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Maori Settlement and Horticulture on the Rangitaiki Plains, Bay of Plenty, New Zealand

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ABSTRACT

The Rangitaiki plains illustrate a range of adaptive strategies used in Maori settlement of an area renowned for swampy conditions. The extent of naturally induced alluviation on the plains rules out any prospect of deliberate manipulation of landscape conditions to achieve habitats suitable for human settlement. Rather, human settlement exploited particularly favourable localities either on the alluvial fans, or where river courses intersect a coast-wise sequence of ash-mantled dunes. Settlement and horticulture occurred in the vicinity of Whakatane township; on the west side of the Whakatane River opposite the township; at Thornton, adjacent to a former course of the Rangitaiki River; and adjacent to the lower Tarawera River. The fan and levees of the Tarawera River, consisting of coarse, free-draining ash alluvium, were extensively used for gardening. The principal locality of gardening on the Tarawera fan was in the Onepu vicinity. The fans and levees of the Whakatane and Rangitaiki Rivers were relatively little used because of heavy soils and poor natural drainage.

Key words: PRE-EUROPEAN, NINETEENTH CENTURY, KUMARA STORAGE PITS, NGATI AWA, WHAKATANE, THORNTON, KAWERAU, KOPEOPEO LOAMY SAND, KAHAROA ASH, ALLUVIUM, DUNE SOILS.

INTRODUCTION

This paper offers an analysis of Maori settlement and horticulture on the Rangitaiki plains, using fresh data gathered in the course of a wider survey of the Whakatane district in October–November 1986, and reviewing the site records and the few published sources for the district. The broader settlement evidence is summarised, particularly for the surrounding hill country (see especially Fig. 1), because it is more than incidental to the examination of horticulture and horticultural potential on the plains.

The Rangitaiki plains have long attracted attention as the setting for an extensive series of swamps from which very important wooden artefact assemblages have been derived. There have also been detailed surveys and/or investigations of settlement and horticulture in the low-lying hill country to the south-west of the plains (Lawlor 1983a, 1983b), and in inland areas of the Whakatane River (Jones 1986). In key areas such as Whakatane township or Te Teko, however, localities in which there are well known concentrations of *pā* (Moore 1973; Mabon *et al.* 1964), nothing is known of horticultural distribution or practice.

Agriculture and horticulture on swamplands have been the subject of much work in wider Pacific archaeology, with particular attention paid to taro and sweet potato horticulture in Papua New Guinea (for reviews, see Farrington (ed.) 1985; Golson and Gardner 1990). In New Zealand, such studies are in their infancy (Barber 1984; 1989), with by far the greatest

concentration of effort on horticulture on land with dry, particularly stony substrates (Leach 1979, 1984: 50).

An initial difficulty is posed by the prospects for horticulture of two of the prehistoric crops introduced to New Zealand, kumara (*Ipomoea batatas*) and yam (*Dioscorea alata*), in a district widely regarded as simply a 'swamp'. Neither of these two crops is regarded as suited to poorly drained ground, unlike taro (*Colocasia esculenta*). The writer has also considered the nature of hill country and alluvial gardening in the eastern North Island. Naturally well drained landforms, natural levees, alluvial fans, and elevated terrace landforms generally, appear to have been preferred (Jones 1986, 1988). In those areas (Gisborne and inland Whakatane), little attention was paid to very low-lying land near the mouths of the major rivers.

This is a matter of some importance in New Zealand archaeology since it has long been recognised that swamps, or rather large low-lying alluvial plains, have been very important in the New Zealand Classic Maori Phase (see Best 1980). Climatic amelioration in near-coastal localities alone may be sufficient to explain horticulture where it occurs, provided physical manipulation of soils was feasible in a subsistence economy. However, there may be other systematic locational strategies exercised by pre-European Maori, allowing settlement in areas otherwise not apparently attractive for subsistence based on a suite of root crops made up, in its most important elements, of dryland crops. This paper examines whether there really was gardening on swamps on the Rangitaiki plains. If not, where was the gardening carried out? If on swamps, were there physical soil manipulations or seasonal changes in water tables that need to be considered?

An influential model of pre-European valley-floor gardening, following on from the destruction of hill-gardening potential, has gained wide currency in Oceanic prehistory (Spriggs 1982, 1985). Some localised effects of human activity, such as influxes of charcoal (McGlone 1983) and wind-borne sand into swamp deposits, arising from human disturbance, may be observed in New Zealand. Nevertheless, in the Rangitaiki case, anthropogenic effects on alluviation (if not on forest cover) can only have been small compared with the effects of massive but episodic influxes of volcanic tephra carried by large rivers draining the areas where tephra fell. Given the size of New Zealand, this situation may be inferred to have occurred elsewhere. If a locational strategy can be identified which simply takes account of natural features in very large areas of poorly drained country, then the need to invoke anthropogenic alluviation as an adaptive strategy, conscious or not on the part of pre-European Polynesians, is weakened.

SETTING AND HORTICULTURAL POTENTIAL (Fig. 1)

This section of the paper seeks in part to identify natural landforms of the Rangitaiki plains which could be used, without drainage modification, for horticulture.

Immediately following the sea-level rise at the end of the Pleistocene, the area of the Rangitaiki plains was a large embayment about 20 km across and running 10 km inland and deep. Two major fault lines run north-south, creating the former embayment and forming the courses of the Whakatane and Rangitaiki Rivers (Nairn and Beanland 1989). The Taupo and Okataina (Mount Tarawera) volcanic zones lie south-west and west of the plains and have fed large volumes of ash alluvium into the embayment from their various Holocene eruptions (Healy, Vucetich and Pullar 1964). The greatest proportion of this ash was carried by the Rangitaiki and Tarawera Rivers in the middle and west of the embayment,

respectively. The ash created new river-levee surfaces and, as it progressively filled in the embayment, isolated inland dune surfaces in a seaward-trending chronosequence of dunes. The dune surfaces were created by longshore drift. Both levee and dune systems have significance for an understanding of human settlement on the plains.

The fans of the westernmost rivers (Rangitaiki and Tarawera) eventually overtopped the inland dunes, which survive in unaltered form only in the east, off the backslopes of the natural levees of the Whakatane River. The shoreline had stabilised in about its present position by the time of the Taupo eruption, 1900 years B.P. A belt of dunes with a mantle of Taupo ash lies about 600 m from the present coastline. This constituted a stable higher-profiled barrier which forced the Rangitaiki River to swing westwards, through several changing distributaries, eventually entering the sea near Matata after merging with the lower course of the Tarawera River. A smaller distributary of the Rangitaiki River ran east towards the mouth of the Whakatane River (Pullar *et al.* 1978; Pullar 1985).

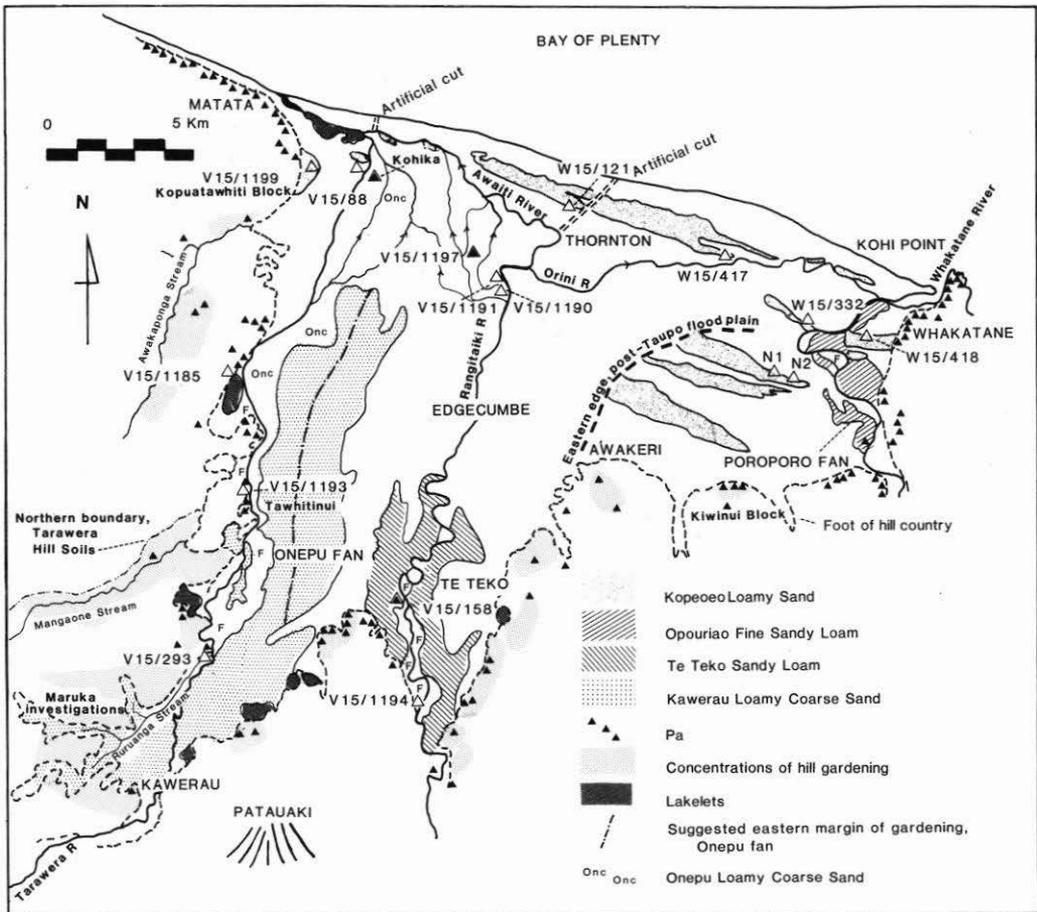


Figure 1: Localities, sites, generalised geomorphology and soil distribution on the plains after Pullar (1985; Pullar *et al.* 1978) and site record data. F: modern flood plains.

The plains had many areas of low-lying, poorly drained floodplain and lakelets, extensively drained after World War I, mainly by shortening the lower, meandering river courses and introducing flood overflow mechanisms (Gibbons 1990). Swamps, lakes and areas with high water tables comprised large areas of the dune swales and backslopes of the river levees in the pre-European period, particularly on the western side of the plains.

In previous papers, the writer has stressed the importance of alluvial fans in the horticulture of the eastern region (Jones 1986, 1988). The physical conditions of the three major fans of the Rangitaiki plains varied greatly one from the other. The levees of the Rangitaiki River are very narrow and its wider post-Taupo flood plain is relatively poorly drained because of slumping and compaction of the great depth of sediments along the principal fault line (Nairn and Beanland 1989). The area available for dryland horticulture was therefore relatively small compared with other areas of the plains. At time of first human settlement, it would have had extensive areas of bog vegetation, dominated by a *Leptospermum* (manuka) shrubland. Lowland podocarp trees (*Dacrydium*) existed in the vicinity of these bogs, in the surrounding hill country (Campbell *et al.* 1973), although the presence of podocarps on the small areas of well drained ground on the former dunes may also be inferred.

