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The New Zealand Historic Places Trust,
and
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CFG HERITAGE

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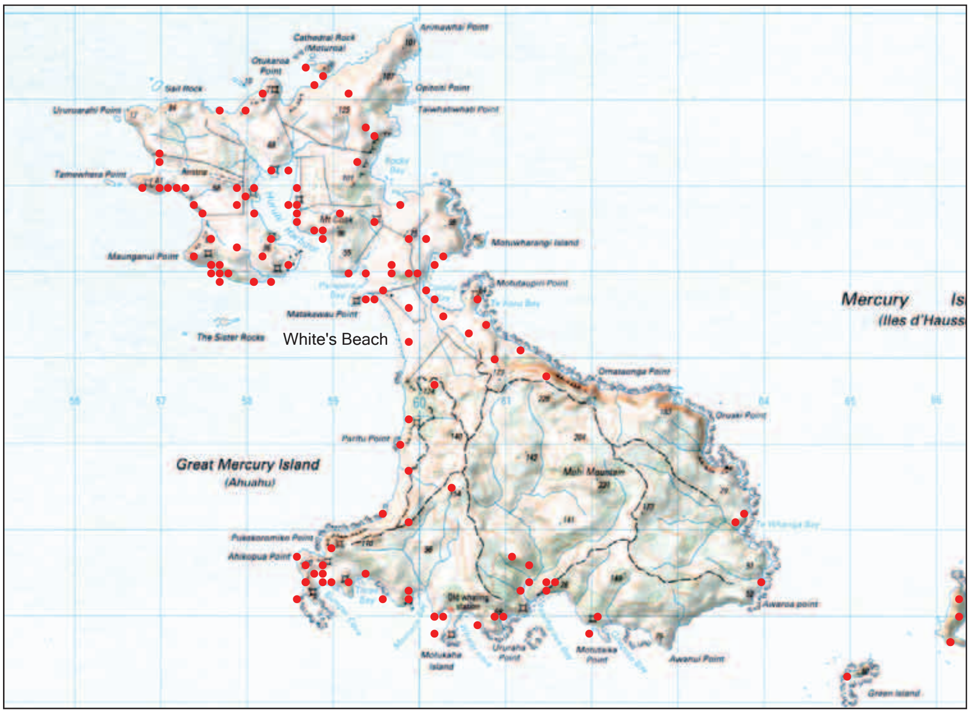
Louise Furey

Between 25 and 27th July 2008 a deep low weather system from the northwest moved down onto New Zealand, causing heavy rain and wind, and large sea swells around the coastline of the North Island. Unusually the storm affected the western side of Great Mercury Island (Ahuahu) and in particular White Beach in the central part of the island (Figure 1). Coastal specialist Jim Dahm of Hamilton estimated the damage to the dunes on Great Mercury was a one-in-two-hundred year event, and it was extremely unusual for the more sheltered western side of the island, given its proximity to the Coromandel coast, to suffer the effects of storm surge. Residents on the island estimate the dune system along the 1 km beach has been cut back by about 10 m distance, leaving a vertical 3 m high scarp at the rear of the beach.

Several weeks after the storm the vertical scarp of the dunes was still present with large blocks of sand, bound by roots of dune vegetation, dropping off to beach level. Alteration to the profile of the beach meant that high tide was lapping at the base of the wave cut scarp, and material dropping off the face was being partially washed away (Figures 2 and 3).

The same storm caused erosion at Matarangi Beach, Whangapoua Beach and at Sarah's Gully on the mainland. Damage to these beaches is usually consistent with an ocean swell from the north east, but the unusual behaviour of the ocean swell on this occasion suggests it was bouncing off a land mass and running down the east coast of the Coromandel Peninsula between Great Mercury Island and the mainland. Coralie Bay on the opposite side of the island to White's Beach is exposed to the east and did not suffer any damage in this storm.



1. Location of White's Beach, Great Mercury Island. Red dots indicate recorded archaeological sites.

2 (top). Oblique aerial view of White Beach, Great Mercury Island, looking north, showing dune system and wave cut scarp.
3 (bottom). Eroding section of White Beach, Great Mercury Island, looking south.

Archaeological deposits were exposed in the vertical erosion scarp and the landowner, Michael Fay, requested advice on their significance. Archaeological authority 2009/32 was obtained from the New Zealand Historic Places Trust under section 18 of the Historic Places Act 1993 to undertake a limited investigation to sample any cultural layers. Over three days from 14–17 August 2008 the deposits were described, photographed and sampled for analysis to provide information about the age of the occupation and how the evidence might be interpreted.

Nine separate exposures of material were recorded over the 1 km length of beach. Black or dark grey charcoal-stained horizons, ovens exposed in section and one small shell midden were recorded. Elsewhere there was diffuse charcoal staining and occasional fire-cracked rocks, large pieces of oven stone and, in the intertidal zone, there were chert and basalt flakes which had been washed from the dune face by the water. Each exposure was described separately, but the evidence overall was grouped into three clusters based on proximity, and site numbers allocated to reflect the interpretation of the exposures as relating to three separate occupations.

Palaeosols, or buried soil horizons, were visible in the exposed section. The lower palaeosol could be traced from the northern end of the beach for almost the entire length of the beach although it was not so distinctive or apparent towards the southern end. This palaeosol, of light grey-brown to grey sand, was consistently about 1.3m from the top of the exposed scarp, and was about 400 mm thick, although it was 250–280 mm thick in some places (Figure 4). The archaeological deposits were within or under the top of the palaeosol. The lower palaeosol can be interpreted as a long period of dune stability when vegetation was present and organic matter built up on the surface of the dune. This layer was subsequently inundated by a large amount of sand on which a shallower soil formed. The younger palaeosol was approximately 350 mm from the top of the dune and was also covered by more recent sand. It was 200 mm thick and was only visible intermittently through the middle third of the beach.

The exposed archaeological layers were described and photographed, and GPS coordinates obtained to allow relocation to ± 7 m. Site numbers T10/944, 945 and 946 were obtained from the New Zealand Archaeological Association Site File, the national database of archaeological sites, and the deposits will be referred to subsequently by these numbers. Copies of the site records are attached (Appendix 1). Samples of charcoal and sand were taken from black charcoal rich layers, from the palaeosol where there were visible charcoal pieces, and from ovens. The intention was to have the charcoal identified to plant species so that the type of vegetation and environment could be reconstructed. Any lithic material such as obsidian, chert or basalt found protruding from the scarp, or present at the base of the scarp, was collected and labelled according to its location. The exposed shell midden

(T10/944 #3) was sampled, and all the excavated material was retained for later analysis. It was not possible to clean up long exposures of the cultural layers as the vertical face of the dune was constantly slumping.

T10/944

Visible intermittently over 50 m as a darker layer varying in thickness between 1.1 m and 1.4 m from the top of the dune and 1.25 m above beach level and HWM. Each exposure of material including ovens and midden is described separately.

Exposure #1

A grey-brown discoloured palaeosol layer 280 mm thick with oven stones, three basalt flakes, one chert and one obsidian flake on the surface. There was a darker staining on the upper 120 mm on the layer (Figure 4). The total length of the darker staining was 3 m but slumped sand probably obscured the continuity of the palaeosol layer. The cultural material was 1.3 m below the top of the dune and the height of the dune at this place was 2.5 m.

