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ARCHAEOLOGICAL SITE STABILISATION AND VEGETATION MANAGEMENT. CASE STUDIES II: AUCKLAND AND NORTHLAND, OTAGO AND CANTERBURY, AND WELLINGTON

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ABSTRACT

Case studies additional to those of *Archaeological Site Stabilisation and Vegetation Management. Case Studies 1* (Science & Research Report No.84) are reviewed. The three vegetation covers recommended for sites are: (a) grazed or mown grass swards; (b) early succession bracken or shrubland; and (c) forest canopies with manipulation of understorey to maintain a gallery effect. Suitable native shrubland 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. Meadow rice grass (*Ehrharta stipoides*, pātītī) is a drought-resistant cover, tolerant of light or open shade, which can invade ungrazed exotic grasslands. However, it does not compete in full sun with subtropical grasses such as kikuyu (*Pennisetum clandestinum*). Also, its seeds are difficult to gather and sow and it is not resistant to trampling. Current work on cultivars may solve these problems.

1. INTRODUCTION

This report is the second of two spanning different parts of New Zealand. In the first, the archaeological sites in the Bay of Plenty and on the Coromandel Peninsula which were the case studies of Hamel and Jones (1982) were re-visited. The 1981 management recommendations were re-assessed and new management prescriptions written where necessary. Both reports record field observations on specific sites, some of which may be used as case studies for identifying detailed management strategies, while the overall experience will contribute to the formulation of a set of guidelines for vegetation management on archaeological sites.

The intent of this report is to promote wider discussion of our observations and recommendations. Vegetation depends on former and present land use, proximity to human settlement, and degree and nature of management. In the revised manual of guidelines, we will be outlining a much fuller set of principles and techniques. Here, we stress: (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 as is appropriate for the character of the site.

2. BACKGROUND

The principles relating to managing vegetation cover to ensure site stabilisation follow those of the earlier report (Jones and Simpson, 1995).

Intervention in the management of a site will depend on its land classification and anticipated level of use. Broadly, the site may be protected for:

- public access and appreciation;
- research potential;
- natural or historic values;
- a wāhi tapu (sacred site) under ss. 32-33 of the Historic Places Act 1993 or an archaeological site reserved for Māori purposes under ss. 338-340 of the Maori Land Act (Te Ture Whenua Māori) 1993.

The international ICOMOS (Venice) and ICOMOS New Zealand charters, and their guidelines, place great stress on the decision on whether or not to intervene. Relevant features are:

- review of the condition and cultural or scientific values of the site prior to intervention;
- management intent - what is being sought by intervention and site management;

- likelihood of change in site condition with no intervention;
- 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, ecological processes;
- public attitudes toward intervention - is public education or information necessary?

Figure 1 shows the range of effects that vegetation has on site stability. A balance is needed between, on the one hand, the surface soil conservation value of shrubs and trees and, on the other, their destructive effects on sub-surface archaeological layers. Many archaeologists would prefer to see widespread grass ground covers, although these, as we shall see, provide some difficulties in planning and maintenance under most New Zealand conditions.

One of the great difficulties is to determine the need and timing of intervention in the course of slow regeneration towards treelands. The site may be 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. Early stages of succession may be best for the site because they minimise root intrusion into the sub-surface archaeological layers.

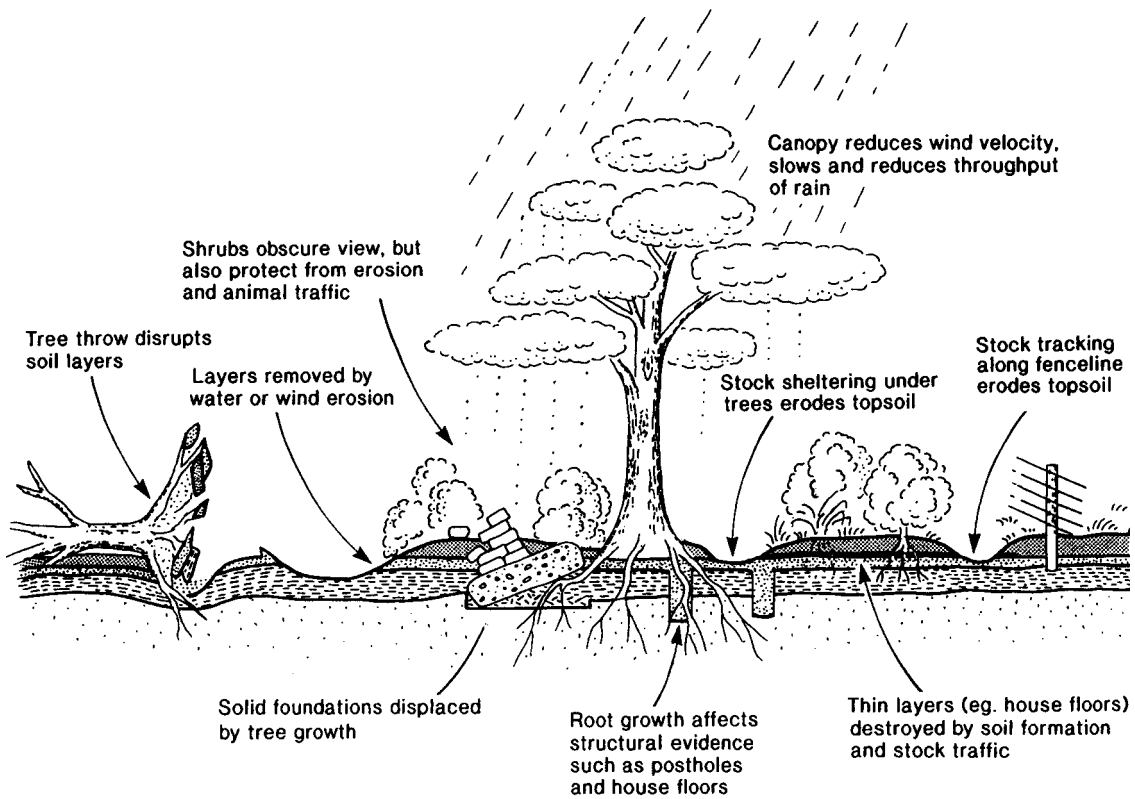


Figure 1 Effects of vegetation on site stabilisation.

