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AUTHOR(S): D. O. BERGIN & J. W. HERBERT

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ESTABLISHMENT OF PLANTING TRIALS

D. O. Bergin & J. W. Herbert

New Zealand Forest Research Institute, Rotorua

ABSTRACT*

Over 30 provenances of pingao seedlings collected from throughout the country have been raised at the NZ FRI Nursery, Rotorua. Seed had been collected in previous year by the NZ FRI and the Department of Conservation. Most provenances have been planted at four different locations - three garden sites and one duneland planting - as semi-permanent collections of pingao for long term monitoring in different regions. Details of the trial locations and layouts are given. The aim is to record variation in seedling survival and growth, plant habit and weaving characteristics of leaves between different provenances at each site.

Variation in size, stem form, habit and colour has been observed with pingao around the country (Walk 1960). Differences in growth rate were also noted by Herbert & Bergin (1991) between a small number of provenances used in a planting trial on an East Coast beach. As pingao is one of the major indigenous and endemic shrubs along the New Zealand coast and its leaves are prized for traditional Maori weaving purposes, a full scale provenance trial was therefore considered worthwhile to quantify differences in plant growth and habit and weaving qualities of leaves between provenances. In late 1990 NZFRI organised collection of pingao seed from a large number of locations throughout the country, including Great Barrier Island and the Chatham Islands. These collections were supplemented by earlier collections organised by the Department of Conservation in 1989. This report lists the provenance locations, and briefly describes the raising of seedlings, the assessment of provenance differences in the nursery, and in more detail, the setting up of permanent garden and field plantings of most provenances to observe differences in the long term.

PROVENANCE LOCATIONS

* Note: This material is unpublished and must not be cited as a literature reference.

RAISING SEEDLINGS

Nursery practice

All seed was sown in seed trays using a 1:1 peat:pumice potting mix in February to April 1992. The date of sowing largely dependent on when seed arrived at the NZFRI Nursery. Many seed collections acquired from the Department of Conservation Nursery at Taupo were collected in early 1989 some 3 years before the NZFRI collections. Although, these had been kept in cool storage, many did not germinate or germinated poorly. Because of the wide variation in amount of seed collected and age of seedlots, detailed monitoring of seed germination rates were not carried out for all seedlots.

As has become standard practice at the NZFRI Nursery, newly germinated seedlings were pricked into small paper pots about 3 months after sowing and onto PB 3/4 polythene bags within 12 months of sowing. About 50 seedlings of 10 provenances that had large numbers of seedlings were transferred to Matawhero Nursery, Gisborne, to determine any differences that may occur in growth or other characteristics between the two nurseries.

By September 1993, seedlings were nearly 18 months old and ready for planting out.

Nursery assessment

A range of plant, leaf and weaving characteristics were assessed for each provenance before planting out. These included a subjective assessment of plant habit (erect, intermediate, tufted) for each provenance. Using a sample of up to 10 seedlings of each provenance, measurements were taken of height and leaf spread, and the number of shoots per plant were counted. Leaf length, width, thickness and coarseness were assessed using a selected leaf from each of 5 seedlings per provenance. These leaves have been left to dry and experienced weavers will assess each provenance for their weaving characteristics.

Visually there are obvious differences in growth, plant habit and leaf characteristics between different provenances of pingao collected from throughout the country (Plate 1). Data from the nursery assessment will be analysed and the results will be produced in a separate report.

PLANTING TRIALS

The pingao provenance seedlings have been planted at four different locations - three garden sites and one duneland planting. The main objective is to establish semi-permanent collections of pingao in different

regions and monitor, under different conditions such as climate and soil type, growth and survival of pingao, and in particular, recording any variation between provenances. A further objective is to establish an archive of pingao exhibiting a range of weaving qualities so that local communities have an opportunity to try fibre harvested from different provenances.

Three pingao gardens have been set up - at the NZFRI Nursery, Rotorua; at the Mercury Bay Community College, Whitianga; and, at the Hawkes Bay Polytechnic, Napier. One large-scale duneland planting is located at Matarangi Beach, Coromandel Peninsula.

NZFRI pingao garden

All 38 successfully propagated provenances are represented in the NZFRI pingao garden. Thirty-four provenances have 10 seedlings each and the remaining 4 provenances have 2-9 seedlings each. Due to lack of seedlings for some provenances, the other garden locations and the duneland trial planting do not have a full complement of provenances.

The NZFRI Nursery garden is located in a raised bed within a polythene house which is heated during winter months if required (Plate 2). The bed consists of well cultivated composted soil. As this garden is located on the NZFRI campus, the intention is to regularly monitor a full range of plant and leaf characteristics at this site including flowering and seed head development, with less intensive monitoring of provenance trials planted at more distant locations.

