ESTABLISHMENT OF SPINIFEX FERTILISER TRIALS, MATARANGI BEACH AND WHIRITOA BEACH, COROMANDEL

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INTRODUCTION

Localised erosion of sand dunes is a recurring problem along many parts of the coastline throughout New Zealand. These problem erosion areas can take the form of blow outs on exposed foredunes, breaches of sand spits due to changes in estuary channels, or heavy seas during occasional storms reducing the sand dune buffer along beaches threatening roads and property along foredunes. Another aspect of concern is rehabilitation of coastal sand mining sites where previous sand dune vegetation has been removed.

Of the indigenous sand binding plants, spinifex (*Spinifex sericeus*) has the best potential for rapid establishment of problem erosion sites in dunelands. It is able to trap sand and build low angle foredunes along exposed coastlines. Its open habit allows establishment of other indigenous species including pingao (*Desmoschoenus spiralis*). Despite its potential, spinifex has not been used extensively in New Zealand for revegetation of dunelands.

The same species of spinifex is also native to Australia where it has been used extensively in large scale rehabilitation of sand dunes. A review of the use of spinifex in both countries (Bergin & Shaw 1991) concluded that for New Zealand, revegetation of dunelands using spinifex is a feasible option for many disturbed sites but comprehensive planting and fertiliser trials were required to determine appropriate techniques and treatments. Sand dune research stations and rehabilitation programmes in New South Wales and Queensland were inspected in June 1993 (Bergin 1993). A highly successful method of extending spinifex in Australia was by top dressing existing stands with high rates of fast release N fertiliser. A comprehensive fertiliser trial was therefore considered essential to determine whether successful treatments used Australia can be used on New Zealand beaches.

A pilot fertiliser trial was established at Maketu, Bay of Plenty, in 1992, and indicated that spinifex seedlings respond favourably to application of fertilisers. However, slow release fertiliser applied to runners of natural plants on the same site did not significantly improve growth compared to unfertilised runners. The current fertiliser trials will test the

response of natural stands of spinifex to a range of fertiliser treatments including fast-release high N fertilisers. These trials are partially funded by the Department of Conservation.

TRIAL SITES

With the assistance of Environment Waikato, two east coast Coromandel beaches were selected for the spinifex fertiliser trials: Matarangi Beach 15 km north of Whitianga, and Whiritoa Beach 15 km north of Waihi.

Matarangi Beach is a 4 km long sand spit with a flat beach and dune system. The fertiliser trial is located 20 m east of a board walk adjacent to the Matarangi golf links toward the western end of the spit (Fig. 1). The 30 m wide dune is dominated by spinifex with sand convolvulus (*Calystegia soldanella*), and a range of adventive species.

Whiritoa Beach is approximately 2 km long consisting of a steep beach and foredune. The fertiliser trial was sited about 150 m north of the Surf Club (Fig. 2). A light cover of spinifex and sand convolvulus forms a band about 15 m wide over the foredune from high water mark to the rear of the dune where it merges abruptly into a dense cover of *Muehlenbeckia complexa.*

TRIAL TREATMENTS

A range of fertiliser types, rates and application times are tested at each site. Treatments were selected on the basis of recommendations from Australian research and operational programmes (Bergin 1993) as well as earlier trials and standard fertiliser applications made by sand dune forest managers in New Zealand. Nitram (Ammonium nitrate - 34% N), a quick release fertiliser used in Queensland, was imported by Environment Waikato and this is being compared with Urea (46% N) which is widely used to maintain marram (*Ammophila arenaria*) on dunes on several of New Zealand's west coast North Island beaches. DAP (di-ammonium phosphate - 18% N) was also included as a treatment on the Matarangi site only.

A full range of treatment combinations of fertiliser type, rates and timings have been applied to the Matarangi site where there was sufficient space. A more limited range or treatments were applied to the smaller Whiritoa site.

