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ARCHAEOLOGICAL SITE STABILISATION AND VEGETATION MANAGEMENT. CASE STUDIES I: COROMANDEL, BAY OF PLENTY AND HAWKES BAY, CENTRAL VOLCANIC PLATEAU AND TARANAKI

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CONTENTS

ARCHAEOLOGICAL SITE STABILISATION AND VEGETATION MANAGEMENT. CASE STUDIES I: COROMANDEL, BAY OF PLENTY AND HAWKES BAY, CENTRAL VOLCANIC PLATEAU AND TARANAKI

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ABSTRACT

Archaeological sites in the Bay of Plenty and on the Coromandel Peninsula which were the case studies of *The Manual of Vegetation Management on Archaeological Sites* by Jill Hamel and Kevin Jones were re-visited 12 years later. The object of the visits was to observe changes in vegetation cover and condition and to draw the necessary lessons on future management of the sites. Treatment of the sites had ranged from a satisfactory benign neglect, through potentially explosive weed control problems, to drastic alteration of the condition of the site from logging and hauling of pine trees, and invasion of noxious weeds and wilding pines. New management prescriptions for the sites are offered.

Some further case studies are reviewed. The Central Volcanic Plateau and Taranaki have a large assemblage of historic reserves, and a review of site management under native forest is also offered.

The three basic vegetation covers recommended for sites are: (a) grazed or mown grass swards; (b) early successions maintained at bracken or shrubland stage; and (c) forest canopies with manipulation of understorey to maintain a gallery effect. Suitable native plant covers of the shrubland succession stage and understorey planting need to be more fully investigated. Grassland covers offer a range of options, the main contrast being between low-fertility native or rough grasses of low productivity, and grazed swards requiring maintenance of fertility and improved grasses and legumes.

The value of the 1981 recommendations is assessed. The main changes from the 1981 case study recommendations are: (a) closer recognition of culturally valuable elements in the flora of the site; and (b) suggestions for manipulating canopy cover, understorey character, and the succession generally in a way that is most cost-effective, while leaving sites in a stable condition with surface features visible.

1. INTRODUCTION

The Manual of Vegetation Management on Archaeological Sites (Hamel and Jones, 1982) discussed many case studies of site stabilisation and vegetation on archaeological sites. In the course of a project to update and expand that manual, a re-visit of the case study sites was essential. First visited in 1981 by the authors of the original manual, most of the sites were re-visited in February 1993 by Jones and Simpson accompanied by Neville Ritchie (Waikato Conservancy) and Lynda Bowers (Bay of Plenty Conservancy). A second round of inspections covered historic reserves on the Central Volcanic Plateau and in Taranaki. Most, but not all, of the case studies from 1981 are included here, and other case studies of more recent years have been incorporated, where they presented key issues of judgement about intervention and ongoing management. The revised manual, provisionally titled "Guidelines on Vegetation Management and Archaeological Site Stabilisation", is still being written. Probably only selected case studies will be used in that manual, so this report is not only an adjunct to the new manual, but also an opportunity to disseminate widely and receive comments on what are, in effect, draft recommendations for the management of these sites.

Sites have been selected to represent different types of vegetation, management regime, climate and historical development pressures. They include inland and coastal sites, but inevitably there will be some site types which are not covered. Even in districts for which we have described a site or sites in detail, land managers will have to consider their local conditions as being more or less different from any of the sites we describe.

The sites are grouped according to the principal type of vegetation around them, beginning with those in early native succession and ending with those in dense forest (usually exotic). Where the cover is of a mixed character, e.g., exotic weeds and early native succession, this classification is not especially helpful, but we have attempted to stress the dominant problem of, or process on, the site. The site descriptions include in order: the name of the district, rainfall, soil and rock type, site name, site record number in the NZ Archaeological Association site recording scheme (metric number followed by the Imperial number in brackets, the latter only where it has been in use), metric grid reference, topography and archaeological nature of the site, details of the vegetation on the site and adjacent to it, vegetation processes, opinions of local managers, and the scheme of management of the vegetation originally proposed in 1981. In the last we attempted to predict future changes in the vegetation and the effects of the management regime. Where species composition of the site cover is described, the management regime should be understood to be about species that will be dominant in the natural or managed succession. Non-dominant species are discussed if they are rare or have other cultural value, that will or may be affected by our recommended management practice.

Following the visits in 1993, we reviewed the changes that had actually occurred to the sites and make some judgement about the wisdom of the original interventions where they had been proposed and carried out. Conclusions on the key case studies carried through from 1981 to 1993 will be contained in discussion in Parts 1 and 2 of the new manual.

One final note should be made about changes in land management and tenure since 1981 relevant to several of the case studies. In 1981, the publicly-owned land was managed by the NZ Forest Service or the Department of Lands and Survey. In 1987, the commercial operations of these departments were made the responsibilities of state-owned corporations. Conservation and recreational functions were made the responsibility of the newly formed Department of Conservation. In 1990-1991, the Forestry Corporation was dis-established over most of the country, and cutting rights to trees (and land management responsibilities) were put out for tender. Successful tenderers for the Whangapoua Forest were Ernslaw 1, Ltd., a Wanganui-based company, and for the Tairua Forest, Carter Holt Harvey Forests, Ltd.

2. PRINCIPLES

This report is issued as documentation for a wider discussion of our observations and recommendations based on the re-visits of the 1981 case study sites. It is primarily a compendium of case studies with notes on the condition of sites that were first discussed in Hamel and Jones (1982). However, we have included new case studies with the view that they would provide a fresh body of studies for a revised manual or guidelines on archaeological site stabilisation and vegetation management. Every site is different, and surrounding vegetation depends on former and present land use and vegetation, proximity to human settlement, and degree and nature of site management. In the revised manual, we will outline a much fuller set of principles and techniques. In the 1982 manual, we had argued for sites to be maintained or converted to grass and grazing for sheep as the most desired option, although, of course, mowing was always an option. On sites with an advanced shrubland succession, we had recommended felling of any shrub or young tree with greater than 10 cm d.b.h. (diameter at breast height). For several reasons that position is probably untenable. Problems with this policy soon developed because of the many historic reserves which actually have a 100-150 year old (estimated) native forest on them (e.g., see Segedin, 1985). It is important to stress that the new principles must take account of trees which have already grown greater than 10 cm d.b.h., in recognition of the need to retain a dense canopy to exclude light from, and prevent erosion of, the ground surface.

We will be outlining a full set of principles and rules with case studies in the new guidelines. Many of the finally selected case studies will of course come from this report. A summary of our current principles can be followed in the figures presented here. Fig. 1 is a model outlining when to intervene in the vegetation process. Intervention in the management of a site will depend on whether or not the site is to be:

- developed for public access and appreciation;
- reserved for its research potential;
- judged to be in stable condition and able to be left alone with no further documentation or investigation of its value - this probably applies to most sites;
- a wāhi tapu (sacred site) under ss. 32-33 of the Historic Places Act 1993 or archaeological site reserved for Maori purposes under ss. 338-340 of the Maori Land Act (Te Ture Whenua Maori) 1993.

One of the great difficulties in intervention is determining need in the course of slow reversion. The essential difficulty is that, on the one hand, the early stages of succession are rapid, potentially expensive to maintain in that state, and yet are best for the site. On the other hand, the stable later stages of succession are a lost cause for historic conservation because the forest is then perceived to have intrinsic value, the site has lost visibility and access, and the successional process is inoffensive (no noxious weeds, readily-combustible fuel load is low).

The international ICOMOS (Venice) and ICOMOS New Zealand charters and their guidelines place great stress on the decision as to whether or not to intervene; i.e., there

should be clear reasons for intervention - it is better to do nothing than to do the wrong thing. Relevant features are:

- definition of the cultural and other heritage values of the place - what are we conserving and why?
- definition of management intent - what is being sought by intervention and site management;
- assessment of the likelihood of change in site condition with no intervention, covering both change from human and biological or physical factors;
- the impact of proposed intervention on the values of the site;
- the impact of proposed intervention on non-archaeological values of the site and its environs, for example (in our area of interest) the flora or broader ecological processes;
- community consultation and public attitudes toward intervention - is public education or information necessary?

Figure 2 shows the range of effects that vegetation has on site stability. Although shrub vegetation can assist in stabilisation, principally by reducing soil erosion and excluding stock, there are a wide range of destabilising effects. An eventual forest succession will destroy finely detailed archaeological stratigraphy (where it exists) and foundations of structures. Figures 3-8 summarise our current approaches to stabilising the condition of sites through the use of vegetation. They are presented as decision-making models and cover five broad cases:

- young native forest (Fig. 4), where the process may be allowed to continue, or intervention to produce a grassland is possible; the latter may or may not be cost-effective (practicable);
- grasslands (Fig. 5), where the choice is between maintenance or allowing reversion; if maintenance of the grassland is sought, a decision has to be made whether to improve fertility status and maintain a fine sward, or to allow for "tall grass" re-generation (see Fig. 9);
- exotic weeds or early succession (e.g., gorse) (Fig. 6), where there may be expensive control solutions, or where non-intervention may be appropriate;
- mature native forest (Fig. 7), where intervention to manage canopy species, and the forest floor may be necessary;
- exotic commercial or farm forest (Fig. 8), where the trees may be felled to waste, or where quite specific felling plans are needed to avoid damage to the site.

There also remains a debate about the best form of grassland to try to achieve on sites. The choice is between economically viable improved pasture lands (where stock provide an income), deteriorating or run-down farm pasture often left in long grass, or deliberate encouragement or conversion to native grasses (Fig. 9).

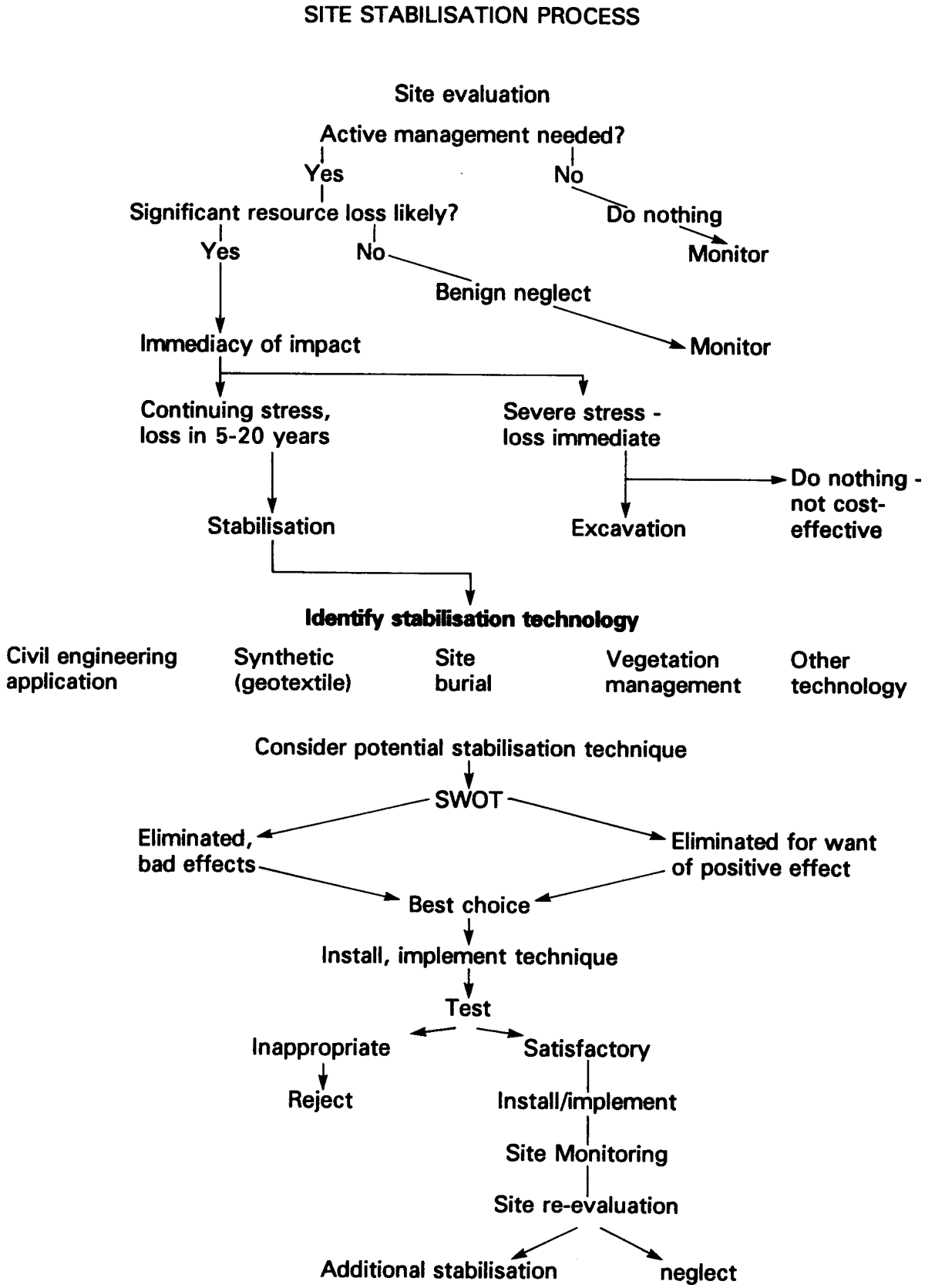

Figure 1 **Site stabilisation decision-making process, after Thorne (1988: 22-35). "SWOT": analysis of strengths, weaknesses, opportunities, threats.**

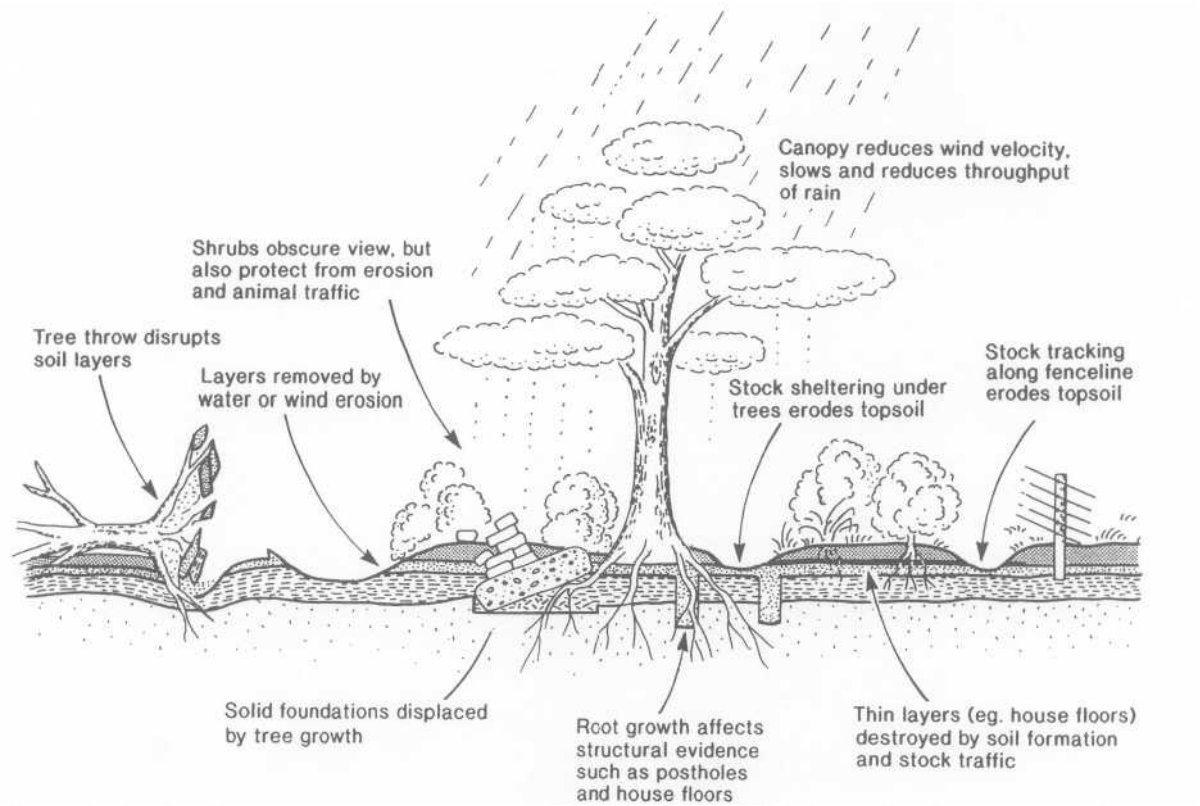

Figure 2 Effects of farm activities and forest vegetation - protective and deleterious - on typical archaeological site profile.

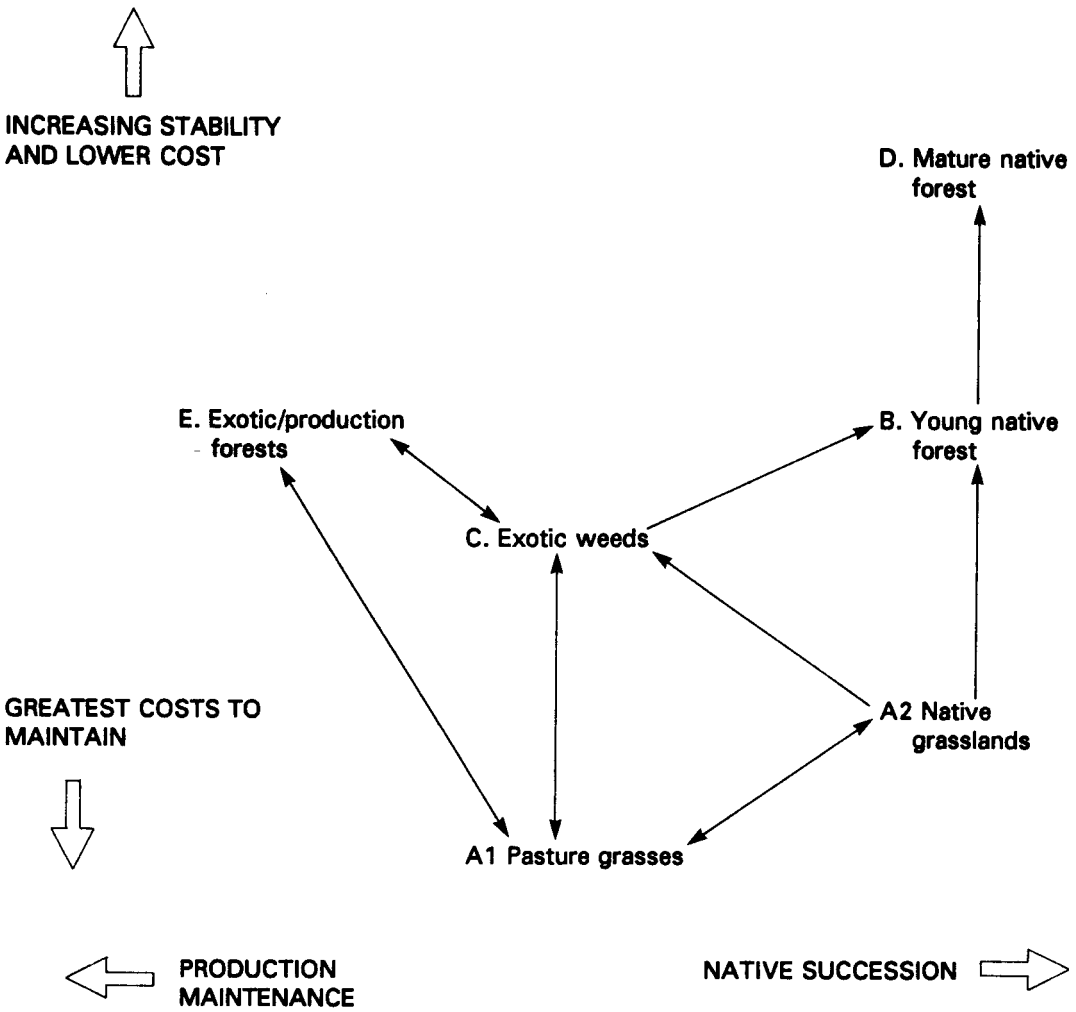

Figure 3 **Steps in maintaining a particular cover, or converting one cover to another, with the objective of site stabilisation: (a) grassland; (b) native forest, early succession; (c) exotic weed cover; (d) mature native forest; (e) exotic forest cover.**

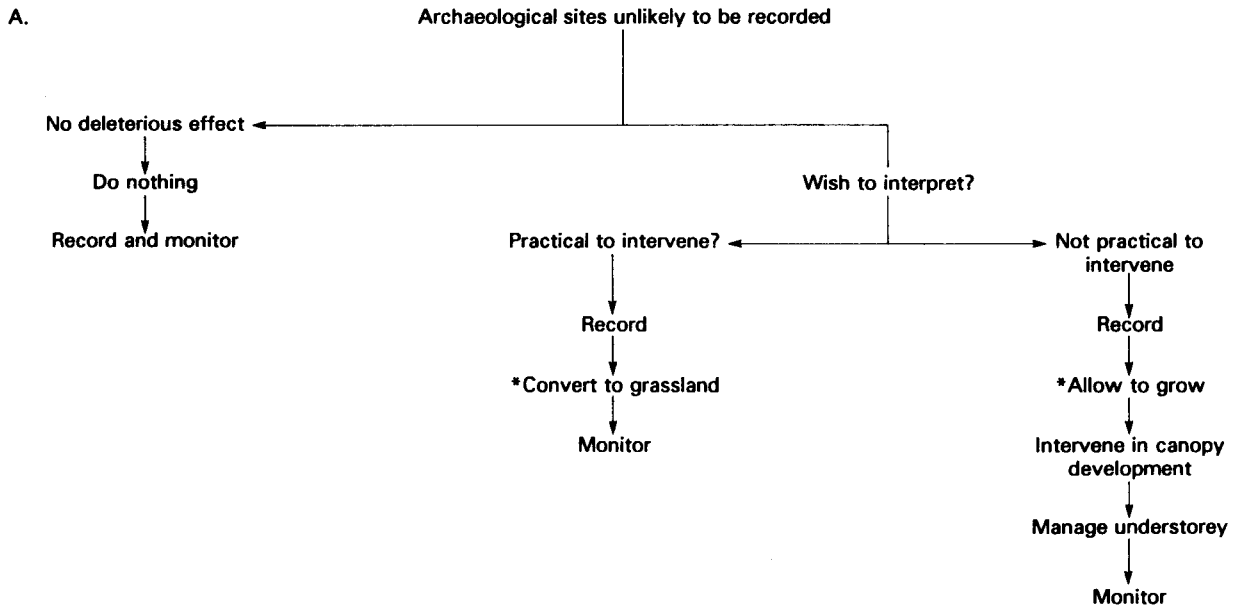

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Figure 4 Native shrubland, early succession.

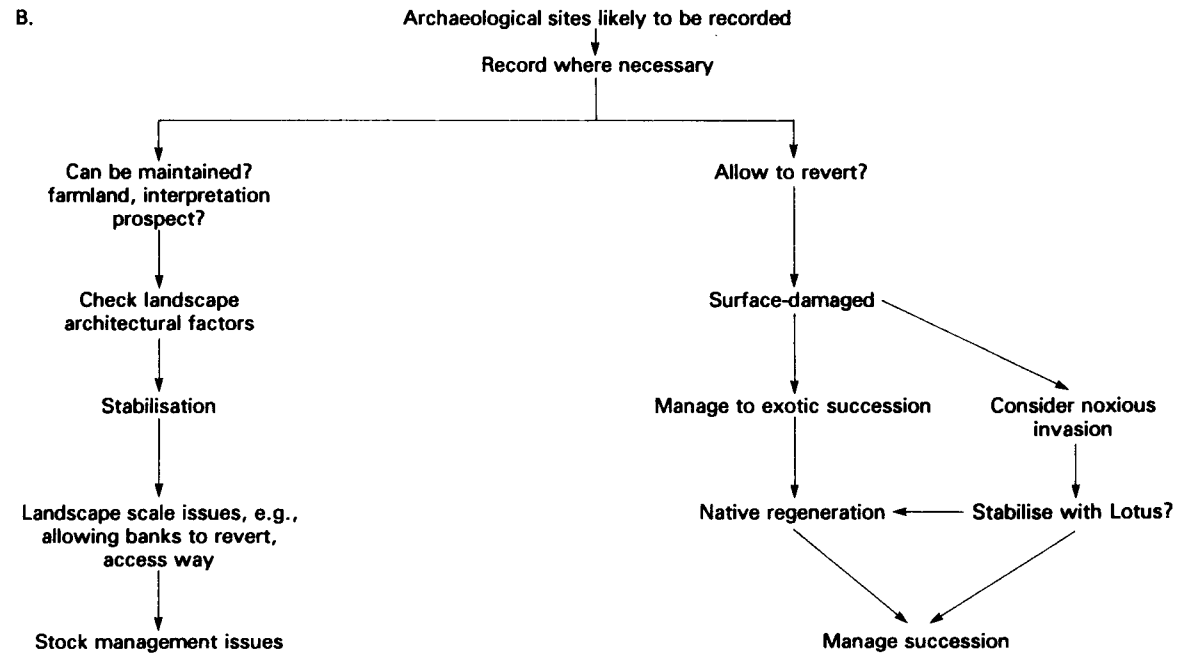

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Figure 5 Grasslands.

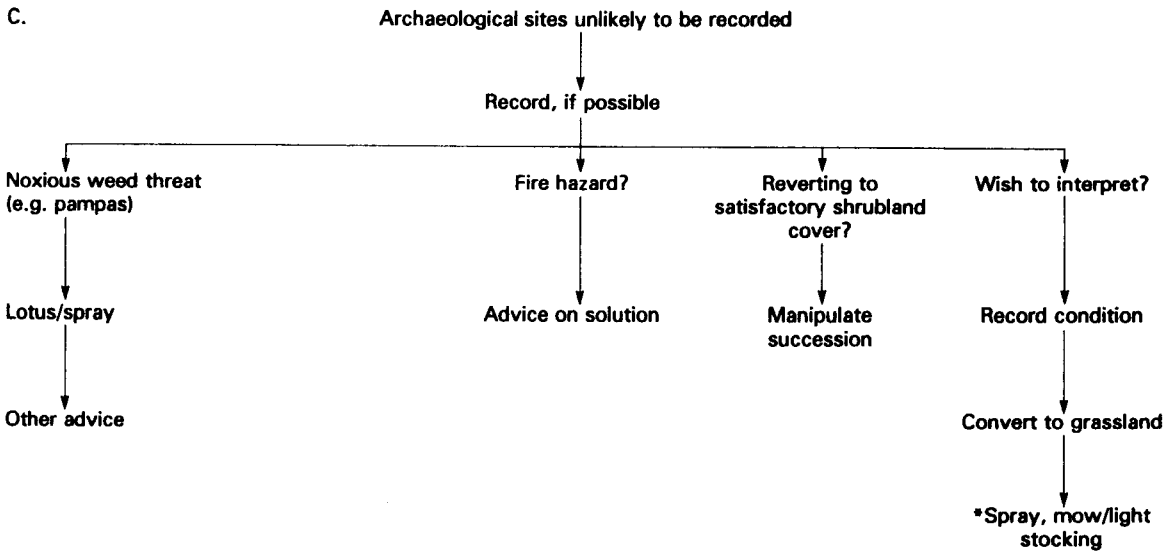

Figure 6 **Exotic weed cover.**

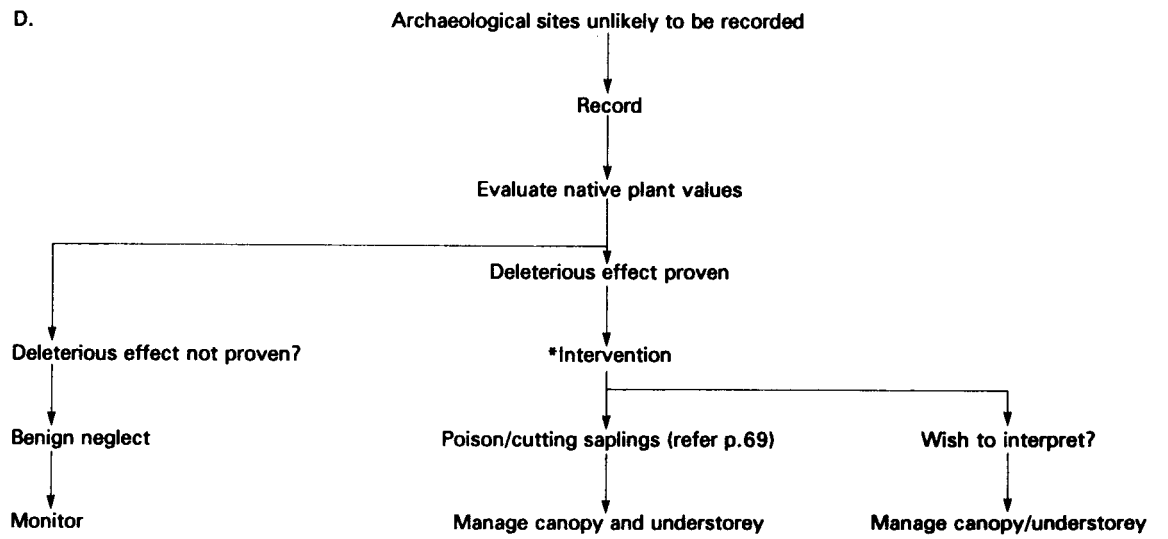

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Figure 7 **Mature native forest.**

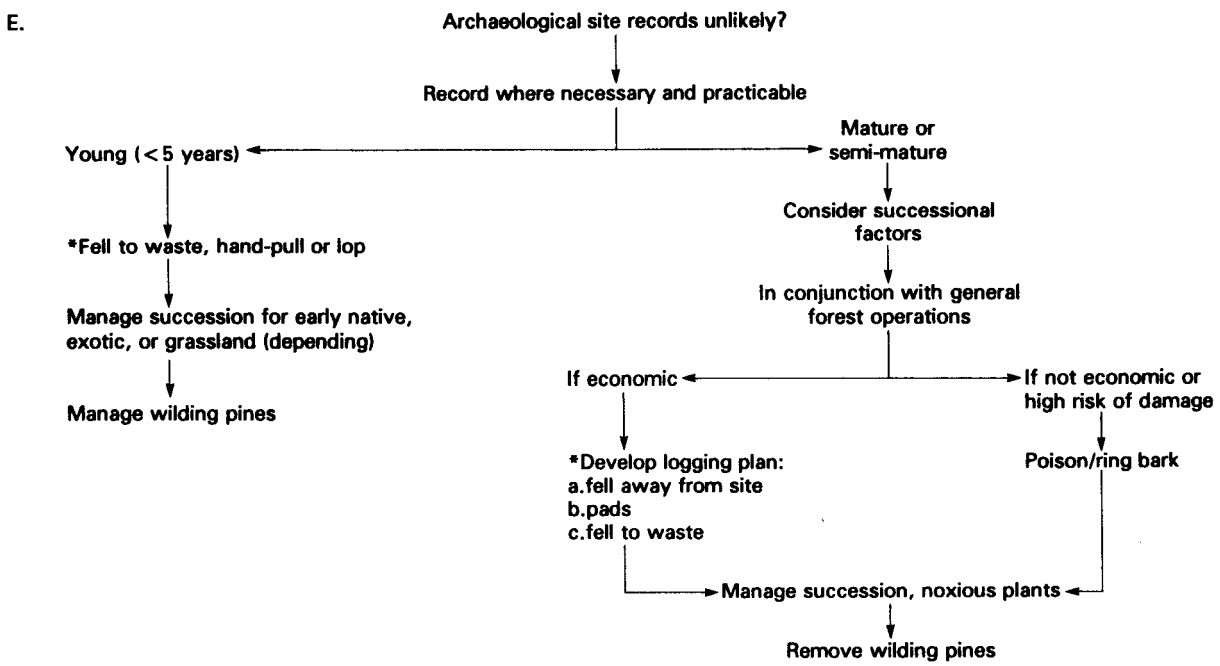


Figure 8 Exotic forest cover.

STOCKED GRASSLAND - MANAGEMENT PRINCIPLES

Principal objects sought: visibility, protection of stratigraphy
Do not reticulate water
Do not stock in winter (except for sheep)

Intensive regime	*Low-fertility regime*
Supply phosphates, sulphur	Lower and reducing stocking rates *
Lime or otherwise lower pH	Poor tillering of grasses, and erosion patches
Encourage legumes; oversow legumes	Grasses bolt to seed
Improve grass palatability	Acid soils (high pH, nutrients less available)
Improve grass tillering; oversow seed	Seedheads shade legumes, reduce nitrogen
Keep stock no's at marginal economic return level, no higher *	Risk of rapid weed invasion
Fence and supply gateways for conservation value, reduce camping, manage sward and grass productivity	Risk of shrubland invasion
Rotate to maintain tillering, tough sward, no erosion patches; adjust stock numbers to suit *	Fire risks of seedhead sward - scope for fire management
Monitor erosion	Opportunity to encourage desirable native grasses; bracken, other low vegetation
Reduced weeds and no scope for shrubland invasion	No solution for stock camping
Can be combined with mowing?	Tussock forms poor for soil surface conservation
	Monitor erosion
	Tall grass produces "tag", of poor erosion-protection quality
	Risk of failure of sward due to grass grub invasion
	Can be combined with low frequency of mowing
	Scope for mowing to cut out stock altogether for up to 10 years * * *

Note: effects which contradict each other have the same number of asterisks.