Seedlings were planted in November 1993. Fertiliser was applied to all seedlings based on earlier trial results (Herbert & Bergin 1991) involving 30 g of Magamp (medium granule) incorporated into the soil at planting. Trial layout and design consists of 2 replicates of each provenance with up to 5 seedlings placed in each replicate. Provenances have been randomly allocated within each replicate. A line of 50mm x 25mm treated wooden peg separates the two replicates with provenance numbers in permanent marker pen identifying each provenance. A layout diagram and list of provenances for the NZFRI pingao garden are given in Appendix 2.

Mercury Bay Community College pingao garden

Thirty-two provenances of pingao were planted in the Mercury Bay Community College grounds on the western side of the nursery glasshouse (Plate 3). The light sandy soil was well cultivated before seedlings were planted in early October 1993. Fertiliser at the rate of 30 g of Magamp was applied to each seedling at planting. Trial design consists of two replicates with 5 seedlings of each provenance randomly located

within each block. Wooden pegs with numbered aluminium tags identify each provenance. Screened bark up to 75 cm thick has been laid over the planted bed to deter weed growth. Careful knapsack application of Roundup along garden edges is being carried out to control weeds. A layout diagram and list of provenances for the Mercury Bay Community College pingao garden are given in Appendix 3.

Hawkes Bay Polytechnic pingao garden

At the Hawkes Bay Polytechnic garden, 34 provenances were planted in mid-September 1993 (Plate 4). The light friable soils were well cultivated and all seedlings were fertilised at planting with 30 g of Magamp (medium granule). Trial design consists of two replicates or blocks with 5 seedlings of each provenance randomly located within each block. Block 1 and part of Block 2 are adjacent to the workshop and the remainder of Block 2 is located next to a log cabin. Wooden pegs with numbered aluminium tags identify each provenance and screened bark up to 75 cm thick has been laid over the planted bed to deter weed growth. A layout diagram and list of provenances for the Hawkes Bay Polytechnic pingao garden are given in Appendix 4.

Matarangi Beach pingao provenance trial

In early November 1993, 25 provenances were planted along the foredune at Matarangi Beach, north of Whitianga on the Coromandel Peninsula (Plates 5 & 6). The trial consisted of four replicates or blocks with 25, 24, 19 and 15 provenances represented in Blocks 1, 2, 3 and 4 respectively depending on numbers of seedlings available for planting. A single provenance was planted in each group with groups randomly allocated to sites within each replicate depending on a Randomised Complete Block design. This was to ensure that any site variation did not influence performance of any particular provenance. Twenty seedlings were planted in each group within a 3 m diameter circle. Groups were identified by a centrally located numbered 50mm x 25mm treated wooden peg with groups located approximately 5 m apart between centres. Each seedling received 50 g of Magamp medium granule fertiliser incorporated into the sand at planting.

Previous sand dune plantings of pingao clearly indicate that the preferred site for establishing pingao is where some sand accumulation occurs, usually the narrow strip along the seaward margin of the foredune. Consequently, the groups of pingao were planted along the foredune at Matarangi Beach just above the high water zone in gaps amongst the spinifex. A layout diagram and list of provenances planted in each block are given in Appendix 5.

MONITORING AND FUTURE MANAGEMENT

All pingao gardens and the sand dune trial will be inspected at least six monthly for the first two years with assessment of survival and selected growth characteristics carried out annually. It is anticipated that growth will be significant within two years of planting. This will enable an assessment of the weaving characteristics of each provenance. Sufficient growth data should also be available by the end second year to allow analysis and reporting of results. Weed control is required for all garden sites at regular intervals using glyphosate to prevent invasion of weeds along edges and hand weeding between pingao.

ACKNOWLEDGEMENTS

We would like to thank the following for their help with this project: Department of Conservation staff and others who assisted with seed collections throughout the country including Roger MacGibbon (DOC Nursery, Taupo) for earlier collections of pingao seed organised by Herwi Sheltus; Colin Faulds and colleagues (NZFRI Nursery, Rotorua) and Phil Stevenson and colleagues (Matawhero Nursery, Gisborne) for raising seedlings; Jody Stent (Hawkes Bay Polytechnic) for establishing the Hawkes Bay Polytechnic garden; Geoff Walls and Ken Hunt (DOC, Napier) for inspecting dune planting sites in the Hawkes Bay; Jan Riley and Paddy Stewart (Mercury Bay Community College) for establishing the Mercury Bay garden and Matarangi dune trial; Mike Harper (Manager, Matarangi Beach Estates) for access and support for the Matarangi trial and the assistance of local beach owners; Jim Dahm and Harley Spence for finding suitable planting sites and establishing trials; and Greg Steward (NZFRI, Rotorua) for establishing the NZFRI garden.

REFERENCES

- Herbert, J. W. ; Bergin, D. O. 1991: Experimental rehabilitation of dunelands with pingao. Forest Research Institute Report: FWE 91/23 (Unpubl.). 15p.
- Walls, G. 1990: Cultivation, provenance and planting trials with pingao (*Desmoschoenus spiralis*). Botany Division, Department of Scientific and Industrial Research Report (Unpubl.). 19p.

