Archaeology of the Bay of Plenty

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Cover: Old sulphur mine with HMNZS *Mako* in the background, White Island, 1960.
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ABSTRACT

This report summarises the state of knowledge of the archaeology of the Bay of Plenty, New Zealand, and reviews research themes and priorities of the past and for the future. The Bay of Plenty is favoured as a place to live today, but this has not always been the case. Its first settlement by Maori seems to have been sparse, whereas there are numerous sites from the later pre-European occupation period. The early economy was based around the marine resources and soils, which were well suited to cultivation of kumara. The first European visitors took relatively little interest in the region as it generally lacked the gold and accessible timber resources that drove early growth elsewhere, and cobalt-deficient soils made pastoral farming unattractive in much of the area. The development of improved transport resulted in greater growth, and pastoral farming increased as the lowlands and swamps were drained. In the second half of the 20th century, exotic forestry, energy and horticulture were the main drivers of growth in the region, which now has a rapidly increasing population. All of these stories are illuminated by the archaeology of the region, and there is great potential to tell more. To do this, research strategies and plans need to focus on gaining a better understanding of Maori settlement and resource use away from the coast, examining the factors leading to the widespread adoption of pa from about AD 1500, and making better use of the archaeological material arising from mitigation excavations of Maori sites. Comprehensive recording of historic archaeological sites is also needed.

Keywords: archaeology, Bay of Plenty, Rotorua, Tauranga, Whakatane, Maori, settlement, resource use, mining, forestry, transport, energy

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1. Introduction

The Bay of Plenty, in the northern North Island of New Zealand, seems to be a particularly well-favoured region today, with its mild climate, fertile soils, good energy availability, and its attractive coastline, inland lakes and rivers. However, it has not always seemed as such to human settlers. Volcanic eruptions, extensive wetlands, poor access, sparse mineral wealth, a lingering war and soils deficient in a key trace element (cobalt) hindered its use until quite recently.

Archaeological study can elucidate the history of the region, from its earliest Maori settlement and through the phases of development that followed their arrival and the arrival of the first Europeans.

For archaeological sites of Maori origin, there is a fairly comprehensive set of data available. Some outstanding work has already been done, but additional and better work is required in some areas. This report summarises what is known and indicates where more knowledge is needed.

There is a much smaller body of archaeological work for the historic period (after the arrival of Europeans). This report compares the small amount of survey work that has been undertaken with the extensive potential for further work, as indicated by the written historical record.

2. Scope

This report summarises the state of knowledge of the archaeology of the Bay of Plenty Conservancy of the Department of Conservation (DOC). Research themes and priorities of the past and for the future are reviewed. The intention was not to undertake new fieldwork or research.

The boundary of the conservancy includes the offshore islands Mayor Island (Tuhua), Motiti, White Island and Moutohora (sometimes called Whale Island) (Fig. 1). On the mainland, the boundary of the study area starts just east of Ohiwa Harbour and follows a catchment boundary until the Urewera Park boundary is met. It then follows the western side of the Park south until State Highway 5 is met, at which point it follows State Highway 5 back towards Taupo. Before Taupo, it diverts along minor roads to the Waikato River at Broadlands. The boundary then follows the Waikato River to Atiamuri, follows State Highway 1 through Tokoroa and Putaruru, and then diverts on to the Waihou River. It leaves that river boundary near Paeroa to follow the northern boundary of the Kaimai/Mamaku Park until it reaches the sea. The area includes the reserve land north of Waihi Beach.

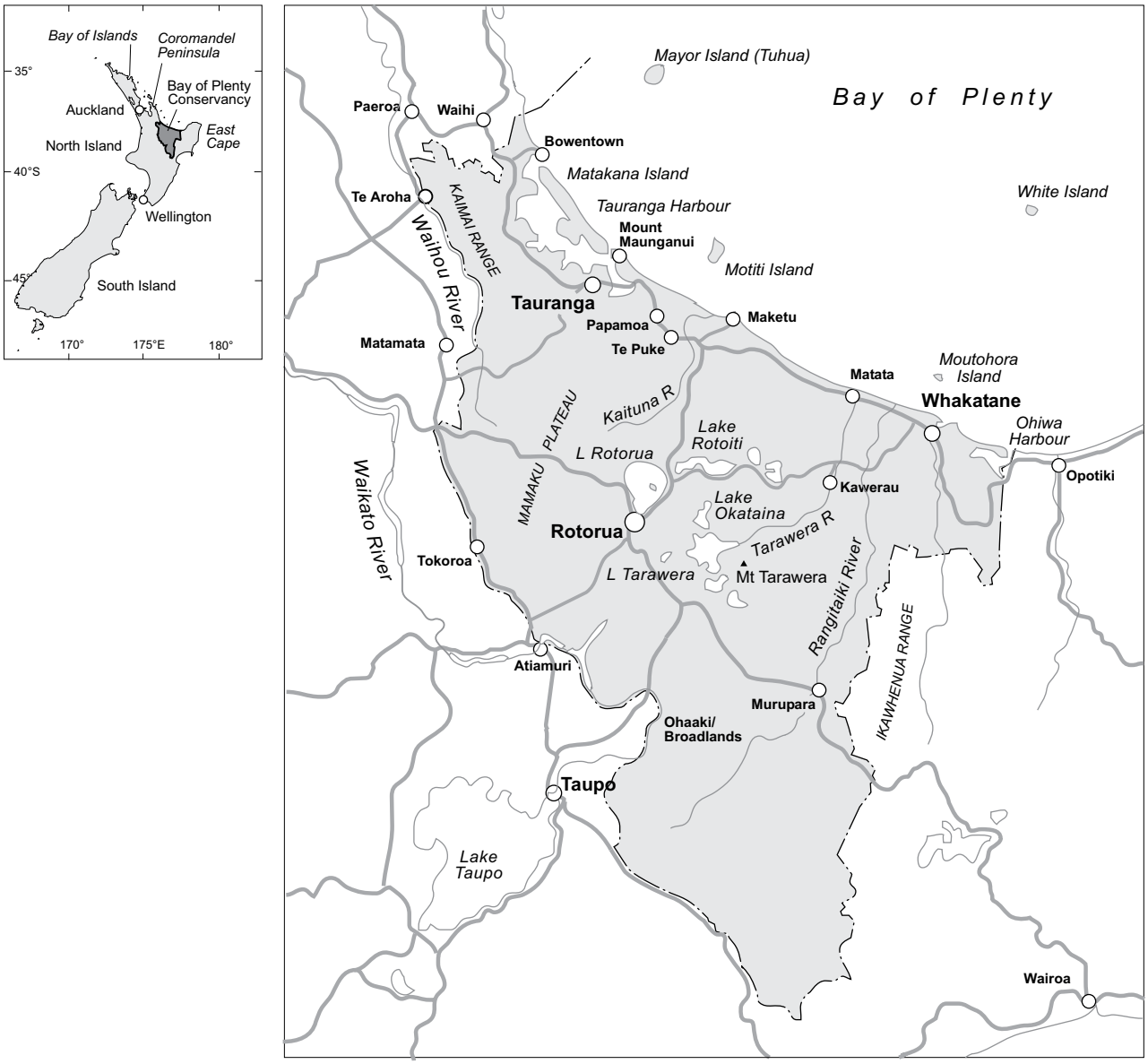

Figure 1. Bay of Plenty Conservancy, Department of Conservation.

The boundaries of the conservancy are not particularly satisfying either from a cultural or topographic perspective, but more or less follow the Bay of Plenty region as it is conventionally understood. In Maori terms, the boundaries cut across several rohe (tribal boundaries). In modern administrative terms, the area includes only the western part of the Bay of Plenty Regional Council, and includes all of Tauranga, Western Bay of Plenty, Kawerau and Rotorua local government areas but only parts of several more. Only parts of the Coromandel goldfields are included. Topographically, the area includes only some of the islands in the Bay from Coromandel to East Cape, and only some of the inland volcanic landscape.

3. Sources of information

TABLE 1. TOTAL NUMBER OF SITES RECORDED IN THE BAY OF PLENTY AS AT 2002.

SITE	NUMBER
Maori	7905
Non- Maori	354
Total	8259

This study has largely drawn on the site record files in the New Zealand Archaeological Association (NZAA) Site Recording Scheme, published reports and the large corpus of unpublished writings about the area.

The region falls into six filing districts of the NZAA scheme. No file area is entirely within the conservancy, but the Bay of Plenty file covering New Zealand Map Series 260 sheets U13–16, V13–18 and W13–16 has by far the greatest proportion of sites. As at February 2002, there were 8259 sites recorded in the conservancy area (Table 1).

Appendix 1 gives details on the site recording that has been undertaken in the past and more information can be found in an unpublished working paper for this project (Law 2002a). The dominance of Maori sites in site records is artificial, as much less effort has been made in the systematic recording of historic (since the arrival of Europeans) archaeological sites.

Many sites have been excavated in the region. Appendix 2 lists the more significant of these. Almost all are Maori sites. Sites where more information may be available are listed in an unpublished working paper prepared for this project (Law 2002b). Reports of excavations on these sites are of particular value. Many of the excavated sites have been dated by radiocarbon dating. These dates are given in Appendix 3, and the distribution of sites through time is discussed further below.

There is a large volume of archaeological literature for the area. More than 80 pages of archaeological and historical references were collected in the course of this study. The majority of archaeological references are of the type that is often described as being 'grey' literature; that is, mostly unpublished reports of which only a few copies exist. This sort of information varies considerably in its value to a researcher. Some reports have quite modest aims; for example, being prepared for a developer who was required to report if there were any archaeological sites likely to be affected—often there were not any. In contrast, reports of mitigation excavations or major surveys are much more important. While formally published material dominated entries in the bibliography in the mid-20th century, by the end of the 20th century this had shrunk to 5% of entries and unpublished or 'grey' literature predominated. Such literature is not easy to access. Material was sourced from the Wellington and Tauranga offices of the New Zealand Historic Places Trust, the Rotorua and Wellington offices of the Department of Conservation, filed with the Bay of Plenty, Coromandel, Waikato and Taupo New Zealand Archaeological Association site records, and, in a few cases, directly from authors. No one place has comprehensive holdings.

Despite the amount of work available, there is no definitive publication on the archaeology of the area and a dearth of monographs reporting the findings from key excavated sites. Irwin's 'Kohika' (Irwin 2004) is the exception. Green's 'Review of the prehistoric sequence of the Auckland Province' (Green 1963a) covered some sites in the west of the region but is now dated and does not cover the vast bulk of more recent work.

There is a number of significant theses and postgraduate degree research essays written about the area, principally from the University of Auckland, that deal with both *prehistoric*[1] (in New Zealand terms, the period before European contact) and historic (after European contact) archaeology (e.g. Holroyd n.d.; Edson 1973; Boileau 1978; Lawlor 1979; Walters 1979; Williams 1980; Kahotea 1983; Spring-Rice 1983b; Mitchell 1984; Seelenfreund-Hirsch 1985; O'Keeffe 1991; Petchey 1993a; Palmer 1994; Phillips 1996). However, the lack of resident archaeologists with an academic base undertaking research that is not driven by development or site management needs has limited the recent development of archaeology in the Bay of Plenty.

Enthusiastic local historians have created a detailed record of the settlement and development of the Bay of Plenty since European settlement. While little of this is directly archaeological, they provide rich sources of material that can be related to the historic archaeological landscape when it is more fully explored. The long-running journal of the Whakatane and District Historical Society—'Historical Review'—is a prime source for this and local archaeological interest. Local historian Don Stafford's many publications on Rotorua are a mine of detailed information, and geographer Evelyn Stokes' works on the Tauranga area (particularly 'A history of Tauranga County'; Stokes 1980) have an immediate appeal to an archaeologist with their integration of social issues into the landscape.

Not many local histories from anywhere in New Zealand start with a sound exposition of the archaeology of the region. Ken Moore's 'Kawerau, its history and background' (Moore 1991) is an exception, bringing in the knowledge of a resident with a long-sustained interest in archaeology.

Early historical resources are less common in the Bay of Plenty than in some other parts of New Zealand. The mission station histories for Te Papa, Tarawera and the Rotorua sites are the exceptions (Vennell 1984; Andrews 2001; Grace 2004), as is the history of the Maketu trading operation of Tapsell (Cowan 1935). More problematic is the novelised account of Valentine Savage's life at Matata in the 1840s (Henderson 1948), where the detail is credible but some may be later additions. There are biographies of three important missionaries, Thomas Chapman (Andrews 2001), Thomas Samuel Grace (Grace 2004) and Alfred Nesbit Brown (Hall 1981), as well as brief accounts of the lives of the important soldier-settlers William and Gilbert Mair (Andersen & Petersen 1956) and a biography of Gilbert Mair (Crosby 2004). Some early travellers passed through Tauranga and the Rotorua Lakes and geothermal region—notably, Percy Smith (1953) in 1858, Hochstetter (1867) in 1859, Meade (1870) in 1864/65 and Dieffenbach (1843) in 1841—but their accounts reflect the itinerant and brief nature of their visits. Few illustrations appear until the arrival of the British troops at Tauranga. Kinder's watercolours and photographs from several visits from 1858 to 1964, covering Tauranga, Rotorua and Tarawera, are a valuable source (Dunn 1985). Robley's portraits and scenes from the 1864 war constitute a treasure-trove of pictorial depictions of the early historical period (Robley 1896; Melvin 1957, 1990).