Figure 9 Comparison of intensive (grazed) and low-fertility regime for grasslands.

CASE STUDIES: COROMANDEL PENINSULA, BAY OF PLENTY AND HAWKES BAY

In the main, these case studies are those of Hamel and Jones (1982), although further cases are added. Site locations are shown in Fig. 10.

3.1 Sites within young native forest

3.1.1 Terraces, pits and midden, T11/213 GR 341844 (N44/185), Whangapoua Forest, Coromandel Peninsula. Rainfall about 2000 mm. Soils brown granular loams and clays on Miocene/Pliocene basalt, andesite and phonolite.

The site is about 150 m north-east of and downhill from Road 57, Compartment 81; altitude 100 m. The site consists of terraces, pits and midden covering an area of about 180 x 23 m on a long gently rolling spur in the valley floor, facing to the north and sheltered from the south (Fig. 11). Surface features when recorded in 1978 were noted as indistinct. There are cultivated soils on the valley floor and hāngi and shell midden on the neighbouring ridge. The site was classified "A" (to be preserved) and has been noted on the document for the cutting rights successfully tendered for by Ernslaw One, Ltd. One of us (KJ) briefly discussed the site with Mr Lyndsay Arthur, the local forest manager for Ernslaw 1, Ltd. Similar sites on this block (the Briar Block) were excavated by Furey (1987) who found a relatively thin topsoil, and extensive, re-worked deposits of midden and storage pits dating to the 16th century A.D.

Vegetation and management in 1981

The site was in rough pasture with patches of low bracken, blackberry, 2.5 m high mānuka, occasional shrubs of gorse, tobacco weed and briar rose. Surrounding vegetation had consisted of recently cleared forest and mānuka, planted in *Pinus radiata* then four years old; tree ferns (mostly māmaku) and nikau in nearby gullies; and patches of native forest (podocarps, rata, rewarewa, puriri, kānuka) in the headwaters of the small catchment (Fig. 11). The kānuka tended to be in the gullies and valley floors and the mānuka on the drier ridges. Pampas grass was the pre-eminent threat to newly planted pine trees.

The local forest manager considered that rotary-slashing of the blackberry and gorse would be impracticable as the site is too uneven and steep. The surrounding young pine forest had suffered badly from wind damage and was not scheduled for tending. The site was not suitable for presenting to the public since it lacked obvious features and would have been difficult to maintain in low vegetation. A heavy growth of bracken would have been the most desirable cover in terms of weed control, and it was likely that on this site the bracken would smother the blackberry and eventually be superseded by mānuka. Native shrubs and trees would have been slow to invade because seed sources are relatively distant. This site could have been scheduled in forest management for inspection every five years and the removal of any tree species which had reached a dbh (diameter at breast height) of 10 cm or more. In 1981, recommendations were for

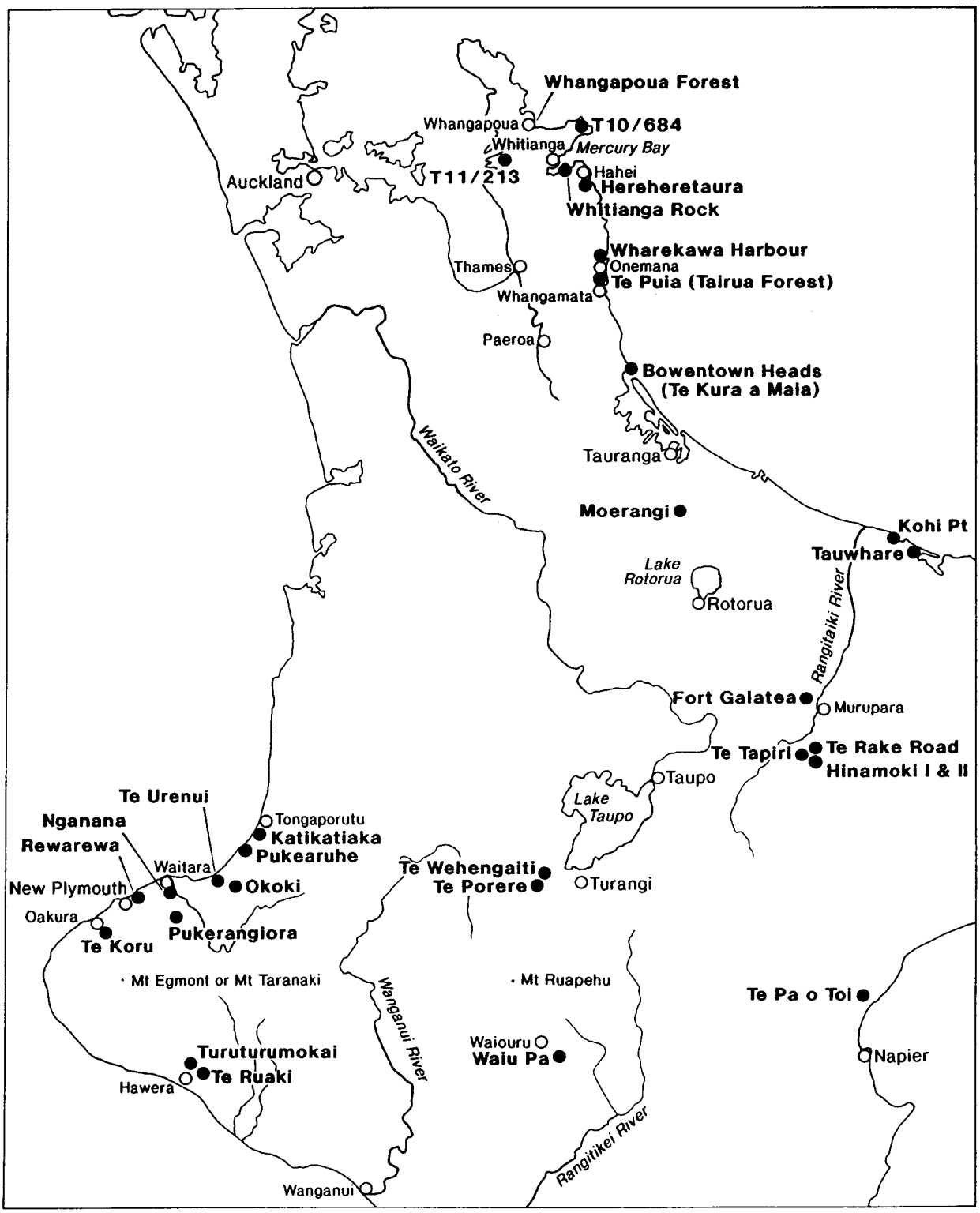


Figure 10 Locality map.

Figure 11 Vicinity of T11/213 (N44/185) in 1978 (NZFS flight no. 120, 4/5/78, S.F. 169) showing site record numbers, and planting lines into gully north-east of the site. Note native-forest seed-sources in riparian strip and on south-facing slopes elsewhere in the vicinity. The sites and numbers delineated are the original archaeologists' field records. North is to top.

a relatively low intensity of site management.

Vegetation in 1993

The site was enclosed by 15-20 m high pines downslope on the north-east perimeter and a belt of Tasmanian blackwood of similar height between the site and the road to the south-west. The site was still in a rough ungrazed pasture with some clumps of shrubs. Surface features were very indistinct. On the ridge margins extending into the pine forest margin, occasional ovenstones could be seen in the pine duff.

Grassland species were: brown top, cocksfoot, sweet vernal, Yorkshore fog, paspalum. Scattered herbaceous plants within grassland included: foxglove, ragwort, *Lotus pedunculatus, Mycelis muralis,* Scotch thistle, *Prunella, Verbena officinalis,* Fleabane, *Centella, Plantago lanceolata, Sonchus oeraceous, Hypochaeris radicata, Senecio bipinnatisectus, Linum* sp. (blue fl.); 4 spp. sedge uncommon; *Nertera depressa* on rock.

Shrubs and ferns included: blackberry, previously dense low thickets, but spraying has killed most of it; gorse, bracken, mānuka, kānuka (1 only), karamu; tree ferns, *Cyathea dealbata* and *C. medullaris, Solanum mauritianum* (tobacco weed), and ground ferns *Doodia media, Blechnum capense.* Seedlings included: young tree ferns on terraces; *Coprosma rhamnoides,* mapou, broom, and *Clematis paniculata.*

Within an estimated 5 years before 1993, the blackberry on the site had been sprayed but not finally killed, and grasses expanded into the area occupied by blackberry. There was some bracken fern on the site, particularly where pigs had rooted, opening up the otherwise tough sward of grass. No pampas was present. The dense grass sward has inhibited not only bracken but also tree/shrub seedling establishment. Areas of dense gorse will expand. Both mānuka and gorse will germinate in areas disturbed by pig-rooting. Forest species will gradually enter beneath mānuka, gorse, karamu. *Solanum* shrubland is at present more dominant around shaded margins, except where gorse occurs.

Management

The site is presently difficult to interpret because of dense gorse, tree ferns and other large forms of vegetation, but would have been even less traversable if the blackberry was still present. Bracken will expand under existing management. Blackwoods and pines will eventually seed into the area. Although patches of native bush are scattered around the block, the vegetation of the site is likely to gradually revert to bracken, then shrubland/fernland in the immediate future. Nearby native forest species include: kowhai, tanekaha, rimu, nikau, putaputaweta, cabbage tree, taraire (seedlings under adjacent blackwood), hinau, māhoe, rewarewa, rangiora, hangehange, karaka (see fig. 11). When the pines are logged in 10-20 years, an opportunity will be provided to reimpose an herbaceous cover. However, a canopy of tree ferns, mānuka and karamu may be better protection against colonisation by weeds, especially blackberry, gorse, fennel, *Solanum* and seedling pines, that should be prevented.

Overall, the minimal management had been satisfactory to protect the scientific value of the site. The site should therefore be left in its present state of minimal management. The site may pose problems in logging the forest in 10 years time since it presents an obvious open landing or skidding area, available for vehicle use. Trees should not be felled across or onto the site and all vehicles should avoid it. The site should be re-evaluated, along with other sites in the forests owned by Ernslaw 1, Ltd in this region, a task which should be undertaken in liaison with the Historic Places Trust as part of the logging planning process.

3.1.2 **Pā near Te Rerenga,** T11/13 GR 473890 (N40/166), Whangapoua Forest, Coromandel Peninsula. Rainfall about 2,000 mm. Soils brown granular loams and clays, formerly with a kauri cover, heavily podsolised and of moderate to low natural fertility, on Miocene/Pliocene volcanics.

The site is on a forest road east of Te Rerenga, altitude 100 m; a pa with indistinct features on an isolated steep knoll with a pakeha quarry face on the north.

Vegetation in 1981

There was a cover of gorse (about 60 cm high), mānuka (about 1 m high), bracken, kumarahou and *Pomaderris ericifolia.* Old gorse stems from a previous burn were still standing. Surrounding vegetation was ten-year old *Pinus radiata.* Pine trees had been planted on this pā and removal had been attempted in July 1978.

Vegetation in 1993

There was still a large number of pine trees, both *Pinus radiata* and juvenile *P. pinaster* (possibly naturally seeded), on the pā. In 1993, vegetation was predominantly shrubland, gorse and mānuka, 10-15 years old, surrounded by emergent pines. Several young pohutukawa occurred on open edges at the road cutting or rock outcrop. Emergent shrubs were: mingimingi, *Pomaderris ericifolia,* kūmarahou and *Coprosma lucida.* Other shrubs included: *Coprosma robusta, Hakea spinosa*, kānuka, māpou, *Olearia pachyphylla* (with big glossy leaves), *Cyathodes juniperina* (densely leafy northern form), *Gaultheria antipoda* and towai (*Weinmannia sylvicola*). Ground plants are very sparse and include: *Dianella* sp., *Leucopogon frazeri, Lycopodium scariosum, Haloragis incana,* the ferns *Blechnum "capense"* and *Cyathea dealbata, Gahnia setifolia* and the small tussock sedge *Moreletia affinis.*

Management

Hamel and Jones thought that, if not disturbed, this site would have gone through a dense covering of kūmarahou to mānuka. It was unlikely to be colonised by other native tree species since there was no nearby seed source. Hamel and Jones' original recommendation, that on this site the mānuka could be left to grow and the site included in a five-yearly inspection plan for tree (>10 cm d.b.h.) removal as required, was

inadequate and should be reviewed on the grounds of lower-priority archaeological values. Wilding pines continue to be a problem. Although some of the pines on the site have been removed, others need to be felled before they become too large or get logged. The gorse and spiny hakea will eventually be overtopped by mānuka and other native shrubs. Places with open ground will be colonised by pohutukawa. The site is well protected at present but is so overgrown that the flanks could easily be inadvertently damaged by roading, fire-breaking or logging. The manuka will eventually thin out and an attractive vegetation will prevail in the long-term. Several native species have botanical interest including "leafy" *Leucopogon* and *Olearia pachyphylla*. Active management to discourage gorse without opening up for invasion of noxious weeds, may also be needed. There is probably no reason to discourage a long-term reversion to forest.

3.1.3 Restored pā, Whangapoua Forest, T10/684 GR 594938 (N40/586), near Opito. Rainfall about 2,000 mm. Soils brown granular loams and clays on Miocene/Pliocene andesites, heavily podsolised and of moderate to low fertility.

The site is on a ridge end 1.2 km inland from Opito Bay and 2 km WNW of Tahanga; access via forest roadway from Otama/Opito saddle on Black Jack Road.

At the western end of the pā there is a deep double transverse ditch and bank, and to the east is a single transverse ditch above a bluff. The sides of the pā are very steep with distinct lateral defensive scarps and terraces to the north. The interior of the pa, covering an area of some 50 x 15 m, consisted of a platform, some 12 terraces and seven pits. In 1982, the western ditches and the platform were inadvertently bulldozed to create a fire break or track. In 1984, a decision was made to restore the archaeological features of the pā (NZ Historic Places Trust permit 1983/40) (Furey, 1984). An estimated 40 m^3 of soil was removed from the bulldozer infilling of the ditches and placed to restore the original interior terraced platform and the double transverse ditch and bank. Furey (1984: 221) described the site as originally covered "in mānuka scrub, hakea and several large self-seeded pine trees".

Site condition in 1993

Our aim was to inspect the success and stability of the restoration work, and also to suggest ongoing management work that might be needed. The western transverse banks were still bare of any vegetation covering and there was a distinct visible gap between the crumbling new fill and the original bulldozer-planed andesite surface. Shrubs such as five-finger were growing at the interface where Louise Furey and Ian Lawlor's team had placed an exterior framework to hold the fill. In time these should grow to protect the reconstructed banks, but the effect is quite unnatural. We also noted a further transverse ditch or rectangular pit on the ridge line to the west some 15 m outside the main defences; these had not been noted in 1984 and may not have shown then but had subsequently become more obvious with rain washing the track.

Vegetation in 1993

In the interior of the pā, the reconstructed part of the terraced platform has a thick growth of 1-2 m-high mānuka, offering good erosion protection. Throughout the rest of the platform there was a considerable exposure of clay surface bearing many young pine trees (*P. pinaster),* as many as 2-3/m^2 and up to 1 m high. The soil disturbance by bull-dozing, and the harsh soil tend to encourage a shrubland of mānuka, kānuka (on margins), hakea (an Australian adventive) *Olearia furfuracea* (prominent), *Leucopogon juniperina, Leucopogon fasciculatus, Coprosma lucida, Hebe macrocarpa, Ackama rosifolia,* hangehange, five-finger, māpou, *Mida salicina,* rewarewa, *Corokia buddleioides* (korokia), *Coprosma rhamnoides,* toro (*Toronia toru*) and *Phebalium nudum* (mairehau). Pohutukawa are scattered over the hillside (within young pine forest). Ground cover includes *Dianella* sp., *Astelia trinervia* ("kauri grass"), bracken, *Cordyline pumilio* (tī rauriki), pampas, *Gahnia* and a rush.

As a whole, the vegetation consists of a diverse shrubland, with colonising surrounding forest species, but more notably colonising exotics, especially pine. The site supports a range of northern shrubs and tree species that might collectively be regarded as uncommon or a distinctive gumland assemblage: *Mida, A ckama,* toro, *Corokia, Cordyline, Phebalium*. The prominence of *Olearia* and *Hebe* is noteworthy. Throughout, the near-ground flora consisted of a distinctive assemblage of native shrubs, consistent with the associated flora of the original kauri forest of the district.

Management

Pig tracking and rooting have disturbed soils and pheasant dusting bowls were observed. The greatest threat is the large number of pine (*P. pinaster*) seedlings. Pine seedlings should be lopped at ground-level wherever they occur within a 20 m circumference of the archaeological features (we estimate I person-day's work). The seedlings should not be pulled since they are well rooted and this practice will disturb the ground surface, opening it up for more seedlings to establish. The pine trees which are too large to lop should be felled (if small) or poisoned or ring-barked (in the case of the very large specimens on the platform itself). The site will eventually revert to native forest, but its dryness means that shrubland will last a long time unless overtopped by pines. Given the unusual species composition and general rarity of shrublands that have not been planted in pines, we suggest that the native shrubland should be encouraged. A low level of pampas grass is benign at present, and may be out-competed by the other desirable species.

The restored bank poses an immediate problem that requires some attention. It should have seed-rich mānuka brush staked on it, or perhaps have grass-seed applied with some fertiliser. The former would be preferable, since the dead brush will offer some protection from erosion in the short-term.

This site, the subject of an ambitious experiment in site restoration and stabilisation, warrants closer monitoring and ongoing management than it has had. It presents an illuminating combination of moderately unstable (in parts) restoration, a potentially

explosive and destructive pine-seedling problem, and a valuable assemblage of native shrub species. The site is managed by Ernslaw 1, Ltd., and the existence of the site should be plotted on compartment records. It should be clearly marked on the ground by white posts 20 m from the western perimeter on the ridge line. The site is not suited to public interpretation, and provided the pine invasion is managed, it should be left to revert in as natural a process as possible.

3.1.4 Te Tapiri and Okupu gunfighter pā, V17/13 GR 268805 (N95/5) and V17/33 **GR** 268804 (N95/58), Whirinaki State Forest, Urewera. Rainfall about 1500 mm. Steepland yellow-brown pumice soils on loose ashfall substrate with underlying greywacke.

Te Tapiri and Okupu gunfighter pā form a pair on either side of a low saddle on a ridge along Te Taupiri Lookout Road, on the western edge Whirinaki hills overlooking Kaingaroa plains.

The southern pā, Okupu, is on a small knoll, with a well-preserved complex of ditches and banks with scarps up to 2 m high. The northern pā, Te Tapiri, on a gentle south-facing slope, consists of a rough rectangle of perimeter rifle trenches and breastworks, enclosing an area of about 60 x 15 m, and several housefloors. For detailed descriptions of the pa, see Nevin and Nevin (1980a, b) and Jones (1989; 1994: 134-135).

Vegetation in 1981

Both pā were cleared of dense second-growth in 1978 (Nevin and Nevin, 1980b) (Fig. 12). By 1981 there was a dense cover of bracken, flax and tutu 2.5-4.5 m high, and areas of grassland with patches of koromiko, five-finger and introduced Spanish heath. Surrounding vegetation was of similar shrubland with much five-finger, large-leaved coprosma, regenerating kamahi and patches of mānuka. There was a moderately mature pine forest within about 100 metres of the southern site. Those ditch edges which had dense flax along the top were particularly well preserved, especially on the southern perimeter of Okupu (for comparative 1981-1993 photographs, see Fig. 13(a),(b)).

Management in 1981

These two pā were suitable for public presentation, since they were beside a scenic road and have very obvious ditch and bank systems. It was noted in 1981 that the pā, if left untended, would revert quite rapidly to kamahi forest through stages of bracken and shrubland. Removal of larger specimens of five-finger, tutu and mānuka from the pā sites proper would need to be done on a regular basis. By judicious planting of flax it would be possible to inhibit the rate of regeneration of tree species and preserve the steeper banks. The flax could also be used to keep the public off vulnerable edges and guide them along ditches and flatter areas. Spanish heath should also be removed regularly in order to maintain a native cover. Tracks for the public should be sown with grass seed and fertilised to encourage a tough sward.

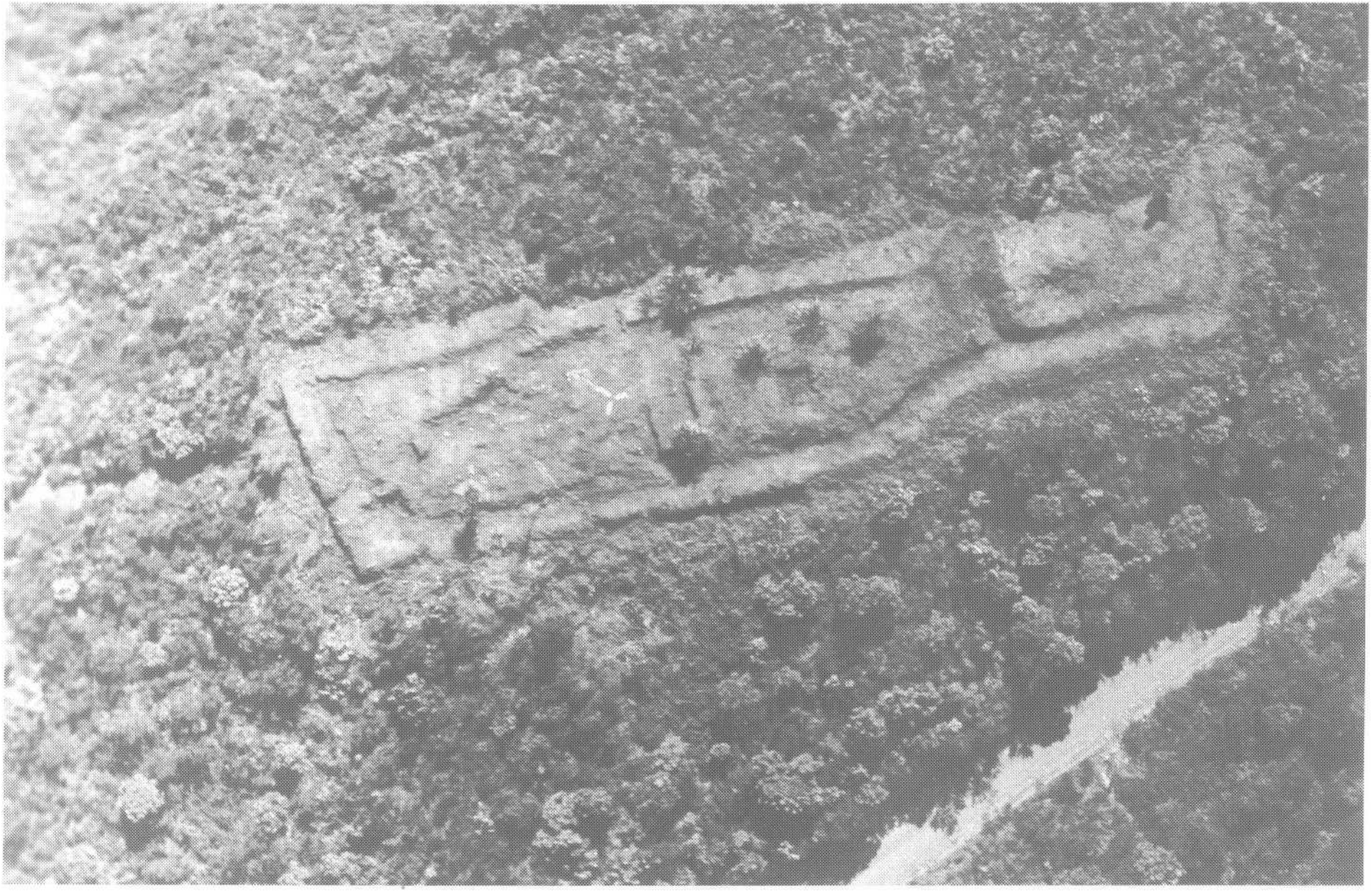
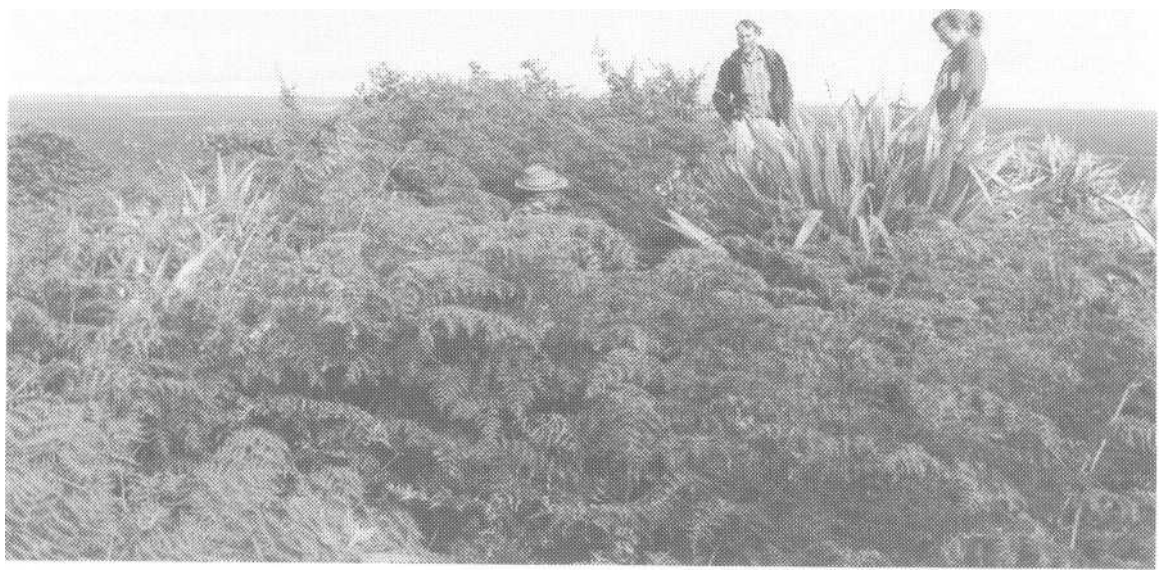


Figure 12. **Te Tapiri (V17/13) after the Nevins' clearance of approximately 1978. North is towards the top of the page. Photo credit: Department of Conservation, Bay of Plenty.**

13(a)



13(b)

Figure 13(a),(b) Okupu (V17/33), the southern fortification, companion of Te Tapiri: (a) 1981 and (b) 1993 views in the southern rifle trench looking to the west. The density of flax has been greatly reduced (some plants presumably killed) by trimming to ground level, to improve visibility and lessen the root system, and weight of the plants on the banks.

In 1988, Te Tapiri was bulldozed along much of its length, the bulldozer entering the northern transverse perimeter, proceeding along the central line of the site, and pushing earth fill from the pā down to exit points on the western perimeter, destroying some 30% of the surface area and 20% of the perimeter breastwork. One of us directed the restoration of the damaged earthworks, including housefloors in the interior (Jones, 1988). As part of this restoration, the site was cleared of shrub growth. The bare earth of the restored areas was topdressed with grass seed "Nui" and Lotus.

Areas of coarse pumice, where the loss of fill could not be fully made up, had seed-rich mānuka brush staked on them. These seed sources struck well, and the restored breastwork and other structures stayed intact. Under the direction of the Bay of Plenty conservancy archaeologist, Lynda Bowers, the two sites, Okupu and Te Tapiri were again cleared of vegetation in December 1990.

Vegetation in 1993

In 1993, there was an induced (by repeated cutting) young seral vegetation within a broader zone of secondary forest, itself an island within extensive pine and Douglas fir forest. The unrestored areas of Te Tapiri were in head-high bracken with the flax lying in much smaller fresh-bladed clumps. On the restored areas, bracken had returned to the walls in most places, but on the western perimeter, where the reconstruction had been deepest and most labour-intensive, the crest of the breastwork was still in grass, as were the interior, bulldozed parts of the pā. (The northern perimeter had been damaged by a hydraulic digger for a second time just prior to our visit, but that damage is not of particular concern here.) On Okupu, bracken was also up to head-height except on the driest high part of the platform where mineral pumice, from erosion exacerbated by the December 1990 clearance, was exposed. On the southern rifle trench and breastwork, the protective cape of flax which had draped over the banks had been reduced in size and numbers by the 1990 clearance (Fig. 13(b)).

Okupu had prominent flax (*P. cookianum*), some of which has the disease Flax Yellow Leaf, but mostly very robust "tussocks". Earth disturbance on Te Tapiri has opened bracken cover to grasses (*Rhytidospermum* sp., toitoi, Yorkshore fog, sweet vernal, plume grass (*Dichelachne*)) and various herbaceous plants like ragwort and *Lotus pedunculatus*. Some of these were intentionally seeded as cover. Mānuka seedlings have established on the bare ground, along with heather (*Erica lusitanica*) and *Gaultheria antipoda*.

Surrounding the pā sites is dense secondary shrubland and young forest - tutu, five-finger, kāmahi, kānuka, makomako, karumu, tī rākau and tī ngāhere. More mature bush contains rewarewa and kahikatea seedlings, indicating that a gradual return to podocarp/broadleaf forest is in progress.

On both sites, bracken and flax have protected earthworks very well. The flax has been cut in places and its overall vigour reduced. Despite the health and attractiveness of flax, the rhizomes will eventually create massive natural mounds and displace soil. Bracken, on the other hand, protects vertical banks well because the fronds all interlink

into a lightweight, flexible canopy that does not move greatly in wind. At ground level, it is impervious to wind, offers excellent raindrop interception, has an open sub-canopy of rachises, only few seedlings of other species establishing underneath, and a relatively open network of thin rhizomes which displace little soil.

Management

Future management of these two sites should include periodic cutting of the shrub vegetation as in December 1990, although flax should not be cut as closely as it was on that occasion. Both heather and flax should be controlled but removal of any plant cover should in future be done in small patches so as to avoid creating large patches of bare ground which might be vulnerable to erosion. In 1993 we were accompanied to the site by kaumatua of Ngāti Manawa and other tangata whenua who expressed an interest in keeping the site in relatively short vegetation, for interpretation purposes. Tall shrubs (e.g., mānuka and karamu) and trees should be removed and a sward established, including native and other grasses, bracken and flax. Making the site stand out from surrounding vegetation would help avoid future bull-dozing or digging errors, which are dangers in production forestry areas because of the logging and fire prevention needs. If it is intended to take groups to the site, or to allow public visiting, then an annual work-cycle of late-spring/early-summer clearance of bracken fern and hand-trimming of grass and bracken may be necessary.

3.2 Sites in grassland

3.2.1 **Wharekawa Harbour site complex,** T12/65 GR 664495 (N49/85), Whangamata Peninsula, Coromandel. Rainfall 1600-2400 mm. Soils brown granular loams and clays on Quaternary pumice.

Site is at the northern end of Whangamata Peninsula on the edge of Wharekawa Harbour and bordering Compartment 115 of Tairua Forest. Midden, pit and terrace site on spurs running north-west down to grassy flats and estuarine mud flats towards the entrance of Wharekawa Harbour.

Vegetation in 1981

The lower half of this site is freehold farmland and the upper half is in the Tairua Forest. When visited in 1981, the upper area was a State Forest, but cutting rights and the management of the forest are now vested in Carter Holt Harvey Forests Ltd. In 1981, the banks of a stream had been eroding. Brush wattle was invading rough pasture and blackberry on the edge of a mature planting of *Pinus radiata* (planted 1931). The wattle was about 4.5-6 m high and the trees on the banks of the stream were collapsing and lifting midden layers with their roots. The fence on the boundary between the forest and the farm was new, and we inferred that the edge of the forest had been grazed until a few years previously and the wattle suppressed. The only native trees were a few large *Myrsine australis,* kānuka and black ponga. The surrounding vegetation was pasture grazed by sheep and cattle, and the *Pinus radiata* plantation was 24-30 m high, with an understorey of native shrubs.

Vegetation and site condition in 1993

We visited the site with Colin Maunder of Carter Holt Harvey Forests Ltd., Whitianga. The pines and brush wattle had been felled. The new pine crop had been planted in 1983 well away from the site boundary and the original belt of wattle had regenerated. A mud flow from torrential rain in 1989 (300 mm in 8 hours) has damaged the site (eroding before the 1988 pines were large enough to hold soil). We had forecast the chance of such an event in 1981. The soil of the mudflow had sparse mixed-up midden shell. Further erosion of the stream banks noted in 1981 (Hamel and Jones 1982: 21) had not occurred, however.

