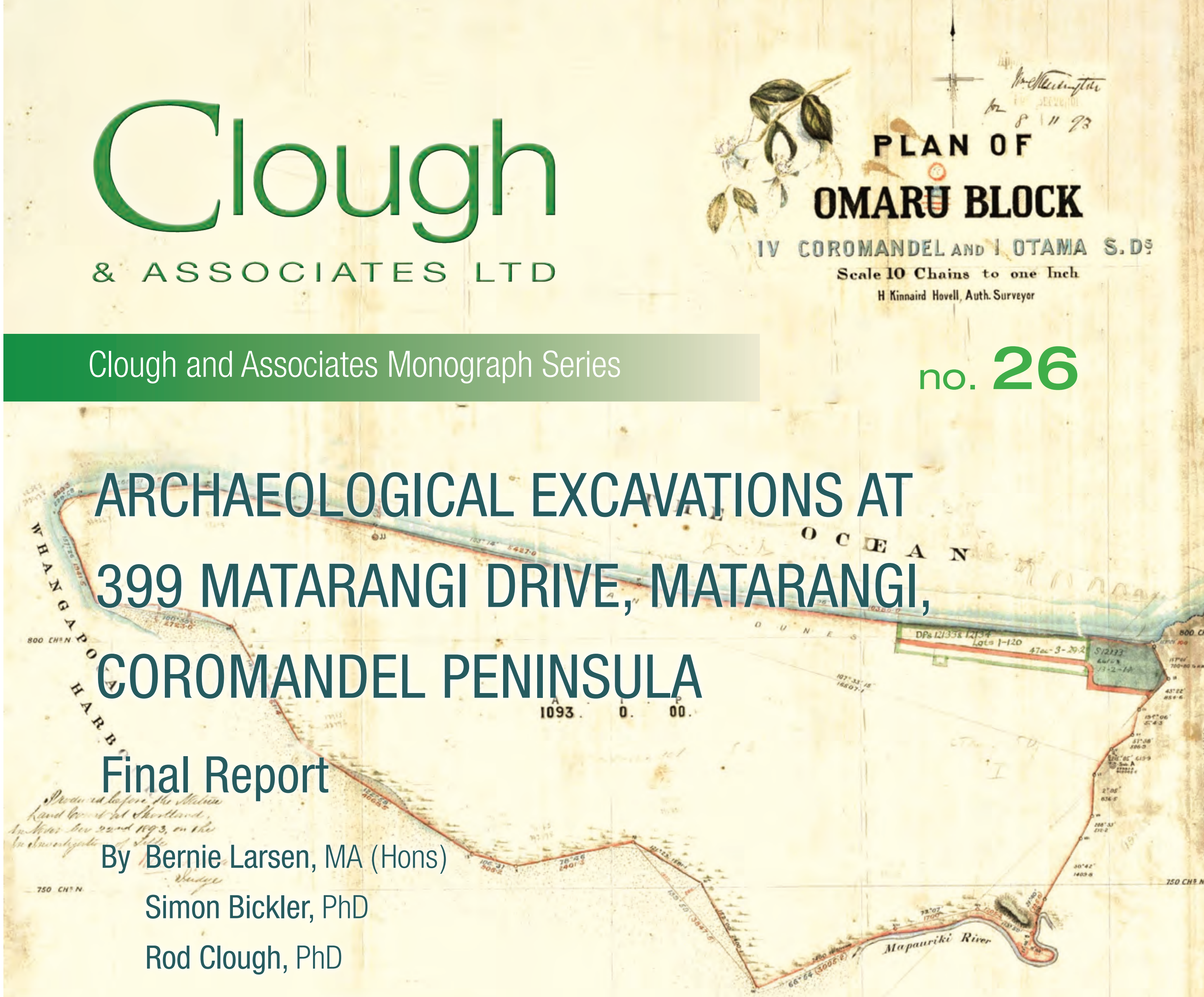


Clough
& ASSOCIATES LTD

Clough and Associates Monograph Series no. 26

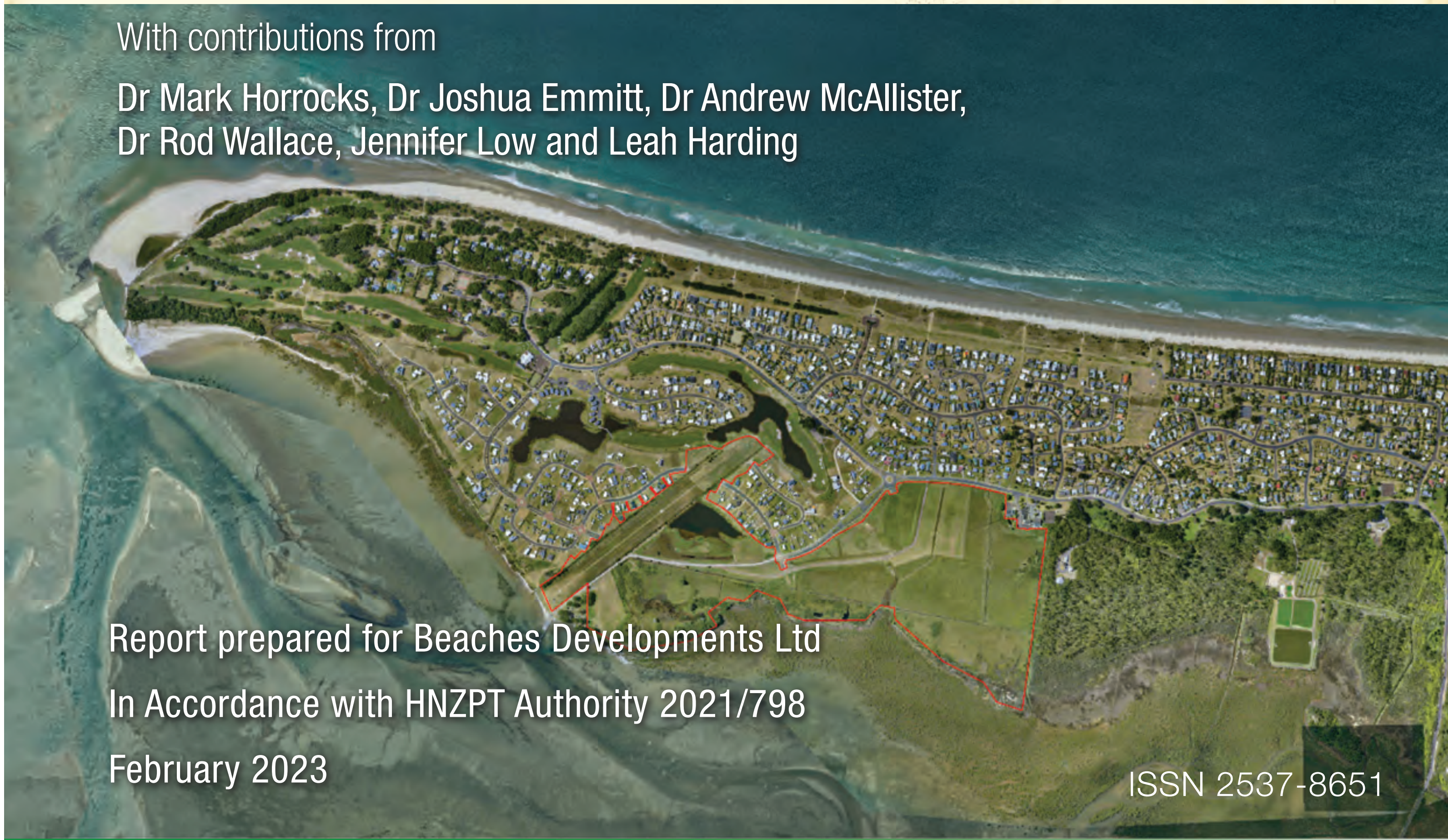
ARCHAEOLOGICAL EXCAVATIONS AT 399 MATARANGI DRIVE, MATARANGI, COROMANDEL PENINSULA

Final Report

By Bernie Larsen, MA (Hons)
Simon Bickler, PhD
Rod Clough, PhD

With contributions from

Dr Mark Horrocks, Dr Joshua Emmitt, Dr Andrew McAllister, Dr Rod Wallace, Jennifer Low and Leah Harding



Report prepared for Beaches Developments Ltd

In Accordance with HNZPT Authority 2021/798

February 2023

ISSN 2537-8651

Archaeological Excavations at 399 Matarangi Drive, Matarangi, Coromandel Peninsula: Final Report

Under HNZPT Authority No. 2021/798

Prepared for Beaches Developments Ltd

February 2023

By

Bernie Larsen, MA (Hons)
Simon H. Bickler, PhD
Rod Clough, PhD

With Contributions from Dr Mark Horrocks, Dr Joshua Emmitt, Dr Andrew McAllister, Dr Rod Wallace, Jennifer Low and Leah Harding

Clough & Associates Ltd

321 Forest Hill Rd,
Waiatarua, Auckland 0612
Telephone: (09) 8141946
Mobile 0274 850 059
www.clough.co.nz

EXECUTIVE SUMMARY

Beaches Developments Ltd has undertaken earthworks for a subdivision of a 48.5ha block, at 399 Matarangi Drive, Omaro Point, Matarangi on the Coromandel Peninsula. The project is a large subdivision including house lots, roading and other related infrastructure. Recently Stages 5 – 8 have been completed, located along the southern edge of the wider development area.

Monitoring of the works identified five areas of archaeological remains located near the southern edge of the project area, near to the estuarine shore. These five areas were centred around previously recorded sites T10/1047, T10/1048, T10/1051, T10/1052 and T10/1054. The remains were characterised by midden deposits with associated firescoops and a small number of rock caches. Very little evidence of structural remains or lithics was found in any of the sites. The most extensive remains were found in Area 1 (T10/1052), which contained two large deposits with varied internal structure and other associated stratigraphic layers. Firescoops in this area were found cut into the top of, within and beneath the midden surface. At the other sites firescoops were found only beneath the midden deposits. Only a single artefact was recovered during the works – a broken adze made of Tahanga basalt found within a rock cache in Area 2 (T10/1047).

Analysis of the archaeological sites investigated during the Beaches Development reflect the targeted harvesting and processing of a narrow range of shellfish species. Local wood resources were utilised, both on the spit and in the mangroves, suggesting the occupation was a highly specialised, concentrated activity, using resources in the immediate vicinity. This activity is interpreted to have been carried out in short time frames, being seasonal or even over a matter of days, where nearby resources were brought to the closest area for processing.

Radiocarbon dating found the sites were reoccupied repeatedly between the late 17th and late 18th centuries AD. The processing of shellfish at these sites was likely part of a larger social, environmental and cultural system that existed in the wider area around the Whangapoua Harbour.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Project Background

Beaches Developments Ltd has undertaken earthworks for a subdivision of a 48.5ha block, at 399 Matarangi Drive incorporating Lot 399 DP 504936, Lot 501 DP 519481 and Lot 17 DP 344647 at Omaro Point, Matarangi on the Coromandel Peninsula (Figure 1-1, Figure 1-2). The project is a large subdivision including house lots, roading and other related infrastructure. Recently Stages 5–8 have been completed, located along the southern edge of the wider development area.

The effects of the development had previously been assessed by A. Hoffman (2015), following an initial assessment by Louise Furey (2005). Hoffman's plan identifying the eight recorded sites in the subdivision area (Figure 1-3) is shown overlaid on the earthworks extent plan (Figure 1-4), with the area proposed for inclusion in an archaeological Authority application shaded in blue (Figure 1-5). Figure 1-6 provides an overview of the proposed cut and fill across the wider property.

Hoffman (2015:7) concluded that:

- The recorded sites T10/1047-1052 could not be effectively avoided and would be destroyed or heavily modified in the process of cut and fill earthworks for the subdivision.
- T10/1051 extends within an esplanade reserve vested in Thames-Coromandel District Council (SA58C/639) and would be modified by the construction of a proposed public walking access path which was to be constructed along the entire length of the esplanade fronting the allotments.
- T10/1053-1054 were largely or completely destroyed (these were within an area of re-contoured land shown on Figure 1-3).
- Other parts of the subdivision were considered unlikely to have archaeological remains.

An updated assessment (Bickler and Clough 2021a) for the purpose of an Authority application to modify sites within the area shown in Figure 1-4 was carried out as changes to the development plan and works since 2015 in and around the property meant that effects had to be re-established.

A management plan incorporating an investigation strategy (Bickler and Clough 2021b) was also prepared as part of the Authority application. The Authority was granted (No. 2021/798) in July 2021 and works began in September 2021.

This is the final report on the archaeological excavations in accordance with Condition 9 of the Authority.

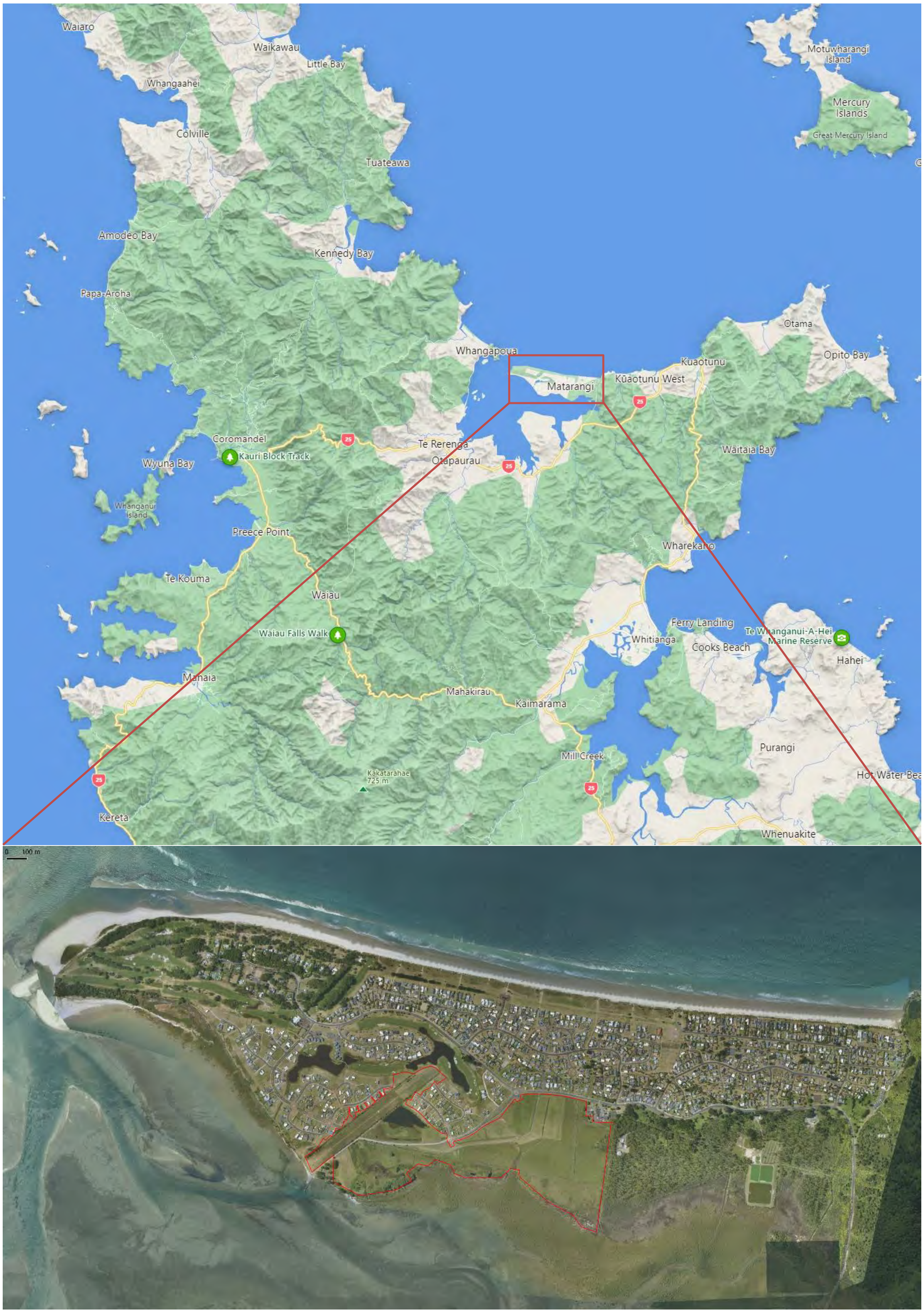


Figure 1-1. Location of project area (source: Bing Maps 2022)

Figure 1-2. Overall subdivision plan for Stages 5-8 at 399 Matarangi Drive with red shaded areas showing extents of sensitive areas associated with recorded archaeological sites (from Hoffman 2015: figure 3)

Figure 1-3. Approximate locations of the recorded sites and boundaries of 'sensitive areas' delineated (red dotted lines). An area of re-contoured land is identified by the blue dotted line (from Hoffman 2015: figure 2)

Figure 1-4. Earthworks extent plan for subdivision (Authority application area shaded in blue) with recorded archaeological sites indicated by red dots

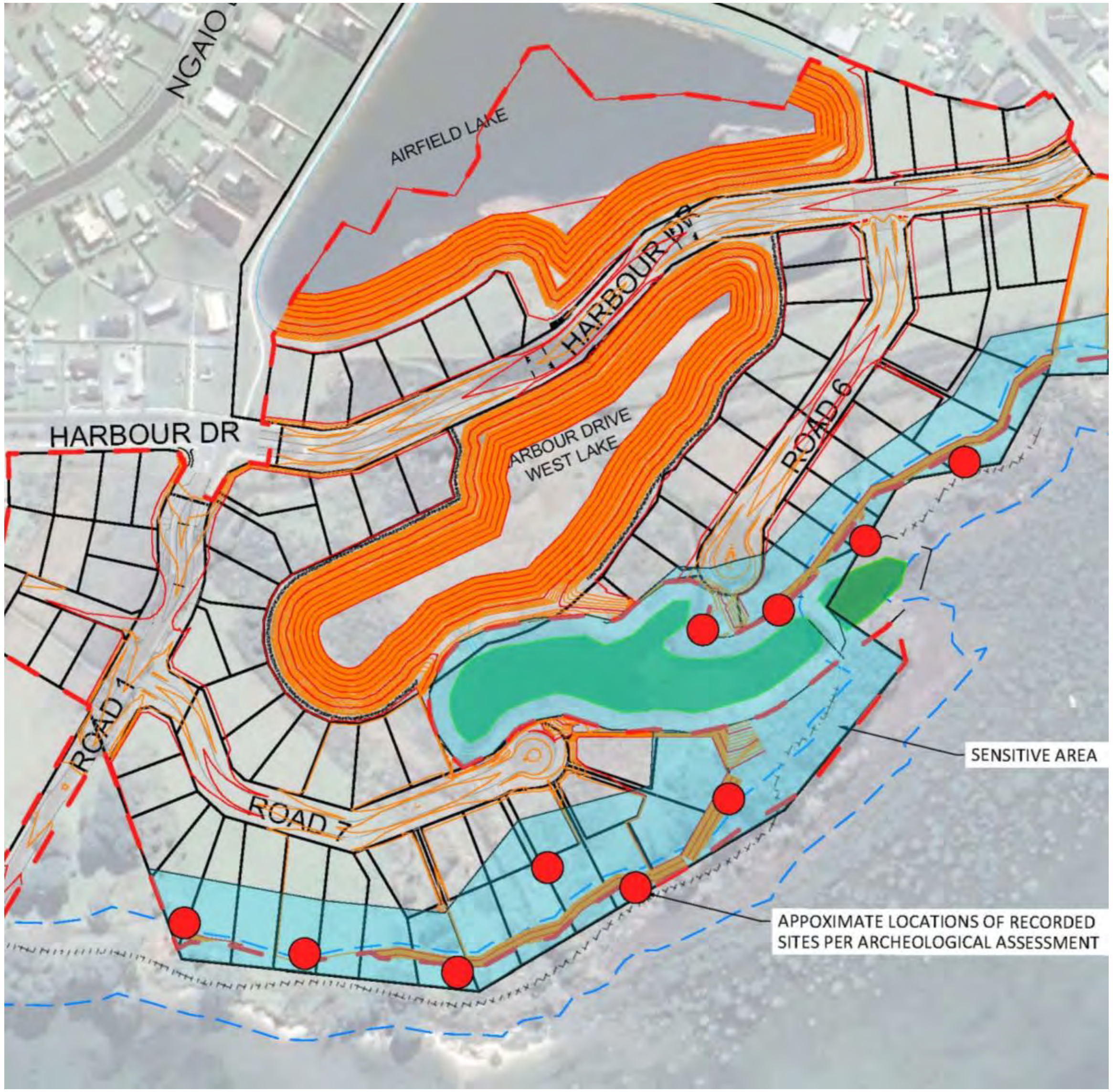


Figure 1-5. Close-up of plan showing Authority application area shaded light blue

Figure 1-6. Overview plan of cut and fill across property with recorded archaeological sites indicated by yellow stars

1.2 Excavation Methodology

Archaeological investigations were carried out prior to the main earthworks of Stages 5–8. The investigations started at the western side of the Authority area, west of the recorded location of T10/1052. Archaeological works began on 9 September 2021 and the final works were completed in April 2022, with the works being carried out in four phases (Figure 1-7).

The first phase of the investigation began in the western end of the Authority area in the vicinity of T10/1052 and progressed eastwards following the southern edge of works to T10/1047, T10/1048 and T10/1049. This was carried out in September 2021. The area investigated measured approximately 280m east to west and 30-50m north to south, with a total area of approximately 9100m².

The second phase was focussed on the area around T10/1051 northeast of the first phase of works and was carried out in early October 2021. This area of works measured 90m long and 6m wide, following the edge of works line that dog-legged. The total area was approximately 650m².

The third phase was investigating archaeology uncovered in the western edge of the project area, at the boundary of the triangular-shaped freedom camping reserve near the previously recorded site T10/1054 (shown in Figure 1-7, lower aerial). The area was cleared in preparation for driving in wooden piles to provide ground stabilisation. The area was inspected and archaeology recorded on 22 December 2021. The area was a strip approximately 3m wide and covered 126.545m².

The fourth phase was monitoring the earthworks for the esplanade path, carried out on 29 April 2022. This involved monitoring the areas of the path that were to be built with gravel, with much of the route in previously earthworked areas or to be built above ground. Monitoring included areas at the southwestern end of the old airstrip in the far west of the project, south of the first phase of works area near T10/1053, T10/1052, T10/1047, and T10/1048, and between the recorded locations of T10/1050 and T10/1051.

The nature of the archaeological remains meant that investigation of the sites was undertaken during the preliminary phase of the main earthworks. This was ideal in terms of silt control and ensuring maximum visibility of any archaeological features.

The initial stripping of topsoil and any subsoil in the authority application area was supervised by archaeologists. As features were exposed, more detailed investigation of these features was undertaken.

Topsoil stripping and any subsoil removal was carried out by qualified archaeologists within the area covered by the Authority as shown in Figure 1-4, to determine the extent of pre-1900 archaeological remains and undertake appropriate investigation and recording.

If in situ archaeological features or deposits were identified, the archaeologist stopped works in the immediate vicinity by notifying the contractor and investigated the remains.

In situ archaeological deposits or features exposed during monitoring were investigated, recorded and sampled by the archaeologist consistent with accepted archaeological practice and in accordance with the requirements of the Heritage NZ authority.

Figure 1-7. Areas of archaeological works shown in light purple, with phases of work identified

Detailed notes of each feature and deposit were made, photographs were taken, and all subsurface features located were detailed on the site plan.

Stratigraphic drawings and photographs of features and deposits were undertaken.

A representative sample of midden, dating and environmental material were retained for analysis and the positions of any artefacts and samples were marked on the site plan.

Further monitoring of soil removal continued until the natural deposits had been reached (where earthworks continue to this depth), or until it became clear that the area had been modified to the point where no archaeology would be expected.

1.3 Research Aims

The archaeological investigations were guided by the research aims set out in the investigation strategy for the project (Bickler and Clough 2021b), which were as follows:

Coastal Settlement:

- Determine the nature and extent of the archaeological features associated with the recorded sites.
- Identify any occupation structures and provide interpretation of those structures.
- Collect samples for dating of the sites and their relationship to the local environment.
- Record geomorphological information and retrieve environmental data, where feasible.

Agriculture:

- Determine if there is further evidence of agriculture at the archaeological sites on the property.
- Determine taphonomic impacts, such as for later farming, that may influence the interpretation of the archaeology.

Chronology:

- Dates from the sites will add to an understanding of the chronology of Māori settlement at Matarangi;
- The implications of the updated chronology will be examined.

1.4 Project Personnel

Dr Rod Clough directed the project as the Section 45 archaeologist with fieldwork carried out under his supervision. The archaeological team included the following:

Name	Role	Responsibility
Rod Clough, PhD	Project Director. Section 45 Archaeologist	Overall direction of project
Simon Bickler, PhD	Project Co-director	Overall direction of project
Bernie Larsen, MA (Hons)	Site Supervisor, Principal Field Archaeologist	Site management, excavation, recording, sampling, GIS management, report preparation
Leah Harding, BSc	Field Archaeologist	Monitor, excavate, record and sample; midden Analysis
Jen Low, MA (Hons)	Analyst	Midden analysis

Site visits, monitoring and excavation were also conducted by cultural monitor Wanda Brljevich for Ngāti Huarere ki Whangapoua.

Artefact analysis was carried out by Doug Gaylard.

Geochemical analysis was carried out by Dr Andrew McAllister.

3D reconstructions drawings were created by Tom MacDiarmid.

Charcoal analysis was carried out by Dr Rod Wallace.

Microfossil analysis was carried out by Dr Mark Horrocks.

1.5 Acknowledgements

Our thanks to Ngāti Huarere ki Whangapoua for providing cultural support during the project and for the assistance of Wanda Brljevich with the archaeological excavation. Thanks are also extended to the crew from Hopper Construction and Winton. Their assistance during the excavations was instrumental in both ensuring the safety of the archaeologists around large moving vehicles and following the archaeological management plan. In particular, Jarrad Vincent was second to none in his communication, flexibility and patience in assisting Clough & Associates' archaeologists in carrying out the archaeological works.

2 BACKGROUND

2.1 Historical Background

2.1.1 **Māori Settlement**

From the time of earliest settlement around the 13th century AD, the Coromandel, or Hauraki, was a much sought-after area. The peninsula had long stretches of coastal beaches, an abundance of freshwater streams, sheltered bays and harbours, extensive kauri forests, bush-clad hills and rich fertile soils – all of which provided an abundance of resources from coastal fish (including snapper, trevally, kahawai, kingfish, mackerel, gurnard and shark), deep sea fish (tuna and swordfish) and shellfish to eels, birds and berries, as well as providing opportunities for cultivation.

Stone tools were also manufactured from basalt extracted from Tahanga hill, located between Kūaotunu and Opito Bay. Obsidian was also utilised from both local sources and from the coveted Mayor Island source in the Bay of Plenty (King and Morrison 1993).

The earliest settlers primarily settled along the coast and the shores of estuaries and river mouths (King and Morrison 1993). However, by around 1500 AD, a change in the make-up of society through population growth and possibly climate changes led to conflict over land and access to resources. This resulted in the development of defended settlement sites (pa). When Cook arrived in 1769, fortified settlements were evident along much of the Coromandel coast (Black 1985).

2.1.2 Early European Contact and Settlement

The first Europeans known to have visited the Coromandel were Captain Cook and the crew of the *Endeavour* in November 1769. Cook and his crew came ashore and met members of both Ngāti Hei and Ngāti Whanaunga in a friendly meeting. The sailors were provided with fish and shellfish and were assisted in finding wood and fresh water (King and Morrison 1993).

The next ship to arrive was the *Fancy* led by Captain Dell in 1794/95. The crew of the *Fancy* were there to source spars for the naval vessels of the East India Company. Over the next few years, at least five more ships arrived to fell timber and trade flax and potatoes with local Māori. In 1820 the Royal Naval storeship *Coromandel* arrived – a ship that was ultimately to give its name to the peninsula itself. On board the *Coromandel* was Samuel Marsden of the Anglican Church Missionary Society (King and Morrison 1993).

Small-scale European settlement began around the Coromandel coast during the 1830s. The Europeans were often protected by local hapu in return for the supply of tobacco, blankets and other imported goods (Black 1985).

By the 1840s major trading posts had been established at Mercury Bay and Tairua, specialising in the trade of timber (especially kauri), meat, dried fish, vegetables, fruit and firewood (King and Morrison 1993). The peninsula had now come under increasing pressure from the new colonists and the Crown as extensive forest areas were leased for timber (Black 1985).

The early 1840s were also to see a change in focus of the early European settlers on the Coromandel. In 1842, visiting whalers found traces of gold. This discovery resulted in an early gold rush in the 1850s around the Coromandel Township, Cape Colville and Mercury Bay. Gold was exploited in bursts in the Coromandel until the early 20th century (Black 1985).

By 1858, the population of the Coromandel was dominated by Europeans, with Māori being overwhelmed not only by social change but also by introduced diseases including whooping cough, dysentery and tuberculosis, and through the effects of alcohol (Black 1985). Since the mid-1800s, large tracts of land on the peninsula were gradually taken and/or purchased by the Crown and sold to individual European settlers for the purposes of logging, mining, farming and settlement.

2.1.3 Matarangi

During the late 19th century, the Māori owners of the Omaro Block (Matarangi sandspit) were known to have collected kauri gum from the block, which covered an area of approximately 422 hectares (Furey 1998). The extent of the block is shown on a historic survey plan dated to 1893 (Figure 2-1) which was presented in support of an application by Samuel Mangakahia before the Native Land Court as part of an investigation into the title of the block in November of that year.

Following the Native Land Court investigation, the Omaro Block was alienated from Māori ownership in 1897. Claimants appearing before the Court were Peneamine Tanui of Ngāti Hei, and Hamiora Mangakahia, both representing others with descent from Te Kotoretahi Taramomoho. Peneamine Tanui reported 'we have kaingas on this land' (Furey 1998, citing Hauraki Minute Book 35:101-102, 113).

For a period during the 20th century the sandspit was farmed. An aerial photograph dated to 1976 shows the sandspit as primarily pastoral grass (Figure 2-2). Residential development of the area did not start until the late 1970s. An aerial photograph dated to 1982 shows the beginnings of the residential development of the area and extensive areas of plantings (Figure 2-3). Approximately two thirds of the spit has now been modified by small lot housing development and related facilities. The remaining areas comprise a golf course, airfield, oxidation ponds and wildlife reserve.

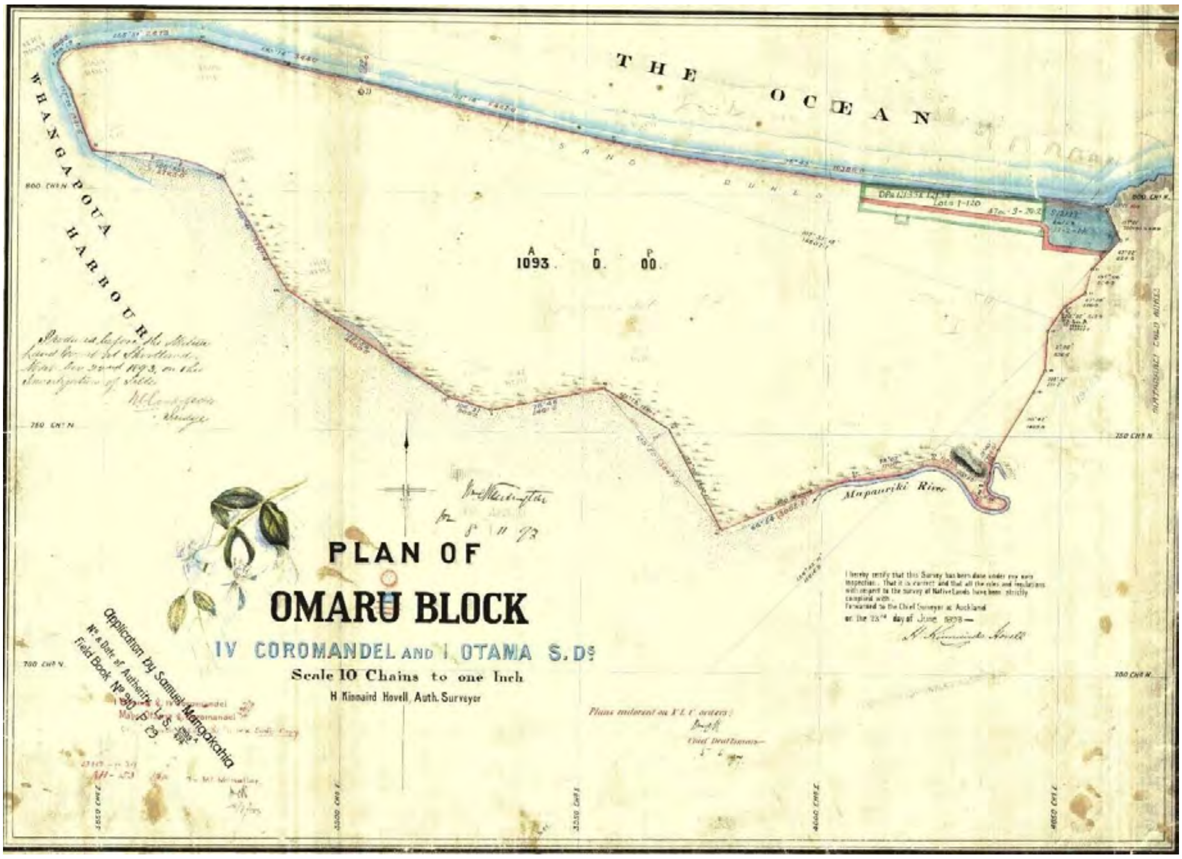


Figure 2-1. 'Plan of Omaro Block', 1893. Source: Quickmap 2019

Figure 2-2. White's Aviation oblique aerial photograph from 1976 looking west over the Matarangi sandspit. Source: National Library ref. WA-73120-G

Figure 2-3. White's Aviation oblique aerial photograph from 1982 looking west over the Matarangi sandspit. Source: National Library ref. WA-76405-F

2.2 Archaeological Background

The Whangapoua Harbour, within which Matarangi is located, and the Kūaotunu Peninsula contain a large number of recorded archaeological sites related primarily to pre-European Māori occupation and to a lesser extent, 19th century gold mining and forestry activities.

Sites date from the earliest recorded period of settlement around the 13th century. The earliest sites within the general project area were focussed on the sheltered coves on the northeastern tip of the Kūaotunu Peninsula, close to Mt Tahanga – an important source of basalt used for the production of adzes and other stone tools.

A number of site investigations were undertaken along the coastal margins of the Coromandel Peninsula during the 1950s–1960s. These investigations tended to focus on early ('Archaic') Māori sites that were rich in artefact material and were in many cases actively eroding along the foreshore dune systems. In the 1950s investigations were undertaken by Jack Golson at an early Archaic Māori occupation site at Sarah's Gully (T10/167), located at the eastern side of Kūaotunu Peninsula. The excavation showed multiple periods of occupation and dated back to the earliest period of settlement on the Coromandel. The midden included shellfish, mammal and fish bone, lithic material and moa bone (including fishhooks) (NZAA site record form).

Despite the large-scale development of Matarangi, detailed archaeological work has been limited. Initial archaeological surveys (e.g., Easdale and Jacomb 1982) recorded the presence of middens on the seaward beach, on the western side of the spit. This was the first recorded site on the spit (T10/262, see Figure 2-4) with the eastern side of the spit already developed.

In 1997, Furey undertook the excavation of a coastal midden site (T10/993, see Figure 2-4) located on the dunes of the sandspit under NZ Historic Places Trust (now Heritage NZ) Authority No. 1997/42. The investigation uncovered the remains of Māori seasonal camp sites, including multiple shell midden deposits, shallow firescoops and a single posthole (Figure 2-5). The shell midden comprised predominantly cockle, tuatua and pipi with some scallop and gastropod also identified. Radiocarbon dates obtained for the site indicated a date of occupation between the late 16th and early 17th centuries, with the sites representing small-scale occupation, probably related to shellfish and mackerel processing (Furey 1998).

Sewell (2000) subsequently undertook monitoring of earthworks for a subdivision to the west of the current project area soon after Furey's work. Most of the recorded features (Figure 2-6) were firescoops associated with shell midden across the area. Sewell (2000:10ff) suggested that this was indicative of numerous temporary encampments associated with harvesting and processing of kai moana. A few small postholes were identified, but no evidence of large structures was found. However, she also noted that the stratigraphy around the property shifted as it got closer to T10/990a (northwest of the airstrip), with some possible evidence of gardening in the soil. Radiocarbon dates from the projects were relatively consistent, pointing to occupation in the 16th and 17th centuries AD. Furey (2003) returned to investigate two further sites, T10/985 and T10/1041, obtaining similar dates to the sites dated previously.[1]

Generally, the midden sites found show a limited number of species, few other faunal types, few stone tools or stone artefacts and limited structural evidence. The sites are interpreted as summer harvesting sites where shellfish was collected, processed for transport and removed to more permanent occupation sites.

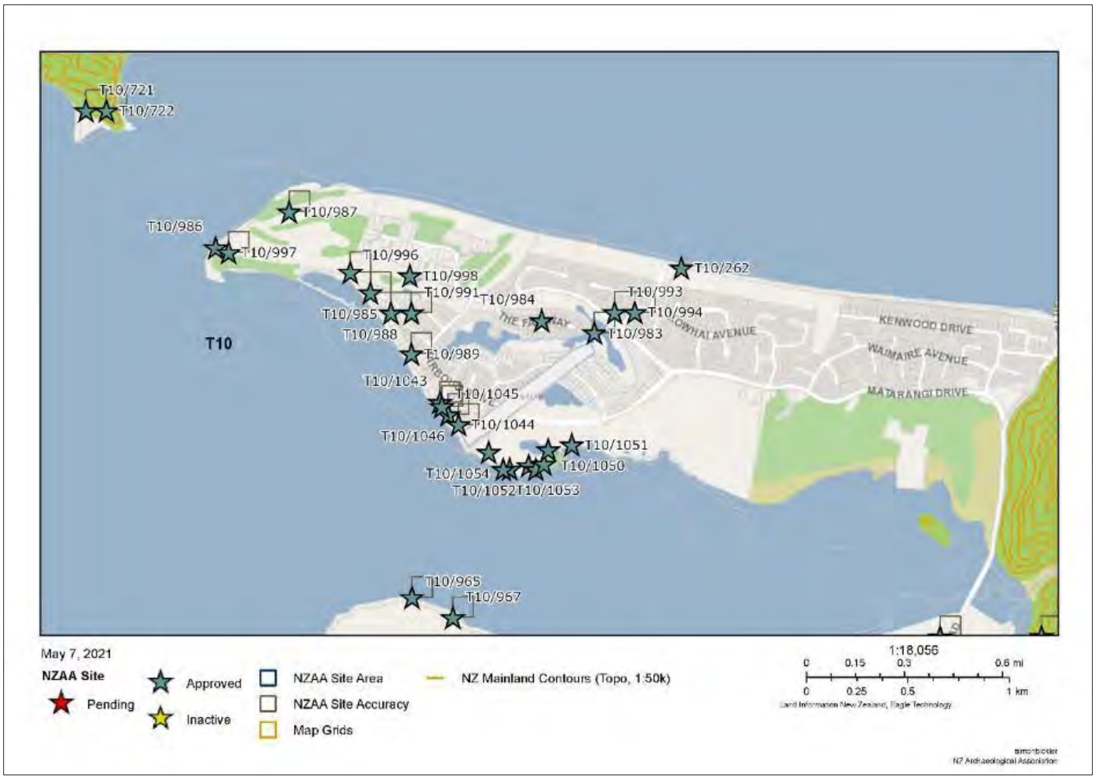


Figure 2-4. Sites recorded in NZAA ArchSite (note T10/990a is in the same location as T10/991)

[1] T10/1041 was inadvertently left out of the digital NZAA ArchSite and has since beeen added back to the database. It was located off Kelly Jade Avenue, west of the current project area.