TRIAL DESIGN

Matarangi Beach

The trial consisted of 3 blocks or replicates with 15 plots in each block based on a randomised complete block (RCB) design. Each plot is approximately 5 m wide and 30 m long and extends across the width of the natural dune. Treatment combinations for each plot were allocated randomly within each block and are given in Appendix 1. Fence posts along the baseline (a fence bearing 340° mag.) are numbered, with numbers facing toward the centre of each plot. A line of 50 mm x 25 mm treated wooden pegs are placed at right angles to, and 20 m out from, each numbered fence post along the foredune to demarcate the sides of each rectangular plot.

Whiritoa Beach

The trial consists of 20 rectangular plots, each 6 m wide and 13-14 m long. Plots are demarcated by numbered 50mm x 25mm treated wooden pegs placed along a baseline (bearing 140°) on the landward side of the dune. Other pegs were placed on the seaward side of the baseline as a guide for fertilising and monitoring of each plot. Two blocks or replicates contain 10 treatment combinations (including 2 unfertilised controls) allocated randomly within each block using a RCB design. Treatment combinations for each plot with details of fertilisers applied to each plot are listed in Appendix 2.

FERTILISER APPLICATION

The rate of fertiliser applied to each plot was calculated on the basis of N content of each fertiliser type. The appropriate weight of fertiliser was applied to each plot by two persons hand broadcasting fertiliser from a bucket to give an even spread throughout each plot from the baseline to the seaward edge of vegetation, which coincided approximately with high water mark. The first fertiliser application was made in spring (mid October 1993) and the second application to appropriate plots in summer (late February 1994) for both the Matarangi and Whiritoa trials. A brief shower of rain occurred within a few hours of the spring fertiliser application at Whiritoa and within 2 days at Matarangi. No rain occurred after the summer fertiliser applications at both sites for at least a week. For single applications, the full rate of fertiliser was applied in spring, whereas for split applications, half the fertiliser rate was applied in spring and the remainder applied in the summer (Appendices 1 & 2).

MONITORING OF VEGETATION

In order to quantify the effect of fertiliser on vegetation, pre- and post-treatment vegetation cover was assessed using a point sampling frequency technique (Cullen 1965). The first assessment, immediately before the first fertiliser application in spring, was carried out at both trial sites in October 1993, with second assessment carried out in late February 1994, prior to the summer fertiliser treatment.

Vegetation cover was measured with a 2 m x 0.5 m sampling frame supporting 20 spring-loaded needles with 60 cm of vertical movement. The frame was moved along the long axis of each plot and positioned at 10 set stations between the seaward edge of the foredune and the rear baseline (fence). Because vegetation condition and response is more critical along the movement-prone front of the dune at Matarangi, the sampling frame stations were concentrated in the front third of the dune. At Whiritoa, sampling frame stations were placed 1.5 m apart along the long axis of each plot. The spring-loaded needles are depressed and initial vegetation intercept recorded by species for each of the 10 stations within each plot. 200 points per plot were sampled. All sampling frame stations were centrally located in each plot to avoid sampling of vegetation on plot boundaries, where vegetation may have been influenced by treatments in adjacent plots.

Spinifex and sand convolvulus are the two most common species at each site. Point intercepts for these two species were recorded as "live" or "dead". This distinction was not made for other species - all first intercepts were recorded by species whether live or dead. Intercepts with unidentifiable dead plant material, debris or sand were not recorded.

In addition to sampling vegetation cover, the number of stolon tips within the 2 m x 0.5 m frame were recorded at each placement of the frame during the February 1994 assessment. It was not possible to record seed head production during the summer assessment as seed had started to move around. Significant differences in the colour of fertilised and unfertilised plots were photographed.

FUTURE ASSESSMENT

Vegetation will be assessed in winter 1994 using the point sampling frame and data from all 3 vegetation assessments then analysed to determine any differences in ground cover between the different fertiliser treatments. Decisions of further applications of fertiliser and extending the current trials to untreated dune surfaces will be made at this time. There is scope to extend fertiliser trials at Matarangi Beach where there are several hundred

metres of relatively uniform dune covered in spinifex either side of the current trial. Other high N fertiliser formulations such as CAN (calcium ammonium nitrate) could also be investigated in new trials.