The pasture is dominated by paspalum and cocksfoot with wild mustard, carrot (common where midden shells create drier soil), Californian thistle, scattered blackberry, barberry, and kānuka seedlings. There are secondary but remnant māhoe, cabbage tree, kānuka and māpou. The grove of māpou trees is distinctive and may have been deliberately left because of the spiritual significance of māpou to Māori. Cattle have severely pugged the surface soil of the grassland, and brush wattle seedlings establish in these open sites.

The pine-wattle zone has been disturbed by logging and erosion. Some of the wattle has fallen over and broken the ground surface, disturbing midden. There is a remnant totara and māhoe (with possum browse) and good understorey of māpou seedlings, *Haloragus erecta* (vigorous weedy growth) on erosion deposits, karamu, ponga and wattle regeneration. *Doodia media* dominates some flat sites, probably former gardens.

Occasional wattle seedlings were springing up in areas of bare ground caused by cattle tracking or pugging, but would presumably be eaten out by cattle or sheep when re-introduced. Cattle pugs were still quite evident in the hard soil surface, and there was minor tracking in and out of the steep slopes of gully heads.

Former management and recommendations

In their 1975 site record, John Coster and Gabrielle Johnstone (then working for the New Zealand Forest Service) had recommended that the wattle and larger trees should be felled and the area grazed by sheep (but not cattle), effectively taking the farm boundary further into the forest. In 1980, Gabrielle Johnston re-visited the site and, having thought further about its condition, advised that it did not need to be protected by clear-felling the trees.

In 1981, New Zealand Forest Service archaeologists (Pierce and Charters) visited the site and recommended that the wattle be cleared. In 1983, the site was again re-visited (Lawlor and Olsen), following the logging and re-planting of pine in the adjacent country. A row of pines had been left on the eastern side of the site. Disturbance of middens in logged areas was noted (files attached to the Site Record Form). Jones and Hamel (1981) had noted that the stratigraphy was unusually intact for a site in this area, except where invaded by the young wattle trees. Because of the gully erosion, this would no longer be the case. Nevertheless, because sites without trees planted on them are unusual along this coast, it was thought to be worthwhile trying to keep this site in a tough grass sward rather than allowing a succession to a small tree and shrub stage. In 1981 it was recommended that the wattles, blackberry and the few native trees could be sprayed, the full area of the site fenced out from the forest, and the boundary fence against the farm modified by removing the two bottom wires to allow sheep in to graze the site. Observations made in 1993 change this view.

Management.

At the time of the 1993 visit, stocking of the site was low. Cattle pugging is nevertheless eroding the grassland, and mudflow is damaging the lower slopes in the wattle. Great care will be needed in future logging of the pine on the upper slopes. Old wattle collapse and disturb soil, and this is exacerbating the erosion. Wattle will regenerate repeatedly, but a native understorey is developing, especially mdpou which is clearly well adapted to the area. A border of long-lived native trees would be superior to wattle.

The site complex remains unsuited to public presentation since it is remote from public access and visitors might disturb stock on the farm. Overall, the complex needs better definition as to its values and extent and to be managed as part grassland and part native forest (between the fence and the *Pinus).*

3.2.2 **Fort Galatea, Rangitaiki Valley,** V17/6 GR 352057 (N86/4), Rainfall 1500 mm. Yellow brown soil developed on Recent pumice alluvium of the river valley terraces.

Fort Galatea is a redoubt of the Armed Constabulary on the flats of the Rangitaiki River valley, in developed farmland between the Rangitaiki River and a swamp gully, north of Murupara. The redoubt (dating to 1875) is square in plan and consists of a fairly deep ditch and bank with flanking angles. The flat ground of the wider area of the Historic Reserve includes related 19th- and early 20th-century settlements including earlier fortifications, a schoolhouse and European village, and Karamuramu, a kāinga. Our comments apply particularly to the redoubt. The Galatea Plains support very little native vegetation. Trees are mostly pine and poplar with an abundance of gorse in places.

Vegetation in 1981

The site was in a rough pasture heavily grazed by cattle, containing much browntop with clumps of blackberry, some gorse and barberry (the latter having escaped from a hedge around the site of the nearby schoolhouse) - and a few old Lombardy poplars in the ditch, planted earlier this century. Spraying and clearing by the Department of Lands and Survey had greatly reduced the barberry and blackberry. Where barberry bushes had been removed from the redoubt ditch, Jones and Hamel had noted that the scarp was steep, and likely to erode somewhat before grass invaded it. The site had a substantial fence around it but only a wire and batten gate. The gate had been trodden down by cattle and there was moderate cattle damage on the site.

Vegetation in 1993

Today, Fort Galatea is clothed in dense 2 m-high gorse regenerating into a pasture consisting of browntop, sweet vernal, cocksfoot, and ryegrass. There are a few herbaceous species - *Galium*, foxglove and scotch thistle - and some blackberry, brier, barberry and especially hawthorn. The fields around the redoubt have heather, bracken and gorse. A totara has been planted in the field. The old schoolhouse of the Fort Galatea settlement is marked by several large trees: Douglas fir, oak, walnut, macrocarpa, a pear tree and several declining plum trees, and two planted natives, lacebark and kowhai. Patches of periwinkle cover the ground, and a hop vine is entangled in the barberry used as a shelter. All of this area is part of the 5 ha Historic Reserve. Adjacent, on the edges of the flood plain, is a swamp (Wildlife Management Reserve) with raupō, harakeke (two provenances) and tī rākau and patches of kānuka, mānuka and karamu. This swamp was clearly valuable to the local community.

Management in 1981

The arrangement with the lessee was to spray the blackberry and gorse and to keep the cattle out. The poorly built gate had worked against this management plan. The site could have been maintained in rough pasture relatively easily by occasionally spraying the gorse, barberry and blackberry and allowing sheep access through a standard fence with the bottom two wires removed. Mr Bob Neale had arranged for the lower wires to be removed from the fence to allow sheep but not horses or cattle inside the enclosure. Invasion by native shrubs was unlikely since there was no nearby seed source

(except kānuka). This was a suitable site for interpretation since it was close to a road and was an Historic Reserve under control of the Department of Lands and Survey. In 1981, visitors were mostly blackberry pickers from Murupara in the autumn, but other visitors may have been deterred by a less than welcoming notice at the roadside entrance.

In 1983, the Historic Reserve was closely managed, and the standing schoolhouse had been restored. The reserve was set for a much closer interpretation programme and management. Unhappily, the schoolhouse was destroyed by fire, and the reserve area has been let go since that time. The redoubt, the European village site, the rather cryptic remains of the papakāinga, and the wetland together constitute a place of significance that could be managed as an entity. The success of the planted totara indicates a natural fertility and good water supply that indicate that tree planting of some areas of low archaeological sensitivity might be a management approach that can be sustained. In 1991, the Bay of Plenty Conservancy archaeologist followed the advice of the *Vegetation Management* manual (Hamel and Jones, 1982: 22), and reinstated the spraying conditions of the lease. Unfortunately, suitable stock to break down the dead gorse and maintain the grass sward are not reliably available because of a rustling problem. Firing the dead gorse is not a practicable option because it would destroy the fence posts. At the time of our visit the old hollow poplars had been felled, to prevent them falling onto and damaging parts of the redoubt.

Management

The redoubt should be cleared of weeds and maintained as rough grassland occasionally mob-stocked with sheep, or hand- or machine-mowed. Any gorse should be periodically cleared. The frequency of mowing could be as little as one in late spring and one in autumn. Not long after our visit, the gorse was cleared (Lynda Bowers, 1993, pers. comm.). The site is now subject to a written conservation plan prepared by the Bay of Plenty Conservancy.

Interpretation of the site should also be considered as part of the wider reserve area and wetland. If visitors are to be encouraged, more intensive site management would be desirable. A proven reasonable stream of visitors may improve security at the site, and it may be possible to re-introduce sheep-grazing and install worthwhile facilities such as a viewing tower.

3.2.3 **Kapu to Rangi (Toils Pā)**, W15/20 GR 623532 (N69/22), Whakatāne/Opotiki coastline. Rainfall 1300 mm. Sandy beaches backed by sand dunes and low cliffs of loose pumice substrate on greywacke or Tertiary marine sediments (forming the ridge country). The substrate consists of different layers and lenses of ash showers, some of which are more vulnerable to erosion than others. The Waimihia Lapilli (white, large lumps) layer erodes particularly easily.

Kapu to Rangi (Toils Pā), lies on Kohi Point, Whakatāne. Formerly a Department of Lands and Survey Reserve with tracks and notice boards, now vested in the Whakatāne District Council. Cars are stopped at a car park well back from the pā and the track

leads over a fence and through sheep-grazed paddocks to the pā. In 1981, the main notice was a metal plaque set in a large rock and supplemented with wooden directing notices, but the pā has since had a notice and interpretative drawing installed on the site itself (vandalised and not replaced at the time of our visit). The pā has a large double ditch and bank across the narrow access point to the terrace country on which the road lies, a central and upper platform, and terraces descending to the north-west from a central knoll (Fig. 14(a)).

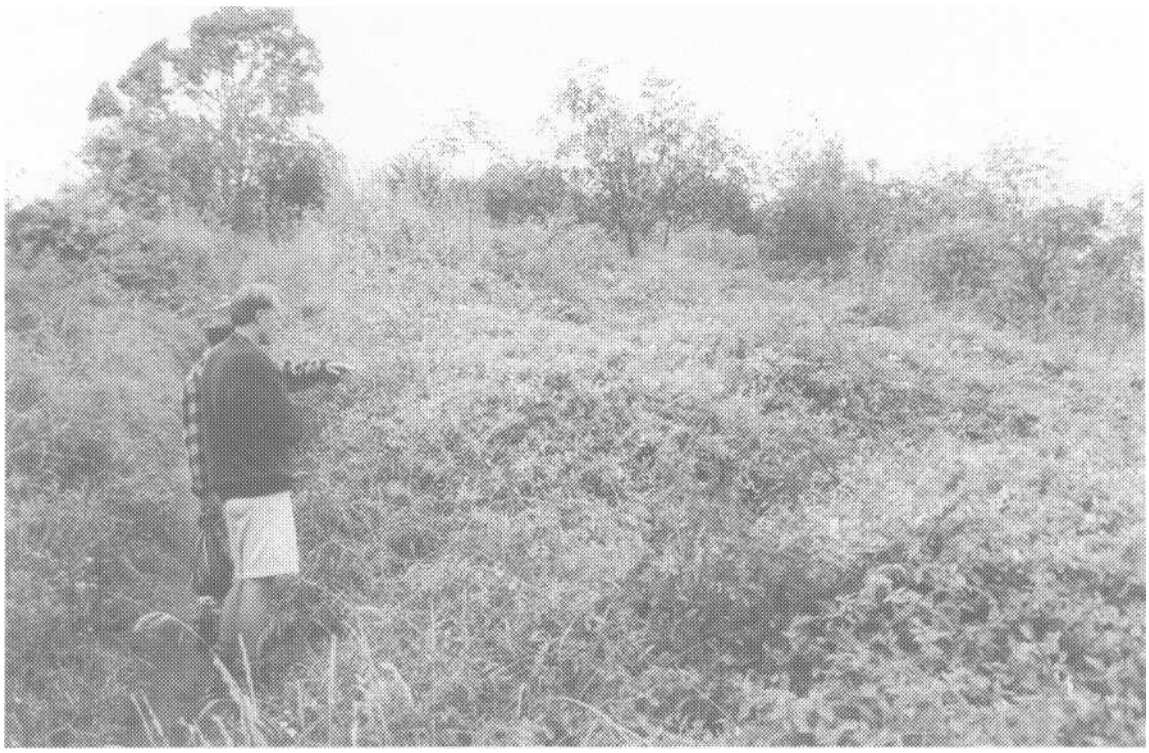
Vegetation in 1981

The site was in rough pasture with some bracken, blackberry and introduced weeds (hemlock, cow parsnip) on flat surfaces. The banks and ditches had taller introduced vegetation and young native trees on them. The species included inkweed, brush wattle, "whiteywood" (i.e., māhoe), five-finger, wineberry and mamaku. On the north-eastern side of the main platform were large pohutukawa whose roots supported steep banks, but erosion had occurred under and around them, where the ditch had been bulldozed to form a track. In two places children had scooped out lapilli and were undermining one of the trees. The rough pasture had been easily broken through by tracks at the edges of banks and in hollows, and the loose substrate had eroded badly in places. Stock fences had been placed across terraces and close to the central defenses, and these had encouraged stock tracks along them. There had also been cattle on the pā **which had** caused bad erosion of edges and along fence lines. Ponga logs had been used in some places to form steps down banks but these had not stood up to cattle and had been damaged. Surrounding vegetation was a dense second growth of five-finger, wineberry, mamaku, adult brush wattles and some senescent *Pinus radiata* trees. Tutu was prominent along track edges nearby.

Management in 1981

Jones and Hamel (1982: 24) suggested a permanent creep-through fence (which allows sheep through) with a strong, padlocked gate to prevent the local farmer putting cattle on the reserve. Over most of this site rough pasture such as browntop and other tough grasses then allowed the public a good view of the defences and yet protected the ground from erosion. Steeper banks could be protected by bracken and some shrub growth. If bracken were to become too vigorous on the flat ground, sheep might be fed hay on top of it during winter and early spring to make them knock the young shoots off. Where patches of bracken or any other tall vegetation were removed, grass seed and fertiliser could have been put down to encourage a grass sward on any bare patches except that as we have found elsewhere, mowing will have to be practised rather than grazing with sheep. Where tracks had eroded down into the substrate these could be filled with a contrasting gravel (to avoid confusing any possible future excavators), and either grassed over or regularly topped with gravel. Any steps down banks should have been very firmly based on a minimum number of metal standards driven deep into the substrate and should have strong steps of durable wood. This advice has been followed. The burrowing into the north-eastern banks should be prevented by planting shrubs hard against the banks, possibly including some uncomfortable species such as toetoe or other "cutty" grass but this recommendation has been largely overtaken by the growth of other shrubs. In 1981 the senescent pine trees in the neighbouring bush looked unattractive and were felled in 1985.

14(a)



14(b)

Figure 14(a),(b) Kapu te Rangi (W15/20), aerial view looking to the west in 1986: (a) the transverse ditches are prominent, with the original platform in mown grass centre right; (b), the lower terraces on Kapu te Rangi with deep (more than 1 m) cover of honeysuckle (foreground) and brush wattle (middle distance).

Vegetation and site condition in 1993

The site had suffered from neglect. It had not been stocked, and only the upper platform and the access paddock from the road had been regularly mowed. On the lower terraces, a mass of wattle, honeysuckle and other weeds to a depth of 1 m obscured the profile of the terraces (Fig. 14(b)). (One of us [KJ] had visited the terraces in 1986, when they were open, and at that stage a track had been cut down hard into the forward treads of the terraces in a most obtrusive manner, with batters as much as 80 cm high.)

On the transverse double ditch and bank, the wattle had reached a height of some 3 m and, isolated from other support, at least one had been torn out by wind and exposed the loose bank fill. A large māhoe in the outer ditch almost completely filled the cavity there. On the north-eastern side of the pā, where the lower bank had been bulldozed (before 1981), koromiko and pohutukawa had come away strongly, protecting the loose lapilli which had been so readily (and potentially dangerously) undermined.

Management

Based on observations in 1993, we have to re-affirm the correctness of the 1981 prescription for management: rough pasture with protective shrubs on steeper banks. We stress particularly the need to remove the young wattle from the banks. The larger trees or shrubs in the base of the outer ditch and at the foot of the north-eastern (formerly bulldozed) scarp should be retained. There is scope on this site for a much closer attention to re-establishment and maintenance of the grass sward on the lower terraces and even in places on the banks. A possible task would be restoration of the ditch profile to the north-east and the double ditch profile on the entranceway which show clearly in 1944 aerial photographs (679/45-47).

3.2.4 Bowentown Heads **pā** complex, U13/31 GR 745106 (N53/38); Te Hoe[?] U13/39 GR 747108 (N53/52); and Tutahi Kahu, U13/991 GR 741108. Western entrance to Tauranga Harbour. Rainfall: 1400 mm. Pumice hill soils on old rhyolite domes, linked to mainland rhyolite terrace country by a tombolo.

The Bowentown Heads is an ambitious project (Tauranga County Council, 1988), conducted by the Western Bay of Plenty District Council, at a landscape-scale of site management. It balances wider public interest for access to an area for fishing, ocean access, and wide viewpoints, with the interpretation and conservation management of several major pā sites. The Heads consist of several weathered rhyolite domes with ash soils of the Whakatāne hill soil type lying on the south west end of the promentary, at the northern side of the channel entrance. The pā may be thought of as lying at the corners of a large triangle of hilltops. The area has a very high visitor use and is clothed in a mosaic of manicured grass, regenerating forest and weedland.

Earlier vegetation and management

Te Kura a Maia was first recorded by Hans Pos in 1964, describing it as follows:

Figure 15 Te Kura a Maia (U13/31), Bowentown Heads, 1993. The terrace surface is mown, while the terrace rises (left) are in *Muehlenbeckia complexa* (naturally established), bracken and grassland. The pohutukawa are on the steep slope to the harbour channel entrance at left.

> The pa is a headland pa, and is defended by a big ditch 8 to 10 [2.5-3 m] feet deep and approx. 20 feet [6 m] wide at the top. On the seaward side the pa is protected by only one terrace and steep sides. The inner harbour side has seven terraces ... [actually, there are 12 terraces carried the full length of the headland]. Some but sites are still visible, and also some places that look like rua pits ... on the northern side [of the transverse ditch and bank] was a slightly terraced cultivation or village, which has now been destroyed and a car park [put] in its place.

The massive lateral terraces of the pā carry some way to the north-west of the surviving transverse ditch and bank which itself is carried over the crest of the ridge and down a steep slope to the water's edge on the south-west. The crest of the pā is estimated to be 40 in a.s.l. Each terrace has a scarp height on average of some 3.5 m (i.e., steep, medium-height scarps). In 1964, the site was "covered with high grass fern, a little blackberry and gorse ... a danger for fire, but this would make it easier to inspect the pa" (Hans Pos, Site Record Form). When Janet Davidson visited the site in 1977, she also found it in good condition, covered in blackberry and gorse, and difficult to see the features.

Vegetation in 1993

The pā had begun to be mowed and the treads of the extensive terracing maintained in a sward of rough grass. On the terrace scarps *Muehlenbeckia complexa* forms tangled masses that restrict "informal" tracking (Fig. 15). Vipers bugloss was observed on some terrace scarps. Seedling pohutukawa and kawakawa were scattered over the area. Mature pohutukawa fringe the coastal cliffs, with karaka and an understorey of

hangehange and kawakawa. Without maintenance the site would revert to wattle which fall when mature and disturb soil. Gorse, blackberry and *Montbretia* would expand on the terraces. In the long-term, without management intervention, pohutukawa forest would establish over the whole site.

Management

The scale of the area is large and maintenance will be a major task. If parts of the pa are left to revert, undesirable weeds would need to be removed (wattle, gorse). There are some multiple lines of deep tracking, exacerbated by erosion, down the harbour (south-eastern) side to fishing spots on the rocks by the channel. There are also several access trackways, some consolidating into grass, through the principal transverse bank by the carpark on the crest of the ridge.

The site is mowed by a small, 4-W-D rotary mower, which has had some trouble with steep access points from terrace to terrace and has shaved some of the surface soil. The machine enters the site from one of the lower terrace levels which leads south-west around to the carpark. Informal trackways have been enlarged up through the steep terrace scarps in several places, presumably taking advantage of existing erosion, while most of the access ways are on the less steep distal end of the ridge near where the terraces converge on the north-eastern cliff. The steep terrace scarps have been left in rank grass, bracken, *Muehlenbeckia* and mānuka, with wattle regenerating in places. Wind-thrown wattle occurs on the lower terraces, and needs to be cleared away. Our view is that the mowing regime as practised is ideal for this site, provided it can continue to be done safely by the operator. The site as a whole needs a thorough review of its tracking needs, as manifested in the *de facto* damage being done. Any desirable tracks should be consolidated and boardwalks, wooden steps, or other erosion-proofing installed where relevant. Access through the transverse ditch and bank from the carpark also needs to be consolidated, perhaps with a bridge or steps elevated above the ground surface. Some limited restoration of the earthwork profile of the transverse ditch and bank would be justified. The scarps of the terraces will need a scrub-saw and weed-eater trim every two to three years, but their scale is such that even three years growth of bracken will not obscure them. With the mower leaving the outer edges of the terraces unmowed, the profile of the terraces is remarkably clear.

Visitors to the site (and the viewpoint provided by the carpark) are estimated to have been 50,000 in number in recent summers. Because the visual impact is considerable, the carpark warrants its own landscaping plan to mask the visual impact of the wide flat surface and the parked vehicles. Although this would also obscure views and tend to press people into the outer earthwork areas of the surviving pā to see the views, increasing pressure there, it would nevertheless be a desirable interpretative development, inducing visitors to go out on the pā itself. Tracking throughout the pā needs to be rationalised by close consideration of the uses that people have for this particular piece of land, and the appropriate uses confined by robust, reinforced and well maintained lines of tracking which take advantage of existing damaged areas, if possible. We have been surprised to find that no detailed map of Te Kura a Maia exists, given that one could be readily compiled from aerial photographs, and we recommend that such a map be drawn as soon as possible so that the condition and trouble spots on the site can be recorded adequately. On clearance of the two other summits, it would be of value to

run low-level stereo aerial photographs of the whole Bowentown Head complex, and low-level vertical stereo and oblique photography of the individual sites against which condition can be monitored.

In the wider area of the reserve, about 500 m north-east of Te Kura a Maia, is the peak, Te Hoe (89 m a.s.l.). Archaeological features here have not been mapped at all, and the site record notes only extensive midden in the bulldozed track to the peak. A large defensive ditch and scarp angles up from the south-western side of Te Kura a Maia, outside its transverse ditch and bank and beneath the carpark, running across and up the slope towards Te Hoe, being finally lost to sight in the fern and shrubs near of the summit itself. This remarkable ditch and bank is some 400 m long and warrants careful management in its own right. At present it is in similar cover to the terrace scarps on Te Kura a Maia, i.e., long grass and small shrubs. The District Council, under the direction of its landscape architect, Mr Rob Humphries, intends to clear the peak of fern and the shrubland, and to maintain it in grass. His basic approach is to spray the margins of the gorse, and to keep up a programme of mowing which expands the edges of the grassland into the former gorse areas. The site exposed by the clearance should be closely mapped and its condition monitored. Several large cabbage trees (two of which are now dead from Sudden Decline disease) should be protected during any vegetation clearance.

Some 800 m west again of Te Hoe, across the low-lying sealed road line, is a separate set of low hills (about 60 m a.s.l.) from which good views of the Te Hoe/Te Kura a Maia complex can be gained. The northernmost of these hills, all with sites, is a pd, Tutahi Kahu, currently in a cover of long grass, fern, gorse and some native shrubs. The ditch and bank encircles the summit, with a perimeter of as much as 500 m, but there are few apparent cultural features within the defended area. The perimeter is broken by a fire break. This site will be cleared of gorse and bracken and maintained in grass by a programme of progressive encroachment of mowing into the gorse area. Given the scale and robustness of the few features on the hill it will readily take large numbers of visitors, usefully drawing visitor-pressure from the Te Kura a Maia vicinity, if promoted that way, since the views over the sea and harbour are similar.

Again, on clearance of the feature, a map will need to be made and pressure points of damage noted. Care will be need to be taken in creating carparks away from the cultural features and consideration should be given to restoring the ditch and bank where it has been crossed by the fire break. Alternatively, this line could be used as the pedestrian walkway to the summit.

3.2.5 **Tauwhare Scenic Reserve pā complex**, three pā (W15/35, GR 676497; W15/33, GR 677500; W15/32, GR 677501) at the western outer edge of Ohiwa Harbour. Whakatane hill pumice soils. The pā lie on a peninsula and set of hillocks on the NW corner of Ōhiwa Harbour, Whakatane.

Reconstruction and stabilisation work has been summarised in Bowers and Jones (1991). That work consisted of reconstruction of some banks, where they had been bulldozed for fencelines, and modification of bulldozed areas to restore the original surface-relief

and allow easier access for mowing (using small 4-W-D ride-on mowers). The site complex had been roaded along the banks of the lateral ditches and banks in the mid-1950s and this work was left to allow for access, following a conservative re-construction philosopy. Fig. 16 shows an aerial view of the complex.

Vegetation in 1993

The vegetation is a mosaic of secondary bush, original pohutukawa/mangeao forest, shrub-weedland (wattle) and maintained grass. On the north-east and cliff-face of the southernmost "flagship" pā, magnificent pohutukawa and mangeao occur with a well developed shrub understorey, consisting of kawakawa, koromiko, kāramu, hangehange, rangiora and ground ferns such as *Pteris*, *Doodia* and *Adiantum*. There are also areas of more or less bare ground under the large trees, displaying the lateral ditches and banks of the pā. Wattle seedlings also occur within the shrub understorey. There are thickets of dense wattle on some terrace sides. The massive seed fall and fast growth probably means that these thickets are self-sustaining. A border of established mdnuka on the western cliffs and at former road margins is common.

There is a single cabbage tree on the site (and another beside the road at the front entrace to the pā) and this tree is probably of historic significance. It has a damaged base from the bull-dozing of the 1950s, which has exposed roots on the edge of the road cutting, and recent weed-eater damage to the lower bark. The tree consists of three rhizome sprouts and has probably regrown from a former tree survived only by the rhizome.

Management

The cost of maintaining a grass sward without the convenience of mowing means that the steeper slopes will be mown or shrub-cut less frequently and could regenerate a shrub cover of mānuka or understorey species. Wattle is not desirable, because of the windthrow-potential, so it should not be allowed to expand beyond its present area of dominance. Brush wattle cannot regenerate in shade when competing with natives. It often has an understorey of shade tolerant natives such as hangehange. If the wattle is physically removed, manuka is able to establish and form a closed canopy that will restrict wattle. Seedlings should be hand-pulled from native shrub areas, especially on the scarps of the pā. Mangeao is fruiting and regenerating on the site and might be useful as a means of gradually excluding wattle. If there is no guarantee of native regeneration, however, the wattle should be left alone. The isolated cabbage tree should have a fringe of mānuka, kāramu, kawakawa, hangehange and rangiora planted around it to protect the root system and prevent lawnmower damage. *Lotus pedunculatus* clearly grows well in this area and may be useful as a ground cover on cleared banks.

The site complex is now subject to a written conservation plan prepared by the Bay of Plenty Conservancy.

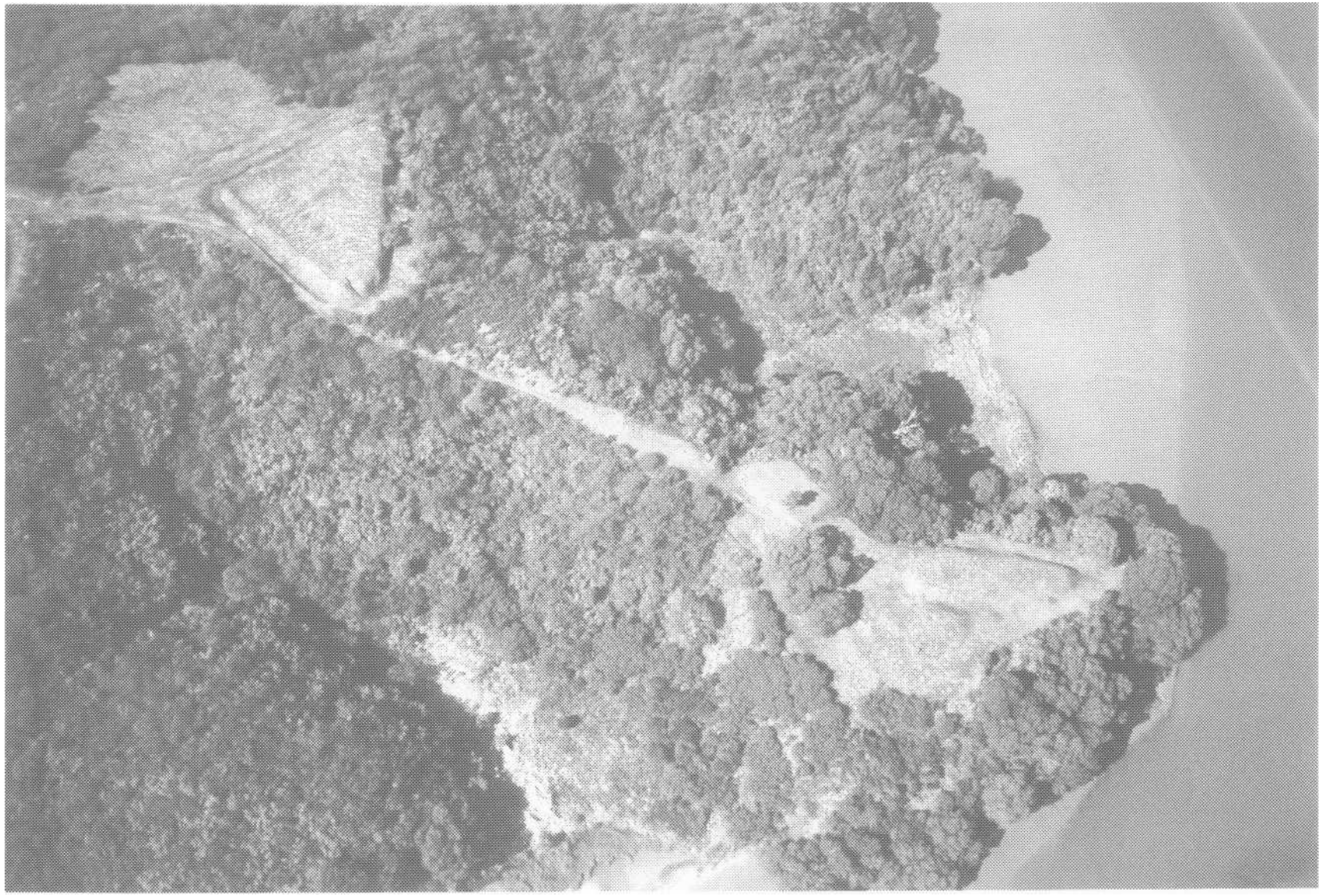


Figure 16 Aerial oblique of the Tauwhare pā complex from the south, Ohiwa Harbour in foreground. The main pā (W15/35) is on the near, cliffed peninsula; W15/33 is the triangular ring-ditch pa at top left. The access track and interpretative board at top left (by the white spot).

3.2.6 Onemana Beach ridge pā, T12/21 GR 660463 (N49/25), Whangamata, Coromandel Peninsula. Rainfall, 1600-2400 mm. Soils brown granular loams and clays on Quaternary pumice.

The site is a ridge pā at northern end of Onemana Beach, sheltered by rising ground to north, altitude 15 m a.s.l.; a transverse ditch and bank encloses an area approximately 45 x 12 m, including terraces and pits, on a ridge above and parallel to the beach. The site is located above a stream which also limits suburban expansion, on a slope leading to a low coastal cliff.

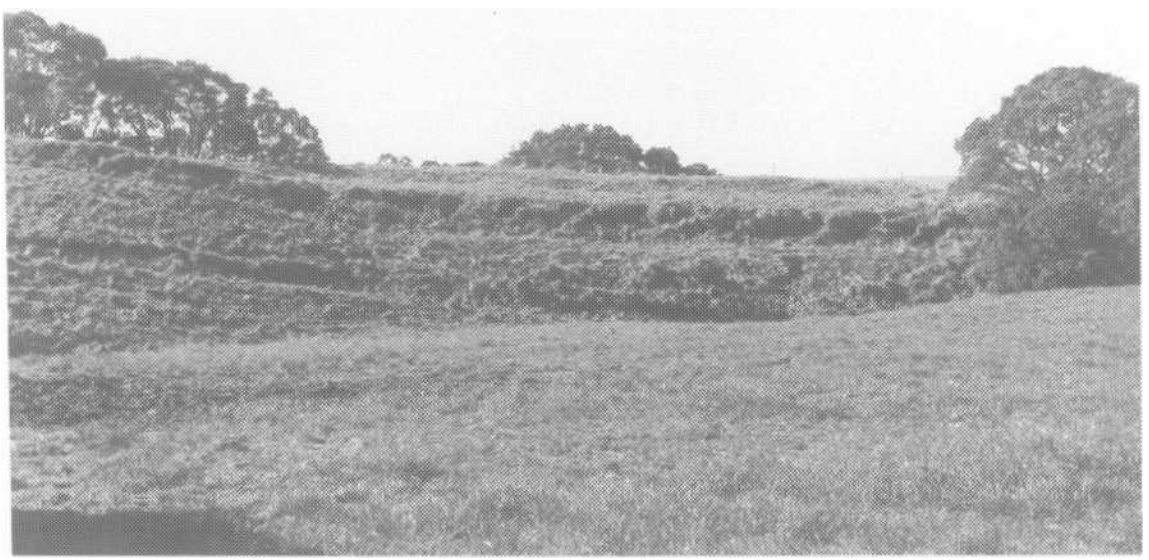
Vegetation in 1981

The site was in rough pasture (grazed by cattle), with pohutukawa trees growing around the edges of the pā and down the small seaward cliff face, with some wind-sheared mānuka on open areas of the cliff. The surrounding vegetation was an "increasingly groomed" grassland on the housing estate, low sand dunes held by marram grass, and a mature pine forest with an understorey of native shrubs and tree species to the north. The outer edge of the pine forest had a fringe of karo and kawakawa (Fig. 17(a)). Cattle grazing was being controlled by badly placed electric fences on wooden battens and light posts running across the site. Some erosion from tracks beside these fences was beginning to show.