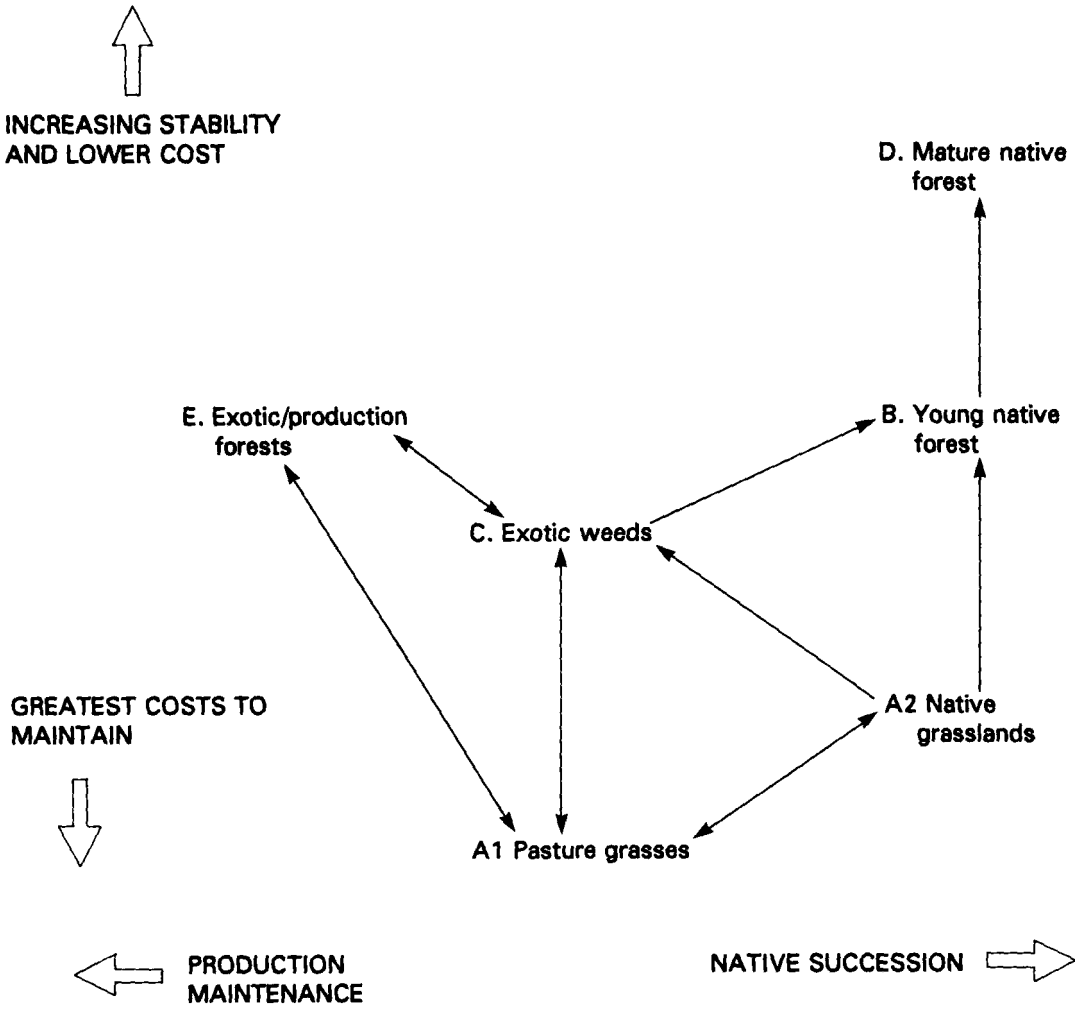


Figure 2 Various options for maintaining vegetation on sites (the alphanumerics refer to the following figures).

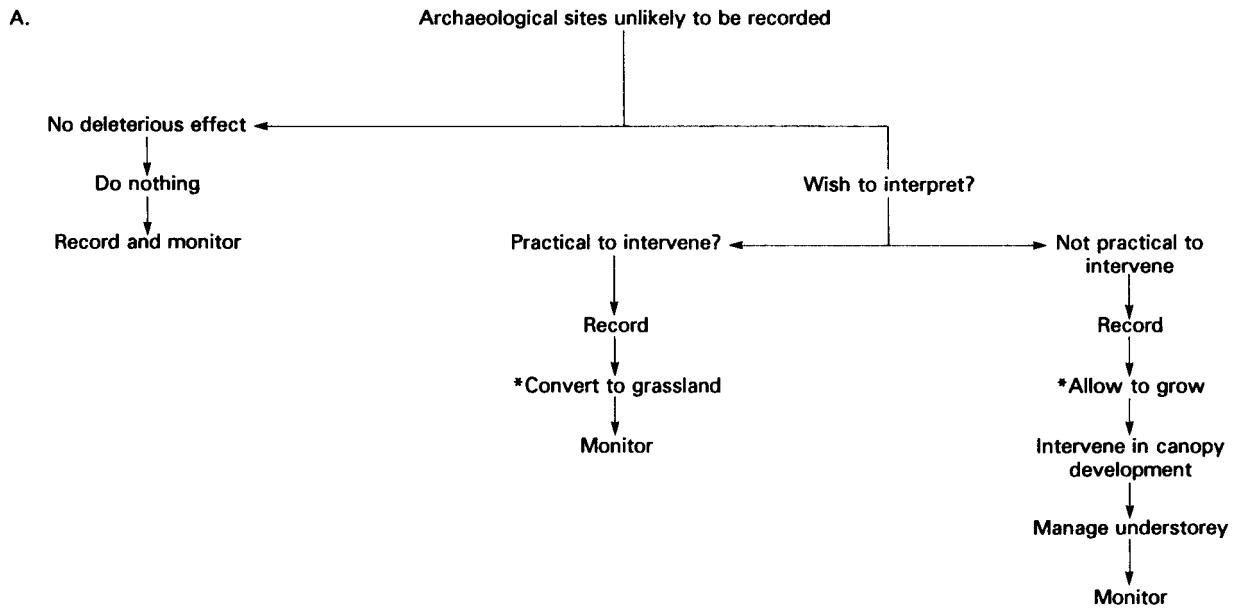


Figure 3 Early native succession.