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APPENDIX 1 — Fertiliser treatments applied to each plot, spinifex fertiliser trial, Matarangi Beach, Coromandel. Fertiliser rates applied to each plot were calculated on the basis of N content of each fertiliser type (Nitram 34% N, Urea 46% N, DAP-diammonium phosphate 18% N). Control plots were not fertilised. Plot dimensions are 30 m x 6 m.

Plot No.	Block No.	Fertiliser Type	Fertiliser Rate (kg/ha)	Timing of application*	Fertiliser applied to each plot** (kg)
1	1	Urea	400	Single	13.1
2	1	DAP	200	Split	8.4
3	1	Control			
4	1	Nitram	200	Single	8.9
5	1	Nitram	200	Split	4.5
6	1	Urea	200	Split	3.3
7	1	Nitram	400	Split	9.0
8	1	DAP	400	Split	16.7
9	1	DAP	400	Single	33.3
10	1	DAP	200	Single	16.7
11	1	Control			
12	1	Control			
13	1	Urea	200	Single	6.5
14	1	Urea	400	Split	6.6
15	1	Nitram	400	Single	17.7
16	2	Urea	400	Single	13.1
17	2	Control			
18	2	Control			
19	2	Nitram	400	Split	9.0
20	2	DAP	200	Split	8.4
21	2	DAP	400	Single	33.3
22	2	Urea	400	Split	6.6
23	2	Nitram	200	Single	8.9
24	2	DAP	400	Split	16.7
25	2	Nitram	200	Split	4.5
26	2	DAP	200	Single	16.7
27	2	Control			
28	2	Urea	200	Split	3.3
29	2	Urea	200	Single	6.5
30	2	Nitram	400	Single	17.7
31	3	Control			
32	3	Nitram	400	Single	17.7
33	3	Nitram	200	Split	4.5
34	3	Control			
35	3	DAP	200	Split	8.4
36	3	Urea	200	Single	6.5
37	2	Nitram	200	Single	8.9
38	3	Urea	200	Split	3.3
39	3	DAP	400	Split	16.7
40	3	DAP	200	Single	16.7
41	3	Nitram	400	Split	9.0
42	3	Control			
43	3	Urea	400	Single	13.1
44	3	DAP	400	Single	33.3
45	3	Urea	400	Split	6.6

* Timing of fertiliser application — for single applications, all fertiliser was applied in spring (October 1993); for split applications half rate was applied in spring (October 1993) with the remainder applied in summer (February 1994).

** Indicates the actual amount of fertiliser applied to each plot in spring and summer where appropriate.

APPENDIX 2 — Fertiliser treatments applied to each plot, spinifex fertiliser trial, Whiritoa Beach, Coromandel. Fertiliser rates applied to each plot were calculated on the basis of N content of each fertiliser type (Nitram 34% N, Urea 46% N). Control plots were not fertilised. Plot dimensions are 13 m x 6 m.

Plot No.	Block No.	Fertiliser Type	Fertiliser Rate (kg/ha)	Timing of application*	Fertiliser applied to each plot (kg)**
1	1	Control			
2	1	Nitram	200	Single	4.6
3	1	Urea	200	Split	1.7
4	1	Urea	200	Single	3.4
5	1	Nitram	400	Split	4.6
6	1	Nitram	400	Single	9.2
7	1	Nitram	200	Split	2.3
8	1	Urea	400	Split	3.4
9	1	Control			
10	1	Urea	400	Single	6.8
11	2	Urea	200	Single	3.4
12	2	Control			
13	2	Nitram	400	Single	9.2
14	2	Nitram	400	Split	4.6
15	2	Control			
16	2	Urea	400	Single	6.8
17	2	Nitram	200	Split	2.3
18	2	Nitram	200	Single	4.6
19	2	Urea	400	Split	3.4
20	2	Urea	200	Split	1.7

* Timing of fertiliser application — for single applications, all fertiliser was applied in spring (October 1993); for split applications, half rate was applied in spring (October 1993) with the remainder applied in summer (February 1994).