Vegetation and site conditions in 1993

By 1993, cattle or stock appear to have been retired off this land for at least a year. The pā was in good condition (Fig. 17(b)) and the problem with the electric fence running parallel to the cliff had ceased. A pond had been built in the gully immediately to the west of the pā, presumably for fire control purposes. The area is predominantly grassland with emerging bracken, blackberry and seedling pine with a coastal fringe of pohutukawa, a dense understorey of kawakawa (possibly reflecting single-species regeneration after grazing has ceased), *Pseudopanax lessonii* (houpara), karo and *Coprosma macrocarpa*. The grass had grown long and a firebreak had been mown down the ridge from the north to the transverse ditch and bank, to protect the forest compartment to the north from fires from the adjacent built-up area. The mowing was presumably carried out by the District Council or the forest owners, Carter Holt Harvey Forests, Ltd. The grassland consisted of paspalum, cocksfoot, *Lotus pedunculatus* and California thistle, with some pohutukawa and coprosma seedlings. Different compositions of grass species were noted on terrace treads and edges respectively; there is a sward of *Trisetum antarcticum* on a drier terrace. On the pā itself, there were three forms of vegetation encroachment on the features of the pā: (a) wilding pines on the seaward terrace; (b) bracken fern advancing from a cliff-edge source on the seaward end, extending about 10 m into the pā; and (c) blackberry extending east from the gully, over the road and up across the lateral defensive scarp on the north of the pā. Comparative 1981 and 1993 views are shown in Fig. 17(a), (b).

Although the grassland on the pā is very dense, bracken, blackberry and thistle are spreading into it and will pave the way in the long-term for pine and pohutukawa colonisation. Pines already form a dense grove at the coastward end of the site. They create an attractive open forest floor with readily interpretable earthworks, but as they



17(a)

17(b)

Figure 17(a),(b) Onemana, pā T12/21 from the west: (a) 1981: note the sheep lynchets on lateral slopes; (b) 1993: note encroachment of wilding pines, bracken (both at right of photograph) and blackberry (bottom left), but overall the grass cover is stable. The transverse ditch and bank is at left, and the distinctive road line running up to the north (left) lies below the lateral defensive scarp of the pā.

grow in size a problem of instability will develop.

Management in 1981

It was noted that, since this site is so close to houses of a holiday area and has obvious features, it should be maintained for presentation to the public. At the time, it was unmarked for fear of vandalism. It would require some other form of grazing than cattle to keep it in a grass sward. The obvious solutions were a creep-through permanent fence for sheep which would permanently bar cattle, one or more stiles for people and, possibly, a padlocked gate. The maintenance of a grass sward would be the best form of preservation of both the stratigraphy and earthworks of the pā. The forest to the north was to be felled in the near future and would be replaced. A native shrub understorey was likely to continue in the forest and so the pā would always be subject to invasion by native shrubs. If it were decided not to mark the pā for public information and even to try and conceal it, a cover of the smaller native shrubs and trees would preserve the site, though rough pasture and/or smothering creepers would be preferable. The pā and its setting were important scenically to the housing subdivision, and scenic values would have to be considered in its management.

Management

By 1993, the inadequacy of some of these forecasts and recommendations was apparent. As elsewhere, there seemed to be a shortage of stock to graze the site, although whether this was a general problem, or created by the inaccessibility of the land is not known. We were not able to determine who had responsibility for maintaining the land but it is presumably the Thames Coromandel District Council.

As elsewhere, the thick, well maintained grass sward, coupled with grazing of a frequency that we cannot judge, had prevented any opportunity for native seedling establishment. In our view, light stocking or mowing is still the best treatment for this site, with the bracken and blackberry growth prevented by spraying. The general pattern of the bracken, spreading from the edge, suggests that is not being adequately controlled by stock. Seedling pines in the open will eventually damage the site and both they and the grove on the end of the pā should be removed now. Pohutukawa are seeding on to the bare earth of the bulldozed track bank. They are acceptable in the short-term, but should be removed if and when they come to obscure the landscape features of the pa.

3.2.7 Te Pare Historic Reserve, two pā: TI 1 /67 (GR 617806) (Hereheretaura), and T11/68 (GR 616803), (Te Pare). Southern entrance of Mercury Bay. Soils and climate as for Whangamataa. The pā are both in the Te Pare Historic Reserve, south end of Hahei Beach.

Hereheretaura is on a dramatically upraised hill point at the eastern end of the reserve, and is linked by a 40-70 m-high run of cliffs to the south-east to Te Pare, a terraced pā on the trig point, forming the southern boundary of the reserve (Fig. 18(a)). The steep south-western approach-slope to Hereheretaura has massive transverse ditches and scarps up to 5 m high. These mount up to give a 6- or 8-tiered scarp effect viewed from the

south-west. Terracing of lighter relief fills the platform area both downslope to the south, and over a lesser area to the north-east, where there is a very steep scrub-covered slope to the sea. To the east, the platform has an upper steep slope falling to 30 m-high cliffs. There has been very heavy multiple tracking through the scarps and terrace edges, with one track to the south-east particularly deeply entrenched, and with an erosion delta filling and obscuring the very lowest transverse ditch. This erosion is now fairly stable, and probably resulted from cattle being used for grazing (Fig. 18(b)). The site has a long history of recording, having had artefacts taken from it in the 1940s, and being first mapped by Molly Nicholls in the 1960s and later by P.R. Moore.

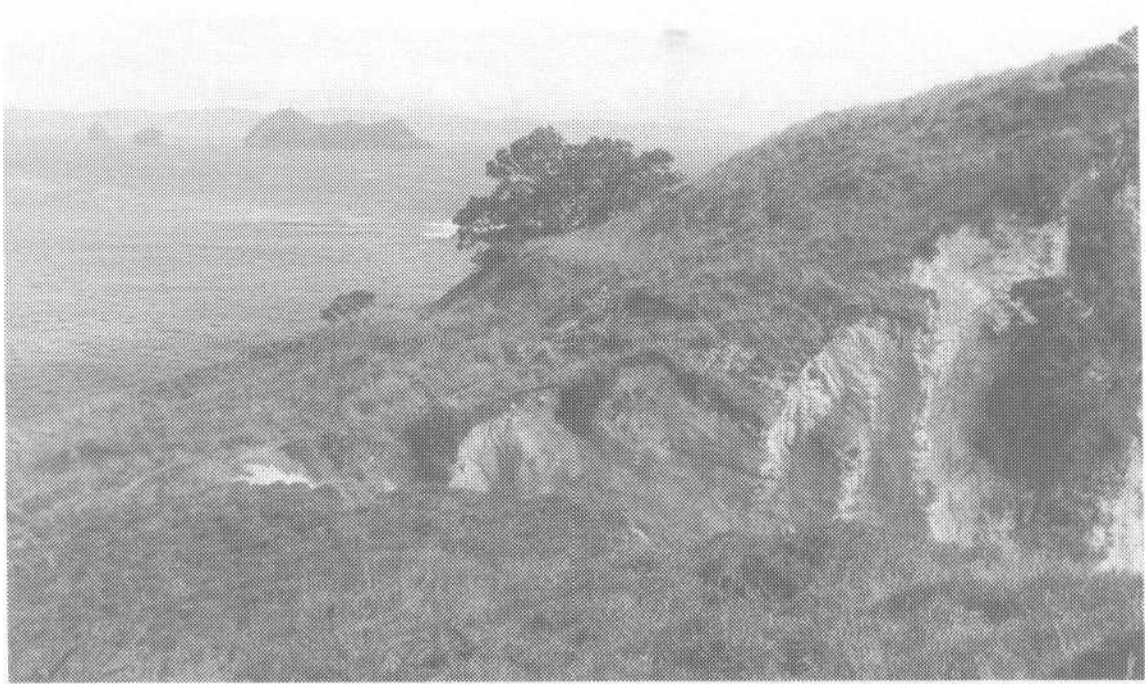
Vegetation

Entrance to the reserve is through a grove of very large karaka trees which are regenerating underneath and to some extent into the adjacent coastal grassland. The coastal strip adjacent to the track into the pā has been fenced and planted in native trees (a Project Crimson project), some of which (e.g., putaputaweta) are inappropriate, but most are appropriate (e.g., pohutukawa). No trees have been planted on the pā itself. The site is dominated by rough grassland with extensive low gorse cover, along with kikuyu, cocksfoot, scotch thistle and wild mustard. The gorse has been cleared progressively to expose regenerating *Pittosporum crassifolium* (karo). A few boxthorns have established at the crest of the pā. A recent fire has burnt the gorse on the north-east coastal bluff. A band of pohutukawa and karo secures the rocky cliff edge in an aesthetic manner.

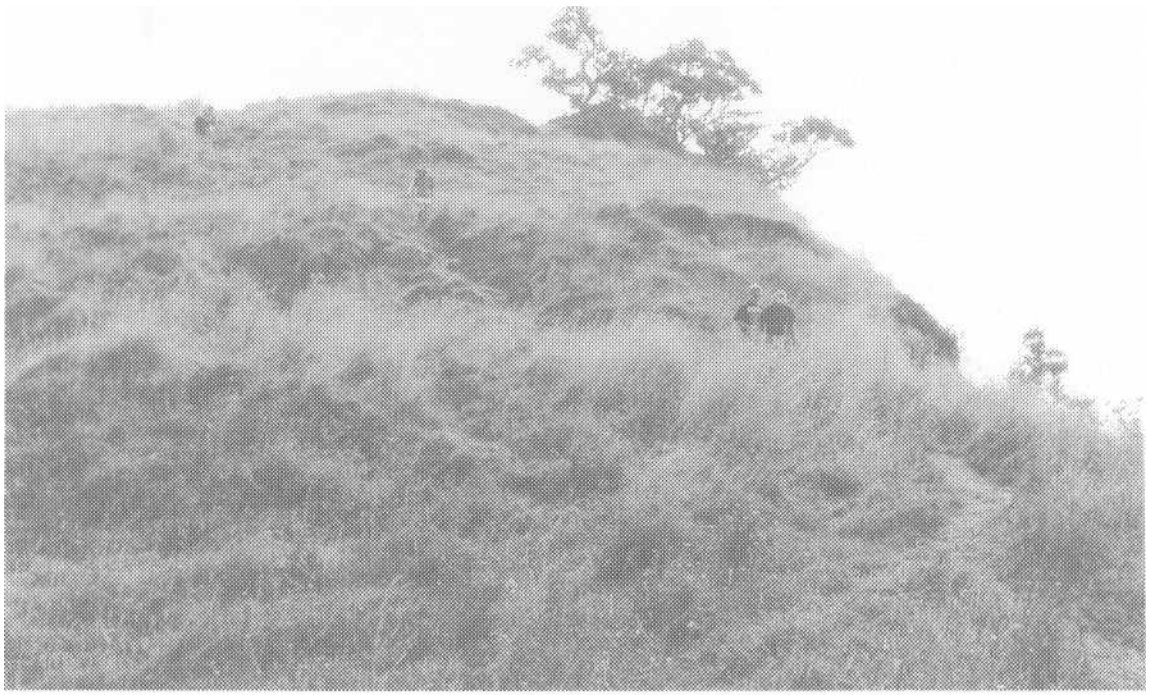
Management

At the time of our visit, stock had been retired from the site for at least 12 months, possibly more, and the grass was rank and offering a good ground cover for conservation.

In the absence of stock or intervention the site will regenerate to coastal bush (pohutukawa, karaka, karo) through an intermediate shrubland of gorse and boxthorns. This is not desirable in the short-term, although the large scale of the reserve could accommodate pohutukawa treeland on all but terraces and ditch areas of the pa itself. Where stock and human-induced erosion have damaged some of the earthworks, improved tracking is needed. The best way would be to consolidate the existing deeply cut channel by the placing of treated pine risers pinned by steel standards. Other channels could be deliberately planted with *Muehlenbeckia complexa*. Boxthorn should be removed, gorse reduction continued and amenity tree planting focussed to fit a long-term management plan designed to protect the archaeological features and the historic landscape views. An immediate action might be establishing pohutukawa on the recently burnt area before it regenerates to gorse.



18(a)



18(b)

Figure 18(a),(b) The transverse ditches and banks of Hereheretaura (T11/67): (a) from south; (b) from west. Note figures coming down large channel created by stocking in the past.

3.2.8 **Moerangi,** U15/119 GR 799670 (N67/48). Kaimai-Mamaku Plateau. Rainfall about 2500 mm, altitude 330 m. Yellow brown soils on loose substrate of volcanic ash and weathered rhyolite terraces.

Moerangi, on the Mangapapa River, south of Tauranga, is a gunfighter pā of 1865 kūpapa origin (see Jones, 1983) in a paddock on the edge of a bush-covered ravine. The pā consists of a perimeter rifle trench and breastwork, with an oblong trench both forward and rear of the breastwork to the north, east and west enclosing (Fig. 19).

Vegetation in 1981

The paddock was covered with a coarse grass, extending over the pa which has never been ploughed. There was a remnant of shrubby weed vegetation which the farmer, Mr Ross Peers, had been removing by spraying. The species present then included gorse, thistles, foxgloves and inkweed, with remains of tree fern stems (Fig. 19(a)). The gully nearby had and still has remnant forest of rewarewa and tawa, badly damaged by fire and grazing, as well as bracken, gorse and stands of *Pinus radiata.*

Vegetation in 1993

The combination of spraying and stocking with sheep had removed most traces of woody vegetation from the site (Fig. 19(b)). Being entirely enclosed within farmland, the site is mostly in grasses with a variety of sward-forming or emergent herbs: sweet vernal, *Ehrharta* (*Microlaena*) *stipoides,* rye grass, Yorkshire fog, brown top, *Poa annua*; sward herbs include foxglove, white clover, hairy trefoil (*Lotus suaveolens*), *Hydrocotyle* sp., *Crepis capillaris,* sorrel, *Carex breviculmis* (one small patch), *Sagina procumbens*, *Cerastium* sp. Dominant emergents are California, nodding and Scotch thistles, and scattered small gorse. The gorse and nodding thistles have been sprayed. There were few areas of actual erosion in the grass sward except for about six areas of sheep-rubbing on the south side of the southern breastwork towards its crest, and on the distinctive, eastern internal "diagonal" breastwork (probably originally cover for an entranceway on the northern breastwork). The pasture composition indicates a low level of fertility in the site and stocking levels have evidently been low. Previously-eroded areas have been reclothed in grass.

Management in 1981

Hamel and Jones (1982: 21) thought that spraying the shrubs and allowing light grazing by sheep was probably ideal management. The banks of the pā had already been damaged to some degree, and continued stock erosion was not anticipated to be a problem. Rabbits were also burrowing into the exposed soil.

Management

By 1993, sheep-rubbing has become a problem in the southern breastwork, however, and a solution needs to be sought. The sheep dig into the top of the breastwork to create a shelter from wind and perhaps sun. Unfortunately, the earthworks provide the sole shelter for sheep (probably from northerly winds); this is unacceptable and alternative sources of shelter need to be arranged in cooperation with the landowner and farmer.

19(a)

19(b)

Figure 19(a),(b) Moerangi (U15/119), a pā of the Tauranga "Bush Campaign" 1865: (a) 1981; (b) 1993. The view is looking west along the southern breastwork. Note the lack of gorse in 1993. The rectangular features are rifle pits inside the breastwork which runs up and left from the centre foreground.

(The landowner is the Ngā Manawa Incorporation, and the land is a fragment of a wider block on the other side, i.e., south-west of the gully.) Perhaps the construction of corrugated iron or even turf shelters on or near the escarpment edge or by the roadline would reduce the tendency for the sheep-camping to occur. Another solution may be to plant low shrubs between the fenceline and the road. Restoration of the sheep damage as it has so far occurred would be a small project, as would be the construction of shelters. Several strands of barbed-wire could also be trailed and staked along the southern breastwork as a temporary measure, or the erosion holes could be filled with rough logs to deter sheep, provided this does not divert their attention elsewhere on the site.

We do not favour fencing out and retiring the land in the long-term, since there are obvious visitor attractions. However, there may be value in fencing-out if there is no solution to the sheep-rubbing. If the site was protected from stock a wider range of pasture species would establish, as shown by the species along the adjacent roadside - paspalum, bracken, *Hypochaeris radicata*, Yarrow, *Lotus pedunculatus, Prunella, Anagallis*, cocksfoot, "dog-daisy", and two ferns - *Paesia* and *Blechnum capense*. Adjacent bush consists of podocarp-broadleaved species such as rimu, hinau, mamaku, māhoe, putaputaweta, mingimingi, lawyer and hangehange. There are groves of *Pinus radiata* and *P. pinaster*. On the roadside banks nearby, besides ferns, we found kāmahi seedlings. If left, the site would revert rapidly to bracken and gorse, and would in time revert to forest species such as kāmahi from sources in the adjacent gully. On balance, we believe that the site should stay in grass and its condition be monitored.

3.3 Sites in exotic weed cover

13.1 **Pā in Tairua Forest,** T12/60 GR 659464 (N49/80), Whangamata Peninsula, Coromandel. Rainfall 1600-2400 mm; soils, brown granular loams and clays on Quaternary pumice. Tairua Forest, Compartment 118, altitude 75 m, about 50 m north of Onemana Bay and 100 m from T12/21.

The pā is on a ridge top facing east to coastal cliffs, with a ditch or scarp, dog-leg in plan, enclosing the easier southern slope and a ditch and interior bank running transversely across the ridge line to the steep slopes dropping to the sea to the north. The total area enclosed by the transverse ditch and the lateral scarp is about 50 m by 30 m. There were several rectangular pits on the ridge line about 35 m exterior to the transverse ditch and bank.

Vegetation in 1981

The site had been planted in *Pinus radiata* in 1931; in 1981 they were 24-30 m high and closely spaced. The understorey of natives was about 3.6-4.5 m high and included five-finger, *Pseudopanax lessonii,* broad-leaved coprosmas, rangiora, kawakawa and lance-woods, with a ground layer of astelias, *Leucopogon fasciculata,* koromiko, *Blechnum* spp. and dying bracken, all particularly dense at the forest/pasture margin. The surrounding vegetation was similar to that on the site.

Management in 1981

The site was scheduled to be logged. Arrangements were made to remove the felled pine trees across the surrounding ditch by two routes only. "Logs should be removed with as little disturbance of the soil surface as possible" (Hamel and Jones, 1982: 18). When the logging was finished, it was thought that the native tree and shrub species would regenerate on the site, particularly five-finger, *Pseudopanax lessonii* and the coprosmas. Appropriate follow-up management was regular inspection and tree removal to prevent damage to remaining earth. Any slash from logging operations was to have been left on the ground to help prevent erosion and was not to be windrowed or piled in heaps that might in time be confused with the prehistoric features of the site.

Vegetation and site condition by 1993

Authority for logging the pā (New Zealand Historic Places Trust 1985/13) was issued and operations appear to have been carried out in 1986. Despite a search of New Zealand Forest Services files in the National Archives, Auckland, no description of the actual operations has been found. Informal reports indicate that trees on the ridge crest were felled onto a pad of logs placed in the ditch of the ditch and bank, and hauled from elsewhere in the interior on the ridge crest over that pad. In our view, the felling must have been very destructive to the ridge crest ground surface, if not to the ditch itself.

On our visit in 1993 neither feature could be relocated. Three predominant vegetation changes were obvious:

- A sward of massive pampas, some native shrubs and many 10–15 m high wilding pines on the ridge crest and in the inferred defended area of the pā (we could not detect the ditch);
- Considerable growth of the fringing belt of māmuku, karamu and bracken on the southern margin of the compartment. Fig. 20(a), (b) shows comparative 1981 and 1993 photographs of the same area of the margin); native species include bracken, karamu, *Coprosma lucida*, *C. macrocarpa*, hangehange, kawakawa, houpara, mānuka, tī rakau, rangiora, *Pomaderris ericifolia*, māmaku, ponga, mingimingi, karo;
- In the south-east, where the pines had been less densely planted, and felled to waste down steep slopes to the cliff, original or regenerating coastal forest dominates. Houpara and *Astelia trinervia* are dominant with ground species such as *Poa anceps*, *Adiantum* sp., *Doodia media* and *Dianella*. Houpara was dominant in the canopy at 2–3 m height. In the long-term the coastal forest will dominate the whole site, mainly pohutukawa with its understorey of shrubs and small trees (houpara and kawakawa to 5–10 m height) and *Astelia* ground cover, and tree ferns.

We were not able to judge the success of the protection of the ditch and bank, because we were unable to re-locate it. The dense colonisation by pampas, and the wilding pines dating from the logging, suggest that damage to the soil surface must have been considerable. It is now a major seed source for pampas for this immediate locality. Some of the wilding pines have been thinned or pruned in the last five years, as if to be logged again.

This site was always going to be a pyrrhic victory ("one more such victory and we are lost" – *Oxford English Dictionary*), if that, for archaeological conservation. We discussed management with officers of Carter Holt Harvey Forests Ltd. They felt that the pampas could be controlled at the second cutting of the forest, by spraying and over-sowing with *Lotus pedunculata*. With the pampas suppressed, it may be feasible to plant a native cover consistent with that to the south-east, i.e. a houpara, *Astelia*, kawakawa cover under the canopy of pohutukawa. The pampas-suppression favoured by the company involves allowing cut-over country to green up for some 18 months, then spraying with "Roundup", and oversowed with *Lotus* and grass seed into which the new pines are planted. This practice clearly has the disadvantage that all species are killed in the Roundup application, and it is a moot point as to whether desirable native species would re-invade such blocks naturally. In our view the value of the site, following logging of 1986, also needs to be re-assessed prior to the second logging or felling to waste, whichever is chosen.

20(a)

20(b)

Figure 20(a),(b) Onemana (T12/60), Tairua Forest, showing the compartment edge viewed from the south: (a) fringing shrubland, māmaku, kawakawa, rangiora, in 1981; 1931 pines closely spaced behind; (b) fringing shrubland in 1993; extensive spread of bracken fern into the grassland towards camera viewpoint with tree fern, hangehange in fringe along the former fenceline. The pā is on the ridge (invisible) 60-100 m beyond the shrubland fringe. The shrubs mask the dense cover of pampas beyond.

3.4 Sites in mature native forest

3.4.1 **Whitianga Rock pā**, T11/76 GR 522816 (N44/17), inner Mercury Bay, across channel from Whitianga township. Rainfall: 1800 mm. Soils: brown granular loams and clays on eroded rhyolite dome or outcrop.

Whitianga Rock pā is a highly scenic, coastal, rock outcrop with pohutukawa forest, urban and bush surroundings. The site is heavily visited, being near the Whitianga township and easily accessible from the ferry landing.

The wider area of the pā (some of it now built on) occupies a broad fairly flat-topped peninsula, rising to the south-west to a precipitous high point approximately 35 m a.s.l. The site was referred to briefly by Banks (1962: 431) in 1769. A very large transverse ditch lies across the broad part of the peninsula, enclosing a small fairly flat area. There may have been a further, outer, transverse ditch to the east, but if so its location is obscured by a house. On the highest point, there are several areas of probable transverse defensive ditches set in the rocky outcrop with putative palisade postholes in the rock generally of a lateral rather than transverse orientation. The site is poorly mapped in the existing records; none of the plans are adequate to document or annotate with site condition.

Vegetation

The areas of the peninsula immediately interior and exterior to the transverse ditch and bank are mown, with the mowing extending up very steep slopes to the rock outcrop. A well formed track has been heavily and obtrusively bedded into the slopes rising to the outcrop, exposing faces of concentrated midden with some black topsoil, the exposed scarps being up to 80 cm high (Fig. 21(a), (b)). The vegetation is basically coastal pohutukawa forest with associated species, including *Astelia trinervia* and epiphytic *Collospermum*, kānuka, mānuka, *Pittosporum crassifolium* and *P. umbellatum*; *Coprosma rhamnoides* and *C. macrocarpa*, kawakawa, māpou, koromiko, rangiora, *Leucopogon juniperina*, *Pseudopanax lessonii*, *Pomaderris ericifolia*, *Earina mucronata*, *Poa anceps* and *Rhytidospermum* sp. (? *gracilis*; dry-land grass), *Muehlenbeckia complexa*, *Blechnum fluviatile* and *Adiantum cunninghamii*. This is a native assemblage typical of Coromandel coastal forest.

The site has an explosive weed problem, with considerable current management costs. In addition to the bush-covered areas are open lawn areas with weedy margins. The most prominent weeds are *Phoenix canariensis* (palm), *Araugia sericifera* (moth plant vine), brush wattle, *Cotoneaster* sp., privet and fennel. Climbing *Asparagus* is also threatening. Some of these weeds are seriously detracting from the value of the site. *Phoenix* are huge plants that would ultimately exclude everything else. There is a constant supply of seed from specimens across the harbour in Whitianga township. *Araugia* is climbing into the pohutukawa, interrupting the natural grace of the branches and smothering the epiphytes. Wattle is short-lived and will eventually collapse with impact on the midden; *Cotoneaster* is capable of growing in rock cracks. Privet establishes extensively dense thickets and forms a canopy. *Pseudopanax laetus* and ngaio have been planted along the lower east side of the site. Neither species appears natural to the area and may represent inappropriate planting.

21 (a)

21(b)

Whitianga Rock pā (T11/76): (a) view to the south-west from the access track and inside the transverse ditch, showing track, pohutukawa (on skyline) and weed-infested margin of grass; (b) view to the north over the grassed access area. The kānuka canopy over the transverse ditch (just above centre, beyond the grass) is about 8 m high. The kānuka is providing good conservative cover at present, especially from rain erosion of the track through it.

Of "benign" weeds, a local population of *Lilium formoseanum* is growing on the pā as well as along roads in the vicinity. It adds charm to the site and does not threaten existing vegetation. A minor ground cover of wild strawberry (*Fragaria*) seems also to be benign.

Management

There appears to be a major problem with weed species and a weed control programme is urgently needed. The technical details of how to remove the *Phoenix canariensis* will need to be the subject of close consultation. There is also an opportunity to establish native species on some weedy margins, but these must be natural to the specific area. Native coastal forest is clearly an integral part of the present-day pā and in defined areas should be encouraged in both quality and quantity. Tracks could benefit from native species along their margins, such as the grasses *Rhytidospermum* sp. (sunny) and *Poa anceps* (shade). *Dichondra repens* (Mercury Bay weed) is also present in the lawn margins and could be encouraged.

Open spaces are very important for visitors, but the margins are extremely weedy. There needs to be a closer relationship between the natural bush and the manicured lawn, with management of the weed problem in the margins into a stable native succession of an appropriate character. We are reluctant to generalise here on measures that could be taken and we suggest that a conservation plan and full documentation of the techniques and issues be produced. The track, for all its obtrusiveness, is probably a re-bedding of an informal, already-eroded trackway into the pa, and the only point needing to be made is that prior to its construction to its present state, an obvious opportunity to re-think and put in place a more sympathetic access-way has been lost. The track up and through the outer outcrop has also been cut heavily into the rhyolite, although a boardwalk covers one particular area where it skirts the head of a steep gully. A track also goes through the transverse ditch base to the bay to the south-east.

3.4.2 **Pā, Tairua Forest environs,** T12/440 GR 661604 (N49/524), general area vested as a reserve in Department of Conservation, Whangamata Peninsula. Rainfall 1600-2400 mm. Soils: brown granular loams and clays on Quaternary pumice.

The pā is on the track from the car park along the western slopes of the Whangamata Peninsula, altitude 50 m; slope running down to Whangamata Harbour, facing slightly west of south with terraces from which shell midden is eroding.

Vegetation in 1981

Vegetation consisted of very open Pinus (species undetermined) about 30 years old and 7.5-9 m tall. There was a vigorous understorey of native species 4.5-6.0 m high, including two species of broad-leaved coprosmas, *Pseudopanax lessonii,* five-finger, mānuka, *Myrsine australis,* "whiteywood" (i.e., māhoe), mamaku, and occasional plants of rewarewa and pohutukawa. A smaller shrub layer included kawakawa and *Leucopogon fasciculatus.* Surrounding vegetation was the same as that on the archaeological site (Hamel and Jones, 1982: 16).

Vegetation in 1993

We were unable to visit the site on the ground in 1993, but gained a good distant view of the shrubland setting from the Whangamataa wharf, across the 200 m-wide estuary channel. There was a dense secondary forest with scattered seedling pines (*P. radiata* and *P. pinaster*). Species include pohutukawa, houpara and rewarewa. Native forest cover without pines is clearly the preferred vegetation for the whole face to provide and improve the setting for a walkway, and as a landscape feature. The local Whangamataa people are keen to see pines removed.

Management in 1981

Hamel and Jones (1982: 16) had noted that the site was not prominent in appearance but with other sites along the scenic bush walk might have provided an interesting grouping. The smaller tree species and the shrub species provided a good cover for the site for preventing erosion, but the pines need to be removed and regular inspections for tree removal written into a management plan.

Management in 1993

No work had been done on pine removal by 1993. The species likely to grow large are the pohutukawa, māhoe, five-finger, and rewarewa. If the site were to be cleared for public interpretation, it would probably be difficult to maintain it in a sufficiently low vegetation to reveal the terraces, and we recommend that the pine trees be felled to waste and smaller wilding specimens cut out periodically, with a relatively unmanaged reversion to follow. Some tracking could be carried out to open up the reserve area, and this could be carried through the sites.

3.4.3 **Taumata Kahawai**, W15/38, 39 GR 628543, Whakatāne Headland, setting as for 3.2.3.

Taumata Kahawai is a pā some 250 m long on the highest point on the Kohi Point walkway overlooking the Whakatāne River entrance. The site consists of three central platforms demarked by transverse ditches with extensive defensive scarps and terraces to the east and south along the ridge terminating at a saddle. To the west is the steep escarpment to the Whakatane River. To the north is a further platform (formerly recorded as a separate site); to the west is the steep escarpment to the mouth of the Whakatane River. Soil and environmental conditions are the same as Kapu te Rangi (W15/20), except that this site appears to have more extreme wind conditions.

Vegetation

Aerial photographs taken in 1944 (679/45–47) show that the site had reverted (since 1930) from farmland to an even canopy, probably of mānuka or kānuka on the ridge lines proper, while on the steeper slopes and gullies to the east and south-east there was an early stage of secondary broadleaf forest. The head of the escarpment to the west was steep bare rock and grass. By 1993, the site had an open cover of broadleaf forest.

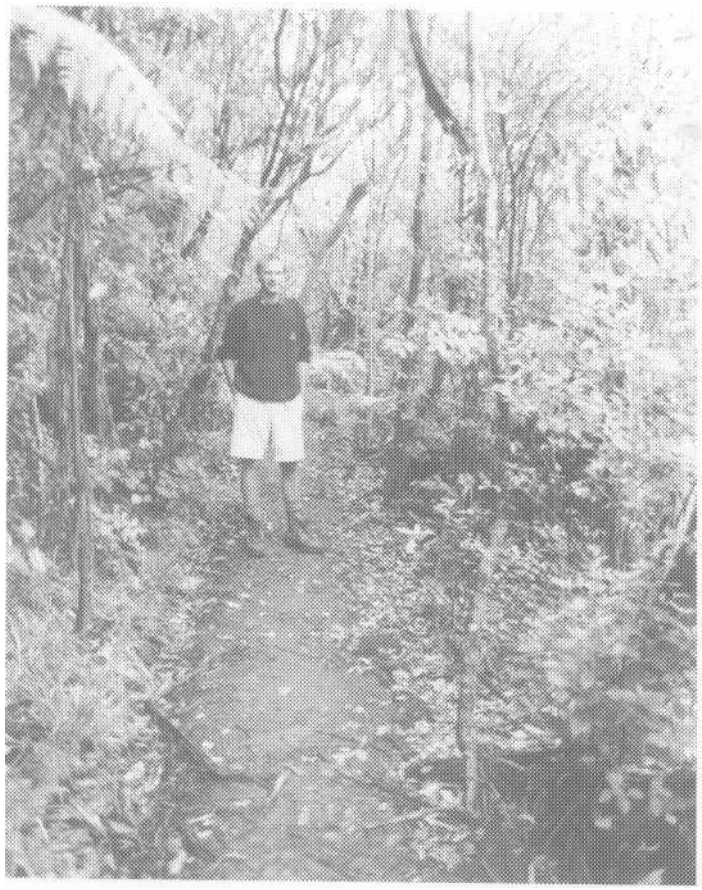
The main canopy, at approximately 6-8 m height, is severely damaged by wind and some trees were unstable.