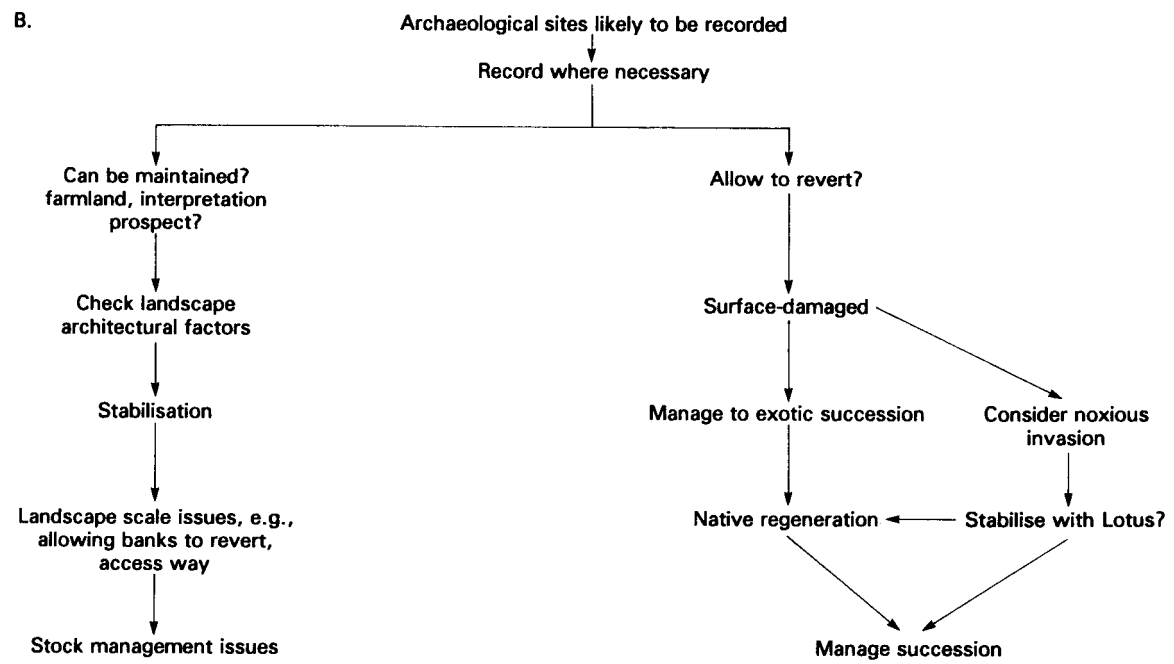


Figure 4 Grasslands.

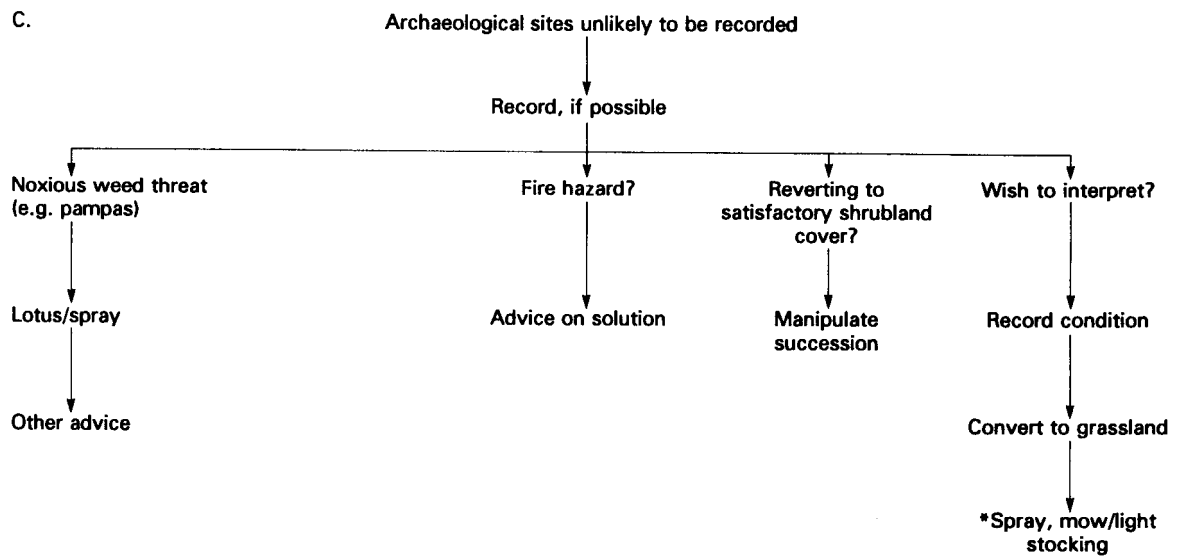


Figure 5 Exotic weeds or early native succession through exotic weeds.

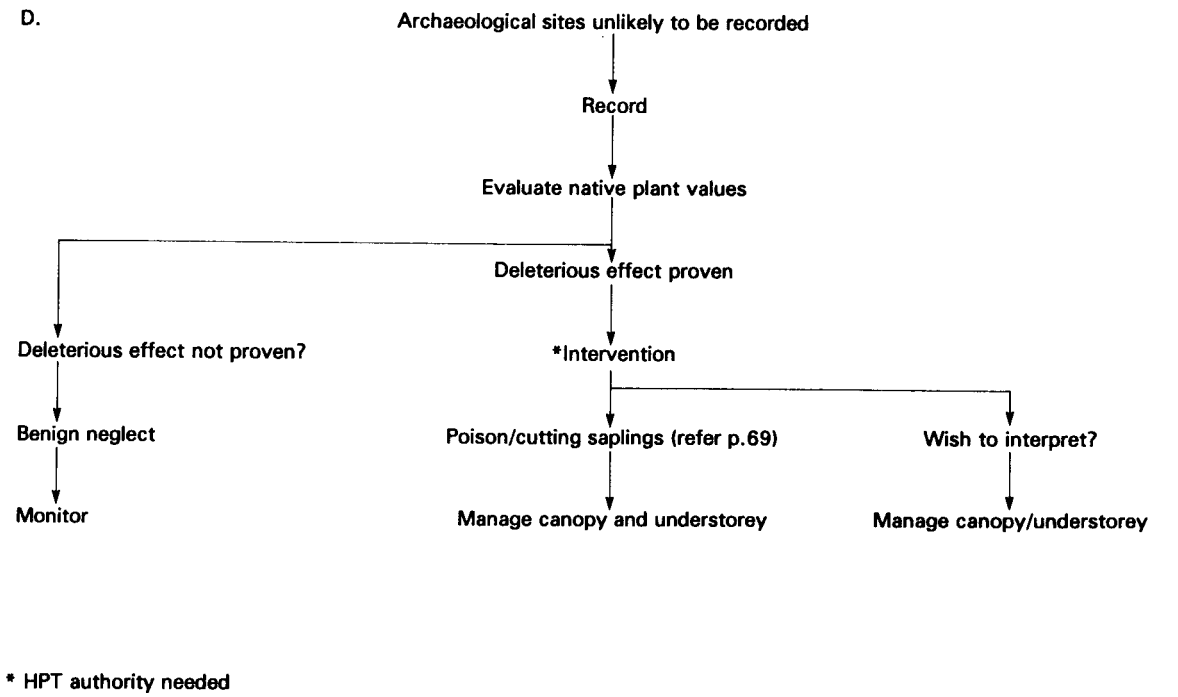


Figure 6 Mature native forest.

