THE SAND DUNE AND BEACH VEGETATION INVENTORY OF NEW ZEALAND I. NORTH ISLAND

INVESTIGATION NO: S3085/418
CORPORATE OBJECTIVE NO: 1.3

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EXECUTIVE SUMMARY (INTERIM)

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INVESTIGATION TITLE: The sand dune and beach vegetation inventory of New Zealand. I. North Island

STUDY VENUE: North Island

INVESTIGATION LEADER: T.R. Partridge

INVESTIGATION STATUS: Completed

CLIENT: Department of Conservation

INVESTIGATION SUMMARY:

An inventory of the vegetation of sand dune and beach systems of the North Island has been carried out, to aid in determining priorities for conservation on these very much modified coastal systems. At each system, structural and vegetation features were recorded using a standardised format. The systems were then rated on a number of criteria, the total giving an indication of those areas with greatest botanical value for conservation. Nearly all beaches were included, those that were not are clearly indicated. The descriptions for each system are presented, covering 173 on the east coast and 100 on the west. Offshore island information was gathered from the literature. Fourteen regions have been recognised and regional priorities for conservation identified for each. Twenty-three dune and beach systems have been identified as national priorities. Many of these are concentrated in the far north of Northland, where a large number of excellent systems are to be found. Others are scattered throughout, but there are some regions where there are no dunes of national value.

OBJECTIVES:

To identify national and regional priority areas for conservation in the North Island, using a habitat inventory approach.

METHODS:

At each beach descriptions of dune structure and vegetation were made using a standard format. From these descriptions, a composite rating of conservation value was obtained. These ratings were then collated and analysed to determine priority areas on both a regional and national basis.

RESULTS:

A total of 273 dune systems were surveyed. Twenty-three have been identified as being nationally important. A larger number have been identified as regionally important.

CONCLUSIONS: by what std.?

The inventory system has proven useful in determining priorities. The far north of the North Island is a region deserving special attention with many valuable dune systems there. Other priority areas are scattered, and there are some regions with little of value left.

RECOMMENDATIONS:

That the priority areas indicated be acted upon, both at a regional and national level. Missing descriptions should at some stage be completed.

Garbage

2. INTRODUCTION

The 1980s have seen a concerted effort towards a rational approach to cataloguing and protecting New Zealand's natural biological resources. This has resulted from concern at the biased representation of different plant communities within the reserve system as revealed by the scenic reserve surveys (e.g. Kelly 1972, Allen 1978, Wardle 1980). The rationalisation started with the definition of ecological regions and districts (Simpson 1982), followed by detailed inventory of representative plant communities within them by the Protected Natural Areas survey (Kelly and Park 1986). At the same time, more detailed inventory of rare and endangered plants has been carried out separately (Wilson and Given 1989).

misuse ↑ vulnerable ↓ threatened ??

not in references !

There are however, certain habitats that are not easily covered by either form of inventory, and the Protected Natural Areas programme has so far tended to emphasise high altitude districts. Many of these habitats cover only small areas but are under considerable threat. One of these is coastal sand dunes, most of which are highly modified, very few are represented in reserves, and they need to be studied and assessed on a national, rather than regional basis. It has been for these reasons that Botany Division, DSIR has carried out a national sand dune inventory. Its purpose is to identify those dune systems with the highest biological values so that they can be included within New Zealand's reserve system, and thereby receive the recognition, protection and management they deserve.

No — essence of PNA is to select best remaining on regional bases : follow this report would give bias in geog. terms.

3. OBJECTIVES

- To record the vegetation and structure of sand dunes and beaches of the North Island according to a standard format.
- To assess the conservation values of each according to various criteria and assign a rating to indicate this value.
- To identify priority areas for conservation on both a regional and national basis.
- To produce a detailed report on the vegetation of the sand dune and beach systems of the North Island.

4. METHODS

What were they ?

The national sand dune inventory has been split into two parts; the North and South Islands. The South Island inventory has been compiled by Dr Peter Johnson of Botany Division in Dunedin, the conclusions of the North Island inventory are presented here. The survey was carried out in a fragmentary fashion between 1984 and 1988 by a combination of surveys by Botany Division's North Island regional botanists, some excursions by Botany Division's South Island botanists, and some contract survey. At each site the structural and vegetation characteristics were recorded using a standardised format, with space for free-form descriptions as well. An important part

Example ? How were study areas found ? (e.g. map / aerial photos / ground survey / local info ... ?)

is the sand dune rating system. Each of the four features listed below was scored on a 0 to 5 scale, making a total out of 20.

Details ? — maximum

Diversity - of communities. Systems that have extensive vegetation sequences and diversity of dune landforms score highly.

Natives - number or proportion of native sand species, or good representation of characteristic or rare dune plants.

Why assume that native spp = "good" ? many

all in 1 score ?? Examples !

Modification - degree of human or animal interference in the system. Unmodified dunes score highly.

Weeds - degree of invasion by adventive weed species. Those without weeds score highly.

Surely what species also impt — i.e. curable or not ? highly invasive or not ?

In many cases these categories are related, e.g. highly modified dunes with natives displaced by a small number of weeds have low ranking on all four, even though a single event may have caused them all. There are however examples of unmodified dunes that are narrow and therefore of low diversity, or dunes with many weeds yet many native species as well. These score highly in some categories but not in others.

Dates of surveys needed.

The detailed descriptions are not presented in this report, they will appear in the detailed inventory itself. An example is, however, listed below to demonstrate the format used.

Where are the raw data stored — obviously more data collected than used

59 HOT WATER BEACH

Grid Ref	-	NZMS1 N44 312570 NZMS260 T11 617762
Length	-	1.8 km
Structure	-	Sand dunes to 12 m.
Material	-	Sand.
Trend	-	Accretion on foredunes.
Hinterland	-	Farmland.
Communities	-	Spinifex/pingao. Spinifex. Pohuehue. Marram/lupin. *Agave*. Kikuyu.
Other values	-	Hot water spring. Burial ground. *Agave* stand.
Present use	-	Scenic Reserve. Picnicking. Hot water spring visits.
Modifications	-	Marram plantings.
Threats	-	Marram, kikuyu spread.
Grazing	-	Nil.
Observers	-	T.R. Partridge/P.N. Johnson

} Use in scores ?

Rating	- Diversity	5	Natives	3
	Modification	3	Weeds	2
	Total - 13			

Two distinct sequences can be seen here, superimposed over each other in a patchy fashion, one involving native, the other adventive species. In the native sequence, the foredunes of 4 m in height have spinifex and pingao at the base and spinifex at the top. The next dune behind has spinifex and pohuehue and eventually pohuehue alone or with *Oxalis*. Where completely stabilised *Cortaderia splendens* and *Coprosma lucida* are present. The adventive sequence usually occurs as strips of marram on the foredune with lupin behind. *Agave* is plentiful on the top of the foredunes of both spinifex and marram, producing a spectacular and unusual visual effect. Kikuyu is important amongst the pohuehue in many places.

5. RESULTS AND CONCLUSIONS

Regional summaries and priorities and the national priorities for the North Island are listed below. They form the main summary and conclusions of the inventory.

REGIONAL SUMMARIES AND PRIORITIES

THE FAR NORTH

East Coast

Waikuku Beach 1	- 16
Whareana Beach 2	- N/I
Ponaki Beach 3	- 17
Ngamaru Point 4	- 14
Kukota 5	- N/I
Kukota to Taeore (12 km) 6	- N/I
Taeore to Paxton Point 7	- 17
Rarawa Beach 8	- 14
Henderson Bay 9	- 13
Kowhai Beach 10	- N/I
Rangunu Bay (16 km) 11	- 13
Kohanga Bay 12	- 8
Puheke Beach 13	- 13
Karikari - 1 14	- 13
Karikari - 2 15	- 12
Whataru Bay 16	- 7
Matai Bay 17	- 2
Tokerau (17 km) 18	- 13

West Coast

Tom Bowling Bay W1	- 16
Spirits Bay W2	- 18
Tapotupotu Bay W3	- 9
Te Werahi Beach W4	- 16
Twilight Beach W5	- 15
Scott Pt - Waikorapupunoa W6	- 13
Waikoropupunoa - Te Arai (20 km) W7	- 13
Te Arai - Waimahuru W8	- 12
Waimaharu - Auopouri (22 km) W9	- 9
Aupouri - Ahipara (48 km) W10	- 8

Sand dunes are one of the dominant geographical features of the 'far north'. There are three separate areas of coastline, each with its own characteristics. The northernmost area, 'the Capes' consists of a mixture of rocky coast and sandy bays. In the west of this area there is some instability with sand being blown inland. Nine dune systems occur there, four (1-4) on the east coast south of Surville Cliffs, the northernmost point, and five (W1-W5) on the west coast. The first three on the west coast section (W1-W3) point northwards. Not included in the survey was one dune system at Whareana Beach (2) on the east coast.

