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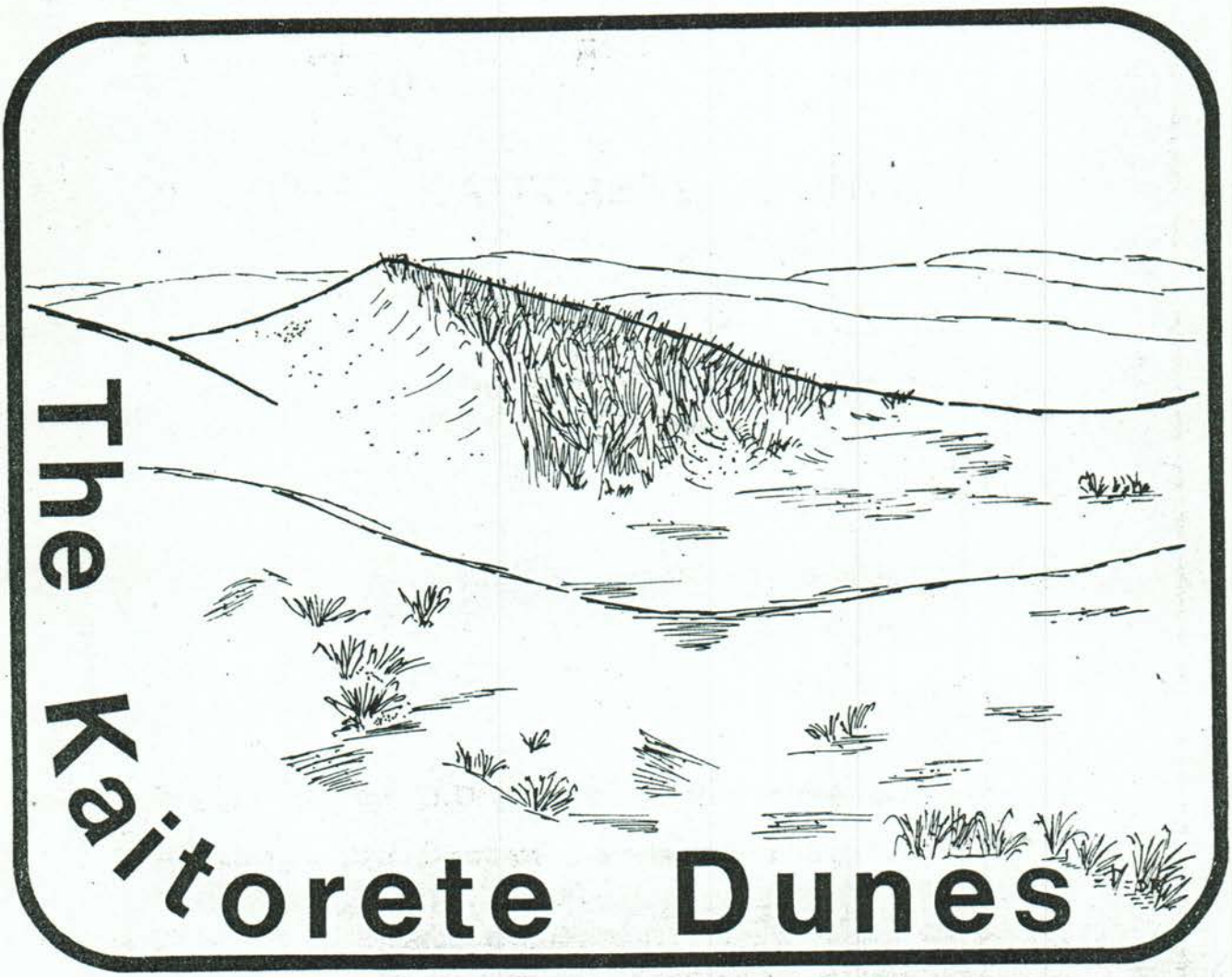

The Kaitorete Dunes

DEPT. OF LANDS & SURVEY
CHRISTCHURCH

THE KAITORETE DUNES

A study of appropriate land uses with particular attention to sand mining

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CONTENTS

INTRODUCTION

The Kaitorete dunes have existed for some 500-1,000 years, evolving during that time a distinctive form and flora as part of the Kaitorete Spit landscape and ecosystem.

Man's treatment and use of the dunes has varied widely. Some land uses have complimented the natural values of the area, while other uses have exploited these values.

In 1973 the Crown land licences over the dunes and inland areas became due for renewal, and a reassessment of the licence areas resulted in the setting aside of two dune and adjacent grassland/shingle flat areas as reserves for scientific purposes. The balance dune complex area remained as unoccupied Crown land pending further reserve investigation.

During the preparation of the above reserves' management plans, certain natural and cultural values of the dunes were revealed, warranting a fuller investigation of the whole dune complex and associated land uses.

Paramount for consideration amongst the present land uses is sand mining - an activity that has required regular assessment of new mining areas and frequent supervision of mining methods.

It is obvious that if land uses such as mining are to be considered then it is desirable to evaluate the whole dune complex and plan for long term use in appropriate areas. This approach is reinforced by resource management provisions contained in the Town and Country Planning Act 1977, the Reserves Act 1977 and the Land Act 1948; the latter being particularly applicable because of the occurrence of Crown owned land.

The report is presented in two parts. Part I looks at the resource, its uses and the controls over its use; followed by a summary of the resource data. Part II evaluates the desirability or otherwise of the "preservation" and "exploitation" land uses. Recommendations are made in light of this evaluation.

Material for the report came from an analysis of relevant literature (see Bibliography) and Lands and Survey District Office files; discussions with various persons having scientific, cultural or other interests in the dunes; a detailed examination of the mining area, and an on-the-ground study of the whole dune complex.