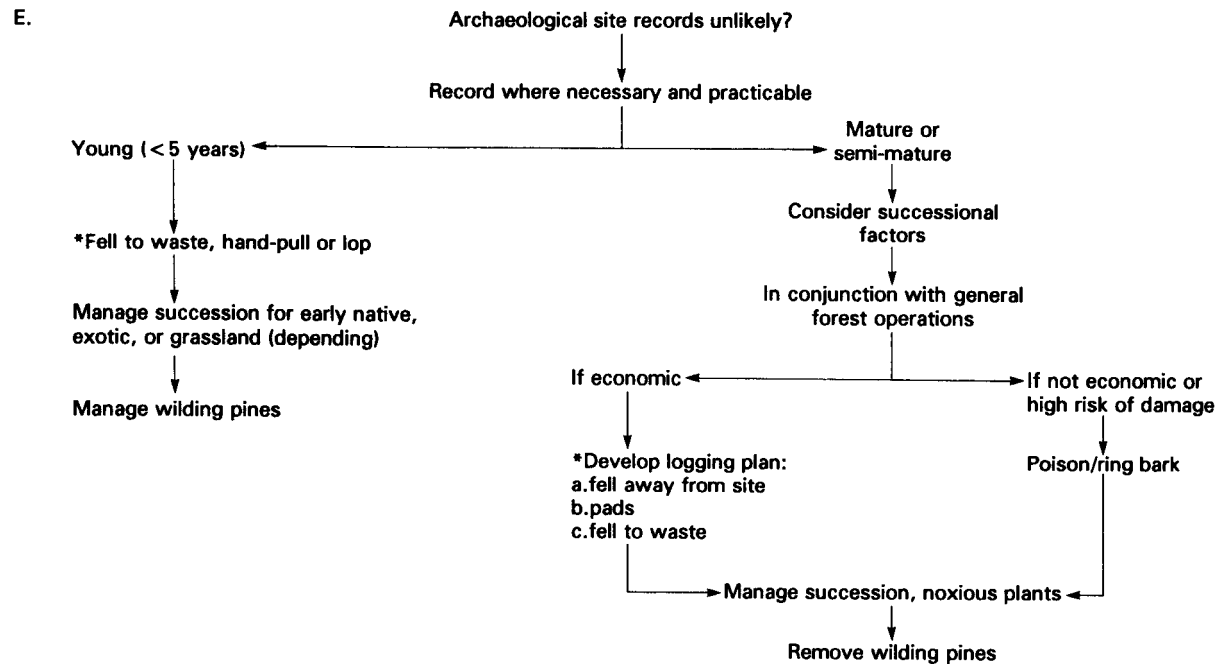


Figure 7 Exotic commercial or farm forest.

However, an early succession is potentially expensive to maintain in that state. In the more stable later stages of succession the historic site loses visibility and access and the forest may be perceived to have intrinsic nature conservation values. In addition, the successional process is inoffensive because it reduces noxious weeds and readily combustible fuel load.

Figures 2-7 summarise our current thinking on stabilising the condition of sites through the use of vegetation. They are presented as decision-making models and cover five broad cases (Fig. 2):

- early native succession (Fig. 3), 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. 4), 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" and/or native grass re-generation;

- exotic weeds or early succession (e.g., gorse) (Fig. 5), where there may be expensive control solutions, or where non-intervention may be appropriate;

- mature native forest (Fig. 6), where intervention to manage the succession of canopy species, and the vegetation on the forest floor may be necessary;

- exotic commercial or farm forest (Fig. 7), where the trees may be felled to waste, or where quite specific felling plans are needed to avoid damage to the site.

Hamel and Jones (1982) had argued for sites to be maintained in, or converted to, grass with grazing by sheep or mowing. On sites with an advanced shrubland succession, felling of any shrub or young tree with greater than 10 cm d.b.h. (diameter at breast height) was recommended. For reasons which will be more fully argued in the case study on Okuratope (3.6 below) this view is no longer tenable (see also Jones and Simpson, 1995: 114; Segedin, 1985). 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.

All these decision-making models and recommended practices are in preliminary form only, and are put forward here for discussion and comment. They will be more fully discussed and justified in the revised manual. We also plan to develop guidelines for sites under specific land management regimes, especially reserves, farms and exotic forests.

3. CASE STUDIES: AUCKLAND AND NORTHLAND

This section describes a range of selected sites mostly on land managed for conservation purposes under the Conservation Act 1986. The entries are arranged by district. Figure 8 shows sites and localities visited.

The site descriptions include: site name, site record number in the New Zealand Archaeological Association site recording scheme (metric number followed by the Imperial number in brackets), grid reference, rainfall, soil and rock type, topography, archaeological nature of the site, details of the vegetation on the site and adjacent to it, current and recommended vegetation management procedures and opinions of local managers. The management regime discusses species that will be dominant in the natural or managed succession. Non-dominant species are discussed only if they are rare or have particular conservation value that will, or may, be affected by our recommended management practice.

AUCKLAND

3.1 Orākei pā, RII/87 GR 716804 (N42/80).

Occupied by Ngāti Whātua, the pā appears to have occupied an elevated part of a ridge line terminating in the opening in the north of the basin. The general pattern is that of a ridge pā with a former transverse ditch to the south across the levelled ridge crest, now marked only by a section of the ditch leading down the slopes to the north-west. To the south-east, the same ditch is just able to be detected on the upper edge of the vertical face of the tuff ring. The northern transverse defences are no longer obvious, although the ridge slopes down just outside Auckland City Council land (on to land belonging to New Zealand Rail, Ltd.). A ditch has been recorded there but we saw no trace of it. The crest of the ridge appears to have been cultivated and levelled post-occupation and, apart from attenuated terraces on the highest point, features are few. This area, about 180 x 10-20 m in plan, is in mown grass. On the margins to the north-west, are several broad terraces sloping down to and below Orākei Road. On the south-east, the platform drops some 2-3 m sheer over the tuff-ring edge, which is in remarkably good condition, to a talus slope and then slopes down steeply approximately 15 m to one large terrace (80 x 15 m) and several smaller terraces. Below this again is the narrow Auckland City Council road to the Orākei Basin, with a steep, ill-formed batter exposing up to 100 cm depth of midden on the uphill side, and a narrow strip of re-claimed flat land leading to the water.

Site management

The crest of the ridge is maintained in mown grassland. The flanks and adjacent foot-slopes are predominantly covered in Chinese privet (*Ligustrum sinense*) forest. The outer flank is very steep and supports a thicket of mostly young Chinese privet, while the inner flank (steepened by the building up of the tuff rim at the top) supports mature privet forest about 10 m tall, with scattered indigenous trees. The forest has been heavily thinned and now exists as an attractive "gallery forest" with a semi-closed

