– ARTICLE –

Excavations at Cook's Cove, Tolaga Bay, New Zealand

Richard Walter,[1] Chris Jacomb[1] & Emma Brooks[1]

ABSTRACT

The Cook's Cove site (Z17/311) on the East Coast of the North Island of New Zealand is an unusual example of an archaeological site spanning close to the full duration of the New Zealand prehistoric sequence. In addition to a record of Polynesian activities, the site is also well known as the type site for the North Island Holocene stratigraphy. Recent excavations at Cook's Cove have resulted in a reinterpretation of the nature of Polynesian occupation and adaptation in this part of the North Island. The application of an 'event phase' interpretative approach provides the means for reconstructing a detailed history of environmental processes and their relationships to cultural activities over a period of 700 years.

Keywords: New Zealand, archaeology, Holocene, Cook's Cove, East Coast, moa

INTRODUCTION

Best known as one of the places where Captain James Cook came ashore in 1769, Cook's Cove is also the location of several archaeological sites including a fortified pa, isolated storage pits and a small undefended settlement. It is the latter site which is the subject of this paper.

The Cook's Cove site is one of a small number of sites located on the east coast of the North Island that contain evidence of occupation within the earliest known settlement phase of New Zealand. There are clusters of such sites to the north, on the Coromandel Peninsula, and another to the south in the Cook Strait region but between these places sites representing what Golson (1959) referred to as the 'Archaic Phase' of New Zealand prehistory are rare.

In their work at Orongo Bay, Gisborne, Green and Pullar (1960) were the first to recognise sites on the East Coast that contained stratified cultural layers in association with tephras and pumice lenses. Cook's Cove became the best known example of this class of site with the work of Wellman (1962). At Cook's Cove Wellman recorded Taupo Tephra, Loisels Pumice and (tentatively) Kaharoa Tephra in association with two cultural layers. Although sites with lenses or layers that fall within a single occupation phase are relatively common, stratified sites with multiple, superimposed occupation phases are rare in New Zealand.

The site, situated along the edge of a small estuary, has suffered considerably from the effects of wave action since being first recorded in 1958. To recover a representative sample of the remaining intact archaeological deposits a two-week excavation was carried out during November 2007. Here we present the results of the excavation and discuss them in the context of change in material culture and economy in the wider New Zealand environment. We also develop an event phase sequence that interprets the deposited strata in terms of a sequence of natural and cultural processes of variable duration.

SITE DESCRIPTION AND SETTING

Cook's Cove is a shallow, northeast facing inlet located south of Tolaga Bay on the east coast of the North Island (Figure 1). Lying between Tolaga Bay and Cook's Cove is a steep ridge of sandstone on which a pa site known as Te Kararoa is recorded as Z17/310 in the New Zealand Archaeological Association Site Recording Scheme (SRS). Te Kararoa is a ridge pa that contains numerous storage pits and terraces, as well as some ditches that cut across the ridge to supplement the strong natural defences. Cook's Cove is so named after the six-day visit of Captain Cook on HMS Endeavour in 1769. Seeking to replenish freshwater supplies, Cook's party had initially landed at Anaura Bay but heavy surf interfered with the loading and they were guided south to Cook's Cove. Here they met the local chief, probably Whakatatare-o-te-Rangi, whose pa was Te Kararoa (Oliver 2007). On board at the time was the Raiatean priest Tupaia, who accompanied Cook as interpreter. Tupaia engaged in various interactions with the people of the district (Salmond 2003) and is said to have rested and held discussions with chiefs and tohunga at a small cave or shelter in the sandstone cliffs on the north side of the estuary. This shelter is known as Tupaia's Cave and is the site of rock drawings and carvings, some of which are attributed to Tupaia himself (Polack 1838: 130).

1 Anthropology Department, University of Otago, PO Box 56, Dunedin, New Zealand

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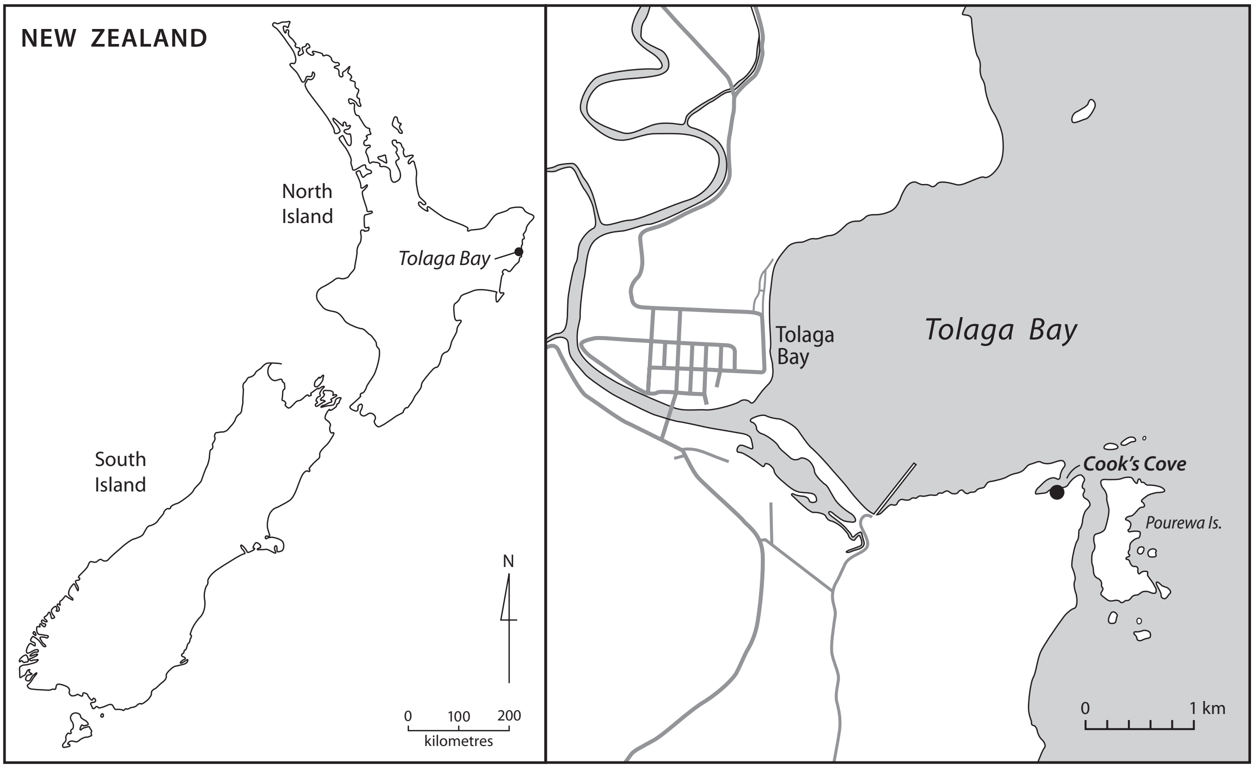

Figure 1. Map showing location of Cook's Cove.

Tupaia's Cave is now recorded in the SRS as Z17/315. The Endeavour scientists left a good account of the natural and cultural landscape at the time of their visit, for example, Hermann Dietrich Spöring sketched the landing place showing palisading running down slope from the pa and a waka on the beach close to the site (Figure 2) and both Banks and Cook reported extensive areas of Maori gardening (Duncan 1902). A sketch made in 1869

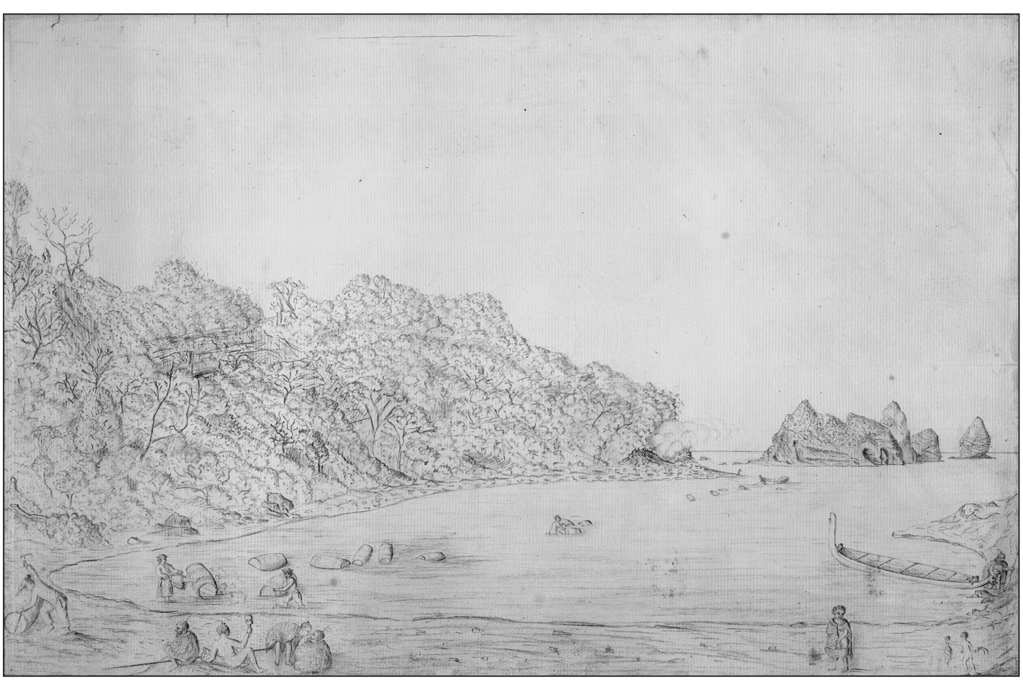

Figure 2. View of Cook's Cove by Herman Diedrich Spöring in 1769 (© The British Library Board Add. 23920, f.38).

by James Richmond, a century after Cook's visit, shows the hills clear of vegetation (Figure 3) and Maori activity still ongoing in the Cove but a photograph taken thirty years later shows the hills reverted to scrub with no more sign of Maori gardening (Figure 4).

The archaeological site z17/311, lies on a narrow beach terrace at the base of a steep hill slope on the east bank of the cove where it is exposed by wave action in the face of the beach terrace (Figure 5). The actual archaeological strata comprise only part of a section that runs for about

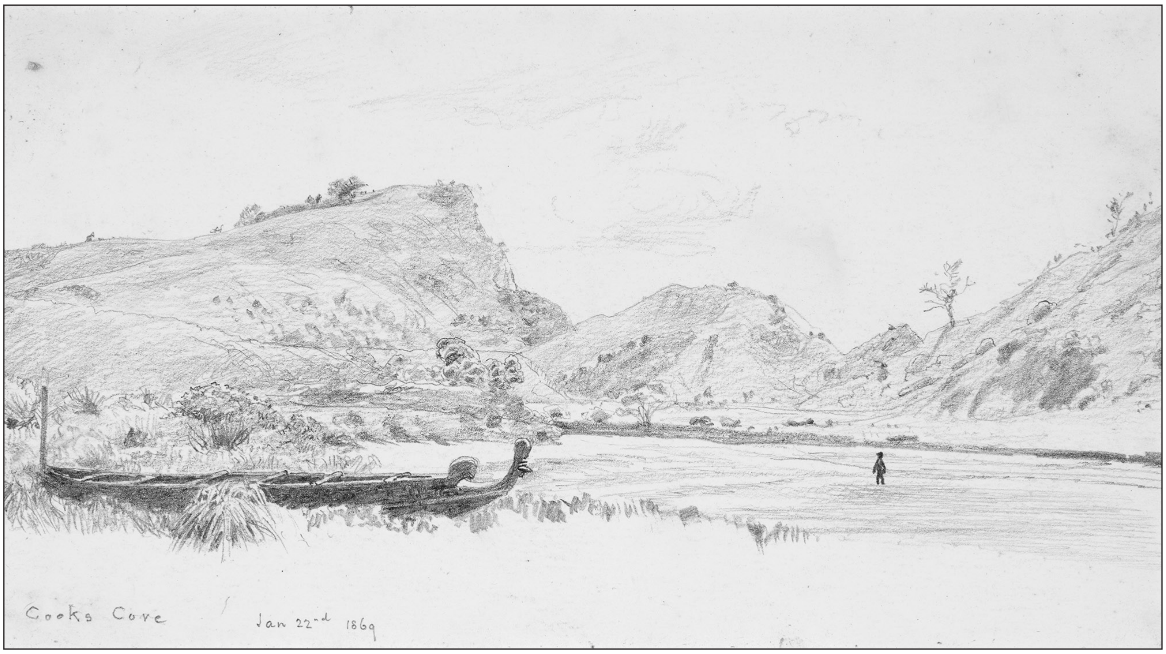

Figure 3. Sketch by James Richmond in 1869 showing lack of vegetation on the hills and Maori activity in the Cove (Courtesy Alexander Turnbull Library, Wellington, N.Z., Reference No. A-245-014).

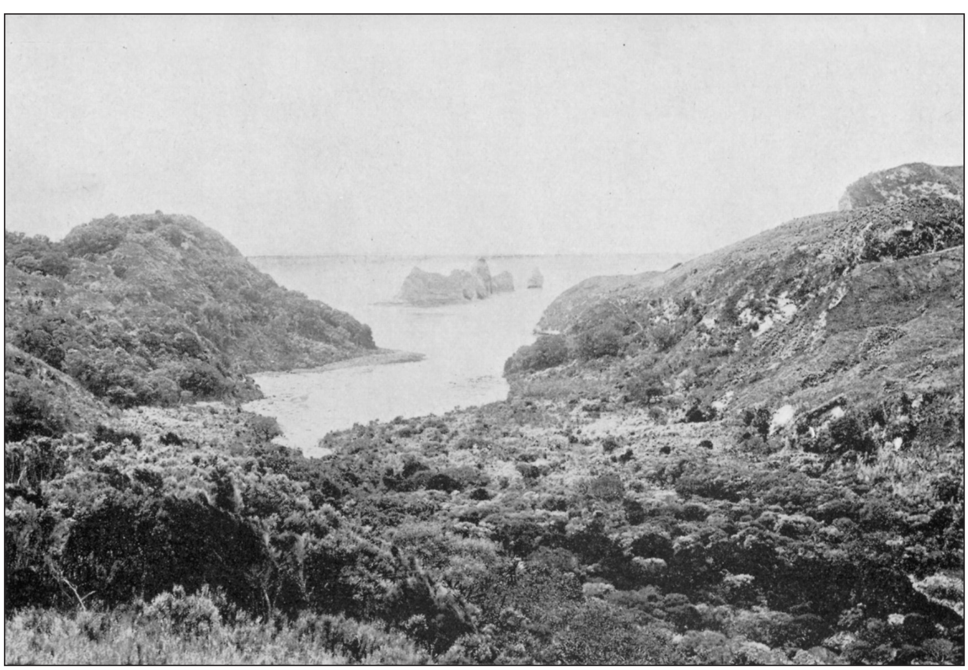

Figure 4. Photograph of Cook's Cove about 1900 showing extent of revegetation (Duncan, R, 1902, Transactions of the New Zealand Institute, Vol xxxv: Plate vii).