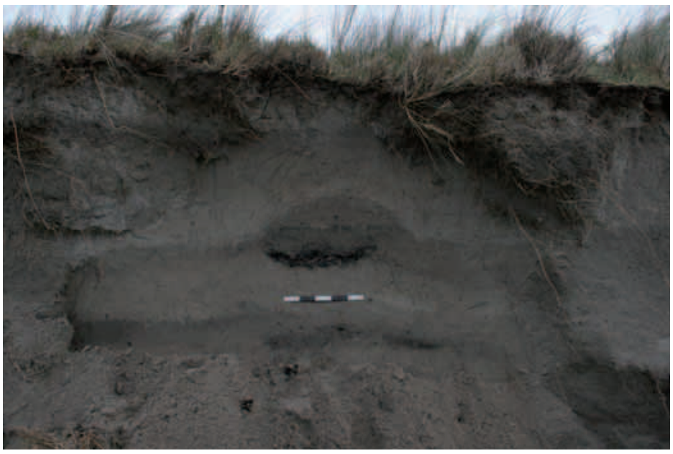
Exposure #2

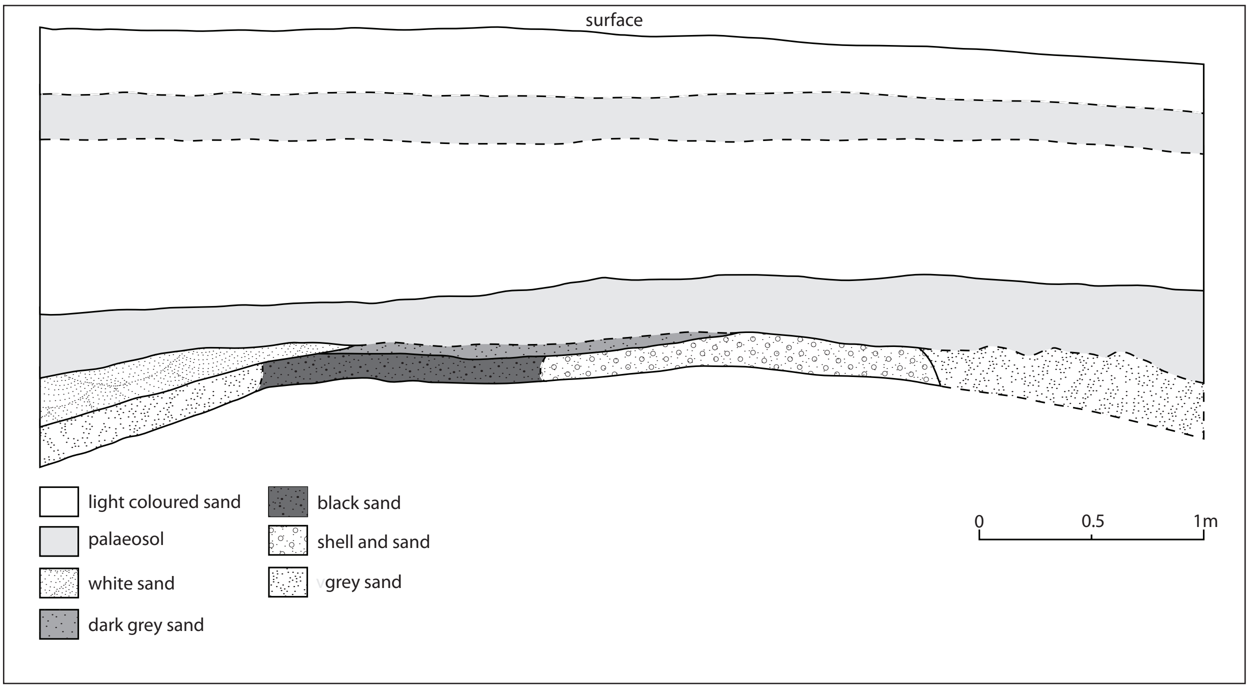
Earth oven, 10 m to the south of #1, within a grey-brown layer 150 mm thick and 950 mm below the top of the dune. The scooped shape of the oven as exposed in the section was 100 mm deep and 700 mm long (Figure 5). It contained charcoal and water rolled and heat fractured oven stones. About 400 mm below the oven (1.55 m below the top of the dune scarp) was the lower palaeosol which contained a sea mammal bone, small water rolled cobbles and one basalt and one chert flake.

Exposure #3

Shell midden and black lens, 20 m to the south of #2, immediately below a light grey-brown sand layer. This grey-brown layer has been interpreted as an organic staining and probably a palaeosol formed over a period of time: it was 350 mm thick and the top of the layer was 1 m below the top of the dune. The dark cultural layer extended for 4.7 m but the midden was a discreet lens 150 mm thick and 1.8 m long within the darker layer. There was a distinct colour difference to the north and south of the midden deposit. To the south the shell and dark grey/black sand merged into a diffuse lighter grey sand which then merged into the unmodified dune sand, and to the north the shell merged into a black layer of the same thickness and width of about 1.2 m length with a distinct colour change to the same diffuse lighter grey sand present

4 (top). T10/944 #1 showing two palaeosols. The chert flakes were on the darker stained surface of the lower palaeosol.
5 (bottom). T10/944 #2 oven with lower palaeosol beneath the photographic scale and the upper palaeosol near the top of the scarp. The oven is within a dark stained occupation lens.





6. T10/944 section showing the upper and lower palaeosols with the occupation layer beneath the lower palaeosol.

at the southern end (Figures 6 and 7). The shell midden was in a dark grey/black matrix and contained oven stones and charcoal. The oven stones were concentrated towards the southern end but did not appear to be within a scoop, and this observation was confirmed when the midden deposit was sampled.

20 m to the south of #3 was a dark lens extending for another 18 m. In the intervening distance was stained sand, distinct from the palaeosol, that, although intermittent, was highly visible and up to 600 mm thick in places.

Exposure #4

Oven 600 x 80 mm within the palaeosol approximately 30 m to the south of the midden deposit (Figure 8). The base of the oven scoop was 200 mm above the base of the palaeosol. Charcoal, stones and dark grey/black sand filled the oven.

7. T10/944, showing black layer with midden (#3) incorporated to the right of the photographic scale (500 mm).

Exposure #5

Approximately 8 m south of #4 was a black lens extending for 6 m at the base of the palaeosol. Small pumice pieces 5–7 mm diameter were present immediately under the palaeosol, at about 1.5 m from the top of the dune, and 600 mm above the beach level.

A similar pumice deposit about 50 mm thick was also visible at the base of the palaeosol about 150 m to the south. This was the only other occurrence of pumice seen along the length of the exposed scarp. The level was about 1 m above the beach, and 1.5 m below the top of the dune.

Also visible in section about 150 m to the south of T10/944 was a short exposure

(#6) of palaeosol with Loisel's pumice at the base of the layer. This lens of pumice, about 30 mm thick, was 1 m from the beach level, and 1.5 m below the top of the dune scarp. The pumice was not seen at any other location on the beach, but the significance of this material will be discussed below in relation to the lower palaeosol.

T10/945

Charcoal stained sand extending for 30–35 m within the palaeosol. Evidence included an oven and basalt flakes.

Exposure #7

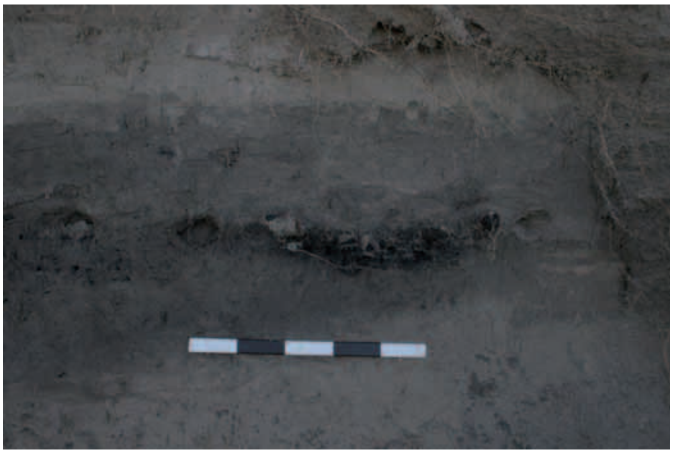
The dunes were over 3 m high at this place, and the palaeosol, evident for 15 m along the scarp, had charcoal, particularly small twigs, exposed.

Exposure #8

An oven below a grey-brown sand 530 mm deep. The upper 180 mm of the palaeosol contains charcoal flecks. The oven consists of a scoop with a lower lens of black sand 50 mm thick at the base of the palaeosol. Over this there was sterile white sand and another charcoal lens directly on top of the lower one (Figures 9 and 10). The top part of the oven was 100 mm thick and contained numerous stones. This was the largest oven recorded at 1.4 m long. Samples of charcoal were taken from both lenses of the oven, and also from the palaeosol which contained the occasional stone flake. The dune face was higher on this part of the beach at about 3–3.5 m high.