** Indicates the actual amount of fertiliser by weight applied to each plot in spring and summer where appropriate.

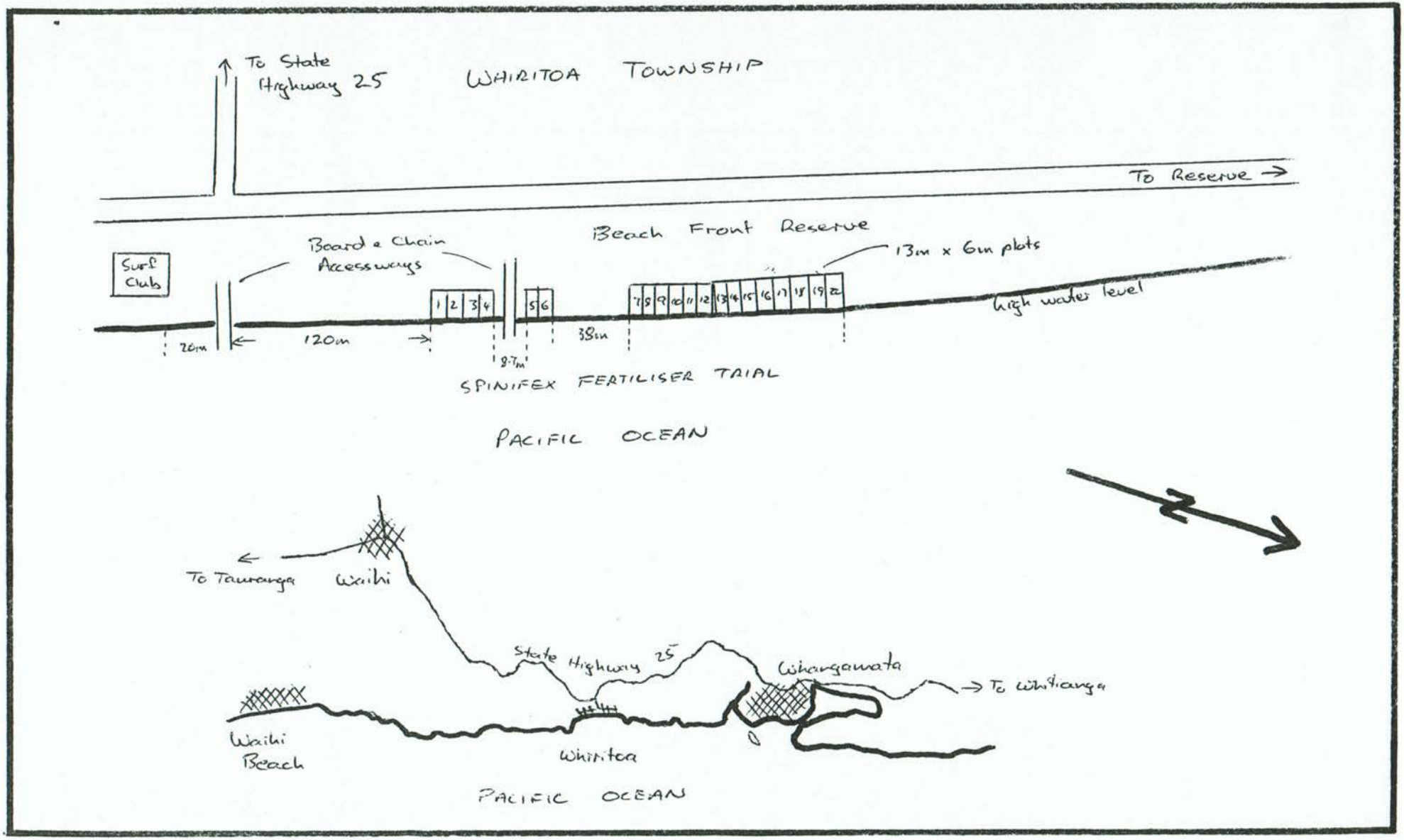

Figure 2: Location of the spinifex fertiliser trial, Whiritoa Beach, Coromandel.

