. Using side-on photographs and memorising the small differences in their spots, he could eventually identify every spotty on the reef.

One of the first things he learnt was how to tell males from females; the males have spots that are less circular and more blotchy. Later he was able to show that each male had a territory, a small area that they never left, but defended as best they could, especially against other male spotties. The females, however, ranged much more widely.

When the breeding season came round it was the females that chose which male to breed with, and they were both fussy and consistent. Some males were extremely popular with the females, while others, perhaps only a few metres away never had any success at all. This raised the question - what were the females choosing, the appearance of the male or something about the territory?

Removing a "stud male" from its territory (which required the written permission of the marine reserve management committee) resulted in a neighbouring less successful male taking over the territory and immediately becoming extremely popular with the girls! Apparently female spotties take very little notice of a male's appearance but are very attracted by territories with large kelp plants.

The "sexist" language may be forgivable in spotties, because Geoff also discovered that most spotties change sex. All spotties are female for the first couple of years and thereafter most become males!

All this and much more is detailed by Dr Jones in a series of scientific papers of considerable interest to fish biologists. But it is also interesting to school children: indeed, many find the whole story fascinating, especially the bit about sex change! They are often so intrigued that they wish to go and see some of this for themselves. They can do so (it occurs in shallow water) but only where the fish are undisturbed, only in places where. the children, as well as others, are not angling or spearing or netting. In fact, only in a completely protected reserve, where the fish are settled into their territories, going about their natural business and ignoring snorkelling scientists or children.

So perhaps "Scrooge" was right for once. Of course, children should have places where they can safely learn to fish. They should also have places where they can see how fish behave. We should arrange it for them.

CHAPTER 5

LESSONS FROM LEIGH

This chapter was written for a U.K. audience and was first presented at the 21st annual conference of the Underwater Association in London, March 1987. It attempts to summarise precisely, but not too technically, what was learnt from the first decade of the marine reserve at Leigh. It concentrates on the scientific and factual lessons, but also refers to educational and recreational aspects. The stress is on the range of benefits, mostly unpredicted, which came from the simple decision to have an unexploited piece of sea.

Abstract

For the past decade a 5 km stretch of coast in NE New Zealand has been protected by law from all exploitive and damaging activity. The creation of this marine reserve encouraged the production of underwater habitat maps; allowed baseline surveys of more natural densities and distributions; and permitted investigations of natural behaviour and interactions. The results of this work are not just interesting in their own right - they also strongly suggest that effective understanding of marine ecology may not be possible without such protected areas.

The idea of controls is central to scientific investigation. The effects of pervasive exploitation cannot be determined without observations and experiments in areas where exploitation does not occur. A system of representative, unexploited and permanent marine reserves is needed to allow proper understanding and hence efficient management of living marine resources.

The New Zealand experience is that the social and political problems of creating such reserves are much larger in prospective imagination than in actual practice. However the scientific, social and economic benefits of fully protected marine reserves proved in the event to be considerable, both in degree and range.

INTRODUCTION

Twenty-one years ago, when the Underwater Association was being formed in the U.K., the idea of marine reserves was being promoted by a group of marine scientists and divers in New Zealand. It took more than 10 years to achieve the necessary changes in public opinion and the law, but by 1977 the first marine reserve was fully operational. An area of shore and shallow sea, covering 5 km of coast and extending 800m seawards, was protected by law from all exploitation and damaging activity. This area, officially entitled The Cape Rodney to Okakari Point Marine Reserve, lies on the NE coast of North Island near the coastal settlement of Leigh.

This paper describes some of the scientific work that was encouraged or made possible by the marine reserve. The aim is not to detail this work, which was carried out by many researchers over a decade, but to trace, with examples, the connections between the existence and nature of the reserve and the kind of investigations that were possible.

The University of Auckland had established a small field station in 1964 alongside what was to become the marine reserve. This marine laboratory and the marine reserve evolved together in a kind of mutual dependence. Workers at the Leigh laboratory provided many of the ideas and much of the impetus for the reserve. The reserve, even in its early voluntary form, encouraged new and more interesting projects.

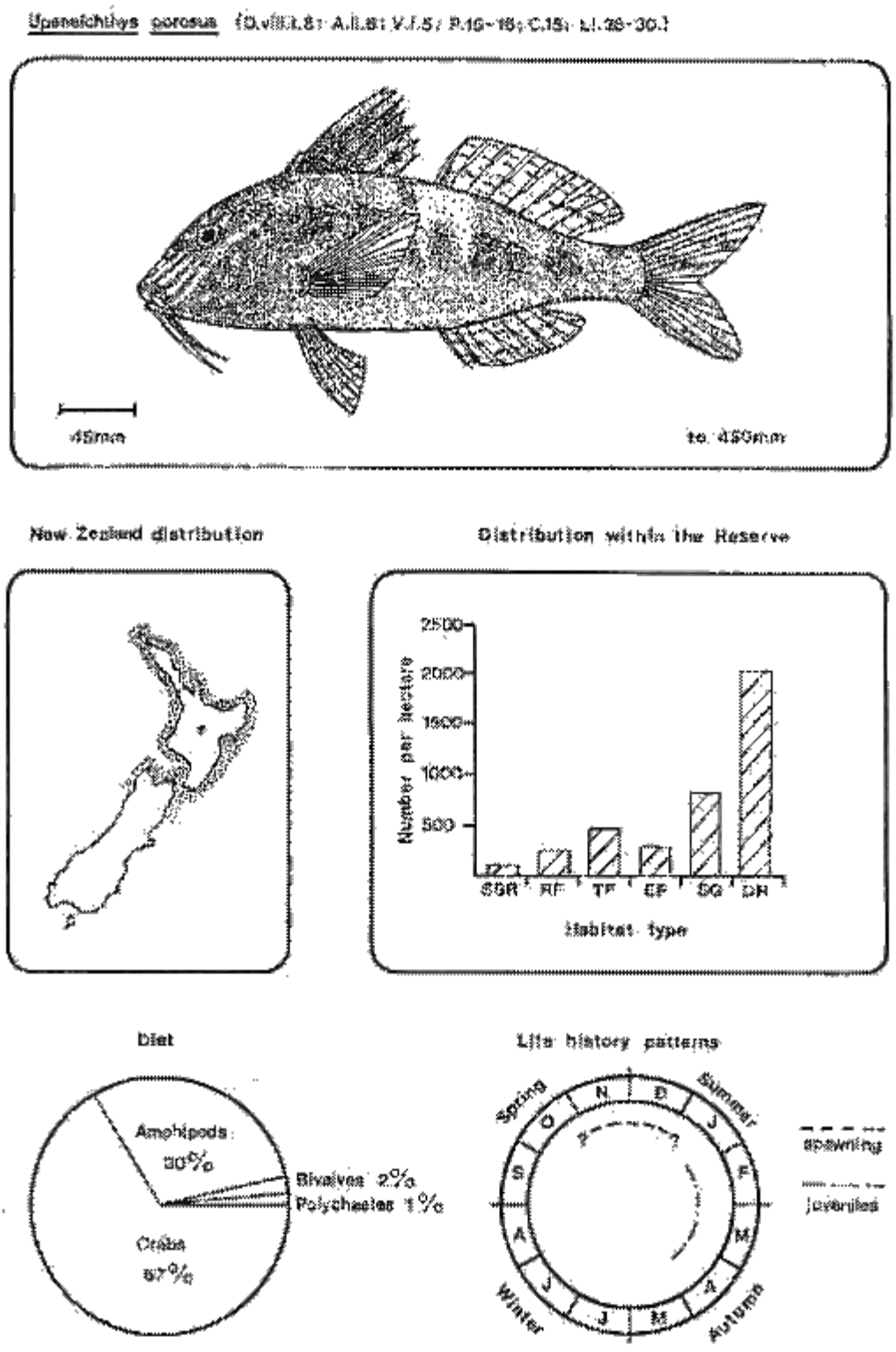


Fig. 19 THE BIOLOGY OF THE GOAT FISH

A page from Sue Thompson's book *" Fish of the Marine Reserve"*, in which 90 species are each given in this layout, so that you can see what is, and what isn't known about their biology. The goat fish, or red mullet is relatively well known (but note the uncertainty about the spawning time).

The results of this work, when widely publicised, promoted proposals for more effective reserve status. This self-reinforcing cycle continues to operate by generating pressure for more reserves of the same type.

At the time, pragmatic and practical views predominated, and the problem was often stated as the need to provide efficient facilities for research by those working at the Leigh laboratory. However, with hindsight, it is clear that

the driving force was not the existence of the laboratory as such, but the idea that protective status would allow much greater understanding of the natural and unnatural events in the sea. This idea began with the scientists, but was only effective in providing legal protection when it was transferred to large sections of the general population by pamphlets, slide shows, newspaper articles and every other available means.

The public were, in fact, very receptive to the idea on both a common sense basis and as an interesting exploratory venture. Many scientists, especially non-divers, were much more cautious, feeling the idea was too large and unfocused to get their professional backing. Elected politicians followed the public feeling. The least receptive people were those who, at least nominally, were responsible for the management of marine resources. They saw the idea as untried, revolutionary and hence threatening. They gave way slowly under the combined pressure of public opinion, common sense arguments about resource management and the steady improvement in factual information.

BASIC SURVEY AND BACKGROUND

One of the first scientific activities specifically due to the idea of a marine reserve was the mapping of the area. By 1975 many specific projects had already been carried out from the Leigh laboratory, including some with detailed maps of some small areas, but no general survey existed (Gordon and Ballantine, 1976). But although scientists approve the acquisition of general background information for their studies, they are not likely to do much about this, unless there is both a clear focus and a set of boundaries for the study. The proposal for a marine reserve provided both.

From the literature available to us we were unable to find suitable methods or protocol for mapping an area of several square kilometres underwater. However, it seemed important to press ahead, and over the next 3 years, methods and results evolved into a complete habitat map (Ayling 1978). Later this was published in three full-colour sheets by a government agency (Ayling, Cumming and Ballantine, 1981) at 1:2000 i.e. a resolution of a few metres. The main methods were aerial photography from light aircraft using standard 35mm cameras and colour film on the rare very calm days; and underwater transects recording habitat type.

In a preliminary survey elsewhere (Ballantine, Grace and Doak, 1974), habitats were defined in a hierarchy of depth, substrate, topography and general biology, but it proved both quicker and more informative to use intuitively-derived definitions of habitat type based on biological features. Later in the survey these definitions were tightened and made more objective using detailed surveys of 5 x 5 m quadrants and finally tested for significance by stratified random samples of fish (Ayling, 1978).

Over the years many other forms of background data gathering were directly or indirectly promoted by the existence of the marine reserve, including continuous recording of climate data for air, shore and sea (e.g. Ballantine, 1982) and guides to the ecology and identification of various taxonomic groups (e.g. on fish, Thompson, 1981; molluscs, Walsby and Morton, 1982; and sponges, Pritchard and Ward, 1984).

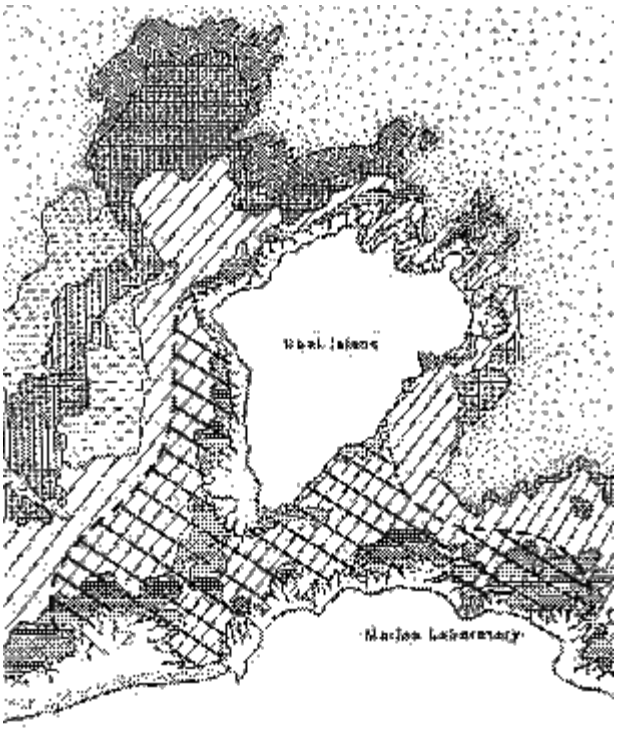


Fig. 20 THE HARD HIT PIECE
The area most heavily spearfished prior to the creation of the marine reserve near Leigh. (this figure and the table below taken from Tony Ayling's *Marine Reserve Survey,* 1978)

Table 1 AVERAGE NUMBERS OF THE COMMON FISH IN EACH HABITAT
(per 500 square metres) in the Cape Rodney to Okakari Point Marine Reserve in February 1978

Fish species	Rock Flats	Sediment Flats	Sponge Garden	Shallow Broken	Kelp Forest	Deep Reefs
Spotty	8.5	1.9	0.6	28.2	11.5	9.2
Banded wrasse	0.2	-	-	3.8	0.7	0.4
Goatfish	13.0	23.9	41.7	5.2	15.8	103.4
Snapper	11.6	58.7	47.4	2.6	5.5	12.5
Red moki	1.4	0.4	-	8.3	3.8	6.3
Porae	0.1	0.4	2.0	-	0.3	3.9
Hiwihiwi	0.8	-	-	14.8	1.0	1.5
Leatherjacket	1.4	-	3.6	2.8	5.7	40.3
Parore	0.2	-	-	13.5	1.4	0.7

NATURAL DENSITIES AND DISTRIBUTION PATTERNS

With the protection of the reserve and the assistance of the habitat map it became much easier and more interesting to survey the abundance and distribution of particular species. Although it is never possible to say an area is completely natural or fully representative, demonstrable increases in these qualities clearly add real interest to results.

The Leigh marine reserve was considered then (and still is, on better information) to be a biologically typical example of the NE open coast, i.e. exposed to the Pacific Ocean over most of the north to east quadrant.

The only special feature was its proximity to Auckland, indeed the nearest such piece of coast by road. This convenience had not just influenced the siting of the marine laboratory but also the depredations of the pioneer skin divers. In the late 1950s snorkel divers had removed most of the reef fish and rock lobster from the central area of the future reserve. The whole area was subject to the normal regional commercial fishing pressures until the mid-1970s - potting for rock lobster, long-lining and trawling (off-shore).

The protection of the reserve meant that the area would become more natural, although this process would occur at different rates with various species. Consequently there were strong theoretical and practical reasons for measuring densities within and outside the reserve quickly and then to compare any changes in time.

There were real problems in achieving this aim. There were no data at all prior to 1970, and the evolution of scientific diving methods and training of personnel went on through 1980 and beyond. These points, plus the partial protection of voluntary status in the early 1970s meant there was no clear starting point for calculations. However, this did not prevent the discovery of many interesting and some highly unexpected processes.

It was quickly established that many reef fish had much higher densities, were larger, and had more stable population structures inside the reserve than in areas accessible to spearfishermen. This was often true even if spearfishing was infrequent, i.e. small amounts of fishing could have drastic effects on some species (e.g. Leum and Choat, 1980). This encouraged work on growth rates, recruitment, territoriality, and social structures.

Extremely detailed (and hence vulnerable) investigations became worthwhile. First because they were guaranteed from human disturbance; second, because habitat mapping could identify properly representative locations; and third, because the differential between reserve and non-reserve sites indicated features of special interest. Several species have been studied in detail including a very common small labrid fish, *Pseudolabrus celidotus* (Jones, 1980, 1981, 1983, 1984 a and b). In many cases, the detailed study of indvidually known fish in natural conditions showed unexpectedly complex behaviour and hence scope for more subtle interactions.

CAUSES OF NATURAL PATTERNS

The increasingly precise and detailed information on patterns of distribution led to a search for causal processes. This began with correlation of existing data and progressed into manipulative experiments in the sea. Unless high-grade information is available on such matters as physical factors, habitat variation, and population dynamics, it is rarely worthwhile attempting manipulative experiments because of the careful experimental designs required to produce worthwhile results. Yet as Underwood (1985) has cogently argued, correlations are not enough. Direct *in situ* manipulations are required to untangle the interplay of physical factors and biological interactions. The problem is that this is even more difficult underwater than on land or the seashore.

Fig. 21 THE LIFE AND DEATH OF A KELP PLANT
A, B and C: growth of sporeling and juvenile; D: spore bearing patches on mature plant; which has lots of other things growing on it (E: tubeworms) or inside its holdfast (F). Isolated plants or those on the edge of the "forest" may be attacked by sea urchins (G and H). All plants lose lamina due to wave abrasion or herbivorous fish (J: butterfish bites). Drawing by Vivienne Ward from *Marine Reserve pamphlet 24,* with text by John Walsby.

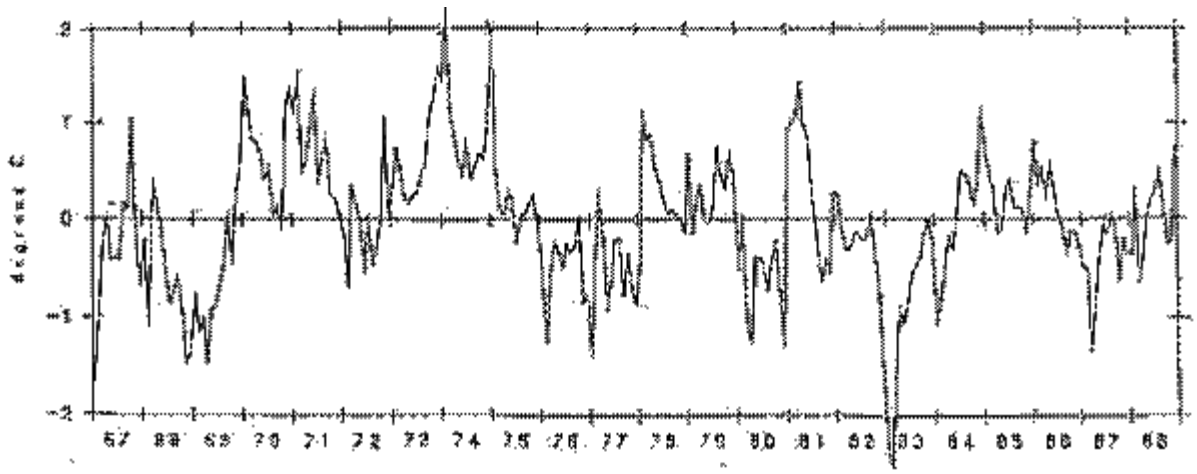


Fig. 22 LONG-TERM VARIATIONS IN SEA TEMPERATURES
A plot of how each month's sea surface temperature differed from the long-term average. Note how warm and cold periods can last many months; also the extremely cold summer of 1982-83, the "El Nino" year. From Evans *Leigh Climate Report 1988.*

The marine reserve provided two levels of support for this kind of work: first, a focus and encouragement for the build-up of the necessary background data; secondly the guarantee of protection for the experiments themselves. This is very important since the experiments involve considerable effort and expense, must continue for long periods to provide useful results, and are usually highly vulnerable even to casual interference.

Sessile species lend themselves most easily to manipulation, and the first subtidal projects involving direct experimentation were on barnacles (Ayling, 1976). The general mosaic of sessile animals and plants has now been extensively studied and has led to some interesting ideas (e.g. the effects of random biting by trigger fish on maintaining a high diversity - Ayling 1981). The use of cages, fences and other manipulations to create changes in density, predation and other conditions is now almost routine, and studies involving many species and habitats have been carried out, e.g. on the recruitment, growth and mortality of juvenile sea urchins in various habitats, densities, population structures and exposures to predation (Andrew and Choat, 1982, 1985).

HABITAT STABILITY AND CONTROL

With some knowledge of causal processes gained in carefully controlled conditions, it became possible to consider the effects on whole communities and habitats. For at least 3 of the major habitat boundaries in the reserve there is now a reasonably good understanding of what maintains them and what kinds of disturbance would shift them. Because these habitats occur generally around northern N.Z. and are variously implicated in the life-cycles of several important commercial species, this knowledge is of practical interest (Choat and Schiel, 1982). Since analogue communities occur in many warm temperate areas of the world the results are also of theoretical interest.

The results were often surprising. The habitat originally labelled "barren rock flats", because it had few large seaweeds or brightly-coloured reef fish, turned out to be an area of high productivity, rapid cycling and the feeding ground for many small fish, including the juveniles of N.Z.'s most important commercial species (Kingett and Choat, 1981). The extent and stability of this habitat depend on the interplay of wave-action, topography and light levels with the grazing activity of the sea urchin, *Evechinus chloroticus* (Schiel, 1982). Recent proposals for harvesting *Evechinus* for export on a large scale are being evaluated in the light of these findings, whereas there is little doubt that only a few years ago they would have been passed without question.

LONG-TERM NATURAL CHANGES

As a picture emerged of the "normal" level for at least some biological conditions and processes, it became possible to consider the natural variation between years. This was greatly aided by the availability of detailed local climate data since 1967.

In the summer of 1982-83, when climate conditions showed major deviations over most of the Pacific area, the sea temperatures at Leigh were 3° C below the long term average (the normal annual range is only 7° C). Many unusual processes could be linked and explained using knowledge gained in the marine reserve. Reports of brown-coloured seawater and associated fish kills were shown to be due to a bloom of a planktonic diatom, normally occuring briefly and sub-dominantly in early spring, but encouraged by the persistent low temperatures. The natural death of this bloom was accompanied by unusually persistent westerly (offshore) winds which created very calm conditions inshore. This caused anoxic conditions to develop near the sea bed, which in turn caused heavy but patchy mortality of bottom-living shellfish, and some fish deaths especially of fish caught on long lines (Taylor, *et al.*, 1985). Without the monitoring of both climate and plankton in the reserve beforehand, the events would have been (and were initially) attributed to pollution.

When local climate monitoring indicates unusual conditions developing, it is possible in some cases, because of normal biological time lags, to "predict" changes and then measure them. For example, the larvae of a reef fish that spawns in late spring may not settle on to the reef before late summer. If late spring is unusually cold, the recruitment to the adult population can be predicted some weeks before settlement can be measured. The unusual conditions of 1982-83 provided such an instance. In one such case, the predicted change in recruitment was opposite to that expected, indicating that second order conditions normally limited larval survival in that species (J.H. Choat -personal communication).

EFFECTS OF EXPLOITATION

Some changes due to the protection of the marine reserve - e.g. the increase in many reef fish species on the cessation of spearfishing - occurred fairly rapidly and as expected. Other expected changes were very slow to develop - e.g. increase in the fish *Cheilodactylus spectabilis* (Leum and Choat, 1980) and in *Haliotis* (R.G. Creese, personal communication). In the first case an unexpectedly low growth rate is suspected and in the second it seems that climatic change as well as exploitation is involved. Other changes that were expected, such as an increase in the laminarian kelp

beds, which were much more extensive at least until the early 1950s, have not yet occurred at all, but it is not clear whether this is because of an irreversible change, the development of an alternative stable state, or simply a very slow recovery process.

On the other hand, some highly significant changes occurred which were not predicted at all. The crayfish or rock lobster (*Jasus edwardsii*) is a very valuable commercial species and had been the subject of many studies. It was known to have an extremely long pelagic larval life (exceeding 10 months) so there was no expectation that protecting a small adult stock would result in any increase in recruitment to their own area. The adults are large animals capable of walking long distances, and tagged specimens had been recorded moving up to 100 km. Mass migrations were also known to occur. Consequently even if fishing mortality ceased in a small area of ordinary coastline, no significant increase in adult density would be expected since the overcrowded ones would simply migrate along the coast to adjacent areas with better conditions.

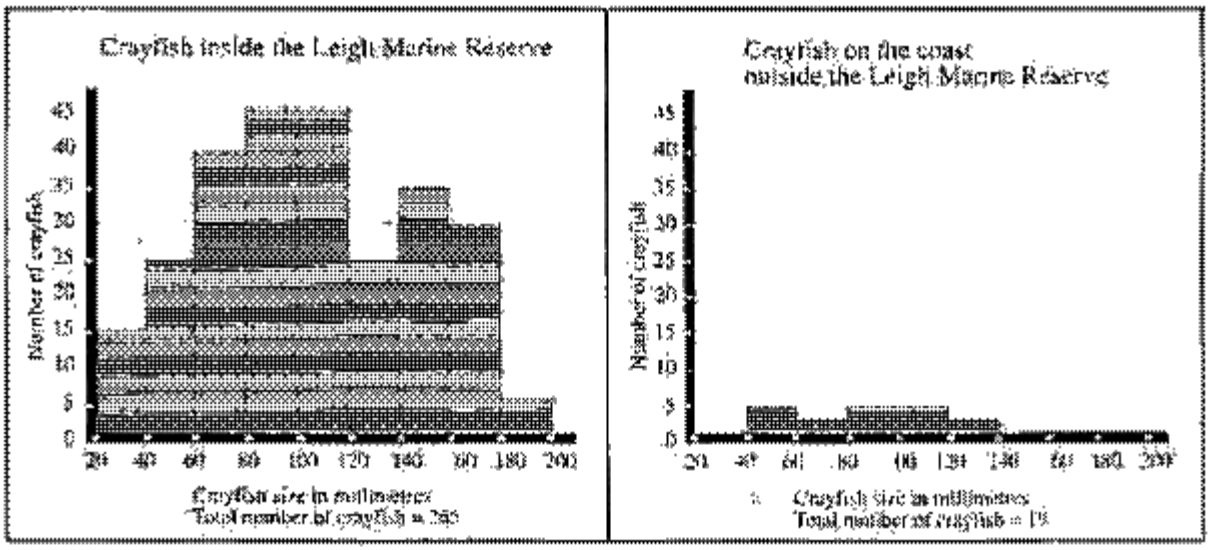


Fig. 23 CRAYFISH INSIDE AND OUTSIDE THE LEIGH RESERVE
from *The Underwater World: a kit for teachers,* Dept. of Conservation, 1990.

In the event, the first of these expectations was confirmed and the other completely refuted. Initial surveys of crayfish showed them to be very patchy and in numbers similar to that outside the reserve (Ayling, 1978). Later, as numbers seemed to be increasing and the protection of the reserve would allow observation of tagged individuals, a project was funded by the Ministry of Agriculture and Fisheries. The intensive study by A. MacDiarmid has recently been submitted as a Ph.D. thesis. Those interested should consult him at Fisheries Research Division, Wellington, for details. For the purposes of this paper it is sufficient to note that his results significantly change our views of the basic biology of rock lobster and radically alter our views as to the best means of managing a fishery for them. The existence of the marine reserve and its strict policy of non-exploitation were essential prerequisites for this work. (See Box 16)

EFFECTS ON PEOPLE

Marine reserves are large scale social experiments, as well as ecological experiments. Real political effort and some social disruption are required to establish them. Because they are experiments, it is not possible to predict their results with any accuracy; but because of the effort needed to start them there is great social pressure to justify them in advance by stating the benefits that "will" accrue.

This problem can be approached in two ways, either by attempting to reduce the disruption or by attempting to maximise the benefits. It is possible to adjust the restrictions of a marine reserve to accommodate existing users, to locate it in a remote locality where it will upset fewer people, and to choose places which are biologically very special to help justify the whole procedure. Unfortunately, all these things, while possibly reducing the political effort required to establish a marine reserve, certainly heavily reduce any benefit likely to develop from having one. The reserve at Leigh was organised on the opposite basis. It had very tight restrictions on activity (including that of scientists), it was easily accessible, and was fully representative of a large region. All these points increased the chances of gaining benefit from it.

The scientific (and consequent management) benefits have been discussed above, but because of the political aspects of the experiment, the social benefits are equally significant. When the reserve was first proposed, commercial fishermen, local landowners and the general public were very divided. It was the first such reserve in the country and a very new concept.

After a decade of operation the reserve has very solid, indeed, almost total support. In a recent survey local commercial fishermen said they were in favour of more such reserves (78%), would actively prevent poaching in the Leigh reserve (78%) and some considered that catches were now higher outside the reserve because of its existence (40%). Since less than 40% of the fishermen had been fishing long enough (10 years) to know personally the previous situation, this last figure is significant.

Table 2 Replies from local fishermen about the Marine Reserve near Leigh
From a survey by Crouch and Hackman, 1986.

Would you like to see more marine reserves?	11	Yes
	0	No
	1	No reaction
	1	Not in this area
	1	Not like Leigh
Would you actively prevent poaching in the reserve?	11	Yes
	3	No

A survey of public visitors to the area showed that numbers had risen markedly since the reserve was established (i.e. since angling, bait-collecting, shellfish gathering, spearfishing and souvenir collecting were banned). Furthermore the vast majority questioned stated that they knew it was a reserve before they set out; had passed other coastal areas where they could have fished on their way to Leigh; and supported the idea of more marine reserves with strict rules (Department of Lands and Survey, 1984).

Table 3: Replies from visitors to the first Marine Reserve, near Leigh
From a survey by the Lands and Survey Department, 1984.

	Yes	No	Don't Know
Would you like to see more marine reserves?	88%	3%	9%

If "Yes", with what restrictions?

Total protection	83%
Partial control	3%
Ban commercial fishing only	8%
Varied types of reserves	5%
Don't know	1%

Total visitors in the six week season (Dec. 26th 1983 to Feb 6th 1984): 14,000.

DISCUSSION AND CONCLUSIONS

In terrestrial communities the word "natural" has little objective meaning except in carefully restricted senses or in remote, largely uninhabited areas. By contrast, in the sea, even close to major population centres, the concept of naturalness is still both objective and very useful. Despite certain pervasive pollutants, some significant introductions and pockets of extreme modification, the sea, including its shallow margins, is largely governed by processes unmodified by human activity.

Present management policies tend to obscure this important fact and also to prevent any use being made of it. Management, where it exists at all, generally persists in assuming that exploitation is a right, except where damage is so great that other conclusions are unavoidable. The resulting lack of control not only maximises disturbance but also makes it pervasive in space. It thus becomes difficult even to imagine alternative and better policies for any particular activity and virtually impossible to demonstrate that they would be better.

The creation of the marine reserve at Leigh, as a completely unexploited area of significant ecological size, encouraged the development of a wide variety of research. Beginning with basic habitat description, this built steadily and rapidly into areas of subtle but fundamental interactions. As the work gained momentum three points became clear:

(i) most of the work depended on the protection of the reserve

(ii) the more basic and the more interesting the results, the more they depended on the protection afforded by the reserve

(iii) most of the results were not predictable from information obtainable from exploited areas.

In short, the marine reserve itself was a large-scale manipulative experiment necessary for the elucidation of many aspects of marine ecology, especially those fundamental and yet subtle interactions that affect resource management. With hindsight this seems fairly obvious, and in New Zealand political and public pressure to create many more such reserves is now considerable. Although there have been some attempts to dilute the concept and make the creation of marine reserves easier at the expense of their usefulness, it is likely that in the near future New Zealand will have a system of completely protected marine areas representing all habitats in all regions.

The scientific, management, economic, and popular uses of a fully protected, accessible, representative marine reserve have been demonstrated and shown to be well worth the initial problems of designation. In New Zealand the lessons seem to have been learnt. Unfortunately, traditional habits die hard and in many places, including the U.K., there are as yet no plans even to try the experiment.

Fig.24 THE KELP FOREST

In the marine reserve near Leigh, the kelp forest (almost all *Ecklonia radiata*) extends from about 10 metres depth down to about 20 metres. The lower limit seems to be controlled by light. In the clearer waters of the Poor Knight *Ecklonia* forest can reach to 50 metres. Water clarity may be diminished by silt and mud (derived from land runoff or just stirred up by storms) or by living phytoplankton (microscopic plants in the water column).

Box 6

NOT IN MY BACKYARD : PRINCIPLES AND DETAIL

Lots of people say, "*Yes, I'm in favour of marine reserves in principle, but we don't want one here. Put it somewhere else*". When local enthusiasts for a marine reserve first come up against this, they often get very worried. If, wherever the suggested site, there is opposition based not on principle but on a strong dislike of personal inconvenience what are the proposers to do ?

First, they could recognise that this problem is so common it even has a title - NIMBY - standing for Not In My BackYard. Second, we have already learnt how to deal with it. Third, the method for tackling it is rather slow, very hard work and there are no short cuts. Fourth, happily a lot of this work has already been done. Finally this is not just a problem in "other" people, we all do it frequently, and, although there is a element of selfishness and illogicality in it, it is both human and forgivable.

I expect you believe, in principle, that we need schools, hospitals, rubbish tips, motorways, ports and so on. So do I. However, I doubt if you are going to be very pleased if any of these is proposed for right next to your home. Even if you have children of primary school age, it is unlikely that you really want a school playground full of noisy children next door. Even if you commute a long distance to work , you probably don't want a busy motorway off-ramp next to your garden. Don't feel too guilty. This is true of nearly everyone.

Despite the fact that there will always be some strong opposition to any site, we still get schools and roads and other facilities that the community feels are important. This proves the second point. We already have social and political systems for preventing individuals from vetoing public projects. In a democracy, these systems depend not on convincing the locals that a particular site is the very best, but on convincing nearly everyone that the principle needs to be serviced.

If the community at large is convinced that children must be educated then sites for schools will be found. The sites chosen will reflect the level of belief in the principle. If a society feels education is very important, then the school sites will be level, spacious and central, but if schools are generally considered a method of keeping kids out of the way until they can do some useful work, then any little hole-in-a-corner will do for the school. The same principle will apply to marine reserves.

We need to convince large numbers of people that marine reserves are a good idea, and we have already. Even the opposition tends to say "*It's a good idea in principle but..*". The next step is to raise the level of belief. If marine reserves are generally perceived as a minor luxury then there will be a few reserves in odd corners. If on the other hand they are important to our successful management of marine resources, a protection of our heritage, necessary for science, education and recreation, etc. then we will get a full and effective network.

But don't be fooled. The NIMBY principle will still apply. It always does. But if enough people believe strongly enough in the principle, NIMBY won't matter. In the meantime we can throw the challenge back at those who say "*I believe in principle but...*" The proper reply is: Spell that out. Tell us what is this principle you believe in, and why everyone except yourself should contribute to it.

This probably won't convert the objector, but it will indicate to all the other citizens present the nature of the objection. This is not just a tactic. One of the strongest opponents to the first reserve at Leigh based his objection on the likely reduction of the value of his land if you couldn't fish off the adjacent shore. Some years after the establishment of the reserve, this land was put up for sale. Prominent in the advertisement was the proud claim "adjacent to the marine reserve"! Perceived values are changing.

CHAPTER 6

LESSONS FROM ELSEWHERE IN N. Z.

This chapter tells the story of marine parks and reserves in New Zealand following the establishment of the first one, near Leigh. The story is complex. Progress at different places overlapped in time. Different ideas were adopted and had varying success. Different people and organisations became involved. I have tried to keep the story simple enough to draw some clear conclusions, but, if you feel it was all rather confused at the time, you are probably right.

THE REACTION

Although the first marine reserve, finally established at Leigh in 1977, became a great success, getting it established was a long hard business. Those interested in establishing more reserves elsewhere in New Zealand made strenuous efforts to find easier and faster ways. This is not surprising, since the reserve at Leigh took 12 years to establish, and some of the problems of that long battle continued for several years.

So it was sensible to look for better ways. In reviewing these, the important point is: were they really better, merely different, or simply fudges? Did any of these other methods get there quicker? Were they any more efficient in generating support and agreement? Did they just create other problems?

There were at least four new ideas. In some places several of them were tried at once, and most of the efforts overlapped in time. However, I will discuss the new ideas separately to make it easier to judge their sense and effectiveness, and the discussion will largely ignore the overlaps.

STRESSING SPECIAL FEATURES

It is clearly simpler to argue in favour of special treatment for places and situations that are themselves unique or very special. For most marine reserve proposals since the one at Leigh, special features have been stressed. This was intended to increase support and reduce opposition. Within certain limits, it does. But the limitations of this argument slowly and insidiously subvert other and more important points.

Concentrating on special features contains a trap for the mind. The idea that the special deserves special treatment is so obviously true that we are tempted to believe that the opposite will not be true. We can easily end up thinking that *only* special places are worthy of special treatment. Then we can imagine that places which are not *very* special are not really deserving. When this happens, those arguing for special treatment start saying things like, *"But this place has a special rare microscopic whoosit we must protect"*. Then everyone else starts laughing and the real point is forgotten. What real point? Well, simply that it is more important to protect some common, ordinary and typical things than the special. Less exciting, less newsworthy by media standards, but more important.

When a marine reserve was proposed at Pollen Island, in Auckland, the media seized on the point that a small rare moth occurred there, but found it difficult to discuss the advantages of keeping an almost untouched marine habitat in the centre of a major city. If it had been a piece of land forest and a freshwater lake, rather than mangrove and tidal saltmarsh, the story might have been different.

We must be careful not to be seduced by excitement. The exciting and special things we talk about most are not most important. We talk about the special gadgets in our new car, but we know the (quite ordinary) engine is more important. We refer often to our special sporting or hobby achievements, but we know that it is more important for our perfectly ordinary legs and liver to go on working in a standard and typical fashion.

The first two marine reserves in New Zealand both had special features, but these were of quite different types:

Leigh special features:
- the site of the University of Auckland's marine laboratory
- the nearest place by road to Auckland on the open east coast
- the first place cleaned out by spearfishermen (at least near the central beach)
- the most accessible and best known open coast site

Poor Knights special features:
- the warmest and clearest waters
- the most spectacular underwater scenery
- the most diverse, colourful and easily seen marine life
- the best dive site in New Zealand

In the case of Leigh, the special features are all organised by people but in the case of the Poor Knights they are all "natural" features. So when we say the places are both special, we mean completely different things. At Leigh we are saying, because of what *we* have already done, we should treat this place differently, but at the Poor Knights we are saying because of what *nature* has already done, we should treat this place differently.

In the most important sense, the two situations are opposite. The reserve at Leigh is, in natural terms, a typical and normal piece of open north-east coast. It was picked to be so. The University of Auckland did not want to work out all the details of some unique spot in the universe; it wanted a site which was reasonably typical, so that information discovered there would be widely applicable. The reserve at the Poor Knights is naturally special, indeed unique. This is its value.

When it comes to more marine reserves in New Zealand, it may be easier to get a few special or unique ones, but it is far more important to get a lot of typical and representative areas. If we stress special *natural* features, it will become more difficult to get anything representative. Since it is impossible to avoid talking about special features, it is fortunate that we can offset the disadvantages by stressing some other points:

We can stress features which are *human* rather than natural.

There are many such features, relating to: accessibility, amount of existing use, ease of recognition, educational value or cultural significance, etc.

A proposed marine reserve site may be especially accessible to ferry services (such as Rangitoto Island,

Auckland): to schools (Red Rocks, Wellington); to population centres (on Banks Peninsula, Christchurch) or tourist routes (near Kaikoura or in the Bay of Islands). Or the site can be especially remote (such as Auckland Islands or Three Kings Islands), or otherwise isolated (e.g. Pollen Island in the centre of Auckland's Waitemata Harbour, but "cut off" by the Northwest motorway !).

A site may be almost unused and relatively pristine (such as Whanganui Inlet, Nelson) or subject to very heavy use (such as the area off the holiday beach at Mount Manganui).

A site may be particularly easy for people to identify and/or recognise the boundaries. In open waters, distance from an island or rock is much easier to determine than some latitudes and longitudes. On coasts, headlands, river mouths or other landmarks can make identification much simpler.

Sites may be of special historic, educational and/or cultural value such as wrecks (e.g. *Rainbow Warrior*), structures (Tolaga Bay wharf), special materials (Mayor Island obsidian), activities (old whaling stations), archaeological sites (Wairau Bar) and, probably of the greatest importance, sites of traditional significance and spiritual value (canoe landing sites).

We can reverse the "everything is unique" argument

Every place is unique in many ways, just as every person is unique in many ways. However, it is equally true that every place and person is typical in many ways. I have unique fingerprints, ear shape and mole patterns but I am quite typical in having two legs, the power of speech, and a need for food at regular intervals. The typical features are generally more important.

For each marine reserve proposal, we should look for and stress in discussion those features which are typical or representative. This will not only dodge the silliness of concentrating on the least important (equals rarest and most peculiar), it will actually focus our attention (and everyone else's) on what is really important.

For Pollen Island we should say *"Let's keep at least one really natural bit of mangrove forest right in the middle of the metropolis of Auckland. Much of the original harbour edge has been developed out of existence or completely altered but this piece is still typical. It contains representative shell banks, bird roosts, saltmarsh, sediment flats and creeks, and these habitats contain their typical flora and fauna. It will serve as a benchmark, so we can judge the rest. It will remind us of our natural heritage. It will help keep us sane, healthy, and informed."*

When we have said a lot to that effect, we could add *"and it has a rare moth."*

We can add representative habitats to special features

Where there are special features, either natural or human-related, especially if these are worthy of reservation alone, the marine reserve proposal should try to include (by extension of boundaries otherwise required) as much typical and representative adjacent area as possible.

For example: White Island is the only usually active island volcano in New Zealand (and these are rare worldwide). Its marine geology and biology are of tremendous interest although little studied so far. The reservation of its submarine slopes is of pressing scientific importance. However, it would be highly desirable to include with this a sizeable piece of the surrounding waters, as typical Bay of Plenty marine habitat. We need a typical piece of the Bay of Plenty in protected status. Any particular area chosen would be somewhat arbitrary. That round White Island would be easier to identify, be quite typical, save administrative effort and make a much more worthwhile total reserve.

The same applies to special human-related features. Wrecks, historic wharves, and places of spiritual significance are surrounded by marine habitats which are often "merely" typical of the region. There may be no *need* to include any of these within a marine reserve, but there are two major advantages in doing so. First, it would provide a protected example of the habitat, which will be needed anyway in some place; and it does so more quickly and with fewer arbitrary decisions. Second, it provides not just a useful buffer zone round the special feature, but also another reason for the whole exercise.

USING DIFFERENT LEGISLATION

There were fairly obvious defects in the Marine Reserves Act, and, in the late 1970s it seemed to some people that using different legislation could speed up the process. The Ministry of Transport, under the Harbours Act 1950, had responsibility for the seabed (and to some extent the waters) round our coasts. They had power to delegate this

authority to a local body - such as a Harbour Board or County Council - and often did, usually for port and wharf purposes.

If (i) a grant of control under the Harbours Act was given to a local authority for a particular area and
(ii) special by-laws controlling fishing were obtained from the Ministry of Agriculture and Fisheries, under the Fisheries Act, then
the area could have a practical level of control similar to that of a marine reserve. Provided the relevant departments agreed, these procedures could be carried out with relatively little administrative trouble. This has been done in three areas - which are called Marine Parks.

The first Marine Park was established at Tawharanui, some 50 km due north of Auckland on the east coast (just north of Kawau Island) where the Auckland Regional Authority has a Regional Park. The idea was first discussed in the mid-1970s and the Park was established in 1981 along the northern shore of the Tawharanui (or Takatu) peninsula. All fishing was prohibited in the Marine Park but the southern shore of the Regional Park remained as a normal fishing area.

The second Marine Park is at Mimiwhangata, about half way between Whangarei and the Bay of Islands, on the east coast of Northland. The Mimiwhangata farm property was owned by New Zealand Breweries Ltd. and in 1973 they commissioned a report on the surrounding marine area (Ballantine, Grace and Doak, 1974). This report described the local marine habitats as varied and relatively untouched. It recommended that a marine reserve be set up. After the farm property became a private trust, and a great deal of consultation and discussion had taken place, a Marine Park was proposed (see Dart, Drey and Grace, 1982). This came into effect in 1984.

The third Marine Park is on the west coast of North Island, around the Sugar Loaf islands, near New Plymouth. The idea was promoted by some local interest groups - including divers and boat owners - who formed a steering committee with representatives from local authorities, the Catchment Commission, and the Harbour Board in the early 1980s. The park was established in 1986.

It could be argued that the different type of legislation used speeded up the process compared to the use of the Marine Reserves Act, but this is difficult to determine. What is clear is that the negotiations and discussions were still very lengthy. It took from 5 to 10 years to establish these parks from the date of first suggestion. If there was any speed-up it was not spectacular, and the price was high: any protection afforded by a Marine Park can be removed by relatively simple administrative decision, and such revocation does not require any formal public consultation.

ADJUSTING THE ACTUAL RULES TO SUIT EXISTING USERS

Many people felt that the Marine Reserve at Leigh took a long time to create because of the flat prohibition on all types of fishing. They considered that if some "reasonable" adjustment was made to accommodate some or all of the existing users, there could still be a worthwhile level of protection, and that this could be obtained much more quickly and easily. This approach was tried at the Poor Knights, Mimiwhangata and the Sugar Loaf Islands.

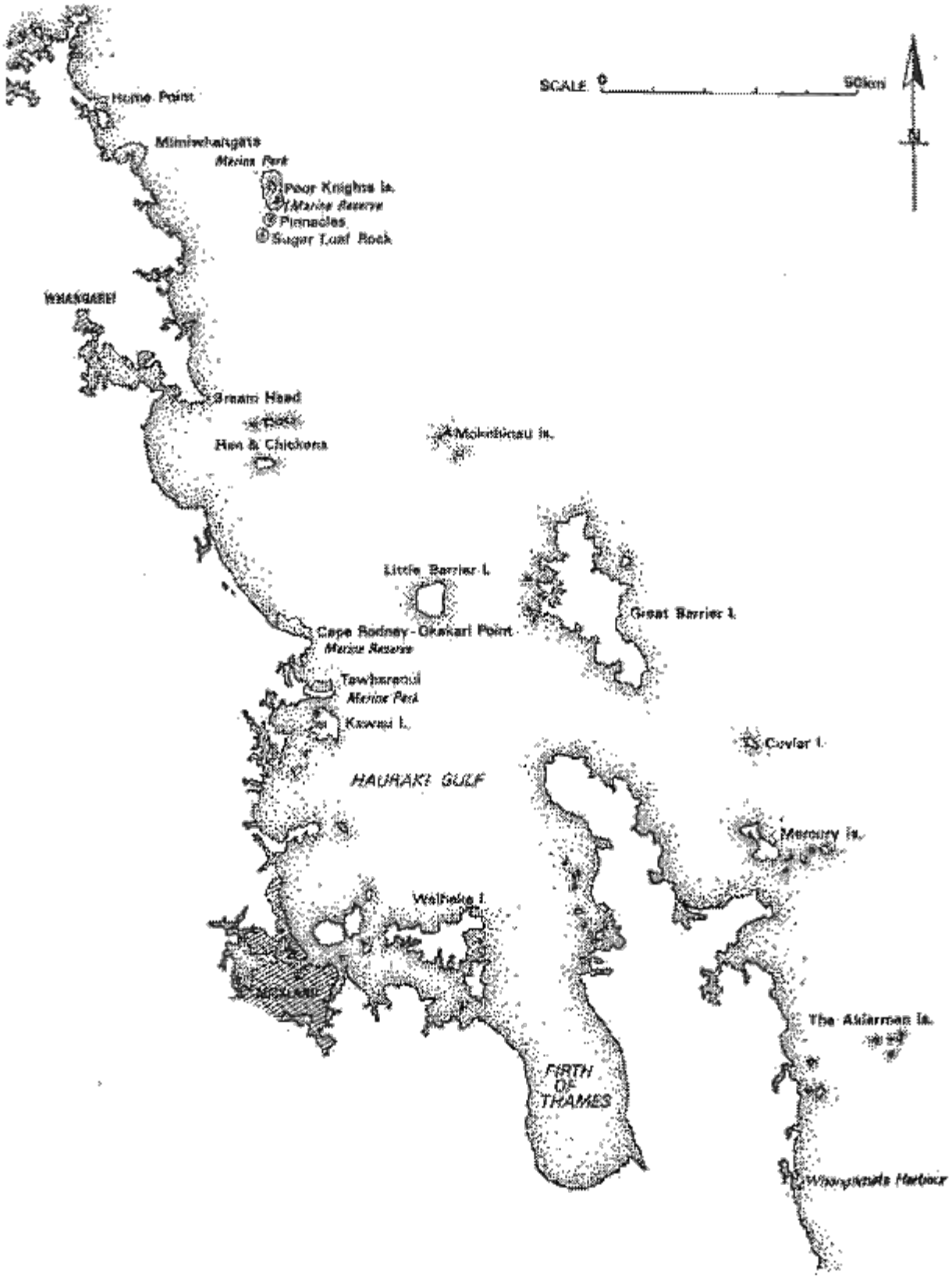


Fig 25 THE FIRST MARINE PROTECTED AREAS

The north-east coast of North Island, showing the location of the first two marine reserves - near Cape Rodney and at the Poor Knights Is - and the first two marine parks - at Tawharanui and Mimiwhangata.

The approach may have been justified at the time for the Poor Knights on the grounds of simple practicality. Charter boats and other boat owners were the only people who went there. The islands themselves are

uninhabited (closed nature reserves) and the area is too far offshore to be observed from the mainland. The charter boat skippers were prepared to accept quite strong protection for most marine life, indeed, were keen on this, but were not in favour of a total fishing ban.

It was decided to have some small areas with no fishing at all. In the remainder of the reserve there were restrictions on methods (e.g. no sinkers) and on the species that could be caught. No commercial fishing was allowed, but recreational trolling and big game fishing continued.

These rules have certainly prevented any major deterioration of marine life at the Poor Knights and have helped stabilise the situation. But it was a compromise and it has its problems. Anyone coming to enjoy the undisturbed natural wonders (and more and more do from ever greater distances) is surprised, and often shocked, to see *any* fishing. You need a good chart, an accurate fix of the position, the page of rules, a close look at the method and the catch before you know whether the fishing is legal or not. Even if it is legal, the historical justification of it makes less sense to fewer of the visitors as time goes on. One charter boat skipper has proposed a complete fishing ban, but others are not convinced.

And of course there are always those who like to push against the edge of the rules. Recently some bright mind discovered that if you spread surface bait liberally (bait that just happened to sink!) and "jigged" with a heavy spoon (not a sinker, of course!) you could catch all kinds of things. One person managed to get 60 pink maomao, though why they wanted to is more difficult to determine. There are always people with more ingenuity than responsibility. This loophole has now been closed, but others will no doubt be found.

The sensitivity to existing users at the Poor Knights may have been an historical necessity at a unique site, but the complex rules that resulted have proved to be a continuing source of niggling problems. They do not provide a good model for other sites.

This has been demonstrated by the situation at Mimiwhangata. The Marine Park there was arranged after elaborate and sympathetic discussions with all the "interested parties". Interest was largely interpreted as those who did fish there, said they did, or might want to. The resulting rules are too complex to detail here. Basically it is possible to catch some species by some methods.

Visitor numbers at Mimiwhangata (virtually nil in 1973) increased when it became a trust, and became substantial when it was acquired as public property. Publicity about the Marine Park told many of the (limited) fishing opportunities there, and lots came, convinced that it would be better than elsewhere. The final result of all the "arrangements" for protecting marine life was an actual increase in fishing. Despite the intelligence and sincerity of those involved in making these complex arrangements it is clear that the marine life would have been better off if they had saved their energy.

The most useful thing about the Mimiwhangata Marine Park is its awful warning to those who think that if their intentions are reasonable, then the resulting rules must be worthwhile and helpful. Anyone who wants to have "careful" rules for any kind of fishing in a marine reserve should read Box 2, and, if that isn't convincing, visit Mimiwhangata and talk to anyone who knew it in the 1970s or earlier.

A small but significant example of "how not to do it" concerned kina (sea eggs). The original marine report had noted:

"a hundred sea-eggs in a single pool can disappear in an afternoon to feed one group of picnickers or provide ground bait for a single boatload of fishermen. Alternatively it could provide a rare and interesting picture of "what has been" to any number of people for the foreseeable future - if there was a way to keep it undisturbed. (Ballantine, Grace, and Doak, 1974, pages 42-43)

Those in control at Mimiwhangata put kina (sea urchins or sea eggs) on the list of species that could be taken, but promised that the situation would be monitored and adjustments made if necessary. One of the first things monitoring showed was that most of the large kina had disappeared from the higher level pools on the shore. I do not know what adjustments were made, if any, but they were too late. The monitoring report, despite noting the vulnerability of these kina pools, was of the opinion that the declines were due to natural causes. They might be right, but if they were right, and there was no human exploitation, what was gained by permitting any? What is certain is that we shall never know for sure what happened. We bent the ruler and then lost it.

CHANGING THOSE IN CHARGE

There have been three government departments in charge of marine reserves. Up until 1972 it was the Marine Department. When this was abolished, its functions were divided between the Ministry of Transport and the Ministry of Agriculture and Fisheries. Marine reserves, of course, didn't really fit in either. Nobody ever thought of putting land reserves under Agriculture. However, Fisheries was more appropriate than Transport for marine reserves and that's where they went.

The Ministry of Agriculture and Fisheries were not very keen on marine reserves, to put it mildly. Although some officiers did what they could, and Lew Ritchie in particular, working out of Whangarei, did sterling work, head office had many more urgent things to occupy their attention. Because nothing much was happening, a movement developed to transfer the responsibility for marine reserves to the Lands and Survey Department. This department already had charge of National Parks and many other reserves on land, and seemed keen to add marine reserves to these.