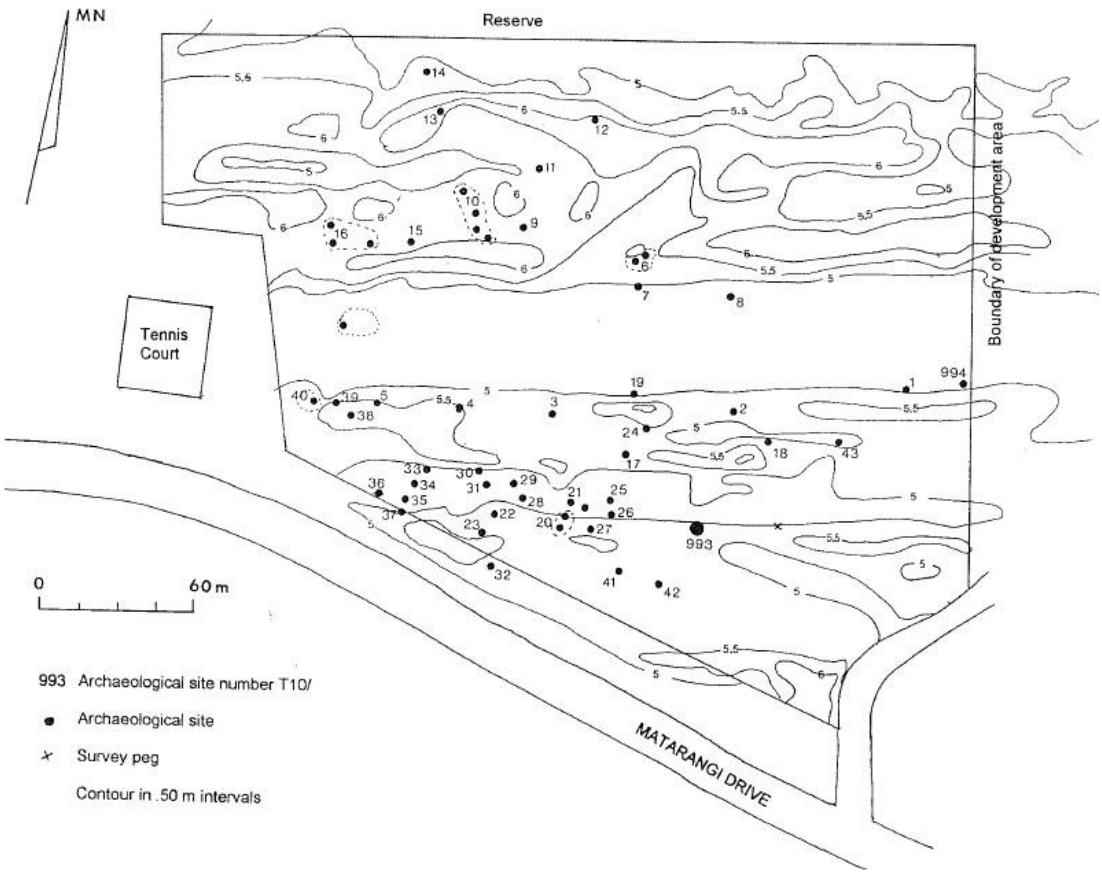


Figure 2-5. Location of archaeological remains identified during excavations of T10/993 (Furey 1998)

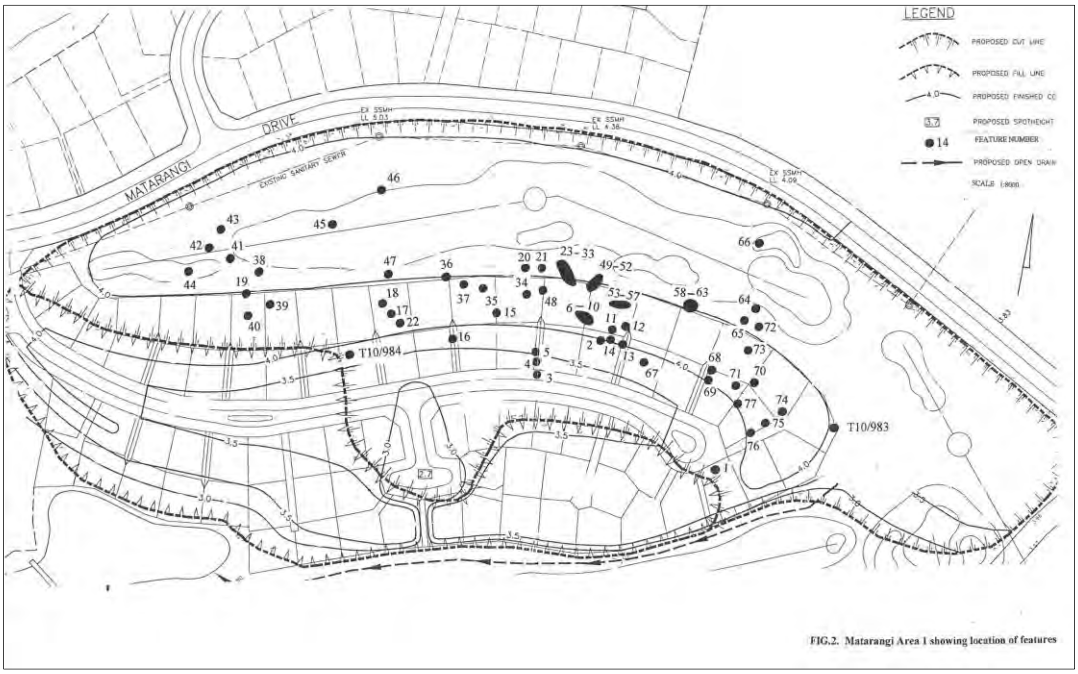


Figure 2-6. Features associated with sites T10/983 and T10/984 excavated to the west of the current project area (Sewell 2000: figure 2)

2.3 Physical Context

The township of Matarangi is located across the 400m long west-running Omaro sandspit that forms a barrier across the eastern entrance to the Whangapoua Harbour. Furey (1998:3) describes the sandspit as being made up of 'up to 18 parallel dune ridges, backed on the harbour side by a coastal barrier flat which covers about two-thirds of the total area of the spit' (after Marks and Nelson 1979:354).

The spit was likely formed in the period between 4000 and 5000 years ago when the sea levels were higher than at present. As the sandspit would have been formed from the seaward side, the dunes 'increase progressively in age with distance from the ocean beach (Furey 1998:3). Furey (1998) also states that it is clear that forest once grew across the spit, as evidenced by large, buried trunks excavated during past construction works across the area and the presence of white leached sands which indicate the past presence of kauri forest. The forest vegetation was deduced as most likely comprising a mixed kauri-podocarp-broadleaf type forest, which was evident within the wider Whangapoua Harbour catchment and across the Coromandel Peninsula prior to widespread logging during the late 19th to early 20th centuries (Furey 1998).

The soils of the dunes comprise a grey/black sandy topsoil 100-150mm deep overlying a weathered reddish-brown or grey-brown dune sand. The dunes sit at a maximum height of c.6m above sea level (Thames-Coromandel District Council GIS; Furey 1998).

Generally speaking, the older, more consolidated, iron rich, slightly cemented, reddish brown sands of the lower horizons are probably 4000 years old or more, along the Whangapoua Harbour and Mapauriki Stream which form the southern edge of the spit, with sands becoming progressively younger closer to Matarangi Beach along the north edge of the spit (Marks and Nelson 1979).

The Matarangi Township was developed in the 1980s as a purpose-built resort town, with a Golf Club resort located at the western tip of the sandspit.

Historic aerial photographs show considerable variance in the coastline of the spit in the latter half of the 20th century, as demonstrated by Campbell (2022) during a recent assessment at the far western tip of the spit (Figure 2-7). This indicates the spit coasts were highly mobile and variable in a moderate time scale. Sand mobility and variability in the localised landforms of the spit are likely to have characterised the development of the spit since its formation 4000-5000 years ago.

An aerial photograph from 1945 (Figure 2-8) shows the Omaro Spit bare of vegetation with the series of parallel dunes covering the northern side of the spit clearly visible and the southern coastal barrier also showing few features. The embayment located in the southwest of the project area is also present and has not changed in shape or extent (Figure 2-9). The coast is also in approximately the same location as today, compared with the higher variability in the west.

Figure 2-7. Historic coastlines at the western tip of the spit overlaid a 2016-2019 aerial (Campbell 2022: figure 8)

Figure 2-8. Detail of SN/292/962/24 dated 1945 showing sparse vegetation and parallel dunes on the northern side of the spit

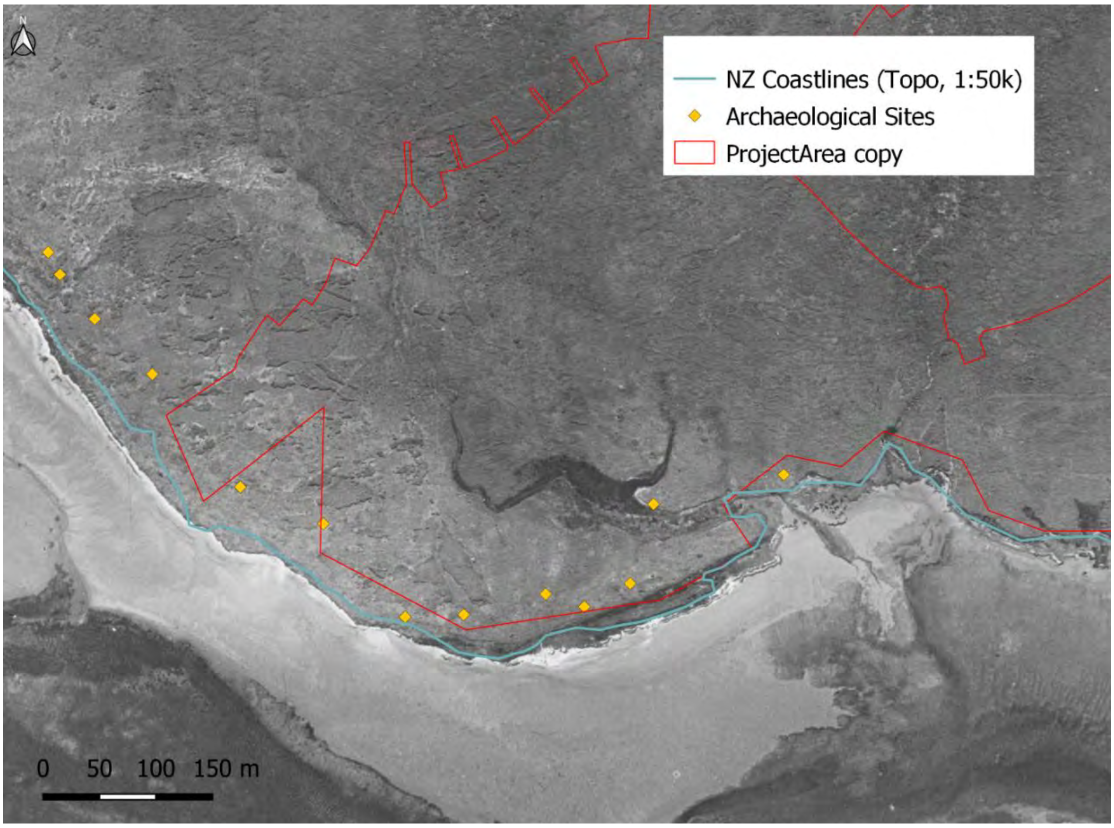


Figure 2-9. 1945 aerial detail showing the embayment, with project boundaries overlaid

3 EXCAVATION RESULTS

3.1 Introduction

3.1.1 Excavation Areas and Sequence

The earthworks contractor supplied a 20-ton mechanical excavator with a smooth-edged tilt bucket for exclusive use for archaeological requirements. The area to be contoured and with the potential to affect archaeology was within the allotment areas. This followed the edge of the project but deviated around the embayment, where a reserve was designated as part of the development (see Figure 3-1, Figure 3-2). The monitoring (Phase 1, Figure 1-7) started west of T10/1052, at the edge of the previously contoured area (west of the project area). The method used was to start at the previously built earth bund running along the south edge of works, working north in ~8m wide strips west to east. This was continued east to a V-shaped drain cut by the farmer, located east of T10/1052, which was avoided as it was part of the drainage and silt control of the site – however, it was clear that any archaeology within the drain had been destroyed. This phase of works continued east and was completed north of T10/1049 near the edge of the wetland area of the embayment. The earthworks area turned northeast after T10/1048 (see Figure 1-6, Figure 3-2) as the design had left the small peninsula at the south side of the embayment and the embayment itself as a reserve.

Heavy rainfall occurred from the middle to the end of the first week which resulted in substantial standing water. This made the ground surface difficult to clear of topsoil and affected the visibility of archaeology. Additionally, an extensive root system was located in the eastern half of the first phase of works from a grove of mature trees that were felled prior to works commencing. The root created significant difficulties in carrying out the soil removal and made visibility very low for small features.

Once the first phase of soil stripping was completed, the archaeological remains uncovered were grouped into three areas, with further detailed investigations carried out, starting with Area 1 and through to Area 3 (Figure 3-1).

The second phase of monitoring was on the north side of the embayment inlet in the vicinity of T10/1051 (Figure 1-7, Figure 3-2). This began at a deep drainage channel and cleared eastwards, uncovering material from T10/1051. The edge of earthworks was then marked out, being 20m north of the water's edge. The midden was sampled and re-buried, with the stripping continuing along the edge of works eastwards to a bush-covered area bordering an inlet. The archaeology uncovered in this phase was labelled Area 4.

During a site visit it was found that an area in the southwestern corner of the project (Phase 3 in Figure 1-7) had been cleared in order to drive posts for land stabilisation. This had cut through the land contouring fill, exposing archaeology along the boundary with the freedom camping reserve. The archaeology was designated Area 5 (Figure 3-1).

The final phase of works (Phase 4, see Figure 1-7) was works associated with constructing the walking path running through the esplanade reserve that skirts the southern edge of the project and covers the rehabilitated wetland of the embayment.

The stripping began west of the freedom camping reserve, at the end of the airstrip running towards the boat ramp. Much of the proposed route was in low-lying boggy areas at the edge of the estuary and was to be built up in a boardwalk, requiring no excavation.

Two stretches required excavation in archaeologically sensitive areas, identified in a field survey prior to the works: a long stretch south of Areas 1-3 and an area west of Area 4 between the recorded locations of T10/1050 and T10/1051. The archaeology encountered was included in the existing Area designations.

3.1.1 Site Phasing

All of the archaeology uncovered was associated with pre-European Māori occupation. The general pattern established was areas of shell midden with associated firescoops (cooking features). The features were in the top of the middens but also found beneath and within them. There was no indication of a hiatus between occupations that would suggest multiple phases of occupation in any of the areas.

3.1.2 Investigation Methodology

Once an area of shell midden and associated features was identified and exposed, the extent was mapped and notes taken on the nature, variability and composition of the midden. For the larger middens in Area 1, a trench was hand dug along the long axis and more trenches dug perpendicularly for the most complex midden. The stratigraphy of the trenches was drawn and column sampling was carried out along the long-axis trench. The shell was then stripped off in spits with the mechanical excavator and any features within or beneath the midden recorded.

Thinner middens were identified by spade testing. These had initially been recorded before the shell was stripped off and underlying features recorded. Bulk samples were taken from the overlying midden rather than column sampling.

A range of cooking features were sampled from each area and sediment samples were taken from various strata.

During the esplanade monitoring (Phase 4), only the extent of shell was mapped and notes were taken on the composition. The excavation depth of the build design did not extend into the shell midden so it was possible to avoid further effects and no samples were taken.

Figure 3-1. Plan of archaeological areas west

Figure 3-2. Plan of archaeological areas east. Note: earthworks were only carried out within allotment areas indicated in grey

3.2 Excavation Results

3.2.1 Overview of Results

A total of 172 contexts (Table 3-1) were recorded, consisting of 59 fills, 56 cuts, 44 layers, 7 midden complexes and 6 voids. Midden complex was used to define the large midden deposits containing layers, with midden layers and cuts defining the variation found within those midden complexes.

See Appendix 1 for context descriptions.

Table 3-1. Context types of the project

Context Type	N.
Fill	59
Cut	56
Layer	44
Midden Complex	7
Void	6
Grand Total	172

The context types consisted of 48 firescoops, 23 midden layers, 7 midden complexes, 6 rock caches and 4 postholes (Table 3-2). The remaining types were 8 general sediments which corresponded to the natural horizons in each area, 8 paleosols, 5 sediment layers, 6 voids and one natural feature. The remaining types correspond to the fills of the features and are not shown in the table.

Firescoop is used here to describe the cooking features found during the investigation. This is used as a catch-all term that is interchangeable with other terms such as fire feature or hangi and is not intended as an interpretative term.

Table 3-2. Context types

Type	N.
Firescoop	48
Midden Layer	23
Midden Complex	7
General Sediment	8
Paleosol	8
Void	6
Rock Cache	6

Sediment Layer	5
Posthole	4
Natural Feature	1
Grand Total	116

3.2.2 Area 1 (T10/1052)

3.2.2.1 Middens

Area 1 was located in the centre west of the investigation area, starting at the edge of the contoured area that comprised the western side of the project area. It contained the largest amount of archaeology uncovered and was centred around T10/1052. A large shell midden was uncovered beneath the turf during the first strip along the earth bund, with one further medium and two small midden uncovered in the area (Figure 3-3, Figure 3-11). The two larger midden – numbered (3) and (5) – appeared to be located on slight rises above the surrounding topography. This was thought to be simply due to the shell itself creating a higher landform; however, south of (3) a slight ridge was apparent extending towards the estuary.

The large midden (3) measured 33m x 14m and was a rough oval oriented east–west. The slight rise in the topography on which it was located was oriented northeast–southwest and extended beneath the bund at the edge of works (Figure 3-4). On the surface the density of shell was greatest in the western end with more fragmented and moderately dispersed areas at the eastern end.

The shell was predominantly tuangi/cockle (*Austrovenus stutchburyi*) and pipi (*Paphies australis*) with some areas of higher concentration of pipi. Some concentrations of pipi were very large individuals (Figure 3-5). Other species included ostrich foot, cat's eye and speckled whelk. The northern edge of the midden had modern farming material dumped on top of the shell, causing some damage. A dog jaw was found on the west side of midden on the surface. Fire-affected stones, charcoal and ash were present in varying quantities with some areas having a high concentration of ash and charcoal, with the shell in these areas being more fragmented and burnt.

Three trenches were hand dug through midden (3) to document the internal stratigraphy and the surface beneath the midden. Trench 1 ran east–west through the centre of the deposit and Trenches 3 and 4 ran perpendicular to Trench 1 (Figure 3-6 to Figure 3-8).

These found that the large midden was thickest and densest at the western side (Figure 3-9, Figure 3-10, Figure 3-12). The shell thinned through the middle before thickening out slightly towards the centre east and thinning out again (Figure 3-13). While appearing as a continuous midden on the surface, the strata suggested main localities of deposition with fragmentation, lateral spread and other post-depositional processes spreading the shell. The shell showed little vertical stratigraphic variation, with the majority of the shell in a single stratum from the surface to the lower sediment layers. However, variation was observed laterally with variation in the density, matrix proportion and fragmentation of the shell units. Smaller pockets of shell were also present with noticeably different species composition, e.g. (19), (20) (see Figure 3-12).

Beneath the thickest deposits of shell in midden (3) a dark brown sandy soil was present that appeared to be a buried topsoil (Figure 3-7, Figure 3-8). The buried soils were not continuous beneath the midden and it is not clear if they were paleosols or in situ pedogenesis. The eastern side of Trench 1 showed a mixed grey, dark grey sand with occasional shell and charcoal inclusions present beneath the main shell layer. This area generally had less shell than the western side.

These layers were clearly visible in the cut at the edge of works that was exposed once the midden was removed (Figure 3-9). The cut at the edge of works also showed that the thickest area of midden deposit was on a slight rise in the topography (Figure 3-10), which continued to the south towards the estuary. It appears a slight ridge was the initial location of shell deposition.

Features were encountered in Trench 1 at the western and eastern sides in multiple stratigraphic positions. At the western side a firescoop was identified cut through the lower layers (29) through the basal sand and cut into the main shell deposit (21) (26). These layers were all within the thickest area of the deposit (Figure 3-14). The firescoops found in the eastern side of the trench were cut through the main shell deposit to the underlying sand (Figure 3-15). These were at the edge of the midden where it thinned out towards the east.

Two trenches were excavated north–south (Trenches 3 and 4) perpendicular to Trench 1 (Figure 3-6). Trench 3 found that the shell thinned to the north of Trench 1 in a gentle slope and continued or thickened to the south of Trench 1 (Figure 3-16).

Trench 4 found that the shell thinned to the south and north of Trench 1, though the top of the shell remained level to the south but sloped down to the north (Figure 3-17).

Figure 3-3. Looking west across Area 1 after initial stripping

Figure 3-4. West end of largest midden in Area 1, looking southwest (scale interval 200mm)

Figure 3-5. Large pipi on surface of midden (3)

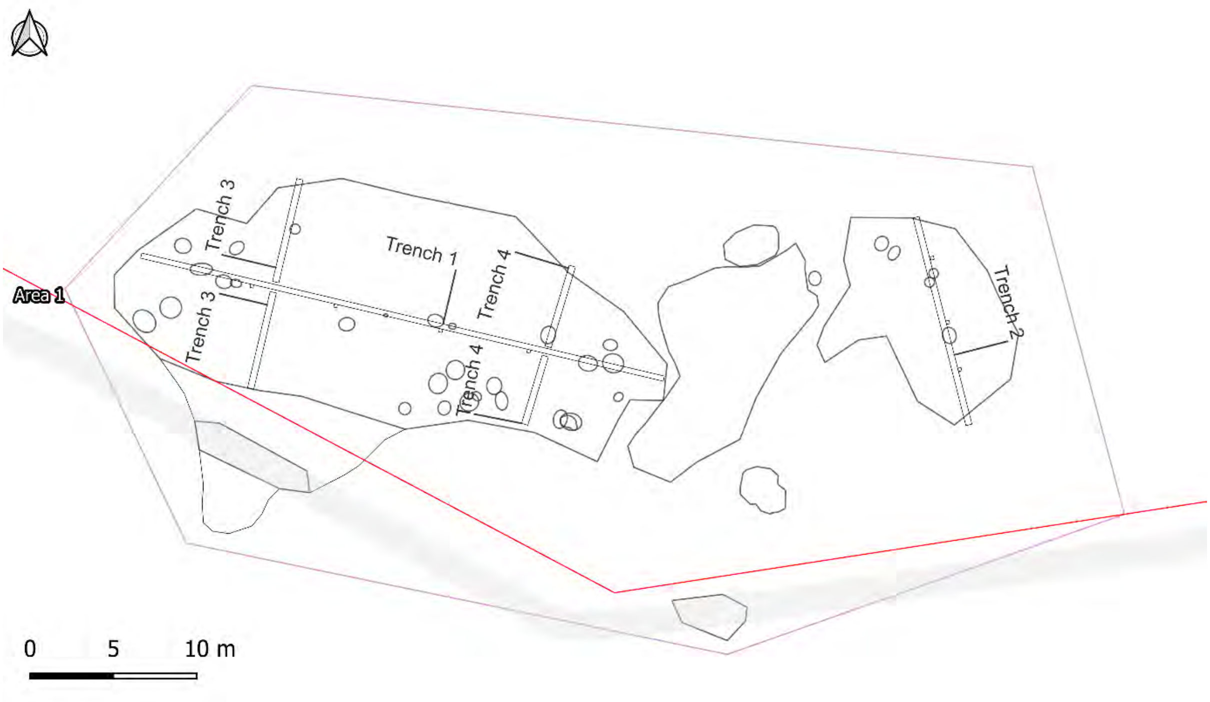


Figure 3-6. Plan showing trenches in Area A

Figure 3-7. Looking southwest at west side of Trench 1 (scale interval 200mm)

Figure 3-8. Looking southeast at east side of Trench 1

Figure 3-9. Looking south at the edge of works cut showing midden (3) in section (scale interval 200mm)

Figure 3-10. Looking south at the edge of works cut showing midden (3) in section (scale interval 200mm)

Figure 3-11. Plan of archaeology in Area 1

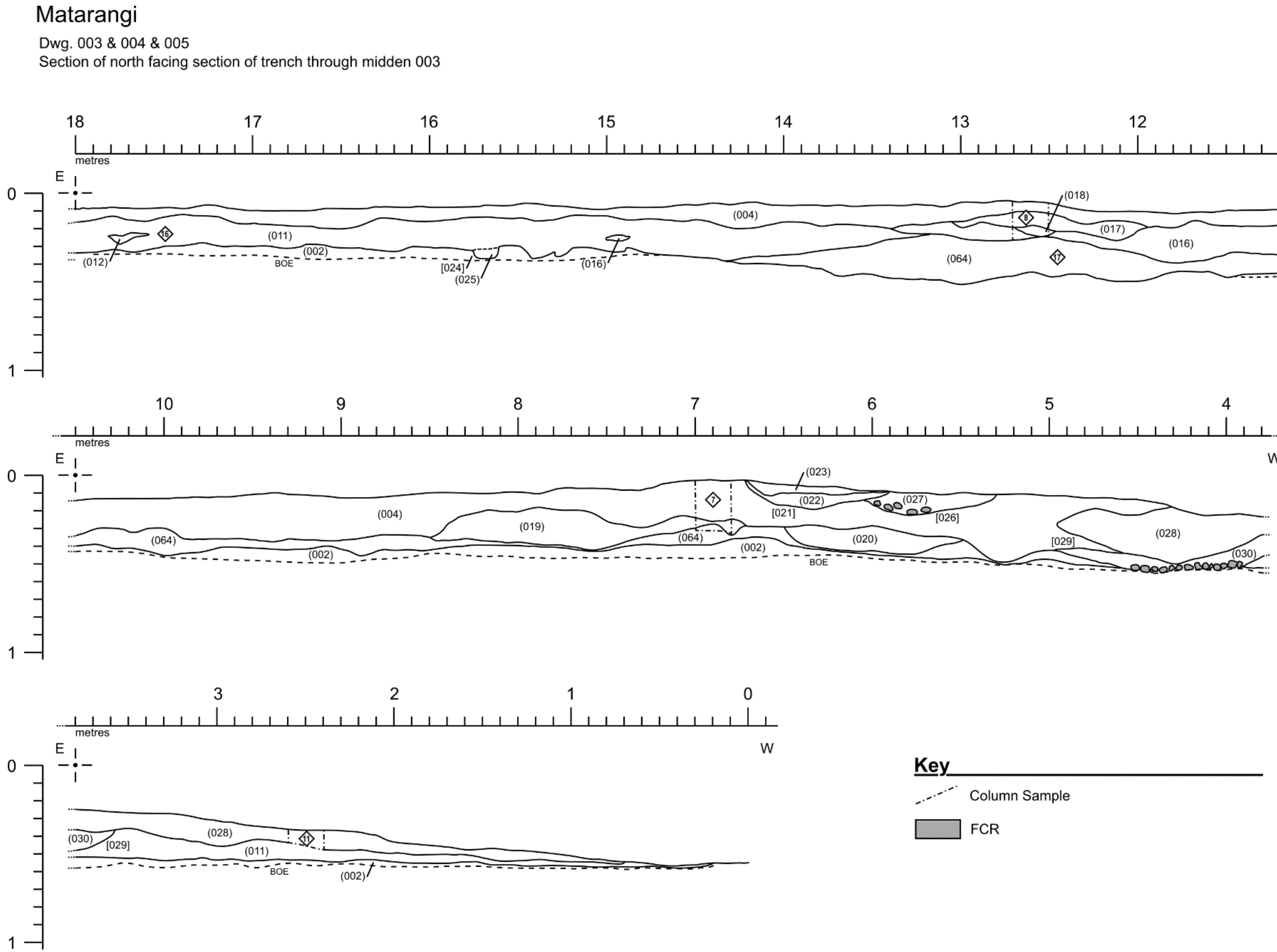


Figure 3-12. North facing section Trench 1 (west)

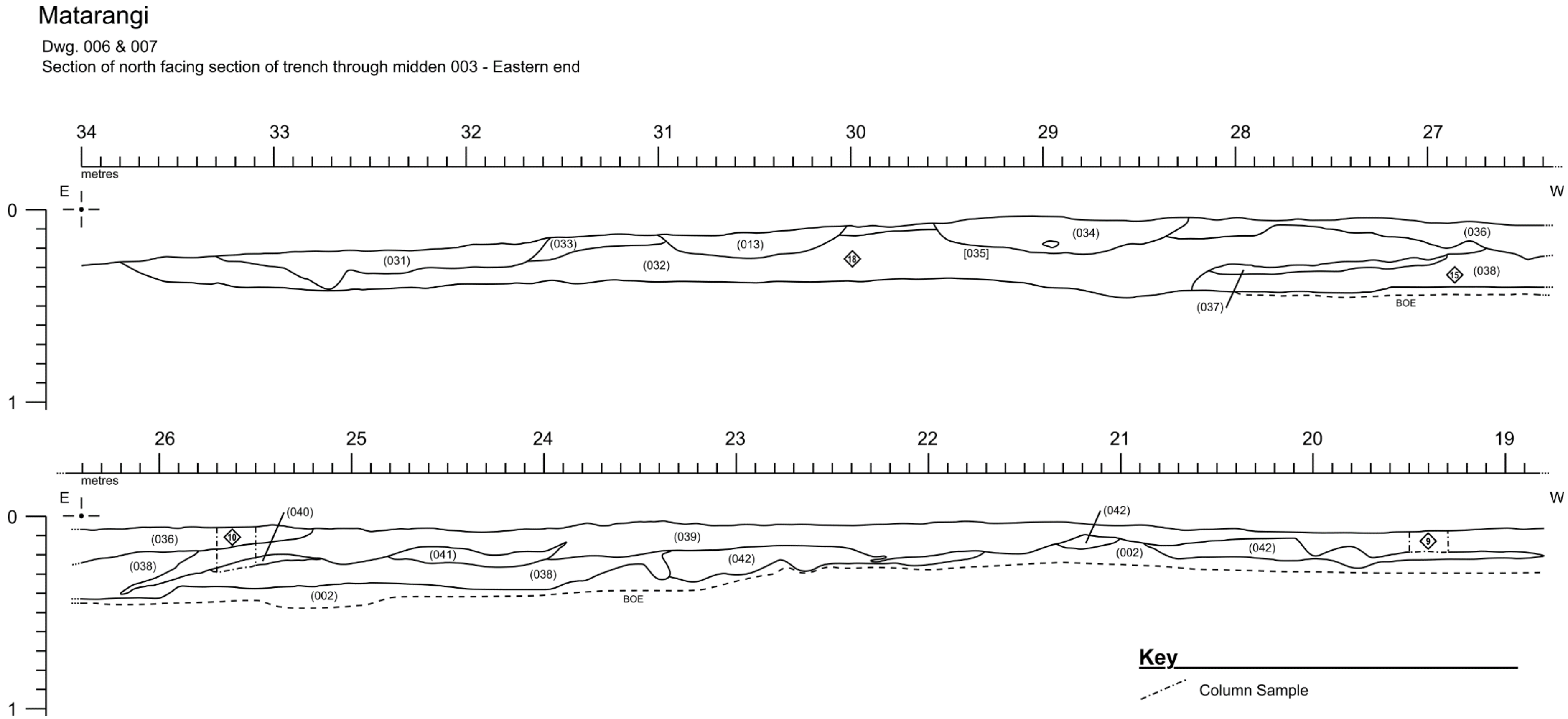


Figure 3-13. North facing section Trench 1 (east)

Figure 3-14. Firescoop [29] in base of Trench 1 in Area 1

Figure 3-15. Firescoop [29] in south–north section of Trench 1 in Area 1

Figure 3-16. Trench 3 (scale bars run parallel) and Trench 1 looking southeast (scale interval 200mm)

Figure 3-17. Trench 1 (scale bars run parallel) and Trench 4 looking southeast (scale interval 200mm)

The second largest deposit with substantial shell located in the east of the area (5) measured 12m x 13m (Figure 3-6). While context (7) was similar in extent it was an area of sparse highly fragmented shell rather than a shell deposit. Trench 2 was excavated roughly north–south along the long axis of the deposits. The other smaller deposits were spade tested, finding they were no more than surface scatters. The two small deposits measured 3m x 3m (6) and 3m x 4m (8).

Trench 2 showed the midden was significantly more dense and thicker at the southern end and thinned to the north where the shell became more fragmented (Figure 3-18, Figure 3-19, Figure 3-20). The major difference in composition between the north and south ends was fragmentation and density. Similar to the large midden (3), beneath the shell was a dark grey-brown sandy soil. This was present across the entire midden but was thicker where the shell was thin in the north, and vice versa in the south. Firescoops were found in the section, concentrated in the north end, where the shell was thinner. The pattern suggests that cooking or processing was carried out in the north of the deposit with shell being disposed of southwards.

The area between the midden deposits was cleared using hand tools to test for any small features such as postholes or further firescoops that were not observed due to the weather conditions during the initial stripping of the soil. No small features were found.

During the monitoring carried out in the esplanade path works further deposits were uncovered associated with the archaeological site T10/1052. An additional extension of midden (3) was found southwest of the main deposit (Figure 3-21), numbered 122 in Figure 3-11. The shell was located on the top and western slope of the slight ridge that ran southwestwards from the main deposit (Figure 3-22). The shell composition was a continuation of the trends seen to the north in (3). A second deposit of shell was uncovered to the south of midden (6) and (7), numbered 123 in Figure 3-11. This was three concentrations of varying size covering a total area of $2m^2$. The composition was the same as that of the other middens found in the area.

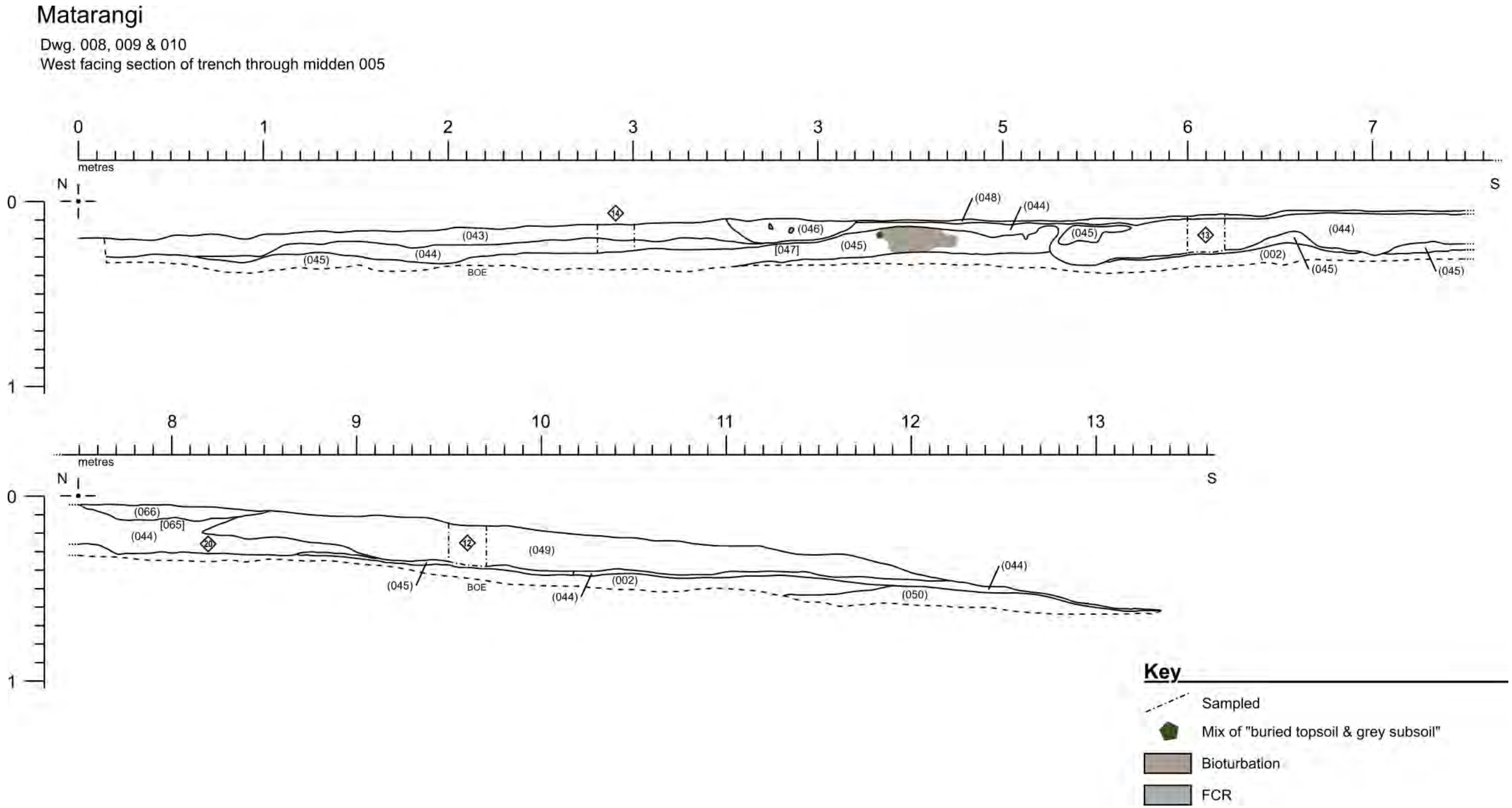


Figure 3-18. West facing section of Trench 2

Figure 3-19. Looking northeast at Trench 2

Figure 3-20. Looking southeast at Trench 2

Figure 3-21. Shell midden uncovered south of midden (3) during esplanade works, looking south (scale 200mm)

Figure 3-22. Looking west at slight ridge in south end of Area 1 (scale interval 200mm)

3.2.2.2 Features

A total of 41 features[2] were found in Area 1 consisting of 39 firescoops and two rock caches (Figure 3-11, Figure 3-23). No evidence of structures was found.