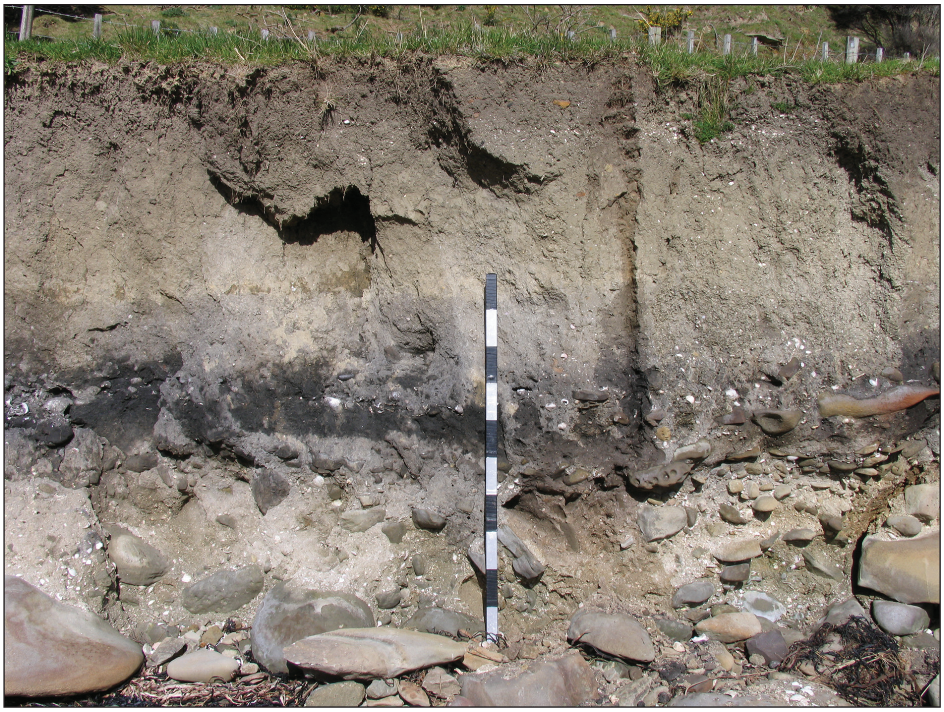

Figure 5. Face of bank exposed through marine action

200 m and was first described in Wellman's (1962) review of the Holocene stratigraphy of the North Island, based on fieldwork there in 1958. Wellman described the North Island Holocene stratigraphy, generally, as comprising six stratigraphic divisions based on volcanic deposits (tephras and sea-rafted pumices) and cultural events. He identified the Cook's Cove section as the best example of this sequence and designated it as the 'type locality' for the Holocene divisions (Wellman 1962: 36, 46). Wellman identified two major occupation layers separated by a shelly sand layer that appeared to have been wave deposited and probably attributable to a storm or tsunami event (Wellman 1962: fig. 7; reproduced here as Figure 6). Within this shell deposit Wellman noted a discontinuous tephra lens

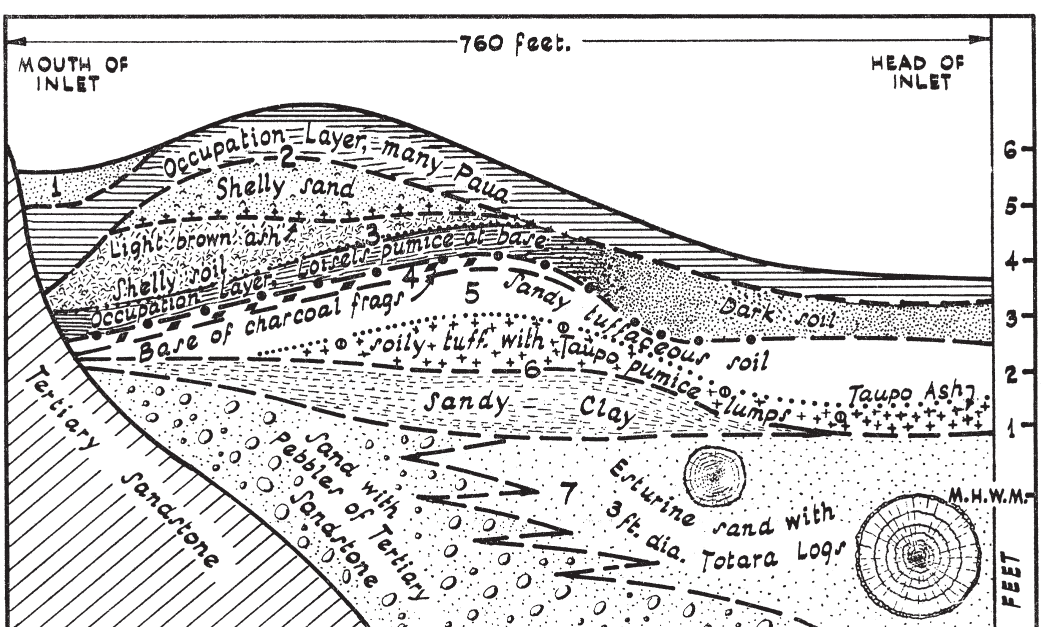

Figure 6. Wellman (1962) section. See Wellman (1962: fig 4) for description of the major stratigraphic divisions (1–7) marked in the drawing.

that he tentatively attributed to the Kaharoa eruption now dated to the early fourteenth century (Hogg *et al.* 2003). Loisels Pumice lay 'in its normal position – at the base of the lower occupation layer' and below this was a thin, discontinuous band of charcoal that Wellman appears to associate, here and elsewhere in the Holocene sections of the North Island, with human activity (1962: 35) despite lying below what he refers to as 'the lower occupation layer'.

Wellman's published profile and description of the cultural layers was influenced by then prevailing views of New Zealand archaeology. Since that time there have been few convincing examples of pre-Kaharoa archaeological strata (although see Furey *et al.* 2008), and there have been a number of revisions of the history of tephra and pumice deposition, along with refinements in their dating (Froggatt and Lowe 1990; Hogg *et al.* 2003; McFadgen 2007; McFadgen 1985; Pullar and Rijkse 1977; Sparks *et al.* 1995). McFadgen (1985: 51, fig. 23) also noted that the occupation layers identified by Wellman were former soils and commented on possible vegetation patterns on the basis of land snail evidence. One of the aims of the 2007 excavation was to re-evaluate Wellman's interpretation of the cultural layers and of their relation to geological strata.

An innovation in Wellman's work was his early use of radiocarbon dating. He collected five radiocarbon samples: one from below the Taupo Pumice, thus predating human occupation of New Zealand, and two samples each from the lower and upper occupation layers. Results are available from at least one sample (NZ 651) from his 1958 fieldwork, along with two samples from the lower occupation layer collected by Wellman in 1964 (Table 1) (see also McFadgen 2007; McFadgen 1982). The site was added to the SRS in 1983 at which time it was described as under threat from both wave action and fossicking (NZAA Site Record Form Z17/311).

The archaeological strata are only present near the northeast end of the wave-cut beach terrace where they are visible as two dark layers separated by a layer of well-mixed topsoil/subsoil. The lower layer extends southwest for about 40 m and is the darker of the two and equivalent to Wellman's (1962) 'lower occupation layer'. The upper layer extends for about 60 m and is equivalent to his 'upper occupation layer'. Visible in the eroding section and in lumps of eroded material lying on the beach are whole and fragmentary marine mollusc shell, bird and dog bone, flakes of chert and obsidian, fragments of charcoal, and numerous fire-cracked rocks. Closer inspection of the beach profile reveals sparse cultural material at various points in the section between the two main cultural layers. Although there are several patches of shell visible in the beach section further up the estuary, these showed no evidence of being of cultural origin and are therefore interpreted as being wave deposited.

RESEARCH AIMS

The current project was set up as a combined research and management initiative following a site visit by one of the authors (RW) in 2006 along with representatives of Te Aitanga a Hauiti and archaeologists from the Department of Conservation and the New Zealand Historic Places Trust. The southeast bank of the estuary showed evidence of heavy recent erosion with midden bone and artefacts scattered along the beach at the base of the bank. Indeed, Wellman noted on his radiocarbon sample submission documentation that there had been severe erosion between the time of his original visit (1958) and 1964 when he collected the samples (Rafter Laboratory Sample Notes). The risk of erosion and fossicking noted in the 1983 Site Record Form appeared to be accelerating and a salvage excavation designed to recover information prior to significant loss of site fabric was planned. The site also displayed attributes that signalled its potential to contribute usefully to ongoing archaeological research investigations. Two features of the site stood out in this regard and these underpinned the research design. The first was the opportunity to obtain a comparative sample of early material from an East Coast site to supplement recent work on early phase sites from elsewhere in the country (Furey 2002; Furey *et al.* 2008; Jacomb 2009; Jacomb *et al.* 2004; Jacomb *et al.* 2010.; Smith and Anderson 2008). The second was the unique opportunity to study a complex cultural and natural sequence spanning the full duration of New Zealand's prehistoric occupation. Our specific interest in Cook's Cove was to take advantage of the multi-layered stratigraphy to examine issues of change during

Table 1. *Radiocarbon dates from Wellman's investigations (Rafter Database).*

Lab. No.	Provenance	Material	CRA[1]	Calibrated Date	$\delta^{13}C$
NZ0631	'Sample in layer stratified above Loisel's pumice in the lower occupation layer.'	Charcoal (unspecified)	525 ± 44	1σ AD 1410–1450 (68.2%) 2σ AD 1390–1490 (95.4%)	–25.00
NZ0632	'Sample from the lower occupation layer, stratified above Loisel's pumice.'	Shell (unspecified)	1008 ± 60	1σ AD 1300–1420 (68.2%) 2σ AD 1240–1470 (95.4%)	1.22
NZ0651	'Wood from below Loisel's pumice. Sample in sandy silt with trees up to 2 ft, no standing trunks.'	Wood (unspecified)	1111 ± 41	1σ AD 1220–1330 (68.2%) 2σ AD 1160–1410 (95.4%)	–24.80

1. Conventional radiocarbon age after Stuiver and Polach (1977).

the first centuries of New Zealand prehistory. To address this, our research design had the following specific aims:

Stratigraphy. To develop a detailed description of the Cook's Cove stratigraphy with special reference to the nature and number of cultural phases and their relationship to natural processes such as tephra depositions and erosion events (as documented by Wellman 1962).

Dating. To recover and date samples from each stratum to provide absolute values for the stratigraphic profile.

Material culture. To recover material culture in dated stratigraphic contexts so as to investigate patterns of change throughout the sequence. There are many existing models of material culture change in New Zealand (Davidson 1984; Duff 1950; Golson 1959) but few are based on, or have been tested against, stratified and independently dated samples.

Subsistence. To develop a model of early East Coast subsistence practices and changes through time.

METHODS

Before excavation a grid was established on the site with the N-S axis aligned parallel to the existing fence line at 21.5 degrees E (very close to magnetic north). Four units were laid out for excavation at the northeast end of the beach terrace and aligned with the site grid (Figure 7). Units 1–3 were placed adjacent to the area where both cultural horizons were well exposed in the nearby bank and were excavated with the aim of recovering spatial information that might allow a functional interpretation of the layers. Unit 4 was excavated immediately inland of Unit 3 and ran east up the slope behind the beach terrace and was positioned to provide information on the history of site development including that of local erosion events.

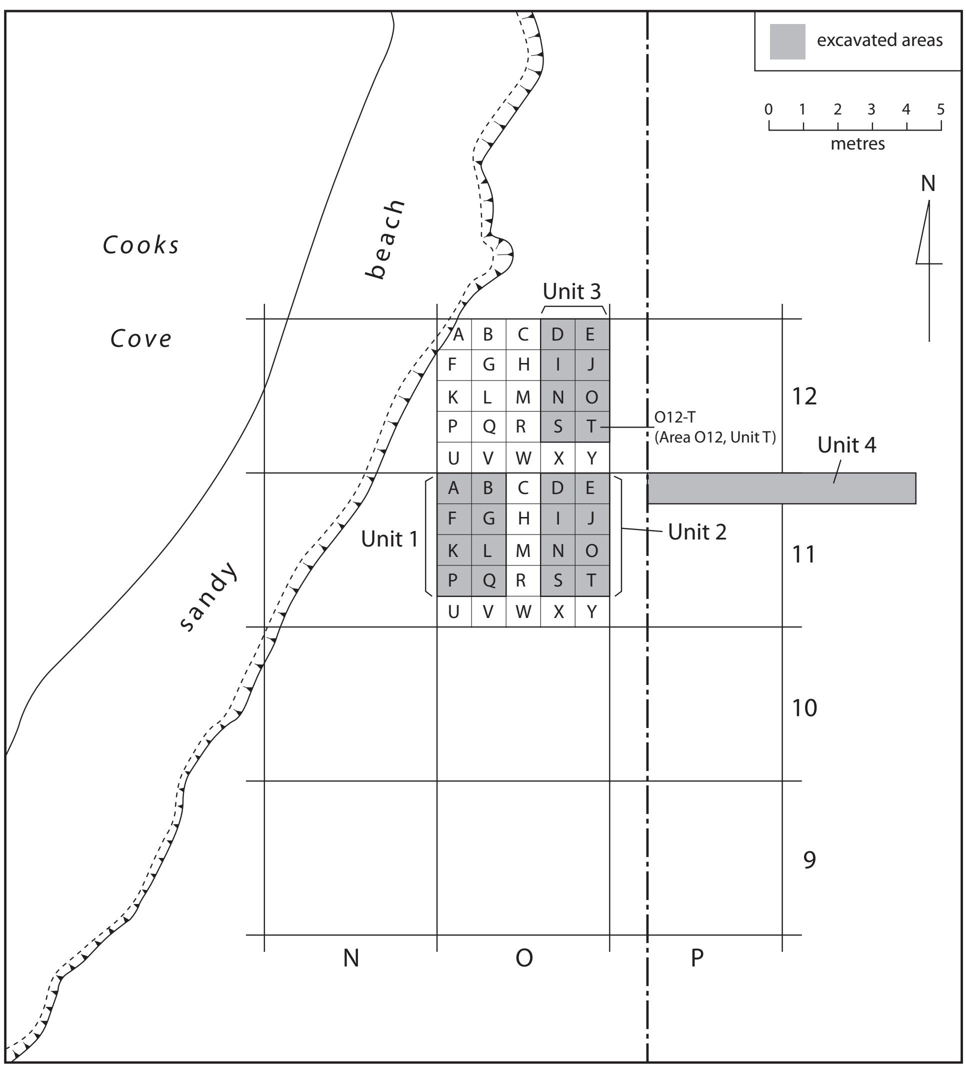

Figure 7. Location of the excavation units (arrow indicates magnetic north).