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[1] See Glossary for definition of this and other italicised terms.

Some significant archaeological work has been carried out just outside the boundaries of the Bay of Plenty Conservancy. Much archaeological work has been done on the Coromandel Peninsula, although there are no recent summaries (but see Law 1982). More recent reviews of the archaeology of Hauraki (Furey 1996; C.A. Phillips 2000) are very relevant to the western parts of the region. A rare example of an inland early site—the Tokoroa moa-hunter site (Law 1973)—is just outside the region, as is the early Whakamoenga Cave site (Leahy 1976). The excavations around Taupo that were prompted by the Tongariro power scheme (Newman 1988) are also relevant.

Part of the Coromandel goldfields are within the conservancy area and their development was influential within the district. The knowledge of these has most recently been summarised in visitor guide form by Moore & Ritchie (1996).

The author has been a participant on a few of the excavations in the district and has visited many sites over recent decades. Therefore, fieldwork for this report was limited to becoming familiar with some historic sites of European origin not previously visited.

4. A short history of settlement

Before introducing the detailed part of this account, it is worth summarising the settlement history of the Bay of Plenty area.

Several of the traditional canoes, or waka, that brought the first Maori settlers to New Zealand are associated with the Bay of Plenty. The traditional landing places of the Takitimu, Mataatua, Te Arautauta and Nukutere waka are in the Bay of Plenty region. Indeed, considering the trajectory of voyagers from eastern Polynesia, a good proportion of landfalls would naturally be expected in the Bay.

The early Maori settlers were highly mobile and drew on the resources of a wide area of the country. The obsidian of Mayor Island (Tuhua) is an example of a Bay of Plenty resource that has been found widely through New Zealand in early Maori occupation sites. The earliest occupants exhibited clear preferences in the sites they occupied. Most preferred were sites with access to the open ocean but with sheltered landing places, just within harbours or estuaries, where fresh water, firewood and, no doubt, the food resources of land and sea were readily available. The earliest settlements in the Bay of Plenty followed this pattern. However, the occupation evidence is not as extensive as might be expected for an area settled so early in Maori history.

The lifestyles of later Maori occupants differed considerably from those of the early settlers, with defence and food sources additional to those of the open ocean, including from horticulture, taking a greater role. As the population increased, the land became occupied by many descent groups who contested the resources of the area with each other and outside rivals.

The Bay of Plenty was not a centre of visitation by the first European explorers. To some extent, this may have been accidental. Captain James Cook visited the Bay only once, on his first voyage in the *Endeavour*. Before this, he had landed in and named Poverty Bay, so the name 'Bay of Plenty' was given in contrast to that, after observing its substantial population as he sailed along its eastern part. However, he never landed, so this name was a presumption of plenty rather than one based on close observation.

The *Endeavour* was followed by a large sail-driven double canoe along part of the Bay, and was vigorously challenged by its occupants (Moore 1965). This challenge was vividly captured by an artist on the ship, variously held to be Parkinson or Spöring. Cook saw a large settlement at Maketu, which he called Town Point, but the *Endeavour* was then blown out to sea in a gale and he never saw the Bay's best harbour at Tauranga. Cook's later stopping places in the north—Mercury Bay, Thames and the Bay of Islands—became much revisited by others, but Tauranga never gained this prominence.

The lack of accessible timber at Tauranga—the result of land clearance by the large Maori population—meant that one of the early trading opportunities was missing and shore whaling efforts and sealing were centred elsewhere in New Zealand. The large Maori population eventually attracted missionaries and traders, but this occurred later than in some other coastal areas of New Zealand. Flax (harakeke, *Phormium* spp.) was a resource where the Bay of Plenty had an advantage, and this featured in Maori trade and later Maori and European industry. The political turbulence of the area during the period of the Musket Wars from 1818 through to the 1830s may have been a disincentive to European settler interest. The seizure and burning of a trading vessel, *Haws*, in 1829 at Motouhora by local Maori, may have established a perception that the Bay of Plenty was not a safe area to trade (Wilson 1906: 31–32), as would have the ongoing warfare at Tauranga through the 1820s and 30s, where there were raids by Arawa, Ngati Maru and Ngapuhi.

Little land in the Bay of Plenty was alienated to Europeans before the New Zealand Wars. Maori in the area took part in the expansion of agriculture and trade during the 1840s and '50s, owning vessels that took their produce to Auckland. A few British troops were stationed in the area as part of the post-1840 presence of the Crown, and they remained for a period to help contain the ongoing tension between Te Arawa and Ngaiterangi of Tauranga, until peace was established between those long-standing combatants in 1845. The long-standing alliance of Tauranga Maori with Waikato Maori led to Maori of the Tauranga area being perceived by settlers elsewhere as a key part of the Waikato-centred King Movement challenge to the British Crown. In reality, there was division amongst Tauranga iwi on the issue. However, as a result of this perception by Europeans, the land of Tauranga Maori was an early target for land confiscation. Some Maori from the Bay of Plenty were among the defenders of Rangiriri during the Waikato invasion of 1863, but seem not to have had any further involvement after that defeat. However, Tauranga was seen as a source of supply to the belligerents in the Waikato. Legislation to legitimise the confiscation of land, which was passed before the Waikato invasion, included Tauranga as a place where the Act would apply; thus, the lines were drawn by the colonial administration before the events of the war developed. The consequence of this was that late in the Waikato

campaign the colonial Government sent troops to Tauranga to challenge the Maori there. In some ways, the challenge mirrored that made to Cook almost 100 years earlier, but with the tables of power turned (Belich 1988: 177).

The eventual military defeat of the Tauranga Maori in 1864 led to land confiscation and land purchase, the latter under circumstances where the parties were scarcely equal. The land was allocated to soldier settlers, marking the beginning of European settlement in the Bay of Plenty.

The New Zealand Wars continued to afflict the Bay of Plenty for many years. For example, Arawa supported the colonial Government against the *Kingites*, where their traditional Tainui enemies had a large role. This position was beneficial to them in the early construction of roads and other communications, in the development of the Rotorua tourist trade, and in national Maori leadership. It is no accident that as late as the mid-20th century Arawa had a large role in the leadership of the Maori Battalion.

The growth of the European settler society was slow in this region, as there was little gold, the harbours were mostly only suitable for small vessels, timber resources were not readily accessible and the soils needed draining or fertilising to give a good yield. Some organised settlements did occur, however, two of which had an Ulster connection. The growth of the Bay of Plenty that gives its name a modern reality has largely occurred in the second half of the 20th century.

The archaeology of the Bay of Plenty has much to tell us about the early and later settlement of the area by Maori, about the Musket Wars as they affected the area, the early missionaries and traders, the New Zealand Wars, and the largely 20th-century expansion of industry and communications.

5. Natural history of the Bay of Plenty area

5.1 GEOGRAPHICAL AND GEOLOGICAL SETTING

The major topographical feature of the Bay of Plenty area is the broad sweep of sandy coast, including a barrier island (Matakana) and several sand spits. Beyond this coast are small offshore islands, and behind it are tidal harbours and estuaries. There are also coastal plains, some poorly drained. In places, *terraces* behind the coast rise to higher, more broken country. One major river—the Rangitaiki—drains through the region and the area is bordered for a short distance by the North Island's largest river—the Waikato. There are a number of large lakes in the Rotorua area, some with no formal outlet, although two rivers—the Tarawera and Kaituna—drain the area. The extensive Kaingaroa and Mamaku plateaus often have high scarps at their borders and at the margins of their internal drainage. The Waihou River plain lies west of the uplifted and rugged Kaimai Range to the west of Tauranga. Mount Tarawera, at 1111 m, is the highest topographical feature, although the Kaimai Range in the northwest of the area and the Ikawhenua Ranges to the east are almost as high.

The climate delivers warm summers and mild winters. Frosts occur inland. Annual sunshine hours exceed 2400 h on the coast but are lower inland. Annual rainfall exceeds 1200 mm; this is weighted towards winter, but the region rarely suffers from drought. As with the rest of the northern North Island, tropical storms occur occasionally in summer, with destructive high winds and unseasonal heavy rain. Over much of the inland catchment, free-draining soils allow high rainfall infiltration. This and the moderating influence of the Rotorua Lakes on flows means the rivers are not particularly prone to extreme floods.

Some particular geological features underpin the human history of the area and the archaeological evidence as it presents to field workers. In particular, much of the region is within the Taupo Volcanic Zone. This volcanic zone occurs where the Pacific plate subducts under the Australian plate and has reached sufficient depth for the subducting plate to commence melting. The consequence of this is volcanism and geothermal activity in a band parallel to the axis of the subduction zone. The point at which the plate descends is thought to have moved progressively eastwards, meaning that the evidence of earlier volcanic activity is found towards the west. The silver and gold mineralisation in the Kaimai and Coromandel Ranges resulted from geothermal water movement that was related to earlier stages of this volcanism. Rifting is also occurring in the zone, but the lowering of the land level associated with this is being offset by volcanism.

The effects of volcanism dominate the landscape of the Bay of Plenty area. Structures of domes, collapsed calderas, and later cones and domes within calderas are common through the zone. All of the offshore islands are volcanic, and the Rotorua Lakes are the product of volcanic activity. Active geothermal

areas are present, which are expressed at the surface as hot springs, mud pools, etc. Sulphur deposits are associated with some of the volcanism.

In addition, volcanism has resulted in frequent deposition of airfall volcanic ash (tephra). The soils that develop on tephra are free-draining and often have good fertility, with the exception of those originating from the Taupo eruption. In the Whirinaki area in the southeast, the folded sedimentary rocks that mark the plate boundary commence, with broken ranges running parallel to the plate boundary axis (southwest to northeast). In much of the central area there are thick sheets of ignimbrite (very thick, often welded deposits formed from clouds of semi-molten material, which are generally closer to the source than the airfall tephras), some of which are from the Taupo eruption. These end in, or erode to form, characteristic steep-walled gully forms, leaving overhangs and caves.

Along the coast, post-glacial sea rise has led to the formation of a barrier islands (Matakana) and spits, some of which are anchored to outcropping harder rock islands (Bowentown, Mount Maunganui, Maketu, Ohiwa). Behind these, embayments have formed harbours and estuaries in some places, whilst being filled with sediment in other areas where the sediment load has been higher (from the Rangitaiki River in particular)—some of these infilled areas are low-lying and swampy, as on the Rangitaiki Plain (Pullar 1985) and along the coast from Papamoa to past Maketu.

5.2 VOLCANIC AND TECTONIC ACTIVITY

Geologically, this is a very active region, with many young geological features. The greater part of the structure of the Taupo Volcanic Zone is believed to be quaternary in age (i.e. formed within the last 1.8 million years). Holocene events in the area (i.e. occurred within the last 10 000 years) are described below.

5.2.1 Mayor Island (Tuhua)

The most recent eruption in the Mayor Island calderas is dated at 4400 years BP (before present) (Houghton et. al. 1992). Extrusion of the dome in the calderas has continued since then and there is speculation that it was continuing as recently as 500 years BP. Mayor Island obsidian was exploited from the beginning of the occupation of New Zealand; therefore, if the island volcano was still active at this time, it did not inhibit human use of its resources.

5.2.2 Taupo eruptions

The second century AD Taupo eruption (probably AD 181; Wilson et al. 1980) blanketed much of the North Island with pumiceous tephra and some smaller areas with ignimbrite. The deposits of ignimbrite and tephra become deeper the closer they are to the Lake Taupo vent. When the lake refilled the caldera after this last eruption, it is believed a debris dam at the outlet burst, depositing alluvial debris down the length of the Waikato River valley, including along the margins of the Bay of Plenty region in the Broadlands

area. This eruption formed significant elements of the coastal and inland topography, and left soils that introduced particular challenges for both Maori and modern farmers.

5.2.3 Loisels pumice

A dark, hard pumice known as Loisels pumice is present in some coastal areas where it arrived by sea rafting. It has been proposed that this occurred within the human period of occupation. This is discussed further below (sections 5.4 and 7).

5.2.4 Kaharoa eruption

One particular eruption occurred close to the main period of settlement of New Zealand by Maori. This is the Kaharoa eruption, and it has become an important marker in studies of the prehistory of New Zealand (Lowe et al. 2000, 2002). The eruption, which was on the Okataina eruptive centre—the same volcanic centre as Mt Tarawera—is believed to have proceeded over several years; Nairn et al. (2001) estimated 4 years, with a range of 4–20 years. The initial stage was a short-duration eruption that deposited rhyolitic ash over all of the coastal part of the Bay of Plenty region and beyond; ash depth is 30 cm on the coast closest to Mt Tarawera, and thins to 4 cm at Waihi on the western boundary of the study area. The ash eruption was followed by rhyolitic dome building, including the creation of much of the present Mt Tarawera. The Kaharoa ash has been very precisely dated to AD 1305 ± 12 (95% confidence limits; Hogg et al. 2003; see also Higham et al. 2000, 2001; Buck et al. 2003); this is the most precisely dated event in New Zealand prehistory. Consequently, this ash forms a stratigraphic marker of known age that can be used to help date settlement in this part of New Zealand.