On the Tarawera River fan, the extremely coarse nature of the sediments from the Kaharoa eruption indicates (a) less susceptibility to settling; and (b) well drained surface soils, even although water tables were high. Although these physical conditions have significance for the horticultural potential of the fan, its fertility status is less certain. At about 600 years B.P., a possible date for first human settlement, they would only just have been deposited as a vast floodplain, looking similar to the great outwash plains of the glaciers of the South Island. Even shrublands may not have established within 50 years of the eruption, because of the considerable extent of the fan. Maori settlement and horticulture was possible only following a period of weathering of the surface, maturation of soils and shrubland/forest, the continuing deposition of levee soils, and the formation of localised peat deposits.

The Whakatane River fan, at Poroporo, on the east of the plains, is composed of very fine alluvium and covers a small area. In this case, the interior Opouriao plains have acted as a sump for much of the solids load of the river, with a massive fan formed on the margins of the Urewera Range, some 18 km further inland. This was an important site of nineteenth century and inferred earlier settlement (Best 1925a: Vol. 2, maps; Jones 1986).

CLIMATE

The plains lie in a north-facing basin, and have a particularly favourable climate for horticulture, recognised as being similar to that of Northland (Aldridge 1985). However, the risk of frost, particularly in the growing season, October–May, needs to be considered.

Ground frosts which would affect a kumara crop are very site-specific in their incidence. The swales of coastal dunes, for example, could suffer a frost while the crests were free. The general pattern of ground frost in the Urewera Region is presented in Table 1. Areas with low incidence of frost are Kawerau, Edgecumbe and Whakatane. Particularly noteworthy is the high incidence of frost at Whakatane Airport which lies on the principal, latest pre-Taupo dune line, which will be the subject of discussion in this paper. It is the only climate station in this location. However, it is highly anomalous. The station (i.e., the airport) is on an artificially levelled surface, separated from the sea by a consistently high

TABLE 1
AVERAGE YEARLY INCIDENCE OF GROUND FROSTS
FOR STATIONS IN THE EAST CAPE REGION
 (after New Zealand Meteorological Service, n.d.).

No. Days = average days of ground frost.

Locality	No. Days	Comments
Kawerau	25	On river flats in valley opening to Rangitaiki Plains.
Te Teko	24	On plains off Rangitaiki River levees.
Edgecumbe	24	On plains on Rangitaiki River levees.
Whakatane	15	On plains on dune crest and levee 2.5 km from sea.
Whakatane Airport	56	On artificially levelled dune, separated from sea by dune crests.
Murupara	75	On Rangitaiki River flood plain, 60 km from coast.
Minginui	132	Enclosed valley floor in Ureweras, 70 km from sea.
Onepoto	38	On saddle to south of Lake Waikaremoana.
Waimana	60	On broad flood plain enclosed by hills, 15 km from coast.

dune-barrier. Both factors lead to poor cold-air drainage. They do not apply to the natural dune crest to as severe a degree, especially where the dunes are adjacent to rivers.

The inland valley floors, such as Waimana or Minginui, have a high incidence of frost. By contrast inland ridges can have very few frosts, e.g., the Onepoto vicinity near Lake Waikaremoana. This pattern of frost risk, and the pre-European positioning of horticultural plots in response to it, is discussed more fully for the Opouriao and Waimana plains elsewhere (Jones 1986). Another important localised event is the katabatic wind which affects the fans of the Whakatane and Rangitaiki Rivers. This is created by the ponding and movement of cold air off the Urewera Ranges into the inland valleys and plains; it is manifested in anticyclonic weather patterns as a chilling morning breeze at points near the river at the inland margins of the plains, i.e., on the principal alluvial fans. The effect of this breeze on growing-season length may have been considerable.

HORTICULTURE ON THE PLAINS

Archaeological evidence for horticulture on the plains is in four forms:

(1) localised presence of kumara storage pits, rectangular semi-subterranean pits originally roofed over, which may show on the surface or as rectangular outlines in section or in plan;

(2) disturbance of airfall ash layers, including the mixing and displacement of volumes of the tephra-derived sandy loams from the crests of dunes;

(3) blackening caused by the introduction and comminution of charcoals in areas disturbed by prolonged gardening as in (2); blackening may also occur in soils occupied by fern and is in its own right direct evidence for burning or horticulture or both;

(4) adding of gravels to topsoil, or the exploitation of topsoils with gravels, typically on fans which have been overtopped by large floods.

In addition to these four, not all of which will apply to any one site, general physical factors such as the length of the frost-free season or seasonal variations in water table will rule out some areas in which soils might otherwise be regarded as suitable. This list of criteria may be subject to criticism on the grounds that it does not include what some suggest to be unambiguous positive evidence of horticultural practice, such as the placement of stones in rows or mounds, or the presence of drainage ditches or trench-boundaries of the types recognised elsewhere in New Zealand. In the writer's opinion, the stone features as criteria cannot be of relevance in regions with few areas of stony soils such as the Bay of Plenty or East Coast. Trenches are the subject of much conflicting interpretation in their own right (see Barber 1989), a problem that will be returned to in discussion. However, it is worth noting that ditches for drainage imply not just soils water-logged throughout their profile, but also usable changes in relief for the drainage or water-concentration effects to occur. This condition is not met in the impounded low-lying alluvial context of the Rangitaiki plains, except in the vicinity of Kawerau.

A minor difficulty arises because pits on or near river banks may have been used to store crops brought in by canoe from other localities more favoured for gardening (Jones and Law 1987: 107). Leaving aside the question of whether there were localities more favoured than those to be discussed, this suggestion is on balance unlikely. There is a high density of pits manifested in the key sections indicating a large volume of crops which would be both difficult to transport from any distance, and impossible to defend at locations remote from primary settlements.

Some objection may also be made to the use of topsoil disturbance as a criterion for gardening, particularly of dune soils, on the grounds that this could be due to natural causes such as windthrow of large trees with subsequent wind erosion. Pullar *et al.* (1978: 41) make reference to disturbance of this kind in some localities. In many of the cases described here, human intervention triggered, and continued to interact with, natural erosion and re-working processes. Nevertheless, the interpretations and conclusions relating to gardening are based on the overall balance of the evidence and the likelihood of natural agents being the sole cause of disturbance is very low.

The survey localities will be discussed from the Whakatane River westward in two major parts of the paper. Sites on the tephra-covered, inland dunes will be described in the first part; the fans and levees of the principal rivers in the second part. Setting and site locations for both parts are shown in Figure 1.

Interpretation of the derivation of ashes in the soil profiles is based on general stratigraphic principles and the author's experience of these as they occur in profiles, and confirmed by reference to the relevant published soil profiles (Pullar *et al.* 1978; Pullar 1985).

PART 1: INLAND DUNES

In the course of the survey, an opportunity was taken to inspect available sections in the vicinity of Poroporo, on one of the most inland of the belts of dunes. These dunes were anticipated to be unaffected by human activity; unlike the coastal dunes, they were some distance from the river course and were probably heavily forested throughout pre-European times. The sections concerned were exposed in the banks of the Te Rahu canal and in a silage pit off Selwyn Road, both about 1.5 km from the Whakatane River (Fig. 1, indicated as N1, N2; Grid References W15/573514 and 564513 respectively). The soils are Kopeopeo Loamy Sands, described at the nearby type locality (Pullar *et al.* 1978: 41–44) as having 20 cm of topsoil over some 25–30 cm of tephra of various discrete ages. At both localities, intact tephra lying on the original dunes was within 50 cm of the surface and had not been disturbed; no charcoals had been introduced into the loamy topsoils.

Gardening or other form of human disturbance therefore appears not to have been undertaken in this locality. Although this is a negative result, it offers a useful contrast to the widespread existence of disturbed and cultivated sandy loam topsoils elsewhere on the plains.

KOPEOPEO PITS (W15/418)

These rectangular pits were exposed in a section on the crest of the inland dune comprising the elevated built-up part of Whakatane township. They are in the original settlement-area of Whakatane, having the locality name Kopeopeo (Coates 1955–6). (The present central part of Whakatane, closer to the narrow estuary, is built on a strip of land reclaimed at the turn of the century.) The crest of the dunes runs to the south of and parallel with James Street (for location of James Street, see Pullar *et al.* 1978: maps). Pullar (1985: 43) had noted widespread disturbance and destruction of the tephra layers of the Kopeopeo Loamy Sand, the soil type formed on the inland dunes, in this vicinity. Figure 2 shows a photograph of the section through three unambiguous pits and several more in which the sides have collapsed. The third pit from the left of the section has an infilling which includes a lens of the original pumice loam topsoil, while the present topsoil is a much-disturbed dark grey sandy loam. An argillite chisel made on a flake occurred in the latter disturbed topsoil. The pits are therefore probably prehistoric in age. There was insufficient charcoal in the fill of these pits to warrant radiocarbon dating, even if its context in fill had been deemed adequate.

PUPUARUHE PITS AND SITE COMPLEX (W15/332)

Pupuaruhe is noted as a *kāinga* in Elsdon Best's *Tuhoe* (1925a: Vol. 2, maps). The site is about 700 m west of the New Zealand Forest Products mill. To judge from exposures in stock rubbings, the site covers an area of several hectares. It lies on a continuation of the line of dunes discussed in the context of site W15/418 at Kopeopeo.

