Archaeology of the Wellington Conservancy: Wairarapa

A study in tectonic archaeology

Department of Conservation
Te Papa Atawhai

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To the memory of Len Bruce,

1920–1999,

A tireless fieldworker and a valued critic.

Cover photograph shows a view looking north along the Wairarapa coastline at Te Awaiti. (Photograph by Lloyd Homer, © Insititute of Geological and Nuclear Sciences.)

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Archaeology of the Wellington Conservancy: Wairarapa

A study in tectonic archaeology

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ABSTRACT

The Wairarapa region is a tectonic landscape at the southeastern corner of the North Island of New Zealand. Seismic events are an important key to its natural and cultural character. Archaeological sites and environmental events are dated by their stratigraphic relationship to earthquake-uplifted shorelines, and with dune-building phases and alluvial deposition episodes thought to be triggered by earthquakes.

Two cultural periods are recognised: early and late. Early period sites are older than or contemporary with a period of seismic activity dated to about the late 15th Century AD. The inferred early settlement pattern was coastal. At the time of Maori settlement the coast was largely forested with extensive lagoons between uplifted beach ridges, and it had been stable for at least 800 years. Economic pursuits, in particular gardening, were related to the geological nature of the coast. Gardening was common where a hard rock platform and coastal sediments of greywacke or limestone resistant to wave erosion occurred in front of the coastal hills. It was virtually absent from parts of the coast where the coastal hills were easily eroded mudstones fronted by soft rocks and coastal sediments poorly resistant to wave erosion. Parts of the coast were abandoned following uplift of the coast that drained lagoons, silted up streams, and reactivated building of stream fans on the coastal platform. I suggest that tsunami inundation killed off the coastal forest that remained following Maori clearance by fire.

During the late period the focus of occupation moved to the main Wairarapa Valley. Gardening was practised in the southern part of the valley and settlement sites tended to be concentrated on the eastern side of the valley. Forest clearance, however, seems to have focused for some reason on the extensive gravelly soils of the Waiohine fans that were deposited from the mountain ranges on the western side of the valley at the end of the last glaciation.

Future research is proposed with the intention of clarifying aspects of the natural and cultural history of the region and their interrelationship. Of particular importance are: the direct dating of two earthquakes that have uplifted the coast between Flat Point and Cape Palliser twice since human settlement; and the field identification of at least two tsunamis that have struck the coast since human settlement. Both types of events would have had severe consequences for the human communities living on the coast that should be detectable in the archaeological record.

1. Introduction

This report describes the pre-European Maori archaeology of the Wairarapa region of the Wellington Conservancy. An earlier report (McFadgen 1997) focused on the Kapiti-Horowhenua region. The Wairarapa region lies east of the Tararua and Rimutaka ranges. The region extends from the Manawatu Gorge in the north across to Akitio on the east coast, a distance of about 65 km, and south some 150 km to Palliser Bay (Department of Conservation 1994) (Fig. 1). Compared with the more northern parts of the North Island, the evidence for human habitation in the Wairarapa region is sparse.

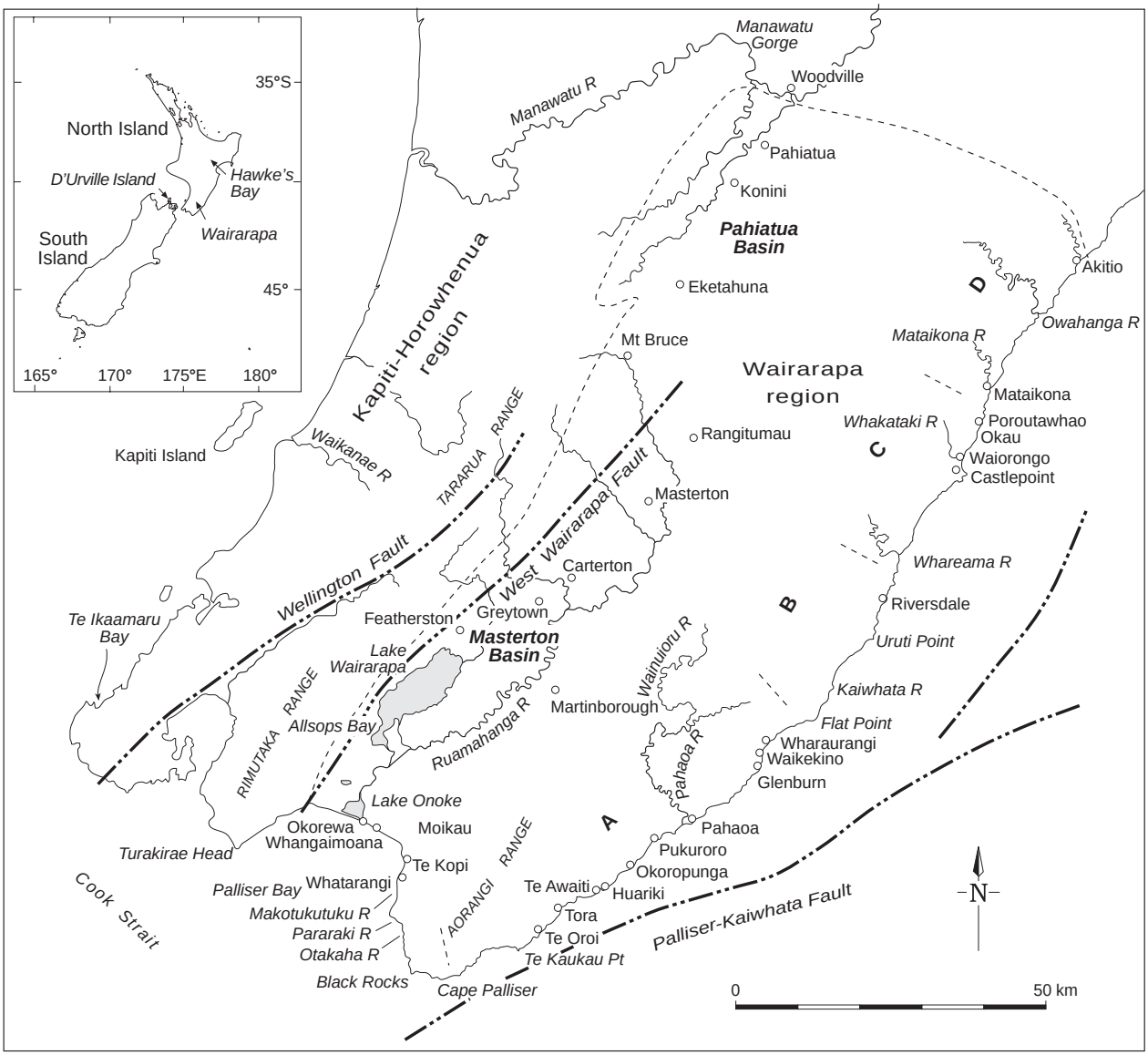

Figure 1. Southern North Island showing Wairarapa region (outlined by dashed line), and places mentioned in the text. Modern settlements and localities shown as open circles. The Wairarapa Valley is approximately the western third of the region. Faults active since human settlement important for Wairarapa archaeology are the Wellington Fault (Van Dissen & Berryman 1996), West Wairarapa Fault (Grapes & Downes 1997), and Palliser-Kaiwhata Fault (Ota et al. 1987; Barnes & Audru 1999). Tectonic sub-regions of Ota et al. (1987) are indicated A, B, C, D and separated by short dashed lines.

Very few of the known archaeological sites in the Wairarapa region are on land for which DOC has a management responsibility. Many sites, however, are on land in which DOC has a statutory interest, especially the coastal region, or a general advocacy interest, such as the protection of wetland habitats. Sites on land managed by the Wellington Conservancy are not representative of the site types across the landscape.

Geologically and environmentally, the region is extraordinarily dynamic. Between the arrival of first Polynesian settlers and of Captain Cook about 450 years later (McFadgen 1997), dramatic environmental changes occurred in response to natural processes such as earthquakes, and to cultural processes such as forest clearance. Polynesian settlers and their descendants burnt the forest to establish their settlements and gardens, and they exploited their environment to meet their needs for food, clothing and shelter. The environmental changes in turn influenced the activities of the prehistoric communities that lived in the region.

The attention given here to the prehistoric environment is more than is usual in archaeological reports. There are two reasons for this. First, when the environment changes, people either move away, adapt to the changes, or die. Understanding the changes that have occurred in the landscape is important for interpreting the cultural history of the region. Second, environmental changes often affect large areas of landscape. If they are short-lived events that leave some sort of recognisable remains, then they may be useful for dating.

Seismic activity has significantly influenced both the landform and the archaeology of the region. The region is severely faulted (Kingma 1967), and active faults have moved during the period of human settlement (e.g. Grapes & Downes 1997) (Fig. 1), causing widespread damage to vegetation, slipping of hillsides, and tsunamis. In 1848, for example, following the Marlborough earthquake, the missionary William Colenso remarked on the erosion of steep cliffs behind the coastal platform and deposition of scree brought down by winter rains from Pahaoa south into Palliser Bay (Bagnall & Petersen 1948). Earthquake uplifts created the coastal strip, and parts of the coastal strip have been subjected to both uplift and tsunami inundation at least twice since human settlement.

Friable soils on parts of the coastal strip were suitable for gardening, and their proximity to marine foods and former coastal forest made the coastal strip, especially at stream and river mouths, favoured places for early habitation. As a result, more than half of the recorded archaeological sites in the region are either located on the coastal strip or are very close to it (Fig. 2). Living on an earthquake-prone coastline close to sea-level exposed communities to the adverse impacts of seismic activity. On parts of the Wairarapa coast these were sometimes severe, and in the worst cases would have resulted in the loss of resources and settlements from uplift and tsunami inundation (Goff & McFadgen 2001). As well as damage and destruction, some of the earthquakes have left a record of uplifted shorelines that is useful for dating. Understanding the earthquake history of the region is, therefore, important for understanding its prehistoric occupation.

The report concludes with recommendations for future research. These focus broadly on the environmental processes and archaeological history of the Wairarapa region. The most pressing needs are for better understanding of the

seismic processes, particularly the earthquake uplifts and tsunami events, that have affected the Wairarapa region, and of the impact of the processes on the prehistoric communities that lived there. Such understanding will both provide insight into the cultural history of the Wairarapa region and beyond, and contribute to better planning for coping with similar events in the future.

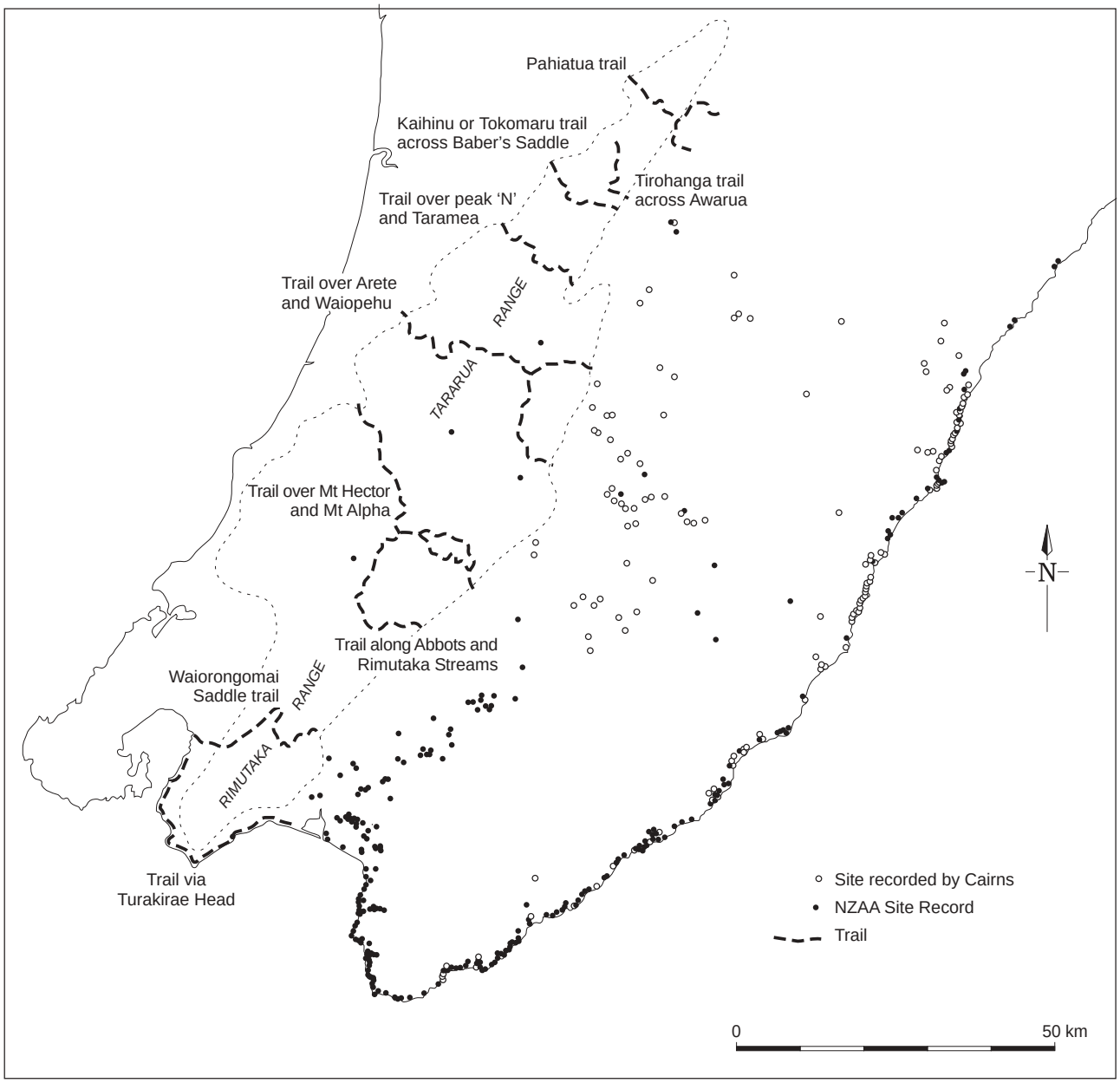

Figure 2. Distribution of archaeological sites in the Wairarapa region, and nine tracks across or around the Tararua Ranges. Track routes based on descriptions by Barton (1959, 1960).

2. Geology and geomorphology

The Tararua and Rimutaka ranges, comprised mainly of Mesozoic greywacke sandstone, rise to more than 1500 m, creating a barrier which restricted contact with the prehistoric communities west of the ranges. East of the ranges the gravel fans of the rivers that disgorge from the ranges form the Wairarapa plains, up to 18 km wide. The plains were the focus of Maori occupation at the time of European settlement. The southern plains, between Mt. Bruce and Palliser Bay (Fig. 1), drain to the south and contain two major lakes, Wairarapa and Onoke, and associated wetlands that traditionally, and to the present day, have been a prized source of eels (Beadel et al. 1998). The northern plains, from Mt. Bruce to a little north of Pahiatua, drain to the north and contain no significant bodies of water. Between the plains and the Pacific Ocean are the eastern hills of deeply dissected Tertiary rock, mostly limestone and easily-eroded mudstone, and Mesozoic rock, mostly greywacke sandstone, that in the south rise to more than 900 m. The region contains all or parts of eight ecological districts: Eastern Wairarapa, Aorangi, Wairarapa Plains, Puketoi, Woodville, Tararua, Manawatu Gorge South, and Eastern Hawke's Bay (McEwen 1987).

The region's coastline runs from Akitio River in the north, to western Palliser Bay in the south (Fig. 1), a distance of more than 180 km. It was the focus of Maori occupation in early prehistoric times, and served as a highway between Wellington and Hawke's Bay in early European times. Along much of the coast the sea is separated from the hills by the Holocene coastal platform, a narrow strip of land less than 1 km wide and no more than 15 m above sea-level (King 1930, 1932). The strip of land, formed by uplift of the coast during earthquakes (Singh 1971; Wellman 1971a, b; Ghani 1978; Ota et al. 1990), is covered with Holocene sediments including stream and river alluvium, colluvial fans, slope wash, sand dunes, and marine-deposited stones, gravel and sand that overlie a marine-cut bench. Older, higher pre-Holocene shorelines are preserved as marine-cut benches at the tops of the cliffs behind the coastal platform (King 1930; Ghani 1978), but they do not appear to have been occupied in pre-European times except at the southern end of the main Wairarapa Valley.

The hills behind the platform are broken at intervals by streams and rivers that flow out across the coastal platform, the biggest break being at Lake Onoke where the main Wairarapa Valley adjoins the sea. In prehistoric Maori times the streams and rivers would have given access to interior valleys and hills for hunting and, where the terrain was suitable, for settlements and gardens. Where the hills abutting the coastal platform are of limestone or calcareous Tertiary mudstone the sedimentary deposits on the coastal platform, especially old lagoon muds, are often alkaline and preserve old animal bones remarkably well. In contrast, where the hills behind the coastal platform are greywacke, which is more acidic than the mudstone and limestone, there are no good natural deposits of animal bones and the only bones that have survived are either very young, or in shell middens.

The present shoreline is predominantly rocky, with few sandy beaches or suitable places for landing canoes, especially in rough or windy weather. It is very exposed, and in spite of its generally southeast to southwest aspect, frequently buffeted by strong northwesterly winds which hit the coastal platform with enormous vigour.

3. Sources of information

The New Zealand Archaeological Association Site Recording Scheme is the main source of information about where archaeological sites are located. Site records have been contributed to the scheme for nearly 50 years by field recorders from archaeological societies, museums, and institutions of learning. The records generally note the type of site, its map reference and location details, and give a brief description of what was seen on the ground. Some 320 records are held by the Association, nearly all relating to sites along the coast or at the southern end of the Wairarapa Valley on the eastern side of Lake Wairarapa (Fig. 2). A second important source of information, particularly valuable for information about sites in the northern and southern Wairarapa valleys (Fig. 2), is the Cairns collection held by the Alexander Turnbull Library.

Keith Cairns was a Masterton resident with an active interest in Maori history. For more than 40 years he collected information about old Maori sites, very little of which was submitted to the New Zealand Archaeological Association Site Recording Scheme. In the early 1960s he wrote to nearly every farmer in the Wairarapa Valley asking for information about old Maori sites on their land (Cairns 1961) and received hundreds of replies. Each reply was recorded, and some sites visited and given a map reference (Appendix 1, Table A1.1). Some sites, such as oven remains uncovered by ploughing in the 1920s, would be difficult for a field recorder to discover today. Not all sites, however, were visited and many are located according to a landowner's name and a road or a river, so it is difficult to pinpoint their location on a map without more information (Appendix 1, Table A1.2). About half the records would be of this sort, but even in this form they are enough to indicate Maori occupation of areas such as the district around Eketahuna and Pahiatua where few other field records currently exist.

For this review the sources of information about the prehistory of the Wairarapa region include published accounts of archaeological investigations and fieldwork carried out over the last 50 years, supplemented by my own private notes and observations collected over the last 30 years. The most intensive archaeological investigation was research by the University of Otago Department of Anthropology into the cultural and economic prehistory of the southern Wairarapa region (B.F. Leach & H.M. Leach 1979a). Staff and students between 1969 and 1972 carried out fieldwork, which focused on the Palliser Bay coast and southern Wairarapa valley, and the investigation was the first, major regional research programme in archaeology to be carried out in New Zealand. The results of the research have had a major influence on the current understanding of, and subsequent research into, New Zealand prehistory. In contrast to the Palliser Bay programme, research on the eastern Wairarapa coast has been considerably less intensive and on a much smaller scale (e.g. Cairns 1959; Smart 1966; McFadgen 1980a, b).

4. Correlation and dating

In any study of prehistory, dating is the lens that brings the past into focus. An important part of the dating process is correlation, i.e. the finding of synchronous events in order to relate the sequence of deposits in one area (or site) with those in another. Radiocarbon dating is the usual method archaeologists use, but radiocarbon dates have an inbuilt measurement uncertainty, expressed as a standard deviation of the age, which is inherent in the method used to measure them (McFadgen 1982; McFadgen et al. 1994). The uncertainty is relatively large compared with the time between Polynesian and European arrival (probably less than 450 years for the Wairarapa region (McFadgen 1997)) and limits the use of the radiocarbon method. The usefulness of radiocarbon dating, however, can sometimes be improved by using the dates in conjunction with geological stratigraphy (McFadgen 1985, 1994, 1997).

By geological stratigraphy I mean *normal* geological stratigraphy of the kind used for correlation by Haast (1874), by Wellman (1962a, b) and by McFadgen (1985, 1994). From the point of view of archaeology, geological stratigraphy is *off-site* stratigraphy (McFadgen 1997). On-site stratigraphy is concerned largely with man-made features such as pits, postholes, and middens. Off-site stratigraphy is concerned with extensive regular layers and provides a stratigraphic record to which on-site stratigraphy can be tied.

Useful off-site stratigraphy in the Wairarapa region includes such sediments as sand dunes, stream alluvium, and uplifted shoreline deposits. It contains a chronological record of environmental events, some of which, like earthquakes and tsunamis, were short-lived and affected a wide area. Local events, such as the occupation of archaeological sites, can sometimes be stratigraphically related to the short-lived, widespread events, and their relative ages established. The radiocarbon dates are then used to find the absolute ages of the widespread events used for correlation. Off-site stratigraphy is currently most useful for correlation in the coastal environment, but only because this is where it has so far been most studied. It is possible that future work, for example on late Holocene river terraces, will find off-site stratigraphy useful for correlation in the Wairarapa valley.

Two identifiable sea-rafted pumices, Taupo Pumice (Healy et al. 1964) and Loisels Pumice (Wellman 1962b), have proved valuable for correlation (McFadgen 1985). Both occur extensively along the North Island east coast. Taupo Pumice is part of the Taupo Tephra Formation (Froggatt & Lowe 1990), and its adopted age, based on the age of airfall tephra from the Taupo Pumice eruption, is 230 AD (1720 cal BP[1]) (Sparks et al. 1995). Loisels Pumice comes

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[1] For consistency, all dates and time intervals are given in the text of this report in calendar years unless otherwise indicated. Radiocarbon ages are indicated by 'radiocarbon years BP' i.e. radiocarbon years before 1950 AD. Calendar dates are derived from radiocarbon dates using the most up-to-date radiocarbon calibration curves for terrestrial and marine samples (Stuiver et al. 1998) and are given in years AD or calendar years BP (cal BP) i.e. calendar years before 1950 AD. For a more detailed discussion on the calibration of Wellington Conservancy radiocarbon dates see McFadgen (1997).

from at least two unknown sources in the southwest Pacific (Shane et al. 1998), and its adopted age is 1360 AD (590 cal BP) (McFadgen 1994). Sea-rafted pumice is known to disperse widely and wash up on beaches far from its source within about 2 years of its eruption (Coombs & Landis 1966), and the age of primary sea-rafted Taupo Pumice is therefore assumed to be the same as of the Taupo Pumice eruption. Loisels Pumice has no known sources, and its age is based on radiocarbon dates from coastal sections. There is currently no evidence that Loisels Pumice from the different sources arrived at greatly different times, and the adopted age is assumed to apply to pumice from each source. This assumption, however, needs to be tested by directly dating when the Loisels Pumice was erupted, possibly by using a technique such as Optically Stimulated Luminescence.

Primary sea-rafted deposits of pumice are the most useful for correlation but their identification as primary deposits is always uncertain because all sea-rafted pumice is subject to possible reworking. Any recognisable pumice is, nevertheless, worth considering for correlation, and even secondary deposits provide maximum ages for the deposits above them. As in coastal sections along other parts of the North Island east coast, the earliest evidence for human activity on the Wairarapa coast, which is cultural charcoal derived from the burning of vegetation on the nearby coast, lies just below the first appearance of Loisels Pumice (McFadgen 1985).

Even in the coastal environment not all events can be correlated by stratigraphy, and radiocarbon dates alone must be used. A full list of archaeological radiocarbon dates for the Wellington Conservancy is given in McFadgen (1997, Appendix 2). Four additional radiocarbon dates, all on shell, have been measured since 1997 and are listed in Table 1 and Appendix 2 (Table A2.1).

Radiocarbon dates are converted into calendar dates by using calibration curves, one for dates of terrestrial plants and animals and one for dates of marine animals (Stuiver et al. 1998). The terrestrial calibration curve is compiled from Northern Hemisphere tree ring data. Whether the terrestrial curve can be applied without modification to calibrate Southern Hemisphere dates is open to debate. Some researchers (e.g. McCormac et al. 1998) observe a difference in radiocarbon content equivalent to about 27 calendar years between contemporaneous trees in the two hemispheres, others observe no difference (e.g. Sparks et al. 1995), or a variable difference which at times is nil (Knox & McFadgen 2001). Following Sparks et al. (1995), no hemisphere correction is made here. The marine calibration curve is a global curve to which a regional correction, ΔR, is applied to compensate for regional variations in the radiocarbon content of surface ocean water around the world. Two values of ΔR are currently available for New Zealand: -30 ± 15 (McFadgen & Manning 1990) and -25 ± 15 (Higham & Hogg 1995). Statistically, there is no difference between the two values and $\Delta R = -30 \pm 15$ is adopted for this report.

5. Off-site stratigraphy in the coastal environment

The Holocene coastal platform that separates the hills from the sea is a wave-cut marine bench overlain by sediments. The sea cut the marine bench at the end of the last glaciation. Following the melting of the ice, sea-level rose reaching the present sea-level about 5500 BC (6500 radiocarbon years BP, Gibb 1986), at which time the shoreline would have been at the foot of the hills. The bench has since been uplifted by intermittent earthquakes and covered with marine sediments, stream and river alluvium, colluvial fans, sand dunes, and slope wash.

The depositional environments with useful off-site stratigraphy are sand dunes, streams, former wetlands, and marine-derived sediments on uplifted former shorelines. Sections, near-vertical exposures a few metres high, usually along a coastline or riverbank (Fig. 3) are extremely important for unravelling the sequence of deposits and events represented in off-site stratigraphy. Ideal sections contain a sequence of fluvial, aeolian, and marine deposits, sea-rafted pumice of known age, buried soils, and occupation remains and give some idea of the nature and age of deposits behind them (McFadgen 1985).

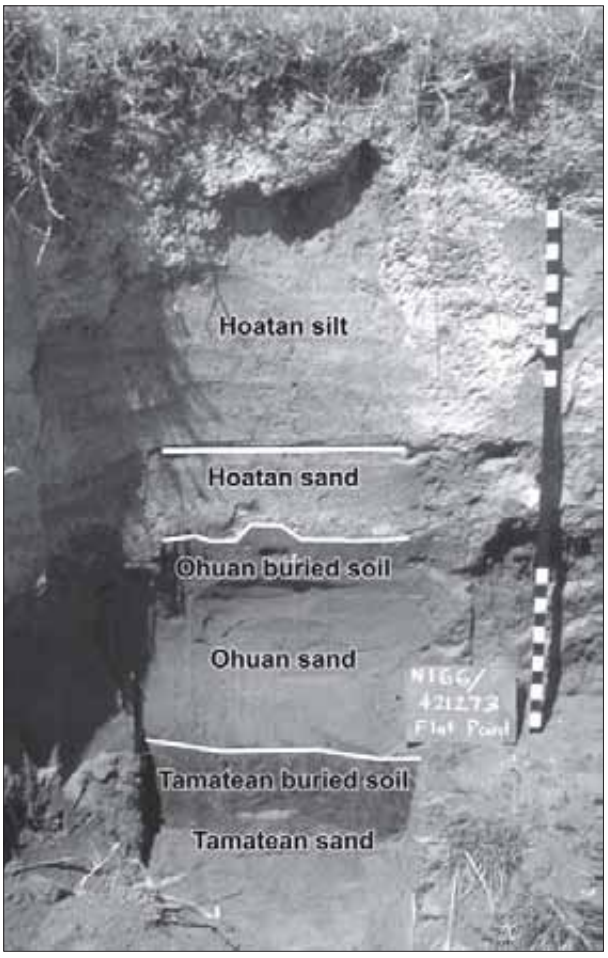

Figure 3. Section exposed in the east bank of the Te Unu Unu Stream at Flat Point showing three sand layers, one silt layer, and two buried soils. Section adjacent to M_1 and M_2 in Fig. 4. Scale = 1 m. (*Photograph: B.G. McFadgen.*)

5.1 SAND DUNES

There are sand dunes at several places on the Wairarapa coast, notably between Glenburn and Flat Point, and between Castlepoint and the Mataikona River (Fig. 1). Flat Point is the only place where the dune stratigraphy has been studied (McFadgen 1985), and here the dunes form a belt about 1 km wide across the Holocene bench. Three phases of dune-building are recognised, named in order of decreasing age, Tamatean, Ohuan, and Hoatan (Fig. 4). The oldest dunes are the farthest inland, and dunes of younger phases have advanced inland burying some dunes of the older phases. Ground soil profile development of each dune-building phase is remarkably uniform. The soils of older phase dunes are more developed than younger phase dunes, and each phase can be identified by its degree of ground soil profile development.

The Tamatean dunes contain primary sea-rafted Taupo Pumice and began to accumulate before the Taupo Pumice eruption. They were still accumulating when the Loisels Pumice was deposited and appear to have stabilised soon after. The Ohuan dunes became active about 1500 AD and may have been active locally until possibly as late as 1650 AD (McFadgen in press). The Hoatan dunes overlie European artifacts in the bank of the Te Unu Unu Stream (Fig. 4) (McFadgen 1985). The three phases match dune accumulation in other parts of New Zealand and Flat Point is the type locality for three depositional episodes apparently synchronous in dunes over much of the New Zealand coast (McFadgen 1985, 1994). The adopted ages of the dune-building phases, based on radiocarbon dating and historic evidence from many sites around the New Zealand coast (McFadgen 1985), are: Tamatean 150–1500 AD; Ohuan 1500–1800 AD; Hoatan 1800 AD to the present day.

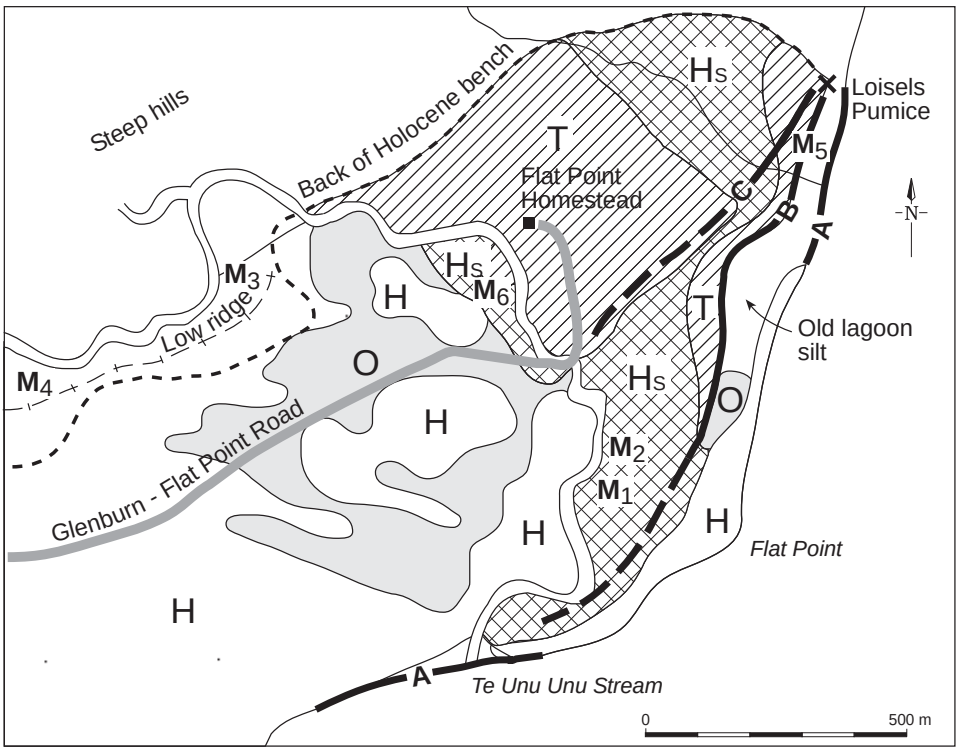

Figure 4. Sketch map of the Flat Point area after McFadgen (1985). Map drawn from aerial photographs. A, B and C are the youngest of 5 beach ridges; A is the growing beach ridge; B and C are uplifted beach ridges. Wind-blown sands belong to three depositional episodes: H = Hoatan; O = Ohuan; T = Tamatean. Hs = Hoatan silt. Six shell middens on buried soils in the sand dunes are shown as M_1 to M_6. × = location of Loisels Pumice in Beach Ridge B.

Ground soils on the dunes, and the dune soils buried by later dune advances, represent surfaces on which people lived. The oldest evidence for human occupation in the dunes is an oven on Tamatean soil exposed in the left bank of the Te Unu Unu Stream (site T27/12). The oven, which was buried by Ohuan sand, contained a moa claw (*Euryapteryx* sp.) with the bones still in a position of articulation when found. Both the Tamatean and Ohuan buried soils contain shell middens.

5.2 STREAM ALLUVIUM AND COLLUVIAL FAN DEPOSITS

On the eastern Wairarapa coast, episodic deposition of stream alluvium is recorded in sections through stream fans at Te Awaiti and Te Oroi (Fig. 5) and is correlated with the Tamatean, Ohuan, and Hoatan depositional episodes (McFadgen 1985). In both sections the alluvium overlies estuarine lagoon mud.

