COASTAL AND MARINE CONSERVATION :

A NEW ZEALAND PERSPECTIVE

A thesis

submitted in partial fulfilment

of the requirements for the Degree

of

Master of Resource Management

in the

University of Canterbury

by

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University of Canterbury

1987

CONTENTS

ABSTRACT

This study introduces New Zealand's coastal/marine environment as both a natural habitat and a natural resource complex. It outlines the unique management features and characteristics of New Zealand's marine environment and describes its habitats and species. It examines the conflicts that are arising because this environment is functioning as both a natural resource complex and a natural habitat. The study then presents a rationale for, and the likely benefits and costs of, a Marine Protected Area (M.P.A.) programme as part of a policy of 'Marine Conservation'.

An approach to natural resource management to achieve a policy of 'Marine Conservation' based on a 'goal' orientated approach to planning is introduced. Appropriate policies, goals objectives, categories and criteria of marine protected areas (M.P.As.) are proposed. A number of categories of M.P.A., designated with specific reference to the selected goals and objectives, are presented. This new approach links criteria for selection of M.P.A. sites directly to the policy of marine conservation and the goals and objectives of a M.P.A. programme. In conclusion this study evaluates the likely success of the M.P.A. programme proposed by the Ministry of Agriculture and Fisheries (M.A.F.) (1985) in achieving the goals and objectives of marine conservation. In doing so the goal oriented approach to planning is suggested as being a better alternative.

ACKNOWLEDGEMENTS

I wish to convey my sincere thanks to the many people, including Centre for Resource Management staff, friends and family, who have provided the encouragement, advise and understanding necessary for the completion of this project. I would especially like to thank Ann Jebson for her personal support and understanding at a time when I probable did not deserve it but most needed it. I would also like to thank John Hayward for his advice, encouragement and support; Carolyn Blackford for her friendship and unselfish assistance; Graham Smitheram for his editorial advice; Judy Parker, Robyn Jebson, Victoria Crawford and Ann Jebson for their invaluable assistance with proof reading; Michael Amer and Vivian from 'Computor Services' for assistance with typing; and the rest of my fellow classmates whose comradeship I will always value.

CHAPTER ONE

INTRODUCTION TO THE RESOURCE

1.0 INTRODUCTION

As society approachs the last decade of the twentieth century and looks forward into the twenty first century, exponential increases in knowledge and technology are allowing greater insight into both positive and negative social, economic and environmental impacts of natural resource use. More flexible and innovative ways of managing the natural resources are needed if negative impacts and conflicts between the uses of natural resources are to be minimised.

One of New Zealand's most extensive natural resources is the marine environment around its shores. Despite New Zealand's small land area its Government is responsible, by International Treaty , for administering the third largest area of ocean of any country in the world. This area is called the 200 Mile Exclusive Economic Zone and is over 1.2 million square nautical miles in total area. The Nation also has direct territorial ownership of a much more modest area called the Territorial Sea extending twelve nautical miles out from New Zealand's shoreline.

As New Zealand's two main islands are elongated in shape the adjacent marine environment stretches across more than thirteen degrees of latitude. This results in an environment with a distinct subtropical character in the north, and a subantartic character in the south. The main islands also have an extensive and sometimes convoluted coastline of over 10,000 kilometres in length. These factors combined with a range of coastal land forms; marine topographic and physiographic features provide a wide range of environments for a diversity of marine and coastal plants and animals particularly within the coastal margins.

1.1 THE RESOURCE

As well as being the habitat for a diversity of flora and fauna the marine environment around New Zealand is a vital natural resource complex, important for the production of material commodities such as minerals, energy, food and other products upon which society depends. The marine environment, (especially in the coastal regions), also provides for non material needs of society, such as; recreational, spiritual, cultural and educational needs. The coastal region of the marine environment has also been percieved by some, as a land resource for reclamation, harbour and marina development and as a convenient site for the disposal of quantities of urban, commercial and industrial waste.

1.2 THE PROBLEM

There is evidence of increasing conflict between some of the different types of use to which the marine environment is being put. This is occuring at a time when there is mounting interest in this resource complex for a variety of uses. It is becomingapparant that excessive pollution, reclamation and overfishing are not compatable with some other uses of the marine environment. Marked decline in fin fish landings worldwide and in New Zealand over the last ten years despite increased fishing effort is one indication of the conflicts. Restrictions on some recreational activities such as swimming and the taking of shellfish in parts of the coastal zone (i.e. the Manukau and Waitemata harbours), is another indication of conflicts arising among users of the marine environment.

1.3 CURRENT STRATEGIES AND LEGISLATION

This recognition of increasing conflict in the use of New Zealand's marine environment parallels a growing awareness of the need for innovative planning in the management of natural resources to achieve 'marine conservation' goals. Perhaps one of the most concise expressions of this growing awareness can be found in:

'Integrating Conservation and Development: a

Proposal for a New Zealand Conservation Strategy',

a document released by the International Union for the Conservation of Nature (I.U.C.N.) and the Nature Conservation Council (N.C.C), (1981).

This document adopted the following major goals under a 'policy' of natural resource conservation:

(1) to ensure the sustainable use of renewable natural resources,

(2) to provide for cultural spiritual and other non-material needs of society by protection and development of diversity in the use of natural resources,

(3) to protect ecological processes and life support systems,

(4) to preserve genetic diversity (the range of genetic information found in organisms that coupled with environmental factors produce the observeable attributes of an organism).

(Until new goals are presented in chapter five these goals will be adopted for the purposes of this study as working goals of marine conservation.)

With regards to natural land areas in New Zealand, government resource management agencies have used a management strategy involving the protection of natural areas within parks and reserves in an attempt to achieve what is in effect the I.U.C.N goals. Until relatively recently such a 'natural protected areas' approach to management was limited to land areas only. Management of the marine environment was restricted within a number of narrowly defined Acts of Parliment including: the Fisheries Act 1908, the

Marine Mammals Protection Act 1978, the Continental Shelf Act 1964, the Marine Pollution Act 1974, the Harbours Act 1950, the Town and Country Planning Act 1977 and the Water and Soil Conservation Act 1967. The only statute allowing limited protection of marine species and habitats within a type of protected area is the Marine Reserves Act 1971, although this Act is however very limited in its scope. With the advent of the new Fisheries Act 1983, and the Ministry of Agriculture and Fisheries (M.A.F.) 1985 proposed update of the Marine Reserves Act 1971, there appears to be much more potential for the application of a range of new management strategies in order to fulfil a wider range of goals in relation to New Zealand's marine and coastal environment. New stategies could include a broader version of the Marine Reserves Act 1971 as part of a 'natural protected areas programme'.

1.4 STUDY OBJECTIVES

With specific reference to New Zealand's coastal and marine environment this study sets out to:

(1) Characterise the unique features of marine and coastal ecosystems for conservation and management, and describe the general physical and biotic features of this environment around New Zealand.

(2) Examine the legitamacy of the claim that there is conflict between types of use of the marine and coastal environment and to assess if coastal ecosystems are being detrimentally affected by human activity including pollution, harvesting and physical modification.

(3) Examine the rationale for the inclusion of some coastal and marine areas within a Marine Protected Areas (M.P.A.) Programme for the purposes of

marine conservation, and also highlight the possible benefits and costs of such a programme.

(4) Suggest appropriate goals and objectives of conservation for a M.P.A.Programme in light of the findings from study objectives (1), (2) & (3).

(5) Present criteria and a conceptual framework for their application in selecting sites to be included in a M.P.A.Programme

(6) Present a preliminary proposal for a M.P.A.Programme with specific attention to goals and objectives of such a programme.

(7) Critique M.A.F.'s proposed New Zealand M.P.A.Programme , (as outlined in the 1985 'Proposed National Policy For Marine Reserves'), with reference to the approach presented in this study .

1.5 STUDY DEFINITIONS

For the purpose of this study the following definitions of *Preservation* and *Conservation*, as defined by Barker and Brown (1979), have been adopted.

(1) '*Conservation* '- implies 'wise' or 'rational' use of biological systems in accordance with natural processes and biological systems in order to retain the characteristics of the resource, and to ensure continuation of the resource in perpetuity. This implies that the resource may be used provided that its quality is not irreversibly diminished and the total quantity of the resource is not utilised at a rate faster than it can be replenished'.

(2) *'Perservation'* - refers to an extreme subset of conservation and means the maintenance of the state of things (existing or original) including quantity, quality and variety. Preservation of a resource therefore only enables use if this does not detract from the maintenance of the resource. Consequently halting of human use of the resource is often required.

OTHER STUDY DEFINITIONS INCLUDE:

(3) *Protected Areas'* - refers to the concept of altering 'property rights' (rights of ownership, access and use of a resource) in regards to a particular area usually by legal means, so that the resource is either conserved or preserved. Implicit in this definition is the assumption of a range catergories of protection, depending upon what alterations are made to existing property rights. A'Protected Area' therefore refers to a set of 'property rights' that provide for the management of an area at some point along the spectrum from consumptive human use to total preservation.

(4) *Coastal/Marine Ecosystems* - refers to the community of organisms occupying a defined region (in this case the coastal/marine regions around New Zealand), their interactions with each other and with the physical features of their environment.

(5) *The Coastal/Marine* region - refers to the areas of sea and ocean off the coastline of the islands of New Zealand included within its Exclusive Economic Zone (E.E.Z.), as well as the coastal margins of land which interact with marine processes.

(The Coastal/marine environment, hereafter refered to as marine environment, is considered to be a 'natural resource complex').

(6) *Natural Resource Complex* - is defined as a range of things or conditions that are able to, (or potentially able to), contribute to human satisfaction in a number of ways by either their consumptive use (for example

fish harvesting), or non-consumptive use (for example appreciating aquatic scenery). Humans consequentially can gain satisfaction from the marine environment as a natural resource complex, along a spectrum from at one extreme total development to the other extreme of total preservation of marine ecosystems.

(7)*POLICY* - is defined as a broad statement of guiding philosophy or purpose which outlines the desired ends of the planning process, (by reflecting societal values) and whose value position is explicitly given.

(8)*GOALS* - are defined as more spercific 'ends statements' which are designed to provide a clear direction towards the satisfaction of policy. Value positions are implicit in goals.

(9)*OBJECTIVES* - are defined as the means of achieving the goal. Objectives are hence an attempt to define policy and goals with measureable criteria. They must be fully specified and attainable.

The next chapter examinse the important features and characteristics of New Zealand's marine and coastal environment.

CHAPTER TWO

CHARACTERISATION OF NEW ZEALAND'S MARINE ENVIRONMENT

SUMMARY

Chapter one introduces the coastal/marine environment around New Zealand as both a natural habitat and its largest natural resource complex. Chapter one puts forward the proposition that this enviroment may need innovative and imaginative management if conservation policies, goals and objectives are to be achieved.

In this chapter the unique features of marine environments and ecosystems are considered in terms of implimenting one class of management, a Marine Protected Areas (M.P.A) programme. The general physical and biotic features of New Zealand's coastal/marine environment are also described. It is concluded that:

(1) The open ocean outside the continental shelf should be afforded low priority in the selection of M.P.As. to achieve two of the I.U.C.N. goals of a M.P.A. programme; maintaining species diversity and production. This is because of the open ocean's naturally low species diversity and production in comparison to the coastal seas.

(2) New Zealands coastal seas generally, and mangroves, kelp and seagrass systems in particular, should have higher priority for the I.U.C.N. goals of maintaining species diversity and production. This reflects the higher potential risk in the coastal zone, the much greater diversity of species and habitat and the significantly higher rates of production in comparison to the open ocean.

(3) Some specific habitats of the coastal zone are critical to reproduction and recruitment of a wide range of marine and coastal species in both their own systems and surrounding areas. Therefore these habitats should have very high management priority in order to achieve the I.U.C.N goals of maintaining species diversity and production.

(4) The marine system is not strickly bounded by the shore lines Mean High Water Mark (M.H.W.M) as activities on land such as pollution can affect the marine environment. This should be given consideration in the management of M.P.As.

(5) Pollution can be transmitted through the marine environment by water currents, or against currents by the feeding interactions of some organisms. Hence both downstream, down current and possibly upstream and upcurrent impacts should be considered in the management and positioning of M.P.As.

(6) The sea often has subtle boundaries to distribution operating for some marine species. Hence New Zealand marine species can show genetic differientiation with many species existing in broad biogeographical 'clines'. These clines form a mosaic pattern of species and subspecies distribution around New Zealand with at least two broad centres of species distribution.

(7) The management of marine species is often difficult because the ecology of coastal ecosystems is complex. Apparently minor interference with some species may have major ramifications on other species because of '*Key Stone*' species effects. Conversely major interference with one species may have little impact on other species due to the buffering nature of some food web relationships. Management practices should initially be conservative until the true nature of these relationships are better understood.

(8) A large number of marine animals are territorial and are ameniable to protection within a designated area. Other marine species are either migratory or non-territorial and therefore other conservation and management strategy, either in association with a M.P.A.Programme, (to protect critical habitats and maintain the general health of marine systems) , may be necessary to conserve these species.

2.0 MARINE AND COASTAL ECOSYSTEMS

INTRODUCTION

The ocean as an environment can be described as an immense three dimensional living hydrosphere. Marine animals inhabit on a permanent basis all areas of this hydrosphere from the floor of the deepest oceanic trench to the ocean surface and coastal fringes. Some free swimming marine animals have distibution patterns and or migratory routes extending for thousands of miles horizontally. In contrast life exists on land as a thin almost two dimensional veneer, surrounded by an atmosphere, which is uninhabitated on a permanent basis. Distribution on land is also often restricted by innumerable physical features. This marine environment (hydrosphere) can be divided into the Open Ocean outside the continental shelf and the Coastal Zone over the shelf, and these now will be considered in turn.

2.1 THE OPEN OCEAN

According to Odum (1967) all phyla and most taxonomic classes of the animal kingdom have representatives in the open ocean, yet this environment is relatively uniform and unproductive compared with terrestrial environments. The 'Open Ocean' refers to the area of seafloor and ocean outside the 200 metre bathymetric seafloor contour. Odum (1967) describes much of the open ocean as 'semi desert' interms of biological productivity. Productivity in this context refers to the ability of plants and other photosynthesising organism (that produce their own food) to convert the suns radiant energy into biomass (biological material). This biomass is then available for consumption by animals and other organisms (that can't produce their own food).

Productivity of a system is usually determined by finely balanced biological and physical factors. Liebergs 'Law of the Minimum', a fundamental law of ecology, states that the productivity of any system is controlled by essential material such as nutrients present in the most limiting amount and providing the least favourable conditions for production.

With the exception of areas of strong current convergence resulting in local nutrient upwelling, (such as around Antarctica), the waters of the open ocean have low nutrient levels resulting in very low productivity compared with most coastal and terrestrial areas (Mann, 1982). Low nutrient levels are attributed to four major factors:

(1) The lack of water turbulance at the sea floor in the deep waters of the open ocean, to recycle up through the water column the essential minerals and nutrients to the shallow productive zone of light penetration near the surface;

(2) The lack of appreciable terrestial nutrient inputs form surface and ground water runoff because of the distance from the coast to the open ocean;

(3) The relatively small area of the biologically productive (autotrophic) zone of light penetration adjacent to the surface in comparison to the unproductive (heterotrophic zone) in deeper water depths.

(4) The absence of the large more productive stationary marine plants in deep water.

As well as being of low productivity, the open ocean is usually characterised by low species diversity (Odum 1967). "Low diversity can be attributed to the ecological maxum that diversity tends to be low in relatively uniform environments with strong physiochemical limiting factors such as low nutrient levels", Connell <u>et al</u>. (1964).

As a result the open ocean generally should be of low interest in terms of importance to species diversity, genetic diversity, fisheries production and abundance. The exception in the case of fishery production would be the few areas of nutrient upwelling, such as occurs around Antarctica.

2.2 THE COASTAL ZONE PRODUCTIVITY & SPECIES DIVERSITY

Only in the shallow coastal waters of the continental shelf are nutrient levels enhanced enough by ocean upwellings, seafloor turbulance and terrestrial runoff to provide increased biological productivity. In New Zealand this area represents only 25% percent of the total area of the Exclusive Economic Zone (E.E.Z.). According to Mann (1972) coastal waters are in general five times as productive as the open ocean. This means that five times more biological material is produced per square metre of sea surface.

Certain areas of the coastal zone, such as saltmarshs and estuaries, can even be up to 15 times as productive as the open ocean. Such productivity is in the same range as the most productive terrestial ecosystem the tropical rainforest. Holdren and Ehrlich (1974) state that 99% of all oceanic productivity take place in less than 10% of its area (predominantly the coastal region), and half of that is in only 0.1% of its area where coastal upwellings predominate.

The site of primary production in the coastal zone differs from that of the open ocean because between 62% and 75% of coastal primary production has been attributed to flowering plants or large species of algae (kelp) according to Odum (1968). In comparison the open ocean is reliant on primary production from microscopic algae. (Large fixed plants and fixed algae have a natural physiological advantage in production over free floating microscopic algae, as water movement around fixed plants and algae continually replenishes chemicals, minerals and nutrients and removes waste to a much greater extent than for the free floating microscopic forms).

The high productivity of the coastal waters, coupled with a large number of habitats, especially at the margin between land and sea, provides for a very high diversity of species. The biological and physical processes that occur at this interface between land and sea characterise the coastal zone as an ecotone (Ray 1976). Ecotones, which are the junctions of biological communities, have an increased variety and density of species over the ecosystems they border (Dolan et al., 1916). According to Ray (1976) many terrestrial and oceanic species depend on the coastal zone for food or as a habitat for part of their life cycle, with the result that coastal ecotones probably boast the greatest diversity of life on earth.

Marine life forms are also generally more varied in morphology and physiology than those found on land because they exist in a more benign and stable environment and have a much longer evolutionary history. This allows greater scope for variations although the total number of marine species has been estimated to be perhaps only a fifth of those found on land (Ray et al ., 1984).

The preceeding authors all emphasise the incredible richness of the coastal zone in both species diverisity and biological productivity and this will be considered in later chapters. First however the characteristics of marine systems will be discussed in relation to *Marine Conservation.*

2.3 BOUNDARIES OF THE COASTAL ZONE AND OPEN OCEAN

The physical boundaries of the coastal zone have been defined by Ray et al. (1984) as;

(i) The terrestrial boundary being the inland extent of astronomical tidal influence.

(ii) The seaward boundary being the outer extent of the continental shelf, usually considered to be the 200 metre bathymetric depth contour. (This contour is also considered to be the boundary of the open ocean.)

Many coastal geographers have noted that the terrestial boundary is highly dynamic. There can be spatial changes to coastline features such as shorelines, dunes, banks, inlets and shoals occuring over a period varying from a few minutes to a range of years. The dynamic character of this boundary means that there can be problems in ridgidly fixing legal boundaries in this zone for management based on coastal features. For example Kirk (1986) has reported that the mean high water mark (M.H.W.M.), a commonly used legal boundary definition on New Zealand beaches, can vary upto 100 metres horizontally in a single year.