Following the eruption, the outlet of Lake Tarawera was dammed by erupted material washed in from a side catchment at the lake outlet (Hodgson & Nairn 2000). The lake rose by an estimated 30 m, but did not stay at any level for very long, indicated by the fact that no lake terraces have been left. It has been estimated that there was 5 years between the dam forming and it bursting. The dome building at Tarawera had not finished when the dam burst, as there is tephra from a late minor eruption over the outwash deposits close to the mountain. The resulting flood peak was substantial, estimated at between 10 000 and 100 000 m^3/s. This flood wave carried much material with it and had a dramatic effect on the Tarawera River valley and the Rangitaiki Plains where the flood emptied, building a new fan.

The volcanic infilling of the Okataina eruptive centre and the frequent re-disturbance of deposited material by later eruptions has left a basin that does not have normal drainage. Many of the smaller and some of the larger lakes, including Lakes Rotoma, Okataina, Rotomahana, Okareka and Rotoehu, have no surface overflow. With underground drainage, their levels are subject to variation according to cycles of wet and dry years, the arrival of sediment (which can restrict the existing flows), and other events that can re-open the water drainage. This variation in water level has resulted in some submerged prehistoric sites on lake margins.

5.2.5 Tarawera eruption

The Tarawera eruption of June 1886 had major effects in its vicinity. The eruption on the mountain crest opened a rift that erupted basaltic lapilli and finer ash—unusual for this volcanic centre. The lapilli blanketed a considerable area around the mountain. Smaller lava eruptions continued through to October 1886. To the southwest, the eruption was mainly phreatic, with water under pressure flashing to steam. These phreatic eruptions ejected mud and fresh and hydrothermally altered rhyolitic rock, as well as some fresh basalt. Eruptions here continued into July 1886.

The Rotomahana crater was empty of water for 7 years after the eruption (Warbrick 1934: 111), but then progressively filled to reach a level 40 m above the adjacent Lake Tarawera, with a depth of up to 280 m.

The known death toll in the eruption was 108 named individuals, but it is believed that more people than this were killed. Many died at Waihi Village, the site of which is now an archaeological tourist attraction. Other archaeological sites were buried by the tephra. Those closest to the eruption source cannot readily be accessed by normal archaeological techniques (Ritchie 1991). At older sites more distant from the eruption, storage *pits* have been infilled and are difficult to see from surface indications, even if terracing and defensive features can still be seen. After the 1886 eruption, the outlet of Tarawera Lake was again blocked by debris, from the same side catchment as the post-Kaharoa dam (Hodgson & Nairn 2000, 2005). This dam may not have formed until some time after the eruption. It raised the lake by about 13 m, during which time an archaeological site on the lake shore (U16/11) was buried (Gregg 1956). The dam burst 18 years after the eruption (in 1904), following heavy rain, and the lake level dropped by approximately 2–3 m over several days; however, it did no regain the pre-eruption level. There was extensive flooding down the Tarawera River, with fan building on the Rangitaiki Plains. Historical records indicate that sediment infilling of the Tarawera River channel associated with this event left the area flooded for a considerable period, until the river channel re-established itself (Pullar 1985). The fan building was exacerbated by a chance erosion event in a tributary of the Tarawera River. The fan seems to be related to the apparent lack of archaeological sites on the river flats around Kawerau, in contrast to the quite high density of sites on the surrounding hills.

The level of Lake Okataina began to rise after the 1886 eruption (most likely as a result of Tarawera ash restricting the underground drainage), causing the Maori population to leave the area. The lake level reached a peak in 1930, but quickly dropped again by 4 m after the 1931 Napier Earthquake, which must have re-opened some drainage pathways. The lake remains at least 10 m above its pre-Tarawera eruption level and has submerged Maori archaeological sites on its shores (Johnson et al. 1967; Grace 1982; Lawlor 1983b). The carbon date of a palisade post from a site now deep in the lake (NZ1129) confirms that the older low level was not short lived. Grant (1996: 105) cited this and variations of lake levels in the district as evidence of changes in rainfall, but the linkage to ash falls and earthquakes at Okataina cautions against this as a sole explanation. The level of Lake Rotorua also rose after the Tarawera

eruption, probably in response to sediment in the Ohau Channel. It then fell back to its modern level.

Lake Rotoma also has a flooded Maori archaeological site on its shore as a result of changes to the underground drainage since the earlier occupation of the site (Moore 1963). Stafford (1999: 23–30) recounted the traditional story of an earlier disappearance of an island in the lake.

An aftermath of the Tarawera eruption was ongoing activity at the Waimangu Valley at the extreme southern end of the rift. The Waimangu (black water) geyser reached heights of 1600 feet. It had sustained activity from 1900 to 1904 and 1917 to 1918, with other briefer outbursts in 1906 and 1915. Visitors to the site were killed by eruptions in 1903 (four deaths) and 1917 (two deaths). During the latter event, a tourist accommodation house 600 m away from the geyser was also destroyed.

Ash from the 1886 Tarawera eruption affected agriculture. At Te Puke and Tauranga, stock had to be moved away until the pasture recovered (Stewart 1908: 98; Taylor 1969: 85). However, the ash deposited at more remote Athenree acted as a fertiliser, encouraging new planting (Stewart 1908: 99).

5.2.6 White Island

White Island is a continuously active volcano. It is one of a series of volcanoes (most of them under water) that extend northeast from the Bay of Plenty.

5.2.7 Land instability associated with geothermal areas and tectonic activity

Land in geothermal areas is frequently unstable. Land subsidence in response to changes in activity is a common occurrence. The flooding of part of a *pa* alongside Lake Rotorua near Ohinemutu (Tapsell 1972: 55) is most plausibly linked to such a movement. Stafford (1994: 15) noted a site a little further to the north, also on the lake edge, which has apparently also been submerged by the lake.

At Ohaaki, steam extraction for geothermal power generation is causing subsidence, which is flooding occupation sites along the edge of the adjacent Waikato River.

Although the Rangitaiki Plains are believed to be an area of recent subsidence and swarms of small earthquakes are common, the area is not believed to be as susceptible to very large earthquakes as other parts of New Zealand. The only substantial earthquake recorded in recent times is the 1987 Edgecumbe earthquake. Registering 6.3 on the Richter Scale, this was linked to vertical fault displacements of up to 2 m. The plate boundary is the site of more frequent earthquakes offshore from the Bay of Plenty coast.

Large earthquake and volcanic events beyond the Bay of Plenty are likely to have impacted on this region. As mentioned previously, the onshore Taupo Volcanic Zone extends northwest into the Pacific Ocean to the Kermadec Islands and beyond. Many submarine volcanoes are now known to exist along this route. The tsunami hazard these currently present to the Bay of Plenty (Latter et al. 1992) must also have existed in the past. Eruptions are not

the only hazard these undersea mountains present. The submarine Macauley Caldera, which is northwest of Macauley Island in the Kermadecs, erupted 6000 years ago. Since the eruption, the northern and southwestern flanks of the caldera have collapsed outwards, and the part of Macauley Island flanking the caldera has also collapsed into it (Lloyd et al. 1996). The date of the collapse or collapses is not known, nor is it known if they caused tsunami that affected the Bay of Plenty. However, tsunami are always a possibility with these events and they present a continuing risk to the Bay of Plenty coast (Wright et al. 2002: 8). The Healy caldera, which is situated a little less than half way to the Kermadecs from the Bay of Plenty, has erupted in the last 2000 years producing pumice. This is considered a possible source of the Loisels pumice (Wright et. al. 2003) and potentially of tsunami during eruptions or subsequent caldera collapse (Walters & Goff 2003: 147).

Studies of sediments behind beaches have identified what are interpreted as tsunami deposits from within the potential time of Maori occupation at Waihi Beach and Ohiwa Harbour (Anon. n.d.b). Earlier events have also been recognised. It is believed events need to have greater than a 5 m run-up (maximum vertical height onshore) to have left a geological trace. Tsunami deposits at Ohiwa are thought to have originated from about the time of the Kaharoa eruption. This is considered a local tsunami event. Later deposits at Ohiwa and Waihi Beach are considered to have originated from a regional event, linked to Loisels pumice and the Healy caldera collapse. This tsunami event is dated by them to AD 1302–1435 (Bell et al. 2004: 36).

Modelling of tsunami waves from different earthquake sources has demonstrated that run-ups of 3 m are feasible in the Bay of Plenty from South American sources and from the Tonga/Kermadec trench (Goff et al. 2006). Goff et al. (2006) did note, however, that the size of Northland and Coromandel tsunami can only be explained by local sources. Such local source waves may have been much attenuated by the time they reached the Bay. If tsunami occurred, they could have affected people residing on the coast and removed archaeological evidence of earlier occupation.

5.3 EROSION AND DEPOSITION PERIODS

Some major periods of erosion have been defined for alluvial deposits from the Whakatane River eastwards (Pullar 1962; Pullar, Pain et al. 1967; Grant 1985). During erosion events, large amounts of material are removed from the hills and deposited in lowland areas. Pullar's original classification was modified by Grant (1985), who defined three precise erosion/deposition periods: the Waihirere alluvium of 680–600 years BP, the Matawhero alluvium of 450–330 years BP, and the Whakarara alluvium of 180–150 years BP. These were dated by C14 dating and tree rings. Grant believed that these erosion/deposition events were linked to climatic cycles.

In the lower Whakatane Valley, a sedimentary history has been defined that extends into the human period (Pullar, Pain et al. 1967). Here, a post-Kaharoa eruption infill surface is recognised, which is estimated to have been formed about AD 1450; the river subsequently cut down through it. This surface

would align with Grant's (1985) Matawhero alluvium. Lessening of sediment supply has been given as a reason for the end of sedimentation, but this is not the only explanation; the Whakatane River also shortened its route to the coast substantially during this time, which would allow upstream lowering of the bed. The depositional surfaces have useful soils and these are of significance to Maori and to later use.

5.4 COASTAL STABILITY AND PROCESSES

Coastal exposures of sediments can be useful for examining sedimentation history. An early study by Wellman (1962) looked at coastal sections in various areas of New Zealand, including some from the Bay of Plenty. He recognised the Kaharoa Ash in these sections (Wellman 1962: 50–54), as well as an earlier pumice layer, now called the Loisels pumice. Based on carbon-dating of charcoal recovered from beneath it both here and elsewhere, this pumice was thought to just post-date human settlement. A date of AD 1350 has been derived from C14 dating, but this would place it later than the Kaharoa ash, which seems strange given that elsewhere it occurs beneath it. However, the pumice in the Loisels deposits has proven to be mineralogically diverse and is now thought to have been deposited from differing sources on varying dates, which may account for the disagreement between stratigraphy and dating. Furthermore, some of the dating problem may arise from pumice being redeposited in contexts of more recent age, as it is light and readily moved around by water.

McFadgen (1985a: 49–50) re-interpreted Wellman's (1962) sections for the Bay of Plenty in terms of erosion events. He inferred alternating phases of stable periods when soils formed and periods when these newly formed soils were buried by new sediment. The period AD 1350–1500 was a stable period when the 'Tamatean' soil formed. Another stable period occurred from AD 1550 to 1800, when the 'Ohuan' soil formed. Grant's (1985) and McFadgen's (1985a) sequences generally align (Table 2).

TABLE 2. COMPARISON OF GRANT'S (1985) AND MCFADGEN'S (1985a) DATES FOR ALTERNATING PHASES OF EROSION/ DEPOSITION AND SOIL FORMATION.

GRANT (EROSION/ DEPOSITION)	MCFADGEN (STABLE: SOIL FORMATION)
Post 1770, Whakarara	
	1550–1800, Oahuan
1500–1650, Matawhero	
	1350–1500, Tamatean
1270–1350, Waihirere	

The Bay of Plenty shoreline is particularly changeable, and this has affected the availability of places for settlement. This is highlighted by examining the changes that have occurred at a range of geomorphological features along the Bay of Plenty coast, from west to east.

The tombolo from Waihi Beach along to the Bowentown head would have formed well before

human occupation. There are minor instabilities along this length of coast (Healy 1978).

Matakana Island is New Zealand's only sand island. It formed on an earlier consolidated Pleistocene sand deposit, now on the harbour side of the island. Holocene development commenced with formation of a wash-over bar extending out from the older parts, which then progressed to coastal spits, extending along both the north and south entrances to Tauranga Harbour (Tauranga Moana) (Shepherd et al. 1997). Wetlands developed on the harbour side of the bar and the coast grew towards the sea on the ocean side, continuing past the Taupo eruption shoreline, which is now typically 200 m inland from the present ocean beach. The new land on the ocean side became forest-covered. As recently as 600 years BP, however, the harbour openings appear to have been much wider than they are now, with the southern opening apparently 3 km wider than at present. Since Kaharoa eruption times, the northern opening has closed by 3 km. It would appear, at least at the southern entrance, that an erosion event occurred before this closure, as a marked shoreline is present that dates back to 600 years BP (the Purakau shoreline; Shepherd et al. 1997: 61–63, 67). The southern entrance quickly narrowed again and the northern more slowly. The cause of these events is not completely clear, though McFadgen (2007: 174) attributed the erosion event linked to the Purakau shoreline to a tsunami. These erosion events define some areas of land where early sites will not be found and later settlement will be limited by the absence of developed soils.

Schofield (1964, 1968) studied a sedimentary exposure in a coastal rock shelter at Ongare Point that had been occupied by Maori. He sought to link its period of occupation to a recent period of low sea level, but accepted that the shelter may have become habitable as a result of land uplift rather than sea level change.

