

## Coastal dune biodiversity — challenges for management

### Philip Grove

Environment Canterbury  
PO Box 345, Christchurch, New Zealand  
philip.grove@ecan.govt.nz

### ABSTRACT

The natural character and physical form of Christchurch's coastal dune systems have been greatly changed since European settlement, with consequent loss of native biodiversity. Under the *Christchurch Beaches and Coastal Parks Management Plan*, management of the Christchurch coastline is the responsibility of the City's Parks and Waterways Unit<sup>1</sup> and managed under the 'Coast Care' programme.

One of the main objectives of the Parks and Waterways Unit's coastal management plan is to preserve, and where possible re-establish, the indigenous ecology of the Christchurch coastal environment, with an emphasis on indigenous wildlife habitats. The challenges to meeting this objective include the often-conflicting demands of urban development and public access for recreation.

This paper provides an overview of coastal dune biodiversity in Christchurch, looks at some of the opportunities for protecting and enhancing this biodiversity, and examines the challenges posed by people, their pets and their vehicles. The question is, to what extent are we, the public, prepared to change or constrain the way we access, use and manage coastal dune systems, so that there can still be a place for the original inhabitants, the native flora and fauna? The focus is on Christchurch, with brief reference to neighbouring coastal dune systems north and south of the City boundaries.

### BACKGROUND — THE SOFT SAND DUNE BEACHES OF PEGASUS BAY AND KAITORETE SPIT

Extensive soft sand dune systems occur on the Canterbury coastline at two distinct areas; north and south of Banks Peninsula at Pegasus Bay and Kaitorete Spit. Pegasus Bay, extending from Godley Head at the northern entrance of Lyttelton Harbour to Teviotdale, just north of the Waipara River, covers approximately 50 km of the North Canterbury coastline. Pegasus Bay is characterised by sandy beaches and associated dune systems for most of its length from Taylors Mistake in the south to approximately Leithfield in the north. North of Leithfield, beach sediments grade to mixed sand and gravel, and sand dunes are not present (Cope et al. 1998). The southern dune system is at Kaitorete Spit, and is located between Banks Peninsula and the Rakaia River, and separates

Te Waihora / Lake Ellesmere from the Pacific Ocean. The Spit, despite its official name, is actually a barrier as it is connected at both ends. It is approximately 27 km long and tapers from a width of 5 km at its eastern end to 250 m at its western end. An extensive sand dune system backs the beach for most of the length of the spit. West and south of Kaitorete Spit, there is a transition to the cobble beaches that characterise the mid- and South Canterbury coastline.

This paper focuses on the dune systems of the Christchurch City coastline, which occupy the southern half of Pegasus Bay from Taylors Mistake to the mouth of the Waimakariri River. Reference will also be made to the neighbouring

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<sup>1</sup> Editor's note: now known as the Greenspace Unit.

dune systems of north Pegasus Bay and Kaitorete Spit, with their contrasting patterns of vegetation and land use.

The Christchurch coastline has the most highly modified and actively managed dune systems of these three coastal areas. With the concentration of population in the adjoining city comes a concentration of associated environmental effects and development pressures. Along much of the Christchurch coastline, the width of the dune system has been constrained by urban development to a single artificially stabilised foredune, rather than the natural sequence of mobile foredune and more stable backdunes (Fig. 1). Management of the beach and dunes is the responsibility of the Christchurch City Council's (CCC) Parks and Waterways Unit. Under the Christchurch Beaches and Coastal Parks Management Plan (CCC 1995), present coastal management seeks to:

- Provide coastal protection, using the foredunes and beaches as a buffer between the sea and the urban areas and coastal parks. This can involve construction of sand fences, mechanical reshaping of dunes and the planting of exotic dune-stabilising species, principally marram grass (*Ammophila arenaria*) and South African iceplant (*Carpobrotus edulis*)
- Carry out planting of native coastal species
- Create/enhance habitat for native wildlife
- Provide recreation opportunities for city residents and visitors (CCC 2000).

These management aims are not always compatible and are listed in order of importance (CCC 2000). Thus management activities deemed necessary for coastal protection purposes will take precedence over those designed to enhance wildlife habitat or recreation opportunities. Public vehicle access to the Christchurch beaches is prohibited, except for the northernmost stretch of beach from Bottle Lake Forest Park to the Waimakariri River where a permit system operates. As there is heavy pedestrian use of the dunes and beaches, the Parks and Waterways Unit have been working to direct pedestrian traffic along

formed access tracks so as to minimise damage to the dunes and vegetation.