The physically defined boundary between the coastal zone and open ocean is even more arbitary. Changes in strickly physical processes that separate the coastal zone form the open ocean are often subtle and can occur over a range of seafloor depths. For the sake of simplicity however, this study will adopt the 200 metre bathymetric contour boundary definition.

The biophysical boundaries of the coastal zone are also a problem to define. Many chemical, biological or physical processes that affect the coastal zone and its ecosystems transend one or both of the zones boundaries. For example terrestial 'run off' (resulting in the passage of beneficial and harmful material across form the land into the coastal zone), and coastal currents (affecting local processes) originate outside this zone.

Many animal species are not restricted to the coastal zone and will migrate across the landward and or seaward boundaries. In New Zealand for example seabirds, furseals, elephantseals, leopard seals, salmon, whitebait, eels and some crab species regularly cross the terrestial boundary (Ray 1984). Similiarly whales, dolphins, many fish and seabirds (notably shelf edge fish species such as red cod and migratory birds such as albatrosses), continually cross the arbitary seaward boundary of this zone.

Some marine species even migrate long distances and transend the open ocean and continetal shelves of many countries. Management of the coastal zone and open ocean is therefore complicated by the fact that neither biologically or physically can these areas be defined as closed systems.

This does not imply that there are no boundaries to dispersal in the marine environment. Many marine species of plants and animals are restricted within certain areas or ranges of dispersal. The boundaries to dispersal for individual species are often subtle however and may depend upon a number of factors such as changes in temperature, salinity, turbidity, nutrient load, oxygen and carbondioxide levels, water depth ;or the presence of eddies, circulation cells, oceanic currents, upwellings and local weather patterns.

These factors in conjunction with more obvious physical barriers to dispersal, such as bars, spits, and other landforms, results in the limited distribution of many species within certain areas or 'natural habitat units'. (A habitat unit is to some extent a selfcontained ecological unit such as a reef). The implication of limits to dispersal is that many marine species can be protected by managing appropriate 'natural habitat unit'

2.4 MARINE SPECIATION

It was commonly percieved until recently, that because of the apparently uniform nature of the marine environment , marine plants and animals had little genetic diversity. Recent findings however show that where there are biophysical boundaries to dispersal for a marine species, local genetically differientiated subspecies or populations can arise and pockets of endemism can be observed. Polunin (1983) reported this to be especially true for marine species where there are boundaries to larval dispersal in association with a short planktonic phase, low fertility and a small parent population. Furthermore in partially isolated marine environments such as fjords, estuaries and deep sea trenchs, Polunin (1983) has reported very significant genetic differientiation indeed between some marine subspecies. (Genetic differientiation refers to changes in the genetic code between populations of a species).

Selander (1976) has found supporting evidence of marine genetic diversity within and across marine species, from measuring the genetic variability (heterozygosity) over a wide cross section of marine species and phyla. He states that "counter to popular consensus marine populations exhibit high genetic variability on a par with terrestial mammals and reptiles". This existance of local and regional marine endemism , high genetic diversity and a richness of unique morphologies and physiologies all point to the potential value of maintaining marine genetic resources. This will be considered in more detail in Chapter four.

2.5 CURRENTS AND CIRCULATION

Coastal and ocean ecosystems share a number of other factors in common that shape their unique nature and set them apart from terrestial ecosystems. One of the most important of the aquatic environmental factors affecting marine organisms is water currents. An understanding of currents is basic to marine systems management including M.P.A.programmes. In providing a transport mechanism for marine organisms currents affect species distribution. Currents transport chemicals, nutrients and particulate food, bring in oxygen and remove waste. Their force determines to a large extent which species may exist in which areas and they also determine, in association with other factors such as tidal range, the quantity, direction and duration of salt water inundation within estuaries and harbour. The circulation patterns which result from currents may in turn influence the temperature regimes in protected bodies of water (inlets, estuaries and harbours), and in coastal waters.

Although human activities have little if any influence on large scale current patterns, they can influence local circulation currents in estuaries and other coastal wetlands; and longshore currents by modifyinginlets or by building groins or other shore protection structures. Changes in local currents and circulation patterns can have both physical and biological ramifications that can, at a locally level, profoundly affect biological distribution. (Kirk pers com. 1986)

2.5.1The 'Sink', 'Downstream Effects' and 'Short Circuits'

The sea is described by Ray (1976) as a 'sink' in that ultimately rainfall and land drainage carries terrestial and atmospheric nutrients, pollutants and silt to the sea. Forests, estuaries, mangroves and marshes are natural filters which retard the passage of these often harmful products . Because most marine species are directly immersed in and have a continuity of body fluids with sea water, they tend to be very succeptable to pollutants. Pollutants can quickly enter the tissues and body fluids of marine organisms and be occasionally passed on to other species by feeding relationships.

If the natural filters are damaged or destroyed the resulting reduction in water quality due to pollution is likely to cause impacts 'downstream' and 'down current' from the pollution sources . This is due to the transport of the pollutants thecurrent. The nature of these impacts will be discussed in chapter three.

In addition many marine species can move through the water both laterally and vertically often against the currents . This can provide a 'short circuit to pollutant transfer via the feeding interactions resulting in 'upstream' and 'upcurrent' impacts as well (Walsh 1972).

2.6 TROPHIC FEEDING STRUCTURES OF MARINE SYSTEMS

Many marine ecosystems are functionally different from terrestial ecosystems in that the greatest biomass often occurs at higher trophic levels (a functional classification of organisms according to feeding relationships), such as at the level of primary consumers (animals that consume plants). High net phytoplankton productivity in the marine environment compensates for the lack of a large standing crop of unconsumed plant tissue at the primary producer level. In ecological terms the marine ecosystems is consequently often described as having an inverted pyramid of biomass (Odum 1967). Also in contrast to terrestrial systems, the open ocean's primary producers do not form a physical structural habitat on which other organisms can live.

Coastal systems, based on large fixed plants (autotrophs), such as mangrove, seagrass, marshgrass and kelp based ecosystems, are the exception to the rule as they provide both a structural habitat, and a biomass distribution between producers and primary and secondary consumers, (animals that consume (1) plants or (2) other animals), that more closely resemble land based ecosystems.

The feeding relationship between marine species range from being complex to quite simple, depending upon local physical and biological factors. Rapport et al., (1985) reports that most feeding relationships in unstressed marine systems seem to be 'unstructured', with most species having a number of major predator and or prey species. This complex type of feeding relationships is usually described as a *'food web.'*

In more stressed marine environments however Rapport et al. (1985) reports that feeding relationships tend to become more structured and simple with often a direct and linear linkages of feeding interactions. An example would be where a species only feeds on one spercific prey species and in turn is eaten by only one species of predator. A simple feeding relationships such as this is usually called a *'food chain'*. In these simpler feeding relationships Paine (1969) identified *'Keystone species'*, because of the fundamental role that they may play in the ecosystems. These predator and or prey species either provide the sole link between species at differient trophic levels in a food chain or control the populations of other species by predation or competition. The previous sections examined important aspects of the coastal zone and open ocean. In this context the next section highlights the unique aspects of the New Zealand marine environment.

2.7 NEW ZEALAND'S COASTAL AND MARINE ENVIRONMENT

New Zealand administers a large area of open ocean within its 200 mile E.E.Z. The coastal zone around New Zealand, (21% of the total E.E.Z. that is found over the continental shelf), is however a relatively narrow strip of sea floor covering an area slightly less than the land area of New Zealand.

2.7.1Major Currents and Sea Temperature

The sea around New Zealand is characterised by wide differences in temperature. Mean sea water temperatures as high as 24° C have been recorded in the Hauraki Gulf, as these waters are reached occasionally by sub tropical currents of the Tradewind Drift. In association with this current, tropical and subtropical marine species have been reported around the Poor Knights Islands (Anon. 1982). In contrast the south-western tip of the South Island experiences substantially colder water from the cold West Wind Drift. For an outline of summer mean sea surface termperatures around New Zealand refer figure 1: page 24.

Off the west coast of both major islands, the Tasman sea has an anticlockwise circulation current called the Tasman Current of subtropical water which sweeps eastward and then flows up New Zealands West Coast. New Zealand's coastal currents are derived from the interaction between these three principle currents and with local topography and weather patterns. For an outline of major coastal current patterns around New Zealand refer to Figure 2: page 25.

2.7.2 Classification of New Zealand's Marine Environment

New Zealand's waters are considery to be mainly subtropical in character with the two main islands falling into the Eastern Temperate Coastal Realm under Rays (1975) classification of marine environments. Hayden et al. (1984) has further divided this realm into two provinces representing broadly recognisible centres of species distribution. They are the warmer Northern Province and colder Southern Province that meet in the coastal region adjacent to Port Waikato and East Cape. Between the two provinces there is extreme overlap of flora and fauna.

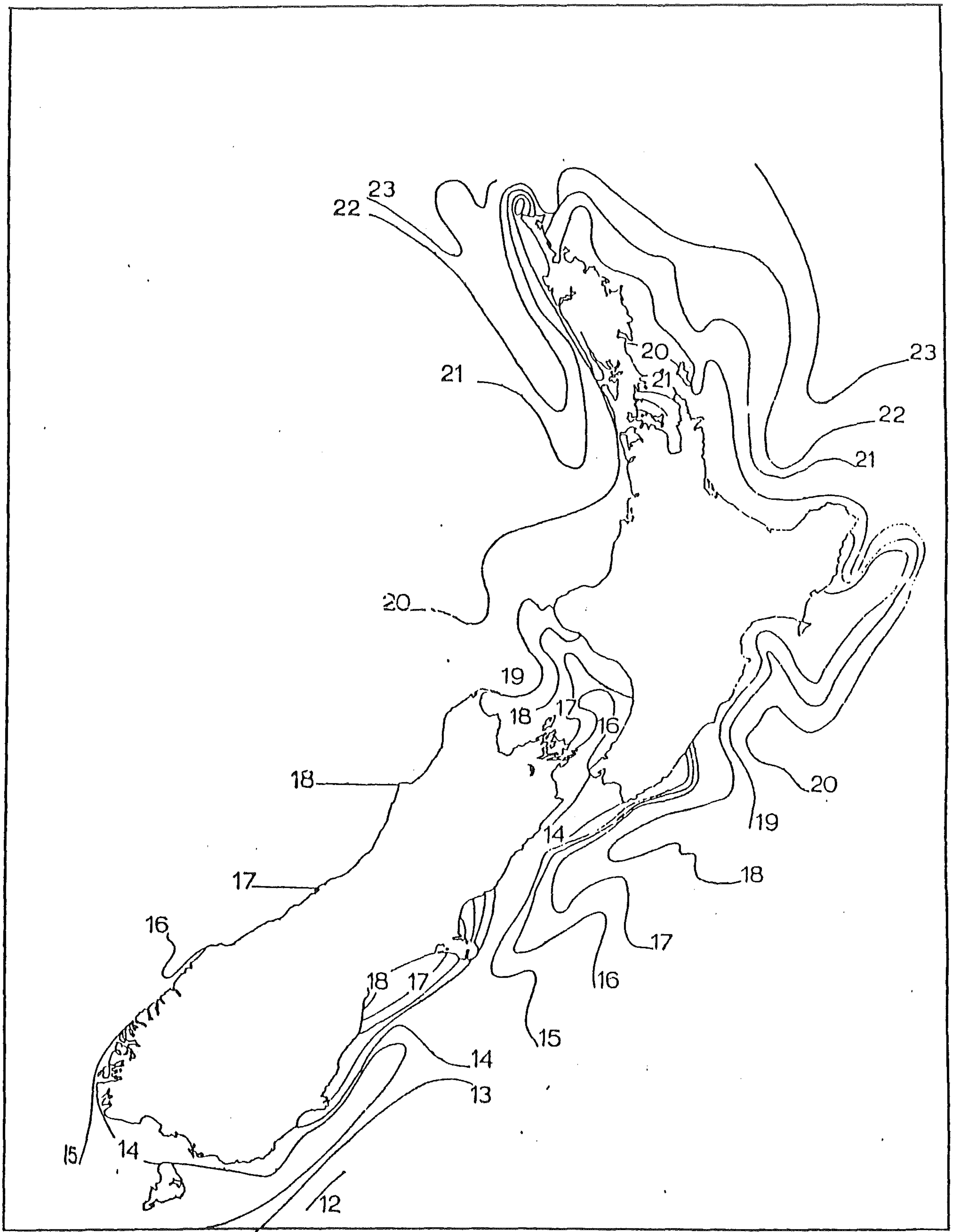

Figure 1.1 Sea Surface Temperature Contours in degrees celcius (Summer). New Zealand Coastal Waters.

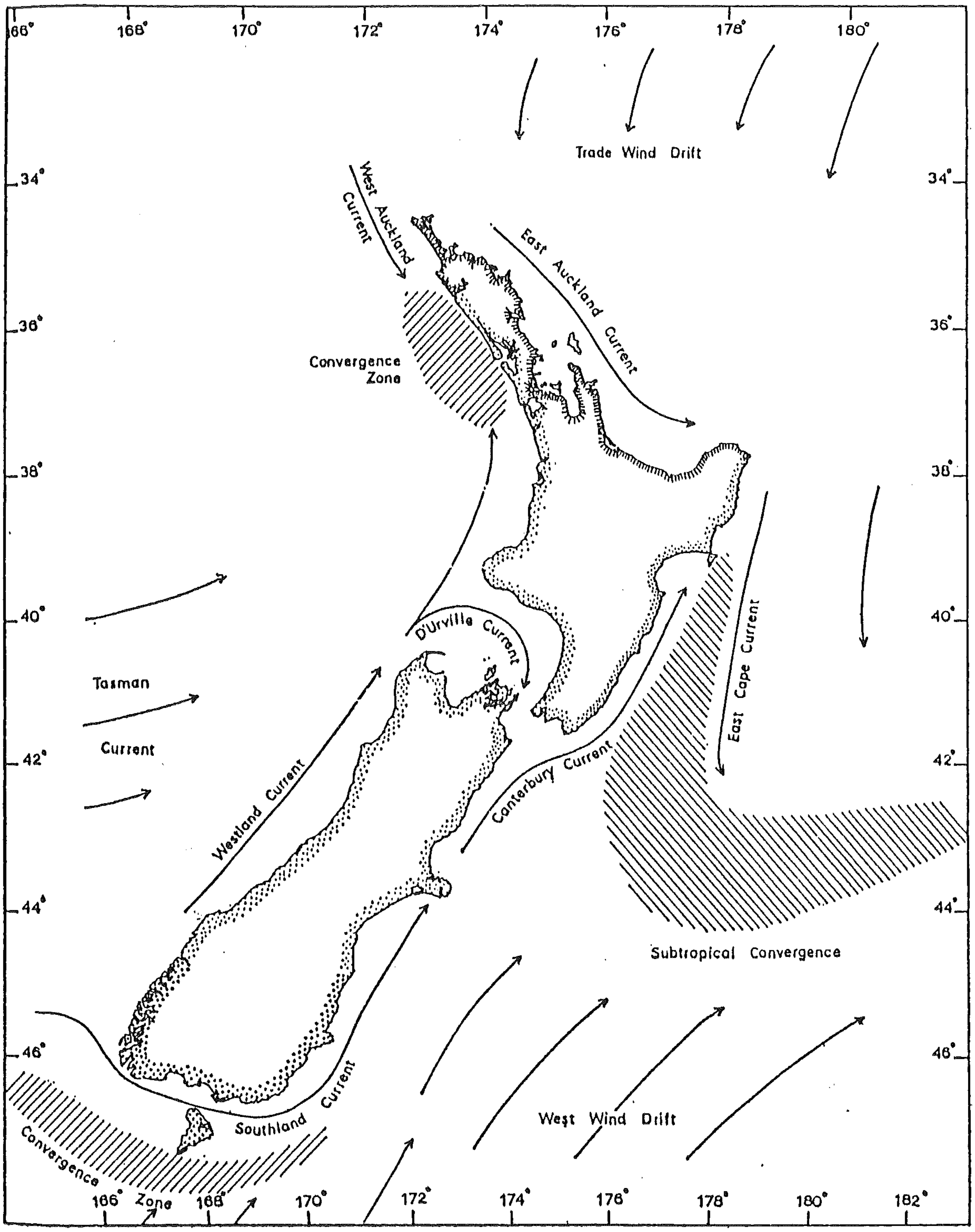

Figure 1.2 New Zealand's Major Coastal Currents.

Based on a slightly differient approach of marine biography, Knox (1975) has identified six marine provinces around New Zealand. They are the;

(A) Kermadec province of tropical and subtropical water temperatures.

(B) Aupourian province of transitional warm termperate water from around the eastern North Island.

(C) Coaliian province of cold temperate water from around central New Zealand.

(D) Forsterian province of transition between subantarctic cold temperate and the cold temperate mixed waters around the southern South Island, Stewart Island and theSnares Island.

(E) Moriorian province of subtropical convergence surrounding the Chatham Islands.

(D) Antipodean province of subantarctic cold temperate waters surrounding the subantarctic islands.

King et al. (1985) have devised a separate classification of coastal and marine areas of New Zealand based primarily on marine topography with reference to hydrology and biological data. Their classification divides New Zealands Coastal waters into three major territories as listed below:

(1) The Northern Neritic Territory - analogous to Hayden's et. al. (1984) Northern province.

(2) The Central Neritic Territory - extending from the northern region to Otago peninsula on the East Coast and Haast Pass on the West Coast.

(3) The Southern Neritic Territory - an area south of the Central Neritic Territory.

Each territory is divided into coastal and shelf ecological regions and then further subdivided into coastal and shelf ecological districts.

In spite of the classification of habitats described above and the restricted distributional range of some New Zealand's marine species, there is much overlap of life forms and living patterns in New Zealand's coastal waters (Tortell 1981). The marine environment often has mosiac patterns of 'species distribution' as distribution often changes in a graded way, forming a biogeographical 'cline'. (A 'cline' refers to a gradual change in genetic makeup of a species across its area of distribution).

2.7.3 Physical Topography

The coastline of New Zealand is very varied in topography. Many harbours and estuaries have been formed through submergence of river valleys and volcanic craters. Resistant volcanic and other hard rocks form the promontorys and corners of the two main islands as well as numerous offshore islands. The subantarctic islands of the New Zealand group are all on submerged plateaus which connect geologically with the mainland. Coastal features such as cliff shores and rocky beaches are found on both main islands as well as on many minor islands. The east coast of the South Island particularly has a large number of hard rock and gravel shores. Between major headlands on both islands sandy beaches occur which may be gradually building up or eroding depending upon local sediment supply and local processes. Natural shoreline erosion is encouraged by a high energy wave climate caused by prevailing westerly and south-west winds, although many northern aspects of islands, capes and peninsulas are relatively sheltered.

