VALUING COASTAL DUNES: A CASE STUDY OF THE MANAWATU PARABOLIC DUNEFIELD

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Abstract

Conservation areas are a public good which society derives a wide range of benefits from. Because conservation lands are public goods, they are normally provided for by the Government. The Department of Conservation is charged with the preservation and protection of all representative examples of the environment, to ensure the preservation of New Zealand's 'natural character'.

The Department of Conservation, contemplating providing conservation land, must consider whether or not the conservation potential of the land is greater than the productivity of the land. When dealing with the environment, values associated with any landscapes cannot be observed in commercial markets.

This research attempts to provide decision-makers with a way to value the potential for an area of conservation. To achieve this a Contingent Valuation Method Survey was used in the form of personal surveys to an affected farming population. These surveys were conducted to gain the willingness to pay, and the willingness to accept compensation for an area of conservation. The research also attempts to determine whether or not the current conservation estate administered by the Department of Conservation is representative of all dune types present in New Zealand.

The information and results obtained from the questionnaire showed that they could provide valuable information and in particular qualitative data concerning individual landforms. However the quantitative data that was attempting to be generated yielded less favourable responses, mainly due to respondents providing biased responses. The examination of the current conservation estate showed that the current conservation estate is unrepresentative when protecting dunelands throughout New Zealand.

Acknowledgements

In the creation of this thesis there are a number of people who have contributed to make it a reality. I would like to take this opportunity to publicly acknowledge them.

Firstly, and most importantly, Associate Professor Patrick Hesp. For giving me the opportunity to study Coastal Management, and to provide me with the opportunities that have arisen throughout the last couple of years. His dedication, commitment and most importantly friendship have been a source of inspiration throughout this trying year.

The entire Geography Department for their assistance in the production of this research. Those little informal 'chats' about what I should be doing and where I am going, provided me with an endless supply of ideas.

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Last but no means least, my family and friends, for their assistance, tolerance and understanding during the duration of this research. You have all helped me retain my sanity throughout the course of this year, and for that I am grateful.

Table of Contents

List of Figures

List of Tables

List of Maps

Chapter One: Introduction

1.1 Introduction

New Zealand's coastline stretches for over 15,000 kilometres, and like all coastal environments around the world, it is increasingly coming under pressure from growing populations and for development purposes. This increase in competition for coastal environments has led to the assimilative capacity of these landscapes being exceeded. If this is allowed to continue it will lead to an overall degradation of the environment.

In New Zealand the Department of Conservation is charged with the protection and preservation of New Zealand's coastal environments. This is done through the identification and evaluation of outstanding landscapes, or those landscapes that have high 'natural character'. The Department's mission is to conserve New Zealand's natural and historic heritage for all to enjoy now and in the future (www.doc.govt.nz).

The protection of New Zealand's coastal dunes is considered to be a priority for the Department of Conservation (Department of Conservation, 1994a; Taylor and Smith, 1997). However the current Department of Conservation protected land areas do not adequately protect all representative examples of dunelands in New Zealand.

This 'lack' of representation in current conservation inventories, has resulted in;

> *"few dunelands bearing much resemblance to their original state because of the impacts of stock grazing, introduced plants, sand mining for iron and silicon, and dune controlling plants."* (Newsome, 1987 in Taylor and Smith, 1997: 75)

It is this competition for the use of the coastal environments, which has led environmental economists to attempt to value the competing uses of these landscapes. But often these valuations have disregarded many of the intrinsic values associated with the formation of these landforms, so begin to be questionable when concerned with the preservation of the environment.

"If the environment is one of the world's bloodiest political battlefields, economics provides many of the weapons. The trouble with these number wars is that the estimate's accuracy is often more akin to that of second-world-war bombers than precision-guided missiles." (The Economist, 1994 in Perman et al. 1996: 250)

Without these valuations, no comparisons can be made between the productive use of the environment and the conservation potential of the environment. Davis and Cocklin (2001) indicate that on private land, ecological areas exhibiting conservation potential are only protected through chance rather than good management.

These views are ratified in "*The Free Radical*" a newsletter distributed to farmers at the 'National Field Days' outlining problems with current property rights, intrinsic values and the Resource Management Act 1991.

"...anything can be described as intrinsically valuable, trees and rocks, to sand dunes and mud puddles – the law is played aces wild, and expensively and onerously administered by those now posturing as guardians of these supposed values." (Perigo, 2002: 7)

1.2 Objectives

The purpose of this research is to determine whether conventional economic valuation techniques can be applied to the implementation and evaluation of conservation land within New Zealand. The objectives of this research are:

1. to establish how much of New Zealand's coastal dunelands are protected within the current conservation estate.

2. to determine if a section of the New Zealand coastal environment has any 'value', especially when looking at the differences between standard farming 'values' and intrinsic 'values'.

3. to determine a valuing technique for the parabolic dunes of the Manawatu coastline.

Application of the methodology will be demonstrated through the use of the Manawatu parabolic dunefield as a case study. A brief outline of the dunefield is provided below.

1.3 Case Study

The Manawatu dunefield will be used as an example of an excellent 'representative' example of a coastal ecosystem that is perhaps being under valued by both the Department of Conservation and by local farmers.

For over a decade the Manawatu dunefield has been recognized as the best example of Holocene dune development in New Zealand, and one of the best examples of parabolic dune development in Australasia (Shepherd, 1987; Muckersie and Shepherd, 1995; Hesp, 2001).

The Manawatu region is ideally suited for extensive dunefield development. A large sediment supply from the five major river systems of the region, plus a strong, relatively constant onshore wind, and low lying topography all combine to aid in the development of the Manawatu dunefield.

There has been very little environmental protection awarded to the dunefield by the Department of Conservation. In 1992 the Foxton Ecological District, through the Recommended Areas for Protection Programme, identified 60 areas for protection within the Manawatu dunefield, 46 of which were considered to be of high priority. None of the 60 areas have been deemed worthy enough of protection by the Department of Conservation (Ravine, 1992).

At present, the dunefield is primarily used for farming and forestry. The intense use of modern machinery and fertilizers has lead to the irreversible modification and alteration to some parts of the dunefield (Smale, 2002).

1.4 Assessing Landscape Value

The perceived risks faced by the New Zealand coastal environment are expressed in current legislation, principally the Recourse Management Act (1991). The Act has effectively placed a bottom line on the use of natural resources; it has ensured that all environmental resources must be used in a sustainable manner. The Resource Management Act (1991) is based on controlling the 'effects' of activities, not the actual activities themselves (Moore, 1999).

"What the effects are, and their relative importance, is determined through weighing up the collective values that society holds for the environment." (Local Government NZ, 1997: 13)

Part II of the Resource Management Act sets out the matters of National Importance for the New Zealand environment[1].

Part II

Purposes and Principles

6. Matters of National Importance –

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:

(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:

(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

(Resource Management Act, 1991: s6)

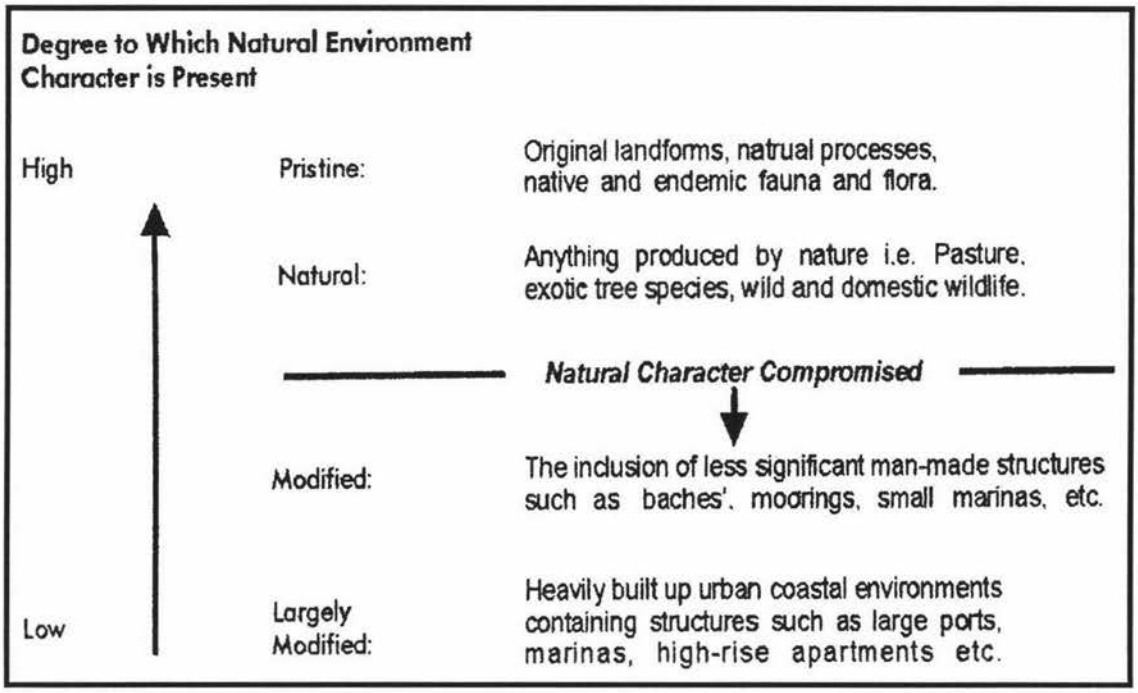
The Reserves Act (1977), the Conservation Act (1987), and the Resource Management Act (1991) all express the desire to preserve all representative examples of New Zealand's natural ecosystems, which in their aggregate gave New Zealand its own recognisable character.

Although the current government legislation talks about the preservation of New Zealand's natural character, there has been much debate over what the term actually means (Nugent and Solomon, 1994; Maplesden, 2000). Maplesden

[1] Appendix One contains relevant sections of the Resource Management Act (1991).

(2000) provides a figure for the varying degrees to which natural character is present in the environment.

Figure 1.1: Degree to which Natural Character is Present



(Source: MAPLESDEN, 2000: 74)

In 1994 the New Zealand Coastal Policy Statement was implemented to achieve the maintenance of the natural character of the environment, without precluding appropriate use and development (Maplesden, 2000). The purpose of the statement is set out in section 56 of the Resource Management Act (1991), and provides definitions of the terms generated in section 6(a) of the Resource Management Act. As such it defines natural character as:

"The qualities of the coastal environment that together give the coast of New Zealand recognisable character. These qualities may be ecological, physical, spiritual, cultural or aesthetic in nature. They may include modified and managed environs." (Maplesden, 2000: 28)

Much condemnation was levelled at this definition, with the Department of Conservation and many Councils (City, District, and Regional) expressing concerns over the inclusion of cultural and spiritual values in the overall definition (www.ew.govt.nz/ourenvironment).

While the term has been defined in government legislation, there have not been guidelines set as how to identify landscapes with high natural character. It has been left to the Courts to decide on how best to assess a landscape. The most significant case to date on this issue has been the Environment Court Case *Wakatipu Environmental Society Inc v Queenstown Lakes District Council* (Environmental Court 1999).

This Case provides the first list of aspects or criteria for assessing a landscape. These are:

(a) the natural science factors – the geological, topographical, ecological and dynamic components of the landscape;
(b) its aesthetic values including memorability and naturalness;
(c) its expressiveness (legibility): how obviously the landscape demonstrates the formative processes leading to it;
(d) transient values: occasional presence of wildlife; or its values at certain times of the day or the year;
(e) whether the values are shared and recognized;
(f) its value to tangata whenua;
(g) its historical association

It goes on to state (section 82) that the word 'outstanding' means:

- 'conspicuous, eminent, especially because of excellence'
- 'remarkable in'

(Kapiti Environmental Action Inc v Kapiti District Council, 2001)

With the Resource Management Act (1991) requiring councils to protect outstanding natural landscapes, District Councils have used this set of criteria to identify 'outstanding' landscapes within their district boundaries (Swaffield and Foster, 2000). But, in the case of the Kapiti District Council and the Horowhenua District Council, only visual assessments have been conducted. Thereby ignoring criteria (a), (b) and (c) in the determination of 'outstanding' landscapes, and thus ignoring the intrinsic values associated with these landscapes (Kapiti Environmental Action Inc v Kapiti District Council, 2001).

The Department of Conservation has created their own separate set of criteria in the identification and evaluation of landscapes with high natural character.[2] Through the use of these two separate sets of criteria, often the areas that are identified by the separate parties are in fact contradictory.

1.5 Conclusion

This chapter indicated that the Department of Conservation views coastal dunes as a priority area for protection. Yet little protection has been awarded to the coastal dunes throughout New Zealand. The determination of the conservation potential of coastal dunes needs to be calculated before any conservation areas can be created.

This research is determined with the calculation of this conservation potential. The use of a classical economic valuing tool, a Contingent Valuation Survey, is being used to determine the value of a section of New Zealand's coastline that is perhaps, at present, being undervalued by both the Department of Conservation and the local affected population.

The identification and evaluation of potential conservation areas is determined by the value associated with it. The use of the term natural character to describe

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[2] These will be discussed in further detail in chapter four.

landforms with outstanding value has created confusion. This chapter showed that there is confusion over the use of the term, and without it being properly defined in current government statutes, policy makers have had to rely on Court rulings when identifying areas of high natural character, often identifying contradictory areas to those identified by the Department of Conservation.

The next chapter will examine the literature on the Manawatu parabolic dunefield, the issues surrounding the implementation of conservation land in New Zealand, with an extensive examination of Government legislation on the issue. It will then outline how economics deals with the provision of public goods, which conservation lands are, and how economics attempts to compare differing uses of the environment.

Chapter Two: Literature Review on Landscape Values

2.1 Introduction

The values associated with coastal resources are a matter that has been examined by a wide and varied set of disciplines ranging from the physical sciences to the political economy. There is a full and diverse literature on the valuation of environmental resources, but there is a limited set of literature on the Manawatu dunefield. The creation of conservation areas in New Zealand is governed by the current government legislation.

This chapter reviews the literature on the local Manawatu Dunefield, the government legislation for establishing conservation areas and World Heritage Sites in New Zealand, and finally the economic criteria and methods for valuing environmental resources.

2.2 The Manawatu Region: Geography and Geomorphology

2.2.1 Geomorphology of the Manawatu Region

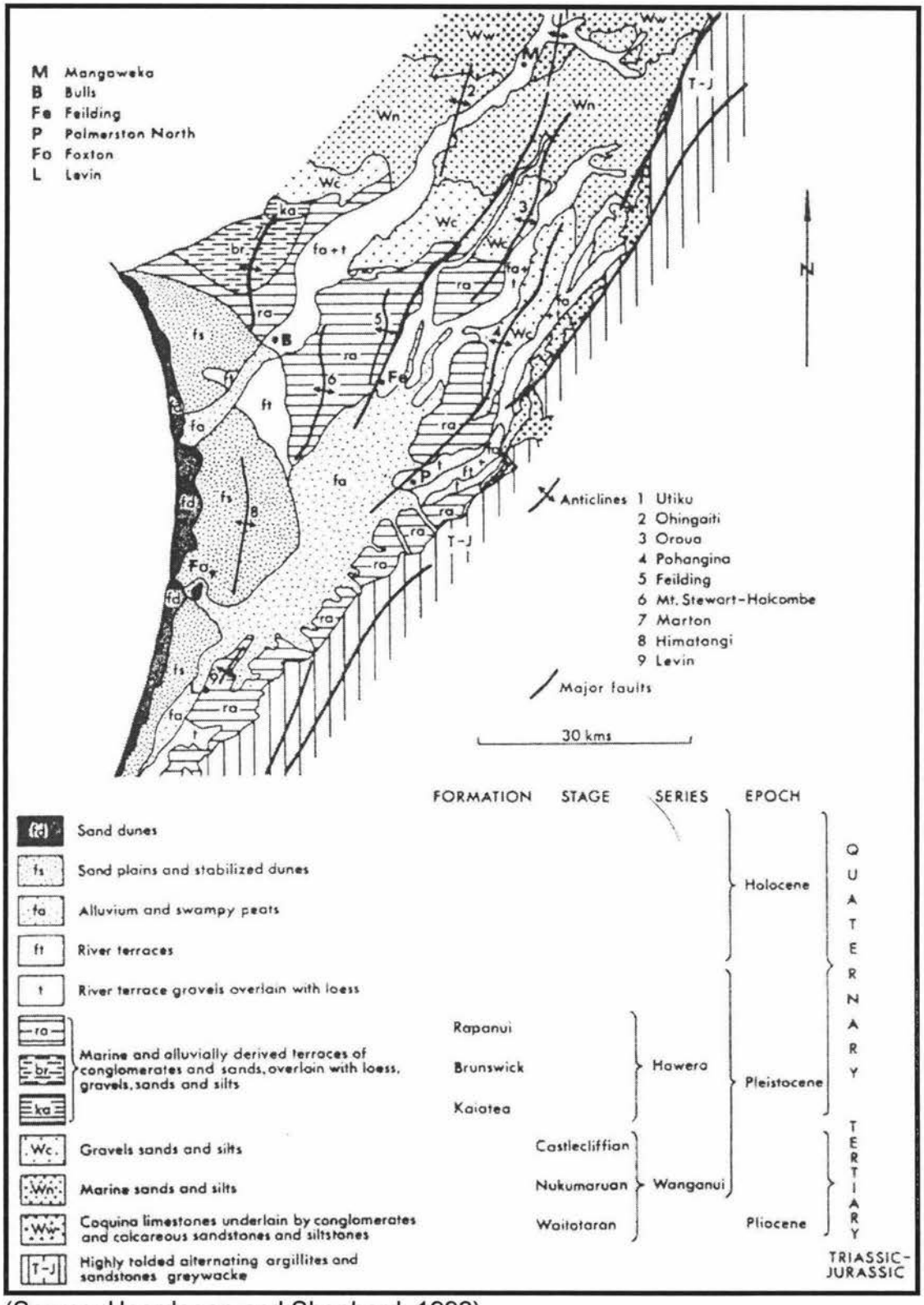
The Manawatu region is situated along the southwest coast of the North Island. The region's eastern margins are defined as being the Tararua and Ruahine Ranges, which form the 'backbone' of the North Island (Molloy, 1988). The ranges were probably initiated by the up warping of the greywacke basement during Jurassic times, but the major phase of uplift probably occurred about 1 million years BP with the deposition of gravels on the flanks of both ranges (Heerdegen and Shepherd 1992). The entire Manawatu region is comprised of sedimentary rocks, with ages varying from Jurassic/Triassic to present day alluvial deposits (Heerdegen, 1972; Heerdegen and Shepherd, 1992).

Along the western side of the Tararua ranges is the Tokomaru Marine Terrace (Cowie, 1961). Hesp and Shepherd (1978) indicate that this terrace rises to a height of around 30-40 meters above mean sea level near Palmerston North. It forms part of the late Cenozoic sedimentation known as the Wanganui Basin, which extends from near Mt Taranaki to the axial ranges of the North Island (Heerdegen and Shepherd, 1992).

The Manawatu flood plain is situated between the Tokomaru Marine Terrance to the east and an extensive zone of coastal dunes to the west (Hesp and Shepherd, 1978; Ravine, 1995). This is a large area of Cenozoic sedimentation (Heerdegen and Shepherd, 1992). The major river terraces are less than 120,000 years old as they lie below the level of the Tokomaru Marine Terrace formed during the last Interglacial (Heerdegen and Shepherd, 1992). Flowing across this elevated and deformed coastal plain are the major river systems of the region, the Wanganui, Rangitikei and Manawatu Rivers.

An extensive zone of sand dunes exists between the flood plain and the Manawatu coastline. Muckersie and Shepherd (1995) state that the dunefield covers ca. 900 km^2, or approximately 90,000 hectares. These dunes have migrated inland to over 18 km at their widest point (Hesp, 2001). This dunefield has developed from a number of environmental and geomorphological conditions combining to provide a prime example of Holocene dune development (Shepherd, 1987). Figure 2.1 on the next page shows the geological structure of the Manawatu region.

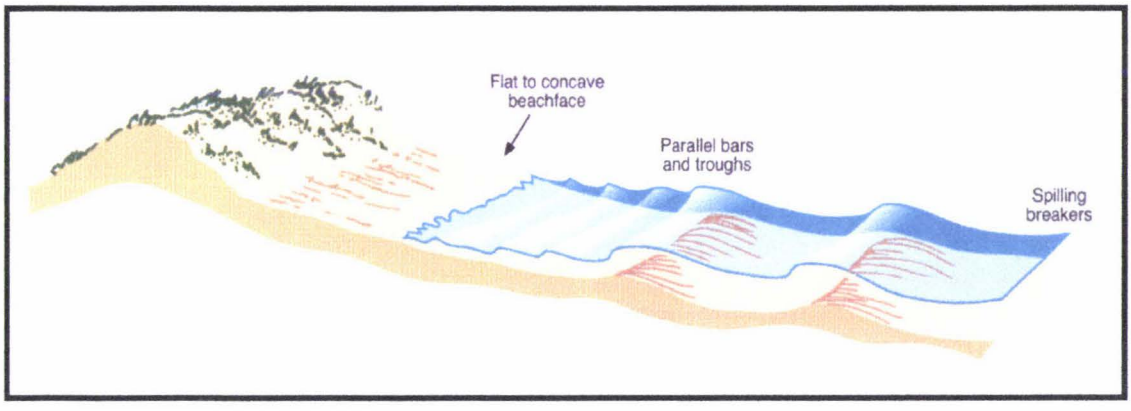
Figure 2.1 The Geological structure of the Manawatu Region



(Source: Heerdegen and Shepherd, 1992)

The Manawatu beach and surf zone is a dissipative system. The incoming wave energy is largely dissipated by repeated wave breaking over parallel bars in the extensive surf zone (Hesp, 2000). It is a multi bar, meso-tidal, low energy beach, with an extensive backshore (O'Dea, 1999). Hesp (2001) states that the Manawatu coastline is progradational and that the coastline is accreting at rates of between 0.5 and 1 meter per year.

Figure 2.2 A Schematic diagram of a typical dissipative beach



(Source: Hesp, 2000)

2.3 The Manawatu Dunefield

The Manawatu coastal environment is dominated by the largest parabolic and transgressive dunefield in New Zealand (Hilton, 2000; Hesp, 2001). The Manawatu dunefield is highly dynamic, that is, there is the potential for rapid change (Heerdegen, 1972). An indication to the dynamic nature of the coastal zone is the existence of an active foredune/blowout complex and landward active parabolic dunefield (Muckersie, 1989; Muckersie and Shepherd, 1995; Hesp, 2001).

2.3.1 The Development of the Manawatu Dunefield

Cowie (1963) provided the first attempt at cataloguing the development of the dunefield. Cowie (1963) noted four distinct dune-building phases in the

Manawatu dunefield. By comparing the soil development, he was able to establish approximate ages of the differing dune phases.

The eldest of the four phases he termed the 'Koputaroa Phase'. These dunes are only preserved at the northern and southern parts of the Manawatu district and have an age of about 6000 years (Cowie, 1963).

The second phase of dune development Cowie termed the 'Foxton Phase' (1963). Cowie (1963) suggested an age of between 4000 and 2000 years old for this phase. This age was established due to the lack of Taupo Pumice alluvium, which is dated at 1850 years BP (Muckersie and Shepherd, 1995).

The third phase was named the 'Motuiti Phase' and according to Cowie is between 1000 and 500 years (1963).

The final phase was termed the 'Waitarere Phase' by Cowie (1963). The advance of this phase is attributed to 'overgrazing and burning' of vegetation, on the previously stabilised dunes by Maori and subsequently Europeans. Cowie (1963) dated the Waitarere Phase at being less than 100 years old.

Muckersie and Shepherd (1995) have conducted further studies into the development of the dunefield, and have estimated dune ages by rates of sand migration and carbon dating. Their first dune building phase, which is roughly equivalent to Cowie's (1963) Foxton phase, was initiated by the onshore movement of large amounts of sediment following the stabilization of sea levels, approximately 6500 years ago, and these phase one dunes were still being initiated up until 4500 BP (Muckersie and Shepherd, 1995).

The second dune phase was initiated 3500 years BP and ended around 1300 years BP (Muckersie and Shepherd, 1995).

Muckersie and Shepherd (1995) split Cowie's (1963) Waitarere Phase into two separate components, with phase three being initiated by Maori 1000 years BP, and the fourth phase being initiated by Europeans, which is ongoing.

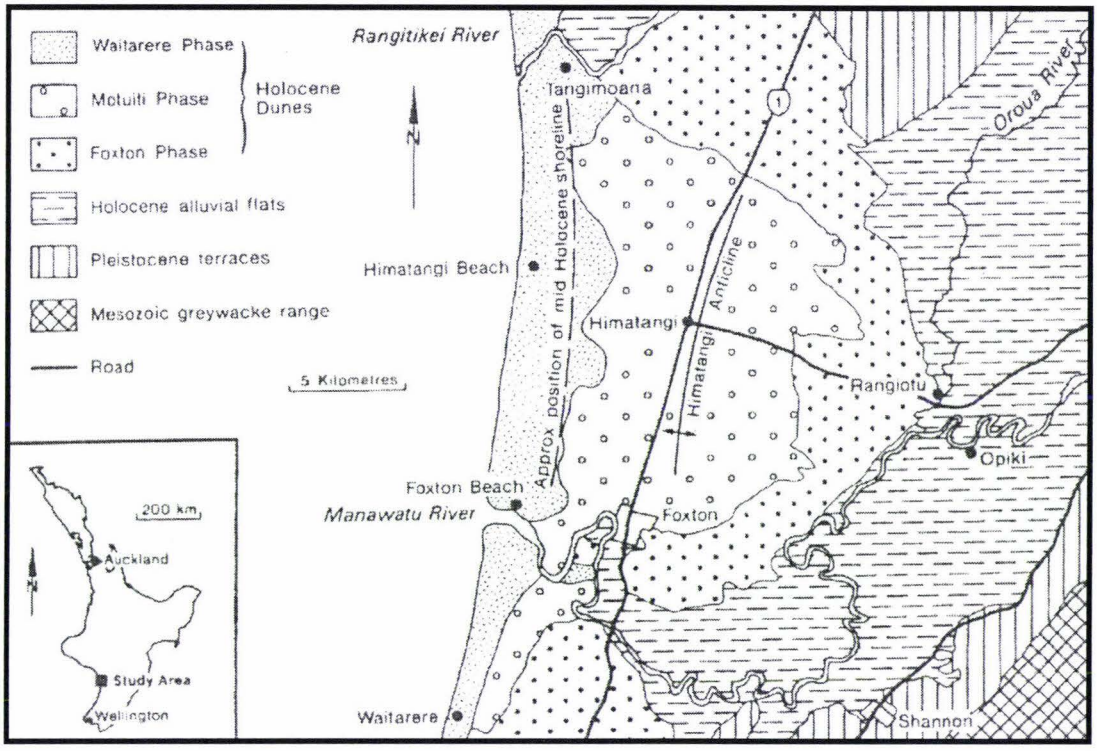
Hesp (2001) disputes both Cowie's (1963), and Muckersie and Shepherd's (1995) beliefs about the initiation of the 'Waitarere' dune phase. He notes that:

"while it is certainly possible that Maori burning and clearing of the vegetation may have initiated dune 'mobilisation', the 7000 year history of this coast is one of either semi-continuous or phase-like development of dunes which continues to this day. Therefore, Maori de-vegetation (partial or otherwise) of the dunes would have resulted in re-activation of existing dunes." (2001: 35)

Hesp (2001) goes on to suggest that an entirely new phase of dune development is occurring, with a set of parabolic dunes forming from blowouts within the foredunes at the present time. He notes that there are 20 new parabolic dunes in just 10kms of coast extending from Himatangi to Foxton. This new dune building phase is largely driven by natural forces, but aided to some degree by human recreational activities, and is migrating inland at up to 25 meters per year (Hesp, 2001).

Figure 2.3, on the next page, illustrates the dune building phases of the Manawatu dunefield.

Figure 2.3 Dune building phases of the Manawatu dunefield, and the Geologic ages of the surrounding Manawatu region

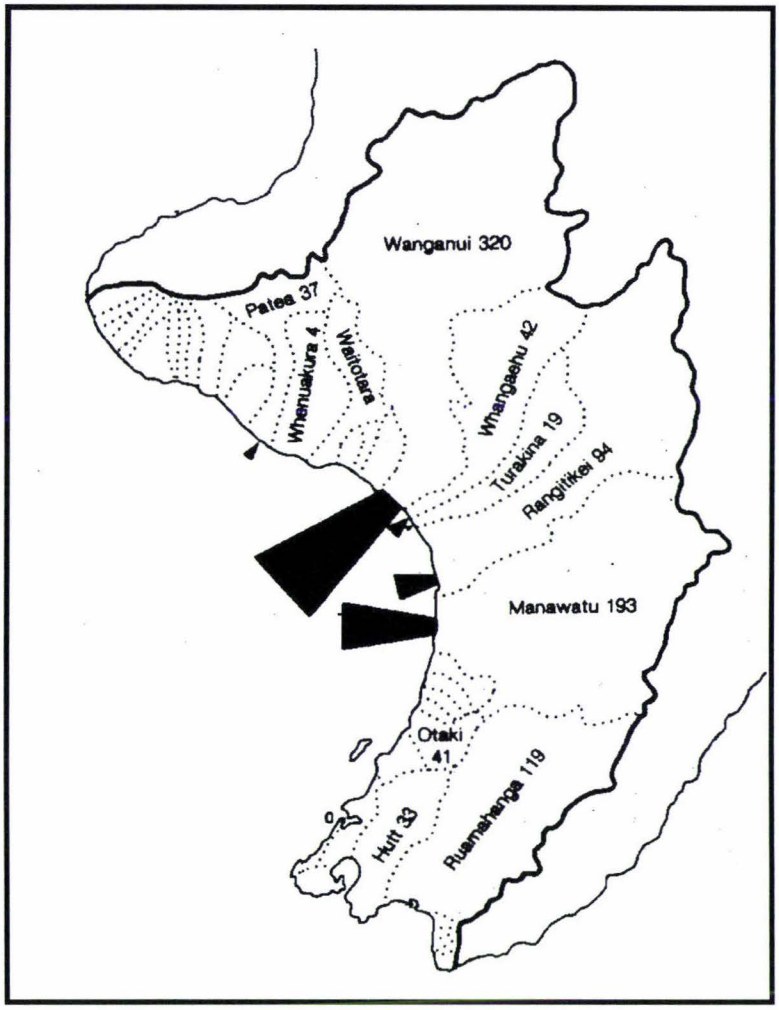


(Source: Hesp, 2001)

2.3.2 Regional Conditions for Dune Development

The dune-field's morphological development has been aided by a number of factors. The backshore topography of the Manawatu coastal zone is conducive to the development of a transgressive and parabolic dunefield. A series of large, flat river plains provide the ideal low-lying topography for aeolian transported sand sediments. Three major river systems, the Wanganui, Rangitikei, and the Manawatu, ensure that there is a large amount of sediment supplied to the coastline (Heerdegen and Shepherd, 1992; Muckersie and Shepherd, 1995). The rivers are the leading transport mechanisms for carrying terrestrial sediments to the Tasman Sea (Harris, 1990). Figure 2.4 shows the mean discharges from the major river systems in the region.