The idea had a lot of logic - better to have someone wanting to do the job in charge of it. However logic doesn't cut much ice in top-level bureaucratic politics. Some serious discussion took place (see Coastal Zone Management seminar reports, 1984), and MAF issued some draft policies on marine reserves in 1985; but in the end it was the Lands and Survey Department that was broken up, and in the process the responsibility for marine reserves passed from MAF to the new Department of Conservation in 1987.

This new department (DoC) had several advantages. First, its prime task was conservation. Second, it had a specific mandate to advocate and arrange *marine* conservation (as well as on land and in freshwater). Third, it could appoint staff with the promotion of marine reserves as their sole or main task. These points represented real progress, but it should be noted that it was not necessary to have a new department for any of them. They could have happened any time in the previous twenty years within any of the departments in charge at the time. It was lack of political will that held things up, not administrative arrangements.

It should also be noted that the high-level political conversion was not complete. At present (1991) before a marine reserve can be gazetted (established in law) not only does the Minister of Conservation have to agree, but so does the Minister of Fisheries. At first sight this seems reasonable. The problem is: what guides the Minister of Fisheries in making his decision. Three things really:

his own departmental officials, whose sole responsibility it is to manage fisheries;
the word "unduly" in the Marine Reserves Act (a marine reserve should not "unduly" affect existing fisheries);
his personal assessment of the public (voter) opinion on the matter.

The only one of these that might lean strongly in favour of marine reserves is the last. So we come back to the simple point, that in a democracy, for a matter of decision on the public domain, it is public opinion that does and should determine what actually happens. The process is slow, yes; it is full of fits and starts, yes; but it is quite proper. If and when large numbers of people in New Zealand clearly show they want more marine reserves, they will get them. And not until then, except in odd cases.

"Proper" political processes for establishing marine reserves will only appear after there is substantial public pressure for them. This is building up, but more is needed (see Chapter 11).

CONCLUSIONS

1. Although special or unique areas may attract more support as potential marine reserves, areas that are typical and representative are of greater use and importance. Our greatest efforts and our priority should be to obtain a network of typical and representative reserves.

2. Using alternative legislation to the Marine Reserves Act does not significantly increase the speed of obtaining marine protection and the protection obtained is much weaker. The Marine Reserves Act may be less than perfect (what isn't), but it will suffice for the purpose if we apply it with care and determination.

3. Adjusting the rules of marine reserves to suit existing users who do not wish to give up all fishing in the proposed site may look like an easy option, but all it does is postpone the trouble, and let it steadily increase, while removing the main point of having a reserve at all.

4. The Department of Conservation has some real advantages over earlier authorities in the matter of marine

reserves, but the basic problems for creating marine reserves still exist and can only be overcome by widespread public support.

Fig 26 THE DEEP REEF (opposite)

Below the *Ecklonia* kelp forest, where the light levels become too low to support large plant growth, is the domain of sponges and other filter-feeding animals. Although a few crusts of pink calcareous "seaweeds" occur at this depth (below 20 metres), almost all the "tufts", "bushes", "ferns", "mosses", lumps and crusts are animals. Natural sea water is a thin soup, containing great numbers of microscopic plants. Any animals that can sieve or filter these out can make a living, without moving about. The problem is to find a good place to "sit" (everything competes for the rock space) and to avoid being eaten. These sessile animals, sponges, sea squirts, tubeworms, brachipods, sea anemones, bryozoa and hydroids, form a rich and multicoloured mosaic on the reef.

This drawing and those at the ends of Chapters 4 and 5 are by Vivienne Ward. They come from a series of Marine Reserve pamphlets entitled Marine Habitats, *illustrated by her and with text by John Walsby. This one is from* Deep Reefs *(No. 25, 1983).*

Box 7

NAMES AND AIMS

The long list of possible names for protected pieces of the sea confuses many people, and provides the opportunity for others to play unhelpful games.

There are several hundred names that could be applied to parts of the sea in which exploitation is controlled in some way. Try it for yourself:

1. Choose from: *Reserve, Park, Area, Zone, Sanctuary, Preserve, Refuge, District,* etc.
2. Add one from: *Marine, Maritime, Coastal, Underwater, Sea, Seashore, Aquatic* etc.
3. Optionally add one or more from: *Protected, Controlled, Managed, Conservation, Wilderness, Nature, Wildlife,*

Biological, Ecological, World, National, Regional, Ecological, Scientific, Fishery etc.

At least 40 of the possible names are in common use round the world, for example:

Marine Reserve	National Seashore
Marine Park	Underwater Park
Maritime Park	Marine Nature Reserve
Marine Habitat Reserve	Marine Life Refuge
Marine Wilderness Area	Marine Wildlife Reserve
Marine Protected Area	Marine Sanctuary

Even in New Zealand at least the 6 in the left column have been used or officially proposed.

It is possible to argue for ever about names, but no useful purpose is served. Indeed, what generally happens is that it becomes an alternative to doing something. More insidiously, worrying about labels is a good way of distracting attention from contents.

The important point is the aim: why do we want to treat some piece of sea differently? This is determined not by the name we give the place, but by the rules we adopt for it. Many people are confused about this. Because they know what they mean by a Marine Wildlife Protection Zone or an Underwater Habitat Park they imagine that other people have the same idea. They are trying to take a short cut.

In fact any label can mean anything we choose. Even when the labels (names) have been legally defined, these definitions can be amended later, and often are. So what we must concentrate on is - What do we want to do? and what rules are necessary to achieve this?

The Marine Reserve label (name) has been used for 25 years in N.Z. It refers to successful examples of what we want to do. It is widely recognised. Changing it is at best a distraction, and at worst a restart of the whole argument. Let us tell all tidy-minded bureaucrats (who would prefer equivalence with terrestrial systems), planning theorists (who can give us controlled-use zonal protection categories faster than you can say that), public relations psychologists (trying to tell us the flavour of the month) and others (who, despite whatever they say, are just trying to slow us down) that we want to create **marine reserves,** areas of sea which have no extractive use and as little disturbance as we can arrange.

CHAPTER 7

WHAT HAPPENS OVERSEAS

It is clearly sensible to look at what happens overseas. At first it seems as if this will be helpful. There is a lot of literature with the right kind of titles and a lot of places with the right kind of labels. But the closer you look, the more you see that despite an enormous amount of discussion, planning and complex arrangements, the result is hardly ever a real marine reserve. While there are lots of places called marine reserves overseas, there are very few places worldwide where all extraction is stopped. The most useful thing to learn from overseas is why this is so.

INTRODUCTION

When you attempt to find out about worldwide experience with marine reserves, it seems at first to be helpful and straightforward. There are whole books with the right sounding titles published by highly responsible authorities. The best one I could find is published by the International Union for Conservation of Nature and Natural Resources with the support of the United Nations Environment Programme. It is titled *Marine and Coastal Protected Areas: A Guide for Planners and Managers* (Salm and Clark, 1984).

Even the chapter headings sound sensible and highly relevant:

Part I Creating protected areas includes chapters on:
The roles of protected areas in conserving coastal and marine resources
Legislative and institutional support
Planning a system of protected areas

It all seems ideal - perhaps all we have to do is follow the instructions. However, as you get into the text, which summarises a series of official workshops held in Bali in 1982, you search almost in vain for anything about complete protection from fishing and other extractions. There is a lot of high-level exhortation about, for example, *"maintaining ecological processes and life support systems"* and *"preserving genetic diversity"*, but the practical bits are about everything and anything except real marine reserves with no extraction.

Even in the general section the accent is more on *"sustainable use", "development of recreation and tourism", "protecting commercially valuable species"*, and *"economic justification"*. The more detailed parts get heavily into management structures, planning procedures and legislation, with plenty on conflicting and compatible uses, identification of threats, coordination of different agencies, etc. All this is very interesting and important but tends to smokescreen the simple question - If we have all these problems due to exploitation, why not have some places where we don't exploit? Is this perceived as too difficult, less urgent than controlled management, or even a marginal luxury?

THE STANDARD APPROACH

The standard approach worldwide to marine conservation in both Third World and developed countries is:

1. Traditional or common law "rights" of unfettered activity in the sea must be allowed to continue unless there is an identified problem or a clear threat of conflicting interests.

2. Problems and threats that can be recognised include:
Overfishing and stock reduction
Loss or degradation of habitat for exploited species
Extinction or loss of diversity
Conflicting activities
Pollution

3. Problems can only be identified when measurable damage has already occurred. Threats are not clear until uses are both multiple and important. In either case the situation is already far from natural and already has strong socio-political significance.

4. The prime aim of action is then to limit damage and to avoid potential conflict. This is a task that can be handled by planning and management.

This is a neat, tight argument. It has internal logic, political practicality and social appeal. It seems complete, and is consistent within itself. In almost all cases the discussion ends here, and the matter is turned over to the planners and managers to arrange within the assumptions.

If we wish to argue further or differently, we need to question the assumptions.

First, the standard argument does not recognise any intrinsic values in the sea nor does it allow for any unrecognised benefits. It assumes that the sea is only there for people to use; and further, that the uses we recognise now are the only benefits that the sea provides.

Second, the standard argument prevents any pre-emptive action. It assumes that the wider community has no responsibility until adverse effects occur, even though it is the community at large that protects the freedom of action involved. This assumption does not allow us to stop problems arising or even to take out any effective insurance.

Third, the standard argument prevents the effective use of any point based on principle or of lessons learnt elsewhere. Unless you can show that the people currently involved with this particular bit of sea will be better off and believe that they will be better off, you can do nothing. If it is assumed that the sea has no rights of its own, and that non-users have no rights either, the political arguments are made simpler, but the options become very limited, and the chances of anything sensible happening are seriously diminished.

However, the most important assumption to challenge is that of how damage can be assessed in the absence of any natural baseline. If everywhere is used until some damage occurs, how will we know there has been any damage? If nothing is left intact or pristine, after a while no one will know what this like. A little later it will be difficult even to imagine the undamaged state. If you cannot imagine something, it is not possible to worry about it. This process is begins slowly and develops without any sudden or dramatic effect. Creeping and piecemeal small losses, minor pollutions and other low grade degradations become common and accepted as natural. This level of damage then becomes the baseline and the next stage proceeds undramatically but inevitably. The assumption that damage can be detected is not valid, unless undamaged situations exist for comparison.

The "standard argument" outlined above is not just the view held overseas. It is shared by many people in New Zealand. It has particular appeal to officials and politicians because it seems to define their role within clear boundaries, and gives them a rationale for shrugging off wider issues. It is also the view almost unconsciously held by ordinary people who are uninterested in the whole business, since it gives them an excuse for remaining uninvolved. Finally it is held by many of those who wish to get on with their own marine exploitation without interference, because it provides the best defence against outsiders having any say in the matter.

Overseas, they have the same marine management problems as we do, but much more so. Their achievements in marine conservation are, however, not proportional. They are locked into the "standard argument", and as a result, doomed to endless complicated patching up of a system which cannot be reformed. The lessons we can learn from overseas are twofold: we can see more clearly what to avoid, and we can gain a bit more courage, because we are not so far down the slippery slope.

SOUTH-EAST ASIA AND THE SOUTH PACIFIC : THE TROPICAL THIRD WORLD

Don Hinrichsen in his recent book *Our Common Seas: Coasts in Crisis* (1990) published in association with the United Nations Environment Programme, concentrates on the tropics and the Third World. His book tells a vivid but depressing story. Throughout the tropics the inshore and shallow areas are dominated by coral reefs and mangroves. These areas are under immense pressure from many activities.

Coral reefs are commonly mined for building material or lime, dynamite fishing and poison fishing are common (even where illegal), siltation from run-off is accelerating owing to deforestation, eutrophication occurs as onshore farming becomes more intensive and raw sewage discharges increase, and the collection of the shells of living and dead molluscs is stripping many areas.

Mangrove forests are fast disappearing because the trees are felled for timber, firewood, or exported for woodchips; the habitat itself is destroyed by reclamation for farm land or the development of fish farms.

The loss and damage to reefs and mangroves are reflected in the loss of traditional fisheries both inshore and offshore; this in turn puts more pressure on what is left. Since the population is increasing rapidly and is concentrated on the coasts, the situation is getting worse. The only available short-term solutions are the sale of more raw materials (more mining, more deforestation), an increase in aquaculture (more loss of natural habitat) or cash subsidies (promoting rural to urban migration, increasing sewage).

In such situations even the most responsible authorities are close to desperation, and the suggestion of marine reserves with no take generally seems like a bad joke.

In a few places where by geographic or historical accident there are relatively few local people, attempts have been made to set up coastal and marine parks, especially where there is an active and economically important tourist trade. Even these have great difficulty. It is hard to get local cooperation and, if this achieved, poaching from outside is a serious problem. Tourism itself, despite being the economic justification for the "reserve", generates more people, a luxury market for fish and souvenirs, more sewage, more land clearance or even reclamations.

JAPAN : INTENSIVE AFFLUENCE

Japan is only slightly larger than New Zealand in area, but has 30 times the population. Like New Zealand, much of the country is steep mountains and the population is concentrated round the coasts. Like New Zealand, the

islands are tectonically active, but are much more subject to downward earth movements and tidal waves. Unlike New Zealand, Japan is highly industrialised, and the industries are also located on the coast. Japan has been involved in aquaculture for centuries and is now highly active in this field.

It is difficult for the average New Zealander to realise what all this means in terms of the "ordinary" coast. Japan has 50 or more "marine reserves". These areas are mostly very small but each attracts visitors in numbers ranging over half a million per year. The activities permitted in these "reserves" include not just swimming and picnicking but also "fishing and shelling".

What then are they "reserved" or set aside from. Very simple, they are reserved from private farm ownership (fish ponds, oyster racks, seaweed culture frames, mussel rafts, etc.). They are reserved from major industry (ports, ship building yards, oil terminals, petrochemical plants, steel mills, fish factories, manufacturing plants, etc.). They are reserved from coastal works protecting against land sinking and/or tidal waves (giant seawalls, massive concrete tetrahedra, etc.). They are reserved from full city or tourist development (beach front apartment blocks, coastal hotels, marinas, etc.).

In short, a "marine reserve" in Japan is what most people in New Zealand would call "ordinary" coast. We don't realise how fortunate we are.

U. S. A. : THE TRIUMPH OF LEGALISM

In the U.S.A., the "standard argument" (given at the beginning of this chapter) is highly developed into an extensive system of environmental law and planning arrangements. The first point in the "standard argument" - the idea that traditional and common law fishing rights are almost untouchable is particularly stressed and tends to control all other arrangements in marine conservation. Indeed, in America, marine conservation tends to mean the conservation of people's activities in the sea, rather than the protection of any innate properties of the sea itself.

This careful concern for individual rights gives rise to a mass of complex regulations, the main purpose of which is to adjust the precise exercise of these rights where they conflict with each other. This is, of course, a worthy aim, but if it becomes the exclusive aim, or even the prime aim, the complexity of the arrangements may prevent anyone noticing that other points require attention. Indeed the main effect of all the effort may be to hide the fact that the driving forces of the universe are simply not affected by human ideas of fairness or democracy. The primary aim is not to adjust to one another, but to adjust to natural laws which we cannot alter.

More words than deeds

There are many types of marine protected area in the U.S.A. Some are organised by federal authorities and others by state agencies. They have many different titles, purposes and rules. It is extremely difficult to determine the real levels of protection in most cases, but it is clear, even from the available literature, that complete protection is rarely even considered as an option. The reasons for this include a very strong emphasis on the separation of decisions on fishing (assumed to be virtually untouchable) from decisions on anything else. This underlying decision about fishing is obscured by a concentration on other and more spectacular issues, such as oil spills, sludge dumping, major reclamations, and on the high profile species like marine mammals and seabirds.

In case this seems a little severe, the reader is referred to the 1988 Spring number of *Oceanus* (edited by P.R. Ryan) published by the Woods Hole Oceanographic Institute, which consists of a series of very interesting and authoritative articles on *U.S. Marine Sanctuaries.* Despite the mass of factual and descriptive information provided, it is very hard to say whether any part of any sanctuary is completely free of fishing. It seems not, since there is specific reference to traditional gleaning and subsistence fishing in the most recent Sanctuary (in American Samoa), clamming in the Gulf of Farallones Sanctuary (California) and spearfishing in the Looe Key Sanctuary (Florida).

The legal approach

Under the normal approach in the U.S.A., it is possible for everyone to be very concerned with marine conservation, very active in making arrangements and very logical in explaining them, without, in the end, achieving very much in the way of complete protection for parts of the sea. This approach takes the view that issues should be addressed in order of importance, and importance is considered almost entirely from a human and political viewpoint.

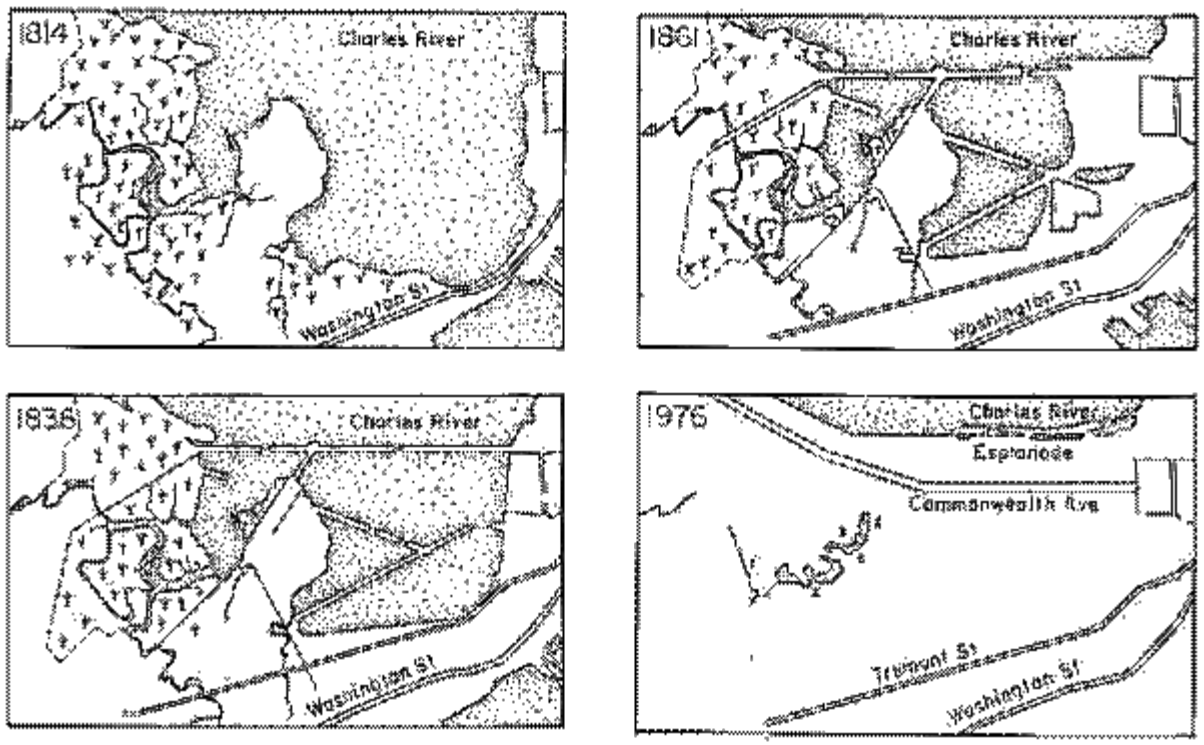
1. Habitat protection

When large chunks of vitally important marine habitats are being completely destroyed or rendered into near deserts by human action, it is reasonable to put control of this at the top of a priority list. There have been, and still are, plenty of examples of this in the U.S. A. (and many other countries).

One of the first places in the world to have the title "marine reserve" was the John Pennekamp Marine Reserve in Florida. It was certainly a good idea to preserve a piece of Florida marine wetland and coast from the prevailing practises of dredging, draining, filling, and reclamation, which turned major sections of natural marine habitat into hotels, marinas, retirement complexes, etc. If, in the process, normal fishing was not just permitted but actually encouraged in the preserved habitat, the action was still obviously worthwhile.

This kind of situation, the urgent need to forestall threats of total destruction, can and does occur commonly in countries like the U.S.A. Indeed, anywhere with locally increasing populations, developing technologies, increased leisure time, tourist demands, new business opportunities, etc. will be faced with new marine habitat threats. Even where planning and legislation gain control of earlier threats, new ones will develop, so the point will always be relevant and often urgent.

Fig 27 CREEPING LOSS OF WETLAND AND HARBOUR HABITATS
Boston, USA, showing the piecemeal destruction of natural marine habitat over 160 years. *Modified from Valiela and Vince,1976*



2. Protection from specific activities

It follows, from the above, that when any threat to marine habitats becomes common, widespread or otherwise an acute problem, planners and politicians should concentrate on providing general rules for its control. This includes both new problems and ones which, although in existence for some time, are recently discovered to be significant, or even just recently perceived to be important by the voting public.

There are plenty of these:

(a) reclamations (whether for agriculture, aquaculture, port facilities, marinas, ordinary building land, roading, sewage works, airports etc.)

(b) "protection works" designed to control coastal erosion

(c) dumping and disposal (ordinary garbage, sewage sludge, dredge spoil, industrial or mining wastes etc.)

(d) channel dredging and other "maintenance and improvement"

(e) pollution (sewage, industrial discharges, urban or agricultural run-off, ship spills, oil drilling operations

etc.)

So rules are developed to control these activities, limiting their occurrence and mitigating their deleterious side effects. This requires a major effort and keeps everyone very busy. Of course, while the emphasis is on preventing damage to marine habitats, the question of limiting fishing or other extractive activities only arises if these are shown to have produced deleterious effects.

3. Protection for single species

If and when particular species are noticed to be under stress, either from overexploitation or habitat problems, special action is taken to reduce the stress. Population declines are noticed only if they are serious and in high profile species (e.g. commercially important, or important to recreational fishermen, naturalists, etc.). Habitat problems would also have to be major and high profile to be noticed.

Numerous actions, by many agencies, in most regions have been taken under this principle, and they are so varied as to be difficult to summarise. However, they share the following features:

(a) action does not occur until after damage is proven;
(b) action is restricted to a single species (or very small group);
(c) action is localised to the problem area;
(d) action may be held up pending discovery of the precise cause of the stress;
(e) action is frequently limited to the perceived cause.

These points ensure that even when action is taken, the effectiveness is limited.

4. Management and Planning

This final principle of the legal approach also follows logically. Having arranged a complex system of planning and management to cover both habitats and species, it follows that if any further problems arise, they can be handled by adjustments to the system - i.e. more planning and management. The system has become effectively immune to criticism of its assumptions. Anything wrong is merely an error of application.

Visiting the U.S.A. to examine their efforts in marine conservation is impressive in many ways; the sheer numbers, facilities and professional expertise of marine environmental scientists, planners, managers, lawyers and educators is amazing to someone used to New Zealand manning levels. The output of these professionals is equally large, both in factual research and in other ways. There are professional journals on every imaginable facet of the subject and excellent courses to train further professionals in every branch.

They have achieved a level of control which, in theory, not only covers every human activity in the sea, but criss-crosses the levels of government and spheres of influence. It is only when you ask carefully about the marine environment itself that you wonder why all this effort could not have produced a series of places in the sea where nobody was allowed to take or disturb anything.

BRITAIN : AMATEUR SUCCESS AND OFFICIAL WEAKNESS

In Britain many important functions have been pioneered by "voluntary" organisations, that is, systems that rely on unpaid staff and/or voluntary subscriptions. These organisations often become permanent, important and have semi-official status. The Royal Society (science), the Royal National Lifeboat Institution (lifesaving at sea), and the National Trust (conservation of land and buildings) are some famous examples. Recently the Field Studies Council (environmental education), the Underwater Association (diving science) and the Marine Conservation Society have become active voluntary bodies. All of these, in various ways, have had a part in promoting marine conservation in Britain.

In the late 1930s the National Trust purchased some areas on the coast of Norfolk, round Scolt Head Island. Although legally "land", these areas included large areas of saltmarsh, intertidal mudflat and other strictly marine habitat. These areas have some claim to being the first marine reserves, although those words were not used. The values of the areas identified at the time included, landforms, wildlife, naturalness and scientific research. New Zealanders may be interested to know that Dr. V. J. Chapman, then in the Botany Department at Cambridge University,

was prominent in the movement. (He later became Professor of Botany at Auckland and was the first to suggest marine reserves in New Zealand).

During the 1970s a number of groups evolved to organise local voluntary marine reserves. Two of the results, around Lundy Island in the Bristol Channel, and Skomer Island, off west Wales, have since become official "marine nature reserves", in 1986 and 1990 respectively. At least six more are still maintained as local ventures, with varying support but no legal sanction (Welton, 1985 and Marine Conservation Society 1987). As might be expected, the voluntary efforts did not go for a complete fishing ban, just control of the more damaging activities.

Contrasting with the enthusiasm and activity on the voluntary front, official moves on marine reserves have been slow and tortuous. Compared to the U.S.A., where it is difficult to determine the real policy because of the sheer mass of official paper, in the U.K. there is very little in the way of official reports on policy (at least available to the general public). There are masses of surveys, Britain's coasts must be the best surveyed in marine biological and ecological terms anywhere, but little on what should happen or why.

After two official reports, in 1973 and 1979 (see last section of Chapter 3), the Nature Conservancy Council became the body that was empowered to set up marine reserves, under the Wildlife and Countryside Act, 1981. Subsequent events were described by Kayes (1987):

"In theory, the Act was a big advance because, for the first time, it allowed the N.C.C. to designate areas below the low-water mark as nature reserves. [However] the Act also ruled that the N.C.C. could not make bylaws to protect marine nature reserves if they 'interfere with the exercise of any function' of Sea Fisheries Committees, local authorities, water authorities or 'any right of any person (whenever vested)' - in other words anyone. ... These restrictions mean that the N.C.C. can ban the collection of specimens of non-commercial species, but it has to persuade the local Sea Fisheries Committee to institute bylaws to conserve fish and shellfish in the area. ...At Lundy, the N.C.C had to consult about 130 groups or individuals. ... It is hard to tell what the designation has achieved in terms of nature conservation. According to the N.C.C. the purpose of a marine reserve is not to restore an area to its natural, pristine state, but is to protect it from further deterioration."

In effect, official action was restricted to confirming what voluntary efforts had already achieved, and no more. This tended to annoy rather than help. It is a kind of compliment to be told that your "amateur" efforts were in the right direction but more is needed to do the job properly. It is more of an insult to be told that what you had volunteered is now compulsory, but with nothing added.

The official result is two marine reserves, in which N.C.C. bylaws say "all marine life is protected", but by legal wizardry this does not include protection from fishing unless the local Sea Fisheries Committee adds other bylaws. In the event these seem only to control some methods of fishing, or the fishing of some species. Despite 20 years of voluntary and official effort, the idea of complete protection has not been tried, or even seriously considered.

AUSTRALIA

Australia is a huge continent with a small population. It has an enormous coastline and despite the concentration of its population in the coastal margins of the south-east, vast tracts of its coast are almost uninhabited. Although our nearest neighbour in both distance and culture, its marine problems are in some ways quite different because of their scale.

Australia has lots of "*Declared Marine and Estuarine Protected Areas*" and a recently published inventory of them is available (Ivanovici, 1984). However, a close look at the details indicates that few of them are fully protected, many of them are very small, and a fair number are just special fisheries areas.

Nevertheless, Australia has made some major efforts in marine conservation, the largest and most famous of which is the Great Barrier Reef Marine Park, set up with its own Authority under a federal law in 1975. The Great Barrier Reef and its Park is enormous, it stretches for 2000 km off the Queensland coast, and is said to be the only biological feature on the planet which was clearly visible to astronauts standing on the moon!

It is not surprising that in such a huge area (nearly 350,000 square kilometres), the planning arangements included a number of different zones (at least 10), each with different regulations. It is more difficult to see why in such a vast, remote and relatively little used region, the amount set aside from any exploitation is so very small. Even here, management is designed to control activities that have proved damaging rather than retain large pristine ecosystems.

Some activities are banned from large areas:

"Oil drilling and mining except for approved research purposes; spearfishing with a powerhead or when using underwater breathing apparatus; taking of potato cod and giant groper longer than 1200 mm; littering."

but the *"Primary purpose of the protected area [is] management of multipurpose use area",* whether or not *"known threats to the area"* include *"Heavy pressure from commercial and recreational activity"* (Ivanovici, 1984).

Some areas are (apparently) totally protected, but these are so small they need map enlargements to find them, and are a trivial proportion of the total. Furthermore, they seem to be only for "scientific research" or the preservation of particular species (such as turtles). Where they exist, access of the public may be denied or very restricted. If there are places in the Great Barrier Reef Marine Park where all types of fishing and exploitation are banned, but people are free to look at the results, they are very small, hard to find, and clearly not one of the prime objectives of the Park.

Marine conservation in Australia is developing rapidly. Different states have quite different programmes and levels of achievement. For example Tasmania launched its marine reserve policy in April 1990, and for the first time proposed a large area in which all types of fishing and extraction would be banned. But the official policy statement hastened to say: "*These marine reserve proposals comprise less than 1% of the entire coastline of Tasmania."* (Department of Environment and Planning, 1990).

Even in the great spaces of Australian waters, it seems there is no rush to ensure that any significant proportion of the sea is kept free from intensive human use, retained in its natural state, or held in reserve from all exploitation.

Conclusions

The lessons from overseas on marine conservation are brutally simple. If we are not to lose our natural marine heritage (which is treasured but largely taken for granted) we must avoid their mistakes. There is no way out through affluence (see Japan), legalisms (see U.S.A), a trust in voluntary activity (see Britain) or free-enterprise (anywhere in the Third World). Even having enormous resources with relatively low pressure (see Australia) does not, in itself, produce a reasonable result.

1. There is a huge amount of literature worldwide on marine planning, marine legislation, marine management, conflicting marine uses, problems with the exploitation of marine life, and the effects of all this on marine conservation.

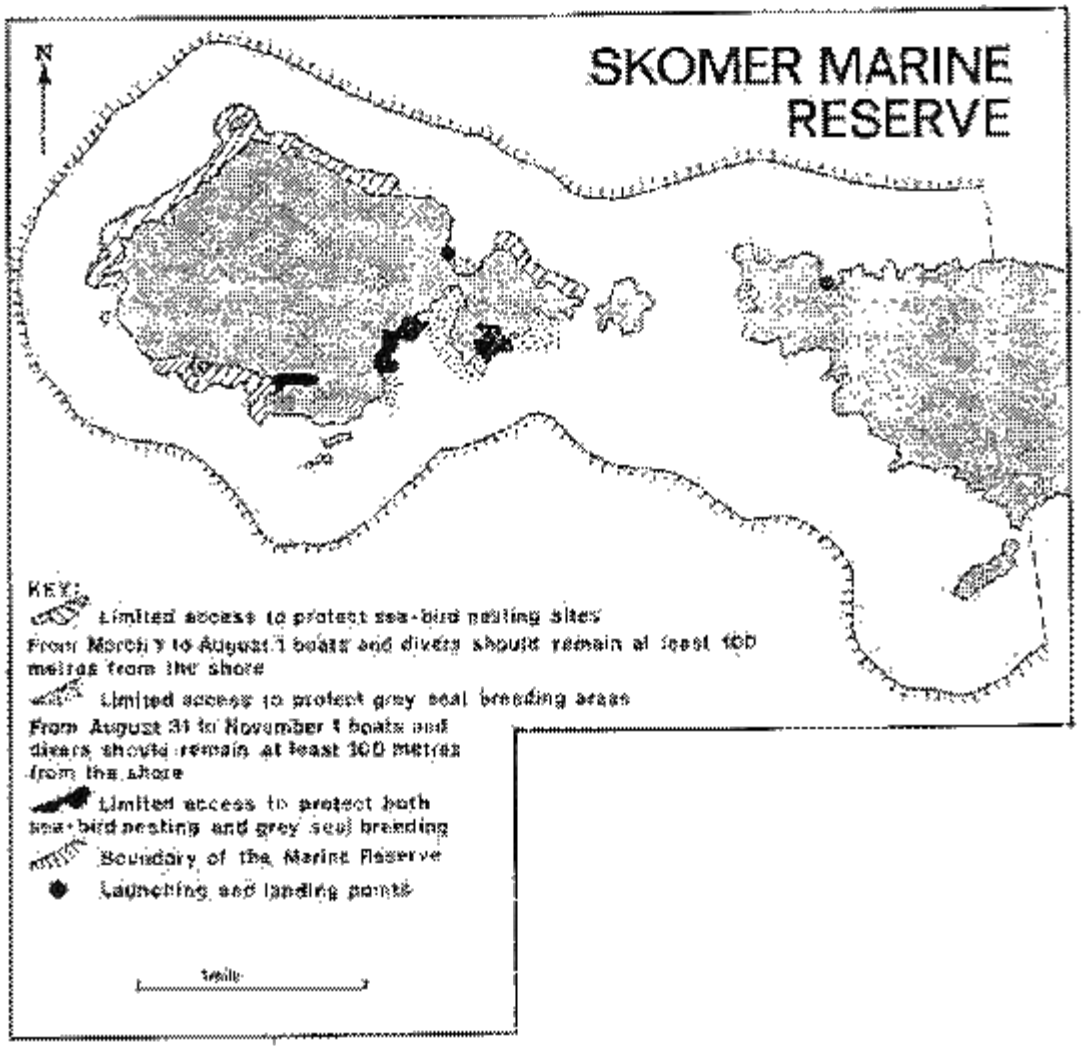
2. Despite this there is very little discussion of the idea of complete non-extraction, and the arrangement of minimal disturbance, while retaining public access.

3. Virtually all the discussion is about controlling and limiting damage, not about having places in which there is no interference with the natural state. There is plenty about reducing habitat loss, restricting degradation, controlling over-fishing, limiting pollution and generally taking more care about human activity in the sea. However, the simple idea of "no take" rarely gets a mention.

4. There are plenty of examples of places overseas with titles like "marine reserve" or something similar, but virtually all of them have rules which allow quite a lot of exploitation or even encourage it. Examples of marine areas in which extraction is not permitted are extremely rare. This is difficult to establish because you need to obtain and study the detailed rules. In some cases the general rules say marine life is protected, but more detailed study shows that this does not include species which are fished for recreational and/or commercial purposes!

5. It is difficult to establish why "no take" marine reserves are so rare. The "reasons" are rarely discussed. They are, in fact, assumptions, not reasons. Such assumptions include:

existing use "rights" cannot be disturbed;
there are no intrinsic values in the sea;
there is no reason to act until problems are demonstrated;
the only need is for controlled management and damage limitation.



Figs 28 and 29 A BRITISH "MARINE NATURE RESERVE"

Lying off the coast of south-west Wales, the small island of Skomer is exposed to the brunt of the Atlantic waves and gales. Its rocky cliffs, seabird populations and underwater fauna are in much colder climate but have many similarities to those at the Poor Knights islands. Skomer became Britain's second legal "marine nature reserve" in 1990, after being a voluntary reserve for about 15 years.

CAN YOU FISH IN IT?

The 1990 Byelaws include, from the Nature Conservation Council:

No person shall (without permit or reasonable excuse), kill, take, destroy, molest or disturb any animal or plant.

On the other hand the South Wales Sea Fishery Committee: has prohibited beam trawling, bottom dredging and taking of scallops by any means.

It thus appears that forms of fishing not prohibited by the Sea Fishery Committee *are permitted*, but a detailed perusal of the fine print of two sets of regulations would be needed to be sure, and the answer could vary depending on which species was being taken, what method was used, the precise location within the reserve, and even the time of year.

*The map above shows its extent and some of the rules when it was still a voluntary reserve. The picture opposite, by S. Hiscock, shows some of the subtidal life. Both are taken from a pamphlet, "*Skomer Marine Reserve" *produced by the Management Committee, revised edition 1984.*

6. The overwhelming impression, however, from a careful study of the world view on marine reserves is that the basic idea has not yet been seriously considered. It is not even "on the board". It is like the idea of iron ships in 1791, or of heavier-than-air machines in 1891 - everyone knew they wouldn't work.

7. From Britain we can learn that local enthusiasm is extremely valuable, but is no substitute for official action. We should also learn that scientific surveys (however detailed) are no substitute for political willingness to act, and don't even help to create it in any significant way. On the other hand, calling for additional surveys is an excellent political gambit for postponing any action.

8. From Japan we can learn that economic affluence has a very high price in reducing natural marine habitats. What any New Zealander can enjoy by the week and the kilometre is enjoyed by the rich Japanese by the hour and in millimetres.

9. From the U.S.A. we can learn that unless we give the sea itself some rights and its natural life some intrinsic value, we could be trapped into a downward spiral which made freedom to exercise legal rights more important than remembering why we wanted them in the first place. We could lose all our natural heritage while arguing who was allowed to interfere with what (and where, and how much, by what method, to what purpose, etc.)

10. From the Third World we can learn how lucky we are in the natural heritage of our seas; and how little it would cost us, in thought and effort, to ensure that our grandchildren would still have these treasures.

NORTH COAST OF SXOMER — Plant and Animal Communities

Box 8

THE TREATY OF WAITANGI (AND THE MAGNA CHARTA)

The Ten Commandments, the Sermon on the Mount, the Magna Charta, and the Treaty of Waitangi are all great statements of fundamental importance. But each is about principles, not specifics. Not only is it possible to interpret them in terms of a particular occasion or issue - it is necessary to do so.

I am sure that the application of the principles of the Treaty of Waitangi could substantially improve the way we

regard and use the living resources of the seas round New Zealand, and that such improvements are urgently needed.

However, I am also very worried that the Treaty might be used to make matters worse. This is not cynical or racist: it is merely recognising that everyone tends to react more strongly to short-term and narrow matters (perceived as urgent) than they do to long-term broad problems (perceived as postponeable).

Some 600 years before the Treaty of Waitangi, the Magna Charta was signed in England. This Great Charter became the foundation stone of freedom, and is still the basis for much of our law. Like the Treaty of Waitangi it included reference to preserving rights over fisheries. When the first marine reserve was proposed in Britain (round the Island of Lundy in the Bristol Channel) it was argued by local fishermen that the Magna Charta guaranteed their "rights", and in 1987, when the "reserve" was established, many forms of fishing were permitted within it.

A year later it was obvious that the fishing pressure around Lundy had actually increased, probably as a result of all the publicity. An outsider could see that the whole exercise was rather pointless - merely controlling some of the lesser activities. The authorities in England, reacting to short-term and narrow interests, chose to interpret the Magna Charta as requiring them to preserve fishing in the sense of permitting fishing activity all the time in all areas.

It would have been quite possible for them to have chosen to believe that to preserve fishing required the preservation of fish stocks, so that there was something to catch. Had they done so, they could have taken the view that an adequate system of marine reserves with no fishing in them was required under the Magna Charta.

We have the same kind of choice in New Zealand, but it is rarely mentioned, still less properly discussed. We should pay more attention to the actual nature of "rights" and the ways you can lose them. It is possible to lose your rights for a time and at some places (by decisions which are reversible), but you can also lose them totally and permanently. The "right" to hunt moa was never taken away by any law, administrative decision or political act, fair or otherwise. But the "right" has ceased to exist. Moa are extinct. Any argument about who, when, where and how they should be hunted is now pointless. We can interpret, modify, change and repeal human laws, but extinction is for ever.

Few marine species face total extinction (as far as we know!) but the general point is still valid. The laws of nature, whether we know them or respect them, operate without our permission or sanction. The only choice we have is whether to accommodate our actions to these natural laws. If we do not, whether willfully or in ignorance, the results of all our other decisions will be nonsense.

CHAPTER 8

TOWARDS A POLICY

It would be simpler to begin with a policy, but policies can be settled only after we have made up our minds what we want and why we want it. We are still doing this, so it is too early for a settled and agreed policy. But it is never too soon to start practising and this chapter provides some attempts. The first is an editorial by Dr. Alan Mark in the Royal Forest and Bird Society's magazine in February 1988.

A Marine Revolution

People are inclined to view the sea as uniform, despite the coral reefs, seagrass beds, fields of sea ice, and outer boundaries of mangroves and estuaries that reveal its diversity. The terrestrial world, on the other hand, is divided into many realms, provinces, regions and districts.

To an extent humans can be forgiven for creating that distinction in understanding between land and sea. We do not, after all, live in the sea. Furthermore, pelagic marine ecosystems carried by warm or cool currents have very mobile boundaries, a feature which has encouraged us to regard the sea as a unified whole.

But like many other parts of our environment which, until recently, have been ignored because they are little understood, the sea is today seen as vitally important to the continuation of life on land. It is our planet's dominant climatic force, not merely because of its great bulk but also because of its intricate physical, chemical and biological organisation.

Most New Zealanders live near the coast. Even if they live inland, their region's geology and biology has been shaped by the sea. Despite this close relationship with the marine world, we are not instinctive marine conservationists, most of us still adopting a hunter-gatherer approach to the ocean's resources. A "Marine Revolution" is needed.

A good place to start is to adopt and support the proposal put forward by marine scientist Dr Bill Ballantine in this issue - set aside immediately 10 percent of New Zealand's coastline as representative protected marine areas. The idea of a representative reserve has worked at Leigh, near Auckland, where fishermen -both commercial and recreational - notice large populations of crayfish and other harvested species inside the reserve, and very few outside. Experience is a powerful teacher.

If exceptions to the "no exploitation" rule are allowed, the system is bound to fail. Just as the sustained yield concept was proven not to work in our native podocarp forests, so too will it not work in our marine reserves. We have learnt to protect stocks, breeding and nursery areas for a wide range of species on land. Why do we not do the same for marine life?

Of course, there are many unique and outstanding coastal areas which are not "representative". These must be protected, but can be dealt with separately as with our special purpose terrestrial reserves. The important point is that there are no impediments - financial or policy - standing in the way of the representative concept. People's attitudes are the main barrier, a hurdle of unknown proportions which can be overcome given sufficient goodwill and firm advocacy. This is another important responsibility of the Conservation Department. Its advocacy is provided for in the Conservation Act and there is a special coastal directorate.

But mental adjustment will have to take place, not easy when life under the sea has long been "out of sight" and to human attitudes therefore "out of mind". A Marine Revolution" is a fitting label for that adjustment, implying on the one hand a return to our beginnings, and on the other an overthrowing of the outmoded ideas of the past. I call on Society members to promote and lead that revolution. *Dr. Alan Mark, President.*

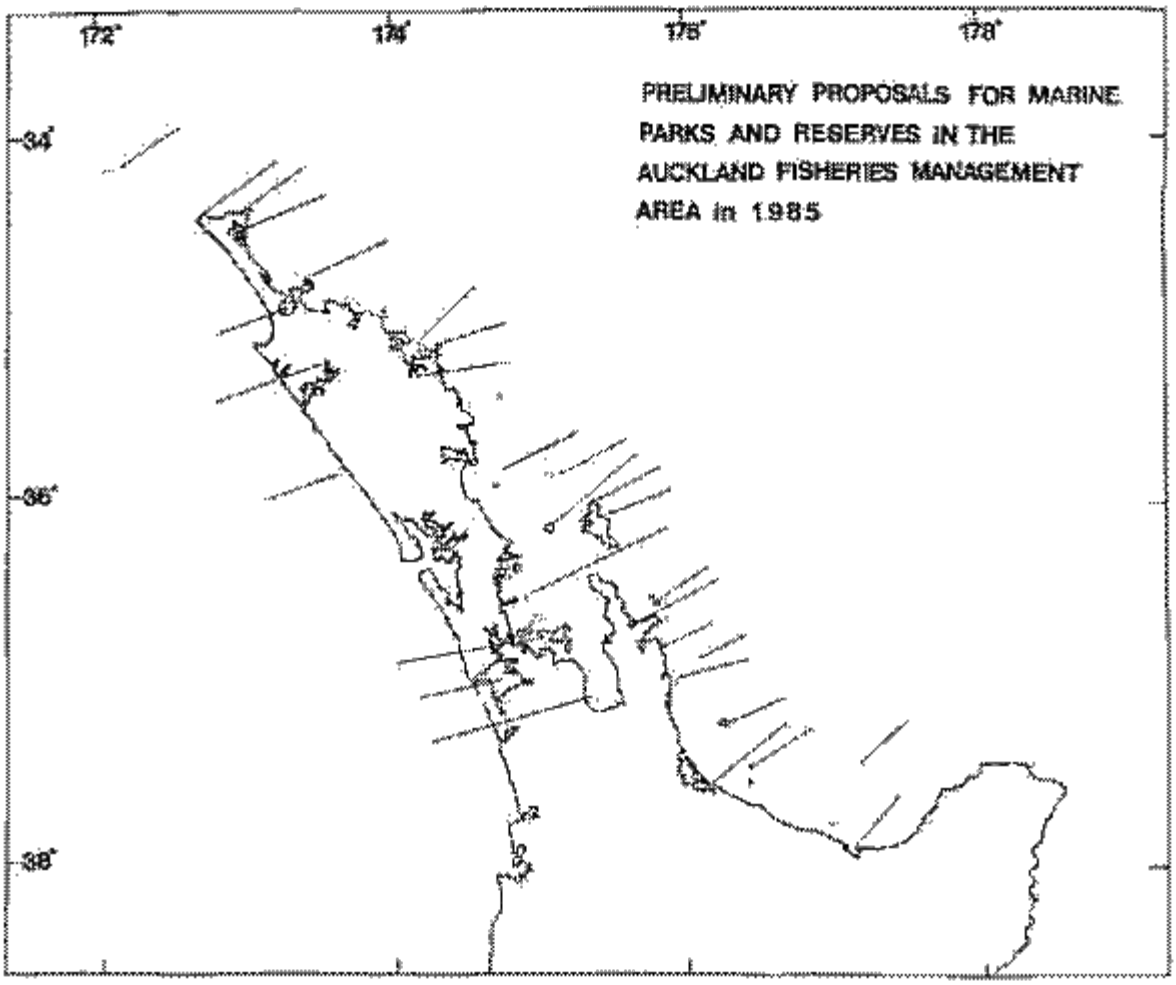


Fig 30 MAF PROPOSALS FOR PUBLIC DISCUSSION IN 1985

Map from *Auckland Region Marine Reserves Plan: a discussion paper* produced by the Fisheries Management Division, Ministry of Agriculture and Fisheries, Auckland in May 1985. The lines merely point to the localities. The areas are too small to show at this scale.

The list of proposals included "marine parks" and "marine habitat reserves", in which varying amounts of fishing would have been allowed, as well as "nil extraction " marine reserves. It contained a proposed national policy for marine reserves - which was also published separately. This included, under Goals and Objectives: *To establish a network of marine reserves and parks in New Zealand Fisheries waters to conserve and protect the widest possible range of marine life forms, habitats and ecosystems from the unique, rare, exceptional or endangered to the typical and representative, for posterity.*

It was an intelligent and brave attempt to produce both a policy and an actual plan. No authorship is given, but the only person employed at the time by MAF to consider marine reserves was Mr. Lew Ritchie, then a fisheries officer in Whangarei.
Although some aspects now seem dated, it was probably well ahead of its time. It did not achieve much public support or official encouragement.

The recent *Proposed Auckland Fishery Management Plan*, Ministry of Agriculture and Fisheries, November 1989, has no positive proposals on marine reserves and barely refers to the previous document (pages 97-99).

This next piece was first presented to a working group of experts at Wairakei in August 1987 (International Union for the Conservation of Nature, Commission on National Parks and Protected Areas). At that time the Department of Conservation was only a few months old and I was invited to help them present New Zealand's marine conservation policy. I naturally jumped at the chance to help make the policy! Alan Mark was a member of the IUCN group and asked me to write up my presentation for the Forest and Bird magazine, where it appeared in February 1988.

Marine Protected Areas: the only enemy is indifference

Although New Zealand does not have many marine protected areas yet, it has had one for a decade and this one is highly unusual in both nature and rules.

The "Leigh" reserve was the first created (1977) and it is highly successful in terms of popularity, value to local fishermen, and as a means of understanding more about the marine environment and our effects on it. The proper title of this reserve is the "Cape Rodney to Okakari Point Marine Reserve" and it covers 5 km of coast, to 800 m seawards, near the village of Leigh on the coast north-east of Auckland.
The success of Leigh is rather surprising and does not support current conventional wisdom on how to select and run marine protected areas.

It is generally supposed that marine protected areas should:
- be special or unique in their natural features;
- be as pristine and natural as possible;
- be remote from large centres of population;
- have few existing human uses or activity.

It is also generally supposed that rules and regulations should permit and approve traditional and culturally important fishing; allow other fishing except when this is proved harmful; and be cooperative with all existing users as much as possible.

Did not conform

The Leigh reserve did not conform to any of these features:
- it was a typical and representative piece of coast;
- spearfishing had ravaged the central area;
- it was an easy drive from New Zealand's largest city;
- it was popular for picnics, fishing, camping, etc.

In addition, the regulations imposed by the reserve forbade all killing, removal or disturbance of life; gave no specific

reasons for the restrictions; and provided no compromises with existing users.

It is generally supposed that such tough restrictions, especially if imposed without specific and demonstrated reasons, will prove both unpopular and/or unworkable. The experience at Leigh, however, shows that the benefits and popularity of the marine reserve are directly linked to the strict regulations and the resulting idea of complete naturalness This is true both in the strictly scientific sense and in the view of the general public.

A more usual kind of marine reserve was created round the Poor Knights Islands off Whangarei in 1980. Spectacular in its scenery and underwater life, the Poor Knights Reserve was virtually pristine apart from deep sea fishing; it was 20 km offshore and difficult to reach; and the islands were uninhabited. Regulations were worked out that allowed big game and some other fishing to continue; distinguished different zones, methods and species; and initially won cooperation from existing users.

These rules have been successful in maintaining the Poor Knights as a very special and unusual set of marine habitats with a high degree of naturalness; at the same time protecting the status quo, including most pre-existing recreational fishing.

New Zealand has, therefore, practical experience with two very different types of marine protected areas. Both have been successful in their own way. One is the type found in many countries and is suitable for protecting special marine areas. The other is less common but has been remarkably successful in creating a major asset out of an ordinary piece of coast.

A Vision of the Future

I believe that the success of the trial marine reserves means:

(i) we should arrange for more

(ii) as some benefits are local, we should have marine reserves throughout N.Z.

(iii) because the benefits only relate to the habitats protected, we should make sure some of each habitat is included in each part of New Zealand.

But what areas of the coastline should be protected? In my opinion, at least 10 per cent of all marine habitats and regions should be aimed for, a figure which would provide a reasonable level of insurance against specific greed and general ignorance.

We should commence at once and proceed rapidly to create more marine reserves. No purchase or compensation is involved, only a change in public policy for a public asset. No useful purpose is served by delay. On the contrary, by pressing ahead quickly any difficulties will be reduced and the benefits maximised.

Of course, special areas will need to be protected because of their unique, rare or spectacular features. Protection of "the best" will obtain widespread support fairly easily. It will be clear which places are "the best", and what rules are needed to protect them. However, precisely because they are "special" these areas will be unable to provide general benefits.

Therefore, the major effort should be put into obtaining the major benefits, and experience has shown that these lie in fully protected areas which are typical, representative and accessible.

The only barriers are pyschological and social, but they are serious and normally inhibiting - unless active countermeasures are adopted. While the case for the protection of specific places for specific reasons is reasonably easy to argue, the reservation of "ordinary" areas for general reasons is really quite difficult in any particular case. "Why was this piece selected?" Hard data can be produced to show somewhere is the "most special" in some respect, but it is not possible to prove anywhere is the "*most* typical" of its kind.

Furthermore, if the general benefits of naturalness are sought, it is not possible to give specific reasons for the banning of particular activities. People who have been fishing or otherwise exploiting an area for years and are told to stop, feel entitled to an explanation. If no actual evidence of harm can be provided, then they will be certain to question any bans.

Prevention is better than cure

But specific sense is not necessarily general sense. It is clearly absurd to wait until obvious damage has been done before we move to save any part. "Prevention is better than cure" may not be universally true, but it is obviously worthwhile retaining one straight ruler, one undamaged piece, one natural bit. But so far we have no system for doing this in the sea.

A practical system for selecting and protecting a network of typical marine habitats would have to include socially and politically effective arguments for each. These could be generated at three levels:

1. The principles noted above - at least one reserve fully representative of each area, each with full protection, accessible to the general public, and totaling 10 per cent by area.
2. A range of local and/or pragmatic points, decided as far as possible by local people, such as ease of boundary recognition, policing and control, degree of exploitation, adjacent land use and effects, size, viability, and distance from other reserves. This would be done so as to maximise the benefits. For example, one site might be handy to schools, preferred by local fishermen as a nursery ground and well away from shipping lanes, while being no better as an example of sheltered harbour habitats than several others.
3. A range of cultural, aesthetic and emotional points which again would be decided locally if possible.

These "subjective" reasons are, in fact, vitally important. In some cases objective supporting evidence is possible and desirable, but the application of such evidence is still in the area of opinion.