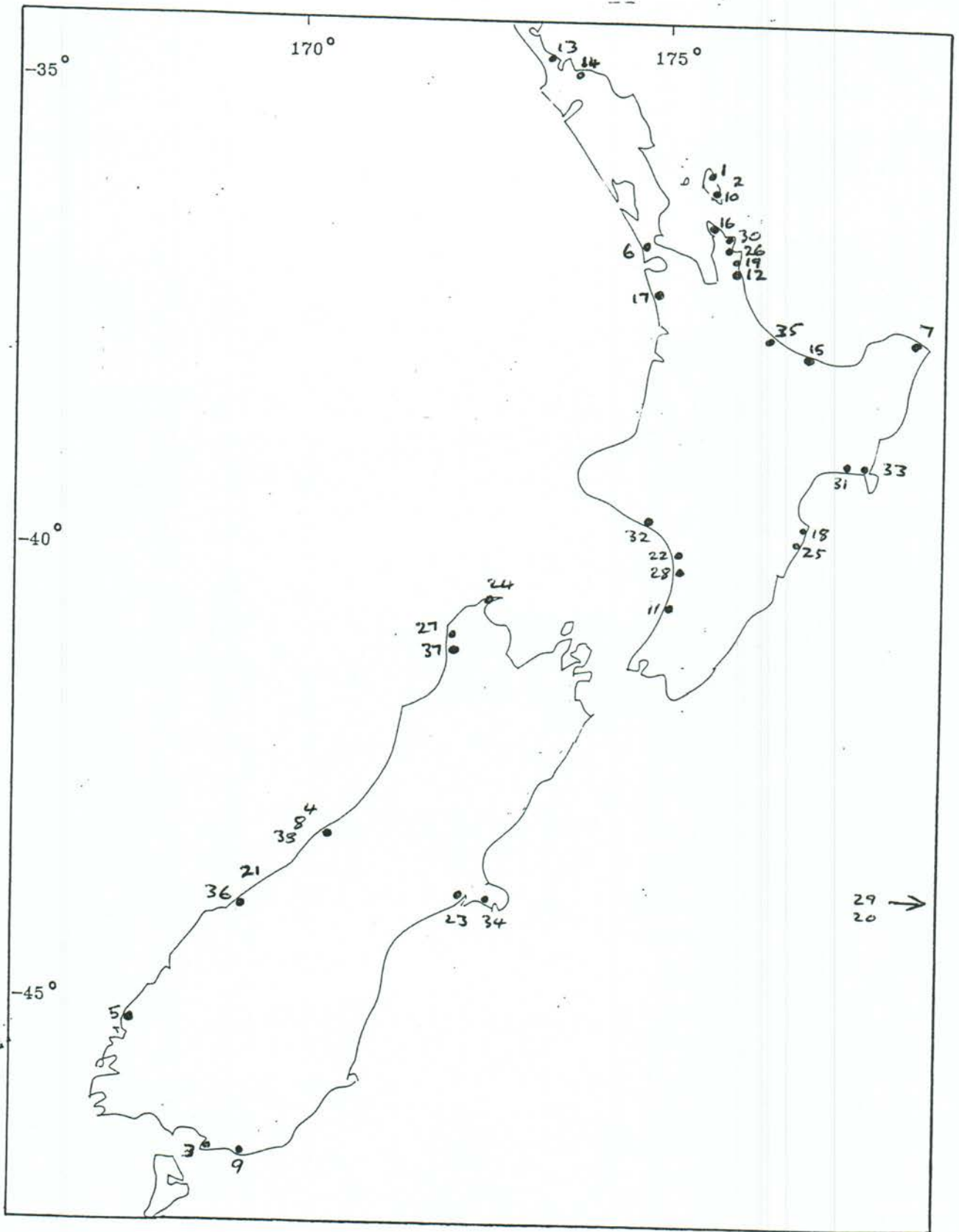
