The Shifting Sands of The Manawatu

Lynn Holland, a coastal researcher for the Manawatu Catchment Board, rubbed the sand out of her eyes long enough to write the story below on the inland rates of sand movement on the Manawatu coastline.

Although Coastal hazards may take several forms, shoreline erosion or retreat is the most widely researched and publicised. Considerably less attention is paid to the effects of inland sand transportation, although the associated problems can be as hazardous for man's landuse as shoreline erosion.

Rates of sand loss inland depend upon the sand supply, foredune condition, state of dune vegetation and wind conditions. Any disruption of the sand-binding vegetation cover enables onshore winds to erode the sand dunes and create wind channels. In these channels, the wind increases both its velocity and its ability to transport sand. These breaches of the foredune form U-shaped dune features or 'blow-outs' and are responsible for the transportation of large amounts of sand inland, depleting the coastal sediment budget.

Examples of the blow outs are found scattered along the southern half of the North Island's west coast, particularly between the Waikanae and Rangitikei Rivers.

The majority of the coastline is prograding at a steady rate with an abundance of sand being supplied by longshore drift from the major rivers in the north. However, sections of coastline fluctuate considerably in the short-term and, south of Paraparaumu, there exists a long-term trend of erosion. Here, the foredune complex is unstable with two types of dune occurring.

The first is the breached dune with the already-mentioned blow-outs. These range from 5 to 10 metres in height at the lateral edges, usually encompassing a sand flat and may extend a tongue of sand several hundred metres inland from the coast.

Secondly, parabolic dunes are present and aligned at an angle to the coastline, oriented towards the predominant wind direction — northwest — southeast. These dunes occur when vegetation stabilises the

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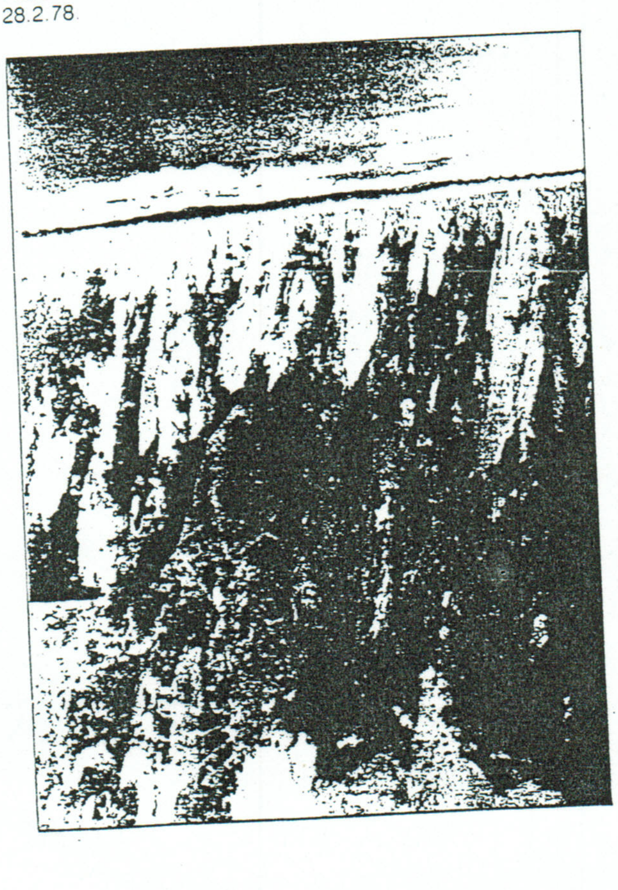
lateral edges of the dune allowing the main body of sand to move inland. The edges of the dune may separate from the foredune and join with adjacent parabolic dunes to form a rear dune. If unvegetated, this dune will continue to drift inland.