RT I : THE RESOURCE

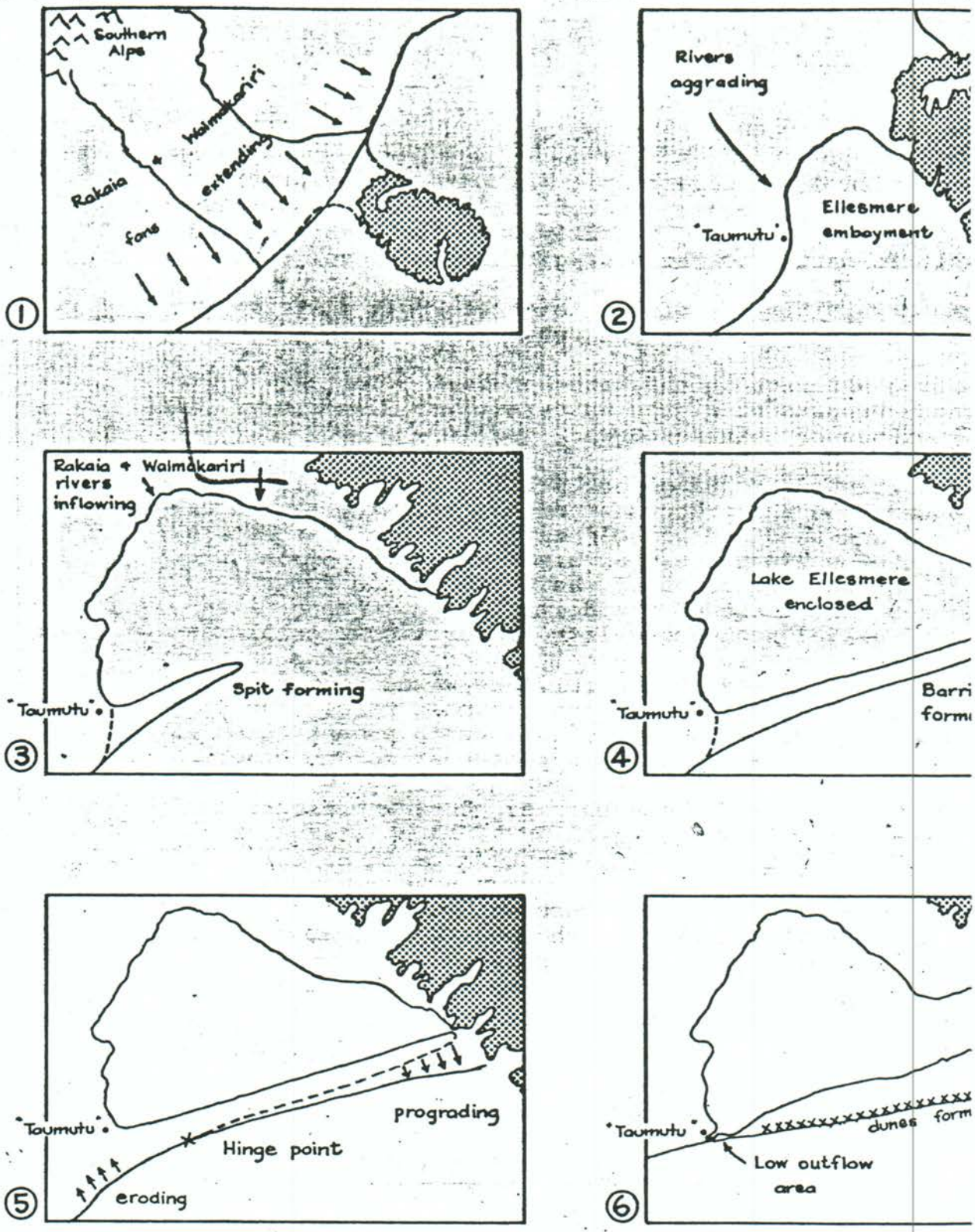
FORMATION OF KAITORETE SPIT AND DUNES

The formation of Kaitorete Spit has been of scientific interest for many years. Speight (1930) was an early writer on the subject, and more recently Suggate (1958) related the spit formation to the post-glacial sea-level rise.

The geomorphic history of the Kaitorete Spit district is complex and in some cases conjectural.

Continuing research in the area has been undertaken by the Geography Department of the University of Canterbury. Kirk (1979) writes of this research:

> "A particular focus of our studies has been to understand the processes and evolutionary sequences in mixed sand and gravel beaches. Such beaches are rare at world scale, but are relatively common along the east coast of the South Island and the lower east coast of the North Island. Among mixed sand gravel sequences, large depositional complexes are even more rare (the only other one being in the Rarangi area near Blenheim), and mixed beaches having associated dune systems are most rare. The Kaitorete dune complex is thus worth preservation at least in part, for this reason if for no other.
>
> However, the Kaitorete barrier complex presents an evolutionary history which is of high interest both locally and internationally among earth scientists.
>
> Early in our studies we were interested to establish the details of this history because at the simplest level, the complex had the "wrong" shape. While it is commonly termed a "spit" and it has long been known that it is built of sediment drifted northward along the shore from Central and South Canterbury, it cannot properly be called a spit. Spits proper have a free end at the down-drift end (in this case it should be the eastern end), and they characteristically thin towards that end with distance away from the supply of sediment. Kaitorete appears to be the reverse shape (to be a spit) and is attached at both ends. It is therefore properly termed a barrier.
>
> .....the barrier complex is about 5-7,000 years old, thus representing a very large amount of growth in a short span of geological time. It (is) clear that several major changes have occurred and that they are preserved in the landforms. One of these events is represented by the dune system."



Diagrams showing the formation of Kaitorete 'spit' and Dunes

A combination of information from Smith (1979) and Kirk (1979) provides the following description of the area's evolution (see also Figure 2):

(1) ca. 15,000 years ago : Full glacial conditions in the Alps. Sea level approximately 30 metres lower than now. Fans of Rakaia and Waimakariri Rivers extended towards and south of Banks Peninsula.

(2) ca. 10,000 years ago : Early post-glacial. Sea level approximately 20 metres lower than present but rising. Beginning of aggradation by Rakaia and Waimakariri Rivers; an embayment existing between the alluvial fan margins and Banks Peninsula.

(3) & (4) ca. 6,000 to 4,000 years ago : Mid post-glacial. Continuing rise in sea level to approximately 3 metres above present level. Continuing aggradation with Rakaia and Waimakariri Rivers flowing into "Ellesmere" area at times. A spit proper growing eastward from a shoreline seaward and south of Taumutu, across the embayment and forming a barrier to enclose Lake Ellesmere.

(5) ca. 2,000 years ago : Late post-glacial. Gradual fall in sea level to about present mean sea level. Coastline eroding west of a "hinge-point" near Taumutu, and barrier prograding east of "hinge-point".

(6) ca. 1,000 to 500 years ago : Modern. Continuing erosion and progradation. Development of a low lake outflow area at the western end of the barrier. Formation of dunes on barrier, and progradation at Birdlings Flat.

Kirk notes that the processes by which the above occurred "are of high scientific interest....

> .....dune formation has been a rarity in the evolutionary sequence, the only dunes of any consequence being those along the central, seaward margin i.e.: those being presently mined. Apart from the infrequent occurrence of dunes on beaches of this type, these ones are notable in that they are....the only ones in Canterbury still presenting any semblance of the native dune plant communities. They are dominated by Pingao, as all of the Canterbury dunes must have been before the introduction of marram grass in the 1880's and '90's.
>
> ....(There is)....a low rate of sand supply to the Kaitorete dunes. Another feature of interest on the barrier is that old surveys show there has been only minimal beach growth during the last century. This apparently stable state contrasts markedly with the record of massive progradation over the preceding few thousands of years. Why this should be so is not known but it is a phenomenon observed on many barrier systems both in New Zealand and overseas. This problem is both the subject of further research and adds to the

scientific interest of the area. It is interesting that there are dunes only along the seaward (most modern) ridge and that this ridge is apparently stable in comparison with the rapid growth evidenced by those to landward."

A detailed study of the formation of the dunes on Kaitorete Barrier (Spit) was undertaken by Armon (1970). The following has been extracted from Armon's study (see also Figure 3):

"Dunes on Kaitorete Barrier."

"Dunes on the Kaitorete Barrier have been divided into three categories on the bases of location and morphology. These three sets of dunes will first be described separately and then their implications for coastal development will be discussed.

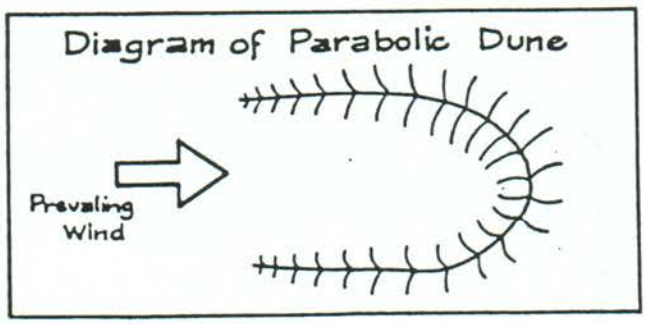
COASTAL DUNES.

Coastal Dunes are the most noticeable dunes on Kaitorete Barrier. They parallel the beach for most of its length but decline in width and height eastward towards Poranui Pt where, for the easternmost 3.2 kilometres , dunes are subdued or absent. For the rest of the Barrier, dunes generally rise 4.5 to 7.6 metres above the Barrier surface and occupy a width of 180 metres....

The variation in form, height, and width, from west to east provides a better understanding of the beach environment.

For the western 8 kilometres of the Barrier wave attack on the seaward margins of the dunes was.... noted. [Since 1970 this "wave attack" has extended over 12 kilometres of the western barrier dunes.] * Parabolic dunes ('U' shaped dunes with two arms aligned parallel to the predominant wind and both arms pointing upwind - see diagram) are present in this coastal sector. Their arms are sparsely vegetated and extend landwards from the backshore for distances up to 70 or 90 metres.....

* Author's note.



....(The) orientation calculated from present wind data and actual dune orientation suggests that the directions of strong winds from the southern vectors have been similar for the period involving the formation of the parabolic dunes. This could involve a period of between 500 and 2,000 years.

For 13 kilometres further east of the western coastal sector there is an eastward-change in character of the dunes. The width of the back-beach area increases, the wave-trimmed dune margins disappear, and a low foredune gradually gains in prominence. Blowout dunes are present in this sector, situated landwards of the fore-dune.....

The Coastal Dunes decrease in height and width to the eastern 5 kilometres of the Barrier where they are present as low dunes less than 1.5 metres high. For the eastern 3.2 kilometres of the beach a thin sand veneer, less than 0.3 metres thick, is present on ridges landwards of the backshore.

WESTERN INNER DUNES.