This northernmost area is connected to the rest of Northland by a long, narrow tombola with sand dunes on either side. The east coast is varied, with large bays (Parengarenga Harbour, Rangunu Harbour), spits (Kukota) and peninsulas (Karikari). With such variation, sand dunes are formed in a variety of situations in systems of varying length and width. Some are rather inaccessible, and three (Kukota 5, Kukota to Taeore 6, Kowhai Beach 10) were not included in the survey, the second of these unfortunately being a long segment of the coastline.

On the west coast, the dune system is continuous and made up of two parts. The coastal strip of dunes have typical structure to dunes elsewhere, whereas inland there are vast areas of destabilised, wind-blown Tertiary sands that have been planted out in marram, lupin and pine to prevent further encroachment over farmland to the east. These plantings have largely been successful, and the vast areas of unvegetated mobile dunelands should become a feature of the past. The coastline survey has been divided up into five systems of varying length.

The dunes of the 'far north' constitute the largest assemblage of botanically valuable dune systems in the North Island and rank as one of the most important areas within New Zealand. Whereas other sections of the coastline to the south have very few to no dunes rating 13 or over out of a possible 20, this section has 16 dune systems (67%) with such a rating. Of those surveyed, six rate 16 or better and can be regarded as prime sites, while the next ten systems ranked 13-15 are also priority areas. Of the remaining eight, the two rated 12 are of secondary importance, leaving only six (25%) as not worthy of much note. The four systems not included need to be surveyed, it is highly likely that they will also receive ratings of greater than 13.

The highest rated dune system in the North Island is at Spirits Bay on the north coast (W2, rating = 18). The rating itself is probably a little harsh. The dune system consists of an almost pristine sequence of foredune and backdunes grading behind into wetland and forest vegetation. Slack communities are present and in relatively good condition. All the important native dune species are present, and amongst the common weeds, marram and kikuyu are apparently absent, leaving a little lupin that is only scattered. Modifications are limited to a small camping ground at the eastern end, and some vehicle tracks that have been colonised by summer grass. This dune system is definitely an area of national importance.

All the dune systems in the area of 'The Capes' have a rating of at least 14 except for the small and highly modified Tapotupotu Bay (W3, rating = 9). In discussing them, it is reasonable to assume that they are in excellent condition and contain a diversity

of species and communities without weeds. By doing so it is easier to concentrate on the points that detract from these values. Waikuku Beach (1, rating = 16) has some weed problems, mainly kikuyu, lupin, and a little marram. Ponaki Beach (3, rating = 17) is in superb condition, but lacks the diversity of communities, with the sand backed up against hills behind. Ngamaru Pt (4, rating = 14) is in a similar situation, and has suffered some instability. Tom Bowling Bay (W1, rating = 16) on the northern coast, suffers a little through lack of diversity and recreational modifications. Te Werahi Beach (W4, rating = 16) on the west coast is in excellent condition, but has both lupin and marram inland. Twilight Beach (W5, rating = 15) is less diverse and has some weeds, especially lupin and pampas.

Southward, the dunes of the east coast of the tombolo tend in the main to have slightly lower ratings, although three areas were not included. The dunes that stand out are those between Taeore and Paxton Pt (7, rating = 17). These dunes have an excellent dune flora and diversity, but are subject to heavy grazing and some parts have been planted in marram. Six dune systems have ratings of 13-15. Rarawa Beach (8, rating = 14) has problems with grazing and weeds, but does contain large amounts of sand pimelea. Henderson Bay (9, rating = 13) has similar problems along with some housing and recently planted marram. The long Rangunu Bay (11, rating = 13) differs somewhat, with extensive areas of sand plain and a rather disorganised structure. Weeds, especially lupin and gorse are a problem in the backdunes, and some areas of these have been burnt. Pines are also spreading from an adjacent plantation. Puheke Beach (13, rating = 13), and Karikari - 1 (14, rating = 13) have similar weed problems but without the spreading pines. The southernmost dune system, the long Tokerau (18, rating = 13) has suffered through extensive recreational use in places, coupled with heavy grazing and the consequent introduction of weeds including lupin and gorse.

The dune systems of the west coast rate no better than 13, and there is a general trend in the ratings which decrease southward. Essentially the major problem with the western dunes involves the effects of the instability inland. Whereas the foredunes in many cases seem unaffected, many of the backdunes have been highly modified by the instability, or have received a compliment of weeds from the adjacent plantings, especially lupin, marram, pampas and occasionally have kikuyu. A further threat is the possibility of spread of pines from the plantings.

It can be generally stated, that with a few exceptions, the sand dune vegetation of the 'Far North' should be preserved in its entirety. The most notable exception is the dune of the south-west. Together, despite their individual problems, they constitute an important national botanical resource that would be envied by the rest of New Zealand.

EASTERN NORTHLAND

Taipa Beach 19	- 4	Ocean Beach 28	- 14
Cable Bay 20	- 1	Marsden Pt Beach 29	- 9
Coopers Beach 21	- 1	Ruakaka Beach 30	- 12

Taukawa Pt - Pareporea Bay	22	- 4	Waipu Cove	31	- 9
Whananaki Spit	23	- 8	Laings Beach	32	- 7
Wooleys/Matapouri Bays	24	- 4	Mangawhai Heads	33	- *
Ngunguru Spit	25	- N/I	Mangawhai Beach	34	- 7
Horahora River	26	- N/I	Te Arai Beach	35	- 8
Parauwanui Beach	27	- 9	Pakiri Beach	36	- 13

The eastern Northland section of coastline is varied, with some parts having extensive dune areas, and others none. Apart from three highly modified dune systems in the north (19-21), the large Bay of Islands segment seems to be devoid of dunes, the many small, sheltered bays having only sandy, wave-washed beaches. Southward, there are scattered beaches along the variable coastline until Whangarei Heads are reached (22-28). This segment includes two beaches not assessed (25-26) because of difficult access at the time of survey. South of Whangarei Harbour are two large bays; Bream Bay (29-32) and the Pakiri Coast (33-36). Therefore, with the exception of the three lowly rated northernmost beaches, the coastline can be divided into three distinct segments containing dunes.

The northernmost segment has one dune system of note at Ocean Beach (28, rating = 14), just north of Whangarei Heads. The foredune has plentiful spinifex and pingao, and apparently no marram. The first backdunes are also dominated by native species including pohuehue, sand coprosma and sand pimelea, with good slack vegetation, but further back lupin and gorse become important. This dune system is an obvious priority area for protection. Whananaki Spit (23, rating = 8) and Purauwanui Beach (27, rating = 9) have minor botanical values as well.

Bream Bay consists of four described systems on a virtually continuous stretch of dune coastline. In the north at Marsden Point Beach (29, rating = 9) industrial development and associated marram plantings have reduced the botanical values, while at Waipu Cove (31, rating = 9) in the south, the dunes are in better condition, but are narrow, being a single foredune sloping back to estuary or modified areas. The best dunes are in the central section at Ruakaka Beach (30, rating = 12). The foredune has spinifex and pingao with only occasional marram. Dune slack communities are in good condition, and the dunes have isolated areas of both *Zoysia* and *Austrofestuca*, two species not found anywhere else on the eastern Northland dunes.