The dunes are of the same approximate age (pre-Taupo) and distance from the sea, but lie west of the Whakatane River. Soon after the Kaharoa eruption at approximately 700 B.P. (McGlone 1980), the river (possibly a distributary) had swung to the west around this line of dunes, although today the river course runs to the east. The abandoned channel is cut by

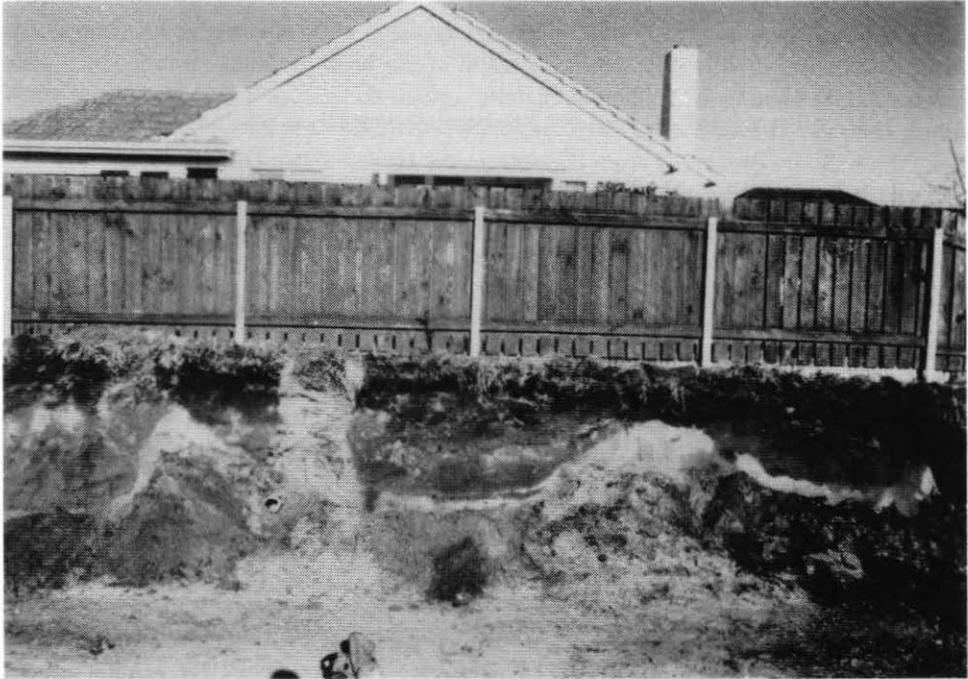


Figure 2: Photograph of section through pits (W15/418), James Street. Photograph: Kevin Jones.

the Whakatane/Te Teko highway, with distinct layers of Kaharoa Ash showing in the walls of road drains cut through the original river banks (see also Pullar *et al.* 1978: maps). The western part of this line of dunes has therefore been close to the river for some time in the last 700 years, although it is now some distance from it. On purely locational grounds, therefore, the dune has been well positioned for Maori settlement.

In the course of monitoring gas-pipeline installation in September 1986, an area 125 x 8m running across the dune was stripped using a hydraulic excavator. Disturbed topsoils were stripped to a depth of up to 40 cm until features on the subsoil surface below began to show. At the crest of the dune, the area was widened to 18 m to allow for batters in the deepest part of the cut. Surface evidence such as scattered shell and obsidian occurred over the rest of the dune for at least 350 m from its eastern end. The plan of several kumara storage pit complexes, ditch and bank fences, and occasional plough marks were recorded on the subsoil surface. The extensive stratigraphic sections recorded after further excavation are shown schematically in Figure 3. They may be summarised as follows.

(1) Fine alluvial silt loams mantle the river side of the dune. These are Opouriao Fine Sandy Loams (Pullar *et al.* 1978: 22–27).

(2) Disturbed Kopeopeo Loamy Sands lie on the crest of the dune, but with some extant tephra subsoils and sand pans overlying unweathered dune sands.

(3) Kumara storage pits had been dug through the tephra or disturbed soils extant at the time of occupation and no more than 50 cm into the unweathered sands. The latter would have provided free drainage for the base of the pits (Fig. 4).

(4) The tephra and weathered sand crust had broken on the side of the dune away from the river and adjacent to the swale lagoon, probably accelerated by human activity on the crest.

(5) In the swale there was a complex sequence of peat deposition, layers of Taupo and Kaharoa Ash, prostrate tree trunks. At the surface were the erosion products from the dune.

Of these features, the last (5) warrants discussion in further detail, since it is the best guide to the chronology of a site which did not otherwise have materials suitable for dating a reasonable sequence of activity. In the upslope part of the section (Fig. 5), the disturbed charcoally sands were sealed at one point by a lens of Tarawera Ash. In the lowest part of the swale, Taupo Ash lay in swamp clays. The swamp deposits were sealed by a distinct layer of Kaharoa airfall ash overlain by a thick deposit of Kaharoa alluvium. Large tree trunks with burnt surfaces lay prostrate in the alluvium, which also had charcoal interspersed throughout. The Kaharoa alluvium included a pink layer, probably diatomite (the secretions of a single-cell plant which thrives in water enriched by the silica from volcanic ash (Pullar 1985: 36–37)). Above the diatomite were layers of alluvium with charcoal, and lenses of oven debris. There were occasional lenses of grey dune sand interleaved with the oven debris. The surface of the swale was a continuation of the black or dark grey, sandy plough-zone topsoil noted on the crest of the dune, particularly thick at the foot of the slope leading from the dune to the swale. This is indicative of extensive ploughing continuing into this century.

The broad chronology of the site can be inferred from this section. There was no occupation before the Kaharoa ashfall, since this would have moved sand and charcoal into the swale before the deposition of the ash. Following the ash fall there was a massive fire through the standing forest of the swale and presumably a then-extant forest on the dune crest. This is consistent with the model of weakened tree canopy and vigour proposed by McGlone (1980: 80–86). McGlone (pers. comm. 1990) has also concluded that the filling of the plains with Kaharoa alluvium was a rapid event. The ash-derived topsoils (Kopeopeo Loamy Sands) of the dune were broken after the Kaharoa alluvial episode, as indicated by the existence of unweathered sands moving into the swale soon after the infilling with Kaharoa alluvium. The disturbance of topsoils, and the wind-aided movement of sands, were both primarily caused by human occupation and horticulture on the dune surface. Considerable volumes of sand must have been entering the swale from about 500 years B.P. or 200 years after the Kaharoa eruption.

In the nineteenth century, ploughing was being practised on the dune, forming distinctive, somewhat irregular, criss-crossed furrows on the subsoil surface at the southern end of the site. A ditch and bank fence or fences were also constructed on the crest of the dune.

THORNTON SITE COMPLEX (W15/121) (Fig. 6)

The Thornton site complex lies on a section of the pre-Taupo dune barrier near the lower course of the Rangitaiki River. The area is distinguished as a dune island or non-swampy land in a map of 1866–67, prepared by H. G. Wrigg (reproduced by Gibbons 1990: 2). At

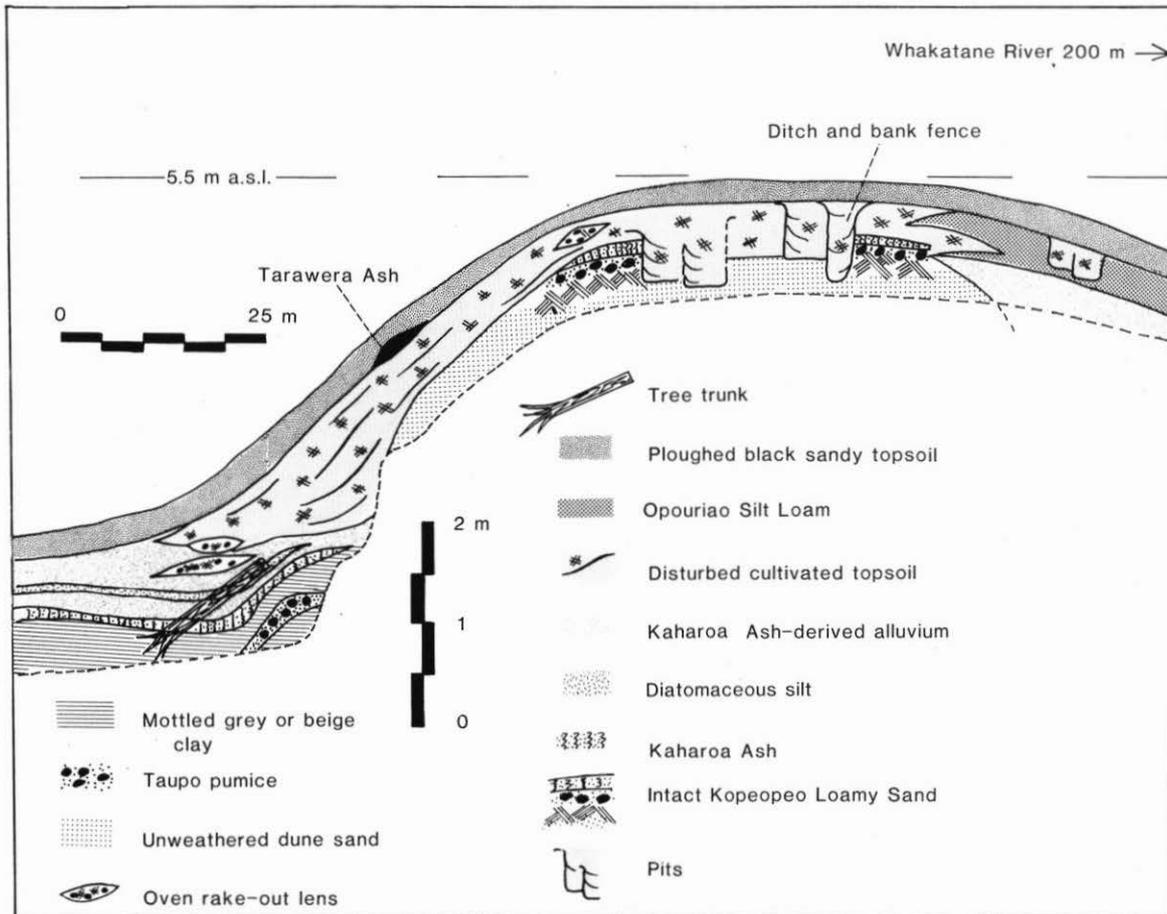


Figure 3: Schematic section through Pupuaruhe (W15/332).