T10/946
Exposure #9

At the south end of beach where three intermittent streams discharge there were basalt and chert flakes and a dark stained area 2 m below the top of the dune. An oven exposed between the first and second streams from the southern end was present in a dark layer which is up to 500 mm thick. The depth of the material, and the fact that the flakes were not at a consistent level, suggested that the layer was disturbed. The oven feature was not sampled as there was no clear definition of the surrounding layer.



8 (top). T10/944 #4 oven exposed in section.
9 (centre). T10/945 showing palaeosol and oven.
10 (bottom). T10/945 closer view of oven.

The dune height around the stream mouths was lower than the remainder of the beach, This was probably due to water eroding the banks and also storm surge up the stream channels.

Summary

The buried soil layers are at a similar level, relative to beach level and to the top of the present dune, over the 1 km length of beach. When the occupation layers were formed, it is likely the dune profile of raised dune at the rear and a flat sand terrace at the back of the beach was similar to what it is today although at least 1 m lower. However it is likely that with the palaeosol only 1 m above beach level, in order for the occupation evidence to have survived from storm surge, the sand terrace must have been wider and extended some distance seaward.

Sampling

The midden deposit on T10/944 was sampled by excavating 300 mm back into the dune across the width of the shell exposure and removing all contents of the layer. It was not possible to obtain a larger sample without substantially cutting back the 1.3 m deep overburden of sand. Forty litres of shell and sand were removed for analysis and the results are described below.

Charcoal samples were recovered from T10/944 oven #2, black lens #5, and oven #4, from T10/945 oven #8 and palaeosol at same location. Three radiocarbon dates were obtained: from T10/944 oven #2 (charcoal), midden #3 (shell) and T10/945 #8 oven (charcoal).

Analysis

Shell, bone, stone and charcoal samples were analysed and, where necessary, sent to specialists for identification.

Shell

The shell deposit from T10/954 was excavated and bagged in four equal samples (a–d). This method was used to quantify variation in the distribution of shellfish species as it was apparent from looking at the midden that the southern end had proportionately more tuatua (*Paphies subtriangulata*) than the northern end. Large oven stones were discarded during excavation for practical reasons related to transporting the samples off the island. The shell samples were dried, weighed, washed and sorted to species. Diagnostic elements of the shell, including hinges of bivalves and spire of gastropods, were used to count minimum numbers of individuals (MNI) (Table 1). The bivalve MNI figure was calculated by dividing the total number of identified valves by two.

The majority of the shellfish were obtained from the sandy shore, most likely directly in front of White Beach. Tuatua are the most commonly occurring bivalve, although there were more cats eye (*Turbo smaragdus*). These gastropods could be obtained off the boulders at the south end of the beach, or the narrow intertidal platform around Matakawau (Stingray Point) at the north end of the beach. Whelk (*Cominella* sp.) inhabit mudflats and so were probably obtained from Huruhi Harbour. The few cockle and pipi were probably collected at the same time, though whelk would have been the target species. The single scallop shell may have been washed up although the species is found off the beach on the sandy bottom in 3–10 m depth of water. Nerita, Cook's turban, spotted topshell and other rocky shore species could be obtained from the same environment as cat's eye. The paua

	3a	3b	3c	3d	Total
Sandy shore					
Tuatua (*Paphies subtriangulata*)	14	32	80	170	296
Scallop (*Pecten novaezelandiae*)			1		1
Estuarine shore					
Cockle (*Austrovenus stutchburyi*)	2	2	3		7
Whelk (*Cominella* sp.)	48	29	36	31	144
Pipi (*Paphies australis*)		1	1	1	3
Rocky coast					
Black nerita (*Nerita atramentosa*)	6	12	8	10	36
Spotted top shell (*Melagraphia aethiops*)	9	6	12	10	37
Cook's turban (*Cookia sulcata*)	7	3	8	8	26
Cat's eye (*Turbo smaragdus*)	43	99	116	118	376
Dark rock shell (*Haustrum haustorium*)	1	4	6	2	13
White rock shell (*Dicathais orbita*)		3		5	8
Limpet (*Cellana radians*)		1			1
Paua (*Haliotis iris*)			P		P
Mussel (*Perna canaliculus*)			P		P
Chiton		1	1	1	3
Australian trumpet shell (*Ranella australasia*)		3			3
Incidentals					
Turret shell (*Maoricolpus roseus*)		1			1
Opercula, large oval (?*Haustrum*)	13	6	14	12	45
Opercula, small round (?*Turbo*, very small)	20	54	106	31	211
Opercula, unidentified				1	1
Oyster (carrier on economic shell)	P	P	P	P	0

Table 1. Shellfish species present in the midden sample.

and mussel were probably also from the same location but are almost certainly underrepresented in numbers as the shell disintegrates leaving few of the diagnostic parts such as hinge or rim which are counted to give minimum numbers of individuals.

The percentage of shell to dry weight of sample (excluding miscellaneous oven stones and stone flakes) varied from 12% to 20% which means it was not a particularly concentrated shell midden, and thoroughly mixed with sand.

Fishbone

A relatively large quantity of fishbone was extracted from the midden sample (Table 2). Diagnostic bones from the head of the fish were identified by Beatrice Hudson, CFG Heritage, but vertebrae were also present.

Snapper (*Pagrus auratus*) was the most common species. Mackerel (*Trachurus* sp.) were identified only from the distinctive scutes (keeled scales), and leatherjacket (*Parika scaber*) from the first dorsal spine. All these fish could have been caught by net, although snapper was probably more commonly taken by hook and line. Leatherjacket was either netted or trapped, and mackerel caught by trolling line or net.

Fish	MNI
Snapper (*Pagrus auratus*)	14
Tarakihi (*Nemadactylus macropterus*)	1
Mackerel (*Trachurus* sp.)	P
Leatherjacket (*Parika scaber*)	3

Table 2. Minimum number of fish present in the midden sample.

Mammal and sea mammal bone

Bone extracted from the midden sample was sent to the Anthropology Department, University of Otago, for identification (see Appendix 2). Bone was also found protruding from the palaeosol below the earth oven at T10/944 #2.

This was a fragment of vertebrae from an unidentified cetacean, and three fragments of unidentified mammal sp. Cetacean is a general term referring to whales and dolphins. The bone was probably collected from a beach wreck, or possibly a stranded animal. Given that stone flakes were found at the same level the bone is more likely to be associated with some activity on the dune rather than have been washed ashore.

The bone from the midden was in relatively small pieces. Body elements identified indicate one female adult fur seal (*Arctocephalus forsteri*), one male subadult fur seal and at least one dog (*Canis familiaris*). Ribs and other bone fragments not able to be identified to species may be part of the individuals identified above.

Artefacts and stone flakes

A number of stone flakes and a few artefacts were recovered from the midden. They are described more fully in Appendix 3.

11 (left). Adze chisel roughouts. The triangular sectioned broken chisel is on the right. (right). Sandstone file pieces and abrader showing wear.

The two adze chisel roughouts were flaked from Tahanga basalt (Figure 11). The triangular sectioned chisel has a formed bevel but the chisel is broken through the mid-section. The other chisel is complete but does not have a formed bevel or blade. It may have been discarded because of the high point on one side which couldn't be removed by further flaking. The cross-section is thin quadrangular.

The body of a sandstone file, without the tip, and a separate tip which is not part of the latter, were also in the midden (Figure 11). These were most likely used for smoothing or filing bone artefacts.

A relatively unusual item is called an abrader for want of a better term. The poll end of a flaked basalt adze roughout has smoothing or wear on both broad surfaces and on the broken surface (Figure 11). More importantly the wear is also on the edges. The stone has been used to rub a hard but not abrasive material, possibly wood, as the smooth patches do not have striations or scratches. Small wooden tools with raised adze marks may have been rubbed to remove sharp splinters, or to smooth the fibres of the wood.