The "subjective" reasons for creating a marine protected area could include:

the tourist and recreational value of protected areas;
protection of historic wrecks;
scenic features and areas of traditional significance;
use for pollution monitoring, management tests;
control of general exploitation levels;
moral and aesthetic preservation values (ranging from preservation of genetic diversity to showing our children what it was all like once).

Finally, it should be recalled that exploitation will still be the norm in the sea. At present it is total in New Zealand (minus some tiny fragments). If the above programme went ahead, the present range and level of exploitation would still continue over 90 percent of all sea areas in all regions. The "compromise" would still be in favour of exploitation and overwhelmingly so. There is no need or value in any further compromise or reduction.

Areas "reserved" for recreational fishing may be required in some places but this is a matter for fisheries management and is separate from, and in addition to, marine reserves. There is no point in confusing these issues.

If full protection from exploitation and the full benefits of naturalness are the watchwords for marine reserves, then the idea can be sold to all intelligent and responsible fishermen as being a direct benefit to them, even more so than for other citizens. If any kind of killing or disturbance is permitted, then most of the real benefits disappear along with the principles, so that while there might be less opposition, there would be virtually no support either.

Marine protected areas with "nil extraction" offer real benefits to all citizens. The creation of a network of such areas covering 10 percent of the coastal and offshore waters requires only the political and social will to do so. This programme does not require large amounts of public or private money, merely the support of large numbers of people. This issue is of real social importance but does not have any predetermined position by party, class, sex, race or religion. There is no enemy except our own indifference.

Box 9

A VARIETY OF SUGGESTIONS

At the time of writing (March 1991) there are three formal proposals for marine reserves awaiting decision by Government:

Pollen Island, Waitemata Harbour, Auckland

Pollen Island, in Auckland's Waitemata harbour, is a small area of mangrove, saltmarsh, and sheltered tidal flats in the middle of a major city. It was proposed as a marine reserve by the Royal Forest and Bird Protection Society in 1990. The area is adjacent to the northwestern motorway, and is more or less protected by it.

There is little active or extractive use at present and reserve status would largely confirm the present state. Although there were the usual reflex objections from some quarters, the only real problem seems to be some complication of responsibility - the area "belonged to" the Harbour Board but now.....? Given some political common sense Auckland and New Zealand should soon have another unique asset - a typical piece of natural harbour habitat preserved in the midst of a million people.

Cathedral Cove, Hahei, Coromandel

The proposed Cathedral Cove marine reserve, near Hahei, is on the eastern coast of Coromandel. This is an indented coast, with several bays, offshore reefs and small islands. It is place of historical note (Cook observed the transit of Mercury nearby), scenic beauty (spectacular white cliffs, stacks and caves), geological interest (a variety of volcanic rocks) and traditional importance (to the Ngati Hei), as well as a popular area for holiday makers from Auckland, Hamilton and elsewhere. The marine life is typical of the open east coast and nearshore islands, but depleted in the popular target species.

The formal proposal was made by the Department of Conservation in 1990, after two rounds of public discussion. The first, in April 1989, concerned the whole Coromandel area and showed support for a reserve in the general Hahei area. The second discussed options around Hahei itself. Some local bach and retirement home owners were very vocal in their opposition. They claimed a "right" to fish off their doorstep, branded the proposal for a reserve as "selfish". They were well organised and got good publicity.

The final proposal was cut back at the eastern end, in front of the Hahei settlement, apparently to accomodate these objectors.

Kapiti Island, Northern Cook Strait, near Wellington.

Kapiti Island is just north of Wellington on the west coast, off Paraparaumu. The island itself, about 5 km offshore, is very rugged, largely forest, and almost all nature reserve. Its coast is rocky, and, on the western side, steep cliffed. The adjacent mainland coast is low, sandy and heavily residential.

As at Haihei, there were two stages of public discussion (February 1989 and April 1990). Despite a 75% approval of the suggestion at the second stage (2000 replies), the formal proposal presented to the Government was significantly reduced, apparently in an attempt to satisfy the various objectors.

All three proposals are in "high profile" areas, either being popular for recreation and holidays (Kapiti and Hahei) or in densely populated areas (Pollen Is.). All three contain marine habitats which are representative of their regions, as well as special features.

It will be very interesting to see how the politicians react to these proposals, the speed of their reaction, any reasons they give for their decisions, and the public reception of all this.

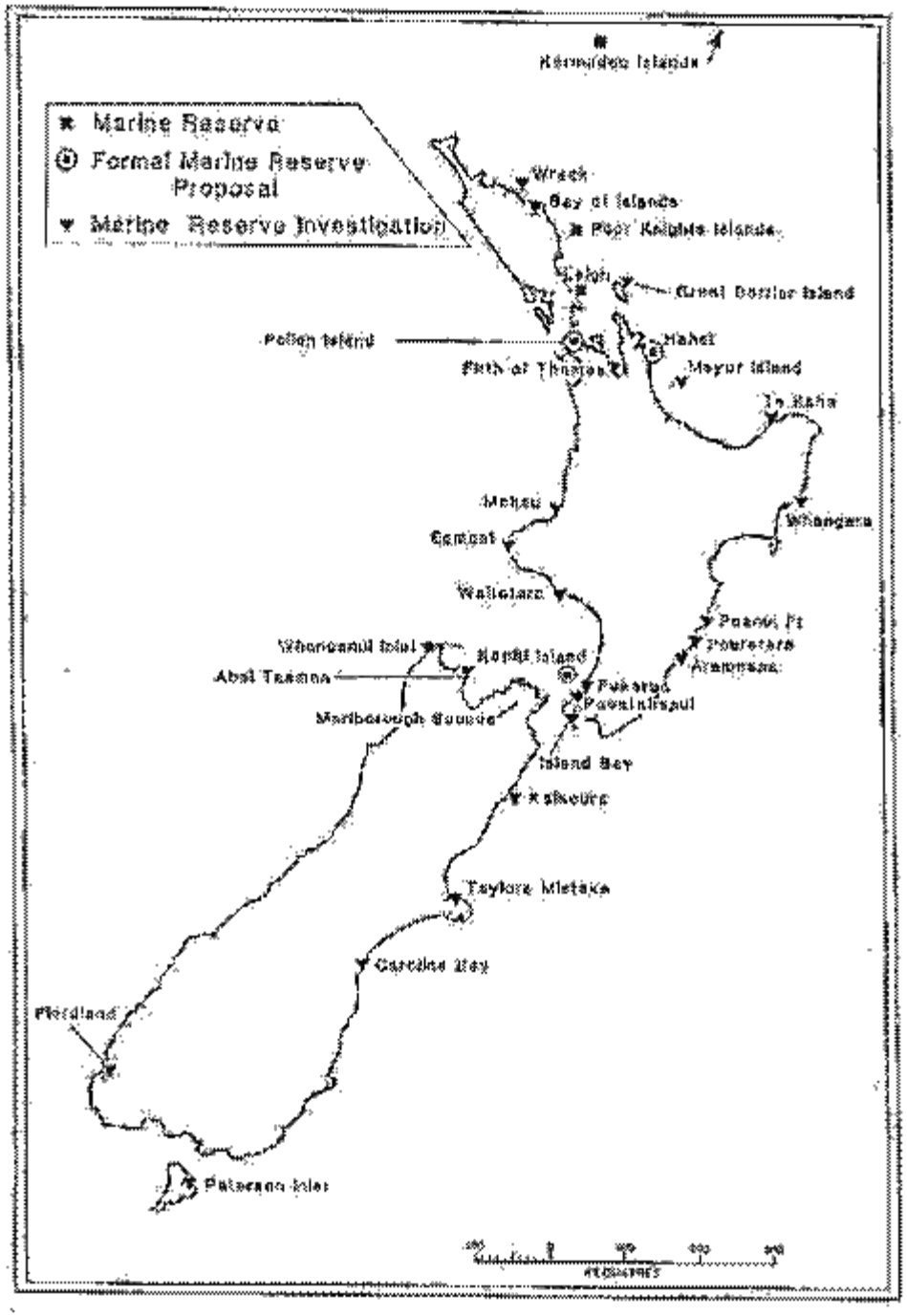


Fig 31 MAP OF DOC AND OTHER PROPOSALS IN 1991

Updated from "*Groundswell*", the Department of Conservation's marine reserves newsletter, showing the 1991 position on marine reserves. Some of the "investigations" are departmental and in an advanced stage of public discussion; others are by unofficial groups and in various stages. The present "policy" seems to be very pragmatic - an attempt to get more examples of marine reserves wherever local support and/or special features makes that possible.

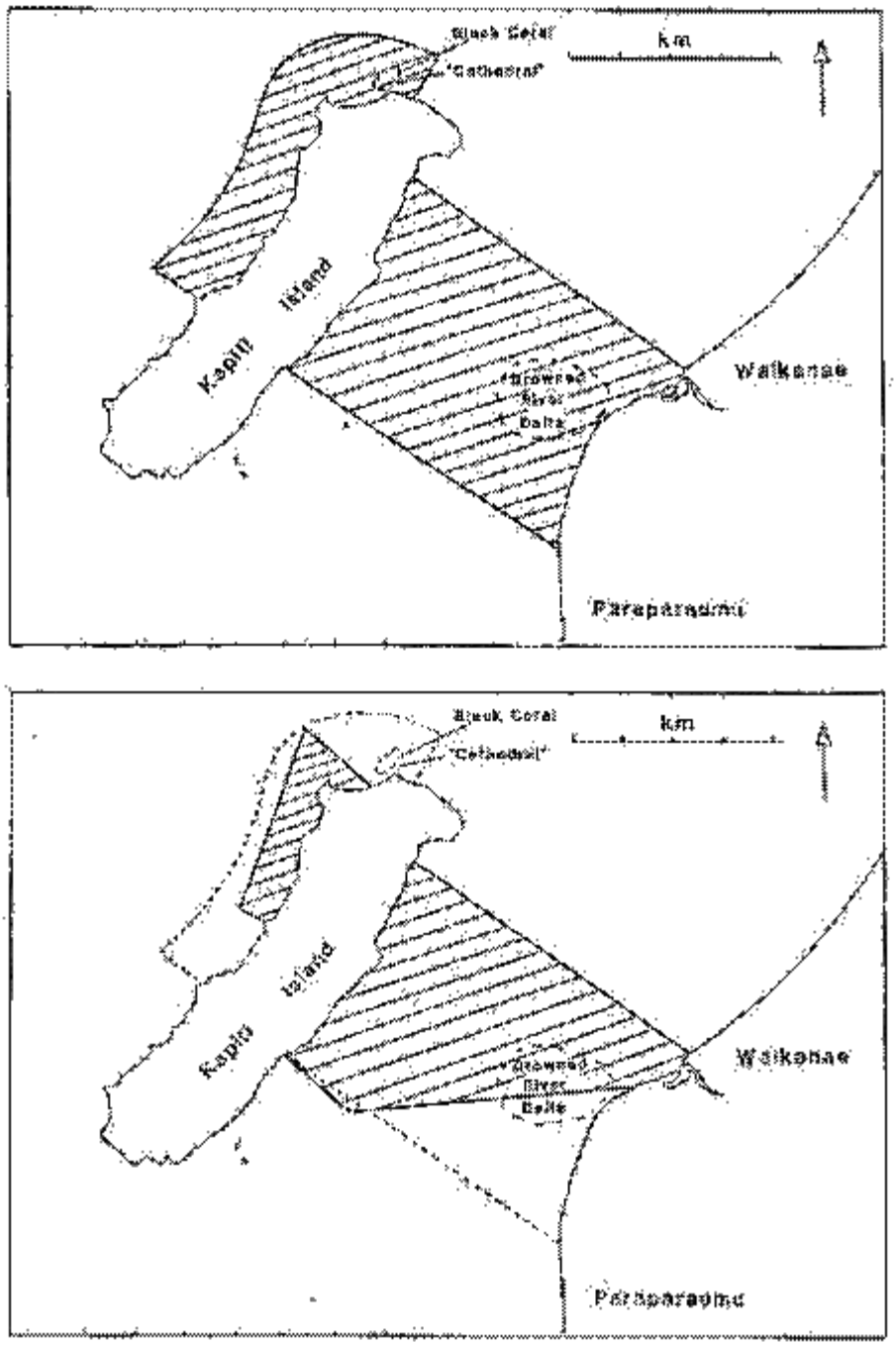


Fig 32 PROPOSALS AT KAPITI

Kapiti Island lies off the west coast of North Island; north of Wellington and opposite the sandy coast of Pararparaumu. Before 1987, the Ministry of Agriculture and Fisheries carried out ecological and user surveys of the area in relation to a possible marine reserve (Baxter, 1987). In February 1989, the Department of Conservation, called for public submissions on the question. After analysing these, DoC in April 1990 produced the "*Kapiti Island Marine Reserve Proposal: a public discussion document*", which contained the map reproduced above (top). Although the great majority of public responses supported this proposal, there were also some objections. In 1991, the department formally proposed a marine reserve to the Minister of Conservation with the boundaries indicated in the lower map. Note that the reserve actually proposed is much smaller and appears to ignore the areas which had been marked as special in the document for public discussion.

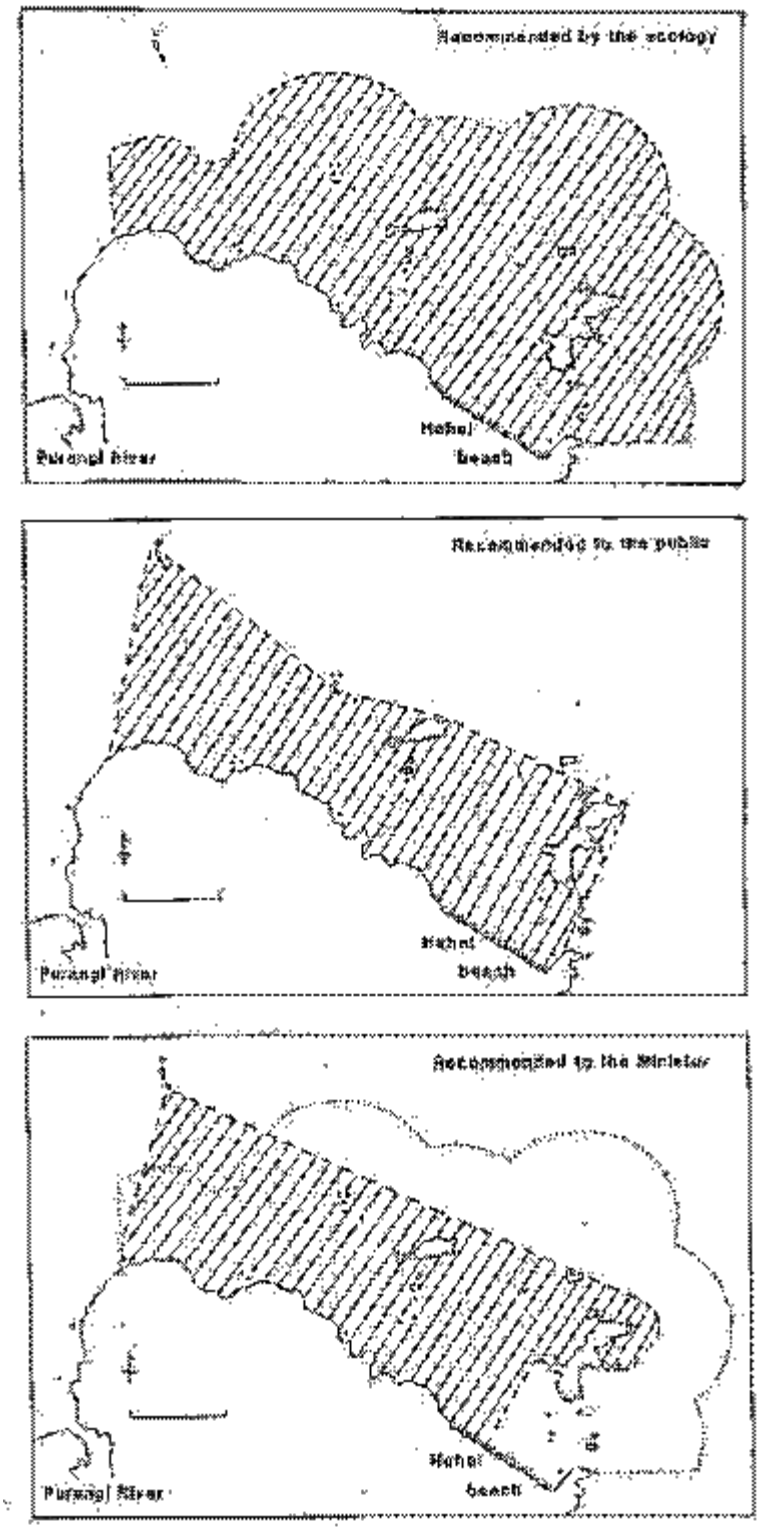


Fig 33 PROPOSALS AT CATHEDRAL COVE, HAHEI, COROMANDEL
All three maps are redrawn from *"Cathedral Cove Marine Reserve Proposal: an application for a marine reserve"* published by the Department of Conservation in September 1991. The top map shows the ideal ecological boundaries of a marine reserve in the area. The middle map shows the boundaries proposed by the Department to the public for discussion. The lower map shows the boundaries that were formally proposed to the Minister of Conservation by the department after getting public reaction. Note the stepwise reduction in size and the shift in emphasis to the east.

The third policy proposal deals with the most general issues. It was written for the scientific forum that preceded the Gaia Symposium held at the University of Auckland in June 1989. It tries to express the fundamental reasons for a precautionary approach to marine management, and to relate these directly to particular policies.

Only one Ocean: Lessons from the Sea

Abstract:

On all scales from the ocean/atmosphere circulations to the life on a small rocky reef, the sea offers many examples of complex but dynamically stable systems.

These systems are robust and resistant to most naturally occurring disturbances, but may be delicate and vulnerable to new or human-induced changes.

Because the sea is less familiar to us, a study of these marine systems is helpful for escaping from our cherished but unfounded assumptions and for understanding better approaches.

It is easier in the sea to follow the real connections between general principles (like conservation and sustainability) and actual decisions (like the creation of a network of marine reserves).

New Zealand has the opportunity now, based on experience, to lead the world in a practical system of marine conservation, which would effectively sustain the benefits of the sea for our children's children.

General principles:

We must learn and teach the full implications of the following general points:

1. Complex, dynamically stable systems are the basis for life on our planet. Our survival, not just our comfort, depends on such systems. These systems are not just interesting and desirable - they are essential to our existence.

2. Such systems, whether large or small, are robust and self-protected from most naturally occurring disturbances, but may be delicate and vulnerable to new or human-induced factors.

3. Our species, by its numbers and technology, creates new factors inevitably and frequently.

4. Our powerful capacity for data gathering and logical analysis generally hides the fact that *specific* predictions about complex dynamically stable systems are *impossible* except for the very near future, no matter how much data or analysis is available.

5. *Non-specific* predictions, recognising the inevitable aspects of probability but using their patterns, *are possible* for such systems. Examples abound in everyday life and are regarded as "common sense".

6. Such predictions are unpopular and under-utilised by both scientists and politicians because they are non-specific in time, place, and quantity - being expressed as probabilities, trends, correlations, patterns, and modes of behaviour.

7. Nevertheless, planning at all levels from personal to global can and must be based on this kind of prediction, if we are to protect those systems which sustain our existence and make all temporary comfort, convenience and "success" possible.

Specific marine recommendations for N.Z.

1. N.Z. should set out to become the world model for marine conservation, because of the unique opportunities provided by its geographic position, population density and cultural history.

2. 10% by area of all marine habitats in N.Z. should be reserved immediately from all forms of exploitation. These marine reserves, similar to the proven example at Leigh, should be distributed through all regions and cover all types of habitat. Because of the widespread dispersal involved in the reproduction of marine life (floating eggs, drifting larvae and spores) these representative reserves would act as breeding reservoirs for all areas.

3. At least a further 10% of all marine habitats should be set aside immediately for a range of restricted purposes including recreational fishing, traditional fishing, and marine farming (see 7).

4. Monitoring of the marine reserves, restricted use areas and "normally" exploited areas should be commenced immediately:

(i) to determine both natural and induced changes
(ii) to measure the nature and degree of predictability.

5. Arrangements should be made to ensure, over the whole coastline, such points as:

(i) right of public access to the coast, and traverse along it
(ii) active protection of marine mammals and seabirds
(iii) increasingly effective pollution control.

6. The exploitation of marine habitats and marine life should be based on the principle of demonstrable sustainability (i.e. with full allowance for present lack of knowledge) reversing the present assumption that anything convenient goes on until damage is proven and publicly unacceptable.

7. A clear distinction should be made between marine farming that seeks to enhance natural processes (hence potentially sustainable) and that driven by current economic advantage (hence merely transferring the problem). The first should be steadily but cautiously encouraged and the second should be banned.

8. Since there is only one sea (continuous and mobile in 3 dimensions), the public interest must be paramount, especially the long-term public interest. There cannot be any permanent private rights in the sea that are separated from the public interest. (While this is probably true on land and globally, it is demonstrable now for N.Z. seas.), Acceptance of this principle would completely alter our attitudes to such things as marina development, waste discharges, fishing quotas, sand mining, etc.

9. Over the next 5 years a Marine Charter should be developed, aiming to maximise the range of compatible, sustainable, publicly beneficial marine activities including particularly those "non-economic" ones such as health, recreation, education, research and conservation on which all "economic" activities depend.

10. International recognition and support for the programme should be sought with the aim of exporting all successful methods and ideas developed through it.

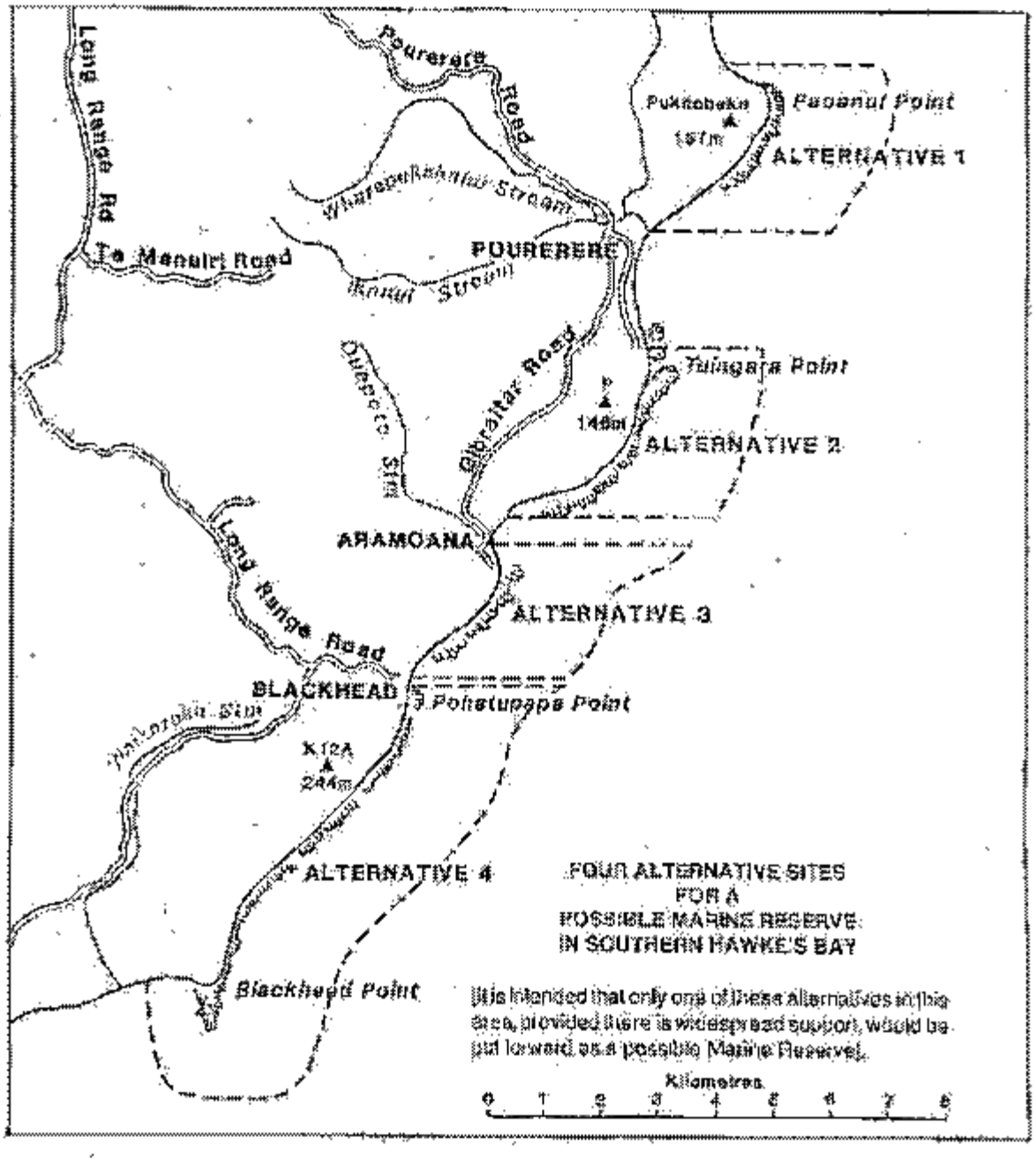


Fig 34 ALTERNATIVE SITES

Map from the pamphlet *"Marine Reserves: Four alternatives for Southern Hawke's Bay"* produced by the Department of Conservation, Napier, in 1990 for public discussion. This approach tries to give more democratic choice and may be appropriate when the sites are more or less equivalent in natural and ecological terms. However the more choices that are provided the less likelihood there is of any one getting a clear majority vote.

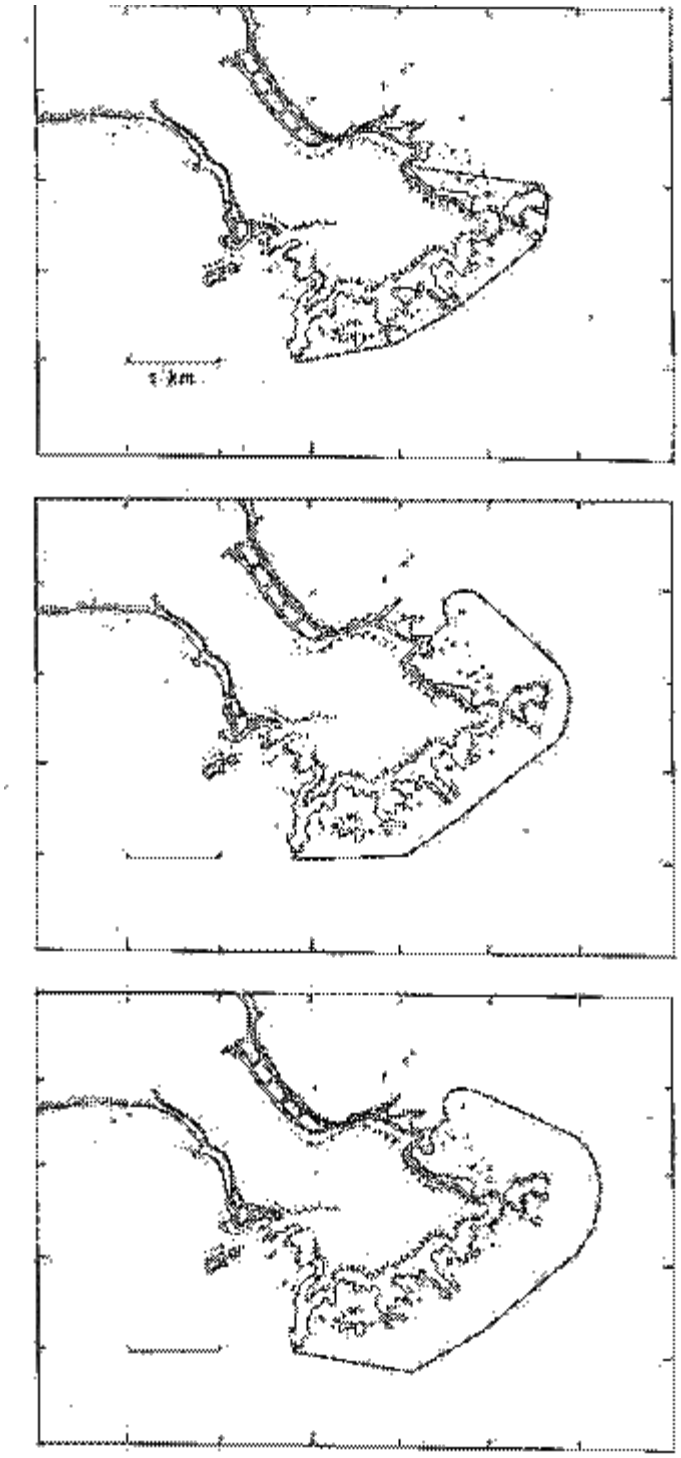


Fig 35 ALTERNATIVE BOUNDARIES

These maps are reproduced from the pamphlet "*Kaikoura Marine Reserve*" issued by the Royal Forest and Bird Protection Society, Wellington, in January 1991 for public discussion and response. Three alternative boundaries are provided, extending different distances seawards. The smallest boundary (upper map) was that originally suggested by the local proponents. The larger alternatives (lower two) were suggested later on scientific and official advice. Note the reversal (getting bigger here) from the situations shown in Figs 32 and 33. It is clear that that responsible for making boundary situations (whether officials or citizen groups) are much more cautious than those offering advice based on principles. The fear of objections is still generally stronger than a belief in the principles or the benefits.

Box 10

WHAT'S THE POINT OF FOOD YOU CAN'T EAT

At a meeting on an East Coast marae, to discuss marine reserves, there was a slide show. Some of the photographs were of holiday-makers looking at the abundant marine life in the Marine Reserve at Leigh. Afterwards one of the elders said, quite gently but firmly, that he didn't see any point in kai (food) you couldn't eat.

I've forgotten what I replied, but whatever it was, it lacked force, because I agreed with him - up to a point. He was reminding me was that, while it was very nice, near Auckland, to provide entertainment for leisured and affluent city folk, in his area people had more serious things to worry about - like getting enough food to eat, or money to purchase essentials.

At the time I was mainly concerned with my insensitivity, and how to atone for it. Later I had a chance to think more deeply about what he'd said, and what I should have replied (after an apology for including matters of little local concern).

I should have led the discussion back to really important points, using his remark as a focus. For, of course, in another context, he already knew the sense of food you could not eat. It happens all the time when we keep some of this year's crop as seed for next year.

When growing kumara or beans, if we want a crop next year, we need to keep some seed. This seed is not the bits we didn't need to eat. It is put aside first, and kept at all costs. Next year's seed is not some low-grade left-over, it is selected as the best. When it has been put aside, it may be looked at, but not eaten.

Is there a useful comparison here? Yes and no. Obviously some fish and shellfish need to be kept to breed, if stocks are to be maintained. However, in the sea, the relationship between what we leave now and what we can expect to have in the future is usually very obscure. Which of these points is more important: the known general principle or our ignorance of exactly how it should be applied?

Put in this way the answer is obvious, and simply an extension of our gardening practise. Even for kumara and beans, the gardener doesn't know exactly what the return will be next year. The weather and other circumstances cause considerable variation in yield. So the prudent gardener keeps more seed to cover the uncertainty, and stores them in more than one place, to reduce the risks of loss.

In the sea, we are very ignorant of the way stocks relate to reproduction, even in the best-studied fisheries. The little we do know indicates large differences in juvenile recruitment from year to year even when stocks are constant. It would clearly be prudent to keep back from harvest a significant amount of each stock. It would be sensible to make sure these breeding reserves were some of the best. It would be wise to have these untouched stocks spread about in different places.

These reserves would then be food you couldn't eat. Having got them for essential purposes, it would be all right to let people look at them, so long as no damage was done. Whether this looking was entertainment for tourists, or education for children, training for students, or research for scientists, it would all be "cream on top". Furthermore these reserves would let us know, for the first time, just what natural healthy marine stocks *should* look like. Some of us think we can tell now, but we don't know this for a fact, it's just a thought, and it could be wishful thinking.

CHAPTER 9

THE PROBLEMS OF MARINE CONSERVATION

This chapter was written in 1980 as my contribution to a book on "Nature Conservation in New Zealand". I sweated over it while on study leave in U.K., but the book never appeared! However, it summarises the general background quite well. Indeed, on re-reading it, I was surprised how little had changed at the basic level, and how important it is to keep reminding ourselves what the basics are.

INTRODUCTION

The sea is a vast and strange place. Throughout history the usual method of dealing with its problems has been to ignore them.

The problems of marine conservation are in fact parallel to those on land, but the much lower level of dealing with them tends to obscure this point and to inhibit even the transfer of well-established principles.

To say that little marine conservation is being practised, that we scarcely know how to begin, and that few people consider it either necessary or even desirable would be a fair comparison with the state of affairs on land.

The prevailing view is that marine resources will look after themselves. Marine resource management and conservation get little attention or investigation. Consequently, documented cases of waste or well-organised use are rare, and in the absence of such evidence most people feel nothing needs to be done.

Even for those professionally concerned with conservation, the relative lack of emphasis on marine resources reflects the level of knowledge and interest, not the areas involved, their biological production or even the economic importance of the sea. This situation is particularly ironic in New Zealand, which lies at the centre of the "water hemisphere", that half of the globe which is nine-tenths sea, but the same picture is found all over the world. Even in the most maritime nations, the marine field is relatively unexplored, and is certainly not given the kind of political, legal, administrative and social protection that is customary for land.

It is worth examining in some detail how this came about because the causes are likely to remain problems.

DIFFERENCES FROM LAND

Movement

Static natural resources are easier to conserve than mobile ones. Migratory birds, downstream effects in rivers, free-ranging herds of grazing mammals and the dispersion of air pollution cause special problems in land management and conservation. But most natural resources on land are static or confined within small definable areas. In the sea, mobility is the rule.

The medium itself and most of the organisms in it are continuously moving. This mobility varies in direction and velocity and frequently involves three dimensions and mixing. Even those species which can be considered static as mature forms (e.g. crayfish and seaweeds) usually have highly mobile dispersive phases, may be controlled by mobile predators and can never be managed as

spatially defined populations. The substrate itself, the seabed sediments, are often mobile to a degree which would make land erosion cycles seem slow and mild.

All these types of movement, the currents, tides and waves, the swimming, floating and drifting do more than make management difficult. They tend to inhibit thought at all levels. It is difficult to isolate anything for study, it is very hard to get precise or predictive data. Valid principles tend to drift out of reach as innumerable exceptions float in. On land, gully erosion and dust storms create special problems in the conservation of grasslands, but the grass itself does not move a few kilometres a week in unpredictable directions. Phytoplankton, the bulk of primary production in the sea, goes where the currents carry it, and current speeds and directions are as variable as the weather.

Mankind is more mobile at sea than on land. From Vikings to modern fishing fleets this has caused severe problems of control. The speed, range and flexibility of exploitation which marine mobility confers is difficult to appreciate in advance from a local land-based administrative centre. The most ordinary boat may pass by several local authorities in a day and through the jurisdiction of several nations in a week, leaving for international waters in a few hours at any stage.

Access

Although humans have been successfully moving on the surface of the sea for centuries, real access into the sea is still fraught with serious problems. The air-sea interface is virtually opaque to direct observation. Working blind

from the surface from boats is inefficient, and the difficulty of maintaining even moderately stable working conditions at sea is so great and expensive that most operations are virtually "hit and run".

Diving, especially scuba, has introduced an enormous improvement in providing information, but it is very limited in depth, duration and visibility, not to mention the problems of training, expense and safety. Work in the intertidal areas at low tide, the use of remote instruments and the construction of artificial systems such as fish ponds, while valuable, are so highly restricted in application that they would be very rarely used were it not so difficult to get at the sea at all.

The difficulties and dangers of working in the sea are so great that those involved have little time or energy to consider the total effect of their actions or the long-term benefits of alternative programmes. Like nomads in very harsh environments on land they are preoccupied with survival and its immediate prerequisites. It is understandable that, if they are skilful and energetic at this, they are often contemptuous and dismissive about suggestions from those sitting safe at home, and angry at attempts at land-based control.

Understandable but not justified, for the sea does not belong to mariners even in the sense that the Arctic belongs to the Eskimo. Fishermen and seamen come home to land. The close and valuable comradeship at sea does not constitute a viable community. There is need for more control than would be apparent while in the thick of the struggle. Nevertheless, the access problems are real. Only in the deep swamps, large lakes and very high mountains does terrestrial resource management have anything like the difficulties which are standard in the sea.

Ownership

Many problems of land conservation derive from the narrow interests of owners, and a common solution to these is the public acquisition of the area. But it is salutary to remember that any kind of ownership, and hence some form of responsibility, is an improvement over none at all. Until very recently it was universally accepted that no one could own a piece of the sea or any of its resources.

The only responsibility required was to maintain the freedom of the seas. Governments at every level were in fact more concerned to disclaim responsibility than to assert rights over the sea. The only actions thought desirable were the prevention of piracy and other anti-social interactions of people. It was felt, and generally still is, that marine resources were there for the taking by anyone who had the skill and initiative to do so.

Even close inshore, where some control may be exercised over a particular fishery, some details of the navigation or the extraction of certain minerals, the adjacent coastal authorities are still unwilling to assert jurisdiction and control in principle or to preempt problems where they can.

In the sea there is no tradition of general control or of any responsibility to arrange management. Indeed the opposite tradition is strong, especially in New Zealand. The idea of a right to do what you will in the sea, with the sole proviso that it should not directly and immediately injure another person, is widely accepted as reasonable.

One result of this vacuum in responsibility is that not only do things frequently go wrong but, when they do, most effort is spent on futile arguments over who contributed what to the disaster. These arguments, whether concerned with declining fish stocks, coastal erosion, or pollution, are so confused, that the most obvious point - nobody was in real charge of events - is missed by the general public. In more professional circles an even more worrying aspect appears. Most of the fire and thunder of the argument is generated by a desire to prevent future responsibility being foisted on their particular organisation.

On the land the struggle is for ownership, or at least power of control. This means that responsibility is perforce accepted by the winners. In the sea since everyone will have the same rights, the contest is to evade responsibility. The result, predictably, is that when the battle dies away there is often nothing left of the asset worth having.

Vastness

The sheer extent and relative featurelessness of the sea tends to inhibit not only feelings of care and responsibility but even those of interest. On land very large, flat and highly uniform habitats are more difficult to conserve and manage because of the relative decrease in public interest. These features are so pronounced in the sea that to most people the sea does not count as a habitat at all. They cannot really conceive that anyone could study it, manage it or be in any way concerned with it other than to travel over it or pull fish out of it in the manner of a lucky

dip.

Ignorance

All the above problems contribute to a situation in which ignorance is the normal state of affairs in any marine consideration. Relative to terrestrial conditions our knowledge of the sea is abysmally poor. This is not just an ignorance of details or a lack of precision - it is much more pervasive. Almost any valid proposition, demonstrable principle or clear fact is a valuable exception to the rule.

Data on marine resources are harder to obtain and more difficult to analyse than equivalent information on land. Fewer people are employed to investigate the sea, they produce less information per unit of effort, yet the areas to be investigated are greater than on land. Only in very recent times have any basic data-gathering organisations been set up and these are still funded, staffed and appreciated at much lower levels than land equivalents.

It is obviously much harder to achieve sensible resource use in the sea than on land. The problems discussed above are real and fundamental. Spelling them out makes somewhat depressing reading. I have done so because unless they are faced and understood, they will continue to provide excuses for making no effort at all. In addition a careful examination of these problems suggests means not so much of solving them but of operating effectively despite them.

Whatever the difficulties, it is just as desirable to improve resource management at sea as it is on land, and the reasons are the same. Continuously sustained yields, multiple compatible use, protection of stocks, preservation of diversity, etc. - all the usual management aims are just as socially and economically valuable for marine assets as terrestrial ones. The most cursory examination of the current use of marine resources shows that gold-rush tactics are normally adopted and that few people complain about the resultant waste and destruction. If such methods were used on land there would be an outcry. Why is it so passively accepted in the sea? Perhaps because the fundamental problems overawe even the would-be reformers. Certainly the standard reaction to pleas for marine conservation is still a big shrug and a dismissal of the thought as mere idealism.

Yet major advances in the intelligent use of our marine assets would not be very difficult. Many of the concepts and techniques required are already available. The greatest problem is not how to act, but to develop the will to act at all.

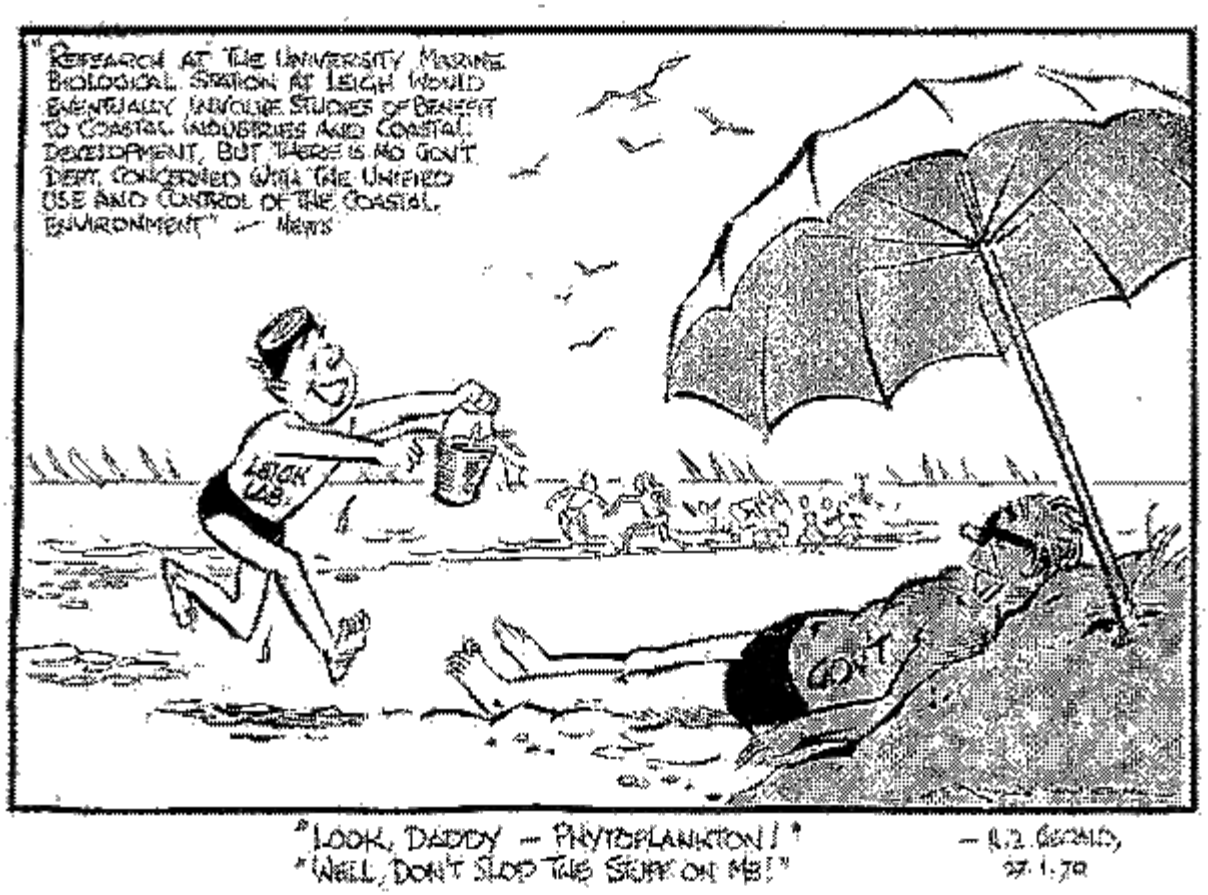


Fig 36 MANAGEMENT OF THE SEA. "WHO?"
This cartoon by the late Sir Gordon Minhinnick appeared in the *N.Z. Hearld* more than 21 years ago, but the basic point is still valid. Planners and conservationists may think it is a joke about indolent and uncaring government, but the majority of the population think it is a joke about stuffy scientists being told to get lost. The ultimate truth is we all prefer laughing at each other to creating a sensible system for marine management. *Reproduced with permission, copywrite New Zealand Herald.*

SPECIFIC PROBLEMS

Inshore fisheries

The conservation of any natural resource is difficult, requiring not only knowledge of the situation and power of control, but also someone with a strong commitment to ensure that it happens. When the resource is a wild stock of mobile animals, owned by nobody in particular, open to exploitation by anyone that feels like it, and with a generally good market value, then the task of proper management is near impossible. Most fisheries fit this picture.

The history of fishing in New Zealand is the usual sad story. When the available technology enables an exploitable stock to be destroyed or seriously reduced as a profitable resource, this happens fairly quickly provided markets are present. Effective controls are generally imposed after the point at which they could provide real protection for the resource or the industry. Those fisheries which continue to exist are due to a fortunate combination of chance events. Some combinations of relative inefficiency of methods, weak markets, distance from ports and similar factors can keep a fishery going indefinitely, but chance, not management, is the common factor.

Starting with seals and whales, and continuing to the present with crayfish, scallops, paua and mussels, the story of unrestrained exploitation of particular stocks to the point of major reduction in yield and profitability is so common as to excite little but shrugs in most quarters. Those involved move on and the original situation barely exists even as a memory.

The recent expansion and subsequent collapse of the Golden Bay scallop industry was conducted precisely like a nineteenth century gold-rush, without even exciting more than passing comment from those not directly involved. During the Chatham Island crayfish boom attempts to enforce even the existing safety regulations for boats were howled down by a public mesmerised by the idea of freedom to get rich.

There is little point in such a situation in blaming those in charge. Few people regard fisheries as other than a source of cheap food or quick profits. They are not yet prepared to back the kind of controls which would allow sustained yields and a continued successful industry.

Even when close attention is given, for example in the Hauraki Gulf snapper fishery, the essential points for real management are still absent. Neither the public nor the industry have yet been able to decide what they really want. Maximum employment (many small boats) or maximum efficiency (a few large boats). Pleasure for people (accent on recreational fishing) or food production (commercial skills and technology). Export profits (high prices) or cheap food at home (low prices). When the aims are confused, more effective management is impossible.

The new offshore fisheries and the EEZ

-

The establishment of jurisdiction over the sea within 200 miles of New Zealand is a tremendous opportunity to introduce rational management principles and develop them steadily. So far little has been done in this direction.

The compelling reason for the EEZ was to ensure legal protection and control of gas and oil drilling programmes offshore, but fishing, navigation, pollution and other activities were unavoidably included - or at least not excluded - in the framing of general legislation. It is unfortunate, but probably significant, that in naming the control area the Exclusive Economic Zone, there is no hint of management or conservation, but a clear statement of an eagerness to enjoy any available benefits. Lip-service to the best principles is cheap and easy, if even this is not attempted, it must be wondered whether the principles are even recognised.

Whether N.Z.-owned or foreign fishing vessels should be allowed to catch whatever is available has received enormous and detailed attention since the establishment of the EEZ. Relatively little attention has been paid to what the stocks of fish are, and virtually none to their detailed dynamics. No area of the EEZ has been declared a non-fishing area so there are no stock refuges. For many of the fish and squid species now forming a large proportion of the catches there is scarcely any information other than the previous catch statistics (which in most cases go back only a few years).

Under the Law of the Sea the coastal nation should allow other nations to catch that proportion of sustainable yield of fish not being utilised by its own vessels. Reasonable enough, but any decision within this proposal depends on knowing the sustainable yield. It is difficult to see how a foreign (or domestic) quota can be fixed for a species when its life cycle is still unknown.

During a period in which fish catches within the EEZ were doubling and trebling, the staff of Fisheries Research Division remained below the level which would allow one scientist to each major commercial fish species. At the same time the government was offering major loans for the purchase of offshore fishing vessels to increase New Zealand's share of the catch.

A recent official display on fishing for Conservation Week was concerned entirely with improved techniques, rising catches, export profits and the increasing New Zealand share. Not a word on stock management or the need for conservation. Surrounding it were children's posters with slogans like *"If we catch all the fish how will they breed", "Save the Whales"* and *"Take care of our Seas"*. Out of the mouths of babes.....?

Aquaculture

-

Relatively little marine aquaculture has yet developed in New Zealand. Oyster and mussel farms are fairly common, and the prospects for ranching eels, flounder and crayfish (for example) are reasonably good.

Despite the low level of activity so far, severe local conflicts have already arisen over the siting of oyster and mussel farms, and the early development of this industry illustrates several problems of marine management and conservation.

Faced with an application for an oyster farm lease in "their" bay, boat and property owners, as well as lovers of the natural scene, often object vigorously. Such objections are reinforced by thoughts of derelict and ugly farms elsewhere, no assurances of how far the development would proceed and no picture of the general value of such enterprises. Those in authority find it very difficult to adjudicate between the business prospects of an individual and

the traditional (if unwritten) rights of the local community or visitors.

While no total solution is ever possible, it is easy to see how the situation could be improved - merely by adopting well-tried principles from the land. In most cases this has been half-done already but not pressed to optimum advantage.

Licensing of oyster farms and actual leases for use of the areas was regulated officially from the beginning. The more-or-less exclusive use of a public asset demanded this. But it was not carried through properly. Potential farmers could (and did) apply for leases wherever they wished. Government was faced with the impossible task of assessing every wild or sensible idea and justifying their decisions in each case. Lengthy delays naturally resulted and some applications sat on desks in Wellington for years. How much cheaper, simpler and better to have had a plan - a fixed number of

licenses in the first period confined to certain limited areas. The objection would have been that all the necessary information for the correct decisions was not available. Very true, but some principles were known, and limited and controlled trials would have improved knowledge very quickly. The objection was, in fact, much more applicable to assessing large numbers of random applications. Even now when much more information is available, the authorities are reluctant to commit themselves. Fisheries Management produced a map of the Mahurangi Harbour (N.Auckland) showing a potential oyster farming area. This caused considerable argument and tended to exacerbate an already conflict-ridden situation. It transpired that the map was meant to show the areas that could be used for oyster leases, not to recommend them for such use and it was presented merely for discussion.

Such handling is unlikely to produce sensible decisions. In the end, someone has to approve or decline the applications, and what is urgently needed is a plan in which relative suitability can be defined in principle.

It is perfectly true that if a policy is vague enough then no one can say whether it has been successful or not, and it becomes difficult to blame anyone in particular. Muddle has been the secret weapon of every authority in history. But it should be used only as a desperate last resort, and it seems inappropriate here. It would not be difficult to get general agreement to the following principles:

(i) aquaculture industries are desirable provided they can be arranged without much damage to other important interests, including the marine environment.
(ii) a step-by-step development in selected regions with government approval and protection is more likely to be profitable and less likely to cause damage.
(iii) the selection of the regions and the magnitude of each development step is best decided by a central management agency and not left to an open-ended dog-fight of local interests.
(iv) once these basic decisions have been made, detailed arrangements are the proper concern of local interests but they should have power only to arrange, not to prevent.
(v) further development will depend on the success of the preceding steps but the initial ventures should continue to be protected within the framework originally approved.

Harbours and estuaries

The greatest problem in the proper management of large natural resources such as harbours is to get them regarded as units. It is the harbour itself that needs management decisions because it is a topographic, hydrodynamic and biological entity. At present a plethora of separate authorities control various human activities in or adjacent to the harbour. All these authorities have their own aims and rules, but none have the prime aim of ensuring the continued health and integrity of the harbour. They are users, not managers.

This state of affairs was vividly illustrated during the later planning stages of Auckland Thermal I. This was to have been a large oil-fired electric power station sited on the south side of the Manukau Harbour. A great deal of investigative work was carried out on the project, and an environmental impact report of about 600 pages was published summarising the engineering decisions and the effects considered likely to occur.

The preferred option for the cooling system involved the creation of a 500 hectare (5 square kilometres) cooling pond made by impounding an adjacent section of the harbour. It was stated that this would be only 2% of the total harbour area and hence was considered environmentally acceptable by those responsible.

A number of questions arose from this proposal :-

(i) What habitats were involved in the 2%, and how did they fit in the whole harbour?
(ii) What previous reclamations had already occurred and what others were planned?
(iii) Was the whole harbour in a healthy state now, and what other stresses were likely in the future?

During a full-scale public enquiry the following points emerged:-

(a) No one had the formal duty to ask, let alone answer, these questions.
(b) The 2% of the harbour planned for the cooling pond would in, fact, be almost 10% of the biologically richest and most important habitat of the harbour, the neap intertidal flats (NIF).
(c) Between 10-15% of the NIF in the Manukau had already been reclaimed or otherwise destroyed without anyone ever having a record of this geographic fact. Reclamations were noted by various national or regional authorities under several headings - date, purpose, legislative authority, method, etc., but nowhere were these recorded by locality, so the total effect on a particular harbour could not easily be determined.
(d) A further 10-15% of the NIF was already planned for reclamation (for sewage works, airport, steel industry, etc.) and legal permission was already granted for much of this, again without anyone being aware of the total effect in the Manukau.
(e) Considerable pollution was present. Using a very conservative standard (obvious changes visible in aerial photographs), it was shown that more than 10% of the NIF was so polluted that recovery was doubtful.
(f) More pollution from the cooling pond construction (washing out and spread of fine sediments during the lengthy period of bund building) was highly likely over a wide area, and further pollution could be expected from other planned reclamations and constructions.