The Western Inner Dunes are low undulating dunes deposited on the Barrier Ridges over the western 8 kilometres of the inner Barrier. Depths of more than 0.9 metres were measured; the depths decrease eastwards and these dunes are absent east of Bayley's new farmhouse. The brown colour of the dune-sand, indicative of considerable weathering, plus the truncated nature of the northern margins (related to an early lakeshore) provide evidence that these dunes are older than the Coastal Dunes .....

It is suggested that the formation of these dunes is related to situations adjacent to earlier shorelines. These dunes appear to represent an overall loss from earlier beach systems because they gradually disappear eastwards and are absent from the rest of the inner Barrier.

EASTERN INNER DUNES.

The Eastern Inner Dunes are a low set of dunes which are situated from 90 to 275 metres landwards of the Coastal Dunes, 3 to 13 kilometres from the Barrier's eastern end.....

The Eastern Inner Dunes, like the Western Inner Dunes, are inactive relict dunes, being vegetated and showing no signs of sediment movement.

The following 3 factors suggest their formation from the Coastal Dunes:

on the coast and the Western Inner Dunes. It explains why dunes are present towards the eastern end of the Barrier adjacent to recent beaches but are absent landwards. Dunes on the Kaitorete Barrier thus allow some insight to be gained into the sediment budget both in the present and past coastal situations."

Kirk (1979), in concluding his report, made the following comments:

"The fact that the shoreline is not growing presently and that the seaward dunes are almost the only ones present, are strong arguments in favour of limiting sand extraction before they are entirely removed. Their replacement by natural processes will be very slow."

(Kirk pers. com. 1980 suggests a time scale here of "hundreds" of years, rather than "tens" or "thousands" of years. Kirk also mentioned that there is now theoretical evidence to suggest that dune removal upsets the beach/dune sediment balance, and can lead to or increase coastal erosion.)

"....(There) is sufficient to indicate....that there are a number of aspects of the physical landscape which would justify preservation of at least a portion of unmodified dune. In both university teaching and in frequent public addresses to community groups in Canterbury,.... there is always a high level of interest in.... the history of the Ellesmere coast.... The barrier complex contains many interesting landforms which reveal a short history of very dramatic events. It would be unfortunate if one of the largest and non-typical elements in the "story" was to be substantially removed, along with its distinctive vegetation cover."

1. Their position inland of the Coastal Dune blowouts..... Blowouts are frequent in this coastal sector.

2. The frequency of strong onshore winds from the south and southwest. They make it conceivable for sand to be moved inland to form these dunes.

3. Their very irregular positions and shapes, which preclude any formation related to earlier shorelines landwards of the present beach.

DISCUSSION.

Both the Coastal Dunes and the Western Inner Dunes show a progressive eastward decrease in extent, and raise the question of why this longshore trend occurs. An understanding of this longshore change lies in the knowledge of the conditions related to dune formation. .....dune formation depends on the presence of both a favourable wind regime and sufficient sand reserves in the coastal zone. Exposure to strong onshore winds does not alter along the Barrier. Thus, the eastward decrease in the Western Inner Dunes and Coastal Dunes suggests a related decrease in sand reserves from the beach and nearshore zone. An eastward decrease in sand reserves in this zone must be related to progressive onshore and offshore losses along the Barrier. Offshore losses are unknown but losses through dune formation are considerable. Both sets of dunes thus confirm the importance of longshore changes in the sediments in the beach system. This tends to substantiate the conclusion, suggested from studying the height of the Barrier surface, that there is a longshore variation in the proportion of sand in the beach sediment.

The question of why the Coastal Dunes have a greater eastwards extent than the Western Inner Dunes may be answered by suggesting a change in the source of sand. An eastward movement of the sand source later in the Barrier's development would mean that, given similar longshore losses from the Beach, dunes formed later would extend further eastwards. It (is) suggested that the fulcrum for the Barrier's development moved north-eastward and that erosion extended on to the Barrier. This eastward extension of erosion indicates a movement of the source which would enable sand to move further eastwards along the Barrier when shorelines were near that of the present.

This hypothesis of events allows an explanation of the difference in eastward extent between dunes

(b) Deflation Hollows

These are thickly strewn with smooth, round, flat stones up to 30 cm across. Many of these are partially or completely covered on their upper surface with a black lichen (*Parmelia* sp), suggesting that the area has existed in its present state for some time. The vegetation is very sparse, consisting mainly of mounds of scabweed (*Raoulia australis*).

Two natives, the perennial herb *Scleranthus uniflorus* and the prostrate shrub *Pimelia prostrata*, and the introduced catsear, sheep sorrel and harestail occur rarely. A few pingao are fixing small mounds of sand which could form the nuclei of future dunes.

Zoysia minima is an important sand binding grass and *Carex pumila* occurs in some hollows. Near the base of the dunes the grass *Bromus diandrus* and isolated tussocks of *Poa laevis* occur but they are more frequent in the vicinity of the rear dune.

(c) Rear Dune

The dominant plant here is pohuehue (*Muehlenbeckia complexa*) which grows in clumps up to 1 metre high and several metres across. *Carmichaelia appressa* is abundant, growing either prostrate, or if associated with pohuehue, up to 1 metre high. On the more open parts there are scattered plants of pingao, sand bindweed, catsear and sorrel. The herb *Craspedia lanata* is not uncommon. The prostrate shrub *Rhagodium triandra*, harestail and the grass *Bromus diandrus* grow in association with the shrubs.

(d) Sandy Flat

The vegetation here is sparse, although less so than in the deflation hollows. The bidibidi (*Acaena* spp) are prominent as are the perennial grasses, needlegrass (*Stipa variabilis*) and danthonia (*Notodanthonia unarede*). Catsear and sorrel are common. Between June and January the area is dominated by the annuals, harestail (*Lagurus ovatus*) and the haresfoot trefoil (*Trifolium arvense*) together with a little *Bromus diandrus*. The perennials scabweed (*Raoulia* sp), *Scleranthus uniflorus*, silver tussock (*Poa laevis* and *Pimelea prostrata* are found occasionally.

(e) Old Dunes

Here is the longest established plant community. It is dominated by *Carmichaelia appressa* and silver tussock. Other grasses are common. Bracken (*Pteridium aquilinum* v *esculentum*) occurs in dense clumps on many of the older dunes.

In some places there is a complete ground cover of the moss *Triquetrella papillionata* interspersed with

2. BIOLOGICAL VALUES

2.1 Vegetation (i.e. the plant community cf. flora - the plants)

The Kaitorete dunes are an extremely harsh environment for plants, on account of the combination of high summer temperatures, low humidity for much of the year, low rainfall, very strong winds, salt spray and the very low water-holding capacity of the substrate. All the plants have some sort of adaptation to enable them to survive, some of which are discussed under "flora".

The vegetation is closely related to the five topographic zones of the dunes system. These five zones are:

(a) The Foredune

(The seaward-most dune ridge.)

(b) Deflation Hollows

(These are flat, roughly circular areas up to 200 metres across and covered with flat pebbles and stones typical of the basement gravels.)

(c) The Rear Dune

((a), (b) and (c) comprise the "coastal dunes" referred to by Armon (1970) in section 1.)

(d) A sandy plain inland from the rear dunes.

(e) Old dunes further inland.

((d) and (e) comprise the "eastern" and "western" inner dunes referred to by Armon (1970).)

Each zone has its own characteristic vegetation.

(a) Foredunes

The golden sand sedge or pingao (*Desmoschoenus spiralis*) is the dominant species. This species was formerly dominant throughout the coastal dune systems of New Zealand. However, this vegetation type has now become scarce because of the invasion of the introduced marram grass (*Ammorhila arenaria*) and lupins (*Lupinus* spp).

Burrows (1973) states, "As far as I know the Kaitorete Spit dunes are the only remaining extensive dune area in New Zealand in which *Desmoschoenus* (pingao) dominates the vegetation, with the possible exception of Mason Bay, Stewart Island".

Scattered plants of the introduced catsear (*Hypochaeris radicata*) sea bindwind (*Calystegia soldanella*), harestail (*Lagurus ovatus*), sheep sorrel (*Rumex acetosella*) and rare patches of native broom (*Carmichaelia appressa*) make up the complement. Much of the ground is bare.

the piripiri or bidibidi (*Acaena novae-zelandia*), Australian sheep's burr (*Acaena ovina*) and hybrids between the two *Acaena* species.