On the eastern Palliser Bay coast there was renewal of colluvial fan activity at several places following human settlement (H.M. Leach & B.F. Leach 1979, pp. 236–237). The renewed activity was explained in terms of human impact on the landscape and change in climate from relatively calm and warm to stormier and cooler (H.M. Leach & B.F. Leach 1979). Goff & McFadgen (2001), however, propose seismic activity as an alternative explanation for the renewal of colluvial fan activity in Palliser Bay, and it is likely that seismic activity accounts for the episodic deposition recorded in fans on the eastern Wairarapa coast as well.

Like the soils on the dunes, ground soils on stream alluvium, and the soils buried by later alluvial deposits, represent surfaces on which people lived. Both the Tamatean and Ohuan buried soils on stream alluvium contain shell middens, and fan surfaces have been gardened.

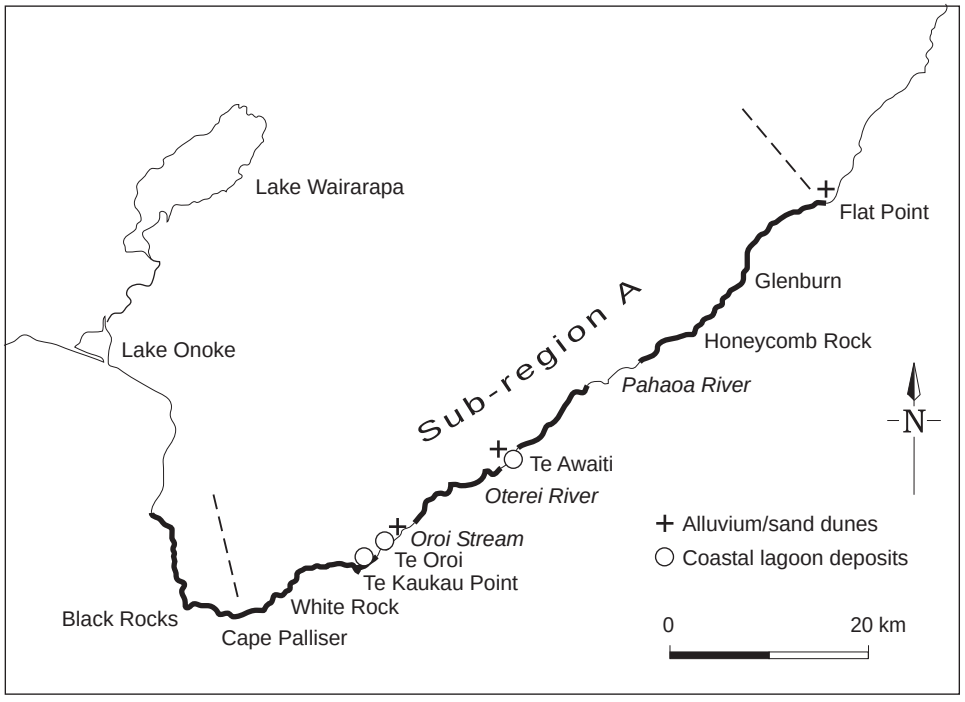

Figure 5. Southeast Wairarapa coast showing sub-region A, and depositional environments with off-site stratigraphy useful to archaeology. Thick line = coast with uplifted beach ridges; + = alluvium (Oroi Stream and Te Awaiti) and sand dunes (Flat Point) correlated with depositional episodes; ○ = coastal lagoon deposits.

5.3 UPLIFTED SHORELINES

Uplift of the Holocene bench is evident as a sequence of terraces that are progressively older and higher with distance from the shore. The terraces are former sub-tidal platforms that have been abraded by wave action and raised above sea-level by sudden earthquake uplifts. The initial uplift was followed by formation of the terrace cover beds by build-up of beach ridge deposits (high tide and storm beach deposits), estuarine silt and mud, marine sediments, stream and river alluvium, sand dunes, and slope wash that accumulated on the newly exposed wave-cut platform after each uplift (Ota et al. 1987, 1990).

Ota el al. (1987) recognised four distinct sub-regions (A to D) between Cape Palliser and Akitio (Fig. 1). Terraces in sub-regions A and B may have uplifted as a result of movement along the Palliser-Kaiwhata Fault (Fig. 1) (Ota et al. 1987; Barnes & Audru 1999). The number of uplifted terraces varies from place to place to a maximum of seven, the highest (at Flat Point) lying about 17 m above sea-level (Ota et al. 1990). Terraces are labelled in order of decreasing age: I, II, III..., the oldest terrace in each sub-region being I. Ota et al. (1987) dated the terraces using radiocarbon and concluded that only in sub-region B, between Flat Point and the Whareama River, has the coast been uplifted since human settlement. The radiocarbon dates for sub-regions A and B are reassessed in Appendix 3, taking into account inbuilt age and the evidence of sea-rafted pumice deposits. The reassessment confirms Ota et al's (1987) dates for sub-region B, but I infer that sub-region A, between Cape Palliser and Flat Point, has been uplifted twice since human settlement.

The beach ridges on the uplifted terraces are roughly parallel to the present coast. They mark former Holocene shorelines in sub-region B at Flat Point and Glenburn (Wellman 1971a), and in sub-region A at Okoropunga (Appendix 3), Oterei (Singh 1971; Ghani 1978), White Rocks (Wellman 1971b), and Cape Palliser (Ghani 1978) (Fig. 5). The number of uplifted beach ridges varies from place to place to a maximum of seven. The beach ridges, by convention, are labelled in order of increasing age: A, B, C..., the youngest (growing) ridge being A, and are composed of coarse sand, gravel and stones derived from material thrown up by the sea. None of the beach ridges is continuous along the coast, parts having frequently been buried by alluvium, eroded away, or never formed. The ridges contain sea-rafted pumice, which is important for dating uplift (Appendix 3), and they have generally well drained and friable soils on them, the older of which were gardened in pre-European times.

Prior to human settlement sub-regions A and B had been tectonically stable for about 800 years. In sub-region B the uplift following human settlement happened about 1450 AD and stranded Beach Ridge B at Flat Point. In sub-region A, the first uplift following human settlement happened about 1500 AD and stranded Beach Ridge C at various places from south of Flat Point to Palliser Bay. Considering the uncertainty of radiocarbon dating the two uplifts may have been a concurrent event sometime during the late 15th Century.

There is no direct evidence for the uplift of Beach Ridge B in sub-region A, and no historic record of uplift since European settlement of the Wairarapa. The uplift of Beach Ridge B probably occurred sometime between about 1550 AD and 1840 AD. If the inference made by Goff & McFadgen (2001), that renewal of

colluvial activity followed earthquake uplift, is correct then the uplift of Beach Ridge B possibly occurred at the end of the Ohuan Depositional Episode, c. 1800 AD.

5.4 TSUNAMI DEPOSITS

In 1855 AD a massive earthquake struck the southern North Island, generated by a rupture of the West Wairarapa Fault (Fig. 1). The tsunami that followed the earthquake struck Te Kopi in Palliser Bay as a series of waves up to 12 m high, removing houses and bales of wool, and possibly continuing along the east coast as a wave up to 9 m high (Grapes & Downes 1997). Goff et al. (1998) attribute tsunami deposits more than 2 km inland in the Okorewa Valley in central Palliser Bay (Fig. 1) to the 1855 AD tsunami, although the dating is uncertain and I think that they may be from an earlier event in the late 15th Century AD that followed a rupture of the Wellington Fault (Goff & Chagué-Goff 1999) or possibly the Alpine Fault (Goff et al. 2000).

Late 15th Century AD tsunami deposits are identified in the wider Cook Strait coastal region, in wetlands of the Abel Tasman National Park (Goff and Chagué-Goff 1999) and in a lagoon at the north end of Kapiti Island (Goff et al. 2000). They are tentatively identified at Te Ikaamaru Bay on the west Wellington coast (Goff & McFadgen 2001). On the Wairarapa coast there are potential tsunami deposits in the vicinity of the Okau Stream, Uruti Point, Okoropunga, and Te Oroi that need to be analysed to establish their origin. The deposits at Okoropunga and Te Oroi are in a stratigraphic context that indicate an age for the deposits that is younger than the uplift of Beach Ridge C and older than uplift of Beach Ridge B.

5.5 COASTAL LAGOON DEPOSITS

At least four lagoons, fed by groundwater or streams, formed behind Beach Ridge C at Te Kaukau Point, Te Oroi (north and south of the Oroi Stream), and Te Awaiti (Fig. 5) while the beach ridge was the growing ridge. The oldest and thickest deposit is at Te Oroi, south of the Oroi Stream, and the lagoon, which contains large lumps of Taupo Pumice, probably began forming more than 1800 years ago. All four lagoon deposits contain Loisels Pumice and were drained by the late 15th Century uplift.

Charcoal from forest fires lit to clear land first appears at or just below the Loisels Pumice in the lagoon deposits. The angular charcoal, which has not travelled far, probably came from fires on the nearby coast (McFadgen 1994).

Too little of the section is left at Te Awaiti to make an inference about the area of the lagoon. Judging from the sections and the positions of beach ridges, the Te Oroi north and south lagoons may each have covered about a hectare. The Te Kaukau Point lagoon was probably > 100 m long but < 20 m wide.

The lagoons would have provided a good source of food and raw materials for artifacts, but these resources would have been lost when the lagoons drained.

5.6 CORRELATION OF OFF-SITE STRATIGRAPHY AND ADOPTED AGES FOR EVENTS

The correlation between terraces and beach ridge uplift with the depositional episodes in sand dunes and stream alluvium is shown in Fig. 6. The adopted age for the late 15th Century AD uplift of Beach Ridge C in sub-region A and Beach Ridge B in sub-region B is 1475 AD. The adopted age for the uplift of Beach Ridge B in sub-region A is 1800 AD.

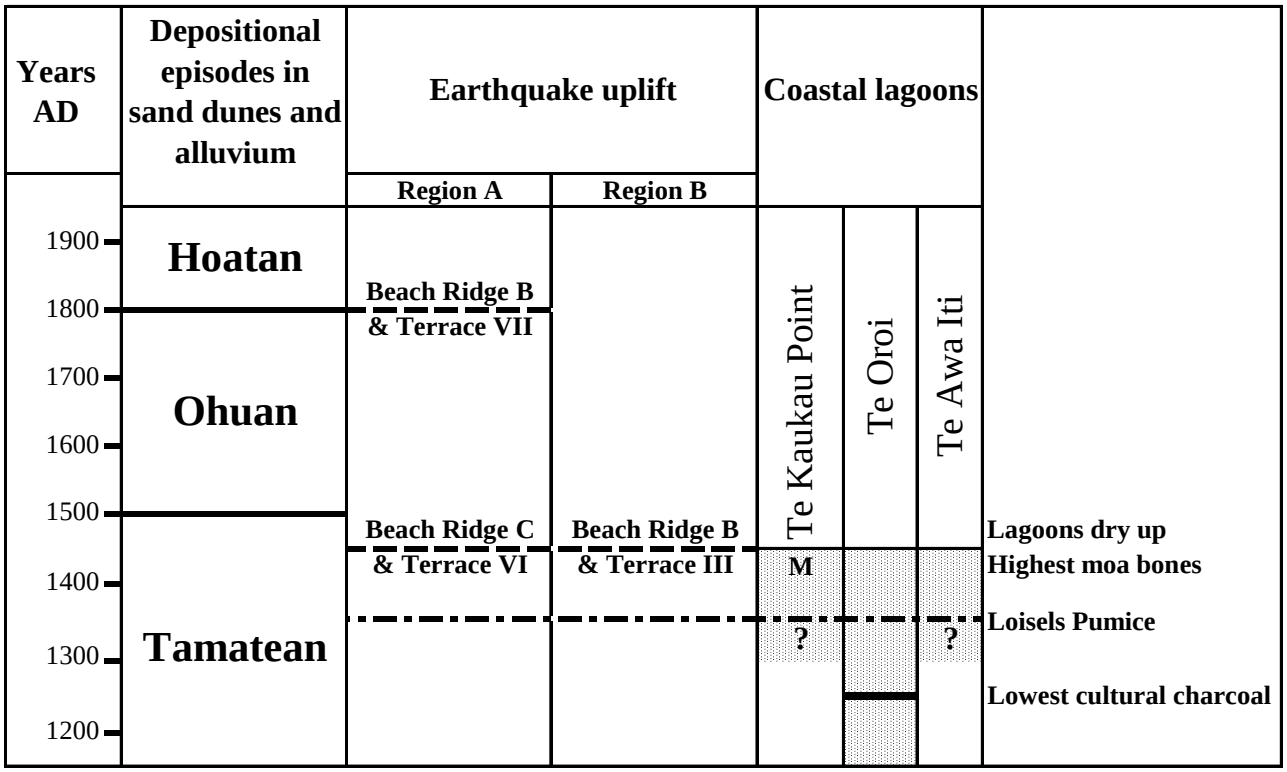

Figure 6. Correlation of depositional episodes, uplifted beach ridges and terraces, and lagoon deposits. Youngest moa bones (M) are bones found in a position of articulation. Uplift of beach ridges and terraces in regions A and B are represented by dashed lines. Position of Loisels Pumice relative to beach ridge uplifts and lagoon deposits is represented by dash-dot line.
? = uncertainty of age of lagoon deposits below Loisels Pumice. Lowest cultural charcoal in lagoon deposits is represented by solid line.

6. Vegetation

It now appears that the Wairarapa region would have been largely forested at the time of Maori settlement (McGlone 1989). Only some riverbeds, unstable dunes along the foreshore, and the youngest beach ridges are likely to have been without forest. To the first settlers the coast would have presented a variety of vegetation types, each depending on the type of soil and site on which it grew. Plant communities that depended broadly on the age of the soil would have been older and more developed on older beach ridges and sand dunes (cf. Bagnall 1975).

Early European accounts and studies of present day bush remnants provide glimpses of what the pre-human forest was probably like (e.g. Hill 1963; Wardle 1967; Sawyer et al. 1997; Simpson 1997; Beadel et al. 1998). Although few remnants of the original indigenous vegetation remain today in the Wairarapa region east of the Tararua Ranges, the many small areas of indigenous secondary growth vegetation in the Eastern Wairarapa collectively indicate a past rich flora (Sawyer et al. 1998). By the time of European settlement, however, large areas of the region had been cleared of forest and replaced by scrub, fern, and grassland (Hill 1963, see figure 1) (Fig. 7). Forest was still present on the eastern slopes of the Rimutaka and Tararua Ranges, on the higher parts of the Aorangi Mountains, parts of the southern Wairarapa Plains, and the higher hills between the Wairarapa Valley and the east coast. The coastal platform, however, had been almost entirely cleared of forest except for a small remnant

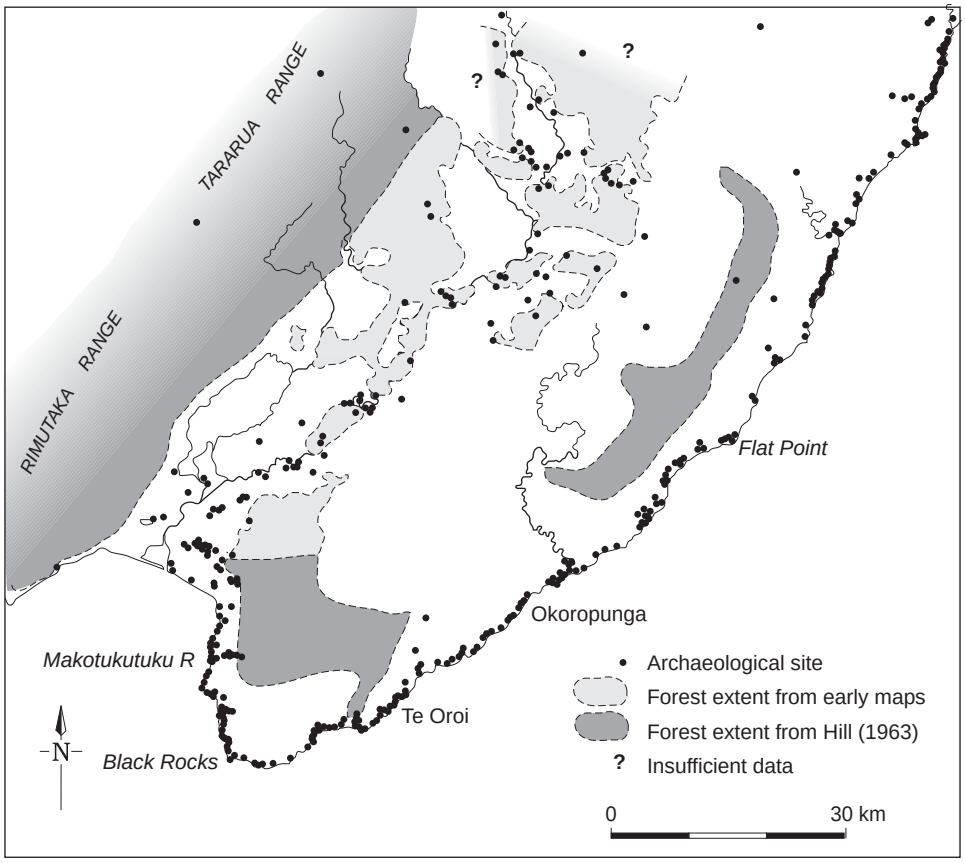

Figure 7. Forest cover in the Wairarapa region at about 1853 scaled from early surveyors' maps, and from data collated by Hill (1963). Note that archaeological sites generally fall outside the forested area.

at Te Oroi, and was described by Colenso in the 1840s and 1850s as barren and treeless (Bagnall & Petersen 1948). Elsewhere, the vegetation is described as a patchwork of grass, swamp, scrub, and forest mingled in varying proportions (Hill 1963).

Forest clearance would have begun on the coast with the arrival of the first settlers who would have needed to clear land for settlements and gardens. At Okoropunga, a totara tree (*Podocarpus totara* or *P. hallii*) growing out on the coastal platform had been burnt and the site later used as a Maori garden (McFadgen 1980b). Only part of a charred root remained, in position of growth in soil buried beneath the garden. The root was radiocarbon dated to about 1350 AD and early Maori settlers had probably cleared the tree in order to establish the garden. Whether all of the destruction of coastal forest occurred as a result of human activity is doubtful. Tsunami inundation, flooding tree roots and killing trees with salt water, was noted by Alfred Wallace (cited in Severin 1997, pp. 131–2) and Minoura et al. (1996), and it is possible that forest clearance of the coastal platform was assisted by tsunami inundation that is thought to have occurred during the 15th Century AD (Goff & McFadgen 2001).

Former coastal forest is indicated by land snail shells in middens on the Tamatean buried soil at Flat Point, Te Awaiti, and Te Oroi (McFadgen 1985), and land snail shells and insect remains in late Tamatean peat at Te Kaukau Point (Appendix 4). In middens on the Ohuan buried soil at Flat Point and Te Awaiti, however, there is a paucity of land snail shells and McFadgen (1985) infers that by about 1500 AD the forest edge was well inland of the middens.

On the eastern Palliser Bay coast, land snail shells in the midden of an early settlement at the mouth of the Makotukutuku River represent dry coastal scrubby forest (Wallace 1979), and in a site about 1.5 km upstream, dense forest. In contrast, land snail shells from an early site at Black Rocks indicate an open sparse cover of grasses and herbs, that later appears to have been replaced by scrub and dry forest (Wallace 1979).

When the inland forest was cleared is not known. Fyfe (1990), possibly on the basis of Maori tradition, suggests around 1600 AD following prolonged drought, and Sawyer et al. (1997) suggests the mid 17th Century AD. In the Eastern Wairarapa, forest remnants, particularly on the taipos (steep, prominent ridges and hills of greywacke (Kamp & Vucetich 1982)), show evidence of having undergone widespread clearance around 450 years ago (A. Townsend pers. comm. 2000). Further work is needed to define more closely the pattern and age of vegetation clearance. For the main Wairarapa Valley, such information will give some indication of how and when the valley was first settled.

Of interest is the possible role played by the late 15th Century AD uplift of the eastern Wairarapa coast. Strong earthquakes can severely damage vegetation growing on steep hillsides. The destruction of nearly one-third of the forest on the western Rimutaka Range followed the historic 1855 AD Wellington earthquake (Grapes & Downes 1997), and vegetation damage along the Buller River, some of which can still be seen in the Buller Gorge today, followed the 1929 AD Murchison and 1968 AD Inangahua earthquakes. It is possible that in the Wairarapa, forest clearance by fire was enhanced by vegetation destroyed by the late 15th Century AD earthquake, which when dry would have fuelled large fires over a wide area.

Not only were the forests burnt, but also new species were introduced. The karaka tree (*Corynocarpus laevigatus*), an important source of food in prehistoric times and often found near former settlements (Mitcalfe 1969), is now a feature of secondary coastal forests (Simpson 1997). It is widespread on the Wairarapa coast, but it is also known to have recently spread aggressively into areas of bush such as Wellington's Otari Native Botanic Garden and Wilton's Bush Reserve, possibly helped by the native pigeon (Gabites 1993), and it need not indicate former Maori settlement.

Forest clearance would have begun with the arrival of the first settlers in order to establish settlements and gardens. Over time there would have been additional reasons for clearing the forest, such as: to induce the growth of bracken fern, to keep tracks open, for security, and for hunting (McGlone 1983). In the dry environment of the Wairarapa, accidental fires may have played a prominent role in clearance (McGlone 1983). For whatever reason, forest clearance continued more or less throughout the prehistoric period until nearly all of the forest had been cleared from the coastal platform, and large inroads had been made into the forest on the southern Wairarapa plains and hills to the east. The forest, however, provided shelter, raw materials for artifacts, and food and its clearance was to have severe consequences for the communities that lived on the east Wairarapa coast.

7. Natural faunal remains, moa and moa hunting

Natural deposits of sub-fossil bones from caves, notably near Martinborough (Yaldwyn 1956, 1958), from coastal lagoon muds near Te Kaukau Point (Appendix 5), and from coastal dunes (Brodie 1950), indicate that a wide range of forest birds and other animals such as tuatara have disappeared from the region since the time of first human settlement (McEwen 1987). Prominent among the bones are those of moa which roamed the Wairarapa region before human contact. Introduced predators and habitat destruction as a consequence of forest clearance, will account for the disappearance of some birds, but bones of many of the species are also found in shell middens (e.g. Anderson 1979; B.F. Leach 1979a; Appendix 6) and indicate that hunting contributed to their disappearance.

Moa bones and moa eggshell are found in sand dunes and swamps at many places along the Wairarapa coast from Akitio to Palliser Bay, but rarely in archaeological sites, a pattern which appears to be common along the whole of the Wairarapa coast (Hill 1914; Brodie 1950). Prior to human settlement, moa nested in the dunes between the Whakataki and Mataikona Rivers and the sand contains extensive deposits of broken eggshell and moa bones. The eggshell and bones probably accumulated over hundreds of years but the coastal strip is not large and the moa population, which at any time would not have been great, probably did not survive very long after human settlement. In the Palliser Bay excavations, so few moa bones were found that it was inferred that moa had become extinct in the southern Wairarapa before human settlement, and that those bones that were found had been imported from the South Island (B.F. Leach 1979a, b) for making artifacts (H.M. Leach 1984). The natural deposits of bones from Te Oroi and Te Kaukau Point include moa bones from above the Loisels Pumice (Appendix 5) and demonstrate that moa were living in the southern Wairarapa after human settlement.

Why are so few moa bones are found in archaeological sites? The answer may simply be that moa were difficult to transport. It is not only moa bones that are uncommon in sites. Fur seals, which still have a colony on the Palliser Bay coast today, are of comparable size to moa and are also not common in Palliser Bay archaeological sites (Smith 1979). Where transport was relatively easy, moa carcasses would be taken to a settlement site to be butchered (Anderson 1989). Where transport was difficult, moa would be butchered where they were found (e.g. Adkin 1948). The Wairarapa coast is rugged in many places and difficult to traverse, with a rocky shoreline and frequent heavy seas (Leach & Anderson 1979a), and there are few large rivers. Based on the analogy of the Maori treatment of pigs in the Wairarapa, reported by Weld in 1845 (Mair 1972) it is likely that when moa were killed, only the flesh was taken and the bones were left behind.

8. Archaeological sites

Archaeological sites are places where human activity has left behind some physical trace—usually, but not necessarily, in the ground. In the Wairarapa region, for pre-European archaeological sites, and for many Maori archaeological sites from the first years after European contact, nearly all of the traces are in the ground. A notable exception is groves of karaka trees, once an important food source. Karaka trees are often found near former settlements, especially near the coast.

The traces are of several different kinds, from discarded waste such as flakes, shells, and bones in middens, to modification of the ground surface from the digging of terraces, pits, and ditches, and mounding up of soil into banks, to changes in soil horizons from gardening. Not all traces would normally be considered as archaeological sites. Some traces are found in depositional environments, such as charcoal and pollen in lake mud, and may record human activity that occurred several kilometres away.

The absence of recorded archaeological sites at any place is not necessarily evidence that sites do not exist. Some parts of the Wairarapa region have not been systematically surveyed for archaeological sites and the absence of recorded sites possibly reflects a lack of attention by archaeologists. Furthermore, the archaeological evidence, which is usually below the ground surface, is easily obscured, for example by later human activity such as farming filling in pits, or by deposition of alluvium by streams and rivers. Some types of gardening leave few visible traces on the ground surface and for some areas is indicated by other types of evidence such as storage pits. The distribution of some types of sites, such as some varieties of gardens, may therefore be biased because they leave few visible traces.

Archaeological site types to which this report refers generally follow the conventions of *Archaeological Site Recording in New Zealand* (Walton 1999).

Pa (Fig. 8) are earthwork fortifications, usually found on hills, often in conspicuous places. The term 'pa' is used by archaeologists in the special sense of a fortified place and contrasts with the use of the term in early European times, and in common use today, to mean a Maori settlement. In early European times if a place was fortified it was often referred to as 'fortified pa' (cf. McFadgen 1963). Pa were defended by ditches and banks, scarps or terraces, and served a variety of purposes. Some were small refuges, some were citadels, and others are full of pits and were possibly fortified storehouses. Headland pa, most common in the Wairarapa region, are the end of a ridge or spur cut off by one or more transverse ditches and banks,

Figure 8. Headland pa typical of many on the Wairarapa coast. The site (New Zealand Archaeological Association site number T28/36) is north of Okoropunga on the southeast Wairarapa coast. Defensive bank labelled B. (*Photograph: B.G. McFadgen.*)

and usually with steep natural defence around the other sides. Less common are ring ditch pa, which have ditch and bank defence along two or more sides. Pa are found mainly on the eastern Wairarapa coast and in the Wairarapa Valley (Fig. 9). There are very few on the Palliser Bay coast.

Pits (Fig. 10) are shallow, more or less rectangular depressions in the ground, with or without a raised rim, and rarely longer than 4 m. They are most common in coastal areas, especially on hill slopes and in valleys behind the coastal platform (Fig. 11). Many are found within pa sites. Some rectangular pits are the remains of old houses, but most are probably former kumara stores and they provide indirect evidence of gardening.

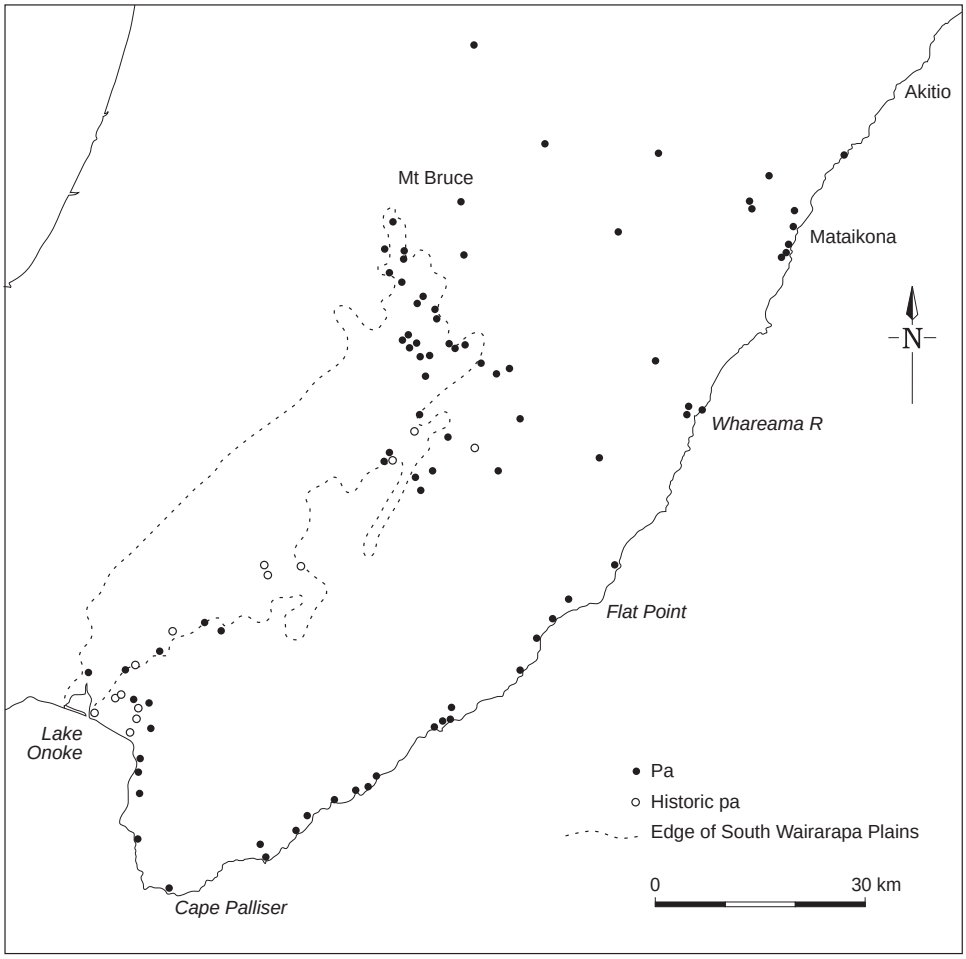

Figure 9. Distribution of pa sites in the Wairarapa region. Dotted line = edge of the southern Wairarapa Plains. Note that because of the map scale, some dots represent more than one pa.

Figure 10. Raised rim pit (New Zealand Archaeological Association site number T28/54) at Pukuroro on the southeast Wairarapa coast. (*Photograph: B.G. McFadgen.*)

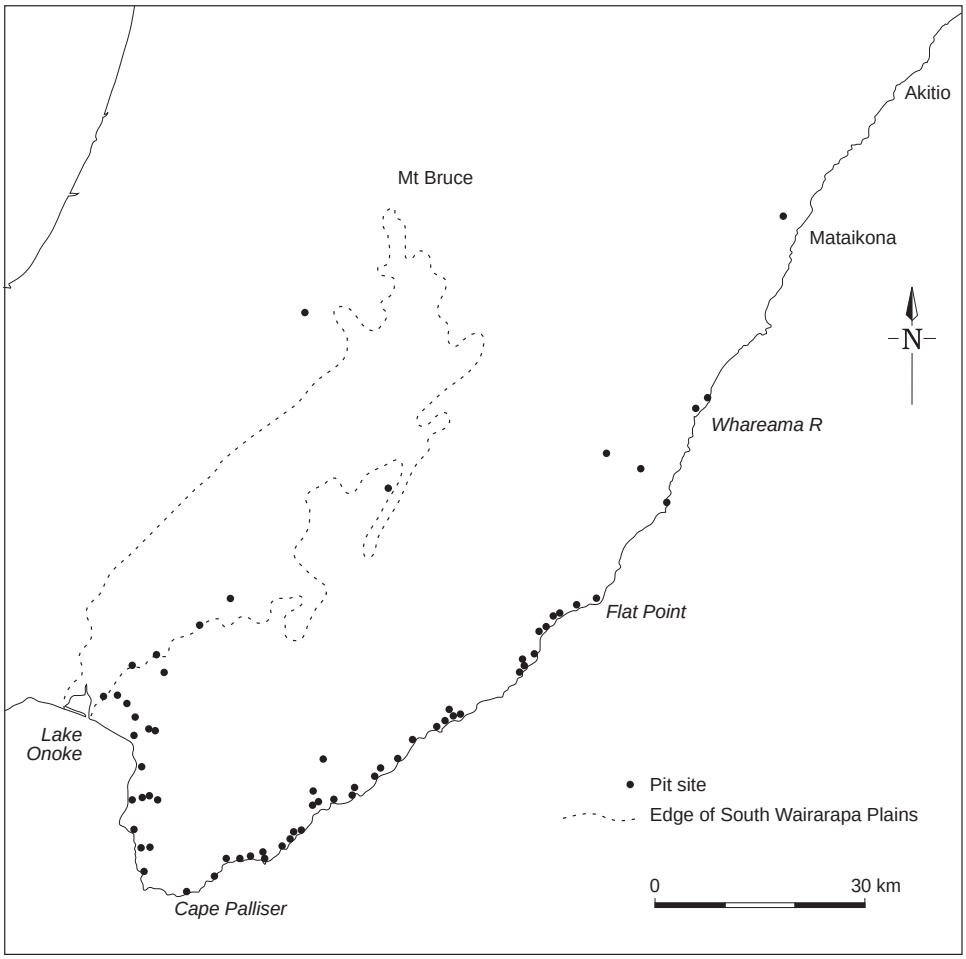

Figure 11. Distribution of sites with pits in the Wairarapa region. Dotted line = edge of the southern Wairarapa Plains. Note that because of the map scale, some dots represent more than one pit.