All excavation was carried out by hand and according to natural stratigraphic units subdivided as necessary into 50 mm arbitrary spits. Excavated material was wet sieved through 3.2 mm screens and all screen residue returned to the Otago Archaeology Laboratories (OAL) at the University of Otago for further analysis.

STRATIGRAPHY AND EXCAVATION UNITS

The stratigraphy was complex and varied in detail between excavation units. During excavation it proved difficult to define the interface between stratigraphic layers, many of which were uneven and discontinuous. A representative profile is described below in reference to the east section of Unit 1 (Figure 8) which contained the clearest example of the major cultural and natural strata encountered on the site. This section lay parallel to the beach face and is located close to where Wellman described the eroding section in 1958. Variations to the general profile are described in the discussion of individual excavation units and beach section below.

Layer 1. A yellow-brown clayey silt. This material appears to be made up of rapidly eroded sediments most likely caused by Cyclone Bola, which struck the East Cape region in March 1988.

Layer 2. A dark brown buried topsoil with no charcoal, shell or other culturally derived inclusions.

Layer 3. A dark brown-grey, mixed silty sediment that appears to be derived from slope-washed terrestrial sediments augmented by shell and charcoal fragments. Layer 3 is probably equivalent to Wellman's (1962) 'upper occupation layer'. Layer 3 comprises three poorly differentiated sub-layers that are distinguished by their relative quantities of shell as follows:

Layer 3a. This upper component of Layer 3 contained crushed shell and some charcoal fragments. Artefacts were found in this layer including two fish-hook points that were probably made from moa bone as well as worked bone fragments, stone flakes, several fragments of glass and metal, and a clay pipe stem.

Layer 3b. This middle component of Layer 3 contained no shell or artefacts.

Layer 3c. This lower component of Layer 3 was similar in appearance to Layer 3a. It contained only one stone flake.

Layer 4. Mixed dark-brown topsoil and yellow-grey subsoil with sparse inclusions of shell, charcoal and soft sandstone nodules. Layer 4 is deep, with no evidence of internal bedding or the development of an upper topsoil. It was laid down rapidly as a single wash or slump from upslope. Near the base of Layer 4 there is a discontinuous lens of light yellow-brown silt that is similar in appearance to Layer 1. This is eroded subsoil, and lumps of

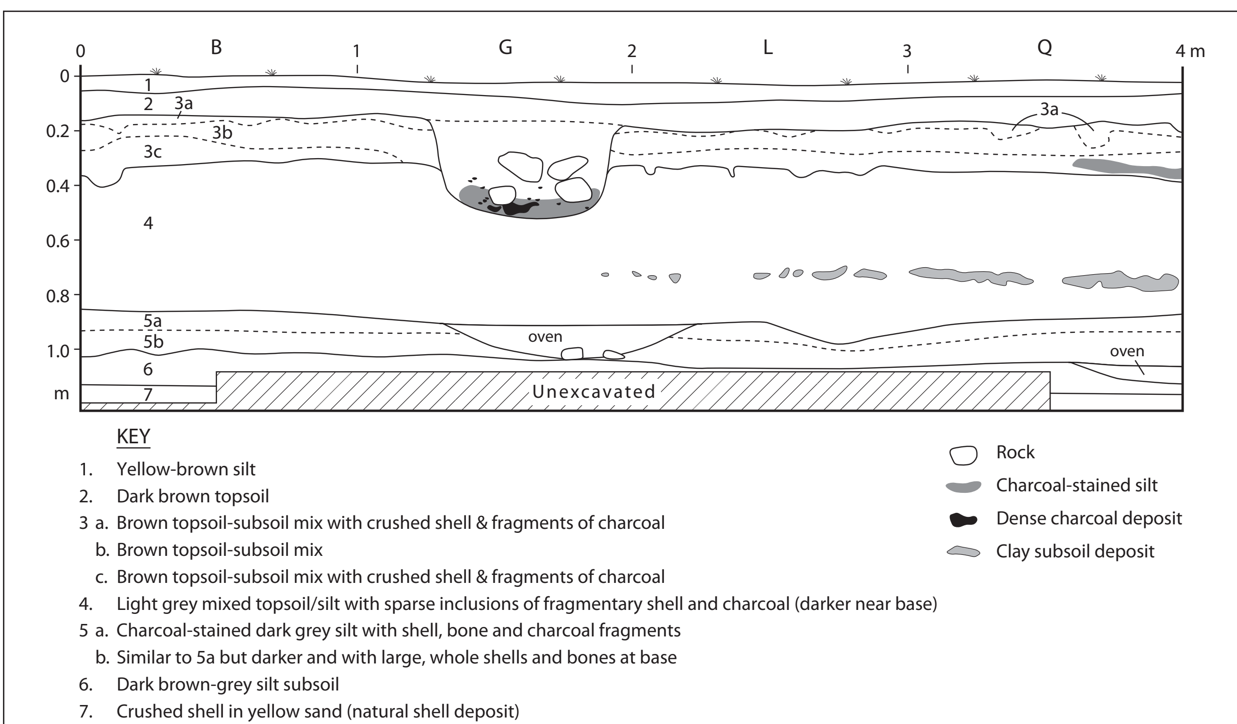

Figure 8. Section, east baulk of Unit 1.

similar material lie on the surface of the site where they were probably washed during the Cyclone Bola event. The interpretation of slope washing or slumping is consistent with the profile shown in the north baulk of Unit 4 (Figure 9). The base portion of Layer 4 was slightly darker than the upper portion although this may have been as a result of differential drying.

Layer 5. Dark grey to black silt. Layer 5 is equivalent to Wellman's (1962) 'lower occupation layer' and is made up of two sub-layers as follows:

Layer 5a. Dark grey charcoal-stained silt with charcoal fragments, artefacts and midden. Artefacts include two one-piece fish hook shank portions (moa bone), a one-piece fish hook point portion (shell) and a complete minnow lure point (moa bone).

Layer 5b. Dark grey to black charcoal-stained with charcoal fragments, artefacts and midden. This sub-layer is more compact than Layer 5a and contains a poorly defined but detectable living surface into which features had been excavated. Artefacts include two one-piece fish-hook shank portions (moa bone), a one-piece fish-hook point portion (moa bone), a complete one-piece fish hook (shell) and an unfinished one-piece fish hook (moa bone).

Layer 6. Brown silty buried topsoil.

Layer 7. Crushed shell in a coarse yellow sand matrix.

EXCAVATION UNITS 1–3

During excavation of Units 1 to 3 a number of historic artefacts were encountered in Layer 3a along with two moa bone fish hooks, a piece of worked bone, and a small quantity of midden fauna, predominantly bone. Layer 3b was recognised by the transition to a zone that contained little shell and Layer 3c was a lower zone containing a heavier concentration of crushed shell. Layers 3b and 3c contained no artefacts apart from a single stone flake in Layer 3c. The presence of moa bone artefacts, historic period material and 4000-year old shells, plus the lack of clear demarcation between sub-layers makes the interpretation of Layer 3 difficult (see below).

Layer 4 did not contain any artefacts or midden below the surface zone, other than occasional shell and bone fragments. A small number of fire-cracked rocks was recovered but this layer contained no features.

Layer 5a contained numerous small fragments of fire cracked rock, scattered midden and a small quantity of stone, bone and shell artefacts. Several possible post-hole and fire features were identified. The transition to the lower sub-layer was marked by a more compact matrix and the surface of Layer 5b is the only compacted occupation surface identified on the site (Figure 10). The northern Unit (Unit 3) contained the majority of the larger bone fragments and was associated with small-scale butchery. The front limb bones of a New Zealand fur seal (Arctocephalus forsteri) were found in the north half of the unit along with several obsidian flake tools. A number of moa

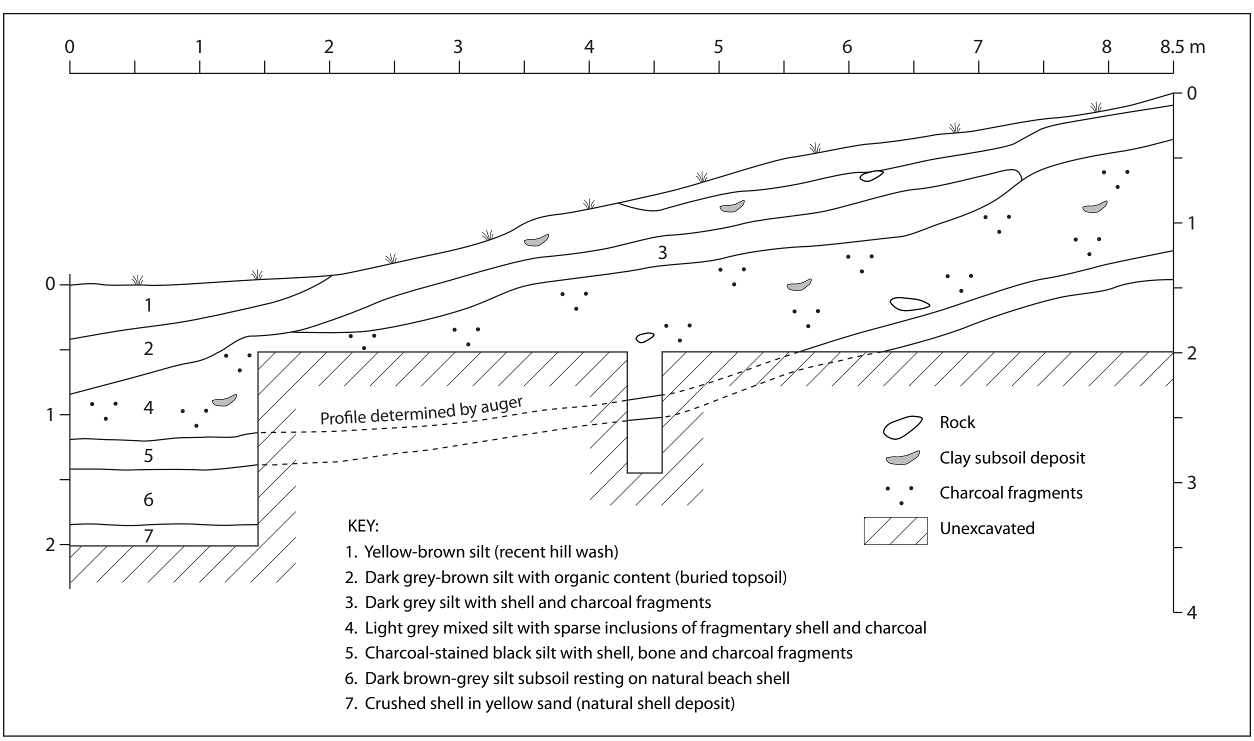

Figure 9. Section, north baulk of Unit 4.

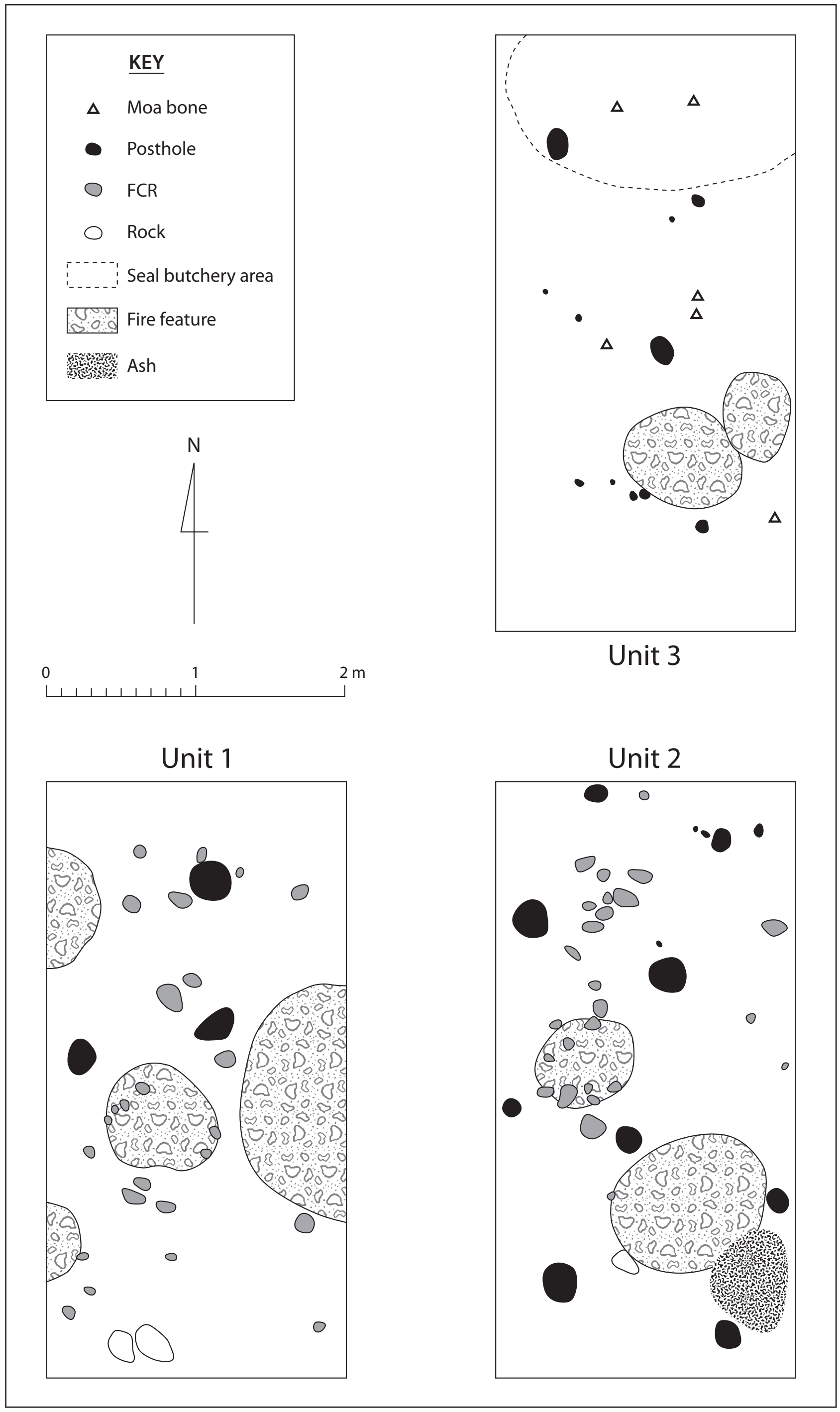

Figure 10. Plan drawing of Layer 5b showing features and distribution of moa bone.

bones, including phalanges, tarsometatarsus and a complete tibiotarsus, were recovered in the southern half of the unit in close proximity to two well-defined fire features that may have been used for cooking the moa and seal meat.