Basalt flakes

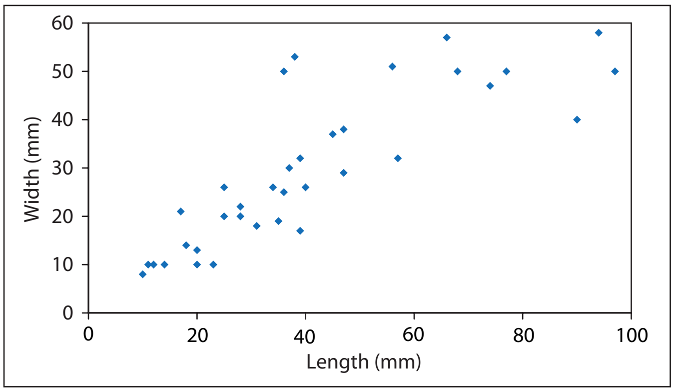
Within the midden there were 35 basalt flakes (Figure 12) ranging from small (18 x 14 mm) up to large (97 x 50 mm). The large flakes shown in Figure 13 tend to have cortex on one side. The total weight of the flakes was 623 grams. One of the flakes had possible usewear on the edge, similar to that described above for the abrader, although this is very difficult to detect on such a hard material as basalt unless the flake had been used repeatedly.

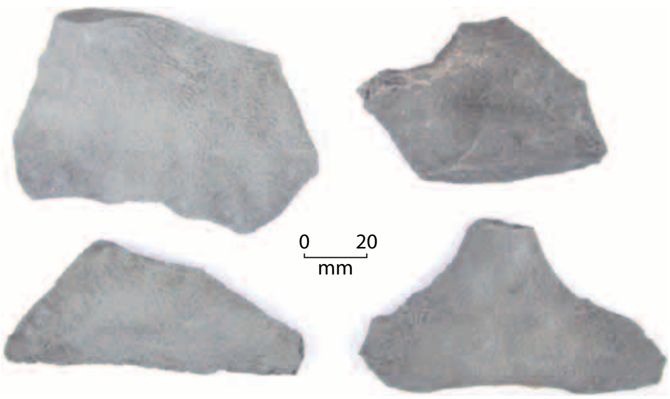
Obsidian flakes

Eleven obsidian flakes weighing 173 g from two, and probably three separate sources were measured. The largest flakes, and only two to have use wear damage on the edges, were green and most likely from Tuhua Mayor Island (Figure 14). There were three flakes, grey in transmitted light, which had large spherulites, flow banding and moderate conchoidal fracture qualities. The other type of obsidian was grey, with rare, small, spherulites and good fracturing qualities. There was one small core in the same material.

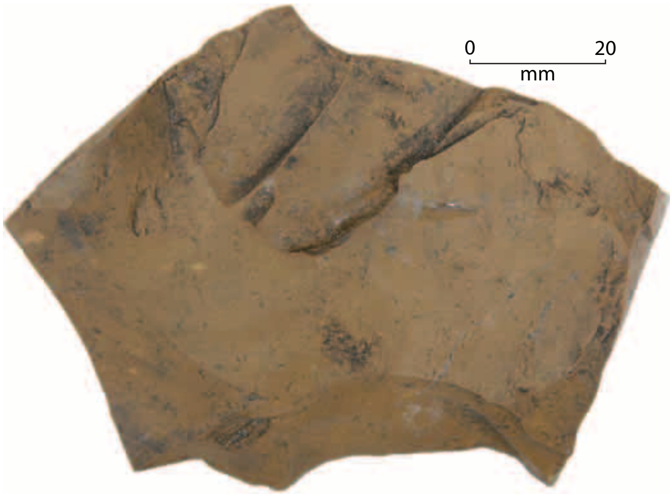
Chert

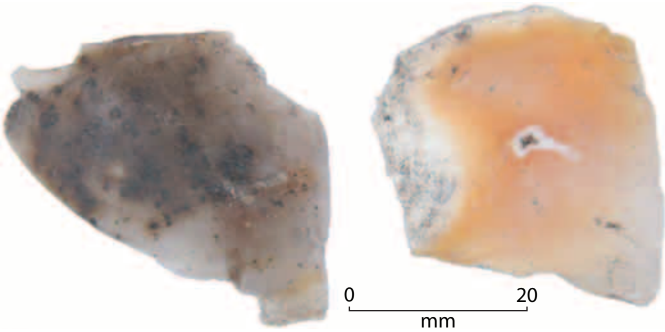
Three of the four chert flakes had cortex on one side, indicating their cobble origin. The largest flake measured 83 x 69 x 43 mm. Two thin chalcedony flakes were also present. A selection of flakes is shown in Figures 15 and 16.





12 (top). Size distribution of basalt flakes from T10/944 midden. 13 (centre). Selection of large basalt flakes from T10/944 midden. 14 (bottom). Obsidian flakes, T10/944 midden.





15 (top). Chert flake, T10/944 midden.
16 (bottom). Chalcedony flakes, T10/944 midden.

Petrified wood

One piece of black and grey petrified wood, although fine grained, had poor fracturing qualities. Better material has been observed on the island.

Petrified wood logs are present on the beach at Coralie Bay and Te Koru Bay, across the narrowest part of the island from White's Beach. Chert of many different colours is also found on the island, with an identified source on the hillslope to the south of White's Beach. Chert cobbles are also present in the intertidal zone on the beach.

The green obsidian is from Mayor Island, and the grey obsidian is most likely from Great Barrier Island and the Mercury Bay sources of either Hahei or Cooks Beach. Only XRF analysis would conclusively separate out the grey flakes, but the abundance vs rarity of spherulites suggest there are two sources represented.

The basalt is almost certainly from Tahanga at Opito. Flakes with cortex indicate some cobbles were brought to the island, but the majority of adzes and chisels would have been roughly shaped near the source, and then transported to the island for shaping. There were no polished adze flakes.

Charcoal

Charcoal in the palaeosol and in the ovens was extracted for further analysis and identification. Samples of the dark coloured sand were removed and placed in a bucket. Water was then added and the slurry agitated. The charcoal which floated to the surface was scooped off in a fine mesh sieve and retained and dried for identification. A large sample was collected in order to give a clearer picture of the vegetation growing on the dune at the time of occupation and identification of wood used in oven fires. Identifications were carried out by Dr Rod Wallace, Anthropology Department, University of Auckland, and his report is presented as Appendix 4.

A range of shrub species, broadleaf trees and coniferous trees were identified (Table 3). All species within the palaeosol sample would have been growing on Great Mercury at the time the palaeosol was forming. Pohutukawa, coprosma, mahoe, lancewood, puriri and totara are present in the palaeosol sample. This sample has the only identification of totara and lancewood, and neither species is listed in the inventory of plant species growing on the island now (Wright 1976). Similarly pate, present in an oven and in the midden sample, is not recorded as growing there today, nor is matai or taraire. The sample collected from the palaeosol was small and the range of species present is therefore limited. The results should not be considered representative of the range of species growing on the undisturbed dunes.

The island's inhabitants would have foraged for suitable firewood, and possibly collected driftwood off the beach. The greatest number of species was from T10/944 #5 black lens where 13 were identified including a mix of trees and shrubs. This lens was within the palaeosol and may also include species growing on the dunes (e.g., mingimingi, ngaio). The most restricted number of species was from the oven T10/945 where only pohutukawa and ngaio were identified. Pohutukawa is the only species common to nearly all samples, followed by coprosma, ngaio and mahoe.

The results are typical of coastal environments that have disturbed vegetation, i.e., the tree species have been cleared to a large extent and shrubs predominate.