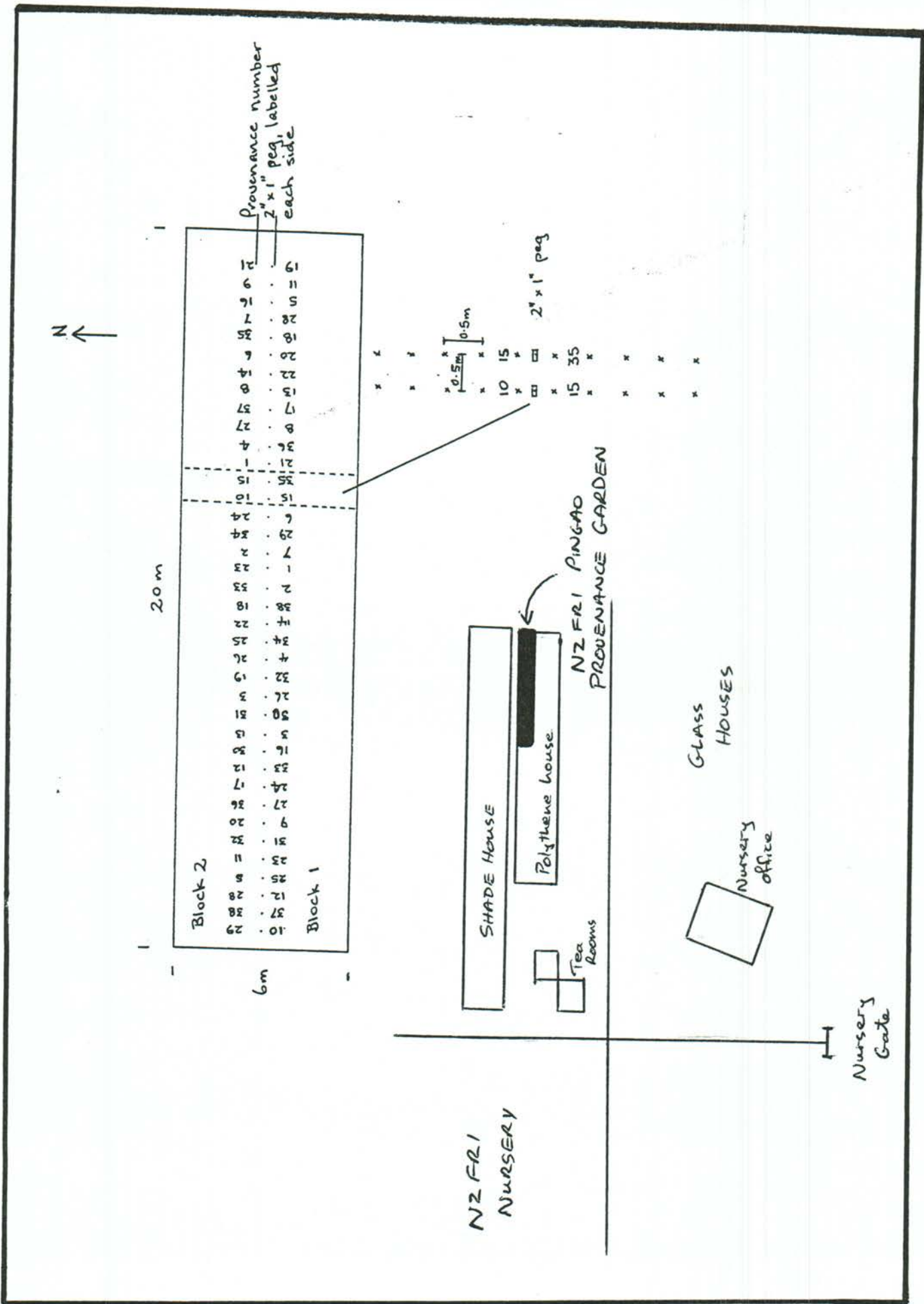