Some open sandy patches occur. On these are found old established mats of scabweed and a few other plants. A second native broom, *Carmichaelia corrugata*, is occasionally found.

Flora

Kaitorete Spit has a large native and introduced flora with a number of features of particular scientific importance and conservation value. Some of these features are:

(a) The presence of pingao (*Desmoschoenus spiralis*) as a dominant over a large area.

(b) Endemic Species (i.e. species found only on Kaitorete Spit)

The prostrate broom *Carmichaelia appressa*. This species is listed by Given (1976, 1979) as a rare and threatened plant in New Zealand.

(c) Uncommon Species

The small, prostrate broom *Carmichaelia corrugata*. This species is uncommon though not endangered at present.

(d) Species at their southern limit

(i) *Muehlenbeckia astoni*

This plant occurs uncommonly from Cook Strait to Canterbury and reaches its southern limit on Kaitorete Spit. A few species occur in two localities on the Spit.

(ii) *Dodonea viscoas*

This plant occurs throughout the Pacific Ocean area and reaches its southern limit on Kaitorete Spit.

(e) Two tree species

The presence of a few gnarled, stunted specimens of ngaio (*Myoporum laetum*) and kowhai (*Sophora microphylla*) give an indication of possible former vegetation. These are thought to be about 60 years old and appear to be being overwhelmed by sand drift and salt.

(f) Species showing a variety of adptations to the severe environmental conditions, particularly summer drought.

The plants can be grouped into three categories according to the means by which they are adapted to drought.

(i) Escapers

That is, annuals which rely on completing their life cycle during the most favourable periods during summer and spring. These are mostly adventives but the indigenous narcissus *Hypoxis pusilla* falls into this group.

Significance

Molloy (1971) writing on the "Possibilities and problems for Nature Conservation in a closely settled area" - an examination of the types of natural communities represented or not represented by reserved lands in the Canterbury Land District - had this to say about Kaitorete Spit:

> "Undisturbed coastal sand country is a diminishing natural resource north of Christchurch (Mason 1968); but south of Christchurch on Kaitorete Spit, separating Lakes Ellesmere and Forsyth from the Pacific Ocean, is a primitive coastline which is unique in its geological, pedological, botanical and archaeological features....
>
> When we think of potential reserves on the Canterbury Plains we usually think in terms of modest acreages, but this strip of natural coastline, covering about 1300 acres and owned by the Crown, surely warrants special consideration. In my opinion, every effort should be made to preserve the entire 1300 acres in its present state."

Molloy (pers. com. 1980) still holds to the above view.

Knox (1979), in discussing "Prospects for New Zealand Biosphere Reserves" as part of the International Man and the Biosphere (MAB) Project, considered the current extent and number of reserved areas in New Zealand. He noted:

> "It would seem that we are well endowed with reserves and that from these we could select a range of biosphere reserves that would include representations of all the different types of terrestial ecosystems found in New Zealand. However a closer analysis reveals that this is far from the case. Many types of ecosystems, especially those of the coast and our wetlands are poorly represented."

In discussing future reserve needs, Knox continued:

> "The greatest length of coastline reserve is in the Fiordland National Park - most of this is little visited and consequently is not subject to human pressure to any extent. This is in contrast to areas close to centres of dense settlement which are the least protected and subject to intense pressure. As pointed out above, coastal ecosystems are grossly underrepresented in our network of reserves. This particularly applies to unmodified sand-dune ecosystems; there are unfortunately now only a few remnants left in such a condition with the rest now covered with introduced species such as marram grass, lupin and gorse."

(ii) Evaders

That is, species which are able to ove[r]come the problems by morphological specialis[a]tion of roots and shoots. A few adventives [a]nd most native species fall into this gro[up]. Most native forbs and shrubs have smal[l] size with a compact vein system and the [l]eaf texture is hard and leathery with a st[r]ong cuticle to resist desiccation, e.g. *Sc[a]evola uniflorus*, *Coprosma propinqua*, *Hymenan[t]hus alpina*. The native grasses have rigid, [i]nrolled leaves, e.g. pingao, *Carex*, zoysia, [a]rrow, *Danthonia* and silver tussock.

Woody plants have a compact shrubby or prostrate form, and some forbs have a [r]osette or cushion habit.

Roots and rhizomes are very strongly de[v]eloped and very long taproots are common.

(iii) Endurers

That is, species which withstand extreme [w]ater saturation deficits by means of physiological specialisation, e.g. *Myoporum laetum* which produces a gummy secretion protecting [the] young leaves.

2.3 Fauna

The fauna of the Spit is not well-known. Most of the Spit's important birdlife occurs on the margins of [L]ake Ellesmere, some distance from the dunes. Various [b]ird and invertebrate species inhabit the dunes and grass[l]ands but most species known of are common in occurrence [e]lse-where. Generally there has been insufficient resea[r]ch to attach importance to the dune area because of any uniqueness in its faunal assemblage. It should be [n]oted, however, that the dunes are essentially in a natural state and therefore offer opportunities for preservation and study of undisturbed coastal dune fauna and habitat.

3. CULTURAL VALUES

In 1944 a local Ellesmere historian, W.A. Taylor, wrote:

> "To the Maori people there is a vast amount of sentiment attached to that narrow strip of land approximately 15 miles long, and covering about 12,000 acres, known to the pakeha as the Ellesmere Spit, but to the natives as Kaitorete. The spit played a part in the Kai Huanga (Eat Relation) Feud, a civil war which decimated the several hapus of the Ngai Tahu tribe to such an extent in North Canterbury that they were not able to hold either Kaiapohia or Onawe against Te Rauparaha and his warriors from Kapiti in 1831."

Taylor also detailed the attempts made by the local Maori people in the 1860's to regain ownership of Kaitorete, the legality of its earlier "sale" being clearly disputable.

Discussions with Riki te Mairaki Ellison (pers. com. 1979), a Kaumatua (Maori Elder) living at Taumutu, revealed that Kaitorete is no less important to the Maori people today. Not only does Kaitorete have a vast amount of history attached to it, as evidenced by the present day archaeological sites and historical writings such as Taylor's above, but the dunes also provide the pingao fibre still used for the decorative tukutuku panels inside the marae meeting houses. Ancestral burials in the Kaitorete dunes increase the respect that the Maori people have for Kaitorete.

ARCHAEOLOGICAL SITES

Large numbers of prehistoric archaeological sites are known to occur on Kaitorete Spit. The following notes regarding the sites have been supplied by Trotter (1979), Archaeologist at the Canterbury Museum.

"THE ARCHAEOLOGICAL RESOURCE

In the thousand years that Man has occupied New Zealand, he has had a not inconsiderable impact on the environment. As the initial settlement population increased, millions of hectares of forest were burnt down, and tens of species of birds were exterminated. The living and breeding patterns of many other animals were changed, and the very face of the ground was modified, deliberately by the construction of pits, terraces, walls and ditches, and unintentionally from the accelerated processes of erosion and deposition.

For most of the human period in New Zealand no written histories exist, and recourse must be made to the interpretation of evidence in archaeological sites to obtain knowledge both on the humans themselves and on their interaction with the environment. Even within the time of European settlement, written records are often inadequate and so-called "historical archaeology" can provide much information not otherwise available.

It must not be thought, however, that the value of archaeological sites lies solely in the information that archaeologists can get out of them. Besides being the tangible evidence of the day-to-day life of past generations, they are, in a sense, monuments to human achievements and failures, to incidents or happenings in the past. Walking over the remnants of an ancient Maori village may impart a much more vivid picture of past life than can be obtained from a lengthy text. Archaeological sites, as with historic sites, must be recognized as an important part of our cultural heritage.

As a resource, however, whether for the archaeologist or the recreationalist, archaeological sites are a finite commodity. Once destroyed they cannot be replaced; they do not regenerate as populations of animals or areas of vegetation might, nor can they be rebuilt or reconstructed with any degree of authenticity.

Besides our present-day uses of sites, we should consciously preserve them for future generations who may have other uses for them. There can be little doubt, for example, that future research objectives will change and that archaeological techniques will continue to improve. In the future

it will be possible to obtain more detailed data from sites. Educational methods, too, are changing, and there is already growing emphasis on learning from seeing sites of historic (or prehistoric) events rather than just reading about them.