The southernmost section is very different, being in many ways more allied to the dunes of the western Northland coast, consisting of a coastal strip of dunes and large areas of unstable inland dunes that have been planted in marram, lupin and pines. The southernmost segment, Pakiri Beach (36, rating = 13) is particularly notable. Here pingao dominates over spinifex and even over the planted marram. On stabilised areas pohuehue and *Scirpoides* dominate and there are wetland communities. Also worthy of note is the spectacular and essentially unvegetated massive dune at Mangawhai Heads, which because of the lack of vegetation has not received any rating. However, it must be realised that natural species - poor vegetation and indeed areas without vegetation are still of great scientific importance as they contain environmental conditions that preclude plant growth.

Within this region the priority areas for protection are therefore fairly clear. Most important are Ocean Beach and Pakiri Beach, with Mangawhai Heads and the central section of Bream Bay, Ruakaka Beach, also being worthy of preservation. The two dune systems not examined need to be assessed however.

WESTERN NORTHLAND

Tauroa Peninsula W11	- 9	Aranga Beach W18	- 11
Herekino North Head W12	- N/I	Omamari Beach W19	- 9
Moerewa Pt - Mitimiti W13	- 8	Baylys Beach - Black Rocks (22 km) W20	- 12
Hokianga North Head (13 km) W14	- N/I	Black Rocks - North Head (34 km) W21	- 14
Opononi - Omapere W15	- 7	Kaipara North Head W22	- 11
Kaikai Beach W16	- 10		
Kawarua - Mangonui Bluff (15 km) W17	- 13		

The western coast of Northland is characterised by a very distinct type of dune system. Included within this type are the dunes of Ninety Mile Beach to the north, and the dunes southward to Muriwai. There are two types of sand dunes; coastal and inland. The coastal dunes occupy a narrow strip of foredune, usually of spinifex, scattered pingao and sometimes marram, with a varying number of backdunes having a mixture of native species such as pohuehue and adventives including lupin. Behind this there is often a slack or swamp before the start of the inland system which consists of destabilised Tertiary sands. This system spreads inland for many kilometres covering former farmland and forest. It has been the target for extensive replanting programmes to stabilise the sand and arrest further inland spread. This has mostly involved planting of marram and lupin followed by pines, and has largely been successful.

This dual system is very consistent along the entire stretch of coastline. This is because the coastline itself changes little, having a constant aspect and virtually continuous dunes interrupted only occasionally by small headlands and the openings to a number of large harbours (Herekino Harbour, Hokianga Harbour, Kaipara Harbour). The dunes do vary somewhat at these harbour mouths, especially where they extend into the harbours themselves, and there are some areas without dunes, especially on the southern sides, or for instance, north of Baylys Beach, where the old sand scarp meets the sea, and only narrow or no dunes are to be found.

As might be expected, the ratings vary little, ranging between 7 and 14. Furthermore the lowest ratings are for those often highly modified dunes that occur on the inner south sides of the harbours (e.g. Oponini - Omapere W15, rating = 7). Unfortunately, the coastline has some sections not assessed. The large, extensive dune systems on the north heads of Herekino and Hokianga Harbours (W12, W14) are rather inaccessible, as is the area between Black Rocks and Kaipara North Head (W21), which was given only a tentative rating. There are therefore many sections of

coast that could be chosen as representative areas in suitable condition. It seems that the area between Kawarua and Mangonui Bluff (W17, rating = 13) may be one of the better sections that was surveyed in any detail. This is one of the few areas that has not only good foredune vegetation, but a dominance of native woody communities on stabilised backdunes. Remnant areas of pohutukawa forest add to the botanical values. Another similar area of interest is further south between Baylys Beach and Black Rocks (W20, rating = 12). The area not visited between Black Rocks and Kaipara North Head (W21) was observed to have extensive swamps and slacks inland of the coastal dune system, giving the good tentative rating that this area has received.

The whole western Northland sand dune system needs to have appropriate areas identified for preservation of representative coastal sand dune communities. This survey has not necessarily identified such areas, mainly because the segments of coastline are large. It has, however, indicated that there are many areas that would suffice. The dune system is so consistent that the dunes differ only in detail.

AUCKLAND

East Coast		West Coast	
Omaha Beach 37	- 14	South Head, Kaipara Harbour W23	- N/I
Snells Beach 38	- 1	Rangitira - Muriwai (41 km) W24	- 11
Waiwera Beach 39	- 5	Bethell's Beach W25	- N/I
Orewa Beach 40	- 1	Piha Beach W26	- 5
Long Bay 41	- 2	Whatipu Beach W27	- 11

To the residents of urban Auckland, 'the beach' is an important aspect of recreational activity. It is therefore surprising to consider that unless they choose to travel some distance away, such residents will not see sand dunes at the beaches they visit. This is particularly so on the east coast, but considering changes that have taken place in recent years, includes the popular Piha Beach on the west coast as well. The main reason that dunes are absent from so many beaches is because the demands of recreational and residential development have caused any dunes present to be flattened and planted in grass lawn, often of kikuyu, buffalo grass or Indian doab.

On the east coast, only parts of Omaha Beach (37, rating = 14) in the north, retain any botanical value. This beach has been only recently, and then only the central section (rating = 2). Unlike the other beaches to the south, which are sheltered by headlands and offshore islands, the development at Omaha Beach has resulted in sand instability, with houses being covered, and stabilising fences being built to counteract the problem. The botanical values are therefore confined to the northern and southern ends, but they are still considerable. The foredunes in particular are of note, with spinifex and some large areas of pingao and only rare marram. Behind there are

many native species including pohuehue and *Scirpoides*, but the botanical values are somewhat reduced by the presence of large areas of lupin. Needless to say, if the central section had not been developed, the rating for Omaha Beach would have been greater. The four other east coast beaches listed have mere fragments of dunes remaining and represent only a small portion of dune systems once present. The western side of the Firth of Thames is too calm for dunes to form, thereby extending the length of coast devoid of dune vegetation even further.

The two northernmost dune systems on the west coast, South Head, Kaipara Harbour (W23) and the very long 41 km section Rangitira to Muriwai (W24), are really the southern end of the vast west coast dune system that starts at the northern end of Ninety Mile Beach, and needs to be treated in the context of that system, as well as in relation to other dunes of the Auckland area. They are typical examples of those west coast dunes, in that they have both a coastal component with dunes dominated by spinifex, and an active inland component that has been generally stabilised by marram and pine plantings. South Head, Kaipara Harbour, was not examined in detail, but considering that preliminary observations suggest that it might receive a high rating, it does need to be examined as a possible area worthy of protection. Compared to the related dunes in the north, the Rangitira to Muruwai system, with a rating of 11, is about average for this stretch of coastline, although the southern Muruwai end is of less note, without any pingao, such a feature to the north. It is possible that there are segments of this dune system that might be botanically worthy of protection as examples of the representative dune communities. The area will have to be examined in more detail to determine these. Also with a rating of 11 is Whatipu Beach (W27) on the north head of Manukau Harbour. Much of the area is a large aggrading sand plain between the sea and the dunes, and although much is unvegetated, there are some good sand plain communities. The vegetation patterns are interesting and the communities diverse, but the system suffers from weed problems, especially marram and kikuyu.

The survey of these Auckland dunes has demonstrated that, despite the degree of destruction of sand dunes in the area, sufficient does remain to be worthy of protection. First priority is the remaining parts of Omaha Beach. Of secondary value is Whatipu Beach, with its peculiar communities. The South Head of Kaipara Harbour does, however, need to be surveyed before a decision can be made on that area.