	T10/944					T10/945		
	#2 Oven	#3 Midden	#4 Oven	#4 Black layer	#5 Oven	#8 Oven upper	#8 Oven lower	#7 Palaeosol
Tutu (*Coriaria arborea*)		•	•		•			
Hebe (*Hebe* sp.)		•			•			
Mahoe (*Melicytus ramiflorus*)		•	•	•	•			•
Coprosma (*Coprosma* sp.)	•	•	•	•	•			•
Fivefinger (*Pseudopanax arboreus*)	•	•			•			
Pate (*Schifflera digitata*)		•			•			
Ngaio (*Myoporum laetum*)	•	•	•	•	•	•		
Akeake (*Dodonaea viscosa*)					•			
Mingimingi (*Cyathodes fasciculata*)					•			
Kanuka (*Kunzea ericoides*)					•			
Manuka (*Leptospermum scoparium*)	•		•	•				
Lancewood (*Pseudopanax crassifolius*)								•
Pohutukawa (*Metrosideros excelsa*)	•	•		•	•	•	•	•
Puriri (*Vitex lucens*)		•		•	•			•
Taraire (*Beilschmiedia tawa*)				•				
Kohekohe (*Dysoxylum spectabile*)			•	•				
Kauri (*Agathis australis*)	•							
Matai (*Prumnopitys taxifolia*)		•	•		•			
Totara (*Podocarpus totara*)								•

Table 3. Summary of shrub and tree species identified in each sample.

Radiocarbon age estimates

Three samples were submitted to the Radiocarbon Laboratory at University of Waikato. These were selected based on the availability of suitable material for dating. Tuatua shell was dated for the midden, and charcoal for oven #1 T10/944; and oven #8 T10/945. The charcoal was short-lived species such as tutu, hebe, mahoe and kanuka (#2); and ngaio and pohutukawa twigs (#8).

Radiocarbon dating cannot give a precise date of occupation, but can give a range of radiocarbon years within which the event being dated (i.e., when the shellfish or plant lived) is likely to have occurred. After calibration a range of calendar years is obtained. These results are presented at 95.4% probability levels. The

Sample	Material	Lab No.	Age estimate BP	cal. AD 95% confidence
T10/944 #2	Charcoal	Wk 25354	149 ± 30	1670–1740 (23.6%)
				1800–1960 (71.8%)
T10/944 #3	Tuatua shell	Wk 25355	807 ± 30	1420–1640 (95.4%)
T10/945 #8	Charcoal	Wk 25353	455 ± 30	1430–1510 (85.3%)
				1800–1960 (10.1%)

Table 4. Radiocarbon age estimations.

time interval does not mean that a site was occupied for that period of time; rather it means that the event being dated occurred sometime within that range of years. Where there are two ranges, the higher the probability means that there is a greater statistical chance of it occurring within that period.

The results (Table 4 and Appendix 5) indicate that there is overlap in the age estimates from T10/944 #3 and T10/945. The occupation evidence at both locations is sitting below the buried soil horizon and likely to have been laid down pre AD 1600, and possibly pre- AD 1500.

The age estimate for the hangi at T10/944 #2 has no overlap with the range of calendar years from the other two samples and therefore certainly not part of the same occupation at the midden approximately 20 m away. The hangi is dug into sand above the top of the buried soil horizon rather than below it. The soil horizon was however at approximately the same height from the top of the dunes as midden #3, and given that there are only two palaeosols, upper and lower, there is no doubt that the lower palaeosol in the two places is the same event. The top of the oven was 1.1 m below the top of the dune, and the midden 1.4 m. This suggests that there was a period of time after #3 was occupied when stable climatic conditions allowed for an organic stain to build up on the dunes.

Coastal stratigraphy on the east coast of the North and South Islands has been correlated through the presence of buried soils (McFadgen 1985). Soil build up represents a stable period in the climate when sand deposition was halted or minimal, coinciding with cooler conditions, more rain and less wind. The unstable periods when sand built up are possibly associated with warmer temperatures, increased storminess and an increased frequency of tropical cyclones. Maori occupation and burning of dune vegetation has also had an effect on stability of dune sand. The age of the lower palaeosol at White's Beach coincides with Tamatean soil, inferred by McFadgen (1985: 51) from radiocarbon dates to have begun forming around AD 1350–1450 and buried by sand by AD 1500–1600. The later end of the date range certainly fits with the Great Mercury evidence. The presence of Loisel's pumice, a sea-rafted pumice from a source outside New Zealand, under the palaeosol also supports interpretation of the layer as a palaeosol. Although Loisel's pumice has been deposited and redeposited, radiocarbon dates from other sites are generally around AD 1300 (McFadgen 1985). McFadgen's later buried soil, Ohuan, was buried by sand around AD 1800, which cannot be confirmed from this site as the upper palaeosol was not dated.

Discussion

The radiocarbon date for the midden is in keeping with the midden contents. The diet of Maori in the first few hundred years of settlement of New Zealand was more varied with shellfish, fish and sea mammals. Fur seals were plentiful around the New Zealand coast prior to Maori arrival. By around 500 years ago they were all gone from the northern coastline and bones of seals are rarely found in archaeological sites after that date (Smith 1989).

The small excavated sample has an impressive amount of other faunal material, stone flakes and tools. It appears that several activities were being carried out which required stone tools that were then discarded in the midden. Interestingly there were no bird bones but this may have been due to the small sample size.

The midden, although small, did display some internal differentiation. The southern side of the midden was predominantly tuatua shells and there were also more fish in the same area. The uneven distribution indicates that the midden is in situ and was not redeposited or shifted from one place to another although there was obviously oven rakeout included as some of the tuatua shells were burnt.

The black layer adjacent to the midden is build-up and staining of the sand associated with the occupation. The amount of charcoal, dark discolouration of the sand, and presence of oven stones, suggests that cooking ovens were nearby, and that small shelters and windbreaks may have also been present. The extent of occupation evidence, if contemporary, suggests that T10/944 was of reasonable size, although it might be expected that a limited range of activities were carried out on the coastal flat adjacent to the beach. It is unlikely, for instance, that houses would be placed there – instead they would have been in more sheltered locations perhaps behind the foredune (Figure 17).

The radiocarbon dates are unlikely to represent the earliest occupation evidence. There was occupation and activity on the mainland at Opito around the early to mid-1300s (Furey et al. 2008) and for various reasons it is likely that occupation here will be as early as that on the mainland. Tahanga basalt at Opito was the focus for so much activity on this part of the coastline and Great Mercury was well placed with its close proximity to the mainland and more importantly, the sheltered anchorage in Huruhi Harbour. During the 19th century boats regularly hove-to in the harbour for safety from big sea swells and winds, and Polynesian sailors would have also sought shelter to protect the big double-hulled canoes. Safe anchorages in large easterly swells, without hauling boats from the water, are rare on the Coromandel coast.

Of the 120 recorded archaeological sites on Great Mercury Island only one, T10/358, fits the description of an early East Polynesian site, i.e., relating to the earliest phase of the settlement of New Zealand by tropical Polynesian people. However, I am aware of at least one other site on the south coast (T10/378) which might also have been occupied towards the early end of the settlement phase. The deflated midden at Coralie Bay (T10/358) produced moa, bird, fish and sea mammal bone, fishhooks, stone flakes, drillpoints, sandstone files and a range of small bone items such as bird bone necklace beads, awls, a bone needle and a bird spear (information from site record). A radiocarbon date on unidentified charcoal gave an uncalibrated result of 410 ± 130 BP (Wk 0094) but unfortunately the high standard error means the date is not a reliable indicator of age of occupation. The site contents do suggest, however, that it is earlier than T10/944 and from the presence of moa bone might be considered to be pre AD 1400 (Holdaway and Jacomb 2000). The Mizen Collection of artefacts from the island held in Auckland Museum has a number of adzes which might be considered early styles.

17. The dune system at White's Beach with low sand platform being cut into by sea, and higher dune behind. T10/944 is approximately to the left of the red building. Coralie Bay to the right is on the eastern side of the island.