It thus emerged that a major section of the biologically most important part of New Zealand's second largest harbour system had been destroyed or seriously damaged without anyone being officially aware of the fact. Various plans already existed (including many actually approved) which would almost certainly double this damage. The harbour habitats were already under some stress, and the cooling-pond proposal, which could virtually finish off the degradation process, had reached the final planning stages before these points had been given any appropriate attention.

It would be comforting to assume that this was an unusual case and that it couldn't happen again. However, it is more likely that the only unusual aspect was that the real state of affairs came to light at all, owing to the large single project of the power station. In most harbours a multitude of small separate activities are not even measured let alone co-ordinated or managed, so that by the time trouble strikes it is impossible for anyone to be sure what happened, still less who caused what.

Take an "ordinary" small harbour such as the Whangateau, on the east coast north of Auckland. It virtually drains at low tide, is almost enclosed by a sandspit and consists largely of fine clean sandy flats with some eelgrass beds and fringes of mangrove and salt marsh. No industrial use is made of the harbour nor is there any commercial fishing in it. Yet human activity has already transformed the Whangateau from its original natural state, and the list of uses and activities which involve this small harbour is so lengthy and complex only some examples can be included here.

Road embankments, cuttings, filling in small bays, causeways across large bays.
Reclamations for farming, playing fields, housing, caravan sites and golf course.
Official rubbish tips, casual dumping of quarry waste and other spoil.
Major sand extraction for the building industry (in the past).
Wharves for public use, launching ramps and small private jetties.
Fishing for flounder and gathering of cockles and pipi.

Dinghy sailing, wind-surfing, large boat moorings, boat building and repair yard.
Development of watershed from bush to farmland, and in intensive market gardening.
Development of holiday or retirement housing (and these to standard residential areas).
Recreational activities from swimming and picnicking to simply enjoying the scenery.
Standpiling to protect margins, rock walls, groynes, etc. to deflect currents.
Drainage from septic tanks, cowsheds, gardens and farmlands.

Plans for the future use include sewage works, a marinas, more housing and general developments. Problems

include severe erosion, channel maintenance, water pollution and conflicts of use.

The local County Council has stated that it sees no need for formal maritime planning at present, and this probably reflects general thinking. However, it does not reflect the facts. The harbour is very important - the activity and investment are already very great. The harbour has real problems - million-dollar protective engineering programmes and lawsuits have already been incurred. Why are we so unwilling to see the harbour itself as a major public asset which needs planning, management and conservation?

This example could be matched anywhere round the coast of New Zealand. Official and public thinking concentrates on regulating each activity separately and even when difficulties arise, tends to deal with symptoms, not causes.

Mangrove forests

-

Marine wetlands are not much use in the ordinary sense of that word. Very little is directly harvested from them, nor while they remain wetlands can they be used for intensive farming or other developments. This has led to them being considered useless in the broad sense, which is far from the truth. The opinion that such areas were useless wastelands was heavily reinforced by the ease with which they could be converted into private assets; their potential value as "reclaimed" into flat land; and their use as cheap ways of creating public utilities such as roads, rubbish tips, oxidation ponds, storage dumps, port facilities, marinas, etc.

The real value and usefulness of marine wetlands have been slow to emerge. In many parts of the world they have only been understood after major declines in commercial fisheries, serious drainage problems, loss of recreational amenities, pollution problems, etc. which followed the large-scale reclamation of wetlands.

The New Zealand mangrove forests are a classic case of this story in minature. Confined to the northern parts of the North Island, mangroves occur mainly as isolated patches and thin fringes in the more sheltered parts of inlets, estuaries and harbours. They are highly vulnerable to destruction during any operations such as roading improvements or rubbish disposal, even when no specific reclamation is intended.

The larger bits were frequently "reclaimed" (a self-justifying word which means filling in and totally destroying) for purposes which were ostensibly agricultural but subdivision and buildings often followed. Whenever public works were involved the fact that mangroves were "free" often ensured that utilities were sited in them even when adjacent land was more suitable and involved less construction cost. Even now, when high-level planning policies are changed, the ingrained habits of local people, the lack of any real policing, and the continued belief in most quarters that mangroves are useless ensure that losses of this habitat occur at much the same rate as before.

Real conservation of mangroves requires an active education and policing policy in the rural north where the habitat is still abundant - although rapidly diminishing. Existing aerial photographs provide the means for rapid and complete surveys. Maps could be drawn and supplied to county

councils and harbour boards with assurances that repeated checks would be made. The usefulness of mangroves in controlling sediments, providing fish and bird breeding and feeding areas, as aesthetic diversity, and as exporters of biological production to offshore fisheries could be stressed at the same time. Once it is appreciated that these mangrove forests are regarded at government level as an important national asset, they might begin to be treated as such where they occur. Precisely the same arguments would apply to other wetlands.

Marine Reserves

The idea of marine reserves is very new. Several countries have developed them but extensive programmes are rare. New Zealand has had one marine reserve for several years, and its history illustrates some of the problems.

The prime difficulty is the originality of the idea. From 1965 when the first suggestion was made, it took six years to get a general empowering act through Parliament, four more years to have the first application approved and a further two years before a management committeee was set up. At each stage large numbers of people had to become accustomed to the idea, not so much the desirability of reserving a particular area of sea or even the feasibility of doing so, but merely being able to visualise the possibility, the principles and the potential advantages.

In order to push the idea along, those in favour of marine reserves settled for a very limited official response. The 1971 Marine Reserves Act was narrowly conceived and much more a reaction to a particular request than a considered framework for marine conservation. This is now causing problems, and a much broader approach is urgently needed.

During the past 10 years there has been a steady increase in public concern for marine conservation, a growing belief that more should be done, and a developing dissatisfaction with the absence of any real positive policy on marine reserves. The establishment of one marine reserve, and its popularity and success is a starting point but much more is needed and quickly.

The reasons for marine reserves are the same as on land:

(i) Aesthetic and moral: we need beauty, variety, naturalness and quietness merely to stay human. We have a duty to preserve good examples, for the future, of what still exists. No amount of money or regret can replace extinct species, habitats or ecosysytems.

(ii) Recreational: all sports and games in open environments require the control of other activities to exist at all. The cheap, simple and passive recreations tend to be squeezed out by intensive or general development unless "parks" are set aside for them.

(iii) Educational: all those whose minds are not yet closed to new experience enjoy and benefit from the chance to see for themselves the real variety of the world, including that in the sea.

(iv) Research: reserves provide not just a location for undisturbed work, but a chance for long-term studies, the discovery of natural principles, the preservation of base-lines for comparison and the general incremental increase of understanding..

(v) Management trials: without areas where exploitive activity is excluded it is impossible to measure the effects of our actions, to compare the efficiency of different management techniques or even basically to know what we are doing.

(vi) Stock refuges and breeding grounds: the simplest and most effective technique for the conservation of commercially valuable stocks is to retain areas where they are completely protected.

(vii) Protection of rare and endangered species, the preservation of genetic diversity, and the general conservation of habitat variety. In the sea the only hope for these aims is the reservation of viable and representative areas of all the various ecosystems. Our level of knowledge does not yet allow more restricted selection.

In the sea there is an additional, much more powerful and yet humbling argument for reserves. We need protection and insurance not just against specific instances of greed and mismanagement - we need it against general ignorance. Whether the activities are gill-netting or reclamations, souvenir collecting or sand-dredging, we need a strong reserve of places where we will not operate, because experience has shown that our assumptions are often badly wrong.

FUNDAMENTAL PRINCIPLES

-

The immediate commencement of planning all round the coast and the accelerated development of management and conservation techniques due to improved data-gathering and distribution will still leave room for plenty of mistakes in our sea. Planning and management must be improved as rapidly as possible because it will take a long time for them to develop to full effect. In the meantime it is necessary to take out some insurance.

Again, the lesson has been learnt on land but has yet to be applied in the sea. New Zealand provided the world with some very early examples of reserve insurance on land. From the Queen's chain (public foreshore reserves) through large city parks to national parks and protection forests, New Zealand built up to the present state where more than 20% of the land area is reserved from exploitive use. There are many kinds of land reserve, they serve many purposes, and they are widely recognised as valuable and worthwhile. In the sea, at the time of writing, there is one tiny reserve. Our ability to understand marine processes is less than on land, our means for controlling activity is less, yet, so far, we have not taken out even the same level of insurance we found appropriate on land.

Pre-emptive reservation is an essential part of rational management and is especially valuable in the early stages. We urgently need several types of marine reservation:-

(i) Large non-fishing zones in the EEZ, to act as stock refuges and insurance against our "guesstimates" of quotas being no better than some of our past efforts.

(ii) Large pristine areas of coastal waters, as the equivalent of national parks and wilderness areas, as well as stock refuges for coastal fish.

(iii) Viable representative examples of every ecosystem and community not included in the above - to serve as natural living museums. No amount of future money will restore or replace a system that has been allowed to become extinct. It is inevitable that a slow decline in some natural marine resources will accompany the increase in population, industry and general development but it is neither desirable nor inevitable that this should be allowed to occur randomly over the whole coast.

iv) Special reserves in addition to the above, to cover uses like particular scenic value, education, recreation, research, etc.

A conservative aim would be 10% of all marine natural resources withdrawn from exploitive use, and designated as reserves as quickly as possible. It should be noted that, since the whole sea is

already public property, this change in management would not involve any direct cost (no purchase required), and the indirect costs would be tiny compared with the direct benefits. These benefits include tourist attraction, cheaper recreation opportunities, educational benefit, research simplification, as well as the prevention of the more inappropriate development suggestions. Other direct benefits would be the ability to measure the effects of what we were doing elsewhere and the chance to retreat without total loss from positions we might find untenable.

CONCLUSIONS

1. On land, conservation is regarded as an essential part of proper resource management. In the sea the two are so involved with each other that it is pointless and harmful to try and separate them. The fundamental differences from the land situation - the vastness, unity and mobility of the sea, the lack of private ownership, the difficulty of access and our general ignorance of how things operate naturally - all mean that, in the sea, control of use and restriction of use (management and conservation) are, if applied intelligently, the same thing. Because of the nature of the sea, safety margins must be wide, and whether this is called conservation, intelligent exploitation or merely common sense is not very important.

2. Relatively little effective marine conservation has been carried out in New Zealand so far. Problems due to unrestrained or inappropriate use of resources are common. It will be necessary to act rapidly and decisively to avoid further serious waste and destruction of our natural marine resources. The main difficulty is to develop the will to act, since the actual idea of marine conservation is so new.

3. Appropriate action would not be very difficult to practise. The main principles required have already been developed on land and sufficient examples are available to show that they would be effective in New Zealand's marine areas. The three main principles are:

(i) that formal planning structures should be established as quickly as possible over all coastal waters and the EEZ. The mere existence of formal planning bodies requiring reports would be a powerful restraint on many existing and spreading problems, and powerful support for those wishing to promote more sustained and rational use of our marine resources.

(ii) that planning is limited by knowledge, especially when there is relatively little as is the case in our seas. Consequently, special efforts are needed to increase our background information and to ensure that what is known is made available in appropriate form to the decision makers.

(iii) that reserving representative and viable areas of all natural marine habitats from any form of exploitive use is the quickest, cheapest, most practical and most effective management strategy available at present. Such reserves provide insurance while planning and management techniques develop as well as providing all the usual advantages that reserves do on land.

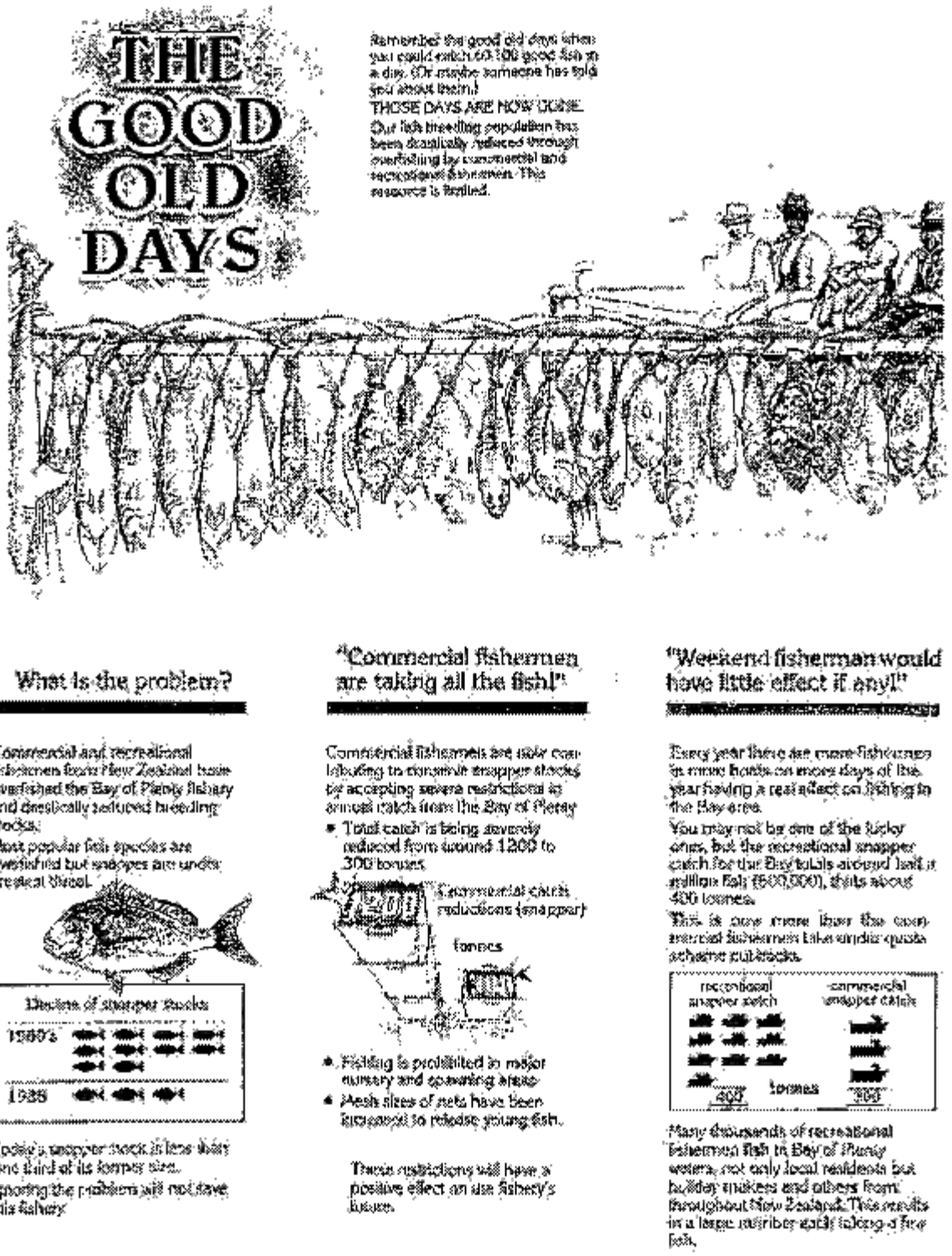


Fig 37 THOSE DAYS ARE NOW GONE

Reproduced from a pamphlet entitled "*The Good Old Days*", by MAFFish, undated (probably 1990) which refers to fishing in the Bay of Plenty, especially for snapper. The points it makes could have been written about many fisheries in many areas. The fishery has been overfished. Reduction in fishing is necessary. All groups must help. Special restrictions will be applied: - quotas on commercial fishermen, individual bag limits for recreational fishermen, size limits on everyone, closure of spawning and nursery areas in certain seasons, etc. However, it is all a reaction to existing damage. The implication is that we cannot interfere before such damage occurs. Why not?

Box 11

THE THISTLEDOWN EFFECT : PLANKTONIC DISPERSAL

One of the reasons why it is so difficult to manage marine life properly is the way it reproduces and disperses. Most of our experience is on land, and nearly all life on land has reproduction within the same population. With land plants and animals, the parents and the offspring occur closely together; the young are born into the same population as their parents. Dispersion also occurs, but this spreading out is either slow or happens mainly to adults.

None of this is generally true in the sea. Most marine species have very large numbers of very small eggs and these are dispersed by drifting away from the parents in the currents. Most marine animals also have drifting (planktonic) larval stages as well. So when settlement and/or metamorphosis occurs the young are a long way from their parents.

These are general rules and there are exceptions. Everyone is familiar with thistles and thistledown drifting in the wind. Thistles are one of the exceptions to the usual rules on land. The reproduction and dispersal of thistles can be used as a model of what happens generally in the sea. Thistles have many small seeds with a fine hairy down which are dispersed by the wind. Even if we control thistles rigorously over most of the country, the dispersal of windborne seeds from scattered patches of thriving thistles will keep producing new thistles everywhere. The thistledown effect is similar to what happens with the planktonic dispersal of marine species.

This is both bad news and good news for marine reserves The first bit of bad news is that no single marine reserve can be self-sufficient, unless it is gigantic. In any reserve of practical size some of its species will be totally dependent on recruitment of juveniles from outside. For many other species in the reserve much of the recruitment will be by larvae, eggs or spores which drift in from somewhere else. So if marine reserves are to be sustainable there has to be a network of them.

The second piece of bad news is that we cannot calculate the result of this planktonic dispersal in precise terms. Or, more accurately, even if we could learn how to calculate it, the result would be different for each species (different lengths of time in the plankton), it would be different in each year (current speeds and directions vary a lot), and it would be very different for each arrangement of reserves (varying with their spacing, size and precise position). In short we cannot calculate in precise terms where we should have the marine reserves.

The first piece of good news is that we don't need precision calculations. We know the principles and the trend of their effects. A farmer does not need to calculate which way or how far thistledown will travel, to know what to do. If he can't or won't do it the Noxious Weeds Board will. Thistles are pests, so we have to reverse the conclusions for marine reserves. It is clear that the precise position of marine reserves is not the crucial question. What we need is a network of maximally reproducing areas scattered around the country thickly enough to have a mass effect on recruitment of juveniles everywhere. Maximal reproduction from an area is generated by full protection i.e. marine reserves. The process can be started anywhere, and local and secondary principles can be used for precise positioning of the first reserves in each region.

The second bit of good news is that we already know how to handle situations like this. We do it all the time to create networks of hospitals, schools, fire brigades, and other systems which the community has decided are important. Precise locations have to be decided, but they are not the point that governs action.. Maximal delivery of the required effect is what we arrange. If we believe the effect is important we already know how to arrange it in political and social terms.

CHAPTER 10

SCIENTIFIC PRINCIPLES FOR A NETWORK OF MARINE RESERVES

This chapter was first presented as a talk at the 1990 conference of the N.Z. Marine Sciences Society. The original aim was to persuade my fellow scientists that it was their professional duty to promote a network of marine reserves. During the exposition of how this could happen and the minimum levels necessary, it became apparent that the discussion also helped with the questions of why it should happen and where.

Abstract:

Marine reserves are essential as controls for much of marine ecology and are often important in other branches of marine science. Equivalent non-exploited areas are required to separate natural and human-induced variation, and to measure either with reasonable efficiency and validity.

The political, administrative and social background for marine reserves has improved to the point that a nationwide network is now a practical proposition.

It is suggested that this society, as a responsible professional body, should support and encourage the creation of such a network.

To assist this, a first-level analysis is given of the marine reserves required for scientific purposes. The minimum set of marine reserves required to provide representative areas throughout New Zealand waters is determined, using existing knowledge of marine climates, biogeography and general ecology.

This minimum set of representative reserves is substantial and, in itself, goes a considerable way to providing the kind of network which could achieve broad conservation aims and other major benefits. These potential benefits make a network of no take marine reserves a socially acceptable project. Such a network would also be a large-scale experiment of considerable scientific interest.

INTRODUCTION

Scientific knowledge, experiment and prediction require controls for any factors which may significantly affect the results. In marine science, until recently, there have been few or no controls for general human exploitation. Either it was assumed these were unnecessary or that it was impossible to arrange them. Neither of these assumptions is generally valid in New Zealand.

The direct and indirect effects of human interference and exploitation in the New Zealand marine environment are now frequent and complex. In many marine investigations the impacts of human action are significant factors that need control comparisons to produce clear and valid conclusions. While it may never be possible to have completely "natural" situations for comparisons, unexploited marine reserves offer more natural baseline controls than are otherwise available.

A number of recent events, including some political and social changes, have made marine reserves easier to create and more generally acceptable.

(i) The two well-established marine reserves have proved practical, popular and beneficial in a number of ways.

(ii) For the first time a government department has been given a mandate to advocate marine reserves and arrange for their creation where this is appropriate for general conservation reasons.

(iii) Major changes in marine resource management and responsibility are in progress (Resource Management Bill, N.Z. Coastal Policy and regional responsibilities).

(iv) Public interest in and concern for the marine environment have considerably increased in recent years.

It is now appropriate for the New Zealand Marine Sciences Society and other professional scientific bodies to advise the government and the public on the scientific aspects of marine reserves. It should be made clear that representative unexploited marine reserves are required for the determination of natural baselines; that such baselines are needed both to facilitate fundamental understanding and to permit the provision of valid and appropriate advice on many marine problems.

In this paper, using a "top-down" approach, and being very conservative on all points, I hope to determine the minimum set of representative marine reserves needed for scientific purposes in N.Z.

BIOGEOGRAPHY

Three remote offshore island groups

A "ring" of remote islands surrounds N.Z. some 500-1000 km offshore, covering almost three-quarters of a circle. The Kermadecs, Chathams, and most of the subantarctic group are politically part of N.Z., but Lord Howe, Norfolk and Macquarie Islands are administratively Australian.

There is little agreement about either the nomenclature or methods of subdivision for marine biogeographic areas (see Knox, 1963 and 1975) and data exist for only some marine groups (see Ballantine 1990), but both the Kermadec and subantarctic island groups clearly have marine floras and faunas which are significantly different from the main islands of N.Z.

The Chathams are a rather different case. In the first place, the marine flora and fauna are not especially different from that of N.Z., except by virtue of many significant absences. Secondly, the marine biota has been heavily exploited for some time. Thirdly, the climate and hydrographic conditions are unique for the region (see Ballantine, 1990).

There is no doubt that, in terms of representing the marine biota of the New Zealand Region, these three island groups require distinct recognition. A large marine reserve has just (Oct. 1990) been established for the Kermadec Group. At least one representative marine reserve is needed at the Chathams and also in the subantarctic island group.

N.B. It might well be argued that the Three Kings Is. and/or the Snares should also be included as additional and separate items in this set, but I am applying the conservative rule and including only those for which there are no reasonable grounds for doubt.

The "mainland" - clines or province

It has long been recognised that there are major latitudinal differences in marine biota and conditions on New Zealand coasts, and that these affect virtually all groups.

There has been much argument about whether these differences are best represented by more or less distinct provinces or by a continuous cline. However, for present purposes, if we are seeking only the minimum set, the answer is the same in either case. Three provinces (Aupourian, Cookian and Forsterian) would require a minimum of three representatives. The minimum number of points that can represent a cline is also three. (Two would be sufficient for a "straight line" cline, but with many species and factors it is inconceivable that all would be represented by straight lines.)

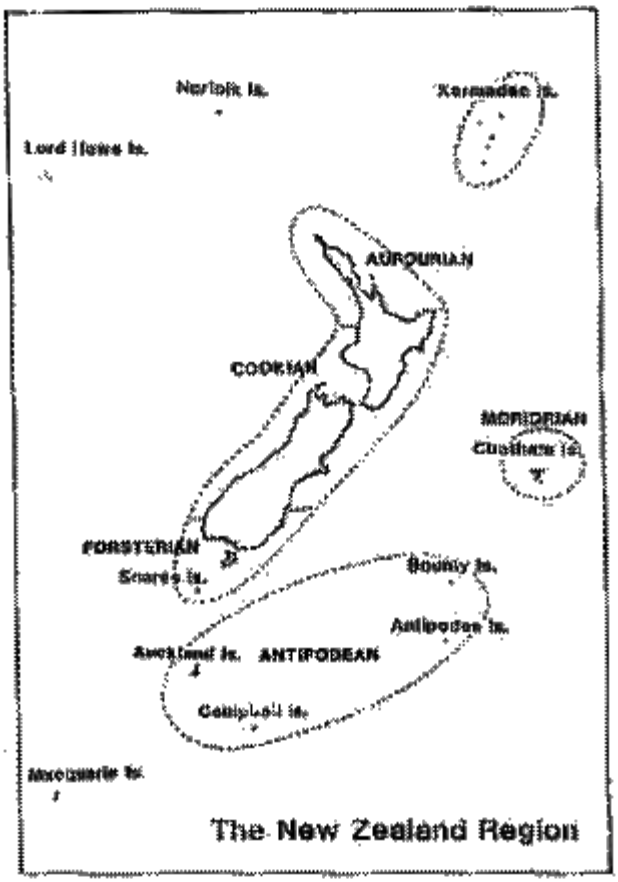
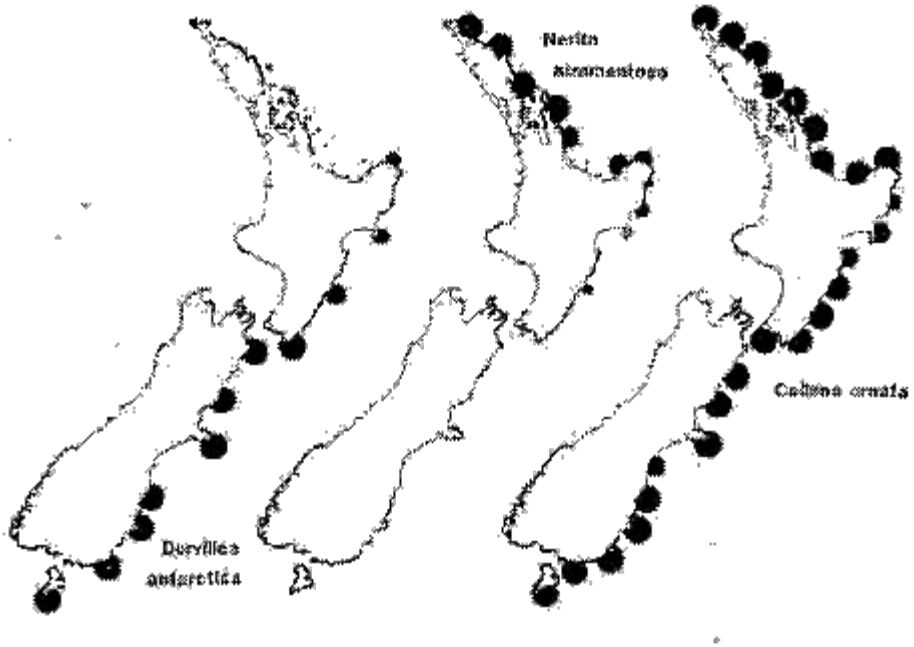


Fig 38 PROVINCES OR CLINES

(above) The New Zealand marine region, including the main islands, can be divided into "provinces" which may be biologically different.

(below) An alternative view for the main islands is that there is merely a gradual change in marine biology from north to south. The diagram shows the abundance on the east coast of a "southern" species, bull kelp (left); a "northern" species, a black snail (centre); and a "widespread" species, a limpet.



So for minimal representation of mainland coasts we will need three representative marine reserves: (a) north (b) central (c) south.

N.B. The conservative rule applies again. I am not arguing that three is the best number or even that it is enough. I am simply saying that it is not possible to have less than three if the problem of representativness is being given proper attention. See King *et al*, (1985) for an extended sub-division.

Two coasts

Although advocates for "provinces" have in the past argued for some form of equivalence between the east and west coasts of New Zealand, I doubt if there are any informed proponents of that view now.

Major differences between the east and west coasts include:
(a) Oceanographic or hydrographic factors e.g. wave regime, temperature ranges and patterns, amount of up-welling, etc.
(b) Geological or substrate factors e.g. sedimentation patterns, rock types, proportion of sandy beaches, etc.
(c) Biological factors. Virtually all species and groups for which good information is available have not only different latitudinal limits on the two coasts but also quite different patterns e.g. *Durvillea antarctica, Littorina cincta*.

Consequently for representative purposes the two coasts must be considered separately. For example, there is nowhere on the west coast that is "represented" in any useful biological sense by the East Cape - Gisborne coastal region.

N.B. In the Cook Strait area it is not always clear which is the "east" or "west" coast, in simple terms, but this complication would increase rather than reduce the set. The Marlborough Sounds have a strong claim to separate consideration. Another area which is clearly distinct in many ways is Fiordland.

On basic biogeographic grounds we thus have a minimum set of 9 areas, each of which must have a representative marine reserve for basic scientific comparisons. It could easily be argued that this set is too small, and prime contenders for an increase would be the Three Kings Is., the Snares, Marlborough Sounds and Fiordland.

Oceanic and outer shelf areas (including EEZ)

In my view representative unexploited marine reserves should be created in all waters under N.Z. control, but I have no expertise in oceanic areas and will leave them out of the argument at this stage. It should be noted, however, that the Law of the Sea requires the responsible country to manage any exploitation of biological resources in its Exclusive Econonic Zone on a sustainable basis. Considering our levels of knowledge of population dynamics in these areas a precautionary approach would seem advisable. Recent experience with orange roughy and hoki fisheries suggests quite strongly that the deliberate and official reservation of part of the stock, at least until a reasonable knowledge of the dynamics was available, would have been advantageous.

ECOLOGY

Coastal types

The subdivision of coastal forms and their associated topographies, physical processes and biotic communities can be carried out to any level. In this review it is suggested that the minimum subdivision which would be credible as representative is :

(a) offshore islands (and open deeper shelf)
(b) open coasts (and adjacent shallow shelf)
(c) protected coasts (and adjacent waters)
(d) enclosed coasts (and enclosed waters).

Offshore islands are those far enough out on the shelf (or beyond) to have major differences in their hydrographic regimes from the adjacent mainland (see Creese and Ballantine, 1986).

Open coasts are relatively straight, with a high proportion subjected directly to the prevailing wave climate and shelf current systems of the shelf.

Protected coasts are indented to the degree that much of the coastline and some of the shelf have physical properties different from the open coast (see Morton and Miller, 1968 Chapters 18-23).

Enclosed coasts, including harbours, inlets and estuaries, are those which are almost entirely protected from the open sea by land and hence have their own physical dynamics (see Heath, 1976 and McLay, 1976).

The topographies, substrates, physical processes and biological communities of these four subdivisions are so different that they are often studied by different groups of scientists using different methodologies.

Habitats, communities and ecosystems

It could easily be argued that many habitats or ecosystems should be given separate status e.g. mangrove forests or submarine canyons. However, the conservative principle is again applied. This is tempered by the probability that many of the arguably distinct habitats will inevitably be included within the general representative reserves.

ACTUAL PRESENCE AND COMBINATIONS

The need for a minimum of 9 areas and 4 types of coast does not produce the number of marine reserves required. The answer is not simply 9 x 4. There are two reasons for this:

(i) Some coastal types do not exist in some of the areas. e.g. there are no enclosed harbours or inlets on the Kermadec islands.

(ii) An actual marine reserve in any area could include more than one coastal type**.** Indeed this should happen if the opportunity arises.

Even allowing for these points, 25 or more separate marine reserves would be required to provide a minimal

representative set for scientific purposes.

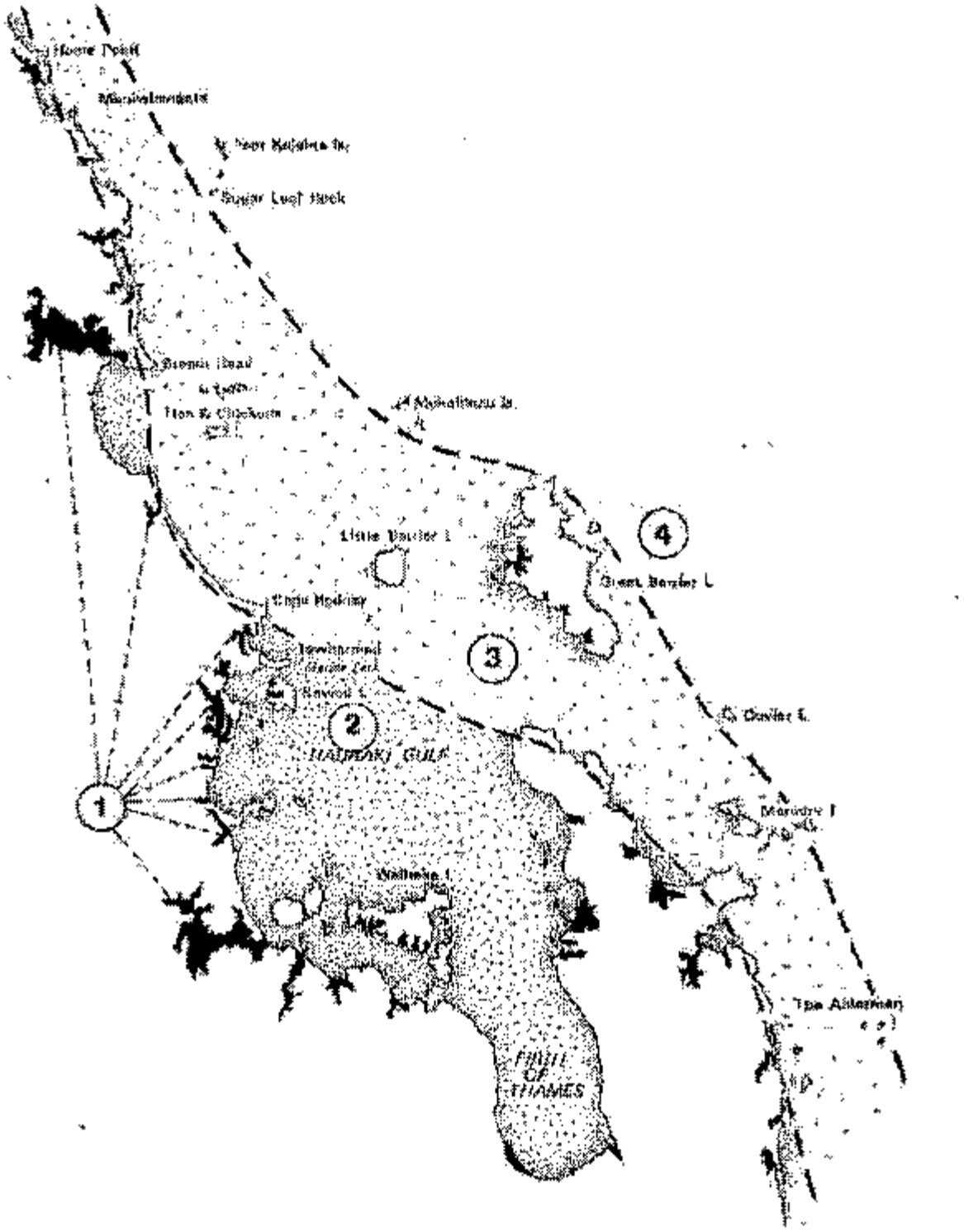


Fig 39 THE FOUR MAJOR COASTAL HABITATS IN THE HAURAKI GULF
Coastlines and many coastal habitats are fractals and thus very difficult to represent on a single map (of one scale). For example, note that all four habitat types actually occur round Great Barrier Island. However the general form of the Hauraki Gulf does allow an approximate division into simple zones. 1: Enclosed harbours and estuaries (in black). 2: Protected coasts and sheltered inner shelf (densely dotted). 3: Exposed open coasts and adjacent shelf (light dots). 4. Offshore islands and outer shelf

REPLICATION

It has often been pointed out, quite correctly, that results from a single marine reserve, however interesting or dramatic, do not prove anything in strict scientific terms about why or how the results occurred. What has happened only once could be a coincidence or other chance event. However, the corollary of this point has not yet had much serious attention.

If replication is required to demonstrate that changes occurring in marine reserves are due to the absence of exploitation and not some chance effect, then either we must have more equivalent marine reserves or we must give up the attempt.

The second option is simply unprofessional. Human use and exploitation of the sea is far too common, varied and important for its effects to be ignored. We must try to understand and, if possible, measure these effects. So we need more marine reserves that are suitable as replicates.

If the difference between the marine reserves and the exploited areas is very large (or virtually nil), and the marine reserves were very similar in all aspects apart from location, similar results from just two reserves could be accepted as a clear demonstration of the effect. However, for most purposes three equivalent reserves would be needed in each case. This point is, from a theoretical viewpoint, extremely obvious and basic, but its practical application would require a great deal, beginning with a serious and public commitment by marine scientists as professionals.

We are now obliged to state, that for the proper understanding of any important point in marine science that is likely to be affected significantly by human actions, suitable replicate unexploited marine reserves are a scientific necessity.

"Suitable" in this context means, as a minimum, falling within one of the subdivisions discussed above. Consequently, the minimum set of marine reserves required for strictly scientific purposes rises from around 25 to around 75. The social and political implications of this are so serious that the matter would probably be dismissed as impractical were it not for compensating (but non-scientific) benefits that would also result (see section on network effects below).

SELECTION AND SURVEY OF THE REPRESENTATIVE AND TYPICAL

Any area is both representative in many respects and unique in many others. It is relatively simple to prove scientifically that a particular area is unique in one or more respects, and hence develop a scientific case for its special treatment. Not only is this logically straightforward - the data collection required is generally quite easy. Because of the focus on extremes, most cases can be dismissed without serious investigation. To determine the deepest fiord or the largest mangrove forest does not require widespread or detailed investigation.

The concept of typical or representative is much more difficult, both in logic and in practical terms. Strictly speaking, it is not possible to prove that something is the "*most* typical" of its kind, except in very restricted cases. Furthermore, the data required to make even rather loose statements about "the best representative" are not limited by any clear criteria. In real situations the most typical or best representative of a set will always be an opinion. No amount of data can prove an area is the most typical of its kind, even if all areas have been investigated, and the more aspects that are investigated the more difficult the problem becomes.

The selection of actual areas as representative marine reserves will, of course, require some scientific information as background, but it must be accepted that both in theory and practice it is not possible to prove on scientific grounds that a particular area is the best representative one. Although politicians, administrators and the general public will press strongly for scientific proof that an area is the "right" one, this must be resisted on professional grounds. The prospect of employment or grants will be tempting, but if we are to retain either public credibility or professional standards we cannot afford to fudge on this issue.

(Note. There will be a gradual change on this point as more marine reserves are established. When, as on land now, there are many marine reserves, scientific data and analysis will become important as an actual selection agent. But not yet. The scientific selection of the first and most representative area for a marine reserve in South Island is a meaningless concept. When there are a dozen or more marine reserves in South Island it will be possible to show scientifically that a particular aspect is not yet adequately represented.)

Fortunately, there is a valid and practical approach which not only gives politicians and the public what they

need, but also employs marine scientists in a proper and useful manner.

Professional marine scientists can and should act at a number of levels:

(a) advise on the need for representative marine reserves on all scales - nationally, regionally and locally - developing this by both principles and examples;
(b) extend a "top-down" analysis to regions and local areas - showing what there is and what needs to be represented;
(c) when actual representative areas have been selected (see below for method), carry out appropriately detailed surveys inside and equivalent areas outside the proposed reserves;
(d) carry out monitoring of established marine reserves and equivalent exploited areas on a continuing basis.

(Note. If the interest is in the effect of the reservation, the monitoring in the reserve is the experiment and outside is the control. If the interest is in the effect of human impact then the labels are reversed. The important point is that studies within marine reserves and without are required in either case. Professional marine scientists should make this very clear to all. It is still very common for impact studies to be done without any attempt at natural baseline comparison. This is scientifically improper, and is much less likely to give valid and useful results.)

The actual selection of the representative marine reserves (i.e. their precise location and boundaries) can and should be done on a pragmatic and social basis within the general boundaries set by scientific data. Pragmatic and social criteria include recognisable boundary markers, ease of access and surveillance, existing levels and types of use, etc. It should be noted that many of these are two-edged. For example, a particular site might be selected because it had easy access and was frequently visited or for exactly the opposite reasons. These pragmatic criteria are important, indeed overridingly so, when precise selection is the issue. They are the proper domain of politicians, planners and the public. Providing the selected marine reserve represents the general conditions and habitats required, it is not for marine scientists, as such, to say whether it should be near or far from a road, boat ramp, or population centre.

UNIQUE AND SPECIAL AREAS

There are often good scientific grounds for wanting to maintain the natural character of unique and special marine areas. These scientific grounds are usually strongly supported by arguments based on heritage, aesthetics, and conservation. Indeed, the arguments in favour of reserves for special or unique areas are so strong there is a danger that they may overshadow the importance of representative reserves. Politicians and the general public are much more likely to see the point of special status for special areas than the point of restrictions on the existing use of typical and representative areas. Because of this, in my view, marine scientists have a special duty to point out the scientific (and other) values of representative marine reserves.

When professional scientists are asked to advise on or survey special or unique areas with a potential for marine reservation, they should seriously consider the possibility of adjacent areas being included as "representative". This has a number of advantages, including the scientific one of providing clearer comparisons with both the special area and exploited areas.

We have seen above the scientific problems of precisely locating representative marine reserves. It is practical and scientifically useful to locate such reserves around or adjacent to some unique or special feature. For example, the waters surrounding a special island, or the area between it and the mainland.

Unique or special marine areas occur on all scales. Large areas include Fiordland, Marlborough Sounds, Banks Peninsula, the Bay of Islands and the Kaipara Harbour. These areas may be so large that there is no question of total reservation. However, they may be so large that several small or moderate-sized marine reserves will be needed within them.

Small unique areas such as White Island, Castlepoint, the lagoon of the Wairau River and Kaikoura might have substantial or total reserve status and include adjacent representative areas.

The minimum number of unique or very special unexploited marine reserves in New Zealand of great value to science is, of course, pure opinion. In my view this number is unlikely to be less than 25.

EXISTING EXAMPLES

New Zealand has only two well-established marine reserves. The first, near Leigh (the Cape Rodney to Okakari Point Marine Reserve), is a typical piece of north-east "open coast". Its only unique features are being the nearest such place to Auckland by road and being adjacent to the University of Auckland's marine laboratory. Although it is an excellent example of a representative area, it should be noted that it was its unique (human arranged) features that promoted and secured its reserve status.

The second marine reserve is around the Poor Knights Islands and is a good example of the special or unique in many respects (and was established for these features), but it is also a representative of the "offshore island" coastal type. With the benefit of hindsight, it is now clear there would have been real scientific (and other) advantages in making the Poor Knights reserve completely unexploited and including a larger area of surrounding sea (as representative of outer shelf in that region).

SIZES AND NUMBERS

The argument, so far, has avoided the issue of the size of reserves and the effect of this on the number required. Although there are many complex points involved, it is possible to reduce their practical effect by dealing with them in the appropriate order.

(i) The minimum number of 9 - to represent biogeographically distinct areas - would not be altered by any practical size of marine reserve.

(ii) Unlike on land, in the sea the largest reserves are not necessarily the best (unless they are enormous and hence impractical). Many marine populations have dispersive phases and reproduction is decoupled from recruitment. It is rarely possible to identify the parental origins of any particular population or to specify to which area(s) the offspring of one population will recruit.

In any case the answer is likely to be different for each species (with different reproductive seasons and length of planktonic phase), and often different in the same species for different years (owing to current variations - whether random or systematic). It follows therefore that a network of reserves (including spaced replicates) is much more effective in promoting recruitment (including to other reserves) than a few large ones.

(iii) Present knowledge of the interactions between different marine habitats and ecosystems is sufficient to show that these are common and important, but is not nearly good enough to specify what sized areas would be self-sustaining. Consequently while reserves should contain as many representative habitats as possible, this should not override the principle of a network.

(iv) The minimum area of biologically useful marine reserves is likely to be a few square kilometres, except where the entire system itself is smaller (e.g. a small estuary). Even in this case the addition of some adjacent sea would be highly desirable, since important interactions with the adjacent sea are very likely.

(v) There is no scientific maximum size, but the need for networks and spacing will, combined with social practicality, impose upper limits.

NETWORKS AND NON-SPECIFIC SYSTEMS

It is unlikely that there would be any serious political urge to set up 50-100 marine reserves just because they would be extremely valuable for scientific purposes. However, there are other potential benefits from marine reserves which can be expected to attract strong political interest. The most important and the most controversial of these are the potential effects of marine reserves on exploited fish and shellfish stocks.

It would be fair to state that fisheries management has been, at best, lukewarm on the issue of unexploited marine reserves. Until recently the reasons seemed clear, practical and compelling. In single species management (which is almost universal), if the fishery was doing well, there was no apparent need for any action. If, on the other hand, the fishery was in difficulty (or had even collapsed) it seemed crude to prohibit fishing for all species in any area. Furthermore, it was rarely, if ever, clear which areas would help (by closure) more than others.

Without denying any of these points, it is now clear that approaching the problem more broadly could be very

helpful. Although single species management is usually the only practical option for most fisheries, it has obvious deficiencies, which become more serious if:

(i) good information on population dynamics is not available;
(ii) other exploitive pressures are strong (affecting the particular species in food, habitat, or other ways);
(iii) there are rapid changes in markets, prices, costs, catching systems, etc.;
(iv) political or social pressures affect the actual management decisions.

Normally, one or more of these problems will be present, with the result that, although the management policy may well be the best practical option, it is often a high risk policy.

It is unlikely, in a real world, that we will be able to get rid of these difficulties, despite continuing efforts to do so. Consequently, we need some insurance to reduce the risk. If this insurance is non-specific, in both senses of that word, so much the better. Indeed in this case, broadening the issue may help provide some of the answers when all attempts to define the problems more closely have been self-defeating.

If we do not wait for measurable damage to a fishery, if we do not look at each species separately, if we do not attempt to identify the "right" areas for closure, if we do not try to achieve specific aims, then we can act on basic principles, create networks and have a much better chance to achieve general aims. These general aims would include:

(i) protection of representative areas, covering all types of habitat in all regions (for heritage and conservation as well as scientific reasons);
(ii) a reduction in the risk involved in *any* specific policies (by having areas in which they did not apply and thus providing some degree of back-stop);
(iii) a gain in basic understanding of natural processes (by having places where they were more natural)
(iv) an increase in the opportunity for learning the effects of specific policies (more clearly, more quickly and more cost-effectively);
(v) a chance to improve specific policies (by earlier notice of effects and improved understanding of basic processes);
(vi) a chance to improve breeding stocks, even in those species currently deemed to be mobile.

A few unexploited marine reserves are unlikely to have any general or widespread effects, however large the difference between their state and that of adjacent exploited areas. However, a network of such reserves is likely to have such effects. We do not know, and may never know, which parts of the network achieved which results. This is unfortunate, but is relatively unimportant compared to achieving the general aims. Furthermore, our capacity to determine the precise effects of particular pieces of the network has nothing to do with the chances of the overall effect being achieved. Ordinary nets are very useful in tying down mixed loads on a truck despite the fact that it is rarely possible to say which bit was doing how much to achieve the overall result. Indeed, since it is usually possible to cut any single strand of a large net without affecting the total result, it is probable that the concept of precise effect is meaningless in this context.

If we are to understand the properties of multiple and variable interactions on large scales (network effects), such as the probabilities of larval recruitment on our coasts, we will require not just new kinds of theory and calculation, but large-scale observations and experiments on which to base these. A network of non-exploited marine reserves offers this possibility.

MEASUREMENT AND TOTAL SCOPE

Coastal features are difficult to measure because of the non-standard geometry. Although some coasts are almost straight (e.g. Ninety Mile Beach), approximating to simple lines with one dimension, and open sea habitats can be considered as areas with two dimensions, the majority of coastal habitats have intermediate properties. They are fractals (Mandelbrot, 1977).

It has long been known that coastlines do not have a length. Any measurement of coastline length depends on the scale of the map and the "stepping" unit. For example, if we set dividers at 1 cm and step them round the coastline of New Zealand on a map:

Scale of map x 1,000,000	No. of steps @ 1 cm	Step distance kilometres	Total coastline kilometres

60	5.2	600	3,120
25	13.3	250	3,325
15	25.2	150	3,780
7.5	55.3	75	4,147
4.0	114.7	40	4,588
2.5	212.0	25	5,300
0.25	3951.0	2.5	9,862

Note: I have not yet made similar measurements on a scale of 1: 50,000 which would probably be the most appropriate, but trials on small areas suggest the total coastline would then be around 15,000 km.

This has important practical effects. If, for instance, it was decided to have marine reserves round the coast at intervals of no more than 100 km, the number of such reserves would depend greatly on how the measurement of 100 km was made (see table above). If we try to simplify and make the 100 km measurements as straight lines, we still have the problem of expressing the resultant set of marine reserves as a proportion of something, and this cannot be the coastline unless we specify both the scale of the map and the unit of stepping.

Despite these technical problems it is worth doing some first-order calculations, just to give the scope and relations of the proposals.

If 75 marine reserves were created in New Zealand, each consisting of 10 kilometres of coastline measured in a straight line, they would in total amount to approximately 10% of the coastal fractal at a scale of 1 : 1,000,000 and with straight line steps of 1 cm (equaling 10 km on the map).

This proportion changes as the scale is changed, decreasing with larger-scale maps and/or smaller stepping distances. At a scale of 1 : 50,000, the above example would reduce from 10% to 5% of the coastline of New Zealand.

Since 1980, I have been recommending that 10% of all New Zealand coastal and marine habitats be placed in nil-extraction marine reserves (Ballantine, 1980, 19887b, 1989b). It is interesting to notice that although this figure is very large compared to existing marine reserves, it is of the same order as the minimum required for scientific purposes.

CONCLUSION

The set of marine reserves round New Zealand required to provide minimum representative properties and replication for scientific purposes can be calculated from basic principles.

This minimum set is a substantial proportion of that needed to provide a nationwide network for conservation purposes and other broad socially desirable aims.

The provision of such a network in therefore not just scientifically desirable, it is also a practical proposition.

This short piece was written in February 1991 for inclusion in the New Zealand Journal of Marine and Freshwater Research, which was starting a "Personal View" column to coincide with their 25th year of publication. The aim was to stress the point that marine reserves are experiments, and must be judged as such in scientific terms. Just because there is no clear evidence that a particular reserve will produce a particular result, is not a good scientific reason for opposing it or being indifferent. Scientists must decide whether the experiment is worth doing. When there is the possibility of a network of reserves, the experiment is a very large one but has correspondingly large potential value in scientific terms.

MARINE RESERVES: THE NEED FOR NETWORKS

Over the next few years New Zealand is likely to establish a significant number of marine reserves; areas of marine habitat without extractive exploitation and in which human interference is minimised. At present there are three marine reserves: at Leigh, the Poor Knights Islands and the Kermadec Islands. Three more - Pollen Island, in Auckland's Waitemata Harbour; at Kapiti, near Wellington; and near Hahei, on the Coromandel Peninsula -. await ministerial decisions. At least 10 more are in an advanced stage of public discussion and further areas are under active consideration. Some of these proposals are being made by the Department of Conservation, others by local iwi, diving clubs, environmental organisations, local authorities and even fishing clubs.

Marine scientists need to decide their reaction to these proposals. Possible reaction ranges from enthusiastic

encouragement to total disapproval, or even complete unconcern. There is not a lot of evidence on which to base a professional reaction to marine reserve proposals; the factual background is capable of a wide range of interpretation and does not allow precise prediction of what would happen if a particular area of sea was reserved from exploitation and active interference.

In my personal view, it is no longer proper for scientists to remain indifferent to this issue. Indeed it is now necessary to consider the potential value of a network of marine reserves, rather than just assess each proposal as it comes up for decision. What is the appropriate scientific reaction to an important matter on which the available evidence is inadequate?

In our normal research programmes we have no great difficulty in sorting out this type of problem. Before proceeding with a scientific experiment we consider:

1. Is the matter scientifically interesting?
2. Is it practical to proceed, do we have the means?
3. Is it likely that useful information would be generated?
4. Are there dangers of harmful side effects to others?
5. Are there likely to be non-scientific benefits?

In our assessment of these questions we examine the available factual evidence primarily for an indication of trend, not for actual predictions; and we use total professional experience rather than precise tests. We must do so, or no worthwhile original experiments would be undertaken. Although setting up a network of "no take" marine reserves is a very large experiment, and has very important political and social implications, I believe we should not be overawed by these points, but concentrate on well-tested professional principles. Applying these:

Are marine reserves scientifically interesting? This is the simplest point. It is obvious that human-induced effects in the sea are frequently significant factors in marine investigations. The fact that the pathways and the degree of the effects are often unknown only strengthens the scientific interest. Any chance of separating more clearly natural and induced variation has high scientific priority. We do not know the extent to which marine reserves would assist in this, but we do know that they would help. It is the duty of professional scientists to argue for straighter rulers and clearer base lines as a matter of principle.