COROMANDEL

Otautu Beach 42	- 5	Ohuka Beach 54	- 1
Port Jackson 43	- 8	Buffalo Beach 55	- 4
Sandy Bay 44	- 5	Maramatotara Bay 56	- 1
Waikawau Beach 45	- 16	Cooks Beach 57	- 6
Kennedy Beach 46	- 8	Hahei Beach 58	- 5
Whangapoua Beach 47	- 8	Hot Water Beach 59	- 13
Matarangi Beach 48	- 8	Ocean Beach 60	- 8
Rings Beach 49	- 7	Pauanui Beach 61	- 3

Kuaotunu Beach 50	- 8	Opoutere Beach 62	- 8
Otama Beach 51	- 16	Onemana Beach 63	- 5
Opito Bay 52	- 5	Whangamata 64	- 11
Wharekaho Beach 53	- 2	Whiritoa Beach 65	- 10

Nowhere in the North Island are the sand dunes more variable than on the Coromandel Peninsula. Apart from a small area at Otautu Beach (42) near Port Colville on the western coast which is too sheltered for dune formation, and the tall, stable dunes at Port Jackson (43) at the northern tip, the sand dunes are confined to the eastern coast. The diversity can to a great extent be attributed to a combination of geographic differences and recent cultural effects. Sand dunes have formed in a variety of situations ranging from sheltered embayments (e.g. Whangamata, 64) to exposed coastlines (e.g. Opoutere, 62) and sand spits (e.g. Matarangi Beach 48). The resultant influences on structure and trend are reflected in the vegetation patterns.

Cultural effects have played a major role as a result of Coromandel Peninsula becoming a popular place to live or have holiday homes. This has meant that formerly isolated bays or quiet beach settlements have become the focus for large subdivisions and the creation of recreational facilities. Such developments have often encroached upon the sand dunes, many of which have been converted to managed grassland above the sloping sandy beaches. Botanical values at places such as Pauanui Beach (61) and Onemana Beach (63), have been severely reduced or even totally lost. At other locations, however, such attempts have resulted in coastline instability such as at Whangapoua Beach (47). In addition to housing are the other threats such as grazing (e.g. Opito Bay, 52) and plantings (e.g. Matarangi Beach, 48). At Whangamata (64) however, the sand dunes, or at least the most seaward part of the system, have not been developed, despite the proximity of a great deal of housing and considerable recreational use, demonstrating that developing does not necessarily have to result in destruction of the dunes.

Those dunes that have retained their botanical values tend to be in the remaining isolated areas where development has been restricted. Three dune systems stand out: Waikawau Beach (45, rating = 16), Otama Beach (51, rating = 16), Hot Water Beach (59, rating = 13). Together they constitute an extremely valuable core of representative communities, each having different features of interest. Waikawau Beach is notable for its dominance by native species and the lush condition of its vegetation. This is very much the result of the main part of the dunes being fenced off from stock. Marram and lupin are both present but very confined. Otama Beach is notable for its diversity of native species including *Austrofestuca* and others rare in many of the dune systems. Scrub communities are important including manuka, *Cassinia retorta* and sand coprosma, and there are good wetland communities. There are some weeds, especially marram and lupin, but they are not a great threat. Hot Water Beach is notable for its spectacular vegetation patterns. Although some of these involve introduced species, they are nevertheless of considerable scientific interest because the communities, whether dominated by native or adventive species, are so well defined. An unusual part of this is the extensive dune crest stands of

Agave americana, a species otherwise only rarely found on other dunes. The native communities do, however, dominate.

Three other isolated dune systems did not rate highly: Port Jackson (43, rating = 8), Matarangi Beach (48, rating = 8), Opoutere Beach (62, rating = 8). Port Jackson and Opoutere Beach are extremely stable, and have little foredune, but large areas of backdunes with dominant lupin and associated adventive weeds. Matarangi Beach has been extensively planted out in adventive species including large areas of ice plant, *Arctotis* and pines, with native species playing only a minor role.

As well as the three high ranking dune systems, two others, both in the south, score well: Whangamatata (64, rating = 11), Whiritoa Beach (65, rating = 10). Both have managed to maintain some valuable native vegetation despite the presence of housing developments. Indeed, Whangamata mght have been expected to be dominated by marram, instead of the extensive areas of spinifex and pingao that are present. Whiritoa is a small beach that unfortunately appears to be eroding, but which has a valuable assemblage of native species including *Austrofestuca*. Ocean Beach (60, rating = 8) at Tairua, also maintains some native vegetation despite development that has encroached as far as the foredune crest.

Twelve of the twenty-four beaches (50%) have ratings of seven or less. Certain of these have formed in places where the potential of sand dunes to develop is strictly limited (e.g. Otautu Beach 42, Sandy Bay 44, Buffalo Beach 55, Cooks Beach 57), but there are others where botanical values would have previously been high. Unlike the western North Island, these areas have not fallen prey to instability, necessitating protective planting, but have been lost to housing and associated developments. It is important that those remaining, especially the five most highly rated, do not fall victim to the same activities. These five priority areas constitute a mere 11.5 km of coastline, the losses are much greater.

WESTERN BAY OF PLENTY

Waihi Beach 66	- 10	Coastlands (11 km) 70	- 10
Mt Manganui - Maketu (26 km) 67	- 10	Ohope Beach (11.5 km) 71	- 12
Otamarakau (27 km) 68	- 12	Ohiwa 72	- 9
Wahieroa 69	- 8	Waiotahi Beach 73	- 9
		Hukuwai Beach 74	- 8

The western Bay of Plenty coastline is virtually a continuous sand dune system of 139 km, interrupted by occasional headlands and openings to bays, rivers and estuaries. It includes the 23.5 km long Matakana Island in Tauranga Harbour, but this area, extensively planted in pines, was not included in the survey, although it has been reported on separately and has a high rating of 14. As can be seen from the ratings which, with only a few exceptions, vary from 8 to 12, the dunes are very similar along the entire coastline. Included in the survey are a number of long stretches of coastline, but the evenness of the vegetation makes further subdivision unnecessary.

Many of the longer systems were examined at a number of locations and found to be particularly consistent.

The typical vegetation is a foredune dominated by spinifex, with pingao and marram scattered at varying densities, and a small number of backdunes, usually dominated by lupin, pohuehue or occasionally bracken. The botanical values therefore mostly lie in the foredunes. Occasionally the foredune is eroded away (e.g. Otamarakau 68, Coastlands 70, Hikuwai Beach 74) with backdunes of pohuehue, lupin and associated species above the strandline or new incipient dunes. The 8 km of dunes at Wahieroa (69) are a little different, having only low foredunes with a sand plain behind, but that is still dominated by lupin.

Two areas have dual ratings, both the result of urban development encroaching on to the dunes. At the western end of Ohope Beach (71 rating = 6), this development has resulted in only remnant spinifex dunes being left, while at Mt Manganui (western end 67, rating = 2), the tall foredune remains, but it is dominated by marram with little else. Along much of the coastline there are other settlements of varying size, but their impacts are either minor or confined. Where the beaches are not settled, they are usually grazed, but only in a few areas is this particularly heavy.

With the dunes all being similar and the ratings being so consistent, it is difficult to determine the botanically most valuable areas. Furthermore, most of the dune systems are so long that it is not feasible to recommend extensive areas of coastline for protection. Also, none of the systems described here have such high ratings that they are also practicable. Such areas should be of manageable size and well defined as well as including representative communities in good condition. Two such areas are the south-eastern end of Waihi Beach (66, rating = 10) and Port Ohope at the eastern end of Ohope Beach (71, rating = 12). At Waihi Beach there is a large area of tall, active dunes dominated by spinifex with areas of pingao, and apparently no marram. On the back dunes, however, there are many adventive weeds including lupin, boxthorn and gorse, although some native species such as *Scirpoides*, pohuehue, and sand coprosma persist in places. At Port Ohope, spinifex dominates the foredune, again apparently without marram. Although lupin is present on the backdunes, they are nonetheless dominated by natives, especially pohuehue, *Scirpoides* and bracken.

There are also many other areas on the other dunes that could be targetted for protection. Near the Kaituna River (67, rating = 10) are fine dunes but with some marram. Areas of the extensive Otamarakau dunes (68, rating = 12) away from settlements and marram plantings could also be identified for protection. Although the foredunes along the Coastlands (70, rating = 10) section are only small, the backdunes have a good variety of species. The other dunes, especially those eroding systems in the east (Ohiwa 72, Waiotahi 73, Hukuwai 74) are dominated by lupin and are not as good as those to the west.