SITES ON THE SPIT (See Figure 4)

Although no comprehensive survey has been made for archaeological sites on Kaitorete Spit, several areas of it have been sampled by volunteer groups from the Canterbury Museum Archaeological Society. This work, plus chance finds by others in the course of farming, quarrying or picnicking, indicates that a very large number of sites exist.

In the wind-blown sand hills along the seaward side of the Spit, sampled areas at the eastern end, and about one third of the way along, had site concentrations of 51 and 23 sites per square kilometre respectively.* Spot checks elsewhere along the coastal fringe suggest that concentrations of this order are fairly constant throughout the dunes. Further in from the coast a better vegetation cover and less erosion makes it difficult to locate archaeological remains, but there is reason to believe that the concentration may not be quite so great towards the lake side. Even under ideal conditions, it should be noted, archaeologists are unlikely to find all the sites that occur in an area; a discovery rate of no higher than about 80 percent could be expected on average.

In the dune area of Kaitorete Spit the majority of exposed sites have had the lighter materials, such as charcoal, winnowed out of them, leaving heavier materials, particularly fire stones and stone artifacts, on the surface. Some sites which have been protected by overlying sand do still contain organic remains, including human bones and grave goods made of bones and teeth. Such sites are of particular importance as they can provide information not available from eroded sites."

The majority of sites date from the moa-hunter period of Maori culture. While many of the individual sites may not appear to be of great significance, the sites collectively are of far greater importance. For this reason any archaeological investigation of the sites in a piecemeal

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*N.B. Although these site concentrations are given per square kilometre of dune plus inland areas, Trotter/Burrage pers. com. 1980 confirm that most of the sites were found within the dune complex. Field work by the author found site concentrations of a minimum of 15 to 20 per linear kilometre of dune complex.

5. RECREATION AND SCENIC VALUES

Recreational use of the Kaitorete dunes themselves is light although use of the spit, especially the beaches, can be very high.

Submissions to the Wairewa County Coastal Reserves Survey (currently under action) from the Canterbury Mineral and Lapidary Club Inc. (Allen 1980) highlight the importance of the Kaitorete Spit beach for the collection of semi-precious stones, geological specimens, and general recreation. Although the Birdlings Flat beach is the most important locality (up to 1,000 people have been counted here during one day - Lands and Survey file 8/5/455 folio 5), collectors do visit the whole Kaitorete Spit beach. The beach is considered by the above club to be unique in world terms.

Submissions from the Waikakahi Beach Association (a holiday bach residents' group based at Birdlings Flat: Burke 1980) also highlighted the recreational use of the Kaitorete Beach, again with most emphasis on the Birdlings Flat vicinity. However, it was pointed out that the whole Kaitorete Beach is used by surfcast fishermen and an annual fishing competition held at the eastern few miles of beach, attracts around 500 entries and up to 2,000 people.

Just west of the Lake Ellesmere outlet, at Taumutu and along to Rakaia, there are also high use intensities, mainly from surfcasting and other fishermen.

Other recreationalists visit the dune/beach areas to picnic, fossick and stroll along the beach, and appreciate the values of the area.

The recreation use pattern then, is high use intensities at the eastern end of the spit and to the west of the spit, with lower use intensities in between and decreasing towards the western end of the spit.

The visual or scenic qualities of Kaitorete Spit are of average quality when compared with other parts of the Canterbury coastline (Conway 1980). The Spit lacks the diversity and containment of the Banks Peninsula bays but ranks more highly than the coastline south of the Rakaia River.

While the intrinsic scenic values of the Spit are not high they are enhanced by the uninterrupted views obtained from the site. The open nature of the site allows good views of Banks Peninsula, the ocean, Lake Ellesmere, the Southern Alps and changing weather patterns. In addition the vegetation of the dunes adds a distinctive colour element to the landscape.

At main visual intrusions on the Spit are, to varying degrees, the presence of the settlement at Birdlings Flat and the adjacent University of Canterbury Research Station,

exotic tree plantations associated with pastoral farming, and sandmining. The settlement at Taumutu is a similar intrusion west of the Spit.

Sandmining downgrades the visual values of the Kaitorete dunes by altering the natural landform of rolling dunes to that of open, levelled areas; by lowering the overall height of the dune area, and by denuding the dunes of their natural cover of coastal vegetation.

While the Kaitorete Spit, and more particularly the dune/beach system, is not accredited with having high scenic qualities, the area does have high natural values, a certain openness to the landscape, and an element of desolateness, that together identify a particular value for the Kaitorete dune/beach system - its "wilderness" value.

"Wilderness" Value

Wilderness has two separate concepts, an area of land and a state of mind - "wilderness is where one feels oneself to be in a wild place" (Huxley 1974).

As an area of land, the Kaitorete dunes/beach system, because of its limited size, would not measure up to the wilderness area criteria used for National Parks and Forest Parks.

However, as regards inducing a wilderness "state of mind" the Kaitorete dune/beach system does this well. For most of the length of the Spit, the signs of civilisation are sparse after one enters the dune/beach system.

That such an area that can provide this "wilderness" experience close to a major metropolitan area, should be regarded highly.

MINING ACTIVITIES

Background

Sand extraction started on Kaitorete Spit in 1952, via an arrangement between W.A. Habgood Limited (cartage contractors servicing the Lincoln/Ellesmere/Banks Peninsula area) and the Crown land lessee.

By 1964 up to 13 cubic metres of sand was being removed per day, with no royalty agreement or payment. The Crown consequently took over control from the lessee and established a five-year licence to Habgoods under Section 165 Land Act 1948, over an area of 3.44 hectares approximately (see Figure 5).

In 1966 a new area of approximately 8.377 hectares was applied for, the area being west of the previously worked area. The application was approved, but rescinded in 1967 when it was found to conflict with a licence issued in 1964 to the Caledonian Tile Co. Ltd and transferred in 1966 to Vibrapac Ltd, although Vibrapac had not extracted any sand itself. Vibrapac's licence has since expired.

A report in 1969 noted that mining had extended to within 30 metres of mean high water mark although the licence set the minimum distance at 60 metres.

In 1973 Habgoods' operations were noted as having extended 2 hectares east of the licence area. The licence area was extended 2 hectares in 1975, subject to the following conditions:-

(a) That areas already mined should be replanted with golden sedge and other suitable beach species.

(b) That operations be restricted to within approximately 2000 square metre blocks at one time. When each block is extracted the replanting should be carried out immediately.

(c) That a reasonable bank of sand should be left on the seaward side of the strip to prevent wind erosion and to enable further build up of sand. Stones graded out of the sand should be deposited in existing exposed gaps.

(d) That a similar bank should be left on the landward side to act as flood protection of adjoining land in the event of a high sea.