While the storm damage was undesirable, it has nonetheless given us an opportunity to record Maori occupation evidence on the seaward side of the foredune. It is not known how far back the sites extend, but coring through the sand to look for sand staining on a regular grid pattern would provide more information. The charcoal rich layers, flakes and shell midden suggest there is a more extensive occupation area to T10/944 than is visible. Shell midden is visible through the grass on the top of the foredune but this may have been deposited later.

After assessing the severity of the erosion on the island, Jim Dahm suggested the storm was a one-in-two-hundred year event. Radiocarbon age estimates from exposed Maori occupation evidence are 5–600 years old, and suggest the storm was at least a one-in-five-hundred year event. Archaeological sites of this age are now rare on the Coromandel Peninsula, with the majority having been destroyed by coastal subdivision, dune erosion and storm surge. In the past, the sand terrace and dunes between the occupation layers and the sea have protected the archaeological site, but now that sand buffer has been eroded away the site is vulnerable to even moderate storm surge and its chances of survival for the next 50 years, much less the next 500 years, are slim.

References

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Smith, I.W.G. 1989. Maori impact on the marine megafauna: pre-European distributions of New Zealand sea mammals. In D. Sutton (ed) *Saying So Doesn’t Make it So: Papers in Honour of B. Foss Leach*, 76–108. New Zealand Archaeological Association Monograph 17, Dunedin.

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Appendix 1 GPS grid references and site records

T10/944	
Northern end E2759627 N6506568, southern end E2759668 N6506506	
#1	E 2759627 N 6506568 ± 7.3 m
#2	E 2759641 N 6506559 ± 7.3 m
#3	E 2759648 N 6506540 ± 7.0 m
#4	E 2759662 N 6506514 ± 6.9 m
#5	E 2759668 N 6506506 ± 7.0 m
#6	E 2759750 N 6506356 ± 6.3 m (pumice)
T10/945	
#7	E 2759775 N 6506295 ± 7.9 m
#8	E 2759799 N 6506202 ± 7.2 m
T10/946	
	E 2759853 N 6506025 ± 8.4 m

Table 1.1. GPS grid references.

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS260)

NZMS 260 map number T10
NZMS 260 map name Coromandel
NZMS 260 map edition

NZAA METRIC SITE NUMBER T10/944
DATE VISITED 14/08/08
SITE TYPE Occupation
SITE NAME: MAORI
OTHER

Grid References Easting .2.7|5|9|6|2.7 Northing .6.5|0|6|5|6.8.

1. Aids to relocation of site *(attach a sketch map)* Hand held Garmin GPS ±7.3m
Great Mercury Island, White beach south of Stingray Point (Matakawau)
Site is in the dunes to the north of the wind sock.

2. State of site and possible future damage
Dunes cut back by storms, exposing midden

3. Description of site *(Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)*
Grid reference is for central part of exposure (midden)but cultural material actually extends from E2759627 N6506568 to E2759668 N6506506. The material exposed is within the palaeosol and under 1.3 m of more recent sand. There is a vertical face exposed as a result of recent storms so that the palaeosol, up to 400 mm thick, is 1.5 above high water level on the beach. Several metres of dunes have been washed away. Chert, basalt and obsidian flakes are present within the palaeosol. Also two hangi and a shell midden and general discolouration and charcoal staining of the palaeosol. The evidence is intermittent over this distance but it reflects material present under the dune surface, possibly all part of one site. Shell midden (shell, fishbone, sealbone, lithics) and charcoal taken for analysis under HP authority 2009/32.
Other sites exposed in the dunes are T10/945, 946

4. Owner M. Fay, D. Richwhite
Address

Tenant/Manager
Address

5. Nature of information *(hearsay, brief or extended visit, etc.)* visit

Photographs *(reference numbers and where they are held)* Yes, CFG Heritage

Aerial photographs *(reference numbers and clarity of site)*

6. Reported by L. Furey
Address CFG Heritage PO Box 10015
Dominion Rd, Auckland

Filekeeper
Date

7. Key words

8. New Zealand Register of Archaeological Sites *(for office use)*
NZHPT Site Field Code

Latitude S

Longitude E

| | |	Type of site	| | |	Present condition & future danger of destruction
| | |	Local environment today	| | |	Security code
| | |	Land classification	| | |	Local body

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS260)

NZMS 260 map number T10
NZMS 260 map name
NZMS 260 map edition

NZAA METRIC SITE NUMBER T10/945

DATE VISITED 15/08/08
SITE TYPE Occupation
SITE NAME: MAORI
OTHER

Grid References Easting .2.7|5|9|7|9.9 Northing .6.5|0|6|2|0.2.

1. Aids to relocation of site *(attach a sketch map)* Hand held GPS ± 7.2 m
Great Mercury Island, White Beach (west coast, central part of island)

2. State of site and possible future damage
Dunes cut back during recent storms exposing cultural material. Scarp is still vertical and dropping away but sand should build up again in front of site. Will remain vulnerable to erosion in storms.

3. Description of site *(Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)*
Charcoal staining apparent in palaeosol 1.3-1.4 m below top of dune surface. Layer extends for 20 m and includes a hangi and basalt flakes. There is a black charcoal layer 50 mm thick at the base of the 480 mm deep palaeosol. Black layer has fire cracked rocks in a shallow scoop depression. Over this is a sterile white layer 120 mm thick, with another black layer 100 mm thick on top. The top part of the palaeosol is 180 mm thick with charcoal flecks. Samples of charcoal were floated from the lower and upper hangi layers and also from the palaeosol surface.

4. Owner M. Fay & D. Richwhite
Address

Tenant/Manager
Address

5. Nature of information *(hearsay, brief or extended visit, etc.)* visit

Photographs *(reference numbers and where they are held)* Held CFG heritage

Aerial photographs *(reference numbers and clarity of site)*

6. Reported by L. Furey
Address

Filekeeper
Date

7. Key words

8. New Zealand Register of Archaeological Sites *(for office use)*
NZHPT Site Field Code

Latitude S

Longitude E

| | |	Type of site	| | |	Present condition & future danger of destruction
| | |	Local environment today	| | |	Security code
| | |	Land classification	| | |	Local body

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS260)

NZMS 260 map number T10
NZMS 260 map name
NZMS 260 map edition

NZAA METRIC SITE NUMBER T10/946

DATE VISITED 14/8/08
SITE TYPE Occupation
SITE NAME: MAORI
OTHER

Grid References Easting .2.7|5|9|8|5.0 Northing .6.5|0|6|1|6.7.

1. Aids to relocation of site *(attach a sketch map)* Hand held GPS ± 6.5 m
Great Mercury Island, White Beach. Beach on western side of island, in middle. Towards south end of beach between southernmost intermittent stream before rocks and the next stream to the north (there are 3 streams/springs present)

2. State of site and possible future damage
Dunes cut back to vertical scarp during recent storms.

3. Description of site *(Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)*
Basalt & chert flakes and dark stained area 2 m below the top of the dune, and 1 m above the beach level. Hangi at E2759853 N6506025. Dark layer up to 50 cm deep. Not sampled as slumping has occurred and no clear definition to the layer.

4. Owner M. Fay & D. Richwhite
Address

Tenant/Manager
Address

5. Nature of information *(hearsay, brief or extended visit, etc.)* visit

Photographs *(reference numbers and where they are held)* CFG Heritage

Aerial photographs *(reference numbers and clarity of site)*

6. Reported by L. Furey
Address

Filekeeper
Date

7. Key words

8. New Zealand Register of Archaeological Sites *(for office use)*
NZHPT Site Field Code

Latitude S

Longitude E

__|__|__|	Type of site	__|__|__|	Present condition & future danger of destruction
__|__|__|	Local environment today	__|__|__|	Security code
__|__|__|	Land classification	__|__|__|	Local body

Appendix 2 Mammal identifications

Analysis by Tiffany Lee-James and Associate Professor Ian Smith, Anthropology Department, University of Otago.