Raised rim pits in Palliser Bay are commonly found singly, or in isolated clusters of two or three, on the edges of high river terraces, and with small terraces. Large groupings, sometimes fortified, are found in the Wairarapa Valley. They were possibly introduced into the Wairarapa from the Hawke's Bay towards the latter end of the prehistoric period (H.M. Leach 1979b).

Gardens (Fig. 12) often leave few visible traces at the ground surface. Surface remains which are associated with former gardens include stone rows and stone mounds on uplifted beach ridges and old stream fans (Fig. 13); and gravel or grit added to an original soil i.e. plaggen soil (see below). Where surface features are absent, finding old gardens depends on identifying disturbed soil profiles. Sites along the east and south coasts are today extremely windy, so windy that it seems surprising that the Maori could have lived there, let alone gardened. In many places on the east coast today it is difficult to even get trees to grow (Dan Riddiford pers. comm.).

Few of the plants cultivated in tropical Polynesia are viable in temperate New Zealand. Six of these plants were cultivated in New Zealand at European contact: kumara (*Ipomoea batatas*), gourd (*Lagenaria* sp.), taro (*Colocasia esculenta*), yam (*?Dioscorea alata*), ti (*Cordyline* sp.), and paper mulberry (*Broussonetia papyrifera*) (H.M. Leach 1979b); but only kumara and gourd, and to a lesser extent taro, are likely to have been grown in the Wairarapa region.

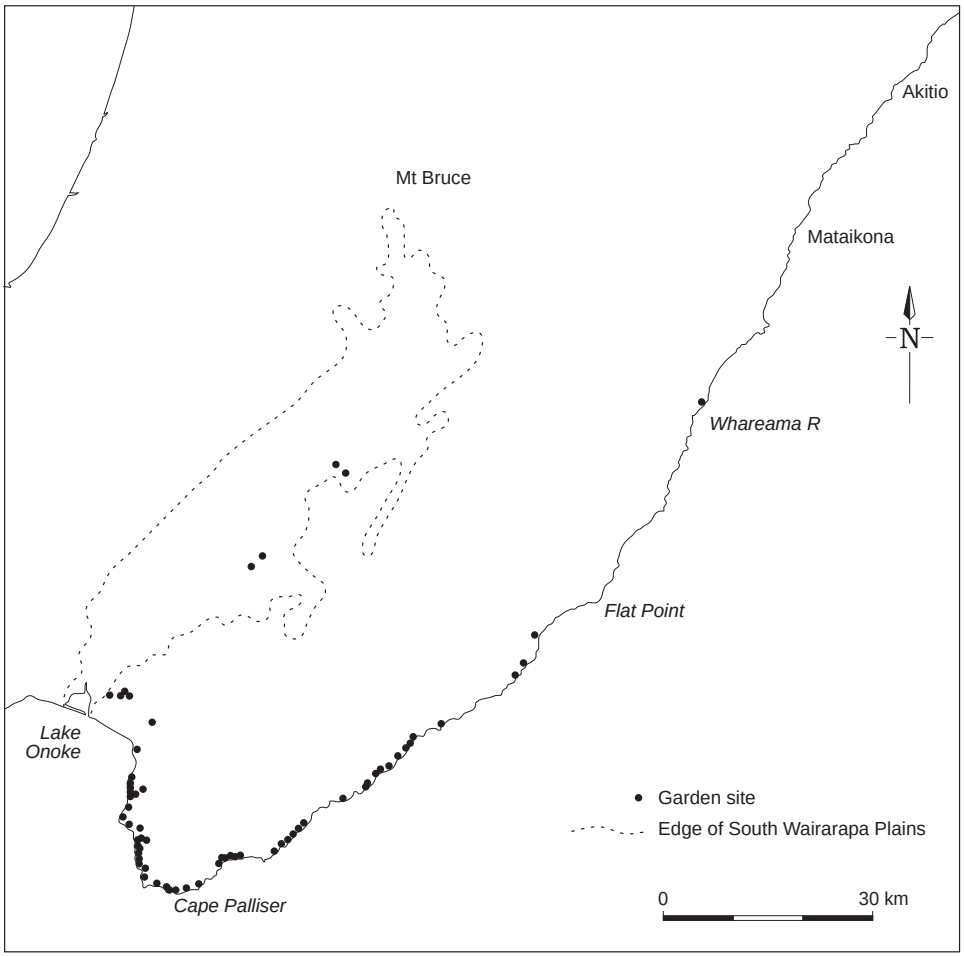

Figure 12. Distribution of gardens (stone row systems, Maori Plaggen Soils, plaggen soils, terrace gardens, and historic cultivation grounds) in the Wairarapa region. Dotted line = edge of the southern Wairarapa Plains. Note that because of the map scale, some dots represent more than one garden.

Stone row systems (Fig. 13) are the most striking archaeological features of the Wairarapa region. They occur in coastal areas, generally on or near stony deposits such as stream fans, riverbeds, and uplifted beach ridges. The rows are long narrow mounds of stones about 2 m wide and 20–30 cm high, laid out in a more or less rectangular fashion interspersed with roughly circular stone mounds 1–2 m in diameter. Their purpose is not fully understood except that there is general agreement that they are in some way related to gardening. There are two contrasting views for their origin. The first, is that the stone rows are a by-product of gardening, the stones having been cleared from garden plots between the rows and used to mark the boundaries of the plots (H.M. Leach 1979a, 1984). The second, is that the stones were gathered together for the express purpose of building the rows, in some instances being 'mined' from nearby underground deposits (McFadgen 1980a), leaving well-defined borrow pits (Fig. 13). In the second view it is not necessary for the plots between the rows to have been gardens, since it is the rows themselves that were the focus of attention.

Plaggen soils (Fig. 13) are soils with added gravel or grit (McFadgen 1980b). They are called Maori Plaggen Soils if they are prehistoric and plaggen-like soils if they are not prehistoric or their age is unknown. It is generally accepted, but not proven, that gravel and grit were added to make soils more suitable for growing kumara and taro (Best 1925). Plaggen soils are similar in that they all contain silt, sand, and gravel, and are sufficiently friable to be worked with a

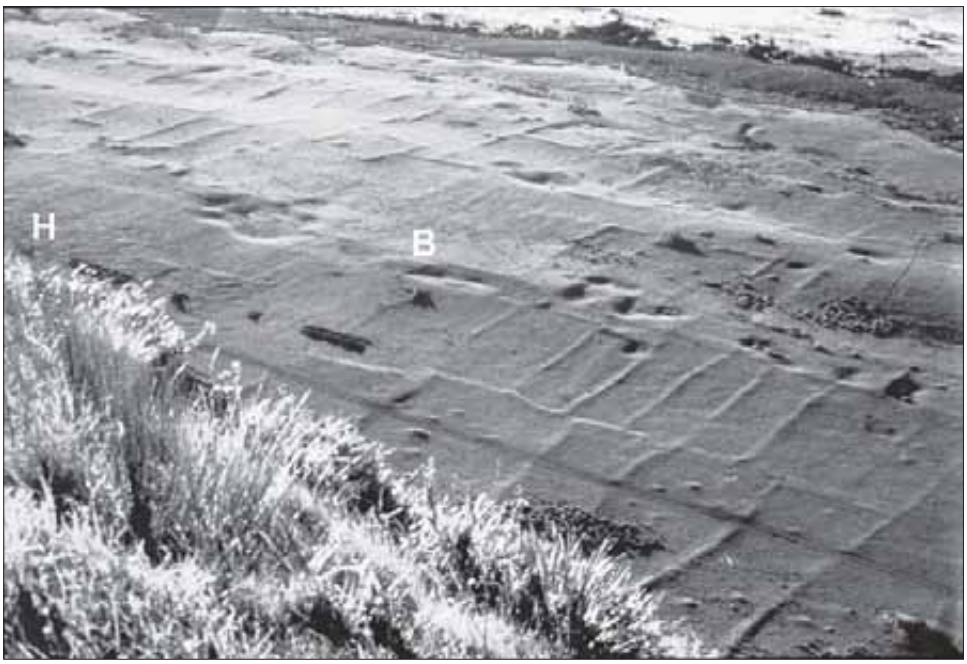

Figure 13. Stone row system on uplifted beach ridges at Okoropunga on the southeast Wairarapa coast. Although the rows appear to delineate garden plots the soils within the plots show no sign of cultivation. Attention appears to have been focused on the rows and mounds. Note the borrow pits (example labelled B) along the beach ridge crests from where the stones in the rows and mounds were mined. Hummocky ground to the left of the photograph (labelled H) is a Maori Plaggen Soil probably used to grow kumaras. (*Photograph: G. Billing.*)

digging stick. Few plaggen soils are recorded for the Wairarapa region. In other parts of New Zealand they are often found because borrow pits, from which grit or gravel have been obtained, are conspicuous, being up to a metre or more deep, and because the soils themselves are distinctive. Their usual size is less than 2.5 ha.

Terraces. Occasionally garden sites are terraces (B.F. Leach 1979a). Terraces were used for many different purposes and their presence is not in itself sufficient evidence for gardening unless, like the Washpool terrace at the mouth of the Makotukutuku River at Palliser Bay (B.F. Leach 1979a), the soils on them are shown to have been gardened.

Shell middens vary from heaps to extensive layers of food refuse: shells and animal bones, generally with charcoal and oven stones. They are rarely conspicuous features in the Wairarapa landscape except when seen on eroding sand dunes. They are found only in coastal areas and rarely more than a few kilometres inland (Fig. 14).

Ovens are the remains of cooking fireplaces or hangi and are usually found as concentrations of burnt stones and charcoal. Farmers in inland Wairarapa reported many areas of oven stones to Keith Cairns, which they had found when they ploughed up river terraces.

Occupation layers are traces of occupation with charcoal and, rarely, oven stones, associated with, but more extensive than, middens. They are rarely visible at the ground surface, but are conspicuous in vertical sections exposed by erosion along the shoreline or along the banks of rivers and streams.

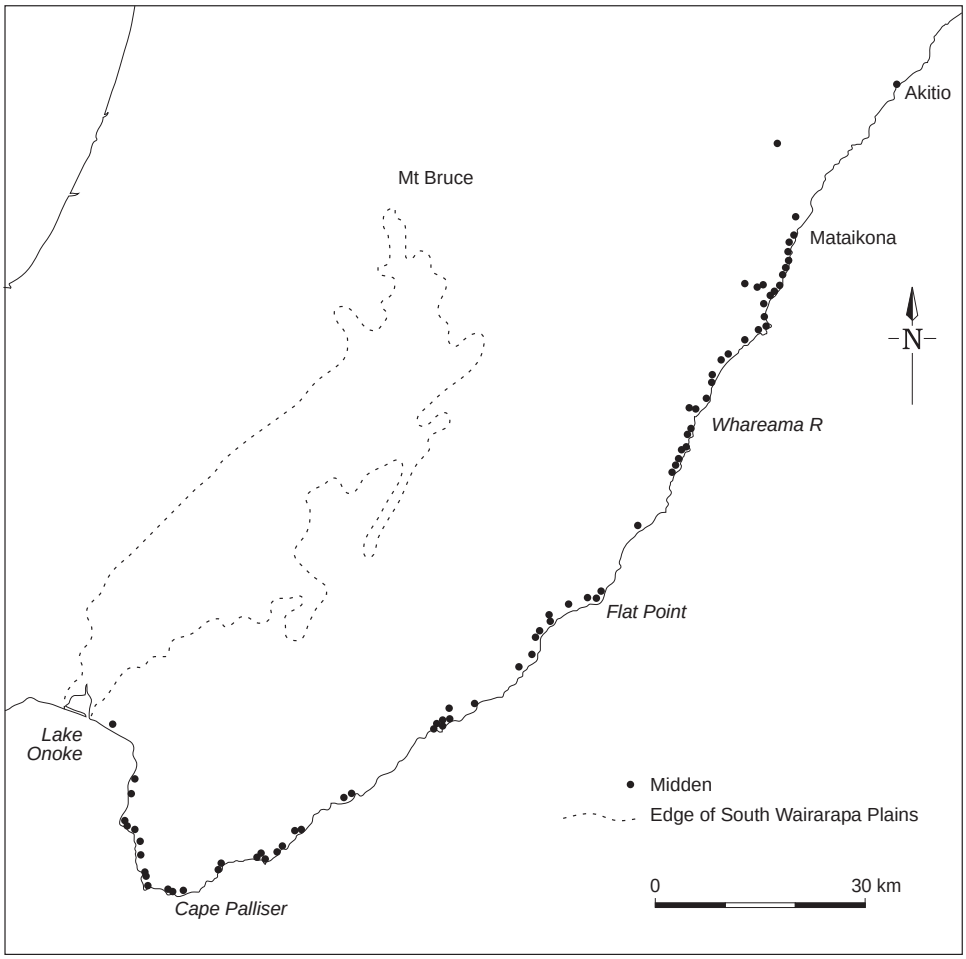

Figure 14. Distribution of sites with middens in the Wairarapa region. Dotted line = edge of the southern Wairarapa Plains. Note that because of the map scale, some dots represent more than one midden.

9. Archaeology

Flat Point marks a boundary in the geological character of the Wairarapa coast that is reflected by the recorded archaeology. From Akitio south to Flat Point the coastal rocks are generally soft, easily eroded Tertiary sandstones and mudstones (King 1930) and the beach deposits derived from them offer poor protection against wave erosion. Compared with the coast south of Flat Point the Holocene coastal platform is generally narrower or non-existent, cover beds of uplifted beach gravel and cobbles are rare, beach and wind-blown sands are common, and recorded archaeological sites are fewer. From Flat Point south to Cape Palliser and west into Palliser Bay the coastal rocks are generally harder greywacke and limestone (King 1930) and beach deposits derived from them are good protection against wave erosion. As a result, the Holocene coastal platform is wider, cover beds of uplifted beach gravel and cobbles are common, beach and dune sands uncommon, and archaeological sites more numerous.

In order to describe the archaeology of the Wairarapa Region, the region is divided into seven sub-regions. Because of the apparent influence of the coastal geology, the four sub-regions identified by Ota et al. (1987), defined by the ages and heights of the uplifted Holocene marine terraces, are used as a basis to describe the archaeology of the Wairarapa coast between Akitio and Cape Palliser. To these four coastal sub-regions is added a fifth coastal sub-region encompassing the Palliser Bay coast. The striking difference in the archaeology of these five sub-regions is the high proportion of garden sites south of Flat Point compared to their almost complete absence in the north (Fig. 15). This difference is partly due to the availability of beach cobbles in the uplifted shorelines south of Flat Point that were used to construct the highly visible and extensive stone row garden systems located on the coastal platform.

To the five coastal sub-regions are added two inland 'sub-regions' encompassing the Wairarapa Valley and the eastern hills bordering it. They are: the southern plains from Palliser Bay to Mt. Bruce, and the northern plains from Mt. Bruce to north of Pahiatua, referred to respectively as Masterton Basin and Pahiatua Basin (Kamp & Vucetich 1982). Clockwise from Akitio River to Lake Onoke the seven sub-regions are: Akitio River to Mataikona River, Mataikona River to Whareama River, Whareama River to Flat Point, Flat Point to Cape Palliser, Cape Palliser to Lake Onoke, the Masterton Basin, and the Pahiatua Basin. The description ends with a brief description of the archaeological remains in the Tararua Ranges.

Artifacts found on the coastal platform include types referred to as Archaic Maori, and types referred to as Classic Maori (Golson 1959). Archaic Maori artifacts are those that are generally considered to be from the earlier part of the prehistoric period. Classic Maori artifacts are those that are generally considered to be from the latter part of the prehistoric period or early historic period (after European contact). In the following description of the archaeology of the seven sub-regions, the terms 'Archaic' and 'Classic' are used for those artifacts that conform to the styles defined by Golson (1959), although in the case of the Wairarapa artifacts there is often no independent verification of age.

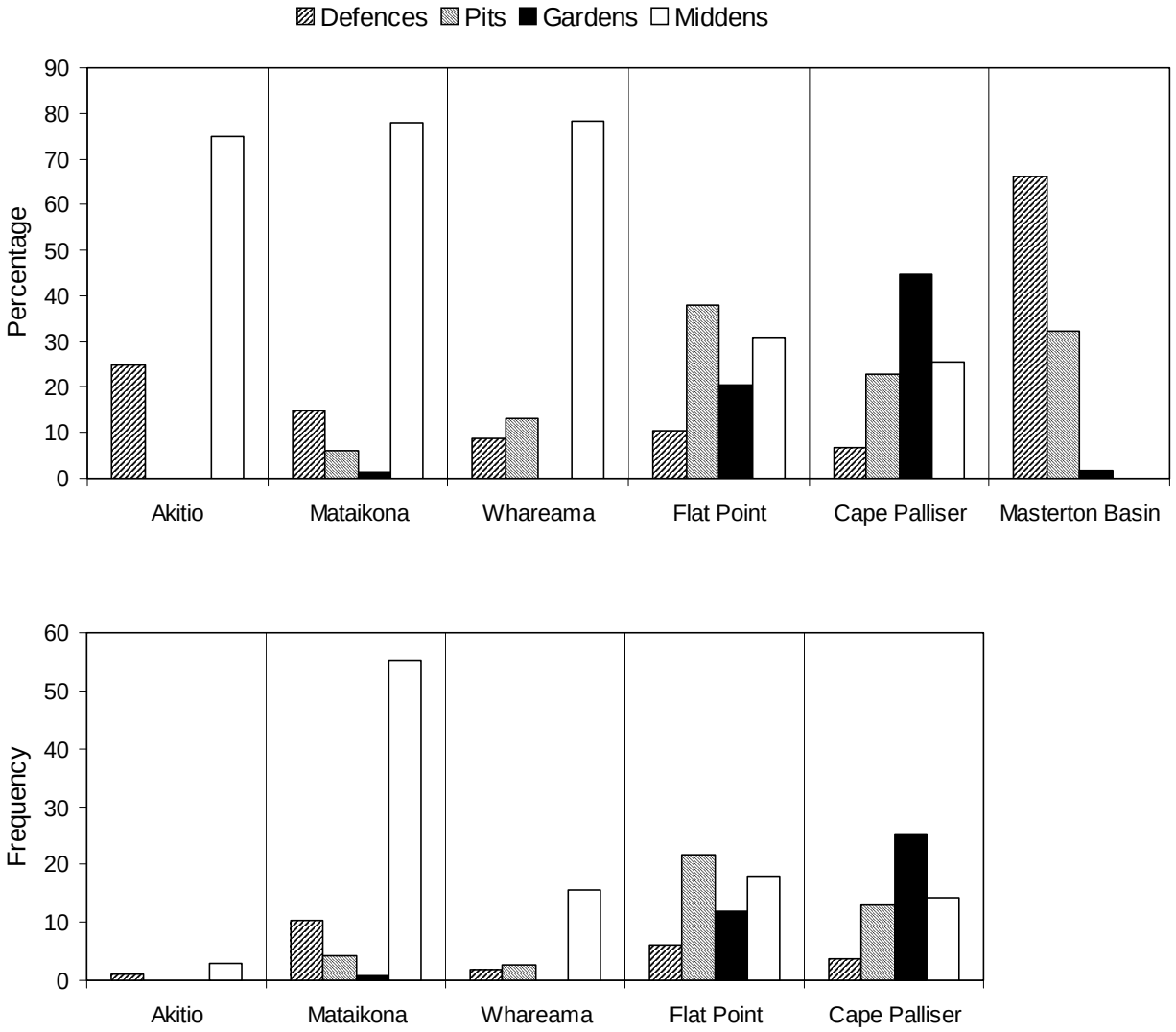

Figure 15. Comparison of the relative abundance of four archaeological site components—defences, pits, gardens, middens. For details see Appendix 7. **Top.** Within coastal sub-regions and the Masterton Basin (data normalised by expressing the numbers of each component in a sub-region as a percentage of the total components for the sub-region). The Pahiatua Basin is excluded because there is insufficient data. **Bottom.** Between coastal sub-regions (data normalised for distance along the coast). The Masterton and Pahiatua Basins are excluded because they are non-linear.

9.1 AKITIO TO MATAIKONA

The coastal platform is narrow or non-existent and in places fans extend from the cliffs to the sea (King 1932) (Fig. 16). The last uplift of the coast was about 1600 years ago (Ota et al. 1987). Site records indicate occupation at the mouths of the Akitio and Owahanga rivers where there are sand dunes, and river terraces provide flat land. The recorded occupation is sparse (five archaeological sites), but there are middens, ovens, terraces, and artifacts—flakes, and three bird spear points (K.R. Cairns unpubl. data)—at the mouth of the Akitio River;

Figure 16. Coastline south of Akitio (sub-region D). The coastal platform is narrow or non-existant and contrasts with the generally wide coastal platform between Flat Point and Lake Onoke (Fig. 17). There are few recorded archaeological sites on the coast. (*Photograph: B.G. McFadgen.*)

and middens, ovens and a pa at the mouth of the Owahanga River. Mounds of stone flakes and obsidian at the mouth of the Owahanga River are described as being up to 60 cm high (K.R. Cairns unpubl. data). Archaic Maori occupation is suggested by a one-piece bone fishhook point found in a midden on the coast about 1.5 km south of the Owahanga River mouth. The midden, in a sand dune, also contained large mammal bones, fish bones, rocky and sandy shore shellfish, pumice, and flakes of flint (K.R. Cairns' notes). Scarlett (1962) identifies moa bones, apparently from an archaeological site at Akitio, as *Anomalopteryx didiformis* but no site details are given. In historic times there was a small Maori village on the north bank of the Akitio River mouth that was visited by Colenso in his journeys up and down the coast, and potato gardens at Whakaraunuiotawhaki, about 11 km north of the Mataikona River (Bagnall & Petersen 1948).

9.2 MATAIKONA TO WHAREAMA

The coastal platform is up to 400 m wide and mostly backed by steep hills and cliffs of soft Tertiary sandstone and mudstone that rise in places to more than 100 m. It was most recently uplifted about 2100 years ago (Ota et al. 1987) and raised beaches are evident at the mouth of the Okau Stream (Brodie 1950). A notable feature is the intertidal rock platform produced by wave action (King 1930). The platform is a flat area crossed by slightly raised bands of harder rock which would have made canoe access to and from the beach a treacherous undertaking, especially when even a small sea was running. Between Mataikona and Castlepoint the coastal platform is largely covered with sand dunes—older dunes of slightly compacted sand, overlain by younger dunes of loose sand (Brodie 1950). Between Castlepoint and Whareama the coastal platform is a narrow beach at the foot of low coastal cliffs (King 1930).

There are 109 recorded archaeological sites, many only known from Keith Cairns' notes. Most sites are within a few hundred metres of the sea on the stretch of coast between Mataikona and Castlepoint. Major exceptions are a small number of pa, terraces, pits, ovens, middens, and karaka groves up the Mataikona River valley and some of its tributaries, middens up the Whakataki River valley, and a cluster of sites at the Whareama River mouth. Middens are the most commonly recorded archaeological remains (Figs. 14 and 15), and

reflect the availability of shellfish on the mainly rocky shore coast. The importance of Mataikona in prehistoric times is suggested by its 12 recorded pa (Fig. 9; Appendix 7), all but one are in the vicinity of Mataikona and its adjacent coast.

The sand dunes between Mataikona and Castlepoint contain archaeological remains, moa bones (identified as *Euryapteryx* sp.) and moa eggshell (Brodie 1950; Davis 1957). According to Brodie (1950), midden debris covered many hectares through the dunes, ovens were common, and occasionally human remains were found near them, but nowhere did he find midden remains in the older dunes, nor moa bones or eggshell in primary association with the middens or ovens. He nevertheless acknowledges the possibility that further work might demonstrate a primary association. Davis (1957) reported that the dunes in the vicinity of the Okau Stream are covered with scattered shells and beach boulders but she was uncertain whether they were of a cultural or a natural origin. Such deposits in dunes elsewhere on the New Zealand coast are considered as possible candidates for tsunami deposition (Scott Nichol, pers.comm.).

Notes kept by Keith Cairns over many years record remains uncovered by erosion and land development, and confirm and enlarge on Brodie's (1950) initial observations of extensive occupation in the dunes. Cairns describes middens containing moa bones and fragments of moa eggshell, but does not conclusively show a primary association between moa and humans. Some middens are stratified, with layers of shells, bones, charcoal and fire-burnt stones separated by layers of sterile sand (e.g. U26/24, Cairns & Walton 1992). Shellfish include both sandy shore and rocky shore species, including an unusual occurrence of rock oyster (possibly *Crassostrea glomerata*) not apparently found in middens elsewhere on the Wairarapa coast (K.R. Cairns unpubl. data). Many bones have been found in the middens and the animals identified (by whom it is not generally said) include moa, bird, dog, seals, human, blackfish (probably pilot whale), and fish. At least nine occurrences of human remains have been recorded, ranging from bones in and around middens, to burials including that of a child with a necklace of eight drilled paua pieces and a pendant or cloak pin of bone. Artifacts include fishhooks (some with serrated decoration) made from moa bone and human bones; pendants of greenstone and bone (moa or human); adzes; a bird spear; flakes and cores of obsidian and chert; necklaces (of imitation incisor teeth, and of drilled paua pieces).

There is no stratigraphic study of the sand dunes between Mataikona and Castlepoint, and no correlation with the dune building phases at Flat Point. However, radiocarbon ages of shell and charcoal from a midden site (U26/24) at Okau (Cairns & Walton 1992) indicate occupation of the coast during the 15th Century AD; and a spade-shouldered Duff (1977) Type 1B adze from the midden (Cairns & Walton 1992) indicates that the occupation was Archaic Maori.

The Okau midden site comprised three occupation layers separated by sterile sand. The sterile sand layers were possibly up to 0.5 m thick and, in common with sterile layers noted in archaeological reports generally, received only scant attention. In view of the environmental processes that affect the Wairarapa coast they need further study. The three occupation layers and their respective

overlying sand layers represent three successive occupations and abandonments of the same site and it would be useful to know whether or not the abandonments were because of the events that deposited the sand.

Radiocarbon ages of shells from a midden site (U26/17) at Castlepoint (Cairns & Lockerbie 1980) indicate an occupation during the mid 16th Century; and radiocarbon ages of shell and charcoal from a small terrace site (U26/14) at Okau (Cairns 1980) date to an occupation during the mid 17th Century. The coast was occupied at the time of European settlement—Colenso reports small Maori settlements at Mataikona, Paroutawhao, and Waiorongo near Castlepoint (Bagnall & Petersen 1948).

Although Colenso refers to potato gardens at Mataikona in 1843 (Bagnall & Petersen 1948), the archaeological evidence for gardening, either historic or prehistoric, is virtually absent. Two pit sites are reported up the Mataikona River valley (Fig. 11), and a stone row system and nearby pits about 2 km north of Whareama River (Fig. 12). Mitcalfe (1968a) draws attention to stony valleys with sloping, sunny, well-drained sites and comments on the absence of stone row garden areas like those south of Flat Point. He suggests that, unlike the coast between Flat Point and Whatarangi where coastal soils were gardened, people who occupied the coast south of Mataikona gardened inland and visited the coast to gather seafood. Before valid comparisons can be made with the southern Wairarapa coast, more systematic recording and excavation needs to be carried out.

9.3 WHAREAMA TO FLAT POINT

Between Whareama and Flat Point soft, easily eroded Tertiary mudstone and sandstone rocks form a series of low cliffs at the foot of which is a narrow beach (King 1932). The coast was last uplifted about 500 years ago (Appendix 3) and uplifted shorelines are evident at Uruti Point and Flat Point (Ota et al. 1987). From Whareama to Uruti Point the beach is sandy. There are dunes at Uruti Point in which there are well-rounded pebbles of igneous rock (King 1932). There are no igneous rock outcrops near the locality (King 1932) and the deposits may be possible candidates for tsunami deposition. South of Uruti Point the beach changes to a steep boulder beach between the Kaiwhata River and Flat Point (King 1932). No correlation has been made between the dunes at Uruti Point and those at Flat Point.

There are 34 sites recorded for this stretch of coast. Shell middens are very common (Figs. 14 and 15) and most are between Whareama River and Riversdale, and in the Flat Point sand dunes. Pits are recorded at Whareama River mouth, inland from Riversdale Beach, and at Uruti Point and Flat Point. On the south bank of the Te Unu Unu Stream at Flat Point, just inland from where the stream leaves the hills to cross the coastal platform, a very large storage pit today marks the site of an historic Maori village occupied in the late 19th Century AD. Three pa are recorded at or near the coast, two in the vicinity of Whareama River mouth, one at the Kaiwhata River mouth.

The Tamatean and Ohuan soils at Flat Point (Fig. 4) both have archaeological remains on them. Land snails extracted from middens on the Tamatean and

Ohuan soils reveal changes in coastal vegetation between the two soils (McFadgen 1985). An oven in Tamatean Soil exposed in the bank of the Te Unu Unu Stream contained a moa claw (Appendix 6) and is one of the few instances on the coast where humans and moa are shown to have been contemporary.

About 1.5 km south of the Whareama River mouth, on a broad, low-lying sandy promontory, Keith Cairns recorded a site c. 300 m by 300 m containing a wide variety of archaeological remains: hut sites; hearth stones; midden shells; bones of humans, moa, and fish; chert and obsidian flakes; and numerous charcoal layers. In the general vicinity of the River, he reported finds of adzes including an Archaic hogback adze about 1.5 km up the Whareama River.

These finds, and the small reported concentration of stone row gardens, pits, and pa sites at and just north of the Whareama River mouth, together with the middens and other signs of occupation along the coast between Whareama River and Riversdale, suggest that this stretch of coast is potentially important. Like the stretch of coast between Castlepoint and Mataikona, the Whareama River mouth and adjacent coast has sand dunes containing moa bones and occupation layers, and evidence of Archaic Maori occupation. In addition, there appears to be some sparse evidence of gardening, which was absent from the Mataikona coast. There is a need for both stretches of coast to be systematically site-surveyed because it is possible that both stretches will provide evidence of early Maori occupation for comparison with the area between Flat Point and Whatarangi.

9.4 FLAT POINT TO CAPE PALLISER

Between Flat Point and Cape Palliser the hills of soft Tertiary sandstone and mudstone give way to harder limestone and greywacke, and between the hills and the sea is a well-defined coastal platform that is up to 1 km wide in places (Fig. 17). For the most part the coastal platform is continuous and covered with uplifted beach ridge deposits, sand dunes, and stream fans. The coast has been uplifted twice since human settlement, first during the late 15th Century AD, then possibly around 1800 AD.

There are records for 174 sites between Flat Point and Cape Palliser. Sites are concentrated on the coastal platform, particularly near places where streams emerge from the hills, the largest concentration being at the mouth of the Pahaoa River. The most common archaeological remains are of gardening—storage pits, soils, and stone row systems. There are proportionately fewer middens than on the coast further north (Fig. 15), possibly because of a greater emphasis on gardening in prehistoric times. About half the pa sites contain pits, and some stone row systems such as at Waikekino and Pukuroro are close to pa sites. Mitcalfe (1968b) commented on the proximity of stone row gardens to pa sites, even though concealment and protection of the gardens did not seem to have been an important factor. But while the association of pits and gardens with pa sites may reflect the significance of the coast for gardening, and hence the need to defend good soils, the relationship between pa and gardens on the coast is yet to be defined.

Figure 17. Coastline south of Pahaoa (sub-region A). The coastal platform in the middle distance is typical of most of the coastline between Flat Point and Lake Onoke. There are many recorded archaeological sites on the coastal platform and on the hill slopes immediately behind. (*Photograph: B.G. McFadgen.*)

As well as friable, cultivable soils and marine foods, the resources of the coast south of Flat Point also included chert, a dense cryptocrystalline rock that was widely used for drill points and small cutting and scraping tools (Keyes 1970). It is found as nodules and beds in the Mungaroa Limestone Formation in at least eight localities between Flat Point and Cape Palliser (Keyes 1970, 1972). Chert was flaked and worked at many sites along the Wairarapa coast, especially at river mouths (Keyes 1970, 1972; K. Prickett 1979). A quarry at the junction of the Pahaoa and Wainuioru Rivers was marked for many years by large mounds of flakes and chips (Sutherland 1947), but the other sources show no signs of quarrying (Keyes 1970) and much of the chert may, therefore, have been picked up as nodules from stream banks.

Artifacts found on the coastal platform include both Archaic and Classic types. Barrow (1959) describes an unusual Archaic style shell tiki found with a burial near Honeycomb Rock, and Cairns (K.R. Cairns unpubl. data) reports finds of one-piece fishhooks in bone and greenstone, minnow lure shanks, and adzes.

From time to time coastal and fluvial erosion of the coastal platform have exposed sections that contain deposits of archaeological signficance (Cairns 1959; McFadgen 1985). Shell middens on the Tamatean and Ohuan soils in stream fan sections contain land snails that indicate changes in coastal vegetation (McFadgen 1985). Marine deposits that interfinger with Ohuan fluvial deposits in the left bank of the Oroi Stream (McFadgen 1985) include a layer of fine gravels extending 50 m inland from the present beach that are possibly the result of a storm surge or tsunami. Radiocarbon dates for shell middens on Tamatean soil buried by Ohuan alluvium indicate occupation during the 15th Century AD at Te Awaiti (McFadgen 1985) and at Te Oroi (Table 1).

Lagoon deposits exposed by the erosion of Beach Ridge C (McFadgen 1985; Appendix 3) indicate the presence of sometimes extensive bodies of fresh or brackish water on the coastal platform that would have been an important source of food, and raw materials for artifacts. Bones from the lagoon deposits show that moa were living on the coast after human settlement, as well as a range of other birds and animals (Appendix 5).

