

**ECOLOGY, SUCCESSION AND CONSERVATION
OF COASTAL KANUKA COMMUNITIES
IN EASTERN BAY OF PLENTY**

INVESTIGATION NO: S3025/553
CORPORATE OBJECTIVE NO: 3.25
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EXECUTIVE SUMMARY (FINAL):

INVESTIGATION NO: S3025/553

CORPORATE OBJECTIVE: 3.25

INVESTIGATION TITLE: Ecology, succession and conservation of coastal kanuka communities in eastern Bay of Plenty

STUDY VENUE: Bay of Plenty Conservancy

INVESTIGATION LEADER: M.C. Smale

INVESTIGATION STATUS: Completed

CLIENT: Department of Conservation

INVESTIGATION SUMMARY:

Coastal kanuka (*Kunzea ericoides*) communities in the eastern Bay of Plenty were studied in 1989-90 by Northern Wildlands Section, Forest Research Institute, Rotorua, under the loop-funding arrangement with the Department of Conservation.

OBJECTIVES:

1. To review the occurrence of coastal kanuka communities on sand dunes in the North Island of New Zealand.
2. To assess the structure and composition of remnant coastal kanuka communities (Whakatane District Council Recreation Reserve, Uretara Island and Whale Island Scenic Reserves) in eastern Bay of Plenty.
3. To describe the natural dynamics of these communities in relation to previous history and likely future successions, to identify threats to their sustainability, and formulate management prescriptions.

METHODS:

1. Occurrence of kanuka communities on North Island sand dunes was reviewed in the literature (published and unpublished records).
2. Temporary plots were established in kanuka stands in the three study areas.
3. Selected kanuka plants were felled and aged, and diameters of all woody plants were recorded.

4. Ground cover was assessed by species in semi-quantitative cover classes.
5. Presence of invasive weeds was recorded.

RESULTS:

Outside the Aupouri Ecological Region in the Far North, viable kanuka communities on sand dunes are now very rare in the North Island, surviving only at East Cape (Hautai sand dunes), South Kaipara Spit (several sites in Woodhill State Forest), and the eastern Bay of Plenty (sites described here).

Multi-stemmed semi-prostrate kanuka forest on exposed consolidated foredunes (Crown land) and blowout dunes (freehold land) at Thornton is aged c. 45 years. The communities on exposed unconsolidated (mobile) dunes at the western end of Boulder Bay, Whale Island, range from <6 to >30 years old. Normal erect kanuka scrub/forest occurs on consolidated dunes at the eastern end of Boulder Bay, Whale Island and on sedimentary rock on Uretara Island, Ohiwa Harbour. All of these kanuka populations have regenerated in invasion waves, after sand has become sufficiently stable (unconsolidated dunes, Whale Island), after frequent burning has stopped (Thornton) or after fire or clearfelling have removed previous vegetation (consolidated dunes, Whale Island and Uretara Island).

No potential canopy trees other than kanuka are present in the Thornton or Whale Island communities. Other potential canopy trees are present in much of the Uretara Island forest.

CONCLUSIONS:

The multi-stemmed semi-prostrate kanuka communities on sand dunes in the central Bay of Plenty are nationally rare and regionally unique. They may replace themselves indefinitely at Thornton, which is isolated from seed sources of other potential canopy trees, and will replace themselves indefinitely on unconsolidated dunes at Whale Island, where their habitat is essentially unstable. Such self-replacing kanuka communities are extremely rare.

The normal erect kanuka communities are successional, and will be replaced by other trees on consolidated sand at Whale Island and on sedimentary rock on Uretara Island.

Sand dune kanuka communities are susceptible to fire, and to invasive weeds (boxthorn at Thornton, pampas and kikuyu at Whale Island).

RECOMMENDATIONS:

1. The reserve designation of the central portion (under kanuka) of the Whakatane District Council Recreation Reserve between the Tarawera and Rangitaiki Rivers should reflect its high biological values.

2. Cattle grazing should not be allowed to continue at Thornton within the existing reserve, or in kanuka forest on old blowout dunes on freehold land.
3. Invasive weeds should be removed from Thornton (boxthorn) and Whale Island (pampas and kikuyu). Possums should be removed from Uretara Island.
4. Permanent plots in sand dune kanuka forest in Woodhill State Forest should be remeasured and analysed.