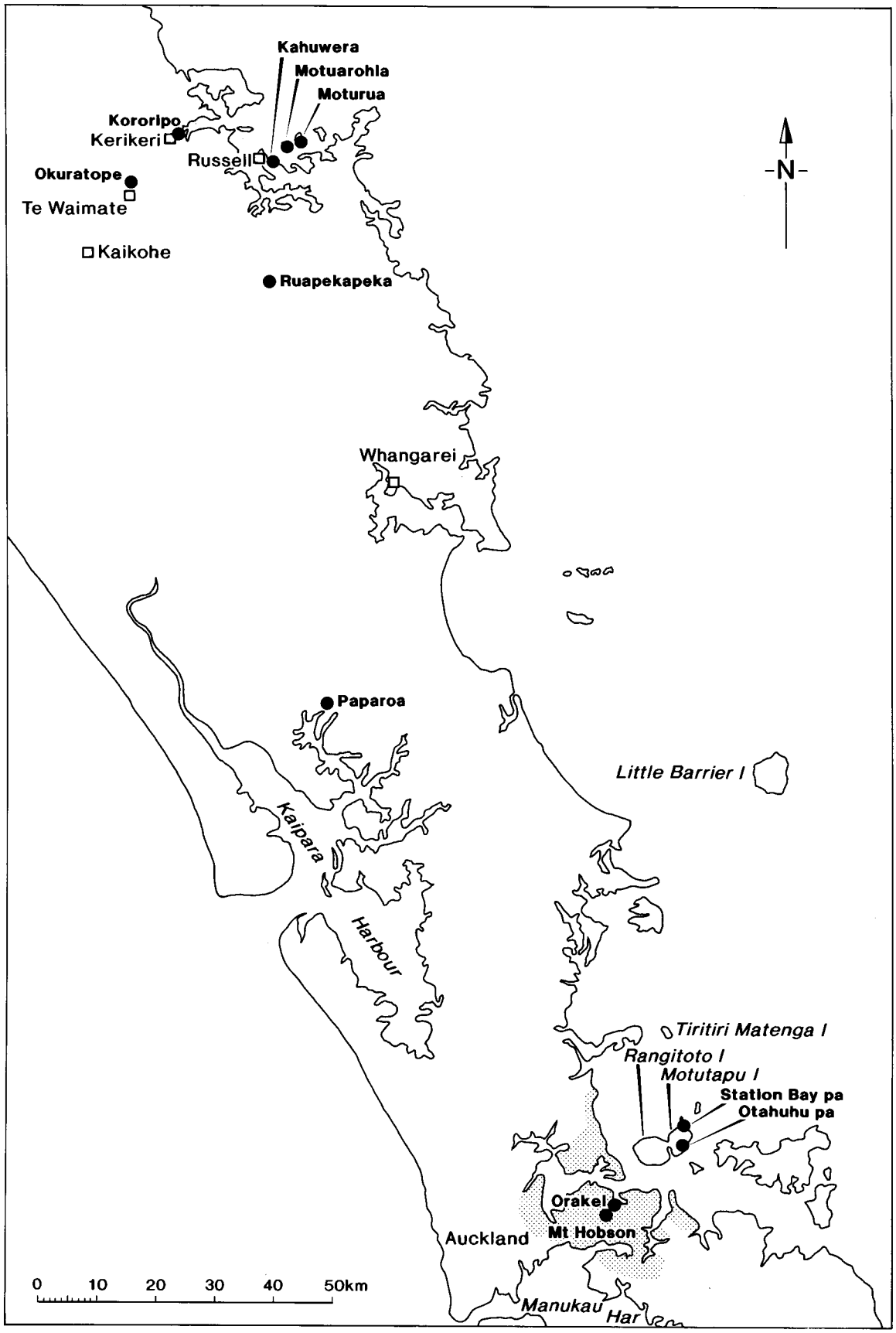
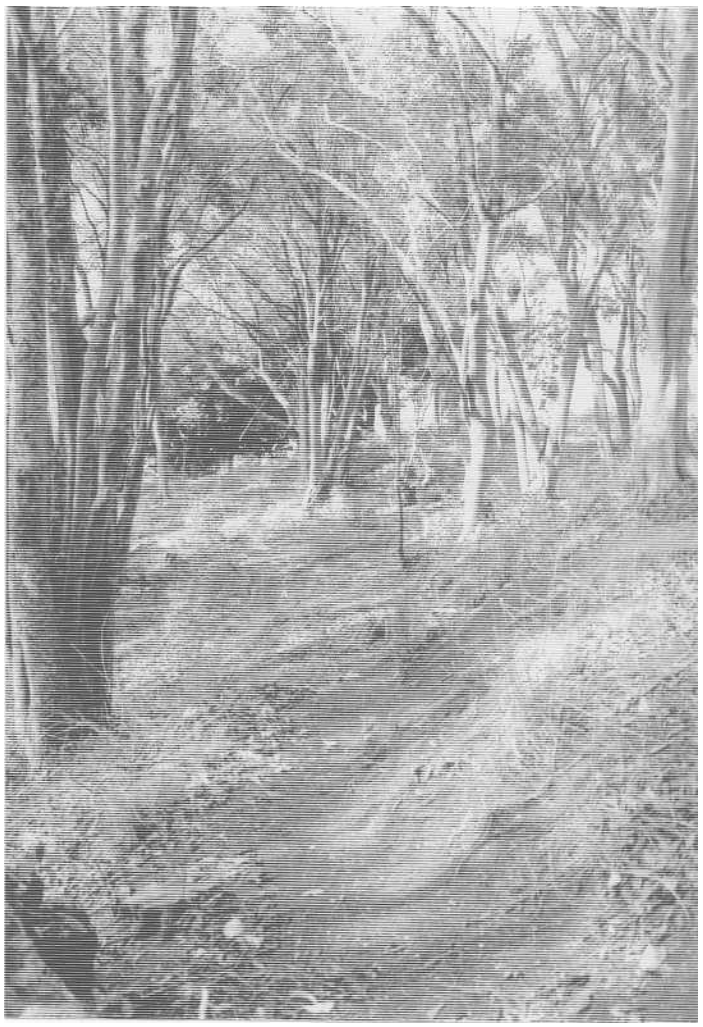


Figure 8 Localities and sites visited, Auckland and Northland.

canopy, ascending clean trunks, and an open understorey. Privet seeds prolifically and its seedlings are tolerant of deep shade, and can out-compete desirable shrub and canopy tree species. This particular site is a good example of privet's ecological dominance if left alone. The Council's intention is to control and eventually eradicate the privet and to establish a native forest or shrubland. On the north-west slopes the procedure has been to slash the bark and paint with a systemic weed-killer, letting in enough light to allow native shrubs to come away without clearance of the privet (which are here more in the form of tall shrubs, 4-6 m high). To the south-east, the privet is of forest size (10-15 m); it has been selectively cleared, leaving about 40% of the original canopy, and the initial re-growth has been sprayed to kill the privet suckers between the remaining trees (Fig. 9).

This process has revealed the large terrace of the south-eastern side, which may have comprised as much as 40% of the available area of the original pā, and is as much as 80% of the surviving intact pā features. On the advice of the Auckland Conservancy, native tree seedlings with the potential to be large trees were removed from the main flanking terrace.

Figure 9 Privet (Ligustrum sinense) "forest" thinned to allow growth of underplanted indigenous species. The long-term plan is to remove privet completely and prevent re-seeding.