Firescoops were identified cut into the surface of the two large middens (e.g. Figure 3-24), with only a single firescoop (context 63) located in an area outside the midden areas. This would suggest the disposal and processing of shellfish were very closely related spatially. Additional firescoops were encountered during the trenching below and within the midden layer. Removal of the shell in roughly 50mm spits found several firescoops were within the midden and cut into the pre-midden ground surface of the large midden (Figure 3-25).

Of the firescoops, only four were clearly cut through the underlying sand, although none were stratigraphically differentiated from the midden above. Eleven of the features were found within the large midden (Figure 3-25), where shell encompassed the feature on both the top and bottom. A large portion of these were clustered on the southern side of the midden, west of Trench 4.

The firescoops showed some variation in the shape, size and fill across the site. However, generally they were oval to round and shaped like a shallow bowl. Similarly, the fills of many of the features were highly fragmented, ash and charcoal filled. This contrasts with many areas of the surrounding shell in the midden that appeared to exhibit lower quantities of ash and charcoal and a larger portion of whole shell.

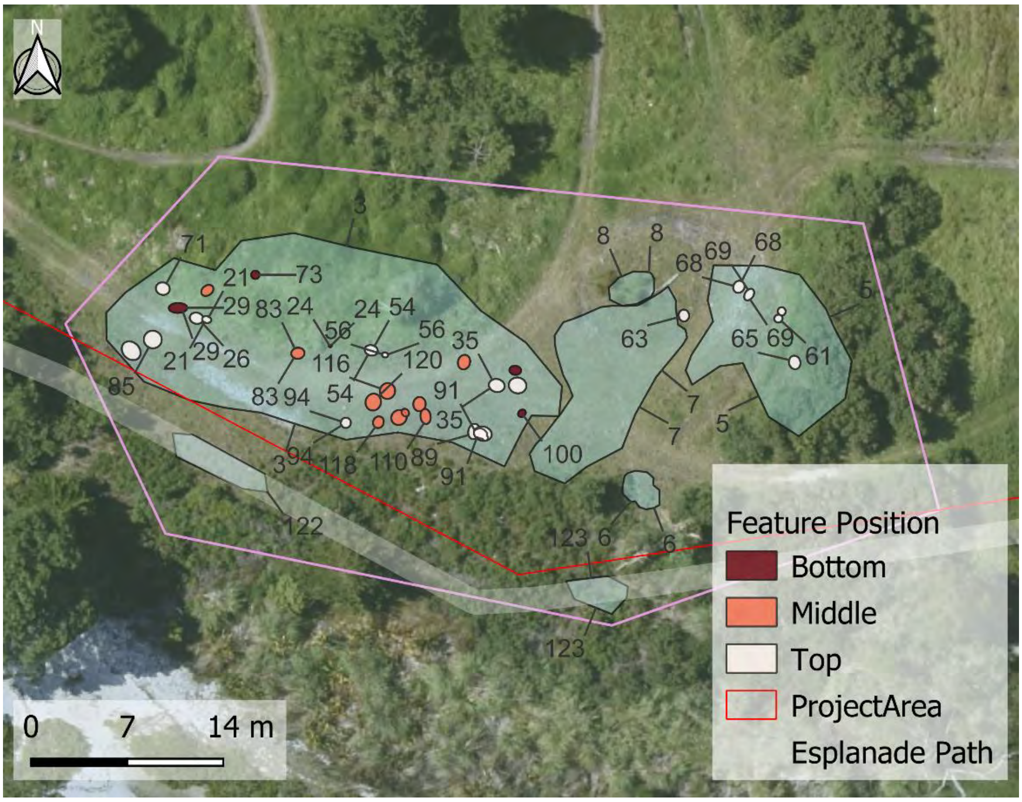


Figure 3-23. Stratigraphic position of features in Area 1

---

[2] Note: dGPS survey data taken during the excavation of feature locations was lost. Not all features could be relocated using available data.

Figure 3-24. Firescoop [71] in the top of midden (3) (scale interval 200mm)

Figure 3-25. Firescoop [83] within large midden in Area 1 uncovered during shell removal (scale interval 200 mm)

Figure 3-26. Half sectioned firescoop [63] looking northeast (scale interval 100mm)

Figure 3-27. Base of firescoop [14] (scale interval 100mm and 10mm)

3.2.3 Area 2 (T10/1047)

Area 2 was located to the east of Area 1, past the farm drain, and was centred around T10/1047 (Figure 3-1). The area consisted of one moderate sized midden covering an area of 12.5m x 9.5m oriented northeast–southwest (Figure 3-28, Figure 3-29). Some of the midden was lost during the initial stripping as the heavy rains made ground visibility difficult and some over-cutting of the ground occurred.

Generally, the midden was of moderate to sparse density but varied over the area of shell. It appeared that an originally more concentrated shell deposit had been dispersed and laterally spread through post-depositional processes. The shell had moderate to high fragmentation and was dominated by cockle with minor pipi, common charcoal and occasional fire-affected stones. The shell appeared to be more disturbed and dispersed than the middens in Area 1.

Test pitting found that the midden was no more than 130mm thick with much of it less than 50mm, so a trench was not excavated. Instead, as the midden was stripped away to expose any sub-midden features, a baulk through the middle was maintained. This created a section running north–south, which was then recorded. This showed the midden was densest and thickest at the southern end but was far less substantial than the two larger middens in Area 1.

Seven features were uncovered in Area 2 (Figure 3-28) consisting of 4 firescoops, 1 posthole and 2 rock caches. The rock caches (e.g. Figure 3-30, Figure 3-31) were both found past the northern edge of the midden rather than beneath, as most features were in the other areas.

Additionally, an adze fragment was found in the base of a very small rock cache found beneath the centre of the midden (Figure 3-32).

All of the archaeology uncovered in Area 2 was destroyed in the process of investigation and no deposits from the site remain.

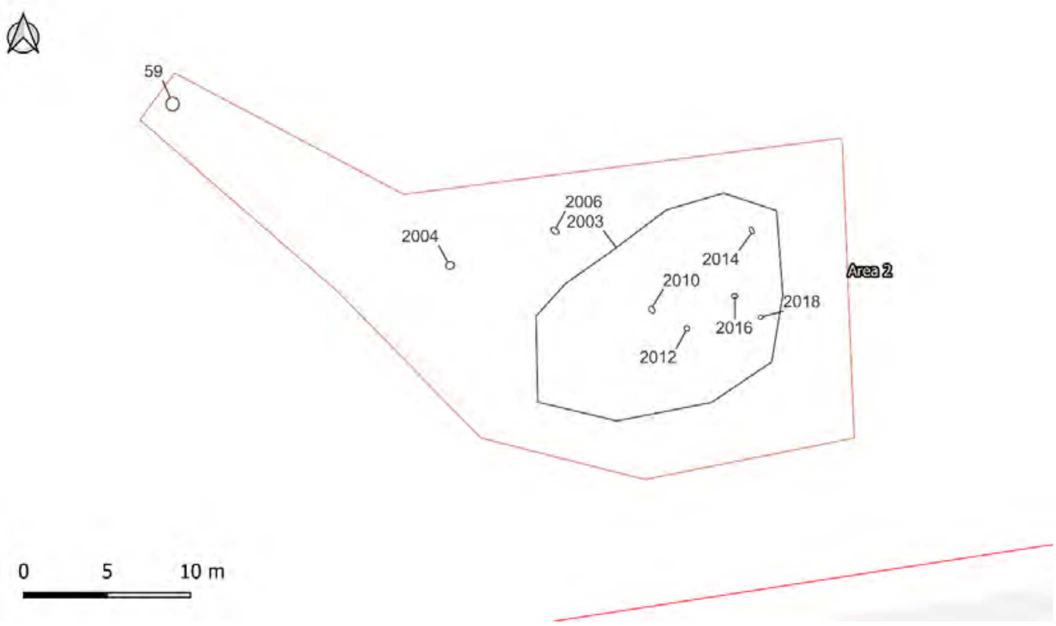


Figure 3-28. Plan of midden and features in Area 2

Figure 3-29. Looking north across partially exposed midden in Area 2

Figure 3-30. Looking southeast over Area 2 after removing shell, with feature [2006] (rock cache) in foreground (scale interval 200mm)

Figure 3-31. Rock cache [2006] pre- (top left) and post-excavation with a close-up of one of the rocks (top right) showing fire-affected red band (scale interval 200mm)

Figure 3-32. Adze fragment

3.2.4 Area 3 (T10/1048)

Area 3 was directly to the southeast of Area 2 centred around T10/1048 (Figure 3-1). The area was dominated by three middens: one moderate sized (3003) and two smaller (3004 and 3005) (Figure 3-33).

The largest midden measured 14m x 7.5m but continued beyond the earth bund at the edge of the works (Figure 3-34 to Figure 3-37). It had varying densities with moderate to high fragmentation, with discrete areas of more whole shell or burnt and higher fragmentation. There was also occasional fire-affected stone with the midden in a dark grey sandy soil matrix that had some ashy areas. The species were dominated by cockle with rare pipi and whelk.

A section cut through the eastern end oriented north–south found the shell varied from 20mm to 100mm in thickness but was generally thin with scatters in between concentrations (Figure 3-36). An underlying subsoil was present in some areas of the section but this varied in thickness, likely due to tree activity from the grove of trees that were located nearby.

The second and third middens were very small, both around 2.2m x 1.2m in size and a maximum of 50mm thick. They had a similar composition to the larger deposit: moderate to low shell density, fragmented and whole shell with some burnt shell. The species were dominated by cockle with rare mudsnail. The two deposits were closer to the area that had been significantly disturbed by the trees and the removal of the trees.

Interestingly, 10 features were found beneath the midden in Area 3, though it was the smallest midden deposit in the first three areas. The features consisted of 7 firescoops, 2 postholes and a single rock cache (Figure 3-38). The relatively small size of the area meant the firescoops were clustered together, creating a relatively high density of features compared to the other areas of the investigation.

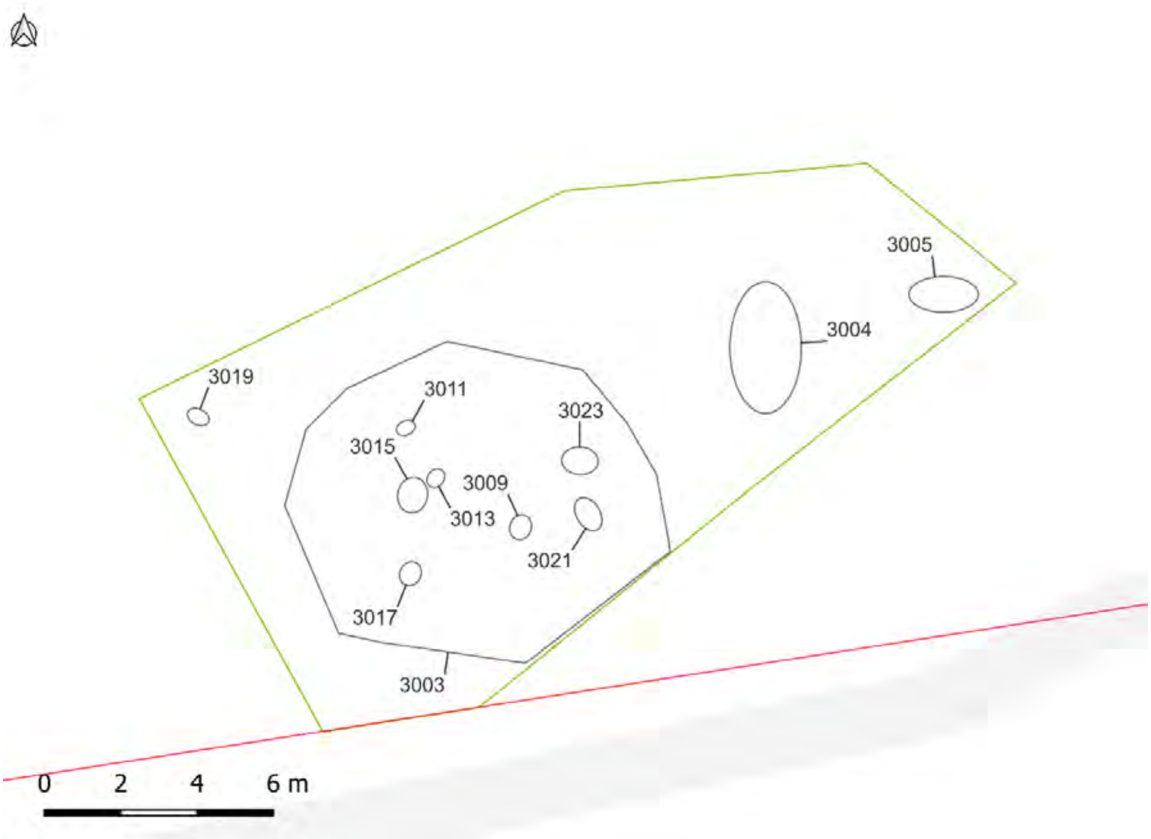


Figure 3-33. Plan of midden and features in Area 3

Figure 3-34. Looking east at Area 3

Figure 3-35. Looking northwest across Area 3 before removing shell

Figure 3-36. Section through midden (3003) looking west (scale interval 200mm)

Figure 3-37. Looking west at Area 3 after removing shell midden (scale interval 200mm)

Figure 3-38. Rock cache [3019] with pre-excavation photo (inset) (scale interval 200mm)

3.2.5 Area 4 (T10/1051)

Area 4 was investigated in the second phase of works after all investigation had been carried out in Areas 1-3, with the shell stripped off, all features recorded, and all sampling completed. These areas were then handed over to the earthmover contractor.

Area 4 was to the northeast of the other areas, on the north side of the inlet (Figure 3-2, Figure 3-39, Figure 3-40). The area was focussed on T10/1051, which in the assessment was considered likely to have significant deposits in situ. The high gorse and tee tree scrub to the south of an exposed area of shell was cleared to the edge of the inlet to find the extent of the site. This found the shell extended almost to the edge of the inlet and continued eastwards with substantial disturbance caused by the roots of a mature tree.

However, marking out the planned edge of works established that the site was not to be affected by earthworks. A sample was taken from the exposed midden (Figure 3-39), the extent was surveyed in and the deposit was re-covered with soil.

A 3m buffer from the edge of works was marked out and the soil stripped off to test for any further deposits near the site. Only two features were found in the area stripped: one small firescoop (Figure 3-41) and one small posthole. These were left in situ and covered over.

Figure 3-39. Looking east at area of T10/1051 exposed prior to reburying (scale interval 200mm)

Figure 3-40. Plan of midden and features in Area 4

Figure 3-41. Looking west across the eastern end of Area 4 showing small scoop (scale interval 200mm)

3.2.6 Area 5 (T10/1054)

A small amount of excavation was carried out in the western side of the works area to prepare an area to drive wooden piles for ground stabilisation (Figure 3-1, Figure 3-42). This uncovered part of the previously recorded site T10/1054.

Shell was exposed in the edge of the cut along the western boundary with the freedom camping area. The shell was exposed intermittently along an area of 32m. Some of exposed length of the cut showed disturbed strata with mixed light grey loose sand with dark grey soil and rock inclusions with occasional shell (Figure 3-43). There were also patches of disturbed shell with loose shell and soil intermixed. The disturbance was caused by the construction of the bund at the edge of the property which disturbed, intermixed and redeposited midden and topsoil. The disturbed shell mix could be differentiated as it was deposited above evidence of an intact natural stratigraphic profile of light grey sand beneath a dark grey organic rich sandy topsoil (Figure 3-44).

The in situ deposits were found at the northern end of the area (Figure 3-45). The in situ shell deposit was a dark grey black fine sandy soil matrix up to 220mm thick with moderately fragmented moderately high density shell and occasional charcoal and rock. The shell was similar to that in other deposits investigated, being dominated by cockle with pipi and rare whelk observed. A single feature was observed in the section, being a firescoop at the base of the layer.

The in situ deposit extended further to the north beyond the edge of the excavated area. The shell also extends west beneath the bund and likely into the freedom camping area. It is estimated that up to 70% of the site remains.

Figure 3-42. Plan of Area 5

Figure 3-43. Area of disturbed shell in southern end of Area 5 looking southwest (scale interval 200mm)

Figure 3-44. Looking northeast at centre of Area 5 section (scale interval 200mm)

Figure 3-45. In situ shell deposits in north end of Area 5 looking east (scale interval 200mm)

3.2.7 Additional Sites

3.2.7.1 T10/1049 and T10/1050

During stripping of soil north of the recorded location of T10/1049, east of Area 3 (see Figure 3-2), occasional very dispersed fragments of shell were found (Figure 3-46). This area of the works showed the largest magnitude of disturbance caused by the tree grove and the removal of the trees. The shell was not in situ and no further archaeology was found in the area of works.

T10/1049 was identified during the survey carried out prior to the esplanade path works (Figure 3-47). Probing found a dense deposit of shell up to 200mm thick to the north and west of the proposed path route where it turns north near Lot 164. The shell covered an area 12m east–west and 11m north–south. The site was not affected by the proposed route and was outside the allotment development area, so no further investigation was undertaken.

The area north of T10/1050 had been already cleared of topsoil prior to the archaeological investigations. Discussions with the operator and site manager indicated no archaeological material was encountered during soil stripping. The works did not further affect the site.

Figure 3-46. Area north of the recorded location of T10/1049

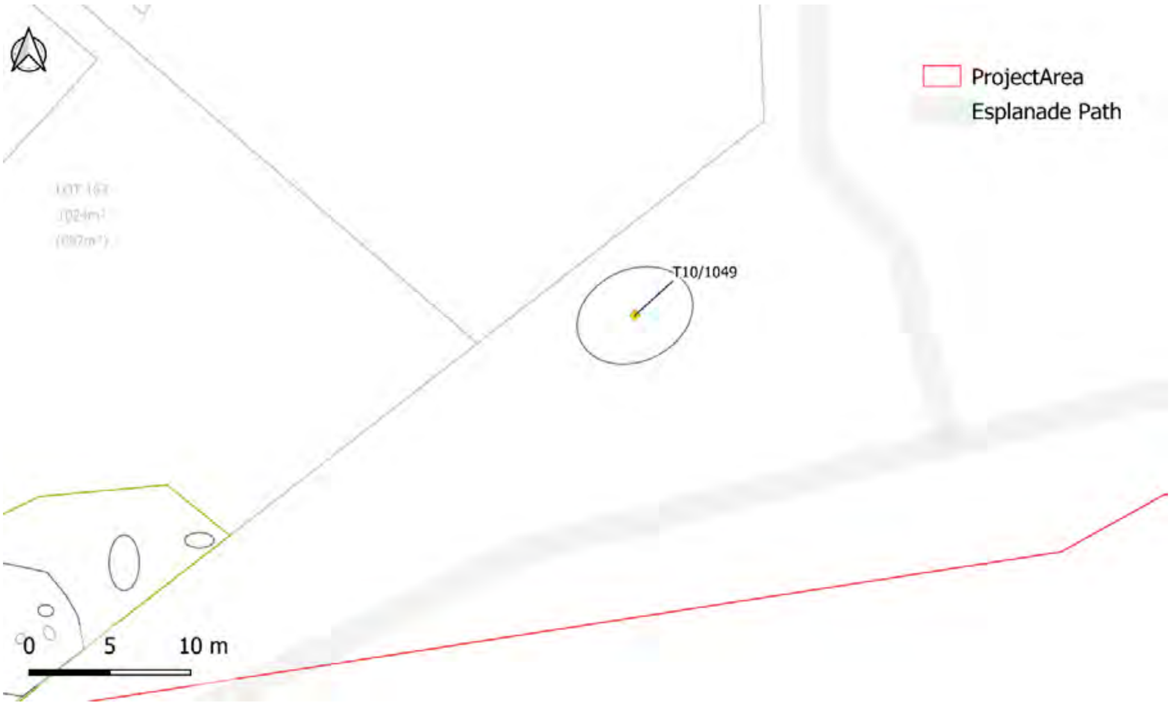


Figure 3-47. Location of 10/1049

3.2.7.2 T10/1172

During the Phase 4 monitoring of the westernmost extent of the esplanade path, at the southwestern end of the airstrip, shell was uncovered. The shell was uncovered 20m west of the boundary of the freedom camping reserve at a depth of 40mm (Figure 3-48). The material was a 1m wide strip of mixed shell and brown sand with rocks throughout (Figure 3-49). The shell was mostly pipi with some cockle present, was in poor condition and the deposit appeared to be disturbed, though it is likely that in situ deposits are in the vicinity. The archaeological authority did not cover the area being worked so the works were halted, and the shell covered up. The path was redesigned to be above ground to avoid further effects. The site was recorded in ArchSite as T10/1172.

Figure 3-48. Location of T10/1172

Figure 3-49. Shell uncovered south of old airstrip looking east (scale interval 200mm)

3.2.8 Summary

A number of midden deposits were uncovered across the southern end of the project area. The deposits were all found in close proximity to the estuary that borders the southern side of the area. The archaeology was concentrated in five areas with all the deposits and features in relatively contained areas. A very small numbers of features were found outside the midden deposit areas.

The densest and most complex archaeology was encountered in Area 1, with extensive midden deposits that had variable stratigraphy vertically and horizontally. The presence of intact stratigraphy appeared to be influenced by the quantity of shell that was deposited in the midden. The largest deposit was located on a small rise in the topography. This was a low, short ridge that ran south towards the estuary and appeared to be the locus for the greatest quantity of shell deposition.

A grey mixed sand was found associated with the large midden in Area 1 with sparse scattered cultural remains such as shell and charcoal present. The layer was not present in other areas away from the midden deposits where the natural stratigraphy was seen. The natural stratigraphy was a dark grey black fine sand topsoil over grey to grey brown Holocene dune sands (Figure 3-50). Additionally, a dark grey black sandy soil that appeared to be a paleosol was present beneath the two large middens in Area 1, though it was non-continuous. It was also in proximity to, but not above or below the mixed grey sand.

The shell deposits uncovered in all the sites appeared to have very similar species compositions through general observation. The shell varied from mostly whole shell to very fragmented, ashy deposits. Fire-affected rock was also common, generally in areas where firescoops were present. Collections of heat retainer rocks were found in caches in two of the areas.

A moderate number of features were found associated with the midden. The majority were fire features, here labelled firescoops. They were generally oval to round in plan with gently sloping sides and a concave base, creating a shallow bowl. There was no relationship between the length and width and the depth, with the features being very shallow with a few exceptions (Figure 3-51, Table 3-3).

A comparison of the areas shows highly variable amounts of features for the amount of shell present. In Area 1, midden (3) had 29 firescoops with an estimated volume[3] of 35m^3, while in Area 3 there were 8 firescoops with an estimated volume[4] of shell of 1.92m^3.

[3] Volume calculated using the formula V=1/3πabh for the volume of an elliptical cone with axis a b and height h. 300mm was used for height to account for the irregular shape of the deposit.
[4] Volume calculated using formula of a cylinder averaging the deposit's depth to 50mm.

Figure 3-50. Looking south at edge of works in Area 1 showing natural stratigraphy (scale interval 200mm, 100mm, and 10mm)

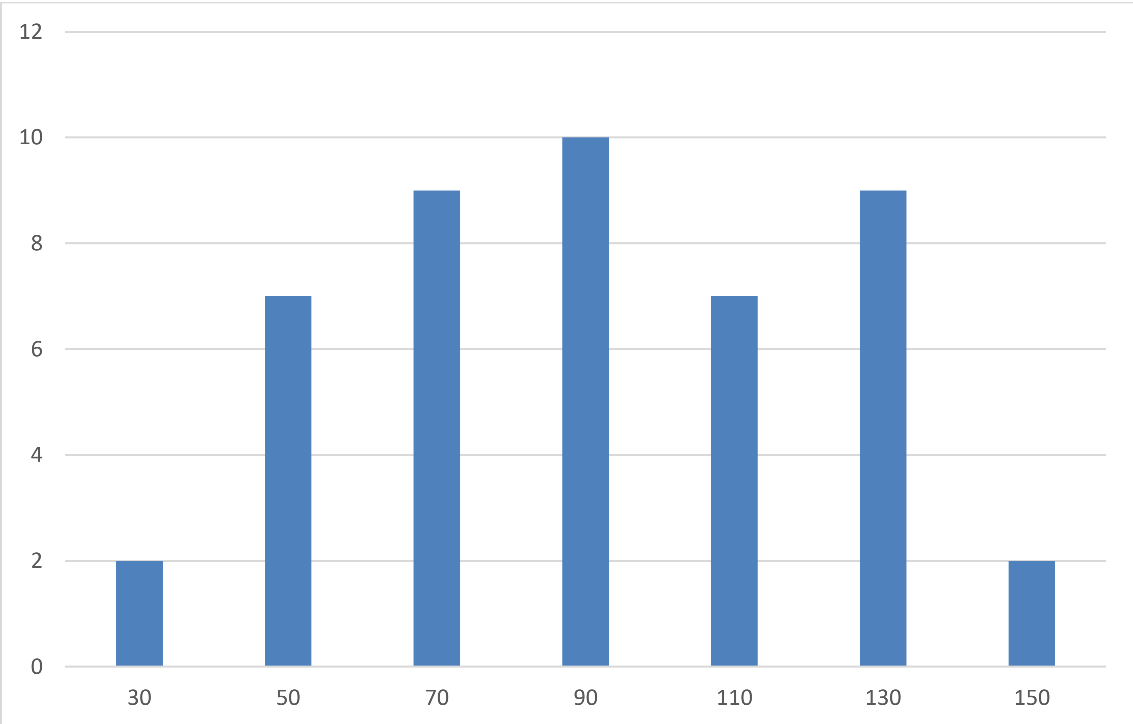


Figure 3-51. Histogram of long axis of firescoops in all areas

Table 3-3. Descriptive statistics of firescoops

	Area			
	1	2	3	4
Min of Length (mm)	58	30	40	68
Max of Length (mm)	150	40	81	68
Mean of Length (mm)	97	37	60	-
Min of Width (mm)	39	27	30	48
Max of Width (mm)	127	36	71	48
Mean of Width (mm)	82	30	52	-
Min of Depth (mm)	8	5	2	10
Max of Depth (mm)	140	10	18	10
Mean of Depth (mm)	33	7	7	-

4 ARTEFACT ANALYSIS

4.1 Introduction

Only a single artefact was recovered from the excavation works. A broken adze (sample 35) was recovered from a rock cache [2018] found in Area 2 beneath the midden (Figure 4-1). The source of the artefact was non-destructively analysed with portable X-Ray Fluorescence (pXRF) by Dr Andrew McAllister and the results are presented in below. The technological attributes of artefacts were examined and described by Dr Joshua Emmitt and are presented in Section 4.3.

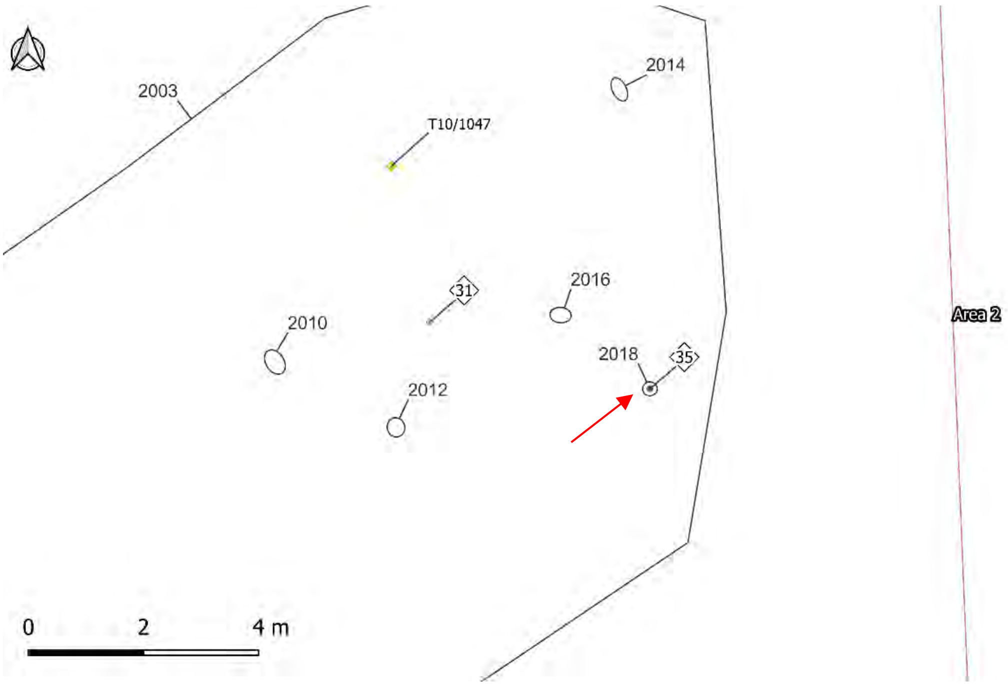


Figure 4-1. Location of artefact in Area 2

4.2 Geochemical Characterization

4.2.1 Methods

In comparison to obsidians, compositional studies of fine-grained stone in New Zealand are not well developed, with the Tahanga basalt quarry at Opito Bay, Coromandel Peninsula, being the only source that has been investigated in detail and published (Felgate 2001). Researchers at the University of Auckland have, however, begun to build comparative compositional databases for fine-grained stone, which, to date, include source samples of materials used for adze production, such as argillite (n=102), basalt (n=40) and greywacke (n=70).

Geochemical analysis of the source reference samples and the adze was carried out at the Anthropology Laboratory, School of Social Science, University of Auckland, using a Bruker Tracer 5i portable X-ray Fluorescence analyser (pXRF). The Tracer 5i employs an

X-ray tube with an Rh target and a 20mm^2 silicon drift detector (SDD), with a typical resolution of <140eV at 250,000 cps. The X-ray tube was operated with a setting of 15keV at 5.0µA, to measure the light elements Mg, Al, Si and P, and a setting of 50keV at 30µA through a filter composed of 25µm Ti and 300µm Al, for the remainder of the elements. A set of reference standards are analysed alongside the artefacts each time the instrument is operated to check for accuracy and consistency (Table 4-1). The adze was analysed three times on different parts of its surface and a Mean of the results is presented in in Table 4-2.

Table 4-1. Comparison of three reference standards' given values to those obtained from the pXRF instrument

	JB-2		NIST-688		AGV-2		
	given	pXRF	given	pXRF	given	pXRF	
MgO	4.62	4.43	8.4	8	1.79	1.71	%
Al2O3	14.64	14.39	17.36	18.18	16.91	16.4	%
SiO2	53.25	52.45	48.4	47.65	59.3	58.51	%
P2O5	0.1	0.13	0.13	0.15	0.48	0.41	%
K2O	0.42	0.39	0.19	0.19	2.88	2.73	%
CaO	9.82	9.64	12.7	12.21	5.2	5.17	%
TiO2	1.19	1.15	1.17	1.14	1.05	0.99	%
MnO	0.22	0.21	0.17	0.17	0.1	0.1	%
Fe2O3	14.25	14.11	10.35	10.56	6.69	6.6	%
V	575	534	250	236	120	110	ppm
Cr	28	22	332	319	17	24	ppm
Ni	17	12	150	143	19	22	ppm
Cu	225	221	96	85	53	60	ppm
Zn	108	101	58	69	86	84	ppm
Ga	17	19	16	14	20	21	ppm
Rb	7	6	2	1	69	67	ppm
Sr	178	182	174	170	658	648	ppm
Y	25	26	21	20	20	22	ppm
Zr	51	49	56	58	230	220	ppm
Nb	2	1	4	4	15	12	ppm
Pb	5	7	3	4	13	18	ppm
Th	0	1	0	2	6	11	ppm

4.2.2 Results

The argillite, basalt and greywacke samples in the reference database can be geochemically separated into rock types using the Linear Discriminant Analysis (LDA) algorithm included in the MASS package for the R software suite (Ripley et al. 2018; Venables and Ripley 2002), and this indicates sample 35 is basalt (Figure 4-2, Table 4-2). A scatterplot of Rb versus Sr and comparison to the source Mean (Figure 4-3) shows that the Tahanga source is a good match for the adze.

Table 4-2. Comparison of the three pXRF analyses of the adze to the Tahanga source Mean

	Analysis 1	Analysis 2	Analysis 3	Adze Mean	Tahanga Mean
MgO	5.25	5.09	5.29	5.21	5.03
Al2O3	14.12	14.07	14.11	14.10	17.38
SiO2	50.90	48.90	49.11	49.64	52.51
P2O5	0.16	0.15	0.15	0.15	0.15
K2O	0.67	0.68	0.76	0.71	0.60
CaO	9.01	8.93	8.91	8.95	9.14
TiO2	1.28	1.16	1.14	1.19	1.08
MnO	0.19	0.18	0.19	0.19	0.21
Fe2O3	10.92	10.18	10.20	10.43	10.45
V	195	189	276	243	22
Cr	264	80	85	83	14
Ni	84	22	21	23	28
Cu	26	68	70	71	95
Zn	76	19	20	20	17
Ga	20	17	15	16	16
Rb	17	293	299	298	301
Sr	303	27	24	26	29
Y	27	106	109	107	97
Zr	106	8	3	6	5
Nb	6	5	9	8	10

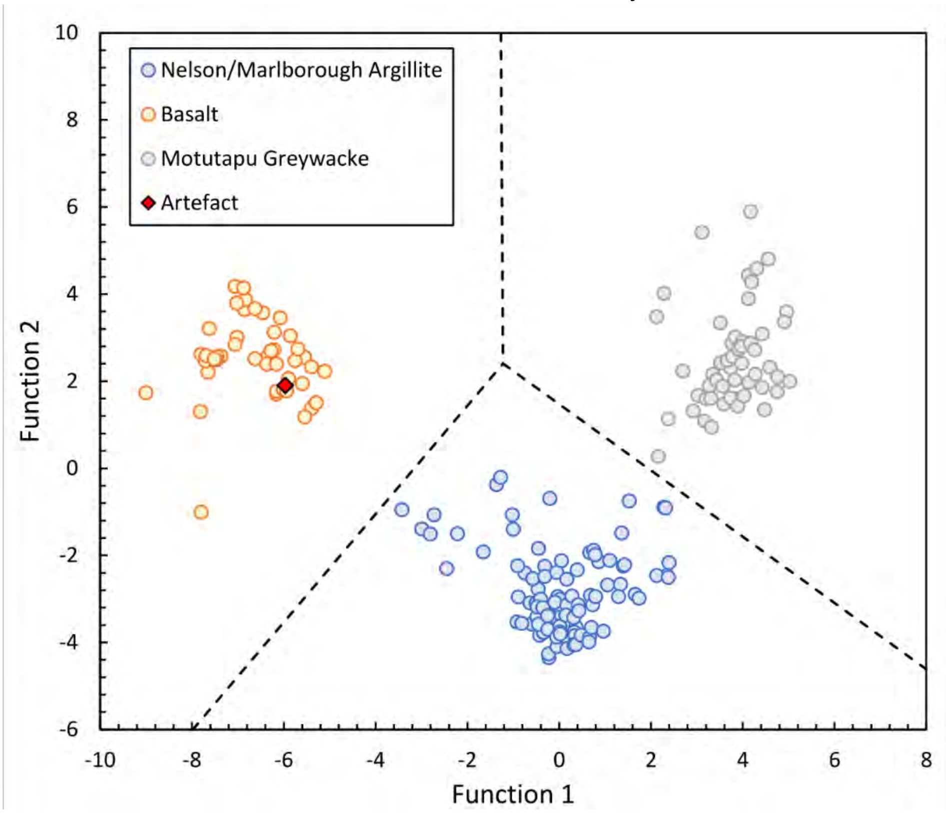


Figure 4-2. Scatterplot of Discriminant Functions 1 and 2 for the three rock types included in the reference dataset and the artefact

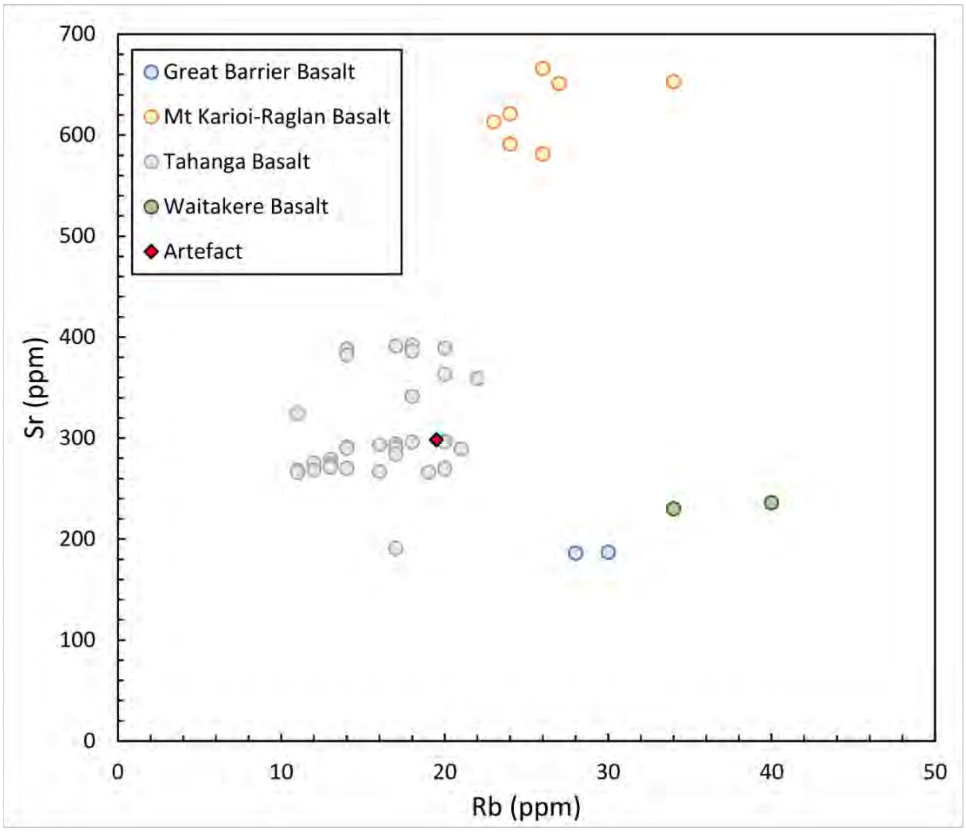


Figure 4-3. Scatterplot of Rb vs Sr, showing the separation of the basalt reference samples and the basalt artefact

4.3 Technological Analysis

4.3.1 Methods

Adzes are described following Turner (2000).

4.3.2 Results

The artefact (

Figure 4-4, Figure 4-5) is a broken adze preform and is likely part of the poll. It has snapped on one side during cortex removal, as 51-75% of the cortex is still present. Cortex removal is evident on the presumed poll side of the preform. The original cobble was rounded and suitable for the end product of an adze based on its shape and size (Table 4-3)

Table 4-3. Maximum dimensions and weight of the artefact

Sample	Raw material	Type	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
35	Basalt	Broken adze preform	76.5	62.8	37.5	342.24

4.4 Summary

The analyses indicate that the broken adze preform is composed of basalt and is chemically consistent with reference samples from the Tahanga basalt quarry at Opito Bay, Coromandel Peninsula. The preform likely represents what would be the poll end of the adze, and it was broken in the early stages of manufacture during cortex removal.