2.7.4 The Biology of New Zealand's Marine Environment

This section provides a generalised description of the marine habitats, plants and animals of New Zealand's coastal and marine environment.

New Zealand's coastal environment can to some degree be divided into the Soft and Hard shore environments and the continental shelf environment.

2.7.5 New Zealand's Soft Shores and Mud Flats

Soft shores and mudflats include the parts of the coastal environment, on the border between land and sea, where the structural component is unconsolidated material such as sand, mud or silt (either eroding or being deposited). Morton and Miller (1968) have further divided this environment into A) Exposed, B) Protected and C) Enclosed shores.

(A) Exposed Soft New Zealand Shores. Exposed soft shores are extremely dynamic and unstable coastal habitats where wave actions and currents are unrestrained by any sheltering features. Large volumes of sandy sediments are transported off or on shore extremely quickly by wave action. There are few suitable anchorage sites for plants or animals. On-site production is limited to microscopic algae. Consequently Miller and Batt (1973) report that the sediments of exposed beaches have a low organic content.

Typical inhabitants of New Zealand's exposed shores must cope with an unstable environment that could quickly bury them, or expose them to a high energy wave environment. As a result species diveristy is limited by this factor and is low in comparison to other types of soft shore. Typical New Zealand exposed shore inhabitants include; shellfish bivalves such as the tuatua, and toheroa, sea slaters, sand lice, sandhoppers; and a limited number of of gastropod (snail) and annelids (segmented worms) species. In the middle and lower sections of the beach the mantis shrimp, ghost shrimp and swimming crab are also common.

(B) Protected Soft New Zealand Shores. In moderate coastal shelter where wave and current influences are restrained by land forms, protected beaches can develop. They represent a more stable and less dynamic environment in comparison to exposed shores. Sediments are a sand/silt mixture, and burrowing and sea floor surface dwelling animals are diverse and abundant. On site primary production, from algae blooms and eel or sea grasses towards low water, is moderately high in comparison to other coastal habitats (Mann 1982).

Typical inhabitants of New Zealand's protected shores include species of pipis, cockles, the bivalve Macomona liliana ; many species of worms such as the acorn worm; starfish (echinoderms) species such as the sea cucumber, sand dollar, and heart urchins; crustaceans including the sand shrimp, swimming crab, mantis shrimp and ghost shrimp, four species of burrowing crab and a species of burrowing shrimp.

The sea grass Zostera sp , found in abundance on protected soft shores, is a moderately important source of primary production for the adjacent coastal food chains according to Mann(1982). Zostera is reported to play a significant role in coastal food chains because of its role in mineral fixation and nutrient cycling. The slow decay of seagrass detritus is also thought to confer a stabilizing influence into some feeding relationships by providing a slow constant nutrient input into the food chain, (regardless of short term seasonal variations in primary produciton). Consequently the presence of Zostera could infers an importance on protected soft New Zealand shores, because of its relationship to local coastal production.

(C) Enclosed Soft New Zealand Shores. Within the protection of estuaries, semi enclosed harbours and lagoons, silty and clay sediment accumulates to form enclosed mud flats and wetlands. Due to lower sediment oxygen levels in these shore sediments , enclosed shores have a smaller range of burrowing fauna in comparison to protected beaches. On site primary production is typically attributed to algae blooms, seagrasses , glasswort swamps and to the mangrove in the northern North Island.

The range of typical species depends on the degree of mixing of salt water and fresh water, however representative species include two species of mud crab, the snapping shrimp, the tiny bivalve shellfish Nucela, three species of gastropod snail, the scavenging whelk and a species of air breathing snail; as well as pipi, cockle and Macomona, (also common to protected shores). Fish species restricted solely to these sheltered bays and estuaries include the grey mullet, yellow eyed mullet and piperfish. The seagrass zostera may also form a low tidal green sward on enclosed beaches.

In the Auckland Province, towards the swampy fringes of the enclosed shore, the highly productive mangrove Avicennia resinifera occurs. The mangrove utilises imported inorganic matter from tidal and terrestrial sources and exports significant quantities of organic matter which supports many coastal food chains. Lear and Turner (1977) reported that in a number of overseas Pacific countries up to 80% of fish caught in coastal waters can be directly linked to mangrove based food chains. Choat (pers comm 1985) has stated that in northern New Zealand at least 30 species of coastal fish are associated with Mangrove systems for part of their life cycle.

Mangroves swamps are sites of very high primary production according to Lear et al. (1977) as mangrove biomass production per square metre can be 20 times that of the open ocean. Mangrove detritus is also thought to be an important coastal supplier of organic forms of two essential nutrients, nitrogen and phosphorus. Mangrove presence should therefore infer high status on enclosed shores, for local coastal food production and harvesting. Mangroves are also reported to play an important role in the prevention of coastal erosion and pollution by acting as a sediment trap, natural filter and by absorbing wave energy.

South of Auckland where the mangrove disappears wide swamps of rushes such as saltgrasses, glassworts and sedges cover the correspondent region of enclosed shores. Studies overseas by Mann (1982) and others have shown that these coastal wetlands and swamps can be highly productive, (up to20 times that of the open ocean, depending upon factors such as duration of tidal inundation, latitude ecetera).

Overseas studies have shown that nutrient inputs of up to 40% of a coastal wetlands net annual primary production can be exported into adjacent coastal water food chains from protected shores Odum (1971), although occassionally such sites can instead act as nutrient sinks by trapping nutrients. When wetlands export nutrients they are likely to be be of importance to coastal food production.

2.7.6 New Zealand's Hard Shores and Reefs

Hard shores and reefs include the parts of the shallow coastal environment where the structural component is consolidated material such as rock. Hard rock shores tend to show much more marked zonation of plants and animals across the intertidal zone, than do soft shores. They also show a greater diversity of habitat and species relative to soft shores of a comparable wave environment.

Typical inhabitants of New Zealand's mid tidal zone on hard shores include barnacle, chiton, limpet, snail, perwinkle and rock oyster. At the lower tidal level the green lipped mussel is also common but is replaced by the blue mussel in more sheltered waters.

700 species of large fixed algae (often called kelp) can be found on or adjacent to hard shores, or in deeper water. Common examples of kelp include the giant bull kelp, bladder kelp species and Ecklonia kelp. New Zealand kelp is usually infested with mollusc, burrowing worms and many species of crustacea. Kelp forests have other residents such as corals, sponges, sea urchins and fish species such as butterfish, parore, silver drummer and black angle fish; and are often visited by other coastal or offshore fish species. On their fringe may be found such species as parrot fish, stingrays and hapuka (groper).

As a site of primary production , kelp species play an important role in the marine ecosystem. Primary production from kelp can exceed that of salt grasses. Overseas Mann (1982) reports that from 38% to 75% of total primary production in coastal areas can be attributed to kelp production.

New Zealand also has a rich rocky reef community. Many species of marine animals including; sponges, tubeworms, corals, mollusc sea squirts, slipper limpets, scallops, cancer crabs, reef starfish, octopus, and anemones can be found there. The richest range of New Zealand fish fauna is also to be found on, or directly above this rocky reef environment. It is a characteristic of many of the inshore pelagic fish species that they are territorial and are usually restricted to particular bottom features adjacent to hard and protected shores Morton et al. (1968). These mainly pelagic fish species include the blue mao-mao, pink mao-mao, butterfly perch, demoiselles, kingfish, kahawai, trevally and koheru.

2.7.7 New Zealand's Continental Shelf

In deeper water, extending out to approximately the 200 metre bathymetric contour, there are a range of sea floor habitats which vary according to the bottom substrate, (of mud, sand, gravel and rubble) covering the continental shelf.

Mud covers a large percentage of this shelf, and representative species to be found in association with this habitat includes the heart urchin, brittle star, the shellfish Dosinia, as well as many species of amphipod and worm. Over these sand and mud sea habitats can be found the demersal fish species such as tarakihi, red gurnard, flounder, spotted smooth-hand, rays, snapper red cod and warehou.

Gravel or rubble shelf habitats can be found in areas of greater current influence. This substrate provides a habitat for a wealth of attached marine life including massive sponges, encrusting polyzoans, hydroids, tubular worms and anemones; as well as a rich variety of gastropod snails, bivalve shellfish and rock oysters. Crab species to be found here include the hermit crab and the corrugated swimming crab. Over the deep gravel and or rocky sea floor swim such fish species as the leather jacket, goatfish, porae, red moki, john dory, snapper, hapuku, blue nose warehou, orange roughy, perch and blue cod.

2.7.8 New Zealand's Marine Fish

New Zealand has approximately 650 species of marine fin fish that have been recorded in its coastal waters. Fenaughty et. al. (1982) reports that New Zealand has a much higher diversity of fish species, but a lower abundance per species, relative to Northern hemisphere coastal regions of an equivalent latitude.

Many of New Zealand fish species are subtropical, especially among northern coastal and inshore pelagic species (Ayling and Cox, 1982). Examples include snapper, tarakihi, goatfish, wrasse and trevally. In addition New Zealand's north eastern coastal regions have a smaller group of inshore subtropical species.. Examples include a reef fish the crimson cleaner, elegant wrasse, blue knife fish and gold ribbon grouper.

New Zealand also has a number of cold temperate fish species which are usually bottom living and found in the central and southern New Zealand region. Examples include john dory, lookdown dory, smooth and spiky oreo, frost fish, ling; and orange and silver roughy. Off the south east coast of the South Island can be found a number of subantarctic species including the southern bluewhiting, black cod, maori fish and ghost shark. Occasionally New Zealand's northern waters, especially around the Poor Knights Islands gets a periodic infusion of tropical fish species such as moray eel and puffer fish.

There is only a small group of fish species endemic to New Zealand and they include Blue cod, spotty, flounder and triplefin species. Many fish found around New Zealand are instead populations or subspecies of more widely distributed species.

The majority of New Zealand fish species are, territorial according to Morton et al. 1968, (with the territory usually defined by seafloor features), and consequently ameniable to protection within defined areas or habitats. Where a fish species is nonterritorial conservation strategies such as a M.P.A. programme can still be used to protect critical habitats or migration pathways. To conserve these species management strategies apart from a M.P.A. programme will also be necessary if one conservation goal (conserving fish stocks) is to be achieved.

2.7.9 New Zealand's Marine Mammals

Many species of whales, dolphins and seals spend part of their life history in the coastal waters or open ocean around New Zealand. Some species regularly use New Zealand waters as a migratory pathway including the sperm whale, and humpback whale. Others species of whales and dolphins spend their whole life history in New Zealand's waters. One species the Hector dolphin, has only been reported in New Zealand's waters.

Other examples of whales and dolphins that have been reported in New Zealand waters include: the pygmy sperm whale, the black right whale (very rare but reported adjacent to the Cambell Islands), sei whale, pilot whale, killer whale, false killer whale, pygmy right whale, tasman beaked whale, scamperdown whale, arch beaked whale, strap toothed whale, cuvier whale, giant bottlenosed whale, bottlenosed dolphin, grampus (or risso) dolphin and dusky dolphin.

As with nonterritorial fish a M.P.A.programme may still be appropriate for the management of some species of whale and dolphin, even though they tend to be migratory. The programme can protect components of the marine system (such as productivity) critical to marine mammals welfare. Additional management strategies to maintain whale and dolphin numbers may also be necessary.

New Zealand has a number of seal species including the fur seal, elephant seal and the leopard seal, (rarely found on the mainland). These species tend to be more territorial and therefore M.P.A. protection is likely to be of direct relevance in their management.

2.7.10 New Zealand's Coastal Birds

New Zealand is known internationally as a land of birds. The large variety of species of wetland and true sea birds testifys to the appropriateness of this description. Of the true sea birds, (that spend time foraging offshore), examples include: royal albatross, red billed gull, black backed gull, australian gannet, yellow eyed penguin, fordland crested penguin and little blue penguin. Examples of species of birds that feed on or inhabitat marine wetlands include: south island and pied oyster catcher, pied stilt; a number of species of shag including; pied, little, blue, king, spotted and black shag species; kingfisher, white fornted tern, banded dotterel, caspian tern, the rare white heron and white faced heron, royal spoonbill, turnstone, knot, wrybill and golden plover, godwit and sandpiper, to name a few. M.P.A.protection could be an important management tool to conserve the critical habitats of importance to the marine wetland bird species of New Zealand.

The next chapter examines the conflicts between New zealand's coastal and marine envronment as a natural habitat and as a human resource.

CHAPTER THREE

CONFLICT BETWEEN RESOURCE USE AND THE NATURAL ENVIRONMENT

SUMMARY

In Chapter One New Zealand's marine environment is introduced as both a natural habitat and a natural resource complex.

Chapter Two outlines the unique features and characteristics of the marine environment with particular regard to the application of a Marine Protected Areas (M.P.A.) Programme. Chapter Two also describes the species and habitats of New Zealand's marine environment.

This chapter highlights some of the detrimental impacts that human activity is considered to have on New Zealand's marine environment. These impacts are examined in terms of the likely need for a M.P.A.programme. The chapter concludes that:

(1) New Zealand's marine environment is in many areas extensively exploited and modified;

(2) Major human activities having detrimental impacts on this environment are:

a) Pollution (mainly due to local eutrophication, heavy metal discharge and petrochemical discharge).

b) Harvesting of marine resources, (especially overfishing of commercial fish species).

c) Physical modification of the coastal zone, (especially reclamation of coastal wetlands, dredging of harbours estuaries,and inlets, some coastal erosion works and opening or closing of coastal inlets).

(3) Impacts are most marked adjacent to heavily urbanised and industrialized areas.

(4) Impacts are likely to be affecting both coastal production and on at least a limited scale species genetic diversity and abundance. Impacts may also be affecting community composition and ecological processes in some areas.

3.0 CONFLICT IN THE MARINE ENVIRONMENT

INTRODUCTION

It has been stated or implied by different researchers including Gardner (1983) and Struik (1983), that many of New Zealand's marine ecosystems have been heavily exploited and modified since European colonisation. Although New Zealand has a small human population relative to the length of its coastline the affects of human use are potentially significant because of the close proximity of 80% of the population to the coastline; the concentration of much of this population in coastal urban areas ; and a history of marine exploitation in New Zealand. These three factors may have resulted in an adverse change in the characteristics of the marine environment. The affect of human activities can be considered under three headings:

(1) Marine Pollution;

(2) Harvesting; and,

(3) Physical Modification.

3.1 MARINE POLLUTION

As mentioned in chapter two, New Zealand's marine environment can be considered as a 'sink', with the result that activities on land, in the air or at sea can result in the passage of materials that affect the marine environment. Where these material have an adverse affect, they are considered to be pollutants.

According to Odum (1983) and Ray (1976), the effect of the majority of polluting material is most marked near their source, usually in the critical coastal ecotone.

Types of marine pollution around New Zealand can be subdivided into the following five categories and each of these are discussed in turn:

(1) Eutrophic Pollutants;

(2) Heavy Metal Pollutants;

(3) Oil and Oil Derivative Pollutants;

(4) Thermal Pollution; and,

(5) Turbidity affecting Pollutants.

3.1.1 Eutrophic Pollutants

Eutrophic pollution or 'Eutrophication' refers to extreme organic enrichment and subsequent depletion of dissolved oxygen in bodies of water. Potential eutrophic pollutants include sewage and other biological materials and nutrients. It would seem paradoxical that an environment that depends on nutrients for primary production can be polluted by excess inputs. However nutrients will pollute a marine environment if the level of discharge of material exceeds the capacity of the environment to assimilate it.

Eutrophication is considered by Gray (1982) to be "the most widespread and severe form of marine pollution worldwide". Around New Zealand White (1982) has recognised eutrophication as an increasing problem exceeding other types of pollution.

(A) Sources of Pollutants.

In New Zealand agricultural use covers the greatest area of land and the application of comparatively large quantities of organic and inorganic fertilisers, such as phosphates and nitrates (to boast agricultural productivity), in association with human and agricultural effluent, has resulted in enrichment of many lowland coastal lakes and estuaries. A number of important sheltered coastal wetlands and estuaries are increasingly eutrophic as a result (White 1982).

An example of this process is Lake Ellesmere in Canterbury (Hughes et. al. 1973). This estuarine lake, (open periodically to the sea), has in the past been very productive playing host to many species of esturine and freshwater species. At present because of intensive agricultural activity in its water shed, as well as domestic sewage discharge from the surrounding district, this lake has become increasingly eutrophic with the appearance of toxic blue green algae and the dissapearance of the aquatic weed beds. Reduction of a number of estuarine fish species, black swan and other coastal and wetland birds has resulted according to Hughes et al. (1973).

Agriculture is not the only cause for concern. The close proxmity of much of New Zealand's population to the coast, especially in the northern North Island, has meant that often untreated sewage has been discharged directly into the coastal environment. Knox (1979) reported that ocean outfalls into the harbours around Auckland released the combined sewage of over half a million people. In Wellington similar outfalls discharge essentially raw sewage into Cook Strait. At other coastal sites, which lack a reticulated sewage system, diffuse (non point) sources of enrichment have resulted from septic tank seepage into ground water and then into the coastal zone. At popular mooring locations, such as in sheltered bays, around Auckland and in the Marlborough Sounds, localised population pressure from pleasure boats, has resulted in eutrophication in the summer months due to the dumping of raw sewage. (Anon. 1981).

Some types of mariculture, such as the raising of salmon in sea cages in sheltered harbours, can also result in localised eutrophication due to the build up of faecal matter and wasted food under the cages. It was reported to a D.S.I.R. conference on Salmon farming at Nelson in 1985 that this has been a major problem associated with intensive mariculture overseas.

In general eutrophication around New Zealand is limited to sites of low turbulance such as wet lands, bays and estuaries which are either exposed to high human sewage inputs locally, or alternatively runoff from intensivly farmed catchment areas. These inputs often occur in association with nutrient inputs from forestry and agricultural based industries such as freezing works, pulp and paper mills and dairy factories. The leachate from coastal rubbish dumps can also result in localised enrichment and eutrophication according to Hutchinson et. al. (1973).

(B) Impact of Pollutant.

The effect of eutophication on marine and coastal ecosystems is often dramatic. Gray (1982) reported the marked reduction in species diversity and an inverse relationship between increasing levels of eutrophication and decreasing size of organisms in eutrophic estuaries, bays and fjords. In badly eutrophic marine environment, the species list can be limited to three or four small tolerant opportunists such as a number of polychaete worm species. These species often feature a wildly fluctuating unstable population reflecting the boom/bust ecological cycle that characterise opportunist species.

Organic enrichment and the resulting increase in turbidity will not only asphixiate most marine animals but can tend to smother plant assemblages, killing individuals and limiting plant production.