Context	Species	Element	Portion	Side	Notes
T10/944-2	cetacean sp	vertebra	frag*	axial	unfused
T10/944-2	mam sp.	unID	frag	unID	NISP=3
T10/944-3	dog	cranium	maxilla + canine x1 + premolar x1	left	
T10/944-3	dog	cranium	maxilla + molar x3	left	
T10/944-3	dog	cranium	premaxilla + incisors x3	right	
T10/944-3	dog	cranium	maxilla + palatal + molar x3 + premolar x2	right	
T10/944-3	dog	premolars x2	complete	unID	one double-root, one single-root.
T10/944-3	dog?	mandible?	frag + canine x1	unID	
T10/944-3B	fur seal	humerus	PS+MS+DS	left	female, adult
T10/944-3B	mam sp.	rib	frag	unID	
T10/944-3B	mam sp.	unID	frag	unID	NISP=2
T10/944-3C	fur seal	tibia	PS+MS	left	male, large subadult ca. 10 years?
T10/944-3C	fur seal	tibia	PE	left	male, large subadult ca. 10years?
T10/944-3C	fur seal or sea lion	vertebra cervical	incomplete*	axial	unfused (prob fur seal, no other sea lion)
T10/944-3C	furseal?	cranium	basioccipital frag	axial	
T10/944-3C	mam sp.	unID	frag	unID	NISP=6
T10/944-3D	fur seal	humerus	PS+MS+DS+D	right	female, adult
T10/944-3D	mam sp.	humerus	PE	unID	
T10/944-3D	mam sp.	long bone	end of	unID	
T10/944-3D	mam sp.	rib	S	unID	NISP=2
T10/944-3D	mam sp.	rib	frag	unID	NISP=3
T10/944-3D	mam sp.	unID	unfused epiphysis frag	unID	
T10/944-3D	mam sp.	unID	frag	unID	burnt, NISP=2
T10/944-3D	mam sp.	unID	frag	unID	NISP=13

Table 2.1. Mamaml bone identifications.

Appendix 3 Description of artefacts recovered from the midden, T10/944

Chisel roughout (basalt)

Length 80 mm, width near 'blade' 35 mm, width near 'poll' 28 mm, thickness 14 mm. Weight 58 g.

Flaked all over, no grinding. Bevel not formed. Poll unfinished. One side has been steepened by flaking to reduce the width of the chisel. The reverse side has some deep irregular flake terminations which may have made the chisel finishing difficult and a high point on the reverse side which couldn't be removed by flaking.

Chisel roughout, incomplete (basalt)

Length 81 mm, width 30 mm, thickness 29 mm. Weight 83 g. Triangular section, broken through the mid-body. Bevel formed by flaking.

Sandstone file (tip missing)

Length 47 mm, width 25 mm, thickness 19 mm. Weight 28 g. Cross-section rounded oval.

Sandstone file (tip only)

Length 16 mm, width 12 mm, thickness 8 mm. Weight 3 g. Unlikely to be part of the same file as described above.

Abrader (basalt)

Length 65 mm, width 29 mm, thickness 18 mm. Weight 45 g.

Poll end of broken adze roughout with 'rubbing' or small patches of smooth surface on three faces. No grinding marks so not used on stone or sandstone.

Obsidian flakes

11 flakes with total weight 173 g.

35 x 42 mm, 66 x 40, 51 x 44, 49 x 34 (use wear), 50 x 46 (use wear), 31 x 36, 30 x 19, 20 x 14, 21 x 12, 40 x 30, 14 x 10.

Petrified wood

34 x 18 mm.

Chert flakes

6 flakes. Total weight 371 g.

40 x 33 mm (red), 43 x 22, 83 x 69, 84 x 40 mm (all yellow-brown). 44 x 27, 31 x 31 (chalcedony).

Basalt flakes

35 flakes. Total weight 623 g.

Measurement of individual flakes in mm. 94 x 58, 90 x 40, 97 x 50, 57 x 32, 31 x 18, 28 x 20, 28 x 22, 25 x 26, 20 x 10, 14 x 10, 18 x 14, 77 x 50, 37 x 30, 39 x 32, 25 x 20, 40 x 26, 23, x 10, 35 x 19, 36 x 50, 68 x 50, 74 x 47, 47 x 38, 38 x 53, 45 x 37, 17 x 21, 20 x 13, 34 x 26, 39 x 17, 47 x 29, 36 x 25, 66 x 57, 12 x 10, 10 x 8, 11 x 10.

Appendix 4 Charcoal identification and ^{14}C sample selection

Introduction

Thirteen charcoal samples from two archaeological sites on Great Mercury Island were submitted for identification and C14 sample extraction. The results are given below.

Site T10/944
#2 – oven

Coprosma	5
Ngaio	9
Manuka	2
Fivefinger	1
Pohutukawa twig	1
Kauri	3

Comments – The 1st 5 spp provided a good sized dating sample.

#3 sample A

Tutu	1
Hebe	3
Mahoe	1
Kanuka	1
Fivefinger	3
Puriri	6
Pohutukawa	10

Comments – The 1st 4 spp provided a small (2–4 gm) dating sample.

#3 sample B

Coprosma	7
Tutu	1
Pate	1
Kanuka	1
Fivefinger	1
Puriri	11
Pohutukawa	15
Matai	1

Comments – The 1st 4 spp provided a small (2–4 gm) dating sample.

#3 sample C

Hebe	1
Coprosma	3
Ngaio	1
Mahoe	3
Kanuka	1
Puriri	9
Pohutukawa	16

#3 sample D

Ngaio	2
Kanuka	1
Puriri	5
Pohutukawa	12

#4 – black layer

Coprosma	2
Ngaio	18
Manuka	3
Mahoe	1
Pohutukawa twig	2
Puriri	1
Tarairi	9
Kohekohe	1

Comments – The 1st 5 spp provided a medium sized dating sample.

#4 – black layer beside oven

Tutu	1
Coprosma	4
Ngaio	7
Manuka	15
Mahoe	1
Kohekohe	1
Matai	9

Comments – The 1st 5 spp provided a small (3–5g m) dating sample.

#5 – black lens

Tutu	1
Hebe	1
Coprosma	3
Pate	3
Akeake	3
Mingimingi	3
Fivefinger	3
Ngaio	2
Kanuka	1
Mahoe	7
Pohutukawa twig	1
Pohutukawa	5

Puriri	3
Matai	2

Comments – The 1st 11 spp provided a small (c. 5 gm) dating sample.

Species	#2	#3	#4	#5	Plant type	Percentages Species	Types
Tutu		2	1	1		1.6	
Hebe		4		1		2	
Coprosma	5	10	6	3		9.5	
Fivefinger	1	4		3		3	
Pate		1		3	Shrubs and	1.6	51
Ngaio	9	3	25	2	small trees	15.5	
Manuka	2		18			8.3	
Akeake				3		1	
Mingimingi				3		1	
Mahoe		4	2	7		5	
Kanuka		4		1		2	
Pohutukawa	1	53	2	6		25	
Puriri		31	1	3	Broadleaf trees	14	43
Tarairi			9			3.5	
Kohekohe			3			1	
Matai		1	9	2	Conifers	4.75	6
Kauri	3					1	
Totals	21	117	76	38	252		100

Table 4.1. Great Mercury Island Charcoal Identification, T10/944.

Site T10/945
#8 Upper oven layer

Ngaio	20
Pohutukawa twigs	3

Comments – all good for C14 dating – a good sized dating sample.

#8 Lower oven layer

Pohutukawa	20

Comments – probably not suitable for C14 dating

#7 Palaeosol

Coprosma	1
Lancewood	1
Mahoe	1
Pohutukawa	8
Puriri	3
Totara	5

Comments – 98% by weight consists of the last 3 species. These are not suitable for dating but the first 3 spp. could be extracted to form an AMS sample.

General Comments on the assemblages

This is the standard coastal northern North Island pattern for landscapes from which forest had long been cleared. The assemblage is dominated by shrub and scrub species with pohutukawa and puriri being the only abundant tree species.