Figure 2.4 The mean discharges in cubic meters per second of the main rivers that contribute sediment to the Manawatu coastal environment



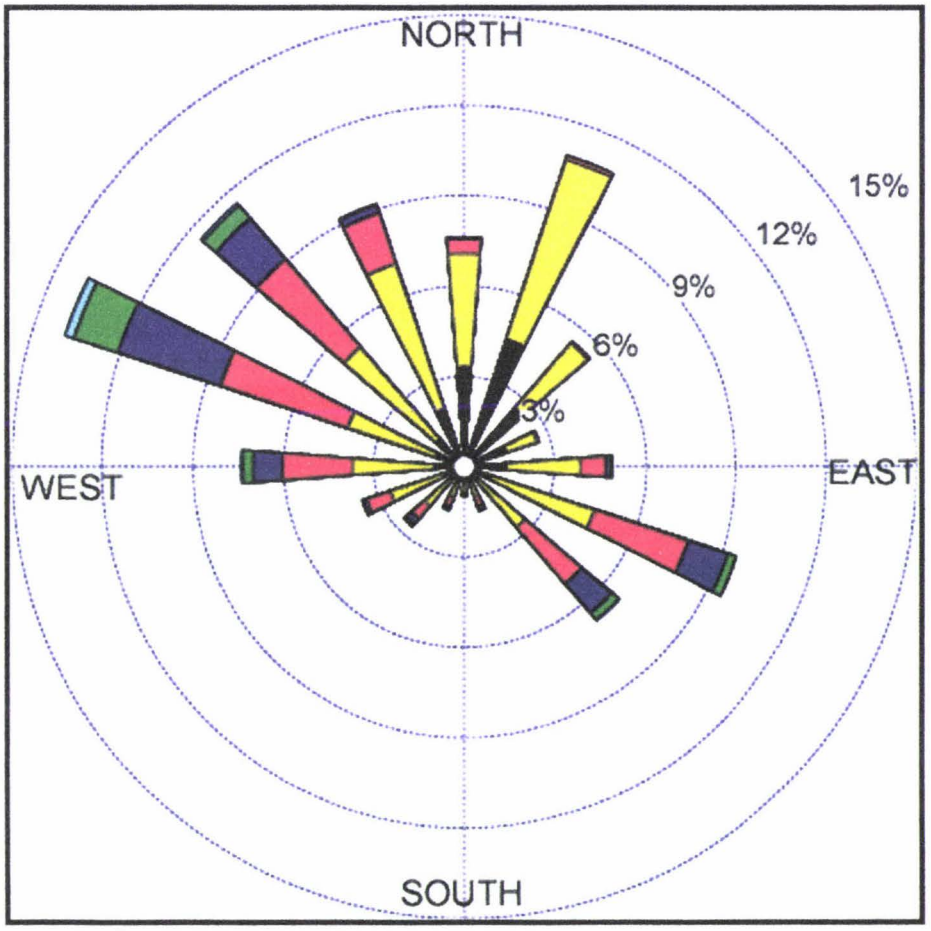
(Source: Harris, 1990)

The New Zealand Meteorological Service has been collecting climatological data from the local Ohakea Air Force base for a number of years. The data collected on wind speeds and directions provides clear evidence to the fact that the Manawatu coastal zone is a prime site for the transportation of aeolian sediments. Shepherd (1987) states that the Manawatu coastal zone has the largest area of aeolian dunes in New Zealand. He states that the Manawatu coast provides an environment particularly conducive to dune activity, including a large sand supply and a very windy climate. Data provided by the Ohakea

Aerodrome near Bulls, shows that winds capable of initiating sand transport (>16kph) gust for approximately 33% of the time (Shepherd, 1987).

The orientation of the parabolic dunes is such that they are transgressing inland with the prevailing or dominant wind direction (Cowie, 1963). Hesp (unpublished) provides summary data of the local wind directions for the Manawatu coastal environment from 1960-2000. As Figure 2.5 on the next page shows, winds greater than 16kph (winds capable of transporting sand sediments) are orientated from the west-north-west, which is also the orientation of the parabolic dunes.

Figure 2.5 Wind Rose for Ohakea Airforce Base from 1960 to 2000, showing the prevailing wind direction to be west-north-west

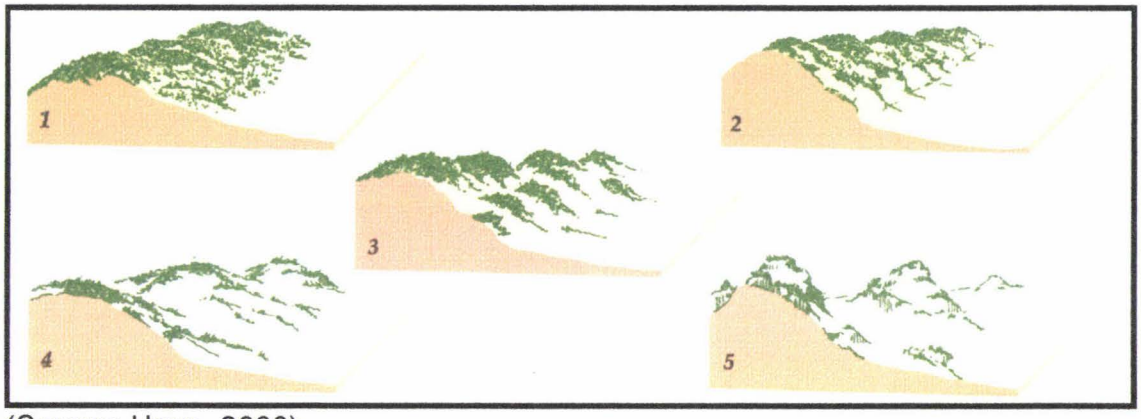


(Source: Hesp, Unpublished, Raw Data Source NIWA)

2.3.3 Dune Types

The backshore of the Manawatu coastal zone is characterized by an active erosional foredune system. Active foredunes can range in type from well-vegetated stable foredunes, type one, to highly erosional foredunes, type five (Hesp 2000). Under Hesp's (2000) five types of foredune development, the Manawatu foredune complex can be classified as type three, that is, they are hummocky and partially vegetated.

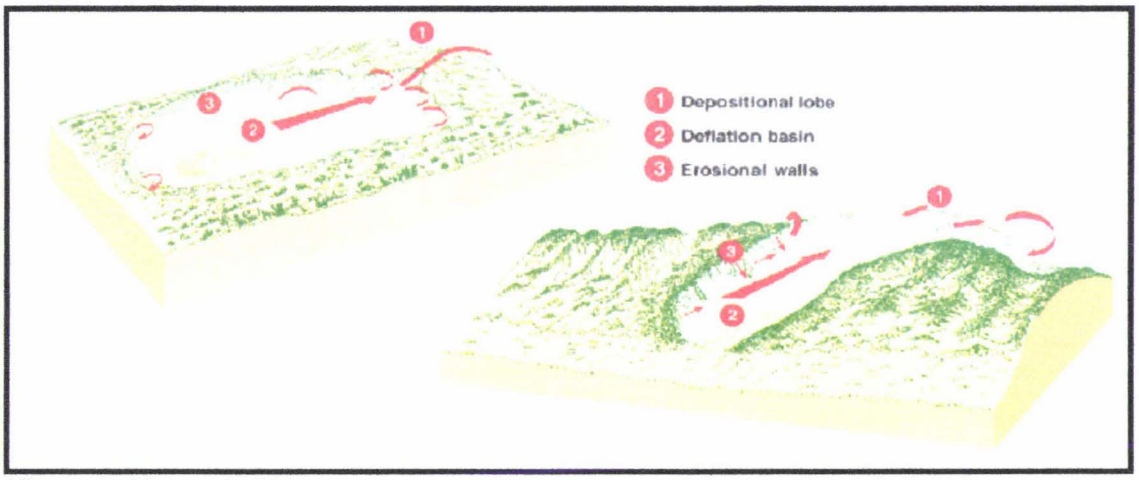
Figure 2.6 The differing types of established foredunes



(Source: Hesp, 2000)

Within this active foredune, blowouts are present. Blowouts are erosional dune landforms. They are either characterized as either small saucer, or elongated trough blowouts that cut through the foredune. Blowouts are initiated by a variety of ways, although all conditions require the reduction of vegetation cover. The wind then erodes the sandy substrate (Hesp, 2000). The maximum deflation level of a blowout is usually reached when either the water table, or a layer of shell, pebble or pumice is reached (Hesp, 2000). The sand eroded from the deflation basin is then immediately deposited downwind to form a depositional lobe. The lobes are parabolic in shape because of the highest wind velocities occur up the centreline of the blowout, thereby transporting sand furthest down the axis and least over the side margins (Hesp 2000). Figure 2.7, on the next page illustrates the two types of blowouts and their typical windflow patterns.

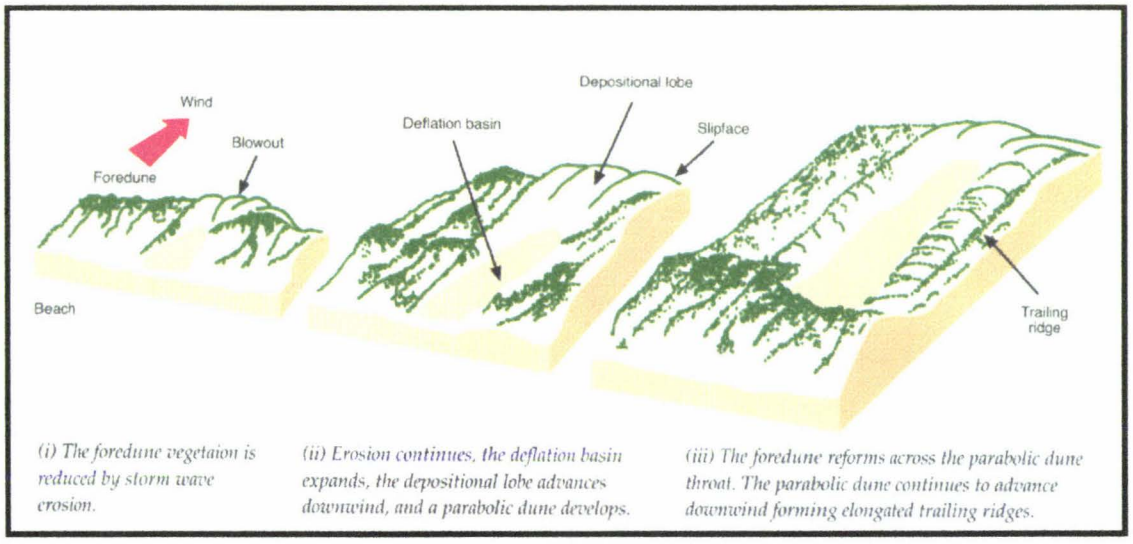
Figure 2.7 The two blowout types and their typical windflow patterns



(Source: Hesp, 2000)

Parabolic dunes are initiated mainly through the formation of blowouts, they continue to enlarge laterally and elongate downwind (Hesp, 2000). They migrate downwind as continued wind erosion advances the depositional lobe of the dune, with trailing ridges forming upwind of the depositional lobe (Hesp, 2000). A parabolic dune is typically distinguished from a blowout by the presence on trailing ridges. Figure 2.8 illustrates the evolution of a parabolic dune from a blowout in a foredune.

Figure 2.8 The evolution of a parabolic dune from a blowout



(Source: Hesp, 2000)

According to Muckersie and Shepherd, (1995) and Hesp (2001), the parabolic dunes on the Manawatu coastline provide an example of the best parabolic dune development and movement in New Zealand. It is likely that increased usage of the dunefield, for both recreation and non-recreation purposes, has lead to an increase in the mobilization of the dunefield and the formation of blowouts (Bate and Ferguson, 1996).

Hesp (2000) states that transgressive dunefields may have formed as a response to rising sea levels or climatic change, in the period of 10,000 to 7000 years BP; in regions of high alongshore and onshore sedimentation; and on coasts experiencing erosion, both natural and human induced. The Manawatu dunefield has developed from the high wind energy, and more importantly, from the large supply of sand sediments (Muckersie and Shepherd, 1995; Hesp, 2000).

2.3.4 Recent History and Current Situation of the Manawatu Dunefield

The current situation of the Manawatu Dunefield is very different to what it once was. With the increase in population and usage of the coastal environment, there has been a change in the use of the dunefield.

Wilde (1992) classified three separate uses for the Manawatu sand country. These were pasture (both good and bad), shelterbelts and farm woodlots (mainly *Pinus radiata*), and bare ground including recent planting of Marram Grass on bare sand (Wilde, 1992). With increased planting of pine forests and trees for shelterbelts, the inland migration of the dunefield has decreased to less than 5 meters per year. But where left to migrate over pastureland, migration rates of over 100 meters per month can occur (Holland, 1983; Hesp, 2001).

2.4 Conservation Areas

Most coastal areas around the world are facing critical problems of rapidly growing human populations, deteriorating environmental quality, lost biodiversity, and increased pressures from natural hazards (Clark, 1991). Exceeding the carrying capacity of coastal systems has been identified as a major contributor to the destruction of unprotected and vulnerable ecosystems (IUCN, UNEP and WWF 1991; Guilcher and Hallegouet, 1996). So it is becoming increasingly important to protect those vulnerable habitats before they are lost completely.

The following section outlines the government legislation involved in the protection and preservation of New Zealand's natural environment.

2.4.1 Government Legislation

The Department of Conservation controls the establishment of Conservation Areas within New Zealand. The Departments statutory powers are based on a number of Government Acts and Policies, including;

- The Wildlife Act (1953)
- The Marine Reserves Act (1971)
- The Reserves Act (1977)
- The Wild Animal Control Act (1977)
- The Marine Mammals Protection Act (1978)
- The National Parks Act (1980)
- The Conservation Act (1987)
- The New Zealand Walkways Act (1990)
- The New Zealand Coastal Policy Statement 1994.

All of these have important roles in the establishment of 'protected' areas within New Zealand. The following provides a short account of each of these statutes.

Wildlife Act (1953)

The Wildlife Act (1953) declares that most indigenous wildlife is to be protected absolutely throughout New Zealand. The Act governs the taking and possession of birds and other animal species. Sanctuaries, refuges or management reserves may be established under this Act to assist in the protection of wildlife (Department of Conservation, 1995a).

Marine Reserves Act (1971)

The Marine Reserves Act (1971) provides for the setting up and management of areas of the sea and foreshore as marine reserves, for the purpose of protecting them in their natural state as the habitat of marine life for scientific study (Department of Conservation, 1995). The Conservation Department establishes marine reserves so that:

- they are preserved as far as possible in their natural state:
- the marine life within reserves shall as far as possible be protected and reserved:
- the value of the reserves as the natural habitat of marine life shall as far as possible be maintained

(Marine Reserves Act (1971), Department of Conservation, 1995a)

Reserves Act (1977)

The Reserves Act (1977) sets out broad principles for the management of reserve lands, and processes for the establishment of new reserves. The Act is administered for:

- providing for the preservation and management for the benefit and enjoyment of the public, areas of New Zealand possessing:
    - (i) recreational use or potential, whether active or passive
    - (ii) wildlife
    - (iii) indigenous flora and fauna

(iv) environmental and landscape amenity or interest

(v) natural, scenic, historic, cultural, archaeological, biological, geological, scientific, educational, community, or other special features or value.

- ensuring, as far as possible, the survival of all indigenous species of flora and fauna both rare and commonplace, in their natural communities and habitats, and preservation of representative samples of all classes of natural ecosystems and landscapes which in their aggregate gave New Zealand its own recognizable character (Reserves Act (1977), Department of Conservation, 1995b).

To help achieve these purposes, the Act provides for seven different classes of reserve; recreation, historic, scenic, nature, scientific, government purpose and local purpose (Department of Conservation 1995a). Appendix Two outlines the relevant sections of the Reserves Act (1977).

Wild Animal Control Act (1977)

The Wild Animal Control Act (1977) seeks to achieve effective control of harmful species of introduced wild animals. The Act is administered so as to:

- ensure concerted action against the damaging effects of wild animals in vegetation, soils, water, and wildlife
- achieve co-ordination of hunting measures
- provide for the regulation of recreational hunting and wild animal recovery

(Department of Conservation 1995a)

Marine Mammals Protection Act (1978)

The Marine Mammals Protection Act (1978) provides for the protection, conservation and management of marine mammals within New Zealand and New Zealand fisheries waters (extending 200 miles offshore). The Act places restrictions on the taking of marine mammals form their natural habitat, and

provides for the establishment of marine mammal sanctuaries (Department of Conservation 1995b).

National Parks Act (1980)

This Act determines the broad principles by which National Parks are to be managed. These parks are established for the purpose of:

"Preserving in their perpetuity...their intrinsic worth and for the benefit, use, and enjoyment of the public, as areas of New Zealand that contain scenery of such distinctive quality, ecological systems, or natural features so beautiful, unique, or scientifically important that their preservation is in the national interest." (National Parks Act, (1980): s.4)

Conservation Act (1987)

The Conservation Act (1987) sets out the broad principles for the management of conservation areas, indigenous freshwater fisheries, and other natural or historic resources. The functions of the Department of Conservation are set out in The Conservation Act (1987), section 6[3]. In summary they include:

(a) To manage for conservation purposes, all land, and all other natural and historic resources, for the time being held under it, and all other land and natural and historic resources whose owner agrees with the Minister that they should be managed by the Department.

(b) To advocate conservation of natural and historic resources generally.

(c) To promote the benefits to present and future generations of conservation of natural and historic resources.

(d) To prepare, provide, disseminate, promote and publicise educational and promotional material relating to conservation.

(e) To the extent that the use of any natural or historic resource for recreation or tourism is not inconsistent with conservation, to foster the

[3] See Appendix Three for the relevant Sections of the Conservation Act (1987).

use of natural and historic resources for recreation and allow their use for tourism.

(f) To advise the Minister on matters relating to any of those functions or conservation generally.

(g) Every other function conferred on it by any other enactment.

(Department of Conservation, 1996a)

Conservation, in the context of managing for conservation purposes, means:

"the preservation and protection of natural and historic resources for the purposes of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options for future generations." (Conservation Act (1987): s.2)

New Zealand Walkways Act (1990)

The New Zealand Walkways Act (1990) provides for the establishment of a system of walking tracks throughout New Zealand for the enjoyment of the public. Walkways can be established through either public or private land, while protecting the rights of landowners (Department of Conservation, 1995b).

New Zealand Coastal Policy Statement (1994)

The New Zealand Coastal Policy Statement (NZCPS) was prepared and issued by the then Minister of Conservation, Denis Marshall, in 1994. It stems from Section 56 of the Resource Management Act (1991). Section One of the NZCPS provides a number of policies that are relevant to the protection of New Zealand's coastal environment, and it's 'natural character' from inappropriate usage, including:

Policy 1.1.3

It is a national priority to protect the following features, which in themselves or in combination, are essential or important elements of the natural character of the coastal environment:

(a) landscapes, seascapes and landforms, including:

(i) significant representative examples of each landform which provide the variety in each region;

(ii) visually or scientifically significant geological features; and

(iii) the collective characteristics which give the coastal environment its natural character including wild and scenic areas;

(b) characteristics of special spiritual, historical or cultural significance to Maori identified in accordance with tikanga Maori; and

(c) significant places or areas of historic or cultural significance

Policy 1.1.4

It is a national priority for the preservation of natural character of the coastal environment to protect the integrity, functioning, and resilience of the coastal environment in terms of:

(a) the dynamic processes and features arising from the natural movement of sediments, water and air;

(b) natural movement of biota;

(c) natural substrate composition;

(d) natural water and air quality;

(e) natural bio diversity, productivity and biotic patterns; and

(f) intrinsic values of ecosystems.

(Department of Conservation 1994b: 5)

Of note is the fact that:

"Existing protected natural areas (which include national parks, scenic and other reserves, other conservation land administered by the Department of Conservation and private land with covenants or other forms of legal protection) do not adequately protect all these classes of natural ecosystems. Those that are poorly represented include lowland forests, low fertility shrublands, sand dunes and some types of wetland ecosystems." (Ravine, 1995: 9)

2.4.2 World Heritage Sites

The United Nations Educational Scientific and Culture Organization (UNESCO) has established a committee to evaluate the nominations for World Heritage sites, both cultural and natural. The World Heritage Committee last met between the 11th-16th of December 2001 in Helsinki, Finland, and held their 25th session (UNESCO, 2001).

At present in New Zealand there are two World Natural Heritage Sites. These are the Tongariro National Park World Heritage Area, which encompasses the Tongariro National Park, and the South-west New Zealand World Heritage Area, which encompasses the Westland National Park, Mount Cook National Park, Mount Aspiring National Park and the Fiordland National Park (www.unesco.org).

The guidelines for establishing World Natural Heritage Sites are highlighted in Table 2.1 on the next page. As can be seen, adjustments have been made to the requirements for World Heritage Sites as environmental and cultural attitudes have changed.

Table 2.1 Changes to the World Heritage Natural Heritage Criteria

as presented in the Operational Guidelines for the Implementation of the World Heritage Convention.

Version of the Operational Guidelines	Natural criterion i	Natural criterion ii	natural criterion iii	Natural criterion iv
1978	Be outstanding examples representing the major stages of the earth's evolutionary history. This category would include sites which represent the major "eras" of geological history such as the "the age of reptiles" where the development of the planet's natural diversity can well be demonstrated and such as the "ice age" where early man and his environment underwent major changes.	Be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment. As distinct from the periods of the earth's development, this focuses upon ongoing processes in the development of communities, of plants and animals, landforms and marine and fresh water bodies This category would include for example (a) as geological processes, glaciation and volcanism, (b) as biological evolution, examples of biomes such as tropical rainforests, deserts and tundra, (c) as interaction between man and his natural environment, terraced agricultural landscapes.	Contain unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man, natural features, (for instance, rivers, mountains, waterfalls), spectacles presented by great concentrations of animals, sweeping vistas covered by natural vegetation and exceptional combinations of natural and cultural elements.	Be habitats where populations of rare or endangered species of plants and animals still survive. This category would include those ecosystems in which concentrations of plants and animals of universal interest and significance are found.
October 1980	Be outstanding examples representing the major stages of the earth's evolutionary history.	Be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment; as distinct from the periods of the earth's development, this focuses upon ongoing processes in the development of communities, of plants and animals, landforms and marine and fresh water bodies.	Contain superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems, natural features, spectacles presented by great concentrations of animals, sweeping vistas covered by natural vegetation and exceptional combinations of natural and cultural elements.	Contain the most important and significant natural habitats where threatened species of animals or plants of outstanding universal value from the point of view of science or conservation still survive.
January 1984	No change	No change	Contain superlative natural phenomena, formations or features, for instance, outstanding examples of the most important ecosystems, areas of exceptional natural beauty or exceptional combinations of natural and cultural elements.	No change
February 1994	Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.	Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.	Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.	Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.
February 1997	No change	No change	No change	No change

(Source: www.unesco.org/criteria)

The UNESCO committee meeting in December 2001 established a definition of what is to be considered 'natural heritage', and thus what is to be protected for future generations:

"natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view;

"geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation;

"natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty." (UNESCO, 2001: 2; www.unesco.org).

All three components that were provided by UNESCO relate to the New Zealand coastal environment, and yet only a fraction of the total national protected areas in New Zealand encompass the coastline. Chapter four will outline what protected areas in New Zealand's have coastal components, and give evidence to why the Manawatu coastal environment should be considered for national recognition as protected area in the Conservation Estate. In Table 2.1, four criteria for inclusion into the World Natural Heritage sites were established in February 1994, and have not been changed since. The Manawatu parabolic dunefield provides examples of all of the four requirements.

2.5 Economics of Environmental Resources

Economics is the study of how markets satisfy the unlimited wants of people, against a limited supply of resources (Hartwick and Olewiler, 1986; Perman, et al., 1996; Costanza, et al., 1991; Frank, 1998). When goods and services are exchanged in the marketplace, the market price for that good or service can serve as an indicator to its value. However market prices may not be a good indication of value due to market failures, and even what is being traded in the market place (Perman, et al., 1996). Environmental resources present a unique example of how the market fails to accurately value them. Only by public investment and intervention can environmental resources by valued and the benefits be experienced by society as a whole.

Investment implies a reallocation of resources (land, labour, capital) from existing use to a new use (Frank, 1998). In making this reallocation of resources, the benefits derived from the original use will be lost, but other benefits will be created by this new allocation (Pearce and Turner, 1990; Perman, et al., 1996). Welfare economics, a sub-discipline of economics, helps in comparing differing allocations of resources to ensure that maximum welfare is being achieved in the marketplace. Perman, et al., state;

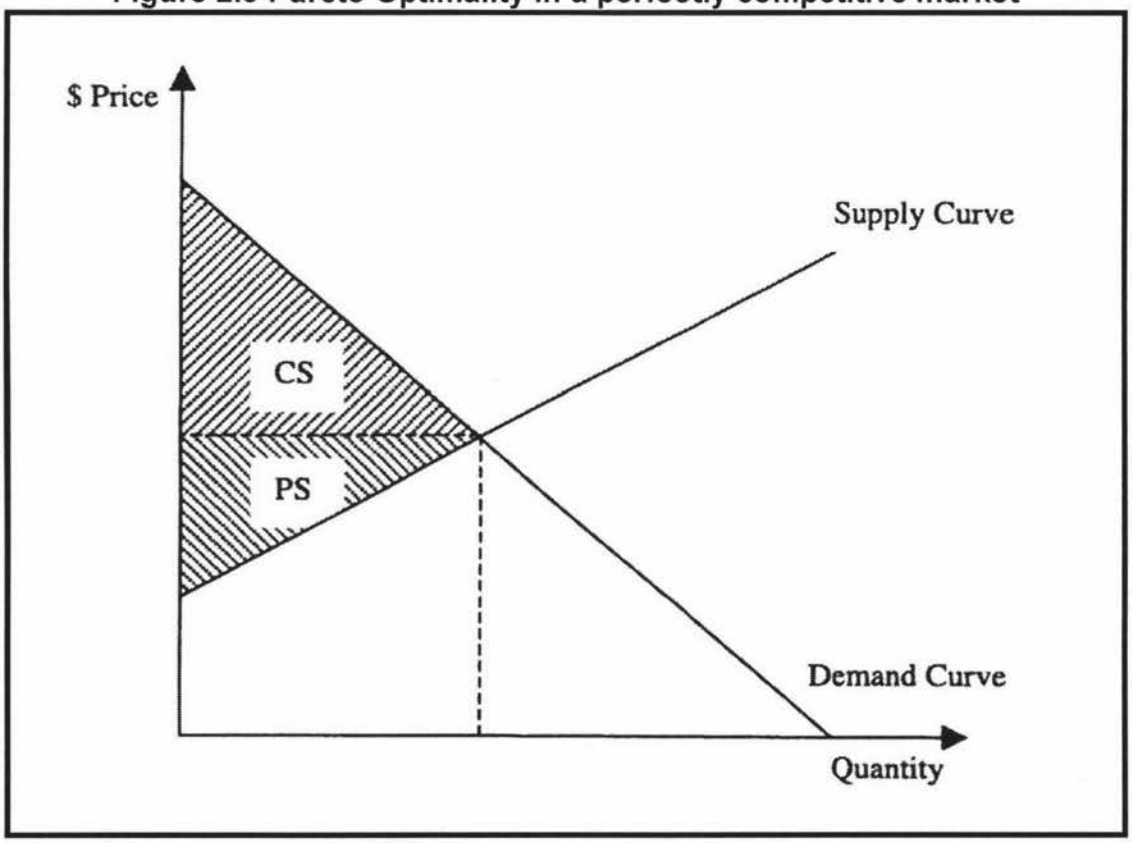
"Welfare economics attempts to identify circumstances under which one can claim that one allocation of resources is better than another." (1996: 8)

2.5.1 Optimal Welfare

If resources were not scarce there would be no conflict in how to allocate them between competing uses. But as environmental resources are scarce, there needs to be a set of criteria established to determine whether or not differing resource allocations yield higher amounts of welfare (Dorfman and Dorfman, 1993; Moore, 1999).

Vilfredo Pareto (1848-1923) is viewed by economic historians as the founder of contemporary welfare economics (Oser and Brue, 1988). Pareto defined optimal welfare as a situation where there is no resource allocation that can be made so that someone is made better off while making no other person worse off (Perman, et al., 1996; Frank, 1998). The basic premise of welfare economics is that a perfectly competitive market system will achieve Pareto optimality – an efficient social outcome (Moore, 1999). Graphically Pareto Optimality can be shown via the following figure 2.9.

Figure 2.9 Pareto Optimality in a perfectly competitive market



(Source: Perman, et al., 1996)

The shaded figures in figure 2.9 shows the maximum benefit that can be obtained through perfectly competitive trade in the marketplace. It is made up of (i) the consumers surplus (CS), that area under the demand curve that represents the difference between what consumers are willing to pay (WTP) and what they actually have to pay; and (ii) the producers surplus (PS), the difference

between the amount producers actually receive and what they are willing to receive.

This Pareto optimum implies (i) an optimal distribution of goods among consumers, (ii) an optimal technical allocation of resources, and (iii) optimal quantities of outputs (Perman, et al., 1996).[4] The concept is essentially based on efficiency, that is, society is maximizing the amount of goods and services it can produce from a limited supply of resources.

2.5.2 Market Failure: Property Rights

As stated above, there are a number of failures in the marketplace when valuing environmental resources. As the term market failure suggests, there is a failure in the market that does not allow for Pareto optimality to exist (Perman, et al., 1996). The most influential market failure in respect to the coastal environment is ill-defined property rights. Randall (1987) states that markets derive their effectiveness from non-attenuated property rights and performs its functions through the instrumentality of efficient relative prices.

For property rights to be effective in allocating resources they need to be non-attenuated, that is, property rights are properly defined and can be enforced. Non-attenuated property rights provide incentives for resource owners to use their resources in such a way as to realise economic efficiency, and hence they lead to Pareto optimality (Moore, 1999). There are four criteria that must be met for property rights to be non-attenuated. Randall (1987) and Tietenberg (1992) provide succinct coverage to the requirements for non-attenuated property rights.

The requirements can be summarised as:

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[4] Perman, et al., 1996: 81-84, provide a thorough account of the conditions needed for a Pareto optimum to exist.

(i) Universality – All resources are privately owned, and all entitlements completely specified (Tietenberg, 1992).

(ii) Exclusivity – All the benefits and costs of a resource must accrue only to the resource owner (Randell, 1987).

(iii) Transferability – Property rights must be transferable from one owner to another in an exchange (Tietenberg, 1992).

(iv) Enforceability – Property rights must be completely enforceable and secure from seizure or encroachment (Randell, 1987).

In essence there are four distinct types of property rights, these can be segmented as follows:

(i) Open Access Property – There is no defined 'owner' of the resource, so the benefits from that resource are available to all (Tietenberg, 1992).

(ii) Common Property – The resource is owned in common rather than privately. The members gather the benefits, and may exclude non-members from use of the resource (Tietenberg, 1992).

(iii) Private Property – Owners have rights but still have a duty to refrain from socially unacceptable uses (Randell, 1987).

(iv) State Owned Property – Where the resource is fully owned by the crown, and others have a duty to observe the regulations set down by the governing body, central or local governments (Tietenberg, 1992).

State ownership governs the New Zealand coastal environment. The Department of Conservation and local authorities are charged with managing New Zealand's coastal resources. Due to the nature of protected areas, only government intervention, or state ownership, will ensure that the New Zealand coastal environment is protected; this is because national protected areas are public goods in essence.