A large number of adzes have been found in the Coromandel area; however, many of these do not have context, having been taken outside of controlled archaeological excavation. A large number are broken roughouts, often misshapen outcomes of failed adze and preform reworking (Turner 2000), a consequence of the close proximity of the source. The artefact found here is another instance, where attempts were made to shape a suitably shaped cobble. The lack of any further flake material illustrates that adze manufacture was not common in the sites investigated. Its context in a rock cache shows its reuse as a utilitarian object, in this case a heat retainer.

Broken adze preforms were often reworked into smaller forms (Gumbley 2007). The discard of this piece and reuse as a heat retainer could be indicative of good access to further high-quality stone such that this cobble could be wastefully discarded since it was of lesser quality.

Figure 4-4. Adze fragment

Figure 4-5. Adze fragment .

5 Faunal Analysis

5.1 Introduction

Midden sampling was carried out using two methodologies. The large midden deposits of Area 1 were sampled using column sampling to test for non-visible stratigraphic variability. The second method was taking bulk samples of 10L from midden deposits with no apparent stratigraphic variability and from firescoops.

The methodology of column sampling was a 200mm x 200mm column excavated in 100mm spits to the end of the shell material. Five columns were sampled from midden (3), roughly equidistant along the trench, to ensure that a range of strata were sampled. Two of the columns were selected for further analysis, column 1 (sample 7) and column 4 (sample 10). This method allows for exploring differences both horizontally and vertically in the composition of the midden.

A total of 16 samples were analysed by Leah Harding and Jennifer Low. Of these, 11 were column spits from four column samples. Two of the columns were from midden (3) (sample 7 with four spits and sample 10 with three spits) and two from midden (5) (sample 12 and sample 13 with two spits each. Five 10Lsamples were analysed, one each from midden deposits in Area 2 (sample 31), Area 3 (sample 32) and Area 4 (sample 39), and two from firescoops from Area 1 (sample 3 and sample 30).

5.2 Methodology

The samples were wet sieved with a 2mm sieve with any charcoal and fishbone floated and separated during this process. The separated components were air dried and weighed.

Identifiable shells were sorted and analysed by taxon. Preferred habitat was also noted for further analysis. The analysis of each taxon examined six aspects: the Minimum Number of Individuals (MNI), MNI percentage, the Number of Identified Specimens (NISP), NISP percentage, weight (in grams) and weight percentage.

NISP is calculated by counting the total number of identifiable shells for each species. For bivalves to be counted an umbo was the minimum requirement. For gastropods whole or nearly whole terminal spires or a complete anterior canal were counted.

MNI is calculated for bivalves by separating the shells into left and right hinge. The larger number is the calculated MNI and the NISP is the sum of the left and right hinges. For gastropods the MNI is the largest number counted of the two methods for identifying individuals and NISP is the sum of the two.

Shell dimensions were analysed to explore what range of sizes were represented in the assemblage. This was carried out on tuangi/cockle. Only complete shells were measured and a measurement in millimetres was made of the distance between the widest two points on the shell.

Figure 5-1. Location of analysed midden samples Area 1 – column samples 7 and 10 from midden (3), samples 12 and 13 from midden (5) and firescoop samples 3 and 30 from midden (3)

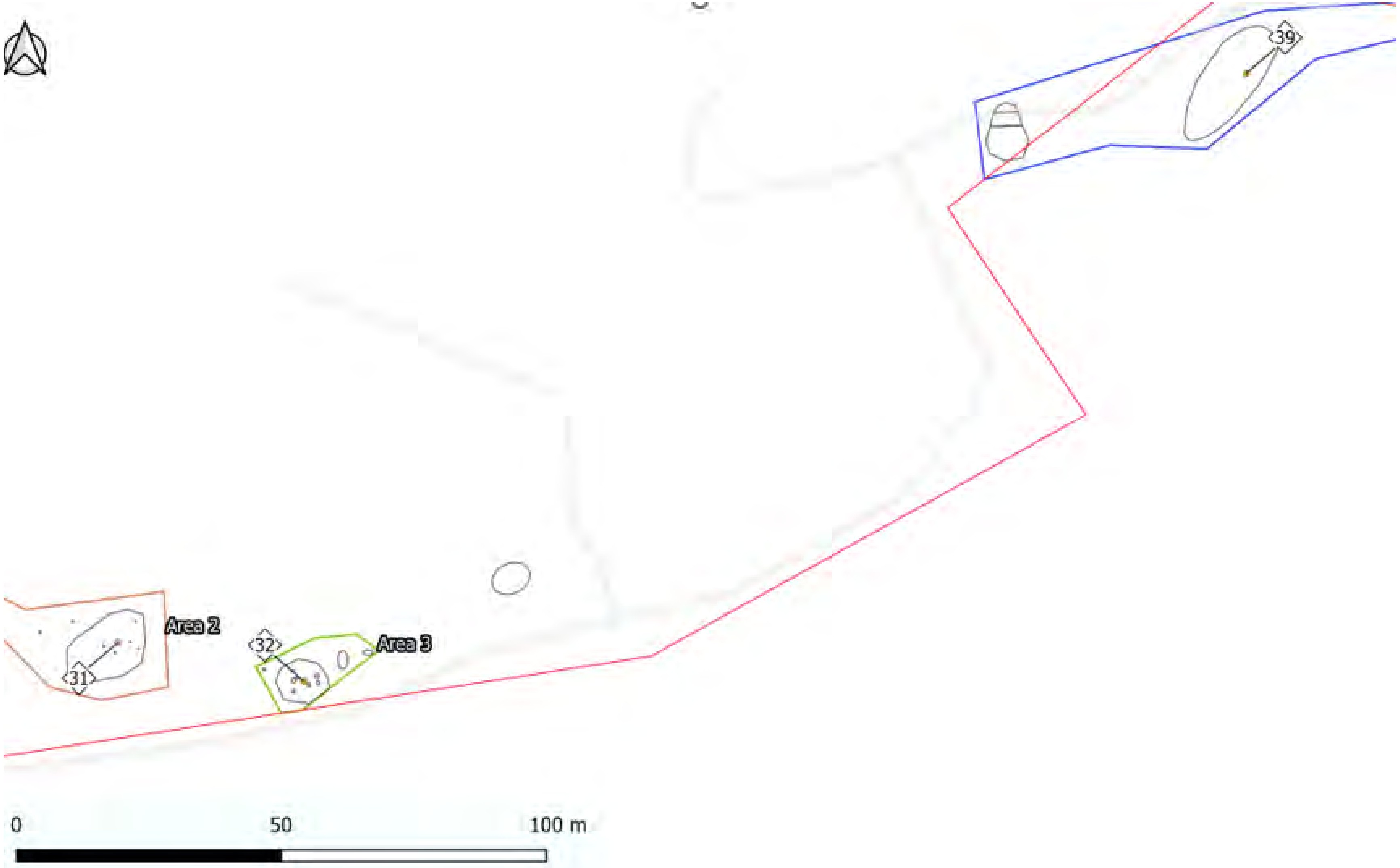


Figure 5-2. Location of bulk midden samples eastern end of project area – Area 2 sample 31, Area 3 sample 32 and Area 4 sample 39

5.3 Results

The results are presented in three parts to reflect the resolution of the data and address different research questions:

1. How do the different deposits compare across the landscape?
2. What internal variability is seen within large midden deposits?
3. How do midden deposits compare to firescoop fills?

5.3.1 Bulk Sample Results

5.3.1.1 Composition

The midden analysis of the 10L samples[5] and the amalgamated columns from across the project area shows the samples were dominated by three main components, sediment, shell and unidentified shell (Figure 5-3, Table 5-1). The portion of these three varied substantially across the samples with sediment ranging from 27% (sample 39 from Area 4) to 78% (sample 31 from Area 2). While sample 39 had a low portion of sediment and a higher relative portion of shell, it also had the largest portion of unidentified shell. Comparably, while sample 32 from Area 3 also had a small amount of sediment (39%) it had a high portion of identified shell (28%). Aside from sample 39, the trend appears to be the lower the sediment portion the higher the identifiable shell.

The proportions of identified shell, unidentified shell and sediment likely are a result of the formational histories of the shell deposits. The variability seen across the samples is due to the variability in formation and the depositional and post-depositional processes that acted to create the archaeological record.

5.3.1.2 Fragmentation

The fragmentation ratio is a metric that can be used to explore some of the formational processes that have acted to create the deposits. Particularly, it is a metric of the breakdown of shell in a deposit that can be attributed to mechanical and chemical processes. The ratio is presented as a coarse metric of the level of breakdown that has occurred in a sample. It assumes the shellfish is collected whole and various processes such as chemical breakdown through heat in cooking, breakage in discard, mechanical breakage through trampling and vegetation infiltration act to fragment the shell.

The ratio is calculated by the identifiable shells separated into those with over 50% of the shell intact and those with less than 50%. The MNI of the less than 50% portion was divided by the greater than 50% portion. The ratio was calculated for tuangi/cockle across all samples and pipi for four of the six samples.

Overall, the ratios are relatively low with all under 1 except sample 10 combined with 1.4 for tuangi (Figure 5-4, Table 5-2[6]).The two combined column samples (7 and 10) were

[5] The firescoop samples are discussed separately below.

[6] Based on the current data collected for fragmentation ratios, from over 140 assemblages, the results could be into six groups: very low = 0-1.5, low = 1.51-2.5, moderate = 2.51-4.5, high = 4.51-10, very high = 10.01-16, and extreme = 16.01+. These groups are roughly organized according to percentiles, with approximately 20% of the total numbers of samples assigned to each group, except for the last two which are around 10% each.

higher than the others at 0.92 and 1.4 while the other four samples were between 0.46 and 0.63. This is interesting as it suggests a higher fragmentation in the column samples even though the columns were taken from the thickest midden deposits.

It is assumed that a thicker deposit will be less fragmented as the thickness of shell will protect the lower layers from chemical and mechanical breakdown. However, as the results suggest the alternative, this clearly points to the larger deposit having more complex formation that has resulted in a higher aggregate fragmentation. The fine-grained analysis may shed light on these differences.

The low ratios across the project indicate the midden sites are relatively unfragmented. This may be interpreted as a lower duration or magnitude of post-depositional processes acting on the deposits. One likely reason is that their location on the edge of farmland has meant little disturbance from modern activity.

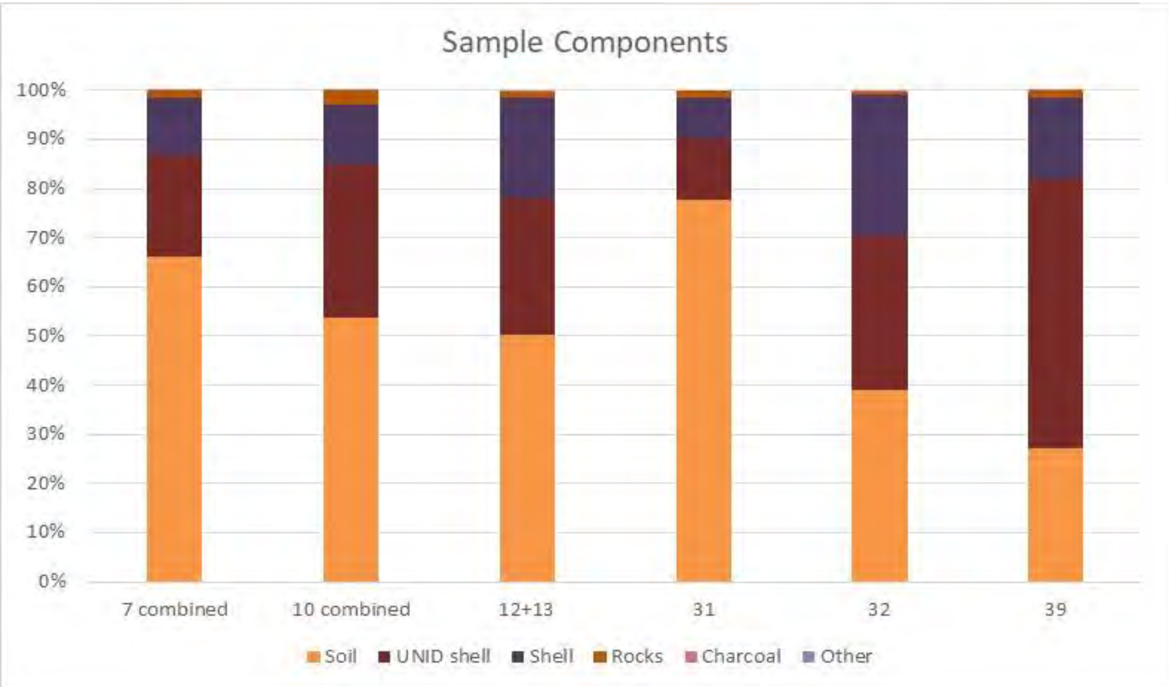


Figure 5-3. Sample components of the bulk sample analysis samples (samples 7 and 10 from Area 1 midden (3); samples 12 and 13 from Area 1 midden (5), sample 31 from Area 2; sample 32 from Area 3 and sample 39 from Area 4)

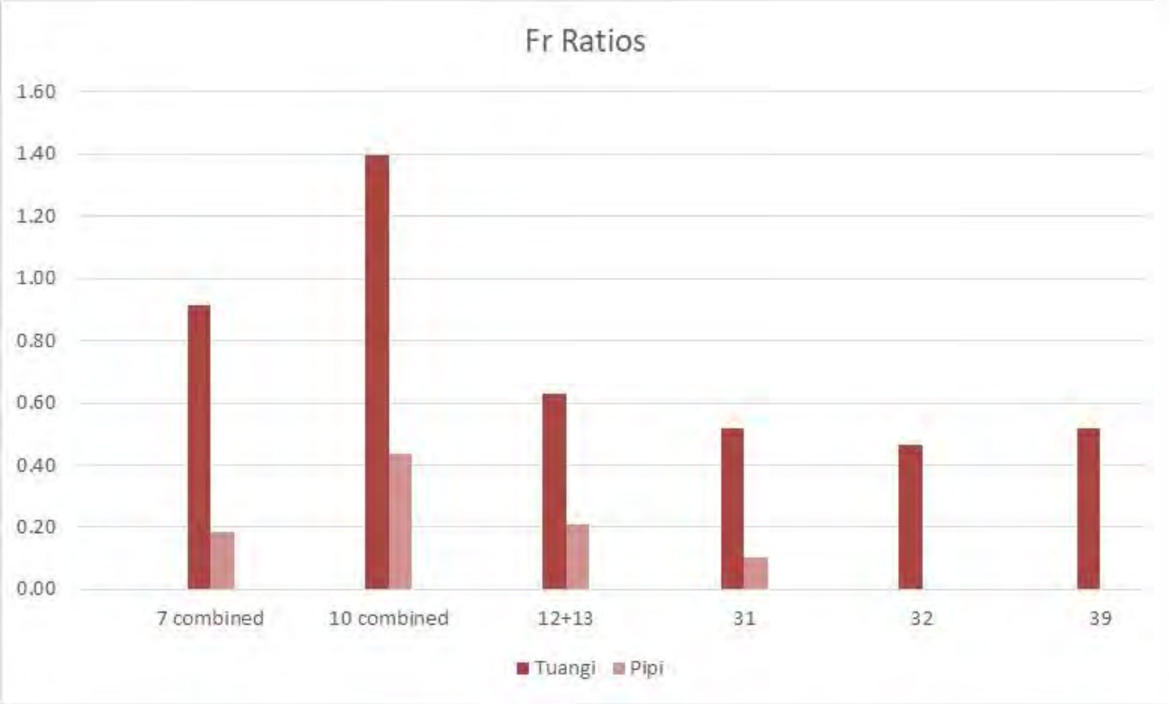


Figure 5-4. Fragmentation ratios of the bulk sample analysis samples

Table 5-1. Sample components of the bulk sample analysis samples

	7 combined		10 combined		12+13		31		32		39	
Soil	9521	66.2	4994	53.8	5675	50.4	8225	77.6	3830	39.0	2249	27.3
UNID shell	2971	20.7	2902	31.3	3129	27.8	1315	12.4	3098	31.5	4516	54.8
Shell	1681	11.7	1123	12.1	2285	20.3	911	8.6	2795	28.4	1357	16.5
Rocks	183	1.3	261	2.8	143	1.3	148	1.4	72	0.7	104	1.3
Charcoal	23	0.2	2	0.0	37	0.3	0	0.0	32	0.3	15	0.2
Other	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	14379	100.0	9282	100.0	11269	100.0	10599	100.0	9827	100.0	8241	100.0

Table 5-2. Fragmentation ratios of the bulk sample analysis samples

	7 combined		10 combined		12+13		31		32		39	
	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio
Tuangi <50%	140		162		29		32		162		126	
Tuangi >50%	153	0.92	116	1.40	46	0.63	62	0.52	349	0.46	185	0.68
Pipi <50%	7		7		29		8					
Pipi >50%	38	0.18	16	0.44	140	0.21	78	0.10				

5.3.1.3 Species

The species results show a moderately low to very low evenness and generally low richness. The two main species present were tuangi/cockle (*Austrovenus stutchburyi*) and pipi (*Paphies australis*) with very small numbers of other species present.

In four of the six samples tuangi dominated, having above 80% of the total MNI with pipi being between 1.1 and 12.4% in those samples (Table 5-3, Figure 5-5). Two of the samples differed in being equal portions (sample 31) and with pipi being the dominant species (sample 12+13) with 65.3% of the total MNI.

The small amounts of other species (Figure 5-6) were no more than 3% of the total of MNI of each sample. Some were small gastropods such as mudflat whelk (*Cominella glandiformis)* or wheel shell (*Zethalia zelandica*), likely taken as a by-catch with the main species. Others may reflect opportunistic harvest taken as a supplement when found, such as titiko/mudsnail (*Amphibola crenata*), kawari/speckled whelk (*Cominella adspersa*) and tio reperepe/rock oyster (*Saccostrea glomerata*).

The pipi dominant sample was the amalgamated columns from midden (5) but the sample where the portions were roughly equal was from the midden in Area 2 (sample 31, context 2003). This indicates there is variation in midden species composition across the different sites and it is unlikely to be simply due to sampling bias. An example where sampling bias is potentially present is in the large midden (3) from Area 1. The qualitative descriptions of (3) indicate there were areas with a high amount of pipi present. The two samples analysed (sample 7 and sample 10) show relatively low amounts at 12.4 and 7.4% respectively. The amalgamated columns do present a representation of the variability present in the midden; however, when considering the relative proportion of the samples compared to the size of the midden it is unlikely they reflect a representative sample.

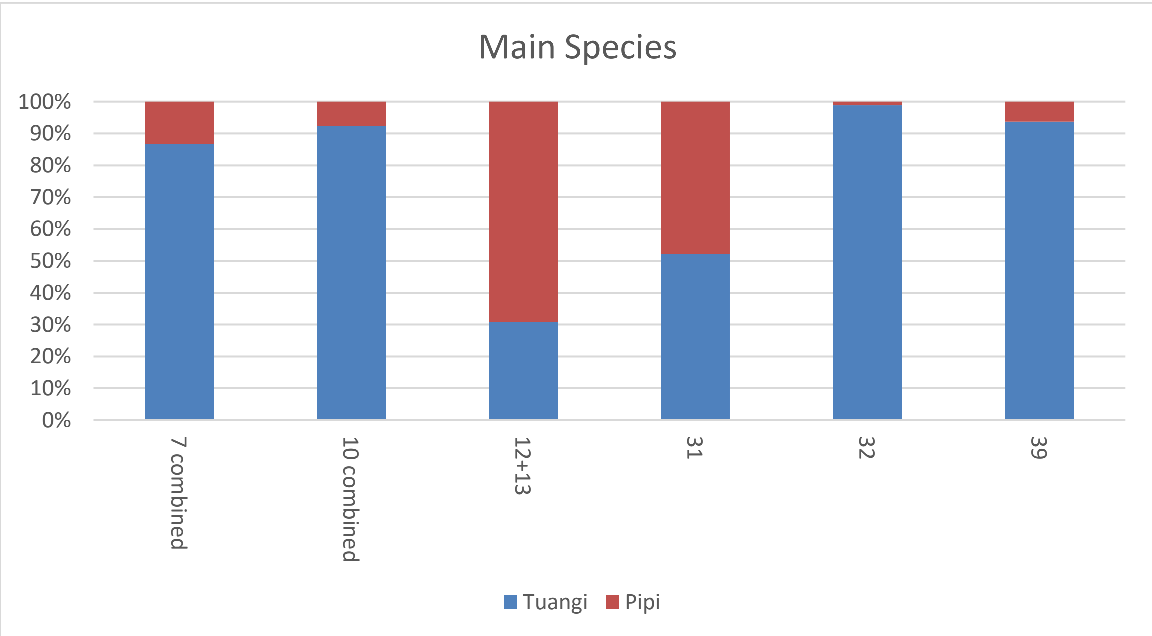


Figure 5-5. Main species in the bulk sample analysis samples

Table 5-3. Species identified in the bulk sample analysis

	7 combined		10 combined		12+13		31		32		39	
Species	**MNI #**	**MNI %**	**MNI #2**	**MNI %3**	**MNI #4**	**MNI %5**	**MNI #6**	**MNI %7**	**MNI #8**	**MNI %9**	**MNI #10**	**MNI %11**
Tuangi	293	81.6	278	89.1	75	29.0	94	51.6	511	97.8	311	89.9
Pipi	45	12.4	23	7.4	169	65.3	86	47.3	6	1.1	21	6.7
Tuatua	5	1.4			4	1.5						
Cat's Eye	1	0.3			2	0.8						
Mudflat Whelk												
Speckled Whelk	7	2.0							2	0.4	6	1.7
Rock Oyster			7	2.2	3	1.2						
Hornshell			1	0.3								
Mudsnail					1	0.4						
Ribbed Slipper Shell					1	0.4						
Wheel Shell							2	2.0	4	0.8	6	1.7
Tonna Sp.											2	0.6
Gastropod Sp.	5	1.4	4	1.3	5	1.9						
Total	356		312		260		182		523		346	

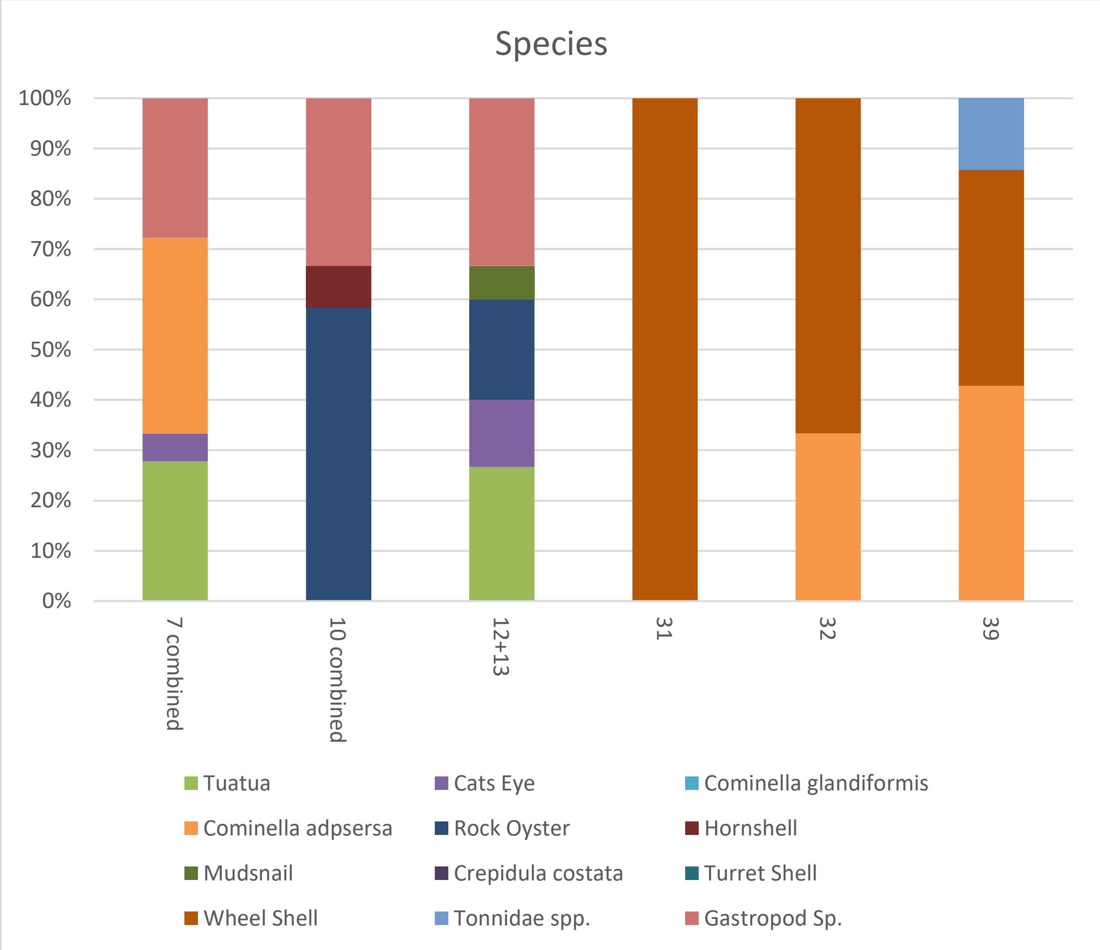


Figure 5-6. Minor species identified in bulk sample analysis samples (note that these minor species collectively made up no more than 3% of the total of MNI of each sample)

The environmental niche of the species represented is unsurprisingly dominated by species that thrive in muddy and sandy substrates (Table 5-4). A small number of rocky shore species were also present and the low numbers are likely due to variability in the surrounding environment rather than targeting of rocky shore areas. The presence of both muddy and sandy environments indicate harvesting on both the northern side of Omaro spit and the nearby estuary. While both environments were available in the near vicinity it is also possible that harvesting was carried out further afield, with numerous suitable environments where shell beds of the target species were available.

Table 5-4. Habitat of species found in the bulk sample analysis samples

Māori Name	Common	Scientific	Environment
Tuangi	Cockle	*(Austrovenus stutchburyi)*	Muddy and/or sandy environment
Pipi	Pipi	*(Paphies australis)*	Muddy and/or sandy environment
Tuatua	Tuatua	*(Paphies subtriangulata)*	Sandy environment

Titiko/Pupu/Karahue	Mudsnail	*(Amphibola crenata)*	Muddy environment
Tio reperepe	Rock Oyster	*(Saccostrea cucullata)*	Rocky environment
Papatai	Turret Shell	*(Maori colpus roseus)*	Muddy environment
Ataata	Cat's Eye	*(Turbo smaragdus)*	Rocky environment
Kawari	Speckled Whelk	*(Cominella adspersa)*	Muddy and/or sandy environment
-	Mudflat Whelk	*(Cominella glandiformis)*	Muddy and/or sandy environment
Kota	Wheel shell	*(Zethalia zelandica)*	Sandy environment
Koeti	Large Horn Shell	*(Zeacumantus lutulentus)*	Muddy and/or sandy and/or rocky environment
-	Ribbed Slipper Shell	*(Maori crypta costata)*	Sandy and/or Rocky environment
		Tonna Sp.	Sandy environment
		Gastropod Sp.	Other / Unknown

5.3.1.4 Dimensions

The maximum dimension of whole shells was measured for tuangi, defined as the greatest distance between two points on the shell. This meant only whole individuals were able to be measured. A n. of 100 was the standard but if 200 were available then 200 were measured.

The descriptive statistics show variability across the different sites in the project (Table 5-5, Figure 5-7). The means for all samples except sample 32 and sample 39 were relatively similar, ranging from 29.67mm (sample 31) to 32.47mm (sample 12+13). Sample 32 and 39 had a similarly small mean of 26.32mm and 25.8mm. The tuangi reaches sexual maturity between 18 and 20mm, indicating that all samples except 39 contained only individuals in the adult phase.

The range varied across the samples with 12+13 having the narrowest range as well as the highest minimum, although this may be due to the small size. While samples 32 and 39 had lower means they had different ranges.

The distributions of the data (Figure 5-8 to Figure 5-21) show that samples 31 and 39 are normally distributed. Samples 32, 12+13, and 10 are all right skewed, with sample 7 being left skewed. Interestingly, sample 7 and 10 are opposite in their skewedness even though the samples were from the same deposit in Area 1. This shows there is as much variability within a deposit as between deposits.

Table 5-5. Descriptive statistics for tuangi dimensions (mm) from the bulk sample analysis samples

	7	10	12+13	31	32	39
N.	227.00	162.00	57.00	101.00	200.00	201.00
Min	21.80	23.14	26.19	20.03	20.00	14.00
Max	42.81	40.25	38.36	37.57	33.00	35.00
Mean	32.35	31.11	32.47	29.67	26.32	25.80
St dev	4.08	4.10	2.89	3.55	2.83	3.47
Median	32.28	30.84	32.61	29.62	26.00	26.00

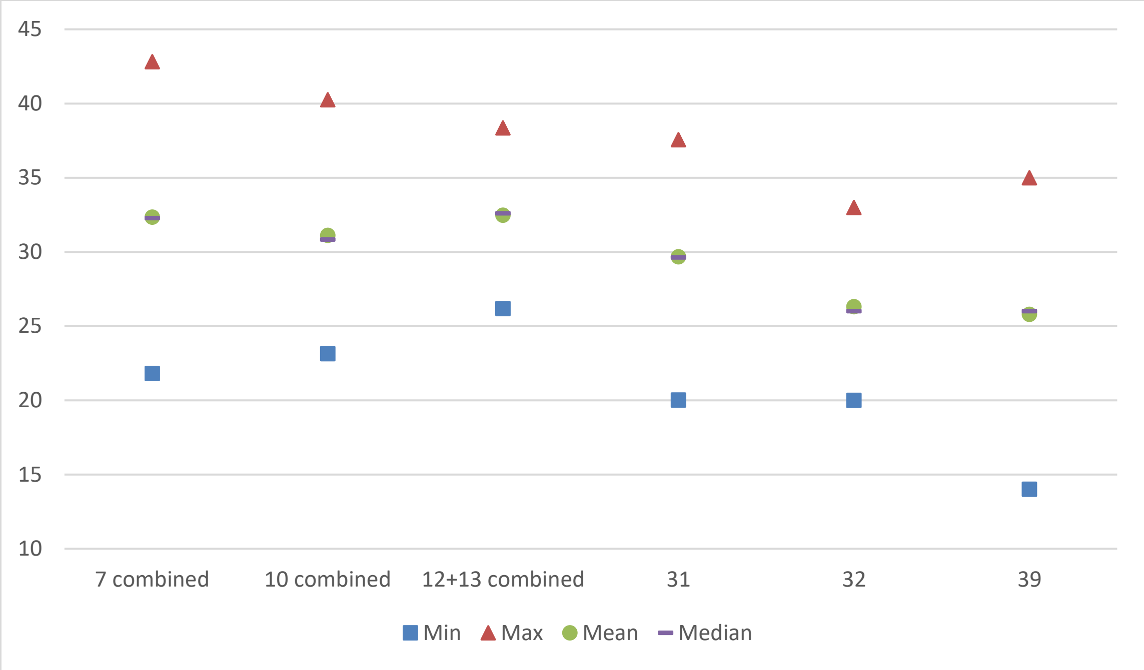


Figure 5-7. Selected descriptive statistics for tuangi dimensions from the bulk sample analysis samples

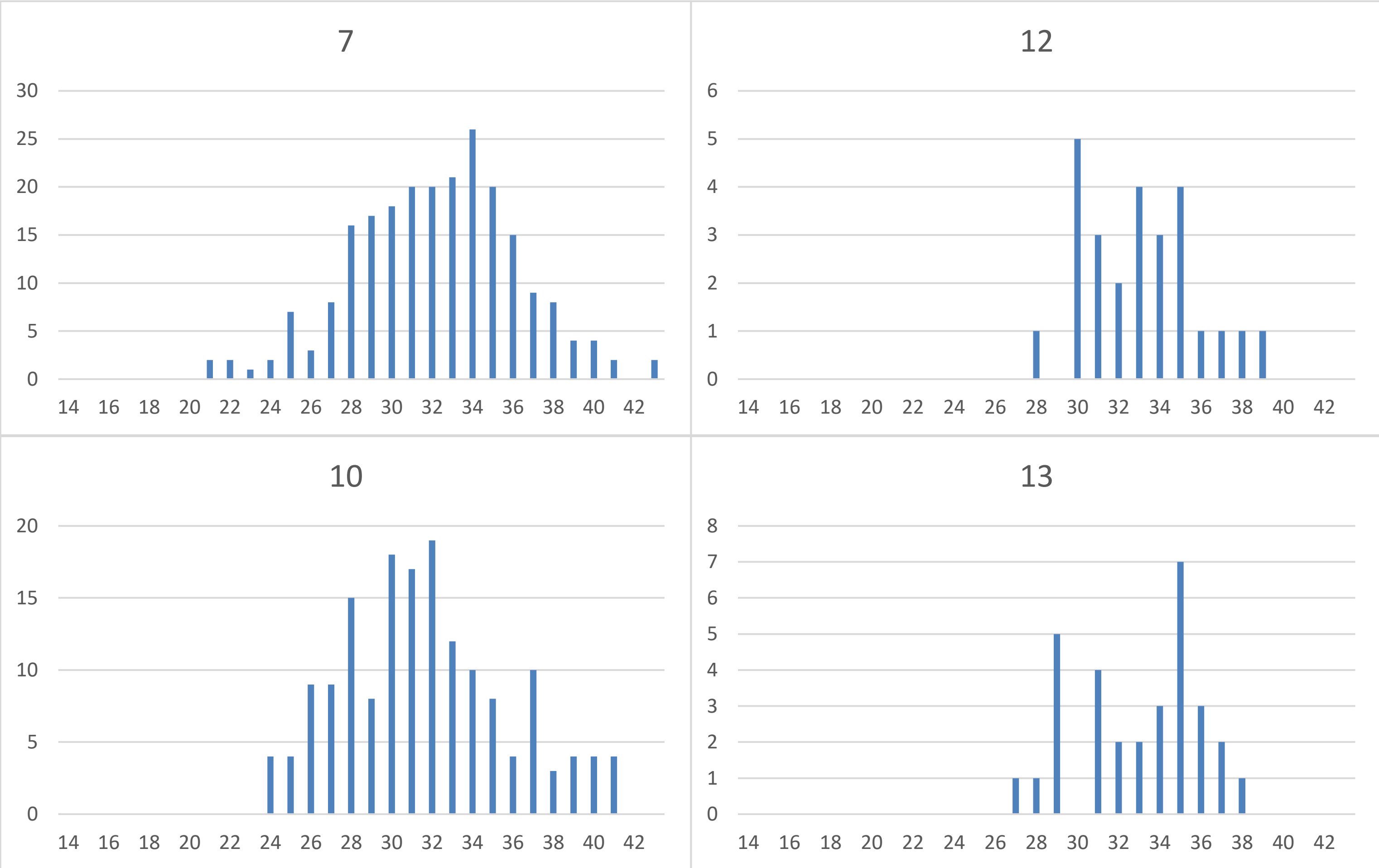


Figure 5-8. Histograms of tuangi dimensions for combined columns

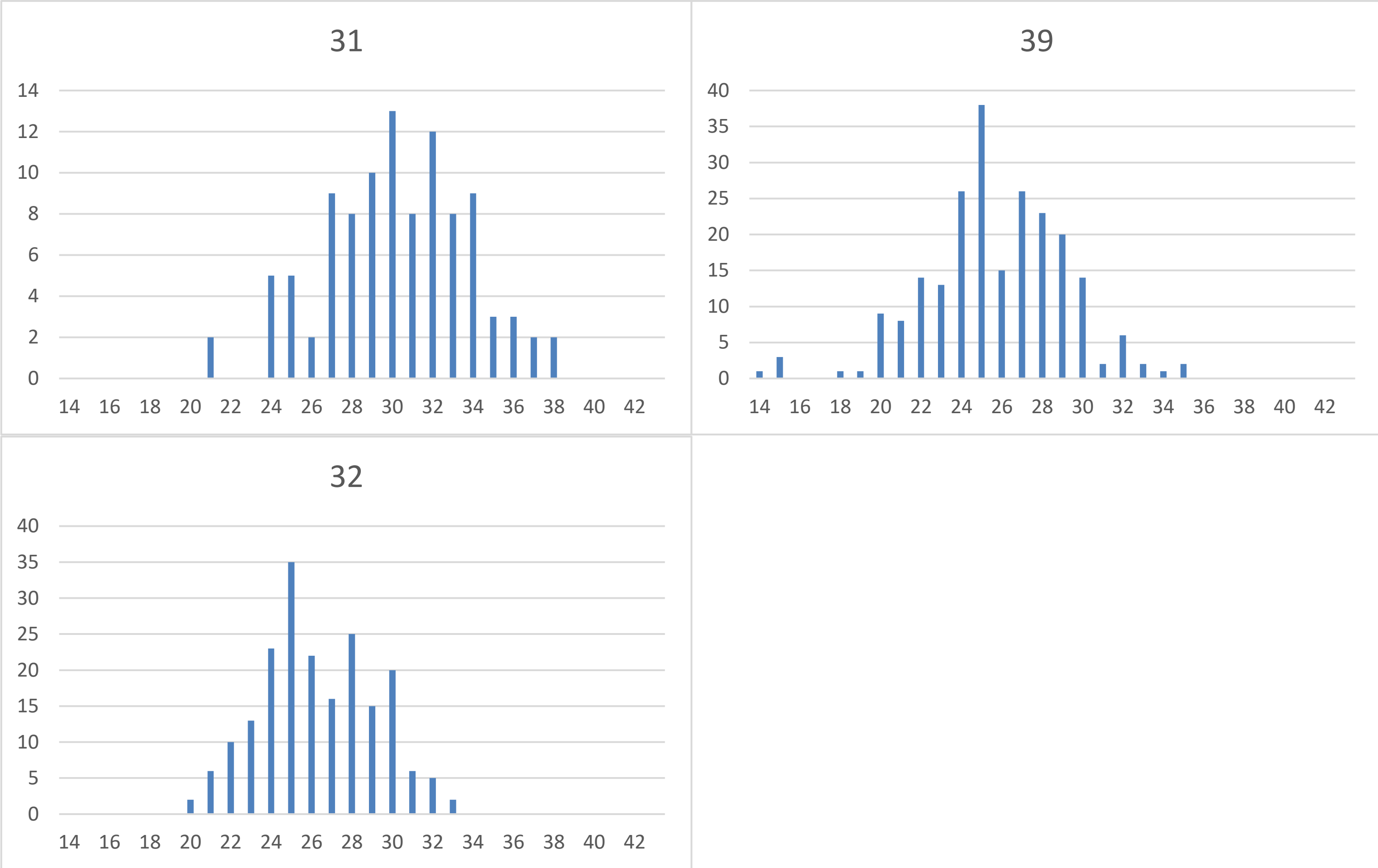


Figure 5-9. Histograms of tuangi dimensions for bulk samples

5.3.2 Column Analysis

5.3.2.1 Composition

The composition of the spit samples was highly variable (Figure 5-10, Table 5-6, Table 5-7). Sediment generally represented a large proportion for many of the samples with 7 of the 11 samples having above 50%. Concurrently, the proportion of shell and unidentified shell was higher with lower sediment and vice versa. The other aspects of the composition made up very small portions.