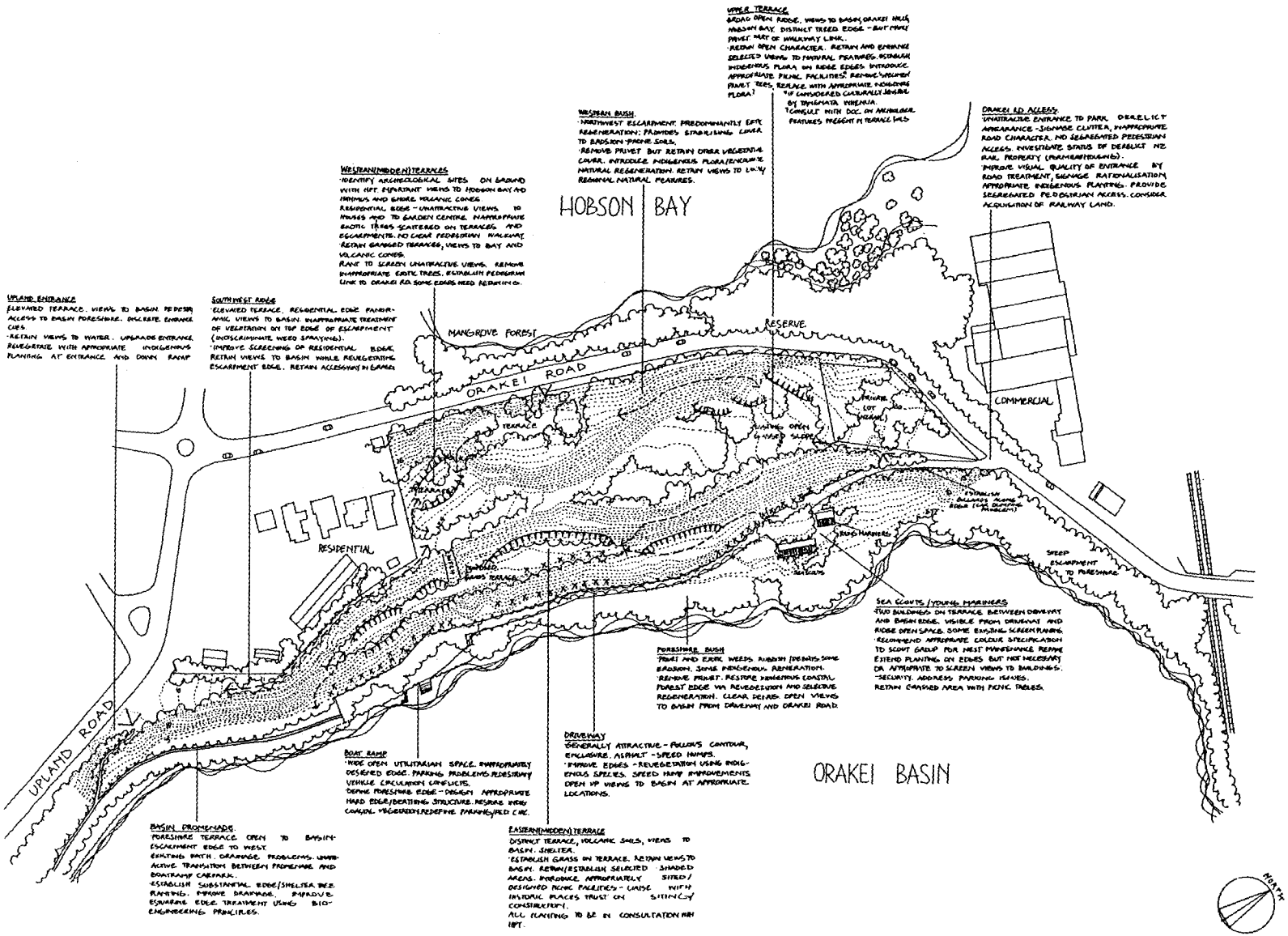


Figure 10 Landscape plan for Orakei pa (R11187). Original drawing courtesy of Auckland City Council.

Native trees and shrubs that were scattered through the privet have responded well to the thinning - they include māhoe, karamu, taupata, houpara, pōhutukawa, karaka, kawakawa, karo and whau (possibly planted). This assemblage indicates that the natural vegetation of the site is coastal forest which, given the regional setting, would be pōhutukawa with a broad-leaved understorey and margin.

Natives which are being planted include ngaio, which is especially vigorous and will form a closed cover within a few years, cabbage trees of mixed provenance and kowhai (which occurs naturally nearby). There will always be a ground cover that includes introduced plants (from the surrounding urban area) that will require management. An introduced Australian sedge (*Carex divulsa*) is common (perhaps relating to the dry, friable volcanic soil), and shining spleenwort (*Asplenium oblongifolium*) could be encouraged to form a ground cover.

Management ideas

On an earlier occasion one of us (KJ) had discussed a landscape plan with Nicholas Chinn (horticultural manager) and Richard Bollard (architectural services planner) of the Auckland City Council. We concluded that the large south-eastern terrace should be grassed while the balance of the slopes should be kept in an open cover of privet and allowed to revert to trees such as karaka (some of which survive on the terrace margins). Most of the terrace would then be in open grassland, with the margins and steep scarps elsewhere reverting to a shrubland or forest. The effect would be to increase open flat areas adjacent to an intensively used area of the basin, while keeping a key area of the site under grass or other low native plants such as ferns. Scarps, especially below the large terrace (to the road) and above it (to the tuff ring), would be kept in a low shrubland. The general approach is as shown in Figure 10. This planting pattern also reveals the geological features more clearly.

The overall management plan of removing privet and replacing it with native species is supported; maintenance of the platform in mowed lawn seems appropriate, but some restoration of the tranverse ditch and bank might help interpretation.

Long term, a fringe of pōhutukawa forest around the key site features will protect the slopes, conform to the mana of the place, and allow viewing by visitors, especially if a dense shrub layer (e.g., kawakawa) was kept to a minimum. Planting of trees of random provenance (e.g., cabbage trees and Tasmanian ngaio) should not continue. Existing ngaio can be managed in the long term to assist the recreation of pōhutukawa forest. Certain introduced ground cover plants (e.g., the sedge, *Carex divulsa*), while performing a valuable soil protection function at present, might in the long term be replaced by appropriate natives such as shining spleenwort (*Asplenium oblongifolium*) or native sedges such as C. *testacea* or C. *flagellifera*.

Chinese privet is common around much of the Orākei basin rim, and a long term plan to remove it is necessary to reduce the incidence of re-colonisation. Chinese privet forest is well suited to soil protection and appears to possess an allelopathic (chemical) retardation of other plants so that an under-canopy gallery effect is created, consistent

with visitors' needs for viewing pā features. However, the invasive character of the seedlings, the allegedly asthma-inducing pollen, and the non-indigenous origin together indicate the desirability of its complete removal in the medium term.

Orākei pā is the subject of an ambitious, and to an extent experimental, programme of managing and eliminating privet by re-creating the conditions for native shrubland and fern/grassland succession. Provided the correct pattern of open terraces, including the broad ridge line, and a regenerating shrubland on slopes can be established at acceptable cost, it provides a good balancing of ecological process, erosion protection, archaeological site conservation, and a visible model for potential work elsewhere on the Auckland volcanic cones.