The tombolo attaching Mount Maunganui to the mainland would have established before humans arrived in New Zealand. As a result of recent development along the Papamoa coastline, its stability has become the subject of considerable recent planning interest. It would appear that this part of the coast has had limited progradation and has been relatively stable over the period of human occupation.

The Kaituna River currently drains through protection works well to the west of the Maketu Estuary, but in the earliest historic record it drained through the estuary. The spit was low and narrow and there is an early record of a ship washing over it in a storm. The estuary was heavily silted by a flood in the 1890s (Stokes 1980: 300) and a new western outlet broke through the dunes in 1907 during a large flood. The mouth then migrated eastward back to the estuary until it was stabilised by engineering works in 1955. The river was also recorded as breaking through the spit in 1840 (Matheson 1999: 79), so it seems that there may be recurring cycles of the river breaking through at the west and then migrating back to the Maketu entrance. The Maketu Estuary formed a second entrance in 1978, which later closed.

The coastline of the Rangitaiki Plain has steadily prograded (moved seaward) since the time of the Taupo eruption (Pullar 1985). Earlier shorelines can be traced only on the eastern part of the plain; it would appear that geological subsidence (the Whakatane Graben is the structure that is sinking) may have resulted in these being covered in the west. The Whakatane River has maintained its present mouth but its course has changed markedly near Whakatane within human history (Pullar 1963; Pullar et al. 1978).

The other rivers of the plains—the Tarawera and Rangitaiki—did not formerly drain through their present outlets. Before 1886, the three rivers (Whakatane, Rangitaiki and Tarawera) had only two outlets. Linked distributory streams carried the water from the Tarawera and Rangitaiki Rivers to outlets at Whakatane and Matata, east and west of their current engineered outlets. The now closed Matata outlet must have been an important waterway. This drainage probably formed after the catastrophic infilling of the plain following the Kaharoa eruption and the Tarawera lake burst that followed (section 5.2.4; Pullar 1985: 23). The Tarawera River was permanently diverted to its present outlet in 1924 and the Rangitaiki in 1914. The presence of diatomaceous deposits over the western part of the plains indicates that lakes must have existed beside the rivers for a substantial period from the Kaharoa eruption onwards. At Kohika, the local area of lake infilled at the end of the occupation of the site in the early 18th century.

The Ohiwa Harbour has been particularly unstable in recent history. There is evidence here of land subsidence after the time of the Kaharoa eruption (Pullar et al. 1977). One study suggests that the spit closing the harbour formed in the last 2000 years (Richmond et al. 1984); it appears to have only commenced forming once sediment sources to the west had completed the infill of the Whakatane graben. In historic times, the entrance has retreated eastwards and then regrown. The most recent retreat, which was occurring from the earliest written records and ceased in the 1970s, removed the former town and wharf of Ohiwa, which was established in the 19th century. The recent additions and removals of land at the harbour entrance limit the survival of early archaeological sites, which may have been removed by erosion. Some new areas are unlikely to have old sites or site types that might be found only in areas of mature soils.

5.5 STONE RESOURCES

Ignimbrite and pumice are the ubiquitous rocks of the region, although other volcanic rocks are also relatively common. Older sedimentary greywacke rock is present in the east. This subject will be revisited in respect to resources used by Maori.

5.6 SOILS

Soils in the Bay of Plenty are predominantly derived from volcanic ash. Some of these are very recent, especially those formed on ash from the Tarawera eruption. Soils derived from Taupo eruption pumice cover a large area in the southern part of the region. The yellow-brown pumice soils have allophane as a clay mineral derivative and are of relatively low fertility because this clay locks up phosphorous. However, although they have some element deficiencies, they respond well to fertilisers (Leamy & Fieldes 1976: 126). These soils are drought prone. Well-drained coastal soils are, more typically, yellow-brown loams formed from older ash (Leamy & Fieldes 1976: 127), with more recent addition of the Kaharoa ash. They are friable and free-draining, store water well and are productive soils, but need fertilising for sustained use.

The earliest pastoral farmers in the central North Island found that the pumice-derived soils could not sustain animal growth (for the affected area see McKinnon 1997: plate 92a). The phenomenon was known as bush sickness, and its cause was unknown until the 1930s, when it was discovered that the pumice lacked cobalt. As a consequence, in early times much of the land in the region was seen as only good for forestry. Although this is not a necessary restriction now, as the deficiency can be corrected with application of fertilisers, exotic forest use is now established as a dominant use in these areas (although pastoral farming is now replacing exotic forestry).

The formerly extensive swamps of the lowlands near the coast have been drained, particularly on the Rangitaiki Plain. These now form fertile areas that are very suitable for horticulture and dairy farming, and of considerable economic significance to the region and New Zealand as a whole.

5.7 VEGETATION

The forests of the central North Island were devastated by the AD 181 Taupo eruption. After the eruption, uplands in the Bay of Plenty region recovered to have conifer/broadleaf-dominated forest, while to the east the higher ranges had beech (*Nothofagus* spp.) forest. The northern end of the region is within the modern growth range of kauri (*Agathis australis*), but the stands found in the 19th century were not extensive. Kauri gum digging around Tauranga Harbour has shown that the extent of kauri was formerly greater there. McGlone & Jones (2004: 37) identified high levels of kauri pollen in pre-Kaharoa sediments at Kohika and suggested that kauri grew in the Tarawera River catchment at that time. On the west of the Kaimai Range, the Waihou River levees would have had kahikatea forest throughout human prehistory, backed by lower swamp vegetation in the wetlands. This type of cover may have prevailed in low-lying areas in the Bay of Plenty, unless disrupted by ash fall.

Mount Tarawera, the highest point in the region, had vegetation that was stratified according to elevation. Pohutukawa (*Metrosideros excelsa*) forest on the shore of Lake Tarawera was succeeded by tall forest, kanuka (*Kunzia ericoides*) scrub and sparse scrub at higher elevations. The 1886

eruption disrupted this pattern, and kamahi (*Weinmannia racemosa*) and tawa (*Beilschmiedia tawa*) became pioneer tree species in the devastated area (Clarkson & Clarkson 1991). Pollen diagrams from coastal wetlands indicate there was stability in the coastal vegetation prior to the Kaharoa eruption. The wetlands had some dry areas where tephra-blanketed old beach ridges rose above the lower-lying areas. Forest was present on these, with sedge, raupo (*Typha orientalis*) and wetland shrubs on areas of lower-lying, but not submerged, land. At Kohika, on the Rangitaiki River, there is evidence that the Kaharoa tephra damaged the dryland vegetation and changed the wetland environment (McGlone & Jones 2004). Pollen studies from this site indicate that there had been fires in the damaged forest. This study showed that there was a time gap between the Kaharoa Ash and full-scale deforestation at Kohika. Other sites studied showed a rise in bracken fern (*Pteridium esculentum*) spores—indicative of fire disturbance—starting at about the time of the Kaharoa ash fall and increasing unabated thereafter (Newnham et al. 1998; Lowe et al. 2002: 136). Typically, charcoal fragments in the pollen core samples rise with the bracken spore count.

In many parts of the Bay of Plenty region, the pattern of disturbance, once established, did not reverse—the scrub did not proceed to forest. This indicates continued human intervention (generally by fire). In other places, where there was not continued refiring, the forest was able to recover. McElvey (1958) illustrated areas in the Urewera Range that have scrub forest recovering from human-induced fires. On drought-prone pumice soils, the presence and use of fire in human settlements and land use areas, and the inflammable nature of the seral bracken and manuka (*Leptospermum scoparium*) scrub, meant that cleared areas stayed cleared and increased in area with repeated fires. McGlone & Jones (2004) noted the frequent presence of kamahi and rewarewa (*Knightia excelsa*) pollen after the Kaharoa ash fall, suggesting regenerating forest patches (these species are prominent in regenerating forest). Kevin Jones (DOC, unpubl. data) noted areas south of the Whirinaki basin that had seral stages of forest recovery, suggesting clearance that was initiated up to 200 years ago.

Where there was intense Maori population pressure, such as around Tauranga Harbour, the forest had gone by the time the first Europeans arrived, and the bushline was already remote from the coast. This delayed the onset of colonial indigenous timber felling in the Bay of Plenty area until other more readily available timber elsewhere had been used. At Ruahihi Pa (U14/38), ash deposits from a fire outside the site have been found across the whole site (McFadgen & Sheppard 1984). This fire has been dated to the mid-18th century, and the amount of ash deposited indicates that Maori forest clearance fires could be very intense.

There is evidence of early human disturbance of the forests around Rotorua (Nicholls 1991: 12). Further inland, extensive scrub-covered areas gave the pumice areas a reputation for infertility with early colonists, particularly at Kaingaroa, where there were frost flats with very little vegetation. Later farmers proved this perception wrong. A classic account of bringing land considered to be of low value into production is provided by Vaile (1939).

5.8 TERRESTRIAL FAUNA

The forested areas of the Bay of Plenty region are likely to have had a full range of the forest birds of New Zealand. The species now finding refuge in the Urewera National Park illustrate the range that would have been present at the time Europeans arrived. These include birds that are now rare in remaining forests, such as kokako (*Callaeas cinerea*), kiwi (*Apteryx* spp.), red- and yellow-crowned parakeets (*Cyanoramphus* spp.), kaka (*Nestor meridionalis*), New Zealand pigeon (*Hemiphaga novaeseelandiae*), New Zealand falcon (*Falco novaeseelandiae*), blue duck (*Hymenolaimus malacorhynchos*), whitehead (*Mohoua albicilla*) and weka (*Gallirallus australis*), as well as other less threatened native forest birds such as morepork (*Ninox novaeseelandiae*), tui (*Prosthemadera novaeseelandiae*), bellbird (*Anthornis melanura*), fantail (*Rhipidura fuliginosa*), grey warbler (*Gerygone igata*), tomtit (*Petroica macrocephala*) and North Island robin (*Petroica australis*).

It is clear that moa returned to the area devastated by the Taupo eruption. Moa remains have been found in areas associated with humans at Taupo (Leahy 1976: 51) and at Tokoroa. At both sites, the species has been identified as a small 'bush' moa, *Euryapteryx curtis* (Law 1973; Worthy & Holdaway 2002: 196). Worthy & Holdaway (2002: 196) noted that there are few fossil sites in the Taupo eruption tephra area, but that some sites on the periphery of the area suggest that *E. curtis* was common once vegetation had re-established. Other moa were also present: an example of *Dinornis giganteus* was found at Turangi—not in human association but clearly post-Taupo eruption (Worthy 2001); and a dated bone in the radiocarbon database, reported as coming from silt (2 m deep) in the Kawarau Valley (*sic*—presumably Kawerau), is firmly within the post-Taupo eruption period and has been identified as *Pachynornis elephantopus*.

Water birds are currently well represented in the Bay of Plenty area, and must also have been common in the past. Habitat for wetland birds such as fernbirds and bitterns was severely reduced in the 20th century, when coastal wetlands were converted to pasture; therefore, their numbers now must be far fewer than in the past.

Petrels (Procellaridae) are common on Bay of Plenty offshore islands, and gannets (*Morus serrator*) nest on White Island. These birds were important resources for Maori and this use has continued until modern times. The name Motiti (for one of the significant islands off the Bay of Plenty coast) might record the presence of petrels (tītī), but the origin of the name is confused. One account suggested the name is a relatively recent contraction of Motuiti (small island) (Matheson 1979: vii). However, renderings with vowel lengths indicated—Mōtitī (Matheson 1979: 21) and Mōtītī (Ballara 2003: 251)—suggest that this derivation from Motuiti is less than likely, as such a name contraction is unusual and would have involved two, if not three, vowel length shifts. Names including titi also occur on the mainland, possibly recording onshore nesting sites of petrels. Nesting of petrels on the mainland, although rare, still occurs at a few sites elsewhere in New Zealand; it no longer occurs in the Bay of Plenty area, however.

The arrival of Polynesian rats (*Rattus exulans*, Pacific rat) had a devastating effect on many of New Zealand's native birds, aided in some cases by direct human predation. Ultimately, it was the destruction of forest and wetland environments from the 19th century onwards that had the most pervasive effect on the abundance of bird species.

5.9 MARINE FAUNA

The Bay of Plenty has a diversity of marine environments. Pelagic (open sea) fish visit the bay and the offshore islands, and reefs provide habitats for more sedentary fish species. Sandy shores provide habitat for shellfish and the species that eat them. Tauranga Harbour is a sizeable sheltered tidal waterway for other fish species. Modern fisheries in the Bay of Plenty area include flatfish from Tauranga and Ohiwa harbours, and shark, kahawai (*Arripis trutta*), snapper (*Pagrus auratus*), skipjack tuna (*Katsuwonus pelamis*), jack mackerel (*Trachurus novaezelandiae*) and blue mackerel (*Scomber australasicus*).

The Bay of Plenty sandy shores have abundant surf-beach species, except along the Pukehina to Matata section of the coast where wave energy is high and the beaches steep. Mainland rocky-shore shellfish environments are abundant on the offshore islands.

Before people arrived, fur seals (*Arctocephalus forsteri*) were much more common in the northern North Island, although seals may never have been common in sandy areas of the Bay of Plenty coastline, as predominantly sandy shores are not attractive to seals as haul-out areas.