To the south, in Units 1 and 2, there was a concentration of fire features, ash, fire-cracked rock and several alignments of post holes. The impression gained is of a cooking zone that may have included one or more structures (Figure 10). The post holes appear to follow a general northeast-southwest alignment and it is possible that a structure enclosed the large fire feature in the southeast quadrant of Unit 2. The Layer 5b matrix contained a low density of flaked stone tools but no distinct flaking areas could be identified.

EXCAVATION UNIT 4

This unit was a long trench excavated up the slope in order to understand the stratigraphy and, in particular, to explain the Layer 4 material encountered in the Units 1–3 excavations. The south facing section of Unit 4 illustrated in Figure 9 shows the Layer 5 soils following a slope line that closely matches the modern profile. This indicates that the west – east profile across the beach terrace and hillside has not changed significantly since first settlement and that the Layer 5 occupation extended beyond the beach terrace onto the higher slopes above. Layer 4 overlies Layer 5 as far as the east end of the Unit and appears to have derived from much higher up the hillside. Its ultimate origin remains unclear but it is reasonable to assume that it is largely built from hill soils enriched during the first occupation (Layer 5) as a result of direct settlement on the hill slopes or perhaps by gardening. Above Layer 4 the Layer 3 material is not uniform in thickness which adds support to the view (see below) that the shell was brought in by Maori to enhance the quality of the local soils for gardening. There was little evidence in the trench excavations for significant occupation of the hill slopes behind the beach terrace following the first (Layer 5) occupation.

THE BEACH SECTION

A stratigraphic section is exposed along the face of the eroding beach terrace from the sandstone cliffs at the northeast for more than 200 m southwest into the head of the cove. For the first 60 m, between the cliffs and a small creek mouth, the upper cultural layer is exposed more or less continuously. Wellman's (1962) figure 7 is a composite profile of 230 m (760 feet) of the same section running from the cliffs at the head of the bay to a stream at the head of the inlet. In this profile Wellman noted natural bands of pumice and tephras along with the two occupation layers. Two of these volcanic events (Loisels Pumice and Taupo Tephra) were situated beneath his lower occupation layer (Layer 5 in our excavations). Wellman identified a band of Kaharoa Tephra between the two layers. In Figure 11 we illustrate the archaeological stratigraphy as we observed it in 2007 without commenting on the finer interpretations of the natural tephra and pumice lenses described by Wellman below Layer 5. Figure 12 relates the profile in Figure 11 to the beach section and excavation units. A fuller treatment of the sequence as it relates to Wellman's earlier profile and description of the Holocene record can be found in Horrocks *et al.* (n.d.). We do note, however, that nowhere in the stratigraphy could we find evidence of Kaharoa Tephra or any other tephra band lying above Layer 5. This is consistent with current dating models which place the Kaharoa eruption at 1314 ± 12 AD (Hogg *et al.* 2003), very close to the beginning of the New Zealand prehistoric sequence.

DATING

Samples were selected for radiocarbon dating and submitted to the Waikato Radiocarbon Dating Laboratory for analysis. Charcoal samples were identified to species by Dr Rod Wallace at the University of Auckland and subsamples of short-lived species selected for dating (Wallace 2008). The results of the radiocarbon analysis and calibration are shown in Table 2 and Figure 13.

Layer 5 comprises two occupation sub-phases which span the period from about AD 1320 to AD 1620 at 1σ. Layer 5b, the first occupation at Cook's Cove, is dated by two samples from our excavation; one on moa bone (WK-23490) and one on paua shell (*Haliotis iris*) (WK-23489).

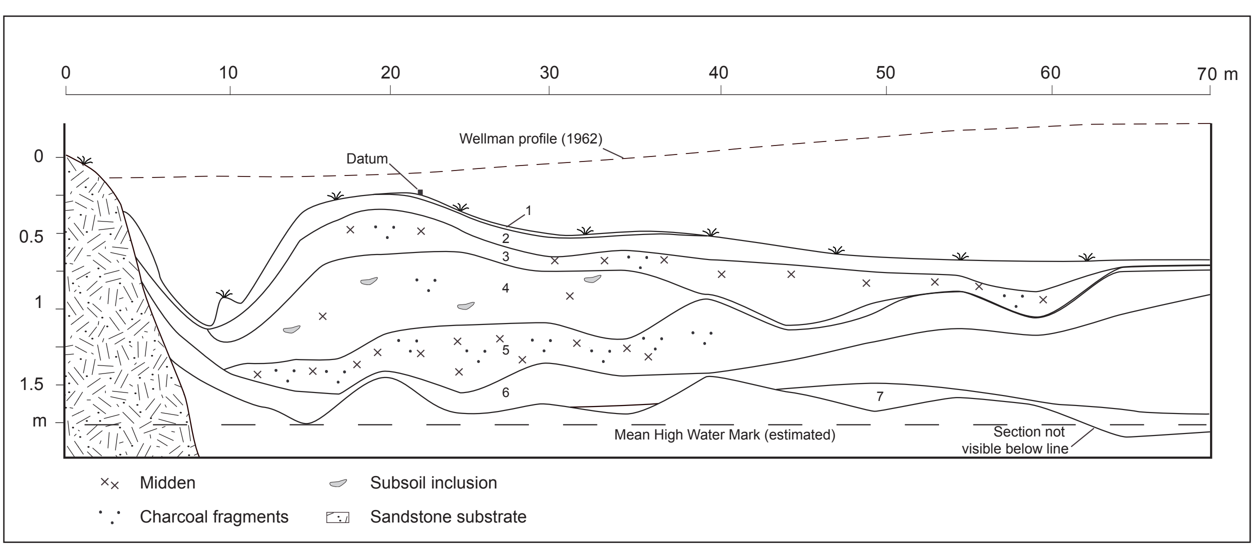

Figure 11. Profile of beach section (see Fig 12 for comparison)

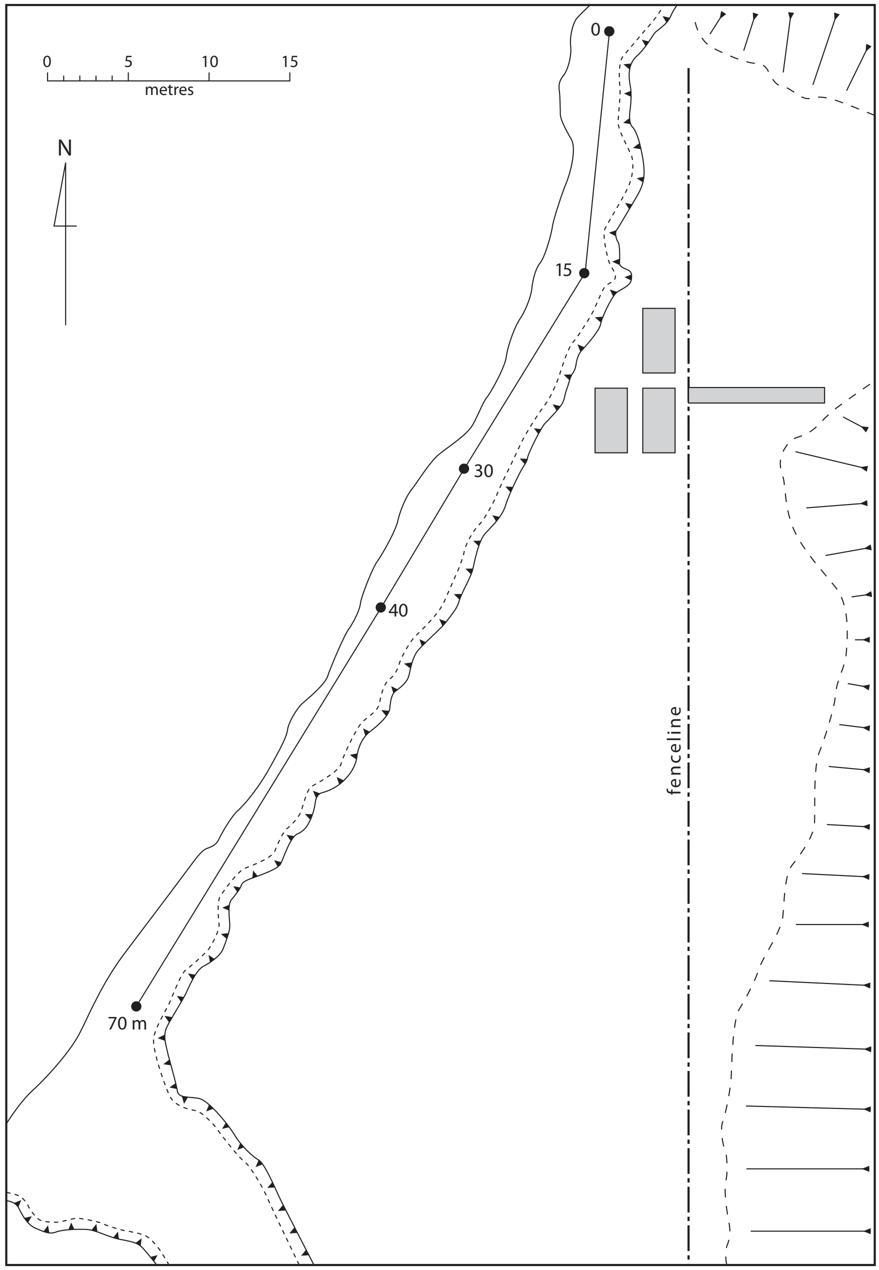

Figure 12. Beach section measurements for comparison with Figure 11.

These dates overlap at 1σ with an overlap range of AD 1391 – AD 1420. This range provides the best estimate for the age of Layer 5b on available evidence and it is consistent with current models indicating extinction of moa by the mid-fifteenth century (Holdaway and Jacomb 2000). WK-23489 overlaps with the two dates from Layer 5a (WK-24846 and WK-24847) but the delta-R value incorporated into the marine calibration of WK-23489 has introduced a spreading effect into the date range. The two dates WK-24846 and WK-24847 each show two peaks in the calibration chart (Figure 13). We consider the first, higher probability, peak to represent the correct date range for the Layer 5a occupation. This can be further checked by recalibrating the two samples as a combined date range (Table 3). As Table 3 shows the highest probability (77%) is that the range lies within the 60 year span commencing in the mid fifteenth century AD.

Layer 4, the hill-washed fill layer, did not contain any suitable dating material.

Layer 3 is dated with four samples. Two samples of marine shell (WK-23487 and WK-23488) were selected from the edges of a fire feature, and from within the matrix of Layer 3. These samples returned calibrated ages of more than 4000 BP with tight overlap and we consider that they

Table 2. *Radiocarbon dates from Cook's Cove. Southern Hemisphere Atmospheric data from McCormac* et al. *(2004); Marine data from Hughen* et al. *(2004); Delta R –7 ± 45; OxCal v4.10 (Bronk Ramsey 2009).*

Lab. No.	Provenance	Material	CRA[1]	Calibrated Date	$\delta^{13}C$
WK-24844	Layer 3, Feature 1	Charcoal	80 ± 35	1σ AD 1710–modern (68.2%) 2σ AD 1697–modern (95.4%)	–26.0 ± 0.2
WK-24845	Layer 3, Feature 1	Charcoal	137 ± 35	1σ AD 1700– modern (68.2%) 2σ AD 1680– modern (95.4%)	–26.1 ± 0.2
WK-23487	Layer 3b	Marine shell	4542 ± 40	1σ BC 2884–2726 (68.2%) 2σ BC 2937–2606 (95.4%)	0.7 ± 0.2
WK-23488	Layer 3, Feature 1	Marine shell	4254 ± 34	1σ BC 2496–2326 (68.2%) 2σ BC 2576–2239 (95.4%)	0.5 ± 0.2
WK-24846	Layer 5a	Charcoal	361 ± 35	1σ AD 1504–1627 (68.2%) 2σ AD 1478–1642 (95.4%)	–25.7 ± 0.2
WK-24847	Layer 5a	Charcoal	389 ± 36	1σ AD 1464–1622 (68.2%) 2σ AD 1459–1628 (95.4%)	–26.6 ± 0.2
WK-23489	Layer 5b	Marine shell	844 ± 33	1σ AD 1430–1517 (68.2%) 2σ AD 1391–1621 (95.4%)	2.6 ± 0.2
WK-23490	Layer 5b	Moa bone	624 ± 30	1σ AD 1321–1406 (68.2%) 2σ AD 1308–1420 (95.4%)	–22.5 ± 0.2

1. Conventional radiocarbon age after Stuiver and Polach (1977)

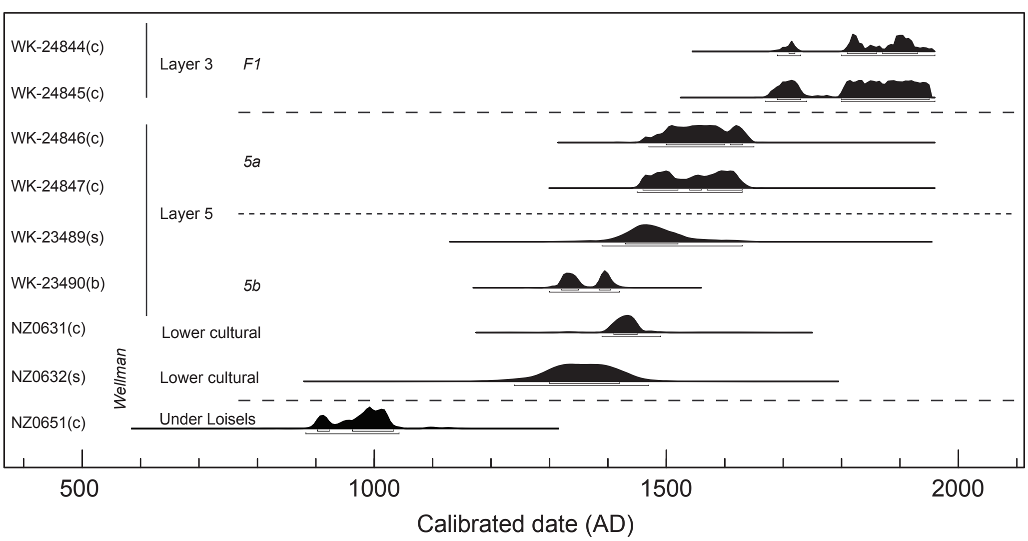

Figure 13. Calibrated radiocarbon dates from Cook's Cove (c=charcoal, s=marine shell, b=moa bone). Does not include WK-23487 and WK-23488.

give a good indication of the age of the shell matrix that makes up the bulk of Layer 3. It seems clear that the highly fragmented shell in Layer 3 was deposited by a storm surge, tsunami, or through deliberate human transport. We favour the third of these options as discussed below.

