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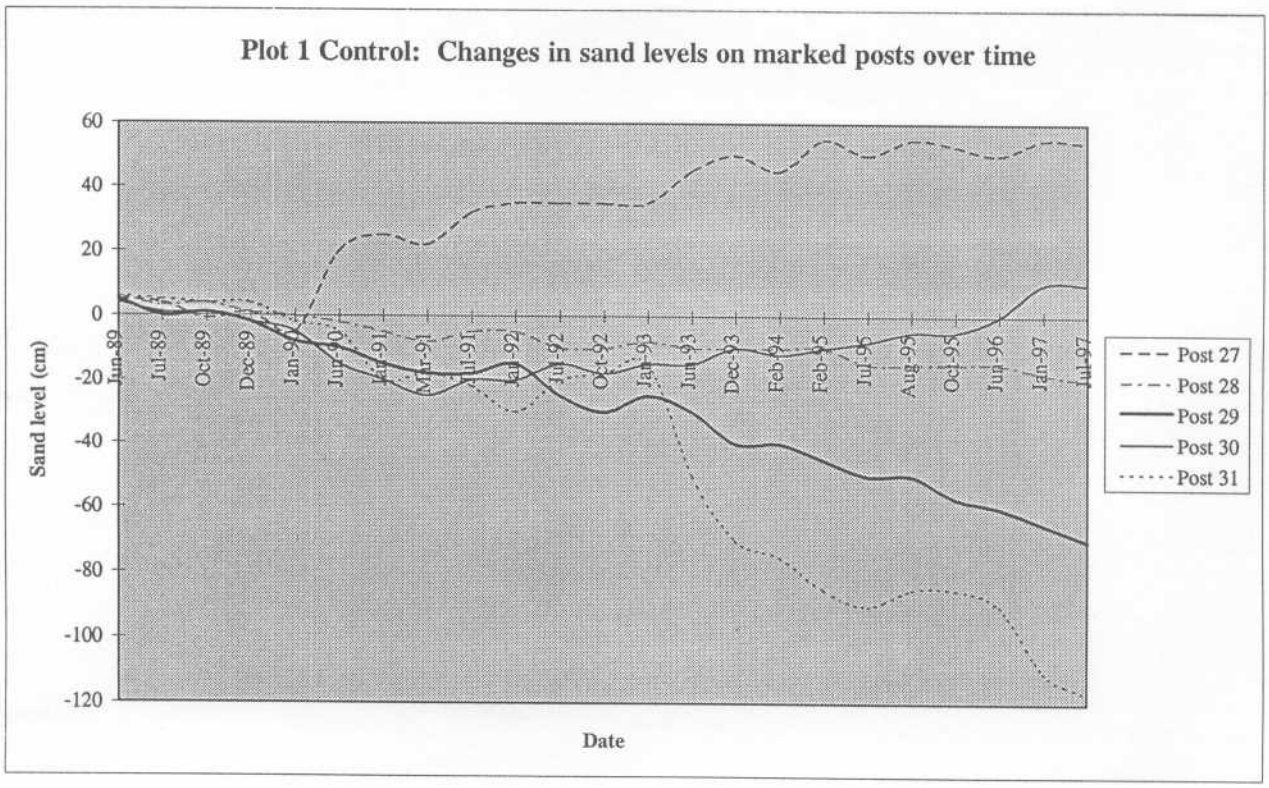

Figure 18. Changes in sand levels over time in the control, Plot 1.