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EASTERN BAY OF PLENTY

Waiaua Beach 75	- 9	Wairuru Beach 88	- 3
Opape Beach 76	- 9	Raukokere Beach 89	- 4
Torere Beach 77	- 4	Rangirewa Beach 90	- 5
Pahiko Beach 78	- 1	Oruaiti Beach 91	- 8
Whituare Bay 79	- 5	Whangaparaoa Beach 92	- 8
Motu Beach - Haupoto 80	- 1	Hicks Bay 93	- 9
Omaio Beach 81	- 6	Onepoto Bay 94	- 4
Orini Beach 82	- 4	Punaruku Beach 95	- 3
Hariki Beach 83	- 2	Te Araroa Beach 96	- 4
Mouriuri Beach 84	- 2	Maruhou Beach 97	- 8
Kereu Beach 85	- 6	Orutua Beach 98	- 8
Waiiti Beach 86	- 1	Hautai Beach 99	- 11
Papatea Beach 87	- 10	Pohauturua Beach 100	- 8

Unlike the western Bay of Plenty with its long continuous dune systems, the eastern Bay of Plenty has a large number of small isolated dune and beach systems. The number of systems is misleading, there being 26, with a total length of only 48 km (1.8 km per dune system), in contrast to the western Bay of plenty with 116 km, but only nine systems described (12.8 km per dune system). These small dune and beach systems fall into three categories; sand dunes (11), gravel beaches (8), and those with both gravel and sand (7). Apart from Waiaua and Opape Beaches (75-76) in the west, the general trend is for the gravel beaches to be in the west, and the sandy systems in the east. There are, however, exceptions such as sandy dunes at Hariki and Mouriuri Beaches (83-84) amongst the gravel systems. There is also an important geographical division, with a long stretch of rocky coastline devoid of beaches between Whangaparaoa Beach (92) and Hicks Bay (93). To a certain extent, this corresponds to the eastern gravel/sand boundary, although both Punuraku Beach (95) and Te Araroa Beach (96) on the same continuous stretch of coast are mostly gravel.

The ratings for all the dunes are low. Sixteen (62%) have six or less, and only two, Papatea Beach (87, rating = 10) and Hautai Beach (99, rating = 11), are greater than 9. In general, the sandy beaches rated best (average 7.1), then the sand/gravel mixtures (average 5.0), with the gravel beaches scoring lowest (average 3.1). None of the completely gravel beaches score more than 6, but one of the mixtures, Papatea Beach (87) which is predominantly gravel scores 10. In general, there are very few native species on the gravel beaches, and Papatea Beach is the only one that has either appreciable numbers or communities. In addition to pohuehue and *Cassinia retorta* in the open shrubland, there is rather unexpectedly, sand pimelea. This beach therefore rates very highly as the best example of gravel beach vegetation in the Bay of Plenty.

Amongst the sand dune vegetation, Hautai Beach scores best with a rating of 11. This score is mainly the result of the presence of sand plain vegetation behind a rather ordinary foredune system. Sand plain vegetation is, however, atypical of the region. A more typical series of communities exists at Hicks Bay (93, rating = 9) with spinifex,

pingao and apparently no marram on the foredune. The backdunes are dominated by lupin and therefore reduce the overall botanical value. These three systems, one on gravel and two on sand are considered to be priority areas for protection within the region. The two sandy dune systems in the west, Waiau Beach (75) and the eroded Opape Beach (76) both with ratings of 9, have a greater affinity to the dune systems of western Bay of Plenty, and are not as good as those recommended for protection within that region.

WAIKATO

Port Waikato, N. Head W28	- N/I	Raukumara Beach W39	- 10
Port Waikato Spit W29	- 12	N. Head Kawhia Harbour W40	- 10
Kaawa Stm Beach W30	- N/I	Taharoa W41	- 12
Waikorea Beach W31	- 9	Marakopa Spit W42	- 6
Carters Beach W32	- 8	Kiritehere Beach W43	- 9
N. Head Raglan Harbour W33	- 8	Nukuhakari Bay W44	- 5
Ngarunui Beach W34	- 6	Ngararahae Bay W45	- 4
Ruapuke Beach W35	- 10	Mangangu Stm Beach W46	- 1
Toreparu Stm Beach W36	- 10	Tarapatiki Spit W47	- 8
Aotea Harbour N. Head W37	- N/I	Waikaretu Stream W48	- 8
Maukutea Beach W38	- 7		

The Waikato coast is of extremely variable structure including cliffs, headlands, bays and harbours. Dunes therefore occur in many different situations including river and harbour sand spits (e.g. Port Waikato Spit W29, North Head Raglan Harbour W33), and narrow beaches backed up against cliffs (e.g. Ngarunui Beach W34, Waikaretu Stream W48). Most are relatively narrow, but a few (e.g. Taharoa W41) extend well inland. Some, especially in the south are rather isolated. The feature that sets these dunes apart from most others is the presence of ironsand as the main constituent of the beaches. These sands have been in great demand for their iron content, and some of the larger dune systems are mined for this material (e.g. Port Waikato North Head W28, Taharoa W41), modifying many of the dunes in the process. Three dune systems, including the extensive Port Waikato North Head (W28), and the inaccessible Aotea Harbour North Head (W37) were not included in the survey.

Considering the individual nature of the dune systems and the variety of situations in which they form, it is surprising to note that apart from some narrow, lowly rating systems in the south, there is a remarkable consistency in the ratings, ranging from 6 to 12. In the north the low ratings are mainly the result of modification and the consequent spread of weeds. In the rather more isolated systems of the south, the dunes lack diversity, and again have many weeds. Spinifex and marram dominate the foredunes and there are usually extensive areas of lupin behind. Kikuyu and other weeds are also very common.

Port Waikato Spit (W29, rating = 12) is a rather unusual dune system consisting of a typical coastal section and a peculiar 'plain' vegetation inland of the backdunes. Most value in the coastal section is in the foredunes which have much healthy pingao and

only a little marram. The backdunes, however, are dominated by lupin. Part of the spit is a grazed Recreation Reserve, which harbours many weeds of potential threat including kikuyu, marram and pampas. The 'plain' vegetation consists of hummocks of pingao surrounded by shell beds and some colonies of sand sedge. The hummocks, however, have been damaged by vehicles and traffic over the flats and need to be protected from this. The dunes at Taharoa (W41, rating = 12) are the coastal strip in front of a large ironsand mining operation. After mining, the inland areas have been planted out in marram, lupin and pine. Botanical values are therefore restricted to the foredunes and a variable number of backdunes. The foredunes are in excellent condition and carry scattered pingao and only occasionally have marram. The backdunes are, like much of the coast, dominated by lupin and other woody weeds. The many small lakes in the backdune areas do, however, have swamp vegetation, often in good condition, but sometimes invaded by willow.

Four other dune systems received ratings of 10. Ruapuke Beach (W35) is notable for its retention of native species in the backdunes, while Toreparu Stream Beach (W36) has good wetland communities. Raukumara Beach (W39) is notable for its lack of modification, but this has not prevented dominance by weeds, and the North Head of Kaipara Harbour (W40) has extensive stands of *Cassinia retorta*. The three areas not included do, however, need to be assessed as, although probably not much different, they may be marginally better than those areas recommended for protection.

The Waikato coast contains two beach systems at Port Waikato Spit and at Taharoa, which are of regional botanical importance and therefore worthy of protection. They do, however, face considerable management problems that will have to be addressed if their values are to be retained.