There are also the practical points: experiments and observations in marine reserves are easier, less vulnerable, and have fewer uncontrolled variables. These can be very important if the work is long-term, has valuable or delicate apparatus, involves subtle behaviour or looks at complex interactions.

Is it practical to plan a network of marine reserves for New Zealand? The final decision on this is, of course, political. Exact prediction is not possible, but the political and social indicators are clearly favourable. There would be little direct cost, and the public mood is now in favour of more care in marine resource management, including actions perceived as pre-emptive or acting as insurance. At the last election all political parties had favourable comments on marine reserves in their manifestos.

Would more marine reserves generate useful information? The two reserves established for more than a decade, have already helped generate a substantial amount of worthwhile science (for summaries see Ballantine 1989a, and the five review articles, 1988, in *N.Z. Journal of Marine and Freshwater Research,* volume 22 p.415-489). As pilot tests the existing reserves give clear indication that the answer is yes. These two reserves are both off the NE coast and relate mainly to shallow rocky habitats.

Results from other regions and habitats can be expected to provide further valuable information of the same type. In addition, comparisons between marine reserves in different regions and habitats would generate new kinds of information. The establishment of "replicate" reserves (i.e. similar habitats in the same regions) would increase the precision for all types of data and enable statistically valid conclusions. The provision of enough marine reserves to form a network would be an experiment of great value, providing information on key questions including larval dispersal, stock/recruitment relationships and large-scale interactions.

Will there be significant harmful or beneficial side effects from more marine reserves? These are undoubtedly the most difficult questions. But even here there are some good indicators. Experience with the first reserves shows that harmful effects (other than the political and administrative hassles of getting them established !) are not serious provided there is sufficiently large public support for their existence. On the other hand there is a strong probability of benefits including those involving cultural heritage, recreation, tourism, education and basic conservation. It is widely perceived that these benefits did arise from the existing reserves, and they are being actively sought by a variety of groups for other areas. Because of their pressure, government at local and national level is becoming interested.

Current management regimes for marine resources worldwide have concentrated on single issues and damage limitation. Virtually all fisheries management policies are single species policies (or applied as such). Virtually all planning for other activities in the sea waits for "problems" and then acts to limit damage or conflict. Historically and practically these approaches have every justification, but as activities increase, not just in amount but in range and overlap, the risks become higher. The results of ever-increasing patch-ups, however carefully arranged, not only provide diminishing returns in effectiveness, they actively prevent any real progress in understanding. As ad hoc reactions multiply the chance of determining natural baselines and the real driving processes rapidly diminish. Other countries, because of greater population density, greater affluence, or higher levels of activity, have traveled much further down this road than New Zealand has done yet. We should note carefully the results for scientific understanding.

Other countries have many times the marine scientific effort available in New Zealand, but in terms of understanding basic marine processes the effect is far from proportional. One important reason is that in New Zealand it is still often possible to estimate natural processes in the sea or at least form some reasonable idea of what they were like. This is not possible in most parts of the world, and could soon disappear here, unless deliberate action is taken.

In New Zealand we could make a decision in principle to arrange a network of non-extractive marine reserves, with the lowest practical levels of human interference, covering all habitats in all regions, and with suitable levels of replication. Such a network would greatly assist marine science. This would help retain natural baselines and the chance of discovering natural processes at all levels - a matter fundamental to all branches of science, whether academic or practical. There would also be a chance of much wider benefits.

Whether a network of marine reserves would produce any significant benefit to exploited fish or shellfish stocks is probably the most controversial question and the most obvious potential benefit. The short answer is there is no conclusive evidence either way, and the reason for this is that the experiment has never been tried. New Zealand has a real chance to do the experiment, and find the answers, which would probably be different for different species and regions.

I believe all professional marine scientists in New Zealand should consider the concept of a network of marine reserves, come to clear conclusions based on principle and overall experience, and make their conclusions widely known. The final decision on each reserve will be political but the concept of a network could raise the matter above local expediency; avoid unproductive arguments about what particular marine reserves might or might not achieve; and provide a scientific rationale for more reserves.

BOX 12

PREACHING TO THE CONVERTED

Henry James, the American novelist, once remarked that new ideas go through three stages. At first people just say, "*Ridiculous*". Some time later on they mutter, "*Well, maybe*." In the end it's, "*We always knew that.*"

I look forward to the time when marine reserves are regarded as obvious, and I believe that if we think carefully and act sensibly, this time is not remote. I hope to see it in New Zealand.

We should look more closely at the process, otherwise we give up too soon. At what stage is some one converted to a new idea? When they stop yelling at you for mentioning it? When they mutter, "*I suppose so*" to stop you bothering them? When they begin to be interested? When they begin to help? Or is the very last step the key - when it really matters to them?

The ten stages:

1. *Be off or we'll put the dogs on you.* The suggestion is wicked.
2. *Go and look on the rubbish tip.* The suggestion is silly.
3. *You can look in our rubbish bins.* The notion is not worth our attention.
4. *You may look under the table for crumbs.* The notion is trivial.
5. *We will try to save some crumbs.* The idea might have something in it.

6. *It may be considered for a small slice.*	The idea is worth thinking about.
7. *It will get a reasonable share.*	The proposal must be considered.
8. *It will be given a decent slice.*	The proposal requires some action.
9. *It will get a big slice.*	The matter is important.
10. *It will be first and best served.*	The matter has top priority.

In the 1960s most New Zealanders' views on marine reserves were somewhere in the first three stages. Either they didn't think about the matter at all, or, if they did, it seemed to have no significance for them. Today many people have moved to stages 4 to 7. The idea of marine reserves has reached them, it has gained some level of respectability, but it has not yet become exciting or important.

For any successful change in the social and political field, such as the establishment of a network of well-supported and effective marine reserves, two points must be covered.

First, the great majority of people must be converted to around stage 5 or 6, and no one left at stage 1. This process is well under way. But it needs more effort and, in schools, a continuing effort. We know how to achieve this level of conversion, but we need more efficient ways of doing it and more people involved.

Second, before much will actually happen, a significant number of people have to be converted to stages 8, 9 or 10, that is, committed to the idea. This process has begun but is still marginal. Some local groups are very active, but the great need is to transform more of the half-converted into effective enthusiasts.

CHAPTER 11

ADVOCACY FOR MARINE RESERVES

This chapter was first presented to a workshop on marine reserves organised by the Department of Conservation in Wellington in March 1990. It aims to draw attention away from legalisms and bureaucratic procedures and to concentrate instead on the fundamental task of convincing a large number of citizens that marine reserves really matter to them. If this is achieved the necessary procedures will be found, but if not, they won't be needed.

SUMMARY

Advocacy for particular marine reserves should aim at creating enthusiastic supporters. Trying to "satisfy" potential objectors should be secondary.

While "locals" and "user" groups must be given attention, the main thrust of advocacy should be directed at all times to produce support amongst citizens at large.

Widespread and enthusiastic support for particular marine reserves requires a general cause (as well as a good particular case).

It is not possible at this stage to have a detailed high-level policy, to act as the "general cause". Such a policy will develop from the success of establishing particular marine reserves.

In the meantime, as a substitute, we can make a series of (almost) self-evident statements about the sea, which strongly indicate the need for active conservation.

If properly organised, these statements produce an informed, concerned and actively-supportive public, and a

general rationale for particular reserves.

Incidentally, these statements suggest "answers" to selfish, narrow-minded or ignorant objectors.

THE BACKGROUND FOR ADVOCACY

1. It is natural, but quite wrong, when attempting to promote a particular marine reserve, to concentrate on the potential objectors. While a certain amount of effort is necessarily given to "answering" objections, even a small amount of commonsense will indicate that, in many cases, this will not be possible - at least to the satisfaction of the objector.

The last point shows that the real problem is not to get rid of the objectors, but to create a large number of supporters. Even when "answering" objections, the real point is not whether your answer convinces the objector, but whether everyone else believes the answer is reasonable and fair.

2. It is natural, and required by the legislation, when promoting a marine reserve, to consult with the "user groups" and "interested parties". However, this should be very carefully interpreted. It does not mean this is where most of the advocacy effort should be placed. Again, commonsense shows that while it would be very nice if all those currently exploiting an area can be persuaded to stop doing so, it is not very likely. What is much more likely is that many other people (not currently "using" the area) can be persuaded that this is a good idea.

3. In the final analysis, Ministers will approve a marine reserve only if they are convinced that it will have very strong support. There will always be some unsatisfied objectors - this can be assumed. What will decide the matter, politically and socially, is whether these are overwhelmed by widespread and enthusiastic support.

4. Local support is, of course, more important than distant support. User group support is more important than that of the general public. These points will be given weight in any decision and will affect the working of any marine reserve that is created. However, it should be stressed that "more important" means just that.

From the creation of the marine reserve at Leigh in 1977 to the marine mammal sanctuary round Banks Peninsula in 1989, it has been quite clear that political approval and effective operation depend not on whether there are 5, 10 or 200 objectors (however vociferous), but on whether there are 20 or 20,000 supporters.

5. It is difficult to create active public support for anything. It takes time and effort. The media are fixated on short-term specific events and public reaction to them; this must be remembered when dealing with the media. "Interest groups" fit the media view and are regularly consulted by them on any issue. But the public at large only becomes concerned if they perceive larger long-term issues.

6. Active support from the general public depends on having a good case for a particular marine reserve, **and** a general cause, a rallying cry, an overall policy that makes sense. The first marine reserve was created because the public felt there should be *somewhere* marine science could operate undisturbed. The Poor Knights reserve was designated because the public felt that *unique underwater life* should be protected. The marine mammal sanctuary came into being because of a general feeling that *N.Z.'s own dolphin* needed it.

It should be noted that the Kermadec reserve, which had virtually no opposition, and was proposed by a government department, took more than 5 years to establish, because it had little if any public support. If the Government had thought a sizeable number of voters cared, it could have happened within months.

7. Department of Conservation staff in each conservancy and district will, with local advice, be able to come up with good cases for particular marine reserves. However, they may have much more difficulty in producing the "general cause" which is needed for success. Even if they could think of a suitable one, they might not be able to state it forcibly because general policy is not their job. The problem is it isn't anyone else's job either, and for hard practical reasons.

8. The problem is a classic "Catch 22". If government at central or regional level did formulate a clearly defined marine reserve policy today or in the near future, it would have to be based on public perception as it exists. However, the whole problem of declining marine stocks, degraded habitats and creeping losses has arisen because public perception was, and generally still is, based on unrestricted exploitation of the sea, except where damage has been proved, measured and assigned to cause. Our level of knowledge about the sea is so low that proof is rarely possible and only when the damage is severe.

The situation is changing, more and more people are dissatisfied with this perception, but they are not yet a majority or in any way united about what action they want.

9. For the foreseeable future the process of *selecting* particular marine reserves is inextricably involved with the development of *policy for* marine reserves and the defining of actual goals. This is awkward, inefficient but inevitable.

Neither the Department of Conservation nor the Government has any wish to impose marine reserves against the will of the people, and even if they did, such reserves would not work.

The New Zealand Herald

Published since 1863

AUCKLAND, TUESDAY, SEPTEMBER 15, 1987

UNDERWATER RESERVES

For a country whose citizens can never get far from the sea, that considers itself something of an aquatic playground, and is justly proud of its many maritime exploits, New Zealand has a sorry record in the conservation of its coastal resources.

The management and planning of the coastal zone has for years been a hotchpotch of varied and often conflicting administration. Only now, with the management mandate given to the Department of Conservation, has it some promise of achieving cohesion and preventing further despoliation.

Of equal concern is the pace at which specific marine areas have been set aside for conservation and protection. This year the country celebrates 100 years of national parks. Nearly three million hectares, including the islands and coastline in three maritime parks, has been devoted to conservation. Yet similar preservation for marine flora and fauna dates only from 1971. And so far, less than 4000 hectares of coastal sea, in two marine reserves and three marine parks, has been conserved.

Current legislation is both restrictive and inadequate. The Marine Reserves Act is primarily concerned with conservation and scientific study. Marine parks, such as that bordering the Auckland Regional Authority park at Tawharanui, had to be accommodated under the Fisheries and Harbours Acts to allow some recreational fishing.

In 1986 the Ministry of Agriculture and Fisheries proposed a network of 34 marine reserves and parks for the Auckland region. It also produced the draft of revised legislation that would allow such areas to be set aside for different purposes. In some reserves there may be total preservation while others might cater for limited recreational fishing.

Sadly, the proposals were almost immediately submerged as the ministry gave priority to restructuring the fishing industry. Now the Department of Conservation, which has assumed responsibility for marine reserves, has retrieved the ministry proposals and hopes to have a revised policy on marine resource protection and a draft bill ready for public scrutiny by Christmas.

That can hardly be too soon. Anyone who doubts the worth of protected areas for conservation, recreation or as economically valuable breeding refuges, need only experience the aquarium-like Goat Island reserve, near Leigh, that began the marine reserve concept. A network of similar reserves has been a long time coming. The national parks' centenary year is an appropriate time to correct that.

Fig 40 LET'S GET ON WITH IT!

An editorial from the *N.Z. Herald* in 1987, which shows that even then the idea of a network of marine reserves was clear and straight forward. The problem is that it has not yet achieved political interest. To get a network of marine reserves, it will be necessary to spread the idea much more widely and generate a sense of urgency.

(reproduced with permission, copywrite New Zealand Herald)

However, the Government has given the Department a *mandate to advocate* marine conservation generally and marine reserves in particular.

10. Providing "the policy" is a careful, clear, sensible, stepwise set of statements with which every reasonable person can agree, it should be possible to start the process of "stating" it now and adding to it in the future, without exceeding authority or upsetting any of the system. It won't be called a policy, just a set of statements which are obviously true. However, when considered in order these statements will provide a general reason for action on marine reserves, and suggest "answers" to objectors.

Individual staff members (and many thinking members of the public) have already started this process. The following is a distillation of points heard over the past two years in various parts of N.Z.

THE GENERAL CASE FOR MARINE RESERVES IN NEW ZEALAND

(a) Marine resources in N.Z. have declined over the years.

(b) The details of this decline (in terms of species, habitats, amounts, locations and causes) are often obscure.

(c) While a great deal of political and social effort is put into "allocating" marine resources, very little has been done, so far, to ensure the continued existence of these resources.

(d) General experience strongly suggests we should not just "share out the cake" properly and fairly, but also make real efforts to "keep the bakery going".

(e) We do not have enough knowledge of marine life or processes to manage marine resources precisely or exactly, and despite our best efforts this situation will not change quickly.

(f) We cannot just stop using the sea, but we need some real insurance against adverse effects of our general ignorance, diverse activities and increasing pressures.

(g) We can stop exploiting some pieces, and experience with marine reserves in N.Z., although limited, strongly suggests that unexploited and undisturbed marine areas are useful in many ways.

(h) Marine reserves are the only really practical measure of the effects of our activities in the rest of the sea.

(i) Clear demonstrations of these effects are essential for sustainable policies throughout the sea. We should not control important activities on mere opinion. The fastest, cheapest and most certain way of measuring effects is to have places they don't occur.

(j) The more important the activity, the more important it is to sustain it, and therefore the more urgent to find out if present levels and methods are sustainable.

(k) Marine reserves greatly improve our knowledge gathering power. Indeed, it is difficult to find out anything important in areas that are being exploited in various ways at the same time.

(l) Marine reserves are a considerable help in training and education at all levels. In fact, learning about the natural basis is only possible where it is not being actively disturbed.

(m) Marine reserves are very important for recreation. All people some of the time (and some people most of the time) wish to see the full natural abundance and diversity of marine life. It is socially just and reasonable for there to be places where they can do this (either personally or via the media).

(n) Tourism and recreation are now major industries. Marine reserves in many cases are an extremely valuable asset for these. People wish to see something different, and as pressures and activities in the sea build up, places with the full natural abundance of life and habitat will be increasingly different.

(o) Marine reserves are necessary for cultural and heritage reasons. While morals are hard to state in a way which in universally acceptable, it is clear that people, including future generations, have a right to know and share the complete

range of natural conditions that we inherited. We need to ensure that this is possible.

(p) For many reasons (standard conservation arguments) marine reserves act to ensure the preservation, not just of the continued existence of marine species, habitats, communities and ecosystems but also of their diversity and natural operation.

(q) It follows from much of the above [especially (h) to (p)], that marine reserves are needed not just in one or two places but in all regions.

(r) It also follows that marine reserves are needed not just for some habitats or conditions but for the full range that exists in our seas (especially because we do not know what all the bits do or how they fit in terms of processes).

(s) There are special reasons for wanting marine reserves for special places (unique, beautiful, historic, etc.) and these should be developed on a specific basis i.e. where the particular reasons are strong enough.

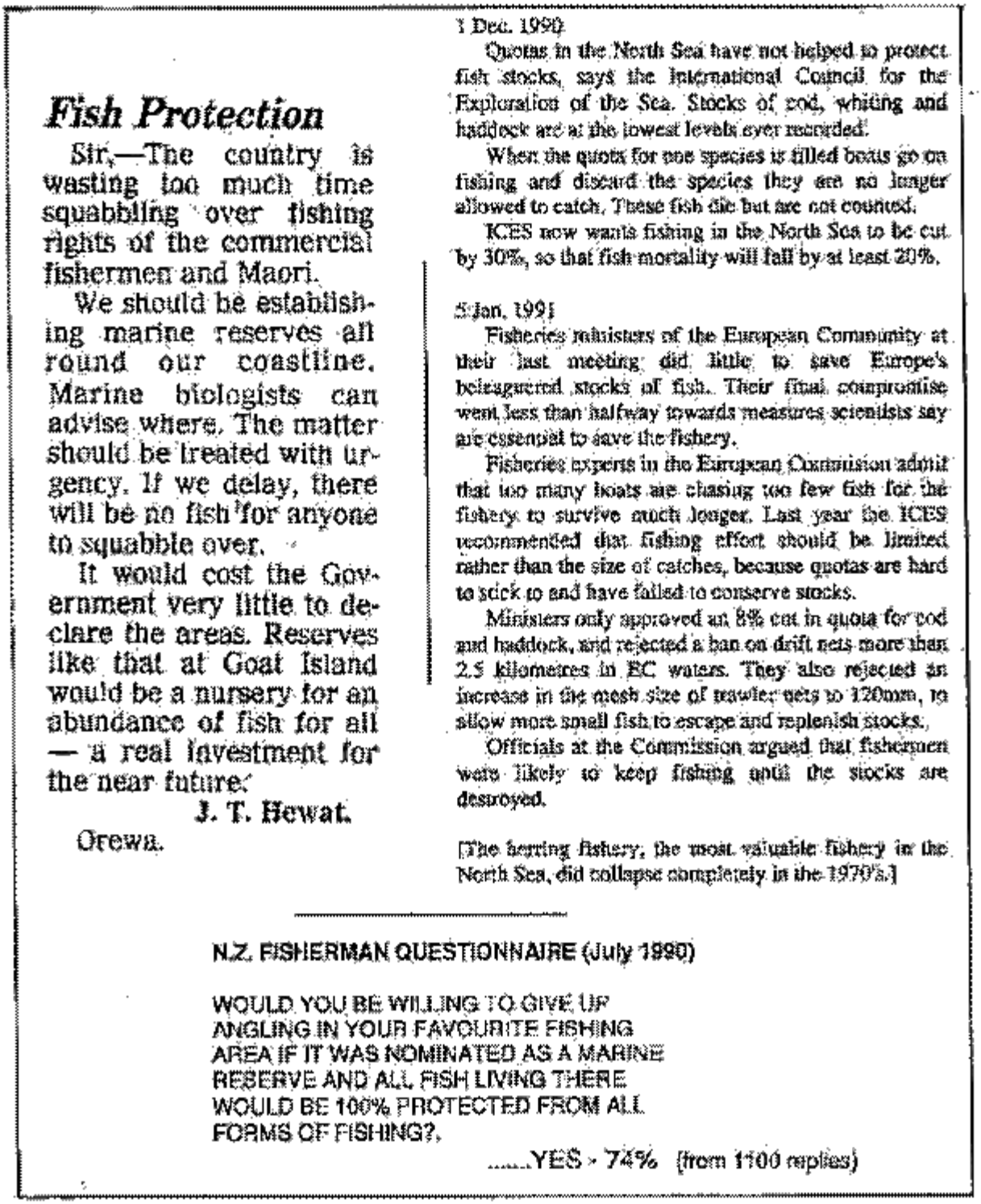
(t) However, the main reasons for marine reserves are such as to require typical and representative areas. These representative reserves, by definition, cannot be precisely positioned solely on information concerning the organisms or habitat.

(u) Additional pragmatic reasons, including social, economic and general geographic factors, must be used to locate representative marine reserves precisely. Such reasons include the enlargement of a "special" reserve to cover some representative areas, location by convenient landmarks, considerations about ease of access, present condition of the area, probability and degree of restoration, etc.

(v) The need for marine reserves in all regions and representing all habitats means that what is required is a network of reserves on a national basis. This requirement is both a signal for worthwhile commitment by the interested general public and a cause for concern to present users. Some indication of scope is needed.

(w) The scope of the planned network must be sufficiently large to gather support from all those concerned and to have a reasonable chance of gaining the general advantages. At the same time it must be sufficiently limited to reassure sensible users that their long-term and basic interests are being protected.

(x) Because most marine organisms have widespread dispersal phases (planktonic eggs, spores, larvae, etc.), a network of marine reserves has a very large but unexpected benefit. At least it is unexpected from a knowledge of **land** animals and plants. Reproduction in most marine species does **not** provide juveniles for the **same** population as the parents. Drift and dispersal of eggs and larvae occur, often over large areas. It follows that a network of marine reserves would act as a high-grade breeding system (stud farms) for all such species. This would occur without any other action on our part (or even our knowledge of the species, their particular methods of reproduction, the currents, etc.).



Fish Protection

Sir,—The country is wasting too much time squabbling over fishing rights of the commercial fishermen and Maori.

We should be establishing marine reserves all round our coastline. Marine biologists can advise where. The matter should be treated with urgency. If we delay, there will be no fish for anyone to squabble over.

It would cost the Government very little to declare the areas. Reserves like that at Goat Island would be a nursery for an abundance of fish for all — a real investment for the near future.

J. T. Hewat.

Orewa.

1 Dec. 1990

Quotas in the North Sea have not helped to protect fish stocks, says the International Council for the Exploration of the Sea. Stocks of cod, whiting and haddock are at the lowest levels ever recorded.

When the quota for one species is filled boats go on fishing and discard the species they are no longer allowed to catch. These fish die but are not counted.

ICES now wants fishing in the North Sea to be cut by 30%, so that fish mortality will fall by at least 20%.

5 Jan. 1991

Fisheries ministers of the European Community at their last meeting did little to save Europe's beleaguered stocks of fish. Their final compromise went less than halfway towards measures scientists say are essential to save the fishery.

Fisheries experts in the European Commission admit that too many boats are chasing too few fish for the fishery to survive much longer. Last year the ICES recommended that fishing effort should be limited rather than the size of catches, because quotas are hard to stick to and have failed to conserve stocks.

Ministers only approved an 8% cut in quota for cod and haddock, and rejected a ban on drift nets more than 2.5 kilometres in EC waters. They also rejected an increase in the mesh size of trawler nets to 120mm, to allow more small fish to escape and replenish stocks.

Officials at the Commission argued that fishermen were likely to keep fishing until the stocks are destroyed.

[The herring fishery, the most valuable fishery in the North Sea, did collapse completely in the 1970's.]

N.Z. FISHERMAN QUESTIONNAIRE (July 1990)

WOULD YOU BE WILLING TO GIVE UP ANGLING IN YOUR FAVOURITE FISHING AREA IF IT WAS NOMINATED AS A MARINE RESERVE AND ALL FISH LIVING THERE WOULD BE 100% PROTECTED FROM ALL FORMS OF FISHING?.

.....YES - 74% (from 1100 replies)

Fig 41 THE KEY POINTS

(i) **Ordinary citizens do understand what is required.**
(letter to the editor N.Z. Herald, August 13th 1988, reproduced with permission)

(ii) **Traditional management is inadequate to protect fisheries.** The example is chosen from Europe's North Sea so as not to offend local politicians or bureaucrats. The North Sea fisheries are even more valuable than ours and their scientific information much better.

(iii) **Responsible users have got the message and are willing to help.**
(from N.Z. Fisherman, reproduced with permission)

(y) If this point is properly appreciated, it not only adds greatly to the support for a network of marine reserves but it also reduces or eliminates most of the reasons for objection. If the exploiters of marine biota see marine reserves as enhancing the stocks which they exploit, it is in their direct interest to encourage the formation of an effective network of marine reserves.

(z) Marine reserves have so many potential benefits that we should reverse present thinking. We should not be wondering if we can squeeze a few in where not too many people will object. We should be insisting on getting the full benefits of a proper network as soon as possible. Such a network would act to the direct benefit of all, especially recreational and commercial fishermen, and also parents, holiday-makers, children, divers, scientists, teachers, tourists, etc.

OBJECTIONS AND THE HARD SELL

Recreational fishing "rights"

1. Fishermen do not own the fish stocks. Marine fishermen never do anything to grow fish, to assist their growth, to feed them, breed them or help them in any way.
2. Fish in the sea are a wild stock, and if they "belong" to anyone they belong to everyone.
3. Anyone catching fish is privileged and permitted by the general community to do so, whether it is explicitly licensed or merely allowed by default.
4. The community sets the rules, fixes the types, numbers, methods and locations, including giving at times some general and widespread permissions.
5. If, in the past, the community has permitted some people to fish more or less where they wished, and those people have enjoyed that privilege, then it is appropriate for those people to be grateful but it is not appropriate for them to demand continuation.
6. Such fishermen are in the same position as a tenant who has had a cheap rent and lots of perks. They are not owners or even managers.
7. There are no grounds other than simple self-interest on which such fishermen can ask for continuation of their fishing, unless they can show it would be advantageous to the community at large.
8. If, after a quiet and careful summary of these points, they carry on about their "rights", independent of the public interest and sustainability, they begin to sound like spoilt children whingeing for lollies rather than responsible adults talking about the freedom of the individual.

Divers "rights"

When divers boast to their children or grandchildren, will they be talking about the crayfish, paua, kingies, scallops, etc they caught or about the numbers that are left?

When their children ask "*What did you do to save the planet, Daddy?*" will they answer "*We fought long and hard to protect our privileges*" (e.g. 6 crays a day each from anywhere) or will they be able to say -
"*We were some of the first to see the light, and despite grizzles and lies, selfishness and ignorance, we kept on saying the sea needed more effective protection. In the end we obtained a network of real reserves. So we are proud of what we kept for you.*"

"Just keep out the big boys"

This is so blatantly selfish it is difficult to make a polite answer. About the best that can be said for this argument is that it might appeal to a politician who was both unprincipled and convinced most voters were the same (more recreational fishing votes than commercial fishing votes).

In cold logic, a dead fish is just as dead whoever killed it and no matter whether it was killed for fun or money, for food, export or "sport". If we, the community, wish to kill some, the obvious order of importance is -

1. Food for us in N.Z.
2. Export to provide for our other needs.
3. (and a long way third) For sport or pleasure.

It is obvious that the first two are much more effectively and cheaply carried out by professionals; that these commercial operators can be as tightly controlled as we as a community choose; that this means both the best chance of sustainability and the best chance of economic efficiency.

Many members of the public like to say that they fish for food, and thus they come in the first category. But nearly all of them are just kidding themselves (even if unconsciously). Of course they eat what they catch, and enjoy

doing so, but that is nothing much to the point. The costs of their time, the fishing gear, the boat and its equipment, the fuel, bait, travel etc. are almost always ludicrously higher that the cost of the "food" they catch. In reality they are fishing for pleasure.

I have heard many apparently sensible people, with $2,000 worth of fishing gear, after traveling 100 km in a high-powered car, while climbing into a $50,000 boat, say they were "*Looking for a feed*". Well, it is not difficult to understand their attitude. They are escaping from daily cares, spouses, kids, bosses, etc. and are going "hunting" for pure fun. But we don't have to pretend that their spoken excuse makes any sense, still less that it forms part of a coherent argument. We don't mind people telling themselves, their families or friends harmless social fibs, but we are not going to let these influence any important policy.

It should also be remembered that recreational fishing is virtually impossible to control in any conservation sense. Even with very tight controls (licenses, daily bags) and good enforcement, no one can predict the actual biological outcome. Everyone could still go to the same place, fish it out and move on. They do in fishing tournaments.

The only real hope for sustainable and enjoyable recreational fishing is:

(i) to come out strongly for a network of marine reserves which are completely no-take. The areas adjacent to these would remain high-grade recreational fishing areas indefinitely.

(ii) to convert to a complete sport, i.e. increasing the skill and deceasing the catch (or even eliminating the actual killing with tag and release - as is already happening in big-game fishing).

BOX 13

LET'S UPGRADE RECREATIONAL FISHING RIGHTS IN THE SEA

We hear a lot of talk about fishing rights. Generally it comes from people who are doing something they enjoy and wish to carry on doing it without any interference, There are plenty of bush-lawyer remarks like "*I've fished off this rock for 40 years and no *** greenie is going to stop me!*" All very understandable, but not necessarily very sensible.

Rights exist at different levels. You have the right to walk about in the rain, if you want. All this means, however, is that the rest of us don't much care whether you do or not. You also have the right to live, and this is a much higher-level right. The rest of us have decided that you (and all other citizens) should continue to live if it is at all possible. So we have arranged a whole set of systems to protect your life and make your continued existence more likely. Not just a police force and the armed services but hospitals, fire services, safety regulations, health inspectors and so on.

At present non-commercial marine fishing is a fairly low-level right. Fishermen are allowed to try their luck in the sea in the same way as they are allowed to be rained on. The community at large permits this. The laws and regulations affecting recreational marine fishing are those designed to prevent conflict with other users (e.g. keep away from the container ports); protect human life at sea (e.g. carry life jackets in dinghies) or divide up fairly whatever is available (e.g. individual catch limits).

It would be possible, however, to upgrade fishing rights in the sea. We could decide that recreational marine fishing was sufficiently important not just to be a permitted activity, but worth ensuring some reasonable result when the activity is practised. This would require major changes in attitude, but not so much from the community at large as from the recreational fishermen themselves.

People fishing for sport in the sea have boxed themselves into a corner by putting together several points that separately seem reasonable. They naturally pride themselves on their skill and effort. They like being able to choose where to go to exercise this skill, and regard this choice as part of the skill, and getting there as part of the effort. They like to show off their catch as proof of their skill and effort. All this seems clear, consistent and reasonable.

However, it misses one vital point. How many fish are there? If the actual numbers of fish are declining, how could you tell the difference between that and not enough skill or effort? While concentrating on the right to go anywhere to fish, we can forget that there is not much point in being allowed to if nothing is available.

In the past our smaller numbers, less leisure time and lower-grade gear meant less pressure on the fish. As more people are able to fish, as the boats get bigger and faster, and as hi-tech gear becomes common, the pressures go up. Everything contributes: better weather forecasts, more and faster road access, SCUBA gear, more marinas, frozen

bait, bigger tournament prizes, carbon-fibre rods, aluminium dinghies, and more coastal subdivisons. Something has to give.

Fishermen have always needed skill and effort. But unless there is to be a steady reduction in the results, they now need to be wise about the total arrangements as well. The "natural" refuges for fish are disappearing fast. Let's recognise this as a major threat, and one which will get worse without active countermeasures. Let's insist that fishing is so important as a recreational activity that we want it properly protected. Let's make it clear that this means active measures to ensure fish are provided with real refuges, not just from some kinds of extraction but all kinds. Let's get past talking about where we can fish. Let's make sure there actually are plenty of fish in the future. Let's upgrade our rights from mere permission to have a go at catching something to a demand for a reasonable chance of success when we do.

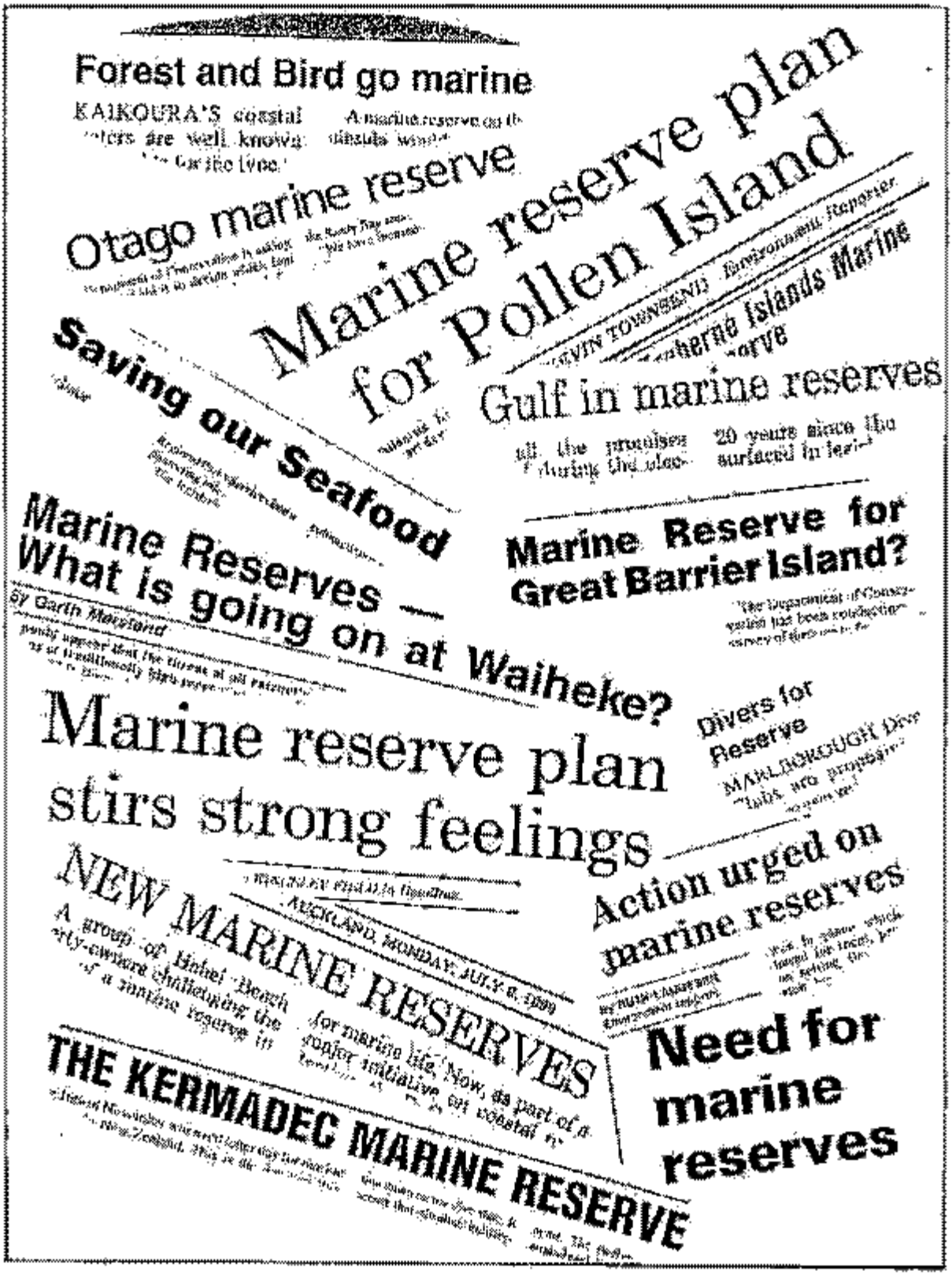


Fig 42 MONTAGE OF NEWSPAPER HEADLINES

Compared to a few years ago, publicity on marine reserves is now frequent, both in response to actual proposals and as comment on the general idea. However, more and better discussion is required to inform the public at large.

CHILDREN AND SCHOOLS : THE SOFT SELL

The most important people in the world are the next generation. If all children were persuaded (NOT told) to behave better then their elders, the world would automatically and quickly improve, but to achieve this the adults would have to admit it was less than perfect now.

Most children have not heard of marine reserves, but will have little trouble understanding the concept if it is explained.

Children find new ideas easier to manage than adults. They have more brain cells and fewer prejudices; more imagination and less experience.

They are very sharp. If you wish to convince them of anything, the argument must be clear, logical and have all the steps. There must be no appeal to political convenience, economic theory, unknown "authority" or other forms of adult wishful thinking.

Children like good stories, new experiences, jokes, pictures and total honesty. All new ideas must be given with real examples and clearly illustrated. They like involvement, asking questions, connected facts and the unvarnished truth.

They dislike condescension (don't talk down to them), pomposity, technical jargon, abstract theory, and any form of bluff, cover-up, or fudge. Adults may be impressed by "clever" talk, children see through it like glass.

So when you talk to a school class, you must forget about yourself and think about them. Show slides, videos, films, posters, photographs etc. (especially underwater scenes, fish, and the range of coasts, human activities). Tell stories, and show how these illustrate more general points.

A possible sequence:

1. The sea is a vast strange place, full of weird and wonderful animals and plants doing all sorts of things - illustrate. Begin with one example, then make a general point. Use further stories if time and material permit.

2. We are only slowly learning about all this and it is difficult, but scientists and others are increasingly active and finding out more all the time. We still know very little; almost anyone can help, by just looking and thinking, even on the nearest shore. Diving helps, so do boats, apparatus and training but the largely unknown starts at high water mark - illustrate with local/recent examples.

3. People are much quicker and cleverer at pulling things out of the sea (fish, shellfish, sand, gas, oil) and throwing things into it (sewage, rubbish, sludge, spills) than they are at understanding what's going on - illustrate.

4. It could be helpful to leave some parts of the sea alone. Fishing is fun, eating fish is nice, but fish need to breed and grow. Can they breed and grow near here now? How do we know they can? Are we just hoping?

5. This idea - marine reserves where nothing is killed, removed or disturbed - has been tried at a few places in New Zealand - Leigh, Poor Knights.

6. These have worked well in many ways - for fun (e.g. watching fish), for research (studying crayfish), for training, for building up breeding stocks, etc...

7. Some people think there should be more marine reserves, indeed all round New Zealand, so as to .... give some of the reasons.

8. What do you think? About the idea, about places, about sizes, about the rules....

9. New Zealand has lots of land reserves, with zero take, why not in the sea? Is it because we just haven't got round to it? What is stopping it being done?

10. Does it just seem too difficult? What could/should you do about it? Would it be a good idea for **you** to: (check this with teacher beforehand, and adjust for age, but make into a discussion)

Think about it, have a discussion, read books, see films

Find out about your local coasts (from maps, charts, pictures).

Make actual trips, find out what it's like near you.

Who is doing what, does it matter?
Ask around about marine reserves, conduct a poll.
Write letters, poems, essays, draw pictures.
Send these to people, newspapers, politicians, government departments.

Note: With captive audiences, especially children in schools, you should **not** propagandise. The solution is to put all controversial points in the form of questions. You can express strong opinions, but it must be clear that the children are free and encouraged to form their own views from the **full** set of possibilities.

Most teachers welcome outsiders giving talks, etc., if and only if:

(i) you understand and cooperate fully with the school's aims and rules (e.g. rigid timetabling is essential in schools; when the bell goes for the next class you *must* have finished);

(ii) you turn up when they want you, talk to the children they select, accommodate to any theme, topic or syllabus they have, and don't expect the school to revolve round you;

(iii) work out all arrangements well in advance, confirm these the day before, and turn up at the office door 10 minutes early, carrying everything you need.

While accepting any practical points that cannot be changed, you can and should push for appropriate aids.

e.g. If you want to show slides ask about projector, screen, blackout, power points and extension cords. If they don't have them, borrow some (you are talking to the local **school**, you can ask anyone). If you have no transport ask someone to ferry you about - NOT the school, some lonely or retired person, a Forest and Bird member etc. - there are dozens of people out there who would like to help, but they don't know how and they have to be asked.

Good teachers when not too rushed will introduce you properly and keep good order for you. But if they are busy, tired or forget, you can and should do it yourself.

Good morning, I am....(name)
I represent...or am a member of.... which does....
Today I am talking about.....
This is currently/locally interesting and important because ....
Please think of questions to ask, comments to make, etc
I will centre my talk on (slides, video, poster, story)
Start...

Insist on discipline in a practical manner. You may not be important but your message is. It needs quiet so that it can be heard - so "*Stop talking"*. It needs stillness so the others can concentrate so "*Sit down and stop fidgeting*". Only one question can be answered at once so "*Put your hand up and wait till I point to you*". Do not start until they behave; do not continue if they don't. Children like to play up, but they respect people who are firm and clear about practicalities.

There are lots of schools and each year there is new lot of 5-year-olds. The task of talking to them all regularly is quite beyond the power of Department of Conservation staff, yet it must be done if we are to succeed in making conservation a positive force. What is the answer? Get someone else to do it. Who? Such people aren't just standing around so they have to be found and encouraged. The piece above was **not** written for DoC staff but for Forest and Bird members - a concerned but not necessarily competent section of the general public. It was an attempt to give them some practical hints, to build up their confidence. It would be relatively easy and very important for DoC staff to continue this process in all districts.

Some advice:

1. Start small and build up. Don't have a grandiose scheme.

2. Keep talking about the need for it, the advantages, the joy it would give. Don't talk about how you would/could/should do it. Ask for help, be modest, even apologetic.

3. Remember not everyone can give a good school talk the first time, indeed you wouldn't expect this: but anyone can practise and learn to do better. The difficult thing is to get started.

4. Provide "excuses" to help someone start. e.g. Would you (anyone) please take these posters, this video, these pamphlets, this whale bone, books, slides, photographs, to this (selected) school and present them to this (selected)

class and add a few words while showing them. (Selection is done by contacting school and particular teacher - being absolutely honest about "first time", etc.)

5. Build up suitable supply of marine posters, pamphlets, specimens, videos, slides, books, etc. If these cost money ask local service clubs to pay for them (they like that providing it will clearly help the local schools).

6. Give lots of credit to anyone helping, especially at first. Phone any volunteers afterwards, pass on thanks, tell local newspaper. Ask teachers to get children to write thank you cards, pictures or letters. (Anyone who has received a packet of primary school children's drawings will know how delightlful and touching this is).

7. Remember the key is visual. Children won't take much abstract talk, but love being shown things and will listen to any informative commentary while looking at something new, different, beautiful, or strange.

Box 14

KERMADECS : THE THIRD MARINE RESERVE

New Zealand's third marine reserve was formally established in October 1990 round the Kermadec Islands. The Kermadecs, about 900 km north of New Zealand proper, are a chain of uninhabited islands and rocks, half way to Tonga. The Meteorological Service and the Department of Conservation maintain a base on the largest island, Raoul. The area is subtropical and 13 species of coral occur, but full coral reefs have not developed. The islands lie just east of the Tonga-Kermadec ocean trench (the same tectonic plate edge that passes through New Zealand) and the area is volcanically active.

The new marine reserve extends 12 nautical miles seawards round all the islands (all territorial waters) and is by far the largest in New Zealand. Indeed, it is larger than any National Park except Fiordland, and, with 7,350 square kilometres, is almost certainly the largest fully protected marine area in the world.

It is the first fully protected marine reserve to include either abyssal depths (down to at least 3,000 metres) or open ocean waters. The protection of the area is justified on the grounds of its uniqueness and scientific interest. A conservation society has said they will ask the government to promote the area for World Heritage status.

It is the first marine reserve in New Zealand to be created by the initiative of government departments and the first to extend to the legal limits. This is New Zealand's only subtropical area, and its marine life is quite different from the mainland.

There are no forests of large brown seaweeds, no kelps at all, and none of New Zealand's commonest sea urchin (the kina, *Evechinus chloroticus*). At low water and just below, a giant limpet, *Patella kermadecensis,* is common. This limpet lives nowhere else in the world (but has fossils like it in New Zealand), grows to 150 mm, piggy-backs its juveniles and males on the adult females, and changes sex from male to female when it becomes territorial and starts a "rock garden".

The fish species at the Kermadecs are mainly subtropical (49%) or tropical (36%), and the commonest species found there are rare or absent from New Zealand. The dominant carnivorous fish is the spotted black grouper, *Epinephelus daemelii.* This is a territorial, slow-growing species which reaches more than 1.5 metres in length. This huge, slow-moving fish is extremely vulnerable to any fishing. As a top predator, its protection is essential to the maintenance of a natural ecosystem. Despite its size, it is "diver friendly" and practically cuddles up to divers!

Many of the species at the Kermadecs are endemic (i..e. occur nowhere else). This includes 29% of the lace corals, 30% of the polychaete worms, 34% of the molluscs and 44% of the starfish and brittlestars.

The eastern slopes are so steep the reserve includes water 3000m deep. Indeed, the islands, although small above sea level, are huge volcanic mountains measured from the ocean floor. Despite several oceanographic and diving expeditions to the area, the basic marine biology of the area is still being discovered.

CHAPTER 12

THE SIGNIFICANCE OF ISLANDS

This paper was written for a conference held in 1989 to discuss the ecological restoration of islands. The organisers had intended to confine their discussions, as usual, to the land, but I pushed for some marine content. Whether for the land or in the sea, islands have the great advantage of concentrating attention and focusing thought. Perhaps we should be able to do this anyway, but islands provide an easier route. Thinking hard and carefully about marine reserves for some of our smaller islands gives us a better chance to come up with generally applicable ideas. After all, our whole country is just larger islands.

ABSTRACT

Most attention to islands has focused on their terrestrially based life and habitats, but their marine communities are just as likely to be both special and endangered and for the same reasons.

Marine reserves which exclude exploitation are still rare and relatively new in New Zealand, but, like the earliest terrestrial reserves, are closely associated with islands.

In the first marine reserve on the NE coast, from Cape Rodney to Okakari Point near Leigh, the presence at its centre of Goat Island significantly increases the physical and biological diversity as well as providing shelter for public and scientific access. This reserve, now 12 years old, provides many examples of abundances, local distributions, size frequencies and behaviour patterns which are very different from nearby coasts. The reserve area is a very typical piece of the open NE coast, apart from its protected status, so the simplest and most likely explanation of these differences is a restoration of more natural conditions.

At the second marine reserve, the Poor Knights Is., 12 km off the NE coast, strong controls on exploitation have conserved a unique and beautiful underwater fauna and, as at Leigh, greatly increased its popularity as a tourist and recreation attraction. The protection does not, however, control strong fluctuations of the "subtropical" fish, whose populations depend on year-to-year changes in ocean current patterns and sea temperatures.

A proposed marine reserve at the Kermadec Islands would protect New Zealand's only tropical marine fauna, one which is unique on a world scale.

More marine reserves are urgently needed to conserve and often to restore the marine communities of New Zealand. This is particularly true for the more remote islands (Kermadecs, Chathams and subantarctic islands) and for the "inner circle" (e.g. Three Kings, Outer Hauraki Gulf, Kapiti, Stewart Is. etc.). On the main coasts of New Zealand the little evidence we have strongly indicates that nowhere is "natural" and that a network of representative marine reserves including nearshore islands would produce unsuspectedly large degrees of "restoration", with considerable and widespread benefits.

INTRODUCTION

As a terrestrial air-breathing species, humans find marine biology difficult and consequently they mostly ignore it. Indeed, they generally ignore the sea altogether except for seaside holidays, fishing for food, and getting across it to some other land. Although New Zealand is the most maritime country on earth, although scientists are supposed to be objective, and although offshore islands are by definition more marine than terrestrial, the main problem for marine biologists so far has been to get marine matters on the agenda at all. Neither a major review of the natural history of offshore islands in 1973 (Atkinson and Bell, 1973) nor the glossy booklet 12 years later on the same subject (Nature Conservation Council, 1985) contains one word or reference to marine life that is not air-breathing. Even the seabirds and marine mammals get short shrift and there is no hint in these publications that they ever get into the sea or do anything there.

There have, of course, been some honourable exceptions to this attitude. The "two Lucys" made a pioneering study of seashore life on the Poor Knights Is. 50 years ago (Cranwell and Moore, 1938) and a recent symposium of the Offshore Island Research Group had 20% of its papers on marine topics (Wright and Beever, 1986). Nevertheless, the prevailing opinion has always been that islands were little bits of land and only interesting as such.

This attitude, although widespread, is completely illogical. It is, of course, easy to explain, but it is not so easy to excuse. Scientists, administrators, politicians and the public can no longer afford to behave as if their perceptions and preferences were more important than the principles of geography and ecology. Ignoring 90% of our hemisphere in terms of effective conservation, given our increasing activity there and our dependence on it, is not just foolish - it is probably dangerous. It would be particularly appropriate to begin making the necessary changes round New Zealand's offshore islands. On these islands there is not only plenty of evidence of previous nonsensical attitudes, but also a growing acceptance that the natural balance should be restored, where that is possible. Hence this conference. But it would also be a good time to expand the review: to examine our current attitudes to the marine life round these islands; to consider what effect our present actions (and inaction) may be having on the marine biota and whether we wish to modify our attitudes.

The matter is urgent. Even in New Zealand, it is unlikely that pristine marine habitats still exist. Any doubt is largely due to a lack of natural biological baselines, a lack of study and hence a lack of hard evidence. The resulting uncertainty may suit some classes of politicians and scientists, but it is not likely to comfort our grandchildren. Overseas, hard evidence is coming in of major ecological disruption of island faunas due to human depletion of their marine food (e.g. Avery and Green, 1989, on sea bird breeding failures in Shetland due to industrial fishing for sand eels). The use of gill nets, purse seines and other indiscriminate fishing systems in New Zealand, where commercial fishermen are controlled only by quota, is probably having similar effects, but there are no arrangements to find or measure them.

There are plenty of simple logical reasons for giving marine conservation a high priority round islands, including the effects this can have on science, recreation and economics. Although our knowledge of marine ecology is at a much lower level than its terrestrial equivalent, what we do know strongly supports the need for special management care round islands. On a common sense basis, our experience with islands demonstrates clearly that, even if marine restoration is not already the name of the game, prevention is better than cure, and cheaper and quicker.

Islands, because of their isolation, may have been spared some types or levels of exploitation and degradation. But they are also, because of their small size, more vulnerable to human interference. These points are just as valid for the isolated and small areas of shallow water habitats round the islands as they are for the terrestrial habitats.

MARINE RESERVES AND ISLANDS

The first marine reserve, at Goat Island Bay, Leigh

The idea of marine reserves is still new, even in New Zealand. The first one, the Cape Rodney to Okakari Point Marine Reserve near Leigh on the open east coast some 100 km north of Auckland, was created in 1977 after 12 years of discussion (see Ballantine, 1979). The process included the passing of a general empowering act - the Marine Reserves Act, 1971. After 12 years of actual operation as a reserve - no killing of marine life, no removals, no disturbance - it has proved an unqualified success, much to the surprise of nearly everyone.

The results of this experiment were not well predicted either by the proposers, including myself, or the opposers (Ballantine, 1980). The proposers thought (correctly) that the reserve would assist some types of scientific experiment, but were unprepared for the biological changes brought about by complete protection (Ballantine 1989a), the opportunities opened up by studies of more natural habitats (see reviews by Andrew, Creese, Jones, Kingsford and Schiel, 1988) or the behavioural subtleties that could be discovered in undisturbed populations (e.g. Jones, 1981 and 1984). The opponents of the reserve thought (correctly) that the reserve would prevent many customary activities, but were unprepared for the public enthusiasm for looking at abundant natural marine life (Dept of Lands and Survey, 1984), the increasing belief of the local commercial fishermen that the reserve was a useful stock refuge and breeding ground (Crouch and Hackman, 1986), or the large educational, recreational and tourist interests that developed (Ballantine, 1987a and 1989a).

An important feature of the marine reserve at Leigh is the presence at its centre of a small island - Goat Island, about 25 hectares in area. The island increases the diversity of marine habitats on an otherwise generally straight and open coast, by providing a greater range of wave exposures, aspects, rock types and slopes (Ayling *et al.*, 1981). It also makes access much easier by providing local shelter for small boat launching and for divers entering the water directly. Goat Island acts as a focus for the reserve in many ways, and provides it with much of its character. The reserve is otherwise a typical piece of the NE open coast. The only special feature of the area is that it is the nearest place to Auckland by road on the open east coast.

The differences between the situation in the marine reserve and similar areas open to exploitation are large, numerous and increasing. They include differences in abundance (e.g. crayfish are many times commoner in the reserve, MacDiarmid 1987), in distributions (e.g. intertidal sea urchins are much more common in the reserve, Kerrigan, 1987), in sizes (e.g. red moki are larger, Leum and Choat, 1980) and behaviour (e.g. fish do not show diver avoidance anywhere in the reserve - indeed, near the beach some species are "diver positive" owing to feeding!).

In strict scientific terms, it is difficult to be certain that these differences are due solely to the protection of the reserve. As yet there is only one reserve on the mainland coast, so studies cannot be fully replicated. There are also problems with properly stratifying samples owing to a lack of detailed knowledge of marine habitats. Nor is it certain, even after 12 years of non-extraction, that the Leigh situation is fully natural (e.g. crayfish numbers still seem to be increasing, and have not yet reached the shallowest habitats they occupied in the 1930s and 1940s).