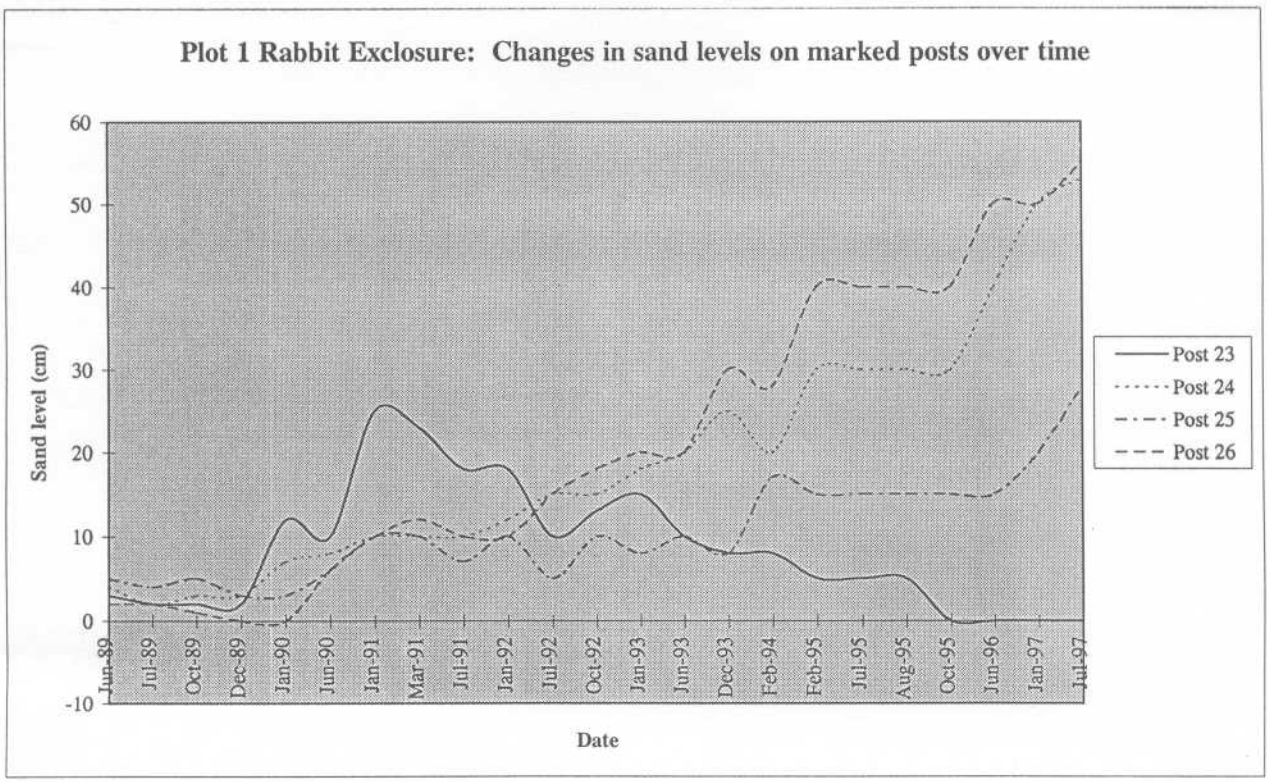

Figure 19. Changes in sand levels over time in the rabbit exclosure, Plot 1.

With the exception of taullinu and knobby clubrush, both at home on the more stable rear dunes and quite long-lived, these plants were transient. They would appear, last for weeks or months on a site, then disappear. They were usually defeated by being inundated or undermined by blown sand, sometimes by seasonal drought and occasionally by rabbits. The annuals and biennials came and went according to their allotted life spans. Most prominent among these was King Island melilot *(Melilotus indicus),* a lush leguminous annual herb that suddenly burgeoned on the dunes in the latter years of the study.