5.10 FRESHWATER FAUNA

Freshwater animals were abundant in the Bay of Plenty when the first humans arrived. Some are still relatively abundant, including eels (tuna, *Anguilla* spp.), freshwater crayfish (koura, *Paranephrops zealandicus*) and freshwater mussels (kakahi, *Hyridella* spp.). These are recorded in Maori place names such as Kaituna and Rotokakahi, and are still sought by modern-day Maori and others. Buck's (1921) early 20th century study of fishing at Rotorua recorded the use of other fish as well. Inanga (whitebait, *Galaxias maculatus*) were once a substantial resource of the Rotorua Lakes. After Europeans arrived, the release of trout (brown trout *Salmo trutta*, and rainbow trout *Oncorhyncus mykiss*), bullies (*Gobiomorphus* spp.) and carp (Cyprinidae) is believed to have considerably reduced the abundance of native species, largely through competition. In the case of the freshwater mussel, its abundance was reduced because transport of the larval stage, which is attached to fish, occurs less readily with introduced species of fish than with native species.

6. Anthropology in the Bay of Plenty

6.1 ETHNOGRAPHY

While there has been much recording of Maori traditional history for the Bay of Plenty region, relatively little of the historic fieldwork in the area resulted in straightforward accounts of the then current cultural practices, such as fishing, though there are some exceptions. Elsdon Best, in his many publications, must have often drawn on his Urewera fieldwork (the Urewera Ranges form the eastern boundary of the Bay of Plenty area), but this is rarely explicit. His normal mode of placing little emphasis on any regional differentiation in Maori culture does not help to distinguish local components. Best's Dominion Museum Monograph publications 'Some aspects of Maori myth and religion' (Best 1922a) and 'Spiritual and mental concepts of the Maori' (Best 1922b) seem to contain fewer citations of other people's work than some of his other publications. Thus, they may well report mainly material he collected. However, a Urewera source cannot be assumed for this information, as he recorded information on Maori practices while resident in other parts of New Zealand as well. Whilst in the Urewera area, Best must have observed bird hunting. It is tempting to suggest that accounts of birding (particularly the hunting of native pigeons) in 'Forest lore of the Maori' (Best 1942), which is un-attributed to other sources, may be based on Urewera observations. Best's Urewera hut is a recorded archaeological site (W16/294).

In 'Primitive economics of the New Zealand Maori', Firth (1929) illustrated his text with a map and photographs of a contemporary Maori village—Ohaua te Rangi—on the Whakatane River. However, it is not clear whether the observations he made there contributed to his publication. It is evident that in quite recent times opportunities for ethnographic recording were lost. This is best illustrated by Buck's (1921) detailed account of fishing at Rotorua, which drew on fieldwork he did there before World War I. This detailed account of an aspect of contemporary culture raises the issue of what else a diligent ethnographer might have been able to record at that time. Another very valuable source of ethnographic observation is Maggie Papakura's 'The old time Maori' (Papakura 1938), which includes a wealth of detail about the lifestyle of Maori in the Rotorua area, particularly during her childhood and up until her departure from New Zealand in 1911. A recent biography gives some background as to the likely places of the experiences she reported (Diamond 2007).

It is sad to look at an account such as Ettie Rout's 'Maori symbolism' (Rout 1926), which was drawn from a Te Arawa informant (Hohepa Te Reke—see Stafford 1999: 107–8), as the material it contains is, to us now, clearly acculturated, and other better informants clearly existed. Examples of more rounded accounts drawn from the historical record have recently emerged. Tapsell's 'Pukaki, a comet returns' (Tapsell 2000) very nicely places

an outstanding taonga—an iconic carving from a Rotorua pa gateway—into its modern and historic cultural context, while Neich's 'Carved Histories' (Neich 2001) reveals the history of the carvings of Ngati Tarawhai of Lake Okataina and much about the carvers and their world in the process. Neich (2002) has studied the gateways of Maketu Pa (V15/158), which were photographed and drawn in the 19th century but have not survived to the present day.

There is clearly an opportunity for archaeology to fill in missing detail. A starting place is studies of objects in museums. With the exception of Neich (2002), these are, as yet, rare. An additional example is a study of the adzes in the Whakatane Museum (Moore 1977), as are studies of Katikati wooden artefact finds at U13/867 (Simmons 1971a, b). Tapsell's (2006) review of the Gilbert Mair collection in Auckland Museum, much of which came from the Bay of Plenty region, shows the rich stories that can be associated with museum collections. There is scope for many more. Archaeology will always be limited in the aspects of society it can reveal, but in terms of the Bay of Plenty, that limit is far from having been reached.

6.2 TRADITIONAL HISTORY AND ARCHAEOLOGY

The Bay of Plenty is well served by published accounts of traditional Maori history. Some of the earliest published accounts, such as the pioneering 'Polynesian mythology' (Grey 1855) and accounts by Shortland (1856, 1882) and Wilson (1906), recount traditions from the Bay of Plenty area. More comprehensive accounts are present in the *Journal of the Polynesian Society*, such as Best (1928) on Whakatane. Best's 'Tuhoe, the children of the mist' (Best 1925), which covers an area straddling the eastern border of the region, is the pioneer in stand-alone publications of traditional Maori history. Following Best (1925), outstanding further contributions include Stafford's (1967) 'Te Arawa', Lyall's (1979) 'Whakatohea of Opotiki', Walker's (2007) 'Opotiki-Mai-Tawhiti', and Grace's (1959) 'Tuwharetoa', the last of which is predominantly about the Taupo region but commences with the Bay of Plenty origins of that iwi. More recently, Steedman's (n.d.) 'Te Toto' recounts Tauranga traditional history and attempts to reconcile conflicting accounts. 'Te Waimana: the spring of Mana' (Sissons 1991) deals with Tuhoe during the period of colonial conflict, but draws on later traditional history and is also a critique of Best's work.

Matheson (1979) drew together Motiti history, as did Tapsell (1940) for Maketu. Both extended their accounts into modern history. Ballara (2003) used the history of conflict at Maketu as one of her study areas in seeking the causes of the early 19th century Maori conflict.

It is not the function of this review to attempt to summarise traditional history. Nevertheless, archaeology and traditional history use different tools and perspectives to deal with the same Maori story, and there must be a common ground between the two approaches. A recent development in publications has been to relate traditional history much more closely to sites and geographical features. In traditional settings, such linkages would,

of course, never have been lost, but the earlier published accounts gave it little recognition. Thus Stafford's two volume 'Landmarks of Te Arawa' (Stafford 1994, 1996) provides a wealth of detail about the localities associated with traditional and more modern Maori history in the Rotorua area. Phillips' two volume 'Landmarks of Tainui' (Phillips 1989, 1995), although focused away from the Bay of Plenty, covers sites in the west and north of the region. However, these reports make only restricted use of archaeological records of the sites identified where they add to or elucidate stories associated with the sites.

At the very least, traditional accounts of sites provide some time benchmarks for when sites were being used. Traditional accounts can never be assumed to provide full accounts of the history of sites, however, as they are very selective of what has been remembered and passed on—generally those events that are socially or politically significant—rather than including accounts of the tools, economy and lifeways of the inhabitants of places. Thus, it is important to realise that traditional history can become very selective and sometimes interwoven with fantastical events. However, it should not be sanitised by removing the latter, as is often done in conventional historical accounts. On the other hand, archaeology can help demonstrate that the manner of land use, economy, tools and lifeways have changed, but cannot identify or confirm which person or social group occupied a site. Therefore, the linkage between archaeology and traditional history is always going to be fraught. Archaeology can, however, provide strong back-up for historical accounts of early settlement. Caroline Phillips' 'Waihou journeys, the archaeology of 400 years of Maori settlement' (Phillips 2000) is a model of integrating archaeological evidence with traditional history.

This shows that there is a major role for archaeology in elaborating Maori history. At present, archaeology is providing most of the information available on the early Maori occupation story. With respect to more recent Maori history, there is still a gap where archaeology could make greater use of traditional history, and traditional history could make better use of archaeology to round out its account. Some Bay of Plenty archaeological fieldworkers, such as Ken Moore and Des Kahotea, have gone some way to integrate the two sources of information, but there is certainly plenty of scope for such integrated studies in the Bay of Plenty.

7. Chronological issues

A number of methods have been used to establish the age of archaeological sites in the region. The airfall tephra layer from the Kaharoa eruption, dated at AD 1305 ± 12, provides a very precise horizon in the archaeology of the Bay of Plenty. The absence of identified archaeological sites below the extensive coastal spread of this tephra, but their presence soon after, sets the time limit of occupation of the region and, indeed, of New Zealand as a whole. Although some pre-Kaharoa sites have been suggested, they have not survived closer scrutiny (e.g. Pullar 1961a, 1961b: 122). The presence of charcoal in sediments or peat prior to the eruption cannot be taken to prove human presence, since it could result from natural fires. Lapilli from the Tarawera eruption (1886) is often found sealing sites and is a useful marker of the rate of infilling of some features, such as ditches, and a test of whether or not sites have been disturbed.

The other known marker present in some coastal areas is the Loisels pumice (first mentioned in section 5.2.3), which is thought to date to around AD 1350, though its age range is somewhat uncertain. This pumice erupted from an undersea source distant from New Zealand and floated to the Bay of Plenty coast, where some of it came to be thrown up onto the land and buried in coastal sediments. It is present in the lowest levels of archaeological sites, such as the midden at the mouth of the Waiotahi River. It has been suggested that it was not derived from a single volcanic event. Pumice dredged from the Healy caldera is a good match in its chemical makeup to some but not all of the Loisels Pumice (Wright et al. 2003: 26). McFadgen (2007) linked the pumice to an eruption of the Healy caldera, but with the provisos that it is not clear how many events of pumice production may have occurred or have been clearly dated (McFadgen 2007: 28, 40), though elsewhere he dated the Loisels pumice to between AD 1305 and 1345 (McFadgen 2007: 222). In addition to primary deposition, erosion and re-deposition of the material may have also occurred, potentially confusing the use of this pumice as a time marker. Utilisation of the Loisels pumice as a time marker in the region has been limited.

Other techniques have been used to assist with dating sites in the period since the Kaharoa eruption. While some dates based on obsidian hydration have been reported from research work covering Matakana and Kauri Point, they have not been discussed in detail or demonstrated a coherent chronological picture. Phillips & Allen (1996a: 268, 1996b: 89) stated that there was good agreement between obsidian hydration and radiocarbon dates for the excavated pa site of Anatere. Radiocarbon dating has provided much of the time control between AD 1300 and the commencement of written records in the 19th century. However, this 500-year span is challenging to differentiate by radiocarbon dating. This is partly because the 95% confidence limits often do not come to less than 100 y, but largely because during the latter part of this time range the ages reported from carbon dating do not translate simply into calendar ages. Natural variations in the abundance of radiocarbon (secular variations) result in a correction curve with wiggles, so that a single date on

a radiocarbon time scale can equate to several calendar ages. Consequently, once the time span of ages has been calibrated to a true time scale, it is even greater than the initial error range.

Figure 2 shows the plot through time of dates in Appendix 3. The time scale is a calibrated one that has been corrected to a true time scale. As can be seen in Fig. 2, there is little evidence for human occupation prior to AD 1300. There is a rapid rise in the frequency of dated sites from the 13th to the 16th centuries, then a plateauing through to AD 1700, followed by a decrease thereafter. In the Bay of Plenty, there are few cases where archaeologists have argued closely timed changes in culture or land use based on radiocarbon dating. We do know that there was some later cultural change, however, as it has been demonstrated stratigraphically at Kauri Point Swamp. The lack of greater use of radiocarbon dating in arguing archaeological sequences must relate either to the limitations of the method applied to this time frame or to archaeologists' use of it.

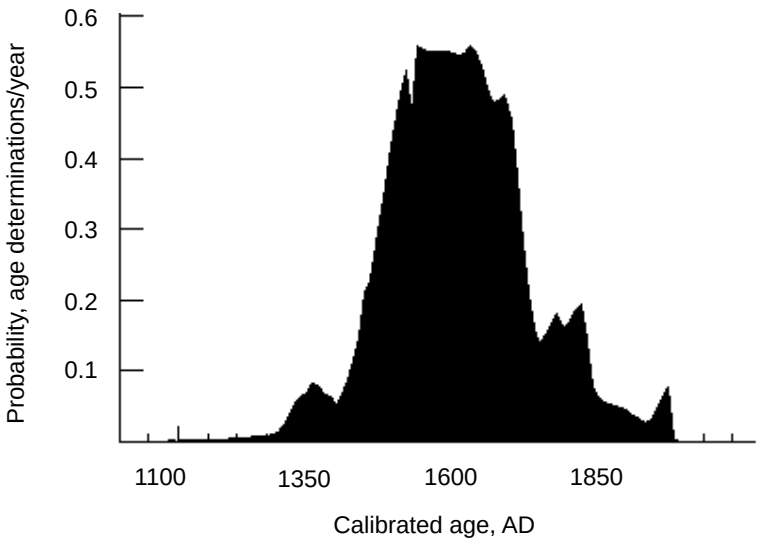

Figure 2. Frequency plot of calibrated C14 ages from the Bay of Plenty.