Plankton based marine communities, according to Gray (1982), are thought to be mainly unstructured in regards to feeding relationships, (refer Chapter two section 2.6) and are characterised by complex '*food web*' type feeding linkages between differient species, with weak links between trophic levels. Eutrophication can cause these feeding relationships to become more simplified, so that they resemble the more structured '*food chains*' with only one or two species providing the links between trophic levels. This is an unstable system in which 'key stone' predators or prey (refer section 2.6) can completely control either plant or animal population density. Gray suggests however that this affect is likely to be localised.

(C) Management Considerations

The preceeding information would suggest that eutrophication is having a significant influence on some coastal areas around New Zealand. If it is considered desirable to maintain or preserve some of these areas it will therefore be important that:

(1) Attempts are made to either control discharges, or treat the eutrophic pollutants to minimise the affect they might have on the local coastal environment.

(2) When implimenting a M.P.A. programme, sites not prone to eutrophic discharges are chosen and regulatory controls are placed on the discharge of eutrophic pollutants into these protected areas and the general marine environment.

3.1.2 Heavy Metal Pollutants

Heavy metal pollution refers to the discharge of material that contains pollutants such as copper, lead cadmium, zinc, fluoride, mercury and silver. Studies by Boyden (1975), Brooks and Rumsey (1965, 1967), Hoggins and Brooks (1973), Millhouse (1975, 1977), Nielson (1975), Nielsen and Nathan (1975), Robertson et at. (1975) and Stoffer et al. (1982) all report elevated levels of heavy metals, significantly above natural background levels, at a number of coastal sites around New Zealand.

(A) Sources Of Pollutants

Activities that liberate these pollutants into the marine environment can be divided into four catagories and they are considered in turn:

(1) Mining;

(2) Heavy and Light Industry;

(3)Agriculture and Horticulture; and,

(4) Urbanisation.

(1) Mining. Many mineral deposits contain heavy metals, and upon exposure to the earth's surface, these metals can be eroded or leached out of mine tailings. These pollutants can then be transported by surface runoff into the local watershed, and from there into the coastal environment ,exposing both freshwater and coastal organisms to heavy metal contamination. Objections were lodged against gold mining at Waihi in the Coromandel Pennsisula by the Environmental Defence Society because of this problem. In New Zealand there are a significant number of mining operations occuring in close proximity to the coast.

(2) Heavy and Light Industry. Heavy industry such as the aluminium smelter at Bluff has been reported by Boyden (1975) to be a "primary source of large scale contamination of inshore waters." Farrier (1973) reported fluoride levels in seawater around the Bluff smelter to be significantly higher than the expected natural level. Many light rural and urban industries such as engineering firms, electroplating, pulp and paper mills, battery manufacturing; and chemical and fertilizer plants have also been shown to be sources of

heavy metal contamination as sewage originating from the above sources is often dumped at sea as sludge. Boyden (1978) suggests that this may be an important agent for contaminating some New Zealand fish species. These pollutants can also be carried to the coast in surface runoff, if waste is dumped on land or in rivers.

(3) Agriculture and Horticulture. The fertilizer super phosphate (extensively used in New Zealand agriculture) has been reported to contain high levels of cadmium. Cadmium can find its way to the coastal zone by surface runoff and Williams and Davies (1973) attribute the high cadmium levels in some scallops dredged up in Tasman Bay to this source. It has been suggested by Boyden (1978) that other inorganic fertilisers and some agricultural and horticultural chemicals may also contain significant amounts of heavy metals.

(4) Urbanisation. In heavily populated areas the widespread use of leaded petrol and a history of use of lead based roof paints has been suggested as a source of marine pollution. Nielson (1975) attributed increasing lead levels in marine organisms in the proximity of Wellington to leaded petrol fumes and runoff from lead based roof paint. As a result Stoffer et al. (1986) reported that both lead and zinc levels, in the upper reaches of Wellington harbour were in the extreme pollution category, (based on World Health Organisation classifications).

The light industry associated with urbanisation is likely to account for other heavy metal pollution. For example Stoffer et al. (1986) found levels of copper, cadmium and mercury in the upper Wellington harbour, to be in the moderate to strongly polluted category. In the Avon-Heathcote estuary adjacent to the Christchurch urban area, Millhouse (1977) reported high lead levels in an algae grazing marine snail, estuarine crab and bivalve shellfish species. Another study by Boyden (1975) showed high copper concentrations in a species of sea lettuce in the upper Otago harbour and McCormacks bay in the Avon-Heathcote estuary. The levels of copper concentration for sea lettuce species at these sites are three to four times higher than levels found in sea lettuces removed from Poole Harbour in the United Kingdom (an area classified as heavily polluted). Hoggins and Brocks (1973) also reported some marginally elevated mercury levels in rock oysters taken from a number of coastal locations around New Zealand.

(B) The Impact of Heavy Metals.

The impact of heavy metals on marine organisms and systems range from direct toxicity (resulting in organism poisoning and death), through to no affect. These affects reflect either direct exposure to the heavy metal in the seawater, or bio-accumulation through feeding (by the heavy metal being concentrated in the tissue of an organism and then passed through the 'food chain' or 'food web' to affect organisms at higher trophic levels).

In the upper reaches of Wellington harbour and possibily in the upper reaches of harbours and estuaries around the other three main centres, the impact on marine organisms and systems of heavy metals, are likely to be towards the direct toxicity end of the spectrum. Nielson's (1975) finding of an inverse correlation of higher lead levels with lower frequency of occurance; and the actual disappearance of rock oysters and mussels in one or two areas of Wellington harbour, would appear to support this statement.. In most other coastal areas around New Zealand, impacts of heavy metals are likely to range from sublethal affects through to insignificant or no impacts.

Sublethal affects of heavy metal pollution will vary with the individual species concerned and the type and concentration of metal involved. Common effects however on invertebrates include:

a) reduction in growth;

b) reduction in larval settlement and recolonisation;

c) loss of osmoregulatory control resulting in reduced tolerance to changes in salinity and temperature, (with a subsequent affect on estuary, inlet and intertidal distribution); and,

d) reduction in reproductive capacity and increase in larval mortality.

Sublethal effects on fish and other vertebrates often include respiratory and osmoregulatory problems which affect both growth and reproduction. Heavy metals can also have behavioural affects on fish by diminishing their ability to perceive changes in environmental salinity and temperature.

Gray (1982) reports that the first net effect of moderate heavy metal pollution is the elimination of rare species that are already under environmental stress because they are at the limit of their distributional range. He states that often smaller tolerant species are also likely to become more abundant, at the expense of species that are more sensitive to heavy metal contamination and this often results in a marked change in the faunal assemblage, (composition and relative abundance of species present at a site).

(C) Management Considerations.

There are relatively few studies of the affects of heavy metals in New Zealand's waters but indications so far suggest heavy metals are having an environmental affect with regard to species diversity especially in proximity to urban-industrial areas (Boyden 1975). It is therefore important for the maintenance of species diversity and production that:

(1) attempts are made to reduce the discharge of heavy metals in the proximity, up and downcurrent from biologically or commercially important marine area especially areas, selected to be part of a M.P.A. programme.

(2) heavy metal discharges are kept to a minimum in the general marine environment both due to the health risk to humans afrom eating heavy metal contaminated seafood and because of the negative affects on species composition and abundance.

3.1.3 Oil and Oil Based Pollutants

These pollutants includes a range of light and heavy oils and oil based products (such as plastics) that can be discharged into the marine environment.

(A) Sources of Pollutants.

Accidental discharges of oil can be the result of maritime disasters, (especially involving oil tankers), accidents on offshore oil and gas exploration and drilling rigs; and systems failures with coastal oil storage facilities and refineries. Intentional discharges can be due to the disposal of waste engine oil from ships and the cleaning out of patially full holds of oil tankers with sea water. Plastic build up in the marine environment can be from urban or industrial rubbish or the use of synthetic fishing nets.

(B) Impacts of Pollutants.

New Zealand has as yet escaped a major marine oil pollution event such as the famous Torrey Canyon oil pollution spill studied by Smith (1968). However New Zealand has the potential for such an oil spill disaster because its sea lanes are used by a number of oil tankers each year, it has coastal oil storage sites, extensive oil and gas exploration occurs in its coastal waters and it has a major oil refinery at Marsden Point.

In the three years since 1984 there have been at least two minor confirmed oil spills into New Zealands coastal waters. In 1984 an oil company was fined $3,000.00 because of a spill of oil from coastal storage tanks (New Zealand Herald 15/12/84). In january 1987 the Christchurch Press reported a minor oil spill from the Marsden Point Oil Refinery. Fishermen have also made allegations that oil tankers illegally clean out their holds with sea water in New Zealand territorial waters, however because this practise is illegal iand occurs out at sea its extent is hard to determine.

Environmental impacts of specific oil spill incidents in New Zealand waters have not been documented as far as this Author is aware. However overseas studies by Smith (1968) an others , outline a number of potential affects of a major spill. They are that:

1) A comparitively small volume of oil can affect a large marine area because it can form a thin surface layer over water (due to oils low characteristic density);

2) Oil can interact with suspended marine sediments and be entrained into bottom sediments, with the potential result of repeated fouling as sediments may be continuously re-exposed over time;

3) The affect on the biological community of oil spills is dependant on the type and volume of oil spilt, the nature of any dispersants used to clean up the spill, and the type of marine environment in which the oil is spilt;

4) Common immediate affects of major oil spills in the affected area, according to Tortell (1981), include a major reduction in primary production due to greatly reduced phytoplankton activity, destruction of kelp forests and salt marshes and direct toxicity of intertidal organisms. The affects on the species list is similar to gross eutrophication with the loss of rare and sensitive species and the proliferation of resilient opportunist species with their characteristic population instability.

5) Oil spills can have quite major short term affects on marine habitats, but are usually accidental one-off events. Gray (1982) reports relatively fast recovery from oil spills, as rapid as 3 to 5 years in coastal areas with a medium to high energy environment, (such as found on exposed rocky and sand shores). According to Tortell (1981) recovery in sheltered or enclosed bays, harbours, fiordlands or estuaries can take up to 10 years, with oil persisting in some very sheltered spots (such as in mangrove swamps) for decades or even centuries.

The nondegradable nature of many plastics and fishing nets means that they can persist in the marine environment, resulting in clogging of some marine organisms and snaging of marine animals.

(C) <u>Management Considerations.</u>

Because oil spills are acute, infrequent and localised they are not as significant a polluting influence as the more chronic affects of eutrophication and heavy metal contamination.

(1) It is advisable however to avoid siting oil storage facilities, tanker sea lanes, refineries or unloading terminals in close proximity to biologically important sheltered or enclosed marine areas especially M.P.As.

(2) Conversely M.P.As. are at risk if they are chosen in close proximity, especially downcurrent to such facilities.

The continual chronic buildup of plastics in the marine environment is of more everyday concern. A possible management strategy would be to limit siting of dumps on the foreshore and encouraging fishermen and manufacturers to use and produce more biodegradable products.

3.1.4 Thermal Pollution

(A) Source of Pollutants

In New Zealand thermal pollution is the result of artificially elevated water temperatures in the vicinity of thermal power stations such as at New Plymouth.

(B) Impacts of Pollutants.

Most marine plants and animals require a relatively stable temperature regime and cannot cope with extreme short term water temperature variations. The result of thermal pollution in a localised affected area would probably be direct mortality of fixed plants and animals and the avoidance of the area by free swimming species.

(C) Management Considerations.

The localised nature of marine thermal pollution suggests that this is not a major problem in New Zealands coastal waters.

3.1.5 Turbidity Pollutants

(A) Sources of Pollutants.

The unnatural discharge of material that affects the clarity (or turbidity) of coastal waters can be considered as pollutants. This can result from deforestation, urban buildup and associated erosion; runoff from inert minetailings and discharge of nontoxic insoluble industrial materials.

(B) Impacts of Pollutants.

This type of material can only be considered as a pollutant if it has an adverse effect on the environment. For example if it smothers marine plants and animals (such as coral or shellfish), results in lower primary production (due to a reduction of light penetration into coastal waters), or unnaturally discolours water to the extent that loss of water clarity becomes aesthetically unacceptable.

(C) Management Considerations.

It is hard to assess the extent to which humans have increased the discharge of often already naturally unclear water into the coastal environment. Efforts to reduce unnaturally turbid discharges into sensitive coastal areas such as coral reefs and some shellfish communities should still be considered, especially in areas of high water quality and in those areas protected by a M.P.A. programme.

3.2 HARVESTING OF NATURAL MARINE RESOURCES

Chapter two gives an indication of the diversity of coastal and marine life in New Zealand waters. Many of these species of plants and animals have been harvested to provide food, clothing and other commodities, ever since New Zealand was first inhabited. The first commercial venture undertaken in New Zealand by europeans, involved the exploitation of marine mammals, such as whales and seals. Perhaps as an indication of what was to follow, seal exploitation resulted in the decimation of total seal population numbers and localised extinction of populations on coastal and offshore island sites. According to Melrose (1973) this reduction in seal numbers took less than twenty years between 1793 and 1815.

3.2.1 Fishing

The total annual harvest of fish from New Zealand's exclusive economic zone (E.E.Z.) is 500,000 tonnes (based on 1986 figures).This is a very modest total catch in comparison to other coastal nations. Japan for instance has a much smaller E.E.Z. and yet they catch many more tonnes of fish in their zone. This is because all fishing in New Zealand waters is restricted to only 21% of the total area of the E.E.Z.. Of that 21% only 6% is suitable for inshore fishing methods because of the depth of water over the majority of the E.E.Z..

The history of commercial fishing within New Zealand's exclusive economic zone (E.E.Z.) is stewn with stories of over-exploitation of natural resources similar to the furseal saga. (In this context overexploitation refers to the harvesting of individuals from the population stock of one species at a rate faster than replacement into the stock by natural reproduction and recuitment, so that the total stock cannot be maintained, and is instead steadily reduced in size).

With the advent of modern fishing methods such as trawling, around the turn of the century, Fenaughty et al.(1981) described the first signs of over exploitation and depletion of fish stocks in Otago harbour. Since then a general decline in commercial fish stocks has been reported. It is only since the late 1960's that the New Zealand coastal and deep sea fish species have been exploited in earnest. From 1965 to 1980 New Zealand total reported domestic catch increased 230 percent. According to the Ministry of Agricultural and Fisheries (M.A.F.) catch by foreign boats in New Zealand waters increased by an even greater amount.

Increased fishing effort has resulted in, according to Struik (1983), "many economically valuable ocean species being drastically reduced by over-hunting, and in some cases having been brought close to extinction on at least a local basis". M.A.F. has documented a marked decline nationwide, in landings of some commercially important species This has come about even with considerable increase in fishing effort. For example Northland snapper populations have come under increasing fishing pressure in the last ten years and according to Sullivan and Gilbert (1978, 1979), Struik and Bray (1979), and Mace (1981) the fishery had almost approached the point of economic collapse. Between 1974 and 1978 the number of snapper caught had decreased by twenty percent annually (M.A.F. 1985) and the mean size of snapper caught reduced by forty percent overall (Struick 1983).

M.A.F. (1985) has reported similar less dramatic declines in the number and weight of fish landings for the following species; tarakihi, trevally, rig, rock lobster and scallops, in a number of New Zealand coastal areas. The main reason for the declines is thought to be excessive harvesting pressure as a result of commercial fishing effort.

Concern has also been expressed by Gardner (1982) about the damaging effect that some fishing methods, notably bottom trawling, is having on the important seafloor habitat, due to physical disruption. Recreational fishing and especially collection of tohoroa and rock lobster has also been reported to have caused a decline in some of these fish stocks.

(A) THE IMPACT OF FISHING ON THE MARINE ENVIRONMENT

The affect on all marine species as a result of recreational and commercial harvesting would appear to be significant. This preceeding statement is supported by a number of long term species diversity and stock size studies undertaken in our coastal waters. A consistent and dramatic decline in species diversity and stock number of both commercial and non commercial species was demonstrated in regards to species entering a coastal estuary in the Marlborough Sounds between 1971 and 1978 (Struik and Bray 1979). A long term coastal travel survey in the Bay of Plenty has also shown similar results. Struik (1983) states that;

> So many coastal fisheries in New Zealand have been overfished that most if not all food chains have been altered and are currently out of balance, and there is little evidence of other species filling the gap left by overexploited species.

According to Larkin (1977) and Reigier and Cowell (1972) in a mixed species fishery significant fishing effort results in:

(1) a reduction in the stability of aquatic ecosystems by affecting food chains and predator prey relationships;

(2) elimination or reduction in either longer lived and less fertile species and the older age classes of a marine fish species; and,

(3) replacement of less fecund species by short lived more fertile opportunist species.

Where there is overexploitation of fish stocks, these problems are compounded by reduction in stocks of even the more fertile opportunistic fish species.

(B) MANAGEMENT CONSIDERATIONS

Currently M.A.F. is trying to redress the problem of overexploitation of some commercial fish resources by a programme of policy, legislative and regulation reform that has resulted in a restructuring of the fishing industry. Changes include;

(1) vesting of ownership of fish stocks in the Crown and,

(2) the limiting of fishing operators and catch restrictions for commercial fish species stocks, by the issuing of 'Individual Transferable Quota's' (I.T.Q's.).

(I.T.Q's. refer to the granting of rights to take a set weight annually of a fish species for which quota is held). The set weight of fish allocated for harvesting from each species depends upon the 'Total Allowable Catch' (T.A.C.) for that species. The T.A.C. is set by M.A.F., with regard to whether the fish stock is large enough so that it can sustain over the long term present levels of fishing effort; or whether the fish stock has been under- or over-exploited, and fishing efforts need to be increased or reduced so that the stock will reach a desired sustainable level.

Even if these amendments lead to the sustained harvesting of stocks, of some fish species, commercial and recreational fishing is still likely to profoundly influence the characteristic of marine ecosystems because it is going to select against less productive species by a process of artifical selection, according to Reigier and Cowell (1972).

Larkin (1977) reports that even in regards to harvesting of a single species at a sustainable level, fishing can affect the characteristic of that species. Most populations of a fish species show genetic variability, with local subpopulations being adapted to their local environment. Some subpopulations are likely to be less productive and hence are likely to be depressed or elimated at the expences of other subpopulations, by artifial selection pressure of fishing effort, even when the total population of that species is not reduced. The result is loss of interspecies genetic diversity.

Because of these factors M.P.A. designation would compliment other fisheries management strategies to protect fish stocks by counteracting the reduction in systems stability, changes in species composition and loss of intra and inter species genetic diversity resulting from fishing pressure.