Each column showed different patterns within the columns as well as comparing columns. The differences can be tracked with the relative proportion of sediment. Sample 7 showed a decrease in sediment proportion from top to middle then an increase at the lowest spit. Sample 10 showed the opposite pattern with low sediment at the top and bottom spots.

Samples 12 and 13 showed the same pattern of lower sediment at the top and higher at the bottom spit. However, the proportion of sediment was drastically different with sample 12 having 53.9% and 71.6% and sample 13 having 24.8% and 48.8% (Table 5-7).

5.3.2.2 Fragmentation

The fragmentation ratios were generally low, to very low with the pipi ratios all below 1 with most clustering around 0.2 (Figure 5-11, Table 5-8, Table 5-9). In all instances the pipi ratio was lower than the tuangi with the exception of sample 12 spit 2 in which the pipi ratio was over double the tuangi (Table 5-9). However, the n. for each species was very low and the ratio may be a result of the small sample size. A general pattern is for the first spit of a column to be more fragmented than the lower, indicating the surfaces of the middens were more fragmented than within the centre of the deposits.

Interestingly there are some parallels between the fragmentation results and the compositional analysis. The pattern of fragmentation ratios for tuangi within a column mirrors the relative portion of sediment to shell. The pattern is a U-shape where spit 1 and spit 4 have higher ratios and spit 2 and spit 3 have lower; this is mirrored by a high proportion of sediment at spits 1 and 4 and lower at spits 2 and 3. This is potentially due to sample size; however, the numbers of tuangi in the four spits were all relatively high. For the other columns, the pattern is the opposite with higher ratios matching with lower sediment proportions.

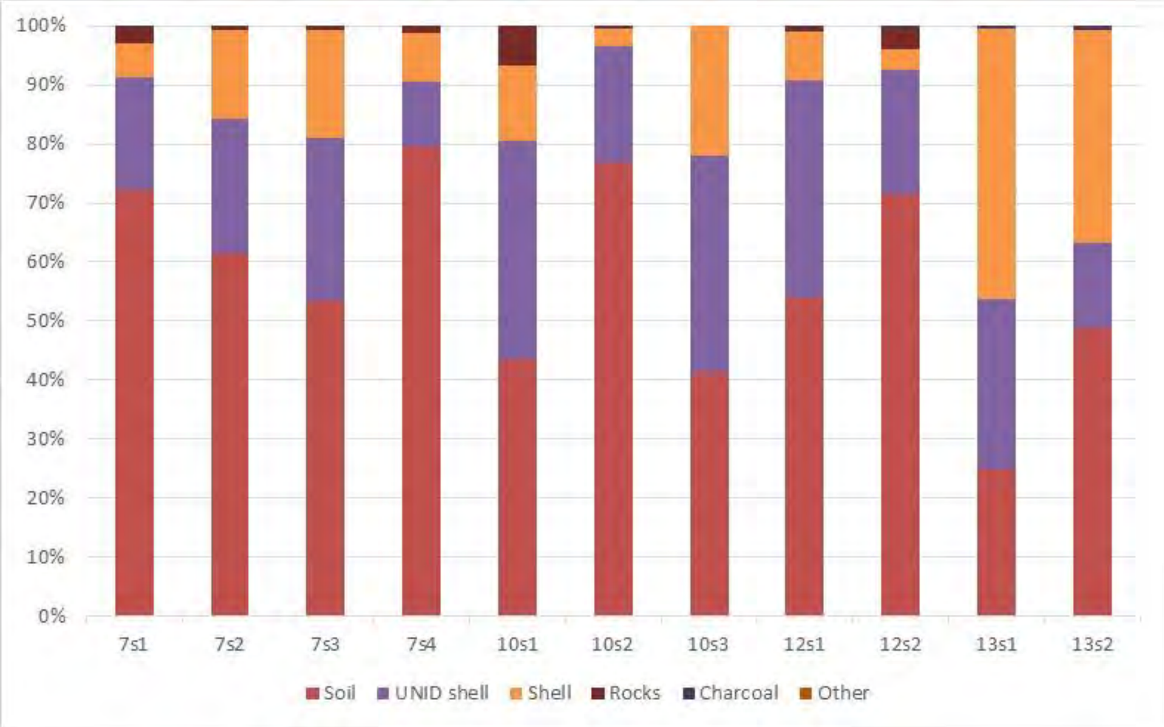


Figure 5-10. Sample components for column spit samples

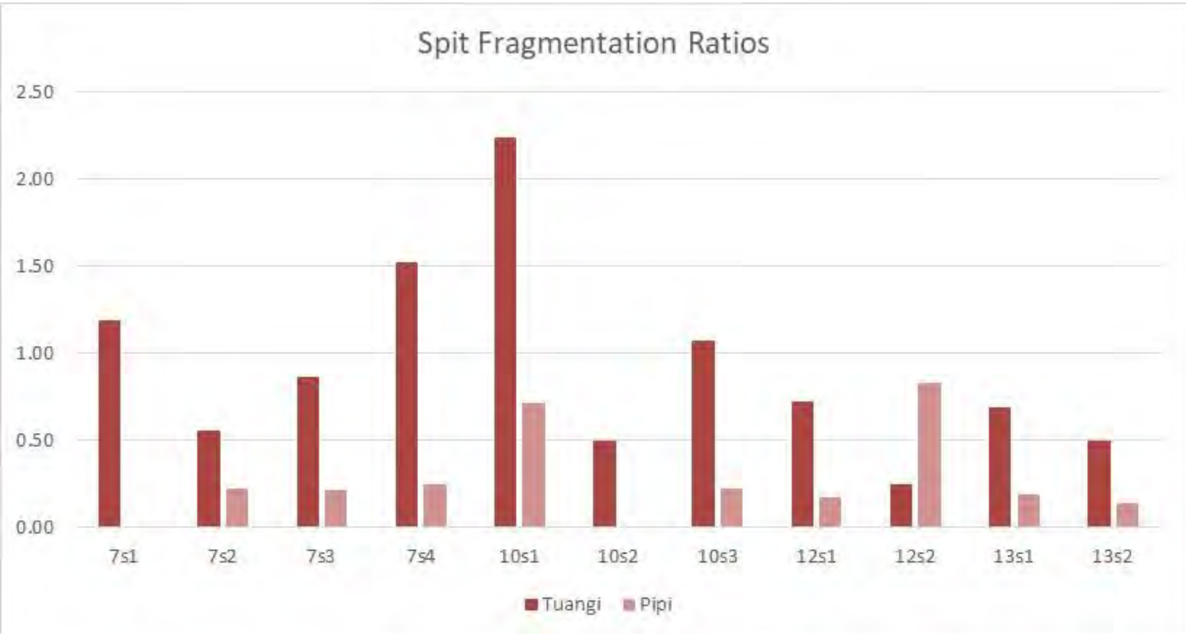


Figure 5-11. Fragmentation ratios of column spit samples

Table 5-6. Sample components of the column spit samples 7 and 10

	7s1		7s2		7s3		7s4		10s1		10s2		10s3	
Soil	3151.0	72.3	2375.0	61.4	1853.0	53.5	2142.0	79.5	1623.0	43.3	2342.0	76.7	1029.0	41.4
UNID shell	833.0	19.1	888.0	23.0	950.0	27.4	300.0	11.1	1388.0	37.1	603.0	19.8	911.0	36.7
Shell	248.0	5.7	577.0	14.9	637.0	18.4	221.0	8.2	485.0	13.0	93.0	3.0	545.0	21.9
Rocks	114.0	2.6	18.0	0.5	20.0	0.6	31.0	1.2	248.0	6.6	13.0	0.4	0.0	0.0
Charcoal	12.0	0.3	8.0	0.2	3.0	0.1	<1	<1	<1	0.0	2.0	0.1	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	4358	100	3866	100.00	3463	100.00	2694	100.00	3744	100	3053	100	2485	100

Table 5-7. Sample components of the column spit samples 12 and 13

	12s1		12s2		13s1		13s2	
Soil	2035.0	53.9	2266.0	71.6	766.0	24.8	608.0	48.8
UNID shell	1389.0	36.8	665.0	21.0	894.0	29.0	181.0	14.5
Shell	318.0	8.4	109.0	3.4	1410.0	45.7	448.0	36.0
Rocks	28.0	0.7	115.0	3.6	0.0	0.0	0.0	0.0
Charcoal	5.0	0.1	11.0	0.3	13.0	0.4	8.0	0.6
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3775	100	3166	100	3083	100	1245	100

Table 5-8. Fragmentation ratios of column spit samples 7 and 10

	7s1		7s2		7s3		7s4		10s1		10s2		10s3	
	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio
Cockle <50%	37	1.19	28	0.56	46	0.87	29	1.53	94	2.24	10	0.50	58	1.07
Cockle >50%	31		50		53		19		42		20		54	
Pipi <50%	0	0.00	2	0.22	3	0.21	2	0.25	5	0.71	0	0.00	2	0.22
Pipi >50%	7		9		14		8		7		0		9	

Table 5-9. Fragmentation ratios of column spit samples 12 and 13

	12s1		12s2		13s1		13s2	
	MNI	Ratio	MNI	Ratio	MNI	Ratio	MNI	Ratio
Cockle <50%	13	0.72	1	0.25	11	0.69	4	0.50
Cockle >50%	18		4		16		8	
Pipi <50%	3	0.18	5	0.83	17	0.19	4	0.14
Pipi >50%	17		6		89		28	

5.3.2.3 Species

The species results discussed in the bulk sample analysis indicated the column samples were generally low in richness and very uneven. This pattern is also evident at the smaller scale of individual spits, with tuangi or pipi being the dominant species (Table 5-10, Table 5-11).

For the major two species of tuangi and pipi, tuangi was highly dominant in samples 7 and 10 (Figure 5-12). Samples 12 and 13 were the opposite, with closer to equal amounts or with pipi dominating. This indicates the differences in species composition is at the scale of the deposit rather than simply a localized variation in the species composition.

The species that had very small amounts (Figure 5-13) did show some spatial distribution patterns. Speckled whelk was only found in sample 7 columns and was found in all the spits. Comparatively, rock oyster was only found in all of the sample 10 spits and spit 1 of sample 12.

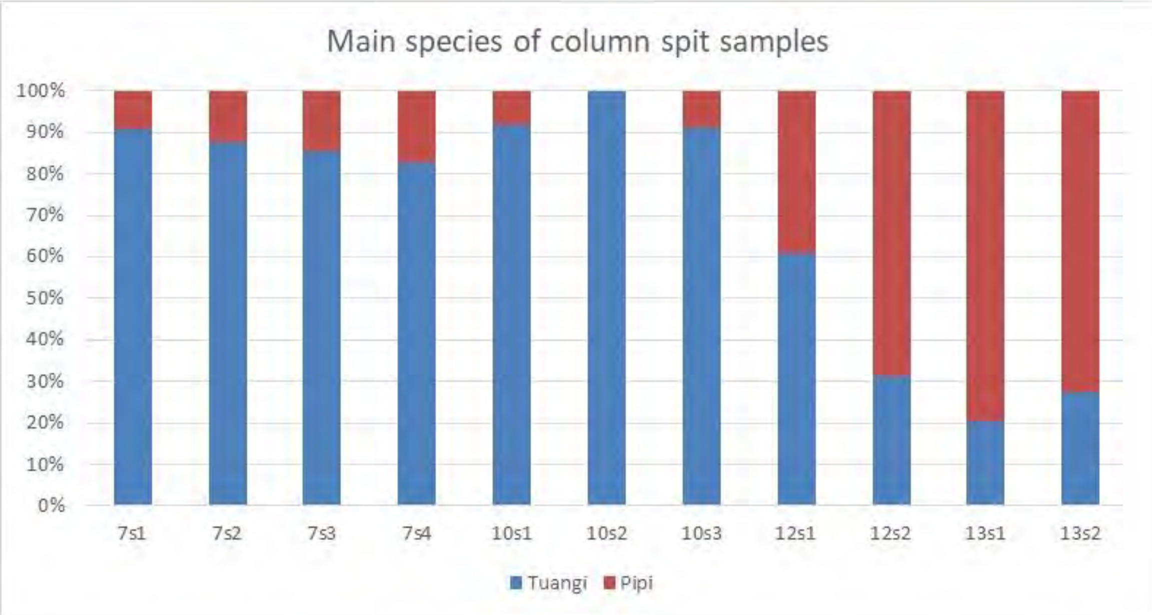


Figure 5-12. Proportion of main species in all column samples

Table 5-10. Identified species of column spit samples

	7s1		7s2		7s3		7s4		10s1		10s2		10s3	
Taxon	**MNI #**	**MNI %**	**MNI #2**	**MNI %3**	**MNI #4**	**MNI %5**	**MNI #6**	**MNI %7**	**MNI #8**	**MNI %9**	**MNI #10**	**MNI %11**	**MNI #12**	**MNI %13**
Tuangi	68	87.2	78	83.0	99	79.2	48	76.2	136	91.3	30	88.2	112	86.8
Pipi	7	9.0	11	11.7	17	13.6	10	15.9	12	8.1			11	8.5
Tuatua					4	3.2	1	1.6						
Cat's Eye	1	1.3												
Mudflat Whelk							3	4.8						
Speckled Whelk	2	2.6	2	2.1	3	2.4	1	1.6						
Rock Oyster											4	11.8	3	2.3
Gastropod Sp.			3	3.2	2	1.6			1	0.7			3	2.3
Total	78		94		125		60		149		34		129	

Table 5-11. Identified species of column spit samples

	12s1		12s2		13s1		13s2	
Taxon	**MNI #14**	**MNI %15**	**MNI #16**	**MNI %17**	**MNI #18**	**MNI %19**	**MNI #20**	**MNI %21**
Tuangi	31	53.4	5	29.4	27	19.3	12	26.1
Pipi	20	34.5	11	64.7	106	75.7	32	69.6
Tuatua	1	1.7			3	2.1		
Cat's Eye							2	4.3
Rock Oyster	2	3.4	1	5.9				
Hornshell	1	1.7						
Mudsnail	1	1.7						
Ribbed Slipper Shell					1	0.7		
Gastropod Sp.	2	3.4			3	2.1		
Total	58		17		140		46	

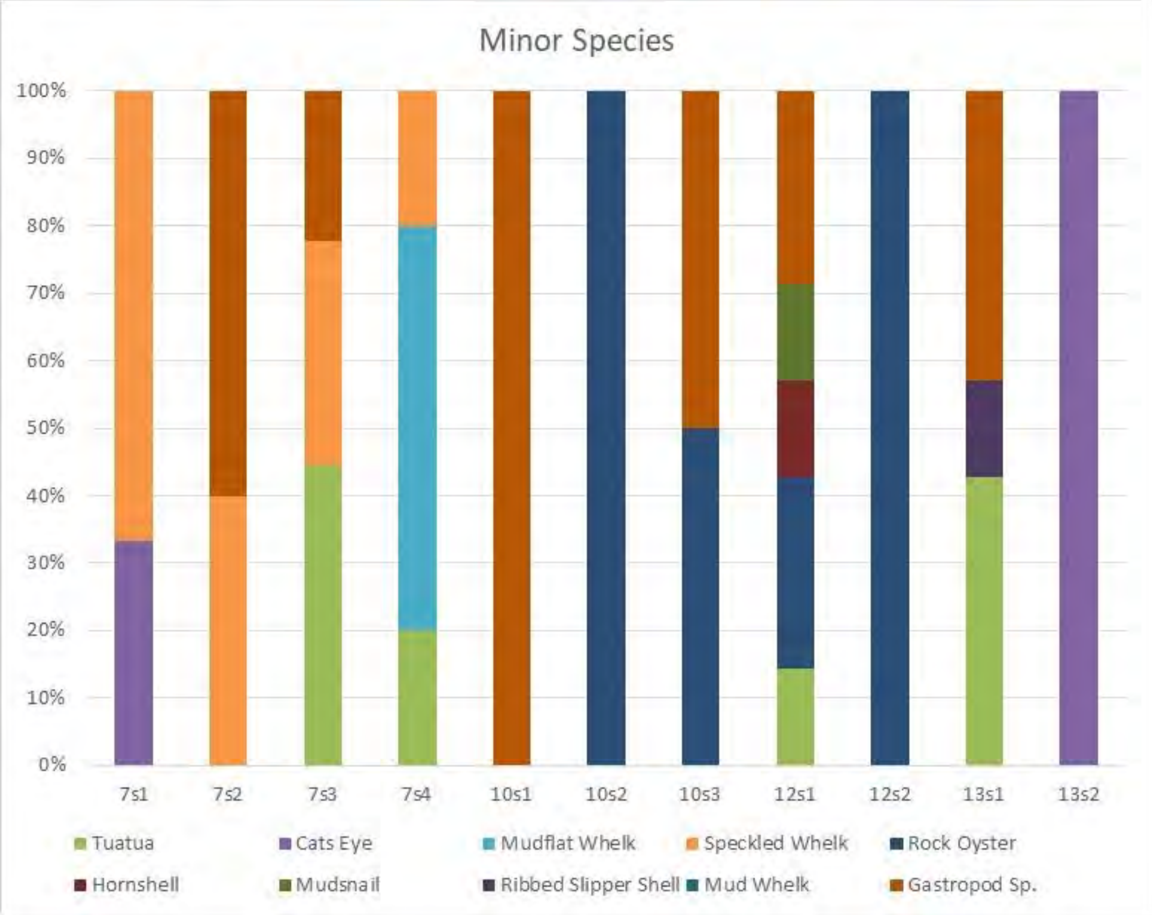


Figure 5-13. Proportion of all minor species identified in column samples

5.3.2.4 Dimensions

The dimension descriptive statistics show broadly the same characteristics as the bulk sample analysis. The means are relatively similar across the columns, clustered around 30mm and ranging from 28.4mm (10s2) to 33.22mm (13s2) (Table 5-12). Similarly, the range of sizes of each spit are relatively similar for samples 7 and 10, but there is a narrower range for the other spit samples. This is potentially due to the low sample size of samples 12 and 13, which have the lowest ranges.

There is somewhat of a pattern in sample 7 of a slight increase in the maximum size from spit 1 to spit 4 (Figure 5-14). In sample 10 the pattern is for a reduction in the minimum, maximum and mean between spit 1 and spit 2 with an increase in all three from spit 2 to spit 3. As with the majority of the bulk samples, the minimum for all column samples was above 18mm, indicating all the individuals were sexually mature.

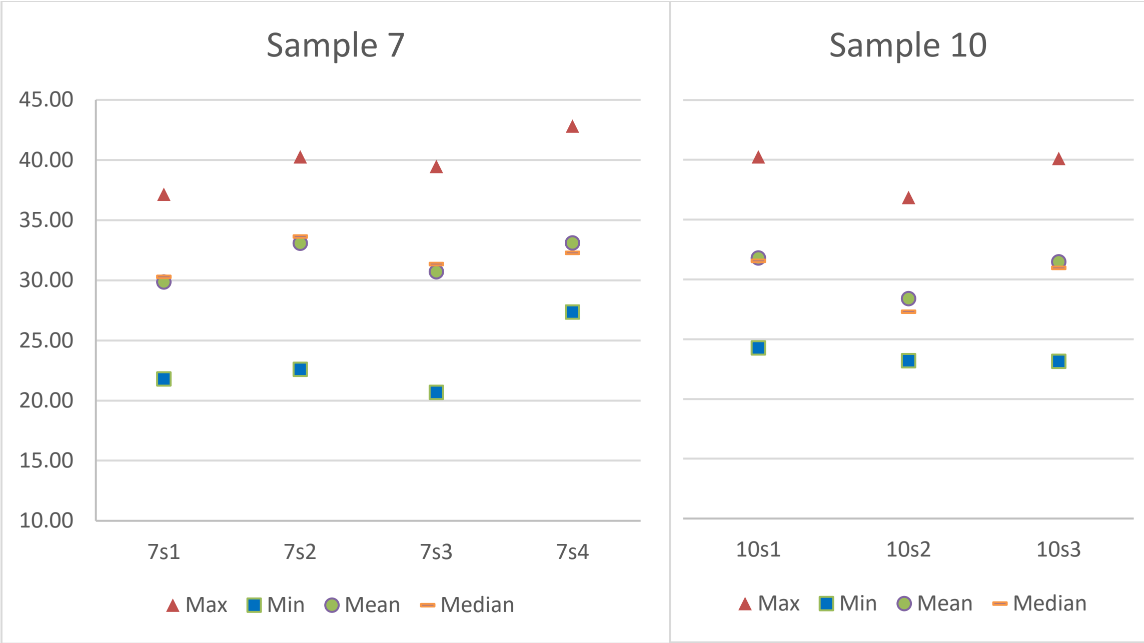


Figure 5-14. Descriptive statistics for dimensions of sample 7 and 10 spits

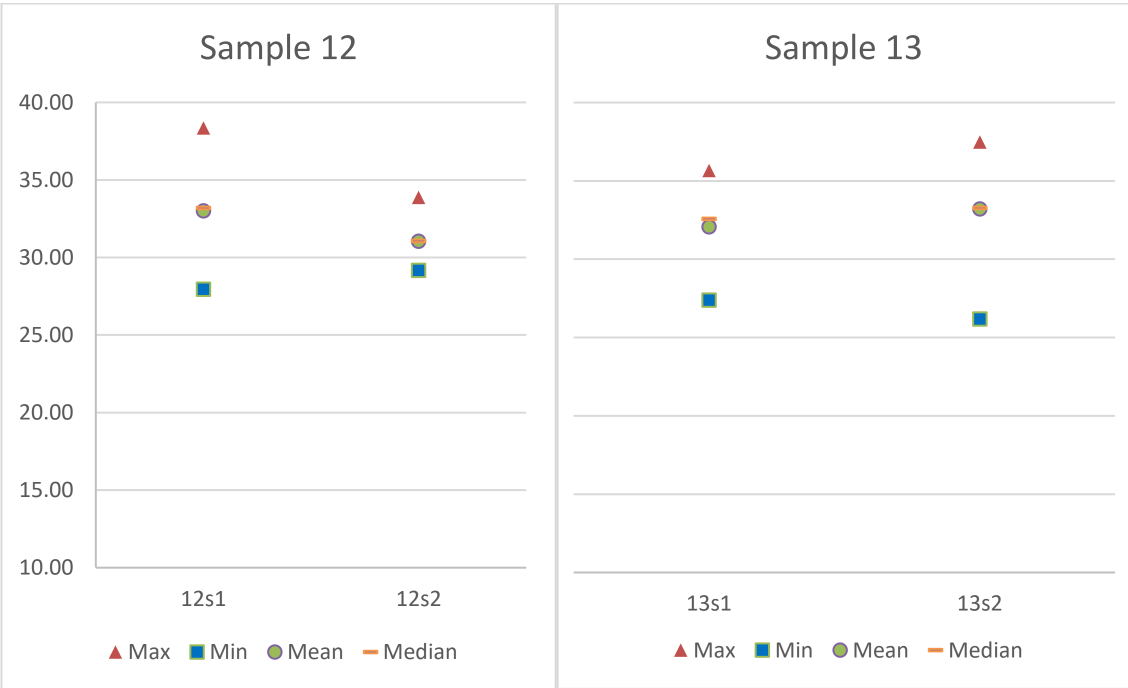


Figure 5-15. Descriptive statistics for dimensions of sample 12 and 13 spits

Table 5-12. Descriptive statistics for all column samples

	7s1	7s2	7s3	7s4	10s1	10s2	10s3	12s1	12s2	13s1	13s2
N.	40.00	77	81.00	29.00	57.00	25.00	80.00	20.00	6.00	22.00	9.00
Min	21.80	22.61	20.68	27.36	24.26	23.21	23.14	27.95	29.17	27.39	26.19
Max	37.16	40.27	39.47	42.81	40.25	36.85	40.11	38.36	33.88	35.66	37.49
Mean	29.85	33.08	30.72	33.12	31.80	28.40	31.46	33.01	31.06	32.07	33.22
St dev	3.52	3.80	3.76	4.07	4.22	3.58	3.80	2.83	1.51	2.75	3.34
Median	30.29	33.64	31.34	32.28	31.54	27.29	30.96	33.21	31.07	32.58	33.28

5.3.3 Firescoops

5.3.3.1 Composition

The composition of the two firescoops shows that the largest proportion is unidentified shell with around 60% of the total sample for each (Figure 5-16, Table 5-13). Sediment was the second largest but this differed between the two, with sample 3 having 40% sediment and sample 30 25.9%.

The results were similar to the two bulk midden samples 32 and 39, from the middens in Area 2 and Area 4. The main difference between the bulk samples and the firescoop samples was the amount of identifiable shell. The firescoop samples had large proportions of shell but very low proportions of identified shell with 1.5% (sample 3) and 8.2% (sample 30).

5.3.3.2 Fragmentation

The fragmentation ratios were moderate at 3.79 and 1.44 for sample 3 and sample 30 respectively (Figure 5-17, Table 5-14). These mirror the sample components where the higher proportion of identified shell in sample 30 has a lower fragmentation rate. The fragmentation ratio of sample 30 is less than what would be expected from the amount of identified shell.

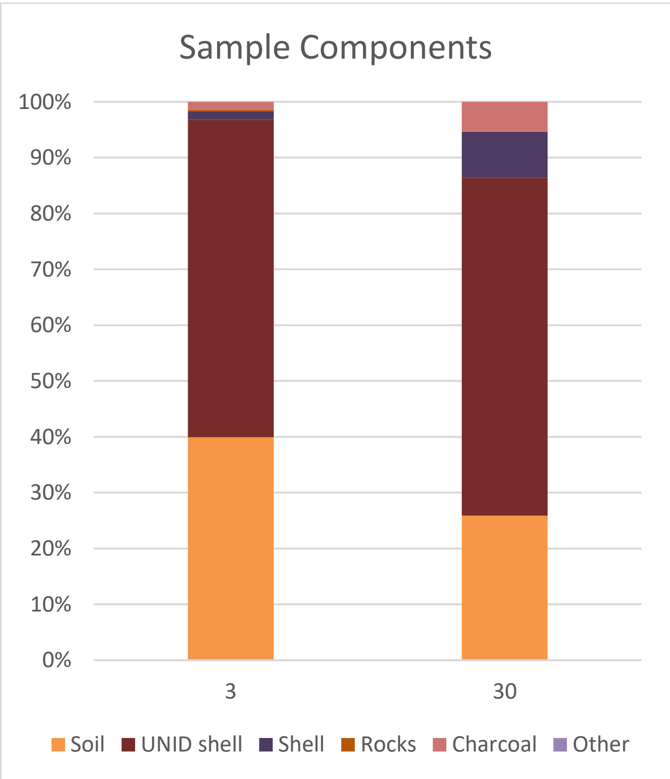


Figure 5-16. Sample components of firescoop samples

Table 5-13. Sample components of firescoop samples

	3		30	
Soil	5818	40.0	949	25.9
UNID shell	8273	56.8	2214	60.5
Shell	225	1.5	300	8.2
Rocks	37	0.3	5	0.1
Charcoal	209	1.4	193	5.3
Other	0	0.0	0	0.0
Total	14562	100.0	3661	100.0

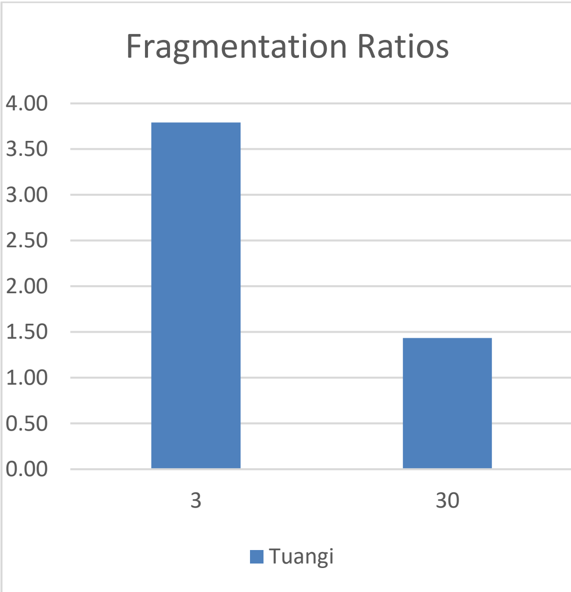


Figure 5-17. Fragmentation ratios of the firescoop samples

Table 5-14. Fragmentation ratios of firescoop samples

	3		30	
	MNI	Ratio	MNI	Ratio
Tuangi <50%	110		56	
Tuangi >50%	29	3.79	39	1.44

5.3.3.3 Species

The species identified in the firescoop samples exhibited very low richness and low evenness, being tuangi dominant with small proportions of pipi, speckled whelk and turret shell in sample 3 (Table 5-15, Figure 5-18, Figure 5-19). The results are comparable to the results from sample 7 and sample 10, both taken from the same large midden deposit (3).

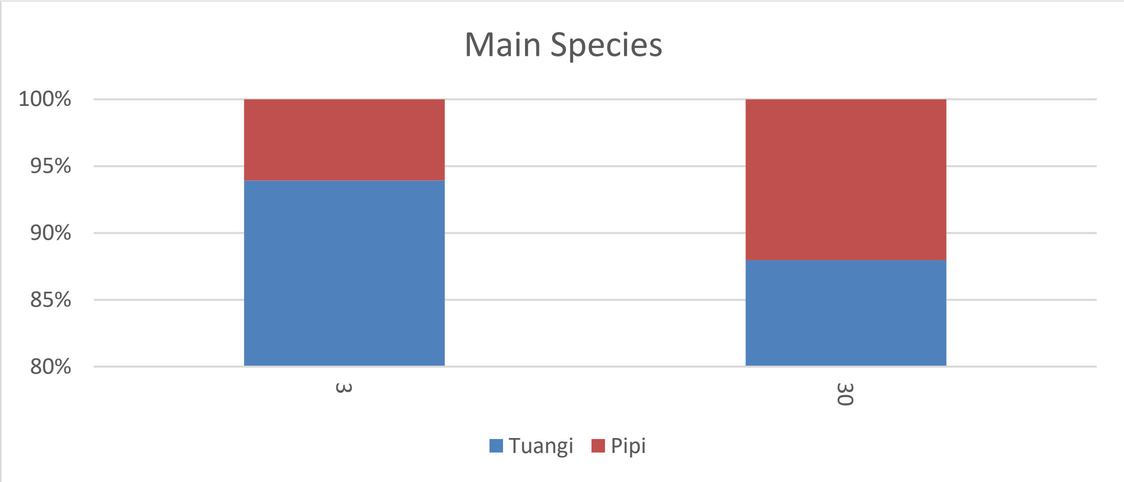


Figure 5-18. Proportion of major species identified in firescoop samples

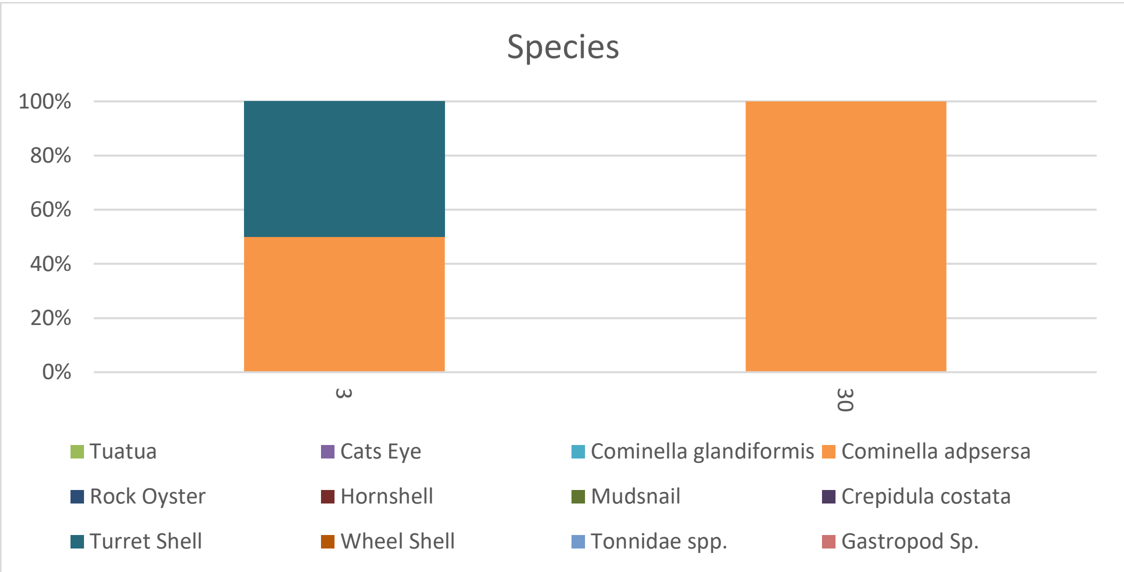


Figure 5-19. Proportion of all minor species identified in firescoop samples (less than 3% of total)

Table 5-15. Identified species of firescoop samples

	3		30	
Species	**MNI #**	**MNI %**	**MNI #**	**MNI %**
Tuangi	139	89.1	95	85.6
Pipi	9	5.8	13	11.7
Speckled Whelk	4	2.6	3	2.7
Turret Shell	4	2.6		
Total	156		111	

5.3.3.4 Dimensions

The dimension results for the two firescoop samples show that the two samples have comparable mean but different minimum, maximum and ranges (Table 5-16, Figure 5-20). The results are similar to samples 32 and 39 from Area 2 and 3 (Figure 5-7) rather than the bulk samples from Area 1, where both firescoop samples were located. The distribution of the samples show sample 3 has a bimodal distribution while sample 30 is near normal with a high peak (Figure 5-21). This suggests sample 30 represents a more targeted harvesting of a narrower range of sizes whereas 3 targeted two size ranges.

Table 5-16. Descriptive statistics for firescoop samples

	3	30
N.	41.00	99.00
Min	12.00	18.00
Max	33.00	29.00
Mean	24.76	23.99
St dev	3.91	2.49
Median	25.00	24.00

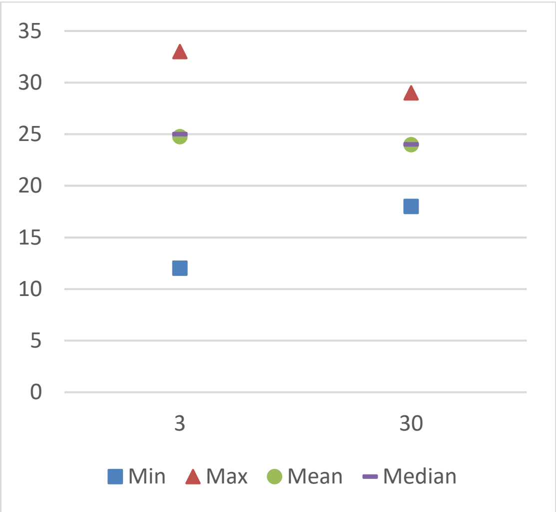


Figure 5-20. Selected descriptive statistics for tuangi dimensions from the firescoop analysis samples

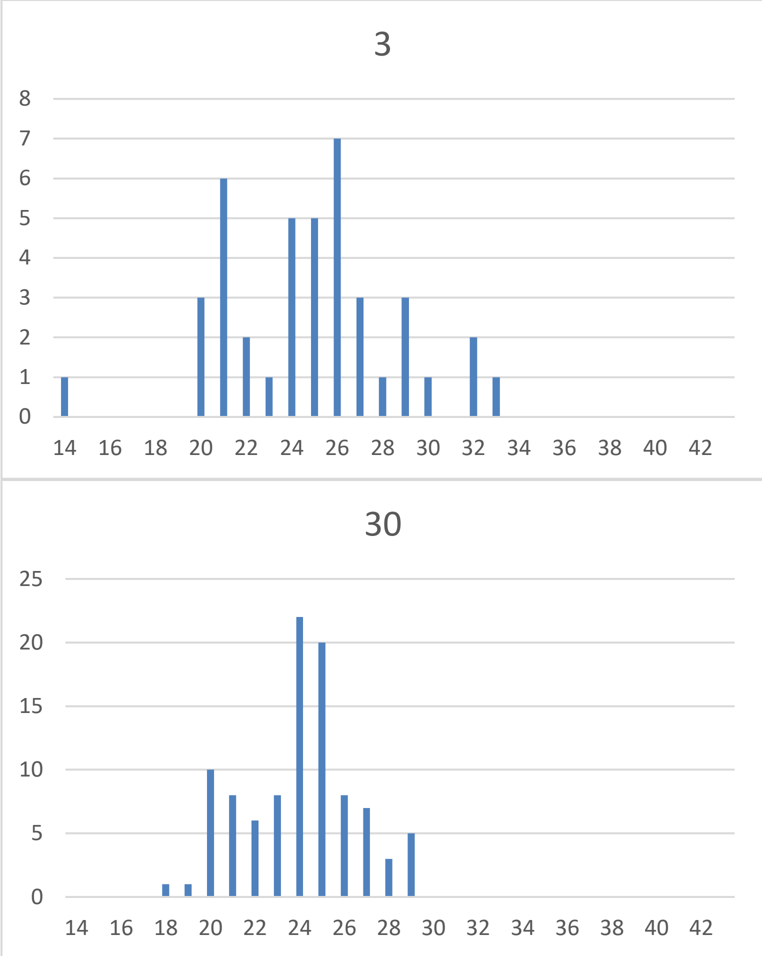


Figure 5-21. Histogram of tuangi dimensions for firescoops

5.3.4 Non-Shell Species

A single instance of dog (*Canis familiaris*) remains was found during the excavation. Two elements were present, the right mandible and lower maxilla, which were found on the surface of the midden (3) in Area 1. The mandible included two teeth, the first and second lower molars, which did not have a large amount of wear present. The teeth indicate the animal was at least 7 months old and the relatively small amount of wear suggests a younger individual. Its presence in the midden and its young age suggest it was consumed rather than died of natural causes.

Figure 5-22. Dog bone in the surface of midden (3)

6 Environmental Analysis

6.1 Plant Microfossil Analysis

6.1.1 Introduction

Two samples (18 and 20) were analysed for pollen, phytoliths, and starch to provide a record of past vegetation, environments, and human activity. Sample number 18 was taken from context (32), described as a light grey to grey sand of moderate to loose compaction. The layer was located in the eastern side of Trench 1 in midden (3), T10/1052. Stratigraphically it was beneath the midden and had a firescoop cut into it (Figure 6-1, Figure 6-2). Sample 20 was taken from context (44), described as a dark grey brown mottled sandy layer (paleosol) located in the west facing section of the trench through midden (5), T10/1052. The layer appeared to be a buried topsoil and was sampled from the walls of Trench 2 (Figure 6-3, Figure 6-4).

The following plant microfossil analysis is by Dr Mark Horrocks.