There are very few natural baseline studies in this subject. No one made it their business to record properly any valuable marine populations in New Zealand before their exploitation became widespread and heavy. This applies not just to fur seals and whales in the 1800s, but also to Chatham Is. crayfish in the 1960s, paua in the 1970s and squid in the 1980s. It is ironic, to put it mildly, that this lack of investigation before exploitation is now sometimes used to question the value of marine reserves in restoring a more natural balance or even to doubt that any real changes have occurred.

Fortunately, despite these problems, it is clear that the many differences between the marine reserve at Leigh and similar but exploited areas elsewhere are most simply and reasonably explained as a restoration of more natural conditions. Indeed, there are likely to be many more cases that have not yet been discovered, and those that are known are likely to have been conservatively estimated.

If the present situation at Leigh is a restoration, then the effects of exploitation have been much more severe and widespread than most people would like to believe. It also means that over most of the country we have no measure of these effects, and cannot have until more marine reserves are established (see Schaap and Green, 1988 for the only alternative). The really important scientific point is that the result of an experiment cannot be stated in advance. Those who do not support more marine reserves are saying they do not wish to know how much natural restoration would occur. They are entitled to that opinion, but not to say they know what would happen.

After following the Leigh reserve throughout its development, having been in close touch with the many research workers who have studied it over the years, and having visited most coastal regions of New Zealand, my opinion is that a non-extractive marine reserve of reasonable size anywhere in New Zealand would, like Leigh, show many large improvements in its marine biota within a decade. The belief that pristine or near-natural marine environments still exist generally around New Zealand seems to me to have no basis other than wishful thinking.

Certainly some regions are more natural than others, some species more depleted than others, some habitats less altered than others, but in a connected single system, the sea, these differences do not prove (or even make likely) the thought that one end of the observed scale must be natural. In my view it is time that we made a nation-wide effort to determine natural marine baselines by the introduction of a network of representative and fully protected marine reserves round the main islands (Ballantine, 1989b). At least 10% by area of all marine habitats, in all regions should be protected, not just for normal conservation reasons but also for their capacity as natural "stud farms" for commercial species.

In addition to this network of "representative" marine reserves round the main coast for general restoration and conservation, New Zealand needs "special" marine reserves to protect unique or particularly vulnerable marine habitats. These special marine reserves will frequently be associated with offshore islands, and one example already exists.

The second marine reserve, round the Poor Knights Islands

The Poor Knights Islands have long been recognised as an important conservation area for their terrestrial habitats and species, and have been a closed nature reserve for many decades. The marine habitats round them are also very special (Doak, 1971) and vulnerable (Ritchie *et al*, 1979). These waters, the sub-tidal cliffs and their marine fauna provide the most spectacular diving in New Zealand (see Kelly, 1983 for review). Underwater visibility is extremely good, the sessile fauna on the vertical cliff faces is rich and varied (Grange, 1986), planktivorous fish school in great abundance (Kingsford and MacDiarmid, 1988), and many subtropical species occur, including fish (see Choat *et al*, 1988), molluscs (e.g. *Volva longirostrata*) and echinoderms (e.g. *Diadema palmeri*). These features promoted its establishment in 1981 as New Zealand's second marine reserve.

This reserve has rather complex rules, with fishing permitted for some species, by some methods, in some areas. These rules were partly a reaction to the demands of the charter boat operators (who were the main "users" of the area and the only people regularly present) and partly a result of the theory that if an activity has not produced any noticeable damage there is no reason to ban it.

This very "reasonable" approach, contrasting with the complete ban on extraction at Leigh, may have facilitated the establishment of the reserve, but has produced continuing difficulties (Ballantine, 1987a). As time goes by, and more and more people travel from greater and greater distances to see the wonders of the marine reserve, they are less and less impressed seeing people fish there. While there are good detailed historical reasons for these fishing exceptions, it becomes more and more tedious for charter boat operators, dive club leaders and tourist couriers to explain them to the ever-increasing number of visitors who are there solely to enjoy the sight of abundant marine life and are not interested in fishing (except to be annoyed by its presence). Recently one of the leading charter boat operators wrote to the Minister for Conservation, suggesting a total ban on fishing in the Marine Reserve.

The Poor Knights Islands Marine Reserve has been successful in protecting some unique marine features, in encouraging public and scientific interest in them and in sharpening our understanding of marine conservation. With this experience, it is now clear that complete protection within marine reserves is in the general public interest, despite quite different initial and widespread feelings to the contrary.

Other marine protected areas

At present [November 1989] there are only two marine reserves in New Zealand, despite a history of pressure over 25 years. There are also three marine parks at Tawharanui (near Kawau Is.), at Mimiwhangata (between Whangarei and the Bay of Islands) and round the Sugar Loaf Islands (off New Plymouth). These are organised under different legislation - a combination of a local grant of control under the Harbours Act, 1950 and local fishing by-laws under the Fisheries Act, 1908. It might be supposed that marine reserves provide strict protection and marine parks are a lower grade, but in fact the degree of protection is quite independent. The Tawharanui marine park has total protection, like the Leigh reserve, and the other two marine parks have certain fishing exceptions, like the Poor Knights reserve.

It is worth noting that the fishing exceptions at the Mimiwhangata marine park have resulted, since its creation, in an **increase** in fishing pressure. The negotiations were conducted widely and with great sensitivity to existing "rights", with the result that many people became more aware of these "rights" and hastened to exercise them in the new park under the impression it would provide better opportunities! The lesson from Mimiwhangata is that while sensitivity to existing use is advisable, it must be remembered that protection of marine life is the aim and object of the exercise. Even when a complete network of fully protected marine reserves has been set up, the balance of areas will be at least 9 : 1 in favour of fishing, and there is simply no point in arranging "labels" for areas that do not protect them.

The public at large are getting disturbed and impatient with piecemeal but continuous declines in fish and other marine resources. Large numbers of people now support not just quotas and total-take restrictions on commercial fishermen but active measures to restore and conserve. Those in authority are still listening to the sharp insistence of local and sectional interests on "fishing rights" and "ownership", but are not yet tuned to the more muted but much wider feeling that if fishing is important the fish stocks must be sustained, not simply shared out as if they were a bunch of lottery tickets. While the public do not grasp detailed technicalities well, they can and often do have a better feeling for fundamentals than those deeply enmeshed in the details. The general feeling now is that management of fish stocks (and other marine biological assets) must contain adequate insurance against the adverse effects of ignorance, general greed, new techniques, and political expediency. The public are no longer satisfied with explanations of decline; they want protection from it and restoration wherever possible.

MAJOR BIOGEOGRAPHIC CONSIDERATIONS: the remote offshore islands

A "ring" of remote islands surrounds New Zealand some 500-1000 km offshore, covering almost three-quarters of a circle. The Kermadecs, Chathams and most of the subantarctic group are politically part of New Zealand, but the Lord Howe, Norfolk and Macquarie Islands are administratively part of Australia. The marine implications of "ownership" of these islands are important in political and economic terms - for example, they greatly increase the size of New Zealand's 200-mile "Exclusive Economic Zone" (EEZ) and affect to a major degree the commercial fishing policies. However, in marine biogeographic terms, some of these island waters are so different from either Australia or New Zealand as to constitute distinct faunal areas. There is little agreement about either the nomenclature or methods of subdivision for marine biogeographic areas (see Knox, 1963), and data exist only for some marine groups (see for

example Gordon, 1984; Hay *et al.*, 1985; Kingsford *et al.*, 1989 and Schiel *et al.*, 1986) but both the Kermadec and subantarctic island groups clearly have marine flora and fauna which are significantly different from those of the main islands of New Zealand.

The Kermadec Island Group

The marine biota of these islands is definitely subtropical with strong tropical elements. While true coral reefs do not occur, several hermatypic coral species have been recorded there in moderate quantity, together with typical associated animals, e.g the "crown of thorns" starfish, *Acanthaster*. Both in terms of absences (e.g. no *Evechinus* or laminarian algae) and presences (e.g. tropical species of fish, corals, bryozoa and algae) the Kermadec marine biota is so different from the rest of New Zealand as to require separate status at a major biogeogaphic level (see Francis, 1987, for fish; Schiel *et al.*, 1986, for corals; Gordon, 1984, for bryozoa; and Nelson and Adams, 1984, for algae.). There seem to be relatively few endemic species, as might be expected from geologically recent and remote islands, but one at least is of considerable interest - the giant limpet, *Patella kermadecensis* (see Fleming, 1973). The marine communities of the Kermadecs are ecologically important in many ways - special populations (giant groper); interesting absences (neither many of the tropical herbivorous fish nor most of the larger brown algae); populations of species at their geographic limits and with doubtful breeding status (corals and crown of thorns starfish); but most of all, the simple existence of a shallow water environment (none eastwards for 10,000 km, none south till New Zealand and none north till Tonga).

The Kermadec Islands are a link between the tropical Indo-Pacific Province (by far the largest and most diverse marine province in the world) and the temperate New Zealand region. Only one other link exists, Norfolk Is., midway to New Caledonia, but that is not under New Zealand control.

So far as is known, the marine fauna and flora of the Kermadecs have been little exploited to date and are not in need of restoration, but they are clearly of unique value, highly vulnerable and in urgent need of protection. A marine reserve proposal was made some time ago (Francis, 1985) but despite lengthy discussion and some preliminary fishing controls, it has not yet been gazetted. This should be done forthwith. There are no valid reasons for delay - no regular fishing by New Zealand interests, no permanent residents, and no real opposition. There is ample scientific justification for a marine reserve under existing legislation (Marine Reserve Act 1971), including biogeographic considerations of global significance. It is to be hoped that this conference will provide the necessary stimulus for the immediate creation of a large, non-extractive marine reserve round the Kermadecs.

[Note: The area round the Kermadec Islands was gazetted as a marine reserve in October 1990]

The Subantarctic Islands

Just as the Kermadecs (with Norfolk Is.) provide the only shallow water habitats to the north of New Zealand in a wide expanse of deep ocean, so the subantarctic islands, especially Auckland, Campbell and Macquarie Islands, provide the only shallow marine habitats between New Zealand and Antarctica. Auckland and Campbell Is., which are under New Zealand control, are on the Campbell Plateau, which is semi-continental shelf in geological terms (generally 500-1000 m deep). They lie in the main belt of westerlies, the "roaring forties", but north of the antarctic convergence. Sea temperatures are cold, with a small range (5-9 degrees C at Auckland Is.) but with no significant sea ice. Although data are sparse (but see Hay *et al.*, 1985, for algae; Kingsford *et al.*, 1989, for fish; Powell, 1955, for molluscs; and Westerskov, personal communication, for general shore and subtidal communities), the marine fauna and flora appear to be classically sub-polar, showing:

(i) relatively few species but those in relatively great abundance (low diversity and high biomass);
(ii) general dominance of algae, especially kelps, and a reduction in herbivores;
(iii) strong seasonality in productivity, reproduction, and (for plankton) actual abundance (with day length rather than temperature controlling the marine biota).

The significance of these islands for air-breathing marine animals - seabirds and marine mammals - has long been recognised both for exploitation (fur-sealers were active here before 1800) and for conservation (legal protection for seals dates from 1875 in New Zealand). Almost all scientific observations so far have been land-based, including counts of breeding aggregations, behaviour at that time, and survival from year to year (e.g. Taylor, 1982). Very little has been done to investigate the actual food requirements of these large active predator populations (seals, sea-lions, penguins, albatross, petrels, etc.) and nothing at all to ensure that they are getting what they need. Indeed when it was discovered

this year that severe losses of Hooker's sea-lions were occurring as "by-catch" in squid fishing fleet nets, it seemed that for all the care and attention on land, in the sea there was no effective protection at all or any system to create some.

Studies of antarctic marine life, from Scott Base and McMurdo, have already been carried out quite extensively, despite the extreme logistic and technical difficulties, but the New Zealand subantarctic marine province has been almost totally neglected, despite regular work on the terrestrial biota. Apart from its intrinsic interest, the shallow water marine life of these islands is the food base for the larger and more "popular" birds and mammals. It should be stressed that, unlike the northern hemisphere, shallow water habitats at these latitudes are very rare in the southern hemisphere (no major areas other than around South America and few small ones). New Zealand has responsibility for a major part of the world's southern cold temperate marine fauna. If we claim the EEZ for 200 miles round these islands we should at least be prepared to study its marine life and, where appropriate, protect it. Indeed, the shallow habitats are so rare and vulnerable it would be reasonable to protect large portions of them immediately to ensure their maintenance.

The effects of large active predators in marine food-chains are difficult to predict but are likely to be very important and far-reaching. Comparisons of islands with and without sea otters in Alaska have shown major effects on sea urchins (food of the otters), their food the kelp, the detritivores dependent on the kelp, and their predators (Duggins *et al.,* 1989). The shallow water marine habitats of New Zealand's subantarctic islands have not even been surveyed yet, and we know nothing about the effects of "keystone" predators.

The Chatham Islands

The marine biota of the Chatham Islands differs in two ways from the remote northern and southern groups. In the first place it is not, except for absences, especially different from that of New Zealand. Second, it has been heavily fished for some time by locally based operators.

Although these islands are at the same latitude as Christchurch and have few endemic marine species, the marine biota of the Chathams is of considerable scientific interest and was the subject of New Zealand's first major marine biological effort, the Chatham Islands expedition of 1954 (see Knox, 1957, and eight further memoirs). At least for the shore and shallow water biota, the Chathams are distinguished by a long list of notable absences, apparently due to the distance from New Zealand and the lack of larval dispersal across it. The species that do occur on Chatham seashores seem to be an almost random selection of the New Zealand "possibles", rather than the ecologically dominant ones at the same latitude. The only patellid limpet at the Chathams is the one confined to the extreme south of New Zealand, while the only common shore barnacle at the Chathams is restricted to northern shores in New Zealand. Most mussel species common in New Zealand are absent from the Chathams despite apparently ideal ecological conditions (Morton and Miller, 1968).

The marine habitats of the Chathams, as a result of these features, form a large-scale natural experiment, from which a great deal could be learnt about the processes that drive and control New Zealand's marine habitats. Almost nothing has been done so far to take advantage of this, largely because New Zealand lacks any effective system to organise coastal marine biological research.

Fisheries research is solely concerned with the currently commercial species and has neither the resources nor a mandate for general marine biology, even when this involves the food and habitat of commercial species. The oceanographic institute is, quite properly, concerned almost entirely with offshore, deep-water, ship-based research. The universities are naturally obliged to concentrate on student training and so select local, inexpensive and convenient topics for research. The museums are hard-pressed even to catalogue and describe the species involved, and the majority of the marine fauna are still undescribed. Despite numerous attempts to organise a "Coastal Research Institute" over many years, New Zealand still lacks a system capable of organising the kind of research everyone takes for granted on land.

Fishing pressure at the Chathams has been irregular but severe. The best known example is the "crayfish boom" of the 1960s, which was conducted with the same speed, waste, and carefree ignorance of a gold rush. Since nothing was done to measure or study the stocks before, during or after, it is hard to be scientific about the matter. The two certain facts are first, that the boom declined as rapidly as it started, owing to stock reduction, and secondly, that the speed with which large quantities of crayfish were dumped on the market significantly depressed the world price of crayfish. Special exemptions to existing rules were allowed to increase this speed (e.g. permission to tail the crayfish at sea and transfer them to shore by helicopter). Those who attempted to control the matter, by enforcing restrictions on boats crossing to the Chathams without proper surveys or certificates, were forced to retreat by loud and widespread accusations of "bureaucratic interference". The result was the loss of a number of boats on passage and several lives. It

was clear that neither the public nor the politicians at the time were very interested in conservation, even of human life or overall profit, still less of crayfish stocks.

Following the crayfish decline, similar assaults were made by boats remaining at the Chathams on scallops, paua, kina and other species, but again there was no study of the effects. Indeed, it would appear that the general lesson has yet to be appreciated at a political level. When, more recently, orange roughy (and other deep water stocks) were discovered, while there were some scientific studies, the issue of fishing quotas was nevertheless given political priority over a knowledge of the stocks, their life history or growth rates. When the quotas of orange roughy for the Chatham Rise seemed inappropriate, some have been transferred to other areas, thereby probably spreading the problem.

It is now clear that the pre-emptive reservation of significant amounts of these stocks (inshore and deep-water) would have been sensible, and that, even now, action on these lines would be highly desirable for restoration.

REGIONAL BIOGEOGRAPHY: the "inner circle" of islands

New Zealand possesses a large number of islands sufficiently far offshore to have significantly different marine conditions but close enough to have essentially the same biota or at least a selection of it. These islands form a series of ecological interpretations of the regional biogeography; they are "natural experiments" and of great theoretical interest. The same point also provides the casual scuba diver, skindiver or shore explorer with a wide variety of communities to look at and enjoy, a much greater range than would occur on a continuous coast.

The Three Kings Islands

These islands are a classic example of the major marine ecological changes that can be produced by a relatively small distance offshore. The Three Kings are open to the influence of current systems over a very wide arc. These systems are complex, and produce both cold water upwelling and relatively warm water of subtropical origin (see review in Harris, 1985). The resulting biota at the Three Kings is an extraordinary mixture of "cold" and "warm" species. Southern bull kelp abounds and the density of large seaweeds rivals the far south (Adams and Nelson, 1985), yet several of the commonest fishes at the Three Kings are otherwise confined to the warm east coast of Northland. The common limpet on the island shores is *Cellana denticulata* which is not living nowadays on the main islands except near and south of East Cape.

The explanation of these unique communities is not clear indeed it is unlikely that there is a single explanation. The strong and almost continuous wave action combined with cold upwelled water and resulting fog may account for the abundance of bull kelp (*Durvillea antarctica*) so far north. The abundance of some "northern" fish may be the result of differential larval recruitment. The thriving populations of *Cellana denticulata* are probably "relict". Shells of this limpet are commonly found with moa bones in Maori middens along the northeast coast, although living specimens are now absent from adjacent shores.

The "volcanic string" of islands on the northeast coast

A large number of islands occur along the northeast coast from the Cavalli Group to Great Barrier Island (see Wright and Beever, 1986) and then on along the east coast of Coromandel and through the Bay of Plenty to White Island. Many of these islands are of volcanic origin and, as shallow water marine habitats, are relatively isolated despite their short distances offshore.

They also lie in the general path of the East Auckland Current, which with many eddies, pulses and other variations moves generally south-eastwards along the shelf as a warm current (Harris, 1985). Not only does this current provide warmer conditions it also transports larvae. Most, marine organisms have planktonic dispersal stages in their life histories. The result of this is that reproduction is effectively decoupled from recruitment in many marine populations. There is simply no direct connection between the abundance and fecundity of a population and the recruitment of new individuals to that population.

On a continuous coastline the effects of this "independence" of recruitment may be significant, but round small isolated islands these effects are maximised and frequently override all other factors. The very low numbers of crayfish at the Poor Knights Islands are not due to adverse conditions there (or to fishing pressure) but to lack of recruitment

(MacDiarmid, 1987). The rarity of *Sypharochiton pelliserpentis* (the commonest shore chiton on the main coasts) on several offshore islands cannot be accounted for by ecological conditions on the islands. It is almost certainly due to a lack of larval transport to these islands (Creese and Ballantine, 1986).

The results of larval dispersal are not just the absence some species from islands. The vermetid gastropod, *Novastoa lamellosa*, which forms reef-like crusts on wave-exposed rocky shores, is almost entirely confined to a string of offshore islands from Moturoa (off Cape Karikari) through Poor Knights and Mokohinau to the Bay of Plenty and also the Chatham Islands! The only place it has been found on the main coast is at Lottin Point, which in terms of the impingement of currents is very like the islands.

Many of the "northern" labrid fish species are confined to or much commoner around the offshore islands, apparently as a result of larval dispersal down current (Ward and Roberts, 1986). The abundant islands on the northeast coast with varying sizes and distances offshore provide a natural laboratory in which, simply by site selection, complex theories on marine dispersal and distribution patterns can be tested (e.g. Kingsford, 1989).

One way in which marine animals can avoid the risks of planktonic dispersal is to cut out the larval stage and brood their young. A small unnamed black chiton common on the shores of some offshore islands (and not on the main coasts) broods its young to the crawling stage in its mantle cavity (Creese and Ballantine, 1986). The percentage of marine species that exhibit direct development is likely to be higher on offshore islands than on continuous coasts, but there has been no analysis of this in New Zealand.

The East Auckland Current shows fluctuations from year to year in its temperature and strength (Harris, 1985). These fluctuations affect not only the supply of subtropical fish larvae but also their chance of survival after settlement. Since the "deviations" of temperature are both large (plus or minus 2°C on an annual range averaging only 6°C) and long-lasting (1-3 years), these current fluctuations can completely control marginal populations. In the 1970s many subtropical species of fish became quite common at the Poor Knights but declined or were totally absent by the mid-1980s (Choat *et al.*, 1988). [They have reappeared in even greater numbers after the two warm years which began in November 1988 (Francis, 1991)].

Stewart Island

The marine communities of Stewart Island are specially interesting on several counts. First, they represent the southern extreme, the nearest to subantarctic features, while still retaining the species diversity of the main coast. Secondly, the coast of the island has some topographic features unique to the region. Thirdly, the biota contains a large number of special communities and populations.

The seaweeds of Stewart Island are especially rich and diverse for New Zealand (Adams et al, 1974). This reflects not only the high latitude but also the climate (low sunshine hours) and the range of aspect, substrate and degree of wave action. Indeed, Stewart Island is probably the only place in New Zealand where the intertidal algae are as abundant in biomass as would be expected from the same latitudes in the North Pacific or North Atlantic.

The north-facing coastlines of Stewart Island and the large, relatively shallow Patterson Inlet are effectively unique to the southern region, offering habitats absent or rare south of Banks Peninsula. Patterson Inlet (Big Glory Bay in particular) has become the site of intensive salmon culture in recent years. As so often in the past, the entrepreneurial use of marine assets has been encouraged in advance of any study of the assets themselves. Already there have been concerns about detrimental effects on the marine habitats owing the large number of fish cages (Southland United Council, 1988) and the serious fish mortalities resulting from algal blooms (Hoe Chang, 1990). Recently the Department of Conservation made the first basic marine biological survey, in an attempt to locate sites for marine reserves (K. Walls, personal communication, 1988).

The "inner ring" of islands around New Zealand provides many opportunities for marine conservation and priority sites for marine reserves. Where there are clusters of islands the sensible option would be to have a non-extraction marine reserve round one or more, with the rest of the group in a zone of controlled exploitation (e.g. the Three Kings, the Hen and Chickens, the Mercury and Aldermen groups). Where the islands are large - e.g. Great Barrier, Mayor, Kapiti, Stewart - part of the coast should be a full marine reserve with the remainder for controlled or open exploitation. The offshore boundaries of the reserves should in each case include a significant amount of "open" sea, so as to protect localised schools of pelagic species (e.g. from purse seining) and the deeper bottom fauna (e.g. from trawling).

THE STANDARD MARINE FEATURES OF ISLANDS

In the context of marine conservation, maintenance and restoration, it is worth reviewing briefly some of the characteristics of islands as they affect marine conditions (see Creese and Ballantine, 1986, for more detail).

Isolation

For the marine communities isolation measurements need to be related to water depths, but the distance from the continuous coast (rather than from other small islands) is a first approximation. Isolation tends to control:

(a) the amount of freshwater runoff which in turn controls the salinity, the suspended sediments, and, often, the supply of nutrients (nitrates, phosphate and silicate that control phytoplankton growth);
(b) the water clarity (depending largely on sediments and/or phytoplankton), which in turn determines the type and depth range of fixed plants (seaweeds);
(c) the type, abundance and reliability of larval recruitment;
(d) the distance from human population centres, which in turn affects the type and degree of exploitation - on the more remote islands pollution and continued exploitation are less likely but quick "rip-offs" are more likely.

Cross-shelf distance

Although simple distance from the coast determines the many land-dependent features of the marine communities around islands, others are better correlated with the distance from the ocean and the main current patterns. If islands are near the edge of the shelf, they are more "oceanic" in their marine communities, regardless of their distance from land. The Poor Knights Islands are no further offshore than Little Barrier Island, but are much closer to the edge of the continental shelf, deep water and the main ocean currents.

Islands near the shelf edge tend to have:
(a) Stronger currents, with less predictable fluctuations (tidal and seasonal) but greater year-to-year fluctuations. The currents are more likely to be unidirectional.
(b) More frequent and larger upwellings, vortices and eddies in their current systems (produced by the islands or by the shelf edge).
(c) Low seasonal ranges in temperature and mild climates, but relatively strong day to day (storm controlled) and year to year differences (current controlled).
(d) Deeper water habitats, steeper slopes and harder rocks.

Size

For marine communities, it is important to measure size at the appropriate depth contour on a chart; nevertheless the size of the island itself gives a first approximation.
Small islands tend to have:
(a) Greater wave action indeed, they focus waves by refraction and have wave exposures greater than theoretically possible on straight coasts.
(b) More unpredictable biota, partly owing to the absence of some habitats, but also to the increased importance of chance events. In populations dependent on current-borne larval recruitment chance events are even more significant than for terrestrial island species.
(c) Milder and more oceanic air climate, with the marine climate more dependent on the local current system than the latitude.

Many of these points interrelate and reinforce each other, providing very strong ecological gradients over short distances. For example, the lower limit of kelp forest (*Ecklonia radiata*) is largely determined by light penetration. This limit is about 1 metre below low tide in sheltered harbours (e.g. the Waitemata), 20 m on the open coast (e.g. Goat Island, Leigh) and 50 m on offshore islands (e.g. Poor Knights). This fiftyfold extension of a major habitat is a product of a complex inshore-offshore gradient - including the interrelated factors of run-off, sediment suspension, depth, wave action, nutrients, currents, temperature, and phytoplankton.

Although this gradient may be altered by pollution (e.g. sewage) or increased run-off due to development of catchments, it is basically quite natural and may be very sharp. Within 10-15 km offshore marine conditions, habitats and biota may change more than in several hundred kilometres along the coast. It is this point that makes islands so

important for marine conservation. The marine biota of a small offshore island is necessarily different from that of the adjacent main coast and more vulnerable to exploitation.

THE SPECIAL OR LOCAL FEATURES OF SOME ISLANDS

Features which may make islands of special interest as marine reserves.

Special rock types

Isolated, small offshore islands are almost certainly composed of very hard rock, generally igneous, and frequently of a rare geological type. The obsidian (volcanic glass) on Mayor Island has been specially regarded for over a thousand years by Maori tool makers, and the unusual rhyolites more recently noted with interest. Other rock types of interest include those of Coppermine Island, ignimbrites, andesites, pumice, basalt scoria (see Hayward, 1986, for more detail and references).

Recent and active vulcanicity

Rangitoto, Mayor and White islands show a range of recent volcanic action. At the last two, underwater vents bubbling gas and devoid of life have been recorded. So far no studies have been made in New Zealand of either colonisation round such vents or their biological effects, although New Zealand (with Hawaii and Iceland) is one of the few places in the world where natural primary colonisation could be studied in shallow water.

Topographic features

The spectacular underwater cliffs, caves, archways and pinnacles of the Poor Knights and their special fauna are well known, but other remarkable marine topographic features occur at the Three Kings, Mokohinau (Creese and Ballantine, 1988), Mayor Island (Jones, 1989), White Island (Westerkov, 1989), the Auckland Islands, and probably many others still unrecorded or even unseen.

Provision of habitat diversity

Although obvious at the sites, it is worth noting that islands frequently add greatly to the marine habitat diversity of an area. This is not dependent on size or distance offshore indeed, it can be very striking for small nearshore islands as at Mimiwhangata (Ballantine *et al.*, 1974) and the reserve at Leigh (Ayling *et al.*, 1981). Islands are often the only habitats of certain types in a large area (e.g. Kapiti Island).

Provision of access and shelter

While islands do not necessarily provide shelter, as many yachtsmen know to their cost, they often do, and thus allow easier access to the marine habitats. This can be important even on the main coasts where small islands give much improved conditions for boat launching and diver access. It also applies to deeper and more open water habitats round offshore islands.

Provision of focus

Islands can be very important simply as a focus or a marker. Where straight open coasts are extensive, small islands or even reefs, while not necessarily significant in themselves, could make excellent markers for reserves (e.g. on Ninety Mile Beach, and in the Bay of Plenty). Islands can also provide markers for essentially open water reserves, making their location less arbitrary and easier to recognise at sea.

Vulnerability

The marine resources around islands are not vulnerable just because they are small, but also because they tend to be out of sight. As a result they are especially vulnerable to quick plundering, particularly if the methods are technically legal. Before anyone really knows what is happening the damage is done. It is often difficult to learn what was done and to separate rumour from fact. Repeated stories about the commercial use of gill nets or purse seines round offshore islands, cleaning out and moving on, cannot be documented, but, in my view, are probably true and are a major cause of the known very large differences in fish abundance between some islands and others.

Food for breeding seabirds and marine mammals

Dense breeding aggregations of birds and mammals on islands may be critically dependent on the relatively small, local, shallow marine habitats for food.

Islomania

People like islands; many people are quite fascinated by them. This may well be a problem for those trying to conserve terrestrial biota on islands, but it is a great help in conserving marine biota. The public will almost automatically give extra support to the conservation of marine resources round an island, rather than to an equally deserving piece of standard coastline or open water. This fact should be used to assist the provision of "representative" as well as "special island" marine reserves.

PRESENT POSITION AND CONCLUSIONS

There is ample evidence in principle (Francis, 1984) and sufficient evidence in detail to regard the creation of more marine reserves in New Zealand as an urgent need. Our knowledge of marine ecology suggests that islands are generally prime sites for marine reserves, and this is frequently supported by other points, including biogeographical considerations, existing land reserves on the islands, relative ease of demarcation and policing, and public perception that islands are indeed special.

The Department of Conservation, on its creation in 1987, became the first government department with a mandate for marine conservation. Since then many individuals within the department have made strenuous efforts to create more marine reserves, but a combination of factors has prevented any more being set up to date.

These factors include:

(a) A lack of commitment at the political level - senior politicians have yet to regard marine reserves as urgent or important.

(b) A lack of marine experience in the department - most staff were (naturally) recruited for their terrestrial experience.

(c) Insufficient funding for "new" activities - no significant funds were transferred from MAF for marine reserves.

(d) Inadequacies in the existing legislation - the current Marine Reserves Act (1971) was written to permit special cases, not to compel general action.

(e) The restructuring of the department after only eighteen months operation - including the abolition of the coastal and marine directorate.

(f) Excessive fears over public reaction which is still unknown and hence particularly inhibiting to sensitive administrators and politicians.

(g) Simple lack of administrative experience - only two marine reserves have ever been created in New Zealand, both a decade ago, and by different departments.

(h) Inappropriate comparisons to land reserves - the creation of more reserves on land, with over a thousand reserves already in existence, is mainly a matter of fine tuning. In the sea, with only two reserves, the general policy is still to be decided.

None of these factors separately would have prevented rapid action but in combination they have been very effective in slowing progress to a crawl. At the time of writing *[November 1989]* it has not even been possible to create the Kermadec Is. marine reserve which was proposed by the Ministry of Agriculture and Fisheries as long ago as 1985 (Francis, 1985).

However, there are strong indications that the public is becoming much less passive about these matters. Indeed, the efforts of many "middle echelon" staff in the Department of Conservation have created a rapidly cresting wave of public interest in marine conservation generally and marine reserves in particular. The Royal Forest and Bird Protection Society has recently expanded its interest into the marine field, joining other environmental groups and finding strong public support in its appeal for funds (see "*Protecting our Coasts: the next conservation frontier*" RFBPS pamphlet issued1989).

Some 9000 submissions were received from the public in response to a discussion paper on a proposed marine mammal sanctuary round Banks Peninsula (Department of Conservation, 1988b). The vast majority of the replies were in favour of the strictest controls on set nets to protect the endemic Hector's Dolphin. Public questionnaires on regional or local marine reserves have attracted hundreds of responses, with the great majority in favour of more active protective measures for marine life (including the Bay of Plenty, Coromandel, Gisborne area and Kapiti). Some political leadership on marine conservation is emerging, albeit so far concerned mainly with the use of large-scale drift nets in international

waters.

It would seem that the time is ripe for some major changes in attitude. Indeed, since there is no scientific basis for pretending that marine organisms and habitats will look after themselves, since the public is becoming increasingly disturbed by the declines in marine resources of many kinds, and since we do have the means to do something about it, perhaps it is time we did.

For the past decade I have been recommending that at least 10% by area of all types of marine habitats in all New Zealand regions should be non-extractive marine reserves (Ballantine, 1980). These would be representative reserves, acting as breeding and stock refuges as well as for all general conservation purposes, including restoration. However, for islands, an additional and special case can often be made as was recognised in the discussion paper put out by Fisheries for the Auckland region - where 60% of the proposals (18 out of 30) were associated with islands (Ministry of Agriculture and Fisheries, 1985). Many island marine reserve proposals would have wide public support and easily demonstrated scientific value. Not just round the remote islands (for reasons on World Heritage level) but also for the "inner circle" (nationally justified) and for inshore islands (with regional advantages).

It took the then Government 13 years to purchase Little Barrier Island as one of New Zealand's first terrestrial reserves (from 1881-1894, see Hamilton, 1961), and it took nearly as long to establish the first marine reserve (1965-1977, see Ballantine, 1979). It is to be hoped that, just as we quickly learnt the value of more terrestrial reserves, we will soon be more decisive about marine reserves. Time is *not* on our side in this matter.

.

Box 15

FISHING FOR SPORT OR FOOD

A confusion of two motives can easily produce nonsensical results even when both the ideas are reasonable. The present state of recreational fishing in the sea provides a good example of this. There are two common motives for non-commercial fishing. One is the fun of it, the sport, the recreation. The other is to obtain food. Both motives contain complex subsidiary points.

Fishing for fun may include ideas of rest and relaxation, escape from other activities, the chance for fresh air and exercise, the opportunity to visit new places, some actual risks, as well as the basic ideas of learning and practising special skills, the thrill of the hunt, and the pride of achievement. Fishing for food may include not just the provision of more and cheaper food, but also fresher and healthier nourishment, more variety and luxury in the diet, and a chance to do favours to friends and neighbours.

The problem is that the two ideas have basically different aims. If you could just whistle and the fish jumped into the basket, it would certainly help in the provision of food, but the fun of fishing would virtually disappear. A worthwhile sport depends on the exercise being difficult; but for the provision of food the simpler and easier the better. Of course, there is no harm at all in enjoying things you have to do, and enjoying catching the fish you need is fine. Similarly, if you kill a fish for fun, it is much better to eat and enjoy it than throw it away.

Still, if you haven't made up your mind why you are catching fish, you get in a muddle, which can produce nonsense. If your fishing is for food, it must be cost effective, or you are effectively starving your family of nourishment. To use up $50 worth of bait, petrol, gear, wear-and-tear, your time, etc. to bring home $20 worth of fish is depriving the family of $30 worth of food. This is not altered if you enjoyed yourself. If your fishing is for sport, there is no sense in trying to maximise the killing. Unless you are the kind of person who enjoys death for its own sake, improving the sport means steadily increasing the difficulty while just staying within your present ability to achieve a result. To add more carcasses just because you can eat them later or give them away does nothing for your sporting pleasure.

On land, all this has all been clearly appreciated for years. People don't go trout fishing or duck hunting for food. We have much cheaper ways of producing food, and if we are hungry we use them. Trout fishing is a sport, and the easy ways of doing it are not just unsporting but illegal. Careful and quite elaborate methods have been worked out to increase the recreational value of trout fishing. These not only improve the sense of achievement of the individual (fly fishing is more difficult and more satisfying than using worms, nets or gelignite); but they also allow more people to indulge in the sport and more often. The individual, the sport and the whole community benefit from making the fishing more difficult. The process continues. Recently bag limits for trout have been reduced from 6 to 3 at Lake Taupo in the interest of the sport.

These ideas have not yet had much effect in the sea, but they are coming. A year ago, a famous big game fisherman from Hawaii visited New Zealand, and expressed shock that in game fishing here the fish were usually killed. He strongly implied that our fishermen were being a bit primitive in their sportsmanship, and explained that overseas it was considered more difficult (and more sporting and more fun) to tag and release. The big game fishing clubs have taken note, and increased their amount of tag and release.

Many sport fishermen would like to see stricter rules for marine fishing - e.g. the banning of scuba gear and set nets for recreational fishing, and a sharp reduction in the total fin fish catch allowed by an individual. Before very long marine sport fishermen generally will be proud of their skills rather than the volume of their catch.

CHAPTER 13

MEASURING CHANGES : MARINE BIOLOGICAL MONITORING

This chapter was written for a conference on Environmental Monitoring held in May 1988. It provided an opportunity to show the existence of a "vicious circle" in the discussion of marine reserves. If we could measure the decline and degradation of our marine resources (fish, shellfish, natural habitats, etc.) then we would have clear reasons for setting up unexploited marine reserves. However, unless we already have unexploited areas, any supposed declines and damage are so difficult to measure they remain largely in the area of opinion. A classic "Catch 22".

Abstract

Major marine biological changes due to human activity have already occurred in New Zealand and more are expected. Large natural changes from year to year are also common. Very few attempts have been made to measure either of these, and the lack of protected marine areas makes any study of natural or induced change extremely difficult. The example of the marine reserve at Leigh shows that a network of representative unexploited marine areas is necessary for cost-effective monitoring. Such a network would also improve significantly scientific research, general marine resource management, public education and recreation.

INTRODUCTION AND GENERAL ARGUMENT

Very little monitoring of marine biology has been carried out to date in New Zealand. If the major commercial fishery species, some marine birds and some marine mammals are excluded [these topics were covered by other authors at the conference], then the amount of data available is barely significant and certainly precludes the standard form of review. This situation is somewhat surprising since there are good examples in New Zealand showing that both natural variation from year to year and human-induced changes have important effects on marine life.

The importance of these changes has both theoretical and economic aspects but the evidence has been regarded by scientists and politicians as a series of isolated cases rather than as an indication of general principles. The lack of proper investigation and the lack of interest in the small amount of available evidence stem from some fundamental attitudes and some practical problems.

In this review, I hope to show that in New Zealand :

(i) Natural year-to-year variation in marine life and habitats is often large and significant for both the population dynamics and the use of these marine resources.
(ii) Human-induced changes in marine life and habitats have already occurred on a major scale and can be expected to continue and accelerate in the future.
(iii) Most of the human-induced changes were unplanned, unrecorded, undesirable and unnecessary. Unless there are significant changes in both attitudes and practical arrangements these points are likely to remain true in the future.
(iv) There are, as yet, only a few, very small, protected natural areas in the sea. While many regard the sea as a wild

and natural habitat, it is not usually practical to measure either natural or induced changes without unexploited areas to act as controls.
(v) Attempts to monitor marine biological changes without unexploited controls result in studies which are expensive and inconclusive, so very few are commissioned.

(vi) Because the changes in marine life and habitats are not measured or studied, any detrimental effects are not perceived until they are large and difficult to remedy. This is already having serious social, economic and political consequences.
(vii) To improve this situation significantly it would be necessary to create a series of representative unexploited marine areas around the country, covering all regions and all habitats.
(viii) Although this would involve radical changes in social and political attitudes, there are good reasons to believe that these changes are practical now.
(ix) Recent government reorganisation has resulted in a department with direct responsibility for conservation including marine areas. This new Department of Conservation has plans for marine reserves although the policy is still to be developed.
(x) The marine reserve near Leigh (Cape Rodney to Okakari Point Marine Reserve) has been operating for 11 years and is a highly successful example of the type of marine protected area required.
(xi) The scientific need for fully protected marine areas would probably not be sufficient to generate a real network of such areas round the country. However, the reserve at Leigh has shown that such areas have additional and important benefits. The educational, recreational and, above all, the resource enhancement benefits of marine reserves form a powerful political argument in their favour.
(xii) As has been demonstrated at Leigh, base-line studies and monitoring of the (increasingly) natural conditions in such unexploited marine areas allow clear separation of natural and induced changes and therefore measurement of both.
(xiii) The provision of marine reserves allows the development of cost-effective local and problem-oriented studies in similar habitats in the same region.

This argument is a relatively long and complex one. It also involves some new concepts special to marine conditions. It is my contention that there is sufficient evidence for each point in the argument at the common-sense level. It must be admitted that for some points the detailed evidence is small in quantity and highly localised. However, this is a necessary consequence, given the paucity of unexploited areas in which unequivocal evidence can be obtained. I submit that there is no practical and effective alternative to the suggested programme. Without proper comparisons with unexploited areas the only kind of monitoring we shall be able to do is the description, after the event, of continued unforeseen and largely undesirable declines and degradations in our marine resources.

EVIDENCE FOR NATURAL CHANGES

There is a widespread assumption that natural changes in the sea are restricted to predictable seasonal cycles or are too long term to be worth much consideration. This assumption is reinforced by the great practical difficulties of working in the sea or recording most of its processes. When measurements are made over more than one year, however, the results generally show non-seasonal variation of considerable and significant amounts. Most such studies have been in the northern hemisphere and on physical factors. They have greatly increased since the advent of satellite-derived data and the recent interest in climate change. Studies of the basic dynamics of the sea, whether general circulation patterns or local eddies and pulses, increasingly require attention to non-cyclic and non-predictable variation. A recent review shows that such studies now extend to phytoplankton and primary production estimates from satellites (Ryan, 1986).

Direct biological studies are much less common, even in the northern hemisphere, but all show similar high variation between years. The largest and longest-running programme is the continuous plankton recording programme, started by Professor Hardy in 1948, covering western Europe and the N. Atlantic (see Colebrook, 1979, for review). Long-term studies on rocky shores have been carried out by Lewis and his co-workers (reviewed in Moore and Seed, 1985) while general benthos has been reviewed by Gray and Christie (1983).

New Zealand studies of natural year to year variation are rare. If we set the standard at more than three years' results, thus excluding almost all research student projects and allowing a measure of the variation, there are only a handful of results. Dr Elizabeth Batham, founder of the Portobello Marine Laboratory as a research station and pioneer of many aspects of marine biology in New Zealand, initiated the longest set of observations in 1953. It included both sea temperatures and records of "krill swarms" - planktonic larval form of the bottom living crustacean *Munida gregaria*. Thirty years later I was able to analyse the temperature results and show that the deviations from the long term average

were both large (often more than 1 C) and long (warm or cold periods exceeding a year). Zeldis (1985) analysed the krill data and showed a huge range between years - from 100 days per year with swarms to none at all.

The summer of 1982-83 was a period with an extreme anomaly in the general atmospheric pressure pattern across the Pacific (Southern Oscillation Index) with co-occurring large anomalies in ocean currents, seawater temperatures and biological features. The NE coast of New Zealand experienced "summer" sea temperatures 3°C below average (the annual range is only 6.5°C); persistent westerly (off-shore) winds; very calm seas; a strong and persisting bloom of a spring diatom (*Cerataulina pelagica*); anoxic bottom conditions following the decay of the bloom; and resultant deaths of fish, shell fish and other benthos (Taylor *et al.*, 1985). Most biological features measured at the time showed strong variation, but not always in the expected direction. For example, recruitment of the labrid fish, *Pseudolabrus celidotus*, was much greater than in any previously recorded year (J.H. Choat, personal communication).

Other examples of between year variation include: -
(a) settlement of mussels on the Maui Gas platform off Taranaki, which occurred in 1976 and 1977 but not subsequently (Foster, 1982).
(b) growth on boulders on Taranaki shores, which shows interrupted succession owing to storms and sand burial (Miller, 1982).
(c) changes in abundance of reef fish at the Poor Knights, apparently caused by variations in sea temperature and currents (Choat *et al.*, 1988).

EVIDENCE FOR INDUCED CHANGES

There are plenty of well-known cases of human-induced changes to marine life and habitats in New Zealand, but the literature reporting these is very poor or non-existent. In most cases the changes were not measured at the time and only the final results are known. Generally the changes were accidental, in the sense that they were merely the incidental result of other aims and actions. For the purposes of this review it is important to show merely that such changes have occurred, are often large, are frequently widespread, cover a great range of species and habitats, and often have important social and economic consequences as well as significant biological impacts.

Habitat Destruction:

All major port constructions (e.g. Waitemata, Tauranga, Wellington) have involved large-scale reclamations, dredging and other total removals of the original natural habitats. Many harbour and estuarine areas have been extensively modified by reclamations or enclosures for airports, oxidation ponds, marinas, industrial sites, rubbish tips, motorways and other large scale purposes (e.g. Waitemata, Manukau, Wellington, Heathcote/Avon and Otago). Most sheltered and enclosed coasts have been modified by sporadic reclamations for local purposes including road alignments and causeways, draining and/or reclamation for farming, and general "edge tidying" with rock walls, stand-piling and filling. These modifications are so common that even in areas that are neither industrial nor residential natural edges are often less common than artificial edges.

Exploitation effects :

The entire history of New Zealand is a story of gross declines or near exterminations of marine biota as a result of exploitation. Beginning with fur seals and whales, even before the main European settlements, and continuing through the northern rock oyster (1900s), Chatham Is. crayfish, Firth of Thames mussels, Golden Bay scallops (1970s), Bay of Plenty trevally (1980s) and now kahawai and orange roughy, the same story is repeated over and over. If there is a resource which is fishable and marketable it is exploited until serious reductions in quantity affect the economics of the exploitation. Only then is serious attention paid to measuring the stocks and considering regulation aimed at sustainability. Where the effects are due to recreational or amateur fishing, to by-catches or to the incidental results of commercially-used gear, official or responsible attention approaches zero.

While it is well known, for example, that:

(a) spear-fishing championships and fishing competitions for large prizes have significant and sometimes long-lasting effects
(b) collection of sea urchins (kina, *Evechinus chloroticus*) for ground-bait, eating, or simply as souvenirs has resulted in their virtual disappearance from intertidal areas on much of the NE coast
(c) the use (and misuse) of mono-filament gill nets has had serious effects on reef fish in many areas

(d) repeated use of heavy trawl gear produces major bottom modifications (both physical and biological)

it is rare that any attempt is made to measure or record such events.

Introduced species :

Deliberate introductions of marine biota have been relatively rare or at least rarely admitted. *Spartina* species (marsh grasses with very active vegetative reproduction) were introduced to promote reclamations. Their subsequent uncontrolled spread has caused serious concern, and programmes to eradicate or reduce their populations are under way in several areas. Accidental or at least unconfessed introductions are more common.

The best known is that of *Crassostrea gigas* (the Japanese or Pacific oyster), which is now well established throughout the Auckland region and is the basis of the oyster farming industry. Dromgoole and Foster (1983) have compiled evidence on many other species accidentally introduced into the Auckland Harbour area, mainly from the N. Pacific and associated with the large increase in direct shipping from Japan. Adams (1983) has reviewed possible algal introductions to New Zealand. In virtually all cases the available information is insufficient to be clear about the causes or dates of the introduction, the subsequent rate and direction of spread or the significance of the effects.

Habitat degradation :

It is probable that there have been large changes in the rates of siltation and the turbidity of seawater around many parts of New Zealand due to changes in land use, especially the clearance of forest cover for farming and other activities. However, I can find little documentation on this subject. Even where there is clear evidence of accelerated erosion on land and associated severe flooding in the lower catchments, there seem to be no studies on the marine fate of the sediments or their effects.

It is known that major declines of *Zostera* (eelgrass) have occurred in several large harbour areas in New Zealand (and overseas). The Whangarei, Waitemata, Manukau and Heathcote/Avon areas have all been seriously affected. It is not clearly established whether any of these declines were due to fungal disease or whether increased run-off, siltation or pollution had significant effects.

Pollution :

Traditionally most coastal centres of population and industry discharged most wastes directly into the nearest sea, with little or no attempt to monitor any effect. More recently there has been a trend towards either long pipelines with ocean outfalls (e.g. Hastings) or increased treatment systems (e.g. Auckland) or both (e.g. New Plymouth).

New large sources of waste, especially when associated with specific industries (e.g. the gas-based industries of Taranaki), are now given considerable attention. However, the cumulative effects of older and more widespread sources are rarely studied until the situation is serious.

The official Manukau Harbour Action Plan (Auckland Regional Water Board, 1987) states "...*a general picture of harbour water quality and the full extent of the pollution problems and how best to manage the resource are not sufficiently known*." Similar statements could be made about many other areas (see review by Ridgway and Glasby, 1984).

PRESENT MONITORING AND REPORTING

While stressing that very little marine biological monitoring has yet been carried out in New Zealand, it is important to acknowledge those few who have perceived the problems, pioneered in the field and struggled with the constraints. Indeed, it is the main thrust of this review that, despite some good ideas and determined efforts, the existing constraints make it virtually impossible to achieve clear, unequivocal and useful results, even on a local scale, within reasonable bounds of cost and effort. When generally useful results on a regional or national scale are required, the present constraints are simply prohibitive. This point can only be made by pointing out the real deficiencies of the very best studies to date.

The following list includes few examples of real monitoring, i.e. studies repeated in a strictly comparable fashion over more than a few years. Most were attempts to provide local and immediate solutions for serious existing problems.

One of the main constraints is the general attitude which insists on problem-orientated work, i.e. restricts work to locations that are already most disturbed and refuses to recognise the importance of natural change.

Several water boards and catchment commissions, notably Auckland and Taranaki, have made real efforts to solve local problems. Around Auckland for some years regular measurements of water quality have been made at marine sites. However, the frequency of recording is low, and the spacing of the sites is related to human use rather than to ecological type. Unless serious (and expensive) efforts are made to evaluate expected and natural changes due to habitat, catchment, weather conditions, season etc., it is difficult or impossible to tell whether changes in the records are due to human impact, still less of any particular kind. In Taranaki, quite sophisticated systems for monitoring marine outfalls now exist and cover several years. Although this was spurred by the advent of large gas-based industries, the monitoring extends to dairy factories and other outfalls. However, the sites are selected in relation to the problem and are still subject to whatever other human impacts occur. For example, it would not be possible to determine the effect of an effluent on the local paua population while all paua habitats are still subject to harvesting.

There have been a number of special studies by various groups:

(i) The studies of Taranaki for the Maui Gas project (see Kibblewhite *et al.*, 1982).
(ii) Work by Professor Knox and his Estuarine Studies Group on several areas and systems (see Knox, 1986).
(iii) The Upper Waitemata Harbour Study (see Auckland Regional Authority, 1983).
(iv) Other specific sites and problems have been studied by the Water Research Centre (Hamilton), the N.Z. Oceanographic Institute, the Cawthron Institute (Nelson), and others, e.g. Healy (1980).

As a result of this work, taxonomic identifications, equipment and recording systems, ship-borne and diver-operated methods, computerisation of results and analysis have all improved in terms of New Zealand expertise and application. Nevertheless, almost all these studies were short-term, often only for a single year. They were usually problem-orientated impact studies and were produced without any instruction or chance to look at natural base-lines.

The studies by professional consulting groups are naturally enough almost entirely in this class and it is important to note why. It is not simply a shortage of money, either real or perceived. Even when the problem is very large and very important, and independent experts are asked to produce the research programme, the same difficulties arise. For the environmental impact report on Auckland Thermal I, a large power station proposed for the south shore of the Manukau harbour, the ecological studies programme was proposed by a very broad-based committee of independent experts. The resulting report (Bioresearches, 1976) competently and clearly carried out this programme. However, the resulting audit (Baumgart, 1977) criticised the scope. The investigation had not been asked to look at the history of the harbour or its present overall state, nor, despite intensive work on the actual site of the proposed cooling ponds, had this area been clearly related to the rest of the harbour.

Many studies of marine biological processes, habitats and organisms have been made at universities in New Zealand. However, very few of these have been concerned either with natural variation beteewn years or with integrating the results into a general picture of the natural baseline.

THE PROBLEM

There is a general failure to perceive that problems relating to marine biology cannot even be defined, still less solved, unless there is some real picture of the natural conditions. The problem in each case is some deviation, distortion or degradation of the natural state of affairs. Unless this natural state is known or can be deduced, together with its processes and rates, workable solutions cannot be reached on any secure basis, only by hit-or-miss guesswork, and even then it will be impossible to tell whether much better solutions were practical.

Cost-effective solutions do not require a return to (or a retention of) naturalness. In many cases this is clearly impossible, e.g. a container port facility. However practical solutions do require sensitive attention to (and generally cooperation with) those natural processes which will continue to operate. An acceptable solution will also require a knowledge of the effects of those natural processes which have been reduced or stopped. In the final analysis this is true (with small changes in expression) not just for problems of pollution or other human-induced degradation but also for purely scientific problems on the one hand and any type of resource management problem on the other.

Until recently, scientists as well as administrators have assumed that controls for the natural state in the sea were readily available in nearby similar habitats or that such controls were not needed for their investigations. They also tended to assume that natural year to year variation did not significantly affect their conclusions. Even when these

assumption are not made, it is extremely difficult to do anything about it. Where in New Zealand is the marine life natural and how can you tell? Even if it is natural how can you tell that the existing conditions are not significantly different from average this year? The depressing answer to both questions is that it is generally not possible. Informed and experienced guesses are likely to be better than others, but there is usually no way of measuring how much better, or how deficient compared to reality. Consequently, in marine biology there is a tacit assumption that provided workers control for those factors for which practical methods do exist, there should be no direct criticism on these fundamental points.