3.2 Mount Hobson, R11/16 GR699788 (N42/8).

This volcanic cone pā, shaping the slopes and crest of Remuera, has lost virtually all its indigenous cover. The vegetation consists of grazed grassland over the crest and upper slopes, sometimes covering modern (e.g., the covered reservoir) and Māori earthworks. There is a woodland of trees forming an arboretum, sometimes with a weedy shrub understorey, around the lower slopes. The whole cone is completely surrounded by cityscape.

The slopes are generally steep, with an abrupt break to the pre-European Māori defensive terraces and features at the crest. There are some further terraces towards the head of the slopes. Soil is a friable, volcanic loam, easily disturbed by grazing cattle (the cattle are preferred over sheep because of theft of the latter).

The grassland is mixed native danthonia (*Rhytidosperma* sp.), meadow rice grass (*Ehrharta stipoides,* pātītī), cocksfoot and rye-grass. In general it is unstable, with tracking, turf breakage and overgrazing revealing the soil. Rye-grass appears to perform better than cocksfoot in stabilising the soil surfaces, perhaps because the latter grows better on slopes which suffer erosion from cattle trampling. Small patches of kikuyu grass are becoming established. While better suited to the hot, dry soils there may be an argument to eliminate it before it becomes dominant. Grazing pressure is unacceptably high, especially on the flanking slopes, where there is much disturbance of soil and downward creep of the soils beyond an acceptable degree of lynchet (small terrace) formation.

The tree-scape holds intrinsic interest because of the wide variety of mature trees - oaks, elms, pines, fir, cypress, fig, olive, among others. Unfortunately the cypress (*Cupressus macrocarpa*) in particular are unstable and several have already fallen, causing damage to the soil. Scattered pōhutukawa and pūriri indicate that a tree-land within grassland is an attractive and useful vegetation cover for both soil stability and visitor amenity. Where trees have fallen there has been the establishment of shrub weeds such as woolly nightshade (*Solanum mauritianum*), jerusalem cherry and privet.

Management

Mount Hobson is broadly representative of the stabilisation problems of many of the Auckland volcanic cone pā. It is subject to visitor pressure, has many potentially harmful plant species escaped from domestic gardens, erratic grazing, inappropriate tree vegetation and, above all, no satisfactory means to maintain grassland on the archaeological features. The latter still need to be kept open in large part because of the potential landscape views (to and from the site), the need to be able to view the archaeological features, and the need to protect the archaeological features from root invasion. Essential steps to take are:

Landscape evaluation

- Re-survey archaeological features to determine which should be retained in grassland for site conservation, landscape visibility and practicable mowing regimes.

- A detailed evaluation of archaeological features and their desirable degree of visibility to visitors, and an appropriate re-vegetation plan developed with a view to reducing various negative features and the stocking pressure.

- Define areas into which appropriate native trees may be planted to create a fairly open treeland but one not subject to weed invasion.

- Define those areas which can be allowed to revert to a low shrubland/flax/fern cover, to be managed by a "weed-eater" perhaps on a two-year cycle - such areas to include steep, otherwise unmowable scarps of archaeological features.

- Determine the overall pattern of the above factors to allow for public and mowing-machine access, and to provide an acceptable accidental-fire control procedure.

Detailed management

- Grazing should be restricted: to the ridge crests, by fencing; to certain seasons, i.e., only late spring and autumn; and in intensity. Much of the kikuyu grass could be removed, if feasible, and native grasses requiring low maintenance, such as meadow rice grass (*Ehrharta stipoides*), could be encouraged instead. On level or near-level areas, mowing should be used instead of stock-grazing on the areas defined from the landscape evaluation.

- Advice should be sought on means to enhance the establishment of the native grasses - mowing or grazing at the wrong time may make establishment difficult (see also appendix 1);

- Following evaluation of archaeological, landscape and visitor values, any proposed fenced-out steep slopes, currently suffering stock damage, should be planted out in an appropriate cover of low shrubs or trees, of suitable provenance.

- On areas to be kept in grassland, mowing should be instituted, with blade settings at a minimum of 10 cm, or more depending on whether surfaces are convex or not. An attempt should be made to establish native grasses which will adapt well both to the arid ridges, and to the semi-shade of the areas of open forest which is recommended.

- A treeland (scattered trees in grassland) of pōhutukawa and pūriri would be consistent with original vegetation, Māori values, soil protection and amenity

usefulness. These species could be planted in designated areas with the objective of enhancing existing treeland areas.

- Unstable trees within the "arboretum" could be removed before they disturb the soil. A stable grassland-treeland would tend to restrict invasion by woody weeds.

- There are several intrinsically interesting ecological features (epiphytic indigenous orchid on an elm, regenerating olives, and the isolated urban population of rabbits which, however, need to be kept at a low population level) that make the area appropriate for walkway interpretation, in addition to the remarkable geological and Māori history and landscape values. The rabbits, however, may need to be removed on the grounds of damage to the archaeological site.

3.3 Motutapu Island

3.3.1 Landscape considerations

The broader landscape issues on Motutapu have been widely debated in recent years (Esler, 1978; Miller *et al*., 1994; Department of Conservation, 1993a). This report is not the place to further this general debate, except for some remarks about particular forest remnants and about what is happening to the grassland, shrubland and forest successions of a few important sites. These remarks should give pointers to how ground covers will behave in other places when grazing pressure ceases.

Most of the island is in grass and has been intensively grazed for many decades until quite recently. Parts of the island's coastal perimeter have been fenced for some years to exclude stock from valuable steepland and cliff forests and shrublands. Currently the fencing line is being re-aligned further inland in places to allow improved prospects of forest re-generation, and to protect the many important historic sites (e.g., pā on headlands) of the coastal perimeter.

Most of Motutapu is covered by an unstable vegetation cover dominated by annual and perennial grasses, extensive or intensive patches of herbaceous or semi-woody weeds. Small valley or coastal fringe patches of coastal forest and valley floor wetlands (dominated by introduced perennial grasses) are scattered over the island.

Near Home Creek Station a gully remnant provides an example of the degenerative processes that have been operating on Motutapu - and, significantly, the range of species forming the presumably original forest. Observations of a limited nature reveal an obvious contrast between the pōhutukawa and coastal broad-leaved forest: the former consists generally of very large trees, the latter is seemingly uniformly aged secondary forest. The original forest was almost exclusively pōhutukawa (as is Rangitoto today). This has been progressively cleared, first by Māori, later by European farmers, and has not regenerated, probably as a result of browsing by wallaby, possums and stock. Gully forests have established in comparatively recent time, probably during the transition from Māori ownership 100-150 years ago or even more recently. The species include taraire, mangeao, pūriri, rewarewa, tōtara, kohekohe, karaka, māhoe, porokaiwhiria, tawa, and tawapou, with a few māmaku, ground ferns and scattered kawakawa. This forest type is degenerating rapidly. A grove of very large pōhutukawa on the adjacent ridge is largely a wasteland of dead, wind-broken trees. The whole shows the debilitating impacts of exposure of the understorey to cold wind, the lack of regeneration caused by animal grazing, and canopy destruction by possums. The presence of many current-season seedlings of totara, tawapou and taraire indicate that regeneration would be rapid if conditions were suitable.