EAST CAPE - POVERTY BAY

Rangitukia Beach	101	- 5	Gable Bay	114	- 4
Te Wharau Beach	102	- 8	Whangara Beach	115	- 6
Reporua	103	- 2	Waiomako River	116	- 12
Whareponga Bay	104	- 2	Pouawa Beach	117	- 4
Waipiro Beach	105	- 6	Makorori Beach	118	- 1
Tokomaru Beach	106	- 4	Okitu Beach	119	- 4
Waioue Beach	107	- 1	Wainui Beach	120	- 4
Anaura Bay	108	- 4	Poverty Bay	121	- 9
Kaiaua Bay	109	- 5	Karaua Stream	122	- 2
Tolaga Bay	110	- 3	Muriwai Beach	123	- 8
Uawa River Spit	111	- 6	Maraetaha River	124	- 10
Waihau Beach	112	- 7	Pukenui Beach	125	- 6
Waiharehare Bay	113	- 2	Tuahuru beach	126	- 4

Between East Cape and Mahia Peninsula, the coastline has scattered beaches, most quite small, and formed in a variety of situations. A common type is where narrow dunes occur at the base of steep hillslopes (e.g. Waioue Beach 107, Wainui Beach

120), although others occur in a variety of situations including sand spits (e.g. Uawa River Spit 111, Muriwai Beach 123), and areas that slope more gently to the land behind (e.g. Anaura Bay 108, Whangara Beach 115). The systems are predominantly sandy, although there are some that have gravel as well (e.g. Rangitukia Beach 101, Te Wharau Beach 102) especially in the north.

Like the eastern Bay of Plenty, the ratings are low, the maximum being an isolated 12. Of 26 systems, only five rate greater than a 7. The low ratings are mostly the result of the systems being highly modified with the native species replaced by adventive binders and weeds, especially marram and lupin. Many of the native species so common in the north are rare. Pingao was not recorded, along with sand coprosma and sand pimelea, and even pohuehue is uncommon. Spinifex is, however, still dominant, especially in the north, and sand sedge, sand convolvulus, *Scirpoides* and *Cyperus* have not suffered unduly.

The dunes at Waimoko River (116, rating = 12) stand out. Although not containing a great diversity of communities, the area is, however, dominated by spinifex, has little marram, is in good condition, and contains a large population of *Austrofestuca*. It clearly stands out as a priority area for conservation.

With this exception the other priority areas are only of local significance, and would not be recommended in certain other areas such as Northland. The four other dune systems with ratings greater than seven are Te Wharau Beach (102, rating = 8) in the north where the ratings are especially low, and in the south, Poverty Bay (121, rating = 9), Muriwai Beach (123, rating = 8), and Maraetaha Beach (124, rating = 10), which are all close to each other.

Te Wharau Beach is unexceptional, and is only slightly more diverse and less modified than the other northern systems. The botanical values are confined to the open sandy areas of spinifex and sand sedge. The comparatively good rating of Poverty Bay is surprising as it is the only beach adjacent to a large urban area. Despite its modification, it has a moderate degree of diversity and native species, these partly a function of its greater size, and because marram is only rare. Muriwai Beach is less modified but has a greater compliment of weeds. Marram was, however, not recorded.

The dunes at Maraetahi Beach are relatively wide, with foredunes in good condition, but backdunes containing weeds as well. There are some good slack communities, and adjacent to the dunes there are cliff communities and secondary forest with native species dominating.

Within this highly modified area, only two dune systems, at Waimoko River and at Maraetuha River, can be recommended for protection, and the second has only regional significance. The other three described are of lesser note and have only restricted botanical value.

HAWKES BAY

Nukutaurua Beach	127	- 4	Waikari River	136	- 5
Opoutama Beach	128	- 9	Aropaoanui River	137	- 6
Nuhaka River	129	- 5	Waipatiki River	138	- 7
Tahaenui R. - Nuhaka R.	130	- 11	Tangoio Beach	139	- 2
Whakaki Beach	131	- 12	Bay View Beach	140	- 2
Ngamotu Beach	132	- 6	Westshore Beach	141	- 8
Wairoa River	133	- 9	Napier - Haumoana	142	- 2
Waihua River	134	- 2	Haumoana - Te Awanga	143	- 8
Mohaka River	135	- 1			

Hawkes Bay is a large bight with a relatively evenly curved coastline of varying structure including sand dunes interspersed with rocky headlands and cliffs. Dunes are formed in small bays, spits at the mouths of rivers, and in the south, along gently sloping benches raised by former land movements including the Napier earthquake of 1931. Most of the dune systems are narrow, as the bight offers a degree of shelter, there is insufficient wind to blow dunes inland, and there is little sand accretion. In many of the bays the dunes abut steep cliffs of weathered material and are restricted in width by this.

The communities that make up the sand dune vegetation are simple, and generally contain few species. Spinifex and marrram dominate the foredunes, while lupin, boxthorn, pohuehue and *Scirpoides* are common on the backdunes. Wet areas typically contain *Cyperus*. Many of the dunes are grazed, with in extreme cases, the backdunes removed and converted to pasture. In the centre of the region, some of the dunes have a mixture of gravel and sand, with a resultant lack of native species. The ratings are all low, the maximum being for two adjacent dunes, firstly between Tahaenui and Nuhaka Rivers (130, rating = 11), and secondly, Whakaki Beach (131, rating = 12). The first of these is notable for the presence of a single dune with pingao, a species not found for some considerable distance. Although dominated by spinifex, it has marram in the north which may pose a threat. Whakaki Beach is also dominated by spinifex, but seems to have no marram. The backdunes, however, have weeds including lupin, boxthorn and gorse. Notable are the presence of hollows of sand sedge and some coastal scabweed, a species apparently here at its northern limit in sand dunes. The presence of pingao and coastal scabweed are therefore botanical features worthy of protection. Of the three dune systems rated 9, the northern Opoutana Beach (128) is noted for its diversity of species, while the southern Haumoana to Te Awanga section (143), although having only small, scattered dunes, does have interesting species including sand coprosma and *Muehlenbeckia ephedroides*. Wairoa River (133) appears to have no marram.

The dunes of Hawkes Bay contain little of botanical value. The two most highly rated systems are notable because they each harbour an unusual species, while one has no marram as well. They can be considered to be regionally important areas only. Three lesser important dune systems are also mentioned for their minor botanical values.

TARANAKI

Awakino W49	- 7	Waitara W52	- 9
Mohakatino River W50	- N/I	Oaonui Beach W53	- 5
Waipingau Stream W51	- 13		

Most of the Taranaki coastline has well developed cliffs, in places reaching over 20 m high. As a result, duneland vegetation is very rare, being more or less confined to river mouths. From Hawera to north of Waitara, the cliffs are composed of volcanic conglomerates and breccias, and this coastal strip is all but devoid of indigenous vegetation, having been developed for pastoral farming right to the cliff edges in most places. Small remnants of indigenous vegetation occur on some of these cliffs and include scrubland and coastal herbfield. Some species of dunes may be found in these communities, including *Euphorbia glauca* and sand pimelea. From north of Waitara to Awakino, the cliffs are of tertiary siltstones, mudstones or sandstones. Indigenous forest still dominates some extensive areas, while rapidly eroding cliffs are unvegetated or have pockets of scrub. Only small areas of duneland are present except for the extensive and well developed system at the mouth of the Awakino River.

With so few dunes, all areas of duneland in Taranaki are priority areas for conservation of a very much under-represented set of plant communities. Even the lowly rated Oaonui Beach (W53, rating = 5) is important as it is the only sand dune system in south Taranaki. In the north, the small area of dunes at Waipingau Stream (W51, rating = 13), stands out as the most important. The presence of pingao and the absence of marram, coupled with the rather curious absence of spinifex as well, contribute to this rating.

Awakino (W49, rating = 7), is notable for its size and areas of spinifex, but is otherwise dominated by marram, lupin and boxthorn. The description for Waitara (W52, rating = 9) was drawn from a brief survey and may have changed appreciably since. It needs to be checked.

All dune systems in Taranaki are of value for conservation, representing plant communities that are extremely rare in the area. Waipingau Stream also rates highly on a national basis and deserves special attention, especially considering its small size.