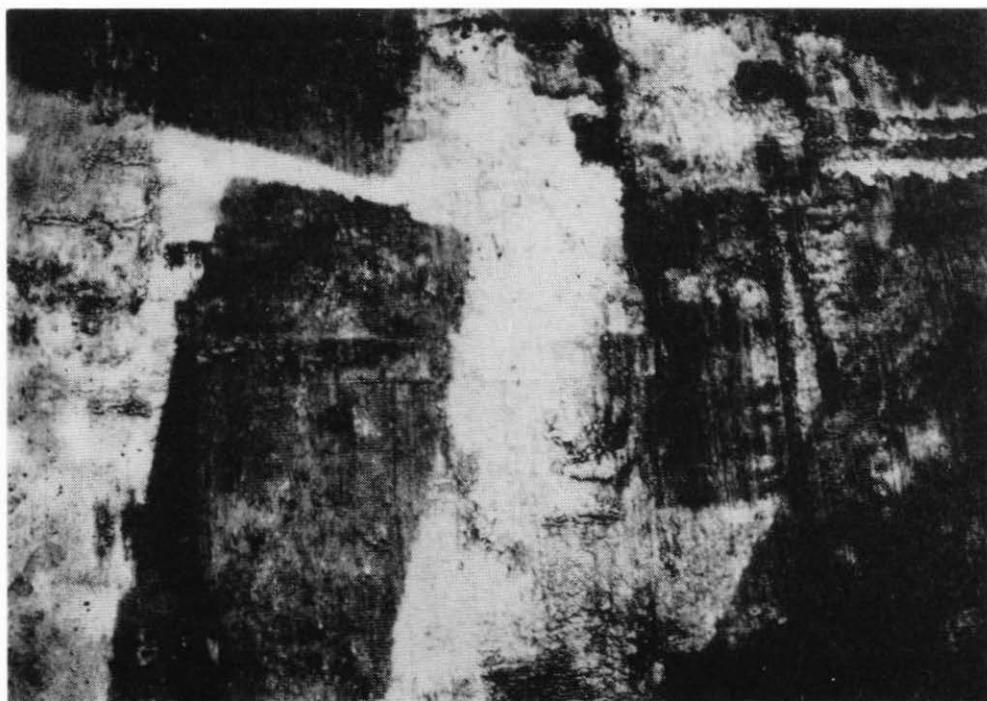


Figure 4: Pits exposed on the surface of unweathered dune sand at Pupuaruhe. Photograph: Kevin Jones.

and following the time of the Kaharoa ash eruption, the coastal dune barriers had forced the lower course of the Rangitaiki River into two distributaries: the smaller Orini River ran east into the Whakatane River estuary, while the Awaiti River ran west, merging with the Tarawera River and entering the sea at Matata. The distributaries took their courses away from the main river at various points up to 6 km from the sea (Pullar 1985: 22–23). Over much of the period of human occupation some flowed close to the inland margins of the dune barriers, coating them with alluvium in periods of flood, as was also the case at Pupuaruhe. Access to the elevated dune area could therefore have been via the river, the mouth of which is no more than 10 km from the dunes, or across the coast-wise line of swamps. In the earlier part of this century, both the Awaiti and Orini distributaries were dammed and a channel cut through the dunes at Thornton to allow an outlet for the Rangitaiki River direct to the sea (Gibbons 1990: 58–63).

In the 1960s, in the course of drainage activities, an assemblage of well preserved wooden artefacts was recovered from an area immediately to the north of the pre-Taupo dune at Thornton and west of the cut channel (Pullar 1961). These included a dis-assembled doorway surround (illustrated by Mead 1984: 200), flat-bladed digging sticks ('spades'), and other items. The spades are in the possession of Mr Moore, the owner of the swamp area, and have been photographed by the writer. They are similar to the spades in Elsdon Best's *Maori Agriculture* (1925b; Fig. 16) with a pronounced shoulder to the blade; however, unlike Best's examples, they have a distinct point at the proximal end of the shaft.

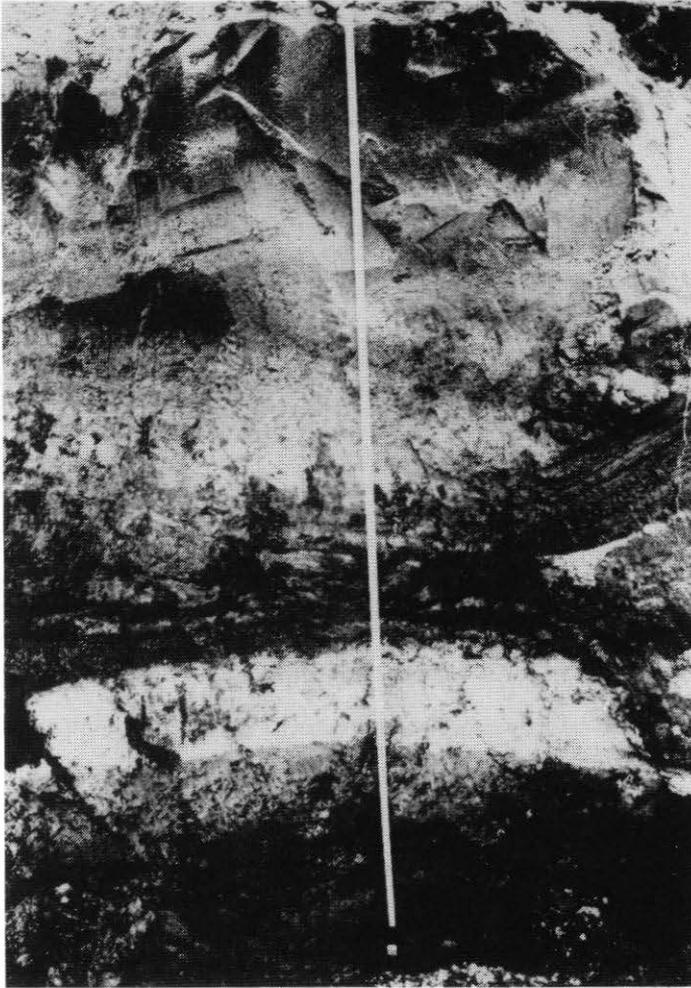


Figure 5: Swale section, Pupuaruhe. From bottom: grey clay, Kaharoa Ash (white), Kaharoa alluvium, black sandy topsoil. Photograph: Kevin Jones.

These finds attracted cursory archaeological attention to the adjacent dunes. Pullar's (1961) record of the section, indicating Thornton occupation-materials lying under Kaharoa Ash, was subsequently retracted (Pullar 1967). (It must be remembered that these were the years of Pullar's pioneering identification of this and other ash showers, including mistaken identifications on Kapu te Rangi, not fully analysed and published until Healy *et al.* (1964)). In the intervening period, Shawcross (1965) cut a section from the dune into the swamp. His analysis adds little to the present study, but the basic description offers a useful section in the swamp itself.

At the time of the 1986 Whakatane survey, the area immediately south of Moore Road had been planted in a shelter belt and ploughed preparatory to planting crops. An area of some 4 ha on the southern side of the dune crest had been exposed and it was possible to

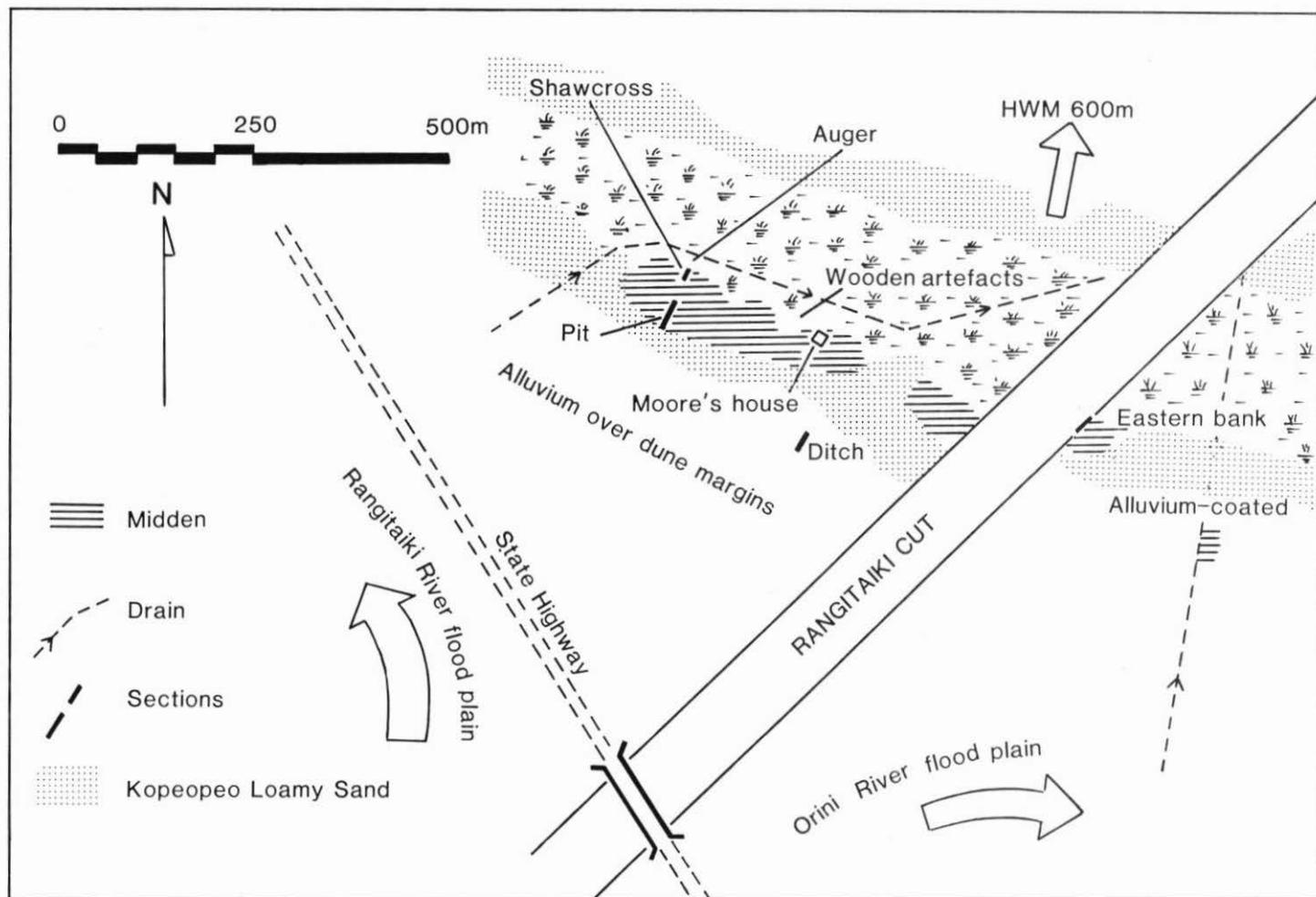


Figure 6: Archaeological sites in the Thornton vicinity. The geomorphology is simplified after Pullar (1985).

determine the extent of the blackened soil and midden on the dune. The blackened area was some 50 by 10 m on the ploughed inland (southern) crest of the dune, and showed in cattle rubbings over much of the northern face of the dune, an area of some 350 by 50 m continuous down to the northern swale. The total area of the site was therefore about 2 ha.

A section was dug transverse to the line of the dune in the southern blackened area during the 1986 survey. Mr Moore, the occupier of the area north of the road, subsequently pointed out to the writer the approximate position of the Shawcross section; by chance it happened to be in about the same line across the dune as the one cut in the 1986 survey. Sections were also recorded in a drainage ditch on the block and in the eastern bank of the artificial Rangitaiki River cut. In November 1988, Dutch soil-auger soundings were also taken in the area of the former swamp adjacent to Shawcross's section.

Figure 7 summarises the five sections from the Thornton area. They include Shawcross's section, the auger soundings, and one from a similar topographic position on the eastern banks (i.e., across the river) from the Rangitaiki River cut. There is also a column section from a drain downslope to the south from the other sections and in the alluvial zone of the main Rangitaiki River distributary, the Awaiti River.