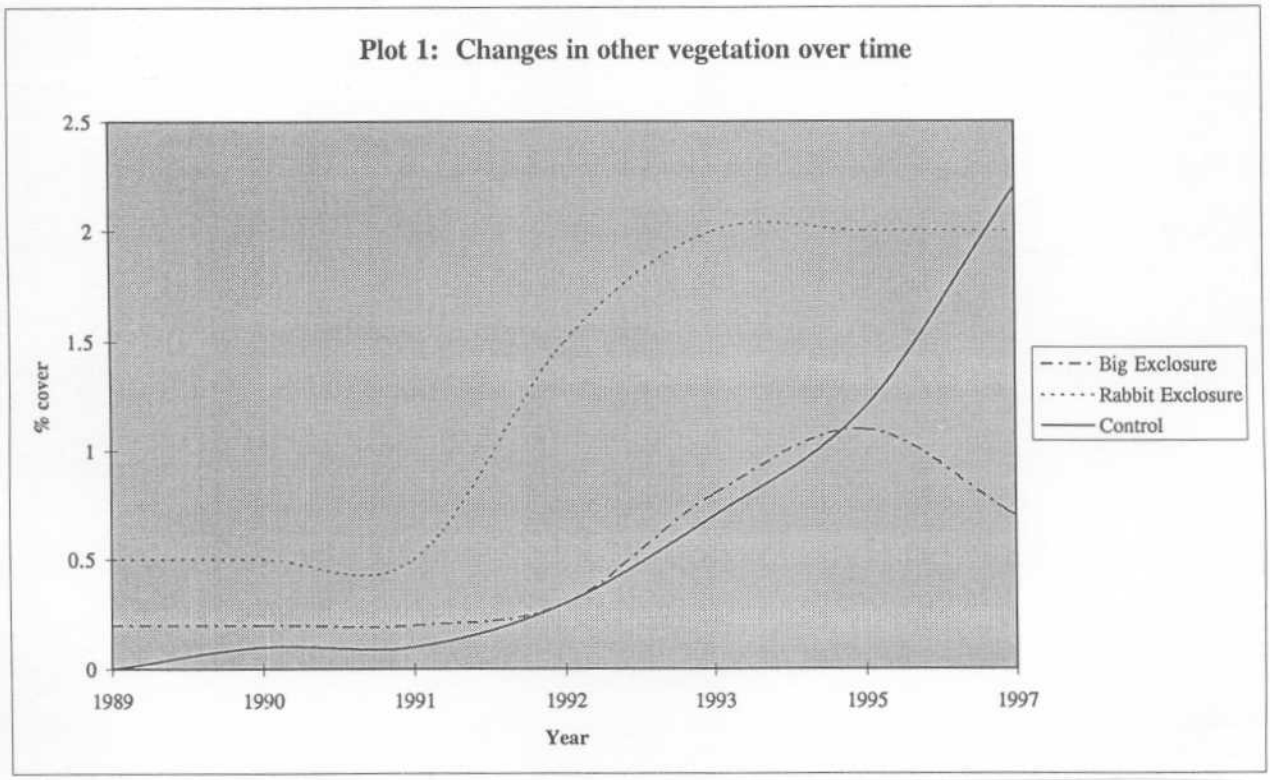

Figure 15. Changes in other vegetation over time in Plot 1.

Figure 15 shows that in all three monitored situations in Plot 1 the total amount of other vegetation increased substantially over time. Within the big exclosure there was a decline latterly and within the rabbit exclosure a levelling-off. Within the control, however, the percentage cover kept rising rapidly. I think the explanation lies in a combination of browsing, particularly by rabbits, and of gradually increasing stabilisation of this part of the dune system by vegetation, led by marram grass. The rabbits held the vegetation back somewhat, whilst the marram increasingly squeezed it, especially within the exclosures.

4.1.8 Sand levels

Figures 16-19 illustrate the trends of the levels of sand on marked posts in Plot 1. In Figure 16 all data for each of the study situations is averaged. What is indicated is a slight sand build-up within the big exclosure (an average of 60 cm over eight years), although the fluctuations were marked,a steady build-up (over 120 cm) within the rabbit exclosure, and a steady deflation (170 cm) within the control.