Appendix 5 Radiocarbon results

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email c14@waikato.ac.nz
Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk- 25353

Submitter	L. Furey
Submitter's Code	T10/945 - 8 upper hangi
Site & Location	T10/945 Great Mercury Island (White Beach) , New Zealand
Sample Material	Ngaio and pohutukawa twigs
Physical Pretreatment	Possible contaminants were removed. Washed in ultrasonic bath.
Chemical Pretreatment	Sample washed in hot 10% HCl, rinsed and treated with hot 1% NaOH. The NaOH insoluble fraction was treated with hot 10% HCl, filtered, rinsed and dried.

$\delta^{13}C$	-24.2 ± 0.2	‰
$D^{14}C$	-55.0 ± 3.5	‰
$F^{14}C\%$	94.5 ± 0.4	%

Result 455 ± 30 BP

Comments

27/4/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- F^{14} C% is also known as pMC (percent modern carbon).

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email c14@waikato.ac.nz
Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk- 25354

Submitter	L. Furey
Submitter's Code	T10/944 - 2
Site & Location	T10/944 Great Mercury Island (White Beach) , New Zealand
Sample Material	Ngaio, coprosma, manuka, five finger
Physical Pretreatment	Possible contaminants were removed. Washed in ultrasonic bath.
Chemical Pretreatment	Sample washed in hot 10% HCl, rinsed and treated with hot 1% NaOH. The NaOH insoluble fraction was treated with hot 10% HCl, filtered, rinsed and dried.

$\delta^{13}C$	-25.8 ± 0.2	‰
$D^{14}C$	-18.3 ± 3.7	‰
$F^{14}C\%$	98.2 ± 0.4	%
Result	**149 ± 30 BP**	

Comments

AG Hogg
27/4/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- F^{14} C% is also known as pMC (percent modern carbon).

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Report on Radiocarbon Age Determination for Wk- 25355

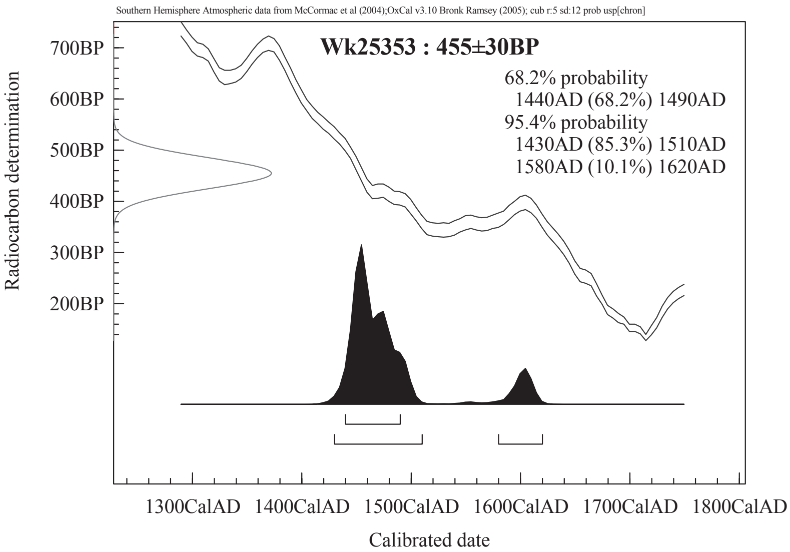
Submitter	L. Furey
Submitter's Code	T10/944 - 3
Site & Location	T10/944 Great Mercury Island (White Beach) , New Zealand
Sample Material	Tuatua shells
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 100 seconds, rinsed and dried.

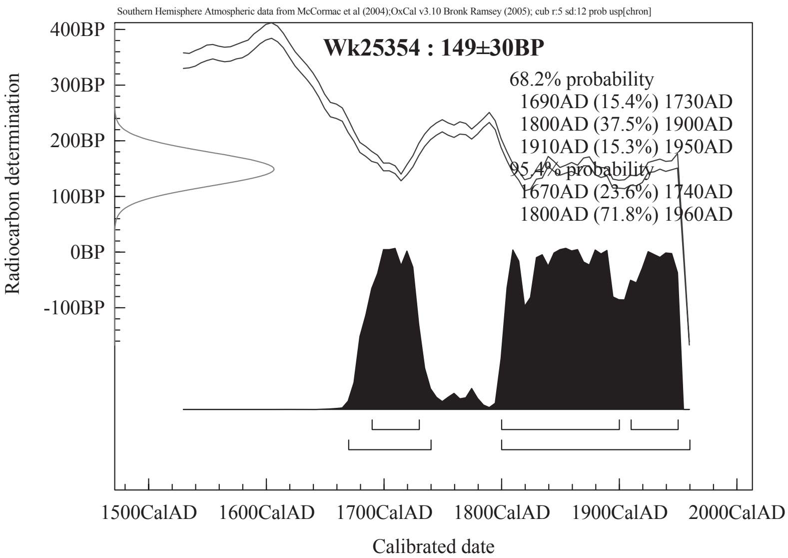
$\delta^{13}C$	1.5 ± 0.2	‰
$D^{14}C$	-95.6 ± 3.4	‰
$F^{14}C\%$	90.4 ± 0.3	%
Result	**807 ± 30 BP**	

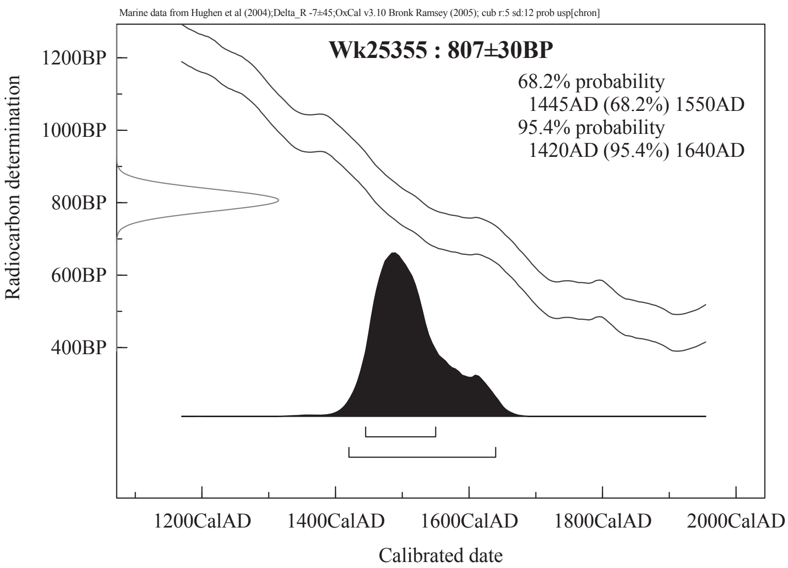
Comments

27/4/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- F^{14} C% is also known as pMC (percent modern carbon).


Southern Hemisphere Atmospheric data from McCormac et al (2004);OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]
Wk25353 : 455±30BP
68.2% probability
1440AD (68.2%) 1490AD
95.4% probability
1430AD (85.3%) 1510AD
1580AD (10.1%) 1620AD
700BP
600BP
500BP
400BP
300BP
200BP
Radiocarbon determination
1300CalAD 1400CalAD 1500CalAD 1600CalAD 1700CalAD 1800CalAD
Calibrated date


Southern Hemisphere Atmospheric data from McCormac et al (2004);OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]
Wk25354 : 149±30BP
68.2% probability
1690AD (15.4%) 1730AD
1800AD (37.5%) 1900AD
1910AD (15.3%) 1950AD
95.4% probability
1670AD (23.6%) 1740AD
1800AD (71.8%) 1960AD
400BP
300BP
200BP
100BP
0BP
-100BP
Radiocarbon determination
1500CalAD 1600CalAD 1700CalAD 1800CalAD 1900CalAD 2000CalAD
Calibrated date


Marine data from Hughen et al (2004);Delta_R -7±45;OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]
Wk25355 : 807±30BP
68.2% probability
1445AD (68.2%) 1550AD
95.4% probability
1420AD (95.4%) 1640AD
1200BP
1000BP
800BP
600BP
400BP
Radiocarbon determination
1200CalAD 1400CalAD 1600CalAD 1800CalAD 2000CalAD
Calibrated date