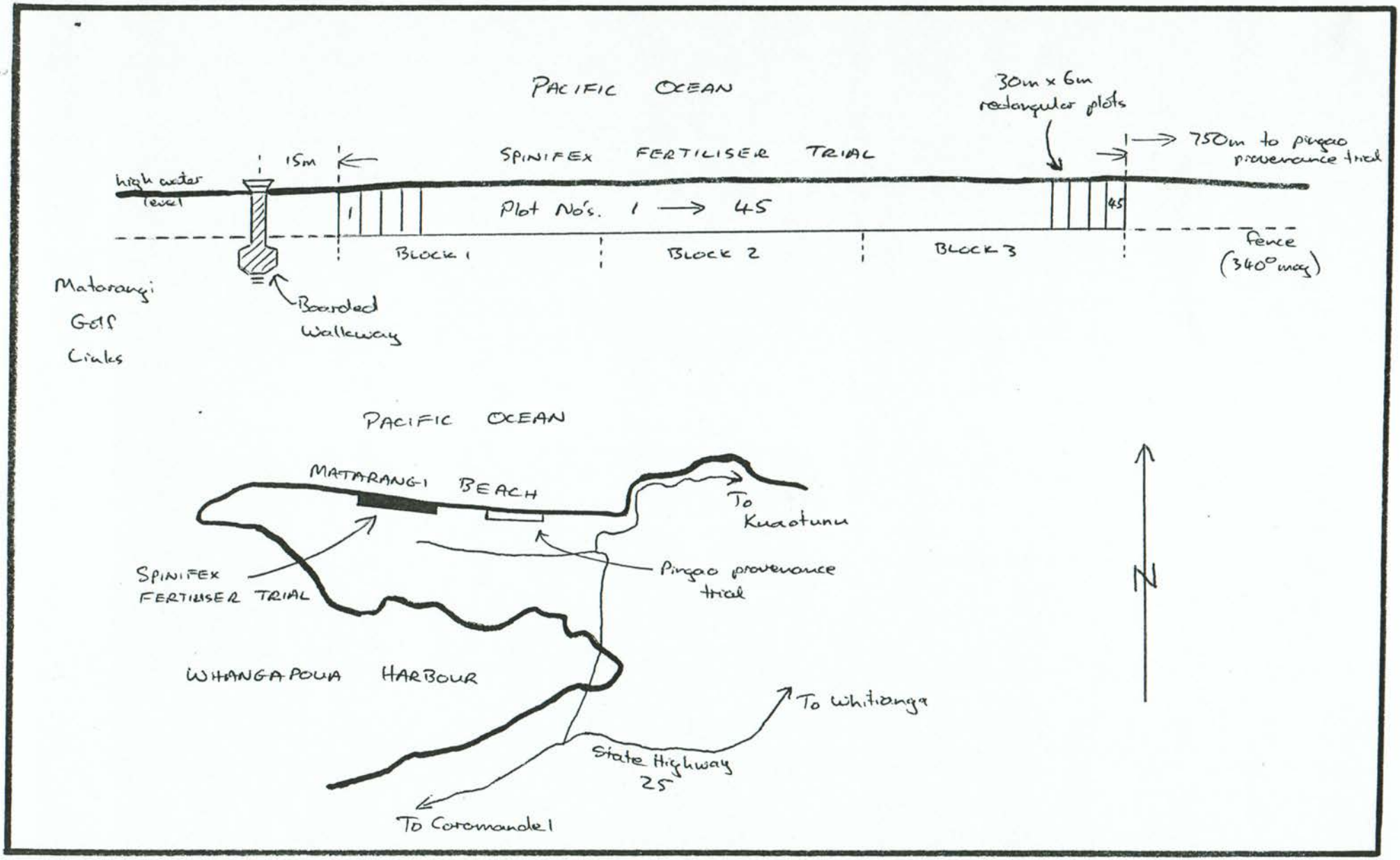

Figure 1: Location of the spinifex fertiliser trial, Matarangi Beach, Coromandel.