The coastal dune systems of North Pegasus Bay (i.e., north of the Waimakariri River mouth) are relatively undeveloped, in the sense that there is still for the most part a semi-natural foredune-backdunes sequence. However, like the Christchurch beaches, the North Pegasus Bay dunes are dominated by exotic plant species, principally marram grass and lupin shrubs (*Lupinus arboreus*). Farmland and plantation forests adjoin the North Pegasus Bay dunes, and there is localised spread of self-sown pines into the dune systems. A major and as yet unresolved issue for the North Pegasus Bay dunes is damage to the dune systems and disturbance of wildlife by recreational vehicles (Fig. 2).

The Kaitorete Spit dunes are for the most part reserve land managed by the Department of Conservation, although in places the dunes do extend back onto adjacent farmland. These dunes are unique in that they support what is probably the most extensive example of indigenous dune vegetation in New Zealand (Courtney 1983). The dominant species is the native sand-binding sedge pīngao (*Desmoschoenus spiralis*), with a range of associated native sand dune herb, grass and shrub species also present. Pīngao was once widespread on New Zealand's coastal dunes, but has now largely been replaced by introduced marram grass. Management issues for this nationally important conservation area are, again, damage by recreational vehicles, and the control of exotic plant and animal species.

#### **VEGETATION HISTORY OF THE CHRISTCHURCH COASTAL DUNES**

Vegetation cover and dune form has changed dramatically in the 150 years since European settlement. The earliest indications of historical vegetation cover are given by paintings, however it is unknown exactly what cover existed before European settlement. Botanical accounts from the late 19th and early 20th Century indicate that, as at Kaitorete today (Fig. 3), pīngao was the dominant species of the foredunes. The native sand-binding spinifex grass (*Spinifex*

*sericeus*) was also present on the Christchurch foredunes and is believed to have reached its natural southern limit here (CCC 2000). Pīngao-covered foredunes are characteristically wide and gently-sloping, with considerable areas of bare sand present around the pīngao plants. Backdune vegetation was apparently a mix of flax (*Phormium tenax*) in damp hollows surrounded by dense, low-statured mānuka (*Leptospermum scoparium*) scrub that also contained a good deal of matagouri (*Discaria toumatou*) (Fig. 4; CCC 2000).

Modification started at a very early stage of European settlement, as coastal areas were included in the early Canterbury sheep runs. A combination of grazing and burning would have affected palatable native spinifex and pīngao, while burning was used to clear mānuka scrub. By the late 1800s these practices had resulted in dune instability beyond the cycle of accretion and erosion that would normally occur. Large volumes of sand were blown inland over the developing city and farmland. The rapid destruction of pīngao dunes by fire and grazing resulted in a lowering and loss of dune form along much of southern Pegasus Bay. Without their stabilising vegetation, wandering dunes developed and migrated up to 4 km inland (CCC 2000).

Plantings of exotic marram and lupin for dune stabilisation began in the 1870s, accelerated over the 1890s, and has continued up to the present. In 1909, a City Council policy of afforestation was adopted in order to check the advance of the dunes. Before pines could be planted, dune stabilisation and higher soil nutrient levels were required. Primary plantings of marram and lupin achieved these aims. In little over 100 years, the natural coastal dune vegetation of pīngao and other plants has been progressively removed and replaced by exotics, principally marram and lupins (CCC 2000). The marram dunes of Christchurch and north Pegasus Bay are now steeper and more densely-vegetated than was the case when pīngao was the dominant cover. This change in vegetation cover and dune form (e.g., Clifton 1979) has had implications for the value of the dune systems as habitat for native wildlife.

A native dune vegetation planting programme has been in operation since the mid-1990s. An increasing number of pīngao plantings have been established on foredune sections of the Christchurch coast and spinifex has been successfully re-established at Taylors Mistake. However, restoration of the pīngao population is limited by the availability of nursery stock, browsing by rabbits, competition from marram grass and occasional disturbance of planting sites in storm events. Planting of native backdune species such as flax, ngaio (*Myoporum laetum*), taupata (*Coprosma repens*), cabbage trees (*Cordyline australis*) and akeake (*Dodonaea viscosa*) have to date proven more widely successful and sustainable. The Parks and Waterways Unit have developed planting techniques to help these species establish in the harsh Christchurch coastal environment.