6.1.2 Methods

6.1.2.1 Pollen Analysis

Pollen analysis includes pollen grains of seed plants and spores of ferns and other plants. It provides insight into past vegetation and environments, and in New Zealand allows the differentiation of sediments deposited in pre-settlement, early Māori, and European times (McGlone et al. 1993; Hayward et al. 2004). Pollen can also provide evidence from archaeological sites of Māori-introduced plants, for example bottle gourd, paper mulberry, and taro, and European-introduced crops such as maize (Horrocks 2004; Horrocks et al. 2008; Prebble et al. 2019). As well as at archaeological sites, taro pollen has also been identified in an offshore marine sediment core (Handley et al. 2020).

The samples were prepared for pollen analysis by the standard acetolysis method (Moore et al. 1991; Horrocks 2020). A sum of at least 100 pollen grains and spores was counted for each sample, and the slides were scanned for types not found during the counts.

Microscopic fragments of charcoal were also extracted during pollen preparation, providing evidence of fire. Starch and other plant remains can sometimes be found in pollen preparations.

6.1.2.2 Phytolith Analysis

Phytoliths are particles of silica formed in inflorescences, stems, leaves, and roots of many plants (Piperno 2006). Phytolith analysis complements pollen analysis and, like pollen, can provide evidence for Māori-introduced bottle gourd and paper mulberry (Horrocks 2004). Other types of microscopic biosilicates, notably diatoms, radiolarians, and sponge spicules, are extracted along with phytoliths during preparation. Diatoms are unicellular algae and have cell walls composed of silica; radiolarians are a type of amoeboid protozoa with siliceous skeletons; sponges are multi-cellular animals with skeletons often composed of siliceous spicules. Diatoms are found in aquatic and sub-aquatic environments; radiolarians and sponges are exclusively aquatic. Diatoms and sponges are found in both marine and freshwater environments; radiolarians are exclusively of marine origin.

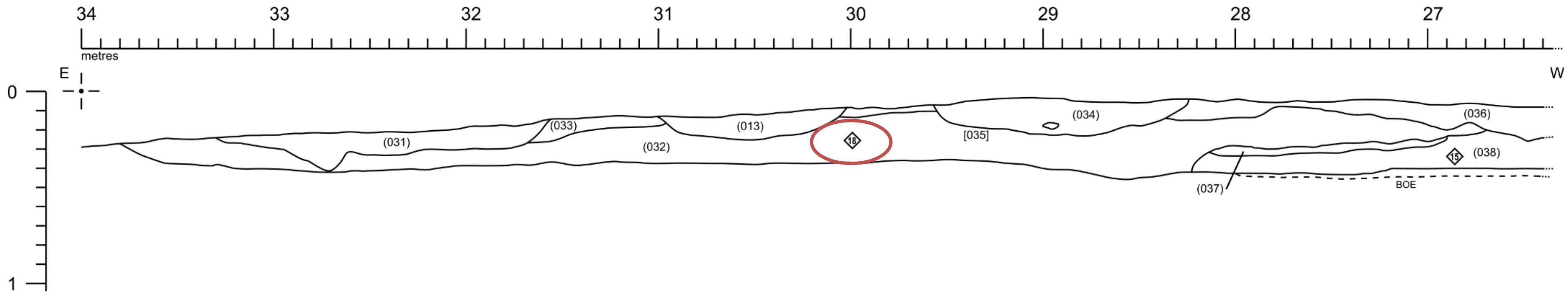


Figure 6-1. North facing section drawing of east end of Trench 1 in midden (3) with sample 18 location circled

Figure 6-2. Looking southeast at east end of Trench 1 with sample 18 location circled

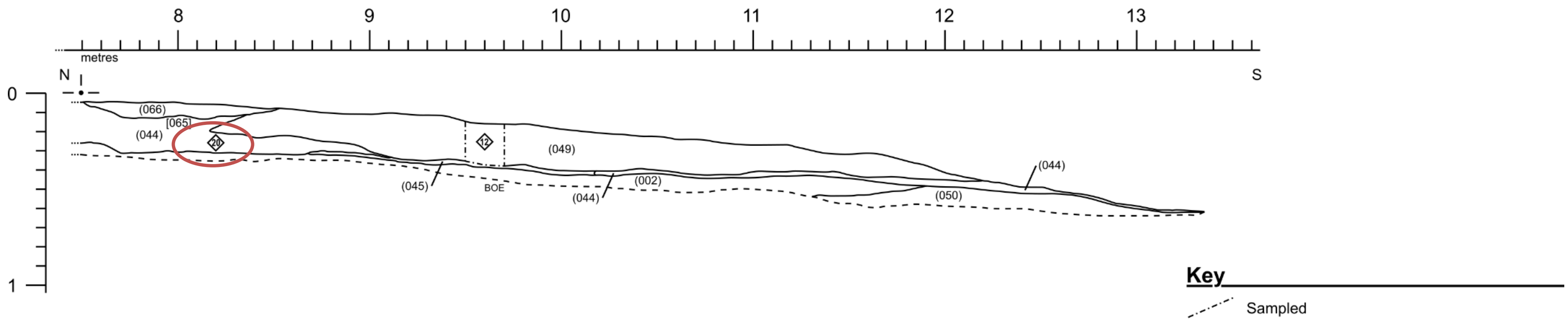


Figure 6-3. West facing section of south end of trench 2 in midden (5) with sample 20 location circled

Figure 6-4. Looking southeast at south end of trench 2 with sample 20 location circled

The samples were prepared for phytolith analysis by density separation (Piperno 2006; Horrocks 2020). A sum of at least 100 phytoliths was counted for each sample, and the slides were scanned for types not found during the counts. Other biosilicates were excluded from the phytolith sum.

6.1.2.3 Analysis of Starch and Other Plant Material

This analysis includes starch grains and other plant material such as calcium oxalate crystals and xylem (Pearsall 2015). Starch is the main substance of food storage for plants and is mostly found in high concentrations of microscopic grains in underground stems (e.g., tubers and corms), roots, and seeds. The grains are synthesised and stored in amyloplasts; sub-cellular units specialised for this function. Calcium oxalate crystals, comprising raphides which are needle-like and druses which are compound, are found in both the aerial and underground parts of many plant taxa. Xylem is a vascular tissue comprising elongated cells through which most of the water and minerals of a plant are conducted. Starch analysis can provide evidence from archaeological sites for Māori introduced starch crops, such as kumara, taro and yam, and European introduced crops such as potato (Horrocks and Barber 2005;', Horrocks and Weisler 2006; Horrocks et al. 2007, 2008). As well as at archaeological sites, kumara and taro starch and associated material have also been identified in an offshore marine sediment core (Handley et al. 2020).

Advances in this method include the use of Fourier Transform InfraRed spectroscopy to positively identify degraded starch, often uncertain due to loss of distinguishing features, and the discovery of non-starch taro microfossil types, namely shoot epidermal tissue and phenolic inclusions from the skin of the corm (Horrocks and Barber 2005; Horrocks et al. 2012a, 2012b, 2014, 2016, 2017; Kahn et al. 2014).

Starch and other remains were prepared for analysis by density separation and presence/absence noted (Pearsall 2015, Horrocks 2020). These remains can sometimes be found in pollen preparations despite the harsh chemicals used in that procedure.

6.1.3 Results and Discussion

6.1.3.1 Pollen and Spores

Both samples contained microscopic fragments of charcoal, reflecting fire activity by people in the area. The pollen and spore assemblages were dominated by spores of bracken (*Pteridium esculentum*) fern (Figure 6-5). Spores of hornworts (Anthocerotopsida) also featured.

These spore types, coincident with the charcoal and a paucity of tree pollen, reflect a majorly disturbed landscape in part cleared of forest by people (Figure 6-5). Bracken is an invasive, indigenous ground fern with widely dispersed spores, common in New Zealand pollen spectra since human settlement and almost always associated with large-scale, repeated burning of forest by early Māori, and subsequently Europeans. It can form tall, dense stands over extensive areas. Hornworts are small inconspicuous plants that commonly colonise freshly disturbed and exposed soils (Wilmshurst et al. 1999).

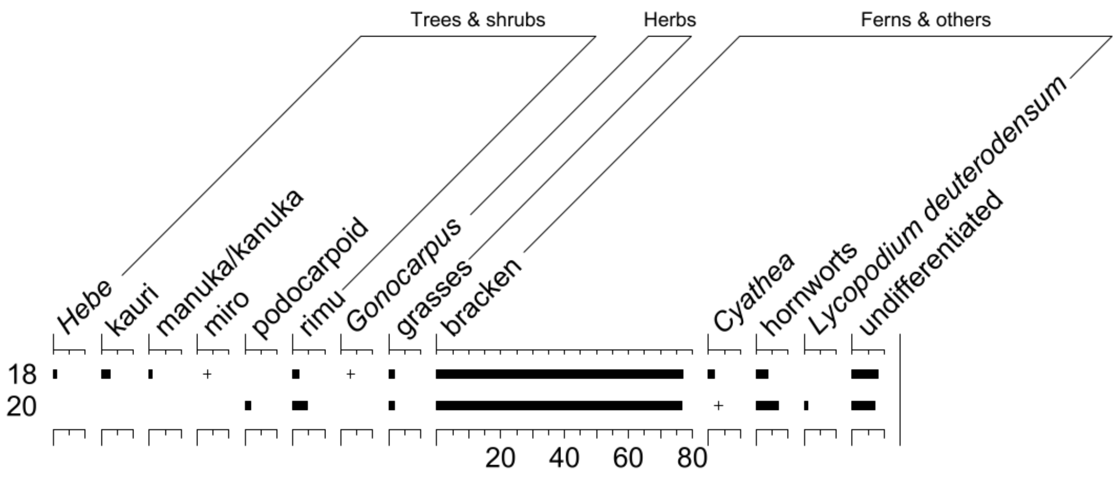


Figure 6-5. Pollen percentage diagram from T10/1052 (+ = found after count)

6.1.3.2 Phytoliths and Other Biosilicates

The sample assemblages were dominated by fern frond phytoliths (Figure 6-6). Sample 20 also recorded a large amount of tree and shrub phytoliths, notably spherical verrucose type. This type is commonly found in the leaves, twigs, and wood of beech (*Fuscospora*) species and rewarewa (*Knightia excelsa*) (Kondo et al. 1994). Given the large amounts of bracken spores in the samples, the fern phytoliths in this case are likely mostly from this species, which supports the pollen and spore evidence for large scale landscape disturbance (Figure 6-5).

The large amount of spherical verrucose phytoliths in sample 20 could reflect the pre-settlement forest; being non-organic, phytoliths can accumulate in substrates for much longer than pollen and spores due to their generally greater resistance to decay (Figure 6-6). In addition, these phytoliths could reflect the use by people of wood as fuel for fire activities.

Other biosilicates found in this study comprised fragments of diatoms and sponge spicules (Figure 6-6). These remains reflect the coastal nature of the site.

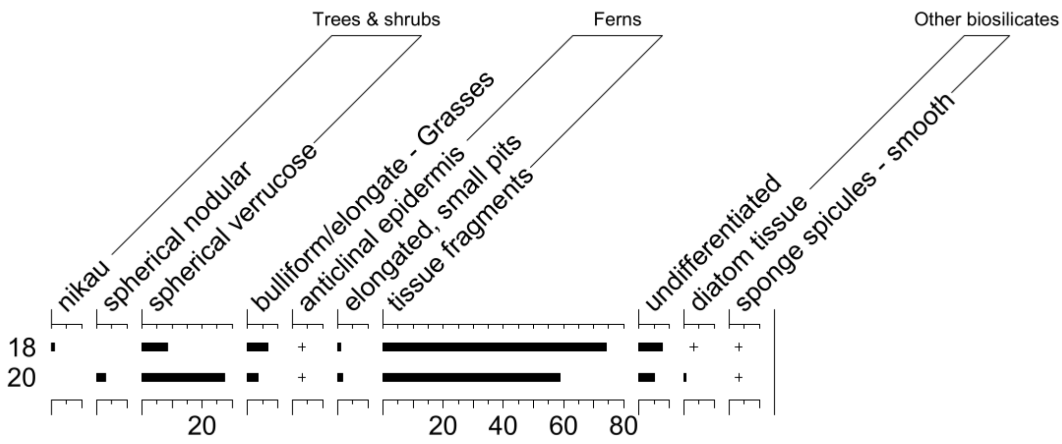


Figure 6-6. Phytolith percentage diagram from T10/1052 (other biosilicates excluded from sum, + = found after count)

6.1.3.3 Starch and Other Plant Material

No starch or other significant plant material was identified in the samples and consequently, there is no microfossil evidence of Māori horticulture.

6.1.3.4 Conclusion

The large amount of spherical verrucose phytoliths in sample 20 could reflect the pre-settlement forest. In addition, these phytoliths could reflect the use by people of wood as fuel for fire activities. The charcoal results found some tree species were present but in smaller quantities, interpreted as wood harvesting of remnant sub-fossil tree stumps after land clearance. Sample 20, being a buried soil, seems to support a left-over remnant of the forest that existed on the spit.

6.2 Charcoal and Wood Analysis

6.2.1 Introduction

Bulk midden and charcoal samples were wet sieved through a 1.5mm mesh. During this process charcoal and other organic material floated to the surface. This material was then air dried and dry sieved. The remaining portion was then examined, and modern vegetation material subsequently removed from the sample. The midden column samples generally had a smaller amount of charcoal present as each spit had a smaller volume than the 10L bulk samples. The firescoop samples had far larger amounts of charcoal, as expected since the samples analysed were selected partly due to the quantity of charcoal present.

A total of nine samples were selected for specialist analysis. This analysis was conducted by Dr Rod Wallace. The samples were used to identify the wood present as charcoal and therefore provide information regarding the local environment and human selection practices.

The samples are from three different types of contexts: five are from column samples in Trench 2 (column 1 and column 4, samples 7 and 10), Area 1; two are firescoop fills located in Area 1 (sample 30 and sample 3); and two are from analysed bulk midden samples from Area 3 (sample 32) and Area 4 (sample 39) (Figure 6-7).

6.2.1 Results

The samples show a large amount of shrub species, particularly manuka and mangrove in abundance (Table 6-1). Only one sample showed substantial quantities of non-shrub species with sample 32 having 25% pohutukawa. A very small amount of larger tree species were present, including very small amounts of large coniferous species in sample 39.

The charcoal is heavily dominated by manuka and mangrove. This indicates that the Omaro sandspit supported manuka scrub at the time the middens formed. The mangrove and the saltmarsh ribbonwood (*Plagianthus divaricata*) reflect the adjacent coastal margins of Whangapoua Harbour. The presence, albeit in very small amounts, of large coniferous species in sample 39 would suggest the presence of remnant stumps of the forest that was cleared in the past.

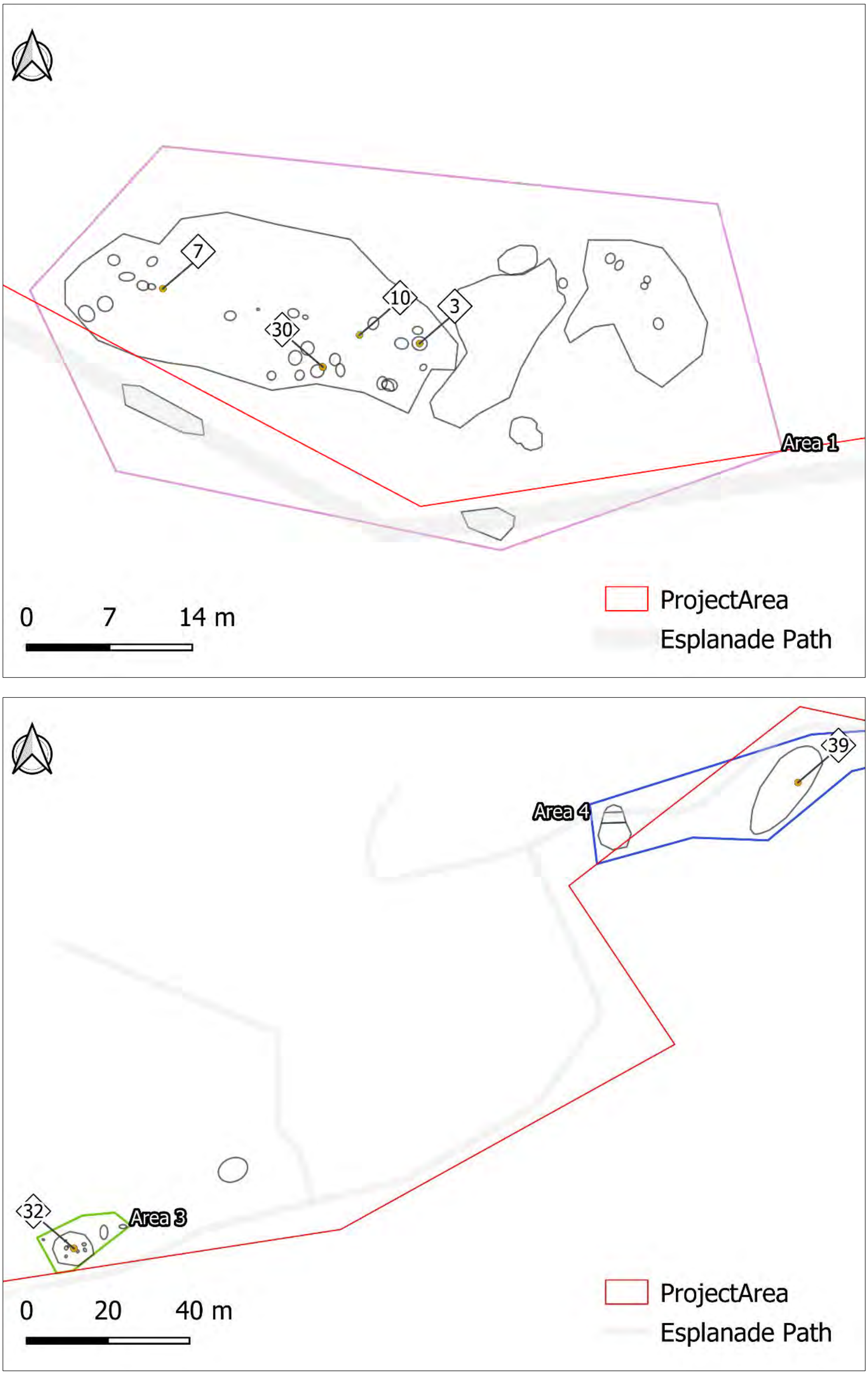


Figure 6-7. Location of charcoal samples analysed

Table 6-1. Table of identified shrub and tree species

			Sample 7						Sample 10			
			Spit 1		Spit 2		Spit 3		Spit 1		Spit 2	
Type	**Species**	**Scientific Name**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Shrubs	Hebe	*Veronica* species		100%		100%		100%		100%		100%
	Coprosma	*Coprosma* species										
	Manuka	*Leptospermum scoparium*	4		6		5		4			
	Mapou	*Myrsine australis*										
	Mangrove	*Avicennia marinaaustralasica*	4		6		5				4	
	Ribbonwood	*Vitex lucens*										
Broadleaf	Pohutukawa			0%		0%		0%		0%		0%
Conifers	Kauri	*Agathis australis*		0%		0%		0%		0%		0%
	Rimu	*Dacrydium cupressinum*		0%		0%		0%		0%		0%
Total			**8**		**12**		**10**		**4**		**4**	

			Sample 3		Sample 30		Sample 32		Sample 39	
Type	**Species**	**Scientific Name**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Shrubs	Hebe	*Veronica* species		100%		95%		75%	3	95%
	Coprosma	*Coprosma* species	1		1		1			
	Manuka	*Leptospermum scoparium*	41		36		13		11	
	Mapou	*Myrsine australis*					1			
	Mangrove	*Avicennia marinaaustralasica*	19		5		8		26	
	Ribbonwood	*Vitex lucens*	8				1			
Broadleaf	Pohutukawa			0%	2	5%	8	25%		0%
Conifers	Kauri	*Agathis australis*		0%		0%		0%	1	2%
	Rimu	*Dacrydium cupressinum*		0%		0%		0%	1	2%
Total			**69**		**44**		**32**		**42**	

6.3 Radiocarbon Dating

6.3.1 Results

Seven radiocarbon dating samples were sent to Waikato Radiocarbon Dating Laboratory. Five were from T10/1052 with one each from T10/1048 and T10/1051. The single dates from T10/1048 (Wk55197) and T10/1051 (Wk55198) were from charcoal extracted from the main midden deposit at each site. Three samples from T10/1052 were from the top, middle and bottom spits of column 7 (Wk55194, Wk55195, Wk55196). The remaining two samples from T10/1052 were from firescoops at the eastern end. Sample 28 (Wk55193) was from a firescoop found beneath the midden and sample 3 was from a firescoop cut into the top of the midden (Wk55199).

The results are summarised in Table 6-2 and standard calibration shown in Figure 6-8 (see Appendix 2 for laboratory report). Wk55193 was dated using pipi with the Marine20 curve and a $\Delta R = -154 \pm 38$. The charcoal dates are all from identified short-lived species (see 6.2 Charcoal and Wood Analysis) and calibrated using the ShCal20 curve. The samples suggest that all three sites probably date from the late 17th century through to the early 19th century AD (Figure 6-8).

The difficulties of calibration mean that the dates for the use of the sites are quite broad despite the number of dates. For T10/1048 and T10/1051, there are only single dates so it is not possible to refine their dates further. This is particular frustrating for T10/1048, which has a largely bimodal calibrated set of dates, the earliest between 1650 and 1680 AD and a second possibility around 1740-1800 AD with the latter considered more probable. The T10/1051 calibrated date range does extend into the modern era but given the likely pre-colonial contents, it is probably no later than 1830.

Table 6-2. Radiocarbon dates from the project (Calibrated using OxCal 4.4.4)

Site	Context	Lab No.	Material	CRA ± Error BP	Calibrated Age Range (Years AD)			
					-1σ	1σ	-2σ	2σ
T10/1052	Sample 28	Wk55193	Pipi	623 ± 21	1630	1810	1530	1890
T10/1052	7a c1sp1	Wk55194	Charcoal: Mangrove	232 ± 20	1660	1800	1650	1810
T10/1052	7b c1sp2	Wk55195	Charcoal: Mangrove	190 ± 12	1670	1810	1670	1950
T10/1052	7c c1sp3	Wk55196	Charcoal: Manuka	174 ± 22	1670	1950	1670	1950
T10/1048	Sample 32	Wk55197	Charcoal: Manuka	252 ± 21	1650	1800	1640	1800
T10/1051	Context 4007	Wk55198	Charcoal: Manuka + Hebe	191 ± 21	1670	1880	1660	1950
T10/1052	Sample No. 3	Wk55199	Charcoal: Manuka	201 ± 21	1670	1810	1660	1950

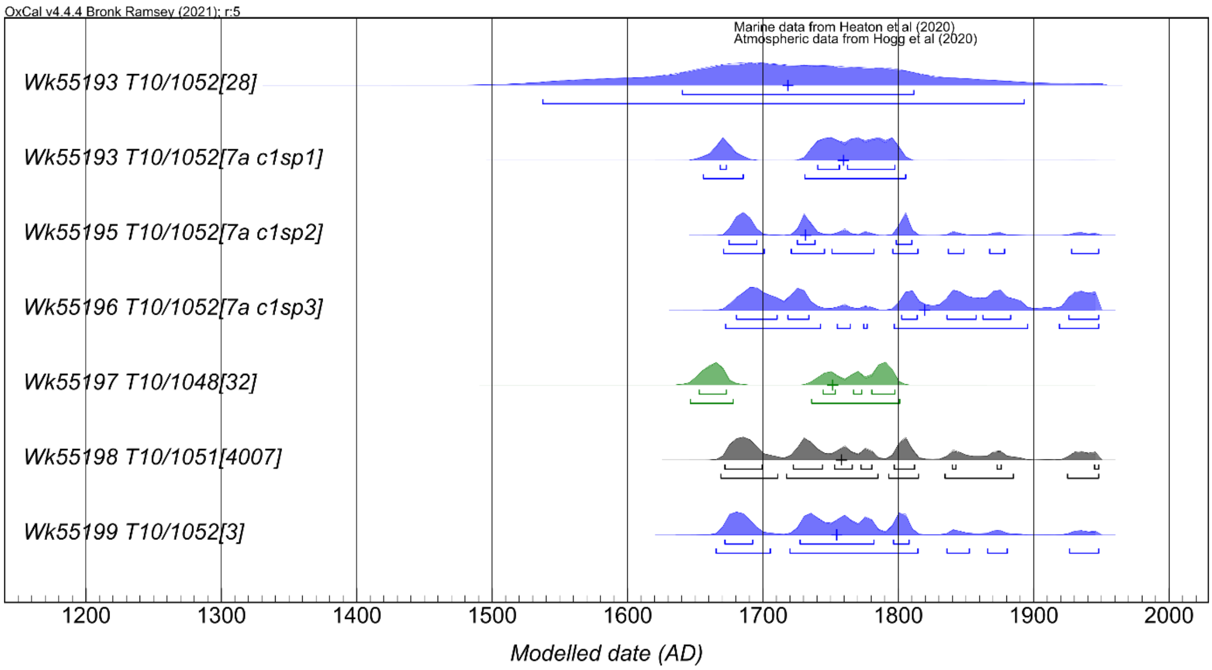


Figure 6-8. Calibrated radiocarbon results (coloured by site number)

In the case of T10/1052, a sequence of three dates from a column sample was taken and provides some basis to further improve the calibration of that site. Using the Bayesian approach available in OxCal 4.4.4, the three column samples were arranged in their stratigraphic sequence and with a more general phase associated with the other dates obtained from the site. The analysis constrains the calibrated date range using the associated sequence. For example, the likelihood of the date from Wk551936 being much later than the early 1800s is quite small as it was taken from a context below both samples Wk551935 and Wk441934.

The results of the calibration are shown in Figure 6-9 and Table 6-3. The main change in interpretation is the likelihood that the site was reoccupied repeatedly from the late 17th century through to the late 18th century AD, probably seasonally.

The charcoal dates from the column samples unusually were in reverse order in their CRA age from their stratigraphic order. It is possible that the sequence represents repeated rake-out from firescoops that involved redeposition of earlier material over later material. However, this is still likely to have occurred across a similar time period as indicated by the Bayesian model and reflects the repeated use of this part of site T10/1052. Comparison of the column dates with the one shell date from sample 28 shows the advantages of the multiple dates, with the result for the single sample unable to distinguish the likely phased use of the site and narrow down its probable occupation.

Table 6-3. Bayesian model date ranges for T10/1052 (calibrated using OxCal 4.4.4)

	-1σ	1σ	-2σ	2σ	median
Wk551936 T10/1052[7a c1sp3]	1678	1734	1671	1761	1715
Wk551935 T10/1052[7a c1sp2]	1723	1742	1676	1781	1732
Wk551934 T10/1052[7a c1sp1]	1733	1774	1729	1805	1755
Wk551939 T10/1052[3]	1672	1808	1666	1948	1754
Wk551933 T10/1052[28]	1640	1811	1537	1891	1718

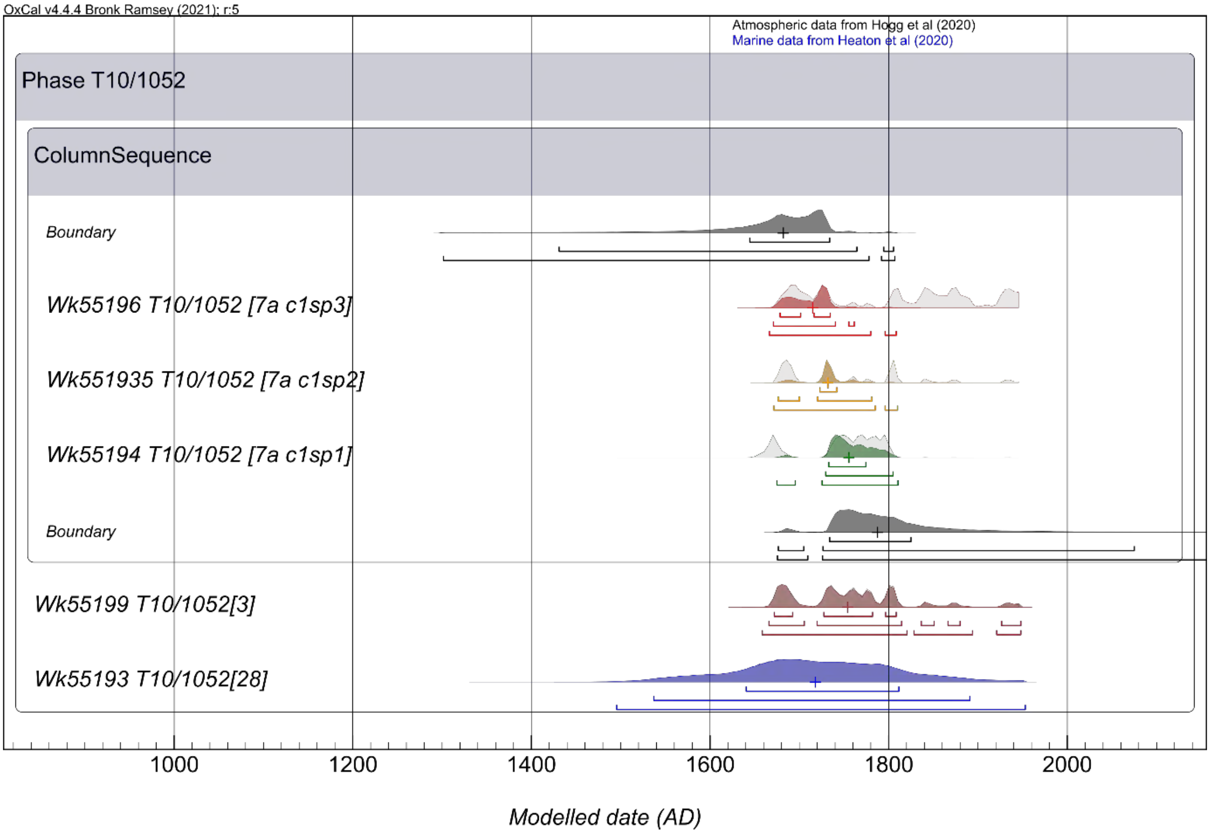


Figure 6-9. Bayesian model of occupation of T10/1052

7 DISCUSSION

7.1 Introduction

Archaeological investigation and monitoring works have recently been carried out as part of the Beaches Development Stages 5 to 8 This found five areas of archaeological remains located in close proximity to the southern edge of the project area, near to the estuarine shore. These five areas were centred around previously recorded sites. The archaeology was characterised by midden deposits with associated firescoops and a small number of rock caches. Very little evidence of structural remains or lithics was found in any of the sites.

The most extensive remains were found in Area 1 (T10/1052), with two large deposits with varied internal structure and other associated stratigraphic layers. The firescoops in this area were found cut into the top of, within and beneath the midden surface. At the other sites firescoops were found only beneath the midden deposits. Very little evidence of structural features was identified across all of the sites. Similarly, only a single artefact was recovered during the works: a broken adze made of Tahanga basalt found within a rock cache in Area 2 (T10/1047).

The charcoal analysed was dominated by shrub and bracken, indicating the Omaro sandspit supported manuka scrub at the time the middens formed, indicative of a landscape cleared by humans. The nearby estuary was also utilised, with mangrove and saltmarsh ribbonwood present. Evidence of a cleared landscape was also supported in the microfossil results. Spore types, coincident with the charcoal and a paucity of tree pollen, reflected a majorly disturbed landscape in part cleared of forest by people. A sample from the buried topsoil beneath a midden in Area 1 found potential evidence of the pre-settlement forest from phytoliths resistant to decay.

The midden analysis found a large amount of variation in the composition of the midden samples analysed, indicating the variation in the processes that acted to form the deposits. The fragmentation of the samples also varied, with what seemed to be fragmented deposits having low fragmentation and vice versa. The columns of the large middens in Area 1 showed higher fragmentation at the surface, lower in the middle then higher at the base. The middens were dominated by tuangi/cockle with pipi being present in substantial amounts and with a few samples dominated by pipi. The middens were generally low to very low richness and evenness, with few other species present. The cockle had a large amount of variation in their dimensions across the sites. There was also variation in size within the column samples that may suggest a decrease in the size of the shellfish over time.

7.2 Formation of Shell Midden Sites

7.2.1 Formation

The shell middens investigated were all situated on relatively similar landforms, the stable mostly flat ground above the high tide level of the estuary. No major differences in the natural stratigraphy were observed in the areas between the shell deposits. The vegetation cover was pasture grass for Areas 1 and 2 with Area 3 being on the edge of a stand of mature pine trees and Area 4 being covered in *Austroderia toetoe*. The location has been utilized for pasture for most of recent history and was shielded from the substantial modern disturbances that have occurred across much of Matarangi. Thus, many of the large-scale processes that act on a landscape were broadly similar across the deposits.

7.2.1.1 Sediment Aspect of the Deposits

It is interpreted that the differences in composition within some midden reflect the different use of space on a small scale. The areas where there is more sediment and a concentration of firescoops is where the shell was cooked/processed and the thicker shell is where it was discarded. This is important as the resulting archaeology has recorded different aspects of the past. The processing areas where sediment built up over time is a record of any other activities that were being carried out while the shellfish was processed and a record of the wider environment through the time of occupation. The lack of lithics, horticultural remains or any other activity has confirmed the specificity of the activity that occurred in these sites.

The shell dumping areas, where larger thicknesses of shell were evident, is interpreted as the dumping areas away from the processing area. Beneath these dumping areas were buried paleosols that reflect an original soil that was present during the early stages of the occupation. These were protected by the deposited shell from post-depositional processes and hold information on the environment close to the beginning of occupation. The results showed evidence of a landscape cleared by humans, indicating the spit had been cleared prior to the occupation. However, there was also evidence of tree species, either of the forest prior to clearance or wood being brought to site. The charcoal results found a small amount of tree species present, interpreted as being from sub-fossil remnant stumps. It appears that there were tree species available for firewood but resources in the immediate vicinity were given preference, rather than resources from further afield being brought to site.

7.2.1.2 Fragmentation

Fragmentation of shell may be caused by a host of processing, depositional and post-depositional processes. These include the level of burning causing breakdown, human and stock trampling, vegetation, mechanical action and water infiltration. With most of the shell having relatively low fragmentation, this suggests they all had similar processes occurring. Unexpectedly, fragmentation was higher in the largest deposit of Area 1 compared with the other midden in the other areas. It was initially assumed that the large amount of shell would act to protect the internal material, due to a larger volume to surface area ratio meaning less material being exposed to surface mechanical and chemical breakdown.

The finer scale analysis of the column samples shows the fragmentation and composition varied between columns and, more importantly, within columns. The smaller columns showed a general, although small, reduction in fragmentation from the top spit to the lowest. This would support the model that post-depositional effects would be higher on the surface. However, the columns of the largest deposit show a reduction of fragmentation from the top to middle and then an increase at the base. What would cause fragmentation at the base is hypothesized to be one of two reasons: the increased weight of shell caused fragmentation at the base, or the shell at the base was affected by different processes from the middle layers.

7.2.1.3 Radiocarbon Modelling

The radiocarbon modelling of the large deposit in T10/1052 indicates that the deposits had no clear hiatuses and were potentially deposited relatively rapidly. This refutes the second hypothesis of a split occupation resulting in higher fragmentation at the base. However, the fact that the large midden had higher fragmentation compared to the other sites may suggest it was an area of higher activity than the other sites, indicating it was revisited more often than other similar locations. The return to a particular place can result from multiple motivations. It could be an iterative process of landscape transformation where deposition modified the desired trait of a processing area, such as being above the waterlogged low area. Subsequent depositions create a higher area which was then selected over other areas.

The motivation or reasons for the return to a particular place in the landscape is likely influenced by both environmental and social factors. An increase in the local availability of resources or reduction in other areas would cause people who are focussing on nearby resources to return to one place. But people’s choices were also constrained by the cultural systems they existed within. These systems are harder to test in the archaeological record as cultural motivations are often intangible and thus have no material remains. Iwi oral history records that members of different status would eat in different areas (Brljevich, pers. comm. 2021) and the larger deposit may reflect high status groups displaying the abundance of resources. This raises questions regarding the spatial distribution of the preparation areas versus the areas of consumption. Higher status consumption may be marked by areas that are relatively clear of material because processed food is brought in. If the meat is extracted from the shell prior to consumption, there would be practically no archaeological remains. In this way the larger midden would indirectly provide evidence of feasting behaviour. Meeting of groups and associated feasting was argued at Omaha Spit north of Auckland (Campbell et al. 2004) and it is possible that the Omaro Spit was also the location of similar activity.

While there are many similarities in the sites investigated in this project, T10/1052 had larger deposits, more features and more complex stratigraphy than the other sites. The amount of material present in the larger middens can be the result of larger quantities of shell being deposited over the same depositional time scale to the smaller middens. Alternatively, it can be the result of similar quantities of shell being deposited over longer time frames. The more intensive dating of the larger midden suggests there was not a large time duration in the deposition of the large midden deposit nor any long hiatuses in the occupation. With the other two dated sites likely dating to within the same time period, it suggests the southern side of the spit was being used around the same time for the processing of shellfish. The more intensive archaeology found at T10/1052 suggests that area was perhaps returned to more often than the other sites. The reasons for this, as discussed above, could be due to more productive shell beds in the vicinity, a more suitable location, or other intangible reasons such as association with people of power or prestige. Collaboration with iwi and hapu groups as well as social scientists presents opportunities to explore this theme.

7.2.2 Species

The species found indicate the targeting of two main species of shellfish: tuangi and pipi. This was found both across the different sites and within the column samples. Generally, tuangi was more prevalent across the project with upwards of 90 percent of the total species. Two samples were found with pipi having a much larger proportion, midden (5) in Area 1 and the midden from Area 2. Conspicuously absent from any of the midden deposits was fishbone remains. Fishbone has been found in other midden sites in Matarangi in low amounts and was almost entirely mackerel (Furey 1998; Sewell 2000). Considering the similarity in the project locations it would not seem likely to be the result of differential preservation. The archaeological excavations of Sewell and to a lesser extent Furey were characterised by dispersed firescoops with smaller amounts of concentrated middens. They reflect a broader range of food processing that included fish as well as shellfish. This may be due to the Furey and Sewell sites being in closer proximity to the open ocean where mackerel was available, whereas the sites in the project area were more distant from the open sea.

The samples were generally of low to moderately low richness, with at most five species found in a sample, indicating that targeting of the main species was focussed. There was no particular patterning in the distribution of the other species, in either the bulk samples or the column samples.

The presence of species from both muddy and sandy environments indicates harvesting on both the northern, ocean beach side of Omaro spit and the nearby estuary to the south. However, the higher proportion of tuangi and pipi suggest the closer estuarine environment was more heavily targeted. Many of the minor species would have been present in the same areas where the main species were harvested. They were likely taken either as a by-catch in the case of the smaller species and/or opportunistically if the species was present in small numbers. As the numbers were low, their presence is interpreted as indicating targeting of intermittent rocky environments rather than intermittent targeting of rocky environments. The only primarily sandy shore species found was tuatua, which was only found in middens in T10/1052. This suggests shell was taken from the northern side of the spit but very infrequently, with the much closer estuary being more heavily targeted.