The bush is basically pohutukawa forest with a diverse understorey. In past time (up to about 65 years ago) it was farmland with scattered trees and gully remnants. Species include kohuhu, mangeao, pigeonwood, rewarewa, and māpou, with shrubs of kawakawa, hangehange, rangiora, *Olearia rani* and *Pimelea tomentosa*. A very large specimen of houpara was noted. The prominence of mangeao means that the forest floor is open, which benefits observation of pā earthworks (Fig. 22(a)). Light levels are high on the ridge line at ground-level. Where the radio masts had been installed, damaging the forest, a small clearing had been invaded by pampas grass. A recent wind storm has caused some damage to the canopy. The archaeologically desirable, low, dense canopy would be a typical result of this damage in such a location. Periodically, wind would defoliate the canopy and expose the ground surface to raindrop impact and minor water flow.

Management

The general line of the track through this site is satisfactory because it skirts the mapped eastern terraces. The track traverses only part of the principal platforms and is not steeply cut into the single transverse trench which it happens to cross. The southern end of the track enters the pā through a very heavy cut (batters 0.6 to 1.3 m high) in the counterscarp of the transverse ditch (approximately 18 m long with a steep scarp of some 4-5 m) (Fig. 22(b)). The damage is of long standing, but the track has recently been enlarged, and further improvement in width would preferably be by way of a boardwalk in the ditch itself extending from counterscarp to scarp along the ditch. The track here is nearly level and erosion is not a problem.

The site is interpreted with a perspective view installed by the Whakatāne Field Centre (Department of Conservation) and District Council in 1989. Some improvements in the visibility of ground-surface features could be made. Clearly, the site is not a prospect for forest- and shrub-clearance and grassing. To improve visibility, we recommend that rewarewa and mangeao (*Litsea calicaris*) be more fully planted into or otherwise encouraged by thinning of other species. If any intervention is warranted, we recommend management of rewarewa and mangeao. We noted here and elsewhere that both species produce leaf-litter or duff that inhibits understorey plants. Although both species can grow to large size (20 m plus height) they are unlikely to do so in the conditions on this site and will provide a stable forest with good ground-level visibility. Some clearance of ground-level shrubs to improve visibility of the archaeological features recorded on the interpretative sign may be warranted.



22(a)

22(b)

Figure 22(a),(b) **Taumata Kahawai (W15/38): (a) cover of rewarewa and mangaeo with wind-damaged canopy above and thick shrubland on the well lit forest floor. If visibility of ditches and banks (out of picture to left) was sought, removal of ground-level shrubs and retention of ferns would be practicable; (b) Track improvements through south-western transverse ditch cut a severe batter in the ditch counter-scarp (in front of figure). Good cover of shrubs on main bank right and fairly open canopy of rewarewa above reduce the erosive effect of rainfall.**

3.5 Sites in exotic production forest

3.5.1 **Te Puia,** T12/152 GR 666406 (N49/184), Tairua Forest, Whangamata Peninsula. Rainfall; 1600-2400 mm. Soils - brown granular loams and clays, on Quaternary pumice.

Te Puia is a coastal pā at the crest of very high cliffs, on the eastern side of the peninsula within mature pine forest due for logging over the next few years, altitude 70 m.

The pā is on a headland sloping down to the north-east, and has two terraces, four pits and a well preserved ditch with an unusual, narrow causeway across it. In 1993, we noted that there was active pig-rooting in the ditch which will reduce the sharp profile in future decades. This had not been noted in 1981 (but was probably occurring then as well). There is some raindrop-impact erosion of the base and sides of the scarps of the ditch. The site and vicinity is managed by Carter Holt Harvey Forestry Ltd., Whitianga.

Vegetation in 1981

Pinus radiata had been planted across the site 15 years previously. The pines were 12-15 m high and had not been pruned or thinned, because of doubts about management. There was no understorey of natives because of shading by the pines. In the surrounding pine forest, where the trees had been pruned and thinned, was a dense understorey of native shrub and tree species such as five-finger, broad-leaved coprosmas, *Leucopogon fasciculatus,* koromiko (Hamel and Jones, 1982: 16 - *Hebe* sp. misidentified, actually *Hebe macrocarpa*), flax, astelia, dead plants of gorse and bracken and a single large pohutukawa beside a rua-like pit. Some of the large pine trees were growing over the cliff edge where they would endanger its stability.

Vegetation in 1993

Many of the pine trees on the site have been poisoned, and rotten stumps are prominent in a cover of gorse which is being rapidly overgrown by native shrubs. The pā itself is open shrubland with the occasional large pine around the edge, but there are pits and terraces within the surrounding pines. The pine stocking level is rather low and an understorey of leafy plants (tree ferns, some shrubs, ground species) has established. Of note are large specimens of *Cordyline pumilio* (tī rauriki) which actually grow in some of the pā features. It is possible that these were cultivated for the kauru (sugar) from their rhizomes. Native species coming away through the gorse canopy include: hangehange, pohutukawa, houpara, *Astelia fragrans* (large ground sp.), tī rauriki, *Dianella,* māpou and rewarewa seedlings, bracken, mingimingi, *Coprosma lucida, C. robusta,* mamaku, *Pomaderris rugosa* (seen only in this local area), *Hebe macrocarpa* and rangiora.

Botanically speaking, the floral assemblage is a coastal forest (pohutukawa) with more typically gum-land shrubland species (ti, *Hebe, Pomaderris*). Wilding pines have become established in many parts of the platform as well. Outside (west) of the transverse ditches, some large rectangular storage pits and terracing were evident near

the cliff edge under a canopy of near-mature pines with a very open understorey. These pits should be regarded as part of the site complex.

Management in 1981

Hamel and Jones (1982: 16) thought that Te Puia might be suited to public presentation, since it was only a few hundred metres from a scenic road and lookout and has obvious features. The site could be completely cleared and grass/legume cover established after logging. If such grooming was envisaged for public presentation this might be a suitable site for introducing a smothering ground cover. On a coastal site such as this the native scrambler *Muehlenbeckia complexa* would probably thrive.

If the site were simply to be preserved, the pine trees should be removed, either by poisoning and eventual removal or carefully controlled logging. Shrub species would have become established and a five-yearly inspection and tree-removal programme might be sufficient to preserve the earthworks.

Management in 1993

The results of the 1981 recommended programme were evident, with a shrubland cover being well established. With the exception of some pig-rooting on the platform, the result is satisfactory. Our current recommendations for this site re-affirm those of the 1981. Close to a major walkway, public visiting is a realistic prospect, especially if a solution is found to the instability of the ditch sides. The prospect could be raised afresh with the forest managers. External to the pā, the pits should be protected by felling and hauling logs away from the site area, with the site perimeter to be clearly marked and avoided by machinery. Within the pā, all wilding pine trees should be destroyed, either by lopping at the base (for smaller ones), or by poisoning. Felling over the cliff edge may be possible and should be considered by the forest managers. Depending on the forest managers' views on pig infestation and the hunting regime to be allowed, there may also be virtue in fencing the site, the fence to compose a mesh type with the mesh dug into a trench some 40 cm into the topsoil. The placing and construction of the fence should be monitored by an archaeologist.

On the ditch and within the defended perimeter of the pā, current management which allows for reversion will be appropriate. Given the steep-sided ditches, a canopy of trees and shrubs is needed to protect the soft, unconsolidated earth features.

3.5.2 **Pā, Te Rake Road,** V17/16 GR 294811 (N95/20), Whirinaki State Forest, Urewera. Rainfall about 1500 mm; soils, steepland yellow-brown pumice soils on loose ashfall substrate with underlying greywacke. Soil is a greasy black peaty loam on a relatively loose pumice substrate which suffers from tunnel erosion in some places and is easily eroded wherever the vegetation cover is destroyed. The peaty A (topsoil) horizon is best developed at higher altitudes.

This pā, is of pre-European type and lies on a headland at the confluence of two creeks at the end of Te Rake Road. The pā is surrounded by steep pumice cliffs and cut off

by a steep-walled trench, 3.5-4.5 m deep, 5 m across and approximately 40 m long, which is eroding at the ends. There is a distinct inner defensive bank rising about 1 m above the level of the defended platform which is largely level with a few rectangular depressions marking the location of wharepuni (houses). The plan of the site is roughly triangular (each side about 40 m long), with a cliff edge to the west and a very steep slope to the north (the latter planted in pine). The site is relatively dry.

Vegetation in 1981

Pinus radiata was planted on the site in about 1960 and in 1981 some of these had been recently poisoned as part of a change in management of the site (Millyn and Nevin, 1978: 4). In 1981, native shrubs and trees had been well developed on the site (canopy 3.0-4.5 m high) and included small-leaved coprosmas, *Coprosma grandifolia*, koromiko, kānuka, *Gaultheria*, *Pittosporum*, flax, *Astelia*, toetoe and bracken. The vegetation had been a kānuka-flax shrubland before conversion to pines. The very steep bank of the ditch remained well protected by flax clumps. The drainage was very sharp and the soil drier than nearby. There was a good seed source of native trees immediately across the river and, following logging, succession on this site would move fairly quickly through shrubland to kamahi-podocarp forest.

Vegetation in 1993

The general area is scheduled for felling, and landing areas had been prepared at the time of our visit. The site is in mature pine forest with a relatively low stocking level and an open, native understorey. The canopy of the understorey appears to be much less dense than in 1981, perhaps due to the shading of the closed-over pine canopy. The understorey is now predominantly ferns (*Cyathea smithii*, *Blechnum "capense"*, *Dicksonia ?squarrosa*, with karamu, *Coprosma propinqua*, lancewood and kamahi, and ground species including large *Astelia ?fragrans*, *Dianella*, *Microlaena avenacea* (rare) and hook-grass (*Uncinia* sp.). Many species of forest seedlings are present.

Management

With the poisoning of the pine trees in 1981, a beginning has been made in converting the vegetation to a shrubland stage. By 1993, little evidence remained of the poisoning effort, and it would appear that only a very few trees had been poisoned. The site now has a commercially significant crop of *Pinus radiata* on it, estimated to be some 30 trees on the platform, and 60 or more on the steep northern flank.

The trees on the platform pose the principal problem. They cannot realistically be omitted from the planned clear-felling because they will be subject to wind-throw. The earthwork features (deep transverse ditch, shallow raised house sites) may be damaged by logging, but trees should nevertheless be removed. Most could be felled without damage, depending on control of direction of felling, but some also need to be felled piece by piece (a tree surgery approach). Poisoning and leaving standing may be best for some individual trees, that cannot be felled without causing damage to the site. Near the two river perimeters, the trees could be felled over the scarp, and hauled from there, or felled to waste on the west side, but not felled to the south or into the area of the pā or over the ditch and bank. On the platform itself, trees near the transverse ditch could

be felled so that they fall to the south over the ditch and bank, but ensuring that the lower bole rises clear of the bank. This could be done by placing waste logs in a pile on the counter-scarp of the ditch (i.e., on the outer edge of the ditch), chained or wire strapped into a "log roll" or a robust corduroy, to dissipate the fall of the tree, with additional logs placed inside the bank and over it in the form of corduroy. Because of the volume of the ditch it is not feasible to fill it with logs, as was attempted at Onemana (see case study 3.3.1). A suggested tree-felling plan is presented in Fig. 23.

Any management of the pā should be doe at the same time as the clear-felling operation elsewhere in the compartment. Once the pines are removed the ground cover can be manipulated to enhance the low tree cover (e.g., lancewood, kohuhu) and restrict *Blechnum* ferns which would probably eventually form a continuous cover that would impede interpretation. However, since the ground features are few and simple a ground cover of *Blechnum discolor* may be generally aceptable. *Dianella* and *Microlaena,* being small "tussock" forms, may be useful to protect but not completely obscure the ground features. The area supports kereru, kaka, tui and korimako. The native understorey of berry-bearing plants probably enhances the bird habitat.

Note: After making these draft recommendations, we understand (Bowers, 1993, pers. comm.) that the New Zealand Forestry Corporation will now poison the trees on the site. The poisoning will be carried out after logging the adjacent block to avoid danger to

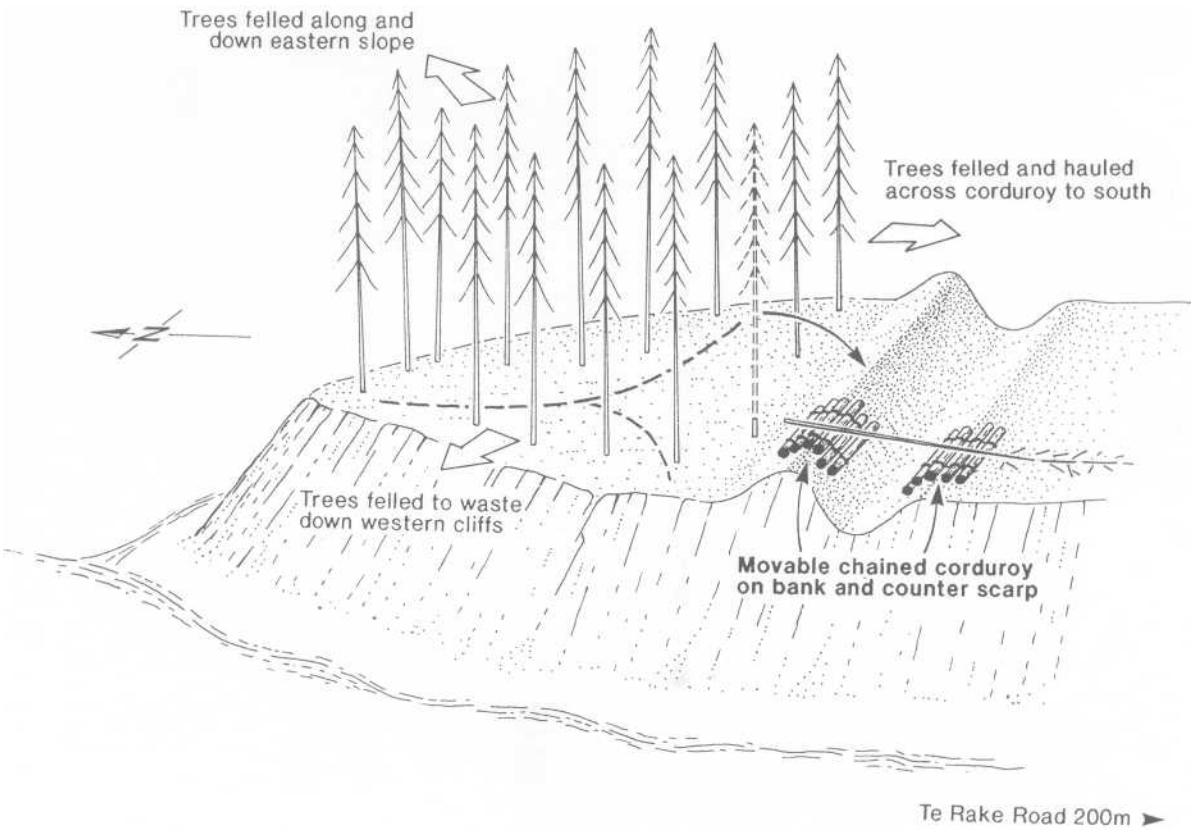


Figure 23 Suggested felling plan for pā V17/16, Te Rake Road, and detail of protection of bank from felled trees.

logging gangs from the dead standing trees. The poisoned trees will be considerably lighter within 18 months and weakened within 4 years, so the risk of windthrow causing damage to the site is relatively slight. We leave our original recommendations for interest.

3.5.3 Hinamoki I and Hinamoki II, Whirinaki State Forest, Urewera, V18/12 GR 274796 (N95/19); V18/33 GR 275797 (N95/56), setting as for Te Tapiri.

Located on a forestry road to west of Forest Headquarters, Minginui. Both are very well-preserved gunfighter pā of the Pai Mārire movement. Hinamoki I has steep ditches and banks up to 2.0 m high constructed on a small knoll enclosing a small deeply pitted area (external appearance is like a wedding cake). The base of the exterior scarps had long been pig-rooted, and the scarps were steep and unstable, actively falling away in places. There was a small informal trackway into one of the interior pits and a short length of rifle trench. It is one of a pair of gunfighter pā on either side of an old clearing. The other site, Himamoki II, is of quite different form, consisting of a rectangular rifle trench perimeter with many buttresses and traverses. Vegetation is similar to Hinamoki I, but pig-rooting is more visible at Hinamoki II and at the time of our visit it had a much more closed-over canopy of fir and a correspondingly thin shrub cover.

Vegetation in 1981

The sites and the surrounding area had been planted in Douglas fir in about 1960 and not tended at all. The trees had a very dense canopy which cut out all light so that all undergrowth had been killed. The undesirability of the forest cover had been well recognised by the forest managers, principally Mr Mike Orchard, environmental forester, who had written some memos on the subject that were influential in the manual (Hamel and Jones, 1982). In December 1980 (seven months before the 1981 inspection) some of the trees on the sites had been poisoned, and were dead. Not all the trees had been poisoned at the same time for fear of windthrow. It was then planned to poison the rest of the trees. The partial poisoning had let light through to the site, and some native shrubs had revived (Fig. 24(a),25(a)). These were *Coprosma grandifolia*, rangiora and mahoe. Seedlings of these species along with seedlings of wineberry, fuchsia and *Gaultheria* were appearing. Other species beginning to grow were thistles, couch, bracken and the native hooked sedge, *Uncinia*. The succession looked then as if it would be bracken and introduced weeds, then shrubby natives, and finally kamahi-podocarp forest (likely to be dominant within a century).

Vegetation and site condition in 1993

Surrounded by dense douglas fir with a sparse understorey, a dense growth of ferns and young native trees 3 m high had formed, including makomako, fuchsia and pate dominating and fewer (with a few māhoe, tree ferns, kohuhu and putaputaweta). *Blechnum "capense"* and *Uncinia* (hook-grass) were dominant at ground level. An *Acaena* species forms patches that are potentially useful to cover a steep slope. There were no introduced weeds. The earth features continue to be extremely unstable under

24(a) 24(b)

Figure 24(a),(b) Hinamoki I(V18/12), views of the north-west face of pā: (a) 1981; and (b) 1993. Note massive growth in shrubs in 1993 after light has been let in.

human trampling, although little visiting has occurred. Pig-rooting is widespread and intensive around the site, including under the banks, but not in the interior. The pumice banks of the pā were and still are very vulnerable and tending to slump. The dead bracken rhizomes appearing in the slumps suggest that the pā has been held together by the bracken since its abandonment. With the death of the bracken, erosion is increasing rapidly.

In places along the track near Hinamoki II, large stumps of former podocarps remain, but mostly the area (prior to planting in fir) would have been fernland with patches of seral forest species. The dense Douglas fir (age about 20-30 years) blocks out light and very few plants establish (supplejack seedlings most common). At the pā site, tree poisoning (12 years ago) has opened the canopy somewhat and a surprisingly wide range of fern and tree seedlings has established (Fig. 24(b),25(b)). Ferns include *Dicksonia* and *Cyathea smithii* seedlings, *Blechnum capense*, *B. minus*, *B. lanceolatum*, *B. fluviatile*, *Thelypteris*, *Asplenium bulbiferum*, *A. falcatum*, *Lastraeopsis adiantiformis*, *Polystichum richardii* (pikopiko), bracken. Forest tree/shrub seedlings include mahoe, five-finger, kaikomako, mapou, pate, kamahi, tawa, kanono, karamu, rangiora, supplejack, *Muehlenbeckia complexa* and bush lawyer.

Hinamoki II has been far less exposed to light than Hinamoki I. However, if opened up further, a similar vegetation to Hinamoki I will establish.

25(a)

25(b)

Figure 25(a),(b) Hinamoki 11(V18/33), views of the south-eastern corner of the rifle-trench perimeter (breastworks not obvious): (a) 1981, (b) 1993. Note open ground conditions, covering of duff and steep profile of the pits. By 1993, shrub seedlings and some ferns are prominent in the ground cover, and the rotted fir stems are collapsing without impact on the site.

Management in 1981

Hamel and Jones (1982: 16-17) maintained that it would be nearly impossible to prevent further erosion as the Douglas fir died and the bracken took over. If light levels increased with the poisoning, then the sowing of grass was indicated. As a shrubland took over, larger-growing tree species should be weeded out.

In 1981, the surrounding forest was of little worth because of the lack of tending, and insect infestation from dead standing wood is not considered to be a problem. This is no longer the case, and the standing crop here is approaching maturity at a time of crucial scarcity of similar-aged and quality wood.

Management

We believe that continued poisoning, not felling and extraction, is the best solution to tree removal. The completion of the poisoning of the Douglas fir and their careful removal will prevent their roots causing any more damage, and should be undertaken as a priority, following discussion as to a possible staged sequence. The trees would come off the site first, and a 20 m perimeter around the site poisoned later. In any event the trees have to be substantially rotten and on the ground before felling of the surrounding forest.

We recommended that future management of Hinamoki I and II should include regular inspection to check on the progress of the vegetation cover and determine the appropriate time to poison the remaining trees. A topdressing with seed and fertiliser in the near future to cover the bare ground that was being exposed in 1981 might be helpful if the grass and weeds do not regenerate vigorously in the first season. Pig rooting, presumably encouraged by the presence of bracken rhizomes, could become a problem during the bracken stage. (A dense growth of grass and weeds or some plants of *Muehlenbeckia australis* as ground cover would have inhibited the bracken and shortened the bracken stage.) As the shrub species began to take over from the bracken, five-yearly inspections and removal of the larger native trees would prevent further root damage. Because of its position and its vulnerability it remains unlikely that this site will ever be used for public presentation, and vegetation cover should be managed for protection only. The expense involved would be warranted, since the site is of considerable historical interest. The ground cover should be kept to a minimum to assist in observing the features.

One of us (KJ) had visited Hinamoki I in 1988, not long after it had been surveyed as a s.439 reserve under the former Maori Affairs Act 1955. (These are now reserves under ss.338-341 of Te Turi Whenua Māori/Māori Land Act 1993. As part of the process of break-up of the former New Zealand Forest Service and the tendering of cutting rights, the land concerned here had been recognised as of historic and traditional value and formally surveyed out from the land parcels subject to cutting rights. However, we understand that because of the lack of formally surveyed access, the intended programme of fencing of the reserve areas has not been carried out.) The surveyors had cut down a swathe of Douglas fir to the north and north-west of IIinamoki I, some 40 x 20 m approximately, for instrument survey, and light had been let in. As a result, the limited growth of native shrubs induced by the 1980 poisoning, had

increased dramatically, and there was active pig-rooting in the vicinity. As in 1981, we believe that pig-rooting will continue to be a problem if the populations are not controlled, and fencing of the sites will be necessary.

The recommended sequence of management at Hinamoki I and II should be thus:

- immediately poison or ring bark the Douglas fir trees still standing on Hinamoki I and II to a 5 m perimeter outside the site (estimate 60-100 trees in total);
- remove by cutting from Hinamoki I the seedlings of primary forest species likely to regenerate on the site (e.g., tawa, rimu), while retaining the dense cover of smaller native plants;
- make a thorough photographic survey of the condition of these sites using vantage points in selected trees around the site and trimming intervening branches or rotten logs on the site where necessary;
- fence to the surveyed boundary of the two reserves, using a post and wire, and lower mesh fence, with the mesh buried to 40 cm to exclude pigs;
- ascertain timing of the cutting programme for the Douglas fir in the vicinity of the reserves;
- in three to five years time, poison balance of trees within the reserve perimeter so that they are dead, without needles, and light in weight if not rotten at time of clear-felling of the Douglas fir;
- cut away larger native trees currently growing on Hinamoki I and encourage desirable native ground covers such as *Uncinia* or *Acaena* sp., bracken and other ferns to grow, if feasible, by deliberate seeding into bare soil surfaces or the duff layer.

The open areas of introduced grasses between the Hinamoki pā are an integral part of the sites (where the niu pole was placed during the conflict). The whole should be managed as a unit, with restricted tree planting and logging activities. The sites are isolated and in the long-term native forest shrubland is probably the most effective cover, provided the detailed earthwork features (e.g., some of the gun-fighting pits, rua) are kept free of trees and large ferns. Spreading herbaceous plants (e.g., *Acaena* sp. – piripiri) could be examined.

3.5.4 **Te Pā o Toi,** V20/32 GR 447029, in very steep hill country in the ranges north of Napier, Hawkes Bay. Skeletal hill soils, with pockets of ash-based pumice soils on Tertiary limestones; soils generally very prone to erosion. General setting: farmland to east, and exotic forest with many patches of native trees. Rainfall: 1500-1800 mm (estimated).

Te Pā o Toi, is a ridge pā above a sharp bend on S.H. 2, 25 km north of Napier. The site is in the Tangoio Soil Conservation Research (administered by the Hawkes Bay Regional Council) and is near the Tangoio Falls Scenic Reserve.

The site comprises a central platform which has had large pines felled off it in the last 5 years. This main platform is defended to the north by a transverse double ditch and bank, with lateral extensions of terrace and scarp running from the base of the ditch to

the platform, and steep natural scarps to the east and west. To the south, the platform falls in a mild slope within the overall defended perimeter to a narrow ridge. Usable logs still exist on the main southern defended spur of the site. On these spurs there are further scarp and ditch defences in moderately good condition which warrant protection as part of the overall plan of the pā. Some bulldozing has occurred on the lower (southern) ridge line, cutting down through terrace scarps and obsuring a transverse ditch. On the ridge to the north of the pā there are large wattle which cover the area of an old farm house and a spring. There is a kind of causeway immediately to the north of the pā, leading up the ridge from the double transverse ditch and bank. The causeway appears to be part of the modern track.

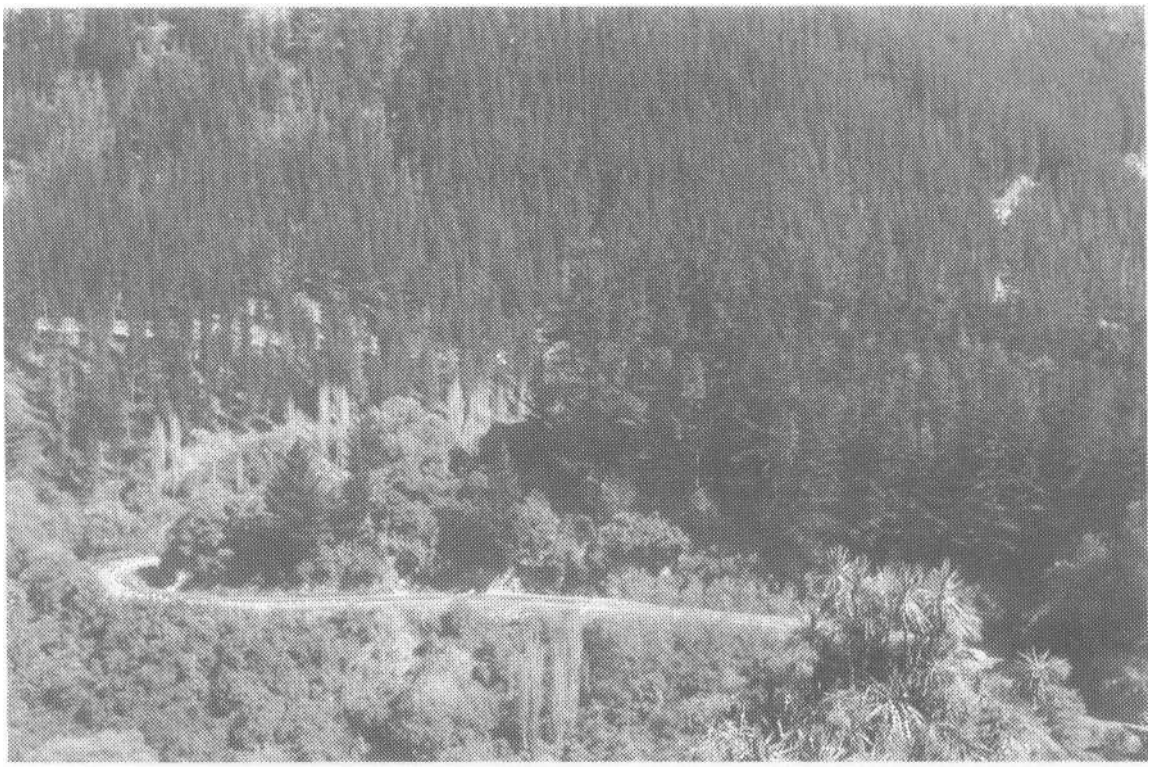
Vegetation

On the main platform, in the last decade, vegetation has been cleared, probably at the instigation of the former New Zealand Archaeological Association filekeeper. There has also been some unlawful removal of macrocarpa as firewood. The cover when first inspected consisted of rough grass and many emergent seedlings of macrocarpa (Fig. 26(a), (b)). On the transverse ditch and bank is a 2 m high thicket of mahoe, bracken and other native shrubs. On the slopes and the outer edge of the platform is a 30-year old stand of macrocarpa, estimated d.b.h. 30 cm and typical height of 15-20 m (moderate-sized trees). On the lower ridges 10-40 m below the main platform is a mature stand of mixed *P. radiata* and macrocarpa. The *P. radiata* has a d.b.h. of 60-80 cm and is 25-30 m high (very large trees). The lower ridge, where cultural features peter out or have been destroyed by bulldozing, is clear of trees, with a low native shrub cover, including. kawakawa, mahoe and titoki and other species.

Management

One of us (KJ) discussed logging of the site with Messrs Robin Black and Doug Hunt (Hawkes Bay Regional Council) and Tim Sandall and Steve Smith of Carter-Holt Harvey Forests, Ltd. The latter were contractors to the council on this reserve. Discussion of the detailed logging plan on site with an archaeologist was a condition of the authority issued for the felling by the New Zealand Historic Places Trust. Figure 27 shows the preferred option of those that were considered. For ground logging and retrieval, it was possible either to log by aerial cable to a high point to the north, or by bulldozer winching from platforms closer to the pā. The latter was the cheaper option and would least modify the overall ridgeline, including the area of the pā. However, in the overall plan for the block, the skyline winching was deemed to be better. Standing rigging would be attached to tall trees on the eastern side of the main platform of the pā while winching the felled trees from the western side and elsewhere in the small valley to the west of the pā up to the skyline to the north-west. This process would entail quite a lot of heavy foot traffic through the site and the setting up of wire cables, and care would have to be taken that cables or debris do not impact on the site below the lower end of the skyline cable.

An option preferred from the point of view of protecting the ground surface was helicopter logging of the whole area. However, this would not be economic for the whole site and skyline hauling of the logs, if feasible, was preferred. The trees would be felled away from the "no-go" area as shown on Fig. 27. Prior to any bulldozing,



26(a)

26(b)

Figure 26(a),(b) Te Pā o Toi, Hawkes Bay: (a) view from east, showing pine and macrocarpa cover on ridge immediately above road; (b) view to south inside transverse ditch and bank.

posts will be installed outside the defended perimeter as shown. General direction of winching was to be as shown by outline arrows in Fig. 27.

To the west and south of the main platform there were some trees that, because of their lean to the east, would have to be felled transversely across the line of the ridge and the platform. Because no bulldozer winch-platforms would be able to go on to the site, they would have to be felled pretty much in the direction of their natural lean. Some of these trees were also heavily branched on the open platform side, because of the "light well" there. They would create a mass of branches on landing, but the advantage is that the branches would soften the landing on to the platform of the main bole of the tree. To the south it would be necessary to fell the trees across the line of the slope (i.e., for the felled trees to lie across the contour, where they may roll down the slope to the road.). Slash would be removed from the platforms or reduced to ground level as far as possible, where it would rot quickly. There was no prospect of maintaining a grass cover on the site by grazing.

Logging operations

The site was logged in August 1993. It was found necessary to gain access through the "causeway" to the slopes north-east of the pā with a small bulldozer to winch the trees to the north, according to the plan discussed (Fig. 27). Elsewhere, to the west, trees were winched across the slope or to the west, and none fell on the platform. Figure 28 shows the pā prior to the helicopter-lifting phase of the trees on the far south-eastern perimeter of the pā.

Management 1993

Since logging the native growth has been flattened or smothered, but will undoubtedly recover. Because of the presence of exotic species such as Japanese honeysuckle, old man's beard, blackberry and pampas grass, the resulting vegetation is likely to be an impenetrable mass that will obscure the pā features for many years. Pines and macrocarpa will also return and ultimately become part of a broadleaved-coniferous forest.