Semi-natural dune systems on the Christchurch coastline persist at Brooklands Spit and Southshore Spit, where the dunes do not immediately adjoin developed urban areas. These sites still have considerable value as wildlife habitat. Exotic vegetation dominates at both sites, but there has been extensive native planting and habitat restoration carried out at Southshore Spit. The remaining dune systems of the Christchurch coastline are artificially constrained by urban development and because of this and high human use offer limited potential for wildlife, especially birds.

### **NATIVE WILDLIFE OF THE CHRISTCHURCH COASTAL DUNES**

#### **Invertebrates**

The katipō spider (*Latrodectus katipo*) is endemic to New Zealand coastal dunes and is present on the Christchurch coast (Fig. 5). Web sites are generally located at the base of marram grass or pīngao and under driftwood within a few hundred metres of the high tide mark. Research conducted at South Brighton beach in the 1960s found that katipō were most abundant in sparse to medium densities of marram grass on steeply sloping ground facing north to west, quite specific habitat requirements (CCC 2000). Over the last 10 years, katipō abundance has declined dramatically in many areas around New Zealand and the

Christchurch coast is no exception. An earlier 1969 survey recorded katipō spider densities as high as 1.1 spiders per square metre at South Brighton Beach. A similar survey of the area in the 1990s found only three spiders at South Brighton Beach. In the period between the two surveys, the sand dunes have been extensively modified by the Christchurch City Council for coastal protection purposes, with the installation of windbreak fencing, and the planting of sand-binding succulents. Recent research has shown that dune modification, in combination with the absence of driftwood and the increase of dense marram on the Canterbury coast is linked to low katipō numbers (CCC 2000).

Although there is little information on other indigenous coastal dune invertebrates, it is expected that the native planting on the back dunes should increase available habitat and food supply for these species.

### Lizards

At least one, and possibly two, species of native skink (*Oligosoma maccani* and *O. nigriplantare polychroma*) occur in the Christchurch coastal environment but identification is difficult. Skink populations probably increased in association with forest clearance and wetland drainage associated with the early development of Christchurch, but with ongoing urbanisation skink populations are again likely to be in decline.

Both common gecko (*Hoplodactylus maculatus*) and jewelled gecko (*Naultinus gemmeus*) were recorded from New Brighton before 1955. Neither species appears to be present in the area now, although both species are present on the Port Hills. Replanting of native species in the coastal zone is likely to enhance lizard habitat. Small-leaved shrubs such as *Coprosma* species, porcupine scrub (*Melicactus alpinus*), pōhuehue (*Muehlenbeckia complexa*) and flax all provide food for lizards. At the same time however, continuing urbanisation of rural land on the outskirts of the city is destroying lizard habitat (CCC 2000). Predators such as domestic cats take a heavy toll on lizards and without effective control will continue to limit numbers even where habitat protection or restoration takes place.

### Birds

Before European settlement the Christchurch coastal dunes hosted large breeding colonies of gulls and terns, as well as providing nesting sites for wading birds such as banded dotterel (*Charadrius bicinctus*) and variable oystercatcher (*Haematopus unicolor*; Fig. 6), and white-flipped penguins (*Eudyptula minor albosignata*). This is reflected in the Māori name for Southshore Spit — te karoro karoro — translated as ‘cry of seagulls’. For the most part, these breeding colonies disappeared within a few decades of European settlement. Disturbance of these ground-nesting birds by humans and dogs, reduction in habitat arising from the spread of exotic vegetation, and predation by introduced mammals were all causal factors. These factors have all worsened with increased population, easier access for vehicles, beach erosion and an almost total smothering of suitable nesting sites by vegetation.

At present, the south side of the Waimakariri River still remains an important roosting site for terns, gulls, cormorants and waders. In recent years there has been limited nesting of threatened banded dotterel above the high tide mark on Brooklands Spit (Fig. 7). However, the reappearance of nesting dotterel here remains tenuous because the area of suitable habitat is restricted to the narrow zone of bare sand and driftwood between the high tide mark and the toe of the marram-covered foredunes, and is vulnerable to passing vehicles. The tip of Southshore Spit is a nationally important roosting site for waders, cormorants, gulls and terns (Fig. 8) and often supports many thousands of birds. Some suitable nesting habitat does remain here but there has been no nesting since the 1960s due to constant disturbance by people and dogs.