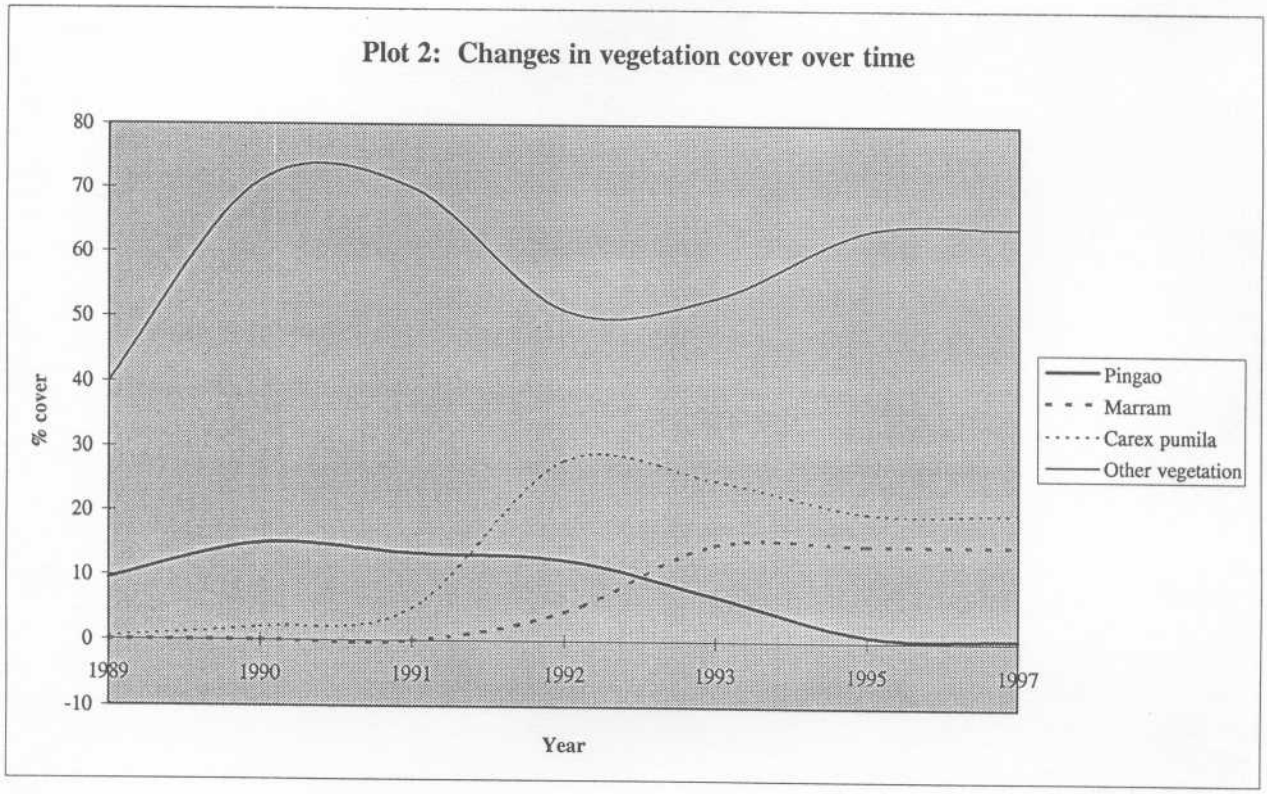

Figure 20. Changes in vegetation cover over time, Plot 2.

Prior to the beginning of the study the dunes were used to winter farm stock, especially cattle, and there were many feral goats around. These animals between them kept the more edible vegetation on the dunes down, diminishing competition for the less palatable pingao and permitting plenty of sand movement. By the time the study had begun, Haupouri Station had lessened its use of the dunes by stock (partly as a result of my interest) and the goats had been removed. That allowed the initial burst of growth in the pingao, unfettered by browse and competition. From then on, though, other vegetation proliferated on the site and the pingao simply couldn't stand the competition for moisture, nutrients and space. Substrate conditions could have been changed by the vegetation build-up as well, allowing the pingao to be exposed to soil pathogens it wasn't accustomed to. The occasional spell of browsing and trampling by cattle didn't help either, and a destructive bout in 1991 may have helped precipitate the decline, but it was the other vegetation that was the ultimate cause of the demise of the pingao on this site.