The key part of the section is the group of intercutting pits. These had been cut through the original ash subsoil to the free-draining unweathered sands below, like the Poroporo and Pupuaruhe examples. Various layered fills occupied the pits, including several lenses of tuatua (*Paphies subtriangulatum*) for which a radiocarbon age from pit B has been obtained. This has a conventional radiocarbon age of 595 ± 50 years B.P. (NZ 7543, $\delta^{13}\text{C} +1.3 \pm 0.1\%$), with a marine calibration of Cal. A.D. 1647–1795 (1 σ limit, 68% confidence) and Cal. A.D. 1553–1860 (2 σ limit, 95% confidence)¹. Pit B had been cut into Pit A, and the shell was in concentrated uncrushed form, so this date provides a close minimum age for the building of pits on the dunes at Thornton. The pits are clearly associated with an important and dominant period in the occupation of the dune.

Pit C had been cut in an area where alluvium had subsequently been deposited and its southern margin was unclear. The pit had collapsed, compacting the fill which suggests a rise in the water table following use of the pit, perhaps in a winter flood.

At the top of the section was a thick (40 cm) deposit of re-worked, black sandy soil indicative of considerable instability of the dune surface from a combination of wind and human activity. This re-worked black sand with much shell and ovenstones had a lens of Tarawera Ash below the plough zone, so that at least a proportion of the disturbance had occurred prior to 1886.

The re-worked black sandy soil of the pit section is similar to the secondary deposit of crushed shell in black sand described in Shawcross's (1965) section as lying on swamp-deposited clay (probably a clay silt derived from Kaharoa ash of secondary, i.e.,

¹Conventional ages may differ from previously published figures, and are derived from the current records of the Nuclear Sciences Group, Physical Sciences Division, New Zealand Department of Scientific and Industrial Research. Measurements made before 1988 have been recalculated by the Radiocarbon Laboratory in accordance with the recommendations of Stuiver and Polach (1977) and stored on a database. From 1988, all results since NZ7543 have been reported by the laboratory in strict accordance with the Stuiver and Polach conventions. The confidence intervals are calibrated ages according to the computer program by Stuiver and Reimer (1986), run by B. G. McFadgen using Method B. Marine correction under Method B (NZ7543 only in this paper) is used with $\Delta R = -31 \pm 13$ (McFadgen and Manning 1990).

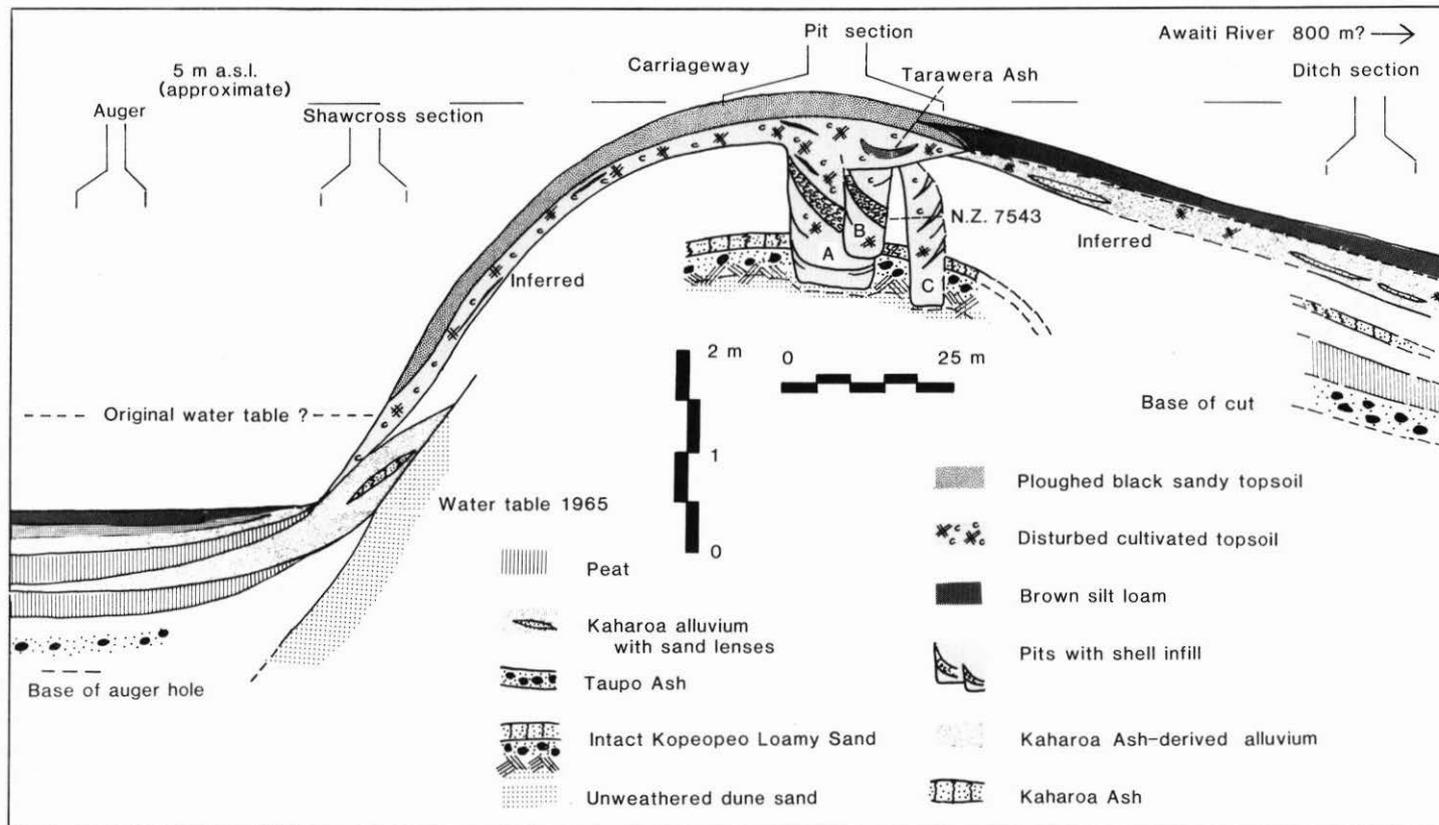


Figure 7: Schematic section through dune at Thornton (W15/121).

alluvial or lacustrine, origin). The shell is described by Shawcross as broken and forming a secondary deposit.

The section in the drain to the south of the dune shows the charcoally alluvium occurring down to 50 cm below the surface with lenses of disturbed sand blown from the crest of the dune. This lies above eroded sand (incorporating Kaharoa Ash at about 90 cm below surface) which in turn lies on peat with large lapilli at the base. The lapilli are interpreted as Taupo in origin, possibly water-rafted; there appears to have been no opportunity for Kaharoa lapilli of this size to be in the Rangitaiki River, except in the unlikely event of having been driven west along the dune lakes. As such, their chronological significance is simply that of a maximum age for the base of the section.

Preliminary results of pollen samples taken from a section in this drain, close to but not identical with the described section (no rafted pumice at base below water level), show a seral manuka (*Leptospermum*) and bracken (*Pteridium esculentum*) dominated profile throughout (McGlone pers. comm. 1990). Although sedges were also present, this profile differs from those of Campbell *et al.* (1973) in which bracken is not present because of the light-exclusion of the manuka canopy. Further interpretation of this profile is not warranted until radiocarbon dates are obtained on the peat, except to note that McGlone stresses that the results are very similar to the post-Kaharoa pollens at Kohika. The prime point of interest yet to be determined is the age of the onset of localised burning, and whether that burning takes potential settlement at this site back to an age earlier than that to be discussed for the pits. A puzzling point about all the deeper Thornton swamp sections (three in total) is the absence or apparent absence of airfall Kaharoa ash. In this vicinity (30 km from the vent) this should have existed in layered sequence with up to rice-sized grains in some layers, as occurred at Pupuaruhe.

In the Shawcross section, a lens of white ash (probably Kaharoa) lay at the bottom of the grey silts overlying dune sand (Shawcross 1965: 188–89). Further from the shoreline into the swamp, the auger soundings were valuable because they showed the peat deposits in which the Thornton artefacts are likely to have occurred. Towards the base of the auger column, there was a layer of coarse vesicular pumice (Taupo ash). This lay at 160 cm below surface in a grey clay silt. Above this was a 60-cm thickness of brown, little-decomposed peat with a layer of grey silt at 60–80 cm below the surface intercalated with the peat. The peat was sealed by thin layers of grey silt, Tarawera Ash, and a brown silt loam. Figure 7 shows a tentative relationship between the auger soundings and the Shawcross section. The peat should be particularly noted; it may be inferred that this was the stratigraphic position from which the Thornton artefacts were derived. Wooden artefacts would have been deposited and preserved in the upper surface of the peat above any likely occurrence of Kaharoa Ash. The age of these artefacts will therefore be that of the associated dune settlement, i.e., late pre-European seventeenth or eighteenth century in age, consistent with the "Puawaitanga" (Classic Maori) ascription of Mead (1984: 200).

The Shawcross section is in a similar topographic position to a naturally exposed section on the eastern side of the Rangitaiki River cut (refer Fig. 6), enabling a more definite interpretation of its place in the general section across this important dune. The south drain, Shawcross and eastern cut sections are similar to that characterised as Paroa Silt Loam on Peat (Pullar 1985: 65).

COMPARISON OF PUPUARUHE AND THORNTON

The Pupuaruhe and Thornton sections are similar, and warrant some comparative discussion. Both have pits cut through ash subsoils, filled with sand and midden (albeit sparse at Pupuaruhe), and sealed by re-worked deposits from the unstable sandy soils of the surface of the dune. The Thornton pits are dug to an apparently greater depth, although the actual depth below the Kopeopeo Loamy Sand B horizon is about the same. This suggests either greater modern stripping of the Pupuaruhe site by modern ploughing, or a greater depth of surface secondary deposits on the surface at Thornton at the time the pits were dug.

On the inland slopes, both dunes are coated with a considerable depth of alluvium with some charcoal fragments or other traces of occupation above Kaharoa alluvium. On the seaward side, Kaharoa alluvium had broken into the coast-wise chain of lagoons before human occupation, since it underlies secondary deposits created by human activity on the adjacent dune crest. Each of the dune sections, including that at Kopeopeo, has its own virtues in respect of detail, but in all cases the presence of pits on the dunes is clear, despite the unstable surface deposits of sands consequent upon the use of these soils for horticulture and the breaking of the ash cap. All the occupation, including the gardening and the earliest traces of charcoal, post-dates the Kaharoa eruption. The exact span of time separating these events is not clear. However, the Kaharoa alluvium would have been deposited fairly rapidly after the eruption, so the human occupation could be as old as 600 years B.P.

ORINI RIVER OUTLET (W15/417)

The Orini River is the distributary of the Rangitaiki River which flowed east. It begins to cut seaward through the inland line of pre-Taupo dunes some 1200 m from the coast and 5 km west of the mouth of the Whakatane River. The locality is indicated as an area of settlement in the Wrigg map of 1866-67 (Gibbons 1990: 2); the site is there named as Rakauhere or Pakauhere.