MANAWATU

Patea R. W54	- 8	Turakina R. - Waimahora Stm W68	- 8
Whenuakura R. - Waverley W55	- 6	Waimahora Stm - Rangitikei R. (15.5 km) W69	- 5
Waverley Beach - Waipipi W56	- 3	Rangitikei R. - Himatangi Beach W70	- 10
NW of Waitotara R. (A) W57	- 9	Himatangi Beach W71	- 9
NW of Waitotara R. (B) W58	- 10	N. of Foxton Beach W72	- 13
Waitotara R. Mouth W59	- 8		
E. of Waitotara R. W60	- 12		

Wainui R. Beach	W61	- 9	Manawatu R. - Waitere (11 km)	W73	- 6
Okehu Stm - Kai Iwi Beach	W62	- 4	S. of Hokio Beach	W74	- 11
Waitarere - Hokio Beach	W74	- 4	N. of Waiwiri Stm	W76	- 7
Wanganui River Spit	W63	- 9	Muhunoa	W77	- 5
Kaitoke Stm Beach	W64	- 4	Ohau R. spit	W78	- 3
N. of Whangaehu R.	W65	- 8	Waikawa Beach	W79	- 5
Harakeke Dunes	W66	- 15	S. of Waikawa	W80	- 8
Whangaehu R - Turakina R.	W67	- 9	N. of Otaki Beach	W81	- 7
			Otaki Beach	W82	- 0
			Otaki R. Mouth	W83	- 4

From Patea to Otaki River, the dunes of the Manawatu occupy the coastline for almost its entire length, as a virtually continuous series of systems. Indeed, they continue southward into the Wellington region as far as Pukerua Bay. Even where the coastline is cliffs, perched dunes are found on the top of these, such as between Okehu Stm and Kai Iwi Beach (W62). Unlike the other two major North Island continuous dune coastlines (W. Northland, W. Bay of Plenty), the Manawatu coast has been divided up into a number of segments, this being necessitated by variable structural and vegetation components of the dunes. The dunes and associated slacks and plains have an unusual structure, confined to the Manawatu and described by Esler (1969, 1970). A narrow zone of foredunes is backed by a large sand plain that is essentially stable and well vegetated. Large parabolic dune systems have blown through from the coastal strip, and in moving inland, have cut off segments of the sand plain, these having their longer axis at almost right angles to the coast. This is in direct contrast to the dunes of Western Northland, that run parallel to the shore. These sand plains add a great deal to the botanical values of the Manawatu dunes. In many places, however, especially in the north, the unstable parabolic dunes have encroached on to farmland behind, and as in Northland, marram and pines have been planted for stabilisation. These plantings often encroach on to the sand plains, and botanical values are lost. The ratings reflect this, as a comparison between systems such as North of Foxton Beach (W72) and Waimahora Stm to Rangitikei River (W69) show.

The differences in ratings are very much the product of the extent of damage incurred by the slacks and sand plain vegetation, and the dominant species of the foredune system. Highest rating areas have no pines, little marram, undrained wetlands and sand plain and foredune vegetation comprising mostly native species. The only dune system which has escaped this damage to any great extent is that at Harakeke Dunes (W66, rating = 15), on the north side of Whangaehu River. The foredunes are much like elsewhere, having spinifex, marram and pingao, but it is the diversity and condition of the sand plain that stand out. Areas occupied by species of salt marsh, turf, rushes and woody species are present. Many species absent or rare on other Manawatu dunes, are found, including the rare and notable gentian *Sebaea ovata*. This area best represents the botanical values of the Manawatu dunes.

The 7 km of coastline of West of Foxton Beach (W72, rating = 13), is the next best example. Vegetated sand flats have *Leptocarpus* or turf vegetation, but there are areas

of lupin, pasture or boxthorn. The presence of some shrubs is unusual while of particular note is the excellent condition of the foredunes, which have abundant spinifex, plentiful pingao, and not a great deal of marram. The foredune at the dunes of East of Waitotara (W60, rating = 12), is also in excellent condition, while the active area behind is a mixture of flats, usually with sand sedge and spinifex, dunes with spinifex and pingao, and bare areas. The more inland dunes, however, have a large proportion of weedy species. Also highly rated is the small segment of dunes south of Hokio Beach (W75, rating = 11). Although containing some lupin, the foredunes are a mixture of spinifex, *Cassinia* and sand coprosma, while sand flats have mostly *Leptocarpus*. Inner dunes are a mixture of native and weedy species. These four segments are the priority areas for conservation of botanical values.

The four dune systems listed above do not, however, rate much more than a further 12 segments between 8 and 10, and which have only slightly lower botanical values. Most of these are in the north, with only the section of South of Waikawa (W80, rating = 8), being the exception. One dune system rated 10 has excellent dune flats (NW of Waitotara R. - B, W58). The foredune does, however, have much marram, while sand areas inland carry extensive lupin. A number of these 12 dune segments have *Gunnera arenaria*, a plant not seen to the north (e.g. Waitotara R. Mouth, W59, rating = 8), while others in this grouping also have dunes with species rare along the southern North Island coasts, such as sand pimelea (Wanganui R. Spit, W63, rating = 9), and *Libertia peregrinans* (Turakina R. - Waimahora Stm, W67, rating = 8). Both these species are, however, found on the highly rated Harakeke Dunes (W66).

The Manawatu coast is therefore made up of segments of coastline with moderate to high botanical value. Apart from those parts with low ratings, there are many areas worthy of preservation of which the best 4 to 5 have been indicated above. The dunes of the Manwatu are, however, peculiar amongst those of the North Island, and although not as highly rated as for instance dunes of the Far North, it is essential that interesting features, especially the sand plains, be protected as a national priority.

WELLINGTON

N. of Te Horo Beach W84	-	6	Raumati Beach W90	-	1
S. of Te Horo Beach W85	-	6	Whareroa Beach W91	-	6
N. of Peka Peka W86	-	7	Paekakariki Beach W92	-	7
Peka Peka Beach W87	-	4	Pukerua Bay W93	-	4
Waikanae Beach W88	-	2	Hongoeka Bay W94	-	3
Paraparaumu Beach W89	-	1	Makara Beach W95	-	5

Long Gully – S. Karori
Fitzroy Bay

The dune systems described for the Wellington district are almost all found in the north-west and are very much a continuation of the extensive continuous dunes of the Manawatu. They are, however, much narrower, and very much affected by the urban nature of most of the coast. The exceptions are two isolated gravel beaches (Hongoeka Bay W94, Makara Beach W95) to the west of Wellington City. The rest of the coast is of gravel and steep cliffs, the few places that contain sand having no

dunes (e.g. Lyall Bay). The survey did not include the spectacular raised beaches at Cape Turakirae, to the east of Wellington City, as the vegetation is essentially uninfluenced by normal beach processes, and has been described in detail by Bagnall (1975).

All the dune systems have low ratings, the highest being 7 for both North of Peka Peka (W86) and Paekakariki Beach (W92). The dunes of North of Peka Peka are the most diverse of the region and include spinifex, which dominates the foredune, and pohuehue. Much of the area is, however, covered by marram, lupin and boxthorn. Paekakariki Beach is notable for a small forest remnant on the backdune. Much of the dunes are, however, in housing or road.

Considering the poor quality of the dune systems of the Wellington area, it seems inappropriate to set even regional priorities for conservation. The forest fragment at Paekakariki Beach is, however, worthy of note, although not strictly part of the typical dune sequence. The adjacent regions of Manawatu and Wairarapa both contain important dune systems within a relatively short distance of Wellington.