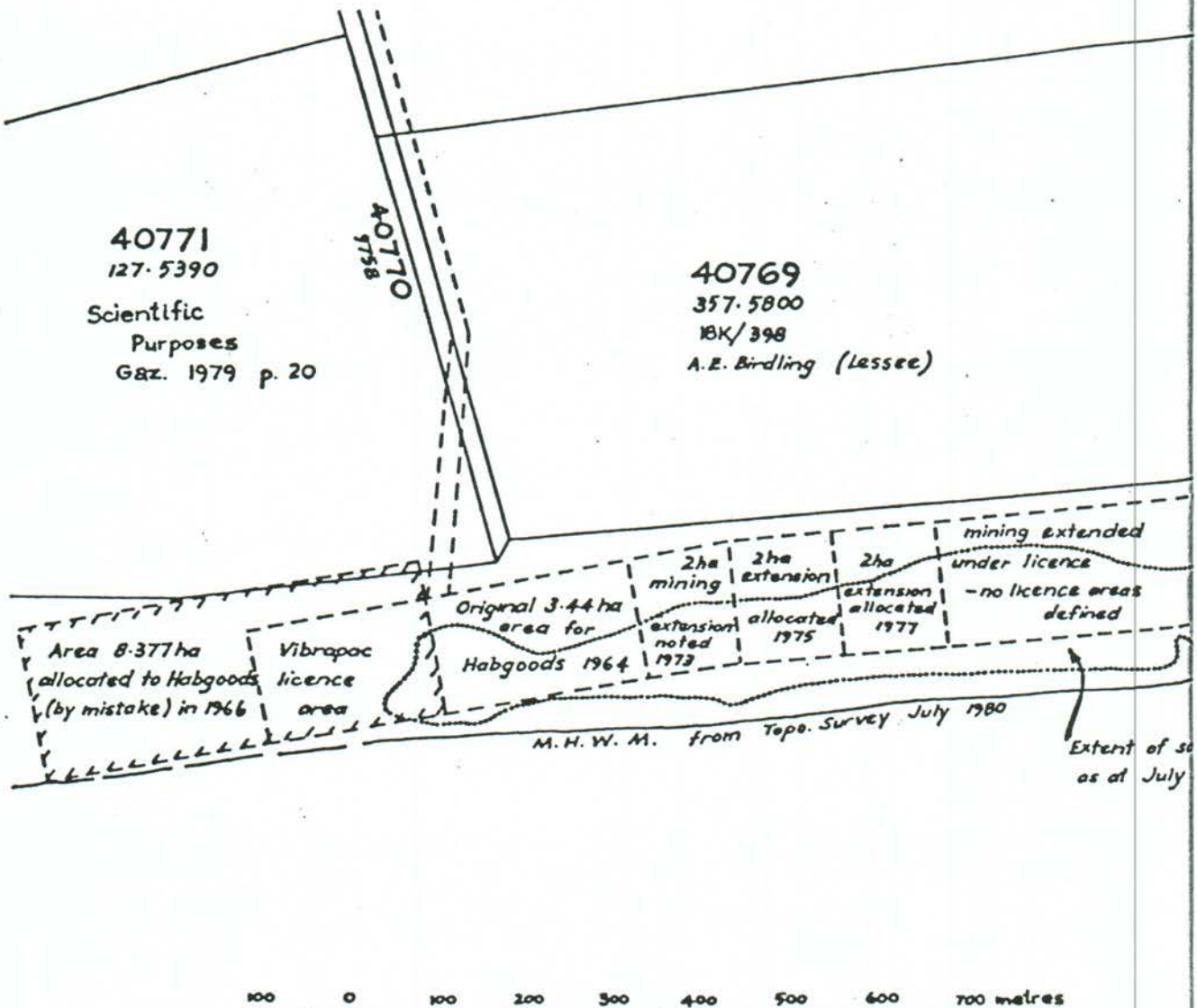
Later in 1975 it was reported that "W.A. Habgood Ltd appear to be making every effort to comply with the conditions of their licence....".

Throughout the 1975-76 period investigations were undertaken into a new sand extraction area 4 to 5 kilometres west of the initial area.

By 1977 it became obvious that the replanting programme was not entirely satisfactory and troubles in this respect have been had since, partly through physical difficulties in re-establishing the vegetation, and partly through lack of attention by Habgoods' staff (Lands and Survey file LR 35 folios 240, 241).

The Habgoods' licence area was extended a further 2 hectares in 1977 and the licence renewed on a yearly, and more recently half-yearly, basis.

From the above and Figure 5, it can be seen that mining has at times extended outside the licence areas, and that areas have not always been defined upon reissue of licences.



FIG

Mining Method

Extraction occurs over a 100 to 150 metre wide strip between the reardune and the "foredune"; most of the foredune being removed in the process (see Figure 6). In earlier years the whole internal dune system was removed, leaving a flat featureless area.

In more recent years efforts have been made to retain some dunes, stone piles, etc., and thus avoid the "flat" aspect. It was also hoped that retention of some mounds would help trap windblown sand and thus encourage dune regeneration. However, the Habgoods' plant operator (pers. com. 1979) did point out that one large foredune that was left intact seaward of the mined area, has since almost completely blown out.

Mining operations have gone to within 15 to 30 metres of mean high water mark and the unexcavated foredune has in several places blown out or been otherwise eroded away, allowing the sea to enter the worked out area.

The dunes (including vegetation, stones, etc.) are excavated by front-end loader and screened to separate the sand. All the sand down to the basement gravels is extracted (often to below mean high water mark level), and stone and vegetation debris left in piles as mentioned above. Some hard fill and clay is carted into the area to provide a firm road-bed. This has lead to the introduction of exotic plants/weeds to the area.

Discussions with the plant operator and observation of the debris piles reveal that archaeological sites are being uncovered and destroyed from time to time. At least one burial has also been excavated.

Revegetation

Spasmodic attempts have been made over the years at revegetating the mined areas. In some areas this has been successful, in others not. Marram grass has been introduced into the area and is obviously thriving, to the long-term detriment of the native pingao, although its spread could be contained.

Revegetation, however, has not been to a similar density as the original cover, nor has it been done in the areas most deserving of attention, namely the exposed faces/slopes of the mined dunes.

It is considered (Newton, Lands and Survey Nursery Supervisor, pers. com. 1980) quite feasible to revegetate the mined area, given the right techniques, manpower and co-operation with the mining operators. Newton suggests transplants should have some of the rhizome root attached, necessitating collection as mining proceeds. Mass planting of mined areas is both possible and needed. Control and/or removal of marram grass is desirable.

Extraction Rate

Habgoods have been required since 1964 to supply records of the quantity of sand removed. The following information has been extracted from these records:

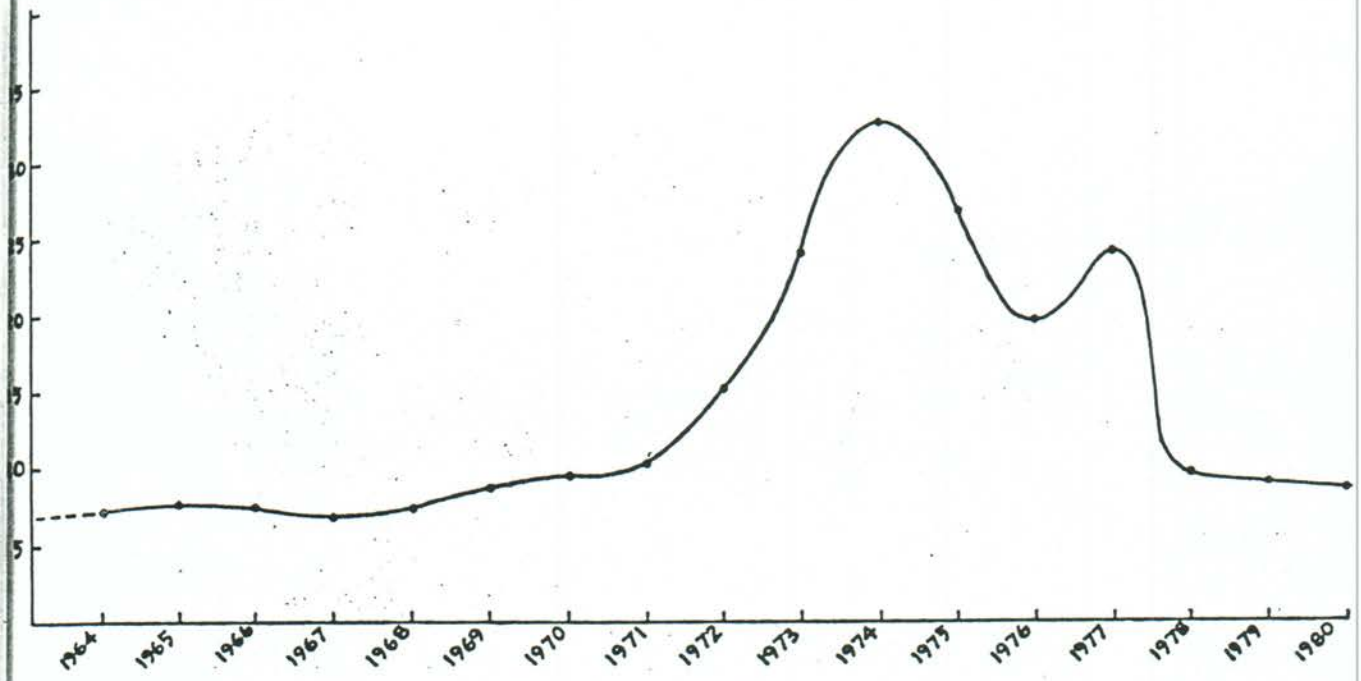


Table 1 : Yearly extraction of sand from Kaitorete Spit

From this table it can be seen that there is considerable variation in the yearly extraction rates, representative of the fluctuating demands of the building industry. A total of 231 904 cubic metres of sand has been extracted over the 1964 to 1980 period. For the 1952 to 1964 period it is assumed that extraction increased constantly from 0 cubic metres per annum in 1952 to the 1964 rate of 7080 cubic metres per annum, giving a total extraction of 42 480 cubic metres. The combined 1952 to 1980 total is therefore 274 384 cubic metres.