8. Resource use

8.1 MAORI RESOURCE USE

8.1.1 Gathered food and plant resources

Forest fruits must have been plentiful for the earliest inhabitants of the Bay of Plenty. Miro (*Prumnopitys ferruginea*) and karaka (*Corynocarpus laevigatus*) berries would have been particularly important resources. Flax nectar and raupo pollen would have been available seasonally from the extensive wetlands. The gradual inland retreat of forest resulting from human pressure in the Tauranga area and elsewhere may have made forest fruits less readily available, but their replacement in the form of bracken fernroot would have been reliable and available throughout the year, albeit less palatable. Clarkson (1991: 94) suggested that the karaka that grow around Lake Rotorua are the result of Maori introductions (one recorded site is U15/619). He also stated that Rengarenga lily (*Arthropodium cirratum*) at Lake Rotoiti was, likewise, the result of planting (its roots were eaten and it was also used medicinally).

There is little archaeological evidence relating to the use of gathered vegetable food. One exception is at Ruahihi, where many plant seeds from consumed fruit have been identified (McFadgen & Sheppard 1984). The presence of fernroot planes (heavily worn surfaces) in the dentition of adult human remains has been used as evidence of the consumption of fernroots in other parts of New Zealand, but little information about this is available for the Bay of Plenty, as there have been few studies of human remains in this area. Starch grains of bracken have been found in an archaeological dog coprolite from the Kohika pa (Horrocks et al. 2004), and fragments of bracken fern occur amongst identified charcoal in remains in a number of middens. Fernroot is prepared by roasting, but would not usually be used for fuel. However, pollen diagrams from adjacent swamps suggest that bracken was abundant in this area; thus, bracken fern may also have been used as fuel. Bracken may also have become established through land clearance fires without necessarily being used for food (Hooker 2001: 17).

The range of materials gathered for uses other than eating is known to have been wide. Boileau (1978) demonstrated that many different woods were used in making wooden artefacts at Kohika. Clarkson (1991: 94) suggested that whau (*Entelea aborescens*) growing on Mokoia Island was probably introduced; whau wood is light and used for net floats. Later in the period of Maori occupation, the inland timber resources of the Bay of Plenty became more important, as there had been substantial clearance of forest along the coast. The Rotorua Lakes area was renowned as a source of canoes (Neich 2001) and Maori from this area traded beyond the region to the Bay of Islands (Stafford 1961: 24). Walls et al. (1990) listed two named varieties of flax collected in the Rotoiti area, pointing to the importance of fibre plants and the maintenance of preferred varieties as cultivars. Archaeological evidence of the use of totara (*Podocarpus totara*) bark exists in the east of the region, with stripped trees recorded at sites V18/14, 15, 46, 32, 34 and 35.

Forest birds such as tui, kaka and pigeon would have been available in areas of undisturbed forest. Shore and water birds must also have been locally readily available, as they had plenty of suitable areas to occupy in parts of the Bay of Plenty. The offshore islands were renowned sites for the collection of immature petrels (muttonbirds) from their burrows and gannets from their nests. White Island, Motunau and Motukahakaha (off Motiti) have all been used for muttonbirding in recent history (Matheson 1979: 31, 33). There is little direct archaeological evidence of the consumption of birds (see Appendix 4), suggesting either that they were minor in relation to other resources or that the archaeological remains may be more concentrated in specialised sites and thus not generally encountered by archaeologists. A remarkable series of discoveries of bird-snaring troughs have been made in no less than six sites (V18/28, 52, 54, 55, 56 and 62) in forest in the Whirinaki Valley, in the inland part of the eastern Bay of Plenty, indicating that pigeon snaring was practised there, and probably elsewhere, during the miro fruiting season. The age of the troughs is unknown, but cannot be great, given that they had survived in aerobic conditions, albeit in a damaged state.

8.1.2 Freshwater and marine resources

Freshwater fish resources seem to have been extensively used and highly valued by Maori, particularly in the Rotorua Lakes area, where freshwater mussel middens have also been recorded. The Kaituna River—consistent with its name—was a renowned eel fishery (Stafford 1962: 4), and an eel channel has been recorded at Minganui (V18/61) (eel channels were built to divert migrating eels into traps). An archaeological example of a freshwater fish trap is also known (U16/44) (Pullar 1975), and a further one has been recorded (U16/ 82).

Extensive marine shellfish middens occur where shellfish are plentiful, particularly on harbours and estuaries. Marine shellfish shells have also been found in occupation sites well away from the coast.

At the time of first contact with Europeans, the Maori population was well-equipped with canoes and they were accomplished offshore sailors. There is no question that their sailing skills were put to use in offshore fishing. Some renowned hapuku fishing locations have been recorded: for example, rocks at Maketu and Wairakei, near Motiti. It can be assumed that large nets were constructed and used as well as bait and lure fishing; likewise, shore fishing, harbour spearing and netting of flatfish will have occurred. The archaeological evidence of different shellfish species in middens is quite extensive but not much studied in overview. As yet, the identification of fish from middens (Appendix 4) is not very comprehensive. Many shellfish middens contain no fish bones, suggesting broad exploitation of the marine environment was not a continuous activity: quite different resources seem to have been used at different times, perhaps in response to seasonal abundances; it is also possible that different groups may have varied in status and thus in their ability to access more prestigious resources.

Marine mammals seem not to have been a sizeable resource in the Bay. There is, as yet, no archaeological or early historical evidence of their exploitation.

8.1.3 Horticulture

The climate and soils of the Bay of Plenty region were suitable for all of the plants introduced by Maori: kumara (sweet potato, *Ipomoea batatas*), taro (*Colocasia esculenta*), gourd (hue, *Lagenaria siceraria*), yam (uwhi, *Dioscorea* spp.), ti (*Cordyline fruticosa*) and paper mulberry (aute, *Broussonetia papyrifera*). In general, however, readily identifiable remains of cultivated plants are rarely present in archaeological deposits. It has therefore been difficult to determine which crops were grown based on archaeological evidence. However, techniques for recognising microfossil remains of plants (e.g. pollen and starch grains) have recently been developed, resulting in the identification of kumara starch in a garden soil on a terrace at U15/9 in Rotorua (Campbell 2005:105; Horrocks et al. 2007). These new techniques offer the prospect of identifying where particular crops have been grown in the past. In the Bay of Plenty area, kumara was extensively grown, but not always recognised in the archaeological record. Gourd is known archaeologically from Kauri Point Swamp. Only one site with living taro has been recorded in the Bay of Plenty—adjacent to a pa site (W15/50) at Ohiwa; this absence contrasts markedly with much more frequent records of living taro from further north in the North Island.

Kumara has a seasonal growth pattern and requires a minimum of five frost-free summer months to mature. This would have been difficult to achieve in more inland areas and sites with warm microclimates that were free from frost damage must have been important. In contrast, potatoes (*Solanum tuberosum*) have less-demanding climatic requirements and were adopted quickly throughout New Zealand after their arrival. In the Bay of Plenty region they appear to have enabled an expansion or enlargement of settlement into cooler inland areas.

Storage pits were used to hold kumara over winter for food and as a source of the new season's plants. These pits, which are believed to have been used only for kumara, are very common archaeological sites throughout the coastal Bay of Plenty area and inland. Their form and history is discussed further in section 9.2.4.

Kumara require good drainage; the plants are quite drought-resistant. Although they are not very demanding of soil fertility, they do benefit from it. The use of ash for soil fertilisation is mentioned by Papakura (1938: 179). Lawlor (see Gumbley 1997: 17) found the addition of wood ash in experimental kumara gardens at Kawerau effective. Soils of Maori origin containing admixtures of sand or gravel are common in New Zealand in the areas where kumara can be grown. They are variously considered to be the result of mulching or of admixtures, with explanations of their purpose including slowing evaporation and assisting the soil in warming (when used as a mulch) or making the soil more friable and/or better draining (when used as an admixture). These soils are variously known as made soils, Maori soils or plaggen soils. The effect of cultivation of soils mulched with gravel is the same as deliberately adding gravels to the soil. Worm action would eventually have a similar effect in moving coarse mulches and additives down through the soil profile. Kumara gardens are frequently described as being formed using planting mounds—commonly called puke. An admixture would be effective in such a garden,

but a mulch would presumably be less so, as it would only be effective in the spaces between the mounds.

The two main ideas on the origin of *admixture soils* are probably not resolvable by archaeological investigation. Admixture soils using sand or gravel are not common in the Bay of Plenty. Jones (1986: 21) identified two sites on the Opouriao river terraces (where gravels may also occur naturally), and Papakura (1938: 179) mentioned adding sand and gravel as a practice. Only four admixture soil sites occur in the records: sites T13/31, T13/747 and U13/59 near Athenree, and site W16/294 on the Whakatane River valley's Opouriao plains. However, since the tephra-derived hill soils of the Bay are naturally friable, sand and gravel addition would rarely have been necessary if friability and drainage was the objective of these additions. Admixture of Kaharoa ash can be achieved in some places by deep cultivation. Such soils, whether produced by this method or as an admixture by borrowing Kaharoa ash from nearby deposits, cannot readily be distinguished from normally cultivated soils that contain this ash as a result of its being close to the surface. Kaharoa ash admixture may have been common in the Bay of Plenty.

Large areas of garden soils have been identified without the need to recognise sand and gravel admixture. Garden soils are recognised by soil A horizons that show signs of cultivation through mottling/inclusion of subsoil clasts and deepening of the soil profile to an abrupt transition to non-cultivated soil below. However, it should be noted that similar profiles can be created by ploughing, so it is important to be able to exclude this origin. Regular plough share furrows in the subsoil are usually distinguishable on excavation; in places that have been ploughed once only, the overturned topsoil or raised subsoil may be recognisable as lumps within the profile.

Substantial areas of Maori garden soils have been recognised by archaeologists on tephra-covered dunes and beach ridges on Matakana Island and at Papamoa (Gumbley 1997). Many other locations have similar evidence of such soils, for example at Athenree, around Tauranga, and on the near-coastal beach ridges of the Rangitaiki Plains (Jones 1991). The spread of evidence of garden soils in the western Bay of Plenty is summarised in figure 4.11 of O'Keeffe (1991).

A pedologist's soil map included in O'Keeffe (1991) shows other substantial areas of garden soil in two elongated areas about 10 km long around Pukehina and Te Puke. Cotching (1998:7) referred to evidence of intensive soil use by Maori at Otamaraku (near Pukehina) and Manoeka (west of Te Puke). The Pukehina soils have been mapped as 'Ohinepanea loamy sand—disturbed phase'; however, causes of the disturbance other than Maori gardening were also suggested. The Manoeka soils were not separately identified in Rijkse & Cotching (1995). Thus, recent soil surveys do not help in confirming whether or not the soils are the result of Maori cultivation. In the case of the area at Te Puke, it is possible that intensive 20th-century urban and horticultural use of the area will have prevented this from being determined in detail—it certainly could no longer be determined today.

Gumbley & McFadgen (1995) interpreted one excavated cross-section as showing cultivation moving progressively from the base to the top of a dune at Papamoa. On a steeper dune, McFadgen & Walton (1996) interpreted a

section as showing the development by successive stages of spreading soil downslope, each with a deep cut into the subsoil. An alternative explanation for the apparently cultivated dune soils at Papamoa has been advanced by Hooker (n.d.), who argued that the dune ridge soils were very drought-prone and less suitable for horticulture than other nearby soils, and thus were unlikely to have been used by Maori. Hooker believed that there has been extensive ploughing of the area, citing some accounts of this and also pointing to the presence of bracken fern root amongst the identified charcoal remains from three middens from the area (Hooker 2001: 17). He suggested that harvesting of bracken fern roots would have had the same effect as cultivation. The seasonal determinations of shellfish from associated middens indicate winter/spring shellfish harvesting, which was the time when fern root was also resorted to for food. Hooker argued that the soil disturbance could have other origins in addition to kumara gardening.

Gumbley (1997) argued that the presence of small storage pits in association with these soils indicates kumara gardening and that 'it seems unnecessarily obtuse to propose that the soil mixing as a result only of gathering bracken root especially when we know that Polynesians were horticulturalists. It can be reasoned that on soils suitable for gardening they would have been used as such'. However, this does not nullify Hooker's explanation. There is a strong case for seeking more direct evidence of plant fossils (using recently developed micro-fossil techniques) to help resolve this interesting difference of interpretation.

8.1.4 Stone resources

Maori used stone for flaked cutting tools, for ground-edge tools like adzes, and for more prosaic uses such as ovenstones and net weights. Pumice was used for a variety of purposes, including small sculptures. Obsidian was a prime resource for cutting tools. Mayor Island (Tuhua) is the major source of obsidian in the region. Obsidian, or volcanic glass, occurs on the margins of acid lava intrusions where the magma has been rapidly cooled before the rock minerals could crystallise. It is more glass-like than crystalline, with conchoidal fractures that form very sharp edges that can be used for cutting. Mayor Island (Tuhua) is unquestionably an early source of this material (Leach & de Souza 1979; Seelenfreund-Hirsch 1985). Later in the history of Maori use of obsidian, Mayor Island (Tuhua) was used less frequently as a source, no doubt as other sources were found. Only three quarries have so far been found on Mayor Island (Tuhua) (Seelenfreund-Hirsch 1985: 157), but the island has not yet been fully surveyed.

Obsidian also occurs in the Rotorua area, but is mostly of less-than-flake quality. One site has been recorded as a quarry (V16/21), but there is no supporting evidence, so the site record must be regarded as suspect. Holroyd (n.d.: 32–35) listed present-day sources of obsidian: Maketu, Rotoiti, Rotokawau, Okataina, Ngongotaha, Hemo Gorge and Tarawera. At some of these, the obsidian is of low quality. The Rotorua sources have been characterised by chemical analysis, but more recent analyses of samples from Maori sites using improved technology have failed to find any obsidian that can be sourced to the Rotorua area.