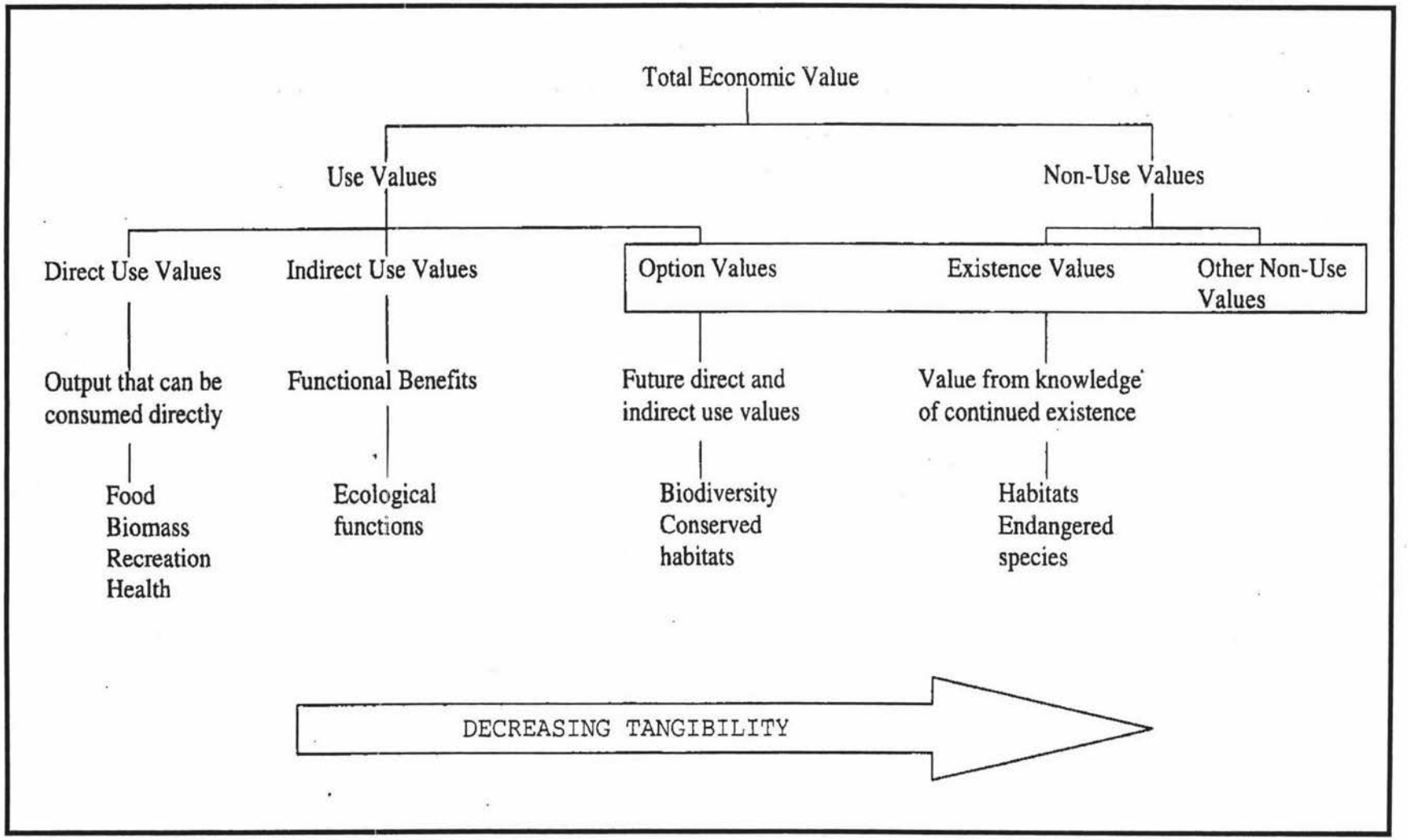
2.5.3 Market Failure: Public Goods

A good or service is termed a 'public good' if a user does not deplete the values it provides, and it is difficult to exclude others from gaining those benefits (Tietenberg, 1992; Perman, et al., 1996; Moore, 1999). A public good is characterised as being non-rival, and non-excludable (Frank, 1998). In comparison a private good, such as a chocolate bar, is both rival and excludable. The chocolate bar can only be consumed once it has been purchased. Once consumed, it is not available for consumption by others. For these reasons a person will provide a private good but generally not a public good. People can not be excluded from the benefits of a public good, so the person providing the public good has no way of making others pay for it. The free market fails to provide public goods, so therefore government intervention is needed.

2.5.4 Total Economic Value

If public goods are to be provided in the market place, estimates to the value that each good provides need to be calculated. Environmental resources provide a unique situation where differing values can be associated with them. Figure 2.10, from Munasinghe (1992) outlines the differing valuations that form 'total economic value.' As can be seen, total economic value is divided into both 'use' and 'non-use' values.

Figure 2.10: The types of value that constitute the total economic value of a resource



(Source: Munasinghe, 1992)

'Use' value is the value that is expected from current and future uses of the resource, whether it be commercial, sport or scenic activities (Kerr, 1986). It includes both direct uses and indirect uses. Direct use is the outputs of the resource being used or consumed directly. Indirect use is the benefits that the resource may provide besides direct uses, for example the ecological functions of the resource.

'Non-use' values are exactly what they suggest. It is the value gained from a resource, but not from either direct or indirect uses. Option value, is a form of 'non-use' value that is unique. It is the value a consumer is willing to pay, to have the option to use the resource for some future use (Kerr, 1986; Perman, et al., 1996). Through this definition it can be seen that option values encompass both 'use' and 'non-use' values.

Two forms of 'non-use' values that are derived from environmental resources are bequest and existence values (Kerr, 1986). Both are unrelated to whether or not the consumer will ever be able to benefit directly or indirectly from the resource (Moore, 1999). Bequest value is derived from the knowledge that future generations are going to be able to experience the resource (Kerr, 1986). Existence values are generated from the knowledge that the resource continues to exist (Perman, et al., 1996). Figure 2.10 provides examples of the differing types of values. All of the examples provided could apply to the New Zealand coastal environment.

It is this concept of 'non-use' values that geographers have studied when attempting to value environmental resources. Nordstrom (1988) looks at the concept of 'Intrinsic' values in depositional coastal landforms. He suggests that natural landforms and processes represent a value in themselves;

"As time passes, natural landscapes become ever more susceptible to conversion, human memory of natural landform characteristics fades,

documentation of those characteristics becomes scarcer, and people accept current conditions as a natural system. The landscape may remain valuable to humans, but the interactions of processes and the resultant landforms that characterised the natural system are modified, and the intrinsic value of the physical landscape is gradually lost." (1988: 68)

He goes on to suggest that at present the most compelling argument for preserving the coastal environment is the protection of habitats for rare or endangered species, or the protection of ecological productivity (Nordstrom, 1988).

Yet these views towards values do conflict with how economists have attempted to value environmental resources. It is widely regarded by economists that only using a Contingent Valuation Method (CVM) Survey can a value be created for environmental resources (Randall, 1987; Mitchell and Carson, 1989; Perman, el al., 1996).

2.5.5 Contingent Valuation Method Surveys

Since the early 1970's the contingent valuation method (CVM) survey has been used to value the costs and benefits of a wide range of non-market goods. These range from recreational experiences, to nuclear power plant accidents (Mitchell and Carson, 1989).

To value the benefits that people gain from a non-market good, the contingent valuation method seeks to estimate either the willingness to pay (WTP) or the willingness to accept (WTA) compensation for some change in the supply or quality of a non-market good, according to the property rights associated with that good (Mitchell and Carson, 1989; Moore 1999). The change in the supply or quality of the non-market good is done through the creation of a hypothetical market.

Mitchell and Carson (1989) state that respondents to contingent valuation method surveys should be presented with material consisting of three complimentary parts:

1. a description of the good being valued, and the hypothetical circumstances under which they are made available to respondents.

2. questions which elicit each respondents willingness to pay for the goods being valued.

3. questions about respondents demographics, their preferences relevant to the goods being valued, and their use of the goods.

The questions concerning the willingness to pay for an environmental resource are considered to be very important and can take two forms (Mitchell and Carson, 1989). The two options are presented below:

Open-ended questions are very simple. They ask respondents to place a value on the goods in question. An example for this research could be;

> *"What is the maximum amount per hectare you would be willing to pay for the establishment of conservation land in the Manawatu dunefield?"*

The limitations are that respondents usually find it hard to quantify this value. For this reason other methods are used, the most common being dichotomous choice (Mitchell and Carson, 1989). This is normally presented as:

> *"Would you be willing to pay $X per hectare for the establishment of a conservation area in the Manawatu dunefield?",*

where X is the dollar amount, and a range of dollar values may be provided for respondents.

The dichotomous choice question attempts to replicate those choices faced in a real market situation. From the answers given by respondents, average and total willingness to pay is able to be determined.

A contingent valuation method survey is normally conducted by face to face interviews, telephone interviews, or mail questionnaires (Perman, et al., 1996).

2.5.6 Limitations of Contingent Valuation Method Surveys

The contingent valuation method surveys are limited by the assumptions that they are based upon, and by the biases that can be created in attempting to quantify respondents willingness to pay for an environmental resource (Moore, 1999). It is important for these limitations to be recognised.

Cummings, Brookshire, and Schulze (1986) consider contingent valuation method surveys to be based on two assumptions. Firstly, the respondents have an incentive to determine their order of preference between the good being examined and other relevant goods and services. This occurs when respondents are asked to value the resource in question against others. They may not devote enough time and effort quoting a value that truly represents their valuation.

Secondly, the respondents will behave strategically. Respondents are able to influence the level of provision of the good or resource. They can be influential in either over or understating their true willingness to pay. This is known as strategic bias, and is one of the less subtle forms of measurement biases that if present, can mean the results of a contingent valuation method survey are unreliable (Cummings, et al., 1986; Moore, 1999).

A complete list of potential biases is presented in table 2.2

Table 2.2 Potential measurement biases that can be present in contingent valuation method surveys

1. *Incentives to Misrepresent Responses*
   Biases in this class occur when a respondent misrepresents his or her true willingness to pay (WTP).
   A. *Strategic Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount (conditional on the perceived information) in an attempt to influence the provision of the good and/or the respondents level of payment for the good.
   B. *Compliance Bias*
      1. *Sponsor Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to comply with the presumed expectations of the sponsor (or assumed sponsor).
      2. *Interviewer Bias*: where are respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to either please or gain status in the eyes of a particular interviewer.
2. *Implied Value Cues*
   These biases occur when elements of the contingent market are treated by respondents as providing information about the "correct" value for the good.
   A. *Starting Point Bias*: where the elicitation method or payment vehicle directly or indirectly introduces a potential WTP amount that influences the WTP amount given by a respondent. This bias may be accentuated by the tendency of some respondents to agree with an interviewer's request regardless of their true views.
   B. *Range Bias*: where the elicitation method presents a range of potential WTP amounts that influence a respondent's WTP amount.
   C. *Relational Bias*: where the description of the good presents information about its relationship to other public or private commodities that influences a respondent's WTP amount.
   D. *Importance Bias*: where the act of being interviewed or some feature of the instrument suggests to the respondent that one or more levels of the amenity have value.
   E. *Position Bias*: where the position or order in which valuation questions for different levels of a good (or different goods) suggest to the respondents how those levels should be valued.
3. *Scenario Misspecification*
   Biases in this category occur when a respondent does not respond to the correct contingent scenario. Except in A, in the outline that follows it is presumed that the *intended* scenario is correct and that the errors occur because the respondent does not understand the scenario as the researcher intends it to be understood.
   A. *Theoretical Misspecification Bias*: where the scenario specified by the researcher is incorrect in terms of economic theory or the major policy elements.
   B. *Amenity Misspecification Bias*: where the perceived good being valued differs from the intended good.
      1. *Symbolic*: where a respondent values a symbolic entity instead of the researchers intended good.
      2. *Part-Whole*: where the respondent values a larger or smaller entity than the researcher's intended good.

a. *Geographical Part-Whole*: where a respondent values a good whose spatial attributes are larger or smaller than the spatial attributes of the researcher's intended good.
b. *Benefit Part-Whole*: where a respondent includes a broader or a narrower range of benefits in valuing a good than intended by the researcher.
c. *Policy-package Part-Whole*: where a respondent values a broader or a narrower policy package than the one intended by the researcher.

3. *Metric*: where the respondent values the amenity on a different (and usually less precise) metric or scale than the one intended by the researcher.
4. *Probability of Provision*: where a respondent values a good whose probability of provision differs from that intended by the researcher.

C. *Context Misspecification Bias*: where the perceived context of the market differs from the intended context.

1. *Payment Vehicle*: where the payment vehicle is either misperceived or is itself valued in a way not intended by the researcher.
2. *Property Right*: where the property right perceived for the good differs from that intended by the researcher.
3. *Method of Provision*: where the intended method of provision is either misperceived or is itself valued in a way not intended by the researcher.
4. *Budget Constraint*: where the perceived budget constraint differs from the budget constraint the researcher intended to invoke.
5. *Elicitation Question*: where the perceived elicitation question fails to convey a request for a firm commitment to pay the highest amount the respondent will realistically pay before preferring to do without the amenity. (In the discrete-choice framework, the commitment is to pay the specified amount).
6. *Instrument Context*: where the intended context or reference frame conveyed by the preliminary nonscenario material differs from that perceived by the respondent.
7. *Question Order*: where a sequence of questions, which should not have an effect, does have an effect on a respondent's WTP amount.

(Source: Mitchell and Carson, 1989: Table 11-1)

The contingent valuation method survey is also limited by the difficulties encountered in determining an appropriate sample of respondents to survey, and the inferences that can be drawn from that survey (Mitchell and Carson, 1989; Moore, 1999). Without sufficient thought and consideration for this, the survey can still be biased without measurement errors. Table 2.3 on the following page highlights some of the potential sampling and inference biases that can be generated when conducting a contingent valuation method survey.

Table 2.3 Potential sampling and inference biases

1. *Sample Design and Execution Biases*
   - A. *Population Choice Bias*: where the population chosen does not adequately correspond to the population to whom the benefits and/or costs of the provision of the public good will accrue.
   - B. *Sampling Frame Bias*: where the sampling frame used does not give every member of the population chosen a known and positive probability of being included in the sample.
   - C. *Sample Nonresponse Bias* : where the sample statistics calculated by using those elements from which a valid WTP response was obtained differ significantly from the population parameters on any observed characteristic related to willingness to pay; this may be due some respondents failing to respond to the survey, or even just some of the questions in it.
   - D. *Sample Selection Bias*: where the probability of obtaining a valid WTP response among sample elements having a particular set of observed characteristics is related to their value for the good.

2. *Inference Bias*
   - E. *Temporal Selection Bias*: where preferences elicited in a survey taken at an earlier time do not accurately represent preferences for the current time.
   - F. *Sequence Aggregation Bias*
     1. *Geographical Sequence Aggregation Bias*: where the WTP amounts for geographically separate amenities that are substitutes or complements are added together to value a policy package containing those amenities, despite the fact that the amenities are valued in an order (for example, independently) different from the appropriate sequence.
     2. *Multiple Public Goods Sequence Aggregation Bias*: where the WTP amounts for public goods that are substitutes or complements are added together to value a policy package containing those amenities, despite the fact that the amenities were valued in an order (for example, independently) different from the appropriate sequence.

(Source: Mitchell and Carson, 1989: Table 12-1)

Unless avoided, measurement, sampling and inference biases can make the results of a contingent valuation method survey unreliable (Mitchell and Carson, 1989; Perman et al., 1996; Moore, 1999).

2.6 Conclusions:

This chapter has presented a thorough overview of the literature on the Manawatu parabolic dunefield, the legislation on the implementation of conservation areas within New Zealand, and the issues surrounding the valuation of environmental resources.

The literature on the dunefield showed that the Manawatu coastal environment has evolved throughout the Holocene. The environmental and topographic conditions have led to the dunefield developing into a highly dynamic and excellent example of dune development throughout Australasia.

The legislation governing the evaluation and implementation of conservation areas throughout New Zealand has led to approximately one-third of New Zealand's total land area being protected. The requirement that the Department of Conservation protects all representative examples of New Zealand's environment, to ensure the preservation of New Zealand's natural character, is a necessary priority.

The Economic literature on the valuing environmental resources shows that the only recognisable method is the use of a Contingent Valuation Method Survey. It is the only method available that can be used to determine both use and non-use values.

The next chapter will outline the methodology techniques to meet the purposes of the research.

Chapter Three: Methodology

3.1 Introduction

This chapter outlines the methodology that was used in researching the values associated with coastal dunes throughout New Zealand. This involves the examination of Department of Conservation Management Strategies, and the surveying of local farmers and forestry owners about the monetary benefits and intrinsic values associated with the Manawatu coastal environment.

This chapter will examine the identification of all the benefits associated with coastal landforms, the questionnaire itself, and the relevant population.

3.2 Protected Dunelands

The Department of Conservation has identified that coastal dunes throughout New Zealand need increased protection (Department of Conservation, 1994a). Yet studies conducted by the Department of Conservation into increased protection for the Manawatu dunefield have also shown that aspects of coastal dunes are not deserving of protection (Ravine, 1992). This research is designed to determine what value coastal dunes have in the current national conservation estate, and what value local farmers place on the Manawatu dunefield.

While conducting this research, it became apparent that the Department of Conservation had very little information to provide about protected dunelands throughout New Zealand. The 13 Conservancies that have coastal components all have differing environmental landscapes to manage, and as such, great variation exists among the differing Conservancy Management Strategies.

The Conservation Management Strategies are broad. While 'priority' areas are outlined sufficiently within the differing management strategies, Conservation,

Reserves, and Wilderness Areas are not. The only indication to why these areas have been protected is the short justifications made within the conservation estate inventories, and even these varied greatly among the differing Conservancies. A prime example from the Auckland Conservancy is the South Kaipara Harbour conservation area;

"...outstanding complex of protected areas focused around the high dune and sand field." (Department of Conservation, 1995a, 185)

By examining the inventories of the conservation estate, a record of the protected areas that have dune components was compiled by Conservancy. These areas were then transposed onto 1:1,000,000 maps. The results of which can be seen in chapter four. The limitations of these dune maps are also outlined in the chapter.

3.3 Identification of Benefits

The identification of all the benefits associated with coastal landforms needs to be calculated before a value can be attributed to that landform. As indicated in figure 2.10, there are a number of differing values associated with environmental resources. Davis and Cocklin (2001) include aesthetic, therapeutic, educational, symbolic, cultural, ethical, religious or moral values to these. The economic benefits associated with conservation can be divided between those involving actual and potential uses and those arising without any actual use.

Table 3.1 shows the differing values associated with the creation of conservation areas throughout New Zealand's dunelands. The benefits in table 3.1 were produced by consulting several sources of information. This included general literature on the subject, the Horowhenua District Council District Plan, and Department of Conservation landscape value reports.

While use values may be easily quantifiable, it is the 'indirect' and 'option' values associated with landforms that may provide the most compelling reason for re-evaluating the values associated with coastal landforms.

Table 3.1 Benefits associated with the creation of Conservation Areas

	Ecological	Aesthetic
Direct and Indirect Use Values	- Act as an essential store of sediment protecting the hinterland from storm erosion and potential sea level rise. - With vegetation, trap wind blown sand and stabilize beaches and dunes. - Provide specialized habitats for plants, birds and animals.	- Preservation of New Zealand's Natural Character. - Increase in enjoyment of possible recreational activities.
Option Values	- If utilized wisely, provide recreational and living space. - Preservation of environment for potential future use.	- Increase visitor satisfaction with the knowledge of environmental protection. - Enhanced International reputation for environmental protection.
Non-Use Values	- Along with beaches, represent one of the most dynamic natural ecosystems in our environment. - Provide us with a range of unique landforms and ecosystems, which have high natural character.	- Increase number of local endemic flora and fauna at the site.

3.3.1 Use Values

Use Values, are defined as values derived from the actual of potential future use of the environment (Perman, et al, 1996). Respondents to this Contingent Valuation Survey have to create a value from the use that they gain from the dunelands. This can be done through the economic revenue generated from the differing uses of the dunefield.

3.3.2 Non-Use Values

Non-use Values are defined as values that are gained unrelated to any use of the environment (Perman, et al, 1996). These values can also be defined as 'Intrinsic' (Kopp, et al, 1997). During this survey, respondents are asked to derive values associated with differing landforms based in the Manawatu sand country. These landforms were identified through previous studies conducted on the dunefield by the Department of Conservation.

3.4 The Survey

The objective of this research is to determine whether or not conventional economic valuing techniques can be used in the identification and implementation of conservation land in New Zealand. As such a contingent valuation method has been chosen as the survey technique.

With the relatively small survey population located within the Manawatu Parabolic Dunefield, personal interviews were conducted. This was deemed most appropriate so that the questions could be tailored to the respondent's circumstances. Questions that were irrelevant could be skipped, or questions could be clarified if respondents were uncertain about the information provided.

3.4.1 The Questionnaire

A questionnaire was written to determine whether or not the surveyed population was aware of the non-economic values associated with the Manawatu dune country. Two examples of this are (i) the dynamic nature of the parabolic dunes, and (ii) the potential for conservation of an 'outstanding' natural landscape.

The objectives of the survey determine what form and style is best. In this research the survey has three primary objectives:

1. To obtain an accurate indication as to how the Manawatu dunefield is currently being used.

2. To gather farmer opinions to previous studies conducted about intrinsic values associated with landforms in the dunefield.

3. To obtain an accurate indication to the willingness to pay for an area of conservation land in the Manawatu dunefield.

To meet these objectives of the survey, various sources were used to establish a list of questions that would be relevant to both the surveyed population and the research being undertaken.

The questions were formulated in a style and sequence with the specific aim of gaining information that allows a more informed decision to be made. Dillman (1978) provides three key questions in the design of any survey:

> Will it obtain the desired kind of information?
> Is the question structured in an appropriate way?
> Is the precise wording satisfactory?
> (Dillman, 1978: 118)

When these three questions are answered in the affirmative the questionnaire is constructed in a manner that allows it to be its own advocate. Appendix Four has a copy of the survey form and associated information sheet that was delivered to willing respondents.

There are three main components to the survey for this research. These are; (i) what the Manawatu Sand Country is currently used for, (ii) the farmer's views on the Department of Conservation report concerning areas that could potentially deserve legislative protection, and (iii) the farmers willingness to accept, and willingness to pay for the implementation of conservation land within the dunefield.

The questions were arranged so that the sections linked with one another. The order was chosen to get respondents to think about the benefits associated with conservation land before questions concerning the willingness to pay were asked.

The first part of the survey is of little primary importance for the research. It is just introductory questioning to get the respondent to think about how the Manawatu dunefield is being used.

The second component introduces the respondents to studies that have already been conducted by the Department of Conservation on the Manawatu Dunefield. With open-ended questions, respondents were invited to express their views about the landforms, and any intrinsic values associated with the landscapes.

The third component is of primary importance for this research, and as such was placed last in the survey. Respondents have already been introduced to studies about what landforms have been considered for protection, and have been asked to think about the associated intrinsic values of these landscapes. By placing the willingness to pay section here, respondents are asked to determine the

conservation potential for the dunefield compared to the current use of the dunes.

3.5 Surveyed Population

An important step in developing any contingent valuation method survey, is to identify the population that is likely to be affected by the proposed project (Mitchell and Carson, 1989). In the case of the creation of a conservation area in the Manawatu sand country, those that are directly affected by the creation of conservation land are local farmers and forestry owners.

To form a list of potential respondents, those that are to be affected by the implementation of a Conservation area in the Manawatu parabolic dunefield had to be identified. For this case study information was solicited from the three District Councils that the dunefield extends through, the Rangitikei, the Manawatu, and the Horowhenua Councils. The Councils had a list of ratepayers and property addresses, but little information about what the properties were used for.

The low-lying flat topography of the Manawatu plains provides the ideal landscape for agricultural practices. The Manawatu parabolic dunefield covers over 900km^2 and extends from north of Turakina to south of Foxton. The Manawatu sand country is primarily used for farming and forestry. Farming practices range from sheep and beef to deer. Two large forestry plots are based within the region. These are Rayonier New Zealand Ltd, based out of Levin, and Ernslaw One, based out of Bulls.

Initial phone conversations were conducted to determine whether or not individual respondents were willing to participate in the surveys. Of those that were willing, appointments were made to suit respondents, and personal surveys were conducted.

3.6 Dunefield Identification

It is the attempt of this research to determine whether or not a section of the Manawatu parabolic dunefield deserves protection in an area of conservation land. In determining this it is important to ascertain whether or not the current conservation estate administered by the Department of Conservation is truly representative of all dune types. It is stated that full representativeness is one of the primary aims of the Conservation Department, and this is backed by there being a legislative requirement for the Department of Conservation to protect all representative examples of New Zealand's environment.

The use of New Zealand Mapping Services aerial photos needs to be used in the identification of protected dune lands in each of the of the current protected areas. Aerial photos are widely used in the identification of landforms. They provide simplicity and ease when needing to identify any types of landforms. With aerial photos, usually, being black and white, most things visible can be seen with the naked eye. The wealth of detail on aerial photos tends to obscure important features that, due to scale limitations, may be invisible. Thus the photos need interpretation. It is possible to make this interpretation either more comprehensive or more selective than a map.

3.7 Conclusion

The construction of a questionnaire to determine what people are willing to pay for an area of Conservation land is not easy. For decision-makers facing similar tasks in the future, the questionnaire developed in this research is a good starting point. With a little tinkering it could easily be adapted to the individual circumstances facing some of the diverse landscapes and the many small coastal communities throughout the country.

As considered in this chapter, there are very good reasons for the layout, design and construction of the questionnaire. The results it yields and possible suggestion for the alteration in it design and delivery will be discussed in chapters 5 and 7.

Chapter Four: Review of the Dunelands in the Current Conservation Estate

4.1 Introduction

One of the most important risks facing New Zealand's coastal environment is the inadequate protection of some of New Zealand's most significant geomorphological areas. The New Zealand coastline stretches for over 15,000 kilometers, and varies greatly from open sandy beaches to rocky cliffs.

Within New Zealand, the Department of Conservation is charged with the protection and preservation of those areas that are considered to be of high 'natural character' or that have high 'outstanding value'. But often it appears that the Department of Conservation has protected areas of the coastline because of extraneous reasons, rather than for being prominent examples of geomorphological landscapes.

This chapter will outline what role the Department of Conservation has in identifying 'outstanding' areas, and with establishing zones of protection. It will then catalogue which Conservancies have adequately protected the coastal dunes of New Zealand. Finally it will identify some problems with the current selection criteria for protected areas.

4.2 The role of the Department of Conservation

On behalf of New Zealanders the Department of Conservation is charged with the protection and preservation of about one third of New Zealand's total land area, protected for scenic, scientific, recreational, historic or cultural reasons. The Department of Conservation also works in partnership with associates and communities for conservation on private land schemes and not just Crown land (www.doc.govt.nz).

The functions of the Department of Conservation are set out in the Conservation Act (1987), section 6. Section 2.4.1 gave a broad summary of the government legislation governing the Department of Conservation's roles in the preservation and protection of New Zealand's environment.

In 1996 the Department of Conservation presented the briefing paper, *'Greenprint:* Conservation in New Zealand', to the incoming Labour Government (Department of Conservation, 2000). It highlighted the five critical issues facing the Department of Conservation and the New Zealand environment. These are;

(1) Turning around the decline in New Zealand's indigenous biodiversity.
(2) Ensuring that the most valuable ecosystems are protected in the conservation estate and that the estate is representative of the range of New Zealand biodiversity, so that conservation of our natural heritage is assured.
(3) Consolidating the new systems of quality assurance and accountability developed after the Cave Creek tragedy.
(4) Reconciling the Department's responsibility under section 4 of the Conservation Act to give effect to the principles of the Treaty of Waitangi with its overall conservation mission.
(5) Recognising that the public interest in conservation, both within New Zealand and internationally, is high, and that many conservation issues engender heated public debate (Department of Conservation, 2000).

These five issues, plus the additional discussion, highlighted that the quality of New Zealand's management of the environment, including land managed by the Department of Conservation, is a significant factor in New Zealand's success in exports and in tourism (Department of Conservation 2000).
The Department of Conservation does not only administer land under the Conservation Act 1987. It is the combination of these other statutes that were reviewed in 2.4.1 that give the Department of Conservation its statutory authority.

4.2.1 The Department of Conservation

With the Department of Conservation being charged with the protection and preservation of New Zealand's environment, the Department has established three main regional areas within New Zealand. These are the Northern, Central, and Southern regions. It has further separated these regions into 14 conservancies. These are:

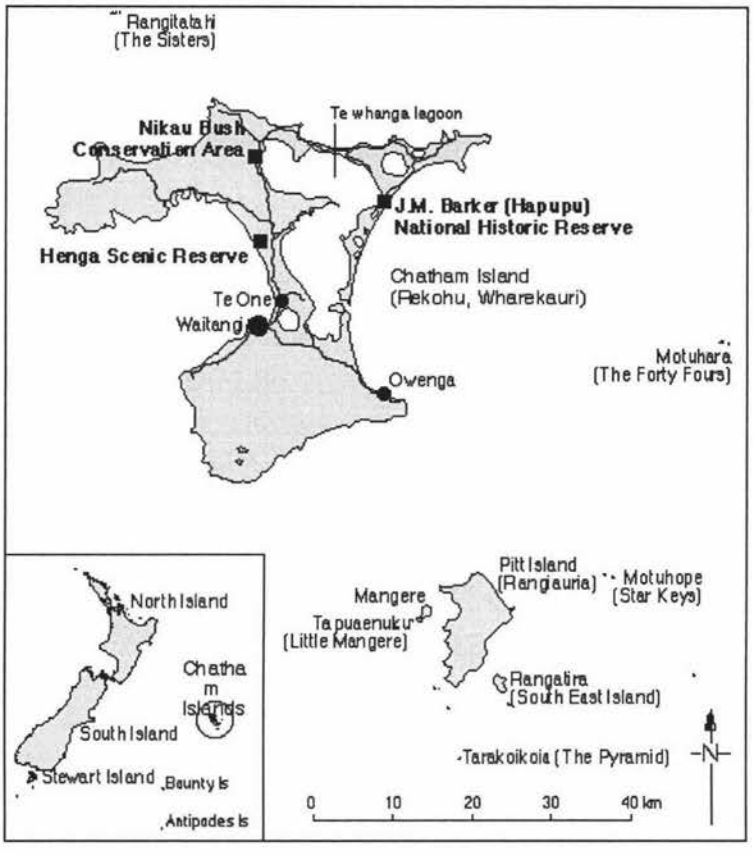
- Northland Conservancy (Northern Region)
- Auckland Conservancy (Northern Region)
- Waikato Conservancy (Northern Region)
- Bay of Plenty Conservancy (Northern Region)
- Tongariro-Taupo Conservancy (Central Region)
- East Coast/Hawkes Bay Conservancy (Central Region)
- Wanganui Conservancy (Central Region)
- Wellington Conservancy (Central Region)
- Chatham Islands Conservancy (Central Region)
- Nelson/Marlborough Conservancy (Central Region)
- Canterbury Conservancy (Southern Region)
- West Coast Conservancy (Southern Region)
- Otago Conservancy (Southern Region)
- Southland Conservancy (Southern Region)

Maps 4.1 and 4.2 in the following pages show the conservancy boundaries within New Zealand.

Map 4.1 Conservancy Boundaries in mainland New Zealand

(Source: www.doc.govt.nz)

Map 4.2 The Chatham Islands Conservancy



(Source: www.doc.govt.nz)

Each of these conservancies is responsible with the preservation and day-to-day management of the environment and the current protected areas within their specified boundaries.

Each conservancy also identifies specific 'ecological districts' within its boundaries. The 268 ecological districts represent a local part of New Zealand where the features of geology, topography, climate and biology, plus the broad cultural pattern, interrelate to produce a characteristic landscape and range of biological communities (Technical Advisory Group, 1986).