Over an area of at least 1 ha there is sparse midden exposed in breaks in a brown sandy topsoil. Test pits showed 20 cm of brown sandy topsoil overlying 20-30 cm of shell, charcoal and ovenstones of varying density in a dark brown or black sand. This lies either on the ash subsoil of the Kopeopeo Loamy Sand, only occasionally present, or on unweathered brown sand. Because of the limited nature of the test pits on this site, the presence of storage pits could not be established. The general lack of the ash subsoil and the presence of re-worked sands on top of the black soil in many of the test pits does, however, indicate disturbance caused by human activity, accelerated by wind-stripping following probable cultivation and settlement of the area.

DUNES IN THE VICINITY OF THE LOWER TARAWERA RIVER

On both sides of the lower Tarawera River there are several areas of dunes, mapped as Kopeopeo Loamy Sands. They are approximately 800 m from the coast, and the modern Whakatane/Tauranga highway runs along the line of their crest. These dunes were named, as if the site of settlement, on the 1866-67 Wrigg map (Gibbons 1990). (The published names are indecipherable.) The modern township of Matata is in a similar setting, except that it is no longer on the banks of the Tarawera River, following its diversion seawards in

a more direct course (Pullar 1985: 22–23). Inland from these dunes on the eastern side of the main Tarawera River was a lakelet, named Okahu on the Wrigg map. The lakelet and surrounding low-lying ground were isolated both by the main river to the west and by an eastern distributary of the Tarawera River, the former Awaiti Paku Stream.

On the south side of the lakelet, lying in an east-west belt, was a series of small islands, the surfaces of former dunes. These lie on either side of the river, and are presumed to be part of a dune belt, heavily truncated and submerged by alluviation, which ran in this approximate position (2 to 2.5 km from the modern shoreline) across the plains. (At its westward extremity, this is also the dune at Pupuaruhe (see Pullar 1985: 28–33, especially sections C and H)). Vertical aerial photographs taken in September 1944 (RN 676/26, 27) show soil marks, probably of ovens, on the ploughed surface of the western dunes. These are probably the localities of a previously recorded site (not visited in the present survey), described as a low mound with terraces (site V15/88). There are several other *pā* known in the general vicinity, most with nineteenth century associations (London 1960: 109). Such naturally well drained localities are now in modern horticulture, and are likely to have manifested a pattern of horticulture similar to that at Thornton or Pupuaruhe.

The Kohika swamp *pā* (V15/80) lies on the inland edge of the Okahu lakelet, its palisades driven at the natural margins of a sand dune surface (McGlone and Pullar 1976) of very low relief (Fig. 8). A regional council drain and stopbank run east-west to the north of the site at the boundary of the dune and the lakelet. At present, the dune surface is no more than 1.5 m above the surface of the surrounding peaty soils; in the past, prior to drainage, the difference in levels would have been less. The area of these sands is so small that it is not plotted in the published soil map (Pullar 1985).

Evidence for gardening is of two kinds. First, observations by the writer of the existing ditch sections on this *pā* show that these low-lying dunes had been covered by peats and coarse alluvium, in the Omehehu Sandy Loam on Peat and Onepu Loamy Coarse Sands soil types (Pullar 1985: 56–57), which along with Matuku Silt Loams form the principal soils of the locality (Pullar 1985: 72). The degree of mixing of the topsoils is not known, awaiting fuller publication of the sections from this site (for preliminary section, see Lawlor 1980). Second, the published preliminary pollen diagram for this site (McGlone 1983: 15) shows that bracken was common in the general vicinity from the time of the Kaharoa eruption. That it does not diminish over time indicates continued human activity and not a one-off effect from the ash shower.

The human activity on this site was represented in an associated peat column. Relevant dates for that peat column have conventional ages of 352 ± 56 years B.P. (NZ 4800, $\delta^{13}\text{C}$ not available; corrected to Cal. A.D. 1510–1639 at 68% confidence, or Cal. A.D. 1451–1659 at 95% confidence) and 534 ± 56 years B.P. (NZ 4801, $\delta^{13}\text{C}$ not available; corrected at 1 σ limit to Cal. A.D. 1326–1339 (7%) or Cal. A.D. 1394–1450 (61%) and at 2 σ to Cal. A.D. 1301–1478) (Lawlor 1980; recalculated by McFadgen).

These factors suggest that gardening did occur in this area, not only of the most likely crop in these conditions—taro—but also of kumara. The coarseness of the pumiceous alluvium enhanced drainage and would have made summer-season cultivation possible. Shrinkage of the lower peat substrate in the modern drainage regime has subsequently lowered the apparent level of the coarse alluvium around the old dune areas, accentuating in a superficially misleading fashion the potential for prehistoric horticulture on the dune itself. In the writer's view, the gardening in the lower Tarawera was on coarse pumiceous alluvium, riding on fixed rafts of peat, with the associated settlement on the truncated dunes.



Figure 8: The locality of Kohika (V15/80), 1991. The eastern palisaded perimeter of the *pā* lay on the west of the drain running from the foreground to the stopbank and north of the pronounced bend. Photograph: Kevin Jones.

The Kopuatawhiti Block is on an elevated (4–6 m above surrounding flood plain) area on the western margins of the plain. The area of the block is a remnant of a dune system which occurred further inland than the coast-wise running, immediately pre-Taupo dune on which the Thornton site occurs. It appears to be in the same general position as the dune on which the Kopeopeo, Pupuaruhe, and Kohika sites lie. This is the principal dune series nearest the coast that has been cut and in many places buried by river action; the principal reason for the widespread traces of human settlement is the river access. In the case of Kopuatawhiti, the remaining section of dune is 60 ha in extent, butted up against the hill country, where it has created a large area of backswamp on its inland margin. This backswamp was undoubtedly an important resource in its own right. The area is Maori Land and has been developed by the Kopuatawhiti Trust for horticulture.

The natural soils on the block are described as Te Rahu Loamy Sands (Pullar 1985: 44), the description of which is not dissimilar to that of Kopeopeo Loamy Sand. The eastern margin of the elevated dune surface has an intensely blackened topsoil with pumice gravel mixed throughout lying on unweathered grey dune sand (V15/1199). The black sandy topsoil

is over 70 cm deep in one place but is typically 40 cm. There is no trace of intact subsoils derived from tephra. This is typical of the disturbance and mixing noted elsewhere caused by gardening. Brief inspections elsewhere on the block suggest that the blackened topsoil is widespread except towards the margins of the hill country where there is a deposit of hill wash.

The area is known for its traditional production of kumara. The eastern margin, which was given the closest inspection, has not been planted in horticultural crops because it has a reputation as 'poor land'. Test pits showed this to be the result of a compacted layer of the mixed black topsoil beneath a friable 20–25 cm of plough zone. The compacted layer is not the product of the introduction of a broad lens of clay or similar material since it is visually similar throughout the profile, although it took several hard cuts of the spade to pass through it. The 'poor land' is probably the result of the compacted layer. It is interpreted as compaction of an unusually deep topsoil by repeated ploughing. A hard subsoil surface is said to encourage the formation of tubers in kumara in a modern cropping regime (Conway 1962: 63). If the hard layer is the result of pre-European practice (of what kind it is difficult to say), it would have been no disadvantage to kumara horticulture.

PART 2: RIVER FANS AND LEVEES

The three principal fans of the Rangitaiki plains have distinctly different climatic, physiographic and soil configurations. From east to west, these fans are: the Poroporo fan (on the Whakatane River); the Te Teko fan (on the Rangitaiki River); and the Onepu fan where the Tarawera River enters the open part of the plains below Kawerau. The latter two fans are massive in scale because of their ultimate origin in catastrophic volcanic events: Taupo at Te Teko, and Kaharoa at Onepu (Nairn and Beanland 1989; Pullar 1985: 27). The enclosed parts of the valleys above the fans will also be discussed, particularly in the vicinities of Te Teko and Kawerau.

POROPORO FAN

This fan lies at the northern outlet of a narrow section of valley that opens, some 2 km further to the south, to the Opouriao Plains (see Jones 1986). The fan is composed of Opouriao fine sandy loams, derived from the greywacke and pumice alluvium of the Urewera catchment (Pullar *et al.* 1978: 22–27; Fieldes and Furkert 1978). This fan is therefore not characterised by the coarse pumiceous alluvium of the other fans to be discussed. The nineteenth century *papa kāinga* of Ngati Pukeko or Ngati Awa, Poroporo, lies on this fan on the edge of the flood plain (Best 1925a: Vol. 2, maps).

At the time of survey in October 1986, the fan had been freshly ploughed and harrowed over much of its area (Fig. 9). Aerial photographs of ploughed areas of the fan show no localised or general blackening of the soils (RN 5229/44, 45; 15.10.66). On foot traverses and in the course of a flight over the area by the writer, no signs of general blackening or localised oven patches were observed. On foot, sparse gravels were noted in the topsoil. These need not have been added by human hand, however, since they are in the same general topographic position, on a fan edge or levee of a braided flood plain. Here, they derive from large flood events, as do similar gravels in levee soils on the Opouriao plains

further inland (Jones 1986: 21). The hills adjacent to the fans have relatively few pits on them.

Although the survey of this fan cannot be described as thorough, the initial results did not give reason to pursue survey more intensively. Taken with the negative results of the two sections in the inland dunes investigated nearby (Fig. 1), it is unlikely that there was much horticulture on this fan. The main reasons for this relative lack of horticulture and settlement on the Poroporo fan would be (1) the fineness of the sandy loams, which would lead to heavy cultivation properties, and (2) lower mean temperatures, reducing the growing season. An important factor in reducing the potential for horticulture is the katabatic wind derived from the Ureweras which ponds in the Opouriao plains immediately inland and produces a marked effect both there and in this locality (Pullar *et al.* 1978: 24; Jones 1986).

TE TEKO FAN

The fan consists of Te Teko Sandy Loams derived from greywacke and pumice alluvium (Pullar 1985: 53). The post-Taupo alluvium comprising the wider fan covers a very large area, as much as 40 km² (Fig. 1). All but the area around Te Teko, however, has sunken over a long period of time (Campbell *et al.* 1973: 318–319; Nairn and Beanland 1988), so that natural drainage was poor and the fan could not be used for horticulture. The well drained area of the fan, centred around the modern township of Te Teko, is some 1500 ha in extent and relatively compact. North of the main area of the fan, composed of Te Teko Sandy Loams, a strip (less than 200 m wide) of Opouriao fine sandy loams forms the levees of the present course of the Rangitaiki River.