3.2.2 Harvesting of Sea Weed

As well as the harvesting of marine animals there is increasing interest in the harvesting of some species of marine plants. The main interest at present is in the harvesting of sea weed species such as bull kelp. These species are harvested to provide the raw material for such diverse products as ice cream, nitrogen fertilizer, soft drinks, comestics, paint, medicine, beer, leather tanning products, and agar for the growing of bacteria and fungi cultures. This industry in New Zealand is comparitively small but if harvesting of sea weeds took place on a large scale the affect on the marine environment could be quite significant at a local level. This is because sea weeds play an important role:

(1) in coastal primary production and have foundation status in many coastal food chains (as discussed in chapter two section 2.7.6.);

(2) as a structural habitat and protective cover for many other species;

(3) in stabilizing sand and gravel movements on the local sea floor environment; and,

(4) by acting as a baffle to dissipate wave energy and therebye providing a natural source of coastal erosion protection (Water and Soil Conservation Authority (N.W.A.S.C.A.) 1983).

MANAGEMENT CONSIDERATIONS

Harvesting of seaweeds should be managed so that this resource is not exploited to the detriment of the coastal system and human use of this system.

3.3 PHYSICAL MODIFICATIONS

Chapter two indicated the importance of much of the coastal ecotone (transition zone between land and sea), in relation to the marine environment because of;

(1) the diversity of species found there,

(2) the critical role some coastal areas, such as wetlands, play in marine system production, and

(3) the important role for reproduction etc. that coastal areas play in the life history of many marine organisms.

3.3.1 Coastal Wetlands

Some areas of the coastal zone are of even greater significance for production and reproduction. These are the coastal wetlands including coastal swamps, estuaries, harbours, inlets and fjords. Internationally Mann (1982) describes such areas as having much greater importance for the total marine system, than would be expected given the small percentage of total area they occupy.

The last two hundred years in New Zealands history has seen many of these coastal wetlands irreversible changed in some way, as in the following examples:

(1) Many of New Zealands relatively shallow coastal estuaries, swamps and inlets have been either drained or infilled to provide land for agricultural, industrial, commercial and urban development; or for roading and airport development , such as around Wellington and Auckland. This has totally destroyed the important role that these areas played in the marine environment.

(2) Some inlets have been used as rubbish dumps and hence have become filled and polluted.

(3) Still others, such as the Moutere Inlet, have had their inlet closed and then have been converted into freshwater reservoirs for urban drinking water or irrigation.

(4) Many estuaries have had their sea water inlet size artificially changed and their catchment area modified by human influence, with a result that estuary characterics such as salinity and temperature distribution patterns, sedimentation and current circulation patterns, total tidal volume and other parameters have been drastically altered.

(5) Some inlets and estuaries have been dredged, so that instead of having a relatively flat gently sloping floor they have been deepened to provide for sea lanes and to improve natural harbours for shipping.

(6) At Lake Grassmere the estuarine lake has been isolated from the sea and has been developed as a site for salt reclamation and salmon farming.

There are also proposals to develop other shallow wetlands for types of mariculture such as (marron) prawn farms.

A National Water and Soil Conservation Authory (N.W.A.S.C.A.) study (1983) estimates that as a result of the changes mentioned above, New Zealand has less than ten percent of the total number of coastal wetlands, that were recorded at the time of european colonisation, still remaining. According to Knox (1980), of the remaining ten percent,one in ten is either moderately or grossly polluted. There are also regional trends apparent, with fewer coastal wetlands remaining in the North Island in comparison to the South Island.

The N.W.A.S.C.A. study states "it is generally accepted that, in New Zealand, coastal wetland systems such as estuaries, inlets, coastal lagoons, mangrove swamps and shallow harbours are seriously reduced in both quantity and natural quality and are in fact an endangered habitat type".

MANAGEMENT CONSIDERATIONS

Due to the extensive loss of coastal wetlands, and their importance as habitats and critical sites for production and species reproduction, it is highly likely that coastal wetland decline has had a major impact on New Zealand's marine environment. In New Zealand there is la ack of empirical evidence to prove such a link between decline in coastal wetlands and species productivity and divisity. However studies overseas by Odum (1970) show a very strong correlation between loss of coastal mangroves and estuaries and decline in coastal fish stocks off the coast of California.

The preceeding discussion would point to the remaining coastal wetlands being an important and endangered natural habitat, that require preservation by statutory protection to maintain their critical role in the marine system for many marine and coastal species. Protection of many of these areas in a M.P.A.programme would seem appropiate.

3.3.2 Coastal Protection Works

Modification of the coastal foreshore by erection of erosion control structures such as groins, jetties, seawalls, bulkheads, revetments, breakwaters; beach renourishment by sediment dumping, and other activities such as beach sand mining, can drastically change the local sedimentations patterns in the coastal marine system. These activities can either encourage erosion or accretion of sediment, both on and off shore and down current by modifying local wave activity and sediment supply. As a result the local coastal marine habitat can be extensively changed by, for example, the changing of a hard rocky shore into a soft shore environment and visa versa. This significantly affects the local community structure.

MANAGEMENT CONSIDERATIONS

Most New Zealand empirical studies into coastal protection works focus on the physical aspects of the project and ignore the likely biological impact of such activity. For example most studies are limited to the physical and economic impact that such activity has on local erosion and accretion patterns. Not withstanding this, careful study of the likely affects of such activities are desirable where they are likely to imfringe on important marine habitats, especially those habitats deemed worthy of protection.

3.4 CONCLUSIONS

In the coastal waters around New Zealand the combined impact of pollution, harvesting and coastal modification appears to be causing significant changes in species diversity and abundance in some areas. Rapport et al. (1985) would describe the likely changes in marine community structure as 'retrogression'. 'Retrogression' refers to a shift in species composition towards often introduced marine species better adapted to harsher environmental pressures (such as pollution and fishing), and away from native and rarer species, or fish less well adapted to a harsher regime. In very badly affected areas such as grossly polluted sites marine communities are likely to become simplier and less stable, with fewer species and greater population fluctuation.

Chapter Four will examine the implication of and benefits from reversing such changes for society.

CHAPTER FOUR

THE RATIONAL FOR PROTECTION OF MARINE NATURAL AREAS

SUMMARY

Chapter one introduces New Zealands marine environment as both a natural habitat and a natural complex.

Chapter Two outlines the unique features and characteristics of this environment, with specific regard to management, including the potential application of a Marine Protected Areas (M.P.As.) programme. A description of New Zealand's marine species and habitat is also provided.

Chapter Three examines the conflict between species and habitats maintenance; and marine system pollution, harvesting of marine species, and physical modification of the coastal zone). Chapter Three concludes that these activities have a significant detrimental impact on marine and coastal species diversity and habitats at a local and perhaps even a regional scale.

This Chapter examines the rational of a management strategy for conserving and perhaps preserving some of New Zealand's marine habitats and species. The rational will be presented in terms of:

(A) An expressed desire for marine conservation within protected areas; and,

(B) The beneftis and costs of a Marine Protected Areas programme.

This chapter concludes that:

(1) Conservation and preservation of New Zealands habitats and species under a protected area programme is increasingly being recognised, at least on land, as a legitirmate social aim.

(2) Marine habitats and species are substantially under represented in comparison to conservation of terrestrial habitats and species.

(3) Conservation and Preservation of important components of New Zealand's marine environment within a Marine Protected Areas (M.P.A) programme will have a number of actual and potential benefits that include:

A) sustainable utilization of harvestable marine resources;

B) preservation of marine genetic diversity;

C) provision of research opportunities for science and management;

D) provision of recreational and tourism activities; and,

E) provision of non-use benefits.

(4) Actual and Potential Costs incurred by a M.P.A. programme relate to:

A) applying harvesting restrictions and controls in protected areas;

B) applying controls on significant marine pollution affecting protected areas;

C) applying controls of significant physical modification of the coastal zone affecting protected areas; and,

D) Costs incurred in setting up, enforcing and administering a M.P.A programme.

(5) The extent of costs will be in relation to the scale and type of protection deemed appropriate.

(6) Many of the costs and benefits of marine conservation are both difficult to compare or alternatively are unknown. Decision making in relation to site selection based solely on cost/benefit analysis is therefore unlikely to be appropriate.An approach to maximise the achievable benefits of a marine protection, while at the same time trying to minimise the costs would seem to be more valid.

4.0 THE DESIRE FOR MARINE CONSERVATION

Introduction

Increasingly there appears to be a belief both here and overseas, among those involved in either the use, study and management of the marine environment, that the benefits of implimenting some kind of M.P.A. programme outweighs the costs incurred from such a programme. These same individuals express the concern that economic and social gains resulting from the use of the 'marine resource complex', are not compensating for the damage that such types of use is having on the marine environment.

Since the late 1960's private and government groups and agencies in New Zealand including; the Fisheries Division of the Ministry of Agricultural and Fisheries (MAF), the Marine Division of the Ministry of Transport (M.O.T.), the Zoology department of Auckland University, Parks and Reserves Division of the Lands and Survey Department, the Wildlife Division of Internal Affairs, Commission for the Environment, Royal Forest and Bird Society, Environmental Defense Society and numerous other environmental and recreational groups have all advocated or been directly involved in the setting up of a M.P.A. programme for marine conservation.

Bjorklund (1974) reports that internationally there has been increasingly vocal calls for marine conservation involving a M.P.A program. Major conferences where this position has been strongly advocated include; all world conferences on National Parks from 1962 onwards, the Eleventh Pacific Science Congress (Japan 1962), the Regional Symposium on Conservation (New Caledonia 1971) the 'U.N. Conference on the Human Environment (Stockholm 1972) and the International Conference on Marine Parks and Reserves (Japan 1975).

The protection of marine natural habitats can still be considered somewhat of a new phenomena however in comparison to protection of land based natural habitats. As land based habitats have until recently been the primary focus of 'protected natural area' (P.N.A.) programmes they will be considered first to give a background perspective to M.P.A. programmes.

4.1 THE PROTECTION OF LAND BASED NATURAL HABITATS

On land the practise of setting aside areas, for conservation or preservation in their natural state, has a long history stretching over 2000 years. Talbot (1982) reports that protected native forest areas were established in India before the time of Christ. The national park concept is itself over 115 years old with the creation of Yellow Stone National Park in the United States of America in 1872. The first national park in New Zealand, Tongariro National Park, is itself over 100 years old, and subsequently this country has developed an extensive system of 1500 separate Government administered terrestial parks and reserves. This system of land based protected areas covers four and half million hectare or sixteen percent of New Zealand's total land area.

Dingwell (1982) reports that the initial Government and public desire for the setting aside of natural areas within parks and reserves was motivated by mainly aesthetic considerations. Such considerations include the desire to preserve as a national asset unique natural landscapes, natural curiousities and scenery. In more recent years the New Zealand parks and reserves programme has focussed on the protection of a diverse range of natural habitats and native species including both endangered and abundant native species and habitats.

The Reserves Act, 1977, provides the clearest legislative expression of intent in regards to the establishment of a 'protected areas' programme in New Zealand. This statute expresses as one of its principle purposes the use of a 'natural protected area' programme to ensure as far as possible ;

> 'the survival of all indigenous species of flora and fauna, both rare and common, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems and landscapes, which in the aggregate gave New Zealand its own recognizable character'.

A fuller discussion of the rational for such protection, can be found by reference to Molloy and Wilson (1986) and Gun and Edmonds (1986) in 'Environmental Ethics: A New Zealand Contribution' edited by (John Howell).

On land at least these appears to be implicit acceptance that the ecological, cultural, recreational, aesthetic, scientific and educational value of protected natural areas outweighs any cost of their protection.

4.2 THE PROTECTION OF MARINE BASED NATURAL HABITATS

New Zealand is often described as being in the conservation forefront however this is inacurate in regards to marine resources. New Zealand Government and its agencies have been very slow to impliment a Marine Protected Areas (M.P.A) programme. Overseas Bjorklund (1974) reports that the first marine reserve was set up over seventy years ago and by 1970 64 countries had implimented some form of M.P.A.. In New Zealand it was not until 1971, with the passing of the Marine Reserves Act (1971), that any areas of the marine environment could be set aside in protected areas. The first marine reserve did not come into existence until four years later in 1975, with the gazetting of theCape Rodney to Okakari Point Marine Reserve.

At the time of publication only one further marine reserve has been created with the gazetting of the Poor Knight Islands Marine Reserve although planning is well advanced on the setting up of a number of new marine reserves including the proposed Sugar Loaf Island Marine Reserve near New Plymouth.

In addition two further marine areas adjacent to the *Mimiwhangata* and *Tawhawanui* penisula have protected status, similar to that of a marine reserve designation. Protection in these areas has been granted by use of the Harbours Act (1950) and Fisheries Act (1983) however this is on a short term basis only. New Zealand also has a number of maritime parks, but protection of natural habitats within these areas is still limited to above the coastal mean high water mark (M.H.W.M.) so that maritime park status does not constitutent a M.P.A .

The result is that only a minute fraction of New Zealand's marine habitats are protected within a Marine Protected Area programme, even when only the relatively small area of sea over the continental shelf is considered. The allocation of marine habitats, as part of New Zealand's natural environment, to a 'protected areas' programme (including parks and reserves), is also insignificant in comparison to the allocation of natural habitats on land. A possible implication of this is that there are fewer benefits and more costs associated with a M.P.A. programme when compared with a land based programme.

The next section will to some extent examine the validity of this view by assessing the likely benefits and costs of a Marine Protected Areas (M.P.A.) programme.

4.3 BENEFITS OF A M.P.A. PROGRAMME

The benefits of a Marine Protected Area program (M.P.A program) can be discussed under four major headings as follows:

1) maintenance of marine harvestable resources;
2) preservation of marine genetic diversity;
3) research and management of marine resources; and,
4) provision for non-material needs of society.

At this point it should be both noted that the individual benefits of marine protection are very much site related and it is unlikely that all classes of beneftis can be achieved simultaneously as some classes of benefits are mutually exclusive.

4.3.1 Benefits of Maintaining Harvestable Resources

(A) Critical Areas

Critical coastal and marine habitats (such as mangroves, estuaries, salt marshes, mudflats, reefs and kelp forests) of vital importance to marine systems have been identified by Odum (1971, 1978, 1984), Ray (1975), Mann (1975) and Lear and Turner (1977). These areas provide critical sites of primary production, reproduction and recruitment, which has a disproportionately large flow on effect into the coastal environment.

Odum (1984) states that "the protection of the identified critical coastal habitats from damage or reduction in size, would be important in ensuring population stability of marine species for harvesting. It would also assist in the long term maintenance of harvesting of commerical and recreational species, by maintaining species recruitment and production".

The extent of harvesting benefits occuring from protection of critical habitats within M.P.A's.depends on the recognition of what are appropriate habitats, and understanding the ecology of such sites so that relevant controls to protect these habitats can be implemented. It also depends on proper management of the harvestable resource as a whole, for example, by placing limits on harvesting of fishery stocks at a sustainable level.

Sustainable utilisation of marine resources is clearly recognised overseas as a benefit of a M.P.A. programme. In Indonesia, for example, two of the principle aims of marine protected areas is to protect productive habitat and to aid in the replenishment of harvestable fish stocks (Soegiorto et al. 1984).

(B) Non Critical Areas

Where a marine area is not critical to species production and recruitment there may still be advantages in M.P.A. status in regards to harvesting in adjacent areas. Mac Diarmid (1986) unpublished) and McCormick (1986) reported a significant increase in the abundance and size of shellfish and fish species found in the Cape Rodney to Okakari Point Marine Reserve in comparison to almost identical habitats outside the reserve. For instance the abundance of the reef fish *Cheilodactylus spectabilis* was found to be three times greater in the reserve, and there were significantly more individuals of this species in the larger size class McCormick (1986). The increase in size and abundance of marine species within reserves is, according to Ritchie (1980), likely to have a spill over effect into adjacent waters due to the radiative movement of many fish species. Other benefits for the sustainable harvesting of marine species can be discussed under section 4.3.2 as follows:

4.3.2 Benefits Of Maintaining Genetic Diversity

Chapter two outlines the marine environment as being genetically both very rich due to the unique morphologies and physiologies found in marine organisms. Significant genetic diversity occurs both across marine species and within a single species across geographical clines of distribution according to Polunin (1983) and Selanders (1976).

Chapter three suggests that some of this rich pool of genetic diversity is under threat. In the New Zealand marine environment loss of intraspecies genetic diversity is likely to be occuring from pollution, coastal modification and harvesting of marine resources. The loss of Interspecies genetic diversity (the more dramatic extinction of whole species) may also be occuring due to extensive modifications of the coastal environment such as reclamation; or the extensive pollution of wetland (known sites of potential endemism).

The benefits of preserving this inter and intra species genetic diversity can be grouped under the three headings of systems stability, mariculture; and the chemical and pharmaceutical industry.

(A) Systems Stability.

Most species dependon the maintenance of a certain amount of genetic diversity (varibility), as this increases their ability to adapt to changing environmental conditions (such as the introduction of new pests, diseases and other environmental stresses). With out genetic variability species cannot evolve successfully to cope with these changes, and hence are succeptable to marked population declines, instability and possibly extinction when faced with such changes. If a keystone species is being effected long term use of the marine resource can be threatened due to possible repercussions on other dependent species.

The necessary genetic information to cope with environmental changes may be quite rare, found only in a small localised species and subpopulation of a species adapted to unique conditions. Where human activity diminishes such genetic information this may have serious future repercussions according to Polunin (1983), even if initially other populations or species are unaffected by human activity.

The need for protection of genetic diversity to help maintain stable marine systems is highlighted by the documented evidence of changes occuring in the marine environment which may need to be adapted to. Changes include enhanced pesticide, heavy metal and hydrocarbon levels in most of the worlds coastal zones and in New Zealand waters, the trial introduction of new and exotic species such as the estuarine marron prawn into some enclosed New Zealand coastal wetlands and the proposal to introduce exotic edible Japanese kelp into some coastal waters.

(B) Mariculture.

Wild stocks of different marine plants and animals have always been the raw material for mariculture (farming of marine species). In New Zealand there recently has been a marked increase of commercial and academic interest in the aquaculture of marine organisms such as sea cage salmon, oysters, scallops, paddle crabs, mussels, rock lobsters, marron prawn, shrimps and agarophytes (agar producing seaweeds).

Riddell (1983) reports that since interest in mariculture is expanding rapidly the value of maintaining wild genetic resources for the improvement of selected strains can also be expected to increase markedly. Wild stocks can be used to provide ovum and sperm material (as many maricultured species are not yet fully domesticated), and they can also be introduced to improve growth rates and disease resistance of domesticated species.

Already Prescott Allen (1984) reports the introduction of new genetic information from wild stocks has increased growth rates in clams and disease resistance in oysters overseas. In New Zealand wild strains of oyster are being investigated in an attempt to introduces resistance (to the oyster parasite) into theFoveaux Strait oyster beds that were affliced in the 1986/87 season.