Each 'ecological district' is responsible for the identification and assessment of unprotected areas within their region that may deserve future protection in the 'Recommended Areas of Protection (RAP's) programme.

4.2.2 Assessing the Environment

Before the Conservation Law Reform Act of 1990, the Department of Conservation was required to create separate management plans for each of the differing land units under the Conservation, Reserves, Wildlife and National Parks Acts (Department of Conservation, 1994a). These were largely unrelated to one another and did not provide a sense of the Department of Conservation's combined activities.

Section 17D(2) of the Conservation Act, inserted by the Conservation Law Reform Act (1990), introduced a new requirement for the Department of Conservation to produce Conservation Management Strategies for all conservancy areas managed by the Department. The purpose of these Conservation Management Strategies, as stated in the Conservation Act, are to implement the policies and establish objectives for the management of natural and historic resources managed by the Department of Conservation under the statutes with which their regulatory powers are founded upon (Conservation Act, 1987; Department of Conservation, 1995a).

Each Conservation Management Strategy provides a map of the ecological districts within the conservancy, plus an inventory of all the land administered by the Department. Each protected area is described, and a short justification is made for why the area deserves protection and preservation.

The Conservation Management Strategies also have a number of important management requirements. They outline the major issues and management functions that should be dealt with over a ten-year period. They outline how the Department of Conservation proposes to fulfill its responsibilities during this period, for present and future users of the land administered by the Department (Department of Conservation, 1995b).

While the Conservation Management Strategies outline what the Department of Conservation currently protects, it is the 'Protected Natural Areas Programme', and the 'Recommended Areas of Protection', which is carried out through each ecological district that identifies those additional areas that may require protection. The programme was established in 1983 in response to the objective expressed in section 3(1)(b) of the Reserves Act (1977), which defined the need for,

"Ensuring, as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems and landscapes which in their aggregate gave New Zealand its own recognizable character." (Ravine, 1992: 5)

The purpose of the protected natural areas surveys, are to identify representative landscapes and ecological features that are inadequately protected, and recommend areas for protection which, if protected, would compensate for these inadequacies (Ravine, 1995).

4.3 Current Protection

4.3.1 Current Selection Criteria

As stated in 4.2.2 the Department of Conservation has established a 'Protected Natural Areas Programme' in each of the 268 Ecological Districts throughout New Zealand. These surveys are carried out to identify and protect examples of the full range of indigenous and biological landscape features in New Zealand, thereby preserving New Zealand's distinctive natural character (Ravine, 1995).
The criteria used in the selection of these potential areas of protection are:

- Representative – examples of ecosystems or communities, or combinations of ecosystems that are either unrepresented or poorly represented in existing protected natural areas.
- Natural Diversity – species, habitats, communities, ecosystems, and physical features (relating to climate, landforms, drainage patterns, geology and soils).
- Rarity and Distinctiveness – contains examples of rare or distinctive elements of New Zealand's natural diversity (including communities that are unique or endemic to either New Zealand or the ecological district).
- Naturalness – the extent to which an area is characterized by a lack of human disturbance or intervention.
- Long-term viability – the extent to which an area will be able to retain its inherent natural values and character over a long time period (including factors related to the nature of the ecosystems and/or communities contained in the area, and factors related to external influences).
- Area, shape, spatial configuration and boundaries – the extent to which an area proposed for protection has been designed to ensure its effectiveness in protecting the natural features it contains, and to ensure its long-term viability

(Department of Conservation, 1994a; Ravine, 1992; 1995).

Through the use of these criteria, one third of New Zealand's total land area has been deemed worthy of protection.

4.3.2 National Protection

The current land administered by the Department of Conservation is protected under the various Acts stated in 2.4.1. As such these protected areas were established for historic reasons, and the land held is preserved under the requirements stated in each relevant Act.

Currently in New Zealand there are 14 National Parks, four in the North Island, nine in the South, and Rakiura on Stewart Island becoming the latest to receive

the recognition of national protection. The National parks combine to cover approximately 3 million hectares, or just over 10 percent of the total land area (Department of Conservation, 2000). They are protected in perpetuity for,

The Department of Conservation has determined that nearly 3000 areas in New Zealand deserve to have protection under the Reserves Act (1977). Table 4.1 below separates each reserve into their various sub-categories.

Table 4.1 Department of Conservation Reserves within New Zealand

Reserves Sub-categories	Conservation Units[5]	Area (in hectares)
National	8	96,388
Historic	140	3,749
Scenic	1,469	373,473
Nature	56	109,133
Scientific	80	15,488
Wilderness area	0	0
Government & local purpose	1,222	50,613
Marine	15	758,050
Net Total	2,977	1,234,026

(Source: www.doc.govt.nz)

[5] A 'conservation unit' is a standard grouping of parcels of land which is used in the Department of Conservation's National Land Register.

In addition to the National Parks and Reserves within New Zealand, the Department of Conservation also administers land under each of the Conservation, Wildlife, and the Marine Mammals Protection Acts.

Conservation Areas are established to protect the natural and historic resources for their intrinsic values and for the recreational enjoyment of the public (www.doc.govt.nz). Both the Wildlife Areas and Marine Mammals Sanctuaries are established for the absolute protection of all wildlife in the areas, and the preservation of critical breeding populations of threatened marine mammals (Wildlife Act (1953) s. 9&10, Marine Mammals Protection Act (1978), www.doc.govt.nz). Tables 4.2 and 4.3 provide figures for the types of wildlife areas and Marine Sanctuaries in New Zealand.

Table 4.2 Wildlife areas in New Zealand

Wildlife Area Sub-categories	Conservation Units	Area (in hectares)
Refuge	41	6,979
Sanctuary	8	1,714
Net Total	49	8,693

(Source: www.doc.govt.nz)

Table 4.3 Marine Sanctuaries in New Zealand

Marine Mammal Sanctuary	Conservation Units	Area (in hectares)
Sanctuaries	2	2,327,500

(Source: www.doc.govt.nz)

While the Department manages the current protected areas at a national level, each conservancy within New Zealand has to provide for the day-to-day management of protected areas at a regional level.

4.3.3 Conservancy Protection

All Conservancies in New Zealand are required, in their Conservation Management Strategies, to identify which areas within their boundaries are at risk from development and modification. A number of conservancies have stated their concern over the lack of protection awarded to the coastal environments within their boundaries. There is a belief that not all representative examples of New Zealand's coastal dunes are being protected (Department of Conservation, 1994a; 1997a; 1997b; 1999; Ravine 1992; Taylor and Smith, 1997).

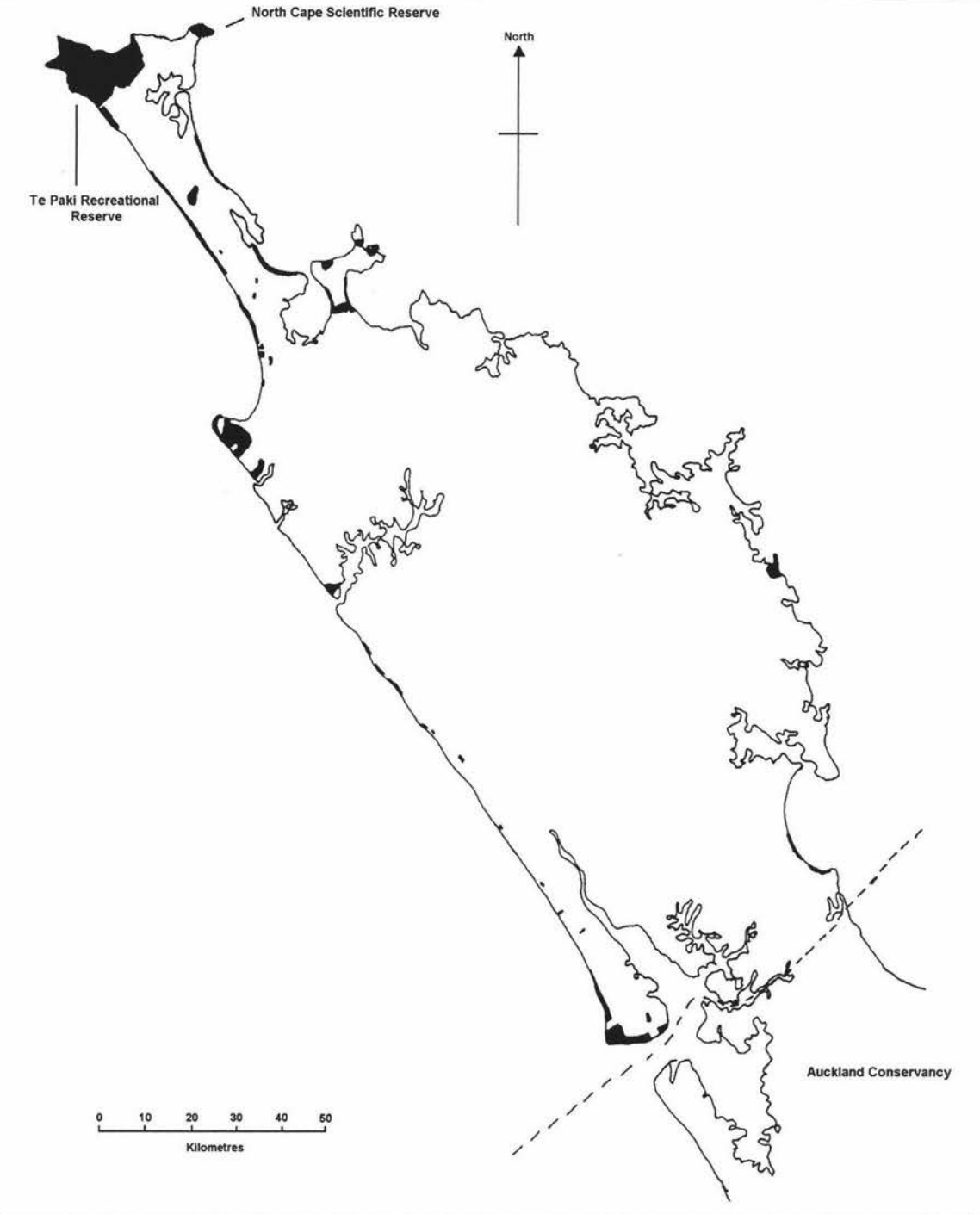
Each conservancy within New Zealand has a differing approach towards the preservation of the coastal environments within their boundaries. Of the 14 conservancies, 13 have sections of coastline. As the priorities of each conservancy differ, so do the scale of protection awarded to the coastal landscapes throughout New Zealand.

Northland Conservancy:

The Northland Conservancy is in the far north of the North Island. Its protection boundaries extend to the Three Kings Islands, and as far south as Kaipara Harbour. Of the 13 conservancies that have coastal components, the Northland Conservancy has protected the largest areas of dunes in New Zealand (Department of Conservation 1999b). This protection of dunelands has come about through the loss, or modification of 85% of the total dunelands in the Northland conservancy over the last 150 years, with those that remain being fragmented and modified to some extent (Department of Conservation, 1999b).

The Conservancy protects approximately 32,000 hectares of duneland, but these dunes are not representative examples of the total dune types nationwide. In fact the majority of the protected lands are either the foreshores or the foredunes of the sandy beaches in the conservancy. Map 4.3, on the next page, shows the protected dune areas within the Northland Conservancy.

Map 4.3 Protected Dune Areas in the Northland Conservancy



Auckland Conservancy:

The Auckland Conservancy is dominated by the largest metropolitan center in New Zealand. Yet the Department of Conservation has identified the 'rhythm and juxtaposition' of the Conservancy's coastline as the most important quality in the 'character' of the Conservancy (Department of Conservation, 1995a).

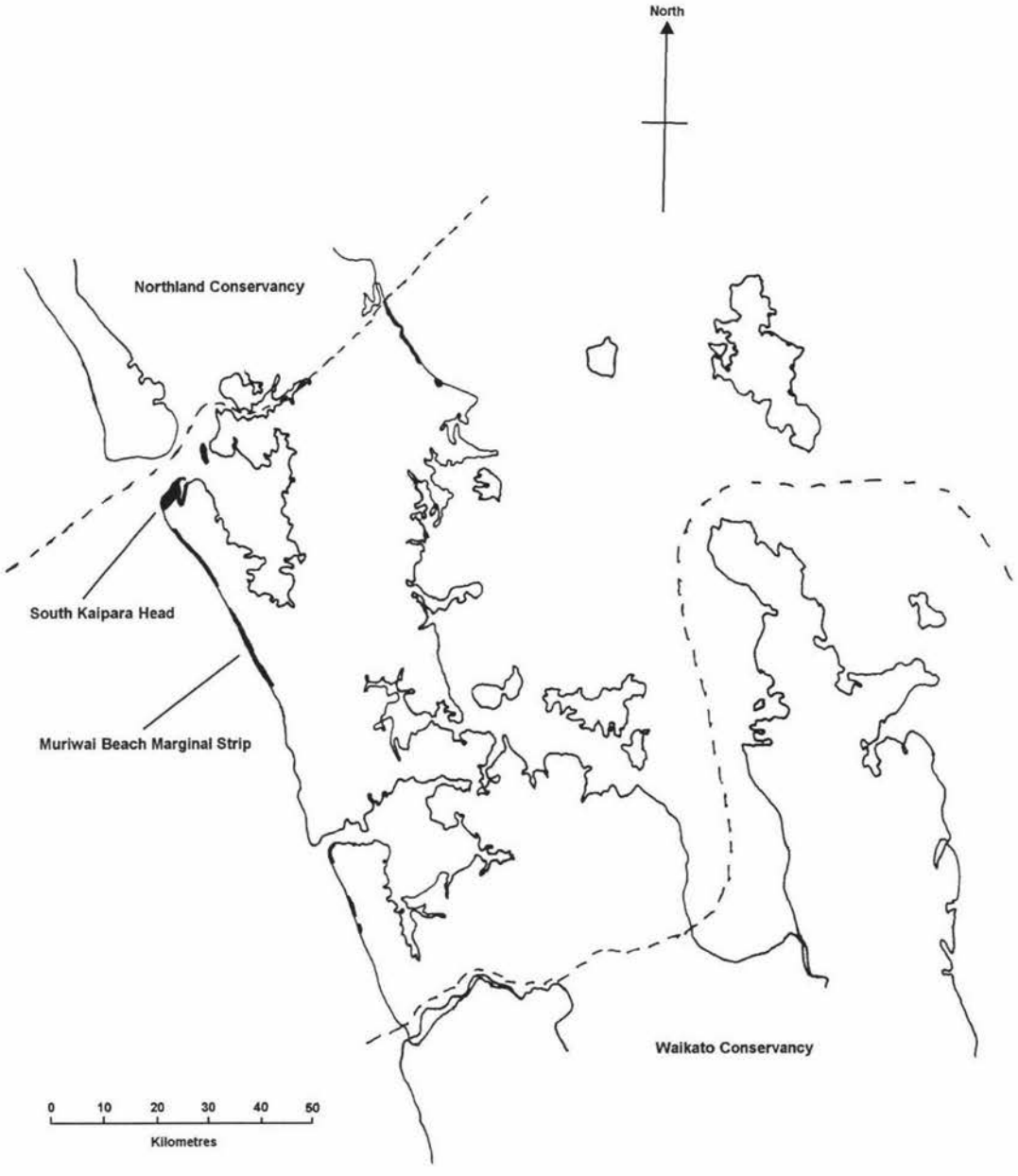
Currently over 36,000 hectares of land is administered by the Department, but only about 10,000 hectares is on the mainland, with the rest being made up from offshore islands.

Within this Conservancy, 16 dune areas, totaling over 1,300 hectares, are currently protected. The largest of these areas, the Papakanui Stewardship Area, is over 1,000 hectares, and is in Department hands for the presence of high foredunes, and rolling dune country from Murawai to Waionui Lagoon (Department of Conservation, 1995a).

Also two of the 'Key Areas' within the Conservancy, Okahukura/Kaipara Harbour, and South Kaipara Heads, have been identified as specially deserving protection for the presence of dunelands and the subsequent indigenous flora and fauna that propagate in the area.

Map 4.4 shows the extent of the protected areas in the Auckland Conservancy that have sections of coastline.

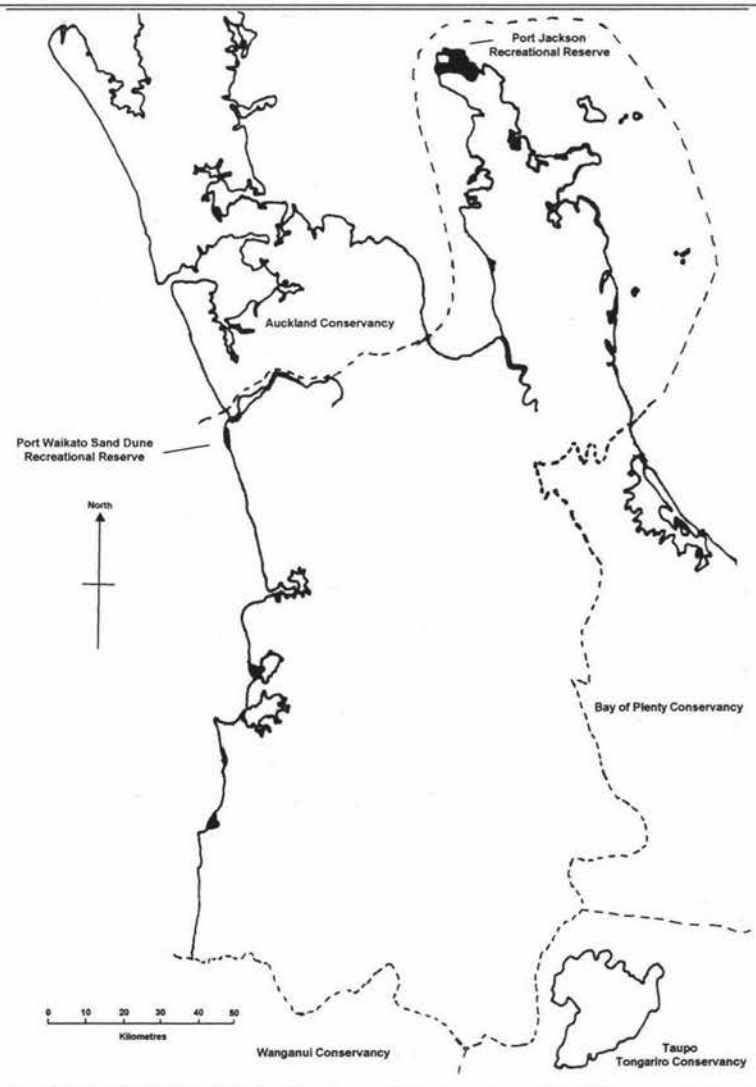
Map 4.4 Protected Dune Areas in the Auckland Conservancy



Waikato Conservancy:

The Waikato Conservancy is the most strongly influenced by local Maori. The Department of Conservation, in consultation with local Maori, has identified a number of historical Maori sites as deserving protection. As a result of these the Conservancy Management Strategy is dominated with the protection and preservation of these historical sites, the Conservancy Management Strategy does not adequately outline why and what environmental areas in the conservancy deserve protection. As Map 4.5 shows there is only little protection for dune areas within the conservancy, the two main areas being Port Waikato and Port Jackson.

Map 4.5 Protected Dune Areas in the Waikato Conservancy

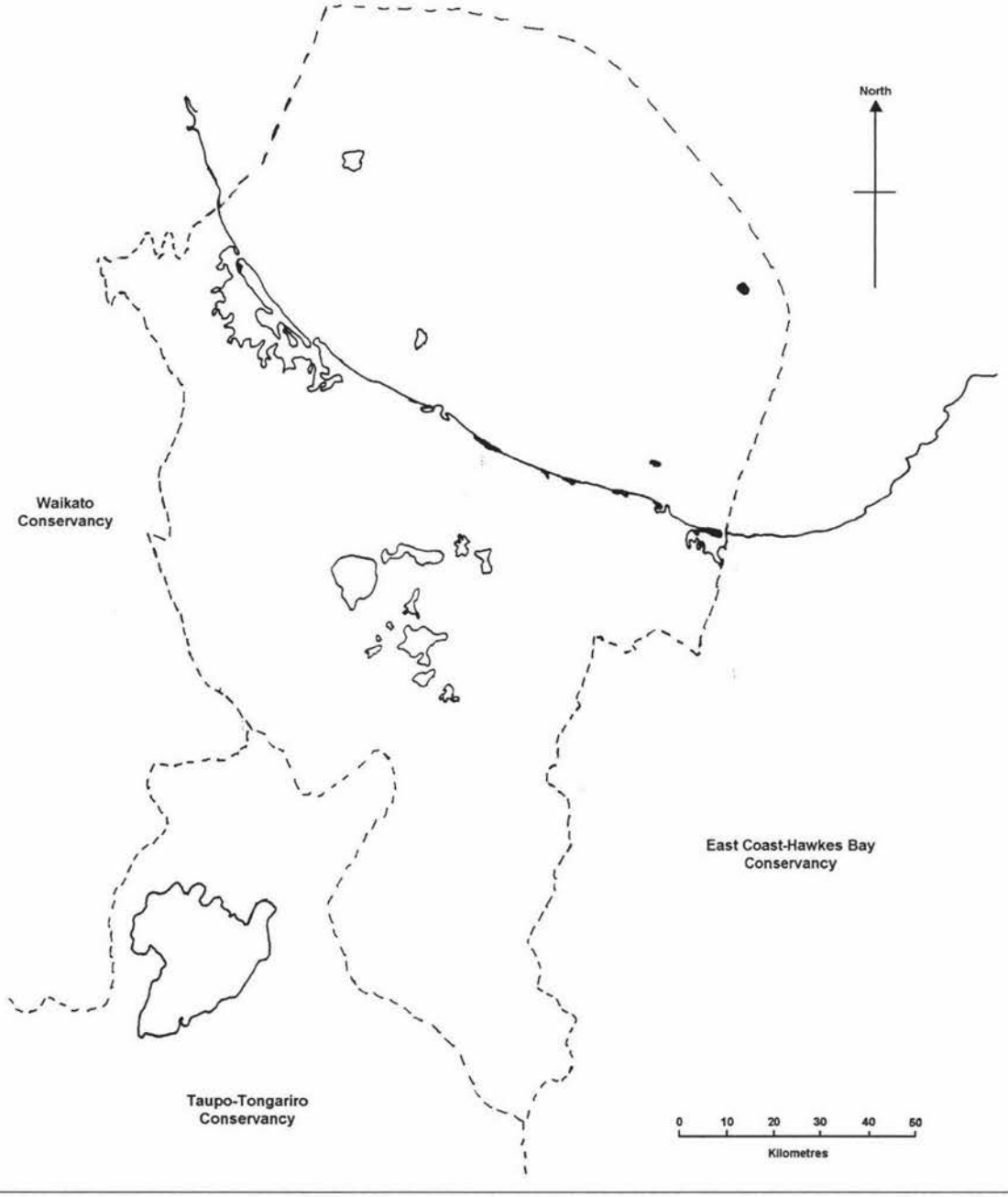


Bay of Plenty Conservancy:

The Bay of Plenty Conservancy coastline consists of an extensive sandy shoreline indented with many estuaries and backed by narrow dunes. These dunes however have been modified greatly along the entire coastline from burning, grazing, urban development and introduced plants (Department of Conservation 1997a). As such these dunes are given little priority for protection by the local Department of Conservation.

The department has identified 35 internationally significant sites within their boundaries, which is the most of any conservancy. But all of these are located within the zone of volcanic activity extending from White Island in the north, to Mt Ruapehu in the Tongariro-Taupo Conservancy. As such the conservation priorities are based around this volcanic zone.

Map 4.6 Protected Dune Areas in the Bay of Plenty Conservancy



East Coast/Hawkes Bay Conservancy:

This Conservancy, with less than 400 hectares, is one of the poorest for dune protection. The Conservation Management Strategy states that the Hawkes Bay coastline is;

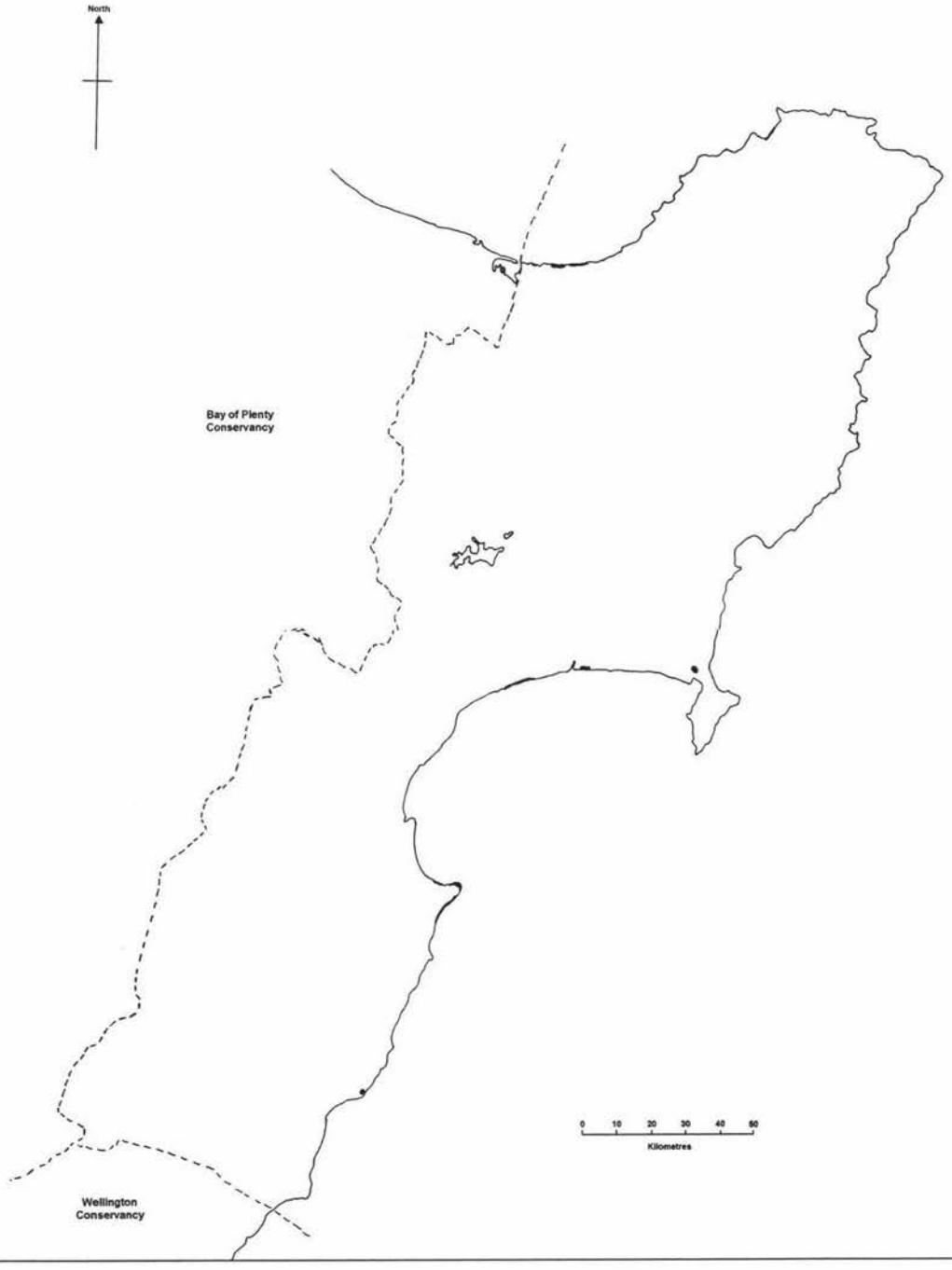
"...conspicuous for it's lack of protected areas, and as such many very important natural and historic values are threatened" (Department of Conservation, 1994a: 62).

Yet the areas identified as being of high priority for protection, do not include any coastal dunes. The Heretaunga and Eastern Hawkes Bay Ecological Districts have however identified the following coastal dune systems as deserving protection;

- Ahuriri-Tangoio coastal flats and wetlands
- Ocean Beach and Rangaiika sand systems, coastal flats and scarps
- Porangahau estuary dunes and coastal flats
- Cape Turnagain cliffs, dunes and Pa sites

(Department of Conservation, 1994a)

Map 4.7 Protected Dune Areas in the East Coast-Hawkes Bay Conservancy



Wanganui Conservancy:

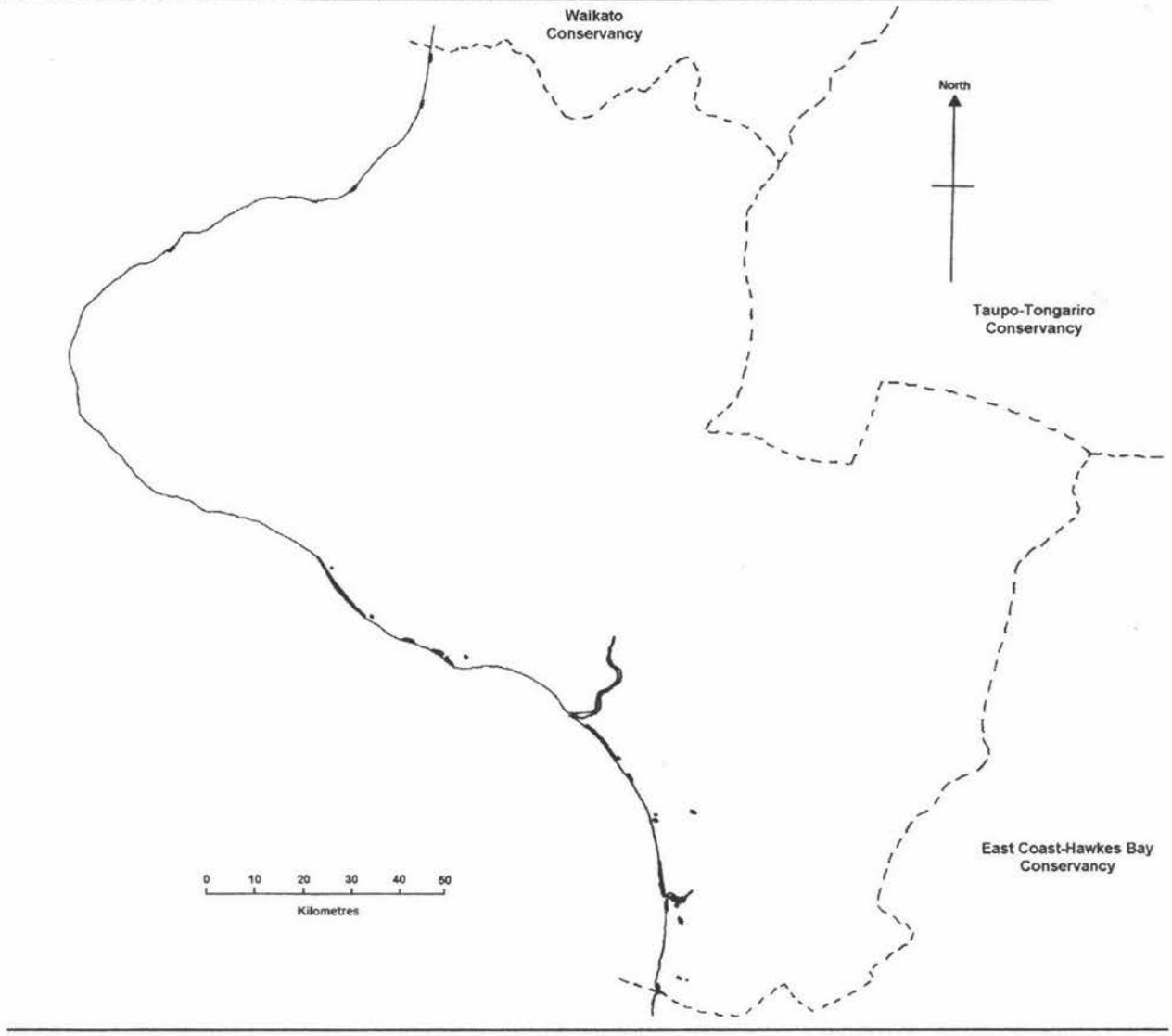
The Wanganui Conservancy encompasses approximately 20,000km^2 of land extending from the Mokau River in the north to the Manawatu River in the south, and inland to the Ruahine Ranges and Mt Ruapehu (Department of Conservation, 1997b). The department administers 299,891 hectares of land, which includes two National Parks, and 713 Reserves and Conservation areas.