We submitted two further samples (WK-24844 and WK-24845) of charcoal from Feature 1. This oven or fire-scoop had been excavated into the top surface of Layer 3 and therefore these samples do not date the layer but simply show that the oven was dug some time between AD 1650 and AD 1950. The historical artefacts, fauna and botanical remains in the upper part of Layer 3 lead us to favour the middle of this range, some time after the contact period.

FAUNAL REMAINS

All excavated material was wet sieved through a 3.2 mm mesh on site and bulk material removed to the OAL in Dunedin for further analysis. In all 272 bags were labelled

Table 3. *Combined dates from Layer 5a. Southern Hemisphere Atmospheric data from McCormac* et al. *(2004); Calib 6.0.1.*

Sample	Pooled Mean Age	Calibrated Date Range at 1σ	Probability
WK-24846 & WK-24847 combined	1575 ± 25	AD 1455–1512	77%
		AD 1601–1616	22%

as containing faunal material. This was made up of 200 bags of bulk material collected from the screens plus 67 bags of bone and five bags of shell hand collected by the excavators.

On inspection the screened fraction appeared to comprise crushed shell, with a very small quantity of bird and fish bone and the occasional fragment of obsidian or chert. Because of the large quantity of material a 20 per cent sample from each layer was selected for final analysis. The bags each represented a single bucket of soil matrix and, since each layer was well mixed, each bag contained very nearly the same weight of material. The sample was made up of two bags from Layer 3 and 31 bags from Layer 5. The shell and bone collected and bagged during excavation represented the larger fragments of fauna and the total sample was analysed.

Midden arrived in the laboratory in clean condition and the bulk sample was rinsed, dried and sorted to primary faunal class; shell, bird, mammal, fish. The fauna was identified to the lowest possible taxonomic classification using the OAL reference specimens. Vertebrate fauna were quantified using the standard zooarchaeological methods of number of identified specimens (NISP), minimum number of elements (MNE) and minimum number of individuals (MNI) (Grayson 1984; Reitz and Wing 2008). These figures were calculated on a site-wide basis rather than within individual excavation areas.

Shellfish

The shellfish fraction tended to be highly fragmented and very few whole shells were recovered. Fragments were first sorted to the classes of bivalve and gastropod and then specimens containing unique quantifiable attributes were removed for identification. For gastropods this was the operculum, apex and basal keel and for bivalves the hinge section. All identifications were made using the New Zealand Marine Shell Reference Collection in the OAL and with reference to shellfish identification guidelines in Crowe (1999) and Powell (1946). The quantification units used were MNI (minimum number of individuals) and weight (Grayson 1984; Reitz and Wing 2008). No quantifiable shell fragments were recovered from Layer 3 and the results of the identifications from Layer 5 are shown in Table 4 as MNI, with the weight of unidentified fragments provided in Table 5.

Table 4. *Shellfish identifications (MNI) from Layer 5*

Taxon	Layer 5a	Layer 5b	Total
*Turbo smaragdus**	2023	805	2828
*Austrovenus stutchburyi**	491	1978	2469
Evechinus chloroticus	753	78	831
*Paphies australis**	96	206	302
*Sypharochiton pelliserpentis**	120	16	136
Turbinidae sp*	71	47	118
Veneridae sp*	–	102	102
*Paphies subtriangulata**	69	19	88
Zeacumantus lutulentus	21	55	76
Protothaca crassicosta	5	67	72
Macomona liliana	5	58	63
Melagraphia aethiops	55	2	57
Cookia sulcata	43	13	56
Patelloida corticata	18	28	46
Nerita atramentosa	18	19	37
Diloma nigerrima	25	12	37
Cellana radians	24	6	30
Trochidae sp	15	12	27
Haustrum haustorium	18	7	25
Ruditapes largillierti	19	2	21
Cellana ornata	9	1	10
Diloma bicanaliculata	6	–	6
Tugali elegans	3	3	6
Haliotis iris	5	1	6
Argobuccinum pustulosum tumidum	5	–	5
Nodilittorina antipodum	2	2	4
Austrofusus glans	1	1	2
Amalda australis	2	–	2
Cominella maculosa	2	–	2
Cominella glandiformis	2	–	2
Ostreidae sp	–	1	1
Crepidula monoxyla	1	–	1
Notoacmea pileopsis	–	1	1
Unidentified to Taxon	485	62	547
Grand Total	**4412**	**3604**	**8016**

* Shellfish categories represented at 2% or greater within the total assemblage

Layer 5 contained a wide range of species. A measure of assemblage diversity can be obtained using the Shannon-Weaver function (H') which assesses the heterogeneity of the sample, or the amount of uncertainty in predicting the species of a randomly selected individual from that sample (Reitz and Wing 2008: 105). Despite the relatively large number of taxonomic categories, Layers 5a

Table 5. *Weight of shellfish from Layer 3 and Layer 5*

Layer	Weight in grams
Layer 3	370
Layer 5a	14,053
Layer 5b	4,446
Grand Total	**18,869**

and 5b both showed low heterogeneity values. This reflects the fact that most of the taxonomic categories are represented at extremely low counts (Table 6). The related V' statistic measures the degree to which species are equally abundant in an assemblage, where values approaching 1.00 represent an even distribution of specimens across taxa. Both sub-layers give similar low measures for V' reflecting the dominance of a small number of taxa (Table 6). In fact only seven taxa (representing 90 per cent of the total count) have greater than 2 per cent representation in the assemblage. These are made up of 43 per cent rocky shore gastropods and 57 per cent bivalves which prefer a sandy shore or estuarine substrate. All of the gastropod species represented in the midden can be obtained within a few hundred metres of the site today but the bay has a muddy substrate that does not currently support a bivalve population. The nearest locations for obtaining tuatua (*Paphies subtriangulata*), pipi (*P. australis*) or cockle (*Austrovenus stutchburyi*) would be in Tolaga Bay or beaches further to the north. It is likely that the beach at Cook's Cove has been altered significantly through silting up and erosion since the fourteenth century and it is possible that some of these species were present nearby at the time of occupation.

Table 6. *Table of H' and V' statistics for shellfish*

Layer	Shannon-Weavers H'	Equitability measure V'
Layer 5a	1.66	0.49
Layer 5b	1.51	0.46

Bird

A total of 374 bird bones was identified which represents 3.7 per cent of the total vertebrate sample. Of these 253 were so fragmentary that it was not possible to identify the element or species. Thirteen species were confidently identified, along with one genus and one family. The majority of the bird is from Layer 5b (78.53 per cent of the bird bone assemblage). There is a broad range of species present in Layer 5b which suggests that no one species was the focus of exploitation. Of the sea birds, blue penguin (*Eudyptula minor*) and petrels (*Procellariiformes*) have the greatest NISP (6 and 14 respectively). In terms of the forest birds tui (*Prosthemadera novaeseelandiae*) kaka (*Nestor meridionalis septentrionalis*) have the highest NISP (6 and 4). The Layer 5a assemblage is considerably less diverse with only four bird species (blue penguin, kaka, tui, and yellow-crowned parakeet) identified. Two bird species were present in Layer 3 (spotted shag and chicken). A list of identified species is presented in Table 7 with NISP and MNI values.

Moa bone was present in Layers 5 and 3 but the majority was fragmentary. The presence of phalanges, including two distal phalanges, in the Layer 5b sample suggests that the carcass was not carried very far from the kill site.

Mammal

Mammal remains account for 9 per cent of the vertebrate sample with a NISP of 854. Of these over half (59 per cent) were too fragmentary to identify beyond class. The fragmentation meant that a further 27 per cent of the sample was not able to be assigned further than the category sea mammal (most likely fur seal or sea lion). The majority of these bones were fragmentary ribs, vertebrae, cranial or long bone fragments which lacked distinctive markers. Three fragments of probable cetacean were also recovered in Layer 5a.

Most of the mammal bone derives from Layer 5b (71.91 per cent) (Table 8). New Zealand fur seal (*Arctocephalus forsteri*) possessed the highest NISP of 31 but only an MNI of 1 followed by Polynesian rat (*Rattus exulans*) (NISP 8, MNI 3). New Zealand sea lion (*Phocarctus hookeri*) is represented by a NISP of 7 and an MNI of 1 while dog has a NISP of 6 and MNI of 1. Several pig bones were identified from Layer 3a.

Fish

Over 7500 fish bones were present in the sample. Many of these were small and fragmentary and it was only possible to confidently identify 536 specimens to element. The majority of the fish bone is from Layer 5 with only 50 bones from Layer 3. It has been standard practice in New Zealand archaeolog y to identify only the five major mouth bones (dentary, maxilla, premaxilla, quadrate and articular) and distinctive special bones (Leach 1997) but in this instance as many elements as possible were identified. This approach served to increase the identified NISP of several species although it did not alter MNI values significantly. The value of this method is that it gives a comprehensive picture of the structure of an assemblage which provides confidence when comparing assemblages between sites. The bones were then identified to the lowest taxon possible which resulted in the identification of eleven species and two families of bony fish. Cartilaginous fish are more difficult to identify to species but one spine has been attributed to stingray (*Dasyatis* sp.) and two vertebrae may be from spiny dogfish (*Squalus acanthus*).

Most of the fish bone is from Layer 5a. The fish species are dominated by wrasses (*Labridae*) and tarakihi (*Nema-*

Table 7. NISP and MNI of bird taxa from Layer 3 and Layer 5

Taxon		Layer 3		Layer 5a		Layer 5b	
		NISP	MNI	NISP	MNI	NISP	MNI
Black Backed Gull	*Larus dominicanus*	–	–	–	–	1	1
Blue Penguin	*Eudyptula minor*	–	–	1	1	8	2
Cf Chicken	*Gallus gallus*	1	–	–	–	–	–
Cf Sooty Shearwater	*Puffinus griseus*	–	–	–	–	1	1
Chicken		5	1	–	–	–	–
Kaka	*Nestor meridionalis septentrionalis*	–	–	1	1	4	2
Little Shag	*Phalacrocorax melanoleucos*	–	–	–	–	1	1
Spotted Shag	*Stictocarbo punctatus*	1	1	–	–	1	1
Diving Petrel	*Pelecanoides urinatrix*	–	–	–	–	5	1
Oystercatcher	*Haematopus unicolor*	–	–	–	–	1	1
NZ Pigeon	*Hemiphaga novaeseelandiae*	–	–	–	–	2	1
Mottled Petrel	*Pterodroma inexpectata*	–	–	–	–	3	1
Petrel	*Pterodroma* sp.	–	–	–	–	5	2
Tui	*Prosthemadera novaeseelandiae*	–	–	2	1	6	2
Weka	*Gallirallus australis*	–	–	–	–	4	1
Yellow-crowned Parakeet	*Cyanoramphus auriceps*	–	–	2	1	–	–
Perching Bird	Passerine	–	–	–	–	2	2
Procellariiforme		–	–	–	–	2	1
Unidentified		13	–	58	–	182	–
Moa		1	–	6	1	27	1
Total		**21**	**2**	**70**	**5**	**247**	**20**

Table 8. NISP and MNI of mammal taxa from Layer 3 and Layer 5

Taxon		Layer 3		Layer 5a		Layer 5b	
		NISP	MNI	NISP	MNI	NISP	MNI
Cetacean		–	–	1	–	–	–
Cf Dog		–	–	–	–	1	–
Cf Cetacean		2	1	–	–	–	–
Cf Fur Seal		1	–	–	–	9	–
Cf Rat		–	–	–	–	1	–
Cf Sea Lion		–	–	–	–	2	–
Cf Sea Mammal		1	–	1	–	–	–
Dog	*Canis familiaris*	2	1	4	–	6	1
Fur Seal	*Arctocephalus forsteri*	2	1	11	2	31	1
Pig	*Sus scrofa*	12	1	–	–	–	–
Rat	*Rattus exulans*	1	1	17	2	8	3
Sea lion	*Phocarctos hookeri*	–	–	–	–	7	1
Sea Mammal		34	–	–	–	194	–
Unidentified		49	–	96	–	345	–
Total		**104**	**5**	**130**	**4**	**604**	**6**

dactylus macropterus) both with a NISP of 132. Other species are present but occur in much lower numbers including red gurnard (*Cheilodonichthys kumu*) (NISP 17), red cod (*Pseudophycis bachus*) (NISP 11), greenbone (*Odax pullus*) (NISP 9), jack mackerel (*Carangidae*) (NISP 7), barracouta (*Thyrsites atun*) (NISP 6), and leatherjacket (*Parika scaber*) (NISP 5). In Layer 5b wrasses and tarakihi are also the dominant species but are present in much smaller numbers. Table 9 contains all of the identified species with NISP and MNI data.

Most of the fish species represented here are caught inshore in reasonably shallow water usually by baited hook. Greenbone feeds on kelp, however, and it is more likely that this species was caught by netting.

Reptile

Two left dentaries of tuatara (*Sphenodon punctatus*) were recovered from Layer 5b.

SOILS, POLLEN AND SPORES

Twenty-eight soil samples were collected by Mark Horrocks of Microfossil Research Ltd for plant microfossil identification, particularly the identification of pollen and starch remains. The samples reported here were collected from the east face of Units 2 and 4.

The identification of pollen from archaeological sites provides insight into vegetation history and the possible identification of human-introduced species such as bottle gourd (*Lagenaria siceraria*), paper mulberry (*Broussonetia papyrifera*) and European crops (Horrocks 2004; Horrocks *et al.* 2008b). Starch grains can provide direct evidence of Pacific root or corm crops such as sweet potato (*Ipomoea batatas*), taro (*Colocasia esculenta*) and yams (*Dioscorea* spp.), and European crops such as the white potato (*Solanum tuberosum*) (Horrocks *et al.* 2008b). The analysis also included the identification of raphides which are needle-like calcium oxalate crystals found in bundles

Table 9. *NISP and MNI of fish taxa from Layer 3 and Layer 5*

Taxon		Layer 3 NISP	Layer 3 MNI	Layer 5a NISP	Layer 5a MNI	Layer 5b NISP	Layer 5b MNI
Barracouta	*Thyrsites atun*	–	–	6	1	1	1
Blue cod	*Parapercis colias*	–	–	2	1	–	–
Blue Moki	*Latridopsis ciliaris*	–	–	2	1	4	1
Jack Mackerel	Carangidae	–	–	7	2	3	1
Cf Blue moki		–	–	–	–	1	1
Cf Carangidae		–	–	4	1	1	–
Cf Kahawai	*Arripis trutta*	–	–	–	–	3	1
Cf Labridae		–	–	1	1	–	–
Cf Red Gurnard	*Chelidonichthys kumu*	–	–	–	–	1	1
Cf Sea Perch	Serranidae	–	–	–	–	1	1
Cf Snapper		–	–	1	–	–	–
Cf Stingray	*Dasyatis* sp.	–	–	–	–	1	1
Cf Tarakihi	*Nemadactylus macropterus*	–	–	11	4	4	1
Conger Eel	*Conger verreauxi*	–	–	1	1	–	–
Shark/ray	Elasmobranchii	3	–	15	–	6	–
Greenbone	*Odax pullus*	–	–	9	3	2	2
Wrasses	Labridae	–	–	132	26	35	3
Leatherjacket	*Parika scaber*	–	–	5	2	4	2
Red Cod	*Pseudophycis bachus*	–	–	11	3	2	1
Red Gurnard		1	1	17	4	2	2
Sea Perch		–	–	1	1	2	1
Snapper		2	1	1	–	1	1
Spiny Dogfish	*Squalus acanthus*	–	–	–	–	2	–
Tarakihi		5	1	132	17	10	3
Unidentified		39	–	5516	–	1459	–
Total		**50**	**3**	**5874**	**68**	**1573**	**24**

in specialised cells in both the aerial and subterranean parts of many plants species (Torrence and Barton 2006). All laboratory methods for the preparation and analysis of specimens followed standard practices for microfossil identification and are described in detail in Horrocks (2008) and Horrocks *et al.* (n.d.).