(C) Importance to the Chemical and Pharmaceutical Industry.

Marine organisms represents a resource of organic and biochemical diversity unmatched in the terrestial environment according to Baker and Murphy (1970). This is attributed, according to Riddell (1983), to the fact that there are more significant differiences in the morphology and physiology of marine organism in comparison to land animals and plants because of the following:

(1) all of the thirty recognised animal 'phyla,' have marine representatives. In addition half these 'phyla' are exclusively marine, and several 'phyla' are predominantly marine In comparison the apparently enormous number of terrestial species belong to only a few major 'classes'(such as insects), of only a few 'phylum'.

(2) many of the classes of marine animals have evolutionary, histories independent from all other 'classes' or even taxonomic 'families', stretching back hundreds of millions of years. In comparison terrestial 'classes' (such as birds, reptiles and mammals) have a much shorter independent evolutionary history.

(3) marine environmental problems and habitats are uniquely different from terrestial problems.

The importance of marine organisms, to the chemical and pharmaceatical industries, for raw materials is not surprising then. The list of major pharmaceutical chemical and industrial products developed from marine organisms is already extensive. Medicine derived or sourced from marine plants and animals are currently used to treat forms of cancer, diabetes, leprosy, viruses, bone disease, arthritis, bacterial infections, parasites and infections; and as pain killers, immunosuppressiants, blood coagulants and anticoagulants; to test for bacterial infections and as research tool into brain function.

Marine organism based products are also used as insecticides and in in the food and textile industries, for example, as adhesives, emulsifiers, stabilisers and food emulsifiers.

These are only a few examples of the many potential uses of marine based products, as Riddell (1983) reports that research world wide into marine biochemistry for useful products is still in its infancy , compared with research into biologically active and useful compounds from terrestial organisms. This is probably because of greater problems of research access to marine organisms and a much shorter history of interest and research in the marine environment.

In New Zealand there have been few studies in this field. Dr Munro and Blunt's (University of Canterbury Chemistry Department) work on the antimicrobial and antivival activity of marine biochemical compounds (found in sponges, ascidians and some other marine organisms), is a notable exception.

The huge potential value of as yet undiscovered compounds derived from marine organisms is a compelling rational for protecting genetic diversity of marine species.

Genetic Diversity Conclusions

Genetic diversity in marine species is potentially extremely valuable in maintaining ecological systems stability for harvesting, assisting mariculture and protecting sources of valuable biochemical compounds.

The present range of genetic diversity is a resource that has taken hundreds of millions years to developed. Once it is reduced, due to short term economic expediancy (such as unnecessary pollution, coastal modification or excessive harvesting of natural resources), it can never be replaced and many of the benefits of high diversity may be lost.

The protection of a range of representative marine habitats and sites known to contain high rates of endemism around New Zealand may be crucial in helping to protect this valuable resource.

4.3.3 Benefits For Research and Management of Marine Resources

This study expresses concern at the ecological damage being done to New Zealand's marine environement. Much of this concern stems from evidence of declines in commercial fish landings, coastal pollution and reclamation, and documented overseas experience of the subsequent affects resulting from marine pollution and reclamation.

The preservation of a range of natural marine habitats free from exploitive interference, would be of great value in guaging the influence that human activity in New Zealand is having on the marine environment. The value of such areas would be in in their role as a biological yardstick, to enable human influences in adjacent waters to be identified and separated out from naturally occuring environmental fluxations within the protected area. Fisheries managers, for example, when setting total allowable catches (T.A.C's) of fish need to know if changes to the fish stock are due to human fishing pressure or other factor, to enable fisheries controls and catch levels to be set appropriately.

The benefits of protected areas to fisheries management, pollution control and other users of the marine environment has already been recognised in a 1985 report by the Ministry of Agriculture and Fisheries.

4.3.4 Benefits for Non material needs of Society.

The coastal / marine environment is important to society because it also helps fulfil more esoteric human needs in addition to the rather more basic material needs (such as food). Marlow (1954) describes in a 'Hiearchy of Needs' how humans strive to meet cognitive and aesthetic needs, once the most basic needs for food, drink, shelter, security and human interactions have been met. These needs according to Marlow (1954) includes the need too know; understand and explore new situations and get involved in challenging new experiences, and to experience grandeur and beauty.

These more esoteric needs are now examined under the broad headings of 'Quest for Knowledge' and 'Recreational and Tourism"

(A) Quest for knowledge

In meeting societies need to know and understand the environment around us, M.P.A. are often considered to be indespensable for understanding the marine environment through research. Pearsall (1984) states that M.P.A.'s are the only valid laboratories where marine ecological studies of population dynamics, species interactions, long term succession, speciation and other natural processes, can realistically be conducted with out the results being invalid due to outside human influence. The setting aside of New Zealands first marine reserve at Leigh for science suggests that protection of marine areas for pure research purposes is already accepted.

Other benefits in terms of appreciation and understanding of the marine environment can arise from using M.P.A's as a educational focus for specific groups and the general public when learning about the marine environement. Education programmes involving marine protected areas could be run in the same way that current interperative programmes are run in conjuction with National Parks and Reserves.

The value of marine protected areas for research, management and education is undoubtedly going to increase in the future as society becomes more dependent on, and interested in, the natural resources of the sea.

(B) Recreation and Tourism.

Recreation in a natural environment is, according to Barker et al (1979) one way in which many of societies nonmaterial needs can be satisfied. Molloy et al. (1986) goes further in suggesting that, for many individuals, the natural environment may be the only source of basic experiences, as these cannot be provided by an urban environment. Molloy et al. relates that the 'Wilderness Experiences', (recreation in an untamed natural environment), provides the needed challenges to survival, offers the excitement of exploration and discovery and can provide a perspective on our place in nature.

Although Molloy et al. (1986) was refering mainly to recreation in the mountains, forests and native bush of New Zealand, a similar 'wilderness experiences' providing exploration, discovery and challenges to survival can be achieved by recreation in the coastal and marine region.

Recreation activities in this environment can be relatively non disruptive (eg. swimming, snorkling, scuba diving, underwater photography, painting, sailing, tidal pool foraging and appreciation of the coastal scenery).

Alternatively some recreational activities have the potential to be more environmentally disruptive and in extreme cases can be incompatible with conservation. Activities such as recreational line, net and spear fishing; shell, shellfish and crayfish collecting, high density boating, speed boating; and beach buggy and trail bike racing on beachs are examples that could fall in this category.

The application of M.P.A. status to marine areas can greatly enhance recreational appeal of many marine and coastal areas for three reasons:

(1) There is higher diversity, abundance and size of marine species found in protected areas compared with comparable unprotected areas according to MacDiamid, (1986) McCormack (1986), Ritchie (1980), M.A.F. (1985) and a number of New Zealand Scuba Diving Associations. Consequently recreational interest to snorklers, swimmers, underwater photographers, tidal pool foragers and scuba divers and others is enhanced.

(2) Some Marine Protected Areas can provide a focus for the provision of recreational amenities and facilities (scuba tank filling stations, boat launching facilities, changing facilities, toilets, ecetera) and this centralisation of facilities helps people more easily enjoy the recreational use of the marine environment.

(3) M.P.A. designation and associated administrative, educational and research activities can focus public attention of the protected area and result in increased interpretive information being proveded about the resource. This in turn can assist the publics use and general enjoyment of marine areas.

There is already ample evidence to back up the increasing recreational importance of M.P.A. generally from New Zealand's two existing marine reserves. A 1984 recreational survey, by the Lands and Survey Department, showed that 14,000 people visited the Cape Rodney to Okakari Point Marine Reserve in a six week period in the 1983/84 summer, 58 percent of whom were scuba divers. The vast majority of these scuba divers reported that they were attracted to the reserve by easy access, and the unique diving conditions provided by the large range and abundance of marine species that could be seen. Similarly the Poor Knights Island Marine Reserve, (always popular with divers), has seen a massive increase in scuba diving activity since its inception, to the point that it is now known among divers, as probably the best scuba diving spot in New Zealand (M.A.F. 1982).

Even at New Zealand's two private 'marine protected areas', at Tawharanui Pensinsula and Mimiwhangata Pensinsular (where protection of the marine environment is less rigerous), recreational activity has enjoyed a major increase since their private designation as coastal parks (Mimiwhangata E.I.R. 1982). At these two sites and at the Poor Knights Island Marine Reserve their is also scope for limited disruptive recreation (such as line and spear fishing for certain species in designated areas of the M.P.A's) along with nondisruptive use.

In New Zealand there is a real trend toward increasing recreational use of the marine environment and this is shown for example by increasing boat sale and diving club membership. This is matched, at least in the western world, by the increasing interest in, and time for recreation in natural areas reported by (Lucas 1984), therefore the provision of some M.P.A's partly to enhance recreational use of the coastal and marine environment would clearly be of benefit to such users.

Internationally some countries have also gained benefits from promoting M.P.A's and their recreational use, as tourist attractions. The promotion of the instance the Great Barrier Reef Marine Park in Australia and coral reef reserves in Indonesia, are two examples.

In New Zealand there is possibly potential for tourist promotion based on M.P.A's as their designation could provide at least regional benefits in some areas such as Northland, by providing an enhanced natural attraction to attract visitors.

When examaining the benefits of recreational use of M.P.A's it should however be remembered that intensive recreation use may be inappropriate in some M.P.A's. Ray (1976) and Lucus (1984) note that the disturbance created by associated amenities on the foreshore and the congregation of large number of people at a M.P.A. may conflict with the major goals and objectives of that individual area, and can result in the other benefits of protection being canceled out. The benefits of recreation therefore should be considered on a case by case basis with regard to other benefits.

(D) Non Use Benefits.

There exists another class of benefits provided by M.P.A's, even when the benefiting individual does not visit or use the resource directly. Pearsall (1984) has called this type of benefit of protected areas 'Inabsentia Benefits'. Such benefits include vicarious benefits arising from some one elses visit, such as enjoying articles, books, films, photography or painting based on a M.P.A.. Another type of vicarious benefit would be 'Bequest Value'. Bequest value, a term coined by Krutilla (1967) refers to the altruistic benefits recieved by an individual on behalf of future generations from knowing that future generations will get the opportunity to enjoy the legacy of a natural protected area.

(E) Cultural and Spiritual Benefits.

M.P.A's can also fulfil a percieved need which is not necessarily a benefit for society as such, but is instead more of a moral position. This moral position promoted by such individuals as Leopold (1949), Passmore (1974) and Graber (1976), is that the conservation and preservation of the natural environment is a moral good (right), because natural systems have intrinsic value independent from their value for human use. This type of position is often culturally or religiously based. Such a position may involve many philosophical problems, not the least of which is the question what is intrinsic value? Does intrinsic value apply at the level of individual organisms, populations, species or infact to the entire biosphere and how do you measure it? (Scott 1986).

For example much of modern society in New Zealand lacks understanding of the natural environment due to the nature of modern society. However despite this many individuals place an intrinic value on nature, shown by the clearly expressed view that endangered marine species (such as the blue whale and yellowed eyed penguin) should be protected from extinction. This is an expressed wish to see species and probably habitats preserved, independent of likely individual benefits.

Another New Zealand example of this type of moral position is the traditional Maori belief that birds, fish, insects and plants and infact some inanimate objects possess 'mana' or a life force essentially similar to human beings. Orbell (1985) relates with regards to the Maori how ,

> 'their closeness to nature and their dependence on it, and their profound knowledge of plants and animals led to the belief in 'tapus', the sacredness of other life forms and the landscape itself'.

This view was expressed in the traditional use of the marine environment by an almost culturally innate sense of conservation, or '<u>ra</u> <u>hui</u>', which involved rules governing fishing season, fishing area, methods and behaviour while fishing.

4.4 THE COSTS OF A M.P.A. PROGRAMME

The preceding sections considers the real and potential benefits of a M.P.A programme. It must be remembered that many of these benefits are site specific and may also only be achieved in either the short or long term. Some classes of benefit may be mutually exclusive at some sites. Some benefits may also depend on an individuals personal values and perceptions, as such they are subjective and difficult to value.

In addition to providing benefits, a M.P.A. programme will produce a number of real and potential costs. Costs incurred from potection will fall into two main categories. The first category include the costs incurred to society and individuals as a result of protection limiting individuals actual or potential ability to use the resource. The second category includes the costs incurred to society as a result of the implimentation, administration and ongoing mangement of a M.P.A. programme.

4.4.1 Costs of Limitation of Use

The costs of limitation of use affect those individuals whose actual or potential use of a M.P.A. is curtailed by protection. The extent of the costs incurred vary greatly (on a site by site basis) depending on; the present and potential use of the site, the site's characteristics, the availability of similar sites, and what level of protection (types of restrictions on use) are deemed appropriate for that site.

Types of restrictions that may be imposed and their cost can be considered under several headings.

(A) <u>Fishing Restrictions.</u>

The protected status of most new M.P.A.'s would almost certainly require placing restrictions on commercial and possibly recreational fishing. The degree of fishing restriction may vary from a total ban in all areas of a M.P.A., to a ban on some methods in part of the area. The degree of restriction deemed appropriate will depend on the objects and goals of the individual M.P.A.. The total cost of protection will also depend on what current and potential future fishing opportunity is curtailed

At present individual fishermen (and perhaps society by paying higher prices for fish), will suffer the major costs of fishing restrictions. Communities based on the fishing industries may also suffer social impacts such as unemployment, social upheaval ecetera as a result of large scale restrictions on fishing, however as an aside this author believes that any social disruption, resulting from M.P.A. fishing restrictions, will be minor in comparison to the disruption resulting from the restructuring that has already gone on in the fishing industry.

If compensation was paid by the Government to fishermen whose present activities were curtailed by a M.P.A. designation, then society as a whole would suffer the costs of curtailment. Compensation, however is not paid at present.

(B) Pollution Controls

At present there is no legal means of enforcing reduction of pollution affecting a M.P.A. to any greater extent than for discharges into the general marine environment. Chapter Three's findings suggest that such controls will be appropriate in M.P.A's.. If this recommendation is adopted, some pollutors will incur costs from having to treat, reduce, relocate or stop pollutant discharges. The pollutors and society as a whole could incur as a result of increased costs of manufacture and community rubbish and effluent treatment.

(C) Physical Modification Restrictions

In the coastal region M.P.A. status may require controls to be placed on coastal works that interfere with the functioning of the M.P.A. Restrictions could relate to reclamation, dredging, opening and closing of inlets and coastal protection works in or adjacent to the M.P.A.

Such restrictions could impose significant costs on land developers and public agencies involved in coastal protection works, and harbour and marina development. The costs of such restrictions are again likely to be incurred both by private individuals and society as a whole.

(D) Access and Recreation Restrictions

In both highly fragile M.P.A.'s and areas where a high level of protection is desirable for research or scientific reasons, the restriction on some or all recreational opportunities and access may be desirable. The resulting loss in current or potential recreational opportunities would represent a cost to any individual directly affected, and possibily to society.

4.4.2 Costs of Implimentation and Administration

There are a number of short and long term costs associated with the implimentation, administration and mangement of a Marine Protected Area (M.P.A.) Programme. If the M.P.A. programme is to meet its goals and objectives, detailed research will be necessary to insure the most appropriate marine areas are selected for protection. Investigation of management regimes to determine desired levels of protection (extent of restrictions) and other management statergies will also be required. Staff may need to be employed to impliment the M.P.A. programme, oversee day to day administration, monitor any affects, enforce possible restrictions, and perhaps to fulfil an educational role by interpreting this environment to the public.

These costs would probably be borne by society unless a strategy of 'user pays' is introduced into the management of protected areas.

4.5 **Conclusion**

From the preceding discussion it is obvious that any form of Marine Protected Area programme will have both significant costs and benefits. In an ideal rational world, the decision-makers would, using 'cost/benefit analysis', (or some other valuation tool) to measure both quantitatively and qualitatively all costs and benefits of alternative strategies of marine conservation, so that they could select a strategy that maximises benefits and at the same minimise the costs.

Unfortunately, this is not an ideal world and despite decision-makers knowing at least qualitatively some of the benefits and costs of a M.P.A. programme, many are extremely difficult if not impossible to value quantitatively. This is because:

(1) Many benefits are only potential benefits, often relying on possible future developments or environmental changes to become real benefits. Examples would be some benefits of maintenance of genetic diversity for systems stability and new product development.

(2) The present value of future benefits will vary greatly depending upon the time frame involved and which 'discount rate' (Randall 1982) is applied. (The rate of discount chosen in turn depending upon the preference that the person who sets the rate places on the desirability of present versus future benefits, and this may also over time.)

(3) The value individuals place on the benefits of marine conservation is difficult to assess because peoples value systems vary greatly.

(4) Even some real present benefits of a M.P.A. program are unlikely to be accurately valued in terms of a common medium such as money, because their valuation is too subjective. For example, how can the spiritual value accorded to the 'realm of Tangaroa' (the sea) or the aesthetic value of the coastal landscape be accurately measured against the dollar value of fish landings. According to Hollick (1980) the very exercise of trying to quantitatively evaluate some costs and benefits by a cost/benefit analysis approach may be by its very nature irrational.

(5) In addition many of the costs and benefits of a M.P.A. programme are site specific to particular areas and relate to unique local conditions. Consequently investigation on a site by site basis using specific guidelines may be the only way that some form of valuation can be achieved.

Given however the ongoing long term nature of many major benfits of marine conservation, such as the maintenance of sustainable harvesting of marine resources, the fulfilling of non-material needs of society, and given the irreplaceability of much of this resource and the likelyhood that its value will increase as natural systems become scarcer, the implimentation of a M.P.A. programme that achieves such benefits would seem in the balance to be worthwhile.

The next chapter develops goals and objectives for a M.P.A. programme and suggests an implimentation approach to maximise the benefits of such a programme.

CHAPTER 5

APPROACHES TO A MARINE PROTECTED AREA PROGRAMME.

SUMMARY

Chapter One introduces New Zealand's coastal/marine environment as both a natural habitat and a natural resource complex.

Chapter Two outlines the unique features and characteristics of New Zealands environment and describes its habitats and species.

Chapter Three examines the conflicts that have arisen because this environment functions as both a natural resource complex and a natural habitat.

Chapter Four presentes a rationale for and the likely benefits and costs of a Marine Protected Area (M.P.A.) programme.

This chapter introduces a goal oriented approach to planning in natural resource management. Appropriate <u>policies, goals objectives and criteria</u> are proposed. They are based on the potential benefits of a M.P.A. programme identified in Chapter Four, the need for such a programme identified in Chapter Three, and the nature of the marine environment identified in Chapter Two.

The study also presents an outline of a M.P.A. programme designed with specific reference to selected goals and objectives. This new approach links criteria for selection of M.P.A. sites directly to the policy of marine conservation and the goals and objectives of a M.P.A. program.