Coastal dunes are present along the entire coast south of Mt Taranaki, small areas of dunes are present north of the Mountain, but cliffs predominate. Many of the Conservancy's threatened species are dependant upon dune habitats, and some have already been lost where these habitats have been modified (Department of Conservation, 1997b). Little recognition is given to the coastline in this Conservancy, with only six areas, totaling 176 hectares, being deemed worthy enough for protection. But of these six areas, three were awarded protection for being coastal dunes.

Of the eight Ecological Districts in the Conservancy, the largest area of coastal dunes dominates the Foxton district. The current protection and other recommended areas in this district will be covered in more detail in 4.2.3.

Map 4.8, on the next page, shows the protected coastal dunes in the Wanganui Conservancy.

Map 4.8 Protected Dune Areas in the Wanganui Conservancy



Wellington Conservancy:

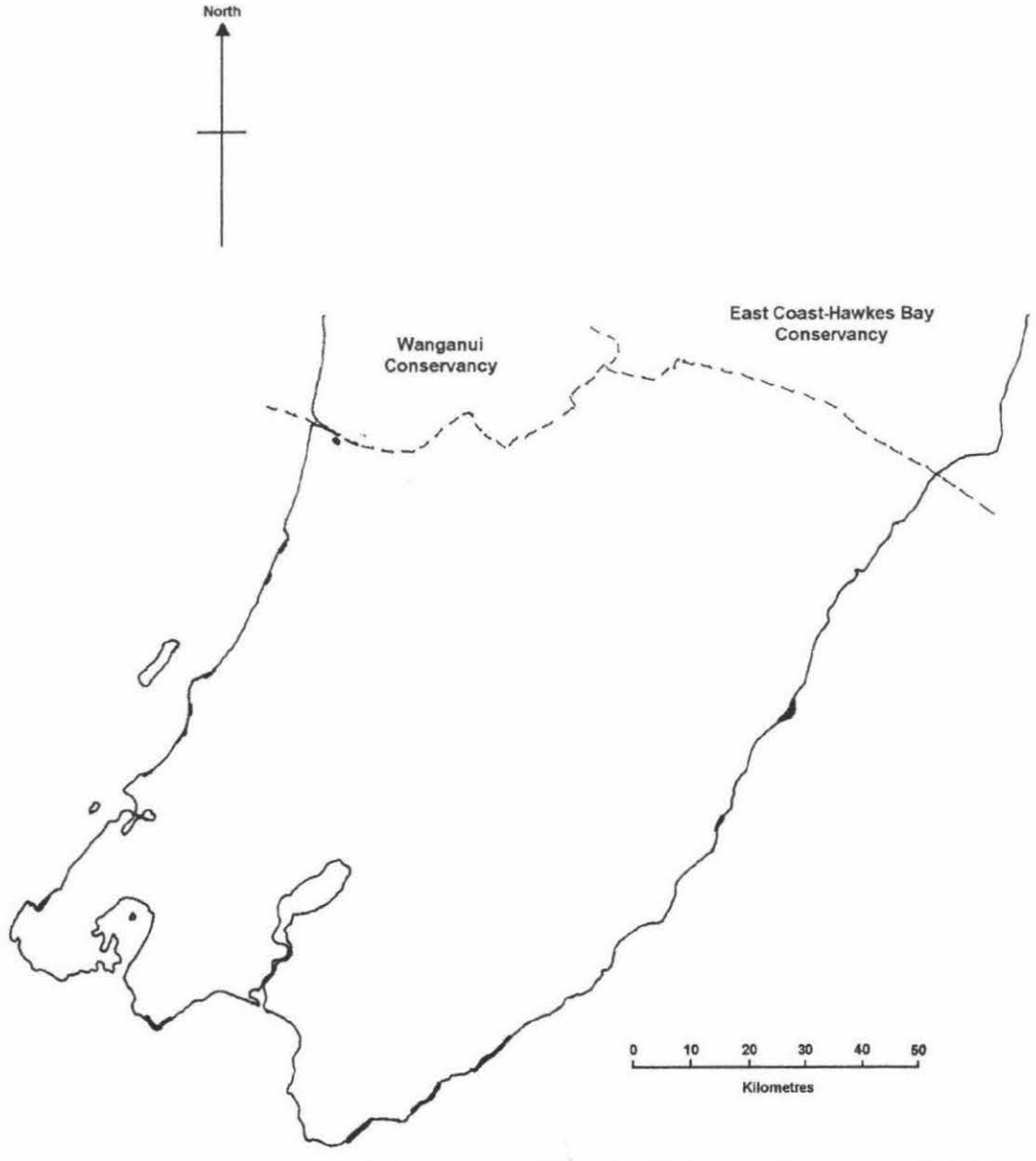
The Wellington Conservancy is based in the lower North Island. Its northern boundary extends from the mouth of the Manawatu River in the west to south of Cape Turnagain in the east.

The only extensive areas of dunelands that have been identified within the conservancy are located along the Kapiti coastline (Department of Conservation 1996c). Even though these dunes have been identified, no dunes within the area

have been awarded protection. However 35 areas have been recommended for protection (Department of Conservation 1996c).

Little consideration has been given to any of the dunes located along the eastern coastline. As map 4.9 shows, the Wellington Conservancy, has an extensive coastal zone along the east coast.

Map 4.9 Protected Dune Areas in the Wellington Conservancy



Chatham Islands Conservancy:

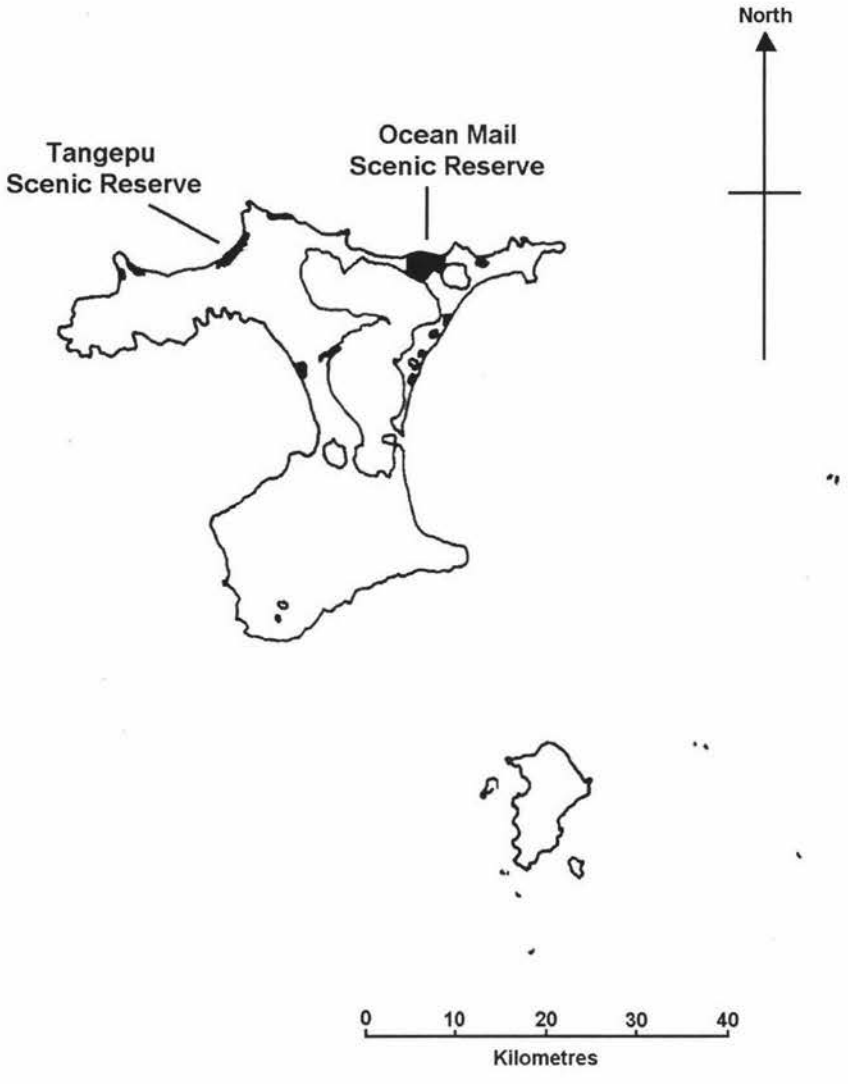
The Chatham Islands Conservancy lies 860kms to the east of the New Zealand mainland, and is the smallest of the 14 conservancies. It is made up of the two main inhabited islands – Chatham and Pitt – and many smaller islands within a 40km radius.

Within this Conservancy, approximately 13% of the total land area, or 7000 hectares, are currently protected. There are eight protected areas, nearly 1400 hectares, which have dunefield components. Of these eight areas, four have been 'gifted' to the Department of Conservation for protection.[6] All the dune areas have been modified to some extent, but are considered to be in better 'condition' than those currently protected on the New Zealand mainland, because of the lack of pressures placed up on these areas from the local population (Department of Conservation, 1999a).

Map 4.10 shows the extent of dune protection in the Chatham Islands Conservancy.

[6] These four areas are; Cannon Pierce Scenic Reserve (60.2ha), Harold Pierce Scenic Reserve (29ha), J.M. Barker (Hapupu) National Historic (29.3ha), Henga Scenic Reserve (170.4ha).

Map 4.10 Protected Dune Areas in the Chatham Islands Conservancy



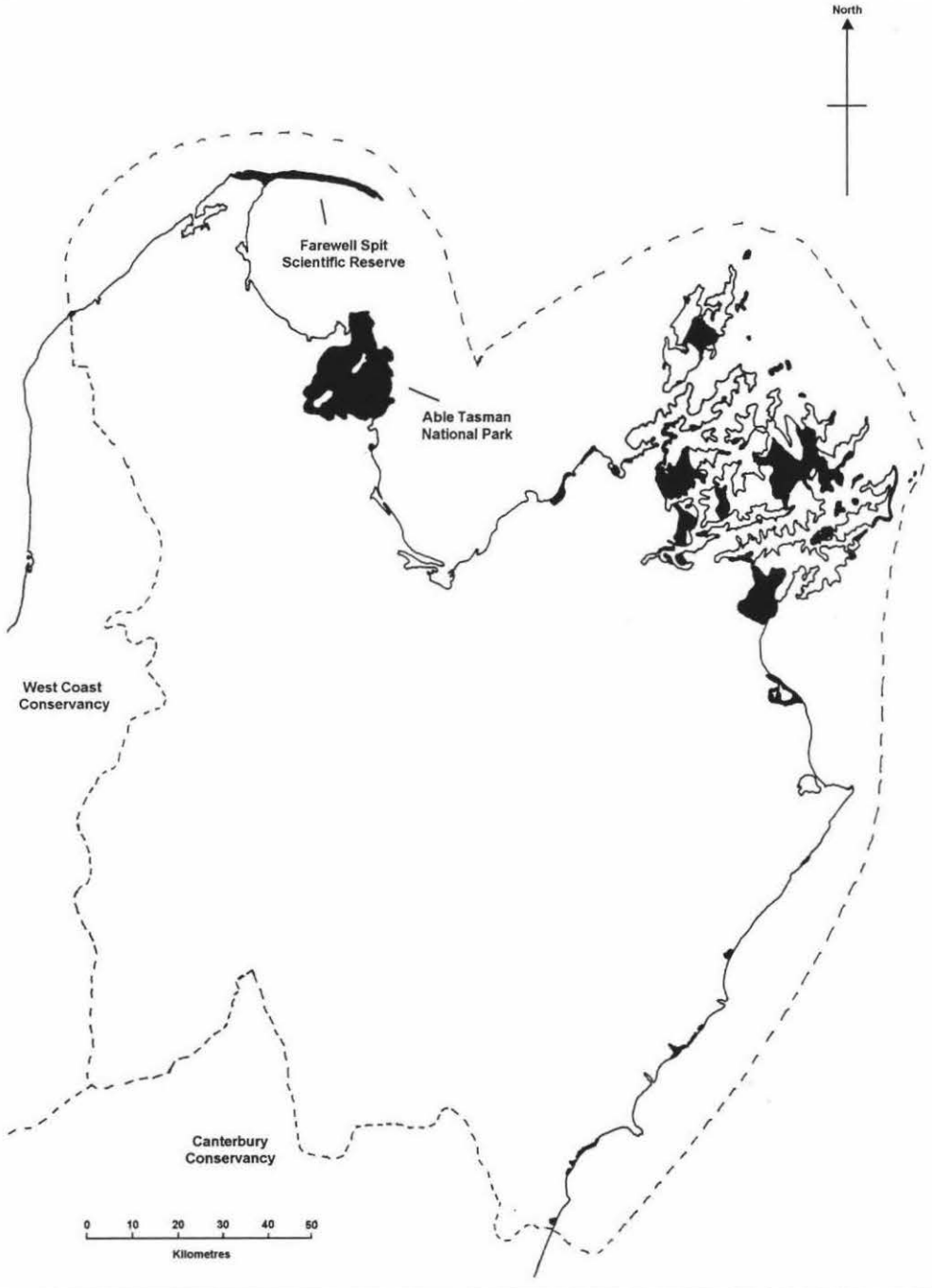
Nelson-Marlborough Conservancy:

The Nelson-Marlborough Conservancy is located at the top of the South Island. The coastline of the Conservancy is dominated by the extensive 'Marlborough Sounds'. These sounds are considered to be of international importance (Department of Conservation, 1996a).

Due to the importance of the Sounds, the majority of the protected coastline is located within the area. (See Map 4.11) But there are significant protected dune

areas in the form of the Able Tasman National Park, and the Farewell Spit Scientific Reserve.

4.11 Protected Dune Areas in the Nelson-Marlborough Conservancy



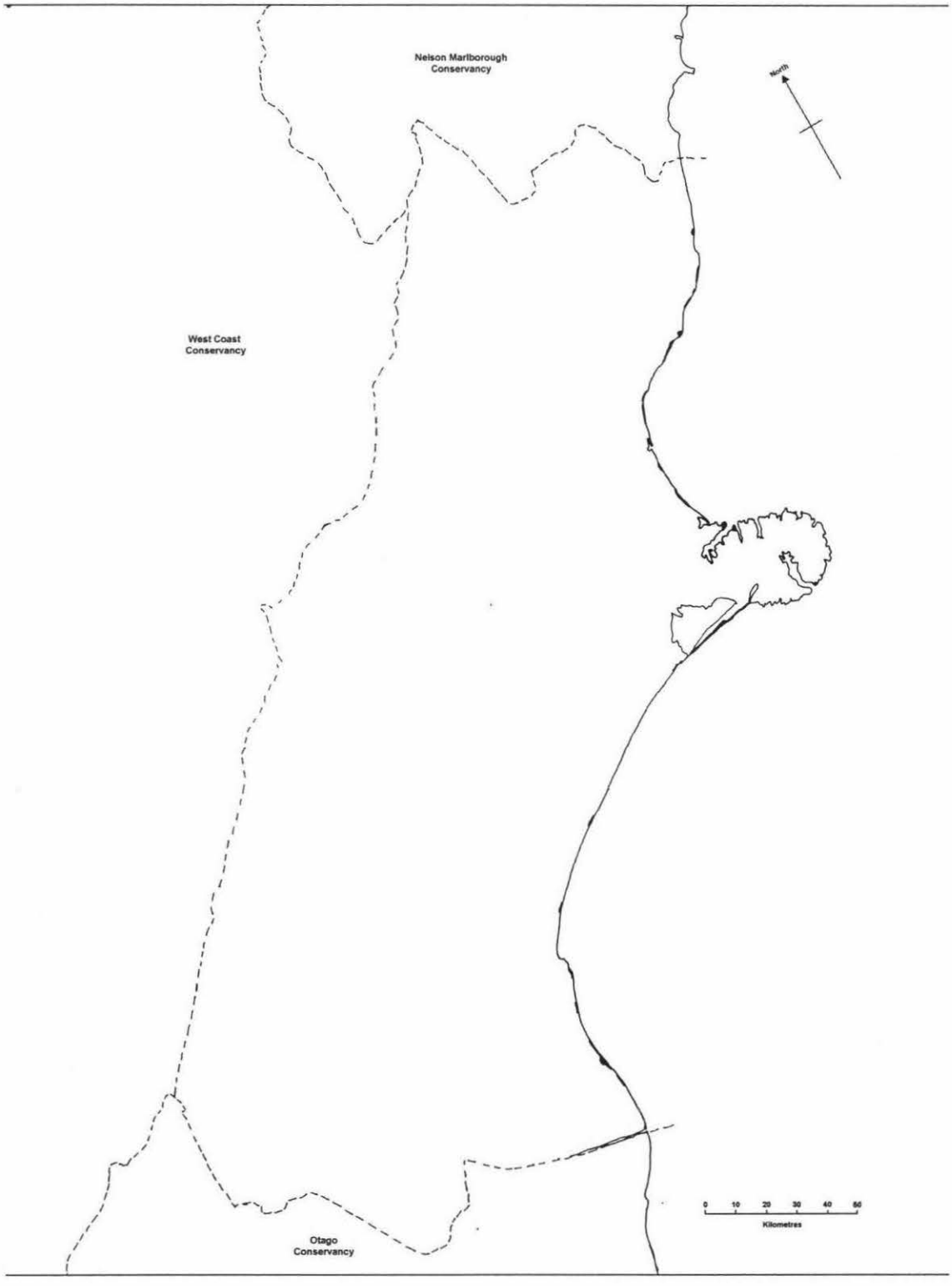
Canterbury Conservancy:

The Canterbury conservancy is situated on the eastern side of the Southern Alps between the Nelson-Marlborough Conservancy and the Otago Conservancy. The Conservancy manages approximately 770,000 hectares of land, and 800 kilometers of coastline (Department of Conservation, 2000).

Coastal dunes within the conservancy have little protection. There are five areas in the Conservancy, which have dune components that have been deemed worthy of protection. The total area of these protected zones is just over 2,310 hectares, and of these five areas, all are protected for the presence of either native vegetation or coastal wetlands.

Map 4.12 shows the extent of dune protection in the Canterbury conservancy.

4.12 Protected Dune Areas in the Canterbury Conservancy



West Coast Conservancy:

The West Coast Conservancy is the largest of the 14 conservancies in New Zealand, and has the largest amount of land administered by the Department (Department of Conservation, 1996d). With only three roads across the Southern Alps, it is one of the least modified and undisturbed landscapes in New Zealand. This is reflected in that 76% of all land within the Conservancy is protected by the Department, much greater than any other Conservancy (Department of Conservation, 1996d).

The coastline of this Conservancy is dominated by 'bald bluffs and wild drift-wood strewn beaches' (Department of Conservation, 1996d). The majority of the coastline within the Conservancy is protected. This is due to the two largest National parks in New Zealand, the 1.2 million-hectare Fiordland National Park, and the 450,000-hectare Kahurangi National Park.

Map 4.13 Protected Coastal Areas in the West Coast Conservancy

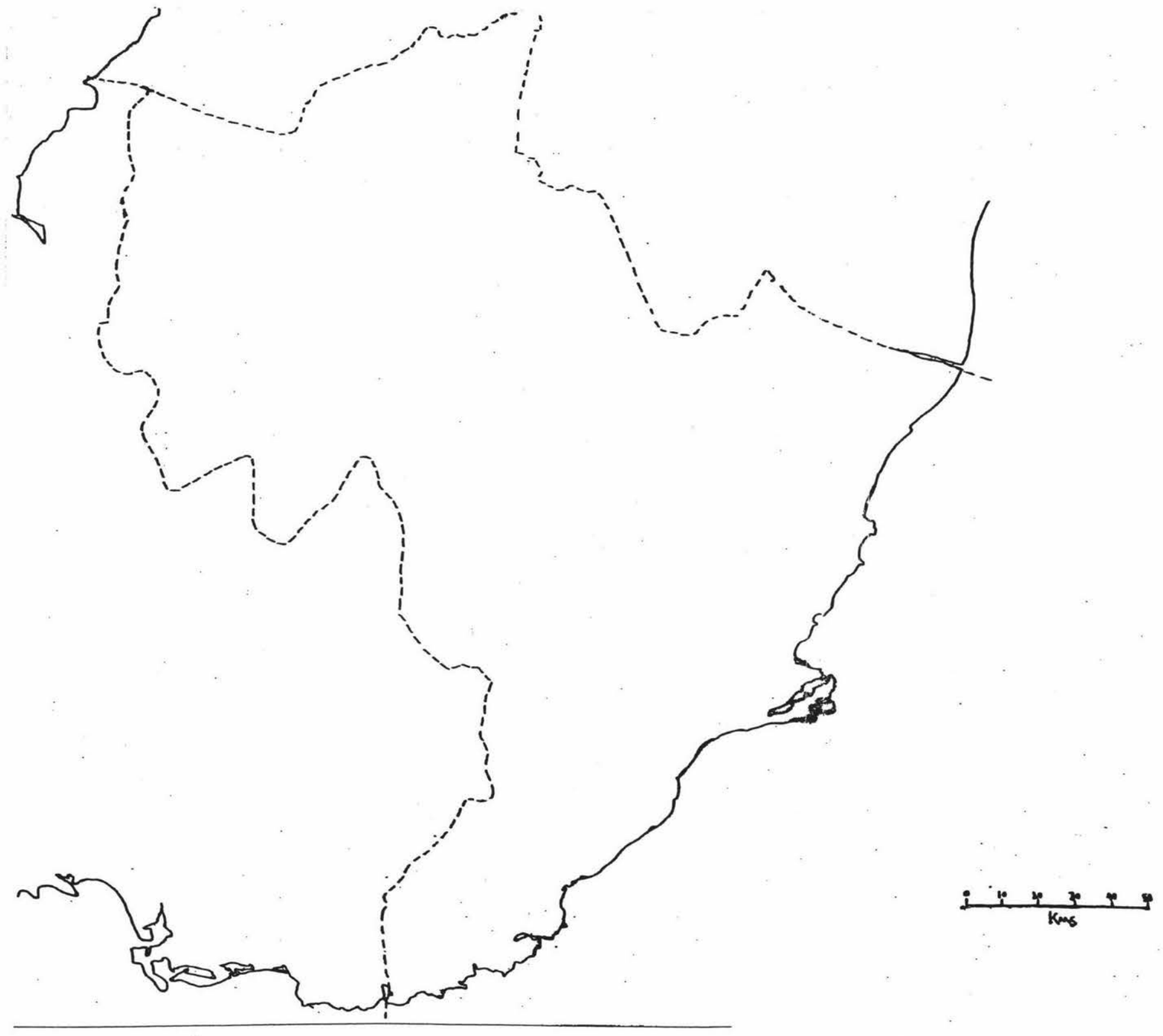
Otago Conservancy:

The Otago Conservancy covers approximately 13.4% of the total land area of New Zealand, but has less than 5.7% of the total population (Department of Conservation, 1995c).

With the lack of population in the Conservancy, there is not the pressure placed upon the coastal environment compared to other coastal areas throughout New Zealand. Yet the Department of Conservation has only protected small sections of the coastline. A large portion of the protected lands within the conservancy are located around the Otago Peninsula and surrounding areas.

Map 4.14 shows the protected dune lands within the Otago Conservancy.

Map 4.14 Protected Dune Areas in the Otago Conservancy



Southland Conservancy:

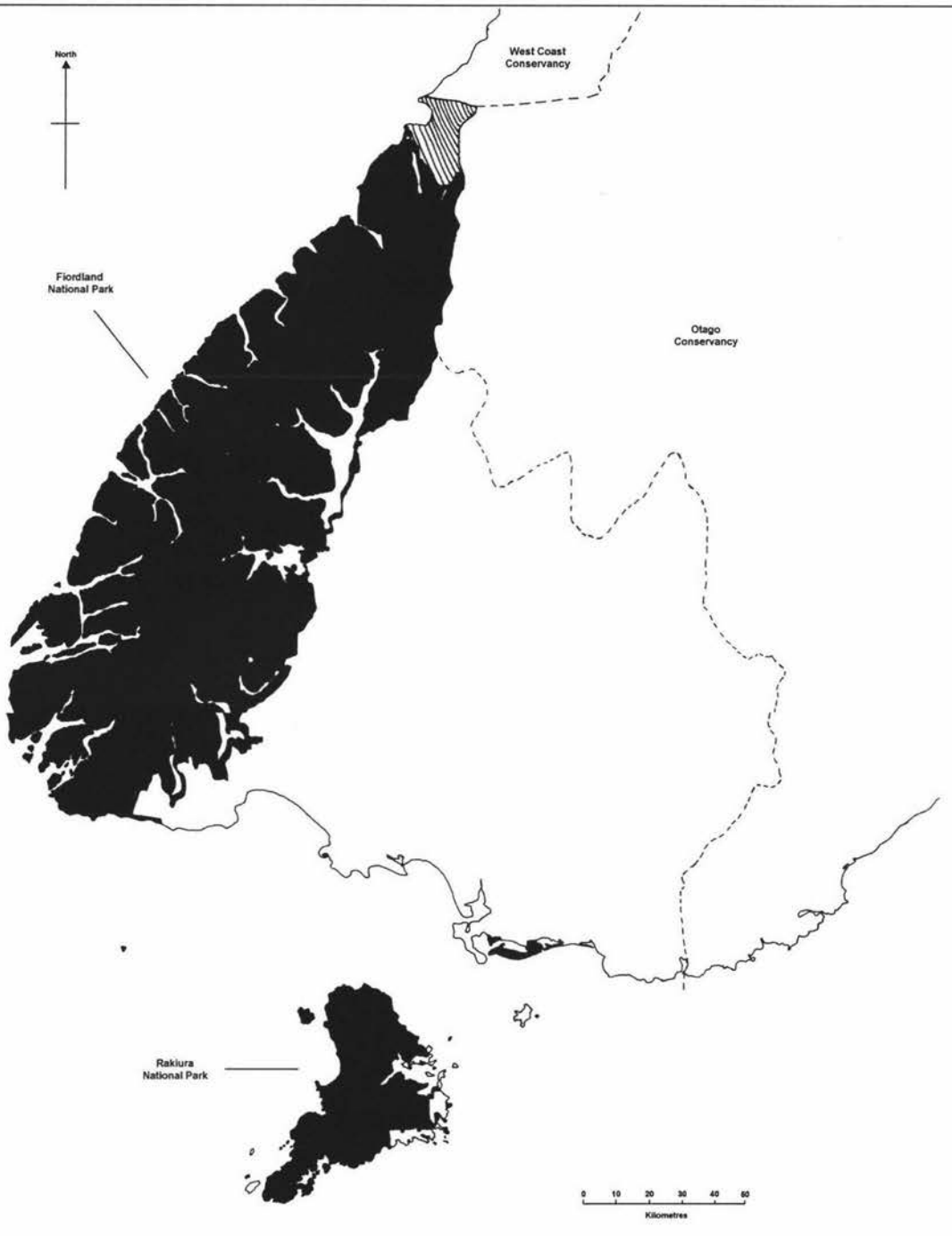
The Southland Conservancy is located at the bottom of the South Island, and includes Stewart Island. The Conservancy can be separated into two distinct parts. Firstly Mainland Southland, which includes New Zealand's largest National Park – The Fiordland National Park, and secondly, Stewart Island, which includes New Zealand's newest National Park – Rakiura.

Due to the lack of pressures associated with population, the environment is still largely in its natural state (Department of Conservation, 1995d).

The conservation land within the Conservancy protects large amounts of the coastline. But again the land is being protected for other reasons, rather than for being prominent examples of New Zealand's coastal environment.

Map 4.15 shows the extent of protected dune land in the Southland Conservancy.

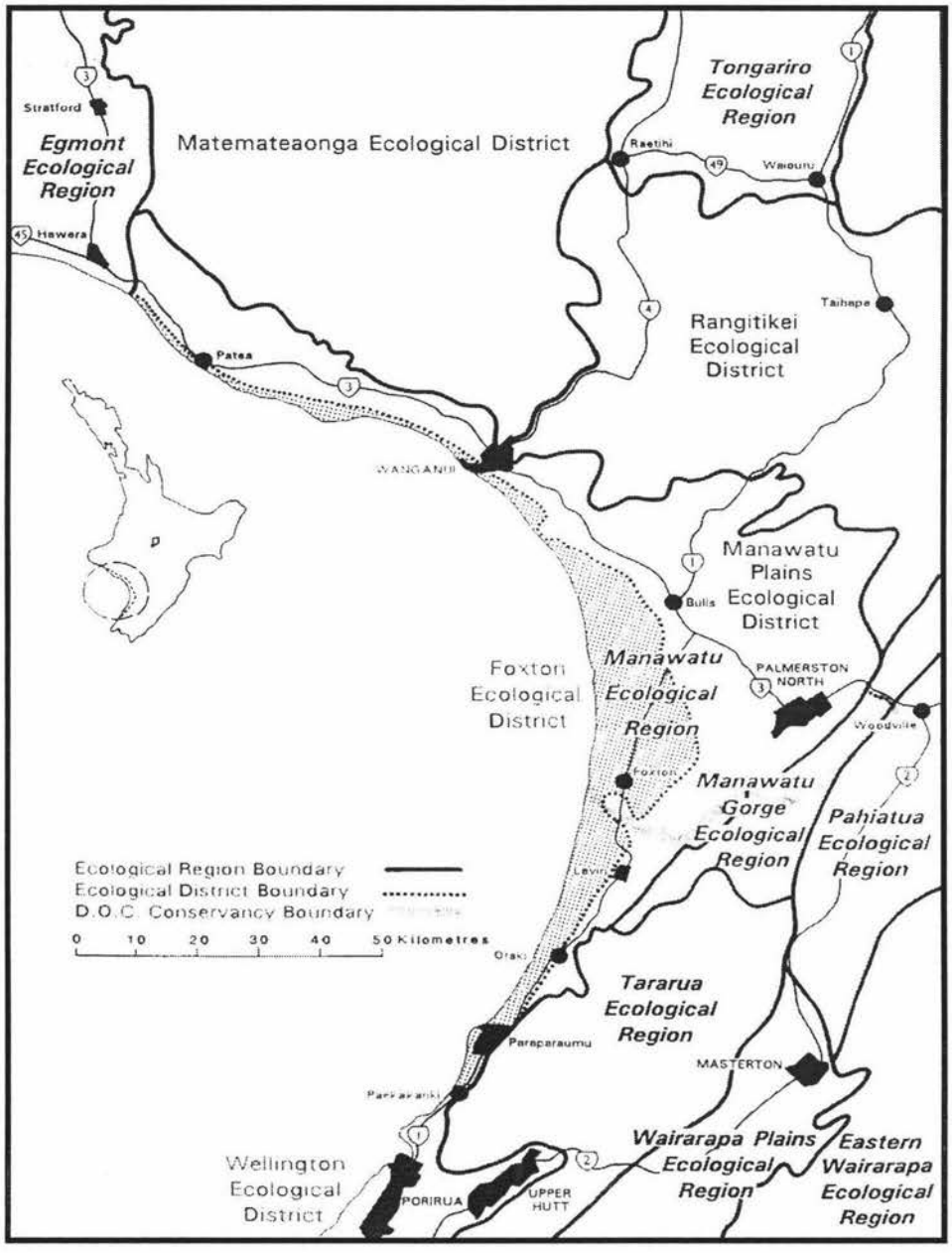
Map 4.15 Protected Dune Areas in the Southland Conservancy



4.3.4 Protection in the Foxton Ecological District

The Manawatu coastal zone is situated in the Foxton Ecological District in the Wanganui Conservancy. Map 4.16 shows the Foxton district in relation to the greater Wanganui Conservancy.