The site will re-generate into natives in 10-15 years. Composition of the existing native shrubs and seedling trees is dominated by māhoe and kawakawa with a diverse range of other species. The seed source for these is the adjacent bush containing kahikatea, nīkau, pigeonwood and supplejack. We believe that the opportunity exists to closely manage the forest regeneration for optimum site interpretation. Exotic species should be progressively removed, beginning with pampas, honeysuckle, blackberry and *Acacia*. The composition of the native bush could be manipulated to produce a dense canopy, clean understorey and dense ground litter, namely māhoe, ngaio, kohuhu, tī kouka (cabbage tree) with a shrub layer of relatively short lived rangiora, hangehange and kawakawa, and a ground cover of ferns such as maiden-hair. This process would be somewhat experimental.

There is a prospect of the area being added to the Tangoio Scenic Reserve, although the local marae may prefer a ss. 338-339 reserve under the Māori Land Act 1993. In consultation with the regional council, the department should be looking into appropriate reserve classifications for this land.

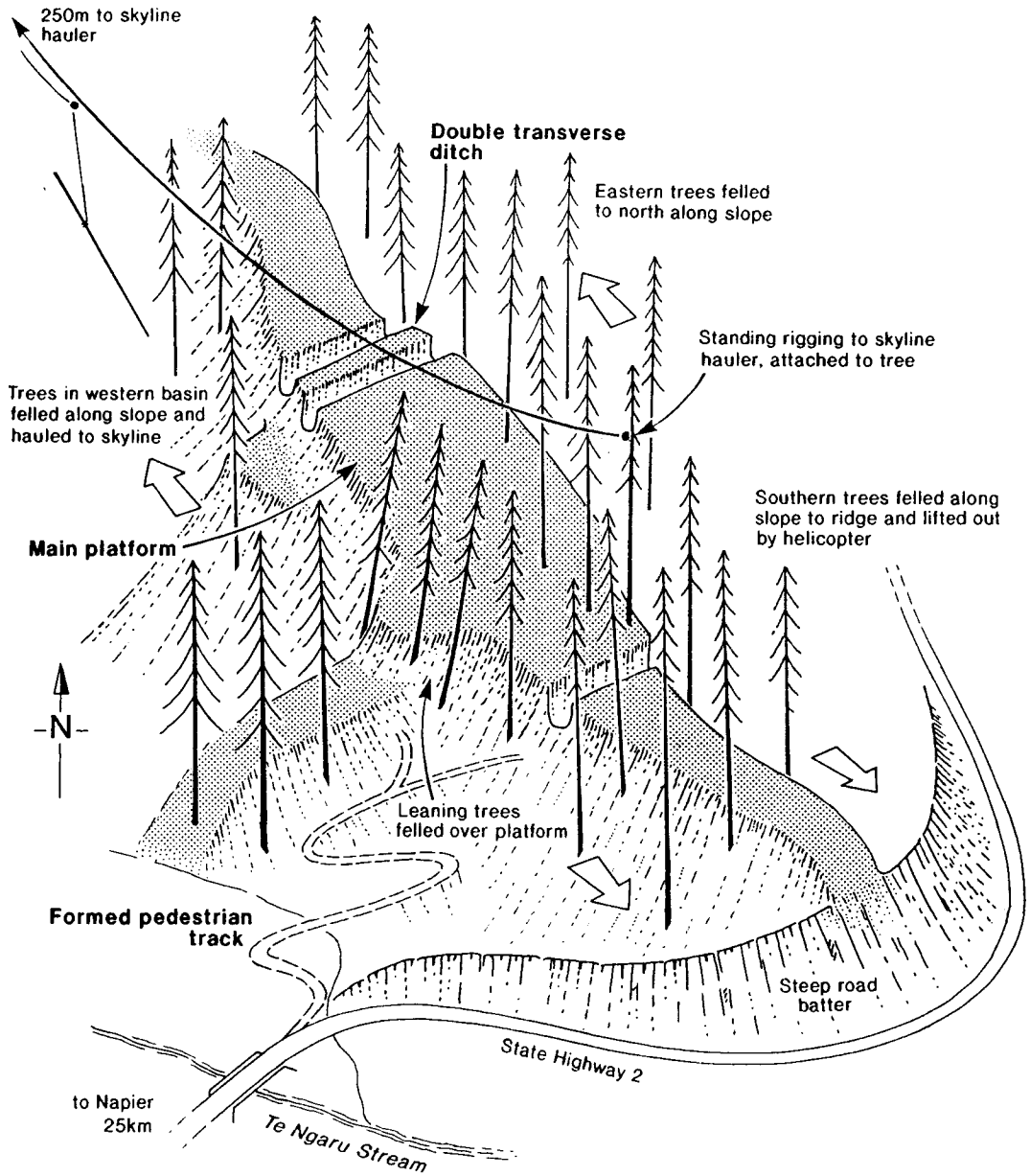


Figure 27 Schematic logging plan in oblique view for Te Pa o Toi.

Figure 28 Te Pā o Toi, part way through logging. The trees to the right have been pulled out to the right and hauled from the skyline anchor near camera viewpoint. The balance of the trees are being hauled through the saddle, and the furthest trees will be lifted out by helicopter.

4. CASE STUDIES: CENTRAL VOLCANIC PLATEAU AND TARANAKI

These sites were visited in May/June 1993. A major object was to visit the suite of historic reserves in the Taranaki region which we knew were being actively managed and to review the lessons learnt there. None of the sites in this part were discussed in Hamel and Jones (1982).

4.1 Sites in early native succession/grassland

4.1.1 **Pukerangiora,** Q19/69,70 GR194368, a pre-European (Q19/69, N109/6) and gunfighter pā and sap complex (Q19/70, N109/7), in terrace country, Waitara River valley, north Taranaki. Rainfall: 1500 mm.

The site lies along the crest of 80 m-high cliffs on the west side of the Waitara River, about 8 km inland and is a pre-European pā of Te Atiawa which was extensively modified in the 1820s, 1830s and 1860s for gunfighting. The site has significance in relation to Te Atiawa's conflicts with northern tribes in the 1820s and 1830s and is as important as other traditionally well documented sites of that period such as Mātakitaki near Pirongia in the Waikato. The site was subsequently the key to the finishing phase of the First Taranaki War (1860-1861), and therefore an important historic place in relation to the commencement of the New Zealand wars. For oblique aerial photographs, see Jones (1994: 174-179).

Preservation of the fullest possible extent of the original features has been relatively poorly served by the reserve survey and enclosure and areas of the original defences now lie outside the reserve. The pā appears to have had three ditches and banks enclosing the cliff edge at the point where the ridge line drops away to the east (Smith, 1910) (Fig. 29). The total length of the surviving ditches and banks is some 400 m. Their general pattern is similar to that of the defences on terrace lands elsewhere, since the slope of the ground within the reserve is generally slight (less than 5°). On the hill top to the south, outside the reserve, indistinct scarps and terraces can be seen on a small hill which is the highest and probably the principal, platform of the site. On the west, the ditches and banks have been cut by the road. Gunfighter features consist of a traversed rifle trench running west-east at the upper crest of the pre-European complex. Its function is unclear, but it may have been a rear defensive line installed by Māori in 1860-1861.

Forward (northwards) of the pre-European pā complex is a transverse ditch and bank (possibly part of the pre-European defences), and north of that again is a redoubt (Te Arei) constructed in 1864 in the course of the second Taranaki War. This redoubt is built upon the principal Maori defence (a stockade) of 1860-61. At the far north-western margin of the reserve, running parallel to and closeby Te Arei Road is a sap, some 200 m long, constructed by the British in the advance against the Maori stockade, Te Arei, in 1861 (first Taranaki War) (Fig. 30(a), (b)).

According to Day's (n.d.) draft management plan report, the whole area of the reserve has been planted at various times (since 1924) in *Pinus radiata*. These were felled in 1963, and breaches in the banks may have been made at this time. The boles of the trees were cut at ground level and are still visible today.

Figure 29 Oblique aerial view of Pukerangiora (Q19/69, 70) from the north-west, August 1991. Pratt's sap with "stiff" avenue of native trees is at bottom; Te Arei is the ditched enclosure, centre by the road; in the distance is the pre-European pā with the prominent ditches and banks enclosing the cliff edges.

30(a) **30(b)**

Figure 30 (a),(b) Te Arei, part of the Pukerangiora complex: (b) the forward bastion of the redoubt, probably in its 1864 European form, rather than the stockade of 1860; (c) the view looking south from Pratt's sap of 1860 to the position of the stockade at Te Arei. Grass sward in both cases is stable with few erosion-patches. Invasion of pampas and inkweed threatens. The tree ferns are left-ovves from the understory of the *Pinus radiata*, now logged and not replanted.

Their size ranges from 50-80 cm in diameter, suggesting moderate-sized trees up to 35 m in height. In 1969 and 1974, a "second crop" was planted in the northern parts of the site, near and over the sap, which had a fringing belt of native trees between it and the road, forming a avenue about 180 m x 10 m in plan. The last batch of *Pinus radiata* planting was removed on the urging of the Taranaki Museum in the late 1980s.

Vegetation

Three somewhat indistinct components dominate the vegetation: grazed grassland, planted native woodland and regenerating bush.

Most of the area of the reserve is grazed by sheep. The pasture is predominantly brown-top (*Agrostis capillaris*), with rush (*Juncus* sp) and sedge (*Cyperus ustilagus*) prominent in the upper zone, and scattered low gorse in the lower, northern zone. The upper zone has substantial patches of "hard fern" (*Paesia scaberula*), forming a dense growth 30-50 cm high on flat and moderately sloping surfaces (Fig. 31(a)). A number of pampas grass clumps have become established within the grassland and bush edge and should be removed before they spread further. The trunks of dead tree ferns are dispersed over the area, representing plants that have died since they were exposed to open conditions and grazing animals after the pines were removed.

In the central portion of the reserve a dense woodland of indigenous trees and shrubs was planted about 20 years ago, including kauri, akeake, rimu, tarata, houhere, karaka and whārangi. Excellent specimens of whārangi contribute to a sheltered amenity landscape. However, grazing and tracking is concentrated beneath the trees so that there is no regeneration. To the south, near or on one of the major ditch and bank lines, several karaka trees have been planted (or established within the earlier pine cover); this shelter has attracted sheep camping and caused locally severe erosion to the large pre-European defensive banks of the pā. Elsewhere, between the road and the sap at the northern end of the reserve, a band of indigenous trees has been planted. These have grown well and do not appear to be disturbing the features of the sap. The composition of the planted woodland (e.g., the presence of kauri, akeake, houhere) bears little relationship to the natural vegetation of the area and could be interpreted as a form of landscape beautification out of keeping with the significance, and broader setting, of the site. Unmanaged regeneration here should not be encouraged, but some provision for replacement of specimens is warranted.

Bordering the reserve on the south and east is a fenced zone of regenerating bush of similar age to the planted woodland. It contains māmaku, patu, rangiora, hangehange, kawakawa, tarata, māhoe, houhere, porokaiwhiri (pigeonwood), kanono (*Coprosma grandifolia*) and tawa seedlings. Apart from the houhere (*Hoheria populnea* - lacebark), which has probably regenerated from introduced planted specimens and is not indigenous to the area, this vegetation is characteristic seral growth. The presence of the tawa seedlings indicates the likely forest-type of the medium-term future. There are scattered seedling pines throughout that could be removed if they are likely to spread elsewhere into the reserve. As already noted, the bush edge is colonised by pampas grass and this should be removed to avoid ongoing seeding into the grassland.

Although the seral bush is extremely dense and the canopy low in height (4-7 m), the bush floor is surprisingly open. The pā features are visible and well-preserved because animals are excluded by the fence.

Management

The site has for some years been grazed intermittently by a small flock of sheep (120 wethers or 60 stock units), now permanently on the site. This is a stocking rate of approximately 4 SU/ha, a very low figure. Overall, the reserve presents an image of rough grazing land with patches of fern and gorse, and indigenous shrubs and trees, especially towards the south-eastern cliff-edge. The sheep, although in low numbers, are causing erosion in two main forms and places. The first is on the principal enclosing bank, where the sheep are congregating and digging into the crest of the bank where a few small karaka trees offer shade (Fig. 31(a),(b)). The second is by a wooden bridge over the forward (northern) trench of the redoubt, where they are forming tracks down into the trench and out the other side. The bridge appears to be too narrow for the sheep and they are jibbing at the crossing. Both these problems need remedial action. Less severe tracking-impacts occur throughout the reserve's grasslands, for example, on the sap, but in the long term will compromise the features.

Existing areas of bush on the pā should be retained, and a clear edge defined so that forest does not further encroach (as it will naturally) on to the grassland. Bracken and

31(a)

31 (b)

Figure 31(a),(b) Pukerangiora: stability and instability: (d) ring ferns (a characteristic species invading high country pastoral lands) protect the bank slopes and provide a low cover allowing the features to be seen; (e) sheep have sheltered from the sun and north-west and southerly winds in the bank of one of the main defences, creating damaging burrows and platforms.

especially hard fern should be encouraged to stay in their present form and area coverage, and to spread further on the banks if possible. The area of open grassland is extensive, easily accessible from the road, and allows good views of significant lengths of the major pre-European ditches and banks. There is some scope for the installation of viewing towers both here and in the lower (1860-1864) works, although there is no evidence that walking on the banks is a real problem.

The open grassland looks a little unkempt and its appearance could be improved. If low maintenance grassland is the preferred conseravtion option (as it probably is here), then this should be explained in signage. Although the site is large, it is of generally easy relief with good access from the road and through the principal ditches and banks. A combination of annual once-over with a small 4-WD mower and the grazing may make for a more presentable sward than at present. Some top-dressing to improve grass palatability, the introduction of clover, and greater suppression of gorse, as currently undertaken by the field centre, will be advantageous. Pampas should be removed as soon as possible. Increased stocking rates above present levels would increase the risk of erosion and should not be encouraged. Stock should be excluded from the severely eroded patches on the banks. It was suggested to us that the simple expedient of placing uncomfortable fallen branches on the camp-floors would achieve this purpose. Some restoration should be considered if this is successful.

Portions of the pā outside the reserve should be incorporated if at all possible, including the southern area rising to be the low crest which supports a declining cabbage tree, which should be recognised as a live feature of the original pa and protected by fencing.

4.2 Sites in grassland

4.2.1 **Turuturumokai Historic and Recreation Reserve,** Turuturumokai Q21/3 GR 210813 (N129/4), Te Umu-a-Tongahake Q21/4 GR 209812 (N129/5), and Turuturumokai redoubt Q21/328 GR 212813 (N129/220), on terrace land adjacent to the Tawhiti Stream, Hāwera, south Taranaki. The surrounding area is mainly grassed dairying and cattle country, with some sheep.

A complex of three sites in a historic reserve (Fig. 32(a)), vested in the South Taranaki District Council. We visited the sites accompanied by the district planner, Mr Rhys Armstrong, and reserves superintendent, Mr Stan Foster.

The main purpose of the visit was to review the management of the Turuturumokai earthworks, notorious for having been "enhanced" in the 1930s - "we can only assume they followed the shape of the original defences" (Prickett, 1990: 29). Turuturumokai, the main pā, lies in two main platforms. The higher, northern platform is about 150 x 40 m in plan, while the southern platform is about 100 x 30 m. A complex of rua and open rectangular pits and a palisaded, carved totara post (tūāhu) are features of the upper platform. Rectangular pits and rua (in the scarps) are prominent on the lower (southern) platform.

Figure 32(a) **Aerial oblique of Turuturumokai from the south. The redoubt is at top right.**

The 1930s restoration

Based on observations of pā elsewhere and nearby in Hāwera itself, our view is that the site has been altered by cutting into and steepening the inner scarps and counter (outer) scarps of the ditches, widening the base of the ditch, and placing the cut fill on to the outer edge of the exterior bank (Fig. 32(b),(c)). This gives the mechanical squared-off effect, high, steep scarps, and deep, wide ditches of the present-day. In addition, some fairly arbitrary interpretation of the corner or flanking details of the ditches has been done, which is quite at variance with normal pā practice. The lateral ditches are now separated from the transverse ditches by small causeways, instead of leaving the laterals draining into the transverse and offering a continuous perimeter of defensive trench, and of some importance, unimpeded drainage. The lack of lateral trench drainage does not appear to have caused any engineering-stability problem, however, in this particular case.

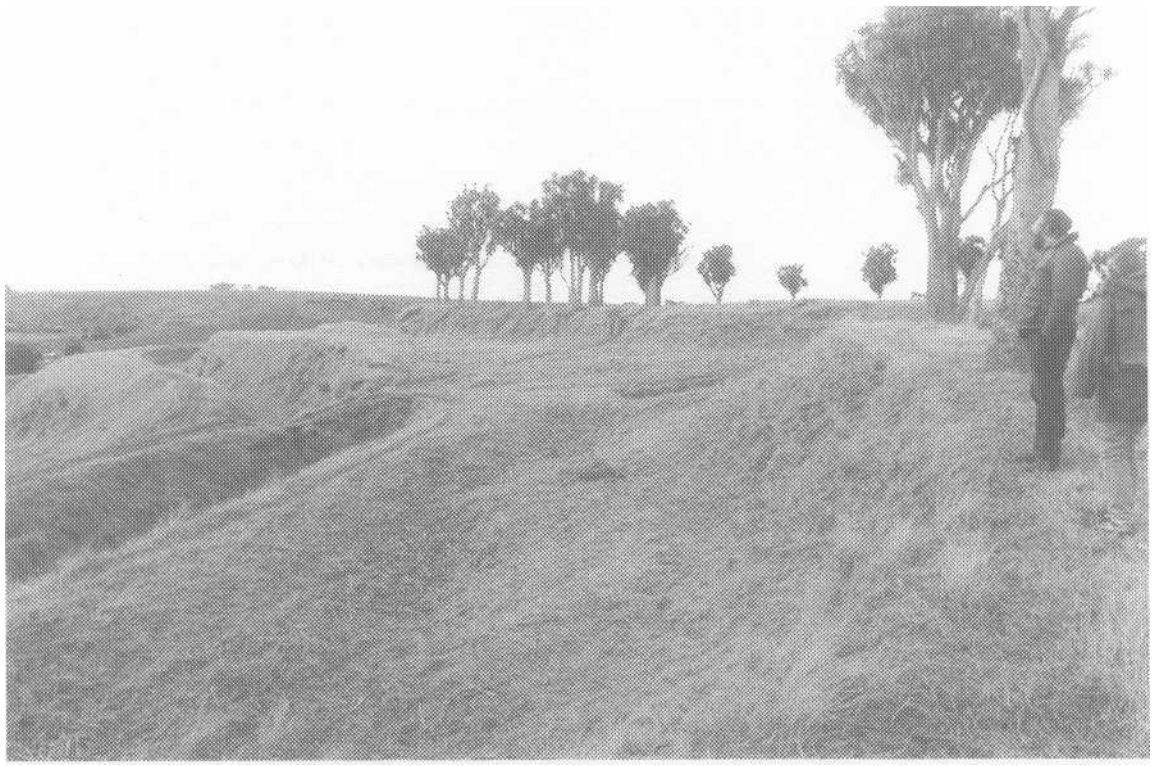
Vegetation and site condition

These changes of the 1930s resulted in a pā with very steep, high scarps which pose a uniquely illuminating example from which a gauge of stock-erosion can be made. The pā is grazed by sheep. Before our visit, the pā had been left ungrazed and a "tag" from previous growth and seed heads had built up. The pā had been grazed by a large mob in the few weeks before our visit, leaving an uneven mat of relatively unpalatable grass stems and seedheads. The tag had suppressed new grass growth and could be lifted in small mats revealing the bare topsoil beneath. This probably offers reasonable protection from erosion caused by rainfall in the short-term, but will suppress new grass growth for the next season. There were some areas on the very steep 1930's scarps where the lynchets (narrow terraces) of the sheep were unstable and had commenced to erode under the mob-stocking. Generally, though, the earthwork surfaces had been well served by the relative neglect of the sward, although it may not be sustainable in the longer term.

Around the margins of the upper platform of Turuturumokai itself are many cabbage trees, about 50 in number, planted in 1940 (the Centennial Year). Mostly, these are stately and in excellent condition but 3 have died (or are in the process of dying) through Cabbage Tree Sudden Decline (Rees-George and others, 1990; Simpson, 1993). This disease may claim other specimens in future years, especially because flax growing within the reserve is harbouring a similar disease, and may well be infecting the cabbage trees. Grazing will also eventually damage the trees.

Te Umu-a-Tongahake

Near the road entrance to the reserve, Te Umu-a-Tongahake (Q21/4), a small ring-ditch pā, roughly triangular in plan (40 m to a side), has been in a different, more frequently grazed regime, and has a more satisfactory pasture. The pasture is in more vigorous condition and has a wider variety of pasture species - white clover, cocksfoot, sorrel, dock, dandelion, and California thistle. The last could be removed in case it spreads through the pasture and limits usefulness to both stock and visiting people. The lateral ditch facing the road had in the past been infilled by a bulldozer, but otherwise the pā was in reasonable condition.



32(b)

32(c)

Figure 32(b),(c) The lateral defences on the north side of Turuturumokai (Q21/3): (a) note squared-off, mechanical effect of ditches and banks; (b) trampled and broken grass sward on the steep northern scarps of Turuturumokai. Note sheep tracking causing erosion; in time, reasonably stable lynchets (small terraces) will form.

It may be possible to improve the pasture of Turuturumokai by gradual replacement of browntop with more nutritious grasses (e.g., cocksfoot, ryegrass) and herbaceous plants (e.g., white clover). One way of doing this is to fertilize (with superphosphate) and seed immediately following removal of tag when exposed soil is maximised. The increased productivity of the sward might be maintained indefinitely if enough legumes establish with the initial treatment (see Eastwood, 1993).

Turuturumokai redoubt

The Turuturumokai redoubt (Q21/328) was occupied in the course of the West Coast campaigns and attacked by Māori in 1868, who entered the redoubt. The Colonial force held the inner bastions. One of these bastions has been removed by the modern roadway construction. The redoubt perimeter has a well worn-down perimeter ditch. The monument to the dead of 1868 is badly sited on the inner edge of the ditch, and is attracting stock rub on the margins of its concrete base. On the exterior side of the redoubt perimeter as one faces the road is a strip of fenced-in, planted native trees, about 25 x 4 m in plan, intruding on to the outer edge of the ditch but not actually in the ditch. These plantings were designed to "frame" the monument in its setting actually in the redoubt but their placement was unwise since the trees now obscure the ditch profile. The trees should have been placed perhaps 4 m further outside the redoubt perimeter.

Overall, our view of the sites is that they are in good condition with the exception of the redoubt. Grazing has done little damage to the main pā, which because of its artificially steep and deep scarps would be especially vulnerable. However, rua (cave pits) on the northern terrace are eroding and could be temporarily protected.

It is intended to maintain grazing in the immediate-term and long-term, following the management plan. The problems with grazing at Turuturumokai are:

- ongoing, intensive management is required; payment to stock owners may be needed at some stage;
- animals gradually damage the ground by tracking and causing the collapse of rua pits, so that in the long-term detailed land features will be flattened out;
- cabbage trees will be damaged through bark chewing and rubbing and will not resprout with aging or regenerate (this may not be desirable anyway);
- the sward of the main pā site appears to require improvement to sustain fertility, mainly by introducing and encouraging clover, which may require financial commitment.

In respect of the last of these points, the contrast between the management of Turuturumokai (the main pā) and Te Umu-a-Tongahake is instructive. The latter has a more stable rounded contour, being original earthworks, and has been more heavily and continuously stocked. Its grass sward, though, could be emulated on the main pā, provided this can be achieved with limited stock numbers.

Interpretation and views obviously favour a grassland. However, the management plan appears to favour reduction in the area of managed grassland in the reserve as a whole through tree planting. We support this policy, especially in the long-term, as long as archaeological features are not compromised. It may also be possible to gradually

replace managed pasture with indigenous grassland or other low-growing vegetation that does not require grazing.

4.2.2 **Te Rūaki**, Q21/5 GR 251803 (N129/6), setting as for 4.2.1 Turuturumokai Historic Reserve.

Te Rūaki lies in two main segments on a descending, progressively narrower ridge above the Tāngahoe River (Fig. 33(a)). The lower segment is defended by a steep scarp to the Mangimangi stream to the east, terraces and artificial scarps above the flats to the west, and a large double transverse ditch and bank to the north (Fig. 33(b), (c)). The platform is about 140 x 15-30 in in plan. A second enclosure further north up the ridge on a broad slope also has an enclosing ditch and bank. This area is approximately 120 x 220 m in plan. The overall plan of the pā is unusual. The lower part is of pre-European age, and the pā as a whole was occupied up until the 1830s when a Waikato raiding party took the pā (Prickett, 1990: 28). The site is entirely covered in a high-producing clover/grass mix, with rougher grass cover down to the stream to the east outside a new fence on the ridge line.

Figure 33(a) Aerial oblique view of Te Ruaki from the west. Note macrocarpa stumps top right.

33(b)

33(c)

Figure 33(b),(c) The transverse ditch and bank of Te Ruaki (Q21/5): (b) new fence line and old, fairly stable stock track; (c) view from the outer defended area looking into the transverse ditch and bank.

The main points of management interest are:

- the need for continued protection of the well-sculpted form of the ditches and banks;
- the site is freehold land and the owner wishes to plant pines on one third of the pā site;
- the light stocking regime recommended by the Department's South Taranaki Field Centre;
- the fencing regime;
- the successful removal of large macrocarpa from the site;
- protection of old cabbage trees.

Stocking is recommended to be kept to light animals (e.g., yearlings) rather than bulls or other heavier stock. Sheep appear not to be a prospect but would be preferable. The fencing recently installed follows the contour of the transverse ditch and bank, and runs across the ridge line. An existing stock track through the ditch and bank (Fig. 33(b)) is now stable and should keep cattle movement away from the fenceline. However, there is locally severe trampling at the eastern tip of the platform.

The macrocarpa trees were large (some 30-40 m high) and stood in a single stand of some 6-8 specimens on the lower platform at its western edge. The trees were felled in about 1989, and left. They were cut up on-site and removed by a Task Force Green group under the supervision of Dave Rogers of the South Taranaki Field Centre of the department. An oblique aerial photograph of August 1991 shows the trees to have been felled on to the platform, not across the trenches on to the flat as would have been the desired option. Given the position of felling, the trees have done little damage since they were cut up and carried out by hand and not hauled out in large lengths. The absence of lynchets (animal terraces) where the trees were is indicative of the single protective advantage of trees over grazing animals.

The only trees now present on the site are three old cabbage trees on the scarp of a south-facing terrace. These trees almost certainly date from the original occupation and therefore represent living taonga. They should be protected by fencing because stock have severely damaged the trunks of all of them. All show signs of crown die-back and one is nearly dead.

4.2.3 **Te Urenui,** Q19/8 GR 306449 (N99/8), north Taranaki terrace lands. Rainfall estimated 1600 mm.

Te Urenui is a pā which occupies a steep-sided "island" remnant of high terrace, the surface lying about 50 m above the Urenui River flats. The pā has a broad top platform some 150 x 100 m, with an intermittent encircling ditch and scarp built on the natural scarp about 20 m below the platform. The site is described in some detail by Best (1974: 194-196) and Buist (1964: 50).

Vegetation

The platform appears to have been mown or grazed in the past, and the sides support a shrubland 15-20 years in age. Bracken fern and gorse has colonised most of the platform, with some still in grass. Best (1975: 199) records kowhai, māhoe, rewarewa, kawakawa, and whārangi on "this place". We observed a well developed bush of karaka, puriri, mahoe, kowhai, and māmaku with some emergent rewarewa. There is a single large, double-trunked cabbage tree on the margin of the platform. The bush/platform margin bears some tobacco weed (*Solanum mauritianum*) which should be removed (Fig. 34(a),(b)).

The northern and western margins of the pā were planted in pine and macrocarpa in 1932 and 1933 to control noxious weeds. At present, there is a dense understorey beneath the macrocarpa consisting of kawakawa, karaka, mahoe, nikau and hangehange. Upon removal of the macrocarpa, these, along with māmaku, will regenerate into a dense indigenous cover. On the north, by the access track for the roadway, is regenerating bush dominated by māmaku, the result of felling the pine trees in 1978-1980. To the south-west on the scarp are stands of 40-year old macrocarpa which will be logged by the Department of Conservation in forthcoming years.

Management

We support Mr Haumiora Raumati, kaumatua of Ngāti Mutunga, who wishes to see the balance of the macrocarpa off the pā. In 1980, the south-western macrocarpa appear to have had lower branches cut to avoid damage to the site in the course of felling. Larger protruding branches may compound damage to the site, but smaller branches will soften the fall of the head of the tree. At the road edge to the west and south-west, it is satisfactory to fell the trees up slope against the foot of the encircling ditch, since tree head velocities will be low and the felled trunks will be cut up *in situ* for firewood. The natural scarps on this site, which are steep, should be allowed to revert, so the recent plantings of the entrance area are not inappropriate. The encircling ditch is open and visible under the kawakawa to the south-west, but is less obvious to the north and north-east (where it may have been damaged by the felling of 1978).

Mr Jim McKinlay of the Historic Places Trust visited the site in 1975, and recommended that the platform be grassed and grazed, although the scarps should be left in a native shrub. The decision (or omission) not to mow the platform and its implied decision that public access is not desirable, will lead to gorse (which is likely to dominate) and is undesirable as it will, in the short-run, restrict use of the area. However, individual patches of bracken fern may be desirable for protecting the open rua and maintaining a relatively open, partly grassed landscape. The retention of wider areas of grass on the platform will in future allow for continued views of the lower valley and seascape. Grazing would damage the surface soil at the entrances to rua, track access would be needed, and secure fencing would be required. The long-term management option for the platform therefore needs to be determined, with iwi consultation, by a proper review of the historic and public values.

Figure 34(a) The wide platform of Te Urenui (Q19/8). Note invasion of bracken, gorse (by figures), and fringing shrubland (probably planted, e.g., the line of flax at right). Note also macrocarpa down slope at far right.

4.2.4 **Pukeāruhe**, Q18/16 GR 414556 (N99/49), north Taranaki coastal terrace lands.

Pukeāruhe is a pre-European pā and Armed Constabulary settlement complex on the first headland south of the Whitecliffs coast, occupied until 1885. "The visitor... will see something of the arrangement of the Ngāti Tama stronghold and the Pakeha redoubt... despite ploughing and other activities which have greatly damaged archaeological remains...." (Prickett, 1990: 61). We visited the site with Mr Steve White of Ngati Tama.

The site is triangular in plan with three platforms, more or less level with each other, and occupying a total area of some 500 x 400 x 350 m (about 18 ha). Steep natural scarps or cliffs fall to the stream and the sea on two sides and terraces occupy the western side from which access is usually gained. A natural gas pipeline passes through the ditch separating the large southern platforms. The principal redoubt lay on the south-eastern corner of the western seaward platform.

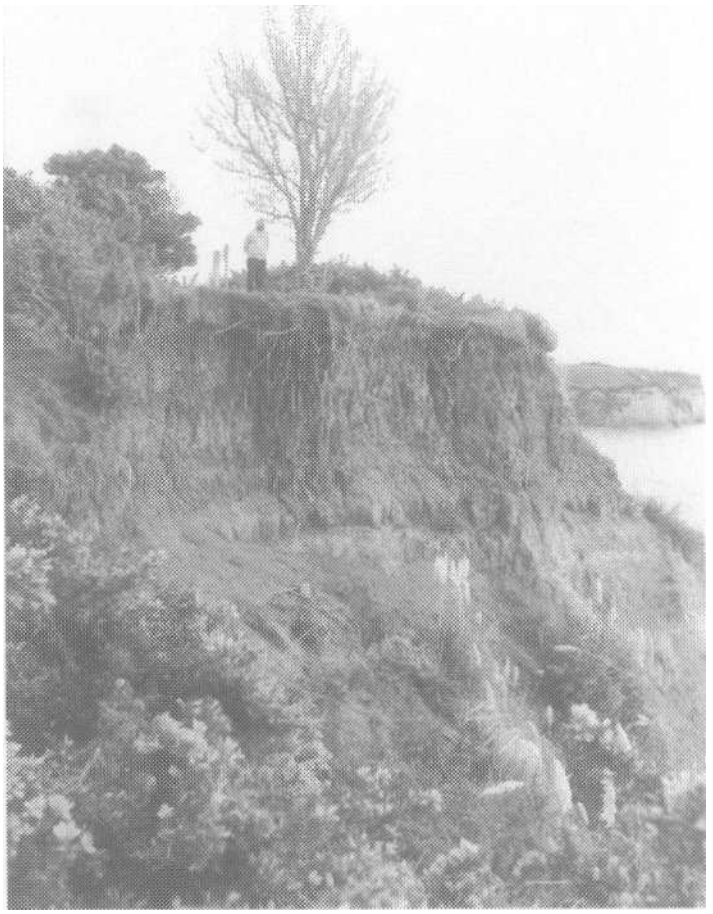
Vegetation

All the features have been heavily ploughed in the past, and are in a pasture sward, closely grazed with light stock - sheep or yearling cattle. Some animal-induced erosion is occurring on the steep, shaded scarp of the north-eastern platform, including areas of midden. The sea is also dramatically eroding the cliff edge, as shown by a dead pohutukawa at the edge with its roots suspended in air (Fig. 35(b)). There is another large pohutukawa on the north-eastern platform that appears to have been planted about a century ago and is a good candidate to represent the original Taranaki form of pohutukawa. Another pōhutukawa and a ngaio (rare in Taranaki) grow on the north-

Figure 34(b) Te Urenui (Q19/8), an oblique aerial view from the north-west, October 1994. The previously cleared and grassed platform has reverted to bracken and a shrubland is dominant on the flanks (to left and right). At right is the area of macrocarpa felled since time of visit.