This study then examines how successful the Ministry of Agriculture and Fisheries (M.A.F.) (1985) proposed M.P.A programme is likely to be in achieving marine conservation goals and objectives .

This chapter concludes that:

(1) a goal oriented approach to marine conservation is appropriate if the benefits of such a programme are maximised at minimal costs

(2) there are four goals of marine conservation involving a M.P.A. programme.

They are:

(1) the sustainable utilisation of renewable marine resources; and

(2) the provision for a diversity of human use and activity in the coastal marine region.

(3) the preservation of inter and intra species genetic diversity (to aid in the achievement of goal (1) and (2) and as a legitimate endeavour in its own right); and,

(4) the provision of research opportunities (to aid in the achievement of goals (1), (2) and (3) and as a legitimate endeavour in its own right).

(3) From these four goals eight distinct objectives can be developed.

These objectives include:

(i) the protection of ecologically representative marine habitats, communities and natural processes;

(ii) the protection of localised unique and rare marine species, communities and natural processes;

(iii) the protection of areas critical to rare or important migratory species;

(iv) the maintenance of harvestable marine resources by protection of critical areas for harvest production;

(v) the protection of large natural and scenic coastal/marine area because of their importance to or potential for recreation, tourism and education;

(vi) the protection of solitary natural features of outstanding value for science and education; and,

(vii) the protection of traditional spiritual and or cultural relationships to the marine environment.

(4) These objectives range along a conservation spectrum from total preservation to sustainable development of natural resources.

(5) The M.A.F. programme is limited in that only three categories of M.P.A. are suggested, given the eight distinct objectives that this study has identified.

(6) Categories of M.P.As. within M.A.F.'s proposed programme, appear to be based solely on the level of protection selected. Hence, there is no guidance given in linking an overiding policy with the goals and objectives of each category. This creates difficulties in applying criteria for site selection in each category.

(7) There is no guidance regarding the appropriate weighting of differient classes of criteria for selection of M.P.As. in terms of the different objectives.

(8) Some potentially important criteria for selection of sites are ignored by M.A.F.'s approach.

(9) A goal oriented approach to a M.P.A. programme is likely to be of more benefit to marine conservation than the approach proposed by M.A.F 1985.

5.0 Policy,Goals and Objectives of Marine Conservation

Introduction

The desireability of 'marine conservation' by protection of components of the marine environment has been consistantly developed as the theme in preceeding chapters. This theme can be restated as a natural resource management policy of ***Marine Conservation.*** A '*Policy*' represents a philosophical direction which irelates to a desired end to the 'planning process'. In this case the adopted policy would mean the '*Wise*' or '*Rational*' use of the marine environment in accordance with its function as both a natural habitat and a natural resource complex.

In order to successfully achieve any policy, including one of marine conservation, Young (1965) advocates the need for planning direction provided by clearly formulated '*ends*' statements. Davidoff et al. (1962) developed an '*ends'/means ' a* pproach to ' planning' by defining planning as

> "a *process for determining appropriate future action through a seqence of choices.*

The use of the word '*appropriate*' implies criteria for making judgement concerning prefered states and therefore, as suggested by Young (1965), planning should incorporate a notion of desired '*ends*' to the process. The use of the word '*action*' is a reference to spercifics, so the need arises to relate general '*ends*' and particular '*means*'.

An appropriate approach to planning for marine conservation consequently require development of both '*ends*' and '*means*' statements to provide; both an overview of what '*ends*' are trying to be achieved and clear guidance of '*means*' to those '*ends*'. The development of a planning hiearchy of '*ends*' / '*means*' statements for marine conservation with a '*policy*' of **marine conservation** at the apex and then in sequential tiers 'goals', 'objectives' and 'criteria' would then provide an appropriate approach. Such a theoretical planning hiearchy is shown in figure 5.1.

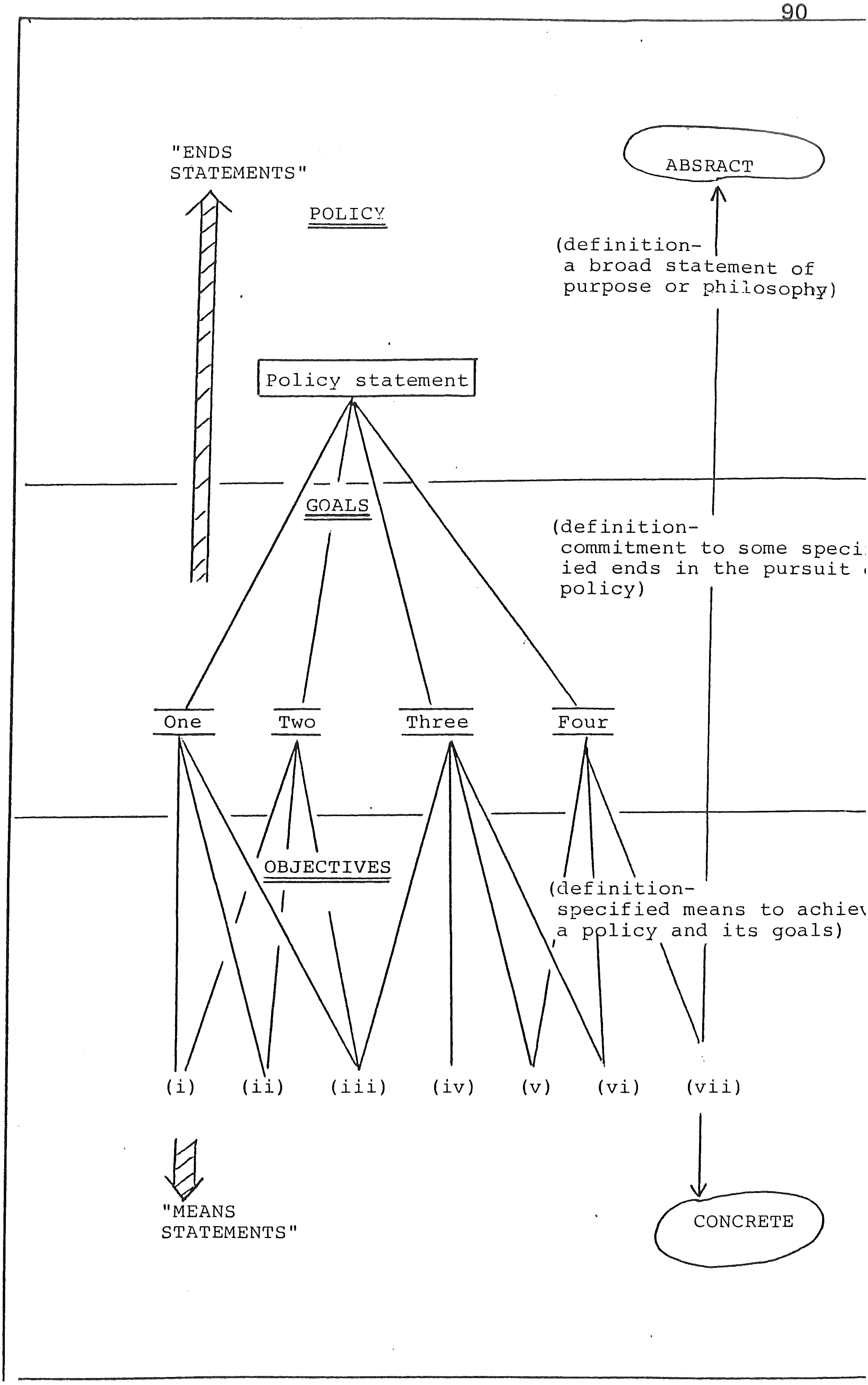

FIGURE 5·1 A PLANNING HIERACHY.

The *'policy'* of **marine conservation**, (a statement of guiding philosophy),has already been presented. What remains is to present goals, objectives and criteria in relation to marine conservation.

5.1 Goals of Marine Conservation

The second tier of '*ends*' statements (as shown in figure 1) are the **'goals'** of marine conservation. (Goals are defined as abstract 'ends' statements that provide a clearer direction than the policy statement towards the desired 'ends' state.

Chapter four introduced a range of potential benefits to society that would arise from a programme of M.P.A's undertaken under a policy of marine conservation. The realisation of these benefits, coupled with a reduction in some of the marine resource use conflicts identified in Chapter three, is considered by this study to be a ligitimate endeavour of natural resource management within a policy of marine conservation. Hence, the goals adopted by this study for marine conservation arising from these benefits are:

(1) Sustainable utilisation of renewable marine resources including both marine flora and fauna.

(2) Provision for a diversity of human use and activity in the coastal/marine area by catering for recreational, cultural, spiritual, educational and other non-material needs of society.

(3) Preservation of inter and intraspecies genetic diversity in the marine environment, to assist in the achievement of goals one and two, and as a legitimate goal of human stewardship of in its own right.

(4) Provision of research opportunities to aid in the achievement of goals one, two and three, and to enable further understanding and knowledge of the Earth's largest inhabited environments.

These goals are compatable with and , (for the purposes of this study), relace the I.U.C.N. goals of marine conservation presented in Chapter one

5.2 **Objectives of a M.P.A. Program**

The third tier of '*ends*'/'*means*' statements (as shown in figure 5.1) are objectives. (Objectives are more clearly defined '*ends*' statements that are fully specified, and obtainable and are adopted as a means to achieving predetermined goals..) The objectives presented here are to some extent developed from the four adopted goals of a M.P.A. programme (and each objective can relate to more than one goal) . They are also loosely based on objectives for all protected areas, developed by the Commission on National Parks and Protected Areas (Bali 1982), but have been redefined in relation to marine conservation.

Objective (I) *To protect ecologically representative examples of marine habitats and communities and to maintain representative natural marine processes in a natural state.*

The fulfilment of this objective would be important in achieving goal (3), the maintenance of genetic diversity (potentially vital for marine systems stability and productivity; and as a legitimate goal in its own right). It would also be important for goal (4), the development of a representative range of natural '*base line*' areas relatively free from human interference, for scientific study, educational purposes and environmental monitoring.

This objective is recognised in M.A.F. 'Proposed National Policy for Marine Resources (1985)' and also by Ray (1976), the I.U.C.N. and the

W.W.F. (1984) This type of objective (in regards to all natural systems) was first included as Major Recommendation Number One at the Second World Conference on National Parks in (1972). For terrestial habitats, communities and processes this objective is recognised under New Zealand law in the Reserves Act 1977.

Objective (II) *To protect unique and rare marine species and communites, and maintain unique and or rare marine natural processes in a natural state.*

The fulfilment of this objective would be important for goal (4), maintaining genetic diversity mainly for its own intrinsic value. It would also be important to the other goals of a M.P.A. program, except goal (1), due to the special interest for science, mangement, recreation and education that rare and unique species and communites often process.

The protection of rare and unique species and communities has been a founding objective of many conservation organisations both in New Zealand and overseas, according to Dingwell (1982) and Talbot (1982). This type of objective is recognised in a number of statutes in New Zealand law including the Reserves Act (1977), Wildlife Act (1953), and the Marine Mammal Protection Act (1979).

Objective (III) *To protect areas critical to biologically, socially or scientifically important rare coastal/marine migratory species.*

The fulfilment of this objective is important for the same reasons as Objective (II) although the approach to protection is likely to be different. Protection here may involve only seasonal protection of critical areas such as seasonal feeding or spawning grounds or migratory pathways, (in comparison to the likely.fulltime protection of an area to achieve Objective II).

This objective has again been adopted by many conservation agencies and is often represented, as in North America, in the form of a sanctuary programme.

Objective (IV) *To maintain production of harvestable marine resources by protection of critical areas of primary production, feeding, breeding, spawning of economically and socially important species*

This objective in association with appropriate controls on harvesting limits, is vital in achieving goal (1) the maintenance of harvestable living resources.

As such this objective is recognised in the New Zealand Conservation Strategy (1981) as high priority. Similarly overseas the IUCN has given this objective high priority, as has Odum (1984) and Ray (1976). It is also been incorporated to some extent into the MAF (1985) proposed policy for Marine Reserves.

Objective (V) *To protect natural and scenic coastal/marine areas of importance for recreation, education, science and tourism.*

The fulfilment of this objective would be important to goal (2), providing for a diversity of human uses, non-material needs and activities in the coastal/marine area, (by focusing attention on an area where the activities can be enjoyed).

As such it has been adopted as an important objective by M.A.F. in their 1985 Marine Reserves Policy proposal. Comparable objectives are to be found in the Reserves Act 1977 and National Parks Act 1980, as well as in the proposed New Zealand Conservation Strategy 1981.

Objective VI *To protect natural marine features of outstanding value for science, tourism and education.*

This objective on a smaller scale would contribute to the attainment of the same goal as objective (V) by protecting discrete unique features of the environment.

The Reserves Act 1977 also allows for comparable protection of terrestial features.

Objective (VII) *To protect traditional cultural relationships of the maori people to the marine environment.*

This objective is important in meeting part of goal (2), in considering the cultural and spiritual needs of indigenous people, as exemplified by the call for protection of traditional Maori fishing grounds under the Treaty of Waitangi.

This objective is recognised by the IUCN Commission on National Parks and Protected Area, for indigenous people, where traditional methods of resource use are practised. There appears to be some recognition of so-called Maori fishing rights in S.88(2) of the Fisheries Act 1983 in so far as these are specifically defined. But there has been few attempts at such definition of such rights until recently. On land the spiritual link of the people with the land has also to some extent been recognised by the Crown through the joint management and long term leasing of part of the Urewara National Park from the Tuhoe people (Lucas 1984).

5.3 Criteria Relevant To M.P.A. Programme

The forth tier of the *'ends'/'means'* planning hiearchy is the development of '*criteria*', that by their judicious application will determine a spercific areas likely contribution, as a 'marine protected area', towards the achievement of the policy, goals and objectives of **marine conservation.**

Criteria discussed here are drawn from the following sources: Clarke and Bell (1984), Cumming (198)4, Raber and Savage (1979), Margules and Usher (1981), Adamus and Glough (1978), Kirkpatrick (1983), Dearden (1978), Van Der Ploeg (1974), Ray (1976), Ray (1984) and MAF (1985).

The relevance of specific criteria in terms of the objectives defined previously is highly variable. This matter will be dealt with more fully in section 5.4 'a proposal for a M.P.A. Programme'. (For a fuller discussion of criteria, refer specifically to Margules and Usher (1981) and Clarke and Bell (1984)).

<u>GROUP 1</u>

<u>BIOLOGICALLY BASED CRITERIA</u>

(A) Ecological Evaluation

(B) Protection Potential Evaluation

<u>GROUP 11</u>

<u>HUMAN USE BASED CRITERIA</u>

(C) Recreation Evaluation

(D) Research Potential Evaluation

(E) Economic/Social Impact Evaluation

(F) Cultural Evaluation

<u>Figure 5.2 Marine Protected Areas: Catergories of Selection Criteria</u>

5.3.1 GROUP I : Biologically Based Criteria.

Biologically based criteria are the evaluative criteria drawn from the sciences such as ecology. They can to some extent be divided into two sub-categories (A) Ecological Evaluation and (B) Protection Potential Evaluation; although both these sub-categories rely to some extent on similar types of inputs and information may often overlap. (Deardin (1978) has adopted Ecological Evaluation and Threshold Evaluation as a similar division of biologically based evaluative criteria).

(A) Ecological Evaluation

This an assessment of an ecosystems or areas qualities per se, independent of human factors, based on the premise that some areas individual ecological attributes are more important or interesting than other areas, regardless of social interest or importance.

Ecological based evaluation of an area can be based on a number of criteria which could include the following:

(1) representativeness of species and or habitat present;

(2) diversity of species and or habitat present;

(3) rarity or scarcity of species present;

(4) uniqueness of habitat or biological community present; and,

(5) criticalness of habitat and or species present to other processes;

(6) the naturalness of the area; and,

(7) the abundance of life in the area.

(B) Protection Potential Evaluation,

This is an assessment proceedure, relates more to clarifying the relationship between nature and human society than reliance on ecological information. This approach assesses ecosystem capacity in terms of resilience to different regimes of human intervention and use; and by this means the appropriateness of applying a range of protection status regimes, (such as differient categories of M.P.As), to different sites can be estimated.. Again this evaluation of an area is based on a number of criteria and these could involve the following:

(1) natural unit Integrity in regards to its size and relationship to adjacent areas;

(2) degree of threat to species, habitat or ecosystems in the area being considered, (as a result of species or system fragility and or proximity to or existance of threat such as pollution, overfishing, physical modification);

(3) stability or persistence of species or habitat despite existing threat;

(4) reproduciability (opportunity to replicate an area elsewhere including possible rejuvenation of existing modified sites back to a relatively natural condition); and,

(5) type Redundancy (because a number of comparable areas, ecosystems or habitats have already been protected).

5.3.2 Group II : Human Use Based Criteria

Another criteria grouping, 'human based criteria' must be considered if conservation goals are to be met. This group of criteria rely on ecological evaluation only in relation to human interest and as such should be considered separately from biological criteria. Group II Criteria are consequently drawn mainly from the social sciences, and reflect human value and practical management and administration considerations. These evaluative criteria can again be divided into sub-categories. They are: (C) Recreational Evaluation, (D) Research Potential Evaluation, (E) Economic and Social Impact Evaluation, (F) Cultural Evaluation.

(C) Recreational Evaluation

This an assessment of the recreational interest value and recreation amenity value of an area. Recreational interest value involves comparing sites according to:

(1) availabilaity of, or potential for, a diversity of recreational opportunities;

(2) a history of recreation use;

(3) type redundancy; and,

(4) interest to recreational users due to some combination of the following (diversity of species or habitat, rarity of species, abundance of life, uniqueness of habitat or area and asthetic appeal of area).

Recreational amenity value assessment involves examining the following:

(5) proximity to recreational users;

(6) potential for or presence of recreational related facilities and including their associated impacts;

(7) accessability; and,

(8) existence of climatic, oceanic and other physiographic and topological feature of an area that would affect the recreational amenity.

(D) Research Potential Evaluation

This assesses the comparative research amenity value of areas from a scientific, educational or systems management related perspective. Assessment of research potential is usually project oriented but again some combination of ecological criteria (rarity, diversity, abundance, criticalness, naturalness, uniqueness and representativeness) are likely to be important. Assessment of research amenity value involves the following:

(1) previous history of research;

(2) existing knowledge and records about an area;

(3) proximity to research agenices and individual;

(4) accessability; and,

(5) existence of climatic, oceanic and other physiographic and topographical features of an area that affect the research amenity.

(E) Economic And Social Impact Evaluation

These proceedures include cost/benefit analysis and social impact assessment.