2. INTRODUCTION

The ecology, succession and conservation of coastal kanuka communities in the Eastern Bay of Plenty were studied in 1989-90 by Northern Wildlands section, Forest Research Institute, Rotorua. The work was funded by the Department of Conservation.

3. BACKGROUND

Coastal tree and shrub communities dominated by kanuka are now rare in much of the Bay of Plenty, as in other parts of mainland New Zealand. Their ecology, succession and conservation status are poorly known, but need to be understood if management strategies are to be formulated. Brief descriptions of the Whakatane District Council Recreation Reserve and Uretara Island Scenic Reserve were made previously by Beadel & Shaw (1986) and Beadel (1987).

4. OBJECTIVES

- * To review the occurrence of coastal kanuka communities on sand dunes in the North Island of New Zealand.
- * To assess the structure and composition of remnant coastal kanuka communities (Whakatane District Council Recreation Reserve, Uretara Island and Whale Island Scenic Reserves) in eastern Bay of Plenty.
- * To describe the natural dynamics of these communities in relation to previous history and likely future successions in them.
- * To identify threats to their sustainability.
- * To formulate management prescriptions for them.

5. METHODS

The occurrence of kanuka on North Island sand dunes was reviewed in published and unpublished literature.

Data were collected from three study areas: Whakatane District Council Recreation Reserve (Thornton), Uretara Island Scenic Reserve and Whale Island (Motuhora) Scenic Reserve.

At Thornton, a linear transect ran from mean high-water mark to 0.6 km inland at right angles to the shoreline. At Uretara Island and Whale Island, temporary plots of various sizes were placed in kanuka stands of different ages. Selected kanuka plants were felled in each plot, and basal discs were removed for aging. Diameters of all measurable woody plants were recorded, along with the heights of felled stems. Presence of seedlings and percentage ground cover were

recorded by species. Site characteristics were also noted, along with presence of invasive weeds.

6. RESULTS

6.1 Occurrence of coastal kanuka on sand dunes in the North Island

Although flattened (semi-prostrate) kanuka was described in 1911 as frequent on sand dunes in northern Northland (Cockayne 1911), virtually nothing has been written about these kanuka communities since. They are still quite common (N.M.U. Clunie, pers. comm.), but the kanuka in them (variety *lineare*) differs from the normal variety in having much narrower, hairier leaves and smaller flowers. Outside the Far North (Aupouri Ecological Region), viable kanuka communities (normal variety) on sand dunes are known to survive in only three regions, all in northern North Island (Figure 1):

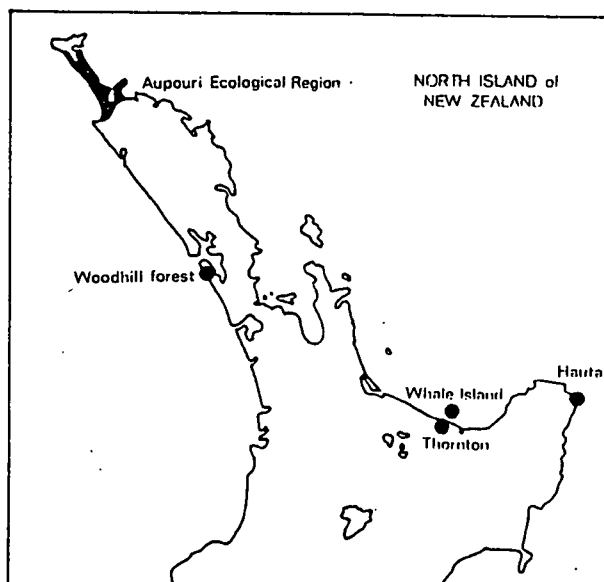


Fig. 1: Location of sand dune kanuka forest in the North Island.

- * Woodhill State Forest, South Kaipara Spit, containing Lookout Ecological Area (57 ha), Coal Seam EA (22 ha), Pukitu (c.3 ha), and an unnamed gully (Cameron & Bellingham (1986), Cameron (1987, 1988)).
- * Hautai sand dunes, East Cape, containing c.20 ha of kanuka forest with tree nettle (*Urtica ferox*) understorey (Regnier *et al.* 1988).
- * Whakatane District Council Recreation Reserve and Whale Island Scenic Reserve, eastern Bay of Plenty (this report).