Map 4.16 The Foxton Ecological District



(Source: Ravine, 1992)

The Foxton Ecological District is dominated by the largest parabolic and transgressive dunefield in New Zealand (Hilton, 2000; Hesp, 2001). As has been stated in chapter two, it is one of the best examples of Holocene dune development in Australasia and one of the best in the world (Hesp, 2001).

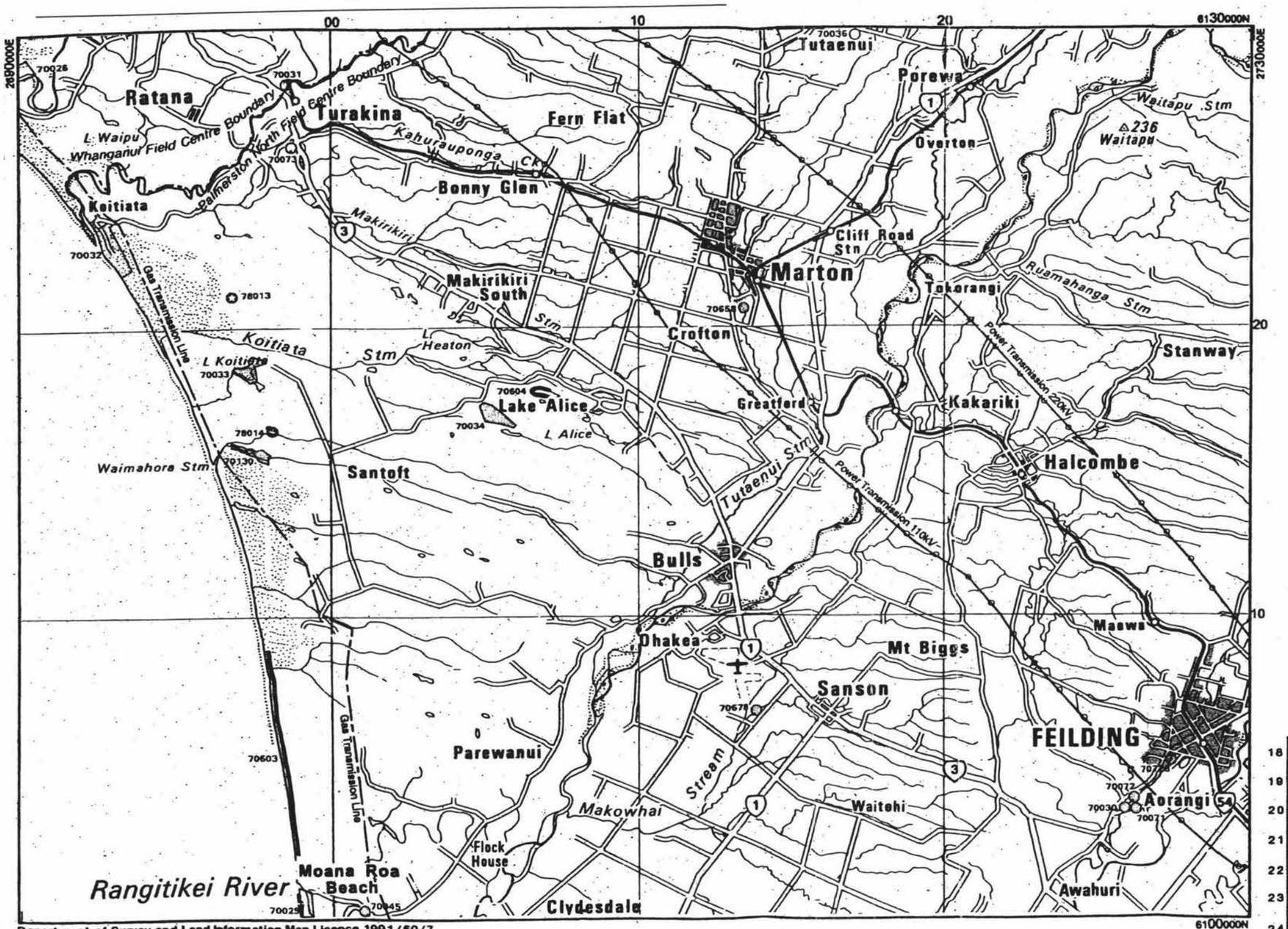
The Manawatu parabolic dunefield is the only remaining example of it's kind in New Zealand. Current areas of protection, at present, do not provide representative examples of parabolic dune development in New Zealand. Areas that are protected are relict, vegetated examples, and the young mobile dunes in the Manawatu provide excellent examples of dune development and migration. But the extent of conservation protection in the district, and particularly the sand country is very poor.

"The present reserves in the sand country ***do not*** *protect the full range of biological diversity which remains. Dune Lakes, swamps and young dunes are particularly poorly represented."* (Department of Conservation, 1997b: 46)

Maps 4.17 and 4.18 show the lack of protection in the Manawatu sand country. As Map 4.17 shows, only 18 areas have been awarded protection, and these 18 areas are very disjointed.

The Koitiata Domain Recreational Reserve and the Koitiata Wildlife Management Reserve, are the only areas that have been identified as deserving protection for the presence of sand dunes, and associated landforms. Yet both areas have been described as being "highly modified", and "deteriorating rapidly" (Department of Conservation, 1997b).

Map 4.17 The Manawatu Dunefield between Turakina and the Rangitikei River

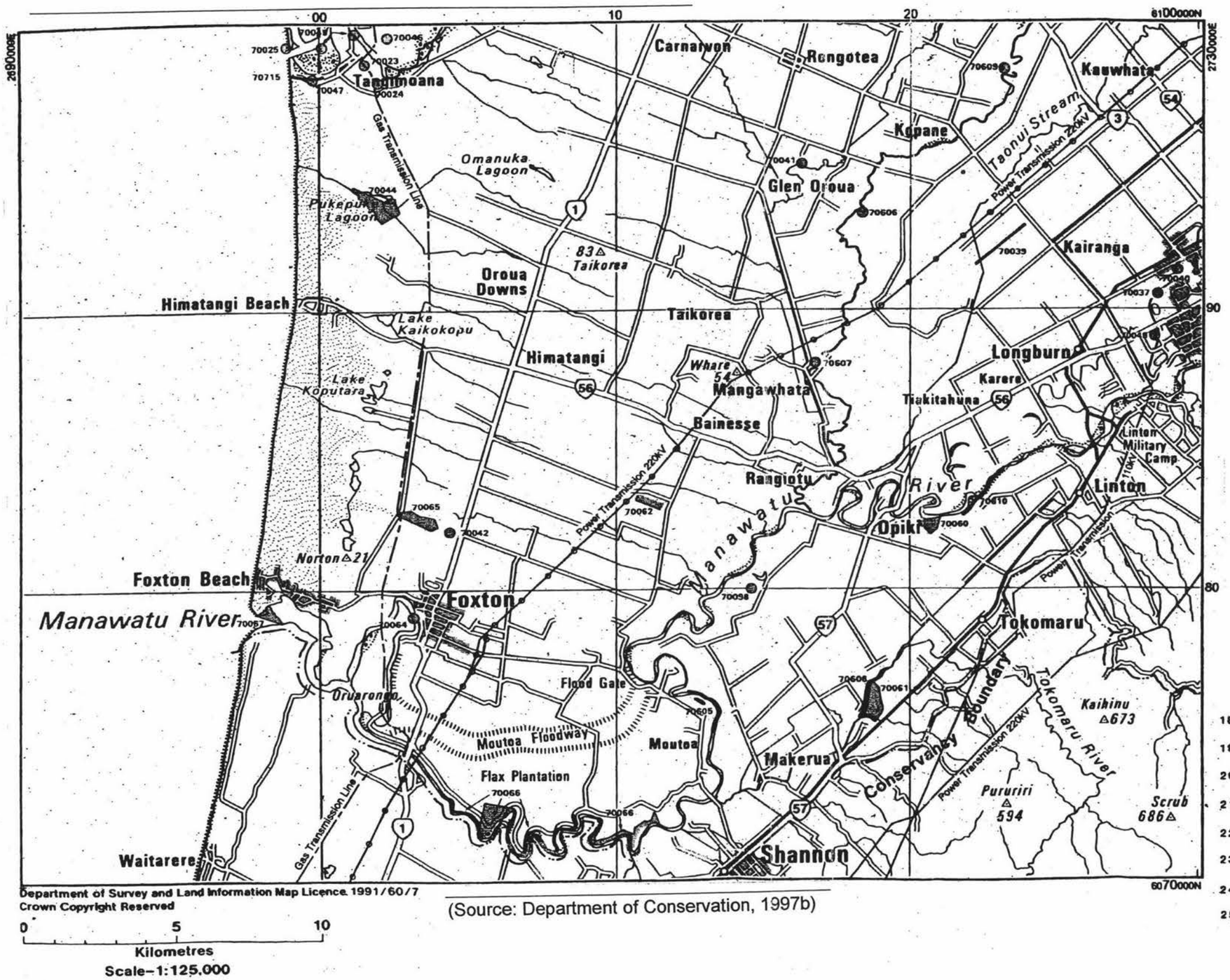


0 5 10
Kilometres
Scale–1:125,000

(Source: Department of Conservation, 1997b)

As map 4.18 shows, 28 areas between Tangimoana and Waitarere have been awarded protection. As can be seen these conservation areas provide only small 'pockets' of protection. Those areas that are protected also only provide protection for coastal wetlands, native vegetation or fluvial landforms.

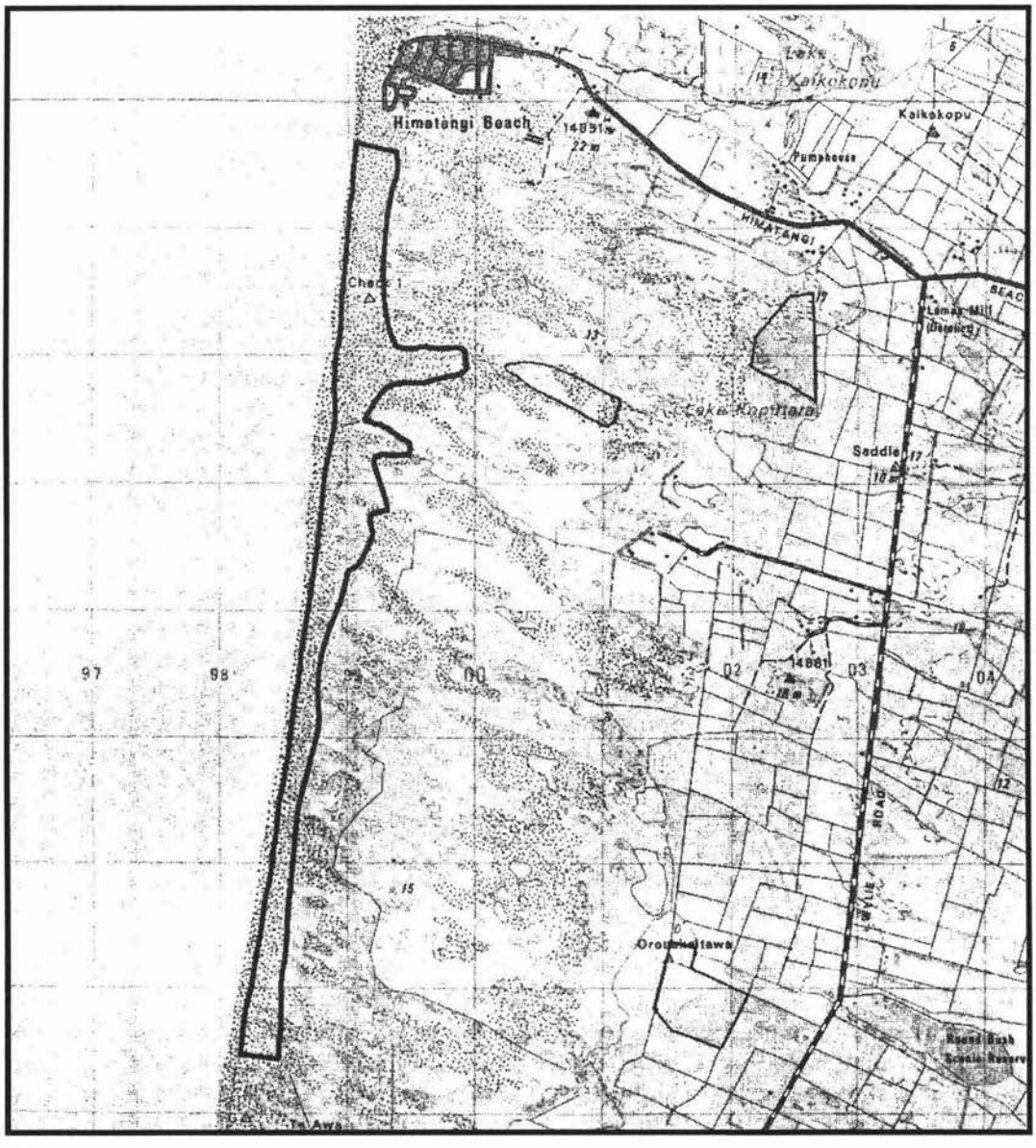
Map 4.18 The Manawatu dunefield between Tangimoana and Waitarere



(Source: Department of Conservation, 1997b)

Map 4.19, from the 'Recommended Areas for Protection' survey conducted by the Department of Conservation in the Foxton Ecological District, shows that an extensive area of the dunefield south of Himatangi is considered to be deserving of protection. This area is considered to be a 'Priority One' area for protection due to the extensive development and modification that has occurred on the surrounding dunefield.

Map 4.19 Recommended Area for Protection: 'Foxtangi' Dunes



(Source: Ravine, 1992)

Also within this area of recommended protection, a number of endangered plant species and indigenous fauna have been identified. Given (1990) in Ravine (1992) identified the following plant species within the area;

- *Eleocharis neozelandica* – Vulnerable
- *Pimelea arenaria* (Sand Daphne) – Indeterminate
- *Desmoschoenus spiralis* (Pingao) – Local

The information on the indigenous fauna is much less comprehensive. Brockie (1957) summarized the invertebrate fauna of the sand dunes, and identified insects, moths, locusts and dragonflies. Some of which are very rare.

"The moth Ericodesma aerodana, caterpillars of which feed on Sand Daphne, was found at Harakeke recently, the first North Island siting for 111 years" (Ogle and Patrick, 1991 in Ravine, 1992: 18).

It is of note that staff of the Department of Conservation in the Foxton Ecological District recommended 60 areas for protection. These areas were identified to make up for the inadequacies of the current protection within the Foxton Ecological district, but none have been given protection at the time of writing.

4.4 Problems with Current Protection

4.4.1 Possible Problems with the Selection Criteria

The criterion used for the selecting of potential areas for preservation and protection is appropriate. The six criteria that were highlighted in 4.3.1 cover all types of landscapes and historic areas.

The selection criteria however are improperly implemented. It is stated in the Reserves Act (1977), and the Conservation Act (1987) that the main mission for the Department of Conservation is the preservation and protection of all

representative classes of natural ecosystems and landscapes that in their aggregate originally gave New Zealand it own recognizable character. Clearly in the case of dunelands in New Zealand this is not occurring. Improper weighting is being given to certain criteria for the identification and preservation of dunelands in New Zealand.

It is stated in the West Coast Conservation Management Strategy that;

"representativeness is the primary criterion in the identification, selection and evaluation of areas for nature conservation, particularly in modified landscapes." (Department of Conservation, 1996d: 81)

Representativeness is made up of three separate components;

- the proportion of natural diversity currently existing
- the proportion of natural diversity represented in protected natural areas in relation to surrounding areas
- the quality of representative sites compared with one another.

(Department of Conservation, 1996d)

With the use of representativeness as the primary criterion, there needs to be an understanding of the geomorphologic processes behind the formation of landforms. This perhaps has lead to not all representative examples of dunelands being protected.

The native flora and fauna that is identified as being worthy of protection, relies on the underlying landscape for survival. So one could argue that it would be prudent to protect the landscapes before the vegetation, so that flora and fauna can propagate in the preserved landscapes.

4.5 Conclusion

With the Department of Conservation charged with the preservation and protection of all representative examples of New Zealand's environment, the use of a stringent selection criterion has been applied to the identification and evaluation of potential landscapes.

However the implementation of the selection criterion appears to be flawed. This was clearly shown in the Foxton Ecological District where 60 Recommended Areas of Protection were identified to make up for the inadequacies of current protection in the district, and none, at the time of writing, have been granted protection.

The establishing of individual Conservancies throughout New Zealand for the day-to-day management of the environment has lead to approximately one third of New Zealand's total land area being protected.

The information provided by the Conservation Management Strategies shows what landforms are protected within the Conservancy boundaries. But with only short outlines and justifications, the information provided means it is impossible to obtain the actual size and extent to which dunelands are currently protected. The Conservancy inventories only state that dunelands are present within each conservation area.

But through the creation of individual Conservancy maps for the protection of dunelands in New Zealand, and with the information gained, all examples of dune landscapes have been identified and mapped.

The following chapter will analyse the results obtained from conduction the contingent valuation method survey.

Chapter Five: Analysis of Survey Responses

5.1 Introduction

To value the benefits that people gain from a non-market good, the contingent valuation method survey is the economist's primary valuing device. The Survey attempts to measure the consumer's surplus as discussed in section 2.5.1. It seeks to estimate either the willingness to pay, or the willingness to accept compensation for some change in the supply or quality of a non-market good, according to the property rights associated with that good.

Through the use of a contingent valuation survey, data was generated about the potential for an area of conservation in the Manawatu dunefield. By interviewing both farmers and forestry owners in the region, responses could be generated concerning three separate areas, (i) the current uses of the dunefield, (ii) respondent opinions to 'intrinsic' values associated within the dunefield, and (iii) the respondents willingness to pay for the creation of conservation land within the Manawatu dunefield.

A vital part of providing decision-makers with any information is the analysis of basic data. Data analysis transforms answers obtained from surveys into clear and succinct information, useful for decision making purposes. In this chapter the data generated by the surveys will be separated into the three categories outlined above. The limitations associated with the results will also be outlined.

5.2 Preparation of Survey Data

All of the data obtained from the surveys was entered into a spreadsheet as soon as responses were gathered. This had the advantage that when the results were being tabulated little additional input of data was required. The final responses were all those who were willing to participate in the survey from the initial phone

conversation. No record was kept of total phone conversations that were conducted, so therefore a survey response rate was unable to be calculated.

The final cut-off date for conducting surveys was the 1st October. There were a total of 47 survey responses returned. Of these, the number of individual questions answered varied. The main problem was that most respondents were unwilling to answer questions concerning the valuations of the property, and the revenue gained from their agricultural practices on the Manawatu sand country (Questions 6 and 8).

The answers to the willingness to pay, and willingness to accept compensation questions (Questions 13 and 14) need to be carefully scrutinized as it was expected that some bias would enter into individual responses.

Individual responses to the question concerning a previous study into the conservation potential of the Manawatu Parabolic dunefield created a challenging situation (Question 11). As the question was open-ended, and asked respondents to provide their opinions to the identified landforms, no quantifiable data could be generated. As respondents were asked to express their opinions, responses were placed into two separate categories, 'agree' and 'disagree', and individual responses were evaluated. All responses given to the survey have been treated as confidential.

5.3 Survey Results

The data obtained from the surveying of local farmers and forestry owners can be analysed in three parts. The first is what the dunefield is currently used for, secondly the values associated with individual landforms in the region, and finally the willingness to pay for an area of conservation in the dunefield. The summary results obtained from the questionnaire are presented in Appendix Five.

5.3.1 The Current Use of the Manawatu Dunefield

The question on the current use of the Manawatu Dunefield shows that farmers identified two separate areas. These were the vegetated 'older' dunelands and the 'young' mobile bare sands. As such these will dealt with separately.

The results of the older dune lands are fairly predictable. All respondents to the survey indicated that the dunelands are used for a combination of grazing, cropping and forestry. A number of the respondents indicated the potential of the dunefield for traditional farming practices.

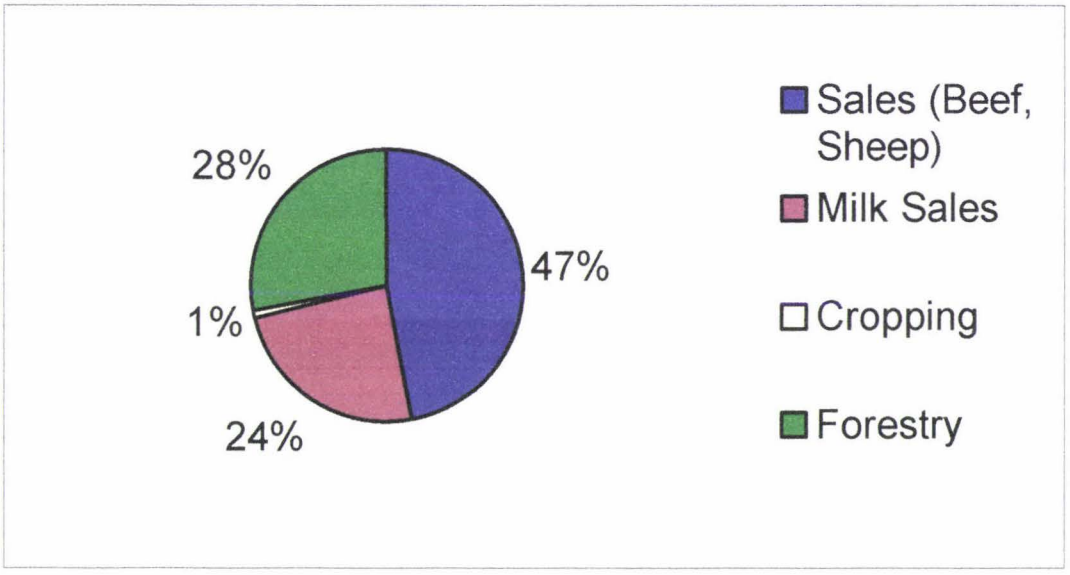
"With irrigation, levelling, and modern drilling techniques, even the most recent sand dunes can be turned into flat irrigated pastures producing approximately 750-1000kg of milk solids per hectare." (SB1 farmer in the Manawatu District[7])

When attempting to determine the revenue gained from each of the farming methods, respondents were very unwilling to give precise monetary values. The only indications that were given were percentages of annual income. Figure 5.1 shows the summary data for the revenue gained from each of the farming practices[8].

[7] S=Sheep, B=Beef, F=Forestry.

[8] These figures do not include the responses gained from the two main Forestry Blocks. These will be discussed later.

Figure 5.1 Percentage of Revenue gained from the use of the Manawatu Dunefield



The results show that the dunefield, with the use of modern irrigation techniques and through the intense use of fertilizers, can be modified to become very productive and profitable.

Respondents presumably identified the younger bare sand as being inherently different from the relict vegetated dunes. It suggests that the users of the sand country understand some of the processes behind the formation of the dunefield.

Those who did identify the bare sand were those located closest to the coastline. The uses of this area varied. But the 'majority' of respondents stated that the area was being stabilised by the use of Marram Planting. This would suggest that the land is 'retired', and only used when necessary. This is backed by individual responses gained.

"The bare sands are only used for grazing when I need to protect the more productive pasture land." (B1 farmer in the Horowhenua District)

"My land closest to the coast is currently being planted with Marram Grass to stabilize the sand." (SB2 farmer in the Manawatu District)

The overall indications from the farmer responses suggest that through the alteration of the dunefield, the land can become very productive. But it is only through the irreversible modification of the landscape that this can occur.

"There are perhaps a few areas left in natural states worthy of protection, but most of the coastal region has been farmed extensively for 150 years, so has no particular importance. However a few areas still covered by native plants, or are swamps, that could, should be preserved for future generations." (BS2 Farmer, Rangitikei District)

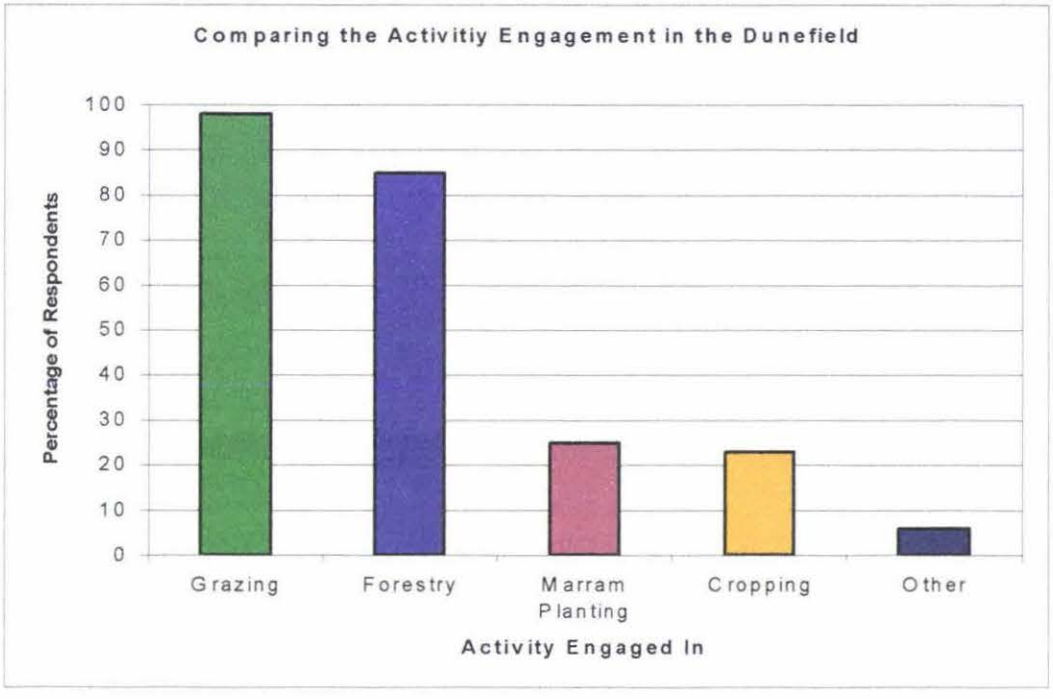
Forestry owners within the dunefield presented unique problems. The forestry blocks represent interests elsewhere; so the gaining of any information from them had to be ratified through the parent office. This meant that if there was any confusion over the survey questions, it was impossible to clarify this. The responses gained from both forestry blocks were predictable. The responses gained show that the land is managed for forestry only and as such 100% of the revenue gained is from forestry.

5.3.2 Analysis of the Current Use of the Dunefield

The answers gained from the questions 1 to 7, show that a high proportion of the respondents engage in traditional farming practices on the Manawatu coastal dune environment.

Figure 5.2 shows the percentage of respondents who engage in differing farming activities within the Manawatu dunefield.

Figure 5.2 Use of the Manawatu Dunefield



The responses gained to questions 1 to 7 were predictable. Those respondents, who indicated that the dunefield was used for 'other' purposes, were primarily for recreation and sporting activities. These activities were seen as not to be harmful or degrading to the dunefield.

"Currently the Red Kiwi Orienteering club is allowed to hold their events on my property. I know that there are a number of others who also allow them access to their properties." (BF2, Manawatu District)

The overall responses indicate that people who rely on the quality of the coastal environment for their livelihoods have an understanding of how the dunefield is to be managed. There is the realization that once dunelands are converted into farmland, these lands need to be managed carefully to ensure the dune sands are not re-mobilized.

5.3.3 Values Associated with the Manawatu Parabolic Dunefield

Questions 10, 11, and 12 of the questionnaire asked respondents to value individual landforms in the Manawatu dunefield. Question 10 asked respondents to value landforms on their property. Responses were fairly predictable, with all respondents indicating that some areas of their property were considered valuable.

"The lakes and wetlands provide an area for me and my sons during duck shooting season." (BS3 farmer in the Rangitikei District)

"The forestry on my property adds to the value of the farm." (B19 farmer in the Manawatu District)

Question 11 asked respondents to list elements that add to the value of landforms. Again the responses were fairly predictable, with wetlands and native vegetation being identified as two of the primary elements.

Question 12 was built upon the investigation conducted by Dr Don Ravine and the Department of Conservation about landforms within the dunefield that perhaps deserve protection and preservation (Ravine, 1992). Interestingly the individual responses gained from the surveys varied greatly amongst the landforms identified. There was no definite response trend to the questions asked.

The Foredune:

Of the responses gained, 87% agreed that the foredune deserved protection. Individual responses to why this was considered important varied greatly from;

"It (the foredune) serves as a natural barrier between the beach and our property." (B1 farmer, Horowhenua district)

to;

"The foredune is the main source of inland sands." (BS4, Horowhenua District)

But there was a general consensus that the area should be protected to prevent the encroachment of sands inland.

"Mainly as protection of inland areas from sand movement." (BS12 farmer, Manawatu District)

The Sand Plains:

Of all the individual responses obtained about the varying landforms of the dunefield, the sand plains gained the least favourable responses concerning protection, with only 19% in favour of protection. The general consensus from respondents was that the potential of the sand plains for conversion into productive farming land was too great. Many respondents in the Manawatu District stated the benefits that could be gained from the sand plains with the use of modern irrigation techniques, and the intense use of fertilizers.

Ephemeral Lakes:

The ephemeral wetlands within the dunefield were highly regarded for protection, and from the responses received, 93% supported the need for conservation. Reasons for these responses varied greatly from: the use for recreational sport to providing for the ecological livelihood for native species.

"The lakes provide areas for shooting and eeling." (B1 farmer, Rangitikei District)

"These areas probably support most of our native flora and fauna still to be found in the lower Manawatu." (BF1, Manawatu District)

The Parabolic Dunes:

The parabolic dunes within the region were viewed very similarly to the sand plains. Only 23% of respondents stated that the dunes possibly deserve some sort of protection. Again the potential of the dunes for both traditional farming, and for forestry far outweighed the conservation values associated with the dunes according to the survey respondents.

"It would also be true to say that with modern technology and equipment this fragile ecosystem can be transformed into productive agricultural land in a very short space of time." (BF3 Farmer, Horowhenua District)

Indigenous Vegetation:

The responses gained from the surveys showed that there was an overall respect for native vegetation within the dunefield, with 97% of respondents agreeing that these areas deserved preservation and protection. There was also the belief that these areas of vegetation also supported native fauna, which added to their conservation value.

"It (native vegetation) is important for its own sake, as well as being support areas for native fish (whitebait, eels) and birds (ducks, Pukeko etc)." (BS15 farmer, Rangitikei District)

"Areas of native vegetation represent what New Zealand's environment was, and as such they should be protected." (BF9, Horowhenua District)

5.3.4 Analysis of the Intrinsic Values associated with the dunefield

Questions 10, 11 and especially 12, were largely based upon the previous study conducted by Ravine and the Department of Conservation into the conservation potential for the Manawatu dunefield (Ravine, 1992). By gaining individual opinions into the values associated with the dunefield, only qualitative data could

be generated. The quotations provided show the general opinions among farmers surveyed.