Figure 1: Seed collection sites for the pingao provenance trial. Refer to Appendix 1 for details of provenance locations.

APPENDIX 1 — Provenances included in the NZ FRI pingao provenance trial where seedlings had been successfully raised from seed. For some locations separate collections were made by different individuals in different years. All collections were kept separate.

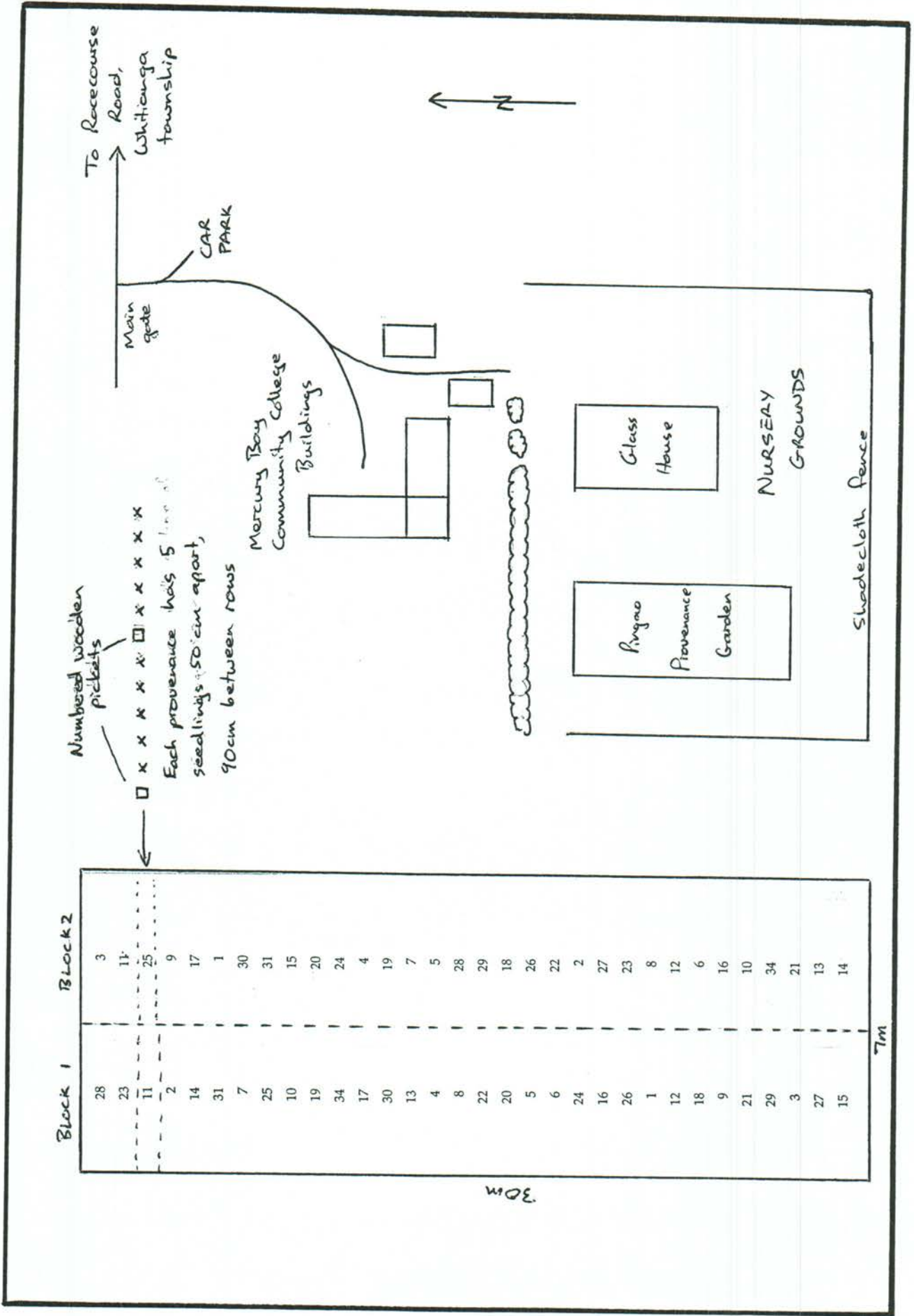
Prov No.	Location	Prov. No.	Location
1	Whangapoua Beach, Gt Barrier Is.	20	Waitangi West, Chatham Is.
2	Gt Barrier Is.	21	South Westland
3	Three Sisters Dune, Omaui, Southland	22	Himatangi, Manawatu
4	Maori Beach, Fox Glacier	23	Kaitorete Spit, Canterbury
5	Coal River, Fiordland	24	Farewell Spit, Golden Bay
6	Whatipu, Auckland	25	Ocean Beach, Hawkes Bay
7	Hicks Bay, East Coast	26	Kuaotuna Beach, Coromandel
8	Hunts Beach, Fox Glacier	27	Heaphy River, Karamea, West Coast
9	Fortrose Spit, Southland	28	Tangimoana, Manawatu
10	Kaitoke Beach, Gt Barrier Is.	29	Kaingaroa Beach, Chatham Is.
11	Hokio Beach, Manawatu	30	Matarangi Beach, Coromandel
12	Whangamata, Coromandel	31	Nuhaka, East Coast
13	East Beach, Rangaunu Bay, Northland	32	Whangarei
14	Tokerau Beach, Doubtless Bay, Northland	33	Mahia, East Coast
15	Maketu, Bay of Plenty	34	Tumbledown Bay, Banks Peninsula
16	Waikawau Bay, Coromandel	35	Papamoa, Bay of Plenty
17	Port Waikato	36	Ship Bay, Haast Fiordland
18	Hawkes Bay	37	Kohaihai, Karamea, West Coast
19	Opoutere, Coromandel	38	Gillespies Beach, Fox Glacier



Appendix 2: Location and layout of the NZFR1 pingao garden, Rotorua.

APPENDIX 2 (continued) — Provenances planted in each block, NZ FRI pingao provenance garden, Rotorua. For each block, 5 seedlings of each provenance are planted in rows at 50 cm spacing.