Figure 35(a) **Pukearuhe (Q18/16), an oblique aerial view from the south, October 1994. The redoubt is the rectangular outline of lighter ploughed out ditches and banks at centre. The ditch and bank defences of the older pa are prominant on the near face of the broad lobe at right. The transverse ditch of the northern extension and the eroding slope are by the single pohutukawa at top.**

Figure 35(b) The eroding cliff edge at Pukearuhe (Q18/16). Note pohutukawa and extent of root system, here failing to hold the cliff but stabilising the surface soils in a stiff plate.



eastern scarp (Fig. 35(a)). These trees are in declining condition because of stock tracking and possum browse.

Management

The current routine management of the pā complex is adequate only for the short term. Its historical values seem rather undervalued and its recreational opportunities evidently important in on-going management. The site lacks interpretation.

Little can be done to prevent coastal erosion, although the present fence should be retained and offers the opportunity to improve the shrubland at the crest of the cliff. Care should be taken so that visitors retain the view from inside the fence and the sense of being at the edge of a cliff, otherwise the temptation will be to burrow through the shrubland with resultant falls. The north-eastern (inland) scarp is in poor condition and could be fenced out on or just below the platform perimeter and retired from grazing. Possum control is also needed, to protect existing trees and to allow additional trees such as local seed-source ngaio and pōhutukawa to grow.

The access road and its banks are in fair condition only and review is needed of its value. At present it intrudes on the landscape view of the southern defensive perimeter of the complex.

Mr White wishes to see the memorial to the Revd. Whiteley, killed here in 1869, removed. This viewpoint needs further review at a senior level in the department. The objection is principally to the implication that Ngāti Tama were responsible for his killing, which they were not. Satisfactory interpretation of the long and varied occupation of the complex, its strategic significance as the northern entry point to Taranaki, and the sufferings of Ngāti Tama, could make this clear. Two other memorials and the gravestones elsewhere on the reserve are unstable. All the monuments need architectural advice and a decision on conservation in the next 5 years.

4.2.5 **Katikatiaka,** Q18/53 GR 453594 (N100/2), on north Taranaki coastal terrace lands, adjacent to cliff. Soils: silt or sandy loams on pumice, tuffs, and underlying Tertiary mudstones, generally erosion prone and unstable. Rainfall: 1600 mm.

Katikatiaka is a pā of pre-European origin but was also occupied in the course of conflict between Ngāti Mutunga and Ngati Maniapoto in the 1820s (Smith, 1910: 3, 293-294). The importance of the site has long been noted:

> Katikatiaka pa... was an important fortress in former days. It was built on a crag which jutted out into the sea, and on three sides was protected by perpendicular cliffs, and on the fourth, or inland side, by a steep ravine; the narrow neck between the edge of the cliff and slope of the ravine being only from thirty to forty feet wide.... This was cut off by a deep double artificial ditch twenty-five to thirty feet deep and served to make this pa one of considerable strength. (W.H. Skinner, cited in Smith, 1910: 3-4)

We were accompanied to this site by Mr Steve White, and the farm owner Mr B.G. Gibbs.

The first record and map were by Ken Gorbey in 1968 and subsequently by D.H. Rawson in 1985. Oblique aerial photographs of the site have been taken by Prickett and by one of us (K.J.) (Fig. 36(a)) (see also Jones, 1994: 47, 274). The site lies in four main platforms, one isolated from the rest by a gully of some antiquity created by the slumping of a large block of the cliff edge on which the bulk of the pā is built. This inner (eastern) platform lies on a ridge between the gully and the main stream to the east again. The defence is a narrow transverse ditch and bank, and the platform is featureless, about 40 x 15 m in plan. To the west, on the slumped block, the two main platforms are divided by a transverse ditch, with a steep, eroding cliff to the west, and many collapsed rua on the surface. The northern platform has an enclosing double ditch and bank formed to the north and east on the scarp of the natural gully, petering out to a single ditch on the south-eastern side (Fig. 36(a), bottom). These platforms are 120 m in total length and 10-20 m wide, with a distinct "panhandle", rapidly eroding into the sea, on the western side of the northern platform. All are in poor unimproved grass, closely grazed at the time of our visit. The southernmost platform is small, no more

36(a)

36(b)

Figure 36(a),(b) (a) An oblique aerial view of Katikatiaka (Q18/53) from the south-west. The heads of the defensive scarps on the inland side are being heavily eroded by stock. The southern, heavily grassed, platform nearest viewpoint is inaccessible to stock and is not eroding on the inland side. The coastal erosion is beyond control; (b) a view of the main coastal platform from the north, showing stock erosion of the scarps.

36(c)

36(d)

Figure 36(c),(d) Katikatiaka, the southern platform: (c) cover of flax, gorse, toetoe, tī, exotic grasses and *Poa anceps* ; (d) *Poa anceps* prominent.

than 25 x 8 m in plan, with steep natural defences by virtue of its position on a small knoll, enhanced by a terrace and scarp to the east. Stock have had no access to this platform since at least the time of Rawson's record in 1985; he described the cover as mainly rough, coarse grass, with some taupata, kawakawa, harakeke, gorse, ti, toitoi, bracken and some convolvulus.

This protected part of the site now has a dense, tall grass sward composed of *Poa anceps*, *Hierochloe redolens*, cocksfoot, emergent kawakawa and flax (Fig. 36(c), (d)). The flaxes are variable in form and suggest the possibility of selections for particular cultural uses. Two cabbage trees occupy central positions on the platform and are likely to have been planted. Karaka trees occur on the inland scarp. Although the site is very exposed it is likely that a low canopy of coastal bush species will eventually develop, shade out the grasses and expose the rua pits beneath.

Apart from the rapid coastal erosion, the northern platform of the site is being heavily worn by stock, especially on the scarps and banks of the extreme north-western platform in the natural gully. The severity of the damage caused by the sheep tracking and camping is compounded by rain, wind and rabbits. The ditches and scarps will become unrecognisable in time. The need for positive action, in the form of fencing out the site with limited stocking, should be reviewed with the owner, but the long-term erosion of the coastal papa cliff is unstoppable.

4.2.6 **Te Pōrere**, 19/55, 56 GR 338365 (N112/1, 2), Volcanic Plateau, central North Island. Rainfall: 1600 mm; altitude, 700 m. Warm summers, severe winter frosts. Soils: pumice loams on free-draining tephra and lapilli.

Te Pōrere is a complex of two sites. The lower site (T19/56 GR 343365) is an informal enclosure of breastwork and rifle trench. The upper site (T19/55) is a more or less rectangular-in-plan breastwork with slight exterior ditch and flanking angles at opposed corners. Both sites have viewing towers installed about 20 m to the west, enabling the plan of the site lay-out to be viewed without the need to walk on the earthwork banks. Visitor numbers to the site complex are not known, but are estimated at 5000 people p.a.

In the past, visitors often walked on the top of the breastworks of the *lower redoubt* wearing them down and creating a channel 25 cm wide and 5-10 cm deep, which threatened to split the breastworks. In the late 1970s, the breastworks were restored by placing turf in these channels. A viewing tower was erected, and a notice was put up asking visitors to stay off the walls. Today there is little sign of visitors having walked on the breastworks (Fig. 37(a),(b)). The base of the rifle trenches is still eroding where there is a change of level (e.g., to a low rifle pit); but this now appears to be stabilising, although the downwear has exposed the base of the breastwork in places. Overall, this site was stable and holding up well to visitor pressure. At the time of the visit, the site had been cut with a circular scrub-saw, and minor cuts had occurred into the bank.

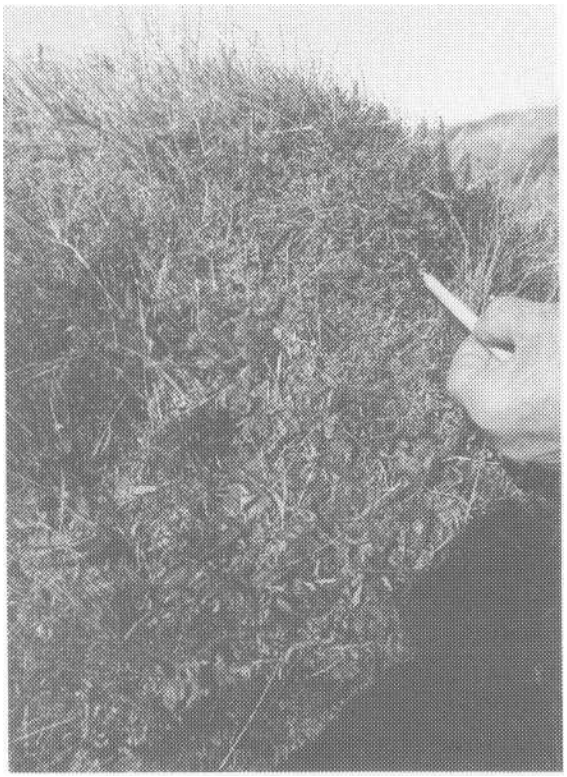
Figure 37(a) Te Porere: viewing tower located above the lower redoubt/breastworks (T19/56).

Lower redoubt vegetation and management

The lower redoubt is set within a frosty basin vegetated by shrubland and emerging seral indigenous forest. The whole area is surrounded by pine forest. The shrubland/seral forest has probably established by colonising a tussock grassland of *Chionochloa rubra* and bracken fernland, itself replacing beech/podocarp forest following fire. The shrubland is dominated by mānuka, monoao (*Dracophyllum subulatum*), *Coprosma taylorae*, and *Hebe stricta*. Emerging through this shrubland are relatively young kanuka, lancewood, toatoa (*Phyllocladus alpinus*), cabbage trees, kohuhu (*Pittosporum tenuifolium*) and kapuka (*Griselinia littoralis*) and a diversity of other species. A remnant of original forest adjacent to the upper redoubt indicates the type of forest that will eventually prevail.

If left unmanaged the redoubt will undoubtedly redevelop forest with the composition broadly outlined above. Many of the species are already present, but the vegetation is maintained in a very early seral state including many introduced species (Fig. 37(c),(d).

Figure 37(b) **Te Porere: oblique aerial view of the lower redoubt/breastworks. Photo credit: New Zealand Historic Places Trust.**



37(c)

37(d)

Figure 37(c),(d) Contrasting micro-environments on the lower breastworks, Te Porere: (c) north-facing with Hawkweed (*Hieracium pilocella*) and heather (*Calluna vulgaris*) prominent in the sward (pencil points to *Stackhousia minima*); (d) south-facing with "hard fern" (*Blechnum vulcanicum*) prominent.

The redoubt vegetation is predominantly grassland - brown-top, sweet vernal, *Festuca* sp, *Poa anceps*, with numerous herbaceous plants (*Hieracium pilosella,* white clover, wild strawberry and ragwort among introduced species and *Leucopogon frazeri*, *Wahlenbergia albo-marginata, Acaena* sp, *Helichrysum filicaule*, *Viola* sp., and *Blechnum vulcanicum* among indigenous species. One minute local herb is *Stackhousia minima* which would not otherwise survive in the surrounding vegetation. Shrubs of many species emerge from the grass-herb sward, including Spanish heather (*Calluna vulgaris*) and several indigenous species - *Pimelea oreophila, Gaultheria depressa, Hebe stricta* and *Carmichaelia* sp. Young mānuka and flax are present. Clearly this vegetation would revert rapidly to shrubland in the absence of continual cutting.

Upper redoubt vegetation and site condition

On the upper redoubt, some sections of the breastworks also have very noticeable footwear channels on top. There is no sign advising against this. The walls are high enough to obscure views from within the redoubt, causing people to seek vantage points. The walls of the breastwork vary in their stability. The wire-mesh gabions of the repairs conducted by J. R. McKinlay soon after the reconstruction of 1960-1961 (Jones, 1989:2) (Fig. 37 (e)) show in a few places, but the walls themselves are stable at these points. Elsewhere, there are several sections that have a foot channel on top, the face of the breastwork bulging and noticeably unstable, and a cavity at the base of the wall (the last possibly resulting from old pig-rooting compounded by freeze-thaw cycles) (Fig. 37(f), (g)). Collapse from this cause is likely to occur in one or two places in the near future,

Figure 37(e) Aerial view of Te Porere upper redoubt (T19/55) from the east in about 1961 after restoration by the late Ormond Wilson and team. Note bulge (overhang) and cavity in base (both marked by shadow) in far wall. Photo credit: New Zealand Historic Places Trust.

particularly if signs asking people to keep off are not erected. Remedial work to fill the channels will have the effect of shedding rain and obscuring the obvious track. The cavities at the base cannot be satisfactorily repaired without complete re-building of the breastwork. Packing soil with a tamping rod may be of limited benefit. If these breastworks collapse, they should be restored on further consultation with the authors.

The upper redoubt has a similar vegetation cover to the lower redoubt but supports a smaller range of species. Browntop and heather predominate with patches of *Muehlenbeckia complexa* and *M. axillaris,* seedling tutu and clumps of flax (*P. tenax).* There is some gorse nearby and several introduced herbs (e.g., California thistle) along the track to the redoubt. A large koromiko *(Hebe stricta)* grows on the marked urupa within the redoubt. Otherwise, the redoubt had been closely shorn prior to our visit.

The bush remnant adjacent to the upper redoubt is composed of Hall's totara, matai, cabbage tree, lancewood and kapuka. At least one of the totara has a scar where bark has been removed for a patua (bird harvesting basket).

Management of the two redoubts

The following are general considerations for vegetation control and management:

- Although the redoubts remain in good overall condition, the present low-growing vegetation is insufficient to protect the breastwork unless people traffic is carefully controlled and monitored.
- The viewing towers are removing visitor pressure, but signage is needed at the upper redoubt.

37(f)

37(g)

Figure 37(f),(g) Te Porere 1993: (f) note foot channel in near wall at right, and along the central bank. Post of viewing tower is at bottom right; (g) view from inside the redoubt showing the bulge and destablishing effect of foot track on top (compare 1961 aerial photograph).

- Continual close-cutting of vegetation is slightly damaging the site and large plants such as flax actually on the banks are likely to create instability as they grow larger; large plants would be better kept to the base of the earthworks. Red tussocks may offer appropriate protection as well as access.
- Vegetation should continue to be cut, but at a slightly greater height (5-8 cm in the case of the lower redoubt).
- There is a wide diversity of both introduced and indigenous species; the former is dominant in terms of cover but will inevitably be replaced by the latter;
- Some indigenous species are very uncommon, e.g., the herb *Stackhousia minima*; and the maintenance of a low vegetation not only provides an appropriate habitat but enables people to see rare species. The site has both historic and nature conservation significance.
- Vegetation patterns in the vicinity show clearly what would happen if active management ceased; in the long term, reversion of the wider reserve to forest may be the most sensible option, but the landscape context of visibility would be compromised and some planning for long-term maintenance of views is needed.

4.2.7 **Te Wehengaiti,** T19/41 GR 364423 (N102/45), Volcanic Plateau, as for 4.2.6. On low terrace-edge 10 km north of Lake Rotoaira.

Te Wehengaiti is a fortification created by a perimeter of traversed rifle trench, with some flanking outliers. The site was first recorded, and much of its western perimeter restored, by Trevor Hosking in 1966 (Newman, 1988). Damage to the perimeter resulted from logging in the vicinity in the 1930s.

The site is noted in the compartment records for the Rotoaira Forest. The site had been cleared by Turangi Historical Society members several years before our visit, and appears to have been marked with small posts by David Nevin who was then working for the former New Zealand Forest Service. The clearance appears to have involved cutting and dragging broom from the site, possibly with stumps poisoned. Dead bracken stems were stacked low on the ground in various places within the perimeter, and left to decay.

Vegetation

The site is surrounded by pine forest. The vegetation consists of grassland with patches of bracken and scattered shrubs. Grassland consists of a dense sward of yorkshire fog, sweet vernal, cocksfoot, *Poa anceps* and toetoe, interspersed with ragwort, foxglove, scotch thistle, bracken and flax. The dense sward has inhibited shrub regeneration but there are some broom, koromiko and regenerating māhoe-wao (*Melicytus lanceolatus*), the last likely to be dominant in the shrub cover if regeneration were allowed to occur. The dense vegetation cover, including the piled-up debris of clearance efforts, obscures from view but at the same time protects the peripheral rifle trenches.

Management

Given that the site is in a production forest and that visitor numbers will remain low, two options are open. These are *periodic clearance* or *regeneration.* Clearance will involve removal of broom and other shrubs from the site and the maintenance of the tall grassland. Shrubs may be allowed up to but not within 5 m exterior to the defensive perimeter. Wilding pines are not a problem at present, but could become so, particularly with disturbance to bracken or grass cover. With the regeneration option, the likely cover is māhoe-wao, a frost-resistant species of this common successional genus. This cover would be distinctive within the wider area of the pine forest and less likely to be disturbed by bulldozer parking, skidding, or transit in the course of logging. Earthworks would be visible beneath the dense canopy.

On balance, we would prefer to see the tall grassland maintained, particularly if a solution can be found to the infilling of trenches with the grass tag and bracken.

4.2.8 **Waiū pā complex,** T21/1,2 GR 504856, 506855 (N132/1,2), southern Volcanic Plateau, Central North Island, in the headwaters of Hautapu Stream. Rainfall: 1000 mm. Climate: montane with severe frosts and winter and spring snow. Soils: free draining pumice substrate with thin ash loam topsoils. The district is Army training land (based at Waiouru), and is freely ranged by wild horses, the numbers of which have increased greatly in recent years.

The Waiū pā complex consists of two gunfighter pā, separated by about 250 m, lying at 1100 m a.s.l. near a patch of slowly-dying forest including Hall's totara, the largest of which have been bark-stripped for roofing whare (Fig. 38(a)). The pā date to about 1880, and were built by Ngāti Whiti and Ngāti Tama (of Moawhango vicinity) to prevent the occupation of the area by Whanganui Māori under Te Keepa Rangihiwinui (Major Kemp).

T21/1 is the better defined and more easily recognised of the two pā. It consists of a central rectangular sunken area, 50-110 cm deep and 6 x 25 m in plan, with a contiguous whare floor offset about 8 x 4.5 m in plan. The floor of the larger rectangle is buttressed in places (not shown in the plan which is part of the site record form). These were probably further subdivisions for whare. The rectangular area is linked to the north and south by a short length of rifle trench to a primary defensive perimeter of irregularly traversed rifle trench and rifle pits, extending 35 x 20 m in plan with a further outlying rifle trench and rifle pit some 12 m to the south-west. The pattern is not unlike Māori gunfighter pā of the mid- to late 1860s, except that the fully enclosed sunken whare area is unusual; whare usually open directly to the rifle trench perimeter (e.g., Te Tapiri, discussed above in 3.1.4; see also Jones, 1983; 1994: 134; 1989: 8; Nevin and Nevin, 1980b).

The second, southern, pā consists of a "central" sunken area about 15 m square with an outlying area (covering some 40 x 30 m) of rifle trenches and fallen palisade posts which do not fully enclose the sunken area. The pattern of the rifle trenches is not clear. The pā is unlikely to be of pre-European origin. Pairs of pa like these two are not

Figure 38(a) The Waiu pā complex of 1880, looking north, September 1967. T21/1 is prominent centre and T21/2 at bottom right. Note snow lying on the horse-induced grass sward around the forest patches, dead timber, and lack of shrubs in pā T21/1 (unfenced at this date).

uncommon, e.g., the Te Tapiri conflict was fought from two pairs of gunfighter pā (Nevin and Nevin, 1980b).

The two pā were photographed from the air by the RNZAF in July and September 1967, offering insights into their earlier vegetation cover. The images are at a low angle (not showing the plan of the features clearly) but the outline of the ditches of T21/1 (N132/1) is clear. T12/2 (N132/2) shows as a rectangular depression (Fig. 38(a)).

Vegetation

The Waiū pā lie within a very extensive plateau of red tussock (*Chionochloa rubra*) grassland, containing a few small patches of low bush (predominantly cedar (*Libocedrus bidwillii*, pāhau-tea)) and wherever volcanic rocks are exposed on valley sides, large expanses of flax (*P. cookianum*, whaariki) and *Coprosma propinqua* shrubland. A scattering of young *Pinus contorta* (< 1 m in height) occurs throughout.

Of note in the RNZAF photographs is the density and uniformity of tussocks in the vicinity, except for a low introduced-grass sward bordering the forest patches (prints on file Historic Places Trust, AR 2045-2052). This pattern of vegetation is created by horses. No shrubs show on the pd themselves, since they were not fenced until some years later.

The *northern pā* is surrounded by coils of barbed wire which restrict access by horses. The pā is clothed in red tussock and scattered shrubs 1-2 m tall, including a few *Pinus contorta*. The ground surface is densely clothed in prostrate shrubs, grasses, herbs, mosses and lichens and is hummocky in surface-form owing to the peat-like development of decaying ground vegetation. The hummocks are sites of tussock regeneration. Overall, the vegetation has a complex structure with the broad trend the re-establishment of forest species. However, this is extremely slow. Forest shrub species include *Coprosma propinqua*, *Pseudopanax simplex* (the incipient forest cover inhibited by possum browse), *Myrsine divaricata*, and *Aristotelia fruticosa*. Open-ground low shrubs include mānuka (dwarfed by frost), *Cassinia vauvilliersii* (tauhinu) and *Dracophyllum subulatum* (monoao) (Fig. 38 (b)). The last is increasing significantly because seedlings can establish through the low cover induced by hare browse. Hare browse can inhibit tussock regeneration (Rose and Platt, 1992). Prostrate shrubs are prominent between the tussocks, especially *Coprosma cheesemanii* and occasional *Gaultheria depressa* and *Pernettya macrostigma*.

A variety of herbaceous plants occur at ground level, including *Leucopogon frazeri*, *Haloragis incana*, *Lycopodium*, *Helichrysum bellidioides*, and species of *Acaena*, *Euphrasia* and *Pimelea*, along with substantial cover of mosses and lichens (Fig. 38(c)). Ferns (*Blechnum penna-marina*, *Polystichum richardii*) and grasses (*Poa anceps*, *Hierochloe redolens*) are prominent in the shaded trenches. A most notable feature of the vegetation is the very low incidence of introduced species, not only a narrow range of species (sweet vernal, browntop, Yorkshire fog, *Crepis capillaris*, *Hieracium pilosella*, *Cerastium* sp., *Hypochaeris radicata*, and white clover), but each is present in very low numbers. Hares and possums are responsible for opening the cover the allow these species entry. Otherwise the vegetation forms a dense, multilayered cover with a high level of stability.

Outside the fence, horse grazing and trampling have modified the vegetation severely. The peaty hummocks disappear through trampling. The red tussocks and intertussock grasses, low shrubs and herbs also mostly disappear and are replaced by a low browntop sward. The *southern pā* shows the influence of these processes well, although there is still a reasonable cover of red tussock in places. Combined with horse-induced erosion of edges, the overall effect is a less clear definition of the earthworks of the pa site. This site appears to be in the process of having a poor-quality grass sward replacing the red tussock, but it is not in poor condition. We noted no active erosion points, only a general flattening of features induced by trampling and weathering. The supposed palisade posts are rotting quickly, since they are now all on the ground.

Looking to the wider vicinity, the pā sites are located in an area with several small remnants of bush, each with a unique composition and condition. The patch to the south-east is predominantly red beech. The patch to the north-west has been largely destroyed and consists of scattered trees only (cedar, pokaka), with fallen trunks and browntop grassland beneath. The patch west of the pā sites and closest to them consists of numerous low-growing hardwoods. Cedar and red beech are absent or rare respectively probably because the trees were harvested for palisades, shelter and fire-wood during the active phase of pā habitation.

38(b)

38(c)

Figure 38(b),(c) (b) Waiu pā (T21/1) with T21/2 in the distance by the trees. Note shrubs (*Coprosma propinqua*) and apparently good condition of red tussock grassland within the concertina wire fence (marked by the steel standards, top right). The wire excludes horses but not deer. (c) Hare droppings, hare nests, grazed red tussock, and invasion of exotic grasses at one place within the enclosure.

The trees in this patch consist of Halls totara (2 trees, both with bark removal scars), red beech, lacebark (*Hoheria sextylosus*), kapuka, *Pseudopanax simplex* (haumakaroa), putaputaweta, mahoewao, a single ti toi (*Cordyline indivisa*), and others. A dense band of shrubs forms a discontinuous buffer to the outside, including *Myrsine divaricata*, *Neomyrtus pedunculata*, *Coprosma propinqua*, *Pseudowintera colorata* (unpalatable peppertree) and there are thickets of bush lawyer. However, there is no ground cover within the bush because horses shelter and graze there. The lacebarks are severely browsed by possums. As existing trees die around the margins they will not be replaced, and the remnant will eventually disappear, as others already have.

Between the two pā sites a west-trending valley contains a flush zone that was undoubtedly the water supply for the pa inhabitants. The wetland vegetation (predominantly grasses and sedges) is in good condition, despite trampling.

Management

On the *northern pā*, in the short to medium term, the shrubs and young trees are not endangering the earthworks, but should eventually be cleared. Tauhinu and monoao will eventually colonise as browsing animals open the tussock cover. Pines should be removed by the Army's contractors in the course of their planned programme, but care should be taken to remove before seeding takes place. The concertina-wire fence should be maintained. In the longer term, an area of as much as 100 ha of the landscape around the pā complex should be protected from horses by fencing in.

The *southern pā*, although not as sensitive to damage as the northern, should probably also be fenced in with the wire rolls. As we have noted, this site is difficult to interpret, and needs mapping. Before that occurs it should be weed-eaten or burned to improve visibility. If weed-eaten, vegetation taller than approximately 30 cm, i.e., mainly the red tussocks, should be cut. Burning would have the advantage of guaranteeing the survival of the red tussock. The site should then be carefully mapped and, if possible, have aerial photographs taken. Care should be taken to avoid damage to the palisade posts lying on the ground. If a museum is willing, a post or posts should be removed for gradual drying and storage, if not display. This should be done before any burning. It will eventually be covered in shrubland similar to the northern pā and will need review as to its composition and suitability for site stabilisation. At some stage removal of shrub cover to encourage tussock may be necessary.

In the long term (10 years), both pā, the gully wetland and at least the closest bush remnants should be protected as a landscape unit. The pā would not have been possible without the essential landscape setting of water and building materials. The bush remnant is as much an archaeological feature as the pā site itself (and contains living trees that were used by the inhabitants - namely totara for their bark). Once fenced, both possum and hare control would also be possible. As the protective shrubland surrounding the pā develops, the growth on the two pā may accelerate and a review of the vegetation cover may be needed, say 20 years after the recommended wider fencing project.

4.3 Sites in exotic weed cover

4.3.1 Ngānana, Q19/104 GR 178435 (N109/45), on terrace country, Waitara River valley, north Taranaki.

Ngānana is a pre-European pā in a Historic Reserve on the edge of the high terrace west of the Waitara River and immediately inland from Waitara township. The pā lies in up to five segments around a broad right-angle bend on the terrace edge. Each segment has a rectangular perimeter of ditch and bank. On the eastern perimeter in the farmland, there is a shallow linear depression suggestive of an outer ditch and bank, although this does not show in early aerial photographs (it may have been destroyed before the 1940s). Compound defences with two lines of ditch and bank occur at the far south-western end, where a ridge leads south-west down to the river flats 30 m below. This ridge comprises a whole new segment of the pā, and is not unlike a ridge pā, with a transverse ditch at the upper end.

Vegetation and site condition

The site has never been adequately mapped and had been most unsympathetically treated by neighbours in the last decade, with rubbish dumped on parts of the pā, bulldozing to the north of the house to secure a view, and inappropriate fencing to enclose a pigpen into part of the southern part of the pā. The central part of the pā is an urupā and also contains several European graves, notably of Henry H. Wood (d. 17/2/1918) and Phillipa Wood (d. 6/7/1927), early owners of the adjoining property. The graves are accompanied by exotic trees: a Moreton Bay fig of large size, an elm, a fine *Magnolia grandiflora*, and Norfolk Island pine.

The whole site has been under exotic forest probably since the turn of the century, since large trees are observable on a 1943 aerial photograph (RNZAF 438/C17-18). The exotic trees are associated with some planted karaka and cabbage trees (although both of these could have been growing on the original pā site) and support a dense understorey of kawakawa and regenerating puriri and karaka. Suckers from the elm have also spread throughout and there are patches of introduced ground cover such as periwinkle and *Montbretia* Fig. 39(a), (b)). Bordering the platform is well-developed bush composed of tawa, rewarewa, mapou, mahoe, matata (*Rhabdothamnus solandri*) and climbing red rata (*Metrosideros fulgens*).

Management

Most of the management problems appear to have been caused by too narrow a survey definition of the extent of the pā, and in recent years unsympathetic use as a place of dereliction or to maintain domestic views. The far north-eastern segment has been partially cleared of *Pinus radiata* and *Cupressus macrocarpa* in recent decades, and has suffered heavy stock tracking also, the latter marked by suspended "aerial" roots of now-dead macrocarpa in the eroded bank (Fig. 39(a)).

The far south-western ridge pā has been cleared of rubbish and weeds (wattle and *Solanum mauritianum* (tobacco-weed)) by the department in the last 18 months, as have the slopes below the north-eastern segment, the latter visible from the lower valley.

39(a)

39(b)

Figure 39(a),(b) (a) Ngānāna (Q19/104), ditch (with figure) and eroded bank of the most south-eastern platform. Cattle have sheltered under the macrocarpa and eroded the bank from the height where the roots commence. (b) One of the interior platforms of Ngānāna showing ground cover of kawakawa, karaka above and elm (*Ulmus x hollandica*) suckers.

Poroporo (*Solanum aviculare*), taupata and flax have been planted as a nursery crop, with rewarewa and ngaio inter-planted. This work followed the wish of kaumatua, Mr Jim O' Carroll, that the pā, because of the urupā, should not be open to the public. The elm suckers may pose a problem in forming a dense thicket, but will probably be kept in check by the dense cover. As far as additional planting is concerned, care is needed to ensure that large plants are not established on earthwork features.

The site actually would lend itself to walkway development, with fine views of the lower and middle Waitara River valley, and its ultimate interpretation and usage should be kept under review. The adjacent river flats have been quarried over the years, leaving a gravel wasteland of 10-15 ha extent; this surface, including a large lakelet, is to be rehabilitated by the department over the next 5-10 years. Overall, the reserve is an interesting experiment in deliberate re-vegetation to manage a weed and dereliction problem. However, we wonder if the implied intent to re-establish forest cover on the entire pā is appropriate in the long-term since the site is an expressly designated historic reserve. The goal of natural rehabilitation should be reviewed, and some scope might be offered for mowing and the maintenance of river valley and historic landscape views.

4.4 Sites in mature indigenous forest

4.4.1 **Te Koru,** P19/53 GR 956302 (N108/26), Taranaki ring plain, superficial geology dominated by lahar mounds and airfall ash loams. Rainfall: 1500 mm.

Te Koru is a pre-European pā lying on a lahar mound in the floor of the Oakura River valley. We visited the site with field centre staff, Dr Alastair Buist and Hip Fenton.

The river borders the site in a large U-shaped bend. The principal tihi (platform) is about 25 m above river level and the site overall occupies an area of about 160 x 65 m (about 1.5 ha). To the north-east, a steep natural river-cut scarp falls 20 m to the riverbed; the scarp decreases in height along the north-west/south-east axis of the pa. The interior is defended by a double transverse ditch on the south face; the lower ditch is approximately 90 m long with an inner defensive scarp some 8 m high. To the north-west, the pā falls in a series of artificial scarps and terraces to the river bed. Rua (cave pits) are prominent in the foot of banks and on platform surfaces, most only partially collapsed, some not at all. The upper scarps are revetted in places, although the very steepest and highest scarps (more than 2.5 m) are not, e.g., the main upper platform scarps are not revetted. (Revetting is the practice of lining a steep face with stones. In this case the stones are 15-30 cm size rounded river boulders.) Towards river level on the north and north-west extremities of the pā are some broad terraces, about 50 m square, separated by a distinct earth wall or bank, probably enhanced by scarping. The lower northern terrace has a distinctive perimeter stone revetted wall. The function of these lower terraces in the overall settlement of the site is uncertain. The wall-enclosed area, however, is reminiscent of taro gardens elsewhere in Polynesia. Further description is in Best (1975: 204-215).