From the responses gained there was a general consensus that the foredune deserved protection. The incentive for this however was to stop the inland migration of sand rather than for any conservation value or potential. This would suggest that if pioneer species were planted for dune stabilization, farmers would be content. This is backed by the results generated from the earlier section of the survey where farmers are already implementing the planting of Marram Grass to stabilize the foredune.

The results concerning the sand plains and the parabolic dunes indicate that there is little regard for the processes controlling the formation of these landforms, or for the intrinsic values of the landforms themselves. All of the responses gained showed that there was general agreement that the sand plains and the parabolic dunes could be successfully converted into productive pastureland. Through the intense use of modern irrigation and machinery, the intense use of fertilization, and the careful management of the resulting pastureland, the successful conversion of the dunes into productive pastureland is easily attainable.

The results concerning the other landforms, the ephemeral wetlands and the native vegetation, indicate that there is a compelling desire for the protection of these landforms. There is the belief that the wetlands support the majority of the remaining indigenous flora and fauna in the region.

The desire to protect and preserve the native vegetation on the dunefield is in accordance with studies conducted by Davis and Cocklin (2001) into native vegetation in the Northland region. Some of the native vegetation in the dunefield is endemic to the dunes themselves. So the protection of the dunes in a conservation area would result in the preservation of the indigenous vegetation.

5.3.5 Willingness to Pay and Accept compensation for an area of Conservation

The willingness to pay for an area of conservation land within the dunefield is to a large extent dependent on the benefits that respondents think they will obtain from it. Some of the presumed benefits of the establishment of conservation land include an increase of indigenous flora and fauna, and a likely increase in satisfaction with the increased environmental protection.

These associated benefits, however, are not reflected in the responses obtained. While there is a regard for the protection of the environment, this is not reflected by a willingness to pay for the establishment of conservation land.

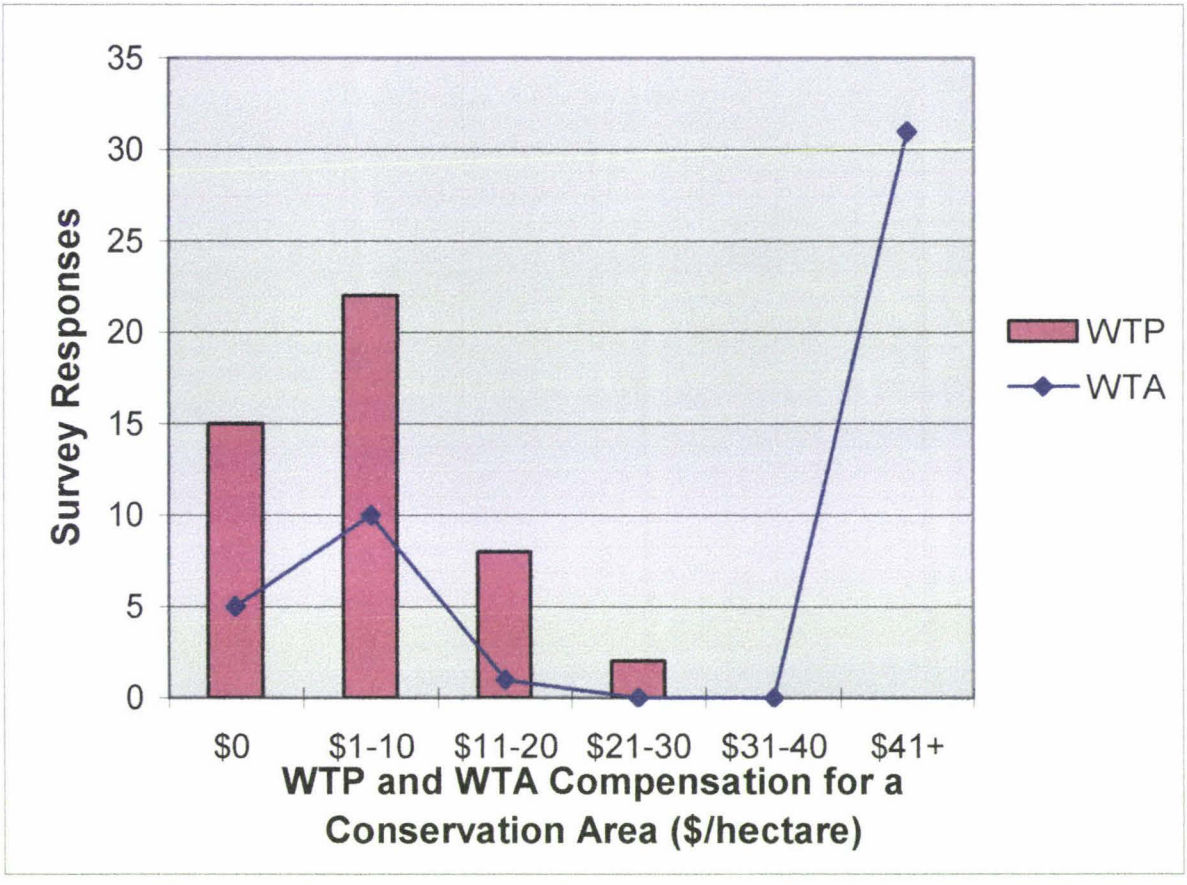
47% of the responses gained indicated that respondents would only be willing to pay $1-$10 per hectare. 31% of respondents stated that they would not be willing to pay for an area of conservation land.

When assessing the responses showing the willingness to accept compensation, the results are possibly typical for the New Zealand farming community. By asking an open-ended question, the question was attempting to get respondents to place a monetary value on the potential for conservation land. However, either through a lack of understanding or being unable to place a value on the dunefield, the majority of respondents used the valuing range identified in the previous question about the willingness to pay for conservation land. 65% of respondents stated that they would have to be compensated very well before they would be willing to give up a section of their farmland for conservation purposes.

"If an area of my property were to be identified for conservation purposes, I would expect nothing less than market rates for my property." (BF7 Farmer, Horowhenua District)

Figure 5.3 shows the combined willingness to pay and willingness to accept compensation for an area of conservation land within the dunefield.

Figure 5.3 The Willingness to Pay and Accept compensation for an area of Conservation Land



What was surprising from these responses given, were the number of respondents who viewed the preservation of the environment as being important.

"As I have pointed out above, preservation of our heritage should be an accepted duty of local government rather than being left to the whims of local landholders." (SB42 Farmer, Manawatu District)

"The preservation of native vegetation in the dunefield adds an aesthetic value to the sand country." (BF7 farmer, Horowhenua District)

5.4.3 Analysis of the Willingness to Pay for Conservation Land

It is of interest to examine why the survey respondents offered the responses to the willingness to pay question (question 13). Knowledge of the reasons why different answers are given may help in the formulation and inception of an area of conservation within the dunefield.

Initial indications suggest that the respondents are willing to pay a small amount for an area of conservation, but are not willing to offer an area of their land for protection, unless compensated at or above market rates. Taking the responses as given shows that there is a NIMBY, Not In My Back Yard, scenario. This would suggest that there was a distinct bias in the way in which respondents choose to answer the question's posed.

The bias generated in the willingness to pay section of the survey could be bought about in two separate ways. Either respondents were uncertain about the value they should place on the dunefield, or there was a strategic way in which respondents answered[9]. The later of the two is more probable. There was the distinct concern that an area of respondent's land may be identified, with only 11% of respondents indicating that they would be willing to give up land for no reimbursement.

The following section attempts to create a hypothetical model based upon some of the data generated from the survey responses.

[9] Refer to Chapter Two.

5.4 Hypothetical Modelling

With the survey results not generating the desired data about the revenue gained from the use of the dunefield, the need to create a hypothetical model based upon other information gained was generated. Once this small-scale model is generated, it can then be applied to represent the entire dunefield, which covers approximately 90,000 hectares. Certain assumptions and criteria need to be established for the model to be realistic.

5.4.1 Model Assumptions

The generation of any model is based upon assumptions. For the purposes of this research there are four main assumptions underlying the creation of this model. These are;

1) A farm size of 200 hectares, which is fairly typical of farm sizes in the region.

2) A standard of 10 head of cattle per hectare, with cattle prices set at the Feilding Stock Yards as at 6th December 2002 (P. Lysaght, Manager Wrightsons, pers comm.).

3) A standard of 275 *Pinus radiata* trees harvested per hectare, with timber prices set at the Feilding Lumber Yards as at 10th December 2002 (Ken Cory, Manger Feilding Lumber Yards, pres comm.).

4) Land Values based on Ratable Valuations as at 8th December 2002.

By establishing these assumptions, a stringent guide can be used to develop data for the economic potential for the dunefield. Once this is generated then a comparison between the economic potential and the ecological potential of the dunefield can be done.

5.4.2 Model

The use of a small-scale model to represent the revenue stream generated in the dunefield is being carried out to create some generalized information and data about the productive potential of the dunefield. This small-scale representative model can then be incorporated to represent the entire dunefield.

The use of information gained from numerous sources has aided in the development of this model. Assuming that a 200-hectare farm, based between Foxton and Himatangi is a representative example of the farm sizes in the dunefield, 170 hectares would be used for grazing purposes. Using the criteria above, there would be a total of 1700 head of cattle on the farm. The current prices at the Feilding Stock yards are $870/head (Paul Lysaght pers comm.). While it is not realistic that all cattle would be sold, this model is looking at the maximization of revenue from the dunefield. Again, assuming that all cattle are the same, then the cattle could potentially be worth $1,479,000.

In this model there would be 20-hectares of the farm planted in forestry. Again for simplicity, it is assumed that *Pinus radiata* is planted at 275 trees per hectare (Ken Cory, pers comm.). Again assuming that the maximization of revenue is the main criteria, then the selling of P1 Grade Trees, the top range, at a rate of $170 per tree could be expected. The income generated would approximately be $935,000.

The remainder of the farm is for various uses. This includes either cropping, dune stabilization with Marram Grass, or recreational uses. These represent a minor income stream so will not attempt to be calculated.

Land values for the dunefield are variable. The land value is dependent upon a number of factors. Assuming that the dunefield between Foxton and Himatangi is a representative sample of the entire dunefield, then the Ratable Valuation of the

dunefield is approximately $7950 per hectare. Assuming that the rate is for all the 200 hectares, then the total land value would be $1,590,000.

Incorporating these figures for the entire dunefield, which is approximately 90,000 hectares, cattle sales would be $66,555,000, timber sales would be $42,075,000, and total land value would be $71,550,000. Again it needs to be stipulated that these are only a rough maximum estimate, and no attempt has been made to account for the costs involved in the generation of these income streams.

While the use of a small-scale model to gain an insight into the maximum revenue potential of the dunefield was insightful, precise information would have been much more desirable. But as survey respondents were unwilling to provide this information, estimates had to be calculated. This is one of the major limitations in the use of a contingent valuation method survey in the agricultural community.

Through the generation of a hypothetical model, the maximum income from a standard farming practice was able to be generated from current market prices. This model demonstrated that the creation of a conservation area in the dunefield would be very expensive, with land prices, cattle prices and timber prices all indicating that the dunefield is a very successful farming environment and at maximum economies of scale, expensive land. By creating a conservation area there needs to be consideration for the potential income lost through the generation of a conservation area in the dunefield.

The model also determined, based on a number of assumptions, what the maximum income generated could be. These figures however are in contrast to those that the survey respondents indicated that they would be willing to pay for an area of conservation. This indicates that there is strong desire, from those respondents who replied, that conservation is potentially not an option for the farming community.

This contrast in figures suggests that the NIMBY, or Not In My Back Yard, scenario is in fact true. The desire for conservation is far outweighed by the economic potential of the dunefield. As a result conservation may be desired, but the survey respondents do not want an area of their property to be identified for protection.

Through the generation of a model, a maximum income stream could be generated from the use of the dunefield. While this was not the most desirable scenario, it did prove useful in the determination of potential maximum income streams, and the willingness to pay for conservation land within the dunefield.

The next section examines the intrinsic values associated with the dunefield, and how they should be valued.

5.5 Intrinsic Values associated with the dunefield

The identification of intrinsic values associated with the environment is a complex and subjective issue. The difficulties encountered estimating the value associated with the environment does not take away the fact that preservation can be very desirable. Protection and preservation of the environment will enhance the welfare of society (Costanza, 1994).

The complexity of the issue is clearly evident by the identifications that have been carried out by both the Department of Conservation and the Horowhenua District Council into the Manawatu Dunefield. Here the landscapes that have been identified are different due to the different criteria used.

While there is possibly no correct way to identify values in landscapes, it is generally recognized that an assessment including the 'natural science factors' is

required[10] (Environment Court, 2001). There also needs to be the realization that continued degradation of the environment will invariably lead to losses in potential valuable environmental assets.

Economics proposes two separate concepts in relation to intrinsic values. These are 'irreversibility' and 'uncertainty'. 'Irreversibility' is concerned with the current degradation of the environment, and the impact that it will have upon future generations. By consuming, or degrading, the environment now, society is depriving future generations of the potential intrinsic values associated with landforms.

The second term 'uncertainty' is concerned with what values may become valuable in the future. The current use and modification of the environment is again depriving future generations of the potential intrinsic values associated with the environment. Bishop (1978: 13) summarizes the terms;

"potential extinction creates an important public policy issue because there is little basis to judge which life forms can be discarded without serious future social and economic consequences. To choose extinction creates the possibility of large future losses."

5.6 Conclusion

The data analysis in this chapter revealed what most conservationists would have feared. The majority of farmers and respondents in the Manawatu coastal environment are willing to help finance the creation of conservation land within the dunefield, but are not willing to let an area of their land be identified for conservation. This is bought about through the profitability and the productivity of the dunefield, once conversion of the dunelands has taken place.

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[10] Natural science factors include; the geological, topographical, ecological and dynamic components of the landscpae.

Results from the survey show that there is regard for the protection of aspects of the dunefield, but not a general preservation of the dunefield. Indications suggest that other secondary landforms and environmental landscapes of the dunefield are valued more than the formation of the dunes themselves. The results gained are consistent with other previous studies conducted by the Department of Conservation in the Northland Region (Davis and Cocklin, 2001).

The use of a hypothetical model to represent some of the economic values associated with the dunefield was necessary due to the unwillingness of survey respondents to provide any economic indicators to the economic potential of the dunefield. While this was not ideal it did provide an indication to the potential success of the dunefield as a viable agricultural landscape and of its economic value.

Tempered against this are the intrinsic values associated with the dunefield. As has been stated the dunefield represents one of the best examples of Holocene dune development in Australasia, and is the largest area of dunelands in New Zealand (Hesp, 2000; Hilton, 2001). The economic concepts of 'irreversibility' and 'uncertainty' need to be factored into any calculations of the intrinsic values of the dunefield. They represent the potential losses in either economic or biological terms if the current modification and alteration of the dunefield is allowed to occur.

In the next chapter information revealed by the use of the Conservation Management Strategies, the maps generated in chapter four, and the use of NZMS aerial photos will be used to determine if the current conservation estate administered by the Department of Conservation is truly representative in the preservation of all coastal dune types throughout New Zealand.

6.0 Dunefield Representativeness in the Conservation Estate

The information gathered from the creation of protected coastal dune maps throughout New Zealand was vital in the determination of whether or not the current conservation estate is truly representative. To determine what types of dunes were present in each of the protected areas, an examination of aerial photos was carried out.

6.1 Duneland Identification

New Zealand Mapping Services aerial photos were used in the determination of the type of dunes present in each of the protected areas throughout New Zealand[11]. Through the use of these aerial photos, dunelands could be identified and categorized to determine the representativeness of the current conservation estate. This is important in the determination of whether or not the Manawatu parabolic dunefield deserves the protection that is being suggested in this research.

The results of this identification process are summarized below and in the maps provided within this chapter.

6.2 Conservancy Protection

Within New Zealand there are 13 Conservancies that have coastal components. Due to the differing landscapes and environments within each Conservancy, the Department of Conservation has established differing priority areas that need to be preserved and protected. It is this contrasting protection that has resulted in

[11] NZMS Series No. 3 First Edition, Scale: 1:15840, Sheets N1/5-S 184/5 were used. These were compiled by NZ Aerial mapping Ltd. for Lands and Surveys Department New Zealand.

the Conservancies protecting different amounts of coastal dunes throughout New Zealand.

With the use of the maps created in Chapter Four, and the use of the NZMS aerial photos, the areas of protected coastal dunes of New Zealand can be identified. The following section and subsequent maps indicate the locations of the different coastal dunes that are protected throughout New Zealand.

The Northland Conservancy is dominated by transgressive dunes along its western coastline. The transgressive dunes continue along the eastern coast of the Northland coastline, but these are also connected with foredunes and more rocky coastal areas associated with the headlands and bays of the region.

The Auckland Conservancy is similar to the Northland Conservancy. The western coastline is again dominated by predominately transgressive dunefields. The east coast of the Conservancy, again with its series of headlands and bays, has predominately foredunes within its more protected areas.

The Waikato Conservancy is dominated by two distinct stretches of coastlines. The western coast is open, with three coastal inlets. This has resulted in predominately transgressive dunes forming along the coast. The second coastal area is the Coromandel Peninsula. This region is a series of headlands and bays dominating the coastal area. The bays in this area are predominately foredunes and foredune plains.

The Bay of Plenty Conservancy is dominated by small foredune plains, and a large foredune plain barrier island, Matakana Island.

The East Coast/Hawkes Bay Conservancy can be separated into two distinct areas. Firstly the small stretch of coastline in the Bay of Plenty has a set of predominately small foredune plains that are protected. The second area is the

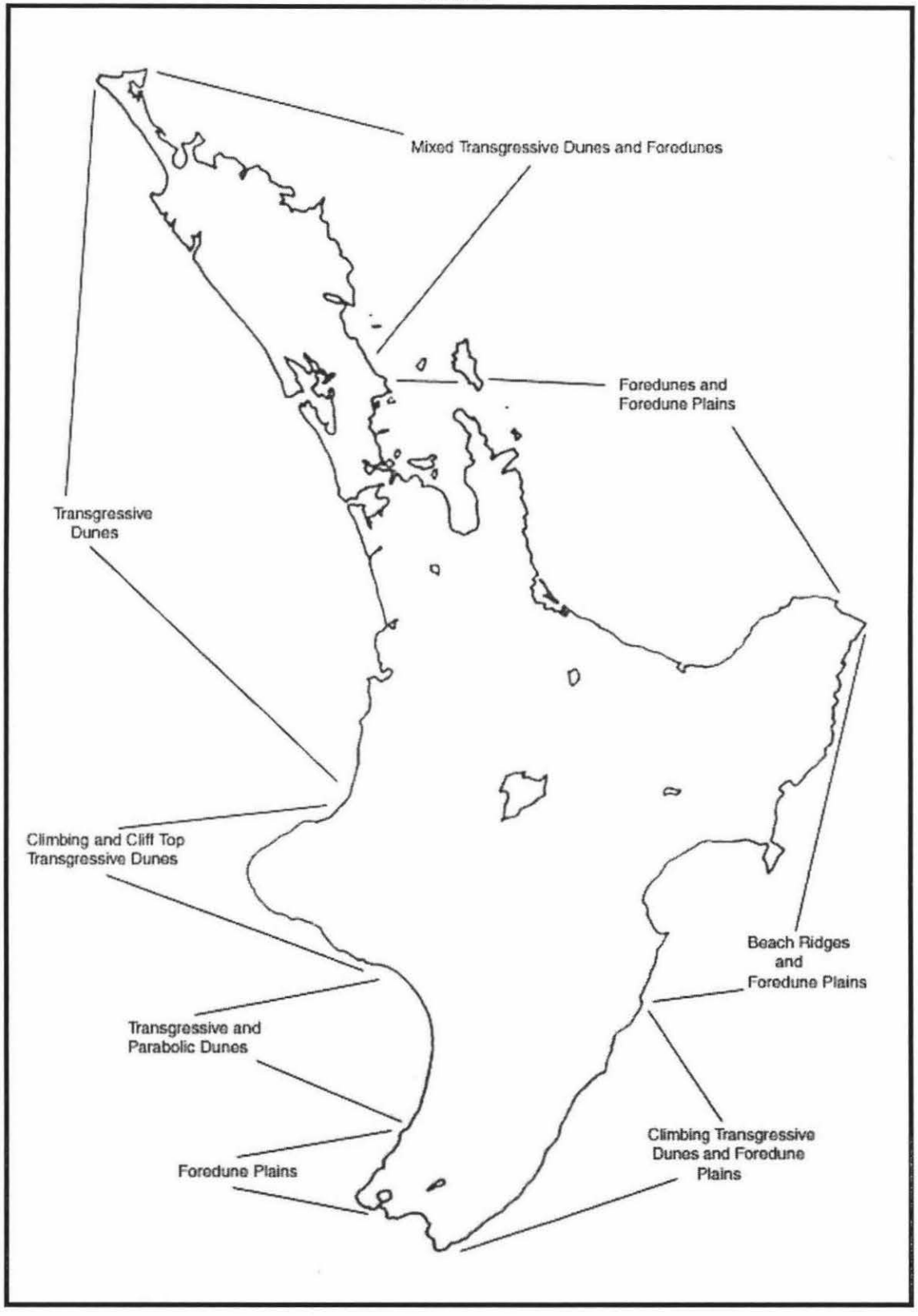
Hawkes Bay. The protected areas along this stretch of coastline are predominately beach ridges and foredune plains.

The Wanganui Conservancy can be separated into three separate areas of coastline. Firstly the protected areas above Mt Taranaki are predominately beach and foredunes. The second area is the area between Mt Taranaki and the Wanganui River; these protected areas are predominately climbing and cliff-top transgressive dunes. The final area is south of the Wanganui River. These Conservation areas are predominately parabolic dunes.

The Wellington Conservancy has three separate coastal areas. The western coast of the Conservancy has parabolic dunes located near Levin. Further south along this coastline, the protected areas are predominately foredune plains. The second area in the Conservancy is the eastern coastline. Here the protected areas are predominately climbing transgressive dunes and small foredune plains. The final area is the south coast of the Conservancy. Here the protected areas are predominately raised beach ridges.

On the next page Map 6.1 shows the location of coastal dune development in the North Island. While it is only a generalised summary, it can be seen that there is only one location of significant parabolic dune development in the North Island.

Map 6.1 The location and type of predominant Coastal Dunes in the North Island



The Nelson/Marlborough Conservancy can be separated into four distinct coastal areas. Firstly the protected area of Farewell spit is a transgressive dunefield. The second area is Golden Bay. The protected areas of this area are predominately foredunes and foredune plains. The third area is the Marlborough Sounds. Here the protected areas are predominately beach and foredunes. The majority of the protected coasts in the sounds are rocky. The final area in the Conservancy is the East Coast of the South Island. Here the protected areas are predominately foredunes and foredune plains.

The Chatham Islands Conservancy is unique in the New Zealand Conservation Estate. It is the only section that is solely Island based. The Chatham Islands are predominately rocky coastlines. But there are sections of coastal dunes around the Te Whanga Lagoon. These are predominately transgressive dunes and foredunes.

The West Coast Conservancy has the longest stretch of unbroken coastline in New Zealand. The protected areas along this coastline are predominately foredune plains, but in places along the coast there is only a single foredune.

The Canterbury Conservancy can be separated into three separate areas. Firstly the coastal area above Banks Peninsula. Here the protected areas are predominately foredune plains. The second area is the Coastal area around Lake Elesmere. Here the protected areas are predominately foredune plains, with some small transgressive dunes, and blowouts. The third area is south of Lake Elesmere. The protected areas here are predominately foredunes and foredune plains.

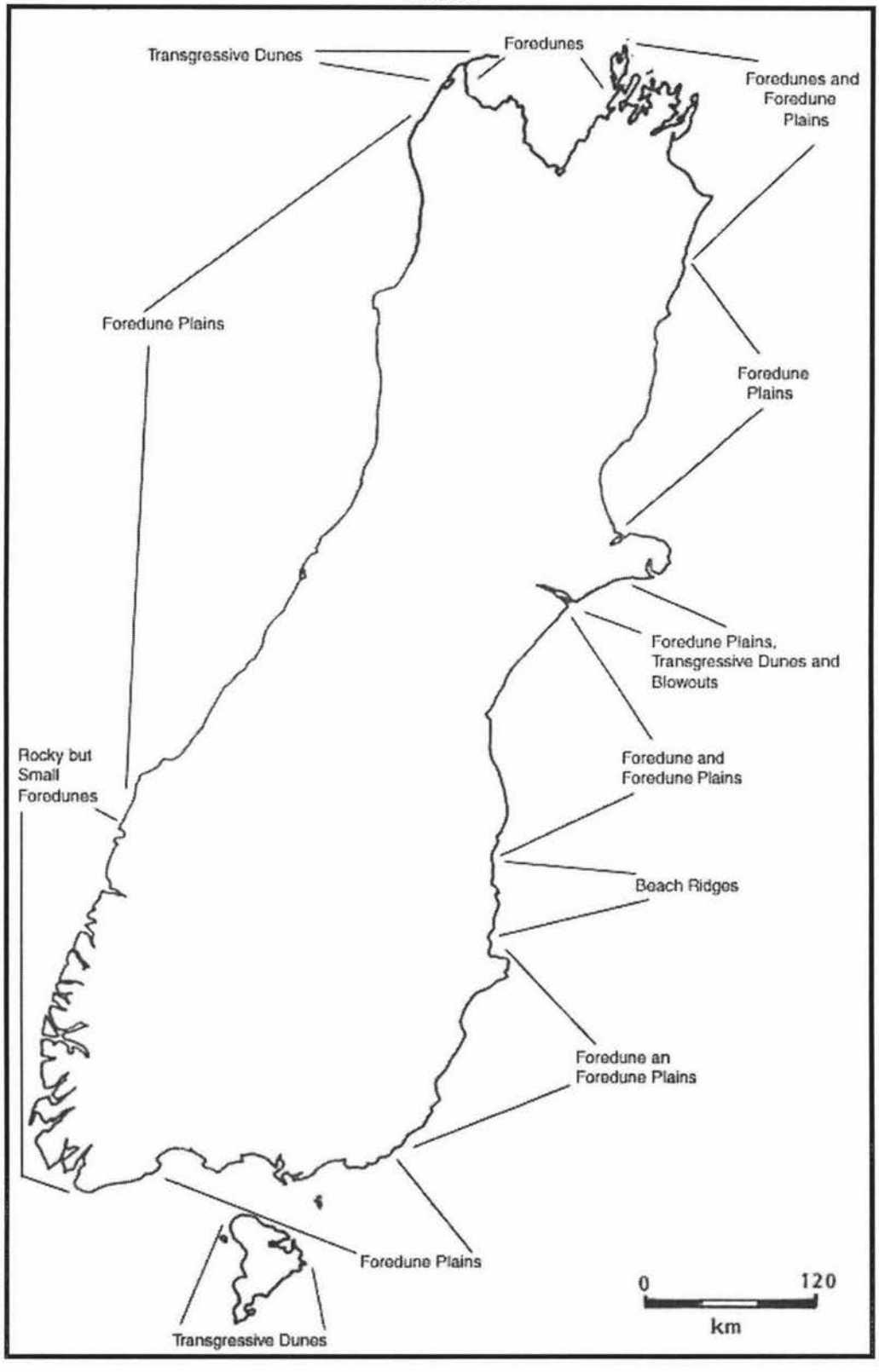
The Otago Conservancy can be separated into three distinct coastal areas. Firstly the area north of the Otago Peninsula. Here the protected areas are predominately beach ridges. Secondly the protected areas of the Otago Peninsula are predominately foredunes and foredune plains. Just to the north and south of the Peninsula however are two large areas of transgressive dunes.

The Final area is the coastline south of the Otago Peninsula. Here the protected areas are predominately foredunes and foredune plains.

The Southland Conservancy can be separated into three separate coastal areas. Firstly the Fiords along the West Coast. Here the coast is predominately rocky, but there are small areas of foredunes. The second area is the southern coast. Here the protected areas are predominately foredune plains. Finally the protected dune areas of Stewart Island are predominately parabolic and transgressive dunes, with the two large dune areas located at Mason Bay and Doughboy Bay.

Map 6.2 on the following page shows the generalized locations of the coastal dunes in the South Island. It can be seen that there is very limited parabolic dune development in the South Island.

Map 6.2 Location and Type of Predominant Coastal Dunes in the South Island



6.3 Conclusion

The identification of dunefield types in New Zealand is important. By determining the types of coastal dunes in the current conservation estate it is possible to identify whether or not the current conservation estate is truly representative in the preservation of all dune types throughout New Zealand.

With the use of the maps created in chapter four, the use of NZMS aerial photos, and the generation of dune location maps in this chapter, it can be concluded that the current conservation estate is not representative. The majority of coastal dunes that are protected are either foredunes or transgressive dunes. The only significant location of parabolic dune development is in the Wanganui Conservancy, and the only areas of protection within the dunefield are small and disjointed.

The Department of Conservation and the Ministry for the Environment have both stated that the preservation of coastal dunes throughout New Zealand is a priority (Department of Conservation, 1994a, Taylor and Smith, 1997). Added to this is the requirement in the current government legislation that all representative examples of New Zealand's environment are protected (Reserves Act, (1977)).

An area of protection within the Manawatu parabolic dunefield would increase the representativeness of the current Conservation Estate. This would ensure that all representative examples of coastal dunes throughout New Zealand are protected.

Chapter Seven: Conclusions

7.1 Introduction

The main aims of this research were to determine (i) how coastal dunes throughout New Zealand are valued both by government organizations and by local populations, (ii) if a section of New Zealand's coastal environment has any value in terms of intrinsic processes, rather than standard agricultural practices, and (iii) a methodology for valuing the Manawatu parabolic dunefield. This was done through the examination of Department of Conservation Management Strategies and the use of personal surveys of the local Manawatu farming population. A central element of this research was the use of the contingent valuation method, in the form of a personal survey, to assess the local populations opinions on the possible creation of a conservation area within the Manawatu parabolic dunefield.

The purpose of this chapter centres around four separate components. Firstly suggestions will be made concerning the way in which the Department of Conservation values coastal dunes throughout New Zealand. Secondly, a comparison of the economic values and the intrinsic values associated with the dunefield. Thirdly, to assess how informative the research methodology is, and to make suggestions for the use of a contingent valuation survey when attempting to value conservation areas. Finally the chapter will conclude by considering the future research required on the valuing of coastal dunes.

7.2 New Zealand's Coastal Dunes

Without some sort of intervention, the consequences of not improving the level of protection awarded to New Zealand's coastal environment could be severe. Increasing pressure placed upon these environments could potentially lead to some form of ecological crisis.

The intention of this section is to draw some conclusions from this research, and to make some recommendations for decision-makers to determine whether or not the creation of a conservation area is justified within the Manawatu dunefield. This will be done on the basis of the knowledge gained from all aspects of the research, not just the survey itself.

7.2.1 The Current Conservation Estate

The Department of Conservation has established a current Conservation Estate that covers approximately one third of New Zealand's total land area. In doing so, the Department of Conservation has to meet the guidelines set down in current government legislation, principally the Reserves Act (1977), the Conservation Act (1987), and the Resource Management Act (1991). All three statutes require that all representative examples of New Zealand's environment be protected, to ensure the survival of New Zealand's own natural character.

As has been shown in both chapters 4 and 6, the current protection awarded to coastal dunes throughout New Zealand is unrepresentative. With each Conservancy required to identify potential landscapes for protection, the differing methods used have resulted in the current disjointed protection of coastal dunes throughout New Zealand.