The Christchurch coastline between Brookland and Southshore spits offers no nesting or roosting areas (lack of habitat and human disturbance) although birds will visit to feed on the sand flats at low tide and in the surf. The remnant dune systems at Sumner and Taylors Mistake beaches have similarly limited value as bird habitat.



## THE CHALLENGE

The challenge now for the managers of the Christchurch coastal dunes is how to more fully give effect to the objective of the coastal plan that calls for:

*'the preservation, and where possible re-establishment, of the indigenous ecology of the Christchurch coastal environment, with an emphasis on indigenous wildlife habitats'.*

Two sections of the Christchurch coastline offer the best potential for preservation and re-establishment of the indigenous ecology — the tip of Southshore Spit and Brooklands Spit. Because these sections of coast do not back onto developed urban areas or farmland, it is less imperative to manage the dunes primarily for coastal protection. The geography of both these coastal dune areas also suggests they could lend themselves to 'mainland island' type conservation management with an integrated programme of habitat restoration and intensive control of exotic pest species which could also involve the construction of predator-proof fences. Perhaps the best-known mainland island example within an urban area of New Zealand is the Karori Wildlife sanctuary in Wellington. Another example under development is Tawharanui Peninsula, managed by Auckland Regional Council, which includes areas of coastal dune habitat.

## SOUTHSHORE SPIT

The current spit shape is very different from its original surveyed boundary, indicating the highly mobile nature of this dune system at the mouth of the Avon-Heathcote Estuary. This mobility has precluded development; the area still supports a relatively natural dune system and is managed as a recreation reserve. Remnants of native vegetation in the dune hollows have been supplemented by extensive replanting of native foredune and backdune species. Wide sand flats are exposed on the beach at low tide but the area of backshore open sand is limited at high tide. Old photographs reveal that the backshore area was formerly quite extensive, nevertheless Southshore Spit still retains more sites of open or sparsely vegetated dunes

above the high tide mark than can be found elsewhere on the Christchurch coast.

The exotic shrub weed boneseed (*Chrysanthemoides monilifera*) is abundant at Southshore Spit forming dense patches in places. However, this infestation does not appear intractable and a programme of progressive eradication and replacement with native species should be attempted here.

As mentioned earlier, Southshore Spit is a nationally important bird roosting site and retains some suitable habitat for ground nesting birds. Progressive removal of marram grass and other weeds would improve the available nesting habitat, particularly if accompanied by control of mammalian predators. However, successful nesting will not occur while disturbance from people and dogs continues here, regardless of other efforts to enhance bird habitat. For the same reason, the area's full potential as roosting habitat cannot be realised. During a recent revision of City Council dog control policy and regulations, excluding dogs from Southshore Spit for purposes of wildlife protection was suggested. Such a change to current access regulations was strongly opposed in public submissions and has not gone ahead. This suggests that any restrictions on human access for the same reason would also be strongly opposed, although the idea has not been formally tested in the public arena.

Animal pests, including rabbits and predators such as cats, ferrets and rodents all threaten the Spit's indigenous biota. Southshore Spit supports a large rabbit population that takes a particularly heavy toll on pīngao plantings. Rabbit poisoning has been carried out in the past, but there is reinvasion from the adjacent beach area and private properties. Poisoning of rabbits and predators here remains problematic because of the risk to children and dogs visiting the reserve (CCC 2000).

Southshore Spit has massive potential for enhancement and restoration of Christchurch's coastal dune biodiversity, but this potential is limited by the apparent unwillingness

of the public to alter a tradition of largely unrestricted access for themselves and their pets. Effective pest control is also limited by the present access regime and public attitudes to poisoning and trapping. At Southshore Spit, the principal challenge for management is to sell the concept of a coastal dune mainland island within the Christchurch urban area to the public and politicians.

### **BROOKLANDS SPIT**

Brooklands Spit, the northernmost section of the Christchurch City coastline, is isolated from urban and farm land by public land at Bottle Lake Forest Park and Spenser Park Beach, as well as Brooklands Lagoon. The spit is vested in the Canterbury Regional Council, reflecting past river works by the old Catchment Board. However, most beach management is by Christchurch City in association with management of Spenser Park and Bottle Lake beaches. The spit separates the sea from Brooklands Lagoon. The importance of this estuarine area for Christchurch's wildlife is second only to the Avon-Heathcote Estuary.