TABLE 1. RADIOCARBON DATE FOR SHELL MIDDEN ON TAMATEAN SOIL AT TE OROI[1].

LABORATORY NUMBER	CRA[2] (YEARS BP)	D[13]C (PPM)	CALIBRATED AGE RANGE[3] (YEARS AD)	MATERIAL DATED
Wk9696	825 ± 37	2.2 ± 0.2	1422–1521 (95%) 1443–1490 (67%)	Paua shells (*Haliotis iris*)

[1] Section 3 shown by Fig. A3.1 in Appendix 3.
[2] Conventional Radiocarbon Age (Stuiver & Polach 1977).
[3] ΔR = –30 ± 15 (McFadgen & Manning 1990).

Glenburn would seem to hold most potential for further stratigraphic study of coastal archaeology and environment. On the coastal platform there are deposits of stream alluvium, and sand dunes extend for about 5 km south along the coast from Flat Point. The dunes contain archaeological remains including burials; Archaic and Classic styles of artifacts; greenstone artifacts; drill points; middens with shells, charcoal, oven stones, bird bones, moa bones and eggshell, chert flakes, and obsidian; and garden sites including stone row systems and pits. It is possible that sites on buried Tamatean and Ohuan soils in the dunes will be relatively intact, not having been subjected to the ravages of wind erosion, stock damage, and fossicking that have affected the more exposed sites.

Three stone row systems have been excavated: Waikekino (Mitcalfe 1970), Okoropunga (McFadgen 1980a, b), and Tora (Mitcalfe 1968b). Waikekino is not a typical stone row system. It is on the bank of a stream, and the rows and mounds, made of river stones and boulders, are much higher and wider than in other stone row systems on the coast and appear to be rough stone walls. Some of the ground between the rows has been lowered at the inland end to form broad terraces that the rough stone walls partly surround. Both rows and mounds contained cultural detritus such as broken artifacts and a midden, and the soil between rows was greasy (Mitcalfe 1970), suggesting that the ground between the rows had been gardened. Charcoal was found 30 cm deep between the rows at Tora (Mitcalfe 1968b), again suggesting that the ground had been gardened, but there is a possibility that the charcoal may be from some earlier activity on the site (cf. McFadgen 1982)

The situation at Okoropunga is different. People went to considerable effort to build the stone row systems. They mined stones from the beach ridges, leaving borrow pits along the crests (Fig. 13), then used the stones to construct the cores of the rows which they covered with soil (McFadgen 1980a). There is no evidence of soil disturbance, such as deepening and lightening of the topsoil horizon, the addition of sand or gravel, or a hummocky ground surface (McFadgen 1980a), that might be expected from gardening between the rows.

H.M. Leach (1984) has suggested that the wind might have blown away the top of the soil and removed the evidence for soil disturbance. Two nearby plaggen soils indicate the depth of soil disturbance caused by gardening. The plaggen soils are between 20 cm and 45 cm thick (McFadgen 1980a) and this much soil would need to be blown away from between the stone rows if all traces of soil disturbance from gardening were to be removed. The Okoropunga environ-

ment, however, is one of deposition not erosion (McFadgen 1980a) and there is no evidence for soil erosion on the scale postulated. Jones (1994) interpreted the stone rows at Okoropunga as delineating garden boundaries but his interpretation is misleading. On the contrary, Okoropunga shows that it was not necessary for stone rows to enclose cultivated ground, and that it was the rows themselves that were the focus of attention as a place for growing plants.

The Okoropunga stone rows were possibly in use before the late 15th Century uplift, indicated by two radiocarbon ages of mid to late 15th Century AD for charcoals in and beneath a stone row near the hills (McFadgen 1980a). Some of the rows at Okoropunga, and also at Pukuroro about 2 km to the north, are built across Beach Ridge C, indicating that stone row systems were also in use after the late 15th Century uplift. Following the late 15th Century uplift but before the uplift of Beach Ridge B there are signs that the stone row system at Okoropunga may have been struck by a tsunami that buried stone rows and infilled a borrow pit (Goff & McFadgen 2001). The tsunami is inferred from photographic evidence (Fig. 18) and needs to be checked in the field. If a tsunami event is confirmed, then Okoropunga is an important site for dating a significant catastrophic event that would have affected all of the Wairarapa coast and the human settlements located on it.

Occupation of the coast in historic times was sparse. Colenso refers to small Maori settlements at Wharaurangi, Pahaoa River mouth, Huariki, and Te Oroi (Bagnall & Petersen 1948). At each of these places today there are archaeological remains, although it is not always clear whether the remains are from the settlements of Colenso's time or earlier.

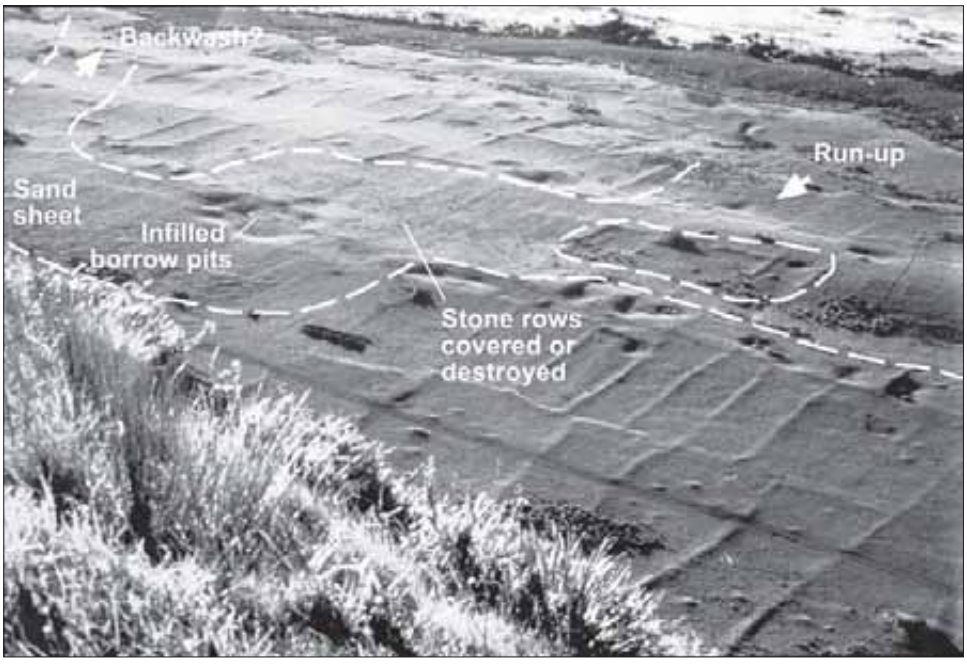

Figure 18. Okoropunga stone row system showing inferred tsunami run-up. Between the inland and seaward stone rows is a partly infilled borrow pit and stone rows that appear to have been partly buried. Near the back of the coastal platform is a sheet of sand estimated to be between 300 and 500 years old. The partly buried rows, infilled borrow pit, and sand sheet are consistent with the run-up and backwash of a catastrophic salt water inundation, or a tsunami event. This event, which probably took place sometime between the late 15th and early 16th centuries AD, has been identified only from photographs and needs to be verified in the field. (*Photograph: G. Billing.*)

9.5 CAPE PALLISER TO LAKE ONOKE

Between Cape Palliser and Whatarangi the coastal platform is up to several hundred metres wide and nearly continuous, with cover beds of uplifted beach ridges, stream fans, and sand derived from the hard greywacke rocks that form the hills behind it. It is highest in the east and gradually falls away westwards. From Whatarangi to the northeast corner of Palliser Bay there is no coastal platform and actively eroding cliffs of soft Tertiary mudstone rise straight from the sea. From the northeast corner of the bay to Whangaimoana, and beyond to the northwest corner, there is a narrow beach of coarse sand. There are no dates for the uplift of the beach ridges between Cape Palliser and Whatarangi. The coastal platform, however, forms the southern flank of the block between Cape Palliser and Flat Point and the ridges were probably uplifted at the same times as those between Cape Palliser and Flat Point.

There are records for 85 archaeological sites between Cape Palliser and Lake Onoke. The sites are concentrated on the coastal platform from Cape Palliser to just beyond Whatarangi, and up the Otakaha and Makotukutuku Streams. As in the stretch of coast between Flat Point and Cape Palliser, the most common archaeological remains here are of gardening—storage pits, soils and stone row systems (Fig. 15). From just beyond Whatarangi to Lake Onoke the few recorded sites include a pa, pits, and a stone row system at or near the coast, and stone rows and a house site inland in the Moikau Valley. No sites are recorded between Lake Onoke and northwest Palliser Bay, where the beach is new and comprised largely of material washed out to the sea following the 1855 AD Wellington earthquake.

Adkin (1955) drew attention to an apparently high density of settlement in eastern Palliser Bay and found artifacts of typical archaic forms, many of which ended up in private hands or in the Museum of New Zealand collection (Leach 1981). Four burials, one with a shark's tooth necklace, were excavated at the mouth of the Pararaki River in the 1950s and 1960s (Davis 1959; Cairns 1971; Leach 1981; Walton 1994). Wellman (1962b) describes a wave-cut section about 3 km west of Cape Palliser lighthouse with moa bone (*Euryapteryx geranoides*) and oven stones near the top. He thought that the moa bone was probably younger than human settlement, and that the coast was extremely windswept and so inhospitable that the human population was probably quite small.

During the 1969 and 1972 University of Otago research programme in the Wairarapa area, sites were surveyed over 1700 km^2 in eastern Palliser Bay and the lower Wairarapa Valley. Some 25 sites were excavated (Leach 1981), including houses, shell middens, pits, terraces, gardens, a campsite, burials, and the ubiquitous and distinctive stone rows (B.F. Leach & H.M. Leach 1979a). What followed was a notably wide-ranging and detailed series of papers that described the excavations (B.F. Leach 1979a; H.M. Leach 1979a; N.J. Prickett 1979) and interpreted the archaeology of the Palliser Bay communities, delving into the protohistoric period (Mair 1979), development of whare puni in New Zealand (N.J. Prickett 1979), use of stone resources (Ward 1974; Leach & Anderson 1978; H.M. Leach 1979c; Leach & de Souza 1979; K. Prickett 1979), horticulture (H.M. Leach 1979a, b), hunting of sea mammals (Smith 1979, 1989), methods and strategies adopted for exploiting food resources (Anderson

1979, 1981; B.F. Leach 1979b, c; Leach & Anderson 1979a), and the impact of exploitation on natural food resources (Leach & Anderson 1979b), prehistoric environment (H.M. Leach & B.F. Leach 1979; Wallace 1979), people's health, mortality and burial practices (B.F. Leach & H.M. Leach 1979c; Sutton 1979), and settlement patterns and social relationships (B.F. Leach & H.M. Leach 1979d). The picture that emerges is of a series of small communities located at stream mouths and up stream valleys, linked by trading networks to communities in other parts of New Zealand, making a precarious living based on gardening, hunting and gathering, and very susceptible to the weather and to changes in their environment.

The human population of the sub-region in the early prehistoric times is estimated to have been about 300, based on the inferred area of stone rows being gardened (Leach 1981). This figure may be somewhat high depending on the interpretation placed on the stone row gardens. H.M. Leach (1979a), after a comprehensive and detailed archaeological analysis of the stone row systems, interpreted the rows as the boundaries of garden plots. She described soil disturbance, which is consistent with gardening; and on a stream fan at Black Rocks, she described soil profiles between stone rows that contained water-worn pebbles which she believed people transported from the beach below.

The soil disturbance, however, is described only within about 1.5 m of the excavated stone rows, and is close enough to the rows to be a result of either row construction or some use which focused on the rows rather than the plots of ground between them. Except for the north bank of the Pararaki River, the ground further out in the plots is untested. At Pararaki, seven test pits excavated along an uplifted beach ridge with stone rows on it all showed a soil horizon, covered with layers of colluvium and sand, into which charcoal had been incorporated. H.M. Leach's inference was that gardening incorporated the charcoal, which is not unreasonable if other mechanisms such as soil biological activity following burning of coastal vegetation could be ruled out, and it could be shown that other soil characteristics were modified.

The modified soil horizon in all pits was less than 16 cm thick (Leach 1976, see figure 29), and considerably less than the 40+ cm depth reported for the cultivated layer on a garden terrace at the mouth of the Makotukutuku River (B.F. Leach 1979a). The garden terrace showed a disturbed lower contact and digging stick penetration (B.F. Leach 1979a), both of which were absent from the test pits, and H.M. Leach (1976, p. 69) notes that the presence of charcoal does not necessarily imply gardening. Furthermore, the water-worn pebbles at Black Rocks almost certainly have a natural origin. The pebbles can be seen throughout the fan deposits in road cuttings and stream banks, and can be traced to the raised marine terrace at the top of the cliffs. Pedological evidence for gardening between the rows in Palliser Bay is thus not strong. Bearing in mind that Okoropunga shows that stone rows do not invariably enclose cultivated ground, the same presumably applies to the Palliser Bay stone rows. The estimate of 300 people should, therefore, be considered a maximum.

If stone rows do not invariably enclose cultivated ground, then questions arise about what purpose the rows served and how they were built. Some may have been garden boundaries, as inferred by H.M. Leach (1979a), or plants may have been grown on top of them, as inferred by McFadgen (1980a). The issue of how

they were built concerns whether or not they were made from stones derived from ground clearance. The ground clearance hypothesis requires proof that the stones were in the soil before the rows were built, which is not necessarily the case, as shown by Okoropunga. Large depressions near many Palliser Bay stone row systems (H.M. Leach 1979a) suggest that some stones in Palliser Bay may have been mined from the beach ridges. If this proves to be so, then attention focuses on the rows themselves. H.M. Leach (1979a) and McFadgen (1980a) have provided alternative testable models about why and how the rows were built, and a basis of observation from which further work can proceed.

The Palliser Bay excavations provided considerable data on environmental changes and changes in prehistoric occupation that were explained in terms of human impact on the landscape and a climate change from a relatively calm, warmer period to a stormy cooler period (B.F. Leach & H.M. Leach 1979a). From an initial settlement sometime during the mid 14th Century AD (Anderson 1991; Appendix 2), the Palliser Bay coastline was abandoned in the 15th Century AD (Goff & McFadgen 2001). Subsistence activities of the early prehistoric inhabitants of Palliser Bay were based on horticulture, and hunting and gathering. The crops grown were probably the subtropical kumara and gourds (H.M. Leach 1979a). Having been brought from tropical Polynesia, they would have been difficult to grow in New Zealand's temperate climate, especially in the southern parts of the country (Davidson 1984). Changes in temperature and storminess brought about by climatic fluctuations may have influenced prehistoric horticulture, and in the 1970s when the Palliser Bay research was carried out, climate deterioration coupled with human impact seemed to be a plausible explanation for change.

Much of the explanation for the environmental changes, however, relied upon the influence of a cooling climate that purportedly paralleled the Northern Hemisphere's 'Little Ice Age' (Leach 1981). Burrows (1982) highlighted the lack of correlative climatic data from New Zealand and the inappropriate use of Northern Hemisphere work by the primarily climatic explanation. More recent New Zealand research indicates that a correlation with the Northern Hemisphere's 'Little Ice Age' is unlikely. Eden & Page (1998) found a climatically warm period in the mid to late 16th Century AD (a period corresponding to the 'Little Ice Age'), that coincides with the timing of the climatic deterioration invoked by H.M. Leach & B.F. Leach (1979). Furthermore, Newnham et al. (1998) found pollen evidence in the North Island, which they consider suggests that the 'Little Ice Age' climatic deterioration occurred between the late 1600s and early 1800s, considerably later than the timing of site abandonment.

Today, however, much more is known about the impacts of seismic activity. Environmental changes in the 15th Century AD around Palliser Bay, inferred from archaeological research, parallel those that were observed in 1855 AD. On this basis, Goff & McFadgen (2001), in a reanalysis of the evidence from Palliser Bay, consider that devastation caused by large earthquakes and their aftermath, rather than climatic deterioration, precipitated the rapid abandonment of the area by human communities in the 15th Century AD.

The coastal platform was reoccupied before the end of the prehistoric period but apparently not by very many people or for very long at a time. There is very

little archaeological evidence for the late prehistoric period and that which exists suggests occupation from time to time by fishing parties (Leach 1981). Late radiocarbon dates for two pits at the Makotukutuku River, one a circular pit with a raised rim close to a garden terrace near the river mouth, the other a rectangular raised rim pit some distance upstream (B.F. Leach 1979a), suggest that the occupation may also have involved gardening.

At the time of European settlement there was a small fishing village on the coast at Okorewa, just east of Lake Onoke, and a whaling station and small port at Te Kopi, both visited by Colenso (Bagnall & Petersen 1948). The Okorewa valley contains marine sand and gravel thought to have been deposited by the tsunami that followed the 1855 AD earthquake (Goff et al. 1998). If the age of the deposit is correct then the Okorewa village would almost certainly have been destroyed by the tsunami, which penetrated more than 1.5 km up the Okorewa valley; however, it is possible that the deposits date from the 15th Century event.

9.6 WAIRARAPA VALLEY TO MASTERTON BASIN

The Masterton Basin is a geological depression 77 km long and 20 km wide. Most of the hills in the basin are east of the Ruamahanga River and are composed of loess-covered, folded and faulted mid-Pleistocene terrestrial deposits and older shallow marine sediments (Kamp & Vucetich 1982). West of the Ruamahanga River the Tauherenikau, Waiohine, Waingawa, and Waipoua Rivers (Fig. 19) form large coalescing gravel fans of pre-Holocene and Holocene age (Vella 1963; Warnes 1992), the growth of which has forced the Ruamahanga River against the hilly topography to the east. The Waiohine and Rosebank fans have a stony surface and no loess cover, and are thought to be only slightly older than the Holocene (Kamp & Vucetich 1982).

The 116 archaeological sites recorded for the Masterton Basin are located mostly on the eastern side of the valley, with only a small scattering on the western side (Fig. 19). The most common sites are pa and ovens, and sites related to gardening—storage pits and garden soils. Middens are rare in the Basin (Fig. 15).

The pa and gardens along the Ruamahanga River south of a line through Carterton, and those between the south end of the Wairarapa Valley and the Aorangi Mountains, are nearly all historic sites that were occupied about the time of European settlement (Appendix 1, Table A1.3). Pit sites, which cluster at the southern end of the valley, are recorded from archaeological field remains and are located in close proximity to the historic sites. Many of the pits have a raised rim, which is thought to be a late introduction into the southern Wairarapa (H.M. Leach 1979b).

Nearly all of the sites north of a line through Carterton were recorded by Keith Cairns, but were not entered into the New Zealand Archaeological Association site recording scheme (Appendix 1). They include the location of artifact finds, ovens, pa sites, a village, a pit, and a burial. Many other sites are known only by road name or landowner name and, on the details recorded, cannot be given a precise location. All of these sites need to be checked in the field and, where confirmed, added to the New Zealand Archaeological Association's site files.

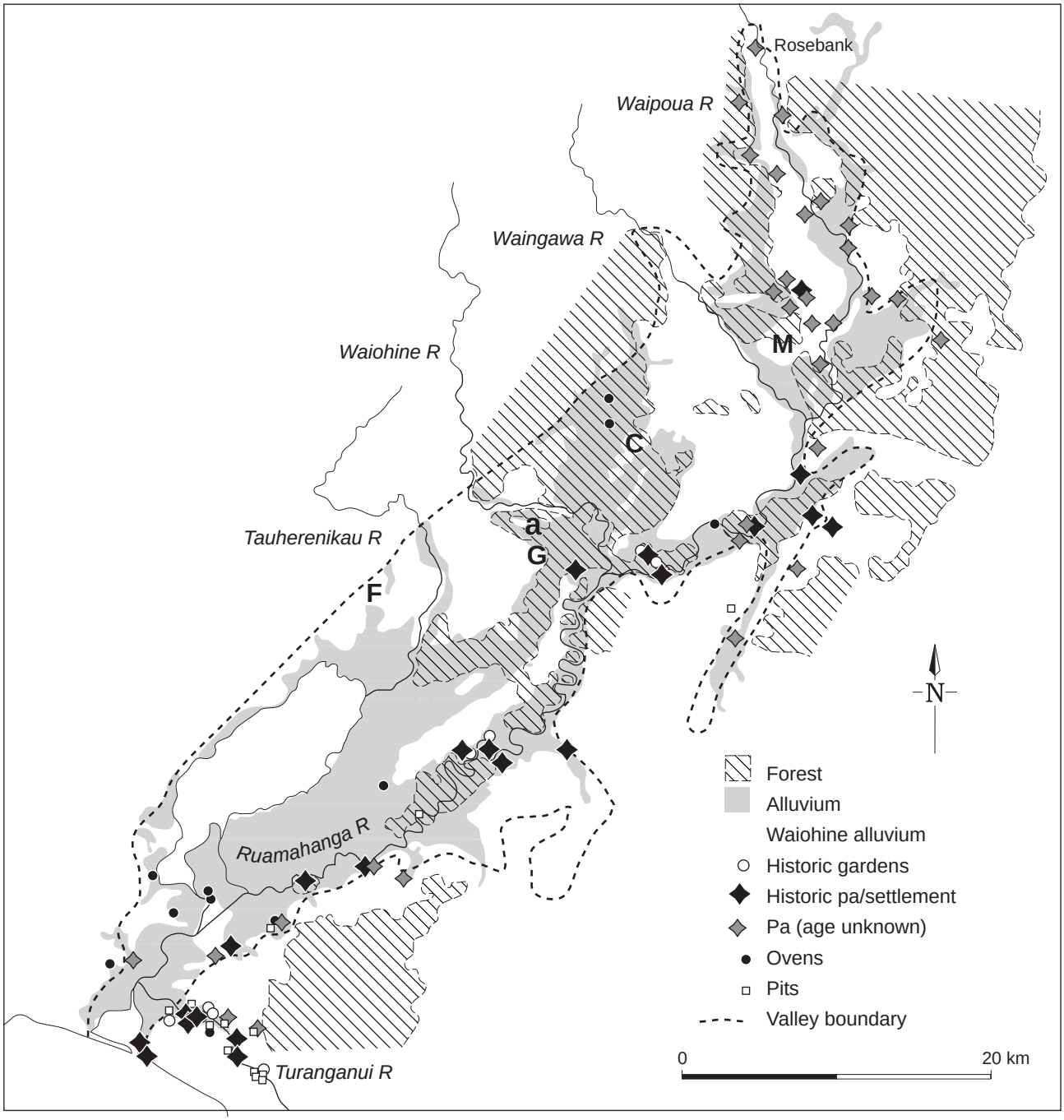

Figure 19. Sediments in the main Wairarapa Valley in relation to forest edge in the mid 19th Century. Note the correspondence between the Waiohine alluvium and forest edge.
M = Masterton; C = Carterton; G = Greytown; F = Featherston; a = small area of cleared Waiohine alluvium near Greytown mentioned in Section 9.6, p. 41.

Forest cover in the Wairarapa Valley in the early years of European settlement is recorded from early maps. At the time of European settlement, forest was absent from nearly all of the Waiohine alluvium and from some areas of pre-Waiohine alluvium (Fig. 19) and these areas carried manuka (*Leptospermum scoparium*), fern (*Pteridium esculentum*), grass, and flax (*Phormium* spp.) (Bannister 1940; Mair 1972). Much of the land along the Ruamahanga River was covered in dense bush, with settlements and gardens in clearings. North of a line through Featherston, forest was present on all but a few patches of

Holocene alluvium, the most extensive absence being around Masterton where the alluvium carried fern, grass, and flax (Smith 1853; Mair 1972). Forest was almost entirely absent from swamplands east and south of Lake Wairarapa, and the vegetation was mostly sedges and grasses including toe-toe (*Cortaderia* spp.), raupo (*Typha orientalis*), and flax (Hill 1963). However, as this area flooded when the Lake Onoke outlet was blocked (Kite 1952), and the vegetation could withstand frequent flooding (A. Townsend pers. comm.), it may be the natural vegetation.

The absence of forest from the Waiohine alluvium is puzzling. The alluvium tends to be on the western side of the valley and, except north of Masterton, nearly all of the known archaeological sites are located along the eastern side. The possibility that even after 10 000 years the Waiohine alluvium was never forested can be dismissed. There is forest cover on the alluvium north of Greytown, and Bannister (1940) reported finding old totara tree roots and burnt tree stumps on the Opaki and Taratahi Plains near Masterton. The surface of the Waiohine alluvium is stony and may have been attractive to Maori, who had established gardens on stony alluvial fans in Palliser Bay. It may be pertinent that two small patches of Waiohine alluvium near Greytown (shown as location a in Fig. 19), coincide with two small forest clearings and, for modern horticulture at least, are some of the most fertile soils near Greytown (Cowie & Money 1965). If Maori had wanted to cultivate the Waiohine alluvium, then they would have needed to clear the forest first.

Bannister (1940) refers to a Maori tradition that the Wairarapa Valley was covered with totara forest which was burned about 1600 AD. Whether or not the forest was accidently burned, or deliberately burned to clear land for horticulture, the archaeological remains indicate that Maori utilised the alluvial fans for some purpose. Keith Cairns' notes refer to many ovens ploughed up on the Taratahi Plains near Masterton, and to adzes found near Francis Line 4–5 km northeast of Carterton. The remains were on lands that had been cleared, but they were not necessarily from occupation following clearance. His notes also refer to ovens, middens, and artifacts from near the Mangatarere Stream, 2–3 km northwest of Carterton, that were on land that was still forest-covered at the time of European settlement. If Maori cleared forest on the Waiohine alluvium, then some record of forest clearance and fire should be preserved in peat deposits. If the alluvium was gardened, then garden sites may still be present. If it were not gardened, then the types of sites may give some indication of what the alluvial fans were used for. There is a need for pollen cores to establish the vegetation history, and for systematic site surveying to extend the recording begun in the south by the University of Otago to places further north in the valley, paying particular attention to the Waiohine alluvium.

9.7 WAIRARAPA VALLEY TO PAHIATUA BASIN

The Pahiatua Basin from Eketahuna north to the Manawatu River comprises two, broad, terraced river valleys, the Mangahao and Mangatainoka (Fig. 20), running more or less parallel from southwest to northeast, separated by a low ridge (Kamp & Vucetich 1982). The rivers run in two fault-angle depressions

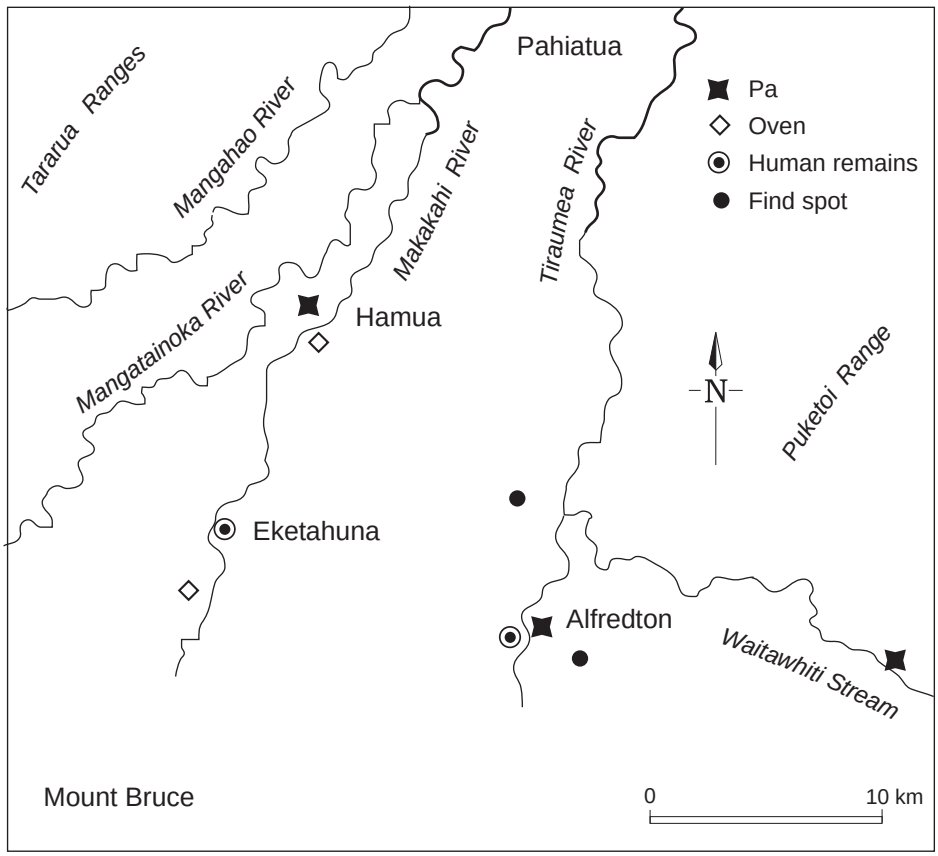

Figure 20. Archaeological site types and their distribution in the Pahiatua Basin sub-region.

formed by the uplift of the eastern sides of three northeast-trending faults, of which one is the Wellington Fault that extends from the Cook Strait to north of Hawke's Bay. Two prominent aggradation surfaces, the Eketahuna (pre-Holocene) and Hukanui (early Holocene), are found in all major valleys (Neef 1974), along with less prominent and younger Holocene aggradation deposits. During the Holocene, rivers have cut down their beds as much as 45 m below the Hukanui surface, forming minor gorges.

The basin was extensively forested at the time of European settlement, with few clearings. The forest, which was the southern part of the Seventy Mile Bush, began just north of Masterton and extended northwards into southern Hawke's Bay (Ropiha 1994). Early accounts (e.g. Smith 1853) describe heavy forest with rimu (*Dacrydium cupressinum*), totara, rata (*Metrosideros robusta*), tawa (*Beilschmiedia tawa*), kahikatea (*Dacrycarpus dacrydioides*), miro (*Prumnopitys ferruginea*), white birch (genus unknown) and supplejack (*Ripogonum scandens*), few tracks, and very difficult to traverse. The larger clearings were at Eketahuna (c. 5 ha) (Smith 1853), Te Hawera (present-day Hamua, c. 12 ha) (Bagnall & Petersen 1948), and Alfredton (Fig. 20; Alexander Turnbull Library Map W24).

The first Europeans to visit the basin found it occupied by Maori, albeit in small numbers. The inhabitants had retreated into the bush during the troubled times a decade or so earlier, and with the promise of more settled times were beginning to re-emerge (Bagnall & Petersen 1948). In 1842, two New Zealand Company Surveyors, Kettle and Wills, journeyed through the basin. They

described potato gardens along the Mangahao and an old bush hut near present-day Pahiatua (Bagnall 1976). Colenso visited Te Hawera in 1846 (Bagnall & Petersen 1948) and met with 41 people, who also included the residents of Ihuraua (near Alfredton) half a day's journey to the east. Colenso also refers to bark huts in the forest previously used by kaka hunters (Bagnall & Petersen 1948).

Keith Cairns reported archaeological remains from the basin but few are given precise location details. Nevertheless, there is sufficient information to indicate occupation both in and around the larger clearings and further afield.

The remains are varied (Appendix 7). They are mainly pa sites, ovens, and artifacts, and they are found from Mt. Bruce in the south to Pahiatua in the north. Two reports are of moa bones associated with ovens, one at Konini and one (*Anomalopteryx* bones) at Rangitumau. There is no indication of the age of any of the finds, and for most it is not known whether they are prehistoric or historic. They indicate the need for systematic site surveys.

9.8 TARARUA RANGES

Maori trails across the Tararua Ranges between the Wairarapa and the west coast were used for food gathering and tribal raids (Barton 1996), and probably also for trade. The archaeological remains that Maori travellers left in the ranges are listed by Barton (1996) and include adzes, obsidian flakes, a sperm whale tooth, a chert or flint knife, a pigeon trough, an old whare, and earth ovens. Barton (1959, 1960) lists nine trails from the Wairarapa that enter or cross the ranges between Turakirae Head and the Manawatu Gorge (Fig. 2). Radiocarbon dates for an oven in the southern Tararua Range (Park 1970), and archaic styles of artifacts found in the northern Tararua Range (Barton 1996), indicate that the ranges were being traversed, either by travellers crossing the ranges or for food gathering, from early in the prehistoric period.

10. Chronology of archaeological occupation

Leach (1981) divided southern Wairarapa archaeology into five prehistoric cultural periods that he broadly correlated with Northern Hemisphere climatic fluctuations, and two historic cultural periods that followed European contact. The correlation of archaeological features with the cultural periods was based on radiocarbon dating. In view of the criticisms made earlier (Section 9) about the use of the Northern Hemisphere climatic sequence, and about the use of unidentified charcoal samples for radiocarbon dating (Appendix 2), there is no justification for retaining the cultural periods as they have been described. It is possible that more accurate and precise dating might eventually support such a fine subdivision of prehistory, but those dates are not yet available. Instead, archaeological occupation and environmental changes are discussed here in terms of two broad time divisions: an early period from the time of first settlement until about the late 15th Century, and a late period from about the late 15th Century until European settlement. The late period includes both the latter part of prehistory and the early years of European contact, which are distinguished only when there is sufficient data to usefully contrast them. The early period corresponds roughly with Leach's (1981) first three cultural periods, the later period with his periods 4–7.

The early and late periods are separated by the catastrophic events of the late 15th Century. No distinction is made between the different events, and while they were not coincident, on the present evidence they probably did occur close together. Any one event could have adversely affected Maori communities, but all three occurring within a short time of one another are considered to have had a fundamental influence on the prehistoric communities in the Wairarapa region, especially those at the coast. They therefore make a convenient point at which to divide the prehistoric sequence, until more becomes known about the events and new data supports a better model.