Results

Pollen preservation was mostly poor, with many samples having insufficient grains for counting. At all sample points *Cyathea* and other ferns were abundant in the natural soils of Layers 6 and 7. Bracken (*Pteridium*) had high values from Layer 4 along with increasing quantities in Layer 2 of puha (*Sonchus* sp.) and dandelion (*Taraxacum* sp.). Also prevalent in Layer 2 were further exotic species including pine (*Pinus* sp.), broom (*Cytisus* sp), gorse (*Ulex* sp.) and various grasses. Two types of starch grain were identified in the Cook's Cove archaeological samples. One of these was consistent with *Ipomoea batatas* and the other with *Colocasia esculenta* although the tiny grains of the latter were extremely damaged and their identification as *Colocasia* could not be confirmed. The raphide data, however, lent support to the identification of *Colocasia* in the samples (Horrocks 2008: 4). The 'long-thin' and 'short-thick' raphide types identified in the Cook's Cove sample are especially abundant in corms and shoots of Colocasia esculenta (Loy *et al.* 1992; Sunell and Healy 1979). These, along with kumara starches were most abundant in Layer 5 but diminish into Layer 6 and throughout all layers the remains of kumara were more abundant than taro. The results of the plant microfossil analysis from Unit 4 are shown in Figure 14 and Figure 15.

Interpretation

Layer 5 shows evidence of human impact and the introduction of horticulture. This layer contains very little tall tree pollen and, while this is certainly due in part to differential preservation factors (Horrocks 2008: 4), bracken and hornwort spores were also present. The former is almost always associated with the burning of forest and the later is a coloniser of freshly exposed soils. This layer also contained the highest concentrations of kumara and taro starch. Raphides of kumara and taro are present in the natural sediments of Layer 6 and there are high bracken counts in Layers 6 and 7. This may indicate a human presence in the catchment prior to the events recorded in Layer 5b although Horrocks *et al.* (2008b) have demonstrated that, in these soils, downwards percolation of pollen and starch can occur through water transportation and it is not unexpected that these introduced species will appear below the level of first occupation. Nevertheless, the thin charcoal bands reported by Wellman (1962) below his 'Occupation One' are also consistent with an early presence somewhere in the catchment.

The presence of pollen from *Brassospora*, a *Nothofagus* species which became extinct in southern Australia and New Zealand about a million years ago (Mildenhall and Byrami 2004), is a signal of upslope soil disturbance and the incorporation of eroded material into soils at lower elevations. Such erosion is most notable in Layer 4 and might signal a prior expansion of swidden agriculture. Pollen of puha or dandelion throughout the profiles is also an indication of human activity within the wider landscape. In short, the microfossil record indicates early forest clearance and the introduction of horticulture concomitant with the first direct record of human presence in Layer 5b. Upslope clearance, perhaps for the expansion of swidden gardens, is reflected in the presence of extinct beech pollens and complements the stratigraphic evidence for rapid erosion events in Layer 4. The presence of bracken and puha throughout the sequence indicates a generally cleared landscape.

MATERIAL CULTURE

Fish hooks

Fish hooks were the most common artefacts found during the excavations at Cook's Cove. They included seven one-piece examples plus a tab fragment of an unfinished one-piece hook (Figure 16: a–g, k), a minnow-lure point of bone (Figure 16: h), and two points from two-piece composite fish hooks (Figure 16: i–j), again with what appears to be an unfinished preform (Figure 16: l) (Table 10). The numbers found are too small for meaningful statistical analysis, but even this small collection can be used to draw some inferences both about the site and about its place in the wider context of New Zealand prehistory. Although Cook's Cove is a North Island site, all of the fish hooks can be typed using Hjarno's (1967) classification of fish hooks from southern New Zealand. This uses a combination of morphological and, to a lesser extent, functional attributes to classify fish hooks into three broad categories: one-piece (Type D), two-piece (Type C) and lure hook points (Types A, B). These are further subdivided according to presence or absence of notches or serrations, the location of any barbs present, and the general shape of the hook. The numbers of each type found and their provenance within the site are as follows:

Two-piece barbed composite bait hook points. Two examples were found, both of which appear to be made of moa bone. One is a Hjarno Type C3a (two-piece point with inner barb) and one is a Type C3b (two-piece point with external barb). Both were found in Layer 3a.

One-piece fish hooks. A total of eight fragments of one-piece fish hooks were found in the site, counting the preform. Six were made of bone – probably moa bone – and two were of shell (*Cookia sulcata*). Although no complete

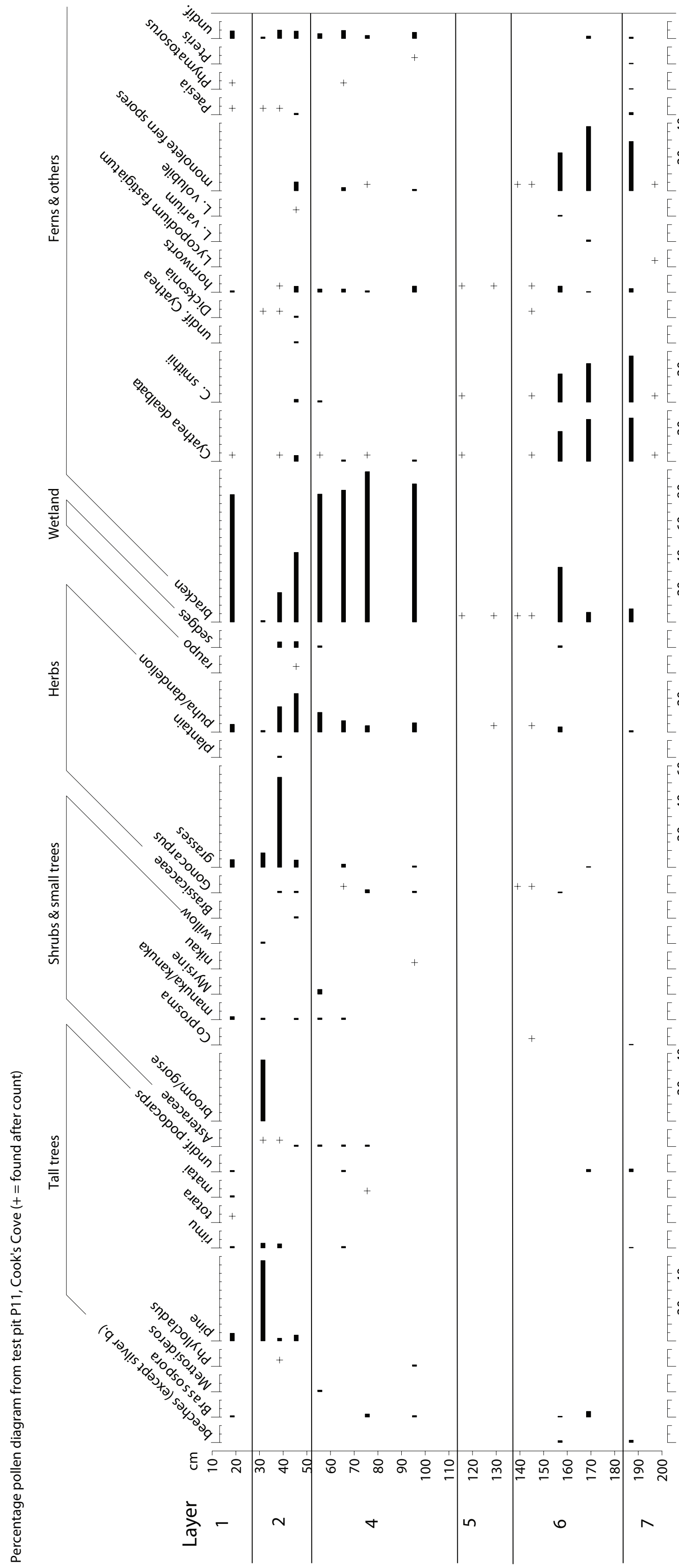

Figure 14. Pollen profiles from Unit 4 (from Horrocks 2008 Figure 1a).

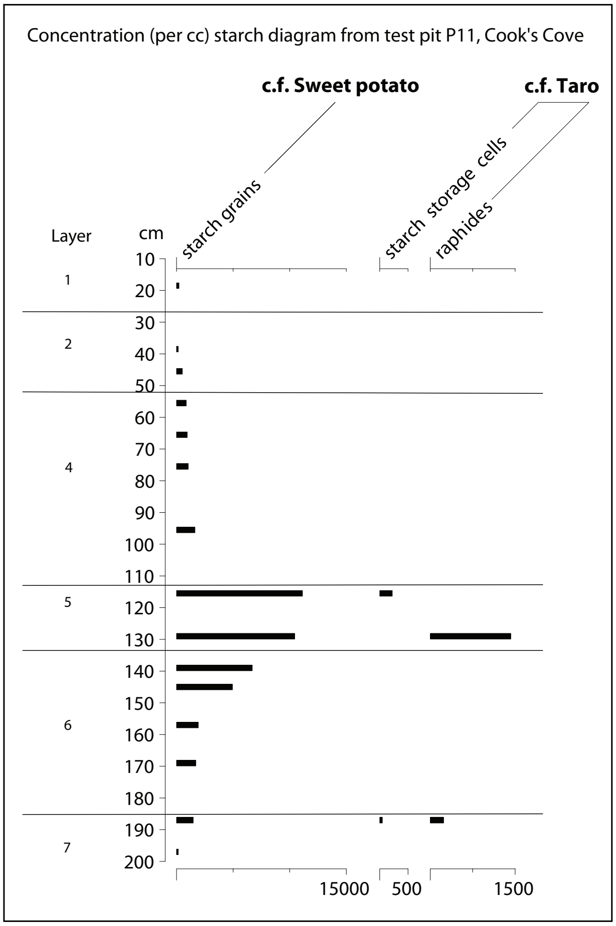

Figure 15. Starch and raphides from Unit 4 (from Horrocks 2008 Figure 2c).

examples were found, all appear to be Hjarno Type D1. All were found in Layer 5.

Minnow lure points. One example of this type was found, a bone Hjarno Type B1 (barbless, with very curved point and one or two perforations at base), in Layer 5, the lowest cultural layer.

Although there are no absolute dates for the hooks, the relative sequence is consistent with earlier models. The moa bone one-piece fish hooks from Layer 5 are in forms that Golson placed within his Archaic Phase assemblage while those from Layer 3 are recognised as belonging to, or at least having grown 'tremendously' in popularity during, his Classic Phase (Golson 1959: 62). The composite bait hooks are likely to be intrusive in Layer 3, which also contained historic material, but the fact that these were found in a separate context from the other fish hooks, all of which were of types firmly ascribed to Golson's Archaic, suggests that there was some passage of time before they were developed.

Table 10. *Fish hooks recovered from Cook's Cove*

Provenance	Type (Hjarno 1967)	Material	Figure 16 reference
O11-S-5-iv	D1	Moa bone?	a
O11-B-5-ii	D1	Moa bone?	b
O11-T-5-iv	D1	Moa bone?	c
O12-O-5-iii	D1	Moa bone?	d
O11-A-5-ii	D1	Moa bone?	e
O12-D-5-iv	D1	Shell	f
O11-P-5-ii	D1	Shell	g
O11-Q-5-i	B1	Bone	h
O11-G-3-ii	C3b	Moa bone?	i
O11-G-3-ii	C3b	Moa bone?	j
O11-S-5-iv	D1	Moa bone?	k
O11-G-3-ii	Type C preform?	Bone	l

Stone tools

In addition to the flake material found at the site (below) ten stone artefacts were found, all in Layer 5 (Figure 17). Included were three retouched flakes, two of chert and one of obsidian (Figure 17: Y a–c); two oval cobbles (Figure 17: Y d–e); and four files or abraders (Figure 17: Y f–i). The obsidian had an olive-green colouring in transmitted light which is usually taken to indicate an origin on Mayor Island in the Bay of Plenty (Moore 1988). The sources of the chert are unknown. The size of the three flake tools makes butchery of large animals such as moa or sea mammals a likely function. The oval sandstone cobbles appear to have been selected – and possibly shaped – for a specific purpose. Their function is not known, although they may have been used as line or net sinkers of some sort. The four files, also of sandstone, are of types often found in association with fish hook manufacturing evidence, for example at Wairau Bar (Duff 1950). Their presence at Cook's Cove is consistent with the evidence for manufacturing fish hooks described in the fish hook discussion, above.

Flake material

A total of 137 flakes of obsidian and chert were recovered from three stratigraphic units (Layers 3, 5a and 5b) (Table 11). All of the obsidian is olive-green in transmitted light, suggesting a Mayor Island source. So far, there has been only limited success in assigning archaeological chert specimens to geological source in New Zealand and the origin of the Cook's Cove specimens is uncertain. Obsidian was only found in Layer 5 and its absence in Layer 3 is unusual and assumed to be a sample size issue given that Mayor Island obsidian was in widespread use throughout this part of the North Island in late prehistory (Seelenfreund-Hirsch 1985; Walter *et al.* 2010).