The spit's isolation means it has relatively low levels of human use. Approved vehicles are allowed to drive along this section of beach seaward of the dunes, under a permit system. Almost all traffic along the beach is to access the south side of the Waimakariri River mouth for fishing. Brookland Spit dune vegetation is now dominated by exotic plant species — dense marram grassland with scattered lupins, and pine trees — and as such is not suitable habitat for native dune wildlife. No native planting has been carried out here. Extensive tracts of indigenous wetland vegetation occur along the inland (lagoon) edge of the spit, however.

At times flocks of terns, gulls, waders and cormorants will roost on the open sand flats near the mouth of the Waimakariri River but, as at Southshore, these roosting colonies are continually disturbed by people, dogs and vehicles. In recent years, several pairs of banded dotterel have nested along Brooklands Spit in the narrow strip of suitable habitat between the high tide mark and the dunes. The dotterel are probably able to nest here

because there is considerably less pedestrian traffic than elsewhere on the Christchurch coast. However, the dotterel eggs and chicks are highly vulnerable to passing vehicles. Signs have been erected advising the public of the presence of nesting dotterel and with markers directing traffic away from nests during the season.

A comprehensive habitat restoration programme is necessary to re-establish the indigenous coastal dune ecology of Brooklands Spit. This will necessitate the progressive removal of exotic marram, lupins and pines, and their replacement with more open native vegetation (pīngao and associated species) that can still effectively bind the sand dunes. The re-establishment of this native dune vegetation will greatly increase the nesting habitat for dotterels and other bird species such as white-fronted terns, Caspian terns, variable oystercatcher, white-flipped penguins (could also use nesting boxes) and black-billed gulls that previously nested on the Christchurch coastal dunes. Intensive predator trapping and pest control will need to be part of the programme; erecting a fence at the southern end of the Spit may well be the most effective means of achieving sustained control. The geography of Brooklands Spit is favourable for integrated pest management while the area's isolation lessens the problems associated with pest control on Southshore Spit.

Better management of people, dogs and vehicles will also be required. Changes to the access policy such as no dogs and, for permitted vehicles, to travel only below the high tide mark could be made conditions of entry. A restored indigenous dune system at Brooklands Spit would form a natural ecological sequence with other valuable areas of native habitat, Brooklands Lagoon and the Waimakariri River, on the northern boundary of Christchurch City. The management challenge here is twofold: first, as at Southshore, gaining public support for restrictions on public access in order to better protect wildlife; second, to obtain resourcing for a comprehensive programme of habitat restoration and pest control.

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**Fig. 1** Dune system adjoining the Christchurch urban area managed primarily for coastal protection. Note the constrained width of the dune, the sand-trap fences and planting for dune stabilisation. (Photo: B. Young).



**Fig. 2** Steep-sided, densely-vegetated marram dunes typical of northern Christchurch beaches and north Pegasus Bay. Any native bird nesting is confined to the narrow zone of open sand between the high tide flotsam and base of the foredunes, where nests are vulnerable to passing vehicles. (Photo: B. Young).



**Fig. 3** Pīngao dunes at Kaitorete Spit. Pīngao was previously the dominant foredune species at Christchurch and north Pegasus Bay. The dune form is typically lower and wider than is the case for marram dunes. There also remain extensive areas of bare sand between the pīngao clumps, where native birds can nest. (Photo: B. Young).





**Fig. 4** Dense low-statured mānuka and harakeke/flax scrub vegetation was widespread across the Christchurch coast backdunes before European settlement. None exists here today; this example is from Farewell Spit, at the north-west tip of the South Island. (Photo: A. Crossland).



**Fig. 5** Katipō spider, endemic to New Zealand coastal dunes and previously abundant on the Christchurch beaches. A documented massive population decline on the Christchurch coast is attributed to habitat loss/modification. (Photo: J. Griffiths).



**Fig. 6** Variable oystercatchers have begun nesting again in north Pegasus Bay in recent years. They could also return to the Christchurch coast given some habitat restoration and protection from human disturbance. (Photo: A. Crossland).



**Fig. 7** Banded dotterel, a threatened species, have recently begun nesting on Brooklands Spit. (Photo: A. Crossland).



**Fig. 8** White-fronted terns roosting at Southshore Spit. These and other species of gull, tern and wading birds used to nest on the Christchurch coast in large numbers. (Photo: A. Crossland).