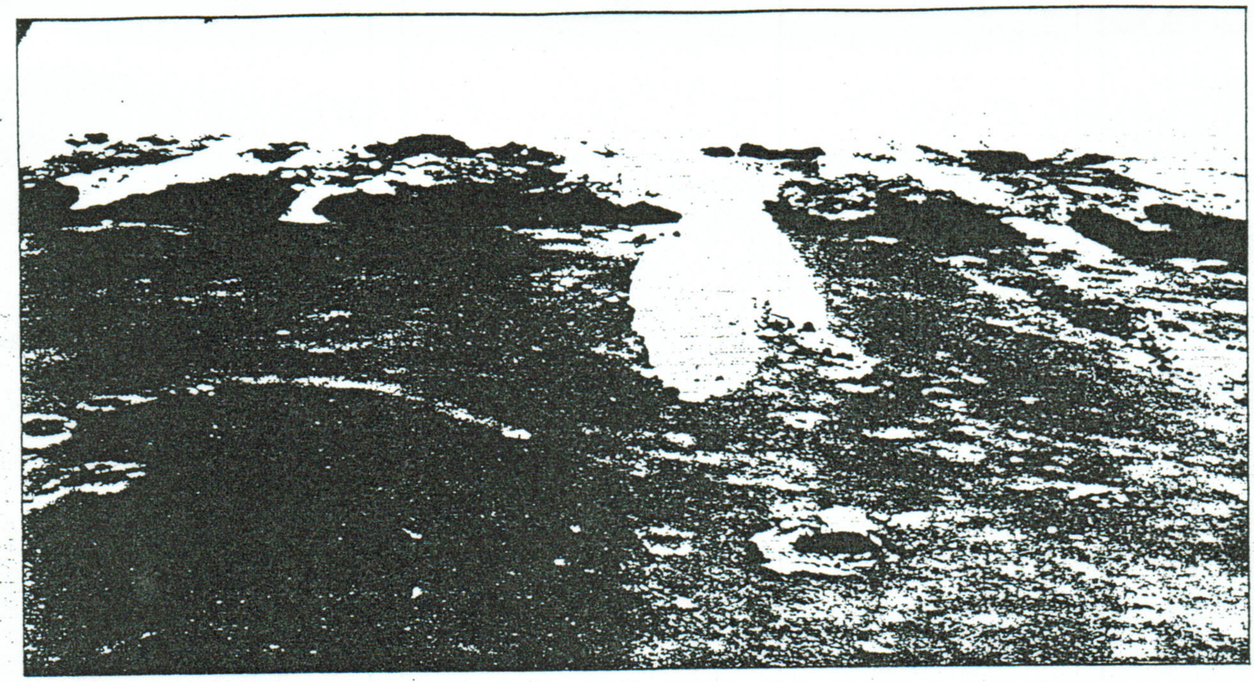
Sand transports from the foredune on to inland sand drifts, and contributes to sand erosion problems, for example: sand migrating onto pasture: blocking drains: engulfing areas of forestry: and threatening settlements. It is well known that coastal stability is delicately balanced and easily disrupted, leading to problems both often difficult and expensive to remedy.

The results of inland sand movement on the Manawatu coastline are no exception. Although the locality is not intensively developed major changes have taken place since the arrival of man. Historical accounts outline a predominantly stable coastal environment at the time of European settlement (Wilson 1959). Wandering dunes did occur but these were considered the exception and eventually 'blew-out' before being stabilised with sand-binding vegetation.

Early this century, stock were introduced onto the foredune dramatically altering the vegetation cover. Spinifex, the dominant native sand-binding species, is palatable to stock and was, at one stage, completely eaten out. The decline in protective vegetation enabled the wind to increase sand transportation and start many blow-outs and sand drifts moving inland.

FIGURE 1: Coastline between Manawatu & Rangitikei Rivers 28.2.78.





Neglected foredunes

Dune vegetation replacement — using both spinifex and marram — was subsequently carried out by local farmers to stabilise the foredune and stop sand drifting onto pasture. However, for economic reasons their efforts were concentrated on the inland sand drifts, leaving the neglected foredune in a very unstable condition. Sand loss through foredune blow-outs continues and represents a sizeable loss from the coastal sediment budget, reducing the amount of sand transported to the southern coastline.

Rates of sand movement have been documented from air photo records and ground surveys. Figure 1, photographed 28.2.78, illustrates a typical section of coastline between Foxton and Himatangi. It is characterised by numerous blow-outs. The belt of pine trees separating pasture from unstable foredunes was planted in 1966. Several foredune blow-outs have subsequently extended inland and overtopped the protective belt of trees. The blow-outs usually have steep sides encasing a sand flat where the bulk of the sand supplied from the foredune has moved inland. Once the sand reaches flat land, the transportation rates increase markedly.