It does seem unfair to criticise research workers for not doing something that was beyond their power. Unfortunately this reasonable point has tended to obscure the more important facts that:

(i) Results that are uncontrolled for potentially important factors are not good science or a good basis for management decisions.
(ii) While it is beyond the power of individuals or most organisations to remedy the situation, it is not inevitable and we already have a few instances which show how this problem could be solved.

EXAMPLES WHICH SUGGEST THE SOLUTION

A habitat: Mangroves

Mangrove forests do not generally produce any directly saleable products, and are consequently often regarded as useless. Nevertheless, experience with their reclamation and destruction, both in New Zealand and overseas, has shown that they provide very valuable indirect benefits. They absorb floodwater, they control sedimentation, they are fish breeding and nursery grounds, and they export very large amounts of organic matter to sustain offshore life (including commercial fish). These points were sufficiently understood in principle to give rise to a national policy some years ago (Nature Conservation Council 1984) to the effect that mangroves should be protected from destruction unless there was a project of overriding national importance. In 1987 the new Department of Conservation was given a mandate responsibility for this policy, and has already commenced a special programme to record and assess all mangrove forests.

There is no incentive, however, for local landowners to fence off mangroves, and so they are often severely damaged by grazing. County councils needing to improve roading and hold costs have every reason to continue to build causeways, fill in creeks and generally destroy mangroves in the public interest as they see it. Even for mangroves, highly visible and relatively easy to study, real programmes for monitoring and public awareness will be required to prevent further serious habitat loss. Most marine habitats are out of sight and have no national policy as yet. It is simply assumed they will look after themselves. The present state of even large harbours like the Manukau suggests this is not a sensible attitude. The provision of fully protected areas for each habitat in each region is urgently required, together with studies of these to establish natural baselines.

An important commercial species: Crayfish

The common crayfish or rock lobster (*Jasus edwardsii*) is a highly valued resource. But our usual systems for obtaining basic information on marine biology are so deficient that it was only recently, and as a result of incidental action, that some of the most important features of crayfish and crayfishing were discovered. Studies in the marine reserve near Leigh, by Dr MacDiarmid, of individually known crayfish in an unexploited state have completely altered our views on such matters as natural levels and the effects of exploitation, recruitment, migration, crowding, feeding and competition (MacDiarmid, 1987 and Box 16). This work was only possible because of the provision of an increasingly natural and totally unexploited area. Contrary to expectations based on previous knowledge, the density of crayfish in the reserve is now many times greater than in any comparable area outside (Cole, 1988). The known effects of the reserve on crayfish provide very important lessons not just for the management of that species but for all commercially exploited species.

A non-commercial species: Red Moki

The red moki (*Cheilodactylus spectabilis*) is a relatively-slow growing, slow-reproducing, and slow-moving fish. Although of no commercial importance it is easily speared by divers in its shallow kelp bed habitats. Large red moki are

now an uncommon sight virtually anywhere that is accessible to spear-fishermen, and total numbers are low. In the marine reserve near Leigh, however, there are high densities of red moki and many of these are large specimens (McCormick and Choat, 1987). Indeed, large red moki are so common in certain habitats in the reserve they are the visually dominant fish and are likely to be biologically important. It should be carefully noted that without the reserve we could not have known that this was the natural state of affairs. The "normal" (i.e. generally occurring) state is quite different.

If such a major and widespread change can take place in a large, common but non-commercial fish without anyone measuring it, except afterwards in a single protected area, it is clear that only the rapid and general provision of marine protected areas will permit most changes to be noticed at all.

RECOMMENDATIONS

Marine biological monitoring in New Zealand requires :

(i) the immediate establishment of a network of unexploited marine protected areas covering all habitat types in all regions;
(ii) the measurement of natural baselines in these areas;
(iii) on-going monitoring of features of interest that show large inter-year variability;
(iv) comparison of "problem" areas with the above as needed.

If the network of protected areas is provided and some baseline studies are carried out, the remainder of the programme will follow. Commercial, public management and scientific interests would then be able to achieve their own specific ends by relatively simple and cost-effective comparisons.

The Department of Conservation has a mandate for marine protected areas and is developing a policy for their creation. It is unlikely that sufficient reserves in the right places for effective monitoring could be created simply for that reason. Major social and political attitude changes are required to create a suitable network. The marine reserve near Leigh, however, is now widely seen as successful and popular in terms of public recreation, education, and the enhancement of fish stocks. These features do provide adequate, indeed compelling, political reasons for a nation-wide system of marine reserves.

Box 16

CRAYFISH AND MARINE RESERVES

The main thrust of the argument in this book is that even when the scientists are doing all that can be expected; and even when the managers are using the best practical systems under the present rules, there may still be real problems. Indeed, because of all the extra difficulties in the sea, this is often the case. It is not helpful in these situations to criticise the people involved. It is generally much easier, however, to blame somebody rather than to consider modifying the basic framework. It would be more helpful to look for ways to relieve the dangers caused by imperfect knowledge and the pressures caused by hard economic facts.

This box provides some scientific and management information on crayfish, in the hope that it will focus attention on the need for some broader thinking. I have restricted the discussion to the red crayfish or rock lobster (*Jasus edwardsii*) round the main islands. These supply more than 90% of the fishery. The example of crayfish was chosen because:

(a) Everyone accepts that crayfish are an important and valuable resource.
(b) Biological and fishery data are as good as or better than the data for other species.
(c) The fishery has used essentially the same methods for a long time.
(d) The standard management systems have already been applied - including a minimum legal size, restrictions on pot design, prohibition on taking females in berry, a limited number of licences, individual transferable quotas (ITQ), and a division of the fishery into controlled areas with total allowable catches (TAC).

In short, none of the common reasons for management problems apply to this fishery. Nevertheless:

(e) All interested parties are seriously concerned about the state of the fishery.
(f) There is no general agreement about what should be done, mainly because the only options under present systems are so fierce as to be politically and economically very difficult.

Alistair MacDiarmid worked on crayfish in the marine reserve near Leigh for three years (1982-85). His intensive study, supported by a Fisheries Research Division scholarship, was the first on a completely protected population. It was also the first to follow large numbers of undisturbed individuals under water for several years. Alistair is a professional fisheries scientist, and as such he has to be very careful about evidence - indeed, much more careful than we would be in ordinary life or even in law. If there is any *alternative explanation, it is not scientifically proper to say that the most likely explanation is proven. It is permitted, based on actual evidence, to say that some explanations are more likely.*

Comment by Alistair MacDiarmid -

One of the most spectacular features of the marine reserve at Leigh is the great abundance of large red crayfish, *Jasus edwardsii*, that can be found at many sites. The presence of this protected population makes the marine reserve the best place in New Zealand to study many aspects of crayfish biology and ecology. It is the only place where natural cycles in crayfish abundance and behaviour can be studied in isolation from the disruptive effects of heavy recreational and commercial fishing.

It was not envisaged in 1975, when the reserve at Leigh was first gazetted, that red crayfish might be one of the species to show spectacular increases in abundance. It was presumed that migration out of the reserve would prevent any great increase in numbers. In fact, the opposite is true. Although there were no surveys of crayfish in the area before the reserve was in place, abundance increased by threefold between surveys carried out in 1978 and 1983, and doubled between 1983 and 1990. The average size of crayfish increased over the same period.

continued overleaf

Comparison of red crayfish populations inside and outside the marine reserve at Leigh also shows that on average crayfish are bigger and there are more of them inside the reserve than at adjacent coastal localities where they are fished commercially and for recreation.

The evidence thus far, though compelling, is circumstantial; the increased numbers of red crayfish in the marine reserve at Leigh might have occurred anyway, without the benefit of protection. The "experiment" needs to be repeated and monitored at similar coastal sites before definite conclusions about the effects of protection on crayfish can be drawn.

Creation of a marine reserve does not necessarily mean that the local crayfish population will increase. The following example illustrates how it can be misleading to extrapolate from what is found with red crayfish in the marine reserve at Leigh to other places.

- The Poor Knights Islands, made a reserve in 1981, have only a tiny population of crayfish, almost all adults. Crayfish are less abundant there than on the adjacent mainland where they are fished. The comparative lack of shallow water boulder habitat necessary for juvenile crayfish and the position of the Poor Knights Islands on the edge of the continental shelf probably account for the absence of all but a few wandering adults.

It is tempting to infer that protection of adult crayfish in marine reserves will eventually increase the numbers available to commercial and recreational fishers elsewhere. This could occur in two ways: by increasing the production of eggs and larvae, or by the migration of adult crayfish out of reserves.

Because there are more and bigger crayfish in the marine reserve at Leigh than on adjacent coastlines of the same length, its yearly production of crayfish eggs and larvae is also far greater. It is small, however, compared to the total New Zealand wide production of crayfish eggs. In order to increase egg production substantially, a much greater proportion of the New Zealand coastline would have to be protected.

Unfortunately, it is not clear that increased egg production will lead to settlement of more juvenile crayfish.

Crayfish have prolonged planktonic (free-swimming) larval phase. During this period, lasting more than nine months, they are carried from inshore coastal waters to beyond the edge of the continental slope. The numbers that eventually swim back inshore probably depend more on the vagaries of currents, food supply and predation than on the numbers that initially hatched.

Emigration of crayfish from a marine reserve to adjacent fished areas will not necessarily boost the local fishery. For this to occur greater numbers of crayfish would have to leave the reserve than enter and be high enough to compensate for the removal from exploitation of the new protected population. Marine reserves have the potential to enhance the abundance and size of the crayfish living within their boundaries. Additional coastal reserves similar to the marine reserve at Leigh may show this is generally true. Whether increased numbers of crayfish in marine reserves leads to increased catches is more equivocal. It is clear that from a scientific point of view, marine reserves are the best places to study some aspects of crayfish biology and ecology, and, because fishing is prohibited, offer insights into the effects fishing has on exploited populations of crayfish. For the diving public the marine reserve at Leigh offers an unparalled opportunity to see huge numbers of these curious and fascinating creatures the way they were before widespread exploitation began. Perhaps for this reason alone we should have more marine reserves. *Alistair MacDiarmid May 1991*

*The following extracts from fisheries publications illustrate the management situation for the crayfish (= red rock lobster) fishery. First some extracts from an article published in "*Catch", *February 1988. Paul Breen and John Booth are scientists with the Coastal Fisheries Section, MAF Fisheries Research Centre, at Greta Point, Wellington.*

from* Current state of the Red Rock Lobster Fishery *by Paul Breen, John Booth and Karen Chant

The red rock lobster fishery is biologically stressed. There is surplus catching capacity and economic returns to fishers have declined in recent years.

The fishery is not able to produce at its full potential, and the resource is not in a safe state. The resource is declining further because of the current high fishing effort. If the fishery continues without management intervention, seriously diminished returns can be expected.

Maximum sustainable yield for rock lobster is estimated to be in the range 4200-4700 tonnes for the North and South Islands combined. This is not available to the fishery because current effort and the fishing mortality rate are both greater than optimum, and the rock lobster standing crop is smaller than optimum.

The present annual catch is not sustainable. Present sustainable yield (PSY) is estimated to be no more than 4200 tonnes annually, and recent catches have exceeded this, probably causing stock decreases.

The fishery is dependent on one or two year classes and is thus vulnerable to external influences. Egg production is lower than desirable, causing concern about recruitment overfishing - reduction of gametes, juveniles or recruits below some optimum or desirable level.

Abuse of the minimum legal size, increasing amateur catches, and poor handling practices all cause the formal stock assessments (which led to the yield figures above) to give a misleading picture - the real situation is probably worse.

Potting is the main method of catch. There has been continued investment in more pots, larger vessels and more sophisticated fishing gear. As a result "gear conflict" (over-crowded fishing grounds) and catching costs per unit of effort have increased.

Increased effort, rising costs in line with inflation, and a recent drop in real prices compared with those prevailing 2-3 years ago have caused average net financial returns to decrease and the fishery is currently over-capitalised - the same catch could be caught with fewer vessels. A management programme is required to address over-capacity and reverse the trend of increasing costs.

Sustainable yield is catch that can be taken every year from a fishery for an indefinite period, while the stock size remains the same on average. MSY is the greatest sustainable yield that could theoretically be taken under perfect conditions - i.e. both ideal stock size and fishing pressure. For a variety of reasons MSY can probably not be maintained for indefinite periods.

Yield estimates for commercial red rock lobster fishery have been made by three groups of researchers using four methods of surplus-production analysis. Estimates of MSY range from 4200 to 4700 tonnes annually.

All methods suggest that the fishery is on the declining limb of the yield curve - fishing effort is greater than it should be and sustainable catches will decrease as effort increases further.

PSY is that yield which could be sustained by the present stock - the yield that would usually result in the same

stock next year. This is estimated to be no more than 4200 tonnes annually. Fishing effort is higher than the effort required to take this catch, so annual catches exceed PSY.

Catches have increased since 1979, the year before the controlled fishery began. However, the fishing effort required to obtain that catch has increased faster than the catch. The number of pot-lifts has increased by 56 percent since 1979 and the catch per unit effort has decreased by about 27 percent.

continued overleaf

from* Report from the Fishery Assessment Plenary, April-May 1990: stock assessments and yield estimates, *compiled by J. H. Annala, Fisheries Assessment Coordinator, MAF Fisheries, Greta Point.

The decline in landings since 1987 is thought to reflect a real decline in the recruited biomass, in turn caused by decreased recruitment caused by factors other than just the new MLS (minimum legal size) measure. The recent recruitment is outside the range which had been predicted and the estimate of MCY [maximum constant yield] made in 1989 (3600 tonnes) is now inappropriate. It is considered that the MCY cannot now be estimated for this stock because recruitment and recruitment variability cannot be predicted from the data available.

For at least 10 years, effort has been 2-3 times higher than optimal for this fishery. As a consequence the stock is smaller than the optimal stock. Further consequences are that the catch is less than the potential MSY; economic yields are small compared with their potential; and the fishery may decline further and be in some danger of stock collapse.

The present fishery is in some danger of collapse even if the stock can be maintained at its present level. The present fishery returns no overall economic surplus. The present catch of 3200 tonnes is far below the estimated sustainable yield near 4300 tonnes that could be taken if the stock were rebuilt. If the fishery were rebuilt it would be far safer and would return an annual surplus on the order of $40 million.

Rebuilding the fishery requires a reduced catch for several years, so that not all the available catch is taken. Current levels of available catch are around 3200 tonnes, so the catch must be reduced below this in order for rebuilding to occur. The lower the catch, the greater the chance that stocks will stop declining and that rebuilding will occur.

There is no certainty that the sum of TACs [total allowable catches = quotas] of 3200 tonnes will reduce fishing mortality rate. Recruitment has become unpredictable, and may possibly decrease further for the 1991-92 fishing year. The probability of a decreasing fishing mortality rate would increase if a lower catch level were set.

No catch level can be considered safe. This is always true for any fishery, but is especially true for this fishery now. If we are seeing stock-recruit effects, then a catch level of zero might not stop what is about to happen.

The present uncertainty underscores the need for rebuilding. The level of uncertainty would be expected to decrease with a rebuilt stock. The present situation, where the fishery removes much of the recruitment each year with a very high fishing intensity, is not at all safe and should not be allowed to persist.

Despite all our knowledge of crayfish (and we do know more about it than about most other marine species) and all our management systems (and we have had tighter controls in this fishery than most), it seems that there is a very serious problem. The situation with other fisheries is often worse, but we have such poor information we learn this only when the collapse actually occurs.

Instead of blaming each other for not perfecting the existing systems, it might be worthwhile trying to add a new piece to the system which would provide more insurance and safeguard. As Alistair carefully tells us, we cannot tell whether any particular marine reserve would help rebuild crayfish stocks or assist with recruitment. However, it is likely that a network of reserves would do so. The same network could also act for all species.

At present we seem paralysed because we cannot say which species would benefit to what degree from any single proposed reserve. But even if only half the network acted to rebuild crayfish stocks and that at only half the level of the Leigh reserve, a 10% network is likely to double the total crayfish stock and recruitment. That seems worth trying when the alternative is to cancel half or more of the quota (also without any certainty of success). And ruining crayfishermen does nothing for other fisheries, while a marine reserve network has the same potential benefit for all fisheries.

CHAPTER 14

A PUBLIC LECTURE : WITH ILLUSTRATIONS

This lecture was first given in Tasmania in April 1990, when I was assisting in the launch of their marine reserve programme. It is a summary, in pictures as much aspossible, of what we have learnt over 25 years about marine reserves in New Zealand. Even without the colour slides, it provides my best general view of the subject. Most of the slides used, including all the underwater ones, were generously donated to the cause by the photographers. I would like to express my thanks to them all, especially Dr Kim Westerskov, Dr Roger Grace, Dr Tony Ayling and Malcolm Francis.

(Slides are numbered and their subject is briefly given *in italics*. The text of the talk is in plain type.)

INTRODUCTION

The problem of marine reserves is one of perception. As a citizen and strong believer in democracy I know that things will be decided the way the majority of people want them to be decided, and this is right and proper. However, as a scientist I know that the number of people believing something has nothing to do with whether it is true. The rules of the universe do not depend on votes.

Hands up those that know that a magnetic compass needle points south in China. Hands up those who believe me when I say a compass needle points south in China. Well you are all wrong. A compass needle in fact aligns itself along the north/south axis. The Chinese invented it. They painted the south end and call it the south-pointing machine. It's just a matter of perception.

Let's check our local perception. When I give talks in Britain I have to explain where I come from. So I show this map -

1. World Map (printed "upside down")

- and say I come from this little country at the top of the world in the middle, from which good ideas like votes for women, state medical services and marine reserves slowly filter down to the nether regions. This gets a laugh, but what of our perception. Where do we live? If we turn a globe so that we are central -

2. Globe (with N.Z./Tasmania centred)

- we see that our half of the world is mainly ocean.

3. Hemisphere centred on N.Z.

In fact for N.Z./Tasmania it is nine-tenths sea, and of the "land" about half is Antarctica, which doesn't really count. Since we are in geographic fact the most maritime places on earth, we should lead the world in maritime matters. Do we?

Tasmania and New Zealand are similar in many ways especially in marine and coastal matters. This can be summed up by saying that in marine matters New Zealand is like Tasmania but more so.

LONG AND VARIED COAST

Both countries have a long coastline, which is scenically varied. There are -

4. Otago Harbour,mudflats and gulls

- sheltered harbours, providing for ports and bird feeding;

5. Pakiri with Leigh in background

wave-exposed beaches with dunes and surf;

6. Deep Cove, Doubtful Sound

deep fiords, surrounded by mountains;

7. Cape Kidnappers

rapidly eroding cliffs of soft rock;

8. Mayor Island, Bay of Plenty

offshore islands of hard resistant rock;

9. Mangawhai, Northland

wide flats of deposited sand and mud.

RICH AND DIVERSE MARINE LIFE

All this variety of habitat supports a diversity of life. Buried in this apparently desert-like sand flat are cockles so numerous they are touching, and so fast growing they are flattened where they touch. The production of edible meat here is greater than for the best cattle pastures.

New Zealand, like Tasmania, has a very rich diversity of marine life. This includes not only the popular groups like birds -

10. Penguin (Eudyptes crestatus, Antipodes Is.)

- penguins, molymawks, gulls, waders; and marine mammals, like -

11. Elephant seal (Mirounga leonina),

- seals, dolphins, and whales ; not just the larger things like -

12. Mangrove (Avicennia, Northland)

mangrove forests in the far north and -

13. Macrocystis, Campbell Is.

giant kelp beds, in the far south, not only the "important" groups like fish

14. Pink maomao, Caprodon longimanus but all the -

15. Crabs *(Leptomithrax australis, Bounty Is.)* and -

16. Snails *(Diloma nigerrima, Cape Foulwind)* and -

17. Limpets *(Benhamina obliquata, Okarito)* and -

18. Slugs *(Aplysia sp., Ninety Mile Beach)* and -

19. Starfish *(Stichaster australis, West Coast)*

20. Encrusting animals on steep rocky slope (Mimiwhangata, Northland)

- and the host of things that may seem wierd and peculiar to us, but are an important part of life in the sea like these gorgonians, sponges, corals and bryozoa

It's not much use asking "What are bryozoa?" Bryozoa are bryozoa, a whole phylum of colonial filter-feeding benthic animals. You may have never heard of them because there are none on land, but there are several hundred species in the sea, they have been around for longer than mammals, they cover at least 10% of most rock surfaces and it's not their fault you haven't heard of them or -

21. Ascidians (Campbell Is.)

- ascidians, either, sea squirts to some people.

HUMAN ACTIVITY IN THE SEA

In New Zealand, like Tasmania, we have a relatively low population density compared to most parts of the world. But this has not prevented us from being energetic and inventive in exploiting the sea. Not only big efforts in open water -

22. Stern trawlers at 48°S

- yielding massive catches from the breeding aggregations of deep water species -

23. Orange Roughy from Chatham Rise

- but inventive systems for inshore fishing.

24. Scallop dredge (Houhora, Northland)

Not just professional fishing for food and profit, but careful encouragement for everyone to join in for fun.

25. Poster for Tuna fishing tournament (East Cape)

We also fill bits of the sea in to make things like -

26. Auckland Airport

- airports, or we use the space for cheaper -

27. Oxidation ponds (Mangere, Auckland)

sewage works. We find the sea is a good place to test things -

28. Explosion (Navy tests, Northland)

- that might be dangerous or annoying on land, and a place from which we can extract bulk minerals, -

29. Beach sand-mining (Bay of Plenty)

- like sand. The sea is handy to get rid of stuff we don't like.

30. Aerial view of brown water seawards from a freezing works, north ofTimaru

This is the effluent plume from a freezing works.

31. Coastal housing on cliff

We build right up to the edge.

32. Real Estate notice "Last of the Beach Front"

A very popular activity. We travel around on the sea surface -

33. Large catamaran passenger ferry (Great Barrier Island)

- in ever larger and faster boats -

34. Trailer load of fizz boats for hire (Waitangi)

- making sure no place is free from our busy ways.

35. Sewage pipeline crossing bay

Often we just need to get something from A to B, but engineers can solve that -

36. Rusting car bodies at cliff base

- or we have just finished with it and the sea is handy.

37. Private Marina and assorted support services

We spend a lot of money and effort making sure we can get away from it all - to somewhere where we haven't done this -

38. Oyster farms racks covering intertidal flats (Bay of Islands)

- and we are rapidly learning to farm pieces of the sea intensively.

All of this activity has been more noted for its vigour and enthusiasm than for its careful planning and management. The pace and intensity of exploitation is increasing; our numbers are increasing; our technology is increasing; but the sea remains the same size and the pressures on it get greater and greater.

THE IDEA OF CONSERVATION

This is beginning to worry some people. They think we might step back for a moment and take the larger view -

39. The earth from space

A new and revolutionary idea occured to some of these people. It was almost a subversive idea, running so contrary to the conventional wisdom it had to be approached with caution. They tried it out on land first, and in a small way.

40. Small wooden box labelled "Conservation" containing some native plants

Nothing very terrible happened, and some good things did so they got a bit bolder. National parks were started in the wilder bits up at the top -

41. Franz Josef Glacier

where the scenery was spectacular and the productivity not very high.

42. Ice wall of the Franz Josef

The tourists liked this and everyone made money out of them, so the idea crept downhill -

43. Distant mountains and forest

After a while actual millable trees were being conserved, even when they were handy to the road -

44. Tall forest either side of road

"Where will it end", cried a lot of people, and for many years part of the answer was "at the shore".

45. Forest edge at the beach

All reserves stopped at high water mark. The sea was different, wild and natural. Anyway, it would look after itself.

46. Rocks, sand and waves on wild shore

THE FIRST MARINE RESERVE

But would it? Were all our activities in the sea having no effect, or no important effect? How would we know when we just did them wherever? Wouldn't it be a good idea to find out?

In 1965 some brave souls from the University of Auckland made the audacious suggestion that a *marine* reserve was possible and even desirable. Naturally such an idea was pooh-poohed by the bureaucrats, who patiently explained to these ivory tower boffins that it wasn't even possible in law. Six years later, an Act of Parliament *made* it possible. (You can say that quickly but I lived through the process, and it seemed a lifetime).

Then they made an application to actually have a marine reserve, and an amazing number of people jumped up and said ....

I've fished off this rock for 40 years and no one...

Great idea, but go and do it somewhere else....

What's the problem, I'm still catching fish...

Just ban the trawlers and leave me to fish...

It is my God-given right to do what I like in the sea...

Four years later the marine reserve application was accepted. (You can say that quickly, too, but I reckon it took ten years off my life). And then the politicians got in a great stew about who was going to be in charge of what and how and when. But two years later it was all arranged and the Minister declared New Zealand's first marine reserve.

47. Marine Reserve notice

That was 1977. What happened over the next 13 years? Well, it can all be summarised quite easily. Nobody predicted

correctly what actually happened. Virtually everything was a *surprise*. More importantly, virtually all the surprises were *pleasant*. That's why I'm here now. To give you the good news. It is not necessary for you to fumble fearfully and slowly like us. You can (with the benefit of the examples) stop worrying about all the so-called problems, which are largely imaginary, and go for the benefits, which are very real.

The rules of the marine reserve at Leigh (proper title the Cape Rodney to Okakari Marine Reserve but a real mouthful, so I will call it Leigh, after the nearest settlement) are very simple. No killing, no removals, and no disturbance.

Note there is no distinction about who, why, how, or what for. No fishing of any kind. The local newspaper headlined the event "Nothing to do at Goat Island Bay any more". Meaning that red-blooded people wouldn't go there if they couldn't hand-line, set-net, spear-fish, grab crays, get shellfish or *anything*. But they do. This was the first surprise.

48. People on beach and in sea

Anyone visiting the marine reserve at Leigh must drive past many places where they can fish to their heart's content. If they are at the Reserve they are either lost or like it there. Although they come in large numbers the reserve is, fortunately, large enough. This photo was taken at the same time -

49. Shore to west with very few people

The Leigh reserve is 5 km by 800 metres. Our experience is that this is about the minimum to achieve something worthwhile on a straight rocky coast. Please note. I have lived alongside the Leigh reserve area for the past 25 years and -

50. Goat Island Bay and Marine Laboratory

- I work at the University of Auckland's marine laboratory, which is on the cliff top in the centre. I will try to tell you what we have learnt from this reserve and what it has taught us about the principles.

RESTORATION OF NATURAL STOCK DENSITIES

We hoped marine reserves would maintain stock densities, but were unprepared for the fact that reserves can show what we have destroyed elsewhere and can sometimes restore more natural abundance -

51. Large Red Moki (Cheilodactylus spectabilis)

Red Moki are slow-growing fish that live a very long time: this 50 cm fish may be 30 or more years old. They are slow-breeding in consequence. They are slow-moving and, unfortunately, slow-thinking as well. Their little brains don't seem to be able to work out that people might be dangerous. So they swim slowly in front of skindivers while they push a spear into them. Experienced spearfishermen don't hunt them - they say it is not sporting; but there are many new spearfishermen each year, they breed faster than red moki and the result is there are no large red moki anywhere accessible on the NE coast - except -

52. Many Red Moki in kelp forest, at marine reserve

in the marine reserve. Only as a result of having one small reserve, were we able to find out that a large, dominant and obvious fish had been almost removed over a long stretch of coastline. This was quite a shock. Especially as it was not a commercially- sought fish.

Even more surprising was what we learnt about crayfish (= red rock lobster). After ten years of no fishing, a study by Alistair McDiarmid, for the Fisheries Dept, and involving the following of tagged individuals underwater in their natural state, showed -

53. Crayfish (Jasus edwardsii) in crevice

the numbers in the reserve were 20 times greater than in equivalent places where they were fished (this was a surprise), and the individuals were larger and heavier;

despite their high density they were growing at normal rates and were not limited by lack of food (another surprise);

they could easily walk or migrate out of the reserve but very few did during the four year study (much surprise);

they were producing as many eggs and larvae (which are released into plankton and drift off for months) from 5 km of coast as from the next 100 km - i.e. the marine reserve was a stud farm for crayfish. (more surprise).

RESEARCH

We hoped that full protection would make research easier, but had no conception of how true that was.

54. Leatherjacket (Parika scaber) feeding

If fish are unmolested they take no more notice of a diver than they do of passing clouds, and you can watch closely to see what happens. Leatherjackets like this have almost no enemies and feed all the time - on junk food. Eating sponges is a bit like eating fibre glass dipped in thin soup, so they have to keep at it.

55. Crimson cleaner fish (Suezicthys aylingi)and koheru (Decapterus koheru)

The small fish is a cleaner: it makes a living picking parasites off other fish, including these koheru, open water fish that call in just for a clean up.

56. Male Spotty (Pseudolabrus ceilidotus)

Male spotties like this have territories, small areas that they never leave and that they defend against other male spotties. The females zoom around where they like and choose which males to breed with. I'm not sure whether that is justice for chauvinists or liberationists, but spotties don't think in those terms anyway. All spotties are female first and most change to males after three years. These basic points of social behaviour and biology could only be determined by careful observation over a long time of individually-known fish in a completely protected area (another surprise result).

57. Aggressive Sandager's wrasse (Coris sandageri)

Because most land animals have their sex determined by genetics at birth, we think all animals do. But fish don't. Spotties have it on a time switch, and in this Sandager's wrasse it is socially arranged. In a group of twenty or more Sandager's wrasse there is only one male, the largest and most colourful. If it dies, the largest female changes within a week or so to look like a male, and within a month or so it is a male.

EDUCATION AND TRAINING

We hadn't really thought much about the effect on education. The fact that it made a big difference was a surprise.

58. Schoolchildren and teacher on shore

When we take the children to see what it's like in the sea, do we just want to show them what no one wanted to eat or sell or do we want them to see the real thing? In the marine reserve at Leigh, they can, they do, and they enjoy it.

59. Adults on shore field trip

So do adults. Indeed, just fossicking about, looking at whatever, is a wonderful relaxation, and if you learn something at the same time, you can probably stand it.

60. Student diver with slate

For efficient advanced training, marine reserves are essential. Learning about natural processes in the sea is hard enough when they are natural. When you train mechanics do you give them a complete engine to study or one where the valuable bits have been sold off or given away?

61. Two children looking into a pool

Not all education is formal. These kids are having fun, but they are learning as well.

62. Female blue-eyed triplefins (Tripterygion bucknilli)

In a fully protected area even the little pool fish are safe and available for their attention.

RECREATION

Not only were we surprised at the popularity of the marine reserve with general public but we were surprised at the range of people involved. Big macho SCUBA divers yes, but in fact -

63. Young male SCUBA diver, middle-aged snorkeller and teenage girl swimmer

- there is no age limit, no particular level of equipment required. All of these folk can look down and see -

64. Snapper (Chrysophrys auratus), sea urchin and seaweed

not just rocks, weed and sea urchins but big fish like this snapper. They couldn't outside the reserve. where big snapper are rare and anyway flee from divers on sight.

65. Small boy lying on dry rock, with face mask and head in pool

Here we have the ultimate in diving technology, proving the extreme effort required to observe some of the wonders of nature.

66. Snails spawning (Trochus viridis)

But, jokes apart, this photo of a group of snails spawning, which was taken at Leigh, in shallow water, is the second time in history a prosobranch mollusc has been recorded breeding. They have no real system. They just chuck it all out and hope for the best. The thin milky line is sperm and the dots above are the eggs.

TOURISM AND ENTERTAINMENT

We thought that a marine reserve might be interesting to some dedicated naturalist types, but it came as a surprise to find a visit regarded as family entertainment and good business.

67. Masses of swimmers and divers

Everyone and anyone can join in - fun, recreation, education or research.

68. Japanese tourists snorkelling

If they pay to come it's called tourism, one of the bigger industries nowadays. This is a busload of Japanese girls at the marine reserve.

69. Film camerman diving

If you don't come yourself but send a TV or film crew, then it's another industry. I've lost count of how many

documentaries, stories and just background pieces have been made in the marine reserve at Leigh.

70. Encrusting sponges and anemones

Whether the viewers see just the pretty colours, appreciate that these are all animals, or discuss the competition for space involved, they are being entertained, and are learning. Since it's all at the frontier, it's research too.

71. Photographer (Heather Angel) on shore

How serious is it all? Well, the professionals take it seriously. This is Heather Angel, one of Britain's leading natural history photographers, who makes a very good business out of it. She's been twice.

72. Worms with extended tentacles

This photo represents the ultimate in patience and understanding. The black spots at the base of these worm tentacles are light-sensitive, they can see movement and shadow. They have giant nerve fibres and disappear into their tubes quicker than you can blink. But Kathy Walls somehow got a close-up. You can't eat it or take it away, but you can sell it, over and over again. The economics of tourism, entertainment and recreation are curious, but very real.

GENERAL DISCOVERY AND EXPERIMENT

We expected the reserve to help with particular investigations but were surprised at the way it changed our general perception and increased our basic understanding

73. Sea surface - blue

We are still terribly ignorant about nearly everything in the sea. We are still at the first stages of exploration. We can appreciate that the sea is different -

74. Sea surface - gold sunlight rippled

- and varied and mobile -

75. Sea surface - cold, grey and choppy

- and largely opaque, often wild, and very difficult of access**.** But we are not always clear that this means that everything we do in it is an experiment, a trial**.**

75. Fouling plate experiment

This is a test of what settles and grows on rough or smooth surfaces, with or without grazing by leatherjackets or by anything. The essence of an experiment is to compare what happens when something is done or it isn't done. Marine reserves are social as well as biological experiments - on a big scale.

76. First crude map of marine reserve - subtidal habitats

This was the first hand-drawn map of the underwater habitats of the marine reserve**.** There were no previous models to work from. We had to invent the methods.

77. Cover of sheet 2 of published map

Eventually, after two summers, 40 volunteer divers (we graciously permitted them to bring their own gear and work for nothing, because there was no grant) and about 2000 dives, we had a map.

78. Detail of published map

This is a section. We even had to invent the categories. The light blue bits look like this -

79. Diver over sea urchins (Evechinus chloroticus)

A sort of pasture, grazed, not by sheep or cows, but sea urchins. Because this is a fully protected area with no-one taking these urchins for ground bait, traditional feasts or selling them to the Japanese -

80. Diver mapping sea urchin numbers

you can persuade students to spend a couple of years of their lives, counting the sea urchins, mapping them and finding out what they do.

81. Plastic discs cemented to rock

Tony Ayling wanted to know their feeding pattern so he stuck plastic discs on the rock -

82. Disc showing sea urchin bite marks

- and monitored the bite marks.

83. Tall kelp forest - (Ecklonia radiata)

We found that the large kelp forests are largely determined by sea urchins (surprise)

84. Butterfish (Odax pullus) bites Neat oval holes in a kelp frond

although Butterfish may bite holes in their fronds

85. Deep reef - sponges etc.- with lowest kelp

and below 20 m the light is too dim for their growth. After 10 years of study we have some ideas about how a few of the major features are controlled.

MULTIPLE COMPATIBLE USE

We expected the marine reserve to conserve marine life, but we were surprised how many other useful things it did as well.

86. Washing hanging on rugby posts

Multiple use is a great thing. Here it's a bit of joke, but in fact this area is not just rugby fields in winter and a cricket oval in summer. There is also, in summer, space round the edge for campers. Three uses for one piece of land.

87. Goat fish (Upeneichthys lineatus) and cleaner fish

The marine reserve not only gives fish stocks a chance to live, grow and breed with full natural vigour, but in doing so it provides a chance for us to find out how they do this, and supplies free stud farms to the fishing industry.

88. Wave and tide recorder in laboratory

The reserve is not only a place for careful experiments and measurements, so we can increase our understanding;

89. Gorgonian sea fan and sponges

and an area where the full diversity of life can flourish without disturbance, for our education and entertainment;

90. Long-term sea temperature anomalies

it is also a focus for long-term study, a baseline against which we can measure natural variation and the results of our activities.

91. Giant kelp (Macrocystis pyrifera) and blue moki - 1st prize (underwater section) Wildlife Photographer of the Year 1987, London. Photographer Kim Westerskov.

It is, above all, a place free from our exploitations, a place where we can keep a sense of proportion and remain not just clever and active but sane, too.

NEED TO COVER ALL REGIONS

In New Zealand it is now clear that we would benefit from marine reserves in all regions.

92. Ninety Mile Beach - sunny and pretty

From the broad sand beaches of the far north -

93. Kaikoura - snowymountains and fishing boats

- to the colder rocky areas of South Island -

94. Corals and crown of thorns starfish (Acanthaster)at Kermadec Islands

- and the offshore islands, from the subtropics -

95. Elephant seal - (Mirounga leonina)

- to the subantarctic.

NEED TO COVER ALL HABITATS

It is also clear that in each region we need marine reserves to cover all habitats -

96. Hector's Dolphin - (Cephalorhynchus hectori)

not only for the popular organisms, such as open coast for the world's smallest and rarest dolphin, the endemic Hector's Dolphin -

97. Mangrove roots (close-up) and thick black mud oozing into someone's boots

but for the unpopular as well, the crabs and worms of the mangrove mud;

98. School of kingfish (Seriola grandis)

not just habitats for the economically important species, like kingfish -

99. Coloured patches of sponges and other rock encrusting life at Leigh

but also for those of no known benefit at present.

OUR IGNORANCE OF THE SEA

100. Diagram of life processes in sea

The most practical reason for this is that we know very little about what does really matter or how. Our understanding of the processes in the sea is still very limited. We think we know the main pathways for energy flow but we thought that 10 years ago and have since changed the picture enormously.

101. Phytoplankton - diatoms and dinoflagellates

Even trying to determine the primary productivity is very difficult, because the "grass of the sea" is, like these diatoms, not just microscopic but mobile in three dimensions. Imagine pastures in which the grass was invisibly small and drifted about in the wind. Hard to measure, difficult to predict and impossible to manage in the usual sense.

102. Diagram of various filter-feeding marine animals

Predictability gets worse up the food chains, and food chains are much longer in the sea. These animals are filter-feeders, grazing directly on the plants, the first order consumers. Most fish are second or third order carnivores. By that point we are just assessing stocks, not predicting much at all.

103. Adult barnacles on rock with newly settled larvae alongside

The sea is different. Marine animal populations reproduce, but their eggs or larvae disperse with the water currents, so marine populations rarely reproduce themselves. The larvae settling here did not come from these adults. The larvae have been drifting in the plankton for days or weeks.

104. Cushion star (Patiriella regularis)and "feeding trail" on glass tank
Even the simplest processes may be totally different from our expectations**.** These cushion stars don't put food into their mouths. They spread their stomachs against the surface to feed.
105. Encrusting red seaweed (Apophloea sinclairii) on a boulder
The growth rate of this seaweed is about 1 mm a year, and the patches are 40 years old.

NEED TYPICAL REPRESENTATIVE RESERVES

106. Estuary, meander and mangrove - Parengarenga (low level aerial)
The most useful and important marine reserves are those representing typical areas, because they will tell us about typical things and conserve them. Typical means ordinary, which means common, and important - for that district.
107. Straight coast with oblique waves - Hokitika (low level aerial)
This straight coast may seem boring to the locals, but it is representative of the West Coast, which is an upwelling area and highly productive.
108. Seaweed beds at low tide - Waitangi
These seaweeds are common everywhere on the northeast coast and are perhaps unappreciated by the humans that live alongside but they are home to the crayfish and nursery grounds for the fish of the area.
109. Demoiselles and leatherjackets - Northland
These demoiselles and leatherjackets are small, common and not highly regarded fish but their picky food habits, one taking large plankton and the other encrusting life, do a lot to maintain diversity. They are biologically important.

SPECIALS SHOULD BE EXTRA

110. Sea pens (Sarcophyllum bollonsi) - Fiordland
We will need special marine reserves for special species like these wierd sea pens from Fiordland -
111. Orange "firebrick "starfish, needle-spined sea urchins and blue maomao - White Is.
and for special habitats like these round the actively volcanic White Is. But specials are extra. The main effort should be for representative areas.

NEED A NETWORK

112. Pepin Island and Waimea Inlet - Nelson, aerial view
Marine reserves are different. On land a few very large national parks provide the best hope for conservation. In the sea we need a network of small to moderate reserves.
113. Marlborough Sounds, aerial view of intricate coast
Because marine animals breed by planktonic dispersal, a network of reserves is the only way we can sustain stocks and maintain all the processes needed to do this.

NEED NO TAKE

114. Month-old Hector's Dolphin dead in set net
Effective marine reserves must be fully protected. When protecting a stock it makes no difference whether death was an accident. This dolphin drowned in a setnet -
115. Cut stumps of bull-kelp (Durvillea antarctica)
or a tradition. These bull-kelp were cut to make mutton-bird bags.

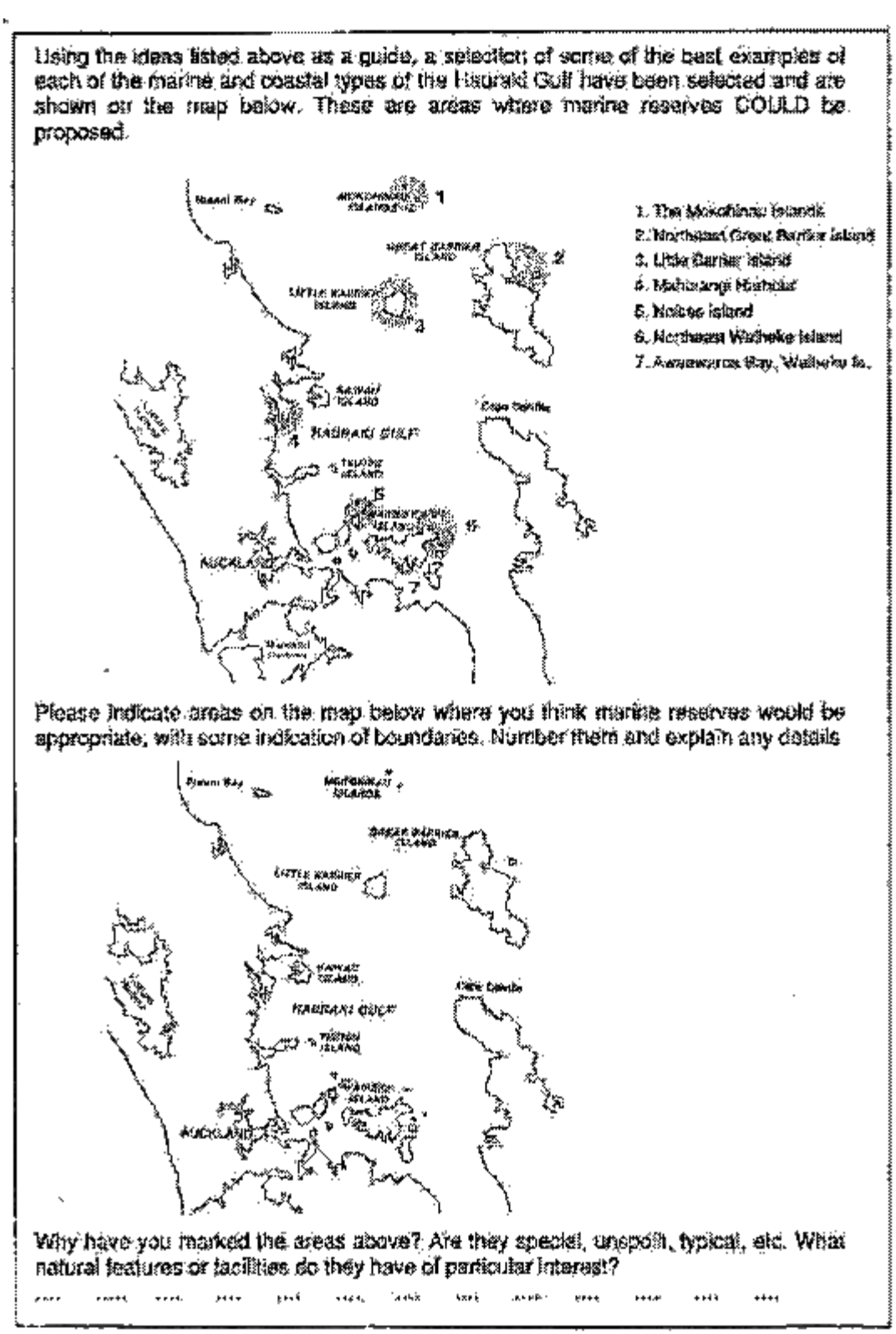


Fig 43 THE FIRST NETWORK?
Taken from a booklet *"A draft Discussion Document for future Marine Reserves on Waiheke Island and in the Hauraki Gulf"* by the Waiheke Underwater Club and the Hauraki Islands branch of the Royal Forest and Bird Protection Society, in February 1991. As well as making suggestions for a marine reserve network (top map) it included a four page questionnaire asking public suggestions (lower map). This was the first time a regional network of marine reserves has been clearly proposed.

116. Fishing boat with craypots
- part of a commercial business

117. Fish catch of spearfisherman in a tournament

or a bit of fun. Dead is dead.

NEED INSURANCE

118. Burning launch - on rocks, Leigh
We need insurance for our marine life, as the owner did for his boat.
119. Firemen putting out the above
We should remember that prevention is better than cure. The firemen put the fire out but no one wanted what was left.
120. Scallop Enhancement Project (Golden Bay) vans and buidings
We can wait until each fishery goes wrong and then painfully and expensively try to restore it, but it is so much better, cheaper and easier to reserve some whole areas now, that act not just as insurance but as active preventers.

NEED BALANCE

121. Auckland Harbour waterfront buildings
When it comes to development we are very active and clever.
122. Black-browed mollymawk over stormy sea - Campbell Is.
But we need to remember that in the sea, like this mollymawk, we are dependent on what's there. We don't grow our fish any more than this bird does. So we had better make sure the fish can continue to grow themselves. Fish catches are valuable, but fish stocks to produce them are priceless.

AND FORESIGHT

123. Fur seal (Arctocephalus forsteri) underwater looking at thephotographer - Kaikoura
I would like my grandchildren to grow up with a chance to look nature in the face, to have places where the full diversity of the marine world on view. I don't want them to grow up thinking that marine conservation -
124. Children with plastic rubbish - Mohaka beach
- consists of picking up adult garbage from beaches. On land we have playing fields and parks even in the city, we have scenic reserves, wildlife refuges, scientific sites and national parks. In the sea we have nothing. We like to call it freedom but in sober fact it looks more like irresponsibility.
125. Marine Reserve - Leigh - aerial from west
The marine reserve at Leigh has shown how we could sustain marine resources. Like many New Zealanders I am proud of it -
126. Brachiopods (Terebratella inconspicua) and other complex marine growths (close-up)
- and how much we have learnt from it, not just about marine life -
127. Children on beach watching a penguin
- but also about ourselves, and what is important. Some of these basis truths are very simple. For example, do we really need all this effort to promote fishing.
128. Family Fishing Contest Poster
In fact, fishing is so popular what we need now is some promotion for fish -
129. Two Goat Fish
- and all other marine life
130. AA signpost - Marine Reserve
In NZ more and more people feel we have learnt enough. There are now active plans for a network of marine reserves, in all regions, for all habitats, with full protection. Since 1980 I have been proposing 10% of everything. Not fiddling little bits, not private spots for recreational anglers, but real viable protected areas. For life, for us, for our children. The signpost is clear.
Now it's over to you. Good luck. Thank you for listening.

.

Box 17

EXCUSES AND RED HERRINGS

Some of the "reasons" given for not establishing marine reserves, for delaying action, or for charging off in different directions are so common they are worth listing. Just knowing these ideas in advance helps to prepare replies. In addition, realising that these hoary old excuses will be trotted out as sure as the sun will rise provides mental protection against any suggestion they have real force or sense, however loudly they are shouted or however many people are initially taken in.

1. Who says I'm doing any harm, what's the problem anyway.....
(and I don't believe in insurance either)

2. There are too many restrictions already.
(Don't ask if they achieve something worthwhile, just count them)

3. I've always fished off this rock - it's my right.
(like my right to hunt moa)

3. Why here? Not in my back yard. Somewhere else is better.
(indeed anywhere else)

4. It's not my department. Don't bother me I'm busy. They will deal with it.
(Who?.....and is that a blank cheque?)

5. We need more research, to find the right places, sizes, boundaries etc.
(when we've counted and mapped all copepods, whales, sponges, kelps and kina round the entire coast, we will know just what to do.)

6. We need more consultation, we musn't upset the....
(and if anyone says boo, we will run away)

7. Yes, but one at a time, we should proceed cautiously.
(like 3 in 25 years)

8. How could you police it?
(more easily than getting people to pay taxes, which is clearly impossible)

9. I can still catch fish.
(translate as "I am not just selfish, but short-sighted and in need of protection")

10. When we've sorted out the quota system, a Maori fishing policy, drift nets, coastal resource management, the economy, plastic debris, etc.
(which, of course ,will only take a few days)

11. We must first produce the general policy, state the precise aims, organise appropriate guidelines, arrange management policies .
(and bury the whole question in bureaucratic bull)

12. Just get rid of the trawlers, the set-netters, the drift nets, the large boats, the outsiders and everything will be fine.
(for me and my mates, and blow you, Jack)

13. Our waters are so cold (or murky or rough) there's no point in a marine reserve here.
(if I can't look at it and say how pretty, there's no point at all)

CHAPTER 15

HOW TO MAKE IT HAPPEN

This final chapter is about what individuals and voluntary organisations can do to get a network of marine reserves for New Zealand. It assumes that you want to do this but are unsure about how. In these confused and troubled times individuals often feel powerless to influence events. However, it is my firm conviction, based on actual experience, that the power of an individual is a simple consequence of his or her ideas. Given a good idea there is no limit.

THIS IS THE TIME FOR MARINE RESERVES

Real, successful examples of marine reserves exist in New Zealand, and have been working well for more than a decade. We know what to do and we know it works. But, although real and successful, the existing examples are trivial on a national scale. What is needed is a nationwide network of marine reserves, like that we already have on land.

The recently established Department of Conservation - has a formal mandate to promote marine reserves, and is keen to do this. But it needs public support.

The Department of Conservation cannot just impose lots of marine reserves. It needs public suggestions, public support and public enthusiasm. There is an opportunity for every citizen to make an effective contribution, but mental energy and initiative will be required.

The general public is increasingly concerned about marine resources and the marine environment. There is a growing feeling that our current arrangements for fishing, waste disposal and other uses of the sea are short-term in outlook and inadequate for the future. Many people would welcome proposals that give a better chance for sustained use of the sea and continued benefits from it. But this feeling, while widespread and strengthening, is not yet focused. The idea of marine reserves with full protection is still new and strange to many people and needs much more publicity.

In addition, we must publicise the fact that marine reserves benefit everyone and that there are many benefits. There are no real losers. However, the benefits are new and different (they require imagination to foresee); the benefits are widespread (they do not easily attract specific support); and the benefits are difficult to express as dollars (which makes them unfashionable!). Although we can develop a crusade for marine reserves with no people or groups as enemies, there will be all the usual enemies - inertia, ignorance and indifference.

So everyone can help. It does not require special skills, money or influence, but it will require thought, effort and commitment.

WRITE TO POLITICIANS

Although there is no limit to the amount of help an individual could give, each will only do as much as he or she feels like. So start small and enjoy yourself. Set out to write one letter - a short (one page), handwritten letter to a politician. Begin with your own M.P., your regional councilor, or your district councillor. Address it to them personally (by name), and send it to their home address if possible. Write and sound like an ordinary citizen and voter (do not use any jargon or puff phrases). If you voted for them, say so. Ask simple questions. *"Have you heard about marine reserves?" "What do you think about them?" "Do you know what plans are there for any in your constituency*? Make it clear you want to know their personal position on the matter, and if they haven't got one yet, that you will help them form one. Say that you are concerned that nothing seems to be happening to create some more [any or enough] in the constituency [region, district or whole country].

Do NOT write to a minister [except when mailing a public submission on a particular issue]. It only gets pushed to some already overworked civil servant to answer. You want to make the politician think, not make extra work for someone else. Keep copies of every letter [use ballpoint pen and carbon paper, if you can't get to a photocopier].

If you get ANY reply, follow it up. Thank them for the reply - mean it, they are busy; thank them for their interest, however tepid, and for the information, however little. Ask further questions based on whatever they said; supply them with some information - judiciously selected and relevant bits. Keep the correspondence going. You are always polite (especially when you don't feel it!), you are grateful (ditto), but you are determined to get some more marine reserves.

If you don't get a reply, write again ...and again. Still politely, and at first, even apologetically - *"I know how busy you must be...."* but don't let them off the hook.

Having got one correspondence going, start another. There are plenty of politicians and they all need to hear about marine reserves from the voters. When you get short (or tired) of elected politicians, start on appointed representatives (e.g. your regional Conservation Board), local political parties, community groups etc. To get more information write to the Department of Conservation and get on the subscription mailing list for *Groundswell,* the DoC

head office newsletter for marine reserves. Start involving your friends and relatives; begin by offering to write the letters for them (to show you mean business); form a correspondence group; start to support groups in other areas.