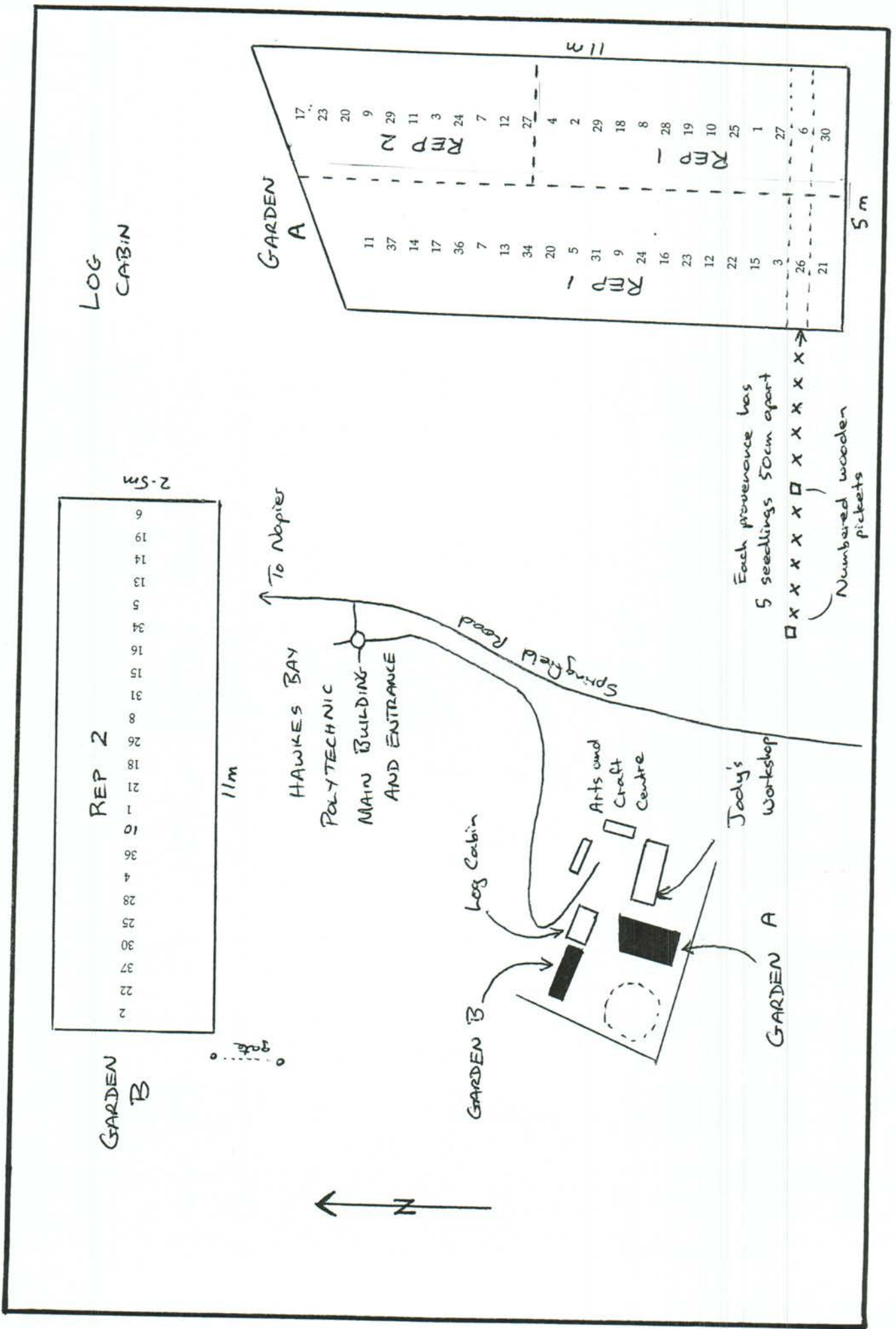
<u>BLOCK1</u>	<u>BLOCK2</u>
<i>38provenances</i>	<i>38provenances</i>
19	21
11	9
5	16
28	7
18	35
20	6
22	14
13	8
17	37
8	27
36	4
21	1
35	15
15	10
6	24
29	34
7	2
1	23
2	33
38	18
14	22
34	25
4	26
32	19
26	3
30	31
3	13
16	30
33	12
24	17
27	36
9	20
31	32
23	11
25	5
12	28
37	38
10	29



Appendix 3: Location and layout of the Mercury Bay Community College pingao garden, Whitianga.

APPENDIX 3(continued) — Provenances planted in each block, Mercury Bay Community College, Whitianga, pingao provenance garden. For each block, 5 seedlings of each provenance are planted in rows at 50 cm spacing