Only fragments remain elsewhere (e.g. Himatangi Bush Scenic Reserve, Manawatu (Esler (1978))).

6.2 Structure and composition of coastal kanuka communities

6.2.1 Whakatane District Council Recreation Reserve, Thornton

Apart from kanuka, the only woody plants present are occasional adventive boxthorn (*Lycium ferocissimum*), mingimingi (*Leucopogon fasciculatus*) and akeake (*Dodonaea viscosa*). Kanuka forms a smooth wind-shorn canopy over much of the linear foredunes, varying from 1 m high on the most exposed sites (e.g., on the crest of the main foredune ridge) to 6 m in the most sheltered sites (e.g., in the lee of the main foredune ridge). Most plants are multi-stemmed and semi-prostrate, with a peculiar "candelabra" form that results largely from having developed in a very exposed environment. Trees in the most sheltered portion of the forest, behind the main foredune ridge, have larger stems and crowns than those elsewhere. In the central portion of the reserve, kanuka forest extends inland for 425 m on old blowout dunes on freehold land.

Within the reserve, the ground cover is mainly meadow rice grass (*Microlaena stipoides*), pohuehue (*Muehlenbeckia complexa*) and several mosses (*Bryum truncorum*, *Homalia falcifolia*, and *Hypnum cupressiforme*). Pohuehue scrambles over the canopy where it is lowest. There is no understorey.

6.2.2 Whale Island Scenic Reserve (Motuhora)

Two kinds of kanuka are present on the Boulder Bay dunes:

Multi-stemmed "candelabra" kanuka scrub/forest with smooth windshorn canopies is present on exposed unconsolidated dunes towards the western end of the island. Canopy height is only 3-4 m in the older stands (~ 30 years). The ground is covered in leaf litter in younger stands (<10 years) with occasional leafless sedge (*Scirpus nodosus*) still surviving from previous open sand dune vegetation. The ground cover in older stands is mainly mosses (mostly *Thuidiopsis furfurosa* and *Hypnum cupressiforme*), with some leafless sedge, and a wide range of native and adventive herbs, grasses and ferns. Understories are virtually non-existent.

Normal erect kanuka scrub (which will develop later into forest) is present on sheltered consolidated dune sands at the eastern end of Boulder Bay, extending inland onto the floodplain on the floor of Camp Valley. Canopy height varies from c.2.5 m to nearly 4 m. The ground is covered in leaf litter, with occasional leafless sedge still surviving from previous open vegetation. There is no understorey.

6.2.3 Uretara Island Scenic Reserve (Ducker's Island)

Kanuka forest growing on sedimentary rock covers much of the southern half of the island, in places with frequent rewarewa (*Knightia excelsa*) emergent through the canopy (Beadel & Shaw 1986). Tall, well-spaced kanuka form a canopy 20 m high or more. On moister sites, mamaku (*Cyathea medullaris*) forms a scattered subcanopy, with scattered mahoe (*Melicactus ramiflorus*) beneath it. On drier sites, there is a better developed understorey, varying in height and density and dominated by hangehange (*Geniostoma rupestre*), kohuhu (*Pittosporum tenuifolium*), and mingimingi - the last two mostly dying or dead. Ground cover everywhere is mainly litter.

6.3 Natural dynamics of and future successions in coastal kanuka communities

6.3.1 Whakatane District Council Reserve, Thornton

The kanuka population has an average age of 45 years (ranging from 30 to 65 years), having gradually invaded (over c.30 years) open sand dune vegetation. Photos from 1944 show much less kanuka, which had probably been restricted by frequent fires. Kanuka usually lives for 80-150 years, but occasionally for much longer (Druce 1966, Burrows 1973). Even if kanuka does not live particularly long on sand dunes, its average age means that the existing forest will survive for many decades yet. There is little evidence of spread by kanuka into exotic grassland (previously lupin (*Lupinus arboreus*) scrub) or pohuehue vineland along the northern (seaward) margin of the forest. Established kanuka seedlings (up to 30 cm high) occur occasionally in forest on the blowout dunes and as no other potential canopy trees are present, kanuka may regenerate indefinitely on the dune system at Thornton. Although a number of other trees occur in forest on old dunes in other parts of the country, the Thornton reserve is effectively isolated from seed sources of such species. Potentially self-replacing kanuka communities such as this are extremely rare.

