

The impact of Marram grass on indigenous dune flora at Mason Bay, Stewart Island

Marram grass (*Ammophila arenaria*) has been used throughout New Zealand to stabilise active dune systems. Unfortunately it is now naturalised and has spread far beyond the initial plantings to such remote coasts as Fiordland and Stewart Island. The ecological cost of the spread of marram grass has been significant. This article addresses the impact of this species on the ecology and geomorphology of the active dune systems of Mason Bay, Stewart Island.

Mason Bay is a 13 km long bay, on the west coast of Stewart Island, which contains extensive transgressive dune systems that reach 3 km inland in places. Parabolic dune forms predominate. Marram grass was planted at Kilbride, at the southern end of Mason Bay, in the 1930's by the pastoral leaseholder to stabilise the dunes. The species subsequently spread rapidly northwards through phalanx (steady creep) and guerrilla (jump) invasion. In a recent study Anne Jul estimated that the cover of marram grass in the central Mason Bay dunes, between Duck and Martins Creek, increased by over 5000% in the 40-year period 1958-1998. Fortunately, marram grass has not yet reached the northern most dunes, so there is scope for comparing the indigenous species diversity in dunes with and without marram grass.

Four dune plant assemblages are identified in Mason Bay. These communities are characterised by the dominant sand-binding species, substrate stability, the amount of cover provided by sand coprosma (*Coprosma acerosa*), the amount of cover provided by marram grass or pingao (sand-trappers) and species diversity. The characteristic features of the plant assemblages are: (1) Sites with dense marram grass cover with few other species present and a large proportion of bare sand. Pingao is rare. These sample sites include



Figure 1: Shrub dune ecotone on the northern side of the transgressive dune field at Mason Bay



Figure 2: The extensive dune system at Mason Bay reaches up to 3km inland

the stoss (seaward) face of the foredune and active depositional lobes and deflation zones of transgressive parabolic dunes. (2) Sites dominated by marram grass and sand coprosma (*Coprosma acerosa*). Pingao is rare, but there are a large number of indigenous specialist dune species present. There is little bare sand cover because of the high total vegetation cover. These sites, which occur on relatively stable dunes, have contained marram grass for a long time (years to decades). (3) Foredune sites and parabolic dunes within a few hundred meters of the coast that possess extensive colonies of pingao. Few other plant species are present. Large areas of bare sand are present. This assemblage occurs in the northern most dunes where marram grass is largely absent. (4) Less disturbed sites in the northern dunes that contain pingao, as well as a large number of other indigenous dune species. The total vegetation cover is high.

The introduction of marram grass has caused a drastic decline in the distribution of a number of indigenous dune species within Mason Bay. Species associated with foredunes and adjacent environments have been the worst affected. Three-quarters of the foredune species noted by Leonard Cockayne in 1908 have disappeared. Sand tussock, *Euphorbia glauca* and pingao appear to be the plant species most effected by the competitive ability of marram at least in the short term (years). The cause of *Euphorbia* decline could be mammalian grazing or changes by marram to the sand budget resulting in burial.

It is likely that the changes in the morphology of the dunes at Mason Bay over the last 40 years appear to be, at least in part, in response to the change in the dominant vegetation cover.

Marram grass invasion has altered the morphology of foredunes and adjacent parabolic

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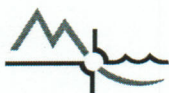


Figure 3: Photograph of stable pingao-dominant plant community at Mason Bay

dunes established in conjunction with pingao. Leonard Cockayne visited Mason Bay in 1908 and his observations of dune flora and morphology, published in 1909, provide a valuable record of the pre-Marram landscape. Cockayne described the morphology of the foredunes at Mason Bay in 1908 as:

"a low line of hay-cock-like dunes ... 6-10 ft tall ... These foremost dunes are quite brown with the pingao, so that the sand is barely seen."

These small shadow and coppice dunes, interspersed with deflation zones, formed in conjunction with pingao and sand tussock. Over the last 40 years or so this landscape has been replaced by a continuous shore-parallel ridge, up to 20 m tall and 200 m wide. Marram grass dominates this massive foredune complex. Pingao is absent from the stoss face of the foredune and it is rare on the leeward slope. This new landform associated with marram grass has trapped a large volume of sand that might otherwise have been transported into and within the hinterland active dune system.

Further to the north, where pingao predominates, the inland movement of sand through the foredunes is less restricted. A reduction in the quantity of sand moving through the foredunes following marram grass invasion may decrease the competitiveness of many specialist dune species. These species will be displaced by wetland and forest species as rates of sedimentation and area of active dune habitat decline. Jul et al. (1998) have described an increase in the number and total area of deflation zones in the dune system since marram grass invasion and foredune complex formation. There has been an increase in wetland habitat characterised by the jointed wire-rush (*Leptocarpus similis*). It is not known what influence marram has had on the wetland development. These habitats are also favoured by many of the introduced pasture

species and indigenous shrub species due to high levels of available moisture. The addition of nitrogen from clover and lupin species is also likely to accelerate dune succession. Thus the impact of marram grass invasion in Mason Bay has been found to extend well inland.

It would also appear that the development of a massive foredune complex associated with the marram grass has affected the development of hinterland dune forms. The deflation zones and trailing arms of hinterland parabolic dune may have eroded at a greater rate following the formation of the foredune complex. We would expect that over time the formation of parabolic dunes, from dune blowouts, may become less frequent as a consequence of marram grass invasion and the development of a stable foredune. The construction of the foredune complex will probably allow the current parabolic dunes to continue to develop and migrate inland with a lower risk of secondary disturbance.

In general, marram grass covered dunes are probably less susceptible to those environmental perturbations that give rise to large scale transgressive dunefield development. The west coast of Stewart Island has experienced repeated episodes of dune system development, followed by stabilisation and re-vegetation. Marram grass has clearly had a significant impact on dune form, dune landscapes and vegetation cover at Mason Bay. But it may have a long-term impact if this species stabilises an otherwise semi-mobile dune system and prevents or inhibits the future development of such active dune systems. This process would result in a serious loss of habitat for a range of plant and animal species associated with active dune habitats.

In conclusion, marram grass is displacing a range of indigenous dune species at Mason Bay, particularly those that occurred across the former pingao-dominated foredunes, and poses a significant threat to the remaining unmodified indigenous dune communities at Mason Bay. Marram grass is also changing the dune form and will inhibit future development of active dune systems. The protection of these dune systems is necessary and a worthwhile investment in the plant ecology of New Zealand. The Department of Conservation along with the Department of Geography, University of Otago, initiated a marram grass control programme at this site last summer.

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