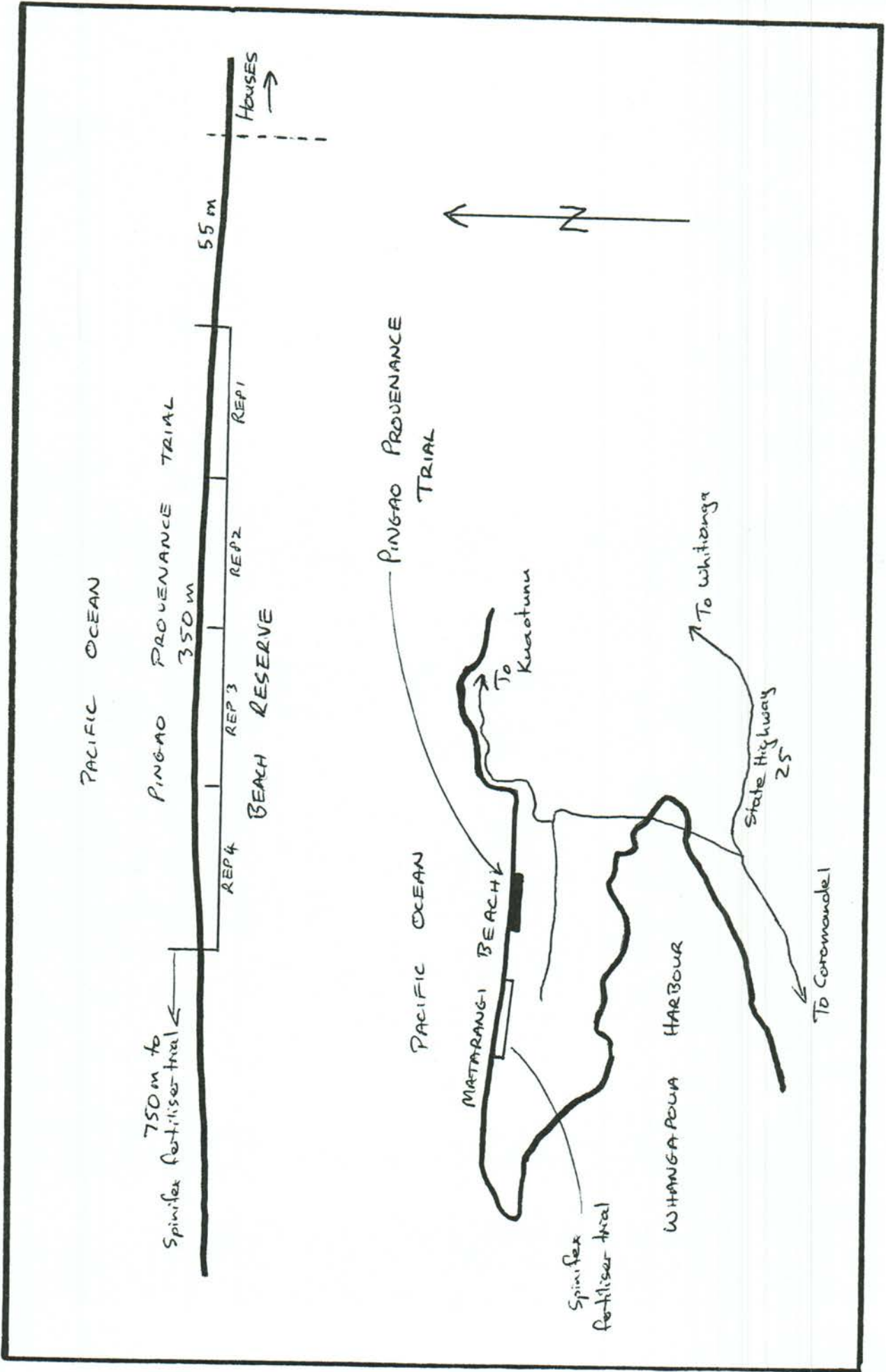
<u>BLOCK1</u> 32 provenances	<u>BLOCK2</u> 32 provenances
28	3
23	11
11	25
2	9
14	17
31	1
7	30
25	31
10	15
19	20
34	24
17	4
30	19
13	7
4	5
8	28
22	29
20	18
5	26
6	22
24	2
16	27
26	23
1	8
12	12
18	6
9	16
21	10
29	34
3	21
27	13
15	14



Appendix 4: Location and layout of the Hawkes Bay Polytechnic pingao garden, Napier.

APPENDIX 4 (continued) — Provenances planted in each block, Hawkes Bay Polytechnic pingao provenance garden, Napier. For each block, 5 seedlings of each provenance are planted in rows at 50 cm spacing.

<u>BLOCK1</u> 34 provenances	<u>BLOCK2</u> 34 provenances
11	17
37	23
14	20
17	9
36	29
7	11
13	3
34	24
20	7
5	12
31	27
9	2
24	22
16	37
23	30
12	25
22	28
15	4
3	36
26	10
21	1
4	21
2	18
29	26
18	8
8	31
28	15
19	16
10	34
25	5
1	13
27	14
6	19
30	6



Appendix 5: Location and layout of the Matarangi Beach pingao provenance trial, Coromandel.

APPENDIX 5 (continued) — Provenances planted in each block, pingao provenance trial, Matarangi Beach, Coromandel. For each block, 20 seedlings of each provenance are planted in 3 m diameter groups along the foredune.