WAIRARAPA

East Coast

Ocean Beach - North 144	- 11
Ocean Beach - Central 145	- 8
Ocean Beach - South 146	- 6
North Waimarama Beach 147	- 3
Waimarama Beach 148	- 2
Pourere Stream 149	- 5
Aramoana 150	- 4
Blackhead Bay 151	- 1
Porangahau - River/North 152	- 5
Porangahau - River/South 153	- 7
Porangahau - Central 154	- 9
Porangahau - South 155	- 13
Porangahau - Golf Course 156	- 10
Cape Turnagain 157	- 11
Tautane Stream 158	- 10
Herbertville 159	- 8
Mataikoana R. - North 160	- 4
Mataikoana R. - South 161	- 3
Mt Percy Coast 162	- 2
Whakataki - Okau 163	- 4
Castlepoint 164	- 7
Wai-ngaio 165	- 7
Whareama R. - Riversdale 166	- 4
Riversdale Beach 167	- N/I
Uruti Point 168	- 11

West Coast

Whatarangi W96	- 9
Te Humenga Point W97	- 14
S. of Otakaha Stm W98	- 6
Te Kawakawa W99	- 2
W. of C. Palliser W100	- 12

Flat Point 169	- 10
Arawhata Stream 170	- 7
Horewai Point 171	- N/I
Tora 172	- 7
White Rock 173	- 12

The hilly, sparsely populated Wairarapa coast provides a great deal of variety for the formation of sand dunes. Three situations are most common, the first being in narrow sheltered bays (e.g. Pourere Stream, 149, Tautane Stream 158), where dunes occupy only short segments of the coastline. Other parts of the coast carry a narrow strip of dunes, often for some distance (e.g. Whakataki to Okau, 163, Te Humenga Pt, W97), and in some situations interrupted to form isolated areas on promontories (e.g. Whareana River to Riversdale 166). Typically, these narrow dunes are formed at the base of steep hills and cliffs. Wider dune systems occur at Ocean Beach (144-146) and especially at the very large dune complex of Porangahau (152-156) in an area that slopes more gently to the sea. A peculiar situation exists at Castlepoint (164) where dunes have formed between the mainland and an island only a short distance offshore. Most of the systems are dominated by sand, but near Cape Palliser in the south, some have gravel and boulders as well (e.g. White Rock, 173, Te Kawakawa, W99). Indeed, the Cape Palliser region carries coarser sand and is therefore closely associated with the adjacent Wellington Coast.

Two dune systems stand out as being of high botanical value: Te Humenga Pt (W97, rating = 14) and Porangahau - South (155, rating = 13). The dunes at Te Humenga Pt are notable because of their condition and absence of weeds. Spinifex and pingao dominate, with some other native species occurring inland, and there is neither marram nor lupin. The dunes are, however, narrow and have a low diversity of species. The ratings for the Porangahau dune complex decrease considerably northwards, the best being that in the south, just to the north of the golf course. Here the dunes are both diverse and wide, with dune ridges and flats that in structure and species resemble the systems of the Manawatu. Many native species are present, but there are also extensive areas of marram, especially on the foredune, and lupin and pines inland.

Two additional dune systems, both in the Cape Palliser area have ratings of 12. White Rock (173) is a sand and gravel beach with short dunes. Although marram is common, pingao is plentiful, but there is no spinifex, making the situation unusual. Also notable is the presence of scabweed, a species that prefers semi-stable shingle areas. This system stands out amongst the gravel systems examined in the North Island as being of special note. A short segment of low dunes to the west of Cape Palliser (W100) has spinifex, but without marram or pingao, and notably *Austrofestuca* on the dunes. Although small, these coarse sand dunes are in excellent condition and are peculiar.

Six further dune systems have ratings of 10 to 11 and are also worthy of note. The north end of Ocean Beach (144, rating = 11) has plentiful spinifex and pingao and fine dune flats. The adjacent areas of Cape Turnagain (157, rating = 11) and Tautane

Stream (158, rating = 10) have a good number of native species. In the south, the dunes at Uruti Pt (168, rating = 11) carry a good diversity of species, while Flat Pt (169, rating = 10) has amongst other native species, *Austrofestuca*. There is a further large number of dunes with ratings of 9 and less. Marram is a common species and dominates many of these, while native species often persist only as remnants.

The Wairarapa coast therefore contains a number of dune systems of particular note. Each has special features that distinguish it from the others, and together the highly rated systems constitute a valuable botanical resource for both the region and New Zealand.

NATIONAL PRIORITIES FOR THE NORTH ISLAND

Listed below are 23 dune systems considered as national priority areas for conservation.

THE FAR NORTH

Spirits Bay W2
Ponaki Beach 3
Taeore to Paxton Pt 7
Waikuku Beach 1
Tom Bowling Bay W1
Te Werahi Beach W4
Twilight Beach W5
Ngamaru Point 4
Rarawa Beach 8

EASTERN NORTHLAND

Ocean Beach 28
Pakiri Beach 36

WESTERN NORTHLAND

Black Rocks to North Head W21
Kawarua to Mangonui Bluff W17

AUCKLAND

Omaha Beach 37

COROMANDEL

Waikawau Beach 45
Otama Beach 51
Hot Water Beach 59

TARANAKI

Waipingau Stream 51

MANAWATU

Harakeke Dunes W66
N. of Foxton Beach W72

WAIRARAPA

Te Humenga Pt W97
Porangahau South 155

OFFSHORE ISLANDS

Matakana Is

It is clear from this listing that the dunes of the northern part of the North Island, and especially the Far North are of special value. Indeed there are a further seven that could have been listed there as they have ratings equal to many of the dunes from the rest of the list. This results in 55% of the systems rated 13 and greater occurring in the Far North, and 72% occurring north of Auckland City. Northland is therefore a priority area for conservation, and especially the most northern part of that region. This area clearly has a botanical resource unequalled in the North Island and a great deal of effort needs to be put into ensuring these values remain. The nine systems listed above are merely the absolute best in a region of great importance. Of these, Spirits Bay is clearly the best with Ponaki Beach and Taeore to Paxton Point of only slightly less value. Four beach systems have not been included in the survey, and need to be examined and compared with the others.

The remaining priority areas are scattered throughout the North Island. The two dune systems of Western Northland represent long stretches of coastline and may actually consist of segments of variable botanical value. The Coromandel Peninsula contains two systems equal to some of the best of the Far North. The single dune listed for Taranaki is a very small, peculiar system in a region where dunes are rare. The extensive dune systems of the Bay of Plenty have no dunes in the list, while there are two from the Manawatu. The Manawatu dunes have unique features that need to be

preserved especially from the effects of forestry. Te Humenga Point in the Wairarapa deserves special note for its absence of marram and lupin, species abundant in the southern North Island. Matakana Island is the only offshore island with dunes of national value.

Large sections of coastline are not represented in the list: Waikato, Eastern and Western Bay of Plenty, East Cape - Poverty Bay, Hawkes Bay, Wellington. These regions contain dune systems that have been identified as of regional priority for conservation.

This list of priority areas provides an important starting point for the application of conservation priorities to coastal sand dune and beach systems. The inventory system of rating the dunes has proven very effective in identifying important areas, even where they are concentrated into one region. The list does not, however, mean that all other areas can be discarded and treated as of no value. Many dune systems around the North Island contain species and communities of note that are worthy of conservation effort.

OFFSHORE ISLANDS

The many offshore islands found at varying distances from the coast of the North Island were not included in the survey. There is, however, a considerable amount published on the botany of many of these islands and island groups. The full report lists these in detail. Dunes are known from the following islands.

Kermadec Is (Raoul Is)
Cavalli Is (Kohangaro, Whatapuke, Motukawanui)
Bay of Islands (Urupukapuka, Moturua, Motuarohia, Okahu, Waewaetorea, Motukiekie)
Hen and Chicken Is (Lady Alice)
Little Barrier Is
Great Barrier Is (including Rakitu)
Kawau Is
Tiritiri Is
Hauraki Gulf Islands (Waiheke, Motutapu, Motuihe, Motukorea)
Great Mercury Is
Whale Is
Matakana Is

Matakana Island contains dunes with a rating of 14. Of particular note are the diversity of native species and the confined presence of marram. There is little information on the extensive dunes of eastern Great Barrier Island and these need to be examined in detail.

6. RECOMMENDATIONS

- That priority be given to detailed survey and appropriate protection for the 23 areas listed as national priority.
- That regional authorities be notified of regionally significant sand dune systems.
- That the missing systems be examined, including Great Barrier Island.
- That this habitat inventory technique be recommended as a suitable way of solving the problem of determination of appropriate areas for conservation.

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