Dimension results that were calculated for tuangi show substantial variation across the project area. It appears that different collection strategies may be evident in the target sizes of tuangi. It may also show variation in the natural populations or potentially multiple different shell beds being targeted. Likely the results are an amalgamation of these possibilities, and it is difficult to identify the relative influence of each.

A pattern identified in the large midden in T10/1052 was a decrease in the size of tuangi from the bottom to the top. The four spits had similar sized ranges but showed a reduction in mean from the bottom spit to the top. This could be evidence of depression of shell beds through continued harvesting over time. The right skew of most of the samples analysed suggests that larger individuals were taken when available in low numbers while small sizes were avoided. The restriction of taking small sizes may reflect a cultural management practice that ensures resources continue to be available. The slight depression in the size seen in column 1 may reflect that sufficient numbers were being harvested to affect the natural populations but practices were in place to avoid large impacts.

7.3 Reconstructing the Changing Landscape

Radiocarbon dates from previous neighbouring investigations in this part of the Coromandel Peninsula have shown a consistent pattern of small-scale settlements during the 16th century through into the 18th century AD (Figure 7-1 and Figure 7-2). The current project sites consistently dated to the end of this occupation and were roughly contemporary with both T10/993 to the north and T10/985 to the west (Furey, 1998, 2003; and Sewell 2000). However, dates from T10/993 indicate that the area was used prior to the 18th century and dates from T10/991 and T10/1041 (dates courtesy of L. Furey) indicate use probably 150-200 years before T10/1052. This occupation sequence is mirrored around the harbour at Whangapoua and at the southern end in the Whangapoua Forest (Figure 7-1), although an anomalously early date was obtained from T11/644 (Crosby et al. 1987). This date should be treated with come caution given the other dates from that site and its neighbours.

Maxwell et al. (2017), based on work at Cook's Beach, have argued that phases of settlement and abandonment were one way in which the landscape was utilised prior to Cook's arrival. The results of the investigations reported by Hoffman (2017) point to evidence of landscape modification at T11/2789 (Cooks Beach) within the 'first half of the 14th century, or at the latest within the last 2-decade [sic] of that century' (Hoffman 2017:25). Subsequent settlement from around 1500–1650 AD, after about 100 years of no occupation, appeared to have been relatively small scale and consistent with short-term encampments by a small number of people accessing the range of available resources, including the local obsidian sources.

A chronological model of the radiocarbon dates suggested that the Cook's Beach area may have fallen into disuse or been abandoned around 1650 AD (Maxwell et al. 2017:15). Hoffman (2017) and Maxwell et al. (2017) discuss explanations for this abandonment, possibly the result of the local soils becoming less productive and/or the result of greater conflict in the region during that period. The abandonment of the Cook's Beach area by the time of Captain Cook's visit in 1769 suggests that conditions had not changed following that abandonment.

As a result of this work, Maxwell et al. (2017) have argued for a three-phase occupation and abandonment model for settlement at Cook's Beach. This is summarised in Table 7-1.

Table 7-1. Chronological model for settlement at T11/2789, Cook's Beach (after Maxwell et al. 2017)

Date (Approximate)	Description
1300 - 1400 AD	Environmental impact/ resource exploitation, etc.
1400 - 1500 AD	Abandonment
1500 - 1650 AD	Cultivation and transient settlement
1650 AD on	Abandonment

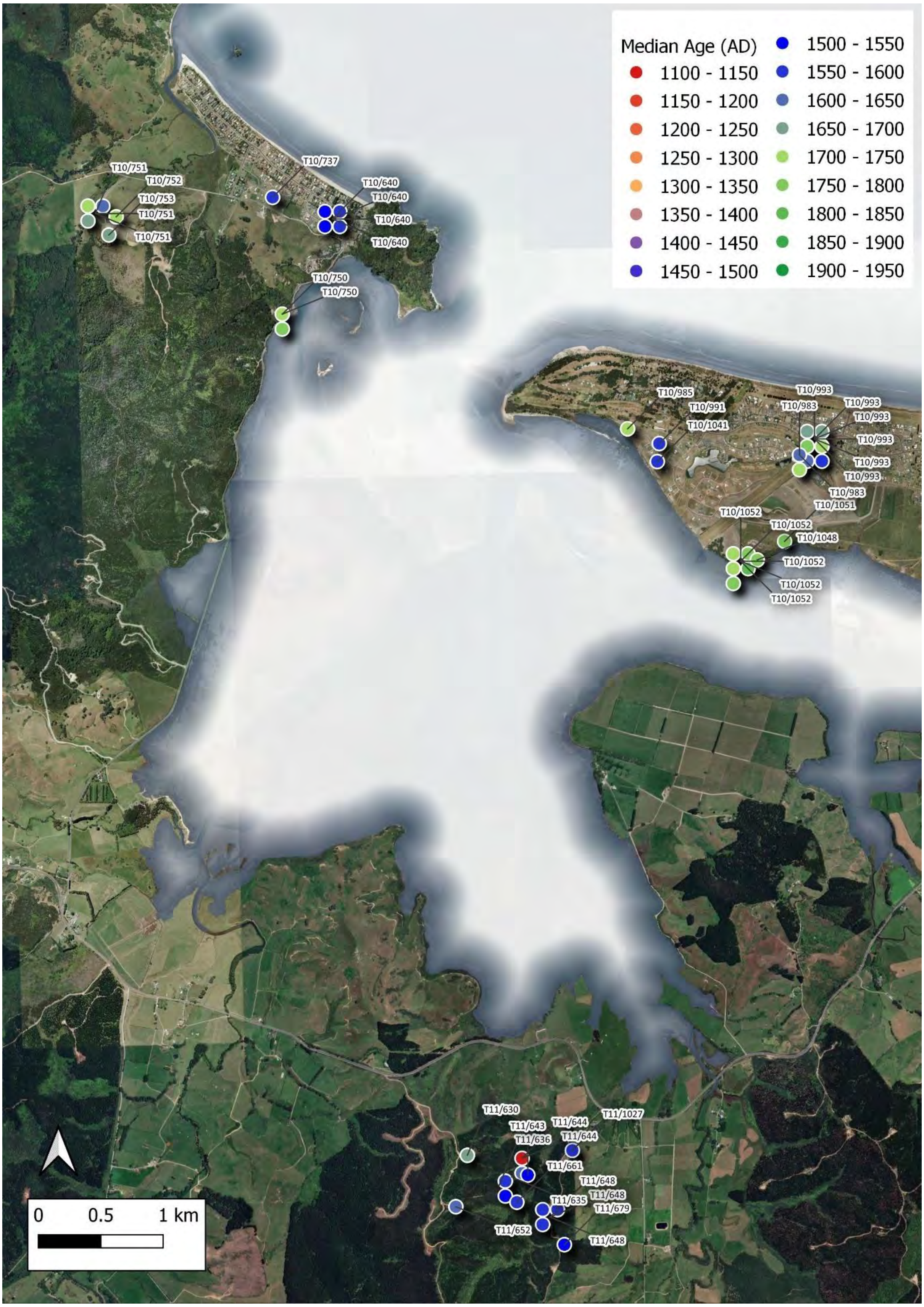


Figure 7-1. Radiocarbon dates from near the project area (source: Dr Simon Bickler, data from Aotearoa New Zealand Radiocarbon Database, Petchey et al. 2022)

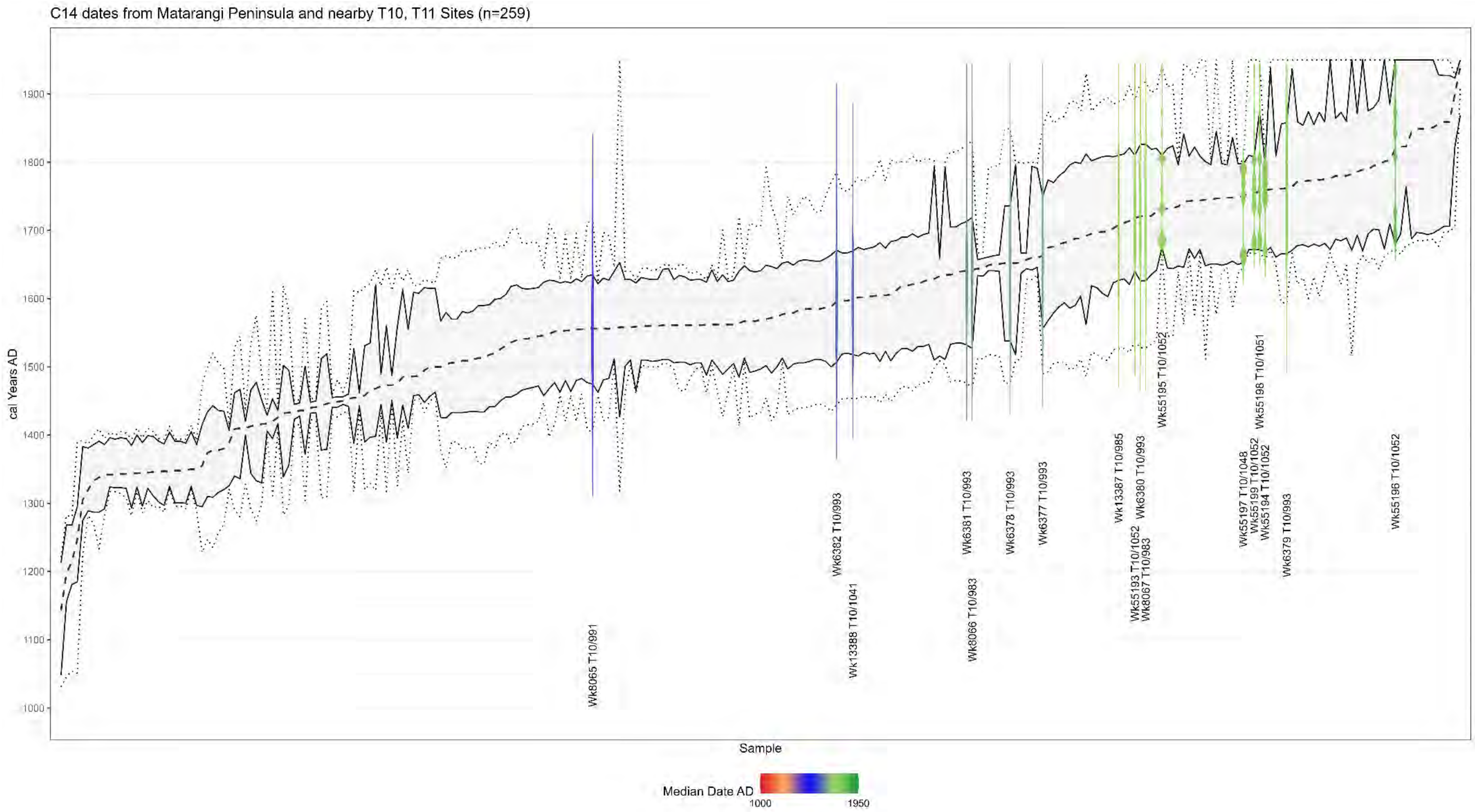


Figure 7-2. Dates from Matarangi compared with dates from excavations nearby on T10 and T11 Map sheets (data from Petchey et al. 2022, chart courtesy Simon Bickler)

Recent work by Jones et al. (2021) at Cooks Beach has suggested that the Cook's Beach area was probably not abandoned during the periods suggested. The pattern of dates found there reflects the shifting use of the sandy dunes for both settlement and gardening during both seasonal and long-term cyclical management of the resources in these Coromandel harbours. Occupation of higher grounds above the dune areas may have offered more desirable living locations with less flooding, more weather protection and improved security.

The Matarangi Peninsula sites are similar to those at Cook's Beach but lack the investigation of gardening areas undertaken there. Soil conditions and previous activities on the site precluded direct data confirming gardening on the sites, but the palynological results discussed earlier certainly point to such activities in the vicinity.

The radiocarbon data around the Matarangi Peninsula argue for relatively continuous, or at least regularly repeated, occupation of the Matarangi Peninsula from at least the 16th century AD onwards. Given the number of sites that are likely to have been lost prior to any form of archaeological investigation and the limited dating available from the more recent works, this sequence of occupation probably extended at least another century earlier. There is no indication of any long-term abandonment of the area during the known sequence.

Recent reconstruction of sites (see, for example, Farley and Bickler 2017; Bickler et al. 2020; Jones et al. 2021) is being undertaken to place the somewhat ephemeral remains of Māori sites within their larger physical and cultural landscape. While the midden sites at Matarangi reflect the processing of shellfish this by no means indicates they were not considered important or significant to the people who occupied the area.

Along the southern coastline, the archaeological evidence does suggest regular but small-scale occupation set within a broader secondary vegetative landscape probably with only minor tree coverage. The inland location probably offered shelter and easy waka landings (Figure 7-3, Figure 7-4).

The results contribute to a better understanding of the intensity and fluctuations of habitation in the coastal zone. The information gained here can be used alongside information from local iwi and hapu regarding the deep history of the region.

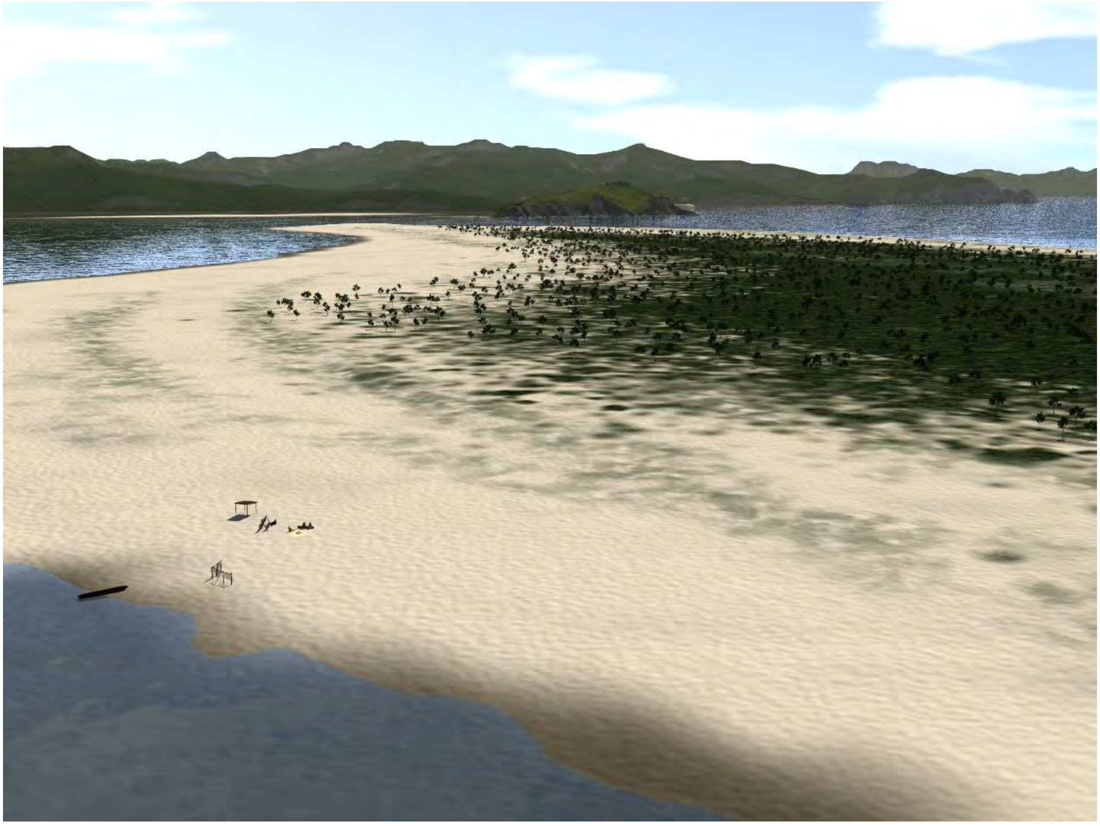


Figure 7-3. Hypothetical 3D model showing reconstructed site T10/1052 looking west across Matarangi Spit with Whangapoua Peninsula in the background (created by Tom McDiarmid)

Figure 7-4. Hypothetical 3D model showing close-up of reconstructed site T10/1052 looking west across Matarangi Spit with Whangapoua Peninsula in the background (created by Tom McDiarmid)

7.4 Research Aims

7.4.1 Settlement

The settlement of Aotearoa/New Zealand has been the subject of extensive research, most recently summarised by Walter et al. (2017), suggesting mass migration from Central Polynesia around 1250 AD. The settlement of New Zealand is significant in terms of Polynesia, not least because of the scale of the landscape that the early Polynesians arrived in – c.268,00 km^2, nearly 10 times the size of the next largest group of islands in Polynesia (Hawaii, at 28,311 km^2). Those Polynesian ancestors gave rise to the Māori, who set about transforming much of the newly settled landscape, a considerable amount of it for agricultural use.

7.4.2 Coastal Occupation

The coastal margin is a key part of Māori settlement and the research at Matarangi has demonstrated that Māori occupation of these coastal zones forms part of an integrated settlement strategy across the wider landscape. Recently, much of the research has focussed on how the Polynesian and later Māori utilised the coastal margin in their horticultural systems. Barber and Higham (2021) have recently demonstrated that kumara cultivation was possible as far south as Dunedin during the mid-15th century AD, although this proved unsustainable in the longer term. Hoffman (2017:26ff) has summarised some of the archaeological work relating to Māori agriculture undertaken in the Coromandel Peninsula and this represents only part of the ongoing research. Hoffman noted kumara agriculture is 'clear' from the range of storage and gardening features found at Cooks Beach. Typically, the crop is assumed to have been the prime target for cultivation at Cooks Beach; however, previous investigation results had provided no direct evidence of kumara agriculture. Recently Jones et al. (2021; Horrocks et al. 2023) found direct evidence of horticulture at Cooks Beach in the form of taro starch, suggesting the horticultural systems on the coast were more complex than a simple focus on kumara. The Cooks Beach sites which provided this evidence were located at the southern extent of the Holocene sand dune and extending to the foothills of the higher topography to the south of the beach. Comparatively, the Matarangi sites are situated on the sandspit, separate from other geological landforms. The differences in the geology and topography would have had an effect on the suite of activities carried out at each location.

Matarangi has thus far had little evidence of horticulture in either associated features such as storage pits, or in palynological evidence; however, few palynological studies have been carried out to date. Sewell interpreted a mixed sandy layer as evidence of gardening, drawing heavily from the modified soils model from Waikato and the Bay of Plenty. However, she notes that the benefits gained from adding sand would be present in the naturally sandy soils (Sewell 2000: 10). It is possible that small-scale horticulture was practiced with taro in the wetter swales and kumara on the dryer dune slopes as was suggested at Cooks Beach (Jones et al. 2021) but this evidence has yet to be found. Horticulture was more likely carried out in more established locations, either in other areas of the spit or in other areas around Whangapoua Harbour (see Horrocks et al. 2023). With the harbour allowing ease of access to multiple varied landscape aspects, these could be combined in a system to maximise the utility of the wider area by specialisation of activity.

Archaeological research around the top of the North Island such as at Cooks Beach (Jones et al. 2021; Maxwell et al. 2017), Weiti Bay and Omaha Beach north of Auckland (Campbell et al. 2004) and Papamoa (see e.g., Gumbley n.d., 2006; Campbell et al. 2009), have all shown how land clearance was probably important for the conversion of dune systems into productive zones for both short- and long-term occupation. The results at Matarangi showed the spit was cleared prior to the occupation of these sites.

At Matarangi this clearance would have allowed re-growth of bracken fern, which itself was considered a valuable, if not particularly desirable, food source. This would have been useful when integrated into a wider dispersed pattern of food acquisition, especially during times when the focus was on seafood harvesting. The clearing of the spit was part of a management approach to the landscape where clearance fostered the flourishing of desired resources. This was maintained over time through a feedback loop as the new habitat became integral to the wider settlement subsistence pattern and so was continued (Laland and O'Brian 2010).

7.4.3 Concentrated vs Dispersed Settlement Pattern

There is a duality in the archaeology of the Coromandel region (see Figure 7-5, Figure 7-6) between earlier sites dating around the 13th to 14th century and later sites from the 15th to the 18th century. Early sites are in localities where a broad suite of resources are brought to a central location. Many later sites exhibit a narrower range of resources, in particular subsistence resources. Additionally there appears in the record sites where a limited range of activities are carried out, specifically where shellfish are processed. It is argued here that these processing sites are part of an interconnected, dispersed pattern where resources and the activities associated with them are carried out in different localities across the wider landscape.

Early sites located around the Coromandel show evidence for a much broader subsistence base in the earlier occupation layers. The excavated 'archaic' sites of Whaorei (Sarahs Gully) and Opito Bays (Arthur Black, Skippers Ridge) record fur seal, whale, dog, moa, rocky shore and mudflat species of shellfish, both forest and sea bird and rat (Green 1963; Sewell 1990; Fury et. al. 2008). In Tairua this was shown stratigraphically with the species of shellfish present being notably different in the upper compared to the lower layers at T11/62. The upper layer investigated (bed 6) was composed of upwards of 98 percent tidal mudflat shellfish, pipi and tuangi; whereas in the lower layer (bed 2) the shellfish species were more varied and predominantly (93.9 percent) from the rocky shore, including cat's eye and denticulate limpet (Smart and Green 1962). Similarly, at Cross Creek rocky shore species were more prevalent early, transitioning to sandy shore species being more prevalent.

Many of the sites with early occupation layers have later occupations at the same location. These sites show a reduction in the range of the subsistence species over time, often with a single species being predominant in the later occupations. The central species of these sites are most often related to the closest available soft shore environment that would support shell beds. A midden analysed at the southern end of the Pauanui sandspit near the foothills of Pauanui Hill (T12/221) found, in decreasing order of abundance, pipi, tuangi and tuatua, with small amounts of rocky shore species (Campbell and Trilford 2019). While the main three species were easily accessible in the nearby Tairua harbour, the closest rocky environment was ~2km away (ibid.: 10).

Similar results were found from a kainga at Pauanui (T12/1028) excavated by Gumbley that indicated people were primarily exploiting the harbour and sometimes the sandy shore (Gumbley 2003), with both being equidistant from the site.

Figure 7-5. Locations of investigations discussed

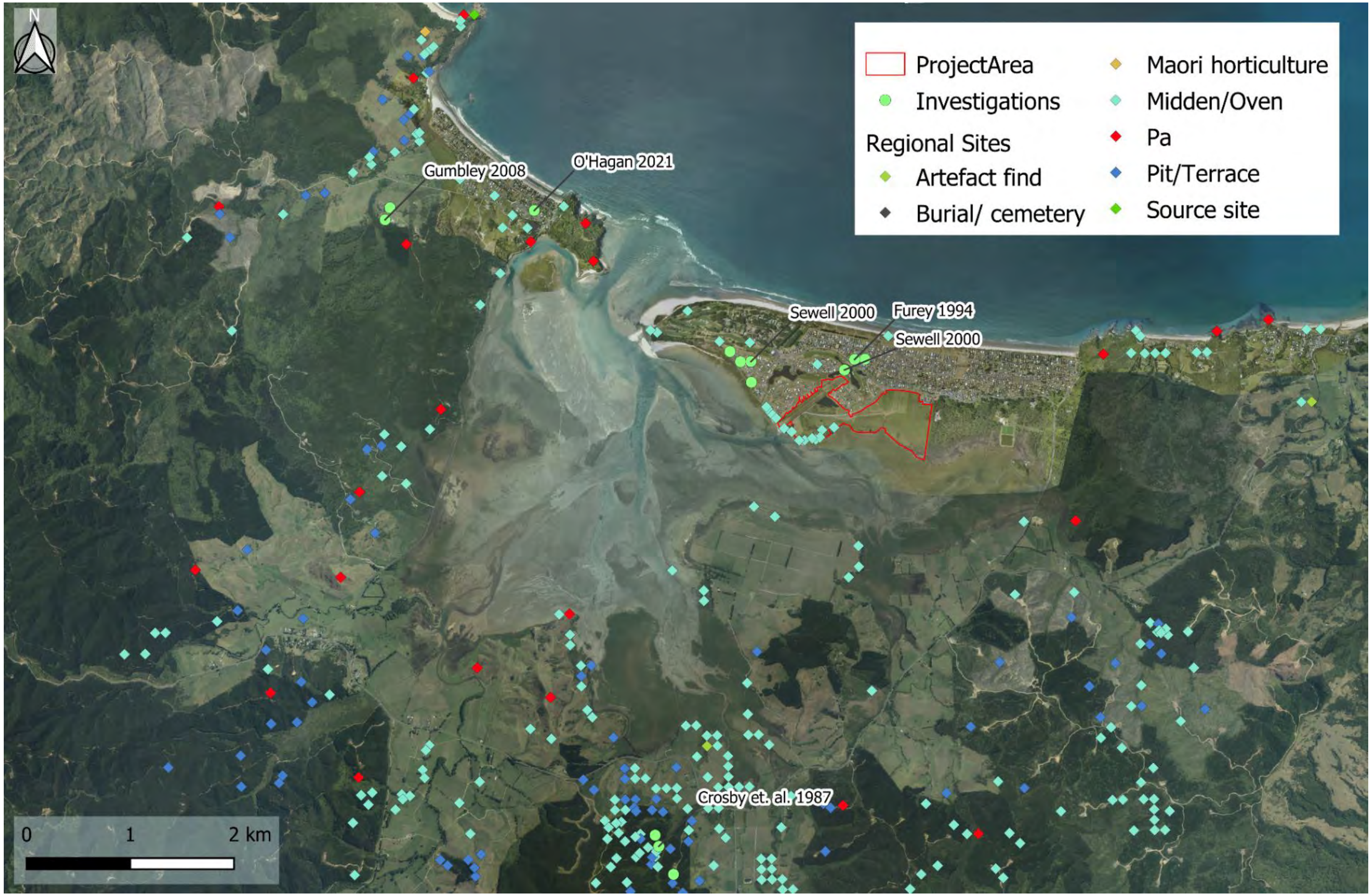


Figure 7-6. Recorded site types around Whangapoua Harbour and investigations discussed

The shift from rocky shore species to soft shore species has been argued to be both environmental and cultural. McFadgen (2013) suggests a tsunami event is likely to have changed the marine environment around 1400-1600 AD and sand was blown over the Coromandel coast, burying many rocky shore environments and causing soft shore areas to be targeted. He also suggests variation may be due to changes in tikanga or preferences for soft shore species over rocky shore (McFadgen 2013). The gradual implementation and development of horticultural systems and extirpation of some endemic species also likely had an effect in shifting the subsistence systems in different areas of Aotearoa.

This investigation has confirmed that the sites in this part of the Matarangi peninsula reflect the targeting of a narrow range of very localised shellfish resources. This specificity of activity at Matarangi would be impossible without the other aspects of the sociocultural subsistence system such as more permanent occupation and the well-documented horticultural systems. The question that remains is the location of these other aspects of the wider system and the nature of the archaeological record which contains evidence for it.

7.4.4 Whangapoua

Three investigations around Whangapoua Harbour provide useful contrasting information from sites in a more inland context. Gumbley (2008) undertook an investigation of shell midden sites T10/751, T10/752 and T10/753 located on the low ridges at the foot of the hills behind Whangapoua Beach (see Figure 7-6). The investigations indicated that the three sites were in fact part of one larger occupation site with associated structural postholes and stakeholes interpreted to be at least one whare, and a series of four rectangular pits. More importantly, the palynological results found substantial evidence of kumara in multiple contexts, providing direct evidence for the storage of the crop. A small stone artefact assemblage of 14 items was recovered, comprising obsidian cores and flakes, a chert core and a basalt flake. Five radiocarbon dates were obtained from the site, providing a date of occupation of late 16th to 17th century AD (Gumbley 2008).

Recent archaeological monitoring works at Whangapoua township found a small number of heavily truncated midden deposits (O’Hagan 2021; see Figure 7-6). The species identified in the analysis were dominated by pipi, with tuangi, both being available in close proximity to the sites. The truncation suggests they were a remnant of much more extensive deposits but it is unclear if they were on the same scale as those found at Matarangi. Two radiocarbon determinations estimated the middens to have been deposited between the late 15th and late 17th centuries. O’Hagan suggested the dating of the two investigations indicates that the coast was the location of initial settlement and that this later shifted to the hills. However, the overlap in the dates may suggest they were partially contemporary occupations and reflect two aspects of a wider settlement pattern.

Crosby, Sewell and White’s (1987) work at the Owera Stream valley, south of Matarangi (see Figure 7-6), excavated in detail three sites (T10/643, T10/644 and T10/648) out of a total of 41 recorded. They uncovered houses and associated shell middens, evidence of stone working and cooking. Radiocarbon dating results from seven of the 41 sites were generally similar, indicating people were living, and probably gardening, on the hill slopes up to 1km from the Whangapoua Harbour between about 1400 and 1600 AD. This places the occupation before the current dating of the Omaro spit; however, it is likely that the occupation of the spit began earlier as there is evidence that land clearance had occurred prior to the midden deposition.

All three inland investigations provide occupation evidence that was not present at Matarangi, such as permanent structures, storage features and stone working. The recorded sites around the harbour indicate there are many locations where similar sites may be located (Figure 7-6). While the Owera Stream Valley sites were earlier, the similarity to the sites investigated by Gumbley suggests there are sites in the foothills in the vicinity of Matarangi that would be contemporary with the occupation of the spit. These sites are not known due to a combination of site destruction, the fact that few large-scale investigations have been carried out, and the limited dating information available from the more recent works.

8 CONCLUSION

The archaeological sites investigated during the Beaches Development at Matarangi reflect the targeted harvesting and processing of a narrow range of shellfish species. Local wood resources were utilised, both on the spit and in the mangroves, suggesting the occupation was a highly specialised, concentrated activity, using resources in the immediate vicinity. The activity at the sites is interpreted as having been carried out in short time frames, being seasonal or even a matter of days, where nearby resources were brought to the closest area for processing. The lack of structural remains, lithics or horticultural evidence confirms the specificity of the activity carried out. Dating evidence found the sites were reoccupied repeatedly between the late 17th century and late 18th century AD. The processing of shellfish at these sites was likely part of a larger social, environmental and cultural system that existed in the wider area around the Whangapoua Harbour.

References

Andrefsky, W. 2005. *Lithics: Macroscopic Approaches to Analysis*. Second edition. New York: Cambridge University Press.

Barber, I.G., and T.F.G. Higham. 2021. Archaeological science meets Māori knowledge to model pre-Columbian sweet potato (*Ipomoea batatas*) dispersal to Polynesia's southernmost habitable margins. *PLoS ONE*, 16(4).

Bickler, S.H. 2018. *CRM Archaeology in New Zealand: A Guide for Students and Practitioners*. Auckland, New Zealand.

Bickler, S.H. and R. Clough. 2021a. Archaeological Assessment of Effects Addendum: for Subdivision of 399 Matarangi Drive, Matarangi, Coromandel Peninsula. Clough & Associates report for Beaches Developments Ltd.

Bickler, S.H. and R. Clough. 2021b. Archaeological Management Plan and Research and Investigation Strategy for Subdivision of 399 Matarangi Drive, Matarangi, Coromandel Peninsula. Clough & Associates report for Beaches Developments Ltd.

Bickler, S., J. Low, B. Larsen, B. Jones, C. Mailhot, L. Dawson and R. Clough. 2020. Archaeology at Weiti Bay, Auckland: Final Excavation Report under Heritage NZ Authority No. 2015/498. *Clough & Associates Monograp*h 22. Report prepared for Weiti Development Limited Partnership, c/o Williams Land Limited.

Black, V. 1985. *The Spirit of Coromandel*. Auckland: Reed Methuen.

Brljevich, Wanda, cultural monitor for Ngāti Huarere ki Whangapoua, pers. comm. 2021.

Campbell, M. 2022. Ōmaro Spit Dune Restoration, 2022–2023 Seasons: Archaeological Assessment. Report prepared for The Matarangi Ratepayers Association.

Campbell, M., S. Bickler and R. Clough. 2004. The archaeology of Omaha Sandspit, Northland, New Zealand. *New Zealand Journal of Archaeology* 25(2003):121-157.

Campbell, M., W. Gumbley and B. Hudson. 2009. The Tara Road sites, Papamoa. CFG Heritage report.

Campbell, M. and D. Trilford. 2019. T12/221, 1201 Hikuai Settlement Road, Pauanui (HNZPTA Authority 2017/754): Final Excavation Report. CFG Heritage report prepared for Watts Group.

Crosby, A., B. Sewell and M. White. 1987. Interim report on excavations in the Holzgang Block, Whangapoua Forest, Coromandel Peninsula, *New Zealand Archaeological Association Newsletter* 30(1): 79-93.

Easdale, S., and C. Jacomb. 1982. Coromandel Coastal Survey: A Study of Archaeological Sites on the Beaches of the Coromandel Peninsula. Unpublished report.

Farley, G., and S.H. Bickler. 2017. The Timberly Road excavation, R11/2379, Mangere, Auckland. *Archaeology in New Zealand* 60 (4):30-41.

Felgate, M.W. 2001. Geochemical characteristics of the Tahanga archaeological quarry complex. *Archaeology in New Zealand* 44: 215–240.

Furey, L.1998. Archaeological Excavations of T10/993, Matarangi, Coromandel Peninsula. Unpublished report.

Furey, L. 2003. Archaeological Investigations, Stage 16, Matarangi. Report to Matarangi Beach Estates. HP Authority 2003/156 and 2004/09.

Furey, L. 2005. Archaeological Site Survey, Stages 17 – 30, Matarangi. Unpublished report for Axis Property Ltd.

Furey, L., F. Petchey, B. Sewell and R. Green. 2008. New observations on the stratigraphy and radiocarbon dates at the Cross Creek site, Opito, Coromandel Peninsula. *Archaeology in New Zealand* 511: 46-64, 2008.

Green, R. 1963. Summaries of sites at Opito, Sarah's Gully, and Great Mercury Island. *Archaeology in New Zealand* 6: 57-69.

Gumbley, W. n.d. Archaeology of Pre-European Garden Soils at Papamoa, Bay of Plenty. Unpublished typescript.

Gumbley, W. 2003. Archaeological Investigation of T12/1028: A Prehistoric Kainga at Pauanui, Coromandel Peninsula. CFG Heritage report.

Gumbley, W. 2006. Archaeological Investigation of Part of U14/2866, April 2006. report prepared for Connell Wagner Tauranga. CFG Heritage report.

Gumbley, W. 2008. Archaeological investigation of sites T10/751, T10/752 and T10/753, Whangapoua, Coromandel Peninsula. Report prepared for NZHPT and Matthew Denize.

Handley, S.J., A. Swales, M. Horrocks, M. Gibbs, M. Carter, R. Ovenden and J. Stead. 2020. Historic and contemporary anthropogenic effects on granulometry and species composition detected from sediment cores and death assemblages, Nelson Bays, Aotearoa-New Zealand. *Continental Shelf Research*, doi: 10.1016/j.csr.2020.104147.

Hayward, B.W., H.R. Grenfell, K. Nicholson, R. Parker, J. Wilmshurst, M. Horrocks, A. Swales and A.T. Sabaa. 2004. Foraminiferal record of human impact on intertidal estuarine environments in New Zealand's largest city. *Marine Micropalaeontology* 53: 37-66.

Hoffmann, A. 2015. Subdivision of DP 467530 on Archaeological Sites, Omaro Spit, Matarangi, Coromandel Peninsula. Unpublished report for Burfoot Ltd.

Hoffmann, A. 2017. Investigation of Archaeological Site T11/2789, Cooks Beach (Pukaki), Mercury Bay: Final Report. HNZ Authorities 2015/867 & 2015/1022. Report to Longreach Developments Ltd and Heritage New Zealand.

Holdaway, S., and N. Stern. 2004. *A Record in Stone: The Study of Australia's Flaked Stone Artefacts*. Melbourne: Museum Victoria.

Horrocks, M. 2004. Polynesian plant subsistence in prehistoric New Zealand: A summary of the microfossil evidence. *New Zealand Journal of Botany* 42: 321-334.

Horrocks, M. 2020. Recovering plant microfossils from archaeological and other paleoenvironmental deposits: A practical guide developed from Pacific Region experience. *Asian Perspectives* 59: 186-208.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, L. González Nualart, S. Haoa-Cardinali and T. Edmunds Gorman. 2012a. Fossil plant remains at Rano Raraku, Easter Island's statue quarry: Evidence for past elevated lake level and ancient Polynesian agriculture. *Journal of Paleolimnology* 48: 767-783.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, S. Haoa-Cardinali, L. González Nualart and T. Edmunds Gorman. 2017. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology* 41: 339-350.

Horrocks, M., W.T. Baisden, J. Flenley, D. Feek, C.M. Love, S. Haoa-Cardinali, L. González Nualart and T. Edmunds Gorman. 2016. Pollen, phytolith and starch analyses of dryland soils from Easter Island show widespread vegetation clearance and Polynesian-introduced crops. *Palynology* 41: 339-350.

Horrocks, M., W.T. Baisden, M.K. Nieuwoudt, J. Flenley, D. Feek, L. González Nualart, S. Haoa-Cardinali and T. Edmunds Gorman. 2012b. Microfossils of Polynesian cultigens in lake sediment cores from Rano Kau, Easter Island. *Journal of Paleolimnology* 47: 105-284.

Horrocks, M. and I. Barber. 2005. Microfossils of introduced starch cultigens from an early wetland ditch in New Zealand. *Archaeology in Oceania* 40: 106-114.

Horrocks, M., S. Bickler, W. Gumbley and B. Jones. 2023. Plant microfossil and 14C analysis of archaeological features at Coromandel Peninsula, New Zealand: Evidence for regional Māori use of introduced and indigenous plants. *Journal of Pacific Archaeology* 14:1-19.

Horrocks, M., M. Campbell and W. Gumbley. 2007. A short note on starch and xylem of *Ipomoea batatas* (sweet potato) in archaeological deposits from northern New Zealand. *Journal of Archaeological Science* 34: 1441-1448.

Horrocks, M., M.K. Nieuwoudt, R. Kinaston, H. Buckley and S. Bedford. 2014. Microfossil and Fourier Transform InfraRed analyses of Lapita and post-Lapita human dental calculus from Vanuatu, Southwest Pacific. *Journal of the Royal Society of New Zealand* 44: 17-33.

References

Horrocks, M., I.W.G., Smith, S.L. Nichol and R. Wallace. 2008. Sediment, soil and plant microfossil analysis of Māori gardens at Anaura Bay, eastern North Island, New Zealand: Comparison with descriptions made in 1769 by Captain Cook's expedition. *Journal of Archaeological Science* 35: 2446-2464.

Horrocks, M., and M.I. Weisler. 2006. A short note on starch and xylem of *Colocasia esculenta* (taro) in archaeological deposits from Pitcairn Island, southeast Polynesia. *Journal of Archaeological Science* 33: 1189-1193.

Horrocks, M., S. Bickler, W. Gumbley and B. Jones. 2023. Plant microfossil and 14C analysis of archaeological features at Coromandel Peninsula, New Zealand: Evidence for regional Māori use of introduced and indigenous plants. *Journal of Pacific Archaeology*.