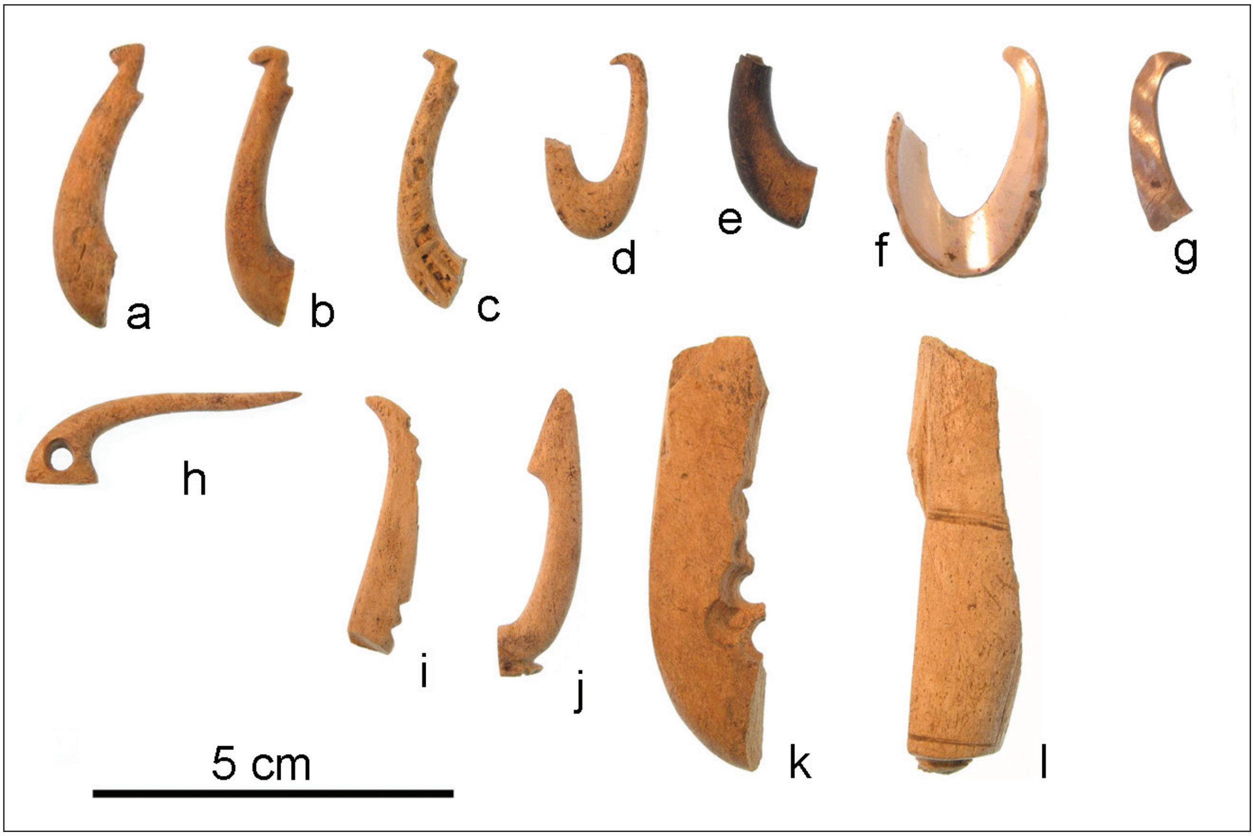

Figure 16. Fish hooks from Cook's Cove (a-e: 1-piece fish hooks, bone; f, g: 1-piece fish hooks, shell; h: minnow-lure point; i,j: composite 2-piece fish hook points, bone; k: i-piece fish hook preform, bone; l: possible preform of composite 2-piece fish hook point).

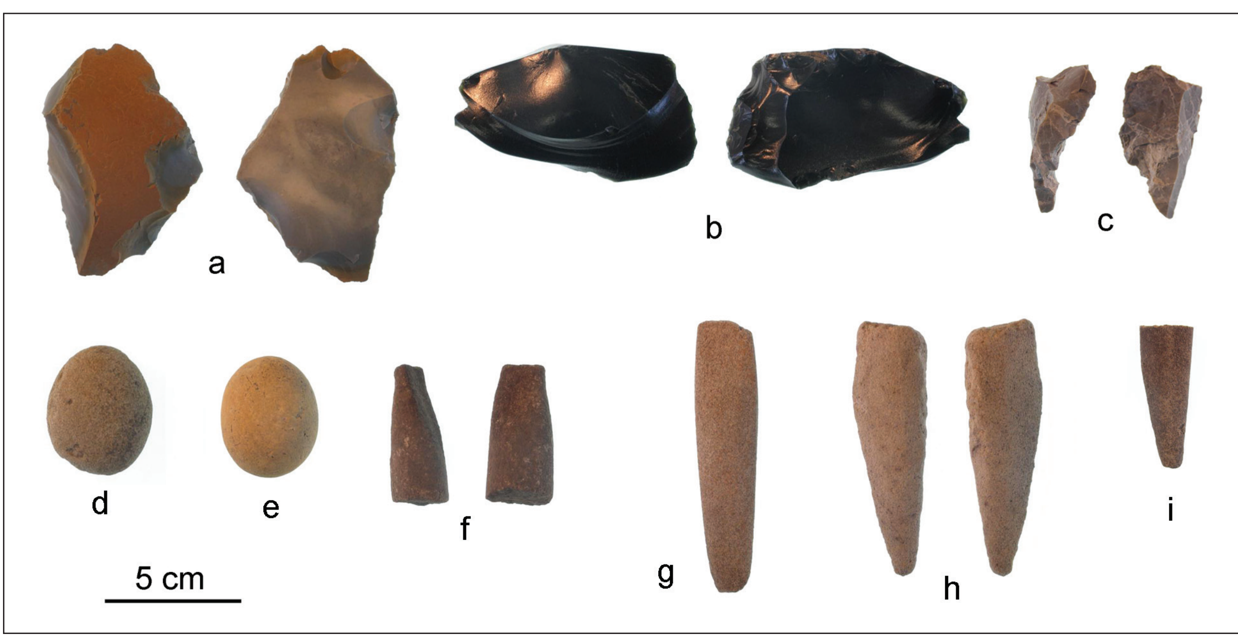

Figure 17. Stone artefacts from Cook's Cove (a. retouched flake, grey-green chert with brown cortex, O11-S-5-v; b. retouched flake, greenish obsidian, O11-N-5-v; c. retouched flake, grey chert, O12-I-5-iii; d. oval cobble, sandstone, O11-E-5-iii; e. Oval cobble, sandstone, O11-D-5-ii; f. file, sandstone, O11-J-5-iv; g. file, sandstone, O11-S-5-ii, h. file, sandstone, O11-S-5-iv; i. file, sandstone, O11-E-5-iv).

Table 11. *Quantity of flaked stone artefacts recovered from Layer 3 and Layer 5*

Layer	Chert	Obsidian	Sub-total
3	12	–	12
5a	49	38	87
5b	16	22	38
Total	**77**	**60**	**137**

The artefacts were sorted into primary artefact classes using a method based on Andrefsky (1998) that focuses on two variables: artefact type and condition of the edge. These two variables generate a total of six potential classes that relate to simple aspects of artefact function (Table 12 and Table 13).

As Table 13 shows, only 3 per cent of the chert artefacts and 6 per cent of the obsidian artefacts showed any evidence of having been used. This is an unusually low ratio. For example, at the late prehistoric pa site of Omaio, located in the Eastern Bay of Plenty, an identical analysis was carried out on the flaked obsidian from a similar sized assemblage ($n = 220$) (Walter *et al.* 2010). At Omaio 25 per cent of the material was recorded as displaying wear marks indicating use as tools. A possible explanation for the difference is that at Cook's Cove the assemblage may have largely derived from areas where obsidian was being flaked for tool production, rather than from places where the obsidian tools were being actually used.

The dimensions of the flakes (length, width, thickness and weight) were measured using standard methods outlined in Andrefsky (1998: 97–100; Appendix 1). No significant difference was noted in the size of chert flakes (as measured by length and weight) between Layers 5 and 3 such as might be expected if there was any change in access to sources between the early and later periods (for length, $t = -0.28$, $p = 0.781$; for weight $df = 22$, $t = -0.26$, $p = 0.795$, DF $= 22$). There is, however, a marked decline in the length of obsidian flakes between Layers 5b and 5a which might signal either differences through time in access, or changes in the function of the tools ($t = -2.67$, $p = 0.011$, $df = 36$). Unfortunately, the sample size is too small to draw any further conclusions.

Table 13. *Flaked stone tool assemblage showing number of tools with evidence of use across the three main tool classes*

Material	Edge	Core	Debitage	Flake
Chert	Unworked	3	47	23
	Worked	1	2	1
Obsidian	Unworked	1	21	30
	Worked			8
Total		**5**	**70**	**62**

DISCUSSION

Cook's Cove is a rare example of a site with a stratigraphy that spans the full duration of the New Zealand prehistoric sequence. The investigations at Cook's Cove were designed to take advantage of this to look at questions of change in material culture, subsistence and local use of the environment.

The Cook's Cove sequence

The first settlement of New Zealand occurred around the mid to late thirteenth century AD with the arrival of one or more voyaging canoes from tropical East Polynesia. These canoes bore colonists who possessed a material culture developed in the island homelands and a tropically adapted subsistence economy and lifestyle. Not much more than a century and a half after first landfall, major changes are visible in the archaeological record of New Zealand that herald the emergence of new patterns of life. These changes include the extinction of moa (Holdaway and Ja-

Table 12. *Variables and attributes used to sort the flaked stone.*

Variable	Attribute	Definition
Artefact type	Core	Object has been used as a source of flakes. It contains multiple flake scars as evidence of flake removal.
	Flake	Artefact was generated deliberately as the result of a single flaking event. Artefact contains striking platform and bulb of percussion. If the object is broken it may contain only part of these features.
	Debitage	Waste or by-product material generated during a flaking event. Debitage does not contain a bulb of percussion or striking platform, although some pieces may contain traces of these features as a result of an earlier flaking event.
Edge Condition	Worked	Object contains micro-scarring as a result of either deliberate edge modification or use wear.
	Unworked	No evidence or micro-scarring that would indicate that the object has been used.

comb 2000), the abandonment of parts of the South Island (Jacomb *et al.* 2010), the loss of certain artefact forms and adoption of others (Davidson 1984), the contraction of exchange networks (Walter *et al.* 2010) and the first construction of fortified villages (Davidson 1984; Schmidt 1996). Sites like Cook's Cove, which, as well as spanning the whole of the prehistoric period, also include more than one cultural horizon within the first few centuries of settlement in New Zealand, provide important information about what happened during this 'colonisation' phase.

The stratigraphic position of the fish hooks is consistent with expectations based on existing models for the developmental sequence of fishing technology in prehistoric New Zealand (e.g Golson 1959; Hjarno 1967). These see one-piece fish hooks and minnow lure points, of the varieties described here, as being typically early. Golson includes both types in his Archaic Phase, for example, and they are the overwhelmingly predominant fish hook types found at Wairau Bar (Duff 1950). The radiocarbon dates for Layer 5 place it firmly in the early part of the New Zealand sequence.

Similarly, these models see composite two-piece fish hooks as being a later development, and the most common types found in sites of the late prehistoric (Golson's 'Classic Phase'). Although it was not possible to obtain suitable material with which to date Layer 3, the source of the two two-piece points at Cook's Cove, it did not yield any early type hooks. The two that were found were typologically late. However, both were probably made of moa bone – a material that would have been relatively scarce within a century or so of the mid-fifteenth century extinction of the moa.

The first inhabitants of Cook's Cove utilised a broad range of faunal resources including moa, seal, dog, tuatara, marine and forest birds, and variety of fish and shellfish. Most of the large faunal resources seem to have been locally extirpated very quickly with a resulting shift to a diet more dependent on the local marine resources probably in association with horticultural crops. The loss of forest bird species would probably have occurred quickly through a combination of human and rat predation and forest clearance. This rapid loss of the megafauna and resulting shift from broad-spectrum resource exploitation to a more targeted utilisation of marine resources is well documented in other sites of the early period (Anderson 1983; Anderson *et al.* 1996; Jacomb *et al.* 2010; Smith 2005). The limited faunal information from the later settlement of the Cove means that inferences about subsistence practices are limited. The Layer 3 material contained a mix of crushed shell, a small amount of fish, bird and mammal bone, a fragment of moa, and pig and chicken which are both clearly historical in origin.

An event sequence

Drawing all the archaeological and historical data together it is possible to define a twelve-phase sequence for Cook's Cove based on various stratigraphic indicators calibrated, where possible, against radiocarbon determinations. In an event phase sequence the events listed are not all equivalent in scale, duration or stratigraphic status (See Anson *et al.* 2005). Some are natural events or processes, some are subtle stratigraphic indications of a brief human presence in the catchment zone, while others correspond to a period of sustained occupation leaving a strong stratigraphic signal.

Event 1. Pre-human development of natural soils and sediments (before AD 1300)

Before first human occupation the ground surface in the vicinity of the site was approximately 1–1.2 m below current levels and was part of a low platform above the beach. Sediments directly under the site consist of sandy silts with water rolled sandstone cobbles which probably formed a flat, exposed surface just beyond the high tide mark. Concentrations of shelly sand are present at this level indicating either an old beach or a storm-washed deposit. Along much of the modern exposed beach section Wellman (1962: 46) described a distinct band of Taupo Tephra separated from a second band of Loisels Pumice by a sandy tuffaceous material sitting above this layer. These are not clear at the northeast end of the bay where they have been exposed to wave action but it is possible that Layer 7 contains these tephras, mixed with crushed shell and some terrestrial sediment and sandstone cobbles, all laid over large boulders eroded from the tertiary sandstones that form the northern bluffs.

Event 2. Human arrival and clearance of forest (about AD 1300)

Finer sediments with a lower proportion of crushed shell comprise the top fraction of Layer 6 and are interpreted as the first phase of soil development above the beach materials. They contain spores of bracken, hornwort and Brassospora pollens, which are all indicators of soil disruption on the hill slopes, plus starches and raphides of taro and kumara (Horrocks *et al.* 2008a: 143). This is the first indirect evidence of human arrival in the bay and is interpreted as representing a phase of forest clearance on the hill slopes and valley floor.

Event 3. Establishment of first settlement at Cook's Cove site (early 1300s–?)

The first occupation of the Cook's Cove site occurred on the new soils that were building as a result of forest clearance (Layer 5b). It is unlikely that there was a significant temporal separation between the two events; indeed, they may have been coeval. During the first occupation event (in Layer 5b) the site was part of a residential zone which included cooking and butchering areas, with some associated structures. Horticulture was carried out nearby as indicated indirectly by the sedimentary record and directly by the presence of kumara and taro microfossils in Layer 5. In addition to horticulture, the first settlers had a small window of opportunity for terrestrial and strandline hunting. Moa species may only have been available in the Cook's Cove – Tolaga Bay catchments for the first decades following human settlement. At least one moa was killed in the vicinity and butchered on site. Seals, marine birds and a few forest bird species were also taken during this early period, then almost disappear from the record thereafter. The shellfish component of the diet included sandy shore varieties which, if taken in the local bay, are indicative of an inshore environment that was not yet subject to extensive siltation. The large stone flake tools found in the site were all from this occupation phase and were probably used to butcher moa and seal carcasses. Early style fish hooks (one-piece bait hooks and minnow lures) were used to catch a relatively wide range of fish, and one-piece fish hooks were being manufactured using stone drills and sandstone files. Some of the fish may have been caught using fine nets with relatively lightweight stone sinkers. Although much of the site has been lost to erosion it is likely that the settlement was small – perhaps comprising a few extended families.