A test pit, adjacent to a *pā* and Armed Constabulary camp (V15/158) 300 m south of Te Teko township, showed 20 cm of grey brown sandy loam topsoil with gravels overlying 25 cm of mixed topsoil and subsoil. The subsoil consists of layers of grey ash (Kaharoa alluvium) and yellow-brown silt to the bottom of the test pit at 70 cm. This area was the scene of a major engagement in the course of the Pai Marire phase of the New Zealand Wars, with the construction of saps and subsequent Armed Constabulary occupation of the vicinity (Cowan 1983: 98–105). However, these events are unlikely to have caused the nature of disturbance recorded here.

WAIMANGEO SPRINGS FLAT (V15/1194)

Four kilometres south of Te Teko on the Te Teko Sandy Loams abutting the western side of the valley, there is a complex of ditches, some with banks. The name Waimangeo is used by Best (1925a, Vol. II: maps) for this locality. Although he notes the spot as the locality of fighting (using the symbol of crossed swords), there is no index reference to such locality either in *Tuhoe* (Best 1925a) or in Cowan (1983, Vol. 2). The puzzle of why Best attributes a battle to this site probably has an archaeological rather than historical answer. It would appear that he was aware of the ditches and banks at Waimangeo and jumped to the conclusion that they were of military origin, possibly even from the 1820s, and therefore otherwise unrecorded. This site had also been identified by Ken Moore, then New Zealand Archaeological Association filekeeper, in his unpublished site record as a European fortification, and it seems likely that both he and Best have mistaken the nature of the site, on the basis of a brief field examination.



Figure 9: The Poroporo fan from the south, 1986. The ploughed fields to the west show no trace of settlement or gardening. The prominent pā is Rauporoa, built in 1869. Photograph: Kevin Jones.

The site lies on an isolated remnant of flood-free terrace soils, heavily eroded at the edges by river action. In this part of the valley, it is the only possible locality for gardening on alluvium. The site was investigated by Wynne Spring-Rice in 1983 in the course of her work on the European (Armed Constabulary) fortifications of the Rangitaiki River. She concluded (Historic Places Trust permit 1983/16) that there were two phases of cultivation at the site:

- (1) an earlier layer composed of 18 cm of Kaharoa Ash, humus, charcoal fragments and river pebbles, mixed; and
- (2) overlying (1), a single episode of later ploughing, truncating the surface of (1), and marked by the presence of Tarawera ash in the profile.

The writer has not inspected this site, but the interpretation of Spring-Rice, as ditch and bank enclosures for gardening, is favoured. Like ditch and bank fences elsewhere (e.g., Trotter 1976), their initial field manifestations can be difficult of interpretation. The surface-visible ditches and the ditch and bank enclosing the flat pre-date the Tarawera Ash shower because the single (horse?) ploughing episode only partially destroyed the ditch and bank. The lower layer will be mid to early nineteenth century or earlier in age.

Elsewhere on the Rangitaiki River, on the levee 4 km north of Edgecumbe township, in Opouriao Fine Sandy Loams, a test pit section (V15/1190, Fig. 1) showed 25 cm of brown silt loam topsoil underlain by 20 cm of mixed brown and grey silt with sparse fragments of charcoal with an uneven interface between. It may be interpreted as having been gardened. Not far from V15/1190, on the backslopes of the levee and exposed in a drain, Tarawera ash lay at a depth of 50–60 cm under recent flood silts. A lightly formed topsoil with charcoal fragments lay at 80–90 cm from the surface (V15/1191). The section was mottled throughout. The presence of charcoal in a lightly developed topsoil suggests some deforestation in this vicinity at a period in the eighteenth or nineteenth century. It is possibly related to gardening on the levees such as that at V15/1190. Overall, the evidence for gardening on the Rangitaiki levees is weak, and it is the Te Teko fan that was the major scene of this activity.

LAW'S PA (V15/1197)

About 1 km north-west of the general vicinity of V15/1190 and 1191, a swamp *pā* was recorded during the 1986 survey near the inactive course of one of the minor western distributaries of the Rangitaiki River (Pullar (1985: 22–23) shows several distributaries in this locality). This comprised a mound some 40 x 15 m in plan surrounded by a channel some 10 m wide (aerial photograph RN 3330/49). The mound was about 100 m from a large area of Awaiti Sandy Loam (Pullar 1985: 54), forming the levees of the distributary. As in the Kohika case, this loamy sand would have been suited to gardening. Shell midden was exposed in the surface of the mound when it was cut into to form a silage pit. The *pā* has been levelled subsequently.

TARAWERA RIVER FAN AND ADJACENT HILL COUNTRY

The Tarawera River drains a relatively small catchment compared with either the Rangitaiki or Whakatane Rivers. Nevertheless, since it drains the primary area of the Okataina Volcanic Centre, the river has carried large volumes of coarse ash and formed a large, well drained fan north-east of Kawerau township. The Kawerau Loamy Coarse Sands of the fan occupy an area of some 1500 ha (Pullar 1985: 50–52). The bulk of the fan, lying east of the Tarawera River, was not surveyed in the course of the survey, although it is suggested that a pattern similar to that on the west will apply.

Before turning to the evidence of horticulture on the fan, note should be taken of the extensive areas of hill gardening in the vicinity of Kawerau. This occurred in the low rolling hill country adjacent to the Tarawera River to the north and west of Onepu. The soils are Tarawera Hill Soils, characterised by a very thick, loose coating of Tarawera Ash over black topsoils derived from Kaharoa ash and earlier eruptions (draft soil maps from Rijkse, pers comm. 1988). The hill country occupies some 3500 ha and was settled in clusters of pit and terrace sites, some of the pits being as large as 14 x 10 m (Lawlor 1983a). Not all of the hill country was closely settled, however, since sites are thinly distributed at points away from the larger open-floored valleys. The inferences of Lawlor (1983a: 223) about overall population density for this area are therefore suspect. A radiocarbon sample, taken on the tree-fern lining of one of these pits, gave a conventional radiocarbon age of 336 ± 56 years B.P. (NZ 5318, $\delta^{13}\text{C}$ not available), which corrects to Cal. A.D. 1513–1647 at 1σ (68%) and to Cal. A.D. 1451–1669 (93%), 1783–1793 (1%) or 1950–1955 (1%) at 2σ (Lawlor 1983a: 225, recalculated by McFadgen).

Much of the flood-free fan at Kawerau itself is taken up with urban and industrial development, hence not available for inspection, although the narrower head-of-valley floors were used for horticulture. This took the form of dendritic drainage channels running from the sides into a central channel (Lawlor 1983b). There are also reports of ditches, probably fences, at the margins of enclosed flats in several localities elsewhere on the Tarawera flood plain (Moore 1976), similar to those noted at Waimangeo Springs above. Ditch and bank fences, indicating nineteenth century gardening, occur in similar topographic positions at Braemar Springs on the western side of the plains (V15/1185).

Evidence for gardening on the flood-free fan comes from several sites. V15/293 is a group of pits at the margin of the flood plain at the point where the Ruruanga Stream enters the Tarawera River from the main body of foothills. The eight pits were irregular in plan and up to 10 m across. 'Probes' undertaken by Moore and Pullar in 1965 (documented in the original site record) showed that the pit bases and surrounding flats were mantled with Tarawera Ash. A probe on the rim of one of the pits showed that the material excavated from the pit had not been dumped on the rim and must have been carried elsewhere. The pits had been dug into varying depths of gravelly alluvium, banded in places with silt and clay. The best interpretation that can be made of these pits is that they were sand or gravel borrow-pits, used for mulches on soils elsewhere on the fan or added to soils which had too high a component of clays or fine silts.

About 4 km downstream from Kawerau, in the Onepu vicinity, there is an active flood plain from where flood waters spill into a series of lakes and swamps on the western margin of the plains (Fig. 10). To the east of the river, the flood-free fan is some 3 km wide (Pullar 1985: map); it is part of a large area described by Pullar (*ibid.*: 27) as having been subject to catastrophic infilling following the Kaharoa eruption. Following the alluvial deposition of Kaharoa Ash, forming the fan, the river worked its way to the west. As a consequence,

the western levees are relatively narrow. Their backslopes bound on to the western lakelets or to several discrete 'islands' of an older dissected terrace landform. The dissected terrace is 10–40 m above the flood plain, and has many pit, terrace and ring ditch *pā* complexes, somewhat obscured by a heavy coating of Tarawera Ash. Some of these *pā* are shown in Figures 10 and 11 which cover the northern aspect of the fan, demonstrating how it eventually lowers in level to the backswamps. A settlement in the nineteenth century, named Parawai, is noted on one of these remnants of the terrace landform (Gibbons 1990: 2).

In 1985, an artificial levee was constructed between one of these islands, Tawhitinui, and one further downstream in an extension of flood protection. Farm trenches were then constructed behind the protection of this levee on the original natural levees. Figure 10 shows the locations of two exposures here of a black soil, consisting of black coarse and sandy ash and charcoal mixed together, formed in the Kawerau Loamy Coarse Sand of the levee (V15/1193). These layers were exposed for upwards of 20 m in section along the edge of a ditch. The black layers were 20–30 cm thick and were stratified immediately below 10–15 cm of airfall Tarawera Ash overtopped by 20–60 cm of very recent alluvium. The charcoal was twigs, assumed to be manuka (*Leptospermum scoparium*), and gives a conventional radiocarbon age of 195 ± 48 years B.P. (NZ 7546, $\delta^{13}\text{C} -24.6 \pm 0.1\%$) which is calibrated at 1σ as 1664–1698 (14%), 1726–1820 (39%), 1859–1863 (1%) or 1922–1944 (14%); and at 2σ as 1658–1888 (79%) or 1913–1944 (16%). These soils appear to have occupied an area of about 10 ha on the levee, and lay on grey mottled sandy alluvium to the base of the section. The mottling indicates a high water table, probably fluctuating seasonally. The very coarse sand of the soil would have provided drainage free enough to allow kumara to be grown. The blackening alone could be the result of a fern/manuka succession on the levee but, as discussed earlier, this is consistent with gardening usage indicated by burning of shrubs and mixing, and the soils may be interpreted as having been gardened.

DISCUSSION

In the introduction to this paper, the possibility of anthropogenic origins for the alluviation of the Rangitaiki plains was considered. The results of this survey indicate that, as anticipated, such an origin is untenable. The result of complex natural processes of infilling, operating over at least 6,000 years since the post-Glacial period, created landforms within a generally swampy environment that offered significant opportunities for pre-European settlement.