<u>BLOCK1</u>		<u>BLOCK2</u>	
<i>25provenances</i>		<i>24provenances</i>	
6		28	
10		13	
16		18	
15		7	
21		14	
3		21	
20		12	
18		3	
7		5	
19		23	
22		2	
29		29	
11		4	
9		15	
14		1	
2		9	
4		10	
28		19	
8		16	
23		11	
12		6	
17		17	
1		22	
5		20	
13			
<u>BLOCK3</u>		<u>BLOCK4</u>	
<i>19provenances</i>		<i>15provenances</i>	
17		13	
16		2	
5		5	
11		15	
10		7	
23		17	
15		9	
7		11	
21		1	
12		12	
9		16	
3		21	
20		10	
6		4	
4		6	
19			
1			
13			
2			

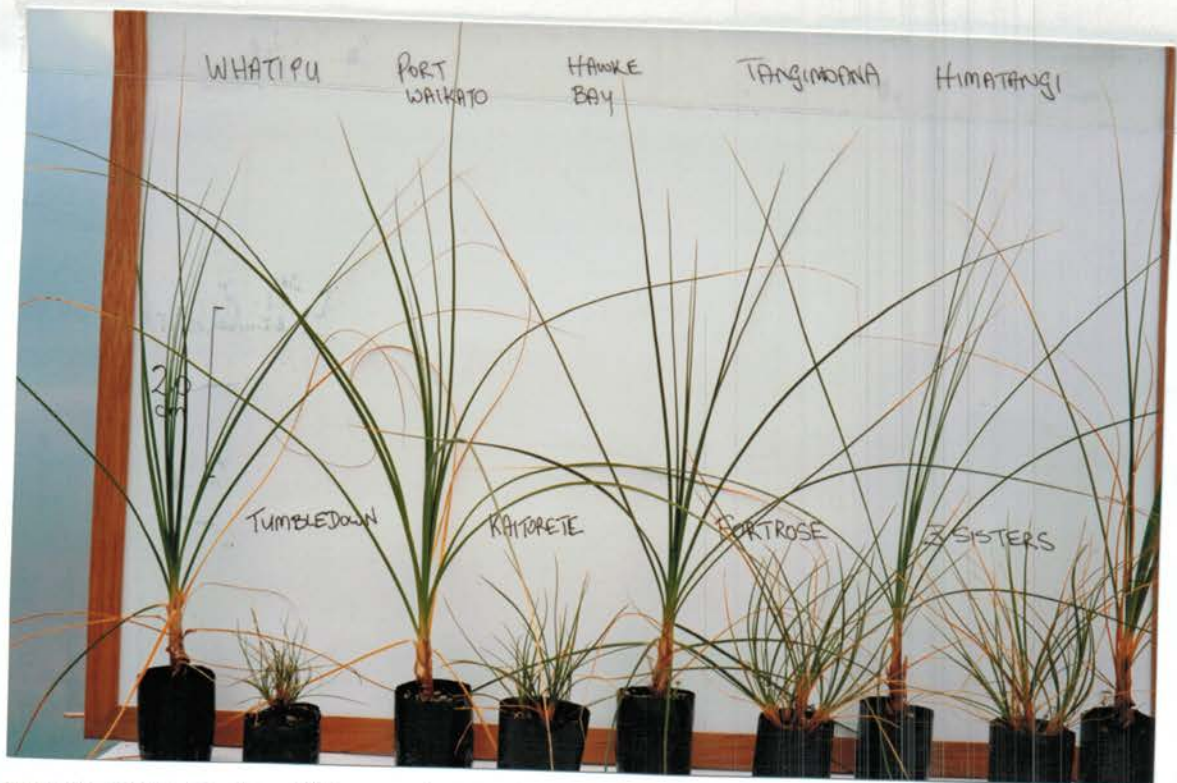


Plate 1: There are clear differences in growth, plant habit and leaf characteristics between different provenances of 18 month old pingao seedlings raised at the NZFRI Nursery.



Plate 2: The pingao garden on the NZFRI campus is located in the nursery within a polythene house which is heated during winter months if required. This garden contains seedlings of all 38 successfully raised pingao provenances. Plant growth and characteristics, including flowering and seeding, will be monitored regularly for each provenance.



Plate 3: A pingao provenance garden is sited in the nursery grounds of the Mercury Bay Community College at Whitianga and is being maintained by local Community College staff.



Plate 4: A third pingao provenance garden is located at the Hawkes Bay Polytechnic grounds in Napier. The garden in 2 separate blocks is being maintained by local Polytechnic staff.



Plate 5: *Pingao seedlings sorted by provenance are lined out on Matarangi Beach before being placed near their planting site. The trial consisted of 4 replicates with each provenance randomly located within each replicate based on a Random Complete Block design to minimise any influence of site variation on seedling performance.*



Plate 6: *At Matarangi Beach, twenty seedlings of a single pingao provenance were planted in each group. Seedlings were planted in a 3 m diameter circle with a numbered peg placed centrally in each group. All seedlings were fertilised at planting. Groups were located at least 5 m apart along the foredune where sand movement occurred in gaps amongst the spinifex.*