FIGURE 3: The blow-out extending over a kilometre inland 28.2.83

FIGURE 2: Foredune blow-out extending a tongue of sand inland overtopping protective belt of pine trees and [illegible] pasture 30 [illegible]

The photos in figures 1, 2, 3 and 4 illustrate the highly mobile nature of the sand country.

Rates of sand movement in one blow-out have been estimated for the period 1978 to 1983. In February 1978, the blow-out was 20m seaward of the protective belt of pine trees. A year later, in April 1979, sand had reached the belt of trees and, by November, sand had progressed 20m onto pasture. Twenty-two months later in October 1981, the sand had jumped 350m inland of the protective belt of trees. By September 1982, the sand limits had travelled a further 40m inland in eleven months.

At this stage, the tongue of sand extending from the blow-out had an average width of 60m for most of its length and increased in depth towards the source of sand supply. The sand depth ranged from a thin veneer at the outer limits, to 1m on average in the centre. An

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incipient embryo dune was beginning to form at the seaward edge of the blow-out as sand accumulated around driftwood on the beach. This foredune replacement will reduce the supply through the blow-out to the inland drift. Three months later, December 1982, the sand in the blow-out had travelled a further 60m inland, and by March 1983, the sand extent had reached 750m inland of the pine trees, covering 300m in three months. The sand level of the tongue of the blow-out dropped during this period, indicating that the increase in blow-out extent was fed by sand already in the tongue.

These results show the highly variable nature of sand movement in the blow-outs. and the high rates of movement that can be achieved under consistently strong onshore winds. Measurements of sand movement in neighbouring blowouts range from 1-200m per annum. suggesting that the blow-out studied behaved in a typical way up until the last six months. With the previously dry winter conditions and the extended season of strong northwesterly winds. sand movement was then able to increasse rapidly. averaging 100m per month

Over the last few months (March to July 1983) calmer weather has been experienced resulting in a thin veneer of sand extending a further 50m from the blow. The tongue of the sand blow is now almost depleted to the humus layer with the 'A' horison visible in places. These areas are below the elevation of surrounding pasture.

Forests

The net result of the sand movement inland is loss of productive land and a very unstable foredune system. This contrasts sharply with the forested sections of coastline south of the Manawatu River. Where forests have been planted the inland penetration of sand is prevented. resulting in greater rates of foredunes at the forested localities are well maintained with less disturbance from wandering stock and human activities. Blow-outs are remedied with fencing and planting of marram grass. The results are striking. with higher rates of progradation occuring along the forested coastline. This is illustrated by the growth of 'embryo' dunes seaward of the main foredune.

Along the non-forested sections of the coastline. local farmers. with the advice and subsidy assistance of the local Catchment Board. combat the inland sand drifts. Marram planting is initially carried out as a primary stabiliser and results improve significantly with nitrogen fertilisation. Yellow lupin is sown as a secondary stabiliser and. by fixing nitrogen. will promote marram grass and later tree or grass growth.

Other methods used to treat inland sand drifts include blue lupin and thatching or fascining. Blue lupin is drilled into bare sand during Autumn or early spring and. in some cases. the dunes can then be planted in pinus radiata or pasture the following year. This method involves precise timing of operations and some luck but. if successful. can reduce sand stabilisation costs by two thirds compared with marram planting. For small areas of bare sand. thatching with straw or cut sand rushes under-sown with a pasture and/or yellow lupin mixture has been very successful. The material is teased evenly over the area to be treated. and does not need to be secured to the ground.

Once the sand movement has been halted and the area stabilised with the nitrofying plants. the 'A' soil horizon will develop rapidly. Approximately 2cm of humus layer can be achieved in a few years if the lupin is not grazed. The stabilised area can then be developed for the appropriate landuse. pasture or forestry.

However. the "answer" to the sand stability problems is ultimately found on the coast. Maintaining a stable. well vegetated foredune in good condition and backed with a protective belt of trees. will prevent sand movement inland and avert the need for remedial action on the farmland.

FIGURE 4: Coastline between Manawatu & Rangitikei River 28.2.83.