Vegetation and site condition

Interest in the state of preservation of this remarkable site has been sustained since the late nineteenth century. The first note of Te Koru's condition was by W.H. Skinner (1893:179) who stated that it was in an "almost perfect state of preservation" in a cover of karaka, rewarewa and ngaio. In his description of the 1920s, Best (1975: 205) also notes the forest cover, "seemingly younger than that of Okoki", of rewarewa, "kohe" [kohekohe], whārangi, karaka, "tawhero" [kāmahi], māpou, māhoe, hangehange, and Cordyline, with "a fine growth" of māmaku and *Cyathea smitthii* ("*Hemetelia* tree ferns"). Best also noted the protective effect of the forest cover which "will *tend to prevent* erosion of scarps" (emphasis added).

Today, the pā is densely covered in secondary indigenous bush composed predominantly of rewarewa, kohekohe and tree ferns with groves of karaka. The understorey is rich in tree seedlings, and saplings (including puriri, not previously reported) and ferns although there are large areas covered in a thick leaf litter (rewarewa and karaka) without regeneration. Stone-faced banks support numerous ferns, especially *Blechnum lanceolatum*. Some rua are encased by tree roots that stabilize the opening. A single *Marattia salicina* (para) may represent the remains of former cultivation as a food plant and the karaka have very large seeds characteristic of planted Taranaki groves.

Cyclone Bola (1987) appears to have facilitated entry of several introduced plant species or to have caused increased numbers of others. *Senecio bipinnatisectus* is common on the forest floor, *Selaginella kraussiana* (a lycopod) and wild strawberry are established among the riparian vegetation, and of greatest concern are occasional thickets of Himalayan honeysuckle *(Leycesteria formosa).* These plants detract from the overall indigenous character of the site.

Some features described by earlier observers were not confirmed, for instance the earlier prevalence of ngaio (not seen), *Cordyline* (*C. banksii*, today only a few plants along the river), and kāmahi (*Weinmannia racemosa*) (not seen). Some of these differences could reflect natural successional change.

Management

Day's (n.d.) recommendations of about 1980 were:

- to maintain a "bush cover" (rewarewa/kohekohe/tree fern at that time);
- selectively remove trees which were damaging historic features, or trees which would cause damage if they fell;
- trees growing on revetted scarps were to be removed first;
- ditches and tracks to be kept clear of hindering vegetation;
- steps to be installed in tracks up scarps and signs erected advising visitors to keep to the steps; Fyfe (1993, pers. comm.) notes that informal tracks had created some damage.

These recommendations were carried out in the early 1980s. The track work and step stabilisation was particularly successful, with no signs of uncontrolled access up scarps on our visit in 1993 (Fig. 40(b)). We saw no revetting with trees at the crest. We found that the northern point of the upper platform had collapsed in the previous few weeks, under the influence of treethrow (Fig. 40(a)), significantly from a dead tree. In future, dead trees in such sensitive locations should be removed. Cyclone Bola stripped many branches and leaves from the canopy and caused some treethrow. The ground-level shrubs increased rapidly with the increased light. In 1992, a programme of ground-level shrub removal was carried out, to reveal the archaeological features. A gallery effect among the rewarewa boles was established.

Where open areas with no canopy occurred, some tree saplings (principally puriri) in platform areas were marked and left with a view to re-establishing the canopy. Current management practice to restrict the growth of a dense understorey but favour canopy replacement trees is strongly supported, although the choice of puriri could be reviewed. Pururi possibly has deep roots compared with rewarewa. Overall, our observations support the contention put forward by Best (1927) that the bush cover is preserving the surface archaeological features. There is little evidence that tree growth is causing bank instability, unless the trees are growing right at the top of the scarp; indeed the opposite seems more likely to be true.

Although trees and large shrubs had been removed in the early 1980s, the condition of the revetting is a matter of concern (Fig. 40(c)). At some points, the revetting has collapsed in the last few years, and at other points the revetting was beginning to bulge

40(a) 40(b)

Figure 40(a),(b) Te Korn: stability and instability (1): (a) outer point has broken away; exact cause is not clear, but it is probably a combination of heavy rain-saturated earth, and windthrow of the canopy overhead; (b) paths have been stabilised by a neat facing and edging of tanalised timber.

out from the scarp face with an apparent cavity between the stones and the soil face behind (Fig. 40(d)). Generally, the revetting is unstable and it may not be possible to stabilise it short of re-construction. Contributing factors to the instability arise from the construction itself, particularly:

- the use of rounded river boulders with little keying potential and which settle in an unstable state;
- inadequate footings with the bottom boulders lying on a sloping soil surface at the rear of the level tread of the terrace, rather than on the tread itself (the treads may have been extended into the original footings in the course of the original occupation).

4.4.2 **Okoki,** Q19/24 GR 336452 (N99/26), on terrace lands north of the Urenui River.

Okoki is a much-discussed and documented pā (Best, 1975: 232-239; Buist, 1964: 55; Prickett, 1990: 58) is of pre-European origin and was also the scene of heavy fighting in the 1830s. It is approached from the state highway by way of the western slopes, from where it presents to the visitor as a rewarewa and karaka-covered hill crest 200 m long, with grass slopes in the foreground (Fig. 41(a)). The true extent of the large top platform is about 250 m x 80 m. There are transverse ditches or steep scarps on the narrow leading ridges to the north (by the Buck Memorial) to the north-west (on the

40(c)

40(d)

Figure 40(c),(d) Te Koru: stability and instability (2): (c) the crest of the revetting on the face towards camera has broken away. Note light coming through thin, storm-damaged canopy; (d) revetting with a good crest of low-intrusive shrub, grasses and ferns, reduces water percolation and assists in stabilisation. The revetting here is actually unstable since the stone face is more or less free-standing with a cavity between it and the earth face behind (not visible).

grassed face) and to the south-east. Long, steep scarps and terraces follow around the west or north-west face within the forested area. The pā actually lies on a ridge pointing out into the Urenui River, and from its platform there would once have been tactically valuable views down the river. No sense of such a position is allowed by its present vegetation cover, access and lack of designed tracking. We visited the site with Mr Haumiora (Sam) Raumati, kaumatua of Ngati Mutunga.

Vegetation

The dominant tree species are rewarewa, karaka, puriri, mahoe and kohekohe (Fig. 41(b)). Kawakawa, kanono (*Coprosma grandiflora*) and supplejack form a dense understorey in places . However, possum browse is severe in the kohekohe canopy and an even-aged growth of kanono (presumably established after fencing 10-20 years ago) has been severely de-barked by goats and will eventually die. The combination of aging of relatively short-lived rewarewa, possum browse on the canopy and goat browse on the bush floor will result in rapid decline of the bush cover unless animals are controlled.

In effect, the goats have removed the ground-level shrubs from this pā, and the gallery effects (visibility) were not unsatisfactory (Fig 41(c)). In this particular aspect, the goat invasion was not without benefit. Minor erosion caused by goat camping of the steep transverse scarp falling to the south-eastern parts of the main platform was noted.

The rewarewa on the site appears to be prone to windthrow, as elsewhere, and a fallen large specimen broken at the base (no root plate uplifted) was noted on the northern end of the main platform. This particular trunk had broken where an early fence wire collar had cut into the cambium, introducing rot and weakening the tree. Removal of forest trees from the pā is unwarranted. However, encouragement of appropriate rewarewa saplings is warranted. If the pā is to be visited (and it will be difficult to prevent this), some measure of continued under-shrubbing may be warranted, although a closed rewarewa-dominant canopy would do much to prevent ground cover plants establishing.

Management

Mr Raumati's views on the site were:

- visitors to the main platform should not be encouraged;
- the grassed slope to the north and west of the fenced-out area of the pā should be re-vegetated;
- the felling of karaka outside the pā by the grazing licensee (of some years back) was inappropriate.

The pā has been tightly fenced on the western ridge line, with the outermost ditch and an exterior small platform exposed to stock. Mr Raumati's firm wish was that the whole of the western grassed face should be allowed to revert, and certainly a more sympathetic fenceline enclosing the lower defences is warranted. Karaka could be reinstated on those north-western slopes with some lead time and the introduction of satisfactory nurse crops to reduce weed invasion when the new area is fenced. The karaka bear the largest fruit of any Taranaki karaka groves, according to Mr Raumati,

Figure 41(a) **Aerial oblique view of Okoki (Q19/24). View is towards the south-west.**

41 (a) 41 (b)

Figure 41(a),(b) (a) Okoki (Q19/24) and the memorial to Te Rangihiroa (Sir Peter Buck), left. Rewarewa and treefern are prominent in the canopy exterior view. (left). (b) Open gallery-effect on goat-grazed platforms under.rewarewa.

and some of the trees are exceptionally large. One of the karaka trees lies outside the fenced area on the western border and some have been removed by the grazing lessee. Three cabbage trees, probably planted in pre-European time, also grow in this grazed zone. For reasons of important vegetation, therefore, this area should be fenced and the trees protected.

However, we believe that visitor access to the platforms cannot be prevented. With proper landscape design (e.g., steps and boardwalks) visitors should be directed and controlled. It may be possible also to open viewpoints at points on the western edge of the main platform, similar to those by the Te Rangihiroa Memorial itself. The history of the pā and the significance of Te Rangihiroa's contribution to Polynesian historiography should be explained. This would be an appropriate recognition of the place acknowledging Ngāti Mutunga's great son, a world-acknowledged Polynesian scholar.

5. DISCUSSION AND CONCLUDING REMARKS

The risk of deterioration of sites from careless land management has been recognised for more than a century and there is widespread international concern about the fate of landscape monuments (Best, 1975; Moore, 1905: 596; Hamel and Jones, 1982; Thorne, 1988; 1990). Despite this concern, practical techniques to ensure site condition have been little formalised, although this situations is being gradually rectified. New Zealand is no exception. Overall, the sites reported on here are in poor management state with grazing and associated animal damage, wild pigs and herbivores, pine trees and associated tracking and seedlings, inpenetrable gorse or other plants that restrict human access, human tracking, etc. Few sites have archaeological features in good condition, secure management, "stable vegetation" and with ease of observation in near or distant view. Indeed, most sites appear to have been ignored and managed only when damaged. The region with the best signs of positive management was Taranaki, where many sites have had close management consideration, management planning and implementation.

Concluding remarks are warranted on what we found with respect to current land tenure and management, and the intentions and plans of land managers; some fresh thoughts on techniques of vegetation management as they apply to archaeological site stabilisation; and the need to consolidate and ensure a solid foundation of experience among archaeologists and managers alike of the practices that we are discussing, many of which are novel in New Zealand.

5.1 Land managers

The principal large land-managing company, operating in the old Tairua State Forest, was Carter Holt Harvey Forests, Ltd. We had several useful discussions with their staff on land management practice, particularly weed control, and regimes for protecting sites in the course of logging operations. Our conclusions on their current management practice and advice on management of specific sites are in section 3 of this report. On the Whangamata Peninsula, the company is required, under the terms of their contract for cutting rights, to write an Environmental Impact Report to be submitted to the Thames Coromandel District Council. We trust our advice will be of assistance in this process. We were interested in their process for controlling noxious weed invasion post-harvest, having experienced the horror of T 12/60 at Onemana (see section 3.3.1), but we would like to see further work done on how a satisfactory medium- to long-term cover other than *Pinus radiata*, and suited to site protection, could be established. Nevertheless, this technique (greening, Roundup, *Lotus* application), or modifications of it, is very relevant to sites where exotic forest cover is removed, such as Te Pā o Toi, Hawkes Bay (Part 3), where there is a severe risk of exotic weed invasion.

The only other company that we visited, Ernslaw One, Ltd., did not have mature forest on its only Coromandel holdings, Whangapoua, and we had no need to discuss the issue of post-logging management. However, we were pleased to be advised that detailed records of sites were plotted into their compartment mapping - an essential step in site protection. At Whangapoua and at Tairua, the unevaluated record of sites should, in the near future, be the subject of a re-evaluation of their protected status, in light of the company's perceived operational needs, with perhaps lesser numbers of sites being given

a greater degree of protection and positive management to stabilise archaeological site condition.

We noted quite wide variation in the commitment of district councils to the management of the historic values on their reserves. Notable was the development of the Bowentown Heads complex where, despite harsh treatment for roading some 20 years ago, the Council now has an active programme of opening up the weed-covered land surface and caring for the historic features thus revealed. Turuturumokai, under the care of the Hāwera District Council, was also under adequate conservative Forest Pasture management, although here some amenity and recreational values had long intruded on the site. In contrast, the Whakatāne District Council, with an outstanding assemblage of sites under its care at Kohi Point, seems merely to be in maintenance or reversionary mode. It is, of course, reasonable to be in reversionary mode if there are insufficient funds or knowledge to maintain vegetation in any other way. Reversion holds the features, but can create long-term problems, such as obscuring of archaeological features which should be on view, or the disturbance of archaeological strata.

The quality of land management of historic reserves under the care of the Waikato Conservancy of the Department of Conservation was difficult to judge, since the original case studies here were not on the Department's land. However, of the two historic reserves that we did visit (Whitianga Rock and Hereheretaura), both seemed delicately poised to suffer ecological changes that will change the conservation status and visitor and landscape potential of the sites. In the Bay of Plenty, the Department is actively managing a useful range of sites (Fort Galatea, Te Tapiri, Tauwhare), and is engaged in a constructive dialogue with New Zealand Forestry Corporation Ltd. about sites.

Taranaki was the most illuminating of the Departmental conservancies visited. Here is New Zealand's most significant assemblage of historic reserves of pre-European and 19th-century origin, on which the spotlight of archaeological attention will continue to turn. Māori interest in the reserves and other historic places in the region is also strong. With little technical or policy guidance from outside the region, the Conservancy's New Plymouth field centre has applied long-tested reserve management skills to the management and grazing of grasslands (Pukerangiora, Pukearuhe), rehabilitation of forests and weedlands (Ngānāna), and a concern for canopy maintenance, understorey clearance, and their effects on ground-level maintenance of site stability (Te Koru). We learnt much from their efforts - because here techniques and insights were applied that can be generalised, justified, and used more widely elsewhere.

Throughout the case study notes, we have made rapid judgements about the rarity or other values of plant assemblages found on the archaeological sites, and perhaps these also need to be evaluated in the light of a wider survey of the plant values of the particular ecological district concerned.

5.2 Reserve classification issues

The statutory classification of the purpose of a reserve is sometimes held as the key to the appropriate management for the place. In the course of these site visits we noted important sites in a number of reserve classifications, and some not reserved at all (on freehold land). On Crown lands or Maori lands, reserves were classified as historic,

recreational or scenic (in some cases devolved to local authorities), Army training lands, soil conservation reserves, and ss. 338-340 reserves under the Maori Land Act 1993. Almost all of the sites reviewed in this report warrant historic reserve classification. The only systematically classified assemblage noted was in the Taranaki region. However, even where classified as historic reserves, the management has not always been well focussed on the historic values:

- many of the reserves are treated and managed as if they had recreational values only;
- even where classified as historic reserves, recreational values were paramount in some cases, e.g., Pukearuhe in north Taranaki;
- in other cases, grassed historic reserves have in preceding years been inappropriately treated as subjects for native shrubland or tree re-vegetation, usually for recreational or landscape purposes, e.g., Pukerangiora.

On the last of these points, there can be no question that native shrublands and even late rewarewa-type seral stages have protected earthworks from erosion, both by reducing rainfall erosion and also the concomitant benefit of removing or reducing stock pressure, particularly where fenced for sustained periods. However, tree re-vegetation should not be thought of as always the preferred method of land management. It should be undertaken in appropriate cases only, and is subject to the authority provisions of the Historic Places Act 1993.

Many of the sites were visited in the company of kaumatua. Sometimes considerable antipathy was expressed towards former management practice, particularly where reserve boundaries did not coincide with pā boundaries, or where culturally inappropriate management practices, such as the treatment of karaka at Okoki, had taken place.

Sites that have been demonstrated to be tapu should be looked at closely as to their management. In the New Zealand context, this may mean allowing reversion to bush - a view stressed to us by Mr Raumati, who visited several of the Taranaki reserves with us. However, we believe that there are a wide range of public interests in these sites, not least cultural, educational, recreational and archaeological, and in the cases where these conflict with tangata whenua views, a balance reflecting positive and informed consultation has to be struck. In most cases, positive interpretation, for example, at Okoki, of the importance of Te Rangihiroa in Polynesian scholarship, may strike the right note.

In general, reserves of all classes with historic sites should be reviewed as to their classification, and management put in place which recognises the historic values and preserves the sites in a distinctive management regime tailored to site needs, and in many cases, to the desirability of guiding visitors on the site.

5.3 Consolidation of experience of site management

Apart from works by one of us (e.g., Jones, 1988) there continues to be a dearth of detailed accounts of site stabilisation. Given that the original manual (Hamel and Jones, 1982) has been described to us as more a "list of possibilities" for management, rather than principles, this lack will continue to be keenly felt. There is not one single

published study or any other report, for example, of erosion control methods or of felling trees on sites. Examples of such treatment or discussed treatment range from the far north (e.g., Segedin, 1985, where the archaeological values of the site are not even referenced in the report) to Kaiapoi pā near Christchurch and Bendigo near Cromwell, where it is known that extensive tree and other vegetation clearance has taken place in recent years. In the course of our trip we learned of plans to fell trees on pā in Omataroa Forest, near Te Teko (Bay of Plenty), a significant event warranting documentation (which may well be carried out). There is no recognisable centre of expertise in this subject, and individual archaeologists advising on the matter do so to highly-experienced logging operators without any feel for the feasibility or, for that matter, safety of their recommendations. This relies on the good faith of logging contractors and their appreciation of what is trying to be achieved in the protection of the historic values, and in all probability tests their patience, too. We trust that the cases of the Whirinaki River valley pā, and Te Pā o Toi (Tangoio, Hawkes Bay), go some way to make up that deficiency.

5.4 Techniques

In a previous section we discussed weed control, and here we comment on the management of succession; manipulation of understorey and canopy species, structure and character; and finally the indigenous vegetation values that we found on these sites.

The original manual, *Vegetation Management on Archaeological Sites* (Hamel and Jones, 1982: 13), invoked a form a clear-felling of any specimen growing larger than 10 cm d.b.h., particularly kamahi and rewarewa. This quickly came under review in the case of Okuratope (a pā P5/204 (N15/15) in the inland Bay of Islands). A report commissioned by the former Department of Lands and Survey noted, in a discussion of our recommendations in the manual (Hamel and Jones, 1982: 13), that this would mean removal of the broadleaf/podocarp canopy which covered a large part of that site, and, in effect, was a clear-felling of native forest (Segedin, 1985: 12). As we have seen, sites often have botanically interesting features - planted trees (cabbage trees and karaka) or uncommon species (*Olearia pachyphylla*, *Pomaderris rugosa*, *Cordyline pumilio*, *Ackama rosifolia*). The sites will become important refuges as time goes by and surrounding land is used productively (in the commercial sense) and native species eliminated. Archaeological sites, then, are often botanical refuges that could even be used to grow threatened species, if these assisted visibility and were compatible with protection of archaeological features.

Now, we do not fully accept the emotive connotations of the accusation of clear-felling, and we stress that, in the final analysis, the reserve classification ("historic" in the case of Okuratope) establishes the permanent archaeological values. The important issue here is the age of the trees. Cutting out saplings of trees which would grow larger than 10 cm d.b.h. is one solution. Felling all existing trees larger than 10 cm d.b.h. is different. These trees are providing a useful light-screening and erosion-proofing effect, and if ground-level shrub cover is removed, the site will still be visible. The first option limits further archaeological damage from tree growth and retains the existing protective canopy (against erosion, if not light and obviates the need for tractors and/or animals that inevitably damage surface features). The second option removes the canopy, may initiate erosion changes (an emotive issue) and will promote a prolific growth of ground-

level shrubs and, worse, noxious exotic plants where there is a seed-source. What finally matters is the balance between *manageability of* any succession that our 1982 recommendations would have induced, on the one hand, and *deleterious effects* on site stabilisation, on the other.

Where sites are known to have been in forest in the 19th century, native forest appears to offer the greatest protection with least management effort. The difficulty is getting the vegetation to a state where the understorey is sufficiently open to allow observation of the features. Without a true canopy, weeds of various sorts inevitably colonise, e.g., thistles, blackberry, gorse, hakea, barberry, hawthorne, *Pinus radiata* and *P. pinaster,* himalayan honeysuckle (and other vines), and pampas grass. Although some of these may protect a site well in the short term, they lack other values associated with important places in the New Zealand system of reserves. Another key feature is the quantity and quality of the forest litter: rewarewa, mangeao and karaka provide excellent covers that restrict seedling establishment.

The maintenance of grasses is another area of site protection that should be investigated further, along with the use of protective coverings of earth for sensitive features such as sub-surface layers. Sites are best appreciated when in short grass, either grazed or mown. To maintain grass, terrace faces will need hand clearance, e.g., brush wattle hand-pulled as seedlings. However, animals damage the sites, inevitably lead to weed growth, and mowing is expensive and limited to relatively flat areas. A marginal band of weeds can develop which threaten the more natural vegetation, e.g., the phoenix palms, mothplant (*Arauja*) and privet at Whitianga Rock. In this case, greater integration of natural (coastal forest) and manicured (lawn) areas is needed to eliminate the weed border which reduces the value of the site to people.

There is an opportunity to explore the use of native grass swards, tussock or shrub species for specific "engineering" roles, such as the following:

- grasses - *Ehrharta* (*Microlaena*) *stipoides, Rhytidosperma* spp., *Poa anceps, Trisetum antarcticum;*
- sedges - *Moreletia affinis* (dry shrubland) and *Gahnia spp.;*
- mat-forming plants - *Nertera depressa, Acaena* spp.;
- "tussocks" - *Dianella, Microlaena avenacea,* ti rauriki;
- shrubs - *Pomaderris ericifolia, Gaultheria antipoda, Hebe macrocarpa* ;
- also, trees such as mangeao develop a clear understorey and thick litter layer, ideal for long-term protection and interpretation.

Many of the New Zealand native grasses will not compete in a production sward, but have attractive characteristics from the site manager's point of view, being tolerant of heat and dry shade; many of them will establish or out-compete exotics as fertility drops when a site is left alone and unstocked. Their deficiencies are poor resistance to treading (tracks will erode easily) and the difficulty of gathering seed. Trials under the direction of Agresearch are currently under way in Northland.

One of the fundamental objections to tree cover is the potential damage caused by roots. Knowledge of the root systems of NZ plants is often limited and there is a need for specific research in relation to impacts on archaeological sites. An hypothesis might be

offered, however, that "arboriphobia" was not a characteristic of early archaeologists but has, rather, been born out of the necessity of tourism, recreation, visibility for scientific examination (e.g., aerial photographs), and long experience that visibility reduces inadvertent destruction.

We can summarise our experience by noting that:

Value of early successional stages

- native and other grasses can provide medium-term protection against shrubland invasion;
- initial stages of succession, e.g., bracken, gorse, are almost always beneficial to site condition, compared with stocking by animals or large tree growth;
- noxious weed successions are undesirable;
- successions of noxious weeds which obscure sites often lead to site damage by inadvertent or ill-considered bulldozing or other mechanical damage;
- given the success of early successions, including bracken, we believe that later successional stages could and should be manipulated to maintain good canopy cover while at the same time keeping a gallery or open effect at ground level.

Values of indigenous forest cover

- indigenous cover is preferable to introduced because of conservation values, longevity and mana of the cover to tangata whenua and many other New Zealanders;
- however, sites have to be managed cost-effectively, with due respect for local ecological influences (including the character of local weed invasions), and archaeological sites should not be the site of experiments in re-establishing native covers;
- manipulation of site vegetation could consist of deliberate planting or seeding of desirable shrub or tree species (we especially mention taupata, kānuka, mangaeo, kohekohe and rewarewa), all of which allow readily for an open gallery effect and either a leaf litter or low fern cover at ground level;
- undesirable understorey and even canopy trees can often be cut out to give a competitive edge to kānuka, mangaeo, and rewarewa (and other regionally appropriate species) to ensure the gallery effect.

Strategic and cost-effective management

- the fewer the resources to manage with, the longer-term the management should be and therefore the more stable the vegetation should be (native forest).

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Note: The names of soils and rock types have been taken from relevant Soil Bureau reports and the New Zealand Geological Survey 1961 *Geological Map of New Zealand.* The common or Māori names of plants are used wherever possible and the scientific names are derived from *Flora of New Zealand*, and *Standard Common Names of Weeds in New Zealand*, updated on advice of taxonomists in the Science and Research Division.

GLOSSARY

Alluvial soils. Soils formed in sediments deposited by rivers or streams. See also colluvial soils.

Aruhe. Rhizome of the fern, *Pteridium esculentum*.

Bastion. A projecting part of a defensive perimeter, usually a feature of fortifications with straight perimeter lengths greater than about 50 metres.

Breastwork. A bank created for fortification, usually forward of a trench, against which a defender lay or kneeled to fire.

Cabbage tree. *Cordyline australis;* a tree with a distinctive head of broad leaves and bare trunk.

Classic. The later period in pre-European times. Period: approximately A.D. 1500 to 1800 (or 350-150 years B.P.). The cultural practices described by Cook and Banks in 1769 are essentially Classic.

Inner, outer. With reference to defences, the inner side is the side nearest the defenders.

Kingite. Supporter of the King Movement, the first Māori King was Te Wherowhero who became Potatau I.

Kūpapa. Paid Māori troops deployed with the Armed Constabulary.

Lateral ditch and bank. A defensive ditch and bank constructed on the sides of a ridge as part of the defensive perimeter of a pā; such features are often simply a long lateral scarp and narrow terrace.

Lynchets. Small terraces or terrace treads. Sheep lynchets: more or less parallel and level, narrow terraces created by sheep tracking.

Midden. Food refuse such as bone, shells, and oven debris.

Oblique photograph, aerial oblique. A view from an angle less than directly vertical.

Outer, inner. See *inner, outer*.

Pā, pā maioro. Earthwork fortification. The defences may be natural, steep slopes, deliberately steepened scarps, or ditches and banks.

Palisade. Defensive fence of tall posts constructed at the perimeter of pā, with lighter timbers between tall posts. See also *stockade*.

Parallel, demi-parallel. A trench constructed at right angles to the line of a sap, to enable a fuller field of fire against the defenders, or to take outlying positions which threaten the sap.

Perimeter, defended perimeter. The outer defensive line of a pā or other fortification.

Plan, plan view. The view of an archaeological site seen or drawn from directly above; the view in the horizontal plane.

Platform. Open level spaces standing at top of slope, usually in a pā. Tihi: the highest, most prominent platform.

Queenite. Māori supporter of the government, or Queen Victoria.

Raised-rim pit. A semi-subterranean pit, rectangular in plan, with a raised rim and often a perimeter drain. In use, the pit had a roof, perhaps of earth, with a central ridge pole and support.

Redoubt. A European fortification, typically square or rectangular in plan, with a perimeter ditch and bank.

Returns. Changes in direction of rifle trench to stop fire along its lengths.

Rifle trench. Trench for protecting defenders and to fire rifle from; may have *returns*.

Ring-ditch, ring-ditch pā. A defensive ditch enclosing most of a site in a more or less continuous line; the defensive perimeter typically includes a cliff face, but in Taranaki, for example, on lahar mounds, the perimeter may be fully constructed.
Rua. Kūmara storage pit; in archaeologist's sense, a fully subterranean pit, usually bell-shaped in section with a narrow opening at the ground surface.
Sap. A trench dug to bring attacking troops up to a defended position.
Scarp. The artificially steepened slope forming the downhill or uphill slope of a terrace or a ditch and bank. See also counter-scarp.
Section. The view of a vertical cut through an archaeological site; the view in the vertical plane. See also *plan.*
Stockade. A defensive perimeter made of solid upright timbers and with loopholes for firing through; may also be constructed with an exterior ditch.
Stratigraphy. The layers of an archaeological site. Vertical stratigraphy shows the sequence in which the site was laid down; horizontal stratigraphy shows the pattern of activities on a surface, for example, a house floor.
Terrace-risers. The uphill or downhill scarp of a terrace.
Terrace-tread. The flat part of a terrace.
Tihi. See *platform*.
Transverse ditch and bank. A defensive ditch and bank constructed across a ridgeline.
Whare. House.

APPENDIX 1 List of common names of plants mentioned in the text

akeake	*Dodonaea viscosa*
astelias	*Astelia* spp., *e.g*., *A. trinervia*
barberry	*Berberis spp., e.g., B. darwinii*
blackberry	*Rubus spp., R. fruticosus, R. laciniatus*
black ponga (see māmaku)	*Cyathea medullaris*
boxthorn	*Lycium ferocissimum*
bracken	*Pteridium esculentum*
broom	*Cytisus scoparius*
browntop	*Agrostis capillaris*
buffalo grass	*Stenotaphrum secundatum*
cabbage tree	*Cordyline australis*
clover, subterranean	*Trifolium subterraneum*
clover, white	*Trifolium repens*
cocksfoot	*Dactylis glomerata*
coastal five finger (see houpapa)	*Pseudopanax lessonii*
convolvulus	*Calystegia turguriorum*
convolvulus (native)	*Calystegia arvensis*
coprosma	*Coprosma* spp.
couch grass	*Agropyron* spp.
cow parsnip	*Heracleum* sp.
crested dogstail	*Cynosurus cristatus*
danthonia	*Rhytidospermum* spp.
Douglas fir	*Pseudotsuga menziesii*
elderberry	*Sambucus nigra*
five finger (see whauwhau)	*Pseudopanax arboreus*
flax	*Phormium tenax, P. cookianum*
foxglove	*Digitalis purpurea*
fuchsia, tree	*Fuchsia excorticata*
gorse	*Ulex europaeus*
Hall's totara (kotukutuku)	*Podocarpus hallii*
hangehange	*Geniostoma ligustrifolium*
hard tussock	*Festuca novaezelandiae*
hemlock	*Conium maculatum*
houpara	*Pseudopanax lessonii*
ice plant	*Mesembryanthemum* sp.
inkweed	*Phytolacca octandra*
ivy	*Hedera helix*
kahikatea	*Dacrycarpus dacrydioides*
kāmahi (tawhero)	*Weinmannia racemosa*
kanono	*Coprosma grandifolia*
kānuka	*Kunzea ericoides*
kawakawa	*Macropiper excelsum*
kikuyu grass	*Pennisetum clandestinum*
kohekohe	*Dysoxolum spectabile*
kohuhu	*Pittosporum tenuifolium*
koromiko	*Hebe salicifolia* and *H. stricta*

kūmarahou	*Pomaderris kumeraho*
lancewood	*Pseudopanax crassifolium*
Lombardy poplar	*Populus nigra* var. *italica*
lotus	*Lotus pedunculatus*
lucerne	*Medicago sativa*
lupin	*Lupinus arboreus*
macrocarpa	*Cupressus macrocarpa*
māhoe	*Melicytus ramiflorus*
māhoe-wao	*Melicytus lanceolatus*
mamaku	*Cyathea medullaris*
mangeao	*Litsea calicaris*
mānuka	*Leptospermum scoparium*
marram grass	*Ammophila arenaria*
māpau	*Myrsine australis*
marbleleaf - see putaputaweta	
matagouri	*Discaria toumatou*
matai	*Prumnopitys tavifolia*
mingimingi	*Leucopogon fasciculatus*
ngaio	*Myoporum laetum*
nīkau	*Rhopalostylis sapida*
pampas grass	*Cortaderia selloana*
pepper tree	*Pseudowintera colarata*
periwinkle	*Vinca major*
piripiri	*Acaena* sp.
podocarp	*Podocarpaceae*
pōhutukawa	*Metrosideros excelsa*
ponga	*Cyathea dealbata*
poroporo	*Solanum aviculare, S. laciniatum*
pūriri	*Vitex lucens*
putaputaweta	*Carpodetus serratus*
rātā	*Metrosideros robusta, M umbellata*
rangiora	*Brachyglottis repanda*
rewarewa	*Knightia excelsa*
rimu	*Dacrydium cupressinum*
ryegrass	*Lolium perenne*
Spanish heath	*Erica lusitanica*
speargrass	*Aciphylla* spp.
spinach, native	*Tetragonia tetragonioides, T. trigyna*
spinifex	*Spinifex hirsutus*
sweet briar	*Rosa rubiginosa*
Tasmanian blackwood	*Acacia melanoxylon*
tauhinu	*Cassinia leptophylla*
tawa	*Beilschmiedia tawa*
tī	*Cordyline* spp.
toetoe	*Cortaderia* spp.
tōtara	*Podocarpus totara, P. hallii*
tree fern	spp. of *Dichsonia* or *Cyathea*
tree tobacco	*Nicotiana glauca*

tutu	*Coriaria arborea*
Viper's bugloss	*Echium vulgare*
wattle, brush	*Paraserianthes lophantha*
whārangi	*Melicope ternata*
whauwhau	*Pseudopanax arboreus*
whiteywood (see māhoe)	
willow	*Salix* spp.
wineberry	*Aristotelia serrata*