During the early period, occupation appears to have been concentrated on the Wairarapa coast. Occupation of inland areas, especially the main Wairarapa Valley, had probably not yet occurred except possibly for intermittent visits by hunting parties. Indications of early settlement in the main valley are only indirect and isolated (Leach 1981). During the late period the pattern of occupation appears to have reversed, with intensive occupation in the main Wairarapa Valley and only intermittent occupation of the coast.

10.1 EARLY PERIOD

When people first settled on the coast, it had been some hundreds of years since the previous uplift. Forest and scrub covered the coastal platform, and in some places lagoons had formed behind the growing beach ridge and at the mouths of streams and rivers. The first people to settle the coast would have needed to clear the vegetation in order to establish their settlements and

gardens. Not surprisingly, the earliest evidence for human activity in the Wairarapa is angular charcoal in wave-cut coastal sections at Te Kaukau Point, Te Oroi and Te Awaiti. The charcoal, found just below the Loisels Pumice, probably represents the first clearance of vegetation at time of settlement c. 700 years ago (McFadgen 1994). Other more reliable archaeological evidence such as middens, however, is not found stratigraphically until above the Loisels Pumice (McFadgen 1985).

The Palliser Bay investigations (B.F. Leach & H.M. Leach 1979a) provide the best picture of what the early part of the prehistoric period was probably like. Palliser Bay was first occupied sometime in the mid 14th Century (Appendix 2) and was abandoned in the 15th Century (Goff & McFadgen 2001). The principle focus for settlements was at the mouths of streams and rivers, and seven such locations have been identified in Palliser Bay (Leach 1981). A second focus for settlement was up the river and stream valleys. Leach (1981) suggests that people moved between the coast and valleys seasonally, spending summers at the coast, gardening and fishing, and wintering inland to avoid storms on the exposed coastal platform. It is possible that a small population was maintained up the river valleys during the summer to tend the gardens.

The most extensively investigated settlement was at the Washpool at the mouth of the Makotukutuku River. Based on remains from this and several other Palliser Bay sites, a model settlement would have had burials, one or more reasonably substantial houses, cooking shelters and ovens, drying racks, food storage platforms, long narrow (food storage?) pits, and a food refuse area. On the nearby coastal platform there would be one or more stone row gardens and complementary gardens and accommodation up the adjacent stream valley.

Chert was probably the most important of the local Wairarapa stone types used to make artifacts. The stone types found at the Washpool site give some idea of the most frequently used (Leach 1978): they include greywacke, siliceous limestone, sandstone, and argillite in addition to chert. Pumice washed up on beaches was also used, mainly for grinding and making fishing floats. The best quality stone materials (obsidian, metasomatised argillite (adzite), and nephrite (greenstone)), were imported over long distances from outside the region (K. Prickett 1979). Chert has been found in archaeological sites in the Kapiti-Horowhenua region where there are no natural deposits, and was probably exported from the Wairarapa across the Tararua Ranges (McFadgen 1997).

The Washpool site deposits contained land snails of species that indicate a dry coastal forest and scrubland around the site (Wallace 1979). From his examination of modern coastal forests, Wallace (1979) inferred that typical trees would have been kanuka (*Kunzea ericoides*), karaka, and ngaio (*Myoporum laetum*) with some kowhai (*Sophora* spp.) and cabbage trees (*Cordyline australis*); and possibly kawakawa (*Macropiper excelsum*), coprosma (*Coprosma* spp.), flax, and tree nettle (*Urtica ferox*). Land snails from the earliest site at Black Rocks, on the other hand, indicate a very open, sparse plant cover of grasses and herbs. The site may have been established sometime after the original vegetation had been cleared (Wallace 1979). The vegetation around the early Washpool settlement is consistent with the generally forested coastal platform inferred from land snails found in middens on the Tamatean soil at Flat Point, Te Awaiti, and Te Oroi (McFadgen 1985).

A striking feature of the Washpool site was the large number of bones of marine fish and birds, terrestrial birds, and sea mammals it contained. This was the result of a thorough and, for New Zealand, innovative approach to midden analysis undertaken by B.F. Leach (1979a). The three stratigraphic levels of the site contained the bones of 273 individual birds, principally tui (87 individuals) and parakeets (95 individuals), with the remaining 91 individuals divided between at least 34 other species. Small and medium, mobile, flocking birds characteristic of mixed forest were clearly dominant and are consistent with the site's inferred environment. Weka (commonly taken for food in the 19th Century) and birds common on stony river beds, were either non-existent or only rarely present. Tui and parakeets were butchered not only to obtain meat, but also to retain the white tui feathers and yellow and red parakeet feathers (B.F. Leach 1979b). At least three species of moa have been identified, including *Pachyornis mappini*, *Euryapteryx geranoides*, *E. gravis* and possibly *Dinornis* sp. *Euryapteryx geranoides* was present in the Te Kaukau Point lagoon deposits (Appendix 5), and may have been obtained locally. Sea mammal remains are rare, especially fur seals, even though it is likely that there was a fur seal colony in eastern Palliser Bay at the time of occupation (Smith 1979). The absence of fur seal bones in middens is probably due to the same reason suggested earlier (Section 7) for moa, that they were difficult to transport. Finfish were more numerous than birds, 365 individuals were identified from at least 26 species, all of which are common on the broken rocky ground of Palliser Bay today. Hook and line fishing would account for most of the catches, with some surface trolling and probably baited traps, nets, and spearing (B.F. Leach 1979c).

Probably for the first time in New Zealand, crayfish (*Jasus edwardsii*) were identified from middens: 69 individuals from the Washpool site, 3 individuals from a site up the Makotukutuku River Valley, and 1529 individuals from the middens at Black Rocks (Leach & Anderson 1979b). The large numbers from the Black Rocks middens were sufficient to investigate the impact of human predation on the species, and they demonstrate the potential of middens to provide long time-series of data relating to human predation and recovery of fauna. Leach & Anderson (1979b) reported that although reduced predation during the period when Palliser Bay was abandoned allowed the crayfish population to return to its former age structure, mean size was slower to respond, and the crayfish have never again attained the size of those caught by the first humans. Similar analysis of paua (*Haliotis iris*), on the other hand, showed that paua did re-attain their previous size (Leach & Anderson 1979b).

The people living in Palliser Bay were gardeners, hunters, and gatherers who exploited the food resources of the forest, rivers and streams, coastal platform, and sea. At best their lifestyle appears to have been precarious. This was reflected in the human skeletal remains from Palliser Bay, some of which show evidence of poor physical condition (Sutton 1979). The significance of fern root in their diet is unclear (Leach 1981), and gardening of kumara and gourd was climatically marginal and needed to be offset by other foods. Collecting habits for other foods do not appear to have protected food stocks. Shellfish gathering concentrated on the largest individuals, and people moved to better beds when yields dropped (Anderson 1981). Over time this approach reduced the size of the shellfish gathered, and increased the time needed to collect them. A

relatively high proportion of parrotfish (*Pseudolabrus* sp.) in the middens is thought by Leach & Anderson (1979a) to reflect generally poor fishing conditions and the need to fish inshore in order to obtain enough food, eventually depleting the parrotfish population.

The Palliser Bay settlements have little surface evidence to identify them other than stone row gardens. Middens adjacent to streams on Tamatean soil at Te Oroi, Te Awaiti, and Flat Point, and the general concentration of archaeological sites at river and stream mouths, suggest a similar locational pattern for the eastern Wairarapa coast. Few sites are recorded up rivers and streams on the eastern Wairarapa coast, but these places have not been as intensively or systematically surveyed for sites as the Palliser Bay coast, which may account for the apparent absence. The main difference between Palliser Bay and the eastern Wairarapa coast is the almost complete absence of gardens northeast of Flat Point. This may again reflect an absence of systematic site surveys and possibly also a different gardening regime that did not employ stone rows.

There is no clear evidence for occupation in the main Wairarapa Valley during this time. The two reports of moa bones associated with ovens at Konini and Rangitumau suggest that some occupation may have taken place, possibly by hunting parties. If chert was traded across the Tararuas, small campsites may be found along the ancient tracks.

The early period ended with the catastrophic events of the late 15th Century: tectonic uplift of the Wairarapa Coast from Flat Point to Palliser Bay, the advance of the Ohuan sand dunes, and quite possibly a tsunami event (Goff & McFadgen 2001). The uplift, which was about 1 m, would have immediately drained the lagoons behind Beach Ridge C between Te Awaiti and Te Kaukau Point with a consequent loss of food resources, and would have stranded many intertidal coastal shellfish resources. Stream fans became active, burying former habitations, and alluvium would have clogged streams, rendering freshwater resources unusable for a time. At Flat Point, the Ohuan sand advanced inland, burying former habitation sites, and it probably advanced inland along all of the Glenburn Coast making that part of the coast temporarily uninhabitable. It is probable that the sand advance also affected the coast between Castlepoint and Mataikona, and at Uruti Point.

The tsunami impact would have had both short-term and long-term effects. In the short term, salt water inundation would have flooded settlements and destroyed houses, removed canoes and other buoyant artifacts, killed trees and crops, and made the soil unusable for at least one growing season. In the longer term, salt water inundation would have accelerated the environmental effects of human forest clearance that was already well under way by the late 15th Century. The removal of the coastal forest would have had two immediate consequences: forest birds would have become harder to catch, and gardens would have become more exposed to wind, making it difficult to grow crops.

At Palliser Bay, where human occupation was already precarious, the outcome was the eventual abandonment of the coast for permanent occupation.

10.2 LATE PERIOD

The extent of occupation during the late period is inferred from the distribution of pa sites. Earthwork fortifications first appeared elsewhere in New Zealand about 500 years ago (McFadgen et al. 1994; Schmidt 1995) and they are unlikely to be earlier in the Wairarapa region. Most, if not all, pa sites in the Wairarapa are therefore likely to be younger than the late 15th Century. They are found on the coast, and appear to be particularly numerous in the main Wairarapa Valley, although many of those from the northern Masterton and Pahiatua Basins were reported by Keith Cairns and need to be confirmed by a visit.

McGlone et al. (1994) relates the appearance of earthwork fortifications in New Zealand to declining food resources and an increasing population. This would explain the situation in the Wairarapa that was exacerbated, first by the catastrophic events of the late 15th Century AD, and second by a migration of outsiders into the Wairarapa around the first half of the 16th Century AD (Leach 1981). With the reduction of food resources and useable coastal land from earthquake and salt water inundation, and the exposure of cultivable land to wind following the removal of trees, the main Wairarapa Valley would have been the nearest source of suitable land for gardening, and of freshwater lacustrine and riverine resources. The migration of outsiders into the Wairarapa probably precipitated a competition for land and the need to defend it.

The parts of the coast where pa occur are: the Mataikona River south for about 4 km, near the Whareama and Kaiwhata River mouths, between Flat Point and Cape Palliser, and Palliser Bay. Except for Palliser Bay, there is little indication of the nature of settlement at these places. Although abandoned for permanent settlement, the Palliser Bay coast appears to have been occupied from time to time on a short-term basis (Leach 1981). The Black Rocks shell midden has a restricted faunal assemblage compared with earlier sites and is thought by Leach (1981) to have been deposited by a fishing party similar to those that visited Palliser Bay from the main Wairarapa Valley during the protohistoric period (Mair 1979). Intermittent occupation of this sort during the latter part of the prehistoric period probably accounts for the currently known archaeological evidence of the Palliser Bay coast (Leach 1981).

Cultivation of crops is inferred from pa sites with pits, and from raised rim pits. If the pits on pa sites were used to store crops and were not depressed house floors, then there were gardens between Flat Point and Cape Palliser, in Palliser Bay, and in the southern Wairarapa Valley (Fig. 21). If raised rim pits are late introductions to the Wairarapa as H.M. Leach (1979b) suggests, and are evidence for gardening, then their distribution (Fig. 21) supports the extent of gardening inferred from the distribution of pa with pits on them. Unfortunately, there is little to indicate which pits and pa are prehistoric and which are early historic in age. Raised rim pits in Palliser Bay have been excavated and dated (B.F. Leach 1979a) and they support the inference of gardening in the late period, although not necessarily the latter part of the prehistoric period. It is not known what types of gardens were in use in the late prehistoric period or what was grown, although the crops presumably included kumara and possibly gourds. Nor is it known whether the coast was occupied all year round, or only during the gardening months.

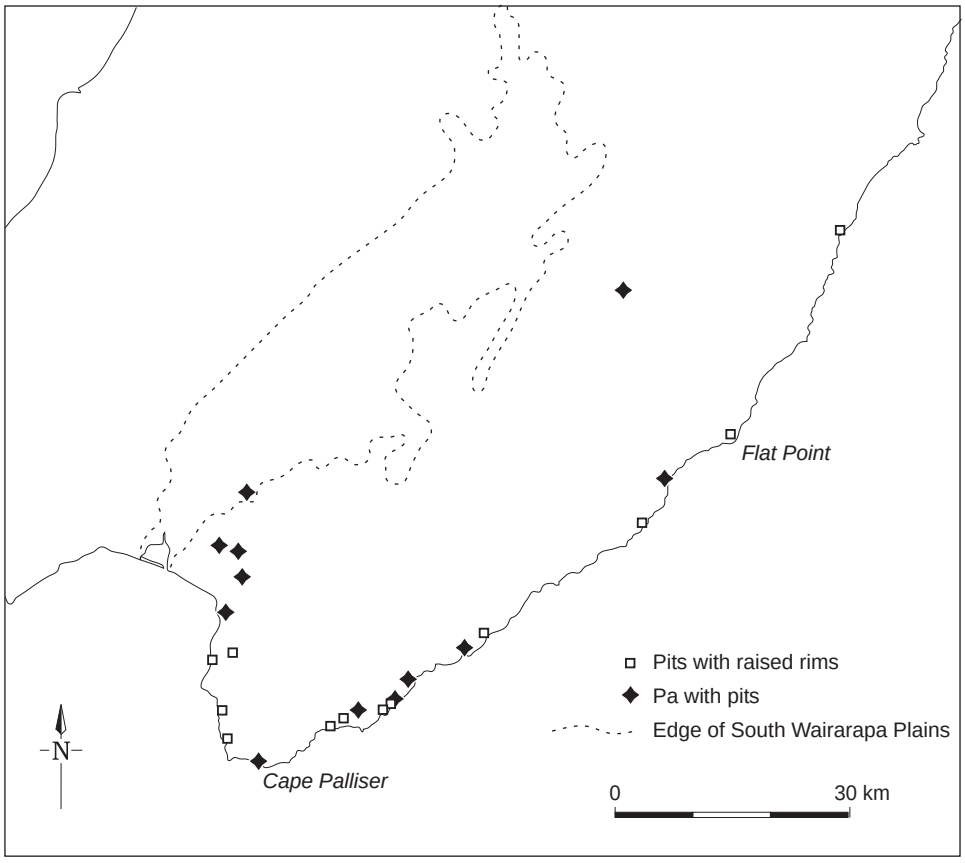

Figure 21. Distribution of raised rim pits and pa sites with pits in the Wairarapa region. Dotted line = edge of the southern Wairarapa Plains. Note that because of the map scale, some dots represent more than one site.

Subsistence activities during the early years of European settlement still made use of some indigenous food sources (Mair 1979) and these provide a rough but incomplete guide to activities that were probably carried out in late prehistoric and early historic times. These include (Mair 1979): sea fishing, shellfish gathering, cray fishing, freshwater fishing (including eel fishing), collecting fern roots and karaka berries, rat trapping, and gardening.

Fewer than 800 Maori lived in the Wairarapa Valley in 1849, of whom about half were at the southern end, east of Lake Wairarapa (Hill 1962). These people had only recently returned from Hawke's Bay, where many had moved more than a decade and a half previously following threats of war from Te Rauparaha and his allies, who had invaded the Wellington district during the 1820s (Mair 1979). Contemporary observations give a reasonable idea of settlement and subsistence during the 1840s and 1850s, but details of settlement and subsistence from the late prehistoric period until the departure to Hawke's Bay are largely unknown. The 1840s and 1850s observations are at best a rough guide. When the people left for Hawke's Bay, their contact with Europeans had been minimal, but they returned having been in close contact with European influences for at least a decade (Mair 1979). Although traditional sites were initially reoccupied when people returned to the Wairarapa (Bagnall 1976), Maori soon began to site their settlements, houses and gardens in places best suited for food production and trade with Europeans (Mair 1979).

Cultivation grounds at the time of European settlement are recorded along the Ruamahunga River, and along the Turanganui River that flows into the southeastern corner of the main Wairarapa Valley (Fig. 19). They were probably

used for European vegetables that were being widely grown by this time: pumpkins, melons, corn, wheat, and potatoes (Mair 1979). Some of these gardens could be readily found today and it might be possible using pollen and phytoliths to find out what crops were grown. During his journeys along the coast between Hawke's Bay and Wellington in the 1840s, Colenso mentions potato gardens at several places between Akitio and Lake Onoke, and by that time the potatoes grown were probably European varieties.

In 1849, the largest single settlement, with nearly 200 inhabitants, was in the northern part of the valley, at Kaikokirikiri near Masterton (Hill 1962). However, there were a large number of settlements in the south (Mair 1979), which suggests that many of the pa recorded by Keith Cairns, if confirmed, may date from the late prehistoric period. Other settlements were in the eastern hills and along the eastern coast and linked with the valley sites by walking tracks, although the coastal settlements do not appear to have been permanently occupied (Hill 1962). Following a pattern that apparently prevailed in traditional times before the move to Hawke's Bay, settlements in the upper valley were more aligned to the eastern hills and coast than to the southern coast, and settlements in the lower valley were more aligned to the southern coast and Wellington (Mair 1979).

11. Future research

The Wairarapa is a seismically active region where successive events have modified the coastal and inland environments and influenced where people have lived. Maori communities adapted their way of life to suit the land, and in turn altered the landscape to suit their lifestyle, but within limits dictated by the seismic nature of the landscape. It is the tectonic uplift and tsunami events that are the key to the natural and cultural character of the Wairarapa.

Suggestions for further research are intended to clarify aspects of the natural and cultural history of the region and show how they are related. The suggestions here are not exhaustive and are intended only as a guide. First, they focus on finding out what the region was like at the times of Maori and European settlement, and what changes occurred in the interval. Second, they focus on understanding how the Maori adapted to the Wairarapa environment and how they adapted the environment to meet their needs. However, in order to distinguish between the natural and cultural processes that have shaped the region, a more detailed knowledge is needed of the processes that were operating in the pre-human environment.

As already noted (McFadgen 1997), radiocarbon dating of events before and after human settlement will be important for understanding the processes. The usefulness of radiocarbon dates is improved when there are many dates for an event, and emphasis should be placed on identifying and dating those events, either cultural or natural, that are also time horizons. For this reason seismic events, including earthquake uplift and tsunami, are important and will be useful for correlation both within and beyond the Wairarapa region.

A combination of field and documentary research should enable the major landscape components, such as forest cover, to be mapped as they were at the time of European settlement, but field research is likely to be the major source of information for pre-European times. It is, however, possible that Maori traditions might provide insights into past seismic events and their consequences. Maori have been in the Wairarapa region since about the late 13th Century AD, and their oral traditions and history have the potential to provide information on the region's earthquakes and other catastrophic events since that time.

Of particular importance is the mapping and dating of the two youngest uplifted shorelines between Flat Point and Whatarangi. There are two immediate reasons for this. The first is to identify the impact of the earlier uplift on the coastal resources available to Maori during the early part of the prehistoric period. The second relates to correlation of events in the different parts of the region, especially between the coastal areas and the main Wairarapa Valley. It is possible, for example, that the events in the main Valley will be evident from stream and river aggradation events.

A closely related issue is the occurrence and impact of tsunamis on the coastal zone. A tsunami, thought to have been generated by movement of the Alpine Fault or the Wellington Fault, is suggested as a cause of the abandonment of the Palliser Bay coast in the 15th Century AD (Goff & McFadgen 2001). It is

suggested that salt water inundation as a result of the tsunami may have killed the coastal forest on other parts of the Wairarapa coast, leaving trees vulnerable to fire, and thus have contributed to the clearance of the forest. The stone row system at Okoropunga shows features that may have been caused by tsunami inundation and the possibility needs to be tested by field investigation. The 15th Century event has been identified in other parts of the Cook Strait Region (Chagué-Goff & Goff 1999; Goff & Chagué-Goff 1999; Goff et al. 2000) and is a factor to consider in the interpretation of coastal archaeological remains in all coastal areas. If it can be identified stratigraphically on the Wairarapa coast, it will provide a useful chronological marker horizon for correlation with other parts of the New Zealand coast.

Of more immediate importance is to find out more about the impact of the 15th Century tsunami on the coastal environment. The tsunami appears to have been a widespread, major event that inundated many parts of the Wellington and Wairarapa coasts (GeoEnvironmental Consultants 2001; Goff & Chagué-Goff 2001), including parts that are administered today by DOC, such as the Waikanae Estuary Scientific Reserve, Lake Wairarapa Wetland and Allsops Bay Wildlife Reserve. The likely impact of a similar event occurring in the future needs to be assessed and, where appropriate, measures adopted to minimise its effect.

Davidson (1987) makes the point that many sites classified as pa were originally some kind of open or undefended settlement. If the pa on spurs and ridges overlooking the eastern Wairarapa coastal platform were originally undefended settlements, the question raised is why were the settlements not located on the coastal platform, as they were during the early period along the Palliser Bay coast. Was protection from earthquake ground-shaking and tsunamis a factor? While staying at Waiorongo just north of Castlepoint, Colenso reports earthquake shocks in 1845, that made the posts of his hut reel to and fro (Bagnall & Petersen 1948). Shaking would be felt more severely on the sediments of the coastal platform than on the hard rocks of the spurs and ridges. A shift of occupation from bays to headlands following tsunami inundation in the 13th Century AD has been suggested for Vancouver Island (I. Hutchison pers. comm.; Day 2001). There appears to have been a similar shift in settlement location in or about the late 15th Century on D'Urville Island (Wellman 1962a), and from Shag River mouth to Shag Point on the north Otago coast (M. Weisler pers. comm.).

The forest edge was an important source of fruits and berries, and of the birds attracted to them. Maori living close to the forest edge in late prehistory had immediate access to its resources. The forest edge of earlier times was in a very different place to its later location, although if the Washpool middens are a guide, it was just as productive and desirable a place to live. The forest in earlier times appears to have been present right down on to the coastal platform, but for a variety of reasons it retreated inland. Its retreat left the coastal platform very exposed to violent northwesterly winds that blow from time to time, and exposure to the violent winds would have made it impossible to continue gardening on the scale of earlier times. Establishing the pattern of forest destruction may enable the shift in the focus of settlement from the coast to the main Wairarapa Valley to be better understood. Earthquakes and tsunami

inundation are factors to be considered, and old land survey records and Protected Natural Area survey data will be important sources of information for establishing the detail of the forest as it was at the time of European settlement.

Turning now to more specific archaeological tasks, there is a pressing need for archaeological site surveys. Good site location and survey data exist for the Palliser Bay coast, and the southeast Wairarapa coast north to Flat Point. Systematic surveys are needed to fill gaps from Akitio to Flat Point, particularly between the Mataikona and Whakataki Rivers, and between the Whareama River and Riversdale. On these latter stretches of coast there are indications of Archaic occupation where gardening was possibly unimportant, that might contrast with Palliser Bay. Inland, there is good site survey data for the southeastern part of the main Wairarapa Valley, but the rest of the Valley needs to be surveyed to as far north as Woodville. Many sites were recorded by Keith Cairns but were not entered into the New Zealand Archaeological Association Site Recording Scheme. He apparently did not visit many of the sites reported to him and many of his pa sites cannot be verified from aerial photographs (A.J. Walton pers. comm.). It is therefore important to revisit the places where he noted or recorded sites, and where sites are verified, to document them for the New Zealand Archaeological Association Site Recording Scheme.

There are many old cultivation grounds historically recorded on the Wairarapa coast and in the main Wairarapa Valley. Many of the gardens in the southern Wairarapa Valley at the time of European settlement should be easily re-locatable from data recorded on early survey maps. Their study should indicate the distinctive features of their soils, how their soils compare with those at the coast known only from the archaeological record, and when they were first established. Recent advances in the study of phytoliths from soils have shown promising results for the study of old Maori gardens in New Zealand (Horrocks et al. 2000) and the extraction of phytoliths from Wairarapa Maori garden soils may provide direct evidence of what was being grown and where.

Currently a lot is known about the early prehistoric period in Palliser Bay, and correspondingly little about the prehistory elsewhere in the region. How and when the main Wairarapa Valley was settled is an outstanding issue.

12. Conclusions

TABLE 2. SUMMARY OF CULTURAL AND ENVIRONMENTAL HISTORY OF THE WAIRARAPA, C. 1350 TO C. 1850 AD.
Changes can be expected as the dating of environmental events is refined and as the archaeology of the region becomes better known.

CALENDAR YEARS AD	ENVIRONMENTAL HISTORY			MAORI HISTORY
	SEISMIC	EROSION	FOREST	
1350			Burning and clearing of coastal forest begins, and forest retreats.	**Maori settlement** Focus of occupation on coast with people living in small, undefended settlements at stream and river mouths with seasonal settlements up stream valleys. Economic activities include hunting of birds and sea mammals, fin and cray fishing and shellfish gathering. Widespread trade for imported stone. Gardens on coastal platform and up stream valleys from Palliser Bay north to Whareama. No gardening north of Whareama.
1450	Earthquake uplifts coast from Whareama to Palliser Bay; tsunami strikes coast; Ohuan sand advances.	Coastal lagoons drain, alluvium accumulates in streams and on coastal fans.	Forest on coastal platform damaged by salt water inundation; burning & clearing continue; and forest clearance begins in the main Wairarapa Valley.	Palliser Bay abandoned, people move to settle in the main Wairarapa Valley. Occupation of the eastern Wairarapa coast continues, settlements on coastal platform abandoned and re-established on spurs and ridges overlooking the coast; pa developed as competition increases for remaining sheltered gardens and resources; population gradually declines as exposure of gardens and settlements to wind increases, people move inland to the main Wairarapa Valley. Focus of occupation now in the main Wairarapa Valley with outlying occupation on the east coast;
1550				
1650				Palliser Bay re-occupied seasonally for fishing and gardening; settlements fortified, economic activity uncertain but probably fishing and fowling in lakes and rivers, and possibly gardening in the southern part of the main Valley.
1750			Forest largely cleared from the main Wairarapa Valley (Masterton Basin).	
1850	Earthquake uplift from Glenburn to Palliser Bay. Hoatan sand advance.	Alluvium accumulates in streams and coastal fans.		Region largely abandoned in face of threat from Ngati Toa and allied tribes and later re-occupied as Europeans settle. **European settlement**

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Appendix 1

SOURCES OF INFORMATION FOR SITES NOT RECORDED IN THE NZ ARCHAEOLOGICAL ASSOCIATION SITE RECORDING SCHEME

TABLE A1.1. SITES REPORTED TO K.R. CAIRNS FOR WHICH A GRID REFERENCE WAS RECORDED.
Sites reported to K.R. Cairns (KRC) for which there are grid references recorded in his notes lodged with the Alexander Turnbull Library. In the case of three sites marked * I have estimated the grid references based on descriptions of their locations. The NZMS1 grid references listed here are probably from the later map grid not the provisional grid. The NZMS260 positions are expressed as metric coordinates that are mathematical conversions of the NZMS1 grid reference to the nearest metre, with 50 m added to the eastings and northings and rounded to the nearest 10 m. They represent the centre of a square 100 m by 100 m centered on the coordinate. Comments are summarised from KRC's notes. Measurements are in Imperial units, as given by KRC. Names of shells with quotes are common names given by KRC where no scientific name was reported. Names without quotes are common names for shells where the scientific name was reported.

SITE TYPE	NZMS1 MAP SHEET	NZMS1 GRID REF		METRIC MAP SHEET	NZMS260 COORDINATE		COMMENTS
		EAST	NORTH		EAST	NORTH	
Artifact find	N163	346700	139800	T27	2762580	6003130	Worked chalcedonic material, scarfed.
Pits	N163	347000	146300	T27	2763030	6009070	
Pits	N163	347000	146300	T27	2763030	6009070	4 pits: 4 ft × 7ft 6 in, 3 ft × 7ft 6 in, 3 ft 4 in × 10 ft, 3 ft × 5ft.
Pits	N163	347200	146300	T27	2763210	6009060	Pits on a terrace, south branch Mangapiuiti Stream.
Midden	N163	347700	138600	T27	2763470	6002010	Along stream.
Midden	N163	347800	137800	T27	2763540	6001270	Includes charcoal and burnt stone.
Midden	N163	348000	138200	T27	2763740	6001640	In sand dunes, includes charcoal, burnt stone and stone flakes.
Pits	N163	351500	141400	T27	2767020	6004470	
Midden	N163	352300	146400	T27	2767880	6009020	In sand dunes, includes charcoal, burnt stones and flint flakes.
Midden	N163	352500	145800	T27	2768050	6008470	In sand dunes, includes charcoal, burnt stones and stone flakes.
Midden	N163	352500	146300	T27	2768060	6008920	In sand dunes, ¼ mile south of Motuwaireka Stream.
Midden	N163	352800	147000	T27	2768350	6009550	
Midden	N163	353300	147500	T27	2768820	6010000	
Midden	N163	353500	147200	T27	2769000	6009720	In sand dunes.
Midden	N163	353600	148000	T26	2769110	6010450	In sand dunes, on Orui property.
Midden	N163	353700	148800	T26	2769220	6011180	Includes flint flakes and shellfish (dark rock shell, *Haustrum haustorium*), 'pipi', 'periwinkle' and catseye (*Turbo smaragdus*)).
Midden	N163	353700	148800	T26	2769220	6011180	Includes flakes of flint. Moa bones found to north of midden.
Midden	N163	354000	149200	T26	2769510	6011530	Includes flint flakes.
Midden	N163	354400	149500	T26	2769880	6011800	In sand dunes, large, moa bones, human bones, flint, obsidian, occupation, flaked adze.
Midden	N163	354600	150000	U26	2770080	6012250	Flakes of flint, obsidian, argillite, white limestone, and shells.
Midden	N163	354800	151500	U26	2770300	6013620	In sand dunes, moa bone, moa eggshell, 2 middens, 100 yd from crouch burial.
Midden	N163	354800	151900	U26	2770310	6013980	Moa bone, human bone, flint, ovens.
Pa	N163	355300	156400	U26	2770880	6018080	Terraced spur and midden, ½ mile up Whareama River, on north side.
Midden	N163	355600	155300	U26	2771130	6017070	South bank of Whareama River.

Midden	N163	355800	155400	U26	2771310	6017160	
Midden	N163	356000	155400	U26	2771500	6017150	In sand dunes.
Midden	N163	356000	155400	U26	2771500	6017150	With terraces.
Pits	N163	357000	156800	U26	2772450	6018400	
Stone rows?	N163	357400	156800	U26	2772810	6018390	
Midden	N163	357400	156900	U26	2772810	6018490	
Occupation	N163	357500	156800	U26	2772900	6018390	
Midden	N163	358300	159500	U26	2773700	6020840	Includes midden, obsidian and other material.
Midden	N163	358500	159800	U26	2773890	6021110	North bank of stream, includes 'cockle', flint.
Midden	N159	358100	160500	U26	2773550	6021760	½ mile south Waingaio homestead, 15 in thick 'tuatua' layer.
Terraces	N159	358700	162700	U26	2774150	6023750	
Midden	N159	359700	162700	U26	2775070	6023730	4 in thick 'tuatua' layer.
Midden	N159	359800	162800	U26	2775160	6023820	
Midden	N159	360300	163500	U26	2775640	6024440	South bank of Otahome Stream, includes 'tuatua'.
Midden	N159	362700	166000	U26	2777890	6026670	North bank of Ngakawau Stream.
Midden	N159	362800	173800	U26	2778190	6033790	Ploughed up.
Pa	N159	363800	187800	U25	2779470	6046570	Hearsay. Grid reference approximate. Pa on Awapiripiri Station on Fernhill. Whakatauama Pa. Exact position not known.
Pa	N159	364000	186700	U25	2779620	6045550	Hearsay. Pa on Te Mai station. Possibly Puketewai. Exact position not known.
Midden	N159	364600	173300	U26	2779820	6033290	
Midden/ovens	N159	364700	167500	U26	2779760	6027990	See Davis (1957), grid reference approximate.
Midden/ovens	N159	364700	167500	U26	2779760	6027990	See Davis (1957), grid reference approximate.
Midden	N159	366100	168100	U26	2781060	6028500	In sand dune, includes cloak pin.
Occupation	N159	366200	169300	U26	2781180	6029590	
Midden	N159	366200	170500	U26	2781210	6030690	
Flint flaking floor?	N159	366300	167800	U26	2781230	6028220	Flint flakes.
Midden	N159	366300	169300	U26	2781270	6029590	Behind Castlepoint cemetery. Includes 'cockle', 'pipi' and 'catseye'.
Midden	N159	366500	168500	U26	2781430	6028850	
Midden	N159	366700	168700	U26	2781620	6029030	
Midden	N159	366700	172300	U26	2781710	6032320	
Midden	N159	366700	172400	U26	2781720	6032410	South of Whakataki River.
Burials	N159	366800	172600	U26	2781810	6032590	
Midden	N159	367000	172700	U26	2782000	6032680	Whakataki River.
Terraces, pits	N159	367500	183700	U25	2782740	6042720	
Midden	N159	367700	173600	U26	2782660	6033480	Large midden, ½ mile north of Christiansen's house in sand hill 8 ft high. See Davis (1957). Grid reference approximate. Thickness up to 12 in. Paua (*Haliotis iris*), limpet *(Cellana radians)*, dark spotted mud whelk (*Cominella maculosa)*.
Pits	N159	367700	183900	U25	2782930	6042900	Raised rims, on high bluff.
Midden	N159	368000	173600	U26	2782940	6033480	See Davis(1957), grid reference approximate.
Midden	N159	368000	173800	U26	2782940	6033660	Large midden, ¾ mile north of Christiansen's house 50 yd square. See Davis (1957). Grid reference approximate. Includes paua, flint.
Adze	N159	368300	175000	U26	2783250	6034750	Archaic adze, Duff (1977) type 1A, light grey argillite.
Midden	N159	368400	174500	U26	2783330	6034290	Occupation remains spilling from sand dune on edge of terrace next to Mataikona Road. Site c. 20 yd west of road. Midden has burnt stone, charcoal, 'paua', catseye, dark rock shell, 'scutus', 'periwinkle', 'cook's turban shell'. Terrace is a long flat area c. 200 yd long next to the road.
Midden	N159	368400	175300	U26	2783350	6035020	
Midden	N159	368400	175500	U26	2783350	6035200	In sand dunes.