A comment is also needed on the balance between hill and alluvial gardening. One of the essential tenets of the wider Polynesian model of Spriggs (1982, 1985) has been the concept of a shift from fire-degraded hill country on to alluvial flatlands, recently filled by the erosion products of that very hill country. As the writer's previous papers (Jones 1986, 1988) have argued, in New Zealand the limiting physical and fertility conditions of any particular catchment were avoided by a number of locational strategies on the part of pre-European Maori, but not by environmental manipulation. The exact outcome of the balancing between these strategies is not easy to predict, particularly for a catchment area as large and as physically complex as the Rangitaiki plains. For catchments of any significant size elsewhere in Polynesia, the environmental conditions prevailing before human settlement would have offered a variety of dune-barrier and small alluvial fan

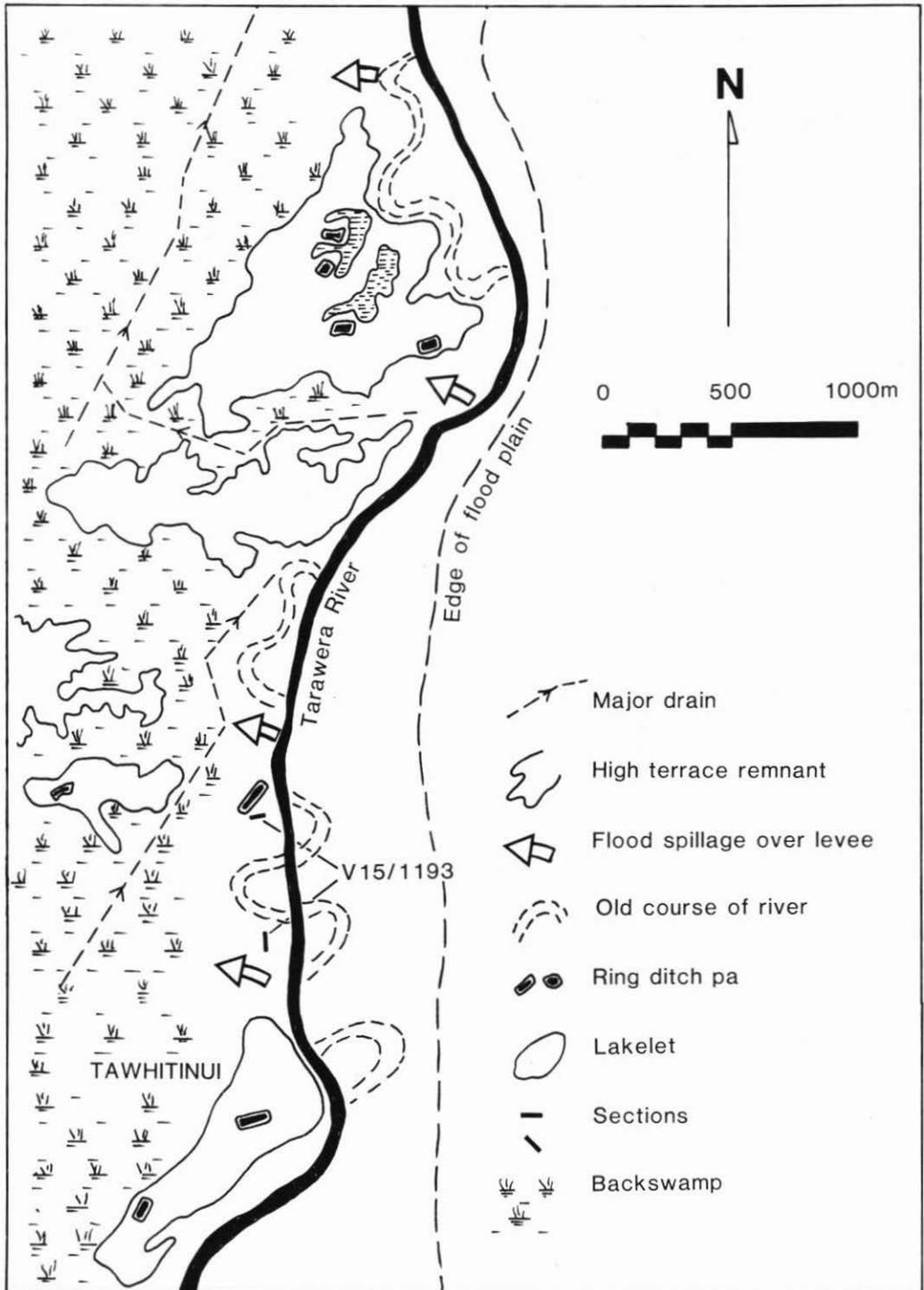


Figure 10: Plan of Tawhitinui vicinity, River Road. The geomorphology is simplified after Pullar (1985) and aerial photographs; archaeological sites are from site records, survey and aerial photographs.



Figure 11: Vertical aerial photograph of Tarawera River course, in the locality immediately to the north of Tawhitinui. The photograph is oriented to north and the river is about 25 m across. (SN 256, RN 680/28, 26.9.44.) Courtesy: Department of Survey and Land Information.

settings. Opportunities to take advantage of naturally available soils, including hill and wet or dry alluvial soils, must have been present in abundance.

The gardened areas of the plains pose two problems worth discussion. First, they are difficult areas in which to determine the boundaries of gardening. It is not known how far settlement would have ranged from the main river courses. On the Waipaoa River gardening occurred up to 800 m from the river, as shown by crop marks on early aerial photographs (Jones 1988: 30–31); this figure might be used to set a limit to the likely areas of gardening on the east of the Tarawera River.

The dunes in the Whakatane township area and elsewhere have been heavily disturbed by gardening in the past over the whole of their area (Pullar *et al.* 1978: 41). The dunes elsewhere along the ocean frontage of the Rangitaiki plains have middens recorded in some places but the gardening appears to be mainly confined to areas that are adjacent to the rivers, of which the Whakatane example is a special case. The extent of gardening on fans is less easy to determine.

Secondly, the fans on the western side of the plains would probably not have had a forest cover at the time of first Maori settlement. The soils would have been of relatively poor fertility because of the chemical nature of the ash and for want of weathering and topsoil development. The capacity to improve such nutrient-deficient soils by burning forest would have been limited. This may be one reason why the lower and outer reaches of the flood plain, for example at Kohika, were favoured for settlement. In such localities the sterile flood plain interfingered with rapidly accumulating peaty soils. Opportunities for cultivation of the type here described for Kohika, with mixing and possibly burning of peats and the coarse alluvium, would have overcome the inherent soil limitations.

Hill gardening on the western side of the plains occupied a series of valleys, low rounded ridges or terrace land-forms, intersecting and running south-west from the natural levees of the Tarawera River. These valleys provide sheltered, north-facing slopes, with access out on to the main areas of gardening identified on the levees or the dunes. From north to south, these are: Kopuatawhiti Block and Awakaponga Stream; Tawhitinui and the Mangaone Stream; Kawerau township/mill vicinity, the Ruruanga Stream and Maruka investigation area. This is a considerable contrast to the eastern side of the plains on the Whakatane escarpment or the Kiwinui hills where, for reasons of difficult topography (steep hills or access barred by bogs), the gardening and settlement are largely confined to the lower reaches of the river levees and the coastwise dunes on which most of the Whakatane township is built. The importance of these flat land soils is reflected in the density of *pā* on the Whakatane escarpment in this vicinity and at Kohi Point.

Little has emerged in the course of this survey of specific gardening practices, such as boundary determination and marking. The writer, in the course of the 1986 survey, sighted many metres of profile of freshly dug or cleaned drainage ditches. No archaeological ditch or trench features were observed. The sole instance has been in the Maruka investigation area (Lawlor 1983b). Although this is the most valuable evidence of such practice, that particular area is in an enclosed valley rather than on a major flood plain as at Kohika. Nor does the Maruka evidence strongly suggest closely spaced and regular ditching with the creation of mulched beds between, as the sparse Northland published records appear to indicate (Barber 1984).

Most of the specific evidence comes from the naturally dry dune crests where mixed soils and pits were noted in several locations. The Maori strategy therefore appears to have been a wider locational one, rather than one of intensive within-field practice. The lack of evidence of within-field practice is not definitive, however.

Sites to investigate such practices on the Rangitaiki plains would be of great interest. However, this degree of intensification may not have been needed where large tracts of levee, dunes and hill soils were in fairly close proximity. This contrasts with the Northland situation where, in the writer's experience, the soils adjacent to the horticulturally suitable recent sands and swamp soils are podsolised and unsuited to gardening.

CONCLUSIONS

The influential island-Polynesian model of hill country degradation followed by occupation of alluvial flats does not hold for New Zealand. The major alluviation episodes in the New Zealand East Cape region, coupled with significant volcanic events of great intensity impacting on the Rangitaiki plains, were simply so great that human activities had no influence. The pre-European Maori adaptive strategy was locational, and appears not to have involved intensive within-field cultivation practices of the type found elsewhere in New Zealand.

The principal areas of soils used for gardening on the Rangitaiki plains and the surrounding hill country were as follows.

(1) Hill soils with a mantle of airfall ash around the margins of the plains, principally the easier rolling country in the west and south-west. These areas are not as extensive or representative as has previously been thought but they have survived in surface-visible form. They are likely to be specialised adaptive forms of gardening practised in tandem with more widespread horticulture on the adjacent fans.

(2) The older dunes with loamy topsoils derived from airfall ash; these occur in extensive strips 600–2600 m from the beach. They were heavily settled in all areas with easy access to the rivers or where they were adjacent to wetlands.

(3) Alluvial fans of very large area on the Rangitaiki and Tarawera Rivers were used in strips along the banks. The full extent of gardening on these fans is difficult to judge because they pose a daunting task as far as field survey is concerned. On the Tarawera River, especially, the alluvium is coarse, and even with high water tables the free-draining nature of the top layers of soil would have made horticulture possible.

(4) Levees of the Whakatane River, particularly in its lower reaches on the plain in the vicinity of Whakatane township.

(5) In the poorly drained lower reaches and on the backslopes of the Tarawera River, very coarse alluvium on peat was cultivated. The extreme drainage characteristics of the alluvium made this possible even with high water tables. The introduction and mixing of mud and peat into the surface layers, perhaps from ditches, may have made these highly productive soils.

Prehistoric gardening flourished from the fifteenth or sixteenth century A.D. in these localities. Earlier gardening is not documented but would have been feasible in the dune country adjacent to the lower river courses through the plains. Many of the locations of gardening and wider settlement are adjacent to localities with a long-recognised high density

of *pā*, or other manifestations of Classic Maori settlement such as at Thornton on the lower reaches of the Rangitaiki River.

There was relatively little gardening at the south-eastern margins of the plain, because of the very steep hill country east of the Whakatane River, the poor soil conditions of the lower hill country, the poor quality and small area of fan soils, and the effects of katabatic winds upon this fan. Overall, horticulture on the plains may be considered to have been practised in a number of modes in a broad arc from the lower reaches of the Whakatane River, along the coastal dunes, and south-west via the Tarawera River and Onepu fan to sheltered hill country at the head of the western stream catchments of the plains and the head of the Tarawera River. There is no evidence for intensification based on within-plot gardening practice such as careful demarcation of boundaries in highly desired areas.

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