Cost/benefit analysis of the protection of natural areas is extremely complex due to the wide range of costs and benefits associated with protected status and the difficulty of evaluating these. For these reasons empirical cost benefit analysis traditionally has tended to undervalue the benefits provided by maintaining the environment in a natural state relative to benefits from consumptive use of the resource. For example many of the benefits of protection are nonexclusive (i.e anyone can enjoy access to the coast) and by establishing protected status over such natural environments, the prospect of generating readily identifiable income that reflects the true value of the resource is not good (Randal 1978).

Another limitation of economic impact assessment is the long time frame over which many benefits are realised, such as maintenance of genetic diversity or increase in research knowledge, as this makes it very difficult to attribute a positive value to these benefits. Even if this was possible the application of present discount rates by the market economic approach would result in such values being discounted almost to zero. The application of cost benefit analysis, as an evaluative proceedure, therefore has major limitations in assessing future benefits of a M.P.A. programme.

However short term economic costs of a M.P.A. programme in relation to commercial fishing, land reclamation and pollution control can probably be assessed accurately using this type of approach. This method can possibly also be employed to assess the likely economic returns from increased tourism and recreational uses and the possible increased medium and long term stability in fish supplies due to increased recruitment success and protection of critical sites to production.

Social impact assessment is also of limited use in assessing the costs of a M.P.A. programme because of its narrow focus. In application it is usually restricted to focusing on aspects of particular M.P.As that are likely to have short term social affects. For example :

(1) possible reduction in available fishing areas and the affect that this would have on individuals associated with the fishing industry;

(2) increasing cost of land due to reduction in the availability of areas for reclamation;

(3) effect on employment rates etcetera due to the extra cost incurred in manufacturing and waste disposal due to tighter pollution controls; and,

(4) the increase in recreational use of some coastal areas with subsequent increases in housing costs and possible dislocation of poorer socio/economic groups from that area, etcetera.

(F) Cultural evaluation

This assesses the cultural compatability of types of control with traditional use. Where it is decided to protect area for the maintenance of tradition rights of access and use, criteria such as history of use, existing use and compatability of use with the wider goals of conservation are important.

Conclusion

As the previous pages have shown, there is a wide diversity of criteria that can be applied to selection of sites in a protected areas program. Considered as a whole, the relative importance of each criteria is virtually impossible to assess adequately. Protected natural areas selection procedures in the past therefore have not surprisingly appeared to reflect and respond more to the aspirations of pressure groups and political considerations, rather than be based on sound ecological, social, cultural, recreational and economic assessment.

5.4 A Proposal for A M.P.A. Programme

The differient objectives presented in section 5.2 reflect a range of goals and because of this there is not one but at least two recognizeable value positions embodied in the range of objectives. The first of these value positions is what could be called the preservationist subset of conservation (refer back to the definition of preservation in chapter one). The second value position is the 'human use' subset of conservation. These two positions are not necessarily distinct and instead can be thought of as forming a conservation spectrum from biological preservation at one end of the spectrum, through to human use at the other. (See figure 5.3).

OBJECTIVES

(I), (ii), (iii), (iv), (v), (vi), (vii),

BIOLOGICAL PRESERVATION < (CONSERVATION SPECTRUM) > **HUMAN USE**

Figure 5.3 THE CONSERVATION SPECTRUM

Each objective can be considered at least quanlitatively in terms of this spectrum because each has a differient balance between these two value positions ,(refer figure 5.3). For instance objective (i) 'the protection of ecologically representative habitats', is much more concerned with preservation in comparison to human use, than is objective (iv) 'the maintenance of production of harvestable marine resources' . Because each objective embodies a marginally different conservation focus they can be considered as distinct for the purposes of management. This reflects the fulfillment of each objective requiring subtle differiences in pursuing the policy and goals of marine conservation.

It would seem appropriate therefore that separate catergories of protected areas are developed in accordance with the distinct objectives. This is a similar approach to the one adopted under the Reserves Act 1980 in which there is a range of catergories of protected area based on distinct objectives. This approach is however fundamentally different to the Auckland Marine Reserves proposal (1985) suggested by M.A.F..

Because this study recognises seven distinct objectives, they would translate into seven catergories of marine protected area. If the number of distinct objectives of marine conservation were increased then it would be appropriate for a corresponding increase in the number of M.P.A. categories, and visa versa. The title selected for each catergory is to some extent based on the International Union For The Conservation Of Nature's (IUCN) 1983 'Protected Areas' nomenclature although they have been modified for application to marine areas. The seven catergories and their associated objectives are:

(I) SCIENTIFIC MARINE RESERVE

Objective - *To protect ecologically representative examples of marine habitats and communities and to maintain representative natural marine processes in a natural state.*

(II) MARINE PROTECTION RESERVE

Objective - *To protect unique and rare marine species and communites, and maintain unique and or rare marine natural processes in a natural state.*

(III) MARINE LIFE SANCTUARY

Objective - *To protect areas critical to biologically socially or scientifically Important rare coastal/marine migratory species.*

(IV) MARINE CONSERVATION RESERVE

Objective - *To maintain production of harvestable marine resources by protection of critical areas of primary production, feeding, breeding, spawning of economically and socially important species*

(V) MARITIME PARK

Objective - *To protect natural and scenic coastal/marine areas of importance for recreation, education, science and tourism.*

(VI) NATURAL LANDMARK RESERVE

Objective - *To protect Natural marine Features of outstanding value for Science, Tourism and Education.*

(VII) INDIGINOUS RESERVE

Objective - *To protect traditional cultural relationships of the Maori people to the marine environment.*

5.4.1 M.P.A. Site Selection

Because each category of the M.P.A. programme is linked to a distinct objective, the process of selecting and ranking marine areas within each separate categories can be clearly focused towards the relevant objective. Evaluative criteria for ranking possible marine sites can therefore inturn be restricted, in the intial stages, to only those criteria relevant to the primary objective. This would have the effect of rationalizing the application of criteria. Instead of considering all the possible criteria presented in section 5.3, which would be expensive, time consuming and confusing, only a few criteria need be considered for each category of M.P.A. under this approach.

This approach can be considered as a hierarchical approach to the

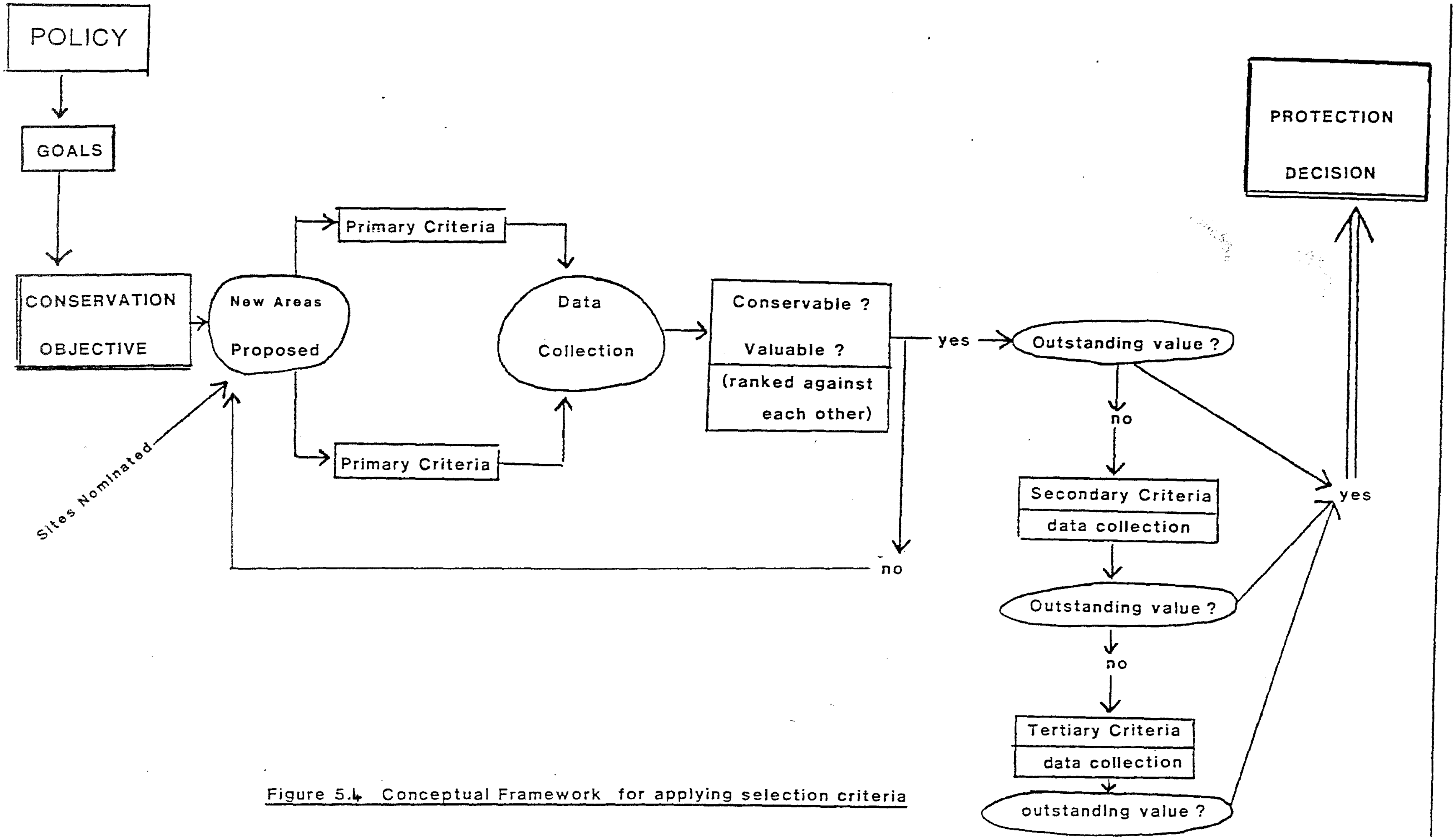

Figure 5.4 Conceptual Framework for applying selection criteria

application of selection criteria in the ranking of sites. There is a need to rank possible marine sites, in regards to each objective, because political pressure against marine conservation is likely to mean that not all potential sites can be included in a M.P.A. programme.

How this approach may work is outlined with reference to figure 5.4. : For example:

(1) A particular objective of a M.P.A programme is adopted based on already developed 'Policy' and its Goals. As an example, the objective adopted for the 'Scientific Marine Reserves' category of M.P.A. is -
To protect ecologically representative examples of marine habitats and communities and to maintain representative natural marine processes in a natural state.

This objective may need further definition by reference to other Government Policy or identified management needs. For example there may be a percieved need or desire to protect as representative 1%, 5%, 10% or even 20% of the coastal seas.

The objective may also need definition by reference to its overiding goals. In the case of a Scientific Marine Reserve, its overiding goals are ; Goal 3 - the preservation of inter and intra-species genetic diversity, Goal 4 - the provision for research opportunities.

(2) Once an objective has been fully defined in this way the appropriate primary selection criteria ,(refer section 5.3), to achieve it can then be specified. With this category of M.P.A. the appropriate selection criteria would be the Biologally based criteria; group I (A) (1) 'representativeness of habitat' (on either a national, regional or perhaps even a district scale); group I (B) (5) 'extent of type redundancy', (for a discussion of

what are appropiate levels of protected area redundancy, refer Cumming 1984); group I (B) (2) 'degree of threat' and group I (B) (3) 'stability or persistance',

Under the Scientific Marine Reserve category of M.P.A. one class of 'human use' based criteria should perhap also be considered as one of the primary criteria. This class is the group II (D) criteria assessing the 'research amenity' and 'research potential' of possible Scientific Marine Reserves. This class of criteria is relevant because the reserves objective has been linked to Goal 4. Since a high rating based on these criteria would provide the most valuable areas in terms of the primary objective of a category (I) M.P.A. this comparatively small group of criteria would make up the Primary Criteria in figure 5.4

In addition one of the primary criteria to consider in the selection of any protected area should be does the area need protection in the first place. This may be because of the ability of the proposed site to fulfil the specified objective of a marine protected areas programme without legislative protection?. In some cases legislative protection may not be needed under the M.P.A. programme, if the site is under no present or likely future threat from disturbance, or if the ecosystem at a site has a very high ability to withstand threats with little affect.

(3) Where the data collection, arising from the use of these primary criteria, indicates that one (or several) of the nominated marine areas would be of outstanding value in achieving the predetermined objective if protected, then the area shoud be protected, under the appropriate catergory, in preference to less well endowed sites. The reason why the opportunty costs are not considered in this particular circumstance is because the benefits of protecting the most highly ranked sites are assumed to be greater than any

likely costs. (This may or may not be an unreal assumption, difficult to prove or disprove because of the valuation problems mentioned in chapter four).

(4) Where a site has no clear advantage, in regards to the primary criteria evaluation, reference should then be made to secondary criteria data collection and evaluation so that the most appropriate areas are selected. Secondary criteria could justifiable include the group II (E) 'economic and social impact analysis criteria so that, where there is a choice, areas that disadvantage the fewest fishermen for example should be selected. Group II 'recreation evaluation' criteria would however be unlikely to be appropriate as a valuation criteria in this case as there is no substantial link between a recreational objective and the goals and objective of a category (I) M.P.A..

(5) The process of examination of the most likely sites should be repeated until a predetermined target is reached. In the case of the category (I) M.P.A the target might be to protect an equavalent area or percentage of total area of representative marine habitat over New zealands continental shelf in comparison to habitat already protected on land. This would mean protecting over 10% of the continental shelf. There may also be some regional or district represational targets.

The same type of procedure outlined in the conceptual framework (figure 5.4) for streamlining the application of site selection proceedure can be repeated for each category of Marine Protected Area (M.P.A.). Because each category's objective is differient however the criteria applied and the targets set will be likely to be differient.

In the case for example of category (II) , 'Marine Conservation Reserve', the relevant criteria would relate mainly to the biologically based criteria such as: Group I (A) - (3), (4), (6) & (7); and Group I (B) (1), (2), (3) &

(5); and possible to a limited extent Group I (D) criteria, as the primary aim is basically a preservationist one to protect rare species and habitats. For this category of M.P.A. the target would be substantially differient to the previous category. Instead of setting predetermined area targets the target instead may be the protection of all marine areas shown to have value in the conservation of rare species and rare habitats.

The outline above provides two examples of how the goal oriented approach, based on linking selection criteria with specific objectives can be implimented so that criteria can be selected from the list presented in section 5.3 that are appropriate to each individual category of M.P.A. and its objective and goals.

The appoach proposed by the Ministry of Agriculture and Fisheries in 1985 for a M.P.A. programme will now be examined in light of this studies goal oriented M.P.A. approach outlined above.

5.5 M.A.Fs Proposal For A M.P.A. Programme

In May 1985 the Ministry of Agriculture and Fisheries, Auckland Region, released a proposal for a Marine Protected Areas Program (M.P.A.) in conjuction with a proposed Auckland Regional Marine Reserves Plan (M.A.F. 1985). The plan containes two major policy statements for marine conservation :

1) to protect and maintain the quality of marine habitat and the biological health of marine ecosystems at the highest level possible, consistant with the need to manage marine resources for a wide range of uses.

2) to establish a network of marine reserves and parks around New Zealands waters to conserve and protect the widest possible range of

marine life forms, habitats and ecosystems ranging from the exceptional or endangered to the typical and representative.

The plan also outlines seven classes of benefit that could arise from such a programme and presente three broad categories of M.P.A.'s: 'Marine Parks', 'Marine Reserves' and 'Marine Habitat Reserves'. These catergories relate principally to the level or type of protection being proposed for an area rather than any reason or likely benefits from establishing the reserve.

Priority for site selection is based on the assessment, using a limited number of criteria, that an area is of 'high profile' or is 'representative'. The criteria for establishment an area as 'high profile' is given as location, abundance and or diversity of species, importance for recreation or other compatiable activities, or because it has unusual or unique features. There are no criteria specified for establishing area an as 'representative' (The likely presumption appears to be that a range of high profile reserves will fulfil this function). Other criteria mentioned that may be important for site selection include; degree of threat, physical and biological attributes of the area; and the likely impact that reserve status would have on other user groups and the adjacent land and marine environment.

5.5.1 Deficiencies In The M.A.F. Approach.

Although the two policy statements presented in the M.A.F. Plan are consistent with the philosophy of the Reserves Act 1980, the I.U.C.N.'Proposal For A New Zealand Conservation Stratergy ' (1981) and with the general policies and goals presented in this chapter, they are not defined in greater depth elsewhere in the plan by a hierarchy of ends and means statements. They therefore provide little effective guidance for the subsequent implimenation and achievement of goals. They are also statements of what should be done, not why it should be done.

The benefits of a M.P.A. programme listed by M.A.F. are compatable to those presented in chapter four. M.A.Fs. plan however fails either to; identify and link supposed benefits of a M.P.A. programme to the objectives they are aiming for, or to differientiate adequetly between types of reserves and their likely benefits. Consequently there is little, if any ,insight as to how these often conflicting benefits can be targeted for by the use of appropriate criteria when selecting M.P.A. sites.

M.A.F. s three proposed categories of Marine Protected Area are useful in that they designate clearly the likely extent of protection to be given at any given site. However they provide little guidance in relation to what weighting should be given to selection criteria, as criteria are not spercifically linked to a hiearchy of goals and objectives. Hence selection proceedures at each site are likely to involve the consideration of most if not all criteria right across the spectrum of marine conservation. The criteria themselves are drawn from a whole range of areas including the biological sciences and the humanities, yet they are all lumped in together, and no real attempt is made to differientiate between criteria.

The plan is also misguided in suggesting that the protection of high profile reserves will result in a representative system of marine areas as this will overlook some less high profile areas (for example areas of naturally lower diversity such as soft shores) that are still of importance in a representative system of reserves.

In essence the M.A.F proposal fails to provide a logical progression from the policy of Marine 'Conservation' to its goals, objectives, categories and evaluative criteria, for a Marine Protected Areas programme so that chosen New Zealand marine protected areas reflect the broad range of purposes or rational behind such protection.

5.6 CONCLUSION

This study identifies the major conflicts occurring in the marine environment around New Zealand some of the potential and actual benefits of reducing the conflicts by implimenting a Marine Protected Area programme as part of a policy of 'Marine Conservation'.

This study also outlined an approach to a Marine Protected Area Programme that provides a conceptual and practical framework for 'planning', so that this component of Marine Conservation is likely to achieve its desired conservation 'Ends'.

However the approach is presented as a preliminary step in planning for a Marine Protected Area programme in New Zealand. What is needed now is a more detailed examination of what are the appropriate policy, goals, objectives, categories and criteria of a Marine Protected Areas Programme to achieve the maximum benefits of such a programme while keeping costs as low as practicable.

The Ministry of Agricultures and Fisheries proposed approach fails, in the authors opinion, to address this central issue. It is the authors hope that other resource management agencies (such as the newly formed Department Of Conservation) can take the lead in the field of marine conservation so that more appropriate M.P.A. programme can be developed that takes account of the many complex issues addressed in this study.

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