Jones, B., S.H. Bickler, B. Larsen, K. Roth, D. Gaylard and R. Clough. 2021. Final Report of Archaeological Investigations: Stage 2B, 4 and 5 Earthworks, 720 Purangi Road, Cooks Beach (Pukaki), Coromandel in Fulfilment of HNZPT Authority 2020/230. Prepared for Longreach Developments Ltd. *Clough & Associates Monograph Series* No. 23.

Kahn, J.G., M. Horrocks and M.K. Nieuwoudt. 2014. Agriculture, domestic production, and site function: Micro-fossil analyses and late prehistoric landscapes of the Society Islands. *Economic Botany* 68: 246-263.

King, M. and R. Morrison. 1993. *The Coromandel*. Auckland: Tandem Press.

Kondo, R., C. Childs and I. Atkinson. 1994. *Opal Phytoliths of New Zealand*. Lincoln: Manaaki Whenua Press.

Laland, K.N., and M.J. O'Brien. 2010. Niche construction theory and archaeology. *Journal of Archaeological Method and Theory*, 17(4): 303-322.

Marck, G.P., and S.N. Campbell. 1979. Sedimentology and evolution of Omaro Spit, Coromandel Peninsula, *New Zealand Journal of Marine and Freshwater Research* 13(3): 347-371.

Marks, C., and C. Nelson. 1979. Sedimentology and evolution of Omaro Spit, Coromandel Peninsula. In: *New Zealand Journal of Marine and Freshwater Research* 13:347-372.

Maxwell, J.J., M.D. McCoy, M. Tromp, A. Hoffmann and I. Barber. 2017. The difficult place of deserted coasts in archaeology: New archaeological research on Cooks Beach (Pukaki), Coromandel Peninsula, New Zealand. *The Journal of Island and Coastal Archaeology*, 13(1): 1-20.

McFadgen, B. 2013. *Hostile Shores: Catastrophic Events in Prehistoric New Zealand and their Impact on Māori Coastal communities.* Auckland University Press.

McGlone, M.S., M.J. Salinger and N.T. Moar. 1993. Paleovegetation studies of New Zealand's climate since the Last Glacial Maximum. In: Wright, H.E. 1993 *Global Climates since the Last Glacial Maximum*. Minneapolis: University of Minnesota Press, pp. 294-317.

Moore, P.D., J.A. Webb, and M.E. Collinson. 1991. *Pollen analysis*, 2nd edn. London: Blackwell Scientific.

New Zealand Archaeological Association ArchSite Database accessed at http://www.archsite.org.nz.

O'Hagan, A. 2021. T10/640 Tangiora Avenue Dish Drain Works, Final Report Pinnacles Civil & Thames-Coromandel District Council Authority Number 2020/282. Report prepared for Thames-Coromandel District Council.

Olsen, K. 1981. Opera Point Site Complex, Whangapoua, Coromandel Peninsula. Unpublished report.

Pearsall, D.M. 2015. *Paleoethnobotany: A Handbook of Procedures*. Third edition. Walnut Creek: Left Coast Press.

Petchey, F., S.H. Bickler, L. Hughes and M. Bunbury. 2022. The Aotearoa/New Zealand Radiocarbon Database Upgrade. New Zealand Archaeological Association Conference, Dunedin New Zealand.

Phillipps, R., S. Holdaway, M. Barrett, S. Middleton and J. Emmitt. 2022. Quantification of stone artefacts assemblages in Aotearoa New Zealand. *Journal of Pacific Archaeology*, 13(1), Available at: https://pacificarchaeology.org/index.php/journal/article/view/337.

Piperno, D.R. 2006. *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*. Lanham: Altamira Press.

Prebble, M., A.J. Anderson, P. Augustinus, J. Emmitt, S.J. Fallon, L.L. Furey, S.J. Holdaway, A. Jorgensen, T.N. Ladefoged, P.J. Matthews, J-Y. Meyer, R. Phillipps, R. Wallace and N. Porch. 2019. Early tropical crop production in marginal subtropical and temperate Polynesia. *PNAS* 116: 8824-8833.

Ripley, B., B.Venables, D.M. Bates, K. Hornik, A., Gebhardt and D. Firth. 2018. Package 'MASS'.

Sewell, B. 1990. Opito and Otama sites revisited. *Archaeology in New Zealand* 33:189-202.

Sewell, B. 2000. Archaeological Monitoring of Earthworks at Matarangi Beach. Unpublished report.

Smart, C.D. and R.C. Green. 1962. A stratified dune site at Tairua, Coromandel. *Dominion Museum Records in Ethnology*, l (7): 243-66.

Turner, M. 2000. The Function, Design and Distribution of New Zealand Adzes. PhD Thesis, Department of Anthropology, University of Auckland

Venables, W.N., and B.D. Ripley. 2002. *Modern Applied Statistics with S*. New York: Springer.

Walter, R., H. Buckley, C. Jacomb and E. Matisoo-Smith. 2017. Mass migration and the Polynesian settlement of New Zealand. *Journal of World Prehistory*. DOI 10.1007/s10963-017-9110-y

Wilmshurst, J.M., D.E. Eden and P.C. Froggatt. 1999. Late Holocene forest disturbance in Gisborne, New Zealand: A comparison of terrestrial and marine pollen records. *New Zealand Journal of Botany* 37, 523-540.

APPENDICES

APPENDIX 1 – CONTEXT RECORDS

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
1	1	General Sediment	dark grey sandy topsoil			
2	1	General Sediment	ashy grey mix with areas of dark grey and brown sandy layer.			
3	1	Shell Midden	large midden c.20m x 12m predominantly cockle and pipi in varying sizes. Areas with concentration of fcr/firescoop stones. Northern part of midden has been dumped with modern farming material on top of shell. A dog jaw was found on the west side of midden. Areas of round ashy burnt shell.	3200	1200	60
4	1	Midden Layer	top layer of large midden 3, predominantly cockle and pipi in varying sizes. Areas with concentration of fcr/Firescoop stones.			
5	1	Shell Midden	large midden c.12m x 12m with predominantly cockle and pipi. Occasional ostrich foot and cat's eye. Areas with concentration of shell and some root blow out. Areas of FCR. Midden located on a natural elevated knoll and east of 004.	1200	1200	
6	1	Shell Midden	small concentrated area of shell southwest of midden 5 and east of midden 4. situated on another elevated knoll. Again predominantly cockle and pipi clean whole to fragmented shell with occasional burnt shell fragments. Some FCR scattered through.	320	140	
7	1	Shell Midden	area of sparse shell between midden 3 and 5. Consisted of whole clean predominantly cockle and pipi with some fragmented. Area of highly fragmented burnt shell.	1600	1100	
8	1	Shell Midden	concentrated area of shell c. 4m x 4m. predominantly cockle and pipi whole clean shell with some fragmented. A few pieces of FCR. Located north of strip but between midden 3 and 5.	310	130	
9	1	Rock Cache Fill	fill of Rock Cache 10, cache of stones in midden 4. in trench 1, 3700 from west end. 240 below surface. sub angular to rounded 28 stones. heat fractured.			
10	1	Rock Cache	irregular oval, bowl shaped irregular sloped sides	35	31	12

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
11	1	Paleosol	dark grey brown mottled sandy layer (buried topsoil). Inclusions of occasional shell at the 3,300 mm point see drawing 3. Fill layer becomes cleaner from 3,300 onwards.			
12	1	Sediment Layer	light grey brown aeolian lens sitting in 011.			
13	1	Fill Of Firescoop	fill of firescoop 14, light grey very fragmented burnt shell moderate firm compaction common charcoal and occasional fcr			
14	1	Firescoop	oval, steeply sloping sides and concave base	118	115	21
15	1	Sediment Layer	light grey brown aeolian lens sitting in 011.			
16	1	Midden Layer	whole clean shell primarily pipi with some cockle deposit sitting underneath 004, 017 and 018.			
17	1	Midden Layer	highly fragmented burnt shell lens with charcoal stained sand.			
18	1	Paleosol	dark grey brown sandy soil potentially root blown from 011 through deposit 016.			
19	1	Midden Layer	whole clean predominantly pipi with few cockle shell deposit.			
20	1	Midden Layer	whole clean predominantly pipi with few cockle shell deposit. potentially associated with context 020 with root blow out causing visual separation in section.			
21	1	Firescoop	cut of potential firescoop.	82		
22	1	Fill Of Firescoop	fill of firescoop 021, highly fragmented burnt shell.			
23	1	Fill Of Firescoop	fill of firescoop 021, burnt shell with ashy deposits and some FCR scattered through. Charcoal stained with some fragments of charcoal.			
24	1	Posthole	cut for potential post hole.		14	10
25	1	Posthole	fill of posthole 24. Although difficult to differentiate between context 011, looks slightly darker. See drawing 003 different potential contexts represented by dotted line.			
26	1	Firescoop	cut of oven feature.	74		

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
27	1	Fill Of Firescoop	fill of oven 026. Base lined with oven stones FCR. with charcoal layer. above this is highly fragmented burnt shell.			
28	1	Midden Layer	clean whole predominantly pipi with cockle shell deposit. Little soil penetration.			
29	1	Firescoop	cut of oven feature in base of trench through midden 003. same as 051. double recorded.	140		140
30	1	Fill Of Firescoop	fill of firescoop 29 consisting of large cache of fcr/Firescoop stones moderately fragmented. Highly fragmented burnt shell with a dark grey ashy matrix.			
31	1	Midden Layer	moderate density, whole and fragmented shell in a grey sand matrix. higher fragmentation at surface.			
32	1	Sediment Layer	light grey to grey sand moderate loose compaction			
33	1	Midden Layer	highly fragmented shell cockle and pipi, common charcoal, in grey to dark grey ashy matrix			
34	1	Fill Of Firescoop	fill of firescoop 35, whole and fragmented shell in a light grey ashy matrix. moderate compaction. shells quite burnt and calcined. low level of fragmentation. major cockle. rare charcoal and fcr. some cementing of shells.			
35	1	Firescoop	bowl shaped base and sloped sides, in section of trench 1, little burning at base of feature some charcoal staining on sand		112	22
36	1	Midden Layer	moderate to moderate firm compaction whole and fragmented shell, major cockle rare pipi in grey sand matrix.			
37	1	Midden Layer	lens of mostly whole cockle shell. Moderate compaction			
38	1	Paleosol	dark grey moderate loose compaction, occasional shell frag inclusion			
39	1	Midden Layer	mostly fragmented some whole shell moderate firm compaction, dense shell, in grey ashy sand matrix.			
40	1	Midden Layer	dense mostly whole pipi with rare cockle in a small amount of light grey sand matrix. moderate firm compaction			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
41	1	Midden Layer	identical to 40			
42	1	Paleosol	grey speckled moderate loose compaction undulating lower boundary. beneath shell.			
43	1	Midden Layer	whole to moderately fragmented clean shell, predominantly cockle and pipi, with occasional whelk. shell deposit sits above buried topsoil layer 044. Light grey ashy sand matrix within shell deposit.			
44	1	Paleosol	dark grey brown mottled sandy layer (buried topsoil) located in west facing section of trench through midden 005. Ephemeral layer seen through the section. Similar to that of 011 in midden 003.			
45	1	Sediment Layer	light grey sandy subsoil, ephemeral layer sits above natural (002). Seen in section mainly at northern end of trench and then disappears, then reappears underneath shell deposit 049.			
46	1	Fill Of Firescoop	fill of firescoop 47, contains FCR, moderately fragmented with some whole. Highly fragmented burnt shell.			
47	1	Firescoop	cut of oven feature gradual sloping sides with a convex base.	70	70	
48	1	Fill Of Firescoop	fill of firescoop 47, highly fragmented burnt shell, most lightly slip wash from oven feature and trample across area as very thin. Gradually gets thicker as you head south. cockle and pipi with ashy grey sandy matrix within shell.			
49	1	Midden Layer	clean whole cockle and pipi deposit with little soil penetration. Some fragmentation at top of deposit most likely from modern tramping. Underneath midden deposit is 044 which changes to 045 at base and then changes back to 044 at sides.			
50	1	Sediment Layer	most likely the natural 002 but has a brownish hue to it, potentially from water table, estuary tide as located south where ground naturally slopes down to a lower elevation.			
51	1	Firescoop	oval, sloped sides and flat base	108	73	21
52	1	Fill Of Firescoop	fill of firescoop 51, lens of very fragmented and burnt shell with common charcoal in a charcoal stained fine sand matrix.			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
53	1	Fill Of Firescoop	fill of firescoop 51, burnt whole and fragmented shell, moderate compaction, occasional charcoal common fcr			
54	1	Firescoop	unknown, sloped sides and concave base		54	10
55	1	Fill Of Firescoop	fill of firescoop 54, very fragmented moderate density shell in dark grey sand moderate compaction common charcoal			
56	1	Firescoop	unknown in plan, steeply sloped sides shallow concave base		39	14
57	1	Fill Of Firescoop	fill of firescoop 56, moderate compaction moderate density shell some whole major fragmented in dk grey black sand			
58	1	Fill Of Firescoop	fill of firescoop 59, containing dark grey brown sandy soil with concentrations of highly fragmented shell and charcoal. Feature located north of site near sand stockpile.			
59	1	Firescoop	cut of small scoop feature	90	87	50
60	1	Fill Of Firescoop	fill of firescoop 61, grey very fragmented burnt shell moderate loose compaction in a grey to light grey ashy sand matrix common charcoal			
61	1	Firescoop	circular steeply sloped sides and flattish base	58	58	12
62	1	Fill Of Firescoop	fill of firescoop 63, very fragmented rare whole shell, very burnt, dense concentration common charcoal in ashy grey sand matrix			
63	1	Firescoop	oval firescoop with very gradual sloping sides and a shallow convex base. some root intrusion.	84	70	100
64	1	Paleosol	dark grey moderate loose compaction fine sand			
65	1	Firescoop	oval, sloping sides and concave base	115	95	12
66	1	Fill Of Firescoop	fill of firescoop 65, highly fragmented burnt shell dense concentration moderate compaction in ashy grey fine sand occasional charcoal			
67	1	Firescoop	oval unexcavated	90	68	
68	1	Fill Of Firescoop	fill of firescoop 67, fragmented burnt shell rare whole v dense rare charcoal and fcr in dark grey sand			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
69	1	Firescoop	oval unexcavated	92	62	
70	1	Fill Of Firescoop	fill of firescoop 70, fragmented burnt shell rare whole v dense common charcoal, concentrated of fcr in top in dark grey sand			
71	1	Firescoop	oval with gradual sloping sides and an almost flat base. cut into buried subsoil.	106	90	100
72	1	Fill Of Firescoop	fill of firescoop 71, fragmented burnt shell rare whole v dense abundant charcoal, concentrated of fcr in top and lining base of feature in dark grey sand. some whelk.			
73	1	Firescoop	oval, sloping sides and concave base	60		17
74	1	Fill Of Firescoop	fill of firescoop 73, moderate dense whole and frag shell, cleanish shell not very burnt, majority cockle with pipi, little quantity of dark grey sand not charcoal stained, common charcoal, occasional fcr			
75	1	Void	oval concentration of highly fragmented burnt shell in a dark grey ashy sand matrix. some charcoal. sondage: no obvious cut, lots of root disturbance void feature.			
76	1	Void	sondaged. VOID.			
77	1	Void	VOID			
78	1	Void	oval VOID			
79	1	Fill Of Firescoop	fill of firescoop 80, highly fragmented clean to burnt shell with occasional whole pipi and cockle clean. some fcr. In dark grey sandy matrix. unexcavated.			
80	1	Firescoop	oval large unexcavated.	150	120	
81	1	Midden Layer	fill of firescoop 80, whole and fragmented shell cockle dominant pipi rare, moderate frag, loose compaction in dark grey brown sand			
82	1	Midden Layer	fill of firescoop 80, moderate loose compaction dark grey sand with shower fragmented shell inclusions			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
83	1	Firescoop	oval, sloped sides, unknown	96	80	
84	1	Fill Of Firescoop	fill of firescoop 83, highly fragmented some whole burnt shell with common fcr and charcoal on surface. in a dark grey ashy sand matrix. cockle dominant with pipi and spotted whelk			
85	1	Firescoop	oval, gradual sloped side on northern profile but more bulbous on southern end. flat base.	130	127	10
86	1	Fill Of Firescoop	fill of firescoop 85, highly fragmented some whole burnt shell with common fcr and charcoal on surface. in a dark grey ashy sand matrix. cockle dominant with pipi and spotted whelk. fcr lining base of feature.			
87	1	Firescoop	long oval, sloped sides and concave base	120	104	24
88	1	Fill Of Firescoop	fill of firescoop 87, majority fragmented some whole shell dominated by cockle with rare pipi, moderate loose compaction high shell density. in grey ashy sand. common charcoal inclusions large oven stones in top of east end			
89	1	Firescoop	oval sloping sides and concave base	110	97	21
90	1	Fill Of Firescoop	fill of firescoop 89, majority fragmented some whole shell dominated by cockle with rare pipi, moderate loose compaction high shell density. in grey ashy sand. common charcoal inclusions occasional oven stones			
91	1	Firescoop	irregular ellipsoid, near vertical sides, undercut at south side, concave bade	94	66	15
92	1	Fill Of Firescoop	fill of firescoop 91, loose compaction whole shell cockle dominant, rare charcoal in loose grey fine sand.			
93	1	Fill Of Firescoop	fill of firescoop 94, highly fragmented burnt shell with small cache of fcr at base and through top, disturbance from digger, with inclusions of charcoal. dark grey ashy sandy matrix.			
94	1	Firescoop	cut of oven feature, slightly oval with gradual sloping sides and an almost flat base.	75	72	60
95	1	Midden Layer	moderate dense moderate firm compaction fragmented and common whole shell cockle dominant with pipi and rare whelk and mudsnail in a dark brown sandy soil matrix. some ashy pockets rare charcoal and fcr			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
96	1	Midden Layer	highly fragmented dense firm compacted shell in a grey sand matrix common charcoal frags rare whole shell.			
97	1	Midden Layer	dense moderate to firm compacted shell equal fragmented and whole portions cockle some common pipi some very large rare mudsnail and whelk. crushed layer at surface			
98	1	Paleosol	dark grey fine sand, undulating lower boundary with context 2			
99	1	Fill Of Firescoop	fill of firescoop 99, highly fragmented burnt shell with occasional whole shell, cockle and pipi. fragments of charcoal, some fcr.			
100	1	Firescoop	oval oven feature. discovered whilst digger scraped down. 2.2m north and 2.5m east of feature 091.	60	50	
101	1	Fill Of Firescoop	fill of firescoop 100, whole clean predominantly pipi with occasional cockle not much soil penetration light grey ashy sand matrix. some burnt powdery shell. some charcoal fragments.			
102	1	Firescoop	cut of feature, discovered whilst stripping midden with digger. 900mm north of trench 1 and 3300mm east of trench 4. cut into subsoil.	85	71	13
103	1	Firescoop	unknown, sloping and concave base			
104	1	Fill Of Firescoop	fill of firescoop 103, highly fragmented burnt shell very dense firm compaction, common charcoal rare fcr			
105	1	Midden Layer	loose compaction dense whole and some fragmented shell. dominated by cockle with common pipi and rare whelk with a very small amount of grey fine sand matrix.			
105	1	Midden Layer	moderate compaction dense whole and some fragmented shell. dominated by cockle with common pipi and rare whelk in brown grey fine sand matrix. similar to 103 with higher fragmentation and root matter. soil formation important process.			
106	1	Firescoop	rough ellipse, unexcavated	97	63	
107	1	Fill Of Firescoop	fill of firescoop 106, whole and fragmented dense shell moderate loose compaction, cockle dominant with rare pipi common charcoal in grey to dark grey ashy sand matrix			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
108	1	Firescoop	circular sloped sides and concave base	103	94	
109	1	Fill Of Firescoop	fill of firescoop 108, whole and fragmented dense shell moderate loose compaction, cockle dominant with rare pipi common charcoal and fcr in grey to dark grey ashy sand matrix			
110	1	Firescoop	circular sloped sides and concave base	110	76	
111	1	Fill Of Firescoop	fill of firescoop 110, fragmented rare whole burnt dense shell moderate loose compaction, cockle dominant with rare pipi common charcoal and fcr grey to dark grey ashy sand matrix			
112	1	Firescoop	circular, sloping sides and concave base	115	106	21
113	1	Fill Of Firescoop	fill of firescoop 112, dense moder ate compaction burnt fragmented rare whole shell pipi dominated with cockle, very burnt v common fcr at base, common charcoal, in grey ashy sand			
114	1	Firescoop	circular sloping sides and concave base	60	50	8
115	1	Fill Of Firescoop	fill of firescoop 114, whole and fragmented dense moderate loose compaction burnt shell, in grey ashy sand. abundant charcoal on n end			
116	1	Firescoop	circular sloping sides and concave base	115	110	11
117	1	Fill Of Firescoop	fill of firescoop 116, fragmented rare whole burnt dense shell moderate loose compaction, cockle dominant with rare pipi common charcoal and fcr grey to dark grey ashy sand matrix			
118	1	Firescoop	circular, sloping sides and concave base	86	78	14
119	1	Fill Of Firescoop	fill of firescoop 118, dense moderate loose compaction fragmented rare whole shell pipi dominated with cockle, very burnt rare fcr, common charcoal, in grey ashy sand			
120	1	Firescoop	oval, steeply sloped sides and flattish base	123		14
121	1	Fill Of Firescoop	fill of firescoop 120, dense whole and fragmented shell pipi dominated with cockle, moderate loose compaction common charcoal and fcr in grey ashy sand			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
2001	2	General Sediment	dark grey sandy soil			
2002	2	General Sediment	light grey to grey sand moderate loose to loose compaction			
2003	2	Shell Midden	patchy shell from moderate-to-moderate sparse density, moderate to high fragmentation, cockle dominant with minor pipi common charcoal and occasional fcr, some areas more charcoal. 60-100 mm below grass surface,	1800	1100	22
2004	2	Rock Cache	oval, sloping sides and concave base, main hollow circular with lip to nw	46	28	14
2005	2	Rock Cache Fill	fill of rock cache 2004, 15 sub angular to sub rounded stones up to140mm in size. banding in broken mudstone shows fire.			
2006	2	Rock Cache	irregular oval near vertical sides and concave base	54	37	20
2007	2	Rock Cache Fill	fill of rock cache 2006, approx. 60 stones rounded to sub angular up to 100 mm in size many smaller. some fractured showing heat effects			
2008	2	Void				
2009	2	Void				
2010	2	Firescoop	oval, sloped sides and concave base	38	30	5
2011	2	Fill Of Firescoop	fill of firescoop 2010, dark grey moderate loose compaction rare charcoal			
2012	2	Firescoop	oval, sloped sides and concave base	38	36	10
2013	2	Fill Of Firescoop	fill of firescoop 2012, dark grey moderate compaction occasional charcoal rare fcr			
2014	2	Firescoop	oval, sloped sides and concave base	30	27	5
2015	2	Fill Of Firescoop	fill of firescoop 2014, dark grey moderate loose compaction rare charcoal rare fcr			
2016	2	Firescoop	oval, sloped sides and concave base	40	28	7
2017	2	Fill Of Firescoop	fill of firescoop 2016, dark grey moderate loose compaction rare charcoal			
2018	2	Rock Cache	circular, sloped sides and v shaped base	20	20	10

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
2019	2	Fill Of Rock Cache	fill of rock cache 2018, grey speckled with dark grey loose sand with two stones			
2020	2	Rock Cache	24 approximate stones, sun angular to rounded many fire cracked and fire affected banding, in brown loose sand. No cut			
3001	3	General Sediment	dark grey sandy soil			
3002	3	General Sediment	light grey to grey sand moderate loose to loose compaction			
3003	3	Shell Midden	area of midden varying densities west of tree area and east of 2003. moderate to high fragmentation, dominated by cockle with rare pipi and whelk. some areas of more whole shell, some areas more burnt and higher fragmentation occasional fcr. in dark grey sandy soil matrix some ashy areas. less soil formation or subsoil as in the deeper midden in area 1. section shows shell varied in thickness from 20mm to 100 mm. the underlying subsoil varies as well but in conjunction with the thickness of shell ie thicker shell does not equal thicker subsoil. likely due to tree roots.	920	830	10
3004	3	Shell Midden	moderate low dense shell fragmented and whole some burnt cockle with rare mudsnail rare fcr and charcoal in tree area disturbed by trees and tree removal			
3005	3	Shell Midden	moderate low dense shell fragmented and whole some burnt cockle with rare fcr and charcoal in tree area disturbed by trees and tree removal.			
3006	3	Paleosol	same as 3001 but beneath shell midden rare shell frag inclusions.			
3007	3	Posthole	unknown plan, vertical sides, u shaped base		11	18
3008	3	Fill of Posthole	fill of posthole 3007, light grey brown sand loose compaction			
3009	3	Firescoop	oval, sloping sides and undulating base	57	53	5
3010	3	Fill Of Firescoop	fill of firescoop 3009, loose compaction rare fragmented burnt shell rare charcoal in dark grey sand rare fcr			
3011	3	Firescoop	oval sloping sides and concave base	41	35	2
3012	3	Fill Of Firescoop	fill of firescoop 3011, loose compaction rare fragmented burnt shell rare charcoal in dark grey sand			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
3013	3	Firescoop	oval, vertical slightly undercut side, concave base	40	30	18
3014	3	Fill Of Firescoop	fill of firescoop 3013, moderate compaction moderate dense whole and fragmented shell some burnt, occasional charcoal rare fcr, cockle dominant, occasional whelk spp.			
3015	3	Firescoop	oval, sloping sides and concave base	74	64	
3016	3	Fill Of Firescoop	fill of firescoop 3015, loose compaction, moderate dense fragments rare whole shell burnt cockle dominant with pipi, occasional charcoal, rare fcr			
3017	3	Firescoop	oval sloping sides and flattish base	64	55	4
3018	3	Fill Of Firescoop	fill of firescoop 3017, moderate loose compaction, moderate dense fragments rare whole shell burnt cockle dominant with pipi, occasional charcoal, rare fcr in dark grey sand matrix			
3019	3	Rock Cache	oval, steeply sloped sides and concave base	55	45	21
3020	3	Fill of Rock Cache	fill of rock cache 3019, grey speckled with dark grey loose sand with 8 stones			
3021	3	Firescoop	oval sloping sides and flattish base	61	58	4
3022	3	Fill Of Firescoop	fill of firescoop 3021, moderate loose compaction, moderate low dense fragments rare whole shell burnt cockle dominant with pipi, occasional charcoal, in dark grey sand matrix			
3023	3	Firescoop	oval, sloping sides undulating concave base	60	81	71
3024	3	Fill Of Firescoop	fill of firescoop 3032, loose compaction, moderate dense fragments rare whole shell burnt cockle dominant with pipi, occasional charcoal, rare fcr in dark grey sand matrix			
4000	4	General Sediment	grey brown sandy topsoil			
4001	4	Firescoop	oval, unexcavated	68	48	
4002	4	Fill Of Firescoop	fill of firescoop 4001, black to dark grey brown sand with occasional charcoal and fcr. waterlogged			
4003	4	Void	void			

Context Number	Area	Interpretation	Description	Length (cm)	Width (cm)	Depth (cm)
4004	4	Void	black to dark grey brown sand with occasional charcoal and fcr. waterlogged			
4005	4	Posthole	circular steeply sloped sides and v shaped base	12	12	17
4006	4	General Sediment	grey sand			
4007	4	Shell Midden	shell midden exposed in erosion cut. pipi dominated with common cockle rare whelk common fcr. from very dense to moderate sparse moderate to moderate high fragmentation, disturbed by pine tree in western end at the edge of inlet on north side.	2560	980	

APPENDIX 2 – RADIOCARBON DATING

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

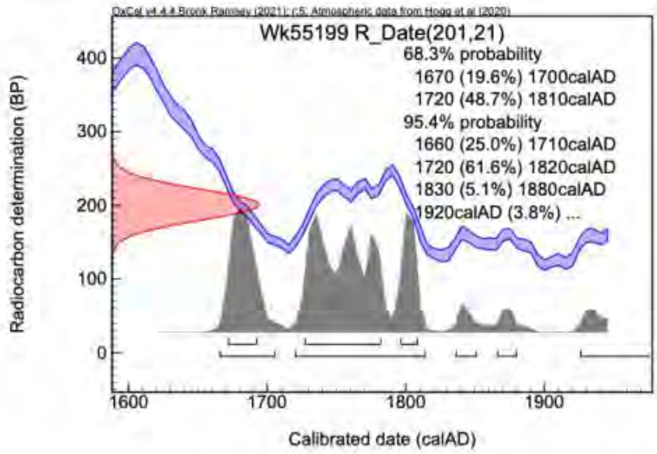
Report on Radiocarbon Age Determination for Wk- 55199

Submitter	B Larsen
Submitter's Code	Sample No. 3
Site & Location	T10/1052, New Zealand
Sample Material	Charcoal: Manuka
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-24.8 ± 2.5 ‰
$F^{14}C\%$	97.5 ± 0.3 %
Result	**201 ± 21 BP**

(AMS measurement)

Comments
Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

Report on Radiocarbon Age Determination for Wk- 55198

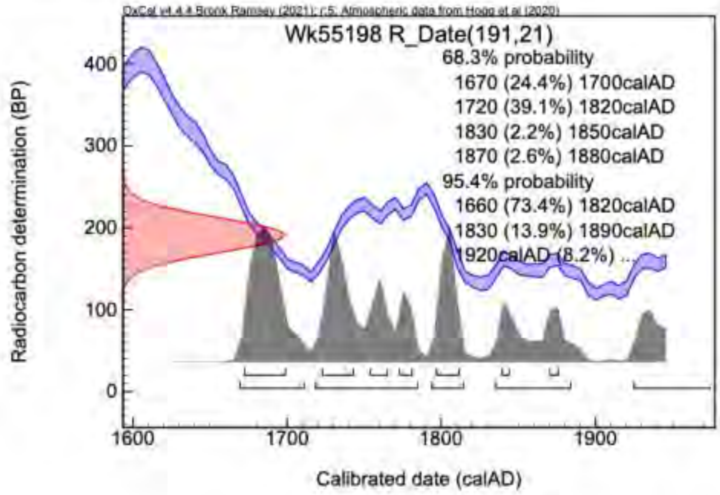
Submitter	B Larsen
Submitter's Code	Context 4007
Site & Location	T10/1051, New Zealand
Sample Material	Charcoal: Manuka + Hebe
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-23.5 ±	2.5 ‰
$F^{14}C\%$	97.7 ±	0.3 %
Result	**191 ± 21 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

Report on Radiocarbon Age Determination for Wk- 55197

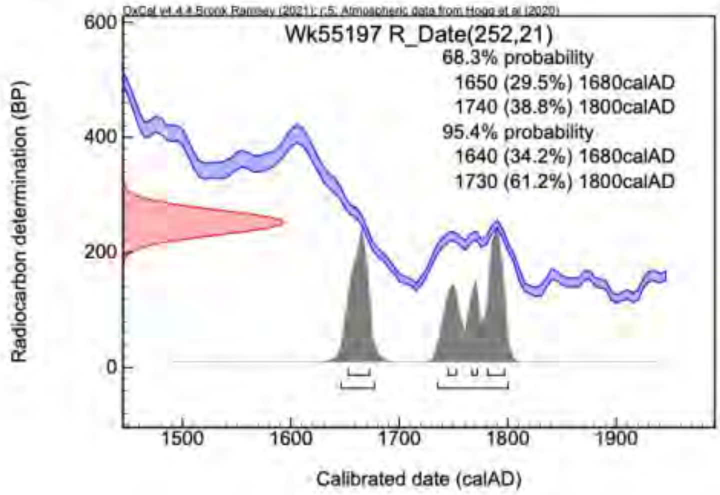
Submitter	B Larsen
Submitter's Code	Sample No. 32
Site & Location	T10/1048, New Zealand
Sample Material	Charcoal: Manuka
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-30.9 ± 2.5 ‰
$F^{14}C\%$	96.9 ± 0.2 %
Result	**252 ± 21 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

M Pettley

Clough & Associates Ltd

THE UNIVERSITY OF WAIKATO
Te Whare Wananga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

Report on Radiocarbon Age Determination for Wk- 55196

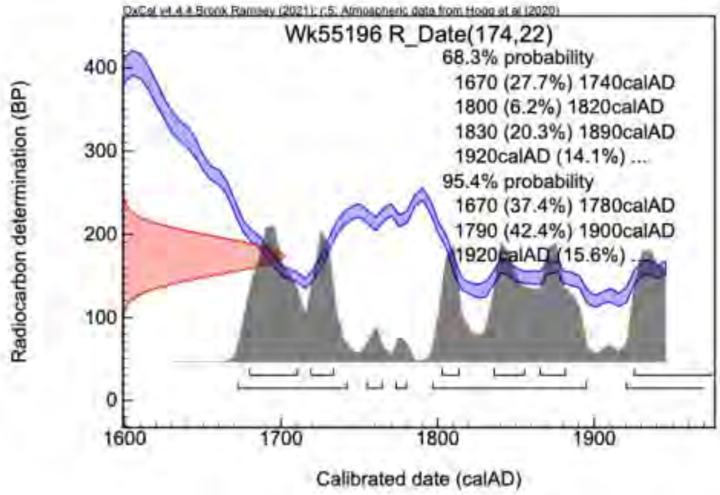
Submitter	B Larsen
Submitter's Code	7c c1sp3
Site & Location	T10/1052, New Zealand
Sample Material	Charcoal: Manuka
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-21.4 ± 2.6 ‰
$F^{14}C\%$	97.9 ± 0.3 %
Result	**174 ± 22 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

Clough & ASSOCIATES LTD

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

Report on Radiocarbon Age Determination for Wk- 55195

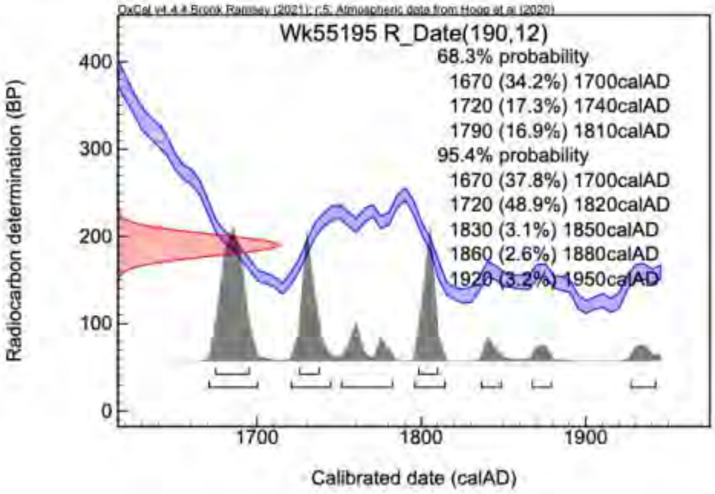
Submitter	B Larsen
Submitter's Code	7b c1sp2
Site & Location	T10/1052, New Zealand
Sample Material	Charcoal: Mangrove
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-23.4 ±	1.5 ‰
$F^{14}C\%$	97.7 ±	0.2 %
Result	**190 ± 12 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

Report on Radiocarbon Age Determination for Wk- 55194

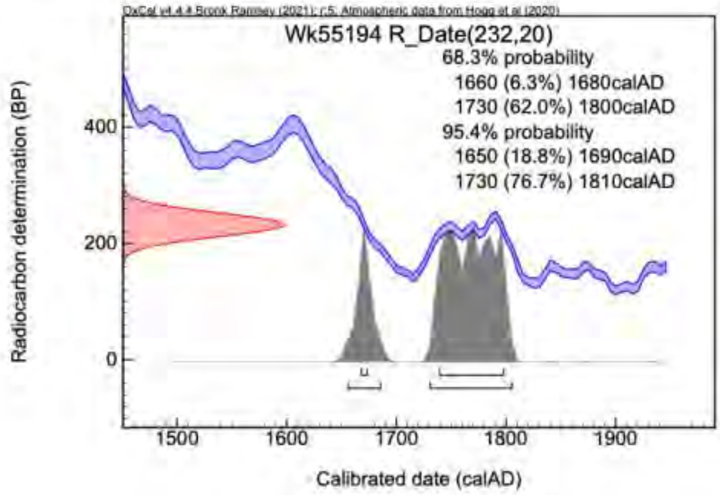
Submitter	B Larsen
Submitter's Code	7a c1sp1
Site & Location	T10/1052, New Zealand
Sample Material	Charcoal: Mangrove
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$	-28.5 ±	2.5 ‰
$F^{14}C$%	97.1 ±	0.2 %
Result	**232 ± 20 BP**	

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C$% is also known as *Percent Modern Carbon (pMC)*.

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz

Radiocarbon Dating Laboratory

Tuesday, 29 November 2022

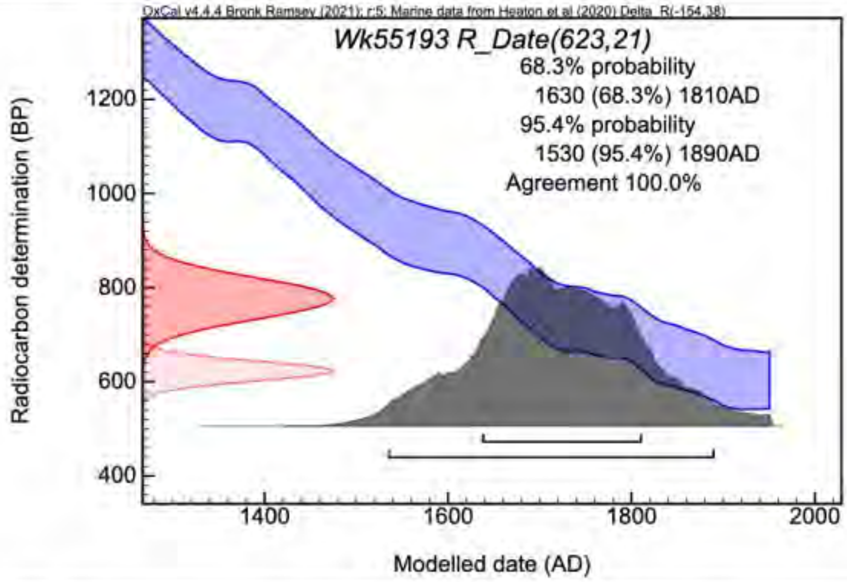
Report on Radiocarbon Age Determination for Wk- 55193

Submitter	B Larsen
Submitter's Code	Sample No. 28
Site & Location	T10/1052, New Zealand
Sample Material	Marine shell: Pipi
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 0.1N HCl, rinsed and dried.

$\delta^{13}C$	3.3 ±	0.7 ‰	(CRDS)
$D^{14}C$	-74.6 ±	2.4 ‰	
$F^{14}C\%$	92.5 ±	0.2 %	
Result	**623 ± 21 BP**		

(AMS measurement)

Comments



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (http://c14.arch.ox.ac.uk/embed.php?File=explanation.php)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following 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 and is measured on sample CO_2
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.