At Maketu, the obsidian occurs as detritial pebbles of unknown original source. Obsidian from Maketu is known to have been used (Moore 2004). At Waihi, at the very northern limit of the region, there are sources of flake-quality material (Moore & Coster 1989). Although no worked quarry is known of, the source has been recognised in obsidian collections from sites from Paeroa through to Matakana (Moore 2005). None of the obsidian was transported more than 30 km from the source and the date of use, where known, appears to be 17th century onwards. Obsidian is also found immediately to the north of the Bay of Plenty region on the Coromandel Peninsula.

Obsidian is very common in archaeological sites in the Bay of Plenty area, often being observed on the surface of sites during surveys as well as being uncovered during excavations. Although obsidian sources were available in the region, obsidian from Taupo and the Coromandel were also used.

Sources of adze material are known from the region. Orokawa Bay is a source of andesite that has been worked (Moore 2001b), and beach boulders have been quarried at Maketu (Moore 1981). Moore (1981) considered the latter site to be early, but the stylistic evidence for that is not convincing. Moore's (1977) study of the adzes in the Whakatane Museum revealed a variety of source materials. The local sources of some of these have yet to be precisely located. Greywacke from the eastern ranges will probably have no specific source, as it is widespread and common in outcrops and river boulders throughout the east of the region. Spilite associated with greywacke has been used in adzes and is more localised within greywacke outcrops; a quarry source may yet be found. Moore (1977) compared a form of limestone that had been used for two adzes with a modern quarry source at Ruatoki (Kevin Jones, DOC, pers. comm.), and andesite used for adzes to similar rocks at Mt Edgecumbe, Otuhepa and Whale Island.

Ochre was used by Maori for personal and other decoration. Stafford (1999: 114) recorded Rotorua red ochre (*kokowai*) sources as being Puarenga River and scum scooped from a thermal pool at Redwood Grove, Whakarewarewa, which was then boiled until it thickened. Stafford (1996: 125) mentioned a further ochre pit at Waikareao at Rotoma. Motiti has been cited as an ochre source (Matheson 1979: 11). Ballara (2003: 252) noted that people travelled inland from Maketu to collect ochre, but did not say where from.

Red ochre fragments are often found in archaeological contexts. The apparent diversity of ochre sources may make possible studies using chemical analysis of major or trace elements to establish patterns of ochre movement, and the history of use of different sources. Ochre was common in the Kauri Point Swamp site (Shawcross 1977), so some information on the date of use is available, at least from that site.

Papakura (1938: 222) recorded that the flat, rounded stones available from Motiti were favoured for use as fishing net weights. Rounded stones were also preferred for earth ovens. In places that were remote from sources of ovenstone, it is likely that stones would be conserved for reuse, even when broken. There is evidence that preferred ovenstones were transported to places without suitable local stone. For example, Petchey (1993a) documented that river cobbles from the western side of Tauranga Harbour and marine boulders from the coast north of the harbour were transported

to Matakana Island for use as ovenstones—Matakana is entirely built of sand-sized Pleistocene and Holocene sediments, and lacks any rock suitable for earth ovens. Other parts of the Bay of Plenty are also deficient in rock suitable for ovenstones, while other locations were known as sources. One of these—Moutohora Island—is still used (Anon. 2003). It is likely that other islands were also used as sources of ovenstones. A traditional story cited by Matheson (1979: 1) has references to ovenstone sources at Waikoroa on Motiti, and at Maketu.

Reed (1958: 100) mentioned a beach on Lake Rotoiti 'famous for its boulders', 'round and convenient in size'—for ovenstones—but did not give more precise location details. Stafford (1996) did not address this matter, but inspection of his maps shows a place at the eastern end of the lake where wave fetch would be effective in producing waves that would create a boulder beach. This beach has the name Te Umutahanganui (Stafford 1996: 155), which could be translated as 'large bare oven'.

Some premier stone resources were brought into the area either in finished or partly finished form. Argillite from the northern South Island was used in early forms of adze. Maori in the Bay of Plenty also used nephrite (greenstone, jade), which was only available from the South Island. An abandoned nephrite slab has been discovered in the ranges between Taupo and Hawke's Bay (Keyes & Matheson 1970), showing that the nephrite trade was in part overland and involved unworked stone as well as finished artefacts.

8.2 EUROPEAN RESOURCE USE

8.2.1 Trade and demand for new resources

The European traders and colonists were reliant on manufactured goods that made their lives less burdensome. However, many of the earliest settlers had very little in the way of funds with which to acquire these on an ongoing basis, and little land on which to produce crops. Hence they needed goods to trade. For traders, such goods were provided by Maori and then on-sold. However, Maori did not allow this trade to be monopolised by Pakeha, and soon acquired vessels so that they could move their own produce to the emerging Auckland market, which flourished up to 1858 (e.g. see Walker 2007: 63–66 for Whakatohea).

After the New Zealand Wars ended locally in 1865, the colonists' desire for land could be satisfied from confiscated land and from more ready land sales. However, Te Kooti's insurgency, which continued until 1970, was an ongoing constraint on development in the Bay of Plenty for several years after war ceased in other parts of New Zealand. Farming was also constrained by bush sickness (cobalt deficiency) and, particularly, by the lack of access to markets. The extensive coastal swamps were a barrier not only to transport but to development, as their agricultural potential could not be realised until they were drained.

The timber resource was initially difficult to access in much of the Bay of Plenty region, and its development came late compared with other areas, e.g. parts of Auckland province, which had more accessible timber and

better water transport. Maize cropping by Maori farmers had become well-established before the New Zealand Wars, and after the wars European settlers also began to grow it extensively. During the late 19th century, dairying expanded, with first cheese then butter factories.

Precious metals, particularly gold and silver, were present in the northwest of the Bay of Plenty region, but large reefs were rare. Mines required capital to be developed and even the best reefs were not economic to mine until the cyanide process was developed in the 1880s. Sulphur was another mineral resource in the region, although in limited quantities. Where water transport was available, it was one of the earliest minerals mined.

The energy and exotic forest potential of the Bay of Plenty did not start to be developed until the 19th century.

Tourism to the Rotorua district flourished for a short period after the New Zealand Wars, but declined substantially following the Tarawera eruption. It only started to recover after the North Island railway was extended to Rotorua in 1894.

8.2.2 Local development of opportunities

Port development in the Bay of Plenty paralleled the development of roads and was much in advance of railway development in the region. This seems to have been led by local initiatives. The coastal ports were tiny and economies of scale were limited because of the small size of the vessels that could use most of them. Roading development was, in part, politically driven, with central government funding roads to Rotorua from Tauranga and on to Taupo and Napier. The Taupo–Napier road had strategic importance in placing a southern boundary around the Ureweras. Some roads were constructed by Maori under contract. Coastal and other internal routes took longer to develop.

Although the goldmining town of Waihi, on the western edge of the Bay of Plenty, was a major industrial centre, it had little effect on development in the region. Some Bay of Plenty produce was sold to miners, and timber harvested in the northern Kaimai Ranges was used as underground roof supports in the mines. Waihi lacked the sea access of Thames, which became the manufacturing centre for the mining industry in the region. There was little direct spin-off for the Bay of Plenty from the Waihi mines.

Indigenous timber exploitation started around Tauranga after other northern resources were exhausted. It then became economic to build the *tramways* needed from the bush to the harbour shore, starting around AD 1900 (Stokes 1980: 270).

The opening of the railways (see section 11.4.4) allowed greater exploitation of all resources in the region. At Rotorua, this was primarily tourism, but dairy farming, indigenous logging and sulphur mining followed. The coastal railway only became effective after a bridge was built across Tauranga Harbour in 1924. This allowed indigenous forest logging to expand along its route and, in parallel, the expansion of the dairy industry, which could then access the rich soils of drained swamplands in the east of the region.

The Tauranga area pioneered the domestic and rural use of electricity in New Zealand (see section 11.4.3). Local hydroelectric resources were being developed, but it was the vision of one man—Lloyd Mandeno—who took

power to the domestic market for more than lighting and who pioneered single-wire, earth-return, rural reticulation, making the cost of reticulation affordable for rural customers (Mandeno 1975).

The modern agricultural landscape in New Zealand makes intensive use of many exotic species, a large number of which now have varieties that were specifically selected or developed for New Zealand conditions. The Bay of Plenty seems to have played a part in the adaptation of only a few species for local conditions, but these few were significant. The golden queen peach (*Prunus persica*), ideal for canning, is the result of local breeding. Matheson (1979: 39) claimed that bumble bees (*Bombus* spp.) were introduced to New Zealand at Motiti in 1887, but it is not stated which species. These bees are much more successful in fertilising red clover than honey bees and hence contribute significantly to the nitrogen-fixing clover grasslands that are so central to the success of New Zealand pastoralism. The Hayward kiwifruit (*Actinidia deliciosa*) variety, which is vital to modern fruit cropping in the Bay of Plenty region, was bred outside the region, but the most recent development of new varieties, including Zespri Gold, has taken place in the region at Te Puke. Development of varieties of radiata pine (*Pinus radiata*) for local conditions has been led by the Forest Research Institute in Rotorua.

The maps in the New Zealand Historical Atlas (McKinnon 1997) show, almost without exception, the slight nature of development in the Bay of Plenty until the late 20th century. The modern wealth of the region has not been built on extractive industries. Capital-intensive forestry, forest product processing, energy and agriculture were the basis of the rapid growth of the region in the late 20th century.

9 Maori settlement pattern and character

9.1 ARCHAIC OCCUPATION

The earliest cultural manifestation of Polynesians in New Zealand is usually termed *Archaic*. Archaic Maori occupation is distinguished by a number of cultural markers, particularly tools and ornaments that have links to Eastern Polynesia. The well-known sites of this cultural stage include Mt Camel at Houhora, Northland, Wairau Bar in the northern South Island, and numerous sites in coastal Otago. Archaic sites are often marked by use of stone resources transferred from remote locations in New Zealand and by use for food of marine and terrestrial animals that later became rare or extinct. In contrast to the areas mentioned above, the number of sites of Archaic occupation known in the Bay of Plenty area is small (Fig. 3).

It is clear that Archaic occupation sites were present at Waihi Beach and Bowentown (Mair 1902; Mitchell 1939). Phillips (2000a) recently reviewed the attempts to relocate the Bowentown site that was recorded in 1977 as U13/149. It may still be possible to relocate this, but its loss to erosion must be considered a possibility. An Archaic site has been reported at Kauri Point inside the north entrance of Tauranga Harbour (U13/1), but it has not been investigated archaeologically. An Archaic-style adze is known from this site, which reportedly contained moa bone.

Kath Fletcher monitored material exposed by coastal erosion after storms at a number of locations in Pilot Bay on the inner harbour side of the Mt Maunganui tombolo. Her finds have made it clear that an Archaic site (U14/363) exists or existed there. Items found have included drill points, bone one-piece hook cores, a bone tab prepared for a hook, a 'point' of bird bone, broken pieces of bone hooks, flakes from polished tools, broken stone files, a Duff 4A or 4C adze, basalt, obsidian, chalcedony, chert and occasional argillite flake material (pers. obs.). The original site is not now apparent, but part of it may still be intact.

It has recently been demonstrated that the old shoreline inside the river mouth at Whakatane had Archaic occupation. This is not surprising given that an Archaic reel ornament was discovered near Whakatane (Leach 1983). No further information is yet available.

A site at Ohope Spit was excavated by members of the Whakatane and District Historical Society from 1969 (W15/82; Moore 1972). Phillips (1996) provided an overview of the results from this site. The fishing gear found is clearly of the Archaic period, but the site has not been dated.