6.3.2 Whale Island Scenic Reserve

The multi-stemmed and the normal populations represent "waves" of regeneration occurring at different times in different places. Average ages of multi-stemmed kanuka populations vary from 6 or less to over 30 years. Average ages of normal kanuka populations range from 7 to 18 years; other older normal kanuka populations which may have existed would have been destroyed by fires in Camp Valley in 1975 and/or 1978. A 1909 photo shows mostly spinifex (*Spinifex sericeus*) and only scattered kanuka, which had probably been restricted by frequent fires.

Kanuka invading open sand dune vegetation on exposed sites forms multi-stemmed stands, a process that is still going on in places. After 20-30 years, there is no more room for seedlings to establish, and existing plants grow slowly to maximum heights of 4-5 m, much less than usual. Where seedlings establish more densely and more quickly, some later arrivals die as stands develop (natural thinning).

Kanuka forms 'normal' erect stands where it has invaded open sand dune vegetation on sheltered sites (over 10-20 years), or sheltered sites (over 5-7 years) where previous vegetation was destroyed by fires. Some natural thinning occurs in all these stands as they develop, but is especially intense in fire-induced stands, where numbers of plants are as high as 150 000/ha in young stands (< 10 years), down to a few thousand per hectare by the time they are 20 years old. Height growth is faster than on exposed sites; ultimate canopy height may be well over 5m.

Occasional kanuka seedlings (up to 15 cm high) are present in all older multi-stemmed stands, but are absent from the dense normal stands which are younger. Unlike Thornton, the kanuka scrub/forest on the Whale Island dunes is within reach of seed sources of a variety of other trees (e.g., karaka (*Corynocarpus laevigatus*), mahoe, pohutukawa (*Metrosideros excelsa*), and ngaio

(*Myoporum laetum*), and shrubs (e.g., kawakawa (*Macropiper excelsum*), and rangiora (*Brachyglottis repanda*)), which occur on old dunes elsewhere in the North Island (Cockayne 1911, Esler 1978). Of these species, only pohutukawa and perhaps ngaio are capable of surviving on the unconsolidated dunes towards the western end of Boulder Bay, but all except ngaio are probably capable of invading normal erect stands on consolidated sands towards the eastern end. In the foreseeable future, therefore, kanuka will persist on the unconsolidated dunes, with a little enrichment by pohutukawa. On consolidated dunes, however, kanuka is likely to be largely replaced by a range of other trees, whose seedlings will establish under them as they mature.

6.3.3 Uretara Island Scenic Reserve

The kanuka population has an average age of 55 years, ranging from 30 to 75 years, having gradually invaded (mostly over c.35 years) pasture abandoned earlier in the century. (An earlier kanuka forest, presumably developing after Maori fires, had been clearfelled in 1910). Growth rates of the larger older kanuka trees are as fast as those anywhere in the country, certainly faster than on sand dunes. The average age means that the existing forest will survive for several decades yet. Kanuka seedlings are totally absent. Saplings of some potential canopy trees (mahoe and pigeonwood (*Hedycarya arborea*) are widespread; others (kohekohe (*Dysoxylum spectabile*), fivefinger (*Pseudopanax arboreus*) and puriri (*Vitex lucens*)) are much scarcer. Although small brush wattle (*Albizia lophantha*) seedlings are widespread, no larger plants were seen, and wattle is unlikely to be a significant component of the future forest (see Section 6.4.2 however). In the foreseeable future, kanuka will be replaced by these other trees; in the longer term, forest something like the existing remnants of pohutukawa forest (see Beadel & Shaw 1986) may develop in places, with pohutukawa, kohekohe, and puriri over mahoe and kawakawa.