SITE TYPE	NZMS1 MAP SHEET	NZMS1 GRID REF EAST	NZMS1 GRID REF NORTH	METRIC MAP SHEET	NZMS260 COORDINATE EAST	NZMS260 COORDINATE NORTH	COMMENTS
Midden	N159	368500	174400	U26	2783410	6034190	
Burial	N159	368500	174500	U26	2783420	6034290	
Midden	N159	368500	174500	U26	2783420	6034290	South of Wharepouri's mark. See Davis (1957). Grid reference approximate. Paua, limpet, dark spotted mud whelk.
Midden	N159	368500	174700	U26	2783420	6034470	
Midden	N159	368500	174700	U26	2783420	6034470	
Midden	N159	368600	175400	U26	2783530	6035110	
Midden	N159	368800	176400	U26	2783740	6036010	In sand dunes, moa bones and moa eggshell to south.
Midden	N159	369000	177200	U26	2783940	6036740	Includes artifacts. Bird bones including moa nearby.
Midden	N159	369100	176800	U26	2784030	6036370	1 mile north of Okau Station. Midden includes: paua, silver paua (*Haliotis australis)*, catseye, dark rock shell (*Haustrum haustorium)*, periwinkle, *Cellana radians, Cellana ornata*. In sand dunes 20 ft to 30 ft below road. Site possibly N159/691768 recorded by KRC.
Midden	N159	369200	176900	U26	2784120	6036460	
Midden	N159	369200	176900	U26	2784120	6036460	Includes flint.
Flint source	N159	369400	177400	U26	2784310	6036910	Large boulders of flint in stream (alongside O'Dowd bach). Flint similar to that found on Maori sites. Flint rocks also in sand dunes east of road. Several colours, black, grey, brown, opal veining. Six or seven large rocks (12 in × 6 in) in a group apparently taken for flaking.
Terraces	N159	369400	179800	U26	2784380	6039110	Terraced area on hill above Te Rerenga-o-te-Aohuruhu. Several terraces above 600 ft contour, steep sides all round. Terraces long and flat.
Midden	N159	369500	177600	U26	2784410	6037090	Occupation material (north of O'Dowd bach) eroding from toe of hillside 30–40 yd west of road. Stratified deposit of charcoal, burnt stone, shells, bird bone etc. Material shows in sand hills in dune hollows. Fragments of moa bones, seal bones, bird bones, moa eggshell, catseye, 'paua', 'cook's turban shell', 'periwinkle'. 3 ft diameter hangi exposed on sand surface, stones on top of a thick black charcoal layer. Moa bones and other fragments from layer just north of O'Dowd bach, Mataikona include burnt bone, flint, obsidian, white limestone, moa eggshell.
Moa eggshell	N159	369500	177600	U26	2784410	6037090	Extensive scattering of moa eggshell fragments (natural?) over area c. 50 yd by 100 yd on surface of sand hill. Counts suggest 30 pieces per square foot. Size ranges from 0.5 in × 1 in to 2 in ×1 in.
Ovens, karakas	N159	369500	178200	U26	2784430	6037640	Occupation material in stream bank. Flat terrace (natural?) on west side of road runs up gently into karaka tree grove. Charcoal, burnt stone covered with grass. Karakas in three groves at toe of hill.
Midden	N159	369500	178500	U26	2784430	6037920	Area of midden at toe of hill 100–200 yd west of road to Mataikona. Area is sloping sand dune at base of hill and site runs up hill c. 30–40 ft. 'Paua', dark rock shell, catseye, plus burnt stone and charcoal.
Midden	N159	369500	179100	U26	2784450	6038460	Occupation area. Charcoal, shell, burnt stone, flake material (flint, obsidian) eroding from bank next to farm track. Stream curves around west and north part of 10 ft high terrace. Midden contains 'paua', catseye, 'cook's turban shell', fish bone, burnt stone, charcoal in a layer of stained black earth on north and west side of terrace at north end. Site excavated in 1976–77 and grid reference corrected to 696791. Six to seven fish hook points found here in 1930s. Points in bone (moa and human) with serrated decoration on edge found in sand just below terrace.
Pa	N159	369500	180400	U26	2784480	6039650	Tareoneone Pa. Many terraces, defensive ditch across top of ridge. Raised rim pits on terraces, cut into full width of ridge. Pa runs up to bush line, on spur leading to Mt. Percy.
Burial	N159	369600	179800	U26	2784560	6039100	Single burial falling out of a bank. Seen by Masterton man in 1930s. On side of hill by Mataikona Station boundary.
Midden	N159	369600	180400	U26	2784580	6039650	Charcoal, burnt stone, 'periwinkle', 'catseye', 'paua', 'cook's turban shell', over area c. 50 yd × 50 yd at base of Taraoneone Pa. Midden among karaka trees. Flint flakes. Blackfish bones from sand below pa.
Midden	N159	369600	180600	U26	2784580	6039830	Midden spilling from sand dune at 200 ft level, 300–400 yd from road. Charcoal-stained sand.
Midden	N159	369700	178400	U26	2784620	6037820	Occupation area exposed in sand dunes. Extensive midden spilling from sand bank 30–40 ft above road. Below midden at lower level 10 ft above road is burnt stone, charcoal, bone, shell eroding from sand bank. Fragments of burnt moa bone taken from midden. Shells include catseye, 'paua', 'periwinkle', 'scutus', 'cominella', dark rock shell, etc. Very large area below road with

							covering of catseye operculae. Moa bone fish hook tab found, shaped for drilling. Burnt seal bone, bird, fish. Charcoal taken for radiocarbon dating. Numerous flint flakes, flint nodules, obsidian flakes found. (Note: grid reference may be 697774. There appears to be a confusion with grid references occasioned by use of 1st edition of NZMS1 maps. The 697784 grid reference may be the 1945 edition before NZMS1 grid shifted.) See separate notes for Okau site of which this appears to be part.
Midden	N159	369700	180200	U26	2784660	6039470	Shells, charcoal, burnt stone on terrace facing east in Taraoneone Bay. Terrace on 300–400 ft contour. Terrace extensive with many karaka trees and shells spilling out around karakas.
Occupation	N159	369700	180500	U26	2784670	6039740	Charcoal-stained sand in sand dune, c. 200 yd from road.
Middens	N159	370000	181000	U25	2784960	6040190	Extensive shell heaps, with stone flakes, charcoal-stained sand in large sand blow north of stream at north end of Taraoneone Bay. Wide variety of rock material on sand surface—flint, white limestone, sandstone, greensand pumice. Greenstone pendant found in stream. See KRC's notes for additional data.
Burials	N159	370200	181500	U25	2785150	6040640	In sand hills west of road to Mataikona. Excavated 1948. Crouched, with necklace of imitation incisor teeth (Niho kakere). Area visited by Mitcalfe in 1968 and burial of 10–12 yr old child excavated (see Mitcalfe 1968a). Necklace of 8 paua pieces, drilled, with pendant (or cloak pin) of moa? bone.
Pa	N159	370300	181000	U25	2785230	6040180	Overlooks bridge to Aohanga Station, above Mataikona Station homestead. Deep ditch and terraces in a pine plantation. Sheer drop to road. Was the site of Mataikona homestead.
Terraces	N159	370300	182500	U25	2785270	6041550	On hill above Mataikona road.
Occupation	N159	370300	182900	U25	2785280	6041920	Charcoal-stained sand.
Pa	N159	370300	186600	U25	2785380	6045300	On spur end, large ditch, about 100 ft contour.
Pa, ovens	N159	370600	184300	U25	2785590	6043190	Pa, with cooking sites. Destroyed by bulldozer. Reported to KRC.
Oven	N159	370600	186600	U25	2785650	6045290	
Pa	N159	370600	186700	U25	2785650	6045380	Aohanga Station. Reported to KRC.
Burial	N159	370700	183000	U25	2785650	6042000	Skull only, washed up on sand alongside Mataikona River. Adult female, Polynesian.
Ovens	N162	300500	155700	S26	2720770	6018870	Destroyed.
Ovens	N162	300500	157500	S26	2720820	6020510	Noted by early settlers.
Canoe	N162	307200	147500	S26	2726680	6011200	Unfinished, 30 ft long.
Ovens	N162	308500	148600	S26	2727900	6012170	Bank of Ruamahanga River, ploughed up.
Pit	N162	309800	142400	S27	2728930	6006470	Raised rim, 50 ft long.
Pa	N162	310100	140200	S27	2729140	6004450	Mangahuia Pa or village, noted by early settlers.
Pa	N162	310500	147500	S26	2729700	6011110	Ahiaruhe Pa. Pits, terraces, raised rim pits.
Pa	N162	311000	148700	T26	2730190	6012200	Hurunui-o-Rangi Pa. Near burial ground.
Pa	N162	314700	145500	T27	2733490	6009180	Hinana Pa. Earthworks, occupation, hut sites, terraces.
Pa	N162	315600	143500	T27	2734260	6007320	Kaiwherowhero Pa. Raised rim pits on ridge, ovens on land below pa.
Pa	N162	315700	154500	T26	2734630	6017380	Te Whiti Pa. Near meeting house, burial ground.
Pa	N162	317400	146500	T27	2735980	6010020	Hinewaka Pa. Burial ground until 1930s–1940s.
Pa	N162	319600	151600	T26	2738120	6014620	Tupurupuru Pa. Broken adze. Traditional mention.
Pa	N162	342200	148700	T26	2758710	6011380	Te Maipa Pa. Ngaumu State Forest.
Pa	N158	309500	179500	S25	2729620	6040390	Raupeka.
Pa	N158	310500	175700	T26	2730430	6036890	Te Keakea.
Pa	N158	310500	183700	T25	2730640	6044200	Hautotaranui.
Pa	N158	312300	174400	T26	2732040	6035650	Paerau.
Occupation	N158	312400	178500	T26	2732240	6039400	
Pa	N158	312500	165700	T26	2732000	6027700	Akura.
Pa	N158	312700	178700	T26	2732520	6039570	Te Rua Taniwha, destroyed.
Pa	N158	313200	166600	T26	2732660	6028500	Matawhero.
Pa	N158	313500	164700	T26	2732890	6026760	Ngaumutawa.
Pa	N158	314500	171500	T26	2733980	6032950	Mauku-Rangi.

SITE TYPE	NZMS1 MAP SHEET	NZMS1 GRID REF EAST	NZMS1 GRID REF NORTH	METRIC MAP SHEET	NZMS260 COORDINATE EAST	NZMS260 COORDINATE NORTH	COMMENTS
Ovens	N158	314700	164300	T26	2733970	6026360	
Pa	N158	314700	165800	T26	2734010	6027730	Kaikokirikiri.
Pa	N158	315200	163600	T26	2734410	6025710	
Pa	N158	315300	172300	T26	2734730	6033660	Tirohanga.
Pa	N158	315600	163600	T26	2734780	6025700	Matau.
Pa	N158	315900	160600	T26	2734980	6022950	Manga a kuta.
Pa	N158	316800	163500	T26	2735870	6025570	Hiona.
Kainga	N158	316900	160700	T26	2735890	6023010	Potaerau.
Pa	N158	317500	170700	T26	2736700	6032140	Kaikouta.
Pa	N158	317700	169500	T26	2736850	6031030	Matapihi.
Kainga	N158	318500	165000	T26	2737470	6026900	Hawaiki Raunui.
Pa	N158	319400	165400	T26	2738300	6027240	Pahauhau.
Pa	N158	321400	178700	T26	2740470	6039350	Heipipi.
Pa	N158	321500	165500	T26	2740220	6027280	Kiri mai nunu.
Pa	N158	324500	162600	T26	2742890	6024550	Mangahina.
Burial	N158	324900	163000	T26	2743260	6024910	
Kainga	N158	325500	161300	T26	2743770	6023340	Paihikaikererū.
Pa	N158	326400	161200	T26	2744590	6023220	Taumataraia.
Pa	N158	328300	161700	T26	2746340	6023630	Taueru.
Pa	N154	320500	186500	T25	2739850	6046500	Paikakako.
Pits	N168-9	300800	196200	S28	2719490	5964470	On west side Awhea River, 200 yd upstream above bridge.
Pits/ occupation	N168-9	301100	196600	S28	2719780	5964830	On flat river terrace between river, road and creek, on west side of road to Te Awaiti and Tora, upriver of bridge.
Pits/burial	N168-9	306600	198800	S28	2724860	5966700	Pits raised rim, on south bank of Oterei River ¼ mile from mouth. Pits 12 ft × 10 ft, long axis perpendicular to river. Mounds and burial on opposite river bank.
Stone rows	N168-9	308300	198700	S28	2726410	5966560	1 mile north east of Te Awaiti homestead. See Mitcalfe (1968c, diagram B).
Pa/stone rows	N168-9	308500	199200	S28	2726610	5967010	Huariki Pa (near land referred to by William Colenso as the Hospital Block (Bagnall & Petersen 1948). On north side of stream about 1 mile NE of Te Awaiti homestead, extensive stone rows on south side of stream below pa. See Mitcalfe (1968c, diagram A).
Midden	N168-9	386900	186500	S28	2706530	5955970	Shells, burnt stone. 'Catseye', dark rock shell, 'periwinkle', 'limpets', 'cominella', flint
Midden/ occupation	N168-9	387000	186000	S28	2706610	5955510	Shells, burnt stone, charcoal, greenstone chisel. Te Rakawhakamotaku Point.
Midden/ terrace/ occupation	N168-9	387300	187100	S28	2706910	5956510	Charcoal, burnt stones. See Mitcalfe (1968d, diagram D3).
Pits/terraces	N168-9	387600	188400	S28	2707220	5957690	Just below bush line, Waiaraheke Stream (west bank), altitude of 300–400 ft.
Pits/stone rows	N168-9	387700	187600	S28	2707290	5956950	Waiaraheke Stream (west bank). Pits & postholes where bank eroded. Stone rows run east–west, pits & hollows on stream terrace.
Stone rows/ pits	N168-9	389200	188200	S28	2708680	5957460	See Mitcalfe (1968d, diagram D9).
Midden/ occupation	N168-9	392700	188300	S28	2711880	5957460	West side of Opouawe River between road and beach front. Burnt stone, charcoal, shells, flakes (flint, chalcedony), spread over large area.

Midden/ occupation	N168-9	392700	188500	S28	2711890	5957650	Eroding out of sand hill, west side of White Rock Road. Opposite side of road to extensive occupation area at river mouth. Includes charcoal, burnt stone and shells.
Pa/pits/ fireplaces	N168-9	392800	190000	S28	2712020	5959010	On raised isolated mound in middle of paddock between Opouawe River and White Rock Road. Large raised rim pits, fireplace in position (stones showing through grass). See Mitcalfe (1968d, diagram F).
Terraces	N168-9	392900	189800	S28	2712100	5958830	House sites? Facing north on west bank Opouawe River.
Pa (Te Kaukau Point)	N168-9	393700	187400	S28	2712770	5956610	Pa on Te Kaukau Point. See Mitcalfe (1968d, diagrams A, D & E, A3, A2).
Gardens/ hut sites	N168-9	395900	188900	S28	2714820	5957930	South of Oroi Stream. See Mitcalfe (1968d, diagram H).
Pa	N168-9	397500	191400	S28	2716350	5960170	On ridge. See Mitcalfe (1968d).
Terrace	N168-9	398200	192100	S28	2717010	5960790	House terrace? 1 mile southwest of Oroi homestead. See Mitcalfe (1968d, diagram F).
Pa	N168-9	399100	192700	S28	2717850	5961320	¼ mile south of Te Oroi homestead. See Mitcalfe (1968d, diagram E).
Pits	N166	301900	102900	S28	2720670	5970570	On high hill behind Tora homestead, between road and Awhea River, east side of river.
Pa	N166	310200	101100	S28	2728210	5968710	On steep narrow ridge, terraces (19 separate platform areas), karakas, steep bluffs each side. Deep fosse and inner ditch (total height c. 10 ft). Midden at base of site. Flats below pa c. 400 yd wide. White limestone piece shaped like an adze found.
Stone rows	N166	311700	101800	S28	2729600	5969310	Stone rows at presumed Hapukura Stream.
Stone rows/ pits	N166	312800	103300	T28	2730650	5970650	Stone rows and pits (raised rim) on south side (sic) of Okoropunga stream.
Stone rows	N166	314300	104600	T28	2732050	5971800	Stone rows on south side of stream south of Aratikitiki Stream. See Mitcalfe (1968c).
Stone rows	N166	314500	104800	T28	2732240	5971980	Stone rows on both banks of Aratikitiki Stream, c. 1.5 miles southwest of Rerewhakaitu Stream. See Mitcalfe (1968c).
Midden	N166	318500	107800	T28	2735980	5974610	In sandy soil 1 mile southwest of Pahaoa homestead. Shells, burnt stone, flakes, adzes, minnow shanks etc. Stone rows nearby.
Pa	N166	319700	109400	T28	2737110	5976050	With terraces, raised rim pits, on a high hill overlooking mouth of Pahaoa River. Site on west side of river and west side of road to Pahaoa Station. Pa 300–400 ft above road. Postholes for houses clearly evident. Gully erosion on one side of pa shows cross.
Pa	N166	320200	108900	T28	2737560	5975580	Historic. Alongside Pahaoa River on west bank near mouth. See sketch of pa with palisades by Smith (1850s). Charcoal, burnt stone, shells in eroded parts.
Occupation	N166	320200	110700	T28	2737600	5977220	[Site at NZMS1 grid reference] 207107 continued. Is on flattened terrace north of Onepu Creek, on west side of road and almost immediately opposite turnoff to Glendhu ford. 15 pits of various sizes, no raised rims. Stream bank 15–20 ft high.
Occupation	N166	320700	110700	T28	2738060	5977210	Defensive ditch cut across point alongside Glendhu turnoff. Probably extension of site on opposite side of road. Site on east side of road to Pahaoa.
Village/pits	N166	321400	110500	T28	2738700	5977010	Historic. On Glendhu Station. East bank of Pahaoa River. Covers a long flat area above river. Site consists of pits (some raised rim), walls of either stone or earth.
Tiki find spot	N166	327100	112900	T28	2743970	5979050	Old style. Found in sand dune 1mile west-southwest of Honeycomb Rock lighthouse. See Barrow (1959).
Terraces	N166	329700	117300	T27	2746460	5983010	On high hill north of Harewai? Pa.
Pits	N166	330200	116200	T27	2746890	5981990	Group of three with a possible fourth. 9 ft × 12 ft × 4 ft deep. Sketched by Mitcalfe (1968e).
Pa	N166	330500	117500	T27	2747200	5983170	Possibly a pa recorded by Mitcalfe (1968e). Four terraces. Other possible terraces on a third ridge inland, north side Glenburn Stream. Could be the pa behind Broughton House. Grid references differ, possibly different map editions.
Pa	N166	330600	117200	T27	2747280	5982890	With large defensive ditch at top. Midden, charcoal, stones, shell, burnt stone. Harewai Pa. Mitcalfe (1968e) describes this site as a kainga half-buried by a landslide.
House sites?	N166	330700	117900	T27	2747390	5983530	Recorded by Mitcalfe (1968e). (Same area as pa site or terraces. Map shows position 1mile south of Glenburn Stream. Grid reference places it alongside stream.)
Pits/terrace	N166	331000	117000	T27	2747640	5982700	Southeast side of Harewai Pa.
Ovens	N166	331300	116400	T27	2747900	5982140	50 yd east of Russell Broughton's house. Oven remains in clay bank 10 yd from high tide mark. Charcoal as 1in thick layer, burnt stone 10 in deep. Umu 9 ft 3 in wide, 20 in below ground. Bank stands 7 ft 6 in above beach. See photographs in Cairns (1959).
Pits/karakas	N166	332400	118800	T27	2748970	5984310	Deep pits among karaka trees next to fenceline at front of hill on west side of road.
Midden/ karakas	N166	332500	118900	T27	2749060	5984400	On same stream as [previous site, at NZMS1 grid reference] 324188 pits/karakas. Midden in karaka grove on west side of road to Glenburn.

SITE TYPE	NZMS1 MAP SHEET	NZMS1 GRID REF EAST	NZMS1 GRID REF NORTH	METRIC MAP SHEET	NZMS260 COORDINATE EAST	NZMS260 COORDINATE NORTH	COMMENTS
Midden	N166	332700	118900	T27	2749250	5984390	East side of road north of stream.
Pa	N166	333200	121800	T27	2749780	5987030	Waikekino Pa [NZ Archaeological Association sites N166/61 & N166/65]. Ridge pa, running north and south, with pits and terraces, and stone rows and mounds at base of ridge on coastal flat. Former meeting houses on flat area. Midden from site includes catseye, 'periwinkle', 'cockle', 'paua', dark rock shell.
Midden/ovens	N166	333300	121500	T27	2749860	5986750	In paddock on south side Waikekino Stream. Burnt stone, charcoal, shells. Ploughed.
Pits	N166	333400	122600	T27	2749980	5987750	On south bank of a dried up stream c. 800 ft north of Waikekino Stream, 200–300 ft west of road. Pits at several places going towards hill (possibly part of Waikekino site).
Adze find spot	N166	333500	121800	T27	2750050	5987020	Moa hunter adze found just north of modern cemetery.
Midden	N166	333500	122500	T27	2750070	5987660	c. 150 yd west of road to Glenburn (between pits and pa).
Kainga	N166	333500	122600	T27	2750050	5987750	Wharaurangi Village.
Pits/karaka	N166	333700	123400	T27	2750280	5988480	Pits on hill above Whatipu Stream. Charcoal exposed in track. Possibly Whatipu Pa. Prolific karaka and ngaio on both sides of stream below site. Site on north side of stream, above a sheer drop to the stream.
Midden	N166	334800	124300	T27	2751310	5989270	Burnt stone, charcoal, shells, flint flakes in sand blow on west side of road. Midden spilling from a sand bank from a blackened layer 10 ft above road.
Occupation	N166	335000	124100	T27	2751480	5989080	Extensive charcoal deposit in a thin layer with burnt stones and flakes.
Midden	N166	335200	124500	T27	2751680	5989440	Burnt stones, charcoal, shells, flint flakes in sand layer on opposite side of road to Huatokitoki Pa.
Midden	N166	335300	124000	T27	2751760	5988980	Spread over large area of exposed sand dune. Charcoal, shells, burnt stone flakes, artifacts reported. Site 200 yd east of road to Glenburn Station, ½ mile south of Waimoana Stream.
Midden	N166	335300	124400	T27	2751770	5989350	Shells, burnt stone, charcoal, flint flakes, spread over exposed sand layer, 20 yd from road on east side.
Pa	N166	335300	124500	T27	2751770	5989440	Pits on ridge overlooking Huatokitoki Stream, with midden, chalcedony, flint, burnt stones, charcoal. Midden sites also on flat below pa alongside road.
Pits/karaka	N166	335400	124700	T27	2751870	5989620	On hill immediately above Waimoana homestead. Site on high hill behind shearers' quarters, north of Huatokitoki Stream.
Burial	N166	335500	124600	T27	2751950	5989530	East side of road to Glenburn Station, north bank of Huatokitoki Stream, in Waimoana Station stockyards. Found in 1955. Greenstone adze from same area.
Pa/kainga	N166	337700	127400	T27	2754040	5992030	Small site c. ¾ mile up Arawhata Stream, on east bank of a stream which joins Arawhata on south side.
Midden	N166	337900	126400	T27	2754190	5991110	With bird bone, moa bone, shells, charcoal, burnt stone. Eroding from sand dune [NZ Archaeological Association site N166 37?]. Dark spotted mud whelk, dark rock shell, 'catseye', 'cockle', moa egg shell, black and grey obsidian, drill point in chalcedonic rock. South side Arawhata Stream.
Pits	N166	338200	126500	T27	2754470	5991190	Small raised rim pits, north side Arawhata Stream, eroded by stream [NZ Archaeological Association site N166/36?]. Pits 3 ft–4 ft deep × 20 ft long × 15 ft wide.
Occupation	N166	354700	150600	U26	2770180	6012800	Charcoal layer in sand.
Occupation	N166	354700	151000	U26	2770190	6013160	Charcoal layer in sand.
Occupation	N166	354700	151500	U26	2770210	6013620	Charcoal layer in sand.
oven	N166	355300	153000	U26	2770790	6014970	Umu in stream bank alongside beach. (No grid reference given. Possibly grid reference 553530*).
Midden/ occupation	N166	355500	152200	U26	2770950	6014240	Moa hunter site 1 mile south of Whareama River on large sand area sticking out to sea (grid reference is 555535, or more likely 555522*). Site covers 300 square yards. Hearth stones, moa bones, midden, human bones, hut sites, flint, obsidian
Pits	N166	357000	157000	U26	2772450	6018590	Up Waimimi Stream. (grid reference possibly 570570*). Five groups, two with five pits.
Midden	N166	357500	156800	U26	2772900	6018390	Extensive.

TABLE A1.2. ARCHAEOLOGICAL REMAINS FOR WHICH K.R.CAIRNS (KRC) RECORDS INFORMATION THAT WAS PASSED TO HIM, BUT WHICH HE DID NOT APPARENTLY VISIT.

Cairns recorded only rough details of location and content, sometimes a grid reference, but usually enough to indicate the approximate district and what was seen. These records indicate, in a very broad way, the districts where occupation occurred for which there may be little no other evidence. Some remains coincide with sites already recorded elsewhere, including the NZ Archaeological Association site recording scheme. File references, refer to records in the Alexander Turnbull Library, Wellington.

FILE REFERENCE	LOCALITY	REMAINS	DESCRIPTION
8.3.41	Akitio	Midden	Just past school.
9.4.39	Akitio	Sites	Midden, pa, terraces, burials, artifacts.
9.4.40	Akitio River	Pa	Waka-wahine Pa, up river.
8.1.a	Alfredton	Adze	Broken. Pa valley. Pigeons for Manawatu Maoris.
8.2.19	Alfredton	Pa	Just out of Alfredton, on way to Ihuraua, with burials.
1.4.6	Alfredton	Pa	In township, on ridge behind Public Hall.
9.6.10	Alfredton	Burial	Tinui Road, ½ mile from Alfredton. Braddock land.
1.4.15	Alfredton	Chisel	Greenstone. 1 mile from school. Over bridge, turn left.
9.1.14	Aohanga	Pa	Waitawhiti River, head of Manawatu River. Trenches, pits etc.
8.2.23	Aohanga River	Pa	Three pa, seen from air, two × 1 mile up river, one on right and one on left. One × ½ mile up river on right.
9.8.28	Awaroa	Burials	Fenced.
5.1.2	Awhea River	Occupation	South bank, 2–3 chains (40–60 m) upstream from mouth, on hill above river and cattle stop.
1.5.18	Awhea Rivermouth	Flint deposit	
1.5.30	Belvedere	Midden	Hooper land. Seen in 1926.
8.5.68	Belvedere	Midden/adze/ovens	Maungatarere Stream, 1 mile from memorial Square towards Tararuas.
9.2.22	Bennet's Hill	Adze	
1.4.9	Black Rock Road	Pa	With pits & terraces. Pahauhau Road, overlooking Kopuaranga River.
8.2.21	Carterton	Adzes	2 adzes, Frances Line.
8.2.26	Carterton	Ovens	Cobden Road, on hilltop, Fencham land.
9.1.1	Carterton	Sites	Reported in vicinity of Glendover.
9.2.15	Castlepoint	Drilled tooth	Near Wharepouri's mark.
9.1.13	Castlepoint	Moa bones	South of Wharepouri's mark.
9.6.5	Castlepoint	Moa eggshell	Near Wharepouri's mark.
9.8.35	Castlepoint	Pendant	Greenstone, from cave under lighthouse.
5.1.5	Craigie Lee Station	Patu	Stone, found near boundary fence.
8.2.24	Eketahuna	Ovens	In Borough, on farm, ploughed.
8.3.32	Eketahuna	Ovens/track	
8.5.70	Eketahuna	Burials	Aynsley land. Alongside Makakahi River.
8.3.36	Eketahuna	Ovens	Aynsley land, 2 miles from Eketahuna. Maori stopping place. Ploughed.
5.2.12	Eparaima	Adze	Classic adze, Duff (1977) type 2B, Pautahanui Stream.
9.7.15	Flat Point	Burial	In sand.
5.2.6	Flat Point	Pa	Te Unu Unu Pa, large, on hill ridge at Flat Point Station.
1.2.-	Gladstone	Pa	Waipoapoa Pa. Maori Land Court minute book 6, p. 203.
1.2.-	Gladstone	Pa	Waikoko Pa. Maori Land Court minute book 6, p. 11.
9.7.26	Gladstone	Burials	
8.5.62	Gladstone	Pa	Near Masterton/Gladstone. Hakikino Pa (Cairns 1958).
8.2.28	Gladstone	Pa/burials	Te Whiti, on main road between Masterton & Gladstone.
9.1.11	Greytown	Burial ground	Woodside, west of Greytown.
9.1.10	Hamenga	Adze	
8.2.20	Hamua	Adze	30–40 yd from Makakahi River.
8.2.20a	Hamua	Midden	Burnt shells, ploughed up, associated with 8.2.20, Makakahi River.
1.4.5	Hamua	Terraces/pits	On hill above bridge.
8.1.I	Hamua	Ovens	On terrace overlooking Hamua flats, several ovens.
9.7.22	Hapairangi	Ovens	Tinui–Masterton Road.
1.4.4	Hikawera	Pa	Near Ponatahi Road, Lawrence land. Pa above river.
8.4.59	Hinakura	Ovens	Two cooking sites, Arcus land, Hikawera Road.
8.1.m	Hinakura	Pa	Now gone, Ngaipu Station, at rear.
8.5.63	Holdsworth	Pa (Pa Punanga)	Refuge pa. On ridge south of lodge on track to lookout.

FILE REFERENCE	LOCALITY	REMAINS	DESCRIPTION
9.7.23	Homewood	Artifacts	
5.2.10	Homewood	Greenstone	Ngamahana, Waikohi.
5.2.8	Homewood	Pits	Ngamahana.
7.5.a	Huangarua	Ovens	Ploughed up.
7.5.b	Huangarua	Pa	Huangaruarua River and Whangaehu River (approximately N165/996297).
9.6.6	Ihuraua	Artifacts	End of Settlement Road, Weston land. Track east of land going to coast.
9.6.9	Kahutara	Adze	Tahora land.
9.7.19	Kahutara	Artifacts	Mathew's land.
9.7.20	Kahutara	Greenstone	
8.3.34	Kahutara	Ovens	Mathew's land, ploughed.
8.1.h	Kaikouta	Adze	Untanged adze, Duff (1977) type 2B, near Kaikouta.
8.1.e	Kaikouta Pa	Rifle pits	In vicinity of pa.
5.3.18	Kaiwhata River	Adze	Duff (1977) type 2B. Orini Station?
9.2.19	Kaiwhata River	Burials	South side river, near sea.
9.1.3	Kopuaranga River	Adze	250 yd from river, 400 yd from Kaikouta Pa.
9.1.5	Kopuaranga River	Burials	Fergusson land. Ploughed. European age.
9.2.21	Kopuaranga River	Ovens	Charcoal, stones (burnt) on river flat, ploughed, Brophy land.
9.9.39	Kopuaranga River	Ovens/adze	On river bank, Fenenor land.
1.5.24	Kumenga	Adze	Paddock, Atkinson land.
8.5.66	Longbush Gully	Pits/trenches/terraces	Left hand side of road, midway between Gladstone Hotel and Store, 100 yd from road.
9.4.41	Longbush Valley	Sites	Old burial grounds, pa, gardens. Dense bush existed in valley at European settlement.
8.4.57	Mahaki	Canoe	Next to Makahi flax mill.
1.6.39	Mahaki river.	Canoe	Above Dyerville.
8.1.j	Makakahi River	Ovens	In vicinity of river, near Hamua.
8.2.18	Makomako Stm	Adzes	3 × greenstone, near track to Manawatu.
8.4.54	Mangahao River	Ovens	Near Ballance Hall, on road to Pahiatua track.
8.3.40	Mangahuia	Pa/pits	On Mangahuia Stream, foot of Bennet's Hill Road where turns towards stream.
5.2.13	Mangapiuiti	Track	Connects inland sites with coast. Sites along stream.
8.4.48	Mangaramarama Valley	Adze	
8.4.49	Mangaramarama Valley	Adze	Next to Mangatainoka River.
8.4.43	Mangatainoka	Adze	By factory.
8.4.44	Mangatainoka	Ovens	Up Mangaramarama Valley Road by Tiraumea River. Ploughed.
8.4.45	Mangatainoka	Ovens	Behind butter factory.
9.8.32	Mangatainoka River	Adze/ovens/midden	Nireaha.
9.6.8a	Maramarama	Ovens	Ploughed up. Many.
8.3.37	Martinborough	Ovens	'The Cutting' (Riddiford's in 1940s). Below house on river flat.
8.3.30	Martinborough	Pa	On flat between Hikawera Bridge and Huangarua Station, next to Huangarua River.
9.1.9	Martinborough	Adze	Tawaha, right bank Ruamahanga River.
8.1.o	Masterton	Burial	Rathkeale College.
8.2.27	Masterton	Pa	Kaikokirikiri. At Mahunga, headland type, between Waipoua River and stream.
9.8.37	Mataikona	Adze	1940s.
9.6.1	Mataikona	Artifacts	Greenstone, in small bay just past river.
9.2.20	Mataikona	Necklace	Dentalium shells, north side of river, at old burial ground.
1.5.16	Matapihi	Burials	Rathkeale land, on bluff above river.
8.1.f	Matapihi	Trench	
8.4.53	Matarawa	Bones & charcoal	Moa? On bank of old stream.
8.1.n	Mauriceville	Adze	Duff (1977) type 2B, Dryer's Rock Road.
1.4.2	Mauriceville	Terraces	Dryer's Rock Road. On hill.
9.7.25	Moiki	Pits/ovens	Kohunui Pa, opposite Kahumingi gates.
8.1.k	Motuwaireka Stm	Ovens/midden	Strathingle.
8.1.g	Mt Bruce	Adze	Duff (1977) type 2B?, Awarua Station at junction of Waipoua and Kiriwhakapapa Rivers.
8.3.33	Mt Bruce	Burials	Ravenstone.
9.2.37	Mt Bruce	Burials.	Ravenstone. Formerly fenced.
1.5.32	Mt Pleasant	Pits	On hill. Fernyhurst, Waihakeke.
9.1.6	Nga Potiki	Adze/midden	Near village at Te Kaukau Point, buried by slip c. 1900 AD.
8.3.31	Ngaawapurua	Ovens	Riverlands, Blatchford land, south side river.
5.1.4	Ngaumu Block	Adze	Skeet Land.