Inside Ohiwa Harbour on its eastern side, the Tokitoki Archaic site has been excavated by McGovern-Wilson (W15/582). Formal reports have yet to be published, but various brief accounts show that the site contains moa bone from moa hunting, massive obsidian tools, tools made from stone from other parts of New Zealand, including the South Island, and bone fish hooks. Harbour shellfish is dominant in middens at the site, but these deposits are

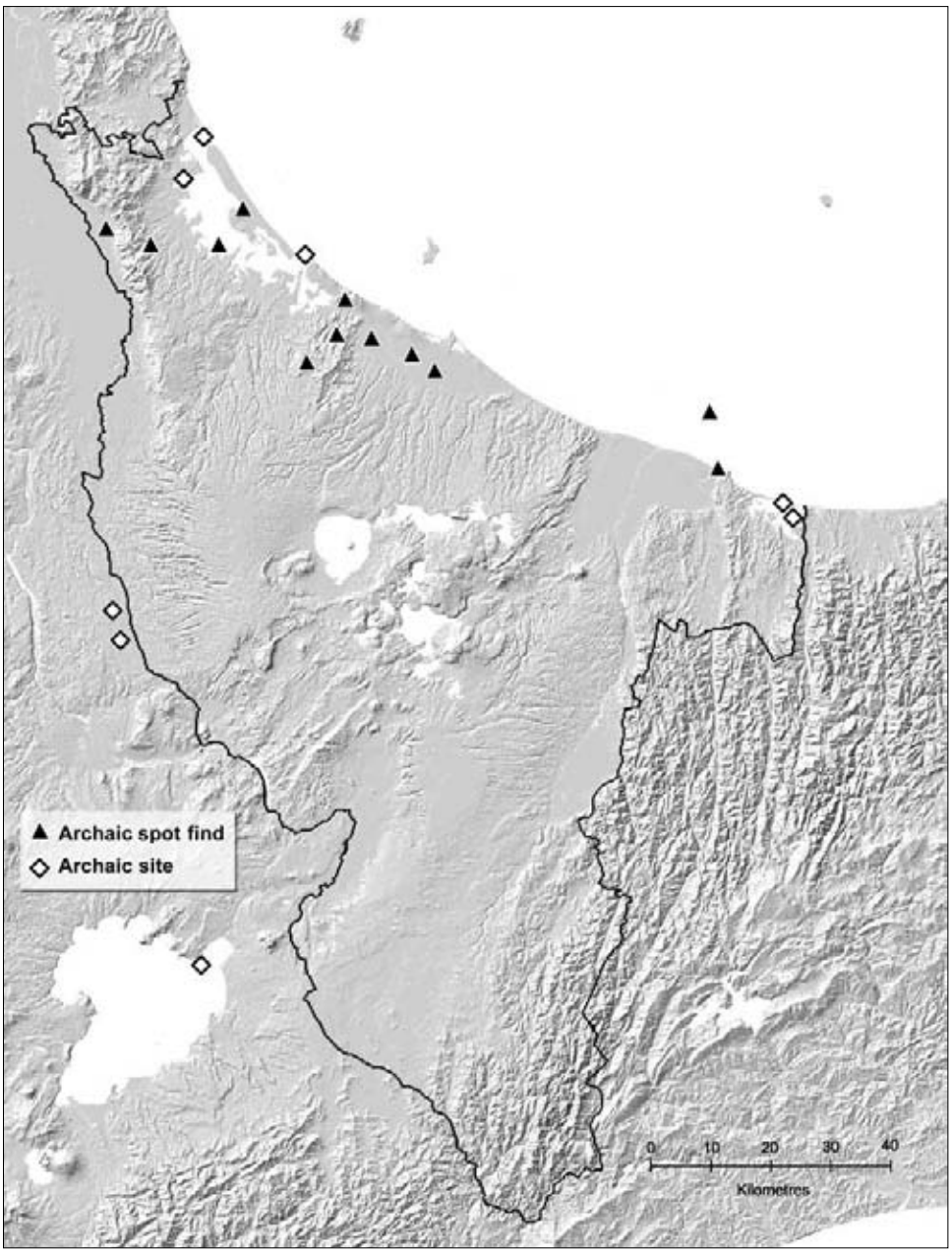

Figure 3. Distribution of Archaic spot finds and Archaic sites in the Bay of Plenty region..

of more recent origin. Rick McGovern-Wilson (pers. comm.) reports that the site was first occupied soon after the Kaharoa tephara was deposited, for there is little sign of soil development on this underlying layer. McGlone & Jones (2004: 40) reported that obsidian hydration dates from the site are in the range of 650–690 years BP. Radiocarbon dates from the locality are listed in Appendix 2. In the absence of an excavation report, it is not appropriate to interpret these.

Although no Archaic sites have been reported from inland areas of the Bay of Plenty region, their presence just outside the region at Tokoroa and Taupo is a reminder that their possibility cannot be excluded. Spot finds of Archaic-style adzes and ornaments are known. Moore (1977), in reviewing the adzes in the Whakatane Musuem, noted many of Archaic form that were located only very generally in the Bay of Plenty. A surprising proportion of these were made from Nelson argillite, which may have resulted from such adzes being preferred by donors or by the Museum.

The distribution of adzes made of Tahanga basalt (from Opito in the Coromandel) extends into the Bay of Plenty area (Moore 1971). This distribution reflects an early northern North Island pattern, but does not necessarily provide a time marker, as the quarries at Opito were used later in Maori history as well. There is an interesting cluster of spot finds of adzes inland from Maketu to Tauranga, which are not matched by known Archaic sites. These may, perhaps, represent later transport and use of earlier styles of adze, but may also indicate that earlier sites could yet be found in these localities.

Obsidian from Mayor Island (Tuhua) is found in the earliest sites throughout New Zealand. This is a clear indication that the Bay of Plenty area was at least visited by people from the earliest occupation period of New Zealand, and that these people likely exchanged goods with people from other parts of New Zealand.

The Kaharoa tephra puts a lower time limit on the settlement of the Bay of Plenty. No pre-Kaharoa occupation site has ever been found in the region, despite this being the subject of some attention and even a few prospects, which turned out to be false. As noted in section 5.7, there is only slight and equivocal evidence of occupation from studies of pollen in sediments below the ash (i.e. possible signs of human disturbance of the vegetation). If the Kaharoa eruption occurred after human occupation of New Zealand, then it was only very shortly after.

The locations of the coastal Archaic sites are typical of these sites—sheltered beach-front sites just inside the mouths of harbours and river estuaries. Figure 3 illustrates the locations of Archaic material from the Bay of Plenty area. Such sites are infrequent in comparison with, for example, the Coromandel area. The absence of inland early sites is not likely to persist with further fieldwork, as the inland area is relatively little explored archaeologically and the presence of sites at Tokoroa and Taupo, just outside the Bay of Plenty region, points to the likelihood of more sites being found.

As so little has been published on the Archaic sites in the Bay of Plenty Region, little can be said in summary. The artefacts recovered exhibit the normal range of Archaic forms of adzes, fishhooks and ornaments, but they are not sufficient in number to help define any local variety to their manufacture. The economy of the occupants is hardly known at all beyond the fact that there are two sites with moa associations so, presumably, some of these birds formed part of the diet of the earliest people in the region. McFadgen (2007: 175) took the view that most moa bone reports from the area are of sub-fossil bone—that is, bone collected for industrial use from long-dead animals. We know nothing about the form of the Archaic settlements.

This sparse evidence of early occupation in the Bay of Plenty region requires consideration in the wider New Zealand context. Why is there such an apparent paucity of evidence of Archaic settlement in this region? The Bay of Plenty is not in the drier east coast areas where large Archaic sites have been found that have frequent evidence of moa use, but nor is the adjacent Coromandel, which also has higher densities of Archaic sites. One possible explanation is that the Kaharoa eruption, which perhaps continued in its dome-building stage during the earliest period of settlement, may have made the region appear dangerous and unattractive (because of volcanic activity, tephra damage and extensive un-vegetated outwash plains) (Jones 1991; McGlone & Jones 2004). It is likely that many of the rivers in the

region would have had high levels of sediment and acidity, and the tephra-covered landscape would have been unappealing for horticulture. However, the extreme effects of volcanism were unlikely to have lasted more than a few decades. Tsunami activity from the Kermadec area may, likewise, have been a disincentive if a tsunami had occurred early in the settlement period. However, the effect of a tsunami would only be particularly apparent at the time it occurred and shortly after, and human memory of these events is normally short.

Although some sites may have been lost to erosion through the movement of estuary and river mouths, the more mobile shores of these areas would not have been preferred locations for more permanent settlements because of the remoteness of fresh water and suitable gardening soils. Recent loss of old sites seems an unlikely explanation for their scarcity: modern human development in the Bay of Plenty has been concentrated in the late 20th century, by which time important sites would not have been found or destroyed without coming to the attention of someone. The fact that sites have survived and been recorded in just the places we would have expected them suggests that the low frequency of recognised Archaic occupation sites reflects the reality that they are rare in this region.

McFadgen (2007: 173) took the view that the peculiar pattern of Archaic sites is probably the result of geological events that struck the coast early in its human history; specifically, the Kaharoa ash fall and tsunami. He does, though, credit the Kaharoa event with leaving soils well suited to later Maori horticultural use. The apparently rapid occupation of the Bay of Plenty area, with some tribal groups originating here but then moving away from the area, sits in contrast to the low intensity of Archaic occupation. The later population seems to have developed from a small base. Thus, perhaps it is our recognition of early sites that is at fault—sites may be more varied in location and content than the coastal artefact-rich sites we consider to be normal.

9.2 LATER PREHISTORIC OCCUPATION

Table 3 shows the prominent Maori site types recorded in the Bay of Plenty region. Their inclusion as Maori sites is one made by the recorders of the sites. The greater part will be pre-AD 1860.

Table 3 includes a few Archaic sites, but the majority are from later periods of occupation. They are shown in map form on Fig. 4.

Leathwick (2000) related the density of pa and pit sites to physical and climatic factors and produced a predictive density map for New Zealand. For the Bay of Plenty, this

TABLE 3. MAORI SITE TYPES.

DESCRIPTOR (SEE GLOSSARY)	NUMBER
Pa	1177
Pit(s)	1353
Rua	230
Terrace(s) or platform	903
Midden	2644
Pit(s) and terrace(s)	372
Midden and pit(s)	59
Midden and terrace(s)	121
Hangi or hangi stones	13
Find spot	179
Cultivated soil	17
Burial or urupa	35

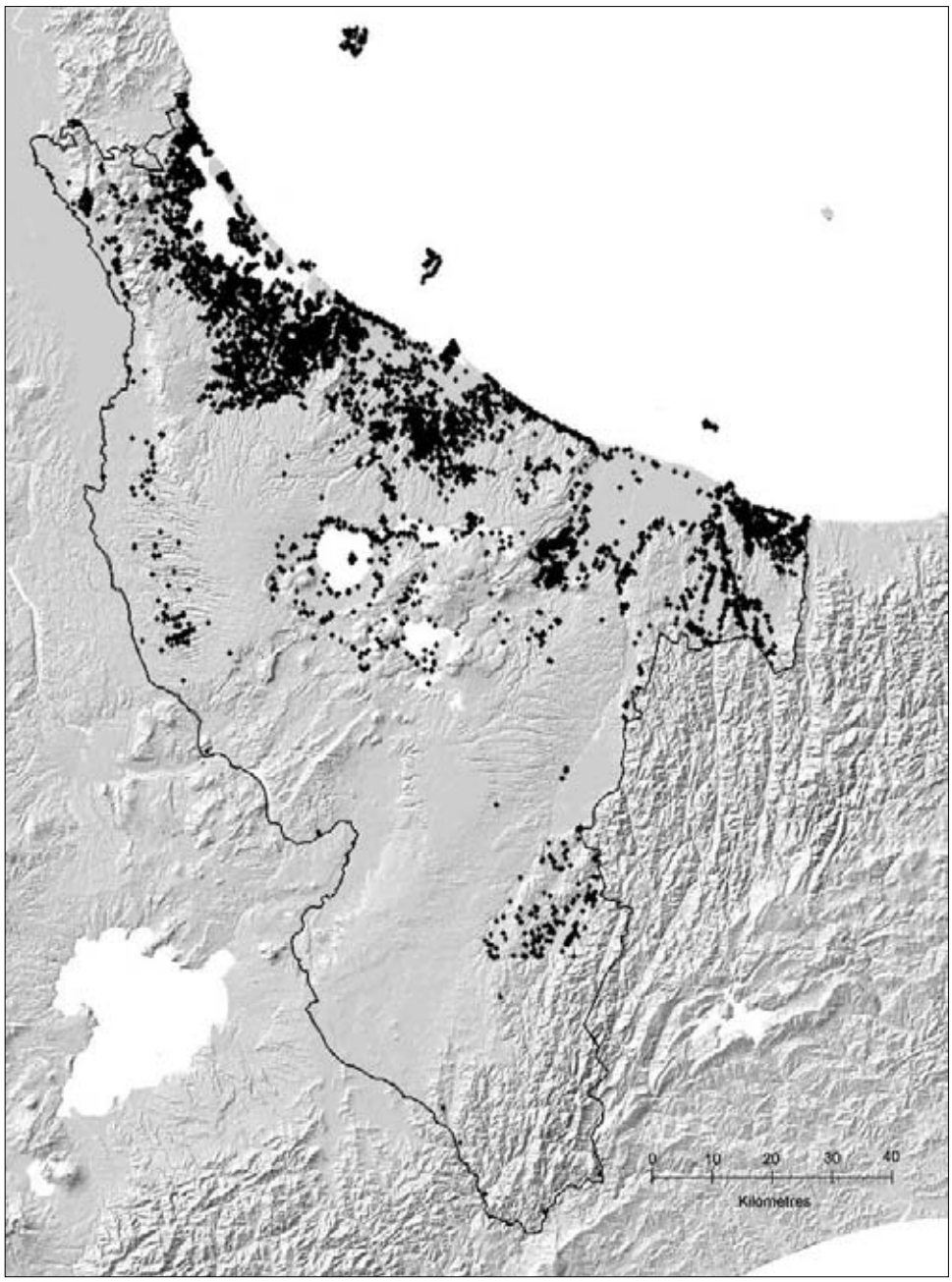

Figure 4. Distribution of recorded Maori sites in the Bay of Plenty region.

map is a very good predictive tool for the location of such sites (Fig. 5), and where this map departs from patterns known from survey, the reasons are rational and can be explained. The coastal sand strips are predicted as having high densities of pa and pit sites, but fewer sites than predicted have been recorded to date: these areas are not preferred for pa as they are hard to defend, and while archaeological pit sites are known in this zone, pits are inevitably infilled so field survey will not often reveal them. The swamp areas behind the shore near Papamoa, Maketu and on the Rangitaiki Plain are also predicted to have a high density of sites, but the actual density is low: pits are not a practical storage solution in swamps, other than on occasional areas of higher land, and swamp pa, while being present, do not occur as frequently as upland pa.

Continue to next file: Part 2