Detailed survey reveals that an 11.034 hectare area over a 1050 metre stretch, has been cleared of dunes. The extent of the mining area in relationship to the mean high water mark, foredune and reardune, can be seen in Figure 6.

From the above approximate figures can be obtained for the amount of sand recovered per unit area (24 867 cubic metres per hectare), for this type and size of dune, and hence the area cleared per year, for varying extraction rates.

Hence (a) if we assume a low extraction rate (take average over years 1964-71, 1978-80) of 8292 cubic metres per year, then 0.3335 hectares of dunes per year will be removed.

SUMMARY OF RESOURCE DATA

Kaitorete Spit is of particular geomorphic interest to scientists and laypersons locally and internationally because of its rate and mode of formation. Mixed sand and gravel beaches, having associated dune systems, are most rare on a world scale.

The dunes formed on the Spit between 500 to 1,500 years ago. The main dunes are the coastal ones where mining is presently occurring. Study of the dunes allows some insight to be gained into the sediment budget both in the present and past coastal situations. Sand supply to the dunes is low and the shoreline is not presently growing. If the dunes are removed by mining their replacement by natural processes will be very slow, measurable in hundreds of years.

The Kaitorete dunes are the only extensive dunes in Canterbury still presenting any semblance of the native dune plant communities, and are one of the very few extensive areas left in New Zealand where the golden sand sedge, pingao, still dominantes. The dunes have a large native and introduced flora with a number of features of particular scientific importance and conservation value.

The dune system is unique in Canterbury and has significance at a national and international level.

Kaitorete Spit and especially the dunes have high cultural values for the Māori people because of ancestral associations with the area.

A large number of archaeological sites exist in the dunes and elsewhere on the spit. While many of the individual sites may not appear to be of great significance, the sites collectively are of far greater importance.

Most of the dune and associated beach area receive little recreational use, and scenic values although not high, are enhanced by views out from the site and by the dune vegetation colour. The scenic values, high natural values, an openness to the landscape and an element of desolateness, combine to give the Kaitorete dune/beach system a "wilderness" value. Being close to the Christchurch metropolitan area, this "wilderness" value should be regarded highly.

Mining for sand has occurred on the Spit since 1952, by W.A. Habgood Ltd. Extraction rates have varied considerably, depending on the building industry demand. The extraction has proceeded under a set of conditions since 1975 but some difficulties have been had both in complying with and enforcing the conditions. The mining method removes all the inner dunes and most of the foredune, increasing the risk of coastal erosion, and producing a rather disfigured landscape. Blowout problems as a result

of mining do occur and archaeological sites are being destroyed. Revegetation of the mined area is possible if the correct techniques are used.

The major user of the sand is Winstones (S.I.) Ltd's concrete block manufacturing plant. Concrete mixes using Kaitorete sand produce a high quality, high strength block. The Kaitorete sand type is unique in the Christchurch area and the only alternative for the above firm, would be manufactured sands that are more expensive and do not produce as high a quality of block. Some technical and costing matters regarding use of Kaitorete sand and production of concrete products, have not been researched for this report.

Other land uses in the area include New Zealand Army live firing exercises and Labour Department explosives destruction and demonstrations. The Kaitorete dune/beach area is ideally suited and is highly regarded for these activities because of its depopulated nature and proximity to Christchurch. Neither activity has an adverse effect on the natural values of the dunes.

Almost the entire dune system is included within unalienated Crown land and two reserves. The two reserves are primarily for scientific purposes and some public access will be allowed. The public is allowed access to the Crown land but does not have access "as of right".

All archaeological sites are given legal protection by the Historic Places Act 1954, and sites can only be disturbed after authority is received from the Historic Places Trust.

The Town and Country Planning Act 1977 requires the local and regional authorities to recognise and provide for seven "matters of national importance", three of which are particularly relevant for Kaitorete Spit and the dunes.

Wairewa County's District Scheme requires a conditional use application and approval for all mining activities. The Regional Scheme as yet contains no policies relevant to the study, but a background report does emphasize the amenity and recreational value of the area.

Values of the Kaitorete dunes satisfy many of the criteria for reserves as set out in the purposes of the Reserves Act 1977.

The Land Settlement Board specifically excluded the dunes from grazing leases in the area and favoured a recommendation that the dunes become a foreshore reserve. The Board considered that sand mining may need to be restricted in order to preserve areas of scientific interest, other than within the two recently created reserves.

The Ministry of Transport has set policies under the Harbours Act for dealing with mining in the coastal zone. While only being applicable below mean high water mark, they are of interest when considering the Kaitorete dunes issue.

PART II : FUTURE MANAGEMENT

9. EVALUATION

It is indisputable that the Kaitorete dunes have high quality natural values of regional, national and even international importance, as well as important archaeological and cultural values.

Legislative responsibilities require that "preservation" be a major land use in this area.

However, the Kaitorete dunes/beach system also harbours several activities or land uses that seem imcompatible with "preservation". Some of the activities appear to be dependent on the Kaitorete locality.

Future management of the area therefore focuses on three basic land use options:

(a) "Preserve" the whole dune complex and its inherent values (accepting past modifications to the dunes).

(b) Make the whole dune complex available for "non-preservation" or exploitive land uses.

(c) Establish a balance between the preservation and exploitive land uses.

It is axiomatic of land use planning today, that if at all possible, a balance be reached between competing land uses. With this premise in mind the evaluation looks at:

(a) Whether the natural and other values can be adequately provided for by "preserving" a representative portion or portions of the dune complex.

(b) The conditions under which sandmining could or should continue and the effect these conditions have on limiting the available mining areas and mining lifespan.

(c) The compatibility of other expoitive land uses with "preservation".

(d) Any "weighting" of the land use "balance" as a result of legislative requirements.

Evaluation of these four factors leads to the subsequent conclusions and recommendations.

9.1 Preservation

In looking at the geomorphological values of the dunes, Kirk (1979) states "that there are a number of aspects of the physical landscape which would justify preservation of at least a portion of unmodified dune".

He also notes the high educational value of the whole dune and "barrier" complex, and, as is evident from Armon's (1970) research, the educational and geomorphic value of the area would be lessened "if one of the largest and non-typical elements in the story was to be substantially removed....". The preference then is clearly for the dune complex to be retained as a whole geomorphic feature, but failing this, representative dune areas should be preserved. Such representative areas could include the eastern and western inner dunes and sample dune areas at intervals along the Spit. The international aspect of the dunes should weight the importance attached to preservation for geomorphic purposes.

Botanical values of the dunes can be classified into two general groups - the scientific values such as the Kaitorete endemic species, rare species and New Zealand species reaching their southern limits, and general values such as the extensive undisturbed dune vegetation. The recently gazetted scientific reserve (including the adjoining dunes) was selected primarily because of its scientific botanical values. The reserve is considered by Molloy (1971 and pers. com. 1980) to be a pristine "core" area that should be situated within a larger reserved "whole" area. Indeed, while the reserve may include the pristine scientific features, field inspections show that the dune areas are less vegetated and more disturbed than dune areas further to the west (this is to be expected after considering Armon's dune formation research - see section 1).

Botanically then, while the pristine scientific botanical values may have been protected by "reserving" a portion of the dunes, additional scientific values and general botanical values depend on the reservation of a much larger area.

The national and possibly international biological importance of unmodified sand dune ecosystems is highlighted by Knox's 1979 paper. In light of this it seems desirable to preserve as much of the remaining unmodified dune complex as possible.

Maori cultural affinity for an area cannot be respected by allowing destruction of ancestral lands. To adequately recognise Maori cultural values the whole dune complex needs to remain in an essentially unmodified state.

Archaeological sites exist throughout the dune area, at relatively high densities. Obviously the preservation of an area of dunes will only protect the sites within that area. The collective value of all the sites needs to be emphasized as does retaining sites as monuments to Man's past, and retaining sites in anticipation of greatly improved techniques for gaining more meaningful data from the sites. Two, at least, of these arguments go against preservation of only part of the dune complex.