FILE REFERENCE	LOCALITY	REMAINS	DESCRIPTION
9.2.18	Ngaumu Block	Adze	Greenstone, Skeet's land.
9.6.11	Ngaumu SF	Pa	Poroporo section. Pa, ovens, burials.
9.6.12	Ngaumu SF	Track	Near Telescope Creek.
9.8.38	Okau	Moa eggshell	In sand.
8.5.69	Opaki	Burials	Alongside Ruamahunga River. Former settlement.
5.3.15	Oriniwhakaruru	Burials	By Homestead (coast?)
5.3.15a	Oriniwhakaruru	Ovens	Cooking sites in sand hills.
9.1.7	Oroi River	Flint outcrop	Near high water mark.
9.2.33	Otahome	Terraces/ovens	Waingaio.
1.6.38	Pahaoa gorge	Ovens	First stream in gorge. Cherry Tree Creek. Giant disked. Burnt stone. Charcoal.
1.5.17	Pahaoa River	Flint quarry	Wainuioru River.
8.2.17	Pahaoa River	Pa	Opposite Bush Gully Station. Fishing Pa, greenstone, mounds, graves.
8.4.46	Pahiatua	Adze	Alongside stream.
8.4.56	Pahiatua	Adze	Greenstone, near Nireaha factory.
8.4.55	Pahiatua	Ovens	Elsmore land, North Road, 4–5 seen.
1.5.20	Pahiatua	Ovens	Foreman land.Waihoki Valley, Tiraumea, c. 1 mile from Pakowai.
8.4.51	Pahiatua	Pounder	Rakanui.
9.8.29	Palliser	Burial	Twin Creek.
9.2.30	Palliser	Burials	Sandy area between Whatarangi and Kawakawa.
9.2.27	Palliser	Pa	Te Hurupi Pa on track to Pinnacles.
9.6.13	Palliser	Trenches	Ning Nong Bay, 20 yd past Pinnacles Creek, on hill.
8.4.52	Papawai Road	Ovens	Bicknell Land. Totara stumps from milled timber (1880s), 4–5 ft diam.
8.3.35	Pihautea	Artifacts	Bidwell land, includes greenstone.
1.4.8	Pirinoa	Pa	Hume farm.
1.5.27	Pirinoa	Pa	Whakatomotomo Road near Pirinoa Station.
1.5.35	Pirinoa	Pits	Pits & mounds, ploughed out, Whakatomotomo Road next to river. Ploughed.
1.5.19	Pirinoa Station	Hut sites	10 ft x 6 ft x 12–15 in deep.
1.5.28	Poroporo Road	Pa	Near Wainuioru School, 200–300 yd south of first bridge, near lagoon.
8.3.29	Poroporo/Homewood	Track	Walking, deeply cut in places.
9.2.29	Puketiriti	Pits	Bulldozed away.
9.1.8	Rangitumau	Ko stick	Near Kaikouta Pa.
1.4.7	Rangitumau	Pits	3–5, above Ramsden land, on McRae land.
9.2.17	Riversdale	Adze	
9.1.12	Stronvar	Adze	Greenstone, on Elliott land.
8.3.38	Taratahi	Ovens/pits	Near railway line, ploughed.
9.6.8	Taratahi	Ovens	Ploughed up. Many.
8.1.c	Tauanui Pa	Eel weirs	In vicinity of pa.
8.1.d	Tauanui Pa	Ovens	In vicinity of pa.
8.1b	Tauanui Pa	Pa	Pits and palisade holes.
9.6.7	Tauera	Pa	In heavy vegetation. Palisades.
8.3.42	Taueru District	Pa	On road between Taueru and Te Parae. Ploughed.
9.8.30	Taueru township	Adze	From Taumataraira Pa.
1.4.10	Taumata	Ovens	Burnt stone and charcoal, freshwater mussel. Up Waihakeke Road, next to lagoon.
1.4.12	Taumata	Pa	With trenches, pits. Ploughed.
8.4.58	Tautare Station	Adzes	Includes greenstone, 'lots found on Tautare Station'.
1.5.21	Te Apiti	Adze	Greenstone. Te Apiti Station.
9.6.2	Te Awa Iti	Patu	Whalebone.
8.1.p	Te Ore Ore	Adze	Whangaehu River, bottom Weraiti Hill, on Lees Road.
9.7.24	Te Ore Ore	Midden/ovens	Back of Lee farm.
1.4.11	Te Ore Ore	Ovens/adze	Between Whangaehu River and Ruamahanga River. Charcoal, burnt stone, adze.
8.2.25	Te Ore Ore	Ovens/taiaha	Potaerau Block.
9.6.3	Te Ore Ore	Pa	Mariri Kapua.
1.5.34	Te Wharau	Adze	Barrer land.
5.1.3	Te Wharau	Adze	Near Ruakiwi Road, on Armstrong land.
1.5.33	Te Wharau	Adzes	Three. Oruatamore, near Westmere down Ruakiwi Road, Armstrong land.
9.8.27	Te Whiti	Burials	
8.4.60	Te Whiti	Pits/?wall	On ridge

FILE REFERENCE	LOCALITY	REMAINS	DESCRIPTION
9.1.4	Tinui	Gardens	Manawa land. Near old track.
1.4.3	Tinui	Midden/ovens	Awanui Station. Near bend in river.
1.4.1	Tinui	Ovens	7 miles from Tinui, towards Masterton.
1.5.31	Tinui	Pa	Bartholomew land.
9.2.28	Tinui	Pa	Trench on limestone bluff, on 'Aberfoile'. Above old lagoon?
1.4.13	Tiraumea	Adzes	Haunui Road.
9.8.34b	Tiraumea	Pa	Near Alfredton, on Tiraumea River, 1.5 miles north Alfredton on branch road to Pahiatua and Pongaroa.
9.8.34a	Tiraumea	Tiki	Found in area.
9.1.14a	Tiraumea	Track	Through or past Haunui Valley to Makuri, cooking sites, adzes along track.
9.1.14b	Tiraumea	Track	Masterton via Wairere. Ovens on track.
9.8.34	Tiraumea	Track	From Aohanga or Mataikona.
8.4.47	Tiraumea River	Canoe	On bank.
1.5.29	Tora	Chisel	Greenstone.
8.4.50	Tora	Artifacts	
9.7.16	Tora	Artifacts	
9.7.18	Tora	Pa/burials/walls/artifacts	
1.6.37	Tuhitarata	Ovens	Cooking sites in sandhills, Nix land.
8.5.67	Upokongaruru Stm	Pits/ovens?	Motukai Road, off Ngaumu Road.
1.4.14	Waihenga	Eel trenches?	
8.2.16	Waingawa River	Adze	Vicinity Chester and Norfolk Roads.
1.5.26	Wainuioru River	Ovens	Cooking sites on hill top. Bannister land.
1.3.-	Wainuioru River	Pa	Maungaraki Pa, on Wainuioru River. See Downes (1912).
8.4.61	Wainuioru River	Pa/adze/burnt stone	Joblin land.
1.5.23	Waiohine River	Obsidian flake	Between Hector Forks and Totara Creek, Tararua Range, above Waiohine River.
5.3.16	Waipupu	Moa bones	Tibia in sand dunes ¼ mile south of Waipupu stream.
8.2.22	Waterson's Road	Middens/ovens/adzes	Near Beef Creek, up Swamp Road.
1.5.25	Western lake	Pits/trenches	Seen 1940s. In bush.
1.6.36	Western lake	Terraces/gardens	East side Mukamuka stream.
9.2.36	Western Lake	Trenches	Quarried. Battery Hill.
9.6.4	Whakatiki	Midden	Sand hill next to road.
9.2.26	Whakatomotomo Road	Pa	Paretanginoa Pa.
9.2.24	Whakatomotomo Road	Pits	40–50, up to 4–5 ft deep, on river flat next to river.
9.2.38	Whakatomotomo Road	Site	Ranana, opposite cemetery.
9.2.23	Whangaimoana	Ovens/burial	River bank near beach.
9.8.31	Whangaimoana Stream	Burial/ovens	East side stream.
9.8.36	Whareama	Adze	Found 1950s.
5.2.14	Whareama	Gardens	Motuwaireka. Reserved from sale.
5.3.17	Whareama River	Adze	Duff (1977) type 4A hogback adze. 1 mile up river, south bank.
9.2.31	Whareama River	Burial	200 yd south of river, near burnt stone, obsidian.
9.2.16	Whareama River	Sites, pits, pa	Waimimi Creek just north of Whareama River.
8.1.1	White Pine Bush Flat	Fireplaces	On bank Ruamahunga River opposite Pa Mutumutu.
9.1.2	Nireaha	Ovens	Cooking sites in vicinity of Wireaha RD2.
8.3.39	Woodville	Ovens	Woodlands Road, ploughed.
9.6.8b	Woodville	Ovens	Ploughed up. Many.
8.5.64	–	Burial	N165/249630.
1.5.22	–	Midden	N168/120655.
9.2.25	–	Pa	Maikuku, on Hume land.

TABLE A1.3. PA, SETTLEMENTS AND GARDENS RECORDED ON EARLY SURVEYORS' MAPS.
Site grid references were determined by graphical resection on NZMS1 topographical maps using at least 4 trig stations. There was not enough trig data for Whakaumu Pa, Te Whiti Pa, Tupurupuru, Temi, Mangahawea, and Taumata and grid references for these sites were found by using the best fit of topographical features such as stream bends. They were converted into NZMS260 coordinates as described for Table A1.1. References to surveyors' maps prefixed S.O. are held by the Wellington District Office of Land Information New Zealand. Maps prefixed W are held by the Alexander Turnbull Library, Wellington.

NAME	NZMS1 MAP SHEET	NZMS1 GRID REF		METRIC MAP SHEET	NZMS260 COORDINATE		REFERENCE TO SURVEYORS' MAPS
		EAST	NORTH		EAST	NORTH	
Okarewa	N165	268000	108500	R28	2689830	5976580	S.O.10538
Upokokirikiri	N165	267700	109400	R28	2689580	5977410	S.O.10538
Pa Omoike	N165	273600	106800	S28	2694910	5974870	S.O.10538
Pa Papangawa	N165	274500	108700	S28	2695780	5976590	S.O.10544
Pa Peritanginoa	N165	274700	110100	S28	2696000	5977860	S.O.10538, S.O.10544
Pa Tewi	N165	271500	111800	S28	2693120	5979500	S.O.10538
Pa	N165	272000	112000	S28	2693580	5979670	S.O.10544
Old Pa	N165	273000	116000	S27	2694600	5983300	S.O.10556
Pa Kohunui	N165	274200	116800	S27	2695720	5984000	S.O.10556
Pa Mangaterouou	N165	279500	121800	S27	2700690	5988430	S.O.10556
Pa Waitapu	N165	280100	121400	S27	2701230	5988050	S.O.10556
Old Pa (Otaraia?)	N165	284000	122900	S27	2704830	5989320	S.O.10556
Gardens	N165	276600	107600	S28	2697670	5975530	S.O.10544
Gardens	N165	272000	111600	S28	2693570	5979300	S.O.10544
Gardens	N165	272500	112000	S28	2694040	5979660	S.O.10544
Gardens	N165	273000	111700	S28	2694490	5979370	S.O.10544
Pa Huangarua	N161	298000	131900	S27	2717870	5997180	W29
Pa Waihinga	N161	293200	130800	S27	2713450	5996300	W28, W29
Pa Ngapuki	N161	292700	131900	S27	2713020	5997320	W28, W29
Gardens	N161	291000	131300	S27	2711450	5996810	W29
Gardens	N161	292500	132600	S27	2712860	5997960	W29
Taumata	N162	304500	144900	S27	2724150	6008890	W30
Mangahawea	N162	303700	146000	S27	2723440	6009920	W30
Pa Hurunuiorangi	N162	311300	148500	T26	2730460	6012010	W25
Tupurupuru	N162	315700	149100	T26	2734490	6012440	W32
Temi	N162	316900	148700	T26	2735580	6012040	W32
Pa Whakaumu	N162	323500	150100	T26	2741650	6013150	W32
Pa Te Whiti	N162	314600	152400	T26	2733570	6015480	W33
Gardens	N162	304300	145600	S27	2723980	6009540	W30
Gardens	N162	303200	146400	S26	2723000	6010300	W30
Pa Kaikokirikiri	N158	314300	165900	T26	2733650	6027830	S.O.10542
Tirohinu	N158	324700	162000	T26	2743060	6024000	W23

Appendix 2

RADIOCARBON DATING AND THE DATE OF FIRST SETTLEMENT OF PALLISER BAY

Probably the commonest source of error, other than measurement error, in radiocarbon dates is inbuilt age (McFadgen 1982) which is particularly important for dates determined on charcoal from old fireplaces. If old wood was used as fuel for fires, then the charcoal gives a date for when the wood died. If the wood came from the centre of an old tree, or lay around on a beach as driftwood, then the date could be many hundreds of years older than the fire. Nowadays charcoals are routinely identified as to species, and charcoals from short-lived species are dated wherever possible. Twigs are short-lived but it is difficult to distinguish between twigs and branches that have had the outer rings burnt off. Unfortunately for the Wairarapa region, most charcoal dates are on samples that are unidentified as to species. Because many of the sites dated are coastal and near to a source of driftwood, inbuilt age is a potential source of error for nearly all the radiocarbon dates on charcoal, including those obtained as part of the Otago University's Palliser Bay research programme.

The Palliser Bay dates, all on unidentified charcoals, were obtained before charcoals were routinely identified prior to dating and were originally interpreted as closely dating archaeological events. The samples included brushwood (NZ1646–1648) (Anderson 1979) and 'twig' charcoal (NZ1309–1317, NZ1512–1514) (H.M. Leach 1979a) and 19 samples identified only as 'charcoal'. Leach & Leach (1979a, pp. 251–272) inferred from the 34 dates that the prehistoric occupation of the Palliser Bay coast began during the mid 12th Century AD, a date somewhat older than the now-accepted date for initial Polynesian settlement of the mid 13th Century AD (Anderson 1991; McFadgen et al. 1994; Higham & Hogg 1997).

The brushwood, although not identified to species, might reasonably be expected to give close dates for the shell middens that it was found with. The same might be true of twigs, except for the difficulty, already mentioned, of identifying that charcoal is from twigs and not from the interiors of branches. With the possible exceptions of the dates of the brushwood and twigs, and one sample found with burial remains and identified as a charred stick (NZ1638), the dates are older age limits for the events with which they are associated.

For the twig samples from the Palliser Bay coast there is an another issue. The 'twigs' are all samples that date stone row systems. They have been removed from the soil in or around the rows, but their interpretation depends on which model is adopted for the construction and use of the stone rows (McFadgen 1982). If the stone rows are a by-product of gardening, being formed from stones cleared from garden plots, and the charcoal is from rubbish thrown onto the rows and burnt (H.M. Leach 1979a), then the twigs will closely date when the rows were used. On the other hand, if the rows were constructed by digging trenches, filling them with stones, and replacing the soil onto the rows (McFadgen 1980a), the charcoal could have been in the original top soil and derived from the burning of vegetation long before the rows were built. The dates would then be older age limits for the construction and use of the stone rows.

By how much the charcoal dates might be too old because of inbuilt age is indicated by the dates of midden shells from three sites previously dated using charcoal (Table A2.1) (Goff & McFadgen, 2001). The three sites are a shell midden (site S28/104) that was dated using brushwood charcoal, a stone row (S28/68) that was dated using 'twig' charcoal, and a small stream mouth settlement (S28/49) that was dated using charcoal (unspecified). Midden shells will generally have negligible inbuilt age because shellfish are short-lived and would have died when they were collected for food. Their collection date, and hence death, is likely to be close to when they were deposited in the midden. Each date is calibrated to a range of ±1 standard deviation (68%). In the case of two of the sample pairs the calibrated ranges do not overlap, and the shell dates are younger than their paired charcoal dates. Normally with statistical tests, if two samples are more than twice their combined standard deviation apart the difference is considered to be significant. In the two cases here, it is the ±1 standard deviation age ranges that do not overlap and the differences between the dates are therefore considered to be significant. If the three dated sites are indeed among the earliest occupied along the Palliser Bay coast, then Palliser Bay was first occupied sometime in the mid 14th Century AD, a date in agreement with that inferred by Anderson (1991).

TABLE A2.1. COMPARISON OF RADIOCARBON DATES ON SHELL AND CHARCOAL FOR PALLISER BAY SITES.

SITE	LAYER	LAB. NO. (YEARS BP)	CRA[1]	^{13}C (PPM)	MATERIAL DATED	CALENDAR AGE RANGE[2] 95% (YEARS AD)	CITED DATE (YEARS AD) BY LEACH & LEACH (1979A)
Black Rocks,	4	Wk6057	890 ± 40	1.8 ± 0.2	Marine shell (*Haliotis iris*)	1352–1480	—
Crescent Midden	4	NZ1648	681 ± 58	–25.58	Brushwood charcoal		1270
(S28/104)[3]					(species unidentified)		
North Pararaki	Wall matrix	Wk7457	790 ± 50	0.0 ± 0.2	Marine shell (*Haliotis iris*)	1428–1619	—
(S28/68)[3]	Wall matrix	NZ1311	676 ± 86	–25.19	'Twig' charcoal		1279
					(species unidentified)		
Washpool	Crust 5	Wk6055	880 ± 40	0.0 ± 0.2	Marine shell	1388–1486	—
(S28/49)[3]	Crust 5	NZ1505	767 ± 45	–25.78	(*Turbo smaragdus*)		1191 – amalgamated with
	Crust 5	NZ1511	797 ± 45	–25.19	Charcoal (unidentified)		NZ1511 to yield 1180
					Charcoal (unidentified)		

[1] Conventional Radiocarbon Age (Stuiver & Polach 1977).

[2] Calibration according to Stuiver et al. (1998) without the hemisphere offset applied. ΔR for marine shell calibration = –30 ± 15 (McFadgen & Manning 1990).

[3] New Zealand Archaeological Association site number.

Appendix 3

DATING EARTHQUAKE UPLIFT

I identify two earthquake uplifts of the sub-region A coastline since human settlement. Each earthquake raised a former sub-tidal platform above sea level. The platforms are evident today as terraces on which have accumulated cover beds of beach ridge deposits, marine sediments, estuarine silt and mud, stream and river alluvium, sand dunes, and slope wash. Dates for the two uplifts, between 1360 AD and 1500 AD, and c. 1800 AD, are inferred from sea-rafted pumice (Table A3.1) and radiocarbon-dated shells, wood, and peat recovered from the cover beds (Table A3.2).

The terrace cover beds provide the stratigraphic context of the samples used to date the uplifts. The stratigraphic context is important because pumice, wood and shells are all subject to reworking, and storm surges and tsunami can wash these materials well inland. Storm surges and tsunamis may also sweep an uplifted platform clean of cover deposits, and a deposit that rests directly on a platform was not necessarily deposited soon after initial uplift.

The close proximity of the youngest uplifted terrace to the sea means that many cover bed deposits such as beach ridges and estuarine lagoon mud will, either directly or indirectly, result from marine processes. Marine-derived deposits exhibiting undisturbed bedding are therefore generally sufficient to indicate that the samples they overlie were deposited, and to potentially date, when the terrace on which they were found was the youngest uplifted terrace.

TABLE A3.1 SEA-RAFTED PUMICE IN COASTAL DEPOSITS. FOR LOCALITIES SEE FIG. A3.1 BEACH RIDGES LABELLED IN ORDER OF INCREASING AGE: A, B, C..., THE YOUNGEST (GROWING) RIDGE BEING A.

LOCALITY	PUMICE	PROVENANCE	REFERENCE
Glenburn Coast	Taupo[1]	Flat Point, back of ridge C	McFadgen (1985)
Glenburn Coast	Taupo	Back of ridge C, south of Flat Point	Wellman (1971b)
Glenburn Coast	Loisels[1]	Flat Point, front of ridge B, near profile 9 (Wellman 1971b)	McFadgen (1985)
Glenburn Coast	Loisels	Front of ridge A, near profile 8 (Wellman 1971b)	Wellman (1971b)
Okoropunga Coast	Taupo[1]	Beneath ridge C at profile 5	Author's observation
Okoropunga Coast	Loisels[1]	Front of ridge C at profile 5	Author's observation
Okoropunga Coast	Taupo[1]	Back of ridge C at profile 4	Author's observation
Okoropunga Coast	Loisels[1]	Front of ridge C at profile 4	Author's observation
Oterei Coast	Taupo	Beneath ridge C, near profile 2 (Singh 1971)	Author's observation
Oterei Coast	Loisels	Front of ridge C, near profile 1 (Singh 1971)	Author's observation
White Rocks Coast	Taupo	In ridge C and in lagoon muds behind ridge C at Te Oroi.	Sections 1 and 2 Fig. A3.2
White Rocks Coast	Loisels[1]	In lagoon mud behind ridge C at Te Oroi.	Author's observation
White Rocks Coast	Taupo	In lagoon mud beneath ridge C, near profile 7 (Wellman 1971a)	Author's observation
White Rocks Coast	Loisels[1]	In lagoon mud beneath ridge C, near profile 7 (Wellman 1971a)	Author's observation
Cape Palliser	Taupo[1]	Back of ridge D at Black Rocks, near profile 29 (Ghani, 1978)	Author's observation
Palliser Bay	Taupo	On Terrace II, between 1st and 2nd uplifted beach ridges	Ota et al. (1990)

[1] Moderately abundant quantities, probably primary sea-rafted deposit.

TABLE A3.2 RADIOCARBON AGES FOR UPLIFTED TERRACE COVER BED DEPOSITS AND BEACH RIDGES.

ZONE	LOCALITY	LABORATORY NUMBER[1], CRA[2] AND 95% CALIBRATED AGE RANGE (Cal AD)[3]	MATERIAL DATED AND CONTEXT	SIGNIFICANCE
B	South of Whareama River[4] (Loc 234)	NZ7128 408 ± 65 BP 1410–1645 AD	Peat on a thin gravel layer just above the bedrock of the lowest terrace	Minimum date for initial uplift of lowest terrace. Calibrated age in good agreement with initial uplift of Terrace III and Beach Ridge B at Flat Point and the formation of the growing beach ridge (A)
B	North of Riversdale[4] (Loc 238)	NZ4692 600 ± 56 BP 1285–1435 AD	Wood in peat layer within beach gravel on lowest terrace	Calibrated age consistent with the initial uplift of Terrace III at Flat Point and the formation of growing beach ridge (A)
B	North of Flat Point[4] (Loc 242)	NZ7145 1903 ± 75 BP 270–645 AD	Shells in growth position in gravel on sandstone underlying middle terrace (?)	Close date for the initial uplift of the middle terrace (= Terrace II at Flat Point?)
B	North of Flat Point[4] (Loc 243)	NZ7161 946 ± 69 BP 1290–1480 AD	Shells (some in growth position) in thin sand and gravel layer on mudstone platform of Terrace V	Close date for initial uplift of Terrace IV and Beach Ridge B, and for beginning of formation of growing beach ridge (A)
B	Flat Point[4] (Loc 245)	NZ7123 900 ± 36 BP 1345–1470 AD	Shells in silty sand and gravel in right bank of Te Unu Unu Stream on Terrace III	Probably midden shells from site T27/12
A	Southwest of Honeycomb Light[4] (Loc 250)	NZ7197 1119 ± 69 BP 725–740 AD 770–1025 AD	Wood (unidentified) in sand beneath peat and silt layers on middle terrace	Date consistent with deposition of cover beds on Terrace VI at Te Kaukau Point
A	Northeast of Glenburn Station[4] (Loc 257)	NZ6626 1051 ± 53 BP 890–1040 AD 1105–1115 AD 1145–1150 AD	Wood (unidentified) close to bedrock in bedded sand on second lowest terrace	Date consistent with deposition of cover beds on Terrace VI at Te Kaukau Point. Maximum date for uplift of lowest terrace
A	South of Rerewhakaitu Stream[4] (Loc 267)	NZ7176 251 ± 74 BP Modern	Shell 1 m down in gravel of growing beach ridge	Date consistent with age of formation of growing beach ridge between Okoropunga and Te Kaukau Point
A	East of Te Kaukau Point[4] (Loc 285)	NZ7118 2446 ± 79 BP 370 BC–30 AD	Shells in growth position in beach gravels resting on abrasion platform at base of lowest terrace (= Terrace VI) and overlain by peat with sea-rafted Taupo Pumice	Close date for the initial uplift of Terrace VI and Beach Ridge D, and beginning of formation of Beach Ridge C
A	East of Te Kaukau Point[4] (Loc 285)	NZ7100 2325 ± 79 BP 205 BC–150 AD	Shells in growth position in beach gravels resting on abrasion platform at base of lowest terrace (= Terrace VI) and overlain by peat with sea-rafted Taupo Pumice	Close date for the initial uplift of Terrace VI and Beach Ridge D and beginning of formation of Beach Ridge C

A	West of Manurewa Point[4] (Loc 292)	NZ7164 1312 ± 67 BP 920–1220 AD	Shells in coarse shelly sand underlain by peat and overlain by coarse gravelly sand and Maori occupation layer on lowest terrace	Unsuitable for dating because of stratigraphy and inbuilt age. Date, however, consistent with the deposition of cover beds on Terrace VI at Te Kaukau Point
A	West of Manurewa Point[4] (Loc 292)	NZ7186 1143 ± 38 BP 780–990 AD	Wood in coarse shelly sand underlain by peat and overlain by coarse gravelly sand and Maori occupation layer on lowest terrace	Unsuitable for dating because of stratigraphic position and inbuilt age. Calibrated age, however, consistent with the deposition of cover beds on Terrace VI at Te Kaukau Point
A	West of Manurewa Point[4] (Loc 292)	NZ7112 1182 ± 69 BP 680–1000 AD	Peat underlain by thin layer of gravel on abrasion platform and overlain by coarse shelly sand on lowest terrace	Unsuitable for dating because of stratigraphy. Calibrated age, however, consistent with the deposition of cover beds on Terrace VI at Te Kaukau Point
A	East of Te Kaukau Point[4] (Loc 293)	NZ7201 1788 ± 30 BP 135–265 AD 275–340 AD	Wood in coarse shelly sand underlying 1.2 m thick peat on highest terrace (V?)	Date consistent with the deposition of cover beds on Terrace V at Te Kaukau Point
A	East of Pukemuri Stream[4] (Loc 296)	NZ7127 3510 ± 82 BP 2035 BC–1625 AD	Wood in sandy clay resting on sandstone and overlain by peat on Terrace V	Maximum date for initial uplift of Terrace VI. Date possibly consistent with the deposition of cover beds on Terrace V
A	East of Te Kaukau Point[4] (Loc 297)	NZ7200 1064 ± 38 BP 895–1025 AD	Wood from layer of unsorted sand, underlain by peat resting on bedrock and overlain by parallel bedded fine to coarse sand with boulders on lowest terrace (= VI)	Maximum date for initial uplift of the present terrace (= P)
A	East of Te Kaukau Point[4] (Loc 297)	NZ7125 990 ± 68 BP 895–1210 AD	Peat resting on bedrock and overlain by layer of unsorted sand and parallel bedded fine to coarse sand with boulders on lowest terrace (= VI)	Minimum date for initial uplift of Terrace VI. Maximum date for initial uplift of the present terrace (= P)
A	Te Roro Stream[4]	NZ7172 1079 ± 51 BP 880–1025 AD	Wood in peat resting on sandstone abrasion platform and overlain by alluvium and beach gravel on lowest terrace	Maximum date for deposition of cover beds on present terrace (= P)
A	East of Te Kaukau Point[5]	NZ1873 2166 ± 63 BP 20–330 AD	Marine shells from hollow in marine bench beneath Beach Ridge C (= Terrace VI)	Close date for the initial uplift of Terrace VI and Beach Ridge D and beginning of formation of Beach Ridge C

[1] Prefixed NZ.
[2] CRA is the Conventional Radiocarbon Age in radiocarbon years before present (BP), where present is the year 1950 AD (Stuiver & Polach 1977).
[3] Determined using calibration data from Stuiver et al. (1998). ΔR for shells = –30 ± 15 (McFadgen & Manning 1990).
[4] After Ota et al. (1990). Locality numbers from Ota et al. (1990).
[5] Sample, collected by author, comprising marine shells: *Irus (Notirus) reflexus, Prototbaca crassicosta, Turbo smaragdus, Cellana denticulata, Pseudacopagia disculus* ($\delta^{13}C = 0.5$).

Some radiocarbon ages are of intertidal rocky shore shells (Beu 1990) that were found in a growth position and were probably killed by uplift. The shells therefore give good close dates for the initial uplift of the terrace on which they were found, and provide a minimum date for the uplift of terraces inland of them, and a maximum date for the uplift of seawards terraces. For the other samples, the type of date (maximum, minimum, or close) depends on their inbuilt age (McFadgen 1982) and their stratigraphic context.

Inbuilt age (McFadgen 1982) is the time between when a sample formed and when it arrived in the place from which it was collected. For primary sea-rafted pumice and *in situ* peat I consider it to be negligible and, depending on stratigraphic context, these samples can provide useful dates for inferring when initial terrace uplift occurred. For secondary (reworked) deposits of sea-rafted pumice, for dates of driftwood, and for shells not found in a growth position, it is a source of error that needs to be taken into account.

Inbuilt age is made up of growth age and storage age (McFadgen 1982) and where either is unknown and possibly large, the type of date for the initial uplift of a terrace is affected. Inbuilt age results in maximum age estimates for uplift as long as the sample is stratigraphically older than the uplift event. A sample, with an unknown and possibly large inbuilt age that is stratigraphically younger than an uplift event, does not provide a minimum age estimate. Growth age is negligible for all pumice i.e. the pumice forms immediately on eruption. Because sea-rafted pumice is known to disperse widely and wash up on beaches within a few years of its eruption (Coombs & Landis 1966), I consider storage age for primary sea-rafted pumice to be negligible. For secondary sea-rafted pumice storage age is unknown and possibly large because its reworking history is unknown. The growth age for shells is small and the main component of inbuilt age is likely to be storage age i.e. the time between the shells dying and being washed up on shore. Storage age is unknown and possibly large for all shells not found in growth position, and both growth and storage age are unknown and possibly large for driftwood.

An example is NZ6626 (Loc. 257, Table A3.2) where, by reason of the bedded sand containing it, the wood was probably deposited when the terrace was the youngest uplifted terrace. The wood was unidentified driftwood (Ota et al. 1987), described as fine, fragile pieces of plant material (Berryman pers. comm.). If the wood were twigs or a similar, short-lived material then its growth age would be small. Its storage age, however, is unknown and possibly large because it was driftwood with an unknown history prior to deposition. It has an unknown and possibly large inbuilt age and does not date the initial uplift of the terrace on which it was found. It does, however, provide a maximum age for the initial uplift of terraces younger than (i.e. seawards of) the one on which it was found, but no information about older terraces (i.e. landwards).

Because of the possibility of being reworked, if samples are from unbedded deposits and overlain by unbedded deposits one can't be certain that the terrace on which they were found was the youngest uplifted terrace when they were deposited. For this reason, the wood and shells from Manurewa Point (Fig. A3.1) (Loc. 292, Table A3.2) do not date the initial uplift of the terrace on which they were found. The peat, on the other hand, gives a minimum date for initial uplift.