Event 4. Change in economic practices (mid 1400s–1500)
Settlement continued at the same locale but subsistence practices changed. The midden shell of Layer 5a is statistically identical in terms of diversity and relative taxonomic abundance to that of Layer 5b. This may be partly due to mixing, but suggests little change in the marine environment, or predation practices during the Layer 5 occupation. On the other hand, moa and sea mammal remains are fewer in Layer 5a, and there are also very few bird bones and a restricted range of species. There is also an increase in fish remains. This suggests that hunting was a brief and unsustainable practice in the Cook's Cove catchment but that fishing and shell-fish gathering may have become more important. Horticulture continued and there may even have been an expansion of the swidden gardening onto the higher slopes as bracken fern (Pteridium) spores show a high count in the overlying Layer 4 sediments.

Event 5. Deposition of erosion sediments (early 1500s)
The Layer 4 deposition shows every sign of being a short-duration event, perhaps a single episode of slope wash following a storm or earthquake. The East Coast has '… extreme instability of slope soils, and corresponding rapid deposition of colluvial and alluvial soils' (Jones 1986: 11). Such depositional events are particularly associated with storms. Pullar and Penhale (1970) note evidence of 'catastrophic storm damage' around AD 1650 in the Tolaga Bay flats. One interpretation of the stratigraphy is that Event 5 is the local Cook's Cove expression of the storm events that caused rapid accumulation of hill soils in the adjacent valley to the north. However, the combined archaeological evidence shows that Layer 5 predated the Tolaga Bay storm by at least a century. The argument that the slip might have been triggered by an earthquake finds some support in McFadgen's (2007: 177) evidence for a major earthquake in the region around the middle of the fifteenth century. Whatever the cause, ground clearance for gardening would have made these slopes particularly prone to environmental triggers.

It is difficult on the basis of the radiocarbon dates to determine when this episode of erosion occurred, beyond the evidence that it happened some time between the bracketing dates of ~AD 1500 and ~AD 1700. We favour the view that the event occurred at the earlier end of this range for two reasons. First, there is no evidence for site abandonment as indicated by the formation of a topsoil at the top of Layer 5b such as we might expect if any significant time had elapsed between the two deposition phases. Second, two small two-piece fish-hook points apparently of moa bone were found in Layer 3. Fresh moa bone was not available after the mid-fifteenth century and it is unlikely that fossil bone would have been used for much longer than a century after this time. Nevertheless, it is worth considering the alternative.

Whatever the age of the slump, it deposited a deep load of mixed hill soils over the top of Layer 5 completely burying the occupation surface. The sudden deposition of slope soils was almost certainly triggered by a natural event, but the vulnerability of the slopes was exacerbated by forest clearance and Layer 4 represents the first sign of radical impact on the local landscape that resulted (probably) from Polynesian subsistence practices.

Event 6. Commencement of gardening phase – shell mulching (late 1500s to late 1600s)
Event 6 is marked by the addition of crushed shell onto Layer 4 to form the base of Layer 3. The shell has been dated to around 4000 BP and, lying between two cultural deposits, has clearly been displaced by some process. The question is: was the shell brought in by people as a garden mulch or by a storm surge or tsunami event? There is no unequivocal answer to this question, but the shelly components of Layer 3 (3a and 3c) are irregular in thickness and discontinuous. This suggests that they were not tsunami deposited. The matched dates of the shell samples are also consistent with their having derived from a subfossil shell deposit, rather than from a sea-floor deposit. Indeed, there is a natural, partly crushed shell bed (Layer 7) in the sediments beneath the natural sub-soil at the base of the site that may have been the source (Figure 8).

Event 6 signals the emergence of the open, dispersed, horticultural settlement pattern in the valley that was described by Cook and his colleagues, and illustrated in the pre-1900 drawings of the Cove (Figure 2) (See also Jones 1989; Jones 1983; Jones 1988; Jones and Law 1987). The pa site (Te Kararoa) was probably constructed at about this time.

Event 7. Abandonment of site (1600s–1700s)
The site was abandoned following Event 6. Occupation may have continued elsewhere in the Cove but did not leave any visible trace. Erosion soils accumulated during this phase.

Event 8. Shell mulching (1700s–1800s)
This event is represented by a second introduction of shell (Layer 3a) presumably for the purposes of mulching.

Event 9. Arrival of European influences (late 1700s–1800s)
Event 9 is represented in the well-mixed garden soils of Layer 3a by the appearance of historic artefacts and the presence of pollens of introduced weed and tree species in the soil matrix.

Event 10. Camp site (1800s)
A fire feature and some associated post holes in Layer 3a represents a short period of reoccupation at the site following Event 8. The living surface is poorly defined but it is possible that a small fishing or agricultural shelter was constructed and used for a season or so by people resident elsewhere in the Cove.

Event 11. Pastoralism(mid-1800s)
Not inferred from the archaeological record of the site itself, but known from the historical record, is a major reorganisation of settlement patterns and subsistence. This includes the gradual abandonment of the gardens and settlements in the bay and of the ridge pa of Te Kararoa, the reversion of the bay to scrub and then its clearance again in the early twentieth century for the introduction of pastoralism . At the northeast edge of the site is a stone chimney base and terrace that has the appearance of being constructed in the historic period.

Event 12. Cyclone Bola (1988)
The Cyclone Bola event of 1988 is probably represented in Layer 1. There has effectively been no soil build-up in the subsequent twenty years.

CONCLUSION

Cook's Cove is one of a very few examples of a deeply stratified archaeological site spanning the duration of the New Zealand sequence. In addition to its archaeological significance, the site has played a major role in defining the Holocene stratigraphic record through the work of Harold Wellman (1962). Wellman's work was innovative in that his interpretations were drawn from a consideration of both cultural and natural strata. One of the objectives of the recent excavations was to revisit the Wellman sequence in light of contemporary models of prehistory. For example, Wellman had his 'lower occupation' sandwiched between Loisels Pumice below, and what was tentatively identified as Kaharoa Tephra above. Kaharoa Tephra is now well dated to AD 1314 ± 12 (Hogg *et al.* 2003) but it is still debated as to whether any in-situ cultural deposits are securely sealed by the tephra. We were unable to locate any evidence for the Kaharoa Tephra in the Cook's Cove section, nor could we see any Loisels Pumice lumps 'up to 2 inches' in size (1962: 46, but see Horrocks *et al.* n.d. for identification of Loisels Tephra in the beach section). Wellman recorded two discrete cultural events which are equivalent to our Layers 3 and 5. At the time of Wellman's visit his 'upper occupation' (our Layer 3) is shown as extending the full length of his 230 m profile with 'many paua' while it is now only visible for a quarter of that distance and has effectively no paua. Similarly, his 'lower occupation' (our Layer 5) extended for about 150 m but is now only exposed for a quarter of that distance. It is interesting to note that Wellman did not describe Layer 4, the erosion event, which is prominent in the modern beach profile. Instead he described a 'shelly sand' overlying a 'shelly soil'. This suggests that the slump did not extend as far as the 1958 beach line. It was not possible to reconcile the current beach stratigraphy with that described by Wellman. It does not seem possible that that the differences between his record and our observations can be attributed purely to erosion, although it is clear that extensive erosion has taken place in the bay. The main source of the variation is almost certainly in the method of representation he used. He noted (Wellman 1962: 37) that most of his measured sections were 'recorded as "text sections" that generalize the stratigraphy from several points along a beach and express it in terms of the average or the best exposed vertical sections'. Once the erosion and the recording method are taken into account, it is clear that there is little point in attempting any reconciliation between the two records beyond what has been done here.

Where Wellman's prime focus was on understanding the geological sequence, our interest was in understanding the archaeological strata in terms of a sequence of natural and cultural events. One of our aims was to develop a strong radiocarbon-based chronology but we were unable to achieve this. The stratigraphy was complex and subtle and the radiocarbon samples did little to resolve it. To understand the stratigraphic record, we developed, instead, a relative chronology using an event-phase approach (Anson *et al.* 2005). In this multi-scalar method the conventional layers are disassembled into stratigraphic units that each represent an episode of human or environmental activity (see Sutton *et al.* 2003). These events are then compiled into a coherent succession using the basic logic of archaeological sequence construction (Harris 1979). The radiocarbon record defines an independent sequence which can be linked to the events at certain points, and at various levels of precision.

In an event-phase approach the events are not all equivalent in either scale or duration. An event may be based on a single observation such as the presence of a European artefact to signal an episode of culture contact. Or it could rely on a group of observations across a range of classes, such as a cluster of bones and artefacts that represent a butchering event. Some events reflect a low-density human presence somewhere in the catchment, others represent a specific activity that took place on the site within a tight time frame, while others correspond to sustained activity over several centuries (Anson *et al.* 2005: 25). One or more events may be contained within a single stratigraphic layer while others might span several layers. It is also possible, as in Layer 3, for events to be nested or to overlap one another. The resulting event-phase sequence is a model or hypothesis; testable and subject to modification as data improves.

The event-phase sequence we propose for the Cook's Cove catchment commenced in the fourteenth century with the establishment of a small community close to the beach. Land was cleared on the hills behind the site and the settlers exploited a narrow window of opportunity for big game hunting before turning to a reliance on fishing, shellfish gathering and horticulture. The presence of humans had an effect on local soils and vegetation, and signals of environmental change are present in the stratigraphic record from as early as Layer 6. Following a period of rapid sedimentation that may have contributed to the demise of the local shellfish beds, the lower slopes of the Cove were converted to horticultural land. The gardening phase spanned up to three centuries with several episodes of soil refurbishment occurring though shell mulching. By the late 1700s when Captain Cook visited, the Cove had become incorporated into a wider settlement pattern dominated by the hill pa, Te Kararoa. Some time in the early to mid 1800s Cook's Cove was abandoned as a permanent centre of Maori settlement although it remained integrated into the wider settlement patterns of the iwi of Tolaga Bay until the present day. Forest was regenerating by 1900 but it was cleared for pastoralism within the next few decades and the landscape today is still dominated by grasslands.

It was our intention that the work at Cook's Cove contribute to a wider agenda of addressing contemporary problems in New Zealand culture change stemming from recent revisions in the sequence. This refers to the 'short chronology' model that has developed over the last 15 years as a result of refinements to radiocarbon dating (Anderson 1991; Higham *et al.* 1999; Higham and Jones 2004). The most radical implication of this revision is that a distinctly Maori way of life must have emerged not after 600 years of gradual adaptation as classic models imply, but as a rapid cultural transformation within a century or so of landfall. In this context Golson's 'Archaic' is more of an event than a phase – perhaps an initial attempt to reproduce tropical Polynesian lifeways. Ironically the shortened sequence also highlights the limits of radiocarbon dating in New Zealand. Current methods simply cannot resolve change at the resolution required, especially given New Zealand's position in a particularly 'wiggly' portion of the radiocarbon curve. One way to address the problem of setting out models of change in the context of a shortened sequence is to turn to relative dating methods. The event-phase approach is an example of a relative chronological method - other techniques, such as seriation, rely on delineating typological and stylistic change in material culture. Sites such as Cook's Cove with rare sequences spanning the transition from first settlement to classic Maori society offer potential opportunities for developing and testing such methods and while the 2007 sample was small, the results suggest the value in reinvesting in material culture studies and refining relative dating approaches to New Zealand chronology.

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APPENDIX 1. *Measurements of stone flake material from Cook's Cove.*

Layer	Worked	Length (mm)	Width (mm)	Thickness (mm)	Weight (gm)
2	No	27.4	23.2	7.9	4.82
2	No	9.7	9.9	2.9	0.18
2	No	12.9	10.0	1.5	0.11
2	No	7.2	10.5	2.7	0.16
2	No	11.0	11.0	2.4	0.24
2	No	18.5	17.5	4.2	1.25
2	No	8.4	19.3	4.0	0.39
2	No	34.9	21.0	5.0	3.58
2	No	16.4	20.0	6.2	1.73
2	No	21.5	16.4	6.3	2.42
5a	No	15.4	19.9	3.4	0.76
5a	No	10.6	12.6	3.5	0.46
5a	No	17.8	17.1	2.4	0.42
5a	No	4.8	9.6	1.2	0.05
5a	No	5.0	6.6	0.6	0.02
5a	Yes	23.5	14.0	3.7	1.12
5a	No	10.9	8.8	2.9	0.31
5a	No	8.5	11.0	1.2	0.11
5a	No	19.1	23.0	6.7	2.46
5a	No	18.0	15.0	7.1	1.56
5a	No	20.0	23.0	5.8	2.52
5a	No	23.5	13.2	3.3	0.81
5a	No	15.7	13.4	2.0	0.29
5a	Yes	23.8	28.2	4.9	2.42
5a	Yes	22.8	26.7	3.8	1.71
5a	No	20.9	14.0	3.1	0.78
5a	No	28.2	42.8	5.7	5.60
5a	Yes	30.3	36.8	7.6	5.41
5a	Yes	31.2	24.4	7.6	4.91
5a	No	7.8	8.9	1.7	0.10
5a	No	7.2	5.8	1.2	0.04

Layer	Worked	Length (mm)	Width (mm)	Thickness (mm)	Weight (gm)
5a	No	16.8	23.7	5.6	2.07
5a	No	21.1	17.2	5.0	1.37
5a	No	10.7	8.0	2.0	0.15
5a	No	21.2	20.3	3.3	0.62
5a	No	30.5	20.0	7.1	5.21
5a	No	23.5	28.4	4.1	2.34
5a	No	49.1	39.3	8.4	14.59
5a	No	23.3	20.0	7.2	2.78
5a	No	11.0	11.1	2.5	0.28
5a	No	6.4	7.9	1.3	0.07
5a	No	5.7	10.2	2.5	0.13
5a	No	10.1	14.5	2.3	0.26
5b	No	21.7	19.9	8.8	2.39
5b	Yes	56.4	93.4	14.2	84.13
5b	Yes	36.1	31.5	14.5	34.30
5b	Yes	60.3	48.6	8.9	8.98
5b	No	10.9	26.7	6.1	1.13
5b	No	27.6	16.7	3.6	1.34
5b	No	14.3	6.4	1.3	0.14
5b	No	21.9	24.8	9.9	5.76
5b	No	28.7	24.8	6.1	5.03
5b	No	10.9	11.9	2.4	0.27
5b	No	17.9	19.5	2.0	0.74
5b	No	21.5	29.4	4.1	1.65
5b	No	7.3	8.5	2.3	0.09
5b	No	15.2	21.3	1.8	0.82
5b	No	25.0	23.3	9.4	3.31
5b	No	22.6	19.0	3.0	1.24
5b	Yes	57.3	36.3	6.5	13.05
5b	No	25.8	22.2	7.0	2.52
5b	No	36.8	44.3	6.3	5.65