Exotic species issues

At Home Creek the grounds support specimens of exotic trees (pine, fig, *Araucaria* sp., and others). Scattered over the island are specimen trees of Norfolk Island pine (*Araucaria excelsa*). In general these should remain because of their distinctive

taxonomic affinity with the New Zealand kauri. In several gullies thickets of exotic (willow, cypress) and native (tōtara) trees have been planted. Most of these can be integrated into the island landscape, but some (e.g., golden macrocarpa), because of their bizarre effect, are entirely unsuited. It is important not to genetically "pollute" Motutapu any further. *Hebe stricta* has been planted on a hill-slope overlooking a gully wetland near the causeway but is naturally common only on rocky ground adjacent to Rangitoto.

There are a number of potentially harmful weeds such as the moth plant (*Araujia*), *Solanum mauritianum,* Apple of Sodom and Italian buckthorn *(Rhamnus alaternus).* In general a policy of containment of troublesome weeds should be practised. There are parts of Motutapu that have a dense growth of *Rhamnus,* especially beneath an open forest canopy (induced) or around artificial bush margins. It is pointless to remove these because the exposed site will immediately be colonised by more weeds. On the other hand, they might be used in an ecologically sensible manner as part of a succession. Experiments could be initiated into establishing a desirable indigenous plant succession within swards of Apple of Sodom or *Rhamnus* that will eventually overtop and eliminate them. However, it would be highly desirable to contain damaging weeds in areas they now occupy and gradually restrict them further by reducing them at the margins as resources become available. Hence, any Apple of Sodom or *Rhamnus* that might become established at Station Bay pā (see below) should be removed.

It is most important to have an accurate map of archaeological sites so as to avoid planting species that would be injurious to these sites. For the most part the sites have already been compromised by farming and many of them are very difficult to identify.

3.3.2 Station Bay pā, R10/26 GR 828933 (N38/25) (Fig. 11, 12)

The features of this pā were described by Davidson (1972):

> A well preserved transverse ditch... forms the principal defence. This ditch continues for a short distance as a lateral defence on the western side. The largest flat area on the site is immediately inside the ditch. A series of small terraces leads down on either side and up towards the *tihi*. . . which is a relatively small area surrounded by a scarp on all sides. On the south side of the *tihi* is a particularly high and steep scarp, below which is a terrace similar to but slightly smaller than the *tihi* and bounded on its south side by a second shallower and eroded transverse ditch. Beyond this a long narrow gently sloping area, with a number of indeterminate features, extends southwards, becoming steeper and narrower, until it drops away in a steep razor-backed slope to the rocks below.
>
> Immediately north of the principal defensive ditch is an apparently truncated terrace, which gives some suggestion of continuing down the western slope as a possible earlier ditch. North of this terrace are three large pits....

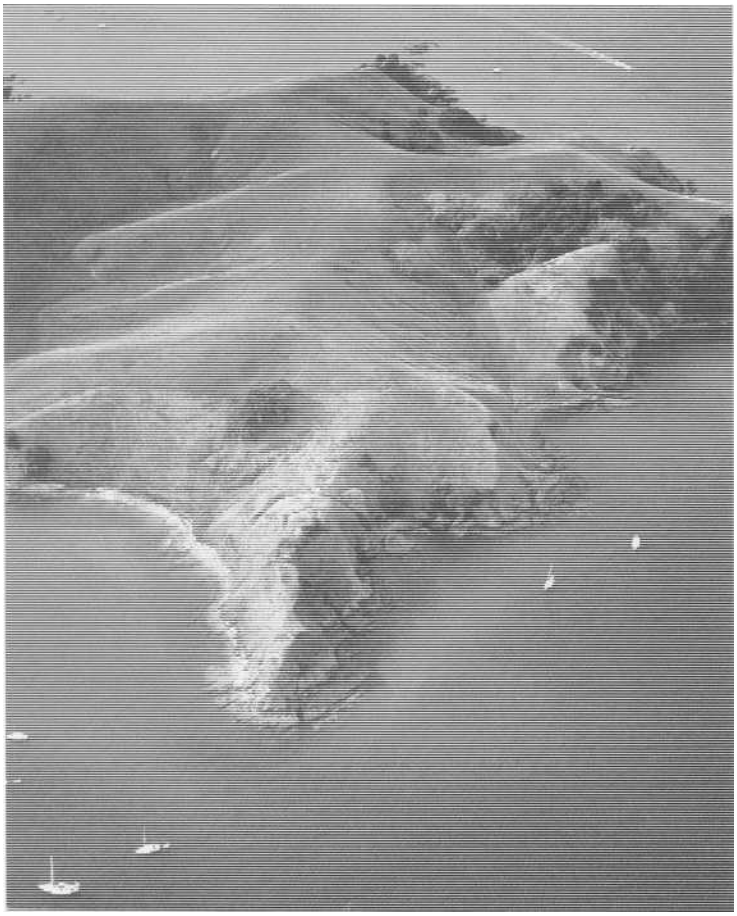


Figure 11 Station Bay pā, aerial view, February 1992. The denser grass cover on land protected from stock is evident. Former stock tracks are still visible and the colonisation by shrubs of stock induced eroded areas on the headland is apparent. Numerous dead pōhutukawa are indications of possum browse.

From excavation, Davidson determined that the site had at least two phases of occupation, first as a ridge line with storage pits, and later as a pā in the form in which it survives today.

Photographs filed with the earlier site record form by Molly Nicholls in 1963 confirm fairly widespread stock-induced erosion of steep banks. By 1978, following the excavations conducted by Davidson and others, the site had been fenced. Areas on the western and southern faces with severe erosion in 1963, some still active in 1994, are shown in the plan (Fig. 12). Erosion on the eastern (seaward) face is not documented or noted. The pā and its immediate surrounds have now been fenced from grazing for about 30 years and the effects are illustrated by the vegetation. Fencing has led to a heartening reduction in erosion.

Vegetation

Outside the pā fence (i.e, where the grazing continues), the grassland is dominated by barley grass, dogs-tail and Poa trivialis with thinly scattered rye-grass, cocksfoot and sweet vernal. Within the fenced area the proportion of cocksfoot and paspalum increases markedly along with rosette herbs such as *Plantago lanceolata* and *Picris echioides.* Large patches of *Ehrharta stipoides* (pātītī, or meadow rice grass) have progressively excluded the exotic grasses in several places (Fig. 13(a)). Other native plants such as

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