Except for shells found in growth position, which I consider probably provide close dates for initial terrace uplift, the types of dates the other materials provide for terrace uplift are listed in Table A3.3 according to inbuilt age and stratigraphic context.

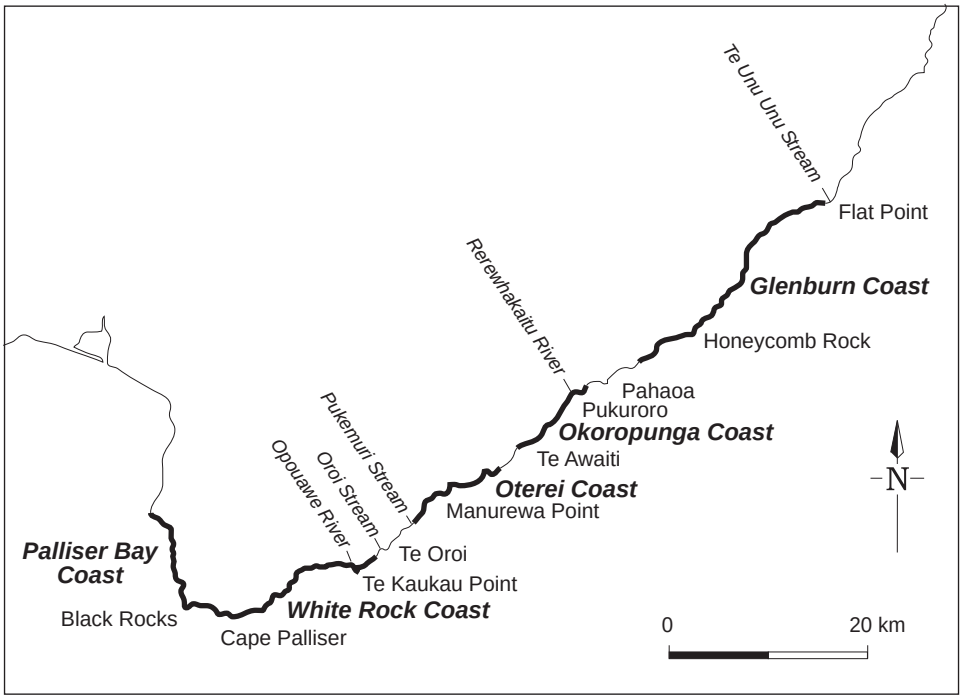

Figure A3.1 Southeast Wairarapa coast showing places mentioned in the text. The thick line at the coast indicates uplifted beach ridges.

TABLE A3.3 DATES FOR THE INITIAL UPLIFT OF TERRACES DEPENDING ON INBUILT AGE AND STRATIGRAPHY.

STRATIGRAPHIC CONTEXT OF DATED SAMPLE	INBUILT AGE: NEGLIGIBLE (1° PUMICE DEPOSITS, PEAT)	INBUILT AGE: UNKNOWN AND POSSIBLY LARGE (2° PUMICE DEPOSITS, WOOD, SHELLS NOT IN GROWTH POSITION)
Lagoon deposit	Maximum for terraces seaward. Minimum for terraces landward and the terrace on which found.	Maximum for terraces seaward. Not useable for terraces landward.
Bedded deposit of marine origin	Maximum for terraces seaward. Minimum for terraces landward and the terrace on which found.	Maximum for terraces seaward. Not useable for terraces landward.
Unbedded deposit of marine or terrestrial origin and not overlain by bedded deposit of marine origin	Pumice and peat not useable for terraces seaward. Peat not useable for terraces landward. Pumice a minimum for terraces landward.	Not useable for terraces seaward. Not useable for terraces landward.

Dates for coastal uplift between Flat Point and the Whareama River

At Flat Point, the beach ridges A, B, and C (Wellman 1971b; McFadgen 1985) are the outer edges of Terraces IV, III, and II respectively. Taupo Pumice is behind Beach Ridge C with Loisels Pumice along the front of Beach Ridge B, indicating that Beach Ridge C was probably uplifted before the Loisels Pumice. Shells from the bank of the Te Unu Unu Stream (Loc. 245, Ota et al. 1990) in Terrace III deposits are midden shells from site T27/12 (the archaeological site with the moa claw in the oven) and the date (NZ7123) is for Maori occupation, not terrace formation. All other radiocarbon ages (Table A3.2) are in good agreement with the pumice deposits and indicate that Terrace II and Beach Ridge C were initially uplifted about 450 AD (1500 BP), and Terrace III and Beach Ridge B about 1450 AD (500 BP) (Ota et al. 1990).

Date for coastal uplift between Palliser Bay and Flat Point

Between Te Kaukau Point and Manurewa Point Ota et al. (1987, 1990) recognised seven uplifted terraces. Beach Ridges B and C at Te Kaukau Point (Wellman 1971a) and the Oterei Coast (Singh 1971) are on the outer edge of Terraces VII and VI respectively. At several places between Pukuroro and Te Kaukau Point there is Taupo Pumice behind Beach Ridge C and Loisels Pumice along the front of Beach Ridge C. The pumices indicate that the beach ridge probably began forming before the Taupo Pumice eruption and was uplifted after the Loisels Pumice arrived.

Along most of the coast between Te Kaukau Point and the Oroi Stream, which includes Ota et al.'s (1987, 1990) sampling locations 285 and 297, the lowest extant terrace is VI (Ota et al. 1987, fig. 2). Good vertical sections of the terrace and beach ridge have been cut by wave action (Figs A3.2 and A3.3), exposing lagoon mud, peat and beach ridge deposits. The lagoon mud deposits, which accumulated behind Beach Ridge C, contain both Taupo and Loisels pumices (Table A3.1) and are overlain by stream alluvium and soils with dated midden deposits.

Three close radiocarbon ages for the initial uplift of Terrace VI at Te Kaukau Point (NZ1873, 7100, and 7118) have calibrated age ranges (Table A3.2) that are consistent with the presence of Taupo Pumice in the lagoon mud deposits behind Beach Ridge C. While their difference is highly significant ($T' = 9.97$, $P < 0.01$, d.f. = 2, (T' test, Ward & Wilson 1978)), their 95% calibrated age ranges overlap between 20 AD and 30 AD and are marginally consistent. The weighted mean of the three ages is 2290 ± 42 BP, which gives a 95% calibrated age range for the initial uplift of Terrace VI of between 85 BC and 125 AD.

There is no close date for the initial uplift of Terrace VII, although four radiocarbon ages (NZ6626, 7125, 7172, and 7200) give maximum dates of between about 900 AD and 1200 AD, and uplift is determined indirectly from the lagoon deposits that accumulated behind Beach Ridge C. The lagoon deposits are exposed in sections at four places where Beach Ridge C has been eroded: section 3 at Te Awaiti (McFadgen 1985, fig. 8), north and south of the Oroi Stream (sections 1 and 2, Fig. A3.2), and at Te Kaukau Point (section 3, Fig. A3.3 and Table A3.4). The lagoons at Te Awaiti and Te Oroi were at stream mouths, the lagoon at Te Kaukau Point appears to have been fed by ground water.

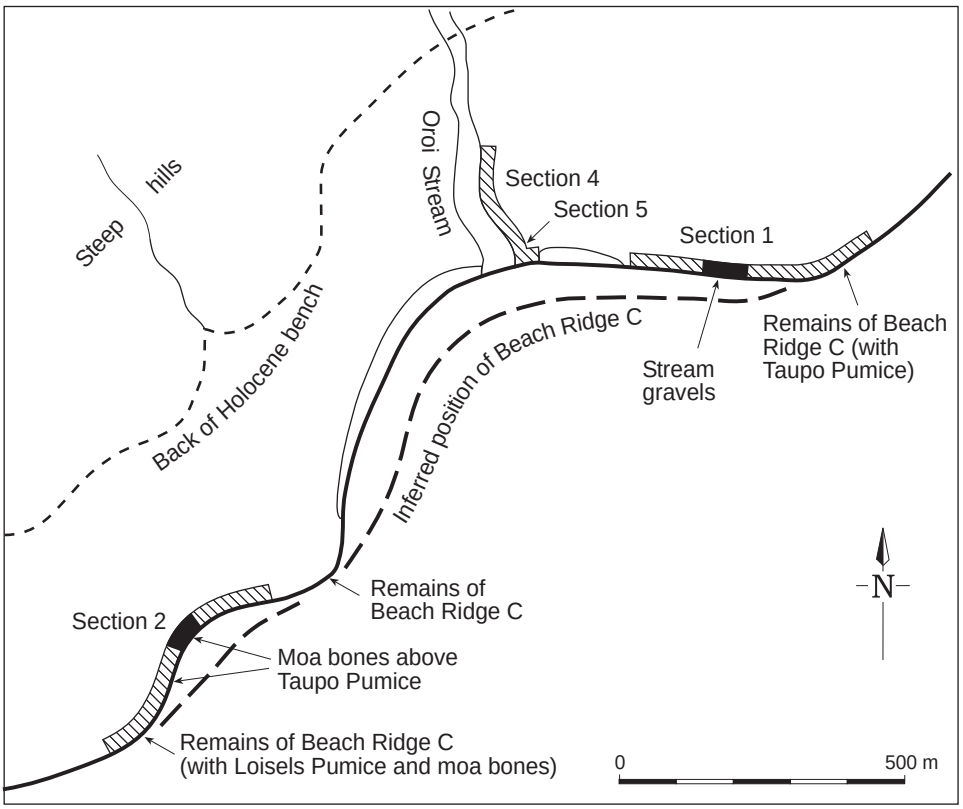

Figure A3.2 Sketch map of Te Oroi showing locations of lagoon sections 1 and 2, and stream sections 3 and 4 (= sections 4 and 5 respectively, McFadgen 1985, fig. 8). The parts of the sections shown as solid are illustrated in Fig. A3.4. Section 1 contains stream gravels and sand (possibly windblown) interbedded with lagoon muds, and Taupo Pumice in remains of Beach Ridge C, but no moa bones. Section 2 contains Taupo Pumice and moa bones, but no interbedded terrestrial deposits.

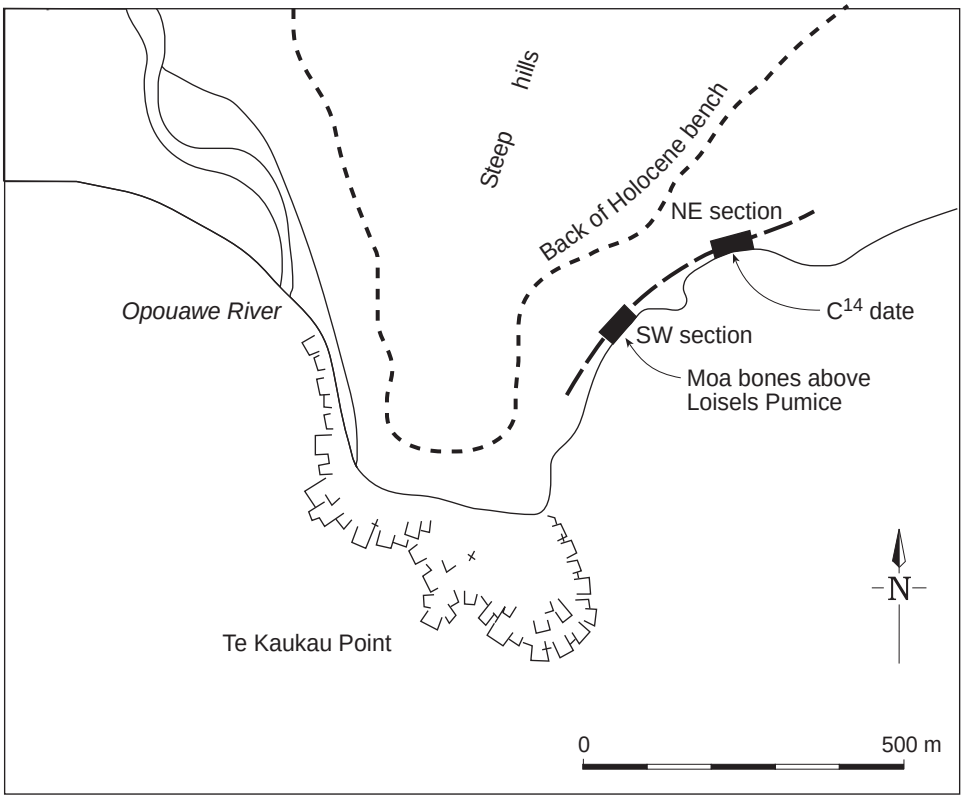

Figure A3.3 Sketch map of Te Kaukau Point showing locations of two sections, identical except for the basal part: NE section (= section 3) with peat, and radiocarbon-dated shells; SW section with numerous moa bones in mud above Loisels Pumice. Line C = Beach Ridge C. For diagram of NE section see Fig. A3.4.

The columns shown in Fig. A3.4 represent sections of the lagoon deposits. They are described in Section 3 (McFadgen 1985) and Table A3.4. The columns are at different distances back from Beach Ridge C and are generalised into an idealised cross-section normal to the coast in Fig. A3.5. The main features of the

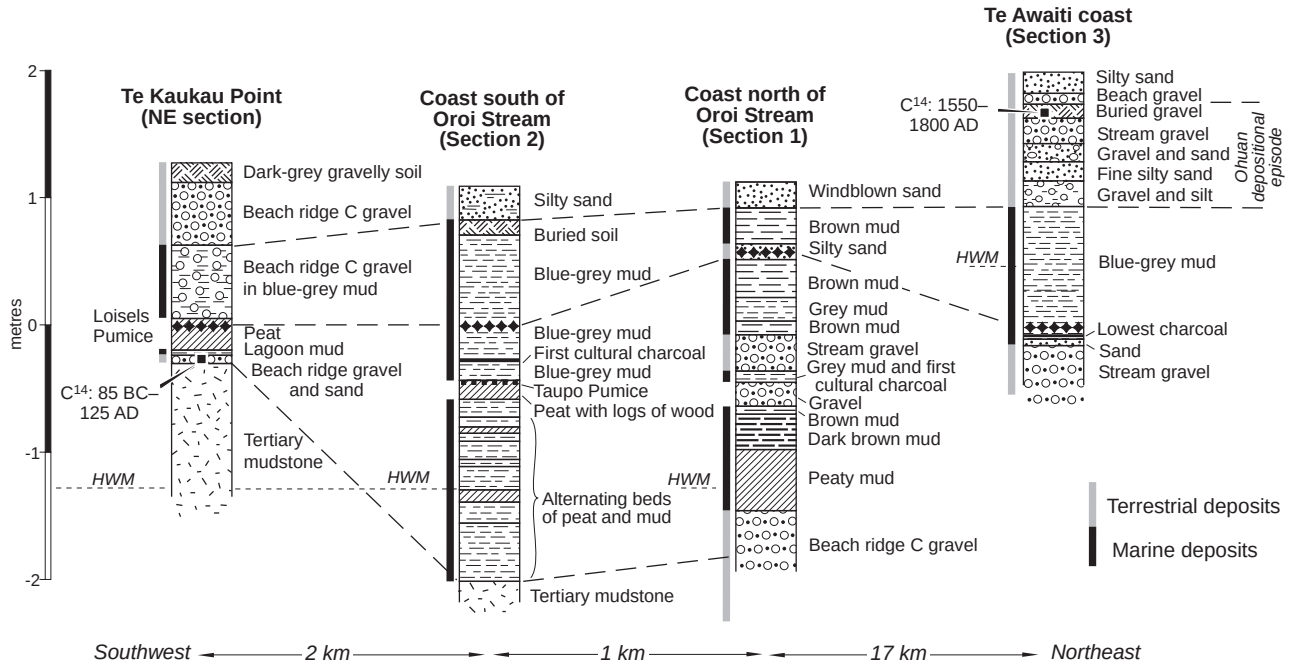

Figure A3.4 Four columns (generalised in Fig. A3.5) to illustrate the growth of Beach Ridge C and deposition of estuarine muds behind Beach Ridge C. Positions of columns shown by Figs. A3.2 and A3.3, and section 3 (McFadgen 1985, fig. 7). The narrow black and grey columns beside the section columns indicate marine deposits (black) and non-marine deposits (grey). Height arrangement is that inferred at time of Loisels Pumice deposition. Post-Loisels uplift has been least at right hand column (Te Awaiti Coast). HWM = high water mark.

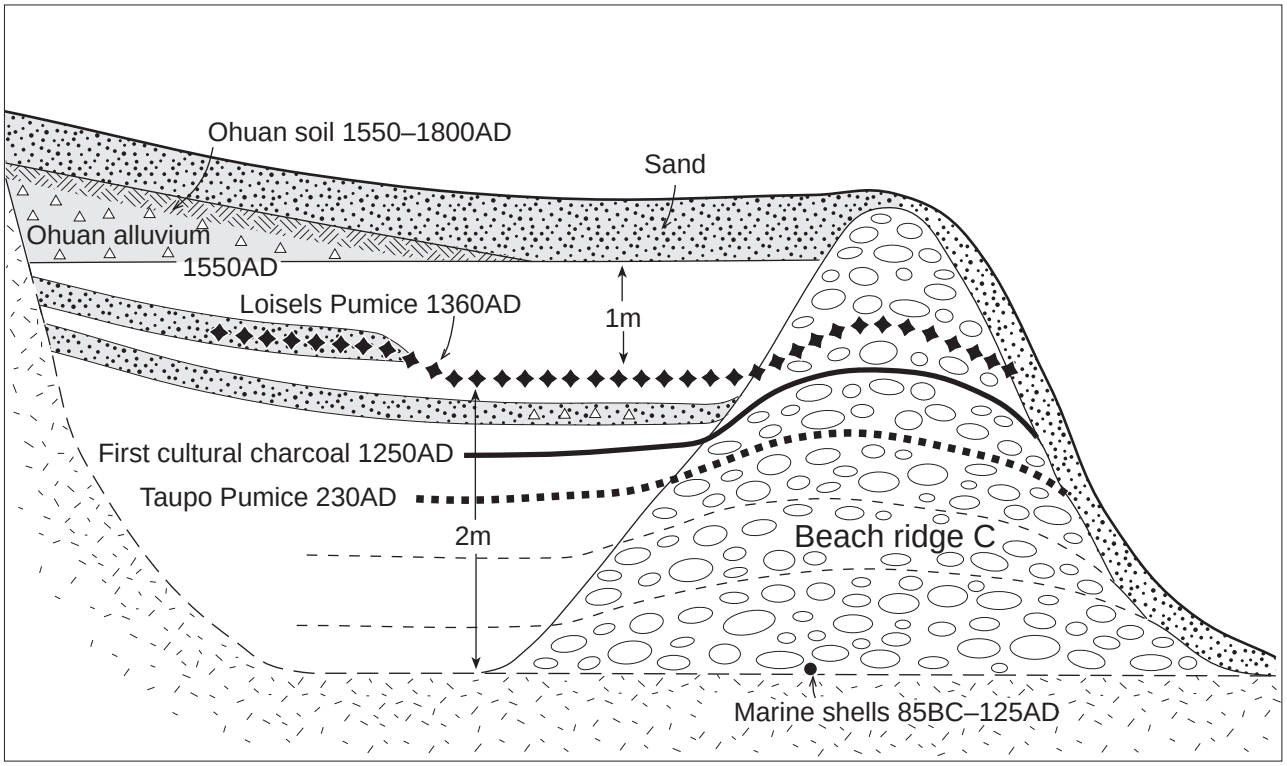

Figure A3.5 Idealised cross-section to show stratigraphic relationship of sea-rafted pumices, lagoon muds, Beach Ridge C, Ohuan alluvium, and sand (possibly windblown). Data from section 3 (McFadgen 1985, fig. 7), sections 1 and 2 at Te Oroi (Fig. A3.2), and NE Section at Te Kaukau Point (Fig. A3.3). Selected columns shown by Fig. A3.4. Grey background = non-marine, mostly stream deposits and windblown sand; white background = marine, mostly estuarine mud.

TABLE A3.4 DESCRIPTIONS OF SECTIONS CONTAINING LAGOON DEPOSITS AT TE OROI AND TE KAUKAU POINT (LAYER THICKNESSES IN METRES).

SECTION 1: Coast north of Oroi Stream (Section 1, Fig. A3.2, Grid Ref S28/153587)	(m)
Windblown sand	0.20
Brown mud with charcoal	0.30
Silty sand, stream gravels, Loisels Pumice and charcoal	0.10
Brown mud	0.30
Grey mud with charcoal	0.20
Brown mud with charcoal and sand	0.10
Lens of stream gravel and charcoal	0.30
Dark grey mud with rare charcoal	0.10
Lens of rounded gravels and sand	0.20
Lens of brown mud	0.05
Dark brown mud	0.30
Dark grey peaty mud grading to silty sand at south end of section	0.50
Beach ridge gravel	0.20+
SECTION 2: Coast south of Oroi Stream (Section 2, Fig. A3.2, Grid Ref S28/143580)	
Sandy silt with round and angular stones, strap iron and fencing wire	0.30
Medium grey silt loam buried soil	0.15
Light grey mud	0.60
Blue-grey mud with yellow mottles and Loisels Pumice	0.10
Blue-grey mud with yellow mottles and rare charcoal	0.30
Blue-grey mud with iron mottles	0.15
Peat with stones and wood	0.15
Blue-grey mud	0.15
Alternating layers of peat and grey, brown and black mud overlain by Driftwood and occasional Taupo Pumice	1.35
NE SECTION: Te Kaukau Point (Northeast section, Fig. A3.3, Grid Ref S28/130570)	
Dark grey gravelly soil, scattered shells, bones and charcoal	0.15
Beach ridge gravel	0.50
Beach ridge gravel in mud	0.60
Peat, fibrous with Loisels and Taupo Pumices near top, rare charcoal, marine shells, and logs of drift wood up to 30 cm diameter	0.30
Blue grey mud	0.05
Beach ridge gravel and sand	0.05
Tertiary mudstone	1.0+

idealised section are: on the seaward side, Beach Ridge C; and on the inland side, lagoonal and interbedded terrestrial deposits; and a sequence of five known and inferred ages. The ages, from oldest to youngest are as follows.

- The radiocarbon age of 85 BC–125 AD for the uplift of Terrace VI and the beginning of growth of Beach Ridge C at Te Kaukau Point.
- An inferred date of less than 230 AD for non-primary Taupo Pumice in sections 1 and 2 at Te Oroi.
- An inferred date of less than 1250 AD for the first cultural charcoal in sections 1 and 2 at Te Oroi. The charcoal gives a maximum date for stream gravels.
- A known date of 1360 AD for primary Loisels pumice in Beach Ridge C in all four sections. The pumice gives a date for the top of Beach Ridge C, for the upper part of the lagoon mud, and for windblown sand and stream gravel within the lagoon mud.

- A known age of 1500 AD for Ohuan deposits and soil at Te Awaiti (McFadgen 1985, section 3). The deposits and soil give a minimum date for the youngest lagoon deposits.

The simplest interpretation of the four sections is simultaneous growth of Beach Ridge C, and accumulation of interbedded lagoon and terrestrial deposits which were abruptly stopped by the earthquake uplift of Beach Ridge C at all three places between 1360 AD and 1500 AD.

There is no direct evidence for the uplift of the Beach Ridge B. There is no historic record of uplift since European settlement, and Beach Ridge B was probably uplifted sometime between about 1550 AD and 1840 AD. If renewal of colluvial activity followed earthquake uplift, as inferred by Goff & McFadgen (2001), then the uplift of Beach Ridge B possibly occurred at the end of the Ohuan Depositional Episode c. 1800 AD.

The occurrence of two uplifts since human settlement conflicts with the conclusion reached by Ota et al. (1987), that the most recent uplift of sub-region A was about 1000 years ago. The conclusion that I have reached, however, is based on a wider range of data than that used by Ota et al., including the correlation of deposits using sea-rafted pumice. Although my conclusion is consistent with Ota et al.'s (1987) radiocarbon ages, more data is desirable to resolve the conflict.

Appendix 4

INSECT AND LAND SNAIL REMAINS FROM A PEAT DEPOSIT AT TE KAUKAU POINT LAGOON SECTION

SPECIES	HABITAT	NUMBER OF SPECIMENS
Insects[1]		
Oribatid mites	Bush	23
Weevils	Bush	4
Hydrophilid beetle	Bush	1
Staphylinid beetle— *Cafius quadriimpressus*	Bush and coastal situation	1
Ants	Bush and coastal situation	17
Land snails[2]		
Charopa bianca		4
Charopa coma		20
Phrixgnathus glabriusculus		2
Omphalorissa purchasi		2
Paralaoma lateumbilicata		4
Paralaoma pumila		20
Phenacohelix giveni		19
Therasia zelandiae		1

[1] Identifications by R.G. Ordish, National Museum of New Zealand.
[2] Identifications by F.M. Climo, National Museum of New Zealand.

Comment (F.M. Climo): The presence of coarsely-ribbed *Charopa coma* is indicative of both logs and a relatively high rainfall (in drier areas *C. coma* has more ribs). The semi-arboreal *P. giveni* and *C. bianca* (suspended litter or epiphytic plants) are indicative of well-developed coastal forest, as is the arboreal species *P. glabriusculus*. *P. pumila* and *T. zelandiae* may be derived from more open areas on bush fringes or in clearings. *P. lateumbilicata* will occur in any undisturbed damp litter and is not a good indicator of anything by itself. *O. purchasi* is usually associated with ground ferns.

Appendix 5

ANIMAL SPECIES IDENTIFIED FROM NATURAL COASTAL DEPOSITS

SPECIES	COMMON NAME	COMMENTS
Te Kaukau Point lagoon section[1]		
Lagoon mud above Loisels Pumice		
Eudyptula minor	Blue penguin	
*Larus novaehollandiae scopulinus**	Red-billed gull	
Macronectes giganteus	Giant petrel	
*Puffinus bulleri**	Shearwater	
Puffinus cf. *gavia*	Shearwater	
cf. *Sterna striata**	Tern	
Stictocarbo punctatus	Shag	
Leucocarbo sp.*	Shag	
Anas sp.	Duck	Includes immature specimen
Anas superciliosa	Grey duck	Includes submature specimen
Anas aucklandica chlorotis	Brown teal	
Tadorna variegata	Paradise duck	
*Haematopus unicolor**	Oystercatcher	
Coturnix novaezelandiae	Quail	
Gallirallus australis	Weka	
Hemiphaga novaeseelandiae	Pigeon	
Strigops habroptilus	Kakapo	
Nestor meridionalis	Kaka	
Cyanoramphus auriceps/novaezelandiae	Parakeet	
Prosthemadera novaeseelandiae	Tui	
Euryapteryx geranoides	Moa	Bones of part of one individual found in approximate position of articulation (MNZ[2] S24413)
*Euryapteryx curtus**	Moa	Includes bones of one individual found in position of articulation (MNZ[2] S24414)
Unidentified moa*	Moa	Includes submature specimens
*Mohoua albicilla**	Whitehead	
Moa eggshell		
Sphenodon punctatus	Tuatara	
?Thyrsites atun	Barracouta	Frostfish or southern kingfish
Anguilla sp.	Eel	
Mystacina tuberculata	Native bat	
Arctocephalus forsteri	Fur seal	Includes immature and submature specimens
Arctocephalus forsteri/Neophoca hookeri	Fur seal or sea lion	
Mirounga leonina	Sea elephant	
Whale		
Beach Ridge C gravels above lagoon mud		
Leucocarbo sp.*	Shag	
*?Euryapteryx curtus**	Moa	
Arctocephalus forsteri	Fur seal	Includes submature specimen
Occupation layer on Beach Ridge C		
Sphenodon punctatus	Tuatara	
?Thyrsites atun	Barracouta	Frostfish or southern kingfish

SPECIES	COMMON NAME	COMMENTS
Peat		
*Mohoua albicilla**	Whitehead	
Moa		Eggshell
Anguilla sp.	Eel	
Te Oroi southern lagoon section[1]		
Euryapteryx geranoides	Moa	Part of tibia, between Taupo and Loisels Pumices (MNZ[2] S1012)
Euryapteryx geranoides	Moa	Pelvis and long bones, between Taupo and Loisels Pumices (MNZ[2] S991)
Euryapteryx geranoides	Moa	Between Taupo and Loisels Pumices (MNZ[2] S992)
Euryapteryx geranoides	Moa	Metatarsus, at level of Loisels Pumice (MNZ[2] S994)
Te Oroi c. 200 m south of Oroi Stream[3]		
?Euryapteryx geranoides	Moa	Femur (MNZ[2] S41082)
Opouawe River north bank section[4]		
Euryapteryx geranoides	Moa	Tibia shaft fragments, below Loisels Pumice (MNZ[2] S993)

1 Identifications by G.S. Markham and Alan Tennyson (*).
2 MNZ refers to Museum of New Zealand collection number.
3 Identification by Alan Tennyson.
4 Identification by J.C. Yaldwyn.

Appendix 6

ANIMAL SPECIES IDENTIFIED FROM A MIDDEN DEPOSIT ON TAMATEAN BURIED SOIL IN TE UNU UNU STREAM SECTION AT FLAT POINT

SPECIES	COMMON NAME	COMMENTS
Macronectes giganteus	Giant petrel	
Hemiphaga novaeseelandiae	Pigeon	2 individuals
Nestor meridionalis	Kaka	
Rattus exulans	Kiore	2+ individuals
Euryapteryx curtus	Moa	Includes 1 fibula, first phalanx of the outer right toe, and claw in position of articulation in fireplace
Unidentified moa species	Moa	2 vertebral fragments, 1 broken tibia
Unidentified sea mammal	Seal (?)	Includes skull fragments, teeth, flipper pieces, ribs, scapulae, foetal backbones, from at least 3 individuals and 1 foetus
Unidentified fish		
Unidentified bird		

Appendix 7

DETERMINING VARIATION OF ARCHAEOLOGICAL SITE COMPONENTS WITHIN AND BETWEEN SUB-REGIONS

Archaeological sites in the Wairarapa Region often comprise several components, of which defences (ditches and or banks), middens, pits, and gardens (stone rows or plaggen soils) are the most common. Other site components, such as flaking floors, ovens and terraces, occur infrequently. Tables A7.1 and A7.2 summarise the four most common site components for six sub-regions: the four stretches of coast that correspond to the sub-regions identified by Ota et al. (1987), the Palliser Bay coast and, for Table A7.1, the Masterton Basin. There are too few data for the Pahiatua Basin.

The tables are based on site data listed in the index to the New Zealand Archaeological Association Site Recording Scheme, maintained by the Science and Research Unit, DOC, and sites for which a grid reference is listed in Keith Cairns' notes held by the Alexander Turnbull Library. Sites clearly duplicated by the two sets of data are removed from the Cairns set, and sites recorded as historic are excluded, but otherwise no change is made. Walton (pers. comm. 2001) has questioned the validity of some of the sites reported by Cairns: for example, some pa sites Cairns reported for the Masterton District cannot be seen on aerial photographs. While it is acknowledged that much of the Cairns data needs to be independently checked in the field, they do represent field observations that are indicative of archaeological remains of one sort or another. They are, therefore, used in conjunction with the Archaeological Association site records as a basis for archaeological inference that, if not always accurate in detail, is probably a reasonable reflection of a general pattern able to be tested by field work. If the Cairns data is removed from the set, the proportions of sites in the categories change, but the overall pattern is unchanged. Listing sites with multiple components once for each component derives the final data set.

The relative abundance of the four archaeological site components is the percentage of each component in each sub-region and is found by dividing the number of each type of component in a sub-region by the total components in the sub-region and multiplying by 100. Because the coast is a linear feature, normalising the number of components with respect to distance can effectively compare their abundance between coastal sub-regions. The Masterton Basin, being non-linear, is excluded. The numbers of each component in each coastal sub-region are, therefore, expressed as the average number of each component per 25 km of coastline. For the sub-regions on the east coast the distance is the straight line between each end. The Palliser Bay sub-region was divided into three segments to take account of the change in direction of the coastline.

TABLE A7.1 COMPARISON OF THE RELATIVE ABUNDANCE OF FOUR ARCHAEOLOGICAL SITE COMPONENTS WITHIN SUB-REGIONS. THE FREQUENCY OF EACH COMPONENT IS GIVEN IN BRACKETS.

NUMBER OF SITES	SUB-REGION	DEFENCES	PITS	GARDENS	MIDDENS
4	Akitio –	25% (1)	0% (0)	0% (0)	75% (3)
82	Mataikona –	15% (12)	6% (5)	1% (1)	78% (64)
23	Whareama –	9% (2)	13% (3)	0% (0)	78% (18)
161	Flat Point –	11% (17)	38% (61)	20% (33)	31% (50)
74	Cape Palliser –	7% (5)	23% (17)	45% (33)	26% (19)
62	Masterton Basin	66% (41)	32% (20)	2% (1)	0% (0)
406		**78**	**106**	**68**	**154**

TABLE A7.2 COMPARISON OF THE ABUNDANCE FOUR ARCHAEOLOGICAL SITE COMPONENTS BETWEEN COASTAL SUB-REGIONS. DATA NORMALISED FOR DISTANCE ALONG THE COAST.

LENGTH OF COAST (km)	SUB-REGION	NUMBERS OF SITE COMPONENTS PER 25 km LENGTH OF COAST			
		DEFENCES	PITS	GARDENS	MIDDENS
25	Akitio –	1	0	0	3
29	Mataikona –	10	4	1	55
29	Whareama –	2	3	0	16
70	Flat Point –	6	22	12	18
33	Cape Palliser –	4	13	25	14
186					