With the main identified recreational value for the dunes being its "wilderness" value, provision for recreation should concentrate on the remotest and most natural areas. Thus it could be considered that the prime recreation area is the dunes and beach adjoining and west of the scientific (western) reserve, to the lake outlet. However, the recreational value of the eastern dune/beach area should not be dismissed. Present day recreational usage of this stretch of dune/beach is the higher of the eastern and western areas, and the area still provides a high quality experience. There is, however, greater signs of Man's activities and the dunes are of less complexity and grandeur.

Because the dune/beach system is linear in extent rather than compact, it is difficult to argue that recreational values towards one end of the spit will be jeopardised by non-compatible land uses towards the other end of the spit. Hence it could be stated that reservation of only a part (although it must be a significant part) of the dune complex, would be adequate to protect the "wilderness" recreational values. For those who are happy to recreate in a less pristine area the balance beach/dune area could still be made available.

The recently gazetted reserves are primarily for scientific purposes. Public access can be restricted and will be to botanically important areas. Preservation of other dune areas is therefore needed, where public use can be a primary objective.

Scenic values of the area are not high, and distant views will remain no matter what happens to the dunes. However, the visual appeal of the dune landform and vegetation colour will be altered by activities such as mining, although a controlled rehabilitation programme of ground modelling and revegetation would lessen the visual impact of a mined area.

In summary then, it seems that to adequately provide for the "preservation" values of the Kaitorete dunes, and to recognise that the Kaitorete dunes are a remnant of a once more widespread natural resource, either a large portion or portions, or preferably the whole dune complex, needs "preserving".

9.2 For Mining

Sand extraction from the Kaitorete dunes satisfies a demand from the Christchurch concrete block manufacturing industry. However, there are some areas of concern with the mining operation. These are:

(a) Virtual total removal of the foredune either directly, or indirectly by subsequent wave and wind action, and mining to depths below mean high water mark which singly or together could aid sea breaching of the weakened foredune.

(b) Removal of the dunes thus possibly upsetting the beach/dune sediment balance and hence increasing coastal erosion possibilities.

(c) Destruction of dune vegetation, although this can be overcome to some extent by attention to proper techniques for revegetation.

(d) Major alteration to dune complex/structure and a lowering of the dune complex height.

(e) Removal of a limited resource.

Present "low" extraction rates (see section 6.4) mean that each kilometre of dunes will yield approximately 30 years' supply of sand, if the extraction methods and dune sizes remain constant.

It is inconceivable, however, that mining be permitted to continue in its present form. If it continues a greater or complete foredune must be left intact and mining not allowed to a depth below mean high water mark. No mining should be allowed in those areas where the dune margins are subject to wave attack, so as to lessen the risks of increased coastal erosion. The dunes seaward of the two scientific reserves should also be left intact, as provided for in the draft management plans.

These four conditions impose considerable limitations on the area available for mining and affect the rate of dune modification.

The total dune complex is 24.2 kilometres in east-west extent (see Figure 8). Some 5.60 kilometres of dunes front the two reserves, and the whole dune complex (12 kilometres) west of and including part of the western reserve is subject to wave attack on the seaward margin. Of the balance area between the two reserves, approximately one-half has either very insignificant dunes, has only one dune ridge, or has only a low foredune and reardune with an intermediate deflation hollow. Mining of these latter areas would require large areas to be modified for a small return of sand.

On balance then, only approximately 3 kilometres of dunes are suitable/available for mining, and 1 kilometre of this having already been mined, leaves only 2 kilometres of dunes. At the 30 year per kilometre extraction rate mentioned above, one might expect this area to suffice for approximately 60 years.

However, even this may be optimistic - the 2 kilometres of dunes do decrease in height and extent as one goes eastwards. Also the conditions regarding foredune retention and depth of mining will mean less sand recovered per kilometre of dunes - possibly by as much as one-half. A sand mining lifespan of 30 years could then be a realistic figure.

The above figures are in parts estimates only, subject to the variations that all estimates can have. However, they do indicate one thing - that the dunes are a limited resource and that only by disregarding the dunes' natural, cultural, archaeological, recreational and coastal protection values, can sand mining be continued essentially forever. If the whole dune complex (24.2 kilometres of it) were made available for mining under present methods, one may get 700+ years of mining activity and that time period may be sufficient to allow dune regeneration. Recognition of other values cuts this time scale drastically.

1.3 Other Land Uses

The only other significant land uses are the activities of the New Zealand Army and the Labour Department explosives personnel.

The New Zealand Army's activities should have no direct effect on the dunes' values, as long as vehicles are not driven within the dunes complex. Indirect effects on wildlife and recreationalists from shell-fire noise can be minimised by careful selection of days and times of the year.

The Labour Department's activities occur on the beach in a tide wash area, with again no direct effect on the dunes' values. Indirect noise effects could again be minimised by careful selection of activity times.

Both the above activities are dependent on an area such as at Kaitorete and it seems that there is no reason why they could not continue, and in fact be compatible with "preservation" of the dunes' values. There may be a case, however, for concentrating both activities in one area, perhaps in conjunction with the mining area.

9.4 Legislative Requirements

The whole dune complex contains many archaeological sites, all of which are absolutely protected by the Historic Places Act 1954. The Historic Places Trust has the right to prevent site modification, or to seek justification from an applicant as to why the Trust should authorise site modification or destruction. At known site densities and a 30 year per kilometre mining rate (see section 9.2 above), one site would be destroyed every one to two years on average. Desirable mining conditions would increase the rate of dune modification and hence site destruction. If site modification were authorised, it would usually be after site investigations at the expense of the applicant.

The Town and Country Planning Act 1977 and its interpretation by the Planning Tribunal make it clear how coastal areas are to be treated. The "protection" offered by the Act must be reinforced in this case by the nationally important values of the area.

It is considered that mining should be subject to a conditional use application to the Wairewa County Council. This would allow submissions and objections to be made by the public and concerned organisations and allow debate over to what extent Section 3 of the Town and Country Planning Act 1977 should be adhered to.

The Reserves Act 1977 gives definite responsibilities to the Department of Lands and Survey as regards reserves and potential reserves. It is very clear from studying the values of the Kaitorete dunes and the purposes of the Reserves Act that the whole dune complex is worthy of reserve status - some areas as pristine "preservation" areas, and other areas more aligned to public use.

The Land Settlement Board as Crown land administrators under the Land Act 1948, have made their policy clear regarding the dunes - namely that the dunes are not pastoral/farming lands, that some dune areas are worthy of scientific reserve status and that the whole area should become a "foreshore reserve" (i.e. a reserve providing for public access/recreation).

Overall, the weight of legislative requirements lies heavily with "preservation". Considerable justification would be needed to counter this weight.

0. CONCLUSION

In view of the Kaitorete dunes' natural, cultural, archaeological, and recreational values, and the legislative responsibilities under the various Acts, it is considered that the present extent of reserved land is inadequate.

The whole Crown land dune complex is worthy of reserve status and as a minimum it is considered that all the dune complex west of the scientific reserve to the lake opening should be reserved.

It is also considered desirable to reserve the balance dune area.

If, however, the sand mining interests can justify continuation of their activity by providing evidence sufficient to override the consideration of the above-mentioned values and legislative responsibilities, then such activity be restricted to the dune area between the two present reserves.

Mining, if allowed to continue, should be subject to stringent conditions regarding protection of the foredune; depth of excavation; non-introduction of alien soil, debris and plant species; and mass revegetation of the mined area with plants naturally occurring in the dunes. It must be recognised that mining under such conditions is a very finite activity - perhaps not lasting more than 30 years.

Also, before any dune modification is allowed the approval of the Historic Places Trust must be sought, as should conditional use approval from the Wairewa County Council.

11. RECOMMENDATION

Seek to give the whole dune complex reserve status under the Reserves Act 1977.

(Significance and priority ratings under the Department of Lands and Survey's Coastal Reserves Survey classification would be national and high respectively.)

12. ACTION TO BE TAKEN BY THE DEPARTMENT

(a) Notify W.A. Habgood Ltd of the above recommendation and seek comments from same regarding contents of this report and any justification for continued mining.

(b) Evaluate comments of W.A. Habgoods (and others if necessary) and make appropriate recommendation to Minister of Lands.

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