Of those areas that have already been awarded protection, the majority of areas have been granted protection due to the presence of native vegetation. But often the vegetation cover is determined by the underlying landforms. Therefore, by protecting the landforms themselves, the Department of Conservation would ensure the survival of any native vegetation that may propagate within these areas. This could potentially increase the native vegetation cover due to larger areas being protected rather than each individually vegetated area.

7.2.2 The Manawatu Parabolic Dunefield

As was identified in chapter two, the Manawatu coastal environment is dominated by the largest parabolic and transgressive dunefield in New Zealand. It is also considered to be one of the best examples of Holocene dune development in Australasia (Hesp, 2001). The Department of Conservation, through their Recommended Areas for Protection Programme, has identified a 250ha area of the Manawatu parabolic dunefield for protection. This area is known as the 'Foxtangi Dunes' (Map 4.19). Yet decision-makers have determined that this priority area is not worthy of any preservation. Subsequently the current protection within the Manawatu dunefield is small and disjointed.

The analysis of Department of Conservation Conservancy Management Strategies and the subsequent creation of protected coastal dune maps showed that the current conservation estate is unrepresentative. There is the requirement in current government legislation for the Department of Conservation to protect all representative samples of New Zealand's environment to ensure the preservation of New Zealand's natural character for future generations.

The responses gained from the surveys indicate that there is a consensus that aspects of the dunefield are worthy of protection. These include the native flora and fauna, the foredune and the ephemeral wetlands in the dunefield. Yet there is reluctance for any formal protection. This revolved around the possibility that parts of property owner's land may be identified for protection.

With the dunefield being both an excellent example of Holocene dune development and the legislative requirement that the Department of Conservation has to ensure the preservation of all representative examples of New Zealand's environment, there is the justification for protection and preservation. Without any protection in the dunefield, the continued farming of the dunefield will irreversibly modify and alter one of New Zealand's outstanding landscapes. The establishment of an area of conservation like the 'Foxtangi

Dunes' would ensure that the Department of Conservation is preserving all representative examples of New Zealand's environment.

If this area were to be established, an extensive buffer area, which would be essential, would ensure that the inland migration of sands would not disturb other farming practices within the Manawatu dunefield.

7.3 Economic Value vs Intrinsic Value

The use of a contingent valuation method survey was used in this research to determine some of the economic values associated with the use of the Manawatu dunefield. As was stated in chapter 5, survey respondents were very unwilling to discuss revenue and economic matters associated with the use of the dunefield. Through the use of a simple model, generated in chapter 5, a rough indication to the maximum profitability of the duneland could be calculated. There does, however, need to be a comparison made between the economic values and the intrinsic values associated with the dunefield.

7.3.1 Economic Values

While the generation of a simple hypothetical model was not ideal for the research purposes, the unwillingness of survey respondents to provide economic indicators to the profitability of the farmlands meant that it needed to be generated. The low-lying topography, which aids in the development of the dunefield, provides the ideal landscape for agricultural purposes. The simple model, plus the success of the farming community, shows that the dunefield is a profitable landscape to farm.

The economic value derived from the present and potential future use, otherwise known as use values, ensures that the Manawatu dunefield will be, and is, a prime location for the agricultural community.

7.3.2 Intrinsic Values

While current government legislation discusses the need for the protection and preservation of outstanding landscapes that exhibit intrinsic values in New Zealand's environment, it has been left up to Court rulings to determine how to measure and identify these landscapes.

The determination and identification of the values, however, does not take into account two key components in the preservation and protection of the environment. These ideas are seen in the economic valuing of environmental resources; 'irreversibility' and 'uncertainty'.

Intrinsic values in the natural environment become natural resources through changes in income levels, population levels, technologies, social institutions, and public policy. The disappearance of these resources is an irreversible change. The current degradation of the environment is surrounded in uncertainty, uncertainty as to which aspects or characteristics may become valuable to us in the future, and which may not.

7.3.3 Value Judgements

With the current government legislation requiring that the Department of Conservation preserve and protect all representative examples of New Zealand's natural environment, a case can be developed for the protection of the Manawatu dunefield. But this is a value judgement that economics is unable to assist with.

While economics can assist with the information behind the productivity performance of the dunefield, and the valuing of the dunefield through a hypothetical market situation in the form of a contingent valuation survey, it is policy makers who, aided by various sources of information, ultimately will have to decide on the best and most sustainable use of the dunefield.

7.4 Assessing the use of a Contingent Valuation Survey

The survey methodology was designed primarily to determine whether or not the local farming population values the benefits associated with the Manawatu parabolic dunefield. Two secondary objectives within the survey were to determine the respondent's views towards the creation of conservation land within the dunefield, and the willingness to pay for the creation of a conservation area within the dunefield.

This section will discuss the effectiveness of the methodology in achieving these objectives. This will be done by examining the survey responses, the identification of the shortcomings in the methodology and by making some recommendations for future research into the area.

7.4.1 Survey Responses

In examining the responses gained from the survey, it could be said that the research topic was not very successful in soliciting the maximum number of farmer responses. Of those that were willing to provide responses, a large portion of responses either could not place a value on the benefits gained, or in fact lodged 'protest' bids.

Several respondents commented on the financing of an area of conservation land, and were in fact worried that an area of their property would be identified for conservation. In this sense the responses gained did not provide a good basis to test the questionnaire, and the biases associated with the responses secured would make any conclusions questionable. The biases associated with the survey questions appear to be similar to those identified in chapter two.

Overall the responses gained from the broad range of questions elicited excellent information. The survey was successful in meeting the first two objectives identified. The analysis of these two objectives in chapter five showed this.

Nevertheless there was a few questions that respondents were unwilling to answer. These included the income and monetary benefits associated with the dunefield.

The third objective, to gain information about the willingness to pay and accept for an area of conservation within the dunefield, was less successful. Responses gained revealed a significant reluctance to discuss any monetary matters. This was also compounded by the perceived possibility that a section of respondent's properties could be identified for conservation protection. The problems identified with these questions highlights some of the shortcomings of applying the methodology to implementing conservation areas. These are considered next.

7.4.2 Recommendations for Improving the Survey Process

For decision makers wishing to employ the contingent valuation survey methodology in the future, the experience of this research suggests that a few alterations should be made.

The research showed that respondents were unwilling to discuss monetary matters; this included the value of the properties and the willingness to pay and accept compensation for a conservation area. By tailoring a survey to only gain qualitative data, rather than quantitative, perhaps more accurate and less biased conclusions can be drawn. It would remove the possibility for any strategic or implied value biases.

The use of personal surveys to conduct the methodology was important, so that any confusion of question wording could be clarified. However, by using a personal survey, time constraints are placed upon both the respondents and the surveyor. This can lead to respondents not being able to fully value the environment. By perhaps posting the survey to willing respondents before personal interviews are conducted, respondents would be able to think about the

environment and hence have a better understanding of the values associated with that environment.

7.4.3 The shortcomings of the Survey Methodology

The survey, by attempting to involve those who would be most affected by the decision making process, attempts to ensure transparency and responsibility. The experience of this research reveals that the methodology is not free from shortcomings, however.

One of the main problems with the methodology was the imperfect user list of relevant households and property owners. Since the three Council's list of ratepayers did not exactly correspond to potential users, the application of the methodology was deficient in the sense that not all users were given the opportunity to participate in the survey. This was compounded by only a limited amount of identified respondents being willing to participate with the survey. While decisions can still be made, and impressions can be gained from opinions expressed, this is not very satisfactory. Within the Manawatu coastal environment, there is only a relatively small amount of residents, yet these residents do own large amounts of land, and are thus affected greatly when questions concerning potential conservation areas are concerned.

Another shortcoming of the methodology, which was experienced in this research, is getting respondents to place a value on the creation of a conservation area. By gaining this willingness to pay, an artificial market value is generated. Yet the responses collected are subject to individual biases from respondents. This leads to doubt over the applicability of this monetary valuation method when attempting to implement and evaluate potential conservation areas.

These shortcomings do not undermine the methodology. As a non-market valuation method, it is well documented that the results gained are not perfect:

"If the results of a non-market valuation exercises are used as a tool for aiding decision makers, rather than as a rule for decision-making, the theoretical and practical limitations of the methods are of less concern." (Kerr, 1986: 16)

7.5 Future Research

The methodology used in this research has been met with varying degrees of success. To make a fair evaluation of the research methodology, it needs to be trialed on other potential conservation areas. A future evaluation should be based on how worthwhile the extra information yielded is for decision-makers, given that the recommendations in the research are adopted.

Future research is needed to provide decision-makers with examples and recommendations on how to value and manage coastal environments, particularly the intrinsic values associated with these landscapes. Obviously, any research needs to be consistent with current New Zealand legislation. But ideally, it would recommend ways in which to improve this legislation. An important part of such research would be an examination of issues and government policy on whether the Conservation potential for coastal environments outweighs the productive potential of the landscapes. When decision-makers have this information, they will be in a much better position in truly protecting and preserving all representative examples of New Zealand's environment for both current and future generations.

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Appendix One
Relevant Sections of the RMA 1991

Relevant Sections of the Resource Management Act (1991).

PART I
INTERPRETATION AND APPLICATION

2. Interpretation - (1) In this Act, unless the context otherwise requires, -

"Amenity values" means those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

"Costs and benefits" includes costs and benefits of any kind whether monetary or non-monetary:

"Environment" includes –

(a) Ecosystems and their constituent parts, including people and communities; and

(b) All natural and physical resources; and

(c) Amenity values; and

(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters:

"Intrinsic values", in relation to ecosystems, means those aspects of ecosystems and their constituent parts which have value in their own right, including –

(a) Their biological and genetic diversity; and

(b) The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience:

**3. Meaning of ``effect''** - In this Act, unless the context otherwise requires, the term ``effect'' in relation to the use, development, or protection of natural and physical resources, or in relation to the environment, includes –

(a) Any positive or adverse effect; and

(b) Any temporary or permanent effect; and

(c) Any past, present, or future effect; and

(d) Any cumulative effect which arises over time or in combination with other effects - regardless of the scale, intensity, duration, or frequency of the effect, and also includes –

(e) Any potential effect of high probability; and

(f) Any potential effect of low probability which has a high potential impact.

PART II
PURPOSE AND PRINCIPLES

5. Purpose - (1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, ``sustainable management'' means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while -

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

6. Matters of national importance - In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the

use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:

(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:

(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:

(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

7. Other matters - In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to -

(a) Kaitiakitanga:

(b) The efficient use and development of natural and physical resources:

(c) The maintenance and enhancement of amenity values:

(d) Intrinsic values of ecosystems:

(e) Recognition and protection of the heritage values of sites, buildings, places, or areas:

(f) Maintenance and enhancement of the quality of the environment:

(g) Any finite characteristics of natural and physical resources:

(h) The protection of the habitat of trout and salmon.

Part III

DUTIES AND RESTRICTIONS UNDER THIS ACT

Adverse Effects

17. Duty to avoid, remedy, or mitigate adverse effects -

(1) Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of that person, whether or not the activity is in accordance with a rule in a plan, a resource consent, section 10 (certain existing uses protected), or section 20 (certain existing lawful activities allowed).

Appendix Two
Relevant Sections of the Reserves Act 1977

Relevant Sections of the Reserves Act (1977).

PART I
PRELIMINARY

2. Interpretation - (1) In this Act, unless the context otherwise requires, -

"Fauna" means animals of any kind:

"Flora" means plants of any kind:

"Plant" means any angiosperm, gymnosperm, fern, or fern ally; and includes any moss, liverwort, algae, fungus, or related organism:

"Reserve" or "public reserve", except as hereinafter provided in this definition, means any land set apart for any public purpose; and includes -

(a) Any land which immediately before the commencement of this Act was a public reserve within the meaning of the Reserves and Domains Act 1953:

(b) Any land vested in the Crown which after the commencement of this Act is reserved or set apart under Part XII of the Land Act 1948 or other lawful authority as a reserve, or alienated from the Crown for the purpose of a reserve:

(c) Any land which after the commencement of this Act is vested in the Crown by or under the authority of any Act as a reserve:

(d) Any land which after the commencement of this Act is taken, purchased, or otherwise acquired in any manner whatever by the Crown as a reserve or in trust for any particular purpose:

(e) Any land acquired after the commencement of this Act in any manner by an administering body as a reserve within the meaning of this Act, and any land vested in any local authority which, not theretofore being a public reserve, is by resolution of the local authority pursuant to section 14 of this Act declared to be set apart as a reserve:

(f) Any private land set apart as a reserve in accordance with the provisions of any Act:

(g) Any land which immediately before the commencement of this Act was a domain or public domain within the meaning of the Reserves and Domains Act 1953:

(h) Any land, other than a National Park within the meaning of the National Parks Act 1952, administered under the Tourist and Health Resorts Control Act 1908:

(i) Any land taken or otherwise acquired or set apart by the Crown under the Public Works Act 1928 or any former Act, whether before or after the commencement of this Act, for the purposes of a recreation ground, a pleasure ground, an agricultural showground, or a scenic, nature, flora and fauna, historic, or scientific reserve, or for a tourist and health resort; -

but does not include –

(j) Any land taken or otherwise acquired or set apart under the Public Works Act 1928 or any former Act, whether before or after the commencement of this Act, for any purpose not specified in paragraph (i) of this definition:

(k) Any land to which section 167 (4) of the Land Act 1948 applies:

(l) Any land taken, purchased, or otherwise in any manner acquired, whether before or after the commencement of this Act, by a local authority, unless the land is acquired subject to a trust or a condition that it shall be held by the local authority as a reserve:

(m) Any Maori reservation:

PART I

ADMINISTRATION

3. General purpose of this Act - (1) It is hereby declared that, subject to the control of the Minister, this Act shall be administered in the Department of Lands and Survey for the purpose of -

(a) Providing, for the preservation and management for the benefit and enjoyment of the public, areas of New Zealand possessing -

(i) Recreational use or potential, whether active or passive; or

(ii) Wildlife; or

(iii) Indigenous flora or fauna; or

(iv) Environmental and landscape amenity or interest; or

(v) Natural, scenic, historic, cultural, archaeological, biological, geological, scientific, educational, community, or other special features or value:

(b) Ensuring, as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character:

(c) Ensuring, as far as possible, the preservation of access for the public to and along the sea coast, its bays and inlets and offshore islands, lakeshores, and riverbanks, and fostering and promoting the preservation of the natural character of the coastal environment and of the margins of lakes and rivers and the protection of them from unnecessary subdivision and development.

(2) In the exercise of its administration of this Act, the Department may take any action approved or directed from time to time by the Minister so far as it is consistent with this Act or is provided for in any other Act and is not inconsistent with this Act.

PART III

CLASSIFICATION AND PURPOSE OF RESERVES

20. Nature reserves - (1) It is hereby declared that the appropriate provisions of this Act shall have effect, in relation to reserves classified as nature reserves, for the purpose of protecting and preserving in perpetuity indigenous flora or fauna or natural features that are of such rarity, scientific interest or importance, or so unique that their protection and preservation are in the public interest.

(2) It is hereby further declared that, having regard to the general purposes specified in subsection (1) of this section, every nature reserve shall be so administered and maintained under the appropriate provisions of this Act that -

(a) It shall be preserved as far as possible in its natural state:

(b) Except where the Minister otherwise determines, the indigenous flora and fauna, ecological associations, and natural environment shall as far as possible be preserved and the exotic flora and fauna as far as possible be exterminated:

(c) For the better protection and preservation of the flora and fauna in its natural state, no person shall enter the reserve, except under the authority of a permit granted under section 57 of this Act and, for the purposes of this paragraph, the expression "enter the reserve" shall, in the case of a nature reserve or part of a nature reserve that is an island or that comprises most of an island, be deemed to include any physical contact with the land by a boat; and for this purpose any physical contact with the land shall be deemed to include the attaching (by rope or otherwise) of a boat to the reserve or to a wharf constructed on or partly on the reserve:

(d) Where scenic, historic, archaeological, biological, geological, or other scientific features are present on the reserve, those features shall be managed and protected to the extent compatible with the principal or primary purpose of the reserve: Provided that nothing in this paragraph shall authorise the doing of anything with respect to fauna that would contravene any provision of the Wildlife Act 1953 or any regulations or Proclamation or

notification under that Act, or the doing of anything with respect to archaeological features in any reserve that would contravene any provision of the Historic Places Act 1954:

(e) To the extent compatible with the principal or primary purpose of the reserve, its value as a soil, water, and forest conservation area shall be maintained.

(3) For the purposes of subsection (2) (c) of this section, where the foreshore of any nature reserve which is an island or part of an island does not form part of the reserve which it adjoins, the foreshore shall be deemed to form part of the reserve.

Appendix Three
Relevant Sections of the Conservation Act 1987

Relevant Sections of the Conservation Act (1987).

PART I
PRELIMINARY

2. Interpretation - (1) In this Act, unless the context otherwise requires, -

"Conservation" means the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations:

"Conservation area" means any land or foreshore that is -
(a) Land or foreshore for the time being held under this Act for conservation purposes; or
(b) Land in respect of which an interest is held under this Act for conservation purposes:

"Department" means the Department of Conservation:

"Management plan" means a plan established under section 10 (1)(a) of this Act:

"Natural resources" means -
(a) Plants and animals of all kinds; and
(b) The air, water, and soil in or on which any plant or animal lives or may live; and
(c) Landscape and landform; and
(d) Geological features; and
(e) Systems of interacting living organisms, and their environment; - and includes any interest in a natural resource:

"Plant" means any member of the plant kingdom; and includes any alga, bacterium, or fungus, and any part of or seed or spore from any plant:

"Preservation", in relation to a resource, means the maintenance, so far as is practicable, of its intrinsic values:

"Protection", in relation to a resource, means its maintenance, so far as is practicable, in its current state; but includes -

(a) Its restoration to some former state; and

(b) Its augmentation, enhancement, or expansion:

(2) In this Act, unless the context otherwise requires, "conservation park", "ecological area", "sanctuary area", or "wilderness area", mean an area held for ecological, park, sanctuary, or wilderness purposes under section 18 (1) of this Act.

PART II

ESTABLISHMENT AND FUNCTIONS OF THE DEPARTMENT OF CONSERVATION

6. Functions of Department - The functions of the Department are to administer this Act and the enactments specified in the First Schedule to this Act, and, subject to this Act and those enactments and to the directions (if any) of the Minister, -

(a) To manage for conservation purposes, all land, and all other natural and historic resources, for the time being held under this Act, and all other land and natural and historic resources whose owner agrees with the Minister that they should be managed by the Department:

(b) To advocate the conservation of natural and historic resources generally:

(c) To promote the benefits to present and future generations of -

(i) The conservation of natural and historic resources generally and the natural and historic resources of New Zealand in particular; and

(ii) The conservation of the natural and historic resources of New Zealand's sub-Antarctic islands and, consistently with all relevant international agreements, of the Ross Dependency and Antarctica generally; and

(iii) International co-operation on matters relating to conservation:

(d) To prepare, provide, disseminate, promote, and publicise educational and promotional material relating to conservation:

(e) To the extent that the use of any natural or historic resource for recreation or tourism is not inconsistent with its conservation, to foster the use of natural and historic resources for recreation, and to allow their use for tourism:

(f) To advise the Minister on matters relating to any of those functions or to conservation generally:

(g) Every other function conferred on it by any other enactment.

PART III

CONSERVATION AREAS

9. Policy statements for conservation areas - (1) The Minister may adopt a statement of general policy for any conservation area or areas, or conservation areas of any class or description; and may from time to time amend any such statement in the light of changing circumstances or increased knowledge.

(2) Before adopting or amending any such statement, the Minister shall give public notice of the proposed statement or amendment; and section 49 of this Act shall apply accordingly.

10. Management Plans - (1) Subject to sections 11 and 30 of this Act, the Minister -

(a) Shall establish a management plan for every conservation area (either individually or together with any other conservation area or areas):

(b) May at any time amend any management plan:

(c) May at any time review any management plan -

(i) To take account of increased knowledge or changed circumstances; or

(ii) Where, in the Minister's opinion, a review is likely to disclose additional knowledge, or changed circumstances, that would make the plan's amendment desirable:

(d) Shall review a management plan once 10 years have passed since it was established or, if it has since been reviewed, since it was last reviewed.

(2) The management plan of any conservation area shall reflect, and in every respect be in conformity with, every provision of this Act relating to the management of conservation areas of the class to which the area belongs.

12. Effect of Management Plans - (1) Subject to subsections (2) and (3) of this section, the Department shall manage every conservation area in accordance with its management plan (if any).

(2) No management plan restricts or affects the exercise of any legal right or power by any person other than the Minister or the Director-General.

(3) No management plan limits or affects the exercise by a lessee or licensee of any area of any right or power conferred by a lease or license granted before the commencement of this Act.

(4) Every management plan shall be available for public inspection during ordinary office hours at the Department's Head Office, and at all other offices of the Department where the Director-General thinks its public availability is desirable.

(5) Where a management plan is established or amended, the Director-General shall give public notice of the fact, specifying the offices at which the plan or amended plan can be inspected; and section 49 (1) of this Act shall apply accordingly.

PART IV

SPECIALLY PROTECTED AREAS

19. Conservation Parks - (1) Every conservation park shall so be managed -

(a) That its natural and historic resources are protected; and

(b) Subject to paragraph (a) of this subsection, to facilitate public recreation and enjoyment.

(2) Where a committee is constituted by or under regulations made under subsection (3) of this section in respect of any conservation park, it may advise the Minister on the area's management.

(3) The Governor-General may from time to time, by Order in Council, make regulations constituting, or providing for the constitution, appointment, or election, of a committee to advise the Minister on the management of any conservation park or parks, and defining its functions.

(4) Regulations under subsection (3) of this section may be so made as to apply to -

(a) All conservation parks, parks of any class or description, or to any specified conservation park or parks:

(b) All committees constituted by or under regulations made under subsection (3) of this section, or to any such committee or committees.

Appendix Four
The Questionnaire

Massey University
COLLEGE OF HUMANITIES & SOCIAL SCIENCES

School of People
Environment and Planning
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Palmerston North,
New Zealand
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Dear Respondent

The bearer of this letter, Richard Poole, is a student studying in the Geography Programme at Massey University, and is conducting an important research project.

I would be grateful of your assistance in the study, which is being carried out as part of a Masters degree within the Geography Programme. Like all research carried out in the Programme, the project is subject to scrutiny by an ethics committee and requires that all the answers you give will be treated in absolute confidence. Neither your name or names associated with your company, farm or operation will be listed in the thesis or available to anyone.

I hope that this assurance will aid your participation in our research. If you have any further questions about the research, please do not hesitate to telephone or email me at the University (06 3455799, extn. 2499; email: p.a.hesp@massey.ac.nz

Thankyou for your help

Associate Professor Patrick Hesp

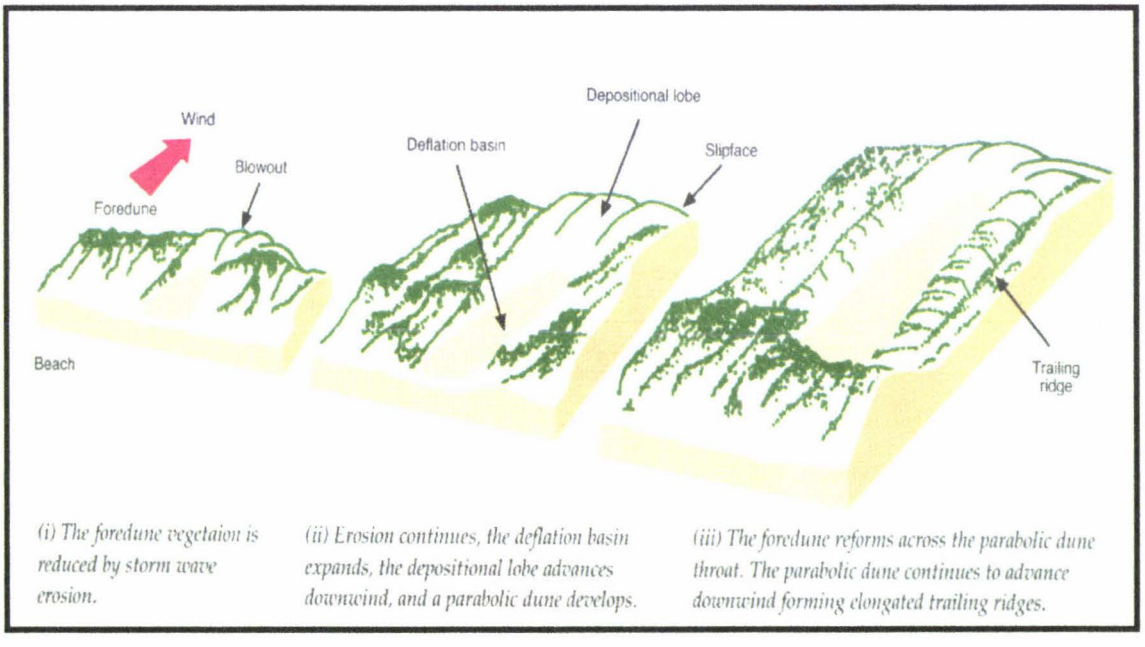
Information Sheet:

Some scientists and conservationists have argued that parts of the coastal dune environment in the Manawatu-Rangitikei region should be in conservation areas or national parks. They argue that the region has high conservation and natural character value due to the range and type of coastal dunes present (both active and stabilised) and the rare flora and fauna in the dunefield.

This research aims to examine the way in which the Manawatu sand country is utilised and the value associated with. And income derived from that use. The intention is to gather data on the range of traditional economic uses (e.g. farming, forestry etc), and compare the value and income derived from those uses with the possible or potential value(s) that might be derived from conservation or recreational uses.

In order to evaluate the income and value of traditional uses, a short questionnaire has been constructed. It would be much appreciated if you could provide as detailed information as possible on this questionnaire.

The stabilised sand dune country typically comprises low, flat plains, long trailing ridges, and high hummocky dune noses (termed depositional lobes on the diagram below). Nearer the coast, there are active foredunes (or frontal dune).



Respondents:

1. What type of farm do you run?

2. What is the total size of your farm?

3. Of the total farm size, how many hectares comprise the Manawatu dune country?

4. What percentage or acreage of your total farmland is covered by active (bare or mobile) dune sand or dunefield?

5. What percentage or acreage of your total farmland is covered by:

Sand Flats	_____
Low Dunes (<5m high)	_____
High Dune Ridges (>5m high)	_____
Swamps	_____
Seasonal Wetlands	_____
Lakes	_____

6. What is the government valuation of your property?

7. What is the dune country currently used for? (Please Tick)

Grazing	_____
Forestry	_____
Marram Planting (Dune Stabilisation)	_____
Cropping	_____
Other (What)	_____
Retired (Unusable)	_____
Nothing	_____

8. What is the average net income from these activities, for the past 3 financial years?

Wool/Beef/Venison Sales _____
Milk Sales _____
Forestry _____
Cropping _____
Unwilling to Answer _____

9. If unwilling to answer question 8, what is the percentage of income for each?

Wool/Beef/Venison Sales _____
Milk Sales _____
Forestry _____
Cropping _____
Unwilling to Answer _____

10a. From question 5, what landforms have any value, other than for farming?

10b. Why?

11. List the elements that you value within a landscape (e.g. trees, water, farmland).

12. The Department of Conservation has identified a number of aspects from the Manawatu sand country as being valuable and worthy of protection. Do you believe that the following are valuable? Why?

i) The Foredune

ii) The Sand Plains

iii) Ephemeral Wetlands

iv) The Parabolic Dunes

v) Indigenous Vegetation

12a. Do you believe that any of the list from question 5, deserve protection from inappropriate use or development? (Please specify)

12b. Why?

13a. If a section of the Manawatu sand country was identified as deserving protection, as a member of the Manawatu region, what is the maximum amount of money that you would be willing to pay annually to preserve that environment?

$1-$10/hectare	_____
$11-$20/hectare	_____
$21-$30/hectare	_____
$31-$40/hectare	_____
$41+/hectare	_____

13b. What is the maximum amount that you would be willing to pay to preserve the environment?

14. If a section of your farmland were indicated as deserving protection, what level of compensation would you need to allow the protection of the landscape?

15. If you have any comments please use the space below.

Appendix Five
Survey Results

District	Responses	Farm Size (ha)	WTP	WTA	Use	Main Income
Manawatu	1	287	$0	$41+	g,mp,f	Beef
Manawatu	2	315	$0	$41+	g,mp,f	Milk Sales
Manawatu	3	862	$1-10	$1-10	g,f,c	Milk Sales
Manawatu	4	195	$1-10	$1-10	g,mp,f	Beef
Manawatu	5	2200	$21-30	$0	g,f,c,o	Beef
Manawatu	6	117	$0	$41+	g,mp,f	Beef
Manawatu	7	234	$0	$41+	g,mp,f	Milk Sales
Manawatu	8	261	$0	$41+	g,f,c	Milk Sales
Manawatu	9	184	$1-10	$0	g,f	Beef
Manawatu	10	313	$1-10	$0	g,f,c	Beef
Manawatu	11	89	$1-10	$1-10	g,f	Beef
Manawatu	12	302	$1-10	$1-10	g,f,c	Milk Sales
Manawatu	13	225	$21-30	$0	g	Milk Sales
Manawatu	14	169	$0	$41+	g,mp,f	Milk Sales
Manawatu	15	210	$0	$41+	g,f	Milk Sales
Manawatu	16	615	$0	$41+	g,f,c	Beef
Manawatu	17	205	$0	$41+	g,f	Milk Sales
Manawatu	18	197	$0	$41+	g,f	Milk Sales
Manawatu	19	164	$0	$41+	g,f	Milk Sales
Manawatu	20	227	$0	$41+	g,f	Milk Sales
Manawatu	21	156	$1-10	$1-10	g,f	Milk Sales
Manawatu	22	145	$1-10	$1-10	g	Beef
Rangitikei	23	75	$1-10	$1-10	g	Beef
Rangitikei	24	440	$1-10	$1-10	g,c	Milk Sales
Rangitikei	25	6299	$1-10	$41+	f,mp	Beef
Rangitikei	26	235	$1-10	$41+	g,f	Beef
Rangitikei	27	215	$1-10	$41+	g,mp,f	Milk Sales
Rangitikei	28	266	$0	$41+	g,f	Milk Sales
Rangitikei	29	283	$1-10	$41+	g,f	Milk Sales
Rangitikei	30	950	$1-10	$1-10	g,f,c,o	Beef
Rangitikei	31	366	$1-10	$1-10	g,f	Beef
Rangitikei	32	215	$1-10	$41+	g,f	Milk Sales
Rangitikei	33	228	$1-10	$41+	g	Beef

Horowhenua	34	185	$1-10	$41+	g,mp,f	Beef
Horowhenua	35	166	$1-10	$41+	g,f	Beef
Horowhenua	36	21	$1-10	$41+	g	Beef
Horowhenua	37	1519	$0	$41+	g,f,c,o	Milk Sales
Horowhenua	38	160	$1-10	$41+	g,mp,f	Milk Sales
Horowhenua	39	191	$1-10	$11-$20	g,f	Beef
Horowhenua	40	258	$1-10	$41+	g,f	Milk Sales
Horowhenua	41	122	$1-10	$41+	g	Milk Sales
Horowhenua	42	503	$1-10	$41+	g,f,c	Beef
Horowhenua	43	857	$1-10	$41+	g,f	Beef
Horowhenua	44	268	$0	$41+	g,mp,f	Beef
Horowhenua	45	242	$1-10	$41+	g,f	Milk Sales
Horowhenua	46	312	$1-10	$41+	g,f,c	Beef
Horowhenua	47	205	$1-10	$0	g,mp,f	Beef

KEY
g= Grazing
f= Forestry
mp= Marram Planting
c= Cropping
o=Other