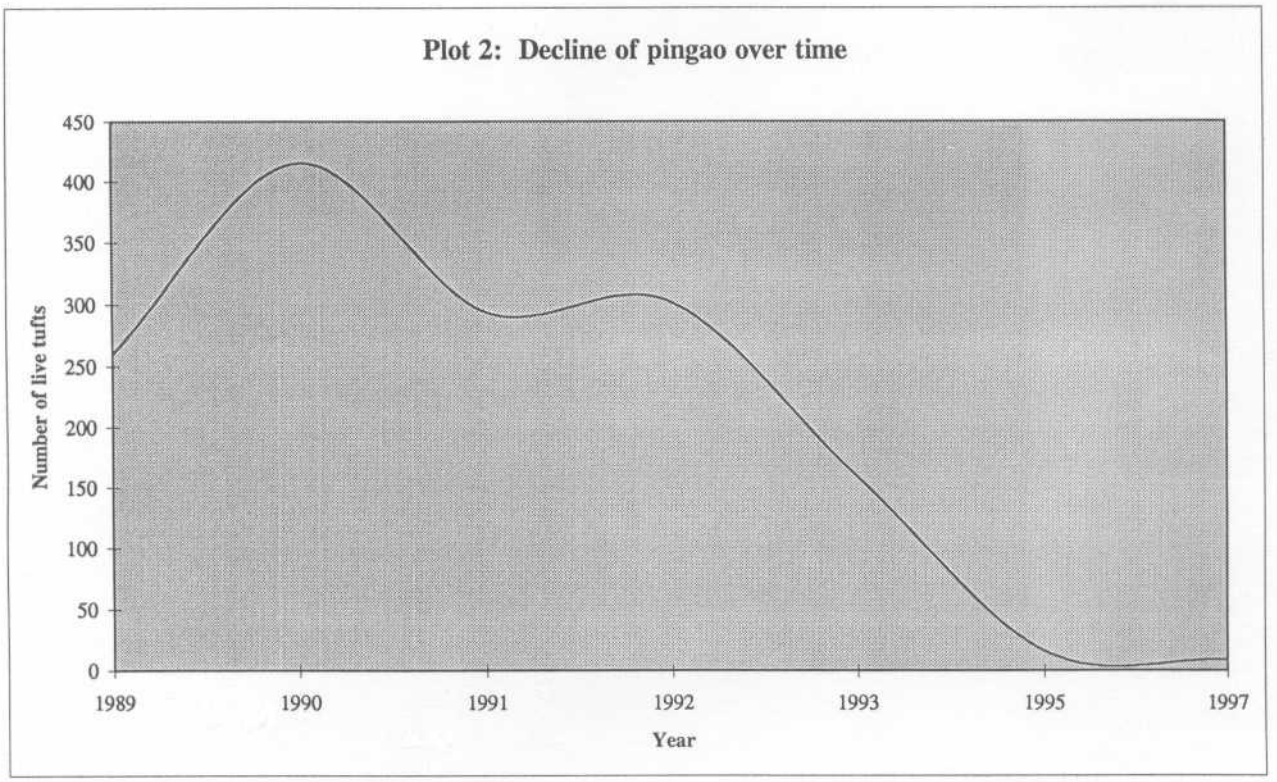

Figure 21. Decline of pingao over time, Plot 2.

The other vegetation consisted of marram grass, *Carex pumila,* hare's tail, knobby clubrush, shore bindweed and a plethora of pasture grasses and herbs. Although the marram invaded the plot during the study, by the time it did so the pingao was already on its way out, so it can't take all the blame. *Carex pumila* proliferated after 1991, probably as a result of lessened browsing, and undoubtedly helped contribute to the competition for the pingao. Its own subsequent decline suggests that it, too, suffered from competition. That competition came from the hare's tail, pasture grasses, rosette plants and leguminous herbs that burgeoned on the site in 1990-91, got knocked back by sheep in 1992-93 and built up again. Knobby clubrush and shore bindweed appeared to be incidental players in the bigger drama.

4.3 PLOT 3

Plot 3 was another little plot, a five metre wide strip of foredune. I set it up to observe the interplay of pingao and spinifex right where they met the sea.

Figure 22 shows that all vegetation in the plot expanded during the study, but the expansion was not linear. Pingao increased steadily until 1995 by seaward expansion, but was knocked back by stormy seas in 1997 that chopped off its seaward runners (Figure 37). The same happened to spinifex, twice: because it extended further seawards earlier than the pingao it was also chopped off in 1992. The other vegetation, made up of small amounts of knobby clubrush, hare's tail, various pasture grasses, rosette plants, sea rocket *(Cakile maritima)* and King Island melilot, waxed and waned largely independent of the wave effect. Fluctuation in the amount of the melilot accounted for most of the change.

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