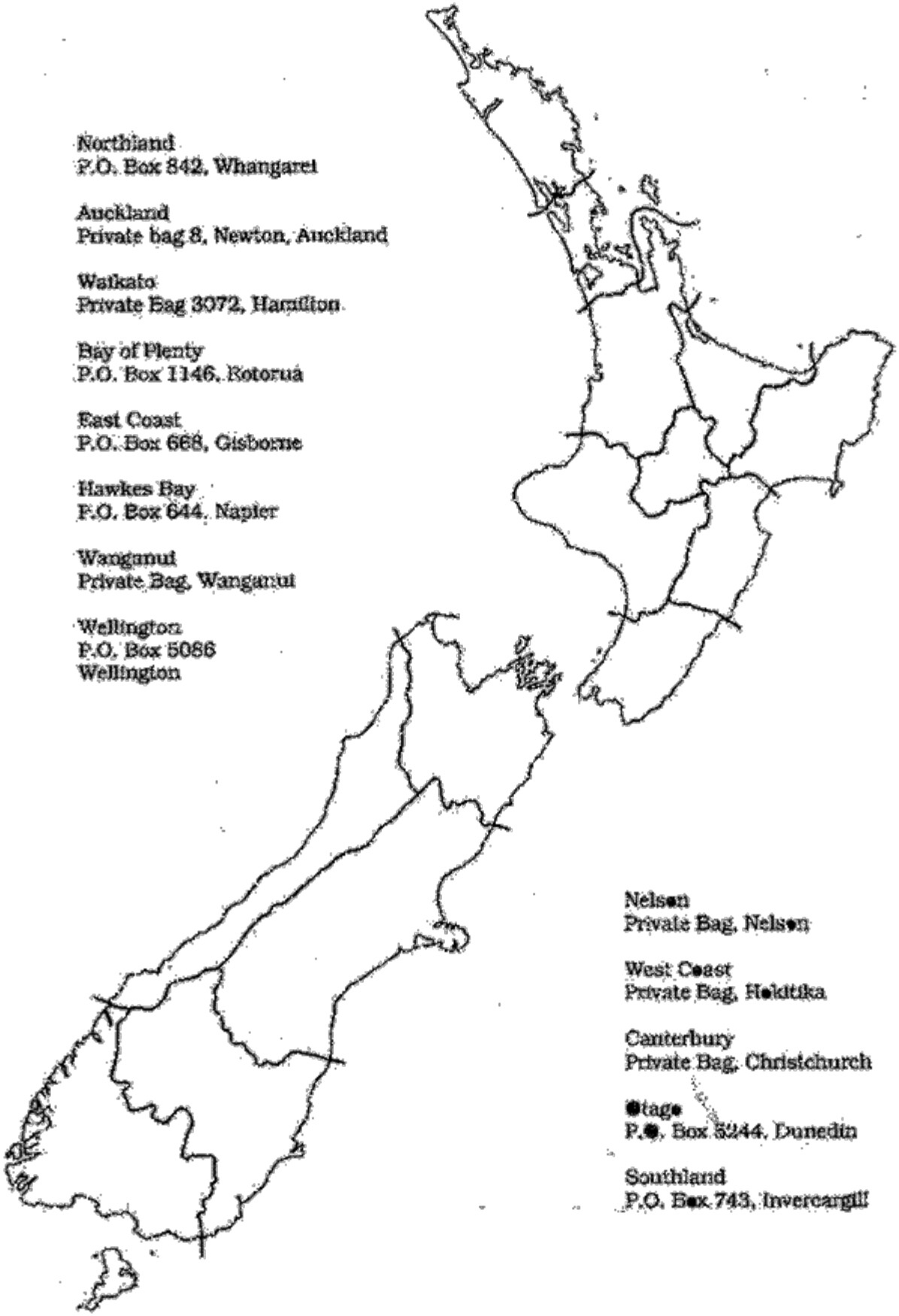
LEARN ABOUT YOUR COAST AND SEA

Go on foot, by car, in a boat, by light plane, diving, or just use maps, charts and books. Learn what kinds of coast you have in your region. Explore, make notes, take photos or videos. Visit the local Department of Conservation office or local library and ask to see the Stage I Coastal Resource Inventory. Get photocopies of some bits and try to add information to them (not difficult, they've only just started). Get the relevant 1:50,000 maps from good bookshop or DOSLI (Department of Survey and Land Information). DOSLI also has aerial photographs. Get the local chart (from bookshop or boaties gear store). Refer to the public library, the district council planning office, old local identities, fishermen and any others with special experience or knowledge.

Start thinking about possible sites for marine reserves and reasons to justify and support these. Ask other people to help - divers, boaties, aero club members, video camera buffs, conservation enthusiasts, teachers ...anyone. It is great fun exploring a coast you don't need to be apologetic for having a second reason yourself! Tell friends, family and colleagues what you are doing - exploring the coast of "your patch". Invite them to join in. Make it a hobby.

Always keep in mind the 10% idea. We want 10% of every kind of marine habitat in the region represented in fully protected marine reserves. So what kinds are there? As you get into it, you will be amazed to find that you are to a large extent pioneering. Worried, too. How did we get to this stage without having any good information on the sea? Maps just colour the sea blue and forget it. Charts are just road maps for the sea, with depths. Yes, you will be really exploring.
Note: "Your" patch of sea and coast is whatever bit you choose. It could be on your doorstep, where you often visit or cruise on holiday, or even some place you have never seen but would like to "adopt".

DEPARTMENT OF CONSERVATION: addresses and boundaries of the conservancies



Northland
P.O. Box 842, Whangarei

Auckland
Private bag 8, Newton, Auckland

Waikato
Private Bag 3072, Hamilton

Bay of Plenty
P.O. Box 1146, Rotorua

East Coast
P.O. Box 668, Gisborne

Hawkes Bay
P.O. Box 644, Napier

Wanganui
Private Bag, Wanganui

Wellington
P.O. Box 5086
Wellington

Nelson
Private Bag, Nelson

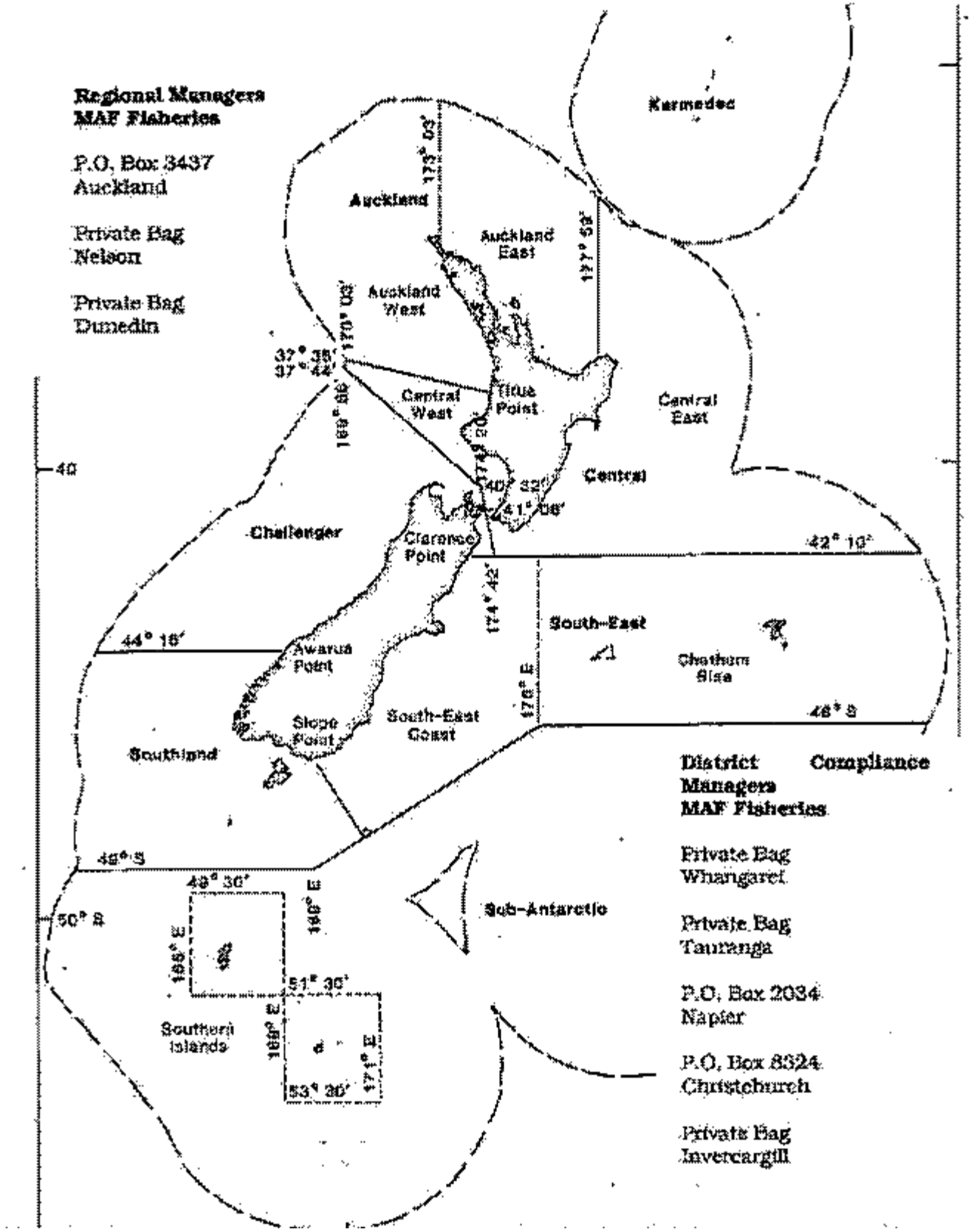
West Coast
Private Bag, Hokitika

Canterbury
Private Bag, Christchurch

Otago
P.O. Box 5244, Dunedin

Southland
P.O. Box 743, Invercargill

MINISTRY OF AGRICULTURE AND FISHERIES: addresses and management areas



BUILD UP INFORMATION FILES

Collect information on the sea and marine reserves, organise it and pass it on to politicians, friends, reporters, schools, etc.

(a) **information on marine reserves** - existing, proposed and planned - pamphlets, articles, reports, books, anecdotes, cartoons
(b). **information on the politicians,** appointees and administrators and community leaders of your locality, district and region - their names, positions, and contact addresses; whether they have been contacted about marine reserves; what their current attitude is, etc.
(c) **information on local, district and regional "marine interest" groups** such as: Maori groups, service organisations, schools, commercial or recreational fishermen's associations, boat clubs, tour companies, conservation groups, photographic clubs, aero clubs, youth groups - particularly contact names, addresses and phone numbers.
(d) **newspaper and magazine cuttings** on marine reserves and associated topics. Not just news items, but editorials, features and readers' letters. Spread the word that you collect them. Also build a file on reporters, feature writers and editors to whom you could send stories or material.
(e) **photographs, videos, objects and specimens** that are useful in displays on marine reserves, talks to schools, articles, etc.
(f) **helpful people** such as those who will type material, photocopy things, provide car or boat transport, take photos or videos, dive and report, organise or chair meetings, give school talks, help raise funds, put pamphlets in envelopes, form a telephone tree, own a computer, etc. Find real jobs for anyone who would like to help.

JOIN OR START A LOCAL MARINE RESERVE ACTION GROUP

A lot can be done by individuals, but it is often more effective and more fun if they combine. Check whether there is already an active group in your area. If not, don't wait for someone else to do it, start the group yourself, and start small. Do not be satisfied that some large group think they are handling marine reserves along with many other things. Don't criticise them; start a sub-group that concentrates on marine reserves.

There are always people who think that marine conservation is protesting about pollution, banning driftnets, picking up plastic rubbish, opposing reclamations, etc. Fine, let them do that; but make sure that your group concentrates on positive action for marine reserves. Your local action group could develop out of your correspondence group or your coast explorers group, or it could begin from your membership of an existing society (e.g. your marae or community centre, a Forest and Bird branch, local dive or boat club, school, service organisation, polytechnic, etc.).

Begin by collecting a small number of highly enthusiastic people, not worrying about whether they are either representative or expert. When you have done a few real things (actual letters, enquiries, explorations, etc.), begin to look for new and different kinds of people, but still those willing to help. Only when you are at the stage of wanting to make public proposals for particular marine reserves should you concern yourself about representation of all types. Your group is an action group, not a steering committee. Your group will concentrate on:

(a) informing and influencing politicians, administrators and planners at all levels
(b) helping with marine conservation awareness in schools
(c) exploring the local sea and coast
(d) collecting, recording and spreading useful information
(e) organising public education and awareness on marine reserves
(f) building up an effective organisation, including any necessary fund-raising
(g) [last but not least] developing ideas on site selection and actual proposals

There are already quite a few such groups, very varied in composition, but all learning fast. It would help to talk to some of the others and find out what they have learnt (mistakes and successes). You can start this through a subscription to the Department of Conservation's marine reserve newsletter "*Groundswell*".

Naturally you want to rush off to the newspaper on day one with your own brilliant idea of where to put a marine reserve. Try to restrain yourself. Test your idea out on a few fellow enthusiasts first. Listen to their equally brilliant ideas. Try to convince each other. Realise there does not have to be just one reserve in your area. Remember networks, representative habitats and 10%. Keep checking back to the "General Case for Marine Reserves".

Develop detailed arguments for your potential proposals. Figure out potential objections. Think how you would answer these. Consider alternatives to your own preferences. Practise amongst yourselves a "public" debate, a "school" talk, a "shop window" display, a "local resident's" questionnaire, letters "to the newspaper", a "local radio" interview or talkback, etc. Put all these into practise WITHOUT mentioning any particular proposals. Start a new round that ASKS for local marine reserve proposals. Do a third round USING some of these. At each stage involve more people, more

organisations.

Keep in touch with the Department of Conservation, listen to them, and try to help them in their general marine conservation work. Do the same with the Ministry of Agriculture and Fisheries, and your Regional and District Council staff. But remember it is your sea not theirs. They are public servants; you are the public. They have lots of other things to do; you can concentrate on marine reserves. They can only act within existing public perceptions and plans; you can change public perception and make better plans.

When the going gets tough or tedious, and it will - remember your grandchildren.

> And God created great whales, and every living creature that moveth, which the waters brought forth abundantly after their kind....
> And God blessed them saying, Be fruitful and multiply and fill the waters in the seas.
>
> *Genesis* **1** 21-22

Box 18

FEEDING THE FISH

It is, of course, pleasant to feed fish by hand and to have animals perform for your entertainment. Why then would anyone worry about people feeding fish in a marine reserve? Is this just the objection of some purists, some obscure scientific point, or a bit of legal nonsense? No, in fact it is quite basic, although not always easy to explain.

The central point is that there is no sense in spending a great deal of time and trouble creating natural conditions for fish (and restricting all kinds of important activities in the process) and then messing up the fish again in a different way for fun, especially when that fun could be obtained almost anywhere.

When people are enjoying themselves it is no use giving them dry lectures, moralising, or even talking about the law, unless you can get them to see a point of real significance to themselves. You ***could*** stand on the law and say that it is illegal to feed fish in a marine reserve because it constitutes a disturbance. Yes, you could. But I am not going into court to say "*Your honour, the accused is charged with feeding a snapper with some sausage in the marine reserve*" I can hear the hoots of mirth already.

So do we just forget it and let people carry on. No, we try to explain, and we use the best educational tool for difficult and subtle social points - humour! We tell jokes that help get the point across.

Some large spear-fishing blokes met me down on the beach and said "*Oh, sorry we gave you such a hard time, when you were trying to get the reserve. We now think its ***. marvelous. We've been in there busting up the sea eggs and feeding them to the snapper. Got a great crowd milling about!*" I cringe inside and wonder how I can get it into their heads that sea eggs (kina) are also animals and fully protected in the reserve and that, in any case, a mass feeding frenzy is not quite what we had in mind when we spent 12 years persuading everyone to allow one place to become more natural.

If you have ever organised a children's party you know that it is a neat idea to finish with a lolly scramble. Tossing handfuls of sweets about is fun, just before they are packed off home. But you also know that no one with any sense would start a children's party with a lolly scramble, you would be lucky to regain control. That's the problem with feeding fish. How do you tell them the party is over? You have had a nice time for a few minutes, the food is all gone, and you say "*O.K. fish. That's it. Off you go about your normal business while I watch."* But all they do is crowd closer for more.. more... more!

It is legal to feed fish anywhere in New Zealand, except marine reserves, and it is truly ironic that the reserve is almost the only place where people commonly do this. Some people find it difficult to see any interest in natural behaviour, or even grant animals any value of their own. Having agreed not to kill these fish, they immediately say "*Well they must justify their existence in some way. Come and perform tricks for my amusement. Here didums, come and get the bread*".

The result is that close to the beach in the reserve many fish crowd round anyone entering the water. This is, for a while, exciting and amusing, because so unusual. But only for a while. Then you notice that this behaviour, prevents you from seeing anything else unless you swim a lot further out. Then you remember that you didn't come here to just "see" fish, you can do that better at any aquarium. What you really wanted to see was undisturbed fish, fish ignoring you but getting on with their own affairs in their own way. But this has just been taken away from you by well-meaning people who just didn't think or selfish people who just didn't care. If you went to a big game park in Africa and all the viewing points had lines of antelopes and elephants waiting for a handout, you would think it was scarcely better than a zoo, and you'd be right.

REFERENCES

Adams, N. M., 1983 Checklist of marine algae possibly naturalised in New Zealand. *New Zealand Journal of Botany 21*: 1-2.

Adams, N. M., Conway, E. and Norris, R. E. 1974 The marine algae of Stewart Island. *Records of the Dominion Museum 8*: 185-245.

Adams, N. M. and Nelson, W. A. 1985 The marine algae of the Three Kings Islands. *National Museum of New Zealand Miscellaneous Series 13*: 1-29.

Andrew, N. L. 1988 Ecological aspects of the common sea urchin, *Evechinus chloroticus*, in northern New Zealand. *New Zealand Journal of Marine and Freshwater Research 22*: 415-426.

Andrew, N.L. and Choat, J.H. 1982 The influence of predation and conspecific adults on the abundance of juvenile *Evechinus chloroticus*. *Oecologica (Berlin) 84*: 80-87.

Andrew, N.L. and Choat, J.H. 1985 Habitat related differences in the survivorship and growth of juvenile sea urchins. *Marine Ecology: Progress Series 27*: 155-161.

Atkinson I. A. E. and Bell, B. D. 1973 Offshore and Outlying Islands. In *The Natural History of New Zealand*. Pages 372-392. Reed, Wellington. .

Auckland Regional Authority, 1983 *Review: Ecology of the upper Waitemata harbour*. 30 pages. Auckland Regional Authority.

Auckland Regional Authority 1987 *Regional Planning Policies for marine areas, lakes and rivers.* 73 pages. Auckland Regional; Authority,, Auckland.

Auckland Regional Water Board, 1987 *Manukau Harbour Action Plan*. Auckland Regional Water Board, Auckland.

Augustin, J. and Evans, J. 1984 The climate in 1983. *Leigh Laboratory Bulletin 17*: 119 pages. Leigh Laboratory, University of Auckland.

Avery, M. and Green, R. 1989 Not enough fish in the sea. *New Scientist 123 (1674)*: 12-13.

Ayling, A.M. 1976 The strategy of orientation in the barnacle *Balanus trigonus*. *Marine Biology 36(4)*: 335-342.

Ayling, A.M. 1978 Marine reserve survey. *Leigh Laboratory Bulletin 1*: 98 pages. Leigh Labortatory, University of Auckland.

Ayling, A.M. 1981 The role of biological disturbance in temperate subtidal encrusting communities. *Ecology 62*: 830-847.

Ayling, A. M., Cumming, A. and Ballantine, W. J. 1981 *Map of shore and sub-tidal habitats of Cape Rodney to Okakari Point Marine Reserve, North Island, New Zealand* in 3 sheets, scale 1: 2000. Department of Lands and Survey, Wellington.

Baird, G. G. and McKoy, J. L. (editors) 1988 *Papers from the workshop to review fish stock assessments for the 1987-88 New Zealand fishing year. 300 pages. Fisheries Reserach Centre, Ministry of Agriculture and Fisheries, Wellington.*

Ballantine, W. J. 1979 New Zealand's first marine reserve. *Environment 77, Proceedings 7 (Coastal Zone Workshop):* 67-71.

Ballantine, W. J. 1980 The need for marine reserves in New Zealand. In *Proceedings of Coastal Zone Management Seminar 3 (Marine Reserves):* 1-9. Ministry of Transport, Wellington.

Ballantine, W.J. editor 1982 Sea surface temperatures. *Leigh Laboratory Bulletin 5*: 43 pages. Leigh Laboratory, University of Auckland.

Ballantine, W. J. 1987a New Zealand's course for marine reserves. *New Scientist 114*: (1565), 54-55

Ballantine, W. J. 1987b Marine Protected Areas in New Zealand: what has happened so far and a vision of the future. In *Conserving the Natural Heritage of the Antarctic Realm*. Proceedings of 29th Session of the International Union for the Conservation of Nature's Commission on National Parks and Protected Areas: 56-60. (Also published in *Forest and Bird 19*: (1), 2-4. February 1988)

Ballantine, W. J. 1989a Marine reserves: lessons from New Zealand. *Progress in Underwater Science 13*: 1-14.

Ballantine, W. J. 1989b Marine biological monitoring. in *Proceedings of a Symposium on Environmental Monitoring in New Zealand*: 117-124. Department of Conservation, Wellington.

Ballantine, W. J. 1990 The significance of island reserves for ecological restoration of marine communities. In *Proceedings of Conference on Island Management: Ecological Restoration of New Zealand Islands*. Department of Conservation, Wellington.

Ballantine, W. J. and Gordon, D. P. 1979 New Zealand's first marine reserve, Cape Rodney to Okakari Point, Leigh. *Biological Conservation 15*: 273-280.

Ballantine, W. J., Grace, R. V. and Doak, W. 1974 *Mimiwhangata Marine Report*. Turbott and Halstead, Auckland. 99 pages and 2 maps.

Baumgart, I. L. 1977 *Auckland thermal No.1 power station: Environmental impact audit*. Commission for the Environment, Wellington.

Baxter, A. S. 1987a Kapiti Island: subtidal ecological survey. *Central Fisheries Management Area Internal Report No. 87/2*: 48 pages. Ministry of Agriculture and Fisheries, Napier.

Baxter, A. S. 1987b Kapiti Island: Marine Recreational Survey. *Central Fisheries Management Area Internal Report No. 87/3*: 19 pages. Ministry of Agriculture and Fisheries, Napier.

Bioresearches 1976 *The ecological impact of the proposed development of Auckland thermal number one at Waiau Pa*. 152 pages and Supplement 122 pages. Bioresearches, Auckland.

Bjorklund, M. I. 1974 Achievements in marine conservation: Marine Parks. *Environmnetal Conservation 1:* 205-217.

Choat, J. H., Ayling, A. M. & Schiel, D. R. 1988 Temporal and spatial variation in an island fish fauna. *Journal of Experimental Marine Biology & Ecology 121*: 91-111.

Choat, J. H. and Schiel, D. R. 1982 Patterns of distribution of large brown algae and invertebrate herbivores in subtidal regions of northern New Zealand. *Journal of Experimental Marine Biology and Ecology 60*: 129-162.

Coastal Zone Management Seminar 1980 *Maritime planning, Regional Planning and Marine Reserves.* 350 pages. Maritime Policy Branch, Ministry of Transport, Wellington.

Coastal Zone Management Seminar 1982 *Collected preprints, papers and reviews.* 380 pages. Commission for the Environment, Wellington.

Coastal Zone Management Seminar 1984 *Coastal planning and its application*. Proceedings of the third biennial seinar. 159 pages. Information Series No. 15. Department of Lands and Survey, Wellington.

Cole, R., 1988 *Marine Reserve Monitoring Report: 1988*. Leigh Laboratory, University of Auckland.

Cole, R. G., Ayling, A. M., and Creese, R. G. 1990 Effects of marine reserve protection at Goat Island, northern New Zealand. *N.Z. Journal of Marine and Freshwater Research* 24: 197-210.

Colebrook, J. M., 1979 Continuous plankton records: monitoring the plankton of the North Atlantic and the North Sea. In Nichols, D. (Ed.) *Monitoring the marine environment*. pages 87-102.

Cranwell, L. M. and Moore, L. B. 1938 Intertidal communities of the Poor Knights Islands, New Zealand. *Transactions of the Royal Society of New Zealand 67*: 375-407.

Creese. R. G. 1988 Ecology of molluscan grazers and their interactions with marine algae in north-eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research 22*: 427-444.

Creese, R. G. and Ballantine, W. J. 1986 Rocky shores of exposed islands in north-eastern New Zealand. in *The Off-shore Islands of Northern New Zealand*. Department of Lands and Survey, Wellington, Information Series 16. 85-102.

Creese, R. G. and Ballantine, W. J. (Editors) 1988 The Mokohinau Islands: a marine survey. *Leigh Laboratory Bulletin 21*: 77 pages. Leigh Laboratory, University of Auckland.

Crisp, P., Daniel, L. and Tortell P. 1990 Mangroves in New Zealand: Trees in the Tide. 69 p. GP Books , Wellington.

Crouch, F. and Hackman P. 1986 *Marine Conservation in New Zealand: an ongoing struggle*. 61 pages. Unpublished report to Farnborough Technical College, U.K. for HND in Conservation Management.

Dart, J., Drey, B. and Grace, R. 1982 *Mimiwhangata Marine Park Environmental Impact Report*. 143 pages. Hauraki Gulf Maritime Park Board, Auckland.

Davidson, R. J. and Moffat, C. R. 1990 *A report on the ecology of the Waimea Inlet, Nelson.* 162 pages and 9 maps. Occasional Publication No.1. Department of Conservation,
Nelson.

Department of Conservation 1988a *Between Sea and Land: a source book for teachers.* 28 pages and folded poster. Department of Conservation, Wellington

Department of Conservation 1988b *Protection of Hector's Dolphin round Banks Peninsula: a paper for public comment.* 22 pages. Department of Conservation, Christchurch.

Department of Conservation 1989a *Banks Pensinsula Marine Mammal Sanctuary.* A two page pamphlet. Department of Conservation, Christchurch.

Department of Conservation 1989b *Protection of the marine environment around Kapiti Island: Public discussion paper and questionnaire.* 19 pages. Department of Conservation, Wellington.

Department of Conservation 1989c *Protection of the marine environment around Kapiti Island: a summary of public submissions.* 8 pages. Department of Conservation, Wellington. Also a full *Analysis of public submissions.* 40 pages.

Department of Conservation 1989d *A marine reserve for Whanganui (West Haven) Inlet.* A six page booklet. Department of Conservation, Nelson/Marlborough Conservancy, Nelson.

Department of Conservation 1989e *New Zealand's Southern Coasts : Worth protecting!* A folder of text, maps, pamphlets and

questionnaires. Department of Conservation, Dunedin.
Department of Conservation 1990a *The underwater world: Te arae nui o hine-moana.* A kit for teachers of Forms 1 and 2. Folder of pamphlets, photos, worksheets and teachers guide. Department of Conserevation, Wellington.
Department of Conservation 1990b *Kapiti Island Marine reserve Proposal: a public discussion document.* 17 pages. Department of Conservation, Wellington.
Department of Conservation 1990c *Cathedral Cove Marine Reserve Proposal.* 29 pages and four maps plus 98 pages of appendicies. Department of Conservation, Hamilton.
Department of Conservation 1990d *Caring for our Coast: The NZ Coastal Policy Statement.* a large format pamphlet. Department of Conservation, Wellington.
Department of Conservation 1990e *Draft New Zealand Coastal Policy Statement.* 26 pages. Department of Conservation, Wellington.
Department of Conservation 1990f *Groundswell: a newsletter on marine reserves.* No.1 (New Series) 8 pages. (a previous series had 8 issues 1988-90) Department of Conservation, Wellington.
Department of Conservation 1990 *Marine Reserves: Four alternatives for Southern Hawkes Bay*. A colour pamphlet. Department of Conservation, Napier.
Department of Conservation 1991 *A marine reserve on Great Barrier Island?; Your chance to have a say*. A coloured brochure plus a questionnaire. Department of Conservation, Auckland.
Department of Environment and Planning 1990 *Joint policy for the establishment and management of marine reserves in Tasmania* Departments of Environment, Parks and Fisheries, Hobart , Tasmania.
Department of Lands and Survey 1984 *The Cape Rodney to Okakari Point Marine Reserve Visitor Survey 1983-84*. 85 pages. Department of Lands and Survey, Wellington.
Doak, W. 1971 *Beneath New Zealand Seas*. 113 pages. A. H. and A. W. Reed, Wellington. (Republished 1979 as *The Cliff Dwellers: an undersea community*. 80 pages. Hodder and Stoughton, Auckland.)
Doak, W. 1972 *Fishes of the New Zealand Region.* 132 pages Hodder and Stoughton. completely revised as:
Doak,W. 1991 *Wade Doak's Worl of Fishes.* 240 pages Hodder and Stoughton.
Dromgoole, F. I. and Foster, B. A. 1983 Changes to the marine biota of the Auckland Harbour. *Tane 29*: 79-96.
Duggins, D. O., Simenstad, C. A. and Estes, J. A. 1989 Magnification of secondary production by kelp detritus in coastal marine ecosystems. *Science 245*: 170-173.

Fleming, C. A. 1973 Kermadec Island giant limpet occurring fossil in New Zealand, and relict distributions in the tropics. *New Zealand Journal of Marine and Freshwater Research 7*: 159-164.
Foster, B. A. 1982 Platform Fouling. In *Maui Development Environmental Study: Report on Phase 2 1977-81*. Pages 139-152. University of Auckland.
Francis, M. P. 1984 Marine Reserves in New Zealand: History, current status and recommendations for future progress. *Fisheries Research Division Internal Report No. 17*. Ministry of Agriculture and Fisheries, Wellington.
Francis, M. P. 1985 The Kermadec Islands: a marine reserve proposal. *Fisheries Research Division Internal Report No. 29*. 42 pages. Ministry of Agriculture and Fisheries, Wellington.
Francis, M. P. 1987 Coastal Fishes of the Kermadec Islands. *New Zealand Journal of marine and freshwater Research 21*: 1-13.
Francis, M. P. 1991 Northland's invaders Part I. *New Zealand Underwater.* February/March issue.,page 2. N.Z. Underwater Association, Auckland.

Franko, G. 1988 A guide to Delaware Inlet and Vegetation Map of the Intertidal Zone, Delaware Inlet, South Island, New Zealand. 42 page booklet and map at scale 1:3750. DSIR Publishing, Wellington, for Cawthron Institute and Department of Conservation, Nelson.

Gordon, D. P. 1984 The marine fauna of New Zealand: Bryozoa: Gymnolaemata from the Kermadec Ridge. *New Zealand Oceanographic Institute Memoir 91*: 198 pages.
Gordon, D. P. and Ballantine, W. J. 1976 Cape Rodney to Okakari Point Marine Reserve: Review of Knowledge & Bibliography. *Tane Supplement to Vol. 22:* 146 pages.
Grace, R. V. 1979 *Mimiwhangata Marine Report 1979*. 25 pages. For Mimiwhangata Farm Park Charitable Trust.
Grace, R. V. 1981 *Tawharanui marine marine monitoring programme.* 32 pages. Report to Auckland Regional Authority**,** Auckland.
Grange, K. R. 1986 Species diversity of shallow rock-wall marine communities in northern New Zealand. In The Offshore Islands of northern New Zealand. *Department of Lands and Survey, Wellington, Information Series* 16: 123-127.
Grange, K. R. 1990 *Unique habitats in the New Zealand Fiords: A case for preservation.* 70 pages plus 10 pages of references. A report from N. Z. Oceanographic Institute, Wellington for the Department of Conservation.
Gray, J. S. and Christie, H. 1983 Predicting long-term changes in marine benthic communities. *Marine Ecology Progress Series 13*: 87-94.

Hamilton, W. M. 1961 Little Barrier Island (Hauturu) 2nd edition. *New Zealand Department of Scientific and Industrial*

Reserach Bulletin 137: 198 pages and maps.
Handford, C. 1986 *Planning for marine protected areas in New Zealand.* An unpublished research essay in Town Planning University of Auckland.
Harris, T. F. W. 1985 *North Cape to East Cape: Aspects of Physical oceanography*. 178 pages. Physics Department, University of Auckland.
Hay, C. H., Adams, N. M. and Parsons, M. J. 1985 Marine algae of the subantarctic islands of New Zealand. *National Museum of New Zealand Miscellaneous Series 11*: 70 pages.
Hayward, B. W. 1986 Origin of the offshore islands of northern New Zealand and their landform development. In The offshore islands of northern New Zealand. *Department of Lands and Survey, Wellington Information Series 16*: 129-138.
Healy, W. B. Editor, 1980 Pauatahanui Inlet: an environmental study. *Department of Scientific and Industrial Research Information Series 141*: 1-198 Government Printer, Wellington.
Heath, R. A. 1976 Broad classification of New Zealand inlets with emphasis on residence times. *New Zealand Journal of Marine and Freshwater Research 10:* 429-444.
Heath, R. A. 1985 A review of the physical oceanography of the seas around New Zealand - 1982. *New Zealand Journal of Marine and Freshwater Research 19:* 79-124.
Hinrichsen, D. 1990 *Our common seas: Coasts in Crisis.* 184 pages. Earthscan Publications, London.
Hoe Chang, F., Anderson, C. and Boustead, N. C. 1990 The first record of a Heterosigma (Raphidophyceae) bloom with associated mortality of cage-reared salmon in Big Glory Bay, New Zealand. *New Zealand Journal of Marine and Freshwater Research 24*: 461-469.

Ivanovici, A. M. (editor) 1984 *Inventory of declared marine and estuarine portected areas in Australian waters*. 2 volumes, 423 pages. Australian National Parks and Wildlife Service, Canberra.

Jones, A. and Garrick, A. S. (compilors) 1990 *Tuhua (Mayor Island) marine habitats An intertidal and subtidal survey*. Technical Report Series No. 4, 82 pages. Department of Conservation, Tauranga.
Jones, G. P. 1980 Growth and reproduction in the protogynous hermaphrodite *Pseudolabrus celidotus* (Pisces: Labridae) in New Zealand. *Copeia 4*: 660-675.
Jones, G. P. 1981 Spawning site choice by female *Pseudolabrus celidotus* (Pisces: Labridae) and its influence on the mating system. *Behavioural ecology and sociobiology 8*: 129-142.
Jones, G. P. 1983 Relationship bewteen density and behaviour in juvenile *Pseudolabrus celidotus*. *Animal Behaviour 31*: 729-735.

Jones, G. P. 1984a Population ecology of the temperate reef fish *Pseudolabrus celidotus* Bloch and Schneider I. Factors influencing recruitment and II Factors influencing adult density. *Journal of Experimental Marine Biology and Ecology 75*: 257-303.
Jones, G. P. 1984b The influence of habitat and behavioural interactions on the local distribution of the wrasse. *Environmental biology of fishes 10*: 43-58.
Jones. G. P. 1988 Ecology of rocky reef fish of north-eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research 22*: 445-462.

Kelly, M. 1983 *A bibliography and literature review for the Poor Knights Islands Marine Reserve*. 126 pages. Ministry of Agriculture and Fisheries, Auckland.
Kerrigan, B. A. 1987 *Abundance patterns of intertidal and subtidal populations of Evechinus chloroticus.* 70 pages. Unpublished MSc thesis, University of Auckland.
Kibblewhite, A. C. Editor, 1982 *Maui Development Environmental Study Phase 2 1982*. 174 pages. University of Auckland for Shell BP and Todd Oil Services Limited.
King, K. J., Bailey, K. N. and Clark, M. R. 1985 *Coastal and marine ecological areas of New Zealand.* Information Series No. 15. Department of Lands and Survey, Wellington.
Kingett, P. D. and Choat, J. H. 1981 An analysis of density and distribution patterns in *Chrysophrys auratus* (Pisces: Sparidae) within a reef environment: an experimental approach. *Marine Ecology Progress Series 5*: 283-290.
Kingsford, M. J. 1986 *Biological Assessments of Marine Protected Areas: a handbook of methodology for rocky reef environments*. 127 pages. Ministry of Agriculture and Fisheries, Management Division, Auckland.
Kingsford, M. J. 1988 The early life history of fish in coastal waters of northern N. Z. *New Zealand Journal of Marine and Freshwater Research 22*: 463-479.
Kingsford, M. J. 1989 Distribution patterns of planktivorous reef fish along the coast of northeastern New Zealand. *Marine Ecology Progress Series 54*: 13-24.
Kingsford, M. J. and MacDiarmid, A. B. 1988 Interrelations between planktivorous reef fish and zooplankton in temperate waters. *Marine Ecology Progress Series 48*: 103-117
Kingsford, M. J., Schiel, D. R. and Battershill, C. N. 1989 Distribution and abundance of fish in a rock reef environment at the subantarctic Auckland Islands, New Zealand. *Polar Biology 9*: 179-186.

Knox, G. A. 1957 General account of the Chatham Islands 1954 expedition. *New Zealand Department of Scientific and Industrial Research Bulletin 122*: 37 pages.
Knox, G. A. 1963 The biogeography and intertidal ecology of the Australasian coasts. *Oceanography and Marine Biology: an Annual Review 1*: 341-404.
Knox, G. A. 1975 The marine benthic ecology and biogeography. pages 353-403 *in* **Kuschel, G.** (editor) *Biogeography and Ecology in New Zealand.* Junk, The Hague.
Knox, G. A., 1986 *Estuarine Ecosystems: A Systems Approach.* Volume I, 289 pages, Volume II, 230 pages. CRC Press, Florida.

Leum, L. L. and Choat, J. H. 1980 Density and distribution patterns of the temperate marine fish *Cheilodactylus specabilis* (Cheilodactylidae) in a reef environment. *Marine Biology 57*: 327-337.

MacDiarmid, A. B. 1987 *The ecology of Jasus edwardsii.* unpublished Ph.D. thesis, University of Auckland 169p.
McCormick, M. I. and Choat, J. H. 1987 Estimating total abundance of a large temperate-reef fish using visual strip transects. *Marine Biology 96*: 469-478.
Mclay, C. L. 1976 An inventory of the status and origin of New Zealand estuarine systems. *Proceedings of the New Zealand Ecological Society 23:* 8-26.
Marine Conservation Society 1987 Marine Protected Areas. Fact Sheet No. 2 M*arine Conservation.* Winter 1987-88 issue. Marine Conservation Society, U. K.
Marine Reserves Act 1971 26 pages. N.Z. Government printer, Wellington.
Marine Reserves Amendment Act 1977 3 pages. N.Z. Government Printer, Wellington.
Marine Reserves Amendment Act 1980 1 page. N.Z. Government Printer, Wellington.
Mandelbrot, B. 1977 *The Fractal Geometry of Nature.* Freeman, New York.
Mark, A. 1988 A Marine Revolution. Editorial *Forest and Bird 19*: (1), page 1.

Marlborough Combined Dive Clubs 1990 *A marine reserve for Marlborough : securing our future.* A folder of pamphlets, maps and a questionnaire. Marlborough Dive Clubs Marine Reserves Committee, Blenheim.
Miller, M. C. 1982 Communities of the shore and immediate offshore. In *Maui Development Environmental Study Report on Phase 2 1982*: 115-138. University of Auckland for Shell BP Todd Oil Services Limited.
Ministry of Agriculture and Fisheries 1985 *Auckland Region Marine Reserves Plan: a discussion paper*. 64 pages. Fisheries Management Division, Auckland.
Ministry of Agriculture and Fisheries 1985 *A proposed national policy for marine reserves.* 6 pages. Fisheries Management Division, Wellington.
Ministry of Agriculture and Fisheries No date *Summary of submissions on proposed national policy for marine reserves.* 17 pages. Fisheries Management Division, Wellington.
Ministry of Agriculture and Fisheries No date *National policy for marine protected areas: analysis of submissions on draft policy.* 18 pages. Fisheries Management Division, Wellington.
Moore, P. G. and Seed, R. Editors 1985 *The ecology of rocky coasts*. 467 pages. Hodder and Stoughton, London.
Morton, J. E. and Miller, M. C. 1968 *The New Zealand Sea Shore*. 638 pages. Collins, London and Auckland.

Natural Environment Research Council 1973 *Marine Wildlife Conservation*. NERC publications series B. No. 5. 39 pages. Natural Environment Research Council, London.
Nature Conservancy Council 1979 *Nature Conservation in the Marine Environment.* Report of the NCC/NERC Joint Working Party on Marine Wildlife Conservation. 65 pages. Nature Conservancy Council, London.
Nature Conservation Council, 1984 *Strategies for the management of mangrove forests in New Zealand.* Nature Conservation Council, Wellington.
Nature Conservation Council 1985 *New Zealand's Offshore and Outlying Islands.* Information booklet No.24. 8 pages. Nature Conservation Council
Nature Conservation Council 1988 *Landforms and geological features: a case for preservation.* Information Booklet No. 28. 17 pages. Nature Conservation Council, Wellington.
Nelson, W. A. and Adams, N. M. 1984 The marine algae of the Kermadec Islands. *National Museum of New Zealand Miscellaneous Series 10*: 1-29.
New Plymouth Underwater Club 1989 *Marine Biology of the Sugar Loaf Islands Marine Park.* (Revised edition) 55 pages. New Plymouth Underwater Club, New Plymouth.

Ottaway, J. R., Oak, I.B, Bossley, M. I. and Gardiner, R. B. 1980 *Marine Reserves in South Australia: Proposals for some future directions.* 2nd edition. 33 pages. Privately circulated.

Powell, A. W. B. 1955 Mollusca from the southern islands of New Zealand. *Cape Expedition Series Bulletin 15*: 152 pages. Department of Scientific and Industrial Research, Wellington.
Pritchard, K. and Ward, V. 1984 Marine Sponges. *Leigh Laboratory Bulletin 14*: 149 pages. Leigh Laboratory, University of

Auckland.

Ridgway, N. M. and Glasby, G. P. 1984 Sources of marine pollution around New Zealand. *New Zealand Oceanographic Institute Oceanographic Summary No.23*: 21 pages.
Ritchie, L., Mason, R., Saul, P. and Bradstock, M. 1979 *Environmental Impact Report: Poor Knights Islands Marine Reserve*. Fisheries Management Division, Ministry of Agriculture and Fisheries, Wellington.
Roberts, L. I. N., Ward, C. and Francis, M. P. 1988 Fishes of northeastern Great Barrier Island. *Journal of Royal Society of New Zealand 16 (4)*: 357-362.
Russell, P. 1989 *Discussion Paper on areas to be investigated for Marine Protected area Status, Canterbury Conservancy.* 52 pages. Department of Conservation, Christchurch.
Ryan, P. R. (Editor) 1986 Changing climate and the Ocean. *Oceanus 29 (4)*: 1-100.
Ryan, P. R. (Editor) 1988 U. S. Marine Sanctuaries. *Oceanus 31 (1)*: 1-96.

Salm, R. V. and Clark, J. R. 1984 *Marine and coastal protected areas: A guide for planners and managers.* 302 pages. International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.

Schaap, A. and Green, R. 1988 Fish Communities on reefs subjected to different levels of fishing pressure. *Technical Report 31*: 42pages. Department of Sea Fisheries, Tasmania.
Schiel, D. R. 1982 Selective feeding by the echinoid *Evechinus chloroticus* and the removal of plants from subtidal algal stands in northern New Zealand. *Oecologia (Berlin) 54*: 379-388.
Schiel, D. R. 1984 *Poor Knights Islands Marine Reserve: A biological survey of subtidal reefs*. 93 pages. Marine Laboratory, University of Auckland.
Schiel, D. R. 1988 Algal interactions on shallow subtidal reefs in northern New Zealand. *New Zealand Journal of Marine and Freshwater Research 22*: 481-489.
Schiel, D. R., Kingsford, M. J. and Choat, J. H. 1986 Depth distribution and abundance of benthic organisms and fishes at the subtropical Kermadec Islands. *New Zealand Journal of Marine and Freshwater Research 20*: 521-535.
Sewall, M. 1985 *Marine Resource Protection in the North Auckland Land District: A preliminary study*. 129 pages. Department of Lands and Survey, Auckland.
Southland United Council 1988 *Marine Farming in Southland: A public discussion document*. 13 pages. Southland United Council, Invercargil.
Steering Committee 1986 *A marine park for the Sugar Loaf Islands*. 81 pages. Taranaki United Council, New Plymouth.

Taylor, F.J., Taylor, N.J. and Walsby J.R. 1985 A bloom of the planktonic diatom *Ceratulina pelagica* off N.E. New Zealand in 1983. *Internationale Revue Gesamten Hydrobiologie 70 (6)*: 773-795.
Taylor, R. H. 1982 New Zealand fur seals at the Bounty Islands. *New Zealand Journal of Marine and Freshwater Research 16*: 1-9.
Thomson, R. M. C. 1977 A bibliography of offshore islands of New Zealand. *N.Z. Oceanographic Institute Miscellaneous Publications 80*: 210 pages.
Thompson, S. 1981 Fish of the Marine Reserve. *Leigh Laboratory Bulletin 3*: 364 pages. Leigh Laboratory, University of Auckland.
Tortell, P. Editor 1981 *New Zealand Atlas of Coastal Resources*. Commission for the Environment, Wellington.

Underwood, A.J. 1985 Physical factors and biological interactions: the necessity and nature of ecological experiments. In T*he Ecology of Rocky Coasts* (P.G. Moore and R. Seed, editors.) 372-390. Hodder and Stoughton, London.

Waiheke Underwater Club 1991 *A draft discussion document for future marine reserves on Waiheke Island and in the Hauraki Gulf*. A booklet with questionnaire. 16 pages. Wiheke Underwater Club and the Hauraki Gulf Islands Branch of the Royal Forest and Bird Protection Society.
Walsby, J.R. and Morton, J.E. 1982 Marine Molluscs I: Archaeogastropods and chitons. *Leigh Laboratory Bulletin 4*: 89 pages. Marine Laboratory, University of Auckland.
Ward, C. and Roberts, L. 1986 The East Auckland current: one explanation for the distribution patterns of the coastal and offshore fish faunas of north-eastern New Zealand. In Offshore Islands of Northern New Zealand. *Department of Lands and Survey, Wellington, Information Series 16*: 211 -219.
Welton, S. 1985 Purbeck and voluntary marine reserves. *Marine Conservation.* April issue pages 6-7. Marine Conservation Society, U. K.
Westerskov, K. 1989 White Island and *Diadema* city. *New Zealand Underwater* October/November issue. Pages 30-31. New Zealand Underwater Association.
Wilson, A. M. 1987 Carribbean marine resources: A report on economic opportunities. *Oceanus 30 (4):* 33-41.
Wright, A. E. and Beever, R. E. Editors 1986 The Offshore Islands of New Zealand. *Department of Lands and Survey, Wellington, Information Series 16*: 255 pages.

Zeldis, J. R. 1985 Ecology of *Munida gregaria* (Decapoda, Anomura): distribution and abundance, population dynamics and fisheries. *Marine Ecology Progress Series 22*: 77-99.

LEIGH LABORATORY BULLETINS

Published by the Leigh Marine Laboratory, University of Auckland

Obtainable from: Friends of the Leigh Laboratory
Leigh
R.D.5, Warkworth
New Zealand

1.	Marine Reserve Survey	A. M. Ayling	1978	98 pages	$15
2.	Leigh Climate	R.C. D. Cornforth	1980	98p	$15
3.	Fish of the Marine Reserve	S. Thompsom	1981	364p	$25
4.	Marine Molluscs Part I	Walsby & Morton	1982	89p	$15
5.	Sea Temperatures	edit. Ballantin	1982	43p	$10
6.	Air Temperatures	edit. Ballantine	1982	115p	$15
7.	Wave Surge	edit. Ballantine	1982	79p	$15
8.	Rainfall and Evaporation	edit. Ballantine	1982	131p	$15
9.	Sunshine and Radiation	edit. Ballantine	1982	67p	$15
10.	The Climate in 1982	Evans & Ballantine	1982	113p	$15
11.	Atmospheric Pressure	Rodgers & Evans	1983	51p	$10
12.	Earth Temperatures	Rodgers & Evans	1983	53p	$10
13.	Marine Molluscs Part II	Willan & Morton	1984	106p	$15
14.	Marine Sponges	Pritchard & Ward	1984	149	$20
15.	Poor Knights Marine Survey	D. R. Schiel	1984	93p	$15
16.	Wind	Augustin & Evans	1984	80p	$15
17.	The Climate in 1983	Augustin & Evans	1984	119p	$15
18.	The Climate in 1984	Evans & Ballantine	1985	111p	$15
19.	The Climate in 1985	Evans & Ballantine	1986	111p	$15
20.	Leigh Climate Report 1986-7	J.H. Evans	1988	66p	$15
21.	The Mokohinau Is	Creese & Ballantine	1988	77p	$15
22.	Crabs of New Zealand	C. L. McLay	1988	463p	$45
23.	Leigh Climate Report 1988	J. H. Evans	1989	61p	$15
24.	Leigh Climate Report 1989	J. H. Evans	1990	56p	$15

This volume:

25. Marine Reserves for N.Z. Ballantine 1991 200p $19.50

Correspondence with the Prince of Whales relating to the original publication of this book.

Commander Richard Aylard, RN
Private Secretary to HRH the Prince of Wales,
St James's Palace, London SW1A 1BS, U.K. 13 September 1991

Dear Commander Aylard,

Thank you for your letter of August 7th (signed by Robert Fraser on your behalf), and for enclosing the foreword by His Royal Highness for my book "Marine Reserves for New Zealand".

I attach a copy of the printed book and a letter of thanks to His Royal Highness. Should pressure of other business prevent His Royal Highness from seeing these personally, perhaps your office would note the following salient points.

(i) I am most grateful for the foreword and consider it exactly right for the purpose.
(ii) It did arrive in time, but only just. The entire text had already been printed, but it proved possible (by 2 hours!) to print the foreword on the inside cover.
(iii) Because the text was already printed, no acknowledgement or thanks for the foreword appears in the text. Naturally I regret this very much, but there was no practical alternative.
(iv) It is expected that the book will be "launched" at the end of this month, probably by a combination of the Department of Conservation and the University of Auckland.

yours sincerely

Dr. W. J. Ballantine
Marine Laboratory,
Leigh,
RD5, Warkworth, New Zealand

HRH The Prince of Wales, K.G., G.C.B.
President, Marine Conservation Society. 13th September 1991

Sir,

Sincere thanks for the foreword you wrote for my book "Marine Reserves for New Zealand". I very much appreciated its tone and nice poise on all the knife edge problems - serious but not stuffy; recommending consideration but not specific action; showing knowledge but not telling locals their business, etc.

I attach a copy of the printed book. The foreword did arrive in time, but only just. I had taken the camera-ready copy to the printers on Monday, August 12th. Your foreword arrived on Tuesday 20th in the noon post. Leaping for a phone, yelled "Stop the press!" They replied, "Too late it's all printed. Why?". When I explained they yelled "Hold the line" and disappeared for a long time. Finally the manager came on the line and said "If you can get it here before 5pm, we think we can put it on the inside front cover". I borrowed a car and made the 120 km journey faster than I would like the Ministry of Transport to know about; getting there 2 hours before they started the plastic lamination.

The story is recounted partly for amusement (All's well that end's well), but also to explain why there is no acknowledgement or thanks for the foreword in the text. I do, of course, regret this, and apologise, but the only practical alternative was not to use the foreword at all. I must admit, I did not even consider that!

So the book appears with two forewords, your own on the inside front cover, where almost everyone sees it immediately, and one - labeled as such, and in the usual place - by Emeritus Professor John Morton.

Back Page of original 1991 Book Publication

The printing of this book and its donation to
Schools, public libraries and other organisations
was made possible by grants from:

PRINCIPAL SPONSORS:

WORLD WIDE FUND FOR NATURE - NEW ZEALAND ROYAL FOREST AND BIRD PROTECTION SOCIETY

NEW ZEALAND UNDERWATER ASSOCIATION

NEW ZEALAND EDUCATION FOUNDATION

DEPARTMENT OF CONSERVATION

MARINE CONSERVATION SOCIETY - UX

Also supported by:

Greenpeace

Maruia Society

Note on Author:

Bill Ballantine is a marine who arrived from U.K. in 1961 on a two-year NATO post-doctoral Fellowship to work with Professor John Morton at the University of Auckland. He was so impressed with New Zealand's, coasts and their marine life he has been here ever since. In 1965

he became the first staff member of the University's marine laboratory at Leigh and was in charge of its development for over 20 years. He was closely involved with the 12 year. campaign to establish N.Z.'s first marine reserve, which is adjacent to the Leigh laboratory. Since 1986 his research, formal teaching and public education efforts have centered on the promotion of more marine reserves.