6.4 Threats to sustainability

6.4.1 Whakatane District Council Reserve, Thornton

Three threats are perceived:

- * Cattle trampling erodes sand from the kanuka root systems, exposes them and may eventually kill them. Although fencing along the southern boundary of the reserve was completed in 1989, Taranaki gates in the fence allow continued access to the reserve, which is leased to adjacent landowners for grazing.
- * Boxthorn, present in small numbers on the seaward side of the reserve, is actively regenerating. It probably has the capacity to gradually replace kanuka as it dies. Boxthorn is a highly undesirable plant, forming impenetrable barriers for humans.
- * Fire could destroy the existing forest, allowing some aggressive weeds (e.g., pampas) to largely replace it.

6.4.2 Whale Island Scenic Reserve

Three threats are perceived.

- * Pampas grass (*Cortaderia selloana*) has the potential to replace kanuka rapidly when it eventually dies. Young plants are scattered through the dunes; most were removed in the 1989-90 summer.
- * Kikuyu grass (*Pennisetum clandestinum*) is not present, but could easily reach the island from the adjacent mainland. It is an aggressive invader of more stable dunes elsewhere in the country (e.g., Esler 1975), ousting almost all other plants. If kikuyu grass appears on Whale Island, it should be removed by herbicide (Roundup, Galant).
- * Fire would allow mass establishment of pampas, ousting kanuka more-or-less permanently from most of the dunes.

6.4.3 Uretara Island Scenic Reserve

Two threats are perceived.

- * Possums (*Trichosurus vulpecula*) are common on the island, and have the potential to alter the natural changes in kanuka forest by reducing or exterminating palatable later successional species like kohekohe. Being a small island, Uretara has good potential for being made and kept possum-free.
- * Fire could destroy the existing kanuka forest, allowing it to be at least partly replaced by brush wattle, small seedlings of which are widespread under kanuka forest.

7. CONCLUSIONS

The multi-stemmed semi-prostrate kanuka (normal variety) communities on sand dunes in the central Bay of Plenty are nationally rare and regionally unique. There are important differences between the multi-stemmed kanuka communities at Thornton and those at Whale Island. The dune systems under kanuka at Thornton are essentially stable while the dune system under kanuka at Whale Island is largely unstable with active erosion (blowouts) occurring at the western end of the foredunes and in the hollow behind them. The Thornton kanuka forest is of only one age class (30-65 years, averaging 45 years); the Whale Island kanuka forest is younger, with stands of average ages ranging from under 6 to over 30 years, resulting from fires at different times and from the unstable nature of much of the dune system.

Kanuka forest may persist indefinitely at Thornton (as it is isolated from seed sources of other potential canopy trees), and will persist on unconsolidated dunes at Whale Island (because of the unstable habitat). Normal erect kanuka forest on consolidated dunes at Whale Island is expected to be replaced eventually by a variety of other trees (e.g., karaka, mahoe, pohutukawa) and shrubs (e.g. kawakawa).

The normal erect kanuka communities on Uretara Island are similar to those elsewhere in the coastal lowlands of the Bay of Plenty and further afield, and are not nationally or regionally rare or unique. This forest is expected to be replaced by other trees (e.g., mahoe), with pohutukawa forest developing in places in the longer term.

8. MANAGEMENT RECOMMENDATIONS

- * "Recreation reserve" is an inappropriate designation for the central portion of the Whakatane District Council reserve between the Tarawera and Rangitaiki Rivers under kanuka. It should be altered to a designation where protection of biological values is paramount. Adequate access to the beach is already provided at the end of Walker Access Rd.
- * Cattle grazing should not be allowed to continue within the existing reserve at Thornton.
- * Kanuka forest on old blowout dunes is not represented in the existing reserve on Crown land at Thornton, and freehold land should be formally protected, e.g., by QE II National Trust covenant. Otherwise, cattle trampling during winter will continue to degrade the forest and may eventually destroy it.
- * Boxthorn should be removed from the existing reserve at Thornton.
- * Pampas should continue to be kept out of the Whale Island dunes. Kikuyu grass should be removed immediately by herbicide (Roundup, Galant) if it ever establishes.
- * Possums should be removed from Uretara Island by poisoning and/or trapping, to allow natural changes to proceed unhindered.
- * Permanent plots in sand dune kanuka forest, established within the last 7 years in Woodhill State Forest north-west of Auckland should be remeasured and analysed.

9. ACKNOWLEDGEMENTS

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